Glacier Bay & Icy Strait Humpback Whale Population Monitoring: 2022 Update

National Park Service
U.S. Department of the Interior

Glacier Bay National Park & Preserve

Whales frequented the West Arm of Glacier Bay in 2022. Here, 12-year-old #2334 dives as a cruise ship approaches in the distance.

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 Hawai'i 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 in SEAK, 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.

This report summarizes results from GBNPP's humpback whale monitoring program in Glacier Bay and Icy Strait (GB-IS) in 2022, our 38th consecutive year of consistent data collection. 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 2022

- The total number of whales in Glacier Bay-Icy Strait (GB-IS) was similar to 2021. In Glacier Bay, abundance increased compared to 2021, while in Icy Strait, abundance decreased.
- Thirty-one of 66 adult whales (47%) with a history of strong site fidelity to GB-IS were missing and most are presumed to have died during or after the 2014-2016 Northeast Pacific marine heatwave (PMH).
- We documented six mother/calf pairs and a declining crude birth rate (CBR) since 2020 (2020: 7.4%; 2021: 6.5%, 2022: 3.6%). Although calf production appeared to be rebounding in 2020 following sharp declines during and after the PMH, it remains far below the pre-PMH mean CBR of 9.1%.
- Juvenile survival appears to be increasing after an abrupt decline during and after the PMH.
- Relatively high residency and low transience rates in 2019-2022 presumably reflect favorable feeding conditions in GB-IS in contrast to PMH years.
- The rate of emaciation (16%) appeared to be lower in 2022 than in recent years and reverses a pattern of increasing emaciation.
- In February 2022, adult female #235/"Spot" (age ≥49) was found dead near Angoon and a necropsy revealed that she likely died after being hit by a large vessel.
- We opportunistically documented forage fish, especially sand lance, but annual forage fish monitoring is needed to systematically assess whale prey trends.

