4. Biologically Important Areas for Cetaceans Within U.S. Waters – Gulf of Alaska Region

Supplementary Descriptions

BIAs are sorted by species common name, BIA type, Importance Score and descriptive name. Child BIAs, if present, follow the parent BIA in the order of Importance Score and descriptive name.

Supplementary Description 4. 1. Beluga small and resident pop.

Species name: Beluga (*Delphinapterus leucas*)

Stock or population: Cook Inlet

Descriptive name: Cook Inlet

BIA type: Small and Resident Pop.

BIA label: S-BIA2-s-b2-GOA002-0

Transboundary across: None

Hierarchy: Non-hierarchical; single BIA

Importance score: 2 (Intensity: 2, Data support: 3)

Intensity matrix: Abundance: 2, Range: 2

Supporting notes for intensity score: This BIA is used year-round by a small and resident population for feeding and breeding; there are limits on food supply such as salmon runs and seasonal movement of other fish species. Acoustic seasonal occurrence patterns show peak detections in upper inlet during summer; occurrence of whales in upper inlet when ice coverage peaked in winter was more prevalent than previously suggested. (Castellote 2020). Acoustic seasonal foraging documented as more prevalent during summer, particularly near upper inlet rivers, than winter; foraging peaks coincided with presence of different anadromous fish runs from spring-fall. Low levels of feeding signals detected in winter suggest lack of feeding aggregation areas, feeding in non-monitored offshore waters, or increased effort on benthic prey (Castellote 2020). In a photo ID study from 2005-2017, a total of 477 photo-ID surveys were conducted annually from April through October in the Cook Inlet Beluga Whale (CIBW) Critical Habitat (CH; NOAA 2011), with 575 beluga groups encountered. All sighting locations were mapped and models were developed to test for temporal and spatial patterns. Land and vessel-based photo-ID showed approximately 400 individuals were identified most recently (McGuire 2020). Areas have general corridors connecting them and are important beluga habitat (McGuire 2020). Aerial surveys have been used for population estimates since 1993; Bayesian methods are primarily used, and as of 2018 the abundance estimate was 279 individuals (Wade, Boyd, Shelden, Simms 2019). Over the most recent 10-yr period (2008-2018) the estimated trend in abundance is a decline of -2.3%/yr. (Wade, Boyd, Shelden, Simms 2019; See Fig 2 & Fig 3 in corresponding manuscript Wild et al.). Diet analysis was conducted in March-November 1992-2012 from 53 stomach contents of subsistence harvests and strandings. From 1992 through 2001 all 24 stomachs showed only Eulachon & Chinook were identified. From 2002 through 2012 the 28 stomachs sampled from March through November contained fish and invertebrates, including salmon (coho, chum, Chinook), cod (saffron, walleye pollock and Pacific cod), smelt (eulachon), and flounder (yellow-fin sole, starry flounder). Longnose suckers were the only freshwater fish identified in stomachs. Salmon were the biggest fish in stomachs, up to 64 cm (25 in). Invertebrates included shrimp, polychaetes, and amphipods (Quakenbush et al. 2015). Satellite tag tracks from 1999-2002 (n=18) show whales spend their time year-round in the CH designated area of the upper Cook Inlet, and shoreline along the lower inlet (Shelden et al. 2015). Aerial surveys from Shelden et al. (2015) show contraction of range (see Fig 5-14 in Shelden et al. 2015) from 1978-2014.

Supporting notes for data support score: List of the main datasets that support this BIA the data support score of 3:
- Passive acoustic monitoring (PAM) from a year-round study 2008-2013, in which 13 locations were monitored within CIBW critical habitat (Castellote 2020).
-Photo ID study 2005-2017: 477 photo-ID surveys conducted Apr-Oct in the CIBW CH, with 575 beluga groups encountered. Locations were mapped, and models were developed to test for temporal and spatial patterns. Land and vessel-based photo-ID resulted in about 400 individuals identified (McGuire 2020).
-Aerial surveys from June 5-15, 2018, by NMFS (Wade et al. 2019) showed a 10-year (2008-2018) decline of -2.3%/yr and overall population of 279 individuals. This decline was corroborated by McGuire et al. (2021) with an annual mortality rate of 2.2% from stranding data.
-Necropsy analysis of 48 females assessed reproductive status collected from 1995-2016 (Shelden 2019).
-Eighteen total satellite tags were deployed May 1999, Sep 2000, July-August 2001, and July-August 2002; results from spring, summer, fall, and winter tracks all show individuals remain in upper Cook Inlet from the Kenai River northward, and along the coast and shore in the lower Cook Inlet, matching the CH designation perfectly (Shelden et al. 2015).

Spatiotemporal variability: s

Supporting notes for spatiotemporal variability: The spatiotemporal variability of the area is characterized by feeding on seasonal salmon and eulachon runs, as well as ice. These areas are mostly static at mouths of rivers, etc. and specific times of year.

Boundary certainty: 2

Supporting notes for boundary certainty: This boundary was drawn around Critical Habitat (CH) as designated by National Marine Fisheries Service (NMFS). Most of the new research we have found occurs only within this CH. It is possible that belugas use areas outside the CH, but unlikely given the habitat is defined by river outlets and streams where primary prey species are found (hooligan in spring, salmon in fall), and some halibut in fall. Additionally, any research done that includes areas outside of CH shows they primarily use the area within CH designation.

Months of year designation is applicable: Year-round

Tagging data supporting designation (Y/N): Y

# of tags: 18

# of years in which supporting tagging data collected: 1999-2003

Supporting information: Satellite data show year-round residency in Cook Inlet (Hobbs et al., 2005; Goetz et al., 2012b).

Shelden et al. 2015: May 1999, Sep 2000, Jul-Aug 2001, and Jul-Aug 2002. Total of
1478 days of tag data. Spring, summer, fall, and winter tracks all show individuals stay in upper Cook Inlet from Kenai River northward, and along the coast and shore in the lower Cook Inlet, matching CH designation perfectly (Shelden et al. 2015).

Visual observations/records supporting designation (Y/N): Y

# of observations/records: 800+ hours (1975-2014) + 42.9 hours (2018; 36 groups detected)

# of years in which supporting visual data collected: 1975-2014 & 2018

Supporting information: Dedicated aerial surveys of Cook Inlet belugas (CIB) conducted by Alaska Department of Fish and Game, Department of the Interior, NOAA, and NMFS year-round with greatest effort during summer months (see Hansen & Hubbard, 1999; Rugh et al., 2000, 2004, 2005b, 2010; Goetz et al., 2007, 2012a; Hobbs et al., 2012b), as well as an Opportunistic Sighting Database maintained at NOAA, NMFS, and NMML.

Shelden et al. 2015 summarized aerial surveys (1977-2014) and opportunistic sightings (1975-2014);

Shelden et al. 2018 & Wade et al. 2018 summarized June 2018 aerial surveys with 42.9 hours. Median beluga count for 2018 survey is 194 whales with an abundance estimate of 279 individuals (Wade et al. 2018).

Acoustic detections/records supporting designation (Y/N): Y

# of observations/records: 11,768 days that contain acoustic data

# of years in which supporting acoustic data collected: 2008-2013

Supporting information: Recordings from 13 passive acoustic moorings (ADF&G monitoring study results available at www.fakr.noaa.gov/ protectedresources/whales/beluga/research.htm#ci).

PAM year-round study; monitoring 13 locations within CIBW critical habitat resulting in 11,768 days that contain acoustic data (Castellote 2020).

Photo-ID evidence supporting designation (Y/N): Y

# of individuals photographed: ~400 individuals

# of years of photo records to compare: 2005-2017

Maximum # of years same individual photographed in area: 6

Supporting information: Photo ID data (McGuire et al., 2011): 186 left side photographs; 255 right side photographs from 2005-2010.

Updated McGuire et al. 2020, summarized 2005-2017 data: 477 photo-ID surveys conducted Apr-Oct in the CIBW critical habitat, with 575 beluga groups encountered. Locations mapped, models developed to test for temporal & spatial patterns. Land and vessel-based; ~400 individuals identified (McGuire 2020)

Genetic analyses conducted supporting designation (Y/N): Y

Weak/moderate/strong support for genetic differentiation: Strong

Nature of supporting information: Strong

Supporting information: O'Corry-Crowe et al. (1997) (37 samples) from 1977-1997. Another 41 samples collected from 1998-2007 (O'Corry-Crowe et al. 2015).
78 individuals had tissue samples taken total.

What factors justify the boundary selection?: Polygon around critical habitat designation (ESA 73 FR 62919 & NOAA 76 FR 20180), which was based on aerial surveys, tagging data, acoustic recordings, and traditional ecological knowledge (TEK) (NOAA 2011). We suggest the BIA continue to mirror that of the boundary for critical habitat (CH) designation, with the acknowledgement that belugas may use areas outside of the CH, but not much work is done outside CH and there is not a lot of evidence to suggest whales spend any significant amount of time outside CH.

Data sources: Endangered Species Act NOAA Final rules: 73 FR 62919 & 76 FR 20180

Approximate % of population that uses this area for the designated purpose (if known): 100

Approximate # of areas known specifically for this behavior (if feeding/cow-calf/mating/migratory) for this population: 1

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Supplementary Description 4. 2. Beluga small and resident pop.

Species name: Beluga (*Delphinapterus leucas*)

Stock or population: Yakutat Bay

Descriptive name: Yakutat Bay

BIA type: Small and Resident Pop.

BIA label: S-BIA2-s-b2-GOA003-0

Transboundary across: None

Hierarchy: Non-hierarchical; single BIA

Importance score: 2 (Intensity: 3, Data support: 1)

Intensity matrix: Abundance: 3, Range: 3

Supporting notes for intensity score: Intensity Matrix Score:
Abundance: 3 (10-12, which is <125 individuals)
Range size: 3 (~1000km2, which is <2,000km2)
Overall Intensity Score = 3

-Count of 10 individuals in 2008 (O'Corry-Crowe et al. 2009; 2015) and 2011 (Lucey et al. 2015)
-NOAA Fisheries regulations under the Marine Mammal Protection Act (MMPA) (50 CFR 216.15) include Yakutat Bay belugas as part of Cook Inlet Stock (75 FR 12498), but the Yakutat belugas are not considered part of the Cook Inlet DPS (ESA, 73 Fr 62919).
-Local ecological knowledge from interviews referencing years 1938-2013 had average group sizes of 6 whales (Lucey et al. 2015)
-Genetic work suggests that while these whales may have come from the Cook Inlet population, their genetics are distinct enough now from CIBW that they have "limited genetic exchange with Cook Inlet" (O'Corry-Crowe 2015).
-Susan Oehlers saw a group of 5 or so near the Esker Creek cabin in Yakutat Bay (NW bay) in August 2017 on a personal trip (pers comm 25 May 2021).
-Jim Capra reported sightings: "single Beluga moving toward the glacier at the mouth of Esker Creek in mid August 2020" and "Last year I did see them in groups of two or three from the air in "Beluga Bay", the ice choked area on the west side of the Hubbard Glacier face." (Jim Capra pers com 14 May 2020).

Supporting notes for data support score: Overall, very minimal data on this population since 2013, nearly 10 years ago.
Round 1 BIAs were based on data from 1976-2008
-We have data from dedicated research to add up to 2013, and three separate sightings from members of the public in 2017, 2018, and 2020.
-Spoke with researchers that have worked in the region in the past: Kate Stafford, Greg O'Corry-Crowe, and Manolo Castellote; nothing new to report since 2013.
SUMMARY OF EXISTING RECORDS:
-Interviews with a number of Tribal elders revealed regular sightings of belugas in the area as far back as the 1930s. A recent traditional ecological knowledge (TEK) study has expanded on these initial interviews (Lucey et al. 2015). -3 sightings of belugas in Yakutat Bay in 1970s (May 1976, Apr & Jul 1979); fishermen recalled often seeing 10-20 during 1970s as well. No subsequent official reports until 1990s. (Laidre 2000)
-1993 Disenchantment Bay & Yakutat bay (September 1993) (Laidre 2000)
-1997-98 there were several sightings of 5-10 animals throughout all seasons of the year (February 1997, August 1997, November-December 1998) (Laidre 2000)
-Aug 2000: 6 individuals estimated (Laidre 2000).
-2002 newborn calf sighted – mentioned in O'Corry-Crowe 2006 abstract, (O'Corry-Crowe and Kinzey, 2002; O'Corry Crowe, 2003; W. Lucey, unpublished data)
-May 2005: 15-day sampling period. Aerial, shore, and boat based surveys. Most sightings in upper Disenchantment Bay, groups of 1-12 individuals. No newborn calves. Max 12 individuals. (O'Corry-Crowe 2006)
- Apart from 1976, all sightings </= 12 individuals (O'Corry-Crowe 2006)
May 2008; acoustic work in head of Disenchantment Bay – 10 day sampling period; 167,579 clicks classified as Belugas during sampling period (O'Corry-Crowe 2009).
Local interviews & knowledge: February, August, September 2009: 1-5 whales in each sighting from winter trolling to park service flight; Local interviews & knowledge:

-May (x2), Aug (x2), Sep 2010: 4-6 belugas seen except on 21 August 2010 Lucy & O'Correy-Crowe did a beluga survey and saw 7-9 belugas with 1 calf. Other sightings were from tourist or park service flights, or seal surveys.
-May, Jul (x2), Aug 2011: 2, 3, 5-6, and 9-10 seen by Lucy each time on surveys
-Jul (x2) & Aug 2012: 8, 7, and 4 seen swimming by Lucy on surveys
-Jul 2013: 6 seen by Lucey swimming on a survey.
-Apart from 1976, all sightings </= 12 individuals (O'Corry-Crowe 2006 & Lucey 2015)
-All sightings since 2008 that list specific locations were North of Knight Island. In 2008, one Khantaak Island sighting was in southern Yakutat Bay on the South side of the islands (Lucey et al. 2015).
-Four acoustic T-PODswere set 10 days in Disenchantment Bay (Beluga Bay) for 10 days (May 2008); 25d 7hr sampling time (607 hr) (O'Corry-Crowe et al. 2009).
-Acoustic moorings were set June 2012-October 2012 off Esker Creek and June 2012-Mar 2013 off Grand Walsh River

(Castellote et al. 2015); 381 days of detections total; Beluga presence averaged 4hr per day off Esker Creek with most activity present from June through September Only 2hr total detected off Grand Wash River.
-Susan Oehlers (USFS) saw a group of 5 (+/-) near Esker Creek cabin in Yakutat Bay (NW bay); August 2017 on a personal trip.
-Jim Capra pers com 14 May 2021 says: “My last sighting was a single Beluga moving toward the glacier at the mouth of Esker Creek in mid August 2020. It was an adult and looked like a male. That was my first sighting at Esker in two years although they seem to move along the shore daily in the fall (chasing Coho?). Last year I did see them in groups of two or three from the air in “Beluga Bay”, the ice choked area on the west side of the Hubbard Glacier face. This seems to be where they spend most of their time. Cruise ships and charter boats don’t enter this area because of the ice, but seal hunters that go up that far in the bay target the area.”

Spatiotemporal variability: s

Supporting notes for spatiotemporal variability: Spatiotemporal variability of this BIA is likely characterized by static properties of the bay such as bathymetric features, and food availability at river mouths, etc. It is a small and resident population that stays within the boundaries of the bay as far as we know.

Boundary certainty: 2

Supporting notes for boundary certainty: -Sightings scattered throughout the bay, thus current boundary includes all of the Bay; (Laidre et al. 2000; O’Corry-Crowe et al. 2006, 2009)
-Jim Capra formerly with NPS, now Yakutat chief of police, says he has seen them in “Beluga Bay”, the ice choked area on the west side of the Hubbard Glacier face. This seems to be where they spend most of their time.” (Pers comm 14 May 2021).
-Because the last known records have all been up by Esker Creek and Beluga Bay, both are further up Yakutat bay so it’s not certain they still use the entire area of the bay.

Months of year designation is applicable: Year-round

Tagging data supporting designation (Y/N): N

# of tags: 0

# of years in which supporting tagging data collected: NA

Supporting information: No Satellite Tags Placed

Visual observations/records supporting designation (Y/N): Y

# of observations/records: 79 observations

# of years in which supporting visual data collected: 1938 - 2020

Supporting information: Lucey et al. summarized obs and local ecological knowledge from 1938-2013 with 76 observations. Group size averaged 6 individuals (1-26 range) (Lucey et al. 2015). Susan Oehlers USFS notes 5 or so seen in Aug 2017 on personal trip (Susan Oehlers pers comm 25 May 2021). Jim Capra saw one individual in August 2020; also saw group so of 2 or 3 in 2018 (pers com 14 May 2021). Visual observations come from both aerial and vessel platforms.

Acoustic detections/records supporting designation (Y/N): Y

# of observations/records: 381 + 25.25 = 406.25 days

# of years in which supporting acoustic data collected: 2008 & 2012-2013

Supporting information: Passive acoustic recordings;
25d 7h passive acoustic recordings, with 167,579 clicks classified with a high probability as beluga clicks in May 2008 (O’Corry-Crowe et al., 2009).
2 Acoustic moorings set Esker Creek (Jun '12-Oct '12) and Grand Walsh River (Jun '12 - Mar '13); 381 days of detections total (Castellote et al. 2015).

Photo-ID evidence supporting designation (Y/N): Y

# of individuals photographed: 960 photos

# of years of photo records to compare: 2008

Maximum # of years same individual photographed in area: NA

Supporting information: 960 photos during a 2008 dedicated photo-ID survey (# of indiv from that estimated to be 10) (O'Corry-Crowe et al. 2009). Pop size recently estimated to number < 20 individuals (Lucey et al. 2015). Additional surveys by Lucy in 2010 but no official report on them and if dedicated photo-ID was done (Lucey et al. 2015).

Genetic analyses conducted supporting designation (Y/N): Y

Weak/moderate/strong support for genetic differentiation: Moderate – 6 total biopsy samples collected in Yakutat Bay between 2002 and 2005 (O’Corry-Crowe et al., 2006)

Nature of supporting information: Strong

Supporting information: 10 biopsies collected 2002-2008; strong support from genetic analysis that the Yakutat Bay belugas are unlikely to represent recent arrivals or seasonal visitors from the nearest population in Cook Inlet (O'Corry-Crowe 2015).

What factors justify the boundary selection?: Boundary will remain the same as BIA Round 1

Data sources: Emails with Kate Stafford, Manuel Castelote, and Greg O'Corry Crowe on dedicated research
Emails with Susan Oehlers (NPS) & Jim Capra (formerly NPS) on data from members of the public.

Approximate % of population that uses this area for the designated purpose (if known): 0

Approximate # of areas known specifically for this behavior (if feeding/cow-calf/mating/migratory) for this population: 1

References: NOAA Fisheries regulations under the MMPA (50 CFR 216.15) include the belugas occupying Yakutat Bay as part of the Cook Inlet stock (75 FR 12498), but the Yakutat belugas are not considered part of the Cook Inlet DPS (ESA, 73 FR 62919). Therefore Yakutat Bay belugas ae not listed under the ESA, but they are defined as depleted under the MMPA (Allen & Angliss, 2014).

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Supplementary Description 4. 3. Fin whale feeding area

Species name: Fin whale (*Balaenoptera physalus*)

Descriptive name: Kodiak Island to Semidi Islands

BIA type: Feeding Area

BIA label: F-BIA1-s-b2-GOA001-0

Transboundary across: None

Hierarchy: Non-hierarchical; single BIA

Importance score: 1 (Intensity: 1, Data support: 2)

Supporting notes for intensity score: The region near Kodiak Island, Alaska, is a foraging area for both fin and humpback whales during summer months (Waite et al. 1999, Baraff 2006, Zerbini et al. 2006, Wynne & Witteveen 2008, Witteveen et al. 2016, Zerbini et al. 2006). Recent tagging and stable isotope studies in coastal bays around Kodiak Island have considered how fin and humpback whales partition their foraging environment (Witteveen et al. 2008, 2015, Witteveen & Wynne 2016). Given that fin whales were strongly associated with dense euphausiid patches, but not with forage fish, prey partitioning by fin whales is suggested. However, rate of prey consumption or caloric intake is not known for this region.

Supporting notes for data support score: The Gulf Apex Predator-Prey Project (GAP) survey (2014 & 2015 seasons) provided a few extra years of data since the BIA Round 1 data summary. Surveys occurred between early May and late September depending on the year (1999-2015).
Other sources include:
Rone et al. (2017) - Fin whales were the most frequently sighted large whale in 2009 and 2013 surveys, and second most frequently sighted in 2015. Sightings occurred throughout the entire study area, on the continental shelf and slope.
Matsuoka et al. (2019) - IWC-POWER Cruise; many detections acoustically & visually of FW. Passive acoustic monitoring for marine mammals was conducted using sonobuoys. FWs detected on 56.1% of sonobuoys (119 buoys). Several high-density fin whale areas were observed around Kodiak Island as well as the eastern part of the Eastern stratum. A total of 261 groups (450 individuals) of fin whales were observed in the research area.
Rice (2021) denoted an acoustic presence of FWs year-round.

Spatiotemporal variability: s

Supporting notes for spatiotemporal variability: Kodiak area is a consistent feeding area for humpback whales & fin whales, both being characterized by prey availability in the area (FW euphausiids as noted McCarthy et al 2021). It should be noted that effort is relatively limited to June through September, which is why we can only really assume whales are there during those months.

Boundary certainty: 2

Supporting notes for boundary certainty: We are reasonably certain the boundaries of this F-BIA encompass the main feeding area in which FWs feed around Kodiak Island.
This includes the bulk and highest density of sightings made in the Gulf of Alaska (GOA), and it is consistent with older data used in BIA Round 1 that had a hotspot of sightings and detections in this area, which was based in part on some of the same data in this BIA (i.e. Witteveen GAP project data that hadn't been analyzed yet).
There have been a few cruises through the area since 2015 that have also noted FW activity around the islands (i.e., DBO cruises, and Matsuoka 2020 POWER cruises).
Boundaries have been expanded somewhat from BIA Round 1 to include sightings and acoustic detections reported on after 2015.

Months of year designation is applicable: June, July, August, September

Tagging data supporting designation (Y/N): N

Visual observations/records supporting designation (Y/N): Y

# of observations/records: 276 sightings/565 whales total from vessel-based line- transect surveys for cetaceans (Zerbini et al., 2006); 80 sightings/139 whales total from vessel-based line-transect surveys for cetaceans (Matsuoka et al., 2012); and 274 sightings/801 whales total from UAF GAP 1999-2013 year-round aerial surveys (Wynne & Witteveen, 2005; Witteveen, pers. comm., 12 January 2015)

# of years in which supporting visual data collected: 3 summers, 2001-2003 (Zerbini et al., 2006); July-September 2011 (Matsuoka et al., 2012); 1999-2013, 15 yrs total, all months (Wynne & Witteveen, 2005; Witteveen, pers. comm., 12 January 2015)

Supporting information: Aerial- and vessel-based sightings

Acoustic detections/records supporting designation (Y/N): Y

# of observations/records: unk

Supporting information: Fin whale calls recorded on moored hydrophones

Photo-ID evidence supporting designation (Y/N): N

Genetic analyses conducted supporting designation (Y/N): N

What factors justify the boundary selection?: Locations of sightings from vessel-based cetacean line- transect surveys (Zerbini et al., 2006)

Data sources: NOAA-NMML (Zerbini et al., 2006), IWC-POWER (Matsuoka et al., 2012), NOAA-PMEL (Stafford et al., 2007), and UAF GAP (Witteveen, pers. comm., 12 January 2015)

Approximate % of population that uses this area for the designated purpose (if known): Unknown

References: Baraff, L. 2006. Summer distribution and habitat characteristics of fin whales (Balaenoptera physalus) and humpback whales (Megaptera novaeangliae) off northeast Kodiak Island, Alaska. M.S. thesis, University of Alaska Fairbanks, Fairbanks, AK. 173 pp.

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Supplementary Description 4. 4. Gray whale feeding area

Species name: Gray whale (*Eschrichtius robustus*)

Stock or population: Eastern North Pacific (ENP) and/or Pacific Coast Feeding Group (PCFG)

Descriptive name: Kodiak Island

BIA type: Feeding Area

BIA label: F-BIA2-e-b2-GOA004-0

Transboundary across: None

Hierarchy: Non-hierarchical; single BIA

Importance score: 2 (Intensity: 2, Data support: 2)

Supporting notes for intensity score: We propose a score of 2 given the robust data that exists through 2015 showing a fair number of gray whales use this area, with some surveys showing up to 69 individuals at a time.We did not score this BIA a 3 due to outdated data, with no new dedicated surveys or effort since 2015. We can't be certain if the same number of whales still use the area in the last 6 years, especially given the ecological changes happening.
Monthly opportunistic aerial surveys with UAF GAP project from 1999-2013 showed gray whales year-round on the eastern side of Kodiak Archipelago, specifically Ugak Bay (Wynne & Witteveen 2005, 2013). New information since BIA Round 1 adds 2014 data from UAF GAP project and corroborates the older findings.(Witteveen & Wynn 2016). The mean number of gray whales sighted (1999-2013) per month was lowest in February through March, increased April throughMay, peaked in June, and was at a high through August; Grey whale numbers remained moderate September through January. (Ferguson et al. 2015 – Round 1 BIAs). Data in Witteveen & Wynn 2016 GAP final report shows 2010 and 2014 actually had higher densities in January-April than other months (Appendix A. Heat Plots). Prey collected during UAF GAP project was primarily dominated by cumaceans, which are generally considered poor prey (Moore et al. 2007, Wynne & Witteveen 2013, Witteveen & Wynn 2016). Fecal samples also corroborated this. Aerial surveys were conducted monthly as part of UAF GAP from October 2009 to February 2011. These surveys showed maximum gray whale numbers were seen in December 2009 (209 individuals), Apr 2010 (71 individuals), and October 2010 (39 indiv). All other monthly surveys showed fewer than 15 individuals. (Table 3, Wynn & Witteveen 2013).
-The number of whales that used this area within the BIA between October 2009 - February 2011 is unknown, but in 2014 there were 130 gray whales sighted during quarterly aerial surveys (GAP 2014 report, Table 25).
- Total number of gray whales seen over 126 aerial surveys flown with the GAP project between August 1999 and December 2014 was 4,082 gray whales.
- Time series of abundance predictions fluctuate, but seem to average around 150-175 gray whales (Fig 27 from Witteveen & Wynn 2016 final report).
- GAP final report 2016 (Witteveen & Wynn 2016) shows gray whales more abundant in the months of September and December 2014 rather than spring and summer of the same year. (Fig 29 Witteveen & Wynn 2016)
- Rice 2021 acoustic study used High Frequency Acoustic Recording Packages (HARP) PAM devices at 5 stations near Kodiak and in central GOA year-round from July 2011 through September 2015. Authors noted gray whale calls detected intermittently from May throughOctober at nearly all acoustic sites but in low numbers overall. Kodiak Shelf station was where most detections happened, and most detections were in summer (Fig 4: Rice et al. 2021).
- Rone et al. 2017 analyzed line transect surveys from 2009, 2013, and 2015 off Kodiak (Fig 1). The 3 years were surveyed in different months: April 2009, June/July 2013, and August/September 2015.
- Most gray whale sightings with large numbers of individuals (24 or 25 in a group) were sighted in 2013 (June/July) and 2015 (August/September) in Ugak Bay, with a few further north in 2009 (April) (Rone et al. 2017, Fig 3C, Table 3). - 2013 Gulf of Alaska Line-Transect Surveys (GOALS) II survey in US Navy Temporary Maritime Activities Area (TMAA) encountered 1 visual sighting of a gray whale, which was in Ugak Bay. No acoustic detections of gray whales on towed arrays or sonobuoys (Rone et al. 2014).

