Journal of Marine Animals and Their Ecology
Vol 5, No 2, 2012
Printed in Canada

Skin disorders in common minke whales and white-beaked dolphins off Iceland, a photographic assessment

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Abstract

Cutaneous conditions were assessed in 83 common minke whales (*Balaenoptera acutorostrata*) and 90 white-beaked dolphins (*Lagenorhynchus albirostris*) photo-identified during whale watching trips in Faxaflói (FB) and Skjálfandi (SB) Bays, Iceland, in 2004-2009. Evident skin disorders in the whales included: oval or circular bite marks by parasitic fish, both cookiecutter sharks (*Isistius* spp.) (*n*=32) and probable sea lamprey *Petromyzon marinus* (*n*=7), cutaneous elevations (*n*= 14), black dot lesions (*n*= 3), hyperplasic lesions resembling warts (*n*= 1), and scars and wounds of anthropogenic (*n*= 4) and antagonistic (*n*= 2) origin. The parasitic copepod *Pennella balaenopterae* was detected in 6 whales and the commensal semi-stalked barnacle *Xenobalanus globicipitis* was noticed in 2 whales. One individual showed extensive annular marks of unknown aetiology. In white-beaked dolphins three categories of cutaneous disorders were distinguished: tattoo skin disease -like marks (*n*= 6), cutaneous elevations (*n*=1) and lesions of anthropogenic (*n*=15) and antagonistic (*n*=3) origin. This study provides a further insight into the appearance and occurrence of natural and anthropogenic conditions affecting the integument of the two most common cetaceans in Icelandic waters. Whether causative factors might synergistically negatively impact general health should be of concern for conservation. This paper further highlights the use of photo-identification as an opportunistic, non-invasive research tool to help monitor the health of free-ranging whales and dolphins. [JMATE. 2012;5(2):29-40]

Keywords: Balaenoptera acutorostrata, Lagenorhynchus albirostris, epidemiology, tattoo skin disease, North Atlantic

Introduction

Cetaceans are affected by various cutaneous disorders caused by infectious agents (11,19,41,46,48), parasite copepods and fishes (21,29,38,54), solar ultraviolet radiation (26) and low salinity (22,56) among others. In some cases, the presence, epidemiological pattern and severity of the lesions may reflect general population health and the presence of environmental stressors (24,49,50,55). Cookiecutter shark (*Isistius* spp.) and sea lamprey (*Petromyzon marinus* and *Lampetra tridentata*) bite marks have been observed in a wide variety of cetaceans worldwide (16,27,29,30,32,40) 40).

The large copepod *Pennella balaenopterae* that embeds its head into the blubber of a wide range of cetacean species, especially balaenopterid whales, may cause local swelling of the skin and thin white scars[a] (21). Records of cutaneous disorders linked to solar ultraviolet radiation are relatively few and are limited to fin (*Balaenoptera physalus*), blue (*Balaenoptera musculus*) and sperm (*Physeter macrocephalus*) whales (26). Disorders due to low salinity are known from the humpback whale (*Megaptera novaeangliae*) and the common bottlenose dolphin (*Tursiops truncatus*) (7,22,55). Skin diseases of infectious origin have been widely studied in these dolphins (11,14,28,47) but, with the exception of tattoo skin disease (TSD), much less in other odontocetes and in mysticetes (9,24,45,46).

Common minke whales (*Balaenoptera acutorostrata*) and white-beaked dolphins (*Lagenorhynchus albirostris*) are commonly observed in Icelandic waters and have been the subject of photo-identification studies since 2001 and 2002 respectively. Common minke whales feed in the productive waters of Iceland from late March to early November before migrating to warmer waters at lower latitudes (34, 52). Since whaling resumed in this country in 2003, their numbers have significantly decreased from 43,633 (95% CI:30,148ï 63,149) in 2001 to 9,588 (95% CI:5,274ï 14,420) in 2009 (8,12,23,34). White-beaked dolphins inhabit the sub-polar waters off Iceland year-round with population numbers estimated at around 30,000 individuals in 2001 (33,35). These dolphins are subject to unknown levels of bycatch in Icelandic waters, primarily in the gillnet fisheries but also in the longline and lumpsucker (*Cyclopterus lumpus*) fisheries (33,53).

During photo-identification studies we observed a variety of lesions, wounds, scars and epizoa in common minke whales and white-beaked dolphins on which we report in order to provide a further insight into the cutaneous disorders affecting these species in the

Received November 1, 2012; Accepted January 28, 2013
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[a] described in pictures at http://www.projectminke.com/

Northeastern Atlantic.

Material and Methods

Surveys and study areas

Photo-identification surveys were conducted during the spring and summer months (May to September) from commercial whale-watching boats in 2007-2009 in Faxaflói Bay (FB) and in 2004-2009 in Skjálfandi Bay (SB) shown in Figure 1. FB is a 50 x 105 km wide bay in southwestern Iceland, located between the peninsulas of Snæfellsnes and Reykjanes (64° 24ôN23°00ôW) (43). Its southern shore harbours Reykjavík, Iceland's capital, home to most of Iceland's population (200,852). SB is a smaller bay, 10-50 km wide by 25 km deep, in northern Iceland (66°05ôN17° 33ôW) bordered by the town of Húsavík inhabited by approximately 2,500 people (17). The study area covered was estimated to be 1,100 km^2 in SB and 4,440 km^2 in FB.

