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Resighting of a Narwhal (*Monodon monoceros*) Instrumented with a Satellite Transmitter

M.P. HEIDE-JØRGENSEN,[1,2] R. DIETZ,[3] K.L. LAIDRE,[1] P. NICKLEN,[4] E. GARDE,[1] P. RICHARD[5] and J. ORR[5]

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ABSTRACT. On 9 August 2001, a male narwhal (*Monodon monoceros*) was instrumented with a satellite transmitter attached to the dorsal side of the tusk in Creswell Bay on Somerset Island in the Canadian High Arctic. The whale was identified five years later, on 22 June 2006, in a photo of a group of narwhals taken from the ice edge in Lancaster Sound. Examination of the position of the transmitter on the tusk showed that the tusk had grown approximately 17 cm in the five-year period. The transmitter was still located on the dorsal side of the tusk and this fact, together with the length of spiral grains at the position of the tag, indicates that the tusk had not turned over (rotated) in the five-year period. The whale was photographed on its spring migration back to the original summer ground where it had been tagged. This resighting confirms evidence for site fidelity of narwhals, as the individual maintained the same migratory schedule and route observed for narwhals from previous satellite tracking studies in Creswell Bay.

Key words: narwhal, *Monodon monoceros*, satellite transmitter, resighting, Arctic, age, growth, tusk

RÉSUMÉ. Le 9 août 2001, un émetteur satellite a été posé sur un narval mâle (*Monodon monoceros*), plus précisément du côté dorsal de sa défense et ce, dans la baie Creswell, à l'île Somerset, dans l'Extrême-Arctique canadien. Cinq ans plus tard, soit le 22 juin 2006, la baleine a été aperçue dans la photo d'un groupe de narvals prise à partir de la lisière de glaces du détroit de Lancaster. L'examen de l'emplacement de l'émetteur sur la défense a permis de constater que la défense avait grandi d'environ 17 cm pendant la période de cinq ans. L'émetteur se trouvait toujours du côté dorsal de la défense et cela, allié à la longueur des fibres torses à l'emplacement de l'étiquette, indique que la défense n'avait pas subi de rotation pendant la période de cinq ans. La baleine a été photographiée pendant sa migration printanière de retour vers l'endroit où elle avait d'abord été étiquetée l'été. Ce repérage permet de confirmer les preuves relativement à la fidélité des narvals à leurs emplacements, car cette baleine avait maintenu les mêmes horaire et trajet migratoires observés chez les narvals à partir d'autres études de repérage par satellite réalisées dans la baie Creswell.

Mots clés : narval, *Monodon monoceros*, émetteur satellite, repérage, Arctique, âge, croissance, défense

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The effect of satellite tagging on cetaceans is the subject of broad discussion: it is difficult to observe and identify long-term behavioral changes since whales are rarely resighted after instrumentation. Furthermore, satellite tags pinned on the skin or dorsal fin are shed within a few months or at most a year, rendering opportunities for observing long-term behavioral changes from resightings nearly impossible. Narwhals (*Monodon monoceros*) and belugas (*Delphinapterus leucas*) offer a rare opportunity for resighting after instrumentation because they have high site fidelity to specific Arctic localities. From late July to late September, these species are concentrated in restricted summering areas close to the shores, where chances for observing them are higher than in other seasons. Satellite tags have been mounted on the dorsal ridge for both species but also on the tusk of male narwhals during studies attempting to collect long-term data on their movements. Resightings of belugas that were once instrumented with a satellite tag have been reported after animals killed in subsistence hunts were found with scarring on the dorsal ridge (Orr et al., 1998); however, until now a narwhal had never been resighted. Here we report on the first resighting of a tusk-mounted satellite tag on a narwhal five years after the instrument was attached in the Canadian High Arctic. This resighting also provides the first direct observation of the rotation of the narwhal tusk, which was used to examine the age-dependent rotation rate of the tusk.

