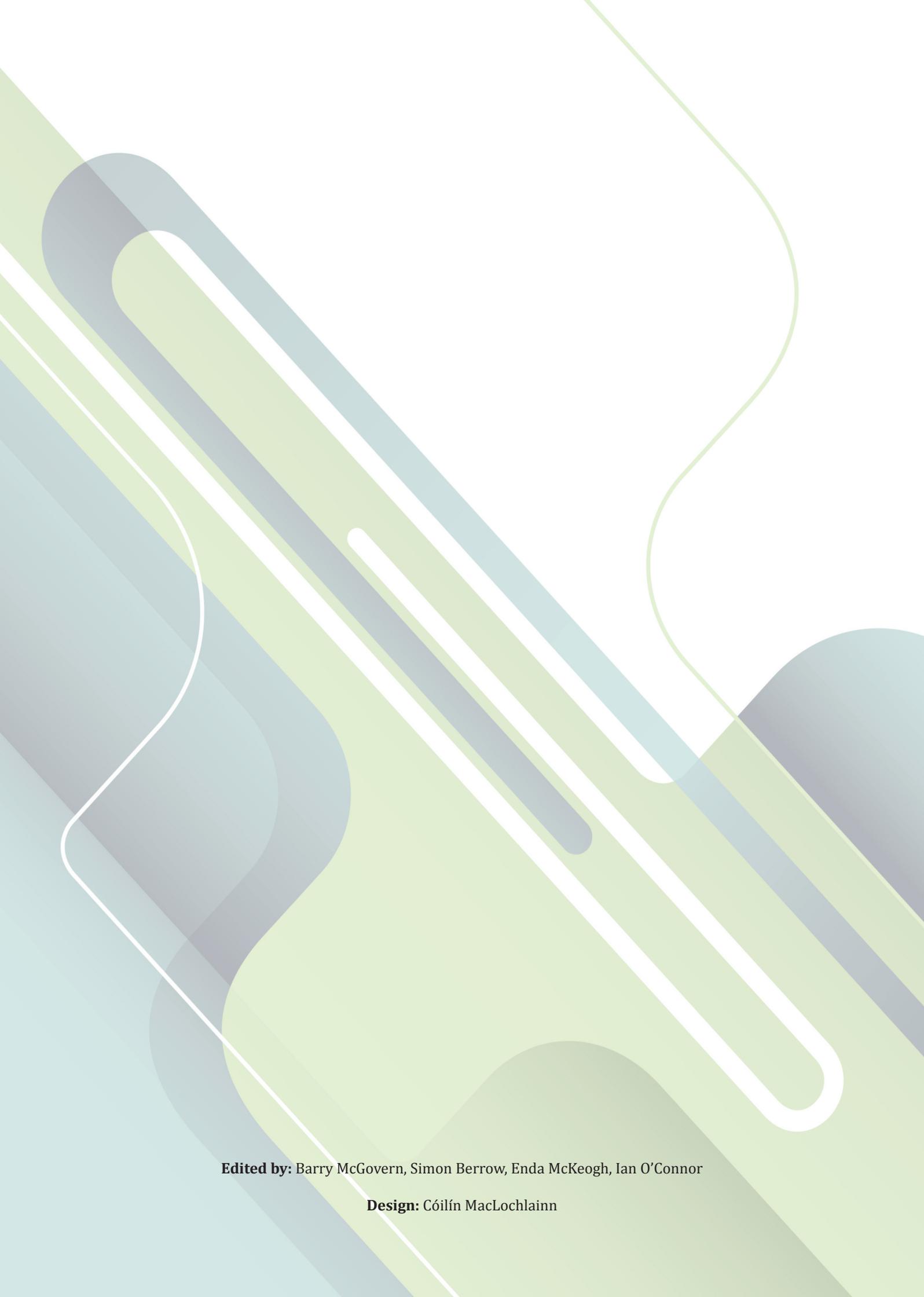


26<sup>TH</sup> EUROPEAN CETACEAN SOCIETY CONFERENCE  
26<sup>TH</sup>-28<sup>TH</sup> MARCH 2012, GALWAY IRELAND

# INFORMATION AND IDEAS WORTH SHARING



GALWAY, IRELAND 2012



**Edited by:** Barry McGovern, Simon Berrow, Enda McKeogh, Ian O'Connor

**Design:** Cólín MacLochlainn



GALWAY, IRELAND 2012

## 26<sup>th</sup> EUROPEAN CETACEAN SOCIETY CONFERENCE

26<sup>th</sup> – 28<sup>th</sup> MARCH 2012

GALWAY, IRELAND

### “Information and Ideas Worth Sharing”

Galway Bay Hotel, Salthill, Galway  
Galway-Mayo Institute of Technology, Galway  
Galway Atlantiquarium



*An Roinn  
Ealaíon, Oidhreachta agus Gaeltachta*  
*Department of  
Arts, Heritage and the Gaeltacht*



*Roinn Cumarsáide, Fuinnimh agus  
Acmhainní Náúrtha*  
*Department of Communications, Energy  
and Natural Resources*



### **HOSTED BY**

Irish Whale and Dolphin Group (IWDG); Galway-Mayo Institute of Technology (GMIT), Marine Biodiversity Research Group (GMIT).

### **SPONSORS**

Marine Institute; National Parks and Wildlife Service of the Department of Arts, Heritage and the Gaeltacht; Environment Protection Agency; Heritage Council; Petroleum Affairs Division of the Department of Communications, Energy and Natural Resources; Bord Iascaigh Mhara.

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### **SCIENTIFIC COMMITTEE**

Mario Aquarone, Simon Berrow (Chair), Ruth Carden, Michelle Cronin, Joanne O'Brien, Ian O'Connor, Graham Pierce, Patrick Pomeroy, Conor Ryan, Meike Scheidt, Cecile Vincent, Dave Wall.

### **ABSTRACT REVIEWERS**

Line A. Kyhn, Mario Aquarone, Marjan Addink, Natacha Aguilar de Soto, Pia Anderwald, Michel André, Monica Arso Civil, Javier F. Aznar, Mick Baines, James Barnett, Suzanne Beck, Steven Benjamins, Simon Berrow, Junio Fabrizio Borsani, Cristina Brito, Andrew Brownlow, Ana Cañadas, Sarah Canning, Ruth Carden, Manuel Castellote, Florence Caurant, Phil Clapham, Bruno Cozzi, Michelle Cronin, Boris Culik, Krishna Das, Rob Deaville, Giovanni Di Guardo, Sarah Dolman, Anneli Englund, Ruth Esteban, Peter Evans, Antonio Fernandez, Mercedes Fernandez, Ruth Fernandez, Andrew Foote, Alexandre Gannier, Manuel Garcia Hartmann, Pauline Gauffier, Douglas Gillespie, Pavel Golden, Philip Hammond, Olivia Harries, Sara Heimlich, Rus Hoelzel, Aleta Hohn, Simon Ingram, Vincent Janik, Thierry Jauniaux, Paul Jepson, Mark Johnson, Carl Kinze, Jeremy Kiszka, Jens Koblitz, Sophie Laran, Giancarlo Lauriano, Jennifer Learmonth, Ruth Leeney, Roland Lick, Christina Lockyer, Klaus Lucke, Patrick Lyne, Colin MacLeod, Ana Marçalo, Barry Mc Govern, Sonia Mendes, Lee Miller, Luca Mirimin, Sinéad Murphy, Paul Nachtigall, Giuseppe Notarbartolo di Sciara, Hanna Nuuttila, Joanne O'Brien, Ian O'Connor, Ayaka Amaha Öztürk, Bayram Öztürk, Aude Pacini, Simone Panigada, Iwona Pawliczka, Rod Penrose, Graham Pierce, Eunice Pinn, Enrico Pirotta, Patrick Pomeroy, Juan Antonio Raga, Dave Reid, Vincent Ridoux, Fabian Ritter, Kevin Robinson, Cilian Roden, Emer Rogan, Conor Ryan, Maria Begoña Santos Vazquez, Aviad Scheinin, Mónica Silva, Tiu Similä, Benoit Simon-Bouhet, Jerome Spitz, Signe Sveegaard, Jonas Teilmann, Michael J. Tetley, Jakob Tougaard, Nick Tregenza, Gemma Veneruso, Philippe Verborgh, Cecile Vincent, Gisli Vikingsson, Dave Wall, Caroline Weir, Fredrick Wenzel, David Wiley, Ben Wilson, Nicky Wiseman.

### **STUDENT VOLUNTEERS**

Aylin Akkaya, Siobhán Ardener, Mona Becherer, Michelle Boonstra, Cecilia Calais, Natalia Carrillo-Elkin, Darienne Colbert, Nathan Colbert, Mark Davey, Jackie Davy, Charlotte Esposito, Lonneke Ijsseldijk, Tara Keena, Anke Kuelger, Heather Lane, Teresa Martin, Giada Maugeri, Christina Milani, Paddy O'Dwyer, Toby Oliver, Tom Rea, Cristel Reyes, Jessica Schop, Reyhan Sonmez, Mareike Volkenandt, Carine Zimmermann.

**LUNCH**

Lunch will be available in the hotel bar and restaurant at hotel rates. A simple conference lunch (e.g. soup and sandwiches) will also be available. There will also be a take-away option, ideal for meetings or picnics (weather permitting!) on the beach at the front of the hotel. Those who have been given lunch vouchers for student grants and student support can avail of the conference lunch or the take-away lunch. Outside of the hotel there are plenty of cafés and bars close by in Salthill village. Dinner is also available in the hotel at hotel rates.

**POSTERS**

Posters can be set up from Sunday 25<sup>th</sup> March at 17:00. You will find your assigned position on the poster plan printed on the door. Please use the poster pins provided by the conference organisers. Presenting authors are asked to be at their posters during their designated poster session:

Monday 26<sup>th</sup>: Poster Session 1 (odd numbers); Tuesday 27<sup>th</sup>: Poster Session 2 (even numbers)

**MEETING ROOMS**

There are plenty of rooms available for quieter meetings with colleagues away from the madness of the conference. Details will be posted on the information board.

**CRÈCHE**

The hotel has crèche and babysitting facilities available for use by conference attendees. Early notice is requested to organise child-minders.

**INTERNET ACCESS**

Free Wi-Fi will be available in the Galway Bay Hotel and GMIT.

**TRANSPORT**

**Bus:** Bus Éireann (Nos 1s, 1d and 1k) and Citylink (No 36) run regularly between Eyre Square (city centre) and Salthill (conference venue). Bus Éireann runs buses (No 9) every 15 minutes between Eyre Square and GMIT (workshop and video night venue).

**Taxi:** Big O Taxis ([www.bigotaxis.com](http://www.bigotaxis.com)) have offered a special flat rate (day or night) for conference attendees of €10 (1-4 passengers) and €14 (4-7 passengers) between Galway Bay Hotel (conference venue) and the city centre and between the city centre and GMIT (workshops and video night venue). Please quote ECS conference when making a booking to avail of the special rate (Big O Taxis, tel: +353 (0)91 585858).

**ICE-BREAKER**

Tickets for the ice-breaker will be included in your registration pack. Only those with tickets will be allowed entry to the Atlantiquarium, so please don't lose your ticket! Two complimentary drink vouchers will be available on entry at the door.

**ACOUSTIC SEISÚIN**

There will be an acoustic session with local musicians in the hotel bar on Monday evening. Anyone who can play an instrument or sing a song (or think they can!) is encouraged to come along and join in.

**VIDEO NIGHT**

The video night will be held in GMIT and is open to the public. It is scheduled to start at 20:30 on Tuesday 27<sup>th</sup> March and buses will leave the Galway Bay Hotel at 19:45, making one stop at Eyre Square in the city centre. Please don't be late for the buses!

**DINNER AND DANCING**

The conference dinner will be held in the Galway Bay Hotel on Wednesday from 20:00, followed by plenty of Craic agus Ceoil! Comfortable shoes are essential! Those who have already paid for the event will receive tickets in their registration pack. Tickets will be available during the conference for purchase – just ask a volunteer.

**EXCURSIONS**

Details on the excursions can be found on the website but these may change depending on bookings. Details will be posted on the information board and people are asked to book by Tuesday evening.

# CONFERENCE PROGRAMME

## SATURDAY, 24<sup>TH</sup> MARCH 2012

### WORKSHOPS

**Live Stranding Course: Student Workshop**

Organiser: Conor Ryan

Full day (Venue: Galway Bay Hotel and beach)

**The EU Habitats Directive and its Implementation in Relation to Cetaceans**

Organiser: Peter Evans

Full day (Venue: GMIT Room 1000)

**Photo-ID for Seals: The Power of Extract-Compare**

Organiser: Patrick Pomeroy

14:00-17:00 (Coffee Break at 15:30)

(Venue: GMIT Room 938)

## SUNDAY, 25<sup>TH</sup> MARCH 2012

### WORKSHOPS

**North Atlantic Killer Whales**

Organiser: Andrew Foote

Full Day (Venue: GMIT Room 1000)

**Linking Science and Whale Watching**

Organiser: Dylan Walker

Full Day (Venue: GMIT Room 940)

***Grampus griseus* 200<sup>th</sup> Anniversary: Risso's Dolphins in the Contemporary World**

Organiser: Ing Chen

Full Day (Venue: GMIT Room 995)

**Aerial Surveys for Marine Mammals**

Organiser: Sophie Laran

Full Day (Venue: GMIT Room 994)

**Best Practices in Research: Tagging and Biopsy Sampling**

Organiser: Michel Andre

Full Day (Venue: GMIT Room 941)

### OFFICIAL/SOCIAL

**17:00 – 20:00 Registration**

Venue: Galway Bay Hotel

**19:00 – 22:00 Icebreaker**

Venue: Galway Atlantiquarium

## MONDAY, 26<sup>TH</sup> MARCH 2012

**08:00 – 09:00 Registration**

**09:00 Opening**

The Minister for Arts, Heritage and the Gaeltacht, Jimmy Deenihan TD  
President of Galway Mayo Institute of Technology (GMIT), Michael Carmody

### INVITED TALK

**10:00 From Despot to Participant: Society and Nature in the 21<sup>st</sup> Century**

Matthijs Schouten

**COFFEE BREAK 10:45 – 11:15**

### ACOUSTICS

**CHAIR: Ian O'Connor**

**11:15 “West Side Story”: An acoustic account of dolphins and porpoises on the west coast of Ireland as determined through Static Acoustic Monitoring**

Joanne O'Brien, Suzanne Beck, Simon Berrow, Barry McGovern

**11:30 PODs adrift: A novel approach to monitoring cetaceans in tidal rapids**

Steven Benjamins, Jim Elliott, Ben Wilson

**11:45 Long-term remote monitoring of cetaceans using a solar-powered autonomous detector**

Gordon Hastie, Cormac Booth, Andy Maginnis, Doug Gillespie

**12:00 Live automated acoustic monitoring of cetaceans at risk during offshore operation: Real-time mitigation and online display**

Michel André, Mike van der Schaar, Serge Zaugg, David Hughes, Michele Micheli, Ludwig Houégnigan, Joan V. Castell, Antoni M. Sánchez

**12:15 The sonar beam characteristics and scanning behaviour of harbour porpoises during prey capture**

Jens C. Koblitz, Magnus Wahlberg, Peter Stolz, Peter T. Madsen, Hans Ulrich Schnitzler

**12:30 The “excitement” call: A universal killer whale call in the North Pacific?**

Nicola Rehn, Olga A. Filatova, John W. Durban, Andrew D. Foote

**12:45 An acoustic approach to the study of bottlenose dolphin community structure in Irish waters**

Anneli Englund, Simon Ingram, Emer Rogan

**LUNCH BREAK 13:00 – 14:30**

## MPA'S & CONSERVATION/MANAGEMENT

**CHAIR: Dave Wall**

**14:30 Does the EU Habitats Directive protect cetaceans?**

Peter Evans

**14:45 Long-term status of a small cetacean population in a protected area**

Barbara Cheney, Ross Corkrey, David Lusseau, Nicola Quick, Vincent Janik, Valentina Islas-Villanueva, Philip Hammond, Paul Thompson

**15:00 Marine protected areas for coastal cetaceans: Should we be thinking outside the box?**

Simon Ingram, Clare Embling

**15:15 The role of spatial modelling in the potential management of a priority Scottish cetacean species, the white-beaked dolphin (*Lagenorhynchus albirostris*)**

Olivia Rachel Harries, Caroline Weir, Susannah Calderan, Nienke van Geel, Juliet Shrimpton, Jonathan Gordon

**15:30 Ringed seals like it mild: How a specialist copes in extreme climate years**

Magaly Chambellant, Steve H. Ferguson

## SHORT TALK SESSION 1

**15:45 – 16:45**

**Whale FM: Classification of marine mammals sounds using crowd-sourcing**

Peter Tyack, Sander von Benda-Beckmann, Robert Simpson, Arfon Smith, Chris Lintott

**Testing POD detection range under optimal field conditions**

Marco Gauger, Christoph Jansen, Dennis Hagedorn, Boris Culik

**New sounds identified in two different species of beaked whale**

Charlotte Dunn, Hilary Moors

**It pays to be single: Investigating factors affecting C-POD detection probability of bottlenose dolphins**

Hanna Nuuttila, Rhiannon Meier, Emily Cunningham, Peter Evans, John Turner

**Assessing interaction between cetacean and maritime traffic in deep-sea waters in the Mediterranean Sea**

Roberto Crosti, Antonella Arcangeli, Léa David, Nathalie Di Méglio, Aurelie Moulins, Paola Tepsich, Mario Letterio Tringali

**Are humpback whales in Ireland young males prospecting new feeding grounds?**

Simon Berrow, Pádraig Whooley, Conor Ryan

**A fully detachable tag attachment system specifically designed for fastloc GPS deployments in small cetaceans**

Andrew J. Wright, Kjeld Moser, Lars Renvald, Tomonari Akamatsu, Rune Dietz, Jonas Teilmann

**T-NASS: Counting whales in the North Atlantic: from science to management advice**

Mario Acquarone, Genevieve Desportes, Jean-Francois Gosselin, Thorvaldur Gunnlaugsson, Mads Peter Heide-Jørgensen, Jack Lawson, Bjarni Mikkelsen, Nils Øien, Droplaug Ólafsdóttir, Daniel G. Pike, Gisli, A. Víkingsson, Lars Witting, Vladimir Zabavnikov

**Notes on male sperm whale reactions to killer whale attack in a high-latitude feeding ground**

Marta Acosta, Heike Vester, Ricardo Antunes, Iva Kovacic, Luca Tassara

**Does looking for oil displace deep-diving cetaceans? The effect of seismic surveys on sperm whale distribution in the Norwegian Sea**

Iva Kovacic, Benjamin Torres, Marta Acosta

**COFFEE BREAK 16:45 – 17:15**

**HUMAN INTERACTIONS**

**CHAIR: Paddy Pomeroy**

**17:15 Do seals and man fish in the same spots? Evidence of low spatial overlap between a top marine predator and specific fisheries off Ireland's west coast**

Michelle Cronin, Hans Gerritsen, Dave Reid

**17:30 Vessel noise affects beaked whale behaviour: Results of a dedicated acoustic response study**

Enrico Pirotta, Rachael Milor, Nicola Quick, Dave Moretti, Nancy Di Marzio, Peter Tyack, Ian Boyd, Gordon Hastie

**17:45 A thermo-energetic model for cetaceans: A potential tool for calculating the biological significance of multiple and diverse anthropogenic activities**

Colin D. MacLeod, Robert, J. Reid, Jennifer A. Learmonth, Andrew Brownlow, Graham J. Pierce

**18:00 Prey engulfment in phocid seals studied with high-speed cameras and accelerometry**

Kristina Skands Ydesen, Danuta Maria Wisniewska, Peter Teglberg Madsen

**18:15 Bowhead whales (*Balaena mysticetus*), killer whales (*Orcinus orca*) and sea ice**

Steven H. Ferguson, Jeff W. Higdon, Cory J. D. Matthews

**POSTER SESSION**

**18:30 – 20:00 Poster Session 1 – Odd Numbers**

**SOCIAL**

**22:00 Acoustic Seisiún in the hotel bar!**

**TUESDAY, 27<sup>TH</sup> MARCH 2012**

**BEHAVIOUR**

**CHAIR: Joanne O'Brien**

**09:00 Social network correlates of food availability in an endangered population of killer whales (*Orcinus orca*)**

Emma Foster, Daniel Franks, Lesley Morrell, Ken Balcomb, Kim Parsons, Astrid van Ginneken, Darren Croft

**09:15 Humpback whale (*Megaptera novaeangliae*) sound production during winter in Iceland**

Edda Elisabet Magnusdottir, Marianne Helene Rasmussen, Marc Lammers

**09:30 Behavioural and endocrinological evidence for social recognition in newly-weaned grey seals (*Halichoerus grypus*)**

Kelly Robinson, Sean Twiss, Neil Hazon, Simon Moss, Paddy Pomeroy

**09:45 Social evidence for distinct coastal and pelagic communities of bottlenose dolphins in Irish waters**

Machiel Oudejans, Fleur Visser

**GENETICS**

**CHAIR: Luca Mirimin**

**10:00 Local and regional genetic structure of spinner dolphins off islands in the southwest Indian Ocean**

Benoit Simon-Bouhet, Laura Ceyrac, Per Berggren, Violaine Dulau, Omar Amir, Narriman Jiddawi, Jeremy Kiszka

**10:15 Using a multi-disciplinary approach to define and assess the conservation unit of killer whales (*Orcinus orca*) in southern Spain**

Ruth Esteban, Philippe Verborgh, Pauline Gauffier, Joan Giménez, Vidal Martín, Mónica Pérez-Gil, Marisa Tejedor, Manuel Arbelo, Andrew Foote, Renaud de Stephanis

**10:30 Reconstruction and comparison of genealogies for bottlenose dolphins and dugongs in Moreton Bay, Queensland, Australia**

Robert Cope, Ina Ansmann, Janet Lanyon, Jennifer Seddon

**COFFEE BREAK 10:45 – 11:15**

## STRANDINGS

**CHAIR: Sinéad Murphy**

**11:15 The use of stranding anomalies to detect changes in spatial and temporal patterns of harbour porpoise abundance/mortality across European waters**

Hélène Peltier, Willy Dabin, Rob Deaville, Paul, D. Jepson, Jan Haelters, Guido, O. Keijl, Olivier Van Canneyt, Vincent Ridoux

**11:30 Investigating pollutant exposure and associated mortality in UK-stranded cetaceans (1990-2009): results of a 20-year study**

Paul Jepson, Rob Deaville, John Baker, James Barnett, Philippe Bersuda, Andrew Brownlow, Nick Davison, Tony Patterson, Rod Penrose, Matthew Perkins, Robert Reid, Mark Simmonds, Nick Tregenza, Robin Law

**11:45 Brucellosis in marine mammals stranded on the Belgian and northern France coast**

Thierry Jauniaux, Cecile Brenez, David Fretin, Jacques Godfroid, Jan Haelters, Emilie Laurent, Patrick Michel, Francis Kerckhof, Jan Mast, Michael Sarlet, Freddy Coignoul

**12:00 Pilot error? Investigation into the *Globicephala melas* mass stranding event, Kyle of Durness, northern Scotland, July 2011**

Andrew Brownlow, Mark Dagleish, Rob Deaville, Jamie Dyer, Geoff Foster, Ailsa Hall, Eva Krupp, Robin Law, Rod Penrose, Matt Perkins, Paul Jepson

## INVITED TALK

**12:15 Song and the lek mating system of the humpback whale**

Louis Herman

### LUNCH BREAK 13:00 – 14:30

**13:15 – 14:15 Annual Student Meeting**

Venue: Inisheer Room

**13:15 – 14:15 Meeting of the National Contact Persons**

Venue: Inishmore Room

## PHYSIOLOGY, PATHOLOGY & TOXICOLOGY

**CHAIR:** Emer Rogan

- 14:30 Mercury in blood of free-ranging seals (*Phoca vitulina*) from the North Sea: Time-trend and association with environmental factors**  
 Krishna Das, Charlène Brochoire, Aurélie Dupont, Sarah Habran, Gilles Lepoint, Cathy Debier, Ursula Siebert
- 14:45 The role of feeding habits and migratory behaviour in generating different toxicological hazard in seven cetaceans species of Gulf of California (Mexico)**  
 Maria Cristina Fossi, Jorge Urban-Ramirez, Cristina Panti, Silvia Maltese, Daniele Coppola, Giacomo Spinsanti, Lorenzo Rojas-Bracho, Begona Jimenez, Juan Munoz-Arnanz, Maria Grazia Finoia, Letizia Marsili
- 15:00 Sepioids do not feed on sperm whales: The evidence to consider biological and environmental variability when interpreting isotopic data in open marine ecosystems**  
 Tiphaine Chouvelon, Jérôme Spitz, Paula Mendez Fernandez, Vanessa Estrade, Florence Caurant, Vincent Ridoux, Paco Bustamante
- 15:15 Resource partitioning in sympatric populations of Indo-Pacific bottlenose dolphins: an integrative approach**  
 Ina C. Ansmann, Janet M. Lanyon, Jennifer M. Seddon, Guido J. Parra

## SHORT TALK SESSION 2

**15:30 – 16:30**

**Gait changes in deep-diving Blainville's beaked whales**

Lucia Martina Martín López, Patrick Miller, David Thompson, Mark Johnson

**Sexual dimorphism in pelvic rudiment of bottlenose dolphin (*Tursiops truncatus*)**

Martina Duras Gomercic, Darinka Skrtic, Tomislav Gomercic, Ana Galov, Hrvoje Lucic, Snjezana Curkovic, Snjezana Vukovic

**Modelling surface textures of the small cetaceans**

Vadim Pavlov, Rieke Scholz, Ursula Siebert

**Characterization of the dolphin cochlear nucleus using cluster analysis**

Lyuba Zehl, Silvia Daun-Gruhn, Helmut H.A. Oelschläger, Wolfgang Walkowiak, Stefan Huggenberger

**Presence of prestin in harbour porpoise cochlea**

Maria Morell, Michel Eybalin, Marc Lenoir, Lineke Begeman, Sjoukje Hiemstra, Sabine Ladrech, Jean-Luc Puel, Michel André

**Genetic analyses of groups of short-beaked common dolphins by-caught in fisheries in the North Atlantic and South-west Pacific Oceans**

Luca Mirimin, Andrew Westgate, Karen Stockin, Sinead Murphy, Simon Northridge, Tom Cross, Emer Rogan

**A pilot study on the effects of emerging contaminants (BPA and PFOA) on three cetacean species: Sperm whale, killer whale and bottlenose dolphin**

Cristina Panti, Giacomo Spinsanti, Chiara Nicosia, Letizia Marsili, Jorge Urban-Ramirez, Maria Cristina Fossi

**Fluctuations in  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  stable isotope ratios in fin whale baleen over a century**

Conor Ryan, Brendan McHugh, Clive Trueman, Chris Harrod, Richard Sabin, Simon Berrow, Ian O'Connor

**Molecular identification of *Anisakis* spp. complex from gastrointestinal tract of stranded cetaceans in Adriatic Sea**

Kristina Blažeković, Ivana Lepen Pleić, Martina Đuras Gomerčić, Tomislav Gomerčić, Ivona Mladineo

**High mortality of harbour porpoise neonates in the southwestern Black Sea in 2010 and 2011**

Ayaka Amaha Öztürk

**COFFEE BREAK 16:30 – 17:00**

**POSTER SESSION**

**17:00 – 18:30 Poster Session 1 – Even Numbers**

**SOCIAL**

**20:30 Video Night**

Venue: GMIT – Buses leave Galway Bay Hotel at 19:45. Pickup at Eyre Square at 20:00.

## WEDNESDAY, 28<sup>TH</sup> MARCH 2012

### TELEMETRY & NEW TECHNIQUES

**CHAIR:** Ronan Cosgrove

**09:00 The territorial long-finned pilot whales of the Alboran Sea**

Philippe Verborgh, Renaud de Stephanis, Pedro García, Jose Luis Murcia, Russ Andrews, Ana Cañadas, Pauline Gauffier, Joan Giménez, Ruth Esteban

**09:15 A service area in the middle of the ocean: Satellite tracking shows that fin whales pause their northern migration to forage in the Azores**

Mónica A. Silva, Rui Prieto, Ian Jonsen, Ricardo S. Santos, Mark Baumgartner

**09:30 Cetacean movements in relation to the dynamics of the sound-scattering layer on seamounts in the Azores**

Irma Cascao, Mónica A. Silva, Marc O. Lammers, Rui Prieto, Ricardo S. Santos

**09:45 Broad menu with kids option: Energy balance of prey selection in deep-diving pilot whales**

Natacha Aguilar de Soto, Peter Madsen, Jacobo Marrero, Patricia Arranz, Alejandro Escanez, Mark Johnson

### DISTRIBUTION

**CHAIR:** Oliver O’Cadhla

**10:00 Seasonal home range of social units of sperm whale (*Physeter macrocephalus*) in the Azores Archipelago: Implications for long-term spatially restricted photo-ID studies**

Marie Guilpin, Jonathan Gordon, Jason Matthiopoulos, Ricardo Antunes

**10:15 A systematic review of global bottlenose dolphin movement patterns in relation to habitat type**

Nienke van Geel, Ben Wilson, Gordon Hastie

**10:30 Cetacean distribution and relative abundance in the Irish EEZ**

Dave Wall, Nick Channon, Ian Enlander, Brian Glanville, Lucy Hunt, Laura Kavanagh, Clare Murray, Joanne O’Brien, Conor Ryan, Peter Tuffy, Dave Williams, Chris Wilson

**10:45 Re-established stone reef in Kattegat, Denmark, attracts harbour porpoises (*Phocoena phocoena*)**

Lonnie Mikkelsen, Kim N. Mouritsen, Jakob Tougaard, Karsten Dahl, Jonas Teilmann

**COFFEE BREAK 11:00 – 11:30**

### WORKSHOP REPORTS

**11:30 – 12:30 Reports on the progress and outcomes of the workshops held on 24<sup>th</sup> & 25<sup>th</sup> March 2012**

**LUNCH BREAK 12:30 – 14:30**

**12:45 – 14:15 Annual General Meeting**

## SHORT TALK SESSION 3

14:30 – 15:30

**Abundance of cetaceans in the central part of Croatian Adriatic Sea by photo-identification and aerial survey**

Ana Mikac, Martina Duras Gomercic, Anita Babacic Ajduk, Tina Dragutin, Tomislav Gomercic

**Fine-scale habitat use and midwater foraging in free-ranging grey seals**

Mark Jessopp, Tom Hart, Michelle Cronin

**Investigation of the interactions between cetaceans and marine traffic in the Istanbul Strait**

Ayaka Amaha Öztürk, Aylin Akkaya

**Can you find whales by measuring chlorophyll?**

Cilian Roden, Simon Berrow, Ian O'Connor, Pádraig Whooley

**Using telemetry data to scale-up haulout counts into abundance estimates for pinnipeds: Methods applied to British grey seal (*Halichoerus grypus*) and harbour seal (*Phoca vitulina*) populations**

Mike Lonergan, Callan Duck, Dave Thompson, Simon Moss, Bernie McConnell, Chris Morris

**An oceanographic model of the Pelagos Area as essential tool for cetacean habitat modelling**

Elisa Casella, Paola Tepsich, Antonella Arcangeli, Xavier Couvelard, Rui Caldeira

**Locomotor costs related to ram-suspension feeding in North Atlantic right whales**

Anna Nousek-McGregor, Douglas Nowacek

**PROJECT CETACEOS MADEIRA II: Identifying critical marine areas for bottlenose dolphin and surveillance of the cetaceans' conservation status in Madeira Archipelago**

Luís Freitas, Ana Dinis, Cláudia Ribeiro, Cátia Nicolau, Filipe Alves

**Investigating harbour porpoise group size in the Baltic region**

Ida Carlén, Len Thomas, Julia Carlström

**Smart phones for better marine mammal research through easy data collecting, sharing and unifying protocols**

Aviad Scheinin

## INVITED TALK

15:30 **Conservation science: The ethics of communication**

Greg Donovan

**COFFEE BREAK 16:15 – 16:45**

16:45 **Awards**

17:30 **Close of Conference**

## POSTER LIST

### ABUNDANCE/DISTRIBUTION

AB 01

**Results of systematic observations of true seals (*Phocidae*) in the Piltun Bay mouth area in 2010**

Evgeniya Dolgova, Maxim Sidorenko, Alexander Burdin

AB 02

**Inventories of harbour porpoise (*Phocoena phocoena*) presence in Russian territorial waters of the Baltic Sea**

Irina Trukhanova, Alexey Guschin, Rustam Sagitov

AB 03

**Pygmy right whale of open waters of the South-eastern Atlantic**

Yuri Mikhalev

AB 04

**Seasonal variation in abundance and time-budget of bottlenose dolphins (*Tursiops truncatus*) in Bahía San Antonio, Patagonia, Argentina**

Els Vermeulen, Alejandro Cammareri, Ludo Holsbeek, Krishna Das

AB 05

**Are Scottish tidal-stream energy sites also porpoise hot-spots?**

Ben Wilson, Steven Benjamins, Jonathan Gordon, Susannah Calderan, Nienke van Geel, Jim Elliott

AB 06

**Visual and acoustic surveys of harbour porpoises (*Phocoena phocoena*) in the southern North Sea**

Verena Peschko, Anita Gilles, René Swift, Sabine Müller, Ursula Siebert

AB 07

**Estimates of abundance and MPA for beaked whales in the Alboran Sea (south-western Mediterranean Sea)**

Ana Cañadas, José Antonio Vázquez

AB 08

**Density surface estimates from the Joint Cetacean Protocol Data Resource**

Charles G.M. Paxton, Timothy E. Dunn, R. Andrew, O. Finlay

AB 09

**Site fidelity and relative abundance of spinner dolphins resting in Samadai reef (Egypt - Red Sea)**

Marina Costa, Amina Cesario, Maddalena Fumagalli, Giuseppe Notarbartolo di Sciara

AB 10

**Abundance of common dolphins in the Bay of Algeciras using mark-recapture data**

Joan Giménez, Carolina Jiménez-Torres, Philippe Verborgh, Pauline Gauffier, Ruth Esteban, Renaud de Stephanis

AB 11

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**Assessing the influence of environmental and anthropogenic factors on distribution of bottlenose and striped dolphins in the Ionian Greek waters**

Alice Galli, Cristina Giacomà, Elena Papale, Andrea Giovannini, Fabio Ronchetti, Marta Azzolin

HA 09

**Boat traffic trends and effects on cetacean sighting rates in Cardigan Bay**

Katrin Lohrengel, Gemma Veneruso, Peter Evans, Daphna Feingold, Giovanna Pesante, Fernando Ugarte

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**Sperm whale habitat preference along the Hellenic Trench (Greece, Mediterranean)**

Popi Gkikopoulou, Alexandros Frantzis, Paraskevi Alexiadou, Vasilis Valavanis, Jason Matthiopoulos

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**Spatial and temporal differentiation in habitat use by five marine mammal species in Broadhaven Bay, northwest Ireland**

Pia Anderwald, Michael D. Haberlin, Michelle Cronin

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Renaud de Stephanis, Philippe Verborgh, Eva Carpinelli, Pauline Gauffier, Joan Giménez, Ruth Esteban, Ana Cañadas, Russ Andrews

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**Central nucleus of amygdala, locus coeruleus and paraventricular nucleus of dolphin's brain: where and why?**

Simona Sacchini, Cristiano Bombardi, Antonio Fernández, Eva Sierra, Manuel Arbelo, Marisa Andrada, Yara Bernaldo de Quirós, Pedro Herráez

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Lisette Zenteno, Enrique Crespo, Nataly Godall, Alex Aguilar, Larissa de Oliveira, Massimo Drago, Eduardo Sechhi, Nestor Garcia, Luis Cardona

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Paula Méndez-Fernandez, Benoit Simon-Bouhet, Paco Bustamante, Tiphaine Chouvelon, Marisa Ferreira, Alfredo López, Collin Moffat, Graham Pierce, Marie Russell, Begoña Santos, Jérôme Spitz, Jose Vingada, Lynda Webster, Florence Caurant

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Vera Krasnova, Olga Russkova, Anton Chernetsky, Vsevolod Belkovich

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Kristina Lehnert, Henrike Seibel, Ilka Hasselmeier, Peter Wohlsein, Maria Iversen, Nynne H. Nielsen, Mads-Peter Heide-Jørgensen, Ellen Prenger-Berninghoff, Ursula Siebert

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Jean-Luc Jung, Nolwenn Hymery, Eric Alfonsi, Sami Hassani

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**Real time positions of GPS tagged marine mammals: information worth sharing between scientists and whale-watchers?**

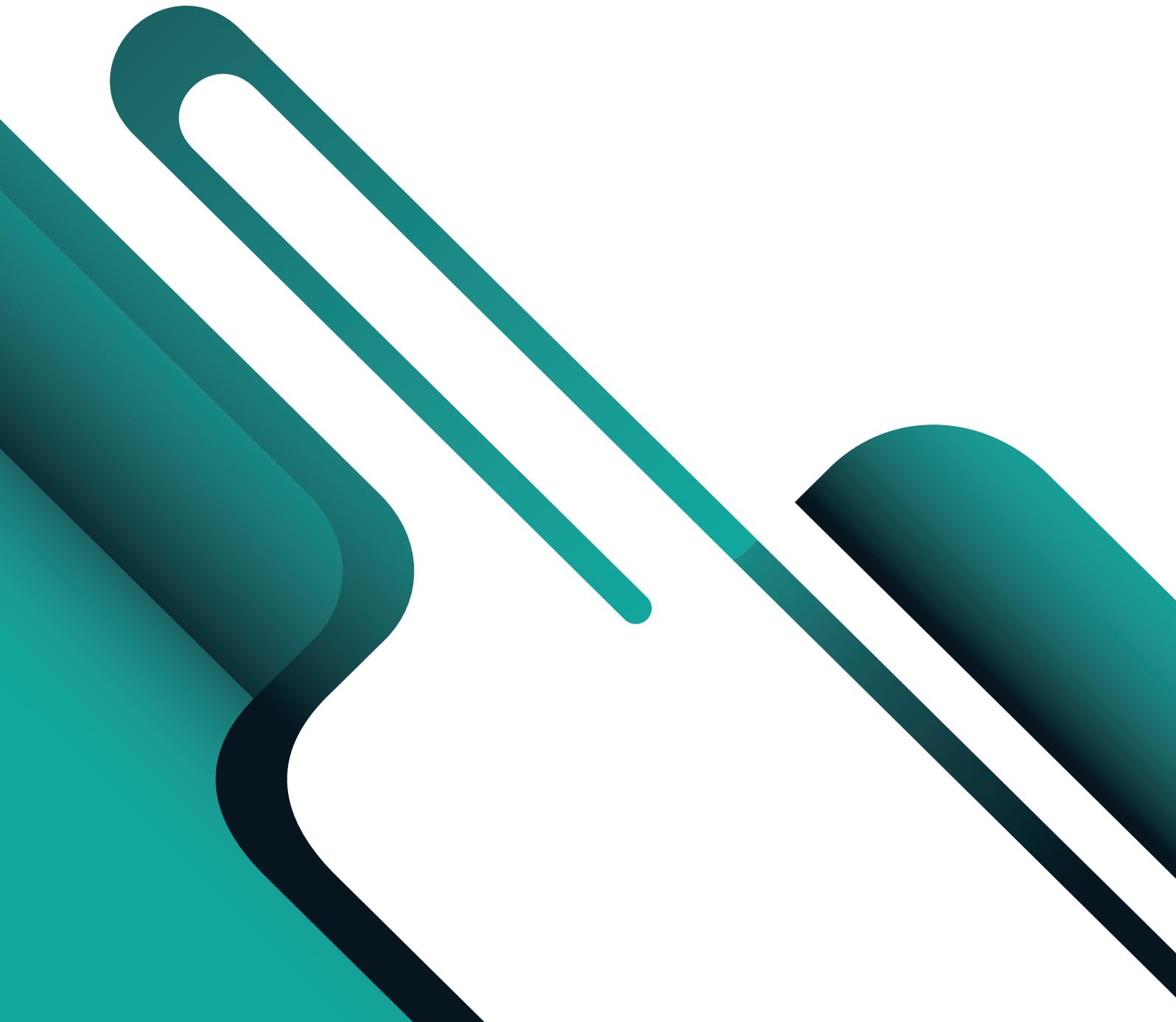
Joern Selling

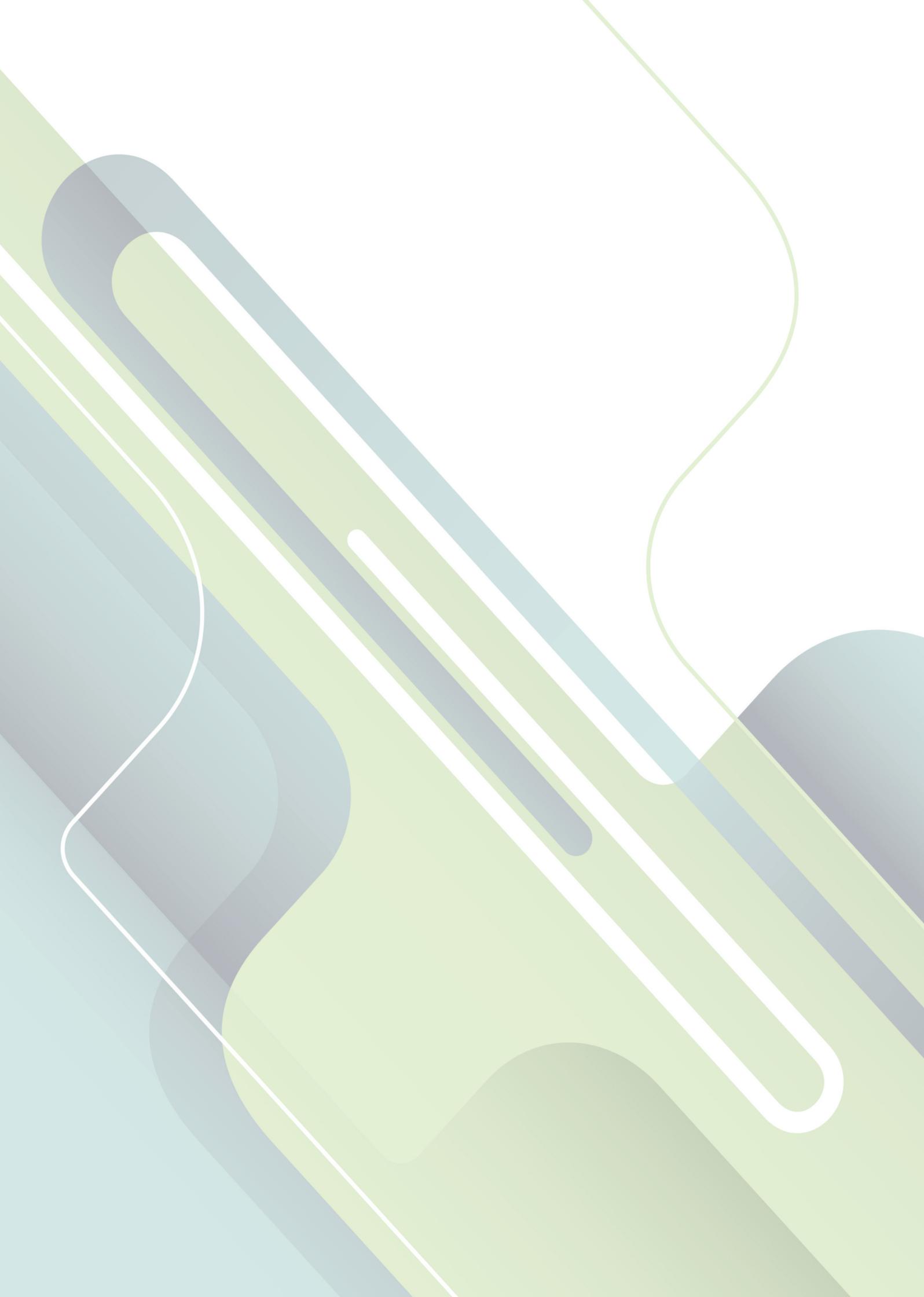
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**Economic impact of whale watching in north Norwegian coastal communities**

Ronny Gebser

# BOOK OF ABSTRACTS





MONDAY, 26<sup>TH</sup> MARCH 2012 11:15

## ACOUSTICS

### **“West Side Story”: an acoustic account of dolphins and porpoises as on the west coast of Ireland as determined through Static Acoustic Monitoring**

Joanne O’Brien (1), Suzanne Beck (1), Simon Berrow (1,2), Barry McGovern (1)

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(2) Irish Whale and Dolphin Group

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Long-term Static Acoustic Monitoring (SAM) was carried out on the west coast of Ireland over a two year period using self-contained click detectors called C-PODs. The aim of the project was to develop a programme to fulfil Ireland’s monitoring requirements under the EU Habitats Directive for Annex II species, Harbour porpoise and Bottlenose dolphin. The data were explored to derive an acoustic monitoring index from which to monitor trends across differing timeframes. The index %DPM was used and recommended. Three sites, Galway Bay, Blasket Islands and the Shannon Estuary were monitored over the project duration. Two of the sites monitored are already designated Special Areas of Conservation (SACs), Blasket Island for harbour porpoise and the Shannon Estuary for Bottlenose dolphins. A total of 2,406 C-POD days (57,744 hours) were monitored across all sites. All data were extracted as Detection Positive Hours DPH, and a generalized linear mixed-effect model (GLMM) was fitted to the binomial data with POD ID included as a random factor. Results from the Shannon Estuary SAC showed that tidal cycle had the greatest level of significance ( $X^2= 427.7, p<0.0001$ ) on bottlenose dolphin presence while most detections were recorded during night-time hours. Data from the Blaskets SAC and Galway Bay showed Harbour porpoise detections to be significantly greater during the autumn and winter, but contrasting results were found for diel and tidal cycles between the two locations. In order to effectively monitor Annex II species, it is imperative that that the seasonal and temporal trends in distribution and abundance are clearly understood. SAM provides a cost effective means from which to obtain year round data especially in areas where weather impacts on visual survey data and would not permit such robust coverage.

**MONDAY, 26<sup>TH</sup> MARCH 2012 11:30****PODs adrift: a novel approach to monitoring cetaceans in tidal rapids**

Steven Benjamins (1), Jim Elliott (1), Ben Wilson (1)

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There is an urgent need to improve our understanding of how marine mammals use tidal rapids, which are of growing interest for renewable energy development. Study of such sites remains difficult, however, partially due to problems in deploying detection equipment. Passive acoustic porpoise detectors (T- and C-PODs) are widely used to study distribution and relative abundance of small cetaceans by being anchored in one location for extended periods. This may be problematic in tidal rapids where strong currents require robust moorings, the constant flow of water past the detector adds appreciable noise to the data, and risks of device damage or loss over prolonged deployments are considerable. The aim of the present project was to develop a novel monitoring method that minimised these problems. C-PODs were suspended 5m underwater attached to passive drifters equipped with GPS devices. They were repeatedly set adrift in a tidal rapid site in western Scotland (UK) during May 2010 and August 2011, in order to assess local distribution and relative abundance of harbour porpoise (*Phocoena phocoena*). A total of sixty-six drifts were completed, covering the entire channel under a range of tidal conditions. POD positions, ambient noise levels and Porpoise-Positive Minutes (PPMs) were identified, georeferenced and mapped using ArcGIS. Drifting POD results were compared to data collected by moored C-PODs deployed simultaneously along the channel. PODs successfully recorded porpoise clicks while adrift in currents of up to 4.1 m/s, along transects of up to 6.7 km in length and up to 3 hours in duration. Recorded ambient noise levels varied considerably in space and time, associated with different tidal phases. Harbour porpoise distribution proved similar to that found using more traditional visual and acoustic boat surveys. A combination of moored and drifting C-PODs provides a powerful tool to study small cetaceans in these energetic environments.

**MONDAY, 26<sup>TH</sup> MARCH 2012 11:45**

## **Long-term remote monitoring of cetaceans using a solar-powered autonomous detector**

Gordon Hastie (1), Cormac Booth (1), Andy Maginnis (1), Doug Gillespie (2)

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(2) SMRU

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The use of autonomous passive acoustic devices is now well established as a method for long term cetacean monitoring. However, the duration of most deployments are restricted by battery life and, particularly when monitoring at high frequencies, by available storage space. We present a system for long term monitoring of cetaceans using a solar powered system in which real time detection algorithms for multiple species can run concurrently on an embedded processing platform. Sample rates of up to 500kHz can be achieved, making the system suitable for the detection of all known cetacean calls. Data volumes of detected calls were typically below 1 Megabyte a day, meaning that data could be transmitted ashore in near real time using cell or satellite phone networks. The combination of solar power, real time processing and data transmission means that deployment lifetimes are limited only by the mechanics of the mooring and the need to remove bio-fouling from hydrophones. We present to results of a deployment to date (approximately 10 months) off the east coast of Scotland in terms of numbers of dolphin and harbour porpoise detections, and discuss the potential possibilities and pitfalls associated with long term passive acoustic datasets.

**MONDAY, 26<sup>TH</sup> MARCH 2012 12:00****Live automated acoustic monitoring of cetaceans at risk during offshore operations: real-time mitigation and online display**

Michel André (1), Mike van der Schaar (1), Serge Zaugg (1), David Hughes (2), Michele Micheli (1), Ludwig Houégnyan (1), Joan V. Castell (1), Antoni M. Sánchez (1)

(1) Laboratory of Applied Bioacoustics, Technical University of Catalonia, BarcelonaTech (UPC)

(2) NATO Undersea Research Center (NURC)

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Artificial noise can have detrimental effects on the marine ecosystems. The problem faced by the industry, and more generally by society, is that many economically important activities at sea are at risk because of a lack of information about the effects of anthropogenic sound on marine mammals and especially a lack of available tools to mitigate these effects. The challenge here is to implement technological developments that combine the interests of the industry and the good environmental status of the oceans. Based on the existing technology developed at underwater observatories in different regions (European Sea-floor Observatories Network of Excellence, ESONET; ANTARES, France; NEPTUNE, Canada; JAMSTEC, Japan) by the Laboratory of Applied Bioacoustics of the Technical University of Catalonia (LIDO, Listen to the Deep- Ocean Environment, <http://listentothedeep.com>), a real-time passive acoustic monitoring solution was developed that includes an automated detection and classification (DC) system to monitor noise and help mitigating the potential effects of noise associated to the offshore industry. Here, we present the RT analysis conducted during the NURC (NATO Undersea Research Centre) 2011 SIRENA campaign where beaked whale presence (and other cetacean species) was continuously monitored and compared with human detection performance. The results demonstrated that:

- the DC of acoustic sources was reliable no matter sea state or light conditions;
- no expertise was needed to operate and retrieve the data on the identification of cetacean species that were displayed on a user-friendly interface;
- the real-time continuous monitoring of cetaceans allowed determining areas of exclusion depending on the sound source and the species involved.

The decision-taking regarding the management of the offshore activity in presence of cetaceans can therefore fall under scientifically contrasted, objective and standardised procedures that ensure the sustainable development of the activity. This presentation includes a live connection to the RT analysis performed.

**MONDAY, 26<sup>TH</sup> MARCH 2012 12:15**

## **The sonar beam characteristics and scanning behaviour of harbour porpoises during prey capture**

Jens C. Koblitz (1), Magnus Wahlberg (2), Peter Stolz (1), Peter T. Madsen (3), Hans-Ulrich Schnitzler (1)

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(2) Fjord&Bælt, Margrethes Plads 1, 5300 Kerteminde, Denmark

(3) Zoophysiology, Department of Biological Sciences, Aarhus University, Build 1131, 8000 Aarhus C, Denmark

Jens.Koblitz@uni-tuebingen.de

Toothed whales use a narrow acoustic transmission beam to increase detection distance and to reduce clutter during echolocation. Most measurements of the beam have been performed on stationary animals and only very little data is available on the beam characteristics of animals during prey capture.

Using a 16-hydrophone array we recorded the echolocation clicks of three harbour porpoises held in captivity in a semi-natural environment during prey capture. The location of the animal was determined using the time-of-arrival differences between the signals recorded at the various hydrophones. This allowed us to perform two-dimensional measurements of the transmission beams from free-swimming animals.

First results support recent transmission beam measurements of stationary animals showing that the harbour porpoise beam is narrower than previously reported. In addition we show how harbour porpoises scan their environment with their echolocation beam during prey capture. Scanning is indicated by deviations of the sonar beam direction from the swimming direction of the animal, especially in the horizontal plane. This scanning is at least partially caused by head movements.

**MONDAY, 26<sup>TH</sup> MARCH 2012 12:30****The “excitement” call: a universal killer whale call in the North Pacific?**

Nicola Rehn (1), Olga A. Filatova (2), John W. Durban (3), Andrew D. Foote (4)

(1) University of Hamburg

(2) Moscow State University

(3) Alaska Fisheries Science Center, National Marine Fisheries Service, NOAA

(4) University of Copenhagen

nicola.rehn@arcor.de

Facial and vocal expressions of emotion have been found in many social mammal species. There has been a debate if these signals are culturally inherited or are truly biologically innate. Evidence for innateness can come from cross-cultural studies. In this study we compared sound recordings from three culturally, genetically and ecologically distinct and socially isolated ecotypes of killer whales in the North Pacific (residents, transients and offshores) including five vocal clans of the resident ecotype. Resident killer whales can be further separated into vocal clans, each clan having discrete culturally transmitted vocal traditions. Killer whales produce stereotyped and variable calls. There is strong evidence that killer whales learn their stereotyped call repertoire. Earlier studies described the variable V4 or “excitement” call that is associated with high arousal socializing behaviour in a population of killer whales in British Columbia, Canada. We found the V4 or “excitement” call in recordings of all three ecotypes and five vocal clans of the resident ecotype. Nine independent observers reproduced our classification of the V4 call from each ecotype and five vocal clans with high inter-observer agreement. Here we report the first demonstrated overlap in the production of the same variable call class between different ecotypes and vocal clans of killer whales. Our findings indicate the V4 call may be universal in Pacific killer whale populations and that transmission of this call is independent of cultural tradition or ecotype. The sharing of the V4 call among distinct ecotypes and vocal clans in this study could potentially be explained by social learning, but in three decades of killer whale research in the North Pacific no social contacts between ecotypes have been observed. We conclude that such universality is more consistent with an innate vocalization than one acquired through social learning.

MONDAY, 26<sup>TH</sup> MARCH 2012 12:45

## **An acoustic approach to the study of bottlenose dolphin community structure in Irish waters**

Anneli Englund (1), Simon Ingram (2), Emer Rogan (1)

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Individually distinctive calls have been demonstrated in the bottlenose dolphin (*Tursiops truncatus*), while group distinct calls are rarely found. Heritable variation could result in within group similarity, be further amplified by social learning and result in increased between group variation. Several putative populations of bottlenose dolphins are present in Irish waters. Some are genetically distinct, with overlapping ranging patterns but no evidence of social overlap. In waters with poor visibility it is presumed that acoustics should be the most likely cue to enable community member recognition and the maintenance of social boundaries. We studied variation in frequency and time parameters of dolphin whistles between and within communities in the Shannon estuary, Cork harbour, Connemara, Mayo and pelagic waters. Comparisons were also made with the American east coast where offshore and inshore bottlenose dolphin types exist. Classification tree analysis was a poor predictor of site (46%) for Irish communities, while 76% of whistles were correctly predicted for American communities. Multivariate analyses of variance revealed significant differences between the communities ( $p < 0.001$ ) for a number of parameters (box-cox transformed) and pair-wise comparisons showed that some Irish communities (Shannon/Cork and Connemara/Mayo) did not vary in any of the parameters ( $p < 0.01$ ), while all other community pairs displayed significant variation in up to four different parameters. Mantel tests revealed no effect of community membership when combining genetics and acoustics in similarity matrices. Photo-identification confirmed individual overlap between Connemara and Mayo, and while no overlap was found between any of the other communities, recent genetic work suggests gene flow between Cork and Shannon. Overall variation between Irish communities was low in comparison to American waters where whistles from the offshore type were distinctly different to whistles from coastal dolphins. Further investigation will be required to understand the cues used for community member recognition by Irish bottlenose dolphins.

MONDAY, 26<sup>TH</sup> MARCH 2012 14:30

## MPA'S & CONSERVATION MANAGEMENT

### Does the EU Habitats Directive protect cetaceans?

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Over the last twenty years, the Habitats Directive has been the major legislative instrument for the protection of wildlife in Europe. Under Annex IV, all cetaceans are given special protective status, and within Annex II, additional conservation measures are required for harbour porpoise and bottlenose dolphin in the form of Special Areas of Conservation within the Natura 2000 network. This presentation first reviews progress by different European countries towards cetacean conservation, and highlights the differences that exist between countries in their approaches. It considers the challenges of assessing favourable conservation status for different cetacean species, in terms of estimating population trends, identifying what is favourable, and addressing the issue of appropriate management units. A dichotomy of opinion exists over the utility of marine protected areas for a mobile animal group such as cetaceans, some favouring their establishment whereas others consider wider conservation measures that tackle particular threats are more appropriate. The pros and cons of each will be examined, with examples of where one method has been more successful than the other and vice versa. Finally, some recommendations are made for how the Habitats Directive could be made more effective, despite challenges for studying species that can readily shift their range, are generally cryptic and therefore difficult to monitor, and for which in a number of cases our knowledge of species biology is poor. In these difficult economic times, measures need to be not only practical but cost-effective, and so resource implications need to be built in as an important factor.

**MONDAY, 26<sup>TH</sup> MARCH 2012 14:45****Long-term status of a small cetacean population in a protected area**

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EU legislation to protect marine species and monitor marine reserves requires accurate information on population abundance and trends to inform management and conservation. We present the first robust evidence of long-term trends, status and use of a protected area by a small cetacean population. The abundance of bottlenose dolphins within the Moray Firth Special Area of Conservation was estimated from 1990-2010 with a refined mark-recapture method, accounting for sampling heterogeneity. Levels of use of the SAC were estimated. A Bayesian capture-recapture model with a state-space approach was used to estimate the trends in abundance for the east coast of Scotland bottlenose dolphin population (1990-2010). Changes in the proportion of the population using the SAC were estimated using a GLM. Passive acoustic monitoring and encounter probability in a core area were used to quantify the time spent by dolphins within the SAC. Despite inter-annual variability, the number of dolphins using the SAC has been stable and there is an estimated 99% probability that the total east coast population is stable or increasing. Use of the SAC has declined by 36%, but in summer, acoustic loggers detected dolphins for a median of 5 hours per day in areas of the SAC and the average probability of encountering dolphins in a core area was 69%. Our refined mark-recapture methodology has reduced the effects of sampling heterogeneity, providing a more robust estimate of changes in abundance within the SAC. This is the first evidence that the number of individuals using the SAC is stable, with a high level of use. The decreasing trend in the proportion of the population using the SAC is likely driven by an increase in the overall population size, rather than fewer individual dolphins using the SAC.

**MONDAY, 26<sup>TH</sup> MARCH 2012 15:00****Marine Protected Areas for coastal cetaceans: should we be thinking outside the box?**

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Cetacean conservation policy in the EU has concentrated on the application of fixed area protection. Subsequently a variety of areas have been designated to protect and/or manage cetacean populations. Some designations, such as the Irish Whale and Dolphin Sanctuary may act as political statements communicating national cultural attitudes towards cetacean conservation and exploitation, but carry no specific legislation, measures of protection or management targets. Others such as SACs, designated in accordance with the EU Habitats Directive, are specifically designed to provide protection and restoration within a network of similar MPAs. Whilst monitoring and reporting are incorporated into SAC management a tendency towards directing effort exclusively within protected areas may neglect the biological parameters and conservation needs of populations outside these areas. Data collected solely within MPAs may actually produce misleading indications of population decline resulting from range expansion and changes in habitat use. We use bottlenose dolphins and harbour porpoises to contrast the challenges in applying fixed area management to mobile coastal cetacean species and suggest how science may inform and drive policy forwards rather than policy directing research effort. In Ireland a single SAC in the Shannon estuary appears to offer protection for bottlenose dolphins in a critical habitat during at least part of the year and within part of their range. However, other highly mobile adjacent populations have also been shown to use Irish coastal waters but appear to have no protection under the Habitats Directive. Meanwhile in the UK there are currently no SACs for which harbour porpoises are listed as a qualifying feature partly due to their widespread distribution and abundance. We examine whether further SAC designations are the most effective way of extending protection to these species or a more dynamic approach based on ranging behaviour and biological parameters of populations is needed.

MONDAY, 26<sup>TH</sup> MARCH 2012 15:15**The role of spatial modelling in the potential management of a priority Scottish cetacean species, the white-beaked dolphin (*Lagenorhynchus albirostris*)**

Olivia Rachel Harries (1) Caroline Weir (2), Susannah Calderan (1), Nienke van Geel (3), Juliet Shrimpton (1), Jonathan Gordon (4)

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Spatial predictive habitat modelling provides useful information about the factors determining cetacean distribution for use in management schemes. Scottish waters represent a significant portion of the geographic range of white-beaked dolphins (*Lagenorhynchus albirostris*) in the North Atlantic. However, little is known about the factors governing the species' spatial distribution within Scottish waters, or how these factors may influence dolphin occurrence temporally. We carried out spatial analysis on white-beaked dolphin distribution off the west coast of Scotland, in a study area spanning the waters from Islay north to Cape Wrath, including the Sea of Hebrides, The Minches and Atlantic waters bordering the Outer Hebrides. Systematic line transect surveys carried out by the Hebridean Whale and Dolphin Trust (HWDT) between 2003 and 2011 recorded a total of 86 visual detections of white-beaked dolphins. Generalised Additive Models (GAMs) were used to relate the sightings to a range of physiographic variables including depth, seabed slope, sediment type, distance from land and sea surface temperature. Temporal variables (month and year) were also included in the model. Three potential "hotspots" of occurrence were identified as areas of apparent importance: an area to the south of the Outer Hebrides, the northern Minch and west of the Isle of Lewis. Although the functional mechanisms of these high density habitats remain unclear, it is likely that these patterns of distribution primarily reflect foraging activities. These results provided information on high and low density habitats that are relevant to the future management of white-beaked dolphins. This species is included as a Priority Marine Feature (PMF) under Scottish Government legislation, for which Marine Protected Area (MPA) search areas should be identified. Consequently, understanding the factors that influence the spatio-temporal distribution of white-beaked dolphins in Scottish waters is of direct relevance to the future development of MPAs for this species.

**MONDAY, 26<sup>TH</sup> MARCH 2012 15:30****Ringed seals like it mild: how a specialist copes in extreme climate years**

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The ringed seal (*Phoca hispida*) depends on a stable ice platform with sufficient snow depth and a productive open-water season for reproduction and survival. Evidence of ringed seal sensitivity to environmental variations has been previously reported, but mechanisms involved were poorly understood. In western Hudson Bay, density, life-history traits, and diet of ringed seals were monitored over two decades, providing an opportunity to understand effects of climatic variations on the population dynamics of this long-lived carnivore. Ringed seal density was estimated through aerial surveys flown in western Hudson Bay in late spring in the 1990s and 2000s. During these decades, ringed seals were also sampled from Inuit subsistence harvests in Arviat, NU. Strong inter-annual variations in life-history traits, diet and density were observed, and related to variations in the sea-ice regime. The exceptionally cold and heavy ice conditions that prevailed in the eastern Arctic in the early 1990s likely induced a shift from pelagic to benthic in the Hudson Bay productivity, reducing the availability to ringed seals of sand lances (*Ammodytes* spp.), their major prey. Heavy ice conditions also allowed ringed seal main predators, polar bears (*Ursus maritimus*) and arctic foxes (*Alopex lagopus*), to hunt for pups on the ice for a longer period in the spring. Ringed seals were not able to compensate for the energy loss from sand lances by feeding benthically and, the nutritional stress endured combined with an increased predation pressure, led to a decrease in ringed seal reproductive performances, pup survival, and density during the 1990s. Variations in ringed seal population dynamics reflected changes in the sea-ice regime, productivity, and fish community of western Hudson Bay, indicating that the ringed seal is a good indicator species of ecosystem changes.

