Glacier Bay & Icy Strait Humpback Whale Population Monitoring: 2021 Update

National Park Service
U.S. Department of the Interior

Glacier Bay National Park & Preserve

Fourteen-year-old whale #2456 forages along a snowy shoreline on June 17, 2021 in Queen Inlet, Glacier Bay.

Background

Migratory humpback whales (*Megaptera novaeangliae*) use the waters in and around Glacier Bay National Park and Preserve (GBNPP) in southeastern Alaska (SEAK) as spring, summer, and fall feeding habitat. The majority of these whales spend the winter breeding season in Hawaii but at least 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. Most 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 37th year of consistent June–August humpback whale monitoring in Glacier Bay and Icy Strait (GB-IS) in 2021 despite the ongoing 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 such as whales 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 2021

- Effort-corrected counts indicate that the number of whales in Glacier Bay-Icy Strait (GB-IS) declined 5% from 2020 to 2021. In Glacier Bay, abundance declined compared to 2020, while in Icy Strait, abundance increased.
- Twenty-seven of 66 adult whales (41%) with a history of strong site fidelity to GB-IS remain missing and most are presumed to have died during or after the 2014-2016 Northeast Pacific marine heatwave (PMH).
- Eleven mother/calf pairs (crude birth rate, CBR, 6.6%) is an improvement over 2015-2019 (CBR 0%-3%) but the birth rate remains below average compared to the pre-PMH average (CBR 9.3%). We documented one case of apparent mid-season calf mortality, which is generally uncommon but has been more frequent since the PMH.
- A relatively high residency rate and record-low transience rate in 2021 stand in contrast to PMH years.
- An increasing proportion of whales (27%) appeared emaciated, including 9 of 11 mothers, compared to recent years.
- Overall, these results suggest that the population is still recovering from the PMH.
- We opportunistically documented numerous forage fish schools, especially capelin, however annual forage fish monitoring is needed to systematically assess trends.
- There was an unusually high number of whale/human interactions, including a severely entangled whale (#2532) in GB who has not been sighted since July 30.