Supporting notes for data support score: We propose a score of 2 for data support given that the data that exist up through 2015 were from acoustic and aerial surveys by marine mammal biologists trained in species ID and were very robust and semi-regular. However, the systematic surveys are relatively old, with very little new information being available since 2015 (i.e. >6 yrs old), other than opportunistic sighting data from marine mammal observers on NOAA surveys that transited the area.
No dedicated research has been done on this population since the UAF GAP project ended in 2016. A few publications have come out since 2015 (e.g. Rone et al. 2017 and Rice et al. 2021) but only present data collected through 2015 and both are broad line transect surveys with acoustics and visual sightings (Rone et al. 2017) and acoustic-only transects (Rice et al. 2021) that focused on a variety of species and had very little gray whale data.
- The GOALS II project in 2013 used towed array hydrophones, sonobuoys, and visual observers to assess marine mammal presence in the US Navy's Temporary Maritime Activities Area (TMAA; 144,560 square kilometers [km2]) in the central GoA, east of Kodiak Island between 23 June to 18 July 2013 (Rone et al. 2014). - The Cetacean Large Whale Survey (CLaWS) in the summer of 2015 surveyed off Kodiak Island, and a bit off the eastern GOA near Sitka (Rone et al. 2015).
- Data for BIA Round 1 mainly included aerial surveys, vessel-based surveys, and photo-ID (UAF GAP project reports and pubs). Some additional acoustic and line transect data available from Rone & Rice papers, but very limited
- 2021 stranding report lists beached gray whale in Ugak Bay on May 10 (from Kate Stafford, listed as a "dedicated aerial survey").
- 2020 tagging showed a single gray whale migration up through the GOA (northbound) that stopped off at Kodiak feeding

area for 14 days, presumably to feed (Urban et al. 2021).

Spatiotemporal variability: e

Supporting notes for spatiotemporal variability: This overall BIA is ephemeral because it is in an area in which a portion of the BIA meets the definition of a static BIA (Ugak Bay), but the remaining area does not. The primary area that whales were consistently found appears to be where whales are feeding mostly on cumaceans, and is centered around Ugak Bay and appears to be consistent throughout the time period there is available data (up through 2015). This area appears to be used year-round, with increased abundance during some parts of the year (e.g. Fall/Winter), but also has a lot of inter-annual variability. However, the rest of the BIA has areas used in varying densities from year to year and from month to month. It is unclear what factors influence the variability in the area, but are likely driven by biological factors such as prey availability (e.g. cumaceans and amphipods) that is influenced by physical factors such as winds, current, water temperature, tidal influence, and upwelling (Witteveen & Wynn 2016 Appendix A).

Boundary certainty: 2

Supporting notes for boundary certainty: For the available data of GAP surveys (aerial & vessel-based), with the new addition of the acoustic (Rice et al. 2021) and line transect surveys (Rone et al. 2017), we score the boundary certainty as a 2.
The GAP aerial surveys went all around Kodiak and farther offshore than gray whale distribution, likely covering any potential boundaries of this BIA. Line transect surveys from Rone et al. 2017 also covered large areas outside of the main gray whale observation area, and acoustic moorings from Rice et al. 2021 covered a wide area as well.

Months of year designation is applicable: April, May, June, July, August, September, October

Tagging data supporting designation (Y/N): Y

# of tags: 1

# of years in which supporting tagging data collected: 2017

Supporting information: A single gray whale tagged in Baja California migrated to the Bering Sea between February and May 2017, stopping in the Kodiak F-BIA for 14 days (Urban et al. 2021).

Visual observations/records supporting designation (Y/N): Y

# of observations/records: 119 individuals

# of years in which supporting visual data collected: 2015

Supporting information: Collaborative Large Whale Survey (CLaWS) in the summer of 2015, with three legs with date ranges of 15-13 July, 6-27 Aug, 1-20 Sep, 2015 (Rone et al. 2015).

Acoustic detections/records supporting designation (Y/N): Y

# of observations/records: NA

# of years in which supporting acoustic data collected: 2011-2015

Supporting information: Five High-frequency Acoustic Recording Packages (HARPs) were deployed in the GOA between July 2011 and September 2015, yielding 3,764 days of recording effort (Rice et al. 2021). Specific number of calls, records, days of calls, or individual gray whales were not reported in the manuscript (Rice et al. 2021). 191 sonobuoys deployed on Leg 2 of the Cetacean Large Whale Survey (CLaWS) in the GOA between 6-27 August, 2015, totaling 330 hours of recordings. Gray whales were detected on 9 sonobuoys (Rone et al. 2015).

Photo-ID evidence supporting designation (Y/N): Y

# of individuals photographed: 18 individuals

# of years of photo records to compare: 2015

Maximum # of years same individual photographed in area: NA

Supporting information: Large Whale Survey (CLaWS), in summer 2015. Leg 1: 15-13 July, 2015; Leg 2: 6-27 August 2015; Leg 3: 1-20 Sep (Rone et al. 2015).

Genetic analyses conducted supporting designation (Y/N): Y

Supporting information: A few biopsy samples were collected on the Cetacean Large Whale Survey (CLaWS) in the summer of 2015 near Kodiak, but it is unknown if those samples have undergone genetic analysis (Rone et al. 2015).

What factors justify the boundary selection?: Aerial sightings were from dedicated cetacean aerial surveys, as well as opportunistic sightings from aerial surveys for steller sea lions of the UAF GAP project, 1999-2013. Prey sampling and bathymetric mapping were also done.
Line transect surveys were ship-based. Finally, a single tagged whale migrating from Baja California to the Bering Sea stopped for 14 days and the track contributes to extending this BIA.

Data sources: UAF GAP project database, shared by Dr. Briana Witteveeen, May 2021.

Approximate % of population that uses this area for the designated purpose (if known): Unk

Approximate # of areas known specifically for this behavior (if feeding/cow-calf/mating/migratory) for this population: 6

References: Calambokidis, J., Darling, J. D., Deecke, V., Gearin, P., Gosho, M., Megill, W., . . . Gisborne, B. (2002). Abundance, range and movements of a feeding aggregation of gray whales (Eschrichtius robustus) from California to southeastern Alaska in 1998. Journal of Cetacean Research and Management, 4(3), 267-276.

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Urban, J.R., Jimenez-Lopez, E., Guzman, H.M., Viloria-Gomora, L. (2021). Migratory Behavior of an Eastern North Pacific Gray Whale From Baja California Sur to Chirikov Basin, Alaska. Front. Mar. Sci. 8:619290. doi: 10.3389/fmars.2021.61290

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Supplementary Description 4. 5. Gray whale feeding area

Species name: Gray whale (*Eschrichtius robustus*)

Stock or population: Eastern North Pacific AND/OR Pacific Coast Feeding Group

Descriptive name: Sitka Sound

BIA type: Feeding Area

BIA label: F-BIA2-e-b2-GOA005-0

Transboundary across: None

Hierarchy: Non-hierarchical; single BIA

Importance score: 2 (Intensity: 2, Data support: 2)

Supporting notes for intensity score: We gave this BIA an Intensity score of 2 given due to the unique prey type and increasing number of whales using this feeding area. Expert elicitation and consistent sightings from year to year (over a long period of time) of large number of individuals by local residents, ADF&G biologists, and researchers, along with a short-term feeding window in this region on herring eggs, indicate a strong argument for an intensity of 2 for this feeding source.
This is a spring feeding area on herring eggs (Sitka Sound March-June) (Straley pers comm). It appears to be a consistent and important feeding area for grey whales in SEAK as few other areas in the region report consistent and larger aggregations of grey whales feeding.
- An increasing number of grey whales come through Sitka Sound in the spring after the herring spawn, based on unpublished data from Straley and Wild and observations from local tour operators, wildlife enthusiasts, and herring fisheries managers at ADF&G. These whales appear to be feeding on herring eggs off kelp and other substrates along the shoreline. Increasing numbers beginning around 2015 went from 30-40 individuals to likely upwards of 70 or 80 individuals by 2021; potentially in the low 100s; all anecdotal.
- Whales appear very close to shore (i.e. within 100 ft.) in the Sitka Sound region and professional observation indicates they are primarily feeding. Since 2018, occasional observations of groups frolicking where penises are seen have been reported each year.
-The feeding window is short-term in this location, averaging 1-2 months, beginning just after the herring spawn in late March/early April, and whales usually depart Sitka Sound by June. Straley notes some whales do stay around Sitka Sound throughout the summer but shift to other prey such as mycids and zooplankton, and it is a small number, not to be included in this BIA.
- Two other known feeding areas occur in Southeast Alaska for this species, though both lack recent and sufficient data to score, and none occur during the same time as this one, in late spring; additionally, what little is known about the other feeding areas suggests they do not have as large of aggregations of whales present.
- This may be one of the first feeding opportunities available to gray whales as they make their northward migration up from the West Coast of the US to the Bering Sea if they are part of the Eastern North Pacific (ENP) population; if they are part of the Pacific Coast Feeding Group (PCFG), they may come to this area for a consistent feeding opportunity during this time period, and numbers are increasing. No dedicated surveys are done on this feeding area, but researchers operate in the area and routinely get reports from Alaska Department of Fish and Game (ADF&G) aerial surveys and area biologists monitoring the herring fishery; reports from local tour guides and members of the public who spend time in the area observing herring spawn, sightseeing local wildlife, and giving tours of local wildlife, including gray whales in the area. Count estimates and time periods noted by researchers as well as wildlife guides and operators. Finally, researchers in the region (i.e. Wild & Straley) observe aggregations of feeding gray whales during this time while conducting humpback whale research surveys, and personal excursions to collect herring eggs and document wildlife. Some notes exist within humpback whale surveys during this time on gray whale observations as well.

Supporting notes for data support score: Data support would need to include systematic surveys on multiple years, biologging, PAM or other data collection in order to be considered for a 3. Due to lack of dedicated surveys to count animals for this feeding area, no photo ID documentation of whales from year to year, and uncertainty on whether this aggregation is stopping by during a migration, or is part of the PCFG that maintains year-round residency between the Pacific Northwest and Southeast Alaska (SEAK), the data support score must be lower than a 3. Given the quantity of reports and size estimates from members of the public and researchers, over a number of years, from vessel and aerial based platforms, we are confident in giving this F-BIA a data support score of 2.
There is no dedicated survey, behavior, acoustic, or tag data collected. A small amount of Photo-ID data was taken by Straley in the 1980s and 90s, through early 2000s, but no catalog has been built and no matching has been done.
- This BIA is based on very little published data or reports, and primarily a plethora of observations & photos/videos from members of the public, ADF&G biologists, and local researchers. Therefore we don't know for certain whether these are ENP or PCFG whales, we don't have a precise of numbers of whales using the area, and we don't know exactly what the spatial boundaries for these whales are.
- Information for delineating this BIA is from members of the public (local tour operators, fishermen, ADF&G flight surveys, USCG flights, local community members' testimony including Facebook posts and direct conversations & videos/photos shared); also opportunistic sightings from researchers in the region doing surveys and research on humpback whales during that time.
- Large aggregations of 30 or more individuals use this region for a relatively short period of time (1-3 months) feeding intensely on amphipods and herring eggs after the annual herring spawn. Overall population size that could use this area during

spring migration is unknown. Estimated number of whales feeding in the area are based on numerous estimates made by a variety of groups that frequent the area (i.e. whale watching groups, wildlife tours, ADF&G biologists, and researchers). It is unknown if this is a group of whales that stops on spring migration up to Bering & Chuckchi Seas (ENP) OR if they are part of thePCFG that was first identified by Calambokidis et al. 2002 and occurs between California and Southeast Alaska (though full range is uncertain and could extend to Kodiak Island). It's also worth noting that two gray whales sighted in Sitka Sound in Nov 1998 were matched to individuals sighted in previous years in the North Washington Coast and US Strait of Juan de Fuca (Calambokidis et al. 2002 Table 4b).
- If this F-BIA is comprised of individuals from the PCFG, that population has a size of ~250 (Calambokidis 2004) while the larger ENP stock has a most recent population estimate of 16,650 individuals (Eguchi et al. 2022). Photo ID records haven't been found to confirm matches, but Calambokids et al (2002) identified whales near this area later in the summer as part of PCFG. This impacts data support score.

Spatiotemporal variability: e

Supporting notes for spatiotemporal variability: This F-BIA is characterized by fixed features including coastline areas that have large quantities of suitable habitat for herring spawn, including macrocystis kelp, seagrass, and other seaweeds. Herring spawning locations within this BIA shift from year to year and within a year, and boundaries have been drawn around the broad area where herring typically spawn and thus where gray whales could occur to feed on eggs. The larger Sitka Sound has been a consistent and large spawning ground for pacific herring for hundreds, if not thousands, of years, according to Tlingit stories and traditional ecological knowledge. Tribal elders say spawn on Kruzof Island in the northern and northwestern part of the BIA boundaries is not historically common and has increased in the past 5-10 years due to fishing pressure. In the mid 2000s to 2010s there were gray whales feeding along the road system of the town of Sitka more frequently. Thus, with rapidly shifting environmental conditions and changes in herring spawning activity being less predictable recently, the entire region can be seen as potential foraging habitat during the spring for gray whales.

Boundary certainty: 2

Supporting notes for boundary certainty: - We are reasonably certain the boundaries of this F-BIA encompass the main feeding areas in which grey whales occur in this area, feeding specifically on herring eggs after spawning has occurred. They are consistently found in the areas where densely aggregated herring spawn occurred, which varies throughout Sitka Sound from year to year but is often along the SW Kruzof Island shoreline in the past 5 years.
- Surveys are only conducted within a limited area, near to Sitka Sound, and where local guides, nature enthusiasts, and local researchers can access with relative ease during the time of year that animals are in this region; thus boundary may not be comprehensive, but given that sightings drop off outside of the area depicted, and boat operators go outside of these areas, we are fairly confident in the boundaries for this BIA.
- Occasional flights with the US Coast Guard helicopters are conducted, but not on an annual basis. Surveys run from Biorka Island north to Cape Spencer, and are flown at altitudes of 200 m or greater along the coastline of Kruzof and Chichagof Islands. None of these flights has indicated gray whales feeding on herring in areas outside of the boundaries we have delineated.
- It is possible grey whales aggregate in other areas feeding on herring eggs during this time, but that they are not captured on opportunistic sightseeing, whale watching, or on other marine mammal surveys that are centered around herring spawn and proximity to Sitka. We suggest researchers and other members of the public monitor this to potentially inform future F-BIAs.

Months of year designation is applicable: March (2nd half), April, May, June (1st half)

Tagging data supporting designation (Y/N): N

# of tags: 0

# of years in which supporting tagging data collected: NA

Supporting information: No satellite tags have been placed on gray whales in this F-BIA that we are aware of.

Visual observations/records supporting designation (Y/N): Y

# of observations/records: Estimated >80 individuals in most recent years

# of years in which supporting visual data collected: Sporadic, 1990s - 2021

Supporting information: Visual observations and count estimates reported from members of the public, ADF&G biologists, and local researchers. Photos and videos taken opportunistically. The number of gray whales reported and estimated each year has increased over time, with upwards of 80 individuals estimated to be feeding in this area in 2020 and 2021 (Straley pers comm).

Acoustic detections/records supporting designation (Y/N): N

# of observations/records: 0

# of years in which supporting acoustic data collected: NA

Supporting information: No acoustic work done on this feeding aggregation that we know of.

Photo-ID evidence supporting designation (Y/N): Y

# of individuals photographed: 7

# of years of photo records to compare: NA

Maximum # of years same individual photographed in area: NA

Supporting information: Photos occasionally taken when researchers or tourism operators are in the area, but no photo-ID work has been done on this F-BIA since the early 2000s (Calambokidis et al. 2012) that we know of and those photos that have been

taken were captured outside of the herring spawning months when this feeding area is active.

Genetic analyses conducted supporting designation (Y/N): N

Supporting information: No genetic work has been done on gray whales that feed in this area that we know of.

What factors justify the boundary selection?: Boundary drawn around anecdotal and observational evidence of where whales have historically been seen by Traditional Ecological Knowledge (TEK), marine mammal researchers, members of the public, and ADF&G herring management biologists all reported to Straley (pers comm May 2021).

Data sources: Personal communication with Jan Straley, local researcher in the Sitka Sound area for over 35 years.

Approximate % of population that uses this area for the designated purpose (if known): Unk

Approximate # of areas known specifically for this behavior (if feeding/cow-calf/mating/migratory) for this population: 6

References: Calambokidis, J., Darling, J. D., Deecke, V., Gearin, P., Gosho, M., Megill, W., . . . Gisborne, B. (2002). Abundance, range and movements of a feeding aggregation of gray whales (Eschrichtius robustus) from California to southeastern Alaska in 1998. Journal of Cetacean Research and Management, 4(3), 267-276.

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Eguchi, Tomoharu, Aimée R. Lang, and David W. Weller. 2022. Abundance and migratory phenology of eastern North Pacific gray whales 2021/2022. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SWFSC-668. https://doi.org/10.25923/x88y-8p07

Supplementary Description 4. 6. Gray whale feeding area

Species name: Gray whale (*Eschrichtius robustus*)

Stock or population: Eastern North Pacific (ENP) and/or Pacific Coast Feeding Group (PCFG)

Descriptive name: Davison Bay

BIA type: Feeding Area

BIA label: F-BIA0-s-b1-GOA016-0

Transboundary across: None

Hierarchy: Non-hierarchical; single watch list area

Importance score: 0 (Intensity: 1, Data support: 1)

Supporting notes for intensity score: - This is presumed to be a summer feeding area on cumaceans near natural hot springs, approx June-September.
- Straley saw them in the 1980s when working for Northern Southeast Regional Aquaculture Association (NSRAA) in Davison Bay area (Straley pers comm May 2021) - Straley was there in the 1990s with Tory O'Connell (cumaceans collected on Submarine 10 May 1994 in Davison Bay at 65m depth); gray whales also observed; Straley field notes say 3 gray whales present when they were there (Straley pers comm May 2021).
- 12 June 1994 Kerry and Mary Chambers reported 20 gray whales off Davison Bay (Straley pers comm May 2021) It is unknown if whales stop here for some time on their way north and south for migration, or if they stay all summer; it is also unknown what population the whales are from, the ENP or PCFG.

Supporting notes for data support score: - Straley saw them in the 1980s when working for NSRAA in Davison Bay area; - Straley was there in the 1990s with Tory O'Connell (cumaceans collected on Submarine 10 May 1994 in Davison Bay at 65m depth); gray whales also observed; Straley field notes say 3 gray whales present when they were there. 12 June 1994 Kerry & Mary Chambers reported 20 gray whales off Davison Bay;
- There may be other reports to Straley in the 1990s, but no recent reports in the last 25 years.

Spatiotemporal variability: s

Supporting notes for spatiotemporal variability: This feeding area is likely static, and seems to have something to do with the Bay having lots of cumaceans, according to expert elicitation (Straley pers comm). Cumaceans are a benthic species that inhabit soft substrate, and are therefore likely to be a fairly static prey source for gray whales in this area.

Boundary certainty: 1

Supporting notes for boundary certainty: No recent data exists to estimate the boundaries of this BIA. Additionally, no comprehensive substrate survey is available to delineate the potential distribution of cumacean prey in the area. Thus the boundaries are drawn around sighting data that is over 25 years old. However, because cumaceans are a benthic prey inhabiting soft substrate, we have no reason to believe this prey no longer exists in the area. We are reasonably certain cumaceans are likely still a potential prey source for gray whales in this area.

Months of year designation is applicable: May, June, July, August, September

Tagging data supporting designation (Y/N): N

# of tags: 0

# of years in which supporting tagging data collected: NA

Supporting information: No satellite tags have been placed on gray whales in this F-BIA that we know of.

Visual observations/records supporting designation (Y/N): Y

# of observations/records: 23 individuals maximum

# of years in which supporting visual data collected: 1994

Supporting information: 3 gray whales sighted and cumacean prey collected from submarine in May 1994 by ADF&G biologist and local whale biologist Jan Straley (Straley pers comm May 2021); commercial fishing family sighted 20 gray whales in Davison Bay in June 1994 and reported to Straley (pers comm May 2021)

Acoustic detections/records supporting designation (Y/N): N

# of observations/records: 0

# of years in which supporting acoustic data collected: NA

Supporting information: No acoustic work has been done on this feeding aggregation that we know of.

Photo-ID evidence supporting designation (Y/N): N

# of individuals photographed: 0

# of years of photo records to compare: NA

Maximum # of years same individual photographed in area: NA

Supporting information: No photo-ID work has been done on this F-BIA that we know of.

Genetic analyses conducted supporting designation (Y/N): N

Supporting information: No genetic work has been done on gray whales that feed in this area that we know of.

What factors justify the boundary selection?: We have drawn the boundary around Davison Bay in general, based on expert elicitation from Straley, who either personally observed whales in this area, or reported the sighting from commercial fishermen. The bay is characterized by soft bottom habitat for gray whale prey.

Data sources: Personal communication with Jan Straley, May 2021.

Approximate % of population that uses this area for the designated purpose (if known): Unk

Approximate # of areas known specifically for this behavior (if feeding/cow-calf/mating/migratory) for this population: 6

References: Calambokidis, J., Darling, J. D., Deecke, V., Gearin, P., Gosho, M., Megill, W., . . . Gisborne, B. (2002). Abundance, range and movements of a feeding aggregation of gray whales (Eschrichtius robustus) from California to southeastern Alaska in 1998. Journal of Cetacean Research and Management, 4(3), 267-276.

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NOAA Fisheries 2021. https://www.fisheries.noaa.gov/national/marine-life-distress/2019-2020-gray-whale-unusual-mortality-event-along-west-coast-and)

Supplementary Description 4. 7. Gray whale feeding area

Species name: Gray whale (*Eschrichtius robustus*)

Stock or population: Eastern North Pacific (ENP) and/or Pacific Coast Feeding Group (PCFG)

Descriptive name: Shelikof Bay

BIA type: Feeding Area

BIA label: F-BIA0-s-b1-GOA015-0

Transboundary across: None

Hierarchy: Non-hierarchical; single watch list area

Importance score: 0 (Intensity: 1, Data support: 1)

Supporting notes for intensity score: -This is a summer feeding area on amphipods in Shelikof Bay area, approx June through August. Straley observed gray whales feeding on amphipods from a submarine with Tory O'connell in the 1990s; amphipods were collected.
-June 12-ish, 1994, Dave Gordon observed 1 Grey whale off Cape Amelia (off Shelikof);
-USCG flight late May 2020 – Wild and Chenoweth observed 4-5 gray whales feeding in Shelikof
-Early June 2020 campers at United States Forestry Service (USFS) north Beach cabin in Shelikof Bay reported a mom/calf live stranding, with animals trapped by the tide in a shallow pool next to some rocks during a minus tide. Whales were able to swim free when the tide came in. -Additional and consistent anecdotal reports from fishermen, USCG, and Straley pers comm indicate gray whales use Shelikof Bay throughout the summer months.
-No estimates of numbers of whales are available, though anecdotal conversations indicate there are likely less than 25 whales at a time in the bay, with some years having fewer than 5.
-These whales may be part of the PCFG (Calambokidis et al. 2002, 2004) or part of the ENP migrating population. -Straley was told they've been going into Shelikof since the 1950s (pers comm).

Supporting notes for data support score: -No dedicated surveys are done in this area, nor are accurate counts available. Most observations from biologists and researchers are greater than 6 years old, and in most cases upwards of 20 years old. No passive acoustic monitoring (PAM) or biologging data are available or exist for this feeding aggregation. United States Coast Guard (USCG) routinely flies over the bay, so reports of dead or stranded whales and anecdotal evidence of consistent whales in the bay is available
-Fishermen routinely report gray whales in Shelikof Bay as well (Straley & Wild pers comm).
-Live strandings have been reported in the bay as well in recent years
-One submarine survey that Straley was on in the 1990s revealed large abundances of amphipods (a primary food source of gray whales) in Shelikof Bay.
-Long-term secondary research activities and reported sightings by members of the public do provide a lot of consistent anecdotal evidence that this area is used by gray whales consistently throughout the summer months, leading to its designation of a '1' for a data support score.
-USCG flight late May 2020: Wild and Chenoweth observed 4-5 gray whales feeding in Shelikof
-Early June 2020 campers at USFS N Beach cabin in Shelikof Bay reported a mom/calf live stranding, with animals trapped by the tide in a shallow pool next to some rocks during a minus tide. Whales were able to swim free when the tide came in.

Spatiotemporal variability: s

Supporting notes for spatiotemporal variability: The feeding area seems to be static, based on amphipods that are present in the bay and have been for over 2 decades according to sighting data, expert elicitation (Straley pers comm) and data from members of the public.
Feeding plumes and feeding behavior has been observed in this BIA when whales have been observed.

Boundary certainty: 1

Supporting notes for boundary certainty: We are fairly certain of this boundary because of the bathymetric features and prey found in the bay. However, not a lot of work is done in the area, so there may be nearby areas that aren't checked as often that also have these features and prey densities, and could be indicative of additional F-BIAs in this region. Additionally, we don't know how much prey is in the bay in recent years because no surveys have been done and the last observations of amphipods and prey were from the 1990s. We are reasonably confident the area proposed encompasses the extent of this F-BIA, due to historic information, fishermen & public reports, and researcher observations on secondary research activities all indicating that this bay is likely the extent of the feeding area at this time for these gray whales.

Months of year designation is applicable: June, July, August

Tagging data supporting designation (Y/N): N

# of tags: 0

# of years in which supporting tagging data collected: NA

Supporting information: No satellite tags have been placed on gray whales in this F-BIA that we know of.

Visual observations/records supporting designation (Y/N): Y

# of observations/records: 7

# of years in which supporting visual data collected: 2020

Supporting information: Two live stranded animals at low tide sighted by the public and video confirmed they swam free at high tide; max 5 individuals seen feeding (fecal plumes) in the bay during USCG survey with whale researchers in May 2020. Prior to that, no official observations noted in Shelikof in last 10 years but Straley (pers comm) says she has heard about them and had fishermen report them – just no official notes and counts and dates exist.

