

Inshore Records of the Striped Dolphin, *Stenella coeruleoalba*, from the Pacific Coast of South America

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ABSTRACT

New data are presented on striped dolphins from nearshore waters off the Pacific coast of South America, and published information on the species in that region is reviewed. Specimen records from coastal waters of Colombia ($n = 3$), continental Ecuador ($n = 4$), Galapagos Islands ($n = 2$) and Peru ($n = 2$) are documented for the first time. A skull from Robinson Crusoe Island (33°42'S, 80°45'W) constitutes the most southern distribution limit in the offshore temperate southeast Pacific, while no striped dolphins have been sighted south of latitude 21°S. As in other seas, *S. coeruleoalba* appears to enter neritic waters only occasionally. The species' avoidance of sea surface temperatures of less than 20°C could also help to explain its scarcity in the cool upwelling-influenced coastal zone off Peru and northern Chile as well as farther south off western South America. Body size of four individuals ranged from 211-218cm, but none was physically mature. Specimens studied presumably form part of the eastern Pacific stock, however population identity remains undetermined because the few skulls and tissue samples (for genetics) available do not yet permit rigorous analysis. Scientists in the region are encouraged to sample any new specimens as completely as possible.

KEYWORDS: STRIPED DOLPHIN; SOUTH AMERICA; PACIFIC OCEAN; DISTRIBUTION; STOCK IDENTITY

INTRODUCTION

The striped dolphin, *Stenella coeruleoalba* (Meyen, 1833) is widely distributed in tropical, subtropical and temperate waters. An offshore, gregarious species, it is commonly found in herds of hundreds or even thousands of individuals. Several stocks but no subspecies have been named (Mitchell, 1975; Perrin, 1975; Leatherwood and Reeves, 1983; Mead and Brownell, 1993).

The species was described in 1833 by the German zoologist Franz Julius Meyen as *Delphinus coeruleoalbus* from an animal found in the vicinity of the Rio de la Plata, southwest Atlantic. More than 130 years later this species was still unknown from Pacific South America (Cabrera, 1960; Hershkovitz, 1966; Sielfeld, 1983). R.A. Philippi (1893) identified a dolphin captured off central or southern Chile as *Delphinus caeruleo-albus* Meyen, however he did not document his own specimen but instead reproduced Meyen's figure and merely translated the original description. The senior author did not find any historical striped dolphin specimens at the Museo Nacional de Historia Natural of Santiago de Chile where Philippi was curator. Without a voucher specimen, we must regard the record of *D. caeruleo-albus* by Philippi as uncertain.

This species was first documented from the eastern Pacific in 1970 (Hubbs *et al.*, 1973) and from the pelagic southeast Pacific in 1976 (Au *et al.*, 1979; Lee, 1993). Since then, information for offshore waters of the eastern tropical Pacific (ETP) accumulated rapidly thanks to the observer programme on tuna purse-seine vessels organised by the US National Marine Fisheries Service (NMFS) and the Inter-American Tropical Tuna Commission (IA TTC) as well as dedicated NMFS cetacean sighting cruises. These sources gave rise to a wide literature on distribution, ecology,

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abundance and bycatch estimates of pelagic dolphins including *S. coeruleoalba* (e.g. Au *et al.*, 1979; Perrin *et al.*, 1983; 1985; Au and Perryman, 1985; Polacheck, 1987; Wilson *et al.*, 1987). Abundance of striped dolphins in the ETP has been monitored since 1986 (Wade and Gerrodette, 1992; 1993; Gerrodette and Palacios, 1996), however no tag-recapture studies have been conducted and, to date, nothing is known about their movements there (Dizon *et al.*, 1994).

Determination of population structure has been difficult because striped dolphins are not frequently associated with tuna, and thus only small numbers are killed in the tuna fishery and few become available for study (DeMaster *et al.*, 1992; Perryman and Lynn, 1994). Perrin *et al.* (1985) suggested the existence of two ETP stocks, a northern and a southern stock divided by the 12°N parallel. Perryman and Lynn (1994) failed to find significant differences in body length between these areas as measured by aerial photogrammetry, with the caveat that their technique's maximum resolution was 4cm. Dizon *et al.* (1994), re-evaluating evidence, concluded that probably a single stock exists and recommended that all striped dolphins in the eastern Pacific be provisionally managed as a single unit.

