Marianne Rasmussen, Rannsókna- og fræðasetur Háskóla íslands á Norðausturlandi, Húsavík.
Whales in Skjálfandi Bay
Desember 2009

Útdráttur á íslensku.

Algengustu tegundir hvala á Skjálfanda eru hrefnur (Balaenoptera acutorostrata), hnýðingar (Lagenorhynchus albirostris) og hnúfubakar (Megaptera novenagliae). Þar sjást einnig oft hnísur (Phocoena phocoena), steypireyður (Balaenoptera musculus), langreyður (Balaenoptera physalus) og háhyrningar (Orcinus orca). Sumarið 2008 sáust þar einnig andanefjur (Hyperoodon ampullatus) og búrhvalir (Physeter macrocephalus).

Boðið hefur verið upp á hvalaskoðun í Skjálfanda hjá Norður-Siglingu á Húsavík frá árinu 1995 og hjá Gentle Giants frá 2001. Nýleg rannsókn sýnir að hvalaskoðun er lykilþáttur í ferðaþjónustu á Norðurlandi og að hvalaskoðunarferðir hafa haft jákvæð efnahagsleg áhrif á Húsavík.

Hluti hvala hér við land tilheyra staðbundnum stofnum, einkum minni hvalir á borð við hrefnur, hnýðinga (af höfrungarætt), hnísur og háhyrninga. Stærri skíðishvalir (hnúfubakur, langreyður, sandreyður og steypireyður) ferðast hins vegar árstíðabundið norður/suður Atlantshaf tvisvar á ári. Þeir makast í heitari sjó sunnar í Atlantshafi og á vorin koma þeir í fæðuöflun við Íslandsstrendur. Þeir koma m.a. inn í Skjálfanda frá maí til september, þó mest yfir hásumarið. Vitað er að sömu einstaklingar, t.d. hnúfubakar, komi inn í sömu firði/flóa við landið ár eftir ár Þeir sjást um allan Skjálfanda og koma oft á tíðum nær alveg upp að landi.

Fjallað er um áhrif segulsvið á hvali og kemur fram að lítið er vitað um áhrif segulsviðs á hvali. Þar kemur einnig fram að ekki hefur verið sýnt fram á með rannsóknum hvort hvalir noti segulsvið til að rata.

Fjallað er um hljóð og hvali. Hljóð gegnir mikilvægu hlutverki í samskiptum hvala. Athuganir sýna að hávaði frá skipum og mikil skipaumferð geti valdið því að hvalir minnki komu sína í hvíldar- og fæðuleit. Einnig kemur þar fram að aukin umhverfishávaði í sjó geti haft áhrif á samskiptafjarlægð og tíðni samskiptahljóða á milli hvala.

Whales in Skjálfandi Bay

By Marianne Rasmussen, Húsavík Research Center, University of Iceland.

Húsavík 1st of December 2009

Whale watching in Skjálfandi Bay

The most common species sighted are Minke whales (*Balaenoptera acutorostrata*), white-beaked dolphins (*Lagenorhynchus albirostris*), humpback whales (*Megaptera novenagliae*), harbour porpoises (*Phocoena phocoena*), blue whales (*Balaenoptera musculus*), fin whales (*Balaenoptera physalus)* and killer whales (*Orcinus orca*). Whale watching have been increasing every year in Iceland since it first started in 1994 (Cecchetti and Rasmussen, 2008). Whale watching have been shown to have economic importance for a local society as Húsavík (Einarsson, 2009; Guðmundsdóttir and Ívarsson, 2008). Salo (2004) used sighting data from the whale watching boats from Húsavík from the summers 1999 – 2002 and Cecchetti (2006) used data from the years 2004 – 2006. Figure 1 shows the tracks of the vessels when going on whale watching trips. The three most common species are humpback whales, Minke whales and white-beaked dolphins.

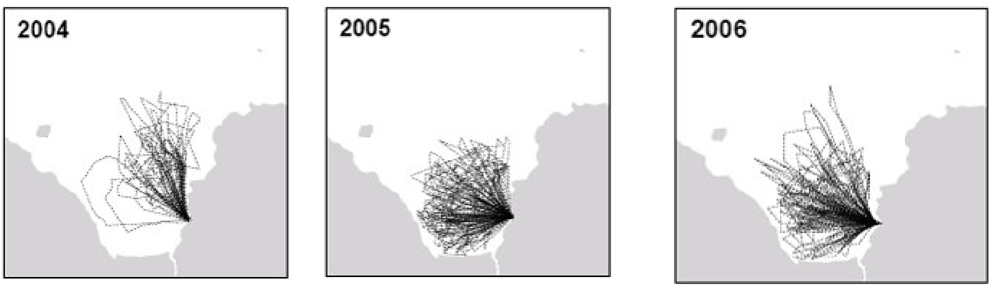

Figure 1: Track of the vessels from 2004, 2005 and 2006 (Cecchetti, 2006).