Acoustic detections/records supporting designation (Y/N): N

# of observations/records: 0

# of years in which supporting acoustic data collected: NA

Supporting information: No acoustic work done on this feeding aggregation that we know of.

Photo-ID evidence supporting designation (Y/N): N

# of individuals photographed: 0

# of years of photo records to compare: NA

Maximum # of years same individual photographed in area: NA

Supporting information: No photo-ID work has been done on this F-BIA since the early 2000s that we know of.

Genetic analyses conducted supporting designation (Y/N): N

Nature of supporting information: Weak

Supporting information: No genetic work has been done on gray whales that feed in this area that we know of.

What factors justify the boundary selection?: We have drawn the boundary around Shelikof Bay based on sightings and bathymetric feature descriptions (i.e. shoreline) as well as expert knowledge from Straley on the extent of where amphipods were found in high densities throughout the bay..

Approximate % of population that uses this area for the designated purpose (if known): UNK

Approximate # of areas known specifically for this behavior (if feeding/cow-calf/mating/migratory) for this population: >6

References: Calambokidis, J., Darling, J. D., Deecke, V., Gearin, P., Gosho, M., Megill, W., . . . Gisborne, B. (2002). Abundance, range and movements of a feeding aggregation of gray whales (Eschrichtius robustus) from California to southeastern Alaska in 1998. Journal of Cetacean Research and Management, 4(3), 267-276.

Calambokidis, J., Lumper, R., Laake, J., Gosho, M., and Gearin, P. 2004. Gray whale photographic identification in 1998-2003: collaborative research in the Pacific Northwest. Final Report prepared for the National Marine Mammal Laboratory, prepared by Cascadia Research Collective, Olympia, WA.

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NOAA Fisheries 2021. https://www.fisheries.noaa.gov/national/marine-life-distress/2019-2020-gray-whale-unusual-mortality-event-along-west-coast-and)

Supplementary Description 4. 8. Gray whale migratory route

Species name: Gray whale (*Eschrichtius robustus*)

Stock or population: ENP

Descriptive name: Gulf of Alaska

BIA type: Migratory Route

BIA label: M-BIA1-s-b1-GOA006-0

Transboundary across: None

Hierarchy: Non-hierarchical; single BIA

Importance score: 1 (Intensity: 2, Data support: 1)

Supporting notes for intensity score: Sufficient data do not exist to evaluate the proportion of the population using the route, but our expert elicitation best guess is 50%-90%, with an intensity value of 2

-Sufficient data do not exist to evaluate the width of the route, but if we assume it is consistent following the CA/OR/WA portion of the migration, the route width is <25km, with an intensity value of 3. However, given that the Bering Strait route is estimated to be 25-100km, we assume that in some portions of the GOA migration, the route expands greater than 25 km. - The number of months the route is used is estimated to be 3 months in each direction N/S (2-4 months gives an intensity value of 2). SWFSC's most recent abundance estimate for the US west coast migratory gray whales of the ENP population was 16,650 whales for 2021/2022 (Eguchi et al. 2022). These are whales migrating by the central CA coast. Observations occurred from 28 December 2021 and 18 February 2022 (S-bound).

The next most recent estimate is from 2019/2020 of 20,580 (Stewart and Weller 2021), a decrease from the previous estimate. Also of note is the 2019-2022 continuing grey whale unusual mortality event.

-A recent study from a single tagged gray whale in Mexican waters that tracked a northbound migration in the spring showed the tagged whale spent April and part of May in the GOA migration, with a 2-week stop in late April off Kodiak to feed (Urban et al. 2021).

-Location of migration from single tagged whale Urban et al. 2021: "The migration route was aligned close to the coastline (<23 km) from February to April. After passing Kodiak Island in May, Maria started traveling far away from the coastline (>70 km) toward the south coast of the Aleutian Islands in the direction of Korovin Island. It then continued to the Unimak Pass, where it went into the Bering Sea."

-Rugh et al. 2001 finds that migration likely averages 54 days, starting in early November and getting into GOA in mid-late November. The width of the migratory corridor is not well understood but where surveys have been done (albeit in 1960s-80s from Braham 1984 & Rugh 1984) there is evidence the corridor is narrow and animals stay close to shore, in part to avoid killer whale predation (Barrett-Lennerd et al. 2001).

-Straley (pers comm 18 June 2021) notes that while gray whales are seen frequently during the northward migration in the spring, she rarely sees any gray whales in the winter during the southbound migration on the outer coast while conducting whale research out of Sitka. Thus she believes the southbound corridor may be located farther offshore, at least in that region of the GOA.

-Ford et al. 2013 used satellite tag data from 5 gray whales tagged 2009 (n=1), 2010 (n=2), and 2011 (n=2) and visual surveys from shore-based stations (16 March – 10 April 2011) to assess the migratory corridor through British Columbia waters. Three of these tagged whales matched the PCFG catalog. Results suggest a majority of whales use inside waters on the East side of Haida Gwaii

(Hecate Strait) to migrate, rather than the outer coast of Haida Gwaii. Of 306 gray whales observed traveling North, 97% used Hecate Strait;

-Ford et al. 2013 found the migratory corridor in Hecate Strait quite broad (25-75km wide), and not closely associated with the E or W shoreline.

Supporting notes for data support score: Braham data are from 1958-1981, and though it is very old, it provides the most comprehensive effort and survey information for the GOA region throughout a broad temporal spectrum. Visual sightings, shore-based & vessel-based.

-Braham 1984 found that March-May was main migration time period and animals migrate close to shore (not found offshore though effort did include it).

-Rugh et al. 1984 uses data from surveys in Unimak pass in Nov & Dec 1977-1979 for S-bound migration. Effort in October one year showed low numbers until 2nd week of Nov. Over 10,223 sightings; whales stay close to shore. Shore-based surveys.

-Rugh et al. 2001 uses data from '98/'99 (though not in GOA) to estimate migration timing & duration to be getting through Unimak pass in mid Nov (peak) and totaling 54 days from when they start (approx. Nov 1) in Bering Sea to when they get to Mexico.

-Barrett-Lennard et al. 2011 presents Unimak Pass data on killer whale predation on gray whales at N-bound migration (May Jun) 2003, 2004, and 2005. Not much from this to add to GOA migration route other than the fact that it's a source of mortality along route and could lead whales to shift migration routes to avoid predation areas, and also justifies the idea that whales migrate close to shore along northward migration.

-Ford et al. 2013 looked at 5 tags (2009-2011) that entered GOA migratory waters; also 1 month visual shore-based in 2011, useful if we include BC in our GOA map

-Urban et al. 2021 contains data from a single gray whale tag on N-bound migration from Baja to Bering Sea. -No passive acoustic monitoring (PAM) data used to study this migratory corridor. Total of 6 sat tags from recent studies (2009-2021). No dedicated visual surveys within AK waters since the 1990s except Barrett-Lennard in Unimak Pass only.

Spatiotemporal variability: s

Supporting notes for spatiotemporal variability: This M-BIA is characterized by fixed features including coastline gray whales that migrate along through the Gulf of Alaska and into the Bering Sea.
Evidence suggests whales stay close to shore, particularly on the Northbound leg of the migration, to help avoid predation by transient killer whales (Barrett-Lennard et al. 2011), but little data exists to estimate the corridor of the southbound migration.

Boundary certainty: 1

Supporting notes for boundary certainty: We are somewhat certain the boundaries of this M-BIA encompass the main route gray whales use on the north and southbound migrations through the Gulf of Alaska, but the data used to determine boundaries is extremely old (1960s-80s and 2003-05) and it's quite possible things have changed in the last 20+ years. It is possible grey whales use a more offshore route on the southbound migration. It is also possible that migration corridors have shifted since they were last observed in the GOA in the 1960s & 1970s (Braham et al. 1984).
-Straley (pers comm, Jun 2021) hypothesizes: on the way north they stop and feed along the way and stay close to shore, but as they go South in November throughJanuary we don't see them close to shore and she thinks they just beeline.
-This brings our boundary certainty score down to a 1, and also highlights the need for more current research on this population of gray whales and their migration route through the Gulf of Alaska.

Months of year designation is applicable: January, March, April, May, November, December

Tagging data supporting designation (Y/N): Y

# of tags: 6

# of years in which supporting tagging data collected: 2009-2011; 2021

Supporting information: Urban et al. 2021 had one tag record that migrated through GOA waters;
and
Ford et al. 2013 looked at 5 tags (2009-2011) that entered GOA migratory waters heading North from BC.

Visual observations/records supporting designation (Y/N): Y

# of years in which supporting visual data collected: 1960's-1980's

Supporting information: Sightings (Braham, 1984; Rugh, 1984; Rugh et al., 2001; Swartz et al., 2006)

Acoustic detections/records supporting designation (Y/N): N

# of observations/records: 0

# of years in which supporting acoustic data collected: NA

Photo-ID evidence supporting designation (Y/N): N

# of individuals photographed: 0

# of years of photo records to compare: NA

Genetic analyses conducted supporting designation (Y/N): N

What factors justify the boundary selection?: -Location of the continental shelf (Braham, 1984; Swartz et al., 2006)
-Polygon around historical sightings, based on Ferguson et al. 2015 with lack of any additional data to change or re-draw them. One additional tag record fits these historical sighting boundaries.

Approximate % of population that uses this area for the designated purpose (if known): 80

Approximate # of areas known specifically for this behavior (if feeding/cow-calf/mating/migratory) for this population: unk

References: Barrett-Lennard, L.G., Matkin, C.O., Ddurban, J.W., Saulitis, E.L., and Ellifrit, D. 2011. Predation on gray whales and prolonged feeding on submerged carcasses by transient killer whales at Unimak Island, Alaska. Mar. Ecol. Prog. Ser. 421: 229-241.

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Rugh, D. J. (1984). Census of gray whales at Unimak Pass, Alaska: November-December 1977-1979. In M. L. Jones, S. L. Swartz, & S. Leatherwood (Eds.), The gray whale, Eschrichtius robustus (pp. 225-247). New York: Academic Press. http://dx.doi.org/10.1016/B978-0-08-092372-7.50016-9

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Supplementary Description 4. 9. Humpback whale feeding area

Species name: Humpback whale (*Megaptera novaeangliae*)

Stock or population: North Pacific

Descriptive name: Sitka Sound Spring

BIA type: Feeding Area

BIA label: F-BIA3-e-b3-GOA021-0

Transboundary across: None

Hierarchy: Non-hierarchical; single BIA

Importance score: 3 (Intensity: 3, Data support: 2)

Supporting notes for intensity score: - Intensity of 2 was given due to unique prey type and relatively large number of humpback whales that feed in this BIA during this time period and limited availability of other prey during that time period. This is a consistent and long-term feeding BIA.
- This is a spring feeding area on herring (March through the 1st half of May)
- It appears to be a consistent and important feeding area for humpback whales in the region (SEAK) with few other areas containing high aggregations of herring.
- Sitka Sound has the largest herring fishery (i.e. herring biomass) in the region.
- Humpback whales make seasonal migrations from breeding grounds to SEAK to feed. For many this is the first feeding opportunity when they get to Alaskan waters.
- The feeding window is short; herring are most lipid rich and energy dense just before they spawn, and soon after they've spawned the humpback whales start moving out of Sitka Sound to exploit prey resources elsewhere in SEAK. - Humpback whale numbers declined from 2014-2016, associated with the marine heatwave in the GOA; during this time, Sitka Sound saw increased numbers of humpback whales during winter months feeding on overwintering herring (Straley, pers comm, June 2021).
- There are no dedicated year-round surveys of the area, but local biologists with the University of Alaska Southeast (UASE) (Jan Straley and her team), do opportunistic surveys and dedicated research projects in this area, often coinciding with the spring herring spawn. Abundance is unknown in this BIA during this time period.
- Barlow et al. 2011 estimated the entire North Pacific population to be at21,000 (SPLASH). Within northern SEAK, the latest population estimate was 1,585 in 2008 using photo ID data from 1994-2008 (Hendrix et al 2012).
- There are no known limits on availability of prey in this BIA other than environmental variability.
- There are many other feeding BIAs in the GOA and SEAK area as a whole.
- This F-BIA is composed of individual humpbacks from both the Hawaii and Mexico DPS's (i.e. breeding populations). Wade et al. (2016) suggests only 6% of SEAK whales go to the Mexico DPS, while the remaining 94% of SEAK whales migrate to the Hawaii DPS using SPLASH data from 2004-2006. Unpublished photo-ID data aggregated in Happywhale shows 11.8% of SEAK individuals with known breeding ground sightings occurring in Mexican waters (Cheeseman, pers comm). The overall abundance for the Hawaii DPS is estimated at 11,398 and Mexico DPS was 3,264 and is also based on SPLASH data (2004-2006) (Wade et al. 2016).

Supporting notes for data support score: -Data support score is a 3 because there is long-term knowledge from local scientists, ADF&G managers, and members of the public on the consistent occurrence of humpback whales feeding on herring in the spring in Sitka Sound, as well as consistent data collected by ADF&G biologists and local scientists and members of the public.
Happywhale database data from 2008-2021, including submissions from: UASE researcher Jan Straley
-Reports from whalewatching operators and personal observations submitted to Happywhale as citizen science data NOTE: Happywhale is created and managed by Ted Cheeseman; the data are collected by and shared by researchers in the region as well as citizen scientists and members of the public.
Data consists of over 22,000 sightings in all of SEAK, reduced to just under 13,000 sightings when limited to one individual per month per year. We were not able to divide Happywhale entries into different BIAs within SEAK at this time.
- No acoustic data, tissue studies, or tagging data has been included in this BIA delineation, but exists in databases with Jan Straley's research lab.
- ADF&G conducts daily flights where they count whales (with location). Data on the location of herring spawning areas from 2012-2021 is distributed from https://www.adfg.alaska.gov/index.cfm?adfg=commercialbyareasoutheast.herring_spawnlocations.

Spatiotemporal variability: e

Supporting notes for spatiotemporal variability: This F-BIA is characterized by fixed features including deep trenches that have suitable refuge for schools of herring prior to spawning, and then coastline areas that have large quantities of suitable habitat for herring spawn, including macrocystis kelp, seagrass, and other seaweeds. Herring spawning locations within this BIA shift from year to year, and boundaries have been drawn around the broad area where herring schools are typically found before and during the spawning period when whales are primarily feeding in large numbers. Herring aggregate in numerous places within the BIA at the same time and whales are found feeding in numerous locations within the BIA at any given time on aggregations of herring. These hotspots turn off and on reflecting mobile prey and are based primarily on bathymetry and environmental drivers.

Boundary certainty: 3

Supporting notes for boundary certainty: We are confident that the boundaries of this F-BIA encompass the main boundaries

within which humpback whales feed on herring in this area during this time.
- Aerial surveys are regularly conducted around Sitka Sound by ADF&G area biologists to look for herring schools, and predators including humpback whales are noted (though counts are not conducted and often not estimated). The boundaries of this BIA contain the majority of humpback whale sightings across the last decade or more, as determined by Happywhale entries (from Straley research team as well as citizen scientists), and viewing ADF&G's Sitka Sound Herring Fishery Updates (https://www.adfg.alaska.gov/index.cfm?adfg=commercialbyareasoutheast.herring) and their interactive maps (https://experience.arcgis.com/experience/52ffb83c47844ef5ba14e7a0f063fcc7). Thus while the boundary may not be exact, and more work could be done to do a detailed summary of whale locations, we are confident in the boundaries for this BIA.

Months of year designation is applicable: March, April, May (1st half)

Tagging data supporting designation (Y/N): N

# of tags: 0

# of years in which supporting tagging data collected: NA

Supporting information: No satellite tags were analyzed to inform prey, timing, spatiotemporal variability, or boundaries of this BIA

Visual observations/records supporting designation (Y/N): Y

# of observations/records: 0

# of years in which supporting visual data collected: NA

Supporting information: Thousands of observations exist from members of the public and local tour operators, but for this BIA designation we only used photo IDs entered into Happywhale from citizen scientists as well as researchers.

Acoustic detections/records supporting designation (Y/N): N

# of observations/records: 0

# of years in which supporting acoustic data collected: NA

Supporting information: No acoustic data were analyzed to inform prey, timing, spatiotemporal variability, or boundaries of this BIA

Photo-ID evidence supporting designation (Y/N): Y

# of individuals photographed: > 22,000 sighting records (Happywhale database)

# of years of photo records to compare: 2008-2021

Maximum # of years same individual photographed in area: UNK

Supporting information: Happywhale database used, containing over 22,000 sightings in all of SEAK, reduced to just under 13,000 sightings when limited to one individual per month per year. Database managed by Ted Cheeseman, photos submitted by citizen scientists, and contributing scientists Gabriele, Neilson, Straley, Pearson, Moran, and Szabo research groups with permission from researchers. Within SEAK as a whole, a minimum of 54 individuals have a 30 year or greater sighting history (Gabriele et al. 2017). Data for individual BIAs within SEAK is not available.

Genetic analyses conducted supporting designation (Y/N): Y

Supporting information: Tissue sample data was not used for support for these BIAs for SEAK; however, tissue data does exist and may be used in the future to support stock structure, foraging ecology, and other population dynamics of this population.

What factors justify the boundary selection?: Boundary drawn around area where sightings are most prevalent, as determined by Happywhale data and ADF&G maps and aerial survey updates, as well as expert elicitation from Straley (pers comm November 2021).

Data sources: Happywhale database, created and managed by Ted Cheeseman, contributed to by research groups: Gabriele, Neilson, Straley, Pearson, Moran, and Szabo research groups with permission from researchers. Additional contributions from members of the public. Accessed 21 August 2021.

ADF&G website maps and announcements (accessed 28 November 2021):
https://www.adfg.alaska.gov/index.cfm?adfg=commercialbyareasoutheast.herring_spawnlocations
https://www.adfg.alaska.gov/index.cfm?adfg=commercialbyareasoutheast.herring
https://experience.arcgis.com/experience/52ffb83c47844ef5ba14e7a0f063fcc7

Approximate % of population that uses this area for the designated purpose (if known): UNK

Approximate # of areas known specifically for this behavior (if feeding/cow-calf/mating/migratory) for this population: >16

References: Barlow, J., J. Calambokidis, E. A. Falcone, C. S. Baker, A. M. Burdin, P. J. Clapham, J. K. B. Ford, C. M. Gabriele, R. LeDuc, D. K. Mattila, T. J. Quinn, L. Rojas-Bracho, J. M. Straley, B. L. Taylor, J. Urbán R., P. Wade, D. Weller, B. H. Witteveen, and M. Yamaguchi. (2011). Humpback whale abundance in the North Pacific estimated by photographic capture-recapture with bias correction from simulation studies. Mar. Mamm. Sci. 27:793-818.

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Cheeseman, T., Southerland, K., Park, J., Olio, M., Flynn, K., Calambokidis, J., Jones, L., Garrigue, C., Jordán, A.F., Howard, A., Reade, W., Neilson, J., Gabriele, C., Clapham, P. (2021). Advanced image recognition: a fully automated, high-accuracy photo-

identification matching system for humpback whales. Mamm. Biol. 2021 pp 15. doi: 10.1007/S42991-021-00180-9

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Straley JM, Moran JR, Boswell KM, Vollenweider JJ, Heintz RA, Quinn II TJ, Witteveen BH, Rice SD. Seasonal presence and potential influence of humpback whales on wintering Pacific herring populations in the Gulf of Alaska. Deep Sea Research Part II: Topical Studies in Oceanography. 2018 Jan 1;147:173-86.

Wade, P.R., Quinn II, T.J., Barlow, J, Baker, C.S., Burdin, A.M., Calambokidis, J., Clapham, P.J., Falcone, E., Ford, J.K.B., Gabriele, C.M., Leduc, R., Mattila, D.K., Rojas-Bracho, L., Straley, J., Taylor, B.L., Urbán R., J., Weller, D., Witteveen, B.H., Yamaguchi, M. 2016. Estimates of abundance and migratory destination for North Pacific humpback whales in both summer feeding areas and winter mating and calving areas. Paper SC/66b/IA21 submitted to the Scientific Committee of the International Whaling Commission, June 2016, Bled, Slovenia.

Supplementary Description 4. 10. Humpback whale feeding area

Species name: Humpback whale (*Megaptera novaeangliae*)

Stock or population: North Pacific

Descriptive name: Berners Bay

BIA type: Feeding Area

BIA label: F-BIA2-e-b1-GOA025-0

Transboundary across: None

Hierarchy: Non-hierarchical; single BIA

Importance score: 2 (Intensity: 2, Data support: 2)

Supporting notes for intensity score: - Very little research done in this area;
- Prey is eulachon Aand some herring in the spring (limited time window for this prey) (Moran & Pearson pers comm, 10 November 2021).
- Whales likely transit through this area, but also feed on eulachon, krill and herring;
- Not many whales use this area (fewer than 50) during this time, but it seems to be fairly consistent and based on a eulachon run in Berners Bay as well as herring spawn in some years in the area (Moran pers comm, November 2021) - Humpback whales make seasonal migrations from breeding grounds to SEAK to feed.
- Humpback whale numbers declined from 2014-2016, associated with the marine heatwave in the GOA. - Abundance is unknown in this BIA during this time period and whales move in and out throughout the time period. - There are many other feeding BIAs in the GOA and SEAK area as a whole.
- Barlow et al. 2011 estimated the entire North Pacific population to be21,000 (SPLASH). Within northern SEAK the latest population estimate was 1,585 in 2008 using photo ID data from 1994-2008 (Hendrix et al 2012).
- This F-BIA is composed of individual humpbacks from both the Hawaii and Mexico DPS's (i.e. breeding populations). Wade et al. (2016) suggests only 6% of SEAK whales go to the Mexico DPS, while the remaining 94% of SEAK whales migrate to the Hawaii DPS using SPLASH data from 2004-2006. Unpublished photo-ID data aggregated in Happywhale shows 11.8% of SEAK individuals with known breeding ground sightings occurred in Mexican waters (Cheeseman, pers comm). The overall abundance for the Hawaii DPS is estimated at 11,398 and Mexico DPS was 3,264 and is also based on SPLASH data (2004-2006) (Wade et al. 2016).

Supporting notes for data support score: - Happywhale database data from 2008-2021, primarily including very few submissions from:
-NOAA Fisheries researcher John Moran
-University of Alaska Southeast researcher Heidi Pearson
-Reports from whalewatching operators and personal observations submitted to Happywhale as citizen science data NOTE: Happywhale is created and managed by Ted Cheeseman; the data are collected by and shared by researchers in the region as well as citizen scientists and members of the public.
Data consists of over 22,000 sightings in all of Southeast Alaska (SEAK), reduced to just under 13,000 sightings when limited to one per individual per month per year. We were not able to divide Happywhale entries into different BIAs within SEAK at this time.
- Only a few humpback whale sightings were noted from NOAA Fisheries 2019 harbor porpoise research cruise, unpublished data shared by Kim Goetz, 29 November 2021.
- Heidi Pearson, unpublished data, 2013-2016 – observer on the Kensington mine shuttle along East Lynn Canal up to Berners Bay
- No acoustic data, tissue studies, or tagging data has been included in this BIA delineation.

Spatiotemporal variability: e

Supporting notes for spatiotemporal variability: - Humpbacks come to this area to feed primarily on eulachon and herring in the spring (Moran & Pearson pers comm Nov 2021).
- In this region the eulachon prey are associated with a spring run associated with river systems, while the herring prey school up to spawn near the shoreline. Both prey are only available during a short period in the spring. Whales are found feeding in numerous locations within the BIA at any given time. These hotspots turn off and on reflecting mobile prey and are based primarily on environmental drivers.

Boundary certainty: 1

Supporting notes for boundary certainty: - We are uncertain exactly where the boundaries of this F-BIA would fall to encompass the main areas within which humpback whales feed on these prey sources during this time period in this area. Subject matter experts provided considerable feedback on the use of Berners Bay, but there was more uncertainty in how the Lynn Canal region outside of the bay ties in to this feeding area.
Increased surveys in this BIA and surrounding area along with prey studies could help shed light on the boundaries. Not much is understood about the northern Lynn Canal region in terms of humpback whale presence, habitat use, and feeding ecology. To the south, boundaries were also created mainly around sighting points, with the southern Lynn Canal boundary created at the tip of Point Retreat, where environmental, bathymetric, and ecological changes occur, thus likely changing the nature of humpback whale presence (prey, timing, etc.). We also note that the specific boundaries within the edges of the BIA where these major waterways meet are not well understood and there is less certainty in how and where to split various biologically

important areas in this region.

Months of year designation is applicable: April, May

Tagging data supporting designation (Y/N): N

# of tags: 0

# of years in which supporting tagging data collected: NA

Supporting information: No satellite tags were analyzed to inform prey, timing, spatiotemporal variability, or boundaries of this BIA.

Visual observations/records supporting designation (Y/N): Y

# of observations/records: 50-100

# of years in which supporting visual data collected: 2013-2016

Supporting information: Kensington Mine ferry shuttle observations, unpublished data provided by Heidi Pearson (November 2021)

Acoustic detections/records supporting designation (Y/N): N

# of observations/records: 0

# of years in which supporting acoustic data collected: NA

Supporting information: No acoustic data were analyzed to inform prey, timing, spatiotemporal variability, or boundaries of this BIA.

Photo-ID evidence supporting designation (Y/N): Y

# of individuals photographed: >22,000 sighting records (Happywhale database)

# of years of photo records to compare: 2008-2021

Maximum # of years same individual photographed in area: UNK

Supporting information: Happywhale database used, containing over 22,000 sightings in all of SEAK, reduced to just under 13,000 sightings when limited to one per individual per month per year. Database managed by Ted Cheeseman, and photos submitted by citizen scientists and contributing scientists Gabriele, Neilson, Straley, Pearson, Moran, and Szabo research groups with permission from researchers. Within SEAK as a whole, a minimum of 54 individuals have a 30-year or greater sighting history (Gabriele et al. 2017). Data for individual BIAs within SEAK is not available.

Genetic analyses conducted supporting designation (Y/N): Y

Supporting information: Tissue sample data was not used for support for this BIA.

What factors justify the boundary selection?: Boundary drawn around the area where sightings are most prevalent and the bay where eulachon run and whales have been observed feeding on them in the spring.

Data sources: 1) Happywhale photo database, created and managed by Ted Cheeseman; sightings and photos contribute by research groups led by: Chris Gabriele, Janet Neilson, Jan Straley, Heidi Pearson, John Moran, and Andy Szabo, with permission from researchers. Additional contributions from citizen scientists. Accessed 21 August 2021.

2) Unpublished data from Heidi Pearson, 2013-2016. Accessed November 2021.

