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National Capital Region

Canadian Science Advisory Secretariat
Science Advisory Report 2020/037

UPDATED INFORMATION ON THE DISTRIBUTION OF NORTH ATLANTIC RIGHT WHALE IN CANADIAN WATERS

Illustration by Scott Landry.

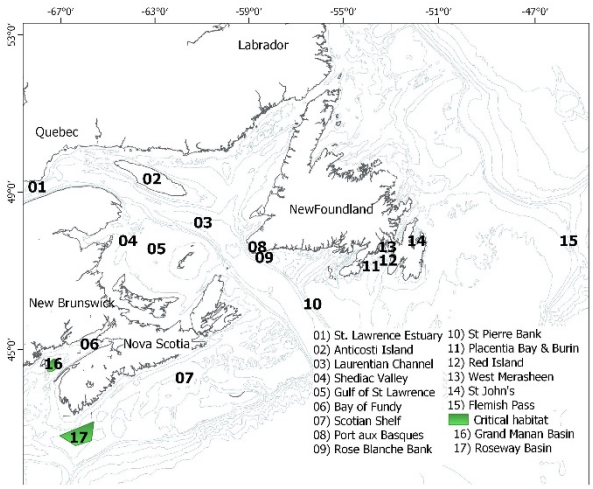

Figure 1. Place names used in this SAR.

Context:

In Canada, the North Atlantic Right Whale (NARW) is listed as Endangered under Schedule 1 of the Species at Risk Act (SARA).

In 2017 and 2019, several NARWs were found dead in the Gulf of St. Lawrence (GSL), some of which were killed as a result of vessel strikes and entanglement in fishing gear. In response to these mortalities, the Government of Canada implemented management measures to reduce collision and entanglement risks. To support these measures, surveillance and detection efforts in eastern Canadian waters were deployed with a special focus in the GSL. These surveillance efforts included systematic aerial surveys throughout Atlantic waters and passive acoustic monitoring around Newfoundland conducted by DFO Science.

Other initiatives of this large research programme and other organisations outside of DFO provide information about NARW occurrence in Canada and the United States, some of which are available on WhaleMap. These other sources of information are not considered in the present review.

The objective of the present meeting was to update the spatial and temporal distribution of NARWs in Canadian waters based on DFO systematic aerial surveys conducted from 29 August 2017 to 22 July 2019, and new DFO analysis of acoustic data collected on the eastern and southern waters of Newfoundland from 2017 to 2019.

This Science Advisory Report is from the National Marine Mammal Peer Review Committee (NMMPRC) 2019 Meeting : Update on North Atlantic right whale occurrence and distribution in Atlantic Canadian waters, held October 21-26, 2019, in St. Johns, Newfoundland and Labrador. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

SUMMARY

- Considerable surveillance effort has been conducted for NARW since 2017 in Canadian waters. Here we report on the results from systematic aerial surveys and passive acoustic monitoring in Newfoundland waters, conducted by DFO. There are other surveillance programmes to assess the occurrence of NARW in Canadian waters and these are reported elsewhere.
- In systematic aerial surveys from 2017 through 2019, the largest aggregations of NARWs were observed in the southwestern GSL. Smaller numbers were observed in the northwestern GSL, with few observed in identified critical habitat areas in the Roseway and Grand Manan Basins.
- At finer spatial and temporal scales in the southwest GSL, there was variability in NARW distribution among years. More years of data are needed to describe this variability.
- The numbers of NARWs in the southern GSL estimated from DFO aerial surveys were similar in 2018 and 2019. The abundance indices support our understanding that a substantial proportion of the population was in the southern GSL.
- The aerial survey sightings indicate that NARWs are present in the GSL in May and are still present in November. This is the period during which sighting effort occurred.
- No NARWs were detected in GSL waters of less than 37 m (20 fathoms) during systematic surveys in which 12% of effort occurred in these shallow areas for 2017 through 2019. Nevertheless, NARWs are known to occur in shallow waters and some individuals were reported in Canadian waters shallower than 37 m (20 fathoms) in 2019.
- Although rare, there are sightings of NARWs in Newfoundland (NL) waters. Ongoing analysis of recent passive acoustic data from NL confirms that NARWs occasionally occur in these waters, particularly in Placentia Bay where there have been a few confirmed acoustic detections in 2017, 2018, and 2019.
- All abundance indices based on systematic surveys have sources of error and potential bias because of the clumped behaviour of the whales and the fact that diving whales will not be detected. Better information of the diving behaviour of whales can be used to reduce bias and thereby improve indices of abundance and distribution.
- Passive acoustic monitoring of NARWs is limited by our incomplete understanding of calling behaviour and the call detection range on the recorder systems used. Studies of calling behaviour, noise modelling efforts, and increasing the number of recording sites will improve our ability to acoustically monitor for NARWs.