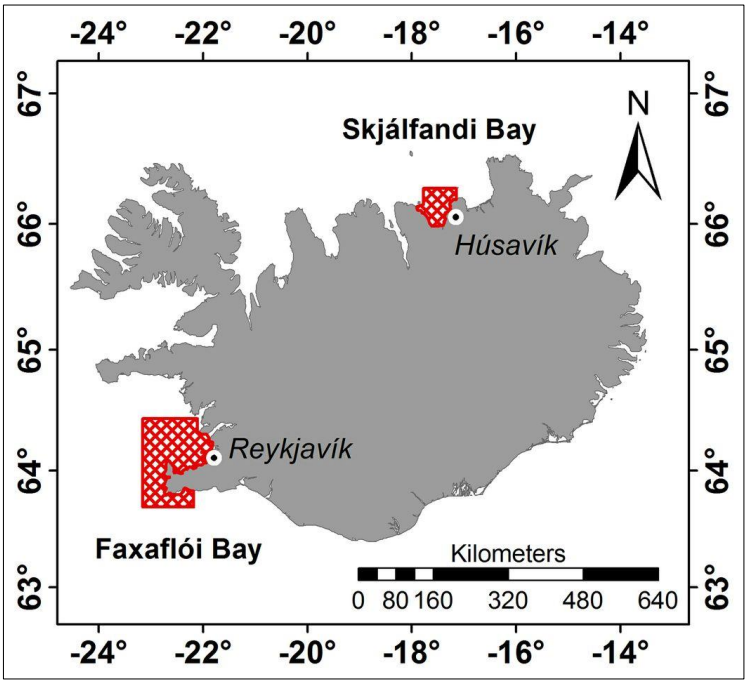

Figure 1: Map of the study area showing Faxaflói Bay and Skjálfandi Bay, Iceland. Surveys were conducted within cross-hatched areas (Map courtesy of Michael J. Tetley).

Data collection and analysis

Cetaceans were photographed using 55-200mm and 70-300mm telephoto lenses in FB, and 28-135mm and 40-150mm lenses in SB. Individual whales and dolphins were identified through natural marks of the dorsal fin (44,56). Their maturity was generally unknown, however none were calves. The body areas most commonly photographed were the back, the dorsal fin and flanks. In the period 2004-2009, 220 and 45 minke whales were photo-identified in FB and SB, respectively. Up to 2009, 286 and 96 white beaked dolphins were photo-identified in FB and SB, respectively. One dolphin (nDEM89) was photographed in both bays.

According to criteria of proximity, sharpness and luminosity, photographs were classified into three categories: good, average and poor. The latter were not used in this study. Images with cutaneous anomalies were extracted and examined by two scientists (MFB, KVW) with extensive expertise in the epidemiology of skin anomalies. Disorders were classified on the basis of their morphological features into five main categories in accordance with current cetacean literature.

1. Lesions of possible infectious origin

In this category we included cutaneous conditions whose macroscopic appearance was consistent with a known disease. However, as biopsy sampling and histological analysis were unfeasible and the aetiology of the lesions could not be confirmed we added the suffix ó-like' to these conditions. Tattoo-like lesions are irregular hyperpigmented marks with a dark outline evoking the stippled pattern seen in positively diagnosed tattoo skin disease (19,49). Herpes-like lesions are defined as small black dot lesions resembling those associated with herpesvirus capsids observed by transmission electron microscopy in skin samples of Peruvian dusky dolphins (*Lagenorhynchus obscurus*) (45). Wart-like lesions are defined as hyperplasic lesions similar to the warts documented in harbour porpoises (*Phocoena phocoena*) in the Bay of Fundy and German waters and in a captive killer whale (*Orcinus orca*) of Icelandic origin (9,20,46).

2. Marks caused by parasitic fishes

Single or numerous, oval-shaped scars and fresh, crater-like wounds were attributed to predation (bites) of cookiecutter sharks (15,27,42). Some fresh and healed lesions, greyish or pale coloured, showing a slightly more circular than oval aspect and with more

texture, including raised borders, were considered probable bite marks by sea lamprey *Petromyzon marinus* (29,38,54).

3. Epizoa

The parasitic copepod *Pennella balaenopterae* (Siphonostomatoida: Pennellidae) and the commensal semi-stalked barnacle *Xenobalanus globicipitis* (Cirripedia: Coronulidae) were recognized by their morphological characteristics (30).

4. Traumatic wounds and scars

In this category we included large wounds and scars of anthropogenic (collisions with vessels, fishing gears or debris), antagonist (predation by killer whales) or of unknown origin (13,25,51). We photogrammetrically estimated the distance between tooth rakes on the basis of a mean dorsal fin height of 28.8 cm (n= 128, SD= 4.50 cm, Median= 29cm,[b] for minke whales and of 25.3 cm (n= 11, SD= 5.3, Median= 26cm)[c] for white-beaked dolphins.

