



ASSESSMENT OF LEATHERBACK SEA TURTLE (*DERMOCHELYS CORIACEA*) FISHERY AND NON-FISHERY INTERACTIONS IN CANADIAN WATERS: 2018 UPDATE

Context

The Leatherback Sea Turtle (*Dermochelys coriacea*) was listed as Endangered under the *Species at Risk Act* (SARA) in 2003, a recovery strategy for the species in Atlantic Canadian waters was published in 2007 (Atlantic Leatherback Sea Turtle Recovery Team 2006), and a proposed action plan was posted in 2018 (DFO 2018). An objective of the recovery strategy is to identify and understand anthropogenic threats to Leatherback Sea Turtles in Canadian waters. This includes synthesizing and evaluating existing data on commercial fishing and other human activities that may impact recovery. The recovery strategy commits to undertaking a scientific review of the sources and rates of human-induced mortality every five years. The previous review was held in 2012 (DFO 2012a), so the Species at Risk Management Division in the Maritimes Region requested an update of this information in 2017. The information generated will be used by Fisheries and Oceans Canada (DFO) to inform continued efforts to protect and recover the Leatherback Sea Turtle.

The objective of this Science Response is to assess the levels of Leatherback Sea Turtle interactions with fisheries in Atlantic Canadian waters, as well as to assess other non-fisheries related interactions. This assessment aims to answer the following questions:

1. What are the current sources of fisheries interactions with Leatherback Sea Turtles in Atlantic Canadian waters?
2. What are the current sources of non-fisheries interactions with Leatherback Sea Turtles in Atlantic Canadian waters?

This update considers new information on anthropogenic impacts to Leatherback Sea Turtles in Atlantic Canadian waters available following the publication of a more detailed Canadian Science Advisory Secretariat (CSAS) review of this topic in 2012 (DFO 2012a). Confirmed threats to Leatherbacks in Canadian waters include ingestion of marine debris and vessel strikes; however, no substantive new information is available on these phenomena. Oil and gas exploration and development, including associated noise, has been posited as threat to this species, yet data specific to the Canadian context is also currently lacking. Therefore, the present summary focuses on Leatherback-fishery interactions. A review of various data sources, including *Species at Risk Act* (SARA) logbooks, fishery observer program records, and recently published turtle-fishery interaction data from citizen science networks suggest that Leatherback Sea Turtle interactions with Atlantic Canadian fisheries have been historically underestimated. The present results indicate that, in addition to pelagic longline fisheries, fixed fishing gear presents a regular hazard to Leatherback Sea Turtles. While this review provides new details on threats to this species in Atlantic Canada, the broad spatial and temporal distribution of Leatherback Sea Turtles in this region makes them challenging to monitor, and estimation of the true incidence of turtle-fishery interactions and accompanying rates of injury and mortality here remain uncertain.

This Science Response Report results from the Zonal Science Response Process of March 29, 2018, on the Assessment of Leatherback Turtle Fishery and Non-Fishery Interactions in Atlantic Canadian Waters.

Background

In 2012, DFO Maritimes Region led a zonal assessment of Leatherback Sea Turtle fishery and non-fishery interactions in Atlantic Canadian waters (DFO 2012a), primarily summarizing records of turtle-fishery interactions documented through fishery observer programs. The results suggested that most instances of incidental capture of Leatherbacks were associated with pelagic longline fisheries, while other fisheries, including many characterized by high levels of fishing effort, yielded few or no records. This update considers new information on anthropogenic impacts to Leatherback Sea Turtles in Atlantic Canadian waters available following the publication of a more detailed CSAS review of this topic in 2012 (DFO 2012a).

Analysis and Response

Non-fishery Interactions

To consider the effects of marine debris ingestion, all necropsy records of Leatherback Sea Turtles conducted by the Canadian Wildlife Health Cooperative, Atlantic Region were analyzed for evidence of marine debris. From 2004–2018, 15 Leatherback Sea Turtle necropsies were conducted. Of these, 6 turtles (40%) had evidence of plastic in the digestive tract, but this was not identified as the probable cause of death. Opportunistic necropsies of Leatherbacks have also been conducted in Newfoundland and at least one attributed mortality to a blockage of the digestive track by plastic debris (J. Lawon, pers. comm.).

