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Short Note

First Records of the Short-Finned Pilot Whale (*Globicephala macrorhynchus*) in Massachusetts, USA: 1980 and 2011

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The center of abundance of the short-finned pilot whale (*Globicephala macrorhynchus*) along the east coast of the United States is in the Mid-Atlantic around 36° N, with the northernmost confirmed assemblage of free-swimming short-finned pilot whales observed east of New Jersey at approximately 40° N (Payne & Heinemann, 1993; Rone & Pace, 2012; Waring et al., 2014). This note reports the strandings of one short-finned pilot whale found dead in 1980 and several live short-finned pilot whales, three of which subsequently died, reported in Massachusetts in 2011.

On 23 April 1980, a single dead pilot whale (350 cm in length) was discovered on Nashawena Island, Dukes County, Massachusetts (41.4236° N, -70.8653° W) (Figure 1). The female carcass was examined and measured on 25 April 1980 (New England Aquarium accession #MH-80-401-Gm). It was in fresh condition with skin intact, aside from a few minor scratches on the pectoral flippers and lower ventrum, suggesting that it had recently died. The head and stomach contents, consisting of a few squid beaks, were collected. Nematodes were later collected from the tympanic bulla. This animal was believed to be at least 9 y old based on the closed pulp cavities of the teeth and an examination of the secondary dentine layers (Kasuya & Matsui, 1984). Although this animal was originally presumed to be a long-finned pilot whale (*Globicephala melas*), examination of the cleaned skull (NUVC 2354) revealed that it was actually a short-finned pilot whale (van Bree, 1971; Bernard & Reilly, 1999) (Table 1). At the time, this specimen was the first confirmed record of a *G. macrorhynchus* stranded north of New Jersey.

In October of 2011, three additional *G. macrorhynchus* specimens were salvaged. Each was initially observed free-swimming but ultimately stranded and died. These individuals were all initially assumed to be long-finned pilot whales due to the historical frequency of strandings in the immediate area, the virtual absence of stranded short-finned pilot whales in the region, and the similarities of their appearance (Sergeant, 1962a; McFee 1990; Olson & Reilly, 2002; Jefferson et al., 2011; Rone & Pace, 2012; Marine Mammal Health and Stranding Response Program National Database [MMHSRP], 2015). Upon close inspection of morphological characteristics (Table 1), in conjunction with genetic analysis, all three of these individuals were subsequently identified as short-finned pilot whales.

On 10 October 2011, three live pilot whales stranded on Duxbury Beach, Duxbury, Massachusetts (42.0354° N, -70.6313° W) (Figure 1). With the incoming high tide, the animals were refloated by beach goers. No other pilot whales were observed in the immediate area. Two pilot whales swam off, and one remained close to shore where it soon stranded again and died (NEAQ-11-309-Gm). This adult male (476 cm in length) was in average nutritional condition. There was no external evidence of significant trauma to immediately suggest cause of stranding. A limited field necropsy was conducted which revealed four partially digested squid and three squid beaks (genus and species not identified) in the stomach,

