

Aspects of the Biology of Burmeister's Porpoise from Peru

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ABSTRACT

Burmeister's porpoise (*Phocoena spinipinnis*), one of the most common small cetaceans in Peruvian waters, suffers the second highest fishing mortality. Biological data obtained from porpoises caught in gillnets off Peru from 1983 to 1989 are presented. The largest specimens are a 183cm female and a 182cm male ($n=402$), although on average, mature males are significantly ($p<0.0001$) larger than females: 170.3cm ($n=63$) versus 165.5cm ($n=56$). The relationship between standard length (X) and body mass (Y) is best described by the equation $\log Y = -0.714 + 2.48 \log X$ ($r=0.97$; $n=123$; $p<0.0001$). Sexual dimorphism is statistically significant ($p<0.05$ and $p<0.005$) in eight cranial measurements and one meristic, but not in the condylobasal length. The correlation between condylobasal length and body length is relatively low ($r=0.72$). Sexual dimorphism in the colour pattern of the ventral field is described. A characteristic of this species is the bilateral asymmetry in the shape and extent of the flipper stripe. Minimum and average length (50%) at sexual maturity are respectively 153cm and 154.8cm in females ($n=56$) and 158cm and 159.9cm in males ($n=63$). The pregnancy rate is estimated at 0.60. Of the pregnant females, 34% were lactating. No evidence for a male seasonal reproductive cycle was found but the sample size was small ($n=37$). Periodicity in occurrence and size of foetuses and neonates suggests a gestation period of 11–12 months, with a peak of conceptions in summer. The sex ratio of foetuses and small neonates did not deviate significantly from 1:1 (χ^2 , $p > 0.50$). Length at birth is estimated as approximately 86cm. The Burmeister's porpoise mainly feeds on fish, including *Engraulis ringens*, *Sciaena deliciosa*, *Anchoa* sp. and *Merluccius gayi*. Endoparasites found include the trematodes *Nasitrema globicephalae*, *Synthesium tursionis*, *Pholeter gastrophylus* and *Braunina cordiformis*, as well as the nematodes *Anisakis typica*, *Stenurus* sp., *Halocercus* sp. and *Pseudalius inflexus*. Ectoparasites recorded are *Isocyamus* sp. and *Xenobalanus globicipitis*. Paita Bay (05°S) is confirmed as the northern distribution limit of the species on the Pacific coast of South America.

KEYWORDS: BURMEISTER'S PORPOISE; SOUTH PACIFIC; INCIDENTAL CAPTURE; MORPHOLOGY/ANATOMY; GROWTH/LENGTH DISTRIBUTIONS; BIOLOGICAL PARAMETERS; REPRODUCTION; SEXUAL MATURITY; FEEDING; FISH; PARASITES; DISTRIBUTION

INTRODUCTION

Burmeister's porpoise, *Phocoena spinipinnis*, was described by Burmeister (1865) from a specimen caught in the mouth of the La Plata River in Argentina. The Louis Agassiz expedition collected a second specimen in Paita Bay, northern Peru, in 1872 (Allen, 1925). Pérez Canto (1895) described his *Acanthodelphis philippii* from a porpoise collected at Valparaiso, central Chile. These, and an additional specimen from Chile (Philippi, 1896), are the only known records of the species in the 19th century.

This century, several authors have contributed to our knowledge of the general biology of this porpoise, including Gallardo (1917), Allen (1925), Praderi (1971), Pilleri and Gihl (1972; 1974), Würsig *et al.* (1977) and Brownell and Praderi (1984). However, as most reports were based on a single or a few specimens, the amount of information available has

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been limited. Other authors have discussed incidental mortality of this species in fishing operations (Clarke, 1962; Grimwood, 1969; Aguayo, 1975; Mitchell, 1975; Clarke *et al.*, 1978; Brownell and Praderi, 1982).

In recent years a systematic study of the status and biology of small cetaceans in Peru, greatly accelerated by the UNEP/IUCN Burmeister's Porpoise Project, has yielded a large amount of new data (Gaskin *et al.*, 1987; Reyes and Van Waerebeek, 1990). Burmeister's porpoise is one of the most common small cetaceans in Peruvian waters, and the species which suffers the second largest fishing mortality (Read *et al.*, 1988; Van Waerebeek and Reyes, 1990; 1994).

Here we present a preliminary analysis of biological parameters of the Burmeister's porpoise from Peru based on a large sample obtained during the UNEP/IUCN project and subsequent studies. Goodall *et al.* (1995) review the available information for this species for southern South American waters.

MATERIALS AND METHODS

Almost all of the porpoises examined had been caught in gillnets set by artisanal fishermen and were obtained fresh. A few stranded animals were, however, included in the material. Most of the specimens were collected at Pucusana (12°30'S), Cerro Azul (13°00'S), Huacho (11°07'S), San Andrés (13°45'S), Ancón (11°47'S) and Pacasmayo (7°24'S). For most specimens, standard length and sex were recorded. However, due to the nature of the fishery and fishery terminal activities, sampling for studies of reproduction, feeding, colour pattern, morphometrics, parasites and osteology was opportunistic. Consequently, sample sizes for each parameter considered vary widely. External morphometrics were recorded as modified from Norris (1961). Colour transparencies were taken in both lateral and ventral aspects supported by notes on the colouration whenever necessary.

Gonads were weighed (testis with epididymis), measured and examined macroscopically before wholly or partially being preserved in 10% formalin. Sexual maturity in females was determined by the presence of ovarian corpora or from evidence of lactation. Males were considered sexually mature if seminal fluid was clearly visible upon cutting the fresh epididymis ('functional maturity' *sensu* Sergeant, 1962). Size at birth was estimated through interpolation of sizes from the largest foetuses and the smallest neonates. Standard length at 50% sexual maturity was derived from a plot of percent mature versus standard length. In calculating the 0.50 maturity estimator it was assumed that a linear relationship exists between bordering experimental values. Confidence intervals have not been developed for this type of estimator (DeMaster, 1984).

Five teeth were removed from the middle of the left lower jaw, fixed in formalin and preserved in 70% ethanol for later examination. The stomach chambers were examined separately. Otoliths found were preserved dry. Squid beaks were preserved in 5% formalin. The skin and internal organs were inspected for the presence of parasites which were collected and preserved according to standard techniques (Dailey, 1978; Pritchard and Kruse, 1982). Osteological material was collected from fresh specimens at fishmarkets and through surveys of beaches and refuse dumps near fishing towns.

A total of 32 skull measurements, taken with vernier callipers to the nearest mm, and four meristics were recorded following Perrin (1975) and Schnell *et al.* (1982). Two-tailed t-tests were applied to examine for sexual dimorphism in the skull morphology. Because no skull character was found to determine unequivocally physical maturity, only skulls of sexually mature animals (20 males, 12 females) were used in the analysis.