While ship strikes have also been previously identified as a threat to Leatherback Sea Turtles (Gerle and DiGiovanni 1997), such interactions are rarely recorded in Atlantic Canadian waters. The Canadian Sea Turtle Network received a report of a vessel strike that occurred in summer 2010; however, the turtle apparently sank following impact and the carcass was not recovered for examination. Two dead Leatherbacks found stranded on the coast of Nova Scotia (one in 2015 and another in 2017) presented with injuries consistent with boat strikes; however, both turtles were heavily autolyzed, so necropsies were not conducted and cause of death was not confirmed.

Oil and gas exploration and development, including associated noise, has been posited as threat to this species, yet data specific to the Atlantic Canadian context is currently lacking. Due to insufficient data on these non-fishery interactions, the present summary focuses on Leatherback-fishery interactions.

Fishery Interactions

Data Sources

Since 2012, additional fishery observer data, reports from citizen science networks, and *Species at Risk Act* (SARA) logbook records attest to regular interaction of Leatherback Sea Turtles with multiple fisheries in Atlantic Canada. These sources of information are considered here. There are numerous caveats associated with the broad suite of data considered. These include unequal or inconsistent observer effort across different fisheries, a lack of standardization in voluntary and prescribed bycatch reporting mechanisms, biases against voluntary reporting of interactions with SARA species, and logistical challenges to implementing fishery-independent

methods of threat assessment. Irrespective of these limitations, research suggests that Atlantic Canadian waters may host the largest high-latitude foraging population of Leatherback Sea Turtles in the Northwest Atlantic (James et al. 2006, Archibald and James 2016), representing all known western Atlantic nesting stocks (Stewart et al. 2013); therefore, further evaluation and mitigation of anthropogenic sources of injury and mortality in this region is key to effective management and recovery of this species.

Citizen Science Reporting Networks

In Atlantic Canada, an unknown proportion of sightings of Leatherback Sea Turtles made by the public are voluntarily reported to various government and non-government entities. Most reports are made directly to environmental groups with mandates to collect citizen science sea turtle information. For example, the [Canadian Sea Turtle Network](#) maintains a database of reports principally corresponding to Nova Scotia, Prince Edward Island, and New Brunswick, while [Whale Release and Strandings Newfoundland and Labrador](#) is the leading recipient of reports made in Newfoundland. While organizations such as these typically undertake ongoing efforts to solicit reporting of sightings, there are challenges to maintaining high rates of reporting over the long-term. For example, when the novelty of contributing information becomes less apparent to new and existing volunteers or volunteer recruitment may be hindered by concerns over potential impacts on livelihoods in the shadow of endangered species legislation (Martin and James 2005).

Hamelin et al. (2016) summarized records of Leatherback Sea Turtle interactions with fixed-gear fisheries (i.e., gear that is stationary after it is deployed, incorporating components that are weighted on the ocean floor) collected from databases of publicly-reported sea turtle sightings in Atlantic Canada (n=205; 1998–2014). The majority of records came from Nova Scotia (n=136) and Newfoundland (n=40), and principally represented entanglements in pot gear targeting shellfish (e.g., crab, Lobster, whelk), and trap nets (e.g., Mackerel). Entanglements corresponded to a wide suite of fixed-gear fisheries, largely operating on the continental shelf, where Leatherback foraging activity is concentrated during the summer and fall. Multiple reporting biases make it difficult to derive patterns from these data; however, they point to the regular interaction of Leatherback Sea Turtles with fixed-gear fisheries in Canadian waters and indicate that the magnitude of Leatherback injury and mortality arising from incidental capture in associated fishing gear has been historically underestimated. The results of Hamelin et al. (2016) have been updated to include data from 2015–2017 (Table 1) and point to the vulnerability of Leatherbacks to entanglement in polypropylene lines (Table 2).

Table 1. Fisheries implicated in Leatherback Sea Turtle entanglements in Atlantic Canada from 1998 to 2017. Data reproduced from Hamelin et al. (2016) and updated to include records from 2015 to 2017.