Figure 2, 3 and 4 show the distribution of the most common cetaceans inside the Bay.

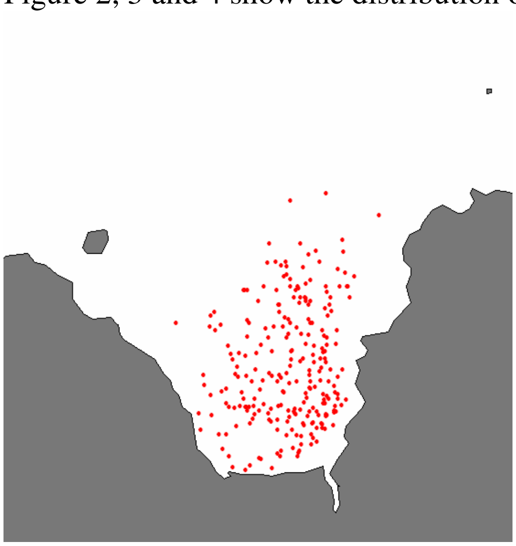

Figure 2: Sightings of Minke whales during the summers 2004, 2005 and 2006 (after Cecchetti, 2006).

Figure 3: Sightings of humpback whales during the summers 2004, 2005 and 2006 (after Cecchetti, 2006).

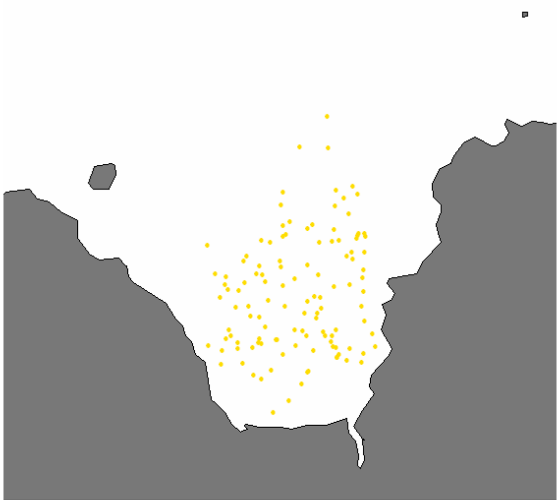

Figure 4: Sightings of white-beaked dolphins during the summers 2004, 2005 and 2006 (after Cecchetti, 2006).

It was shown during the summer 2008 that it was possible to follow and study the distribution and abundance of whales and the interactions with boats from the light house in Húsavík (Guðrunardóttir, 2008).

Table 1 gives an overview of different species of cetaceans that has been seen in Skjálfandi bay during the summers 1995 – 2006.

Species	Year	Month
*Balaenoptera acutorostrata**	1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006	May, June, July, August, September
Balaenoptera physalus	1996, 1998, 1999, 2001, 2004, 2005	August
Balaenoptera borealis	1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004	not available
*Megaptera novaeangliae**	1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006	May, June, July, August, September
Balaena musculus	1997, 1999, 2000, 2001, 2002, 2004, 2005, 2006	June, July
Physeter macrocephalus	2006	May
Hyperoodon ampullatus	1997, 1999, 2001	Not available
Orcinus orca	1995, 1997, 1998, 1999, 2000, 2001, 2003, 2004, 2005	July, August
*Lagenorhynchus albirostris**	1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006	May, June, July, August, September
Lagenorhynchus acutus	2004	July
*Phocoena phocoena**	1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006	May, June, July, August, September

Table 1: Sightings of cetaceans in Skjálfandi Bay from 1995 to 2006. Data source "North Sailing" Whale watching company (after Cecchetti, 2006).

