Environmental Biology of Fishes **71:** 413–417, 2004.
© 2004 *Kluwer Academic Publishers. Printed in the Netherlands.*

Occurrence of the parasitic sea lamprey, *Petromyzon marinus*, on western North Atlantic right whales, *Eubalaena glacialis*

Owen C. Nichols[a] & Philip K. Hamilton[b]
[a]*Center for Coastal Studies, P.O. Box 1036, 59 Commercial Street, Provincetown, MA 02657, U.S.A (e-mail: nichols@coastalstudies.org)*
[b]*New England Aquarium, Edgerton Research Laboratory, Central Wharf, Boston, MA 02110, U.S.A*

Received 5 September 2003 Accepted 27 April 2004

Key words: cetacean, ectoparasite, host, attachment, distribution

Synopsis

Few data exist on the marine distribution and host organisms of the parasitic sea lamprey, *Petromyzon marinus*. Some observers have speculated that cetaceans serve as hosts for these fish based on scars, but few lamprey – cetacean interactions have been described in detail in the literature. Here we discuss 35 previously unreported records of sea lampreys that were observed while attached to western North Atlantic right whales, *Eubalaena glacialis*, during the period 1984 – 2002. Of these observations, 11 were photographically documented with images of sufficient quality to identify the lamprey as *P. marinus* based on morphological characteristics. The majority of the attachments were recorded in the Bay of Fundy during the summer months when *P. marinus* are preparing to spawn. It is unknown how lampreys might benefit from this association or what cost may be incurred by their right whale hosts. Feeding and transport are two possible reasons for the attachments.

Introduction

Little is known of the marine life history of anadromous sea lampreys. Current knowledge of the distribution of the parasitic sea lamprey, *Petromyzon marinus*, in the northwest Atlantic is almost exclusively based on approximately 100 specimens captured in trawl surveys and coastal trap nets (Beamish 1980, Halliday 1991). There is also a scarcity of data concerning hosts of sea lampreys during the marine phase, although it has been speculated that cetaceans are hosts for several parasitic sea lamprey species. Japha (1910) examined a number of sei, *Balaenoptera borealis* and fin whales, *Balaenoptera physalus*, killed by whalers in the eastern North Atlantic, noting round scars (~5 cm), which he attributed to *P. marinus*, although no lamprey was ever collected from a whale. Pike (1951) and Nemoto (1955) made similar observations in the north Pacific Ocean, comparing the dentition of the Pacific lamprey, *Lampetra tridentata*, with scars on fin whales and attributing the bulk of the round scars on many species of whale to this species of lamprey. Van Utrecht (1959) made similar observations on harbor porpoises, *Phocoena phocoena*, in the North Sea, providing photographs of scars and dentition of an unspecified lamprey caught in the area.

Although most of the above authors stated the hypothesis that the bulk of the round or ovoid scars found on whales were the result of lamprey attacks, they also noted that many of the scars that they described as 'crater wounds' did not have any marking resembling lamprey dentition. Jones (1971) examined the photographs presented by Pike (1951), Nemoto (1955), and van Utrecht (1959) and attributed the 'crater wounds' to the cookie-cutter shark, *Isistius brasiliensis*. Shev-

chenko (1970) independently concluded that warm – water sharks caused the majority of the scars on whales while the whales were close to the equator during winter migration.

No attempt has been made to quantify the extent that parasitic lampreys actually prey on cetaceans. In a review of the effects of parasites on marine mammals, Geraci & St. Aubin (1987) described the lamprey as 'the most voracious marine mammal parasite'; however, this assertion was based solely on a reference to the findings of Pike (1951). Halliday (1991) asserted that sei and perhaps other whales are frequent hosts of *P. marinus* based on observations of scars and references to Pike (1951) and van Utrecht (1959). Halliday (1991) also noted that there had been no documented accounts of *P. marinus* actually attached to whales. Here we present direct photographic evidence of the occurrence of *P. marinus* on western North Atlantic right whales, *Eubalaena glacialis*.