Fishery Type	Number of Records	Proportion of Records (%)
Pot*	105	47.7
Trap net	53	24.1
Gill net	24	10.9
Benthic longline	7	3.2
Rod and reel	4	1.8
Bait net	4	1.8
Aquaculture	3	1.4
Offshore pot configuration	2	0.9
Other/unknown	18	8.2

*Pot fisheries include inshore Lobster, Snow Crab, Rock Crab, Whelk, and Hagfish fisheries

Table 2. Fishing gear components implicated in Leatherback Sea Turtle entanglements in Atlantic Canada, 1998–2017. Data reproduced from Hamelin et al. (2016) and updated to include records from 2015–2017.

Part of Gear	Frequency (Number of Records)	Proportion of Records (%)
Main buoy line	105	47.7
Miscellaneous rope	25	11.4
Haul-up buoy line	22	10.0
Mooring line	16	7.3
Net	15	6.8
Trap net (free-swimming)	15	6.8
Head rope	5	2.3
Hook	4	1.8
Bottom longline	3	1.4
Hi-flier line	2	0.9
Other/Unknown	8	3.6

SARA Logbooks

In 2005, DFO Maritimes Region implemented mandatory reporting of Leatherback Sea Turtle-fishery interactions by the Canadian Atlantic pelagic longline fleet, via completion of SARA logbooks. Completion of SARA logbooks is now a licence condition for most, but not all, commercial fisheries in DFO Maritimes Region that could potentially interact with Leatherbacks. The SARA logbook program was introduced to different fisheries at different times, and, while mandatory, measuring and enforcing compliance is challenging and participation rates are low. First introduced in Maritimes Region, the SARA logbook program expanded to DFO Quebec, Gulf, and Newfoundland and Labrador regions, although there are different associated data collection requirements and reporting formats in each region. Here we include all records to 2017. In DFO Maritimes Region, 391 SARA logbooks referencing incidental capture of 477 Leatherbacks were submitted for the period 2006–2017. The majority of these SARA logbook

reports correspond to incidental capture of Leatherbacks in the pelagic longline fishery targeting swordfish and tunas in waters of the continental shelf, slope, and further offshore (n= 379 SARA logbooks with n=442 Leatherback captures; Figure 1). The remaining 12 SARA logbook records of Leatherbacks in DFO Maritimes Region represent turtle interactions with fixed-gear snow crab fisheries on the continental shelf.

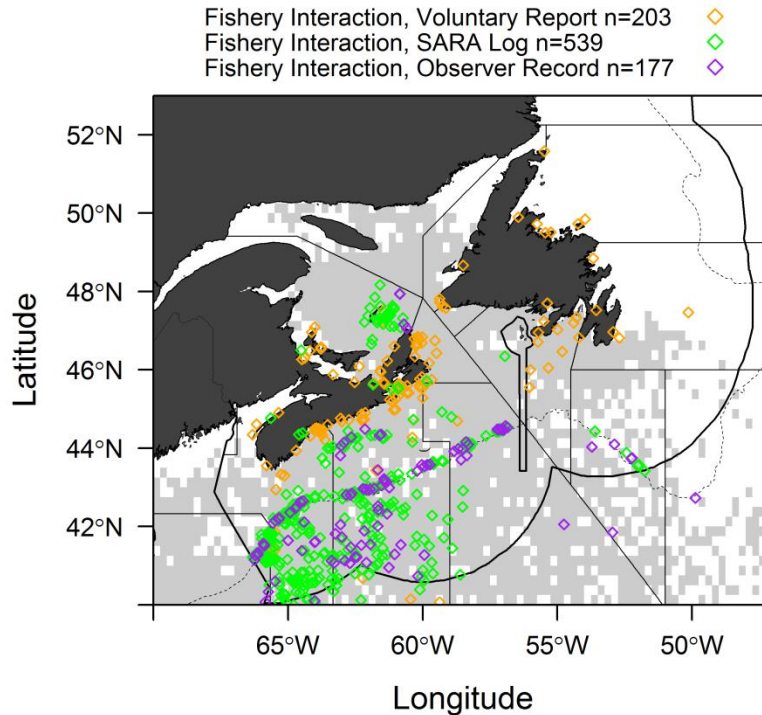


Figure 1. Available location data for Leatherback entanglement records across all DFO Atlantic Canada regions (Maritimes, Gulf, Quebec, Newfoundland and Labrador) from citizen science networks, SARA logbooks, and fishery observer programs. Background grey shading represents Leatherback spatial use derived from satellite telemetry (1999–2017; n=130 turtles; counts of median daily locations scaled in 0.25° by 0.25° grid; M.C. James, unpublished data). Dashed black line=1000 m isobath; solid black line=Canadian Exclusive Economic Zone (EEZ).