Seasonal distribution and diving behaviour of whales in Skjálfandi Bay

Salo (2004) and Cecchetti (2006) used the data from the whale watching boats to look at the seasonal distribution of the whales in Skjálfandi Bay. Figure 5 shows the seasonal distribution of dolphins from the years 1999 – 2002. Figure 6 shows the seasonal distribution of Minke whales from the years 1999 – 2002. Figures 7 – 9 show the seasonal distribution of dolphins (Figure 7), Minke whales (Figure 8) and Humpback whales (Figure 9) during the years 2004 – 2006 in Skjálfandi Bay. SPUE is the sightings per unit effort.

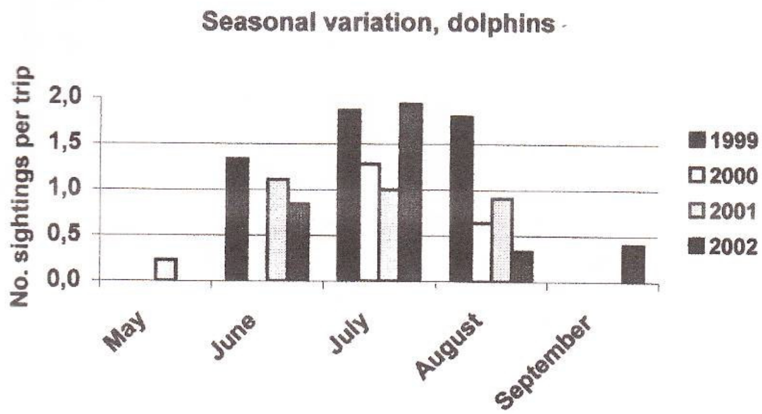

Figure 5: Seasonal variation of dolphins in Skjálfandi Bay from the years 1999 – 2002 (after Salo, 2004).

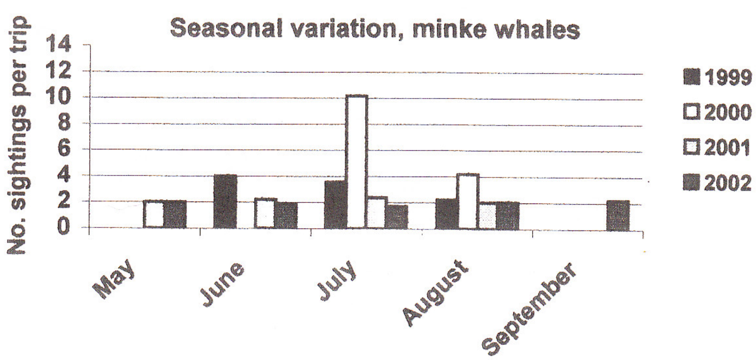

Figure 6: Seasonal variation of Minke whales in Skjálfandi Bay during the years 1999-2002 (after Salo, 2004).

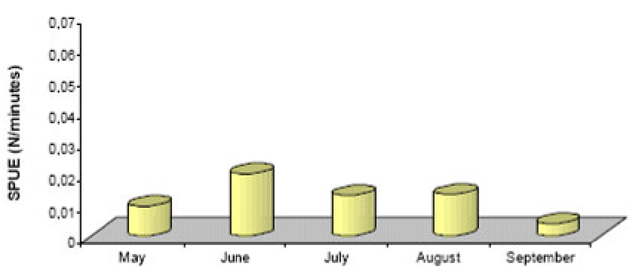

Figure 7: Seasonal variation of dolphins in Skjálfandi Bay during the years 2003 – 2006 as function of SPUE (sightings per unit effort)(after Cecchetti, 2006).

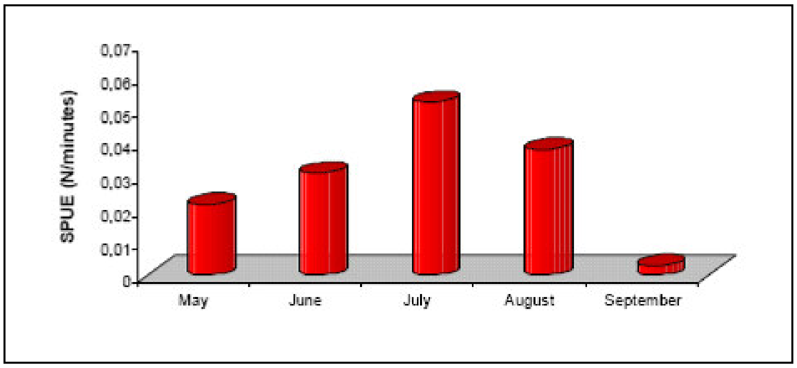

Figure 8: Seasonal variation of Minke whales in Skjálfandi Bay during the years 2003 – 2006 as function of SPUE (sightings per unit effort)(after Cecchetti, 2006)

