THE SHETLAND BEACHED BIRD SURVEY, 1979–2004

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SUMMARY

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Results of monthly beached bird surveys in Shetland over a 26-year period are summarised. After initial high oiling rates in 1979, the incidence of oiled birds dropped to lower levels by winter 1980/81. Operational controls at the Sullom Voe Terminal to prevent deballasting at sea by visiting tankers almost certainly contributed to the reduction. Since then some periods of relatively high oiling rates have occurred, interspersed with increasingly longer periods of lower oiling rates. At all times since 1979, oiling rates compared favourably with those recorded from long-term beached bird surveys in the southern North Sea, particularly during 1999–2004. Recent analyses of oil samples from beaches and birds indicate that fuel oils predominate, whereas a majority of samples during 1979/80 were of crudes or crude sludges. In view of recent changes in crude oil throughput at the Sullom Voe Terminal, beached bird surveys remain an important tool for monitoring chronic oil pollution around the islands.

INTRODUCTION

Shetland, the northernmost island group of the British Isles, comprises more than 100 islands with a total coastline of 1450 km. Thirteen islands are inhabited by 22 000 people. The coastline can be divided into an "outer" coast facing the open sea, and a more sheltered "inner" coast. The former consists of long stretches of rocky cliffs interspersed with small beaches, some sandy, but more usually consisting of shingle, on which relatively large numbers of dead seabirds accumulate. The inner coast borders long inlets (voes) and sounds between the larger islands, where no concentrating effect on seabird corpses occurs, except at the very heads of voes in certain conditions.

Besides hosting internationally significant numbers of breeding and wintering seabirds (Pennington *et al.* 2004), Shetland also has the Sullom Voe Oil Terminal (SVT), one of Europe's largest oil exporting facilities. The SVT opened in November 1978, processing and exporting crude oil pumped ashore via two pipelines from oil fields in the East Shetland Basin.

Environmental oversight of the SVT and its associated tanker traffic has been provided by the Shetland Oil Terminal Environmental Advisory Group (SOTEAG), which also conducts an independent environmental monitoring programme using external contractors (Dunnet 1995). Since May 1978, monitoring of seabird populations in Shetland has been an integral part of this programme, one element of which has been standardised beached bird surveys to monitor chronic oil pollution around the islands. This paper describes the establishment and maintenance of the Shetland Beached Bird Survey and updates its results.

METHODS

In summer 1978, beaches were selected for the survey on the basis that they would

- accumulate dead birds,
- face different directions to allow for variation in wind direction,
- provide good geographic coverage of the outer coast of Shetland,
- provide good coverage of the inner coastline adjacent to the SVT, and
- be easily accessible by road.

Early surveys were interrupted by the response to the *Esso Bernicia* spill of 1174 tonnes of heavy bunker fuel oil at the SVT on 30 December 1978 and other unattributed spills that affected the Shetland coastline in early 1979 (Heubeck & Richardson 1980, Richardson *et al.* 1982). Standardised monthly surveys resumed at the end of March 1979 and have continued since.

Beaches are surveyed on or about the last Sunday in each month, but surveys are occasionally postponed for some days when snow covers tide lines. Corpses are categorised as 'intact' or 'remains', the latter meaning that sufficient plumage or body parts were missing that the observer could not be sure whether the bird had been oiled or not; the results presented here combine both 'intact' and 'remains'. They are identified to species, and aged and sexed by external examination as far as possible. Additional data recorded includes whether any oiled plumage is visible (clean, lightly, medium or heavily oiled), whether any bands are present, and whether carcasses are entangled in fishing net, other plastic debris or fish hooks. Corpses are then removed and disposed of well away from the beach. Landbirds, waders and freshwater Anatidae found are recorded but are not included in the seabird totals. When funding has been available, samples of oil from beaches and birds' plumage have been collected for analysis.

Coverage of beaches has changed only slightly since 1979. Initially, more beaches were included than could be surveyed consistently, and some volunteers dropped out of the scheme. Current coverage, which has not changed for 15 years, is of 15.6 km (34 beaches) on the west-facing outer coast of Shetland, 12.3 km on the east-facing outer coast (28 beaches) and 20.8 km (14 sections) on the sheltered inner coast of Sullom Voe and Yell Sound to monitor pollution from the SVT (Fig. 1). Surveys are conducted by a mix of SOTEAG

contractual staff, other professional conservationists, and interested members of the public. Results are relayed to participants through an annual report (publicly available), articles in the newsletter of the Shetland Bird Club, and occasional publications in scientific journals (Heubeck 1987, Heubeck 1995).