INTRODUCTION

The western North Atlantic right whale (*Eubalaena glacialis*; NARW) is a large baleen whale with adults measuring up to 17 m in length and weighing approximately 60-70 tonnes. Adult females are typically a metre longer than males. NARWs are generally black in colour with occasional white belly and chin patches and no dorsal fin or throat grooves. Data on longevity are limited, but the oldest individual on record was estimated to have been at least 70 years old. The average age of sexual maturity is not known, but females have been seen with their first calf at approximately 10 years of age. Age at sexual maturity for males is estimated to be about 15 years. NARWs give birth to a single calf. The interval between births has historically been around four years. In the 1990's, the average calving interval appeared to have increased to

approximately six years. In 2017 the average inter-calf interval was estimated to be 10.2 years for those females that have had one or more calves and are presumed to be alive.

The NARW population was reduced to an extremely low level by whaling. In 1990, the population was estimated to be 270 individuals, but increased to approximately 482 individuals in 2010. Since then, the population declined to an estimated 458 (95% Credible interval = 444-471) individuals in 2015. In 2017, the population was estimated to be approximately 411 individuals. Of particular concern is the divergent trend in sex ratio with males becoming more abundant than females (1.46M:1F in 2015 versus 1.15M:1F in 1990) as a result of lower female survival after age five. The recent decline in the population resulted from a combination of increased anthropogenic mortality, and decreased reproduction which was likely due to lower prey availability in some feeding areas.

NARW range from Florida to Iceland and Norway, but there is no single area within their range where all NARWs are present at the same time. Although there may be considerable individual variation, in general NARWs use the more southerly areas for calving during the winter, and move to northerly areas during the summer for feeding and socializing. Some individuals may remain in northern areas year-round. NARWs mainly feed on lipid-rich, late development stages of three species of *Calanus* copepods in areas where *Calanus* densities are sufficient to support their energetic needs. Although the summering location of a considerable component of the population is unknown, the regular seasonal use of some specific areas by large numbers of NARW has resulted in the designation of Critical Habitats in both Canada and the United States. In Canada, Critical Habitat has been designated in the Grand Manan Basin of the Bay of Fundy and Roseway Basin off southwest Nova Scotia (Figure 1).

Low numbers of NARW have been reported in the GSL and Newfoundland for many decades. However, since 2015, observations of NARW in the southwestern GSL, and since 2016 north of Anticosti Island, have increased. A detailed examination of the available acoustic dataset shows an increase in detection of NARWs in the southern GSL since 2015 which indicates a true increase in the use of this habitat.

ASSESSMENT

Distribution and abundance

Systematic aerial surveys

Systematic aerial surveys were designed to cover most eastern Canadian waters, with increased effort in habitats deemed suitable for foraging NARWs or where their presence was reported from other sources. These surveys provide an indication of the distribution of whales over a fixed period of time. A systematic survey covering the entire southern GSL was not completed in 2017, whereas five were completed from April to October in 2018, and three in 2019 for this update, i.e., from May to July 2019.