Methods

We collected data as part of a long-term study of the western North Atlantic population of *E. glacialis*. Data from over 20 000 sightings of right whales dating from 1935 to the present have been contributed to and archived by the North Atlantic Right Whale Consortium. Observers on board research vessels documented lampreys on an opportunistic basis during the application of a standardized photographic identification technique (Payne et al. 1983, Kraus et al. 1986). Photographs of the heads, dorsal surfaces, tailstocks, and flukes of right whales were taken using 35 mm film and digital SLR cameras. Observation and documentation of the ventral surfaces of the whales was rarely possible due to the behavior of the whales, with the exception of the flukes and tailstocks, which are usually raised during dives. Shipboard survey effort has been consistent in the Bay of Fundy during the summer months of every year since 1986, and sporadic in Cape Cod Bay during winter and spring of every year since 1984. There is comparatively little shipboard effort in other known right whale habitat areas.

Attachments of parasitic sea lampreys to free-swimming western north Atlantic right whales were recorded 35 times during the period 1984 – 2002. Of these observations 11 were documented with images of sufficient quality to identify the attached animal as *P. marinus* (Figure 1, Table 1). In these cases, species identification was based on morphological characteristics including body shape and size (length ca. >0.5 m), a dorsal fin composed of two separate lobes, 7 pairs of gill openings, and coloration (bluish-brown with blackish mottled patches). Documentation of the remainder of the observations was limited to photographs that lacked sufficient coverage of the attached fish to allow species identification. Collection of a lamprey from a free-swimming whale was not possible. However, as *P. marinus* is the only lamprey species found in Canadian Atlantic waters and the Gulf of Maine (Scott & Scott 1988, Scott & Crossman 1998, Flescher & Martini 2002), we conclude that the other lampreys recorded were all *P. marinus*.

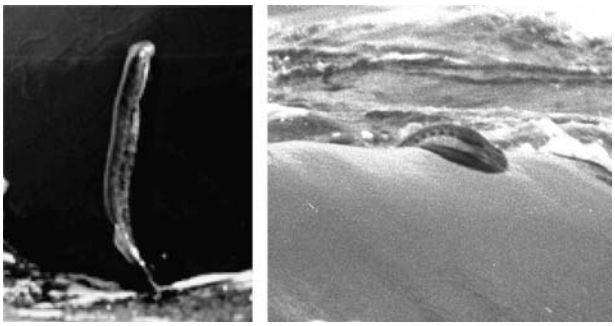

Figure 1. Sea lampreys, *Petromyzon marinus*, attached to North Atlantic right whales (*Eubalaena glacialis*). Left: 24 August 2002, Bay of Fundy. Right: 19 April 1984, Cape Cod Bay.

Table 1. Occurrences of sea lampreys on North Atlantic right whales, 1984–2002. **Bold** type denotes observations documented with images of sufficient quality for species identification.

