Status of the Pacific White-sided Dolphin, *Lagenorhynchus obliquidens*, in Canada*

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Stacey, Pam J., and Robin W. Baird. 1991. Status of the Pacific White-sided Dolphin, *Lagenorhynchus obliquidens*, in Canada. Canadian Field-Naturalist 105(2): 219-232.

The Pacific White-sided Dolphin (*Lagenorhynchus obliquidens*) appears to be an abundant permanent resident of the pelagic waters off the west coast of Canada and a regular visitor to inshore waters. This report summarizes the general biology and management of this species with special reference to its status in Canada. One hundred and fifty-six records from Canada's 320 km (200 mile) extended economic zone are presented. Group size ranges from 1 to 1000, with a mean, median and modal size of 62, 15 and 6 respectively. Depth of water from sighting locations ranges from 10 to 2000 fathoms, with mean, median and modal depths of 617, 400 and 100 fathoms, respectively. Sea surface temperature taken at 73 record locations had a range from 6° to 17°C, with a mean, median and mode of 12°, 13° and 15°C respectively. The Pacific White-sided Dolphin is taken directly and incidentally in small numbers in fisheries throughout its range. From 1985 through 1987 a total of 14 (four of which were released alive) were caught in an experimental drifnet fishery for Flying Squid (*Ommastrephes bartrami*) in offshore Canadian waters, the second most frequent incidentally taken cetacean. Small numbers are also taken incidentally in net fisheries in British Columbia, but a lack of comprehensive recording of net-induced mortality makes determination of the extent of this catch or its impact on populations difficult. Based on sighting records, the number of Pacific White-sided Dolphins in Canadian waters is probably high. Exact determination of status, especially population trends, cannot be made at this time. With the presumed lack of serious threats, however, and until further studies elucidate population numbers and trends, the Pacific White-sided Dolphin should be considered not in jeopardy and therefore not in any COSEWIC category.

Le Dauphin à flancs blancs du Pacifique (*Lagenorhynchus obliquidens*) semble fréquenter en grand nombre et de façon permanente les eaux profondes au large de la côte ouest du Canada et effectuer de fréquentes incursions dans les eaux côtières. Le présent rapport expose de manière générale les particularités biologiques de cette espèce, sa situation, particulièrement au Canada, et les mesures de gestion dont elle fait l'objet. Les auteurs y font état de 156 observations qui ont eu lieu à l'intérieur de la zone économique élargie canadienne de 320 kilomètres (200 milles). Le nombre d'individus observés varie d'un à 4000; la taille moyenne, médiane et le monde des troupeaux est de 62, 15 et 6 respectivement. Ces observations ont eu lieu dans des eaux de 10 à 2000 brasses de profondeur, avec des valeurs moyenne, médiane et mondale de 617, 400 et 100 brasses respectivement. La température de l'eau en surface mesurée à 73 points d'observation variait entre 6 et 17 degrés Celsius, avec des valeurs moyenne, médiane et modale de 12, 13 et 15 degrés Celsius respectivement. Dans toute son aire de répartition, le Dauphin à flancs blancs du Pacifique est capturé directement et accidentellement, en petit nombre, par des pêcheurs. De 1985 à 1987, dans le cadre d'une pêche expérimentale de l'Encornet géant (*Ommastrephes bartrami*) à l'aide de filets maillants dérivants dans les eaux hauturières canadiennes, ce cétacé occupait la deuxième place en importance parmi les prises accidentelles, soit un total de 14 prises (dont quatre ont été relâchés vivant). On sait qu'il s'en capture également accidentellement en petits nombres dans la pêche au filet en Colombie-Britannique; malheureusement, faute de statistiques exhaustives sur la mortalité par prises accidentelles, il serait hasardeux de vouloir se prononcer sur l'effet de ces prises sur les populations. D'après les observations consignées, on peut supposer qu'un grand nombre de Dauphins à flancs blancs du Pacifique fréquentent les eaux canadiennes; il est néanmoins impossible de déterminer avec exactitude la situation de ces populations, et encore moins les tendances démographiques. Cependant, comme cette espèce ne semble pas gravement menacée par quelque facteur que ce soit, en attendant que des études nous éclairent sur les populations et les tendances démographiques, elle ne doit pas être considérée comme menacée et ne doit donc pas être inscrite dans aucune des catégories du CSEMDC.

Key Words: Pacific White-sided Dolphin, Dauphin à flancs blancs du Pacifique, *Lagenorhynchus obliquidens*, Canada, North Pacific, status, cetacean.

This report reviews the biology and management of the Pacific White-sided Dolphin, *Lagenorhynchus obliquidens* Gill 1865, with particular reference to its status in Canada. This review has been undertaken by request of the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), Fish and Marine Mammal Subcommittee. All marine mammals

*Report accepted by COSEWIC 11 April 1990 — no status designation required

have been included in the mandate of this committee, regardless of their status, because of their listing under CITES, the Convention on International Trade in Endangered Species of Wild Fauna and Flora. CITES has taken a conservative approach to management by listing all cetaceans under either Appendix I or II, due to the inability of non-specialists to distinguish various cetacean species, or parts thereof, in international trade.

The Pacific White-sided Dolphin reaches maximum lengths of at least 2.5 m and weights of up to 181 kg (Everitt et al. 1980; Walker et al. 1986). Leatherwood et al. (1982) and Walker et al. (1986) provide detailed descriptions of this small toothed whale. The most apparent physical characteristic of the Pacific White-sided Dolphin, seen when surfacing, is the tall, usually falcate dorsal fin which is bicoloured; the forward third dark and the trailing two-thirds light. The dorsal fin varies considerably in size, and ranges in shape from falcate and sharply pointed to lobate and more rounded on the tip. Such differences may be age-related (Walker et al. 1986). The basic body colour is black dorsally, grey and black laterally and white ventrally. A pair of light-coloured stripes extend along each side from the head, upwards towards and past the dorsal fin, and down, ending in a light grey flank patch (Figure 1). The forehead and the sides of the body in front of the dorsal fin are grey. A thin dark band separates the grey and black zones of the side from the white ventrum. The small dark beak is distinctly marked off from the head. The pectoral fins are long, and are occasionally similar to the dorsal fin in coloration, being dark on the leading edge and light posteriorly. The dark flukes have a concave trailing edge and a median notch. The teeth are small, pointed and slightly recurved. Numbers of teeth range between 21 to 33 in each side of the upper and lower jaws (Leatherwood et al. 1982; Leatherwood and Reeves 1983; Minasian et al. 1984).

Several colour variations have been recorded from Pacific White-sided Dolphins. These include largely all-white individuals (Figure 2), and those with an unusual white stripe along the upper side of the body (Figure 3) [Brown and Norris 1956; Walker et al. 1986; Black 1989]. All-black individuals have also been observed (S. Leatherwood, San Diego National History Museum, San Diego, California, personal communication). It is not known what implications these colour variations have, if any, on stock differentiation (Leatherwood et al. 1982). Walker et al. (1986) found a marked reduction in cranial size in Pacific White-sided Dolphins found above 37°N compared to those found below 32°N. Based on cranial morphometrics they suggest the existence of two populations in the northeastern Pacific. Leatherwood and Reeves (1983) note that two stocks, northwestern and northeastern Pacific, separated by an area of low density along the south side of the central Aleutians, have been proposed. Sleptsov (1955) described *Lagenorhynchus ognevi* from the North Pacific, but this species designation is now thought to be invalid, with the diagnostic characters well within the limits of variation found within *Lagenorhynchus obliquidens* (Tomilin 1957; Walker et al. 1986). In the older literature the Pacific White-sided Dolphin is called the Pacific Striped Dolphin or the Pacific Striped Porpoise (Osgood 1901; Cowan and Guiguet 1965).

