Fin Whales!
(especially in British Columbia)

Eric Keen

Abstract
This is a review of the natural history of the fin whale, with special emphasis on those occurring in British Columbian waters, with even more emphasis on those occurring within the Kitimat Fjord System (Gitga’at First Nation marine territory and the study area of CetaceaLab and the Bangarang Project).

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1 Bangarang Backgrounders are imperfect but rigorous reviews – written in haste, not peer-reviewed – in an effort to organize and memorize the key information for every aspect of the project. They will be updated regularly as new learnin’ is incorporated.
Fin Whales
*Balaenoptera physalus* (Linnaeus, 1758)

**Etymology**

*Balaeno-* Baleen (whale)
*ptera* - wing or fin (referring to dorsal fin)

**physalus**

“bellows” (ref. either to its ventral pleats or its blow)\(^2\)
“rorqual whale”\(^3\)
“a kind of toad that puffs itself up” – inflation of ventral pouch during feeding\(^4, 5, 6\)
“a wind instrument” (Grk. *physalis*, perhaps for the flute-like inhalation sound.)

**Other English common names:**

- Finback\(^8\)
- Common rorqual\(^9\)
- Razorback (after the sharp dorsal ridge on her caudal peduncle)\(^10\)
- Herring whale\(^11\)
- True fin whale\(^12\)
- Gibbar\(^13\)
- Finner\(^14\)

**Notable other languages:**\(^15\)

- Norwegian: finefisk, finvhal, sildror,
- Japanese: Nagasu-kujira
- Russian: Finval, seldianoi polostaik, kiit
- German: Finnfisk, sillval, rorval
- Icelandic: Sildrek, seldreki, hunfubaks
- French: Baleine americaine, vraie baleine
- Dutch: Vinvis, gewone vinvis
- Eskimo: Tykyshkok, keporkarnak
- Spanish: Ballena de Aleta
- Italian: Capidolio (not Capidoglio, or sperm whale)

**Taxonomy**

This species was originally described by Frederik Martens in 1675\(^16\), and again by Paul Dudley in 1725.\(^17\) Linnaeus assigned this species the name *Balaena physalus* in 1758.

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\(^2\) Reeves et al. 2002.
\(^3\) Reeves et al. 2002.
\(^4\) Reeves et al. 2002.
\(^5\) Reeves et al. 2002.
\(^6\) Gambell 1985.
\(^7\) Leatherwood and Reeves 1983.
\(^8\) Gambell 1985.
\(^9\) Reeves et al. 2002.
\(^10\) Reeves et al. 2002.
\(^11\) Reeves et al. 2002.
\(^12\) Gambell 1985.
\(^13\) Gambell 1985.
\(^14\) Gambell 1985.
\(^15\) Gambell 1985.
\(^16\) Aguilar 2008
\(^17\) Aguilar 2008
Subsequently, Lacepede moved the species into the newly defined *Balaenoptera* genus in 1804, assigning it the name *Balaenoptera rorqual*. In 1903, Bacovitza synonymized *B. rorqual* with two other redundant descriptions – (1) *B. australis* from Gray 1846, described from voyage of HMS Erebus and Terror, and (2) *B. patachonicus* from Burmeister 1865 -- all under the single name *Balaenoptera physalus*.

As early as 1829, the two hemispheric populations were known to be distinct. The southern population was recognized as subspecies *B.p. quoyi* (Fischer 1829). The northern subspecies is *B. physalus physalus*. The fin whale’s subspecies taxonomy is an area of active research, and revisions are expected (see “Phylogeny”).

**Measurements**

Most sources disagree. All metrics found in the literature are shown.

**At Birth:**
- **Length:** 19'2-21’ (6-6.5m)
- 19'6-23’ (6-7m)
- **Weight:** 4,000 to 6,000 lbs (1,800 – 2,700 kg)
- 2200 – 3300 lbs (1,000 – 1,500 kg)

**Adult**

Sexually mature fin whales are dimorphic; the females are 5-10% longer.

**Maximum Length:**
- Northern hemi.: 79’ (24m)
- Southern Ocean: 89’ (27.1m)

**Average Length:**
- Northern hemi.: 70’ (21.5m)
- 72’ – 78’ (22-24m)
- 59’-75’ (17 – 23m)
- 74’ (22.5m) for females, 68’ (21m) avg. for males
- Southern Ocean: 82 – 89’ (25-27m)
- 85’ (26m) average female, 82’ (25m) average males

Note that body weight can vary substantially throughout the year due to winter fasting. The result is that the relative mass of body tissue varies seasonally according to nutritive condition.

**Maximum Weight:**
- 260,000 lbs (120,000 kg, 117 metric tons)
- 198,000 lbs (90,000 kg, 90 metric tons)
Average Weight:
Northern hemi: 88,184 – 110,230 lbs (40,000 – 50,000 kg, 40-50 metric tons)\(^{39}\)
92,000 lbs (42,150 kg, 42.14 metric tons)\(^{40}\)

Southern Ocean: 132,000 – 176,370 lbs (60,000 – 80,000 kg, 60-80 metric tons)\(^{41}\)
176,370 lbs (80,000 kg, 80 metric tons.)\(^{42}\)

Organ Weights
The largest captured Antarctic female fin whale (total weight: 57 tons) that was weighed organ by organ yielded the following results.\(^{43}\)

- Ovaries: 2.7 ton ovaries
- Blubber: 13.78 tons of blubber
- Meat: 25.22 tons of meat
- Heart: 0.13 ton heart
- Bone: 11.42 tons of bone
- Skull: 2.62 ton skull
- Vertebrae: 4.76 tons of vertebrae
- Mandible: 1.25 ton jaw

Of interest: the fin whale’s right lung is known to be 10% heavier than the left.\(^{44}\)

Description
The fin whale is the second largest animal on earth\(^{45}\), but of the great whales she is the fastest in the ocean.

BODY SHAPE
The fin whale’s slender, sleek fusiform body is greatly compressed towards the caudal region\(^{46}\). Her maximum girth is 40-50% of her total length.\(^{47}\)

PIGMENTATION - BODY
Dark gray above and white- to cream-colored below.\(^{48}\)
Flukes are bordered with gray underneath.\(^{49}\)
Individuals can be identified by means of scarring, pigmentation patterns, dorsal fin shapes, and/or dorsal nicks\(^{50}\).

PIGMENTATION - JAW
The right mandible is white (mneumonic: “White on Right”), a trait diagnostic for fin whales\(^{51}\).
This pale coloration is also found on the right front baleen plates\(^{52}\).

PIGMENTATION – HEAD
Fin whales have strikingly asymmetrical head pigmentation\(^{53}\).

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\(^{39}\) Aguilar 2008
\(^{40}\) Barlow et al. 2008.
\(^{41}\) Aguilar 2008
\(^{42}\) Eder 2001.
\(^{43}\) Nishiwaki 1950.
\(^{44}\) Aguilar 2008
\(^{45}\) Reeves et al. 2002.
\(^{46}\) Gambell 1985.
\(^{47}\) Aguilar 2008
\(^{48}\) Reeves et al. 2002.
\(^{49}\) Reeves et al. 2002.
\(^{51}\) Reeves et al. 2002.
\(^{52}\) Reeves et al. 2002.
\(^{53}\) Aguilar 2008
They boast a V-shaped Chevron pattern across the back behind head (this is used for photo-identification)\textsuperscript{54} as well as swirls of pigmentation ("blazes") on the right side of the head\textsuperscript{55}. A dark stripe runs up and back from each eye.\textsuperscript{56}

**HEAD & ROSTRUM**

The fin whale’s highly pointed rostrum contributes greatly to its sleek look. The head occupies 20-25\% of the body length\textsuperscript{57}. When the mouth is closed the lower jaw extends 10-20cm beyond top of the snout.\textsuperscript{58}

**BLOW:** The fin whale’s blow is tall and columnar\textsuperscript{59}, 13'-19'6 (4-6m) in height\textsuperscript{60, 61}.

**BALEEN**

260 to 480 plates\textsuperscript{62} of black or olive green baleen\textsuperscript{63} (except for the cream-colored plates on the anterior right), a maximum of 70cm in length\textsuperscript{64}, can be found on each side of the mouth.

**VENTRAL PLEATS**

50-100 pleats\textsuperscript{65} of the fin whale’s ventral groove blubber extend from the mandible at least to the umbilicus\textsuperscript{66}.

**FECES:** Fin whale feces appear as bright orange, football-sized floating masses\textsuperscript{67}.

**DORSAL**

This specie’s namesake dorsal fin can be up to 2’ (60cm) tall\textsuperscript{68}, is 2.1-2.5\% of the body length\textsuperscript{69}, and is located at 75\% of the total body length\textsuperscript{70}. This is larger than that of blue whales, but lower than in Sei and Bryde’s whales. The fin whale’s dorsal is variably shaped and unique in every individual and is used by researchers for photo-identification\textsuperscript{71}. The dorsal’s leading edge rises smoothly from the back at an angle of approximately 40 degrees\textsuperscript{72, 73}. This smooth curve is in contrast to the sharp onset of the dorsal found in sei and Bryde’s whales.

**FINS**

The fin whale’s acute tail flukes have a conspicuous central indentation.\textsuperscript{74} The pectoral fins are relatively small and lancet-like\textsuperscript{75} and are 7.5-9.9\% of total body length.