The southern distribution boundary off South America was established at about 7°-80°S, off northern Peru, and the species has not been sighted in the ETP further south than about 14°S nor has it been reported inshore (Wilson *et al.*, 1987; Dizon *et al.*, 1994; Perrin *et al.*, 1994).

From numerous surveys of beaches and extensive monitoring of fishing ports along the Pacific coasts of South America by the authors and colleagues in 1984-1997 it transpired that, although uncommon, striped dolphins occasionally do enter inshore waters of Colombia, Ecuador, Peru and Chile. We analyse here for the first time information for twelve substantiated records as a base for future studies.

MATERIAL AND METHODS

The study area is defined as the continental shelf off western South America, from the Colombia/Panama border to Cape Horn. Where relevant, we also discuss published offshore

occurrences in the southeast Pacific. We screened primary and local literature in search of original sighting and specimen data and perused marine mammal collections for specimen holdings. Records are presented chronologically for each country. New specimen records (and one sighting) are plotted in Fig. 1.

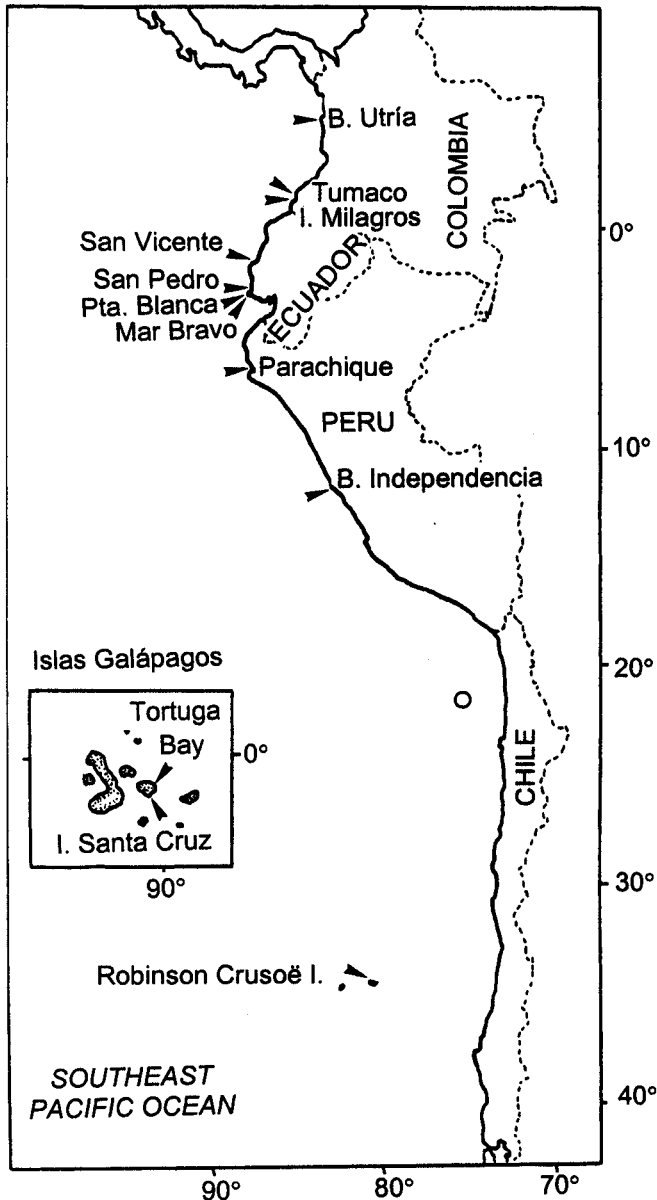


Fig. 1. New specimen records (arrows) of the striped dolphin, *Stenella coeruleoalba*, collected in 1988-98 from the Southeast Pacific region, and a first confirmed sighting from Chilean waters (open circle). Details are presented in the Results section.