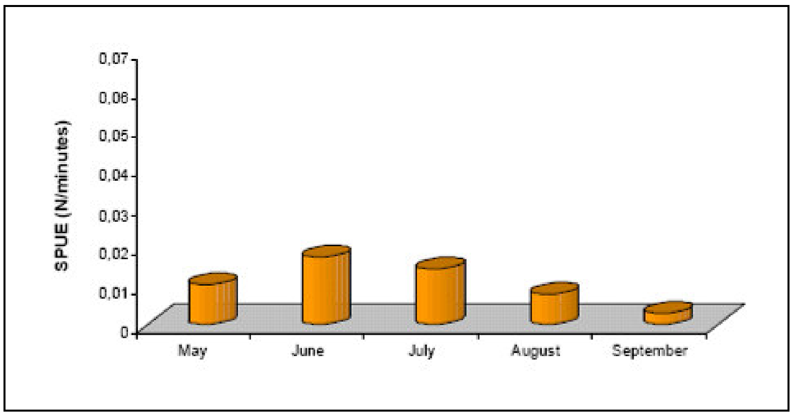

Figure 9: Seasonal variation on humpback whales during the years 2003 – 2006 as function of SPUE (sightings per unit effort)((after Cecchetti, 2006)

Iversen et al. (2009) studied the diving behaviour of blue whales and Cecchetti et al. (2008) studied the diving behaviour of humpback whales in Skjálfandi Bay. They used the whale watching boats as a platform for getting the data. The mean dive time was 3 minutes and 47 seconds (n=61) for blue whales (Iversen et al, 2009) and Mean Dive Time (MDT) was up to 8.38 minutes (n =50) for humpback whales (Cecchetti et al, 2008).

Migration and magnetic field

Baleen whales, such as Blue whale, Fin whale, Humpback whales, Minke whales and Sei whale, migrate north and south twice a year. They mate in warm water and in the North Atlantic they travel to Iceland to feed during the summer. Some humpback whales have been re-sighted in the same bay in Iceland from one year to the next (personal observation). Some baleen whales stay in Icelandic waters all year round, as for example a humpback whale was sighted in Skjálfandi Bay in December 2008 (personal observation). Minke whales have recently been tagged with satellite transmitters in Icelandic waters (Vikingsson and Heide-Joergensen, 2005). One of the animals swam all the way from Faxaflói Bay to 1000km northwest of the Cape Verde Islands (Vikingsson and Heide-Joergensen, 2005).

Sperm whales as the largest of the tooth whales are migrating as well. Migrations of sperm whales are not as regular or as well understood as those of baleen whales (Whitehead, 2002). Killer whales have not been tagged in Icelandic waters, but we know from satellite tagged killer whales in Norwegian waters in 2000 and 2001 (http://www.imr.no/english/activities/the_herring__killer_whale_interaction_project/the_whales). Of the smaller tooth whales only one male white-beaked dolphins has been tagged with a satellite tag in August 2006 (Rasmussen et al, 2007). That individual swam from Faxaflói Bay and swam north to Breiðafjördur, Isafjördur and ended close by Westman islands in February 2007. Harbour porpoises have been tagged with satellite tags in Denmark (Teilmann, 2000). Male harbour porpoises tended to swim longer distances than females, the females harbour porpoises tended to stay more in local area (Teilmann, 2000). We do not have any knowledge about the movements of harbour porpoises in Icelandic waters. We know from a photo-identification study in Faxaflói Bay that the same individuals have been re-sighted up to nine times during a three month period (Rasmussen and Jacobsen, 2003). We do not know the sex of these animals, but it could be that female white-beaked dolphins stay in more local areas and not migration as far as the males as the example with harbour porpoises in Danish waters.

It is not known if cetaceans use a magnetic sensory system when migrating. Walker et al. (2002) describe magnetic sense and its use in long-distance navigation by animals and Kirschvink et al. (2001) describe magnetite-based magnetoreception. It has been suggested that correlation between coastal locations of cetaceans and live stranding are due to the whales possess a magnetic sensory system (Klinowska, 1985; Kirschvink et al., 1986). However experimental evidence is still missing. Walker et al. (1992) demonstrated statistically reliable associations of sighting positions of fin whales with areas of low geomagnetic intensity. Aluminum smelters use high-amperage DC current, which generate locally intense magnetic fields. It could affect both whales and birds. The question becomes the spatial scale of the magnetic anomaly outside the plant area.