MONDAY, 26<sup>TH</sup> MARCH 2012 15:45 - 16:45

## SHORT TALK SESSION 1

### **Whale FM: classification of marine mammals sounds using crowd-sourcing**

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Researchers are faced with increasingly large acoustic datasets of marine mammal sounds. Automatic classification algorithms are currently being developed, but their performance is still limited by the lack of ground-truth datasets and absence of consensus on how to categorize the sounds. Ground-truth datasets tend to be limited in size because they are expensive and time-consuming to produce because expert judges are generally used to audit the datasets. To address these problems, a public web-based experiment, called Whale FM, was launched at the end of 2011. This experiment aims to involve a broader public to help categorize large datasets of marine mammal sounds. This approach is commonly referred to as crowd-sourcing, or citizen science, and has the potential to drastically increase the speed and efficiency at which large datasets can be analysed. In this experiment, volunteers are asked to categorize sounds of killer whales and pilot whales. A well-defined categorization scheme already exists for killer whale sounds, which we use to test the reliability of non-expert judgments. For pilot whales, a common categorization scheme is still lacking. We plan to use the judgments made by the volunteers to establish a categorization scheme using a large dataset consisting of pilot whale calls recorded in Norway and the Bahamas. We will present the Whale FM project, initial results obtained with this experiment, and share our experience of using crowd-sourcing for classifying marine mammal calls.

## Testing POD detection range under optimal field conditions

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The autonomous cetacean detection system C-POD is in use worldwide. However, although the manufacturer specifies 300 m detection range of these devices for harbour porpoises, this has never been tested under controlled field conditions.

We developed an autonomous harbour porpoise click generator PAL (Porpoise ALarm, pat. pend.) aimed at generating harbour porpoise click trains to alarm these animals in the vicinity of gillnets (c.f. 2011 ECS in Cádiz).

PAL is omnidirectional and broad band (resonant frequencies at 65 kHz and 105 kHz) and generates harbour porpoise clicktrains at a SL of 155 dB at 132 kHz. Here, programmable clicktrains (1.2 s) were repeated every 4 s, consisting of 700 clicks (60 ms each) in an upsweep from 200 to 1000 clicks/s.

In November 2011 we tested a total of 20 C-PODs (V0 and V1) at the sonar facilities of the German Navy (WTD 71) at Lake Plön, Germany. Water depth in the testing area is in the range of 10-12 m. Water Temp was 8.8°C, salinity 0.2 PSU and speed of sound 1442 m/s throughout the water column. Wind speed was 2-3 Bft and sea state 2. Background noise was determined at 56 dB rel 1µPa/Hz.

All PODs were moored between 5 and 7 m below the surface. The PAL was lowered vertically to 5 m below the water surface from a canoe. Position of the wind driven canoe (speed < 0.3 m/s) was determined via GPS. We conducted a total of 3 transects from 2 - 400 m distance to the moored PODs.

Within the 125 kHz channel 50% detection threshold of C-PODs was reached at 186 m (v0, n=12) and 250 m (v1, n=8) from the sound source. Knowledge of POD detection range has important implications for the design of research programmes.

## New sounds identified in two different species of beaked whale

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While echolocation in beaked whales has been studied extensively, the use of sound for communication in these animals is largely unexplored. We present analyses of acoustic recordings from two species of beaked whale describing a vocal pattern we term the “double-click” – a pair of clicks with inter-click intervals (ICIs) much smaller than those of immediately following clicks. We analysed opportunistic recordings of northern bottlenose whales (*Hyperoodon ampullatus*) from field efforts in 2006 and 2007 in the Gully, South of Nova Scotia, and recordings of Blainville’s beaked whales (*Mesoplodon densirostris*) from DTAGs placed on animals off Andros Island in the Bahamas in 2007. Double-clicks were produced by *Hyperoodon* at the start of regular echolocation click trains both when at the surface and after individuals began foraging dives, and were produced by *Mesoplodon* at the start of regular click trains, while foraging at depth. DTAG data for the *Mesoplodons* shows that all click trains may commence with a double-click. The double-clicks of both species have a mean ICI less than half the duration of a regular click ICI (172.14ms (SE = 20) double-click ICI versus 388.53ms (SE = 18.24) regular ICI for *Hyperoodon*, and 124.59ms (SE = 1) versus 353.30ms (SE = 7.4) for *Mesoplodon*). We can speculate on the function of this vocal pattern, but double-clicks are unlikely to be directly used for foraging, as they show no correlation with buzzes thought to indicate prey capture attempts. It is possible that the double-click serves some initiation function for echolocation click trains, either psycho-physically by recalibrating an acoustic-scene or physiologically associated with air circulation and sound production. It is also possible that double-clicks may serve a social communication function, as in sperm whale codas, and may act as cues on the age/sex class of the vocalising.

## **It pays to be single: investigating factors affecting C-POD detection probability of bottlenose dolphins**

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Static acoustic methods are a popular tool to monitor cetaceans, with huge potential for density estimation. Here we investigate the effect of various variables on the detection probability of bottlenose dolphins using a combination of five static acoustic loggers (C-PODs, Chelonia Ltd.) and visual observations. Paired comparison between units revealed a high correlation in the sensitivity of the units. False positive rate was ascertained from sample data. Detection functions for distance with different variables were fitted with binomial Generalized Linear Models (GLM) and Generalized Linear Mixed Models (GLMM) were used to examine the influence of random effects from site, season and dolphin encounter. Effective detection radius (EDR) was 641m - 948m, and maximum detection distance was 1328m - 1779m. There was a significant seasonal effect, with higher detection rates in summer than winter and spring. Detection probability ( $p$ ) was affected by distance and behaviour whereas group size had a selective effect on detectability. Detection probability for single dolphins (0.38, SD = 0.46,  $n=2046$ ) was significantly higher than for groups (0.30, SD=0.49,  $n=1097$ ),  $X^2 = 20.3881$ ,  $df = 1$ ,  $p\text{-value} = 6.322e-06$ . Solitary dolphins were more detectable than larger groups and detected regardless of behaviour, distance or encounter duration. Feeding increased detectability for larger groups and an increase in encounter duration and group size increased detectability only for feeding dolphins. This study illustrates the capacity of C-PODs to reveal variations in vocal behaviour of wild bottlenose dolphins, including seasonal trends. Here we show that acoustic behaviour of single dolphins is significantly different from those of larger groups affecting the detectability of dolphins by SAM devices. The findings emphasize the importance of prior knowledge on animal's activity and behaviour state to the effective placement of loggers and demonstrate the potential ability of C-PODs to convey behavioural information or to establish potential feeding sites.

## Assessing interaction between cetacean and maritime traffic in deep sea waters in the Mediterranean Sea

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The Mediterranean Sea is a region with intense maritime traffic and several Multilateral Environmental Agreements (such as Accobams, Pelagos Sanctuary, Barcelona Convention-SPA/BD) require for States Parties the assessment and management of the interactions between cetacean and vessels. Until nowadays, however, interactions have been investigated only nearby coastal areas and consequently only for bottlenose dolphin. There are no large scale direct observations in deep sea waters notwithstanding the expected increase in maritime traffic following the EU policies on environment and sea transport (i.e. Motorways of the Sea). For these reasons, between the aims of the network that systematically monitors cetacean using ferries as observation platforms along fixed transect lines, in central-western Mediterranean Sea, there is the assessment of the interactions with maritime traffic. Along the seven ferry routes dedicated cetacean observers through seascape scan sampling computed the number of large vessel detected, in deep sea waters, both during cetacean sightings (n=1230) and randomly (n=1451). Differences in percentage, values and distributions of the two computation were tested.

Overall results showed that during sightings maritime traffic was significantly reduced. The reduction was not uniform across the species. In particular *Z. cavirostris*, *S. coeruleoalba*, and *Balaenoptera* spp sightings occurred with lower number, while *T. truncatus* sightings occurred with an higher numbers of vessels compared to random.

The network travelled (speed between 16 and 36 knots) more than 80.000 MN (includes data collected in the '90 in central Tyrrhenian Sea) recording three near miss event. Cetacean behaviour/avoidance, number of MN travelled without collisions, maritime traffic intensity, encounter rate and distribution of animals along the specific maritime routes are all needed parameters to be taken into account within a framework of developing a "collision risk assessment" so to manage sustainably the near future increase of sea shipping.

## **Are humpback whales in Ireland young males prospecting new feeding grounds?**

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Humpback whales are frequently recorded in inshore Irish waters from July through to December. Since 2001, images of 17 individual humpback whales in Irish waters have been collected. Fourteen of these have been re-sighted within a year and eight re-sighted inter-annually, a rate of 47%. Some individuals have been recorded over a 3-4 month period within the same year suggesting that the habitat provides a good foraging area. Four individuals have been recorded over a three year period and one animal over seven years. Estimated length of humpback whales photographed in Ireland were less than 12m and none were considered to have reached adult size. From these 17 individuals, biopsy samples were collected from eight animals. Using molecular sexing all individuals sampled to date were determined to be male. We suggest that humpback whales that have been recorded inshore around the coast of Ireland are young, sexually immature males that are returning each year to good feeding grounds prior to attaining sexual maturity. Where these whales travel outside of Ireland to breed is still not known but we suggest that following attainment of sexual maturity, humpback whales may change their pattern of migration and do not return to these coastal feeding areas.

## **A fully detachable tag attachment system specifically designed for fastloc GPS deployments in small cetaceans**

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Tags on small cetaceans generally provide long-term, low-resolution data or short-term, high-resolution data. Newer logging and telemetry technologies (e.g., fastloc GPS) are starting to bridge the gap, giving scientists the capability to provide managers with important new information about 3-dimensional habitat use by protected cetacean species over longer durations. However, the state-of-the-art attachments techniques remain the very short-term suction cups and the semi-permanent pin attachments. To take advantage of the new high-resolution medium-term technologies, while limiting the impact of the use of these typically larger units on the animals, we developed a new pin-attachment system. This system completely detaches from the fin of the animal after a pre-programmed time. The core of the system is a wire under tension through hollow pins and held in place by a hinge clamped shut with a releaser cable. It is not any more difficult or time-consuming to deploy than more conventional pin-attachment systems. The new system also has benefits over conventional pin attachments systems for the animals that are tagged, as the holes, which are still required in the dorsal fins, become clear of all material after detachment, allowing them to heal. Trial deployments on harbour porpoises have been promising, leading to some refinements. Although the low-budget prototypes could still benefit from additional refinement, the advantages presented by the new deployment system are notable. Location data from fastloc GPS tags has been demonstrated to be more accurate than ARGOS locations. Furthermore, if the location acquisition frequency (and thus battery life) is tailored to the expected length of attachment, the number of good quality locations can also be substantially increased in comparison to semi-permanent ARGOS deployments. In the on-going tagging project in Danish waters the number of good locations is 5-6 per hour in comparison to 3-5 per day in ARGOS (quality 3-1).

## **T-NASS – Counting whales in the North Atlantic: from science to management advice**

Mario Acquarone (1), Genevieve Desportes (2), Jean-Francois Gosselin (3), Thorvaldur Gunnlaugsson (4), Mads Peter Heide-Jørgensen (5), Jack Lawson (3), Bjarni Mikkelsen (2), Nils Øien (6), Droplaug Ólafsdóttir (4), Daniel G. Pike (1), Gisli, A. Víkingsson (4), Lars Witting (5), Vladimir Zabavnikov (7)

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NAMMCO coordinated a basin-wide sightings survey to estimate the abundance of cetacean populations in the Northern North Atlantic from survey data collected during summer 2007. The survey, called T-NASS (Trans-North Atlantic Sightings Survey) added to the series of North Atlantic Sightings Surveys (NASS) conducted in 1987, 1989, 1995 and 2001, thus forming a 20-year time series, providing a realistic opportunity for detecting changes in abundance over time for cetacean species with long life spans and slow reproductive rates.

T-NASS was conducted from 7 vessels and 5 aircraft provided by the Faroe Islands, Iceland, Greenland, Norway and Canada. Additional 5 fishery surveys vessels (Russia, Germany, Norway and UK) covered adjacent areas.

For the first time, a Trans-North Atlantic survey was achieved. The 12 platforms of the core survey covered over 54,000 nm of transects with survey effort in an area of about 1.8 mill. nm<sup>2</sup>, spanning from the Eastern Barents Sea to the southeast coast of Canada and from 78°N in the north to 52°N in the east and 42°N in the west to the south. This represents the largest coordinated whale survey to date in the Atlantic.

All requested stock assessments for large whale species in the North Atlantic based on sightings data from the T-NASS 2007 survey, and additional surveys in 2009, have now been finalized. The information was used directly in the management programs of NAMMCO, the IWC and national management agencies in setting levels of removal (direct, by-catch or other) that can be sustained by the involved stocks. These stock assessments by the Scientific Committee of NAMMCO constitute the main basis for catch limits set for some baleen whale stocks (fin and minke whales) in the North Atlantic.

The next T-NASS is scheduled to take place between 2013 and 2015, and planning is already under way.

## Notes on male sperm whale reactions to killer whale attack in a high-latitude feeding ground

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Killer whales (*O. orca*) have been reported as predators-competitors of sperm whales (*P. macrocephalus*), where wounded individuals and female groups with calves seem to be the main targets, and tend to establish defensive formations. This study compiles some of the first evidences of killer whales targeting large male sperm whales and their response. Opportunistic observations from whale watching vessels off Andenes, Northern Norway, took place on three occasions in different behavioural contexts and responses: (1) during the 1990's (personal communication), (2) 30th/July/2009 (behavioural data and photographs), and (3) 23rd/July/2011 (behavioural data, photo identification images, video and acoustic recordings). In (1) a sperm whale surrounded by killer whales at the surface responded by defecating until the attackers were avoided. During (2), a sperm whale surfaced in the middle of a group of killer whales feeding on herring. As a response, the sperm whale repelled the attack by bending and shaking its caudal peduncle 90° sideways. On (3), at least four different individual male sperm whales were involved. These whales appeared to have interrupted diving and clustered in the surface very close to the observation vessel. The fluke of one of the individuals showed bleeding scars on its tips, though no other lesions were detected. Acoustic recordings made during one of the attacks were analysed and two different coda types (5 R and 5+1) were recognized as well as creaks. Killer whales were silent during the attack, which corresponds with earlier reports of marine mammal eating killer whales in other parts of the world. Whether these events correspond to a predator-prey relationship or inter-specific competition remains unknown. We expect that the data compiled here will provide insight and help direct other studies on the trophic interactions between these two species.

## Does looking for oil displace deep-diving cetaceans? The effect of seismic surveys on sperm whale distribution in the Norwegian Sea

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Understanding the effect of noise on the distribution of the cetaceans is crucial for increasing the understanding of mechanisms underlying the distribution and developing effective conservation measures of protecting the key habitats. This study examined habitat preferences of a deep diving cetacean species regularly present in the Norwegian Sea and the effect that the seismic surveys have on the distribution in the Lofoten basin. Sperm whales (*Physeter macrocephalus*) are present year-round in the deep Bleik canyon off Andoya Island. We used sighting data collected between 2000 and 2010 from two opportunistic platforms (between 90 and 500 observations per year) and the seismic shooting tracks log provided by the NPD. The area was divided into a 1x1 km grid, and a Maximum Entropy model was used to examine how environmental variables as depth, slope and sea surface temperature were related to the sperm whale distribution. A significant shift in the distribution towards shallower waters was noticed during the seismic survey period. We suggest that, as the animals occasionally occurred close to the seismic survey boats without showing signs of stress, the displacement might be due to the change in prey availability, rather than a direct consequence of noise avoidance. This is in accordance with lower rates of some fish species CPUE in the area during the survey period, and with studies reporting that airguns do not seem to upset sperm whales. However, the results of this study imply that long-term displacement of the prey from the key feeding areas and its consequences for the sperm whale population should be taken into consideration when assessing the impacts of seismic surveys on this species.

MONDAY, 26<sup>TH</sup> MARCH 2012 17:15

## HUMAN INTERACTIONS

### **Do seals and man fish in the same spots? Evidence of low spatial overlap between a top marine predator and specific fisheries off Ireland's west coast**

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Seals and humans are both top predators in many marine ecosystems, often targeting the same food resource which can lead to competition. This long-standing contentious issue is of mounting concern with fish stocks in global decline. With advances in telemetry technologies it is possible to track top marine predators at sea for extended periods and relate their distribution to that of the resource. However, it is difficult to obtain spatially and temporally discrete resource distribution data. Spatially and temporally explicit data are, however, now available for fishing activity from vessel monitoring system (VMS). Using this we can study the overlap of foraging activity for both seals and fishing vessels, and to examine whether or not overlap in space and time can be interpreted in terms of resource exploitation overlap. We used VMS and fast acquisition GPS to compare the distribution of fisheries and seals in Irish waters on the same spatial and temporal scale to quantify overlap. Our findings suggest a significantly low rate of spatial overlap between all grey seals tagged and the offshore whitefish fishery on the Irish continental shelf. If the sample is representative of the population of grey seals using Irish waters, it suggests direct competition for the resource may be far less than expected. Seal-fishery interactions in Irish waters may therefore be more of an issue at the operational and individual level, suggesting that seal population control measures will be ineffective and therefore unjustifiable. The approach could be applied elsewhere when VMS data is made available to the scientific community to examine spatial overlap of humans and key marine species. This will provide critical data for the development of mitigation measures (e.g. for by-catch, over-fishing) which will ultimately contribute to the conservation of these species, many of which are fundamental for healthy ecosystem.

**MONDAY, 26<sup>TH</sup> MARCH 2012 17:30****Vessel noise affects beaked whale behaviour: results of a dedicated acoustic response study**

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Some beaked whale species are susceptible to the detrimental effects of anthropogenic noise. Most studies have concentrated on the effects of military sonar, but other forms of acoustic disturbance (e.g. shipping noise) may disrupt behaviour. An experiment involving the exposure of target whale groups to intense vessel-generated noise tested how these exposures influenced the foraging behaviour of Blainville's beaked whales (*Mesoplodon densirostris*) in the Tongue Of The Ocean (Bahamas). A military array of bottom-mounted hydrophones was used to measure the response based upon changes in the spatial and temporal pattern of vocalizations. The archived acoustic data were used to compute metrics of the echolocation-based foraging behaviour for 16 targeted groups, 10 groups further away on the range, and 26 non-exposed groups. The duration of foraging bouts was not significantly affected by the exposure. Changes in the hydrophone over which the group was most frequently detected occurred as the animals moved around within a foraging bout, and their number was significantly less the closer the whales were to the sound source. Non-exposed groups also had significantly more changes in the primary hydrophone than exposed groups irrespective of distance. Our results suggested that broadband ship noise caused a significant change in beaked whale behaviour up to 27 kilometres away from the vessel. The observed change could potentially correspond to a restriction in the movement of groups, a period of more directional travel, a reduction in the number of individuals clicking within the group, or a response to changes in prey movement.

**MONDAY, 26<sup>TH</sup> MARCH 2012 17:45****A thermo-energetic model for cetaceans: a potential tool for calculating the biological significance of multiple and diverse anthropogenic activities**

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One of the biggest challenges for conservation is determining whether human activities have biologically significant impacts either individually or cumulatively. Here, we present a thermo-energetic model that could be used to determine this for cetaceans. We tested this model by using it to calculate the number of days a harbour porpoise could survive without feeding (days to starvation - DTS) for different initial blubber thicknesses. Based on data from 125 otherwise healthy harbour porpoises killed by bottlenose dolphins in eastern Scotland, we show that there was a strong non-linear relationship between monthly average DTS and the number of animals recorded as dying from starvation (Deviance Explained: 76.2%,  $p < 0.001$ ). Therefore, DTS of healthy animals can be used as an indicator of starvation mortality. However, starvation mortality only increased substantially when average DTS fell below six days. From this, we propose that effects of human activities can be defined as biologically significant if they cause average DTS of a species in a specific area to fall below six days as this has the potential to result in a substantial increase in additional mortality from starvation. The effect on DTS for any human activity can be calculated from this model by working out its impact on energy intake, expenditure and storage. The cumulative effects of very different activities can be determined by subtracting the effect each one has on DTS from the current average DTS for animals in a population to see whether the overall reduction in DTS would bring it below the six day threshold. We demonstrate this for two very different impacts on porpoises, an increase in water temperature caused by climate change and a decrease in prey abundance caused by over-fishing, and show that such over-fishing makes populations more vulnerable to climate change.

**MONDAY, 26<sup>TH</sup> MARCH 2012 18:00**

## **Prey engulfment in phocid seals studied with high-speed cameras and accelerometry**

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A key component in understanding the ecological role of marine mammal predators is to identify how, where and how much prey they capture in time and space. Satellite and archival tags on pinnipeds normally only render dive and geolocation information, and foraging events are then guestimated to take place in certain portions of the dive. However, specific movements of the head and jaws may provide reliable feeding cues by involving fast specific changes in acceleration. These might even be prey or context specific. To test this we trained harbour seals (*Phoca vitulina*) to wear mulitsensor Dtag3, with triaxial accelerometers sampled at 500Hz, on their head. Seals were trained to swim towards and catch prey in front of two underwater digital high-speed video cameras.

The results show that harbour seals apply both suction and raptorial feeding. Specific jerk signatures and the speed of suction feeding were found and related to actual prey captures documented by video. These results demonstrate that reliable feeding cues can be recorded using fast-sampled accelerometer tags on free ranging pinnipeds in their natural marine environments, holding a very promising prospect for long term studies of their foraging ecology and field energetics.

MONDAY, 26<sup>TH</sup> MARCH 2012 18:15**Bowhead whales (*Balaena mysticetus*), killer whales (*Orcinus orca*) and sea ice**

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The bowhead whale (*Balaena mysticetus*) is adapted to life in Arctic environments. We tested whether bowhead whales make use of seasonal variation in the sea ice environment and investigated reasons for patterns of habitat selection. Bowhead whales from the Eastern Canada-West Greenland (EC-WG) population were tagged with satellite transmitters in Nunavut, Canada, 2002-06, that provided location information used to calculate habitat selection. We used resource selection functions to evaluate bowhead seasonal selection of sea ice coverage, thickness, and floe size throughout their annual range. The highly variable sea ice landscape cycles from near complete coverage in winter to near complete absence of sea ice in summer. The EC-WG bowhead population selected (1) low ice coverage areas in winter presumably to reduce risk of ice entrapment while remaining in ice-covered waters whereas (2) high ice coverage areas were preferred in summer. We argue that summer sea ice selection by bowhead whales relates to an anti-predation strategy that reduces risk of killer (*Orcinus orca*) whale predation while providing feeding opportunities. Next, we (1) analysed stable isotope biomarkers in killer whale tissue, (2) interviewed Inuit hunters to assess killer whale diet, and (3) modelled killer whale energetics. Results indicate that the recent population increase in bowhead whales has mirrored an increased use of bowhead whales in the diet of killer whales. Our results suggest that a predator-prey pattern of increased feeding on bowhead whales by killer whales combined with a reduction in sea ice refugia may create a demographic halt to the growth of the EC-WG bowhead whale population.

TUESDAY, 27<sup>TH</sup> MARCH 2012 09:00

## BEHAVIOUR

### **Social network correlates of food availability in an endangered population of killer whales (*Orcinus orca*)**

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For the majority of social species group composition is dynamic, and individuals are interconnected in a heterogeneous social network. Social network structure has far reaching implications for the ecology of individuals and populations. However, we have little understanding of how ecological variables shape this structure. We use a long term dataset (1984-2007) to examine the relationship between food availability and social network structure in the endangered southern resident killer whales. During the summer months individuals in this population feed primarily on chinook salmon (*Oncorhynchus tshawytscha*), which show annual variation in abundance. We tested the hypothesis that temporal variation in chinook salmon will correlate with variation in social network structure. Using a null model that controlled for population demography, group size and sampling effort, we found a significant relationship between the connectivity of the social network and salmon abundance, with a more interconnected social network in years of high salmon abundance. Our results demonstrate that resource availability may be an important determinant of social network structure. Given the central importance of the social network for population processes such as the maintenance of co-operation and the transmission of information and disease, a change in social network structure due to a change in food availability may have significant ecological and evolutionary consequences.

TUESDAY, 27<sup>TH</sup> MARCH 2012 09:15**Humpback whale (*Megaptera novaeangliae*) sound production during winter in Iceland**

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Humpback whales (*Megaptera novaeangliae*) have been recorded singing at higher latitudes and on migratory routes during early and late autumn and in late spring in the North Atlantic, therefore it has been suggested that the whales sometimes start singing before migration. We report results from the first long-term acoustic recordings of humpback whales at the NE-coast of Iceland. The recordings were made during September 2008 – February 2009 and April 2009 – September 2009. Two seabed mounted ecological acoustic recorders (EARs) were deployed in Skjálfandi Bay and were set to record for 1 minute every 15 minutes throughout the whole deployment periods. A total of 3032 humpback whale signals were detected of which 2228 were identified as units, i.e. components of a song. These units were only heard during the winter deployment period. Of these, 27 different song units were identified based on earlier findings in the North-Atlantic. To detect acoustic signals of interest an algorithm was created within the acoustic monitoring program Ishmael 2.0. Each detected signal was inspected visually and aurally to determine correct detections using the analysis software Osprey. Using that same software each unit was measured to obtain duration, start frequency, high and low frequency and the frequency change. The singing activity increased substantially from the mid of December and continued throughout the earlier recording period, the greatest activity was detected during dark hours. When the singing started there was less variety in song unit production, however, the variety increased as the period progressed, peaking around the mid of January. With these findings we conclude that some individual humpback whales stay within their high latitude feeding grounds during the winter where they are engaged in singing, emphasizing the importance of Icelandic coastal waters for humpback whales on a year round basis.

TUESDAY, 27<sup>TH</sup> MARCH 2012 09:30**Behavioural and endocrinological evidence for social recognition in newly-weaned grey seals (*Halichoerus grypus*)**

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Recognising individuals and behaving appropriately towards them is a crucial ability for many species. Aspects of pinniped reproductive behaviour, such as site fidelity, mean that individuals may encounter the same animals within and across seasons. However the ability to recognise non-related individuals has never been tested in pinnipeds outside of studies between territorial males. To investigate the recognition capabilities of grey seals, 12 weaned pups were penned in 2 groups of 6 during the 2010 breeding season on the Isle of May, Scotland. Over 14 days each pup took part in a series of paired pen trials with either individuals they had previously co-habited with (familiar) or ones they had never encountered before (stranger). As declines in investigative behaviour indicates familiarity in paired pen trials, the number of visual and olfactory “checks” and the number of interactions between pups were recorded. Trials with paired strangers had significantly more “checks” (mean increase: 22.4 checks/trial,  $p=0.026$ ) and interactions (mean increase: 17 interactions/trial,  $p=0.034$ ) than trials with familiars. Plasma samples were taken to detect peaks in the neuropeptide hormone oxytocin, which is released during positive social interactions with familiar individuals. Several individuals in familiar trials exhibited a significant rise in plasma oxytocin (basal: 11.1pg/ml, trial: 192.8pg/ml,  $p<0.01$ ) whilst none in stranger trials did. Previous studies show evidence of breeding female grey seals consistently affiliating over successive seasons, with potential energetic rewards for associating with animals that recognise and adjust their behaviour towards each other. The involvement of oxytocin indicates that individuals received a physiological benefit from associating with them as it acts on the hypothalamo-pituitary-adrenal axis to reduce anxiety and stress responses. This study begins to unravel the mechanism behind non-filial recognition in grey seals, showing that even newly weaned pups can recognise familiar individuals and respond differently to them.

**TUESDAY, 27<sup>TH</sup> MARCH 2012 09:45****Social evidence for distinct coastal and pelagic communities of bottlenose dolphins in Irish waters**

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Bottlenose dolphins off NW Ireland were found to belong to two distinct social communities: a coastal and a pelagic community. Over the period 2008-2011, 281 individual dolphins were photo-identified during 42 encounters off the coast of County Mayo, NW Ireland. Social analysis of individuals with permanent markings (N=157) showed that 80 individuals, belonging to 38 groups, were part of a strongly connected social network (network density:  $0.3 \pm 0.2$  SD; network strength:  $22.3 \pm 7.5$  SD). This network showed a fission-fusion social structure for the bottlenose dolphins (mean HWI association index:  $0.3 \pm 0.1$  SD), consistent with findings in many areas worldwide. All 38 groups were encountered within a distance of 2.5 km from the coast. The remaining 77 individuals, belonging to 4 groups, were not connected to this network, but only to individuals within their own group. Given the strong connectivity of the discovered social network, the probability that these individuals belong to the same network  $\sim 0$ . In addition, the non-connected individuals were present significantly further offshore, 5 - 42 km, and the proportion of group members with significant markings was almost twice as high as for the individuals within the network (0.81% vs. 0.43%). Thus, these individuals belong to a different social community, inhabiting more offshore waters. Recent genetic evidence has shown the existence of at least three populations of bottlenose dolphins off the Irish coast, one in the Shannon Estuary, a coastal population in NW Ireland and a third, thus far unknown, population. Our results support the existence of multiple populations in Irish waters, and point at two socially distinct communities present in NW Irish waters: the coastal NW Ireland population, as previously defined by genetic analysis, and a second, pelagic community of bottlenose dolphins.

TUESDAY, 27<sup>TH</sup> MARCH 2012 10:00

## GENETICS

### Local and regional genetic structure of spinner dolphins off islands in the southwest Indian Ocean

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Delphinid populations may show highly variable patterns of genetic diversity and population structure. At the species level, a panmictic population may range over an entire ocean, or be geographically limited to a stretch of coast or the surrounding waters of an island. Gray's spinner dolphins (*Stenella longirostris longirostris*) are distributed in all tropical oceans, and are particularly common around islands, atolls and reef banks from continental to oceanic insular systems. Population structure of spinner dolphins is known to considerably vary among regions. Here, we investigated the genetic patterns of spinner dolphin individuals from three distant islands of the south-western Indian Ocean (Zanzibar, Mayotte, and La Réunion) to assess any population differentiation that could have resulted from geographic isolation. We combined analysis of mtDNA control region sequences and 12 microsatellite markers to assess the diversity levels and population structure across the study area. The main results showed a decreasing genetic diversity from the continental coast of Africa (Zanzibar, number of mitochondrial segregating sites  $S = 52$ , nucleotide diversity  $H_d = 0.0191$ , mean number of alleles across nuclear loci  $N_{all} = 10.25$ ) to the remote oceanic island of La Réunion ( $S = 22$ ,  $H_d = 0.0118$ ,  $N_{all} = 8$ ). In addition, a significant genetic structure (overall  $F_{st} = 0.048$ , Jost's  $D$  and 95% confidence interval =  $0.318 [0.268-0.373]$ ) was revealed between four distinct populations using Bayesian computations. Surprisingly, one of the strongest differentiation was measured between two populations from Zanzibar (pairwise  $F_{st} = 0.086$ ,  $D = 0.425 [0.348-0.546]$ ). This population subdivision suggests that even in a seemingly homogenous habitat, gene flow breaks between groups of individuals may arise at a local scale. This unexpected structure underlines the necessity of managing spinner dolphin populations locally, at a level where direct (fisheries bycatch and hunting) and indirect threats to populations can be effectively managed.

TUESDAY, 27<sup>TH</sup> MARCH 2012 10:15

## Using a multi-disciplinary approach to define and assess the conservation unit of killer whales (*Orcinus orca*) in southern Spain

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Identifying discrete, demographically independent conservation units is a key goal for management. Previous genetic work assigned killer whales that are known to occur seasonally in the Strait of Gibraltar in a population with whales occasionally seen in the Canary Island. However, there was weak differentiation between the Canary Island and Strait of Gibraltar individuals. This could result from historic gene flow and an absence of contemporary gene flow or migration between the Canary Islands groups and the Strait of Gibraltar groups. Here we present new analyses of photo-identification and individual genotypes to assess the level of contemporary gene flow and migration between groups. A total of 26,430 dorsal fin images collected over 10 years were analysed, showing the presence of 47 different individuals in the Strait of Gibraltar and 16 individuals in the Canary Islands, no matches were found between both areas. During the photo-id sessions, group structure was noted, and the catalogue was analysed with Socprog, resulting in the identification of a total of 5 pods in the Strait of Gibraltar and 2 pods in the Canary Islands. The temporal relationships were fitted to models calculating their lagged association rates resulting in a social system based on Rapid Dissociation and Constant Companions and Casual Acquaintances. Mitochondrial DNA haplotype was shared by all individuals sampled within each group (constant companions), but differed between the two Canaries groups and between groups within the Strait (casual acquaintances), suggesting that social structure was matrifocal and there was little or no migration between groups. Kinship analysis detected no close kin between Canaries and Gibraltar individuals, suggesting low or no contemporary gene flow. The results suggest that the individuals within the Strait of Gibraltar are a distinct “conservation unit”. This study contributed to propose a Site of Community Importance (SCI) in the Strait of Gibraltar.

**TUESDAY, 27<sup>TH</sup> MARCH 2012 10:45**

## **Reconstruction and comparison of genealogies for bottlenose dolphins and dugongs in Moreton Bay, Queensland, Australia**

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Marine mammal populations in close proximity to major human population centres are particularly vulnerable to impacts on behaviour and demographics. Moreton Bay, in southern Queensland, Australia, is home to two large marine mammal species: the dugong (*Dugong dugon*) and bottlenose dolphin (*Tursiops aduncus*). In this study, we use genetic identity data and other biological information to construct genealogies for dolphins and dugongs in Moreton Bay, and use these genealogies to inform comparisons of population demographics and breeding behaviour.

We have constructed genealogies for 107 bottlenose dolphins and 652 dugongs, based on identity determined by a panel of 20 and 26 microsatellite loci respectively. Genealogies were constructed via Maximum Likelihood Estimation using the Cross-Entropy method informed by biological data including sex (determined by molecular markers) and observed size class, using software developed specifically for this project. Previous work indicates that the dolphins in Moreton Bay form two sympatric subpopulations and have a fission-fusion social structure, and our genetic data are supported by known network associations. In comparison, dugongs form a single population within Moreton Bay and our population sample forms a significant proportion (>85%) of the total population, but network associations and social structure are not well known. Further, we have no knowledge of direct genetic relationships between individual dolphins, but have observed >100 unique cow-calf pairs within the dugong population. We will discuss the structure of the resulting genealogies and the insights that comparisons provide into population structure and network associations, relationships between individuals, and breeding strategies and events. Understanding the similarities and differences between these two species will assist conservation agencies to identify appropriate population management units and strategies, and thus assist in the protection of these vulnerable species in the face of major human impacts.

TUESDAY, 27<sup>TH</sup> MARCH 2012 11:15

## STRANDINGS

### **The use of stranding anomalies to detect changes in spatial and temporal patterns of harbour porpoise abundance/mortality across European waters**

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Monitoring cetacean population by dedicated surveys remains expensive and reduces the potential of anticipating changes in cetacean abundance or distribution. The increasing need of cetacean population indicators in EU marine strategies requires improving ecological significance and statistical credibility of cost-effective data. Stranding data have been collected for decades in Europe and constitute an underuse source of cetacean population indicators. Under the null hypothesis that small cetacean abundance and mortality are uniform in space and time, stranding data expected under drift conditions only were calculated. The stranding anomaly was defined as the difference between observed and expected stranding records. Harbour porpoise stranding anomalies were constructed in the North Sea, English Channel and Bay of Biscay. We compared monthly distribution and long term series of stranding anomaly across Europe. The monthly distribution of stranding anomalies in the whole North Sea and eastern Channel did not differ statistically from 0 ( $P > 0.785$ ), suggesting that the weak seasonality in stranding anomaly was mostly explained by variations in drift conditions. In the western Channel and Bay of Biscay, a strong seasonal pattern dominated stranding anomaly records ( $P = 0.019$ ), suggesting that seasonality was not due to drift conditions but to variations in porpoise abundance and mortality. Long term stranding anomalies from 1990 to 2009 showed that long term variations observed in porpoise strandings were not due to changes in drift conditions ( $P < 10^{-3}$ ), except in the western North Sea ( $P = 0.379$ ). Comparison of stranding anomalies across Europe allowed detecting increase of dead porpoise numbers at different periods across the study area, allowing us to build a scenario of spatial and temporal variations of dead porpoises. These results were consistent with the scenario of a southward movement of porpoise distribution inferred from the SCANS surveys conducted in 1994 and 2005, and provided additional explanatory hypothesis about recent changes in porpoise distribution.

TUESDAY, 27<sup>TH</sup> MARCH 2012 11:30**Investigating pollutant exposure and associated mortality in UK-stranded cetaceans (1990-2009): results of a 20 year study**

Paul Jepson (1), Rob Deaville (1), John Baker (2), James Barnett (3), Philippe Bersuda (4), Andrew Brownlow (5), Nick Davison (3), Tony Patterson (6), Rod Penrose (7), Matthew Perkins (1), Robert Reid (5), Mark Simmonds (8), Nick Tregenza(9), Robin Law (4)

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The UK has one of the largest global time series datasets (20 year period) on chemical contaminants and pathology in UK-stranded harbour porpoises (*Phocoena phocoena*). Organochlorine pesticide levels declined markedly between 1990 and 2005 (n=368-483), but summed blubber concentrations of 25 chlorobiphenyl congeners (sum25CBs) levels were both significantly higher and temporally stable since 1997 (n=540) despite the use of PCBs being progressively banned from open and closed uses in the UK from 1981 onwards. Brominated diphenyl ethers in porpoises increased in 1990s (peak in 1999) then decreased markedly after a series of EU risk assessments and bans enforced between 2004 and 2008 (n=415). Levels of hexabromocyclododecane (HBCD) increased to 2003 in UK-stranded porpoises, then subsequently declined from 2003-2006 (n=223). HBCD is subject to ongoing risk assessment. Case-control studies found levels of sum25CBs in porpoises that died of infectious diseases (n=182) had significantly greater sum25CBs concentrations (mean = 22.3 mg/kg lipid) than a “control” group that died of physical trauma (n=276) (mean = 11.4 mg/kg lipid) (p<0.001). This association occurred independently of age, sex, two indices of nutritional status, season, region and year found. Mean sum25CBs levels in the infectious disease mortality group exceeded a proposed threshold for adverse health effects (including immunosuppression) in marine mammals of 17 mg/kg lipid total PCBs. These findings show that PCBs are not declining in cetaceans in European waters and that PCB exposure in inshore bottlenose dolphins (*Tursiops truncatus*) (n=15) and killer whales (*Orcinus orca*) (n=5) exceed all known thresholds for mammalian toxicity. Although by-catch is often blamed for most impacts on cetacean populations in recent decades, declines or local extinctions of inshore bottlenose dolphins and killer whales in Europe, harbour porpoises in the Baltic Sea and river dolphins in India and China all occurred in “global hotspots” of organochlorine pollution.

TUESDAY, 27<sup>TH</sup> MARCH 2012 11:45

## Brucellosis in marine mammals stranded on the Belgian and northern France coast

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*Brucella* sp. infections in seals and cetaceans were first reported in 1994. Since then, the infection has been documented in a wide range of marine mammal species inhabiting a large part of the world's ocean, with high sero-prevalence in some species, *Brucella* sp. being also isolated from various tissues. However, the relationships between *Brucella* sp. infection and lesions have been established in very few cases and *Brucella* sp. has also been isolated from bycaught animals without evidence of *Brucella*-associated pathology. Recently, *B. ceti* and *B. pinnipedialis* has been described as being the cetacean *Brucella* sp. and the seal strain, respectively. The present communication describes *Brucella* sp. infection in marine mammals stranded on the Belgian and northern France coast. Samples (spleen, lymph nodes, lung, epididymis, brain and selected lesions) of 85 harbour porpoises (*Phocoena phocoena*), 27 common seals (*Phoca vitulina*) and 5 grey seals (*Halichoerus grypus*) were examined for the presence of *Brucella* sp. by culture, real-time PCR, immunohistochemistry (IHC) and electron microscopy. *B. ceti* was identified in samples of 8 harbour porpoises and *B. pinnipedialis* in samples of 2 common seals and 1 grey seal. Most frequent post-mortem observations on *Brucella*-infected animals were emaciation, skin ulcers, pneumonia, multiple parasitosis. Epididymitis was observed in one porpoise. Three *Brucella* positive animals were bycaught. The IHC revealed intracytoplasmic positive staining in different tissues and lesions, including mammary gland, skin ulcers and in lung nematodes. In Europe, most cases of marine mammal brucellosis have been reported for the coasts of the United Kingdom and Germany and many similarities appear with the present cases but in the present study the incidence is much higher (9.5% for porpoises). The observation of *Brucella* sp. antigens in skin and mammary gland may represent ways of transmission between individuals and raise the question of the risk of zoonosis.

TUESDAY, 27<sup>TH</sup> MARCH 2012 12:00**Pilot error? Investigation into the *Globicephala melas* mass stranding event, Kyle of Durness, northern Scotland, July 2011**

Andrew Brownlow (1), Mark Dagleish (2), Rob Deaville (3), Jamie Dyer (4), Geoff Foster (1), Ailsa Hall (5), Eva Krupp (6), Robin Law (7), Rod Penrose (8), Matt Perkins (3), Paul Jepson (3)

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The cause of cetacean mass stranding events (MSEs) have long been a mystery and many factors, both natural and anthropogenic are suspected to play a contributory role. In July 2011, a mass stranding of pilot whales (*Globicephala melas*) occurred in north-west Scotland. Here we describe the logistical, diagnostic and investigative pathways used to investigate if the stranding mechanism was an intrinsic “error of navigation” or a result of one or several extrinsic aetiologies. On the 22nd July 2011, a pod of approximately 70 long-finned pilot whales entered the Kyle of Durness, a tidal inlet bordering Cape Wrath, Northern Scotland. Herding the pod back towards open water was attempted using rigid inflatable boats and a team of Royal Navy divers but at least 39 animals subsequently live-stranded. A rapid response from local people and strandings response teams enabled the successful refloat of a large proportion of the stranded animals on the following tide. Nonetheless, 17 animals were known to have died during the MSE. Sixteen animals comprising eight males and eight females were recovered and necropsied to investigate potential trigger factors for the MSE. The investigation included detailed gross pathological examination to quantify overall disease burden and a number of additional diagnostic tests including microbiology, histopathology, morbillivirus (RT-PCR), and quantitative analyses for algal toxins (domoic acid and saxitoxin), organochlorine pesticides and 25 individual chlorobiphenyl congeners in blubber plus heavy metal concentrations in liver. External factors, such as unusual climatic conditions, commercial shipping or seismic surveys, were also investigated. A request to the UK Ministry of Defence, under the Freedom of Information legislation was made to establish the tempo-spatial distribution of military sources of underwater noise preceding the MSE. Initial results suggest a combination of intrinsic disease (in 1/16 individuals) and external acoustic events may be influential factors in this case.

TUESDAY, 27<sup>TH</sup> MARCH 2012 14:30

## PHYSIOLOGY, PATHOLOGY & TOXICOLOGY

### Mercury in blood of free-ranging seals *Phoca vitulina* from the North Sea: time-trend and association with environmental factors

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The harbour seal (*Phoca vitulina*) population from the North Sea has experienced various fluctuations these last decades due to habitat loss, prey fluctuation and pollution of the marine environment. Recently, development of monitoring programs and non-invasive sampling techniques, including seal catches allowed blood sampling on a regular basis together with measurements of blubber thickness, body mass, sex and body length. Concentrations of total mercury (T-Hg) and other trace elements (Cd, Pb, Zn, Cu, Fe) as well as  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  values were determined by mass spectrometry in blood of 75 wild harbour seals caught in the German Wadden Sea between 1997 and 2011.  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  mean values (-17.5 ‰ and 18.1 ‰ respectively) were strongly similar to that measured previously in the muscle of stranded harbour seals from the Wadden Sea. In contrast,  $\delta^{15}\text{N}$  mean value was strikingly higher than that recorded in grey seals (*Halichoerus grypus*) from Scotland (14.1 ‰ respectively; Habran et al. in prep.) while  $\delta^{13}\text{C}$  values remained similar between the two seal species. These values confirmed the high trophic position of the harbour seal in the North Sea. In contrast to Cd and Pb, T-Hg in blood harbour seals reached concentrations as high as 2.1  $\mu\text{g.g}^{-1}$  dry weight (10 times higher than the 0.21  $\mu\text{g.g}^{-1}$  dry weight recorded for grey seals from Scotland) but depended on several factors including  $\delta^{15}\text{N}$  values, age group and the body mass. T-Hg was detected in juveniles confirming maternal transfer to offspring and time-trend revealed no decrease of T-Hg in blood of harbour seals these last 15 years.

TUESDAY, 27<sup>TH</sup> MARCH 2012 14:45

## The role of feeding habits and migratory behaviour in generating different toxicological hazard in seven cetaceans species of Gulf of California (Mexico)

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In this work we investigate the interspecific differences in CYP1A1, CYP2B, gene expression biomarkers (AHR, E2F1 and ER1) and contaminants levels (OCs, PBDEs and PAHs) in four odontocete species (common bottlenose dolphin - *Tursiops truncatus*, long-beaked common dolphin - *Delphinus capensis*, sperm whale - *Physeter macrocephalus* and killer whale - *Orcinus orca*) and three mysticete species (blue whale - *Balaenoptera musculus*, fin whale - *Balaenoptera physalus* and Bryde's whale - *Balaenoptera edeni*) of Gulf of California using skin biopsy. A suite of diagnostic biomarkers was applied to the seven species in order to evaluate the role of the feeding habits and migratory behaviour in the toxicological status of this cetacean species in the Gulf. The diagnostic tool underlined differences in contaminant levels and molecular biomarker responses between the odontocete and mysticete species of Gulf of California. The canonical discriminant analysis on PCA factors, performed to reveal clustering variables, shows that odontocete species are characterized by the highest levels of lipophilic contaminants respect to the mysticete species, with the highest levels of PCBs, DDTs and PBDEs detected in killer whale and the lowest levels in Bryde's whale. The same analysis applied to the biomarkers data shows an extremely interesting interspecific differences between the seven species revealing highest CYP1A, CYP2B in the mysticete fish-eating species (Bryde's whale). In conclusion, three main factors seem to regulate the responses of different CYP isoforms and the gene expression biomarkers in the species studied: the inductive ability of POPs and PAHs, the different evolutionary process of the two cytochromes related to the different feeding habits and the migratory behaviour of some species (blue whale).

**TUESDAY, 27<sup>TH</sup> MARCH 2012 15:00****Sepioids do not feed on sperm whales: the evidence to consider biological and environmental variability when interpreting isotopic data in open marine ecosystems**

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Cetaceans play an important role in food webs although the study of their trophic ecology is often difficult in marine environments. Carbon and nitrogen stable isotopes measured in consumers' tissues may constitute reliable indicators of their trophic position and/or their feeding zone. However in open marine ecosystems, a high biological diversity and various oceanic and terrigenous influences may lead to misinterpretations of isotopic field data for the study of trophic relationships. Indeed in the north-eastern Atlantic, using the Bay of Biscay as the main case study, a simplistic interpretation of nitrogen signatures could conclude small sepioids (15.1 ‰) feed on sperm whales (11.1 ‰). The present study reports carbon and nitrogen stable isotope ratios from 11 cetacean species and more than 50 prey species. We showed that different biological and environmental factors of variations have to be taken into account to use these ecological tracers for studying trophic relationships. Firstly, we highlighted that the trophic enrichment factor for nitrogen between cetaceans and their prey is significantly lower (<2 ‰) than those commonly used in isotopic models (3.4 ‰). Secondly, we found that the different metabolisms existing within cetacean species can bias inter-specific comparisons of isotopic signatures. Finally, considering several types of consumers, we evidenced a change in the baseline along the inshore-offshore gradient (>3 ‰ for carbon and >5 ‰ for nitrogen), which can also considerably bias the calculations of the trophic positions. In the context of the need for robust tools when studying structure and functioning of marine ecosystems, our results suggested that a reliable use of isotopic signatures to identify the place and the role of cetaceans in open marine ecosystems must take into account: 1) the original metabolism of cetaceans both between cetaceans and their prey, and within cetacean species; and 2) the environmental heterogeneity typically found in these environments.

TUESDAY, 27<sup>TH</sup> MARCH 2012 15:15

## Resource partitioning in sympatric populations of Indo-Pacific bottlenose dolphins: an integrative approach

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Population structure over small geographic areas is often driven by niche specialisation. Here we integrate multiple methodologies (spatial habitat modelling, stable isotope and trace element analyses) to assess resource partitioning among two genetically divergent sympatric populations (North and South) of Indo-Pacific bottlenose dolphins (*Tursiops aduncus*) in Moreton Bay, Australia. Given their genetic population structure and apparent spatial segregation within the bay, we hypothesized that these populations would show differences in their habitat use, feeding ecology and trace element concentrations. Spatial habitat modelling indicated that the North population occurred mainly in the north-eastern and central bay in significantly deeper water (mean depth  $\pm$  s.e.:  $11.4 \pm 5.5$  m) than the South dolphins ( $6.0 \pm 3.0$  m) ( $P < 0.001$ ), which were found near sandbanks in south-eastern nearshore waters. Ratios of stable carbon and nitrogen isotopes in skin samples suggested dietary partitioning with North dolphins feeding on relatively more pelagic, offshore, higher trophic level prey (significantly higher isotopic  $\delta^{15}\text{N}$  but lower  $\delta^{13}\text{C}$ ), whereas dolphins in the South foraged on more coastal, benthic prey (lower  $\delta^{15}\text{N}$ , higher  $\delta^{13}\text{C}$ ). Habitat partitioning was also reflected by higher blubber concentrations of most of the 13 measured trace elements, in particular lead (Pb), in coastal South compared to more pelagic North dolphins ( $0.84 \pm 0.43$   $\mu\text{g/g}$  compared to  $0.44 \pm 0.29$   $\mu\text{g/g}$  (mean  $\pm$  s.d.) respectively;  $P < 0.01$ ). Such niche specialisations likely influence the genetic structure of sympatric populations and need to be considered when developing conservation and management plans.

TUESDAY, 27<sup>TH</sup> MARCH 2012 15:30 - 16:30

## SHORT TALK SESSION 2

### Gait changes in deep-diving Blainville's beaked whales

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Marine mammals modulate their swimming gaits (i.e. steady stroking, stroke-and-glide, prolonged gliding) to promote locomotor efficiency, and gliding patterns are influenced by animal buoyancy. Beaked whales are reported to produce extremely long and deep foraging dives which likely exceed their aerobic capacity, but little is known about their swimming behaviour during dives. Here, biomechanical data recorded with suction cup DTags attached to nine Blainville's beaked whales were analysed to provide the first report on swimming gait patterns and variability in the thrusting strokes for this species. Fluking versus gliding periods were identified as cyclic variations in the accelerometer and magnetometer signals. All three types of swimming gaits were apparent in the dive records, with the number of fluke strokes varying as predicted due to the effects of speed, body pitch, and dive depth on drag and buoyancy forces. Whales produced fewer strokes in the descent phase of shallow versus deep dives, suggesting that whales dove with less air volume during non-vocal shallow dives compared with foraging deep dives. All whales used two types of strokes, termed A and B. The variation in body pitch caused by Stroke B was twice as large as that of Stroke-A. While Stroke-B was always made before an ascent glide, Stroke-A was always used in a steady stroking gait. Nonetheless, overall forward speed was maintained during occurrence of Stroke-B suggesting they produce more thrust than Stroke-A. In 48 out of 52 deep dives, Stroke-B appeared during the ascent phase after a mean duration of  $34.7 \pm 5.1$  min had elapsed from the start of each deep dive, but only occurred in one of 223 shallow dives. The occurrence of Stroke-B may be related to physiological limitations associated with foraging dives with durations that are likely to be well in excess of their aerobic dive limit.

## **Sexual dimorphism in pelvic rudiment of bottlenose dolphin (*Tursiops truncatus*)**

Martina Duras Gomercic (1), Darinka Skrtic (1), Tomislav Gomercic (1), Ana Galov (2), Hrvoje Lucic (1), Snjezana Curkovic (1), Snjezana Vukovic (1)

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In the bottlenose dolphin pelvic rudiment is all that remains of the hind limb skeleton. It is positioned dorsal to the anus and serves as attachment point for muscles acting on the genitalia and the abdominal body wall. The aim of our study was to determine morphological and morphometrical characteristics of pelvic rudiments and correlate them to the sex of an individual. Pelvic rudiments of 132 bottlenose dolphins were studied. They originated from the collection of the Faculty of Veterinary Medicine University of Zagreb, Croatia which hosts skeletons of whales found dead from 1990 to 2011 in the Croatian part of the Adriatic Sea. Ten measurements were used in the morphometrical analysis (vestigial hip bone length, length from cranial tip to highest point, length from cranial tip to middle of the crest, crest width, crest height, height at the cranial 1/8 of the length, width at the cranial 1/8 of the length, height at the caudal 1/8 of the length, width at the caudal 1/8 of the length, length from highest point to caudal tip). There were taken from each pelvic rudiment with 0.01 cm precision using a caliper. Sex dependent shape of the pelvic rudiment is observed in animals older than 12 years and with a body length > 266 cm. Female pelvic rudiment of adult bottlenose dolphins is significantly shorter and gentler in shape. The most accentuated morphological difference lies in the central part of the pelvic rudiment. Here, in adult males a lateral, prominent crest is arising from the dorsal, convex edge. This crest is significantly wider and higher in males than in females. Our study shows that pelvic rudiment of adult bottlenose dolphins is sexual dimorphic and its use in sex assignment is reliable.

## Modelling surface textures of the small cetaceans

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The surface texture and coloration of skin in small cetaceans presents valuable information for a range of investigations including biomimetics, photoidentification of individuals, and sightings. Spatial distribution and arrangement of skin structures was studied in the frame of an ongoing project on the flow/skin interface in dolphins. A frozen specimen of a by-caught harbour porpoise was scanned with Atos V7 optical scanning system by IGS Development GmbH. Scanned data were processed with GOM software and exported in CAD format as set of the cross-sections. Three-dimensional model of the harbour porpoise was constructed with SolidWorks software in 1:1 scale based on straightened body position. Dermal ridges direction was inspected in two steps on the surface of the animal using elaborated scheme of sampling. At the first step the direction of ridges was determined in the nodes of an 18x9 mesh. At the second step a substantial amount of sampling points was added in the regions with complex morphology including eyes, mouth, blowhole, and fins. The marks on the porpoise surface were used for the construction of lines indicating the dermal ridges direction in CAD environment. The final arrangement of dermal ridges on the surface of the porpoise model was done with the Tecplot software. The results obtained present the next step in the study of realistic three-dimensional scenario of the flow/skin interface in dolphins and porpoises. The methods of mapping the two-dimensional surface textures onto the three-dimensional model could also be used for further development of dolphin photoidentification.

## Characterization of the dolphin cochlear nucleus using cluster analysis

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The analysis of the nervous system of toothed whales is challenging because its study on a cellular level is limited to morphological examinations of rare post-mortem material. For this reason we established a new approach using cluster analysis to characterize the structure of auditory nuclei. To verify this method we restricted the analysis to the cochlear nucleus (CN) because its cytomorphology is known to be comparable to that of terrestrial mammals. We digitally segmented 20362 neurons within the whole CN and in its proximity in 2.5-times magnified high-resolution digital photos of a series of 13 Nissl stained coronal microslides of the common dolphin (*Delphinus delphis*; G. Pilleri collection; 35 µm slide thickness with every 20th slide stained) to determine four typical cytomorphological characteristics (maximum diameter, circularity, orientation of the maximum diameter and the modal grey value). We used cluster analysis (algorithm of Ward) to perform a largely observer independent topographical examination of morphological characteristics to identify different neuron types as well as, in a second step, the quantitative distribution and composition of specific neuron populations. It was possible to distinguish 9 different neuron types and to discriminate the main subnuclei, the dorsal CN, the anterior ventral CN, and the posterior ventral CN. Moreover, four other small subnuclei could be distinguished, among them areas that may be homologous to the dorsolateral ventral CN and the dorsomedial ventral CN. Cluster analysis is proved to be an effective tool for future in-depth analysis of brainstem nuclei in Nissl-stained microslide series of rare brain material that can be easily adapted to analyse additional histological parameters.

## Presence of prestin in harbour porpoise cochlea

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Prestin is a motor protein located in the lateral wall of mammalian outer hair cells (OHCs) of the organ of Corti, responsible of rapid changes in the length and stiffness of the OHC. The motile responses of the OHCs are believed to provide a region specific amplification in the movement of the organ of Corti that enhances both cochlear sensitivity and frequency selectivity. Although it is known that cetaceans present the gene coding prestin, there is no information of the cochlear expression of this protein in these animals. To evaluate the presence of prestin by immunofluorescence, we used a goat anti-Prestin polyclonal IgG antibody (Santa Cruz ref. SC-22692, 1:200) in semi-thin sections of harbour porpoise cochlea. Since the samples displayed autofluorescence, Sudan Black B was used to optimize contrast. Sections were observed with a Zeiss Apotome or a Zeiss LSM 5 Duo confocal microscope. It was found, for the first time, that harbour porpoise OHCs contained prestin all along the cochlear spiral, including the basal turn, which codifies very high frequencies. The presence of prestin alone may not be sufficient to help understanding the apparent selective acoustic sensitivity of harbour porpoise in those frequencies. Morphological features encountered in this portion of the cochlea, such as the small size of OHC, the high stiffness of the basilar membrane, the robust cup formation of the Deiters cell body, the high development of the supporting cell cytoskeleton and the thick reticular lamina might bring pieces to the “puzzle” of this complex processing.

## Genetic analyses of groups of short-beaked common dolphins by-caught in fisheries in the North Atlantic and Southwest Pacific Oceans

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Large numbers of marine mammals (among other species) have been accidentally killed (by-catch) in various fisheries worldwide, some of which have now been closed. The present study investigates composition of groups of short-beaked common dolphins (*Delphinus delphis*) that mass-stranded on the west coast of Ireland (n=9) or were by-caught in albacore tuna (n=76), bass (n=27), swordfish (n=49) and jack mackerel (n=36) fisheries in the eastern and western North Atlantic and in the South-West Pacific Oceans, respectively, between 1990 and 2005. Genetic profiles were obtained using 14 microsatellite loci and 360bp of the mtDNA control region; gender and sexual or physical maturity of each individual were established by inspection of gonads and total body length measurements. Overall, the total number of dolphins analysed was 197 from 54 groups (ranging between two and six individuals per group). Males tended to be more abundant than females (119 males, 73 females and five unknown) however, groups varied in composition, including a mixture of adults and juveniles of both sexes. Parentage and kinship analyses revealed that dolphins by-caught in the same net tended to be unrelated to each other, with the exception of mother-offspring pairs, which were identified in tuna, bass and mackerel fisheries (eastern North Atlantic and South-West Pacific), but not in the swordfish fishery (western North Atlantic). With the exception of mother-offspring pairs, individuals from the same group rarely shared the same mtDNA haplotype, indicating the presence of multiple maternal lineages. Results were consistent across all sampled areas, suggesting similar patterns of group composition of common dolphins in the studied regions.

## **A pilot study on the effects of emerging contaminants (BPA and PFOA) on three cetacean species: sperm whale, killer whale and bottlenose dolphin**

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Studies on the toxicological effects of the emerging contaminants in marine mammals are few. Bisphenol A (BPA) is one of the most abundant plastic derivate in aquatic environment and it is considered to act as endocrine disruptor. The Perfluooctanoic acid (PFOA), mostly used for industrial activities, is also considered interfere with endocrine system. On this regard, in this work the responses to both compounds have been explored in an in vitro system in three cetacean odontocetes species which have different position in the food web: sperm whale (*Physeter macrocephalus*), killer whale (*Orcinus orca*), and bottlenose dolphin (*Tursiops truncatus*). The sequence of the peroxisome proliferator-activated receptor alpha and gamma (PPAR A, PPAR G) involved in PFOA and BPA specific responses were obtained in all the three species skin biopsies. The levels of mRNA of PPAR A and PPAR G, the E2F-1 transcription factor (E2F-1) and the estrogen receptor 1 (ER1) have been evaluated in biopsy slices exposed to increasing concentration of both BPA and PFOA. On one hand, the results show that the BPA treatment induce the expression of the genes PPAR A and PPARG, showing a dose-response effect. Increasing the BPA concentration increases the bottlenose dolphin, killer whale and sperm whale mRNA levels, as well as for E2F-1 apart from the killer whale. Regarding ER1 no dose-response effect was detected. On the other hand, the PFOA exposure show a down-regulation of the PPAR G and PPAR A expression both in killer whale and sperm whale, while the ER1 and E2F-1 are slightly induced by PFOA in both species. In conclusion, these data show for the first time the potential effect of two classes of emerging of contaminants in three cetacean species, suggesting the genes PPAR A and PPAR G as suitable biomarkers for exposure to plastic derivates and PFOA.

## Fluctuations in $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ stable isotope ratios in fin whale baleen over a century

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Trophic niche-width and trophic level are convenient ways of describing the position and role of a species in its ecosystem or community. Carbon ( $\delta^{13}\text{C}$ ) and nitrogen ( $\delta^{15}\text{N}$ ) stable isotope ratios in the tissues of predators may be used to estimate these parameters. Baleen grows continuously representing a time-integrated proxy for diet when analysed for stable isotope ratios along the growth axis. Baleen plates, comprised of keratin, are metabolically inert after formation and store well at room temperature allowing the analysis of museum specimens. In this study, baleen plates sampled between 1914 and 2010 from 16 fin whales (> 14m in length and hence weaned) were analysed at 50mm increments (i.e. seasonally, assuming a continuous growth of 200 mm per annum). The exact date of stranding or the month of capture was known. A stable isotope time-series was generated starting near the gingival end of each baleen plate. The pooled range in  $\delta^{15}\text{N}$  was 6.2 ‰ indicating a marked variation in trophic level (TL) (1.8 TL assuming a fractionation of 3.4 ‰ per TL) among individuals sampled. The mean  $\delta^{15}\text{N}$  range ( $\pm\text{SD}$ ) for individuals was 1.7 ‰ (0.7) suggesting a wide trophic niche-width for fin whales in the region, especially in recent years. Decoupling influences of fractionation and baseline fluctuations however is difficult in light of the current paucity of data on  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  baselines over this time scale. The sub-polar gyre has profound influence on sea surface temperature and hence primary productivity, in turn affecting  $\delta^{13}\text{C}$  ratios of plankton which are transferred to consumers. A significant relationship exists between  $\delta^{13}\text{C}$  ratios during the period 1998 - 2010 and the sub-polar gyre index (after consideration of temporal auto-regression) indicating that whales are consistently feeding in regions where temperature variations are controlled by the sub-polar gyre.