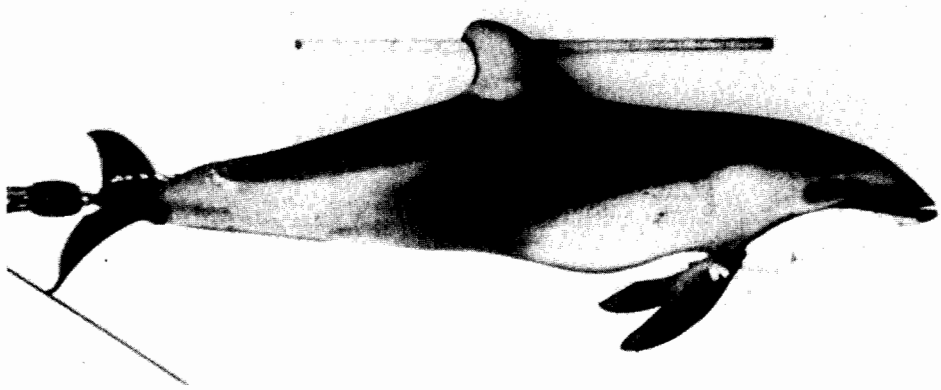

FIGURE 1. Normal coloration of the Pacific White-sided Dolphin. Photo by Richard Stroud, U.S. Fish and Wildlife Service.

FIGURE 2. Anomalous-coloured white individual three miles east of Pedro Point, Santa Cruz Island, California, November 1967. There has been no verification that the white form is albinism. Photo by Steve Leatherwood/Norbert Brilschmidt.

Distribution

The Pacific White-sided Dolphin is restricted to the temperate waters of the North Pacific Ocean (Figure 4). Canadian waters are in the central portion of their coastal range. Their presence has been recorded as far north as Amchitka Island in the Aleutians and throughout the Gulf of Alaska (Leatherwood et al. 1982). In the eastern Pacific the southern portion of their range extends around Baja California into the Gulf of California (Aurioles et al. 1988). They are found in the western North Pacific from the Kurile and Commander Islands to Taiwan (Walker et al. 1986).

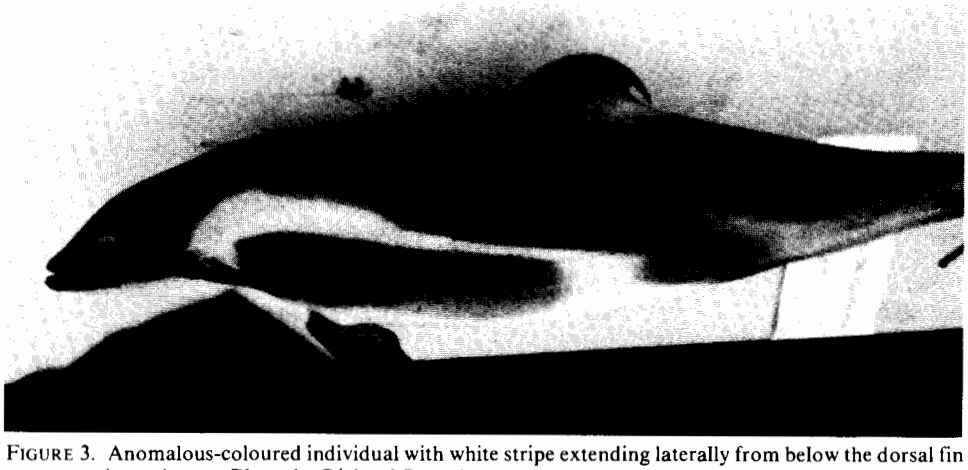

FIGURE 3. Anomalous-coloured individual with white stripe extending laterally from below the dorsal fin to above the eye. Photo by Richard Stroud.

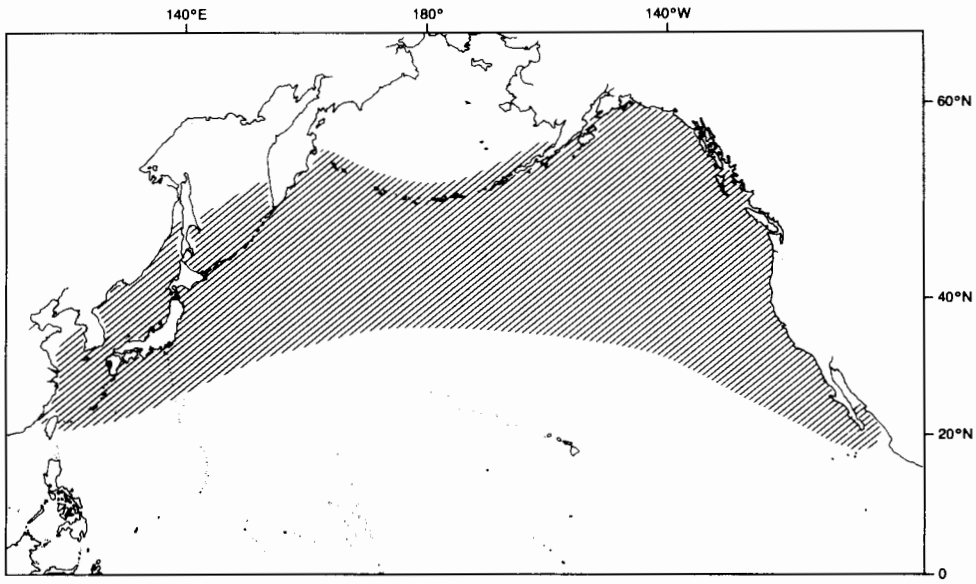

FIGURE 4. Approximate range of the Pacific White-sided Dolphin. Effort in many areas was minimal so actual range may be greater than shown.

Other than a few reports of sightings or strandings, no scientific studies have been undertaken on this species in British Columbia. Although they are generally considered abundant in British Columbia waters, only 23 detailed records have actually been published from the Canadian 320 km (200 mi) extended economic zone (EEZ). Because of this lack of published information on this species in British Columbia waters, we have made an attempt to collect as many published and unpublished records as possible to October 1988, and to analyze these records for seasonal distribution and abundance, herd size, habitat preferences (depths, temperature), and interspecific associations. Since that time we have obtained additional records from prior to 1988, but they are not included or analyzed here. Analyses of records available through 1979 for the entire eastern Pacific were presented by Leatherwood et al. (1984). Records presented here from the United States National Marine Mammal Laboratory (NMML) Platforms of Opportunity Program prior to 1979 were used by Leatherwood et al. (1984), but were not presented in detail. Since there has been no quantification of effort, absolute determination of trends in distribution or seasonal abundance cannot be made, and only a qualitative interpretation of the records is presented here.

The first recorded sighting of a Pacific White-sided Dolphin in British Columbia comes from Osgood (1901), who reports on "a porpoise supposed to be this species" in Hecate Strait. A skull found off the west coast of Vancouver Island in 1943 is reported by Cowan and Guiguet (1952) to be the first specimen record from Canadian waters, although Scheffer and Slipp (1948) describe the collection of a single animal from a school off Race Rocks Lighthouse, at the southern tip of Vancouver Island, in 1936. Pike and MacAskie (1969) list 35 sightings off British Columbia, 15 of which are outside the EEZ and so are not included in this analysis. The inclusion in this paper of records from adjacent United States and international waters might give a more accurate account of this species' biology, but for convenience of record collection and presentation, only Canadian records are presented here.

Recent records from within the Canadian EEZ have been acquired from several sources. These records and previously published records, totalling 156, are presented in Table 1 (*see also* Figure 5). Additional records are available that are most likely this species, but positive identification could not be made, so they are not included here. There are few cetacean sighting records compiled from offshore waters in British Columbia by Canadian researchers or authorities. A lack of experienced observers also contributes to the poor knowledge of the distributions and abundance of small or offshore species. As well, considering that there is no accepted central repository for cetacean records in British Columbia, it is likely that many more records exist than are reported here.