**AT SURFACE**

Fin whales surface with their blowholes showing before their dorsal does. When a fin whale begins its dive, it “appears to wheel over”\textsuperscript{76} and raises its body further out of the water. However, it almost never flukes.

**SIMILAR SPECIES**

The fin whale is most easily confused with the Sei and Bryde’s whales.\textsuperscript{77} However, both these smaller species lack the distinctive facial coloration of the fin whale and their highly falcate dorsal fins are set further forward on

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\textsuperscript{54} Reeves et al. 2002.
\textsuperscript{55} Reeves et al. 2002.
\textsuperscript{56} Gambell 1985.
\textsuperscript{57} Gambell 1985.
\textsuperscript{58} Gambell 1985.
\textsuperscript{59} Reeves et al. 2002.
\textsuperscript{60} Gambell 1985.
\textsuperscript{61} Eder 2001.
\textsuperscript{62} Reeves et al. 2002.
\textsuperscript{63} Reeves et al. 2002.
\textsuperscript{64} Aguilar 2008
\textsuperscript{65} Ivashin 1972
\textsuperscript{66} Reeves et al. 2002.
\textsuperscript{67} Richard 1936, Orsi Relini & Cappello 1992
\textsuperscript{68} Gambell 1985.
\textsuperscript{69} Gambell 1985.
\textsuperscript{70} Aguilar 2008
\textsuperscript{71} Reeves et al. 2002.
\textsuperscript{72} Gambell 1985.
\textsuperscript{73} Leatherwood and Reeves 1983.
\textsuperscript{74} Gambell 1985.
\textsuperscript{75} Gambell 1985.
\textsuperscript{76} Gambell 1985.
\textsuperscript{77} Reeves et al. 2002.
their backs. Unlike the wheel-like surfacing of fin whales, in which the blowholes first appear then the dorsal, Bryde's whales show the two at once.

Less similar species include the blue and humpback whales. The blue whale, besides being much larger, has blue-gray mottling, a much smaller dorsal fin, and a broad and blunter head. The humpback is darker, smaller, and stockier than the fin whale, and frequently raises its flukes when diving.

**Phylogeny**

**Higher Order**
Within the mammalian taxon Cetacea, fin whales are mysticetes (baleen whales). The fin whale’s closest living relative is the humpback whale, from which it diverged 6-7 million years ago. The humpack-fin clade is sister to the gray whale, and the humpback-fin-gray clade is sister to the remainder of the rorqual whales.

The fin whale shares the same chromosome number (2n=44) with its congenics. Although the blue whale is not the fin’s closest living relative, several blue-fin hybrids have been described. In one case, a female hybrid was pregnant. No humpback-fin whale has been described.

**Subspecies**

Within the fin whale species, the taxonomy of geographically separate populations has come into question. There are small variations in body proportion and coloration among fin whales from various regions of the world’s oceans. For instance, flippers of whales from the northern hemisphere have been described as shorter and broader than those of their southern counterparts. The Society of Marine Mammalogy currently recognizes

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78 Reeves et al. 2002.
79 Reeves et al. 2002.
80 Reeves et al. 2002.
81 Reeves et al. 2002.
84 Aguilar 2008
85 Aguilar 2008
86 Aguilar 2008
88 Aguilar 2008
89 Aguilar 2008
three subspecies\textsuperscript{90}: \textit{B. p. physalus} (Linnaeus 1758) in the Northern Hemisphere, \textit{B. p. quoyi} (Fischer 1829) in the Southern, and \textit{B. p. patachonica} (Burmeister 1865), the pygmy fin whale recently described by Clarke (2004) based on a stranding at the mouth of Rio de la Plata in Argentina.

Given that the Isthmus of Panama closed 4 million years ago\textsuperscript{91} and that the species’ range does not extend into the Arctic passages, it is likely that Atlantic and Pacific fin whales have been isolated for some time and probably should not be considered the same subspecies.\textsuperscript{92} A 2013 paper on mitogenomic phylogenetics confirms this suspicion.\textsuperscript{93} Current data suggest that fin whales from all oceans share a common ancestor that lived 2 million years ago\textsuperscript{94}. North Pacific fin whales diverged from the Southern Ocean/Atlantic Ocean population 1.94 mya\textsuperscript{95}, probably due to the the immigration of a Southern Ocean group across the equator. The North Atlantic/Mediterranean fin whales diverged from the southern hemisphere group approx.1 mya\textsuperscript{96}. Significant genetic\textsuperscript{97} and acoustic\textsuperscript{98} differences separate the Mediterranean and North Atlantic populations\textsuperscript{99}.

In the species’ phylogenetic tree, North Pacific fin whales are distributed in three clades, meaning they are polyphyletic and suggesting there were at least three colonizations of the North Pacific by Southern Hemisphere fin whales: the original immigration that established a North Pacific population, then two subsequent colonizations in the 2 million years since. It does not seem like this immigration was two-way; no North Pacific haplotypes are found in the Southern hemisphere. This strongly indicates that Northern Hemisphere fin whales should be assigned to multiple subspecies, but further study is needed. As a result of the Archer et al. (2013) study, the global taxonomy of the species may go into revision soon.\textsuperscript{100}

**North Pacific fins**

Perhaps as a result of these multiple colonizations of the North Pacific, fin whale population structure within the ocean basin is unclear\textsuperscript{101}. Although it has been suggested that fin whale populations break into independent breeding units\textsuperscript{102}, that structure has not been detected in genetic studies. Panmixia is not assumed\textsuperscript{103}, but the actual structure remains unknown.

Mizroch et al. (1984) cites evidence for subpopulations in the North Pacific\textsuperscript{104}. Gambell (1985) writes, “In the North Pacific there is evidence from whale marking, blood typing, and morphological analyses for three stocks – on the eastern and western sides which intermingle and overlap to varying extents in the Aleutian area, and in the east China Sea.”\textsuperscript{105} The International Whaling Commission recognizes two stocks of fin whales in the North Pacific: East China Sea and the rest of the North Pacific\textsuperscript{106}. The MMPA stock assessment reports recognize three stocks of fin whales in the North Pacific: 1) the Cal/OR/WA stock, 2) the Hawaii stock, and 3) the Alaska stock. The Archer et al. (2013) mitogenomics data hinted at a divide to the north and south of Pt. Conception in southern California. However, none of these studies are conclusive. Fujino (1964) suggested an isolated stock existed off BC, in addition to eastern and western N Pacific stocks.\textsuperscript{107}

**British Columbia fins**

The increasing presence of fin whales in BC waters over the course of the season and the presence of mature females throughout the season supports Fujinon’s (1964) hypothesis that BC fin whales comprise a discrete population.\textsuperscript{108} However, it is also possible that BC fin whales belong to populations to the north or south\textsuperscript{109}.

\textsuperscript{90} Committee on Taxonomy 2012.
\textsuperscript{91} Kiegwin 1978
\textsuperscript{92} Archer et al. 2013
\textsuperscript{93} Archer et al. 2013
\textsuperscript{94} Archer et al. 2013
\textsuperscript{95} Archer et al. 2013
\textsuperscript{96} Archer et al. 2013
\textsuperscript{97} Berube et al. 2002, Berube et al. 1998.
\textsuperscript{98} Castellote et al. 2011.
\textsuperscript{99} Notobartolo-di-Sciara et al. 2003.
\textsuperscript{100} Archer et al. 2013
\textsuperscript{101} Gregr et al. 2006.
\textsuperscript{102} Aguilar 2008, Berube et al. 1998
\textsuperscript{103} Carretta et al. 2011.
\textsuperscript{104} Mizroch et al. 1984
\textsuperscript{105} Gambell 1985.
\textsuperscript{106} Donovan 1991
\textsuperscript{107} Fujino 1964.
\textsuperscript{108} Gregr et al. 2000
\textsuperscript{109} Gregr et al. 2006.
According to Gregr et al. (2006), “there is no way to presently determine whether animals sighted in Pacific Canadian waters are from either of the [California-Oregon-Washington and Alaska] stocks defined by NMFS [National Marine Fisheries Service]. Indeed, there is currently no evidence to determine whether these two putative stocks are truly distinct populations or whether they represent a single, eastern North Pacific population.” These populations are thought to move seasonally between international, Canadian, US, and possibly Mexican territorial waters.

Range and Habitat

General
The fin whale can be found in all major oceans, but it is usually confined to the temperate and polar latitudes. It is almost never seen near the equator or the ice limit in extreme latitudes. In the North Pacific, fin whales are rarely encountered south of the Baja Peninsula.

Fin whales can also be found in relatively confined seas. Fin whales are the only mysticetes found regularly in the Mediterranean Sea, where an estimated 900 individuals concentrate in the Corsican-Ligurian Basin. There is also a resident population in the Gulf of California. However, there are similar habitats in which they are not found: the eastern Mediterranean, the Baltic Sea, the Persian Gulf, the Red Sea, and equatorial seas.

British Columbia
Fin whales occur in Pacific Canadian waters year-round, with highest numbers seen in the summer months. The range of the whales that occur in BC waters is unknown but it may extend from the Aleutians to Southern California. During the summer, the fin whale’s distribution is concentrated between Vancouver Island and the Aleutians.

Historically, fin whales were observed in BC’s exposed coastal area (Hecate Strait and Queen Charlotte Sound) and occasionally in more protected waters of Queen Charlotte Strait, the Strait of Georgia, and the Intra-Coastal Zone (ICZ). Only 17% of fin whale kills (1908-1967) for which positions were recorded by BC coastal whalers were on the continental shelf. The Kitimat Fjord System was one of the few areas within the ICZ that were used by fin whales, which may speak to the unique inland habitat it offers.

