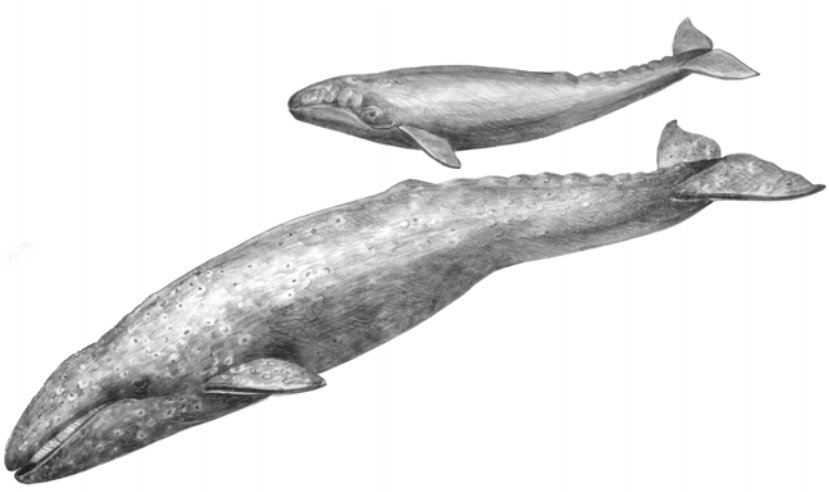
COSEWIC
Assessment and Status Report

on the

Grey Whale
Eschrichtius robustus

in Canada

Atlantic population
Northeast Pacific population



EXTIRPATED - Atlantic population
2000
NOT AT RISK - Northeast Pacific population
1987

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada

COSEPAC
Comité sur la situation
des espèces en péril
au Canada

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Reeves, R.R. and E. Mitchell. 1987. COSEWIC status report on the gray whale *Eschrichtius robustus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 1-35 pp.

Production note:
This species is currently referred to as Grey Whale on the Species at Risk list. When this report was prepared it was referred to as “Gray Whale”.

Please note that the status recommended in the Section “Evaluation and Recommended Status” of the report may differ from the latest status assigned to the species by COSEWIC.

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Également disponible en français sous le titre Rapport du COSEPAC sur la situation de la baleine grise de Californie (*Eschrichtius robustus*) au Canada.

Cover illustration
Grey Whale — Judie Shore, Richmond Hill, Ontario

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COSEWIC
Assessment Summary

Assessment summary – May 2000

Common name
Grey whale – Atlantic population

Scientific name
Eschrichtius robustus

Status
Extirpated

Reason for designation
Extirpated apparently by human hunting, before the end of the nineteenth century.

Occurrence
Atlantic Ocean

Status history
Extirpated before the end of the 1800s. Designated Extirpated in April 1987. Status confirmed in May 2000. Last assessment based on an existing status report.

Assessment summary – April 1987

Common name
Grey whale – Northeast Pacific population

Scientific name
Eschrichtius robustus

Status
Not at Risk

Reason for designation
Populations decimated by exploitation have recovered.

Occurrence
Pacific Ocean

Status history
Designated Not at Risk in April 1987.

COSEWIC
Executive Summary
from the 1987 Status Report

Grey Whale
Eschrichtius robustus

The Grey Whale (*Eschrichtius robustus*) historically inhabited continental-shelf waters of the North Atlantic and North Pacific oceans. The species was extirpated in the North Atlantic, apparently by human hunting, before the end of the nineteenth century. In the North Pacific there are two stocks: west Pacific ("Korean") and east Pacific ("Californian"). Both stocks were exploited by aborigines in ancient times and by commercial whalers in the nineteenth and twentieth centuries. An international agreement in 1937 provided a degree of protection to Grey Whales. However, some hunting of both North Pacific stocks continued. Though the west Pacific stock is now effectively protected from whaling, it presently numbers no more than a few hundred individuals. This stock clearly is endangered. The east Pacific stock is still exploited by the U.S.S.R. under a quota set by the International Whaling Commission. Grey Whales belonging to the east Pacific stock are also taken occasionally by villagers in Alaska, and some incidental mortality occurs in fishing gear along the west coast of North America. This stock appears to have recovered substantially since the late 1800s and now is thought to contain at least 15 000 whales. In addition to its continuing importance in the "subsistence" of Native peoples the east Pacific stock has attained considerable importance as an aesthetic and economic resource off western North America. The annual Grey Whale migration to and from winter "nursery" lagoons in Baja California, Mexico, attracts thousands of tourists. In view of the Grey Whale's extirpation in the North Atlantic and its precarious state in the west Pacific, it would seem particularly important to manage the east Pacific stock in a conservative way. It represents the best, possibly the only, hope for the continued existence of the mysticete family Eschrichtiidae.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) determines the national status of wild species, subspecies, varieties, and nationally significant populations that are considered to be at risk in Canada. Designations are made on all native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fish, lepidopterans, molluscs, vascular plants, lichens, and mosses.

COSEWIC MEMBERSHIP

COSEWIC comprises representatives from each provincial and territorial government wildlife agency, four federal agencies (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biosystematic Partnership), three nonjurisdictional members and the co-chairs of the species specialist groups. The committee meets to consider status reports on candidate species.

DEFINITIONS

Species	Any indigenous species, subspecies, variety, or geographically defined population of wild fauna and flora.
Extinct (X)	A species that no longer exists.
Extirpated (XT)	A species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A species facing imminent extirpation or extinction.
Threatened (T)	A species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.
Not at Risk (NAR)**	A species that has been evaluated and found to be not at risk.
Data Deficient (DD)***	A species for which there is insufficient scientific information to support status designation.

* Formerly described as “Vulnerable” from 1990 to 1999, or “Rare” prior to 1990.
** Formerly described as “Not In Any Category”, or “No Designation Required.”
*** Formerly described as “Indeterminate” from 1994 to 1999 or “ISIBD” (insufficient scientific information on which to base a designation) prior to 1994.

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list.

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Canada

The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

COSEWIC Status Report

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Gray Whale
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Atlantic population
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Randall R. Reeves
Edward Mitchell

1987

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INTRODUCTION

The Gray Whale (*Eschrichtius robustus*) is a medium- to large-sized mysticete (baleen) whale (Figure 1). Its distribution in recent times has been limited to the North Atlantic and North Pacific oceans. That the Gray Whale is readily distinguished from all other extant mysticetes became apparent from the first illustrations of the skull of this species to be sent to Europe (Beneden 1877). All subsequent work has shown that the Gray Whale has a variety of distinctive characteristics (Barnes and McLeod 1984), which support its assignment to a separate monotypic family, Eschrichtiidae (Ellerman and Morrison-Scott 1951).

The Committee on the Status of Endangered Wildlife in Canada has requested a review of the Grey Whale's conservation status. Because several geographical distinct stocks of Grey Whales exist (or existed), it is necessary to consider and, where appropriate, manage each of these stocks separately. As the species is the sole living representative of its family, there is a particular note of urgency about its preservation.

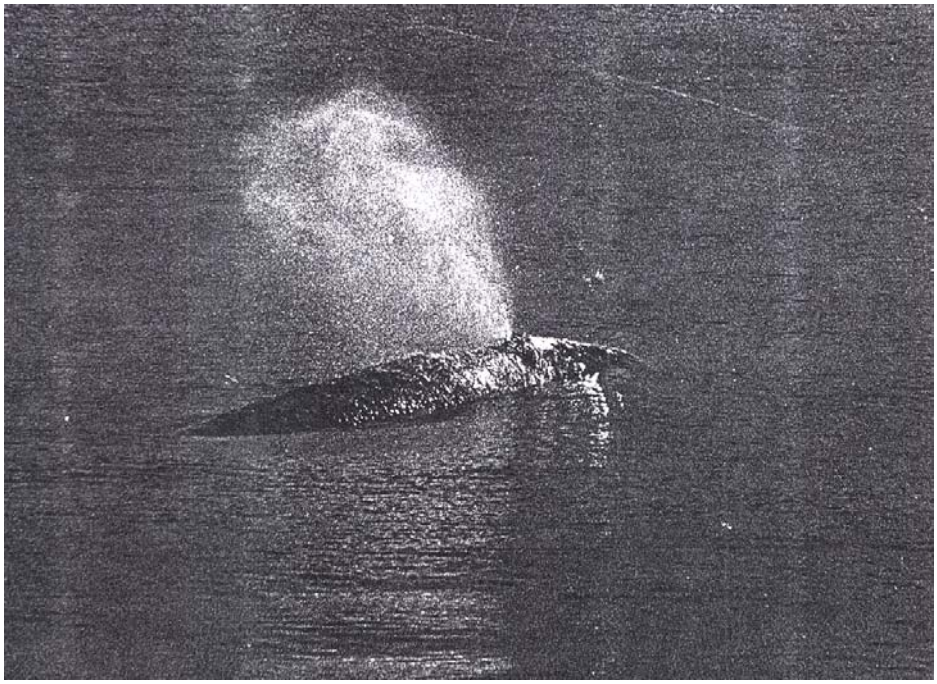

Figure 1. A Gray Whale during the southward migration off Point Loma, San Diego, California. Photograph by R. Reeves.

DISTRIBUTION AND STOCK IDENTITY

North Atlantic

The sum of knowledge about Gray Whale distribution in the eastern North Atlantic consists of seven subfossil specimens (*listed by* Mead and Mitchell 1984: Table 1,

Figure 2) and of inferences made from sixteenth- and seventeenth-century documents describing whales found around Iceland and Spitsbergen (Fraser 1970, Mead and Mitchell 1984). From this evidence it can be stated with certainty that the Gray Whale was present in the Baltic and North seas and the English Channel, and probably around Iceland, during post-glacial times. It is unlikely that these areas represent more than a small part of the species' former Northeast Atlantic range, assuming that long-distance seasonal migrations were made there as in the North Pacific at present.

Published records of subfossil specimens of Gray Whales found along the east coast of North America, numbering ten at the time of this writing (1986), span a somewhat narrower range of latitudes than those from Europe and England. The northernmost is from Long Island, New York (Mead and Mitchell 1984); the southernmost, from St. Lucie Inlet on the southeast coast of Florida (Odell 1983). References in the literature to the "Scrag" Whale (e.g. Dudley 1725) have been interpreted as applying to the Gray Whale (Denise and Junge 1937, Schevill 1952). The Scrag Whale was known at least from New England waters. Taken as a whole, the evidence suggests that Gray Whales were at one time distributed from at least Massachusetts Bay south to Florida. Odell (1983) speculated that Gray Whales may have bred and given birth in the shallow lagoons and bays of south-central and southeast Florida.

The question of whether there was more than one stock of Gray Whales in the North Atlantic obviously cannot be addressed on such limited evidence. If North Atlantic Gray Whales, like North Pacific Gray Whales, had a coastal distribution and migrated annually between the Arctic and the subtropics, then it is reasonable to speculate that at least two stocks, eastern and western, existed. Gray Whales may have visited Canadian waters, including the Scotian Shelf, Gulf of St. Lawrence, and Grand Banks. If they went further north hugging the coast, they may have entered Hudson Bay during summer. We would expect them to have followed the coast in a northward migration, returning annually to shallow feeding grounds with high benthic productivity.

North Pacific

Fossil and subfossil records are known from various portions of the Gray Whale's present range in the North Pacific (Omura 1984, Barnes and McLeod 1984). The latter authors described the only Pleistocene specimen apparently of this species (though the ventral surface of the skull was not prepared and described). Barnes and McLeod made the interesting zoogeographic argument that the genus *Eschrichtius* should have a long Tertiary record, but no such record is documented at present. They specifically emphasized (p. 26) the absence of eschrichtiid and Gray Whale barnacle (*Cryptolepas*) fossils in the Pliocene San Diego Formation.

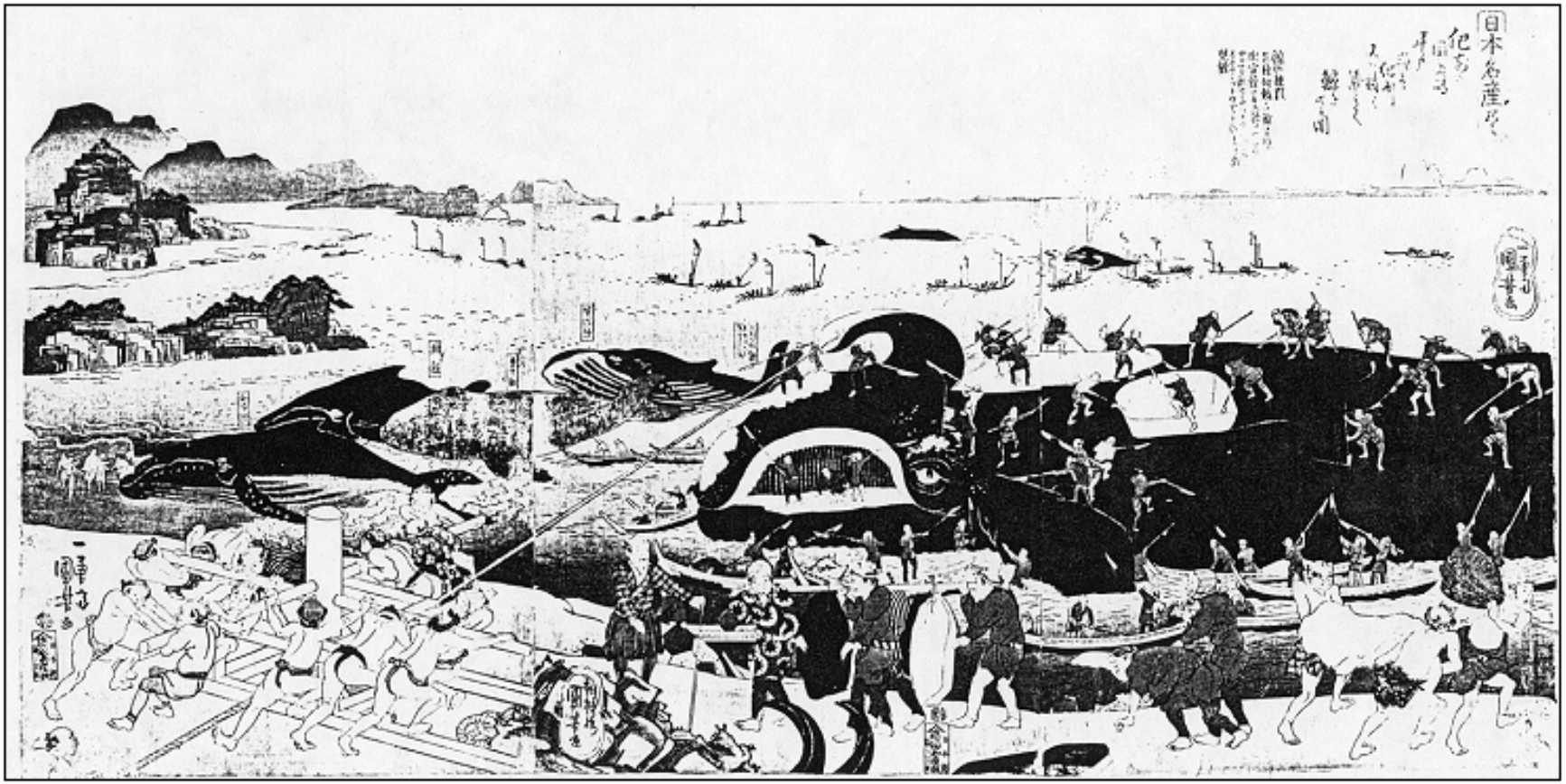

Figure 2. Gray Whales were among the species taken in the Japanese coastal net and harpoon fisheries which began in the sixteenth and seventeenth centuries, respectively. The wood block print (above) features Humpback Whales (far left) and Right Whales (*Eubalaena glacialis*; far right) but also what is probably meant to be a Gray Whale amongst the Humpbacks. Courtesy of Kendall Whaling Museum.

If the fossil record of cetaceans is sufficiently complete to allow the use of such negative evidence (and it is not clear that it is), then the absence of fossils of *Eschrichtius* spp. from the San Diego Formation, coupled with the persuasive logic of Henderson (1984: 181-182) for the historic absence of regular winter occurrences of large numbers of Gray Whales in San Diego Bay, might be taken to demonstrate that the winter inshore distribution of calving whales has remained essentially restricted to the bays or lagoons along the outer coast of Baja California. Such a conclusion would be Barnes relevant to arguments about historic changes in environmental carrying capacity.

The general limits of Gray Whale distribution in the North Pacific at present can be described as follows (after Rice and Wolman 1971):

1. In the east from as far south as the Baja California peninsula and lower Gulf of California (Gilmore *et al.* 1967) to as far north as the Chukchi Sea and, to a limited extent, the Beaufort Sea (Maher 1960, Rugh and Fraker 1981) and East Siberian Sea (Miller *et al*. 1985). This herd of whales is commonly known as the Californian or east Pacific stock.

2. In the west from as far south as Korea Strait and the Seto Inland Sea (Omura 1974, 1984) to as far north as the Sea of Okhotsk and the coast of Kamchatka Peninsula. This herd is the Korean or west Pacific stock (Andrews 1914). Omura (1984) referred to two different populations, one migrating along the east coast of Japan and possibly calving in the Seto Inland Sea, and the other migrating along the east and south coasts of Korea and the coasts of southwest Honshu and northwest Kyushu. For the present, both groups are considered part of the Korean stock.

One striking aspect of their distribution is that Gray Whales usually do not occur outside the continental shelf. They are coastal animals which congregate near shore and in embayments during winter, follow continental margins during migration, and venture far offshore only while feeding in summer across the broad, shallow shelf of the Bering and Chukchi seas (Pike, 1962). Two sightings of Gray Whales made in June 1979 east of Honshu, Japan, in waters 4 000 to 5 000 m deep have been taken as evidence that these whales “can cross the Pacific without keeping to the shallow shelf waters” (Votrogov and Bogoslovskaya 1986). Without more details on the basis for the species identifications, we remain sceptical of this evidence.

Another important feature of the Gray Whale’s distribution is that it encompasses more than 45 degrees of latitude. Thus, the whales winter in waters as warm as 18° to 22°C and summer in waters as cold as 0° to 8°C (Rice and Wolman, 1971).

The migration route and schedule of the east Pacific stock have been the subject of detailed investigation and scientific debate (Swartz 1986). Of particular interest has been the question of whether the whales follow the coast of British Columbia north from Vancouver Island or head diagonally across the Gulf of Alaska toward the eastern Aleutian islands en route to the Bering Sea summering grounds. Pike’s (1962) view that

the whales “retain contact with the coast while circumscribing the Gulf of Alaska” has generally been upheld by subsequent research. Braham (1984) suggested that the availability of sublittoral food resources is the main reason for the Gray Whale’s coastal habit during migration. There is marked segregation in the population during migration, at the winter lagoons, and probably on the summer feeding grounds (Swartz 1986).

Some Gray Whales do not participate in the entire 18 000 km round-trip migration each year (Rice and Wolman 1971; Dohl *et al*. 1981; Gill and Hall 1983; Braham 1984; Herzing and Mate 1984; Sumich 1985; Blokhin 1986; Swartz 1986). From a Canadian viewpoint, the Gray Whales of particular interest are those that do not migrate to the Bering Sea in summer. Although the migration of whales close along the coast of British Columbia was known for some time (Pike 1962, Pike and MacAskie 1969), it was not until the 1970s that notice appeared in the scientific literature of Gray Whales summering on the coast of Vancouver Island (Hatler and Darling 1974). More recent observations indicate that a few Gray Whales summer along the entire outer coast of Vancouver Island, from Victoria to Cape Scott, and on the mainland coast at least in the vicinity of Calvert Island (Darling 1984). In any one summer, the number of “resident” Gray Whales in British Columbia waters is probably on the order of 35 to 50. In at least one portion of the southwest coast of Vancouver Island (Trevor Channel), the summering Gray Whales forage in nearshore kelp beds, consuming mainly mysids (*Holmesimysis sculpta*) (Murison *et al.* 1984).

PROTECTION

International

The 1937 International Agreement for the Regulation of Whaling forbade the killing of Gray Whales and “right” whales (balaenids) by signatory states (*see* Reeves 1984 for more details). Canada acceded to this agreement in 1938. The International Convention for the Regulation of Whaling was established in 1946. Its Schedule restated the ban on commercial taking of Gray Whales but sanctioned taking “when the meat and products of such whales are to be used exclusively for local consumption by the aborigines”. It is under this exemption that “subsistence” whaling for Gray Whales has continued to the present in Alaska and along the Chukotsk Peninsula of the Soviet Union.

With the adoption of new management procedures by the International Whaling Commission (IWC) in 1975, stocks were classified in one of three categories: Initial Management, Sustained Management, or Protection (International Whaling Commission 1976). The west Pacific stock of Gray Whales has been classified as a Protection Stock, with no catching permitted. The east Pacific stock was classified as a Protection Stock until 1978, when it was reclassified as a Sustained Management Stock (International Whaling Commission 1979a: 26). A catch limit of 178 to 179 whales per annum has been set since that time, with the entire catch reserved “to be taken by aborigines or a Contracting Government on behalf of aborigines” for non-commercial purposes. The stable catch level in recent years is thought not to have caused any decline in the stock size (International Whaling Commission 1987).

The International Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) of 1973 was ratified by Canada in 1975. Gray Whales were listed under CITES on Appendix 1. However, Canada reserved the species on that appendix until 1982 when the reservation was lifted.

National

Mexico

In 1972, the Mexican government declared Laguna Ojo de Liebre and Laguna Guerrero Negro, the nearest major wintering lagoons to southern California, to be refuges for Gray Whales (Brownell 1977, Swartz and Jones 1987). From January 1974, commercial vessels were required to obtain permits before entering Laguna Ojo de Liebre, and even with a permit they were restricted to a single channel near the lagoon inlet (Jones and Swartz 1984). This restriction of access to Laguna Ojo de Liebre resulted in a shift of whalewatching to Laguna San Ignacio, some 150 km further south along the outer coast of Baja California. In 1979 the Mexican government made Laguna San Ignacio a Gray Whale refuge and imposed restrictions on whalewatching there. There is now a limit on the number of tourboats that can visit the lagoon at one time and on the number of days a given vessel can remain. Between 15 December and 15 March, all commercial vessel traffic is confined to the lower third of the lagoon. The effect of this restriction is to protect from disturbance an area of the upper lagoon identified as a nursery for mothers and calves (Jones and Swartz 1984, 1987).

United States

The Gray Whale has been fully protected in U.S. waters by the *Endangered Species Act* of 1973 and the *Marine Mammal Protection Act* of 1972. Under these acts, it is forbidden for Gray Whales to be “taken” by anyone subject to U.S. jurisdiction or in waters under U.S. jurisdiction. To “take” is defined as “to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill”. The killing of Gray Whales “for subsistence purposes” by Indians, Aleuts, and Eskimos in Alaska is not illegal, as Native subsistence use is covered by an exemption in both acts. No regulations have been published pertaining specifically to the harassment of Gray Whales.

The National Marine Fisheries Service, the federal agency responsible for protecting whales within U.S. waters, has defined “harassment” in regulations pertaining to Humpback Whales (*Megaptera novaeangliae*) in Hawaii (Anonymous 1979). In these regulations, overflights at altitudes of less than 1000 feet (*ca* 300 m), boat approaches to within less than 300 yards (*ca* 275 m), changes in vessel speed while close to whales, separation of mothers from calves, and deliberate herding or driving of whales are actions defined as harassment when conducted inside sensitive areas (i.e. calving and breeding grounds).

Canada

Gray Whales are protected in Canada by the Cetacean Protection Regulations, established under the *Fisheries Act* by P.C. 1982-1790 (SOR/82-614). Licences are required for anyone other than an Indian or an Inuk to hunt cetaceans, including Gray Whales. To "hunt" is defined in the regulations as "to chase, shoot at, harpoon, take, kill, attempt to take or kill, or to harass cetaceans in any manner". Indians and Inuit are allowed to hunt whales (other than balaenids) without a licence, as long as the whales are used for "local consumption". Whalewatching "guidelines" have been published by the Department of Fisheries and Oceans (Breton 1986).

EXPLOITATION

North Atlantic stock(s)

There is no direct evidence that the North Atlantic Gray Whale population was hunted. However, Mitchell (1973) speculated that it was "exterminated by human activity" and that "long-term and intensive hunting accounted for the last few animals." The early literature summarized by Fraser (1970) and Mead and Mitchell (1984) suggests that whalers were familiar with the Gray Whale and its product yields.

West Pacific stock

There is a sparse record of aboriginal whaling in the Sea of Okhotsk, and it can only be supposed that Gray Whales were hunted by the ancient inhabitants of its shores (Krupnik 1984). Gray Whales were a part of the catch in the extensive harpoon fishery in Japan begun by the sixteenth century (Figure 2) and the net fishery begun in the second half of the seventeenth century (Omura 1974, 1984). Large numbers of Gray Whales were also caught in the Sea of Okhotsk, north of 53°N, by American pelagic whalers, whose main target was the Bowhead Whale (*Balaena mysticetus*), beginning in the late 1840s (Henderson 1984: 176-177). This fishery declined by the 1880s.

Modern (Norwegian) whaling began on the coast of Korea in about 1903, and by 1933 the catch of Gray Whales had declined to an insignificant level (Andrews 1914, Mizue 1951). Although single Gray Whales killed off the northern Kurile Islands in 1942 and off the southeast coast of Honshu in 1959 and 1968 have been considered as possible "strays" from the east Pacific stock (Mizue 1951, Nishiwaki and Kasuya 1970, Bowen 1974), we agree with Brownell and Chun (1977) that these whales more likely belonged to the much-reduced west Pacific stock. No direct exploitation of west Pacific Gray Whales is known to occur at present (*see* Brownell and Chun 1977 and Brownell 1981 regarding recent Korean whaling). The killing of Gray Whales by fishermen when the whales are found near fishing gear may go largely unnoticed (*see* Nishiwaki and Kasuya 1970, Ivashin 1986).

East Pacific stock

There is a long history of aboriginal whaling for baleen whales, including Gray Whales, from as far south on the American coast as the present-day state of Washington, across the Aleutian islands, and on both sides of the Bering and Chukchi seas (Rice and Wolman 1971; Mitchell 1979; Ivashin and Mineev 1981; Krupnik *et al*. 1983; Chlenov and Krupnik 1984; Krupnik 1984, 1987; O'Leary 1984). Such whaling continued, with some changes in technology, until 1928 (Figure 3) on the coast of Washington (Rice and Wolman 1971: 120) and until the 1960s and early 1970s in Chukotka (Krupnik *et al.* 1983; Krupnik 1987).

Commercial whaling for Gray Whales was conducted from shore stations along the North American coast (Rice and Wolman 1971; Sayers 1984; Nesheim n.d.) (Figure 4) and in the Mexican lagoons and offshore by American nineteenth-century pelagic whalers (Scammon 1874; Henderson 1972, 1984). In addition, about 1 000 Gray Whales were taken by modern floating factories from Norway, the USSR, and Japan in the twentieth century (Reeves 1984). A catch of Gray Whales was made by the U.S. and Canada (Figure 5) during 1953-1970 under special scientific permits (Pike 1962; Rice and Wolman 1971).

In recent years, the direct exploitation of Gray Whales from the east Pacific stock has been limited to the catch of 150 to 200 made each summer by a modern Soviet catcher boat and delivered to villages along the Chukotsk Peninsula (Ivashin and Mineev 1981; Krupnik *et al*. 1983; Krupnik 1987) and a few more (less than 10 in most years) by the native people of Alaska, mainly at St. Lawrence Island, Wainwright and Barrow (Marquette and Braham 1982). Gray Whales in Alaska are usually killed with high-powered rifles (Maher 1960: 263). In the Soviet fishery most of the carcasses are delivered to the villages of Lorino, Uelen, Novoe Chaplino, Sireniki, Yanrakinnot, and Uelkal (Krupnik 1987). According to the IWC Schedule of Whaling Regulations, the products of these hunts are to be used only for local consumption by aboriginal peoples. Gray Whales brought ashore at Chukotka are used as follows:

> Part of the fresh meat and skin (with blubber) is distributed among the local inhabitants; portions of fresh skin and gum tissue are also consumed directly during the processing (Krupnik 1987).

The meat of stranded Gray Whales is sometimes used as fox bait and for dog food.

Entanglement in fishing gear is an indirect form of exploitation that affects the east Pacific stock. Between November 1980 and June 1985, 33 Gray Whales were reported as entangled in gillnets between San Francisco and San Diego, California; 19 of the whales are known to have died (International Whaling Commission 1986: 102; *also see* Heinonen 1985; Talbot 1985). Gill-net entanglement has been a problem for Gray Whales migrating along the California coast since at least the 1950s (Norris and Prescott 1961: 360-361), but the recent increase in the use of synthetic fibres for netting

Figure 3. Gray Whales were hunted for subsistence by the Makah Indians at Neah Bay, Washington, into the early twentieth century. Photograph by Asahel Curtis, 1910, courtesy of University of Washington, Northwest Coast Collection.

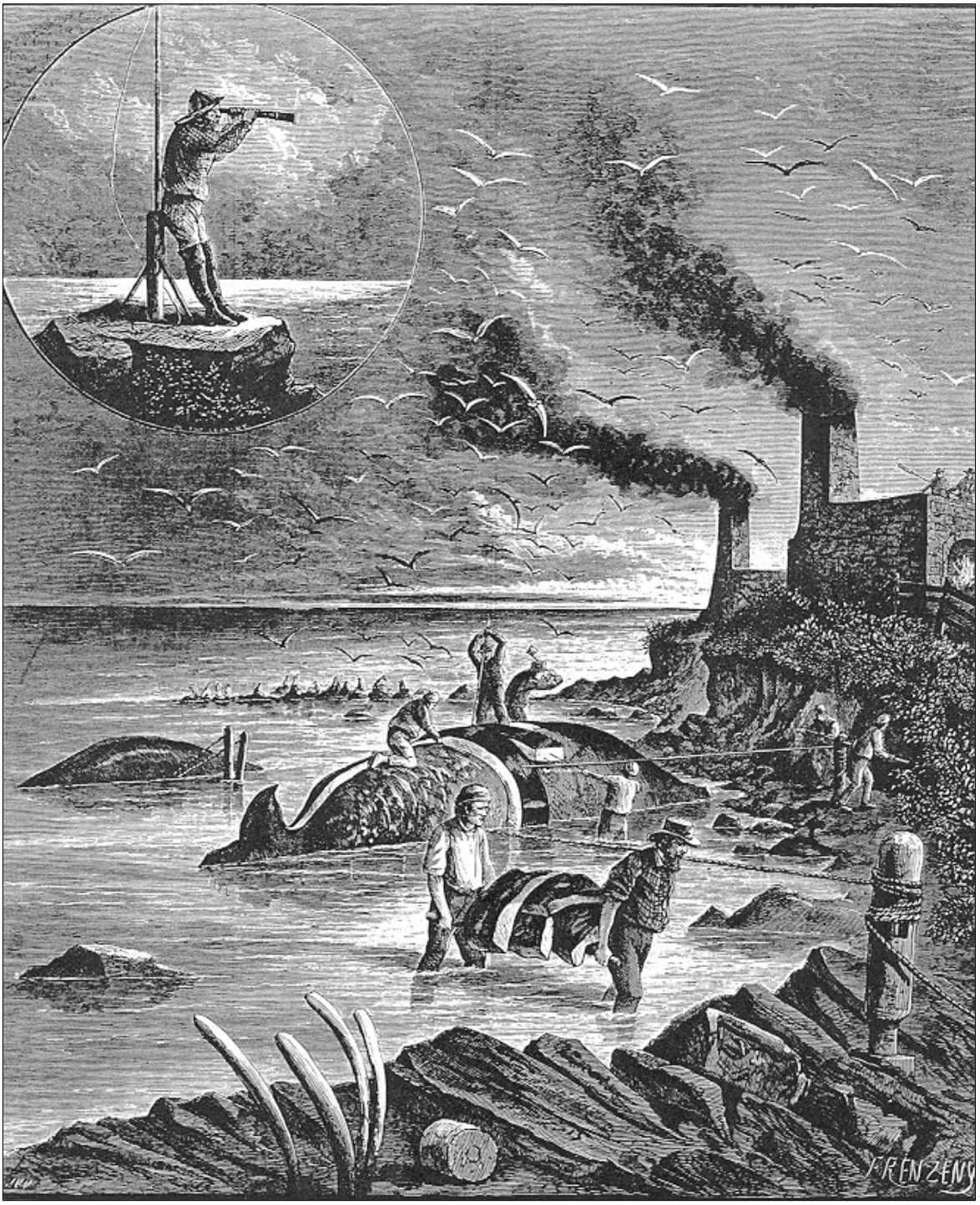

Figure 4. An uncoloured wood engraving from the cover of *Harper's Weekly, A Journal of Civilization*, 23 June 1877, Vol. XXI, No. 1069, showing a whaling station on the coast of California. According to the article on page 483 of the magazine, "the whale most commonly taken" at such stations was the "Gray-back", or Gray Whale, although the engraving is not sufficiently detailed to judge whether the whale pictured is intended to be a Gray Whale. Courtesy of Libby Ingalls and the Peabody Museum, Salem, Massachusetts, FBL No. C7.

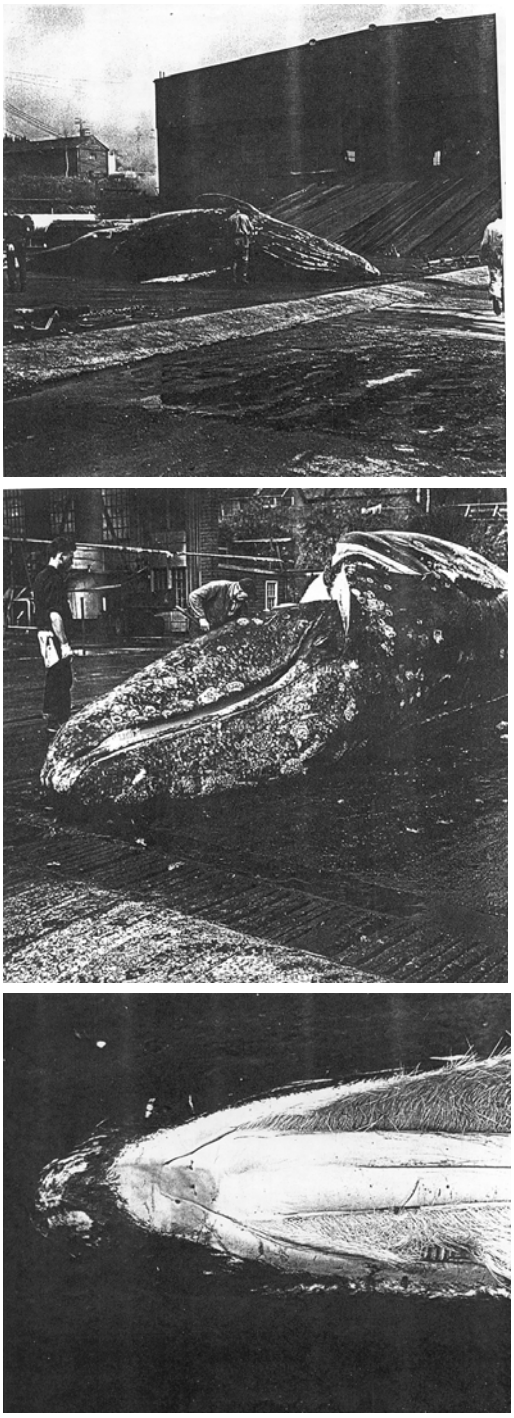

Figure 5. Ten Gray Whales were taken at the Coral Harbour, British Columbia, whaling station in April 1953, under a special government permit (Pike and MacAskie 1969). Note the 3 prominent gular grooves, the large flippers, and the protuberant uro-genital area (top). The slightly open mouth shows the light-coloured baleen plates and the route followed by filtered water as it escapes from the mouth (middle). The two sides of baleen do not meet at the front of the mouth, as they do in balaenopterids (bottom). This creates an opening into the mouth cavity which allows the skim-feeding whale to sample continuously a horizontal column of water as it swims with the mouth slightly open. Note too that the Jacobsen's organs lie within the functional buccal cavity, unlike in the Balaenopteridae in which they lie outside it. Photographs from the Gordon C. Pike Collection.

probably has made it more difficult for the whales so entangled to break free. There is also at least one documented record of a Gray Whale calf being entangled in a fishing net in Laguna Ojo de Liebre (Withrow 1983: Figure 8).