## Molecular identification of *Anisakis* spp. complex from gastrointestinal tract of stranded cetaceans in Adriatic Sea

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There is a general lack of data concerning cetacean ecology in the Adriatic Sea, moreover on migrational patterns, feeding habits and health, thus any information that might contribute to clarification of such mechanisms is important. Parasites have been considered as good biomarkers in revealing their host history, reflecting their natural ecological relationships and possibly enabling tracing of host migrational patterns. Marine mammals serve as a definitive host in lifecycle of Anisakid species, representing the only source where the parasite matures to the adult stage and reproduces. Available information indicates that as a probable result of co evolution, cetacean-*Anisakis* relationship is species specific. The lack of firm morphological features differentiating between members of genus *Anisakis*, makes molecular identification the only tool of choice for their identification. Parasites showing morphological features consistent with genus *Anisakis* were collected from gastric compartments of eighteen cetacean carcasses belonging to three species (*Ziphius cavirostris*, *Stenella coeruleoalba* and *Tursiops truncatus*), found along Croatian coastline from 2004 to 2011. In detecting possible mixed infection at least 10 parasites per dolphin were analysed by molecular identification of mtDNA. In total, DNA was isolated from 96 samples preserved in ethanol and 2 fixed in formalin, and PCR reaction amplified 500 bp fragment of COXII gene using published primers and protocol. BLAST analyses with homologous sequences in GenBank indicated the presence of three different *Anisakis* species in stranded cetaceans of the Adriatic Sea: *Anisakis pegreffii*, *Anisakis simplex* and *Anisakis physeteris*. This represents an important first geographical report of the last two species, previously recorded only in the west Mediterranean and Atlantic. *Anisakis pegreffii* showed the highest prevalence (94.9 %) which is in accordance with occurrence of its preferred host, bottlenose dolphin, in Adriatic. The finding of new *Anisakis* spp. in this area might elucidate migrational patterns of their cetacean hosts.

## High mortality of harbour porpoise neonates in the southwestern Black Sea in 2010 and 2011

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Harbour porpoises (*Phocoena phocoena*) in the Black Sea are facing various threats in the Black Sea. The most serious threat is the bycatch in turbot nets. It is common to see juvenile animals getting bycaught and stranded eventually, but not many neonates have been reported as bycatch and stranded in previous years. In summer of 2010 and 2011, we found 10 and 28 harbour porpoise neonates stranded on the western coast of Turkish Black Sea, respectively. The body lengths ranged from 58 cm to 88 cm. Three of them were live stranded, but two soon resulted in death as the animals were too small to survive on their own. Some of them were found floating on the water. In the Bulgarian water, seven carcasses were found floating on the water during the oceanographic survey of IO-BAS in the summer of 2011. Usually there was no net mark or cuts observed on these stranded neonates, which implied that these were not bycaught animals. Considering the period of events and their small body size, they were still suckling at the time of death and it is unlikely that they dived to the sea bottom to feed as adult animals do. We suspect, therefore, they stranded from starvation as they had lost their mothers. Since the illegal turbot fishery still continues in early summer in the Turkish and Bulgarian coastal waters, the most probable cause of their mothers' mortality is bycatch, although we did not find many mature females bycaught and stranded. It is important to monitor and control the turbot fishery not only in the Turkish and Bulgarian coastal waters, but also in the whole Black Sea, for the protection of nursing harbour porpoises and consequently neonates.

WEDNESDAY, 28<sup>TH</sup> MARCH 2012 09:00

## TELEMETRY & NEW TECHNIQUES

### The territorial long-finned pilot whales of the Alboran Sea

Philippe Verborgh (1), Renaud de Stephanis (2), Pedro García (3), Jose Luis Murcia (3), Russ Andrews (4), Ana Cañadas (5), Pauline Gauffier (1), Joan Giménez (1), Ruth Esteban (1)

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The Mediterranean long finned pilot whales have been described as a management unit in the Mediterranean Sea, especially in the Alboran Sea, and some areas of the Ligurian Sea. Even if well studied in these areas, very little is known about their migration movements and diving behaviour. This study aimed at understanding horizontal and vertical movements of those whales in the Alboran Sea. During the winter 2011 3 SPOT5 Argos tags were deployed at both entrances of the Alboran Sea (Strait of Gibraltar and Cartagena). During the summer 2011, 3 MK10A (Argos and depth profiles tags), and 3 SPOT5 Argos tag were deployed in the Strait of Gibraltar, Almeria and Cartagena. The tags lasted for a mean of 40 days each, and gave 2343 positions. The whales showed different territorial behaviour, related to depth, surface temperature, and chl in function of the clan tagged. A total of 2103 hours of depth profiles were analysed, showing different strategies in function of the clan tagged, with deep dives (mean of 604m) independently of daytimes in the Strait, deep dives (mean 800m, max 1022m) during daylight in the central Alboran Sea, and deep dives preferentially during night hours in Cartagena area. These results show how the different clans of pilot whales adapt their feeding strategies to the area where they live. Moreover, they show a territoriality rarely described in a cetacean population. Short penetrations (of days) to other clan territories could reflect the reproduction strategy of these matrilineal species. These results show also the importance also for 3 critical habitats for the species in the Alboran Sea (The Strait of Gibraltar, the area of the Seco de los Olivos, and the area of Cartagena).

**WEDNESDAY, 28<sup>TH</sup> MARCH 2012 09:15****A service area in the middle of the ocean: satellite tracking shows that fin whales pause their northern migration to forage in the Azores**

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North Atlantic fin whales are thought to undertake annual migrations between low-latitude, oligotrophic breeding grounds and high-latitude, productive feeding areas. Although there is some information on the whale's distribution and behaviour in these high-latitude areas, very little is known about their migratory paths and behaviour. In 2009-2011, 9 fin whales were instrumented with satellite transmitters in the Azores to investigate their migratory movements and behaviour. Hierarchical switching state-space models were applied to the combined tracking data to allow improved estimation of Argos-satellite locations and of discrete behavioural states (transiting vs. area restricted search-ARS). Three tags stopped transmitting 1-3 days after tagging while the whales were in the Azores. The remaining whales were tracked for periods of 17-55 days and distances of 1433 to 5627 km. After leaving the Azores, the whales followed a nearly linear northerly trajectory (heading 345-15°). Sixty percent of the tracking locations were inferred as transiting behaviour, 34% as ARS and 6% were considered uncertain. ARS behaviour occurred close to the Azorean islands, between the Mid-Atlantic Ridge and the Rockall Plateau and on the southeastern Greenland shelf. Whales with track durations >16 days remained in the Azores for 5-18 days and spent 47% ( $\pm 34$ ) of the track time there in ARS. This study shows that some fin whales suspend their migration to high-latitude feeding areas to forage in the Azores, taking advantage of the increased productivity in the area during spring and early summer. Movements of tracked whales suggest the existence of a mid-Atlantic migratory corridor between middle latitude sites and the feeding grounds located off Greenland and Iceland.

**WEDNESDAY, 28<sup>TH</sup> MARCH 2012 09:30****Cetacean movements in relation to the dynamics of the sound-scattering layer on seamounts in the Azores**

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Several seamounts have been identified as hotspots of marine life in the Azores, possibly acting as feeding stations for top predators, including cetaceans. The pelagic predator-prey interaction is a crucial ecological factor affecting animal distribution and abundance. To understand this relationship, this study explores cetacean movements in relation to the dynamics of the sound-scattering layer (SSL) around/near different seamounts. In 2007 we deployed fixed-bottom mounted hydrophones (Ecological Acoustic Recorders) at four seamounts in the Azores to monitor the occurrence of cetaceans, their temporal patterns and changing levels of activity. We carried out several active acoustic surveys per year at those seamounts, using an echosounder, to characterize the density, spatial and temporal distribution of the SSL. Differences were observed in the spatio-temporal dynamics of the sound-scatterers between seamounts and “open-water”, with higher levels on the summit and along the slopes. The data suggested obvious diel migrations and depth variability. Migrations were evident in “open-waters”, concentrating in deeper waters (below 500 m) during the day and ascending to the top 150 m at night. Over/around the seamount, SSL was more evenly distributed across all depth layers, both during the day and at night, suggesting that micronekton organisms aggregate on the summit and along the slopes. Acoustic recordings revealed the presence of several species of cetaceans and associations between species. Seasonal patterns of cetacean occurrence were also observed, consistent with known periods of high trophic productivity which takes place during spring, especially in March. There was also a clear interaction between season and diel pattern of cetacean acoustic activity, with higher levels of activity during daytime in March and during night time periods from March onwards. Cetaceans may exploit the March trophic bloom and as it recedes in late spring they change their foraging strategy to feed on the nocturnally rising scattering layer.

WEDNESDAY, 28<sup>TH</sup> MARCH 2012 09:45

## Broad menu with kids option: energy balance of prey selection in deep-diving pilot whales

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Animal fitness depends on the foraging decisions of each individual. Short-finned pilot whales (*Globicephala macrorhynchus*) sprint at depth, defying expectations of oxygen management in order to target rewarding prey. However, this tactic is only one of the hunting techniques employed by this species. Data from acoustic and orientation recording DTAGs attached to 80 short-finned pilot whales show that they perform three main foraging dive tactics (deep-day, and shallow and deep night-time dive types) seemingly adapted to target a range of prey with variable cost-benefit trade-offs and adjusted to the vertical circadian migration of deep-sea organisms. Here, these trade-offs are uncovered using independent measures that provide correlated estimates of relative hunting energetic costs of the dives: indirect respirometry, ODBA and speed-dependent hydrodynamic drag. The abundance and depth-distribution of prey are derived from the echolocation activity of the whales. Results show that the estimated oxygen uptake after dives is well predicted by the energy spent in overcoming the drag-cost during dives, i.e. there are cheap and expensive foraging tactics and the cost is dictated by the depth and the speed reached during each dive. The combination of the drag-cost and the number of prey targeted in the three dive types indicates differences of up to 40 times in the caloric value of prey targeted with different tactics. Although diving capabilities are related to body mass for air-breathing diving predators, large adult males and smaller females/sub-adult males reach similar maximum depths and speeds. In contrast, juveniles only perform “cheap” dives, foraging shallower/slower than adults because of their higher mass specific metabolic rate compared to their oxygen stores. This apparent ontogenic partial niche segregation and the broad diet-breadth of short-finned pilot whales may be essential to sustain the large and cohesive social groups of this top-predator in the deep ocean.

WEDNESDAY, 28<sup>TH</sup> MARCH 2012 10:00

## DISTRIBUTION

### **Seasonal home range of social units of sperm whale (*Physeter macrocephalus*) in the Azores Archipelago: implications for long-term spatially restricted photo-ID studies**

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Conservation of sperm whale populations relies on the effective monitoring of populations. Mark-recapture (MR) using photo-identification has proven to be an effective method for providing these data. Sperm whales are a long-lived and slow reproducing species, long-term data collection is therefore required but funding this can be prohibitive. Whale watching has become a thriving activity in the Azores, which is both a feeding, and breeding ground for sperm whales. Photo-ID data collected from whale watching boats by skippers and biologists/guides could provide inexpensive alternatives to dedicated surveys and provide long-term datasets. Sperm whales range widely and, individuals are thought to visit the Azores seasonally. Using a 20-year photo-ID dataset, this study investigated seasonal “home ranges” of sperm whale units within the Azores, and implications for biases in photo-ID data collected by spatially restricted whale watching operations. Data from several identified sperm whale stable social units was used. The distribution of presences and associated absences was modelled with a GAM, which included a spatial covariate (non-linear lat/long interaction) and a temporal covariate (year). The deviance explained and the output of a confusion matrix confirmed the good predicted power of the model. Certain sperm whale social units showed a preference for specific areas within their seasonal home range, which appeared stable in time. Sperm whale site fidelity can affect capture probability and compromise photo-ID MR studies. These findings could be used to explore biases in population estimates and how to minimise them. Notwithstanding the need for additional work, it is already clear that data collected opportunistically by a commercial whale watching operation is providing useful data for research and management over extended periods of time. If continued, initiatives such represent a practical method for obtaining the long-term data sets required.

WEDNESDAY, 28<sup>TH</sup> MARCH 2012 10:15

## A systematic review of global bottlenose dolphin movement patterns in relation to habitat type

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Bottlenose dolphins (*Tursiops truncatus* and *T. aduncus*) are found in a range of coastal and offshore habitats worldwide. Globally, bottlenose dolphins show considerable variation in their degree of mobility. At opposite ends of the spectrum, some communities are nomadic, moving seasonally or unpredictably, while others may be long-term resident within highly limited ranges. Despite being fundamentally important to many aspects of spatial management, the factors that drive communities to have different ranging patterns are poorly understood. Additionally, conservation effort is complicated by the lack of detailed long-term data for many bottlenose dolphin populations. Therefore, the aim of this study is to review current knowledge on bottlenose dolphin movements, residency, site-fidelity and home ranges and to investigate whether generalisations in bottlenose dolphin ranging patterns can be made for different habitats. A systematic review of published articles, book chapters and reports presenting quantitative dolphin movement data obtained via photo-identification and telemetry methodologies was conducted. The following habitats were included in the assessment: estuaries, closed embayments, open coastal waters, fiord systems, waters surrounding oceanic islands and the open ocean. Results show a substantial variation in dolphin ranging patterns within the habitat types, partially influenced by both data collection method, and the temporal and spatial scales of the studies. Nevertheless, distinctions can be made for dolphin movement between different habitats. Generally, movement appeared to increase with increasing openness of the environment. Whereas this stratification has been suggested before, this is the first time this hypothesis has been explored systematically. For many of the studies incorporated in this synthesis, investigating bottlenose dolphin movements were not the primary aim, and consequently, a relation with study method was found. Nevertheless, the factors driving movement patterns have significant implications for management.

**WEDNESDAY, 28<sup>TH</sup> MARCH 2012 10:30**

## **Cetacean distribution and relative abundance in the Irish EEZ**

Dave Wall (1,2), Nick Channon (1), Ian Enlander (1), Brian Glanville (1), Lucy Hunt (1,2), Laura Kavanagh (1,2), Clare Murray (1), Joanne O'Brien (1,2), Conor Ryan (1,2), Peter Tuffy (1), Dave Williams (1), Chris Wilson (1)

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From January 2005 to April 2011 cetacean line transect surveys were conducted from research, naval and commercial vessels within the Irish EEZ. The surveys were conducted under two government funded programmes and a voluntary cetacean monitoring network. Over 4,800 hours of survey effort was conducted during this period and 2,400 sightings of 17 cetacean species, totalling 25,400 individuals were recorded. Distribution and relative abundance maps at a 50km<sup>2</sup> are presented for each species and seasonal distribution and relative abundance maps are presented for those species for which sufficient data were available.

Some species showed strong temporal shifts in distribution and relative abundance, while others showed seasonal presence within the EEZ. In the case of beaked whales, sufficient data was gathered to indicate at least one area of potential conservation importance for this group within the Irish EEZ and follow-on studies of habitat use have been instigated. Data was also gathered on potential foraging behaviour in blue whales along the slopes of the Irish Shelf.

In light of the requirement for EU member states to report on the favourable conservation status of all cetacean species on a six year cycle and considering the vast scale of the area to be monitored (10 times Ireland's land area), the use of platforms of opportunity offers a cost efficient method of wide scale monitoring of cetaceans within the Irish EEZ. In addition, the collection of cetacean distribution and relative abundance data in conjunction with oceanographic, bathymetric and fisheries data on board Irish and EU research vessels has provided an opportunity to study cetaceans in relation to the physical and biological characteristics of their marine ecosystems.

WEDNESDAY, 28<sup>TH</sup> MARCH 2012 10:45**Re-established stone reef in Kattegat, Denmark, attracts harbour porpoises (*Phocoena phocoena*)**

Lonnie Mikkelsen (1), Kim N. Mouritsen (1), Jakob Tougaard (2), Karsten Dahl (2), Jonas Teilmann (2)

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In 2008 the nature restoration project Blue Reef re-established 4.5 hectare of cavernous boulder reef at Læsø Trindel in the northern Kattegat, Denmark. Stony reefs in shallow water support an abundant and species-rich animal community and may thus attract predators such as the harbour porpoise. To investigate whether porpoises are attracted to such areas, their acoustic activity was monitored by static acoustic loggers, T-PODs, before and after the restoration project. Two T-PODs (Version 3) were placed at the Læsø Trindel reef and two at a reference reef 10 km away, during the summers from 2006 to 2010. Results showed that porpoise activity increased significantly at the Læsø Trindel reef after the reconstruction in 2008. PPM (porpoise positive minutes) increased from 6.9 day<sup>-1</sup> before, to 15.0 day<sup>-1</sup> after 2008 (118 % increase,  $p < 0.0005$ ). At the same time activity decreased in the reference area from 12.6 to 4.6 PPM day<sup>-1</sup> (64 % decrease,  $p < 0.0005$ ). Porpoises not only appeared more often, but also stayed longer at Læsø Trindel: encounter durations increased by 59 % from 2.9 to 4.6 min ( $p < 0.0005$ ). Furthermore, there was a striking diel pattern in porpoise activity at Læsø Trindel where most activity occurred during the night. This was barely evident in 2007 ( $\theta = 04:45\text{h}$ ,  $r = 0.17$ ) but became increasingly apparent and peaked in 2010 ( $\theta = 00:25\text{h}$ ,  $r = 0.30$ ). At the reference site, in contrast, most activity took place at daytime both before (2007:  $\theta = 12:02\text{h}$ ,  $r = 0.30$ ) and after (2010:  $\theta = 13:39\text{h}$ ,  $r = 0.40$ ) the restoration at Læsø Trindel. It is argued that these changes reflect a new food source appearing at night on the re-established stone reef, and fed upon by the porpoises.

WEDNESDAY, 28<sup>TH</sup> MARCH 2012 14:30 - 15:30

## SHORT TALK SESSION 3

### **Abundance of cetaceans in the central part of Croatian Adriatic Sea by photo-identification and aerial survey**

Ana Mikac (1), Martina Duras Gomercic (2), Anita Babacic Ajduk (3), Tina Dragutin (3), Tomislav Gomercic (2)

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Bottlenose dolphin (*Tursiops truncatus*) is the only resident cetacean species of the Adriatic Sea. Previous studies indicate anthropogenic influence on habitat use in the Central Adriatic Sea, while systemic monitoring of bottlenose dolphin abundance in this area is lacking. In Šibenik-Knin county, which lies in the central part of Croatian Adriatic Sea, we estimated the number, defined the abundance and distribution of bottlenose dolphins. The study area covered 2680 km<sup>2</sup>, i.e. 76 km in length and 41 km in width, and included Kornati National Park. During 2010 and 2011 boat surveys were conducted and dolphin schools photographed in order to photoidentify present animals. The number of animals was estimated by aerial survey carried out in 2010 during one day at 200 m height with a Cessna 172 airplane. On this occasion 41% of the study area was covered. Five bottlenose dolphin groups were observed with an average school size of 2,4 animals. The estimated number of bottlenose dolphins in the study area was 44. All sightings were registered in the data base available at <http://crodolfin.vef.hr>. During boat surveys 42 bottlenose dolphin groups were encountered. They consisted of 2 to 21 specimens. A group of striped dolphins (11 individuals) was encountered at one occasion. During our study 95 bottlenose dolphins were photoidentified. In addition to previous indications that marine traffic influences the abundance of bottlenose dolphins in the Central Adriatic Sea, we observed that fish breeding sites attract bottlenose dolphins and influence their spatio-temporal distribution.

## **Fine-scale habitat use and midwater foraging in free-ranging grey seals**

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Crucial to understanding the links between foraging behaviour and habitat use is obtaining spatially accurate behavioural data. The development of Fastloc GPS technology has greatly increased our ability to study the foraging ecology of wide-ranging marine species. Eight female grey seals in southwest Ireland were equipped with time-depth recorders linked to Fastloc GPS tags following the annual moult in 2009 to investigate foraging behaviour and fine-scale habitat use. In total, 324,901 dives were recorded over an 8 month period, with position and kmeans analysis used to characterise dives as shallow, midwater, or dives to the benthos. Increased position accuracy enabled dives to be confidently linked to environmental variables such as water depth, sediment type, and whether dives occurred during daylight or darkness. Dives to the seabed occurred more during daylight hours than at night. 68% of dives occurring in deep water were dives to the seabed, consistent with previous studies describing grey seals as demersal feeders. However, 32% of dives were either shallow or midwater dives, suggesting grey seals may also be feeding on pelagic prey. A significant effect of sediment type on dive behaviour was noted; dives to the benthos were less common over muddy and sandy sediments, while benthic and surface dives were more common over rocky substrates. Fine-scale habitat use of grey seals helps to explain regional differences in diet of grey seals, with a predominance of gadoids associated with rocky substrates in the southwest and flatfish associated with finer sediments in the east of the country. This study gives us a better understanding of the drivers of seal foraging behaviour, which will allow us to make more accurate predictions of habitat use in “data poor” areas, essential for the effective conservation of these key marine species.

## **Investigation on the interactions between cetaceans and marine traffic in the Istanbul Strait**

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Marine traffic is one of the most important threats to the survival of the dolphin population in the Istanbul Strait. As a preliminary part of a two years study, in order to investigate the potential effects of marine traffic on common dolphins, bottlenose dolphins and harbour porpoises, behavioural data were used to identify whether there was any relation between dolphins and marine vessels. To determine the critical habitats of cetaceans, land and boat based surveys were made to collect data on the feeding, breeding, socializing and resting behaviour between August and October 2011. Theodolite was utilized for investigating the interactions between the marine vessels and cetaceans.

The highest marine traffic intensity was recorded in the southern entrance of the Istanbul Strait with an average of 570 vessels daily, the majority of them being fishing boats and ferries. However the lowest intensity was recorded in the northern entrance of the Istanbul Strait with an average of 83 vessels daily.

It was found that 92% of cetacean encounters, marine vessels were present. Totally 118 dolphins were recorded in 19 sighting between August and October and 76 of it were sighted in the southern entrance of the Istanbul Strait. Main activity observed for the cetaceans was dive-feeding followed by surface-feeding. It was also repeatedly observed that dolphins that were travelling or feeding changed their behaviour to longer diving if there was a marine vessel around. Furthermore, if the distance between the marine vessels and cetaceans were less than 50m, they showed negative reactions either by prolonging their diving intervals or increasing their travel speed.

According to the results of this study, primary high risk areas will be determined and effective measures will be taken during the development of management and conservation plans on the protection of cetaceans in the Istanbul Strait.

## **Can you find whales by measuring chlorophyll?**

Cillian Roden (1), Simon Berrow (1,2), Ian O'Connor (1), Pádraig Whooley (2)

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Ecology is supposedly about integrating all aspects of the natural world, but too often it relapses into over specialisation. Here the links between phytoplankton ecology and cetacean studies are explored. In this short talk patterns of cetacean sightings are compared to patterns in chlorophyll distribution in three locations in Irish waters, the coastal waters of Connemara, the upwelling region along the south coast and the deep sea canyons west and north of the Porcupine Bank. A number of intriguing patterns are illustrated but the difficulty in linking the behaviour of some of the smallest and largest organisms in the marine food chain are not to be underestimated.

## Using telemetry data to scale up haulout counts into abundance estimates for pinnipeds: methods applied to British grey seal (*Halichoerus grypus*) and harbour seal (*Phoca vitulina*) populations

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Many pinniped populations are monitored by counting animals that are hauled out on land. Provided the surveys are carried out under similar conditions, and the behaviour of the animals does not change, the results provide indices of abundance. While indices can reveal trends, assessments of conservation status and the likely effects of anthropogenic impacts, that remove particular numbers of animals, depend on knowledge of absolute abundance. Converting counts of hauled-out seals to estimates of population size requires an estimate of the proportion of the animals that is at sea during the surveys. Electronic telemetry tags provide one way of doing this. We present two examples of applying this strategy. The first uses data from 107 tags, glued to the fur of grey seals (*Halichoerus grypus*) during previous studies. It provides an estimate of abundance in 2008, 91,800 animals (95% confidence interval, CI, 78,400-109,900), that is independent of the pup production estimates used in most of the monitoring of the British grey seal population. It also shows that the recent slowing in the rate of growth of this population is due to reductions pup survival. The second example uses data from 22 tags, attached to the flippers of harbour seals (*Phoca vitulina*) to rescale moult counts and show that the population in Orkney declined at 13% (95% CI 10.8-14.8) per year over the period 2001-2010. The sex-ratio of this population is unknown but, assuming it was close to 1-1, the Orkney population of harbour seals will have been around 3586 (bootstrap 95% CI 2970-4542) animals in 2010. We briefly discuss the assumptions and limitations of this approach, and the implications of the differing trajectories of the British seal populations.

## **An oceanographic model of the Pelagos Area as essential tool for cetacean habitat modelling**

Elisa Casella (1), Paola Tepsich (1), Antonella Arcangeli (2), Xavier Couvelard (3), Rui Caldeira (4)

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While sea surface oceanographic processes are well observed and described worldwide by remote sensing satellites, availability of oceanographic data related to water column still lack the desired spatial and temporal resolution. Nevertheless, cetacean distribution is more likely to be driven by environmental condition of deeper waters rather than surface. This is particularly true for cetacean feeding on zooplankton patches at depth, as for example fin whales in the Pelagos Sanctuary (Northwestern Mediterranean sea).

In order to gather data which could describe the oceanographic process which lead to the formation of zooplankton patches through the water column, we use the Regional Ocean Modelling System (ROMS) configured at a resolution of 3 Km for a domain covering the Western Mediterranean Sea.

The model is forced with daily-mean boundary (oceanic) conditions extracted from MERCATOR, and with three-hourly winds, extracted from COSMO-7, models. The use of wind high resolution data highly improve model performances in modelling eddies occurrence. We simulated two years (2009 and 2010) and we validated the solutions for the study region by comparing model output with Sea Level Anomaly and Sea Surface Temperature maps and with current data obtained by current meter and ADCP data deployed in the Corsica Channel. A first attempt for characterize fin whale habitat has been done comparing species preferences along the water column (from 0 to 500m depth) towards current vorticity, current speed, Kinetic Energy and Mixed Layer Depth in the western, central and eastern region of the Pelagos Sanctuary. Results indicate that fin whale habitat in the western region is described by Anticyclonic vorticity, slower current speed and lower KE than the available habitat while cyclonic vorticity, faster speed and higher KE are selected in the eastern region. We than hypothesize the existence of two feeding grounds with opposite oceanographic conditions within the Pelagos Sanctuary.

## Locomotor costs related to ram-suspension feeding in North Atlantic right whales

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The continuous ram-suspension feeding method of mysticete cetaceans in the Family Balaenidae has been suggested to be energetically expensive because this method requires powering a large surface area through the marine environment. Recent work has estimated the costs of intermittent lunge-feeding method used by balaenopteridae whales and suggested that this method incurs higher foraging costs than those of balaenids; however, no such estimates have been made. In this study, we investigated the locomotor costs of continuous ram suspension feeding by attaching high-resolution suction-cup archival tags to free-ranging North Atlantic right whales at their foraging grounds in the Bay of Fundy. Periods of horizontal gliding made by whales when foraging at depth and travelling near the surface were used to estimate the deceleration rate and, subsequently, determine drag coefficients during those two behaviours. Four right whales met the criteria for determining drag coefficients, so 630 glides (316 foraging, 314 travelling) were included for drag analysis. The average drag coefficients for foraging and travelling behaviours were 0.0052 and 0.0014, respectively, and these estimates were similar to those of other cetacean species. Foraging dives had significantly higher drag coefficients than travelling ones (Mann-Whitney test:  $U_1 = 173.86$ ,  $p < 0.0001$ ), despite having a significantly slower mean speed (Mann-Whitney test:  $U_1 = 9.00$ ,  $p = 0.003$ ) Resulting drag forces were significantly higher during foraging dives than travelling ones (Mann-Whitney test:  $U_1 = 377.99$ ,  $p < 0.0001$ ). These results support the suggestion that balaenid ram feeding is less costly than balaenopterid lunge feeding and match predictions of relative foraging cost based on differences in prey type, foraging parameters and body shape between the families. Finally, when placed in the context of the overall energetic expenditure, these locomotor costs constitute a reasonably small portion of the total energy budget of these whales.

## **PROJECT CETACEOS MADEIRA II: identifying critical marine areas for bottlenose dolphin and surveillance of the cetaceans' conservation status in Madeira Archipelago**

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The Madeira Whale Museum project CETACEOSMADEIRA II aims to: 1) identify critical marine areas for bottlenose dolphin in Madeira archipelago; 2) define operation areas for the whale-watching (WW) industry, establishing their carrying capacity and 3) surveillance of the cetaceans' conservation status in Madeira offshore waters. Sea work comprises nautical surveys (systematic/random), using distance sampling methodology and photo-id for objective 1; boarding's on WW boats and recording GPS tracks for objective 2 and boarding's on the tuna fishing vessels for objective 3. Between May 2010 and September 2011 47 days of systematic surveys were performed, accomplishing 3464km, registering 136 cetaceans' sightings on effort. Nine different species were recorded being bottlenose dolphin the second most sighted (22 sightings). Concerning photo-id data, 9090 photographs were taken, partially processed, with 30 new individuals added to the catalogue so far. 111 boarding's on the WW boats were done and 590 GPS tracks were registered. For the third objective of the project, 63 days of effort were performed between June 2010 and September 2011 totalizing 2143,447 km and 64 cetaceans' sightings registered. Nine species were recorded, being the common dolphin the most sighted. 137 fishing events were sampled, 4 had the presence of cetacean and on 3 of them cetacean disturbed the fishing activity. No cetacean by-catch was registered. The data collected in objective 1 will be used for spatial modelling to develop criteria to protect the bottlenose dolphin and promote the conservation of cetacean species and their habitats. The GPS tracks will provide information on the WW areas of operation and boarding's data will be used to define the carrying capacity. The data collected in objective 3 will be analysed according to IUCN criteria (RAMAS© software) to determine the conservation status of cetaceans in the offshore waters of Madeira.

## Investigating harbour porpoise group size in the Baltic region

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The EU LIFE+ project SAMBAH is currently carrying out a 2-year deployment with porpoise click detectors in the Baltic Proper, Åland Sea and Archipelago Sea, with the aim to provide reliable estimates of density and abundance of the Baltic Sea harbour porpoise population. Methods for estimating density and abundance will rely on several different paths, for example snapshot point transects for groups and “ideal gas methods” (models that aim to fit group encounter rates in continuous time by accounting for group movement and detectability). In both of these cases the estimation of group size and its possible spatial variation is essential.

The mean size of porpoise groups has been estimated in areas close to or within the Baltic Proper in previous studies. However these estimates do not take into account the possibility of group size being influenced by spatial variables.

Here, approximately 13 000 sightings of live animals from several sources were used to investigate the spatial variation in group size of harbour porpoises in the Baltic region.

General Additive Modelling was carried out for the three harbour porpoise populations in the Baltic region; the Inner Baltic Sea (approximately 480 data points); Western Baltic Sea, Inner Danish Waters and Kattegat Sea (approximately 12000 data points); and Skagerrak Sea (approximately 400 data points). Environmental predictor variables included latitude, longitude, depth and salinity.

The results indicate that there is a significant difference in group size between the Inner Baltic Sea and the two other population areas. Group size does vary spatially in relation to environmental variables, although models do not have a high explained deviance. Generally, the results from effort sightings correspond rather well to estimates from previous studies, while group size in incidental sightings is significantly larger.

## **Smart phones for better marine mammal research through easy data collecting, sharing and unifying protocols**

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In an ideal world, marine mammal researchers will work with a standard protocol and collaborate to share knowledge. In reality protocols vary enormously; different databases are used, leading to very little data sharing even when researchers are willing to share. Keeping this in mind, most marine mammal researchers working from small crafts use the highest quality pencil and paper pad while their brand-new Smart phones with GPS are concealed in their pockets. In my view, data collection at sea should be done using generic off-line software which will be downloaded into the smart-phone and adjusted to fit the specifications of the particular research. A simplified version can be distributed to volunteers who regularly report sightings. The data collected at sea will be synchronized into a main database via internet, Wi-Fi or GPRS/3G. The researchers will have access to their own data in the main database via internet which will be secured by a password. The Data can be downloaded for backup in the researcher's own computer. Pictures collected during the survey will be connected to the data collected at sea using the time stamp of the pictures and the time collected by the GPS in the smart-phone. The Smart-phone will be protected by a waterproof and crash proof case available for sale. IMMRAC's researchers have been using similar software with a regular PDA since 2007 with 3 field stations operating simultaneously. This very successful small scale project will be the foundation for the large scale project suggested here. In my vision, a large internet corporation, such as Google, Microsoft or even Facebook, will invest in such a project that has an enormous potential in different research fields too, enabling researchers to collaborate for a better world.

# POSTER ABSTRACTS



# ABUNDANCE & DISTRIBUTION

AB 01

## Results of systematic observations of true seals (*Phocidae*) in the Piltun Bay mouth area in 2010

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Considerable attention has recently been paid to the monitoring of marine mammals on the northeastern coast of Sakhalin Island where oil and gas exploitation is now very intensive.

Systematic shore-based counts of true seals were being made during the period of time from the 11-th of July up to 25-th of August, 2010. The counts were performed using a 1000-power terrestrial telescope from a 35-m lighthouse located approximately 1.5-2 km toward north-west from the seal hauling-out areas. The counts were made three times during the light day when the visibility conditions permitted to do it. In total, 38 counts were performed.

Three hauling out sites of seals of three species (*Phoca largha*, *Phoca hispida*, and *Erignathus barbatus*) were found located on sandy bars and sandy beaches in the Piltun Bay mouth area, the seals came to these sites when tides ebbed. The true seals identified in Piltun Bay on hauling-out sites are represented by the following species: spotted seals (*Phoca largha*), ringed seals (*Pusa hispida*) and bearded seals (*Erignathus barbatus*). Mixed species hauling-out groups consisted of dominating spotted seals with sporadic bearded seals. The last were found lying separately at the edges of hauling-out sites. The total number of seals per count ranged from 0 to 608 (mean = 157.34 ±SD 146.68). In July, the average number of seals per count amounted 195 (±SD 77.24), in August this value increased up to 321 (±SD 211.0).

In the period of ice melting the Piltun Bay area is an important hauling-out and feeding site for true seals. Nevertheless in spite of abundance of invertebrates and bottom-dwelling fishes only few bearded seals were observed in the area. The high anthropogenic activity in the region is proposed to be responsible for the rare findings of bearded seals in the studied area.

AB 02

**Inventories of harbour porpoise (*Phocoena phocoena*) presence in Russian territorial waters of the Baltic Sea**

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Harbour porpoise *Phocaena Phocoena phocoena* (Linnaeus, 1758) was considered extinct in the eastern part of the Baltic Sea. Nevertheless there are some data obtained recently by Finish biologists on detection of *P.P. phocoena* in Finish water area. In the Russian Federation there were no recent studies devoted to determination of *P.P. phocoena* status in the Russian part of the Gulf of Finland. With support of ASCOBANS we implemented short-term project aimed to find out if harbour porpoise still occurs in Kaliningrad region and Leningrad region of the Russian Federation. All in all 92 responders whose work is closely related to the sea area (fishermen, ichthyologists, border guards etc.) participated in the survey. Questionnaire survey in Kaliningrad region gave positive results showing that the sightings of harbour porpoise occurred in 1993, moreover several skulls belonged to harbour porpoise were found in AtlantNIRO museum and the most recent one was dated 1970s. In 2006 there were two reported cases of sightings of *Delphinus delphis* in the same area. In Leningrad region no harbour porpoise sightings were reported, study of the islands' coast line in the Gulf of Finland brought no positive results - no remains were found. Museum collections in the Zoological institute in St. Petersburg include several skeletons of harbour porpoise found in the area in early XX century. The only dolphin remains (vertebrae column) found on the shore of one of the island was dated back to 1992 and seems to be unavailable for the moment. We can conclude that harbour porpoises were common in Russian territorial waters in the beginning of last century but during the last 40-50 years their visits to the area are occasional and very rare.

**AB 03****Pygmy right whale of open waters of the South-eastern Atlantic**

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Due to small size (length not exceeding 6.5m) and, probably, small number of animals, pelagic whaling of *Caperea marginata* (Grey, 1846) was not practiced. An unexpected discovery by Soviet whalers of a new area habitat of these whales in open waters and at greater depths in South-East Atlantic Ocean from November 29 to December 7, 1970 is of special interest. The whales were single, in pairs and in groups of 8 animals. Without a special survey of the area no less than 25-30 individuals were recorded. The whales were calm, fed on zooplankton in the surface layer of water whose temperature varied from 18.4°C to 21.1°C.

The whales were clearly putting on weight. Apparently, they migrate to the coast of Africa and back, and they are part of the same population with the whales by African coast.

The study of skeletons of the caught whales showed that they were all physically mature animals. The degree of ossification of the epiphyses of the thoracic vertebrae in females was greater than in the male. Since under the conditions at the whaler deck the mounting position of the first pair of ribs could not be determined precisely, the formula of the spine as determined by us as  $C7T17L3Cd13 = 40$ , or  $C7T18L2Cd13 = 40$ .

In the absence of extensive whaling in the Southern Hemisphere it is needed to intensify the field observations of pygmy right whales, taking their photo identification and biopsy for more detailed molecular genetic studies. It is necessary to more closely examine all the museum exhibits, as well as whaling ships "biologists" scientific logs preserved in public and private archives.

AB 04

**Seasonal variation in abundance and time-budget of bottlenose dolphins (*Tursiops truncatus*) in Bahía San Antonio, Patagonia, Argentina**

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The abundance and time-budget of bottlenose dolphins (*Tursiops truncatus*) was assessed in Bahía San Antonio, Patagonia (Argentina) in the years 2009 and 2010. A total of 366.4 boat-based survey hours resulted in 64 contact hours with a total of 88 dolphin groups. Mark-recapture abundance estimations, based on 63 identified dolphins, resulted in a corrected maximum estimate of 97 and 83 individuals during winter, and a minimum of 34 and 38 individuals during autumn of 2009 and 2010 respectively. Between 25% and 68% of the population consisted of unidentifiable individuals depending on the season, indicating the high presence of juveniles and calves.

Behavioural data indicated that the dolphin's time-budget consisted mainly out of resting and feeding, variable over the seasons. Dolphins increased their time feeding and socializing during winter and spring, whereas feeding dropped to a minimum in autumn. During summer, the dolphins spent up to 46% of their time diving, behaviour presumably associated with a tail out/peduncle-dive foraging strategy.

Based on these data, we assume more prey availability during winter and spring (main food source being pelagic fish) and a notable decrease in prey availability during summer with benthic prey species being the main food source. In autumn, even less prey items might be available. Furthermore, the increase in social behaviour during winter and spring combined with a peak in the presence of calves during these seasons, suggests the existence of a mating and calving season.

These estimates of abundance are in line with the sizes of other coastal populations of bottlenose dolphins elsewhere in the world, and fit the occupancy patterns described for other coastal areas with small resident communities. The study further suggests that dolphins specifically use the study area to rest and feed, and to give birth and raise their young, specifically during winter and spring.

**AB 05****Are Scottish tidal-stream energy sites also porpoise hot-spots?**

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Harmful collisions between marine mammals and tidal turbines are a significant environmental concern for this rapidly developing industry. Modelling work suggests that the overlap between harbour porpoises and tidal turbines may be significant but assumes that porpoises use sites suitable for tidal-energy extraction equally to other areas. The porpoise literature is split whether high energy tidal-stream sites should be considered to be hot- or cold-spots for this species. The aim of this study was to investigate porpoise density in two West of Scotland sites of interest to tidal-stream developers (Sound of Islay and Kyle Rhea). We used standard survey techniques including visual and acoustic boat surveys as well as moored porpoise detectors. However, the boat surveys needed to be redesigned because at peak flow the water itself could be moving over the bottom at speeds close to vessel speed (2-4 m/s). These surveys were conducted from the HWDT research vessel “Silurian” over 16 days in July 2009 and May 2010 covering a total of 1310 km. Porpoises were detected on the boat surveys 126 times visually and 504 times acoustically. Results showed that porpoises, though present, were at very low densities in the areas of high tidal flow but at much greater densities in neighbouring slow moving waters. These findings are discussed in relation to the implications for planned developments at these sites, implications for other tidal-energy sites and the suitability of existing techniques for conducting marine mammal surveys in habitats that experience significant flow rates.

AB 06

**Visual and acoustic surveys of harbour porpoises (*Phocoena phocoena*) in the southern North Sea**

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Ship-based visual and acoustic line-transect distance sampling surveys of harbour porpoises were conducted in the southern German North Sea. In order to infer on changes in distribution, density and behaviour of porpoises in the alpha ventus wind farm area surveys were conducted before, during and after the construction phase. The survey design comprised a set of 28 transects with 1,680 km of transect length in the 2,116km<sup>2</sup> study area. A double platform approach was used with two independent observer teams to correct for animals missed on the transect line. Acoustic detections of harbour porpoises were recorded with a hydrophone array towed 200m behind the ship. Between August 2008 and April 2011, 5 surveys were conducted with 4,827km of visual effort. In total 590 sightings with 801 individuals were recorded, of which the highest amount was recorded in April 2011 with 407 sightings. The encounter rate was highest in April 2009 and 2011 and lowest in April 2010. Porpoise distribution was following a similar pattern during four of the surveys, showing many sightings in the north and south. The porpoise behaviour observed in 2011 was very different from the former years, with many sightings of resting animals. Acoustic data was collected during 4 surveys, resulting in 6,240km of acoustic effort with 244 porpoise detections in total. Detections were concentrated in the southern part of the study area. Results show that combined visual and acoustic line transect surveys are a useful tool to study the occurrence and behaviour of porpoises. Both methods complement each other well, especially during periods with bad weather conditions when visual observations were impossible. A strong increase in porpoise sightings was encountered in April 2011 which is concurrent with observations from aerial surveys in the same area and in neighbouring countries. Possible reasons have to be further assessed.

**AB 07****Estimates of abundance and MPA for beaked whales in the Alboran Sea (south-western Mediterranean Sea)**

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Links between atypical mass strandings of beaked whales and military maneuvers have been demonstrated in several parts of the Mediterranean, including the Alboran Sea. Here, information on distribution and abundance of Cuvier's beaked whales is presented for the Alboran Sea, which has been shown to be a high use area for this species. Such information is of great importance to allow the impacts of mass strandings, entanglements, etc. to be put in a population context and to highlight the most important areas for this species that may be a focus for conservation action. The data used for these analyses come from two sources: data collected during the summers of 2008 and 2009 on board the vessel Alliance during the Sirena08 and Med09 surveys; and data collected during surveys carried out under the umbrella of the NGO Alnitak from 1992 to 2009. Detection functions were obtained using distance sampling methods and density surface Modelling was undertaken for two different datasets: a) northern section of the Alboran Sea (1992-2009); and b) whole Alboran Sea (2008-2009). Uncorrected estimates of density (in animals/km<sup>2</sup>) were 0.0037 (CV=17.6%), and 0.0046 (CV=52.7%), respectively. Corrections for availability bias (0.899, CV=7.4% and 0.621, CV=10.4% respectively) were applied to these estimates, based on data from focal follows done in the area in 2009 and 2010, to generate more realistic estimates. Based on these results, and comparison with estimates from elsewhere, it is clear that the Alboran Sea supports one of the highest densities of Cuvier's beaked whales in the world. This information has been used to propose a MPA for this species in the Alboran Sea, as well as to establish the basis for a management plan for such area.

**AB 08****Density surface estimates from the Joint Cetacean Protocol Data Resource**

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The Joint Cetacean Protocol data resource is the largest collection of cetacean survey data ever assembled in Europe. Data, from more than 10 countries, were provided by governmental organisations, non-governmental organisations, academic institutions and marine renewable energy companies and were used to estimate spatio-temporal patterns of abundance for six of north-west Europe's most commonly occurring cetacean species. The spatially and temporally referenced abundance estimates were modelled using generalised estimating equations, with spatial and (where possible) temporal smoothing, incorporating a new method for dealing with complex topographies. Other variables considered included sea surface temperature, availability, depth and bathymetric slope. The density surface models were then used to predict cetacean density over a fine spatial grid and for each season from 1987 to 2010. The results of this analysis will be used for species conservation status reporting and will help provide context to industry Environmental Impact Assessments. Temporal trends and changes in density since 1987 will be discussed.

AB 09

**Site fidelity and relative abundance of spinner dolphins resting in Samadai reef (Egypt - Red Sea)**

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Site fidelity and relative abundance of spinner dolphins (*Stenella longirostris*) were investigated during a systematic underwater photo-identification study between October 2005 and September 2006 in Samadai, a small reef off Marsa Alam, in the southern Egyptian Red Sea. This site is a resting area for spinner dolphins, a species known to spend daylight hours in protected and sheltered areas, after having foraged at night in offshore waters. During 107 surveys, dolphin groups were encountered on 81 days (76%) with an average group size of 56 individuals (range 3-170). Daily photographic sessions were carried out 72 times and 15,402 underwater pictures collected, allowing the identification of 218 individuals. Mark-recapture analysis performed on highly marked individuals using good quality images produced a preliminary abundance estimate of 290 dolphins. High values of re-sighting rates of individuals combined with a sharply decreasing rate of discovery suggests evidence for site fidelity by this dolphin community.

**AB 10****Abundance of common dolphins in the Bay of Algeciras using mark-recapture data**

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The Bay of Algeciras is of special interest due to its role as a breeding and feeding area for the threatened Mediterranean common dolphins (*Delphinus delphis*), but until now no population studies have been carried out in this area. The aim of this study was to estimate the absolute abundance of common dolphins in the Bay of Algeciras, based on mark-recapture analysis. Surveys were carried out between June and August of 2010. During this period, 11 days of photographic effort were used for the analysis. A total of 3660 pictures representing 4930 dorsal fins of common dolphins were analysed and 606 marked individuals have been identified in the catalogue. The program CloseTest was used to investigate population closure showing that an open population of common dolphins inhabits the Bay of Algeciras. Thus, open mark-recapture models were designed using the POPAN formulation in the program MARK. A total population of 1578 individuals ( $CV=0.14$  95%CI=1208-2120) was estimated (corrected estimate for the proportion of marked individuals in the population). Although CloseTest indicated an open population, heterogeneity in capture probability, which is often encountered in cetacean populations, can cloud the ability to detect closure violations. In situations where the population is truly closed, heterogeneity in capture probability can cause the rejection of the null hypothesis of closure. Thus, closed models using program CAPTURE were also designed, obtaining a population of 1868 common dolphins ( $CV=0.12$  95%IC 1483-2356). These are the first abundance estimates of common dolphins using this area. These data are a useful baseline to monitor the presence of endangered common dolphins in the area over the years, which is important due to the increasing human activities in the bay such as high levels of waste waters, heavy factory contaminants dumping, intense maritime traffic and an increasing whale-watching industry targeting the species.

AB 11

**Long-finned pilot whale population size and temporal density fluctuations on Basque coast, south-eastern Bay of Biscay**

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Southeastern Bay of Biscay has been revealed as an important area for several cetacean species, mainly the areas near CapBreton canyon's. Since 2003, shipboard visual surveys have been carried out to study those cetacean populations. Several investigations confirmed the presence of long-finned pilot whale all year round. The aim of this study was to determine inter annual and annual density fluctuations and to estimate relative and absolute abundance of that population. Photo-identification technique was used to estimate population size by capture-recapture analysis, using 4746 pictures taken between 2003-2010, from which 392 individuals were identified in the catalogue. Population estimates were done using the appropriate mark-recapture model in the program CAPTURE that is integrated in the program MARK. Long-finned pilot whale population size was estimated at 1391 individuals (CV: 0.15; 95% CI 1052-1890). Encounter rates were computed to determine temporal relative abundance, showing significant differences between years ( $p < 0.01$ ,  $df=7$ ) and intra annual variations ( $p < 0.001$ ,  $Chi^2 47.61$ ,  $df=3$ ), whereas the density was higher in winter. The population estimate from this study is the first for the area from photo-identification data. The CODA survey in 2009, which used line transect distance sampling in the area, estimated a population size of 599 individuals (CV: 0.46; 95% CI: 253-1420) by model based estimation. The point estimate found with photo-identification was well above the results from the Coda survey, however, the confidence intervals overlaps the one found in this study showing a large population of long-finned pilot whales living the Bay of Biscay.

AB 12

**Distribution of sperm whales (*Physeter macrocephalus*) off the south coast of São Miguel, Azores: the relationship between bathymetry, slope and bottom aspect**

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The sperm whale (*Physeter macrocephalus*) has been a cetacean of interest in the Azores since the beginning of the XIX century till now. Between 1830 and 1986, it was target of commercial whaling, due to the fact that it was a very common resident species in the region; and later on, from the early 90s, they became target of whale watching companies, which are one of the main touristic activities on the Azores Islands. During the commercial trips of the whale watching companies, sightings are registered giving us important information, that even with some limitations, allows us to keep on studying cetacean biology and ecology, the ecosystem and the impact of any possible change in their environment which ultimately, translates into an appropriate conservation planning. Sperm whales' distribution off the south coast of São Miguel has been studied in relation to the bathymetry, slope and aspect of the sea bottom. Data used was registered along 2010 during commercial trips of a whale watching company. They were analysed using Geographical Information Systems (GIS). 734 sightings were registered, most of them, in July and September. Out of those, 73.84% were registered between 700 and 1300 m depth (mean 1031.66 m), 97.28% were registered on a slope with a declination inferior to 25% (mean 9.68%) and 57.55% were registered towards SSE. According with other authors, this pattern can be related with the distribution of the main prey of sperm whales in the area, the giant squid.

AB 13

**Distribution, movements and abundance of bottlenose dolphin (*Tursiops truncatus*) in the Eastern Ligurian Sea**

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The knowledge of ecological and demographic parameters is essential for evaluating the conservation status of the wild populations. The aim of this study is to estimate the distribution, movements and abundance of bottlenose dolphins (*Tursiops truncatus*) in the Eastern Ligurian Sea (North-West Mediterranean Sea). The analysis was based on an aggregation of data collected by Acquario di Genova within the project named “Delfini Metropolitan” and by Centro CE.TU.S. from 2001 to 2010. Two areas were identified: area 1, from Capo Arenzano to Punta Mesco, and area 2, from Punta Mesco to Marina di Pisa. A total of 285 sighting occasions with the target specie were recorded; 276 were limited in shallow waters (<100 m). Comparing the encounter rate (sighting/km) in area 1 (ER = 0, 00389) and area 2 (ER = 0, 10106), we found a statistically significant difference ( $X^2 = 27, 06$ ;  $p < 0,01$ ). Using photo-identification technique, 272 individuals were included in a photographic catalogue. The analysis movements of the animals sighted at least two times ( $n = 191$ ), using the GIS system ArcView 9.3, showed a residential attitude of the bottlenose dolphins: the average distance recorded between sightings was  $20,08 \pm 0,97$  km and the average maximum distance was  $44,74 \pm 2,31$  km. The estimate of the population size was obtained using mark-recapture Modelling between 2005 and 2010: no significant trend emerged from the abundance analysis. These results show the need of long term monitoring studies for the preservation of *Tursiops truncatus*.

**AB 14****Protection of Marine Mammals (PoMM)**

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The European Defence Agency (EDA) project, 'Protection of Marine Mammals' (PoMM) between the Ministries of Defence for Germany, Italy, the Netherlands and Norway started in August 2010 and will run for 3 years. The additional membership of Sweden and the United Kingdom is awaiting formal confirmation. The project aims to protect marine mammals against the impact of active sonar and maintain the ability to operate active sonar at the same time. A comprehensive common marine mammal database, being essential for risk mitigation tools, will be established. The database will provide knowledge on marine mammals with focus on the abundance, seasonal distribution and density of different species in areas of operational interest for European Navies. Special investigations on marine mammal acoustics, like the development of technological devices and algorithms, will help to improve the detection and classification of marine mammals. This project will involve the collection and exchange of marine mammal data like seasonal density and distribution, sightings, strandings and species characteristics. Due to the co-operation spatially limited data sets can be combined to a common global database, which is important for effective risk mitigation measures. Navies of the contributing members will be able to use the common database, both in the planning and in the operational phases, to avoid negative impact on marine mammals by military active sonars.

AB 15

**Seasonal dynamics of distribution of marine mammals in the area off Antarctic Peninsula (vessel-based observations)**

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In 2005-2009, the observation on board ship recorded 14 cetacean species whose percentages were different. Fin whales (*Balaenoptera physalus*) – 4.3%, sei whales (*Balaenoptera borealis*) – 3.2%, sperm whales (*Physeter macrocephalus*) – 0.4%, Cuvier' beaked whales (*Ziphius cavirostris*) – 0.6%, southern bottlenose whale (*Hyperoodon planifrons*) – 0.6%, hourglass dolphins (*Lagenorhynchus cruciger*) – 7%, pilot whales (*Globicephala melas*) – 0.2%, occurred predominantly in open waters (Drake Passage, Scotia Sea). Southern right whales (*EuBalaena australis*) and Commersons dolphin (*Cephalorhynchus commersonii*) were recorded off Falkland Islands (by 0.2 %). Peales dolphins (*Lagenorhynchus australis*) – 8.6% were recorded in the coastal zone of Tierra del Fuego. *Lagenorhynchus* – 0.2% were noted in «0 trip». Minke whales (9.5%) and killer whales (*Orcinus orca*) (4.6%) were recorded both in coastal and open waters. Killer whales kept in family groups by 4-6 specimens. In 2007, a group of 15 killer whales was recorded which were actively hunting involving their young. The most mass species of those recorded was humpback whale – 60.4%. Further on, we will mention dynamics of seasonal distribution. We did not observe resting and foraging Minke whales. In the area of our investigations they occurred as single individuals. In bays they spent up to 73% of time in the resting state (that of sleep-rest). Actively foraging whales (by two-three specimens) in March occurred in straits, as rarified groups by 10-12 specimens. They rapidly swam past our vessel, often in immediate proximity of humpback whales. The maximum size of the group (four specimens) was noted just once. Thus, during the season the distribution, abundance, and behaviour of whales change. During 15 years of active ecotourism the humpback whales learned not fear of vessels and “Zodiacs” and this may be highly dangerous to them if Japan would decide to resume whaling.

**AB 16****A fixed line transect network to monitor cetacean diversity in central-western Mediterranean Sea**

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Cetacean has been widely studied in Mediterranean Sea since late 1980s but we are still far from a true comprehension of pattern of presence and distribution of the species, mainly due to the uneven spatial and temporal coverage of researches and to the use of different methodologies that prevent the possibility of gathering together data coming from different studies.

Since 2007, systematic cetacean monitoring using ferries as observation platforms along fixed transect lines lead to a continuous monitoring of cetacean presence. Up to 2011 the network increased from 1 to 7 inter-regional ferry routes allowing a synoptic large scales sampling in central-western Mediterranean Sea (2.000 km weekly monitored during summer). In 2011 the network entered the Pelagos-France research programme as tool for monitoring cetacean population within the Pelagos Sanctuary.

Since 2007, the network travelled 90.600 Km under an effort of 1.683 hr, with 2.334 sightings of almost 15.200 animals. Data on all cetacean species presence, distribution and relative abundance are displayed and discussed year by year in order to point out the spatio-temporal variability observed. Special attention is given to fin whale in order to highlight data that can help in the understanding of specie migration pattern in the Mediterranean basin. Concern is express about cetacean diversity in central Mediterranean Sea as only *S.coeruleoalba*, *T.truncatus* and *Balaenoptera* spp. occur quite regularly in almost all the monitored areas while other species, known to be regular in the Mediterranean region, are quite rare and extremely confined. Moreover, minimum frequency and spatio-temporal scale needed for efficient monitoring programmes in the contest of the legislative framework goal is discussed.

**AB 17****Humpback whales in summer feeding areas in the Russian Far East.**

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Our field efforts were conducted at three known North Pacific humpback whale (*Megaptera novaeangliae*) feeding areas in Russia, but the main data was collected near the Commander Islands water area. We started to collect fluke photographs during the (SPLASH) project. We use over 1,500 fluke identification photographs collected in 2004-2011 to estimate the abundance of humpback whales in the Commander Islands water area. Here, we summarize the photo-identification results from the study seasons 2004-2011, which after matching of all fluke photographs yielded 852 unique individuals. Site fidelity is the trend for individuals to return to the same area over and over. Humpback whales have exhibited fidelity to specific foraging areas in Russia such as Commander and Karaginsky Islands. To investigate if site fidelity exists in the Commander Island summer feeding ground an identity matrix was created. We also compared our data with catalogues from Okinawa and Ogasawara Islands and as a result almost 30 migrations were documented between these areas. Our photo identification studies also allowed us to study the social structure of these whales in the feeding grounds.

AB 18

**Filling gaps in Mediterranean cetacean knowledge: new information from poorly known zones of the north-western basin**

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Knowledge about Mediterranean cetaceans mostly comes from limited well-studied zones. Increasing effort is being deployed to predict ecological scenarios for the entire basin. Empirical validation of such predictions is still pending, along with increasing knowledge of poorly studied sea areas. In 2010, a research project was set up in a slightly studied zone, the Barcelona-Balearic Islands strip (NE Iberian Peninsula) aiming to provide new information. A methodological approach consisting in aerial and boat-based surveys was chosen, using both visual and acoustic equipment. We present results concerning presence, diversity and sighting rates after 2800 km of visual effort. 8 cetacean species were detected in 95 sightings, corresponding 55% to striped dolphins (*Stenella coeruleoalba*), 11% to fin whales (*Balaenoptera physalus*), 8% to bottlenose dolphins (*Tursiops truncatus*), 4% to sperm whales (*Physeter macrocephalus*), 3% to Risso's dolphins (*Grampus griseus*), 3% to Cuvier's beaked whales (*Ziphius cavirostris*), 1% to short-beaked common dolphins (*Delphinus delphis*), 1% to long-finned pilot whales (*Globicephala melas*), and 14% to non-identified cetaceans. An increase in cetacean diversity toward the northern portion of the Balearic Sea is highlighted in the species richness map, based on MCPs (minimum convex polygons) computed for each species with sightings obtained in the area. Globally, striped dolphin sighting rate was significantly higher; conversely, we found no significant differences among sighting rates of all other species (ANOVA and Tukey post-hoc test, all  $p < 0.05$ ). These results describe basic, but formerly unknown, parameters about cetacean populations in the area comprised between the Balearic Islands and the Barcelona province. These data point out the importance of this area for species usually considered as common or rare at the Mediterranean Sea scale. Further effort is currently being planned in order to get deeper insight and to contribute to the collaborative effort in research and conservation actions at the Mediterranean level.

AB 19

## Encounters of rare and endangered cetacean species in the waters of the Russian Far East in 2003-2011

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Long-term data on cetacean distribution and occurrence are essential for determining the conservation status and trends of species, especially those classified in the World and Regional Red Lists as endangered, vulnerable, rare or data deficient.

Here we present data on the threatened cetacean species encountered in the summer period of 2003-2011 during the opportunistic vessel surveys in the Russian Far East waters including the Bering Sea, Okhotsk Sea, Kamchatka Peninsula, Kuril and Commander Islands.

Among the endangered species encountered during the surveys were the following: Bowhead whale (1 encounter of 7 individuals in the northern part of the Okhotsk Sea in 2011), North Pacific right whale (2 encounters of 1 individual near Eastern Kamchatka in 2009), Fin whale (54-103), Humpback whale (75-224) and Gray whale (65-150), although we are not sure if gray whales encountered along Eastern Kamchatka belong to the endangered western or to the least concern eastern population. No Sei whales or Blue whales have been met during the whole nine year study.

Among the species classified as rare or data deficient we encountered the following: Harbour porpoise (57 encounters of 125 animals), Baird's beaked whale (20-100) and Cuvier's beaked whale (1 encounter of 1 animal near Southeastern Kamchatka in 2004). No Stejneger's beaked whale has been ever seen during the research.

Among dolphin species classified as least concern in the IUCN Red List and not listed in the Russian Red Data Books, but whose range partially or completely covers the Kuril Islands and the southern part of the Okhotsk Sea (in total 8 species) only Pacific white-sided dolphin (1 encounter of 4 individuals near Southern Kuril Islands in 2003) and Bottlenose dolphin (1 encounter of 1 animal in the southern part of the Okhotsk Sea in 2010) have been observed.

AB 20

**Modelling habitat selection by beaked whales from land-based sightings data with a modified point sample method**

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The oceanic habits, inconspicuous behaviour and prolonged dives of the beaked whales difficult the study of their habitat preferences with traditional visual sampling techniques. The presence of rare coastal populations of Blainville's and Cuvier's beaked whales off the steep coast of El Hierro (Canary Islands) has provided a long dataset of land-based observations. Here we present a novel analytical technique allowing the development of a fine-scale model of habitat selection for these species in this area, where the probability of detecting a beaked whale depends both on the distance whale-observer and on the habitat preferences of the animals. A modified point transect method is applied to simultaneously model the distribution of cues (whale surfacings) with respect to the distance from the coast and depth without the conventional assumption of uniform animal distribution. The results of the model, based on 1789 sightings recorded between 2004-2010, estimate that Blainville's and Cuvier's beaked whales off El Hierro have a preference for the slope (500-1200m depth). These results coincide with the depth of the foraging dives of Blainville's beaked whales recorded with tags in the same area, suggesting that the distribution of these whales is dictated by that of their prey. This innovative method provides valid estimates of the density of surfacings of beaked whale groups using observations conducted from coastal platforms and simultaneously allows to draw inferences about their habitat preferences. The preference for the slope is not extrapolable to the large number of Ziphiid species occurring in all oceans, where they occupy habitats beyond steep slopes, but it may explain why Blainville's and Cuvier's beaked whales are the species most often found near oceanic islands and it is germane to apply the results to identify critical conservation areas in which mitigate human activities of risk for beaked whales.

AB 21

**Large delphinids on the Portuguese continental coast: data compilation from sightings and strandings records**

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The Portuguese coast hosts 21 species of cetaceans, including large delphinids such as the risso's dolphin (*Grampus griseus*), two pilot whale species (*Globicephala* sp.), the false killer whale (*Pseudorca crassidens*) and the killer whale (*Orcinus orca*). There are several studies on the occurrence of cetaceans in Portugal, but there is a gap in knowledge regarding large delphinids. This study aims to contribute towards the compilation of available data, such as historical records from whaling and naturalists' records, historical and recent sightings and strandings. We collected, through an extensive bibliographic review, a total of 214 records: 6 historical, 5 captures, 77 sightings, 127 strandings. Sightings from platforms of opportunity were obtained from 2005 to 2011. A descriptive analysis was made and the earliest records were grouped in terms of their occurrence. There has been an increase of sightings and strandings, with a peak in recent years, largely due to the growing interest in whale watching and their study, and also due to the implementation of a national stranding network in 1979. Most sightings seemed to occur during the summer, which may be related to the upwelling occurring in coastal waters and consequent increase in productivity, but it may also be related to a higher whale watching activity during this period. Strandings were recorded with greater intensity during the spring when sea conditions are irregular. The largest number of sightings occurred between 0-100 meters deep, where the majority of the Portuguese continental slope is, which ultimately reflects the local preference for feeding of these species. The most frequently sighted large delphinid was the risso's dolphin and the most frequently stranded large delphinids were pilot whales. Although this study is descriptive, it may serve as a basis for a more detailed and focused research on this group of cetaceans.