Whaling data (1943 – 1967, from Coal Harbour) suggest a seasonal trend in fin whale presence in the study area and other sectors of the ICZ.

Next page, from Gregr and Trites (2001): Fin whale monthly probability predictions overlaid with the positions of whale kills between 1943 and 1967. Dark areas represent a high probability of whale occurrence. The zoomed-in figures of the study area are screenshots taken by EM Keen.
a) April (44 kills, 0 in study area).

b) May (404 kills, 0 in study area)

c) June (620 kills, 1 in study area)

d) July (727 kills, 6 in study area)

e) August (828 kills, 3 in study area)

f) September (410 kills, 10 in study area)

April: None caught in ICZ (Intra-Coastal Zone) or study area.

May: One in Hecate Strait, 2 near Dixon Entrance. None caught in ICZ or study area.

June: 9 caught within Hecate Strait, 8 in Dixon Entrance, and 1 in the study area: 1 right on the border of Caamano Sound.

July: Many in QC Sound, 10 in Hecate Strait, 20 in Dixon Entrance, 5 in outer Milbanke Sound, and 7 in the study area: 4 in Caamano Sound, 1 in Campania Sound, 1 in what looks like Taylor Bight (south Gil Island), 1 in Estevan Sound.

August: 26 in Eastern Hecate Strait, 15 in Dixon Entrance, 7 in Milbanke Sound (one of which is FAR up a fjord), and 3 in the study area: 2 in Campania, 1 near Fawcett Pt in Squally Channel.

September: 8 in E Hecate, 2 in QC Sound, 1 far up fjords in Milbanke Sound, 7 in Dixon Entrance, and 9 in the study area: 8 in Caamano Sound, 1 near fin island in Squally.
Over the course of BC whaling’s second era (1948 to 1967), the distance of capture from the nearest shore increased significantly until they were extirpated from coastal waters entirely.

In the early 2000’s, sightings of fin whales in Pacific Canadian waters were predominantly from the west coast of Vancouver Island, Hecate Strait, and QC Sound, and occurred in summer and winter. Fin whales were considered to prefer offshore waters but to sometimes stray into Hecate Strait, Queen Charlotte Sound, and occasionally Queen Charlotte Strait. The waters off Vancouver Island have been suggested to contain a summer feeding aggregation.

The Department of Fisheries and Oceans (DFO)-is actively surveying the coast to define critical habitat areas for BC waters (see “Current Research” section at end). These DFO surveys found fin whales widely distributed over BC’s continental shelf with concentrations found in the most productive whaling grounds: west of Vancouver Island and Haida Gwaii, in Queen Charlotte Sound, in southern Hecate Strait, and in Dixon Entrance. They were also encountered in the confined waterways of Caamaño Sound and Squally Channel in the Kitimat Fjord System.

Proximity to Shore
Most of the literature refers to fin whales as a shelf, slope, and/or offshore species:

“Tend to concentrate in coastal and shelf waters, but can be found in the deep ocean.”

“Occurs throughout the world in both near-shore and deep waters beyond the edge of the continental shelf.”

“The only recent record from sheltered waters is of a dead fin whale pushed into Tacoma in 1985 by the bow of a freight vessel.”

“Mediterranean fin whales are sighted almost exclusively offshore (mean water depth of sightings: 2,248m), though there have been instances of near-coast sightings.”

However, fin whales have been seen in the inland/intra-coastal waters of the Gulf of St. Lawrence and Bay of Fundy.

Seasonal Movements
Southern Ocean fin whales are known to follow migration patterns typical of intermediate-sized mysticetes: regular seasonal movements between temperate waters where mating and calving occur, and more polar feeding grounds (Mackintosh 1965). They move toward poles in spring and toward the equator in fall. Their migration routes seem to follow areas of low geomagnetic intensity and gradient. Not all components of the population’s demographics move together; pregnant females are the first to initiate movement while lactating females and juveniles of both sexes are the last to migrate. It is thought that northern and southern hemisphere populations do not come into contact because of their alternate migration schedules. This lack of contact has led to genetic isolation.

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130 Gregr et al. 2000
131 Gregr et al. 2006.
132 Spalding 1996.
133 Pike and MacAskie 1969
134 Ford et al. 2010a
135 Reeves et al. 2002.
136 Creswell et al. 2007.
137 Spalding 1996.
139 Zanardelli et al 1992
140 Notobartolo-di-Sciara et al. 2003.
141 Sergeant 1977, Ray et al 1978
142 Gambell 1985.
143 Aguilar 2008
144 Leatherwood and Reeves 1983.
146 Aguilar 2008
147 Aguilar 2008
148 Aguilar 2008
Earlier literature (and some field guides still) report similar migration patterns in the northern hemisphere\textsuperscript{149,150}. There does seem to be seasonal movement of some kind, but its pattern and extent is still unclear\textsuperscript{151,152}. Mediterranean fin whales remain in their semi-enclosed basin year-round, meaning they calve there\textsuperscript{153}. In the Northeast Pacific, fin whales have been said to winter in waters from southern California down to 20 degrees South\textsuperscript{154}, and summer from central California into the Chukchi Sea.\textsuperscript{155} However, northeast Pacific (NEP) fin whales are found over a broad latitudinal range throughout the year. Some whales remain in higher latitudes during the coldest months of the year or in low latitudes year-round if food is available\textsuperscript{156}. BC whaling records show that fin whales were regularly caught north of 40 degrees latitude in the winter months\textsuperscript{157}. There are fin whale aggregations year-round in southern/central California\textsuperscript{158,159,160}, in the Gulf of California\textsuperscript{161}, in summer in Oregon\textsuperscript{162,163}, and in summer/autumn in Shelikof Strait/ the Gulf of Alaska\textsuperscript{164}. Acoustic signals are detected year-round off northern California, Oregon, and Washington, with a concentration of activity between Sept. and Feb\textsuperscript{165}.

It is unknown where BC fin whales go in the winter. In the BC whaling years, distance from shore changed significantly from month to month for female fin whales.\textsuperscript{166} However, the proportion of pregnant females killed remained constant, suggesting reproductive state did not influence seasonal movements\textsuperscript{167}. The 20 Hz call has been observed offshore of BC, suggesting that fin whale breeding may be occurring in this area\textsuperscript{168}. Conversely, whaling data do suggest age-structured movements. Larger individuals arrived in British Columbian waters ahead of small ones\textsuperscript{169} and shelf catches were primarily of immature animals\textsuperscript{170,171}, suggesting that BC waters were a feeding ground primarily for sub adult animals\textsuperscript{172}.

These loose patterns (or lack thereof) have led to several alternative hypotheses to stereotyped migration. It has been suggested that some populations may shift in winter to occupy the summer habitats of others\textsuperscript{173}. But the prevailing idea is that, in the North Pacific, fin whale individuals “that concentrate near the coast in the feeding season tend to disperse into open waters during the winter, therefore being more difficult to detect.”\textsuperscript{174}
Reproduction

Life History
Fin whale population sex ratio is 1:1\textsuperscript{175}. Sexual maturity is reached at 18.3m (females) and 17.7m (males) in the north Pacific\textsuperscript{176}, and 20m and 19m, respectively, in the southern hemisphere\textsuperscript{177}. These lengths correspond to approximately 6-7 years in males and 7-8 years in females.\textsuperscript{178} Age of first parturition and birth rates diminished during the height of whaling.\textsuperscript{179}

Males grow faster than females but stop growing sooner.\textsuperscript{180} Physical maturity (defined by ossification of vertebral column) happens at \textasciitilde25 yrs. in both sexes.\textsuperscript{181} Longevity has not been determined, but individuals of up to 80-90 years old are known.\textsuperscript{182}

Mating
Very little is known about the species’ mating system\textsuperscript{183}; mating has never been observed. No distinct breeding or calving grounds have been identified for the fin whale.\textsuperscript{184} Considering the proportionally reduced mass of male fin whale testes, the species’ mating system probably relies on competition among males for females (with no sperm competition).\textsuperscript{185} Chasing has been observed among pairs of fin whales or groups of three in late autumn on the feeding grounds. This behavior is possibly related to courtship.\textsuperscript{186} Interspecific mating between the fin and blue whales has been known to occur.\textsuperscript{187}

In the northern hemisphere, the mating period is Dec. – Feb.; in the southern hemisphere, it is May to July.\textsuperscript{188} Breeding – calving and mating is believed to occur in the winter.\textsuperscript{189,190} In the Mediterranean, births peak in Nov. but occur throughout the year at lower rates\textsuperscript{191}.

