

HEBRIDEAN WHALE AND DOLPHIN TRUST

SUMMARY REPORT TO SCOTTISH NATURAL HERITAGE OCTOBER 2008



**SCOTTISH
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RESEARCH

Silurian

Since 2003, surveys on the Hebridean Whale and Dolphin Trust's research vessel, *Silurian*, have been conducted throughout the summer months (April to September inclusive), amassing a significant and unique long-term dataset on cetacean distribution and abundance in the Hebrides. Visual surveys have been conducted over more than 2600km (which does not include 2008 data, which are yet to be analysed). Surveys have been most intensive and consistent in the Argyll Islands region, with additional effort in other regions of the West Coast (see Figs. 6). Effort has increased substantially since 2003 (Table 1), with more than twice the coverage in 2007 of either 2003 or 2004. Acoustic survey effort was added to the protocols during the 2004 season. This effort also increased dramatically in subsequent years, effort more than doubling from 2004 to 2007 (Table 1). 2008 was also another high-effort season.

Methodology – 2008 season

In 2008, HWDT conducted twelve survey trips from April to July. Five of these trips were run using volunteers and support from Earthwatch. One of them formed part of the Sea Mammal Research Unit MRes programme (see below). Three trips were based out of Kyle of Lochalsh, and surveyed more northerly and westerly areas, an initiative that is proving very successful, as it is enabling the baseline surveying of more poorly understood areas, whilst allowing us to maintain our core coverage. The survey methodology used in 2008 was identical on all monitoring trips, and has remained very similar since 2003, with some methodological and equipment adaptations and improvements where necessary. Trips were either nine or twelve days long (seven and ten of those respectively being dedicated survey days, with an arrival and departure day at the beginning and end of the trip). The usual distance covered was between 300 – 500 nautical miles depending on the weather conditions and the duration of trip. Surveying was generally carried out for eight to nine hours per day, again depending on conditions and levels of light available at the time of year. During these surveys we undertook the following activities:

- Visual observations were conducted for all cetacean species, plus basking sharks, seals, seabirds, marine litter, and other vessels. In 2008, as part of a project investigating minke whale entanglement (see below), the occurrence of creels was also recorded by logging sightings of creel pot marker buoys
- Photographs of minke whales, bottlenose dolphins, common dolphins, white-beaked dolphins, killer whales, Risso’s dolphins and basking sharks were collected for individual identification. These photographs showed the dorsal fins and any body scars or flank patterns that could be used to distinguish individual animals. A Canon EOS 10D with a 300mm lens was used for photo-identification. Images have been contributed to the appropriate catalogues
- Continuous acoustic monitoring of harbour porpoises and other cetacean species was conducted using a high frequency towed hydrophone and detection/analysis software
- Recordings were made of any anthropogenic sounds detected, in particular Acoustic Deterrent Devices (ADDs)
- From 2007, sea surface temperature was recorded using a temperature probe
- All data were collected and stored using the real time data logging program LOGGER (developed by International Fund for Animal Welfare).

Table 1. Visual and acoustic effort from *Silurian*, 2003 – 2007 (2008 data under analysis)

| Survey Effort (km) | 2003 | 2004 | 2005 | 2006 | 2007 |
|---------------------------|-------------|-------------|-------------|-------------|-------------|
| Visual | 4007 | 3104 | 4371 | 6416 | 8187 |
| Acoustic | N/A | 5407 | 4634 | 7395 | 11170 |

Volunteers

Approximately 60 volunteers work on *Silurian* monitoring trips each year, with a maximum of six per trip. Volunteers stay onboard *Silurian*, and work as observers to collect data during visual surveys for cetaceans. They also conduct acoustic monitoring, enter data and assist with the deployment of hydrophones and other project equipment. For all these tasks, volunteers receive full training from our staff. In addition to training provided for research work, our science staff also deliver lectures and lead discussions on a variety of topics related to marine research and conservation. *Silurian* is a fully-

equipped sailing vessel, and being involved in its running is an important aspect of the survey. Volunteers have ample opportunity to learn about sailing, and also assist with the day-to-day running of the research vessel, including cooking and cleaning.

Volunteers can come from any walk of life, and each volunteer brings with them an invaluable range of skills and experience, from those who understand the sea and sailing to those who may never have set foot on a boat, or seen a cetacean in the wild before. Our volunteers make our research possible, and present excellent value-for-money in the work they carry out. They work long hours carrying out visual observations and logging data, especially in the middle of summer when daylight hours are very long. Teams of two rotate as visual observers, entering data into our computer system and logging seabird sightings. Teamwork is extremely important if the research is to run smoothly.

What volunteers learn and gain from volunteering on one of our surveys is as varied as their backgrounds. They get full training in scientific research techniques, and benefit greatly from having marine science and sailing experts constantly at hand. They have the opportunity to see an amazing variety of wildlife in its natural habitat, visit remote and beautiful places, and get to know and work closely with a small team of like-minded people. Volunteers know that their hard work and enthusiasm contribute directly to knowledge and conservation of cetaceans in the Hebrides.

Survey routes 2003 - 2007

Our coverage of our survey area has been extensive and thorough. The survey tracks taken from 2003 to 2007 are as follows:



Fig. 1. 2003 survey tracks

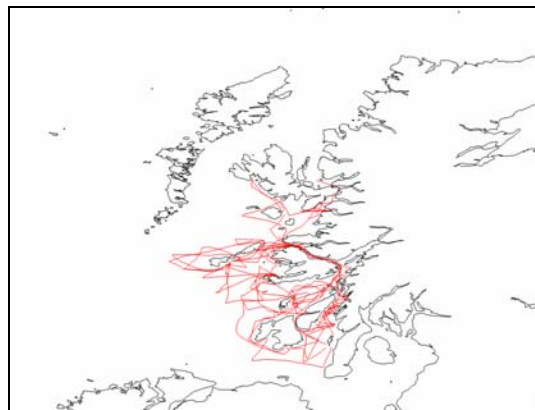


Fig. 2. 2004 survey tracks

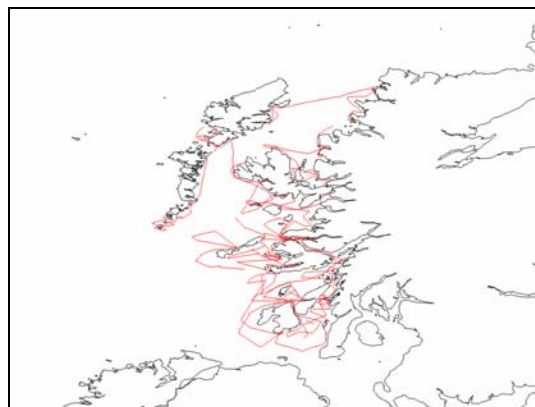


Fig. 3. 2005 survey tracks

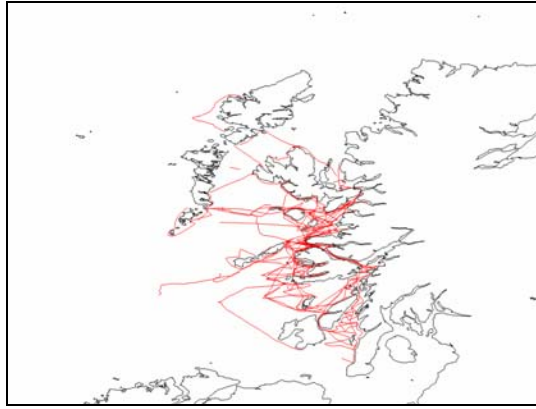


Fig. 4. 2006 survey tracks

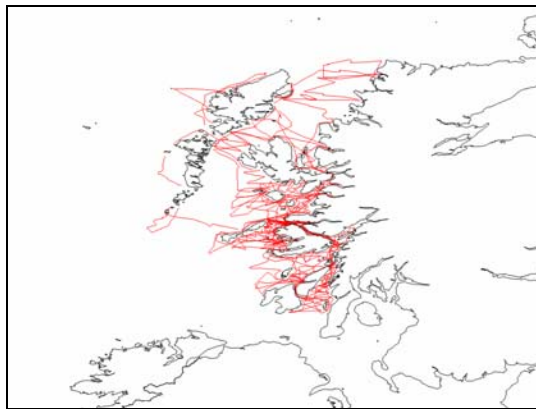


Fig. 5. 2007 survey tracks

As discussed, survey effort has been highest around the Argyll Islands, with additional coverage in more recent years in more northerly and westerly areas of the Hebrides. Figure 6 demonstrates the relative intensity of survey coverage across the area, both visually and acoustically from 2003 to 2007 (no acoustic surveys were conducted in 2003).

Survey coverage 2003 - 2007

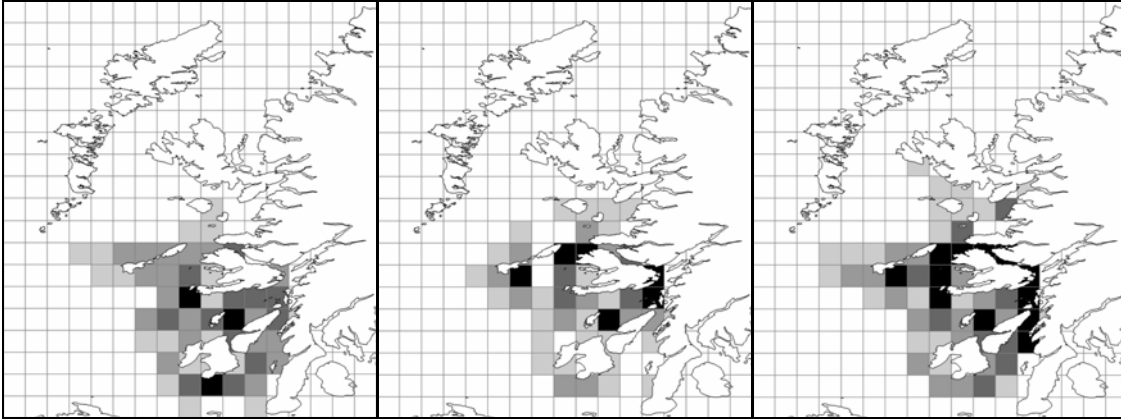


Fig. 6.1. visual effort 2003

Fig. 6.2. visual effort 2004

Fig. 6.3. acoustic effort 2004



Fig. 6.4. visual effort 2005

Fig.6.5. acoustic effort 2005

Fig.6.6. visual effort 2006

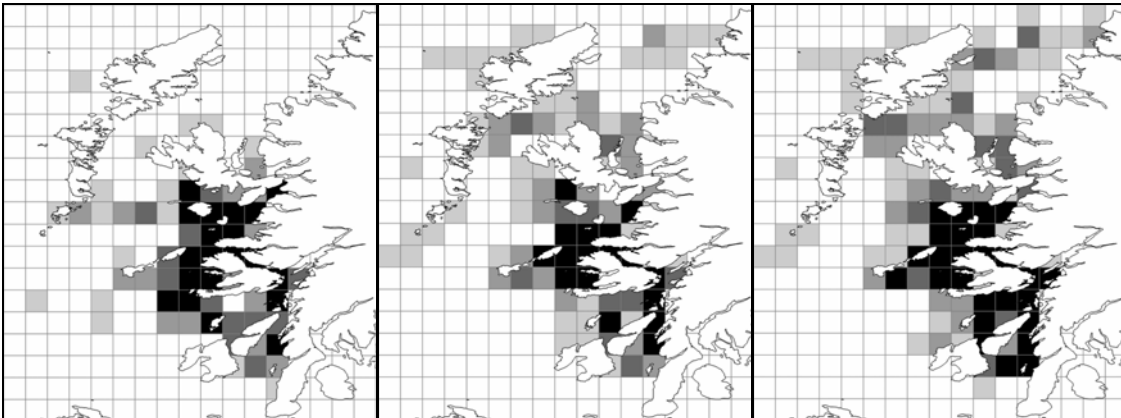
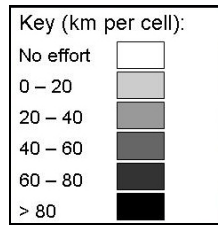


Fig.6.7. acoustic effort 2006

Fig. 6.8. visual effort 2007

Fig.6.9. acoustic effort 2007



Sightings

From 2003 to 2007, sightings of Hebridean cetacean species from *Silurian* were as follows:

Table 2. On effort sightings in sea states of <4 from 2003 to 2007

| Species | Sightings | Individuals | Years sighted |
|------------------------------------------------------------|-----------|-------------|----------------|
| Harbour porpoise (<i>Phocoena phocoena</i>) | 1096 | 1916 | all |
| Common dolphin (<i>Delphius delphis</i>) | 37 | 1398 | 03, 05, 06, 07 |
| Minke whale (<i>Balaenoptera acutorostrata</i>) | 140 | 171 | all |
| White-beaked dolphin (<i>Lagenorhynchus albirostris</i>) | 17 | 78 | 03, 06, 07 |
| Risso's dolphin (<i>Grampus griseus</i>) | 17 | 58 | all |
| Bottlenose dolphin (<i>Tursiops truncatus</i>) | 12 | 50 | all |
| Killer whale (<i>Orcinus orca</i>) | 5 | 13 | 03, 04, 07 |
| Humpback whale (<i>Megaptera novaeangliae</i>) | 1 | 1 | 06 |

As the 2008 season has only recently finished (end of September 2008), data are yet to be analysed. The individual routes taken each trip in 2008, and the species encountered are as follows (Figure 7 and Table 3).

