Research and Development Series

The Ulster Wildlife Trust Basking Shark Project

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The Ulster Wildlife Trust Basking Shark Project

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The Ulster Wildlife Trust Basking Shark Project 2004

Report and Summary 2002-2004

Ulster Wildlife Trust

ENVIRONMENT AND HERITAGE SERVICE

This research project was funded by EHS and carried out by The Ulster Wildlife Trust

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1. Introduction

1.1 Ulster Wildlife Trust

The Ulster Wildlife Trust was founded in 1978 by a number of people who identified the need for a voluntary organisation that would actively seek
'to conserve the natural habitats of Northern Ireland'.
Since then the Trust has grown to become the major locally based conservation organisation.

We are seeking an 'Ulster rich in wildlife' and it is our aim to help everyone to recognise that a healthy environment, rich in wildlife and managed on sustainable principles, is essential for continued human existence.

We do this by:
- Promoting a wider understanding of wildlife issues through communication, education and training
- Protecting species and habitats, both common and rare
- Managing nature reserves for wildlife and for people

1.2 The Wildlife Trusts partnership

The Ulster Wildlife Trust is one of a 47 strong network of Wildlife Trusts across the UK. The combined influence of 'The Wildlife Trusts' partnership is a 560,000 strong membership and a network of 2500 nature reserves throughout the United Kingdom. The marine environment is a major focus of the work of The Wildlife Trusts, UK-wide they take on the role of watchdog, lobbyist and partnership builder, working with Government, regulators, industry, and awareness raising with the public.

1.3 Background to the Basking Shark Surveys

The Wildlife Trusts Basking Shark Project has operated successfully in the Western English Channel since 1999, establishing much valuable information on the temporal and spatial distribution of the basking shark (*Cetorhinus maximus*), the project has concentrated on identifying sites with the most regular levels of surface sightings of the species, sites which are now the subject of further study.

In 2002, it was decided to focus the range of the survey on the coastline of Northern Ireland, and the West of Scotland, using the same effort related line transect survey techniques which are the backbone of this type of work. The Ulster Wildlife Trust, funded by EHS, undertook the basking shark survey in Northern Ireland.

1.4 Project Aims

The Northern Ireland Basking Shark Survey Project aim was to ascertain the status and distribution of the basking shark around Northern Ireland and would input into a wider examination of the status and distribution of the species around the western seaboard of the UK. Effort-related line transect methodology would be employed, and areas where existing records show a high level of surface sightings would be examined to assess their importance to the species. Assessment of risk of anthropogenic threats to the species, such as ship strike, pot rope entanglement and set net by-catch would be assessed, especially in areas with high levels of sightings.

The Ulster Wildlife Trust contracted MER consultants to carry out the research work. The report within presents their findings.

2. Methodology

2.1 Vessel and Equipment

The survey vessel used was the 11.7m sailing boat “Forever Changes”, which is fully equipped for this type of work, and is capable of accommodating a large volunteer crew in safety and comfort.

“Forever Changes” in the Fal, Cornwall, prior to setting off on survey. Built in 1983, she is a Small Commercial Vessel with full MCA Category 2 status.

Equipped with full professional digital camera and video equipment, and the most up to date on-board computer and navigational equipment, she has completed 10732 Km of effort-corrected line transect surveys over 1115 hours in UK waters during the last three years, sighting 265 sharks and training 300 volunteers in the relevant survey techniques.

The European Basking Shark Photo-identification Project, now based at The Shark Trust (www.baskingsharks.co.uk) has been developed to enable a database of images of basking sharks for comparison and identification of individuals. Wherever possible, film and still images of sharks are examined for potential matches with individuals already photographed and contained within the database. These images can also be shared with partner organisations for public and promotional work.

The survey vessel has a built in temperature sensor in the hull, enabling sea surface temperature (SST) readings to be accessed via the mechanism of the sonar unit at all times.

2.2 Crew

The full time crew consisted of Colin Speedie, Commercial Yachtmaster, David Marshall, Commercial Yachtmaster and Oceanographer and Louise Johnson, Environmental Consultant.

The volunteer crew was selected from Northern Ireland in order to establish a trained pool of individuals to assist in future surveys, and to raise awareness

of the presence and value of the basking shark and other marine species in Northern Ireland Waters.

The second volunteer crew of 2004 prepare to set out from Ballycastle to survey the North Antrim coast. All of the survey crews have received training in marine survey techniques, and form a pool of volunteer surveyors capable of operating aboard platforms of opportunity in NI waters.

2.3 Survey method and technique

The survey employed a simple scientifically sound methodology, where account was taken of perception bias factors (e.g. sea state, height of eye, swell height). A wide variety of environmental data was recorded on a half hourly basis including Sea Surface Temperature (SST), and the vessel's position was fixed at the same time using the vessels GPS navigation system. Position information was gathered via an MLR FX 412 12 channel GPS receiver, interfaced with a Dell Inspiron 8600 notebook PC running Sea Pro Plus navigational software. Depth and temperature data were gathered via an Interphase TwinScope forward scanning sonar, with built-in temperature sensor.

During the surveys SST is recorded (along with all other environmental data) at 30-minute intervals, and provides a simple means of observing large (or small) temperature discontinuities associated with fronts. At the same time, a careful visual lookout is kept looking for the tell tale signs of fronts such as seabird activity, lines of surface debris and long, calm slicks on the water. This also enables areas of mixing associated with strong tides, uneven bottom topography and downstream of headlands and islands to be watched for, with their associated lower SST relative to more stable areas of stratified water.

Surveys were also corrected for sea state, with a maximum Beaufort Scale value of sea state 4, as it is recognised that perception bias for sharks in excess of sea state 4 would be excessively diminished. No survey was therefore started with a sea state in excess of 4, and if sea state increased to exceed sea state 4 during a survey, the survey was abandoned. Sightings data recorded throughout the survey period could then be correlated with survey effort, and expressed in terms of per unit effort, such as sharks sighted/ hours of observation. In this way, a scientifically valid assessment of relative abundance for the region during the study period could be arrived at.

Two observers were employed at all times, each observing one side of the vessel, through a 90º sector relative to the ships bow. A third individual was tasked with data recording, using standardised survey forms (Appendix I). All

roles were rotated on a maximum two hourly basis, particularly important with observers, where the risk of observer variability due to eye fatigue or boredom can form the single greatest weakness with this type of survey. All volunteers received training in operating this type of survey efficiently, and the data recording techniques required. All roles were overseen and assessed by experienced crew members at all times, especially in relation to more complex tasks, areas recognised as being of high importance where volunteers are involved (Evans *et al*, 2002).

When sightings were made, a dedicated sightings form (Appendix II) was used to capture all relevant data, including size, sex (where possible) and individual markings, as well as selecting (and recording) from a suite of recognised behavioural activity such as courtship-like behaviour. Records of individual identification photographs were simultaneously logged to avoid confusion between individual animals. Video footage was gathered whenever conditions allowed, in order to allow further behavioural (and identification) analysis at a later date.

The standard methodology employed for these basking shark surveys is identical to that employed for cetacean surveys (amongst others), and corresponds to the highest category (7) identified in terms of effort intensity, ie "dedicated watching for cetaceans by experienced observers using line transect methodology" (Evans *et al,* 2003). As a result, the project has also gathered valuable additional information on the status, distribution and relative abundance of cetaceans encountered throughout the survey period, particularly the harbour porpoise.

2.4 Photo-identification

Photo-identification has the ability to compliment such high-tech approaches used by the CEBS (see page 18), in a low-cost benign way that can involve the public (Speedie, 2000). Photo-identification has already shown that it can be successfully employed to examine such awkward aspects of shark biology as growth rates (Sims *et al*, 2000b), which would otherwise be difficult to examine with such a sizeable animal, which cannot be kept in captivity.

This has direct implications for observers in Northern Ireland, especially those who have access to a boat, and who could therefore contribute images to the basking shark photo-id database.

Individual animals may be identified by significant marks, scars, injuries or anomalous pigmentation, usually on the first dorsal fin, but also of the caudal fin (Oke, 2000)

This individual displays markings consistent with net entanglement in the past, and is easily identifiable.

3. The Northern Ireland Survey 2004

3.1 Results

The survey vessel arrived in Ardglass on the 10th of July, where the first Northern Ireland crew of the season joined the vessel. The following day the survey commenced in light to moderate northwesterly winds. The shelter afforded by the coastline was ideal, allowing the **first survey transects (to Carlingford and back) to be completed successfully**.

