Considerable increase in bowhead, blue, humpback and fin whales numbers in the Greenland Sea and Fram Strait between 1979 and 2014

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Abstract In the frame of our long-term study of cetacean abundance and distribution in polar marine ecosystems begun in 1979, a drastic increase in the bowhead Balaena mysticetus North Atlantic “stock” was observed from 2005 on, by a factor 30 and more: from 0.0002 per count between 1979 and 2003 (one individual, n=5430 counts) to 0.06 per count from 2005 to 2014 (34 individuals, n=6000 counts); the most significant part of the increase occurred from 2007 on. Other large whale species (Mysticeti) showed a similar pattern, mainly blue Balaenoptera musculus, humpback Megaptera novaeangliae and fin whales Balaenoptera physalus. This large and abrupt increase cannot logically be due to population growth, nor to survival of a hidden “relic” population, nor to a changing geographical distribution within the European Arctic, taking into account the importance of the coverage during this study. Our interpretation is that individuals passed through the Northwest and/or Northeast Passages from the larger Pacific stock into the almost depleted North Atlantic populations coinciding with a period of very low ice coverage — at the time the lowest ever recorded. In contrast, no clear evolution was detected neither for sperm whale Physeter macrocephalus nor for Minke whale Balaenoptera acutorostrata.

Keywords Greenland Sea, Fram Strait, bowhead whale, blue whale, humpback whale, fin whale


1 Introduction

Populations of large whales in the North (N) Atlantic and N Pacific used to be separated, probably by high ice coverage closing the Northeast and Northwest Passages. Both stocks were submitted to different whaling pressure, the Atlantic one being much more severely exploited than the Pacific one, which resulted in much lower densities in the Atlantic. Most striking is the case of Atlantic bowheads Balaena mysticetus (the “Spitsbergen stock”), very close to depletion with a population level reduced to tens of individuals in the 20th century. Similarly, important differences in population level were noted for blue Balaenoptera musculus, humpback Megaptera novaeangliae and fin whales Balaenoptera physalus¹⁻⁵. In the frame of our long-term study on seabird and marine mammal distribution in polar marine ecosystems, our data have allowed us to note possible temporal evolution in these cetacean numbers.

2 Material and methods

Data were collected during (strip) transect counts from the bridge mainly in the Greenland and Norwegian seas and Fram Strait on 30 expeditions. These summer expeditions basically covered the northern Greenland Sea and Fram Strait, mainly along the 79°N and 75°N transects between Greenland and Spitsbergen; typical examples of Polarstern route are shown in Figure 1 in order to display the important
Considerable increase in whales numbers in the Greenland Sea and Fram Strait
geographical coverage. Each count lasted 30 min, without width limitation; cetaceans were detected with naked eye, observations being confirmed and detailed with 10×50 binoculars; one observer out of three was continuously counting from the bridge during ship’s transects, light conditions permitting; the ship’s speed was 11 knots in open water. Description and comments about the counting method were published previously[6-8]. Basic uncorrected data are presented in this article as numbers per count; they were all collected by the same team, same methodology and, from 1988 on, same platform. For illustration, photos of the main species are included in Figure 2.

3 Results

Bowhead whale Balaena mysticetus used to be very rarely encountered in the Greenland Sea and Fram Strait: during 16 expeditions for a total of 5400 counts from 1979 to 2003 (including the Barents Sea ones) only a single individual was tallied by late Jacques Tahon[10]. This minimal encounter rate seems to correspond to the very low N Atlantic population level, estimated as less than twenty individuals. Drastic increases in encounter rates started from 2005 on – especially from 2007 on: bowheads were encountered in every second expedition with 34 individuals during 14 cruises over 6300 counts, i.e. 0.006 individuals per count, mean value. The increase was thus much more than by one order of magnitude. Changes were as important for other species: from zero to 200 humpback whales Megaptera novaeangliae (0.04 per count), from zero to 70 bue whales Balaenoptera musculus (0.01 per count), from 21 to 670 fin whales Balaenoptera physalus (0.11 per count). Minke Balaenoptera acurostrota and sperm whales Physeter macrocephalus numbers did not increase at a similar level.
As a consequence, numbers of all large whale species pooled strongly increased as well, by one order of magnitude, from 115 (0.02 per count) before 2005 to 1220 after 2005 (0.20 per count) (Table 1, Figure 3). The Sei whale *Balaenoptera borealis* was not included in this discussion, being observed in very low numbers only – less than ten – even if an increase was detected during last decade.