The main collections examined were:

- (1) Colombia: Unidad de Zoología de la Universidad del Valle, Cali; Museo del Mar, Universidad Jorge Tadeo Lozano, Santafe: de Bogota;
- (2) Ecuador: Charles Darwin Research Station at Puerto Ayora, Santa Cruz Island, Galapagos Islands; Fundación Ecuatoriana para el Estudio de Mamíferos Marinos (FEMM), Guayaquil; Centro Natural Educativo Peninsular (CINAP-FEMM), La Libertad; Laboratorio de Biología de la Universidad de Guayaquil;

- (3) Peru: Centro Peruano de Estudios Cetológicos (CEPEC), Pucusana; private collection Julio C. Reyes, Lima; Museo de Historia Natural de la Universidad Mayor de San Marcos, Lima;
- (4) Chile: Facultad de Recursos del Mar, Universidad de Antofagasta; Departamento de Zoología, Universidad Arturo Prat, Iquique; Museo Nacional de Historia Natural de Santiago; Museo Municipal de Ciencias Naturales y Arqueología de San Antonio, Llo-lleo; Universidad de Concepción and Museo Regional de Concepción (Ruiz and Oyarzo, 1987); Instituto de Zoología, Universidad Austral de Chile and Instituto de la Patagonia, Universidad de Punta Arenas.

Cranial maturity was determined from the degree of fusion between cranial sutures, as defined by Ito and Miyazaki (1990) and Van Waerebeek (1993). For a detailed description of skull and postcranial morphology of *S. coeruleoalba* see Okada (1936). Standard cranial and external measurements taken are listed in Tables 1 and 2 respectively.

RESULTS

Colombia

Sightings

Numerous sightings are reported from Pacific Colombian waters and the Panama Bight, most of these gathered during dedicated cetacean sighting cruises in the ETP. For details we refer to Hubbs *et al.* (1973); Vidal (1990); Florez and Capella (1995); Au and Perryman (1985) and Wade and Gerrodette (1993).

Specimens

Until 1995 no striped dolphin specimen was available from the Colombian Pacific (see Vidal, 1990; 1992; Flórez *et al.*, 1992; Flórez and Capella, 1995). Below we document the first stranded individuals which were briefly listed by Mora-Pinto *et al.* (1995) as 'one encountered in collections' and 'two in the field'.

- (i) A fresh specimen of unknown sex and length stranded in October 1988 on Milagros Island at the mouth of the Mira River ($01^{\circ}36'33''\text{N}$, $79^{\circ}03'52''\text{W}$), Narino. Photographs by D. Amorcho are deposited in the archives of Fundación Natura, Santafe: de Bogota, with copies kept by one of us (DMM-P); these photos are the only evidence. The cause of death is unknown. However, at the base of the left side of the head, a hole that appeared to have been made by a sharp object was visible. It is unclear whether this wound was inflicted before or after the animal stranded.
- (ii) The carcass of a 217cm animal of unknown sex and weighing 93kg washed ashore in Tumaco ($01^{\circ}48'28''\text{N}$, $78^{\circ}48'04''\text{W}$), Narifio, on 25 July 1991 and was collected by V. Rojas. The cause of death is unknown. The complete skeleton and skin samples are deposited at the Universidad del Valle, Cali (without collection number, at the time of writing). External measurements were taken on the frozen carcass on 25 October 1991.
- (iii) A striped dolphin of unknown sex live-stranded on a beach south of the bay of Utria ($06^{\circ}02'58''\text{N}$, $77^{\circ}22'42''\text{W}$), Choco, in September 1991. The dolphin managed to refloat and return to sea but was reported to swim erratically. It is not known whether it survived but it was not seen again. Positive

identification is based on photographs taken by C. Hernandez which are deposited at Fundacion Natura, with copies in the files of DMM-P.

Ecuador

Sightings

Striped dolphin groups are frequently seen around the Galapagos Islands and in offshore waters (82°-84°W) west of mainland Ecuador (Au *et al.*, 1979; Au and Perryman, 1985; Perrin *et al.*, 1985; Holt and Jackson, 1987; Holt and Sexton, 1987; Lyrholm *et al.*, 1992; Merlen, 1995) but, so far, not in coastal waters (Haase and Felix, unpub. data). Day (1994) stated that its occurrence in Galapagos waters is related to areas deeper than 1,853m (1,000 fathoms). During 16 dedicated cetacean cruises conducted around the Galapagos between March 1993 and March 1994, 34 striped dolphin groups were sighted with an average group size of about 40 animals (D. Palacios, unpub. data). Striped dolphins tended to be found in warmer waters to the north of the central group of islands, while short-beaked common dolphins, *Delphinus delphis*, tended to be concentrated in the cooler, more productive waters to the west/southwest of the islands, where upwelling is prevalent. Thus, the two species appear to occupy different habitats within the archipelago. Striped dolphins were more often seen (25 sightings on 118 effort days) during the warm period (mid-December to mid-June) than during the cooler months (mid-June to

mid-December) when 6 sightings in 64 effort days were documented. However, the difference was not statistically significant at $\alpha = 0.05$ (chi-square = 3.40, $p = 0.065$).