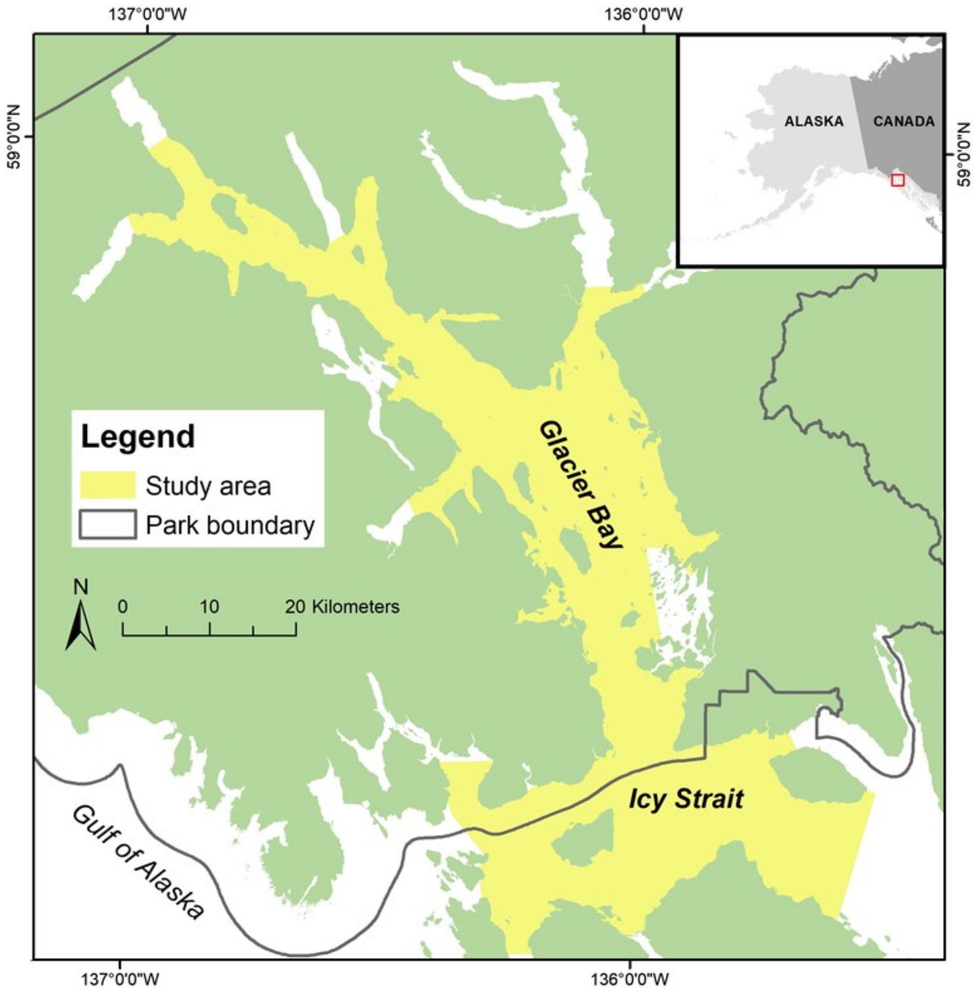

Figure 1. Study area in Glacier Bay and Icy Strait, Alaska.

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 28-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 28 and September 27, 2022, 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 to 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.

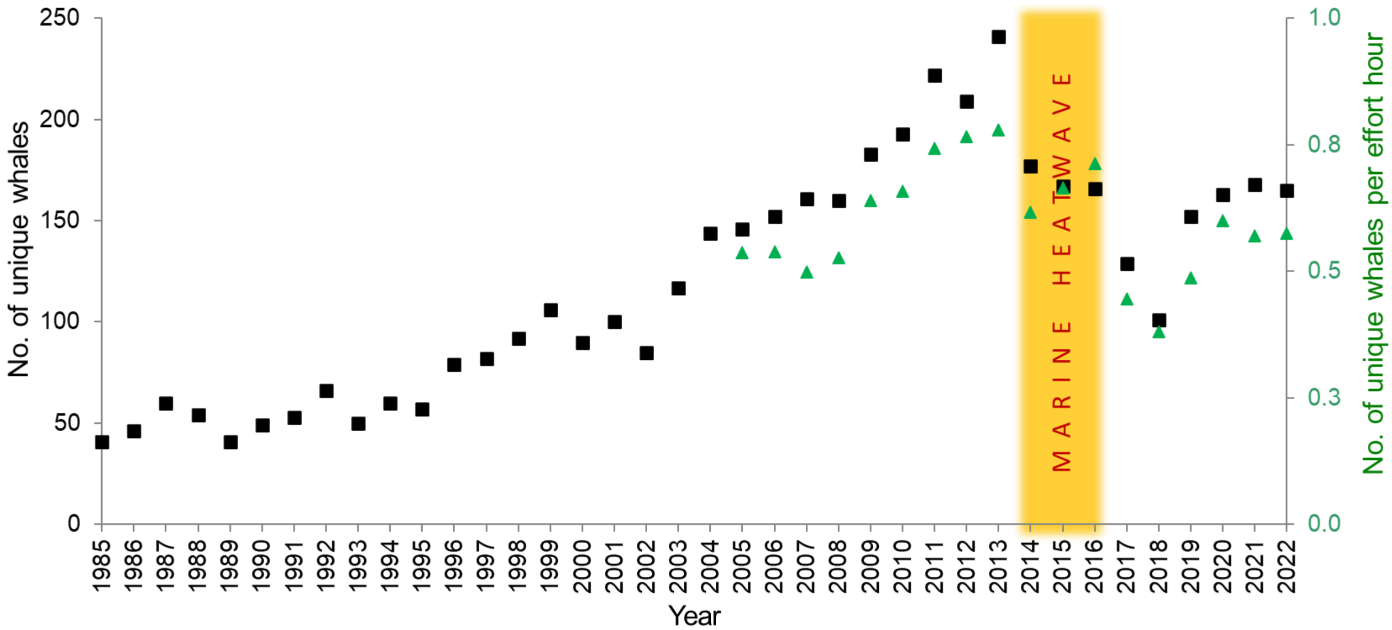

Figure 4. Relative abundance metrics for Glacier Bay & Icy Strait. Annual whale counts (black squares) and annual whale counts corrected for survey effort (green triangles) from June 1 – August 31, 1985–2022. A marine heatwave dominated the NE Pacific Ocean during the period highlighted in orange. Whales/effort hour is not available for 1985–2004.

What Did We Find in 2022?

