

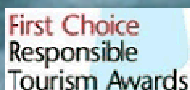


EXPEDITION REPORT

Expedition dates:
12 June – 6 July | 14 August – 7 September 2013

Report published:
December 2013

**Awesome orcas and their relatives:
Studying basking sharks, whales, dolphins and other
cetaceans around the Hebridean Islands of Scotland.**



**BEST
VOLUNTEERING
ORGANISATION
UK**



**BEST FOR
GREEN-MINDED
TRAVELLERS
UK**



**TOP
RESPONSIBLE
HOLIDAY
UK**



**BEST NEW TRIP
USA**



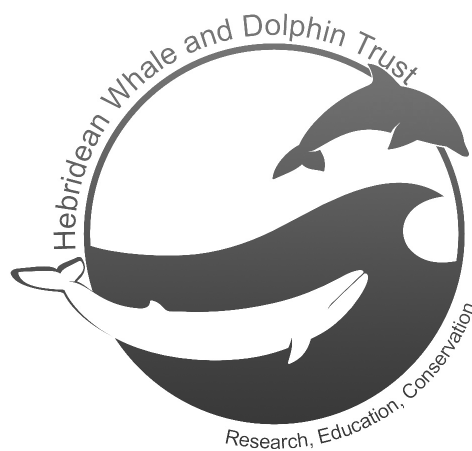
**BEST IN
SUSTAINABLE
TRAVEL
USA**



**ENVIRONMENT
AWARD
Germany**



**TOP HOLIDAY
FOR NATURE
Germany**



EXPEDITION REPORT

Awesome orcas and their relatives:
Studying basking sharks, whales, dolphins and other
cetaceans around the Hebridean Islands of Scotland

Expedition dates:

12 June – 6 July | 14 August – 7 September 2013

Report published:

December 2013

Authors:

Olivia Harries

Hebridean Whale & Dolphin Trust

Matthias Hammer (editor)

Biosphere Expeditions

Abstract

In 2013, Biosphere Expeditions and the Hebridean Whale and Dolphin Trust (HWDT) together ran four marine mammal and basking shark monitoring surveys from Tobermory, Isle of Mull, Scotland. Visual and acoustic surveys were carried out by HWDT, as well as photo-identification of target species between May and the end of September, with Biosphere Expeditions teams involved for two months between June and September. In total, 2,868 nautical miles (nm) of visual and 2,681 nm of acoustic surveys were conducted. During the whole survey season, 722 visual sightings were recorded: 408 of these sightings were of cetacean species, 282 were of pinnipeds and 32 sightings were of basking sharks. Photo-identification data were collected during encounters of 14 common dolphin, 6 white-beaked dolphin, 1 bottlenose dolphin, 1 Risso's dolphin, 1 orca and 26 basking shark. There were 821 harbour porpoise acoustic detections. Acoustic recordings were also made of common dolphin, white-beaked dolphin, bottlenose dolphin, Risso's dolphin, orca and the two pinniped species (common and grey). In total, 325 items of marine litter were recorded, as well as 3,051 static fishing gear marker buoys. In addition, 782 half-hour bird and boat traffic surveys were completed. The species sighted in 2013 were consistent with previous years, with harbour porpoises being the most regularly sighted marine mammal species, closely followed by the pinniped species. The data gathered in 2013 will be incorporated into HWDT's databases, where they will be available for future comprehensive analyses of species distribution, relative abundance and habitat preferences.

Contents

Abstract	2
Contents	3
1. Expedition review	4
1.1. Background	4
1.2. Research area	5
1.3. Dates	5
1.4. Local conditions & support	7
1.5. Local scientist	8
1.6. Expedition leaders	8
1.7. Expedition team	8
1.8. Expedition budget	9
1.9. Acknowledgements	10
1.10. Further information & enquiries	10
2. Research survey review	11
2.1. Introduction and background	11
2.2. Methods	12
2.3. Results	16
2.3.1. Effort	16
2.3.2. Sightings	16
2.3.3. Acoustic monitoring	23
2.3.4. Photographic identification	24
2.3.5. Anthropogenic impacts	25
2.4. Discussion	28
2.5. Conclusions	30
2.6. Literature cited	30
Appendix I: Expedition diaries & reports	32

1. Expedition review

Matthias Hammer
Biosphere Expeditions

1.1. Background

Biosphere Expeditions runs wildlife conservation research expeditions to all corners of the Earth. Our projects are not tours, photographic safaris or excursions, but genuine research expeditions placing ordinary people with no research experience alongside scientists who are at the forefront of conservation work. Our expeditions are open to all and there are no special skills (scientific or otherwise) required to join. Our expedition team members are people from all walks of life, of all ages, looking for an adventure with a conscience and a sense of purpose. More information about Biosphere Expeditions and its research expeditions can be found at www.biosphere-expeditions.org.

This expedition report deals with an expedition to Scotland that ran from 12 June – 6 July and 14 August – 7 September 2013. The expedition was part of a long-term research project, set up and run by the Hebridean Whale and Dolphin Trust (HWDT), with the aims of (1) monitoring the temporal and spatial distribution and habitat preferences of cetaceans and basking sharks, (2) investigating movement patterns and demographics of Hebridean cetacean species and basking sharks and (3) mapping anthropogenic environmental impacts (e.g. sound, debris, installations).

Hebridean waters provide an important habitat for European cetaceans and this is arguably one of the most significant areas in Europe for these fascinating mammals. The overall goal of HWDT's work is to quantify this perception with high-quality data and to provide detailed information on cetacean and basking shark relative densities and distributions within the region. Identifying habitats of most importance to these species is a vital step towards effective management.

Twenty-four cetacean species have been recorded in the waters off western Scotland, where a complex submarine topography and cold and warm waters (an effect of the Gulf Stream) combine to provide an oceanographically diverse environment that is able to support a high species diversity of cetaceans and other large marine predators such as the basking shark. Many of the species found in this area are recognised as conservation priorities at national and international levels. But despite the diversity and abundance of these species, there are few management strategies that are directed specifically towards their long-term conservation in this region. Therefore data need to be collected to inform policymakers and generate recommendations for effective marine management.

The marine environment is ever changing and, with the prospect of climate change, offshore renewable energy development and changes in the management of fish stocks, it is essential to understand how a species may react to changes in its environment over time. The effects of climate change on marine animals are still uncertain; however, habitat fragmentation leading to population declines is a concern. The collection of sound scientific data is therefore vital for the continued survival of the iconic cetacean species and basking sharks found on the west coast of Scotland.

1.2. Research area

The Hebrides includes some 550 islands distributed over approximately 40,000 square kilometres (see Fig 1.2a). The UK government has designated the islands as an Area of Outstanding Natural Beauty (AONB) for their diverse land- and seascapes and abundant wildlife. In addition to the species mentioned above, the seas of western Scotland are inhabited by a variety of seabirds, including white-tailed eagles, gannets, Manx shearwaters, storm petrels and puffins, to name but a few. On land, red deer, mountain hares, pine martens, rare wild cats, otters and the endangered red squirrel can be seen. Otters are a constant favourite of wildlife enthusiasts visiting the Hebrides and they can often be sighted scampering around rocky shorelines at dusk.

There are a wide range of marine habitats of international importance, including rocky reefs, turbulent tidal streams and deep-water channels. The seas are dominated by two main water masses – warm, saline Atlantic water brought in by the North Atlantic Drift, and fresher and colder Irish Sea water, which enters the area through the North Channel. Near the coasts, there is also fresh coastal water from rivers and freshwater runoff. On land, the coastal landscape on the mainland and islands features moorlands, rocky mountains, lochs, salt marshes and the machair (a rare coastal environment exclusive to the north and west of Scotland and Ireland).

Rare and unique orchids can be found throughout the islands, supporting a variety of butterfly species, dragonflies and bumblebees. The Hebrides are an excellent place to view Scottish flora, as intensive agriculture has never taken hold. What is most evident is the dramatic variation in the Scottish landscape, from the sheer cliffs of Scarba to the long stretches of sandy beaches on Tiree, and the high sand dunes of Coll to the raised beaches west of Jura. The west coast of Scotland indisputably possesses truly spectacular scenery. Each of the west Scottish islands has its own unique character and is steeped in Highland history, traditions and culture. The area is made up of small close-knit communities that are open and welcoming to visitors. The economic and social fabric of these communities relies to a great extent on fishing, farming and tourism. The expedition's marine research objectives contribute to and support sustainable fishing and farming methods and Biosphere Expeditions' local partners are heavily investing in encouraging responsible codes of conduct within marine-based ecotourism.

1.3. Dates

Biosphere Expeditions assisted HWDT for the following periods during HWDT's 2013 research season:

12 – 23 June | 25 June – 6 July || 14 – 25 August | 27 August – 7 September 2013

All groups were composed of a team of international research assistants, a scientist, a skipper and first mate and an expedition leader (see below for team details).