RESULTS AND DISCUSSIONS

Of a total of 402 Burmeister's porpoises of known length and sex (235 males, 167 females) the largest female measured 183cm and the largest male 182cm standard length. The mean length of sexually mature males was 170.3cm (SD=5.36; $n=63$), which was significantly larger (two-tailed t-test, this and all subsequent; $t=4.20$, $df=117$, $p<0.0001$) than the 165.5cm (SD=7.06; $n=56$) mean length of mature females, a characteristic that distinguishes this species from the harbour porpoise, *Phocoena phocoena* and probably from the vaquita *Phocoena sinus* (Gaskin *et al.*, 1984; Brownell *et al.*, 1987; Vidal, 1994).

The greatest body weights recorded were for males ($n=70$), 72kg for a 170cm specimen and females ($n=60$), 79kg for a 173cm animal. A standard length-body mass relationship was derived from a dataset of 123 (postnatal) porpoises. A linear regression was applied after a log-log transformation of the variables (Fig. 1): with Y = body mass (in grams); X = standard length (in cm); $\log Y = -0.714 + 2.48 \log X$ ($r=0.97$; $p<0.0001$). Weights for some organs of both sexes are shown in Table 1.

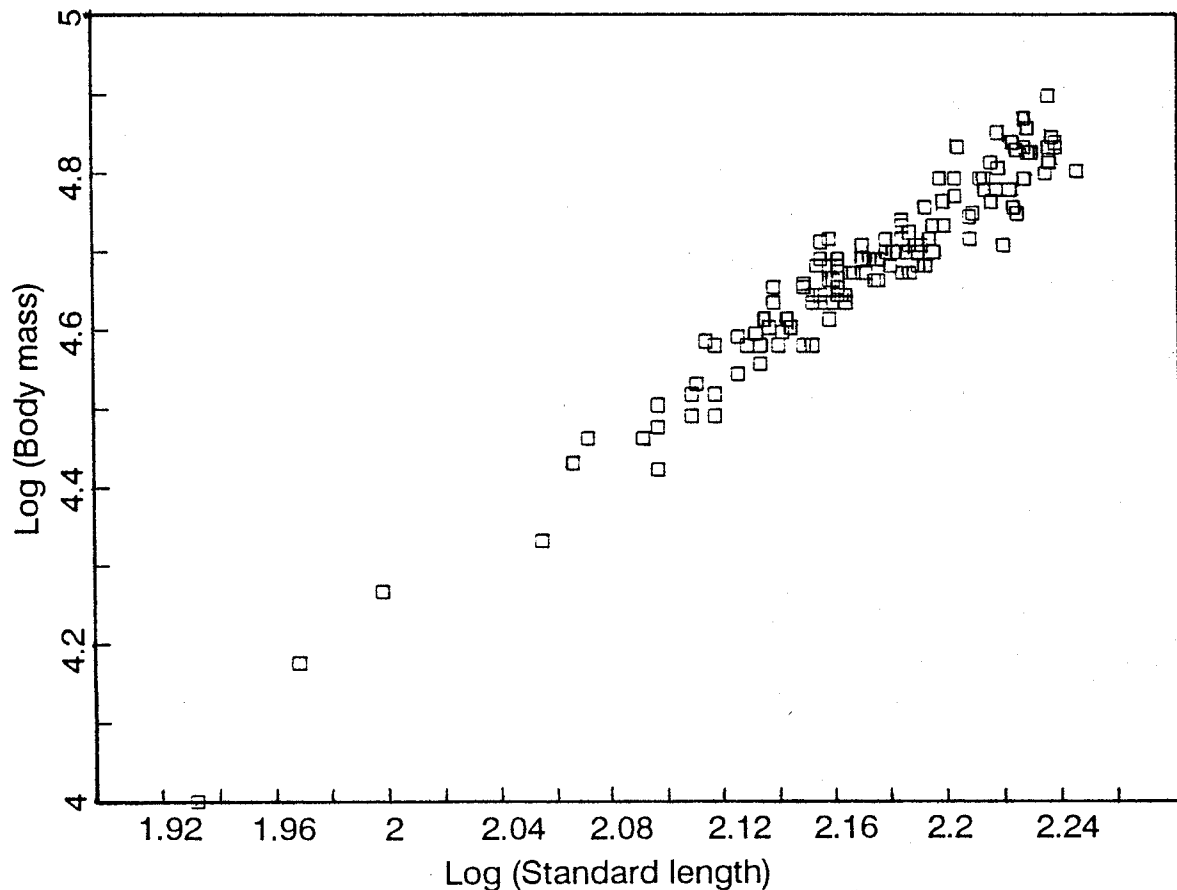


Fig. 1. Standard length-body mass relationship for 123 postnatal Burmeister's porpoises from Peru. The regression is described by: $\log Y = -0.714 + 2.48 \log X$ ($r=0.97$, $p<0.0001$), where Y = body mass (in grams) and X = standard length (in cm).

Cranial morphology

Summary statistics for cranial measurements and meristics of sexually mature Burmeister's porpoises are listed in Table 2. No significant difference in skull size (condylobasal length, CBL) was found between sexes (t-test, $p>0.05$), but the sample

Table 1
Weights of selected organs, in grams, of adult *P. spinipinnis* from Peru.

No.	Sl(cm)	Total wt(kg)	Left gonad	Right gonad	Left kidney	Right kidney	Liver	Pancreas	Spleen	Heart	Left lung	Right lung
Females												
JCR273	153	55	11	1	150	181		90	21			
JSM003	159	58			214	248		93	22			
KVW928	160	59	26	8	210	225		130	26			
KVW754	164	62	17	2	270	270		160				
KVW199	164	62	7	2	200	210		84	25			
JCR1150	164	60	12	8	305	270		165	24			
JCR256	165	65	26	1	278	291		190	14			
JCR975	166	71	17	2	290	300	2450	160	30	400	1130	1150
JCR500	169	68	12	1	228	224		132	20			
JCR657	173	63	7	1	300	325		100	52			
JCR1485	173	79	14	1	280	275		150	21			
Males												
KVW383	160	62	240	240	180	185		110				
JSM001	162	56	183	182	204	186			52			
KVW954	162	52	100	85	215	215		150				
JSM005	163	56	256	240	197	210		95	16			
JSM002	169	56	228	216	205	223			31			
JSM226	170	62	300	300	170	190	1600	80	10	290	860	740
KVW366	170	72	360	320	280	280			60			
JCR702	171	67	296	247	160	170		154				
JCR1275	174	69	290	270	285	270		160	54			

sizes were small. Sexual dimorphism was statistically highly significant ($p < 0.005$) in zygomatic width, parietal width, height of braincase and maximum length of tympanic bulla, and significant ($p < 0.05$) in rostrum length from base, postorbital width, upper tooth row length, number of teeth upper right and greatest width of tympanic bulla (Table 2).