TABLE 1. Records of the Pacific White-sided Dolphin in British Columbia.

Date	Location[a]	Number	Source[b]	Type[c]
17 September 1936	off Race Rocks	1	1	1
pre-June 1943	Estevan Point	1	2	2
pre-October 1943	Port Hardy	1	3	3
01 June 1956	48°00'N,127°30'W	4	3	4
24 March 1958	47°48'N,128°00'W	20-30	3	4
12 March 1959	off Triange Island	5	3	1
16 June 1959	53°30'N,133°40'W	1000+	4	4
04 August 1959	48°00'N,128°00'W	100	3	4
08 January 1960	Fitzhugh Sound	50-100	3	4
10 March 1960	Fitzhugh Sound	100	3	4
21 June 1960	Fitzhugh Sound	3	3	4
20 July 1960	51°48'N,130°39'W	30-40	3	4
01 October 1960	Goletas Channel	200-300	3	4
06 November 1960	Port Hardy	200	3	4
12 December 1960	Fitzhugh Sound	200-300	3	4
26 January 1961	51°45'N,128°00'W	10	5	4
27 January 1961	52°13'N,128°45'W	5	5	4
09 February 1961	54°16'N,130°28'W	6	5	4
19 March 1961	51°45'N,127°56'W	15	5	4
14 May 1961	Goletas Channel	30	3	4
17 May 1961	Queen Charlotte St.	10	3	4
24 May 1961	Goletas Channel	6	3	4
15 June 1961	48°27'N,126°30'W	30	3	4
06 August 1961	Port Hardy	8	3	4
07 March 1962	52°N,128°W	100	3	4
21 June 1963	49°26'N,130°34'W	4	5	4
21 June 1963	49°26'N,130°31'W	1	5	4
15 May 1964	51°N, 131°W	100	3	4
02 August 1964	49°N,127°W	8	3	4
25 January 1967	49°03'N,127°13'W	5	5	4
25 January 1967	49°01'N,128°35'W	4	5	4
03 February 1967	48°26'N,126°16'W	2	5	4
03 February 1967	48°26'N,126°20'W	6	5	4
14 February 1969	Pat Bay, Victoria	1	6	2
09 May 1970	48°34'N,125°49'W	1	5	4
20 April 1972	48°27'N,125°58'W	1000	5	4
02 May 1972	48°25'N,125°55'W	30	5	4
02 May 1972	48°30'N,126°03'W	200	5	4
03 May 1972	48°26'N,125°59'W	200	5	4
30 August 1973	48°28'N,126°44'W	4	5	4
02 September 1973	48°20'N,128°42'W	17	5	4
10 March 1974	52°23'N,128°29'W	100	5	4
09 May 1974	51°23'N,127°51'W	150	5	4
15 March 1975	51°52'N,127°56'W	100	5	4
04 August 1975	53°35'N,133°47'W	20	5	4
03 April 1976	52°21'N,128°31'W	100	5	4
18 October 1977	49°41'N,128°04'W	250	5	4
12 February 1978	51°50'N,127°55'W	30	5	4
08 July 1978	51°22'N,131°23'W	6	5	4
09 July 1978	49°10'N,127°00'W	20	5	4
11 July 1978	48°32'N,126°50'W	100	5	4
11 July 1978	49°13'N,128°30'W	15	5	4
11 July 1978	49°33'N,129°19'W	6	5	4
11 July 1978	49°58'N,130°21'W	15	5	4
11 July 1978	49°58'N,130°21'W	55	5	4
15 September 1978	49°49'N,128°22'W	25	5	4
18 September 1978	50°13'N,128°10'W	200	5	4
19 November 1978	49°58'N,127°52'W	350	5	4
03 February 1979	49°18'N,127°22'W	4	5	4
13 May 1979	51°20'N,131°28'W	2	5	4

TABLE 1. *Continued.*

Date	Location[a]	Number	Source[b]	Type[c]
23 June 1979	Francis Is.	1	6	2
30 June 1979	51°45′N,129°02′W	60	5	4
16 August 1979	51°01′N,129°57′W	15	5	4
06 September 1979	54°00′N,131°00′W	75	5	4
18 November 1979	52°24′N,128°26′W	30	5	4
18 January 1980	52°35′N,128°28′W	100	5	4
29 March 1980	51°13′N,131°20′W	6	5	4
30 March 1980	49°27′N,127°46′W	80	5	4
02 May 1980	53°05′N,128°33′W	100	5	4
02 May 1980	52°24′N,128°30′W	2	5	4
02 May 1980	52°23′N,128°30′W	8	5	4
19 June 1980	51°06′N,130°07′W	6	5	4
25 July 1980	50°29′N,128°50′W	8	5	4
25 July 1980	50°25′N,128°46′W	5	5	4
25 July 1980	50°05′N,128°18′W	6	5	4
25 July 1980	50°02′N,128°15′W	75	5	4
02 August 1981	49°45′N,134°05′W	20	5	4
20 August 1981	Ramsay Is., QCI	1	6	2
10 November 1981	51°59′N,127°56′W	200	5	4
29 November 1981	52°04′N,127°56′W	35	5	4
17 April 1982	53°17′N,128°53′W	2	5	4
22 August 1982	50°56′N,132°09′W	200	5	4
23 August 1982	48°46′N,126°31′W	75	5	4
19 November 1982	48°38′N,126°12′W	4	5	4
25 February 1983	53°14′N,128°48′W	13	5	4
02 March 1983	Vancouver Harbour	1	7	2, 5
16 April 1983	52°47′N,128°32′W	10	5	4
13 May 1983	51°43′N,127°55′W	40	5	4
17 June 1983	Long Beach	1	6	2
22 June 1983	49°20′N,127°23′W	25	5	4
19 July 1983	48°17′N,126°15′W	50	5	4
19 July 1983	48°19′N,126°20′W	3	5	4
19 July 1983	48°19′N,126°21′W	3	5	4
20 July 1983	50°45′N,132°27′W	150	5	4
20 July 1983	51°03′N,133°36′W	1	5	4
29 July 1983	49°13′N,127°17′W	10	5	4
29 July 1983	49°23′N,127°46′W	3	5	4
17 August 1983	48°35′N,126°56′W	6	5	4
18 August 1983	48°39′N,127°40′W	10	5	4
18 August 1983	48°40′N,127°49′W	7	5	4
18 August 1983	48°48′N,129°05′W	11	5	4
22 August 1983	49°13′N,129°59′W	5	5	4
10 October 1983	50°40′N,129°27′W	200	5	4
13 October 1983	52°32′N,133°46′W	80	5	4
14 October 1983	50°30′N,129°03′W	3	5	4
03 February 1984	52°11′N,128°29′W	20	5	4
03 February 1984	53°18′N,129°09′W	3	5	4
14 March 1984	52°19′N,129°06′W	10	5	4
28 March 1984	49°02′N,125°41′W	3	5	4
01 April 1984	48°26′N,128°43′W	4	5	4
11 April 1984	52°34′N,128°28′W	2	5	4
11 April 1984	53°25′N,129°24′W	6	5	4
03 May 1984	52°36′N,128°29′W	100	5	4
19 June 1984	51°26′N,134°51′W	6	5	4
19 February 1985	48°24′N,127°53′W	3	5	4
13 April 1985	53°52′N,130°04′W	40	5	4
01 June 1985	52°40′N,128°32′W	4	5	4
22 July 1985	47°35′N,130°48′W	1	8	6
18 August 1985	49°26′N,131°39′W	1	8	7
12 November 1985	51°57′N,127°56′W	30	5	4