With a predominantly northwesterly airstream forecast to cover Ireland for the first week of the Northern Ireland survey, it was decided to concentrate on the East coast for the duration of the first leg of the survey. The coastline beyond Fair Head is beset by very strong tides (particularly around Rathlin Island), and subject to a big Atlantic swell for much of the time, especially in winds with a northerly component. Also, there isn't a great deal of shelter to be found as many of the harbours are exposed with potentially dangerous entrances in such winds.

As it happened, the weather forecast was correct, and the survey of the East coast as far as the Isle of Muck was achieved in light to moderate conditions. The survey vessel was (for the most part) based in Ardglass but also visited Strangford and Bangor during the week.

The famous massif of the Giants Causeway, viewed from the West.

Strong tides and a prevalent swell from any winds with a westerly or northerly component make this a difficult area to survey except in light winds and calm conditions.

The **second crew** joined in Bangor, and the vessel set off to complete the **survey of the north coast**, arriving in Ballycastle the next evening. The weather forecast for the week was for light to moderate south or southeast winds, increasing fresh at times, ideal for the north coast, but leaving a moderate to rough sea along the east coast. **Conditions were varied throughout the week,** and although at times the winds were too strong to carry out the surveys, by seizing every opportunity when conditions allowed, the **full survey of the north coast was completed successfully**. Towards the end of the survey week, departure was made from Portrush in a strengthening south-easterly wind, and the moderate to rough sea along the east coast, the crossing of the North Channel was made.

It was the aim of the survey to cover all transects twice if at all possible. The vessel was due to return to Northern Ireland in early September to complete the contingency leg of survey – aimed at completing any transects not completed in the first two survey weeks due to adverse weather conditions or other unforeseen circumstances. **The survey had covered all transects along the north coast twice, and had covered all of the transects south from the Isle of Muck to Carlingford in a similar manner, leaving only the section from Fair Head to the Isle of Muck to be completed a second time**.

In the preceding days to the contingency leg of the NI survey, the weather deteriorated dramatically with a succession of strong gales sweeping in from the West –the tail end of an American hurricane. The survey crew spent two days in port hoping to wait out the storm. When it became clear that the weather conditions were not going to improve within the allotted timescale, unfortunately **the decision had to be made to abandon the third leg**. This was due to crew safety implications (especially an Atlantic crossing), and inability to complete transects in these conditions.

For the second year running no sharks were sighted, despite the generally favourable conditions. It was also a poor year in terms of cetacean sightings, with the exception of the harbour porpoise (*Phocoena phocoena*), and a sunfish (*Mola mola*). This mirrored the experience of the research team in the western English Channel earlier in the season, where there was a marked absence of all varieties of marine life. However, sharks were sighted at other locations close to the surveyed area during the summer, including several reports from Inishtrahull Sound off the Donegal coastline, and **anecdotal evidence suggests that this was the best year for some time for sharks in Irish waters.**

A single ocean sunfish (*Mola mola*) was sighted off Lacada Point during the survey. In common with most sighted in UK waters, this was a small individual of less than 1 metre diameter.

The world's largest teleost fish, the sunfish has a circumglobal distribution, and can reach nearly 3 metres diameter and 2 tonnes in weight.

Due to the weather problems with the third survey, **no extra in terms of time and distance surveyed was possible**. However, although we failed to achieve more than 2003, we were still considerably up on 2002. **42 Transects were completed** (2 were abandoned due to bad weather), **covering a total of 587km over 53 hours of timed observation**. A spreadsheet of the transects completed in 2004 is attached as Appendix III.

As no sharks were sighted during this years' survey, no new images exist for this season. However, a shark sighted in the Firth of Clyde during the 2003 survey appeared to this observer (C.Speedie) to be NI BS # 5, sighted off Larne on 18/7/02.

NI BS # 5 sighted during the Northern Ireland Basking Shark Survey in 2002 was a large shark (9m) and had the characteristically floppy first dorsal fin of such animals. An obvious change in angle of the leading edge of the first dorsal fin in this animal offered evidence of an apparent injury at some stage in its life, which was confirmed when the still images and video were later examined, making it highly suitable for this benign research technique.

Approaching the Skerries off Portrush from the East.

This area proved to be highly productive for sightings of the harbour porpoise (*Phocoena phocoena*) especially in the warm waters of the shallow Bay off Portstewart and the Tuns Bank.

It was a great achievement to cover the north coast so effectively, due to the challenging nature of the conditions that can occur there. Much has been learned as a result.

3.2 The 2004 Crew:

Each volunteer crew was carefully selected by the Ulster Wildlife Trust to comprise a member of EHS staff, a UWT member of staff, a UWT member, a marine biologist/student and/or an environmental Non Government Organisation, all were local people. Marine enthusiasts and applicants with sailing experience were selected so that post survey they would continue basking shark and other marine recording and continue contribute to marine conservation in NI. The volunteer crews assisted with media work during the survey and in addition to this they will raise the profile of marine conservation and marine issues amongst their peers.

<u>Volunteer crew for the first survey:</u>

Trevor Harrison	Environment & Heritage Service, staff
Maeve Rafferty	Ulster Wildlife Trust, staff
Elaine Adair	Young Farmers Clubs of Ulster, marine enthusiast
Malachy Campbell	WWF-Northern Ireland, marine specialist
Ross Towers	Ulster Wildlife Trust, member & marine enthusiast

Volunteer crew for the second survey:

Helen Nutt	Environment & Heritage Service, staff
Julia Heaton	Marine student, Oxford University
Kate Bradbury	Marine Environmental educator
Mark Magreehan	Ulster Wildlife Trust, member & marine enthusiast
Victoria Meredith	Ulster Wildlife Trust, staff

Volunteer crew for third survey:

Gary Burrows	Environment & Heritage Service, staff
Tom Stewart-Moore	Ulster Wildlife Trust, member & marine biologist
Seamus Burns	Ulster Wildlife Trust, staff
Conor O'Luby	Marine enthusiast
Charmaine Blake	Marine Biologist, Queens University

4. Summary of results – 2004 Survey

- No Basking Sharks sighted
- Harbour Porpoises sighted (see section 5.6)
- 1 Sunfish sighted
- All transects covered twice with the exception of the section between Fair Head and Isle of Muck which was covered once
- Anecdotal reports of contemporary sightings of basking sharks in adjacent waters.
- 42 transects
- 587km of survey time
- 53 hours of survey time

5. Northern Ireland Survey 2002-2004

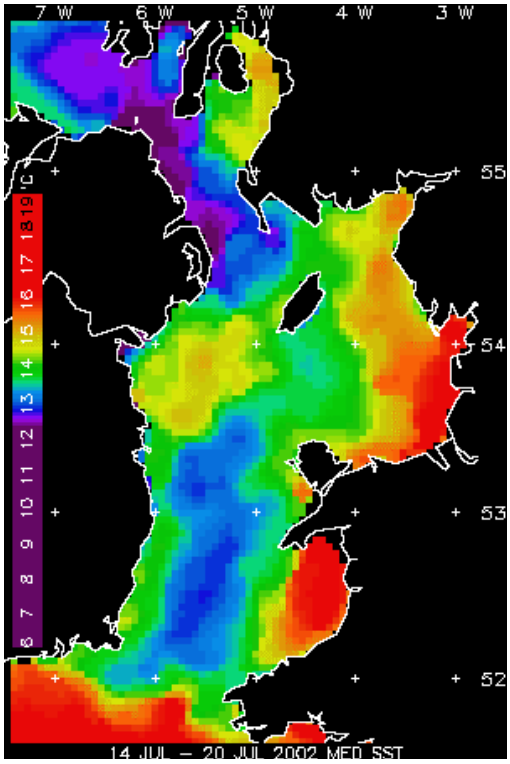
5.1 Summary

Prolonged windy weather affecting plankton activity might well explain the lack of Basking Shark sightings in 2003 and 2004 in Northern Irish waters, as strong winds affected much of the most productive areas throughout the survey period. In 2002 the survey vessel arrived in the area during a long spell of settled, high pressure weather, that would have allowed localised frontal systems to stabilise, accounting for the surface sightings in the first days of the survey.

Areas identified in this manner included the zones between Strangford Lough and the Copeland Islands (***Figure 1***), Black Head out to the Maidens plateau (both areas where sharks were recorded in 2002), Torr Head around Fair Head as far as Sheep Island and finally the area around the Skerries. These have all supported sightings in the past, and, given the right combination of physical factors, may be expected to do so again.