Based on the systematic surveys, the overall distribution of NARWs in eastern Canadian waters was similar in 2017, 2018, and 2019 with the main aggregation found in the southwest GSL (Figure 2). Although systemic surveys did not detect NARWs outside the southern GSL in 2019, they have been observed in previous years. Small numbers of NARWs were observed in the northwest GSL and in critical habitats of Roseway and Grand Manan Basins in all three years.

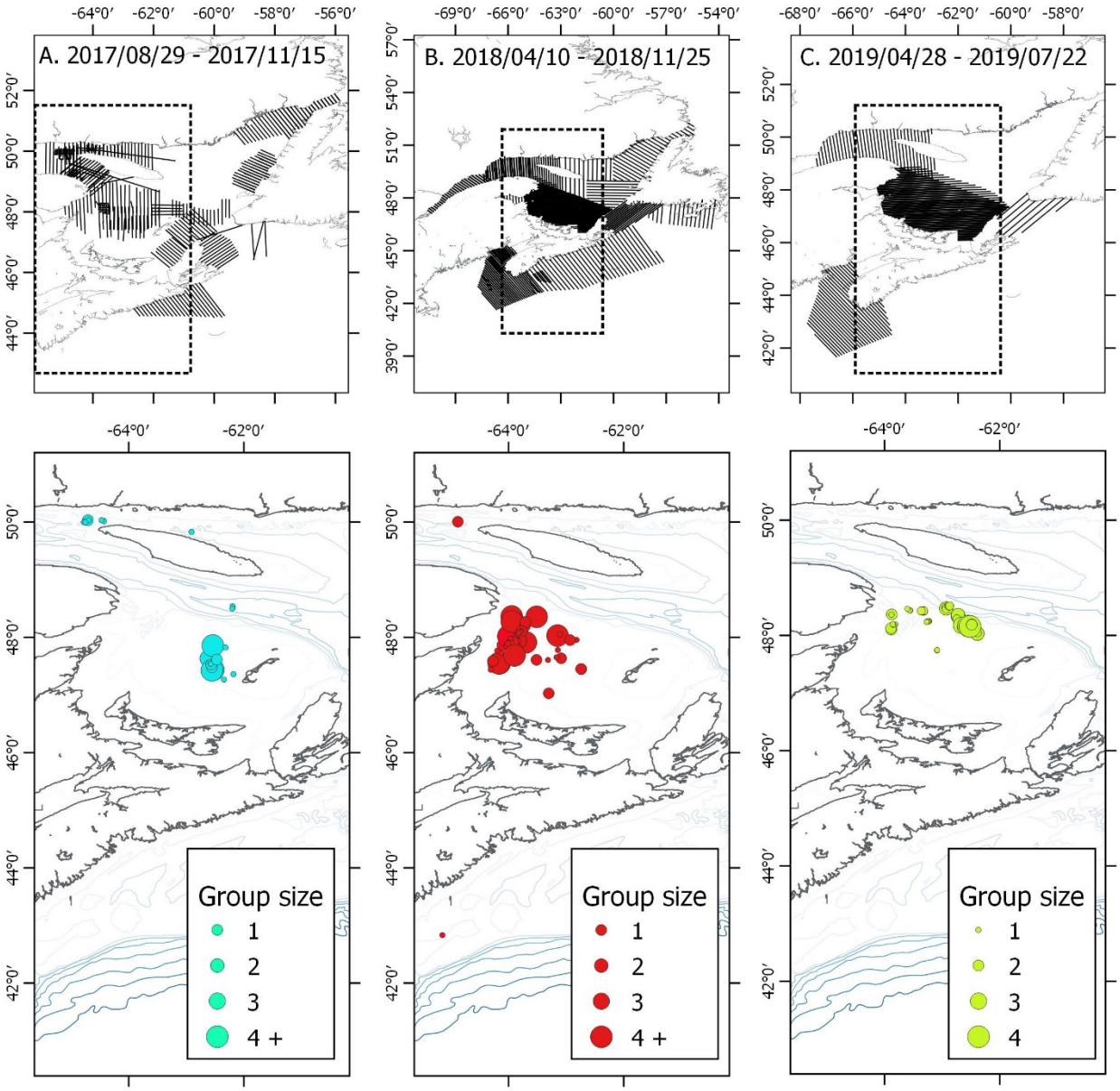

Figure 2. Distribution of survey effort and groups of North Atlantic Right Whale detected during systematic aerial surveys flown in the St. Lawrence Estuary, Gulf of St. Lawrence, Bay of Fundy, south coast of Newfoundland, and Scotian Shelf from A) 29 August to 15 November 2017, B) from 10 April to 25 November 2018, and C) 29 April to 22 July 2019. Darker areas indicate multiple surveys.

At finer spatial and temporal scales in the southwest GSL, there was variability in NARW distribution among years. In May-June 2018, all NARWs were detected in the Shediac Valley, whereas for the same period in 2019, some NARWs were also present to the east in valleys along the southern slope of the Laurentian Channel before moving to the Shediac Valley. We recognise these differences, but the interannual difference in survey coverage is a confounding factor that should be considered when interpreting fine scale changes in distribution. Currently, there are only two years of observations with comparable systematic survey efforts and it is not possible to determine if this apparent shift reflects actual differences in the whales' seasonal or

annual distribution patterns or simple variability in movements within the general area. Correspondingly, predictions about where NARWs are expected to occur seasonally within the southern GSL remains challenging and more years of data will be needed to describe the extant of this temporal and spatial variability. Care should be taken when considering the maps presented here, as well as from WhaleMap, as interpreting sightings without associated effort can bias the representation of distribution.