TABLE 1. *Concluded.*

Date	Location[a]	Number	Source[b]	Type[c]
26 January 1986	54°27′N,130°40′W	6	5	4
20 February 1986	50°48′N,127°33′W	3	5	4
26 April 1986	48°20′N,125°55′W	6	5	4
13 June 1986	48°17′N,126°10′W	8	5	4
27 July 1986	48°23′N,129°16′W	1	8	7
29 July 1986	47°50′N,130°00′W	1	8	7
22 August 1986	51°37′N,136°17′W	1	8	7
14 October 1986	49°14′N,128°03′W	16	5	4
20 October 1986	51°44′N,127°55′W	400	5	4
23 October 1986	Round Is. (Pt. Hardy)	1	6	7
00 November 1986	Campbell River	> 300	9	4
13 November 1986	50°10′N,125°21′W	5	5	4
13 November 1986	50°15′N,125°23′W	30	5	4
19 July 1987	49°05′N,130°38′W	2	8	7
25 July 1987	48°30′N,129°16′W	20-25	8[d]	4
25 July 1987	48°30′N,129°16′W	2	8[d]	7
25 July 1987	48°30′N,129°16′W	3	8[d]	6
27 July 1987	48°29′N,129°22′W	1	8	7
29 July 1987	48°30′N,129°34′W	1	8	7
11 April 1988	53°08′N,128°33′W	100	9	4
25 May 1988	48°26′N,126°12′W	15	10	4
18 June 1988	48°45′N,126°20′W	25	10	4
13 August 1988	49°16′N,127°36′W	100	10	4
19 August 1988	48°25′N,126°W	1	11	7
21 August 1988	52°22′N,130°59′W	12	9	4
21 August 1988	52°22′N,130°58′W	11	9	4
28 August 1988	49°06′N,126°54′W	15	10	4
30 August 1988	48°05′N,128°10′W	25	10	4
30 August 1988	48°07′N,128°16′W	3	10	4
30 August 1988	West Coast of Queen Charlotte Islands	6	9	4
29 September 1988	Port Hardy	1	11	7
30 September 1988	48°23′N,126°07′W	22	10	4
30 September 1988	48°24′N,126°13′W	12	10	4
30 September 1988	48°24′N,126°16′W	2	10	4
02 October 1988	48°20′N,125°28′W	1	10	4
30 October 1988	48°07′N,125°51′W	3	10	4

[a]Location of previously published records as presented in the original source.

[b]Source of Record: (1) Scheffer and Slipp 1948; (2) Cowan and Guiguet 1952; (3) Pike and MacAskie 1969; (4) Pike 1960; (5) NMML Platforms of Opportunity Program; (6) Royal B.C. Museum records; (7) Vancouver Public Aquarium; (8) G.D. Heritage, Pacific Biological Station, Nanaimo, B.C.; (9) B.C. Marine Mammal Sighting Program; (10) K. Morgan, Canadian Wildlife Service, Sidney, B.C.; (11) Stacey et al. 1989.

[c]Type of Record: (1) Collection; (2) Stranding; (3) Remains in Indian Midden; (4) Sighting; (5) Capture for Captivity; (6) Incidental Catch, Released Alive; (7) Incidental Catch, died.

[d]Although this occurrence is considered as three records, for the purposes of depth and temperature analysis it is used once.

Over 50% of the records presented are from 1980 through 1988. However, it cannot be determined whether this difference is due to an actual change in abundance, or just to an increase in recording effort. Although Pacific White-sided Dolphins do not appear to be particularly common in inshore waters, inshore records from British Columbia waters have been reported in nine of the last 10 years. Some authors have reported that they occur regularly in Juan de Fuca Strait and the Strait of Georgia (Cowan and Guiguet 1965; Osborne et al. 1988), but records compiled do not support this suggestion. However, due to limited research in this area at any time, it is likely that they may be more common than reported.

Protection

International

Regulation of international trade between members of the Convention on International Trade in Endangered Species of Wild Fauna and Flora 1973 (CITES) and between non-members

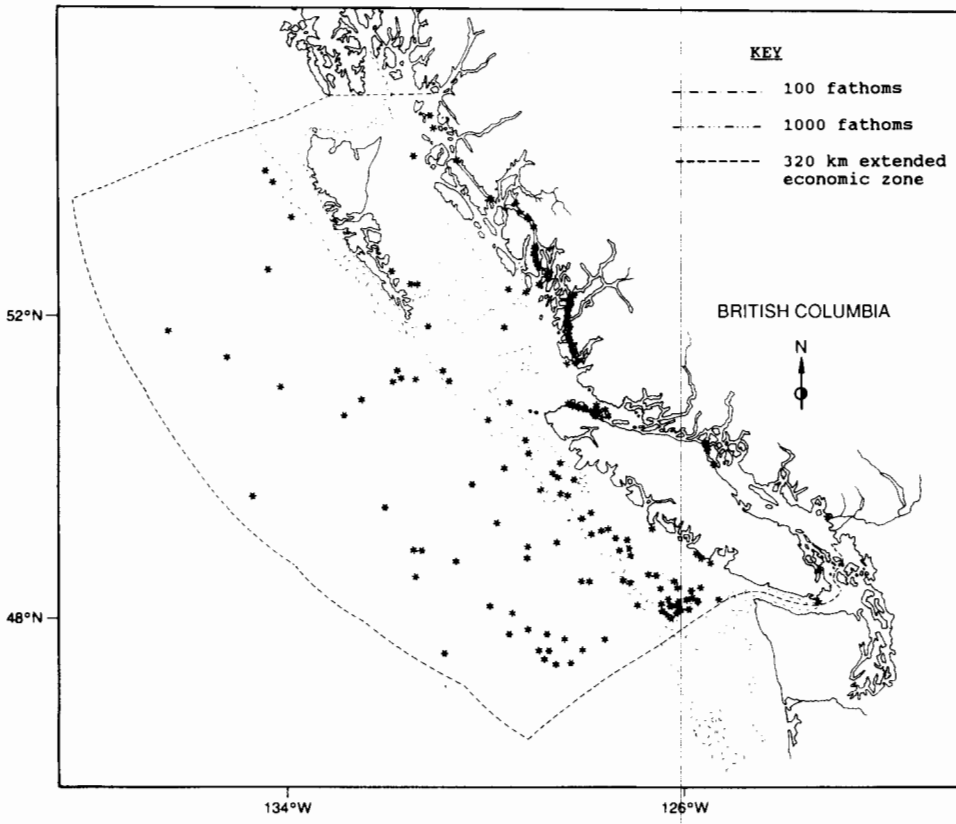

FIGURE 5. Records of the Pacific White-sided Dolphin in the Canadian 320 km extended economic zone. See Table 1 for details of date, location, number, source and type of record. Records from immediately adjacent U.S. or offshore waters are not shown.

and Convention members, has been established by listing the Pacific White-sided Dolphin under Appendix II of the Convention (*see* Birnie 1982). The International Whaling Commission (IWC) regulates the taking of whales in accordance with the current Schedule provisions, but whether this Commission's mandate covers the Pacific White-sided Dolphin is unclear, as members of this Commission are divided to whether "whale" refers to all cetaceans or only to some species (Klinowska 1987).

National

Canada: The 1982 Cetacean Protection Regulations of the Fisheries Act of Canada of 1867 (as amended to date) provide protection for this and other species of cetaceans, for all but aboriginal hunting. "Hunting" is defined as "to chase, shoot at, harpoon, take, kill, attempt to take or kill, or to harass cetaceans in any manner", and can only be undertaken under licence.

United States: All cetaceans are protected under the Marine Mammal Protection Act of 1972, as well as through the Packwood-Magnuson Amendment of the Fisheries and Conservation Act and the Pelly Amendment of the Fisherman's Protective Act.

