

First Mass Stranding of Killer Whales (*Orcinus orca*) in the Gulf of California, Mexico

Mercedes Guerrero-Ruiz,¹ Héctor Pérez-Cortés M.,^{2,3}
Mario Salinas Z.,⁴ and Jorge Urbán R.¹

¹Programa de Investigación de Mamíferos Marinos, Departamento de Biología Marina, Universidad Autónoma de Baja California Sur, A.P. 19-B, La Paz, B.C.S., C.P. 23081, México

²Instituto Nacional de Ecología, M. Ocampo 1045 Col. Centro, La Paz, B.C.S., C.P. 23000, México

³The School for Field Studies, Center for Coastal Studies, A.P. 15 Puerto San Carlos, B.C.S. 23070, Mexico

⁴Laboratorio de Mamíferos Marinos, Departamento de Pesquerías y Biología Marina, Centro Interdisciplinario de Ciencias Marinas-IPN, A.P. 592, La Paz, B.C.S., C.P. 23000, México

Abstract

We present the first report of a mass stranding of killer whales (*Orcinus orca*) in Mexican waters. This species is a temporal inhabitant of the region. On 31 July 2000, eight killer whales stranded alive at the southern tip of Isla San José in Bahía de La Paz (24° 54' N, 110° 35' W). All the individuals died despite the attempts performed by local fishermen to return them to sea. The group consisted of an undetermined number of females, immature males, and two calves. Skin and blubber samples were collected, as well as a skull on 2 August from a 4.6-m immature male. A second skull was collected on 19 August, which belonged to an individual of undetermined sex that measured 5 m in length. The teeth from both individuals were completely worn down. A couple of months later, two other skulls were collected. Individual strandings of killer whales are rare, and six records have been documented in the Mexican Pacific and Gulf of California. This report represents the first mass stranding of killer whales in Mexico. Since 1972, more than 160 killer whale sightings have been collected in the Gulf of California, with more than 90 photo-identified killer whales; nevertheless, no matches with the stranded individuals were found. There are few cases of killer whales found stranded live, probably as a result of whales chasing or following prey, or as a result of an outgoing tide. Causes of this stranding remain unknown.

Key Words: Killer whale, *Orcinus orca*, strandings, mass strandings, Gulf of California, Mexico

Introduction

The killer whale (*Orcinus orca*) is a cosmopolitan species (Leatherwood & Reeves, 1983). They have an uneven distribution around the world, with

concentrations in regions such as the Antarctic, Japan, Iceland, Norway, British Columbia, Alaska, and Washington, with only scattered sightings in other areas (Ford et al., 1994). In some parts of the world, there is a detailed knowledge of the status of killer whale populations, while in other areas, virtually nothing is known. They are better known in the coastal waters of British Columbia and Washington, where the population of identified killer whales is around 600 individuals (Ford et al., 1994), and in southern Alaska, where the population is around 300 individuals (Ford & Ellis, 1999). The intensive field studies carried on in these areas have revealed many aspects of the whale's lifestyles and natural history (Ford & Ellis, 1999).

Killer whale habitat in Mexico varies; nevertheless, they are more frequently seen in coastal waters and around islands (Guerrero-Ruiz, 1997; Guerrero-Ruiz et al., 1998). They are found in the Gulf of Mexico (O'Sullivan & Mullin, 1997; Würsig et al., 2000) and on both coasts of the Baja California Peninsula in the Pacific (Dahlheim et al., 1982).

Distribution of killer whales in Mexican waters and particularly in the Gulf of California has been reviewed in several papers. Their presence has been documented in various locations and seasons throughout the Gulf of California (Vidal et al., 1993; Pérez-Cortés et al., 2000). Breese & Tershy (1993) sighted killer whales in every month at Canal de Ballenas during a study conducted in 1985-1986, while Silber et al. (1994) recorded the species only occasionally in the northern Gulf of California during the colder months of the year. The presence of four communities inhabiting the Gulf of California, with comments on their distribution, was described by Guerrero-Ruiz et al. (1998). Black et al. (1997) compiled a photographic catalog of the killer whales of California

and western Mexico, which includes 71 identified killer whales in northwest Mexico. Since then, the catalog from the Universidad Autónoma de Baja California Sur (UABCS) has added more individuals, which have been re-identified in other areas of the Gulf of California. Inside La Paz Bay, killer whale sightings have been documented a few times, mainly towards its middle portion and around “Los Islotes” rookery (Urbán et al., 1997).

Killer whale strandings, even single strandings are rare (Dahlheim & Heyning, 1999). There are a few records of live-stranded killer whales in different parts of the world, including Washington (Hoyt, 1990), Alaska (Dahlheim & Heyning, 1999), the eastern coast of the United States (Katona et al., 1988), eastern Canada (Mitchell, 1976; Goodman, 1984; Lien et al., 1988), and the Bahamas (Backus, 1961), maybe as a result of the involved animals chasing prey in shallow waters. Other individual strandings have been reported in Florida (Moore, 1953; Caldwell et al., 1956), eastern Canada (Sergeant & Fisher, 1957; Sergeant et al., 1970; Lien et al., 1988; Mitchell & Reeves, 1988; Wenzel & Sears, 1988), the eastern North Atlantic (Hammond & Lockyer, 1988), and west Greenland (Heide-Jorgensen, 1988). Mass strandings are particularly uncommon events, and there are records of only a few worldwide, including Vancouver Island (Carl, 1946), Alaska (Lowry et al., 1987), the eastern Canadian Arctic (Dearden, 1958; Reeves & Mitchell, 1988), the western North Atlantic (Katona et al., 1988; Mitchell & Reeves, 1988), Norway (Oritsland & Christensen, 1982), New Zealand (Slijper, 1962; Mitchell, 1975), and Argentina (Goodall, 1978). Some individual strandings have taken place in the Mexican Pacific and Gulf of California, with osteological specimens being held mostly in U.S. collections. Delgado-Estrella et al. (1994) recorded the discovery of osteological remains of killer whales in the upper Gulf of California, which by that time, were the only ones housed at a national institution—the Instituto de Biología of the Universidad Nacional Autónoma de México in México City.

To increase the knowledge regarding killer whales in Mexican waters, the purpose of this paper was to present the first report of a mass stranding of killer whales in the Gulf of California, located on the west coast of Mexico between the Baja California Peninsula and the mainland of Mexico. The Gulf is approximately 1,400-km long and 150-km wide (at its widest point), and totals an area of approximately 210,000 km².

Materials and Methods

On 29 July 2000, a pod of eight killer whales was found alive by fishermen on a beach at the

southern tip of Isla San Jose (24° 54' N, 110° 35' W) in La Paz Bay (Figure 1), but the event was not reported to the authorities until 31 July. After coordinating the efforts to respond, officers from the Mexican Navy offered to transport the response team on one of their vessels, but later the same day, they informed us that a boat patrolling near the location was instructed to check the area and only found the floating bodies of the killer whales along a beach. Bad weather precluded a timely response, and after obtaining support with a vessel, we visited the area located at 47.8 nmi from La Paz on 2 August. No remains were found in the area of the first report, and after an unsuccessful search in the surrounding waters, we traveled to El Pardito, a small island in the vicinity inhabited by fishermen, who provided us with further details regarding the live whale response and directions to find one of the floating bodies. The fishermen reported that they could only turn the animals to face the sea, and despite their efforts and attempts to release the stranded animals, all died. All the bodies were resting on the beach, but the great tides refloated them and, thus, only some were found scattered in the area and on different days.

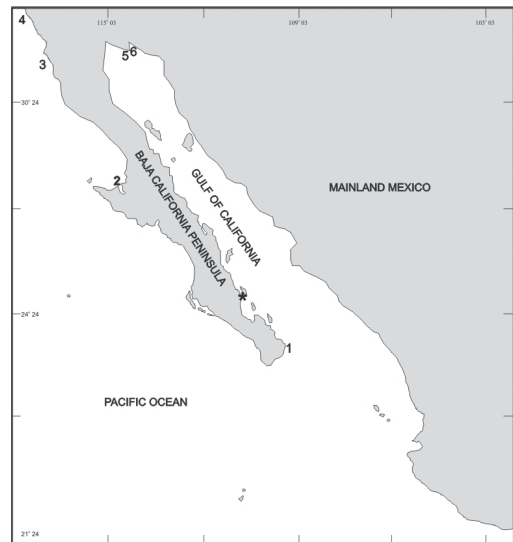


Figure 1. Six localities where killer whale strandings have occurred (see Table 1 for details); * location where the mass stranding occurred.

Results

In Mexico, there are six records of individual killer whale strandings in the Mexican Pacific and Gulf of California from the mid-1950s to December 1990 (Figure 1; Table 1). The event reported in this paper represents the first documented mass stranding of the species in the region, taking place

Table 1. Osteological records of Mexican killer whales

Map reference	Date	Locality	Nature of specimen	Scientific institutions holding Mexican specimens of killer whales	Reference
1	Mid-1950s	23° 25' N, 109° 20' W	Apparently no materials were collected		Dahlheim et al., 1982
2	17 April 1951	Bahía de Sebastián Vizcaíno, Baja California	Partial skull	Los Angeles County Museum	Dahlheim et al., 1982; Vidal, 1991
3	8 June 1952	Punta Cabras, Baja California, 31° 20' N	Weathered skull		Dahlheim et al., 1982
4	6 October 1987		Other bones (ribs, vertebrae)	Southwest Fisheries Science Center (SWFSC)	Perrin & Kashiwada, 1989; Vidal, 1991
5	May 1992	Faro de Punta Borrascosa, south from El Golfo de Santa Clara, Sonora	Other bones collected (ribs, sternum, tympanic bulla, and pectoral appendage)	Instituto de Biología, Universidad Nacional Autónoma de México (IB-UNAM)	Delgado-Estrella et al., 1994
6	December 1990	Punta Borrascosa, Sonora	Dead animal; apparently no materials were collected		Guerrero-Ruiz, 1997
*	31 July 2000	Isla San Jose, 24° 54' N, 110° 35' W	8 live stranded killer whales; 4 skulls collected	Centro Interdisciplinario de Ciencias Marinas (CICIMAR); Universidad Autónoma de Baja California Sur (UABCS)	This paper

approximately ten years after the last killer whale stranding there.

The first body was found on 2 August after following directions given by the fishermen, and it corresponded to a catalogued 4.6-m immature male (Figure 2). We trawled the body to the closest beach, where data were collected and a necropsy was conducted. At the beach, we tied the body and anchored it from the head region and the flukes. The work was carried on with the corpse partially floating, which allowed us to turn it around when needed, to check different parts, and to make



Figure 2. Immature killer whale male (4.6 m) stranded on 29 July 2000 in the Gulf of California, Mexico

incisions. The carcass was catalogued as moderately decomposed (level 3) under condition code (Geraci & Lounsbury, 1998). The coloration and color pattern were still visible, but skin was peeling off. The skin was clean, free of parasites or other epifauna, and several lacerations were found in the ventral region, probably due to the live animal resting on the beach. The carcass was bloated, the eyes and the blowhole were inflamed, and the penis was protruding. Even though it was a young animal, all the teeth were observed to be severely worn down and flat at the level of the gum.

A second skull was collected on 19 August, which belonged to an undetermined individual that measured 5 m in length. Only two teeth were found and collected from this animal, which were also completely worn down (Figure 3).

It was not possible to perform a necropsy, to obtain tissue or other organ samples from this specimen, due to the fact that it was in a highly advanced state of decomposition. This stage also made it impossible to determine the sex or identify the animal from its markings.

Even though the rest of the group was taken away by high tides, two other skulls from unidentified individuals were recovered a couple of months later. The skull from the 4.6-m immature



Figure 3. Immature killer whale male with completely worn teeth

male is being held at the Centro Interdisciplinario de Ciencias Marinas (CICIMAR), while the other three are kept at the marine mammal osteological collection of the Universidad Autónoma de Baja California Sur (UABCS). These collected skulls are the first ones to be housed in a Mexican institution (Table 1).

Discussion

Individual strandings of killer whales are considered rare (Dahlheim & Heyning, 1999), and they appear to be equally rare in other parts of the world (Dahlheim et al., 1982).

Some species, such as short-finned pilot whales (*Globicephala macrorhynchus*), false killer whales (*Pseudorca crassidens*), and sperm whales (*Physeter macrocephalus*), are known to mass strand, but similar strandings of several individuals of killer whales are not common (Heyning & Dahlheim, 1988). According to Geraci & Lounsbury (1998), a mass stranding is an event in which two or more individuals of the same species, excluding a cow-calf pair, are involved. Since killer whales occasionally hunt collectively, the event can be related to the chasing of prey since no other evidence was found in the individual more closely analyzed.

There are over 100 records of cetacean strandings in La Paz Bay, which include six species of mysticetes and 18 species of odontocetes, since the early 1900s up to 2005 (Miller, 1920; Cockrum, 1956; Gilmore, 1957; Van Gelder, 1960; Mitchell, 1965; Mullen, 1977; Norris & Dohl, 1980; Gómez, 1983; Aurióles et al., 1984, 1993; De la Parra et al., 1984; Fleischer et al., 1984; Vidal & Findley, 1984; Aurióles, 1987; Rizo, 1990; Vidal, 1991; Urbán & Jaramillo, 1992; Urbán & Aurióles, 1992; Aurióles & Urbán, 1993; Urbán, 1993; Urbán et al., 1993; Perez-Cortes, 1994; Urbán & Flores, 1996; Michel et al., 1997; Palmeros et al.,

1997; Urbán et al., 1997; Pérez-Cortés & Urbán, 2000; UABCS, unpub. data).