Approximate % of population that uses this area for the designated purpose (if known): UNK

Approximate # of areas known specifically for this behavior (if feeding/cow-calf/mating/migratory) for this population: >16

References: Barlow, J., J. Calambokidis, E. A. Falcone, C. S. Baker, A. M. Burdin, P. J. Clapham, J. K. B. Ford, C. M. Gabriele, R. LeDuc, D. K. Mattila, T. J. Quinn, L. Rojas-Bracho, J. M. Straley, B. L. Taylor, J. Urbán R., P. Wade, D. Weller, B. H. Witteveen, and M. Yamaguchi. (2011). Humpback whale abundance in the North Pacific estimated by photographic capture-recapture with bias correction from simulation studies. Mar. Mamm. Sci. 27:793-818.

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Hendrix, A.N., Straley, J., Gabriele, C., and Gende, S.M. (2012). Bayesian estimation of humpback whale (Megaptera novaeangliae) population abundance and movement patterns in southeastern Alaska. Can. J. Fish. Aquat. Sci. 69: 1783-1797

Moran JR, Heintz RA, Straley JM, Vollenweider JJ. Regional variation in the intensity of humpback whale predation on Pacific herring in the Gulf of Alaska. Deep Sea Research Part II: Topical Studies in Oceanography. 2018 Jan 1;147:187-95.

Straley JM, Moran JR, Boswell KM, Vollenweider JJ, Heintz RA, Quinn II TJ, Witteveen BH, Rice SD. Seasonal presence and

potential influence of humpback whales on wintering Pacific herring populations in the Gulf of Alaska. Deep Sea Research Part II: Topical Studies in Oceanography. 2018 Jan 1;147:173-86.

Wade, P.R., Quinn II, T.J., Barlow, J, Baker, C.S., Burdin, A.M., Calambokidis, J., Clapham, P.J., Falcone, E., Ford, J.K.B., Gabriele, C.M., Leduc, R., Mattila, D.K., Rojas-Bracho, L., Straley, J., Taylor, B.L., Urbán R., J., Weller, D., Witteveen, B.H., Yamaguchi, M. 2016. Estimates of abundance and migratory destination for North Pacific humpback whales in both summer feeding areas and winter mating and calving areas. Paper SC/66b/IA21 submitted to the Scientific Committee of the International Whaling Commission, June 2016, Bled, Slovenia.

Supplementary Description 4. 11. Humpback whale feeding area

Species name: Humpback whale (*Megaptera novaeangliae*)

Stock or population: North Pacific

Descriptive name: Fredrick Sound & Stephens Passage

BIA type: Feeding Area

BIA label: F-BIA2-e-b2-GOA020-0

Transboundary across: None

Hierarchy: Non-hierarchical; single BIA

Importance score: 2 (Intensity: 2, Data support: 3)

Supporting notes for intensity score: - This is a summer/fall feeding area on mixed euphausiids
- It appears to be a consistent and important feeding area for humpback whales during this time
- Humpback whales make seasonal migrations from breeding grounds to SEAK to feed.
- Humpback whale numbers declined from 2014-2016, associated with the marine heatwave in the GOA. - There are no dedicated year-round surveys of the area, but local biologists with the Alaska Whale Foundation (Andy Szabo and his team), do opportunistic surveys and dedicated research projects in this area, and local tour operators and members of the public contribute photos and sightings to the Happywhale database.
- Abundance is unknown in this BIA during this time period and whales move in and out throughout the time period. Barlow et al. 2011 estimated the entire North Pacific population is 21,000 (SPLASH). Within northern SEAK the latest population estimate was 1,585 in 2008 using photo ID data from 1994-2008 (Hendrix et al 2012).
- There are no known limits on availability of prey in this BIA other than environmental variability.
- There are many other feeding BIAs in the GOA and SEAK area as a whole.
- This F-BIA is composed of individual humpbacks from both the Hawaii and Mexico DPS's (i.e. breeding populations). Wade et al. (2016) suggests only 6% of SEAK whales go to the Mexico DPS, while the remaining 94% of SEAK whales migrate to the Hawaii DPS using SPLASH data from 2004-2006. Unpublished photo-ID data aggregated in Happywhale shows 11.8% of SEAK individuals with known breeding ground sightings occurring in Mexican waters (Cheeseman, pers comm). The overall abundance for the Hawaii DPS is estimated at 11,398 individuals and Mexico DPS was estimated at 3,264 individuals. Both are also based on SPLASH data (2004- 2006) (Wade et al. 2016).

Supporting notes for data support score: - Happywhale database data from 2008-2021, including submissions from: -Alaska Whale Foundation researcher Andy Szabo
-University of Alaska Southeast researcher Jan Straley
-Reports from whalewatching operators and personal observations submitted to Happywhale as citizen science data NOTE: Happywhale is created and managed by Ted Cheeseman; the data are collected by and shared by researchers in the region as well as citizen scientists and members of the public.
Data consists of over 22,000 sightings in all of Southeast Alaska (SEAK), reduced to just under 13,000 sightings when limited to one individual per month per year. We were not able to divide Happywhale entries into different BIAs within SEAK at this time.
- Bruce Mate / Oregon State University (OSU) tagging group out of Seymour Canal in November 2014 and 2015 (Palacios et al. 2019): -Photos (233 individuals were identified) in Seymour/Frederick Sound/Petersburg
-37 Satellite tags were placed in a neighboring area (Seymour canal), many of which transited through or used this BIA, but we do not have available data on exactly how many whales used this BIA and what their movement behavior was within this area.
- No acoustic data, tissue studies, or tagging has been included in this BIA delineation.
- Data support could include more dedicated surveys year-round, as well as perhaps some published tagging work detailing this area specifically to help solidify boundaries and detail feeding behavior but it is pretty well covered and there is a lot of work done in this area during the summer and fall when humpback whales are typically on their feeding grounds. Additional tagging work has been done by Alaska Whale Foundation (AWF) group, and future publication and analysis of this data will potentially strengthen the support for this BIA even more.

Spatiotemporal variability: e

Supporting notes for spatiotemporal variability: Humpbacks come this area to feed primarily on zooplankton (Szabo pers comm 10 November 2021); in this region the prey are associated with persistent but mobile features of the ecosystem, such as currents and eddies and whales are found feeding in numerous locations within the BIA at any given time. These hotspots turn off and on reflecting mobile prey and are based primarily on environmental drivers.

Boundary certainty: 2

Supporting notes for boundary certainty: - We are reasonably certain the boundaries of this F-BIA encompass the main boundaries within which humpback whales feed during this time period.
- Boundary information primarily gained from Happywhale sighting data, as well as expert elicitation from Szabo & Straley (pers comm, November 2021).

Months of year designation is applicable: June, July, August, September, October (1st half)

Tagging data supporting designation (Y/N): Y

# of tags: 37

# of years in which supporting tagging data collected: 2014-2015

Supporting information: Satellite tags were deployed in a neighboring BIA, but were not analyzed to inform prey, timing, spatiotemporal variability, or boundaries of this BIA.

Visual observations/records supporting designation (Y/N): Y

# of observations/records: numerous

# of years in which supporting visual data collected: 2019

Supporting information: NOAA Harbor Porpoise survey, 2019, sighting data (unpublished data provided by Kim Goetz, NOAA Fisheries, on 29 November 2021).

Acoustic detections/records supporting designation (Y/N): N

Photo-ID evidence supporting designation (Y/N): Y

# of individuals photographed: > 22,000 sighting records (Happywhale database)

# of years of photo records to compare: 2008-2021

Maximum # of years same individual photographed in area: UNK

Supporting information: Happywhale database used, containing over 22,000 sightings in all of SEAK, reduced to just under 13,000 sightings when limited to one individual per month per year. Database managed by Ted Cheeseman, photos submited by citizen scientists, and contributing scientists Gabriele, Neilson, Straley, Pearson, Moran, and Szabo research groups with permission from researchers. Within SEAK as a whole, a minimum of 54 individuals have a 30 year or greater sighting history (Gabriele et al. 2017). Data for individual BIAs within SEAK is not available.

Genetic analyses conducted supporting designation (Y/N): Y

Supporting information: Tissue sample data was not used for support for these BIAs for SEAK; however, tissue data does exist and may be used in the future to support stock structure, foraging ecology, and other population dynamics of this population.

What factors justify the boundary selection?: The boundary was drawn around the area where sightings are most prevalent, as determined by Happywhale data, as well as expert elicitation from Szabo & Straley (pers comm November 2021).

Data sources: Happywhale database, created and managed by Ted Cheeseman, contributed to by research groups: Gabriele, Neilson, Straley, Pearson, Moran, and Szabo research groups with permission from researchers. Additional contributions from members of the public. Accessed 21 August 2021.

NOAA Harbor Porpoise survey, 2019, unpublished data used with permission from Kim Goetz (29 November 2021)

Approximate % of population that uses this area for the designated purpose (if known): UNK

Approximate # of areas known specifically for this behavior (if feeding/cow-calf/mating/migratory) for this population: >16

References: Barlow, J., J. Calambokidis, E. A. Falcone, C. S. Baker, A. M. Burdin, P. J. Clapham, J. K. B. Ford, C. M. Gabriele, R. LeDuc, D. K. Mattila, T. J. Quinn, L. Rojas-Bracho, J. M. Straley, B. L. Taylor, J. Urbán R., P. Wade, D. Weller, B. H. Witteveen, and M. Yamaguchi. (2011). Humpback whale abundance in the North Pacific estimated by photographic capture-recapture with bias correction from simulation studies. Mar. Mamm. Sci. 27:793-818.

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Wade, P.R., Quinn II, T.J., Barlow, J, Baker, C.S., Burdin, A.M., Calambokidis, J., Clapham, P.J., Falcone, E., Ford, J.K.B., Gabriele, C.M., Leduc, R., Mattila, D.K., Rojas-Bracho, L., Straley, J., Taylor, B.L., Urbán R., J., Weller, D., Witteveen, B.H., Yamaguchi, M. 2016. Estimates of abundance and migratory destination for North Pacific humpback whales in both summer feeding areas and winter mating and calving areas. Paper SC/66b/IA21 submitted to the Scientific Committee of the International Whaling Commission, June 2016, Bled, Slovenia.

Supplementary Description 4. 12. Humpback whale feeding area

Species name: Humpback whale (*Megaptera novaeangliae*)

Stock or population: North Pacific

Descriptive name: Glacier Bay & Icy Strait

BIA type: Feeding Area

BIA label: F-BIA2-e-b2-GOA017-0

Transboundary across: None

Hierarchy: Non-hierarchical; single BIA

Importance score: 2 (Intensity: 2, Data support: 3)

Supporting notes for intensity score: -Prey is mixed schooling fish, including capelin, sandlance, herring, juvenile pollock, and myctophids (e.g. northern lampfish), as well as some zooplankton (e.g. euphausiids)
-Prey prevalence varies within and among years (Gabriele pers comm Dec 2021; Marsteller et al. 2020). -Prey are fairly plentiful in SEAK (the region) during the summer months
-Humpback whales make seasonal migrations from breeding grounds to SEAK to feed
-Humpback whale numbers declined from 2014-2016, associated with the marine heatwave in the GOA; -Glacier Bay National Park employs two whale researchers that conduct photo-ID surveys of Glacier By and central Icy Strait waters 4-5 days per week from 1 June to 31 August each year (Gabriele et al. 2017). Opportunistic surveys outside of these dates are also conducted, and some surveys go outside of central Icy Strait (Gabriele et al. 2017).
-Current catalog through 2020 for Glacier Bay and Icy Strait contains 786 individuals (Gabriele pers com Dec 2021), though it is important to acknowledge the impacts of the marine heatwave on reproductive rates and survival of humpback whales (Gabriele et al. 2022 proof).
-Abundance peaked in 2013 at 241 individuals, and subsequently declined to a low of 101 individuals in 2018 before beginning to increase again in 2019 (Neilson & Gabriele 2020).
-Barlow et al. 2011 estimated the entire North Pacific population to be21,000 (SPLASH). Within northern SEAK the latest population estimate was 1,585 in 2008 using photo ID data from 1994-2008 (Hendrix et al 2012).
-There are no known limits on availability of prey in this BIA other than environmental variability
-There are many other feeding BIAs in the GOA and SEAK area as a whole.
-This F-BIA is composed of individual humpbacks from both the Hawaii and Mexico DPS's (i.e. breeding populations). Wade et al. (2016) suggests only 6% of SEAK whales go to the Mexico DPS, while the remaining 94% of SEAK whales migrate to the Hawaii DPS using SPLASH data from 2004-2006. Unpublished photo-ID data aggregated in Happywhale shows 11.8% of SEAK individuals with known breeding ground sightings occurring in Mexican waters (Cheeseman, pers comm). The overall abundance for the Hawaii DPS is estimated at 11,398 and Mexico DPS was 3,264 and is also based on SPLASH data (2004-2006) (Wade et al. 2016).

Supporting notes for data support score: Supporting information has come from the following resources: Happywhale database data from 2008-2021, including submissions from: -Glacier Bay National Park and Preserve researchers Christine Gabriele & Janet Neilson
-NOAA Fisheries researcher John Moran
-Alaska Whale Foundation (AWF) researcher Andy Szabo
-Reports from whale-watching operators and personal observations submitted to Happywhale as citizen science data NOTE: Happywhale and the data it contains is created and managed by Ted Cheeseman.
Data consists of over 22,000 sightings in all of Southeast Alaska (SEAK), reduced to just under 13,000 sightings when limited to one per individual per month per year. We were not able to divide Happywhale entries into different BIAs within SEAK at this time.
-Humpback whale sightings from NOAA Fisheries 2019 harbor porpoise research cruise, unpublished data shared by Kim Goetz, 29 November 2021
-A bottom-mounted hydrophone in Glacier Bay National Park, near Bartlett Cove, continuously records humpback whale acoustic activity within this BIA, with thousands of hours of recordings. The acoustic records of humpback whale activity align with the temporal period chosen for this BIA (Gabriele pers comm, December 2021).
-Additionally there are 8,188 hours of acoustic array recordings collected by Michelle Fournet from May through October 2015 and April through October 2016 in Glacier Bay. These data are for a project describing ambient sound in Glacier Bay National Park as well as investigating whether humpback whales adjust their calling behavior in response to natural and vessel-generated sound (Fournet et al. 2018 MEPS).
-No tissue studies or tagging has been included in this BIA delineation.

Spatiotemporal variability: e

Supporting notes for spatiotemporal variability: Humpbacks come to this area to feed on forage fish, plus some krill (Neilson pers comm 29 Nov 2021); in this region the prey are associated with persistent but mobile features of the ecosystem, such as currents and eddies and whales are found feeding in numerous locations within the BIA at any given time. These hotspots turn off and on reflecting mobile prey and are based primarily on environmental drivers.

Boundary certainty: 2

Supporting notes for boundary certainty: -We are reasonably certain the boundaries of this F-BIA encompass the main boundaries within which humpback whales feed in this area.
-Surveys are more consistent within the Glacier Bay National Park boundaries, while surveys and data reporting from the Icy

Strait portion of the BIA are less consistent and thus the boundaries are not as well understood.
-The boundaries in this BIA surround the bulk of humpback whale sightings within Glacier Bay National Park and Icy Strait, and are bounded on the sides by major confluences of water bodies, where the behavior of whales and prey likely changes, according to subject matter experts. Thus the specific boundaries within the edges of the BIA where these major waterways meet are not as well understood and there is less certainty in how and where to split various biologically important areas in this region.

Months of year designation is applicable: May, June, July, August, September, October

Tagging data supporting designation (Y/N): N

# of tags: 0

# of years in which supporting tagging data collected: NA

Supporting information: No satellite tags were analyzed to inform prey, timing, spatiotemporal variability, or boundaries of the BIAs in SEAK

Visual observations/records supporting designation (Y/N): Y

# of observations/records: Numerous

# of years in which supporting visual data collected: 2019

Supporting information: NOAA Harbor Porpoise survey, 2019, sighting data (unpublished data provided by Kim Goetz, NOAA Fisheries, on 29 November 2021).

Acoustic detections/records supporting designation (Y/N): Y

# of observations/records: Decades of continuous records

# of years in which supporting acoustic data collected: 2000-2021

Supporting information: A bottom-mounted hydrophone in Glacier Bay National Park, near Bartlett Cove, continuously records humpback whale acoustic activity within this BIA, with thousands of hours of recordings, but acoustic records were not directly used in defining this BIA. The acoustic records of humpback whale activity align with the temporal period chosen for this BIA. Additionally there are 8188 hr of acoustic array recordings collected by Michelle Fournet from May-Oct 2015 and Apr-Oct 2016 in Glacier Bay for a project describing ambient sound in Glacier Bay National Park, investigating whether humpback whales adjust their calling behavior in response to natural and vessel-generated sound (Fournet et al. 2018 MEPS).

Photo-ID evidence supporting designation (Y/N): Y

# of individuals photographed: >22,000 sighting records (Happywhale Database)

# of years of photo records to compare: 2008-2021

Maximum # of years same individual photographed in area: unk

Supporting information: Happywhale photo database used, containing over 22,000 sightings in all of SEAK, reduced to just under 13,000 sightings when limited to one per individual per month per year. Database managed by Ted Cheeseman, photos submitted by citizen scientists, and contributing scientists Gabriele, Neilson, Straley, Pearson, Moran, and Szabo research groups with permission from researchers. Within SEAK as a whole, a minimum of 54 individuals have a 30-year or greater sighting history (Gabriele et al. 2017). Data for individual BIAs within SEAK is not available.

Genetic analyses conducted supporting designation (Y/N): Y

Supporting information: Tissue sample data not used for support for these BIAs for SEAK; however, tissue data does exist and may be used in the future to support stock structure, foraging ecology, and other population dynamics of this population.

What factors justify the boundary selection?: Boundary drawn around area where sightings are most prevalent, with input from subject matter experts. Heat maps were built from sighting data compiled from a variety of researchers. For edges of BIAs in this region we relied on bathymetric features that potentially separate different prey fields, impact whale behavior in those areas, and/or affect temporal aspects to humpback whale presence.

Data sources: 1) Happywhale photo database, created and managed by Ted Cheeseman (Cheeseman et al. 2017 & 2021); sightings and photos contribute by research groups led by: Chris Gabriele, Janet Neilson, Jan Straley, Heidi Pearson, John Moran, and Andy Szabo, with permission from researchers. Additional contributions from members of the public. Accessed 21 August 2021.
2) NOAA Harbor Porpoise survey, 2019, unpublished data used with permission from Kim Goetz (29 November 2021)

Approximate % of population that uses this area for the designated purpose (if known): UNK

Approximate # of areas known specifically for this behavior (if feeding/cow-calf/mating/migratory) for this population: >16

References: Barlow, J., J. Calambokidis, E. A. Falcone, C. S. Baker, A. M. Burdin, P. J. Clapham, J. K. B. Ford, C. M. Gabriele, R. LeDuc, D. K. Mattila, T. J. Quinn, L. Rojas-Bracho, J. M. Straley, B. L. Taylor, J. Urbán R., P. Wade, D. Weller, B. H. Witteveen, and M. Yamaguchi. (2011). Humpback whale abundance in the North Pacific estimated by photographic capture-recapture with bias correction from simulation studies. Mar. Mamm. Sci. 27:793-818.

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Neilson, J.L., and Gabriele, C.M. (2020). Glacier Bay and Icy Strait humpback whale population monitoring: 2019 Update. National Park Service, Gustavus, Alaska, 6pp. https://irma.nps.gov/DataStore/Reference/Profile/2259827.

Wade, P.R., Quinn II, T.J., Barlow, J, Baker, C.S., Burdin, A.M., Calambokidis, J., Clapham, P.J., Falcone, E., Ford, J.K.B., Gabriele, C.M., Leduc, R., Mattila, D.K., Rojas-Bracho, L., Straley, J., Taylor, B.L., Urbán R., J., Weller, D., Witteveen, B.H., Yamaguchi, M. 2016. Estimates of abundance and migratory destination for North Pacific humpback whales in both summer feeding areas and winter mating and calving areas. Paper SC/66b/IA21 submitted to the Scientific Committee of the International Whaling Commission, June 2016, Bled, Slovenia.

Supplementary Description 4. 13. Humpback whale feeding area

Species name: Humpback whale (*Megaptera novaeangliae*)

Stock or population: North Pacific

Descriptive name: Juneau area

BIA type: Feeding Area

BIA label: F-BIA2-e-b2-GOA018-0

Transboundary across: None

Hierarchy: Non-hierarchical; single BIA

Importance score: 2 (Intensity: 2, Data support: 3)

Supporting notes for intensity score: Prey are fairly plentiful in SEAK (the larger region) during the summer months and there are no known limits on availability of prey in this BIA other than environmental variability
Prey is mixed: primarily herring throughout the year; secondary prey is euphausiids and other zooplankton. Other opportunistic prey sources include sand lance, capelin, salmon (hatchery chum salmon releases in the spring), young of the year pollock, and lampfish (Moran pers comm Nov 2021, Straley et al. 2018).
- Boswell et al. 2016 did acoustic surveys on overwintering herring in the Juneau area in 2007/2008 and 2008/2009, showing that herring likely respond to whale predators in the fall months by being in dispersed schools throughout the water column; when whales depart, schools change to deep and dense schools. It's older data, but relevant for prey info.
- Humpback whales make seasonal migrations from breeding grounds to SEAK to feed
- Humpback whale numbers declined from 2014-2016, associated with the marine heatwave in the GOA; - There are no dedicated year-round surveys of the area, but local biologists with the University of Alaska Southeast, NOAA fisheries, and graduate students with the University of Alaska Fairbanks do opportunistic surveys and dedicated research projects in this area.
- Barlow et al. 2011 estimated the entire North Pacific pop at21,000 (SPLASH). Within northern SEAK the latest population estimate was 1,585 in 2008 using photo ID data from 1994-2008 (Hendrix et al 2012).

- There are many other feeding BIAs in the GOA and SEAK area as a whole.
- This F-BIA is composed of individual humpbacks from both the Hawaii and Mexico DPS's (i.e. breeding populations). Wade et al. (2016) suggests only 6% of SEAK whales go to the Mexico DPS, while the remaining 94% of SEAK whales migrate to the Hawaii DPS using SPLASH data from 2004-2006. Unpublished photo-ID data aggregated in Happywhale shows 11.8% of SEAK individuals with known breeding ground sightings occurring in Mexican waters (Cheeseman, pers comm). The overall abundance for the Hawaii DPS is estimated 11,398 and Mexico DPS was 3,264 and is also based on SPLASH data (2004-2006) (Wade et al. 2016).

Supporting notes for data support score: - Happywhale database data from 2008-2021, primarily including submissions from:
*NOAA Fisheries researcher John Moran
*University of Alaska Southeast (UASE) researcher Heidi Pearson
-2013: weekly in August
-2014: monthly April-September
-2015: monthly April-September
-2016: every 2 weeks, May-September
-2017: weekly May-September
-2018: monthly May-July
-2019: every 2 weeks May-September
-2020: weekly May-September
-2021: weekly May-September
*Reports from whalewatching operators and personal observations submitted to Happywhale as citizen science data NOTE: Happywhale and the data it contains is created and managed by Ted Cheeseman.
Data consists of over 22,000 sightings in all of Southeast Alaska (SEAK), reduced to just under 13,000 sightings when limited to one per individual per month per year. We were not able to divide Happywhale entries into different BIAs within SEAK at this time.
- Humpback whale sightings from NOAA Fisheries 2019 harbor porpoise research cruise, unpublished data shared by Kim Goetz, 29 November 2021
- Heidi Pearson, unpublished data, 2013-2016
- No tissue studies or tagging has been included in this BIA delineation
- Boswell et al. 2016 acoustic surveys on overwintering herring in '07/'08 and '08/'09 relevant for prey, but not on whales.
- Michelle Fournet has acoustic data from 2020 and 2021 in this BIA from a project comparing calling behavior in a summer with low anthropogenic sound (i.e. tourists) and a summer with high tourism and anthropogenic vessel noise in the water.

Spatiotemporal variability: e

Supporting notes for spatiotemporal variability: Humpbacks come to this area to feed primarily on herring throughout the year; secondary prey is euphausiids and other zooplankton (Straley et al. 2018; Moran pers comm Nov 2021). Other opportunistic prey sources include salmon hatchery chum salmon releases in the spring, and young of the year pollock are consumed when there isn't much else available. In this region the prey are associated with persistent but mobile features of the ecosystem, such as currents and eddies and whales are found feeding in numerous locations within the BIA at any given time. These hotspots turn off and on reflecting mobile prey and are based primarily on environmental drivers.

Boundary certainty: 2

Supporting notes for boundary certainty: Subject matter experts provided considerable feedback on boundaries based on decades of experience in the area. We are reasonably certain the boundaries of this F-BIA encompass the main boundaries within which humpback whales feed on these prey sources during this time period in this area.
- Some uncertainty remains in the outer boundaries of this BIA because of a lack of dedicated surveys done consistently throughout the year across the entirety of the area, lowering the boundary certainty score to a 2.
- The boundaries in this BIA surround the bulk of humpback whale sightings within the Juneau area. The area to the north in Lynn canal represents where sightings taper off, and not much is understood about the northern Lynn Canal region in terms of humpback whale presence, habitat use, and feeding ecology. To the south, boundaries were also created mainly around sighting points, with the southern Lynn Canal boundary created at the tip of Point Retreat, where environmental, bathymetric, and ecological changes occur, thus likely changing the nature of humpback whale presence (prey, timing, etc.) We also note that the specific boundaries within the edges of the BIA where these major waterways meet are not well understood and there is less certainty in how and where to split various biologically important areas in this region.

Months of year designation is applicable: April, May, June, July, August, September, October

Tagging data supporting designation (Y/N): N

# of tags: 0

# of years in which supporting tagging data collected: NA

Supporting information: No satellite tags were analyzed to inform prey, timing, spatiotemporal variability, or boundaries of this BIA

Visual observations/records supporting designation (Y/N): Y

# of observations/records: 50-100

# of years in which supporting visual data collected: 2013-2016

Supporting information: Kensington Mine ferry shuttle observations, unpublished data provided by Heidi Pearson

Acoustic detections/records supporting designation (Y/N): Y

# of observations/records: unk

# of years in which supporting acoustic data collected: 2020-2021

Supporting information: Michelle Fournet has acoustic data from 2020 and 2021 in this BIA from a project comparing calling behavior in a summer with low anthropogenic sound (i.e. tourists) and a summer with high tourism and anthropogenic vessel noise in the water.

Photo-ID evidence supporting designation (Y/N): Y

# of individuals photographed: > 22,000 sighting records (Happywhale database)

# of years of photo records to compare: 2008-2021

Maximum # of years same individual photographed in area: 13

Supporting information: Happywhale database used, containing over 22,000 sightings in all of SEAK, reduced to just under 13,000 sightings when limited to one per individual per month per year. Database managed by Ted Cheeseman, and photos submitted by citizen scientists and contributing scientists Gabriele, Neilson, Straley, Pearson, Moran, and Szabo research groups with permission from researchers. Within SEAK as a whole, a minimum of 54 individuals have a 30 year or greater sighting history (Gabriele et al. 2017). Data for Juneau area comes from personal communication with Heidi Pearson. Data for other BIAs within SEAK is not available.

Genetic analyses conducted supporting designation (Y/N): Y

Supporting information: Tissue sample data was not used for support for these BIAs for SEAK; however, tissue data does exist and may be used in the future to support stock structure, foraging ecology, and other population dynamics of this population

What factors justify the boundary selection?: Boundaries were drawn around the areas where sightings are most prevalent; heat maps were built from sighting data compiled from a variety of researchers. For edges of BIAs in this region we relied on sighting data and bathymetric features that potentially separate different prey fields, impact whale behavior in those areas, and/or affect temporal aspects to humpback whale presence.

Data sources: 1) Happywhale photo database, created and managed by Ted Cheeseman; sightings and photos contribute by research groups led by: Chris Gabriele, Janet Neilson, Jan Straley, Heidi Pearson, John Moran, and Andy Szabo, with permission from researchers. Additional contributions from members of the public. Accessed 21 August 2021.
2) Unpublished data from Heidi Pearson, 2013-2016

Approximate % of population that uses this area for the designated purpose (if known): UNK

Approximate # of areas known specifically for this behavior (if feeding/cow-calf/mating/migratory) for this population: >16

References: Barlow, J., J. Calambokidis, E. A. Falcone, C. S. Baker, A. M. Burdin, P. J. Clapham, J. K. B. Ford, C. M. Gabriele, R. LeDuc, D. K. Mattila, T. J. Quinn, L. Rojas-Bracho, J. M. Straley, B. L. Taylor, J. Urbán R., P. Wade, D. Weller, B. H. Witteveen, and M. Yamaguchi. (2011). Humpback whale abundance in the North Pacific estimated by photographic capture-recapture with bias correction from simulation studies. Mar. Mamm. Sci. 27:793-818.

Boswell KM, Rieucau G, Vollenweider JJ, Moran JR, Heintz RA, Blackburn JK, Csepp DJ. Are spatial and temporal patterns in Lynn Canal overwintering Pacific herring related to top predator activity?. Canadian Journal of Fisheries and Aquatic Sciences. 2016;73(9):1307-18.

Cheeseman, T., T. Johnson, K. Southerland, and N. Muldavin. 2017. Happywhale: Globalizing marine mammal photo identification via a citizen science web platform. Paper SC/67A/PH/02 submitted to the Scientific Committee of the International Whaling Commission, May 2017, Bled, Slovenia.

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Supplementary Description 4. 14. Humpback whale feeding area

Species name: Humpback whale (*Megaptera novaeangliae*)

Stock or population: North Pacific

Descriptive name: Prince William Sound

BIA type: Feeding Area

BIA label: F-BIA2-d-b2-GOA008-0

Transboundary across: None

Hierarchy: Non-hierarchical; single BIA

Importance score: 2 (Intensity: 2, Data support: 2)

Supporting notes for intensity score: - Humpback whale numbers in Prince William Sound (PWS) declined from 2014-2016, associated with the marine heatwave in the GOA;
- Current PWS humpback whale catalog, which has been matched with all sightings submitted to Happywhale from researchers and members of the public, contains 359 individuals. Since 2017, fewer than 40 whales have been seen in a given survey (fall or spring). Prior to 2017, the top number of individuals in a year was 180 individuals in 2014. Teerlink et al. (2015) estimated the PWS humpback whale abundance to be 194 (+/- 17) individuals in 2009. Barlow et al. 2011 estimated the entire North Pacific population at21,000 (SPLASH), which indicates the PWS feeding population as a small percentage, < 2% of the overall population.
- This F-BIA is composed of individual humpbacks from both the Hawaii and Mexico DPS's (i.e. breeding populations). The proportion of each breeding population using PWS as a feeding area is thought to be split fairly evenly (Wade et al. 2016). The overall abundance for the Hawaii DPS is 11,398 and Mexico DPS is 3,264 based on SPLASH data (2004-2005) which is very outdated (Wade et al. 2016). Thus the number/density using this feeding area relative to the total abundance of each DPS could be estimated at 2% of Hawaii and 6% of Mexico using the 180 or 194 abundance estimates (Teerlink et al. 2015 & Straley/Moran database accessed 27 July 2021) which is pretty low and would suggest a low intensity score. When looking at number/density relative to total abundance, if we take into account the time period and the prey targeted, this is a spring and fall herring feeding population, and the only other major herring feeding area in spring and fall for humpbacks in the GOA is in SEAK (March-May). Despite declines in number of whales seen in spring and fall in the PWS region, the area likely has a relatively high proportion of individuals relative to total population coming to feeding grounds that time of year and for the prey resource of herring, suggesting a slightly higher intensity score.
- This population makes a long-range seasonal migration between feeding and breeding grounds.
- Herring are primary prey here during these times; rate of consumption or caloric intake is noted to be 2,639 to 7,443 tons over 182 days September through January 2007-2008 and 4,388 to 12,989 tons over 182 days September through January 2008-2009 (Moran et al. 2018).
- There are known limits on availability of food supply of herring in this BIA, which are limited in their availability in 2 ways – first in the limited availability of herring in PWS which are depleted after the Exxon Valdez Oil Spill (EVOS); second, there are limitations in the seasonal caloric peaks in herring. Herring are more calorically dense in spring before they spawn, and over the winter are building energy stores.
- There are many other feeding BIAs in the GOA, Aleutian Islands, and Bering Sea (SEAK, Kodiak, and Shumagins), but for the peak time periods (March-May and September-December or thereabouts), and for herring prey, this area is likely of higher importance.

Supporting notes for data support score: - GulfWatch Alaska (GWA) does annual spring and fall photo-ID surveys that last 5-7 days in PWS and is the only dedicated resource for humpback data in PWS that we are aware of.. Other GWA surveys happening in PWS (i.e. aerial surveys for herring, vessel-based KW surveys or vessel-based herring surveys) record opportunistic humpback whale sightings and notify GWAs humpback project Principal Investigators. Opportunistic activity by researchers in PWS in the summer exists, but all humpback data are opportunistic between May and September and October through December. Lack of dedicated surveys outside of these time periods suggest a lack of additional data that might be useful in better understanding when whales show up and how the population changes throughout the feeding season, especially between May and September.
- No acoustic data or tagging has been done with GulfWatch.
- Biopsies are collected for genetics; no analysis done for population dynamics in over 10 years (since Witteveen et al. 2011).

Spatiotemporal variability: d

Supporting notes for spatiotemporal variability: Humpbacks come to the larger PWS area consistently to feed on herring in the spring and fall. The location of herring schools and feeding hotspots within the sound can vary from year to year, but for the past 5 years or so has remained consistent (Straley & Moran pers comm 20Jun2021).

Boundary certainty: 2

Supporting notes for boundary certainty: - We are reasonably certain the boundaries of this F-BIA encompass the main feeding area in which humpback whales feed around Prince William Sound. Annual spring and fall surveys dedicated to humpback whale research cover much of the sound, and opportunistic sightings from other surveys throughout the sound are shared with project leaders.
- These boundaries are consistent with older data used in BIA Round 1 and none of the new sighting data suggests there is much difference in boundaries of this BIA, other than some small adjustments along the edges of the boundaries.

Months of year designation is applicable: March, April, May, September, October, November, December

Tagging data supporting designation (Y/N): N

# of tags: 0

# of years in which supporting tagging data collected: NA

Supporting information: No satellite tags have been placed on humpback whales in this BIA over the past 10 years that we know of.

Visual observations/records supporting designation (Y/N): Y

# of observations/records: 72

# of years in which supporting visual data collected: 2015-2021

Supporting information: Happywhale.com
These sightings are consistent with thousands of sightings prior to 2015.

Acoustic detections/records supporting designation (Y/N): N

# of observations/records: 0

# of years in which supporting acoustic data collected: NA

Supporting information: No acoustic work has been done with PWS humpback whales in the past 10 years that we know of.

Photo-ID evidence supporting designation (Y/N): Y

# of individuals photographed: 359 individuals from 1690 photos

# of years of photo records to compare: 2007-2021

Maximum # of years same individual photographed in area: Unk

Supporting information: Photographs from PWS humpback whale database through GulfWatch Alaska project, shared by Straley & Moran in July 2021.

Genetic analyses conducted supporting designation (Y/N): Y

Supporting information: 120 tissue samples exist from the GulfWatch Alaska project from 2007-2021. Additionally, 111 samples were analyzed prior to 2007 through the SPLASH project by Witteveen et al. 2011.

What factors justify the boundary selection?: The boundary was drawn around the area where sightings have occurred. The boundaries are nearly identical to those of BIA Round 1, though we have extended around the northern region of PWS to include additional sightings and support feedback from researchers that work in the area.

Data sources: GWA humpback whale database sightings used to draw polygon boundaries, accessed 27 July 2021

Approximate % of population that uses this area for the designated purpose (if known): Unk

Approximate # of areas known specifically for this behavior (if feeding/cow-calf/mating/migratory) for this population: >10

References: Moran, J.R., Heintz, R.A., Straley, J.M., and Vollenweider, J.J. (2018). Regional variation in the intensity of humpback whale predation on Pacific herring in the Gulf of Alaska. Deep-Sea Research Part II. 147: 187-195.

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Straley, J.M., Moran, J.R., Boswell, K.M., Vollenweider, J.J., Heintz, R.A., Quinn II, T.J., Witteveen, B.H., and Rice, S.D. (2018). Seasonal presence and potential influence of humpback whales on wintering Pacific herring populations in the Gulf of Alaska. Deep-Sea Research Part II. 147: 173-186.

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Wade, P.R., Quinn II, T.J., Barlow, J, Baker, C.S., Burdin, A.M., Calambokidis, J., Clapham, P.J., Falcone, E., Ford, J.K.B., Gabriele, C.M., Leduc, R., Mattila, D.K., Rojas-Bracho, L., Straley, J., Taylor, B.L., Urbán R., J., Weller, D., Witteveen, B.H., Yamaguchi, M. 2016. Estimates of abundance and migratory destination for North Pacific humpback whales in both summer feeding areas and winter mating and calving areas. Paper SC/66b/IA21 submitted to the Scientific Committee of the International Whaling Commission, June 2016, Bled, Slovenia.

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Supplementary Description 4. 15. Humpback whale feeding area

Species name: Humpback whale (*Megaptera novaeangliae*)

Stock or population: North Pacific

Descriptive name: Seymour Canal

BIA type: Feeding Area

BIA label: F-BIA2-e-b2-GOA019-0

Transboundary across: None

Hierarchy: Non-hierarchical; single BIA

Importance score: 2 (Intensity: 2, Data support: 3)

Supporting notes for intensity score: -This area appears to be a consistent and important feeding area for humpback whales in the region (SEAK) in the summer and fall months.
- There are no known limits on availability of prey in this BIA other than environmental variability.
- Humpbacks are feeding primarily on mixed euphausiids and overwintering herring are likely also prey (Straley pers comm, Nov 2021).
- Lack of year-round surveys means it is unknown if humpbacks use this BIA in winter and spring and if so, how much use it gets. Historically Straley and Moran did surveys in January (e.g. in 2011) and found whales in this area, but not in large numbers. Since then, so much has changed environmentally it would be difficult to suggest the area is used heavily in the winter/spring without more recent data. Humpback whale numbers in SEAK overall declined from 2014-2016, associated with the marine heatwave in the GOA.
-There are no dedicated year-round surveys of the area, but local biologists with the Alaska Whale Foundation (led by Andy Szabo), have been doing summer surveys and dedicated research projects in this area, and local tour operators and members of the public contribute photos and sightings to the Happywhale database.
- Humpback whales make seasonal migrations from breeding grounds to SEAK to feed.
- Abundance is unknown in this BIA during this time period, and this is an open population of whales coming and going throughout the summer and fall. Barlow et al. 2011 estimated the entire North Pacific pop to be 21,000 (SPLASH). Within northern SEAK the latest population estimate was 1,585 in 2008 using photo ID data from 1994-2008 (Hendrix et al 2012).
- There are many other feeding BIAs in the GOA and SEAK area as a whole.
- This F-BIA is composed of individual humpbacks from both the Hawaii and Mexico DPS's (i.e. breeding populations). Wade et al. (2016) suggests only 6% of SEAK whales go to the Mexico DPS, while the remaining 94% of SEAK whales migrate to the Hawaii DPS using SPLASH data from 2004-2006. Unpublished photo-ID data aggregated in Happywhale shows 11.8% of SEAK individuals with known breeding ground sightings occurring in Mexican waters (Cheeseman, pers comm). The overall abundance for the Hawaii DPS is estimated at 11,398 and Mexico DPS was 3,264 and is also based on SPLASH data (2004-2006) (Wade et al. 2016).
- Straley notes that in 1980 there were a bunch of herring that whales were feeding on, but no real indication if they still are or not.
- ADF&G management documents say in 2018 about 600 herring were sampled in a survey so there are still herring there, but not large quantities.
- Bruce Mate & colleagues with Oregon State University tagged 37 humpback whales in Seymour Canal in November of 2014 and 2015 (Palacios et al. 2019), with whales leaving the area primarily in November and December, supporting the time period of this BIA.

Supporting notes for data support score: - Happywhale database data from 2008-2021, including submissions from:
-Alaska Whale Foundation researcher Andy Szabo
-University of Alaska Southeast researcher Jan Straley
-NOAA fisheries researcher John Moran
-Reports from whale watching operators and personal observations submitted to Happywhale as citizen science data NOTE: Happywhale and the data it contains is created and managed by Ted Cheeseman.

-Data consists of over 22,000 sightings in all of Southeast Alaska (SEAK), reduced to just under 13,000 sightings when limited to one individual per month per year. We were not able to divide Happywhale entries into different BIAs within SEAK at this time.

- Bruce Mate / OSU tagging group out of Seymour Canal in November 2014 & 2015 (Palacios et al. 2019):
-Photos (233 indiv identified) in Seymour/F.Sound/Petersburg
-Satellite tags placed in 2014 & 2015 (n=37)
-Biopsy samples collected in 2014 (n=12) & 2015 (n=15)

- No acoustic data has been included in this BIA support
- Data could benefit from year-round surveys to pinpoint time periods whales use this area most heavily, but enough long-term knowledge, fairly recent tagging, and recent summer surveys exist to give this a data support score of 3.

Spatiotemporal variability: e

Supporting notes for spatiotemporal variability: Humpbacks come this area to feed primarily on zooplankton and some overwintering herring (Straley pers comm Nov2021); in this region the prey are associated with persistent but mobile features of the ecosystem, such as currents and eddies and whales are found feeding in numerous locations within the BIA at any given

time. These hotspots turn off and on reflecting mobile prey and are based primarily on environmental drivers.

Boundary certainty: 2

Supporting notes for boundary certainty: - We are confident that the boundaries of this F-BIA encompass the main boundaries within which humpback whales feed during this time period in this area. Boundary information on the northern end of the BIA at Tiedeman Island was primarily gained from Happywhale sighting data, as well as expert elicitation from Straley (pers comm, November 2021). This BIA is a canal, and the entrance to the canal likely separates whale behavior, use of space, and timing of space use primarily due to prey movement. Dr. Andy Szabo notes that krill are likely advected up into Seymour canal from Frederick Sound during the summer and fall months (pers comm 10 Nov 2021).

Months of year designation is applicable: June, July, August, September, October, November, December

Tagging data supporting designation (Y/N): Y

# of tags: 37

# of years in which supporting tagging data collected: 2014-2015

Supporting information: Bruce Mate with OSU tagged 37 whales in November of 2014 & 2015; one whale tagged twice, so 36 individuals. Photo ID and biopsy also accompanied these efforts. (Palacios et al. 2019)

Visual observations/records supporting designation (Y/N): Y

# of observations/records: numerous

# of years in which supporting visual data collected: 2019

Supporting information: NOAA Harbor Porpoise survey, 2019, sighting data (unpublished data provided by Kim Goetz, NOAA Fisheries, on 29 November 2021).

Acoustic detections/records supporting designation (Y/N): N

# of observations/records: 0

Supporting information: No acoustic data were analyzed to inform prey, timing, spatiotemporal variability, or boundaries of this BIA

Photo-ID evidence supporting designation (Y/N): Y

# of individuals photographed: > 22,000 sighting records (Happywhale database + Palacios 2019)

# of years of photo records to compare: 2008-2021

Maximum # of years same individual photographed in area: UNK

Supporting information: Happywhale database used, containing over 22,000 sightings in all of SEAK, reduced to just under 13,000 sightings when limited to one individual per month per year. Database managed by Ted Cheeseman, photos submitted by citizen scientists, and contributing scientists Gabriele, Neilson, Straley, Pearson, Moran, and Szabo research groups with permission from researchers. Palacios et al. 2019 detailed 233 humpbacks photo-ID'd in the Seymour/F.Sound/Petersburg area. Within SEAK as a whole, a minimum of 54 individuals have a 30 year or greater sighting history (Gabriele et al. 2017). Data for individual BIAs within SEAK is not available.

Genetic analyses conducted supporting designation (Y/N): Y

Supporting information: Tissue sample data was not used for support for these BIAs for SEAK; however, tissue data does exist since BIA Round 1 (Palacios et al. 2019 as well as Straley database) and may be used in the future to support stock structure, foraging ecology, and other population dynamics of this population.

What factors justify the boundary selection?: Boundary drawn around area where sightings are most prevalent, as determined by Happywhale data, as well as expert elicitation from Straley (pers comm November 2021).

Data sources: - Happywhale database, created and managed by Ted Cheeseman, contributed to by research groups: Gabriele, Neilson, Straley, Pearson, Moran, and Szabo research groups with permission from researchers. Additional contributions from members of the public. Accessed 21 August 2021.

- NOAA Harbor Porpoise survey, 2019, unpublished data used with permission from Kim Goetz (29 November 2021)

Approximate % of population that uses this area for the designated purpose (if known): UNK

Approximate # of areas known specifically for this behavior (if feeding/cow-calf/mating/migratory) for this population: >16

References: Barlow, J., J. Calambokidis, E. A. Falcone, C. S. Baker, A. M. Burdin, P. J. Clapham, J. K. B. Ford, C. M. Gabriele, R. LeDuc, D. K. Mattila, T. J. Quinn, L. Rojas-Bracho, J. M. Straley, B. L. Taylor, J. Urbán R., P. Wade, D. Weller, B. H. Witteveen, and M. Yamaguchi. (2011). Humpback whale abundance in the North Pacific estimated by photographic capture-recapture with bias correction from simulation studies. Mar. Mamm. Sci. 27:793-818.

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Supplementary Description 4. 16. Humpback whale feeding area

Species name: Humpback whale (*Megaptera novaeangliae*)

Stock or population: North Pacific

Descriptive name: Sitka Sound - Fall/Winter

BIA type: Feeding Area

BIA label: F-BIA2-e-b2-GOA022-0

Transboundary across: None

Hierarchy: Non-hierarchical; single BIA

Importance score: 2 (Intensity: 2, Data support: 2)

Supporting notes for intensity score: - This is a fall/winter feeding area on mixed euphausiids and overwintering herring that appears to be a consistent and important feeding area for humpback whales in this region (SEAK) during those winter months.
- Humpback whales make seasonal migrations from breeding grounds to SEAK to feed.
- Humpback whale numbers declined from 2014-2016, associated with the marine heatwave in the GOA; during this time, Sitka Sound saw increased numbers of humpback whales during winter months feeding on overwintering herring (Straley, pers comm, June 2021).
- There are no dedicated year-round surveys of the area, but local biologists with the University of Alaska Southeast (Jan Straley and her team) do opportunistic surveys and dedicated research projects in this area, and local tour operators and members of the public contribute photos and sightings to the Happywhale database.
- Abundance is unknown in this BIA during this time period.
- Barlow et al. 2011 estimated the entire North Pacific pop=21,000 (SPLASH). Within northern SEAK the latest population estimate was 1585 in 2008 using photo ID data from 1994-2008 (Hendrix et al 2012).
- There are no known limits on availability of prey in this BIA other than environmental variability.
- There are many other feeding BIAs in the GOA and SEAK area as a whole.
- This F-BIA is composed of individual humpbacks from both the Hawaii and Mexico DPS's (i.e. breeding populations). Wade et al. (2016) suggests only 6% of SEAK whales go to the Mexico DPS, while the remaining 94% of SEAK whales migrate to the Hawaii DPS using SPLASH data from 2004-2006. Unpublished photo-ID data aggregated in Happywhale shows 11.8% of SEAK individuals with known breeding ground sightings occurred in Mexican waters (Cheeseman, pers comm). The overall abundance for the Hawaii DPS is estimated at 11,398 and Mexico DPS was 3,264 and is also based on SPLASH data (2004-2006) (Wade et al. 2016).

Supporting notes for data support score: Data support score is a 2 because there is long-term knowledge from local scientists and members of the public on the consistent occurrence of humpback whales feeding in Sitka Sound during this time period, and some photo ID work, but not much consistent work or sighting data from researchers in recent years.
Happywhale database data from 2008-2021, including submissions from: -University of Alaska Southeast researcher Jan Straley
-Reports from whale-watching operators and personal observations submitted to Happywhale as citizen science data NOTE: Happywhale is created and managed by Ted Cheeseman; the data are collected by and shared by researchers in the region as well as citizen scientists and members of the public.
Data consists of over 22,000 sightings in all of Southeast Alaska (SEAK), reduced to just under 13,000 sightings when limited to one individual per month per year. We were not able to divide Happywhale entries into different BIAs within SEAK at this time.

- No acoustic data, tissue studies, or tagging has been included in this BIA delineation.

Spatiotemporal variability: e

Supporting notes for spatiotemporal variability: This F-BIA is characterized by fixed features including deep trenches that have suitable refuge for schools of overwintering herring, as well as dynamic environmental features such as currents and eddies that impact zooplankton prey. Herring and krill aggregate in numerous places within the BIA at the same time and whales are found feeding in numerous locations within the BIA at any given time on these prey sources. These hotspots turn off and on reflecting mobile prey and are based primarily on bathymetry and environmental drivers.

Boundary certainty: 2

Supporting notes for boundary certainty: We are reasonably certain the boundaries of this F-BIA encompass the main boundaries within which humpback whales feed during this time period. The boundary information was primarily gained from Happywhale sighting data and Straley database, which is limited in recent years, as well as expert elicitation from Straley (pers comm, November 2021).

Months of year designation is applicable: September, October, November, December

Tagging data supporting designation (Y/N): N

# of tags: 0

# of years in which supporting tagging data collected: NA

Supporting information: No satellite tags were analyzed to inform prey, timing, spatiotemporal variability, or boundaries of this

BIA.

Visual observations/records supporting designation (Y/N): Y

# of observations/records: 0

# of years in which supporting visual data collected: NA

Supporting information: Thousands of observations exist from members of the public and local tour operators, but for this BIA designation we only used photo IDs entered into Happywhale from citizen scientists as well as researchers.

Acoustic detections/records supporting designation (Y/N): N

# of observations/records: 0

# of years in which supporting acoustic data collected: NA

Supporting information: No acoustic data were analyzed to inform prey, timing, spatiotemporal variability, or boundaries of this BIA

Photo-ID evidence supporting designation (Y/N): Y

# of individuals photographed: > 22,000 sighting records (Happywhale & Straley database)

# of years of photo records to compare: 2008-2021

Maximum # of years same individual photographed in area: UNK

Supporting information: Happywhale database used, containing over 22,000 sightings in all of SEAK, reduced to just under 13,000 sightings when limited to one individual per month per year. Database managed by Ted Cheeseman, photos submitted by citizen scientists, and contributing scientists Gabriele, Neilson, Straley, Pearson, Moran, and Szabo research groups with permission from researchers. Within SEAK as a whole, a minimum of 54 individuals have a 30-year or greater sighting history (Gabriele et al. 2017). Data for individual BIAs within SEAK is not available.

Genetic analyses conducted supporting designation (Y/N): Y

Supporting information: Tissue sample data was not used for support for these BIAs for SEAK; however, tissue data does exist and may be used in the future to support stock structure, foraging ecology, and other population dynamics of this population.

What factors justify the boundary selection?: Boundary drawn around area where sightings are most prevalent, as determined by Happywhale data & Straley database, as well as expert elicitation from Straley (pers comm November 2021).

Data sources: -Happywhale database, created and managed by Ted Cheeseman, contributed to by research groups: Gabriele, Neilson, Straley, Pearson, Moran, and Szabo research groups with permission from researchers. Additional contributions from members of the public. Accessed 21 August 2021.

-Straley database. Accessed 12 September 2021

Approximate % of population that uses this area for the designated purpose (if known): UNK

Approximate # of areas known specifically for this behavior (if feeding/cow-calf/mating/migratory) for this population: >16

References: Barlow, J., J. Calambokidis, E. A. Falcone, C. S. Baker, A. M. Burdin, P. J. Clapham, J. K. B. Ford, C. M. Gabriele, R. LeDuc, D. K. Mattila, T. J. Quinn, L. Rojas-Bracho, J. M. Straley, B. L. Taylor, J. Urbán R., P. Wade, D. Weller, B. H. Witteveen, and M. Yamaguchi. (2011). Humpback whale abundance in the North Pacific estimated by photographic capture-recapture with bias correction from simulation studies. Mar. Mamm. Sci. 27:793-818.

Cheeseman, T., T. Johnson, K. Southerland, and N. Muldavin. 2017. Happywhale: Globalizing marine mammal photo identification via a citizen science web platform. Paper SC/67A/PH/02 submitted to the Scientific Committee of the International Whaling Commission, May 2017, Bled, Slovenia.

Cheeseman, T., Southerland, K., Park, J., Olio, M., Flynn, K., Calambokidis, J., Jones, L., Garrigue, C., Jordán, A.F., Howard, A., Reade, W., Neilson, J., Gabriele, C., Clapham, P. (2021). Advanced image recognition: a fully automated, high-accuracy photo-identification matching system for humpback whales. Mamm. Biol. 2021 pp 15. doi: 10.1007/S42991-021-00180-9

Hendrix, A.N., Straley, J., Gabriele, C., and Gende, S.M. (2012). Bayesian estimation of humpback whale (Megaptera novaeangliae) population abundance and movement patterns in southeastern Alaska. Can. J. Fish. Aquat. Sci. 69: 1783-1797.

Straley JM, Moran JR, Boswell KM, Vollenweider JJ, Heintz RA, Quinn II TJ, Witteveen BH, Rice SD. Seasonal presence and potential influence of humpback whales on wintering Pacific herring populations in the Gulf of Alaska. Deep Sea Research Part II: Topical Studies in Oceanography. 2018 Jan 1;147:173-86.

