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RECORDS OF DUSKY DOLPHINS, *LAGENORHYNCHUS OBSCURUS* (GRAY, 1828) IN THE EASTERN SOUTH PACIFIC

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ABSTRACT

Fourty-seven authenticated locality records of the dusky dolphin along the west coast of South America are presented, based on original data, museum specimens and the literature. Confirmed distribution limits are Chimbote ($09^{\circ}05'S$) in north-central Peru and Isla Treble ($55^{\circ}07'S$ $71^{\circ}02'W$), Magallanes, in southern Chile. Accounts are absent from a roughly 1,000 km coastal strip between $36^{\circ}30'S$ and $46^{\circ}S$, suggesting the existence of a distribution gap. Specimens encountered south of this area are thought to form part of the Southwest Atlantic population. No abundance estimates are available but fishery mortality data indicate that *L. obscurus* is the most common cetacean off central Peru and, based on limited sightings, possibly also off northern Chile. Dusky dolphins are present throughout the year off the central Peruvian coast, however consistently larger numbers are caught in winter and spring than in summer. Whether this is due to changes in fishery effort or to seasonal movements of the dolphins, or both, remains unclear. Their habitat in the Southeast Pacific appears to be limited to the coastal branch of the Humboldt Current (i.e. the Fiords Current), with sea surface temperatures mostly $\leq 17^{\circ}C$, although in Peru dusky dolphins have not been observed nearshore. The maximum known offshore range of *L. obscurus* in the region is approximately 50 nautical miles. Apparently it is absent from Chilean oceanic islands and, generally, from far offshore waters of the Southeast Pacific.

RESUMEN

Se presentan cuarenta y siete registros de localidad confirmados del delfín oscuro a lo largo de la costa oeste de Sudamérica, basados en datos originales, especímenes de museos y de literatura. Los límites confirmados de distribución son Chimbote ($09^{\circ}05'S$) en el norte-central del Perú, y la isla de Treble ($55^{\circ}07'S$ $71^{\circ}02'W$), Magallanes, en el sur de Chile. No se tiene registro alguno en ca. 1000 km de la franja costera entre $36^{\circ}30'S$ y los $46^{\circ}S$, lo que sugiere la existencia de una distribución a intervalos. Los especímenes encontrados al sur de esta área están considerados como parte de la población del Atlántico suroeste. No se ha estimado la abundancia, pero los datos de mortalidad debido a la pesca indican que *L. obscurus* es el cetáceo más común de la costa central del Perú y basados en observaciones aún limitadas, posiblemente también del norte de Chile. Frente a la costa peruana central, el delfín oscuro se presenta durante todo el año, pero sistemáticamente hay mayor cantidad de animales capturados en invierno y primavera que en verano. No es claro si se debe o no a los cambios en el esfuerzo de la pesca y/o a los movimientos estacionales de los delfines. Su hábitat en el Pacífico sureste aparenta

estar limitado a la rama costera de la Corriente de Humboldt, la llamada Corriente de Fiords, con temperaturas superficiales mayormente < 17°C, sin embargo en Perú no han sido avistados cerca de la orilla. El rango máximo mar afuera para *Lobscurus* en esta región es de aproximadamente 50 millas náuticas; está aparentemente ausente de las islas oceánicas chilenas y, en general, de aguas pelágicas del Pacífico sureste.

INTRODUCTION

Crucial for the sound management of a commercially exploited wildlife species, such as the dusky dolphin, *Lagenorhynchus obscurus* (Gray, 1828) off western South America (Read *et al.*, 1988; Van Waerebeek & Reyes, 1990a, in press), is precise information on its range and movements. Until fairly recently, a major obstacle in obtaining reliable data on the distribution, and other biological aspects, of southern hemisphere *Lagenorhynchus* species has been a long-standing confusion concerning the taxonomy of this species (see True, 1903; Lillie, 1915; Bierman & Slijper, 1947, 1948; Davies, 1963; Scheffer & Rice, 1963; Hershkovitz, 1966; Webber, 1987). Kellogg (1941), Fraser (1966), Fraser & Noble (1968) & Mitchell (1970) clearly characterized differences between *Lobscurus* and the other two southern hemisphere congeners, Peale's dolphin *L. australis* (Peale, 1848) and the hourglass dolphin *L. cruciger* (Quoy & Gaimard, 1824), Webber (1987) presented a good review of current insights.

Dusky dolphins primarily inhabit temperate waters of the continental shelf and slope off Peru, Chile, Argentina, south-western Africa and New Zealand (Leatherwood & Reeves, 1983; Webber & Leatherwood, 1990a). Records on a global scale were discussed by Brownell (1965, 1974) and Webber (1987); accounts for New Zealand were presented by Gaskin (1968a, 1968b, 1972) and Baker (1972, 1983); for south-western Africa by Findlay (1989); and for Argentinian waters by Lichter & Hooper (1984), Würsig & Würsig (1979, 1980), Bastida & Lichtschein (1984) and Würsig & Bastida (1986). Nevertheless, our knowledge of the range of *Lobscurus* remains incomplete; in particular very little has been published on the occurrence of this species off the west coast of South America (Clarke *et al.*, 1978; Webber, 1987).

Cabrera (1961), Scheffer & Rice (1963) and Marcuzzi & Pilleri (1971) ambiguously stated

that *Lobscurus* is found in temperate waters off South America. Gaskin (1982) in his figure 6.10 did not indicate the species for the eastern South Pacific, but this may have been an oversight. Oliver-Schneider (1946) claimed *Lobscurus* to be common along the coast of Concepción (southern Chile). Yañez (1948), obviously copied by Cabrera & Yépes (1960), described the range of *Lobscurus* in Chilean waters from Tierra del Fuego and Magallanes north to Coquimbo. Oliver-Schneider (1946), Yañez (1948) and Cabrera & Yépes (1960), however did not distinguish *L. australis* as a separate species nor did they substantiate their claims. Mann (1958) named both species for Chile without adding any comments and Donoso-Barros (1975) simply cited above-mentioned authors. The most equitable description was presented by Aguayo (1975, p.1132) who admitted not having confirmed the presence of *Lobscurus* off Chile himself but believed that this species and *L. australis* possibly may occur together in coastal central-southern waters of Chile. Finally, Tamayo & Frassinetti (1980) and Tamayo *et al.* (1987) included the three austral *Lagenorhynchus* species in their lists of Chilean marine mammals.