Population Size(s) and Trends

Leatherwood et al. (1984) noted that the Pacific White-sided Dolphin may be the most abundant delphinid in the temperate eastern North Pacific, although no accurate population estimate is possible with the currently available data. One population estimate presented by the U.S. Department of Commerce (1988) was of 30 000 to 50 000 animals for the eastern Pacific, not including Alaskan waters. Nishiwaki (1972) gave an estimate of 30 000 to 50 000 animals from the waters around Japan. The number of records has greatly increased in Canadian waters in recent years, but with no quantification of effort it is unknown whether this is due to an actual increase in population numbers, a change in distribution, or an increase in effort.

Habitat

Pacific White-sided Dolphins occur both on the continental shelf and further offshore (Leatherwood et al. 1984). Fiscus and Niggol (1965) note that of 135 sightings, few were seen inside the 100 fathom or outside the 1000 fathom contour. Black (1989) records sightings in depths ranging from 100 m (*ca* 55 fathoms) to 3000 m (*ca* 1640 fathoms) in Monterey Bay, California. Water depths associated with 141 records in British Columbia ranged from 10 to 2000 fathoms, with a mean, median and modal depth of 617, 400 and 100 fathoms respectively.

Black (1989) found that Pacific White-sided Dolphins in Monterey Bay, California, were sighted in waters ranging from 12.1-19.0°C. Sea surface temperatures of 73 records from British Columbia waters were obtained from the NMML Platforms of Opportunity Program, and from the experimental Flying Squid (*Ommastrephers bartrami*) fishery (Jamieson and Heritage 1987, 1988). Temperatures range from 6° to 17°C, with a mean, median and modal temperature of 12°, 13° and 15°C respectively.

General Biology

Reproduction

Figures available for reproductive parameters have been quite variable, possibly due to the presence of two separate populations (Walker et al. 1986). No estimates of calving interval or annual pregnancy rates are available. Estimates of gestation range from 10 to 12 months (Harrison 1969; Perrin and Reilly 1984; Kajimura and Loughlin 1988). Sightings and foetal records indicate that mating and calving may occur from late spring through autumn, although this is based on few data (Brown and Norris 1956; Tomilin 1957; Norris and Prescott 1961). Estimates of length at birth range from 0.8 to 1.24 m (Leatherwood et al. 1982; Perrin and Reilly 1984).

Osborne et al. (1988) note that sexual maturity is attained between six and 10 years of age. This species attains sexual maturity at lengths ranging from 1.67 to 2.13 m in the male and 1.70 to 2.16 m in the female, with an average length of sexually mature animals of 1.90 m for males and 1.92 m for females (Perrin and Reilly 1984; Cowan et al. 1986). Minimum weight of a mature testis is approximately 170 g (Kasuya and Izumizawa 1981), while maximum reported weight is 559 g, although these weights are from animals from the western and eastern Pacific respectively (Perrin and Reilly 1984). Ovulation rate has been noted as high compared to other delphinids (Perrin and Reilly 1984). Longevity has not been determined, but up to 46 growth layer groups in teeth have been reported, with the assumption made that one growth layer group represents one year (Walker et al. 1986).

Species Movement

Leatherwood et al. (1984) note that Pacific White-sided Dolphins exhibit typical northern and offshore movements in spring and summer and southern inshore movements in fall and winter. They are year-round residents in some areas (Leatherwood et al. 1982). A radio-tagged individual reported by Leatherwood and Evans (1979) showed little net movement over a 45-day period off the California coast. Wilke et al. (1953) report migrations along the Japanese coast in relation to fish and squid abundance.

In British Columbia waters there are inshore records from all months except July, and offshore records from all months except December. The largest number of records have been collected in July and August (26 and 25 respectively). Since recording effort is highest and sighting conditions are also probably best during these two months, this does not necessarily reflect a peak in abundance. The largest number of records in inshore waters are from January through May, and from November. Considering the small number of records in inshore waters in June through October, the large number of records in November and in January through May might reflect movements into inshore waters in winter and spring.

Behaviour

Pacific White-sided Dolphins travel in congregations that are among the largest of any dolphin, sometimes in groups of several thousand (Leatherwood et al. 1982). Maximum group size reported by Leatherwood et al. (1984) was of 6000 individuals, with a mean of 88 individuals per group. They found herd size in the eastern North Pacific to be larger in southern and northern areas of the Pacific White-sided Dolphins' range than in the central area. Analysis of group size from 149 sighting records reported here indicates that mean group size is 62, with a range of one to 1000. The median group size is 15 and the mode is six individuals, while 100 is the second most frequently reported group size.

Pacific White-sided Dolphins are opportunistic feeders, preying primarily on cephalopods and small schooling fishes from the epipelagic (0 to 200 m, *ca* 109 fathoms) and mesopelagic (200 to 1000 m, *ca* 109 to 547 fathoms) zones (Kajimura et al. 1980; Stroud et al. 1981). These authors also note that feeding most likely occurs at night and in the morning. Fitch and Brownell (1968) inferred from prey habits that the diving depth is at least 120 m (*ca* 66 fathoms). Stomach volume has been reported as 1600 cc (Fiscus and Niggol 1965).

Stroud et al. (1981) review feeding habits, and note that prey includes several commercially important species, such as salmon (*Oncorhynchus* sp.), Northern Anchovy (*Engraulis mordax*), Hake (*Merluccius productus*), and Market Squid (*Loligo opalescens*). In Washington waters, squid from stomach contents represented seven families (Loliginidae, Enoploteuthidae, Octopoteuthidae, Onychototeuthidae, Gonatidae, Chiroteuthidae, and Cranchiidae). Jellyfish have been recorded from the stomach contents of at least one individual (Scheffer 1953).

Reports of interspecific associations are frequent; Black (1989) reports that of 224 schools of Pacific White-sided Dolphins observed in Monterey Bay, California, interspecific associations occurred 50% of the time. A summary of species recorded in association with Pacific White-sided Dolphins is presented in Table 2. Associations have been noted with seven species of odontocetes, three species of mysticetes and two species of pinnipeds, as well as with sea birds. Interspecific associations have only been noted in four records from British Columbia waters, three with Northern Right Whale Dolphins (*Lissodelphis borealis*) and a fourth with both Northern Right Whale Dolphins and Short-finned Pilot Whales (*Globicephala macrorhynchus*). Associations with Northern Right Whale Dolphins and Common Dolphins (*Delphinus delphis*) were most frequently reported (Black 1988). The low number of associations with these two species in British Columbia may be due to a low number of sightings of them here. There are only 17 known occurrences of Northern Right Whale Dolphins in British Columbia waters (Baird and Stacey 1991) and only one record of a Common Dolphin in British Columbia (Guiguet 1954). Although discrepancies in record reporting may partially account for the small numbers of interspecific associations, the difference in the proportion of associations from that found by Black (1988, 1989) appears substantial.

Pacific White-sided Dolphins are often acrobatic, leaping clear of the water (Figure 6), and doing bellyflops and somersaults. They have become accomplished performers in captivity, are displayed in aquaria in Canada, Japan, New Zealand, and the United States (Defran and Pryor 1980). Epimeletic (care-giving) behaviour has been reported (Caldwell and Caldwell 1966; Kasuya and Miyazaki 1976). Pacific White-sided Dolphins are avid bow-riders, and have been seen to displace Common Dolphins to obtain the best position while bow-riding (Leatherwood et al. 1982). Observations of this type suggest intergeneric hierarchies (Leatherwood and Reeves 1978).

Limiting Factors

Fourteen Pacific White-sided Dolphins were incidentally caught in an experimental Flying Squid driftnet fishery in Canadian waters from 1985 through 1987, resulting in 10 known mortalities (Jamieson and Heritage 1987, 1988). This was the second most frequent incidentally taken cetacean in this fishery, which has now been discontinued. Small numbers have also been caught incidentally in coastal net fisheries in British Columbia (Stacey et al. 1989; Stacey et al. 1990; Baird et al. 1991), but exact determination of these numbers is virtually impossible since commercial vessels are not encouraged or required to report incidental catches. Some are also taken incidentally in tuna, anchovy and salmon fisheries (Leatherwood et al. 1984). Wilke (1953) reports large numbers of Pacific White-sided Dolphins

TABLE 2. Species recorded in association with Pacific White-sided Dolphins.