A linear regression of CBL against standard length, with sexes pooled ($n=54$) gave a line of best fit of $Y = -1190.63 + 9.90 X$ ($r=0.72$, $p < 0.0001$), where Y = standard length in mm and X = CBL in mm (Fig. 2). In general, the size of the skull was found to be a poor index of maturity because small animals may have relatively large skulls and vice versa. Estimation of standard length and cranial maturity based on the CBL is not to be recommended.

Teeth

The number of erupted teeth in fresh animals ranged from 10 to 23 ($n=148$) in each upper row and from 14 to 23 ($n=147$) in each lower row. There is great variation in the number of visible upper teeth, in particular due to the presence on both sides of a series of 3–5 small teeth which are not anchored in alveoli and only slightly protrude from the gums. Young porpoises tend to have higher tooth counts than older animals, suggesting that these non-alveolar teeth are lost with age, as the latter can easily be removed by simple pulling. Non-alveolar teeth are often lost during preparation of the skull. In addition one to three pairs of very small teeth are embedded in the gum at the tip of both upper and lower toothrows and are rarely seen in the fresh animal. Both factors together explain why tooth counts in skulls and in fresh heads are not directly comparable.

Table 2

Cranial measurements (in mm) and meristics of sexually adult Burmeister's porpoises from Peruvian waters. Student t-values are given where significant differences (two sided, $p < 0.05$) exist between sexes. NS = not significant. Condylbasal length (CBL), length rostrum from base (LRBA), length rostrum from pterygoid (LRPT), width rostrum at base (WRBA), width rostrum at 1/4 length (WR1/4), width rostrum at 1/2 length (WR1/2), width premaxillaries at 1/2 length (WP1/2), width rostrum at 3/4 length (WR3/4), preorbital width (PROW), postorbital width (POOW), zygomatic width (ZYW), parietal width (PARW), height braincase (HBR), length braincase (LBR), maximum width of premaxillaries (MWPR), width external nares (WEN), temporal fossa length (TFL), temporal fossa width (TFW), orbital length (ORL), length of antorbital process (LAP), separation pterygoids (SEPT), width of internal nares (WIN), length upper toothrow (UTRL), number of teeth upper left (NUUL), number of teeth upper right (NUUR), number of teeth lower left (NULL), number of teeth lower right (NULR), length lower toothrow (LTRL), height of mandibular ramus (HRA), length of mandibular ramus (LRA), width of foramen magnum (WFM), maximum width of nasals (WINA), maximum width of palatines (WIPA), length of tympanic bulla (LTV), width of tympanic bulla (WTY), and length of periotic (LPE).

Variable	Females				Males				t	p
	n	Range	Mean	SD	n	Range	Mean	SD		
CBL	14	279-292	284.64	3.95	22	270-297	283.68	7.61		NS
LRBA	14	121-131	127.07	2.79	22	116-132	124.64	3.74	2.09	<0.05
LRPT	13	149-165	155.46	4.88	20	141-162	153.45	5.18		NS
WRBA	13	78- 87	83.08	2.29	19	77- 87	83.00	3.04		NS
WR1/4	14	58- 66	61.93	2.62	20	55- 64	60.85	2.30		NS
WR1/2	14	48- 54	51.71	2.13	21	48- 56	51.38	2.50		NS
WP1/2	14	25- 29	26.93	1.44	22	23- 29	26.68	1.49		NS
WR3/4	14	36- 41	39.00	1.75	21	35- 43	38.95	2.38		NS
PROW	14	124-139	131.07	4.34	21	127-140	133.38	3.47		NS
POOW	14	147-156	152.21	2.69	21	150-162	154.81	2.82	2.72	<0.02
ZYW	14	150-160	156.00	2.88	21	155-166	159.10	2.90	3.11	<0.005
PARW	14	128-137	132.21	3.19	22	127-144	135.27	4.07	3.76	<0.001
HBR	14	79- 90	87.07	2.70	22	86- 95	90.05	2.61	3.29	<0.005
LBR	14	109-119	113.00	3.37	22	110-121	114.64	3.36		NS
HWPR	14	32- 43	39.36	2.98	22	36- 45	40.14	2.32		NS
WEN	14	27- 34	30.36	2.06	22	27- 35	30.73	2.21		NS
TFL	13	55- 63	59.85	2.15	21	53- 65	59.76	3.74		NS
TFW	13	45- 54	47.62	3.31	21	40- 55	48.48	3.84		NS
ORL	13	45- 55	49.23	2.83	20	46- 59	50.75	3.31		NS
LAP	14	24- 30	26.86	1.70	21	19- 32	28.10	2.72		NS
SEPT	14	22- 27	23.57	1.40	21	18- 27	22.19	2.11		NS
WIN	14	44- 51	47.71	2.02	22	43- 52	47.68	2.28		NS
UTRL	14	72-103	84.86	10.6	22	69- 99	77.86	6.86	2.41	<0.05
NUUL	12	13- 21	17.50	2.20	17	14- 22	16.82	1.74		NS
NUUR	12	16- 20	17.42	1.24	20	14- 19	16.40	1.35	2.12	<0.05
NULL	12	17- 22	20.00	1.28	22	18- 21	19.23	1.02		NS
LULR	12	18- 25	19.42	1.93	22	18- 23	19.59	1.33		NS
LTRL	14	86- 97	90.50	2.77	22	82- 98	89.77	4.00		NS
HRA	14	53- 59	57.14	1.92	22	53- 60	56.68	2.23		NS
LRA	14	211-229	219.57	4.36	22	209-225	218.14	4.69		NS
WFM	14	28- 34	31.29	1.73	21	28- 34	31.00	1.64		NS
WINA	14	25- 31	28.07	2.09	22	24- 33	29.10	2.69		NS
WIPA	14	47- 54	49.86	1.96	21	47- 54	51.14	1.98		NS
LTV	14	29- 32	30.36	0.74	19	30- 33	31.47	0.70	4.40	<0.0005
WTY	14	18- 20	19.50	0.65	19	18- 21	20.05	0.78	2.15	<0.05
LPE	14	27- 30	28.86	1.03	20	26- 31	29.10	1.29		NS