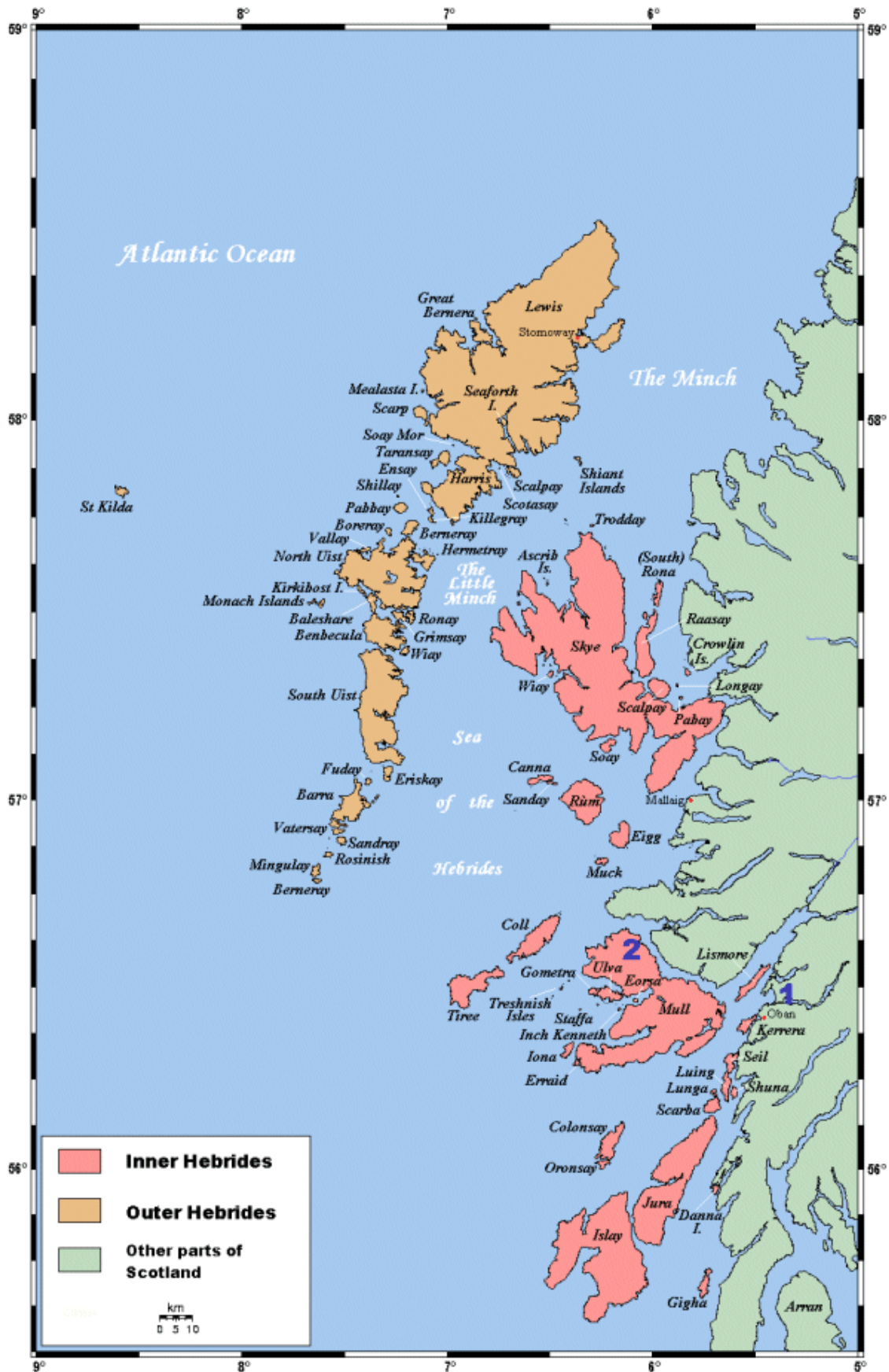


Figure 1.2a. Map of the Hebrides and the study area.
 1 = primary expedition assembly point (Oban), 2 = secondary assembly point (Tobermory).

1.4. Local conditions & support

Expedition base

The expedition team worked and lived on board the 60-foot yacht *Silurian*, a Bermudan rigged ketch with two masts. *Silurian* has been modified from a private cruiser to a research yacht with the addition of a crow's nest for enhanced visibility, hydrophones to enable acoustic monitoring, and a fully equipped computer system allowing for the collection of 7,000 km of survey data each season. *Silurian* carries extensive safety equipment, including lifejackets for all on board, a twelve-man life raft and a four-metre tender. The *Silurian* has a good-sized galley, complete with refrigerator, freezer and cooker. She also has two heads (bathrooms) with showers and flushing (hand pump) toilets, as well as 10 berths. Two team members shared a cabin. Vegetarians and some special diets were catered for. Special sailing wet weather gear was provided to all expedition team members.

Weather

The west coast of Scotland has a relatively mild and wet maritime climate, with changeable weather. The weather during the 2013 field season was characterised by high winds and heavy rain on some days. However, we still achieved good coverage of all our core survey areas. Across the season, sea surface temperatures ranged between 7°C at the start of the field season in May and 14°C at the end of the field season in September.

Field communications

The boat carried a VHF radio for communication. Mobile phone coverage was not always available. Regular expedition diary updates were uploaded to the [Biosphere Expeditions blog](#), [Facebook](#) and [Google+](#) for friends and family to access.

Transport

Team members made their own way to either the primary Oban or the secondary Tobermory assembly point on time. From there onwards, during research activities and back to the assembly point, vehicle and boat transport was provided for the expedition team.

Medical support

The expedition leader, scientist, skipper and first mate were all trained first aiders and the expedition carried a comprehensive medical kit. The standard of medical care in the UK is high and further medical support was provided by a network of 11 hospitals located on various isles of the Hebrides. Safety and emergency procedures were in place, but did not have to be invoked. There were some falls on the boat during swells, one resulting in a minor fracture. There were no serious medical incidents during the expedition.

1.5. Local scientist

Olivia Harries, HWDT's Marine Biodiversity Officer, was the local scientist on this expedition, responsible for running the monitoring surveys on board the research yacht, as well as coordinating the visual and acoustic data collection. Olivia joined HWDT in February 2011 as a recent graduate from the University of St Andrews, where she gained a Masters in Marine Mammal Science. Her interests lie within population biology and ecological and environmental modelling. She has conducted marine mammal based field work in Honduras, Central America; Plettenberg Bay, South Africa; Florida, USA; and in Cardigan Bay, Wales, which is her native country.

1.6. Expedition leaders

Kate Fox led the 12 June – 6 July 2013 rotation. Kate graduated from The University of Wales, Aberystwyth, with a degree in Rural Resources Management and went on to volunteer locally as a Nature Reserve Warden followed by a year as a practical Conservation Officer in the north of England. She then worked a summer season in Cumbria as a conservation project coordinator and leader and has led international conservation projects since 1997 in Europe, USA, Canada, New Zealand and Japan. She particularly loves wildlife and wild places and generally being outdoors. She has done numerous long-distance hikes and canoeing/sea kayaking expeditions in the UK and overseas. Her other hobbies include horse riding, mountain biking and camping.

Adam Stickler led the 14 August – 7 September 2013 rotation. Adam was born in Paris and has since lived in the UK and Kenya. Adam studied Biology and is also a PADI qualified diving instructor. He has cycled extensively across Europe and Africa as well as driven a hatchback from England to Mongolia. He is a first aid instructor and a qualified lifeguard. A passion for culture, wildlife and conservation has driven him to discover more about the world we live in and how we can preserve it.

1.7. Expedition team

The expedition team was recruited by Biosphere Expeditions and consisted of a mixture of all ages, nationalities and backgrounds. They were (with countries of residence):

12 – 23 June 2013: Marcus Benner (Germany), Verena Hutter (Switzerland), Judy Marshall (USA), Emily Naylor (UK), Michael Seipel (Germany), Irina Tarasenkova (Russia).

25 June – 6 July 2013: Céline Geiger (France), Brian Green (UK), Elke Hermann (Germany), Alex Ross (UK), Steve Tusler (Australia), Lena-Marie Zangari (Canada).

14 – 25 August 2013: Leanne Blair (UK), Eva Kühn (Germany), Karen Smith (UK), Manfred Starck (Germany), Anne Storie (UK), James Weckerle (USA).

27 August – 7 September 2013: Denise Mead (UK), Tim Moore (UK), Catherine Nagler (USA), Peter Pilbeam (UK), Fiona Sommerville (UK), Heather Suffron (USA), Franziskus von Kerssenbrock (Austria, journalist).

The crew for the first two groups above were: Stuart Cook (UK), Tom Reade (UK), and for the last two groups above: John Lambert (UK), James Haine (UK), Tom Reade (UK).

1.8. Expedition budget

Each team member paid towards expedition costs a contribution of £1580 per two week slot. The contribution covered accommodation and meals, supervision and induction, all maps and special non-personal equipment, and all transport from and to the team assembly point. It did not cover excess luggage charges, travel insurance, personal expenses such as telephone bills, souvenirs, etc., as well as visa and other travel expenses to and from the assembly point (e.g. international flights). Details on how these contributions were spent are given below.

Income	£
Expedition contributions	39,681
Expenditure	
Staff includes salaries, travel and expenses, living expenses	14,869
Research includes equipment and other research expenses	815
Base & transport includes board, lodging and other yacht services, bus transfers, fuel, etc.	6,912
Administration includes administrative and miscellaneous costs	887
Team recruitment Scotland as estimated % of PR costs for Biosphere Expeditions	6,400
Income – Expenditure	9,798
Total percentage spent directly on project	75%

1.9. Acknowledgements

This study was conducted by Biosphere Expeditions, which runs wildlife conservation expeditions all over the globe. Without our expedition team members (listed above) who provided an expedition contribution and gave up their spare time to work as research assistants, none of this research would have been possible. The support team and staff (also mentioned above) were central to making it all work on the ground. Thank you to all of you and the ones we have not managed to mention by name (you know who you are) for making it all come true. Biosphere Expeditions would also like to thank Swarovski Optik and the Friends of Biosphere Expeditions for their sponsorship and/or in-kind support.



As ever, we would not be able to collect these valuable data without the assistance of volunteers. We would like to thank all the volunteers who participated in this year's surveys very much for their great efforts and great company this season. It was a privilege to have sailed with you all and we hope you will stay in touch. Funding for the work of the Hebridean Whale and Dolphin Trust was provided by Biosphere Expeditions, Earthwatch Institute, Heritage Lottery Fund, Argyll and Islands Enterprise, Scottish Natural Heritage, Marine Scotland and WWF.

1.10. Further information & enquiries

More background information on Biosphere Expeditions in general and on this expedition in particular including pictures, diary excerpts and a copy of this report can be found on the Biosphere Expeditions website www.biosphere-expeditions.org.

Copies of this and other expedition reports can be accessed via www.biosphere-expeditions.org/reports. Enquires should be addressed to Biosphere Expeditions via www.biosphere-expeditions.org/offices.