AB 22

**The beluga whale (*Delphinapterus leucas*) migrations along the Chukotka Peninsula: results of coastal observations**

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Our knowledge about the beluga migrations in the Northern Bering Sea, Chukotka is very poor. The hypothesis is that in spring belugas migrate north along the coast towards the Chukchi Sea, and move back to the Bering Sea in autumn. This assumption is based on questionnaire data collected from local communities. Present research attempts to verify this hypothesis and is based on the data collected by the inspectors of the Beringia Nature-Ethnic Park from 1999 to 2011. The observations were conducted from 6 points on the southern coast of the Enmelen (1999-2000), Nunlingran (1999, 2007-2011), Sireniki (1999-2011), Provideniya Bay (1999, 2001-2002, 2006, 2011), Tkachen Bay (1999-2011), Senyavina Strait (1999, 2004-2011) daily. Number of belugas, behaviour, route, age structure, ice and weather conditions were recorded. In total, 25 500 whales were observed. Most of the belugas were sighted in spring and winter (135 and 65 times, respectively, all the observation points). In summer, they were spotted only 14 times (all in small numbers), and in autumn – 8 times. In winter-spring, belugas were mostly observed in the stationary coastal polynya near Sireniki (approx. 260 whales per month) and Nunligran (approx. 30 whales per month). Different group sizes (in average, approx. 90 belugas) and all age categories were observed. The most common behaviour was travelling. All whales seemed to move east along the coast regardless of season. In Sireniki, where the highest number of belugas was observed in winter months, the Anadyr current reaches its maximum speed and goes east close to the coast. We suppose that belugas inhabit off-shore waters in summer and autumn. Instrumental methods of research are necessary to check the suggestion.

AB 23

**Distribution of harbour porpoises (*Phocoena phocoena*) in the southern bay of the North Sea and the eastern English Channel, France**

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Harbour porpoise is the smallest but the most abundant cetacean species present in the North Sea. The present study aims to document distribution of harbour porpoises in the southern bay of the North Sea and the eastern English Channel (France) using the boat line-transect method. Surveys were conducted between March 2009 and September 2011, and carried out at wind speed of 3 Beaufort or less. During sightings, the number of porpoises, the behaviour, the presence of neonates, the water temperature, the bathymetry and the geographical position using GPS have been recorded. Results show that more sightings are recorded in the southern bay of the North Sea than the eastern English Channel. The mean group size of harbour porpoises is  $2.39 \pm 0.36$  (N=155), with no significant variation according to months (March, April, August, September and October;  $p < 0.385$ ). Using Geographic Information Systems and spatial analytic techniques, we investigated the relationships between the distribution of sightings and the distance from the coast but also with the bathymetry. Results show that distance from the coast plays an important role in the distribution of this species. Indeed, more sightings of porpoises are recorded near the coast in Summer (August and September) and farther offshore in Spring (March and April). Finally, our data suggest that the distribution of harbour porpoises are also influenced by the bathymetry. Harbour porpoises are more frequently observed on sandbanks (less than 30 meter) than in deeper waters (30 meters and more). Data on spatial distribution will be used to better characterize Marine Protected Areas of this part of France.

AB 24

## Using platforms of opportunity in Nazaré (Portugal): cetaceans' occurrence and preliminary results on the whale watching activity in the area

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In the past few years, the whale watching activity in Nazaré has increased and taken on an important role as a tool for environmental education actions and the dissemination of marine ecosystems issues to the general public. For that reason, and the number of hours spent in the field, whale watching surveys are potential platforms of opportunity for scientific research about cetaceans, showing that dedicated studies are still missing. The main objectives of this work were to identify the species that can be found in this area and map their occurrence, and to characterize the current whale watchers profile. Between 2010 and 2011, 63 boat-based visual surveys aboard two vessels, accompanied by a marine biologist, were conducted on the coast of Nazaré, totalling, approximately, 154 hours spent at sea. The species most frequently observed was the common dolphin (*Delphinus delphis*) (87.3%), followed by the bottlenose dolphin (*Tursiops truncatus*) (7.9%). A mixed group of common and striped dolphins (*Stenella coeruleoalba*) was observed once very close to a group of bottlenose dolphins. A fin whale (*Balaenoptera physalus*) was observed once, around 3 miles from shore. The estimated sighting rate was 94.9% in 2010 and 83.3% in 2011. In 2011, inquiries were done to tourists, and in what concerns the current profile most participants were 18-24 years old, with slightly more females and an equal proportion of Portuguese and foreign people. Most tourists had never had any contact with this type of activity before, and most had no knowledge about the species they would probably see. Although the whale watching trips are not fully aimed at scientific research, they provide relevant information. The Nazaré Canyon provides important upwelling currents that make this area very rich in nutrients, potentially gathering the optimal conditions for the occurrence of several species of whales and dolphins.

AB 25

**First photo-identification collaborative effort to disentangle the distribution and habitat use of long-finned pilot whales in northern Norway**

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Though long-finned pilot whales, *Globicephala melas*, are widely distributed over the Eastern North Atlantic, little information on distribution, abundance and habitat use of the species is available for Norwegian waters. Information collected over the past years suggests a concentration area around the Lofoten - Vesterålen Archipelagos, which dedicated research and the whale watching industry have recently confirmed. Since 1987 whale watching operators departing from Andenes, in Vesterålen have reported 53 sightings to date with highest peaks of sightings occurring from end June to beginning of July. This coincides with a time where less vessel effort is conducted, which might suggest periods of absence in the area. Photo identification images of *G.melas* were collected on most of the encounters, but to date only digital images from 2 encounters in 2009 and 4 encounters in 2011 have been analysed. Dedicated research trips have been conducted from Henningsvær in Lofoten during 2006-2011. Regular sightings have been recorded in the Vestfjord area, with peaks during the summer months which correlates with increased research effort due to good weather and light conditions. Photo identification analysis has led to two catalogues consisting of 43 individuals in the Andenes area and 122 individuals distributed in 9 groups in the Lofoten area, though images of 2010 and 2011 are still being updated. The present datasets constitute the first photo identification catalogue developed for the species in the area. This will be updated and matched in order to develop a unique catalogue for the species in the region and also to gain a better understanding of the habitat use and movement pattern of the groups in the area. The results of this research will help to gain a deeper understanding of the *G.melas* population in northern Norway. The outcomes of the catalogue matching will be presented at the conference.

AB 26

**Distribution of *Stenella coeruleoalba* and *Tursiops truncatus* in the northern Tyrrhenian Sea: spatio-temporal variability and correlation with prey distribution**

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This research investigates distribution, relative abundance and seasonality of cetaceans along a transect in the northern Tyrrhenian Sea, at the southern-eastern border of the Pelagos Sanctuary and cross the Tuscan Archipelago Protected Area. Data from weekly observations were undertaken from February 2009 to February 2011 with dedicated surveys along the fixed transect Livorno-Bastia route, using ferries as a research platform. In total, 102 journeys were made with 288 hours on effort and 65 cetacean sightings were registered of almost 350 animals. The most observed species were striped dolphin (52%) and bottlenose dolphin (34%), followed by sperm whale and common dolphin (3% both). No sightings of fin whale were done during the study period, in disagreement with previous results and with the hypothesis of the migration passage in this area. The two species most sighted showed a different presence and seasonality during the two years of monitoring: striped dolphins (total ER sight. /hr 0.12) were sighted regularly year-round; bottlenose dolphins (total ER sight. /hr 0.08) sightings reduced during the second year, especially in summer (ER first year 0.17, ER second year 0.04;  $p=0.03$ ). Diet composition was inferred from the results of stomach content of dolphins stranded in this area: the different bathymetric distribution along the transect of the dolphins was compared with the areal distribution of preyed species. Preliminary results highlighted some areas of particular importance: striped dolphin was detected during the afternoon in a shallow area known as a fish's nursery; bottlenose dolphin showed a clear behaviour of feeding on trawlers near the coast. We also estimated the naval traffic in this area both in presence and absence of cetaceans, to test the possible influence on species distribution.

AB 27

**Residency patterns, home ranges and movements of Risso's dolphins (*Grampus griseus*) in the Western Ligurian Sea**

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Risso's dolphins have been studied in various parts of the world but many aspects of their ecology, including their ranging patterns, remain unclear. Data have been collected by the Tethys Research Institute during ad libitum surveys over a period of twenty years (1990-2009) and combined with data collected by whale watching boats. During 2,343 days at sea a total of 194,265 km were covered over an area of circa 25,000 km<sup>2</sup> resulting in 175 Risso's dolphin sightings. Analysis revealed that 20 (9.7%) of the animals photo-identified (n=205) have a high degree of residency (>11 re-sightings) within the study area. Home ranges of the 20 resident individuals have been calculated through the Minimum Convex Polygon (MCP) and fixed-Kernel (KHR) methods, resulting in different ranging patterns for each animal. The average home range calculated by the MCP method covers an area of 860.4 km<sup>2</sup> (SD=332.60 km<sup>2</sup>) and calculated by the KHR method covers an area of 2,444.7 km<sup>2</sup> (SD=1,147.45 km<sup>2</sup>) and of 513.5 km<sup>2</sup> (SD=419.30 km<sup>2</sup>) at 95% and 50% Utilisation Distribution (UD) respectively. The home ranges estimated with the two methods were significantly different (Wilcoxon T<0.001, p<0.0001, n=20). All the core areas are within 50 m and 2,200 m of depth and there is considerable overlap among them, suggesting that the animals use these areas intensively. These cetaceans showed a preference for routes along bathymetric lines between 200 m and 1,600 m of depth, with some exceptions towards the continental shelf and the pelagic waters. There was no significant difference in the ranging patterns for males and females (MCP: M-W U(13,7)=33.0, p=0.351, n=20; KHR 95%: M-W U(13,7)=42.0, p=0.817, n=20; KHR 50%: M-W U(13,7)=42.0, p=0.817, n=20). Results suggest that these animals are also likely to frequent regions outside of the study area, particularly to the West and to the East.

AB 28

**Archaeological findings of marine mammals from Crimea peninsula (Ukraine) in the ancient epoch**

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Archaeological findings of marine mammals from Crimea peninsula are not systematized. It is important to review some of them to get the background for further studies of the marine mammal's ancient geographic distribution and history of interaction with humans. Hereafter abstract is the second part of archaeological data review of marine mammals in the North Pontic Area. First part was dedicated of prehistoric findings of marine mammals in the northern Black Sea region (Liashenko, 2010).

Dolphin's vertebrae were found in all coastal settlements from eastern part (Porfmyi settlement, Kerch Peninsula) to western part (Belyaus, Kalos-Limen settlements) of Crimea peninsula. The bones were found from the ancient stratum and dated approximately from the end of 5th century BC to 4th century AD.

In the settlements from the northeastern part of Crimea (Kerch Peninsula, shores of the Sea of Azov and the Kerch Strait) contained more remnants of harbour porpoise (*Phocoena phocoena*) (92%) than bottle-nosed dolphin (*Tursiops truncatus*) (8%) (Svintitsky, 1999) and that is about 18% of all maritime fauna remnants. Settlements which situated in the coast of the Black Sea (Kimmerik, Kitey, Kerkinityda, Kalos-Limen settlements), contained more remnants of bottle-nosed dolphin (*Tursiops truncatus*) (Kutaisov, 1992).

High rate of dolphins remnants can be explain by undoubtedly trade significance of dolphins in the ancient period.

Interestingly, that all archaeological findings of bottle-nosed dolphin (*Tursiops truncatus*) remnants from Crimea peninsula correspond with ancient time and do not have yet reliable findings from pre-antique stratum in the Northern Black Sea region (Liashenko, 2010).

Also, several fragments of fossilized marine mammal ribs were found in Nimfey settlement, Kerch Peninsula (Lyashenko).

AB 29

**News from an endangered population: porpoises in the Baltic proper**

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Harbour porpoise (*Phocoena phocoena*) abundance in the Baltic Proper (BP) is at a level where measures for improving the status of this genetically and morphologically discrete population are urgently needed. Without knowledge about its seasonal and geographical distribution, a common basis for conservation efforts was lacking for the past decades. We deployed 22 porpoise detectors (T-PODs) from March 2005 to August 2007 in the eastern German Baltic Sea to study seasonal migrations and abiotic factors associated with porpoise presence/absence patterns. Thirty months of continuous monitoring resulted in over 9,000 recording days from 15 stations within the Baltic Proper (BP), with only 131 porpoise positive days (ppd - day with verified porpoise registration), equalling 1.46 % ppd over the whole study period. Data were analysed using generalised additive models to find significant influencing factors. Registration rates in the BP peaked seasonally twice, in summer and winter. The summer peak is associated with the occurrence of animals from the neighbouring Belt Sea population. We suggest that porpoises from the inner Danish waters migrate during summer and autumn not only into western German waters, but even into the adjacent Baltic Proper. The winter peak correlated with (a) cold air temperatures and (b) air temperatures being lower than water surface temperatures. The latter suggests that porpoises from the Baltic Proper migrate towards mostly ice-free waters in winter to avoid suffocation. In conclusion the German part of the Baltic Proper is thus shared by porpoises from two different populations. Conservation measures such as the reduction of harmful gillnetting must be at least seasonally regulated or less harmful fishing methods have to be used.

AB 30

**Mapping diversity and relative density of cetaceans and other pelagic megafauna by aerial surveys in the French tropical EEZ and adjacent waters: the REMMOA program**

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The French MPA Agency decided to conduct a series of aerial surveys for collecting data on cetacean and other pelagic megafauna across the tropical EEZ. Named REMMOA, for REcensement des Mammifères marins et autre Mégafaune pélagique par Observation Aérienne (Census of marine mammals and other pelagic megafauna by aerial survey), the surveys follow a standardized methodology, that would allow comparisons within and between regions. The first surveys were conducted from February-March 2008 across the EEZ of Martinique and Guadeloupe (Caribbean, 8,400 km of transect) and in October 2008 off Guiana (7,800 km). The SW Indian Ocean survey was conducted from December 2009 to April 2010 (90,000 km of transect). The French Polynesia survey was conducted from January to May 2011 (99,000 km). Spatial distribution of marine mammals encounter rates was compared for the 3 regions (Atlantic, Indian and Pacific ocean) on a 60x60km grid. French Guiana, Mozambique Channel and Seychelles shown the highest value while south of French Polynesia present the minimum values. Relative abundance of delphinids varies from almost null in the south of French Polynesia to 1.5 sighting/100km of effort in the centre of the Mozambic channel. For the deep divers, sperm whales and Kogidae, figures vary much less between regions: from 0 to greater than 0.15 sighting/100km in the Mozambic channel or Marquesas islands; while beaked whales figures get greater than 0.025 sightings/100km in all sectors and peaks in the Mozambique Chanel. The critical habitat map are produced using statistical relationships (GAM) with environmental covariate. The long term objectives of the REMMOA surveys is to establish an initial situation of cetacean and other pelagic megafauna diversity and relative abundance and to build up a monitoring strategy to be implemented from this point onwards.

AB 31

**Movements of individually identified killer whales (*Orcinus orca*) in Icelandic waters**

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Predators specialised in migratory prey whose migration route changes regularly face the challenge of finding prey with an unpredictable distribution. Killer whales in Iceland feed on the Icelandic summer-spawning (ISS) stock of Atlantic herring (*Clupea harengus*). ISS herring migrates throughout the year from overwintering to spawning and feeding grounds. However, the location of these grounds as well as their number may change between years, making this an unpredictably distributed prey resource for Icelandic killer whales. For example, over the last 30 years the largest herring overwintering grounds changed from East to West Iceland. Although some individually identified killer whales were previously re-sighted between overwintering and spawning grounds, the lack of recent photographic data has made it difficult to understand if killer whales in Icelandic waters adjust their movements according to the distribution of their herring prey.

Here we investigate the movements of individual killer whales photo-identified in different locations in Iceland. Photographs were collected in Vestmannaeyjar in July 2008-2010 (spawning ground), off Snæfellsnes in June 2008 (spawning ground) and Breiðafjörður in February and March 2011 (overwintering ground). Catalogues of identified individuals built for each area were compared to investigate if the same individuals were seen across different areas. We found movement of identified individuals between ISS herring spawning grounds and the most recent overwintering grounds and also between the previous overwintering grounds in East Iceland and West Iceland. These findings indicate that individual killer whales follow the year-round migration of ISS herring and are able to adjust their movements according to the distribution of this unpredictable prey resource. Not all whales were re-sighted, but further research is necessary to evaluate whether this is due to a low sampling effort or actual individual or group differences in ranging patterns in relation to changes in herring movements.

**AB 32****Risso's dolphin in Ireland: an inshore species of the continental shelf?**

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Irish Whale and Dolphin Group

Although Risso's dolphin are commonly recorded in Ireland little is known of their ecology. During over 6198 hours of offshore line transect survey effort in Irish waters, between 2001 and 2011, 27 sightings of Risso's dolphin were recorded. A significant finding of these surveys was the lack of Risso's dolphin sightings in deep water and slope habitats. This was at variance with the reported preference for these habitat types exhibited by Risso's dolphins elsewhere. Sightings data from Irish waters suggests that Risso's Dolphins have a largely coastal distribution and regularly occur at inshore locations on the southeast and southwest coasts of Ireland and in the Irish Sea. Risso's dolphins were recorded on 11 transects (38%) around the Blasket Islands, Co Kerry between 1/6/2009 and 17/8/2011. Group size varied from 5 to 50 with a mean of 14 animals. Photo-identification of individual dolphins taken from these surveys and commercial whale watch operators suggest there was some site fidelity with 1 individual recorded more than once 14 days apart within a season and two individuals recorded 14 and 32 months apart respectively.

AB 33

**Determining ecological and observer-based factors influencing variability of sightings of minke whales (*Balaenoptera acutorostrata*) and white-beaked dolphins (*Lagenorhynchus albirostris*) in Faxaflói Bay**

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Given the high costs of specialised cetacean surveys, the use of whale-watching boats provides a potentially valuable method of collecting data. Data collection involving the recording of *B. acutorostrata* and *L. albirostris* sightings, effort, environmental parameters and GPS positions were collected from April to September (2010) in Faxaflói Bay, SW Iceland. Ecological and observer-based factors influencing variability of sightings of whales and dolphins were calculated. We ran a step-wise regression, initially consisting of 19 possible explanatory variables to determine sightings of each species (consisting of both ecological factors which could influence spatial position of the cetaceans and observer-based factors which could influence sighting potential by an observer). Reduced models, following the stepwise procedure, were significant, but had low explanatory power ( $r^2=0.184$  for minke whales and  $0.076$  for white-beaked dolphins), and consisted of both ecological and observer-based factors. Tests to see if specific surface behaviours occurred in different depths of water (i.e. surfacing behaviour was recorded above deeper water than that of feeding behaviour), showed no significant difference in mean depths, but did show differences in the variability of depths above which each surface behaviour was observed (Bartlett's test = 18.051 d.f. = 4  $P = 0.001$ ). These results are concurrent with GIS analysis – indicating much, but not all, surfacing behaviour occurred from deeper areas of the bay. We conclude that in this study, other unidentified variables, or more likely stochasticity in spatial and temporal position of the cetaceans, appear most important in governing the sighting of white-beaked dolphins and minke whales, within this area. To determine whether unidentified factors or stochasticity are responsible for the unexplained variability in sightings, dedicated, fixed effort, cetacean surveys, or advanced statistical techniques to normalise sampling effort would be required.

AB 34

**Using a krill fishing vessel as a platform of opportunity for whale observations in the Scotia Sea, Antarctica**

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Cetacean observations from a platform of opportunity were conducted aboard a Polish trawler Dalmor II that fished Antarctic krill, during a cruise from March to July 2011. Most of the fishing season the vessel spent to the north-east of the South Orkney Islands. Observations were conducted on the vessel deck or on the bridge. The following data were recorded: observation details, time, geographical coordinates, species and number of animals in a group (or minimum abundance estimate), distance from the vessel and behavioural specific details. Also the photo material was collected.

50 sightings of at least 280 individuals were recorded over the observation period. Vast majority of recorded sightings (90%) and individuals (at least 90%) were minke whales (*Balaenoptera bonaerensis*); humpback whales (*Megaptera novaeangliae*) were recorded in 5 cases. The largest minke whale groups were recorded at 1-10 April, 2011. Whales in these groups demonstrated feeding behaviour and actively fed on the high density krill aggregations. Group size varied from 2-3 up to a few tens individuals (mean  $6 \pm 9.23$  (standard deviation), median 3 individuals). Mean number of individuals in groups at 1-10 April was 12 whales ( $\pm 15.75$  (S.D.), median 8 individuals). Distance to the animals also varied from a few meters to 5-7 kilometers. However, direct interactions of whales with the vessel were never recorded. By late April to early May, number of sightings sharply declined, they became sporadic. During that period fast migrations of small whale groups were recorded. Also minke whales demonstrated “nervous” behaviour, coming to the surface frequently and moving fast and jerky.

Humpback whales were recorded in groups of 2-3 individuals at late April near the South Orkney Islands and early May near the South Shetland Islands.

# ACOUSTICS

## AC 01

### Acoustic and visual survey of cetaceans in the Azores Front area

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We present results of the project Memphys (Mesoscale marine mammal population and hydrographic survey), conducted from 26 May to 7 June 2011 in the Azores Front area. The aim of the study was to assess the habitat use of cetaceans in the Azores Front area in relation to the predominant oceanographic parameters, and to evaluate a new towed hydrophone array for passive acoustic monitoring. Furthermore, the occurrence of marine mammals around sea mounts, and especially of beaked whales, should be studied.

During the line transect survey, conducted by the WTD 71 with RV Planet, a new towed hydrophone array of WTD 71-FWG and another array, operated by Univ. of Pavia, were used for acoustic monitoring. A passive analysis software sonar (PASS) including a special tool for marine mammal acoustic detection was connected to both arrays to record and classify vocalizations. Automatic detections were recorded, registered and classified simultaneously by experienced operators. During daylight hours visual observations of marine mammals were constantly recorded and identified by an experienced observer team. Oceanographic parameters of the Azores Front were measured using CTD probe and ADCP.

During 990 km of visual effort 23 sightings with 180 individuals were recorded. Six different odontocete species were identified. At least 107 acoustic events were recorded, consisting of 66 dolphin, 39 sperm whale and 3 confirmed beaked whale (Cuvier's) events. There was no obvious higher detection rate in the sea mount areas. The meandering current of the Azores Front could be measured and plotted successfully. An additional set of 8 transects was conducted during the last survey day close to the Azores covering a depth range between 2500 and 1000 m. There a much higher occurrence of cetaceans was encountered. A "presence only" model approach was tested and used here to assess the habitat use of marine mammals.

## AC 02

**SAMBAH: Static Acoustic Monitoring of the Baltic Sea Harbour Porpoise**

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The Baltic harbour porpoise (*Phocoena phocoena*) population is listed as critically endangered by IUCN and in Annex II and IV of the EU Habitats Directive. There is considerable uncertainty about population size, important areas are essentially unknown, and NATURA 2000 areas have only been designated or proposed in three of eight EU Member States bordering the Baltic Sea. To provide reliable assessments of abundance and distribution and to identify habitat preferences and important areas, the trans-Baltic EU-funded project SAMBAH (2010-2014) is undertaking a 2-year deployment of 300 click detectors (C-PODs) at 5-80m depth in the Baltic Proper. Density and abundance estimation will rely on C-POD data as well as supplementary data, such as echolocation rate, group size and C-POD detection function. Echolocation rate will be investigated by placing acoustic tags on wild porpoises, group size by spatial Modelling of sightings and C-POD detection function by a set of experiments within or in cooperation with SAMBAH. Detection function experiments include concurrent visual and acoustic tracking of porpoises, playback experiments, triangulation by hydrophone arrays, and acoustic observations of porpoises swimming in pound nets. Habitat preferences and important areas will be identified by spatial habitat Modelling based on density estimates by C-POD sites, satellite positions from tagged animals, and environmental data layers. The environmental layers may include bathymetry, bottom substrate, oceanographic parameters (depth in relation to halocline, salinity, and current), oxygen concentration, secchi depth, ecological features and vessel traffic. In addition to the scientific aspects of the project, large efforts are put into dissemination actions to increase the knowledge and awareness of the Baltic harbour porpoise among policymakers, managers, stakeholders and the public. Overall, the project is expected to provide a reliable abundance estimate and basis for designating protected areas and other mitigation measures.

AC 03

**Underwater acoustic interactions between emerging tidal-energy technologies and marine mammals**

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Commercial scale deployment of marine renewable devices in European waters is likely to be realised in the near future. However, one potential barrier to the deployment of tidal-stream devices is the perceived collision risk to marine mammals. Marine mammals have excellent sensory perception and underwater agility, but existing collision parallels have shown that marine mammals - though capable - do not always avoid hazards. Marine mammals' primary underwater long-range sense is hearing. The aim of this presentation is to outline the potential acoustic interactions between emerging tidal-stream devices and marine mammals. Whilst there is much data regarding ambient noise in deep water, there is very little information describing shallow water tidal-stream areas. Also unknown is: how the soundscape may be modified by the tidal devices; and whether the devices will be audible to marine mammals in time to alert them to the devices' presence. Our underwater sound mapping work suggests considerable heterogeneity in underwater ambient noise and that ambient noise levels are linked to the tidal flow speed and bathymetry. Mapping work conducted in the Sound of Islay, west of Scotland measured broadband sound pressure levels ranging between 81-128 dB re 1  $\mu$ Pa. This leads to results that inform the debate regarding the collision risk to marine mammals from marine renewable devices.

AC 04

**Temporal patterns of male sperm whale slow clicks off northern Norway**

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Sperm whales produce different types of vocalizations, some of which are used for echolocation and others for communication. Studies of so-called slow clicks have shown that these vocalizations are made by mature males in higher latitudes, where they forage solitarily, as well as on the breeding grounds, where they search for females to reproduce. Little is known about the behavioural context in which these vocalizations are produced or what function they serve.

To investigate this, 67 hours of recordings from four D-tagged male sperm whales in northern Norway were analysed. For one whale, where data was obtained from 30 shallower dives to a maximum depth of 537m, 17% of the slow clicks were produced during ascent, 35% at the bottom phase and 48% at the surface. From a total 394 slow clicks, 167 were detected between 100m and 300m depth and 227 slow clicks between the surface and 20m. Two other tagged individuals produced very few slow clicks (33 and 36, in 21% and 29% of the dives, respectively) at the surface (79% and 89%) or very near, while ascending. The fourth tagged whale produced slow clicks only in 2 out of 9 dives deeper than 400m, during the ascent phase, always deeper than 120m. Slow clicks were never detected during descent from any of the individuals. At the surface, slow clicks may be used to echolocate conspecifics, and/or to maintain cohesion between individuals. Slow click production may also be used to obtain echo information about bathymetry and scattering layers. Some of the slow clicks produced during ascent were categorized into patterns. The more frequent were sequences of 2, 3 and 4 slow clicks. These patterns may represent some degree of communication among different males (similar to coda function in family units), containing information on individual identity and behavioural states.

AC 05

## Underwater noise in the Sado Estuary, Portugal, and its potential impact on the resident bottlenose dolphins

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Maritime traffic is a known contributor to high levels of noise in the ocean; still there is a great need to detail the effects of specific sources and their impact on cetacean populations.

One of the most important harbours in Portugal – Setúbal – is located in the Sado estuary, and it is also an important area for the only resident population of bottlenose dolphins, *Tursiops truncatus*, in Portugal.

The use of Sado estuary by the dolphins is differential. To assess if the dolphins' distribution is related to levels of maritime traffic noise, sound pressure levels of underwater ambient and vessel noise were measured with a calibrated underwater recording system. For ambient noise, eight measuring stations were used; for vessels, 59 sampling sessions were carried out.

The noise produced by different types of vessels (e.g. cargo ships, oil tankers, seiners, trawlers, ferries, tugboats and leisure boats) was measured at known distances and the sound pressure at 1 m was estimated using a cylindrical propagation model. All files were analysed in 1/3 octave bands.

Ambient noise is highly variable along the estuary, ranging from 68.30 to 109.68 dB re 1  $\mu$ Pa. High levels of underwater ambient noise were recorded near the Setubal Harbour and at the estuary mouth. Prevailing lower frequency noise was largely related to the ship noise dominant frequencies (below 500 Hz).

In fact, all vessels recorded produce higher sound pressure levels in the low frequencies, except seiners, trawlers and leisure boats. These produce higher sound pressure levels in mid-frequencies, which are important for dolphins' vocalizations. Therefore, at least leisure boats should be considered with more attention when developing protection measures for this endangered dolphin population.

During daylight periods, dolphins spent less time in areas where underwater noise and maritime traffic was higher, using them mainly for travelling.

AC 06

**Monitoring of ambient noise and cetacean echolocation click during Sirena11 Sea Trial**

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Recently there has been an increasing awareness on the effect of the acoustic energy in marine environments. The European commission, with its 'Marine Strategy Framework Directive', defines the anthropogenic acoustic energy a pollutant for marine habitats. Directly linked to these new concerns arises the question of how anthropogenic noise affects cetaceans. The SIRENA11 sea trial held in the Ligurian sea over the last 5 months (Jul to Dec) of 2011 provided the opportunity to simultaneously measure background noise and to assess cetacean presence and hence to address these issues simultaneously. During the trial various acoustic recording systems were deployed, but in this paper we shall consider some of the ecological acoustics recorders (EAR) buoy. Developed at the University of Hawaii these systems have a sampling frequency of 80 kHz and a hydrophone with a flat sensitivity of  $-193.5 \pm 1$  dB re 1  $\mu$ Pa up to 40 kHz. The area investigated is located near various harbours and ferry routes and the recording systems have been deployed at a depth of about 850 m in a canyon region known to host a population of Cuvier beaked whales (*Ziphius cavirostris*). In this paper we will concentrate on the results obtained for two of the five EAR systems which were recovered early in the experiment. Noise levels and cetacean echolocation clicks were monitored. Particular attention was given to the monitoring of beaked whales presence in the area. Average noise levels measured were found to be about 20 dB higher than expected (in comparison with simulated and bibliographic data for deep sea noise levels). Mean noise levels were about 3-5 dB lower at EAR1 location. Low levels of beaked and sperm whale detection were obtained on both systems.

AC 07

**Examining the quality of different automatic train detection classifiers and human visual classifiers in the C-POD software**

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C-PODs (Cetacean [Porpoise] Detectors), developed by “Chelonia Limited”, UK, record tonal signals and clicks within a frequency range of 20 kHz to 160 kHz. They store specific features like signal duration, bandwidth and amplitude. The C-POD software includes a train detection classifier, seeking for click trains of different sources (e.g. porpoises, dolphins, boat sonars, other sources) and classifying them to different likelihood-levels (high, moderate, low, doubtful), depending on the signal characteristics.

We compare the results of visually screened data with the results of the former detection algorithm v.1.054, the Kerno classifier v.2.025, and the Hel 1 encounter classifier. Hel 1 was particularly developed, using C-POD data collected by Hel Marine Station, University of Gdansk, Poland while running ‘Active protection of harbour porpoise against bycatch’ project in the area with low harbour porpoise density. It is more conservative on the decision of trains being classified as from harbour porpoise origin. Furthermore, the differences between the human visual classifiers are analysed. As harbour porpoise detections regarded are minutes with high and moderate trains.

In high density areas, the v.1.054 algorithm correctly classified (true positives) nearly all high and moderate porpoise trains, resulting in a positive predictive value of 1, while only 1/4th of the visually confirmed porpoise detections were actually found, resulting in a sensitivity of 0.26. The sensitivity of the Kerno classifier is higher, but the positive predictive value lower. Hel 1, which revises the results of the Kerno classifier, has a raised specificity. It finds trains that Kerno falsely appointed as porpoise (false positives) and rejects them.

In areas with low harbour porpoise densities, false positives influence the results more than in high density areas, as their proportion to true positives is high. We will discuss the true-to-false positive ratio, at which a more conservative classifier is advisable.

AC 08

**A new recording on hourglass dolphin (*Lagenorhynchus cruciger*) echolocation clicks**

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Previous acoustic studies of hourglass dolphins (*Lagenorhynchus cruciger*) suggest this species produces narrowband, high frequency echolocation clicks similar to the echolocation clicks of the genus *Cephalorhynchus*. Furthermore, molecular analyses indicate *L. cruciger* may in fact belong to the *Cephalorhynchus* genus. This study, however, reports echolocation click characteristics of *L. cruciger* similar to the sounds produced by other species within the *Lagenorhynchus* genus. The data were collected in South Atlantic offshore waters, north-east of the Falkland Islands where hourglass dolphins have previously been sighted. Series of acoustic pulses were recorded simultaneously with visual sightings of wild hourglass dolphins on multiple occasions during a passive acoustic monitoring survey off a seismic vessel. The recorded sounds were processed digitally and the pulses manually characterised in terms of length, bandwidth and inter-click interval. The clicks were found to be shorter, with broader bandwidth and with shorter inter-click intervals than previously reported. Whilst this may be due to differences in collection and analyses of data, it may also be indicative of individual or population differences.

**AC 09****Passive acoustic monitoring with volumetric towed arrays**

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Passive acoustic monitoring (PAM) is the method of choice to detect acoustically active whales and dolphins and monitor their behaviour. PAM may be implemented with a variety of complexity, using single hydrophones suspended from drifting boats to multi-hydrophone arrays towed by ships that are moving through the ocean. The NATO Undersea Research Centre (NURC) has recently implemented CPAM, a compact passive acoustic monitor, consisting of three arrays of two hydrophones each, combined in a fixed three-dimensional arrangement. Having a volumetric configuration, the CPAM is capable of estimating a unique direction, characterized by azimuth and elevation, of the arriving sound. In addition to this three-dimensional direction, the CPAM may, under certain conditions on the whale – CPAM geometry, estimate also the range to the animal. This spatial resolution capability of the CPAM improves further the possibility to estimate the number of vocalizing animals, boosting the monitoring aspect of PAM.

The objective of this presentation is to report on the implementation of the CPAM at NURC and to discuss the results that were obtained during different NURC sponsored sea trials, called Sirena10 and Sirena11. Sirena10 was carried out in the Atlantic off the coast of Portugal, while Sirena11 occurred in the Ligurian Sea. In addition to the detection of beaked whales, which are the primary species of interest of NURC, the broadband setup of the CPAM allowed passive acoustic detection and monitoring of other odontocetes, especially sperm whales and dolphins. The monitoring capability of CPAM not only allowed easy counting of animals but also gave evidence on the at-night attraction of dolphins to the NRV Alliance, the research vessel that was towing the CPAM system.

**AC 10****Harbour porpoises in the Fehmarnbelt area: do they stay or do they go?**

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Several studies on harbour porpoises in the Western Baltic Sea showed clear seasonal abundance patterns that are higher during spring and autumn than during winter and summer. This pattern is often discussed as a relic from former times when porpoises were thought to be following herring stocks from the Belt Sea into the Baltic proper.

We conducted a two year study on porpoise presence in the Fehmarnbelt area located within the Western Baltic with close connection to the Danish Belt Sea using passive acoustic monitoring with autonomous porpoise click detectors (C-PODs). C-PODs were deployed at 27 locations. We found an almost constant presence of harbour porpoises over the whole study period. Taking all data into account, no clear seasonal trend was recognisable in the POD data, at least at the daily scale being investigated in this study. Next to a high temporal oscillation in the POD data a pronounced spatial variation with high variability between single stations could be detected. Statistical modelling of C-POD data revealed that static station specific variables like water depth and longitude were most important for the detection probability of porpoises. Out of several hydrographic variables, which were only weak predictors of porpoise presence, water temperature showed the strongest effect due to an abrupt decrease when temperature dropped below 4°C. This can be interpreted as porpoises avoiding ice cover and leaving areas before ice coverage starts. Results of the study indicate that the distribution of harbour porpoises in the Fehmarnbelt is rather influenced, either primarily or secondarily, by location specific environmental conditions than by seasonally changing parameters.

AC 11

**The acoustic repertoire of bottlenose dolphins in the North-west Atlantic Ocean**

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Whistles are a primary component in communication signals in many delphinid odontocetes. They have been found to vary between species but also within species. The main aim of this study was to describe the acoustic repertoire of bottlenose dolphins (*Tursiops truncatus*) in the North-West Atlantic Ocean, and to compare and contrast intraspecific variation in acoustic repertoires of estuarine, coastal and offshore groups of bottlenose dolphins. A total of 2283 whistles were used in this study. Whistle duration and frequency variables were used to describe whistles. Whistle types were also classified based on six overall categories (constant frequency, up-sweep, down-sweep, concave, convex and sine). Statistical analysis was carried out using PRIMER v6, which is based on non-parametric multivariate statistics. Frequency parameters and duration of whistles were found to vary between the three habitat types. Overall, the offshore groups of bottlenose dolphins exhibited the most variation ( $R=1$ ,  $P=0.1$ ) when compared with the other two groups, while characteristics of the coastal and estuarine groups were more similar ( $R=0.05$ ,  $P=0.2$ ). Offshore bottlenose dolphins displayed overall higher frequencies ( $= 17.4$  kHz) and longer whistle durations (0.97s), while whistle parameters from the coastal and estuarine areas did not display very extensive variation between the two groups (Max Freq - 12.8 kHz & 15 kHz; duration - 0.39s & 0.48s). The relative abundance of whistle types also exhibited variation, mainly between the offshore group with the coastal and estuarine groups. Sine type whistles dominated the offshore whistle repertoire (33%), while up-sweeps mainly characterised coastal and estuarine whistle types (32% & 35%). These findings may support the idea that local environmental conditions influence differences in acoustic repertoires of bottlenose dolphins in the North-West Atlantic.

AC 12

**Acoustic gaze adjustments follow attention during active target selection in echo-locating porpoises**

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Animals use their sensory systems to acquire and interpret information from their surroundings. Echolocation is the primary sensory modality employed by toothed whales for navigation and prey finding. Adaptive bio sonar behaviour can therefore reveal the information an animal actively seeks in order to perform a particular task. Here we designed an experiment with free-swimming harbour porpoises tasked with actively choosing between and approaching two hydrophone-equipped targets to gain insight into how porpoises incorporate information across echoes and actively control the properties of their sonar signals when closing in on a target in a multi-target dynamic scene. Echograms obtained from on-board Dtag3 recordings show that the porpoises needed to negotiate a complex auditory scene. When discriminating between objects the animals sequentially directed their acoustic gaze at the targets and employed short target fixations, implying that only few echoes were required to build up a perceptual image of an object. Upon the initiation of buzz, however, they focused their attention entirely on a single target and repeatedly scanned across it, suggesting that active scanning has two functions: target recognition and cursory localization in the approach and precise target tracking in the terminal phase. Whenever the animals fixated their gaze on the targets, they implemented range-dependent changes to the inter-click intervals concomitant with source level variations that followed a one-way gain compensation pattern. When switching attention to another target after the initiation of buzz, the animals accurately withdrew their gaze to accommodate the change in spatial relationship before focusing on the new target. This implies that porpoises have spatial memory that is updated with each target fixation and that they can convert the stored spatial information into ICI changes. Echo locating porpoises can therefore exert significant control over their signals and dynamically adjust the range of their acoustic gaze to sequentially accommodate multiple targets.

AC 13

## Diversity of monophonic and biphonic calls in mammal-eating and fish-eating killer whales of the North Pacific

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Killer whale groups have repertoires of stereotyped calls that are stable over the years. Some of these calls contain an overlapping high-frequency component, which is thought to enhance recognition and indicate the caller's direction of movement. These calls are usually referred to as biphonic calls. It was shown previously that the diversity of monophonic calls was substantially higher than the diversity of biphonic calls in four populations of fish-eating ("resident") killer whales in the North Pacific. In this study we compared the diversity of call contours within and between mammal-eating ("transient") and several populations of fish-eating killer whales. We used recordings of mammal-eating killer whales from False Pass (Eastern Aleutian Islands), British Columbia (Canada) and Kamchatka (Russia), and recordings of fish-eating killer whales from British Columbia, Alaska and Kamchatka. Call frequency contours were extracted and compared using a dynamic time-warping algorithm. Diversity of monophonic and biphonic calls in mammal-eating killer whales followed the pattern revealed previously for the fish-eating populations: median similarity for monophonic calls (58%) was lower than the median similarity for biphonic calls (68%). Inter-population comparison showed that the monophonic repertoire of the mammal-eaters differed almost equally from those of all four fish-eating populations. In contrast, biphonic calls compared using the low-frequency component were the most similar to the Alaskan fish-eating population, while biphonic calls compared using both the low- and the high-frequency components were the most similar to the Southern Resident fish-eating population inhabiting the waters around southern Vancouver Island. Our results show that the low- and the high-frequency components of biphonic calls have different patterns of similarity across populations and suggest that monophonic and biphonic calls in both fish-eating and mammal-eating killer whales may evolve following different rules.

## AC 14

**Why are bottlenose dolphins banging and braying when toadfish are singing?**

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The Lusitanian toadfish (*Halobatrachus didactylus*) is a solitary, sedentary benthic fish that produces conspicuous vocalizations, as part of agonistic and sexual displays. These calls enable passive acoustic detection by dolphins and, this species has been indicated as a possible prey of bottlenose dolphins. In the Sado estuary, Portugal, this toadfish is common and occurs in important feeding areas for the resident population of bottlenose dolphin. Nevertheless, this suggestion has not been confirmed in stomach contents.

During 2011, field recordings of bottlenose dolphin in foraging activities were made from April to November using a calibrated underwater sound recording system. Behaviour patterns, group size and visible prey detected were noted. The occurrence of toadfish sounds was also noted.

Preliminary results show that there were no significant differences in group size counts (mean size = 7.3) according to foraging style (surface or bottom prey). However, vocal emissions differed significantly ( $p < 0.001$ ) depending on the probable target prey. During feeding events with mullets or other fish near the surface no brays or bangs were recorded, suggesting that these sounds are not generalized feeding arousal signals. On the contrary, brays and loud bangs were common during bottom feeding events while toadfish vocalizations were audible.

Brays and bangs seem to be prey-related calls, possibly eavesdropping by predator on prey signals. The main function of these calls could be to change the prey's behaviour, stunning or inducing the solitary bottom fish to expose their location.

AC 15

**Sounds recorded from the transient killer whales during hunting on a fur seal at Commander Islands**

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Transient (mammal-eating) killer whales are known to differ from the resident (fish-eating) killer whales by vocal repertoire and acoustic behaviour. Transient killer whales are much less vocal and usually call only when socializing and during or after the hunt. In this study we describe the sounds recorded during hunting on a fur seal off the fur seal rookery at Medny Island (Commander Islands) on 11 July 2011. Six killer whales took part in the hunt, including two juveniles and four females or others. There were no adult males in the group. The hunt lasted for 122 minutes. Underwater sounds were recorded 5-30 m from the hunting whales. During the recording the killer whales were swimming around the injured prey (young male fur seal) and slapped him with their tail flukes. We made three recordings during the hunt (total length of about 10 minutes). The most frequent sounds in these recordings were tail slaps from the whales which tried to kill the seal with their flukes. Occasional echolocation clicks were also recorded. Communicative sounds were mostly represented by whistle-like calls with slightly upsweep contour which started at  $3167 \pm 187$  Hz and ended at  $3808 \pm 202$  Hz. The lengths of these calls were  $0.97 \pm 0.21$  s. These calls didn't match with any call types described for the mammal-eating killer whales in the North Pacific. However, they have some similarities with the high-frequency component of the FP1vi call type recorded in the False Pass (Eastern Aleutian Islands) which sometimes occur without its lower-frequency component.

AC 16

**Simulating the auditory effects of a strong sound source moving at different speeds**

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Cetaceans can experience auditory fatigue when exposed to strong and/or long-lasting sound level. For wild animals, the exposure dose is the result of an evasion process in response to the sound source. Marine mammals can develop auditory temporary threshold shift (TTS) if they are briefly exposed to a very intense sound, or conversely if they are exposed during hours to less extreme sound levels. We simulated this process for sonar, taking the source speed as a test variable. Our simulation software (programmed with Matlab) featured: (1) an evasion process steered by the perceived sound level and based on movement parameters as documented from the literature, (2) TTS and PTS onset based on sound exposure dose and synthetic audiograms for different cetacean families evolved from published data, (3) spherical sound propagation, (4) a sound source with a level of 230 dB@1m moving in straight line and transmitting a 2 kHz and 2 sec sonar pulse every minute, (5) a deep sea area 50 km wide and 100 km long, (6) typical population densities for one ziphiid and one delphinid species. When the sonar source speed varied between 1.5 m/s (3 knots) and 7.5 m/s (15 knots), no delphinid were affected by a TTS. Ziphiids were TTS-impacted in all cases: the maximum impact was obtained for a speed of 9 knots with about 10% of the population, and lower impacts were simulated for the lowest and the highest speed. At low speed, cetaceans have more time to escape the highest sound levels, and at high speed they are exposed for only short time to the highest levels. Although such a simulation cannot deliver accurate results in absolute terms, it is useful to compare scenarios for different sources or to understand sound exposure effects observed in the wild for different cetacean species.

AC 17

## Geographic and intrapopulation variability of belugas' (*Delphinapterus leucas*) "vowel-like" sounds

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Investigations of the acoustic communication of belugas from different populations have revealed that the species possesses a rich and complicated vocal repertoire. However, contrary to such wide variety of belugas sounds, some distinct types of signals are used by belugas from almost all the examined populations. These types of signals are, therefore, very appropriate for researching geographic (interpopulation) variation of belugas' acoustic communication. In this work, we have studied physical features of a "universal" type – "vowels" – in two populations. Audio records from the following regions were analysed:

(1) The White Sea: the Myagostrov stock (Onega Bay, 2006, 2008 and 2009); the South stock (Onega Bay, 2007); the Solovetsky stock (Onega Bay – Basin, 1999-2003); and the Mudyug stock (Dvina Bay, 1999 and 2011);

(2) The Okhotsk Sea: the Amur estuary (1983) and audio records of two Okhotsk Sea belugas kept in an enclosure in the White Sea (2007).

Only one physical feature – the pulse repetition rate - was measured, so we had a chance to use low-grade audio records. We have discovered that:

(1) "Vowels" recorded in the same place in different years are identical with regard to the parameter used for measurement.

(2) There is an interpopulation variability: the Okhotsk Sea belugas produce more high-frequency "vowels" than the White Sea belugas. This fact is the first striking example of the geographic variability of sounds shared by different belugas populations.

(3) "Vowels" of belugas from the Onega Bay and those from the Dvina Bay display a difference that can be regarded as a "vocal dialect" – the difference between the acoustic signalization of independent but potentially contacting groups. Interesting as the obtained results are, they demand further investigation because they help us to explore the intrapopulation and social structure of the species as the genetic and photo ID methods do.

AC 18

**The tonal signals of chukchi white whales (*Delphinapterus leucas*) summering in Anadyr Bay**

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The work considers sound signals of the beluga whales recorded in the Anadyr Estuary in summer 1989. The Chukotka beluga whales emitted the sounds of all basic categories described earlier. Overall vocalization rate was average or low. Tonal calls were observed to dominate. Tonal signals (n = 510) referred to 30 types by time-frequency characteristics and shape of frequency contour. All types of tonal signals were divided in two categories: high-frequency (HFW) – 11 types (fundamental frequency was higher than 5 kHz) and low-frequency whistles (LFW) – 19 types (fundamental frequency was lower than 5 kHz). HFW made 37.7% of all whistles and LFW – 62.3%. Short and average signals prevailed. Duration of the signals varied from 22 to 3727 ms with average value of 712 ms, maximal fundamental frequency varied from 1.0 to 18.1 kHz with average value of 5.5 kHz. Whistles of the Chukotka beluga whales had a weakly developed harmonic structure and 48.5% of signals didn't have it at all. Majority of the whistles had a simple shape of frequency contour. 32% of the whistles had inflection points. Average amount of inflection points per a signal made 2.9 with a range from 0 to 35. Two specific groups of whistles were especially notable in the general background: 1) low-frequency, mainly short whistles made in series, during which the shape of frequency contour could vary a lot, and 2) high-frequency stereotype whistles (which mentioned of signature-whistles of bottlenose dolphins (*Tursiops truncatus*)).

AC 19

## Does the number of individuals affect the coda? Ionian sperm whales under examination

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The sperm whale (*Physeter macrocephalus*) emits multi-pulse sounds called clicks. Codas are short clicks sequences with distinctive stereotyped time pattern. Codas are the expression of sperm whale culture and indicate the geographic origin as they are learned inside the maternal group. Vocal clans, even if they are not perfectly matrilineal, possess specific vocal repertoire, that is the set of codas of a group. Codas are used for intraspecific communication by these highly social animals and contain vital information. The meaning of codas remains unknown. Mediterranean sperm whales mostly use the 3+1 coda, but a variety of other patterns has been already identified.

The INFN NEMO-ONDE (Ocean Noise Detection Experiment) station was deployed on the seafloor at the depth 2050 m, 25 km offshore Catania (Sicily, Italy) in January 2005. Equipped with four wide-band hydrophones, it operated until November 2006.

A 5' recording sample was taken every hour, for a total of 7359 files. Files were listened, and sounds and number of individuals were manually classified. GAMs, GEEs, and GLMs were performed considering as factor the presence and the number of whales, the year, the day of the year, the hour of the day, the lunar cycle, the SST, and the kind of sounds they were emitting.

An unexpected presence of sperm whales was found, in contrast with recent literature. Codas were the second most common sound after regular clicks. The number of individuals present influences the probability that sperm whales perform codas and the coda pattern. 3+1 is confirmed to be the most common choice, referable to more common situations. Other codas seem to be used in different context.

For the first time, we have demonstrated a relationship between the number of individuals in acoustic contact and the coda performed. This could be explained by the complexity of social interactions.

AC 20

**Detection ability and calibration of C-POD units off the west coast of Ireland**

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If static acoustic monitoring (SAM) is to be used to monitor the distribution, abundance and habitat use of cetacean species it is essential to determine the detection ability and variability of the acoustic equipment. It is important to know over what distance the acoustic device effectively detects the target species and the variation between individual units in the study. Calibration trials and detection distance trials were conducted in Galway Bay and the Shannon Estuary cSAC as part of PReCAST, a long-term cetacean monitoring project. Nine field calibration trials of 27 C-POD units were carried out over the project duration. An orthogonal regression model of Detection Positive Minutes (DPM) across hourly segments, with a  $\pm 20\%$  error margin, was applied to each C-POD pair and compared against a null model assuming no variation in C-POD performance. Investigations revealed differences in C-POD performance but the majority of units performed within the  $\pm 20\%$  DPM per hour error margin. No units were continually highlighted as problematic and therefore all units were used in subsequent analyses. Field trials and analyses such as those conducted here are sufficient to monitor C-POD performance, identify outliers in need of re-calibration and will allow for comparison of data between units and locations. Detection distance trials were carried out with simultaneous deployments of C-POD units and land-based theodolite tracking. A small number of T-PODs were also tested. Cyclops Tracker was used to calculate distances from an animal's location to the SAM gear. Harbour porpoise (*Phocoena phocoena*) detection distances were calculated as 441.m for C-PODs and 534.3m for T-PODs. Bottlenose dolphin (*Tursiops truncatus*) detection distances were estimated as 797.6m for C-PODs.

AC 21

**PAM-based monitoring of harbour porpoises (*Phocoena phocoena*) during the construction of the Nord Stream gas pipeline in the Pomeranian Bight**

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Under water operations like pile driving, dredging or even shipping go along with considerable noise emissions that potentially affect harbour porpoises (*Phocoena phocoena*) in different ways. In order to investigate possible disturbance or displacement effects of harbour porpoises during the construction of a gas pipeline, BioConsult SH monitored harbour porpoise presence with static hydrophones including data logger (C-PODs) during 2009 and 2010 at 13 positions within the Pomeranian Bight (Baltic Sea). At seven positions distributed over the Pomeranian Bight T-POD data were already collected between 2002 and 2006 by the German Oceanographic Museum. Thus, T- and C-PODs were deployed simultaneously at these positions to keep data comparable to former studies. Six further positions were chosen in close vicinity of the gas pipeline. A short comparison of C- and T-POD data and a visual verification of click trains showed that both data sets are significantly correlated to each other. POD data from 2010 provided no indication for a wide-ranging displacement effect of harbour porpoises in the Pomeranian Bight due to the construction activities of the Nord Stream pipeline. The distinct seasonal pattern and the relative high numbers of porpoise detections during autumn fit well with data collected during former studies. Additionally, our data indicate a slight increase of porpoise abundance in that particular area. The investigation is on-going and future work will focus on a possible small scale effect of construction activities on porpoises.

AC 22

## **A neural network approach to discrimination between vocalizations of Orcas and bottlenose dolphins**

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We have compared several audio signal recognition algorithms for embedding into the autonomous satellite hydroacoustic buoy for industrial noise monitoring and marine mammal detection in real time, which is being developed in frame of the OSEO-FASIE French-Russian project. A low power consuming CPU was chosen for the computer of the buoy in order to provide prolonged time of autonomous work. Thus the algorithms of signal recognition should not require extensive computational resources, and using of neural networks is a natural choice in this case. Vocal repertoires of bottlenose dolphins and orcas are rather different in general, but in rare cases their sounds are quite similar. The data sets we used included mostly such signals. Also, algorithms don't involve processing of high frequency component and work with short segments of audio signals. These factors make the problem of discrimination not obvious. We examined neural networks based on RBF and SVM architecture and used coefficients of either short-time Fourier transform or discrete wavelet decomposition of the signal as inputs of the algorithm. The parameters subject to change were the window function (its type, width and overlapping) for STFT and mother wavelet for DWT, data clustering algorithms for the hidden layer of the network, and the standard deviation of the Gaussian kernel used as distance function. Large amount of available data allowed proper estimation of the performance and discarding those cases where good results were achieved due to overfitting of the network. The best results were obtained using a set of SVMs each solving a one-versus-all problem for a particular type of signal. On the other hand, one RBF network for all range of signals works significantly faster and still shows acceptable robustness, which makes it preferable in case of limited computational resources.

AC 23

**Which environmental factors influence the harbour porpoise population of the St Lawrence Estuary, Canada?**

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We investigated if and how the acoustic density of harbour porpoises was affected by specific environmental factors.

From August to October 2010, passive acoustic monitoring was carried out in two different areas of the St. Lawrence Estuary, Canada. One area (PB) was 5 kilometers away from the coast and up to 33 metres deep. The other area (FV), 12 kilometres away from the coast and up to 120 metres deep, was regularly frequented by a ferry. On 17 days, 3 to 4 C-PODs were moored simultaneously in 5, 20, 30 and 50 (FV only) metres depth from an inflatable boat for six hours per day on average. The effect of day, time, water depth and tidal phase on the minutes with porpoise registration per hour (%PPM/h) was analysed employing a generalised additive model (GAM). The effect of the ferry, including its distance and direction, on the acoustic porpoise density was evaluated using %PPM per 10 minutes.

In both areas, the %PPM/h varied considerably between observation days, reflecting the mobility of harbour porpoises. Nevertheless, the C-PODs recorded more %PPM/h with increasing water depth. Only in FV, the tidal phase had a significant effect on the %PPM/h. The ferry negatively impacted the %PPM/10min, starting 20 minutes before the ferry reached the study area. Being abeam, the negative effect of the ferry increases, and reaches its maximum when the ferry leaves the area.

Although the study areas are just 20 kilometres apart from each other, the harbour porpoise use the two areas very differently. Apart from the impact caused by the ferry, prey availability and the effect of the currents on the prey are important factors influencing the activity and distribution of the harbour porpoises.

AC 24

**Discovery of Sound in the Sea: an online resource**

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The scientific community and the public have become increasingly aware of, and concerned about, underwater sound. There is increasing interest in learning about sources and uses of sound, and potential effects of sound on marine life. Underlying this interest, however, is a need to provide scientific information at a level appropriate for the general public and for educational and media professionals. The “Discovery of Sound in the Sea” website (<http://www.dosits.org>) provides scientific content introducing the physical science of underwater sound and how people and animals use sound to accomplish various tasks. It also includes three major resource sections. The Media Resources section includes a Facts & Myths quiz, Frequently Asked Questions, and PDF reprints of a tri-fold pamphlet and a 12-page educational brochure. The Teacher and Student Resources sections include structured tutorials and educational games. DOSITS recently launched a significantly redesigned site. The look and feel has been refreshed without losing functionality and content. The redesign includes an interactive front page, an interactive Audio Gallery, and a redesigned Scientist Gallery. DOSITS provides comprehensive, efficient access to timely information on the science of underwater sound and the current state of knowledge of the effects of underwater sound on marine mammals and fishes.

AC 25

**Acoustic detection functions of C-PODs: estimating probability of detecting harbour porpoise clicks using playback experiments**

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Click detectors such as the C-POD are used to study the spatial distribution and seasonal occurrence of harbour porpoises. However, there is a desire to go one step further and use them to estimate absolute density. To do this, one required input is the effective area monitored by the detector or, equivalently, the probability of detecting animals as a function of range. Estimating detection probability for wild animals is difficult when density is low, such as in the Baltic Sea. We therefore investigated the acoustic detection function using playbacks of synthetic porpoise-like clicks. C-PODs with different detection thresholds were used, and playbacks were performed at source levels ranging from 146 to 176 dB re 1  $\mu$ Pa @ 1m (peak-peak) at horizontal distances from 0 to 300 m and at various depths. Given a source level of 176 dB, fifty percent or more of the clicks were received up to a distance of about 180 m. The estimated acoustic detection function will differ from that expected for wild animals under natural conditions, due to differences primarily in the transmitted signal (porpoises use variable source levels, have a very directional sound source and move relative to the C-POD), but also environmental factors such as ambient noise may influence detectability. The estimated detection functions are compared to a test where porpoises caught in a pound net were recorded on C-PODs placed at different ranges from the net.

AC 26

**Bedtime for dolphins: diurnal cycles of bottlenose dolphins (*Tursiops truncatus*) in the Turkish Mediterranean Sea**

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In a remote location in southern Turkey, two captive Mediterranean bottlenose dolphins (*Tursiops truncatus*) are undergoing a rehabilitation process in a sea pen (20m diameter, 15m deep) prior to release back into the wild.

An acoustic monitoring device (C-POD) was deployed at a depth of about 7m from the surface next to the enclosure to monitor the dolphins' echolocation activity. Two main acoustic datasets were collected in 2011: February-March and May-July. Clicks in trains were identified using the KERNO classifier in CPOD.exe v.2.025.

A highly significant daily pattern of minimal acoustic detections by the C-POD during a 24-hour period each day was found (displayed by an auto-correlation graph) although the dolphins must have been within 20m of the logger. We found that the pattern of click detection rates indicated that this was not due to clicks being missed by the logger and must be due to periods when the dolphins did not echolocate. From the first dataset we hypothesized that bottlenose dolphins do not echolocate at certain times each day of the year.

The distribution of the summed duration of the click trains logged each hour in the 19 whole days of data in February-March showed a period of around 5 hours occurring between 20:00hrs and 01:00hrs when the sum of train durations detected was very low, ('Active' period mean 266.8s/h, CV 0.9; 'Quiet' period mean 20.8s/h, CV 2.8) A similar quiet period was present in the May-July dataset (75 days) at the same time of day, ('Active' period mean 129.9s/h, CV 1.3; 'Quiet' period mean 21.6s/h; CV 3.3), suggesting that the diurnal cycle may be consistent throughout the year. It is likely that during these silent periods the dolphins are in a state of rest, but no visual observation data are available to confirm or refute this.

AC 27

**Novel approaches to calculating a C-POD detection function for the harbour porpoise (*Phocoena phocoena*)**

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SAMBAH (Static Acoustic Monitoring of the Baltic Harbour porpoise) is an international European Union LIFE-funded project aiming to estimate density and abundance, and produce distribution maps of harbour porpoise in the Baltic Sea. To this end, static acoustic monitoring devices (C-PODs) will be deployed for 2 years at 300 locations on a randomly allocated grid covering most of the Baltic. The C-PODs contain on-board processing software and record the number and timing of detected echolocation clicks, together with summary statistics about each click. Estimating density from the resulting data requires calculating the area effectively surveyed by each C-POD; this involves estimating the relationship between probability of detection and range (the “detection function”). Several methods supplementing already published results will be employed some of which are playback trials, modelling based on theoretical porpoise click propagation, visual observations in an area with a grid of C-PODs, acoustic localization using a large array and acoustic tags on opportunistically caught porpoises recording their acoustic activity. We detail some of these, and discuss their pros and cons. One major constraint is that porpoise density is extremely low in many parts of the Baltic, hence finding a method that can estimate how detectability varies spatially is challenging.

AC 28

**Harbour porpoise acoustic ecology: nocturnal peak in activity documented by T-PODs in the Great Belt, Denmark**

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Abundance and activity of harbour porpoises were studied in connection with construction of a small offshore wind farm north of Sprogø, Great Belt, Denmark, within a designated Natura2000 area. The wind farm consists of 7 turbines (2.3MW) on gravitational foundations. Two passive acoustic data loggers, T-pods (Chelonia Ltd.), were placed in vicinity of the wind turbines and two in a reference area 20 km to the north. Monitoring took place over the summer months (April through November) in the years 2008-2010, corresponding to before, during and after construction of the wind farm (BACI design).

The data showed very high levels of porpoise activity around Sprogø, higher than the reference site, prior to, during and after construction of the wind farm, consistent with the recognition of the area as being of high importance to porpoises. Acoustic indicators of porpoise abundance (porpoise positive minutes and waiting time between encounters) did not decrease statistically significant during the construction year. This indicates that any effects of the construction was likely very local around the turbine foundations and working vessels. Results support the notion that construction and operation of a small offshore wind farm need not be in conflict with the objectives of a Natura2000 area, given appropriate planning and choice of construction methods.

At the stations at Sprogø, data showed pronounced diel variation with a high click activity during night hours (measured as number of click trains recorded), whereas the click activity for the control area showed no clear pattern. A corresponding diel variation in mean inter-click intervals (ICI) within individual click trains was also observed. Thus mean ICI decreased during night hours. Click sequences linked to foraging (feeding buzzes) are characterized by low and decreasing ICIs and the results are thus consistent with an increase in foraging behaviour at night.

AC 29

## Micro- and macro-geographic variations of the whistles of striped dolphins (*Stenella coeruleoalba*)

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*Stenella coeruleoalba*, a cosmopolitan species distributed in tropical and temperate pelagic waters, is an extremely vocal dolphin with wide acoustic repertoire.

This study analyses the geographic variability of the acoustic parameters of whistles between the Mediterranean Sea and the Atlantic Ocean, taking into account the intra basin variation.

Acoustic data from Eastern and Western basins of the Mediterranean Sea and from two archipelagos of the Macaronesia (the Azores and the Canary islands) in the Atlantic Ocean were collected from 1994 to 2011, using multiple platforms. 51 independent sightings were made, approximately 22 hours of recordings were inspected and 1152 high quality sounds were extracted and analysed. 12 acoustic parameters of whistles (1 for temporal duration, 5 for frequency and 6 for modulation of the sound) were measured and compared.

At the macro geographic level, among the Atlantic Ocean and the Mediterranean Sea, significant variations were expressed for duration, maximum frequency, frequency range and all the modulation parameters. Discriminant function analysis correctly classifies the sounds in the 75% of the cases.