Survey Effort

Our survey effort during the June 1 – August 31, 2022 core period (287 h) was similar to the average in 2005–2021 (mean 285 h, SD = 22.7 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 issues and marine mammal strandings). We normally conduct opportunistic surveys through late October, however we ended the 2022 field season early on September 27, due to frequent poor weather.

Whale Counts

Between June 1 and August 31, we documented 165 unique humpback whales (Fig. 4, black squares) in GB-IS. This raw count represents a 1.8% decline compared to 2021. However, correcting the count for survey effort reveals a 1.0% increase compared to 2021 (Fig. 4, green triangles). Whale abundance in GB-IS remains approximately 30% lower than at its peak in 2013 prior to the 2014–2016 Northeast Pacific marine heatwave (PMH), which caused widespread and prolonged ecological disruption (Arimitsu *et al.* 2021, Suryan *et al.* 2021).

In Glacier Bay, abundance increased compared to 2021, while in Icy Strait, abundance decreased. This is opposite to the pattern we found in 2021 and these trends were consistent across the raw and effort-corrected counts. In Glacier Bay, the raw count of whales (n = 128) was 6.7% higher than in 2021 (n = 120) and the effort-corrected count was also 6.7% higher. In contrast, in Icy Strait the raw count (n = 78) was 22.8% lower than in 2021 (n = 101) and the effort-corrected count was 14.7% lower.

Outside of the core monitoring period, we documented two additional whales in IS in May, for a grand total of 167 unique whales in 2022. Five whales (one in GB, three in IS, one in both areas) had not been documented previously in the study area.

Reproduction & Juvenile Survival

We documented six mother/calf pairs and a crude birth rate (CBR) of 3.6% (Fig. 5). Calf production declined compared to 2020 (CBR 7.4%) and 2021 (CBR 6.5%) and remains far below the mean CBR prior to the PMH (9.1%, 1985–2013). Although calf production appeared to be rebounding in 2020, it has since fallen every year. A declining birth rate was also documented elsewhere in northern SEAK (Alaska Whale Foundation 2023). However, after a pulse of

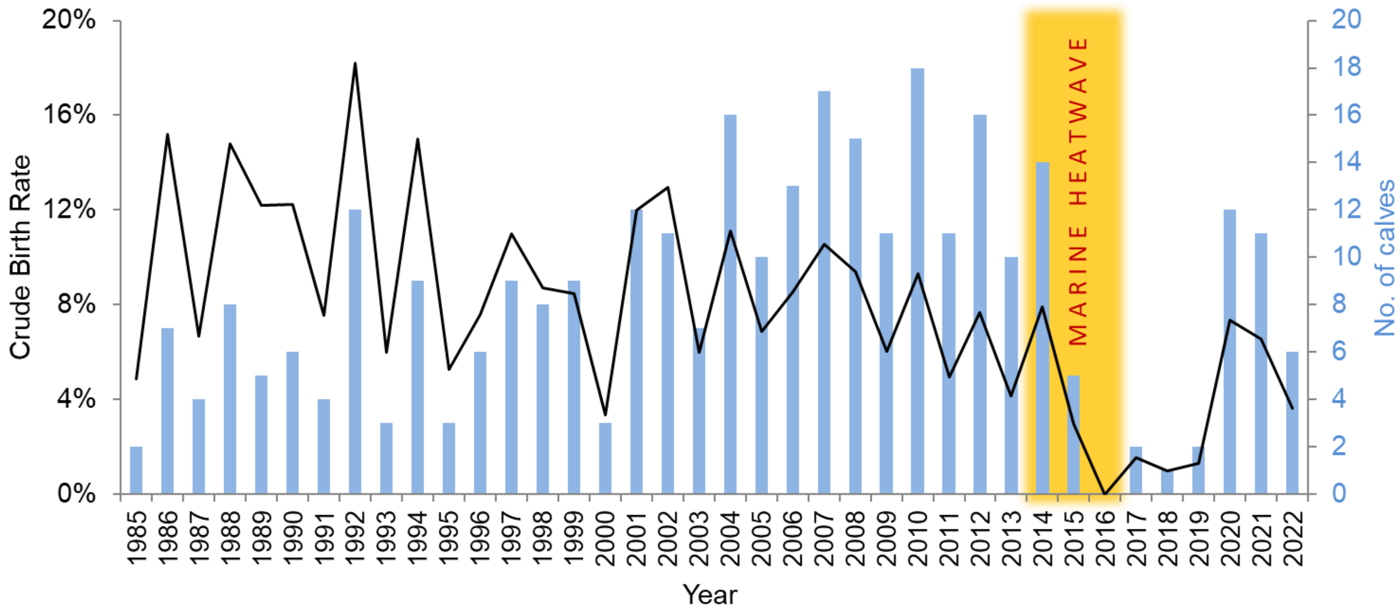

Figure 5. Crude birth rate (black line; # calves/total # whales) and annual number of calves (blue bars) in GB-IS from 1985-2022.

apparent mid-season calf mortalities during and after the PMH, we detected none in 2022.