Calving
Gross pregnancy rates (number of pregnant females in relation to that of adult females) are between 38-49\%\textsuperscript{192}. Gestation is 11-12 months.\textsuperscript{193} Females give birth every 2-3 years to a single calf.\textsuperscript{194} Twins have been observed in utero, but there is no evidence that any survive.\textsuperscript{195} Calves stay with their mother for 6-8 months, when the calf is 11-13m long.\textsuperscript{197} This weaning is followed by 6 months of rest and recuperation for the mother, after which mating takes place again.\textsuperscript{198}

\textsuperscript{175} Clapham et al 1997
\textsuperscript{176} Gambell 1985.
\textsuperscript{177} Aguilar 2008
\textsuperscript{178} Aguilar 2008
\textsuperscript{179} Gambell 1985.
\textsuperscript{180} Aguilar 2008
\textsuperscript{181} Aguilar 2008
\textsuperscript{182} Aguilar 2008
\textsuperscript{183} Reeves et al. 2002.
\textsuperscript{184} Reeves et al. 2002.
\textsuperscript{185} Aguilar 2008
\textsuperscript{186} Reeves et al. 2002.
\textsuperscript{187} Reeves et al. 2002.
\textsuperscript{188} Aguilar 2008
\textsuperscript{189} Reeves et al. 2002.
\textsuperscript{190} Leatherwood and Reeves 1983.
\textsuperscript{191} Notobartolo-di-Sciara et al. 2003.
\textsuperscript{192} Leatherwood and Reeves 1983.
\textsuperscript{193} Reeves et al. 2002.
\textsuperscript{194} Reeves et al. 2002.
\textsuperscript{195} Reeves et al. 2002.
\textsuperscript{196} Reeves et al. 2002.
\textsuperscript{197} Aguilar 2008
\textsuperscript{198} Aguilar 2008
Behavior

Surface Behavior
Fin whales practice a wheel-like surfacing, in which the blowholes first appear then the dorsal.\textsuperscript{199} The fin whale rarely raises its flukes when diving\textsuperscript{200,201}.

Aerial Behavior
It seems that, in most populations of fin whales, breaching is rare.

“Breaching is very rare, except when the whale is harassed.”\textsuperscript{202}

“They do breach on occasion.”\textsuperscript{203}

This author has observed fin whales porpoising in the confined channels of BC in what looked like a particularly energetic feeding frenzy.

The one population in which breaching seems more regular is in the Mediterranean Sea. Breaching was observed in 4\% of sightings in the Tyrrhenian Sea\textsuperscript{204}, and in 6.9\% of sightings in the Ligurian-Corsican-Provencal Basin (1990-1999).\textsuperscript{205} The mean number of consecutive breaches there is 2.45 (range=1-6)\textsuperscript{206}.

\textsuperscript{199} Reeves et al. 2002.
\textsuperscript{200} Reeves et al. 2002.
\textsuperscript{201} Gambell 1985.
\textsuperscript{202} Reeves et al. 2002.
\textsuperscript{203} Leatherwood and Reeves 1983.
\textsuperscript{204} Marini et al 1996c
\textsuperscript{205} Notobartolo-di-Sciara et al. 2003.
\textsuperscript{206} Notobartolo-di-Sciara et al. 2003.
\textsuperscript{207} www.tethys.org
Speed

Bursts

Known as the “greyhound of the sea”\textsuperscript{208}, fin whales are the fastest of the large whales\textsuperscript{209}. Their top speed bursts have been reported as 11 knots\textsuperscript{210}, 25 knots\textsuperscript{211}, “over 20 knots”\textsuperscript{212}, “in excess of” 17.3 knots\textsuperscript{213}, and 15 knots\textsuperscript{214}.

Sustained swimming

Sustained cruising speed has been reported as 5-8 knots\textsuperscript{215}, 3.5-7.5 knots in the Northeast Pacific (discerned through acoustic localization)\textsuperscript{216}, 4.9 knots\textsuperscript{217}, 2.0-7.8 knots near Iceland\textsuperscript{218}, and 2.7 knots in the Mediterranean (averaged from 24 focal follows)\textsuperscript{219}. Tag data suggest that during sustained travel fin whales cover between 90 and 180 miles a day\textsuperscript{220}.

Respiratory Cycles

A respiratory cycle is composed of a dive, or prolonged apnoea phase, then a near-surface period of frequent breathing. The most rigorous respiration interval study for fin whales was conducted in the Mediterranean: 2068 breaths organized in 477 respiratory cycles were recorded\textsuperscript{221}. In the Mediterranean, the near-surface period averaged 62 seconds in length with an average of 4.6 breaths\textsuperscript{222}.

Diving

Fin whales practice very shallow dives between their breaths followed by a deep dive during their prolonged apnoea phase. The mechanics and evolution of fin whale dive behavior has been thoroughly studied (see the Lunge Feeding Backgrounder for more).

The average dive time for Mediterranean fin whales was 3.75 minutes\textsuperscript{223}. The longest recorded dives are as long as 16.9 minutes, which is much shorter than their Theoretical Aerobic Dive Limit (TADL) of 28.6 min\textsuperscript{224}. This is due either to the dispersal behavior of prey or the high energetic cost of foraging\textsuperscript{225}.

The deep dive occurs during both traveling and feeding, though the depth and duration of the dive changes by behavioral context. Foraging dives are deeper and longer in duration than traveling dives and are characterized by vertical excursions where lunging occurs\textsuperscript{226}. In California waters, fin whales dived to 97.9m and for 6.3 min when foraging and to 59.3m and for 4.2 min when not foraging\textsuperscript{227}.

In a foraging dive, lunges into the prey field occur at depth. These lunges are vertical excursions of 21.2m or more that occur an average of 1.7 times per dive (maximum of 8)\textsuperscript{228}. Lunges seem to occur during ascent, making the rate of ascent higher than that of descent during a dive\textsuperscript{229}.

Dive Depth

Fin whales are generally deeper divers than blue and sei whales. Median depths reported for foraging dives (deeper than traveling dives) are between 100 and 230m\textsuperscript{230}. The deepest dives known for the species have been observed in the Mediterranean\textsuperscript{231}. Dive depths exceeding 470m have been observed twice, dives of at

\textsuperscript{208} Reeves et al. 2002.
\textsuperscript{209} Reeves et al. 2002.
\textsuperscript{210} Watkins 1981
\textsuperscript{211} Reeves et al. 2002.
\textsuperscript{212} Gambell 1985.
\textsuperscript{213} Leatherwood and Reeves 1983.
\textsuperscript{214} Leatherwood and Reeves 1983.
\textsuperscript{215} Aguilar 2008
\textsuperscript{216} Aguilar 2008
\textsuperscript{217} McDonald et al. 1995.
\textsuperscript{218} Ray 1978.
\textsuperscript{219} Watkins et al 2006
\textsuperscript{220} Lafortuna et al. 2003.
\textsuperscript{221} Lafortuna et al. 2003.
\textsuperscript{222} Lafortuna et al. 2003.
\textsuperscript{223} Croll et al. 2001.
\textsuperscript{224} Croll et al. 2001.
\textsuperscript{225} Croll et al. 2001.
\textsuperscript{226} Croll et al. 2001.
\textsuperscript{227} Croll et al. 2001.
\textsuperscript{228} Croll et al. 2001.
\textsuperscript{229} Panigada et al 1999.
least 150m were routinely performed around sunset\textsuperscript{232}, and the maximum observed dive depth on record is 565m\textsuperscript{233}.

**Social Associations**

**Mean Group Size**  Fin whales are usually found travelling alone or in small groups\textsuperscript{234}. Here we define a group, after Notobartolo-di-Sciara et al. (2003), as “affiliations in which two or more individuals swim side by side within 1-2 body lengths and generally coordinate at least their surfacing and diving, as well as their speed and direction of movement.”\textsuperscript{235}

In the Mediterranean mean group size is 1.4, which is slightly less than reported elsewhere.\textsuperscript{236} In our study area, the confined channels of BC’s north coast, observations from 2007-2010 reveal an average group size of 1.8, ranging from 1 to 6.\textsuperscript{237} Field guides have cited common group sizes of “single or in pairs…3 to 10 to 20”\textsuperscript{238} and “3 to 7 individuals”.\textsuperscript{239} Larger groups may coalesce into a broad concentration of 100 or more unassociated individuals\textsuperscript{240} on feeding grounds.\textsuperscript{241}

**Group Stability**  Stable groups appear to be rare in fin whales\textsuperscript{242}. The only stable social interaction is between mom-calf pairs and this interaction vanishes at weaning\textsuperscript{243}. Fin whales are sometimes associated with blue whales\textsuperscript{244} and humpback whales\textsuperscript{245}.

\textsuperscript{232} Notobartolo-di-Sciara et al. 2003.
\textsuperscript{233} Panigada et al. 2003.
\textsuperscript{234} Reeves et al. 2002.
\textsuperscript{235} Clapham 2000.
\textsuperscript{236} Notobartolo-di-Sciara et al. 2003.
\textsuperscript{237} Pilkington et al. 2011.
\textsuperscript{238} Gambell 1985.
\textsuperscript{239} Leatherwood and Reeves 1983.
\textsuperscript{240} Reeves et al. 2002.
\textsuperscript{241} Gambell 1985.
\textsuperscript{242} Reeves et al. 2002.
\textsuperscript{243} Aguilar 2008
\textsuperscript{244} Reeves et al. 2002.
\textsuperscript{245} this author, unpubl.
Acoustics

All fin whale populations of the world are known to vocalize. Both male and female fin whales make very loud, low-frequency vocalizations that can travel over hundreds of miles in deep water (reviewed in Edds-Walton 1997). The bandwidth used by fins is 14-750 Hz, with most of their energy in the 20-40 Hz range.

Propagation

Fin whale moans can be heard for at least tens and probably hundreds of kilometers. Payne and Webb (1971) estimated source level of 65-100 dB re: 1 dyne/cm² at 1 yard, probably 80 dB. This call could be heard from 45 miles away (assuming spherical loss) to 525 miles (through the deep-sound channel). In ideal conditions (which would never occur in reality), 700 miles would be the upper limit. In practice, Southern Ocean fin whales have been detected up to 56km from the recorder. The average source level for these calls is 189 ± 4dB re: 1 microPa -1m over 15-28 Hz.