Specimens

CONTINENTAL ECUADOR

(i) A 217cm male (OSc-001-92) beached moribund or freshly dead at San Pedro (01 °56'S, 80°43 'W), Guayas Province, on 20 March 1992. The fresh carcass, retrieved by personnel of the Centro Nacional de Acuicultura e Investigaciones Marinas (CENAIM) was kept in cold storage before it was examined by two of us (FF, BH). External measurements were taken (Table 2) and a necropsy was performed on 29 March 1992. A traumatic injury on the upper right mandible, with blood exuding from the surface, resulted in the loss of all teeth over 11 cm of gumline. In addition, teeth were broken over 7.5cm in the right maxillary. The nature of the wound strongly suggested it was inflicted by a human-made object, possibly fishing gear. There were no netmarks, which would be in accordance with a purse-seine net encounter. We presume the trauma was directly related to, if not the cause of the death of the dolphin, because it appeared in good physical condition without any signs of emaciation or other signs of pathology. The absence of tooth marks argues against

Table 1

Standard cranial measurements (mm) and meristics of striped dolphins (by collection no.) from western South America. Cranial maturity criteria follow Ito and Miyazaki (1990) and Van Waerebeek (1993).

	OSc-001-92	OSc-002-93	-	?	AGG-732	KVW-1028	JF/RC/002/86	-
Origin	Ecuador	Ecuador	Ecuador	Galápagos	Peru	Peru	R. Crusoë, Chile	Colombia
Cranial maturity	Subadult	Mature	Subadult	Undeter.	Mature	Mature	Subadult	-
Standard length	217cm	212cm	~2m	-	-	218cm	-	217cm
Condylobasal length	396.0	433.0	433.0	> 387	439.0	454.0	(425)	426.0
Rostrum length	226.0	254.5	252.0	>208.5	254.0	266.0	>244	246.0
Rostrum width at base	115.0	111.0	120.5	109.0	115.0	112.0	105.0	116.0
Rostrum width at 60mm	71.0	74.0	71.0	-	74.0	78.0	-	-
Rostrum width at 1/4 length	dam	73.0	-	73.0	73.5	75.0	76.0	72.5
Rostrum width at 1/2 length	59.0	63.5	60.5	64.5	60.5	63.0	66.0	61.5
Rostrum width at 3/4 length	48.0	46.0	split	59.6	dam	48.0	53.0	43.5
Premaxillary width at 1/2 length	29.5	31.5	31.5	30.0	28.5	32.0	31.0	>30
Rostrum tip to external nares	273.0	305.0	307.5	-	312.0	318.0	-	-
Rostrum tip to internal nares	285.0	305.0	314.0	-	dam	322.0	>290	-
Preorbital width	188.0	195.0	201.5	-	192.0	210.0	180.0	-
Postorbital width	208.0	214.5	222.0	211.0	216.5	230.0	206.0	212.0
Zygomatic width	203.5	210.0	221.5	215.0	215.0	227.0	203.0	214.0
Parietal width	165.0	164.0	161.1	177.0	161.0	175.0	155.0	-
Greatest width premaxillaries	80.5	83.5	86.5	89.5	78.5	86.0	80.0	-
External nares width	48.0	47.0	54.0	43.5	46.5	48.0	45.0	48.0
Internal nares width	60.5	61.0	60.0	58.0	dam	68.0	58.0	-
Temporal fossa length	68.0	60.2	-	64.5	68.0	71.0	63.0	-
Temporal fossa width	47.0	41.7	48.9	50.2	45.5	47.0	52.0	-
Orbital length	52.0	55.0	49.2	56.0	51.0	55.0	57.0	-
Antorbital process length	51.5	54.0	60.5	58.3	57.0	63.0	48.0	-
Upper tooth row length	196.0	222.0	216.5	>173	226.5	231.0	>213	200.5
Lower tooth row length	200.0	-	-	-	-	209.0	217.0	200.0
Ramus length	352.0	-	377.0	-	-	380.0	369.0	374.0
Ramus width	65.0	65.0	69.8	-	-	71.0	65.0	67.0
Tooth count upper left	49.0	47	42	-	> 42	>43	>46	41.0
Tooth count upper right	>47	46	42	-	dam	>42	>47	40.0
Tooth count lower left	47.0	-	44	-	-	>39	>45	37.0
Tooth count lower right	ossified	-	44	-	-	>39	>46	39.0
Tooth width	4.0	4.4	3.7	-	-	3.8	-	-
Bulla length	30.9	31.8	-	-	-	31.5	-	-
Bulla width	18.4	18.3	-	-	-	17.0	-	-
Periotic length	-	-	-	-	-	33.0	30.0	-
Height braincase	117.0	116.0	121.5	-	121.5	120.0	107.0	-
Length braincase	119.0	123.0	-	-	125.0	130.0	125.0	-

