CETACEAN CONSERVATION IN NORTHWEST SCOTLAND: PERCEIVEDTHREATS TO CETACEANS

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INTRODUCTION The west coast of Scotland has an abundant and diverse population of cetaceans: to date, twenty-four cetacean species have been reported from this region, making it one of the most important habitats for cetaceans in Europe (Evans, 2000).

PERCEIVED THREATS TO CETACEANS IN NORTHWEST SCOTLAND

Directed takes Commercial whaling occurred in West Scotland (from Loch Tarbet, Harris) from 1904-1928 and briefly re-opened between 1950-1951. The whaling station predominantly caught fin, sei and blue whales (1538, 378 and 316 animals, respectively) with some catches of northern right, sperm, northern bottlenose and humpback whales (94, 77, 1 and 19 whales, respectively) (Thompson, 1928; Brown, 1976). At present, Norwegian commercial whaling operations are being undertaken in waters adjacent to Scotland; the target species being North Atlantic minke whales. At present, there is little information on the movements or migratory patterns of minke whales. It is feasible that the movement and migratory patterns of minke whales, but it is feasible that these could take them from Scottish waters into current or future whaling grounds for part of the year.

Incidental takes Gillnet fisheries are known to be major problem for small cetacean populations (e.g. Tregenza *et al.*, 1997). Northridge and Hammond (1999) presented preliminary data collected by observers on a small number of gillnet boats operating in the waters to the west of the Outer Hebrides. The study demonstrated that by-catch of harbour porpoises does occur in this area . This region is also exploited by Spanish fishing vessels operating within and immediately adjacent to Scottish waters. The level of cetacean by-catch inflicted by these foreign vessels is unknown.

In 1986, the use of monofilament gillnets was banned for Scottish inshore fisheries; however, the ban was repealed in 1996. After this repeal, there was concern from some environmental groups that the return of monofilament gillnets may lead to high levels of harbour porpoise by-catch in the inshore waters of Northwest Scotland. However, the amount of gillnet fishing in this region is very low, which is mainly due to the fact that gillnetting is currently unprofitable compared with other types of fishing (Gill, 1999). However, the fishing industry is very dynamic and the level of gillnet fishing effort could increase in the future.

Pollution

Organochlorines There is only limited information about the levels of anthropogenic contaminants in cetaceans from Northwest Scotland. Published data on concentrations of organochlorines are summarised in Table 1. Several of the levels of organochlorines summarised in Table 1 are of a magnitude equal to those which have been reported to cause reproductive (e.g., Subramanian *et al*., 1987) and immune system (e.g. Lahvis *et al*., 1995) changes in other species of small cetacean. However, in general, the organochlorine concentrations reported upon are relatively low.

Table 2. Concentrations of organochlorine pollutants in the blubber tissue of cetaceans from Northwest Scotland (concentrations are expressed as parts per million, wet weight).

Area	Species	n	ΣPCB	Dieldrin	HCB	Σchlordane	ΣDDT	Reference
Ayr	*Phocoena phocoena*	1	10.0	2.21	-	2.01	7.34	McKenzie, 1999
Oban	*Lagenorhynchus acutus*	1	33.1	4.74	0.76	12.4	45.7	McKenzie *et al.*, 1997
Islay	*Stenella coeruleoalba*	2	5.63-7.25	0.51-0.84	0.22-0.26	1.62-2.21	5.46-6.98	McKenzie, 1999
Coll	*Grampus griseus*	1	9.54	0.69	0.07	1.09	7.51	McKenzie, 1999
Mull	*Physeter macrocephalus*	1	0.71	-	-	-	-	Wells and Echarri, 1992
Skye	*Physeter macrocephalus*	2	2.62-2.90	0.13-0.15	0.17-0.18	0.42-0.52	3.61-4.32	McKenzie, 1999
	Stenella coeruleoalba	1	6.37	1.48	0.19	4.49	10.2	McKenzie, 1999
	Mesoplodon bidens	1	3.12	0.02	0.09	0.12	1.89	McKenzie, 1999
N.Uist	*Lagenorhynchus acutus*	1	30.2	4.60	1.10	11.9	54.6	McKenzie *et al.*, 1997,
	Lagenorhynchus acutus	1	3.57	0.95	0.66	2.09	7.20	McKenzie, 1999
Lewis	*Phocoena phocoena*	1	4.08	0.23	0.23	0.23	1.96	McKenzie, 1999
	Globicephala melaena	4	6.16-10.3	0.37-1.15	0.16-0.26	1.71-4.51	7.83-14.1	McKenzie, 1999
	Grampus griseus	1	4.32	0.55	0.08	0.83	1.85	McKenzie, 1999
	Mesoplodon bidens	3	3.10-3.33	0.07-0.09	0.07-0.11	0.27-0.54	2.00-2.82	McKenzie, 1999

Trace metals Published information on trace element concentrations in cetaceans from Northwest Scotland is summarised in Table 2. Concentrations of mercury and cadmium are reasonably high (up to 71 and 99 ppm, respectively), particularly in the long-finned pilot whales and striped dolphins. Both of these species forage upon cephalopods, and the fact that these two species have accumulated elevated levels of cadmium and mercury suggests elevated concentrations in their prey species.