2. Research survey review

Olivia Harries
Hebridean Whale and Dolphin Trust

2.1. Introduction and background

The Hebridean Whale and Dolphin Trust (HWDT) has been conducting cetacean monitoring surveys since 2003 and is the only long-term monitoring project collecting broad-scale data on the west coast of Scotland. Knowledge of the distribution, relative abundance and important habitats of cetaceans is essential for the development of effective marine management policies relating to the threats which may affect cetaceans. While initial survey efforts were restricted to the Argyll Islands region, in recent years survey efforts have extended north, south and west to increase the geographical scope of data collection.

HWDT has three research objectives:

- Investigating temporal and spatial patterns of cetacean distribution and habitat preference
- Investigating movement patterns and demographics of Hebridean cetaceans
- Mapping anthropogenic environmental impacts (e.g. underwater noise, marine debris, coastal and offshore industry).

Cetaceans are highly mobile and live in an environment free from most obvious boundaries. Knowledge of population characteristics and the movement within and between areas is very important in developing effective management strategies. A key research methodology for investigating patterns of cetacean distribution and movement is mark-recapture using photo-identification, whereby individually distinctive natural markings on animals, such as fin notches and scars, can be used to identify individuals on repeated occasions without the need to capture, restrain or mark animals. These 'natural tags' can also be used to estimate demographic parameters such as animal abundance, social structure, survival and reproductive rates. Several species in the study area are the subject of ongoing studies using natural markings for identification, and HWDT has several long-running photo-identification catalogues, including for minke whales, bottlenose dolphins and orcas, which have been used in a range of collaborative studies (<http://www.whaledolphintrust.co.uk/research-photo-identification.asp>). In this project, photo-identification was carried out for minke whales, common dolphins, white-beaked dolphins, bottlenose dolphins, Risso's dolphins, orcas and basking sharks. Additional ID-photographs are also obtained from wildlife tour operators and via HWDT's Community Sightings Network.

Another of HWDT's key research methodologies is passive acoustic monitoring, a non-invasive survey technique with which distribution, abundance and other qualitative and quantitative cetacean data can be gathered through monitoring animal vocalisations using hydrophones and other associated acoustic hardware and software. HWDT has been at the leading edge of developing acoustic monitoring strategies in cetacean research over the last ten years.

Cetaceans on the west coast of Scotland are subject to a number of anthropogenic impacts (Warburton et al. 2001). Direct and indirect takes of cetaceans are globally considered to be major threats to many cetacean populations and both of these have an impact on cetaceans on the west coast of Scotland (Warburton et al. 2001). Habitat degradation and disturbance are a cause for concern (Parsons et al. 2000), with shipping, fishing and aquaculture all impacting on cetaceans in the region (Parsons et al. 2000). These activities can also cause noise pollution, an ever-increasing and poorly understood threat (Parsons et al. 2000). Both UK and local Biodiversity Action Plans (BAPs) (<http://jncc.defra.gov.uk/page-5155>) have identified these as significant threats to cetaceans, but data on their level and extent are sparse, making HWDT's collection of data on vessel traffic, fishing gear and marine debris an important part of their research strategy.

HWDT's surveys have enabled the collection of numerous data streams over several years, resulting in a large and complex dataset. This enables both projects investigating specific research questions using discrete parts of the dataset, and also collaborative work where data contribute to larger Scottish or UK-wide initiatives as part of comprehensive long-term analyses. As the HWDT dataset expands, with ongoing surveys using consistent methodology, its value will increase in terms of its capacity to provide the trend data often required by researchers and policymakers.

2.2. Methods

In 2013, 10 surveys took place between May and the end of September. Four of these were scheduled to be run with volunteers from Biosphere Expeditions. One of them formed part of the Sea Mammal Research Unit MRes programme at St Andrews University. Five surveys were run exclusively by HWDT.

Surveys were either 9 or 12 days long (with 7 and 10 of those, respectively, being dedicated survey days, with an arrival and departure day at the beginning and end of the survey). The typical distance covered was between 200 and 500 nautical miles, depending on the weather conditions and the duration of the survey. 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.

Surveys were conducted from the HWDT research vessel *Silurian*, a 16-metre ketch fully equipped to operate as a research vessel. Systematic visual and acoustic line transect surveys were carried out at an average speed of 6 knots, under motor when winds were low, and under sail when there was enough wind. Visual observations were carried out from the front deck (2 metres above sea level) by teams of trained volunteers. Two observers were positioned on the front deck searching the water from -5° to 90° of the transect line on both sides of the vessel using naked eye and binoculars (Marine Opticron 7 x 50 or Swarovski Optik SLC 8 x 56B) (see Fig. 2.2.a). When cetaceans, pinnipeds or basking sharks were spotted, the distance, bearing (using an angle board), heading of the group/individual, species, group size and behaviour were recorded directly into a computer below deck via a voice relay system (see Fig. 2.2b).

All data were collected and stored using the real-time data logging program LOGGER 2010 (<http://www.marineconservationresearch.co.uk/downloads/logger-2000-rainbowclick-software-downloads/>) developed by the International Fund for Animal Welfare.

Visual observers switched sides after 30 minutes, and the watch was changed every hour to avoid observer fatigue. Occasionally, deviations were made from the track line in order to conduct photo-identification. When this happened, the effort was recorded as 'with whales' (encounter effort). Once encounter effort was finished, the vessel returned to the track line and effort changed back to 'on-effort'. All effort-related data were recorded directly into a computer using the LOGGER program. GPS location was recorded automatically every 10 seconds along with depth, wind speed and direction, and boat speed from the vessel's NMEA (National Marine Electronics Association) compatible instruments. Environmental conditions (sea state, swell, visibility, sun glare and weather conditions) were recorded every 15 minutes or whenever they changed. Sea surface temperature was recorded using an automated temperature probe. Survey effort and engine status, whether it was 'on' or 'off', were noted whenever they changed.



Figure 2.2a. Two observers positioned on the front deck of Silurian. © Kate Fox.

Photographs of minke whales, common dolphins, white-beaked dolphins, bottlenose dolphins, Risso's dolphins, orcas and basking sharks were collected for individual identification. When this was done, line transect sampling protocols were interrupted.

Photographs were taken of the dorsal fins and any body scars or flank patterns that can be used to distinguish individual animals. A Canon EOS 10D with a 350 mm lens was used to take photo-identification photographs (see Fig 2.2c). Images were then added to the species catalogues (<http://www.whaledolphintrust.co.uk/research-photo-identification.asp>). When white-beaked dolphins or Risso's dolphins were encountered, capturing acoustic recordings took precedence over photo-identification, and five minutes of acoustic recordings were made before focusing on photo-identification data collection.



Figure 2.2b. Recording data into the computer below deck.



Figure 2.2c. Taking photo-identification photographs. © HWDT.

Passive acoustic monitoring was conducted continuously and simultaneously with the visual surveys during systematic line transect surveys. A towed hydrophone array was deployed in all sea conditions during daylight hours in waters deeper than 10 m. Continuous acoustic monitoring was conducted at a 500 kHz sample rate and one-minute recordings were made of audible sounds (96 kHz sample rate) every 15 minutes by volunteers (see Fig. 2.2d). PAMGUARD (www.pamguard.org) software was used to classify transient sounds detected on the hydrophone array. The hydrophone array consisted of two high-frequency elements with highest sensitivity at 150 kHz and a near flat frequency response between 2 and 140 kHz. Elements were housed in a streamlined sensor section consisting of 10 metres of 35 millimetre diameter polyurethane tubes filled with ISOPAR-M oil, which was towed 100 metres behind the boat on a Kevlar-strengthened cable (see Fig 2.2e).

Surveys for marine litter, static fishing gear, birds and boat traffic also took place.



Figure 2.2d. Volunteers making sound recordings.

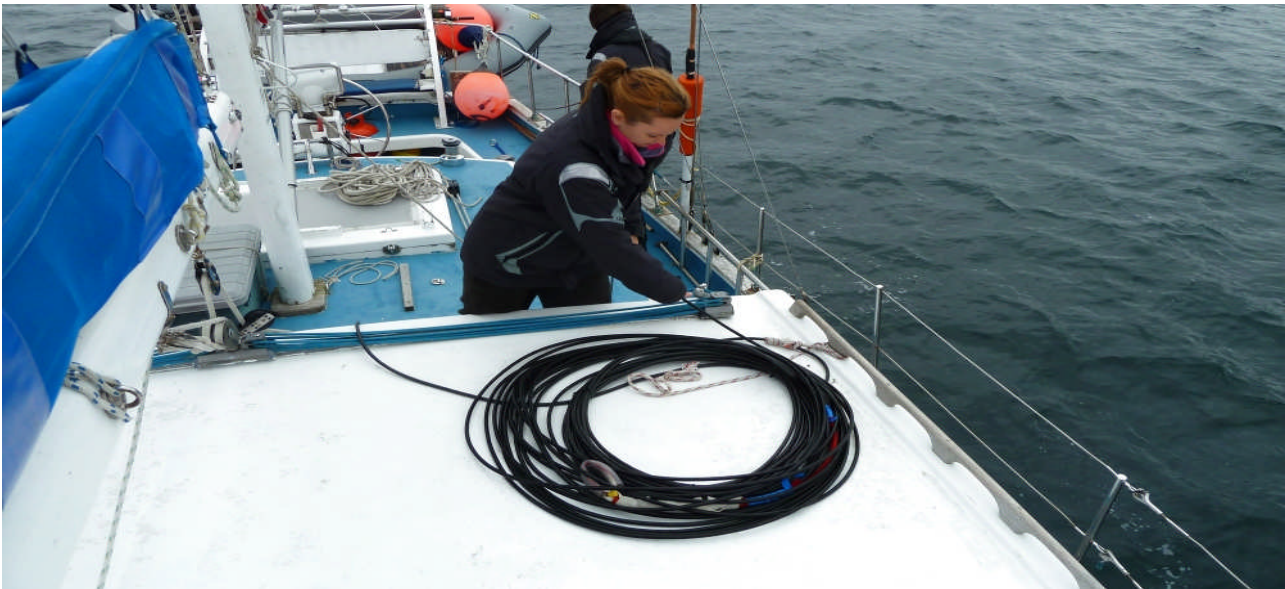


Figure 2.2e. Expedition scientist Olivia Harries coiling the hydrophone array.