There have been relatively few Leatherback Sea Turtle SARA logbook reports submitted outside of DFO Maritimes Region. This is somewhat anomalous given the broad distribution of Leatherbacks in Atlantic Canadian waters during the summer and fall, when many fisheries employing gear types known to interact with this species (e.g., pot gear) are active. In DFO Gulf Region, 6 Leatherbacks were reported, 4 in the lobster fishery, 1 in the mackerel fishery and 1 by a research vessel. In Newfoundland and Labrador Region (NL), 11 Leatherbacks were reported within commercial logs, corresponding to the following fisheries: cod (n=2), Snow Crab (n=1), shrimp (n=3), turbot and halibut (n=1), and whelk (n=2). In DFO Quebec Region, 45 SARA logbook records of Leatherbacks were submitted. The majority of these were clustered in the Magdalen Shallows, representing entanglements in whelk pot gear (n=25). This result is consistent with biotelemetry results pointing to the southern Gulf of St. Lawrence as high-use habitat for Leatherbacks in late summer and fall (James 2005).

Given the uncertainties associated with SARA logbooks as a means of tracking turtle-fishery interactions, this tool is not currently considered to be a reliable data source for management and summary data is presented here for information purposes only.

Fishery Observer Program Data

For the period 2001–2017, fishery observers recorded 171 Leatherback-fishery interactions in DFO Maritimes Region, 5 in DFO Gulf Region, and 1 in DFO Quebec Region. No records were found in readily accessed databases for NL (which may not represent all observations or all interactions). These numbers reflect differences in the extent and implementation of the industry observer program in each region and are not considered an accurate reflection of interaction rates in each region.

Ninety-six percent (96%) of DFO Maritimes Region fishery observer records (2001–2017) corresponded to the pelagic longline fishery (4% corresponded to crab pot fisheries), which reflects both the relatively high level of observer coverage in the pelagic longline fleet and, potentially, the relative regularity with which this fishery interacts with Leatherbacks. Note, however, that these results are difficult to interpret for several reasons. Annual fishery observer effort throughout the period 2001–2017 was not standardized (e.g., in 2001 and 2002 observer effort in the pelagic longline fleet was enhanced to better assess turtle interactions). Fishing effort by the pelagic longline fleet is also highly spatially and temporally dynamic over time. Therefore, the present turtle-fishery interaction data do not support estimation of the distribution and relative abundance of turtles, nor can they be effectively used to estimate rates of incidental capture.

As license conditions require harvesters to record turtle-fishery interactions at all times, including when a fishery observer is aboard, a comparison of fishery observer data with SARA logbook records may provide insight into the effectiveness of the SARA logbook tool as a means of tracking incidental capture of Leatherbacks. Of 77 fishery observer records from the DFO Maritimes Region pelagic longline fleet spanning the period 2006–2017, 23 (30%) had matching SARA logbook records. Between 9 and 31% (mean= 22%) of the total number of active pelagic longline vessels each year (2006–2017) submitted SARA logbook records of one or more Leatherback interactions (Figure 2).

