Monodon monoceros Linnaeus, 1756

English: Narwhal
German: Narwal
Spanish: Narval
French: Narval

Family: Monodontidae

1. Description

Narwhals are completely mottled on the back with white ventral and lateral fields that increase with age. Old males only maintain a narrow dark spotted pattern on the top of the back, whereas the rest of the body is white. Newborns are grey to brownish and develop the mottled pattern after 2 years. The rear margin of the tail flukes is markedly convex and the fin is replaced by a low ridge. Average Body length is 400 cm and 450 cm in adult males and females, respectively, and mass reaches 1000 kg and 1600 kg, respectively (Heide- Jørgensen, 2009).

In males, usually the left one of two elongated maxillary teeth grows and protrudes through the maxillary bones and skin of the rostrum. Some males lack the tusk whereas others may develop two. Females may sometimes have a tusk as well. The largest tusk measured was 267cm long, normal size is 200 cm. The tusk is believed to be a secondary sexual character determining social rank among males (Heide- Jørgensen, 2009). During growth, the tusk spirals and grooves to the left. However, the tusk as a whole does not seem to revolve during growth (Heide- Jørgensen et al. 2008).

2. Distribution

http://www.iucnredlist.org/apps/redlist/details/13704/0/rangemap

Narwhal Monodon monoceros *distribution in the Arctic Ocean and adjacent Greenland Sea, Baffin Bay, Davis and Hudson Strait (Jefferson et al. 2008; © IUCN).*

The narwhal is discontinuously circumpolar and arctic. It is observed very infrequently south of 65°N in Greenland. However, during spring, when distributional ranges may overlap north of Greenland, its range may become circumpolar (Born, 1994). The main part of the population occurs in the eastern Canadian Arctic and west Greenland. Observations by Gjertz (1991) suggest that off Svalbard narwhals concentrate in the north-west area of Spitzbergen.

Narwhals are vagrant south to the coast of Labrador (Rice, 1998), rare to accidental south to Iceland, the Norwegian Sea, the North Sea (south to the British Isles, The Netherlands and Germany), the White Sea, and the arctic coast of mainland Eurasia, and east into the Chukchi Sea and the Bering Sea, as far south as Komandorskiye Ostrova and the north side of the Alaska peninsula (Rice, 1998).

3. Population size

The most recent population estimates come from Nunavut waters in Canadian Arctic waters, where the highest narwhal concentrations are found (Jefferson et al. 2008). Abundance estimates for Somerset (45,358; CV = 0.35; Innes et al. 2002); Admiralty (5,362; CV = 0.5); Eclipse (20,225; CV = 0.36); East Baffin Bay (10,0073; CV=0.31) and North Hudson Bay (5,053; CV = 0.4) sum up to a total of 86,000 individuals (DFO, 2008).

Abundance in Inglefield Bredning and adjacent fjords in northwest Greenland was estimated using aerial digital photographic techniques in August 2001 and 2002, resulting in abundance estimates of 2,297 (95% CI: 1,472-3,122) and 1,478 (95% CI 1,164-1,793) in these two years, respectively (Heide-Jørgensen, 2004). This corresponds to a 10% decline as opposed to line-transect surveys conducted in 1985 and 1986 (Born et al.1994)

In the Eurasian sector of the Arctic the only known estimate of narwhal numbers is from Scoresby Sound and King Oscar Fjord in eastern Greenland. A conservative figure of only 176 was obtained from an aerial line-transect survey carried out in September 1983 by F. Larsen (cited in Hay and Mansfield, 1989). Born (1994) confirms that more detailed data is lacking. He suggests that in this sector, narwhals prefer areas distant from the coast and may number at most a few thousand individuals. There is no recent data available for any of the north-east Atlantic waters (Jefferson et al. 2008; Heide-Jørgensen, 2009).

4. Biology and Behaviour

Habitat: Narwhals are considered deep-water cetaceans, associated with the pack ice (Hay and Mansfield, 1989). Other investigators, however, dispute their characterization as deep-water species, noting that they occur in waters of different depths. Born (1994) suggests that the occurrence of narwhals and belugas (*Delphinapterus leucas*) is mutually exclusive, since summering and wintering grounds differ both in location and time, which seems to exclude competition for food. When both species do occur in the same areas, they seem to reduce competition by foraging at different depths.

Schooling: Most pods consist of 2-10 individuals but they may aggregate to form larger herds of hundreds or even thousands of individuals (Jefferson et al. 1993).

Reproduction: The gestation period is estimated to be 15.3 months. The season of conceptions is March to May and calving occurs during July and August. Since the lactation period exceeds 12 months, the interval between successive conceptions is usually three years, but about 20% of females conceive at the first breeding season following birth of their calves. The annual population birth rate is calculated to be about 0.07. The basic life history features of the narwhal are similar to those of other medium-sized toothed whales (Hay, 1985). Narwhals can reach very high ages: Age estimates based on the racemization of l-aspartic acid to d-aspartic acid in the nucleus of the eye lens yield a maximum estimated age of 115 years in a female specimen. Age at sexual maturity is estimated to be 6-7 years for females and 9 years for males (Garde et al. 2007).