2.3. Results

2.3.1. Effort

In 2013, 2,868 nautical miles (nm) of visual and 2,681 nm of acoustic effort was completed. Biosphere Expeditions surveys contributed 1,412 nm and 1,305 nm to the total amount of visual and acoustic surveys, respectively. The maps below (Figures 2.3a–e) show the routes taken by each Biosphere Expeditions survey. Routes were chosen to take into account weather and sea conditions and to obtain an even coverage of survey effort throughout the area. In spite of poor weather on some surveys, good coverage of all core survey areas was achieved. We were also able to extend coverage to investigate previously unsurveyed regions, including Northern Irish waters.

Overall, 54 volunteers came on board *Silurian* during 2013, of which 24 came via Biosphere Expeditions. Additionally, 18 students participated in the Sea Mammal Research Unit surveys on board *Silurian*, where students from St Andrews University came on board as part of their MRes course.

2.3.2. Sightings

Table 2.3a. Sightings of the 2013 survey season.

Species	Count of species*	Total animals recorded
Harbour porpoise <i>Phocoena phocoena</i>	316	581
Common seal <i>Phoca vitulina</i>	116	150
Grey seal <i>Halichoerus grypus</i>	104	138
Unidentified seal	62	63
Minke whale <i>Balaenoptera acutorostrata</i>	34	42
Basking shark <i>Cetorhinus maximus</i>	32	129
Common dolphin <i>Delphinus delphis</i>	22	262
Unidentified dolphin	18	61
Unknown	10	9
White-beaked dolphin <i>Lagenorhynchus albirostris</i>	6	22
Risso's dolphin <i>Grampus griseus</i>	1	1
Orca <i>Orcinus orca</i>	1	3

*Count of species = number of encounters with species

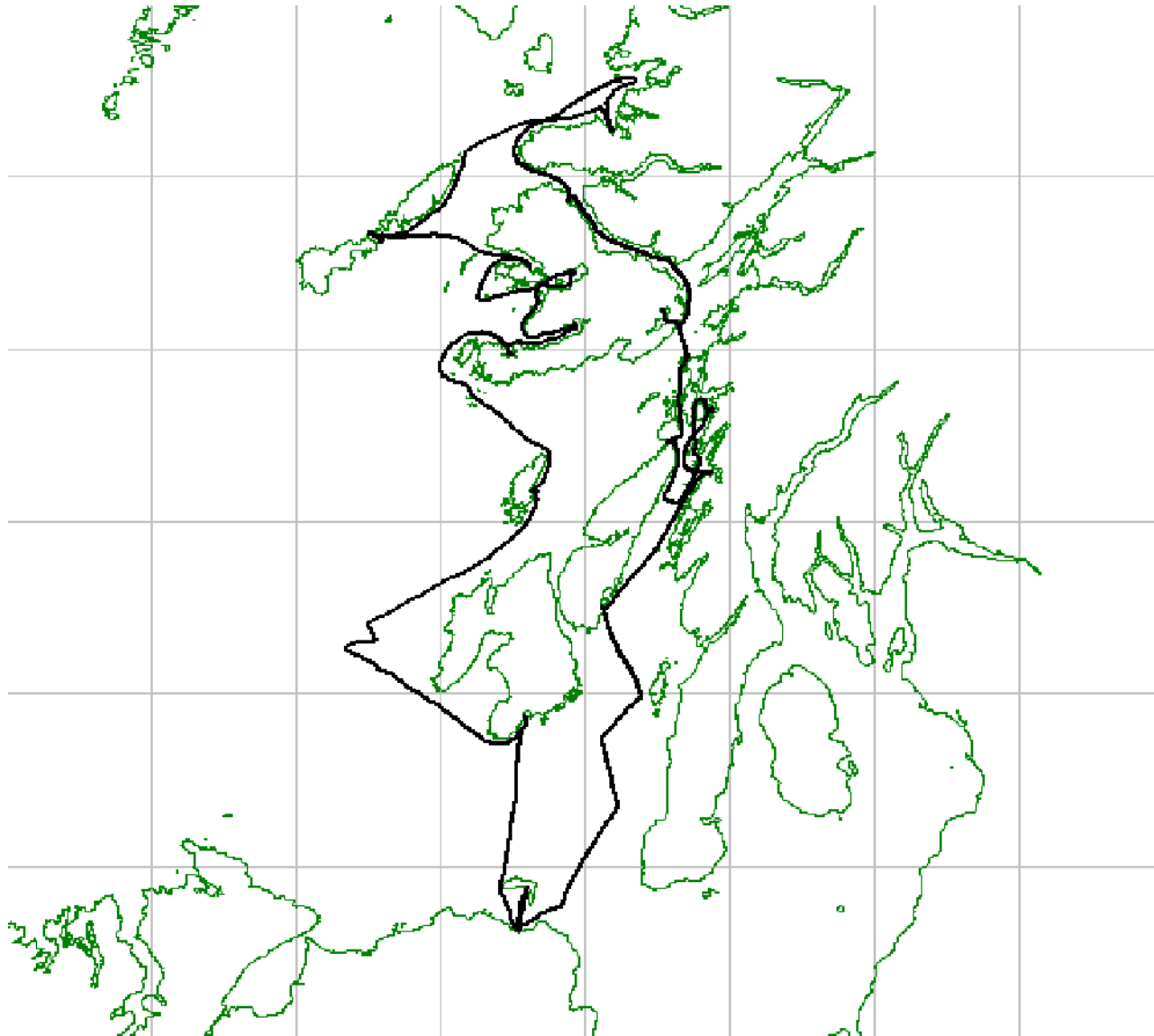


Figure 2.3a. Biosphere Expeditions survey 12 – 23 June 2013. 429.4 nm travelled.

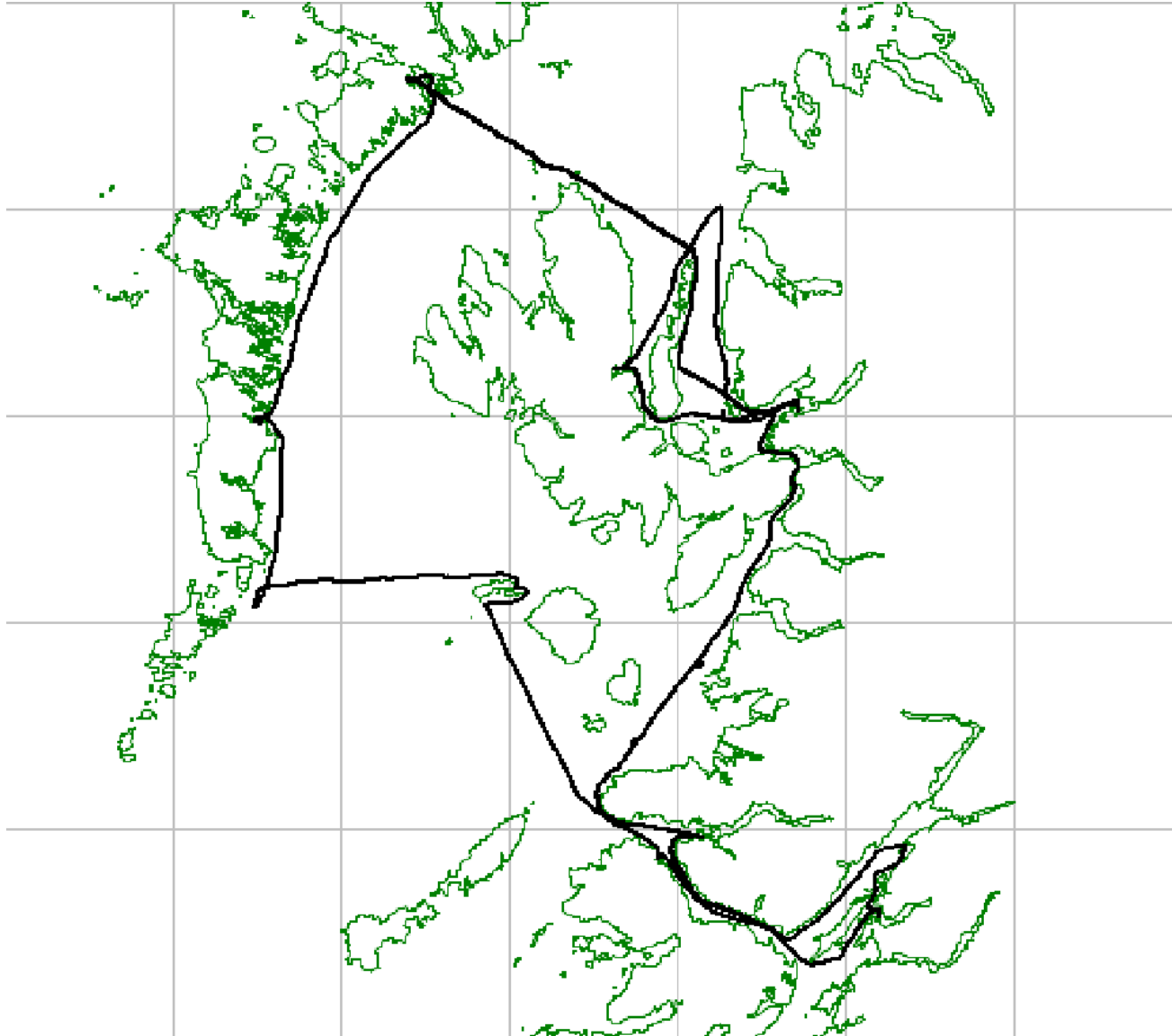


Figure 2.3b. Biosphere Expeditions survey 27 June – 7 July 2013. 404.4 nm travelled.

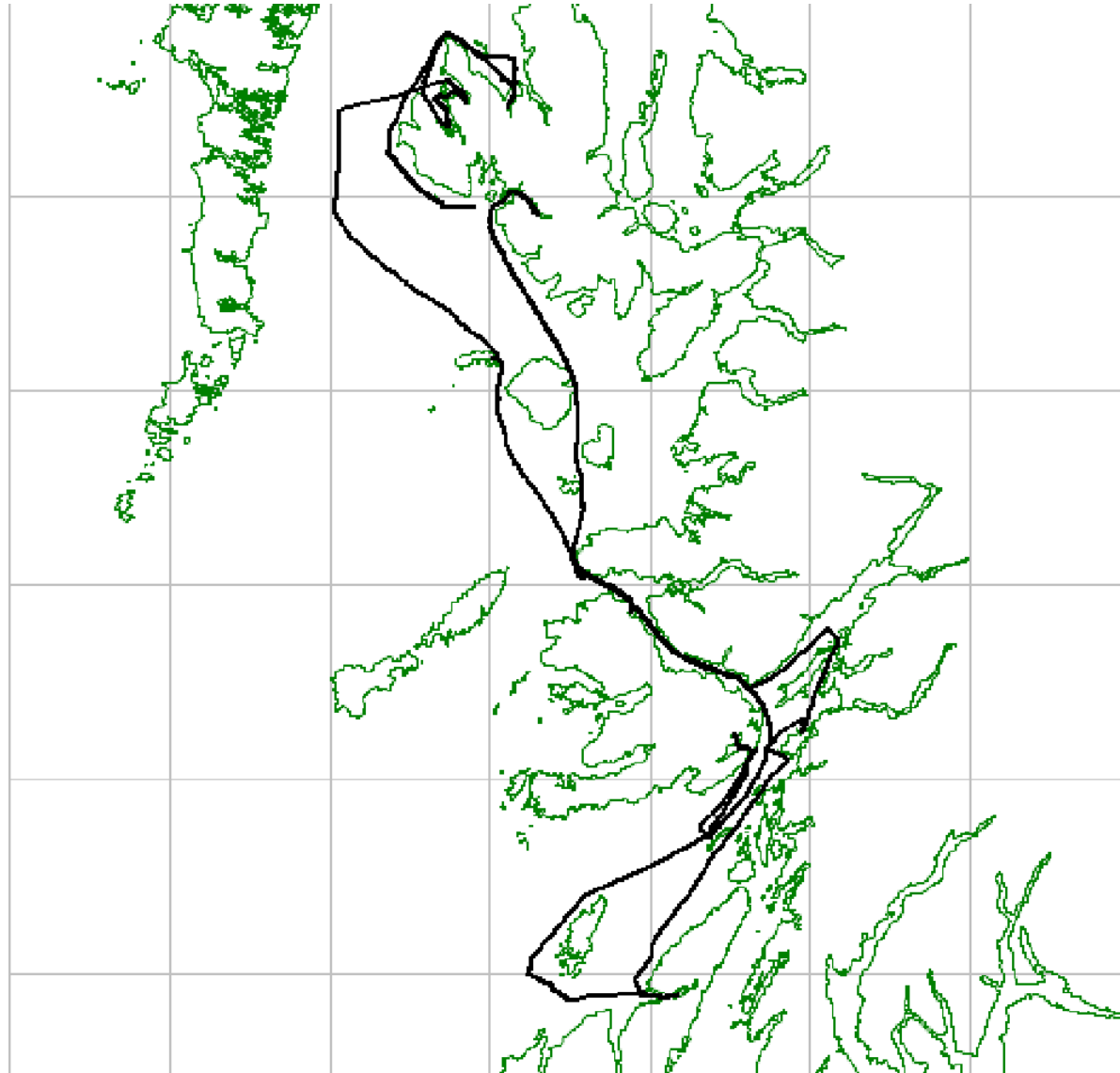


Figure 2.3c. Biosphere Expeditions survey 14 – 25 August 2013. 405.0 nm travelled.

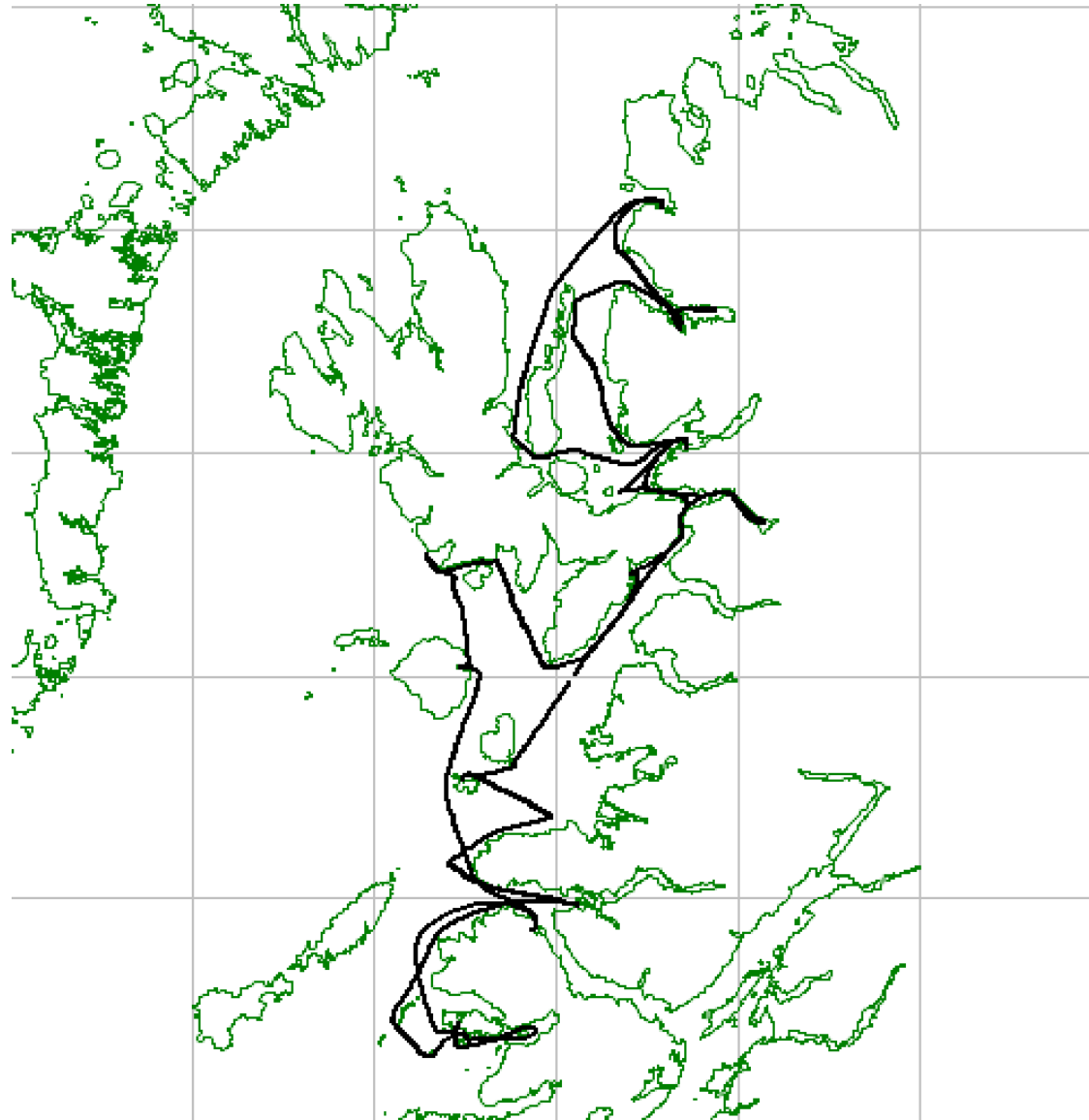


Figure 2.3d. Biosphere Expeditions survey 27 August – 7 September 2013. 366.9 nm travelled.