Table 3. Concentrations of trace element pollutants in the tissues of cetaceans from Northwest Scotland (concentrations are expressed as parts per million, wet weight).

Area	Species	n	Tissue	Cd	Hg	Pb	Sn	Zn	Reference
Islay	*Phocoena phocoena*	1	Liver	<0.07	0.7	<0.07	-	49	Law *et al.*, 1991
	Stenella coeruleoalba	2	Liver	5.5-10.3	16.7-20	b.d.	0.13-0.28	46-87	McKenzie, 1999
Skye	*Stenella coeruleoalba*	1	Liver	5.5	15.9	b.d.	0.13	30.5	McKenzie, 1999
Benbecula	*Stenella coeruleoalba*	2	Liver	4.5-8.0	2.09-4.89	b.d.-0.12	0.15-0.17	44-83	McKenzie, 1999
			Kidney	33.2-33	0.88-3.38	b.d.-0.03	0.07-0.10	33-36	
N.Uist	*Lagenorhynchus acutus*	1	Liver	0.3	0.89	b.d.	0.09	70	McKenzie, 1999
			Kidney	0.26	0.33	b.d.	0.06	23	
Lewis	*Globicephala melaena*	4	Liver	2.1-37.2	1.99-71	b.d.-0.28	0.07-0.20	13.8-53	McKenzie, 1999
			Kidney	47-99	1.58-7.26	b.d.-0.21	0.05-0.13	22-40	
	Grampus griseus	1	Liver	8.70	1.47	0.10	0.10	27	McKenzie, 1999
			Kidney	3.34	7.97	0.41	0.16	27	
	Mesoplodon bidens	3	Liver	0.40-6.7	0.97-1.05	b.d.	0.14-0.86	28-35	McKenzie, 1999

b.d.: below detection limits.

PAHs A neonate harbour porpoise, stranded on the isle of Islay, is the only cetacean from the west coast of Scotland which has been examined for the presence of PAHs (polycyclic aromatic hydrocarbons). The PAHs are a carcinogenic group of contaminants which are primarily derived from the combustion of fossil fuels and oil-related industry. The porpoise had detectable levels of PAHs despite being a neonate (Ekofisk equivalents: 1.0ppm; Chrysene equivalents: 0.23 ppm, wet weight; Law and Whinnett, 1992). It would be expected that adults from the region would accumulate greater concentrations of this class of pollutant. Considering the potential for PAH contamination in Northwest Scotland, the analysis of cetacean tissues for PAHs warrants further research.

Hydrocarbons The most obvious hydrocarbon pollutant is crude oil, whether it is released into the environment deliberately (as the result of sluicing out the tanks of oil tankers after offloading) or unintentional (accidental discharges and oil spills). Due to the close proximity of oil fields to the coast of Northwest Scotland, there is a considerable volume of oil-related shipping traffic which passes through the area, and there are several oil-related installations, particularly in the northern Outer Hebrides. In addition, discharges have occurred of fuel oil, frequently the result of leaking vessels and sometimes the result of shipping accidents. The hydrocarbons contained in fuel oil may not have the physical impact on the marine biota that crude oil has (e.g. covering seabirds in a tarry hydrocarbon film), but nonetheless they may have a toxicological impact.

Butyltins Butyltins (BTs) have been described from several species of cetacean in recent years and there is concern about the possible toxicological implications for BT pollution on cetacean populations (Iwata *et al.*, 1994, 1995). Butyltins are primarily used as anti-fouling treatments upon ship hulls and marine structures, such as fish farm cages. Davies *et al.* (1987) reported that BT contamination was elevated in sea lochs, the result of contamination from fish farms, coupled with an enclosed water system. In 1986, the use of tributyltin on boats less than 25m was banned in Scotland. However, Ambrose (1994) noted that around 69% of ships are still being painted with BT anti-fouling paints. Therefore, it would be expected that coastal species frequenting sealochs and harbours, such as bottlenose dolphins and harbour porpoises, would be exposed to elevated levels of BT contamination. As yet, there have been no studies upon the level of BT contamination in cetacean species from western Scotland, and this issue needs attention.

Sewage There are few sewage plants in this region of Scotland and most domestic discharges are small scale from septic tanks, although there are some areas where untreated discharges may cause localised pockets of sewage pollution. Sewage pollution resulting from industrial discharges (from the wool, leather, distilling and seafood industries) is probably more problematic. Fish farms are the greatest source of untreated sewage pollution in the coastal waters of West Scotland.

Fish-farming pollutants Fish-farms produce a variety of pollutants, the monitoring of which are the responsibility of the fish-farm operators. These pollutants include butyltins, which are used as anti-foulants on cages, and faecal matter. The amount of sewage pollution produced by fish farms in Northwest Scotland is greater than the total marine sewage discharge of the region's human population. This faecal matter is entirely untreated and this waste gathers in high concentrations underneath fish-farm cages together with unconsumed fish food to a dense mat of decaying organic matter. As fish-farms are typically situated in sealochs and sheltered areas, these enclosed water systems result in the accumulation of the organic detritus, with an accompanying increase in anoxic conditions and sewage-related pathogens. In addition, the aquacultured fish are treated with various chemicals such as neurotoxic organophosphates and cypromethrin, to combat fish lice. The cultured fish are also fed with hormonal growth promoters and antibiotics to improve fish yields. These chemicals could have biological impacts on populations of cetaceans inhabiting adjacent areas by altering reproductive development, and causing a reduction in their natural resistance to pathogens.