Female #219 (age ≥41) was seen with a calf in Hawai'i in January[1] and we documented her with the calf in Icy Strait beginning June 3rd. This was her 13th known calf, making #219 one of the most prolific females in the SEAK catalog (Gabriele *et al.* 2017, NPS unpublished data). Female #250 (age ≥45; KBMML unpublished data) was seen with a calf off Baja, Mexico in February[2] and we documented her with the calf in Glacier Bay beginning June 23rd. Female #2324 (age 12) "appeared to be traveling with a calf" in Hawai'i on March 1, 2022[3] but this was not confirmed. We sighted #2324 repeatedly during summer 2022 without a calf, so if she had one it died.

Resightings of juveniles have trended upwards in recent years after calf survival dropped from 40% to 3% during and after the PMH (Gabriele *et al.* 2022). In 2022 we documented two yearlings in GB: #2695, a GB-IS calf in 2021 (Fig. 6), plus #2701, who had been a calf in British Columbia in 2021.[4] The survival of three recent GB-IS calves was discovered through Happywhale sightings in other areas in summer/fall 2022 (yearling #2692 in British Columbia[5], yearling #2696 in Washington[6], and two-year-old #2665 in British Columbia[7]).

Figure 6. Yearling #2695 returned to Glacier Bay in 2022, frequenting many of the same areas it had as a calf in 2021.

Only seven out of 52 (13.5%) of the GB-IS calves born during or after the PMH (2014-2021) are known to have survived past their calf year, with no known survival of any GB-IS calves born in 2014-2018. Since 2019, juvenile survival appears to be increasing after an abrupt decline during and after the PMH.

Site Fidelity

For the fourth year in a row, the residency rate (whales resighted over a span of ≥20 days; 69%, n= 114, range 21-91 days) was above average (1985-2021 mean = 62%, SD = 9%). Conversely, the 'transience' rate (whales sighted one day only; 21%, n = 34) was below average (1985-2021 mean = 26%, SD 7%) but not as low as in 2021 (12%). Three of the 34 transients were new to GB-IS. From 2014-2018 (during and after the PMH), we documented a general trend of low residency and high transience but now the rates are more similar to before the PMH. High residency and low transience rates presumably reflect favorable feeding conditions in GB-IS.

In 2022, 47% (n= 31) of 66 adult whales with a long-term pattern of site fidelity to GB-IS (annually observed 2004-2013 = 'regulars') were missing from the study area (Fig. 7; 15 females and 16 males with an age range of 23-49+ years old) with only a few having sightings elsewhere.

Adult male #159 (Fig. 8) is one of 19 'regulars' who have maintained unbroken GB-IS sighting histories during and after the PMH. Moreover, #159 has been identified in GB-IS for 36 consecutive summers (1987-2022), a feat that only one other whale is known to have matched (male #1012, see next page). Whale #159's earliest known sighting was in GB in 1974 (Sea Search Ltd., unpublished data), giving him a 49-year sighting history, the longest of any living GB-IS whale.

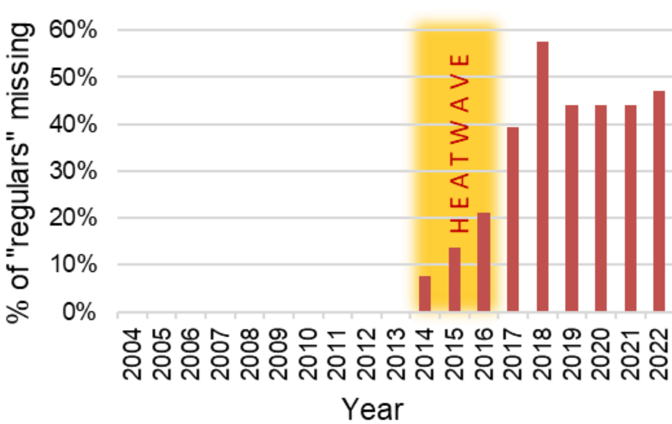

Figure 7. Percentage of 'regulars' missing from GB-IS, 2004-2022.

Figure 8. Whale #159, seen for 49 years and counting!

Two adult females (30-year-old #1302 and 35-year-old #1046) were notably missing in 2022. Whale #1302, documented in GB-IS every year since she was a calf in 1992 (except 1993 and 2003), was last seen in mid-January 2022 in Hawaii.[8] Whale #1046, documented in GB-IS most years since she was a calf in 1987, and every year since 2004 (except 2018), was last seen in July 2021 in GB (NPS unpublished data). The absence of these two females, who have exhibited such high site fidelity in past years, was unexpected.

One of the 31 missing 'regulars' (male #1817) was sighted numerous times in IS during summer 2022 just outside our study area.[9] Another missing whale (#235) was found dead (see below). The fate of the other 29 missing regulars (44% of pre-PMH regulars), remains unknown despite attempts to locate them elsewhere in the North Pacific. 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, and some (like #1302 and #1046) have not been missing long enough to draw any definitive conclusions. Automated fluke matching technology has proven increasingly valuable in tracking the sighting histories of individual whales throughout their range.

On February 10, 2022, adult female #235 (age ≥49) was found dead on Killisnoo Island near Angoon, Alaska. On February 14, National Oceanic and Atmospheric Administration (NOAA) staff conducted a necropsy of #235 and found injuries consistent with blunt force trauma that was likely caused by a collision with a large vessel. Her blubber layer was also relatively thin, indicating that she was nutritionally stressed when she died (NOAA Alaska Region unpublished data).

First documented in GB in 1977 and nicknamed "Spot" by the Jurasz family, #235 exhibited strong annual site fidelity to GB-IS every summer until the PMH (1986-2014 = 29 years). During and after the PMH (2015-2021), her sighting pattern became irregular. She had at least 14 calves between 1981-2020 (giving her a minimum age of 49 years old when she died), and representing a reproductive span of at least 40 years. Spot holds the record for having the highest number of calves in the SEAK catalog.

Tissue Samples

We collected 10 sloughed skin samples from nine unique individuals, including two calves (Fig. 9). Since 1996, we have collected 386 sloughed skin samples which are analyzed by our collaborators at Oregon State University for sex determination, mitochondrial DNA haplotype, and nuclear DNA genotyping.

Figure 9. Breaches knock loose pieces of dead skin when the whale lands. We collected skin from this breaching calf on June 3, 2022.

Physical Condition

We observed numerous thin whales during the core monitoring period, however the rate of emaciation (16%) appeared to decline compared to recent years (Fig. 10). Prior to the PMH, we typically observed a few "skinny" whales, especially in the spring when whales return from fasting during their annual migration to the breeding grounds, but beginning in 2016 we started to notice more whales in poor body condition in the summer. Emaciation is most likely attributable to insufficient food intake (which presumably reflects

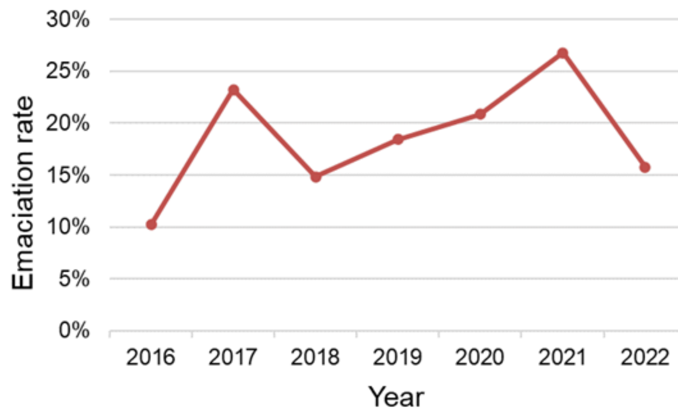

Figure 10. Rate of emaciation (number of "skinny" whales observed June 1-August 31 divided by the total number of whales during this period) in GB-IS whales in 2016-2022.

decreased prey abundance and/or quality), but may also indicate injury, disease, or entanglement.

Abnormally thin adult male #1012 (age ≥36 and seen in GB every summer since 1987) returned to GB in 2022. This whale first appeared emaciated in 2016 and by 2020, he had developed labored breathing.

In 2022, the proportion of mothers who appeared thin was lower than in 2021. In 2021, nine of 11 mothers (82%) and one calf appeared thin (Neilson *et al.* 2022) while in 2022, three of the six mothers (50%) and one calf appeared thin.

Although these observations are opportunistic, systematic photogrammetric data collected using unoccupied aerial systems (UAS, or 'drones') elsewhere in northern SEAK also showed evidence of an increase in humpback whale body condition (*i.e.,* less emaciation) in 2022 compared to 2020 and 2021 (Alaska Whale Foundation 2023).

We observed few whales (n = 5; 3%) with abnormal skin (*e.g.,* gray blotchy and/or rough), not including 'bumps'. This rate is similar to 2019-2021 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 in 2022 documented the presence of capelin, sand lance, lanternfish, eulachon, and (likely) herring near feeding humpback whales in the study area (Table 1). Sand lance appeared to be more abundant and more broadly distributed in GB than normal, with numerous sightings of dense sand lance schools near-shore in lower to mid Glacier Bay and at the mouth of Dundas Bay.

Table 1. Species identified near feeding humpback whales in GB-IS in 2022 (n = number of detections).

Species	n
Capelin (*Mallotus catervarius*)	8
likely capelin	4
Pacific sand lance (*Ammodytes personatus*)	5
likely sand lance	3
Unidentified lanternfish (Myctophidae spp.)	2
Eulachon (*Thaleichthys pacificus*)	1
Likely Pacific herring (*Clupea pallasi*)	1
Unidentified forage fish	16

On July 5 we dip-netted a sample of sand lance near a humpback whale in Sitakaday Narrows and on August 21 we dip-netted a sample of capelin at the mouth of Bartlett Cove with a whale nearby. These opportunistic samples are analyzed by our collaborators at the U.S. Geological Survey for algal toxins (which when consumed, can bioaccumulate in apex predators like humpback whales and seabirds). Results from the 2022 samples are not yet available, however none of the sand lance, capelin, or herring samples that we collected in 2018-2021 had high levels of biotoxins. Most were below the detection limit and a few samples had detectable but low levels of saxitoxin (Y. Arimitsu, pers. comm.).

On June 1 we opportunistically collected a fecal sample from yearling #2695 to be analyzed for algal toxins and macronutrient content. The NOAA Wildlife Algal-toxin Research and Response Network for the U.S. West Coast (WARRN-West) Lab found that levels of domoic acid and saxitoxin in the sample were below detection limits.

Forage fish abundance in 2021-2022 appears to have increased following a drop in detections during and after the PMH, but our ability to understand whale population dynamics is limited by a lack of quantitative annual metrics on forage fish abundance and quality.

Whale/Human Interactions

No entanglements or collisions were reported in the study area in 2022. On June 2, we observed healed propeller scars on 15-year-old whale #2030 that had been acquired since June 22, 2021 (Fig. 11).

Figure 11. Propeller scars on #2030 that were new since 2021.

In recent years, we have seen rapid growth in commercial whale watching in waters adjacent to the park, especially around Point Adolphus (*e.g.,* Fig. 12) and the Pleasant Island reef. The growth of the fleet is occurring concurrently with a 62% decline in the number of humpback whales in IS following the PMH

Figure 12. A group of whale watching vessels concentrates near #219 and her calf at Point Adolphus on August 12, 2022.

(204 whales in 2013 vs. 78 whales in 2022). As a result, there are not only more whale watching vessels, but the ratio of whale watching boats to individual whales is increasing, raising the risk of whale-vessel collisions and disturbance. Minimizing disturbance is vital because humpback whales rely on a limited feeding season to maintain body condition, particularly following the PMH which left many whales in poor condition. Near Juneau, where the fleet has also grown rapidly, increasing the regulated approach distance and encouraging operators to abide by voluntary best practices were recommended to ensure the sustainability of the industry (Schuler *et al.* 2019).