Wade, P.R., Quinn II, T.J., Barlow, J, Baker, C.S., Burdin, A.M., Calambokidis, J., Clapham, P.J., Falcone, E., Ford, J.K.B., Gabriele, C.M., Leduc, R., Mattila, D.K., Rojas-Bracho, L., Straley, J., Taylor, B.L., Urbán R., J., Weller, D., Witteveen, B.H., Yamaguchi, M. 2016. Estimates of abundance and migratory destination for North Pacific humpback whales in both summer feeding areas and winter mating and calving areas. Paper SC/66b/IA21 submitted to the Scientific Committee of the International Whaling Commission, June 2016, Bled, Slovenia.

Supplementary Description 4. 17. Humpback whale feeding area

Species name: Humpback whale (*Megaptera novaeangliae*)

Stock or population: North Pacific

Descriptive name: Southern Chatham Strait

BIA type: Feeding Area

BIA label: F-BIA2-e-b1-GOA024-0

Transboundary across: None

Hierarchy: Non-hierarchical; single BIA

Importance score: 2 (Intensity: 2, Data support: 2)

Supporting notes for intensity score: This is primarily a summer feeding area on mixed prey consisting primarily of euphausiids and herring depending on the location and timing. It appears to be a consistent and important feeding area for humpback whales.
- Moran notes that Chatham Strait is characterized by a deep trench, and very different environmentally and with currents than some of the other straits and passages in SEAK (pers comm Nov 2021).
- Szabo notes that S. Chatham and N. Chatham are very different and the change is right around Pt. Gardner. S. Chatham is an area that is predictable and consistent in terms of humpback presence every year; 200 whales from late May to early July every year in Tebenkof feeding on herring; those whales likely then move to other areas in SEAK to follow herring or perhaps switch to krill. Some may stay in the same area and not leave.
- S. Chatham is influenced oceanographically by the Gulf of Alaska much more than N. Chatham (Szabo pers comm, 2 Jan 2022); researchers encounter pelagic birds and marine mammals in this BIA (Szabo pers comm, 2 Jan 2022). Whales frequent S. Chatham in late spring and early summer and then move to Frederick Sound area or up into Northern Chatham and other areas of SEAK (Szabo, 2 Jan 2022). This area peaks for whale presence in June and July. - Straley notes that in August & September there's an outflux of those whales through S. Chatham (Straley pers comm Nov 2021).

- Humpback whales make seasonal migrations from breeding grounds to SEAK to feed.
- Humpback whale numbers declined from 2014-2016, associated with the marine heatwave in the GOA. There are no dedicated year-round surveys of the area, but local biologists with the Alaska Whale Foundation (Andy Szabo and his team) do dedicated surveys and dedicated research projects in this area in the summer, and local tour operators and members of the public contribute photos and sightings to the Happywhale database.
- Abundance is unknown in this BIA during this time period and whales move in and out throughout the time period. - There are no known limits on availability of prey in this BIA other than environmental variability.
- There are many other feeding BIAs in the GOA and SEAK area as a whole.
- Barlow et al. 2011 estimated the entire North Pacific population at21,000 (SPLASH). Within northern SEAK the latest population estimate was 1,585 in 2008 using photo ID data from 1994-2008 (Hendrix et al 2012).
- This F-BIA is composed of individual humpbacks from both the Hawaii and Mexico DPS's (i.e. breeding populations). Wade et al. (2016) suggests only 6% of SEAK whales go to the Mexico DPS, while the remaining 94% of SEAK whales migrate to the Hawaii DPS using SPLASH data from 2004-2006. Unpublished photo-ID data aggregated in Happywhale shows 11.8% of SEAK individuals with known breeding ground sightings occurred in Mexican waters (Cheeseman, pers comm). The overall abundance for the Hawaii DPS is estimated at 11,398 and Mexico DPS was 3,264 and is also based on SPLASH data (2004-2006) (Wade et al. 2016).

Supporting notes for data support score: - Happywhale database data from 2008-2021, including submissions from:
-Alaska Whale Foundation researcher Andy Szabo
-University of Alaska Southeast researcher Jan Straley
-Reports from whalewatching operators and personal observations submitted to Happywhale as citizen science data
NOTE: Happywhale is created and managed by Ted Cheeseman; the data are collected by and shared by researchers in the region as well as citizen scientists and members of the public.
Data consists of over 22,000 sightings in all of Southeast Alaska (SEAK), reduced to just under 13,000 sightings when limited to one per individual per month per year. We were not able to divide Happywhale entries into different BIAs within SEAK at this time.

- No acoustic data, tissue studies, or tagging data has been included in this BIA delineation.
- While similar data are collected in Northern Chatham and Frederick Sound BIAs, there is less data support for this region, which results in a slightly lower data support score than nearby BIAs.

Spatiotemporal variability: e

Supporting notes for spatiotemporal variability: Humpbacks come this area to feed primarily on zooplankton & herring (Szabo pers comm 10 Nov 2021); in this region the prey are associated with persistent but mobile features of the ecosystem, such as currents and eddies and whales are found feeding in numerous locations within the BIA at any given time. These hotspots turn off and on reflecting mobile prey and are based primarily on environmental drivers.

Boundary certainty: 1

Supporting notes for boundary certainty: - We have some certainty in the boundaries of this F-BIA and how they should be designated in this region, but there is some uncertainty, specifically at the northern and southern bounds of this BIA, and how they fit or are separated from neighboring BIAs.

- Boundary information primarily gained from Happywhale sighting data, as well as expert elicitation from Szabo, Straley, and Moran (pers comm, November 2021).

Months of year designation is applicable: May (2nd half), June, July, August, September (1st half)

Tagging data supporting designation (Y/N): N

# of tags: 0

# of years in which supporting tagging data collected: NA

Supporting information: No satellite tags were analyzed to inform prey, timing, spatiotemporal variability, or boundaries of this BIA. However, some of the 37 satellite tags deployed in Seymour Canal in November of 2014 & 2015 did move through this BIA for an undetermined amount of time either foraging or transiting out of Southeast Alaska to begin southbound migrations (Palacios et al. 2019).

Visual observations/records supporting designation (Y/N): Y

# of observations/records: Numerous

# of years in which supporting visual data collected: 2019

Supporting information: NOAA Harbor Porpoise survey, 2019, sighting data (unpublished data provided by Kim Goetz, NOAA Fisheries, on 29 November 2021).

Acoustic detections/records supporting designation (Y/N): N

# of observations/records: 0

# of years in which supporting acoustic data collected: NA

Supporting information: No acoustic data were analyzed to inform prey, timing, spatiotemporal variability, or boundaries of this BIA

Photo-ID evidence supporting designation (Y/N): Y

# of individuals photographed: > 22,000 sighting records (Happywhale database)

# of years of photo records to compare: 2008-2021

Maximum # of years same individual photographed in area: UNK

Supporting information: Happywhale database used, containing over 22,000 sightings in all of SEAK, reduced to just under 13,000 sightings when limited to one per individual per month per year. Database managed by Ted Cheeseman, photos submited by citizen scientists, and contributing scientists Gabriele, Neilson, Straley, Pearson, Moran, and Szabo research groups with permission from researchers. Within SEAK as a whole, a minimum of 54 individuals have a 30-year or greater sighting history (Gabriele et al. 2017). Data for individual BIAs within SEAK is not available.

Genetic analyses conducted supporting designation (Y/N): Y

Supporting information: Tissue sample data was not used for support for these BIAs for SEAK; however, tissue data does exist and may be used in the future to support stock structure, foraging ecology, and other population dynamics of this population.

What factors justify the boundary selection?: Boundary drawn around area where sightings are most prevalent, as determined by Happywhale data, as well as expert elicitation from Szabo, Straley, and Moran (pers comm November 2021). Northern and southern bounds made at major confluences.

Data sources: Happywhale database, created and managed by Ted Cheeseman, contributed to by research groups: Gabriele, Neilson, Straley, Pearson, Moran, and Szabo research groups with permission from researchers. Additional contributions from citizen scientists. Accessed 21 August 2021.

NOAA Harbor Porpoise survey, 2019, unpublished data used with permission from Kim Goetz (29 November 2021)

Approximate % of population that uses this area for the designated purpose (if known): UNK

Approximate # of areas known specifically for this behavior (if feeding/cow-calf/mating/migratory) for this population: >16

References: Barlow, J., J. Calambokidis, E. A. Falcone, C. S. Baker, A. M. Burdin, P. J. Clapham, J. K. B. Ford, C. M. Gabriele, R. LeDuc, D. K. Mattila, T. J. Quinn, L. Rojas-Bracho, J. M. Straley, B. L. Taylor, J. Urbán R., P. Wade, D. Weller, B. H. Witteveen, and M. Yamaguchi. (2011). Humpback whale abundance in the North Pacific estimated by photographic capture-recapture with bias correction from simulation studies. Mar. Mamm. Sci. 27:793-818.

Cheeseman, T., T. Johnson, K. Southerland, and N. Muldavin. 2017. Happywhale: Globalizing marine mammal photo identification via a citizen science web platform. Paper SC/67A/PH/02 submitted to the Scientific Committee of the International Whaling Commission, May 2017, Bled, Slovenia.

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Supplementary Description 4. 18. Humpback whale feeding area

Species name: Humpback whale (*Megaptera novaeangliae*)

Stock or population: North Pacific

Descriptive name: Southern Lynn Canal & Northern Chatham Strait

BIA type: Feeding Area

BIA label: F-BIA2-e-b2-GOA023-0

Transboundary across: None

Hierarchy: Non-hierarchical; single BIA

Importance score: 2 (Intensity: 2, Data support: 3)

Supporting notes for intensity score: - This is primarily a summer feeding area on mixed prey consisting primarily of euphausiids & herring depending on the location and timing. In parts of the BIA humpback whales feed on juvenile salmon at hatchery release sites along N. Chatham Strait.
- N. Chatham & S. Lynn Canal – distinct oceanographically; whales encountered there tend not to be out in the deep waters throughout the summer feeding and diving deep.
- Moran notes that all of Chatham & S. Lynn Canal is characterized by a deep trench, and very different environmentally and with currents than some of the other straits, and passages (pers comm Nov 2021).
- N. Chatham tends to be over-represented in data collected by members of the public because of bubble netters (Straley pers comm Nov 2021);
- Whales in N. Chatham don't seem to be resident there; whales don't seem to stick around there for the most part. Andy Szabo and Jan Straley and John Moran say it's a river of whales traveling through N Chatham.
- Szabo notes krill are primary prey in N. Chatham and are pretty predictable and consistent from Jun-Sep; this region is all part of one continuous system that moves into Fredrick sound and Stephens Pass and Seymour Canal.
- It appears to be a consistent and important feeding area for humpback whales.
- Humpback whales make seasonal migrations from breeding grounds to SEAK to feed.
- Humpback whale numbers declined from 2014-2016, associated with the marine heatwave in the GOA.
- There are no dedicated year-round surveys of the area, but local biologists with the Alaska Whale Foundation (Andy Szabo and his team) do opportunistic surveys and dedicated research projects in this area, and local tour operators and members of the public contribute photos and sightings to the Happywhale database.
- Abundance is unknown in this BIA during this time period and whales move in and out throughout the time period.
- Barlow et al. 2011 estimated the entire North Pacific pop=21,000 (SPLASH). Within northern SEAK the latest population estimate was 1585 in 2008 using photo ID data from 1994-2008 (Hendrix et al 2012).
- There are no known limits on availability of prey in this BIA other than environmental variability.
- There are many other feeding BIAs in the GOA and SEAK area as a whole.
- This F-BIA is comprised of individual humpbacks from both the Hawaii and Mexico DPS's (i.e. breeding populations). Wade et al. (2016) suggests only 6% of SEAK whales go to the Mexico DPS, while the remaining 94% of SEAK whales migrate to the Hawaii DPS using SPLASH data from 2004-2006. Upublished photo-ID data aggregated in Happywhale shows 11.8% of SEAK individuals with known breeding ground sightings occurred in Mexican waters (Cheeseman, pers comm). The overall abundance for the Hawaii DPS is estimated 11,398 and Mexico DPS was 3,264 and is also based on SPLASH data (2004-2006) (Wade et al. 2016).

Supporting notes for data support score: - Happywhale database data from 2008-2021, including submissions from:
-Alaska Whale Foundation researcher Andy Szabo
-University of Alaska Southeast researcher Jan Straley
-Reports from whalewatching operators and personal observations submitted to Happywhale as citizen science data
NOTE: Happywhale is created and managed by Ted Cheeseman; the data are collected by and shared by researchers in the region as well as citizen scientists and members of the public.
Data consists of over 22,000 sightings in all of Southeast Alaska (SEAK), reduced to just under 13,000 sightings when limited to one individual per month per year. We were not able to divide Happywhale entries into different BIAs within SEAK at this time.

- No acoustic data, tissue studies, or tagging data has been included in this BIA delineation.
- Data support could include more dedicated surveys year-round, as well as perhaps some published tagging work to help solidify boundaries and detail feeding behavior, but there is consistent work done in this area to suggest the time period and prey. Tagging work has been done by AWF group, and future publication and analysis of this data will potentially help strengthen the support and understanding of boundaries for this BIA.

Spatiotemporal variability: e

Supporting notes for spatiotemporal variability: Humpbacks come this area to feed primarily on zooplankton and herring (Szabo pers comm 10 Nov 2021); in this region the prey are associated with persistent but mobile features of the ecosystem, such as currents and eddies and whales are found feeding in numerous locations within the BIA at any given time. These hotspots turn off and on reflecting mobile prey and are based primarily on environmental drivers.

Boundary certainty: 2

Supporting notes for boundary certainty: - We are fairly certain in the boundaries of this F-BIA and how they should be designated in this region.

- Boundary information primarily gained from Happywhale sighting data, as well as expert elicitation from Szabo, Straley, and Moran (pers comm, November 2021).

Months of year designation is applicable: June, July, August, September

Tagging data supporting designation (Y/N): N

# of tags: 0

# of years in which supporting tagging data collected: NA

Supporting information: No satellite tags were analyzed to inform prey, timing, spatiotemporal variability, or boundaries of this BIA

Visual observations/records supporting designation (Y/N): Y

# of observations/records: Numerous

# of years in which supporting visual data collected: 2019

Supporting information: NOAA Harbor Porpoise survey, 2019, sighting data (unpublished data provided by Kim Goetz, NOAA Fisheries, on 29 November 2021).

Acoustic detections/records supporting designation (Y/N): N

# of observations/records: 0

# of years in which supporting acoustic data collected: NA

Supporting information: No acoustic data were analyzed to inform prey, timing, spatiotemporal variability, or boundaries of this BIA

Photo-ID evidence supporting designation (Y/N): Y

# of individuals photographed: > 22,000 sighting records (Happywhale database)

# of years of photo records to compare: 2008-2021

Maximum # of years same individual photographed in area: UNK

Supporting information: Happywhale database used, containing over 22,000 sightings in all of SEAK, reduced to just under 13,000 sightings when limited to one individual per month per year. Database managed by Ted Cheeseman, photos submited by citizen scientists, and contributing scientists Gabriele, Neilson, Straley, Pearson, Moran, and Szabo research groups with permission from researchers. Within SEAK as a whole, a minimum of 54 individuals have a 30 year or greater sighting history (Gabriele et al. 2017). Data for individual BIAs within SEAK is not available.

Genetic analyses conducted supporting designation (Y/N): Y

Supporting information: Tissue sample data was not used for support for these BIAs for SEAK; however, tissue data does exist and may be used in the future to support stock structure, foraging ecology, and other population dynamics of this population

What factors justify the boundary selection?: Boundary drawn around area where sightings are most prevalent, as determined by Happywhale data, as well as expert elicitation from Szabo, Straley, and Moran (pers comm November 2021). Boundaries were defined by bathymetry of this area, characterized by a deep trench and major water flow, which influences environmental conditions and prey available to whales.

Data sources: Happywhale database, created and managed by Ted Cheeseman, contributed to by research groups: Gabriele, Neilson, Straley, Pearson, Moran, and Szabo research groups with permission from researchers. Additional contributions from citizen scientists. Accessed 21 August 2021.

NOAA Harbor Porpoise survey, 2019, unpublished data used with permission from Kim Goetz (29 November 2021)

Approximate % of population that uses this area for the designated purpose (if known): UNK

Approximate # of areas known specifically for this behavior (if feeding/cow-calf/mating/migratory) for this population: >16

References: Barlow, J., J. Calambokidis, E. A. Falcone, C. S. Baker, A. M. Burdin, P. J. Clapham, J. K. B. Ford, C. M. Gabriele, R. LeDuc, D. K. Mattila, T. J. Quinn, L. Rojas-Bracho, J. M. Straley, B. L. Taylor, J. Urbán R., P. Wade, D. Weller, B. H. Witteveen, and M. Yamaguchi. (2011). Humpback whale abundance in the North Pacific estimated by photographic capture-recapture with bias correction from simulation studies. Mar. Mamm. Sci. 27:793-818.

Cheeseman, T., T. Johnson, K. Southerland, and N. Muldavin. 2017. Happywhale: Globalizing marine mammal photo identification via a citizen science web platform. Paper SC/67A/PH/02 submitted to the Scientific Committee of the International Whaling Commission, May 2017, Bled, Slovenia.

Cheeseman, T., Southerland, K., Park, J., Olio, M., Flynn, K., Calambokidis, J., Jones, L., Garrigue, C., Jordán, A.F., Howard, A., Reade, W., Neilson, J., Gabriele, C., Clapham, P. (2021). Advanced image recognition: a fully automated, high-accuracy photo-identification matching system for humpback whales. Mamm. Biol. 2021 pp 15. doi: 10.1007/S42991-021-00180-9

Hendrix, A.N., Straley, J., Gabriele, C., and Gende, S.M. (2012). Bayesian estimation of humpback whale (Megaptera novaeangliae) population abundance and movement patterns in southeastern Alaska. Can. J. Fish. Aquat. Sci. 69: 1783-1797.

Straley JM, Moran JR, Boswell KM, Vollenweider JJ, Heintz RA, Quinn II TJ, Witteveen BH, Rice SD. Seasonal presence and potential influence of humpback whales on wintering Pacific herring populations in the Gulf of Alaska. Deep Sea Research Part II: Topical Studies in Oceanography. 2018 Jan 1;147:173-86.

Wade, P.R., Quinn II, T.J., Barlow, J, Baker, C.S., Burdin, A.M., Calambokidis, J., Clapham, P.J., Falcone, E., Ford, J.K.B., Gabriele, C.M., Leduc, R., Mattila, D.K., Rojas-Bracho, L., Straley, J., Taylor, B.L., Urbán R., J., Weller, D., Witteveen, B.H., Yamaguchi, M. 2016. Estimates of abundance and migratory destination for North Pacific humpback whales in both summer feeding areas and winter mating and calving areas. Paper SC/66b/IA21 submitted to the Scientific Committee of the International Whaling Commission, June 2016, Bled, Slovenia.

Supplementary Description 4. 19. Humpback whale feeding area

Species name: Humpback whale (*Megaptera novaeangliae*)

Stock or population: North Pacific

Descriptive name: Kodiak Island

BIA type: Feeding Area

BIA label: F-BIA1-d-b2-GOA013-0

Transboundary across: None

Hierarchy: Non-hierarchical; single BIA

Importance score: 1 (Intensity: 2, Data support: 1)

Supporting notes for intensity score: - Not a lot of effort exists in this specific area around Kodiak Island since 2015, but all existing data does suggest that this is still an important feeding area for humpback whales.
- Humpbacks make long-range seasonal migrations between breeding & feeding grounds;
- Witteveen et all. 2017: GAP surveys photo ID from 1999-2015 document 293 unique IDs in a single year ('07). Over 17 years of the study, 1187 unique ID individuals, across 2173 sightings. The most seen in a single year was 864. Total abundance during SPLASH, in the middle of this sighting period, was estimated to be about 21,000 in the entire North Pacific (Barlow et al. 2011). Thus this F-BIA may be used by about 5-6% of the overall population in the entire North Pacific. Of those that come to the GOA to feed, this would be a much higher proportion.
- Rone et al. 2015 survey (CLaWS) results had 444 individual sightings of humpback whales around Kodiak, as well as multiple acoustic detections.
- Masuoka et al. 2019: POWER Cruise noted that high-density areas of humpbacks were NE and SE Kodiak Island. Red fecal matter observed to indicate whales feeding on krill (mid July–mid Sep).
- Euphausiids and small schooling fish are the main prey in the area (Witteveen et al. 2012). There are no known limits on availability of food supply aside from climate change, warm water events (i.e. the "blob"), environmental drivers, etc.
- There are many other feeding BIAs in the GOA, some larger and some smaller than the Kodiak F-BIA.
- Humpback whales are divided into Distinct Population Segments (DPS) by NOAA (81 FR 62259, September 2016). The DPSs that feed off Kodiak are thought to be those that breed in Hawaii and those that breed in the Western North Pacific (NOAA 2016).

Supporting notes for data support score: - Aerial surveys flown as part of the UAF GAP project (1999—2015), which included an additional 2 years (2014 & 2015) from the data included in BIA Round 1 (Witteveen database, accessed July 2021). Surveys occurred between early May and late Sep depending on the year (1999-2015).
- All other data support came from surveys that weren't dedicated to humpbacks in the Kodiak area, but were surveying all cetacean species over the broader GOA, and so did not have tracklines that covered Kodiak area substantially.
- NOAA Collaborative Large Whale Survey (CLaWS) visual and acoustic survey spent some time around Kodiak and documented humpbacks sightings and acoustic detections; 6-27 August 2015 (Rone et al. 2015 & 2017).
- NOAA's Arctic Whale Ecology Study (ARCWEST) 2010-2016, Aug-Oct cetacean research cruises. Sightings & acoustic sonobuoy detections in Kodiak area available in July & Aug of 2013 (Vate Brattström et al. 2017).
- IWC POWER Cruise visual/acoustic line transect surveys 2019 documented sightings and acoustic detections (Matsuoka et al. 2020).
- NOAA's Distributed Biological Observatory research cruises, humpback sightings 2011-2019; sightings south of 60N are mostly Jun-Aug. (Distributed Biological Observatory 2011-2019)
- LeDuc et al. 2004 - A NMFS cruise and aerial survey from 2002 for North Pacific Right Whales in the Bering Sea and Gulf of Alaska (LeDuc et al. 2004).

Spatiotemporal variability: d

Supporting notes for spatiotemporal variability: This area appears to be a consistent feeding area overall for humpback whales, likely characterized by prey availability in the area. Within the larger Kodiak region, humpback distribution varies with respect to prey aggregations, which are affected by warm and cold years that impact eddies and fronts, and nutrient upwelling. Stabeno et al. 2004 & Kendall et al. 1980 note that the Kodiak Archipelago is one of the most productive regions in the GOA, which results in high biodiversity that supports multiple marine predator and prey species. Studies of humpback whale diet in this region have shown that whales are generalist consumers foraging primarily on euphausiids, walleye pollock, capelin, and pacific sandlance (Witteveen et al. 2012, 2016b).
It should be noted that authors of most data sources suggest May-Sep is peak feeding period for this region, which aligns with what we know about humpback migrations to and from the breeding grounds.

Boundary certainty: 2

Supporting notes for boundary certainty: - We are reasonably certain the boundaries of this F-BIA encompass the main feeding area in which humpback whales feed around the the Kodiak Island Archipelago.
- This is consistent with older data used in BIA Round 1 and none of the new sighting data suggests there is much difference in boundaries of this BIA.
- However, due to a lack of much dedicated research in this region past 2015, we note that the boundaries could be adjusted with additional information and surveys.

Months of year designation is applicable: May, June, July, August, September

Tagging data supporting designation (Y/N): N

# of tags: 0

# of years in which supporting tagging data collected: NA

Supporting information: No satellite tags have been deployed on these individuals that we know of

Visual observations/records supporting designation (Y/N): Y

# of observations/records: thousands of sightings

# of years in which supporting visual data collected: 1999-2019

Supporting information: Non-systematic vessel surveys, line transect surveys, and aerial surveys (Vate Brattström et al. 2017, Witteveen and Wynn 2016a, Matsuoka et al. 2020, Rone et al. 2015 & 2017, Distributed Biological Observatory (DBO) research cruises 2011-2019). Older data not used, but supports the designation and boundary of this BIA: Zerbini et al. 2006 line transect surveys & LeDuc et al. cruise and aerial survey (2004).

Acoustic detections/records supporting designation (Y/N): Y

# of observations/records: hundreds of hours of recordings

# of years in which supporting acoustic data collected: 2010-2016

Supporting information: NOAA's ARCWEST cetacean research cruises Aug-Oct of 2010-2016; sightings & acoustic sonobuoy detections (Vate Brattström et al. 2017). NOAA's Collaborative Large Whale Survey (CLaWS) visual and acoustic survey spent some time around Kodiak and documented humpback sightings and acoustic detections from the 6-27 August 2015 (Rone et al. 2015 & 2017).

Photo-ID evidence supporting designation (Y/N): Y

# of individuals photographed: thousands of records

# of years of photo records to compare: 1999-2015

Maximum # of years same individual photographed in area: NA

Supporting information: Database sightings from UAF GAP data (Witteveen & Wynn final report 2016; Witteveen database shared 22 Jun 2021).

Genetic analyses conducted supporting designation (Y/N): Y

Supporting information: NOTE: This category is more for small & resident pops where we're trying to see if they are genetically distinct from other pops.

What factors justify the boundary selection?: Boundary originally drawn around area where sightings have occurred. Updated in Round II here to include some sightings farther south that weren't encompassed in first round polygon, specifically around Sitkainak and Tugidak islands; also included a broader area in the NE that included the Barren Islands, etc. Bathymetric features were followed in areas where no sighting data existed.

Data sources: - Distributed Biological Observatory (DBO) vessel sightings. 2009-2019. NSF Grant Award #: OPP-1702211. arcticdata.io (doi:10.18739/A26T0GX06). Used with permission from Sue Moore and Kate Stafford. Accessed 8 Jun 2021.
- NOAA's Arctic Whale Ecology Study (ARCWEST) 2010-2016, Aug-Oct cetacean research cruises. Sightings & acoustic sonobuoy detections in Kodiak area available primarily for 2013 (Vate Brattström et al. 2017).
- Witteveen database from UAF GAP project, shared 22 June 2021.

Approximate % of population that uses this area for the designated purpose (if known): Unk

Approximate # of areas known specifically for this behavior (if feeding/cow-calf/mating/migratory) for this population: > 10

References: Barlow, J., J. Calambokidis, E. A. Falcone, C. S. Baker, A. M. Burdin, P. J. Clapham, J. K. B. Ford, C. M. Gabriele, R. LeDuc, D. K. Mattila, T. J. Quinn, L. Rojas-Bracho, J. M. Straley, B. L. Taylor, J. Urbán R., P. Wade, D. Weller, B. H. Witteveen, and M. Yamaguchi. (2011). Humpback whale abundance in the North Pacific estimated by photographic capture-recapture with bias correction from simulation studies. Mar. Mamm. Sci. 27:793-818.