Abundance indices were obtained using two methods, referred to as passing mode and closing mode. Both are subject to different biases that need to be accounted for in order to estimate the number of NARW present in an area. The closing mode indices are higher than the passing mode indices as they include a circling procedure for 20 minutes over detected groups of NARWs to allow animals to come to the surface and to be detected by observers. As such they may be positively biased. The number of NARWs in the GSL estimated from systematic aerial surveys conducted by DFO, were similar in 2018 and 2019. The maximum closing mode abundance indices for the southern GSL were 174 (95%CI: 34 – 882) in 2018 and 204 (95%CI: 96 – 433) in 2019.

Acoustic monitoring off Newfoundland

Previous acoustic analyses have indicated that NARWs are rare in Newfoundland waters, with a single confirmed NARW upcall recorded south of Newfoundland in November 2016. More recent acoustic recordings from Newfoundland were analysed and 21 confirmed NARW calls occurred in Placentia Bay during summer and early autumn in 2017 to 2019. Unconfirmed ('possible') calls were also identified in other areas (Table 1). While NARW do at least occasionally occur in Newfoundland waters, especially Placentia Bay, there is not yet evidence to support that they occur there regularly or in any kind of aggregation. While acoustic detections indicate the presence of whales, a lack of acoustic detections does not necessarily mean an absence of whales, e.g., whales could be present but not calling, or loud background noise levels could be masking whale calls. Analysis of acoustic data from Newfoundland and other areas is ongoing.

Table1. Acoustic recorder effort to collect NARW calls in Newfoundland and Labrador since late 2017 (grey shaded cells with dashes). After manual validation, green cells contain counts of confirmed NARW vocalizations (upcalls and/or gunshots) and yellow cells with data in square brackets is unconfirmed NARW vocalizations.

	2017												2018												2019						
Mooring Site	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Red Island	-	-	-	-	-		10	1	-	-	-	-	-	-	-	-	-	1	[2]				-	-	-	-	-	-	-	1	[2]
West Merasheen	-	-	-	-	-	-	-	1		1	-							-	-	3	1	-		-	-	-	-	-	-	-	[1]
Burin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[1]	2				-	-	-	-	-	-	
Flemish Pass																-	-	-	-	-	-	[1]	-					-	-	-	-
St. Pierre Bank	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[1]	-											
Port aux Basques	[1]											[1]	-											-	[1]			-	-	-	
Rose Blanche Bank	-	-	-	-	-	-	-	-	-	-	-	[1]	-							-	-	-	-	-	-	-	-	-	-	-	

