Aquatic Mammals 1993, **19.3**, 159–169

Helminth parasites and phoronts of dusky dolphins *Lagenorhynchus obscurus* (Gray, 1828) from Peru

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Abstract

The scanty information published on parasites of the dusky dolphin *Lagenorhynchus obscurus* is reviewed. Prevalence of helminths in relation to body length/sex of the host and intensity of infestation is analysed for 321 dusky dolphins killed in an artisanal coastal fishery off Peru. A total of 707 animals were checked externally for ectoparasites and phoronts and 266 skulls from Peru and Chile were examined for bone lesions revealing parasitosis. Three species of trematodes, three nematode species and two cestodes were registered. These are (with prevalences): *Nasitrema* sp. in cranial sinuses (78.3% SE=4.2%); *Phyllobothrium delphini* larvae in blubber of anogenital region (70.0% SE=10.0%); *Anisakis* sp. mostly in the main stomach (40.0% SE=3.3%); *Braunina cordiformis* (8.5% SE=1.9%) and *Pholeter gastrophylus* (8.0% SE=1.9%) primarily in the pyloric stomach; and an unidentified adult cestode in the intestines (3.7% SE=3.6%). Except in a single specimen, no *Crassicauda*-caused cranial bone lesions were seen, nor was the nematode itself found in cranial sinuses or in the blubber/muscle interface. The occurrence of the phoront *Xenobalanus globicipitis*, present overall on 38.9% (SE=1.8%) of dolphins, peaked in June and December. The 6-month phase difference suggests a seasonal factor determining the barnacle's life-cycle. *X. globicipitis* can serve as a sensitive ecological marker on a small temporal scale (months), but exactly the high 'resolving power' makes it unreliable as an indicator of breeding populations. Prevalence of helminth parasites was independent from total length and sex of dolphins, except for *Braunina cordiformis* where infestation rate significantly declined with body length, suggesting progressive host immunization. *Nasitrema* sp., *B. cordiformis*, *P. gastrophylus*, *Halocercus* sp., and *X. globicipitis* constitute first records for the host species *L. obscurus*.

Key words: dusky dolphin, Lagenorhynchus, phoronts, