



RECOVERY POTENTIAL ASSESSMENT OF THE HUMPBACK WHALE, PACIFIC POPULATION



Illustration by A. Denbigh, DFO

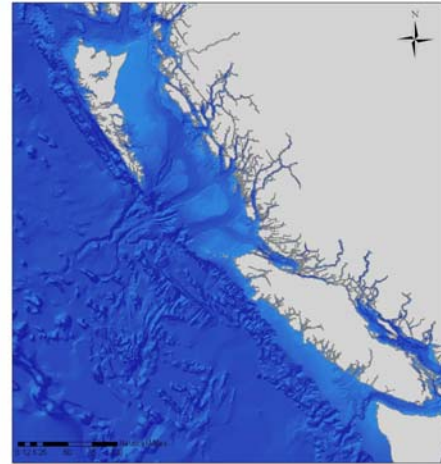


Figure 1: Bathymetric map of the Pacific coast of Canada

Context :

Humpback whales (*Megaptera novaeangliae*) in both the Atlantic and Pacific waters of Canada were heavily reduced by commercial whaling from the late 19th to mid 20th centuries. The status of humpback whales in Canada was first evaluated by COSEWIC in 1982, and Atlantic and Pacific populations were designated as Threatened. A re-evaluation in 1985 resulted in the Atlantic population being downlisted to Special Concern, while the Pacific population remained Threatened. The species was again examined by COSEWIC in 2003 and the status of the Pacific population was confirmed as Threatened. This population was legally listed under SARA in 2005.

SUMMARY

- The best estimate of population size of humpback whales in waters off the Pacific coast of Canada is 2145 individuals in 2006 (95% confidence interval 1970-2331). The population grew over the period of 1992-2006 at an estimated annual rate of 4.1% (95% confidence interval 3.9-5.1%).
- Historical pre-whaling abundance is poorly known, but there were an estimated minimum of approximately 4000 whales in the population in 1905, before large-scale whaling began.
- Humpback whales are widely distributed off the Pacific coast of Canada, including both inshore and offshore waters. Their range is expanding as the population grows.
- Total allowable harm was calculated to be 21 animals per year using the Potential Biological Removal (PBR) method.
- Potential threats include vessel strikes, entanglement in fishing and aquaculture gear, acoustic disturbance and prey limitation.

BACKGROUND

Rationale for Assessment

The *Species at Risk Act* (SARA) provides legal protection to species listed in Schedule 1 including the humpback whale (Pacific population). Under SARA it is prohibited to kill, harm, harass, capture or take an individual of this population and also to destroy any part of its critical habitat. Section 73 of SARA authorizes competent Ministers to permit otherwise prohibited activities affecting a listed wildlife species, any part of its critical habitat, or the residences of its individuals if certain preconditions are met.

Under section 73(2) of SARA, authorizations may only be issued if: (a) the activity is scientific research relating to the conservation of the species and conducted by qualified persons; (b) the activity benefits the species or is required to enhance its chance of survival in the wild; or (c) affecting the species is incidental to the carrying out of the activity.

Section 73(3) establishes that authorizations may be issued only if the competent minister is of the opinion that:

- (a) all reasonable alternatives to the activity that would reduce the impact on the species have been considered and the best solution has been adopted;
- (b) all feasible measures will be taken to minimize the impact of the activity on the species or its critical habitat or the residences of its individuals; and
- (c) the activity will not jeopardize the survival or recovery of the species.

Decisions made on permitting of harm and in support of recovery planning need to be informed by the impact of human activities on the species, alternatives and mitigation measures to these activities, and the potential for recovery. An evaluation framework, consisting of three phases (species status, scope for human-induced harm, and mitigation) has been established by DFO to allow determination of whether or not SARA incidental harm permits can be issued. A recovery strategy, and subsequently an action plan, is required for all wildlife species listed in Schedule 1 as threatened, endangered, or extirpated. The analysis provided herein will inform issuance of incidental harm permits and recovery planning. In the context of this status report, “harm” refers to all prohibitions as defined in SARA.

Historical Whaling

Humpbacks were hunted commercially in the North Pacific from the late 1800s to 1965, when the species was protected internationally. At least 28,000 humpbacks were caught between 1905 and 1965. An estimated 1500 humpback whales remained in the North Pacific at the end of the whaling era.

In waters off the Pacific coast of Canada, whaling of humpbacks took place in the 19th century, although there are few details from this period and few whales were taken. However, at least 5,638 humpbacks were taken in these waters between 1908 and 1967, with most catches prior to 1917. Although humpback whales were hunted throughout the region, most catches were made off the west coast of Vancouver Island.

Species Biology and Ecology

The humpback whale *Megaptera novaeangliae* is a medium-to-large baleen whale that occurs in all the world's oceans, although it is uncommon in Arctic waters. It is a member of the Family Balaenopteridae, along with blue, fin, sei, and minke whales, but due to its substantial morphological differences from these species, it is placed in its own genus. Humpback whales typically reach lengths of about 13 m for males and 14 m for females. Adult humpback whales weigh an average of 34,000 kg, and up to 45,000 kg. The species is easily recognizable due to its stocky body shape, long pectoral flippers (to almost 1/3 of the body length), rounded tubercles on the rostrum ("head knobs"), and tendency to raise its flukes when diving. It is well known for its frequent aerial displays, including breaches, tail slaps, and flipper slaps. The species is also noted for its long, complex underwater songs, sung by males primarily while en route to or on low latitude wintering areas.

Like many species of baleen whales, the humpback whale is strongly migratory. The whales spend much of the year, generally spring through fall, on feeding areas that are located in productive cool waters in high latitudes. In late fall, most humpbacks migrate to low-latitude tropical or sub-tropical wintering areas where breeding takes place. These wintering areas are often associated with shallow coastal areas of continents or around offshore island groups. In the North Pacific, wintering areas include the Hawaiian Islands, coastal waters of western Mexico and the Revillagigedo Islands, Central America, the Philippines, and Ryukyu and Ogasawara island groups of Japan. Females give birth to a single calf at intervals of 1-5 years, but mostly commonly every two years. Newborn calves are about 4.5 m long at birth, and are weaned at about one year of age, though some beginning taking food at about 6 mos. Both sexes reach sexual maturity at an average of 5 years and length of about 12 m. Physical maturity is not reached until 8-12 years following sexual maturity. Longevity is at least 48 years.

Due to their cosmopolitan distribution and highly migratory behaviour, humpback whales occupy a wide variety of habitats. Wintering areas in both hemispheres are mostly located between 10° and 23°, and little if any feeding takes place in these areas. In summer, the whales feed extensively in productive cold water areas generally between 35° and 65°. Feeding areas include both nearshore and offshore waters. Migratory paths taken by humpbacks between winter and summer concentration areas are poorly known, but they include both coastal and oceanic waters. Humpback whale populations are highly structured genetically both between and within ocean basins. Within an oceanic area, populations are segregated into discrete subpopulations which are not separated by geographic barriers. Much of this segregation appears to be due to maternally-directed fidelity to particular feeding areas. Considerable mixing of these subpopulations may take place in wintering areas.

The humpback whale is a 'gulp' or 'lunge' feeder that preys on dense patches of zooplankton or shoals of small fishes. Humpback whales use a variety of tactics to corral and concentrate their prey while feeding, such as 'flick feeding' and 'bubble netting'. Humpback whales forage both alone and in cooperation with other individuals, especially when undertaking bubble net feeding. Individual whales may specialize on particular feeding techniques and prey types.

Humpback whales feed primarily on larger zooplankton such as euphausiids and crab zoea, and less so the smaller zooplankton such as copepods, which are targeted by skimming-type feeders (e.g., right whales). In the southern hemisphere, euphausiids (notably *Euphausia superba*) are the primary prey of humpback whales. In other regions, humpbacks feed on euphausiids of several genera, including *Euphausia*, *Thysanoessa*, and *Meganyctiphanes*, as well as schooling fish. Species of fish targeted by humpbacks include herring (*Clupea*),

mackerel (*Scomber scombrus*), sand lance (*Ammodytes*), sardines (*Sardinops* or *Sardinella*), anchovies (*Engraulis mordax*), and capelin (*Mallotus villosus*).

In cold-water feeding areas such as off the west coast of Canada, the primary activity of humpback whales is feeding. The movements of whales in this region is likely driven by the abundance and distribution of their primary prey, which can vary both within and between years.

ASSESSMENT / ANALYSIS

Population Structure

Humpback whales that feed off the Pacific coast of Canada migrate to two geographically discrete wintering areas. Whales that are found in waters off the north coast of BC and around the Queen Charlotte Islands mostly migrate to the Hawaiian Islands. A substantial proportion of whales found off southern BC and adjacent waters of Washington State also migrate to Hawaii, but the majority migrate to wintering areas in Mexico. The whales utilizing these different wintering areas show differences in mtDNA haplotype frequencies, but they are not currently considered to represent two distinct populations.

Current Distribution and Trends

The species ranges widely throughout nearshore, continental shelf, and deep oceanic waters off the Pacific coast. They are also found in inlets and fjords along the mainland coast. Most sightings are concentrated within 15-20 km of shore. They can be found in BC waters in all months of the year, though they are most common from May through October.

The range of humpback whales in BC has expanded considerably over the past two decades, and habitats utilized by the species prior to depletion from whaling are being re-occupied (e.g., Barkley Sound, Queen Charlotte Strait). Densities of humpback whales in particular areas can vary considerably both within and between years, likely as a result of changes in prey availability.

Current Abundance and Trends

Humpback whale abundance in the North Pacific has recently been estimated at about 20,000 individuals. Abundance off the Pacific coast of Canada has been estimated from capture-recapture models using photo-identification data collected during 1992-2006 (Figure 2). The best population estimate for the population in 2006 is 2145 individuals (95% confidence interval 1970-2331). The population in BC waters grew over this period at an estimated annual rate of 4.1% (95% confidence interval 3.9-5.1%). The population also had a high survival rate of 97.6% (95% confidence interval 96.0-99.2) over this period. This population growth rate is consistent with that recently estimated for the North Pacific as a whole.

Critical Habitat

Critical habitat for this population has not yet been officially designated under the Species at Risk Act. Because the primary activity of humpback whales in BC waters is feeding, potential critical habitat is likely to be characterized by waters containing high densities of the whales' primary prey, euphausiid zooplankton (*Euphausia pacifica* and *Thysanoessa spinifera*) and

schooling fish, including Pacific herring (*Clupea pallasii*), Pacific sardine (*Sardinops sagax*) and sand lance (*Ammodytes hexapterus*).

Although there is significant seasonal and interannual variation in habitat use patterns of humpback whales in BC waters, several areas with fairly predictable concentrations of whales have been identified (Figure 2). These include waters off the north coast of Graham Island and the east coast of Moresby Island in the Queen Charlotte Islands (Haida Gwaii), Whale Channel and Ursula Channel on the north mainland coast, and areas off the north and southwest coasts of Vancouver Island. Other important habitats for humpback whales likely exist but have yet to be identified.

There is considerable fidelity to specific feeding areas among individual humpback whales. Most resightings of identified individuals occur within 75 km of the initial or previous sightings. This suggests that specific important or critical habitats within the region would likely only be so for a subset of the population.

Humpback whales do not have any known dwelling-place similar to a den or nest during any part of their life cycle, hence the concept of “residence” as defined in the Species at Risk Act does not apply.

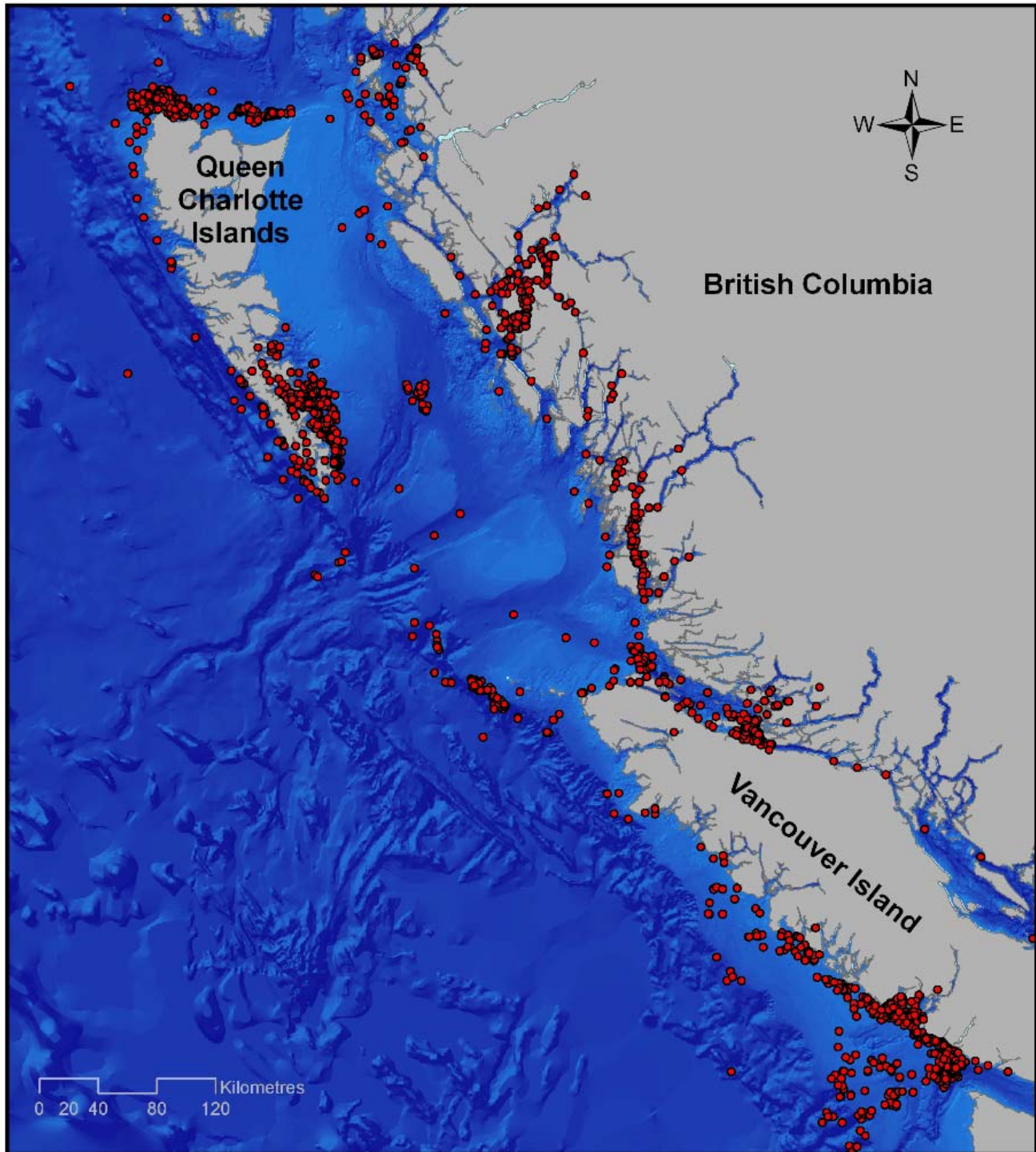


Figure 2. Locations of humpback whales photo-identified in BC waters, 1984-2007.