Sound and whales

Sound is very important for marine mammals. Often vision can not be used due to poor visibility under water and the whales have to rely only on sound for communication, tooth whales also for navigating and for finding the prey. Tooth whales use sound for echolocation, these are often in high frequencies (Au, 1993; Au, 2000) and even their communication sound can be in the frequency range from 1 kHz – 35 kHz (e.g. Rasmussen and Miller, 2002). Baleen whales on the other hand communicate using low frequencies from 10 Hz – 2 kHz depending on the species (Richardson, 1995). Most species are able to hear the same frequencies as they produce. Audiograms have been made for several species in captivity, so far we only know what some tooth whales can hear and we don't know the hearing of any baleen whales. For instance bottlenose dolphins are able to hear up to 150 kHz (Au, 1993).

Target species – Sound production and hearing

The most common species sighted during the whale watching trips in Skjálfandi Bay are humpback whales, Minke whales and white-beaked dolphins. Humpback whales and

Minke whales are baleen whales. In addition blue whales have been sighted in June and July and a few times fin whales have been spotted as well. Humpback whales make sound around 1 – 8 kHz, Minke whales make moans around 60 - 140 Hz, blue whales make moans in the frequency range 12 – 390 Hz and fin whales make moans in the frequency range 14 – 118 Hz (Richardson, 1995; Au and Hastings, 2008). We don't know anything about the hearing of these species. White-beaked dolphins produce whistles with a fundamental frequency from 1 kHz – 35 kHz and echolocation clicks with energy up to 250 kHz (Rasmussen and Miller, 2002). Auditory brainstem method was used to investigate the hearing of a white-beaked dolphin. That individual had best hearing around 100 kHz, but it could hear up to 180 kHz (Nachtigall et al., 2008). Harbour porpoises and killer whales are also sighted in Skjálfandi Bay. Harbour porpoises make narrow band clicks centered about 130 kHz (Au et al., 1999). Killer whales produce three types of sound: whistles, calls and echolocation clicks (Ford et al., 1989). The clicks have a centre frequency of 22 – 80 kHz (Au et al., 2004 and Simon et al., 2007). Whistles have been described as signals with frequencies ranging between 1.5 and 18 kHz, with most of the energy in the 5 – 8 kHz frequency band and with durations ranging from 50 ms up to 18 s (Ford 1989, Thomsen and Franck 2001). The mean peak frequency for calls reported from Norwegian killer whales is 3 kHz and the mean duration of the call is about 1 s (Strager 1995). Simon et al., (2006) recorded calls from Icelandic killer whales with very low peak frequencies (about 700 Hz). Calls from 'resident' groups can be heard over distances of several kilometers (Miller 2000a in Deecke et al., 2005) whereas the 'transient' calls are often weaker in amplitude (Deecke et al., 2005). Table 2 gives an overview of the different type of sound produced by the different species of cetaceans.

Species	Sound type	Frequency	Reference
Blue whale	Moans	12 – 390 Hz	Richardson et al. (1995)
Fin whale	Moans	14 – 118 Hz	Richardson et al. (1995)
Humpback whale	Moans	1 – 8 kHz	Richardson et al. (1995)
Minke whale	Moans	60 – 140 Hz	Richardson et al. (1995)
Sperm whale	Clicks	14 – 16 kHz	Møhl et al. (2003)
Killer whales	Clicks, calls, whistles	22 – 80 kHz, 700 Hz – 3 kHz, 1.5 and 18 kHz	Au et al. (2004), Simon et al. (2007), Strager et al. (1995), Simon et al. (2006), Thomsen and Frank (2001)
White-beaked dolphins	Clicks, whistles	10 – 250 kHz, 1-35 kHz	Rasmussen and Miller (2002)
Harbour porpoises	Clicks	120 – 140 kHz	Au et al. (1999)

Table 2: Different type of sound produced by different species of cetaceans.

Table 3 gives an overview of hearing abilities of different species of cetaceans.

Species	Hearing (frequency range)	Reference
Blue whale	Unknown	
Fin whale	Unknown	
Humpback whale	Unknown	
Minke whale	Unknown	
Sperm whales	Unknown	
Killer whales	15 – 30 kHz	Hall and Johnson, (1971)
White-beaked dolphins	16 -181 kHz	Nachtigall et al. (2008)
Harbour porpoises	3 – 70 kHz	Andersen (1970)

Table 3: Hearing abilities of different species of cetaceans.