- an attack by a large predator such as a shark. The lungs and airways did not contain any water or foam. One kidney weighed 305.5g. The following samples (OSc-001-92) are in the collection of the Fundacion Ecuatoriana para el Estudio de Mamiferos Marinos (FEMM), Guayaquil: complete skeleton, teeth, right testis (10% formalin), skin (70% ethanol) and hepatic trematodes. The vertebral formula was Cv (3)+4; Th 14; Lu+ Ca 58 (+-3) = 79 (+~3).
- (ii) On 5 October 1993, BH found the carcass of a 212cm female (field number BJH-034) in an advanced state of decomposition on a beach of San Vicente (00°33'S, 80°25'W), Province of Manabi. No obvious mutilations or marks of fishing gear were visible and the cause of the stranding is unknown. Only the cranially mature skull (fused cranial sutures), with teeth, was retained. It is deposited at CINAP-FEMM collection as Osc-002-93. The skull lacks signs of *Crassicauda* infection.
- (iii) A subadult individual of undetermined sex stranded on a beach at Punta Blanca (02°11'S, 80°50'W), Guayas Province, and was collected on 9 October 1985 by personnel of the University of Guayaquil. No other information on the stranding or its possible cause is available. The ca 186.5cm mounted skeleton (without collection number) was examined by KVV and FF at the Laboratory of Biology, University of Guayaquil. Accounting for intervertebral discs we estimate that the live animal measured some 2m. Physically subadult status is deduced from the partial epiphyseal fusion in most vertebrae and full fusion in 19 caudals. Vertebral formula was Cv (2)+5; Th 12; Lu+Ca 61 = 80. The thoracic cage consisted of four double-headed ribs at the right and three at the left side.

Table 2

External measurements (cm) taken axially on left side, of three striped dolphins from western South America (see text). Tooth counts refer to visible teeth emerging from the gums in the fresh specimen.

	OSc-001-92 Male	UWZS.31501 Female	[Tumaco] Undet.
Standard length (SL)	215	211	217
Length of gape	26	25	28
Snout to apex of melon	8.5	-	10
Snout to centre of eye	31	34	34
Snout to centre blowhole	26.5	29	29.5
Snout to ear meatus	35.5	-	37
Snout to tip of dorsal fin	-	125	-
Snout to insertion of pectoral fin	46.5	50 (R)	46
Snout to centre of umbilicus	98.5	-	97
Snout to centre of genital slit	131.5	-	135
Snout to centre of anus	150	138	153
Girth at eye	76	76	76
Girth at axilla	101	-	98.5
Maximum girth	103	-	-
Girth at anus	65	-	62
Anterior length of left flipper	26.8	27	27
Posterior length of left flipper	17.8	19	-
Maximum width left flipper	7.5	8.6	16
Dorsal fin height	16.5	16	16
Dorsal fin base length	29.5	27	28
Span of flukes	49	45	-
Flukes width	14	12.5	15.5
Fluke notch depth	2.4	2	1.8
Tooth count UL	42	40	-
Tooth count UR	43	41	-
Tooth count LL	42	45	-
Tooth count LR	-	45	-

- (iv) A wounded female of 199cm beached alive on 23 January 1998 at Mar Bravo (02°15'S, 80051'W), Salinas, Guayas Province. Both mandibular rami were broken 8cm from the tip, probably the result of entanglement in fishing gear. A small wound of about 1cm² was present also on the tip of the dorsal fin as well as on the right fluke. One of us (BH) measured and photographed the animal (photos filed as no. XGI 105/24-35).