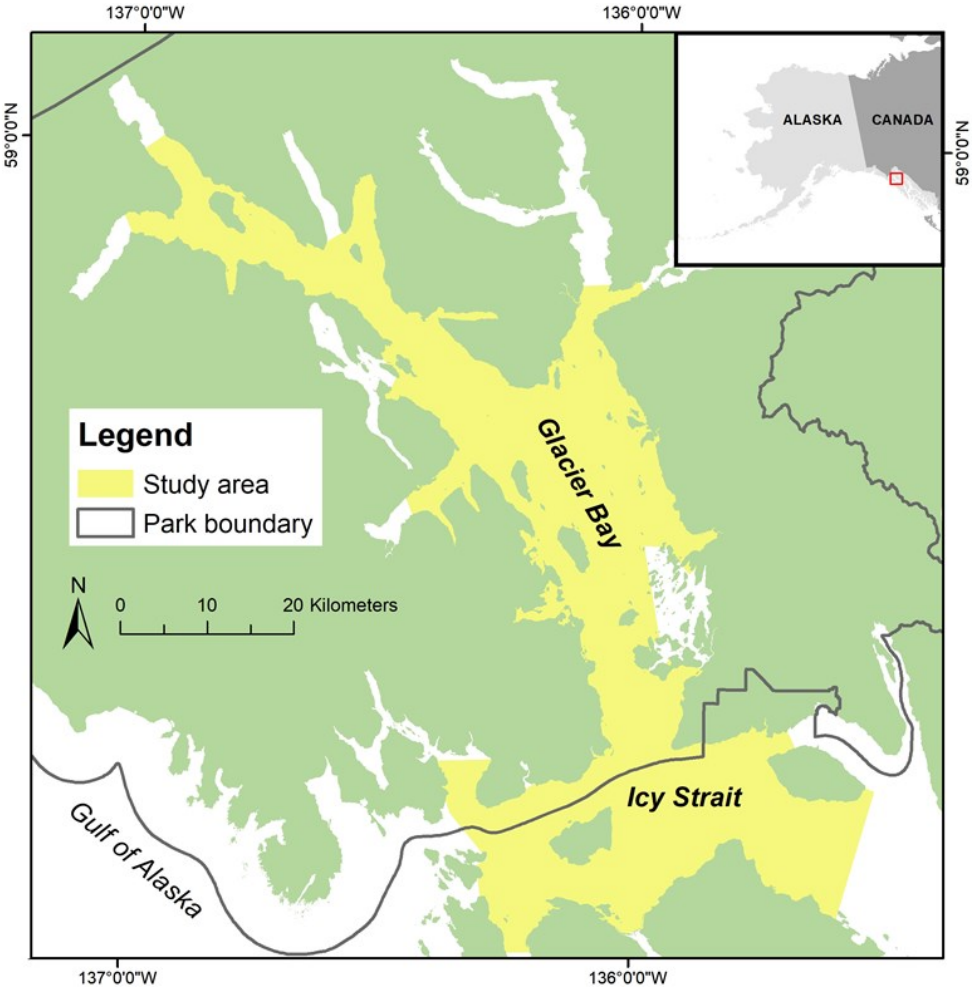

Figure 1. Study area in Glacier Bay and Icy Strait, Alaska.

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. (Photo © UNESCO /Mark Kelley)

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 27 and October 5, 2021, we searched for and photographed humpback whales from the 5.8-m *R/V Sand Lance* (Fig. 3). 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 count the total number of whales and determine the identity and past sighting history of each whale. We used the Happywhale.com automatic matching system to identify whales that had not been sighted before in GB-IS. We entered sighting data, including group composition and behavior state in a database shared with the University of Alaska Southeast in Sitka. 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.

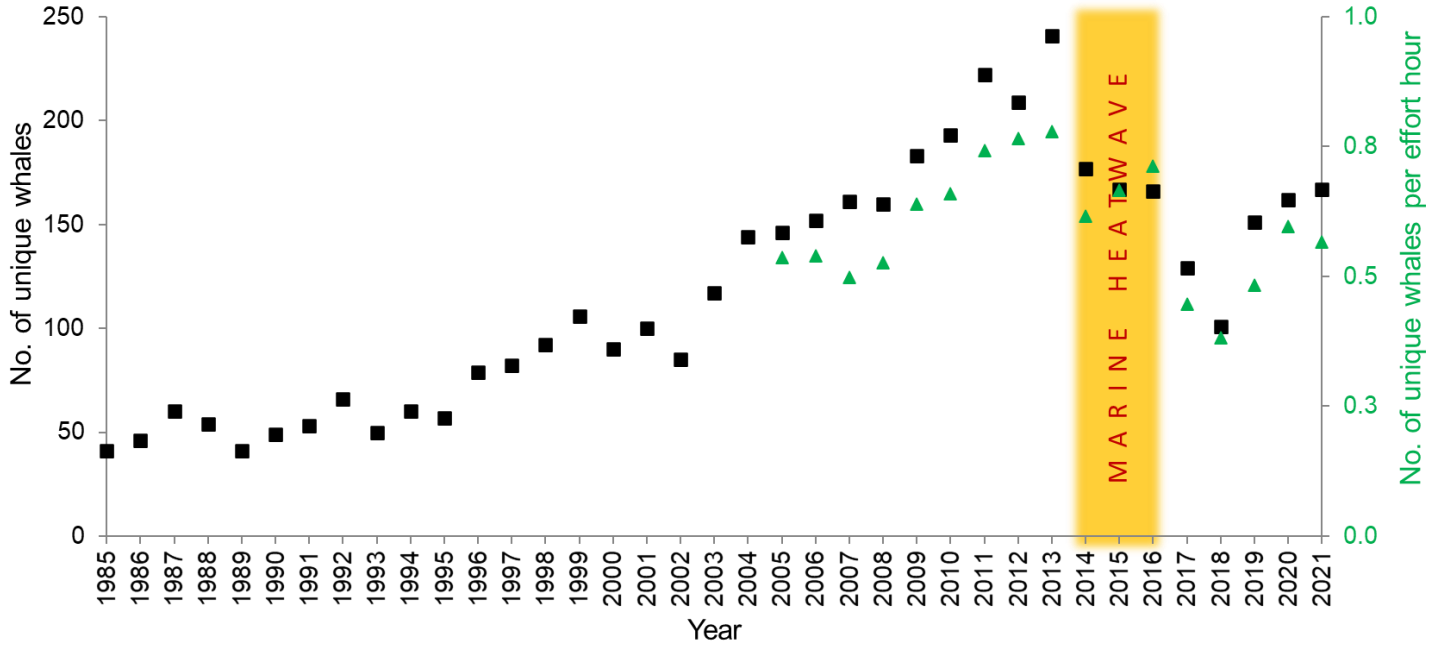

Figure 4. Relative abundance metrics for Glacier Bay & Icy Strait. Annual whale counts (black squares) and annual whale counts corrected for survey effort (green triangles) from June 1 – August 31, 1985–2021. A marine heatwave dominated the NE Pacific Ocean during the period highlighted in orange. Whales/effort hour is not available for 1985–2004.