Collisions of Gray Whales with powered vessels have been documented on the U.S. west coast (Patten *et al.* 1980). Some of these collisions have caused the whale's death. In other instances, the whale has survived but in mutilated condition (*also see* Gilmore 1959).

ABUNDANCE

Atlantic stock(s)

Gray Whales are extinct in the North Atlantic, and there is no information on the size of the population(s) that formerly existed there.

West Pacific stock

The west Pacific stock is severely depleted. Considering the magnitude of known removals by hunting during historic times, there must have been several thousand whales in this stock before it was exploited. The population in 1910 has been estimated as about 1 000 to 1 500 (Rice and Wolman 1971).

It was assumed that by the 1930s the west Pacific stock had been virtually exterminated (Mizue 1951; Rice and Wolman 1971: 122; Bowen 1974). However, at least 67 Gray Whales were taken in Korean waters from 1948 to 1966 (Brownell and Chun 1977), and recent observations in the Sea of Okhotsk, near the Kurile Islands, in the Sea of Japan, and off the Pacific coast of Japan demonstrate that Gray Whales still occupy parts of the stock's historic range (Furuta 1984; Blokhin *et al*. 1985; Votrogov and Bogoslovskaya 1986). Some authors have dismissed recent sightings in the west Pacific as involving "strays" from the east Pacific (Nishiwaki and Kasuya 1970; Bowen 1974). It seems to us unlikely that such straying could account for all of the sightings recorded to date, but the point remains moot until some biochemical or other means of distinguishing between individuals of the two populations is found and used to resolve this question.

As many as 20 Gray Whales, of various sizes, have been seen recently during summer and autumn near the north end of Sakhalin Island in the Sea of Okhotsk (Blokhin *et al*. 1985; Berzin *et al*. 1986; *also see* Votrogov and Bogoslovskaya 1986). Soviet investigators have interpreted these sightings as evidence not only of the west Pacific stock's continued existence but of its slow recovery. The number of Gray Whales surviving is probably in the tens or low hundreds.

East Pacific stock

Charles M. Scammon (1874: 23), a literate and successful whaling captain (Landauer, 1982), estimated that no more than 10 800 Gray Whales were killed off western North America between 1846 and the early 1870s. He guessed that the "initial" population (in 1853 to 1856) "did not exceed 40 000 - probably not over 30 000". Scammon supposed that no more than 8 000 to 10 000 California Gray Whales survived by 1874. From a detailed reconstruction of the catch history, Henderson (1972: 185) estimated that the population size in 1845 was about 15 000 to 20 000. Ohsumi (1976) estimated historical population trends, assuming a current, stable population level of about 11 000 and that the rate of removals by aboriginal hunters was a constant 1.5 percent per year since before 1846 and until 1975. Ohsumi used the commercial kill records provided by Henderson (1972), Townsend (1887), and Rice and Wolman (1971) in his model, and he concluded that by 1846, when commercial whaling began, the east Pacific stock had been reduced by aboriginal whaling to about 11 600 whales, compared to a carrying-capacity level "somewhat larger than 15 000." According to Ohsumi's model, the population reached a low of 4 400 in 1875, with recovery to 11 000 and "stability" in the early 1960s. Ohsumi believed the current carrying capacity to be less than that of the past but on what basis is unclear. By his calculations, the current stock of 11 000 is 74 percent of the present carrying-capacity level of 14 900, and 30 percent above the maximum sustainable yield level (estimated as 57 percent of the potential virginal level). Mitchell (1979) argued that Ohsumi's estimates of removals by aborigines were too low, resulting in an underestimation of initial population size. [Note that O'Leary's (1984: 99) statement that Mitchell (1979) "assumes that the aboriginal take was all Gray whales" is in error]. Mitchell (1979) also questioned the validity of Ohsumi's assumption of a decrease in carrying capacity from the mid-1880s to recent times.

Reilly (1981) simulated the population history over the period 1800 to 1980, using various combinations of biological parameters, aboriginal kill rates, and pre-exploitation (carrying capacity) population sizes. The values producing a trajectory which fit most closely the expected behavior of the population during this time were 24 000 whales for carrying capacity, reduced to 12 000 whales in 1800 due to an aboriginal removal rate of 600 per year.

From an age-structured population model Lankester and Beddington (1986) estimated a minimum pre-exploitation (1845) population of 10 000 and a maximum of about 25 000. The application of a deterministic population trajectory model, using known catch records and with built-in density dependence of the kind currently applied in the IWC, consistently indicates a population decrease in the period 1967 to 1980 (Lankester and Beddington 1986). Thus, either the Lankester-Beddington model is intrinsically flawed, the values of the parameters used in their model are inappropriate, the catch record they used is grossly incomplete or inaccurate, the carrying capacity has increased since 1845, or the population did not begin its recovery from a depleted state until much later than is generally assumed.

There is no doubt that by the 1870s and 1880s the stock was depleted, but to what extent is unclear. Shore counts of Gray Whales were made in California beginning in the early 1950s (*see* Reilly *et al*. 1980 for a summary). Gray Whales have also been censused from shore as they funnel through Unimak Pass, in the eastern Aleutian islands, during the southward fall migration (Rugh 1984). Aerial counts of Gray Whales in the Mexican lagoons during winter were first attempted in 1952 and have been conducted periodically since then (*see* Reilly 1984: Table 1, for a summary). The Unimak Pass counts made in three successive years (1977 to 1979) resulted in a conservative best estimate of about 17 000 Gray Whales (Rugh 1984). The California shore counts have given similar results. Based on 13 consecutive years of California shore census data, Reilly *et al.* (1983) estimated the population in 1980 as 15 647. From these data, they also concluded that the population had been increasing over the period 1967 to 1979 at an exponential net rate of about 2.5 percent per annum. Though Cooke (1986) challenged this conclusion, Reilly's (1987) reanalysis confirmed that a net upward trend, on the order of 0.5 to 4.0 percent per annum, had occurred.

Estimates of current population size from shore censuses have taken account of observer biases and impaired visibility. However, the most serious shortcoming of shore censuses has been the lack of reliable information on night travel rates (Reilly 1981, 1984). It has been assumed that the whales maintain a constant rate of movement past the shore censusing stations over a 24-hour period, and raw counts have been extrapolated accordingly to make the population estimates. Eighteen Gray Whales were radio-tagged and tracked off California during the shore census in January 1986 (Swartz *et al*. 1987). No statistically significant change in swimming rate between night and day was noted, so the assumption behind previous extrapolations appears justified.

After a lapse of four years, a full (60-day) census was made near Monterey in December 1985 - February 1986, with the following important results (Breiwick and Dahlheim 1986): (a) Since the late 1970s the migration route in the vicinity of Monterey may have shifted farther offshore (*see also* Dohl and Guess 1979). (b) Given (a) above, and the fact that even experienced and well-trained teams of observers fail to detect some fraction of the whales passing the census site (Rugh *et al.* 1986), earlier estimates of population size based on shore counts probably are underestimates of absolute abundance.

The problem of reconciling winter aerial counts with shore counts during migration remains. Rice *et al.* (1981, 1983 *as cited in* Reilly 1984) made the most recent systematic aerial counts at the winter grounds in Mexico. They estimated 7 601 adults and 1 439 calves from their 1981 census. Because of differences in methodology, these estimates could not be compared with previous aerial estimates. Reilly (1984) pointed out that the implied crude birth rate from Rice *et al*.'s estimates (0.19) is unrealistically high. According to Swartz (1986), there are probably many more Gray Whales outside the breeding lagoons during winter than had been assumed previously. Also, it is likely that substantial numbers of whales are missed in aerial surveys, for a variety of reasons listed by Reilly (1984). Thus, winter aerial surveys probably lead to gross underestimates of absolute Gray Whale abundance.

Given the severe problems affecting estimates made on the calving grounds (Reilly 1984), resources should be applied preferentially to shore censuses during migration rather than to aerial censuses on the wintering grounds. A high priority for improving the reliability of future Monterey shore censuses is to study the offshore distribution of whales during the censusing period, using aerial or shipboard observations.

HABITAT

As a species which passes close to industrially developed coastlines during its annual migration, the Gray Whale is exposed to a variety of pollutants. Strandings of Gray Whales following an oil spill in Santa Barbara Channel, California, in January 1969 prompted reports in the media that the whales had died from the effects of crude oil (Orr 1969). It is interesting that in the same area, whalers working out of Goleta during the 1860s supposedly abandoned the station “because [naturally-occurring] petroleum floating in the ocean ‘frightened the whales away’ and badly gummed the whale-lines” (McGrew 1922 *in* Nesheim n.d.: 31). Brownell (1971) found no evidence that the number of strandings was exceptional in 1969 or that oil contamination of any kind caused any of the Gray Whale deaths.