Previous records of mass strandings within La Paz Bay include short-finned pilot whales, which is the main species to mass strand in the area with four strandings between 1953 and 1989 (Gilmore, 1957; Norris & Dohl, 1980; De la Parra et al., 1984; Urbán, 1993), followed by sperm whales with two confirmed records in 1954 (Cockrum, 1956) and 1993 (Urbán et al., 1993); Cuvier's beaked whale (*Ziphius cavirostris*), with one record in 1980 (Aurióles et al., 1984) and another in 2002 (Taylor et al., 2004); and false killer whales with one record in 1940 (Mitchell, 1965; Vidal, 1991) and one in 1964 (Van Gelder, 1960). Other species that have mass stranded in the area but have been registered only once are Baird's beaked whale (*Berardius bairdii*) (Aurióles, 1992), eastern spinner dolphins (*Stenella longirostris orientalis*) (Perez-Cortes, 1994), striped dolphins (*S. coeruleoalba*) (UABCS, unpub. data), common dolphins (*Delphinus* sp.) (UABCS, unpub. data), and the present report of killer whales. According to Rizo (1990), La Paz Bay represents a natural entrapment for cetaceans—mostly for offshore species. This entrapment most likely occurs when these cetaceans are following their prey and end up trapped in shallow waters. Nevertheless, there is a low degree of *post mortem* analysis to support this or any alternative hypothesis of the possible causes of these strandings and sometimes the beached individuals are not fresh enough to provide useful information to determine the causes of death.

Particularly in the case of killer whales, the low frequency of both individual and mass stranding events in the Gulf of California could be due to (1) the generally low tendency of the species to strand as reported elsewhere, (2) the fact that main concentration areas have not been discovered yet, and (3) the fact that only certain localities of the Gulf are systematically searched for strandings. Dahlheim et al. (1982) also stated that much of the shoreline of Baja California, Mexico, is inaccessible and that scientists or other people infrequently visit most of these shores. Another fact is that most of the strandings are reported by local people to authorities, so there is no real search effort made to look for stranded species in the area.

There are few cases of killer whales found stranded alive, probably because of whales chasing or following prey, or because of an outgoing tide (Dahlheim & Heyning, 1999). Some factors of mass strandings can be the presence of toxins and pollutants, such as polychlorinated biphenyls (PCBs) and the pesticide DDT in water, which may affect the animals' immune systems and hinder reproduction (Harwood, 2002; Reijnders

& Aguilar, 2002). This fact does not seem to be a current problem in the Gulf of California, at least for species such as the blue whale (*Balaenoptera musculus*) in which analysis of the presence of pollutants found in the blubber have been made (Valdez et al., 2001). Other possible causes of mass strandings are the presence of too much noise from whale-watching boats and other vessels, seismic operations, and the use of high-intensity sonars by navy boats (Hildebrand, 2004)—activities that occur in La Paz Bay. Strandings also can happen due to food shortages during a certain part of the year. Although, the killer whales that inhabit the Gulf of California and Mexican Pacific feed year-round, and some communities feed both from marine mammals and fish (Guerrero-Ruiz et al., in prep.), this does not seem to be a plausible cause of death for the killer whale mass stranding.

It is known that as odontocetes age, teeth start wearing down, and so is the case of killer whales, in which tooth wear is often seen in old teeth (IWC, 1980). Both individuals reported in this mass stranding presented an extensive wear of their teeth as expected in older individuals, although they were considered to be young individuals. Christensen (1984) reported an adolescent growth spurt in males from 5.5 to 6.1 m at the time of sexual maturity, while Perrin & Reilly (1984) reported that males reach sexual maturity at lengths of 5.2 to 6.2 m. Even though variation in size at maturity exists geographically, we conclude that at least the 4.6-m male reported in this paper had not reached sexual maturity and was a juvenile; whereas, according to Perrin & Reilly (1984), who reported that females attain sexual maturity between 4.6 to 5.4 m, the 5-m individual of unknown sex reported in this paper could be either a juvenile male or a female starting to attain sexual maturity.

Dahlheim & Heyning (1999) reported that killer whale teeth often showed extensive wear flush with the gum line, exposing the pulp cavity leading to possible penetration or infection, but they do not specify the age class in which this event takes place. Therefore, even though these killer whales showed an extensive wear of teeth, we cannot say this fact caused dental infection leading to their death since we did not observe any lesions associated with this condition. The extensive tooth wear could be associated with play behavior, hunting behavior, or the predation on a certain prey item. Probably, this condition might have affected their ability to capture prey, but its relation to the stranding remains unknown.