5. Others

Skin elevations are single or numerous, whitish to dark grey, and vary in diameter from pinhead-size to a few cm (26,50). This category included both UV-radiation induced blisters (26) and nodules of unknown origin (50). Expansive annular skin lesions are annular marks with a light centre and a hyperpigmented outline, evoking lesions reported in a fin whale stranded in the UK sometime before 1992 (5), in a Chilean dolphin (*Cephalorhynchus eutropia)* calf from Palena province (48) and in two common bottlenose dolphin calves, one from the Sado estuary, Portugal (47) and another from

	B. acutorostrata		***L. albirostris***	
	Faxaflói Bay, NPI=73	Skjálfandi Bay, NPI=10	Faxaflói Bay, NPI= 76	Skjálfandi Bay, NPI = 14
Cutaneous disorders				
1. Lesions of possible infectious origin				
Tattoo-like disease	0	0	5	1
Herpes-like lesions	3	0	0	0
Wart-like lesions	1	0	0	0
2. Bite marks of parasitic fish				
Isistius spp.	26	6	0	0
Petromyzon marinus	7	0	0	0
3. Epizoa				
Pennella balaenopterae	5	1	0	0
Xenobalanus globicipitis	1	1	0	0
4. Traumatic wounds and scars				
Anthropogenic	4	0	15	1*
Antagonistic	2	0	2	1
Linear scars of unknown origin	0	0	12	2
5. Others				
Cutaneous elevations	11	3	1	0
Expansive annular lesions	0	1	0	0

*Table 1: Common skin disorders in minke whales (Balaenoptera acutorostrata) and white-beaked dolphins (Lagenorhynchus albirostris) from Icelandic waters in 2004-2009. Abbreviations: NPI= total number of photo-identified specimens; *dolphin was also seen in Faxaflói Bay.*

[b] G. Víkingsson, Marine Research Institute, Reykjavík, unpublished data; [c] S.D. Halldórsson, Marine Research Institute, Reykjavík, unpublished data.

Monterey Bay, California (37).

Results

Common minke whales

Images of 73 photo-identified whales from FB and 10 whales from SB were considered of sufficient quality for skin disorder evaluation. One to five images were examined for each whale in FB while only one was available for the SB whales.

Of the 73 whales in FB, 69 (94.5%) had some kind of skin disorder (Table 1). 10 individuals suffered 2 or more skin conditions (Table 2). All 10 whales photographed in SB had some sort of cutaneous affliction (Table 1). Besides, 1 non-photo-identified individual in SB also presented lesions that we found relevant enough to report on.

1. Lesions of possible infectious origin

No tattoo-like lesions were discerned in minke whales. Hundreds of dark grey or black dot lesions (Figure 2a) evoking herpes-like lesions were seen on the back, flanks and dorsal fin of 3 whales (DEM92, nDEM42, dDES22) in July and August 2008-2009. Several medium to large areas of hyperplasic, wart-like cutaneous lesions were observed on the flanks, back and head of whale nDEM30 in August 2008 (Figure 2b).

2. Marks caused by parasitic fishes

Single or numerous (over 10), oval-shaped scars in variable shades of grey (Figure 3a) attributable to bites of cookie-cutter sharks were present on the back and flanks of 26 whales from FB and in 6 individuals from SB. Fresh, crater-like wounds were seen in only 1 specimen (DEM30). In whale DEM92 the bites were associated with parallel, sinuous or linear, light grey, sliding marks (Figure 3b). Mostly healed but also some fresh greyish or pale circular lesions, with considerable texture including raised borders, were seen in 7 whales from FB (Figure 3c) and thought to be sea lamprey bite marks. Parallel, sinuous or linear, light gray sliding marks were associated with such injuries in whales dDES03, DEM70 and DEM87 (Figure 3c).

3. Epizoa

1-3 specimens of *Pennella balaenopterae* protruded from the bodies of 5 whales (Figure 3d) in FB and of 1 (dDES06) in SB. *Xenobalanus globicipitis* were attached to whale DEM31 and was possibly present also in dDES06.

4. Scars and wounds of miscellaneous origin

Lesions of anthropogenic origin were observed in 4 minke whales in FB. The long, linear scars on the

	Parasitic fish marks			Epizoa		Scars and wounds			Punctiform marks	Cutaneous elevations
	Isistius	*Petromyzon*	Skidding marks	*Pennella*	*Xenobalanus*	Anthropogenic	Antago-nist	Linear scars		
B. acutorostrata										
DEM87	x	ã	ã	x	x	x	x	x	x	x
DEM92	ã	x	x	x	x	x	x	x	ã	x
DEM31	x	x	x	x	ã	x	x	x	x	ã
DEM98	ã	x	x	x	x	x	x	x	x	ã
DEM88	x	ã	x	x	x	x	x	x	x	ã
DEM99	x	ã	x	ã	x	x	x	x	x	x
DEM61	ã	x	x	x	x	ã	x	x	x	x
nDEM16	ã	ã	x	x	x	x	x	x	x	x
DEM27	x	ã	x	x	x	ã	x	x	x	x
dDES03	x	ã	ã	x	x	x	x	x	x	x
L. albirostris										
DEM152	x	x	x	x	x	ã	x	ã	x	x
nDEM76	x	x	x	x	x	ã	ã	x	x	ã

Table 2: Multiple skin conditions in minke whales (Balaenoptera acutorostrata) and white-beaked dolphins (Lagenorhynchus albirostris) from Faxaflói Bay, Iceland, in 2004-2009.