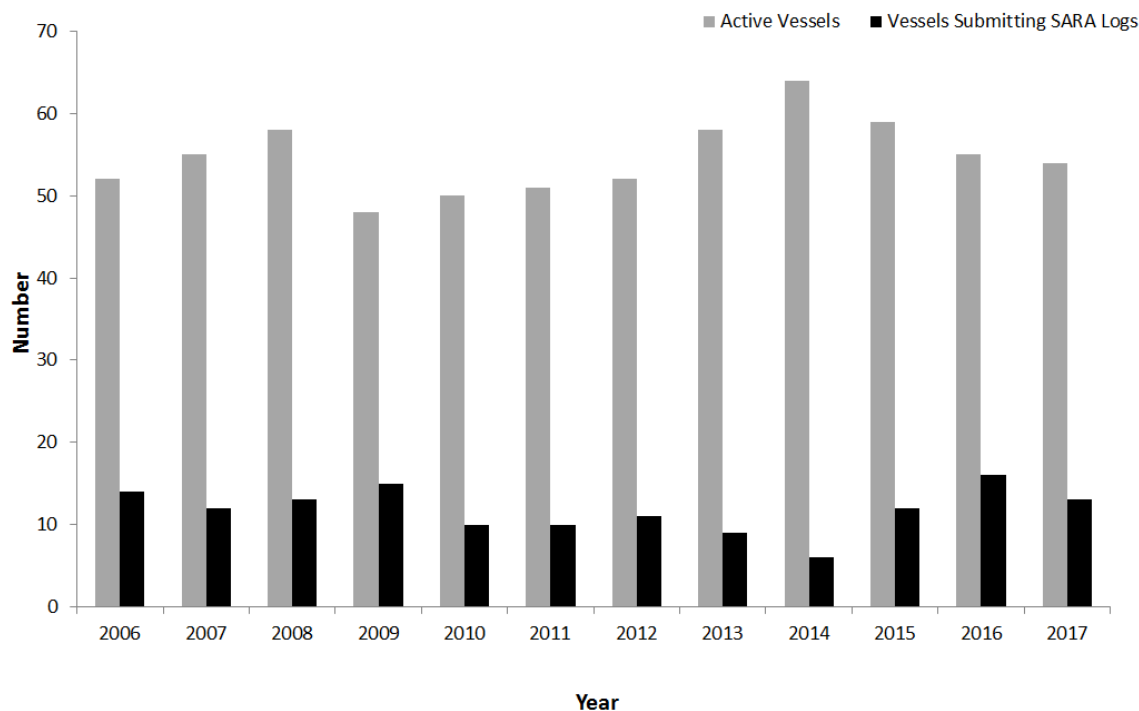


Figure 2. Annual total number of active pelagic longline vessels and number of pelagic longline vessels submitting SARA logbook records of Leatherback Sea Turtles (DFO Maritimes Region, 2001–2017).

Distribution of Turtle-fishery Interaction Data Relative to Leatherback Distribution in Canadian Waters

Results of biotelemetry research indicate that while Leatherback Sea Turtles are broadly distributed in Atlantic Canadian waters, persistent high-use foraging areas for this species can be identified (DFO 2012b). A comparison of the distribution of fishery interaction data presented here with patterns of Leatherback spatial use derived from satellite telemetry indicate a few notable results (Figure 1). First, there are a preponderance of fishery observer records corresponding to waters in the vicinity of the continental shelf break and further offshore, and the fishing basins off central Nova Scotia. These records are mainly associated with pelagic longline fishery interactions. The SARA logbook records are largely biased towards these same areas, but also extend to more northerly regions, including the southern Gulf of St. Lawrence. In contrast, volunteered data from citizen science reporting networks is more biased to coastal waters off Nova Scotia and Newfoundland. There are conspicuous large areas where regular occurrence of Leatherbacks has been established from biotelemetry, but where recorded interactions are sparse or lacking altogether. This may reflect further reporting biases or less intensive fixed-gear fishing effort in these areas at the times when Leatherbacks are present. This issue may be clarified through further comparison of turtle and fishery spatio-temporal distributions.

Sources of Uncertainty

There are multiple biases inherent in the data considered here, as they were collected opportunistically and mechanisms are not currently available to gauge compliance with voluntary and mandatory reporting.

The value of SARA logbooks as a tool for documenting species interactions with fisheries may be limited; a more detailed analysis, using Leatherback Sea Turtle as a case study, is underway.

A lack of consistency in observer program requirements and protocols for recording Leatherback Sea Turtle observations across DFO regions needs to be considered further.

There remains limited information on the vulnerability of Leatherback Sea Turtles to marine noise, vessels strikes, and ingestion of marine debris.

Changes in Leatherback Sea Turtle distributions in Atlantic Canada may occur in the future, with accompanying implications for the species' susceptibility to sources of anthropogenic harm (as has been recently associated with North Atlantic Right Whale increased use of the Gulf of St. Lawrence). Therefore, ongoing monitoring of Leatherback Sea Turtle occurrence is essential.