Since 1972, around 200 sightings have been reported in the Gulf of California, with more than 100 photo-identified killer whales; no match was found with the juvenile specimen collected on 2

August, however. The collected teeth, skin, and blubber samples from the 4.6-m male, as well as the two dental pieces from the 5-m individual, will be analyzed to obtain information regarding age, feeding habits, pollutants, and genetics.

Acknowledgments

We appreciate the efforts of the fishermen from El Pardito for both attempting to release the killer whales and for reporting the event. The Mexican Navy provided vessel support and information. We acknowledge the professional efforts from Ciro Arista, the boat driver from CICIMAR, who besides taking us to the location, helped during the necropsy. Carlos Barrera and Esther Jimenez also provided their help during the necropsy and in reviewing information. We also thank José Sánchez for collecting the last two skulls in the area.

Literature Cited

- Aurioles G., D. (1987). Stranding of seven Baird's beaked whales in the southwestern Gulf of California. *Proceedings of the Seventh Biennial Conference on the Biology of Marine Mammals*, Miami, FL.
- Aurioles G., D. (1992). Notes on a mass stranding of Baird's beaked whales in the Gulf of California, México. *California Fish and Game*, 78(3), 116-123.
- Aurioles G., D., & Urbán R., J. (1993). Sexual dimorphism in the skull of the pigmy beaked whale (*Mesoplodon peruvianus*). *Revista de Investigación Científica UABCS No. Especial SOMEMMA*, 1, 39-52.
- Aurioles G., D., Maravilla Ch., M. O., & Muñoz, L. M. E. (1984). *Ocurrencia de mamíferos marinos poco comunes en la Bahía de la Paz, B.C.S., México*. Resúmenes IX Reunión Internacional para el Estudio de los Mamíferos Marinos, La Paz, B.C.S., México.
- Aurioles G., D., Urbán R., J., & Enríquez P., L. (1993). *Dwarf sperm whales strandings and sightings on the southwest coast of the Gulf of California, México*. Proceedings of the Tenth Biennial Conference on the Biology of Marine Mammals, Galveston, TX.
- Backus, R. H. (1961). Stranded killer whale in the Bahamas. *Journal of Mammalogy*, 42(3), 418-419.
- Black, N. A., Schulman-Janiger, A., Ternullo, R. L., & Guerrero-Ruiz, M. (1997). Killer whales of California and western Mexico: A catalog of photo-identified individuals. *NOAA Technical Memorandum (NMFS-247)*. 175 pp.
- Breese, D., & Tershy, B. R. (1993). Relative abundance of cetacea in the Canal de Ballenas, Gulf of California. *Marine Mammal Science*, 9(3), 319-324.
- Caldwell, D. K., Layne, J. N., & Siebenaler, J. B. (1956). Notes on a killer whale (*Orcinus orca*) from the north-eastern Gulf of Mexico. *Quarterly Journal of the Florida Academy of Sciences*, 19(4), 189-196.

- Carl, G. C. (1946). A school of killer whales stranded at Estevan Point, Vancouver Island. *Report of the Provincial Museum of Natural History and Anthropology*, B21-B28.
- Christensen, I. (1984). Growth and reproduction of killer whales, *Orcinus orca*, in Norwegian coastal waters: Reproduction in whales, dolphins, and porpoises. *Report of the International Whaling Commission, Special Issue 6*, 253-258.
- Cockrum, E. (1956). Sperm whales stranded on the beaches of the Gulf of California. *Journal of Mammalogy*, 37(2), 288.
- Dahlheim, M. E., & Heyning, J. E. (1999). Killer whale *Orcinus orca* (Linnaeus, 1758). In S. H. Ridgway & R. Harrison (Eds.), *Handbook of marine mammals. Volume 6: The second book of dolphins and porpoises* (pp. 281-322). London: Academic Press. 442 pp.
- Dahlheim, M. E., Leatherwood, S., & Perrin, W. F. (1982). Distribution of killer whales in the warm temperate and tropical eastern Pacific. *Report of the International Whaling Commission*, 32, 647-653.
- De la Parra V., R., Amares, O. J., & Galván, P. B. F. (1984). *Resultados preliminares sobre el registro de observaciones de cetáceos en la costa del municipio de Ahome Sinaloa*. Resúmenes IX Reunión Internacional para el Estudio de los Mamíferos Marinos, La Paz, B.C.S., México.
- Dearden, J. C. (1958). A stranding of killer whales in Newfoundland. *Canadian Field Naturalist*, 72(4), 166-167.
- Delgado-Estrella, A., Ortega-Ortiz, J. G., & Sánchez-Ríos, A. (1994). Varamientos de mamíferos marinos durante la primavera y otoño y su relación con la actividad humana en el norte del Golfo de California. *Anales del Instituto de Biología UNAM Serie Zoológica*, 65(2), 287-295.
- Fleischer, L. A., Cervantes, F., Fuentes, R., & Michel, E. (1984). *New records of whale strandings at the Bay of La Paz, Baja California Sur, México*. Resúmenes IX Reunión Internacional para el Estudio de los Mamíferos Marinos, La Paz, B.C.S., México.
- Ford, J. K. B., & Ellis, G. M. (1999). *Transients: Mammal-hunting killer whales*. Vancouver: British Columbia Press, University of British Columbia. 96 pp.
- Ford, J. K. B., Ellis, G. M., & Balcomb, K. C. (1994). *Killer whales*. Vancouver: British Columbia Press, University of British Columbia. 102 pp.
- Geraci, J. R., & Lounsbury, V. J. (1998). *Marine mammals ashore: A field guide for strandings* (CD-ROM). Baltimore: National Aquarium in Baltimore.
- Gilmore, R. M. (1957). Whales aground in Cortéz Sea. *Pacific Discovery Academy of Sciences. San Francisco*, 10(1), 22-27.
- Gómez, G. C. (1983). *Primer registro y morfometría de un ejemplar de cachalote enano Kogia simus, en la Ensenada de La Paz*. Resúmenes VIII Reunión Internacional para el Estudio de los Mamíferos Marinos, La Paz, B.C.S., México.
- Goodall, R. N. P. (1978). Report on the small cetaceans stranded on the coasts of Tierra del Fuego. *Scientific Reports of the Whales Research Institute*, 30, 197-230.
- Goodman, D. (1984). Annual report on cetaceans in Canada. *Report of the International Whaling Commission*, 34, 667-672.
- Guerrero-Ruiz, M. E. (1997). *Conocimiento actual de la Orca Orcinus orca (Linnaeus, 1758) en el Golfo de California, México*. Tesis de Licenciatura, Departamento de Biología Marina, Universidad Autónoma de Baja California Sur, México. 59 pp.
- Guerrero-Ruiz, M., Gendron, D., & Urbán R., J. (1998). Distribution, movements and communities of killer whales (*Orcinus orca*) in the Gulf of California, México. *Report of the International Whaling Commission*, 48, 537-543.
- Guerrero-Ruiz, M., Urbán, R., J., Gendron, D., & Rodríguez, V., M. E. (In prep.). Prey items of killer whales in the Mexican Pacific.
- Hammond, P. S., & Lockyer, C. (1988). Distribution of killer whales in the eastern North Atlantic. *Rit Fiskideildar (Journal of the Marine Institute Reykjavik)*, 11, 24-41.
- Harwood, P. (2002). Mass die-offs. In W. F. Perrin., B. Würsig, & J. G. M. Thewissen (Eds.), *Encyclopedia of marine mammals* (pp. 724-726). San Diego: Academic Press. 1,414 pp.
- Heide-Jorgensen, M. P. (1988). Occurrence and hunting of killer whales in Greenland. *Rit Fiskideildar (Journal of the Marine Institute Reykjavik)*, 11, 115-135.
- Heyning, J. E., & Dahlheim, M. E. (1988). *Orcinus orca. Mammalian Species*, 304, 1-9.
- Hildebrand, J. (2004). *Impacts of anthropogenic sound on cetaceans (IWC/SC/56/E13)*. Sorrento, Italy: International Whaling Commission.
- Hoyt, E. (1990). *Orca: The whale called killer*. Camden East, Ontario: Camden House. 291 pp.
- International Whaling Commission (IWC). (1980). Report of the workshop age determination of toothed whales and sirenians. *Report of the International Whaling Commission, Special Issue 3*, 1-19.
- Katona, S. K., Beard, J. A., Girton, P. E., & Wenzel, F. (1988). Killer whales (*Orcinus orca*) from the Bay of Fundy to the Equator, including the Gulf of México. *Rit Fiskideildar (Journal of the Marine Institute Reykjavik)*, 9, 205-224.
- Leatherwood, S., & Reeves, R. R. (1983). *The Sierra Club handbook of whales and dolphins*. San Francisco: Sierra Club Books. 302 pp.
- Lien, J., Stenson, G. B., & Jones, P. W. (1988). Killer whales (*Orcinus orca*) in waters off Newfoundland and Labrador, 1978-1986. *Rit Fiskideildar (Journal of the Marine Institute Reykjavik)*, 11, 194-201.
- Lowry, L. F., Nelson, R. R., & Frost, K. J. (1987). Observations of killer whales, *Orcinus orca*, in western Alaska: Sightings, strandings, and predation on other marine mammals. *Canadian Field Naturalist*, 101(1), 6-12.