Survey routes 2008

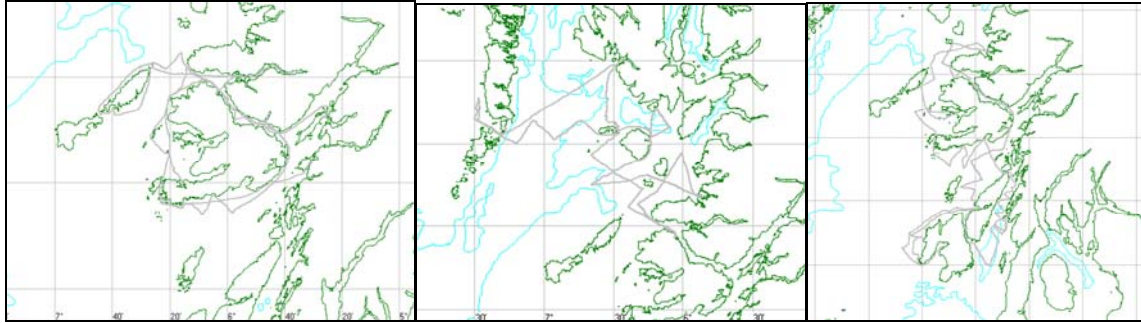


Fig. 7.1. 31/03/08 – 10/04/08

Fig. 7.2. 29/04/08 – 07/05/08

Fig. 7.3. 19/05/08 – 30/05/08

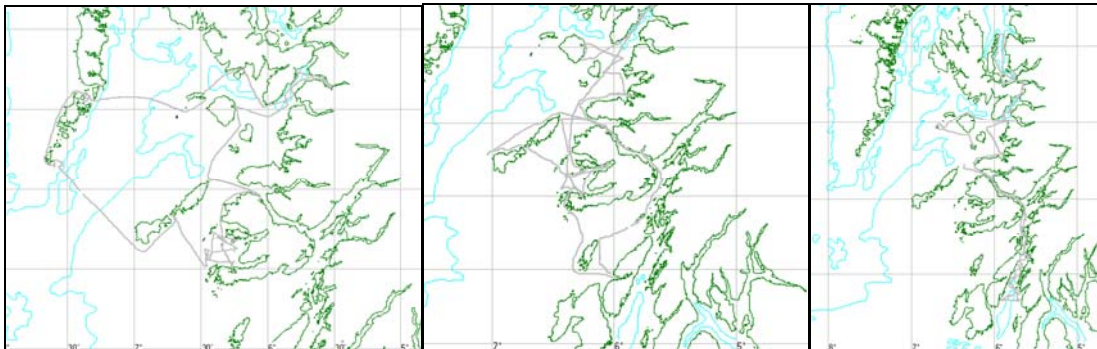


Fig. 7.4. 02/06/08 – 13/06/08

Fig. 7.5. 16/06/08 – 27/06/08

Fig. 7.6. 30/06/08 – 11/07/08

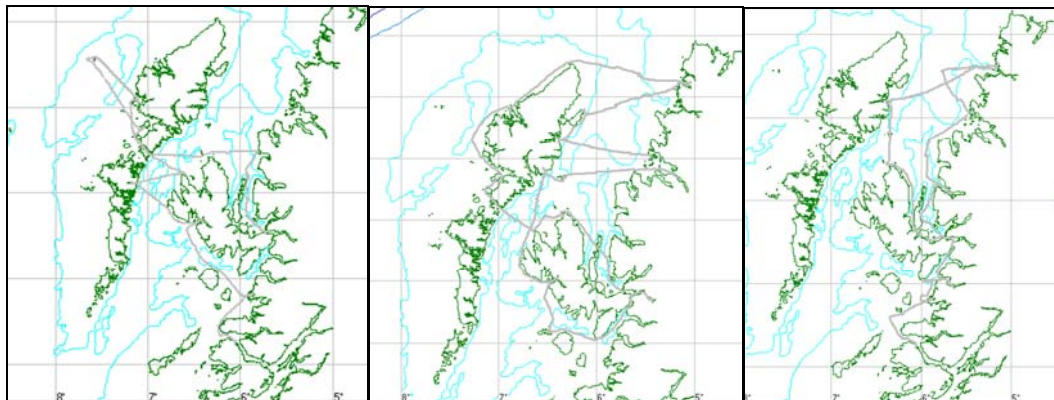


Fig. 7.7. 20/07/08 – 27/07/08

Fig. 7.8. 29/07/08 – 09/08/08

Fig. 7.9. 10/08/08 – 17/08/08

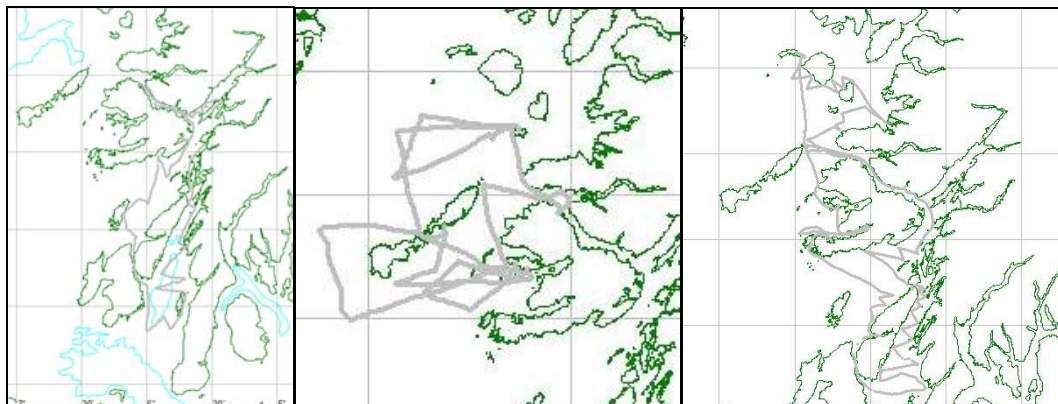


Fig. 7.10. 18/08/08 – 26/08/08

Fig. 7.11. 29/08/08 – 06/09/08

Fig. 7.12. 15/09/08 – 25/09/08

Sightings 2008

Table 3. Sightings 2008 (total)

| Species | Sightings | Individuals |
|---------------------------------------------------------------|-----------|-------------|
| Harbour porpoise (<i>Phocoena phocoena</i>) | 467 | 788 |
| Common dolphin (<i>Delphinus delphis</i>) | 18 | 228 |
| Minke whale (<i>Balaenoptera acutorostrata</i>) | 45 | 50 |
| White-beaked dolphin (<i>Lagenorhynchus albirostris</i>) | 8 | 68 |
| Risso's dolphin (<i>Grampus griseus</i>) | 1 | 14 |
| Bottlenose dolphin (<i>Tursiops truncatus</i>) | 3 | 22 |
| Killer whale (<i>Orcinus orca</i>) | 3 | 12 |
| Humpback whale (<i>Megaptera novaeangliae</i>) | 0 | 0 |
| Atlantic white-sided dolphin (<i>Lagenorhynchus acutus</i>) | 3 | 33 |
| Northern bottlenose whale (<i>Hyperoodon ampullatus</i>) | 1 | 1 |

As for previous years, harbour porpoise continue to be the most frequently sighted cetacean in 2008. It was as apparent as ever how heavily influenced these visual sightings are by sea state, with anything but the calmest conditions significantly negatively impacting on sightings rates. The worth of our acoustic survey equipment, which can continue to function and collect data irrespective of weather, sea state or light levels, is again, clear. The distribution of harbour porpoise on the west coast of Scotland is amongst the highest in Europe, but it is apparent that, although these animals are distributed throughout our survey area, there are certain areas with environmental and oceanographic features more conducive to harbour porpoise occurrence. This study of high-use areas has identified patterns in the distribution of this conservation priority species that are related to oceanographic features such as tidal currents and bottom type (Figure 8). Work in this area was conducted by Clare Embling, from the Sea Mammal Research Unit (SMRU), University of St Andrews, as part of her PhD. For an executive summary of the chapter in her PhD on this work, see Appendix 1. Cormac Booth, also at SMRU, has been conducting PhD research in conjunction with HWDT since 2006, and is intensively developing the research carried out by Embling. To this end, survey design has been modified, allowing considerable time to be spent intensively surveying in areas which have been identified as potential harbour porpoise hotspots or which may help to

refine the habitat models. SNH are the CASE partner to this PhD; for further detail on the study, see Appendix 2.

Minke whale sightings remained low in 2008, compared to numbers seen before 2005. Minke sightings began in mid-May, but failed to gain any significant momentum in core survey areas. It continues to look likely that minke whale distribution may be higher in more northerly and westerly areas of the Hebrides. The probable cause of these changes in distribution, an alteration in the patterns of availability of the small schooling fish on which minke whales feed, is clearly continuing to affect the region's whales. Anecdotal reports also suggest another poor breeding season for those seabirds in the area which feed on sandeel.

In general in 2008, there has been a wide range of species sighted, reflecting the rich biodiversity of the oceanographic environment of the west coast of Scotland. In addition to the species sighted with some regularity, Atlantic white-sided dolphins were also encountered (a species more often associated with waters outwith the Continental Shelf edge on the west coast of Scotland). In September, a northern bottlenose whale was also sighted in the Sound of Mull. The core habitat of this species of beaked whale is more northerly, offshore, deeper waters, although they are known to pass through more coastal waters on the west coast of Scotland, particularly in the autumn, sometimes staying in an area for some time. It is possible that the animal sighted in the Sound of Mull is the same one that has been in Loch Eil for three weeks at the time of writing of this report. Two northern bottlenose whales (believed to be different animals) were also sighted in Loch Scridain on Mull in September, provoking considerable local and press interest.

Although dolphin sightings have been numerous (see table 3), group sizes have in general been quite small. This is particularly noticeable in the case of common dolphins when compared to sightings in 2007, where groups of several hundred were encountered, especially in the more northerly and westerly sectors of the survey area. These fluctuations may be attributable to variations in the availability of prey sources.

Photographic Identification

Many cetacean species have individually variable natural markings or scars on the body that allow for long-term identification of individual animals. Photographs of these natural markings can be used much like a natural tag to monitor individual animals over many years. HWDT uses photographs collected during monitoring surveys or through collaborative work with other groups along with those submitted to the project by local whale watch operators or the public to study the movements and relative abundance of several local species. HWDT is actively involved in photographic studies of minke whales, bottlenose dolphins and killer whales on the west coast, and maintains photographic collections of common and Risso's dolphins.

Bottlenose dolphins

Great progress has been made with HWDT's ongoing collection of photo-identification image catalogues in recent years. In the case of bottlenose dolphins, this has been in large part due to HWDT's participation in a government-funded project to study the distribution of bottlenose dolphins in Scotland which began in 2006. HWDT collaborated with Aberdeen University, the Sea Mammal Research Unit and the Scottish Association for Marine Science on the three-year study. HWDT operated a public sightings hotline for the project. This access to prompt information on dolphin location proved vital to the success of the programme. To date, there are 35 animals in the bottlenose dolphin catalogue for the Inner Hebrides, and 18 animals in Barra Sound. So far no matches between the two populations have been found, although a solitary animal seen around Coll and Tiree in 2004 and possibly 2005 has been matched with an animal which is now regularly sighted in Barra (2006 and 2007).

Minke Whales

Our minke whale catalogue now comprises 108 animals. This catalogue is now at a point which allows comparison with animals on the east coast of Scotland, analysis which is currently underway in collaboration with the Cetacean Research and Rescue Unit (CRRU). This has potential to show whether there is a cross-over between the east and west coast populations, and will greatly increase our knowledge of minke distribution and movements. The catalogue is also being used in a collaborative project between the

University of St Andrews and HWDT funded by the Scottish Government to investigate minke whale entanglement in fishing gear, especially creel lines. In conjunction with a student from the Sea Mammal Research Unit Marine Mammal Science MRes course, we have been examining images in our catalogues for evidence of scarring which could be attributable to interaction with fishing gear. Also as part of this project, on HWDT's *Silurian* surveys, all sightings of creel buoys are being logged to assess the differing density of creel fishing across the Hebrides.

Killer Whales

There is only a very small group of killer whales present in Hebridean waters. A collaborative project on Scottish killer whales between the Hebridean Whale and Dolphin Trust and Andy Foote, a PhD student at the University of Aberdeen funded by the Scottish Executive, Scottish Natural Heritage and the Carnegie Trust is currently underway, analysing killer whale data from the west coast in the context of the eastern North Atlantic population as a whole. There are 10 regularly sighted whales off the west coast. One has not been since 2001 and may be dead. No new calves have been photographed going back to our earliest data of 1992 (usual inter-calf interval for a killer whale adult female is five years) and there are five adult females in this group. The group has five adult males (including the possible dead whale) which is an unusual demographic. Some animals have been identified over many years, and the re-sighting rate is high. One animal, 'John Coe', has been sighted regularly over the past 15 years around the west coast of Scotland. He has also been sighted off County Donegal, in Pembrokeshire, and as far North as the Western Isles. He has been an adult male since first being sighted making him at least 34 years old. However, in general, the west coast population does not appear to be wide-ranging, with no sightings of Hebridean animals in Shetland, Orkney, the east coast of Scotland, Iceland or Norway. This work is resulting in a number of publications in peer-reviewed journals (see below).

In addition to our photo-identification catalogues for bottlenose dolphins, minke whales and killer whales, our image records of common dolphins, Risso's dolphins and white-beaked dolphins have also been added to this season. Basking sharks are also photographed and the images sent to the Shark Trust.