Bini (1951) first demonstrated the presence of dusky dolphins off Peru by publishing a photograph of a freshly caught specimen; unfortunately his paper remained largely unknown, including to authors specifically discussing Peruvian mammals (Grimwood, 1969; Sánchez, 1973). In 1968, K.S. Norris reported on a few specimens caught in a sciaenid fishery in Peru (in Aguayo, 1975; Mitchell, 1975). Numerous skeletal specimens were collected for the US National Museum of Natural History by J.G. Mead and C.W. Potter (pers.comm.) in the course of a dedicated survey in December 1982.

The purpose of this paper is to compile and summarize all positive records, both published and new, of the dusky dolphin from the eastern South Pacific and thus generate a solid base for

discussion and further investigations. Interpretation of this data set has yielded preliminary insights in distributional aspects such as range limits, relative abundance, possible stock separation and seasonality.

MATERIAL AND METHODS

Field work by the author carried out in the period 1984–90 focused on the central Peruvian coast but also included surveys in coastal areas from Buenaventura, Colombia ($03^{\circ}53'N$), south to Chiloé Island (ca. $43^{\circ}S$) in south-central Chile. New information was gathered through monitoring of dolphin catches at fishing terminals, inspection of fish dumps and of beaches (strandings), boat surveys, and the examination of cetacean material in various museum and university collections (see Guerra *et al.*, 1987; Van Waerebeek *et al.*, 1988). Information gathered from interviews with fishermen and port authorities, although invaluable as guidance, was not considered factual unless substantiated. Additional data came from exhaustive literature searches including local journals, from colleagues, and from the files and specimens of the United States National Museum of Natural History (USNM) and the British Museum (Natural History). The study area comprises coastal and offshore waters of the southeastern Pacific, delimited north by the equator and south by Drake Passage.

Specimen distribution proved extremely uneven, very abundant at some sites and at others absent from extended stretches of coastline, reflecting heavy bias in fishery and monitoring effort. Therefore, rather than assigning each specimen a separate record number, as is usually done, it was opted to group all specimens from a single site in a "locality record"; the sightings of dolphins with unique positions were considered each a separate record. All existing voucher material has been examined by the author, except if explicitly indicated otherwise. Authenticated locality records are listed below in latitudinal order (north to south); dubious records are discussed as *incertae sedis* but are not entered in the list.

Skeletal voucher material from Peruvian dusky dolphins is kept at the Centro Peruano de Estudios Cetológicos (CEPEC), Pucusana, Peru; the United States National Museum of Natural History (USNM), Washington D.C.; the Zoölogisch Museum of the University of Amsterdam (ZMA) and the Koninklijk Belgisch Instituut voor Natuurwetenschappen, Brussels.

RESULTS

Confirmed records of *Lobscurus* from Peru (Fig. 1)

1. Four weathered skulls of dusky dolphin were rounded up by J.G. Mead (pers.comm.) from a beach at Chimbote ($09^{\circ}05'S$) on 30–31 Jan. 1976. The skulls had to be abandoned on-site, but the authority of the source is convincing enough (see also the discussion below). A calvarium was collected from a beach near Chimbote in May 1956 by C.J. Overweel, who donated it to the Zoölogisch Museum of the University of Amsterdam (ZMA 9079).
2. One specimen collected at or near Pativilca ($10^{\circ}42'S$), Ancash, on 24 March 1972 is kept in the USNM, Washington D.C. (MV 141870). One fisherman, considered a reliable source, claimed that dusky dolphins are occasionally landed at the nearby port of Supe ($10^{\circ}48'S$).
3. In the period December 1984–July 1986, skeletal remains of 78 dusky dolphins were collected at the port of Huacho ($11^{\circ}07'S$) by Van Waerebeek *et al.* (1988). Seven freshly caught specimens were brought ashore by local fishermen on 9–10 September 1985 (J.C. Reyes, CEPEC, pers.comm.). On several visits made by the author in summer (12–13 Dec. 1984, 16 Dec. 1984, 18–19 March 1985, 18 Feb. 1986) no fresh animals were seen, nor was there any indication that dusky dolphins had been landed in the days preceding the visits.
4. One animal of a group of 75 was harpooned near Mazorca Island ($11^{\circ}23'S$ $77^{\circ}44'W$) on 24 Feb. 1941; its skull is at the US National Museum of Natural History (USNM 270418, own observations). See also Brownell (1974) and Ta-