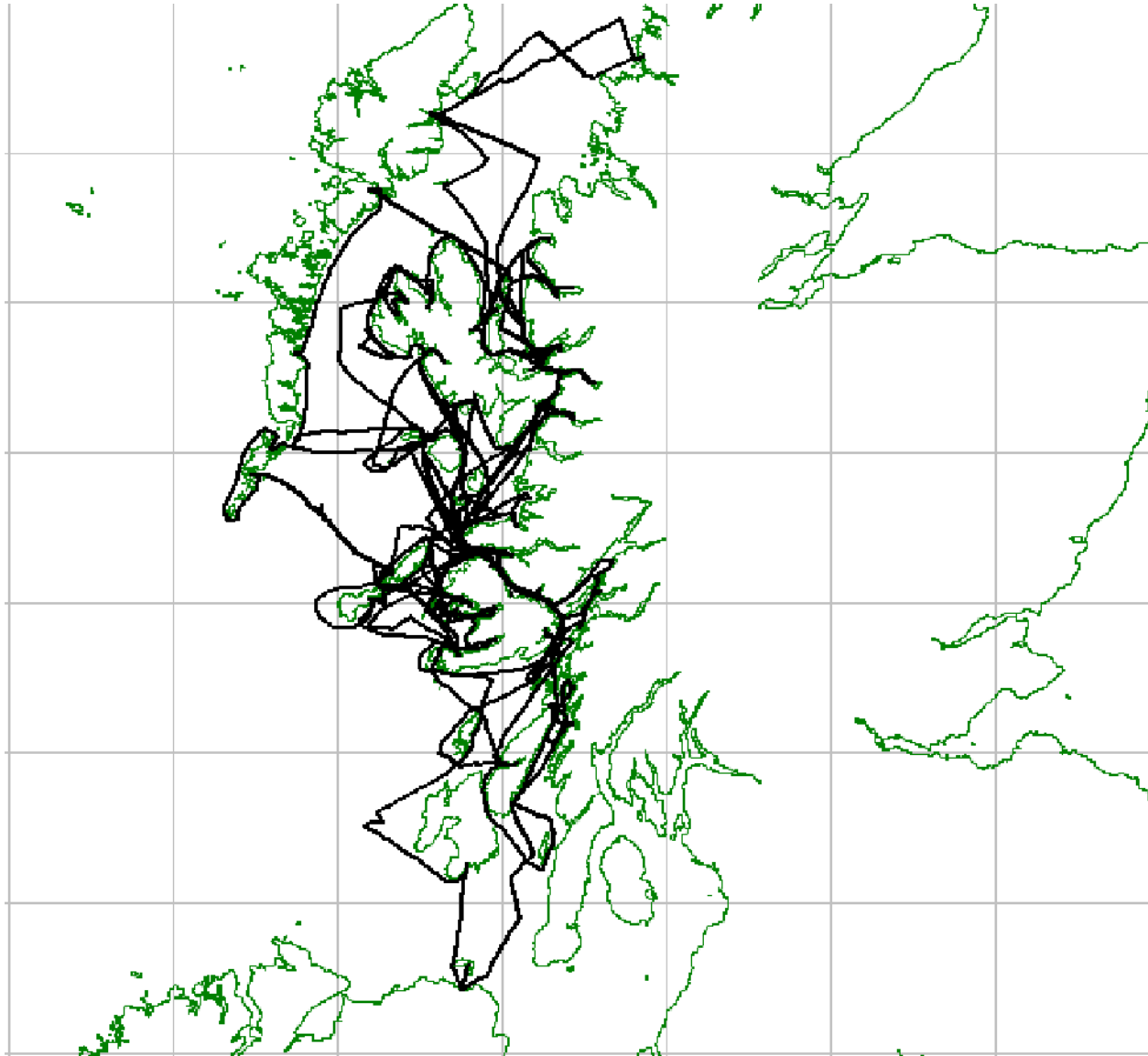


Figure 2.3e. 2013 survey season, all tracks. Total 3,228.4 nm travelled.

Harbour porpoise was the most commonly seen species in 2013, both in terms of the number of encounters and total number of animals seen. This is consistent with previous years of HWDT Silurian surveys. There were 34 minke whale encounters and 32 basking shark encounters. However, basking shark group sizes were larger than those of minke whales; 129 basking shark individuals were seen compared to 42 individual minke whales. In August, a group of orcas was encountered at the entrance to Soay Sound, near the Isle of Skye. The group comprised three individuals, all of which were matched to the HWDT orca photo-ID catalogue, belonging to a group known as the West Coast Community (Comet, WCC005; Aquarius, WCC008; and Lulu, WCC006) (see Fig 2.3f.).



Figure 2.3f. 'Aquarius' WCC008 from the West Coast Community. © HWDT.

Fourteen encounters of basking sharks were recorded in and around Gunna Sound over two days in July, when a minimum of 50 individuals was counted. These two days contributed substantially to the total number of basking sharks encountered (Table 2.3a above).

Common, white-beaked, bottlenose and Risso's dolphins were sighted during the 2013 season. Group sizes varied greatly, with common dolphin groups containing over 100 individuals in some instances and the Risso's dolphin encounter consisting of just one individual. White-beaked dolphins were found in the North Minch, an area previously identified by HWDT as an area of particularly high importance to this species (Harries et al. 2012).

2.3.3. Acoustic monitoring

Automated acoustic classifiers designed to identify harbour porpoise vocalisations indicated 821 harbour porpoise acoustic detections (see Fig. 2.3g) during the 2013 season (compared to 316 visual encounters). Six acoustic encounters with white-beaked dolphin were recorded during the 2013 survey season. Sightings of bottlenose and Risso's dolphin and orcas also resulted in acoustic detections of these species.

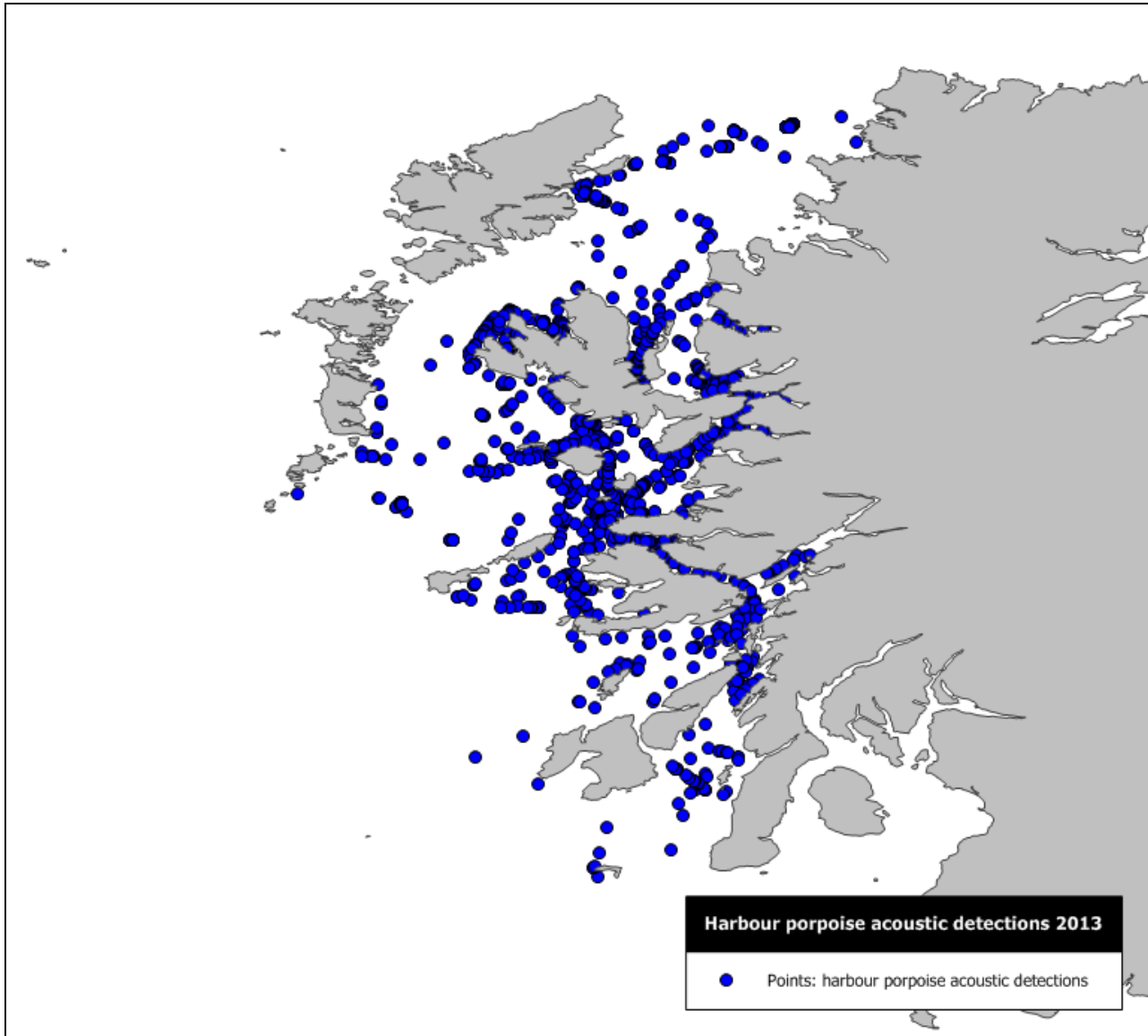


Figure 2.3g. Harbour porpoise acoustic detections during 2013.

2.3.4. Photographic identification

Minke whale

Minke whale photo-identification work this season was very successful, with 17 photo-identification encounters. Typically for this species, most encounters were of only one animal, although some encounters comprised two to six animals. In 2010, the minke whale catalogue comprised 125 animals. In the coming months, the database will be updated to include new images and a reassessment will take place on the number of individually identified minke whales. Collaborative work conducted by St Andrews University and HWDT on this species (Northridge et al. 2010) will also contribute to this reassessment (see the section on anthropogenic impacts below for further information).

Bottlenose dolphin

Research continues to take place on the photographic identification of bottlenose dolphins found off the west coast of Scotland. Images taken in 2013 are being added to the already-established catalogue (http://www.whaledolphintrust.co.uk/research-photo-identification-gallery.asp?gallery_id=13). The catalogue currently consists of 35 individuals that make up the Inner Hebridean group. Of the bottlenose dolphins encountered and photographically-identified by HWDT during 2013, one apparently new identification has been made. It is unclear at this stage, however, whether this addition represents a new individual not seen in previous years, or is one of the individuals previously seen but not subsequently recognised due to mark loss in intervening years. Further research into this individual will take place over the winter.

Orca

HWDT continues its collaborative research on the 'West Coast Community' of orcas photo-identification catalogue. There appear to be just nine regularly sighted individuals: 4 males and 5 females.

Other species

In addition to HWDT's photo-identification catalogues for minke whales, bottlenose dolphins and orcas, its photo-identification catalogues for common, white-beaked and Risso's dolphins have all been added to this season (<http://www.whaledolphintrust.co.uk/research-photo-identification.asp>). Basking sharks are also photographed and the images sent to the Shark Trust for analysis.

Obtaining the high-quality photographs necessary for individual identification requires us to interact with animals for a longer period of time and at closer range than we might otherwise wish. We therefore operate under a research permit from Scottish Natural Heritage which permits these interactions. The total time in 'encounter effort' with each species sighted in 2013 is as follows:

Table 2.3b. Encounter effort of the 2013 survey season.

Species	Total encounter time (mins)
Bottlenose dolphin <i>Tursiops truncatus</i>	90
Minke whale <i>Balaenoptera acutorostrata</i>	344
Orca <i>Orcinus orca</i>	55
Risso's dolphin <i>Grampus griseus</i>	26
Common dolphin <i>Delphinus delphis</i>	235
White-beaked dolphin <i>Lagenorhynchus albirostris</i>	26
Basking shark <i>Cetorhinus maximus</i>	432

2.3.5. Anthropogenic impacts

We have continued our research into marine litter, as its presence, particularly that of plastics, is a significant conservation concern for cetaceans, which can ingest litter and/or become entangled in it. In 2013, approximately 70% of items observed were confirmed as plastics (either plastic bags, bottles or other plastic items).