GALAPAGOS ISLANDS

- (v) On 6 September 1990 a 211cm female stranded alive at Puerto Ayora, Santa Cruz Island, in front of the Port Captain's headquarters (field no. 93/SCz/055). It died 20min. after stranding (P. Whelan, Charles Darwin Research Station, pers. comm. to DMP, 18 October 1994). The animal was measured (Table 2), buried and the skeleton recovered in 1993. The latter is deposited in the Zoological Museum of the University of Wisconsin, Madison (UWZS.31501), USA. Reportedly tissue was sampled and frozen but its whereabouts is unknown.
- (vi) In January 1992, a weathered calvaria without teeth was collected in Tortuga Bay, Santa Cruz Island, by Galapagos resident F. Zambrano. The skull is in the personal collection of Zambrano at Puerto Ayora, Santa Cruz Island. Species identification is supported by black/white photographs of the skull taken by DMP, with copies deposited in the CEPEC files.

Peru

Sightings

Perrin *et al.* (1983, fig. 8) show the general distribution of sightings in pelagic waters far off the northern Peruvian coast. Donovan (1984) sighted one group of approximately 270 and another of 75 animals off northern Peru within EEZ boundaries in December 1982. No striped dolphins were seen during three oceanographic cruises in Peruvian coastal waters in 1995-96, totalling 61 observation days and a search distance of 3,875 n.miles (Arias-Schreiber and Alfaro-Shigueto, 1996), nor during occasional surveys from small fishing boats in nearshore waters off Peru in 1985-93 (KVV, unpub. data).

Specimens

No historical skeletal or other material of *S. coerulealba* exist from Peru (see Grimwood, 1969; Van Waerebeek *et al.*, 1988; unpublished CEPEC files). It has never been recorded in the flesh from small cetacean bycatches in Peru.

Here we authenticate specimen records which, although previously listed for Peru (Reyes and Van Waerebeek, 1991; Reyes, 1992), have not yet been described.

- (i) On 22 January 1988, the senior author, accompanied by J.C. Reyes, found the remains of a 218cm male striped dolphin on Playa Chucho (14°08'S, 76°13'W), northern Bahia de Independencia, Paracas National Park. The mummified condition suggested the specimen (collected on 10 March) stranded many months and possibly more than a year earlier. The nearly complete skeleton is in the CEPEC collection (KVV-1028). Unfused vertebral epiphyses indicate it is physically immature.
- (ii) On 19 February 1993, a heavily worn calvaria with fractured rostrum and a fragment of the right mandible (AGG- 732, CEPEC collection) was found in northern Peru by A. Garcia-Godos of CEPEC on a beach just

north of the port of Parachique (05°44'S, 80°52'W). The site and abundant associated bones of other small odontocetes (*Delphinus capensis*, *Phocoena spinipinnis* and *Tursiops truncatus*) are circumstantial evidence that these cetaceans were caught and landed by fishermen operating from Parachique (see Van Waerebeek and Reyes, 1994).

Chile

Sightings

No sightings of striped dolphins have previously been recorded in either neritic or pelagic waters off Chile despite considerable observer effort since the 1970s (see Gilmore, 1971; Aguayo, 1975; Clarke *et al.*, 1978; Sielfeld, 1983; Oporto, 1984; Guerra-Correa *et al.*, 1987), nor have they been encountered in far offshore waters between Valparaiso and Easter Island in winter (Aguayo *et al.*, 1996). Cardenas *et al.* (1986) included the species in their marine mammal guide for Chile, but the authors' intention was to indicate expected presence, not actual observations (J.C. Cardenas, pers. comm. to KVW).