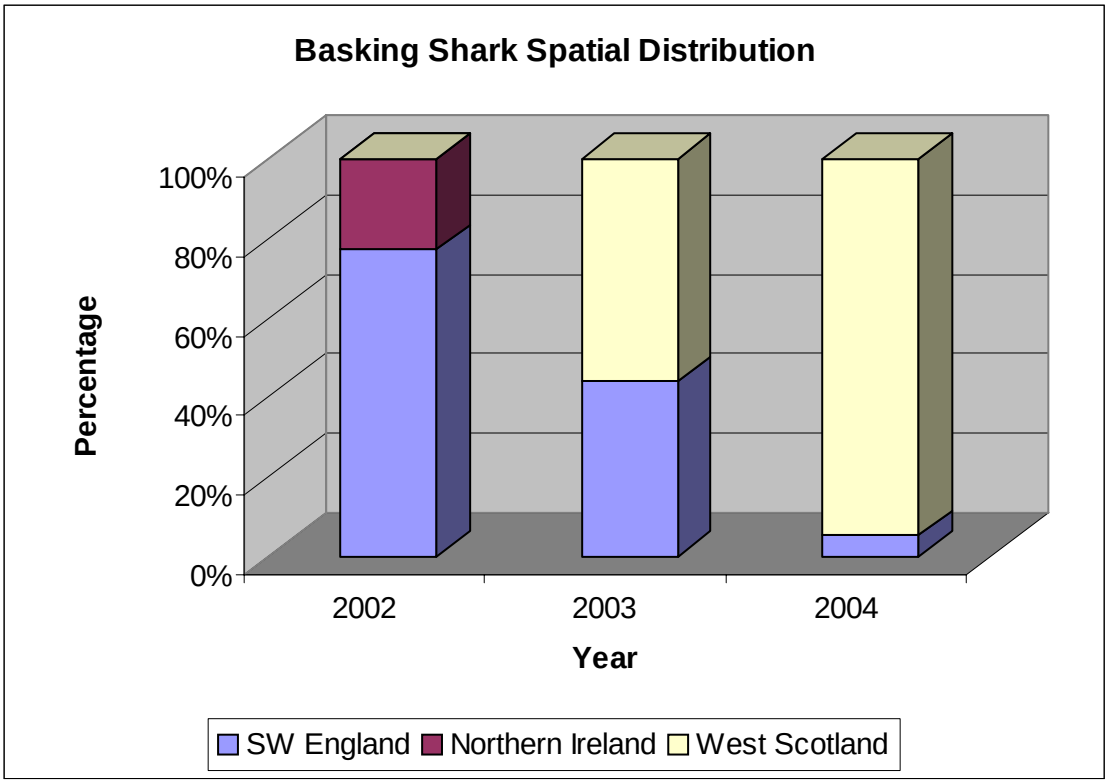
Figure 1. NOAA AVHRR Sea Surface Temperature composite map for the week of 14/7/02, during which all shark sightings in Northern Irish waters were made. It may be seen that a large mass of frontal water (between 14º C and 16º C) is situated just to the South of Strangford Lough with cooler, more mixed water to the North. 4 out of the 5 basking sharks sighted in Northern Ireland during the survey were sighted in this colder water mass. Significant evidence of the presence of fronts was visible in this area at the time of these sightings.

Image courtesy of the Remote Sensing Group, Plymouth Marine Laboratories.



During the UK-wide project, a dramatic short-term change in shark spatial distribution has been observed between the English Channel (after a period in that region of high abundance between 1997 & 2001), towards more northerly Latitudes (***Figure 2***). Basking sharks can, and will, migrate over long distances to forage for the most productive food sources.

Figure 2



5.2 Discussion and analysis

During late spring and summer periods, basking sharks are regularly sighted swimming at the surface within the coastal waters of the western British Isles and Ireland, displaying both feeding and courtship behaviour (Sims & Merrett, 1997, Sims *et al*, 2000a). The seas in this region are characterised by an extensive continental shelf reaching up to 200 Nautical Mile (Nm) offshore. This extensive shallow sea area, combined with the intense tidal forces that are known to occur within the area cause strong thermal fronts to form, acting as boundaries between the tidally mixed inshore water and stratified offshore water. These fronts and the distribution of plankton within these water masses is further disrupted by the complex topography typical of the British and Irish coastline and bathymetric features of the shelf sea floor (Pingree *et al* 1975, Simpson & Pingree 1978, LeFevre 1986).

Frontal areas are consistently regarded as regions of high productivity that act as strong aggregating features for planktonic organisms and for species throughout the trophic levels (Pingree *et al* 1975, Le Fevre 1986). Two particular types of fronts typically occur in the waters described here.

Oceanic fronts, such as the Ushant front that occurs in the approaches to the English Channel may have a Sea Surface Temperature (SST) contrast of 4-5 degrees Celsius as its defining boundary between the well mixed, strong tidal conditions near the French coast and the more stable, stratified water in the weaker tidal regime of the southern Celtic Sea (Simpson & Pingree, 1978).

Studies of chlorophyll-a distribution across the front show dense phytoplankton blooms persist throughout late spring and early summer on the stratified side of the frontal boundary (Simpson & Pingree, 1978). This distribution is seemingly explained by lower levels of light penetration on the mixed side of the boundary. However, in the mixed area, levels of inorganic nutrients are relatively high. As a result, the front between these water masses offers a stable region where the combination of high levels of nutrients and a non-limiting light regime create suitable conditions for rapid or sustained phytoplankton growth (Simpson & Pingree 1978).

Shelf sea and headland fronts occur generally in shallow coastal waters where a combination of strong tidal streams, bathymetry and coastal topography combine to cause powerful local mixing and therefore a reduction in stratification (Simpson, 1981). This can be exacerbated where the surrounding offshore water is well stratified, leading to sharply defined and thus highly productive frontal systems (Simpson & Pingree, 1978, Alldredge & Hamner, 1980). In a similar manner to oceanic fronts or shallow sea fronts productivity is greater in these regions as nutrient mixing and upwelling is enhanced. As with oceanic fronts, headland fronts aggregate surface debris, buoyant matter and oily, slick surfaces, visual clues to the higher levels of zooplankton below the surface.

It has been conclusively shown that a relationship exists between basking shark abundance and areas with high levels of primary (phytoplankton) and secondary (zooplankton) productivity, centred on oceanic fronts (Sims & Quayle, 1998). Areas where strong headland fronts persist have also been shown to yield the highest levels of sightings in the waters of South Devon and Cornwall (Speedie, 2001a). Recent research shows that the sharks may reside in areas of persistent frontal activity (Sims *et al*, 2003) throughout the year, and may utilise thermal cues as their primary means of orientating themselves to areas of high secondary productivity over long distances (Cotton *et al*, In Press). A recent discovery suggests that sharks possess a remarkable ability to detect the sometimes minute temperature discontinuities associated with frontal activity (<1000th degree) via an extra cellular gel contained within the electro sensory canals (Brown, 2003).

The discovery of an extra-cellular gel contained within pit organs such as the ampullae of Lorenzini (seen here on the rostrum of a large shark), may help to explain the mechanism by which they orientate themselves over huge distances to find dense patches of exploitable prey.

Basking sharks surface-feed in areas in which their preferred calanoid copepod prey, *Calanus helgolandicus* is 2.5 times as numerous (~1,500 organisms per m^3) and 50% longer (~2mm) than in areas in which sharks do

not feed (Sims & Merrett, 1997) and will selectively forage for specific aggregations of their preferred zooplankton species (Sims & Quayle 1998). It has been suggested that they can orientate themselves effectively towards such areas at close range using a combination of cues in addition to thermal variability. These may include electro-reception of muscle activity in zooplankton, as well as olfaction of dimethyl sulphide, which is produced by phytoplankton when grazed by zooplankton (Sims & Quayle, 1998). These abilities are critically important for a planktivorous creature that may have to forage over long distances to find exploitable levels of prey species, although it has now been shown that the energetic requirement of the basking shark is lower than had previously been suggested (Sims, 1999), and that as an obligate ram filter-feeder, the species has optimized its feeding and cruising speeds consistent with reducing power output and energy intake (Sims, 2000).

These thermal/tidal effects may also have an important role to play in bringing sharks together for the purpose of mating, as high levels of courtship have been observed within frontal areas (Sims *et al*, 2000), giving them a high priority in terms of conservation. The species is listed as "**Vulnerable"** on the IUCN Red List of Threatened Species, largely reflecting the perception that numbers in the northeast Atlantic have been significantly diminished by two centuries of over-exploitation. Additionally the species received an Appendix II listing under the Convention on the International Trade in Endangered Species of Flora and Fauna (CITES) in 2002, led by the UK Government, a significant step that reflected not just the endangered nature of this species, but its critical place in our national heritage. UK waters remain one of the finest areas in the world for surface sighting the basking shark, and it is, in fact, our biggest wild inhabitant.