The implications of this propagation is that “fin whales...may be in tenuous acoustic contact throughout a relatively enormous volume of ocean and that such contact might be of use for finding each other or for joining, or keeping together in, widely dispersed herds.”

Adaptive Acoustics

The reason for fin whale vocalizations may never be fully understood. The long-distance communication may allow mating to occur without the need for aggregating on breeding grounds; this may explain why winter breeding grounds have not yet been found for fin whale populations. If male fin whale songs (the 20 Hz pulses, below) attract females from great distances to aggregations of patchily distributed prey, as has been proposed, there could be some functional association between food resources and male reproductive display.

Fin whale calls are probably not acting as vertical sonar; they are too low frequency and unnecessarily loud for that. However, it is possible that the calls serve as a kind of horizontal radar, using countercalling among the pod to measure oceanic sound speed profiles. The amplitudes of the horizontal travel path of an incoming call and those of its reflected paths off the sea surface and seafloor could be compared. The ratios of these amplitudes may be indicative of sound speed and temperature profiles, which are results from changes in the depth of the thermocline (which control productivity in an area). If so, fin whales may be able to remotely assess the productivity of a foraging ground. This needs to be tested, and who the heck knows how that is going to happen?

Call Types and Descriptions

Regional differences in fin whale call types have been found between Gulf of California and several Atlantic and Pacific regions. Worldwide, however, calls can be placed into 3 general groups: 1) the stereotyped, “classic” 20 Hz pulse; 2) the irregular higher frequency (30-90 Hz) downswept call; and 3) “other.” All of their calls are frequency modulated downward.

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246 Reeves et al. 2002.
250 Sirovic et al. 2007.
251 Payne and Webb 1971.
253 Croll et al. 2002.
254 Clark et al. 2002.
255 McDonald et al. 1995.
256 Clark 1993.
257 McDonald et al. 1995.
258 McDonald et al. 1995.
259 Aguilar 2008.
261 Clark et al. 2002.
263 McDonald and Fox 1999.
Regular 20 Hz Downswept Pulse
The classic, stereotyped pulse contains energy between 28 and 15 Hz\textsuperscript{264} with most around 20 Hz, has a downward sweep in frequency of about 6 Hz\textsuperscript{265}, and has little or no harmonic energy. In the Mediterranean, this pulse modulates from 25 to 19 Hz\textsuperscript{266}. The pulse direction is 0.8s\textsuperscript{267} to 1s\textsuperscript{268,269}. The interval between pulses ranges from 6 to 46 seconds\textsuperscript{270}, with reported averages of 30 seconds\textsuperscript{271} and 19 seconds in the California Current\textsuperscript{272}.

From Ford et al. 2010b:

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure11.png}
\caption{Example from a series of stereotyped 20 Hz pulses produced by fin whales at Unior Seamount. Spectrogram parameters: 512 pixels image height, 162.83 Hz max frequency, 512 FFT size, Hanning window.}
\end{figure}

It is believed that the 20 Hz pulse is a male breeding call\textsuperscript{273}. In the Eastern North Pacific, the 20 Hz pulse is seasonal with most calling occurring between October and April, coinciding with the winter breeding period, and little calling occurring during the summer months\textsuperscript{277}. These calls have been heard in association with courtship displays (Watkins 1981) in the W North Atlantic\textsuperscript{278}, perhaps to attract females from great distances to prey aggregations\textsuperscript{279}.

Irregular 30-90 Hz Downswept Pulse
These “high frequency” fin whale calls are still all under 100Hz. The downsweep has been reported to occur between 75 and 40 Hz\textsuperscript{280} or between 90 and 30 Hz\textsuperscript{281}. The irregular series can last from only a few minutes to more than a day. These irregular calls generally represent only a small fraction of fin whale calls, but in the

\textsuperscript{264} Castellote et al. 2012.
\textsuperscript{265} Watkins et al. 1987, Thompson et al. 1992
\textsuperscript{266} Notobartolo-di-Sciara et al. 2003.
\textsuperscript{267} Ford et al. 2010.
\textsuperscript{268} Notobartolo-di-Sciara et al. 2003.
\textsuperscript{270} Watkins et al 1987
\textsuperscript{271} Rothenberg 2008.
\textsuperscript{272} McDonald et al. 1995.
\textsuperscript{273} Watkins et al 1987
\textsuperscript{274} Croll et al 2002
\textsuperscript{275} Watkins et al 1987
\textsuperscript{276} Reeves et al. 2002.
\textsuperscript{277} Watkins et al 1987 and Watkins et al 2000
\textsuperscript{278} Gambell 1985.
\textsuperscript{279} Croll et al 2002
\textsuperscript{280} Gambell 1985.
\textsuperscript{281} McDonald and Fox 1999
North Pacific during the summer they can comprise 90% of all calls recorded\textsuperscript{282}. Irregular calls seem to be used in a variety of behavioral contexts\textsuperscript{283}, perhaps for communication among nearby fin whales\textsuperscript{284}.

\textit{From Ford et al. 2010b:}

\begin{figure}
\centering
\includegraphics[width=\textwidth]{example_image.png}
\caption{Example of an irregular repetition interval call type produced by fin whale(s) at Union Seamount. Spectrogram parameters: 512 pixels image height, 162.83 Hz max frequency, 512 FFT size, Hanning window.}
\end{figure}

Other
“Ragged” low-frequency pulses and “rumbles” have also been reported\textsuperscript{285}. In the Mediterranean, a narrow-band pulse type (1s, 22-19 Hz), referred to as a “back beat”, has been observed\textsuperscript{286}.

\textbf{Pacific Northwest Seasonality}
Fin whale calls are heard year round on recorders offshore in the Gulf of Alaska and Bering Seas, with a broad peak in the fall\textsuperscript{287}. DFO’s Cetacean Research Program has 9 seafloor-mounted acoustic recording packages (5 – 1000 Hz) monitoring British Columbia’s coast.

\begin{figure}
\centering
\includegraphics[width=\textwidth]{map.png}
\caption{Map showing passive acoustic monitoring sites in the Pacific Northwest.}
\end{figure}

\textsuperscript{282} McDonald and Fox 1999
\textsuperscript{283} McDonald and Fox 1999
\textsuperscript{284} Gambell 1985.
\textsuperscript{285} Gambell 1985.
\textsuperscript{286} Notobartolo-di-Sciara et al. 2003.
\textsuperscript{287} Moore et al. 2006
The Union seamount and La Perouse Bank recorders have been analyzed thus far. Fin whales were detected frequently on both, showing seasonality in occurrence\textsuperscript{289}. The stereotyped 20 Hz pulse call was detected a low number of times in February and April at Union Seamount and not at all at La Perouse Bank\textsuperscript{290}. Irregular repetition interval calls were detected at fairly consistent but low rate at both sites with the exception of a notable increase in August-September at LaPerouse Bank.\textsuperscript{291}

\textit{From Ford et al. 2010b:}

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\textsuperscript{289} Nichol and Ford (2011).

\textsuperscript{290} Ford et al. 2010.

\textsuperscript{291} Ford et al. 2010.
Food and Foraging

Diet

General
The species’ diet has been described with some variation among sources:

“[Fin whales eat] Krill and various small schooling fish, notably herring, capelin, and sand lance.”

“They feed] mainly on planktonic crustaceans but also consume some fish and cephalopods. There is considerable variation by area and season...In both the North Atlantic and North Pacific oceans fish are commonly taken: herring, cod, mackerel, Pollock, sardine, and capelin, together with squid and euphausiids and copepods. Just what is consumed is probably determined by availability as much as preference in these northern areas.”

“Fin whales eat a wide variety of food, including krill and other invertebrates, capelin, sand lance, squid, herring, and lanternfish.”

“They feed on a wide variety of organisms, depending on availability. Possibly, diet varies with season and locality.”

There is no difference in diet between male and female whales.

Other Regions
Mediterranean fins have never been observed feeding on anything other than the euphausioid species Meganyctiphanes norvegica (this includes investigations of stomach contents). In the southern hemisphere, fin whale diet is almost exclusively krill (Euphausia vallentini) but also E. superba and sometimes the copepod Calanus tonsus. The summer diet of fin whales in the North Atlantic is dominated by crustaceans:

“Preferred prey... seems to be krill composed of the euphausiid Meganyctiphanes norvegica, although other species of planktonic crustaceans (Thysanoessa inermis, Calanus finmarchicus), schooling fishes such as capelin (Mallotus villosus), herring (Clupea harengus), mackerel (Scomber scombrus) and blue whiting (Clupea harengus), and even small squids are also consumed.”

North Pacific
It has been estimated that North Pacific fin whales consume between 490,329 and 488,367 tons of prey annually. Another study yielded a lower estimate: 318,582 tons annually. One study estimates that individual fin whales eat up to 1 ton of euphausiids per day.

North Pacific fin whales eat planktonic crustaceans, schooling fishes, and squids — in that order of preference. In the California Current, large zooplankters are thought to constitute 70%-80% of fin whale diet. The remainder is small squid (5%), “small pelagic fish” (5%), mesopelagic fish (5%), and “miscellaneous fish” (5%).
resulting in an effective trophic level of 3.4\textsuperscript{309}. In the Aleutians the whaled fins had a higher proportion of fish, mainly sardines and pollack, in their stomach\textsuperscript{310}.