At the micro geographic scale, the same pattern of variation is present among the Eastern and the Western basins of the Mediterranean Sea, with a significant variation also for minimum frequency. The sounds of Eastern and Western areas can be discriminated in the 68% of the cases. Within the Atlantic Ocean, between Azores and Canary archipelagos, only modulation parameters are significantly different.

The results of this study suggest that genetic differences, identified in other studies both between Atlantic Ocean and Mediterranean Sea and within the Mediterranean, can affect the variation of frequency parameters and promote the variability among these areas, while habitat adaptation, individuality, sociality and vocal learning may be the factors promoting differences for modulation parameters between Atlantic groups.

**AC 30****The efficiency of static acoustic devices for monitoring bottlenose dolphins in a Special Area of Conservation**

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Bottlenose dolphins are listed under Annex II of the EU Habitats Directive and thus member states must designate Special Areas of Conservation (SAC) and ensure that they are at a Favourable Conservation Status, which requires ongoing monitoring. The efficacy of static acoustic monitoring (SAM) techniques (using T-POD, C-POD and a hydrophone) for detecting bottlenose dolphins were compared to visual observations during 2008 and 2009 in the Lower River Shannon cSAC on the west coast of Ireland. A total of 252 hours with concurrent visual observations and acoustic monitoring were carried out. Overall, dolphins were observed during 8.9% of the total observation time while the T-POD (0.2%), C-POD (1.3%) and hydrophone (3.3%) performed less efficiently. When comparing simultaneous acoustic detections to visual observations, (the) SAM (equipment) successfully detected the presence of bottlenose dolphins even though the acoustic detection rate was 1.6% (T-POD), 15.3% (C-POD) and 29.2% (hydrophone) of the visual detection rate. Acoustic detection rates were all lower but generally consistent between years. There was a significant difference ( $p < 0.04$ ) between years by the T-POD with a higher proportion of DPM / h recorded in 2009 compared to 2008. There was no significant difference in visual detection rates ( $p > 0.86$ ) or that recorded by the hydrophone ( $p > 0.53$ ) between years. There were significantly less dolphin detections recorded by the C-POD compared with the hydrophone ( $p < 0.025$ ) in 2009 but more detections recorded by the C-POD than the T-POD ( $p < 0.008$ ). The percentage of dolphins observed but not recorded by the hydrophone was consistent between the two years (2008: 32%, 2009: 38%). Visual observations are restricted to favourable sea conditions during daylight hours which acoustic methods are not. Acoustic methods could provide a reliable method for monitoring dolphins and the consistency recorded here between years is encouraging.

**AC 31****A review of methods for studying marine mammals in tidal stream sites**

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Few inshore environments present greater difficulties for the study of marine mammal distribution, abundance and habitat use than tidal streams due to the large and variable forces associated with the rapid flow of water. These areas are, however, of increasing interest for tidal energy development, and much more detailed information is required on how marine mammals make use of them. Over the years, a range of different survey and monitoring methods have been developed that could potentially be applied in these environments; each with its own benefits and drawbacks. This presentation's aim is to illustrate a review for their applicability in studying marine mammal distribution, abundance and habitat use in tidal streams, with particular focus on Scotland. It will include examples of specific developments used by the authors in five locations at tidal speeds greater than 4m/s acquiring over 500 hours of operational data.

AC 32

**Static Acoustic Monitoring of harbour porpoise (*Phocoena phocoena*) around the world's first commercial tidal turbine in Strangford Lough, Northern Ireland**

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As part of the environmental monitoring programme for the world's first full-scale commercial demonstration tidal turbine at Strangford Lough, harbour porpoises site use was monitored using static acoustic monitoring methods. TPODs were deployed in Strangford Lough around the turbine site from 2006-2011 in order to detect porpoise presence. A modelling approach was employed to allow the effect of environmental, oceanographic and temporal covariates in assessing the presence and magnitude of any turbine related effects. Generalised Additive Models (GAMs) built within a Generalised Estimating Equations (GEEs) model construct were used to explain harbour porpoise habitat preferences within Strangford Lough. GEEs were used to account for temporal and spatial autocorrelation within the dataset. Porpoises were detected on 86% of days in the study area indicating that porpoises are generally present in the region throughout the study period. Detections per hour were generally low, with most sites recording porpoise detections in <10% of monitored periods and mean detections positive minutes per hour of <1. Time of day, tidal phase, TPOD identity, time of year, installation phase, region and turbine operation all variously affected porpoise detection rates. Diurnal patterns were the strongest observed, with detections being much higher during the night than in the day. Strong tidal patterns were also observed indicating that porpoises may be coming into the lough on the incoming ride, remaining in the Inner Lough over high tide, and moving out of the Lough on the ebb tide. There was no effect of turbine operation at sites closest to the turbine, in the Narrows though a small but significant decline in detections occurred in the Inner Lough when turbine was operating relative to when it was inactive. The magnitude of the turbine related effects were low relative to diurnal, seasonal, monthly, and tidal and TPOD related variation in porpoise detections.

AC 33

**Signature whistles of bottlenose dolphins (*Tursiops truncatus*): reality, anomalies, and artifacts**

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More than 40 years ago, D. & M. Caldwell assumed that “signature whistles” (the personal contact signals designating sound-producers and their location) are the base of the vocal repertoire of Bottlenose dolphins. At present, most researchers recognize the existence of the given category of sounds and their functions. But some phenomena (like a “mimicry” or uttering of the similar signals by several individuals) seem to contradict the “signature” hypothesis.

In 2010 and 2011, we investigated the underwater acoustic activity of captured bottlenose dolphins - two males (aged 25 – 30 years) and two females (8 – 9 years). The research aimed at a description and analysis of individual repertoires as well as the calculation of the portion of signatures. We used the method of “relative isolation” for the identification of concrete sound-producers.

Our analysis of the findings showed that the portions of signatures in the repertoires of different dolphins (this may also refer to their functions) differ very considerably. It was found that the repertoires of females are the most stable and are more similar to the “classical” conception of signatures. They produce these signals permanently and not only in situations of isolation or fusion-diffusion (which are rather relative in the dolphinarium in any case).

The sounds produced by males can be marked as signatures only conditionally; and a large part of such whistles was produced by both of them. We interpret this phenomenon not as a “mimicry,” but as the “joint use of a part of the repertoire.” The “classic” signature-mimicry in investigated dolphins seems to be connected with a hierarchical status of individuals. For example, the signature of the youngest female was imitated by all the other dolphins; the signature of the dominating male might be used by both males, but was never imitated by females.

# BEHAVIOUR

**B 01**

## **Seasonal, diel and tidal variation in male harbour seal (*Phoca vitulina*) vocalizations in Danish waters**

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Male harbour seals make underwater calls in the mating season but remarkable little is known about the circumstances under which the calls are made and the role of the calls in mating.

This study reports on the first recordings of harbour seal calls from Danish waters and investigates the feasibility of using passive acoustic monitoring to determine seasonal and possible diel and tidal variation in calling behaviour as well as site preference.

Two autonomous data-loggers (Loggerheadinstruments, Florida) were deployed approximately 2 meters above the sea bed in shallow waters off a haul-out site (Blinderøn) in Limfjorden, Denmark, from June 9th to July 7th 2011. Same method was used at a haul-out site in the Wadden Sea (north of the island Rømø), Denmark, from July 7th to August 1st, 2010.

More than 2000 calls were recorded in Limfjorden and more than 5000 calls from Rømø. Individual calls varied in structure but overall resembled signals recorded by others. Peak energy was around 120 Hz and little energy above 2 kHz.

The recordings from Limfjorden showed that the calling begins by the end of June, and ends in early August. A strong diel pattern in the vocalization rate with a peak around midnight was found. Recordings of calls on both sides of the haul-out site (a narrow sand bar) showed no indication of preference of one side over the other. Recordings from Rømø, showed peak in call-rate at high tide.

The study has demonstrated passive acoustic monitoring as a feasible method for studying underwater calling behaviour of harbour seals. This gives prospects of a tool, which can aid in identifying essential underwater areas used in mating behaviour by the seals, and can allow assessment of the need for adequate protection of these areas as required by the Habitats Directive.

B 02

**Pulsed sounds and tail-slap in free-ranging Mediterranean striped dolphins**

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Striped dolphin (*Stenella coeruleoalba*), one of the most widespread cetacean species in the Mediterranean Sea, is an extremely vocal mammalian species, with a developed use of both vocal and non-vocal acoustic communication cues. However most of its visual and acoustic behaviour remains poorly studied. For the first time, the pulsed sounds of *Stenella coeruleoalba* were analysed in relation to the “tail slap” surface behaviour. The Tail-slap were recognized as a flat and noisy contact of the caudal section on the water surface with the animal in dorsal position.

During the summers 2009-2010, continuous passive acoustic recordings and behavioural simultaneous data were collected, in an area of over 700 Km<sup>2</sup>, located in the Ionian Sea (Gulf of Corinth, Greece). Recordings were made in the proximity of the animals with a single hydrophone and a digital audio M-Audio microtrack recorder. 63 surveys were made, 44 sightings were recorded, and 3.5 hours of behavioural observations and simultaneous recordings were sampled. Visual and acoustic data were broken down into 3-minute-intervals. For each 3-minute-interval, the number of pulsed sounds and the frequency of “Tail slap” were considered for statistical analysis.

Statistical analysis showed a significant positive correlation ( $P < 0.05$ ) between pulsed sounds and “Tail slap” and a significant variation ( $P < 0.05$ ) in the number of pulsed sounds emitted, into the 3 minute-intervals, in relation to the presence or absence of the “tail slap”. In presence of the tail-slap, the number of produced pulsed sound increased.

We suggest that, as reported for other species (i.e. *Stenella frontalis*), dolphins could be in alarming or stressing situations while producing the pulsed sounds associated with “tail slap”.

**B 03****Feeding at night: diel patterns in echolocation behaviour of harbour porpoises**

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Acoustic monitoring, using porpoise click detectors (T-PODs) has been carried out in the German Baltic Sea for a decade now and showed clear seasonal variation in porpoise registrations.

Data collected with T-PODs at four different locations in the German Baltic Sea was analysed. The water depth at the locations varied from 8 to 28 m. T-PODs were all placed 5-7 m below water surface. Averaged over one year, the registration of porpoise echolocation, indicated by porpoise positive ten minutes (pp10min), was 1.5 to 2 times higher during night than during day at three locations. Porpoise click detectors can also be used to gather information on the behaviour of porpoises based on the echolocation click patterns. A total of four years of data was visually screened and feeding buzzes were identified based on a set of criteria. At night, a two- to fourfold increase of feeding attempt positive 10 min (fap10min) was seen at three of the four locations. The increase in fap10min was larger than the increase in pp10min. This indicates that the increase of feeding attempts at night is not based on an increase in porpoise abundance but rather in a change of behaviour. Feeding at night might be advantageous for porpoises since some prey species reduce swim speed and show less schooling behaviour at night. In addition schools of some prey species display a diel vertical migration. They are located closer to the surface at night than at day, which would lead to reduced energetic costs for foraging porpoises.

B 04

**The case of care of offspring of belugas (*Delphinapterus leucas*) in natural conditions (Solovetsky reproductive gathering, White Sea)**

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In summer 2011 we had an opportunity to monitor the female beluga (*Delphinapterus leucas*) behaviour near the dead neonate. Usually death cases were observed only in captivity.

The monitoring was realised in the place of belugas reproduction gathering near the Beluzhiy cape (Solovetskiy Island, White Sea). The female beluga with dead neonate appeared in the gathering on July 4 and visited the cape every day till July 10. The age of the baby was defined visually basing on noticeable body folds, light-brown colour and big head. During the whole monitoring period beluga was keeping it on the water surface pushing him forward by its muzzle. The behaviour was stereotyped: natural moving in water area with regular dives. First two days it was in the group of five individuals: three nobileous belugas, one baby and one neonate. It's remarkable that all the babies including the neonate contacted the monitored beluga in tactile way. First four days its respiratory pauses generally were about 11.8-22.2 seconds. After two days the female beluga left the group and later joined it very seldom. By that time the size of the dead baby became 1.5-2 times bigger. During the last monitoring day beluga with dead baby was swimming separately from the others in the certain area of water with its head towards the shore. The respiratory pause decreased down to 7.5 seconds. Despite it continued keeping the baby on the water surface, the pushes to the water surface became sporadic. It may prove its fatigue caused by continuous baby carrying.

The afterlife of this animal is not clear. Some tourist watched it on June 11 in 40 km far from Solovetskiy Island.

Thus our monitoring proves the fact of strong affection between mother and baby.

B 05

**Tidal currents facilitate movements of resident bottlenose dolphins in the Sado estuary, Portugal**

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The common bottlenose dolphins (*Tursiops truncatus*) of the Sado estuary constitute the only resident community of dolphins in mainland Portugal and its numbers have declined in the past decades, reaching only 25 individuals in 2011. The estuary is an extremely important habitat for these dolphins, which depend on it for foraging. This investigation focuses on the role that the tidal currents play on the dolphins' movement and distribution. Land-based observations of the lower part of the estuary were carried out over 18 days in 2009, on average between 08.00 h and 19.00 h. Dolphin presence was detected in 78% of surveyed days. Dolphins were seen more often entering the estuary during the flood tide (67%) and leaving during the ebb tide (71%) ( $X^2 = 8.85$ ;  $df = 3$ ;  $p < 0.01$ ); this may indicate that they use the tidal currents to move between coastal waters and the estuary, which may allow them to save energy with movement. Some dolphin prey species, such as mullets, also exhibit movements with the tidal currents, and dolphins may take advantage of this predictable movement to maximize their capture. It is unknown whether these dolphins spend the night in the protected and quiet estuary waters or if they head out to coastal waters. Passive acoustic monitoring techniques could provide important clues about these movements during nighttime and in poor visibility conditions. It is important to undertake further studies on the dolphin movement patterns to help develop new protection measures for the Sado estuary and this endangered bottlenose dolphin community.

B 06

**Comparison of social behaviour of bottlenose dolphins (*Tursiops truncatus*) in two different habitats in the North Atlantic Ocean**

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The Bottlenose dolphin (*Tursiops truncatus*) is a cetacean that can be seen in different habitats all over the world. This research focused on the habitat use of *Tursiops truncatus* in two different habitats in the North Atlantic ocean: the Mullet peninsula at the North Western coast of Ireland and Santa Maria, one of the islands of the Azores, Portugal. The main focus of this research was group behaviour, subdivided into travelling, resting foraging and socializing, and the differences in occurrence of these different group behaviours within and between the different research areas.

This research was conducted mainly from land, extended with vessel-based focal follows if focal animals were sighted and conditions allowed. The measured behavioural parameters logged during focal follows were: location of the focal group, group size, group spacing, subgroups, individual events, calve presence and group behaviour. Considerable differences in group dynamics existed within focal follows, between focal follows and between the two different Northern Atlantic coastal habitats. Behavioural transition probabilities were calculated with the use of Markov chain analysis. Specific behavioural patterns observed in this research differed significantly between Ireland and the Azores. At the Azores overall behavioural transition probabilities were found more in the direction of travelling than in Ireland. In Ireland overall behavioural transitions probabilities were found to be more towards resting and socializing, but due to small sample sizes, especially at the Azorean part of the research (Azores: n=90, Ireland: n=375) these results have to be interpreted with caution.

B 07

**Interactions between killer whales (*Orcinus orca*) and the Irish pelagic trawl fisheries during the winter 2010/2011 fishing season**

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Interactions between killer whales and commercial pelagic trawlers have been described in several regions of the NE Atlantic, namely Scottish and Norwegian waters (Couperus, 1994; Luque et al., 2006; Foote et al., 2010). Here, we expand on the behavioural observations previously described, to as far south as the NW coast of Ireland. Observations were made by independent marine mammal fisheries observers aboard the Irish pelagic fleet from August 2010 to March 2011. During fishing activities in ICES sub-area VIa in December and January, observers recorded numerous interactions between killer whales and fishing vessels. In total, killer whales were sighted on 17 separate occasions during eight different fishing trips. Fifteen of these sightings occurred during mackerel (*Scomber scombrus*) fishing, while the other two sightings occurred during horse mackerel (*Trachurus trachurus*) fishing. Group size ranged from 4 - 40 individuals, with juveniles and/or calves present in ten of these sightings. In most instances, the whales initially appeared near the vessel when the net was being hauled or pumped onboard, displaying foraging behaviour (tail slapping, surface rushes, bubble netting and milling) around the net and vessel until fishing operations ended. On more than one occasion in the fishing grounds, killer whales were seen travelling from one vessel to another, as the latter hauled in a fishing net. Furthermore, females with calves never approached the vessels and remained at a greater distance from the vessel than the rest of the group. No instances of killer whale incidental catch were recorded. The observations described support the existing theory that this killer whale population is obtaining a significant proportion of their diet from fish “lost” (fallen) from mackerel fishing vessels and furthermore that these animals follow these vessels south along the mackerel run to at least the NW coast of Ireland.

B 08

**The group associations and behaviour of humpback whales (*Megaptera novaeangliae*) off the coast of Zanzibar: a background study in investigating the impacts associated with whale tourism**

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Since 2008 humpback whale behavioural data has been collected during July, August and September in coastal waters of Zanzibar, which is currently data deficient. During the winter months when mating and calving befalls, humpback whales are regularly observed in Zanzibar waters between July and October, with the peak in season occurring at the end of July and beginning of August. The Zanzibar channel is speculated as a winter breeding ground since the whales are sighted at the correct time of year and contemporaneous male singing occurs. With the expected increase in whale tourism across Zanzibar and the fact that the whales may use these waters to breed, populations using this area are likely to be threatened. This is a background study in investigating the impacts associated with tourism. Results show the most common group type observed was pairs (n=106; 39.70%), followed by singletons (n=70; 26.22%), groups (n=39; 14.61%), M/C (n=25; 9.36%), competitive pods (n=22; 8.24%) and M/C/E (n=4; 1.50%). Humpback whales spent on average a smaller proportion of their time resting ( $8.19 \pm 20.72\%$  s.d) and socialising ( $18.03 \pm 25.91\%$  s.d). Instead they spent more time travelling ( $72.65 \pm 31.97\%$  s.d). In all years there was a statistically significant difference in the median proportion of time spent in different behavioural states for all group compositions except M/Cs in 2009. M/C groups spent a greater proportion of time resting and competitive pods spent a greater proportion of time socialising. The speculated increase in whale tourism may be detrimental to humpback whale populations around Zanzibar. Tourist boat interactions may lead to individuals spending even less time socialising and resting, causing a reduction in individual health, perhaps leading to a long-term reduction in reproductive success. It is fundamental that management is put in place and effectively managed for the initiated increase in tourism.

B 09

**Effect of abiotic factors on the dynamics of the belugas' (*Delphinapterus leucas*) numbers in Solovetsky reproductive gathering, White Sea, 2010-2011**

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The effect of abiotic factors on daily dynamics of the belugas visiting of the reproductive gathering off Cape Beluzhy, Solovetsky Island, White Sea, was considered during two seasons (June-August 2010-2011). The following abiotic factors were analysed: the time of day, tide conditions, air and water temperature, atmospheric pressure, wind speed and direction. Weather conditions were fixed automatically every hour at Weather Station 36-3242, Model WH-1080. Water temperature was recorded by multi-purpose sonde. Diurnal maximum of animal numbers was observed during the low tide. The correlation coefficient between the sea level and number of animals ranged from 0.58 to 0.75 ( $p=0.05$ ), depending on the time of day. The maximum water temperature (17 °C) corresponded to the period of a low tide. If low tide fell on day and night, a pronounced daylight peak of animal numbers and water temperature was registered. During the evening and morning low tides were reported two much weaker peaks. The difference in temperature during low tide and high tide was 6-7°C. The correlation coefficient of the animal number and the water temperature is 0.68 ( $p=0.05$ ). During the observation season the number of animals at the cape slightly increases with the increase of air temperature,  $r=0.3$  ( $p=0.00010$ ). Weak inverse relationship between the number of animals and wind speed has been established,  $r=-0.24$  ( $p=0.00679$ ). The maximum number of animals was observed under southern wind (mean=29.3), the least number was under north-eastern wind (mean =10.6). A weak positive correlation ( $r=0.18$ ;  $p=0.0021$ ) was found between the number of animals and atmospheric pressure. Thus, the features of the daily dynamics of belugas visits to the area of Solovetsky reproductive gathering are determined by: tide, water temperature, time of day and, to a lesser extent, weather conditions - wind speed and direction, air temperature and atmospheric pressure. Programme was supported by IFAW.

**B 10: Cancelled****B 11****Comparison of killer whale activity budgets between different areas of Kamchatka and the Commander Islands**

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Differences in distribution of resources lead to heterogeneity in habitat usage. Some areas are used for foraging, and others for movement between food spots. Comparing behavioural budgets in different habitats helps reveal patterns of habitat structure which influence habitat usage. Such information is necessary in planning habitat protection. North Pacific fish-eating killer whales feed on spawning salmon as they move into coastal waters. In the Northeast Pacific, killer whales spend over half their time foraging and less than 10% travelling inside study areas. The purpose of this study was to make a comparative analysis of activity budgets of killer whales from different areas of the Northwest Pacific. Behavioural data was collected in Avacha Gulf (Kamchatka) in 2005-2010 and the Commander Islands in 2008-2010. We compared killer whale activity budgets between different areas: (1) Northern Avacha Gulf (114 encounters, 315 hours), (2) Southern Avacha Gulf (126 encounters, 322 hours) and (3) near the Commander Islands (91 encounters, 174 hours). We found differences in the proportion of different types of killer whale activity ( $p < 0.05$ ). Killer whales spent about 75% of their time traveling near the Commander Islands with its straight coastline compared to only 25% in Southern Avacha Gulf which is full of capes and bays. In the Northwest Pacific killer whales spent more time travelling inside studied areas than in the Northeast Pacific. They spent no more than 41% of their time foraging inside one area. Kamchatka has a straighter shoreline compared to the fjordic western North American coast. These geographical differences have an effect on killer whale distribution and habitat use. Spawning salmon migrates along the coastal currents which are formed near capes and bays. Probably migrating salmon groups are more scattered along straight coastlines such as are found along Kamchatka and this influences killer whale habitat usage.

**B 12: Cancelled****B 13****When a mother fin whale (*Balaenoptera physalus*) trusts humans as babysitters....**

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Positive intraspecific interactions occur in cetacean species because they are highly social mammals. However it is rare to observe interspecific interactions between different species of cetaceans that are not linked to predator-prey relationships. It is the case as well with other animals, as cetaceans are carnivores and thus hunt a large variety of prey. With humans the relationship is ambiguous. Indeed for centuries humans have been hunting marine mammals, whereas since some decades they became aware of the importance of such animals in the ecosystems and started to study and protect them. Now even if most of the interactions are not harmful for the animals anymore, at least in the Mediterranean Sea, the cetaceans are not yet to the point of looking for interactions with humans. This poster presents an unusual and unique behaviour of a mother Fin whale (*Balaenoptera physalus*) which entrusted its calf to a human boat while it was feeding. The interaction occurred after a ferry almost hit the pair and another whale. The mother first responded in jumping out of the water, which is already behaviour seldom seen and then, as we gently followed it, it came towards the boat. It then let its calf alone, coming back every 15 minutes to vocalize with it. The poster gives maps and illustrations of this particular interaction.

**B 14****Short-term effects of capture and tag attachment in harbour seals**

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The application of biologging devices is common in modern biology but research into the short-term effects of capture, chemical immobilisation and tag attachment is lacking. Using telemetry data from nine common seals (*Phoca vitulina*), two metrics were investigated for short-term aberrations at the start of a time-series: percentage time hauled out (HO %) and the 90th percentile of dive duration (DD90). Using a resampling approach (method 1), significant short-term responses were identified and their magnitude calculated. If a significant response was found following release, the duration of this significance was subsequently investigated using a second resampling approach (resampling method 2). No seals were found to show a significant short-term response in dive duration (DD90) however, six seals showed significant changes in HO% of up to 45%. Using a resampling approach 2 it was found that the significant response lasted up to 6 days. However when accounting for a single juvenile, which in the literature of other species suggests may react differently than adults to stress and anaesthetisation, when the single juvenile was removed significant effects on adult common seals lasted 4 days and HO% tended to increase. As DD90 is not affected, it is unlikely that ability to forage is limited and moreover changes in HO% lasted only a few days, suggesting the ethical concerns surrounding tagging projects in common seals are limited. However, investigating short-term effects in other species is recommended. It is advised that when analysing biologging datasets from common seals that the first 4 days of data are removed.

**B 15****The unit for heart-beat for a marine mammal in underwater conditions**

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The device is used for on-line control and subsequent analysis of heart beat of a marine mammal. The small size of the device allows to place it in the underwater suite and record the divers heart beat in conditions of his free movement. The device can also be used to record the heartbeat of marine mammals in dolphins water pools. Besides the discussed device may be applied in public health service as well. The unit includes a belt with electrodes and the EKG amplifier and generator which transforms each R-wave into a radio impulse and subsequently into the light and acoustic signals. Another device is used to determine the upper and lower heart beat boundaries. An extra light and acoustic signal shows up every time when the boundary is surpassed. The acoustic signal is registered in the memory of digital sound recorder. The data of instant heart beat measurements (with up to 36 hr volume) registered in the sound recorder can be passed over to a computer in a couple of minutes with further processing.

It was recorded of dolphins heart beat after physical exercises, and the dolphins heard beat during “vocalizations”. Our studies have shown that heart rate increases during vocalization more stronger than during exercise.

**B 16****Synchronous surfacing of wild bottlenose dolphin female-calf pairs on the north-eastern coast of Sardinia, Italy**

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Bottlenose dolphins express affiliation by proximity, physical contact and synchronous movement. The aim of this study was to investigate variables that could be related to female-calf synchronous surfacing's. The data were collected as a part of an on-going long term study off the north-eastern coast of Sardinia Island, Italy. Boat based observations were performed between February and November 2011, where 6 individually identified female bottlenose dolphins and their calves (between 3 and 38 months of age) were observed through continuous focal follows. Synchronous surfacing was defined by the mother and the calf breaking the water surface simultaneously to breathe. Our hypothesis were that the synchronous surfacing's would decrease with increasing age of the calf as a sign of the calf gaining independence of the mother. Correlations between synchronous mother-calf surfacing's and group size, group composition, age of the calf, and behaviour were performed. The results showed that approximately 50% of the mother and calf ventilations were synchronous. This study showed that the age of the calf did not play a significant role in synchronous surfacing between the mother and the calf. No relationship was observed between the synchronous surfacing's and group size or composition. Correspondingly, the observed behaviour did not alter the mother-calf synchronous surfacing's. Hence, the importance of synchronous surfacing's as a tool in the study of bottlenose dolphin mother-calf social relationships is questioned and needs to be addressed further in future studies.

**B 17****Sociogram focused on bottlenose dolphin infants on the basis of affiliative tactile interactions**

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As members of a fluid but socially structured society, bottlenose dolphin (*Tursiops truncatus*) infants, in the period between zero and one year of age, are involved in reiterated and diversified affiliative interactions. Through sociograms representing the infants' social links, this work aims to delineate the contacts promoted or received by calves from conspecifics. Behavioural data were systematically collected on four calves born in different periods (1995, 1997, 2003 and 2007) at the Rimini Delfinario (Italy). During their first year of life, a total of 1440 sessions lasting 30 minutes each (total 720 hours) were carried out. The software Observer 5.0 (Noldus) was applied to assess the frequency of following behaviours: "contact", "rubbing", "bonding", "bumping" and "beak-genital propulsion". Even if accompanied by a gradual decreasing in affiliative contacts with months, the mother remained the pivot around which calves' relationship with other individuals revolved. Nutritional and protective factors firmly set the mother-calf pair with frequency values over 70% of active touches and about 60% of passive. At the opposite, the male parent has almost no role. As for other conspecifics, the choices of preference within the group showed adult nulliparous females to be useful aunt in neonatal phases while juveniles males appeared, besides the mother, the most interactive partners after the first month of life. Both classes registered about 15% of given contacts and over 20% of received. In conclusion, distinctive social roles and links could be detected depending on sex-age-kin characteristics, confirming how calves' tactile relationships are extremely affected by both age and differences in group composition and size.

**B 18****Influence of perceived predation risk on foraging behaviour among different social groups in Northern fish-eating killer whales**

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The perception of predation risk is context dependent and varies across individuals and groups within a species. Anthropogenic disturbance has been proved to be an adverse stimulus and able to elicit anti-predatory responses in cetaceans. This study focuses on the impact of anthropogenic disturbance among different social groups in the hierarchical matrilineal social structure of the Northern fish-eating killer whales. Specifically inter-group variation in the probability of engaging in foraging activities has been tested under different ecological conditions. Changes in behavioural budget represent responses to stress and anti-predatory behaviours reflect disturbance's perception and its impact at group- and population-level. This study shows differences in foraging likelihood among matrilineal groups under anthropogenic disturbance. Different matrilineal groups appear to use the study area differently and the occurrence and the time spent in it vary considerably. Therefore habitat familiarity appears to be important in determining differences in foraging probability among social groups. We also describe how the impact of the perceived risk varies across social groups. While the type of predator doesn't alter risk perception and anti-predatory responses, associated with predator specific characteristics, are constant at the population scale. These findings show behavioural variations among social groups under perceived predation risk and highlight the importance of these differences in evaluating long-term consequences of disturbance.

B 19

**Occurrence of a lone juvenile bottlenose dolphin in the Alvor estuary, Portugal**

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A solitary juvenile wild bottlenose dolphin, *Tursiops truncatus* (Montagu 1821), was daily observed in the Alvor estuary, in the South of Portugal, from July to September of 2011. Approximately 60 hours were spent observing the animal from a land-based point at the entrance of the estuary. A photographic registry was also taken. Additional information was obtained from local fishers. The individual seemed to be in good physical condition and well fed, despite presenting some marks in the body. It displayed, in general, a very shy behaviour and a mean dive time of 2 minutes. More activity was observed, such as aerial behaviours, whenever the animal was at least 500 m away from the estuary mouth seawards. Clear evasive maneuvers towards the vessels were recorded, contrarily to most reported cases. This event posed a great opportunity for cooperation and awareness with the local community, namely fishers that usually have daily and long-term contact with these marine animals. It was also a good occasion to improve their understanding on the importance of preserving these species, since the dolphins are frequently pointed by fishers to be responsible for impacting negatively various fisheries. Furthermore, tourists were as well a target for environmental education outreach as the dolphin was easily spotted from land during the summer season.

**B 20****Effects of vessel disturbance on seasonal migratory behaviour of harbour porpoises in the Kerch Strait**

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Safeness of cetaceans during their seasonal migrations is important for species survival. Studies were conducted during autumn and spring migrations of harbour porpoises (*Phocoena phocoena*) from Azov Sea to Black Sea and back through the Kerch Strait in 2009-2011. Coastal observations were conducted at the narrowest part of the strait, 4 km (2.5 m), at the Cape Fonar, from the observational points elevated on 40 and 66 m. 106 records of vessel passing close (at 5-300 m) to harbour porpoises (65 groups, 740 individuals) were made at the distance of 0,5 - 1,5 km from the coastline. Vessels were classified as large (70 vessels), medium (23) and small (13) ones. While vessel passing most of harbour porpoise groups demonstrated foraging behaviour (88 cases) and some of them were travelling (18 cases). In 66 cases animals changed their behaviour after meeting with vessel: in 58 cases they stopped foraging and moved away, and returned to foraging later in 24 cases only; in 8 cases moving animals significantly accelerated their speed. In 40 cases harbour porpoises did not noticeably react on passing vessels: 30 of these groups continued their foraging, 10 travelled in the same direction. Dependence of behavioural reaction for close vessel passing on size or type of the vessel was not found. These results demonstrate significant vessel influence on harbour porpoise behaviour at the time of their highest concentration in the narrow part of the Kerch strait during seasonal migrations.

B 21

**Determining habitat use by harbour porpoise and bottlenose dolphins off the west coast of Ireland, using Static Acoustic Monitoring**

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In order to successfully monitor a protected species of international importance such as the harbour porpoise (*Phocoena phocoena*) or bottlenose dolphin (*Tursiops truncatus*), it is essential to understand many aspects of its ecology, including habitat use. Static Acoustic Monitoring (SAM) is a powerful tool especially in areas where unfavourable sea conditions can restrict visual surveys, such as off the west coast of Ireland. C-POD's were deployed at three sites (Galway Bay, the Blasket Islands cSAC and the Shannon Estuary cSAC) for up to two years to record acoustic activity of dolphins and porpoises. Click trains were extracted and classified according to minimum inter-click interval (MinICI). A MinICI of <10ms was used as a proxy for probable foraging behaviour, where  $\text{MinICI} < 10\text{ms} = 1$ , termed "feeding buzzes" (probable foraging) and  $> 10\text{ms} = 0$  (not foraging). A generalised linear mixed effects binomial model was fitted to the data. POD ID was added as a random factor to account for intra-POD variability. Season was highlighted as the most significant predictor of harbour porpoise feeding buzzes in both Galway Bay and the Blasket Islands. However, winter contained the highest rate of feeding buzzes in Galway Bay and summer in the Blasket Islands. In the Shannon Estuary, the only protected site for bottlenose dolphins in Ireland, season, tidal phase and diel phase were found to be important predictors of feeding buzzes, although this correlation was not as strong as that recorded for harbour porpoises. The results demonstrate the value of SAM in areas where year round visual surveys are not an option. They show that SAM can be a useful tool for understanding habitat use within SAC's and the potential of click train analysis for identifying foraging areas.

**B 22****Respiratory rate in resting wild walruses**

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There are many investigations of physiological parameters in captive walruses but few similar studies in natural conditions were conducted. We made observations on Pacific walrus breathing on their haulout in Vankarem Cape, Chukchi Sea in August-September 2011. The air temperature varied at this period between 4.5 and 10.2 °C. Frequency of breathing (FB), duration of respiratory rate (outward breath-breath, DRR) and respiratory pause (RP) in individual resting animals for 5-14.6 minutes (total 5.7 h) were measured. We chose for the observations walruses from different parts of the haulout and of any age group, which slept (laid motionless) or made minimum movements (lifted heads or changed a pose). 37 animals were observed. On average, FB of adult walruses (females and males) was 2.9-6.1 br/min in 6-9-yr-old individuals (n=5), 2.7-4.9 br/min in 10-15-yr-olds (n=13), and 2.4-6.7 br/min in 15+-yr-olds (n=5). FB didn't depend on location of walruses on the haulout (centre or edge). Single walruses (n=2) resting apart from the haulout and walruses on it had the same FB – 3.2-3.7 br/min. FB of skinny and ill (pulpitis) individuals resting on the haulout and FB of healthy walruses did not differ (2.4-2.8 br/min). DRR of adult animals averaged 4 s (lim 1-12) and RP 13.9 s (lim 1-49). RB of young animals aged 4-5 yrs (n=4) averaged 3.5-4.7 br/min, 3-yr-olds (n=1) 10.7 br/min, 2-yr-olds (n=1) 3.7 br/min, 1-yr-olds (n=1) 4.1 br/min, calves-of-the-year (n=3) 10 br/min. One 3-yr-old animal strongly trembled during the whole time of the observation. DRR and RP of young animals (not including calves-of-the-year) averaged 2.9 s (lim 1-6) and 12 s (lim 1-28), respectively. Results of the investigations indicated that average FB in resting adult walruses typically composes 3.7 br/min (lim 2.4-6.7). The young walruses starting with 1 year old have FB close to one in adult animals.

B 23

**Occurrence of mother-calf pairs of the Western gray whale (*Eschrichtius robustus*) population in the Piltun Lagoon area (Sakhalin Is., Russia) in 2011**

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Annually the most part of gray whale females in different physiological conditions (pregnant, lactating, or resting) and calves of the year come into the Piltun feeding area where the oil and gas exploitation is now very intensive. This is why great interest is displayed to the gray whales population monitoring program. The total number of whales in this area does not exceed 130 animal and only 29 of them are known reproductive females.

Since 1995 photo-identification studies of gray whales population have been conducted annually in the Piltun feeding area. The method of photo-identification is based on the recognition of unique native or acquired specific marks and features on the whale body. This approach has been successfully used when studying various aspects of eastern gray whale biology, identifying mother-calf pairs (MCPs), and recording their migration. The paper focuses on data obtained in the summer 2011. During this season 12 calves were identified (11 MCPs and one weaned).

The first MCP was observed on the 7th of July, and up to the beginning of August 67% of all the MCPs identified had been recorded. The last MCP was registered on the 20th of August. By the end of August, calves started leaving their mothers and this is why the number of calves observed separately from their mothers increased. These calves join other calves or newly arrived MCPs.

The most part of MCPs were recorded within the coastal waters at the distance ranging from 50 m to 1 km from the sea coast at the depths of about 5 -10 m. Shallow highly productive waters are very favourable for calves training and feeding. Mothers and calves often form interactive "social groups" of 2-3 pairs. Up to now the gray whale MCPs social behaviour has not been studied properly.

B 24

**Equally social males and females: bisexually bonded community model in common bottlenose dolphins**

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Bottlenose dolphin social structure varies drastically, from fission-fusion societies where individuals make choices to join or leave a group, to being mainly driven by constant companionship. This 6-yr long term study focused on group living pattern of common bottlenose dolphins along the north-eastern coast of Sardinia, Italy. Specific predictions of the different models of bottlenose dolphin social organization were tested and a total of 858 sightings were selected for analysis and presentation of data. A total of 22 identified bottlenose dolphins (15 females and 7 males) were sighted with a mean of  $113 \pm 26$  times during the whole study period. Bottlenose dolphins off Sardinia showed a fission-fusion social structure with a non-random social behaviour. The observed social organization presents a situation where the importance for individuals to keep the level of alliances stable year round outweighs the potential short-term benefits of forming preferred associations related to the mating period. Both males and females associated together and formed preferential companionships, suggesting a bisexually bonded society where ranging patterns are not sex-specific. Some males formed stable pairs, but trios and second-order alliances were not in evidence in any period of the year. Likewise, females formed preferred and stable associations independently of their reproductive status. These findings reflect the fact that the fission-fusion social structure of this small social community loses much of its fluidity in favor of a considerably more stable, bisexually bonded society. This study provides insight into bottlenose dolphin ecology and improves the knowledge about the evolution of complex social structures.

# CONSERVATION/MANAGEMENT

C 01

## The current status of dolphinariums in Turkey

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Turkey, with 9 facilities, is one of the countries that have numerous dolphinariums in the Europe. Contrary to certain other countries, in line with increasing demand, there are new initiatives for founding further facilities.

This study proposes to obtain what the current standards are for dolphinariums in Turkey. To determine the current status of facilities, data has been collected through interviews with trainers, visiting facilities or reading the flyers or posters of the facilities.

6 of these 9 facilities offer dolphin assisted therapy in addition to shows and swimming sessions. These dolphinariums contain a total of 64 animals which originate from Turkish, Japanese, Russian and Ukrainian Seas. 64 % of these individuals are cetaceans such bottlenose dolphins and belugas, while the rest of them are pinnipeds such as sea lions, fur seals and walruses.

Due to the lack of legislation on captive animals, most dolphinariums do not develop sufficiently the physical capacity of the facility, and have low standards which don't meet the requirements of the animals. A facility should be considered as a whole, including its pools' size, water quality, medical care services and employees' suitability.

We argue that all dolphinariums should be controlled regularly by certain state, civil societies or universities. Internet-based information systems may be used for the control and management of these facilities, so that their working practices can be made more transparent. In order to reduce contraband catches used to replace those dying in captivity which is common in Turkey, individual specific controlling systems should be developed. If the animals could be traced individually, their life stories can be followed and this will give us the chance to track their welfare. New regulations on standards may prevent the opening of new sub-standard facilities.

C 02

**Monitoring, management and conservation of local cetacean populations using marine stewardship strategy: the case study of “Maresme Canyons” (NE Spain)**

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Marine stewardship is a strategy intending to generate accountability among civil society for the conservation and proper use of marine natural environment, across marine stewardship agreements. The implementation of this strategy is a new tool for cetacean conservationists in the Mediterranean and it has been accepted among other conservation strategies and directives as a complement for the protection of endangered habitats and species. Marine stewardship promotes the participation of the stakeholders in the sustainable management of a specific area in a way that conserves all of its ecological values. “Canyons Del Maresme” is a wide area (2300km<sup>2</sup>) located off the central coast of Catalonia (NE-Spain) where this marine stewardship strategy is being implemented. The area reaches the edge of the continental shelf at 20 nm of the coastline, where the seafloor suddenly drops to over two kilometers. The “Canyons del Maresme” ecosystem includes shallow sandy banks, sea grasses meadows, three deep-water canyons and portions of the continental slope and abyssal plain, configuring habitat for a wide diversity of species. Up to 5 cetacean species have been cited in the area, although focused studies and monitoring programs are conducted mainly in local populations of bottlenose dolphin (*Tursiops truncatus*) and Risso’s dolphin (*Grampus griseus*) involving recreational sailors, the nautical sector, fishermen and fishing industry and local administration. The initiative began in 2009 in collaboration with the autonomous government and during this period, steps accorded and data obtained have been of notorious relevance, a fact that had led to create a bio-political lobby to start promoting the conservation of this marine area.

C 03

**Cetacean surveys in Maio, Cape Verde**

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The Maio Biodiversity Foundation is a recently created conservation organization designed to protect the fragile ecosystems of the island of Maio, Cape Verde, and also to educate the residents and visitors of the island about the importance of conservation and biodiversity. This foundation is currently developing projects to protect and monitor loggerhead turtle nesting beaches, monitor bird biodiversity, create a biodiversity and conservation education center, and also a marine and coastal reserve. In order to determine the importance of the marine reserve and the size and location of the most valuable area, we plan to undertake marine mammal surveys of the area in the spring of 2012. There have been reports of more than twenty species of cetacean observed in Cape Verde; however there have been few, if any, studies of pinnipeds and no studies specifically off the coast of Maio. This project aims to determine the species present, their abundance, distribution and habitat use of the various species of marine mammals over the course of several years of surveys. These data will then be used to support the design and creation of a marine reserve in Maio and encourage the development of ecotourism as a source of income for Maio's inhabitants.

C 04

**Marine mammal risk assessment and mitigation at NATO's Undersea Research Centre (NURC)**

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The Marine Mammal Risk Mitigation project at NATO's Undersea Research Centre (NURC) is providing naval exercise planners with information and expertise, in order to assess and mitigate risks to marine mammals from the use of naval active sonar. Support is provided at several stages, from environmental scoping for preliminary risk assessment to marine mammal monitoring tools and risk mitigation. This is achieved through a combination of data collection systems, data analysis and information management tools. With a well-established tradition in underwater acoustics, NURC has developed and tested a range of passive acoustic monitoring tools for marine mammals. These include moored systems for long term observations, deep sea gliders for cost-effective monitoring of large areas, and towed arrays for ship-based cetacean surveys. Information collected using these systems, together with oceanographic data and visual sightings of marine mammals, allows us to model their distribution, habitat preference and behaviour. The Integrated Decision Aid (IDA), developed at NURC, combines such models with the results of a sound propagation model, mapping areas of risk to marine mammals associated with various operational scenarios. We present the components of the risk assessment and mitigation process conducted at NURC, from data acquisition, analysis and management to decision support, outlining challenges and perspectives for our work.

C 05

**Conservation plan for the harbour porpoise (*Phocoena phocoena*) in The Netherlands: towards a favourable conservation status**

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In 2011, at the request of the Dutch Ministry of Economics, Agriculture & Innovation, a species conservation plan for the Harbour Porpoise *Phocoena phocoena* was established, based on current seasonal occurrence and abundance of porpoises within waters under Dutch jurisdiction aiming to achieve favourable conservation status. Harbour Porpoises have increased markedly in numbers in the southern North Sea in recent decades. The conservation status of the Harbour Porpoise in The Netherlands has recently been evaluated as “Inadequate”, the population as “Vulnerable”.

Porpoises are legally protected in The Netherlands following international, European and national legislation. Current policy in The Netherlands doesn't accomplish adequate protection of this species. Implementing the research and mitigation measures, as advised in this plan, serves to get porpoises into the desired conservation status, to fulfil obligations of the relevant international legal treaties.

The conservation plan is generic rather than area-orientated as recent research in Dutch waters failed to identify areas of particular ecological significance for any significant length of time. Based on available scientific evidence and experiences in other countries, mitigation measures and suggestions for urgently needed additional scientific research have been formulated. A stakeholder consultation was part of the project.

It is recommended to establish observer schemes on all passive gear fleets to assess bycatch-rates according to internationally accepted protocols, to investigate alternative gear or set-net modification, to use pingers (controlled) when bycatch is identified, to facilitate bycatch landing, to control illegal fisheries, to amend EC812/2004 and to evaluate effectiveness of mitigation measures.

Regarding adverse effects of impulsive underwater noise (detonation, seismic, pile driving) a system of standards and protocols to mitigate and investigate the impact should be developed and implemented. A national scientific research group will be established to deal with aspects such as research needs, research quality and evaluation of quality and conclusions of reports.

C 06

**First project to instruct local young learners in cetacean guides by the training school of the Strait of Gibraltar, Tarifa, Cá Diz, Spain**

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From May 2010 to May 2012 the training school of the Strait of Gibraltar started a 2 year project with the objective of instructing local young learners in cetacean guides as most of the workers in Tarifa working in this ambit are foreigners. In order to carry out the project an environmental educator with cetacean experience and 8 local young learners were selected . The requirements for the students selection were:

- age from 18 to 25 years
- low school level
- unemployed

and they received a wage of 460euros/month.

The project was divided in theory and practices, and the students were instructed in marine biology, cetaceans, geography, meteorology, English language, Communication skills and nautical studies for 14 months and for 10 months they worked in 2 different whale watching companies as cetacean guides. Their work in the companies consisted in whale watching, public attention, reception, recording scientific data and helping in the boats. Cetacean and bird organizations (CIRCE,MIGRES) collaborated with the project giving also an opportunity to the students to participate in investigation projects. Several surveys of the students took place in order to assess their knowledge and level of interest. After the first year the students showed a good knowledge in cetaceans, biology and geography. In the second year they integrated well in the whale watching company but with a weak level of English and ability of communication. Students who demonstrated high motivation and care for the environment worked much better than those with very little interest. For future projects a more specific selection of young learners is recommended in order to achieve higher success.

C 07

**The importance of community sightings in bottlenose dolphin research**

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The West coast of Scotland is home to one of three resident bottlenose dolphin populations in the UK. It is divided into two communities: one found in the waters of the Inner Hebrides and a second community found in the Sound of Barra. Since 1997 sightings reported by the public have been recorded by the Hebridean Whale and Dolphin Trust. In 2006 the Scottish Bottlenose Dolphin Project was conducted and in 2007 an online sightings form was added to the website. Systematic data collection requires a substantial investment of resources by researchers. Community sightings data therefore offer an alternative method of collecting potentially valuable information on the distribution and range of marine mammals. Using community sightings data collected between 2003 and October 2011, we assessed the value of bottlenose dolphin sightings reported by members of the public via an online sightings form, reports by email and calling a telephone hotline. In total, 852 definite encounters were reported between 2003 and October 2011. The months of June (20.5%), July (22.9%) and August (14.4%) held the most number of sightings throughout the year. Sighting rates peaked in the years of 2006 and 2007. Public sightings are not commonly used for data analysis however, it is possible to obtain information about the general movements as well as other information (e.g. group size) on bottlenose dolphins or other species. any information, even from non-effort sources, can add important pieces to an existing dataset. However, it is also crucial to assess the errors that could affect the data. Data collected by the public may contain errors. Thus, having a protocol in place enables minimizing possible errors (e.g. wrong species). With errors being kept to a minimum community sightings offer additional value to a dataset.

C 08

**Aerial survey of cetaceans along the Portuguese Coast: 2011 campaign**

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Aerial surveys were carried out during October 2011 in order to estimate distribution, abundance and habitat use by cetaceans occurring along the Portuguese coast.

The study area comprises the Portuguese Continental coastal region between Caminha and Vila Real de Sto. António. The survey was conducted using the line transect sampling method under a systematic sampling scheme with perpendicular 100 Km transects and with 18,5 Km spacing between transect lines. A previous survey performed in 2010 showed that aerial surveys using equal spacing are a reliable and relatively low budget methodology to assess cetacean abundance.

The observation team included three trained observers and a data recorder. Surveys were made on a Partnavia P-68 modified with “bubble windows” in continuous effort with 21 hours of flight time and 4533 km of total effective survey, yielding a rate of 1,08 sightings per each 25 Km of sampled survey line. A total of 8 species of cetaceans were detected. The common dolphin was the most recorded species with 71 sightings and a total of 1107 individuals. The following most observed species were bottlenose dolphins (9 sightings and 78 individuals), striped dolphins (8 sightings and 837 individuals) and harbour porpoises (7 sightings and 10 animals). We were also able to detect two species of mysticetes whales in these surveys: minke whale and fin whale (7 sightings, 9 animals and 7 sightings, 10 animals, respectively). These results will be analysed and incorporated into the monitoring studies in course within the MarPro Life+ project framework. This same methodology will continue to be used in the following years in order to understand inter-annual variations in cetacean abundances in the Portuguese coast, ensuring sufficient data for the definition of future Nature 2000 sites and their management plans.

C 09

**First survey off International Marine Park of the Strait of Bonifacio, northeastern Sardinia (Western Mediterranean Sea): implications for large and medium cetacean conservation**

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The all-year-round knowledge on cetaceans off Sardinia is scarce and mostly focused on the coastal species. This work aims to increase information on pelagic cetaceans off the International Marine Park of the Strait of Bonifacio. The study area is located in the Tyrrhenian Basin and includes the Caprera Canyon. It is about 15-40 nautical miles off the northeastern coast of Sardinia, adjacent to the Pelagos Sanctuary and particularly productive. Visual surveys were conducted during 26 days distributed from January to October 2011, using a whale watching catamaran and a dedicated boat. Collected data were boat coordinates, sighting positions, photo-identification and weather conditions. The covered area was about 1350 km<sup>2</sup>, with 945km/70.5h on-effort. A total of 143 sightings (5 cetacean species) has been recorded. The most abundant encountered species were: striped dolphin (58%), fin whale (31%) and Cuvier's beaked whale (6%). A newborn with fetal folds of Cuvier's beaked whale have been observed during the surveys. Cetaceans have been sighted mainly on the continental slope however some fin whales and all sighting of bottlenose dolphins were above the continental shelf. The encounter rates (ER) expressed in sightings/100-km on effort, were ER=8.78 for striped dolphin, ER=4.66 for fin whale, for ER=0.95 Cuvier's beaked whale. The ERs highlight that Caprera Canyon waters may be considered as a potential hotspot of cetaceans. Data of the present work is compared with data collected during the pilot study conducted in 2010 in the same study area. Data are also compared with results obtained in Ligurian Sea. The quantity of fin whale and the presence of the newborn Cuvier's beaked whale point out the special interest of the study area for conservation and may support the proposal to create an open sea SPAMI in the Tyrrhenian Sea in accordance with SPA and Biodiversity Protocol.

**C 10**  
**Bottlenose dolphin (*Tursiops truncatus*) dispersal In Welsh waters: are current conservation guidelines enough?**

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Cardigan Bay, West Wales has long been known as an important region for bottlenose dolphins and as such two Special Areas of Conservation (SAC) were designated. However, it has become clear that dolphins travel outside the SACs in winter to unprotected waters off North Wales northwards at least to the Isle of Man, including areas where industry and pollution is high. Survey data from 2007-11 were analysed to investigate dolphin dispersal and to assess whether the species is adequately protected by current SAC designations. Possible factors such as food availability and life history characteristics that might affect dispersal were also investigated. From a photo ID catalogue consisting of at least 361 dolphins, 57% have migrated outside of the SACs, particularly in winter where 94% of dolphins identified in the waters off North Wales had been recorded previously in Cardigan Bay. 30% of mother-calf pairs identified in Cardigan Bay migrated within the first year of birth, showing that North Wales is host to dolphins of all ages.

Encounters of animals in summer months off North Wales also occur, including 39% of dolphins recorded from Cardigan Bay. However, 61% of individuals identified have never been recorded within the SACs, suggesting that there may be dolphins that never use Cardigan Bay. It is not clear why individuals that have previously shown a strong fidelity to Cardigan Bay in summer have been identified in waters off North Wales at the same time of year. Despite differences in levels of feeding between years in Cardigan Bay SAC ( $\chi^2=15.165$ ,  $DF=4$ ,  $p<0.05$ ), there is no evidence to show that more dolphins were identified further north in years when food availability appeared to be lower within Cardigan Bay. It is recommended that conservation management plans should incorporate waters off North Wales.

C 11

**Winter presence of large cetaceans in the Strait of Gibraltar**

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Summer presence of large cetaceans in the Strait of Gibraltar has been described by previous studies; however winter data are scarce mainly due to a lack of effort. Fin whales (*Balaenoptera physalus*) are known to migrate through the Strait in May-July to the Atlantic Ocean; until now the existence of a possible migration to the Mediterranean Sea in winter was only supported by few opportunistic sighting data and 4 individuals resighted during their westerly migrations. Regarding sperm whales (*Physeter macrocephalus*), the area is a known spring-summer feeding ground and the species presented a very low encounter rate the rest of the year. In November-December 2009-2010, a land-based survey focusing on large cetaceans was carried out from the Natural Park “P.N. del Estrecho”. Thirteen days and 11 days on effort from the land station allowed the observation of 20 and 11 fin whales as well as 13 and 17 sperm whales in 2009 and 2010 respectively. Sperm whales displayed the same feeding behaviour previously described in summer in the area. Fin whales were all observed travelling easterly to the Mediterranean Sea, alone or in groups of up to 5 individuals. Furthermore, “encounter rates” for the species (defined as number of animals sighted per day on effort) were similar in winter and summer (summer=1.05 95%CI=1.01-1.17/winter=1.29 95%CI=1.13-1.66). These results confirm the importance of the Strait of Gibraltar for both species in winter and challenge the existing 13-knot speed limit recommendation in the critical area for cetaceans initially designed from April to August only, suggesting the need for year-round effective management of this important area. Moreover, these findings confirm the existence of an easterly migration of fin whales during the winter months. They also indicate bidirectional seasonal movements of a small population of fin whales through the Strait of Gibraltar.

**C 12: Cancelled****C 13**  
**Expert knowledge informs and refines Ecological Risk Assessment for the effects of fishing for cetacean species**

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Productivity Susceptibility Analysis (PSA) is a key stage in Ecological Risk Assessment for the Effects of Fishing (ERAEF) on species. The “Susceptibility” element of the analysis has four components, where scores are derived for each species based on Availability, Encounterability, Selectivity and Post Capture Mortality. Availability and Encounterability score the likelihood of a species encountering a fishing activity, given geographic distribution and position in the water column relative to the gear type in question. Selectivity is the potential of a gear to capture and retain species. Post Capture Mortality scores the likelihood that a species could be released alive from a gear and survive.

As part of a project conducting ERAEF Assessments for fisheries in Irish waters, we convened a panel of experts to inform and refine PSA assessment for cetaceans. There is a need to refine “Selectivity” scoring for cetaceans. To this end we have compiled a species/gear type selectivity scoring matrix. This matrix has been completed by each member of the expert panel. Each species/gear type pair has been given a score of one to three (One - low risk, Two - moderate risk, Three - high risk). The score given depended on the opinion of expert as to whether a particular gear could physically capture that species. The opinion of the expert was informed by their own knowledge of the occurrence of bycatch of that particular species in that particular gear type or by similar species in similar gear types. Assessment was conducted at Level 5 of the Council Regulation (EC) No 199/2008. Additional information, pertaining to specific mesh sizes, target species etc., was incorporated, where available, to refine the assessment further.

We present the “Selectivity” scores produced for each gear/species pair and discuss the other measures we are taken to formalise the input of cetacean experts into the ERAEF process.

C 14

**Habitat use of bottlenose dolphins in Cork Harbour and interactions with recreational craft**

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Bottlenose dolphins are often sighted in Cork harbour and a group of six individuals regularly started using the outer harbour in 2006 (Ryan et al., 2011). In the last year, two calves have been born within this group. Using a combination of land-based scan sampling and theodolite tracking, we aim to determine habitat use by this semi-resident group and to evaluate the interaction with boat traffic. Surveys were carried out from a cliff top, with an elevation of approximately 30m with a wide view of the outer harbour and in Beaufort state of  $\leq 3$ . Between October and November 2011, bottlenose dolphins were seen on 70% of watches. Animals were primarily sighted in a core area at the mouth of the harbour, over a 1km area and frequently sighted in the shipping lanes. Group size ranged from two to eight individuals (average 5 individuals). Boat traffic is highly variable, ranging from one boat sighted in 3 hours, to 22 boats in a 15 minute scan sample. While the majority (79%) of small recreational boats (<8m) maintained their course when passing within 100m of the dolphins, interactions initiated by dolphins occurred <20% of the time whereas the boats initiated >80% of interactions and often came within <3m of the dolphins. Dolphins have never been seen initiating an interaction with a recreational craft maintaining its course. While bottlenose dolphins are protected under National Legislation (S.I No. 94 of 1997) which states that no one can deliberately disturb them, there are only “best practice” guidelines in place to ensure this. They suggest that recreational boats should maintain their course if cetaceans are seen and that the boats should not pursue or attempt to initiate an interaction; both of these suggestions are currently ignored.

C 15

**Towards an ecologically coherent MPA network: the necessity of a Hebrides Marine Park for cetaceans in Scottish waters**

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To ensure Marine Protected Areas (MPAs) meet their conservation objectives they must be part of an ecologically coherent network. Scotland, through the Marine (Scotland) Act 2010, was granted powers to designate nature conservation MPAs (ncMPAs) to achieve adequate completion of a National, UK, EU and wider OSPAR network. Mobile species (including cetaceans) have been accepted as important components of this network. Through restricted consultation, Scottish agencies have identified minke whales, Risso's dolphins and white-beaked dolphins as three cetacean Priority Marine Features (PMF) which will drive the process of identifying MPA Search Areas. However, with the exception of the minke whale within a small locality on the Scottish west coast (around the Small Isles), no other Search Areas, including the remaining cetacean PMFs, have been proposed. ncMPAs which include cetaceans not only help but are necessary to ensure the completion of the ecologically coherent network. Therefore, to adequately protect cetaceans, a Hebrides Marine Park is proposed as part of the wider Scottish MPA network, incorporating IUCN zoning criteria, as the west coast of Scotland contains critical habitat identified for all three PMF species. A Hebrides Marine Park would be further enhanced by the inclusion of Special Areas of Conservation (SACs) for harbour porpoises, where some of the highest densities in Europe are recorded. Furthermore, a candidate SAC is envisioned for the small, discrete population of 12-15 bottlenose dolphins within the Sound of Barra, Outer Hebrides. Such a comprehensive network would also provide protection for less regular cetacean visitors to the region, not deemed suitable for place-based protection in Scottish waters. An initial assessment of socio-economic concerns demonstrates the relative overlap and impact upon and by current sectoral activities (military, aquaculture, fisheries, renewable energy) would be low, assuming any future management measures, including those for underwater sound, were adequately implemented and regulated.

C 16

**Characterising habitat use by a resident bottlenose dolphin population within a Marine Park by means of passive acoustics**

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Long-term surveys of resident cetacean populations in coastal zones are one of the key objectives of management agencies in particular within Marine Parks or Marine Protected Areas. Knowledge on the habitat use and its natural variability are critical for evaluating potential disturbances caused by natural or human events. In temperate zones, the high seasonal variability in environmental conditions and human exploitation of coastal areas requires a year-round monitoring. Many cetacean species, including bottlenose dolphins (*Tursiops truncatus*), are known to vocalize extensively. Their repertoire and calls also convey information on their social structure and behaviour. The long-term study of their vocal output therefore represents a powerful complementary monitoring tool. Here we present the first results of a project aiming at evaluating the potential of passive acoustics in characterizing the spatiotemporal and functional use of the bottlenose dolphin population of the Iroise Marine Park. By deploying three autonomous recorders within the dolphin habitat that recorded continuously over four months and in all weather conditions, we found variations between the recording sites in terms of diel presence and vocal activity. The preliminary results also showed that the presence at the different locations was correlated with the time of the day and the tidal level. Furthermore, differences were found in the types of vocalizations recorded per site and per time of the day. These differences may indicate the presence of functional zones in terms of behaviour and social associations. This work shows the high potential of passive acoustics as a non-intrusive, long-term and weather-independent tool, to contribute to a better knowledge of the habitat use by a resident dolphin population. It also identifies acoustic proxies to be applied for management purposes.

C 17

**Cetabase: a bilingual tool to enhance data sharing and public outreach on endangered species**

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Studies of abundance and distribution of species of megafauna with large movement capabilities such as marine mammals are challenging but essential for the conservation of these often endangered species. Many areas of population research rely on identifying individuals by natural or artificial markings. However, long range movements of the animals and the difficulties inherent in applying a homogeneous research effort throughout the distribution area of the species result in missed identifications and partial data. Lack of coordination among the different research groups involved often results in keeping separate identification catalogues and abundance estimates. This impedes a correct estimation of the overall population abundance of the species resulting in over or underestimations of the population abundance. On the other hand, the general public constitute an increasing source of sightings and photo-video records. An easily accessible tool would be welcomed to incorporate their sightings or to contact with local researchers to inform them about the sighting of an already identified animal. [www.cetabase.info](http://www.cetabase.info) is an example of such a tool working as a virtual catalog of marine mammal sightings and photo ID with analytical tools, designed to share information among scientists in different parts of the world, and to integrate public in the scientific process. Cetabase is programmed as a bilingual database-intensive web application constructed using the open software tools /PHP and MySQL/. The chosen web server has a Debian GNU/Linux OS. Cetabase uses a logic database structure to store information from sightings and individual animals allowing data to be linked according to defined data fields, extract parts of the data and export results in user friendly formats. Cetabase also includes analytical tools targeted primarily for data extraction towards population abundance estimates. Further enhancement will enable the users to extract data required for social structure, population structure and animal movement analysis.

C 18

**Long-term patterns in residency and site fidelity of bottlenose dolphins (*Tursiops truncatus*) in Cardigan Bay, Wales**

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Cardigan Bay supports the larger of only two semi-resident populations of bottlenose dolphins (*T. truncatus*) found in UK waters; therein, *T. truncatus* is a primary feature of two Special Areas of Conservation designated for the protection of vulnerable habitats and species. In order to best protect *T. truncatus* in Cardigan Bay, sites with an important role in supporting the population must be afforded the highest level of protection; evidence of such sites is herein presented. Photo-Identification has been used to monitor the Cardigan Bay population by a variety of teams; resulting in catalogues from 1990-94 (Holly Arnold) and 2001-11 (Sea Watch Foundation Monitoring Project). This study is the first to unify these catalogues, creating a 21-year dataset. 31% of individuals were seen in 1 year only, 40% in 2-5 years and 29% in >5 years, supporting earlier conclusions of an open metapopulation of residents, occasional visitors and transients using the bay. Considering animals of known gender only, 63% of residents were female. 24.8% of individuals were photographed in both 1990-94 and 2001-11 and 8.6% photographed in both 1990-94 and 2010-11. Sightings locations and known-ranges of select individuals were plotted, indicating that although residents use the entire bay throughout the summer, they exhibit a strong fidelity to certain sites within Cardigan Bay. Core areas of females were significantly smaller than males ( $p=0.031$ ); females showed particularly strong site fidelity when accompanied by a dependent calf, suggesting those areas may form important nursery grounds. This study is the first to demonstrate that there is a mainly female cohort of individuals whose residency and site preferences in Cardigan Bay have extended over two decades. Evidence of important sites should be considered in future management of human activities, in order that *T. truncatus* may achieve a favourable conservation status in Cardigan Bay.