- Michel, E., Zarate, A., Saavedra, L., & Fleischer, L. (1997). *Registro de cuatro varamientos de Kogia simus* (Owen, 1866) en la Bahía de La Paz, B.C.S., México. Resúmenes XXII Reunión Internacional para el Estudio de los Mamíferos Marinos, Nuevo Vallarta, Nayarit, México.
- Miller, G. S., Jr. (1920). American records of whales of the genus *Pseudorca*. *Proceedings of the United States National Museum*, 57(2311), 205-207.
- Mitchell, E. D. (1965). Evidence for mass strandings of the false killer whale (*Pseudorca crassidens*) in the eastern North Pacific Ocean. *Norsk Hvalfangst-Tidende*, 8, 172-177.
- Mitchell, E. D. (Ed.). (1975). Review of biology and fisheries for smaller cetaceans. Report and papers from a meeting of the Subcommittee on Smaller Cetaceans, International Whaling Commission, in Montreal, April 1-11, 1974. *Journal of the Fisheries Research Board of Canada*, 32(7), 875-1240.
- Mitchell, E. D. (1976). Canada: Progress report on whale research, June 1974-May 1975. *Report of the International Whaling Commission*, 26, 444-447.
- Mitchell, E., & Reeves, R. R. (1988). Records of killer whales in the western North Atlantic, with emphasis on eastern Canadian waters. *Rit Fiskideildar (Journal of the Marine Institute Reykjavik)*, 9, 161-193.
- Moore, J. C. (1953). Observations of marine mammals to Florida waters. *American Midland Naturalist*, 49(1), 27-62.
- Mullen, D. A. (1977). The striped dolphin, *Stenella coeruleoalba*, in the Gulf of California. *Bulletin of Southern California Academy of Sciences*, 76, 131-132.
- Norris, S. K., & Dohl, T. (1980). Structure and function of cetacean schools. In L. M. Herman (Ed.), *Cetacean behavior: Mechanisms and functions* (pp. 211-261). New York: John Wiley & Sons. 463 pp.
- Oritsland, T., & Christensen, I. (1982). *A mass stranding of killer whales at Lofoten, northern Norway, in June 1981*. (IWC Doc. SC/Jn81/KWI Addendum).
- O'Sullivan, S., & Mullin, K. D. (1997). Killer whales (*Orcinus orca*) in the northern Gulf of Mexico. *Marine Mammal Science*, 13(1), 141-147.
- Palmeros R., M., Velázquez Ch., G., & Urbán R., J. (1997). *Cetáceos varados recientemente en la Bahía de La Paz, B.C.S.* Resúmenes XXII Reunión Internacional para el Estudio de los Mamíferos Marinos, Nuevo Vallarta, Nayarit, México.
- Pérez-Cortés, M. H. (1994). *Varamiento de delfines tornillo Stenella longirostris en la Bahía de La Paz*. La Paz, B.C.S., México: Coloquio sobre la Bahía de La Paz.
- Pérez-Cortés M., H., & Urbán R., J. (2000). *Rescate de una ballena azul y un zifio de Cuvier varados en la Bahía de La Paz, B.C.S., México*. Resúmenes XXV Reunión Internacional para el Estudio de los Mamíferos Marinos, La Paz, B.C.S., México.
- Pérez-Cortés M., H., Villa-R., B., Delgado Estrella, A., & Patiño V., J. L. (2000). Familia Delphinidae. In S. T. Alvarez-Castañeda & J. L. Patton (Eds.), *Mamíferos del Noroeste de Mexico II, Vol. 2* (1st ed.) (pp. 597-626). La Paz, B.C.S., México: CIB Nor. 873 pp.
- Perrin, W. F., & Kashiwada, J. V. (1989). Catalog of the synoptic collection of marine mammal osteological specimens at the Southwest Fisheries Center. *NOAA Technical Memorandum* (NMFS-SWFC-130). 19 pp.
- Perrin, W. F., & Reilly, S. B. (1984). Reproductive parameters of dolphins and small whales of the family Delphinidae. *Report of the International Whaling Commission, Special Issue 6*, 97-134.
- Reeves, R. R., & Mitchell, E. (1988). Distribution and seasonality of killer whales in the eastern Canadian Arctic. *Rit Fiskideildar (Journal of the Marine Institute Reykjavik)*, 11, 136-160.
- Reijnders, P. J. H., & Aguilar, A. (2002). Pollution and marine mammals. In W. F. Perrin, B. Würsig, & J. G. M. Thewissen (Eds.), *Encyclopedia of marine mammals* (pp. 948-957). San Diego: Academic Press. 1,414 pp.
- Rizo D., L. E. (1990). *Análisis de algunos aspectos físicos y biológicos de los varamientos de cetáceos en la Bahía de La Paz, Baja California Sur, México*. Tesis de Licenciatura, Facultad de Ciencias, Universidad Nacional Autónoma de México, México. 80 pp.
- Sergeant, D. E., & Fisher, H. D. (1957). The smaller cetacea of eastern Canadian waters. *Journal of the Fisheries Research Board of Canada*, 14(1), 83-115.
- Sergeant, D. E., Mansfield, A. W., & Beck, B. (1970). Inshore records of cetacean for eastern Canada, 1949-68. *Journal of the Fisheries Research Board of Canada*, 27(11), 1903-1915.
- Silber, G. K., Newcomer, M. W., Silber, P. C., Perez-Cortes M., H., & Ellis, G. M. (1994). Cetaceans of the northern Gulf of California: Distribution, occurrence and relative abundance. *Marine Mammal Science*, 10(3), 283-298.
- Slijper, E. J. (1962). *Whales* (2nd ed.). London: Cornell University Press. 511 pp.
- Taylor, B., Barlow, J., Pitman, R., Balance, L., Kliner, T., DeMaster, D., et al. (2004). *A call for research to assess risk of acoustic impact on beaked whale populations* (IWC/SC/56/E36).
- Urbán R., J. (1993). Varamiento y rescate de calderones de aletas cortas, *Globicephala macrorhynchus*, en la Bahía de La Paz, B.C.S. *Revista de Investigación Científica UABCS No. Esp. SOMEMMA*, 1, 59-67.
- Urbán R., J., & Aurioles, G. D. (1992). First record of the pygmy beaked whale *Mesoplodon peruvianus* in the North Pacific. *Marine Mammal Science*, 8, 420-425.
- Urbán R., J., & Flores, S. (1996). A note on Bryde's whales (*Balaenoptera edeni*) in the Gulf of California, México. *Report of the International Whaling Commission*, 46, 453-457.
- Urbán R., J., & Jaramillo, L. A. M. (1992). Segundo varamiento de *Berardius baridii* en la Bahía de La Paz, B.C.S. *Revista de Investigación Científica UABCS No. Especial SOMEMMA*, 3, 85-92.
- Urbán R., J., Gómez-Gallardo U., A., Palmeros R., M., & Velázquez Ch., G. (1997). Los mamíferos marinos de la