Month	Day	Year	Time	Lat (°′N)		Lon (°′W)	
4	**19**	**1984**	**1632**	**41**	**54.1**	**70**	**09.5**
8	31	1990	1604	44	36.2	66	31.4
8	20	1993	1149	44	39.5	66	27.2
9	21	1994	1151	44	41.2	66	22.6
9	22	1994	1330	44	42.7	66	18.7
8	17	1995	1512	44	38.7	66	30.1
9	11	1995	1442	44	41.2	66	22.9
7	26	1997	1202	44	39.0	66	26.7
8	2	1997	1140	44	42.8	66	27.0
8	3	1997	1650	44	38.4	66	29.8
8	13	1997	1638	44	33.5	66	30.5
8	23	1997	1445	44	43.7	66	22.5
8	25	1997	1137	44	35.2	66	27.8
9	4	1997	1259	44	41.8	66	22.7
9	6	1997	1102	44	40.2	66	26.7
9	11	1997	1401	44	36.3	66	32.1
8	6	1998	1425	44	39.1	66	32.2
8	3	1999	1606	44	40.7	66	21.3
8	23	1999	1511	44	27.3	66	31.4
8	25	2000	1435	44	35.1	66	28.7
8	**27**	**2000**	**1411**	**44**	**41.2**	**66**	**26.3**
4	6	2001	1240	41	52.6	70	26.1
7	20	2001	1819	44	50.2	66	36.3
8	**19**	**2001**	**1349**	**44**	**38.6**	**66**	**23.9**
9	**20**	**2001**	**1600**	**44**	**39.3**	**66**	**27.7**
9	**20**	**2001**	**1619**	**44**	**38.9**	**66**	**27.3**
8	**20**	**2002**	**0843**	**44**	**41.7**	**66**	**29.1**
8	**20**	**2002**	**0901**	**44**	**41.9**	**66**	**29.3**
8	24	2002	916	44	40.2	66	26.2
8	**24**	**2002**	**1141**	**44**	**43.3**	**66**	**23.2**
8	29	2002	1216	44	34.6	66	24.4
8	**29**	**2002**	**1220**	**44**	**34.7**	**66**	**24.3**
9	**2**	**2002**	**1629**	**44**	**38.7**	**66**	**24.1**
9	**14**	**2002**	**1450**	**44**	**38.2**	**66**	**26.3**
9	26	2002	1508	44	42.3	66	20.6

Results and discussion

All of our observations were in summer in the lower Bay of Fundy, with the exception of two spring sightings in Cape Cod Bay, in the southern Gulf of Maine. Of the 11 records that included photographs of high enough quality for species identification, 10 were in the lower Bay of Fundy and one was in Cape Cod Bay (Table 1). A total of 33 attachments could be assigned to a specific body area. Of these, 22 (67%) were observed on the tailstocks or flukes of the whales, including several attachments at the notch of the flukes. While the heads of whales were always photographed, no lampreys were observed in this region.

On several occasions, the area of lamprey attachment on an identified individual whale was observed free of lampreys earlier or later in the same month. In one case, the same individual whale was photographed on two occasions 4 days apart (24 and 29 August 2002). On 24 August, the whale was observed with three lampreys attached: two at the fluke notch, and one on the left flank. On 29 August, the notch was observed free of lampreys and one lamprey was present on the left flank, albeit ca. 0.5 m posterior to the previously observed attachment site. It is impossible to determine if the two different attachments on the left flank represented two different lampreys or the movement of a single fish along the body. As the entire body of a

whale is rarely visible during surfacing, and because observers may not always note or notice visible lampreys, *P. marinus* may occur on right whales more commonly than these data suggest. Due to bias from inconsistent shipboard survey effort in known right whale habitats (with the possible exception of the Bay of Fundy), it is impossible to make a strong statement about trends in abundance or distribution of lampreys.

The timing of coastal distribution of right whales in spring and summer coincides with the upstream spawning migration of lampreys in the Gulf of Maine and the Bay of Fundy. *E. glacialis* is present in Cape Cod Bay from winter to early spring, and in the lower Bay of Fundy in summer and early fall (Winn et al. 1986). Upstream migration of *P. marinus* occurs from March through September, with a trend toward later migration with increasing latitude (Beamish 1980). Lampreys photographed in the lower Bay of Fundy exhibited golden coloration, a characteristic of spawning adults (Scott & Scott 1988).

It is unclear if lampreys benefit from the association with right whales or if the whales incur any costs as a result. It is possible that lampreys attach to the whales for transport, conserving energy necessary for spawning while the migrating whales bring them closer to the mouths of rivers. However, given the variability of whale distributions, such 'hitchhiking' may provide inconsistent benefit. Another possibility is that the lampreys are feeding on the whales. Given that a majority of the observed attachments occurred on the tailstocks and flukes and that these are the most active part of the whale's body and likely difficult to remain attached to, it is reasonable to hypothesize that lampreys benefit from attachments specifically to this body region. Right whale flukes are highly vascularized to facilitate thermoregulation (Pabst et al. 1999) and may provide easier access to blood than other areas of the body.