Fig. 1a

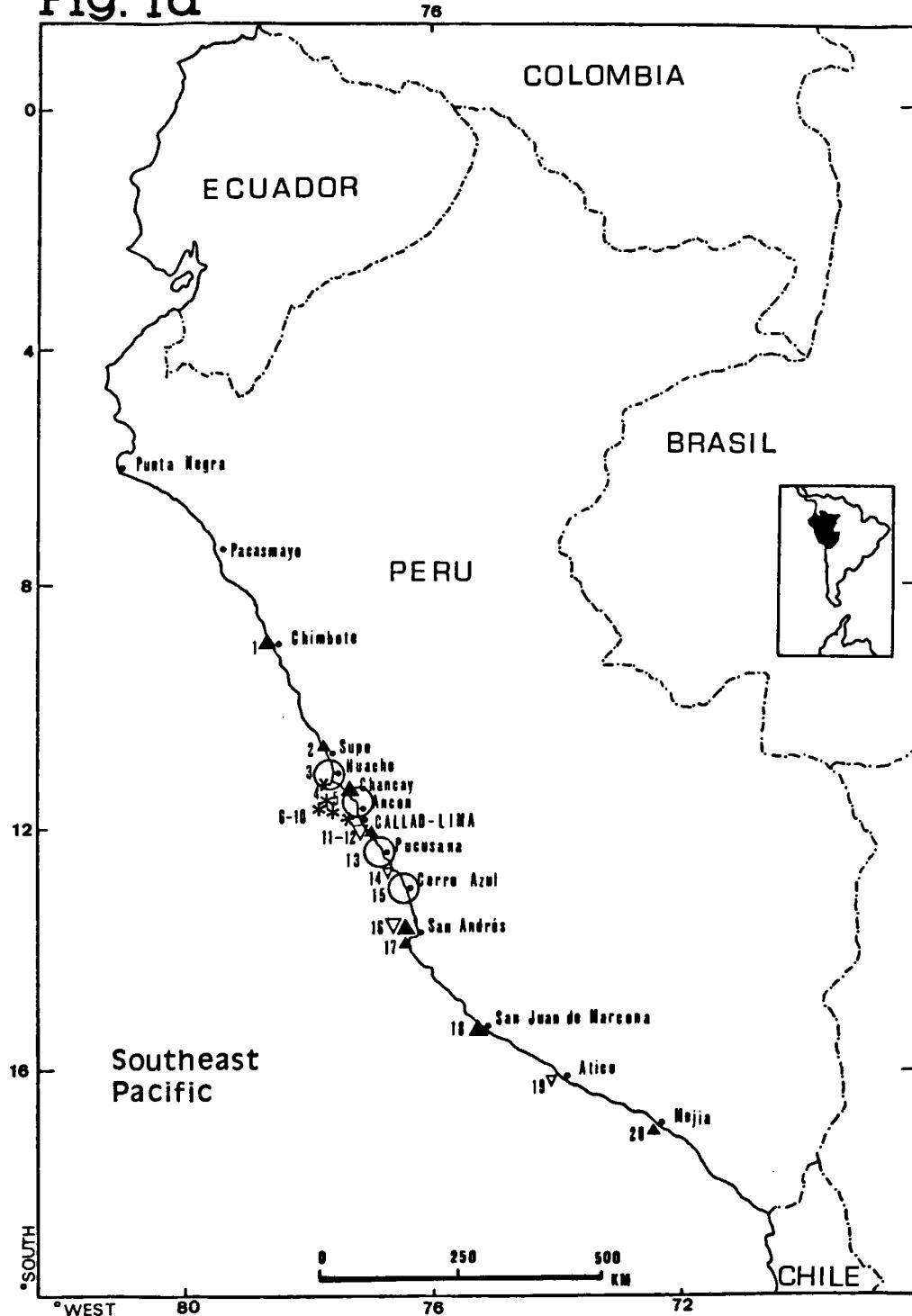


Fig. 1a. Coastal waters off Peru with authenticated locality records for *Lagenorhynchus obscurus*, from 1893 till the present. Numbers refer to these in the text. Records include sightings (stars), animals caught in fishery operations (open triangles), and others or non-specified (closed triangles). A large triangle indicates that several specimens are reported. Encircled sites are ports where large numbers of dusky dolphins are known to be landed by local fisheries.

mayo & Frassinetti (1980).

5. Cranial remains of four specimens were found by J.C. Reyes (pers.comm.) in Chancay ($11^{\circ}32'S$) on 10–11 Sep. 1985 but were not collected.

6,7,8,9. R.L.Pitman sighted dusky dolphins off Ancón ($11^{\circ}47'S$) when on board a U.S. National Marine Fisheries Service research vessel on 18 March 1982 (J.W.Gilpatrick Jr. *in litt.*, 17 Sep. 1990): 45 associated with boobies at $11^{\circ}46'S$ $77^{\circ}32'W$; 65 dolphins and hundreds of birds at $11^{\circ}49'S$ $77^{\circ}27'W$; 200 dolphins associated with some 800 boobies at $11^{\circ}51'S$ $77^{\circ}24'W$. On 24 March 1982, just north of Callao at $11^{\circ}58'S$ $77^{\circ}16'W$, Pitman sighted about 162 specimens.

10. Gaskin *et al.* (1987) estimated that 1,416 (SE=188) dusky dolphins were landed by artisanal fishermen at Ancón in the period July–October 1985. Biological samples were collected for several tens of dolphins. A port survey in summer 1991 (January–March) resulted in only 7 landed animals seen on 16 days of monitoring. On the other hand, several hundreds of dusky dolphins, besides common dolphins, were unloaded at the Ancón wharf over a period of four weeks in late winter, August–September, 1991 (A. García-Godos, CEPEC, pers.comm.).

11. Six fresh specimens (JCR-290 to JCR-295), landed at Callao on 22 June 1985, were transported to Pucusana to be butchered (J.C.Reyes, pers.comm.). Gaskin *et al.* (1987) mentioned large numbers landed by artisanal and industrial fleets at Callao ($12^{\circ}03'S$), based on second-hand information.

12. The complete carcass of a 198 cm female stranded on Playa Arica (ca. $12^{\circ}20'S$), some 40km south of Lima, in early February 1988. No net marks were observed (Reyes & Van Waerebeek, unpubl. data). Record #35 and this are the only known strandings of complete specimens which may have died from another cause than fishery interaction.

13. Intentionally and incidentally caught small cetaceans were almost continuously monitored at the fishing terminal of Pucusana ($12^{\circ}30'S$) from 1985 till 1990. The estimated yearly catches of dusky dolphins were: 95 in 1985 (SE=22); 691 in 1986 (SE=94); 711 in 1987 (SE=25);

1,725 in 1988 (SE = 124); 1,893 in 1989 (SE=151). Detailed monthly statistics are presented by Read *et al.* (1988) and Van Waerebeek & Reyes (1990a, *in press*). Landings took place all the year round, but the largest catches were recorded during winter and spring. Large numbers of skulls were collected in near-by fish dumps. Important sets of biological material is deposited at CEPEC, USNM, the Zoölogisch Museum (University of Amsterdam), and at the University of Guelph, Ontario.

14. A dusky dolphin was found stranded by S.Zambrano on the beach of Puerto Viejo (approx. $12^{\circ}40'S$) on 4 October 1987. The specimen was complete except for the longissimus dorsii muscle which had been removed, presumably by locals. Photographs are kept at CEPEC.

15. A fishery similar to the one in Pucusana operates out of Cerro Azul ($13^{\circ}00'S$). Estimated kills of *L.obscurus* were: 476 in 1986 (SE=77) (Read *et al.*, 1987); 37 (SE=16) in December 1987 and 122 (SE=47) in July 1988 (Van Waerebeek & Reyes, 1990a, *in press*). Dusky dolphins, although landed at all seasons, are most often seen at the fish market in winter and spring. In addition several tens of skeletal specimens were found on beaches in the vicinity of the port.

16. Both the author and J.G. Mead collected several skulls on the beach near the fish market of San Andrés ($13^{\circ}45'S$) which are kept at CEPEC and at the Museo de Historia Natural de la Universidad Nacional Mayor de San Marcos, Lima. Fresh animals have been reported only on three occasions: one 184cm female on 7 Nov. 1984 (J.C.Reyes, pers.comm.), a male and female (MWC-39, MWC-40) on 18 Dec. 1987 by M.Chandler (McGill University, Montreal, pers.comm.), and one male photographed by J.Tello also in Dec. 1987 (CEPEC files). Most cetaceans however are said to be landed at El Chaco, a wharf at the entrance of the Bahía de Paracas, a few km south of San Andrés.

17. A bulla and periotic bone of a dusky dolphin from Lagunillas ($13^{\circ}53'S$, Paracas National Park) gathered on 2 February 1976 by J.G.Mead is kept in the USNM (504334).

18. One calvarium (JSM-012) and two mandibula (KVW-258,-259) gathered on a beach in

San Juan de Marcona ($15^{\circ}22'S$) form part of the CEPEC collection. Very few small cetaceans are landed at the local wharf (Gaskin *et al.*, 1987).

19. A good photograph of a male dusky dolphin, harpooned 3 miles offshore just north of Atico ($16^{\circ}12'S$) was published by Bini (1951), representing the first substantiated record of *Lobscurus* from Peru.

20. An incomplete skull was collected from a beach in Mejia ($17^{\circ}06'S$) by B.A. Luscombe (Van Waerebeek *et al.*, 1988).

Confirmed records of *Lobscurus* from Chile (Fig. 2).

21. Lester and Olst found a worn calvarium on the beach north of Arica ($18^{\circ}29'S$) at the Chilean-Peruvian border in September 1969 (USNM 395755).

22. Two skulls, one from Caleta Cavancha, Iquique ($20^{\circ}13'S$) and another from an unspecified location in northern Chile were collected by W.Sielfeld in July 1986 (no specimen numbers; Departamento de Ciencias del Mar, Universidad Arturo Prat, Iquique).

23. Eight skulls were gathered from beaches around the port of Chipana ($21^{\circ}24'S$) by W.Sielfeld in June 1987 and deposited in the University Arturo Prat, Iquique. Another skull was collected in Chipana on 29 June 1986 by C.Guerra and deposited in the Instituto de Investigaciones Oceanológicas (IIO), University of Antofagasta. Almost certainly these are remains from dusky dolphins killed in fishery operations.

24. Fifteen skulls of animals caught by local fishermen were collected at Cobija ($22^{\circ}33'S$) on 18 January 1985 (Guerra *et al.*, 1987). The specimens, housed at the IIO, University of Antofagasta, were identified by the author.

25. C.Guerra retrieved a skull from a beach at Michilla ($22^{\circ}44'S$) in January 1985 (IIO, Section Aves y Mamíferos Marinos, No. AMM-001).

26. A group of about 300 specimens was photographed 800m off Punta Angamos ($23^{\circ}05'S$) on 22 March 1986 (Guerra *et al.*, 1987).

27. K.S. Norris recovered the complete skeleton of an immature animal at the port of Mejil-

lones ($23^{\circ}06'S$) on 13 August 1968 (USNM 395382).

28. A harpooned dusky dolphin was photographed at the wharf of Mejillones on 17 May 1985. As it was butchered on the spot, no samples could be taken (Guerra *et al.*, 1987).

29. The author sighted about six dusky dolphins travelling north, off Peninsula Mejillones ($23^{\circ}13'S$ $70^{\circ}41'W$) on 27 August 1986 (Van Waerebeek & Guerra, 1986; Guerra *et al.*, 1987).

30. C.Guerra and the author obtained the fresh head of an incidentally captured specimen at the fishing terminal of Antofagasta ($23^{\circ}28'S$) on 1 September 1986 (IIO, No. AMM-029).

31. The author observed a group of 150–200 specimens, heading east and associated with seabirds, off Punta Tetas ($23^{\circ}33'S$ $70^{\circ}36'W$) on 28 August 1986 (Van Waerebeek & Guerra, 1986; Guerra *et al.*, 1987).

32. A group of about 30 dusky dolphins was observed off Antofagasta ($23^{\circ}39'S$ $71^{\circ}14'W$) on 27 August 1986. Anchovies were abundant in the area at that moment (Van Waerebeek & Guerra, 1986; Guerra *et al.*, 1987).

33. A skull was retrieved on a beach of Cachinales ($25^{\circ}10'S$) on 10 September 1986 (IIO, No. AMM-030).

34. During the *Alert Expedition*, R.W. Coppinger collected a cranially mature skull at Coquimbo ($29^{\circ}58'S$) (Flower, 1885) which was subsequently deposited at the British Museum (Natural History) as No.1881.10.28.1.

35. A fresh, 194cm long female, cast on the rocks at Montemar, Valparaiso Bay ($32^{\circ}57'S$) on 23 November 1978, was examined but no voucher material was conserved; however a good photograph is presented (Andrade & Báez, 1980).

36. The skull and photographs of a dusky dolphin stranded at Montemar in December 1981 are reportedly kept at the Museo de Historia Natural, Valparaíso (without number; Sielfeld, 1983). Although this material could not be examined by the author, the identification by W. Sielfeld inspires confidence.

37. An "adult" dusky dolphin reportedly captured by artisanal fishermen near Dichato ($36^{\circ}33'S$) in July 1984 was examined for parasites by M.Acevedo and L.Pastene (Fernandez,

Fig. 1b

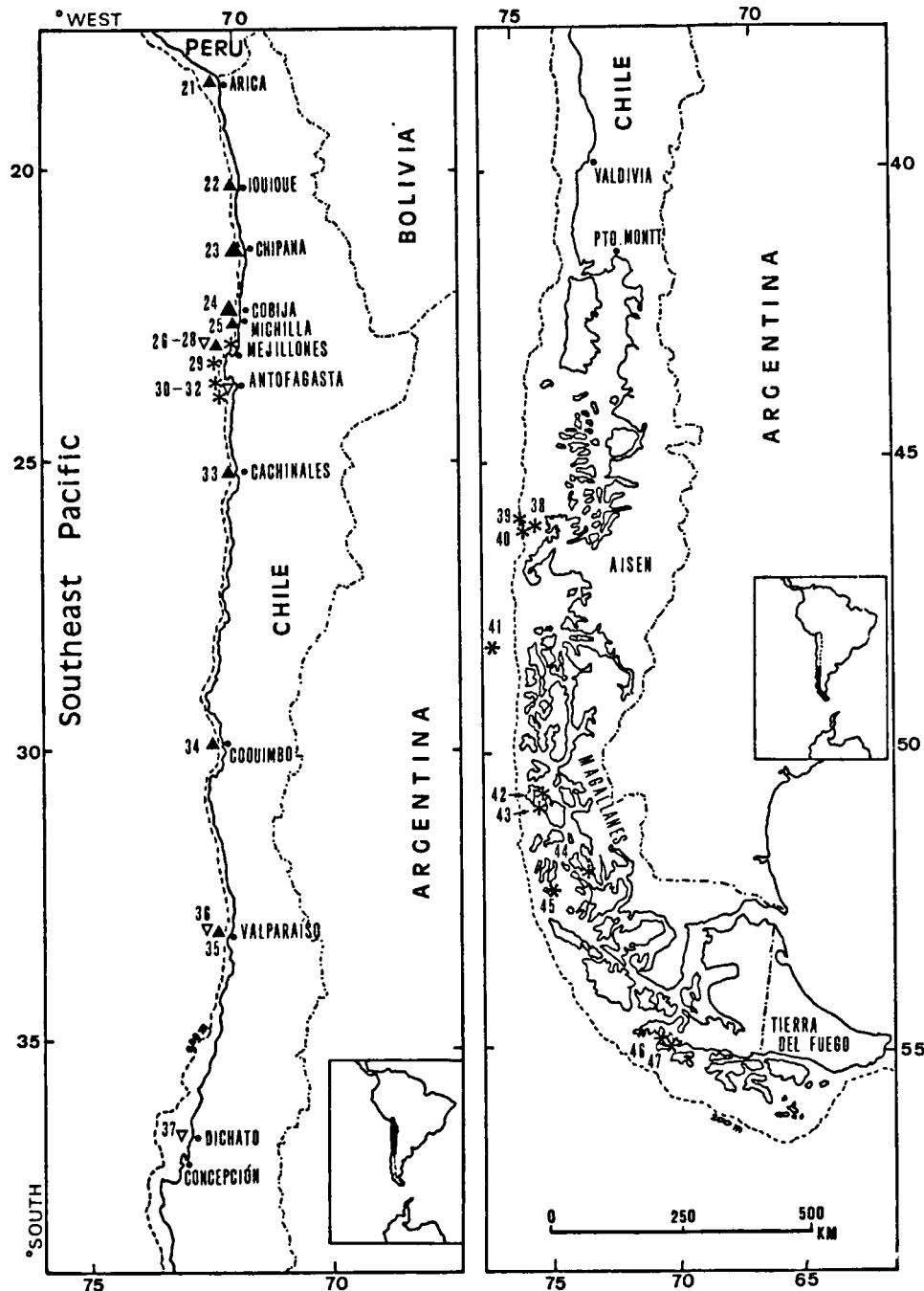


Fig. 1b. Coastal waters off Chile with authenticated locality records for *Lagenorhynchus obscurus*, from 1893 till the present. Numbers refer to these in the text. Records include sightings (stars), animals caught in fishery operations (open triangles), and others or non-specified (closed triangles). A large triangle indicates that several specimens are reported.

1987). The specimen was discarded after study.

38,39,40. Steve Leatherwood (*in litt.*, 25 April 1990) sighted dusky dolphins on 2 March 1990 at the following positions: 700–800 together with ± 50 *Lissodelphis peronii* at 46°13'S 74°29'W; 25 at 46°09'S 75°29'W and 35–40 feeding at 46°08'S 75°29'W.

41. Philippi's *Phocaena posidonia* (1893, p.9), based on a dolphin harpooned off Aysén at 48°10'S 77°00'W, was put within the genus *Lagenorhynchus* by True (1903) and synonymized with *L.cruciger* by Bierman & Slijper (1947) and Hershkovitz (1966). The general colouration, including the bifurcated flank patch, indicates that it actually belongs to *L.obscurus*, as first suggested by Kellogg (1941) and by Cabrera (1961). The type specimen is supposed to be at the Museo Nacional de Historia Natural, Santiago, but it could not be located.

42. About 11 dusky dolphins were sighted near Isla Buenaventura (50°45'S 75°09'W) on 24 February 1984; the sea surface temperature (SST) was 12°C (Oporto, 1984). No photographs were taken but J.A. Oporto is familiar with both *L.obscurus* and *L.australis* (*pers.comm.*).

43. Seven specimens were observed in Bahía Salvación (50°55'S 75°05'W) on 23 January 1984 (Oporto, 1984).

44. Sielfeld & Venegas (1978) sighted a group of 12 dusky dolphins in Collinwood Strait (51°50'S 73°40'W) on 29 January and again on 30 January 1978; it is believed these were the same individuals. Coastal waters between Isla Wellington and Peninsula Brecknock were surveyed for 24 days from January to February 1978.

45. Three animals were sighted near an island called "Isla Grupo de 40 días" (52°22'S 74°48'W) on 1 February 1984; SST: 11°C (Oporto, 1984).

46. A small pod of ten animals was sighted off the island "Isla Met" (55°03'S 71°06'W) on 27 February 1984; SST: 9.0°C (Oporto, 1984).

47. A group of 22 dusky dolphins was seen off "Isla Treble" (55°07'S 71°02'W) on 27 February 1984; SST 9.1°C (Oporto, 1984).

DISCUSSION

INCERTAE SEDIS

1. Trained observers of the Inter-American Tropical Tuna Commission (IATTC) sighted 40 unidentified dolphins, at 06°46'S 89°10'W in tropical, far offshore waters on 27 February 1988 (M.Scott, IATTC, *pers.comm.*). The description and a sketch strongly suggest a *Lagenorhynchus* sp., identified by the observers as "delfín lagenorringo". While a field sketch clearly shows a single flank patch, accompanying notes imply more than one stripe or patch ("una especie de bandas"). The head region is drawn surprisingly pale, yet may not have been observed well. It seems inopportune to try to identify these dolphins to species using vague and partly contradictory information concerning key characteristics. The pigmentation of the posterior body as apparent from the drawing (presumably closest to truth) and the offshore position raises the question whether a link exists between the IATTC sighting and the small group of *Lagenorhynchus* sp. sighted by Leatherwood *et al.* (1991) off the Cook Islands (18°10'S 163°20'W) in the western tropical Pacific. The description and good-quality photographs presented for the latter are sufficient to bar the possibility of dusky dolphins; we concur with the provisional identification by Leatherwood *et al.* (1991) that the Cook Island specimens were a form of *Lagenorhynchus australis*.