Owing to the lack of concrete knowledge of its current population numbers, distribution and habitat requirements, any sites recognised as providing a favoured habitat where mating behaviour may take place should be considered in the future as worthy of some form of site protection. Another factor that could contribute to this further level of protection might be the presence of 'young of that year' sharks (2m +) at recognised sites of surface abundance, as has occurred at a significant number of the sites so far identified. Evidence of regional philopatry over the short term (<5d) to long term (694 – 1111d) has been demonstrated through re-identification of individuals using photo-identification techniques (How *et al*, in Prep.), that would support demands that the precautionary approach should be applied for such sites.

Other factors such as the tidal cycle may have an effect. It has been shown in other areas that extensive plankton blooms only occur during neap tides when water masses are relatively stable, but do require stronger spring tides to bring nutrients up to the surface, thus initiating plankton blooms (Pingree *et al*, 1975). There is, of course, a time lag involved in this equation associated with the development of primary and secondary production. Periods of stronger winds may also disturb the equation, as even large channel fronts are still susceptible to meteorological factors, and wind stress plays an important role

in the mixing of surface layers through disturbance of the surface layer (LeFevre, 1986). Shorter spells of moderately increased wind can cause some surface mixing which can act constructively, as primary production becomes enhanced by a fresh nutrient supply. In the case of longer spells of much stronger winds, the resulting mixing will eventually limit activity by removing organisms from the photic zone (LeFevre, 1986).

The use of Advanced Very High Resolution Radiometer (AVHRR) satellite images offers a means of assessing SST, the location of different water masses and therefore the location of front boundaries. False colour images of AVHRR recorded SST processed by the Remote Sensing Group at Plymouth Marine Laboratory (PML RSG) allow broad scale identification of mixed, stratified and frontal water within a study region, and have a spatial resolution of 1 km and a sensitivity of +/- 0.1K (Ashley, 2003). Composite front maps (Miller, 2001) processed by PML RSG offer a method to observe the temporal and spatial development, movement and breakdown of fronts with greater accuracy. Using this more accurate mechanism, when fine tuned, may allow a means of predicting the likely presence of surface feeding basking sharks relative to frontal systems via remote sensing means (Ashley & Speedie, In Prep).

Basking shark sightings appear to be cyclical, with their long-term spatial and temporal distribution driven by changes in the current gyres in the North Atlantic driven by the North Atlantic Oscillation (NAO). These NAO driven changes may lead to reductions in the levels of available zooplankton (Fromentin & Planque, 1996). For example, it has long been believed that excessive hunting captures in the Achill Island fishery caused a long-term decline in numbers of sharks in the area (Parker & Stott, 1965). However, it may also be the case that the long-term decline may have been partly caused by a parallel decline in zooplankton in the local ecosystem (Sims & Reid, 2002) during the lifespan of the fishery. Recent tagging studies conducted with Pop-up Archival Tags (PAT) in the English Channel (Sims *et al*, 2003b) have shown that one animal tagged exhibited potential philopatry, having covered a distance of over 500kms before returning to the location in which it was originally tagged. Another shark moved from the English Channel along the Continental Shelf Edge to the west of Ireland before moving up to the west of the Hebrides, so such journeys are perfectly within the normal parameters of a foraging basking shark.

It should also be remembered that sharks may be present in local waters, but simply not appearing at the surface. Historic records from just prior to World War II show that many sharks were caught in nets, or indeed passed straight through them, causing much damage. This in turn led to Fisheries Board Cruisers ramming sharks in the Firth of Clyde to kill them (over 50 in 1938). Questions were even asked in the House of Commons, when the Member for Greenock demanded action on *"the menace of basking sharks much more dangerous all round the coasts, of western Scotland and Northern Ireland."* (Fairfax, 1998).

5.3 Northern Ireland relative abundance of basking sharks

The three years of study now completed have allowed an assessment to be made of the relative abundance of the basking shark in Northern Ireland waters. Throughout the survey, the same basic methodology has been followed, during the same period, following the same transect route, with only the vagaries of the weather interfering with the basic survey platform.

Year	No of transects observed	No of sharks sighted	Km travelled	Hours
2002	13	5	255	28
2003	60	0	779	81
2004	42	0	587	53
Total	**115**	**5**	**1391**	**162**

From the table above it can be seen that in 2003 due to favourable survey conditions on all three survey legs, additional transects were completed. However, in 2004, due to adverse conditions only the required survey transects were completed twice with the exception of one transect which was surveyed once.

The accepted means of expressing the relative abundance for the species in a given area is via a simple value per unit effort, in this case individual sharks sighted per hour observed. Using this formula, the basic value for Northern Irish waters over the three-year period of **0.03 h-1**. This is a low figure compared with our average figure of 0.25 h-1 for the South West UK prior to the commencement of the survey, however it is worth noting that in 2002 the NI value of 0.18 h –1 compared favourably with the overall survey value that year of 0.07 h – 1. It will be valuable to observe over time the NI value compared relative to other areas and the overall value arrived at via the "Conserving Endangered Basking Sharks Project".

5.4 The Conserving Endangered Basking Sharks Project (CEBS)

The line transect data gathered during the Ulster Wildlife Trust Basking Shark Survey is clearly highly valuable, being the first effort corrected data for the waters around Northern Ireland. However, by sharing this data with other researchers, we are able to multiply its value several times over, and between us come up with the answers to key questions such as population abundance in UK waters, distribution patterns and sites of critical importance.

This is the case with the Wildlife Trusts' Project, where all data (for all regions) is pooled with other Organisations within the CEBS project (www.mba.ac.uk), led by Dr David Sims, NERC Research Fellow at the Marine Biological Association, Plymouth. Each of the contributing Organisations provides data or expertise from their particular field. In the case of the MBA, Dr Sims' team provide effort corrected line transect data, satellite tracking data and surface behavioural studies. The Marine Conservation Society provide data from their long running public sightings scheme, whilst the Hebridean Whale and

Dolphin Trust and the International Fund for Animal Welfare provide more localised line transect data and photo-identification images. The Shark Trust provide photo-identification expertise, including data entry and management of the European Basking Shark Photo-identification project (www.baskingsharks.co.uk).

The combination of these various strands of information offers a vital opportunity to work towards a number of goals in terms of establishing the distribution and abundance of the species. The inclusion of availability bias factors such as surface swimming duration and dive activity (Sims *et al*, 2003a) is of critical importance, as is the recent discovery that the basking shark employs habitat specific diel vertical migration (DVM) patterns (Sims *et al.*, in press). In deep, well stratified waters sharks exhibit normal DVM dusk ascent – dawn descent) by tracking migrating sound scattering layers characterised by their favoured plankton prey *Calanus* and euphausiids. Sharks occupying shallow, inner-shelf areas near thermal fronts conduct reverse DVM (dusk descent-dawn ascent) possibly due to zooplankton predator-prey interactions that result in reverse DVM of *Calanus.* These opposite DVM patterns result in the probability of daytime-surface sighting differing between these habitats by as much as two orders of magnitude. Ship-borne surveys undertaken at the same time as satellite trackings reflected these behavioural differences (Sims *et al.*, in press).

This new knowledge has major implications for the development of a statistical model to be created combining data from effort-corrected line transect work, satellite tracking and behavioural data aimed at enabling an overall population estimate to be postulated within the CEBS project. This latest study shows that without bias reduction for habitat-specific DVM patterns, current surveys could under–or over- estimate shark abundance by at least ten-fold (Sims *et al.*, in press). It may also mean that the use of mark-recapture data from photo-identification may be of great importance in developing an alternative model with the same potential goal.

The CEBS project is on course to publish its findings in 2005, and this offers a substantial step towards answering many of the questions that remain outstanding for the species. UWT expect to receive this report once published and will make this available to EHS.

5.5 Perceived threats to the basking shark in NI waters

Despite protection within the 12 mile limit of England and Wales under the Wildlife and Countryside Act (1981), and more recently the Countryside and Rights of Way Act (2000) the basking shark still has no formal protection from hunting, disturbance or harassment within the waters of Northern Ireland. Hopefully this is simply an anomalous situation that will be rectified during the current review of the Wildlife Order (NI) 1985, to bring the same level of protection to the species as exists elsewhere within the UK. As the basking shark is a priority species within the UK Biodiversity Action Plan, this would be logical and timely development at least in terms of direct threats.