Timing of detections

From 2010 to 2018, the first acoustic detections of NARWs in the southern GSL occurred in late April, although the frequency of detections increased substantially in May. The first visual observations of NARWs in the GSL occurred around mid-May in all three years (13 May 2017, 19 May 2018, 13 May 2019). NARWs were first seen in the northwestern GSL and north of Anticosti in late July and in August. The frequency of NARW acoustic detections in the southern GSL decreased from September to December with some detections occurring as late as January. The latest systematic surveys in the southern GSL were completed around mid-

November and provided closing mode abundance indices of 99 (95%CI: 15 - 646) and 24 (95%CI: 5 - 113) on 9 and 13 November 2017 respectively and 91 (95%CI: 44 - 187) from 5 September to 17 October 2018. This shows that high numbers were still present in the southern GSL during the autumn.

Water depth and NARW presence

Management measures related to fisheries in Canada have identified temporary closure protocols for non-tended fixed gear, that apply specifically to waters less than 37 meters (20 fathoms) or less than 18 meters (10 fathoms). To evaluate the efficiency and relevance of these measures, information on occurrence of NARWs in these shallow waters is required. No NARWs were detected in waters shallower than 37 m (20 fathoms) during systematic aerial surveys despite 12% of the survey effort over these shallow waters. Only one out of 182 (0.5%) NARWs was detected in waters shallower than 37 m (20 fathoms) when combining systematic aerial survey and aerial transit over Canadian waters from 2017 to 2019. Of the 3,100 sighting events or 3,846 individual NARWs reported to WhaleMap in the GSL from April 2017 to July 2019, only one whale was in water shallower than 18 m (10 fathoms) and only one additional whale was in water shallower than 37 m (20 fathoms). However, except for the DFO systematic survey that provided an even coverage of all water depths, the other platforms reporting to WhaleMap from the GSL (i.e. DFO Conservation and Protection, Transport Canada National Aerial Surveillance Program, National Oceanic and Atmospheric Administration) were mostly monitoring the aggregation in the Shediac Valley, the shipping lanes, or the fishery activities, and their coverage of the shallow waters was low. The proportion of NARW in shallow waters was higher in the Bay of Fundy where one out of 54 individuals (1.9%) reported to WhaleMap from April 2017 to July 2019 was in waters less than 37 m (20 fathoms). One NARW was reported on WhaleMap feeding in less than 12-18 m of water near Cape Bonavista, Newfoundland on 19 September 2019.

If the main prey of NARW, *Calanus* spp. form concentrations that are suitable for NARW foraging all the way to coastal waters, these concentrations usually extend over wide geographic areas and therefore are mainly over waters deeper than 37 m. Habitat modelling of NARWs along the eastern coast of the U.S. based on survey data from 1992 to 2014 predicted relatively few NARW in shallow waters for most Canadian waters except for the Bay of Fundy in the autumn, but more around Cape Cod and off Rhode Island mostly in spring. However, satellite monitoring of NARWs tagged in the Grand Manan area showed that a high proportion of tagged individuals (5 out of 18, 28%) did transit to waters less than 18 m (10 fathoms). Transiting whales are difficult to detect during surveys. The use of satellite tracking in the GSL that has been initiated in recent years may provide more information on the proportion of individuals that may use shallow waters in this area. Therefore, although the probability of occurrence in shallow waters may be low, it is not zero and given the distance that NARW can travel in short periods of time, the risk of interactions with fishing gear and vessels in shallow water is likely higher near areas where large aggregations of whales occur, as has been the case for the Shediac Valley from 2017 to 2019.