A dominant and growing activity in the study area is aquaculture, both of fin fish (predominantly salmon) and shellfish (predominantly mussels and oysters). Every major sea loch on the west coast of Scotland contains fish farms and over 50% of these employ anti-predator devices (known as Acoustic Deterrent Devices or ADDs), which emit high source level noise (typically up to 194 dB re: 1µPa at 1m) intended to deter seals from preying on the salmon. The ADD sound frequencies used (typically around 10 kHz, but with higher and lower frequencies depending on the type of device) are similar to those used by many cetacean species. Booth (2010) found that these devices have the potential to displace harbour porpoises from important habitats over large ranges. We recorded ADDs within the Sound of Mull, Firth of Lorne and the Sound of Sleat (including its adjacent lochs) during 2013. These data will contribute to our long-term research project investigating the potential adverse effects of ADDs on cetaceans.

The Sea Mammal Research Unit at St Andrews University and HWDT are investigating the potential risks of minke whales becoming entangled in creel lines (creels are fish traps widely used in west Scottish coastal waters to catch shellfish such as crabs, lobsters and langoustine (Northridge et al. 2010). An estimated 17.7% of identified minke whales in the Hebrides show some evidence of previous entanglement. The head of the whale is the body region most commonly found with scars, suggesting that minke whales become entangled in gear whilst feeding. There are two areas (north of the Isle of Skye and South Uist) where minke whales appear to be at particularly high risk of entanglement (Matthewson 2012). Figure 2.3h shows the 2013 sightings of minke whales and their geographical proximity to the creels, also recorded during 2013. The results of Matthewson (2012) and Northridge et al. (2010) highlight areas that future mitigation methods should focus on, and provide information for developing and implementing appropriate mitigation methods.

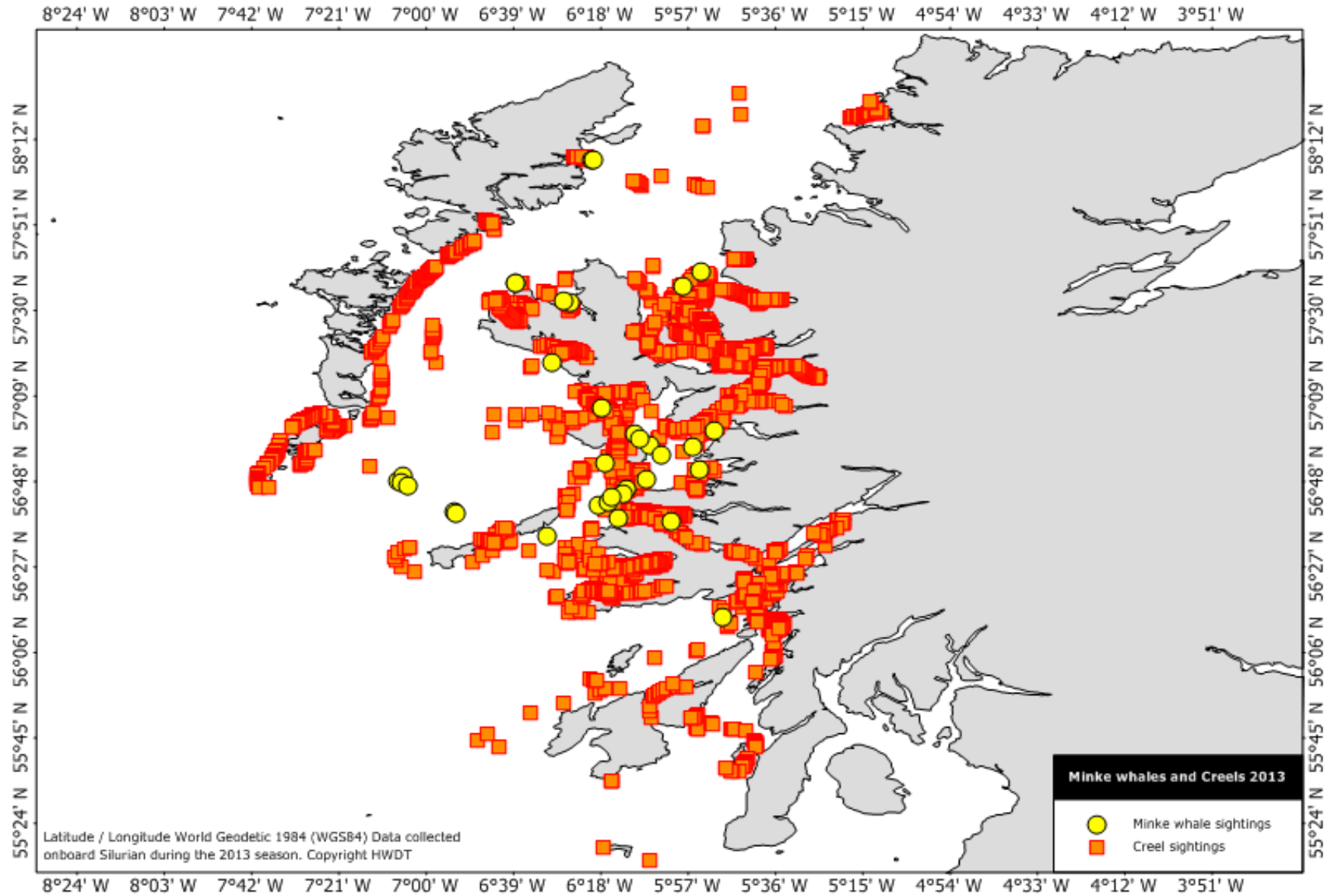


Figure 2.3h. Minke whale (yellow) and creels (orange) recorded during 2013 surveys.

The goal of producing 80% of Scotland's energy requirement from renewable sources by 2020 will require a substantial programme of offshore construction. These developments are likely to impact west Scottish cetaceans, chiefly through construction noise generated by pile driving (particularly in the case of wind turbines), and collision risk (in the case of tidal turbines). All offshore developments have the potential to lead to disturbance, habitat loss, and elevated risks from increased boat traffic associated with offshore industries (underwater noise, ship strikes etc.). The Biosphere Expedition 1 survey effort included a transit of an area west of Islay (Figure 2.3g), which is a proposed offshore wind farm site, to add to the body of data on marine mammal distribution in the area.

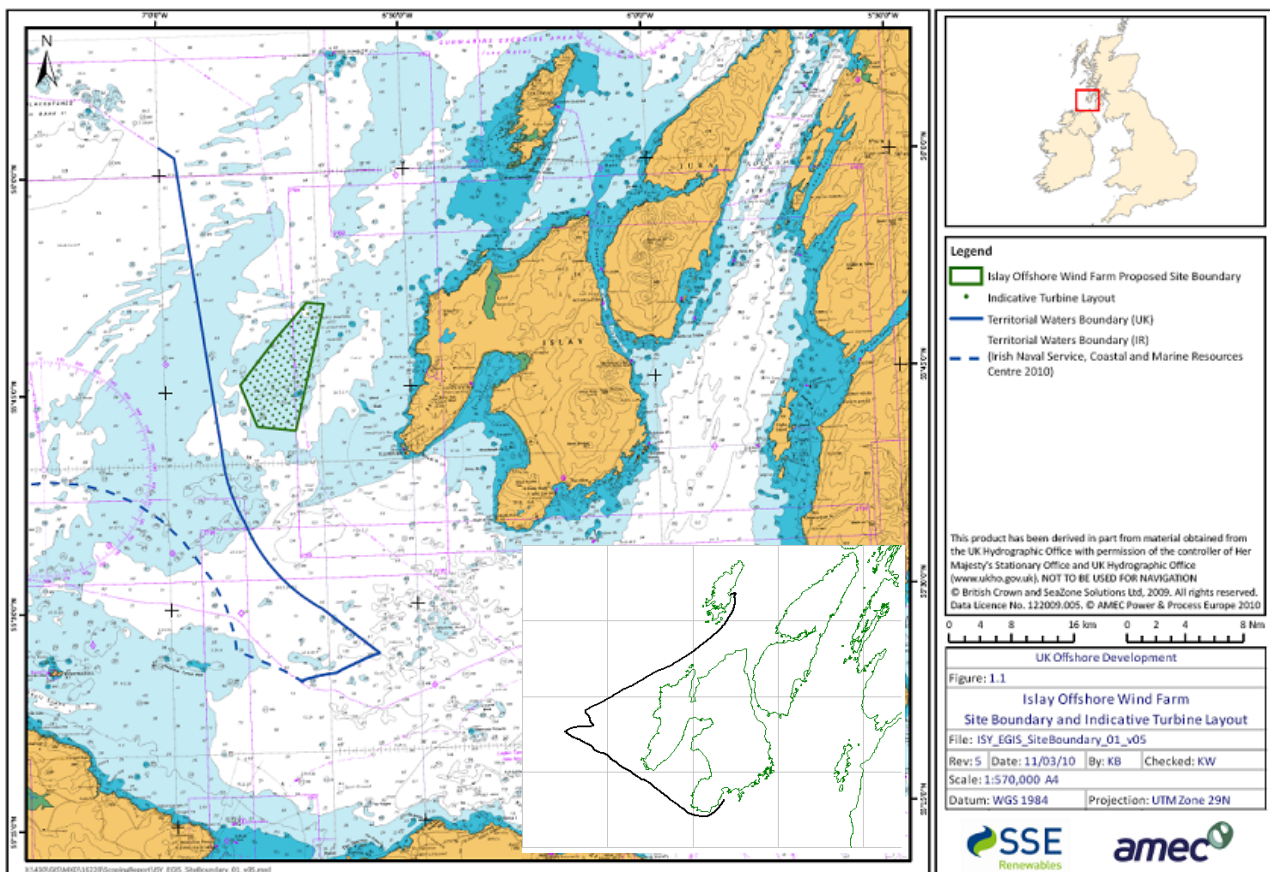


Figure 2.3g. Islay offshore wind farm proposed site boundary (green, on colour map) and survey route on 18 June 2013 (inset map).