Anthropogenic impacts

During surveys, various anthropogenic impact factors are recorded by HWDT. Both UK and local BAPs have identified potential threats to cetaceans including marine debris, shipping and aquaculture activities. Noise pollution in particular is a substantial and under-recognised threat. Vessel traffic, a primary source of noise and also a risk of collision for some species, is monitored. Ambient noise levels are recorded at regular intervals. When sources of noise such as acoustic deterrents (designed to prevent seal predation) from fish farms are heard, these recordings are used to map the extent and degree to which cetaceans are exposed to these sounds. Their presence is especially high in the Sound of Mull/Firth of Lorne area. These data are currently being used in a collaborative project between the University of St Andrews and HWDT for the Scottish Aquaculture Research Forum (SARF) investigating the effects of ADDs on cetaceans using two complimentary approaches working at different scales.

Floating marine debris, notably plastics, which can result in problems for cetaceans and other wildlife through entanglement or ingestion, are also routinely recorded. Cetaceans are known to become entangled in fishing gear, leading to injury and sometimes death. Minke whales and humpback whales entangled in fishing gear have been reported in Scottish waters, with some mortalities identified, but the extent of the problem is unknown. As mentioned above, the location of fixed fishing gear has been recorded and additional protocols are being developed to obtain photographs to document scarring due to prior entanglement of minke and other baleen whales.

Our seabird research, using seabird distribution as an ecological indicator to provide information on environmental and habitat changes has also continued into 2008.

Sea Life Surveys

Commercial wildlife tour operators spend virtually every day in summer on the water searching for cetaceans. This is a vast and potentially valuable source of information. However, in almost all cases these data are nearly impossible to analyse because there is no information recorded on where the vessel searched. HWDT developed an innovative collaboration with a whale watch business on Mull, Sea Life Surveys to collect data on

their sightings using the same computer software run on board *Silurian* (LOGGER). This automatically records the vessel position, and thus search effort, throughout the trip. This highly successful project, with records dating from 1992, has now been used to investigate habitat use by minke whales and harbour porpoises in the waters north of Mull, adding to the dataset available from *Silurian*, and increasing our fine-scale knowledge of animal distribution.

Public sightings

The HWDT Public Sightings Network began officially in 2001, although records go back to the early 1990s. In 2007, the collection of sightings reported by the public was made more efficient through the provision of an online data recording facility. The majority of sightings reports in 2008 continue to be of minke whales and bottlenose dolphins, although in 2008, more unusual reports have also been submitted, such as a beluga, northern bottlenose whale, sperm whale and humpback whale. The Network has been particularly useful in our collaborative work on killer whale populations (see above). The Network also includes the reporting of strandings, and played a key role in the early part of 2008, when multiple strandings of deep-diving cetaceans, in particular Cuvier's beaked whales and pilot whales, occurred on the west coasts of Scotland, Ireland and Wales (see below). It is also invaluable as an important way of involving people in their marine environment, through increased awareness of their local wildlife, and of HWDT. The remodelling of the HWDT website (see below) will further involve the public in reporting and finding out more about sightings through the addition of interactive mapping features to show where and when sightings are occurring.

Biodiversity objectives and actions

Since 2003, HWDT has monitored marine biodiversity and conservation priority cetaceans in west coast waters, in particular harbour porpoises, minke whales and bottlenose dolphins. This monitoring has directly addressed actions identified in local and national Biodiversity Action Plans (BAPs) and is linked to EC Habitats Directive priority species, thus delivering locally, nationally and internationally recognised biodiversity objectives.

Without an understanding of the critical habitat requirements of cetacean species, it is not possible to provide effective protection measures. For example, the UK is required to establish Special Areas of Conservation (SACs) for harbour porpoise under the Habitats Directive, but has failed to take action in this matter because of uncertainty about what locations are of key importance and why. The Action Plan specifically calls for more study “on the areas frequented by harbour porpoise to identify waters which may qualify for further protection as SACs or Marine Nature Reserves.” The west coast of Scotland has among the highest densities of harbour porpoise in European waters and HWDT surveys are providing vital information to address habitat use in the area. Similarly, two small and apparently independent groups of bottlenose dolphins are found on the west coast. These groups do not use the only SAC for bottlenose dolphins in Scotland, as this is on the east coast. More information is needed to identify the ranges and habitat use of these vulnerable dolphin populations.

Many of the species studied by HWDT have been recognised as priority species for conservation locally, nationally and internationally. Of the 20 BAP priority species of whales, dolphins and porpoises, 14 have been identified on the west coast by previous HWDT monitoring; seven of these have been seen regularly. Two of these species, harbour porpoises and bottlenose dolphins, are also European priority species and are listed under Annex II of the EC Habitats Directive. These two, along with minke whales, are the primary subjects of HWDT study. The objectives of the Action Plans for these species all include maintaining and, where possible, expanding the geographical range and the abundance of the species. However, there is very little information on the current range or relative numbers of these animals, thus several of the species Action Plans explicitly highlight the need for monitoring activities such as those pioneered by HWDT.

Since 2003, HWDT has been working to address these data needs and, as has been demonstrated, has greatly increased our knowledge of west coast species habitats and abundance, directly addressing the needs highlighted by local and national Biodiversity Action Plans.

Military Activity

The effects of military activity, in particular the use of sonar, is a conservation concern for cetaceans, and is an issue which HWDT continues to monitor. In 2006, HWDT joined a 2006 Continental Shelf-edge trip in conjunction with WDCS to monitor military activity in the area. In early 2008, an atypical stranding even of deep-diving cetaceans in the Hebrides (see above) was considered to be possibly attributable to military activity. In conjunction with WDCS, HWDT submitted a Freedom of Information request to the Ministry of Defence to help ascertain whether this event could have been connected to the use of military sonar. Subsequently, HWDT co-authored a paper to the IWC on this multiple stranding event (see below). In April 2008 HWDT monitored Operation Joint Warrior, a large international NATO marine training exercise which was carried out over two weeks, and recorded prolonged use of sonar, which is to be analysed later this season. The monitoring of military activity is of key importance, and it is essential for work to continue in this area.

Public Consultation

HWDT has been involved in the Sound of Mull SSMEI (Scottish Sustainable Marine Environment Initiative) project working group since its commencement, and in Scottish Environment LINK's Marine Task Force. Through these bodies, and through making organisational representations at public consultations, in the media and through academic publications and conferences, HWDT has ensured that a local, expert voice on cetacean and marine biodiversity issues is strongly represented on a national scale.

Students

HWDT continues to work with and support students at all levels, and gains considerably from these valuable collaborations. Clare Embling completed her PhD in 2008 on predictive models of cetacean distributions off the west coast of Scotland. Cormac Booth, Andy Foote and Mike Tetley continue their PhDs all collaborating with HWDT on harbour porpoise, killer whales and minke whales respectively. 2008 saw the first year of the University of St Andrews Marine Mammal Science MRes, to which our first monitoring trip of the year was devoted as a survey techniques module, and from which a student, Mirjam Held has conducted a minke whale project. During 2007 and 2008,

HWDT has also supported Chris Walker, a student of Multimedia Design at Sheffield Hallam University, for whom HWDT has been a 'client' and basis for project design work. During the season, the science department has also run two marine mammal courses, and three day courses for the University Marine Biological Station, Millport (part of the University of London) (see below).

Communication of results

If our research is to impact on policy-makers, fellow researchers and members of the public, it is essential that our results be communicated to as wide a range of audiences as possible, both within and outwith the scientific community. In 2007/8, HWDT has been particularly successful in this respect.

Papers and Presentations using HWDT data

(Staff in bold, Students in bold italics)

2008 ECS presentations

Bolt H. E., P. V. Harvey, **L. Mandleberg**, P. M. Thompson and **A. D. Foote** Estimating killer whale predation levels on Shetland harbour seals.

Booth, C. G., C. B. Embling, P. T. Stevick, D. Gillespie, J. Gordon and P. S. Hammond. Inter-annual differences in harbour porpoise distribution on the west coast of Scotland.

Calderan, S. V., C. R. Weir, M. Unwin, R. L. Pitman, **C. Booth**, T. Photopoulos and K. Robinson. White-beaked dolphin (*Lagenorhynchus acutus*) occurrence in the Minch (Scotland, UK) during August 2007.

Foote, A. D., T. Simila, G. Vikingsson and **P. T. Stevick**. Estimates of movement and site fidelity of North Atlantic killer whales using opportunistic individual identifications.

Mandleberg, L. C., S. V. Calderan, P. T. Stevick, C. B. Embling, J. Shrimpton and **C. G. Booth**. Cetacean diversity in north west Scotland: an oceanographic perspective.

2008 IWC presentations

Dolman, S.J. Reid, R.J., Barley, J.P., Deaville, R., Jepson, P.D., O'Connell, M., Berrow, S., Penrose, R.S., Pinn, E., **Stevick, P.T.**, **Calderan, S.**, Robinson, K.P., Doyle, T.K., Brownell, R.L. and Simmonds, M.P.. A preliminary note on the unprecedented strandings of 45 deep-diving odontocetes along the UK and Irish coast between January and April 2008. Document SC/60/E5 presented to the International Whaling Commission, May 2008 .

Stevick, P. T. 2008. Quantifying rates of inter-area movement using capture-recapture results: a comparison of methods. Document SC/60/SD7 presented to the International Whaling Commission, May 2008.

Papers

Submitted

Bolt H. E., P. V. Harvey, **L. Mandleberg**, P. M. Thompson and **A. D. Foote** Estimating killer whale predation levels on Shetland harbor seals. Submitted 25/2/08 to Marine Ecology Progress Series.

Weir, C. R., C. D. MacLeod and **S. Calderan** Fine-scale habitat use by white-beaked and common dolphins in the Minch (Scotland, UK): evidence for interspecific competition or coexistence? Submitted to the Journal of the Marine Biological Association of the United Kingdom.

In Preparation

Calderan, S. V., **Stevick, P. T.**, **Mandleberg, L. C.** Similarity in spatial occurrence of marine debris and cetaceans on the west coast of Scotland: does feeding ecology give cetaceans a disproportionately high exposure to marine debris?

Cheney, Culloch, Elwen, Hammond, Islas, Janick, Ingram, **Mandleberg**, Pope, Quicke, Robinson, **Stevick**, Thompson, Wier, Wilson (provisional authorship in alphabetical order) Distribution and abundance of bottlenose dolphins in Scottish waters.

Cheney, Culloch, Elwen, Hammond, Ingram, **Mandleberg**, **Stevick**, Thompson, Wilson (provisional authorship in alphabetical order) Differences in ranging patterns and site fidelity of two communities of bottlenose dolphins using the west coast of Scotland.

Cheney, Culloch, Elwen, Hammond, Ingram, **Mandleberg, Stevick**, Thompson, Wilson
(provisional authorship in alphabetical order) Using sightings reports to track coastal
bottlenose dolphins.

Embling et al., (authorship to be determined) Predictive models of harbour porpoise distribution
& relative abundance in the Inner Hebrides, Scotland: Evaluating the effect of different
survey data techniques, time and space on model robustness.

Foote, A. D., Vikingsson, G. Øien, N., Bloch, D., Davis, C. G., Dunn, T. E., Harvey, P.,
Mandleberg, L. Whooley, P. and Thompson, P. M. Distribution and abundance of killer
whales in the North East Atlantic. In prep for Mammal Review.

Foote, A. D., T. Simila, G. Vikingsson and **P. T. Stevick**. Estimates of movement and site
fidelity of North Atlantic killer whales using opportunistic individual identifications. In
prep for Journal of Applied Ecology.

Mandleberg, L. C., S. V. Calderan, P. T. Stevick, C. B. Embling, J. Shrimpton and **C. G.**
Booth. Patterns of cetacean biodiversity in west Scotland are related to oceanographic
features.

Stevick, P. T., S. V. Calderan, C. Speedie, J. Shrimpton and **C. B. Embling**. A trophic shift off
West Scotland: minke whales and basking sharks.

Non-refereed publications

Foote, A. D., Vikingsson, G., Øien, N., Bloch, D., Davies, C.G., Dunn, T.E., Harvey, P.,
Mandleberg, L., Whooley, P. and Thompson, P.M. 2007 Distribution and abundance of
killer whales in the North East Atlantic. Paper SC/59/SM5 submitted to the Scientific
Committee of the International Whaling Commission (invited paper).

Mandleberg, L. Bottlenose dolphins of the Hebrides: a summary report from five years of
research (2001-2005).

Robinson, K. P., **P. T. Stevick** and C. D. MacLeod (eds). 2007. Proceedings of the workshop; An
integrated approach to non-lethal research on minke whales in European waters. Held at

the 21st Annual Conference of the European Cetacean Society, San Sebastian, Spain, 2007. ECS Special Publication Series No 47.

Stevick, P. T. 2007. Evidence for changes in minke whale prey off Scotland: Why collaboration matters. pp 42-47 in Robinson, K. P., Stevick, P. T. and MacLeod, C. D. (eds). Proceedings of the workshop; An integrated approach to non-lethal research on minke whales in European waters. Held at the 21st Annual Conference of the European Cetacean Society, San Sebastian, Spain, 2007. ECS Special Publication Series No 47.

Stevick, P. T. 2008. The changing status and distribution of whales. Proceedings of the conference on Whaling and the Hebrides. Islands Book Trust

Mass Media coverage 2008

Table 4. Media coverage for HWDT up to October 2008

| Medium | Date | Publication | Title |
|-----------|----------|---------------------------|-------------------------------------------------------------------------------------------------|
| Magazine | Jan-08 | Easyjet inflight magazine | Monitor Whales and Dolphins in Scotland |
| Newspaper | Feb-08 | Press & Journal | Plea over dolphins and whales washed up on beaches |
| Newspaper | Feb-08 | Am Muileach – local paper | Stranded dolphins on west coast beaches |
| Newspaper | 21/02/08 | The Oban Times | Dolphin and whale spotter wanted |
| Newspaper | 28/02/08 | Daily Mail | This whale washed up dead on a Scottish beach. In it's stomach...the remains of 23 plastic bags |
| Newspaper | Mar-08 | Round & About – local | World book day offer |
| Newspaper | 16/04/08 | The Press and Journal | Naval Sonar activity suspected of causing high number of rare whale strandings |
| Radio | 24/04/08 | BBC Radio 4 | Open Country |

| | | | |
|-----------|------------|---------------------------|--------------------------------------------------------------------------|
| Newspaper | May-08 | Am Muileach – local paper | Rare Whales Stranded in the Hebrides |
| Newspaper | 09/05/08 | Ullapool News | Beach clean highlights rubbish issue |
| Newspaper | June-08 | Am Muileach – local paper | The seal that came in from the cold |
| Newspaper | June-08 | Ullapool News | Watch out for whales and dolphins |
| Magazine | July-08 | The Sea | Watch Whales in the Hebrides |
| Magazine | Spring-08 | WWF | The Sundance Kids |
| Magazine | Spring-08 | WWF | Record year for Killer Whales |
| Magazine | Spring-08 | Clyde Breakers | Argyll & Bute beach Forum Birthday Event |
| Magazine | Summer-08 | WWF | A Permanent Feature? |
| TV | Jul-08 | STV | A Day out with HWDT |
| Newspaper | Jul-08 | Hamilton Advertiser | Norman's close encounter with a minke whale |
| Newspaper | 14/09/2008 | Scotland on Sunday | Rare pair are having a whale of a time after swimming into Loch Scridain |
| Newspaper | 11/09/2009 | Daily Record | Bottlenoses making waves on the Isle of Mull |
| Newspaper | Oct-08 | Round & About - local | Rare whales cause traffic jams |
| Newspaper | 02/10/2008 | Oban Times | So much to learn about at environmental fair |

PUBLIC OUTREACH

Public workshops, talks and events:

Over the last three years HWDT has organised and attended a wide variety of workshops, talks and events to increase public awareness and understanding of cetaceans sighted on the west coast of Scotland. Through these key events, thousands of people have been involved in learning about their natural marine and coastal heritage and have been encouraged to feel a sense of responsibility for the marine biodiversity of this area. These outreach events have been located throughout Argyll and the Atlantic Island area and also occasionally in a wider area. Certain events focused on different sectors of the local community, for example, beach workshops targeted participation from families. Special interest groups were also catered for such as WI's, sailing, wildlife or kayaking. In total since April 2005 about 60 workshops, talks and events have been delivered. The following table outlines those delivered between October 2007 and September 2008.

Table 5. Public events attended by HWDT, October 2007 to September 2008

| Event | Description | Date | Location |
|---------------------------------------------|--------------------------------------------------------------------|--------------------------------|-----------------|
| Clyde SSMEI Forum | Forum for Clyde Scottish Sustainable Marine Environment Initiative | November 2007 | Glasgow |
| SAC – Firth of Lorn and Loch Creran meeting | Special Area of Conservation stakeholders meeting | January 2008 | Oban |
| Open Boat | Local business information event | 24 th October 2007 | Tobermory |
| Beach forum | Presentation and workshops, Marine Litter CD-ROM launch | 23 rd October 2007 | Oban |
| Talk | Meeting of Glasgow University Zoological Society | 24 th January 2008 | Glasgow |
| Talk | Presentation by Clare Embling on PhD work | 14 th February 2008 | Tobermory |
| Celebratory event | RSPB Nadair project, provider | 28 th March 2008 | SAMS, Oban |

| | | | |
|----------------------------------|------------------------------------------------|------------------------------------------------|-------------------------|
| | of beach workshop for children | | |
| Talk | Talk for holiday visitors | 5 th May 2008 | Craignure, Mull |
| Open boat | Aboard <i>Silurian</i> | 14 th May 2008 | Port Ellen |
| Wildlife week | Local wildlife events | May 2008 | Tobermory |
| National Whale and Dolphin Watch | Cetacean watch for general public | 23 rd June 2008 | Ardnamurchan lighthouse |
| Opening event | Stall and workshop provider | 3 rd July 2008 | Tobermory |
| Crinan Classic Boat Festival | Stall and interpretation | 5 th July 2008 | Crinan |
| Eigg playscheme | Workshop on the beach for 23 young people | 8 th July 2008 | Isle of Eigg |
| Beach workshop | For general public | 15 th July 2008 | Tobermory |
| Highland Games | Stall and interpretation | 24 th July 2008 | Tobermory |
| Highland Games | Stall and interpretation | 26 th July 2008 | Fort William |
| Highland Games | Stall and interpretation | 30 th July 2008 | Arisaig |
| Bunessan Show | Stall at community show | 1 st August | Bunessan, Mull |
| Beach Workshop | Activities and sand sculpture for young people | 5 th August | Tobermory, Mull |
| West Highland Yacht Week | Late shop opening, publicity stand | 6 th August | Tobermory, Mull |
| Sunart Agricultural Show | Stall at community show | 9 th August | Strontian |
| Beach Workshop | Activities and sand sculpture for young people | 12 th August | Calgary, Mull |
| Salen Show | Stall at community event | 14 th August | Salen, Mull |
| Sea Watch | Wildlife watch for the public | 27 th August | Ardmore Point, Mull |
| Oban Highland Games | Stall at Games | 28 th August | Oban |
| ABREEF | Open day on <i>Silurian</i> and evening stall | 25 th to 27 th September | Oban |

Following the successful introduction of Open Evenings on *Silurian* last year, a similar event was included in the May education visit to Islay. This allowed about 60 parents, children and interested members of the general public to learn about the work of the Trust and local marine life by joining staff aboard. More recently on 27th September an Open day was held in Oban in association with the Argyll and Bute Regional Environmental

Education Fair (ABREEF), attracting around 80 participants, despite poor weather. These events were considered successful as they encouraged people to get involved and find out more about the marine environment and perhaps become stakeholders in its future.

HWDT delivered a series of beach workshops following successful developments in this area last year. Workshops were based mainly around Mull and were targeted at both young visitors and locals alike, to educate and inspire children about the local beach environment and its life, by providing exciting first-hand experiences. We also delivered one workshop in Lochaber, reflecting our plans to expand our coverage area in the near future.

Over the last three years HWDT has travelled extensively in Argyll and the Islands to run stalls at community shows and games to provide both information (such as leaflets and newsletters) and raise awareness of the marine environment. We have also targeted young people by running competitions and providing information which was appropriate for this audience. Over the years thousands of people have been involved and these events have proved valuable in increasing interest and awareness of cetaceans and raising the profile of HWDT's work within local communities. We also sell merchandise at some events to contribute to the financial sustainability of our programmes. This year we added three community events to our schedule in the Lochaber area, to expand the geographical area which we serve.

Newsletter

Table 6. Wave and Wavelet publication dates

| Dates: | Wavelet editions: | Wave editions: |
|-----------------------------|--------------------------|------------------------|
| April 2005 – March 2006 | Spring | Spring |
| March 2006 – April 2007 | Summer, Winter | Summer, Winter |
| April 2007 – March 2008 | Summer, Autumn, Winter | Summer, Autumn, Winter |
| April 2008 – September 2008 | Spring | Spring |
| | Total editions: 7 | Total editions: 7 |

HWDT has continued to publish our adult members’ magazine, Wave and junior edition, Wavelet, on a regular basis to provide readers with an update of our work, local marine and cetacean issues and other topics of interest. This members’ magazine reaches a wider audience via our shop, at events and is offered to all schools which participate in our programmes. Each edition of Wave is distributed to around 1000 people and each edition of Wavelet about 500 and so more than 10,000 copies in total have been distributed within the three year period.

Website

The website remains a key method of communicating to a geographically widespread audience. We have continued to prioritise updating the content and functionality of our website in order to maximise its effectiveness. The web log has been updated again daily this season to provide a wide audience with information about both our monitoring and education trips on *Silurian*. News items on our homepage have been regularly renewed to provide latest sightings, report findings and raise awareness of forthcoming events.

On the Kids Site, eleven new activities have been added to the ‘Make and Do’ pages. The website-generated ‘ask us’ questions have continued to keep the Education Team busy – between January 2005 and September 2008 we received 345 enquiries. Therefore, on average, we respond personally to more than ten enquiries per month. Downloadable teaching resources have been made available online since January 2007 and on average 150 people per month have visited this area of our site since then, of which 54% visited the Primary level resources.

Visits to the website have remained high:

Table 7. Website use 2006 – 2008

| Period covered | Number of months | Total numbers of users | Average number of users per month |
|------------------------------------|-------------------------|-------------------------------|------------------------------------------|
| April 2006 – September 2006 | 6 | 247, 032 | 41, 172 |
| October 2006 – | 6 | 287, 640 | 47, 940 |

| | | | |
|----------------------------------------|---|----------|---------|
| March 2007 | | | |
| April 2007 – September 2007 | 6 | 325, 497 | 54, 250 |
| October 2007 – March 2008 | 6 | 287, 898 | 47, 983 |
| April 2008 – September 2008 | 6 | 289, 304 | 48, 217 |

These data refer to total sessions served i.e. individual user visits (the number of visitors to the site) and do *not* refer to hits.

We are currently redeveloping our website to ensure that it provides the most up to date information possible and to make use of ever progressing technical changes. The new site will include improved functionality, design and navigation, new elements including an online shop, newsletter sign up and revamped Kids Site. Additionally the content for the whole site has been rewritten to improve the quality of the text and also to reflect the many changes which have taken place in the Trust in recent years. We plan to add additional modules at a later stage including a photo gallery with online sales and interactive sightings maps. With continued improvement to our website we look forward to improving further the numbers of users.

EDUCATION

School visits

In the last three years the education programme has gone from strength to strength in terms of quality of service, efficiency and value. 1, 679 students from 58 different schools have benefited from our formal education programmes either on *Silurian*, in the classroom or on the beach. All schools have been visited in the Atlantic Islands area with many mainland additions. 45% of these schools have received two or more visits in this period which has added value and allowed for more in depth coverage of content and very positive relationships to develop between HWDT and these schools. (see Table 8)

Table 8. Multiple Visits to Schools

| Establishment | Visit 1 | Visit 2 | Visit 3 |
|----------------------|----------------|----------------|----------------|
| High Schools: | | | |
| Oban | 2005, Boat | 2006, Boat | 2008, ABREEF |
| Tobermory | 2006, School | 2007, Boat | 2008, School |
| Tiree | 2007, Boat | 2007, School | |
| Islay | 2005, Boat | 2006, Boat | 2007, Boat |
| Campbeltown | 2007, School | | |
| Lochgilphead | 2006, School | | |
| Tarbert | 2007, School | | |

| Establishment | Visit 1 | Visit 2 | Visit 3 |
|-------------------------|----------------|----------------|----------------|
| Primary Schools: | | | |
| Arinagour, Coll | 2007, Boat | 2008, School | |
| Bowmore, Islay | 2005, ABREEF | 2007, Boat | 2008, Boat |
| Bunessan, Mull | 2006, Boat | 2007, Boat | |
| Dervaig, Mull | 2005, Boat | 2006, Beach | |
| Gigha | 2005, Boat | 2006, School | |
| Iona | 2006, Boat | 2007, Boat | |
| Keills, Islay | 2005, ABREEF | 2006, Boat | |
| Kilchattan, Colonsay | 2006, Boat | 2007, School | |

| | | | |
|-----------------------|--------------|--------------|--------------------------------------------------|
| Lismore | 2006, Boat | | |
| Lochdonhead, Mull | 2007, School | 2007, Beach | |
| Luing | 2005, Boat | 2007, School | 2008, ABREEF |
| Park primary | 2005, ABREEF | 2008, ABREEF | |
| Port Charlotte, Islay | 2005, ABREEF | 2006, Boat | |
| Port Ellen, Islay | 2005, ABREEF | 2007, Boat | 2008, Boat |
| Salen, Mull | 2007, Boat | 2008, Beach | 2008, ABREEF (and additional school visit) |
| Small Isles, Jura | 2005, Boat | 2007, Boat | 2008, Boat |
| Tiree | 2007, Boat | 2007, School | |
| Tobermory, Mull | 2005, Boat | 2007, School | 2008, School |
| Ulva, Mull | 2005, Boat | 2006, Boat | |

Feedback has confirmed that well qualified staff deliver a high quality product using materials and practices which have been refined over the last few years. Schools value the unique work we do, our expertise and the high staff to student ratios offered. Here are examples of teacher comments:

‘High quality experience for all the children. Relaxed, intelligent and well presented they captivated and educated all in one breath.’ Arisaig Primary School Teacher, workshops on board *Silurian*.

‘ Thank you for such an informative and enjoyable afternoon. You pitched the session just right for the age group and they all thoroughly enjoyed the experience as well as learning such a lot about living on a boat and sea life.’ Small Isles Primary School Teacher, workshop on board *Silurian*.

‘The children loved their visit. It was well resourced and children were fully engaged at all times. Many thanks.’ Bowmore Primary School Teacher, workshop on board *Silurian*.

‘I cannot praise the staff and content enough. The children really enjoyed their visit, learned a lot and were able to reflect on their visit. Fantastic visit, thank you so much.’
Arisaig Primary School Teacher, workshop on board *Silurian*.

‘The visit exceeded my expectations in that your presentation was of an extremely high standard. It was great that you were able to very quickly set a suitable standard for the audience and you clearly held their attention throughout.’ Tobermory High School Teacher, classroom-based school visit.

All schools receive a feedback form at the end of their visit and so since 2005 we have received nearly 100 completed forms. Analysis of this feedback confirms the positive response to our work. Since February 2008 these forms have been redesigned to allow numerical analysis. This table shows the results of this:

Table 9. Analysis of feedback forms between February 2008 and September 2008

| General questions | Mean score |
|-----------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| | Key: 6 = excellent, 1 = poor |
| How would you rate the pre-visit information? | 5.3 |
| How would you rate the content of the workshop/visit? | 5.7 |
| How would you rate the structure and organisation of the visit? | 5.8 |
| Was the ‘pitch’ appropriate to the age group? | 5.7 |
| How would you rate the quality of the teaching? | 5.8 |
| Did the activities tie in with the curriculum? | 5.5 |
| Did your group enjoy the experience? | 6 |
| Do you consider that you received value for money? | 5.7 |
| Overall, how satisfied were you with this workshop/visit | 5.8 |
| Questions about A Curriculum for Excellence | Percentage in agreement |
| Do you think the visit effectively contributed to the following purposes of ‘A Curriculum for Excellence’? – Responsible Citizens | 82% |
| Do you think the visit effectively contributed to the following | 100% |

| | |
|-------------------------------------------------------------------------------------------------------------------------------------|-----|
| purposes of 'A Curriculum for Excellence'? – Successful Learners | |
| Do you think the visit effectively contributed to the following purposes of 'A Curriculum for Excellence'? – Confident Individuals | 91% |
| Do you think the visit effectively contributed to the following purposes of 'A Curriculum for Excellence'? – Effective Contributors | 87% |

These responses show very positive scores, especially in areas of quality of teaching, student enjoyment, structure and organisation of visit, and overall satisfaction level. The lowest average score is for pre-visit information, which was improved in Spring 2008 in response to lower scores in this area at the beginning of the year. Since then it has been standard practice to call schools a minimum of twice before the visit, send a confirmation letter of the details of the visit to school staff, a prepared letter for parents, risk assessments, and a document outlining school visits in general a month in advance. However despite this improvement the scores have remained similar. We have come to the conclusion that this reflects the internal communication in schools, rather than our communication with the trip leader, and will reword this question to overcome this limitation. The question about the curriculum relevance scored on average 5.5 and we conclude that this reflects the timing of our visits and is not necessarily a weakness, especially when considered and compared with the very high percentages received for the effective teaching of the purposes of A Curriculum for Excellence. See Appendix 3 and CD-ROM for additional feedback forms and comments.

HWDT has continued to offer input to schools in remote areas despite the considerable time and costs involved to visit these children, and staff in these areas have been very receptive to HWDT's 'outside' programmes. Outdoor learning has remained a priority and has been found to be powerful and beneficial to those students involved. *Silurian* provides a unique teaching environment which allows for direct hands-on learning about the marine environment.

As the three year programme comes to an end, we have been looking at ways to increase the sustainability of the programme. We have been researching, piloting and implementing the use of a small charge, in-line with other organisations delivering

educational programmes. All visits in 2008 have included this charge, and analysis of feedback shows a positive response to this, confirming that the level of this charge is about right (see Table 9. above).

School visits between October 2007 and September 2008 have included a range of high quality school based visits and outdoor learning workshops both on the beach and on *Silurian* and has involved more than 460 students. Pre-visit information has been improved and standardised, as discussed above, to ensure all group leaders and parents are well informed of HWDT and the education work they are to participate in and leaders are fully aware well in advance of the hazards, risks and control measures adopted.

Table 10. School Visits October 2007 to September 2008

| School | Island/Mainland | Number of Children | Dates visited | Location of Visit |
|------------------------------|-----------------|--------------------|-----------------------------------------------------|-------------------|
| Kilchattan Primary, Colonsay | Island | 10 | 15 th November 2007 | School |
| Tiree Primary | Island | 39 | 11 th and 12 th December 2007 | School |
| Tiree High School | Island | 12 | 12 th December 2007 | School |
| Arinagour Primary, Coll | Island | 21 | 4 th March 2008 | School |
| Tobermory Rainbows | Island | 7 | 11 th February 2008 | School |
| Tobermory Primary | Island | 16 | 13 th February 2008 | School |
| Tayvallich Primary | Mainland | 18 | 12 th May 2008 | Boat |
| Port Ellen Primary, Islay | Island | 24 | 13 th May 2008 | Boat |
| Bowmore Primary, Islay | Island | 42 | 14 th and 15 th May 2008 | Boat |
| Small Isles Primary, Islay | Island | 15 | 16 th May 2008 | Boat |
| Salen Primary, Mull | Island | 19 | 3 rd June 2008 | Beach |

| | | | | |
|---------------------------|----------|----------------------|-----------------------------------------------------|--------|
| Tobermory Primary, Mull | Island | 31 | 10 th June 2008 | School |
| Muck Primary, | Island | 9 | 8 th September 2008 | Boat |
| Eigg Primary | Island | 9 | 8 th September 2008 | Boat |
| Inverie Primary, Knoydart | Mainland | 11 | 9 th September 2008 | Boat |
| Mallaig High | Mainland | 19 | 9 th and 11 th September 2008 | Boat |
| Mallaig Primary | Mainland | 39 | 10 th September 2008 | Boat |
| Lady Lovat Primary, Morar | Mainland | 10 | 11 th September 2008 | Boat |
| Arisaig Primary | Mainland | 22 | 12 th September 2008 | Boat |
| Dalmally Primary, Argyll | Mainland | 7 | 25 th September 2008 | ABREEF |
| Oban High | Mainland | 30 | 25 th September 2008 | ABREEF |
| Park Primary, Oban | Mainland | 16 | 25 th September 2008 | ABREEF |
| Rockfield Primary, Oban | Mainland | 18 | 25 th September 2008 | ABREEF |
| Luing Primary | Island | 10 | 26 th September 2008 | ABREEF |
| Taynuilt Primary, Argyll | Mainland | 7 | 26 th September 2008 | ABREEF |
| Salen Primary, Mull | Island | 8 | 26 th September 2008 | ABREEF |
| Dunbeg Primary, Argyll | Mainland | 8 | 26 th September 2008 | ABREEF |
| Total number: 28 | | Total number: 466 | | |

Courses

Over the three years we have extended and developed our outreach and education activities in the areas of university level education, teacher training, the education of interested adults and educating people whose work is associated with conservation.

Since March 2006 we have run eight Marine Mammal Courses for adults to learn about marine mammal research including lectures and one day of training and monitoring on *Silurian*. The course has been refined and developed to be very successful with good uptake of places, focused content and a wide range of participants including those with a general interest to those whose work involves conservation (for example, Wildlife Trusts, and SNH). Feedback has been positive, especially for recent courses which have benefited from HWDT's growing experience of course delivery. Comments in 2008 have included:

'The course excelled...'

'Great experience, thanks a lot'.

'HWDT staff are so enthusiastic about their subject, I could not help but be drawn up in it with them'.

'I have gained an enormous increase in my understanding...'

Another training development has been the three days of field-based courses run for the University Marine Biological Station, Millport (part of the University of London), teaching students practical vessel-based cetacean research skills on *Silurian*.

Between 18th and 26th August 2008 the Education Officer facilitated an Earthwatch teacher training course on *Silurian*. In addition to monitoring work, this course involved participants in developing educational resources for the classroom and planning a post-expedition project while on board. Teachers enthusiastically engaged with all activities on board and found the experience challenging and extremely rewarding. The classroom resources, once edited, will be made available on our site. We are continuing our collaboration with Earthwatch and plan to deliver an additional teacher training course on board *Silurian* in April 2009.

Plans are also developing for a programme of courses for Argyll College, part of the University of Highlands and Islands, network which will continue development of this area of HWDT's work.

Table 11. HWDT Courses October 2007 to September 2008

| Title: | Dates: | Land or boat based: |
|----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|----------------------------|
| WISE (accreditation scheme for wildlife boat operators) | March, 2008 | Boat |
| SMRU MRes field work modules | 31 st March – 10 th April 2008 | Boat |
| Marine Mammal Course | 11 th – 13 th April 2008 25 th – 27 th April 2008 | Land and boat |
| University Marine Biological Station, Millport. Part of the University of London | 12 th – 14 th July 2008 | Boat |
| Teacher Training in collaboration with Earthwatch | 18 th – 26 th August 2008 | Boat |

Resource development

The Education Team has created resources to effectively interpret the marine environment and educate a diversity of people including teachers and the general public. HWDT's new interpretative banners and leaflets have been used to good effect at events, talks, and in our Visitors Centre.

To raise awareness of the issue of marine litter the Education Team created a CD-ROM resource in September 2007 for high school teachers. The CD was distributed to all high schools in Argyll and Bute, Highland Region, North Ayrshire, South Ayrshire, Orkney, Shetland, Western Isles, and Inverclyde as well as to some coastal High Schools in Dumfries and Galloway. Copies were sent to all Biology and Geography High School teacher training colleges in Scotland, many of the marine rangers in Scotland, marine and

environmental education centres throughout the UK and other organisations including the RSPB, WWF, JMT, SNH, FSC and MCS.

Other resources developed for primary and secondary level teachers have been published online. These cover a range of curriculum linked topics including food chains and webs, population distributions, and research methods, for example. Recent growing interest in Eco-schools has encouraged HWDT to include a set of resources online to help teachers deliver the Biodiversity topic. Internal documentation and cataloguing work now means that HWDT has materials for use on the beach, in school and on *Silurian* available, putting us in a very good position to develop our programmes further in the future.

Other work

Volunteers are important to HWDT and we continue to offer and support Scottish environmental volunteering objectives via our boat and land based volunteer projects. We offer high quality experiences to people from across Scotland and also offer local community based volunteering opportunities in our offices and Visitors centre on Mull which attracts approximately 15,000 visitors each year. Office-based volunteers have always been important to HWDT's education and research teams. Since October 2007 the education team has hosted six volunteers who have worked on specific projects including the development of teaching resources, in Science, Art, and Geography and cleaning cetacean skeletons for classroom and Visitor Centre use. HWDT has benefitted from the skills and time offered by these volunteers who completed effectively the project outcomes.

In the last three year period HWDT has consolidated its work. Policy and strategy documents are now in place to support our work in the future. The education strategy forms a key part of the 5 year business plan which is currently being revised. Health and safety procedures and practices are firmly established.

APPENDICES

Appendix 1 – PhD chapter abstract – Clare Embling

The following is the executive summary of the chapter on predictive models of harbour porpoise distribution from the PhD of Clare Embling (Embling, C.B., 2007 Predictive models of cetacean distribution off the west coast of Scotland. PhD thesis. University of St Andrews) using data collected in collaboration with HWDT. The chapter in its entirety is available on request.

Predictive models of harbour porpoise distribution & relative abundance in the Inner Hebrides, Scotland: *Evaluating the effect of different survey data techniques, time and space on model robustness*

Introduction

Harbour porpoises (*Phocoena phocoena*) are the most abundant of the coastal cetacean species in the Northeast Atlantic (Harwood and Wilson 2001). The Inner Hebrides is also home to one of the highest densities of harbour porpoise in Europe (SCANS-II 2006). However, there are a number of threats to harbour porpoises in the area, the most important of which is noise pollution such as that from military exercises (Parsons et al. 2000). The military have carried out training exercises several times a year since the 1940s, for which there is some evidence of negative effects on harbour porpoise sightings rates (Parsons et al. 2000). Elsewhere in the world, military sonar (very loud sounds used to detect submarines) has been linked with cetacean strandings (Cox et al. 2006). As a result of such evidence, the Department of Defence are currently putting into operation a system which uses marine mammal predictive distribution maps to determine locations in which testing can be carried out in such a way as to minimise the risk to marine mammals. For this purpose, this project was instigated to produce predictive maps of cetacean species that are abundant in the waters off the west coast of Scotland, including the harbour porpoise.

The main aim of this chapter was therefore to determine the most robust predictive model for harbour porpoises in the Inner Hebrides, ensuring the model is robust according to survey methodology, time and space.

Methods

Systematic visual cetacean surveys were carried out on a monthly basis from the Hebridean Whale and Dolphin Trust (HWDT) motor-sailor research vessel, *Silurian*, in the Inner Hebrides, on the west coast of Scotland (55°14'-58°25'N, 5°26'-7°43'W) over three consecutive summers from 2003-2005. Passive acoustic surveys were carried out simultaneously to the visual surveys during the later two consecutive summers from 2004-2005. At least once a month the core study area around the Argyll Islands (55°18'-56°51'N, 5°26'-7°25'W) was surveyed in a zig-zag type transect design in order to cover the area as evenly as possible over a period of ten days within the constraints of weather conditions and location of ports. Additional surveys were occasionally carried out with the Argyll Islands, covering the Small Isles in 2003 & 2004 (up to 57°8'N), and the entire Inner Hebrides in several surveys in 2005 (up to 58°25'N and out to 7°43'W).

Survey data were divided into 2km segments of effort, and the number of groups sighted or detected acoustically was analysed with environmental variables using Generalised Additive Models (GAMs). Environmental variables included in the model included:

- *Survey variables*: sea state, boat speed, engine on/off and ambient noise levels
- *Temporal variables*: time of day (calculated as a ratio of time since sunrise: time between sunrise and sunset to compensate for day length changes), position in the spring-neaps cycle (from 0 neaps tide – 1 spring tide), and tidal state (from 0 last low tide to 1 next low tide).
- *Topographical variables*: depth & slope (from Digibath 250), sediment type (converted to % sand, % mud and % gravel based on the Folk triangle conversion of the UKHO RSDB sediment type data)
- *Oceanographic variables (only available 2003-2004)*: depth & strength of the mixed layer, halocline and thermocline, Sea Surface Temperature (SST), Sea Surface Salinity (SSS), surface, mid-depth, and bottom average daily and hourly currents. Source: POLCOMS oceanographic model from Proudman Oceanographic Laboratory (POL), processed by Phil Gillibrand at SAMS.
- *Tidal variables*: maximum tidal current speed, and spring tidal range from models generated by POL.

To check for model robustness the data was analysed in a number of ways:

- i) Developed different models for visual and acoustic data to investigate the effect of survey technique on model selection;
- ii) Divided the data randomly into training (75%) and test (25%) datasets – the models were built on the training set and tested for within-area and within-space robustness on the test set;
- iii) Built models on 1 or 2 years of data and tested on an unused year of data – to test for robustness in time;
- iv) Built models on the core area surveyed and tested it on the larger area surveyed – to test for robustness in space.

Results

A total of 14,700 km were surveyed in the Inner Hebrides off the west coast of Scotland in the summers between 2003-2005, of which 11,300 km had visual survey effort, and 6,700 km had acoustic survey effort (see figure 1). Overall, during 2003-2005 in good sightings conditions (sea state ≤ 3) there were 437 groups of a total of 787 harbour porpoises detected visually (1.8 porpoises per group, and 0.091 porpoises per km). During the 2004-2005 analysed acoustic effort, there were 986 groups of a total of 1539 harbour porpoises detected acoustically (1.6 porpoises per group, and 0.231 porpoises per km). Harbour porpoise detections were scattered fairly evenly over the survey area, though appeared to concentrate more within coastal areas, with fewer detections in the more offshore areas to the west of Islay, Mull and Coll & Tiree (see Figure 1).

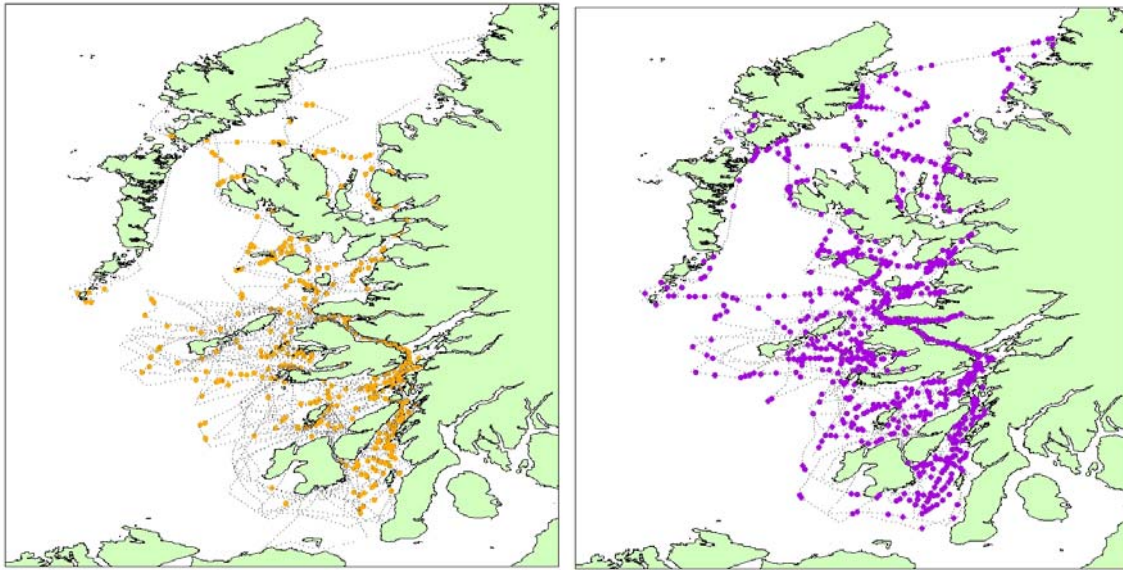


Figure 1 – (left) visual survey effort showing all 2km segments (black dots) and those segments with harbour porpoise sightings (orange dots) from 2003-2005; (right) all 2km segments for which there were both visual and acoustic survey effort (black dots) and those segments with harbour porpoise acoustic detections (purple dots) from 2004-5 in the Inner Hebrides, off the west coast of Scotland.

Model results

Since the oceanographic variables were only available for 2003-2004, any models including 2005 were limited to temporal, topographical and tidal variables.

After compensating for sea state (since sightings rate reduced rapidly above sea state 1), overall the best model for the number of harbour porpoise groups detected *visually* per 2km model from 2003-2005 for the core survey area included (in order of importance): maximum tidal speed, time of day, and position in the spring-neaps cycle. The oceanographic variables were only able to explain some of the within-year variance, but were unable to explain variance over time. For example, harbour porpoises were shown to prefer areas of low salinity and muddy substrates in 2003, but when extended to include 2004 data, both these variables dropped out in preference for areas of low tidal speed, and spring tides. The model is consistent over time, with maximum tidal current and the position in the tidal cycle included in every model from 2003 to 2005 and all years combined.

For the acoustic survey data, the modelling resulted in a different set of important predictor variables. Firstly, the data were compensated for survey effects: namely ambient noise levels (detections reduced with increasing ambient noise levels), and boat

speed (the number of groups detected decreased with increasing boat speed). Having compensated for survey effects, the most important model for the number of porpoise groups detected acoustically per 2km in 2004-2005 included (in order of importance): percentage mud in the sediment and spring tidal range. With acoustic detection of harbour porpoise groups being highest over muddy sediments and high spring tidal range. The model predictions for both the best visual & acoustic model for 2004-2005 for the core area are shown in Figure 2.

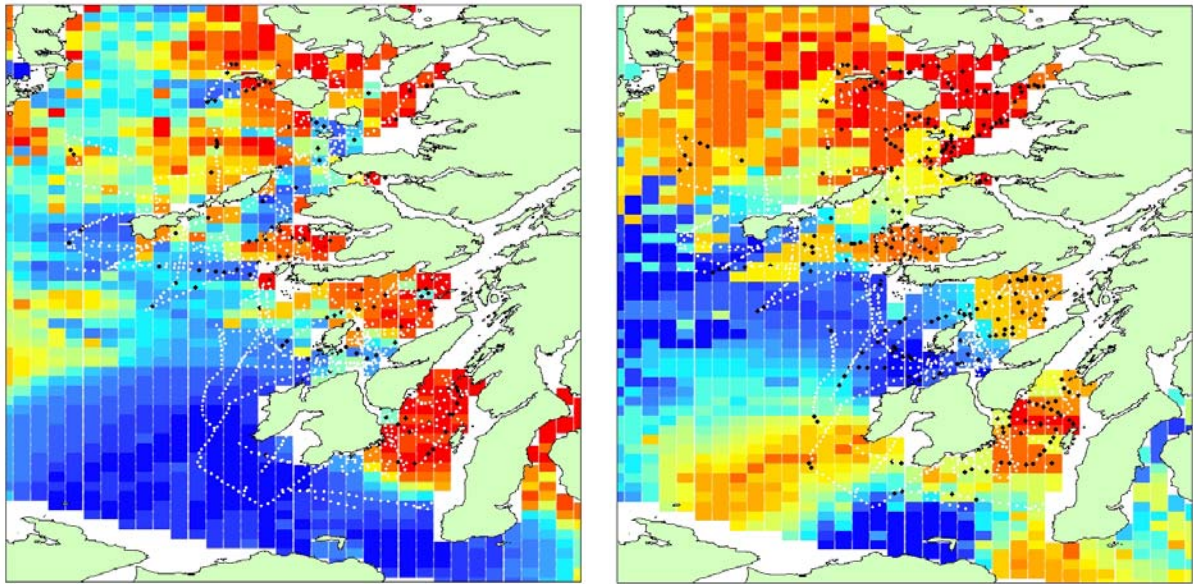


Figure 2 – Spatial prediction of harbour porpoise density (groups/2km) for (left) the best model based on visual detections, and (right) the best model based on acoustic detections for 2004-2005. Overlaid on the maps are the effort segments (white dots) and the visual (left) or acoustic (right) detections (black dots). Colours represent density from low (blue) to high (red), ranging from 0-0.1 for the visual model (left) and 0-0.6 for the acoustic model, colour gradation based on 20 levels using quantile classification.

The predictions show very similar core habitat areas (Sound of Jura, Firth of Lorne, Treshnish & Small Isles) but the acoustic model predicts a wider distribution, with high densities to the west of Islay (near the Islay Front), and in the whole of the Sea of Hebrides (except just north of Coll & Tiree).

Some of the potential sources of bias due to survey technique were investigated, and it was found that ambient noise levels (affecting acoustic detection rate) were significantly affected by the environmental conditions. Ambient (high frequency) noise levels were

found to increase over shallower water, gravel substrate, in flood tides, with higher boat speed and higher tidal currents. However, sea state (affecting visual detection rate) was also affected by environmental conditions to some extent, with higher swell and sea state in areas of high tidal current. It is unclear from the analysis whether it is these effects or others (such as harbour porpoises being more visible when aggregating during foraging) that result in different habitat preference models, but it is worth further investigation.

Finally, examining robustness of the model in space, the model was used to predict over the whole of the Inner Hebrides, and compared to the model based on survey data collected for this wider area (Figure 3). The model for the full survey area based on visual survey data from 2003-2005 (only with effort over wider area in 2005) resulted in a model in which spring tidal range replaced maximum tidal current as the most important predictor variable, though maximum tidal current was still included in the overall model for 2003-2005 (not when considered only for 2005). The predicted density of harbour porpoises still predicted areas of relatively high density in the Sound of Jura, Firth of Lorne, and Treshnish Isles. However, it also predicts much higher densities in the Sea of Hebrides and the Minch, which were predicted as areas of low density in the model based only on data from the Argyll & Small Isles. Neither model performed better than the other, however, it would be imprudent to rely on the model for the full area without further data collection to better investigate distribution and habitat preferences of harbour porpoises in these areas.

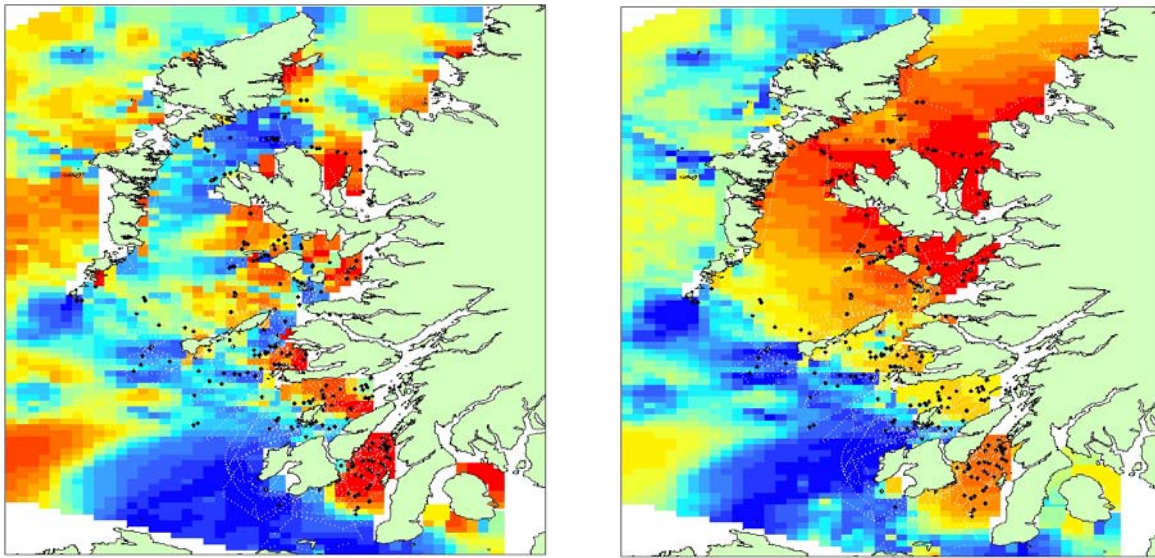


Figure 3 – Predictive plots based on the best GAM models by forward model selection for the core survey area dataset (left) and the full survey dataset (right) for 2003-2005 modelling the number of harbour porpoise groups with topographical, sediment and tidal covariates. Overlaid on the maps are the effort segments (white dots) and the visual detections (black dots). Colours represent density from low (blue) to high (red), ranging from 0 to 2.3, colour gradation based on 20 levels using quantile classification (ArcGIS 9.0).

Discussion

Within the core survey area of the Argyll and Small Isles, the model is robust in time, with harbour porpoises preferring areas of low tidal current, and sighted in higher numbers at spring tides. The preference for areas of low tidal current may seem counter other studies of the habitat preferences of harbour porpoises (Calderan 2003; Johnston et al. 2005). However, both Calderan (2003) & Johnston et al. (2005) concentrated on areas known to have high densities of porpoises within a single location – sites with a combination of deep water, steep topography and high tidal currents. Within the Inner Hebrides, the highest tidal currents can be found within the area surrounding the North Channel where the Irish Sea pushes through between Ireland and the Mull of Kintyre (see Figure 4). There have been very few sightings of harbour porpoises in this area, perhaps due to the poor sea state in such areas, or perhaps due to the lack of combination of high tidal currents with the appropriate topography for aggregating prey species. On this larger scale analysis, it would appear that harbour porpoises generally avoid areas of high current – since large areas of high current are energetically expensive to swim in, and

have minimal aggregation of prey. It is likely that at a smaller scale harbour porpoises choose narrow channels between islands combined with high currents (e.g. the Corry Vreckan), since these areas provide both aggregation of prey, and the ability to move into and out of the high current areas to minimise energy expenditure.