What Did We Find in 2021?

Survey Effort

Our survey effort during the June 1 – August 31, 2021 core period (295 h) was slightly above average compared to 2005–2020 (mean 284 h, SD = 23.3 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). We normally conduct opportunistic surveys through late October, however on October 5 the *Sand Lance* engine broke down, which ended the season earlier than planned.

Whale Counts

Between June 1 and August 31, we documented 167 unique humpback whales (Fig. 4, black squares) in GB–IS. This raw count represents a 3.1% increase compared to 2020. However, correcting the count for survey effort reveals a 5.0% decline in abundance compared to 2020 (Fig. 4, green triangles). Decreased abundance in 2021 was also noted elsewhere in northern SE Alaska (Alaska Whale Foundation 2021). Abundance in GB–IS remains approximately 30% lower than the 2013 peak whale numbers prior to a five-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).

In Glacier Bay, abundance declined compared to 2020, while in Icy Strait, abundance increased. In Glacier Bay, the raw count of whales (n = 119) was 3.3% lower than in 2020 (n = 123) and the effort-corrected count was 12.9% lower. In contrast, in Icy Strait the raw count (n = 101) was 14.8% higher than in 2020 (n = 88) and the effort-corrected count was 12.1% higher.

Outside of the core monitoring period, we documented four additional whales (two in May and two in September), for a grand total of 171 unique whales in 2021. Seven of these whales had not been documented previously in the study area.

Reproduction & Juvenile Survival

We documented 11 mother/calf pairs and a crude birth rate (CBR) of 6.6% (Fig. 5). The 2021 CBR represents a positive trend compared to PMH and post-PMH years (2014–2019 mean = 2.5%), yet it is lower than the mean CBR prior to the PMH (9.3%, 1985–2013). We documented one case of apparent mid-season calf mortality, which is uncommon but has occurred more frequently in recent years (see Gabriele *et al.* 2022). We sighted whale #1896 with a calf on

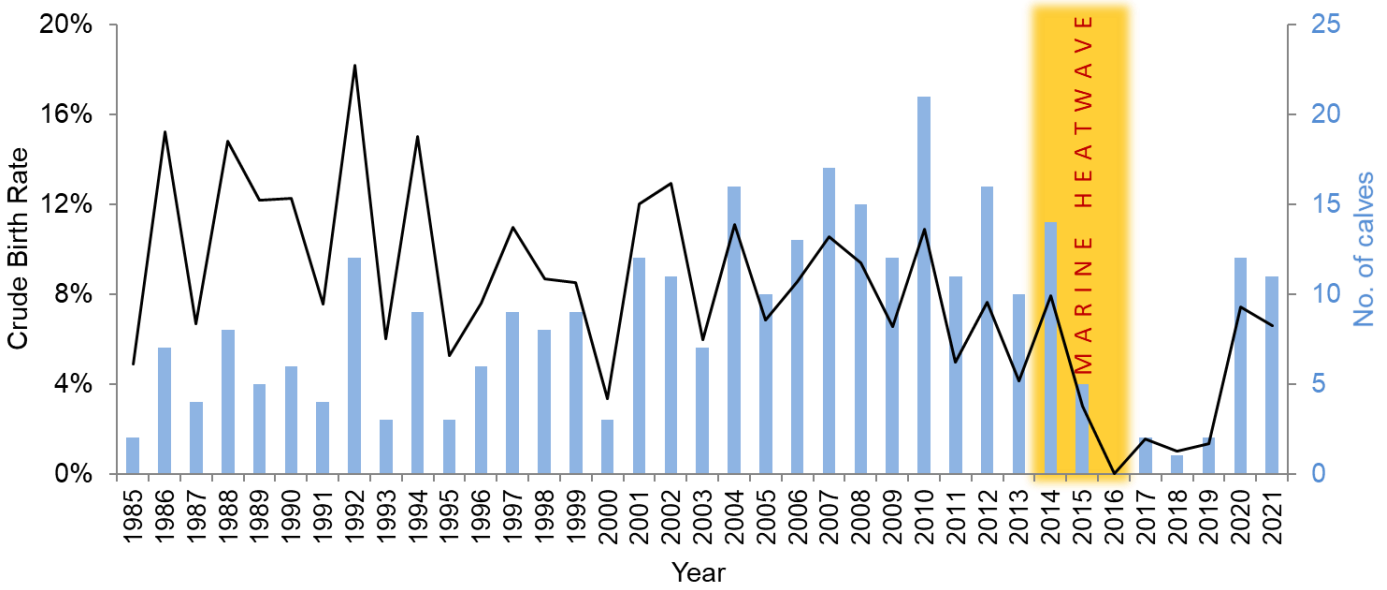

Figure 5. Crude birth rate (black line; # calves/total # whales) and annual number of calves (blue bars) in GB-IS from 1985-2021.

July 9 and July 12, but then sighted her without her calf on four dates between July 23 and August 31.

We documented two yearlings in 2021 and one two-year-old. None of the other GB/IS calves born 2014-2020 have been documented since they were calves. Calf survival dropped from 40% to 3% during and after the PMH (Gabriele *et al.* 2022).

Site Fidelity

For the third year in a row, the residency rate (whales resighted over a span of ≥20 days; 71%, n= 118, range 21-90 days) was above average (1985-2020 mean = 62%, SD = 9%). Conversely, the 'transience' rate (whales sighted one day only), which was below average in 2019-2020, dipped to a record low in 2021 (12%, n = 20; 1985-2020 mean = 26%, SD = 7.1%). Four of the 20 transients were new to GB-IS. These are relatively high residency and low transience rates in 2019-2021 compared to during and after the PMH (2014-2018), when we documented a general trend of low residency and high transience.

In 2021, 44% (n= 29) of 66 adult 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 22-46+ years old) (Fig. 6). This is the same proportion (representing the same individuals) that were missing in 2019 and 2020, indicating that the problem may have stabilized after a pulse in 2018.

Two of the 29 missing whales were sighted elsewhere in SEAK (female #235 was in Sitka Sound in March, and male #1815 was near Juneau in June and in Chatham Strait in August). The fate of the other 27 missing regulars, which represent 41% of pre-PMH regulars, remains unknown despite attempts to locate them elsewhere in the North Pacific through a research collaboration coordinated through Happywhale. In light of the documented decline in non-calf survival from 0.982 pre-PMH to 0.899 post-PMH (Gabriele *et al.* 2022), it appears increasingly likely that many of these whales are dead, although some may have re-located to areas where photo ID is not taking place. Automated fluke matching technology (*e.g.,* Happywhale) will continue to help illuminate individual movement, dispersal patterns, and survival.

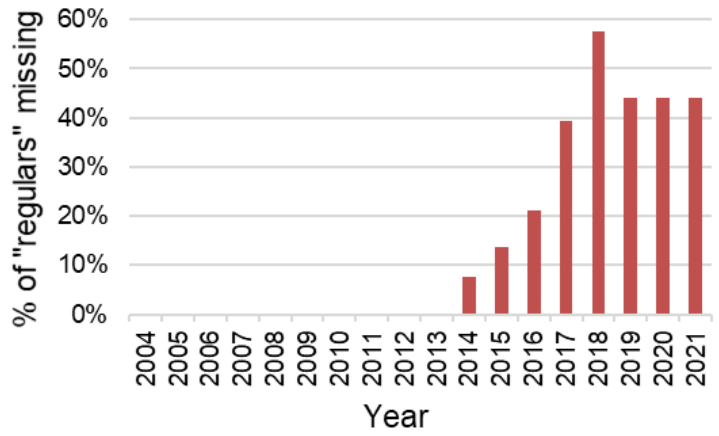

Figure 6. Percentage of 'regulars' missing from GB-IS, 2004-2021.

Tissue Samples

We collected 10 sloughed skin samples from 10 surface active individuals. Since 1996, we have collected 376 sloughed skin samples which are analyzed by our collaborators at Oregon State University for sex determination, mitochondrial DNA haplotype, and nuclear DNA genotyping. We collected one fecal sample for hormone and biotoxin analyses.

Physical Condition

We observed numerous abnormally thin whales during the core monitoring period. The incidence of emaciation continues to increase after declining in 2018 (2016 = 10%; 2017 = 23%; 2018 = 15%; 2019 = 19%, 2020 = 21%; 2021 = 27%). Although these observations are opportunistic, systematic photogrammetric data collected using unoccupied aerial systems (UAS, or 'drones') elsewhere in SEAK also showed evidence of a decline in body condition in 2021 compared to the previous three years (M. van Aswegen *et al.*, unpublished data). It was notable that nine of the 11 mothers (82%) that we observed in GB-IS during the core season appeared thin (*e.g.*, Fig. 7), along with one calf (#2698).

Figure 7. Female #1896's scapula was prominent, indicating emaciation, on July 23, 2021 (the same day we first documented that her calf was missing). She also has a poorly understood bumpy skin condition that is common in some individuals.

We documented adult male #1012 numerous times in GB from late April through late August. This whale has been present in the study area every summer since 1985. He first appeared emaciated in 2016 and he has been especially thin since 2019, with labored breathing since at least 2020. Emaciation is most likely attributable to insufficient food intake but may also indicate injury, disease, or entanglement.

Across all dates, we observed few whales (n = 3; 2%) with abnormal skin (*e.g.,* gray blotchy and/or rough), not including 'bumps'. This rate is similar to 2019-2020 and an improvement over 2018, when 16% of whales (n = 17) had abnormal skin.

Whale Prey and Feeding Behavior

Whales in GB-IS predominantly feed on forage fish, although krill are important prey in other parts of SEAK. Opportunistic observations of near-surface forage fish schools in 2021 documented the availability of capelin, sand lance, and herring (Table 1). In 2015-2017, we saw far fewer fish schools, corresponding with the PMH that is known to have reduced forage fish abundance and quality (Arimitsu *et al.* 2021, Suryan *et al.* 2021). It appears favorable that more fish schools were visible in 2021, but our ability to understand whale population dynamics is limited by a lack of quantitative annual metrics on forage fish abundance and quality.

Table 1. Species identified near feeding humpback whales in GB-IS in 2021 (n = number of detections).

Species	n
Capelin (*Mallotus catervarius*)	13
Likely capelin	6
Pacific herring (*Clupea pallasii*)	7
Likely herring	1
Pacific sand lance (*Ammodytes personatus*)	6
Unidentified forage fish	7
Unidentified zooplankton	1

Subsurface feeding is the most common feeding behavior in GB-IS. Observations of group bubblenet feeding in Icy Strait were rare over the first three decades of this study, but occasional late summer occurrences are becoming more common in recent years (2017, 2018, 2020; GBNP unpublished data). The groups are largely composed of whales that are not otherwise found in the study area, but include a few whales known from Point Adolphus. On August 31 we observed six whales group bubblenet feeding on herring near Pleasant Island reef in Icy Strait (Fig. 8).

Figure 8. Six whales bubblenet feed near Pleasant Island on August 31, 2021. A herring (circled in red) is visible inside the mouth of one of the whales.

Whale/Human Interactions

There was an unusually high number of whale/human interactions in 2021. Between June 28–July 30, we documented #2532 (age 12, sex unknown) with a potentially life threatening entanglement in line during six encounters in GB. Numerous tight wraps of line cut into a pre-existing injury on the right fluke blade (Fig. 9). The whale was emaciated and heavily infested with cyamids (whale lice), indicating poor health.