The most important zooplankton prey taxa are several species of euphausiids and calanoid copepods\textsuperscript{311}. Kawamura (1982) hypothesized that fin whales in the nearby Gulf of Alaska prey switch from euphausiids (abundant in late spring and early summer) to copepods (most abundant in summer and fall).

**BC fins**

The majority of North Pacific diet studies pertain to regions farther offshore or north of BC\textsuperscript{312}. British Columbia’s historical whaling database reveals regional prey preferences. Stomach data comes from studies between 1963 and 1967, when data collection was higher in quality and more consistent\textsuperscript{313}. 578 of 650 killed fin whales were examined for stomach contents between 1963 and 1967\textsuperscript{314}. Non-empty FW stomachs contained mainly (sometimes exclusively) euphausiids in all five years\textsuperscript{315}, but the proportion of diet components changed significantly between years. In 1964 and 65, higher percentages of copepods, fish, and cephalopods were found.

The euphausiids preyed upon by fin whales included *Euphausia pacifica*, *Thysanoessa spinifera*, *T. longipes*, and *T. inermis*. Important calanoid species include (Neo)*Calanus cristatus*, *C. plumchrus*, *C. finmarchicus*, and *Metridia lucens*\textsuperscript{316}.

Low frequency of fish in the fin whale diet is surprising when compared to the larger role fish play in other areas\textsuperscript{317}. Fish in the diet of the whales killed off the BC coast were primarily found in stomachs of whales killed in the spring\textsuperscript{318}.

**Timing of Feeding**

**Seasonal**

Both Southern and Northern Hemispheric populations are thought to feed in the summer and fast while breeding in the winter\textsuperscript{319,320}.

**Daily**

Feeding activity seems to escalate in the crepuscular hours. Tagged individuals in the Mediterranean reveal diving behavior that coincides with the evening vertical migration of their prey, *M. norvegica*. The tagged whale began performing deep (greater than 400m) dives at 5:00pm\textsuperscript{321}, then showed a marked decrease in diving depth, dropping from 400m at 7:40pm to less than 50m by 9:50pm\textsuperscript{322}.

\textsuperscript{309} Barlow et al. 2008.  
\textsuperscript{310} Spalding 1998.  
\textsuperscript{313} Flinn et al. 2002  
\textsuperscript{314} Flinn et al. 2002  
\textsuperscript{315} Flinn et al. 2002  
\textsuperscript{316} Flinn et al. 2002  
\textsuperscript{317} Flinn et al. 2002  
\textsuperscript{318} Flinn et al. 2002  
\textsuperscript{319} Aguilar 2008  
\textsuperscript{320} Aguilar 2008  
\textsuperscript{321} Panigada et al. 2003.  
\textsuperscript{322} Panigada et al. 2003.
From Panigada et al. 2003:

Lunging
As rorqual whales, fin whales feed by lunging\textsuperscript{323}. Lunges may involve bursts of speed up to 25 knots\textsuperscript{324}. Lunges can occur at depth or at the surface, though there may be some geographic structure to such behavior (which may correspond to the primary prey of a region). In the Ligurian Sea, where deep euphausiids comprise the majority of fin whale diet, feeding behavior at the surface has not been observed\textsuperscript{325}.

See the dedicated Lunge Feeding Backgrounder for more information.

Use of Right Jaw
The following information comes from field guides that do not cite their sources:

“Lunge-feeding is commonly seen, during which the whale often turns on its right side.”\textsuperscript{326}

“Fin whales have been observed feeding at the surface by swimming on their right sides and making a lateral scoop with the open mouth and distended throat region.”\textsuperscript{327}

“It lunges at concentrated prey as other Mysticetes do, but the fin whale turns on its right side and swings on its right flipper while lunging. In this position, the dark left side and white lips on the right side maintain the whale’s countershading, making it less obvious to its prey.”\textsuperscript{328}

Foraging

Fin whales are known to associate with their prey and/or the oceanographic conditions that tend to aggregate their prey, such as oceanic fronts\textsuperscript{329}. In BC high, localized abundance of euphausiids around bathymetric margins allows the fin whales to migrate to the continental shelf and feed continuously throughout summer\textsuperscript{330}. In the Bay of Fundy, fin whales occurred primarily in shallow areas with high topographic relief and these occurrences were correlated with herring and euphausiid concentrations\textsuperscript{331}. In summer in the northeastern US and Bay of Fundy distribution is associated with low surface temperatures\textsuperscript{332}. In the Mediterranean fin whale sightings are very closely correlated to high \textit{M. norvegica} densities in very deep waters\textsuperscript{333}. Due to this deep diving, associations between whales and marine birds are extremely scarce in the Ligurian-Corsican-Provencal Basin\textsuperscript{334}. In the Gulf of St. Lawrence, distribution of blue, fin, and humpback whales was associated with the
formation of sea surface temperature (SST) gradients\textsuperscript{335}. The temperature gradient itself may have a herding effect on krill\textsuperscript{338}. Thermal fronts are created by tide or wind-induced upwelling and this upwelling may also increase productivity and attract whales.

Island wake systems are known to predictably aggregate plankton and weak nekton\textsuperscript{337}. In the Bay of Fundy, plankton and weak nekton concentrated in eddies behind islands where tidal currents were reduced in flow and vorticity was high\textsuperscript{338}. The mesoscale eddies that occur to the south of Haida Gwaii are considered prime habitat for fin and blue whales in BC waters\textsuperscript{339}. Beyond this, however, there has been limited effort to relate whale distribution to habitat features in BC waters\textsuperscript{340,341}.

**Competition**

Given the fin whale’s diverse diet and large range, interspecific competition is likely to occur. It is especially likely that fin whales compete with blue whales\textsuperscript{342} and humpback whales. Trites et al. (1999) suggested that some species of fish are significant competitors of whales in the Bering Sea\textsuperscript{343}.

Swordfish swords have been recovered from fin whale carcasses on multiple events\textsuperscript{344}; who the hell knows why swordfish have problems with fin whales.

**Predation**

Fin whales can be victims of killer whale attack\textsuperscript{345,346}. They are often seen with signs of past attack on flippers, flukes, and flanks\textsuperscript{347}. A mother-calf pair was seen being pursued by transients in the study area (H. Meuter, pers. comm.). Other potential predators include false killer whales and the white shark\textsuperscript{348}.

**Parasites**

**Ectoparasites**

The fin whale’s external parasites are primarily crustaceans\textsuperscript{349}. The copepod *Penella balaenoptera* is particularly common in the southern hemisphere\textsuperscript{350} and the Mediterranean\textsuperscript{351}. Cirripeds (barnacles) and *Cyamus* whale lice infect fin whales in warmer waters but are lost in the colder southern waters\textsuperscript{352}. In adults skin of the rear trunk flanks are covered by round scars and stripes attributed to the attachment of lampreys and remoras\textsuperscript{353}. Marine lampreys (*Petromyzon marinus*) seem to be particularly common ectoparasites in the Mediterranean\textsuperscript{354}. Diatoms are contracted as surface films in the summer months in the Antarctic\textsuperscript{355,356}; this has also been observed in BC waters (this author).

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\textsuperscript{335} Doniol-Valcroze et al. (2007)
\textsuperscript{336} Doniol-Valcroze et al. (2007)
\textsuperscript{337} Wolanksi & Hamner 1988
\textsuperscript{338} Johnston et al. 2005.
\textsuperscript{339} Nichol and Ford 2011
\textsuperscript{340} Dalla Rosa (2010).
\textsuperscript{341} Gregr and Trites 2001
\textsuperscript{342} Aguilar 2008
\textsuperscript{343} Trites et al. 1999.
\textsuperscript{344} Gambell 1985; Jongsgard 1962; Peers and Karlsson 1976
\textsuperscript{345} Leatherwood and Reeves 1983.
\textsuperscript{346} Vidal and Peclter 1989
\textsuperscript{347} Aguilar 2008
\textsuperscript{348} Connor 2000
\textsuperscript{349} Gambell 1985.
\textsuperscript{350} Gambell 1985.
\textsuperscript{351} Richiardi 1874, Anthony & Calvet 1905
\textsuperscript{352} Gambell 1985.
\textsuperscript{353} Aguilar 2008
\textsuperscript{354} Notobartolo-di-Sciara et al. 2003.
\textsuperscript{355} Gambell 1985.
\textsuperscript{356} Aguilar 2008
Endoparasites

Internal parasites, found during the whaling years and in necropsies, include tapeworms and Acanthocephala (Mackintosh and Wheeler 1929).\textsuperscript{356}

\textsuperscript{356} Gambell 1985.

\begin{figure}
\centering
\includegraphics[width=\textwidth]{figure.png}
\caption{Pennella balaenopteran, habitus.}
\end{figure}

\begin{figure}
\centering
\includegraphics[width=\textwidth]{figure.png}
\caption{Parasite in the tissue of the whale, B: Hole of the parasite in the skin of the whale.}
\end{figure}

\textsuperscript{357} http://www.tparazitolderg.org/text.php3?id=285

\textsuperscript{358} http://www.tparazitolderg.org/text.php3?id=285

\textsuperscript{356} Gambell 1985.
Whaling

Fin whales have been hunted in larger numbers than any other whale species in the 20th century. Before the invention of steam power and the explosive harpoon, fin whales were too fast to catch. They became targeted at the onset of modern operations in 1870 and after the severe depletion of blue whale stocks.