Threats to the species of an anthropogenic nature include bycatch, and basking sharks have been known to be caught in a wide diversity of fishing gear, including beam trawls, bottom and surface set gill nets, mid water trawls and fixed fishing gear ropes, but the greatest danger appears to be from both surface set and bottom set gill nets in inshore waters. Whilst there is a significant difficulty in evaluating levels of bycatch of the species due to the reluctance of fishermen to report bycatch, it would be valuable to have a greater understanding of the prevalence of this type of fishing gear in the waters of Northern Ireland, and to examine bycaught sharks whenever possible to determine whether any one particular gear type appears to be a problem.

Basking sharks are vulnerable to certain types of fishing gear. Once entangled the pectoral fins become inoperative, and the shark, being negatively buoyant, sinks to the bottom, where it may spend several hours trying to “swim” – hence the flayed tail on this young male.

Ship strike (i.e. surface collision between vessels and sharks) is being examined in the waters of the south Cornwall, as an increasing number of small craft add to the existing small and large vessel commercial traffic. Anecdotal reports from anglers and yachtsmen indicate that collisions are an increasing problem, and the Seaquest project has photographed a number of sharks over the years that display injuries consistent with collision with surface vessels.

Habitat specific reverse DVM patterns in shelf sea frontal areas such as between Strangford Lough and Belfast Lough could result sharks spending a greater time by day at the surface in an area with high levels of surface traffic, and thus at risk from collision with small craft. It may be that current volumes of surface vessel traffic are far lower in the waters of Northern Ireland than on the south-west coast of England, however, with the recent dramatic growth of the Irish economy this is likely to increase in line with rest of the UK. Recent marina developments at Ardglass, Portaferry, Glenarm and Ballycastle bear this out, as residents and visitors explore the magnificent coastline of Down and Antrim.

There may also be elements of marine tourism activity that may impact upon the animals, as visitors and residents may wish to view them (Speedie, 2001). All of the sharks sighted during the survey were in coastal areas which could be viewed as “pathways” running parallel to the coast between busy pleasure vessel areas such as the entrance to Strangford Lough (NI BS # 1) and Belfast Lough.

Areas of strong frontal activity around headlands are often subject to dense pleasure boat traffic, forming as they do natural "highways" between one port and another. As a result, collisions can and do occur, especially because the sharks are not always at the surface, and may be feeding just sub surface, or hardly visible in rough seas or in poor visibility or at night. This might prove a problem between Strangford and the Copeland Isles.

A recent study in the south-west of England (Kelly *et al*, 2004) concluded that levels of disturbance and harassment to marine mammals and sharks in coastal waters of the South West peninsula do not appear to be changing or increasing to any significant degree. However, this was tempered by the likelihood that any such incidents may be unreported owing to a lack of clarity at all levels of the current legislation appertaining to such species, and a lack of co-ordination and consensus amongst agencies and practitioners working within the field. Given the current lack of protection for the basking shark in Northern Irish waters, any move to change the animals legal status should be accompanied with a widely publicised chain of command for reporting any such incidents, combined with viable means of enforcing the law (Speedie, 2001b).

The public have never been better informed about marine wildlife, including the basking shark. As a result, there is an ever-greater demand for opportunities to encounter these animals, but that may bring its own set of responsibilities. But where does harmless enjoyment end and harassment begin?

The final sighting in 2002 of NI BS # 5 was almost directly along the ferry route from Scotland to Larne, and, indeed, several ferries including the HSS were observed travelling along that route during the time spent observing that animal. It might be imagined that occasional surface collisions might be unavoidable in such areas, and it could be the case that not only the shark might be vulnerable in such circumstances, as NI BS # 5 was estimated at 9m TL, and thus would have weighed in excess of five Tonnes.

It would be impossible for this report to make any substantive comment on the potential for disturbance or harassment of sharks in Northern Irish waters due to the lack of quantitative data. However, during the course of the survey, two vessels were made known to the Captain, both expressing an interest in participating in ecotourist type activities in Northern Irish waters, one on the north coast, and one on the east coast. This is in line with similar developments in other parts of the UK, particularly with the widespread adoption of Rigid Inflatable Boats (RIB's). To counteract any potential problems that this type of activity may create, the WiSe Scheme was created (www.wisescheme.org), the first UK based Training and Accreditation scheme directed at marine ecotourism. It is hoped that any potential operators in NI waters would see the sense of availing themselves of the hard-won knowledge that WiSe can offer, so that any disturbance of wildlife may be minimised. At the time of writing this report, the first application for WiSe training has been made by a Sea Safari operator based in Ballycastle, so the latent demand for training exists. Whilst ecotourism may be in its infancy in Northern Ireland, in the longer term it may be expected to grow in line with other areas.

Basking sharks may generally be viewed as slow swimming planktivores that pose little threat to man. Yet they are unpredictable, and can leap clear of the water, or suddenly lash out with their tail, threatening swimmers or small craft.

This young animal has received a severe battering along the upper surface of its back, consistent with a propeller injury. Every year a number of such individuals are recorded, many of which are in the later stages of the healing process.

There is also the question of unintentional harassment and disturbance. It should be noted that in most other areas of the UK there are increasing reports of this type of (potentially illegal) disturbance, and it should be envisaged that this might become a more widespread problem with more and more people taking to the water. Most disturbance or harassment is not deliberate, which does not mean that it may be viewed as harmless – in the worst cases it most certainly may be.

Time and energy spent in public awareness raising, to highlight the presence of the basking sharks in Northern Irish waters – as carried out by UWT throughout the survey periods 2002/2003/2004 – has dramatically raised the awareness of basking sharks and marine conservation in general amongst the NI people. This has also had a valuable educational role, going some way to protect both the shark and the general public from disturbance or even injury.

The final threat to the basking shark in all UK waters may be the most difficult to quantify, and also the most difficult to counteract – climate change. Given the breadth and depth of new knowledge concerning the sharks' utilisation of thermal cues as a means of orienting itself to high levels of available prey (e.g. Sims et al, 2003b, Cotton et al, In Press), and the need for behavioural modification in fish species in response to climate change (Wood and McDonald, 1997), the basking shark might be a loser in the current period of rising temperatures.

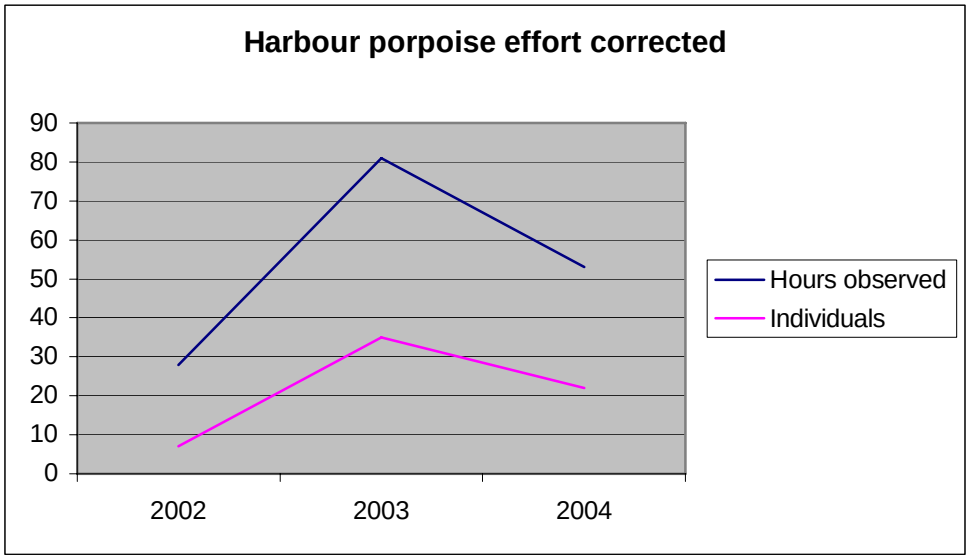
In 2004, seabirds in the Northern and Western Isles suffered yet another catastrophic breeding season, the latest in a series of such disasters.

The movement of zooplankton further North has been blamed, as the primary cause of the problem, due to climate change. This might affect the basking shark in years to come?