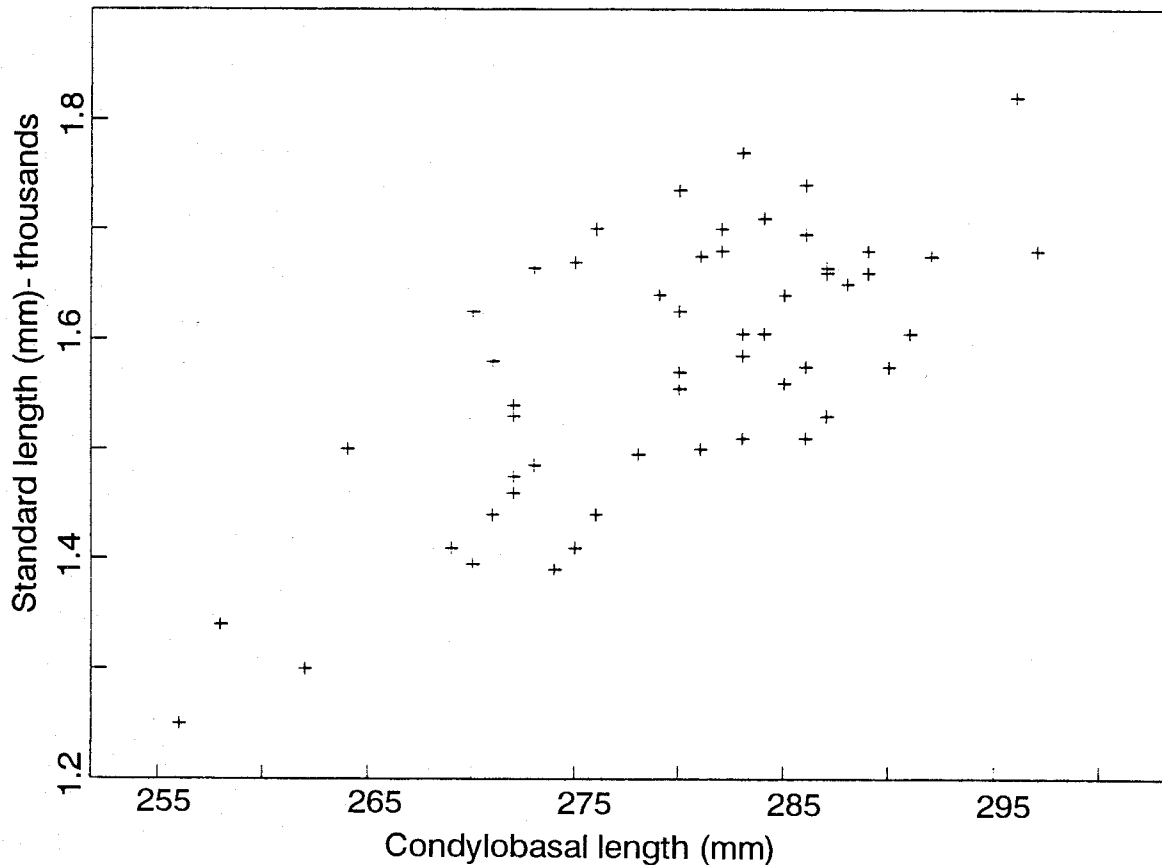


Fig. 2. Relationship between standard length and condylbasal length for 54 Burmeister's porpoises from Peru. The regression line was fitted from the equation: $Y = -1190.63 + 9.89X$ ($r=0.72$, $p<0.0001$), where Y =standard length (in mm) and X =condylbasal length (in mm).

Colouration

Several authors (Burmeister, 1869; Pérez-Canto, 1895; Philippi, 1896; Würsig *et al.*, 1977; Brownell and Praderi, 1984) have given, sometimes conflicting, descriptions of colouration of Burmeister's porpoise. Fresh porpoise carcasses of both sexes and all age classes examined in this study ($n=87$) were dark gray (less often lead gray) dorsally and laterally, with a light gray abdominal field. The gray sometimes had a brownish hue although this was not widespread in the sample. The few animals landed alive did not differ from this pattern. The porpoise has a well-defined eye patch surrounded by a light gray halo, a distinctive feature it shares with the vaquita and the spectacled porpoise (*Australophocaena dioptrica*). An anterior projection of the eye patch ('tear' after Brownell *et al.*, 1987) is observed in some specimens. A wide apex to the blowhole stripe (*sensu* Mitchell, 1970) which joins the lip patch is also present. The flipper stripe is dark gray and sharply defined and extends from the mandible to the insertion of the flipper. Unique among phocoenids is the asymmetry in the shape and width of the flipper stripe. On the left side the width of the stripe is nearly uniform, and at its anterior end fuses with the lip patch beneath the mouth angle. However, on the right side the flipper stripe becomes narrower with curving borders, and descends towards its anterior end where it joins the lip patch near (or often in) the chin patch (Fig. 3). A thin, light gray line runs parallel to, and below, the flipper stripe.

A pair of stripes is also present on the abdominal field. These project from the middle of the lower flanks, extending posteriorly towards the genital area where they bifurcate,

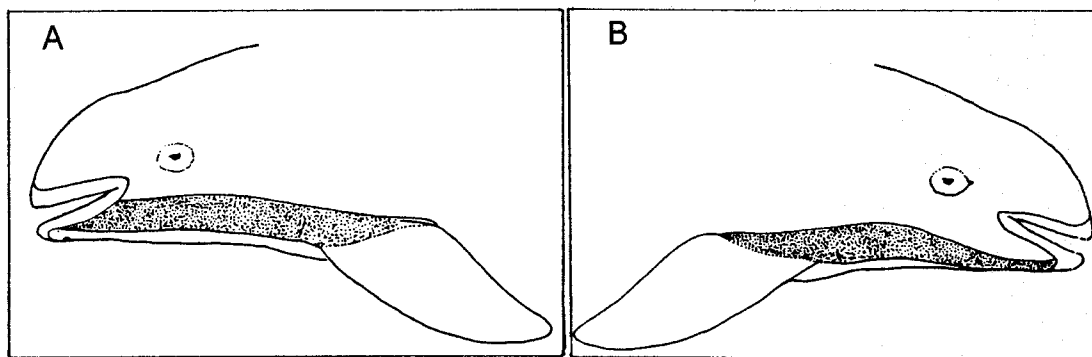


Fig. 3. Schematic representation of the asymmetry in the flipper stripe in Burmeister's porpoise: A. left side; B. right side.