During the 1997-98 IWC/SOWER Blue Whale cruise off Chile, which surveyed waters for cetaceans between Iquique and Punta Arenas, observers (including KVW) on the RV *Shonan Maru No.2*, encountered about 60 striped dolphins at 20°57'01 S, 72°10'44"W in waters 3,900-4,100m deep. This was the only sighting on a total combined trackline completed by both survey ships of 4,454 n.miles and a total of 390 observation hours, mostly between the 200 n.miles EEZ and the 12 n.miles territorial sea boundary (Findlay *et al.*, 1998).

Specimens

The only specimen known from Chilean territory is a skull (field no. JF/RC/002/86) retrieved at El Arenal Beach on Robinson Crusoe Island (33°37'S, 78°53'W), Juan Fernandez Archipelago, in November 1986 (Cardenas *et al.*, 1991). The tips of both rostrum and mandibles are heavily eroded. Poor fusion in cranial sutures, despite an estimated condylobasal length of 425mm, suggests subadult status. Gender is unknown. Cranial measurements are given in Table I. The skull is in the Museo Nacional de Historia Natural, Santiago de Chile.

DISCUSSION

Stock identity

The present understanding of striped dolphin stock structure in the South Pacific is largely hypothetical; specimens and sightings, especially from the southern parts, can hardly be assigned to a population. Merely on distributional grounds and by default, striped dolphins occurring off western South America may form part of the provisionally defined 'eastern Pacific stock' (*sensu* Dizon *et al.*, 1994; Archer, 1996), but dedicated research is necessary to confirm whether stock continuity exists south of the equator towards Chilean waters.

The largest individual we examined ($n=4$) was 218cm long but had not attained physical maturity. Adults may reach greater size in the western Pacific (max. 256cm) than in the eastern Pacific (Perrin *et al.*, 1994). Skull size in the two known Pacific populations follows a similar pattern (Archer, 1996).

Variation in cranial measurements for South Pacific striped dolphins (Table 1) can not yet be interpreted in population terms due to small sample size, especially since

Pacific stocks exhibit clear cranial dimorphism (Archer, 1996). Only two, possibly three, tissue samples have been kept that would be useful for molecular genetic analysis.

Distribution, habitat and abundance

The striped dolphin has a wide pelagic distribution in the ETP, correlated with regimes of shallow thermocline. Au *et al.* (1979) reported twelve sightings at temperatures lower than 24.5°C primarily during January on the edge of the Peru current just off Peru-Ecuador. The equatorial distribution extends westward in the South Equatorial Current to at least 135°W (Au *et al.*, 1979) and in southern subtropical waters to as far south as 16°S offshore (Perrin *et al.*, 1994) and 21°S along the northern Chilean coast (this paper). The latter record however may be atypical, influenced by higher than normal sea surface temperatures, a consequence of the severe 1997-98 El Niño.

Notwithstanding considerable search effort over the past decade (e.g. Guerra-Correa *et al.*, 1987; Van Waerebeek *et al.*, 1988; Vidal, 1990; Felix and Samaniego, 1994; Van Waerebeek and Reyes, 1994; Mora-Pinto *et al.*, 1995; Brito, 1996), the paucity of individuals (nine) found along the entire coastline of western South America compared to the abundance of other species and the absence of truly nearshore sightings, suggests that the striped dolphin avoids neritic waters in this region. Off South Africa and in both the eastern and western North Atlantic, striped dolphins are normally found beyond the continental shelf in waters deeper than 1,000m (Ross, 1984; Forcada *et al.*, 1990; Baird *et al.*, 1997).

Robinson Crusoe Island (33°42'S, 80045'W) constitutes both the southern and westernmost confirmed record in the southeast Pacific. The unique oceanographic conditions at the Juan Fernandez Archipelago combine a cold-temperate habitat with subtropical Indo-Pacific elements (Sepulveda, 1987). It remains wholly unclear whether the individual found there represents an unusual vagrant or if it is indicative of a normal distribution range extending this far south. Miyazaki and Kato (1988) did not encounter striped dolphins in the Southern Hemisphere in waters colder than 20°C, which may help to explain why so few striped dolphins enter the cool coastal waters of the Humboldt Current system off Peru and Chile. In the southwest Pacific, the species has been recorded beachcast in New Zealand between 37°S and 41°S during summer months, when inshore sea surface temperatures range between 18-23 °C (Baker, 1990, and pers. comm. to KVW, 15 March 1998). Off the Canadian east coast, striped dolphins were only sighted when water temperatures exceeded 15°C (Baird *et al.*, 1993).