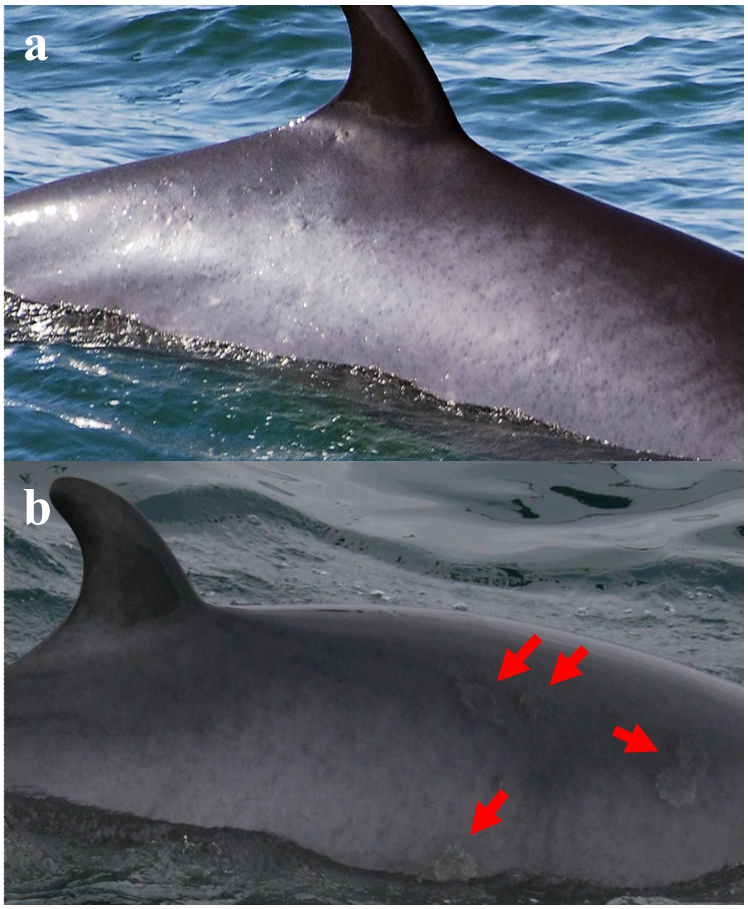

Figure 2: Examples of lesions of possible infectious origin in common minke whales from Faxaflói Bay : (a) dark black dot lesions, nDEM02, August 2007; (b) wart-like lesions, nDEM30, August 2008. Reproduced with permission.

anterior body of DEM27 were suggestive of net entanglement (Figure 4a). The deep scar seen on the tail-stock of nDEM18 may have been caused by a propeller/ship collision or by entanglement (Figure 4b). DEM61 and DEM70 showed deep, but healed, cuts in their dorsal fins. Wounds and scars possibly inflicted by killer whales were present in 2 whales of FB photographed in 2008 and 2009. nDEM33 had large healed tooth rakes on the right flank (Figure 4c) while DEM76 showed large, semi-circular healing wounds and tooth rakes on the right flank and tail-stock. The spaces between tooth rake marks were estimated to measure between 25.6 mm and 27.8 mm i.e. within the range of inter-dental measurements for killer whales (13).

