Glacier Bay & Icy Strait Humpback Whale Population Monitoring: 2020 Update

National Park Service
U.S. Department of the Interior

Glacier Bay National Park & Preserve

Calf #2661 temporarily separates from a large group of whales that was feeding near Point Adolphus in Icy Strait on July 23, 2020.

Background

Migratory humpback whales (*Megaptera novaeangliae*) use the waters in and around Glacier Bay National Park and Preserve (GBNPP) in southeastern Alaska as spring, summer, and fall feeding habitat. The majority of these whales spend the winter breeding season in Hawaii but about 10% migrate to Mexico. By the mid-20th century, commercial whaling had decimated these populations, however they have since recovered to the point that only the Mexico population remains listed as threatened under the Endangered Species Act. Individual whales return year after year to the same feeding areas where their mother brought them as a calf and this strong maternally directed site fidelity has driven population growth over time.

We were fortunate to be able to conduct the 36th year of consistent June-August humpback whale monitoring in Glacier Bay and Icy Strait (GB-IS) in 2020 despite the global COVID-19 pandemic. The initial impetus for this program stemmed from concern in the 1970s that increased vessel traffic in Glacier Bay may have caused many whales to abandon the bay (Jurasz & Palmer 1981). Understanding the condition of park resources is essential to making informed management decisions. GBNPP's annual monitoring program is unique within Alaska and has produced one of the world's longest and most complete time-series of data on a baleen whale population.

Key Findings from 2020

- The Glacier Bay-Icy Strait (GB-IS) humpback whale population is increasing following significant declines attributed to ecological disruption from the 2014-2016 Northeast Pacific marine heatwave (PMH).
- With or without correcting for effort, whale abundance remains at least 25% lower than at its peak in 2013 and was comparable to what we observed in 2008.
- Twelve mother/calf pairs led to a crude birth rate (CBR) of 7.5%, which is a positive trend compared to recent years, yet below average compared to 1985-2013 (average CBR 9.3%).
- Increased whale abundance in 2020 was driven by a relatively high number of calves (n = 12) and a 13% increase in the number of whales in IS, while abundance in GB remained similar to 2019.
- Twenty-nine of 66 whales (44%) with a history of strong site fidelity to GB-IS remain missing and increased mortality due to the heatwave seems likely.
- Opportunistic forage fish observations suggest a continuation of improved feeding conditions in recent years, yet many whales (21%) appeared emaciated, including nine mothers and three of their calves.
- During and after the PMH, whales were more often alone than in pairs or larger groups, and they were much more likely to be feeding than other behaviors.
- Temporary whale waters and reduced speed limits were not needed in 2020 due to low whale use of lower GB and reduced vessel traffic (~45% decline compared to recent years due to the COVID-19 pandemic).

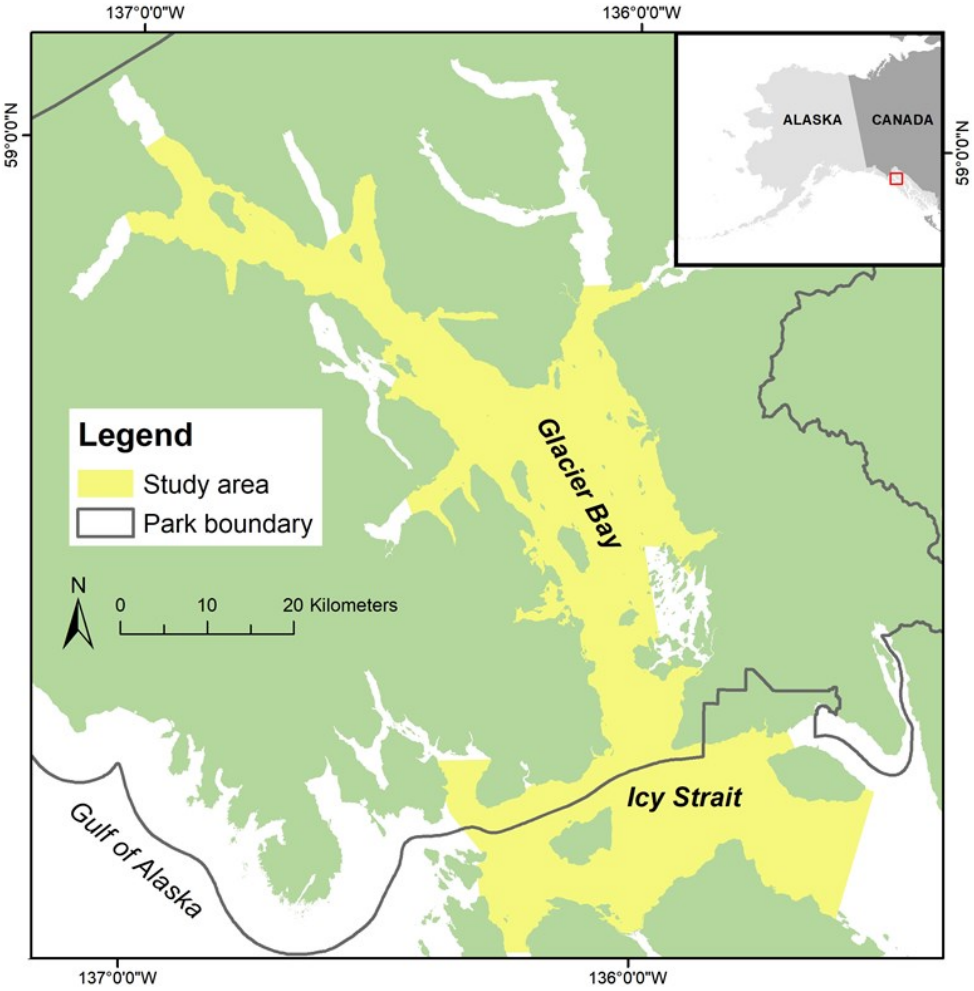

Figure 1. Study area in Glacier Bay and Icy Strait, Alaska.

Figure 2. The stable, distinct coloration and shape of a whale's flukes allow researchers to track individuals over time. Each whale receives a unique identification number. For example, the whale with black flukes is adult female #1834 (left) and the whale with white flukes is 26-year-old male #1293 (right).

Figure 3. R/V *Sand Lance* underway with research team. (Mark Kelley photo)

Where & How Do We Gather Data?

Every year since 1985, GBNPP biologists have conducted small boat-based photo-identification surveys in GB-IS (Figs. 1, 2) 4-5 days per week from June 1 – August 31 (core period) with less frequent surveys in the spring and fall (see Gabriele *et al.* 2017 and Neilson *et al.* 2018 for detailed methods). Our primary goal is to describe the distribution and abundance of humpback whales in a way that is comparable between years. We use a mixed approach in which we target 'hotspots' where whales have been reported or are known to frequent, while also surveying areas where whales may or may not be present.

Between April 23 and October 29, 2020, we searched for and photographed humpback whales from the 5.8-m *R/V Sand Lance* (Fig. 3), and the 6.7-m *Boomer*. We took photographs of each whale's flukes and dorsal fin with a Nikon D7200 digital camera equipped with a 80-400mm zoom lens.

We compared these photos to previous GBNPP photos and to fluke photos from other areas in SE Alaska to determine the identity and past sighting history of each whale. We used the Happywhale.com matching system to identify whales that had not been sighted before in GB-IS. We recorded group size and behavior state and we entered sighting data in a database shared with the University of Alaska Southeast in Sitka, Alaska. We calculated the crude birth rate (CBR) as # calves/total # whales identified during the core monitoring period.

Other information that we collected opportunistically included: 1) sloughed whale skin for genetic analysis and 2) opportunistic observations of whales' body condition (*e.g.,* emaciation), body size (*e.g.,* small), and probable whale prey. We also recommended to the GBNPP superintendent where and when 'whale waters' vessel speed and/or course restrictions should be implemented to protect humpback whales from vessel collisions and disturbance.

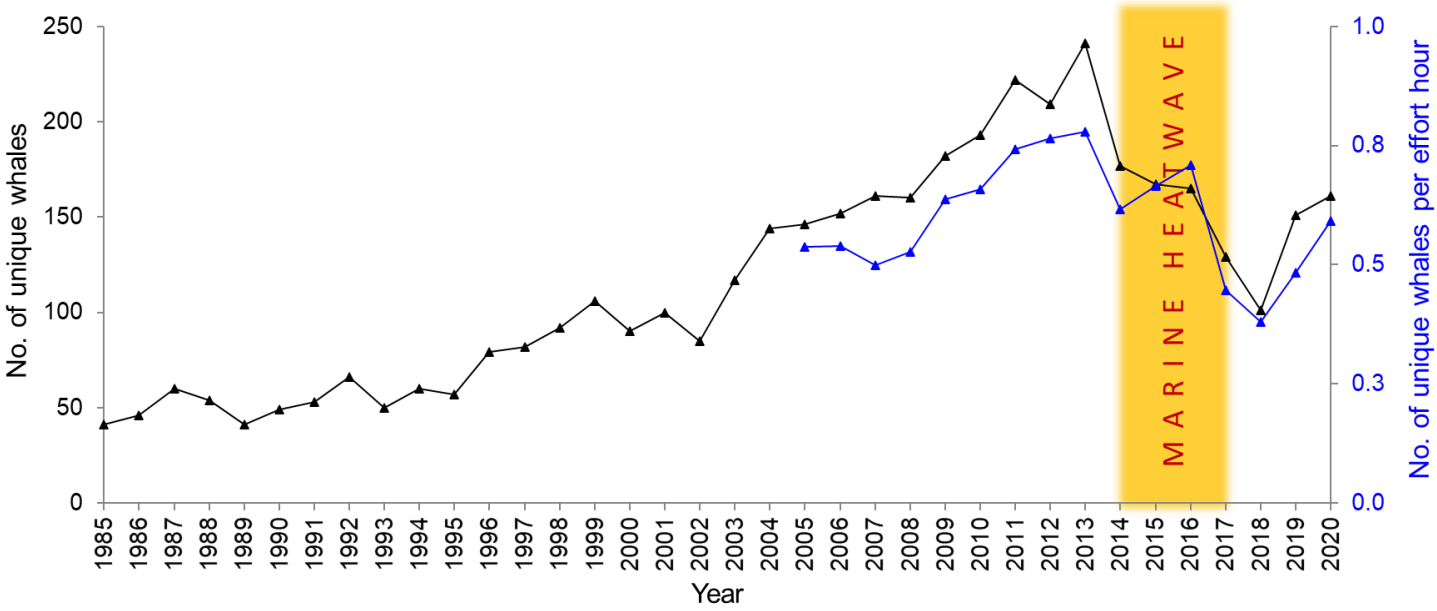

Figure 4. Relative abundance metrics for Glacier Bay & Icy Strait. Annual whale counts (black) and annual whale counts corrected for survey effort (blue) from June 1 – August 31, 1985–2020. A marine heatwave dominated the NE Pacific Ocean during the period highlighted in orange. Whales/effort hour is not available for 1985–2004.

What Did We Find in 2020?

Survey Effort

Our survey effort during the June 1 – August 31, 2020 core period (272 h) was below average compared to 2005–2019 (mean 285 h, SD = 23.9 h) but within the range for survey effort in these years (233–323 h). We strive to maintain consistent survey effort each year but it inevitably fluctuates as a result of factors such as weather, staff availability, and unexpected events (*e.g.,* mechanical difficulties and marine mammal strandings).

Whale Counts

Between June 1 and August 31, we documented 161 unique humpback whales in the study area (Fig. 4), a 6.6% increase compared to 2019. Correcting this count for survey effort reveals a 22.3% increase in abundance compared to 2019. However, the 2020 raw counts and effort-corrected counts remain lower than when abundance peaked in 2013 and were comparable to what we observed in 2008. The GB-IS humpback whale population appears to be increasing following a 5-year period (2014–2018) of ecological disruption attributed to the 2014–2016 Northeast Pacific marine heatwave (PMH) (Arimitsu *et al.* 2021, Suryan *et al.* 2021) but the magnitude of the gains documented in 2020 (6.6%, 22.3%) were less than in 2019 (49.5%, 27.5%).

In Glacier Bay proper, the number of whales in 2020 (n = 122) remained similar to 2019 (n = 121). Overall, the increase in abundance was driven by a relatively high number of calves compared to recent years (see below) and a 13% increase in the number of whales in Icy Strait (n = 87) compared to 2019 (n = 77).

Outside of the core monitoring period, we documented 17 additional whales (an unusually high number for the non-core period), for a grand total of 178 unique whales in 2020. We observed 10 in May, two in September, three in October, and the same mother/calf pair in both May and October.

Reproduction & Juvenile Survival

We documented 12 mother/calf pairs and a crude birth rate (CBR) of 7.5% (Fig. 5). This CBR represents a positive trend compared to recent years, yet productivity remains below average compared to 1985–2013 (mean 9.3%). We documented four additional mother/calf pairs outside of the core monitoring period and a fifth pair was documented in GB in May by a park visitor (S. Neilson, pers. comm.). Five of the mothers were not previously known to be female.

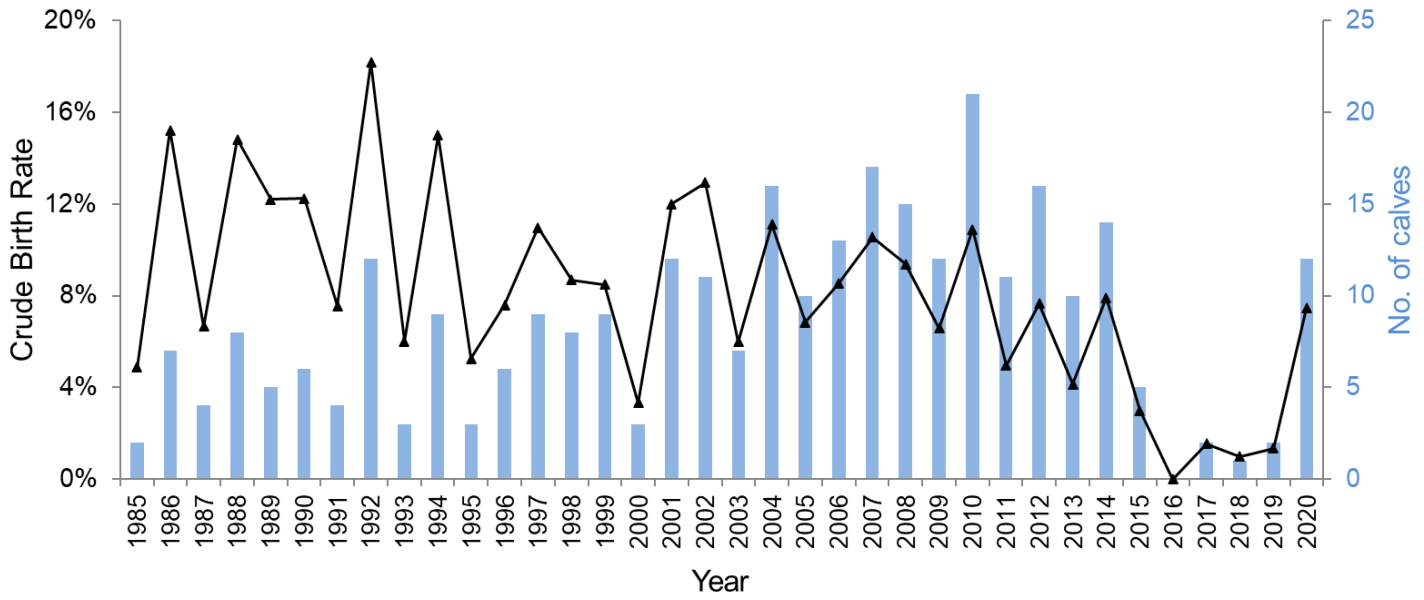

Figure 5. Crude birth rate (black line; # calves/total # whales) and annual number of calves (blue bars) in GB-IS from 1985-2020.

We documented one yearling (#2652, calf of #219) but, surprisingly, none of the other 24 GB-IS calves born in 2014-2019 have been documented beyond their calf year.

Site Fidelity

For a second year in a row, the residency rate (whales resighted over a span of ≥20 days; 68%, n= 110) was above average (1985-2019 mean = 62%, SD = 9%), yet lower than the record high rate (76%) in 2019. Also for a second year in a row, the 'transience' rate (whales sighted one day only; 22%, n = 36) was below average (1985-2019 mean = 26%, SD = 7.2%), yet it increased compared to the record low rate (17%) in 2019. The above-average residency and below-average transience rates in 2019-2020 presumably reflect improved feeding conditions compared to 2014-2018, when we documented a general trend of low residency and high transience.