2. A sighting by Murphy (1926, p.225) almost certainly refers to *L.obscurus*: "The handsome black and white beakless porpoises which played beneath the stem of the *Alcatraz* during the trip toward Huacho, probably belonged to a species called *Cephalorhynchus albifrons*". The mentioned nominal species however has been synonymized with *C.hecktori* (see Hershkovitz, 1966) which has a distribution exclusive to New Zealand coastal waters. There is no other small odontocete known from Peruvian waters (see Van Waerebeek *et al.*, 1988) which fits the description by Murphy (1926).

3. Clarke (1962) reported on a school of eight "*Lagenorhynchus cruciger*", associated with a fin whale, off central Chile at 33°40'S 74°55'W, an

identification accepted by Leatherwood & Reeves (1983) and Webber & Leatherwood (1990b). The general confusion in nomenclature of this genus up to about 1970, as mentioned earlier, makes one wonder whether these dolphins actually may not have been *Lobscurus*. Moreover, the given position is rather out of range for *L.cruiciger*, Miyazaki & Kato (1988) sighted this species from 46°29'S to 67°38'S. On the other hand *L.australis*, although recorded from as far north as the mouth of the Aconcagua river, Concón at approx. 33°S (Aguayo, 1975), is the most inshore of the *Lagenorhynchus* spp. and doubtfully has any relation with the offshore sighting by Clarke (1962).

4. Gilmore (1971) and Brownell (1974, his record #20) reported on two dusky dolphins sighted in the central Strait of Magellan. Gilmore (1971), however, refers to the dolphins both as *L.australis* and *Lobscurus* on the same page, demonstrating uncertainty about their taxonomical status. R.L. Brownell Jr. (*in* Webber, 1987) conceded they may have been either species. The same may apply to two other observations at sea made from the R/V *Hero*, at roughly 49°S off southern Chile (Brownell, 1974, his record #11), one of which is supposed to be identical with a sighting of an unspecified number of "dusky dolphins" in the Messier Channel (48°30'S 74°33'W) on 15 August 1969 reported by Aguayo (1975). The source manuscript by Brownell & Gilmore, thought to be on file at the Smithsonian Institution, could not be located (J.G. Mead, *in litt.* 4 April 1991; R.L. Brownell Jr., *in litt.* 11 April 1991). At this moment it seems appropriate to classify these sightings as *incertae sedis*.

5. Philippi (1895) described *Tursio? panope* [sic] based on a skull of unknown origin (No.584, Museo de Historia Natural de Santiago, Chile) but supposedly Chilean. Brownell & Mead (1989) recognized it as belonging to *Lobscurus*. In 1988, both the author and J.C. Reyes independently examined the skull at the Santiago museum and came to the same conclusion.

DISTRIBUTION BOUNDARIES

Northern limits – Chimbote (09°04'S) is the north-

ernmost locality on the west coast of South America whence *Lobscurus* material is known, pertaining almost certainly to remains of captured animals [Record No.1]. In Chimbote, dolphins are mostly landed by industrial purse seiners which leave port for several days; therefore, the dolphins may have been netted in more southerly waters. During visits to the wharf and inspections of nearby beaches by the author and J.C. Reyes (March 1985, July 1986), both fresh specimens and skeletal material of common and bottlenose dolphins were seen, but not of dusky dolphins, suggesting the latter species is only rarely landed.

A northern range limit to about Punta Negra (06°S), northern Peru, as shown by Webber (1987, fig.8) and cited in Leatherwood *et al.* (1991), is not supported by firm data. Coastal surveys in northern Peruvian provinces (Piura & Tumbes), at and north of 06°S (Van Waerebeek *et al.*, 1988; Van Waerebeek & Reyes, unpubl.data; S.Zambrano, ECCO, pers.comm.; M.Chandler, McGill University, pers.comm.) and boat surveys in southern Ecuador (Haase, 1990; Haase & Van Waerebeek, unpubl. data) yielded not a single positive record and indicate that *Lobscurus* does not normally occur in sub-equatorial coastal waters off western South America. Landings of cetaceans were monitored at the Pacasmayo fish terminal (07°24'S) for 15 days in the period March–July 1986 without dusky dolphins being encountered. Pativilca (10°42'S) is the second northernmost locality with a confirmed specimen, probably originating from adjacent waters (No.2). The actual northern range may oscillate annually due to fluctuations in the intensity of coastal upwelling and summer El Niño countercurrents, but it is expected to lie somewhere between Pativilca and Chimbote, corresponding to the 18°–19°C mean annual SST isotherm (following Schott & Schu, 1910, cited in Gunther, 1936), in fair agreement with the species' known upper temperature limits (see below).

Western limits – The offshore range of *Lobscurus* off the west coast of South America is unknown but it is thought to be mostly restricted to the

narrow continental shelf. In Peru, shelfwaters extend from 3–4 nautical miles off Cabo Blanco, northern Peru, to a maximum of 70 miles off Chimbote, and an average of 30–40 miles off the central Peruvian coast (Schweigger, 1964; Anonymous, 1979). Local fishermen, who capture the majority of dusky dolphins, seldom set nets outside the shelf zone. The four confirmed sightings for Peru all fell within the 180m isobath. Three sightings in the Antofagasta area, northern Chile (Nos. 26, 29, 31), were registered above the continental slope and only one (No. 32) beyond it, as was one sighting off Aysén in southern Chile (No. 41). These last two, although in waters deeper than 1000m, must still be considered coastal at distances not exceeding 50 nautical miles from the coastline. As discussed by Van Waerebeek *et al.* (1991), confusion may arise with the labelling of cetacean sightings "oceanic/pelagic", or alternatively, "inshore/nearshore" if observations are made at positions within short distance of the coast where continental shelf and slope are extremely narrow.