RESULTS

During July–November 1978, prior to the SVT opening to tanker traffic, 176 km of beaches were surveyed and 1101 dead seabirds were found, seven of which were oiled (0.6%). Although these surveys covered only part of the year, and at a season when oiling rates have since been found normally to be relatively low, they do indicate little chronic oil pollution; during the same period in 1979, 5.0% of 937 corpses found were oiled.

Between March 1979 and December 2004, a total 15 336 km of coast was surveyed and 59 007 dead seabirds were found, of which 4364 (7.4%) were oiled. The oiling rate was highest in 1979 (23.2%), partly because of long-dead corpses being found from oil spills that occurred earlier that year (Fig. 2). Since 1979, the annual oiling rate has exceeded 10% only in 1985 (11.9%), 1995 (16.6%) and 1996 (12.4%). Since 1998, the rate has remained below 4%. In 2004, it was 1.5%, the lowest annual value yet recorded.

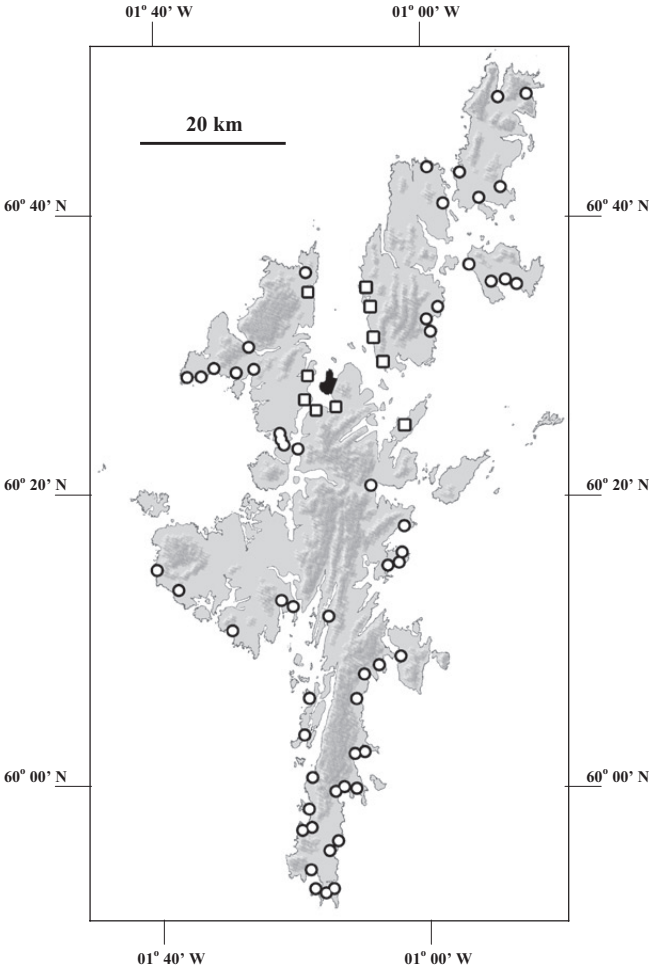

Fig. 1. Map of Shetland showing the location of beaches currently included in the survey. Some closely adjacent beaches are indicated by a single symbol. Square symbols indicate beaches in Sullom Voe and Yell Sound. The site of the Sullom Voe Terminal is shaded black.

Seasonal patterns of occurrence on beaches and oiling rates differ markedly between species. The overall rate of oiling (all species combined) tends to be higher during winter, although it has occasionally been relatively high in summer, most notably in 1985 and 1995 (Fig. 2). Analyses found that oil pollution in the summer of 1985 was residues of bunker fuel, probably discharged from a single ship, mainly in September. Oil pollution in 1995 was largely crude oil residues illegally discharged from at least two tankers cleaning their cargo tanks at sea. In addition, a series of slicks of fuel oil residues originated from a fleet of large Eastern European factory trawlers using the port of Lerwick for trans-shipping fish.