Species	Source[1]
Northern Right Whale Dolphin, *Lissodelphis borealis*	a
Risso's Dolphin, *Grampus griseus*	a
Striped Dolphin, *Stenella coeruleoalba*	b
Common Dolphin, *Delphinus delphis*	c
Short-finned Pilot Whale, *Globicephala macrorhynchus*	d
Bottlenose Dolphin, *Tursiops truncatus*	e
Dall's Porpoise, *Phocoenoides dalli*	f
Humpback Whale, *Megaptera novaeangliae*	f
Sei Whale, *Balaenoptera borealis*	f
Grey Whale, *Eschrichtius robustus*	g
California Sea Lion, *Zalophus californianus*	e
Northern Fur Seal, *Callorhinus ursinus*	a
Sea Birds	g

[1]Source: (a) Pike 1960; (b) Minasian et al. 1984; (c) Brown and Norris 1956; (d) Norris and Prescott 1961; (e) Leatherwood and Walker 1979; (f) Brownell 1964; (g) Leatherwood 1974. Only a single early source is presented, even if noted by other authors.

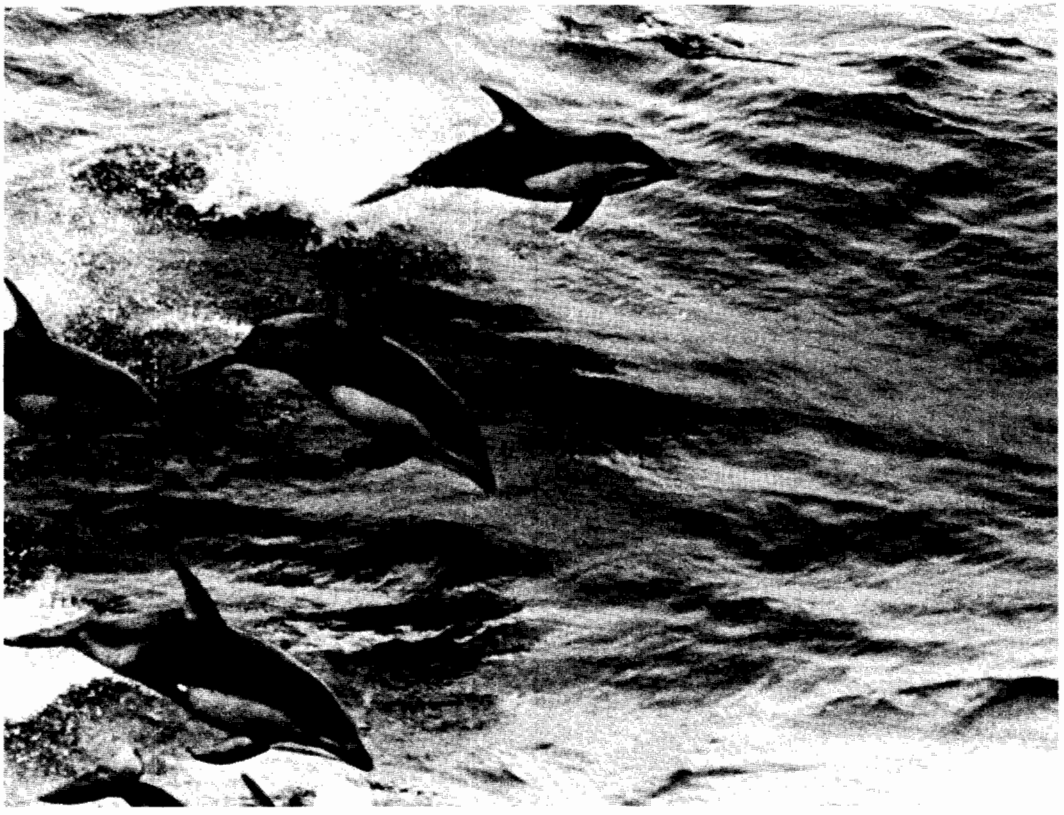

FIGURE 6. Pacific White-sided Dolphins racing alongside a Japanese fishing vessel. Photo by David Ambrose, National Marine Fisheries Service.

taken off Japan in fisheries for dolphins and porpoises. Between 1979 and 1987 the number taken yearly off Japan has ranged from 2765 in 1984 to 37 in 1986, reflecting both direct and incidental catches (IWC 1986, 1988). More than 80 individuals were live-captured for display or research between 1966 and 1979 (Leatherwood et al. 1984). Accidental hooking on fishing lines has been reported (Norris and Prescott 1961).

Hoyt (1984) refers to predation on Pacific White-sided Dolphins by Killer Whales (*Orcinus orca*) in Nishiwaki and Handa (1958), but examination of that reference does not specifically indicate predation. However, Wells et al. (1980) list Killer Whales as predators; a likely occurrence as the range of the Pacific White-sided Dolphin in inshore waters overlaps with concentrations of transient Killer Whales, which feed primarily on marine mammals. We are not aware of any reports of predation by large sharks, but this may occur; shark predation on other species of dolphins has been reported (Wood et al. 1970; Ross and Bass 1971).

Mass strandings of this species have not been reported in the literature, although mass strandings of the genus *Lagenorhynchus* are not uncommon (Sergeant 1982). Single strandings of individuals are most likely the result of pathological conditions. Cowan et al. (1986) describe pathologies from stranded animals, but the determination of the positive cause of death and the role of pathogens in mortality is difficult to ascertain. A variety of fungal, viral and bacterial disease agents have been reported from the Pacific White-sided Dolphin (Migaki et al. 1978; Dailey 1985). Parasites of the genus *Nasitrema* have been associated with brain lesions in an animal found disoriented in Vancouver Harbour as well as in stranded animals off California (Cowan et al. 1986; Lewis and Berry 1988). Other parasites documented include the nematodes *Crassicauda* sp. and *Anisakis* sp. (Cowan et al. 1986; Walker et al. 1986), and the cestodes *Phyllobothrium delphini, Monorygma grimaldii, Tetrabothrius* sp., and *Strobilocephalus triangularis* (Dailey and Walker 1978). Although not necessarily detrimental to individuals, ectocommensal barnacles *Xenobalanus globicipitus* and diatoms *Cocconeis ceticola* have been reported from this species (Norris and

Prescott 1961; Morejohn 1979). Mortality by choking on prey was reported for a single individual off California (Houck 1961).

High levels of pollutants have been reported from an individual that was held in captivity in New York [1023 ppm wet weight DDT, 147 ppm wet weight PCBs; Taruski et al. (1975)]. The cause of death of this individual was not given. The role of these pollutants in mortality is unknown; however, there is speculation that reproductive failures in both cetaceans and pinnipeds might be linked in some way to the effects of contamination by organochlorine residues (Addison 1989). High levels of organochlorines have been implicated in immunosuppression and high mortality in the St. Lawrence population of Beluga Whales, *Delphinapterus leucas*, (Martineau et al. 1987). The effects of industrial activities, such as oil and gas development and shipping on odontocetes are largely unknown but warrant further study (Hain et al. 1985).

Evaluation

The Pacific White-sided Dolphin is widespread and abundant throughout the North Pacific basin, and its population in Canadian waters does not appear to be particularly at risk, as long as incidental catches in Canadian fisheries can be curtailed. However, because of a lack of comprehensive population surveys, it is not possible to accurately determine population levels or trends, and a reassessment of status should be made after such studies have been undertaken. Radiotelemetry studies, aerial or ship-based surveys, monitoring of commercial net fisheries and maximizing information gained from stranded animals would all allow for greater understanding of the population status of this species in Canadian waters.