In 2020, 44% (n= 29) of 66 whales with a long-term pattern of site fidelity to GB-IS (annually observed 2004-2013 = 'regulars') remained missing from the study area (13 females and 16 males with an age range of 21-45+ years old) (Fig. 6). This is the same proportion (representing the same individuals) that were missing in 2019. Two of the 29 missing whales were present in GB outside of the core monitoring period (female #235 in May 2020, S. Neilson pers. comm.; and male #1815 in October 2020, GBNP data).

In addition, male #1817 was sighted in eastern IS outside the study area (Alaska Whale Foundation/ www.Happywhale.com unpublished data). The fate of the other 26 missing regulars remains unknown despite attempts to locate them in other feeding and breeding areas in the North Pacific through our collaboration with Happywhale. The lack of sightings anywhere of these 26 whales, which represent 39% of GB-IS pre-heatwave regulars, makes it increasingly likely that the heatwave led to increased mortality in SEAK humpback whales (Gabriele *et al.*, in press), as was documented across numerous taxa in the Gulf of Alaska (Suryan *et al.* 2021). It is also possible that some of these whales re-located to areas where photo ID is not taking place. Automated fluke matching technology will continue to help illuminate the movement, dispersal patterns, and survival of individual whales.

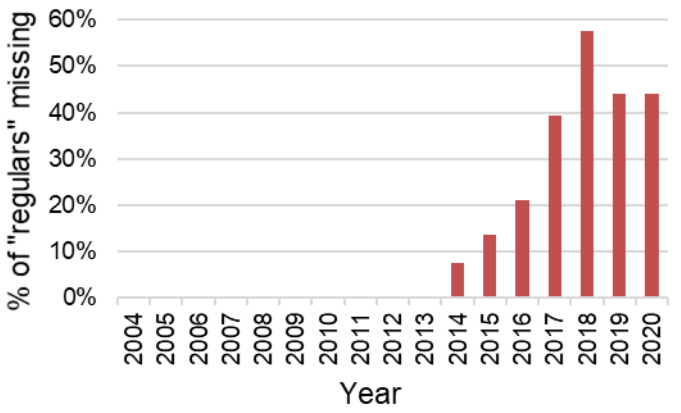

Figure 6. Percentage of 'regulars' missing from GB-IS, 2004-2020.

Genetic Samples

We collected 16 sloughed skin samples from 14 surface active individuals (*e.g.,* Fig. 7), including six calves. Since 1996, we have collected 366 sloughed skin samples which are analyzed by our collaborators at Oregon State University for sex determination, mitochondrial DNA haplotype, and nuclear DNA genotyping.

Figure 7. Whale #2488 breaches, shedding skin into the water.

Physical Condition

We observed numerous abnormally thin whales during the core monitoring period. We were surprised to find that the incidence of emaciation continues to be increasing after declining in 2018 (2016 = 10%; 2017 = 23%; 2018 = 15%; 2019 = 19%, 2020 = 21%), although these data are not collected systematically. Notably, nine of the 12 mothers (75%) observed during the core season appeared thin, along with three of their calves. We were surprised to resight #1012, an adult male who has appeared emaciated since at least 2016 and was especially thin in 2019. Emaciation is most likely attributable to insufficient food intake but may also indicate illness or disease. We hope to begin gathering quantitative body condition assessments by collecting photogrammetric data using unoccupied aerial systems (drones).

Across all dates we observed few whales (n = 4; 2%) with abnormal skin (*e.g.,* gray blotchy and/or rough). This rate is similar to 2019 (n = 5; 3%) and a continued improvement over 2018, when 16% of whales (n = 17) had abnormal skin.

Whale Prey and Feeding Behavior

Opportunistic observations of near-surface forage fish schools in 2020 documented the availability of capelin, sand lance and other typical species (Table 1). In 2015-2017, we saw far fewer fish schools, corresponding with the Pacific marine heatwave (PMH) that is known to have reduced forage fish abundance and quality (Arimitsu *et al.* 2021, Suryan *et al.* 2021). In the absence of quantitative metrics of prey abundance, we surmise that these observations may indicate more favorable feeding conditions for whales in 2020.

Table 1. Species identified near feeding humpback whales in GB-IS in 2020 (n = number of detections).