Fish-farms are probably the largest contributor to anthropogenic pollution in the coastal waters of Northwest Scotland, yet the impacts of these pollutants upon coastal and sealoch-dwelling cetaceans (such as harbour porpoises and bottlenose dolphins) has, as yet, been unstudied. An investigation of these impacts should be considered a research priority.

HABITAT DEGRADATION AND DISTURBANCE

Prey depletion The north-west of Scotland holds many important fishing grounds and many commercially important fish species caught in the regions are also important prey species for

cetaceans - such as herring and mackerel. There is currently a fisheries quota system in operation in Scotland, with takes being calculated to alleviate the problem of over-fishing. However, the quotas are based upon the amount of fish landed at recognised ports. The quotas do not take into account fish which are discarded at sea, transferred to other ships offshore, or landed illegally. Due to a combination of these factors, fisheries quotas are being greatly exceeded and stocks of fish are being diminished.

Fisheries Another impact of Scottish fisheries upon the marine ecosystem are trawl and scallop dredging fisheries. Swathes of seabed are obliterated by gear used in these fisheries. One of the problems of these fisheries, particularly in coastal areas, is that the seabed is not left to recover before being trawling again. If coastal waters were managed by local fishing organisations, which allowed seabed recovery before re-trawling, it would not only maximise the yields of fishermen, but also allow some habitat and prey protection for cetaceans. This is currently not possible, however, as trawlers frequently come in to coastal waters from outside areas, with no knowledge as previous fishing effort in the trawl sites.

Oil exploration In addition to the potential risk from oil-related pollution, as mentioned above, the oil industry also poses a threat to cetaceans with respect to the degradation of their habitats. Several oil companies are currently conducting a series of seismic surveys off the coast of the Outer Hebrides, in a search for new oil fields. The area in which these seismic surveys are being conducted is known to be inhabited by several species of cetacean, in particular beaked, bottlenose, sperm, fin, sei and pilot whales, and Atlantic white-sided dolphins (Stone, 1997, 1998; Hughes *et al*., 1998; Lewis *et al*., 1998). In a recent study off Outer Hebrides, Swift (1997) monitored the acoustic behaviour of delphinids and sperm whales before, during and after seismic surveys and noted significant behavioural changes. The UK Government has recently issued the oil industry with a code of practice to attempt to mitigate the impacts of seismic surveys upon cetaceans. This code of practice should prevent the lethal and sub-lethal effects of seismic testing (e.g. auditory damage) but the issue of habitat degradation and disturbance of cetaceans within breeding and resting grounds as the result of oil exploration, still remains.

Fish-farms The fish-farm industry has already been highlighted above as a major source of pollution and degradation within cetacean habitats. Another area in which fish farms cause an impact on coastal cetaceans is the use of acoustic harassment devices to scare seals away from fish farm cages ("seal scrammers"). The acoustic devices would not only deter seals from fish-farm sites, but also could exclude cetaceans species from breeding, feeding or resting sites.

Shipping The north-west of Scotland is an important maritime area with a substantial volume of commercial and recreational shipping activity. Shipping can impact cetacean populations in two ways. Firstly, collisions with shipping may injure or kill cetaceans. As yet, this has not been reported to have occurred in Northwest Scotland. Secondly, the noise produced by shipping may cause disturbance, stress and degradation of the habitats of cetaceans (Richardson, 1995; Evans, 1996). A code of conduct for boat-users in the vicinity of cetaceans has been drafted and distributed in Northwest Scotland (HWDT, 1999), which will hopefully help minimise some of the disturbance caused by marine shipping.

Military Activities The Northwest of Scotland is the site of many military exercises, in particular, submarine exercise areas occupy most of waters in the region. The extensive use of sonar and a high density of submarine activity could disturb a variety of cetacean species. The Ministry of Defence's British Underwater Test and Evaluation Centre is situated near the Kyles of Lochalsh, with the adjacent area is used as a torpedo testing range: some 130 squares miles of the Sound of Raasay are considered to be a danger area to shipping because of the use of explosives in this region. This

area is also an important habitat for cetaceans, notably the harbour porpoise and, on occasions, northern bottlenose whale. In addition, a missile firing range is situated on the island of South Uist, which fires ordinance westwards out into an area of high cetacean abundance. Finally, joint forces training exercises are conducted three times a year in Northwest Scotland. Concern has been voiced from wildlife tour operators that this exercise coincides with a period of abnormally low local cetacean (minke whale & harbour porpoise) abundance.

The amount of military activity in Northwest Scotland is considerable, as is the potential for lethal and sub-lethal impacts upon cetacean populations in this region. This issue, therefore, needs investigation.

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