C 19

**Sperm whale (*Physeter macrocephalus*) movements within the Mediterranean Sea: new evidence from photo-identification data**

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The Mediterranean sub-population of sperm whales is considered as Endangered according to the IUCN Red List. Conservation policies require the populations of protected species to be monitored, but the movements of sperm whales across the Mediterranean basin are still poorly understood, probably due to the difficulty of sighting and tracking individuals that inhabit mainly oceanic waters. However, the photo-identification technique has proven to be effective to monitor large cetaceans and specifically sperm whales. CIRCE's catalogue of the Strait of Gibraltar (containing 47 individuals, 1999-2011) was compared with the photo-identification catalogues from (a) the Gulf of Lion and Provence (France, EcoOcéan-Institut, 1994-2011), (b) the Balearic Islands (Spain, University of St. Andrews, 2003-2008) and (c) the Hellenic Trench (Greece, Pelagos Cetacean Research Institute, 1998-2009). Three out of the 47 whales from the Strait of Gibraltar have been resighted in the Balearic Islands, one offshore the Gulf of Lion and none in the Hellenic Trench. The results are consistent with previous studies and further highlight long-range movements of sperm whales throughout the whole western Mediterranean basin, while there are no evidences of movements towards the eastern basin. The number of individuals from the Strait of Gibraltar resighted in the western Mediterranean basin increased to 15 (32%). These results show that data sharing between research groups is essential to understand sperm whale distribution and movements. Where the remaining 32 individuals are going, when they are not in the Strait, is still undetermined. We therefore stress the need of a basin-wide monitoring program to get information about sperm whales in unsurveyed areas and compare all existing photo-identification catalogues. This will help fully understanding movements within the basin and having a minimum sperm whale population estimate of the Mediterranean Sea, both necessary to provide better baselines for conservation measures.

C 20

**A Big Blue Network: building a case for place-based management of blue whales on the high seas**

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The highly endangered blue whale (*Balaenoptera musculus*) is a charismatic umbrella species. Recent studies have highlighted the importance of three unique Ecologically and Biologically Significant Areas (EBSAs) including the Costa Rica Dome (CRD), the South East Shoals of the Grand Banks (SES) and the Saya de Malha Banks (SDM), for achieving global efforts in the conservation of *B.musculus*. In particular, though each area faces different pressures, these three have been proposed as crucial for “place-based” management effort through the use of Marine Protected Areas (MPAs) via the Global Ocean Biodiversity Initiative (GOBI) and the Convention on Biological Diversity (CBD). However, determining specific boundaries or management zones is difficult in view of the highly mobile whales and the highly complex and dynamic oceanographic features, the interactions of which form their Critical Habitats. Therefore a specific knowledge of blue whale Critical Habitat, across the Atlantic, Pacific and Indian Oceans, is needed. To address these obstacles, the present study attempted to combine previous assessments of the species’ known distribution, ecology and behaviour with ecological niche modelling and predictive habitat suitability mapping methodologies, to further quantify our understanding the species’ seasonal Critical Habitat needs. Results of the study indicated that though these areas investigated did provide multi-season habitats for *B.musculus*, variation occurred in each proposed MPA, both in the spatial extent of modelled habitat between the seasons as well as the specific associations with the covariates examined (Bathymetry, SST, Chl-a, Fronts). These findings, concerning the spatio-temporal consistency of areas deemed potentially critical, were then used to build upon work regarding the classification of zones for further spatial management within the CRD, SES and SDM, both on the high seas and within neighbouring national EEZs.

C 21

## Potential to develop whale watching activities in two Marine Protected Areas in the Portuguese coast: a first approach

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Marine Protected Areas (MPA) may promote different types of tourism, namely whale watching. In this work, the potential for the development of whale watching activities in two Portuguese MPA, i.e. “Reserve Natural das Berlengas” (Peniche) and “Parque Marinho Luíz Saldanha” (Sesimbra), where no commercial whale watching takes place, was comparatively analysed based on cetacean sighting and client motivation. Cetacean sightings were estimated based on 105 boat surveys, performed between 2007 and 2011. The results of a total of 171 questionnaires were used to evaluate the motivation to do whale watching by tourists and the local people living close to the two MPA. Short-beaked common dolphin (Peniche-70% of total encounters; Sesimbra-55%), bottlenose dolphin (Peniche-20%; Sesimbra-39%), striped dolphin (Peniche-10%; Sesimbra-5%) and minke whale (Sesimbra-4%) were the species observed during boat surveys. Observations of opportunity by other people also add Risso’s dolphin and humpback whale, in Sesimbra and sperm whale, in Peniche. The majority of respondents to our questionnaires was between 18 and 45 years old, female, Portuguese, with secondary education degree and were employed. More than 35% of the interviewed have never done this activity but would like to do it, mainly to see cetaceans and landscape, learn about conservation issues and for nature sightseeing. Mostly, the choice of a place with the activity would be one of the reasons to move from their residence town. More than 32% of the people would pay more than € 35 for one trip. With a sighting rate for Sesimbra of 58% and for Peniche still unknown, it should be evaluated in the future if this rate would influence the success of whale watching and some alternatives like bird watching from the boat or land-based points to find the cetaceans could be added to increase the potential of this activity in the two MPA.

C 22

**Uses of remote sensing for modelling marine megafauna in the Irish Sea**

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The need for improved marine management in the UK has been recognised at a national level for many years. It is also now recognised, following the passing of the UK Marine and Coastal Access Act 2009, that a more integrated approach to the management of the marine environment is required. One of the major factors hampering improved marine management has been insufficient data relating to a wide range of issues from natural processes to human activities. Highly mobile species such as cetaceans pose a particular challenge when considering the implementation of marine strategies. The development of techniques for marine ecological studies is fundamental to the future of successful marine management. In this study, the use of remote sensing data for modelling the seasonal distribution of cetaceans over whole sea areas has been investigated. The study aimed to identify essential habitat and key areas for species in order to target sampling effort and develop innovative techniques for monitoring species over whole sea areas, including those based on shore-based robotic telescopes and airborne surveys. Specifically, this study modelled habitat use and preferences for the more commonly sighted cetaceans in the Irish Sea area. Species data made available to the study were used in the analysis in addition to the environmental explanatory variables including bathymetry, slope, seabed habitat, tidal data and remotely sensed data, sea surface temperature (SST) and chlorophyll-a (Chl-a) concentration derived from Advanced Very High Resolution Radiometer (AVHRR) and Moderate Resolution Imaging Spectrometer (MODIS) sensors. This study provides valuable information on habitat use and preferences of cetacean species in the Irish Sea and can be used for informing future conservation measures and marine spatial planning.

C 23

**A novel technique for cetacean localization and surveillance by means of a radio-controlled aircraft**

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Conventional techniques to study cetaceans are often limiting in order to localize and survey these marine animals. Long range searching and fast approaches without disturbance are essential to study most of the species. EDMAKTUB association at the cetacean surveys BCNCET (Barcelona-Balearic islands, Barcelona Zoo grant) implements a new method to research and film cetaceans in their environment. The development of this new technique is being funded by Fundación Biodiversidad and consists of a First Person View, radio controlled (FPV R/C) aircraft which sends real-time images with flying and location data to researchers on board of the vessel that acts as aircraft base. The basic system comprises: an aircraft model with a brushless electric motor, a small light weight high definition camera in the front, a small GPS locator system, a wireless audio/video transmitter and receiver, some lipo batteries for powering electric motor and video gear, video goggles or monitor with good resolution and a multichannel transmitter. This model plane is able to fly more than 4 miles away from the boat, allowing the search of the animals located acoustically by the hydrophones. This aircraft being light, low noise and slow flying allows undisturbed approaches to surfacing cetaceans with easily more than 45 minutes range. The development of the new methodology of the FPV R/C aircraft opens interesting doors in remote studies at a distance of the cetaceans, about surface behaviour, group composition, or even individual identification. The reduced size and low cost of the equipment may allow the use of this technique from a boat and more easily from land, being an interesting tool to monitor coastal species. Despite the high level of experience to handle the plane, the introduction of this new methodology in the protocols of monitoring cetacean populations will increase the perspectives for a better cetacean knowledge.

C 24

**Assessing the taxonomic status of bottlenose dolphins (*Tursiops* spp.) in Australia using three-dimensional geometric morphometrics**

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Successful wildlife conservation and management require baseline information on species identity, diversity and distribution. The taxonomic status of the genus *Tursiops* is controversial with several species described in the past and a new Australian species, *T. australis*, described in 2011. In addition to traditional linear measurements, we use innovative geometric morphometrics to describe the three-dimensional shape of the skulls and mandible using a 3D-digitiser (MicroScribe G2X). This method is gaining popularity in the study of systematics and palaeontology, and has been used on many vertebrate species but in a limited way on cetaceans.

We present data on approximately 300 specimens and 9 species (*Tursiops truncatus*, *Tursiops aduncus*, *Sousa chinensis*, *Stenella attenuata*, *Stenella longirostris*, *Stenella coeruleoalba*, *Steno bredanensis*, *Lagenodelphis hosei* and *Delphinus delphis*) from around Australia. Landmark-based morphometric methods were used for the geometric comparison of skulls (71 landmarks). These capture the form of the organism in a way that linear measurements are not always able to. Principal Components Analysis (PCA) showed that the length and the width of the skull and the rostrum relative to the skull size explain most of the skull shape differences between the species included in this study. *Tursiops truncatus* and *T. aduncus* clustered together with some *S. attenuata* skulls adjacent, but have a distinct skull shape that is different from other delphinid species. Two skull shapes are apparent in Australian *Tursiops* spp., and these have affinities to the type specimens of *T. aduncus* and *T. truncatus*. The width of the skull and rostrum are the dominating shape differences between *T. truncatus* and *T. aduncus*.

C 25

**Conservation measures for harbour porpoises in the Pomeranian Bay (South Baltic)**

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The main threat of bycatch for Harbour porpoises in the Baltic Sea are gillnets. The small size of the Baltic population of these mammals has caused them to be recognized as critical endangered (Hammond 2007) and is a subject to several international and national protection acts released by the environmental sector. In order to reconcile policies on both promoting environmental protection and fishing, the Council Regulation (EC) No.812/2004 has been established, which lays down measures concerning incidental catches of cetaceans. One of the measures is the obligatory use of pingers by gillnetters above 12m fishing in ICES 24. This study has analysed structure of the gillnets fleet and fishing areas, where used pingers. Data used to analyses the catch of fishing vessels equipped with pingers came from Polish Fisheries Monitoring Centre in Gdynia and covers the years 2008-2010. Analysis of these fishing operations shows that the pingers weren't fully utilized. In 2008, only 42% of all catches conducted by vessels equipped in pinger took place in the area designed as ICES 24. In the next years this percentage was respectively 58% and 36%. Besides, fishing operations by vessels over 12m made up 12-14% of all fishing in this area. Remaining 86-88% of fishing belonged to vessels less than 12m, which use the same type of gillnets, but aren't covered by the Regulation 812/2004. Results of this analysis show that despite legislation regarding the protection of the Harbour porpoise in the Baltic Sea, the measures aren't sufficiently implemented. It is important to continue the monitoring of the fishery operations in a study area. Moreover it is necessary to change the Regulation 812/2004 so that it covers fishing boats under 12m, which consisting the majority of fishing vessels in ICES 24 to effectively protect harbour porpoises against the by-catch.

C 26

**What is the price of a common dolphin in the Bay of Algeciras?**

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Since the 1980s, whale watching activities operating from Gibraltar have developed around common dolphins (*Delphinus delphis*) in the Bay of Algeciras, Spain. Common dolphins are seen all year around representing the main target of the whale watching activity in the area, although other cetacean species can also be sighted. A total of 8 operators are running the activity all year around, with its peak in July and August, with 2-8 trips/day of 60-90 minutes depending on the season. In this study we analysed the economic potential of common dolphins living in the Bay of Algeciras. An estimated population of 1868 (CV: 0.12; 95% CI: 1483-2356) individuals inhabits the bay of Algeciras, and the surrounding area. From the literature, we assumed a life span of 30 years. The whale watching industry generated a total of 1,853,994 Euro income (618,889 Euro and 1,235,105 Euro of direct and indirect income respectively) with 35,371 dolphin-watchers in 2008. Approximately 993 Euro would be generated annually per individual. Hence, each common dolphin could generate a total of around 29,775 Euro during their life, giving an economic potential of around 55,619,700 Euro for the whole common dolphin population of the Bay of Algeciras, if the activities economic income remains stable during the following years. This approach could be used to highlight the economic value of dolphins towards competent administrations. In conclusion, the resource (common dolphins) should be preserved with conservation measures in order to protect the high economic value of the common dolphins inhabiting the Bay of Algeciras.

# ECOLOGY

E 01

## Age and year effects in individual grey seal pupping dates

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During the last 20 years mean pupping dates of grey seals breeding in colonies in the Orkney Islands (Scotland) have become later while in the Scottish Hebrides they have become earlier. Mean values however, are unable to reveal the individual level processes behind these changes. Candidate explanations for changes include demography (loss of early breeding old females or increased recruitment of later breeding young females, immigration or emigration) and physiology (later implantation/ extended gestation) possibly linked to environmental causation.

We used birth date data collected from >400 seals over the period 1979-2009 during a long-term study of female grey seals on the Hebridean colony of North Rona to investigate how birth dates were affected by age and how they changed in relation to mean date of birth at the colony.

North Rona's mean birth date has remained around 8 October over the last 20 years but as the colony's pup production decreased, the duration of the season has contracted. Individual birth dates varied from 23 September -26 October, maternal partum masses ranged from 127-243kg (mean 186.5kg) and ages ranged from 4-36. Individual seals had different birth dates (GLM:  $F_{1,294}=8.994$ ,  $P<0.001$ ) and greater maternal partum masses accompanied earlier birth dates. Although some individuals ( $n=27$ ) had remarkably stable pupping dates, +2-3 days over a decade, there was evidence of a quadratic effect of age on some individuals' birth dates working to shift young, late pupping females' birth dates earlier, towards the colony mean, then getting later again. Older mothers were less successful at rearing pups, irrespective of their masses at parturition. This suggests selective pressure on colony pupping dates that favours prime mothers giving birth around the mean pupping date, countered by ageing effects.

E 02

**Comparative aspects of reproductive seasonality in male common dolphins (*Delphinus delphis*) and harbour porpoises (*Phocoena phocoena*)**

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At both the species and population level males adapt different reproductive cycles and mating strategies, reflected in physiological and morphological adaptations, due to reproductive isolation and availability of receptive females. Reproductive seasonality synchronises energetically demanding biological periods, such as lactation in females, to the most favourable time of the year. Consequently, male seasonal breeders may exhibit spermatogenesis regulation with individuals being subject to cycles of testis involution and reactivation. Testicular activity is controlled both genetically and hormonally, though environmental and other factors can inhibit reproduction. Within the current study, a full assessment of seasonal changes in testicular function and structure in mature males was undertaken on two cetacean species exhibiting reproductive seasonality and inhabiting temperate environments. Histological evaluations of spermatogenesis were carried out on stranded and by-caught mature males from North-east Atlantic populations of the common dolphin (*Delphinus delphis*) (n=92) and harbour porpoise (*Phocoena phocoena*) (n=78). Models were used to describe seasonal variations in testicular size and proportion of germinal cells present in the seminiferous tubules, and included covariates such as age, health and nutritional status. Both species partake in sperm competition, identified by their relative testes size. Considering the cost of such testicular maintenance, it would be expected that males undergo a period of involution or complete arrestment of spermatogenesis outside the breeding period. For both species, males exhibited seasonal testicular regression, though not a complete cessation of spermatogenesis. Meiosis was ongoing and spermatozoa were observed in seminiferous tubules collected outside the defined breeding period. This is in contrast to a contiguous *P. phocoena* population in the western North Atlantic, where complete involution and recrudescence was observed. Comparative aspects between both species in testicular form and function, effects of nutritional condition on sperm production and the presence of old sterile individuals are explored further within the study.

E 03

**Structure of the cetacean community around the Antarctic Peninsula**

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The aim of the present study was to investigate if cetacean diversity varies among areas with different oceanographic conditions around the Antarctic Peninsula. The study areas comprise the Drake Passage, Bransfield and Gerlache Strait and the Weddell Sea. This region has a complex circulation pattern, including mesoscale jets and eddies, which together with dimensions of shallows and canyons in bays, fjords and straits makes the complexity of current fields. These characteristics play an important role in the transportation, concentration and retention of nutrients, favoring primary and secondary productivity and attracting the top consumers. The area was divided into 10 sub-areas based on oceanographic features such as surface circulation patterns. Cetacean distribution data were obtained during ship-based surveys within the Brazilian Antarctic Program from 1998 to 2011 austral summers. Line transect sampling methods were used to estimate cetacean encounter rates (ER). Approximately 7000 nautical miles were navigated and 1823 sightings were made on effort. The Kruskal-Wallis test was used to confirm significant differences of ER on spatio-temporal scales. The diversity index for each area was determined by the Shannon-Weaver diversity index. Significant differences ( $\alpha=0,05$ ) were found for most areas supporting the hypothesis that the distribution of cetaceans is not random, and some species such as humpback whale show a significant inter-annual variation. Humpback, minke and killer whales were the most frequently sighted species, predominating in areas with low species richness such as Gerlache Strait. Areas without species dominance (e.g. Elephant Island and Weddell Sea) showed greater diversity. Ours results suggest that open areas and areas close to oceanographic fronts sustain lower ERs for individual species but support greater diversity than confined areas.

E 04

**Cetacean spatial distribution in relation to anthropogenic variables along the north-eastern coast of Sardinia (Italy) by vessel survey**

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Data regarding the distribution of cetaceans along the north-eastern coast of Sardinia mostly relies on observations within three miles offshore or observations from opportunistic platforms. This study presents the first systematic cetacean survey started in 2011 in order to provide the first set of baseline data of cetacean species existing in the area in relation with anthropogenic variables (type and number of boats and fisheries) through the use of GIS. Vessel surveys were carried out from February to November 2011, in a total area of 854 km<sup>2</sup> and 1115 nm corresponding with 358 hours of observation (158 hours spent “on effort”, 193 hours “off effort” and seven hours in “passing mode”). Regarding the cetacean and anthropogenic distribution the study area was divided in a grid of squares of 25 km<sup>2</sup> in order to find the density of each of the species and the density of boat traffic in the area monitored and represented in GIS. Within this study, 179 cetacean sightings were recorded. The density of cetaceans was calculated as the number of surveys with presence of cetaceans in a square per total times of the corresponding square being monitored. Common bottlenose dolphin (*Tursiops truncatus*) was the most sighted species, followed by striped dolphins (*Stenella coeruleoalba*), fin whales (*Balaenoptera physalus*) and short-beaked common dolphins (*Delphinus delphis*). The last two mentioned species are classified “endangered” and the common bottlenose dolphin (*Tursiops truncatus*) classified “vulnerable” species in the Mediterranean Sea according to the IUCN Red List. Regards to the bathymetric distribution; striped and short-beaked common dolphins were sighted in deep waters, fin whales in both coastal and pelagic environments and bottlenose dolphins exclusively in shallow waters (<100m). This study evidences the importance of the north-east Sardinian coastal and pelagic waters for the conservation of cetaceans in the Tyrrhenian Sea.

E 05

**Modelling seal movements across the English Channel using a hydrodynamic tidal model (TELEMAC2D)**

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Grey seal (*Halichoerus grypus*) and harbour seal (*Phoca vitulina*) pathways were tracked by Fastloc GPS/GSM telemetry between the French and English coasts from 2006 to 2011. A possible influence of sea currents on the shape of the seals pathways was suggested. This study investigates the effect of sea currents on the seals' tracks by modelling the seals' movements using a numerical tidal model based on TELEMAC software (EDF LNHE, France). The seal is modelled as an «active» drifting-buoy which is able to adapt itself to the ambient currents. Various scenarios of seal navigation are modelled. A first model assumes constant direction and swim speed. A second one assumes constant swim speed and variable direction calculated from the current position to the destination point, which is defined by the real tracking data. For each time step, the drift due to tidal current and the seal swim movement is calculated; a trajectory pattern is obtained and compared with the real track of GPS locations. We show that simple navigation rules explain successfully the actual routes taken. In this experiment, the second model gave relatively realistic movement patterns in the English Channel. This would imply that grey seals and harbour seals would have the ability to assess their position at sea, allowing them to adjust their direction to accommodate drifting by currents. These navigational mechanisms however still need to be addressed.

E 06

**Use of photogrammetry to estimate sperm whales body length in the Ligurian Sea, NW Mediterranean**

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The sperm whale (*Physeter macrocephalus*) has unique body features and its size can be estimated using acoustic and photogrammetric techniques. Measuring animal body size, an important characteristic affecting physiological, ecological and life-history traits of a species, can function as tool for summarising diverse biological information. Here, we present photogrammetric body length estimates of sperm whales from the Ligurian Sea. Visual and acoustic shipboard surveys, performed ad libitum between 2008 and 2011, resulted in 239 animals acoustically detected, tracked and recorded. When possible, simultaneous photo-identification pictures and distance to the animal, obtained through a laser rangefinder (LRF), were collected. The camera/lens and the LRF were previously calibrated to relate the distance and the photograph to the fluke span; body size was estimated through a regression equation, previously described for this species. Out of 87 identified whales it was possible to estimate the body length of 40 (45.9%); their size ranging between 7.94-12.88 metres. Based on the current knowledge of sperm whales occurrence in the area, we assumed all animals to be males; accordingly, their age ranged between 6 and 23 years. These findings support earlier acoustic body measurements from the same area. Animals smaller than 9.45 metres (46.3%) were encountered in loose aggregations, while larger individuals (53.7%) were mostly observed alone, confirming what previously reported in the literature. These data represent the first photogrammetric sperm whales length estimates for the Mediterranean Sea, where the population classifies as “Endangered”. This technique does not preclude animals identification, is fast processing and allows several replicates; furthermore, it is very cost-effective not requiring any special equipment. For these reasons it represents a useful tool to evaluate both individual life-history and population parameters, such as growth rate, community structure, size related distribution, density, and home ranges, essential to address conservation issues and establish management measures.

E 07

**Non-pup Steller sea lion annual mortality rate on rookeries in Russian Far East**

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Until the middle of the last century Steller sea lion (SSL) was considered to be a quite prosperous species, but nowadays it undergo through a catastrophic decline and is in a state of depression. Among the possible reasons of the decline the adult and immature SSL (the animals at the age of 1 year and older) mortality numbers increase was named. In condition of high concentration of animals on the reproductive rookeries, where sea lions gather during breeding season, the risk of factors (infectious diseases, starvation, conflicts with predators, intraspecific conflicts, etc.) is maximal. Based on nine year observations on the eight of ten major rookeries located in the Russian Far East we evaluated causes of mortality during breeding season. We are estimate annual mortality rate (AMR) as proportion of cumulative number of dead animals discovered on each rookery during each season of maximum non-pup count. Estimated AMR for all sites combined during our study was 0.48%. The majority of observed mortality events caused by intraspecific conflicts. Adult males caused the most of the deaths. At six rookeries AMR did not exceed 0.29%, but it was an abnormally high on two rookeries located on Brat Chirpoev and Lovushki Islands (0.80% and 1.19% accordingly). We observed several bull-killers on these rookeries that were responsible for intentional and/or accidental kills of females and both sex juveniles during copulation events occurred in tidal pools or lasted unusually long. Entangled sea lions were regularly observed on rookeries, but no mortality event from entanglement was recorded. Killer whales were regularly seen in proximity of the rookeries and several harassment attempts were observed. But none of them ended with a successful kill. In general AMR on the rookeries in Russian Far East during the breeding season compose only a small proportion of the annual mortality.

# FEEDING/FORAGING

F 01

## What's for dinner? Diet composition of grey seals (*Halichoerus grypus*) and harbour seals (*Phoca vitulina*) in Swedish waters

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The digestive tract from nearly 400 grey seals (*Halichoerus grypus*) from the Baltic Sea and 40 harbour seals (*Phoca vitulina*) from the Kattegat and Skagerrak, collected between 2009 and 2011, were examined. The seals had been shot, by-caught or found dead. Whole prey items, otoliths and other hard parts were sampled from the stomach, small intestines and, if possible, faeces for identification to the lowest possible taxon. Nearly 30 species were found in the harbour seals diet, where herring (*Clupea harengus*), cod (*Gadus morhua*) and whiting (*Merlangius merlangus*) were found in 43%, 43% and 33% of the seals analysed. For grey seals, about 20 fish species were identified and the most common ones were Baltic herring (*Clupea harengus*) (both in frequency and biomass) and sprat (*Sprattus sprattus*) which were found in 61% and 21% of the seals. Cod was also an important prey for seals from the Baltic proper as whitefish (*Coregonus lavaretus*) was for seals from the Gulf of Bothnia. In general, a grey seal digestive tract contained one to three species, while the majority of digestive tracts from harbour seals contained three or more species. Compared to studies from the 1970th, our result showed a shift in grey seal diet with an increase in herring intake and a decrease in cod. As for harbour seals, our result show similar pattern with studies from the 1980th where cod and whiting are among the most frequent prey fish along with herring. A difference was the lack of lemon sole (*Microstomus kitt*) in our study and the increase in flounder (*Platichthys flesus*). By knowing their choice of prey we can understand their effect on fish stock biomass and recruitment as well as evaluating seal health status by doing contaminant studies on both seals and prey fish.

F 02

**Fractionation of stable isotopes in fin whale tissues and their application to diet assessment in cetaceans**

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The use of stable isotopes to study diet composition requires knowledge on fractionation factors ( $\Delta^{13}\text{C}$  and  $\Delta^{15}\text{N}$ ) between the consumer and its food. These are calculated as the difference between the isotopic signal of the consumer tissues and that of its food items. Fractionation factors have only been determined in species in captivity subject to controlled and constant feeding over a period of time large enough to ensure that the isotopic signal has turned over to fully reflect diet. Because large whales cannot be kept in captivity, their fractionation factors have never been determined. Fin whales from northwestern Spain are known to base their diet almost solely on the euphausiid *Meganyctiphanes norvegica*, and their muscle isotopic profile (n=63) does not vary with age, for which it can be assumed that the diet of the population remains fairly uniform and constant. Therefore, fractionation values can be reliably calculated from this wild population. To do so, we determined the stable nitrogen and carbon isotope ratios in muscle, bone, skin, liver, kidney, brain and stomach of 11 fin whales and their food source (*M. norvegica*), all collected in northwestern Spain.  $\Delta^{15}\text{N}$  values between krill and whale tissues ranged from 2.33 to 3.94‰ and those of  $\Delta^{13}\text{C}$  from 1.24 to 3.11‰, the variation being consistent with that found in other groups of mammals and attributed to the varying composition and physiology of the tissues. Given that fractionation factors are relatively constant between taxonomically close species, results from the fin whale may be extrapolated to other cetaceans. The fractionation factors of skin are of particular relevance to the monitoring of diet through biopsies or other non-destructive sampling methods.

**F 03**  
**Fisheries development does not affect the diet of South American sea lions (*Otaria flavescens*) in southern Brazil**

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Although incidental bycatch is often considered a main negative impact of fisheries on marine mammals, depletion of food resources due to overfishing is also of major concern. Industrial bottom trawling in southern Brazil has developed since 1990 and has resulted in a significant reduction in the average individual size of the exploited fish species, which in turn resulted in a reduction in biomass of species situated at higher trophic level. Stable isotopes of carbon and nitrogen have been used to assess whether these changes have affected the diet of the South American sea lions, *Otaria flavescens*, foraging in the region. Male sea lions prevail in southern Brazil and are thought to disperse from the breeding colonies in Uruguay. Bone samples were collected from the skulls of 47 males from this species that were found dead stranded in southern Brazil from 1986 to 2010. Samples were grinded, soaked in 2:1 chloroform:methanol solution to extract lipids, treated with hydrochloric acid to remove inorganic carbon, and analysed using a mass spectrometer. Male age was assessed by counting growth layers in the dentine of canines. No statistically significant correlation was found between stranding year and the values of  $\delta^{13}\text{C}$  or  $\delta^{15}\text{N}$ , either for the whole sample or for subsamples including only males younger than 7 years (immature males) and older than 6 years (adults). Furthermore, no statistically significant differences were observed in the  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  of males of any age class stranding before and after the development of the fishery (1990). These results suggest that the development of the industrial fishery has not caused relevant changes neither in diet composition nor in patterns of habitat use by South American sea lions, even if changes in food availability have occurred.

*Research funded by Fundación BBVA*

**F 04**  
**Stomach contents of Northern bottlenose whales (*Hyperoodon ampullatus*) stranded in the NE Atlantic**

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We have analysed the stomach contents of nine northern bottlenose whales, *Hyperoodon ampullatus*, stranded in the NE Atlantic (Scotland, N=6, England, N=1, Ireland, N=1, and The Netherlands, N=1). Seven of the whales were sub-adults and at least six of them had stranded alive. In addition, all but one whale (recorded in the River Thames in January 2006) were stranded between August and October which corresponds with the main period of southward migration for the species. All nine whales sampled had food remains in their stomachs although no fish and few crustacean remains were found. Twenty-one cephalopod species were recorded, the most abundant taxa being *Gonatus* sp., *Histiotheutis* sp., *Teuthowenia* sp. and *Taonius pavo*. Only small amounts of cephalopod flesh were found in three of the stomachs. Given that cephalopod beaks can remain within the stomach for several days, and that there was no evidence of inshore feeding (no coastal species were present among the prey), the whales may not have fed for several days prior to stranding. As previously recorded in other deep diving teuthophagous cetaceans, two animals had ingested small amounts of plastic debris. The causes of the stranding of deep diving cetaceans in areas surrounded by relatively shallow waters, such as the British Isles and the North Sea Basin, are still unclear but often involve younger animals entering coastal waters where they do not feed resulting in dehydration and loss of nutritional condition.

F 05

## Long-term studies on stable isotopes reveal no change in the diet of South American fur seals along the southern Brazilian coast

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High levels of fishing have altered the structure of many ecosystems, depressing the average trophic level of heavily exploited ecosystems. The coastal fisheries of southern Brazil operate utilizing diverse gears from coastal to offshore waters and currently many commercial stocks are overexploited or fully exploited. South American fur seals, *Arctocephalus australis*, do not breed in southern Brazil, but migrate seasonally to forage. This species is not a boat follower and hence do not interact directly with fishing operations, but competitive interactions cannot be discarded. In this scenario, the intense exploitation of marine resources in southern Brazil might have resulted in a drop of the average trophic level of this high trophic level predator through time. Stable isotopes of carbon and nitrogen were analysed to test this hypothesis. Skull samples (turbinate bones) were taken from 45 adult male of South American fur seals from two scientific collections at southern Brazil. These animals were found dead on shore along the coast of southern Brazil from 1994 to 2009. Age determination was made by counting growth layer groups in the teeth and only adult males older than seven years old were used for further analysis. Bone samples were dried in a stove at 60°C for 36h and grounded to a fine powder. Lipids and inorganic carbon were both removed with a chloroform/methanol (2:1) solution and hydrochloric acid (0.5N), respectively. Dried samples were weighed into tin capsules and analysed with a continuous flow isotope ratio mass spectrometer. No statistical significant correlation was found between stranding year and the values of  $\delta^{13}\text{C}$  or  $\delta^{15}\text{N}$ , which were rather constant through time. This result reveals no major change in the diet of fur seals since 1994, although changes over a broader time span, as consequence of human activities, cannot be ruled out.

Research funded by Fundación BBVA

**F 06**  
**Evidence of salmonids in the diet of grey seals (*Halichoerus grypus*) in southwest Ireland**

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Grey seal abundance in Ireland has increased steadily since the first population assessment in the 1960's. This increase has resulted in seals and fisheries competing for dwindling fish stocks. To address this competition robust data on the diet of seals is necessary. To date there is relatively little known on the diet of grey seals in Ireland, in particular on the south-west coast, as the limited studies to date were conducted on the south-east and west coasts. We present new information on the diet of grey seals from a nationally important colony at the Great Blasket Island, Co. Kerry, with particular reference to commercially important species such as salmonids. Both seasonal and inter-annual variation in grey seal diet was investigated based on the recovery and identification of sagittal fish otoliths, bones and cephalopod beaks from 136 faecal samples, collected between 2009 and 2010. A total of 969 prey items were recovered, representing a minimum of 47 individual prey species. The diet was dominated by Gadiformes, particularly *Trisopterus* species, while seasonal and inter-annual differences in sandeel (*Ammodytidae*) abundance were also apparent. These variations may be attributed to differences in yearly recruitment levels, changes in fish migration timings and seals foraging range and/or differing energy requirements during the seals annual life cycle. Other families such as Salmonidae, Callionymidae, Pleuronectidae and Cephalopod species were also present in the diet in varying quantities. Up to 35% by mass of the diet comprised salmonids. This is the first study in Ireland to identify salmonids in substantial numbers in the grey seals diet, with remains recovered from 25% of samples during the months of February and April. Overall, results indicate that grey seals in this region display an opportunistic, generalist feeding strategy, foraging throughout the water column on species which are locally and seasonally abundant.

**F 07**  
**Long-term foraging of bowhead whales (*Balaena mysticetus*) in the eastern Canadian Arctic described using stable isotope ratios in baleen**

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Bowhead whales (*Balaena mysticetus*) in the eastern Canadian Arctic migrate seasonally between Hudson and Davis Straits in winter to northwestern Hudson Bay/Foxe Basin and Gulf of Boothia in summer. Habitat use, including where and when bowhead whales feed across their annual range, is poorly understood. Chemical signatures in baleen, which grows continually and is biochemically inert once formed, provide a means to study eastern Arctic bowhead whale foraging patterns because dietary changes over short time increments are recorded in its stable isotope and trace element composition. We measured stable carbon and nitrogen isotope ratios ( $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$ ) along baleen plates from ten eastern Canada-West Greenland (EC-WG) bowhead whales, and found evidence for annual oscillations in both  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$ .  $\delta^{13}\text{C}$  oscillations typically measured less than 1‰, but the magnitude varied from year to year and was sometimes as great as 2-2.5‰.  $\delta^{15}\text{N}$  oscillations were more consistent than  $\delta^{13}\text{C}$  oscillations, and typically measured 0.5-1‰ (maximum 2-2.5‰). Stable sulphur isotope ratios ( $\delta^{34}\text{S}$ ) were measured along three of the ten plates, and also showed oscillations of approximately 0.5‰ (maximum 1-1.5‰). The magnitude and patterns of oscillations varied among individuals indicate seasonal and interannual changes in diet, which could be due to seasonal fasting (e.g., enrichment in  $\delta^{15}\text{N}$  and  $\delta^{34}\text{S}$  resulting from protein catabolism) or feeding in locations across their annual range with different isotopic signatures.

F 08

**Prey selection influence on killer whale (*Orcinus orca*) behaviour in Avacha Gulf (Kamchatka, Northeast Pacific)**

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Prey selection is connected to a trade-off between the costs of foraging activity and the benefits from prey intake. Studying animal behaviour dependent on various prey types is important for understanding the costs of foraging and prey selection mechanisms and for effective conservation planning. In Avacha Gulf (Kamchatka, Northeast Pacific), killer whales spend about half of their time foraging. Atka mackerel (*Pleurogrammus monopterygius*) and salmon (*Oncorhynchus* spp) species are the main killer whale prey in Avacha Gulf with fundamental differences in biology and patterns of distribution in the area during the summer season. These commercial fish species have been under severe pressure from illegal fishing in Kamchatka. In 2007 an important Atka mackerel breeding ground and killer whale feeding area in Avacha Gulf became depleted due to overfishing. The aim of this study was to compare killer whale behaviour between two periods: (1) 2005-2006 when killer whales were mostly foraging on Atka mackerel and (2) 2007-2010 when killer whales were foraging on salmon and no observed foraging on Atka mackerel occurred. We analysed 177 foraging events observed during work with 240 killer whale aggregations. The length and frequency of foraging events became significantly higher when killer whales started to feed only on salmon ( $p < 0.05$ ). Foraging on salmon occurred significantly more often in dispersed aggregations than in compact groups compared to foraging on Atka mackerel ( $p < 0.05$ ). Since 2007 we observed a positive correlation between seasonal salmon abundance and the average number of killer whales visiting Avacha Gulf. Atka mackerel form large, tight spawning colonies which are more predictably distributed in the area than small scattered groups of migrating salmon. Killer whales spend less time detecting Atka mackerel colonies and probably less energy than for detecting salmon groups. They use collective techniques hunting on Atka mackerel compared to solitary hunting on salmon.

F 09

**Eat locally, move globally: individual movements and foraging strategies of grey seals at the periphery of their range**

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The southernmost grey seal colony in the Northeast Atlantic is located in the Marine Natural Park of Iroise (Brittany, France). Twelve seals were fitted with GPS/GSM tags (SMRU) in 2010 and 2011 in order to document their movements and behaviour. They spent over 75% of the tracking time within the limits of the marine park. Five seals moved to other grey seal colonies in Cornwall, the isles of Scilly, Ireland, Wales, or even Scotland (up to >1200 km from the capture site). In Brittany, foraging trips were usually located 5 to 15 km from the seals' haulouts. Seals returned repetitively to the same foraging areas during several months, or even from one year to the next. There was however little overlap between individual preferred areas. When seals moved further north, their foraging return trips were located at a much greater distance from haulout (up to 70-130km from the isles of Scilly, 50-75km along the Irish coast and 150-200km from the Scottish isles). Such geographical differences in foraging strategies could be due to differences in prey availability and/or competition with congeners, their numbers being much lower in Brittany than in the southwest British Isles and Ireland. Combined to previous telemetry data, maps of grey seals habitat use within the Marine Natural Park of Iroise are provided to managers, with a particular emphasis to potential interactions with fisheries. The frequency and distance of seal movements between colonies of different countries highlight the need for an international network for the management of this protected species as well as the interactions between seals and fisheries.

**F 10**  
**Zooplankton prey species of humpback whales off the Commander Islands, Russia**

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Waters of the Commander Islands are known to be an important feeding ground for humpback whales. The earlier stable isotope analysis revealed the low trophic level of humpback whale prey in the region, which means that they feed on zooplankton rather than on fish. The goal of this study was to analyze the size and species composition of plankton to find which species are the most likely humpback whale prey in the region. We collected the plankton samples with a net of 500  $\mu\text{m}$  aperture in the 0-100 layer every two weeks from June through September (13 stations in total) off the western coast of Bering Island. Various copepods were the most abundant in the samples during the whole season, including the large oceanic species *Neocalanus* spp. and *Eucalanus bungii*. *Chaetognatha Parasagitta elegans*, *trachymedusae* *Aglantha digitale*, and *hyperiidae* *Themisto* sp. were also regularly observed in the samples. In the most coastal samples we found *Mysidacea*, which were apparently caught in the near-bottom layer. Various hydromedusae and invertebrate larvae (*mollusca*, *Polychaeta* and *Decapoda*) were also observed in the coastal samples. The large plankton euphasiid species (mostly *Thysanoessa inermis* and *Traschii*) were occasionally caught on different stations during the season, but usually these were just single catches. *Euphasiidae* were caught in mass – about 50 specimens per sample (which is, 2.5 specimens per 1m<sup>3</sup>) – on the most offshore station during the night sampling in August. Therefore, *euphasiidae* stay at depth during the day, but rise to the surface at night. According to their size, *euphasiidae* appear to be the most likely prey of humpback whales, but the intensity of whales feeding may be limited by the circadian movements of *euphasiidae*. Indeed, during the day we usually observed the whales feeding at depth, while the mass surface lunge-feeding was seen only at dusk.

**F 11**  
**Stable isotopes as indicators of diet and feeding ecology in high trophic level marine mammals: ground truthing results**

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Stable isotopes are increasingly used to describe feeding ecology and to produce mixing models, sometimes in the absence of other data, to indicate prey. However, the assumptions associated with mixing models may be problematic.

Four species that coexist in South Australia are examined as a case study. Diet and feeding ecology were investigated using carbon and nitrogen stable isotope and stomach contents analyses. Opportunistically collected carcasses of three dolphin species, *Tursiops australis* (n = 39 individuals for SIA and n = 91 stomachs), *T. truncatus* (n = 14, n = 14), *Delphinus delphis* (n = 44, n = 93) and Australian sea lions, *Neophoca cinerea* (n = 38, n = 93) were analysed.

Intra-specific similarities in *D. delphis* suggested these feed on similar diets throughout its range. By contrast, there were clear differences in *T. australis* from adjacent areas. *T. australis* and *D. delphis* fed at a similar trophic level (TL), *T. truncatus* fed at a higher TL. Delta15N suggested *N. cinerea* fed at the highest TL and shark tissue was found in the stomach contents, but this was shark eggs. The TL indicated by  $\delta^{15}\text{N}$  is likely to be similar for an egg and the parent that produced it, such that it would reflect similarly in a predator's  $\delta^{15}\text{N}$ . However, the ecological implications of preying on shark egg versus adult shark are very different. Furthermore, the life history of *N. cinerea* includes regular bouts of fasting which influences  $\delta^{15}\text{N}$ . During fasting an animal's tissue may be catabolised, increasing  $\delta^{15}\text{N}$  as the animal is effectively "consuming itself".

This case study demonstrates the utility of combining complimentary methods and including other ecological data for studying feeding ecology, particularly when producing mixing models from stable isotope signatures. It also indicates the importance of conventional dietary methods such as stomach content analysis.

**F 12**  
**Experimental insights and observational evidence of prey switching by killer whales (*Orcinus orca*) in the Northeast Atlantic**

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Studies in the Pacific have identified distinct killer whale ecotypes that are either specialized mammal- or fish-eaters. The different types have developed specialized hunting strategies that would suggest specialization could be more advantageous than generalist. However, it has been suggested based on long-term dietary markers of tooth wear and stable isotope values that lineages in the north Atlantic are generalist, but with individual variation in the proportion of prey consumed. Here, we present the results of ten years of observational and photo-identification data of a population of killer whales that follows the Norwegian spring-spawning stock of Atlantic herring. The observations were predominantly of feeding upon herring, but included three observations of one pod interacting with seals. This pod was also observed feeding on herring in association with other known herring-eating killer whale pods. This supports the hypothesis based on the long-term markers of a degree of specialization, with small number of groups persistently feeding upon mammals, but switching between herring and seals. We further investigated this prey switching using an experimental approach by conducting playbacks of Norwegian herring-eating killer whale sounds to Norwegian harbour seals at haul-out sites on the herring spawning grounds. The responsiveness of the Pacific harbour seals to familiar fish-eating has been shown to be optimized to reduce losing foraging opportunities by not responding to cues that do not illicit a threat. Conversely, we recorded changes in behaviour consistent with an anti-predator response, suggesting the seals perceived the herring-eating killer whales as a potential threat and had not habituated to their calls. This could be due to the risk of herring-eating killer whales switching to mammalian prey, or the difficulty of discriminating between killer whale pods due to the large population size and number of killer whale call dialects in this population, or a combination of both.

**F 13**  
**Prey engulfment in phocid seals studied with high-speed cameras and accelerometry**

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A key component in understanding the ecological role of marine mammal predators is to identify how, where and how much prey they capture in time and space. Satellite and archival tags on pinnipeds normally only render dive and geolocation information, and foraging events are then guesstimated to take place in certain portions of the dive. However, specific movements of the head and jaws may provide reliable feeding cues by involving fast specific changes in acceleration. These might even be prey or context specific. To test this we trained harbour seals (*Phoca vitulina*) to wear multisensor Dtag3, with triaxial accelerometers sampled at 500Hz, on their head. Seals were trained to swim towards and catch prey in front of two underwater digital high-speed video cameras.

The results show that harbour seals apply both suction and raptorial feeding. Specific jerk signatures and the speed of suction feeding were found and related to actual prey captures documented by video. These results demonstrate that reliable feeding cues can be recorded using fast-sampled accelerometer tags on free ranging pinnipeds in their natural marine environments, holding a very promising prospect for long term studies of their foraging ecology and field energetics.

**F 14**  
**20,000 leagues across the sea: modelling two-dimensional habitat use of Southern elephant seals**

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Southern elephant seals (*Mirounga leonina*) are deep-divers travelling thousands of kilometres in the Southern Ocean between their breeding and moulting sites and their feeding areas during their post-breeding and post-moulting migrations. Identifying these foraging areas by combining tracking data and dive data has already been done and correlating them with oceanographic variables has often been done considering only covariates from the surface of the ocean. In this study, the foraging areas of 59 elephant seals tagged between 2004 and 2009 on the island of South Georgia were investigated. A grid of 100x100km cells was created over the tracks and time spent in each grid cell was calculated to identify where seals spend most of their time at sea. Differences between males and females and postbreeding and post-moulting migrations were investigated. Different Generalised Estimating Equations (GEEs) were fitted with static and dynamic oceanographic variables to characterise the areas where searching/foraging events occurred. Gridded time spent plots showed that males and females spend time in different areas. Also, males tend to travel to specific areas and spend a lot of time there while females do not spend as much time in one specific area but search/forage in many areas. Seals were also shown to travel further away from South Georgia during the post-moulting migration than during the post-breeding migration. Statistical results showed that seals tend to search/forage in areas of higher seabed roughness. Females' searching/foraging areas also have a slightly lower seabed roughness than males'. Distance from tagging point and year were also significant covariates but indicators of water turbulences such as current speed or eddy kinetic energy were not. However, these results should be considered carefully as the GEE models could not be assessed properly.

# GENETICS

G 01

## Testing the potential use of environmental DNA (eDNA) for genetic monitoring of marine mammal populations

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The assessment of species distribution is a first critical phase of biodiversity studies and is necessary to many disciplines such as biogeography, conservation biology and ecology. However, several marine mammal species are difficult to detect, for example the harbour porpoise is small and produces ultrasonic clicks with a low active space. Detection by visual and acoustic surveys is therefore limited to within a few hundred meters of the survey platform. Here we present a novel approach, based on the limited persistence of eDNA in the environment, to detect the presence of a harbour porpoise in seawater. We use specific primers that amplify short mitochondrial DNA sequences to track the presence of harbour porpoise in controlled environments and at sea where the probability of false negatives were assessed using acoustic detection on c-pods. To determine the range from the organism that eDNA could be detected we conducted sampling at various distances away from a netted off sea pen containing 4 individuals. We also tested the ability to identify the different lineages present within the sea pen. We could successfully detect harbour porpoise, but the geographic range of detection was quite small and comparable with that by visual and acoustic surveys. However, this method does offer additional insights in to population structure and could therefore be complimentary to visual and acoustic surveys.

G 02

## The “southern form” of short-finned pilot whales (*Globicephala macrorhynchus*) in Taiwanese and more southern tropical West Pacific waters

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Short-finned pilot whales (*Globicephala macrorhynchus*) are widely distributed throughout temperate to tropical pelagic regions of the Atlantic, Indian, and Pacific Oceans. Evidence suggests that this species may be a complex of multiple species or subspecies, and particularly that the “Southern form” of southern Japanese waters is distinctive morphologically, ecologically, and genetically. However, this whale species in the tropical west Pacific is poorly studied and much about its status remains uncertain. To determine the phenotype(s) and genotype(s) of short-finned pilot whales in this region, we examined 892 photographs taken from 11 groups at sea, body length and photographic records of 14 stranded whales, and genetic data (derived from a 700 bp mitochondrial DNA control region fragment) of five stranded whales from Taiwanese waters. We also examined a video clip of short-finned pilot whales filmed in the South China Sea, as well as a 580 bp mitochondrial DNA control region fragment collected from two whales in Philippine waters. Our results revealed both morphological and genetic similarities to published data on the previously more northerly located “Southern form” of short-finned pilot whales. Moreover, the data supports a previously reported study indicating that the genetic diversity of the “Southern form” of whales is relatively higher than that in other *Globicephala* populations. Our study is highly suggestive of a more southward distribution of the “Southern form” of short-finned pilot whales into the tropical west Pacific, although more observational and genetic study is required to determine the southern range extent of the Southern form of short-finned pilot whales in the west Pacific Ocean.

G 03

**Social structure and relatedness patterns in male bottlenose dolphins (*Tursiops* sp.) of western Shark Bay, Western Australia**

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Alliance formation among males for the purpose of competition over oestrous females provides an evolutionary puzzle, as males cooperate to obtain a resource that cannot be shared. Kin selection may provide an evolutionary explanation for male cooperation, as males may gain indirect fitness benefits by cooperating with relatives. In the eastern gulf of Shark Bay, male bottlenose dolphins (*Tursiops* sp.) form multi-level alliances. On the first level, allied pairs or trios cooperate to sequester females in reproductive condition. On the second level, alliances cooperate to capture females from other alliances or to defend against theft attempts. Analyses of relatedness among cooperating males revealed contrasting results. Males in stable first-order and the derived second-order alliances are often closely related, while those in large second-order alliances are not more closely related than expected by chance. In this study, we assessed (i) the social structure of male bottlenose dolphins in the western gulf of Shark Bay, and (ii) whether or not these males preferentially form alliances with maternal kin. Data from five field seasons were analysed using the social analysis program SOCPROG. Coefficients of association (CoA) using the simple ratio index revealed that males in the western gulf of Shark Bay also form first- and second-order alliances. Furthermore, we assessed matrilineal genetic relatedness by sequencing a 426 base pair mitochondrial DNA fragment comprising parts of the hyper-variable region I.

G 04

**A genetic study of the harbour porpoise's comeback around French coasts**

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The two SCANS campaigns highlighted a global shift in harbour porpoise distribution in European waters during the last 15 years. Since the mid-90s, this species came back along French Atlantic coasts and in English Channel to become today one of the most abundant cetacean species. Using a genetic approach, we have investigated the potential origins of this come-back by analysing stranded and by-caught harbour porpoises. The main questions were to test whether these individuals were coming from genetically distinct populations and to confirm their geographical origin(s). For that purpose, we sequenced a 581 base-pairs fragment of mtDNA control region and genotyped 7 microsatellite nuclear loci from 52 harbour porpoises sampled between 2000 and 2010 along French coasts. The analysis of the mtDNA control region discriminated two genetically distinct groups that were also found when comparing our sequences with previously published by others on Genbank: one of these groups was closely related to the Iberian and African harbour porpoises, and the second one was closely related to individuals from the more northern waters of Europe. Harbour porpoise found today along French coasts clearly possess a double genetic origin. The analysis of nuclear polymorphisms assessed using the microsatellite loci did not retrieve such group distinction. The difference between the two markers can be explained by the difference in heritability, the mtDNA being maternally inherited in contrast to nuclear loci that are bi-parentally inherited. Our results therefore provide evidence that a major proportion of our sampling is composed of admixed individuals between the two genetically distinct populations previously identified along the Iberian coasts and in the North Sea and adjacent waters. The French Atlantic coasts are nowadays clearly a place where two previously separated populations of harbour porpoises are meeting now. They therefore deserved a special attention, especially in terms of conservation.

G 05

**Spatial and temporal patterns of population structure of humpback whales in west coast of Africa**

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In the eastern South Atlantic Ocean (breeding stock B), humpback whales are distributed along the western coast of the African continent, from Gulf of Guinea to western South Africa. Several questions remain over the population structure of stock B. The most recent data available suggest that Breeding stock B is possibly sub-structure, with a B1 sub-stock that breeds in Gabon and possible in other areas of Gulf of Guinea through Angola and B2 sub-stock, where west coast of South Africa represents a summer feeding ground and/or a winter migration corridor for this sub-stock but the respective location of the breeding ground for this whales are unknown. In this work an evaluation of spatial and temporal population structure in humpback whales on the west coast of Africa using maternally (mitochondrial DNA control region) and bi-parentally (10 microsatellites) inherited markers was conducted. It was amplified, sexed, genotyped and sequenced a total of 2018 samples from B1 (Gabon, Angola, São Tomé) and B2 (West South Africa) regions. The results revealed significant genetic divisions at spatial (between regions) and temporal (between seasons) scale between B1 and B2 sub-population, even with high gene flow and current interchange between the two regions. The work presented here provide additional information on humpback whale population structure of stock B, the results indicate that there is some spatial and temporal population substructure in humpback whales in B stock and support previous data that the whales sighted in B1 region have at least two feeding migratory destinations.

G 06

**Mitochondrial DNA control region diversity of the bottlenose dolphin (*Tursiops truncatus*) from the Adriatic Sea**

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The bottlenose dolphin (*Tursiops truncatus*), is the only resident marine mammal species of the Adriatic Sea. This species is considered endangered due to intensive eradication operations in the middle 20th century and is legally protected. Genetic variability is considered prerequisite for the long - term persistence and adaptability of populations. The aim of this study was to investigate the level of mitochondrial DNA control region diversity in the bottlenose dolphin population from the Adriatic Sea. Total genomic DNA from muscle samples of 108 bottlenose dolphins found dead during the period from October 1997 to September 2011 both on Croatian (106 individuals) and Italian (2 individuals) coast of the Adriatic Sea was extracted. 739 bp –long fragments of the mtDNA control region were amplified and sequenced with universal MTCRf primer and a newly-designed primer DUPr. Totally, 11 haplotypes with 26 polymorphic sites were identified, with a nucleotide diversity of  $0.010452 \pm 0.005435$  and gene diversity of  $0.6108 \pm 0.0494$ . Haplotype DD01 was the most frequent (65 individuals, 60.2%) and was shared between Croatian and Italian samples. The second Italian sample was separated into its unique haplotype. Both estimates of haplotype diversity and nucleotide diversity for Adriatic bottlenose dolphin population were lower than those found in the western Mediterranean Sea.

# HABITAT USE

HA 01

## **Temporal patterns in habitat use of harbour porpoises (*Phocoena phocoena*) in Broadhaven Bay, northwest Ireland**

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Acoustic data loggers, C-PODs, were used to investigate the habitat use of harbour porpoises in Broadhaven Bay, Co. Mayo, northwest Ireland during 2010. These devices were located 10km apart at the entrance (LS4) and in the inner part of the bay (LS2), respectively. Detection positive minutes per hour (DPM/h) were extracted for both locations, manually checked against the raw files, and analysed with respect to seasonal (Julian day), daily (daylight, dawn, dusk and night) and tidal patterns (hours after high water, fitted as a cyclic smoother) using Generalised Additive Models (GAMs) with quasi-poisson distributions. At LS4, a tidally active area, higher detection rates were recorded (88.8% positive days) in comparison to LS2 (28.9% positive days). However, the same seasonal pattern was identified for both stations, with lowest values recorded during summer and a peak in winter. Significantly higher DPM/h was recorded during the night than during daylight hours at LS4. However, harbour porpoise occurrence (presence/absence) at the same location showed no significant difference between night and day, indicating that harbour porpoises may travel through the area at day and dwell during the night due to feeding activity. An examination of the behaviour by analysing click trains could support this assumption. This daily pattern was absent in the inner part of the bay, where a significant tidal pattern was detected instead, with highest DPM/h just after low water and lowest rates around 2-4h after high water. The fact that this parameter was non-significant at LS4, combined with the difference in detection rates between the two locations, suggests that the area at the entrance of the bay provides feeding opportunities at all states of the tidal cycle and porpoises follow a daily pattern of feeding activity, while tidal currents may primarily dictate feeding opportunities in shallower waters of LS2.

HA 02

**Interactions between porpoises and oceanographic variables to inform the deployment of a tidal energy device**

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This project examines the relationship between small scale oceanographic variables and harbour porpoise (*Phocoena phocoena*) distribution in a tidal stream area off the Isle of May in the Firth of Forth, Scotland. The objective is to identify significant determinants of porpoise distribution within the study site with particular reference to the biophysical characteristics of the habitat and to identify how any changes to the vertical habitat during operation of a small scale tidal device might influence porpoise distribution. A detailed preconstruction oceanographic study using continuous recordings of water column biological and physical characteristics alongside passive acoustic monitoring and land based observational surveys on marine mammal distribution in the area was undertaken in the summer of 2010 and 2011. Porpoises were acoustically detected almost every day (99%, n= 107 days) with a mean of  $1.25 \pm 0.07$  (se) detection positive minutes (DPM) per hour and a maximum of 40 DPM per hour. There was a strong diel influence on detections with a significant difference in DPM per hour of day (Kruskal-Wallis  $p < 0.0005$ ) with most detections at night. Tide direction (ebb/flood, Kruskal-Wallis,  $p > 0.5$ ), lunar phase (Kruskal Wallis,  $p = 0.7$ ) and current speed (Kruskall-Wallis  $p = 0.8$ ) all had no significant effect on porpoise presence. Sea surface temperature (Wilcox test  $p < 0.0005$ , chlorophyll levels (Wilcox test  $p < 0.0005$ ) and strength of the thermocline (Wilcox test,  $p = 0.01$ ) had a significant effect on porpoise presence with less porpoise detections in more thermally stratified water and more detections in higher levels of chlorophyll. Seasonal variation was also apparent, related to changes to the oceanographic variables as the summer progressed. These data will allow greater understanding of the fine scale habitat use of porpoises related to local biophysical conditions.

**HA 03****Data of opportunity for the study of the spatial patterns of an estuarine population of bottlenose dolphins (Sado Estuary, Portugal)**

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The Sado estuary harbours one of the few resident bottlenose dolphin populations known in Europe, on which a number of specific scientific studies have been carried since the 1980's. The estuary is regularly crossed by ferries and passenger catamarans that travel between the city of Setúbal and the Tróia peninsula on regular routes that cross an area of known importance for the bottlenose dolphin population, for it is a mandatory passage way when entering and exiting the estuary, which makes these vessels a privileged observation platform to study the spatial patterns of the population. Our approach was to use data collected by skippers and crew members for the study of the bottlenose dolphin population's spatial patterns. A number of training actions were deployed and an observation protocol was developed that includes recording the location of observations on a map, together with the corresponding date and hour, surface behaviour, activity, travel direction and group size. During 2011 (365 days) 373 valid observations were registered showing a spatial pattern consistent with previous studies, with a preference for the south channel of the estuary and the main activity being travelling, followed by feeding and socialization. The data were also analysed in relation to the tide phase and the results showed a significant correlation between the travel and tide directions. These findings show the potential of non-specialized or dedicated observations in long term monitoring studies of cetacean populations.

HA 04

**Habitat preference between groups of Risso's dolphins as evidence of coastal nursery areas**

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Previous studies have shown strong site fidelity by Risso's dolphins at a site off Pico Island, Azores. Females with calves tend to be seen together, often with newborn calves. In this study we analyse position and photo-identification data gathered on ocean surveys from 2004 to 2007 to look at the distribution of females with calves of different ages (newborns to 6 months old, 6 months to 2 years and 2 to 4 years) and compare it with pods with no calves present. The association of the different groups with selected ecogeographical variables was tested, and a maximum entropy model was used to create habitat suitability maps, using a 50mx50m grid. The female pods with younger calves were found to have a significantly distinct distribution from those with older calves or without calves. The main difference was that the pods with younger calves tended to be found closer to the shore, whereas the other groups used a wider offshore area. More extensive sampling is required in order to validate the existence and geographical distribution of coastal nursery areas for this species. However, we believe the present data is enough to elicit precautionary conservation measures to reduce human impact on a vulnerable part of the dolphin society, such as that associated with boat traffic, whale watching and swimming with dolphins operations.

HA 05

**Towards an objective and quantitative approach for dolphin habitat: characteristics of bottlenose (*Tursiops* sp.) and spinner dolphin (*Stenella longirostris*) habitat and their application to management and conservation**

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Quantitative and comprehensive information related to cetacean habitat usage is considered a priority in the establishment and development of management plans for marine protected areas where cetaceans are resident or migrant. However, in many cases, cetacean habitat has been investigated only by relating distribution patterns to a limited number of environmental factors or classification to a relative habitat “type”. Few studies have quantitatively measured more than one environmental variable, which therefore places limits on a clear understanding of cetacean habitat. The primary objective of this work was to develop a rationale in which to expand our understanding of dolphin habitat and what it actually means for these animals. In order to do this we developed an approach to test fine-scale in-situ field techniques aimed at quantitatively describing habitat which were then applied to two case studies. The first case study focused on a small population of spinner dolphins (*Stenella longirostris*) observed to frequent a tropical reef complex off the coast of Fiji. The second focused on bottlenose dolphins (*Tursiops* sp.) in a recently declared South Australian marine protected area. A range of biotic and abiotic factors, dolphin presence and behaviour were investigated at each location. Field observations and analysis have suggested preferences in the way dolphins utilize their environments. The rationale developed in this work aims to amend the way in which we think about and undertake investigations into cetacean habitat. It is believed that through this approach, future cetacean habitat studies will increase our understanding of underlying driving factors of cetacean habitat, rather than just describing distribution patterns. Finally, it is anticipated that this study and the techniques developed throughout could have broader applications to other species and regions, which ultimately will be more directly applicable within management frameworks and of benefit to conservation initiatives.

HA 06

**Seasonal fluctuation of common bottlenose dolphins presence in the Gulf of Alghero, Italy**

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In this work, we present the results of a 3 years photo-identification study of temporal distribution, site fidelity and group dynamics of common bottlenose dolphins (*Tursiops truncatus*) in the Gulf of Alghero (Sardinia, Italy). In all, 81 days, during 16 months and 8 seasons were spent in the field. A total of 289 hours were spent at sea and 33 groups of bottlenose dolphins were sighted during 32 hours. Results of this study show how bottlenose dolphins show a high seasonality with a higher presence during fall and winter months. The observed group size varied between 1 and 13 individuals, with a 72% of groups formed exclusively by adults and a 28% of groups with immatures. Seventy one marked individuals were identified during this period. High variability in re-sighting frequencies suggests that most individuals frequent the study area sporadically. Dolphin groups with immatures are more common in shallow waters and far of human activity. Finally these results can be compared with previous studies carried out near an offshore fish farm to highlight how bottlenose dolphins appear to be part of a larger and open metapopulation.

HA 07

**Using a synoptic ocean model of the Gulf of St Lawrence to investigate habitat preferences and ecological determinants of group size in harbour porpoises**

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A summer population of harbour porpoises occurs in the northern Gulf of St. Lawrence (Canada), where their distribution overlaps with local fisheries. Because incidental catches constitute a major anthropogenic threat for these animals, it is crucial to better understand their habitat preferences. Modelling fine-scale species-environment relationships in marine habitats often relies on proxies of underlying dynamic features. Computer models of oceanographic processes can provide these dynamic variables for any moment in time, which is difficult to obtain from in-situ sampling and remote sensing. We used non-systematic survey data collected in 1997-2003 to study porpoise distribution in the Jacques Cartier Strait. Generalized Estimating Equations (GEEs) were used to analyse habitat use in relation to environmental variables derived from an ocean model with atmospheric, hydrologic and ocean forcings. Although variable in space and time, occurrence of porpoises was strongly influenced by local upwelling areas caused by winds and topographic features. Distribution patterns changed across months, with porpoise selecting shallower waters in June than later in the summer. This preference could reflect higher availability of capelin during coastal spawning events or selection of sheltered areas by females with calves. We also used GEEs to investigate ecological determinants of group size. Larger groups were predicted to occur in the shallow waters of the north-eastern sector, characterized by southward currents and low turbulence. The hypothesis that waters around the Mingan Archipelago constitute a nursing area could be tested with additional data on breeding behaviour and presence of calves.