Noise effects on marine mammals

Ambient noise exists in the ocean, this can be wind or wave-generated, coming from earthquakes or from biological sources such as whales or fish. Vessel traffic increases the ambient noise level. Ocean noise and boat traffic have been shown to have an affect on the distribution of marine mammals. These include the following examples: Bottlenose dolphins in Australia decreased their feeding and resting behaviour with many dolphin watching boats (Crosti and Arcangeli, 2001). Areas most heavily used by inshore boat traffic were seldom visited by Indian humpback dolphin (*Sousa plumbea*) in South Africa (Karczmarski et al. 1997).

The effects could be physical (auditory or non-auditory), perceptual (like changing the frequency of vocalization), behavioral (changing of behaviour or displacement from an area), chronical/stress (for example decreased viability of individual or Increased vulnerability to disease) or indirect effects (Reduced availability of prey, increased vulnerability to predation or other hazards, such as collisions with fishing gear, strandings etc.).

Noise from ships dominates marine waters and emanates from the ships' propellers, machinery, and the hulls passage through the water (Gordon and Moscrop 1996). Most shipping has a low frequency range i.e. less than 1 kHz that coincides with the frequencies used, in particular by baleen whales for communication and other biologically important activities. Figure 10 shows example of ship noise. In general, older vessels produce more noise than newer ones and larger vessels produce more than smaller ones (Gordon and Moscrop, 1996). Ross (1976) noted that noise from a supertanker (at 6.8 Hz) could be detected 139-463 km away. Figure 11 shows an example of noise from a supertanker. Although, typically shipping produces frequencies below 1 kHz, small leisure craft generate sound from 1 kHz, up to 50 kHz range (Evans 1996) which has the potential to impact toothed whales also. Evans et al. (1992) studied the effects of pleasure craft on bottlenose dolphins and reported that the cetaceans exhibited negative responses to boat traffic, including changes in dive times and the avoidance of an approaching vessel at a distance of 150 - 300m.

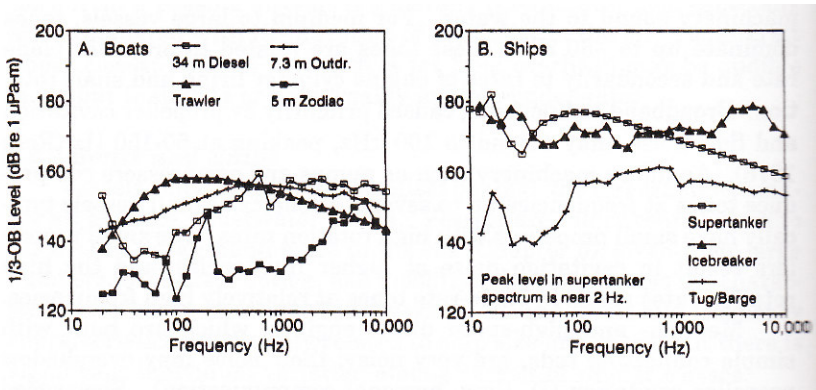

Figure 10: Noise from boats and ships (after Richardson et al., 1995)

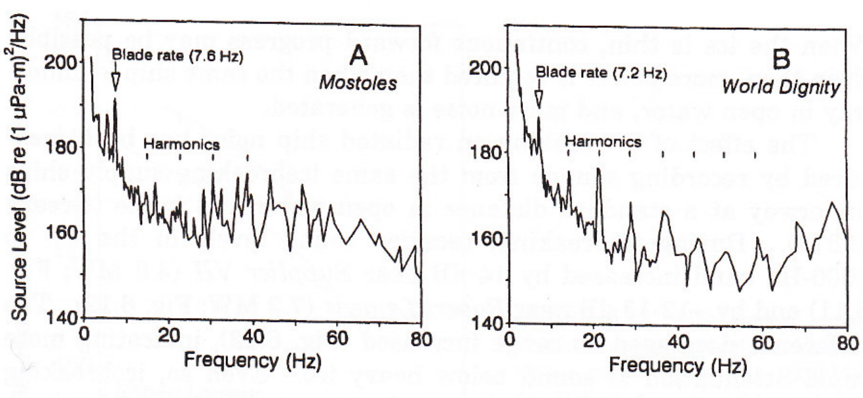

Figure 11: Noise from two different super tankers (after Richardson et al., 1995)

The best evidence for noise being fatal comes from the multiple species stranding in the Bahamas in 2000, where dissected animals showed hemorrhaging in their inner ears and brain as a result of an intense, acoustic event. The U.S. Navy later admitted that its own tactical, mid-range sonar was the most plausible cause of the injuries and stranding. No one had predicted such a severe, immediate reaction, especially as the sonar appears to have caused a population-level effect. The resident population of Cuvier's beaked whales was probably destroyed, or at least seriously displaced. (Simmonds et al., 2003).