The Wildlife Trusts' UK-wide Project aimed to fulfil many of the actions outlined in the UK National Bio-Diversity Action Plan (BAP) for the basking shark, namely 5.4.1, 5.5.2 and 5.5.3, and link directly to 5.7.1. (Appendix IV) Delivery of these aspects of the BAP will be all important, as they concentrate on the interface between man and the basking shark, such as identifying areas of critical importance for the species, and evaluating and enhancing the existing Code of Conduct.

5.6 Other species

It is a matter of course throughout the surveys to record incidental sightings of other marine megafauna such as cetaceans or turtles. Two cetacean species were recorded during the surveys, the harbour porpoise (*Phocoena phocoena*) and the minke whale (*Balaenoptera acutorostrata*). Harbour porpoises were observed on 51 occasions, with a total of 88 individuals, although not all of these were sighted when on transect. 43 encounters of 64 animals were made when on transect (162 hours total), giving a value per unit effort (porpoises per hour observed) of 0.39 h-1.



The highest densities of porpoise sightings were made in the area between Portrush and the Tuns Buoy, a shallow plateau of warm water during the survey of the north coast. The area between Strangford Lough and the Copeland Isles also yielded sightings on a consistent basis. However, the species was encountered throughout the study area, including a number of sightings off transect inside Strangford Lough and Carlingford Lough. Porpoises were sighted (on transect) close to Belfast.

The harbour porpoise is listed under Section II of the Habitats Directive, so is recognised as a species of high importance. Further surveys to discover the population status and distribution for this species would seem to be a priority given the observations made during the survey. Areas such as the entrance (or within) Strangford Lough should prove suitable for a combination of shore based observation and acoustic survey using a suitable device for single or multiple deployment, such as the T-POD, an automated cetacean click detector capable of 24hr operation over extended periods. Similarly the T-POD would be suitable for deployment in the area between Portrush and the Tuns Bank, coupled with boat based surveys to give a reliable estimate of harbour porpoise abundance, distribution and foraging preferences.

Harbour porpoises were sighted throughout the survey area, even within Carlingford Lough and Strangford Lough, and as far up Belfast Lough as Cultra.

A careful look out was kept at all times for other cetacean species, particularly around headlands, as many of these areas regularly report sightings of

Risso's dolphins (*Grampus griseus*), for example, but to no effect. This was somewhat surprising, as many of the physical features such as fronts that attract basking sharks to certain localities due to their high levels of primary and secondary productivity also attract other fish stocks and, therefore, major predators.

The single minke whale was sighted feeding along a weak front running along the 100m contour, south east of the east Maiden light in 2003. Many birds were in the area at the time, including gannets, gulls and Manx Shearwaters

5.7 Summary of conclusions of 2002 – 2004 project

Surface Temperature and Frontal activity

There were no significant differences in surface temperature between 2002-2004, however the sightings in 2002 ranged at temps between 12.8 and 13.7 (generally at the lower end), while the same transects from 2004 year, were roughly the same, although a little higher. This is consistent with sightings, which tend to be on the lower temperature side of the fronts.

In 2002 the survey period took place during a long spell of settled high pressure weather, thus allowing frontal systems to stabilise, accounting for the surface sightings during the 2002 survey. Whereas in 2003 & 2004 survey periods prolonged spells of windy weather affecting plankton activity and inhibiting frontal systems from stabilising might well explain the lack of sightings.

Potential frontal system and therefore basking shark feeding (sighting) areas that the survey has identified is the zone between Strangford Lough and the Copeland Islands, Black Head out to the Maidens plateau, Torr Head around Fair Head as far as Sheep Island and finally the area around the Skerries. These areas have all supported sightings in the past and given the right physical factors maybe expected to do so again.

Timing of Basking Shark Sightings

Through the UK wide survey it has been observed that Basking Shark sightings peak early June in W Cornwall, then peak in August in the Hebrides. Therefore, July would be consistent with the trend of more northerly arrival that has been observed.

However the Marine Conservation Society (MCS) Basking Shark Watch 1987-2001 Report, shows a peak in June for NI. Further, local shell fishermen have suggested that they regularly see basking sharks in end of May and June.

The UK-wide basking shark survey has recorded a dramatic short-term change in shark spatial distribution between the English Channel, which was a region of high abundance between 1997 & 2001, towards the more northerly latitudes, with the west coast of Scotland now being a region of high abundance.

The UK-wide survey has show that basking shark abundance is a movable feast (see Figure 2), and that whilst we are aware that sharks have been abundant in NI waters during the 30's, this may (at some unpredictable date) occur again, especially when climate change is factored in, which may (or may not) favour frontal systems around Northern Ireland.

Anecdotal Evidence

Anecdotal evidence suggests that this was the best year for some time for sharks in Irish costal waters, with reports from the Irish Whale and Dolphin Group (IWDG) that a large (100+) group had been spotted off the coast of west Cork earlier in the season. In addition the survey crew were told of an angling vessel based at Moville that reported a number of sightings to the IWDG from Inishtrahull Sound, but have as yet been unable to confirm this.

Disturbance – fishing / Ferries / Eco tourists

Areas of strong frontal activity around headlands are often subject to dense pleasure boat traffic, forming as they do natural “highways” between one port and another. As a result, collisions can and do occur, especially because the sharks are not always at the surface, and may be feeding just sub surface, or hardly visible in rough seas or in poor visibility or at night. This might prove a problem between Strangford and the Copeland Isles and Belfast Lough.

There is always a risk of basking shark entanglement in fishing gear, however, the level of fixed fishing gear in NI is relatively low, and highly localised. Given the low level of surface sightings during the survey, this particular threat is a difficult one to assess, or indeed to prove that a threat exists. In light of this, it would be useful to try to obtain anecdotal evidence of bycatch in NI waters.

6. Summary of Recommendations

A number of specific recommendations for consideration have been drawn up as a result of the survey, with a view to consolidating and developing the information gleaned so far:

1. Support should be given to expanding the public sightings schemes run by the Ulster Wildlife Trust, Irish Whale and Dolphin Group and the Marine Conservation Society. This would give a "barometric" reading of shark sightings over time, and would permit the establishment of simple exploratory boat surveys using local platforms of opportunity such as ecotourist vessels (Speedie, 2001) in the future.

2. Continue programme of training of dedicated volunteer observers should be encouraged, in order that all land based observations would be effort-corrected. This could be achieved in conjunction with others (such as the IWDG), and would be useful for establishing distribution and abundance for other species such as cetaceans and turtles, for example.

3. It is envisaged that the existing survey might continue to operate in the same way, using some of the trained volunteers as a core crew, who will then be able to share their expertise with others in the locality in the future, using local platforms of opportunity. It is envisaged that local yachtsmen, anglers and divers could be inspired to take part in at sea surveys of this nature. Perhaps to coincide with shore based watches involving other species such as cetaceans, e.g. the Northern Ireland Whale Watch, as part of the Wildlife Trusts' Marine Week – this would not only be highly desirable, but would also ensure that the vital element of quantified effort was included in any such surveys.

4. Offer the basking sharks a similar level of protection as exists in England and Wales, through the mechanism of the Wildlife Order (NI) 1985.

5. Research from the MBA satellite-tagging programme indicates that although basking sharks tagged in UK waters move long distances, over seasonal scales (1.7-8.5 months) they remain within the European continental shelf and shelf edge area in the immediate vicinity of the UK. This would suggest that the current UK protection zone is inadequate, and that, in the future such protection should be extended out to the 200 mile limit. Support for such a move would be required from all Government Agencies, including EHS.

6. Consideration should be given to developing a Northern Ireland Species Action Plan for the basking shark to drive forward the conservation of the Northern Ireland basking shark population.

7. Consideration should be given to establishing a research project to look into the impact of different fish gear and methods on the Northern Ireland basking shark population. This research could be expanded to cover other key marine pelagic vertebrates.

8. Consideration should be give to a research project looking into the correlation between fronts and pelagic vertebrate distribution patterns as identified in the Irish Sea Pilot Project, Vincent et al 2004.

9. In order to create the necessary management structures to minimise animal disturbance we would recommend the inclusion of a Marine Wildlife Watching Code, as is the case in Scottish Law:

Scotland Nature Conservation Act 2004

(1) Scottish Natural Heritage (SNH) must prepare and issue a code, to be known as the Scottish Marine Wildlife Watching Code, setting out recommendations, advice and information relating to commercial and leisure activities involving the watching of marine wildlife.

(2) The Code may, in particular, contain information on-

(a) activities which are likely to disturb marine wildlife,

(b) circumstances in which marine wildlife may be approached, and

(c) the manner in which marine wildlife may best be viewed with minimum disturbance.