HA 08

**Assessing the influence of environmental and anthropogenic factors on distribution of bottlenose and striped dolphins in the Ionian Greek waters**

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Bottlenose and striped dolphin distribution has been investigated in relation to environmental (slope, distance from shore and depth) and anthropogenic (n° of boats) variables, in an area of the Ionian Greek waters interested by intense boat traffic especially in the summer period. In the summers 2008, 2009 and 2010, 480 hours of survey were carried out in an area of over 2600 Km<sup>2</sup>, navigating 6500 Km. 21 sightings of bottlenose and 9 of striped dolphins were collected. The mean encounter rate (ER=n° of sightings/monitored km) resulted 0.003 for bottlenose dolphins and 0.001 for striped dolphins. The analysis of spatial data elaborated with the software Arcgis 9.3 and Maxent allowed to study the relationships among dolphins and the environmental variables, and to elaborate prediction models of distribution for both species. Statistical analysis (Mann-Whitney Test) showed the slope parameter as the most relevant environmental factor influencing the bottlenose dolphin distribution, while for striped dolphin the depth represents the significant one. For bottlenose dolphin the distribution model confirms that the most relevant parameter is slope (AUC=0.880), while for striped dolphin distance from shore resulted the most important one (AUC=0.772). In the study area boats distribution leads to a high overlapping with the presence of *Tursiops truncatus*. Overlapping with *Stenella coeruleoalba* instead is not significantly relevant because the pelagic areas in which the species is more distributed are less interested by commercial and tourist traffic. A preliminary behavioural analysis has been conducted in order to investigate if boat presence influence bottlenose dolphin behaviour. In the 68% of the analysed interactions, the bottlenose dolphins showed a positive response to the boats displaying the following behaviours: inspecting boat, bow riding and surfing. Further behavioural studies are needed to better understand if the highlighted positive interactions could affect negatively the animals in the short or long term.

HA 09

**Boat traffic trends and effects on cetacean sighting rates in Cardigan Bay**

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Boat traffic is increasingly being recognised as an important factor affecting distribution and behaviour of coastal cetaceans. With the increase of leisure boat activity around the UK, the aim of this study was to identify trends in boat traffic in Cardigan Bay, West Wales and potential effects on the resident bottlenose dolphin population there. Data were collected from 2007 to 2011 on dedicated surveys of Cardigan Bay, during which cetacean sightings were recorded continuously and the number of boats logged by scan sampling every 15 minutes. Tremadog Bay in NW Wales was found to have the highest level of boat traffic, averaging 20.2 boats per hour. Other areas with high level of boat traffic included Aberystwyth, Barmouth, Aberporth and New Quay, all averaging between 6 and 9 boats per hour. All these locations showed an increase in boat traffic between 2007 and 2011, the greatest increase being at Aberporth from 2.2 boats per hour to 9.5 boats per hour and New Quay with 6.6 boats per hour (2007) increasing to 14.8 boats per hour (2011). Bottlenose dolphin sighting rates were highest off Cardigan Island, Aberporth and New Quay but showed a downward trend over five years at the last two sites coinciding with increased boat traffic. At Aberporth, sighting rates decreased from an average of 3.1 sightings per hour in 2007 to 0.5 sightings per hour in 2011 and at New Quay from an average of 1.6 sightings per hour in 2007 to 0.9 sightings per hour in 2011. This could indicate long-term local effects of disturbance. Further studies are recommended to fully assess the effects of boat traffic in Cardigan Bay.

## HA 10

**Sperm whale habitat preference along the Hellenic Trench (Greece, Mediterranean)**

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The Hellenic Trench (Eastern Mediterranean Sea) is a key area in the Mediterranean basin for the sperm whale (*Physeter macrocephalus*) population. As in other areas of the Mediterranean where links between sperm whale distribution and environmental covariates have been found, within the Hellenic Trench species distribution is heterogeneous, likely due to environmental variation and species habitat preferences. In addition, high shipping traffic in the area requires the design of protected areas for sperm whales. To define such areas knowledge on sperm whale distribution and habitat preferences are of vital importance. Boat-based distribution surveys were carried out during 12 summers, 1998-2009. A towed hydrophone was used to search for sperm whales and upon locating the animals visual observation was followed. Surveys resulted in 178 successful visual follows of sperm whales. A final dataset of presence/absence data points was derived from visual observations and acoustic stations without animal detection. Logistic Generalized Additive Models and Generalized Estimating Equations (GEE) with environmental covariates were used to model species presence. GEEs account for the exploration of any autocorrelation existing in the presence/absence dataset. We found differences in habitat preferences between sexes. Female Social Units seem to have a stronger preference for specific habitat in comparison to males. Females occupy only a small range of depths in comparison to solitary males. Although both females and males use areas that are relative close to the coast, females were found further offshore. The Mediterranean sperm whale population has been characterised as “Endangered” according to the International Union for Conservation of Nature and Natural Resources (IUCN) Red List criteria. Thus, it is important to understand the underlying drivers of their distribution in order to formulate appropriate management decisions for their conservation.

HA 11

**Spatial and temporal differentiation in habitat use by five marine mammal species in Broadhaven Bay, northwest Ireland**

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Based on sightings data collected year-round from two cliff-based sites in Broadhaven Bay (ca. 70km<sup>2</sup>), Co. Mayo, northwest Ireland, during 2002, 2005 and 2008-11, we compared the spatial and temporal habitat use by minke whales, bottlenose and common dolphins, and grey and harbour seals using pairwise Generalised Additive Models (GAMs) with a binomial distribution. Models for temporal differentiation included year, tidal state, sea surface temperature (SST) and a coefficient of variation for sea surface temperature as explanatory variables. A second set of models included Julian day instead of SST. Models for spatial differentiation included depth, slope and distance from a tidally active area at the entrance to the bay. Spatial models performed better than temporal models in separating all species pairs except for minke whale vs. common dolphin and minke whale vs. harbour seal. The best classification success was achieved between bottlenose dolphin and minke whale (57% of deviance explained), and bottlenose and common dolphin (deviance expl. = 55%) in the spatial models, mainly due to differences in distribution with respect to depth. The poorest overall classification was detected between the two seal species (<10% of deviance explained for both spatial and temporal differentiation). The most important temporal parameter in explaining the deviance across all comparisons was year, and the most important spatial variable was depth. The replacement of SST with Julian day led to an improvement in all temporal models involving common dolphin, while models with SST instead of Julian day performed better for three out of four models involving minke whale. Apart from the comparison between the two seal species, all species could be successfully separated by temporal and spatial explanatory variables even over the relatively small area of the present study, suggesting differences in habitat use at fine spatial scales.

HA 12

**Critical habitat for sperm whales in the South-west Mediterranean Sea**

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Sperm whales are distributed along the Mediterranean Sea, with presence in both eastern and western basins, but no interchange with the Atlantic area has been observed so far. The aim of this study was to describe the critical habitat for the species in the Strait of Gibraltar, Alboran Sea, and South of the Balearic Islands. Two approaches have been used. First habitat prediction models for the species were applied on a data set of 40 and 230 sightings, and 64798 km of effort and 23430 km of effort in the Alboran Sea and the Strait of Gibraltar respectively. These analyses showed how the whales are related to depth, and sea surface temperature, highlighting a hot spot for sperm whales in the Strait of Gibraltar and the area of the Seco de los Olivos. The temporal distribution of encounter rates and photo-id analyses showed how the same individuals are present in the area mainly between January and July every year. To determine the habitat use of the species during their highest presence and during the end of their annual presence, two SPOT5 ARGOS tags were deployed on two sperm whales. The first whale, with the tag deployed at the end of April, showed short movements between the Strait, and the area comprised between the Djibouti Sea Mountains and the Seco de los Olivos. The second whale, showed a migration to the Balearic Islands (during 10 days), and stayed at the south of the Balearic Islands for 25 days, confirming the work done by Priotta et al 2011. This research program confirms that 3 critical habitats could be declared for this species in the area: the Strait of Gibraltar, the Djibouti sea mountains-Seco de los Olivos, and the South of the Balearic Islands.

# HEALTH/ANATOMY

HE 01

## Rebuilding of a fin whale calf skull

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The Mediterranean Marine Mammal Tissue Bank (MMMTB) of the University of Padova was established in 2002 within the ACCOBAMS agreement. The mission of MMMTB is to collect samples from marine mammals stranded along the Italian coastline or in other countries facing the Mediterranean basin for comparative anatomical studies, pathology and ecotoxicology investigations. The MMMTB now stores approx. 3,000 samples, including over 40 brains and skeletal remains from 45 animals, most of which incomplete.

Although the MMMTB is not a Museum, the increasing amount of bone specimens warrants specific attention. Collected skeleton samples for the museum exposition are usually cleaned by water immersion for several months, then when necessary - lightly bleached by hydrogen peroxide treatment and finally rebuilt articulating every bone. However, in the preparation of young specimens with incomplete deposition of calcium salts, even if this procedure might represent a real challenge.

Here we describe in some details the case of a new-born fin whale calf (*Balaenoptera physalus*), stranded on the Ligurian coast in 2006. De-fleshing procedures required extreme caution especially in the skull, since several bones were still partially cartilaginous. Bone deposition in the sutures was still incomplete and single osseous elements were separate, thus allowing favourable conditions to study early ossification in this species. In our specimen, the temporal bone was still subdivided into petrosal and squamous sub-units, and the whole basal skull was easily divided into its constituents. After maceration, resins were added to the single bones to increase rigidity and resistance to the weaker fragments.

This study is a contribution to the knowledge of early maturation of cranial bones in Mysticetes.

HE 02

**Central nucleus of amygdala, locus coeruleus and paraventricular nucleus of dolphins' brain: where and why?**

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The brain is still nowadays a great mystery for researchers. Furthermore dolphins' brain is almost an undiscovered world if we consider the extreme rarity to achieve fresh brain samples of such unique animals with so big brains. There is a great lack of information concerning neuroanatomy of cetaceans. In front of our results (Arbelo, 2007; Herraéz et al., 2007), we have purposed to investigate those nuclei relationated with acute catecholaminergic stress-response. Massive catecholamine's liberation from the adrenal glands has been reported in alive stranded cetaceans, as a capture response (alarm reaction) (Cowan and Curry, 2008). But what could trigger such a dramatic reaction? We focused on three nuclei that are known to be involved with the alarm reaction: central nucleus of the amygdaloid complex (NCA), locus coeruleus (LC) and paraventricular nucleus (PVN).

Serial 50 µm sections of the amygdaloid complex, hypothalamus and brainstem (at the level of the inferior colliculus) were made using a sliding-microtome with a cooling unit. Sections were later stained for Nissl substance with thionin and immunocytochemically stained for Calbindin (NCA), Tyrosine Hydroxylase (LC) and Vasopressin (PVN) using the free-floating technique. This is a preliminary study; the final goal of our research is to obtain a microscopical description of these nuclei, in order to later detect the expression of some acute stress biomarkers like c-fos and HSP70 (Heat Shock Protein 70).

HE 03

**Anatomical and neurochemical characterization of the hippocampal formation of the bottlenose dolphin (*Tursiops truncatus*)**

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The neurochemical characterization of the circuitry of the cetacean brain is still far from complete, due to the difficulty of obtaining fresh tissue samples. In the present study we report the anatomical description of selected areas of the archicortical region in adult specimens of *Tursiops truncatus*, stored in the Mediterranean Marine Mammal Tissue Bank (MMMTB) of the University of Padova. The MMMTB was established in 2002 to collect whole organs and tissue samples from animals that stranded along the coasts of Italy or died in captivity and were sent to the MMMTB facilities for postmortem diagnosis (<http://www.mammiferimarini.sperivet.unipd.it/eng/index.htm>). Tissues were graded for preservation quality and adequate samples were properly prepared for histology and immunohistochemistry. Nissl-stained sections were used to study the cytoarchitecture of the hippocampal formation (including hippocampus, fascia dentata, and subiculum). Comparisons were made with the seminal literature of the Morgane group (Morgane et al., J. Hirnforsch. 1982, 23: 465-552). In our study we describe the laminar organization of the neural cells of the different hippocampal areas and the specific morphology of the neurons, often organized in nests. Interestingly, von Economo neurons were also tentatively identified. Immunohistochemical analyses using antibodies against three calcium-binding proteins (parvalbumin, calbindin and calretinin) as markers indicated the presence of distinct classes of neurons in these areas of the limbic system.

HE 04

**Lipid content and morphological structure of the blubber in the striped dolphin (*Stenella coeruleoalba*)**

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The aim of this study was to investigate stratification patterns and topographical variations in the blubber of the striped dolphin (*Stenella coeruleoalba*). Blubber samples from 10 striped dolphins that stranded along the eastern coast of Spain were excised from 11 body positions from the dorsal, lateral, and ventral regions. Blubber lipid content and histological measurements (adipocyte number and adipocyte area) were analysed for each position. Results revealed stratification into outer, middle, and inner layers. Both the adipocyte number and size were largest in the middle layer. However, the adipocyte number was higher in the outer layer than the inner layer, whereas adipocyte size was higher in the inner layer than the outer layer. Only the ventral anterior position did not follow this pattern, most likely due to its proximity to the blubber regions involved in acoustic transmission, which has differential biochemical composition. This stratification most likely reflects functional differences, where the outer layer would provide structural support to the skin and act as a mechanical barrier with minor role in energy storage, the middle layer would mostly play a thermoregulatory function, and the inner layer would be central for energy mobilization, a function favoured by its proximity to the body core and a higher blood perfusion within the layer. We also found an increasing gradient from dorsal to ventral positions in both number of adipocytes and lipid content. The only exception was the caudal region, where differences were not observed among positions. Such topographical variation suggests locally different functions of the blubber. Although both the ventral and dorsal blubber have insulator and buoyancy functions, the ventral blubber would mainly serve as energy store.

HE 05

## Use of oxygen isotope in bone carbonate to track home-range of South American sea lions (*Otaria flavescens*) along the South-west Atlantic Ocean

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Bone apatite grows at a constant temperature in mammals and, hence, variations in the  $\delta^{18}\text{O}$  of apatite carbonate reflect changes in the  $\delta^{18}\text{O}$  of ingested water. As in marine mammals food is the only relevant source of water, the  $\delta^{18}\text{O}$  of their apatite bone is expected to reflect that of their food, which in turn reflects that of the surrounding water mass. Thus, the  $\delta^{18}\text{O}$  of apatite in marine mammal bone is a potentially useful habitat tracer for marine ecosystems and we used it to investigate dispersal patterns of South American sea lions in the south-west Atlantic. Samples were collected from the skulls of individuals that were found dead stranded in Brazil (32 males), northern Patagonia (40 males and 39 females) and Tierra del Fuego (19 males and 7 females). Bone samples were grinded and soaked into a hydrogen peroxide solution to oxidize organic matter, the original structural carbonate was isolated from potential contaminants using a solution of acetic acid buffered with calcium acetate, and its O isotopic signal analysed using a mass spectrometer. A statistically significant correlation was found between the latitude of the stranding point and the  $\delta^{18}\text{O}$  value of adults males ( $n=39$ ,  $r_p=-0.335$ ,  $p<0.037$ ), which agrees with the latitudinal gradient of  $\delta^{18}\text{O}$  in the ocean. This correlation suggests limited dispersal of adult males along the coast of South America. On the other hand, variability in the  $\delta^{18}\text{O}$  values of young and immature sea lions of both sexes from northern Patagonia is much wider than that of adults from the same region, which suggests that young and immature sea lions disperse more widely than adults. Nevertheless, the dispersal period of females was much shorter (<3 years) than that of males (<8 years), consistently with the female philopatry revealed by genetic markers.

*Research funded by Fundación BBVA*

## HE 06

**Concentrations and patterns of polychlorinated biphenyls in five toothed whale species from the NW Iberian Peninsula**

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Thirty two polychlorinated biphenyls (PCBs) were determined in the blubber of five toothed whale species stranded or by-caught along the NW Iberian peninsula: common dolphin (*Delphinus delphis*), harbour porpoise (*Phocoena phocoena*), bottlenose dolphins (*Tursiops truncatus*), striped dolphin (*Stenella coeruleoalba*) and long-finned pilot whale (*Globicephala melas*). Differences in the PCB patterns between individual marine mammals of the same species and between those of different species can occur as a result of the capacity to metabolize the congeners and the differences in diet, body condition, age, sex and possibly location. Multivariate analyses were applied to evaluate the ability of PCB patterns to discriminate between these five species and to evaluate their relevance as tracers of diet and/or habitat. The mean concentrations of the sum of the 32 PCBs were 17.19 µg/g lipid weight (lw) for common dolphin, 20.45 µg/g lw for harbour porpoise, 56.43 µg/g lw for bottlenose dolphin, 15.73 µg/g lw for striped dolphin and 16.17 µg/g lw for pilot whale. The five investigated species can be separated according to their PCB patterns. The congener 183, which does not have vicinal H-atoms, was mainly responsible for the harbour porpoise discrimination, whereas congeners 157 and 137, which have vicinal H-atoms exclusively in the ortho-and meta-positions, differentiated striped dolphin and pilot whale from common and bottlenose dolphins. This may be due to the different metabolic capacities of the species, as already described in the literature for the harbour porpoise. Differing exposures to these contaminants, resulting from different diets or habitats, also explain the difference in PCB patterns. Contaminants could have thus the potential to be used as long-term tracers for identifying segregation between these species and improve our knowledge of their relative sensitivity towards the more toxic PCB congeners.

## HE 07

**The use of ecological tracers such as fatty acid profiles to discriminate pilot whale (*Globicephala melas*) population structure in Atlantic waters**

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Complementing studies on the genetic structure of wild populations with the analysis of ecological factors can allow the understanding of possible ecological structures within a population and at the same time provide information on habitat use and distribution, feeding ecology and social structure. Within a species, variations in feeding habits can be found between different geographical areas. Stomach contents analysis provides information about short-term differences and therefore should not, alone, be considered as an indicator of sub-population structure. However, in addition to providing information on diet, fatty acid analysis on depot fat can act as a biochemical tracer, reflecting characteristics of the population habitat and, can thus be applied to population structure studies. We examine the extent to which the fatty acid composition of pilot whales depot fats can be used to distinguish between populations and provide information about diet by analysing samples of blubber collected from pilot whales stranded along Iberia (n=15), Scotland (n=26) and the USA (n=10) and their prey. In addition, to provide comparative information, stomach contents data from pilot whales stranded in Portugal (n=6), Galician (n=32) and Scotland (n=10) were analysed. Results of stomach contents analysis showed evidence of significant variation in the diet of pilot whales with respect to area, season and whale size. Significant differences were identified in the numerical importance of prey categories between whales from Scotland and Iberia, with *E. cirrhosa* occurring in higher numbers in Iberian samples, while Ommastrephidae dominated Scottish samples. Fatty acids data will be examined to also try to detect differences in feeding niches between Scottish and Iberian whales and possible population structure among the West and East Atlantic basins.

HE 08

**Influence of sex, age and time after capture on circulating levels of thyroid hormone in beluga whale (*Delphinapterus leucas*) of Far East population**

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Beluga whales, (BW) blood samples were collected from at the Far East of Russia in 2010. 23 BWs were sampled in the Amur river estuary. Four more animals were sampled in the vicinity of Ust'-Khairiuzovo village (western coast of Kamchatka peninsula). Of those BWs 13 were males and 14 - females. Only 16 individuals were adult. Hormonal testing was done by ELISA. Blood samples were tested with the commercial kits to determine the level of thyroid hormones (free triiodothyronine (fT3) and free thyroxine (fT4)). Concentration of fT3 was determined in 25 samples. Concentration of fT4 was determined in 19 samples. In 13 BWs concentration of thyroid hormones was determined in paired samples, taken with 1-5 hours between each blood drawing. Data analyses were accomplished in GraphPad PRISM 5 environment. The concentrations of fT3 were 2.31 pg/ml (sd=0.75 pg/ml) and of fT4 - 14.38 pg/ml (sd=3.02 pg/ml). No significant differences have been found in thyroid hormone concentrations while compared for males to females, and for adults to juveniles (unpaired t-tests, two-tail  $p>0.05$ ). The lack of distinct effect of sex and age on hormone concentrations in our research may be connected with the low sample size. Pauses between blood drawings did not affect thyroid hormones levels in consecutively taken samples (paired t-tests, two-tail  $p>0.05$ ). This study was conducted under the "Beluga Whale-White Whale" program. We are continue to to analyse these samples on cortisol and catecholamines levels. We are planning research serum samples of BWs collected in 2011.

**HE 09****Assessment of health status of Solovetsky belugas (Onega Bay, White Sea) by the results of photo-ID**

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The work is based on photo-ID data of Solovetsky beluga reproductive gathering (Onega Bay, White Sea) in July-August 2011. Photographed skin lesions were examined. We tried to get information about the health of Solovetsky belugas by the number of skin lesions of various etiologies. Every year during May-September belugas gather off Cape Beluzhy, Solovetsky Islands. The size of the gathering is about 300-350 individuals. The adult animals make half of the cluster (50,6%). Immature (25,6%) and yearlings (23,8%) form another part of the gathering. Dermatophilus - like bacteria is a more common skin infection (20%). It looks like sunken pits or round spots. Pseudomonas (15%) is in the second place of occurrence with the solid round nodes, often with a necrotic centre, scattered about the body. Both young and adult belugas (10%) are affected by herpes, 5% of belugas suffer from candidiasis. Yearlings (8 %) are Pox-virus infected. There was a very interesting pair of belugas a female and a 1 - 2 month yearling with a full range of skin infections such as dermatophilus - like bacteria, pox-virus, papillomavirus. The calf was infected by panniculit – the infection, damaging the subcutaneous fat. The occurrence of skin - infected couples indicate an evident decrease in their immune system and pollution of the surrounding waters. Polluted environment causes a disfunction of the immune system, and can be a source of various infections. Thus, our work has suggested that 42% of the individuals had mechanical injuries markers, and 58% of individuals had lesions and skin infections. This work was supported by the IFAW.

## HE 10

**Parasitism and associated pathology in harbour porpoises (*Phocoena phocoena*) from waters off Greenland in 2009**

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Little is known about the health status of harbour porpoises from waters around Greenland, so far only two studies have been performed in 1988 and 1995. In 2009, pathological investigations on 20 harbour porpoises hunted by inuits in the waters of Greenland were conducted. Parasitic infection of the peribullar cavity (*Stenurus minor*) was found in all investigated animals. Mild infections with the lungworm *Halocercus invaginatus* were identified in most of the porpoises. Many porpoises were infected with stomach worms (*Anisakis simplex*), and *Campula oblonga* was present in liver and pancreas of 90 and 30%, respectively. *Crassicauda* spec. was isolated from the perimuscular fascia and mammary gland in 45% of the animals. *Monorygma grimaldii* and *Phyllobothrium delphini* were found in the blubber layer and in the abdominal cavity of the porpoises. Bronchopneumonia, gastroenteritis, cholangitis, pericholangitis, periductal fibrosis, hepatitis, proliferation of bile ducts, pancreatitis and panniculitis etc. were almost exclusively associated with parasitic infection and usually mild. Microbiological investigations revealed a mild nonspecific mixed flora in 16 (80%) of the animals.

The absence of *P. inflexus* and *T. convolutus* from the Greenlandic porpoises is striking, as they belong in the same family (*Pseudaliidae*) with *H. invaginatus* and *S. minor*, which are the parasites with the highest prevalence found in this study. This may be related to their lifecycle characteristics using either species-specific fish intermediate hosts or direct transmission in some species. An increase in prevalence of parasitic infection has occurred over the last 15 years in all organ systems. Parasite species that previously did not appear in porpoises from Greenland are now emerging (*A. simplex*, *tetraphyllidean merocercoids*). This may be due to a changing diet or susceptibility to parasitic infection because of immune suppression due to anthropogenic stress.

**HE 11****To a question on adaptation of marine mammals to captivity condition**

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The long-standing subject for very strained discussions between scientists, policy-makers, public and businessmen is the question: "Is it necessary or is it unnecessary to adapt marine mammals to living in captivity conditions." There are different points of view on this acute question. The main negative arguments are: the high degree of mortality during adaptation (stress-factors, pathogens); an ethical component including the inhumane relation; diseases are connected with restriction of space (for example, hypodynamia); infectious diseases received from the human; chronic intoxication of chlororganic compounds as a result of obligatory disinfection of water etc. The basic positive arguments are: one from possible ways of recovery of rare and vanishing species under condition of reproduction of these species in captivity; education marine ecological programs for children; possibility of more deep studying of marine mammals in commercial oceanariums and research marine stations. For more deeply to understand the causes of high death rate of marine mammals during adaptation to living in captivity, and on-possibility, to lower high mortality, the complex of lifetime diagnostics of a physiological condition of the marine mammals, based on the interconnected change haematological, immunological and microbiological indices has been developed. From 1999 till 2011 scientists from Russia and Ukraine in collaboration with trainers and vetstaff from commercial dolphinariums has develop of measures on decrease of mortality of marine mammals in captivity. As a result of our work: 1. suppression of immune function during first months of adaptation was observed; 2. the pathogenic microorganisms: S.aureus, S.piogenes, S.pneumonia, S.ineae, E.Coli, spp.Salmonella, Pseudomonas was found. These microorganisms can be cause of acute or chronic infectious process, and also to lead to death. Besides, it was observed that in captivity wild animals have the microflora which was steady against the majority of antibiotics. This microflora was absent at wild animals during capture. Using of a complex of investigations on a regular basis will allow to estimate physiological status of animals and in due time to take measures that not to tolerate mortality of marine mammals.

**HE 12**

**Isolation of CD34+ cells from peripheral blood and bone marrow of *Tursiops truncatus***

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In human, hematopoietic progenitor cells, that can differentiate in vitro into different cell lineages, can be isolated using antibodies directed against a cell surface marker, the CD34 marker. We have shown that such antibodies can cross react with a cell surface marker present on peripheral blood and bone marrow cells of the bottlenose dolphin. On the basis of this cross reactivity, we have isolated and cultivated dolphins cells, that are very good candidate as progenitor cells of the immunological system in the bottlenose dolphin.

These results clearly offer possibilities to develop new models to detect and study in vitro immunotoxic effects of various pollutant compounds on marine mammals.

**HE 13****Acute “decompression-like” sickness in Risso’s dolphins**

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Although marine mammals appear to have developed adaptations to avoid most mechanical and physiological effects related to this type of diving disease (Kooyman, 1989), gas bubble-like lesions have been found. Since its publication in a brief report in 2003 (Jepson et al., 2003), and then fuller descriptive papers of atypical mass strandings of beaked whales (Family *Ziphiidae*) associated in time and space with naval exercises involving mid frequency sonar (MFA) (Fernandez et al., 2005) and other single strandings of small odontocetes (Jepson et al., 2005), “gas bubble” lesions have become a greater concern in cetaceans.

Several hypotheses have been proposed as a cause effect relationship between MFA sonar use and these stranding events (Cox et al., 2006). One of them is the alteration of beaked whales’ diving behaviour in response to MFA sonar exposure in such a manner that behavioural or physiological mechanisms employed for protecting against the formation of nitrogen gas (N<sub>2</sub>) bubbles are overridden (Fernández et al., 005; Cox et al., 2006). According to this proposal, bubble evolution occurs as a result of severe alterations in dive behaviour (e.g. extremely rapid surfacing or remaining at the surface and possibly vigorously swimming).

Risso’s dolphins inhabit deep oceanic and continental slope waters, generally 400-1,000 m deep, mostly occurring seaward of the continental slope. They frequent subsurface seamounts and escarpments, where they are thought to feed on vertically migrant and mesopelagic cephalopods (Baird 2009). Risso’s dolphins have not been reported in atypical mass strandings linked to naval exercises, but “gas bubble” lesions have been found in single stranded Risso’s dolphins in UK and now in the Canary Islands. A description of these cases with the corresponding pathological findings will be presented in this communication as well as most likely linked cause/s.

HE 14

**The effects of hot-iron branding on the skin of Steller sea lion (*Eumetopias jubatus*) pups**

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The long-term monitoring of demographic parameters in Steller sea lions requires permanent marking of individuals within the population. The application of unique marks with hot-iron branding has been shown to be the only reliable method for permanent marking. However, skin injuries caused by the burning might negatively affect the health of the animals. We examined 200 Steller sea lion pups after branding on July 5, 2011 at Tuleny Is (Sakhalin, Russia). We found that dry hair at the time of branding resulted in a thermal burn while wet hair produced a thermal and steam burn. We report significant differences in rates of burn healing among pups branded with dry versus wet fur. The pups with wet fur got deeper burn than pups with dry fur (ANOVA,  $p < 0,001$ ). The 47% dry pups and 12% wet pups had dim symptoms of medial inflammation; 20% dry pups and 47% wet pups had an average inflammation; 3% dry pups and 33% wet pups had a heavy inflammation. There are the 30% dry pups and the 8% wet pups without medial inflammation. Granulation tissue in pups with dry fur formed about two days earlier than among pups with wet fur ( $8,2 \pm 1,2$  vs  $10,5 \pm 1,7$  respectively, t-test,  $p < 0,01$ ), and scar tissue in pups with dry hair appeared almost two days earlier ( $9,8 \pm 2,5$  vs  $11,7 \pm 1,7$  respectively; t-test,  $p < 0,001$ ). We found no significant difference in duration and quality of burn healing relative to the sex of pups. So our studies at Medny in 2010 and at Tuleny Is in 2011 showed that cases of rapid deterioration of animal health or death associated with burns were not observed. The inflammation after the brand application appeared to be local and we found no apparent negative health effects.

HE 15

**Microbiology investigation of blow samples of gray whale (*Eschrichtius robustus*) as one way of estimating the health status of a population**

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Every year the questions of conservation of populations marine mammals are actual and important more and more in the world. Therefore it is necessary to search for methodical approaches for an estimation of influence of anthropogenic factors on the wild cetaceans. As the population of Western North Pacific or the Ohotsko-Korean of Gray whales (*Eschrichtius robustus*) is included the Red book of the Russian Federation, a category 1 – “being under the threat of disappearance”, very much an important point for discussion between scientists, industrialists, the government - petroleum industry influence on populations of the Gray whales living in a zone of active oil extraction. Therefore there is a necessity of search of lifetime, non-invasive methods of an estimation of a health status of Cetacean. We consider that such method are microbiological investigations of blow of a whale. These researches allow to reveal the pathogenic microorganisms circulating in the given area and to define health status of population.

In the summer of 2011 in Olga bay (Kamchatka) we have selected a material from 21 individuals of the Grey whale. Sampling blow from Gray whales has been made by a method offered K. Acevedo-Whitehouse at al. As a result of the conducted microbiological investigations different microorganisms have been isolated from 86 % of samples. In blow of each animal we have found out not less than two species of microorganisms. The isolated microorganisms have been defined how next genius: Staphylococcus, Pseudomonas, Bacillus, Streptococcus, Candida. Thus the greatest quantity Staphylococcus and Streptococcus has been isolated from blow of whales with an unpleasant smell.

Thus our investigations have shown possibility of use of lifetime microbiological diagnostics for an estimation of the Grey whales.

## HE 16

**Water-borne emerging zoonose? Case report on Erysipelas (*Erysipelothrix Rhusiopathiae*) in harbour porpoise (*Phocoena phocoena*) and harbour seal (*Phoca Vitulina*)**

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An adult female harbour porpoise (*Phocoena phocoena*) and a juvenile male harbour seal (*Phoca vitulina*) have been found stranded dead on the Belgian coast in late 2001. As the two bodies were in good condition (CC = 2), necropsy and bacteriological analyses were performed as well as other post-mortem investigations. Blood heart and organs (liver, digestive and respiratory tract, lungs, spleen, brain, kidneys) samples have been collected and analysed. The porpoise showed evidence of septicaemia, and the seal presented lesions of acute enteritis. Pure and abundant growth of a small rod-shaped, Gram-labile bacterium was obtained aerobically and anaerobically on Columbia blood agar from heart blood, mouth, pharynx, lungs, intestine and anus of the porpoise, and from intestine, pharynx, mouth, nose and anus of the seal. The colonies were surrounded by a narrow zone of alpha-hemolysis. Catalase- and peroxydase-tests gave negative results. Rapid ID 32 Strepto (Biomérieux, France) sugar tests identified this isolate as *Erysipelothrix rhusiopathiae*. *E. rhusiopathiae* could be therefore considered as the cause of septicaemia on the porpoise as it was present in heart blood and internal organs, and could be associated primary or secondary with the enteritis reported on the seal as the bacterium was isolated in pure culture in the digestive tract. *E. rhusiopathiae* infections have been reported in captive dolphins and sea lions. This zoonotic pathogen is also involved in human local infections, like the seal finger, resulting from captive pinnipeds bites. However, it has not been so far described as systemic pathogens of wild cetaceans and pinnipeds. *E. rhusiopathiae* could be therefore considered as a potentially emergent pathogen which could have important repercussions on human health, particularly veterinarians, marine mammals rescue teams and zoos.

HE 17

***Helicobacter cetorum* infection in three cetacean species from the southwest coast of England**

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A novel *Helicobacter* species was first isolated from two Atlantic white-sided dolphins (*Lagenorhynchus acutus*) in the USA in 2000. Since then *Helicobacter* species have been demonstrated in cetaceans globally. This report describes the opportunistic isolation of *Helicobacter cetorum* in four stranded cetaceans from Cornwall, UK:- two common dolphins (*Delphinus delphis*), an Atlantic white-sided dolphin and a striped dolphin (*Stenella coeruleoalba*) submitted for necropsy between July 2008 and October 2009. None of the animals had any evidence of recent feeding and all four had gross lesions in the gastrointestinal tract including haemorrhages and ulcers from which *Helicobacter cetorum* was isolated, suggesting *H. cetorum* may have been a contributory factor in the aetiology of these lesions. Phylogenetic relationships of these isolates, based on the sequence of the virtually complete 16S rRNA gene, grouped them with a number of previously described *H. cetorum* isolates from bottlenose dolphins (*Tursiops truncatus*), beluga whales (*Delphinapterus leucas*) and Atlantic white sided dolphins. Although *Helicobacter* infection can be excluded as the cause of death in these animals, it may have contributed to their poor condition as has been reported in captive cetaceans. We believe these four cases to be the first confirmed evidence for *H. cetorum* infection in free-living cetaceans in European waters and the first confirmed cultural isolation of *H. cetorum* from a striped dolphin.

HE 18

***Helicobacter cetorum* infection in three cetacean species from the southwest coast of England**

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Marine mammal wildlife pathologists are frequently confronted with severely autolysed and scavenged corpses, and assessing post mortem changes is often challenging. An estimation of the time of death can be of great importance to be able to backtrack to the location of death. In contrast to the large amount of information available for human forensic pathology, this information is scarce for marine mammals. Therefore any well-documented information on post mortem change may be of value. During an ongoing study about extensive skin and blubber defects in harbour porpoises (*Phocoena phocoena*), opportunistic information was gathered about post mortem changes of two animals. For the original study, three frozen relatively fresh (decomposition code 2), harbour porpoise bodies were thawed, floating capacity was assessed in a water tank, standard external pictures were taken, and full body images were made with computed tomography. Bodies were labeled with four tags (flippers, dorsal fin, and fluke) and released from a ship in the North Sea on the 14th of March 2011. Two of the three corpses did not float and were lost. Those two corpses were found later on beaches close (approximately 30 km) to the site of releasing three weeks and 13 weeks later, respectively. Full body pictures of the remains were taken for the second time, and necropsy on the remains was performed as far as possible. Changes, which occurred during the time between loss and stranding, were recorded. Most significant there was almost complete loss of the blubber layer that was measured on the CT scan as being 8 mm and 10 mm respectively prior to release. There was loss of almost all of the internal organs and mandible in both cases. The apposition of the bones of the corpse that was retrieved after 13 weeks was partly (flippers and skull) lost.

**HE 19****Grey seal mortality in Cornwall: an insight from necropsy data**

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Grey seals (*Halichoerus grypus*) from the coast of Cornwall have been necropsied at AHVLA Polwhele, Truro since 1985, including animals submitted under the UK Marine Mammal Strandings Programme (now the Cetacean Strandings Investigation Programme), the AHVLA Diseases of Wildlife Scheme and the National Seal Sanctuary, Gweek. A study of necropsy reports from 1998 to 2011 was carried out to determine what information could be gathered on wild grey seal mortality. Using the criteria: - a) found dead or euthanased in extremis on the coast, or b) died or euthanased in extremis in the first week of rehabilitation, over 40 seals qualified for inclusion in the study. Conditions considered likely to have contributed to death or euthanasia was extracted from reports. Over a third of the seals were assessed to have had more than one contributory condition. Infectious conditions (e.g. septicaemia, pneumonia, (meningo) encephalitis, peritonitis) were reported in around two thirds and starvation in nearly a quarter of pups and juveniles. Severe traumatic injuries were encountered in relatively few animals but some infectious conditions, e.g. septic arthritis, were likely to have been initiated by trauma. In adults, starvation was most commonly reported, although the sample size was small. The laboratory is planning to provide a more detailed necropsy, reporting and sampling protocol for grey seals in the future and it is hoped that this initial study will provide a baseline against which data gathered from the new protocol can be compared.

HE 20

**Variability in the blubber lipid content of odontocetes with respect to body site and blubber depth: implications for estimating body condition**

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The body condition of mammals can be defined in several ways, one of the most common of which is nutritive condition. Nutritive condition can be specifically quantified as the fat stores of the animal, which in cetaceans, are principally in their blubber. The way in which these lipid energy stores are distributed through the blubber depth and across the body can vary by species, gender, reproductive status and season, and this variation must be taken into consideration when trying to estimate the body condition of free-ranging cetaceans using remote dart biopsy samples. This project thus aimed to identify how the lipid content of the blubber can vary across the body through the analysis of necropsy blubber samples taken from 5 species of stranded odontocetes. Lipid was independently extracted from the blubber samples using a modified version of Folch et al.'s (1957) protocol. Analysis of the blubber lipid content using a generalized linear model revealed that there was no relationship between blubber thickness and lipid content. Blubber thickness is thus not a good indicator of nutritive condition. Using the same modelling approach, it was seen that the middle blubber layer is the most lipid-rich part of the blubber, and attempts should therefore be made to sample this layer when estimating body condition using remote dart biopsy samples from free-ranging cetaceans. The models also revealed that there was significant variation in the blubber lipid content across the body, and that it varied more from the dorsal to ventral regions than across the anterior to posterior of the animal. Due to this variation, species-specific comparisons should be made using a larger number of individuals in both good and poor body condition to determine where blubber biopsy samples should be taken from to best represent the fat stores of an individual.

## HE 21

**Biopsy as a non-invasive sampling technique for mercury monitoring in internal organs of live toothed whales**

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The investigation of trace elements in toothed whales is generally based on samples obtained from stranded individuals. Liver and kidney tissues are the target organs that are considered the most frequently to assess individual contamination. However remote biopsy sampling has provided a mean to collect skin and blubber tissues from cetaceans alive, and could allow evaluating trace element impregnation of these animals if a correlation was established between concentrations of contaminants in skin or blubber and those in storage organs. Thus the objectives of the study were to determine the levels of trace elements in skin, blubber, liver and kidney tissues of stranded animals in order to examine the relationships between external tissues and internal organs for the same individuals.

Four species of toothed whales, i.e. common dolphin (*Delphinus delphis*), harbour porpoise (*Phocoena phocoena*), bottlenose dolphin (*Tursiops truncatus*), and striped dolphin (*Stenella coeruleoalba*), were investigated (n=130). Mercury (Hg) concentrations were measured using an Advanced Mercury Analyser-254 while concentrations of zinc, copper, cadmium, nickel, silver, cobalt, manganese and iron were determined with an Inductively Coupled Plasma – Mass Spectrometer. Mercury concentrations in skin and blubber ranged from 0.57 to 7.98 and from 0.02 to 2.35  $\mu\text{g.g}^{-1}$  dry weights, respectively. Among the considered trace elements, only Hg showed significant correlations between the values in skin/blubber and those in liver/kidney ( $p < 0.001$  for all four). These results suggest that skin and blubber biopsies can be used to evaluate Hg concentrations in liver and kidney of live toothed whales, and more generally, those biopsies can be suggested as a non-invasive sampling method to predict Hg concentrations in internal tissues and the potential ecotoxicological risk that this element represents for these species.

**HE 22****Toxic element concentrations in the harbour porpoise (*Phocoena phocoena*) collected in Portugal**

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We provide the first data on 10 inorganic element levels (As, Cd, Co, Cr, Cu, Hg, Mn, Pb, Se and Zn) in harbour porpoises found dead along the central and northern Portuguese coast.

Element concentrations (ww basis) were assessed by ICP-MS in kidney, liver and muscle of 31 porpoises divided in 3 age classes (calves, juveniles and adults, based on body length and reproductive organs' histology).

In our study, general element concentrations were in accordance with other available data on porpoises from European waters, except for mercury concentrations. We found higher hepatic (25.87µg/g) and renal (2.74µg/g) mercury concentrations in comparison to those reported for porpoises from German and Danish waters.

Mercury concentrations in liver, kidney and muscle were higher in adult individuals ( $p < 0.0001$ ) than in juveniles or calves, which is in accordance with other studies on porpoises from European waters. In the present study the average Hg liver concentration for adults is 46.96µg/g (max = 168.5µg/g).

Several other element concentrations varied according to age class but no significant variations according to individual's sex were observed.

For the majority of elements, values obtained in this study were in accordance with those reported earlier for European waters except for hepatic Hg values. Also, harbour porpoises presented higher values of Hg (in all tissues) in comparison to common dolphins collected in Portugal.

Portuguese harbour porpoises belong to the Iberian population (demographically isolated from Northern Europe), which includes a small number of individuals, heavily subjected to by-catch. Further evaluations of heavy metal accumulation on Iberian porpoises are important to the conservation and long-term viability of this population.

HE 23

**Mercury concentration in Baltic Sea grey seal (*Halichoerus grypus*) living in captivity and in the wild**

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Mercury is considered as one of the most toxic metals found in the marine environment. Because of its ability to biomagnification the top predators are most vulnerable to its toxic effects. In order to broaden the knowledge about mercury concentration in the tissues of Baltic Sea top predators a pilot study was conducted, devoted to assessment of mercury concentration in grey seal tissue samples obtained from five individuals. Post-mortem samples were derived from three animals lived in captivity in Hel Marine Station, University of Gdansk (Poland) and from two individuals found stranded on the Polish coast. Analysis of total mercury content was made using an atomic absorption spectrophotometer AMA 254. The results were obtained in micrograms of Hg in grams of wet weight tissue.

Mercury concentration in liver, kidney and muscle tissues of examined seals were lower than the values obtained in 1990s. The Hg concentration in liver tissue, with average value of 15,18mg·kg<sup>-1</sup>w.w., did not exceed 60 mg·kg<sup>-1</sup> w.w. considered as a threshold value for marine mammals above which the liver damage may occur.

A comparison of intoxication level of seals living in captivity and in the wild was conducted. Greater degree of mercury accumulation was observed in tissues of wild seals, probably due to different diet and living conditions. Relatively higher concentration of mercury was found in the immune system structures of these organisms. It may indicate difficulties with detoxification of mercury which may cause malfunctioning of immune system of wild animals.

In conclusion, the mercury concentrations obtained in this study were lower than the values received in previous decade. There is a need to conduct a research on a larger number of individuals to confirm the decreasing trend of mercury accumulation in Baltic Sea grey seals.

# HUMAN INTERACTIONS

HU 01

## **Spectral characteristics of vessel noise eliciting distinct reactions of harbour porpoises (*Phocoena phocoena*)**

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Harbour porpoises are known to avoid boats. But does the reason of their avoidance behaviour only reside in physical presence of the vessels or does the boat-generated noise also play a role? Shipping noise has been shown to have a negative impact on cetaceans by masking their echolocation and social signals, disturbing their behaviour and impairing their hearing sensitivity. However little is known about the specifics of the adverse reaction and characteristics of the noise evoking it. Here we designed an experiment to characterise vessel noise that elicits distinct reactions of harbour porpoises. The experiment was conducted with captive animals at Fjord&Bælt Centre in Kerteminde, Denmark. The captive environment allowed to exclude the physical presence of boats as a factor contributing to the reaction. Sound recordings alongside with visual observations were performed to register behavioural reactions to boats passing the Centre. Response to boat noise was noted when the animals increased their swimming speeds, surfacing intervals became shorter and blow rates increased. The behavioural response combined with spectral analyses of the sound recordings revealed that porpoises reacted mostly to small older boats with external engine, which produced characteristic broad-frequency noise, likely largely caused by cavitation. Sound levels of the adverse noise were exceeding 100dB re 1 $\mu$ Pa with peak frequencies between 1-5 kHz. An understanding of what distinctive features of noise affect harbour porpoises could potentially contribute to the protection of this species.

HU 02

**Assessment of zones of the acoustic impact on the Arctic marine mammals at industrial activity in Barents Sea**

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Hydrocarbon activities along with shipping are the main sources of manmade noise in the ocean. But very little information on the noise emitted from E&P industry activities in Arctic is currently available. We expect increasing of background noise level in the Russian sector of the Barents Sea in the next decade due to large scale construction planned at the Shtokman project, one of the world's largest natural gas deposits. Unique technologies for gas recovering will involve the largest and noisiest vessels into construction. We tried to estimate possible acoustic impact on marine mammals caused by that activity. First, we have estimated today's background noise levels in the site of future location of the Shtokman project. For TL calculation we used PDPE model. Estimated noise budget includes 77 fishing ships really distributed in the Barents Sea in May and the sea surface noise at wind velocity 10m/s and 20 m/s. Integral noise level in this band was estimated as 92 dB re mkPa for ships and -105 dB at 10m/s and 113 dB at 20m/s for wind. The results in frequency band up to 500 Hz show the dominating of noise caused by wind. Consequently, the area today is quiet enough. But in the next decade the Shtokman undoubtedly will change soundscape in basin scale. For estimation of the acoustic impact at different stages of Shtokman construction we calculated the sizes of the Safety Zones around construction area. It was done by accurate modelling using literature data on noise levels of vessels involved into construction and TL calculation with environmental parameters for that site in the Barents Sea. In results we present footprints of Safety Zones depending on the stage of construction, specific environmental conditions as well as the local species of marine mammals exposed to noise.

HU 03

**Harbour porpoises do not react to high levels of shipping noise in the Great Belt, Denmark**

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The last decade has seen a rapid increase in the interest in ambient underwater noise and the possible negative effects on marine life by the increased anthropogenic contribution to the noise. While there is ample evidence that cetaceans, such as harbour porpoises, react negatively towards many types of sound sources (pingers, seal scarers, pile driving, outboard motors, etc) there is limited information on reactions towards noise from large ships. This is despite the fact that ship noise is among the most significant man made sources of acoustic energy in the ocean.

The Great Belt, Denmark is one of the areas where harbour porpoises are most abundant and at the same time among the world's busiest waterways with more than 40.000 ships above 300 tons passing every year. Noise loggers (DSG-loggers, Loggerheadinstruments, Florida) and porpoise dataloggers (T-PODs) were deployed in and next to shipping lanes as part of the EU Interreg study BaltSeaPlan.

Recordings were analysed in 1/3-octave bands and compared with T-POD detections of porpoises, whenever possible. No clear (negative) correlation between noise levels and porpoises could be found in the data, indicating little or no reaction of porpoises to individual passing ships, at least at distances of some hundred meters from the ships. Highest received broadband levels of noise were in the range of 130-150 dB re. 1 uPa rms and thus consistent with studies on other sound sources which have found reaction thresholds above this level.

The results have implications for the implementation of the EU Marine Strategy Framework Directive, which operates with universal indicators for ship noise at 63 and 125 Hz. At least for harbour porpoises, these indicators may not adequately reflect actual impact on the animals and other types of boat traffic with higher pitched noise may be more relevant to monitor.

HU 04

**Rescue and rapid release operation of a bottlenose dolphin (*Tursiops truncatus*) bycaught in a longline fishery**

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Fishery-cetacean interactions evoke ecological and social concerns. There are numerous mortality and injury reports as results of fishery-cetacean interactions. Bycatch is one of the important issues in such interactions. In this study, we report a rescue operation of a bottlenose dolphin (*Tursiops truncatus*) which was caught accidentally with a long line on June 30th 2011; the fishermen reported a wounded dolphin on the coast of Haydarpasa, Istanbul. This animal was 182 cm, a juvenile female. In the physical examination, we found several long line cuts on her flukes. After the general examination, we decided to provide medication to improve general condition, protect her against a systemic infection and shelter to rest in. A temporal sea pen was built to observe her behaviour within the marina. During the transportation on the boat to this sea pen, she was given necessary medications. After over viewing our rehabilitation capacity and the state of the dolphin we decided a rapid release. Dolphin was released in one nautical mile off the coast with the help of rescue boats after the twelve hour-long operations.

This is the first reported case of cetacean bycatch in a bottom long-line in Turkish waters. This operation was the first successful rapid release reported in Turkey, and it proved that our stranding network has functioned well although it should be developed further in other areas of Turkish coasts, so that we can respond to more emergencies of stranded animals in the future.

HU 05

**Relating washed ashore carcasses to incidental mortality of *Franciscana*, *Pontoporia Blainvillei*, in the gillnet fishery of Rio Grande Do Sul (Rs) State, Brazil**

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Estimated incidental fishery mortality of franciscana dolphins based on stranding data is biased downwards because washed ashore carcasses represent only a fraction of the total bycatch. The objective of this study was to determine the probability that a franciscana incidentally killed in the coastal gillnet fisheries of RS washes ashore, and to use this information as a correction factor for stranding data of 1076 carcasses collected between 1979 and 1998. From November of 2005 until January of 2009 between 10 and 20 vessels volunteered to participate in the study in which fishermen tagged franciscanas accidentally killed in nets, returned them to the sea and recorded tag number, date and geographic position. Beach surveys were conducted regularly to register the number and location of tagged franciscanas found ashore. Logistic regression was used to model the probability that a tagged franciscana reaches shore as function of the covariates wave period, wind direction, wind intensity, distance from the coast and target species of the fishery. Bayesian inference was performed in OpenBUGS. Eleven of 145 tagged franciscanas were recovered ashore. Of all covariates only “target species” provided a significant effect on the stranding probability. The estimated stranding probability in the *Micropogonias furnieri* fishery (posterior median = 0.105; ICr95% credibility interval [0.05; 0.18]) was higher than in the *Cynoscion guatucupa* fishery (median = 0.013; ICr95% [0.0003; 0.069]) which happens farther off the coast. Based on these probabilities, the number of franciscanas killed between 1979 and 1998 by the gillnet fishery was estimated in 17139 individuals (ICr95% [8516; 227976]). The proposed methodology can provide a correction factor whenever incidental mortality has to rely on stranding data.

HU 06

**Communication on the seal/fishery conflict between scientists and policy-makers at the European Parliament**

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Conflict exists between seals and fisheries, with seals affecting fisheries through damage to catch and gear and competition for resources. Fisheries can affect seals through accidental by-catch, and overfishing can reduce prey availability. The situation is a complex one and has led to serious conflict between conservationists, members of the fishing industry, policy makers and resource managers across the range of many seal species. Communication and engagement of these stakeholders is necessary for effective conflict resolution. The Committee on Fisheries of the European Parliament called a workshop in Brussels in November 2010 to seek scientific advice from representatives from countries on the northeast Atlantic fringe where the seal/fishery conflict is most acute. Each representative presented a briefing note of the situation in their respective countries. We present here a summary of the Irish briefing note we presented to the European Parliament which provided a comprehensive review of the situation in Irish waters, using existing data augmented with information from key industry stakeholders, providing a representative account of the current situation. A combination of historical data and information from the fishing industry show seal interactions with commercial fisheries in Ireland are most significant in inshore (< 12 nautical miles from shore) static-net fisheries (e.g. gill, tangle and drift-nets). Overall, there is clearly a need for further research before the full extent of seal/fisheries interactions in Irish waters can be quantified and the situation adequately addressed. Specific recommendations on research priorities based on the identified gaps in current knowledge were provided. Recommendations were outlined to aid management decisions for reducing the interactions between seals and fisheries in Ireland. A national stakeholder workshop has since been held by the Marine Institute to address the situation, which led to a consensus on critical issues and general approach, an important step to effective conflict

HU 07

**Whalers' stories (19<sup>th</sup> century): the reasons for some editorial failures**

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Nowadays it seems that some great books, published during the 19th century and dealing with cetaceans, have been immediate and complete editorial successes: *Moby Dick* by Melville seems one of the best known references – even if most of people who “know” it didn't ever read it in its entirety. But in fact, when this novel was published in 1851, the readers were scarce, because of its very particular conception of writing, half symbolic, half scientific novel. Another book describing cetaceans didn't meet with editorial success: Scammon's *Marine mammals* (1874), a very important account in the history of American whaling. These books describe cetaceans throughout detailed pages and are very concerned with science. On the contrary, novels such Kingston's *Peter the Whaler* (1851) or Verne's *Vingt mille lieues sous les mers* (*Twenty thousand leagues under seas*) (1870) met with success, whereas *Moby Dick* and *Peter the Whaler* were published exactly at the same period. So, how can this difference be explained? In fact, Kingston's and Verne's novels are ordinary adventure novels in a maritime context: the life aboard (and its hazards) is interesting enough in itself, even if the scientific aspect is variable; Verne wrote for educational purpose, based on second hand encyclopaedic knowledge. The reason can be the difference of literary genre, and time: the readership interested in marine mammal science between 1850 and 1875 was certainly very small. Nowadays the editorial situation has changed, and *Moby Dick*, and Scammon's *Marine mammals*, to a lesser extent, are greatly prized in themselves and because of their historic interest.

HU 08

**Cetaceans in the bays of Sevastopol: life in disturbed habitat**

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Sevastopol area (Heraclea Peninsula) is one of the Black Sea hot spots. Human activity during last two centuries (intensive naval and civil navigation, shipping industry, fisheries, uncontrolled waste waters, oil pollution) put irreversible changes in marine environment of embayed coastline (about 40 land-locked harbours) and adjoining sea area. Despite of high level of anthropogenic pressure, cetaceans occur in Sevastopol waters all year round. Data on their geographical, annual and seasonal distribution, specific structure, and strandings are sparse. The analysed material was obtained from polling of 2995 university students, local people and volunteers (219 of respondents are residents of Sevastopol, the others visit it regularly) in 2002-11; 346 sightings and 165 strandings were reported. The most of sightings were recorded in the southern part of area – Balaclava Bay (28.1%), Fiolent Cape (10.2%), Laspi Bay (6.8%), - some intramural bays, e.g. Cossack (Kazach'ya) Bay (6.0%), and to the north of Sevastopol Bay – in Lyubimovka (5.5%), Kacha (4.7%), Orlovka (3.8%) and Uchkuevka (3.4%). Harbour porpoises (44.7% of identified cases), bottlenose dolphins (36.9%) and common dolphins (3.9%) occurred mainly in summer (72.9%), but also in spring (13.7%), autumn (9.4%) and winter (4.0%). Winter sightings were observed along the all coast, in Balaclava, Cossack and Sevastopol Bays more frequently than in Andreevka, Lyubimovka and Kacha sea areas. The annual rates of cetacean occurrence agreed with environmental dynamics, e.g. fish migrations. Harbour porpoises (79.6% of identified cases) dominated in strandings; they were located mostly in Balaclava (13.7%) and Cossack (9.2%) Bays, Fiolent Cape and Park of Victory (in 6.9%), Chersonese (5.3%), Northern side of Sevastopol Bay and Uchkuevka (in 6.1%), Lyubimovka (8.4%), Orlovka (4.6%) and Kacha (9.2%), and the trends of annual and seasonal distribution were close to sighting rates.

HU 09

**The hunting of ringed seal in the Russian North basin and dynamic of catches in the 18<sup>th</sup> century in the Solovetsky Islands area**

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The ringed seal hunting was one of the main types of Russian coastal fisheries in the White and Barents Sea basins. First records on the ringed seal hunting in the White Sea dated from 1622. The ringed seals were hunted near the entire Russian coast in the 17-18th Centuries all year. In the White and Barents Sea basins in 1785 – 1792, the average annual catch was 5054 ex. (max 7994), in 1900 – 1915: 6374 (max 8912). More representative quantitative data on the ringed seal hunting exists for small location. We analysed quantitative data on the ringed seal hunting in the Solovetsky Islands water area for 22 years from 1751 to 1794 (total catches, catches per boat, amount of blubber, number of hunters and fishing boats, etc.). These data were found in Solovetsky monastery documents, Russian State Archives for the Ancient Documents in Moscow. Seal catches decreased during the period under study. The correlation coefficient of catch size with year  $r = -0,55$ ,  $p < 0,05$ . However there was no consistent change in weight of seal. Fishing effort did not change during 1710 – 1794 (5 boats and 10 seal hunters). We compared our data with the known time-series on temperature and ice condition. Correlation was negative with time of ice cover on Dvina river ( $r = -0,57$ ,  $p < 0,05$ ) and with 10-year running mean of temperatures based on analysis of oxygen isotope from Camp Century on the Greenland ice sheet. Therefore, we assume that the catch dynamic was influenced by hydro-meteorological factors that affect either the migration of ringed seals to Solovetsky Islands area, or the conditions of hunting, or both.

HU 10

**Measuring interactions between common bottlenose dolphin (*Tursiops truncatus*) and artisanal fisheries in the Ligurian Sea**

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Interactions between foraging common bottlenose dolphin (*Tursiops truncatus*) and artisanal fisheries are widely reported in Mediterranean waters. However, it is not always clear what constitutes an “interaction” and to what extent damages to fishing nets are due depredation by dolphins. These interactions were examined by monitoring the presence of dolphins near fishing nets at night using a modified Ecological Acoustic Recorder (EAR), adapted to be easily attached and removed on a set net. Fishing operations occurred between April and September 2010 in an inshore area in the proximity of Chiavari harbour, in the eastern Ligurian Sea. The EAR was programmed to record 30 seconds every 3 minutes at 50 kHz sample rate for 12 hours, from 7 pm to 7 am, first on a trammel net and later on a gill net, following the fishermen’s fishing schedule. Depredations events documented by fishermen are usually based on specific damages observed on the net, such as rips with a distinctive shape (holes with hanging strips), presumably caused by dolphins feeding on caught fish. Fish landed during sets were identified and counted. Dolphin’s presence was recorded during 21 of 34 fishing operations. Only in 3 cases was dolphin presence in the proximity of the net coincident with net damage. Damages occurred in 4 of 34 fishing operations with both loss and increments of single fished species; the overall effect of depredation was 14% loss of the commercial catch.

**HU 11****Seal depredation and bycatch in Irish setnet fisheries**

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Seal depredation of set net fisheries in Irish waters is thought to be increasing. Anecdotal reports by industry suggest current depredation rates of up to 30% in gill net, tangle net and trammel net fisheries. There are no current quantitative estimates of catch losses, however, and over 10 years have passed since previous research in this area. Funded under the BIM Marine Environmental Measure, project partners BIM, the CMRC and MI are carrying out a one year pilot scale assessment of seal depredation in Irish waters. The study will include an assessment of depredation rates, a review of potential seal depredation mitigation measures and provision of data on bycatch of seals and other species in Irish set net fisheries. Approximately 100 days observer coverage will be carried out on two inshore vessels and one offshore vessel based in the west and south west of Ireland. Depredated fish will be classified based on damage attributable to seals, invertebrates or other unknown sources. Hidden losses i.e. fish entirely removed from the net will be accounted for by leaving fish enmeshed in nets, marking the gear and counting how many remain after normal soak time. Where possible, bycatch species will be measured, sexed, photographed and samples taken for follow up dietary, genetic and stable isotope analyses. Mitigation measures such as changes to operational practices, deterrent devices, gear modifications or alternative gears, as well as ideas from fishermen themselves will be reviewed and assessed in terms of their potential for success. The study will be completed in summer 2012 and results used to inform the development of management measures for seal fisheries interactions in an Irish context.

HU 12

**Changes in gillnet fishery in the context of Baltic harbour porpoise protection in Poland**

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The population of Harbour porpoises (*Phocoena phocoena*) in the Baltic Sea has been classified as critically endangered (Hammond 2007). In 2002 it was estimated at about 100 species (Berggren et al. 2004). One of the factors, which contributed to low numbers of this species in the Baltic Sea was by-catch, in particular by-catch in gillnets. 67 by-catch of harbour porpoises in fishing nets have been reported in the Polish Baltic Sea between 1990-2011, of which 58 concerned by-catch in gillnets (Skóra, Pawliczka 2003 and un.pub. data). In order to determine the current scale of the threat that gillnets fishing poses to the Harbour porpoises population in the Polish part of the Baltic Sea area the analysis was conducted on data that reached back to the year 2004, when Poland started implementing CFP. The data covered the years 2004-2010 and came from Polish Fisheries Monitoring Centre in Gdynia. Results showed a reduction in the number of gillnetters. Their numbers have fallen more than 40% between the years of 2004 and 2010. The changes have concerned mostly fishing vessels exceeding 15m. This was why in 2010 polish gillnets fishery consisted in 90% of fishing vessels under 12m. Reduction in gillnetters had impact on the number of fishing operations. Between 2004-2010 this value had fallen by about 60%. The number of issued sets of gillnets decreased even more, by nearly 70%. Areas where most of those nets were issued were coastal waters, which are preferred by harbour porpoises. Changes in gillnets fishery indicate the pressure on harbour porpoise in Polish part of Baltic Sea has decreased. Nevertheless the pressure is still high, because the resources of this species have been probably reduced in the meantime. It is important to continue monitoring changes in gillnets fishery and observe areas where gillnets are used.

HU 13

**Detecting salmon in the diet of grey seals (*Halichoerus grypus* Fabricius, 1791) off the south-west coast of Ireland**

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Grey seal (*Halichoerus grypus*) populations are thought to be increasing around the UK and Ireland. As a result, there has been growing interest into the interactions between these populations and commercial fisheries and in particular their potential negative impact on important commercial stocks, such as Atlantic salmon (*Salmo salar*). Due to difficulties associated with tracking salmon mortality at sea, these impacts have traditionally been estimated through dietary analysis, particularly the analysis of hard structures found in scat. An analysis of 60 scat samples collected from the Blasket Islands (SW Ireland) during Aug/Sept 2009 and Mar/Apr 2011 was performed. A total of 35 species were identified, with salmon occurring in over 26% of scats. However, captive feeding studies suggest that salmon may be severely underrepresented in pinniped diets due the fragile nature of their bones and otoliths. Additionally, both size and weight are also needed to assess the impact of grey seals on salmon stocks. However, little data exists on the relationship between these parameters and the bones of salmon. To address these problems, a grey seal-salmon feeding study was designed to obtain number correction factors (NCFs) and erosion co-efficients for salmon otoliths and premaxillae, the most commonly recovered structures. An extensive reference collection was also created for salmon, in order to derive robust regression equations for length and weight from salmon premaxillae and other bones. When these regression equations were employed, incorporating corrections for erosion, and NCFs, the contribution of salmon to the diet by biomass increased from 9% to 16% (excluding NCFs), and there was a three-fold increase in salmon consumption in the study area.