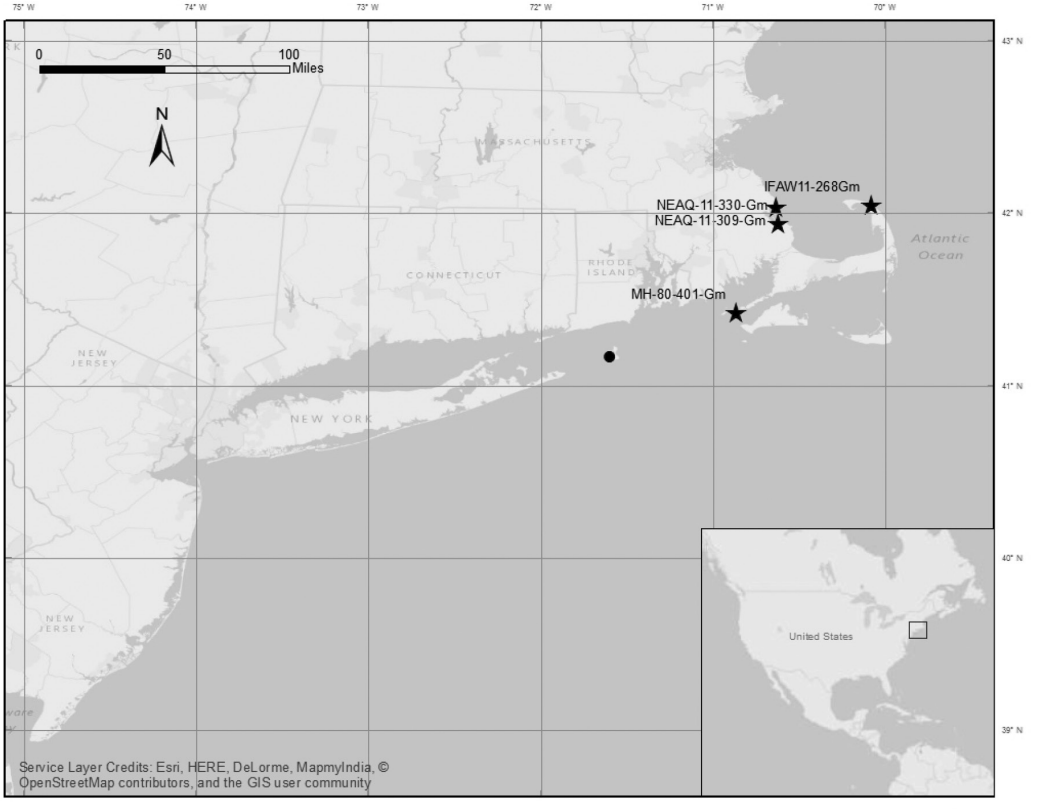

Figure 1. Stranding locations of short-finned pilot whales (*Globicephala macrorhynchus*) along the northeastern U.S. ★ = locations for specimens collected in Massachusetts in 1980 and 2011, and • = single additional specimen stranded north of the New Jersey coast line in 2001.

and a moderate burden of *Monorygma* sp. associated with internal urogenital organs. No significant findings were documented upon internal examination. These findings were supported by histopathologic analysis which revealed no specific inflammatory or degenerative changes. The head was removed for later extraction of the brain and for examination of the ears. The remains of the carcass were buried on site. Histological examination of the testes demonstrated that they were active, which confirmed this animal was sexually mature. The skull (without the mandible) was preserved (NUVC 12907).

On 11 October 2011, a live pilot whale stranded at Head of the Meadow Beach in Truro, Massachusetts (42.0518° N, -70.0779° W), and died a short time later (IFAW11-268Gma) (Figure 1). Three to four additional pilot whales were reported swimming 45.7 to 91.4 m from shore. The stranded individual was an adult female (345 cm in length). There was no external evidence of significant trauma to immediately suggest cause of stranding. A necropsy the following day revealed minor pathologies (i.e., verminous gastritis and pleural, pulmonary, and meningeal fibrosis) noted both grossly and histologically, but the cause of death was undetermined. The stomach contents included partially digested squid and a few squid beaks (genus and species not identified). Follicular atresia was evident upon histological examination, which confirmed this individual to be sexually mature. The complete skeleton was preserved (NUVC 12910).

On 15 October 2011, two pilot whales were reported stranded in Plymouth, Massachusetts (41.9420° N, -70.6202° W) (Figure 1). The animals refloated with the incoming tide and swam off. The next morning, a solitary individual was reported free-swimming nearby and was monitored over the next few days. The animal remained alone and was observed to be lethargic with frequent events of stranding in inaccessible areas followed by self-refloating over the course of a few days. On 20 October 2011, it was euthanized, and

Table 1. Morphometric, pigmentation, and skull osteological characteristic data for *G. macrorhynchus* and *G. melas* species and four *Globicephala* sp. stranded in Massachusetts, USA; NE = not examined.

Select physical characteristics	Short-finned pilot whale	Long-finned pilot whale	MH-80-401-Gm	NEAQ-11-309-Gm	NEAQ-11-330-Gm	IFAW11-268Gma
Adult male total body length (cm)	424-491*	458-625^	NA	476	NA	NA
Adult male mean total body length (cm)	452.6*	552 ^				
Adult female total body length (cm)	334-392*	350-512^	350	NA	330	345
Adult female mean total body length (cm)	357.5*	432 ^				
Flipper straight length (cm)			59.5	87.2	58	63
Flipper length as % total body length	15.8-18.9*	19-30.3 ^	17	18	18	18
Anchor patch: Color & location	Dark gray to axillary	White/gray to genital aperture	NE	Dark gray to axillary	Dark gray to axillary	Dark gray to axillary
Tooth count: Maxillary/ mandible (van Bree, 1971)	14-18 /14-18	18-24/18-24	14/14	13/14	19/15	NE
Maxillae completely or partially covered premaxillae (van Bree, 1971)	Yes	No	Yes	Yes	Yes	Yes