4 Discussion

Older sightings of bowheads used to be very scarce in this area: with a single individual recorded in 1987 and 1990[2, 9], and seven individuals at Franz Josef Land in 1990[10].

In contrast, recent studies of bowhead abundance in the N Atlantic have detected significant numbers: up to 20 individuals were encountered at eight stations in 2006 along a 2000 km long transect[11]. The synthesis of data collected from 1949 to 2009[12-13] showed no clear trend in density but an increase of contacts from 1980 on: this might be due to increasing efforts, e.g. during the *Polarstern* expeditions.

During extensive ship- and plane surveys in 2006—2008, 17 bowheads were encountered in 13 observations[14]. Multiple recordings of bowheads’ calls and songs in the Fram Strait in 2008[15] provide a confirmation of their presence. Seven bowheads were detected during a 850 km long plane transect in the North East Water (NEW) polynya in 2014, plus five out of effort[16]. Moreover a pod of 80 bowheads was noted in the Fram Strait, West of Spitsbergen in June 2015[17] [or a pod of 40 seen twice?], and individuals were recently observed off the Cornwall coast and Scilly Island, United Kingdom[18]. These observations seem to correspond to the important increase we detected in 2005/2007.

Figure 2 Illustration: a, sperm whale *Physeter macrocephalus*; b, humpback whale *Megaptera novaeangliae*; c, bowhead *Balaena mysticetus*; d, blue whale *Balaenoptera musculus*; e, fin whale *B. physalus* and f, Minke whale *B. acurostrata* in the Greenland Sea and Fram Strait (Photos CR Joiris).
### Table 1 Summary of the large cetacean observations in the North Atlantic Ocean, 1979—2012

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Notes: N = total number recorded; mean per count; n = number of 30 min transect counts. Published data from references [8-10, 22-26, 28, 29]
Considerable increase in whales numbers in the Greenland Sea and Fram Strait

It has been suggested that a kind of relic population could have survived, hidden and undetected off East Greenland[16]. This however seems highly improbable, since the area was regularly covered by our study (Figure 1). Considering on the other hand that such a drastic and sudden increase cannot be due to population growth, usually estimated as seven to nine per cent a year[19], the best hypothesis is that the increase can only be due to an inflow from adjacent areas. The proposed interpretation is that very low ice coverage in 2005 and mainly 2007 – at the time the lowest ever recorded – allowed opening of the Northeast and/or Northwest Passages (Figure 4) and that individuals could move from the much more abundant Pacific population to the very low, almost depleted one, in the N Atlantic. The same mechanism might explain the increased bowhead abundance in West Greenland exceeding by far population growth[20]. This possibility was confirmed by the observation in the Northwest Passage of two satellite tagged male bowheads, from West Greenland and Alaska respectively[21].

The fact that other baleen whales (Mysticeti):
humpback, blue and fin whales showed a similar and simultaneous increase seems to support the existence of a single mechanism for the different species. Other species showed a much lower increase – if any – by less than a factor two: sperm whale, Minke whale. This might be explained by the limited depletion of these species in the N Atlantic during the whaling era. The consequence of this interpretation is that separate “stocks” merged into one single N Atlantic population: if so, genetic effects should be detected by future DNA research.

Two important aspects are on the one hand the geographical differences in distribution: bowhead and Minke whale at the ice edge, fin whale in the eastern Greenland Sea (at the shelf slope off W Spitsbergen) and humpback in the western Greenland Sea (at the shelf slope in Denmark Strait). And on the other hand the existence of large seasonal aggregations: 145 humpback whales off East Greenland[22], 140 fin whales off West Spitsbergen[23]. Both factors result in an important heterogeneity/patchiness in the data, making density calculations vain as well as statistical analysis.

One can also consider the risks of consanguinity for the pre-2005 close to depleted bowhead N Atlantic population, now avoided by inflow of new N Pacific individuals.

5 Conclusion

The drastic and abrupt increase in abundance of the N Atlantic bowhead and other large baleen whale populations from 2007 on – starting in 2005 already for some species – cannot be interpreted as reflecting the persistence of a hidden “relic” Spitsbergen population, nor to population growth, nor to changes of distribution pattern within the European Arctic.

The most reasonable hypothesis consists thus in considering an inflow from the higher Pacific populations following opening of the Northeast and/or Northwest Passages in 2005 and 2007, at the time the period with lowest ice coverage ever recorded. The access of the Northwest Passage to individuals from West Greenland and Alaska[21] provides an important argument supporting this interpretation.

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Considerable increase in whales numbers in the Greenland Sea and Fram Strait


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