Extensive dolphin survey effort in the eastern tropical Pacific by the Inter-American Tropical Tuna Commission (Hammond & Tsai, 1983; Hammond & Hall, 1985; Buckland & Anganuzzi, 1988) and Donovan (1984), during the 1982 IWC/IDCR research cruise, demonstrate that dusky dolphins are absent from that region. This is further corroborated by the large data base of dedicated cetacean surveys in the same area by the US National Marine Fisheries Service (Au *et al.*, 1979; Au & Perryman, 1985; Holt & Sexton, 1989, 1990; J.W. Gilpatrick, Jr., NMFS, *in litt.* 17 August 1990). During a shipboard survey from Valparaíso, central Chile, to Easter Island (27°08'S 109°23'W) and back, covering a distance of 4300 nautical miles in September 1991, no dusky dolphins were encountered (C.G. Guerra, University of Antofagasta, pers. comm., 2 December 1991). The species is absent from the cetacean record of the Chilean offshore islands of Juan Fernández (approx. 33°40'S and 79°W – 80°45'W) (Cárdenas *et al.*, 1991).

Also, there is no evidence that any dispersion may occur across the Pacific; the New Zealand population does not extend further east into the

central Pacific than the coastal shelf around the Chatham Islands (ca. 44°S 176°30'W). None were sighted during extensive cruising east from the New Zealand archipelago to longitude 140°W in sea surface temperature and latitudes apparently favourable to the species (Gaskin, 1968b, 1972).

Southern limits – Fraser (1964) & Brownell (1974) recognized *Lobscurus* as occurring at or near the Antarctic Convergence; Goodall & Galeazzi (1985) preferred to classify it as a sub-Antarctic species. Nishiwaki (1977: figure 4) claimed its presence in Drake Strait, "but not farther south than 58°S and 300–500 km north of the Antarctic Convergence"; however no substantiated accounts were provided. Kasamatsu *et al.* (1990), summarizing data of ten years of cetacean sighting cruises in high latitudes of the southern hemisphere, never recorded dusky dolphins in Drake Strait and found them nowhere south of 51°44'S. Sighting latitudes presented by Miyazaki & Kato (1988) did not exceed 49°20'S.

Yáñez (1948) stated that "*Lobscurus*" is common in the canals of Tierra del Fuego and Magallanes, while Olrog (1950) reported on "*L. cruciger*" as occurring in small pods inside the canals of the Cape Horn archipelago. In absence of any description, either of these accounts may in fact cover both *L. cruciger* and *Lobscurus*. Cárdenas *et al.* (1987) listed the dusky dolphin as one of the species affected by the centolla crab fishery in the region from Cape Horn to Navarino island (at 55°S, Tierra del Fuego), but no particular cases are cited. Nonetheless, a few sightings by experienced observers (Nos. 44 – 47) confirm that *Lobscurus*, at least occasionally and in summer, can occur in small groups in canal waters of Magallanes and Tierra del Fuego.

DISTRIBUTION GAP AND STOCK SEPARATION

Sufficient authenticated records exist to believe that the distribution of *Lobscurus* is more or less continuous from Huacho (11°07'S) in northcentral Peru, south to Concepción (36°50'S), BíoBío region of Chile (Figs. 1, 2). This does not neces-

sarily imply, however, that a single breeding unit is involved. Actually, small but statistically significant differences in skull morphology have been found between central Peruvian and northern Chilean specimens (Van Waerebeek, 1992). It should be established whether variation is clinal or discrete before breeding units can be defined.

Positive accounts are absent for a coastal strip of roughly 1,000km from 36°30'S to 46°S. This apparent distribution gap is supported by shipboard surveys in canal waters between Puerto Montt and Punta Arenas by Oporto (1984) and a survey from 26–30 December 1988 by C. Guerra (pers.comm.) and D. Torres. It seems significant that the dusky dolphin has never been encountered in the well-studied zone around Valdivia (39°48'S) (J.A. Oporto, CIMMA, pers.comm.) and is unknown from small cetacean by-catches in the artisanal fishery at Queule (39°23'S) (Oporto & Brieva, 1990). Peale's dolphin, on the contrary, is common in the area.

On the other hand the presence of *Lobscurus* off Tierra del Fuego has been well-established since it was first mentioned by Lahille for Bahía San Sebastián (1899, *in* Lichter & Hooper, 1984). Skeletal material from two specimens were collected on the Atlantic side (Goodall, 1978; Lichter & Goodall, 1988; Goodall, 1990). Piana *et al.* (1986) found bones of at least 8 specimens, carbon-dated at 6,000 years BP, in kitchen middens of Yahgan Indians on the north coast of the Beagle Channel (54°49'S 68°10'W). Lichter (1984) sighted about 200 animals at 53°21'S 64°18'W, some 150 km east of Río Grande, Tierra del Fuego, on 2 February 1984 (SST 5°C; depth 130 m).

Webber & Leatherwood (1990a) thought that dusky dolphins from central Chile may venture into far southern Chile during infrequent or seasonal periods of favourable conditions. The author rather believes that the distribution gap in south-central Chile (if confirmed) suggests that dusky dolphins recorded off southern Chile (south of 46°S) more likely belong to the population occurring in the Southwest Atlantic. Admittedly, at the moment, there are no sufficient data to corroborate either view.

MOVEMENTS, HABITAT AND ABUNDANCE

Local migration of *Lobscurus* is well-known in New Zealand where the dolphins leave the northern waters of Hawke's Bay in summer with rising water temperatures and return in autumn/ winter when the sea cools off (Gaskin, 1968b; Webber & Leatherwood, 1990a). In Golfo San José, Argentina, this species is less abundant March through July than during spring and summer, and the decrease in abundance indicates that at least some of the population migrate out of the area on a seasonal basis (Würsig & Würsig, 1980). Tagged specimens have been resighted about 780km southwest of the tagging site, substantiating the belief that at least some dusky dolphins travel for long distances (Würsig & Bastida, 1986).

A north-south seasonal migration has been suggested also for northern Chile (Cardenas *et al.*, 1986), however J.C. Cárdenas (pers.comm.) admitted recently that no firm data supported this. In Peru, from the presence of freshly caught specimens in fish terminals, we know that dusky dolphins are present all the year round off Huacho, Ancón, Pucusana and Cerro Azul (Department of Lima, see Figure). At these ports, systematically more animals are landed in winter and spring than in summer and autumn (Read *et al.*, 1988; Van Waerebeek & Reyes, 1990a,b) which may either reflect partial seasonal movements of dusky dolphins (inshore-offshore or north-south) or simply seasonal changes in fishing effort. An answer requires sighting surveys because the extreme variability of effort and yields in the artisanal fishery is a serious obstacle in the interpretation of catch statistics. Current information is insufficient to allow any statements be made on possible migration off southern Peru and Chile.