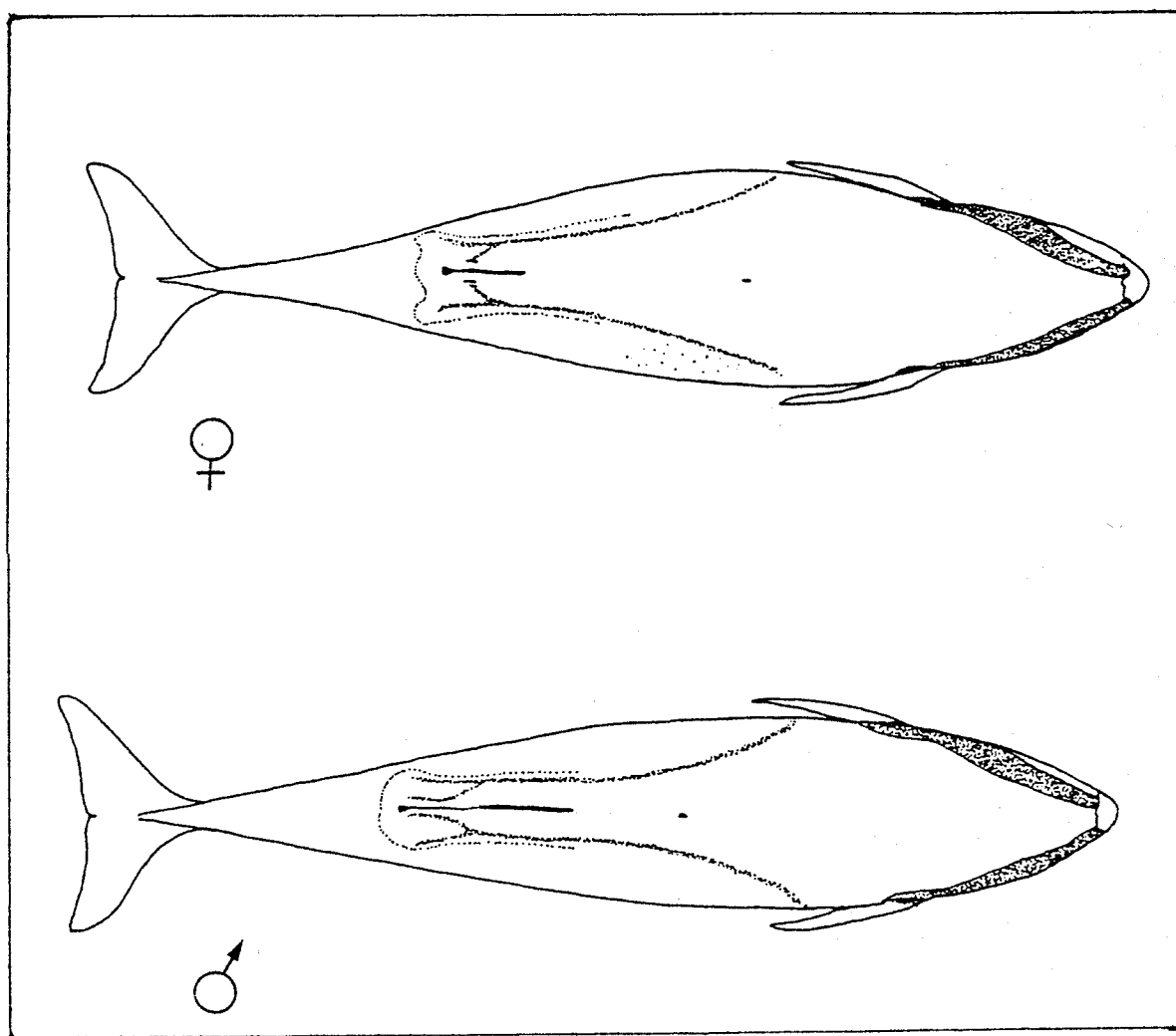


Fig. 4. Sexual dimorphism in the ventral colour pattern of the Burmeister's porpoise.

producing accessory stripes. In females, the accessory stripes end in the mammary slits, while in males they converge immediately behind the genital slit to flank the perineal groove (Fig. 4).

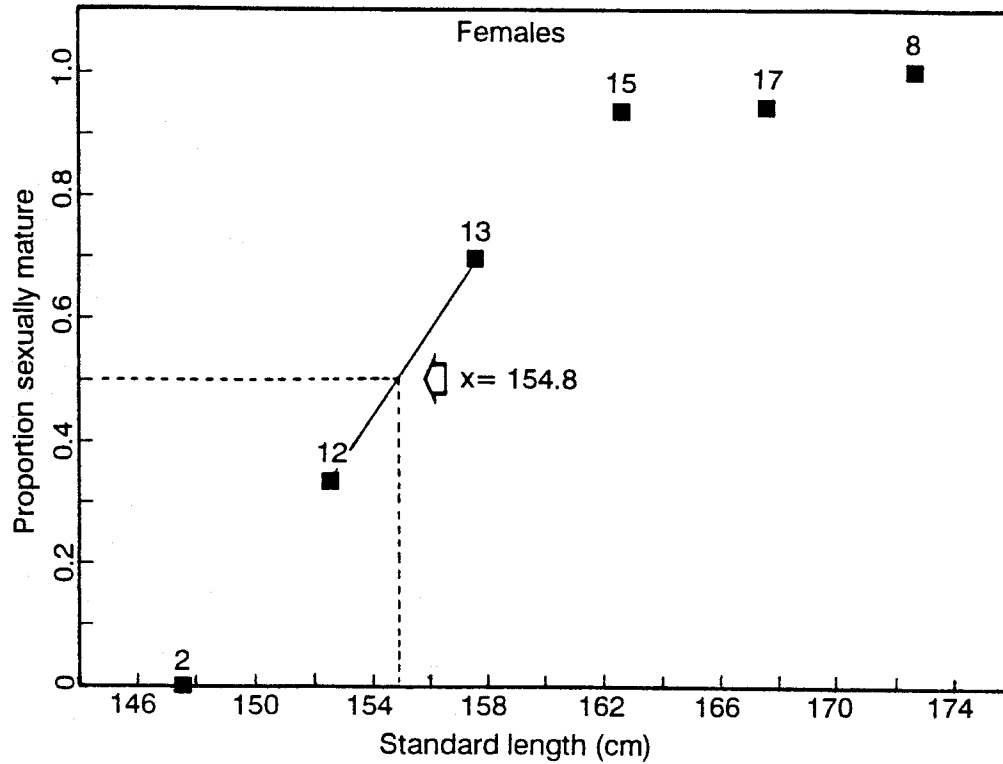


Fig. 5. Plot of standard length class midpoints versus proportion mature female *P. spinipinnis* of Peruvian waters. Figures above plot marks indicate class frequencies. Length at $P(0.50)$ is estimated through linear interpolation between bordering class midpoints: $Y = -10.62 + 0.072 X$. Variance estimates have not been developed.