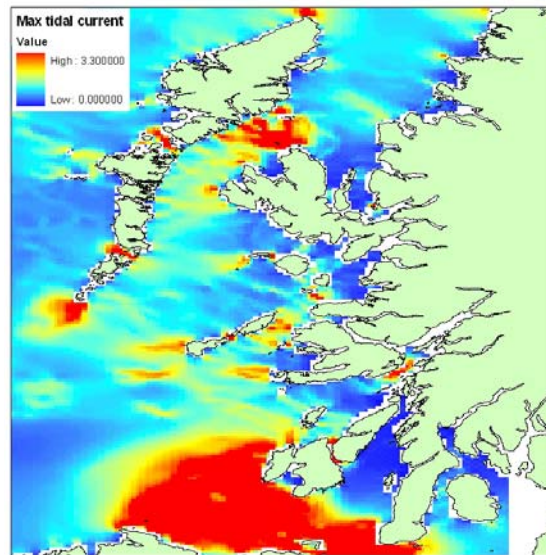


Figure 4 – Proudman Oceanographic Laboratory (POL) maximum tidal speed in m/s for the Inner Hebrides

The model does not appear to be as robust over space, with spring tidal range being a more important predictor than maximum tidal current over the full range of the Inner Hebrides, suggesting that on the whole, harbour porpoises do tend to prefer areas of high tidal activity. However, more data in the Northern & Little Minch, and Sea of Hebrides is required to determine whether this is a reliable indicator of harbour porpoises.

As a final comment, it is worth considering survey method when modelling habitat preferences of harbour porpoises. From the results of this modelling, it is evident that visual and acoustic methods are subject to different effects that may affect results:

- Visual survey methods are affected by:
 - i) Sea state & variables influencing sea state (e.g. tidal current)
 - ii) Detection *ahead* of the vessel, before any responsive movement
 - iii) Behaviour (e.g. more visible when aggregating in response to aggregated prey)
- Acoustic survey methods are affected by:

- i) Ambient noise levels which is influenced by the environment (noisier over shallow, gravelly substrate, in flood tides, with higher boat speed and higher tidal current)
- ii) Detected *behind* the vessel, after any responsive movement
- iii) Vocal behaviour (though evidence suggests they vocalise nearly continuously).

Despite these differences between detection ability between survey methods, it is very encouraging to find that the core areas of high use predicted by both models are very similar, and that both methods have proven to be good monitoring tools.

From the models it is evident that on the whole, porpoises are found throughout the coastal waters of the Inner Hebrides. Due to the wide distribution of harbour porpoises in the area it was difficult to model much of the variation in their distribution. Porpoises will both be foraging and travelling between foraging locations, yet it is these foraging locations that are most closely linked to the environment. The predicted high-density areas are most likely to represent their foraging locations, and since porpoises are very small and unable to store large quantities of energy in blubber, they have to remain close to their food source to supply their energy requirements (Koopman, 1998).

References

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Appendix 2 – PhD outline – Cormac Booth

The following provides more detail on Cormac Booth’s ongoing PhD research into harbour porpoise habitat preferences. It comprises the study plan at the year 1 mark of the PhD, and chapters are subject to change. Requests for further updates on this work should be made directly to Cormac Booth and the Sea Mammal Research Unit.

Investigating temporal and spatial variation in distribution of the harbour porpoise (*Phocoena phocoena*) on the west coast of Scotland

This PhD will focus on improving knowledge of harbour porpoise distribution and habitat use through finer scale predictive modelling; investigating true habitat preferences through hypothesis testing (and/or explanatory modelling); and addressing seasonal variations in habitat usage. Progress towards fulfilling these goals will enable more successful protection of the species, both on the west coast of Scotland, and throughout harbour porpoises’ range. These objectives can be split into the following sections (further details and methods of data collection will be discussed in the ‘Future Work’ section):

- 1. Refining the factors in Embling’s (2007) model by exploring scale and seasonality.**
 - 1.1. Investigating temporal and spatial changes in harbour porpoise distribution (large scale).*
 - 1.2. ‘Hypothesis testing’ of predictions of harbour porpoise distribution (medium scale).*
- 2. Linking the predictions of the models to ecological mechanisms.**
 - 2.1 Investigating long term inter-annual variations in harbour porpoise distribution using data from ‘platforms of opportunity’.*
 - 2.2 Investigating habitat usage at fine scales using explanatory modelling.*
- 3. Investigating how survey and oceanographic variables potentially bias modelling efforts.**
- 4. Studying how anthropogenic sound affects habitat usage of harbour porpoises and investigating received levels of ADD (Acoustic Deterrent Device) systems.**

Future Work

1. Refining the factors in Embling's (2007) models through exploring scale and seasonality.

1.1 Investigation into seasonal differences in harbour porpoise habitat usage on the west coast of Scotland.

I will investigate how harbour porpoise distribution changes through the course of the spring & summer season across the west coast of Scotland. Analyses will necessarily be limited to areas which have been sufficiently surveyed over the temporal periods being considered. The extent of survey coverage is affected by both logistical demands and the weather. I will include different temporal scales in the models to see its effect, and then create separate predictive models for each temporal period to determine the key factors influencing changes across the seasons.

Table 2 – shows the details of the variables and data sources I plan to use in models. Please note: this list is not exhaustive and will be expanded upon. HWDT – Hebridean Whale and Dolphin Trust. SMRU – Sea Mammal Research Unit. POL – Proudman's Oceanographic Laboratory. UKHO – United Kingdom Hydrographic Office. SAMS – Scottish Association for Marine Sciences.

| Variable | Source | Organisation | Availability |
|-------------------------------|---------------------------------|---------------------|--------------------------|
| <i>Latitude and Longitude</i> | From <i>Silurian</i> | HWDT | Yes |
| <i>Boat Speed</i> | From <i>Silurian</i> | HWDT | Yes |
| <i>Depth</i> | Digibath 250 (or EDINA Digimap) | SMRU | Yes |
| <i>Slope</i> | Digibath 250 (or EDINA Digimap) | SMRU | Yes |
| <i>Tidal Data</i> | POLPRED or POLTIPS | POL | TBC |
| <i>Sediment Data</i> | UKHO RSDB code / SAMS RGS F.T. | UKHO / SAMS | UKHO – TBC SAMS - Yes |
| <i>Boat Activity</i> | From <i>Silurian</i> | HWDT | Yes |
| <i>Water temperature</i> | From <i>Silurian</i> | HWDT | TBC |
| <i>ADD activity and</i> | From <i>Silurian</i> | HWDT | Yes |

1.2 ‘Hypothesis testing’ of predictions of harbour porpoise distribution (medium scale). Previous work by Embling (2007) has provided predictive models for harbour porpoise distribution in relation to survey and oceanographic variables over the Inner Hebrides (large scale). The two most important factors in these models were position in the tidal cycle (e.g. spring or neap) and the percentage of mud in the bottom sediment. I will use this as a starting point for a study into medium scale preferences. I will investigate harbour porpoise distribution in two areas where fine scale sediment datasets are available. These are the Firth of Lorn (dataset from SAMS) and the Little Minch / Minch (UKHO dataset – availability to be confirmed) (Figure 3). I will use designed line transect surveys over areas of variable bottom sediment during different phases of the tide (i.e. flood, slack and ebb during spring and neap tides). These transects will be run from *Silurian*.

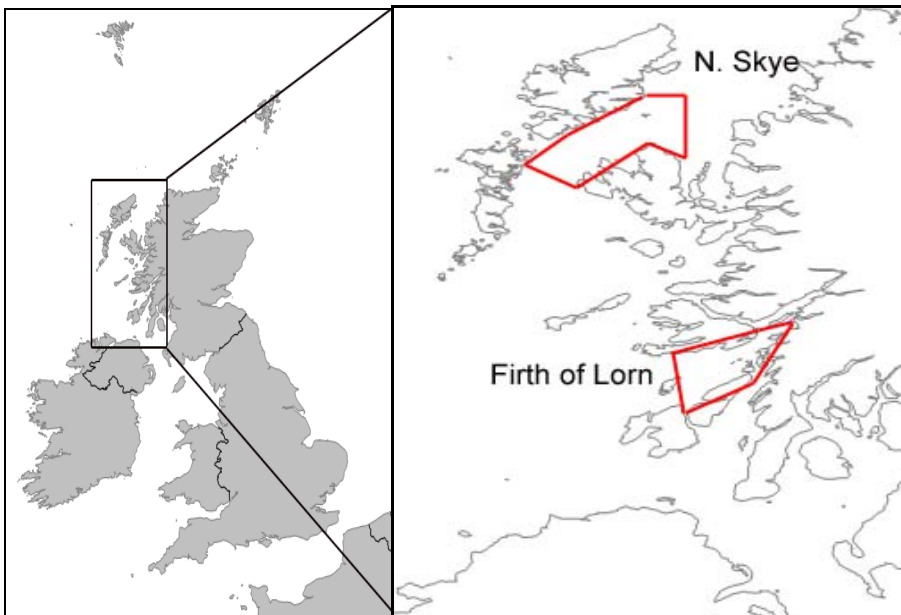


Figure 3 - shows the proposed study areas for this research (outlined in red).

2. Linking the predictions of the models to ecological mechanisms.

2.1 An investigation into long term inter-annual variations in harbour porpoise distributions using data collected from ‘platforms of opportunity’.

Visual data on distribution have been collected from non-randomised surveys in a standardised manner using the Logger program on Sea Life Surveys (SLS) vessels – a

whale watching group that run daily trips out of Tobermory, Isle of Mull.. Surveys have run from 1992 to present and will continue in 2008. This provides a 17-year dataset with which I will investigate inter-annual variations in harbour porpoise distribution/habitat usage. This dataset provides intensive coverage over a relatively small scale and may provide insights unobtainable from larger scale datasets. SLS surveys west of Mull, around Coll and the southern Small Isles (Figure 5). Minke whales (*Balaenoptera acutorostrata*) are the target species of these trips, but sightings data for other species are logged. MacLeod, *et al.* (2003) used the minke whale sightings data to investigate seasonal distribution of animals in this area. Survey effort, environment and sightings data are collected and, although these surveys are not designed, the coverage obtained is sufficient to provide meaningful results. Data from 1992-2002 have already been analysed by Rene Swift. I will be able to take advantage of these data and expand upon them. I will build models using the methods described by Williams, *et al.* (2006) to investigate long term variations in harbour porpoise distribution. It may also be possible to compare SLS data with the data collected from *Silurian* (and compare these models with models based on *Silurian* visual data). It may also be possible to include these data in the work described in Objective 2.2.

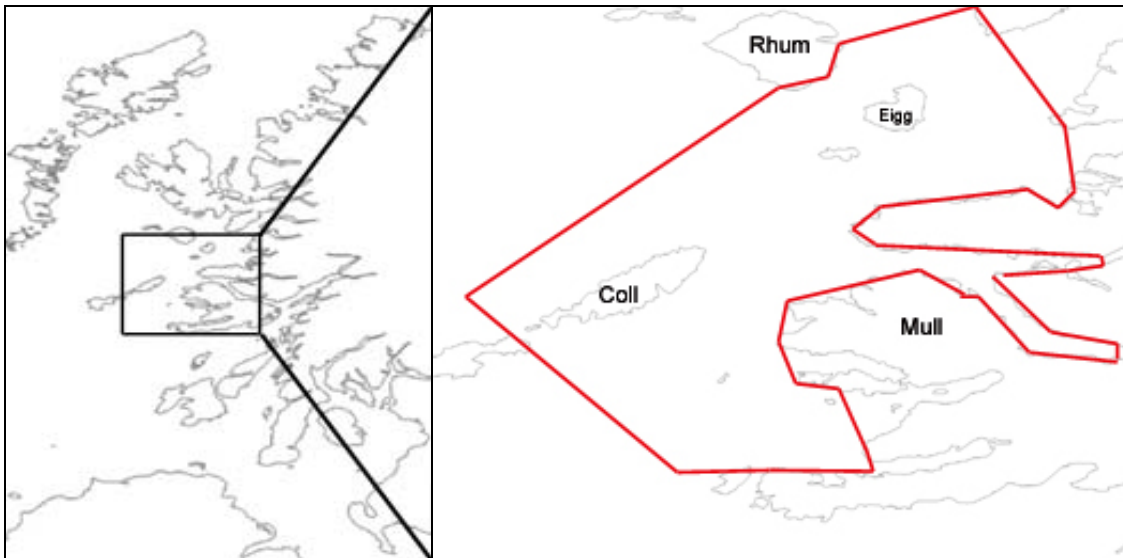


Figure 5 – shows the coverage of Sea Life Surveys trips between 1992-present (outlined by the red line). Small Isles: Rum, Eigg and Muck (SW of Eigg).

2.2 Investigating harbour porpoise habitat usage at fine scales using explanatory modelling.

I will investigate more closely the oceanographic and ecological factors identified from larger scale studies across a very small area (1 nm by 2 nm). Preliminary results of visual and acoustic surveys from *Silurian* and SLS (visual only) suggest that the area around Ardmore Point headland (Figure 4) is an important area for harbour porpoises. I would like to investigate at this fine scale how depth, slope, tides and bottom type affect harbour porpoise distribution in this area, and to examine, how these factors are interlinked in the ecosystem.