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Rone, B.K., Zerbini, A.N., Douglas, A.B., Weller, D.W., and Clapham, P.J. (2017). Abundance and distribution of cetaceans in the Gulf of Alaska. Mar. Biol. 164: 1-23.

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Supplementary Description 4. 20. Humpback whale feeding area

Species name: Humpback whale (*Megaptera novaeangliae*)

Stock or population: North Pacific

Descriptive name: Southern Southeast Alaska

BIA type: Feeding Area

BIA label: F-BIA1-e-b1-GOA026-0

Transboundary across: None

Hierarchy: Non-hierarchical; single BIA

Importance score: 1 (Intensity: 2, Data support: 1)

Supporting notes for intensity score: - Happywhale sightings are limited; very low effort from researchers in this region
- It is difficult to say exactly how and when space is used
- SMEs and historical data indicate prey is mixed schooling fish (e.g. herring, sandlance, capelin) and euphausiids.
- Humpback whales make seasonal migrations from breeding grounds to SEAK to feed.
- Humpback whale numbers declined from 2014-2016, associated with the marine heatwave in the GOA.
- Most sightings are citizen science data from past 10 years, and that is biased heavily to where tour operators go and are based out of.
- Some sightings in major waterways along a line transect from a harbor porpoise survey in 18Jul-12Aug 2019
- Notes from Heidi Pearson & Nicole LaRoche (pers comm 1 Dec 2021) indicate whales seen nearly every day while conducting research along the western shoreline of Prince of Wales Island in June-Aug 2017-2018.
- Presence of humpbacks in this region is primarily May-Sep from Happywhale data, but there are some March sightings that should be noted and watched for herring feeding in the spring.
- Abundance is unknown in this BIA during this time period and whales move in and out throughout the time period.
- There are no known limits on availability of prey in this BIA other than environmental variability.
- There are many other feeding BIAs in the GOA and SEAK area as a whole.
Barlow et al. 2011 estimated the entire North Pacific pop=21,000 (SPLASH data, 2004-2006). Within northern SEAK the latest population estimate was 1585 in 2008 using photo ID data from 1994-2008 (Hendrix et al 2012).
- This F-BIA is comprised of individual humpbacks from both the Hawaii and Mexico DPS's (i.e. breeding populations). Wade et al. suggests only 6% of SEAK whales go to the Mexico DPS, while the remaining 94% of SEAK whales migrate to the Hawaii DPS using SPLASH data from 2004-2006 (2016). Unpublished photo-ID data aggregated in Happywhale shows 11.8% of SEAK individuals with known breeding ground sightings occurred in Mexican waters (Cheeseman, pers comm). The overall abundance for the Hawaii DPS is estimated 11,398 and Mexico DPS was 3,264 and is also based on SPLASH data (2004-2006) (Wade et al. 2016).

Supporting notes for data support score: - We were unable to gather any dedicated researcher data from researchers based in this region of Southeast Alaska. However, we do have data supplied from some researchers that used the waters of southern SEAK opportunistically and on some surveys.
- Happywhale database data from 2008-2021, primarily consisting of citizen science observations.
NOTE: Happywhale is created and managed by Ted Cheeseman; the data are collected by and shared by researchers in the region as well as citizen scientists and members of the public.
Data consists of over 22,000 sightings in all of Southeast Alaska (SEAK), reduced to just under 13,000 sightings of one individual per month per year. We were not able to divide Happywhale entries into different BIAs within SEAK at this time.

- Humpback whale sightings from NOAA Fisheries 2019 harbor porpoise research cruise, unpublished data shared by Kim Goetz, 29 November 2021.
- Satellite tag data from 37 tags that were deployed on humpbacks in 2014 and 2016 in Seymour Canal, three of which used southern SEAK waters (Palacios et al. 2019).
- No acoustic data or tissue studies have been included in this BIA delineation

Spatiotemporal variability: e

Supporting notes for spatiotemporal variability: Humpbacks come this area to feed primarily on small schooling fish (e.g. herring) and mixed zooplankton (e.g. euphausiids). Whales are found feeding in numerous locations within the BIA at any given time, and there are likely small and localized hotspots for feeding on various prey. These hotspots probably turn off and on reflecting mobile prey and are based primarily on environmental drivers.

Boundary certainty: 1

Supporting notes for boundary certainty: - We are reasonably certain the boundaries of this F-BIA encompass the main boundaries within which humpback whales feed on these prey sources during this time period in this area.
- However, we have highlighted a large area within southeast Alaska as a whole for this BIA with the knowledge that there are likely areas within this BIA that are not used by humpback whales, and areas that are used more frequently.
- Lack of data in this area as a whole results in an uncertainty about the boundaries in southern Southeast Alaska for biologically important areas.

Months of year designation is applicable: May, June, July, August, September

Tagging data supporting designation (Y/N): Y

# of tags: 3 records

# of years in which supporting tagging data collected: 2014-2015

Supporting information: Of the 37 tags placed in November 2014 & November 2015, three tag records showed humpback whale movement into this region, and all were on the outskirts of the region (Palacios et al. 2019).

Visual observations/records supporting designation (Y/N): Y

# of observations/records: Numerous

# of years in which supporting visual data collected: 2017-2018

Supporting information: Heidi Pearson & Nicole LaRoche (pers comm 1 Dec 2021) noted that humpback whales were seen nearly every day while conducting research along the western shoreline of Prince of Wales Island in June-Aug 2017-2018.

Acoustic detections/records supporting designation (Y/N): N

# of observations/records: 0

# of years in which supporting acoustic data collected: NA

Supporting information: No acoustic data were analyzed to inform prey, timing, spatiotemporal variability, or boundaries of this BIA

Photo-ID evidence supporting designation (Y/N): Y

# of individuals photographed: > 22,000 sighting records of individuals (Happywhale database)

# of years of photo records to compare: 2008-2021

Maximum # of years same individual photographed in area: NA

Supporting information: Happywhale database used, containing over 22,000 sightings in all of SEAK, reduced to just under 13,000 sightings of one individual per month per year. Database managed by Ted Cheeseman, and photos submitted by citizen scientists and contributing scientists Gabriele, Neilson, Straley, Pearson, Moran, and Szabo research groups with permission from researchers. Within SEAK as a whole, a minimum of 54 individuals have a 30-year or greater sighting history (Gabriele et al. 2017). Data for individual sighting records BIAs within SEAK is not available.

Genetic analyses conducted supporting designation (Y/N): Y

Supporting information: Tissue sample data was not used for support for this BIA.

What factors justify the boundary selection?: Boundary drawn around area the entire region; edges confined by land and bathymetry and expert elicitation.

Data sources: 1) Happywhale photo database, created and managed by Ted Cheeseman; sightings and photos contribute by research groups led by: Chris Gabriele, Janet Neilson, Jan Straley, Heidi Pearson, John Moran, and Andy Szabo, with permission from researchers. Additional contributions from citizen scientists. Accessed 21 August 2021.

2) Unpublished data from Heidi Pearson, 2013-2016

Approximate % of population that uses this area for the designated purpose (if known): UNK

Approximate # of areas known specifically for this behavior (if feeding/cow-calf/mating/migratory) for this population: >16

References: Barlow, J., J. Calambokidis, E. A. Falcone, C. S. Baker, A. M. Burdin, P. J. Clapham, J. K. B. Ford, C. M. Gabriele, R. LeDuc, D. K. Mattila, T. J. Quinn, L. Rojas-Bracho, J. M. Straley, B. L. Taylor, J. Urbán R., P. Wade, D. Weller, B. H. Witteveen, and M. Yamaguchi. (2011). Humpback whale abundance in the North Pacific estimated by photographic capture-recapture with bias correction from simulation studies. Mar. Mamm. Sci. 27:793-818.

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Hendrix, A.N., Straley, J., Gabriele, C., and Gende, S.M. (2012). Bayesian estimation of humpback whale (Megaptera novaeangliae) population abundance and movement patterns in southeastern Alaska. Can. J. Fish. Aquat. Sci. 69: 1783-1797

Wade, P.R., Quinn II, T.J., Barlow, J, Baker, C.S., Burdin, A.M., Calambokidis, J., Clapham, P.J., Falcone, E., Ford, J.K.B., Gabriele, C.M., Leduc, R., Mattila, D.K., Rojas-Bracho, L., Straley, J., Taylor, B.L., Urbán R., J., Weller, D., Witteveen, B.H., Yamaguchi, M. 2016. Estimates of abundance and migratory destination for North Pacific humpback whales in both summer feeding areas and winter mating and calving areas. Paper SC/66b/IA21 submitted to the Scientific Committee of the International Whaling Commission, June 2016, Bled, Slovenia.

Supplementary Description 4. 21. Humpback whale feeding area

Species name: Humpback whale (*Megaptera novaeangliae*)

Stock or population: North Pacific

Descriptive name: Offshore Gulf of Alaska

BIA type: Feeding Area

BIA label: F-BIA0-?-?-GOA028-0

Transboundary across: None

Hierarchy: Non-hierarchical; single watch list area

Importance score: 0 (Intensity: 1, Data support: 1)

Supporting notes for intensity score: - Happywhale sightings are limited; very low effort from researchers
- Difficult to say exactly how and when space is used
- Straley notes she's often seen humpbacks on the 100fa edge offshore in large numbers feeding.
- SMEs note there are humpbacks offshore, as seen during SPLASH and other research activities, and it is likely and important area
- Ted Cheeseman also noted that the offshore waters of SEAK and the GOA in general is an area that is severely lacking in research and data on humpback whales (pers comm 16 Aug 2021).
- Boundary is likely 50-300fa but very uncertain in that; just a guess from what Straley has seen. There is likely use of seamounts and other oceanographic features farther offshore as well, and too little is known about this area to speculate on this (Straley, Moran, Gabriele pers comm, November 2021).
- Timing unknown but probably summer months (May-Sep)

Supporting notes for data support score: - Witteveen et al. 2011 – SPLASH data 2004-2006 outdated
- Rone et al. 2015 – visual observations and sightings
- Subject matter experts (Straley, Moran, Gabriele pers comm, November 2021; Cheeseman pers comm August 2021)

Spatiotemporal variability: ?

Supporting notes for spatiotemporal variability: Without any dedicated research in this area, we are unable to define a spatiotemporal variability indicator at this time.

Boundary certainty: ?

Supporting notes for boundary certainty: Lack of data in this area as a whole results in an uncertainty about the boundaries in offshore waters for biologically important areas.

Months of year designation is applicable: May, June, July, August, September

Tagging data supporting designation (Y/N): N

# of tags: 0

# of years in which supporting tagging data collected: NA

Supporting information: No satellite tag records were used in designation of this BIA.

Visual observations/records supporting designation (Y/N): Y

# of observations/records: Numerous

# of years in which supporting visual data collected: 2015

Supporting information: Rone et al. 2015 – visual observations and sightings

Acoustic detections/records supporting designation (Y/N): N

# of observations/records: 0

# of years in which supporting acoustic data collected: NA

Supporting information: No acoustic data were analyzed to inform prey, timing, spatiotemporal variability, or boundaries of this BIA.

Photo-ID evidence supporting designation (Y/N): N

# of individuals photographed: 0

# of years of photo records to compare: NA

Maximum # of years same individual photographed in area: NA

Supporting information: No photo ID was used in designation of this BIA.

Genetic analyses conducted supporting designation (Y/N): Y

Supporting information: Tissue sample data was not used for support for this BIA.

What factors justify the boundary selection?: Boundary drawn around depth contours where subject matter experts have seen humpback whales consistently and in large numbers;

Approximate % of population that uses this area for the designated purpose (if known): UNK

Approximate # of areas known specifically for this behavior (if feeding/cow-calf/mating/migratory) for this population: >16

References: Barlow, J., J. Calambokidis, E. A. Falcone, C. S. Baker, A. M. Burdin, P. J. Clapham, J. K. B. Ford, C. M. Gabriele, R. LeDuc, D. K. Mattila, T. J. Quinn, L. Rojas-Bracho, J. M. Straley, B. L. Taylor, J. Urbán R., P. Wade, D. Weller, B. H. Witteveen,

and M. Yamaguchi. (2011). Humpback whale abundance in the North Pacific estimated by photographic capture-recapture with bias correction from simulation studies. Mar. Mamm. Sci. 27:793-818.

Hendrix, A.N., Straley, J., Gabriele, C., and Gende, S.M. (2012). Bayesian estimation of humpback whale (Megaptera novaeangliae) population abundance and movement patterns in southeastern Alaska. Can. J. Fish. Aquat. Sci. 69: 1783-1797.

Rone, B.K., P.J. Clapham, D.W. Weller, J.L. Crance, and A.R. Lang. 2015. North Pacific right whale visual and acoustic survey in the northwestern Gulf of Alaska. Final Report. Submitted to Marine Mammal Commission, Bethesda, Maryland. Prepared by National Marine Mammal Laboratory, Seattle, Washington; and Southwest Fisheries Science Center, La Jolla, California. October 2015.

Wade, P.R., Quinn II, T.J., Barlow, J, Baker, C.S., Burdin, A.M., Calambokidis, J., Clapham, P.J., Falcone, E., Ford, J.K.B., Gabriele, C.M., Leduc, R., Mattila, D.K., Rojas-Bracho, L., Straley, J., Taylor, B.L., Urbán R., J., Weller, D., Witteveen, B.H., Yamaguchi, M. 2016. Estimates of abundance and migratory destination for North Pacific humpback whales in both summer feeding areas and winter mating and calving areas. Paper SC/66b/IA21 submitted to the Scientific Committee of the International Whaling Commission, June 2016, Bled, Slovenia.

Witteeveen, B.H., Straley, J.M., Chenoweth, E., Baker, C.S., Barlow, J., Matkin, C., Gabriele, C.M., Neilson, J., Steel, D., von Ziegesar, O., Andrew, A.G., Hirons, A. (2011). Using movements, genetics and trophic ecology to differentiate inshore from offshore aggregations of humpback whales in the Gulf of Alaska. End. Sp. Res. 14: 217-225.

Supplementary Description 4. 22. Humpback whale feeding area

Species name: Humpback whale (*Megaptera novaeangliae*)

Stock or population: North Pacific

Descriptive name: Peril Strait

BIA type: Feeding Area

BIA label: F-BIA0-?-?-GOA027-0

Transboundary across: None

Hierarchy: Non-hierarchical; single watch list area

Importance score: 0 (Intensity: 1, Data support: 1)

Supporting notes for intensity score: - Whales likely transit through this area, but also feed on krill and herring.
- Very little research done in this area.
- sightings do exist in Happywhale
- Researchers and subject matter experts say there are always whales in the area but no one focuses research there.
- Spatiotemporal variability is unknown, as we don't yet understand prey dynamics in this area.
- Wade et al. (2016) suggests only 6% of SEAK whales go to Mexico DPS, while unpublished photo-ID data aggregated in Happywhale shows 11.8% of SEAK individuals with known breeding ground sightings occurring in Mexican waters (Cheeseman, pers comm).

Supporting notes for data support score: - Happywhale database data from 2008-2021, primarily consisting of citizen science observations for this BIA.
NOTE: Happywhale is created and managed by Ted Cheeseman; the data are collected by and shared by researchers in the region as well as citizen scientists and members of the public.
Data consists of over 22,000 sightings in all of Southeast Alaska (SEAK), reduced to just under 13,000 sightings of one individual per month per year. We were not able to divide Happywhale entries into different BIAs within SEAK at this time.

Spatiotemporal variability: ?

Supporting notes for spatiotemporal variability: Without any dedicated research in this area, we are unable to define a spatiotemporal variability indicator at this time.

Boundary certainty: ?

Supporting notes for boundary certainty: Lack of data in this area as a whole results in an uncertainty about the boundaries in Peril Strait for biologically important areas.

Months of year designation is applicable: May, June, July, August, September

Tagging data supporting designation (Y/N): N

# of tags: 0

# of years in which supporting tagging data collected: NA

Supporting information: No satellite tag records were used in designation of this BIA.

Visual observations/records supporting designation (Y/N): N

# of observations/records: 0

# of years in which supporting visual data collected: NA

Supporting information: No visual observations were used in designation of this BIA.

Acoustic detections/records supporting designation (Y/N): N

# of observations/records: 0

# of years in which supporting acoustic data collected: NA

Supporting information: No acoustic data were analyzed to inform prey, timing, spatiotemporal variability, or boundaries of this BIA.

Photo-ID evidence supporting designation (Y/N): Y

# of individuals photographed: >50 (Happywhale database)

# of years of photo records to compare: 2008-2021

Maximum # of years same individual photographed in area: UNK

Supporting information: Happywhale database used, containing over 22,000 sightings in all of SEAK, reduced to just under 13,000 sightings of one individual per month per year. Database managed by Ted Cheeseman, and photos submitted by citizen scientists and contributing scientists Gabriele, Neilson, Straley, Pearson, Moran, and Szabo research groups with permission from researchers. Within SEAK as a whole, a minimum of 54 individuals have a 30-year or greater sighting history (Gabriele et al. 2017). Data for individual sighting records BIAs within SEAK is not available.

Genetic analyses conducted supporting designation (Y/N): Y

Supporting information: Tissue sample data was not used for support for this BIA.

What factors justify the boundary selection?: Boundary drawn around sightings in this area; edges confined by land and expert elicitation.

Data sources: Happywhale photo database, created and managed by Ted Cheeseman; sightings and photos contribute by research groups led by: Chris Gabriele, Janet Neilson, Jan Straley, Heidi Pearson, John Moran, and Andy Szabo, with permission from researchers. Additional contributions from citizen scientists. Accessed 21 August 2021.

Approximate % of population that uses this area for the designated purpose (if known): UNK

Approximate # of areas known specifically for this behavior (if feeding/cow-calf/mating/migratory) for this population: >16

References: Barlow, J., J. Calambokidis, E. A. Falcone, C. S. Baker, A. M. Burdin, P. J. Clapham, J. K. B. Ford, C. M. Gabriele, R. LeDuc, D. K. Mattila, T. J. Quinn, L. Rojas-Bracho, J. M. Straley, B. L. Taylor, J. Urbán R., P. Wade, D. Weller, B. H. Witteveen, and M. Yamaguchi. (2011). Humpback whale abundance in the North Pacific estimated by photographic capture-recapture with bias correction from simulation studies. Mar. Mamm. Sci. 27:793-818.

Cheeseman, T., T. Johnson, K. Southerland, and N. Muldavin. 2017. Happywhale: Globalizing marine mammal photo identification via a citizen science web platform. Paper SC/67A/PH/02 submitted to the Scientific Committee of the International Whaling Commission, May 2017, Bled, Slovenia.

Cheeseman, T., Southerland, K., Park, J., Olio, M., Flynn, K., Calambokidis, J., Jones, L., Garrigue, C., Jordán, A.F., Howard, A., Reade, W., Neilson, J., Gabriele, C., Clapham, P. (2021). Advanced image recognition: a fully automated, high-accuracy photo-identification matching system for humpback whales. Mamm. Biol. 2021 pp 15. doi: 10.1007/S42991-021-00180-9

Hendrix, A.N., Straley, J., Gabriele, C., and Gende, S.M. (2012). Bayesian estimation of humpback whale (Megaptera novaeangliae) population abundance and movement patterns in southeastern Alaska. Can. J. Fish. Aquat. Sci. 69: 1783-1797

Wade, P.R., Quinn II, T.J., Barlow, J, Baker, C.S., Burdin, A.M., Calambokidis, J., Clapham, P.J., Falcone, E., Ford, J.K.B., Gabriele, C.M., Leduc, R., Mattila, D.K., Rojas-Bracho, L., Straley, J., Taylor, B.L., Urbán R., J., Weller, D., Witteveen, B.H., Yamaguchi, M. 2016. Estimates of abundance and migratory destination for North Pacific humpback whales in both summer feeding areas and winter mating and calving areas. Paper SC/66b/IA21 submitted to the Scientific Committee of the International Whaling Commission, June 2016, Bled, Slovenia.

Supplementary Description 4. 23. Humpback whale feeding area

Species name: Humpback whale (*Megaptera novaeangliae*)

Stock or population: North Pacific

Descriptive name: Shumagin Islands

BIA type: Feeding Area

BIA label: F-BIA0-d-b2-GOA012-0

Transboundary across: None

Hierarchy: Non-hierarchical; single watch list area

Importance score: 0 (Intensity: 1, Data support: 1)

Supporting notes for intensity score: - Humpbacks make long-range seasonal migrations between breeding & feeding grounds;
- Abundance in this feeding area is unknown; Zerbini et al (2006) abundance estimates were 494 in 2003; Photo-ID surveys from the UAF GAP project were taken from 1999-2015 in this region specifically, and in July and August only; the highest number of whales seen was in 2012 at 169 unique individuals; over the 16 years there were 654 individuals across 1437 total sightings (Witteveen et all. 2017). Witteveen et al also found not much interchange between Kodiak and Shumigan whales, indicating they're likely not mixing much. 31 individuals of the 654 were seen in Kodiak and then Shumigans, while 27 were first seen in Shumigans and then Kodiak. Only 4 occasions had the same individual seen in both areas in the same year. This makes the case for Shumigans being a discrete feeding area (Witteveen et all. 2017).
- Unknown number or density feeding here relative to total abundance; the total abundance of North Pacific humpbacks during SPLASH, in the middle of this sighting period (2004 & 2005), was estimated to be about 21,000 individuals (Barlow et al. 2011).
- Humpback whales are divided into Distinct Population Segments (DPS) by NOAA (81 FR 62259, September 2016). The DPSs that feed in the Shumigans are thought to be those that breed in Hawaii and those that breed in the Western North Pacific (NOAA 2016).
- There are no known limits on availability of food supply in the sense that the presumed prey (euphausiids) in this region do not experience many limitations other than climate change, blob years, environmental drivers, etc.
- There are many other feeding BIAs in the GOA, some likely much larger (i.e. Southeast Alaska, PWS, Kodiak, etc.)

Supporting notes for data support score: - Not a lot of effort done in this specific area since 2015.
- Witteveen et al. 2017 summarizes Shumigan work, which was mostly collected in 2-5 day periods in late July or early Aug from 1999—2015.
- Vate Brattström et al. 2017 – NOAA's Arctic Whale Ecology Study (ARCWEST) 2010-2016, Aug-Oct cetacean research cruises in Northern Bering Sea – did some tracks in Aleutians & western GOA in Jul/Aug 2013 and noted humpback whale sightings. Clusters off Shumigans.
- Masuoka et al. 2019: IWC POWER Cruise; many detections acoustically & visually of humpbacks. The cruise didn't go directly through the Shumigans so it's hard to use this data source to really evaluate use of this area. No acoustic detections made, but several sightings in the area.
Older data:
- Zerbini et al. 2006 has good coverage in western GOA and in discussion notes that humpbacks and fin whales seem to resource partition, which is the same thing Witteveen et al. 2016b found in the same region.
- LeDuc et al. 2004 - A NMFS cruise and aerial survey from 2002 for North Pacific Right Whales in the Bering Sea and Gulf of Alaska (LeDuc et al. 2004).

Spatiotemporal variability: d

Supporting notes for spatiotemporal variability: This area appears to be a consistent feeding area for humpback whales, likely characterized by prey availability in the area. Within the larger Shumagin Islands region, humpback distribution varies with respect to prey aggregations, which are affected by eddies, fronts, currents, and nutrient upwelling. It should be noted that effort is mostly restricted to Jun-Sep, which is why we can only really assume whales are there during those months. However, this time period does align with when humpback whales are generally in GOA waters on summer feeding grounds. Studies of humpback whale diet in this region have shown that humpback whales are generalist consumers foraging on small schooling fish and zooplankton (Witteveen et al. 2016b).

Boundary certainty: 2

Supporting notes for boundary certainty: - We are reasonably certain the boundaries of this F-BIA encompass the main feeding area in which humpback whales feed around the Shumigan Islands.
- This BIA boundary includes the bulk and highest density of sightings made in the western GOA, and it is consistent with older data used in BIA Round 1 that had a hotspot of sightings & detections in this area, which was based in part by some of the same data in this BIA (i.e. Witteveen GAP project data that hadn't been finished yet).
- There have been a few cruises through the area since 2015 that have also logged humpback activity around the islands (i.e. Vate Brattstrom 2017, NOAA DBO cruises, and IWC POWER cruise in 2019 (Matsuoka et al. 2020)).
- Due to a lack of recent dedicated research in this region since 2015, we suggest the boundaries could be adjusted with additional information and surveys.
- Zerbini et al. (2006) data suggests there could be a continuous use of the coastline between Unimak Pass and Kodiak, but not enough work has been done since then on other parts of the coastline to confirm or refute this. Additionally, the data are

outdated and more research needs to be done along this area to better understand humpback feeding habitat in this region.

Months of year designation is applicable: June, July, August, September

Tagging data supporting designation (Y/N): N

# of tags: 0

# of years in which supporting tagging data collected: NA

Supporting information: No satellite tags have been deployed on these individuals that we know of

Visual observations/records supporting designation (Y/N): Y

# of observations/records: >1700 sightings

# of years in which supporting visual data collected: 1999-2015

Supporting information: NOAA's ARCWEST cetacean research cruises transited the region July-August of 2013 – 31 sightings; UAF GAP surveys documented 1681 sightings in the database between 1999-2015.

Acoustic detections/records supporting designation (Y/N): N

# of observations/records: 0

# of years in which supporting acoustic data collected: NA

Supporting information: No acoustic recordings have been made of individuals that we know of

Photo-ID evidence supporting designation (Y/N): Y

# of individuals photographed: 654 individuals

# of years of photo records to compare: 1999-2015

Maximum # of years same individual photographed in area: 15

Supporting information: Database sightings from UAF GAP project with Bree Witteveen, 1437 total sightings of groups of whales across the full range of years (Witteveen & Wynn final report 2016).

Genetic analyses conducted supporting designation (Y/N): Y

Supporting information: 86 biopsy samples from Shumigan Is. have been collected between 1999 and 2015. Data for the biopsies came from Witteveen & Wynn 2016. NOTE: This category is more for small & resident pops where we're trying to see if they are genetically distinct from other pops.

What factors justify the boundary selection?: The boundary is drawn around area where sightings have occurred, and around bathymetric features . We have expanded this polygon a bit from BIA Round 1 to fit around the raw data from the full period of the UAF GAP project and various NOAA cruises (Witteveen database, accessed July 2021; ARCWEST & CHAOZ 2010-2016, Aug-Oct cetacean research cruises, DBO cruise raw data).

Data sources: - Distributed Biological Observatory (DBO) vessel sightings. 2009-2019. NSF Grant Award #: OPP-1702211. arcticdata.io (doi:10.18739/A26T0GX06). Used with permission from Sue Moore and Kate Stafford. Accessed 8 Jun 2021.
- NOAA's Arctic Whale Ecology Study (ARCWEST) 2010-2016, Aug-Oct cetacean research cruises. Sightings & acoustic sonobuoy detections in Kodiak area available July-Aug 2013 (Vate Brattström et al. 2017).
- Witteveen database from UAF GAP project, shared 22 June 2021.