2.4. Discussion

The 2013 season made a further valuable contribution to HWDT's growing long-term dataset of visual and acoustic cetacean, pinniped and basking shark survey data, and to other environmental and ecological data streams. These data constitute the only effort-based marine mammal survey data for the west coast of Scotland, and are an important source of trend data for both discrete and collaborative projects. Data from 2013 have increased the body of information available in the following areas of study:

Minke whales and basking sharks

In 2013, the number of encounters of minke whales and basking sharks was very similar, although the number of individual basking sharks was threefold higher than that of minke whales (see Results). In the case of basking sharks, there is evidence of particular 'hot spots' of distribution over the summer months, for example around the islands of Coll and Tiree. HWDT has been investigating the trophic relationship between basking sharks and minke whales for many years. Stevick et al. (2007) found a rise in the number of basking shark sightings concurrent with a fall in those of minke whales on the west coast during the early 2000s. This may partly be due to a recovery of basking shark numbers after years of exploitation, but may also reflect a change in the availability of the small schooling fish on which minke whales feed, and which themselves feed on the copepods that constitute the prey of basking sharks. The relationships are complex, but these apparent changes may reflect an overall ecosystem shift for which continuing survey data can provide more information.

Harbour porpoises

The harbour porpoise was the most regularly sighted species during the 2013 season. This is unsurprising given that the west coast of Scotland has among the highest densities of harbour porpoise in European waters (Embling et al. 2010). Harbour porpoise, bottlenose dolphin, grey seal and common seal feature in Annex II of the European Commission (EC) Habitats Directive (92/42/EEC). Species listed in this annex require the designation of Special Areas of Conservation (SAC). Whilst SACs exist in our study area for grey and common seal there are no SACs for the two cetacean species. Embling et al. (2010) and Booth (2010) both addressed the previously identified problem of deficient data for harbour porpoise to enable SAC designation, using HWDT data to suggest suitable areas for potential SAC designation. Using the findings of these studies, a proposal for a western Scotland and Inner Hebridean harbour porpoise SAC has been submitted (Evans and Prior 2012). Areas representing crucial factors for the life cycle of this species can be identified by the continuous or regular presence of the species (although subject to seasonal variations); good population density (in relation to neighbouring areas); and high ratios of young to adults during certain periods of the year.

During the 2013 survey season high sighting rates of harbour porpoise were recorded throughout the study area. Calves were sighted regularly during June, July and August. These data will thus contribute to the proposal and the future management of this species in Hebridean waters.

Orcas

Sightings of the West Coast Community of orcas are rare, with Silurian encountering some members of the group only once a season. This was true of the 2013 season with just three members of the community encountered. Whilst our current research suggests that this community will go extinct in our lifetime (Beck et al. 2013), HWDT is involved in a proposal to upgrade the West Coast Community to Appendix I of the Convention on the Conservation of Migratory Species of Wild Animals (CMS) agreement. This upgrade would not only afford better protection for these vulnerable animals, but would lead to greater efforts to elucidate why the community is so small and whether it is as isolated as the current research suggests.

White-beaked dolphins and Risso's dolphins

The data collected on white-beaked and Risso's dolphin during the 2013 season will contribute directly to the Scottish Government's plans to designate Marine Protected Areas (MPAs) in 2014. MPAs will be designated using Priority Marine Features (PMFs) such as the basking shark, minke whale, white-beaked dolphin and Risso's dolphin.

In 2012 HWDT was commissioned by Scottish Natural Heritage and Marine Scotland to investigate the acoustic characteristics of white-beaked dolphin and Risso's dolphin clicks. We found that white-beaked dolphin and Risso's dolphin clicks have distinct characteristics in their structure that could be used to identify them to species during acoustic surveys where there is an absence of visual confirmation (Calderan et al. 2013). These click characteristics are distinct enough for there to be the potential of developing an automated click classifier, which has already been done for harbour porpoise clicks. Acoustic data from Silurian of both Risso's and white-beaked dolphins were used in this study in conjunction with data collected by other organisations in other areas of UK waters to assess the most comprehensive dataset of recordings possible. Acoustic data collected in the six white-beaked dolphin encounters on board Silurian during 2013 will contribute to this innovative project.

Aquaculture and Acoustic Deterrent Devices

Collaborative research between HWDT and SMRU for the Scottish Aquaculture Research Forum (SARF) on predator control at fish farm sites has been ongoing, and as an extension of this work we made recordings of active Terecos ADDs during the 2013 research season. Using the HWDT data set, Booth (2010) found that harbour porpoises avoided areas where some types of ADDs were active and that some ADDs produce sounds which might result in temporary hearing loss in this species. Recent research suggests that the Terecos ADD may not impact harbour porpoise distribution as severely as other types of ADDs. Therefore, these devices might be useful as a lower-impact type of ADD in areas where acoustically sensitive coastal cetaceans, such as the harbour porpoise, may be affected (Northridge et al. 2010). This is a significant finding for the harbour porpoise and we will continue to collect data on these and other ADD types to establish and manage potential mitigation strategies.

Offshore renewables

Several sites within our research area are potential locations for offshore renewable developments. Whilst offshore renewables have value in the generation of non-carbon-based energy, their construction and operation also have implications for the area's cetacean populations. Simply by carrying out our regular programme of surveys across the west coast, we are collecting a valuable dataset to increase the baseline data available for these areas. These data can then be used by renewable energy companies for an Environmental Impact Assessment (EIA) and by the Scottish Government for future Marine Spatial Planning.

2.5. Conclusions

The 2013 season was successful in collecting data that will contribute to the long-term monitoring programme on the distribution and densities of marine mammals and basking sharks in west Scottish waters. There were a wide range of species sighted, reflecting the rich biodiversity of the oceanographic environment of the west coast of Scotland. Data collected in 2013 will contribute towards larger projects to assess cetacean distribution, relative abundance and habitat use, such as the Scottish Government's initiative to identify areas for possible Marine Protected Areas featuring cetaceans and basking sharks. Since 2003, HWDT has been working to address these needs. Its research work has greatly increased our knowledge of the habitats and abundance of west coast species. HWDT will continue its involvement in the various management projects as the only organisation collecting long-term, effort-based survey data in this area.

2.6. Literature cited

Beck, S., Foote, A.D, Kötter, S., Harries, O.R., Mandleberg, L., Stevick, P.T., Whooley, P. and Durban, J.W. (2013) Using opportunistic photo-identifications to detect a population decline of orcas (*Orcinus orca*) in British and Irish waters. *Journal of the Marine Biological Association of the United Kingdom*, available on CJO2013. doi:10.1017/S0025315413001124.

Booth, C.G. (2010) Variation in habitat preference and distribution of harbour porpoises west of Scotland. PhD Thesis, University of St Andrews.

Calderan, S., Wittich, A., Harries, O., Gordon, J. and Leaper, R. (2013) White-beaked dolphin and Risso's dolphin click characteristics and the potential for classification and species identification. Scottish Natural Heritage Commissioned Report, Scottish Natural Heritage.

Embling, C.B., Gillibrand, P.A., Gordon, J., Shrimpton, J., Stevick, P.T. and Hammond, P.S. (2010) Using habitat models to identify suitable sites for marine protected areas for harbour porpoises (*Phocoena phocoena*). *Biological Conservation* 143 (2), 267–279.

Evans, P.G.H. and Prior, J.S. (2012) Protecting the harbour porpoise in UK seas; identifying a network of draft SACs for the harbour porpoise in the UK. A report to the World Wildlife Fund UK. August, 2012. 105pp.

Harries, O.R., Weir, C.R., Calderan, S.V., van Geel, N.C.F., Shrimpton, J. and Gordon, J.C.D. (2012) The role of spatial modelling in the potential management of a priority Scottish cetacean species, the white-beaked dolphin (*Lagenorhynchus albirostris*). Presentation made at European Cetacean Society Conference, March 2012, Galway, Republic of Ireland.

Matthewson, F. (2012) Non-lethal entanglement of minke whales (*Balaenoptera acutorostrata*) in fishing gear in the Hebrides. BSc Thesis, University of St Andrews.

Northridge, S.P., Cargill, A., Coram, A., Mandleberg, L., Calderan, S., Reid, B. and Held Wirz, M. (2010) Entanglement of minke whales in Scottish waters: an investigation into occurrence, causes and mitigation. Final Report to Scottish Government CR/2007/49. Sea Mammal Research Unit, St Andrews. 57pp.

Northridge, S.P., Gordon, J.G., Booth, C., Calderan, S., Cargill, A., Coram, A., Gillespie, D., Lonergan, M. and Webb, A. (2010) Assessment of the impacts and utility of acoustic deterrent devices. Final Report to the Scottish Aquaculture Research Forum, Project Code SARF044. 34pp.

Parsons, E.C.M., Shrimpton, J. and Evans, P.G.H. (2000) Cetacean conservation in northwest Scotland: perceived threats to cetaceans. Presentation made at European Cetacean Society Conference, March 2000, Cork, Republic of Ireland.

Stevick, P.T., Calderan, S.V., Speedie, C., Shrimpton, J. and Embling, C.B. (2007) A trophic shift off west Scotland: minke whales and basking sharks. Presentation made at European Cetacean Society Conference, March 2007, San Sebastian, Spain.

Warburton, C.A., Parsons, E.C.M., Woods-Ballard, A., Hughes, A. and Johnston, P. (2001) Whale-watching in West Scotland. Report for the Department for Environment, Food & Rural Affairs. Department for Environment, Food and Rural Affairs, London.

Appendix I: Expedition diaries & reports.



A multimedia expedition diary is available on <http://biosphereexpeditions.wordpress.com/category/expedition-blogs/scotland-2013/>



All expedition reports, including this and previous expedition reports, are available on www.biosphere-expeditions.org/reports.