Recovery Targets

A quantitative recovery target for population size of humpback whales off the Canadian west coast has not yet been determined. The abundance of humpback whales in BC waters prior to commercial whaling is not known. However, based on the numbers of whales taken at whaling

stations on the west coast of Vancouver Island from 1905-18, at least 4000 humpbacks likely existed in the population in 1905. As whalers only operated in waters off the west coast of Vancouver Island during that period, the overall population in Canadian waters was probably much larger and this estimate should be considered a conservative minimum.

At the current annual growth rate of 4.1%, the humpback whale population in BC waters would double in about 17 years. This growth rate assumes that the carrying capacity of the habitat today could support the same abundance of humpbacks as in the early 20th century, which is unknown.

Allowable Harm

The Potential Biological Removal (PBR) was calculated to serve as an estimate of potential allowable levels of human-induced mortality. PBR can be calculated as follows (Wade 1998):

$$PBR = N_{MIN} \times \frac{1}{2} R_{MAX} * F_R$$

where:

- N_{MIN} = the minimum population estimate,
- $\frac{1}{2} R_{MAX}$ = one-half the maximum theoretical or estimated net productivity rate at a small population size,
- F_R = a recovery factor between 0.1 and 1.

For the calculation of PBR for humpback whales in BC waters, the following parameter values were used:

- N_{MIN} = 2066, the 20th percentile of the population estimated in 2006 (Ford et al. 2008)
- R_{MAX} = 0.04, the default value recommended for cetaceans, and
- F_R = 0.5, the recovery factor recommended for depleted whale populations (Wade 1998).

PBR for the humpback whale population was calculated to be 20.7 animals per year.

Threats to Recovery

Vessel strikes is a confirmed source of human-caused mortality in humpback whales. There were 21 vessel strikes documented in BC waters during 2001-08, 15 of which were witnessed and 6 of which were inferred from fresh injuries. No humpback whale mortality that can be attributed to vessel strikes has been observed in BC. Cetaceans are most vulnerable to being struck by from vessels travelling at high speeds. Most strikes witnessed in BC waters involved small (< 10 m) high speed boats. These may cause injury to whales but pose a lesser risk of mortality than collisions from large ships. The actual rate of mortality due to vessel strikes in BC waters is unknown. Efforts taken to date to minimize vessel-whale interactions include raising awareness of whale distribution, encouraging reporting of collision events to help inform vessel traffic management policies and mitigation efforts, as well as the development and support of multi-jurisdictional, transboundary (Pacific Canada and Washington State, USA) guidelines for vessel operations around marine mammals.

Because of their nearshore habitat and body morphology, humpback whales are susceptible to entanglement in fishing and aquaculture gear. As many as 1 in 2 humpback whales in BC waters show evidence, in the form of distinctive scars on the tail stock, of having been entangled at some point in their life. Within BC waters, gillnet fisheries (salmon, herring roe), trap fisheries (crab, prawn, sablefish), long-line fisheries (ground fish) and aquaculture facilities

have all proven to pose entanglement risks to humpback whales. Since 1987, there have been 40 reports of humpback whales entangled in fishing or aquaculture gear in BC waters. At least four of these entanglements resulted in the whales' death. Scarring rates reveal that considerably more humpback whales encounter fishing gear and become temporarily entangled than actual witnessed entanglements would suggest. Mortality rates of entangled whales are unknown, but are also likely greater than the number documented.

The BC Marine Mammal Response Network was recently established by DFO and the Vancouver Aquarium to track and respond to incidents such as entanglements. It includes a full-time toll-free reporting hotline to inform the Network Coordinator of incidents, who then arranges response actions from network members as required. A support team of marine mammal biologists, veterinarians, pathologists and enforcement personnel are called upon for advice and assistance as needed. This network will increase the likelihood that entangled humpback whales will be reported and a response initiated in time to effect a successful disentanglement effort. Other potential actions to reduce the frequency of humpback entanglements in fishing gear in BC include monitoring of spatial and temporal overlap between fishing operations and humpback whale occurrence, with the implementation of temporary area closures as needed. The inclusion of weak links in fixed long-line or trap gear so that buoy lines will part if entangled is another potential mitigative action.