Conclusions

New information from citizen science reporting networks, at-sea fishery observers, and SARA logbook programs suggest that, in addition to regular incidental capture in pelagic longline fisheries, Leatherback Sea Turtles are vulnerable to entanglement in a broad suite of fixed-gear fisheries throughout Atlantic Canada, particularly those incorporating vertical lines extending to the surface, and horizontal lines at or near the surface. Recognizing that deployment of such lines is a generalized and widespread hazard to Leatherback Sea Turtles, effort must be broadened to consider potential impacts of fisheries characterized by low fishery observer effort, low levels of voluntary reporting, and/or low rates of participation in SARA logbook programs. Biases associated with reporting, including mechanisms for collecting volunteered data, SARA logbooks, and fishery observer programs, indicate that the magnitude of Leatherback-fishery interactions in Atlantic Canada has been historically underestimated. Importantly, Leatherback Sea Turtle interaction rates with different fisheries, and associated survivorship estimates at and following release, are not currently established but may vary markedly between gear types and/or by line entanglement configuration.

The results of this work suggest that, for Leatherback Sea Turtles, a precautionary approach, specifically considering entanglement risk, is warranted when designing and implementing management measures for both existing and emerging fisheries. A precautionary approach should include both consideration of the potential for incidental capture resulting from overlap in turtle-fishery distributions and how gear characteristics influence susceptibility to entanglement.

Spatial or temporal changes in Leatherback Sea Turtle habitat use and/or fishing effort (including potential emergence of new fisheries) could lead to a change in the extent of fishery interactions. Therefore, continued monitoring of Leatherback Sea Turtle distributions in Canadian Atlantic waters (including potential changes in patterns of habitat selectivity) is needed to ensure that efforts to mitigate Leatherback entanglement are effective.

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Sources of Information

- Archibald, D.W., and James, M.C. 2016. Evaluating Inter-annual Relative Abundance of Leatherback Sea Turtles in Atlantic Canada. *Mar. Ecol. Prog. Ser.* 547: 233–246.
- Atlantic Leatherback Turtle Recovery Team 2006. Recovery Strategy for Leatherback Turtle (*Dermochelys coriacea*) in Atlantic Canada. Species at Risk Act Recovery Strategy Series. Fisheries and Oceans Canada, Ottawa, vi + 45.
- DFO. 2012a. Assessment of Leatherback Turtle (*Dermochelys coriacea*) Fishery and Non-fishery Interactions in Atlantic Canadian Waters. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2012/041.
- DFO. 2012b. Using Satellite Tracking Data to Define Important Habitat for Leatherback Turtles in Atlantic Canada. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2012/036.
- DFO. 2018. Action Plan for the Leatherback Sea Turtle (*Dermochelys coriacea*) in Atlantic Canada [Proposed]. Species at Risk Act Action Plan Series. Fisheries and Oceans Canada, Ottawa. v + 29 p.
- Gerle, E., and DiGiovanni, R. 1997. An Evaluation of Human Impacts and Natural Versus Human-induced Mortality in Sea Turtles in the New York Bight. Proceedings of the 17th Annual Sea Turtle Symposium, NOAA Tech. Memo. NMFS-SEFSC-415: 187–189.

- Hamelin, K.M., James, M.C., Ledwell, W., Huntington, J., and Martin, K. 2016. Incidental Capture of Leatherback Sea Turtles in Fixed Fishing Gear off Atlantic Canada. *Aquat. Conserv. Mar. Freshw. Ecosyst.* 2017: 1–12.
- James, M. C., Ottensmeyer, C. A., and R. A. Myers. 2005. Identification of High-use Habitat and Threats to Leatherback Sea Turtles in Northern Waters: New Directions for Conservation. *Ecol. Lett.* 8: 195–201.
- James, M.C., Sherrill-Mix, S.A., Martin, K., and Myers, R.A. 2006. Canadian Waters Provide Critical Foraging Habitat for Leatherback Sea Turtles. *Biol. Conserv.* 133: 347–357.
- Martin, K. and James, M. 2005. The Need for Altruism: Engendering a Stewardship Ethic Amongst Fishers for the Conservation of Sea Turtles in Canada. *Mar. Studies* 3(2) and 4(1): 105–118.
- Stewart, K.R. James, M.C., Roden, S., and Dutton, P.H. 2013. Assignment Tests, Telemetry, and Tag-recapture Data Converge to Identify Natal Origins of Leatherback Turtles Foraging in Atlantic Canadian waters. *J. Anim. Ecol.* 82: 791–803.

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