There were no 2022 sightings of entangled and emaciated whale #2532, a 12-year-old whale that we last documented in poor health in Glacier Bay on July 30, 2021 (Neilson *et al.* 2022), therefore the fate of this whale is unknown.

Outside the study area, on August 15 in Port Frederick near Hoonah, a humpback whale reportedly breached near three kayakers and the resulting wave capsized one of the kayaks (KINY social media post, Aug 15, 2022).

Whale Waters

Beginning in mid-June, sustained whale activity in the mid to upper bay (especially in the West Arm) led to six successive temporary whale waters areas from June 18 until September 10. These whale waters consisted of a 13-knot vessel speed limit but no course restriction.

In early July, whale use of lower GB increased and a 13-knot speed limit was implemented from July 9-September 21. From September 22-October 20, the mid-channel requirement in lower GB was lifted but a 20-knot speed limit remained in place due to continued whale use of the area. In recent years, the cruise ship season in GB is extending progressively later in the fall.

Acknowledgements

We thank GBNPP staff, volunteers, external researchers, & visitors for contributing whale sightings. Thanks to Kathy Hocker & Jozee Archambault for continuing to volunteer and to Yumi Arimitsu (USGS) and Craig Murdoch (NPS) for identifying forage fish in our photos. Thanks to David Cannamore for relaying whale news to us. We are increasingly grateful to Ted Cheeseman & Ken Southerland for their innovations in fluke matching and for facilitating data sharing (www.Happywhale.com).

The Happywhale sightings cited in this report are thanks to: [1]California State University Channel Islands, [2]Cabo Trek (including Angelika Ludwiczak), [3]Chuck Babbitt, [4]Marine Education and Research Society (private data), [5]Laskeek Bay Conservation Society, [6]San Juan Excursions & Outer Island Excursions, [7]Prince of Whales Whale Watching & Maya's Legacy Whale Watching, [8]Hawaiian Adventures Kona, [9]Hoonah Travel Adventures, Makayla Tideman, Alaska Yacht Charters, Allen Marine Tours, & Alaska Whales and Drones. All whale photos were taken under NMFS ESA/MMPA Permit 21059.

Literature Cited

Alaska Whale Foundation. 2023. 2022 End-of-Year Report. Unpublished report. 13 pp. www.alaskawhalefoundation.org

Arimitsu, M.L., *et al.* 2021. Heatwave-induced synchrony within forage fish portfolio disrupts energy flow to top pelagic predators. Global Change Biology (doi:10.1111/gcb.15556)

Gabriele, C.M., *et al.* 2017. Natural history, population dynamics, and habitat use of humpback whales over 30 years at an Alaska feeding ground. Ecosphere 8: 1-18 (doi:10.1002/ecs2.1641).

Gabriele, C.M., *et al.* 2022. Sharp decline in humpback whale (*Megaptera novaeangliae*) survival and reproductive success in southeastern Alaska during and after the 2014-2016 Northeast Pacific marine heatwave. Mammalian Biology (doi.org/10.1007/s42991-021-00187-2)

Jurasz, C.M., and V.P. Palmer. 1981. Censusing and establishing age composition of humpback whales (*Megaptera novaeangliae*), employing photodocumentation in Glacier Bay National Monument, Alaska. National Park Service Unpublished Report, Anchorage, Alaska.

Neilson, J.L., *et al.* 2018. Humpback whale monitoring in Glacier Bay and adjacent waters 2017: Annual progress report. Natural Resource Report NPS/GLBA/NRR-2018/1660. National Park Service, Fort Collins, Colorado.

Neilson, J.L., *et al.* 2022. Glacier Bay & Icy Strait Humpback Whale Population Monitoring: 2021 Update. National Park Service Resource Brief, Gustavus, Alaska.

Schuler, A.R., *et al.* 2019. Humpback whale movements and behavior in response to whale-watching vessels in Juneau, AK. Frontiers in Marine Science (doi.org/10.3389/fmars.2019.00710)

Suryan, R.M., *et al.* 2021. Ecosystem response persists after a prolonged marine heatwave. Scientific Reports (doi:10.1038/s41598-021-83818-5)

Suggested Citation

Neilson, J.L., C.M. Gabriele, and L.E. McCaslin. 2023. Glacier Bay & Icy Strait Humpback Whale Population Monitoring: 2022 Update. National Park Service Resource Brief, Gustavus, Alaska.

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