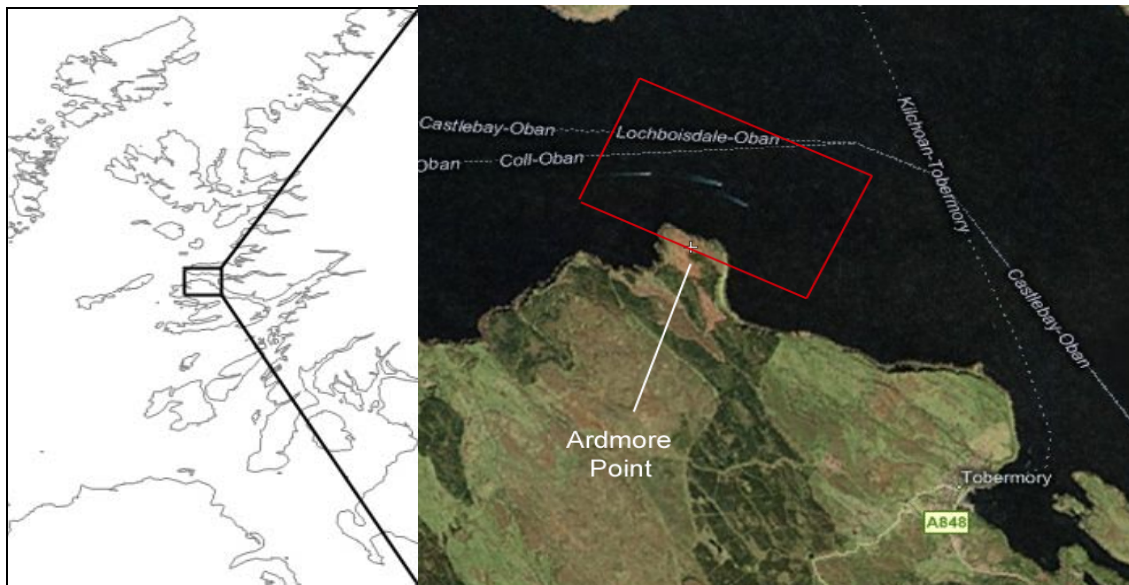


Figure 4 – shows the location of the headland, Ardmore Point, the proposed location of the theodolite (the white crosshair) and study area (outlined in red).

3. Investigating variation in ambient noise in relation to survey and oceanographic variables.

One issue affecting acoustic surveys is how ambient noise (background noise in the environment without any distinguishable source) affects the detection of animals – as ambient noise levels increase, the acoustic detection of cetaceans decreases (Gordon 2000, Gillespie and Chappell 2002). In general, speed of the survey boat, sea state, the depth of water, the bottom sediment type, current speeds and anthropogenic activities all affect levels of ambient noise (Table 3)(Richardson, *et al.* 1995).

Table 3 - shows the relationship between survey and environment variables and ambient noise. e.g. an increase in the speed of the survey vessel causes an increase in ambient noise.

| Variable | Change in variable | Effect on ambient noise |
|--------------------------------------|---------------------------|--------------------------------|
| <i>Sea State</i> | Increase | Increase |
| <i>Depth</i> | Decrease | Increase |
| <i>Percentage Gravel in Sediment</i> | Increase | Increase |
| <i>Speed of Current</i> | Increase | Increase |
| <i>Presence of Motor Vessels</i> | Increase | Increase |

In Embling’s (2007) acoustic models, background noise levels (in the porpoise frequency band) and boat speed were the two most important factors affecting the detection of harbour porpoises. Acoustic detections of porpoises decreased linearly as levels of background noise and the boat speed increased. Acoustic detections also varied significantly over different bottom sediments. However, it is not clear whether this is a genuine habitat preference for areas with a particular sediment type or simply a bias from increased levels of ambient noise, i.e. porpoises being more difficult to detect in areas of high ambient noise derived from, for example, different sediment types.

There is therefore a need to investigate in greater detail how the acoustic detection of harbour porpoises is affected by surveying from particular survey vessels. Specifically, what processes, boat factors (e.g. speed, engine on/off) and environmental variables are affecting the acoustic detection of harbour porpoises. This is something that is important for each survey vessel used. Different vessels will likely affect the detection of harbour porpoises in different ways. Here I will investigate how ambient noise levels vary over areas of different sediment types, and also investigate how ambient noise varies on *Silurian* with survey and oceanographic variables. I will also investigate snapping shrimp’s effect on detection of harbour porpoise clicks as part of this work.

During the 2007 season, full bandwidth recordings (recording up to 250 kHz) have been made for two seconds every two minutes to account for loud point sources of ambient noise. Recordings will be made across varying survey (e.g. engine on/off), environmental (e.g. sea state) and oceanographic states (e.g. different sediment types). Dedicated recordings will allow discrimination between the different factors that may affect background noise.

ADD received levels and effects on porpoise distribution

Previous studies have indicated that ADDs (devices used to deter seals from fish farm sites) adversely affect harbour porpoise habitat usage, with complete displacement being documented out to between 200 m (Olesiuk, *et al.* 2002) and 400 m (Johnston 2002) from the sound source, and significantly reduced relative abundances out to 3.5 km (Olesiuk, *et al.* 2002). However, it is known that ADD signals can propagate over 15 km from the source under certain conditions (Calderan, *et al.* 2007). In most of the work to date on this subject, the experimental exposures of animals to ADDs were short in duration and over a small scale. There has been little work investigating the effects of ADDs over larger scales and with longer exposures.

Referenced recordings are being made from *Silurian* whenever an ADD system is heard. From these recordings I can calculate received levels for the ADD signals at the hydrophone. This will provide valuable data on propagation of ADD signals in key porpoise habitats. These data will also enable me to calculate detection ranges for porpoise and other marine animals.

Appendix 3 – Schools evaluation forms



Education Visit Evaluation Form

School: Tobermory High School___

Date: ___13/12/06___

Name: _Alan Makeham_____

It's important for us to get feedback on the work we do with schools so we can continually improve. I wonder if you would be kind enough to answer the following questions: (Please use the back of this form or a separate sheet if needed).

1. How well were your expectations of the visit met?

The visit exceeded my expectations in that your presentation was of an extremely high standard. It was great that you were able to very quickly set a suitable standard for the audience and you clearly held their attention throughout. The use made of I.T. combined well with your enthusiasm and knowledge to produce a presentation that everyone enjoyed and learned from.

2. Did the activities for the students tie in with the curriculum? Was the 'pitch' appropriate to the knowledge of the different age groups?

The pitch was perfect for the range of pupils present. I am sure that it is of benefit to the pupils to feel that the data they have to work with is "real" rather than an exercise from a text-book.

3. Were there any activities that you would like repeated or extended in a future visit?

It would be great to have another session once Rebecca has had the class analyse their data. Another idea that I would like to explore is that I run the school's Eco- committee and they would be interested if there are any local projects with which the school could become involved.

4. Do you have any suggestions for changes in existing activities or additional activities for future visits?

We are always on the look-out for new and interesting ways to present challenges to the pupils, thank-you very much for taking the time to come and see us. You will be most welcome to come back to the school if you have other project ideas, and we shall let you know how we get on with our maths.

School: LUING PRIMARY SCHOOL

Date: 13.2.07

Name: CFOTHERGILL

It's important for us to get feedback on the work we do with schools so we can continually improve. I wonder if you would be kind enough to answer the following questions: (Please use the back of this form or a separate sheet if needed).

1. Did you feel that the pre-visit information and organisation that you received was sufficient?

Yes.

2. Was the level of 'pitch' appropriate to the knowledge of the different age groups?

Absolutely - there was an excellent range of activities, which built on the knowledge of the children

3. Did the activities for the students tie in with the curriculum? Were there any activities that you would like repeated or extended? Yes - the children used fun ways to

extend their knowledge and research skills. This seemed to be a winning formula for learning!

4. What experience was the most benefit to your students?

The practical activities made the learning very meaningful to the children.

5. What experience was the least benefit to your students?

6. Do you think the visit effectively contributed to the following purposes of 'A Curriculum for Excellence'? (Please tick)

Successful learners

Confident Individuals

Responsible Citizens

Effective Contributors

Please feel free to add any general comments on the visit, particularly any suggestions you have for improvements; e.g. - do you have any suggestions for changes in existing activities or additional activities for future visits?

The activities really harnessed the childrens enthusiasm and this was maintained throughout the session.

THANK YOU very much for giving your time to this evaluation.

Education Visit Evaluation Form

School: TREE HIGH SCHOOL

Date: 3 May 2007

Name: LYNN McARTHUR

It's important for us to get feedback on the work we do with schools so we can continually improve. I wonder if you would be kind enough to answer the following questions: (Please use the back of this form or a separate sheet if needed).

1. Did you feel that the pre-visit information and organisation that you received was sufficient?

Yes

2. Was the level of 'pitch' appropriate to the knowledge of the different age groups?

Yes

3. Did the activities for the students tie in with the curriculum? Where there any activities that you would like repeated or extended?

Indirectly.

4. What experience was the most benefit to your students?

All was very beneficial

5. What experience was the least benefit to your students?

None

6. Do you think the visit effectively contributed to the following purposes of 'A Curriculum for Excellence'? (Please tick)

Successful learners

Confident Individuals

Responsible Citizens

Effective Contributors

Please feel free to add any general comments on the visit, particularly any suggestions you have for improvements; e.g. - do you have any suggestions for changes in existing activities or additional activities for future visits?

The visit was excellent on all counts. From safety instruction to technical information. Although these children see these animals on the shore, they had little knowledge of them. The respect shown for the animal was an important element. The Trust staff managed the exercise very efficiently and were skilled at delivery & handling Q's.

Your visit was very much appreciated.

THANK YOU very much for giving your time to this evaluation.

Education Visit Evaluation Form

Thank you for participating in our programme. In order to evaluate the success of our programmes and to improve our workshops, it is vital that we receive feedback from schools.

School Name: Fort Ellen Primary

Date: 13. 5. 08

Student year group: P5/6

Please circle the number that you feel reflects the level of your experience

6 = Excellent 1 = Poor

| | | | | | | |
|-----------------------------------------------------------------|---|---|---|---|---|---|
| How would you rate the pre-visit information? | 1 | 2 | 3 | 4 | 5 | 6 |
| How would you rate the content of the workshop/visit? | 1 | 2 | 3 | 4 | 5 | 6 |
| How would you rate the structure and organisation of the visit? | 1 | 2 | 3 | 4 | 5 | 6 |
| Was the 'pitch' appropriate to the age group? | 1 | 2 | 3 | 4 | 5 | 6 |
| How would you rate the quality of the teaching? | 1 | 2 | 3 | 4 | 5 | 6 |
| Did the activities tie in with the curriculum? <i>Class</i> | 1 | 2 | 3 | 4 | 5 | 6 |
| Did your group enjoy the experience? | 1 | 2 | 3 | 4 | 5 | 6 |
| Do you consider that you received value for money? | 1 | 2 | 3 | 4 | 5 | 6 |
| Overall, how satisfied were you with this workshop/visit? | 1 | 2 | 3 | 4 | 5 | 6 |

Do you think the visit effectively contributed to the following purposes of 'A Curriculum for Excellence'? (Please tick)

Successful learners

Confident Individuals

Responsible Citizens

Effective Contributors

Please add any additional comments you have overleaf. Many thanks.

Please tick here if you would prefer your comments not to be used in our publicity and promotional materials



Education Visit Evaluation Form

Thank you for participating in our programme. In order to evaluate the success of our programmes and to improve our workshops, it is vital that we receive feedback from schools.

School Name: SALEN PRIMARY

Date: 3.6.08

Student year group: Primary 1-3

Please circle the number that you feel reflects the level of your experience

6 = Excellent 1 = Poor

| | |
|-----------------------------------------------------------------|-----------------------------------|
| How would you rate the pre-visit information? | 1 2 3 4 5 6 |
| How would you rate the content of the workshop/visit? | 1 2 3 4 5 6 |
| How would you rate the structure and organisation of the visit? | 1 2 3 4 5 6 |
| Was the 'pitch' appropriate to the age group? | 1 2 3 4 5 6 |
| How would you rate the quality of the teaching? | 1 2 3 4 5 6 |
| Did the activities tie in with the curriculum? | 1 2 3 4 5 6 |
| Did your group enjoy the experience? | 1 2 3 4 5 6 <i>The say</i> |
| Do you consider that you received value for money? | 1 2 3 4 5 6 |
| Overall, how satisfied were you with this workshop/visit? | 1 2 3 4 5 6 |

Do you think the visit effectively contributed to the following purposes of 'A Curriculum for Excellence'? (Please tick)

Successful learners

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Thank you for a great morning of outdoor learning. The activities were age appropriate and I really liked the way the children were encouraged to work collaboratively within small groups. I'll let you know how we get on with our book of the sea.
Kindest regards, Nancy

Thought you might enjoy a sample of some of the children's comments.

It was great fun learning about all the different things (Hannah)
It was very kind of you to give up ~~to~~ your time to be with us. (Daniel).

It was very, very, very fun - Iain.

Finding crabs was fun! - Kyle

I enjoyed it. It was interesting - Tanica

Thank you for taking us to the shore - Toby

It was good fun - Abbie

We learned a lot about shells and seaweed - Aaron/Kerr

"Thank you Gemma" - everybody!

Salen P.S. 3-6-08