Sources of Uncertainty

There is considerable uncertainty in our understanding of the distribution and abundance of NARW in Canadian waters driven by the biology of the species. NARWs extend over a large geographic range and their low number makes their detection difficult. While systematic surveys are useful to detect aggregation areas, i.e., where large numbers of animals spend more time, they are less efficient at detecting transit areas where animals spend less time or detecting

single individuals scattered over wide areas. However, systematic survey effort has been greater in potential feeding areas where NARWs are expected to aggregate. It is possible that only a few large concentrations that can be located exist while the remaining animals in the population are scattered over the extended range.

Our understanding of the distribution and persistence of NARWs in Canadian waters is also limited by the amount of survey effort that has been completed. Limited monitoring occurred in a number of areas, and for most areas there is only a short time series of monitoring. This limits our ability to provide scientific advice for management decisions. Consistent efforts over multiple years will be required to determine whale abundance, distribution, migratory timing and the various factors influencing inter-annual variation in habitat use. In some areas, such as Roseway Basin and Bay of Fundy, several decades of data were available to evaluate seasonal and inter-annual variability in distribution, and used to identify Critical Habitat for NARWs. Additional years of data will be required to determine how the distribution of NARWs in the GSL may vary among years. Given the uncertainty associated with the relative importance of changes in effort and possible seasonal and inter-annual changes in distribution within the GSL, incorporating all of the available sightings data is considered to be the most appropriate approach to delineate the population's current distribution.

Abundance estimates of NARWs can be obtained from visual and photographic surveys. However, indices based on sightings of whales at the surface must be corrected for both perception (i.e., whales that are present but missed by observers) and availability (i.e., whales present below the surface) biases. Our ability to sight whales varies among monitoring platforms, observers, and environmental conditions. As well, the proportion of time NARWs spend at the surface and at various depths is poorly known, and will be influenced by group size, behavioural state (e.g., feeding versus migrating, individuals versus surface active groups) and demographic variation in whale presence. Gaining improved understanding of diving and surfacing behaviour of NARWs is necessary to improve our ability to quantify detection rates from survey platforms and estimate risk from fishing gear and moving vessels.

There are a number of uncertainties associated with passive acoustic monitoring of NARWs. These include our lack of understanding of the factors that influence calling rates (e.g., sex, age, group size, behaviour, etc.), as well as detection range that varies with ambient noise, environmental conditions, and the characteristics of the whale calls. These uncertainties impact our ability to determine if whales may be present, but not acoustically active, and to estimate numbers of animals based on acoustic detection rates. These uncertainties are also confounded by the relatively small number of acoustic monitoring sites, with variable detection ranges, that are collecting data.

CONCLUSIONS AND RECOMMENDATIONS

The additional systematic survey data analysed since the last assessment confirms that a substantial proportion of the NARW population now utilizes the southwestern GSL for part of the year. There were low numbers detected in other areas including in the traditional feeding areas and Critical Habitats of Bay of Fundy and Roseway Basins. At finer spatial and temporal scales in the southwest GSL, there was variability in NARW distribution among years. More years of data are needed to describe this variability.

No NARWs have been detected in GSL waters in less than 20 fathoms (37 m) during DFO Science systematic surveys in which 12% of survey effort occurred. Nevertheless, NARWs are known to occur in shallow waters and some individuals were reported in Canadian waters shallower than 37 m (20 fathoms) and less than 18 m (10 fathoms) in 2019.

The systematic aerial survey sightings indicate that NARWs are present in the Gulf in May and are still present in November which agrees with the acoustic data from the southern Gulf that indicate that NARWs are detected from the end of April to mid-January.

There are rare sightings of NARWs in Newfoundland waters. The acoustic monitoring data confirms at least an occasional presence of NARW in these waters, particularly in Placentia Bay where there have been a few confirmed acoustic detections in 2017, 2018, and 2019. Placentia Bay is an area of important marine traffic that raises concerns of collision risks.

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SOURCES OF INFORMATION

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DFO. 2018. Science Advice on Timing of the Mandatory Slow-down Zone for Shipping Traffic in the Gulf of St. Lawrence to Protect the North Atlantic Right Whale. DFO Can. Sci. Advis. Sec. Sci. Resp. 2017/042.

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