- Bahía de La Paz. In J. Urbán R. & M. Ramírez R. (Eds.), *La Bahía de La Paz: Investigación y conservación* (pp. 193-217). La Paz, B.C.S., México: UABCS, CICIMAR, SCRIPPS. 327 pp.
- Urbán R., J., Enríquez, P. L., Salinas, V. J. C., Jaramillo, L. A., Ortiz, M. J., Alba, F. C., et al. (1993). *Informe sobre dos varamientos recientes de cachalotes* *Physeter macrocephalus*, en la costa suroccidental del Golfo de California. Resúmenes XVIII Reunión Internacional para el Estudio de los Mamíferos Marinos, La Paz, B.C.S., México.
- Valdez, M. M., Gendron, D., Lares, M. L., & Camacho, I. V. (2001). *Hidrocarburos clorados en biopsias de ballena azul* *Balaenoptera musculus* y *eufásidos del Pacífico mexicano*. Resúmenes XXVI Reunión Internacional para el Estudio de los Mamíferos Marinos, Ensenada, B.C., México.
- Van Gelder, R. G. (1960). Results of the Puritan-American Museum of Natural History expedition to the Western Mexico. 10: Marine mammals from the coasts of Baja California and the Tres Mariás Islands, Mexico. *American Museum of Natural History Novitates*, 1992, 1-27.
- Vidal, O. (1991). Catalog of osteological collections of aquatic mammals from Mexico. *NOAA Technical Report* (NMFS-97). 36 pp.
- Vidal, O., & Findley, L. T. (1984). *Los cachalotes* *Physeter macrocephalus*, en el Golfo de California, con reporte sobre un varamiento múltiple. Resúmenes IX Reunión Internacional para el Estudio de los Mamíferos Marinos, La Paz, B.C.S., México.
- Vidal, O., Findley, L. T., & Leatherwood, S. (1993). Annotated checklist of the marine mammals of the Gulf of California. *Proceedings of the San Diego Society of Natural History*, 28, 1-16.
- Wenzel, F., & Sears, R. (1988). A note on killer whales in the Gulf of St. Lawrence, including an account of an attack on a minke whale. *Rit Fiskideildar (Journal of the Marine Institute Reykjavik)*, 11, 202-204.
- Würsig, B., Jefferson, T. A., & Schmidly, D. (2000). *The marine mammals of the Gulf of Mexico*. College Station: Texas A & M University Press.