There is experimental evidence that migrating Gray Whales react to a variety of acoustic stimuli, including noise from marine geophysical exploration air gun systems as well as taped playbacks of sounds associated with oil or gas exploration or development operations (Malme *et al.* 1983). In experiments conducted off California, the whales gave “annoyance” and “startle” responses and changed their speed and course when subjected to playbacks. Air gun activity caused the whales to slow down, turn away from the source, and increase their respiration rates.

The quality of the Gray Whale’s Mexican wintering grounds is of particular concern. Some of the lagoons formerly used “have probably been so modified by man that they are no longer available, and the ultimate stable level of the [east Pacific] population could therefore be now below that in the past” (Allen 1980: 94; *and see* Ohsumi 1976; Mitchell 1979). A variety of activities have been conducted over the past century and a half at Laguna Ojo de Liebre, an important calving or nursery lagoon. Guano and *orchilla* (raw material of red and violet dyestuffs) collection, turtle fishing, and gold mining have taken place in and along the shores of this lagoon (White and Matthews 1956, Henderson 1972). The most important activity has been salt mining. Extensive saltworks were developed in the inner lagoon during the 1950s and 1960s, and salt continues to be an important export from this area. At present, there is only one major channel within Laguna Ojo de Liebre which is not frequented by whales, and this is transited several times a day by salt barges. There is no conclusive evidence that Gray Whales formerly used this area, but “it seems likely that the whales have learned to avoid” it (Withrow 1983). Canal de Ballenitas is a former nursery area that has been diked and is now used as a pumping station and salt evaporation pond. Salt production and dredging in Laguna Guerrero Negro, a small lagoon just north of Laguna Ojo de Liebre, is thought to have caused Gray Whales to desert this lagoon during the 1960s

(Gard 1974). With the re-routing of salt traffic since 1967, Laguna Guerrero Negro has been re-occupied by Gray Whales (Bryant *et al.* 1984). It has been claimed that San Diego Bay in southern California was a Gray Whale calving ground or nursery, and that whales are now excluded from it by human disturbance (e.g. Gilmore 1960). However, Henderson (1984: 181-182) convincingly argued against the popular belief that this bay was ever a significant part of the winter range of Gray Whales.

An unusually large number of Gray Whales was sighted in the southern Strait of Georgia (British Columbia) and Puget Sound (Washington) in spring and early summer 1984 (Anonymous 1984). Eight whales were found dead, and their deaths were linked in the media to various toxic substances, including pesticides, PCBs, heavy metals, and wood preservatives (Knox 1985). However, no conclusive evidence has been published linking the whales' deaths to the presence of these substances in their tissues.

LIFE HISTORY

Age and growth

The ear plugs of Gray Whales, when longitudinally bisected, reveal laminae assumed to be deposited annually (Rice and Wolman 1971, Blokhin and Tiupeleyev 1987). Because the laminae laid down in the earliest years of life may "disappear" in mature whales (Rice and Wolman 1971: 39-40), readings from ear plugs may underestimate absolute age. Adult females can be aged more reliably by reference to corpora on the ovaries.

Asymptotic lengths were estimated at 12.97 m for females (n = 68) and 12.43 m for males (n = 100) (Rice and Wolman 1971). Maximal length in females is about 15 m; in males, about 14.3 m. Gray Whales continue growing until about 40 years of age. One male specimen examined by Rice and Woman (1971) had 70 growth layers in the ear plugs. As would be expected, the major growth spurt occurs the first year, when calves grow from a birth length of about 4.6 m to about 7 m at the time of weaning in August and 8 m by one year of age (Sumich 1986).

The mean age at sexual maturity is 8 years (Rice and Wolman 1971) or 6 to 7 years (Blokhin and Tiupeleyev 1987) for both sexes.

Reproduction

The Gray Whale is the only mysticete for which good specimen material is available representing the early embryonic phase and the perinatal period (Rice 1983). Although sexual behavior by Gray Whales has been observed year-round, the period of conception is well defined on the basis of the condition of ovaries in adult females and the lengths of fetuses. The mean date of conception has been calculated as 5 December (Rice and Wolman 1971). Thus, the peak of effective mating occurs in late November and early December, while the whales are still en route to the Mexican "breeding" lagoons. Courtship in and near the lagoons is intensive, i.e. the abundance

of courting whales is high, from the end of December through the second week of February (Swartz 1986). The median date of parturition has been calculated as 27 January on the basis of calf counts in Laguna Ojo de Liebre (Rice *et al*. 1981; *also see* Jones and Swartz 1985). The mean date of five observed Gray Whale births was 21 January (Rice 1983). Rice (1983) revised the estimated gestation period from about 13 months (400 days) (Rice and Wolman 1971) to 418 days, or closer to 14 months. There appears to be a period of arrested growth during the last month of fetal development, which Rice called the prenatal diapause.

Most adult females give birth to a single calf in alternate years (Jones and Swartz 1985). Only one instance of twin fetuses has been reported (Blokhin 1987).

Mortality

The rate of calf mortality in and just outside the Mexican wintering lagoons has been estimated as 5.4 percent, based on the number of dead calves observed (Swartz and Jones 1983). Pooled data on strandings in Laguna San Ignacio, Laguna Guerrero Negro, Laguna Ojo de Liebre, and Boca de Soledad between 1954 and 1983 demonstrated that calves are much more susceptible to fatal stranding in the lagoons than are adults (calves averaged 91.4 percent of total dead whales vs. an adult proportion ranging from 0 to 5 percent) and that yearling mortality is also higher than adult mortality (yearlings constituting from 0 to 19.5 percent of the strandings) (Jones and Swartz 1984). A separate study of stranding patterns suggested that nearly 75 percent of first-year mortality occurs within a few weeks of birth, in the wintering lagoons, and that juvenile mortality is concentrated in the first two year-classes (Sumich and Harvey 1986) (Figure 6).

In addition to the strandings in lagoons, some calves die during the northward migration as a result of shark or Killer Whale (*Orcinus orca*) predation, or of becoming lost, disoriented, and separated from their mothers before weaning (Swartz and Jones 1983). Numerous attacks on Gray Whales by Killer Whales have been observed (Rice and Wolman 1971, Ljungblad and Moore 1983, Ivashin 1986).

The overall annual adult mortality rate is between 0.08 and 0.10 for both sexes (Rice and Wolman 1971).

Feeding

On their northern summer feeding grounds Gray Whales are stenophagic consumers of benthic amphipods (Rice and Wolman 1971; Nerini 1984; Wuersig *et al.* 1986). There is a marked change in nutritive condition between whales en route to their winter grounds in late fall and those en route to their summer grounds in spring (Rice and Wolman 1971). To a considerable extent, Gray Whales appear to fast in winter and feast in summer. However, increasingly there is evidence of opportunism in the Gray Whale’s diet and feeding behavior. Southward-migrating Gray Whales have been seen preying on “small bait fish” in January off Monterey, California (Sund 1975). Based on