Food: Narwhals feed heavily during migrations, but very little during the open water season (Hay and Mansfield, 1989; Reyes, 1991 and refs. therein). Consequently, stomachs collected from narwhal summer harvests were mostly empty with little evidence of recent feeding. Stomachs collected in late fall and winter harvests had considerable amounts of undigested material with evidence of recent feeding. In summer, Arctic cod (*Arctogadus glacialis*), polar

cod (*Boreogadus saida*), and *Gonatus* squid spp. constituted the narwhal diet. In the fall, *Gonatus fabricii* was the only prey item observed. In late fall and winter, Greenland halibut (*Reinhardtius hippoglossoides*) and *G. fabricii* were the dominant prey items, observed in 51% and 73% of stomachs collected, respectively. Greenland halibut taken by narwhals were on average 39 cm and 556 g and *G. fabricii* were on average 23 g with mean mantle lengths of 85 mm. The low diversity of prey species indicates narwhals have a restricted diet across all seasons (Laidre and Heide- Jørgensen, 2005).

Further prey items include the shrimps *Pasiphaea tarda* and *Hymenodora glacialis* (Hay and Mansfield, 1989; Reyes, 1991 and refs. therein). In Baffin Bay, narwhals fitted with satellite-linked time-depth recorders selected bottom temperature ranges and gradients in their wintering grounds which often coincided with areas of concurrent high density of Greenland halibut and predictable open water in winter pack ice (Laidre et al. 2004). Stomach content analyses suggest that they feed over a wide range of depths, at least in the Baffin Bay area (Hay and Mansfield, 1989). Whales occupying one wintering ground spent most of their time diving to between 200 and 400 m whereas narwhals in a separate wintering ground spent less time at shallow depths and most of their time diving to at least 800 m (Laidre et al. 2003). The deepest recorded diving depth was 1,864m, and dive times usually amounted to 25-30 min (Heide-Jørgensen, 2009).

5. Migration

Throughout the year, narwhals live in close contact to the Arctic pack ice (Born, 1994). They follow the distribution of the ice and move towards coastal areas when these are ice free. During freeze-up, the coastal areas are abandoned and the narwhals move offshore (Heide-Jørgensen, 2002). Observations from airplanes suggest that narwhals overwinter in small groups within heavy pack ice, whereas only a few animals were observed in loose pack ice and open water (Koski and Davis, 1994).

Narwhals instrumented with satellite transmitters in Tremblay Sound, northeast Canada went northwest visiting adjacent fjords before moving south, along the east coast of Baffin Island. The narwhals arrived on the wintering ground in northern Davis Strait in late October. Speed and range of movements declined once the wintering ground was reached. Late summer and winter kernel home ranges were approximately 3,400 km² and 12,000 km², respectively. (Heide-Joergensen et al. 2002). Female narwhals tracked by satellite from their summering ground near Somerset Island in the Canadian High Arctic went to wintering grounds in central Baffin Bay which are spatially discrete from another narwhal wintering ground located earlier. The area of the summering ground was approximately 9,464 km² and the area of the wintering ground was 25,846 km² (Heide-Jørgensen et al. 2003). Resighting of a tagged narwhal 10 years after tagging confirms evidence for site fidelity and for the same migratory schedule and route over large time periods (Heide-Jørgensen et al. 2008).

At summering grounds in West Greenland and Canada, narwhals moved back and forth between glacier fronts, offshore areas and neighbouring fjords (Dietz et al. 2001). When fast ice formed, the whales moved out to deeper water, usually up to 1,000m water depth. In October, the whales moved southward toward the edge of the continental shelf where water depth increases over a short distance from 1,000 to 2,000m. This slope in central Baffin Bay was also used as a wintering ground, and even though the whales seemed stationary in this area, they still conducted shorter movements along the steep continental slope. Narwhals satellite-tracked from Canada and West Greenland were within a few kilometres from each

other at these wintering grounds. The importance of this wintering ground in central Baffin Bay has also been confirmed by aerial surveys (Heide-Jørgensen, 2002).

The regular occurrence of narwhals at Repulse Bay in north-western Hudson Strait suggests that they may overwinter there as well, or possibly in Hudson Strait where they were also observed by McLaren and Davis (Hay and Mansfield, 1989).

The migratory cycle in east Greenland waters is not well known. Apparently narwhals migrate to the north and north-east into the ice fields of the Greenland Sea during May-July. Some whales migrate eastwards to the vicinity of Franz Josef Land and as far east as the new Siberian Islands. A few whales also visit the fjords of north-western Greenland. Their southward migrations in autumn lead them to the southern Greenland Sea, Barents Sea and Denmark Strait (Hay and Mansfield, 1989).

Genetic data shows that narwhals from the eastern Canadian Arctic have little contact with animals from eastern Greenland, and even between geographically close areas, which is attributed to their fidelity to specific summer and autumn feeding grounds (Born, 1994; Palsboll et al. 1997).