* After Yonekura et al. (1980); ^ after Bloch et al. (1993)

a necropsy was conducted the next day. The *post-mortem* examination revealed a female (NEAQ-11-330-Gm) in thin nutritional condition. This animal also had a moderate burden of medium-sized *Monorygma* sp. within its abdominal muscle and associated with the internal inguinal region. Minor pathologies of the lungs, heart, and pterygoid sinus were noted grossly and histologically; however, a cause of stranding could not be identified. Gross observations of at least two *corpus albicans* confirmed this animal to be sexually mature. The complete skeleton was preserved (NUVC 12906).

External characteristics shared among the 2011 specimens led to an identification of *G. macrorhynchus* instead of the expected commonly stranded *G. melas* (Table 1). They all displayed a gray, anchor-shaped patch of pigmentation from the ventral chin to the axillary region. This pigmentation did not extend along the ventral midline to the genital aperture, which has been regularly described for long-finned pilot whales but not for short-finned pilot whales (Sergeant, 1962a; van Bree, 1971; Yonekura et al., 1980; Jefferson et al., 2011). At sexual maturity, short-finned pilot whales are moderately shorter in total body length than long-finned pilot whales, which was documented in all of the Massachusetts specimens (Sergeant, 1962a; Yonekura et al., 1980; Bloch et al., 1993; Bernard & Reilly, 1999). Relative flipper lengths for all four specimens fell within the higher range accepted for short-finned pilot whales; however, they also had relative flipper lengths within the lower range accepted for the long-finned species (van Bree, 1971; Yonekura et al., 1980; Bloch et al., 1993). Similarly, tooth counts for these animals were low, suggesting *G. macrorhynchus*, but within the range in which these two species overlap (van Bree, 1971). This characteristic alone could not be used to conclusively make a positive identification. Due to the commonalities in the observed external physical characteristics, the parameters described above were useful but not 100% reliable. The most conclusive ways to distinguish between the two species are through the examination of osteological differences in skull morphology (van Bree, 1971; Bernard & Reilly, 1999) or through genetic analysis of mitochondrial DNA sequences (Oremus et al., 2009; Waring et al., 2010; Rone & Pace, 2012).

The premaxillae of all four specimens completely cover the maxillae over the anterior 60% of the rostrums, and the rostrums are relatively short, confirming the identification of short-finned pilot whales (Figure 2). This is in contrast to long-finned pilot whales whose rostrums are more elongated and for whom the premaxillae are narrow, leaving approximately 1 cm lateral margin of the maxilla uncovered (Figure 3) (van Bree, 1971; Bernard & Reilly, 1999). In addition to using skull morphology, the identities of the 2011 specimens were confirmed through genetic analysis of mitochondrial DNA control region sequences. Skin or muscle tissues from the 2011 specimens were sent to the National Marine Fisheries Service's Southeast Fisheries Science Center's Marine Mammal Molecular Genetics Lab. DNA was extracted from the tissues, and the mitochondrial DNA control region was amplified and sequenced following Rosel et al. (2009) using primers L15963 (Vollmer et al., 2011) and H16498 (Rosel et al., 1994). The resulting 426 bp of the control region sequence was identical for the three stranded individuals. Phylogenetic analysis of the sequence was completed using the *Globicephalinae and Orcininae*, Version 4.3 database of DNA surveillance (Ross et al., 2003), and 1,000 bootstrap replicates, which placed the "unknown" sequence within the clade of short-finned pilot whales with 99% bootstrap support. Furthermore, the sequence is identical to a control region haplotype that is common for short-finned pilot whale samples from the Atlantic Ocean (Oremus et al., 2009).

The stranding event that occurred in October of 2011 is unique in that it represents the first confirmed account of a group of short-finned pilot whales (3 to 6+ individuals) north of 41° latitude. Unlike previous stranding records from the northeast U.S. where single carcasses were recovered, these individuals were alive and reported to be with conspecifics prior to or during stranding (MMHSRP, 2015). Information collected *post-mortem* suggests that these animals were actively foraging as stomach contents from two of the three individuals showed evidence of recent feeding on squid. Information regarding a dead stranded short-finned pilot whale found in Nova Scotia has been reported in seven consecutive National Oceanic and Atmospheric Administration (NOAA) marine mammal stock assessment reports beginning with the *2005 Western North Atlantic Stock Assessment* (Waring et al., 2006). However, this individual ended up being a misidentified *G. melas* (G. T.