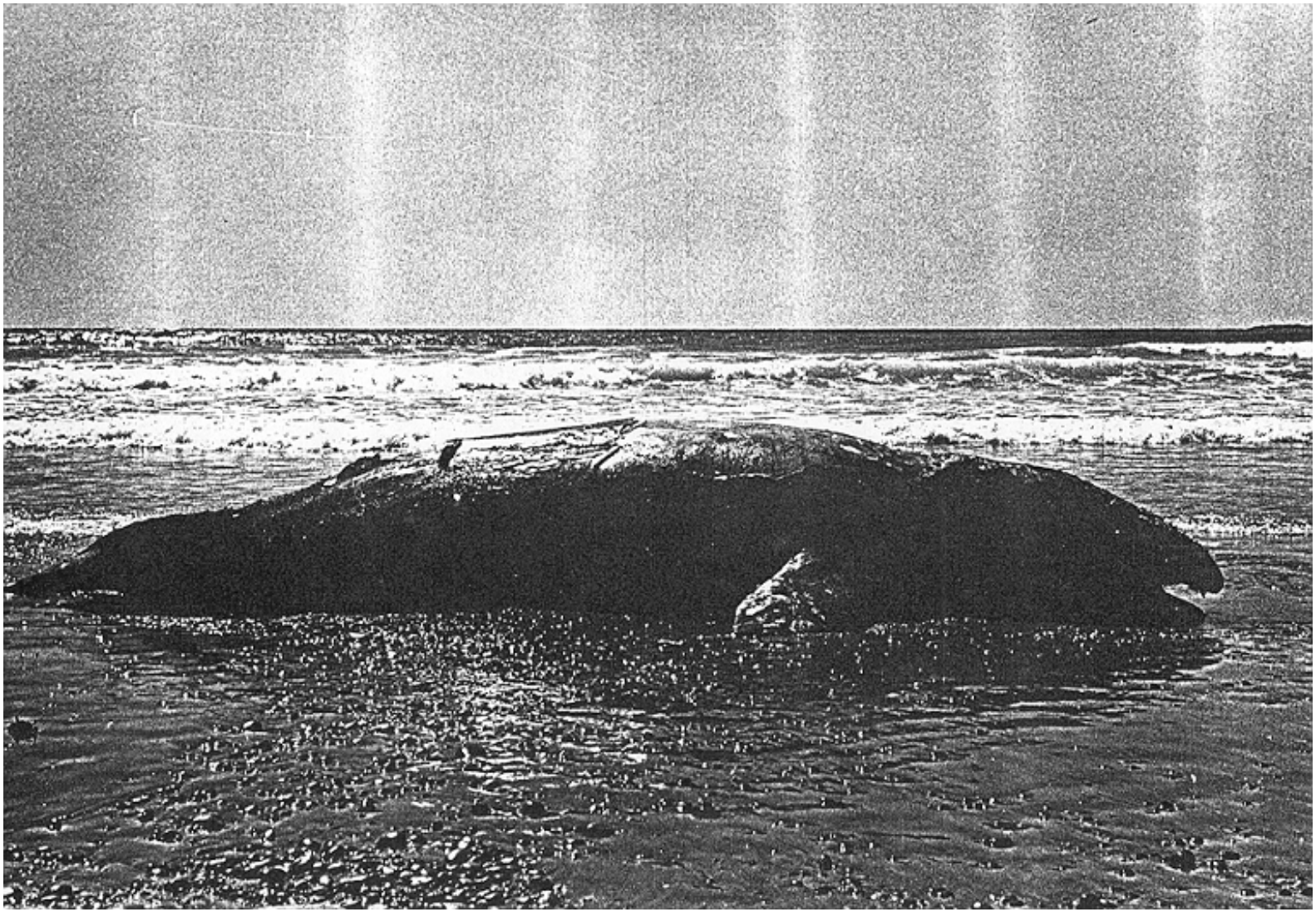

Figure 6. A young 8.2-m male Gray Whale which stranded at Wreck Bay, Vancouver Island, in August 1966 (see Pike and MacAskie 1969:31, 33, for additional data on the specimen). Photograph from the Gordon C. Pike Collection.

the stomach contents of birds killed while feeding with a Gray Whale along the Alaska Peninsula in September, Gill and Hall (1983) inferred that the whale was feeding on an epibenthic Sand Shrimp (*Crangon septemspinosa*). Observations of a small (*ca* 6 m) Gray Whale mouthing kelp off Santa Barbara, California, in April were interpreted as evidence of attempts to catch quantities of the small kelp mysid *Acanthomysis sculpta* (Wellington and Anderson 1978, *also see* Cochrane 1981). The question of whether, or how extensively, Gray Whales feed in and near their Mexican wintering grounds has been mooted for some time (e.g. Gardner 1963; Gilmore 1968; Rice and Wolman 1971; Walker 1971; Norris *et al.* 1983; Swartz and Jones 1987). There is good circumstantial evidence (*reviewed by* Norris *et al*. 1983) that they do some feeding there, probably mainly on Red Crabs (*Pleuroncodes planipes*) and the euphausiid *Nyctiphanes simplex*. However, the bottoms of calving lagoons show no evidence of Gray Whale feeding excavations; nor do these lagoons appear to have bottom communities of invertebrates suitable for extensive feeding by Gray Whales (Oliver *et al*. 1983b; Swartz and Jones 1987).

The waters near Bamfield Marine Station on the west coast of Vancouver Island have provided researchers with opportunities to study Gray Whale feeding behaviour through both surface (Murison *et al*. 1984) and underwater observations (Oliver *et al.* 1984; Guerrero 1985; Hudnall 1985; Plewes *et al.* 1985). Mysids are an important prey, but the whales also feed on dense ampeliscid amphipod communities in this area.

Because they arrive much later than other whales, females with calves spend only about 3.5 months on the northern feeding grounds; whereas, newly pregnant females spend nearly twice as long (6.9 months) in high latitudes (Swartz 1986). Though the ranges of Gray Whales and Bowheads overlap to some degree in the northeast Chukchi Sea, the two species are essentially allopatric there, with the Gray Whales arriving after the Bowheads have migrated east into the Beaufort Sea and departing for the Bering Sea before the Bowheads return on their westward autumn migration (Moore *et al.* 1986).

SPECIAL SIGNIFICANCE OF THE SPECIES

Ecological

As pointed out by Kanwisher and Ridgway (1983), whales probably play a significant role in lifting nutrients upward in the water column, as they are forced to approach the surface regularly for air. “Even the whales’ fecal output does not move downward: because it is liquid, it tends to disperse rather than sink when it is released.” As almost exclusively benthic feeders, Gray Whales probably play as important a role in the gross nutrient dynamics of their environment as any large marine predator could (*cf*. Oliver and Slattery 1985). Their energetic demands, estimated on the basis of a population of 15 500 whales foraging for 3 to 5 months in summer, might require them to turn over 3 565 km^2 of sea bottom per year, or about 9 percent of the available amphipod community in the Bering Sea (Nerini 1984). Gray Whales use suction in feeding (Ray and Schevill 1974), and consequently they excavate depressions in the

sea floor (Nerini 1984, Swartz and Jones 1987). In an area closely studied off the west coast of Vancouver Island, Oliver *et al*. (1984) noted:

> "Gray whales remove a large volume of sediment and infauna from each excavation, and produce a large valley within a dense tube mat of amphipod crustaceans. These valleys provide open space, trap suspended and drifting particles, and undoubtedly attract particular groups of colonizing species".

This interaction of Gray Whales with the benthic invertebrate community implies a close indirect connection between Gray Whales and other vertebrates which depend on the benthos for food (*see* Oliver and Slattery 1985). For example, by disturbing the sediment, Gray Whales might increase production of several species of amphipod crustacean, which in turn decrease the recruitment of young bivalves (through predation, trampling, etc.). In this way, Gray Whale foraging could reduce the availability of bivalves as food for Walruses (*Odobenus rosmarus*) and other clam predators (Oliver *et al*. 1983a).

Economic (whalewatching)

Rice (1961) stated: "In managing the Gray whale, its commercial value should be regarded as secondary to its esthetic value". Already by the early 1960s, large numbers of tourists were watching the Gray Whale migration, both from land and from sportfishing boats offering special excursions to whalewatchers. The first excursion boat entered Laguna Ojo de Liebre (Scammon's Lagoon) in 1970, and by 1973 approximately 30 trips were made to this lagoon during the winter whalewatching season (Gard, 1974). This traffic was superimposed upon the activities of salt barges, trailered boats, and private yachts. Many naturalists voiced concern about the impact of tourist traffic and industrial activity on the east Pacific stock of Gray Whales (American Society of Mammalogists 1971, 1972; *see* Reeves 1977 for a summary), and some measures have been taken to protect the whales and their habitat from such disturbances (*see* Protection).

Long-term studies of lagoon utilization patterns and the effects of whalewatching were initiated at Laguna San Ignacio in 1978 (Jones and Swartz 1984, Swartz and Jones 1987). No significant changes in the whales' use of this lagoon have been detected. At least since 1975, some Gray Whales in Laguna San Ignacio have approached boats in a curious or friendly manner, giving thousands of tourists an opportunity to touch or pet these wild whales.

Whalewatching in California (Figure 7) has considerable economic significance, with estimates of gross income of $2 187 000 in 1981 (Kaza 1982) and $2 600 000 in 1984 (Tilt 1985).