Depletion of important prey resources by fisheries is a potential threat to recovery of humpback whales. Nutritional stress caused by prey limitation could have a range of effects, including reduced reproductive success, survival, and displacement from traditional feeding habitats. Fisheries exist for the primary prey of humpback whales in BC waters, euphausiid zooplankton and schooling fish, including Pacific herring and Pacific sardine. However, there is no indication of a slowing in the population growth rate of humpback whales in BC, so prey limitation does not appear to be a factor in their population dynamics at present.

There has been increasing concern in recent years about the effects of underwater noise on cetaceans. Background noise from vessel traffic can potentially result in masking of communication signals used for social contact or behavioural coordination, or interference with auditory cues used for navigation or prey detection. Loud acute noises have the potential to cause a range of effects in cetaceans, including hearing threshold shifts, production of stress hormones, and a variety of behavioural responses. Sources of acute noise include military and commercial sonars, airguns used in seismic surveys for oil exploration or geophysical research, and pile driving and underwater explosions associated with construction. These sounds can be extremely intense and may travel large distances underwater.

Protocols have been developed to reduce or limit the exposure of humpback whales and other marine mammals to intense underwater sounds in Pacific waters of Canada. Seismic surveys proposed for the Pacific Region are reviewed by DFO marine mammal experts and mitigation measures are developed based on the species of concern in the area of the survey for each project. The Department of National Defence (DND) has established protocols to protect marine mammals from disturbance and/or harm from the use of military active sonar.

Sources of Uncertainty

The historical pre-whaling abundance of humpback whales off the Pacific coast is poorly known, making it difficult to set quantitative population recovery targets. The current carrying capacity of the habitat in this region is also unknown. There is some uncertainty associated with the current population abundance estimate, but the confidence limits are fairly narrow. Further research is needed to better understand the seasonal and regional importance of different prey

resources to these whales, and the biomass of prey needed to sustain a growing or recovered humpback whale population.

The rate of mortality associated with entanglement in fishing and aquaculture gear, as well as vessel collision, is unknown.

The potential effects of acute and chronic underwater noise on humpback whales are poorly understood.

CONCLUSIONS AND ADVICE

The best estimate of current population size is 2145 individuals in 2006 (95% confidence interval 1970-2331). The population grew over the period of 1992-2006 at an estimated annual rate of 4.1% (95% confidence interval 3.9-5.1%). Annual survival is high at an estimated 97.6% (95% confidence interval 96.0-99.2). The pre-whaling population abundance was at least 4000 individuals, and likely considerably greater.

Humpback whales are distributed widely in waters off western Canada, including mainland fjords, continental shelf and deep offshore waters. The range of the population is expanding to include formerly-occupied habitats as abundance increases. Canadian waters are used primarily for feeding during May-October. Most whales migrate to sub-tropical wintering areas during January-April, though some individuals may be found in all months of the year.

Distribution of humpback whales in the region is likely determined by the availability of their preferred prey, euphausiid zooplankton and schooling fish. Individuals show high fidelity to particular feeding areas. Several areas where humpback whales predictably concentrate have been identified in BC waters. These areas are off the north coast of Graham Island and the east coast of Moresby Island in the Queen Charlotte Islands (Haida Gwaii), Whale Channel and Ursula Channel on the north mainland coast, and areas off the north and southwest coasts of Vancouver Island. Further studies are needed to determine whether these areas represent Critical Habitat as defined in the SARA. Humpback whales do not have residences, as defined in the SARA.

Allowable harm for the population of humpback whales off Canada's west coast, as calculated using PBR, is 21 animals per year. This total would also include any human-caused mortalities that this population may experience outside of Canadian waters.

Important potential threats include vessel strikes, entanglement in fishing and aquaculture gear, acoustic disturbance and prey limitation.

SOURCES OF INFORMATION

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