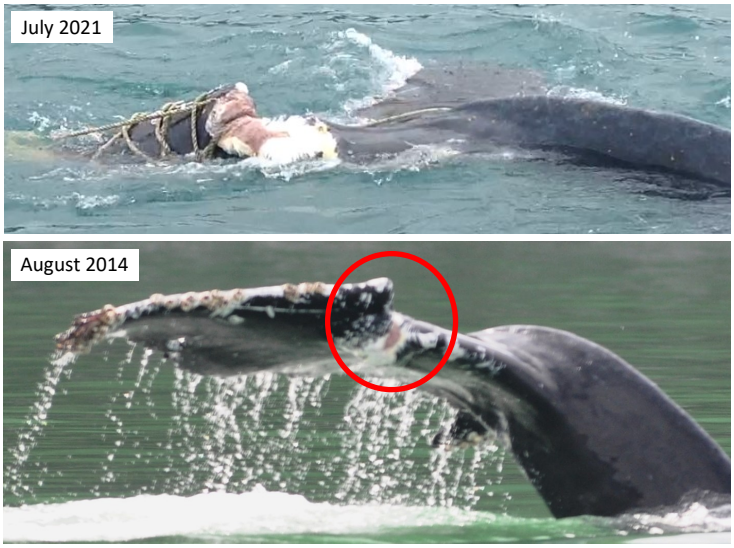

Figure 9. Multiple tight wraps of line around 12-year-old whale #2532's right fluke in July 2021 (top photo). This whale has a pre-existing injury (red circle) shown in the bottom photo taken in August 2014, presumably from a prior entanglement. This past wound created an unnatural snag point for the 2021 entanglement.

Poor underwater visibility and the whale's behavior precluded us from fully characterizing the entanglement, which appeared complex. A Juneau-based NOAA disentanglement response team was ready to assist us with additional assessment tools and possible disentanglement, but weather and a lack of further sightings prevented this response. We hope for additional sightings, but until then, the whale's fate is unknown.

On July 10, a humpback whale struck the anchor chain of a 14 m private vessel in North Sandy Cove. The vessel was anchored in ~15 m of water with several whales feeding nearby when suddenly a whale contacted the anchor chain so forcefully that it spun the boat around. The vessel owner believes that the whale snagged the excess chain scope but did not move the anchor itself.

On July 27, we documented fresh (pink) entanglement injuries around 24-year-old male #1299's caudal peduncle (Fig. 10). He did not have these injuries in photos from June 28.

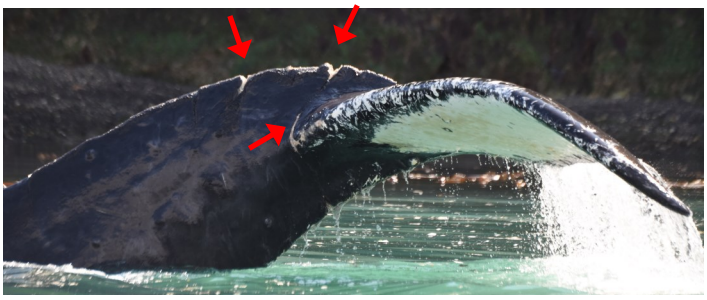

Figure 10. Twenty-four-year-old male #1299 on July 27, 2021 with fresh entanglement injuries.

On August 2, a local whale-watch captain reported an injured calf at Point Adolphus (Tod Sebens, M/V *Taz*). The next day, we documented injuries on #1907's calf (Fig. 11), which were consistent with a vessel collision and were acquired between July 28–August 2 based on photo comparisons. Interestingly, in 2019, #1907 was also injured by a vessel at Point Adolphus (Neilson & Gabriele 2020) and in 2008, her only other known calf (#2536) was also injured in a collision at Point Adolphus (Neilson & Gabriele 2008).

Figure 11. #1907's calf near Point Adolphus on August 5, 2021 with injuries consistent with a vessel strike.

On September 15, we documented a small amount of monofilament fishing line and a circle hook (consistent with halibut sport fishing) dangling from the right fluke tip of male #2341. He did not appear to be encumbered by the entanglement, which was deemed non-life threatening.

On December 2, Alaska state ferry *LeConte* passengers and crew observed an entangled humpback whale near the Gustavus dock and swimming rapidly westward. A single photo shows the whale towing a line and two orange/yellow buoys. We searched for the whale on December 2 and 3, but we did not re-locate it.

Whale Waters

Temporary whale waters were designated at the entrance to the East and West Arms from June 26–July 10. Sustained whale activity around the East Arm entrance led to temporary whale waters from July 10–September 1. By late July, whale use of lower GB increased and a 13-knot speed limit was implemented from July 24–August 21. Shortly thereafter, whale activity in Whidbey Passage also increased, warranting temporary whale waters from July 31–August 21.

Whale #1808 head slaps on June 15, 2021.

Acknowledgements

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https://www.nps.gov/glba/learn/nature/whales.htm

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Whales congregate to feed off Drake Island on June 28, 2021.