(3) SNH must review the Code from time to time and may, following such a review, revise it

(4) SNH must -

(a)before preparing the Code, and

(b)when reviewing it,

consult such persons appearing to them to have an interest in marine wildlife watching and such other persons as it thinks fit.

(5) SNH must -

(a)publish the Code and any revisions to it in such manner (including on the internet or by other electronic means) as it thinks fit, and

(b)promote awareness and understanding of the Code and any revisions to it.

7. Outcomes and Benefits of Project as stated in the Research Contract

(a) *By actively involving and training key personnel from Northern Ireland, we will foster greater activity and interest in the basking shark locally, and will leave a viable pool of observers to give far greater overall coverage of the Western seaboard.*

This project was the first to train local volunteers in scientifically correct survey methodologies – it has generated 30 trained volunteer observers who can continue to observe and contribute sightings. This in turn will produce invaluable information in establishing distribution and abundance of not only basking sharks, but other marine species.

(b) *The high profile of our activities will be used to generate much needed public awareness, and will be used as a tool for engaging political support.*

Throughout the survey years the Ulster Wildlife Trust planned and implemented an effective public awareness campaign through public events, favourable media coverage, distribution of publications, and lobbying activity. Exploris Aquarium hosted a basking shark exhibition to help publicise the survey. In addition to this, the crews encountered many local people on their journeys and were always met with very positive responses and a great deal of interest about the project. Overall this has considerably increased knowledge and awareness of the plight of the basking shark, and the need for its protection, and has generated support for our marine environment.

(c) *It will enable us to continue to develop the overall area of our photo-identification studies – vital if this benign research tool is to fulfil its promise.*

The first to employ photo-identification as a valid research tool in Northern Irish waters. On the 2002 survey 5 individual basking sharks were sighted and photo-identification was used – these have been contributed to the European Basking Shark Photo-identification project. During the 2003/04 surveys no sightings were made of basking sharks, however photographs were taken of the other marine species encountered which included sunfish and harbour porpoises.

(d) *By following the seasonal distribution of sharks we may well, over time, identify further key sites for basking shark behavioural studies, as well as consideration for some form of protection.*

The Ulster Wildlife Trust Basking Shark survey has been a substantial development. It is the first effort related survey to be carried out in Northern Ireland's coastal waters.

The survey has further highlighted the need for protection in NI Waters in line with that afforded to the rest of the UK. The Ulster Wildlife Trust will continue to campaign for this.

In all of these aspects it must be deemed a success.

8. Acknowledgements

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Thanks also go to the many individuals and organisations who made us so welcome at every stopover during the survey, especially Tom McKnight at Glenarm, John Morton at Ballycastle, the Harbourmaster at Portrush and all of the staff at Ardglass Marina. Due to the odd hours we kept, we had on occasion to call on assistance beyond the call (and hours) of duty, assistance that was always cheerfully given, and was vital to enable us to achieve our goals.

All of our volunteer crews during throughout the survey were first class, hard working members who shared many enjoyable experiences with us. Our thanks go to all of them for their support and unfailing good humour. We hope that they will have taken something away from the project that enables them to give something back to the coastal and marine heritage of their wonderful homeland.

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10. Appendix

Appendix I **Standardised survey forms**

Appendix II **Dedicated sightings form**

Appendix III **Spreadsheet of transects completed in 2004**

Appendix IV **Links with the UK and NI Biodiversity Action Plans**

Appendix I Standardised survey forms

Seaquest Basking Shark Sightings Cruise Log

CRUISE ROUTE:…… DAY/MONTH/YEAR:……

VESSEL TYPE:…… OBSERVATION HEIGHT (m):…….. VESSEL SPEED:……

OBSERVER NAME:…… CONTACT ADDRESS:……TRANSECT No……

Time of Day (BST/GMT)	Location (Co-ordinates)	Vessel Bearing	Wind Dir. and Speed	Sea State	Swell Height	Weather and Cloud Cover	Visibility	Depth & Sea Temp.

Appendix II Dedicated sightings form

Basking Shark Sighting Form.

Transect number:	Sighting number:	Date:		
Start time:	Finish time:			
Ships heading:	Relative bearing:	Distance:		
Latitude:	Longitude:			
Markings:	Size:	Sex:	Tags:	Scars:
Plankton haul number:				
Behaviour:				
EOS 1V # 1 film no:	Frame nos:			
EOS 1V # 2 film no:	Frame nos:			
DV footage film no:	Time start:	Time finished:		
Associations:				
Mating Behaviour:				
Breaching:				
Other species:				
Wind:	Sea state:	Swell Ht:		
Weather:	Cloud cover:	Visibility:		
Water depth:	Water temp:	Turbidity:		
0ther details:				

Appendix III Spreadsheet of transects completed in 2004

				Start location		Finish location		Duration				Distance			
Transect No.	Date	From	To	Latitude	Longitude	Latitude	Longitude	Start time	Finish time	Duration hrs	Decimal hrs	Dist nm	Dist km	Roundup km	Comments
136/04	11/07/04	Phennick Point, Ardglass	St. Johns Point	54.254	-5.597	54.202	-5.661	10:30	11:10	00:40	0.67	3.839	7.110	8	
137/04	11/07/04	St. Johns Point	Helly Hunter Buoy	54.202	-5.661	54.002	-6.034	11:10	14:05	02:55	2.92	17.868	33.092	34	
138/04	11/07/04	Helly Hunter Buoy	St. Johns Point	54.002	-6.034	54.212	-5.661	14:05	17:15	03:10	3.17	17.868	33.092	34	
139/04	11/07/04	St. Johns Point	Phennick Point, Ardglass	54.212	-5.661	54.251	-5.596	17:15	17:45	00:30	0.50	3.839	7.110	8	
140/04	11/07/04	Phennick Point. Ardglass	Strangford Fairway Buoy	54.251	-5.596	54.310	-5.511	17:45	18:30	00:45	0.75	4.479	8.295	9	
141/04	12/07/04	Strangford Fairway Buoy	Phennick Point, Ardglass	54.310	-5.512	54.251	-5.597	10:28	11:11	00:43	0.72	4.479	8.295	9	
142/04	12/07/04	Phennick Point	Strangford Fairway Buoy	54.251	-5.597	54.310	-5.512	11:11	12:05	00:54	0.90	4.479	8.295	9	
143/04	12/07/04	Strangford Fairway Buoy	South Rock Lightship	54.310	-5.512	54.348	-5.459	12:05	12:35	00:30	0.50	7.781	14.410	15	
144/04	12/07/04	South Rock Lightship	Strangford Fairway Buoy	54.348	-5.459	54.307	-5.500	12:35	16:52	04:17	4.28	7.781	14.410	15	
145/04	12/07/04	Strangford Fairway Buoy	Phennick Point, Ardglass	54.307	-5.500	54.258	-5.596	16:52	17:35	00:43	0.72	4.479	8.295	9	
146/04	13/07/04	Phennick Point, Ardglass	Strangford Fairway Buoy	54.259	-5.591	54.309	-5.512	07:47	08:45	00:58	0.97	4.479	8.295	9	
147/04	13/07/04	Strangford Fairway Buoy	South Rock Lightship	54.309	-5.512	54.075	-5.364	08:45	10:18	01:33	1.55	7.781	14.410	15	
148/04	13/07/04	South Rock Lightship	Skull Martin	54.075	-5.364	54.531	-5.431	10:18	11:26	01:08	1.13	7.533	13.951	14	
149/04	13/07/04	Skull Martin	South Briggs Buoy	54.531	-5.431	54.699	-5.591	11:26	12:55	01:29	1.48	11.147	20.644	21	
150/04	13/07/04	South Briggs Buoy	Greys Point, Bangor	54.699	-5.591	54.682	-5.743	12:55	15:55	03:00	3.00	5.266	9.753	10	
151/04	14/07/04	Greys Point, Bangor	Black Head	54.672	-5.683	54.769	-5.677	10:00	10:55	00:55	0.92	5.632	10.430	11	
152/04	14/07/04	Black Head	Isle of Muck	54.769	-5.677	54.849	-5.670	10:55	11:48	00:53	0.88	4.829	8.943	9	*
153/04*	14/07/04	Isle of Muck	The Maidens	54.849	-5.670	54.852	-5.708	11:48	12:06	00:18	0.30	4.25	7.871	8	
154/04	14/07/04	Isle of Muck	Black Head	54.852	-5.708	54.767	-5.644	12:06	14:34	02:28	2.47	4.829	8.943	9	
155/04	14/07/04	Black Head	South Briggs Buoy	54.767	-5.644	54.684	-5.578	14:34	15:30	00:56	0.93	5.441	10.077	11	
156/04	14/07/04	South Briggs Buoy	Skull Martin	54.684	-5.578	54.530	-5.414	15:30	17:06	01:36	1.60	11.147	20.644	21	
157/04	14/07/04	Skull Martin	South Rock Lightship	54.530	-5.414	54.408	-5.365	17:06	18:10	01:04	1.07	7.533	13.951	14	
158/04	14/07/04	South Rock Lightship	Strangford Fairway Buoy	54.408	-5.365	54.311	-5.508	18:10	19:12	01:02	1.03	7.781	14.410	15	
159/04	15/07/04	Strangford Fairway Buoy	South Rock Lightship	54.310	-5.507	54.410	-5.366	11:15	12:15	01:00	1.00	7.781	14.410	15	
160/04	15/07/04	South Rock Lightship	Skull Martin	54.410	-5.366	54.524	-5.412	12:15	13:15	01:00	1.00	7.533	13.951	14	
161/04	15/07/04	Skull Martin	South Briggs Buoy	54.524	-5.412	54.686	-5.591	13:15	14:43	01:28	1.47	11.147	20.644	21	
162/04	18/07/04	Wilsons Point	Black Head	54.671	-5.680	54.767	-5.676	11:15	12:12	00:57	0.95	5.671	10.503	11	
163/04	18/07/04	Black Head	Isle of Muck	54.767	-5.676	54.849	-5.711	12:12	13:05	00:53	0.88	4.829	8.943	9	
164/04	18/07/04	Isle of Muck	Torr Head	54.849	-5.711	55.197	-6.018	13:05	16:20	03:15	3.25	5.034	9.323	10	
165/04	18/07/04	Torr Head	Fair Head	55.197	-6.018	55.234	-6.134	16:20	16:50	00:30	0.50	23.433	43.398	44	