5. Others

Single or numerous cutaneous elevations occurred

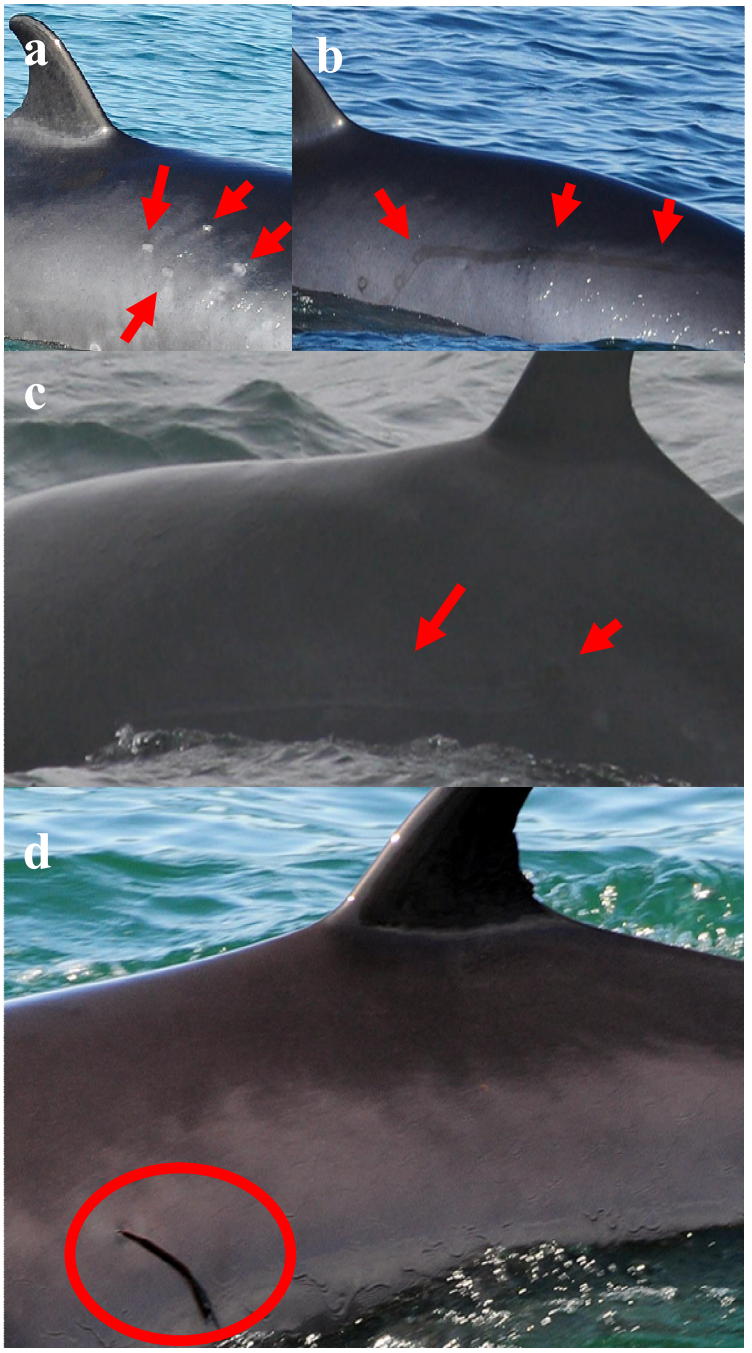

Figure 3: Examples of marks caused by parasitic fishes and epizoa in common minke whales from Faxaflói Bay: (a) oval scars attributed to Isistius spp., DEM109, August 2008; (b) oval scars and associated skidding marks attributed to Isistius spp., DEM92, August 2009; (c) bite mark attributed to Petromyzon marinus, dDES03, June 2008; (d) Pennella sp., DEM99, July 2009. Reproduced with permission.

on the head, back, flanks and dorsal fin of 11 minke whales from FB and 3 whales from SB in 2007-2009 (Figures 5a & 5b). Some were possibly UV-radiation

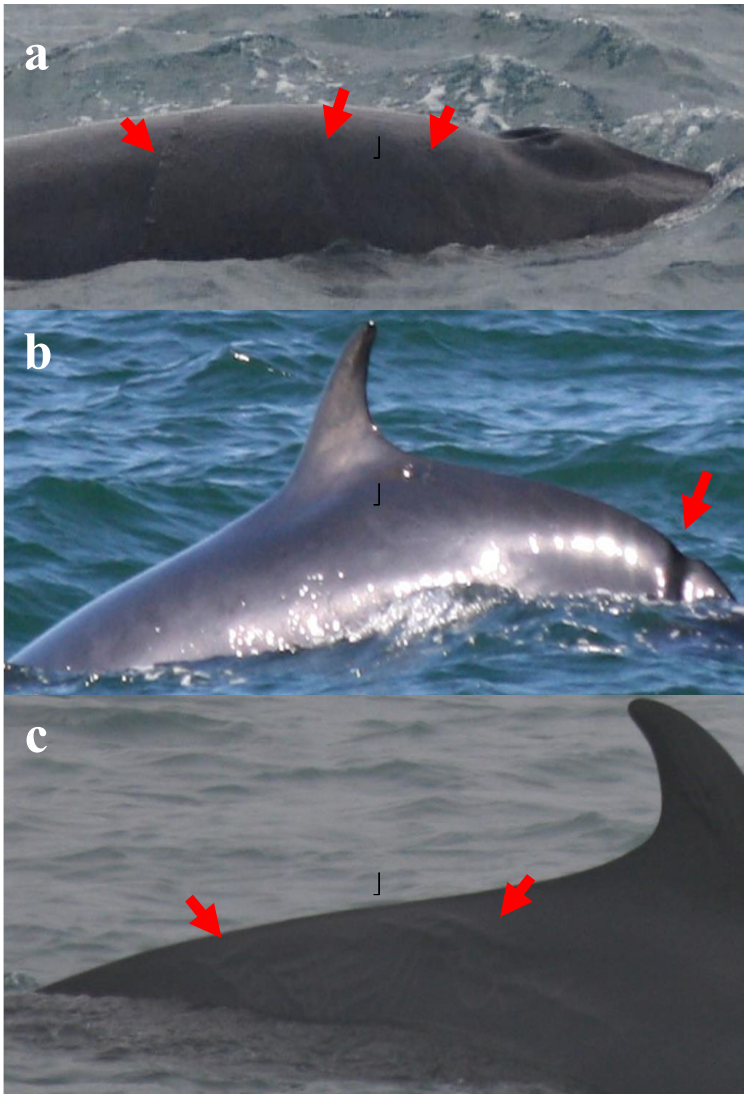

Figure 4: Examples of traumatic wounds and scars in common minke whales from Faxaflói Bay: (a) Linear scars, DEM27, July 2007; (b) deep, healed lesion on tailstock of nDEM18, July 2007; (c) tooth rakes by a killer whale, nDEM33, July 2008. Reproduced with permission.

induced blisters (e.g. nDEM36, Figure 5a) while others may represent a cutaneous inflammatory reaction to predatory fishes and pennellid copepods (e.g. DEM69, Figure 5b). At least 10 medium-sized to large, expansive annular lesions were observed on the back and left flank of a non-photo-identified whale in June 2009 (Figure 5c). The lesions covered an estimated 30% of the visible body.