Little is known about environmental conditions associated with *Lobscurus* in the Southeast Pacific. It appears however that off Peru and northern Chile dusky dolphins basically may be restricted to waters of the Fiords current, a surface and coastal branch of the cool Peru Coastal Current (the Humboldt Current), which reaches some 30m in depth and has an axis positioned 100km offshore (Gunther, 1936; Bernal *et al.*, 1982). Dur-

ing winter months, most of Peruvian coastal waters are cold ($\leq 17^{\circ}\text{C}$) to an average of 60 nautical miles offshore while the 20°C SST isotherm is situated at over 100 miles; in summer the cold area off central and southern Peru has an offshore limit of less than 10 miles; spring and autumn have intermediate characteristics (Muck *et al.*, 1989). Oporto (1984) reported SST of 9° – 12°C during summer sightings in southern Chile (Nos. 44–47). In other regions *Lobscenus* has been related to SST of 10° – 16°C off southern Africa (Findlay, 1989), 10.4° – 15°C off New Zealand (Gaskin, 1968b; Miyazaki & Kato, 1988), 10.4° – 14.9°C off Argentina (Bastida & Lichtschein, 1984) and 10°C – 16°C in 26 sightings at various locations (Kasamatsu *et al.*, 1990). Around Peninsula Valdés, Argentina, dusky dolphins apparently avoided summer SST of over 18°C but not 10°C waters in winter (Würsig & Würsig, 1980). Kasamatsu *et al.* (1990) report a sighting from south of Madagascar ($31^{\circ}46'\text{S}$ $49^{\circ}18'\text{E}$) in waters of 25°C . However, in view of the unusual locality, the abnormally high SST and the documented sighting of the similar *L. australis* in tropical waters (Leatherwood *et al.*, 1991), there is need for some reserve about the identification of the species in the Madagascar record.

Dusky dolphins are assumed to be relatively abundant throughout their range but no population estimates have been obtained (Leatherwood & Reeves, 1983; Webber & Leatherwood, 1990a). Würsig & Bastida (1986) suggested "there are several thousand" along the coast of Argentina but added that the exact number is unknown. Off Chile, Oliver-Schneider (1946), without offering any data, characterised *Lobscurus* as "the most common small cetacean along the coast [of the Concepción Province], abundant in the Gulf of Arauco [around 37°S] and at the mouth of the Bío-Bío river [$36^{\circ}50'\text{S}$]". It is likely that Oliver-Schneider actually referred to *L. australis*, considering the common name used ("Tunina negra") and the fact that no material is present in the zoological collections of the University of Concepción and Museo Regional de Concepción (Ruiz & Oyarzo, 1987).

Rough estimates of fishery-caused mortality in

Peru, amounting to several thousand dusky dolphins per annum derived from government statistics (Van Waerebeek & Reyes, 1990a, in press) show that the Peruvian population, at least at pre-exploitation levels, must have been considerable. In ports around Lima, three out of four small cetaceans landed have been dusky dolphins (Van Waerebeek & Reyes, in press). The species arguably is the most common cetacean off central Peru. Unfortunately, for lack of funding, only very limited surveying has been possible. Near-shore waters of the Reserva Nacional de Paracas (centered around $13^{\circ}50'\text{S}$) and a narrow coastal strip north to Tambo de Mora ($13^{\circ}30'\text{S}$) were surveyed from a 12m boat during several days in January and March 1988. Adverse weather conditions limited the effective census time to 44h 23min. Numerous bottlenose dolphins and Burmeister's porpoises were sighted, but no dusky dolphins (Van Waerebeek & Reyes, 1990b). Opportunistic and dedicated beach and cliff-top observations at various locations in central Peru (Van Waerebeek & J.C. Reyes, pers. observations; Haase, 1987) did not yield a single sighting of *Lobscurus*, which suggests that Peruvian dusky dolphins usually do not approach shore as close as their counterparts in New Zealand and Argentina (see Würsig & Würsig, 1980; Würsig *et al.*, 1989), and possibly in South Africa (Tayler and Saayman, 1972).

In the course of five trips on board pelagic purse-seiner vessels off northern Chile in an area delimited by latitudes 22°S and 24°S and as far as 140km offshore in the period 16–28 August 1986, the author sighted dusky dolphins on three occasions (Nos. 29,31,32). Total observation time was 57h 55min and the mean group size 128 (N=4, range 6–300). In southern Chile, Oporto (1984) reported only five sightings during 672 observation hours of boat surveys over 2,597 nautical miles of coastal and channel waters of Aysén and Magallanes, from Puerto Montt ($41^{\circ}28'\text{S}$ $72^{\circ}57'\text{W}$) to Bahía Cook ($55^{\circ}10'\text{S}$ $70^{\circ}10'\text{W}$) in November 1983–March 1984 (Nos. 45–47). Also the size of groups seen was much lower (mean=11, N=6, range 3–22). During a winter–spring survey in 1977 by A. Sanhueza, from Isla Petters, canal Ladrillero ($49^{\circ}14'\text{S}$

75°18'W) south to Bahía Beaufort (52°45'S 73°45'W) no dusky dolphins were reported (Sielfeld & Venegas, 1978).

Although survey effort and platforms are difficult to compare, these data at least suggest that dusky dolphins may be more abundant off northern Chile than in southern Chilean waters. From the list of records, it is apparent that material is fairly common in osteological collections in northern Chile while it is absent at institutions in southern Chile (Venegas & Sielfeld, 1978; Sielfeld, 1983; A.C. Lescrauwaet, pers.comm.); it is also rare in Argentinian Tierra del Fuego (Goodall, 1978; Goodall, 1986, 1990; Goodall *et al.*, 1988). According to A.C. Lescrauwaet (*in litt.*, 22 September 1989) the practice of capturing dolphins for bait in the king and false king crab fisheries should not be disregarded as a possible factor in the rarity of *Lobscurus* in Magallanes. The relative abundance of bones among sub-fossil remains found by Piana *et al.* (1986) hint to the possibility that in the late Pleistocene this species may have been more common in Fuegian waters.

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