				Start location		Finish location		Duration				Distance			
Transect No.	Date	From	To	Latitude	Longitude	Latitude	Longitude	Start time	Finish time	Duration hrs	Decimal hrs	Dist nm	Dist km	Roundup km	Comments
166/04	18/07/04	Fair Head	Rue Point (Rathlin Island)	55.234	-6.134	55.249	-6.195	16:50	17:08	00:18	0.30		0.000	4	
167/04	18/07/04	Rue Point (Rathlin Island)	Castle Point	55.249	-6.195	55.211	-6.233	17:08	17:36	00:28	0.47		0.000	6	
168/04	19/07/04	Castle Point	Rue Point (Rathlin Island)	55.212	-6.236	55.252	-6.192	12:05	12:27	00:22	0.37		0.000	6	
169/04	19/07/04	Rue Point (Rathlin Island)	Bull Point	55.252	-6.192	55.287	-6.289	12:27	13:03	00:36	0.60		0.000	7	
170/04	19/07/04	Bull Point	Bengore Head	55.287	-6.289	55.260	-6.473	13:03	14:13	01:10	1.17	6.554	12.138	13	
171/04	19/07/04	Bengore Head	Portstewart Point	55.260	-6.473	55.191	-6.735	14:13	15:50	01:37	1.62	9.796	18.142	19	
172/04	19/07/04	Portstewart Point	Bann Mouth	55.191	-6.735	55.178	-6.775	15:50	16:05	00:15	0.25	1.9	3.519	4	
173/04	19/07/04	Bann Mouth	Portstewart Point	55.178	-6.775	55.190	-6.737	16:05	16:32	00:27	0.45	1.9	3.519	4	
174/04	19/07/04	Portstewart Point	Ramore Head	55.190	-6.737	55.213	-6.673	16:32	16:56	00:24	0.40	2.96	5.482	6	
175/04	20/07/04	Ramore Head	Great Stookan	55.221	-6.662	55.250	-6.521	12:02	13:03	01:01	1.02	4.786	8.864	9	
176/04	20/07/04	Great Stookan	Ramore Head	55.250	-6.521	55.217	-6.663	13:03	13:41	00:38	0.63	4.786	8.864	9	
177/04	21/07/04	Ramore Head	Bengore Head	55.221	-6.661	55.255	-6.469	08:19	09:19	01:00	1.00	7	12.964	13	
178/04	21/07/04	Bengore Head	Bull Point	55.255	-6.469	55.307	-6.283	09:19	10:25	01:06	1.10	6.554	12.138	13	
179/04	21/07/04	Bull Point	Skerriggh Point	55.307	-6.283	55.316	-6.236	10:25	10:36	00:11	0.18	1.406	2.604	3	
180/04	21/07/04	Skerriggh Point	Mull of Kintyre	55.316	-6.236	55.301	-6.110	10:36	12:30	01:54	1.90	15.8	29.262	30	

153/04* Transect abandoned due to sea state / wind

Appendix IV

Links with the UK and NI Biodiversity Action Plans

This Project will specifically link in with several of the actions outlined within the UK BAP framework for the basking shark, namely:

5.2 Site safeguard and management

5.2.1 Develop and implement a code of conduct to reduce levels of harassment, in collaboration with scientists engaged in research on this species. (ACTION: CCW, DANI, DTI, EHS, EN, JNCC, LAs, MAFF, NAW, SE, SFCs, SNH)

5.3 Species management and protection

5.3.1 Extend protection provided in GB waters to Northern Ireland. (ACTION: DoE(NI))

5.4 Advisory

5.4.1 Develop and publish a code of conduct regarding interactions with basking sharks to reduce levels of harassment (see 5.2.1). (ACTION: CCW, EHS, EN, JNCC, MAFF, NAW, SE, SFCs, SNH)

5.5 Future research and monitoring

5.5.1 Commission research to elucidate the life cycle of this poorly understood species. (ACTION: CCW, EHS, EN, SNH)

5.5.2 Quantify and monitor population size, structure, dynamics and movement patterns and range of 45 individuals occurring in UK waters. (ACTION: CCW, EHS, EN, JNCC, NERC, SNH)

5.5.3 Improve long-term studies to: assess scientifically the population trends; elucidate migration and over-wintering areas which may identify locations where basking sharks mate and the pregnant females reside; and minimise unnatural mortality in these areas. Genetic studies may help determine the degree of mixing between populations. (ACTION: CCW, EHS, EN, JNCC, NERC, SNH)

5.7 Links with other action plans

5.7.1 Action plans for some other species (marine mammals, turtles, and other elasmobranches) identify similar requirements regarding codes of conduct that could be addressed on a similar basis.

Delivery of these aspects of the Basking Shark BAP will be all important, as they concentrate on the interface between man and the basking shark, such as identifying areas of critical importance for the species, and evaluating and

enhancing the existing Code of Conduct. The Basking Shark is also identified in the Northern Ireland Biodiversity Action Plan, as a species to which action will be undertaken through the UK Species Action Plan.

The proposed survey also links to the following Northern Ireland Biodiversity Strategy and EHS Implementation Plan:

- **NIBS 57** – Contribute to UK habitat and species action plans through the preparation and implementation of costed Northern Ireland components of these plans.
  - **EHS Plan Action 29 –** co-ordinate the implementation of action plans for which EHS has a role – Fish- *Cetorhinus maximus*
- **NIBS 59** – Review the lists of Northern Ireland species of conservation concern and priority species, see additional information and conduct further reviews of the lists as required.
  - **EHS Plan Action 35 –** Input information to inform lists of NI species of conservation concern and priority species requiring NI action plans.
- **NIBS 64** – Assess the conservation status of poorly known elements of biodiversity.
  - **EHS Plan Action 41 –** Agree and publish a research programme for species based on the requirements of the Northern Ireland Biodiversity Strategy Recommendations.
- **NIBS 67** – Monitor species of conservation concern.
  - **EHS Plan Action 41 –** Agree and publish a research programme for species based on the requirements of the Northern Ireland Biodiversity Strategy Recommendations.
- **NIBS 68** – Make more locally-relevant information on biodiversity available within Northern Ireland.
  - **EHS Plan Action 42 –** Research information made available for the internet.
- **NIBS 69** – Engage influential sectors of society on a partnership basis to conserve biodiversity.
  - **EHS Plan Action 44 –** The photo-identification part of the survey will generate interest and awareness amongst a wide range of individuals and The Ulster Wildlife Trust, in conjunction with The Wildlife Trusts partnership, have a key interest in the development of marine biodiversity.

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Our aim is to protect and conserve the natural and built environment and to promote its appreciation for the benefit of present and future generations.

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