White-beaked dolphins

Images of 76 FB dolphins and 14 SB dolphins

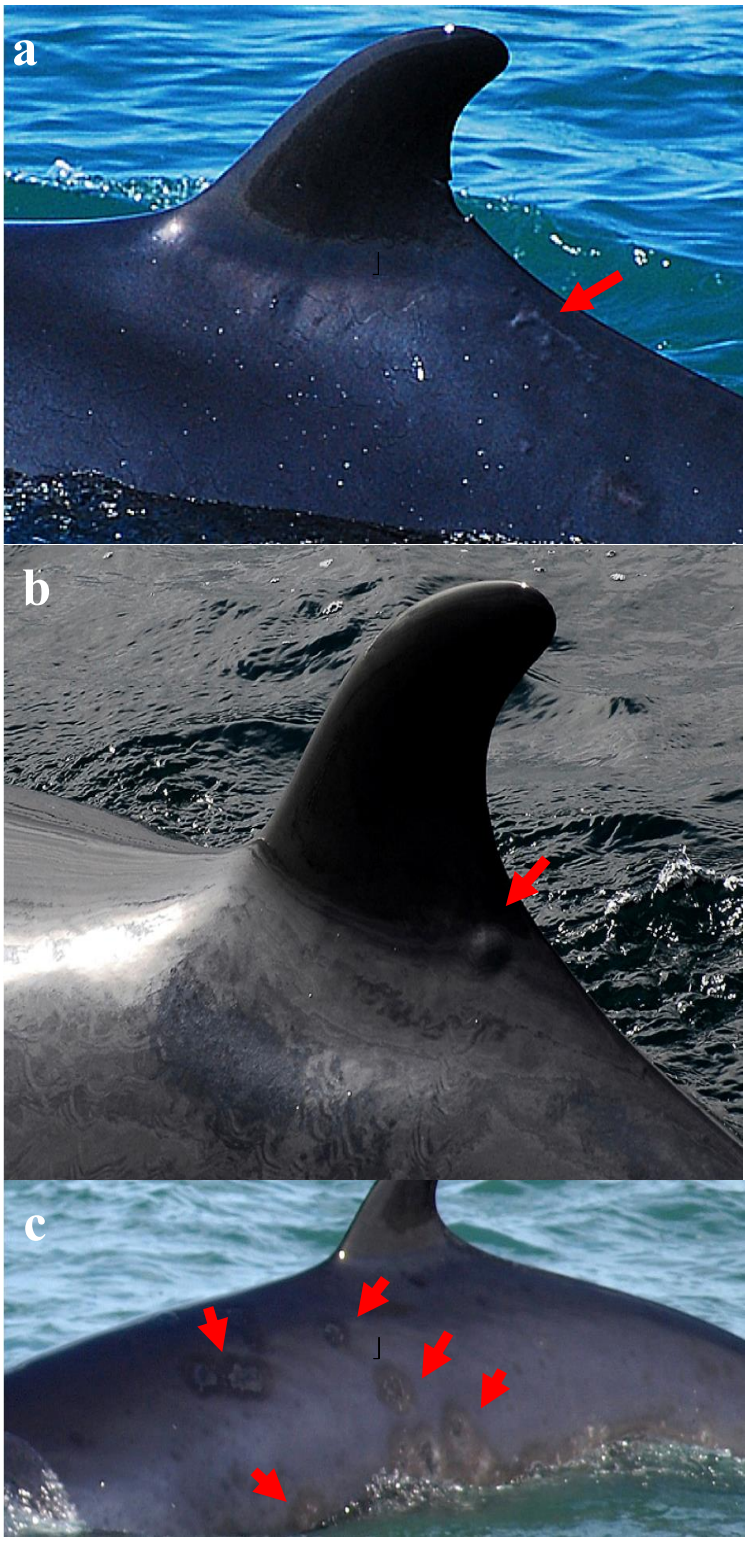

Figure 5: Examples of other cutaneous afflictions in common minke whales from Faxaflói (FB) and Skjálfandi (SB) Bays: (a) cutaneous elevations in DEM69, July 2008, FB; (b) cutaneous elevations in nDEM36, July 2009, FB; (c) annular marks on non-photo-identified minke whale, June 2009, SB. Reproduced with permission.