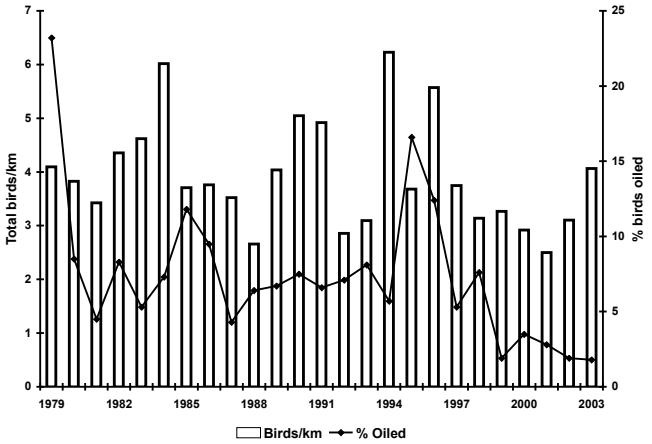

Fig. 2. Annual number of seabird corpses found on the Shetland Beached Bird Survey, 1979–2004: oiled, unoiled, and percentage oiled.

TABLE 1
Species composition of oiled seabirds found on the Shetland Beached Bird Survey, 1980–2004[a]

Species	Total	Oiled	
		(n)	(%)
Common Loon *Gavia immer*	33	15	33.3
Northern Fulmar *Fulmarus glacialis*	16 990	900	5.3
Northern Gannet *Morus bassanus*	1 510	153	10.1
European Shag *Phalacrocorax aristotelis*	2 743	80	2.9
Common Eider *Somateria mollissima*	541	37	6.8
Oldsquaw *Clangula hyemalis*	93	16	17.2
Great Skua *Stercorarius skua*	457	20	4.4
Herring Gull *Larus argentatus*	3 288	132	4.0
Glaucous Gull *Larus hyperboreus*	36	6	16.7
Great Black-backed Gull *Larus marinus*	2 761	102	3.7
Black-legged Kittiwake *Rissa tridactyla*	6 267	301	4.8
Common Murre *Uria aalge*	15 107	1633	10.8
Razorbill *Alca torda*	1 862	199	10.7
Black Guillemot *Cepphus grylle*	614	69	11.2
Dovekie *Alle alle*	378	35	9.3
Atlantic Puffin *Fratercula arctica*	1 823	139	7.6

[a] Species for which 20 or more oiled individuals were found or in which the oiling rate exceeded 10% are listed.

Northern Fulmars *Fulmarus glacialis* and Common Murres *Uria aalge* are abundant breeding species in Shetland, with populations of 188 500 pairs and 173 000 individuals respectively (Mitchell *et al.* 2004). These two species dominated the corpses found, at 29% (fulmars) and 26% (murres) of the total during 1980–2004 (Table 1). Whereas Northern Fulmar corpses peak during summer, Common Murres usually peak (in more variable numbers) in mid-to-late winter (Fig. 3). Although oiling rates for the two species have been similar in some consecutive runs of years (1986–1990 and 1999–2004), they differed considerably in other years (Fig. 4). A high rate for murres compared with a low rate for fulmars may indicate heavy chronic oil pollution in late winter (e.g. 31% of 301 murres oiled in January/February 1982), or may reflect variations in the number of murres dying from natural causes such as starvation. During the winters (November to March) of 1991/92 and 1992/93, oiling rates were high, but the total number of birds was low (1991/92: 22%, n = 59; 1992/93: 44%, n = 63). Conversely, in 1993/94, a large wreck of emaciated birds in February contributed to a much lower oiling rate (5%, n = 1086). Until 1998, the relationship between the annual oiling rate and the number of Common Murres found was negative, but this finding was partly obscured by six subsequent years with no winter wrecks and low oiling rates (Fig. 5).

Because the *Esso Bernicia* oil spill of early 1979 was essentially an inshore incident, and long-dead corpses continued to be recorded throughout the spring and summer of 1979, the oiling rates and oiled species recorded that year differed from those found in other years between 1980 and 2004 (Table 1). For example, 25% of European Shags *Phalacrocorax aristotelis* found in 1979 were oiled (n = 160), as were 51% of Common Eiders *Somateria mollissima* (n = 79), 85% of Long-tailed Ducks *Clangula hyemalis* (n = 13) and 56% of Black Guillemots *Cepphus grylle* (n = 48). Since 1979, oiling rates for those and other inshore species have been considerably lower, although rates recorded in the small numbers of Common Loons *Gavia immer* (33%) and Long-tailed Ducks (17%) found have been higher than for more pelagic species such as Common Murres (11%) and Atlantic Puffins *Fratercula arctica* (8%).