In the 20th century, 725,000 fin whales were killed in the Southern Hemisphere alone. However, due to the fin whale’s greater original abundance, it was not as severely depleted as the blue whale (roughly 300,000 blues were taken, reducing their population to 0.1% of historical abundance).

North Pacific

46,000 fin whales were taken from the North Pacific by commercial whalers between 1947 and 1987. From 1919 to 1965, 5,000 were taken from the US west coast. The ecological repercussions of these whaling efforts have been a topic of exciting scientific debate.

Aboriginal

"[The] fin whale was the largest species eaten by the Makah and Quileute off the Olympic Peninsula, though aboriginal whalers may have taken this large species only when they found a dying whale floating."

Current Whaling

In 1983, the fin whale was still hunted in Iceland (Hvalfordur Station) and Spain. The Spain program was discontinued in 1985, and Iceland stopped hunting fins in 1989 but reinitiated in 2006. In 2009, fin whales were still exploited in West Greenland (19 individuals per year), Antarctica (3-10 individuals per year since 2005 under the Japanese Special Permit Program), and Iceland (7 individuals were taken in 2006 when whaling was reinitiated).

British Columbia

From 1908 to 1967, at least 7,605 fin whales were killed. The history of these whaling operations is covered in its own Backgrounder. The catch records are reviewed in Pike and MackAnsie (1969), Nichel and Heise (1992), and more recently in Nichol et al. (2002) and Gregr et al. (2006).

Fin whales, which were locally depleted by the end of commercial whaling, represent one third of total kills from BC stations. The largest fin whale catches occurred in the 1950s and 1960s. In the first era of modern BC whaling (pre-World War II), their contribution to total catch declined from a peak in 1912 to less than 20/yr in 1942. In the second era all kills were from the Coal Harbour station and there was a dramatic rise and fall in the number of fin whales caught, peaking in 1958 with 573 animals.

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359 Reeves et al. 2002.
360 Reeves et al. 2002.
361 Aguilar 2008
362 Leatherwood and Reeves 1983.
363 Reeves et al. 2002.
364 Aguilar 2008
365 Gregr et al. 2006.
366 Rice 1974
367 Tonnessen and Johnsen 1982
368 Clapham et al 1997
369 e.g., Trites et al. 1999.
370 Spalding 1998.
372 Aguilar 2008
373 Aguilar 2008
374 Gregr et al. 2000
375 Gregr et al. 2006.
376 Gregr et al. 2000
377 Mizroch et al 1984
378 Gregr et al. 2006.
379 Gregr et al. 2000
380 Gregr et al. 2000
In all months, male and female fin whales were caught in roughly equal numbers\textsuperscript{381,382}. In both sexes, the shortest fin whale individuals were taken in June and August. Both monthly and annual fin whale lengths were below the estimated length at sexual maturity (but above legal limit), implying a geographic population structure in which immature whales were found more inshore\textsuperscript{383}. The annual proportion of pregnant females killed decreased between 1948 and 1967\textsuperscript{384}.

\textsuperscript{381} Gregor et al. 2000
\textsuperscript{382} Gregor et al. 2000
\textsuperscript{383} Gregor et al. 2000
\textsuperscript{384} Gregor et al. 2000

\textit{From Nichol and Ford (2011 Figure 9): Distribution of geo-referenced Fin Whale catch. Naden Harbour (green symbols) operated 1911-1941 geo-referenced catch 1924-1928, Rose Harbour (yellow symbols) operated 1910-1943 georeferenced catch 1924-1928, Coal Harbour (red symbols) operated 1948-1967, all catch geo-referenced, Kyuquot (black symbols) operated 1907-1925 geo-referenced catch 1924-1928, Sechart (orange symbol) operated 1905-1917 no catch geo-referenced (BC Historical Whaling database DFO; Nichol et al.2002).}
From Gregr et al. 2006:

Figure 2: Annual and monthly catches of sei, fin, and blue whales by British Columbia coastal stations (Gregr et al. 2000).

Figure 6. Mean lengths for males (○) and females (●), shown annually (a) and monthly (b), for data pooled from all British Columbia whaling stations. Horizontal lines represent estimated lengths at sexual maturity for males (-----) and females (------). Results shown with standard error bars, in one direction only, for clarity. Statistically significant trends, based on regression analysis ($P < 0.05$), shown as trend lines.
Current Status

Generally, fin Whales are considered moderately abundant but depleted in the North Atlantic and North Pacific.\(^{386}\)

Other Regions

It is unknown whether they are recovering in Antarctica – the only current population estimate is 15,000\(^{387}\). The central North Atlantic contains an estimated 25,800 fin whales\(^{388}\), the northeastern North Atlantic has about 4,100\(^{389}\), the Spain-Portugal-British Isles area contains around 17,400\(^{390}\), the western Mediterranean basin contains about 3,500\(^{391}\), and in northeastern North American waters (incl. Gulf of St. Lawrence) there are about 2,800\(^{392}\). A minimum of 149 individually identified fin whales have been found in the Gulf of California\(^{393}\).

North Pacific

Before whaling, there were 42,000-45,000 fin whales in the North Pacific\(^{394}\). By 1973, the North Pacific population was reduced to 13,620-18,680\(^{395}\), of which 8,520 –10,960 belonged to eastern Pacific stock. In 1985 there were an estimated 20,000\(^{396}\), though this has since been revised downward. At their most depleted, North Pacific fin whales were at less than 38% of historic carrying capacity\(^{397}\).

In the northeastern Pacific, there are currently about 14,000\(^{398}\) fin whales which have an estimated total biomass of 88,473 tons\(^{399}\). 5,700 of these whales are in the Bering Sea, Aleutian Islands, and Gulf of Alaska\(^{400}\).

As of 2002, the NEP fin whale status was uncertain\(^{401}\) and no growth rate estimates were available\(^{402}\). There was some indication that fin whales were increasing in California coastal waters in the 1990's\(^{403}\), but NOAA line transect surveys in the early 2000s did not suggest this\(^{404}\). However, Bayesian analyses of these data do in fact suggest that California fin whales have been increasing\(^{405}\) at a rate of 4.8% per year which is similar to growth rate estimates in Alaskan waters\(^{406}\).

The current best estimate of fin whale abundance in California, Oregon and Washington waters is 3,044-3,300 whales\(^{407}\). The absolute minimum estimate is 2,624. Their Potential Biological Removal (PBR) is 16\(^{408}\).

British Columbia

The present population in BC waters is inferred to be less than 50% of its level 60-90 years ago\(^{409}\). As of 2006, no current abundance estimates or trends were known for fin whales in western Canadian waters. Researchers recognized an “urgent need for information on their abundance and distribution, their habitat, and the threats they face”\(^{410}\). Williams and Thomas (2007) released the first population estimate for the coast, which was based on distance sampling transects from the Strait of Juan de Fuca to the Alaskan border: 496, with a 95%
confidence interval of 201-1220. – a very high degree of uncertainty. The authors divided the intracoastal zone into primary sampling units (PSUs), from which they randomly selected a few for transect coverage. The Kitimat Fjord System was one of these PSUs selected, but the 2004-2005 surveys did not detect any fin whales in the inland waters.

Fin whale sightings from Williams and Thomas (2007):

**Threats**

The most imminent threats in Pacific Canadian waters are collisions with vessels, noise from industrial and military activities, and habitat displacement resulting from shifts in the physical and biological structure of the ocean.

**Acoustic:** Increasing levels of anthropogenic sound is a habitat concern for many large whale species. Whales are known to move away from airgun arrays. Vessel noise, low-frequency active sonar, and other anthropogenic sound sources may induce behavioral responses of unknown severity. Researchers have detected modifications in whale acoustic communication to compensate for increased background noise and that a sensitization process may play a role in observed temporary displacement. In high noise conditions the fin whale’s 20-Hz note duration has been observed to shorten, decrease bandwidth, decrease centre frequency, and decrease peak frequency.

**Ship Strike:** Fin whales continue to be at risk from ship strikes. From 1972 to 2001, 46 of 287 fin whale carcasses found (16%) were certainly killed by boats. In US waters before 2003, 75 out of 292 ship strikes were fin whales, suggesting that the most-whaled whale species is now the most-struck. Ship strikes were implicated in the deaths of four fin whales and the injury of another from 2004-2008. The average observed
mortality/injury due to ship strikes is 1 per year\textsuperscript{424} though additional mortality probably goes unreported\textsuperscript{425}. Despite these risks, it is uncertain whether the current frequency of strikes could significantly affect population\textsuperscript{426}.

In BC, there have been 8 accounts of fatal fin whale ship strikes between 1999 and 2006\textsuperscript{427}. The highest relative risk of ship strike occurs in bottlenecks, regions where both whale and boat densities are concentrated\textsuperscript{428}. Williams and O'Hara (2010) modeled ship strike risks for BC fin whales based on the only systematic abundance survey available (Williams and Thomas (2007), which found no fin whales in the mainland’s confined channels). Because those abundance data come from the years before fin whales had re-entered the study area, no ship-strike risk was noted for the proposed Northern Gateway and LNG tanker routes\textsuperscript{429}. The impact assessments cited this area as low risk despite the NCCS intervener report demonstrating fin whale presence in the Confined Channel Assessment Area\textsuperscript{430}.

**Whaling:** There is no current risk of fin whaling in BC waters today unless international policies substantially change. Illegal and scientific whaling is still a concern near Iceland, Antarctica, and West Greenland\textsuperscript{431}.