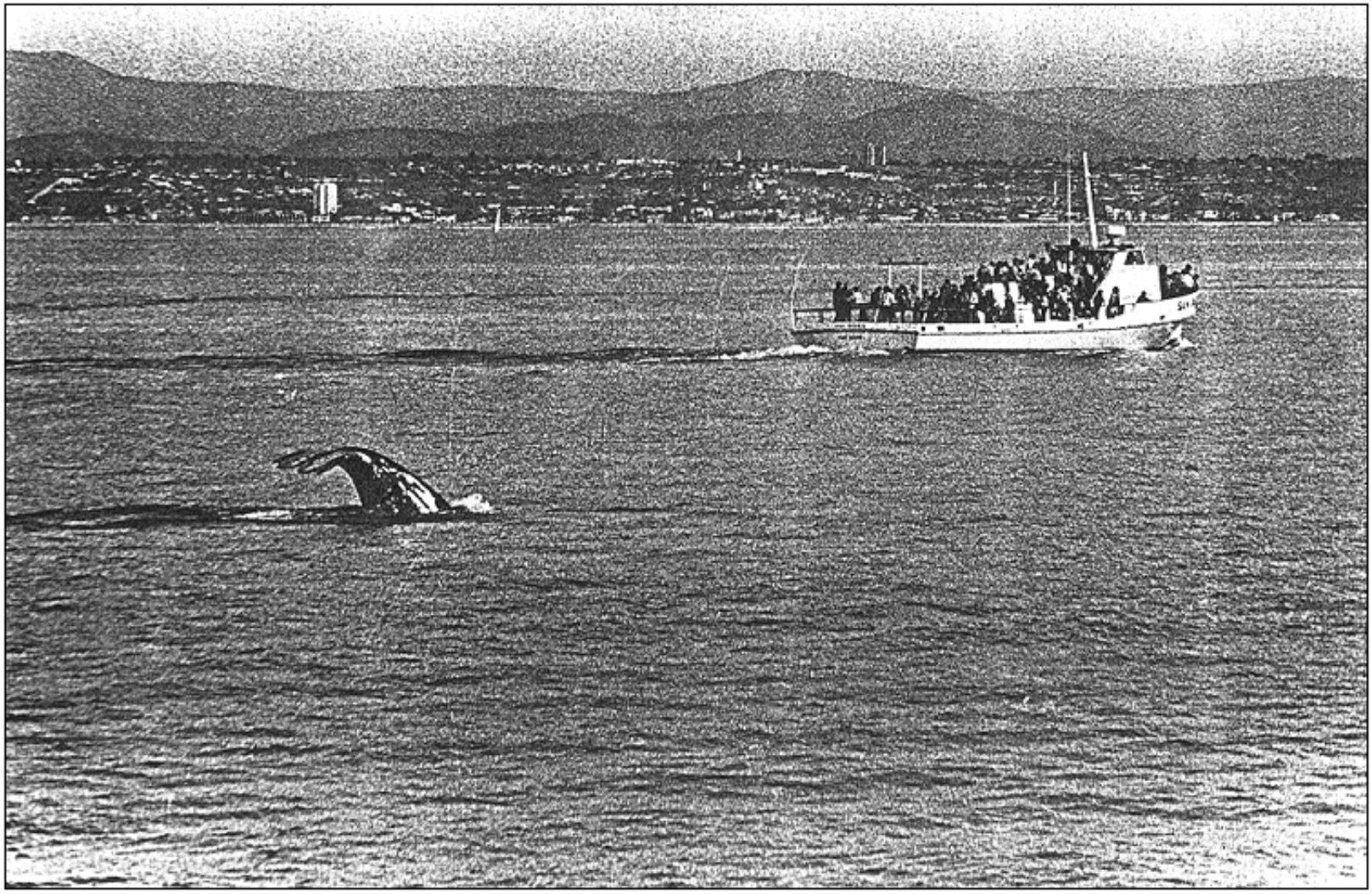

Figure 7. Gray Whales are observed by thousands of tourists each year as they migrate along the west coast of North America. Photograph by R. Reeves, off San Diego.

Economic (subsistence)

The rationale for making the take of Gray Whales by Native peoples exempt from the moratoria imposed by the International Convention for the Regulation of Whaling, the U.S. *Marine Mammal Protection Act*, and the U.S. *Endangered Species Act* is that such taking contributes to subsistence. Marquette (1979) stated that "although the muktuk of the Gray is thinner and less desirable than that of the bowhead, the meat from this [the Gray] whale is highly prized for food" on St. Lawrence Island. Rice and Wolman (1971: 121) stated that the whale catch at Gambell was "almost entirely Gray whales". However, the reported landed catch of Gray Whales on St. Lawrence Island (Gambell and Savoonga) from 1965 to 1980 was 12 (Marquette and Braham 1982), while the reported Bowhead catch during the same period was 36 (Braham *et al*. 1979; Braham *et al*. 1980; Marquette and Bockstoce 1980; Johnson *et al*. 1981). Although more Gray Whales have been taken in recent years at Gambell than at any other village in Alaska, "Eskimos here do not regularly hunt Gray whales, but rather take them opportunisticaly only after the late spring-early summer Walrus (*Odobenus rosmarus*) hunting season" (Marquette and Braham 1982). Marquette and Braham "found no evidence to suggest that Gray whales are at present of any particular interest to the Eskimos". The Gray Whale apparently plays a negligible or minor role in the present-day subsistence of Alaskan Native peoples.

At the 1983 meeting of the International Whaling Commission, concern was expressed in the Aboriginal/Subsistence Whaling Sub-Committee of the Technical Committee about the legitimacy of the USSR's claim that the Gray Whale catch off Chukotka is for "subsistence" (*see* Rinehart and Dawson 1983). The USSR responded by noting the difficulty of collecting information on Gray Whale utilization from the seven to nine "dispersed settlements along the coast at which Gray whales are landed" (International Whaling Commission 1984: 21). The representative of the USSR assured the group that efforts were being made to "increase the output of products for human consumption from the carcasses". Papers submitted to the sub-committee the following year included information "on the variety of foodstuffs consumed by the aboriginal population in the Chukot Region" (International Whaling Commission 1985: 18). Krupnik (1987) supplied some information on the processing and utilization of Gray Whales at Chukotka in recent years.

EVALUATION

The Atlantic stock of Gray Whales is extirpated, and the only option for "managing" it is to re-introduce whales from the North Pacific in the hope of establishing a North Atlantic population. At present, this option might be considered impractical, although the technology and competence exist for capturing and transporting cetaceans the size of young Gray Whales over great distances. A Gray Whale ("Gigi") was captured alive as a newborn in 1971 and released into the wild a year later (Evans 1974, Coerr and Evans 1980). It is also relevant to note that adult Killer Whales are transported regularly over long distances by marine parks, and these animals are as large (to 9 m and 8 tons) as

young Gray Whales (Wolman [1985: 69] reported the size of two immature Gray Whales taken on their northbound migration as 9.25 and 9.90 m and 8808 and 8876 kg, respectively).

The west Pacific stock is endangered, as its present abundance is far below the pre-exploitation level. However, with no rigorous estimate of either initial or current population size, it is impossible to estimate what percentage of initial stock size the current population represents. Full protection is warranted for an indefinite period. A potential means of enhancing this stock might be to reduce the catch of Gray Whales off Chukotka. There is some chance that by thus allowing full recovery (to the "initial" stock size or the present carrying capacity) of the east Pacific stock, emigration or "bleeding" from that stock into the west would occur or increase. This could be envisioned as an experiment on a grand scale, but some means would need to be found for confirming that the current population in the west Pacific is not already a result of such migratory "bleeding". It is unlikely that a large sample of skulls and skeletons for morphometric comparisons will become available from the whales presently occupying the Okhotsk Sea stock's range. Thus, approaches other than the conventional comparison of hard parts will be needed to establish whether these whales differ appreciably from whales in the east Pacific stock. Fujino (1960) has demonstrated with other mysticetes the utility of blood-group comparisons to evaluate stock relationships at this level. We recommend that serological (or other tissue) studies be attempted, for example, using blood from freshly stranded carcasses, blood obtained with a biopsy dart, or blood obtained from whales that are temporarily restrained (accidentally in fishing gear or intentionally by some live-capture technique).

The east Pacific stock should not be classified as endangered. It has recovered substantially from depletion by whaling. If Reilly *et al*.'s (1983) estimate of stock size in 1980 (15 647 whales) is taken as the best estimate available, and Reilly's (1981) estimate of 24 000 is used for the maximum equilibrium population level, then the current stock size is in the order of 60 to 65 percent of initial. Since many decisions by the IWC about stock classification are built upon the premise that the maximum sustainable yield (MSY) level occurs in mysticetes at 60 percent of initial, it could be argued that the east Pacific stock is at or above the MSY level. The IWC Scientific Committee's Sub-Committee on Protected Stocks noted in 1978 that if Ohsumi's (1976) model is accepted [current population at 74 percent of "potential virginal level"—but see Mitchell (1979), Reilly (1981), and Lankester and Beddington (1986)], this stock should be classified as an Initial Management Stock with a quota of 50 males and zero females in addition to the Soviet "aboriginal" catch of 150 to 200 per year (International Whaling Commission 1979b: 84). The Scientific Committee, however, recommended (International Whaling Commision 1979b: 49), and the Commission agreed (International Whaling Commission 1979a: 26), on its classification as a Sustained Management Stock (which assumes the stock to be at a level of 54 to 72 percent of initial), with a catch limit of 178 whales, reserved for the use of aborigines. Thus, direct exploitation is at present limited by an internationally agreed quota which is believed to be set below MSY. Compliance with the quota appears to be good. No IWC member has formally announced any intention to resume commercial whaling for this species.

Additional modelling is needed to understand trends in population size for the east Pacific stock. A more detailed reconstruction of catch history than is presently available, particularly for the years after about 1874, would be useful for future attempts at modelling the population. The compilation by Sayers (1984), based principally on newspaper records and other printed sources (including some cited by Nesheim n.d.), provides a “fragmentary” accounting of Gray Whale catches from shore stations. Much additional effort is needed to fill in the years for which no catch is currently documented, to convert production statistics into whales landed, to estimate loss rates, and to prorate catches of unspecified “whales” so that the Gray Whale component can be determined. Also, the more precise listing of the removals from the stock by year (*cf*. Henderson 1972: Table 1; 1984: Table 1) might allow examination of the short-term impacts of large kills on the population.

A decision against listing the east Pacific stock as threatened or endangered presupposes that: (1) there will be no increase in the direct harvest by the USSR, by North American aborigines or by others; (2) there will be no further deleterious modification by man of the population’s critical winter and summer habitats; (3) regulation of tourism (whalewatching) will continue in the present manner or, if anything, become more strict; and (4) incidental mortality caused by fishing gear will not increase. If, at any future time, any of these desiderata is no longer met, the stock’s conservation status should be re-considered. The stock should be managed as a threatened stock at this time, given that the stock is still hunted on its summer feeding grounds and that industrial activity is increasing in many parts of its range. We consider this classification a conservative one. However, given the current population size and the situation in Canadian waters the stock would be not in any COSEWIC category.

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