Approximate % of population that uses this area for the designated purpose (if known): Unk

Approximate # of areas known specifically for this behavior (if feeding/cow-calf/mating/migratory) for this population: >10

References: Barlow, J., J. Calambokidis, E. A. Falcone, C. S. Baker, A. M. Burdin, P. J. Clapham, J. K. B. Ford, C. M. Gabriele, R. LeDuc, D. K. Mattila, T. J. Quinn, L. Rojas-Bracho, J. M. Straley, B. L. Taylor, J. Urbán R., P. Wade, D. Weller, B. H. Witteveen, and M. Yamaguchi. (2011). Humpback whale abundance in the North Pacific estimated by photographic capture-recapture with bias correction from simulation studies. Mar. Mamm. Sci. 27:793-818.

Matsuoka, K., Crance, J., Gilpatrick Jr., J. W., Yoshimura, I., and Okoshi, C. (2020). Cruise report of the 2019 IWC-Pacific Ocean Whale and Ecosystem Research (IWC-POWER). Paper SC/68B/ASI/xx presented to the xxth IWC Scientific Committee, June 2020 (unpublished). 59pp.
NOAA. 2016. Endangered and Threatened Species; Identification of 14 Distinct Population Segments of the Humpback Whale (Megaptera novaeangliae) and Revision of Species-Wide Listing. Federal Register, Final Rule. 81 FR 62259, September 2016.

Vate Brattström, L., J.A. Mocklin, J.L. Crance, and N.A. Friday, editors. (2017). Arctic Whale Ecology Study (ARCWEST): Use of the Chukchi Sea by Endangered Baleen and Other Whales (Westward Extension of the BOWFEST). Final Report of the Arctic Whale Ecology Study (ARCWEST), OCS Study BOEM 2017. Marine Mammal Laboratory, Alaska Fisheries Science Center, NMFS, NOAA, 7600 Sand Point Way NE, Seattle, WA 98115-6349.

Witteveen, B.H., and Wynne, K. (2016a). GAP12: A synthesis of findings (Final Comprehensive Report, NOAA Federal Program Award Number NA10NMF4390123). Available from University of Alaska Fairbanks Alaska Seagrant program. https://seagrant.uaf.edu/map/gap/reports/index.php.

Witteveen, B.H., and Wynne, K.M. (2016b). Trophic niche partitioning and diet composition of sympatric fin (Balaenoptera physalus) and humpback whales (Megaptera novaeangliae) in the Gulf of Alaska revealed through stable isotope analysis. Mar. Mamm. Sci. 32(4): 1319-1339.
Witteveen, B.H., and Wynne, K. (2017). Site fidelity and movement of humpback whales (Megaptera novaeangliae) in the western

Gulf of Alaska as revealed by photo-identification. Can. J. Zool. 95: 169-175.

Zerbini, A. N., Waite, J. M., Laake, J. L., & Wade, P. R. (2006). Abundance, trends and distribution of baleen whales off Western Alaska and the central Aleutian Islands. Deep-Sea Research Part I, 53, 1772-1790. http://dx.doi.org/10.1016/j.dsr.2006.08.009.

Supplementary Description 4. 24. North Pacific right whale feeding area

Species name: North Pacific right whale (*Eubalaena japonica*)

Stock or population: North Pacific Right Whale

Descriptive name: Kodiak Island

BIA type: Feeding Area

BIA label: F-BIA1-d-b2-GOA007-0

Transboundary across: None

Hierarchy: Non-hierarchical; single BIA

Importance score: 1 (Intensity: 2, Data support: 1)

Supporting notes for intensity score: The best population size estimate for NP right whales is 29 individuals (Wade et al. 2011). In recent surveys (2013, 2014, and 2019) it has been unclear how many vocalizing animals have been heard, but acoustic detections have been made. One visual sighting (4 individuals in 2021) has been made in the BIA since 2006. This BIA is centered around the NOAA critical habitat area and is one of the only areas in the GOA where they have been detected or observed. It is unknown if NPRW make long range seasonal migrations between feeding & breeding grounds.
The overall population is estimated at fewer than 100 individuals, with an estimated 30 individuals making up the Eastern stock that inhabits Alaskan waters (Muto et al. 2020). The rate of prey consumption or caloric intake is unknown; diet is thought to be primarily large copepods (Gregr & Coyle 2009), and dense aggregations of copepods and euphausiids in the Barnabus Trough in summer (Wade et al. 2011). Stomach contents of North Pacific right whales in the Gulf of Alaska exist for only 3 right whales caught under scientific permit on August 22, 1961 South of Kodiak Island; these whales had all consumed Neocalanus plumchrus (Calanus plumchrus: Omura et al. 1969). Known limits on availability of food supply are unknown.; Wade et al. (2011) reports that all 4 sightings of NP Right whales from 2004-2006 were in association with dense zooplankton layers in Barnabus Trough, suggesting it is an important feeding habitat for right whales in the GOA.
This BIA is one of a few known feeding areas in the eastern North Pacific and Bering sea. There are more consistent sightings in a feeding area in the Bering Sea, and there have been some recent sightings off Haida Gwaii, British Columbia suggesting a feeding area in that region.

Supporting notes for data support score: Older data that we kept includes Waite et al. 2003, Mellinger et al. 2004, and Wade et al. 2011 sightings and detections of NPRW in this area. Sirovic et al. 2015 reported on upcalls detected at Quinn Seamount on 21 Jun & 3 Aug 2013; down-calls were detected for 50 hrs between 27 Jul– 5 Sep 2013. NOTE: This area is not within the BIA and is out in the middle of the GOA. Rone et al. 2014 shows line transect surveys between 23 Jun - 18 Jul 2013 in the Navy training area Temporary Maritime Activities Area (TMAA) near Kodiak Island with acoustics & visual surveys. No visual sightings confirmed, but 4 acoustic detections were made. Rone et al. 2015: CLaWS survey near Kodiak, 10 & 16 August 2015 (Figure 21-23 in report) detailed 6 detections on Leg 2. Masuoka et al. (2020) reported on the GOA POWER Cruise where sonobuoys were deployed from 17 Jul – 14 Sep 2019 throughout the GOA. Ten confirmed detections (not individuals) were made between 8-14 Sep 2019. Three potential detections made from 21-27 Jul 2019.
A NOAA fisheries news story, 9 September 2021, describes an encounter within the BIA of 4 right whales, observed visually and tracked acoustically during a line transect survey (https://www.fisheries.noaa.gov/feature-story/four-endangered-north-pacific right-whales-spotted-gulf-alaska). Two were seen within the Critical Habitat, and two were seen Southwest of the Critical Habitat, all within the F-BIA bounds. One animal was matched to an individual seen 12 June 2021 off Haida Gwaii, BC. Survey report not yet available.

- There has been some amount of effort to detect right whales in this BIA region, both with acoustics and visual sighting from vessel-based surveys.
- No satellite tagging or biopsies since the last round of BIAs, though there have been 4 sightings since then (2021) and multiple acoustic detections (2015, 2019, and 2021 surveys).

Spatiotemporal variability: d

Supporting notes for spatiotemporal variability: The Barnabas Trench area is characterized by bathymetry, but within the area, there is a lot of dynamic variability in that the locations of whales are likely driven by prey movement. Copepods and zooplankton prey are a dynamic prey resource that moves and is concentrated by the dynamic oceanographic currents and eddies. However, there does seem to be something with the fixed feature of the Barnabus Trough and Albatross Bank area, in that the way the currents move through the fixed features, the prey gets concentrated.
The GOA Critical Habitat area for NPRW (and the larger BIA) is influenced by large eddies, submarine canyons, or frontal zones which enhance nutrient exchange and act to concentrate prey.
The area lies adjacent to major ocean currents (i.e. the AK Coastal Current) and is characterized by relatively low circulation and water movement.

Boundary certainty: 2

Supporting notes for boundary certainty: We are reasonably certain the boundaries of this F-BIA encompass the main feeding area in which North Pacific right whales occur in the Gulf of Alaska. This includes most of the detections and sightings made in the GOA, and effort did include many other areas within the GOA. It is consistent with older data used in BIA Round 1 that had a hotspot of sightings & detections in this area. We have expanded the BIA to include an area to the Northeast of the BIA

following the bathymetric contours and encompassing an area where potential acoustic detections were made in 2013. Given the very low number of sightings and detections overall, and the uncertainty regarding how the boundary should be drawn, we suggest additional information should be gathered to determine actual boundaries.

Months of year designation is applicable: June, July, August, September

Tagging data supporting designation (Y/N): Y

# of tags: 0

# of years in which supporting tagging data collected: 0

Supporting information: No reports of satellite tagged NP Right whales in or around this F-BIA

Visual observations/records supporting designation (Y/N): Y

# of observations/records: 9 sightingss

# of years in which supporting visual data collected: 1998, 2004, 2005, 2006, 2021

Supporting information: Aerial- and vessel-based surveys.

Waite et al. 2003 documented July 1998 sighting; Wade et al. 2011 documented the 2004-2006 sightings; the 2005 sighting was photo-ID'd and genetically identified as male; one of the 2006 sightings was also photo-ID'd. No visual sightings from Rone or Matsuoka or anything since 2006 that we could find. Nothing additional here from the last round of BIAs (Ferguson et al. 2015).

Ferguson wrote: "Five sightings of five whales since 1998: 1 sighting of 1 whale in July 1998, NOAA-NMFS-AFSC-NMML aerial surveys (Waite et al., 2003); 1 sighting of 1 whale in August 2004, NOAA ship Miller Freeman (Wade et al., 2011b); 1 sighting of 1 whale in August 2005 from the NOAA ship Oscar Dyson (Wade et al., 2011b); 1 sighting of 1 whale in September 2006, NOAA ship Miller Freeman (Wade et al., 2011b); and 1 opportunistic sighting of 1 whale in September 2006 by a fishing vessel (Wade et al., 2011b)";
Finally, 4 individuals observed in August 2021 on NOAA line transect survey PacMAPPS.

Acoustic detections/records supporting designation (Y/N): Y

# of observations/records: 21 confirmed detections, 19 potential detections

# of years in which supporting acoustic data collected: 2000; 2004; 2013; 2015; 2019; 2021

Supporting information: North Pacific right whale calls recorded on hydrophones.
In the study area: 2000 (10 calls probable); 2004 (1); 2013 (4 + 6 maybes); 2015 (6); 2019 (6 + 3 potential); 2021 (4 individuals confirmed).

In total, 21 confirmed detections, 19 potential detections, all within BIA. Waite et al 2003 recorded probable calls on 6 Sep 2000 in the critical habitat area; Wade et al. documented the 2004 detection using passive acoustic monitoring; Rone et al. 2014: line transect surveys 23 Jun - 18 Jul 2013 in Navy training area Temporary Maritime Activities Area (TMAA) with acoustics & visual survey. No visual sightings, but 4 acoustic detections + additional potential detections. Rone et al. 2015: CLaWS survey near Kodiak, 10 & 16 August 2015 (Figure 21-23 in report) – 6 detections on leg 2. Matsuoka et al. 2019: POWER Cruise; sonobuoys deployed 17 Jul – 14 Sep 2019 throughout GOA. 10 confirmed detections (unknown number of individuals) between 8-14 Sep 2019; 3 potential detections 21-27 Jul 2019. Finally, 4 individuals observed and recorded in August 2021 on NOAA line transect survey PacMAPPS.

NOTE that the Mellinger et al. 2004 detections (5 days of detections in Aug-Sep 2000) totaling 60 certain upcalls and 1 near-certain upcall, were all recorded at an instrument outside of the Kodiak Area (Table 2 in Mellinger et al. 2004), further SW of the shelf break and out in the open ocean at 52° 38'N, 157 ° 23' W (Black star in Fig 1 of Mellinger et al. 2004).

Photo-ID evidence supporting designation (Y/N): Y

# of individuals photographed: 6

# of years of photo records to compare: 2005; 2006; 2021

Maximum # of years same individual photographed in area: 0

Supporting information: Photographs. Minimum of 2 (Wade et al., 2011).

Wade et al. 2011 documented the 2005 & 2006 Photo-IDs; neither whales matched any individuals in the NP photo-identification catalog, which consists of 16 right-side and 15 left-side identifications from individuals photographed in the Bering Sea (1996-2004). Finally, 4 individuals observed and recorded in August 2021 on NOAA line transect survey PacMAPPS.

Genetic analyses conducted supporting designation (Y/N): Y

Weak/moderate/strong support for genetic differentiation: Weak – 1 biopsy sample, August 2005, NOAA ship Oscar Dyson (Wade et al., 2011b)

Nature of supporting information: Weak

Supporting information: 49 biopsy samples total, but only 1 from the Gulf of Alaska and the rest from the Bering Sea. Wade et al. documented the biopsy taken in 2005 from a single animal off Kodiak. Genetically identified as male. LeDuc et al. (2012) notes that of 49 biopsy samples taken from 24 individual NP Right whales, they have as an aggregate lost genetic diversity, and that males outnumber females 2:1. Additionally, the eastern NP population is likely genetically distinct from the western

NP population.

What factors justify the boundary selection?: Polygon around all sightings of North Pacific right whales since 1998 (Figure 1b in Wade et al., 2011). Boundary originally drawn around the area where sightings and acoustic detections have been made, as well as potential acoustic detections. We have expanded it a bit from Round 1 to include some additional potential acoustic detections in recent years (2013), but it has primarily remained the same.

Data sources: None

Approximate % of population that uses this area for the designated purpose (if known): Unknown

Approximate # of areas known specifically for this behavior (if feeding/cow-calf/mating/migratory) for this population: 3

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Supplementary Description 4. 25. Sperm whale feeding area

Species name: Sperm whale (*Physeter macrocephalus*)

Stock or population: North Pacific

Descriptive name: Gulf of Alaska

BIA type: Feeding Area

BIA label: F-BIA2-s-b2-GOA014-0

Transboundary across: None

Hierarchy: Non-hierarchical; single BIA

Importance score: 2 (Intensity: 2, Data support: 3)

Supporting notes for intensity score: -Long-range migrations are made by male sperm whales to feeding grounds in the Gulf of Alaska and other high latitudes.
-Feeding grounds such as the GOA region are frequented during spring to fall months, but sperm whales are present in the GOA year-round.
-Food is available year-round in this region (i.e. groundfish and squid) that are the primary prey of sperm whales (Wild et al. 2020).
-Genetics has indicated this F-BIA is predominantly used by males (Mesnick et al., 2011). Sighting data from SEASWAP corroborates this (Straley pers comm 2021). Females and calves have been reported in the Aleutian Islands & Bering Sea (2010 NOAA report), and a calf washed up on Kodiak Island in 2001, but there have been no confirmed live sightings of calves or females in the GOA. Fishermen have reported smaller individuals they thought were calves but could have been juvenile males following and learning depredation behavior from larger adult males.
-Groundfish and squid are the primary prey of sperm whales in the GOA (Kawakami, 1980; Wild et al., 2020) and available year-round throughout the region. Feeding grounds such as the GOA region are frequented during spring, summer, and fall months, but sperm whales are present in the GOA year-round (Mellinger et al., 2004; Straley et al., 2015; Diogou et al., 2019).
-Prey consumption rates & caloric intake varies between depredating and non-depredating individuals. Rough calculation by SEASWAP has estimated male sperm whales naturally foraging in the GOA would require 132 +/- 70 fish per day for sustenance, and natural foraging creak rates in the region are consistent with this estimate (Mathias et al., 2012). Creak rates are much higher for depredating animals than non-depredating whales, with estimates that whales can attain three to four times the caloric intake per unit time while depredating (Mathias et al., 2012).
-It is unknown what role this feeding area plays to the larger sperm whale population, though sperm whales are also known to feed in the Bering Sea and Aleutian Islands region. We also know that sperm whales feed while on the breeding grounds too. -We know that other feeding areas exist for this species in the region and nearby regions from whaling catches and sightings: for example, they feed more on squid in the western GOA and Bering Sea, and have been seen there on cruises; and they are sighted feeding off Washington coast and BC by fishermen as well. There are also likely prey resources and historical catches further offshore in the central GOA, where acoustic detections have been made (Mellinger 2004 & Diogou 2019/20?) -Overall abundance is not known but was thought to be reduced to approximately 938,000 individuals by the late 1970s due to commercial whaling (Rice, 1989), but no current estimates exist, nor do estimates exist for the GOA specifically (Muto, 2020). Estimates in one section of the eastern GOA are 150 individuals (Straley et al. 2015), while off Kodiak a 23 Jun - 18 Jul 2013 abundance (N) and pooled density (D) estimated at N = 296; D = 0.0018; CV(N) = 0.57). A second density and abundance estimate was obtained for sperm whales using acoustic localizations from the towed-hydrophone array (N = 215; D = 0.0013; CV = 0.18) (Rone et al. 2014).
-IWC POWER cruise did cetacean line-transect surveys in the Gulf of Alaska in 2019 from 17 July to 14 September (Figure Matsuoka et al. 2020). 20 sperm whales were sighted throughout the western and eastern gulf, all in water depths greater than 1000m and all solitary (probably lone male) but no photo-ID or biopsies were taken (Matsuoka et al. 2020). -From Rone et al. 2017: In 2013, all sperm whale sightings occurred on the continental shelf break and slope with the exception of one sighting near a seamount. In 2015, sperm whales occurred on the continental shelf break and slope within the inshore stratum and the pelagic waters and seamounts offshore. The largest sighting of individual sperm whales in this area was comprised of 11 animals, including one calf.
-Diogou et al. 2019 analyzed acoustic data from ocean station PAPA (OSP) in the southern GOA (50 N) from 2007-2012 year round; sperm whales detected year-round, with higher detection rate (70% higher) in summer (May-Sep) than winter (Dec Jan).

Supporting notes for data support score: The Data Support score was high (3) because of the breadth of data available to analyze movement, foraging ecology, presence, and habitat use in the GOA. There are a wide variety of data available since 2003, including satellite tag, acoustic tag, tissue samples, dietary analysis, photo-ID research, marine mammal survey observations, acoustic detections from towed arrays, sonobuoys, and autonomous recorders, and independent knowledge from commercial fishermen.
Information sources for this BIA included photo-identification records, satellite and acoustic tag records, genetic samples, dietary data from tissue samples, and acoustic recordings. In the eastern GOA, the Southeast Alaska Sperm Whale Avoidance Project (SEASWAP) data include hundreds of hours of photo-identification and field observations from trained researchers (122 individual whales in photo-ID catalog); 35 satellite tag records placed between 2007 and 2017 that had an average deployment period of 45 days; 11 acoustic tag records placed in 2007 and 2009 that yielded 146 hours of acoustic and movement data from a 2-axis accelerometer; 33 tissue samples taken between 2007 and 2018 for dietary analysis; nine tissue samples taken between 2004-2009 used in genetic analysis; thousands of hours of acoustic recordings from autonomous

recorders and towed arrays between 2003 and 2019; and hundreds of fishermen testimonials. SEASWAP focuses efforts in the eastern GOA, roughly between Cape Ommaney and Cross Sound (approximately 56.15 N, 134.67 W), with very little dedicated sperm whale research or SMEs working outside of that area in the GOA. However, NOAA collects observational data on sperm whale interactions on both their federal longline sablefish survey and through logbook data with the commercial longline fishing fleet throughout the GOA, Bering Sea, and Aleutian Islands.
Throughout the central and western portions of the GOA, data include 4,586 km of line transects surveyed on an International Whaling Commission Pacific Ocean Whale and Ecosystem Research (IWC-POWER) cruise from mid-July to mid-September 2019, where visual observations of marine mammals were recorded, and 229 sonobuoys were deployed. This cruise resulted in 47 visual observations of sperm whales, no photo-identification or biopsies, and acoustic detection of sperm whales on 52.8% (n=112) of the sonobuoys. In addition to the ICW-POWER cruise, NOAA funded a Collaborative Large Whale Survey (CLaWS) which was conducted from mid-July to mid-September 2015 in the GOA (Rone et al. 2015). The second leg of the survey departed and returned to Kodiak, AK, and encountered sperm whales both visually on line transect surveys and acoustically on sonobuoys. Visually, 3,117 km of line transects were surveyed, with 46 individual sperm whales sighted. Additionally, 191 sonobuoys were deployed, with 107 (56%) detecting sperm whales acoustically. Finally, in 2013 a NOAA-led GOA Line-Transect Survey (GOALS II) was conducted for marine mammal occurrence in the Temporary Maritime Activities Area (TMAA) of the US Navy (Rone et al. 2014). Of the 4,504 km line transects conducted visually, 22 individual sperm whales were sighted. Of the 6,304 km of line-transect effort with towed array hydrophones, there were 241 sperm whale detections acoustically out of 379 total acoustic detections (64%). Out of the 181 sonobuoys deployed, 47 (26%) detected sperm whales (Rone et al. 2014).

Spatiotemporal variability: s

Supporting notes for spatiotemporal variability: This F-BIA is characterized by the continental slope region, a fixed region defined by bathymetry, which is thought to be the primary habitat for sperm whales in the GOA based on whaling records, visual and acoustic surveys, tagging records, and SEASWAP analysis (Ivaschenko et al. 2014; Rone et al. 2014 & 2015, Matsuoka et al. 2020; Thode et al., 2007; Sigler et al., 2008; Schakner et al., 2014; Straley et al., 2014; Wild et al. 2021 In Review).

Boundary certainty: 2

Supporting notes for boundary certainty: -We are reasonably certain the boundaries of this F-BIA encompass the main feeding area in which sperm whales occur in the Gulf of Alaska.
-Most, if not all sightings from fishermen accounts, acoustic moorings, and dedicated vessel-based research trips occurring on the continental slope habitat. However, these are biased to effort being primarily in that area due to the fishing activity that funds much of this research occurring on the slope habitat. BUT, satellite tag data from animals tagged on the shelf edge show animals tagged do not move out into the central gulf or off the shelf edge after tagging, so that leaves us fairly certain we have the main feeding habitat encompassed in this BIA.
-Acoustic & visual line transect surveys near Kodiak that went off the shelf edge and into the deep ocean also show that sperm whales are predominantly found in water depths above the slope (Rone et al. 2014 & 2015, Matsuoka et al. 2020, Rice et al. 2021). -Tags collected data on whales for up to 167 days after tagging, and tracked whales throughout the region, confirm the boundaries and movements throughout the GOA of the whales included in this F-BIA (Straley et al. 2014, Wild et al. In Review).
-Matsuoka et al. 2019: Sperm whales were widely distributed throughout the Western and Eastern strata where the water depth was over 1,000 m (Figures 2g and 5). A total of 20 schools (20 individuals) were sighted (Table 2a). All observed schools were solitary individuals (probably large male). Sperm whales were recorded in waters with SST ranging from 10.9˚C to 16.7˚C (25th to 75th quartiles: 11.5-14.5 ˚C) (Table 3). No individuals were photographed and no biopsy samples were collected.
In the future we suggest researchers explore a hierarchical way to make a parent BIA throughout the shelf break of the entire GOA, with a few high density smaller BIAs (i.e. Kodiak, SEAK, etc.). However, we don't have much effort or tags to delineate Seward area, or Yakutat area, and expert knowledge says we know those are high density areas as well.

Months of year designation is applicable: April, May, June, July, August, September

Tagging data supporting designation (Y/N): Y

# of tags: 32 tags, 29 individuals

# of years in which supporting tagging data collected: 2007-2016

Supporting information: Straley et al. 2014 & Wild et al. In Review 2021...

Visual observations/records supporting designation (Y/N): Y

# of observations/records: hundreds of records

# of years in which supporting visual data collected: 2003-2020

Supporting information: Fishermen and other surveys contributing sightings over the years that were not identifiable or did not photograph.

Acoustic detections/records supporting designation (Y/N): Y

# of observations/records: >2000 hrs

# of years in which supporting acoustic data collected: 2004-2016

Supporting information: Data comes from PAM sources: towed array and autonomous recording devices, as well as acoustic tags (11 tags placed on 9 individuals). Towed arrays deployed from fishing vessels and research vessels in the vicinity of fishing vessels. Autonomous recording devices set directly on commercial fishing gear, as well as on separate anchored buoylines.

Photo-ID evidence supporting designation (Y/N): Y

# of individuals photographed: 122 individuals

# of years of photo records to compare: 2003-2020

Maximum # of years same individual photographed in area: 10-14

Supporting information: Unpublished data from SEASWAP catalog.
122 individuals in SEASWAP catalog (Straley et al. 2015)

Genetic analyses conducted supporting designation (Y/N): Y

Nature of supporting information: Moderate

Supporting information: Mesnick et al. 2011 used 16 or maybe 11 genetic samples.
SEASWAP has many more, close to 35 or 40 now that haven't been analyzed.

What factors justify the boundary selection?: This F-BIA covers the entire GOA offshore waters of depths 200-2,000m, which is generally considered the outer continental shelf and the continental slope habitat (Figure 5). This delineation is based on satellite tag records, acoustic data, stable isotope diet analysis, sighting data, and conversations with fishermen, scientists, and fisheries managers finding distributions of sperm whales throughout the GOA across the slope habitat (Thode et al. 2007; Sigler et al. 2008; Schakner et al. 2014; Straley et al. 2014; Wild et al. In Review). Satellite tag data from animals tagged on the shelf edge in the eastern GOA show that tagged whales do not move out into the central GOA or off the shelf edge after tagging (Straley et al. 2014, Wild et al. In Review). Acoustic and visual line transect surveys near Kodiak Island that extended off the shelf edge and into the deep ocean also found that sperm whales were predominantly located over the continental slope habitat (Rone et al. 2014 & 2015; Matsuoka et al. 2020; Rice et al. 2021). Matsuoka et al. (2020) noted that sperm whales were widely distributed throughout the GOA on a line transect survey where the water depth was over 1,000 m. Most sightings from fishermen accounts, acoustic moorings, and dedicated vessel-based research trips occurred on the continental slope habitat. Preliminary work using spatial modeling suggests that sperm whales are distributed widely across the GOA slope habitat (Wild et al., In Review). Additional tag work, genetic analysis, and movement modeling could help determine whether the overall BIA should be broken down into smaller areas, or if a hierarchical framework might fit the population better. A majority of the data has been collected in the eastern GOA, and there is a lack of in-depth research in the central and western GOA. Additionally, a majority of sightings are geographically biased because observation effort is primarily on the continental slope, where the fishing activity that funds much of the existing sperm whale research occurs. Thus with high quality data in only one portion of the GOA region, and the other regions needing additional data, the boundary certainty score was determined to be a 2.

Data sources: Southeast Alaska Sperm Whale Avoidance Project (SEASWAP)

Approximate % of population that uses this area for the designated purpose (if known): Unknown

Approximate # of areas known specifically for this behavior (if feeding/cow-calf/mating/migratory) for this population: Unknown

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