The preponderance of oiled seabirds were found on the outer coasts of Shetland exposed to the open sea. Typically, elevated levels of oiling have been recorded on either the east (e.g. early 1996) or west (e.g. summer 1995) coasts on given surveys, but usually not on both simultaneously. Few oiled birds have been found on the sheltered coasts of Sullom Voe and Yell Sound since the early 1980s; during 1995–2004 only 29 (1.2%) of 2413 corpses were oiled (range: 0%–3.1%), mostly on beaches close to the Atlantic and North Sea entrances to Yell Sound.

Of 259 samples of oil analysed during 1979–2004, 70% were of refined fuel oils (probably illegal discharges of bilge waste), 28% were crude oils (probably from tank washings or installations) and

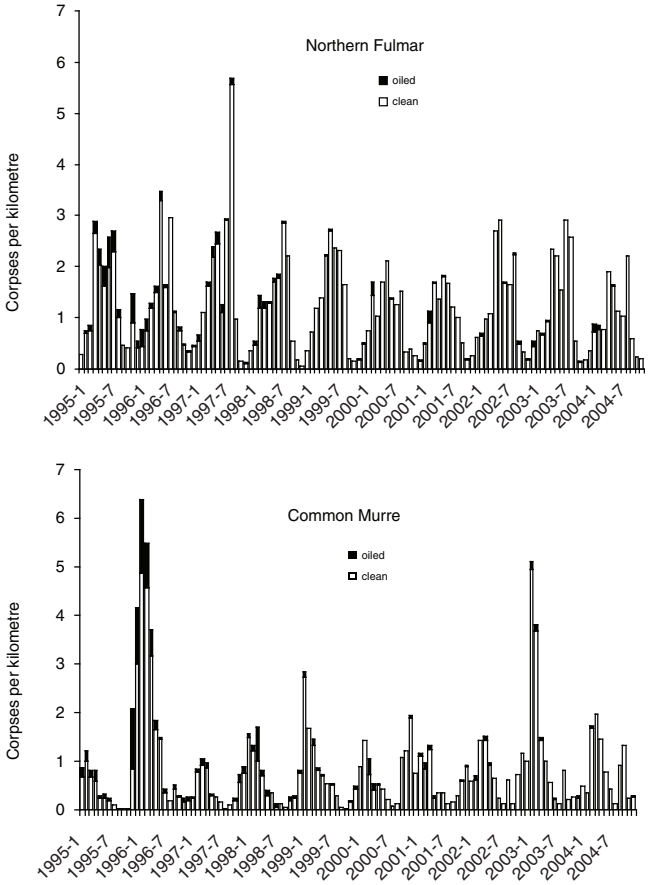

Fig. 3. Monthly deposition of Northern Fulmar *Fulmarus glacialis* and Common Murre *Uria aalge* corpses on Shetland beaches, 1995–2004.

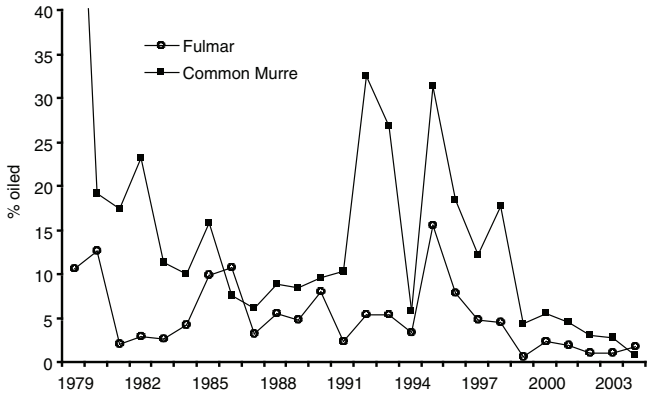

Fig. 4. Annual percentage oiled among Northern Fulmars *Fulmarus glacialis* and Common Murres *Uria aalge* found on Shetland beaches, 1979–2004. Value for Common Murre in 1979 was 73.9%.