6. Threats

Direct catch: The narwhal has been hunted since the earliest times by the Inuit (Reyes, 1991), with an annual take in the order of 1,000 animals. Recent data confirms that these levels are still maintained today, with annual catch rates at 535 and 433 between 2000-2004 in West Greenland and Canada, respectively (Heide-Jørgensen 2009). However, while male narwhals compose most of the landed catch, annual harvest statistics underestimate total numbers of narwhals killed due primarily to the non-reporting of struck-and -killed but lost whales. The estimated total kill of narwhals may exceed the reported landed catch by 40% (Roberge and Dunn, 1990).

The North Atlantic Marine Mammal Commission (NAMMCO) has repeatedly expressed grave concern on the apparent decline of stocks in West Greenland, and while commending Greenland for the recent introduction of quotas, there is still serious concern that present takes of narwhals in West Greenland, according to the advice of both the NAMMCO Scientific Committee and the Canada/Greenland Joint Commission on Narwhal and Beluga Scientific Working Group are not sustainable and will lead to further depletion of the stocks. The quota for Greenland was 385 animals in the 2006/2007 season, again well above the recommended level of 135. In east Greenland, around 100 are assumed to be taken annually, without quotas nor harvest sustainability assessment (NAMMCO, 2006).

Narwhals supply various staples in the traditional subsistence economy. Today the main products are muktaaq and ivory. The large tusks of adult males are sold in the speciality souvenir market both inside Canada and in the global marketplace. The price of narwhal ivory has increased substantially over the past years. Canadian narwhal ivory traditionally was exported to the United Kingdom, then often re-exported. The EEC ban closed the direct link with the United Kingdom. Consequently, new markets developed in Japan and Switzerland. Narwhal hunting remains an important source of food and cash income for residents of some coastal communities in the eastern Canadian Arctic and Greenland. The international ivory trade provided an incentive to procure large tusks, and this may have strongly influenced the nature and intensity of the hunt (Reeves, 1992). However, international trade is now regulated through the Convention on International Trade in Endangered Species (CITES), requiring

national permits for import and export (all Cetacea are listed in either CITES Appendix I or II). Furthermore, Greenland installed a ban on all narwhal product exports in 2006 (Heide-Joergensen, 2009).

Natural enemies: Natural enemies include Greenland sharks (*Somniosus microcephalus*), orcas, polar bears and walrus, although the mortality rates inflicted by these species do not seem to be very high (Born, 1994). The same author reports that narwhals do occasionally become trapped in fast forming ice and may die during the winter because of exhaustion in an attempt to keep the breathing hole open.

Habitat degradation: Because of their prevalence for high-density pack-ice, narwhals are susceptible to man-made as well as natural climatic changes influencing the water currents and ice formation in the Arctic (Heide-Jørgensen, 2002).

Pollution: Anthropogenic threats include pollution via heavy metals and organochlorines (Heide-Jørgensen, 2009). Cadmium concentrations seem to be significantly higher in narwhals than in other cetaceans (Born, 1994 and references therein). Highest Cadmium concentrations were reported from narwhals living along the Canadian coast, whereas lead concentrations were higher in west Greenland animals. Narwhal skin as a whole (in Inuktitut known as "muktuk") is considered to be a delicacy by native Canadian and Greenland people. However, concentrations and patterns of polychlorinated biphenyls (PCBs), chlorinated pesticides, and polybrominated diphenyl ethers (PBDEs) in narwhal blubber from Svalbard, Norway showed a broad range of pollutants in relatively high concentrations. PCBs and pesticide levels in lipid were approximately 9 µg/g 24 µg/g, respectively, while PBDEs 47 levels were approximately 170 ng/g. Compared with other marine mammals from the same area, contaminant levels are among the highest ever measured, indicating a low capacity for contaminant metabolism. These high levels are further explained by substantially high contaminant levels in the benthic diet of narwhals (Wolkers et a. 2006). While PCB and DDT concentrations in West Greenland narwhals were half those found in East Greenland and Svalbard (Dietz et al. 2004), the concentration of total mercury is 0.59 µg/g (wet wt) in narwhal skin as a whole (muktuk), exceeding Canadian Government's Guideline (0.5 µg/g wet wt) for fish export and consumption (Wagemann and Kozlowska, 2005). To conclude, human consumption of narwhal muktuk seems to bear health risks.

7. Remarks

Range states (Jefferson et al. 2008) :
Canada; Greenland; Russian Federation; Svalbard (Norway) and Jan Mayen (Norway).

The species is included in Appendix II of CMS and in Appendix II of CITES. The narwhal is categorized as "Near Threatened" by the IUCN (Jefferson et al. 2008), because there is clear evidence for the ongoing decline of several sub-populations of the species, also attributed to intensive hunting of the species in Canada and Greenland.

The IWC Scientific Committee (2000) recommended that genetic and telemetric studies are needed to identify stocks, and improved catch-reporting (including estimation of hunting loss) should be conducted in Canada and Greenland.

Information on life history, distribution, abundance and actual hunting loss rates are needed to assess and manage the stocks. The probable effects of pollution, industrial development and climatic change should be fully studied, since these may represent a potential threat.

8. Sources

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