The narwhal was captured on 9 August 2001 in a net set at its summering ground in Creswell Bay, Somerset Island,

[1] Greenland Institute of Natural Resources, Boks 570, DK-3900 Nuuk, Greenland
[2] Corresponding author: mhj@ghsdk.dk
[3] National Environmental Research Institute, Frederiksborgvej 399, PO Box 358, DK-4000 Roskilde, Denmark
[4] PO Box 11263, Whitehorse, Yukon Y1A 6N5, Canada
[5] Fisheries and Oceans Canada, 501 University Crescent, Winnipeg, Manitoba R3T 2N6, Canada

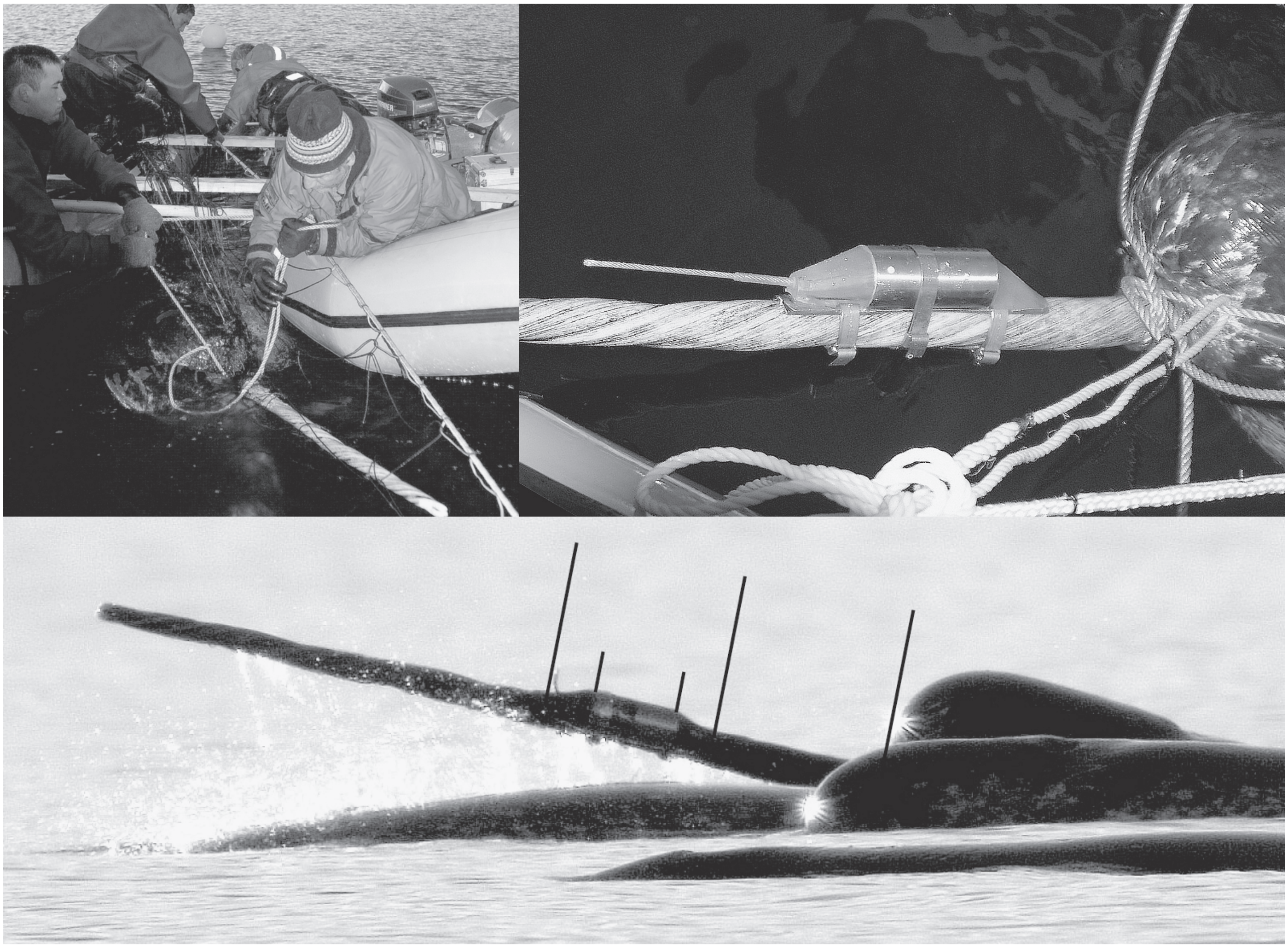

FIG. 1. Upper left: Capture of the whale at Creswell Bay on 9 August 2001. Note the broken tip of the tusk. Photo credit M.P. Heide-Jørgensen. Upper right: Attachment of the transmitter to the tusk of the whale. Photo credit M.P. Heide-Jørgensen. Below: Resighted whale together with other narwhals at the southwest corner of the mouth of Admiralty Inlet on 22 June 2006. Superimposed lines delimit the transmitter length and the distance between the melon and the tusk tag. Photo credit P. Nicklen.