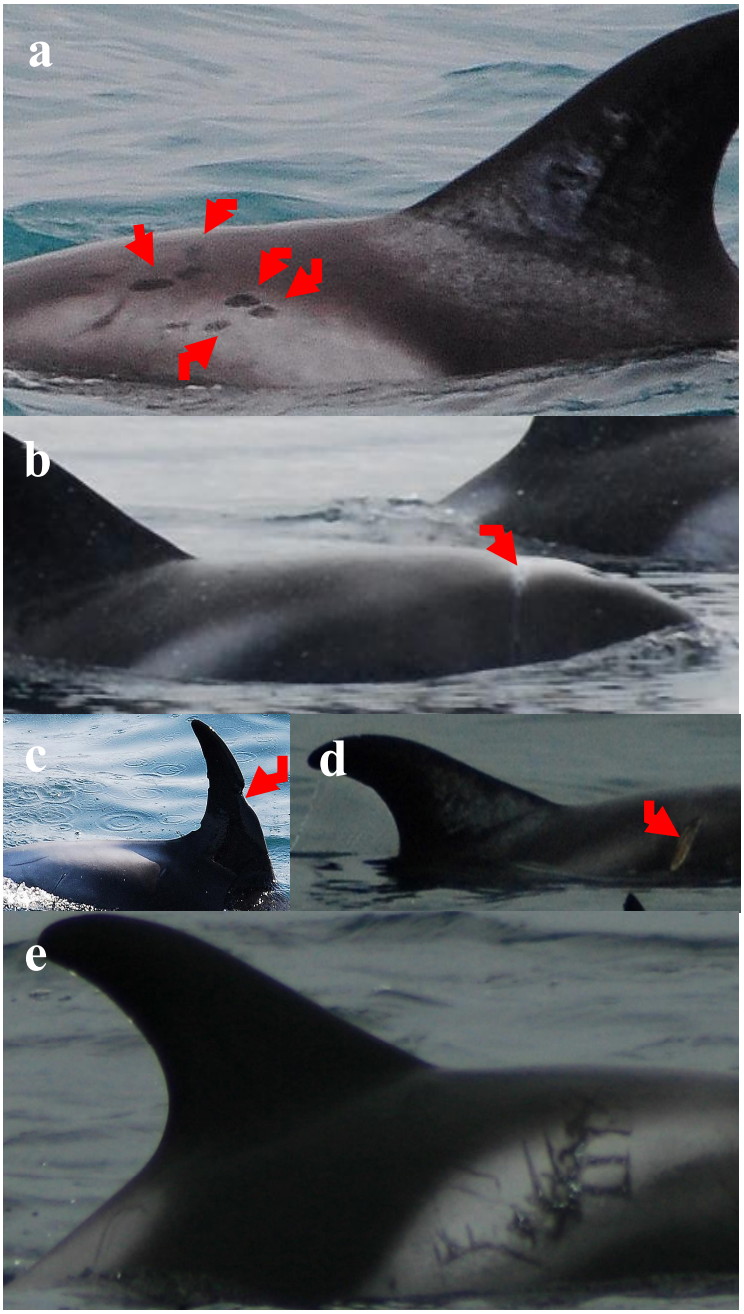

Figure 6: Examples of skin conditions encountered in white-beaked dolphins of Faxaflói Bay: (a) tattoo-like lesions, DEM99, July 2009; (b) gillnet marks, nDEM89, July 2009; (c) healed cuts in dorsal fin of DEM79, August 2009; (d) deep incised wound on the upper flank of DEM 119, July 2008; (e) wide, healing tooth rakes likely inflicted by killer whale on the flank and dorsum of nDEM76, May 2008. Reproduced with permission.

were considered of sufficient quality for skin disorder evaluation. Between 1 and 5 images were available for the diagnosis of cutaneous disorders in FB dolphins. With the exception of (nDEM34) only 1 photograph was available for each of the SB dolphins. Among the 76 white-beaked dolphins from FB, 56 (73.7%) had at least 1 cutaneous condition (Table 1) compared to 5 of 14 (35.7%) dolphins in SB. 2 of the dolphins presented 2 kinds of marks (Table 2). Tattoo-like lesions and traumas were the conditions most often observed. Tattoo-like lesions were observed in 5 white-beaked dolphins from FB in 2007-2009 (Figure 6a) and in 1 dolphin from SB in 2004. Visible on the back, head and flanks, 1-10 lesions ranged from small to large. In dolphin DEM99 from FB (Figure 6a) the lesions increased in size and number over the period May 2008-July 2009. Scars and wounds of anthropogenic origin, as from fishing gear or marine debris, were detected in 15 dolphins from FB. 1 (nDEM89) showed typical net marks behind the head (Figure 6b), 12 had fresh or old traumas on the dorsal fin (Figure 6c) and 2 (DEM119 and DEM152) showed freshly inflicted, deep incisive wounds on the flank and back (Figure 6d). nDEM89 was seen in SB two weeks after the initial sighting in FB and still showed the lesions. Large, healing tooth rakes as from killer whales were present on the back and flank of 2 dolphins from FB (nDEM76 and nDEM83; Figure 6e) and 1 from SB in 2008-2009. In the 3 dolphins the spaces between the rake marks were estimated to measure between 23.3 mm and 31.1 mm *i.e.* within the range of inter-dental space measurements for killer whales (13). Linear scars of unknown origin were noted in 2 and 12 white-beaked dolphins from SB and FB respectively. Numerous (>10), small skin nodules associated with large tooth rakes were detected on the back and right flank of nDEM76 from FB. These were similar to those observed in Indo-Pacific bottlenose dolphins (*Tursiops aduncus*) in Japanese waters (50).

Discussion

This study reports on various cutaneous conditions, traumas and epizoa in common minke whales and white-beaked dolphins photographed in late spring and summer off Iceland in 2004-2009. Skin elevations, hyperplasic lesions, herpes-like lesions and expansive annular lesions are reported for the first time in minke whales.

A wider variety of cutaneous conditions was found in minke whales than in white-beaked dolphins (Table 1), presumably reflecting the different life

histories. While minke whales migrate large distances between high and low latitudes (52), white-beaked dolphins are resident in the cold waters off Iceland (35). Bite marks attributed to cookiecutter sharks were only observed in common minke whales. These sharks inhabit oceanic subtropical and tropical waters of the North Atlantic, predominantly from Cape Verde Islands southwards (27), so common minke whales logically are predated on when migrating and in their southern breeding grounds (15,21). Most bite injuries appear to heal before the northbound spring migration ends in Icelandic waters, considering that fresh wounds were detected in only one whale (DEM30). Bite marks attributable to sea lamprey predation were seen in this study on 7 common minke whales. *P. marinus* was previously reported off Iceland on both common minke whales and killer whales (30,38) and a specimen of *P. marinus* was observed attached to a common minke whale in Faxaflói Bay in July 2011[d]. This parasitic fish has been noticed more frequently in Icelandic waters since it was first recorded in 1998, possibly because of gradual increases in sea temperatures (2,3). The sliding marks sometimes found associated with bite marks are thought to result from parasitic fish skidding over the skin to reattach at a more favourable location (29,32,40). During the present study, the copepod *P. balaenopterae* was exclusively observed in common minke whales with numbers seen during surfacing varying between 1 and 3. Though *P. balaenopterae* has a global distribution and has been reported embedded in the flesh of a wide variety of cetacean species including the striped dolphin (*Stenella coeruleoalba*)(4), white-beaked dolphins do not seem to be a host species for *Pennella*. Tattoo-like marks were recognized in 6 white-beaked dolphins in this study. TSD is common in odontocetes from the Atlantic and Pacific Oceans (49). If confirmed in white-beaked dolphins from Icelandic waters, it would constitute the northernmost distribution of TSD in odontocetes. The lesions increased in size and number over a 14 month-period in 1 dolphin. Though poxviruses and TSD have been observed in mysticetes from the Northern (*Balaena mysticetus* and *Eubalaena glacialis*) and Southern (*Megaptera novaeangliae*) Hemispheres (6, 10, 24), they were not detected in minke whales.