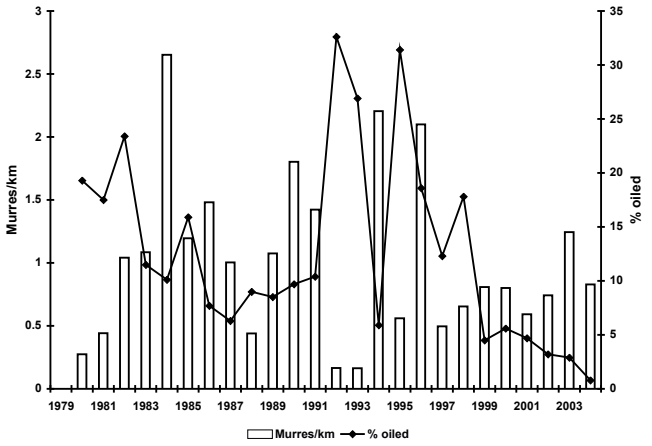

Fig. 5. Comparison of the annual number and percentage oiled of Common Murres *Uria aalge* found (km^{-1}) on Shetland beached bird surveys, 1980–2004.

3% could not be typed (Table 2). Those proportions have varied between sampling periods, however, with crude oils predominating during 1979–1980 and fuel oils predominating since the mid-1990s (see "Discussion").

As well as monitoring chronic oil pollution, the Shetland surveys assist in interpreting changes in population parameters of seabirds that are unrelated to oil pollution. One example is the number of Common Murres found dead after the breeding season in Shetland (Fig. 6). Before 1996, few Common Murres were normally found dead on the August, September or October surveys. The number of corpses in 1994 and 1995 were typical of earlier years. Unusual numbers of first-winter birds were found dead in October 2000, and again in 2004, when the number of older birds was also higher than in previous years. Many of the older birds were still in wing moult in late September or early October, and one individual had not begun body moult. Adult Common Murres normally begin a complete postbreeding moult in late July and are in winter plumage and capable of flight again by mid-September.

Breeding success of Common Murres has been measured by SOTEAG since 1989 in a study plot at Sumburgh Head, at the southern tip of Mainland Shetland. Despite other seabirds experiencing periodic breeding failures, murres maintained reasonable breeding success until 2003/04 (lower success in 1997 was the result of a storm washing eggs out of the plot). Reduced success in 2003 and 2004, an occurrence in common with many other seabirds, was almost certainly attributable to a scarcity of Lesser Sandeels *Ammodytes marinus*; growth rates of the few chicks that survived to banding age were low (Heubeck & Mellor 2005). A sample of chick weights and wing lengths has been collected annually during banding visits to Sumburgh Head, and the number of dead first-winter murres found on beaches correlated negatively with chick weight at a wing length of 65 mm—that is, close to fledging size (Fig. 7). Although it cannot be certain that the juvenile birds were of local origin, the beached bird survey data provide strong circumstantial evidence that post-fledging mortality has been higher in years when chicks leave the colony at a lighter weight.

TABLE 2
Analyses of oil samples from dead seabirds and from beaches in Shetland, 1979–2004

Period	Samples	Crude [n (%)]	Fuel [n (%)]	Unidentified [n (%)]
1979–1980	40	25 (62.5)	15 (37.5)	0
1982	52	12 (23.1)	35 (67.3)	5 (9.6)
1985–1986	33	11 (33.3)	21 (63.6)	1 (3.0)
1996–2000	63	14 (22.2)	49 (77.7)	0
2001–2004	71	9 (12.7)	61 (85.9)	1 (1.4)
Total	259	71 (27.4)	181 (69.9)	7 (2.7)

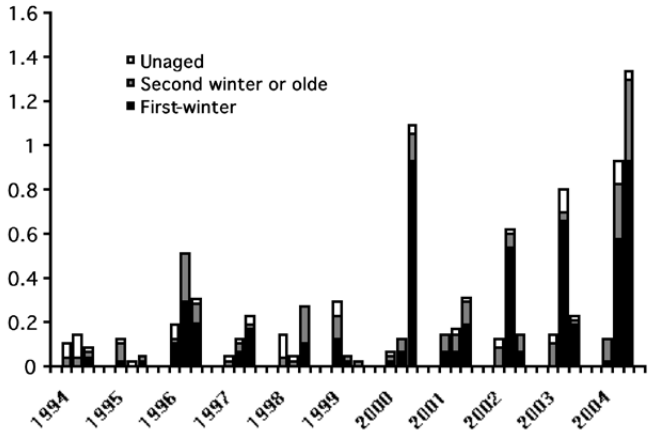

Fig. 6. Monthly rates of Common Murre *Uria aalge* corpses (km^{-1}) on the August, September, and October beach surveys in Shetland, 1994–2004, and annual breeding success (chicks fledged per egg-laying pair) in a study plot at Sumburgh Head. Corpses aged by the presence (first-winter) or absence (second-winter or older) of white tips on greater under-wing coverts.