Gerrodette and Palacios (1996) estimated the number of striped dolphins in Ecuadorian EEZ waters (within 200 n.miles from shore) at 16,290 individuals (95% CI: 6,640-41,942) which makes it the second most abundant species after the common dolphin, *Delphinus delphis*. However, low search effort, resulting in an unsatisfactory coverage of the northern part of Ecuadorian waters (Gerrodette and Palacios, 1996), and the absence of stratification in the abundance estimation procedure to account for a predictable strong density gradient with distance from shore, diminishes the reliability of the estimate. Gerrodette and Palacios (1996) also provide an estimate for EEZ waters, of Colombia, namely 25,785 individuals (95% CI: 17,324-38,379). This translates into the highest density (78.26 striped dolphins per 1,000km²) compared to EEZ waters from Mexico to Ecuador. No abundance estimates are available for Peru and Chile. Although, it appears that this species is an uncommon visitor

to inshore waters, especially rare in the austral part of the study area. Of nine striped dolphins found alive or freshly dead, five stranded in late winter/early spring (September-October); any study of inshore seasonality requires a larger sample. In Pacific Canada most stranding records of single individuals also occurred in winter/spring (Baird *et al.*, 1997).

External features

In OSc-001-92, a fresh specimen from Ecuador, body colouration (terminology following Perrin *et al.*, 1994) was characterised by a distinct spinal or shoulder blaze, a single flipper stripe (double in 3 of 4 animals from the northeast Pacific; Fraser and Noble, 1970) and a strongly developed main lateral and subsidiary stripe behind the eye. Pigmentation on the lower jaw extended from the tip along the margin of the lip as in northeast Pacific animals (Fraser and Noble, 1970).

Five individuals ranged from 199 to 218cm (standard length), but none had attained physical maturity. In striped dolphins from the northwest Pacific most cranial bones attain adult size early in life, i.e. at age 3 (Ito and Miyazaki, 1990), so most of our specimens are thought to be young. Subadult striped dolphins are suspected to move closer to the coast than adults or mixed schools (Bannister *et al.*, 1996) and, therefore, suffer a higher risk of being killed in coastal fisheries.

Reproduction and feeding habits

The right testis, with epididymis, of one 217cm male (OSc-001-92) weighed 104.4g. The sample awaits histological examination to determine its sexual maturity. In comparison, maximum weight of testis with epididymis for 38 ETP striped dolphins was 157g (Gurevich and Stewart, 1979) and maximum known combined testis weight is less than 500g (Perrin *et al.*, 1994). There are no data for females. In the northwest Pacific, sexual maturity is attained at 7.1 and 8.8 years for females and males respectively (Miyazaki, 1977).

Nothing is known on the species' feeding habits in the study area, as no stomach contents have been recovered.

Parasites and pathology

The liver, stomachs, lungs and kidneys of dolphin OSc-OO 1-92 were examined macroscopically for parasites and gross pathologies. No ectoparasites were apparent. Some 200-300 trematodes of about 10mm were present in the hepatic ducts and were provisionally identified as *Zaiophotrema pacificum* by J. Buestan of the Instituto Nacional de Higiene, Guayaquil, Ecuador. The blubber of the ventral area contained some (> 5) larval cysts of *Phyiobothrium deiphini*. Fore, main and pyloric stomachs were empty. Six skulls (Peru, 2; Chile, 1; mainland Ecuador, 3) were examined for basket-like bony lesions indicative of *Crassicauda* infestation but none was affected.

No other information on pathology is available.

Concluding remarks

Much of the information and biological material discussed above was reported or gathered opportunistically, rather than during the course of specific investigations on cetaceans. At present, sample sizes for biological parameters are far too small to permit any comparative studies with striped dolphins from other ocean basins, and it may take considerably more time before such adequate baseline

datasets become available. Therefore we recommend that cetologists working in the region maximise any opportunities to obtain information from stranded or incidentally caught specimens of *S. coeruleoalba*. In particular the collection of skulls and skin samples (in DMSO) as well as gonads, teeth and size data should be emphasised to help shed light on stock structure and reproductive parameters.

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