Large traumatic scars and wounds were found in both species studied. Lesions consistent with fisheries interactions were seen in the whales and dolphins from FB. Of concern is the high percentage of white-beaked dolphins (19.7 %, n= 76) with such traumas suggesting that interactions occur frequently. Bycatches of white-beaked dolphins have occasionally been reported in Icelandic fisheries but there are no accurate estimates (33,53). External injuries following interaction with fisheries may result in secondary mortality of unassessed numbers of escaping but injured dolphins and whales (1,36). The deep scar seen on the tailstock of whale nDEM18 may have been caused by a ship. Collisions with vessels are a well-documented conservation problem for several cetacean populations worldwide including common minke whales (25,51). Injuries attributed to killer whale predation were seen in white-beaked dolphins and common minke whales in both bays. A group of killer whales feed on the Iceland summer spawning (ISS) stock of Atlantic herring (*Clupea harengus*). Its distribution has followed the movements of its prey that migrates throughout the year from overwintering to spawning and feeding grounds (18,31,39). In FB and SB killer whales have occasionally been sighted and, on 23 July 2008, a pod was spotted hunting and feeding on a minke whale in SB[e]. Predation on aquatic mammals (*Phoca vitulina, Halichoerus grypus* and *B. acutorostrata*) and seabirds by members of the herring-eating population of killer whales has been documented in Icelandic waters and around the Northern Isles in Scotland (18).

Other conditions in Iceland's cetaceans such as herpes-like black dot lesions, wart-like hyperplasia and expansive annular lesions demonstrate the variety of disorders for which aetiology and pathogenesis remain elusive, underscoring the need for dedicated epidemiological and clinical research. Despite extensive literature survey we found no reports of wart-like and herpes-like lesions in other mysticetes. Expansive annular lesions were described in a fin whale from the British Isles (5) and in a humpback whale in the Antarctic[f]. Some of the cutaneous elevations observed in minke whales may be the consequence of acute sun damage (26) pending confirmation. The nodules seen in dolphin nDEM76 may result from scarring or an inflammatory process secondary to injuries sustained after a killer whale attack. Several infectious agents including herpes viruses have the potential to cause

[d] C.G. Bertulli, unpublished data; [e] M.H. Rasmussen, pers. com
[f] M.-F. Van Bressem & K Van Waerebeek, unpublished data.

debilitating and potentially lethal diseases in cetaceans (41). Expansive annular lesions have been linked to the death of two calves (*Cephalorhynchus eutropia* and *Pseudorca crassidens*) in the Southern Hemisphere[f] and are considered an indicator of a degraded environment (47,48).

Conclusions

The present study highlights the usefulness of photo-identification as an opportunistic, non-invasive research tool to establish, in relative terms, what 'normal' cutaneous health may entail and to monitor over time the presence of cutaneous conditions in whales and dolphins. However, the fact that prevalences cannot be reliably determined due to partial body exposure during surfacings is a significant downside. Long-term visual health assessment surveys combined with a detailed analysis of anthropogenic factors affecting cetaceans in Icelandic coastal waters may provide useful insights for cetacean management and conservation.

Both minke whales and white-beaked dolphins exhibited distinct skin conditions of anthropogenic, antagonistic, infectious and parasitic origin. While micro- and macro-parasites and predators evidently have interacted with host species over evolutionary time -scales, recent factors including fisheries, whaling, ship collisions, climate change, chemical and acoustic pollution cause additional pressures. Whether these factors might synergistically affect general health through an increase in traumatic injuries, modifications in prey-predator and parasite-host relationships, and ultimately whether it could lead to higher morbidity and mortality, should be of conservation concern.

Acknowledgments

Photo-identification studies have been conducted in collaboration with Elding Whale-watching (Reykjavik) and North Sailing (Húsavík). Field work was conducted with the help of the Faxaflói Cetacean Research and Húsavík Whale Museum volunteers. We kindly thank Dr Juan Antonio Raga, Francisco Aznar, Droplaug Ólafsdóttir, Gisli Víkingsson, Sverrir D. Halldórsson, Filipa Samarra, Dave Snow for helpful comments or data, Dave Janiger for making several papers available and JMATE reviewers for their constructive comments. Dr M Rasmussen, University of Iceland, authorized reproduction of photographs by C. Bertulli and C. Schmidt. Cecchetti partially supported by ERDF through Operational Competitiveness Program & national funds through FCT under project PEst-C/MAR/LA0015/2011.

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