Acknowledgments

We thank the World Wildlife Fund (Canada) for financial assistance for the preparation of this report; Robert Campbell and COSEWIC for assistance; Wayne Campbell and David Nagorsen for access to records at the Royal British Columbia Museum; the Captains and crews of Canadian Department of Fisheries and Oceans vessels contributing to the British Columbia Marine Mammal Sighting Program; Daniel Cheng, National Oceanic Atmospheric Administration, Northwest and Alaska Fisheries Center, Seattle, Washington, for unpublished records obtained through the Platforms of Opportunity Program; Ken Morgan, Canadian Wildlife Service, Sidney, B.C., for unpublished records; National Marine Fisheries Service, Steve Leatherwood and Richard Stroud for permission to use their photographs; and Dave Duffus, Laura Kotler, and several anonymous reviewers for comments on various versions of the manuscript.

Literature Cited

Addison, R. F. 1989. Organochlorines and marine mammal reproduction. Canadian Journal of Fisheries and Aquatic Sciences 46: 360–368.

Aurioles, D., S. Leatherwood, and **E. Munoz.** 1988. Pacific White-sided Dolphins (*Lagenorhynchus obliquidens*) in the Sea of Cortez. Bulletin of the Southern California Academy of Sciences 87(1): 44–45.

Baird, R. W., and **P. J. Stacey.** 1991. Status of the Northern Right Whale Dolphin, *Lissodelphis borealis*, in Canada. Canadian Field-Naturalist 105(2): 000–000.

Baird, R. W., P. J. Stacey, and **K. M. Langelier.** 1991. Strandings and incidental mortality of cetaceans on the B.C. coast, 1990. Paper SC/43/01 presented to the IWC Scientific Committee.

Birnie, P. 1982. Legal measures for the prevention of "pirate" whaling. International Union for the Conservation of Nature and Natural Resources (IUCN) Environmental Policy and Law Paper 19: 1–163.

Black, N. 1988. *Abstract.* The behavior of Pacific White-sided Dolphins (*Lagenorhynchus obliquidens*) in the Monterey Bay area, California. Abstracts of the American Cetacean Society Third Biennial Conference and Symposium. November 11–13, 1988. Monterey, California.

Black, N. A. 1989. *Abstract* The behavior of Pacific White-sided Dolphins (*Lagenorhynchus obliquidens*) in Monterey Bay, California. Page 7 *in* Abstracts of the Eighth Biennial Conference on the Biology of Marine Mammals, December 7–11, 1989, Pacific Grove, California.

Brown, D. H., and **K. S. Norris.** 1956. Observations of captive and wild cetaceans. Journal of Mammalogy 37(3): 311–326.

Brownell, R. L. 1964. Observations of odontocetes in central Californian waters. Norsk Hvalfangst-Tid 53(3): 60–66.

Caldwell, M. C., and **D. K. Caldwell.** 1966. Epimeletic (care-giving) behavior in cetacea. Pages 755–789 *in* Whales, Dolphins and Porpoises. *Edited by* K. S. Norris. University of California Press, Berkeley.

Cowan, D. F., W. A. Walker, and **R. L. Brownell.** 1986. Pathology of small cetaceans stranded along southern California beaches. Pages 323–367 *in* Research on Dolphins. *Edited by* M. M. Bryden and R. Harrison. Clarendon Press, Oxford.

Cowan, I. McT., and **C. J. Guiguet.** 1952. Three cetacean records from British Columbia. Murrelet 33(1): 10–11.

Cowan, I. McT., and **C. J. Guiguet.** 1965. The mammals of British Columbia. British Columbia Provincial Museum Handbook 11. Third Edition.

Dailey, M. D. 1985. Diseases of Mammalia: Cetacea. Pages 805-847 *in* Diseases of Marine Animals, Volume IV, Part 2. *Edited by* O. Kinne. Biologische Anstalt Helgoland, Hamburg.

Dailey, M. D., and **W. A. Walker.** 1978. Parasitism as a factor (?) in single strandings of southern California cetaceans. Journal of Parasitology 64(4): 593–596.

Defran, R. H., and **K. Pryor.** 1980. The behavior and training of cetaceans in captivity. Pages 319-362 *in* Cetacean behavior: mechanisms and functions. *Edited by* L. M. Herman. John Wiley and Sons. New York.

Department of Commerce. 1988. Marine Mammal Protection Act of 1972, Annual Report 1987/1988. U.S. Department of Commerce, Washington, D.C.

Everitt, R. D., C. H. Fiscus, and **R. L. DeLong.** 1990. Northern Puget Sound Marine Mammals. U.S. Department of Commerce Interagency Energy/Environment R. & D. Program Report EPA-600/7-80-139.

Fiscus, C. H., and **K. Niggol.** 1965. Observations of cetaceans off California, Oregon, and Washington. United States Fish and Wildlife Service Special Scientific report — Fisheries No. 498.

Fitch J. E., and **R. L. Brownell.** 1968. Fish otoliths in cetacean stomachs and their importance in interpreting feeding habits. Journal of the Fisheries Research Board of Canada 25(12): 2561-2574.

Guiguet, C. J. 1954. A record of Baird's dolphin (*Delphinus bairdi* Dall) in British Columbia. Canadian Field-Naturalist 68(3): 136.

Hain, J. H. W., M. A. M. Hyman, R. D. Kenny, and **H. E. Winn.** 1985. The role of cetaceans in the shelf-edge region of the northeastern United States. Marine Fisheries Review 47(1): 13-17.

Harrison, R. J. 1969. Reproduction and reproductive organs. Pages 253-348 *in* The biology of marine mammals. *Edited by* H. T. Anderson. Academic Press, New York.

Houck, W. J. 1961. Notes on the Pacific striped porpoise. Journal of Mammalogy 42(1): 107.

Hoyt, E. 1984. Orca: The whale called killer. Camden House Publishing Ltd. Toronto.

IWC. 1986. Report of the sub-committee on small cetaceans. Reports of the International Whaling Commission 36: 112-117.

IWC. 1988. Report of the sub-committee on small cetaceans. Reports of the International Whaling Commission 38: 117-125.

Jamieson, G. S., and **G. D. Heritage.** 1987. Experimental flying squid fishing off British Columbia, 1985 and 1986. Canadian Industry Report of Fisheries and Aquatic Sciences No. 179.

Jamieson, G. S., and **G. D. Heritage.** 1988. Experimental flying squid fishing off British Columbia, 1987. Canadian Industry Report of Fisheries and Aquatic Sciences No. 187.

Kajimura, H., and **T. R. Loughlin.** 1988. Marine mammals in the oceanic food web of the eastern subarctic Pacific. Bulletin of the Ocean Research Institute, University of Tokyo 26(1): 187-223.

Kajimura H., C. H. Fiscus, and **R. K. Stroud.** 1980. Food of the Pacific White-sided Dolphin (*Lagenorhynchus obliquidens*), Dall's Porpoise, *Phocoenoides dalli*, and northern fur seal, *Callorhinus ursinus*, off California and Washington; with appendices on size and food of Dall's porpoise from Alaskan waters. National Oceanic and Atmospheric Administration Technical Memorandum, National Marine Fisheries Service. F/NWC-2.

Kasuya, T., and **N. Miyazaki.** 1976. An observation of epimeletic behavior of *Lagenorhynchus obliquidens*. Scientific Reports of the Whales Research Institute 28: 141-143.

Kasuya, T., and **Y. Izumizawa.** 1981. The fishery-dolphin conflict in the Iki Island area of Japan. Report No. MMC-80/02. U.S. Marine Mammal Commission. Washington, D.C.

Klinowska, M. 1987. The status of marine mammals in the southern North Sea. Pages 75-95 *in* Reasons for concern — proceedings of the 2nd North Sea Seminar '86. *Edited by* G. Peet. Amsterdam.