DISCUSSION

Little knowledge of, and no published data on, levels of chronic oil pollution around Shetland were available before the SOTEAG surveys began in 1978. Beached bird surveys had begun in March 1976 in Orkney, the island group south of Shetland, and by February 1978 had recorded an overall oiling rate for seabirds of 5.6% (Jones 1980). Rates for Common Murres and Razorbills *Alca torda* were high, at 47.1% (n = 403) and 51.9% (n = 108) respectively, although total numbers were rather small.

When the SVT opened to tanker traffic on 28 November 1978, deballasting facilities were still under construction and would not become fully operational for another year. Ten days after the first shipment of oil, unusual numbers of oiled birds were noticed on Orkney beaches. The pattern spread to Shetland over the next few weeks (adding to the effect of the *Esso Bernicia* spill at the SVT) and was reflected in the beached bird survey data from both island groups (Richardson *et al.* 1982, Heubeck 1991, Heubeck *et al.* 1992). Oil sampling in Orkney during 1978 and 1979 indicated a sharp rise in the proportion of crude oils coincident with the opening

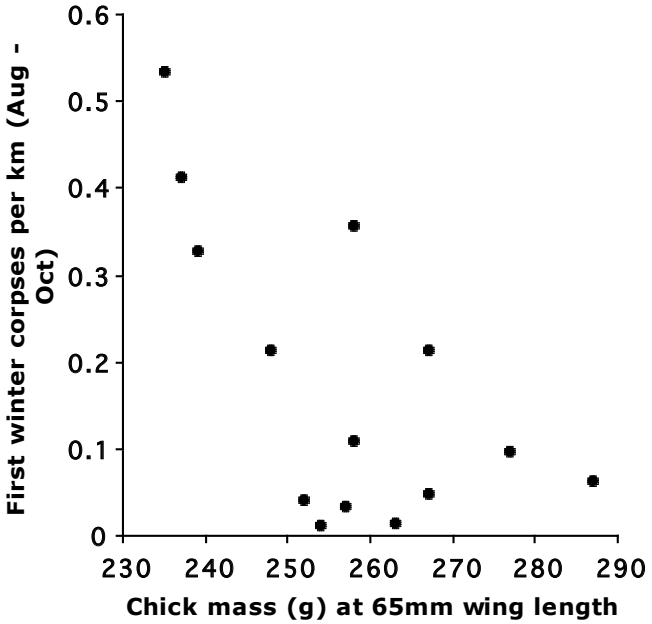

Fig. 7. Annual rates of first-winter Common Murre *Uria aalge* corpses (km^{-1}) on the August, September and October beach surveys in Shetland, and the mean body mass of chicks with a wing length of 65 mm recorded at Sumburgh Head in the same years.

of the SVT, and it was strongly suspected that inbound tankers deballasting at sea were the culprits. Stricter controls introduced at the SVT in early 1979 included aerial surveillance of tankers, minimum ballast water requirements, and the threat of refusal of loading for polluting tankers. Beached bird surveys indicated a reduction of about 50% in oiling rates during winter 1979/80 and a considerably greater reduction by winter 1980/81.

Since 1981, the pattern of chronic oiling around Shetland has been sporadic, with occasional spans of several months of relatively high oiling rates followed by cleaner periods of increasing length. Most recently, six consecutive years have had extremely low rates—the oiling rate of intact Common Murres (carcasses complete enough to ensure detection) over the winters 1999/00–2004/05 has averaged only 2.6% in Shetland. That level compares favourably with other North Sea coasts, especially those of southern England, Belgium, Netherlands, Germany and Denmark where, despite a gradual long-term decline, rates remain in the range of 35%–60% (Camphuysen 2004; D. Fleet, pers. comm.).

The need for vigilance remains, however. Although exports of oil from fields to the east of Shetland fell from 55.6 million tonnes in 1986 to 14.9 million tonnes in 2003, oil has recently begun to be imported from fields to the west of Shetland by shuttle tanker (6.1 million tonnes in 2003) and by pipeline (Shetland Islands Council 2004). In 2004, the SVT also began to be used as a transfer point for crude oil from more distant sources, such as Ural crude shipped from Murmansk. Dedicated aerial surveillance of tankers using the SVT ceased in 2004, and beached bird surveys remain a valuable tool in confirming current low oiling rates, quantifying any short- or longer-term rise and, through sample analyses, identifying sources of pollution.

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