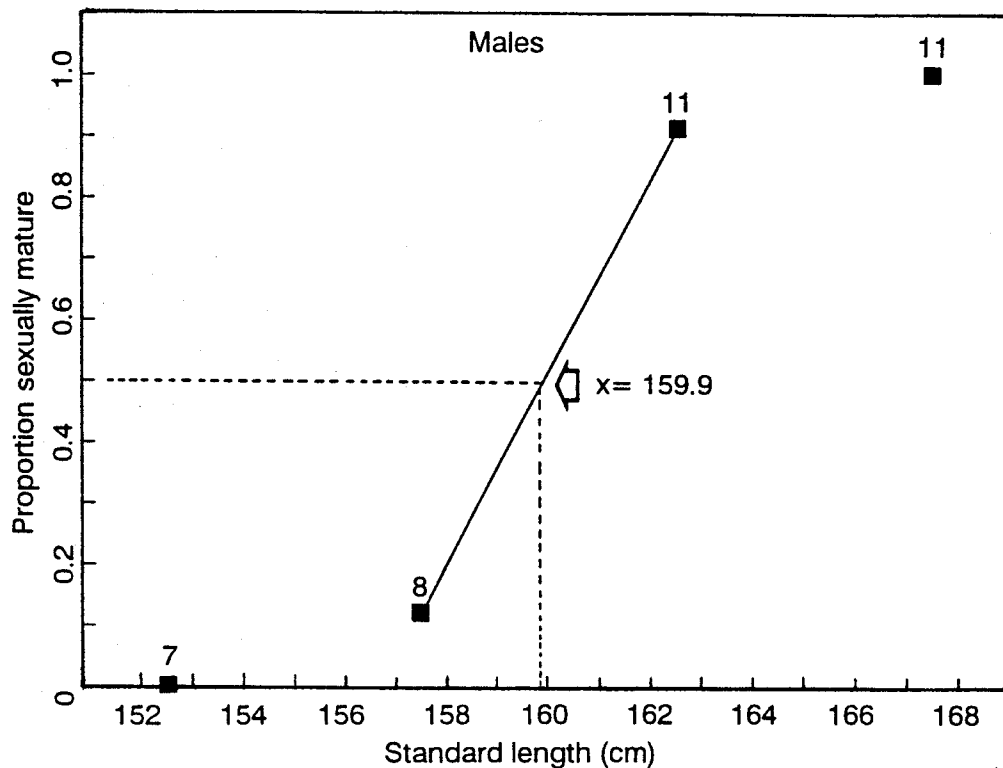


Fig. 6. Plot of standard length class midpoints versus proportion mature male *P. spinipinnis* of Peruvian waters. Length at $P(0.50)$ is estimated through linear interpolation between bordering class midpoints: $Y = -24.57 + 0.157 X$.

Reproduction

In our sample, 50% of females ($n=148$) had attained sexual maturity at an estimated length of 154.8cm (Fig. 5), which is about 5cm smaller than for males (see below). The largest sexually immature female ($n=92$) was 166cm long while the smallest mature female ($n=56$) measured 153cm. Of the 53 adult females examined, 60% (32) were pregnant. The actual pregnancy rate however may be somewhat higher, since only females with a foetus large enough to be noted by gross examination were included. Eleven (34%) of the pregnant females were simultaneously lactating, indicating that annual reproduction can occur, assuming that lactation is less than one year as in *Phocoena phocoena* (Gaskin *et al.*, 1984).

On a combined sample ($n=31$) of foetuses above 50mm (below which they cannot be sexed reliably, see Kasuya and Marsh, 1984) and small neonates, 54.8% are female. The observed deviation from a 1:1 sex ratio is not significant ($\chi^2=0.29$; $p>0.50$).

Length at 50% sexual maturity in males is estimated at 159.9cm (Fig. 6). The smallest sexually mature male ($n=63$) was 158cm with a mean testis length and weight of 129mm and 300g respectively. The minimum weight for a mature testis (with epididymis) was 85g. The mean single testis weight of adult porpoises plotted by month did not suggest seasonality in the male reproductive cycle (Fig. 7). However, the sample size was small and further work is required to confirm or deny this.

Brownell and Praderi (1982) reported on a 44cm long foetus of Burmeister's porpoise which they referred to as 'near term'. Gaskin *et al.* (1984) discussed size at birth in phocoenids and stated that 'probably no phocoenid is less than about 60cm long at birth'. The data for *P. spinipinnis* from Peruvian waters are in agreement with the latter statement. The largest recorded foetuses were 85.5cm and 87cm in length ($n=33$). The smallest neonate seen measured 85.5cm ($n=4$). Therefore length at birth in this species is approximately 86cm.

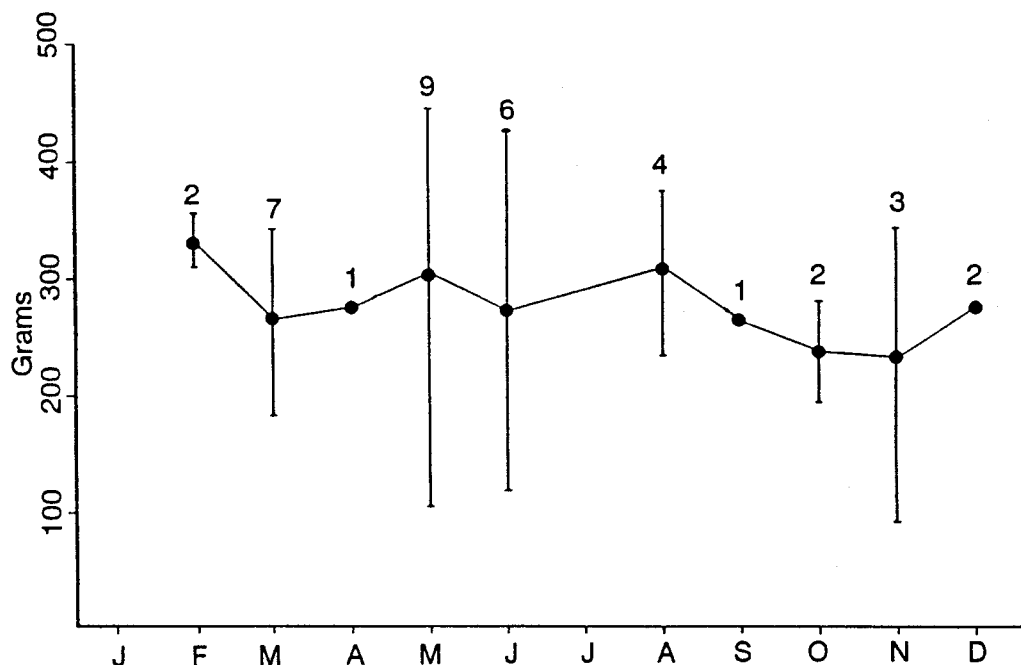


Fig. 7. Mean single testis weight and range bars for sexually mature *P. spinipinnis* from Peru plotted by month. Sample sizes are shown.