Canada (72˚45.859′ N; 94˚05.180′ W), using methods described in Dietz et al. (2001). It was instrumented with a satellite transmitter (ST-16 with one D-cell developed by Wildlife Computers, Redmond, Washington) mounted in a cylindrical housing with oblique epoxy profile at both ends to improve hydrodynamic performance. The tag had an antenna (20 cm long and 5.5 mm wide) protruding from the front end (Fig. 1). The transmitter was 30.5 cm long (with the cylindrical portion 14 cm), and 6.5 cm in diameter. The weight was 1160 g in air and 580 g in water. The transmitter was attached parallel to the tusk on the dorsal side with three 3/4-inch (19 mm) wide Bandit stainless steel hose clamps, approximately 10 cm in front of the melon of the whale. The hose clamps were double-layered and tightened so that the transmitter could not slip along the tusk. The transmitter was mounted about 10˚ to the right of the dorsal midline of the whale to prolong the transmission time out of the water. This was done because it was assumed that while growing, the left-spiraled tusk would turn counterclockwise over time. The whale's body length was 420 cm from the tip of the melon to the insertion of the tail, the tail width was 112 cm, and the tusk was 114 cm long but with a recently broken tip (Fig. 1). The whale was not sexed, but it was assumed to be a male because of its long tusk.

Approximately five years later, on 22 June 2006, a narwhal with a satellite transmitter attached to the tusk was resighted (by P. Nicklen) at the floe edge on the west side of the mouth of Admiralty Inlet (73˚35.179′N, 84˚37.960′W). All of the ice to the north of this edge was composed of large, loose, shifting pans of ice moving north and south with the tide. The width of the ice lead at that time varied between 30 and 2000 m. The whales swam eastward along the floe edge. There were many animals in groups of varying composition (groups of males, individuals, mothers and calves), and occasional tusking behavior (in which individual narwhals display and touch their tusks against each other) was noted. A photograph of the whale with the transmitter was taken from the edge of the landfast ice. This photo was later examined and compared to photos of

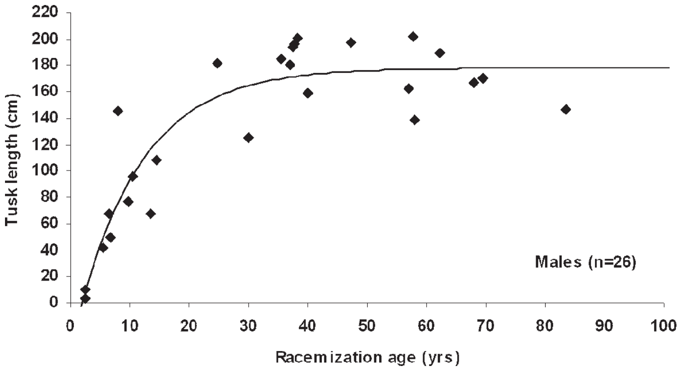

FIG. 2. Growth of tusks in male narwhals with a growth curve fitted to a von Bertalanffy model. Age estimates were based on the racemization of L-aspartic acid to D-aspartic acid in the nucleus of the eye lens (from Garde et al., 2007).

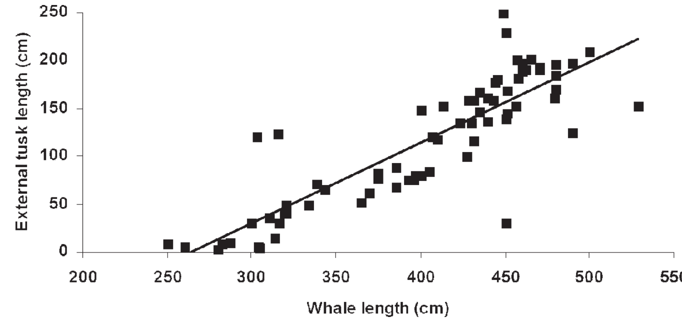

FIG. 3. Growth in external length of tusk with length of whale (n = 71, data from the Greenland Institute of Natural Resources).

two male narwhals instrumented with that same type of transmitter during the initial tagging events in 2001. The whale was identified as an animal instrumented on 9 August 2001 on the basis of the position of the central hose clamp and the form and thickness of the tusk. One other narwhal instrumented with this type of transmitter had the hose clamps positioned differently and did not have a broken tusk at the time of instrumentation.