Leatherwood, J. S. 1974. A note on gray whale behavioral interactions with other marine mammals. Marine Fisheries Review 36(4): 50-51.

Leatherwood, S., and **W. E. Evans.** 1979. Some recent uses and potentials of radiotelemetry in field studies of cetaceans. Pages 1-31 *in* Behavior of marine animals, current perspectives in research, Volume 3: Cetaceans. *Edited by* H. E. Winn and B. L. Olla. Plenum Press, New York.

Leatherwood, S., and **R. R. Reeves.** 1978. Porpoises and dolphins. Pages 97-111 *in* Marine mammals of the eastern North Pacific and Arctic Waters. *Edited by* D. Haley. Pacific Search Press, Seattle.

Leatherwood, S., and **R. R. Reeves.** 1983. The Sierra Club handbook of whales and dolphins. Sierra Club Books, San Francisco.

Leatherwood, S., and **W. A. Walker.** 1979. The Northern Right Whale Dolphin, *Lissodelphis borealis* Peale in the eastern North Pacific. Pages 85-141 *in* Behavior of marine animals, current perspectives in research Volume 3: Cetaceans. *Edited by* H. E. Winn and B. L. Olla. Plenum Press, New York.

Leatherwood, S., R. R. Reeves, W. F. Perrin, and **W. E. Evans.** 1982. Whales, dolphins and porpoises of the eastern North Pacific and adjacent Arctic waters — a guide to their identification. NOAA Technical report NMFS Circular 444.

Leatherwood, S., R. R. Reeves, A. E. Bowles, B. S. Stewart, and **K. R. Goodrich.** 1984. Distribution, seasonal movements and abundance of Pacific White-sided Dolphins in the eastern North Pacific. Scientific Reports of the Whales Research Institute 35: 129-157.

Lewis, R. J., and **K. Berry.** 1988. Brain lesions in a Pacific White-sided Dolphin. Journal of Wildlife Diseases 24(3): 577-581.

Martineau, D., P. Béland, D. Armstrong, and **L. R. Shugart.** 1987. *Abstract.* Pathology of stranded Beluga Whales (*Delphinapterus leucas*) from the St. Lawrence Estuary, Quebec, Canada. Page 45 *in* Abstracts of the Seventh Biennial Conference on the Biology of Marine Mammals, December 5-9, 1987. Miami, Florida.

Migaki, G., R. L. Font, W. Kaplan, and **E. D. Asper.** 1978. Sporotrichosis in a Pacific White-sided Dolphin *Lagenorhynchus obliquidens*. American Journal of Veterinary Research 39(12): 1916-1919.

Minasian, S. M., K. C. Balcomb, and **L. Foster.** 1984. The world's whales: the complete illustrated guide. Smithsonian Books, Washington, D.C.

Morejohn, G. V. 1979. The natural history of Dall's porpoise in the North Pacific Ocean. Pages 45-83 *in* Behavior of Marine Animals, current perspectives in research, Volume 3: Cetaceans. *Edited by* H. E. Winn and B. L. Olla. Plenum Press, New York.

Nishiwaki, M. 1972. General biology. Pages 3-204 *in* Mammals of the Sea: Biology and Medicine. *Edited by* S. H. Ridgway. C. C. Thomas, Illinois.

Nishiwaki, M., and **C. Handa.** 1958. Killer whales caught in the coastal waters off Japan for recent 10 years. Scientific Reports of the Whales Research Institute 13: 85–96.

Norris, K. S., and **J. H. Prescott.** 1961. Observations on Pacific cetaceans of Californian and Mexican waters. University of California Publications in Zoology 63(4): 291–402.

Osborne, R., J. Calambokidis, and **E. M. Dorsey.** 1988. A guide to marine mammals of Greater Puget Sound. Island Publishers, Anacortes, Washington.

Osgood, W. H. 1901. Natural history of the Queen Charlotte Islands, British Columbia. North American Fauna 21.

Perrin, W. F., and **S. B. Reilly.** 1984. Reproductive parameters of dolphins and small whales of the Family Delphinidae. Reports of the International Whaling Commission Special Issue 6: 97–133.

Pike, G. C. 1960. Pacific striped dolphin, *Lagenorhynchus obliquidens*, off the coast of British Columbia. Journal of the Fisheries Research Board of Canada 17(1): 123–124.

Pike, G. C., and **I. B. MacAskie.** 1969. Marine mammals of British Columbia. Fisheries Research Board of Canada Bulletin 171.

Ross, G. J. B., and **A. J. Bass.** 1971. Shark attack on an ailing dolphin *Stenella coeruleoalba* (Meyen). South African Journal of Science 67(8): 413–414.

Scheffer, V. B. 1953. Measurements and stomach contents of eleven delphinids from the northeast Pacific. Murrelet 34(2): 27–30.

Scheffer, V. B., and **J. W. Slipp.** 1948. The whales and dolphins of Washington State with a key to the cetaceans of the west coast of North America. American Midland Naturalist 39: 257–337.

Sergeant, D. E. 1982. Mass strandings of toothed whales (Odontoceti) as a population phenomenon. Scientific Reports of the Whales Reseach Institute 34: 1–47.

Sleptsov, M. M. 1955. Novyy vid del'fina dal'nevostochnykh morey *Lagenorhynchus ognevi* species nova. [A new species of porpoises of far eastern seas *Lagenorhynchus ognevi*: species nova.] Fisheries Research Board of Canada Translation Series No. 1670, 1971.

Stacey, P. J., K. W. Baird, and **D. A. Duffus.** 1990. A preliminary evaluation of incidental mortality of small cetaceans, primarily Dall's porpoise (*Phacaenoides dalli*), harbour porpoise (*Phocoena phocoena*), and Pacific white-sided dolphins (*Lagenorhynchus obligvidens*) in inshore fisheries in British Columbia, Canada. Paper Sc/42/SM20 presented to the IWC Scientific Committee.

Stacey, P. J., R. W., Baird, and **K. M. Langelier.** 1989. Stranded whale and dolphin program of B.C. — 1988 report. Wildlife Veterinary Report 2(1): 10–11.

Stroud, R. K., C. H. Fiscus, and **H. Kajimura.** 1981. Food of the Pacific White-sided Dolphin *Lagenorhynchus obliquidens*, Dall's porpoise *Phocoenoides dalli*, and northern fur seal, *Callorhinus ursinus*, off California and Washington. Fishery Bulletin 78(4): 951–955.

Taruski, A. G., C. E. Olney, and **H. E. Winn.** 1975. Chlorinated hydrocarbons in cetaceans. Journal of the Fisheries Research Board of Canada 132: 2205–2209.

Tomilin, A. G. 1957. Mammals of the U.S.S.R. and adjacent countries. Volume IX. Cetacea. Israel Program for Scientific Translations, Jerusalem, 717 pages, 1967.

Walker, W. A., S. Leatherwood, K. R. Goodrich, W. F. Perrin, and **R. K. Stroud.** 1986. Geographical variation and biology of the Pacific White-sided Dolphin *Lagenorhynchus obliquidens*, in the northeastern Pacific. Pages 441-465 *in* Research on Dolphins. *Edited by* M. M. Bryden and R. Harrison. Clarendon Press, Oxford.

Wells, R. S., A. B. Irvine, and **M. D. Scott.** 1980. The social ecology of inshore odontocetes. Pages 263-317 *in* Cetacean behavior mechanisms and functions. *Edited by* L. M. Herman. John Wiley and Sons, New York.

Wilke, F., T. Taniwaki, and **N. Kuroda.** 1953. *Phocoenoides* and *Lagenorhynchus* in Japan, with notes on hunting. Journal of Mammalogy 34(4): 488–497.

Wood, G., D. K. Caldwell, and **M .C. Caldwell.** 1970. Behavioural interactions between porpoises and sharks. Investigations on Cetacea 2: 264-277.

Accepted 16 July 1990