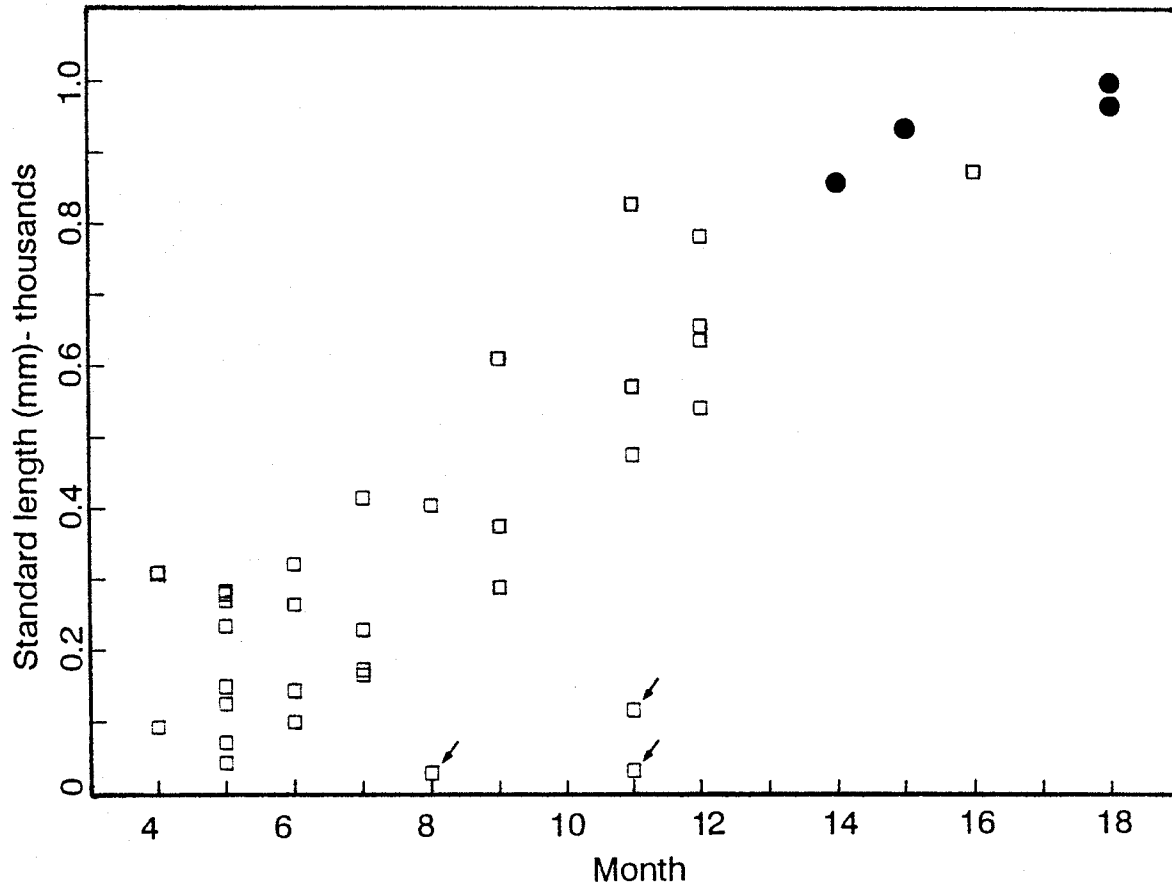


Fig. 8. Size of foetuses (boxes) and small neonates (circles) of *P. spinipinnis* from Peru by month of occurrence. Data are adjusted to a 14 month period (e.g. April=4 and 16) so as to permit small neonates to be plotted in linear sequence and fitted by regression: $Y = -152.3 + 66.09X$ ($r=0.93$; $p<0.0001$). Three outliers, indicated by an arrow, were eliminated from the regression dataset.

The correlation between time of the year and size of foetuses and small neonates ($n=34$) is shown in Fig. 8. Although data on foetuses smaller than 29mm, representing the earliest phase of the growth curve, are not available, it indicates that the peak of the mating season occurs during summer, possibly in February-March. This, and the fact that the smallest neonates were seen in February (85.5cm) and in March (93cm) suggests a gestation period of 11-12 months. A few small foetuses found in November and August (outliers in Fig. 8) indicate that at least some successful mating occurs out of the main season.

Feeding habits

McKinnon (1988) examined stomachs from 62 incidentally-caught Burmeister's porpoises from Peru. In the present study, stomachs from an additional 61 porpoises were examined to compare for possible temporal or spatial shifts in food composition. The results of stomach content analysis for porpoises landed at Pucusana and Cerro Azul during the period 1987-9 are shown in Table 3.

Anchovy was by far the most common food (52 of 54 stomachs (96%) with contents examined) similar to findings of McKinnon (1988) in the period 1985-6. Hake was another important prey species with the second highest incidence (13%). Surprisingly, no anchoa otoliths were found in the period 1987-9.

Table 3

Prey composition from stomach content analysis of Burmeister's porpoises (n=61) from Peruvian waters.

Species	Scientific name	% Total count of prey items	% Incidence of items	% Incidence in McKinnon (1988)*
Anchovy	<i>Engraulis ringens</i>	91.0	96.3	94.2
Hake	<i>Merluccius gayi</i>	0.6	13.0	3.8
Drum	<i>Sciaena deliciosa</i>	0.5	7.4	17.3
Jack mackerel	<i>Trachurus murphyi</i>	0.4	7.4	-
Silverside	<i>Odoniesthes regia</i>	5.9	5.5	-
Sardine	<i>Sardinops sagax</i>	0.1	3.7	5.8
Patagonian squid	<i>Loligo gahi</i>	1.1	3.7	9.6
Unidentified/traces		0.3	5.5	

* Also weakfish (*Cynoscion analis*) 9.6% and blackruff (*Seriolella violacea*) 1.9%.

Stomach contents analysis and ecological data on prey species found (Sánchez, 1977) suggest that Burmeister's porpoises may feed at varying distances from the coast. Supposedly, demersal species such as drum and weakfish as well as the pelagic Patagonian squid are preyed upon close to shore. Hake and possibly blackruff are thought to be pursued further offshore. Anchovy and sardine may be captured either inshore or offshore.

McKinnon (1988) suggested that Burmeister's porpoises were less affected than dusky dolphins (*Lagenorhynchus obscurus*) by the reduction of food availability resulting from the *El Niño* phenomenon that occurs regularly in the area. However during the summer of the *El Niño* year 1983, several emaciated porpoises were landed at the port of Chorrillos (12°15'S) and several specimens were found stranded on beaches south of Lima. It is not known whether or not these incidences were induced by the *El Niño*. With oceanographic conditions returning to normal, these events have not happened again.