Species	n
Capelin (*Mallotus catervarius*)	8
Likely capelin	7
Pacific sand lance (*Ammodytes personatus*)	3
Pacific herring (*Clupea pallasii*)	2
Northern lampfish (*Stenobrachius leucopsarus*)	1
Unidentified lanternfish (Myctophidae sp.)	1
Eulachon (*Thaleichthys pacificus*)	1
Juvenile salmon (Oncorhynchus sp.)	1
Unidentified zooplankton	1
Unidentified forage fish	6

On July 23 and August 6 we observed group bubblenet feeding near Point Adolphus in Icy Strait. This involved up to 7-8 whales with five individuals present on both dates (male #875, female #1480, female #1907, mother #1703, calf #2661). Group bubblenet feeding is rarely observed near Point Adolphus (GBNP unpublished data).

We examined group size (# adults) and behavior relative to the years we saw population-level effects of the 2014-2016 PMH (Fig 4,5). We found that during (2014-2018) and after (2019-2020) the PMH, whales were significantly more likely to be alone (82%-88%), as compared to prior to the PMH (77% in 2009-2013) when pairs and larger groups were more common. Prior to the PMH about 66% of whales were classified as feeding, but also traveling (28%), resting (2.6%) and surface active (2.7%). During and after the PMH, a significantly higher proportion of whales were feeding (77%-78%) to the exclusion other types of behavior.

Whale/Human Interactions

No entanglements or dead whales were reported in the study area to GBNPP or to the National Marine Fisheries Service in 2020. However, on August 26 an adult humpback whale was reported entangled in gillnet and salmon trolling gear near the study area in Cross Sound. The whale was not resighted or individually identified (NOAA Alaska Region unpublished data). In addition, on November 25 whale #2156, a 16-year-old male frequently seen in GB-IS, was reported entangled in commercial Tanner crab pot gear in Tenakee Inlet and later partially disentangled (NOAA Alaska Region unpublished data).

Vessel traffic in GB-IS was about 45% below average in 2020 due to the COVID-19 pandemic, resulting in greatly reduced underwater sound levels (Gabriele *et al.* 2021). Previous work suggests that quieter conditions would allow whales to communicate over greater distances (Gabriele *et al.* 2018) and not need to call louder or cease calling to compensate for vessel noise (Fournet *et al.* 2018). We documented several cases of vessels pursuing whales in violation of the park's humpback whale approach regulations (36 CFR 13.1170). One whale-vessel collision was reported in GB-IS. Near midnight on July 12, an anchored sailboat in Reid Inlet reported being struck by a humpback whale. The people onboard awoke after feeling a wave hit the boat, then saw a humpback whale nearby. Next, they saw what "looked like a torpedo come at the boat and...rammed into the boat broadside." There were no human injuries or apparent vessel damage. No photos were obtained to allow identification of the whale involved, and no injured whales were reported in the area.

Whale Waters

The COVID-19 pandemic resulted in anomalously low vessel traffic in GB in 2020, especially among larger vessel classes (*e.g.,* >30 m), which lowered the risk of collisions and disturbance compared to past years. In addition, there was relatively low humpback whale use of lower GB, especially in June. Therefore, a 13 kt vessel speed limit was not implemented in lower GB in 2020. Although whales congregated in high numbers at several locations in mid and upper GB, temporary whale waters were not warranted due to low vessel use of the area. This was the first year since 1996 that temporary whale waters were not designated anywhere in GB.

Conclusions

Our results from 2020 indicate that humpback whales in Glacier Bay and Icy Strait are increasing following significant declines attributed to ecosystem disruption from the 2014-2016 marine heatwave. Abundance has not reached pre-heatwave levels, but the overall trend is positive and prey availability appears to have improved in 2019 and 2020 based on observations of near-surface fish schools. The continued absence of many GB-IS 'regulars' and the high rate of emaciation suggests that some whales died. The 7.5% crude birth rate and grand total of 17 calves are encouraging and bode well for the population if favorable oceanographic conditions continue. Key indicators to watch for will be continued increases in abundance and productivity, along with declining numbers of emaciated whales.

Two whales surface in lower Glacier Bay on July 15, 2020.

Whale #801 head slaps during an encounter on August 23, 2020 at the mouth of the West Arm. This female, who had a calf in 2020, was first documented in Glacier Bay in 1975 by Charles Jurasz (Sea Search unpublished data), making her at least 46 years old in 2020.

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Acknowledgements

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Thirty-year-old whale #1083 on October 19, 2020.