Examination of the initial photo taken when the tag was deployed showed that the tag was mounted about 12 cm in front of the melon. This distance was estimated by comparing with the known length of the transmitter. The resighting photo shows that five years later, the transmitter (30.5 cm in length) was almost one full transmitter length away from the melon, implying that the tusk had grown about 17 cm in five years.

Judging by standard curves for length-at-age and tusk-length-at-age, with age determined by aspartic acid racemization of the eye lens (Garde et al., 2007), the whale was about 13 years old at the time of the tagging (Fig. 2). According to the growth curve, the predicted tusk length five years later (at age 18 years) would be 137 cm. This is not much different from the estimated tusk length (~129 cm) based on the length-at-capture plus the estimated growth (~17 cm) during the five years before the resighting.

However, the tusk was broken at the time the narwhal was captured. A narwhal with a body length of 420 cm (the size of the captured animal) has an expected tusk length of ~135 cm (Fig. 3), so it is likely that about 20 cm had been broken off the tusk by the time of capture. Assuming this, then the actual age of the narwhal may have been closer to 17 years at the time of capture (Fig. 2) and 22 years at the time of the resighting. The expected tusk length at 22 years would be 150 cm, or close to the estimate from the sum of the recalculated unbroken tusk length at capture and additional growth (~135 + 17 = ~152 cm).

Examination of the photo of the tusk taken at the time of capture shows that a concentric spiral grain at that position of the tusk was about 15 cm long (~length of the steel portion of the transmitter) for a 180˚ rotation. So a full 360˚ rotation would require a growth of ~30 cm in length of the tusk or a rotation of 360˚/30 cm = 12˚ cm^{-1}. These figures are inconsistent with the information from the resighting photo, which showed that the transmitter was still sitting on the upper side of the tusk slightly to the left of the originally mounted orientation from 2001. A coarse estimate of the angle of the transmitter at the resighting would be between 30˚ and 45˚ (not more than 45˚) to the left. Given that it was originally mounted about 10˚ to the right, this implies that the tusk rotated about 40˚ to 55˚ in five years, or 8˚ to 11˚ per year, and that a full rotation at this age of the animal would take over 30 years. The observed growth of ~17 cm in five years means that a full rotation would require tusk growth of more than 1 m (17•360/47.5). Either the spiral grain does not give an estimate of the roll of the tusk, or the rotation has slowed considerably during the five-year interval. Narwhal tusks reach maximum lengths of 200 cm (Fig. 2), and it seems likely that rotation is reduced with the growth in length of the tusk. Growth in length of tusks declines rapidly after the age of 20 yrs (Fig. 2).

Narwhals tracked from the Creswell Bay population in 2001 (Heide-Jørgensen et al., 2003) overwintered in central Baffin Bay and returned to Lancaster Sound in May. Data from two female whales that were tracked for over 14 months showed that these whales were close to the mouth of Admiralty Inlet in June, in a location similar to the one where this resighting was made. This implies that the tagged whale maintained the same site fidelity and migratory pattern as other whales from this population and that the overall migratory behavior of the whale was unaltered by the instrumentation. This resighting provides additional evidence that narwhals from the Lancaster Sound region return to this area for summering year after year. It is the first observation of male site fidelity to the summering ground.

Much discussion has occurred on how to evaluate the performance of satellite tags from the perspective of understanding not only the causes of tag failures, but also the fate of tags and the potential impacts of satellite tagging on the animal (e.g., Mate et al., 2007). The resighting documented here suggests that there are few negative long-term effects on migratory behavior from instrumentation with tusk transmitters. The animal instrumented did not give any indications of abnormal behavior five years after tagging and was located with several groups of whales traveling in the same direction. Furthermore, tusk growth had occurred as would be expected in healthy, untagged animals. The whale was behaving in a social manner traveling with other whales, and it continued to maintain the migratory schedule characteristic of the subpopulation. This supports the idea that satellite-tagging data collected from narwhals are representative of normal behavior. It has been proposed that the hose clamps placed on tusk transmitters loosen over time and tags are prematurely lost (Dietz et al., 2001). However, the resighting reported here suggests that tusk mounts can be highly durable and that these instruments have the potential to provide at least five years of migration information if reliable electronics can be obtained.

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