On the other hand, no strandings of dusky dolphins were recorded in central Peru during the 1983 *El Niño* event. Arntz (1986) reported a reduction in 'porpoise' sightings (supposedly delphinids, including dusky dolphins) off Lima and Pisco in summer 1983 and an abundance of these animals off southern Peru during the autumn of 1983. It may be that Burmeister's porpoises do not undertake long-range movements such as dusky dolphins are known to do (Cockcroft *et al.*, 1991), possibly in search of prey.

It is believed that changes in the composition of the fish fauna during a severe *El Niño* event, such as in 1983 (Arntz, 1986), may have a significant effect on *P. spinipinnis* off the Peruvian coast.

Parasites

The only previous report of parasites in Burmeister's porpoise was that of Brownell and Praderi (1984) who reported unidentified nematodes in the stomach of one specimen from Uruguay. In the present study, 158 porpoises (83 males, 75 females) were investigated for parasites. The organs most regularly examined were stomachs, intestine, pancreas, kidneys, cranial sinuses and lungs. Liver and blubber were checked in a more opportunistic way.

Eight species of helminths were collected, including four trematodes and four nematodes (Table 4). A single adult acanthocephalan encountered in the forestomach of one porpoise was thought to have been secondarily introduced as a parasite of an ingested

Table 4

Helminth parasites of Burmeister's porpoises (*Phocoena spinipinnis*) from Peruvian waters.
Ne = number examined; Ni = number infected.

Parasites	Infection site	Ne	Ni	Incidence %
A. Trematoda				
<i>Synthesium tursionis</i>	Pyloric stomach, middle ear	114	85	74.6
<i>Pholeter gastrophylus</i>	Pyloric stomach, small intestine	59	8	13.5
<i>Nasitrema globicephalae</i>	Air sinuses, middle ear	54	5	9.3
<i>Braunina cordiformis</i>	Pyloric stomach	56	1	1.8
B. Nematoda				
<i>Stenurus</i> sp.	Air sinuses, middle ear	76	71	93.4
<i>Pseudalius inflexus</i>	Lungs	32	27	84.4
<i>Anisakis typica</i>	Stomachs	128	36	28.1
<i>Halocercus</i> sp.	Lungs	18	3	16.7

fish. Adult and larval cestodes such as *Tetrabothrius forsteri*, *Phyllobothrium delphini* and *Monorygma grimaldi* commonly reported in Peruvian bottlenose dolphins (Reyes, 1989; Van Waerebeek *et al.*, 1990) were not recorded.

All porpoises infested with the trematode *Nasitrema globicephalae* were adults. This fluke was always found in mixed infestation with the nematode *Stenurus* sp., by far the most common parasite found in Burmeister's porpoises (93.4% incidence, $n=76$). In severe cases, *Stenurus* sp. was found tightly packed in the cranial sinuses and middle-ear. Delyamure (1968) reported haemorrhages and tissue reaction to the presence of *Stenurus* in harbour porpoises from the Black and Azov Seas. However, gross inspection did not reveal damage to the internal mucosa of Burmeister's porpoises. Animals less than 125cm in length ($n=7$) were not infested, suggesting that ingestion of solid food may be a necessary condition for infestation. Evident pathology with formation of cysts was only visibly associated with the presence of the lungworm *Halocercus* sp. and the fluke *Pholeter gastrophylus*. In some cases calcified remains of these parasites were found inside the cysts, but it is unknown if this had a significant effect on the health of the porpoises infested. Crater-like ulcers were often visible in the forestomach. These ulcers were the point of attachment of some specimens of the nematode *Anisakis typica*.

Ectoparasites, specifically cyamids of the genus *Isocyamus* were seen on seven out of 116 porpoises (6%) examined. These crustaceans were found on fresh wounds and in areas such as the angle of the mouth, the genital slit, the axillae and the posterior base of the dorsal fin. The specific identity of the cyamids is currently under study.

Huaman and Reyes (1986) reported on the presence of *Xenobalanus globicipitis* attached to the fins of Burmeister's porpoises captured in Peruvian waters. These aberrant sessile barnacles (Clarke, 1966) were present in 10 out of 42 porpoises (23.8% incidence). The largest number of barnacles collected was 40 from a young porpoise landed in the summer of 1983.

Pathology

One specimen showed extensive necrosis and infection of soft tissues on the left side of the head. Underlying bones, in particular maxillary, the premaxillary, the nasal and the pterygoid were characterised by a severe osteolysis on both upper and lower surfaces.

Degeneration of the pterygoid bone has been associated with nematodes of the genus *Crassicauda* (Dailey and Perrin, 1973; Raga *et al.*, 1982). Reviewing other authors, Dailey and Perrin (1973) suggested *Stenurus* may be another cause for such osseous lesions. Although this porpoise was heavily infested with *Stenurus*, we doubt that this nematode was directly involved, because with a population infestation rate of over 90% (see above) such a pathological condition would be much more common.

Strandings

Only a few stranded Burmeister's porpoises have become available for examination. The cause for the strandings generally could not be determined, although one porpoise was found on the shore after a storm. A few specimens have been recovered from the Bahía de Paracas which is suspected to act as a natural trap. Since in Peru small cetaceans are used for food, stranded animals will quickly be taken away by locals, reducing the chances for scientists to study the probable cause of strandings.

In a recent survey (February-April 1990) of the northern Peruvian coast, S. Zambrano (pers. comm.) found several porpoises on the beaches of Bahía de Sechura (05°40'S), which had been discarded after being caught in nets. The area is one of the few in Peru where small cetaceans are only rarely consumed. A general disinterest for dolphin meat is also known for neighbouring Ecuador (Van Waerebeek and B. Haase, unpub. data).

Distribution

The known range of Burmeister's porpoise on the Atlantic coast of South America has recently been extended north to Santa Catarina (28°48'S, 49°12'W), southern Brazil (Pinedo, 1989; Simoes-Lopes and Ximenez, 1989) and as far south as Tierra del Fuego (Goodall, 1978). On the Pacific coast, Burmeister's porpoise has been recorded from Valdivia (39°50'S), Chile, north to Bahía de Paita (05°05'S) (Allen, 1925; Aguayo, 1975). Despite systematic surveys, no specimens have been encountered north of Paita (Van Waerebeek *et al.*, 1988; B. Haase, pers. comm.). It must be noted that at this locality the cold Humboldt Current veers off west away from the coast (Schweigge, 1964). The southernmost confirmed record in Peru is from San Juan de Marcona at 15°22'S (Gaskin *et al.*, 1987; Van Waerebeek *et al.*, 1988). However there is no reason to doubt that the distribution is continuous into Chile (Guerra *et al.*, 1987).

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