**Entanglement:** Fin whales can incidentally entangle in fishing gear, but this is not thought to be common\textsuperscript{432}. The offshore gillnet fishery is the only likely taker of FWs\textsuperscript{433}, but fishermen report that large whales usually swim through nets without entangling and with very little damage to the nets\textsuperscript{434}. One fin whale death has been observed since 1990, when NMFS began observing the fishery\textsuperscript{435}.

**Habitat & Trophic Displacement:** Degrading habitat conditions due to vessel noise and fishery intensity may displace fin whales from their historical foraging grounds. Decadal oceanographic oscillations and anthropogenic climate change may also bring about shifts in suitable fin whale habitat\textsuperscript{436}.

It is possible but unlikely that the remaining populations may be too small to recover\textsuperscript{437}. There is the risk that large baleen whales may have been “replaced” in the ecosystem to some extent by ecologically-equivalent finfish stocks\textsuperscript{438}. On the upside, due to their low trophic level and oceanic distribution, overfishing is not of great concern\textsuperscript{439}.

**Predation:** Increased abundance could lead to increased predation\textsuperscript{440}.

**Pollutants:** Overall contaminant levels in fin whales are extremely low compared to other marine mammals\textsuperscript{441}.

**Behavioral Response Studies:** Mediterranean fin whales responded to disturbance from biopsy sampling efforts from small inflatable craft by moving away and altering respiration patterns.\textsuperscript{442} The behavioral response of fin whales to navy sonar is currently being written up by Cascadia Research Collective (Ann Allen, pers. comm.)
Protection

Global
As a species, fin whales received protected status by the IWC in 1976\textsuperscript{443,444,445}. The IUCN (International Union for Conservation of Nature) lists the species as "Endangered"\textsuperscript{446}. The Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES) lists fin whales under Appendix 1 (species threatened with extinction, in which international trade is prohibited)\textsuperscript{447}.

USA
The fin whale was formally listed as endangered in the Endangered Species Act. As such, the west coast stock was automatically listed as “depleted” and “strategic” under the MMPA\textsuperscript{448}. Recently, however, the endangered status for some Northern Hemisphere populations has recently been challenged\textsuperscript{449}.

Canada
The fin whale is currently listed as Threatened under both the Canadian Species At Risk Act (SARA)\textsuperscript{450} and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC)\textsuperscript{451}.

Both Atlantic and Pacific stocks were originally considered a single unit and were designated of Special Concern in April 1987. This single unit was subsequently split into two populations (Atlantic and Pacific) under SARA in May 2005. The Pacific stock was designated as Threatened in May 2005\textsuperscript{452}.

SARA prohibits harm (killing, harassing, capture, or take) to listed species, includes provisions to protect critical habitat, and requires the development of a recovery strategy for each listed species\textsuperscript{453}. No licenses for the taking of cetaceans have been issued for Pacific Canadian waters since 1967\textsuperscript{454}. Any application for a Scientific License for invasive or disturbance-based sampling would require a rigorous assessment based on Section 73 of the SARA\textsuperscript{455}.

BC Protected Areas
Currently no marine areas are designated to protect the habitat of blue, fin, or sei whales specifically. Under the Canada National Marine Conservation Areas Act, Parks Canada is responsible for the creation of National Marine Conservation Areas (NMCAs). As of 2006, the only NMCA under consideration was south of Haida Gwaii. The Fisheries Act has provisions to protect marine mammal habitat. MPAs may also be established under the Oceans Act. Once critical habitat is identified, approaches for its protection under the provisions of the SARA will be more easily determined\textsuperscript{456}.

The Pacific North Coast Integrated Management Area (PNCIMA), a collaborative effort of Department of Fisheries and Oceans and nongovernmental organizations, cited the mainland’s confine channels (the Bangarang study area) as an “Important Area” for fin whales, but the federal government withdrew funding from this initiative in September 2011 after pressure from the pipeline lobby and the PNCIMA initiative was abandoned\textsuperscript{457,458}.

Critical Habitat Designation

\textsuperscript{443} Carretta et al. 2011.
\textsuperscript{444} Carretta et al. 2011.
\textsuperscript{445} Gregr et al. 2006.
\textsuperscript{446} Gregr et al. 2006, Klinowska 1991.
\textsuperscript{447} Gregr et al. 2006.
\textsuperscript{448} Carretta et al. 2011.
\textsuperscript{449} Reeves et al. 2002.
\textsuperscript{450} Nichol and Ford 2011.
\textsuperscript{451} Gregr et al. 2006.
\textsuperscript{452} Gregr et al. 2006.
\textsuperscript{453} Gregr et al. 2006.
\textsuperscript{454} Gregr et al. 2006.
\textsuperscript{455} Gregr et al. 2006.
\textsuperscript{456} Gregr et al. 2006.
\textsuperscript{457} Gregr et al. 2006.
\textsuperscript{458} Gregr et al. 2006.
\textsuperscript{447} \url{http://www.davidsuzuki.org/media/news/downloads/2011/PNCIMA_Funding_Backgrounder.pdf}
\textsuperscript{458} \url{http://www.pncima.org/}
Designation under SARA requires that critical habitat in Canada and threats to that habitat be identified for the threatened species. Critical habitat has not yet been designated for the fin whale, though DFO is actively conducting the research required to do so (Nichol and Ford 2011).

The recovery plan for fin whales (and other large balaenopterids) lists the following strategic steps:

1. Identify critical habitat
   a. “Basic abundance and distribution data is required in order to identify critical habitat.”
2. Rigorously determine species abundance and distribution
3. Outline means of mitigating threats

As with all highly mobile animals, “the recovery of these populations is unlikely to be accomplished by Canadian efforts alone. The need for multi-lateral and international cooperation is therefore considered essential to the successful recovery of these species.”

**Ongoing BC Research**

**Coast-wide**
In an effort to identify critical habitat for BC’s largest baleen whales, Department of Fisheries and Oceans’ (DFO) Cetacean Research Program (CRP) has been conducting ship-based surveys since 2002 which have totaled 2,000 hours of effort in all seasons and covered over 40,000km of ocean. The fin whale was the third-most encountered whale species during these surveys, with an encounter rate of 1.161 individuals per 100km. An extensive acoustic monitoring network has been installed on the BC coast as well.

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From Nichol and Ford (2011 Figure 7): Fin Whales sightings, DFO surveys, 2002 to 2010 (Ford et al. 2010a; CRP-DFO unpubl. data).

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459 Gregr et al. 2006.
460 Gregr et al. 2006.
461 Gregr et al. 2006.
462 Nichol and Ford (2011), Ford et al. 2010a
Identification photos from these surveys are being prepared for mark-recapture analysis to generate a regional BC abundance estimate\(^{466}\). To determine broader movement patterns and Northeast Pacific stock structures, DFO is also planning to compare fin whale photos from these surveys to photo-ID catalogs from Washington, California and Alaska.\(^{467}\)

Nichol and Ford (2011) summarize this decade of effort. “BC waters support foraging whales of these species where habitat features contribute to concentrating and sustaining prey, although the occurrence of fin whales year-round and the detection of male mating calls underscore the need to better understand the function of BC habitat for Fin Whales.”

In order to complete the critical habitat identification process for fin whales, DFO reported in 2011 that the following research efforts are urgently needed\(^{468}\):

1. Expanded acoustic monitoring, both offshore and inshore, with a special emphasis on identifying the behavioral context of fin whale vocalization.

2. Documenting the fine-scale habitat features with which fin whales and their prey are associated “particularly in Hecate Strait and Caamano Sound. Study approaches should include systematic visual surveys, photo-identification, satellite tagging and collection of hydroacoustic data to document potential prey.”

3. Systematic survey coverage in key inshore areas such as Caamano Sound. “The occurrence of fin whales in Caamano Sound and adjoining waterways on the northern mainland coast is intriguing as it is one of few inshore areas where fin whales are found in BC and where they were encountered historically as well.”

4. Linking whale distribution to oceanographic processes. “Concurrent data on whale distribution and oceanographic processes at appropriate spatial and temporal scales are lacking.”

Kitimat Fjord System
The confined channels near Caamano Sound, to which Nichol and Ford (2011) refer so regularly above, have been monitored visually and acoustically for whales by the North Coast Cetacean Society (NCCS) for the past decade and is now the centerpiece of the Bangarang study area as well.

Between 1968 and 2006 (38 years), there were only a few sightings of fin whales in the confined channels by DFO or reported on the BC Cetacean Sighting Network (BCCSN): one in Beauchemin Channel (August 1994), one in Squally Channel (July 1992), and one in Campania Sound (2005)\(^{469}\). Almost all fin whale sightings were from the continental shelf off Vancouver Island, southern Haida Gwaii, and western Dixon Entrance\(^{470}\). Then, in 2006, NCCS had 5 fin whale sightings over 3 days\(^{471}\). In the seasons since, the number of sightings has increased dramatically. Between 2006 and 2011, NCCS had 116 days with fin whales, with 28 individuals identified\(^{472}\). These developments may represent the re-occupation of a historic inland fin whale feeding ground\(^{473}\).

\(^{466}\) Nichol and Ford (2011).
\(^{467}\) Nichol and Ford (2011).
\(^{468}\) Nichol and Ford (2011).
\(^{469}\) JKB Ford, pers. comm.
\(^{470}\) Nichol and Ford (2011).
\(^{471}\) Pilkington et al. 2011.
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\(^{473}\) Gregr et al. 2006.
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