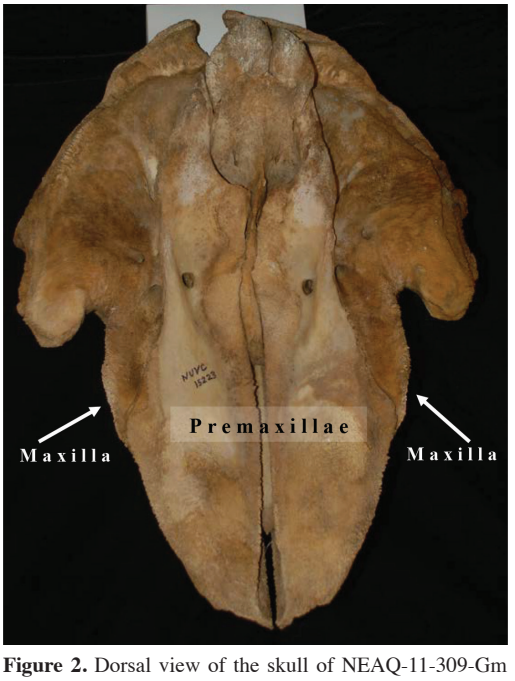

Figure 2. Dorsal view of the skull of NEAQ-11-309-Gm showing how the premaxillae cover the maxillae over the anterior 60% of the rostrum; this osteological characteristic was observed in all four specimens.

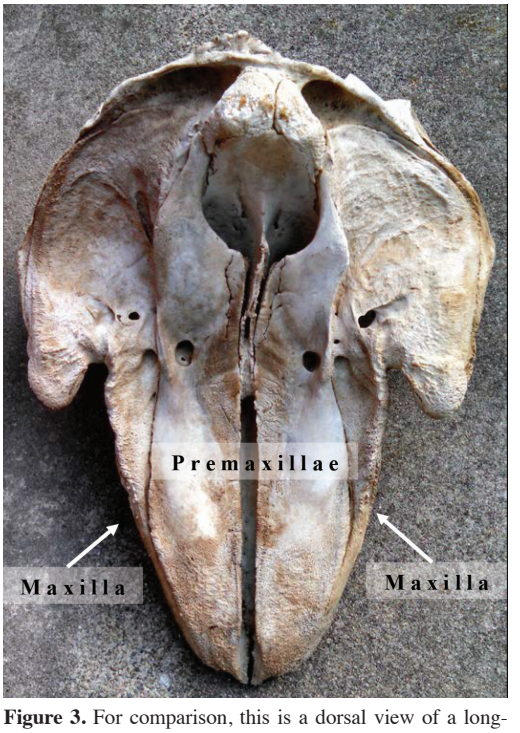

Figure 3. For comparison, this is a dorsal view of a long-finned pilot whale skull from an adult female (NUVC 17342/IFAW09-146Gm), showing how the rostrum is more elongated and the premaxillae are narrow, leaving approximately 1 cm lateral margin of the maxilla uncovered.

Waring, pers. comm., 22 April 2015). The only other record of a stranded short-finned pilot whale north of New Jersey appears to be one that dead stranded on 6 June 2001 on Block Island's Snake Hole Beach off of Rhode Island (Waring et al., 2005; Kenny & Vigness-Raposa, 2010).

The significance of these strandings as they relate to species distribution is unclear. Short-finned pilot whales are known to feed primarily on deep water squid (Mintzer et al., 2008). The seasonal distribution of pilot whales is closely associated with the movements of their preferred prey species (Sergeant, 1962b; Desportes & Mouritsen, 1993; Payne & Heinemann, 1993; Gannon et al., 1997), which are discretely linked to changes in sea surface temperature (Fullard et al., 2000).

The findings reported in this note stress the need to maintain an active stranding network capable of examining nearly all stranded marine mammals closely enough to make positive identifications, ensuring that species range shifts due to changes in prey base, climate change, or other factors will not go unnoticed. Since all U.S. marine mammal stock assessment reports to date have been unable to separately assess the two species of pilot whale due to difficulties with at-sea differentiation, it is also important to develop and employ methods to accurately monitor these two species at sea (Mullin & Fulling, 2003; Waring et al., 2014). Without this ability, neither species' status can be properly monitored.

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