HU 14

**Dolphin species' diet, fisheries association and net damage in coastal fisheries of the North Aegean Sea (Greece)**

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Aspects of ongoing research involves a fishermen questionnaire study undertaken between October 2005 and 2010 focusing on the most important small scale fishery ports of the Gulf of Kavala. Weekly based questionnaires were collected for 1328 sampling days. Data on gears employment, damages incurred dolphin sightings and interactions with fishing activities were recorded in the Gulf of Kavala and Thassos Island in Greece. Five net gears considered included: different trammel nets for soles *Solea* sp., red mullets *Mullus* sp., cuttlefish *Sepia officinalis* and deep water rose shrimp *Melicertus kerathurus* respectively and gill nets for European hake *Merluccius merluccius*. The most common dolphin species observed by fishermen include: *Tursiops truncatus*, *Delphinus delphis* and *Phocoena phocoena*. From the data collected it appears that, during the study, trammel nets for deep water rose shrimp, gill nets for European hake and trammel nets for red mullet have recorded most damages with a relative frequency of 37.7%, 35.0% and 27.5% respectively. While *Tursiops truncatus* was considered responsible for net damages in most cases, in recent years damages were also incurred by *Phocoena phocoena*. The latter species, immigrant from the Black Sea, is rare in the Mediterranean Sea and data on it are therefore unique and valuable.

Research on stomach content on 15 stranded dolphin species and comparison with fisheries landings, indicate that the stranded individuals were feeding mainly on species of no local commercial value, and not the target species for the fishing gear used. Such fish prey may have been by-caught by the fishing gears or provided an opportunistic food source easily available to the dolphin, causing damages to the nets. Ongoing studies will continue to investigate which of these options is most common in the study area.

HU 15

**Common dolphin (*Delphinus delphis*) response to boating pressure on the south coast of Portugal**

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The southern region of Portugal, Algarve, is the destination of thousands of tourists every summer and its population triplicates during this period. Consequently, in the coastal zone of the larger cities, the boating pressure, including recreational and tourist vessels, rises considerably. In these waters, nine species of cetaceans, both odontocetes and mysticetes, were reported and the most sighted one is the common dolphin (*Delphinus delphis*). During the summers of 2010 and 2011 (July to October), the behaviour of this species upon the presence of vessels was recorded. Observations were carried out, from whale watching boats, in a high-pressure area (Albufeira) and in a low-pressure area (Sagres). The response of the group was categorised into three different types: positive (approach), neutral (indifference) and negative (avoidance). The behaviour was registered during 2 minutes after the vessel entered within a 300 m radius area around the group. Common dolphins were observed in 514 encounters, 399 in Albufeira and 115 in Sagres. In 62% of the encounters, either positive or negative interaction was recorded. Evasive behaviours accounted for approximately 8% and 4% of the total, in Albufeira and Sagres, respectively. However, these percentages varied over the season, and in both locations the higher peak was reached in August, the month with greatest anthropogenic pressure. In this month, 12% of the responses were negative in Albufeira, whereas in Sagres in 5% of the encounters the dolphins avoided the vessels. The analysis suggests that the animals are disturbed by the vessel traffic and that interaction behaviour towards the vessels is likely to change in areas with different pressure levels. These results reinforce the need to increase the authorities' control, since during most of the encounters in high-pressure areas, the number of vessels surrounding the groups of dolphins is higher than that allowed by the Portuguese law.

**HU 16****Historical exploitation of marine mammals in the Argentinean Patagonia**

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Current status of populations cannot be properly understood unless knowledge on the history of removals is available. We have worked on historical documentation to ascertain when and where exploitation of marine mammals occurred in the Argentinean Patagonia, what species were targeted and what was the magnitude of the catches. In this area, exploitation of marine mammals developed through three well-differentiated operations: The first one started in 1790 with the activities of the Spanish Real Compañía Marítima which initially targeted whales but soon shifted to sea lions and fur seals. Their pioneering expeditions were followed by a period of sparse exploitation by both Spaniards and locals that continued up to the end of the 19th century; information on these activities is mostly preserved in Spain's historical archives and, although references are abundant, they contain insufficient detail to allow proper quantification of removals. A second operation was undertaken by non-Spanish expeditions, mostly British and American that sailed along the coast taking both whales and pinnipeds. They started soon after the Spanish operations and peaked between 1820 and 1870. The fact that they did not have a base on land favoured the existence and preservation of vessel logbooks recording details of catches. Documentation on these expeditions is mostly available in American and British archives. Finally, a third operation developed approximately during 1920-1950 and mostly targeted sea lions and elephant seals; it consisted in well-organized Argentinean land-based operations whose documentation, of varying quality, is preserved in local archives. Research funded by Fundación BBVA.

HU 17

**A record of a grey seal (*Halichoerus grypus* Fabricius, 1791) in the coastal waters of the eastern Crimea (Black Sea)**

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Monk seal *Monachus monachus* inhabited the Black Sea until 1990s. Also various pinnipeds escaping from captivity have been recorded in the coastal waters of Crimea and in the north-western Black Sea. We have been receiving data about regular sightings of a seal in the coastal waters of eastern Crimea since 2001. We identified it as a grey seal (*Halichoerus grypus* Fabricius, 1791) after observations and photoidentification. It was an adult female, more than 6 years old, 160-170 cm long. The seal was recorded in February and from April to August. More than 33% sightings fell on May. The animal was observed regularly in May and June in 2010 and 2011. Movements of the seal were seen in the coastal waters; they were interpreted as foraging behaviour. Feeding was often registered close to fishing gears. Identified prey objects were mullets. The seal used an underwater cave as a shelter.

Escape from captivity is the most likely way of invasion of the grey seal to the Black Sea. We are not aware of the subspecies of this seal at present. According to available data (body size, moulting seasonality), we tentatively identify it as a representative of the Baltic subspecies *Halichoerus grypus macrorhynchus* Hornschuh et Schilling, 1851. The DNA analysis will answer this question. Being an ecologically flexible species, grey seal well adapted in a new habitat. The observed individual is in a good body condition, it moults successfully every year. In addition, a seal living in this region is an indicator of lack of human disturbance. Biotope requirements of grey seals and monk seals are similar: both species use coastal karst caves and grottos. Thus, the invasion of a seal in this region indicates the possibility of successful recolonization of the Black Sea by monk seals.

**HU 18****The organization of research work on studying and conservation of marine mammals with children and students**

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Scientific work with children begins with opening in many respects the mysterious world of sea mammals. Interest to investigation of biology of marine mammals should arise in the childhood. Therefore scientific biologists should conduct educational activity in the specialized centres of additional education of children. For this purpose on the basis of the Palace of creativity of children and youth "Intellect" the experimental biological laboratory in which children have possibility to receive knowledges in sea biology is created. In laboratory all children can be engaged, which wish. Here for attraction of children to scientific-research activity we use different forms of work: interesting lectures and seminars of marine biologists, demonstration of scientific-informative films, excursions to the dolphinarium and zoo, acquaintance with results of scientific researches of teachers. As a result of it the child has interest to problems of investigation and conservation of marine mammals and has wished to engage in serious scientific activity. Such children under the direction of the skilled marine biologist choose a theme of the project, select a material, conduct necessary researches and represent the project on special competitions and scientific conferences. Scientific works of children are estimating by independent experts from among known scientists, professors of universities and teachers of biology. Works of winners are exposing at scientific exhibitions where all visitors can get acquainted with them. As a result of it problems of investigations and conservations of marine mammals cause the increasing interest. And in the future the scientific community can expect occurrence of new Marine scientists.

HU 19

**Collisions of dolphins with ships in the Black Sea waters of Crimea**

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Collisions with sea transport can be a mortality factor for cetaceans in the areas with high shipping activity. Bottlenose dolphins (*Tursiops truncatus*) and common dolphins (*Delphinus delphis*) are expected to be primary species affected by ship collisions in the Black Sea because they often interact with vessels. However there is little information about ship collisions by present.

In December 2008 and March 2011 dolphin carcasses (a bottlenose dolphin and a common dolphin, respectively) were stranded at the coast of Nikolaevka (south-west Crimea, Ukraine). Ship collision marks were recorded on them. The first animal had a spine trauma and splintered rostrum. The second dolphin was virtually cut in two (probably by a propeller); also it had splintered rostrum. Furthermore scratches and cuts were found out on the animal skin. Yet the ship collisions could happen to dead animals in both cases.

There are anecdotal reports from local residents about interactions of dolphins with vessels. As an example, information about specific entertainments of young people is regularly reported. They are told to gather around cetaceans with their waverunners and literally scratch the dolphin backs being a cause of injuries and harassment.

It should be noted that strandings of dead cetaceans often occur at the Crimean south-western coast. Nevertheless information concerning strandings is incomplete due to high-density building zone and summer influx of tourists. As far as monitoring in the resort areas is improved, we can discover new facts of ship collisions and estimate the impact of shipping on dolphin mortality in the Crimean waters.

HU 20

**Promising results of the first land-based cetacean surveys from Andenes lighthouse, Norway**

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Wild cetacean land-based research has greatly increased in the last decades, and has proven to be an important tool for behavioural studies and interactions with human activities. It also constitutes a valuable device for whale watching companies helping to detect cetaceans, reducing the time and fuel invested to survey the area, and help the coordination among different vessels to avoid sharing sightings and therefore, reduce the disturbance. The present study was carried out during summer 2011 from Andenes lighthouse (height= 42 m), Norway. The location of the lighthouse allows 240° of view range and 22 km towards the horizon. Surveys consisted of 3 hour shifts carried out twice a day, in blocks of 20 min using Big Eyes binoculars that together with the software logtoolv4 (developed by Johnson, M.) allow estimating the position of individuals/groups identified. For each observation, the species, number of individuals, behaviour and presence/absence of boats and birds were recorded. A total of 32 surveys were carried out, 26 of which were successful allowing 61 sightings of 6 species: harbour porpoise, Atlantic white-sided dolphin, sperm, killer, humpback and minke whales, and 2 unknown species. Additionally it was possible to witness the interaction of cetaceans with whale watching vessels and a whaling operation. The methodology was highly dependent on weather conditions; however the results were motivating. Long term use of this tool will allow identifying the habitat use of the different species as well as their temporal distribution. It will also help measuring the level of disturbance the cetaceans are exposed to, studying behavioural responses and blow rates, and contribute towards developing better whale watching practice in the area.

HU 21

**Are harbour porpoises (*Phocoena phocoena*) displaced from operating wind turbines?**

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The expansion of renewable energy production goes along with rapidly construction of offshore wind farms in European waters. Actually, wind farms cover large marine areas. Even though it could be shown that offshore wind farm areas are still used by harbour porpoises during operation some concern exist about scaring effects of operational turbines at least in close vicinity and during highest noise emissions during high wind speeds.

Since noise emission of wind turbines significantly correlates with the speed of the rotor blades and thus energy production we took the power output of the turbines as a value for sound emission into the water. Porpoise presence was measured by means of C-POD detections which were then correlated to the turbine power output. We analysed recordings from three POD positions deployed in the vicinity of wind turbines (between 510m and 1000m away) and from three reference POD stations deployed at distances between 9km and 16km from the nearest turbine. We could not found any negative relationship between porpoise detections and power of the nearest turbine neither at POD stations near the turbines nor at the reference stations. In contrast, findings even show an increased detection rate of harbour porpoises in the vicinity of the wind turbines during days where turbines operate at their maximum capacity. Our results do not provide any evidence that harbour porpoises are deterred from operating wind turbines due to noise emission. Together with results from other studies it can be concluded that the operation of offshore wind farms does not affect porpoises negatively.

HU 22

**Does the use of a Big Bubble Curtain (BBC) as a noise mitigation system during pile-driving reduce porpoise avoidance behaviour?**

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Offshore wind farming is a rapidly extending industry and several new wind parks are constructed in the North Sea and in the Baltic Sea at present. This raises the question how construction work effect marine mammals and if this effect could be reduced by the use of noise mitigation systems?

Until today we know little about the spatial and temporal scales with which these activities affect the population of harbour porpoises (*Phocoena phocoena*), the only regularly occurring cetacean species in North Sea and Baltic Sea.

During the construction work at the wind park Borkum West II the response of harbour porpoises to wind farm construction were monitored by continuous registration of the echolocation clicks of these animals using hydrophones with data logger, the porpoise detectors (PODs). These PODs were placed at distances of 750 meters and 1.500 meters from each construction site. Additional noise measurements were made at the same positions using broad band hydrophones.

The pile driving works were accompanied by two mitigation measures:

1. Use of deterrence devices 40 minutes before pile driving started during every pile driving event
2. Use of a 'Big Bubble Curtain' in order to reduce noise during a considerable number of pile driving events.

The constant measurements of noise and porpoise detections at these two distance classes will be analysed and discussed following the main question: Does the harbour porpoise reoccupy the area around the construction site faster when the noise mitigation system was used?

# PHOTO ID

P 01

## Regional cooperation and collaboration in grey seal (*Halichoerus grypus*) photo-identification research informs species-level conservation

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For grey seal conservation measures to be effective, a better understanding of seal movements between interdependent sites is required. Long-term photo identification of seals benefits from the development of networks of specialists working alongside trained volunteers. The evolution of one such network in SW England is described. Since 2000, a photo identification catalogue for grey seals in St Ives Bay has been generated. In 2004, Cornwall Seal Group (CSG) was set up and members began sharing data to create an holistic picture of seal activity in the area and to initiate the tracking of individual seals around the coast. By 2008, this network expanded to include Cornwall Wildlife Trust (WT), Looe Voluntary Marine Conservation Area (VMCA) volunteers and the University of Exeter. Using this successful model of collaboration, in 2011 the CSG network grew rapidly, as a result of enhanced communication with other established players operating in the region, including British Divers Marine Life Rescue, Polzeath and St Agnes VMCA, Isles of Scilly (IoS) WT, Cornwall College and eco tour operators. This association of public, private and voluntary organisations and growing interaction with more distant organisations (WT of South and West Wales, the Isle of Man WT and Swansea University) has increased our understanding of how seals move around the coast. As a result, 131 seals from St Ives Bay have been identified at 30 other locations across Cornwall including Looe (n=4) and Boscastle (n=4); IoS (n=22); Devon including Morte (n=2) and Lundy (n=1) and SW Wales Skomer (n=23). Eighteen are known breeding seals (3 beachmasters and 15 mums) whose repeated, seasonal movements have been tracked between sites over several years, demonstrating the need for integrated management approaches to species conservation. CSG look forward to linking with colleagues working in other areas of the Celtic Sea.

P 02

**Photo-identification of coastal bottlenose dolphins off Sesimbra (Portugal): new methodological approaches and first results**

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Considering the occurrence of coastal populations of bottlenose dolphins (*Tursiops truncatus*) in the waters adjacent to the Sado estuary (Portugal) which is home to a resident population of bottlenose dolphins, it becomes critical to develop a continuous study to evaluate the intraspecific interactions between non-resident and resident populations. This study aims to assess the demography and patterns of residency of non-resident bottlenose dolphin populations in the vicinity of the Sado estuary. Boat-based surveys were conducted with pre-defined transects along the coast between Cape Espichel and the Sado estuary, as well as the marine and coastal area of the peninsula of Troia. Also, complementary boat trips with no fixed routes were conducted. Classical photo identification methods for individual recognition were used in the majority of the cases, although in some specific cases, such as over time altered dorsal fins, it was used a self-built method inspired by Rowe 2009. The constructed method calculated a percentage of similarity, through the non-coincident area of overlapped dorsal fins. Bottlenose dolphins were sighted in 27 (of a total of 96) surveys which were conducted in the area between 2007 and 2011. Preliminary analysis shows no seasonal preference for their occurrence in the area. There is a significant preference for waters shallower than 50 m deep ( $p < 0.01$ ). The average group size is 15 individuals and juveniles and new born calves have been sighted in 61% of the encounters. We catalogued about 80 individuals, with 29 re-sightings within and between years. These occurred mainly on May to July. The association indexes indicate the presence of two different groups with a possible seasonal influence. Further analysis is needed to estimate population size and to propose conservation measures to the region and both coastal populations.

P 03

**Identifying ecological threats using natural marks on dusky dolphins (*Lagenorhynchus obscurus*)**

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Photo-identification (photo-id) of distinctive natural marks has become a common non-invasive method of re-identification of cetaceans, but only few studies have investigated the possible origins of these marks. Unusual scars, examined and photographed during opportunistic sightings and necropsies of stranded animals, have been the topic of reports on whales and dolphins. Possible sources of natural marks on dolphin dorsal fins include rake marks and wounds caused by intraspecific interactions and natural predators. As well, distinctive marks may arise from anthropogenic causes including entanglements in fishing gear and boat collisions. Our study focuses on analysing living animals in nature, attempting to use scars, wounds and notches on the dorsal fins of dusky dolphins (*Lagenorhynchus obscurus*) off Kaikoura, New Zealand, to identify possible ecological threats. We compared photo-id pictures taken in May 2011 and from October 2011 through January 2012 to marks with known origin being described in the literature, and defined different categories, including conspecifics, killer whales, sharks, boats and various fishing net types. Preliminary data suggest that from 453 pictures taken, 57.6% (260 photos of 161 individuals) had either notches or scars or both. However, only 33% of the marked individuals could be positively identified as rake marks caused by conspecifics.

Little is known about predation as well as the fisheries impact on the species. High predation pressure and anthropogenic impacts can alter the population's behaviour, habitat use, mate and food choices; and can even critically affect the population off Kaikoura and the entire ecosystem in the long-term. It is therefore important to identify both natural and anthropogenic influences on living animals. The results of this study provide a method to assess predator-prey interactions and ecological threats of dusky dolphins, and may also provide suggestions for conservation management. Our approach may be useful for other species and ecosystems.

P 04

**Presence of epidermal lesions in resident southern Australian bottlenose dolphins (*Tursiops australias*) and short-beaked common dolphin (*Delphinus delphis*) in Port Phillip, Victoria, Australia**

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Cetacean poxvirus and epidermal lesions are prevalent in many dolphin populations across the world. Severe lesion outbreaks have been recorded in Australia in the Swan River, Western Australia, and Gippsland Lakes, Victoria. Prior to 2011, epidermal lesions were present but inconspicuous on the resident southern Australian bottlenose dolphins (SABD), *Tursiops australis*, in Port Phillip. A significant change was noted in February 2011 when a juvenile, “clean-finned” animal was photographed with extensive epidermal lesions. Dedicated photo monitoring surveys conducted by the Dolphin Research Institute (DRI) in April 2011 recorded at least six different epidermal lesion types on 74 re-identifiable resident Port Phillip dolphins (73 SABD’s and 1 short-beaked common dolphin *Delphinus delphis*). Of these, 43 dolphins showed evidence of lesions; 19 animals exhibited two types of lesions and 24 dolphins a single form of lesion. All affected dolphins displayed normal behaviours and appeared to be in good condition. The most prevalent type of lesion on re-identifiable dolphins was white circular; this type was observed on 22 of the re-identifiable dolphins. Eighteen re-identifiable animals, including a short-beaked common dolphin, were photographed with white-fringed lesions, the second most common type. Photographs taken ten days apart of one individual with a large cloudy lesion, showed significant healing with limited signs of the lesion after ten days. The situation in Port Phillip is consistent with descriptions in the literature, with lesions occurring after a change in salinity and mostly in younger animals prior to them developing adult immunity. There is a need to develop a systematic classification protocol for lesions. DRI will continue to monitor the presence and extent of epidermal lesions in the resident SABD and short-beaked common dolphins as part of our on-going core research program.

P 05

**Photo-identification of bottlenose dolphins in Broadhaven Bay (cSAC), northwest Ireland**

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Photo-identification of bottlenose dolphins *Tursiops truncatus* was carried out in Broadhaven Bay, County Mayo, Ireland, in 2002 and 2008-2011 as part of an ongoing marine mammal monitoring project. Twenty-six photo-ID surveys were conducted during this period. Group size estimates based on photo ID ranged from 5 to 65, with a median of 22 animals. To date, 198 individuals have been identified using left and right sides (defined as highest number of animals identified from one side). Of these, 54 are well-marked (significant permanent fin damage), 75 slightly marked (slight fin damage) and 69 are poorly marked (superficial transient marks). Re-sighting rates were high, with 116 individuals (59%) re-sighted at least once and one animal re-sighted 11 times. The discovery curve for well and slightly marked individuals has levelled off since August 2010, with only 8 new individuals identified in 2011. 63 of the animals seen in 2009 were re-sighted in 2010, while 4 individuals have been seen every year between 2008 and 2011. There have been no matches between 2002 and later years. The bottlenose dolphins using Broadhaven Bay are known to be part of a larger population travelling north and south along the west coast of Ireland (Mirimim et al., 2010). Five animals have also been matched with individuals photographed in the Moray Firth, Scotland (Robinson et al., in prep), while one animal sighted in Broadhaven in 2009 and 2010 has since been matched to an individual photographed on the east coast in Killiney Bay, County Dublin, in 2011. The results along with the presence of sub-adults (juveniles and/or calves) in 18 encounters (69%), indicate the importance of the study area as a bottlenose dolphin habitat and implies a degree of site fidelity to Broadhaven Bay.

P 06

**Photo-identification of humpback whales (*Megaptera novaengliae*) off the north-east coast of Iceland**

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The productive waters around Iceland are an important summer feeding ground for humpback whales (*Megaptera novaengliae*). Photo-Identification of humpback whales was carried out in Skjálfandi Bay along the north-east coast of Iceland between 2001 and 2011, mainly using whale watching vessels as research platforms and humpback whales can be observed regularly from April to October in this bay. During this 11-year-period, 191 individual humpback whales were identified using the unique patterns of the fluke and marks, scars and blotches on the dorsal fin. Twenty seven (14%) of these whales were photographed in Skjálfandi Bay in more than one season with one individual being photographed during four, and another individual being photographed during even six consecutive years, showing a high site fidelity to the area. The inter-annual re-sighting rate varied from 6.67% (in 2005) to 25.64% (in 2007) respectively with the mean re-sighting rate being 15.80%. The number of individually identified humpback whales varied from 0 (during the 2003 season) to 39 (during the 2007 season). In addition to the photo-Identification catalogue for Skjálfandi Bay, pictures from other parts of Iceland have been collected from tourists, other whale watching companies and cruise ships. By comparing these pictures with the photo-Identification catalogue for Skjálfandi Bay, several matches were found, providing useful information about the migration patterns of humpback whales within Icelandic waters. In cooperation with the College of the Atlantic (Maine, USA) and the Irish Whale and Dolphin Group (IWDG) two humpback whales were also successfully matched to individuals that had been photographed outside Icelandic waters; off Cape Verde, North-West Africa. This further emphasizes the importance of long-term research projects and collaboration among research groups on exchanging photo-identification material to learn more about humpback whale movements.

P 07

**Social structure of long-finned pilot whales in the Ligurian Sea (Pelagos Sanctuary, Northwestern Mediterranean Sea)**

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Although long-finned pilot whales (*Globicephala melas*) are common in the western portion of the Mediterranean Sea, there is a dearth of information on this species in the whole basin, which prevents proper evaluation of its conservation status. Photo-identification data were used to assess social structure in the Pelagos Sanctuary, where long-finned pilot whales are regularly observed. Data were collected during summer shipboard surveys (June to September) between 1990 and 2011 in an area of approximately 25,000 km<sup>2</sup>. *G. melas* was encountered on 38 occasions and 104 individuals, being sighted from 1 to 6 times (mean= 1.96), were photo-identified. Despite many of them being sighted only once, suggesting a larger home range than the study area, 57 were recorded on multiple occasions and the interval between the first and last identification varied from 1 day to 20 years. Group size ranged from 2 to 80 individuals (mean= 26.86, SD= 21.95). Calves were present in 79.17% of all groups encountered and were observed throughout the whole summer, suggesting the importance of the study area for calving and nursing. Groups containing only adults were significantly smaller than groups containing also calves (Mann-Whitney test,  $P < 0.01$ ). The relationships among pairs of individuals were evaluated using both the half-weight index (mean= 0.14, SD= 0.06) and the simple ratio (mean= 0.09, SD= 0.04). Although a large proportion of associations appeared to be casual, certain individuals seemed to exhibit long-lasting relationships ( $HWI \geq 8.0$ ,  $SR \geq 6.5$ ), suggesting a social system based both on casual acquaintances and constant companions. The results of this study require additional data from different areas of the basin and further research on social structure, re-enforced by genetic analysis, to better understand this population. Nevertheless, the importance of the Pelagos Sanctuary for conservation of cetacean species regularly using this area was further highlighted.

P 08

## Photo-identification of minke whales (*Balaenoptera acutorostrata*) in the coastal waters of Faxaflói and Skjálfandi Bays, Iceland

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*Balaenoptera acutorostrata* is endemic to the North Atlantic and present in Icelandic coastal waters mainly during the summer months; however, little is known about site fidelity and seasonal abundance. Photo-identification studies were conducted from April-September between 2007 and 2010 and 2001 and 2010 during whale-watching operations in Faxaflói Bay (FB) and Skjálfandi Bay (SB) in the SW and NE coasts of Iceland, respectively. Minimum population sizes, annual and seasonal site fidelity, and movement between bays were calculated. During 1465 (699 in FB, 766 in SB) surveys on-board whale watching vessels, minke whales were observed on 85.0% and 67.4% (n=594 in FB, n=516 in SB) and 3330 high quality colour digital photographs were analysed. A total of 292 individuals were identified in FB, and 61 in SB. An average of 1.77 SD=1.34 (FB) and 1.25 SD=0.48 (SB) animals identified per survey. Mean group size in FB was 2.45 (SD=2.44), while in SB was 1.21 (SD=0.59). 103 individuals were sighted on multiple occasions, 81 (27.8% of the population) in FB, 22 (36.1% of the population) in SB. In FB, 24 whales (8.2%) were also sighted on multiple occasions within the same day, and four individuals (6.6%) in SB. Overall mean residency time in FB was 19.96 (SD=22.43; range 1 to 117 days) and overall mean residency time in SB was 13.04 (SD=19.18; range 1 to 100 days). Annual sighting rate was 23.3% (n=68) in FB, 16.4% (n=10) in SB with one whale (0.3%) matched between FB and SB (first documented wide-range distance movement from SW to NE using photo-identification). The southwest and northeast coasts of Iceland are important sites for minke whales and provide excellent research opportunities due to their critical habitat and to the nature of the readily available opportunistic platforms for research e.g. well supplied and developed whale-watching industries.

P 09

## Current knowledge on the distribution, migratory patterns and relative abundance of humpback whales (*Megaptera novaeangliae*) off the Cape Verde Islands, Eastern North Atlantic

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During the winter/spring months from 1990 to 2011, 15 cetacean surveys were conducted around the Cape Verde Islands off West Africa. The main target species was the humpback whale (*Megaptera novaeangliae*). Study periods varied from 14 to 90 d in duration. Study platforms included a 5-m inflatable boat, a 12-m catamaran, and/or 15-m sailing or motor vessels. Collectively, we obtained 121 individual humpback fluke photographs from this region. These fluke photographs have been compared to over 8,500 individual fluke photographs maintained in the North Atlantic Humpback Whale Catalogue. Based on photo-identification, humpbacks in the Cape Verde Islands have a relatively high inter-annual resight rate (> 25%) compared to other studied breeding locations in the West Indies. While this is partly due to increased probability of detection in a small population, this result nonetheless suggests strong site fidelity to this breeding ground.

Nine photo-identified individuals from the Cape Verde Islands had been previously photographed on high-latitude feeding grounds. Four off Bear Island, Barents Sea, Norway; three off Iceland, and two have been resighted in the Azores in the spring, presumably enroute to their northern feeding grounds. These findings are consistent with the belief that the Cape Verde Islands represent a breeding ground for eastern North Atlantic humpback whales.

Further research is required to clarify the importance of this small population and its breeding grounds. A delicate balance is required between the ever increasing human activities on the water and the protection of the species and its calving habitat. Measures to obtain this balance should include whale watching guidelines, habitat preservation and enforcement of the regulations.

P 10

**Photo-identification of beluga whales (*Delphinapterus leucas*) in Tigil'ski region of Western Kamchatka, Far East Russia**

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Photo identification is a widespread approach to explore many aspects of cetacean biology. PhotoID on white whales has many technical difficulties in making good quality images and analyzing animals without contrast color patterns. Although, this method was successfully used for Alaska's Cook Inlet (Alaska, USA) and White Sea belugas (Russia). Our study is also based on identification of individual animals by their natural marks and comparison of matches. The goals of our research are description of local herd of belugas summering in mouth of Moroshechnaya River (Western Kamchatka) and checking for evidences of belugas local movements between different geographical sites.

Our field season was conducted in the period of 17 August – 13 September 2011. In total we made more than 24 thousands of pictures during 47.3 hours of work. Images were underexposed for the best contrast of faint marks on white animals. All pictures were sorted by quality and analysed for identification of individual animals. We identified 28.5% (357) of total encountered animals (1274) and 29 (2.3%) animals were encountered repeatedly. There were found considerable amount of white animals, unavailable for individual identification because of absence of any visible marks. Comparing recent data with previous year, when our work site was located at 40 km to the north, we found a few animals (6) encountered during both seasons. It can be explained as low level of animal's movements as well as small pool of available photoID data in comparison of total population size.

Two field seasons allow us to begin cataloguing of our images for white whales photoID database. Collecting more long-term data from different regions we hope to learn more about little-studied population of belugas and their movements in western Kamchatka coastal waters.

P 11

## **Entanglement as a welfare issue for grey seals (*Halichoerus grypus*) in north Cornwall, UK**

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Entanglement in marine debris has been internationally recognised as a potential threat to marine species since the 1984 International Workshop on the Fate and Impact of Marine Debris. In particular 56% of pinniped species have records of entanglement.

Average entanglement rates of grey seals *Halichoerus grypus* at a haul out site in North Cornwall range from 2-5% of sightings. Entanglement rates an order of magnitude lower than this have been implicated in population declines of other pinniped species.

Whilst the focus of many studies has been the population level effects on species, a long-term photo identification study of grey seals *Halichoerus grypus* visiting this haul out site found that even seriously impacted seals are capable of surviving for up to seven years. This raises welfare concerns for the affected animals that are spending months to years of time with deep constrictions and persistent open wounds.

**P 12****Inshore bottlenose dolphins in Ireland use the entire Irish coastline**

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Images of individual bottlenose dolphins have been collected from around the Irish coast since 2005. Some of these were collected during dedicated fieldwork, but many opportunistically while carrying out other fieldwork, or submitted by members of the Irish Whale and Dolphin Group. These data were used to explore movements, site fidelity and home range. Of the 192 individual dolphins recognized, 54 have been re-sighted – a rate of 28.1 %. A total of 26 individuals (13.5%) have been re-sighted on three or more occasions and 15 (7.8%) on four or more occasions. One dolphin in Donegal was re-sighted in Cork 46 days later, a distance of around 1000km. There is evidence of group cohesion with some dolphins recorded together up to four years apart. Two dolphins were recorded together on four occasions, off Co Antrim in Northern Ireland, off Co Donegal and off Co Kerry. Bottlenose dolphins in Ireland are highly transient occurring off all Irish coasts. The re-sighting rate should be considered a minimum as most images were collected opportunistically but is high suggesting the coastal population of bottlenose dolphins in Ireland may be quite low, in the order of a few hundreds of individuals. A more robust abundance estimate is required but clearly any conservation actions and policies must consider the entire Irish coast. This work also highlights the importance and value of voluntary sightings schemes and the quality of images members of the public can obtain and will over time identify those areas frequently used by individual bottlenose dolphins.

P 13

**First evidence for long-term social associations in Baird's beaked whales (*Berardius bairdii*) in the waters of the Commander Islands, Far East Russia**

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Little is known about social structure in Baird's beaked whales. No detailed studies have been conducted to date; most information about the species comes from the whaling industry in Japan. We analysed the photo-ID data from 17 encounters with Baird's beaked whales during four field seasons (2008-2011) in the Commander Islands State Biosphere Reserve, Far East Russia. We identified 27 matches of individual animals in these encounters: nine animals were encountered twice, three animals were encountered three times, and four animals were encountered four times. Two animals were re-sighted after three years, two animals after two years and three animals after one year. We found several long-term social associations numbering two to four animals: in one case between two field seasons and in four cases within a field season. The time between the re-sightings of these associations within a season was 4, 9, 14 and 25 days, and between seasons 245 days. These stable alliances were encountered either alone or in groups with other animals for which no stable associations were registered. Once we observed two stable alliances in the same large group (up to 15 animals). Animals in this group demonstrated surface-active behaviour and produced underwater vocalisations (whistles and buzzes). Generally, it appears that the social structure of Baird's beaked whales in the waters of the Commander Islands resembles a fission-fusion society with some animals forming long-term social associations. Similar social structures are found in some odontocete species, such as common bottlenose dolphins (*Tursiops truncatus*) and northern bottlenose whales (*Hyperoodon ampullatus*).

P 14

**Results of bottlenose dolphins monitoring by photo-identification around Hyeres' Islands in 2009**

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As part of the PELAGOS Sanctuary research program 2007-2009, the GECEM conducted a study by photo-identification on bottlenose dolphins around Hyeres' Islands on the French Provençal coast from April to October 2009. The data collected were compared to those already collected by GECEM since 2005 along the French Provençal coast and since 2000 in Corsica. Nine groups of bottlenose dolphins were photo-identified by GECEM and its partners during the study, identifying 113 individuals. Only 10 dolphins were already known by GECEM, showing that the population frequenting this area remains mainly unknown. Among the 10 known individuals, 4 have already been photographed in Corsica, confirming the movements of certain individuals between Corsica and the French Provençal coast. The hypothesis suggesting that the dolphins cross the Ligurian Sea to move between the French coast and Corsica has been comforted by a study recently published (Gnone et al., 2011). These long distance displacements have since been confirmed by a record distance of 427 km between two sightings of an individual. Fifteen dolphins were photographed on more than one occasion during the course of the survey. All the groups include at least one and never more than 3 dolphins in common with another group. The groups' size was highly variable and comprised between 5 and 60 individuals. All the groups (less than 25 individuals) have been observed within the 500 m isobaths, excepted for the big group (around 60 individuals) observed travelling across a 1500 m deep canyon. This study, conducted during a very short time, provides very interesting results showing the interest and need of pursuing this species monitoring with photo-identification. It would be today interesting and necessary to create a network in north western Mediterranean Sea to monitor the bottlenose dolphin population.

P 15

**Population size and trend of endangered northern bottlenose whales (*Hyperoodon ampullatus*) on the Scotian Shelf off Nova Scotia**

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The northern bottlenose whale (*Hyperoodon ampullatus*) population on the Scotian Shelf off Nova Scotia is genetically distinct from other populations off Labrador and in the eastern north Atlantic. The population is listed as Endangered (Committee on the Status of Endangered Wildlife in Canada, 2002; Species at Risk Act, 2006). Mark-recapture analyses of photo-identification data from 1998-2003 indicated a stable population over that period. Determining whether the Scotian Shelf northern bottlenose whale population at present is stable, increasing or decreasing is vital in order to assess the effectiveness of current conservation measures. Photo-identification studies are a useful tool to monitor cetacean population size and growth. Over the summers of 2010 and 2011, I collected 3910 high-quality photographs of dorsal fins. Photo identification studies currently underway will fit open population models that incorporate heterogeneity in mortality and individual identifiability. The inclusion of these recent data will add a substantially greater time span over which to examine population trends, and considerably increase power to detect non-linear trends. A current population estimate and trend are part of the Department of Fisheries and Oceans Canada's recovery strategy mandate for the Scotian Shelf *H. ampullatus* population, and will inform future management decisions relating to the conservation of this endangered beaked whale population.

P 16

**Photo-identification of harbour porpoises in the Oosterschelde estuary, The Netherlands**

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In the Dutch Oosterschelde estuary, a small population of Harbour Porpoises is present year-round. In 2011 we started a Porpoise Catalogue. Using photo-ID, we have already noticed that several individuals are “regulars” in certain parts of the estuary. In the next few years we hope to answer several critical questions, such as how many individuals inhabit the Oosterschelde, their site fidelity, birth-rate and social structure.

Little is known about this population. To organize the scientific endeavour, a team of volunteers called Stichting Rugvin (Rugvin Foundation) started a dedicated field research in the estuary in 2009. By photographing the individuals we encountered during our research trips, we noticed that we could tell individual porpoises apart based on unique characteristics, such as body scars and skin pigmentation patterns. Based on this experience, we started a Porpoise Catalogue in the autumn of 2011. This catalogue is linked to a database of sightings.

Photo-ID research involving Harbour Porpoises seems to be unique. As far as we are aware, the only other dedicated attempt at identifying Harbour Porpoise individuals takes place in the San Francisco Bay area since 2009.

Our analysis so far seems to prove that several individuals are “regulars” in certain parts of the estuary, favouring certain locations according to the tides. In particular, the deeper areas, where the water depth is at least 20m deep seem to attract them during the upcoming tide, presumably because fish are concentrated there by strong tidal rips.

In the next couple of years we hope to answer several critical questions, such as how many individuals inhabit the Oosterschelde, their site fidelity and their birth-rate. Our work to unravel their presence in the estuary may also lead us to understand more about their social structure.

P 17

**From birth to death: how sharing sightings and strandings data is revealing grey seal ecology**

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Between 2005 and 2011, Cornwall Wildlife Trust Marine Strandings Network (CWT MSN) recorded 492 dead grey seals (*Halichoerus grypus*) on the beaches of Cornwall, SW England, UK. The animals were routinely examined, measured and photographed for the CWT MSN's extensive database, which now holds over 4500 photos. Photographs showing the pelt markings of suitable seals were shared with Cornwall Seal Group (CSG), which monitors the movements of this species by photographing live seals that visit various haul-out sites around Cornwall and Devon. Each seal's unique, lifelong pelage pattern has enabled CSG to build up a catalogue of over 1000 different grey seals, against which sightings can be compared. Eighty sets of photos taken by the CWT MSN were identified as suitable for analysis by CSG (records of whitecoat pups and decomposed carcasses with no pelt markings were excluded). Due to their extensive experience of comparing pelt markings by eye, CSG was able to analyse images that computerised photo ID software would reject as unsuitable. However, a list of factors that limit the success of this method was also compiled. On comparison of both live and dead photo sets, a total of 11 dead seals (four female and seven male) (14%) were positively identified, including two seals that had survived net entanglement for seven years and one rehabilitated seal. Two of the seals were known to have visited Skomer Island, Wales, where one had given birth to a pup and the other had been a dominant male. One seal had been monitored since birth. This method of comparing live and dead seals from photos enables the partners to determine the identity, migration, site fidelity and longevity of individual seals, in one case from birth to death, and clearly demonstrates the benefits of close communication between research groups studying the same species.

P 18

**Post-release monitoring of grey seal (*Halichoerus grypus*) pups rehabilitated at the National Seal Sanctuary, Cornwall, UK**

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The National Seal Sanctuary has been rehabilitating rescued grey seal pups back to the wild for over 50 years. Every winter season since 1996-97, pups have been tagged with a small plastic roto-tag through the webbing of a rear flipper, which has a seasonal colour code and unique identifying number that should last their lifetime. Two other tag types have also been trialled, paint and hat tags, to increase public reporting. Paint tags were used in 2001-02 and each pup had a different colour and symbol painted on their head. Hat tags (pyramid-shaped plastic tag that was affixed to the fur on the head of each pup) were used in the 2003-05 seasons. Both methods were temporary, lasting a maximum of year until the seal moulted. Paint tags did not increase reporting rates so were not re-used. Hat tags did increase reporting rates, but the tags were decided to be unsuitable due to the method of attachment and their use discontinued. Cornwall Seal Group carries out monitoring and photo-identification of local wild seals by matching pelage patterns to track seals over time and between locations. As this method has been successful, a photo-ID catalogue for each season is now kept so photos can be matched back if the flipper tag is not seen. Of 491 seals released since 1996-97, 112 (23%) have been resighted, consisting of 576 records mainly from Southwest England, but also from the coasts of Wales, Ireland and northern France. This distribution matches the suspected range of this species in what is known as the “Celtic Fringe” population. Three rehabilitated females have been recorded breeding and successfully raising their own pups, demonstrating the success of the current post-release monitoring methods and of the rehabilitation process.

# STRANDINGS

S 01

## Review of Irish cetacean stranding data from 1901-2010

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The Irish cetacean stranding scheme is one of the oldest in the world with anecdotal records dating back to 752 AD (Fairley, 1981).

Temporal and regional trends in stranding records over the last century of selected species were analysed, reflecting on changes of sea surface temperature (SST) in Irish waters.

A highly significant association between stranding species and geographical regions was found ( $X^2_{region} = 171.6$  [df12],  $p < .001$ ), with some species contributing more than others. A range shift of striped dolphin (SD), a warmer water species, from south to north was demonstrated, with significantly increased SST over the last century as potential driver.

Supporting an efficient and systematic long-term stranding scheme of Irish cetaceans should be prioritised by decision makers in order to protect these otherwise difficult to study animals.

**S 02: Cancelled**

**S 03: Cancelled**

**S 04**

## **Muscular atrophies in stranded cetaceans in Canary Islands between 1996-2008**

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Gross and histopathologic evaluation of skeletal muscle was performed in 148 stranded cetaceans (belonging to 21 different species) neonate to senile specimens, undergoing post-mortem examination in Canary Islands between 1996 and 2008. Animals were evaluated for grossly evident muscle lesions, and muscle samples were fixed in formalin, processed routinely, and stained with haematoxylin and eosin (HE), Phosphotungstic Acid Haematoxylin (PTAH), periodic acid-Schiff (PAS) for glucogen, and Von Kossa for calcium. Samples were also postfixed in Osmium tetroxide for lipids. In addition, immunohistochemical examination was performed using primary monoclonal (fast and anti-slow myosin heavy chain) and polyclonal antibodies (myoglobin and fibrinogen). Generalized or focal/multifocal muscular atrophy was the second most common muscular finding and it was detected in 42 animals (28.4%). Morphological diagnosis of muscular atrophy was made based on: decrease myofiber diameter (subjective and morphometrically evaluated), increased fiber size variation, morphological myofiber alterations (angular atrophy), endomisial fibrosis, fat infiltration, fiber type involved and alterations in fiber type distribution. The combination of histopathological findings and overall data concerning the cause of death was useful in order to establish an aetiological diagnosis of muscular atrophy in these animals. Caquexia/malnutrition and senility were the first common cause of muscular atrophy in stranded cetaceans (40.5%, respectively), followed by denervation atrophy (16.7%) and disuse atrophy (2.4%). Morphological and lesional pattern of each atrophy group will be widely discussed.

S 05

**Is it the bottlenose dolphins? Traumatic lesions in two cetacean species stranded within a 37km stretch of coastline (Cork, south-west Ireland)**

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From 21st October to 14th November 2011, six harbour porpoises (*Phocoena phocoena*) and two common dolphins (*Delphinus delphis*) were washed ashore along a 37km stretch of coast in South Cork; six individuals were recovered for post mortem examination.

There were evidence of traumatic lesions in two harbour porpoises (a 149cm male and a pregnant female of 171cm) and one common dolphin (male, 193cm). All had fractured ribs, broken scapula on both sides and periosteal haemorrhage. Haemorrhaging was also found around the thorax and the head with some lacerations in the lungs and hemothorax. The blubber was also separated from the underlying muscle mass; however, teeth and net marks and injuries due to a boat collision were not detected. Another common dolphin (female, 1.14m length) was found with similar damage in Cork harbour on 24th August, following an interaction the bottlenose dolphins.

Days before the first harbour porpoise was recovered, a group of bottlenose dolphins and a porpoise were seen in the same area. Cork harbour is home to a semi-resident group of bottlenose dolphins, currently comprising six adults and two juveniles. These animals also range outside the harbour. Previously Ryan (2008) gave an account of an aggressive interaction between this group and a harbour porpoise. To date, there have only been two recorded visual accounts of aggressive interactions in this area, but given the injuries on some of the animals recovered for post-mortem examination, it seems possible that aggressive interactions occur more frequently, involving at least two species.

**S 06**  
**Cetacean stranding records on the Turkish Western Black Sea coast during September 2009-August 2010 on a monthly basis**

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Between 1 September 2009 and 31 August 2010, stranding surveys covering a total of 46 km spread on 200 km of seashore were conducted monthly for one year. Stranded cetaceans were recorded, photographed and measured. In total, 61 stranded cetaceans were found, which included 40 harbour porpoises (65%), 11 bottlenose dolphins (18%), 9 common dolphins (15%) and one unidentified delphinid individual. Seven individuals were reported through the TUDAV (Turkish Marine Research Foundation) Cetacean Stranding Network. Most strandings were observed during April (30%), followed by June (20%) and July (18%). Strandings per km were 0.39, 0.26 and 0.24, for April, June and July, respectively. Most of the carcasses were at an advanced stage of decomposition (stage 4 and 5, 92%), as a result of which we could not figure out the cause of death and sex of most of them (76%). One harbour porpoise had a netmark. Parts of tail flukes of five individuals were missing, which may have been the results of bycatch in fishing nets. These possibly bycaught carcasses were found in October, April, May and June. The number of cetacean strandings per km was similar to the previous study, which was conducted in the same area in 2003-2005 and 2007-2009, except for the unusual mass strandings in the summers of 2003 and 2009. But high neonate mortality of harbour porpoise was observed in July. The study is the first monthly study for cetacean strandings in Turkey including Turkish western Black Sea coast.

**S 07: Cancelled****S 08****Unusual mass mortality of cetaceans in the northern Black Sea in 2011**

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Unusual mass stranding of dead harbour porpoises was observed at April 28 to June 5, 2011, at the 150 km coast between Meganom Cape in south-eastern Crimea and the area of Bolshoy Utrish in north-western Caucasus. 106 carcasses were recorded; among them, at least 67 animals stranded between April 28 and May 10. The maximum rates were observed at Chauda Cape (at least 27 carcasses at 4 km coast) and Yakovenkovo (at least 33 carcasses at 7 km coast), up to 8 animals in a group. All carcasses at the Crimean coast had by-catch marks where they could be detected; no by-catch marks were recorded from the Caucasian coast. Cetacean stranding rate remained higher than usual in June to August at Crimean southern and south-western coasts with harbour porpoises dominating in strandings. Also a high mortality rate was recorded at the southern coast of the Sea of Azov during warm season with the peak in July and August (at least, 83 cases, up to 3 carcasses per km), following the triennial stranding cycle observed there for 13 years: porpoise strandings were recorded both at Crimean and Caucasian coasts. As a result, the highest annual stranding rate for porpoises is recorded in the northern Black Sea region since 1990. These mortality events were accompanied with changes in reproductive seasonality. Region-scale climate changes, namely shift of seasons, are suggested to affect spatial and temporal migration patterns for fish stocks and thus for feeding cetaceans, making them more vulnerable to by-catch.

S 09

**Spatial analysis of Cuvier's beaked whale strandings along the Italian coasts: evidence of sex ratio imbalance**

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Cetacean stranding data from the Italian coasts have been regularly collected on a national basis since 1986. The Italian strandings database (BDS) contains about 4000 records, concerning 14 species. In this study the spatial distribution of Cuvier's beaked whale (*Ziphius cavirostris*) strandings along the Italian coasts has been analysed. Out of 71 specimens, 32 were females, 17 males and for the rest the gender was undetermined. In order to perform the spatial analysis, a gridded representation of coastline was created with a cell size of 0.8 decimal degrees. The number of stranding events per km of coastline and the sex composition of the animals were then evaluated for the 66 cells. The sex ratio was found overall imbalanced being about 1.9 F/M. A Cluster Analysis (CA) was performed to find homogeneous cells on the basis of the sex ratio of the stranded animals. CA enabled to classified the 66 cells into 3 groups: strandings with higher percentage of males, strandings with higher percentage of females and finally strandings dominated by the undetermined. The strandings per km of these 3 groups was investigated and the cells with strandings dominated by females were found significantly associated to a higher stranding occurrence per km (Kruskal Wallis test: chi-square: 35.5; df: 2; n: 63;  $P < 0.001$ ). Finally the coastline cells were subdivided into 5 subareas: (Ligurian and Sardinian coast, Tyrrhenian coast, Sicilian coast, Ionian and Southern Adriatic coast and Northern Adriatic coast). The F/M ratio was then evaluated also in this 5 subareas. The Ionian and Southern Adriatic coast was found the subarea with the highest F/M ratio (Kruskal Wallis test: chi-square: 12.6; df: 3; n: 49;  $P < 0.01$ ).

S 10

**The evaluation of olfaction in stranded California sea lions (*Zalophus californianus*) and its relevance to Domoic Acid Toxicosis**

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Domoic acid (DA) is a neurotoxin produced by the diatom *Pseudo-nitzschia* that bio-accumulates in the food chain and affects multiple species of marine life. In the past two decades, DA toxicosis has been linked to neurologic disease in California sea lions (*Zalophus californianus*) along the California coast. The most severe effect of domoic acid is hippocampal necrosis following binding of DA to glutamate receptors on neurons. In some intoxicated sea lions, necrotic neurons have been observed in the olfactory bulb. Although acute exposure to DA can lead to epilepsy and death, the distribution of these lesions suggest that sublethal chronic effects could include disruption of olfaction, which in turn could impact establishment of the mother/pup bond. In this study, a simple behavioural assay was used to assess olfactory function in California sea lions using a differential response to a scented and non-scented stimulus. Forty four California sea lions stranding from May 12 2009 to Oct 15 2011 were tested. Individuals with DA toxicosis had hippocampal atrophy diagnosed by magnetic resonance imaging or histology. The other animals tested ("controls") were suffering from malnutrition, trauma, or cancer, and had presumably normal hippocampal morphology. Time spent exploring a fish-scented object and a matched non-scented object was recorded to video, and each session was reviewed. Control sea lions spent significantly more time with the scented object than with the non-scented, establishing this method as effective in demonstrating olfactory function in California sea lions. There was no statistical difference of proportion of time with the scented (S+) between the control (n=23) and chronic exposed (n=18) animals. A more detailed analysis of sea lions with demonstrated olfactory lesions may provide results that suggest DA animals have impaired olfaction.

# WHALE WATCHING

WW 01

## Modelling deep divers habitat from whale watching data: can it work?

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Cuvier's beaked whale is one of the less known species worldwide. Its elusive behaviour together with its deep diver character make collecting presence and distribution data even more difficult than for other species. As a consequence effective habitat modelling is challenging and usually based on few data. Whale watching vessels are widely recognized as a suitable platform for collecting ample dataset about cetacean distribution, but do they perform well even with elusive species? In this study we used Cuvier's beaked whale distribution data collected during whale watching trips in the Ligurian Sea, (NW Mediterranean Sea) from 2004 to 2007. Generalized Additive Models have been used to describe species habitat preferences and in particular to inspect the role of submarine canyons in structuring its distribution. Different topographic variables have been used as environmental descriptors and a novel GIS methodologies have been applied for the identification of canyon axis and canyon basins. The model has been built using a fine resolution grid (1x1 km) in order to deal with complex topography of the study area. In order to minimize bias arising from the use of opportunistic dataset, effort data spatial and temporal coverage have first been analysed. An ecological buffer has been applied to sighting positions in order to take into account the false absence bias due to species diving behaviour. The final model highlighted two different preferred habitat for the species: a canyon-related one as well as a pelagic one. The model was able to explain 73.8% of deviance. Model performance has been evaluated with an independent dataset and the final model accuracy resulted to be 0.63, with a sensitivity of 0.9 and a specificity of 0.62. The applied methodology allowed for an effective use of data collected from platform of opportunity in the habitat modelling of Cuvier's beaked whale.

**WW 02****Effects of whale watching on acoustic behaviour of sperm whales in Kaikoura, New Zealand**

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Whale-watching has been shown to influence the surface behaviour of sperm whales, but it is not well understood if and how it may affect their foraging behaviour. There is now strong evidence that sperm whales use echolocation to locate prey, and that rapid series of clicks “buzzes” indicate prey detection at short ranges. We monitored the surface and acoustic behaviour of focally followed individuals over a two-year study period in Kaikoura, New Zealand. We aimed at comparing click patterns and buzz rates before, during and after individuals encountered whale-watching vessels. Continuous recordings were made with a two-element towed hydrophone array. Clicks were extracted from 11 individuals on 22 follow occasions. Whale watching vessels were present in 36 (47%) of the surfacings, including boats, aeroplanes and helicopters. Environmental variability was controlled for within and across the follows and individuals using spatial and temporal environmental covariates in a generalised additive regression model (GAM). We fit full models with and without surface covariates (e.g. blow rate) so that we could distinguish between any direct effects on diving behaviour and those related to changes in surface behaviour. The initial interclick interval was predicted to increase by 0.12 seconds with every 100 metre increase in fluking depth and close to two-way sound travel times to the bottom. With individual and seasonal variation, this suggests that whales were on average echolocating near the bottom in the beginning of the dive. Duration of the first click train was predicted to increase in deeper waters (+7s / 100m), and after surfacings with higher blow rates and whale-watching boats present. Longer first click train duration could indicate that whales dove deeper after boat encounters. However the cause or biological significance of this result is not known and vessel presence was not an important predictor of any buzz-related variable.

WW 03

**Interpreting the effectiveness of whale watching: experimenting with intentions**

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Given the on-going and current state of endangerment that whales are facing, it is strongly recommended that the fast growing whale watching industry should maximize benefits accruing to the sustainable use of whales. The whale watching experience is publicly praised due to its educational value which should motivate whale watchers towards socio-political action that supports whale conservation. The purpose of this study is towards a richer understanding of the effectiveness of the various aspects of the on-board interpretation which should trigger behavioural intentions and foster agreeing behaviour. An experiment was set up in Tenerife, Spain in which the interpretation on a whale watch boat was manipulated. Whale watchers were subjected to interpretation that either transferred solely knowledge, evoked their feelings of empathy or provoked their feelings of responsibility. Results of this study support the notion that whale watch experiences that contain a targeted interpretation message effectively influence intentions related to pro-conservation behaviours. Evoking empathy on whale watch boat appears to be a key aspect in preparing whale watch operators to effectively make the whale watchers donate money to projects that aim to help the endangered whales. However, a measurement of corresponding behaviour three months later did not yield positive results. It is to question whether different outcomes will be observed when having a similar study taking place in whale watch destinations that offer bigger whales and attract a different type of tourists.

**WW 04****Whale watching profitability assessment in mainland Portugal**

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The whale watching activity in mainland Portugal began in 1998, mainly due to the resident bottlenose dolphin population in the Sado estuary, which enabled it to be one of the best locations for dolphin sighting. Ever since 2000 the whale watching industry started to grow tremendously in the South of Portugal, and it is now an important part of the maritime touristic activities in the area. But it was not until 2006 that a specific law was created for whale watching activities in Portuguese continental waters. Currently, there are 16 companies with a total of 28 boats with the legal permit to operate in southern Portugal, in the area between Tavira and Sagres. Nevertheless, there are numerous companies operating without the required permit. Most of the companies operate two boats (64.3%) and, on average, the boats' capacity is 15 tourists. The majority of the companies operate 4 trips per day during the high season (June to October). The trips have duration of approximately 1.30 to 2.00 hours, and the cost of each trip varies between 30€ and 45€. During the summers of 2010 and 2011, the revenue of four whale watching companies was determined. The total income during these two years was estimated to be ca. 1,377,145€. Due to the profitability of this activity in the area, more boats and companies are expected in the next few years. This region is especially important since it has now the highest number of whale watching companies in mainland Portugal, although there are few studies regarding the abundance and distribution of cetaceans in the area. Therefore there is an urgent need to evaluate the situation, conduct studies, investigate the natural and anthropogenic threats and reinforce the legislation and management of the whale watching activities in the South of Portugal.

**WW 05****The socio-economic value of whale watching to local Welsh communities**

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Cetacean tourism in west Wales is a relatively young industry and is still developing. The first whale watching operators were not established in west Wales until 1994 (Parsons *et al.*, 2003), but the number of operators, whale watchers and expenditure was deemed minimal (Hoyt 2001; O'Connor *et al.*, 2009). The number of people that went whale watching in Wales rose from 17,000 to 33,349 between 1998 and 2008, whilst the number of operators rose from 3 to 17. This resulted in an increase in direct expenditure from \$192,000 to \$863,266 with total expenditure increasing from \$722,000 to \$2,606,724 (O'Connor *et al.*, 2009). This study aims to assess the socio-economic value of present-day cetacean-based tourism in west Wales and the potential sustainability of the industry for future generations. Twenty-six operators have been identified conducting marine wildlife tours in west Wales, with bottlenose dolphins and grey seals as the main target species. Tours operating out of Pembrokeshire also target common dolphins, harbour porpoises and minke whales, whilst those around Anglesey recognise Risso's dolphins as an additional target.

The growth of whale watching has increased concerns for the possible negative impacts of the industry to cetaceans, notably in the form of disturbance. Whale watching remains the most environmentally responsible and economically beneficial use of cetaceans but careful management is necessary to ensure its sustainability. An economic evaluation of the whale watching industry in west Wales will be of interest to local and national governments and conservation organisations. The management scheme for the Moray Firth Special Area of Conservation involved understanding the value of whale watching to the local community so that conservation of the cetaceans did not involve economic or social loss (Hoyt 2001). This acknowledgment that environmental protection is comparable to the protection of local economies is necessary for successful ecotourism.

**WW 06****Whale watching boats as a platform for cetacean research**

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The AWF, a UK registered charity, has operated the volunteer programme on the whale watching industry boats of Tenerife for some sixteen years. Volunteers have largely been undergraduate marine and biology based students from all over the world.

Some thirty whale watching boats operating out of four ports in the straits between the island of Tenerife and La Gomera have provided an all year round platform for several thousand undergraduate volunteers over the years. They have worked on a number of research, conservation and education initiatives.

Research has revolved around the creation of three core databases: Photo identification databases of resident pilot whale and bottlenose dolphin populations and a database of species migrating through the area. The photo identification databases are supported by further data collection based on the Tethys Institute recommendations for non-intrusive cetacean research. The 12,000 plus sightings, apart from facilitating the identification of family structure and social movement within the two populations observed. The migrating species database also shows invaluable insight/ evidence relating to changes in migration patterns.

Apart from research, the student volunteers have worked on a number of conservation and education programmes. With one million tourists on the boats each year, the whale watching boats operate an invaluable platform to educate the public about cetaceans and, in particular, to their conservation, and to inspire action on the part of the tourists to get involved.

This paper will outline the various researches, conservation and educational work developed over the years and explores the possibilities and limitations of such activities as witnessed over this time. The paper will offer a blue print for developing such initiatives with other whale watching operations around the world and explore ways of integrating into academic research programmes, educational institutions and conservation groups.

**WW 07****Watching cetaceans from land in the Canary Islands: implications for the management of whale watching**

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In the Canary Islands, 29 cetacean species have been documented. Boat based whale watching has been established in the early 1990s, growing slowly in most islands, while having witnessed an extreme growth on Tenerife. Effective regulation of the industry is scarce.

From 19 October until 18 November 2010, a study was conducted on La Gomera to find feasible viewpoints for land-based observations of cetaceans. The suitability of viewpoints was evaluated by the possibilities to identify animals to the species level and to observe interactions between boats and cetaceans.

Observations were made with a telescope and binoculars from several viewpoints close to the area where most whale watching activities take place, and ranging between approximately 70-180 m above sea level. 28 h 30 min of sighting effort resulted in 8 cetacean sightings and a total of 2 h 25 min of observation. During every sighting the species could be identified and during five sightings it was possible to conduct behavioural observations. Interactions with whale watching boats were recorded in four instances. In one case it was possible to direct a whale watching boat to a group of cetaceans via mobile phone.

Thus, it was demonstrated that it is possible to identify cetaceans and observe their behaviour and interactions with vessel from land-based viewpoints. It also was feasible to direct whale watching boats to cetaceans spotted from land.

These results underscore the significance of permanent outlook on the coast. We recommended such an installation on – La Gomera and other Canary Islands – because it can be useful to improve the sighting success of whale watchers as well as to guide whale watching vessels so as to diminish numbers of boats around animals. Finally, it will be most helpful to monitor compliance to the whale watching regulations of the Canary Islands.

**WW 08****Environmental education analysis of the whale watching industry in the Strait of Gibraltar (Spain)**

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The whale watching industry in the Iberian Peninsula (Spain) emerged at the end of the 90s in Tarifa, in the Strait of Gibraltar. This flourishing sector, which forms part of the so-called ecotourism, has increased for the last years peaking at 25,000 tourists during the months of July and August 2007.

The aim of the following study was to determine which the educative strategy of the whale watching companies is and evaluate, in a qualitative and quantitative way, the characteristics of these educational programs and their results.

Different environmental education strategies were analysed during 163 whale watching trips in the summer 2007. The educational programs were evaluated internally and externally, so the speaker, the recipient, the channel and the message were analysed. Firstly, the education strategy that concerns the cetacean conservation was examined: educative materials, guides and talks. The educative talks to the tourist resulted as the main component of the educational process.

Then the educational characteristics of these talks were also evaluated; its environmental characteristics (biological, ecological, socioeconomic, cultural...), the problems of the habitat to conserve (dangers, conservation programs, legislation...) and finally the recipient personal willingness to change his/her environmental habits.

Also the results of the educational strategies were evaluated through surveys that the passengers answered after the trip, assessing the educational program of the whale watching company.

From these analyses we can conclude that the levels of the whale watching educational programs were very low, both in the quality of the educational materials and the explanations given during the trip.

The environmental education and the increase of the public awareness are the key of the cetacean conservation and it must be done more efficiently. Therefore, it is essential to design effective educational plans with the involvement of all the sectors and the support of experts.

**WW 09**

**Real time positions of GPS tagged marine mammals, information worth to be shared between scientist and whale-watchers?**

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In times that allow fast and easy transfer of information, questions arise concerning the hypothetical transfer of real time information from scientists to whale-watchers. The aim of this work is to use an anonymous online survey to request points of view of actors of both groups of interest about ethical, economical and sustainability issues.

**WW 10****Economic impact of whale watching in north Norwegian coastal communities**

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Whale watching is a growing industry worldwide, over 13 million visitors generate expenditures of more than NOK 11.3 billion (€ 1.35 billion) per year (IFAW 2009). In the coastal communities of the Vesterålen archipelago whale watching companies have been operating since the late 1980s, with the number of visitors growing from 300 to up to 20.000 annually. In most other European whale watching communities a minority of tourists expenditures are created through whale watching (under 20%), but we suggest that in the Vesterålen islands whale watching is the single most important branch of tourism triggering the development of the whole community. In order to examine this hypothesis, we examined visitor spending data and the number of tourists for the years 2009 and 2010, provided by the community registers and “Visit Vesterålen” for Stø, and Andenes. The revenues created through direct spending on Whale watching and souvenirs are NOK 14.822.000 (€ 1.660.000) 2009 and NOK 14.629.000 (€ 1.840.000) 2010. It is the single most important tourist attraction in both communities, regarding numbers of visitors and revenues created. We conclude that both coastal communities, depending on the primer sector, benefit considerably from whale watching tourism, despite of its seasonal character. Further research, however, is required in order to obtain information on spending behaviour of local companies, operational characteristics of business and indirect visitors spending as well as visitor motivation. The results obtained could play an important role in the local policy making and community development in Vesterålen and support the development of more effective measures of local cetacean population conservation. In the future we aim to complement this study by exploring the possibilities of additional value creation based on whale watching-related ecosystem services.



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