Acknowledgements

Data used in this manuscript were collected by researchers from the Center for Coastal Studies, Laurie Murison (Grand Manan Whale and Seabird Research Station), the New England Aquarium, and the Woods Hole Oceanographic Institution and archived by the North Atlantic Right Whale Consortium. The Consortium database is an enormous resource that has value beyond the study of a single species. Special thanks are due to Carolyn Miller and Laurie Murison, who provided additional data and images, to Dagmar Fertl and Michael Moore for assistance with the literature search, and to the staff at the Right Whale Research lab at the New England Aquarium for assistance in all areas. Moira Brown and two anonymous reviewers provided helpful comments on earlier drafts of this manuscript.

References

Beamish, F.W.H. 1980. Biology of the North American sea lamprey, *Petromyzon marinus*. Can. J. Fish. Aquat. Sci. 37: 1924–1943.

Flescher, D & F.H. Martini. 2002. Lampreys. Family Petromyzontidae. pp. 16–19. *In*: B.B. Collette & Klein-MacPhee G. (eds.), Fishes of the Gulf of Maine, Smithsonian Institution Press, Washington, DC.

Geraci, J.R. & D.J. St. Aubin. 1987. Effects of parasites on marine mammals. Int. J. Parasitol. 17: 407–414.

Halliday, R.G. 1991. Marine distribution of the sea lamprey (*Petromyzon marinus*) in the Northwest Atlantic. Can. J. Fish. Aquat. Sci. 48: 832–842.

Japha, A. 1910. Weitere Beitrage zur Kenntnis der Walhaut. Zool. Jahrbuch Suppl. 12: 711–718.

Jones, E.C. 1971. *Isistius brasilensis*, a squaloid shark, the probable cause of crater wounds on fish and cetaceans. Fish. Bull. 69: 791–798.

Kraus, S.D., K.E. Moore, C.E. Price, M.J. Crone, W.A. Watkins, H.E. Winn & J.H. Prescott. 1986. The use of photographs to identify individual North Atlantic right whales (*Eubalaena glacialis*). Reports of the International Whaling Commission (Special Issue 10): 145–151.

Nemoto, T. 1955. White scars on whales (I) Lamprey marks. Scientific Reports of the Whales Research Institute 10: 69–77.

Pabst, D. A., S. A. Rommel & W. A. McLellan. 1999. The functional morphology of marine mammals. pp. 15–72. *In*: J.E. Reynolds & Rommel S.A. (eds.) Biol. Mar. Mammals, Smithsonian Institution Press, Washington, DC.

Payne, R., O. Brazier, E.M. Dorsey, J.S. Perkins, V.J. Rowntree & A. Titus. 1983. External features in southern right whales (*Eubalaena australis*) and their use in identifying individuals. pp. 371–445. *In*: R. Payne (ed.) Communication and Behavior of Whales. AAAS Selected Symposium 76. Westview Press, Boulder, CO.

Pike, G.C. 1951. Lamprey marks on whales. J. Fish. Res. Board Canada 8: 275–280.

Scott, W.B. & E.J. Crossman. 1998. Freshwater Fishes of Canada. Galt House Publications, Oakville, Ontario. 966 pp.

Scott, W.B & M.G. Scott. 1988. Atlantic fishes of Canada. Can. Bul. Fish. Aquat. Sci. 219: 1–731.

Shevchenko, V.I. 1970. Puzzling white scars on whale body. Priroda 6: 72–73 (in Russian).
van Utrecht, W.L. 1959. Wounds and scars in the skin of the Common Porpoise, *Phocaena phocaena* (L.). Mammalia 13: 100–122.
Winn, H.E., C.A. Price & P.W. Sorenson. 1986. The distributional biology of the right whale *Eubalaena glacialis* in the western North Atlantic. Reports of the International Whaling Commission (Special Issue 10): 129–138.