Other less profound effects are the changing of the sound produced by the whales in order to be able to communicate. For example, Wiggins (2001) observed that blue whales vary the intensity of their sound production level in response to varying ambient noise levels and also killer whales have been shown to change the frequency of their communication signals with increased ship traffic (Foote et al., 2004).

Acoustic Thermography of Ocean Climate (ATOC) a program led by the US Scripps Institute of Oceanography that utilize the deep sound channel reportedly to gain measurements of average ocean temperature. Results from the aerial surveys conducted as part of the ATOC Marine Mammal Research Program showed that both humpback and sperm whales were generally seen farther from the sound source during experimental compared with control surveys ($p<0.05$) (Calambokidis et al., 1998).

Dredging comes in many forms. It can be for removing silt and sediment from the seabed, or as a means of fishing for shellfish. No dredging though will be done for the construction of the Acloa-Bakki plant, but it will be during construction of a new harbour in Húsavík. Figure 12 shows the effect of dredging with range. Several studies have documented the effects of underwater noise produced by dredging operations on cetaceans. For example, grey whales avoided the Laguna Guerro Neggro, Baja, California, for several years after dredging operations started in the area (Bryant et al., 1984). In addition, bowhead whales exposed to playbacks of dredger noise recordings at broadband received levels of 122-131 dB were displaced from the area (Richardson et al., 1985a, 1985b; 1990; Wartzok et al., 1989). Bowhead whales stopped feeding and moved until they were over 2 km away from the sound source. Moreover, whale vocalizations decreased and changes in surfacing, respiration and diving patterns were recorded (Richardson et al., 1985a, 1985b; Wartzok et al., 1989).

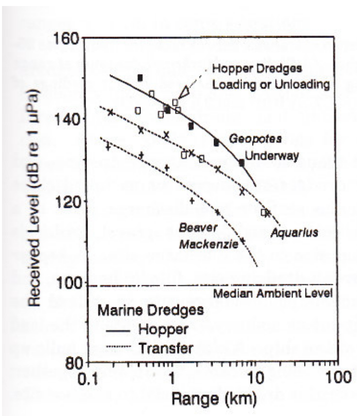

Figure 12: Dredging noise versus range (after Richardson et al., 1995)

Case study – white-beaked dolphins and noise

Currently we don not have any measurements of ambient noise level in Skjálfandi Bay, but we do have measurements from Faxaflói Bay (Rasmussen et al., 2006). A calculation of the maximum communication distance for white-beaked dolphins were performed using source level estimates of their whistles and ambient noise level in the bay. The white-beaked dolphins would be able to communicate up to 10.5 Km in Faxaflói Bay under these noise levels. Table 4 shows an example of what effect it will have on white-beaked dolphin communication if noise level is increased. It can be seen on Table 3 that the communication distance decreases significantly with increased noise level.

Noise Level	**Frequency**	Communication Distance
75 dB re. 1 µPa	3 kHz	10.5 Km
110 dB re. 1 µPa	3 kHz	600 m
140 dB re. 1 µPa	3 kHz	22 m
150 dB re. 1 µPa	3 kHz	7 meter

Table 4: White-beaked dolphin communication distances and how these are going to change with increased noise level.

Chemical compounds in air emissions

Chemical compounds in air emissions were investigated by the Norwegians (Statens forureningstilsyn, 2001) from 15 industrial places in Norway including aluminium smelters in Norway (as for example Hydro Aluminium and Elkem Aluminium ANS). Statens forureningstilsyn (2001) found high levels of Beryllium, Aluminium, Vanadium and Nikkel close by Årdal (Hydro Aluminium a.s.). Marine mammals are top predators in the ocean and any heavy metals would be accumulated in them (e.g. Dietz, 2008).

Whales accumulate PAHs. Mikalian et al. (1999) investigated if dental and bone abnormalities could be caused by high exposure to fluorides. They found a difference between the beluga whales from Hudson Bay and from the St. Lawrence Estuary and they suggested difference in diet to explain the difference between these two populations. Belugas feed partly on bottom invertebrates (Martineau et al, 1985). PAHs released from a smelter caused cancer in Belugas (*Delphinapterus leucas*) in the St. Lawrence estuary (Martineau et al., 2002). They examined 129 of 263 beluga carcasses. They observed cancer in 27% of examined adult animals found dead, a percentage similar to that found in humans. The estimated annual rate (AR) of all cancer types (163/100,000 animals) is much higher than that reported for any other population of cetacean and is similar to that of humans and to that of hospitalized cats and cattle (Martineau et al., 2002).

Recommendations of analyzes

Before construction of a possible aluminium plantat Bakki, Húsavík:
1). It would be very important to keep on monitoring the distribution and abundance of whales in Skjálfandi Bay in order to get more predictable base line data.
2). It would be good to have dive time data on more species of cetaceans in the bay. This can be done using the whale watching boat as a platform or better to deploy time-depth recorders (TDRs) on the whales in Skjálfandi Bay. Time-depth recorders have not yet been placed on any whales in Skjálfandi Bay.
3). I would be very important to have a base line data of the acoustic noise from whales in Skjálfandi bay. These base line data does not exists.
4). It would be very important to monitor the acoustic of the whales and to use several data loggers as for example EARs to track the movements of the whales acoustically.
5). It could be an idea to get an idea of what the different whale species are feeding on. This could be done by taking skin samples (biopsies) for stable isotope analyzes.

During construction of an almuninium plant:
1). It would be very important to keep on monitoring the distribution and abundance of whales in Skjálfandi Bay. Do the whales change their distribution and abundance during construction?
2). It would be good to have dive time data on various species of cetaceans in the bay during construction. Does the dive time of the whales change during construction?
3). It would also be important to monitor any possible change in the ambient noise level both for short time and for longer time periods. What is the level of ambient noise during construction?
4). It would be very important to monitor the acoustic of the whales and to use several data loggers to track the movements of the whales acoustically. Do the whales change their movements during construction?

After construction of an aluminium plant:
1). It would be very important to keep on monitoring the distribution and abundance of whales in Skjálfandi Bay. Do we find any difference from our base line study?
2). It would be good to have dive time data on various species of cetaceans in the bay. Do we find any difference from our base line study?
3). It would be very important to monitor the acoustic of the whales and to use several data loggers to track the movements of the whales acoustically. Do we find any difference from our base line study?
4). It would also be important to monitor any possible change in the ambient noise level both for short time and for longer time periods. Do we find any difference from our base line study?
5). It would also be of importance to keep on monitoring the health status of the whales in the bay. Do we find any difference from our base line study during a long term time period?
6). It would also be of importance if whales strand in the area to get samples of different tissues as lungs, kidney for contaminants analyzes. Do we find any difference from our base line study during a long term period?

Summary of possible impacts of an aluminium plant on whales in Skjálfandi Bay

No definite answers can be said beforehand, but it would be important to investigate any possible impact.

Distribution of whales - noise effect on whales
We do not know how a possible increase of underwater noise level due to building and running of an aluminium plant will affect the whales or if increased noise level at the harbor site and fromincreased traffic of large ships will affect the whales, causing avoiding behavior. Studies from other places in the world have shown that increased noise and ship traffic can change the habitat and distribution of whales. It would therefore be important to measure the ambient noise level to have some base line data and to monitor changes in ambient noise level and to keep on monitoring the distribution of whales in Skjálfandi Bay to study any possible change in distribution.

Impact of pollutants on whales
Air born PAH from the aluminium can possibly accumulate in whales that dwell close to the plant for some time. PAH released from an aluminium smelter caused cancer in Belugas in the St. Lawrence estuary in Canada. We do not know the risk for whales in Skjálfandi Bay, especially for white-beaked dolphins and for harbour porpoises which are present year round in coastal waters. We know that the white-beaked dolphins have been sighted all year round in Skjálfandi Bay, but we do not know if it is the same individuals. Baleen whales are thought to mainly be feeding during the summer time at their feeding ground as for example in Icelandic waters and we do not know the long term risk for these species either. Some humpback whales have been re-sighted in Skjálfandi bay from one year to the next. It would be very important with long term studies to monitor the health status of the whales.

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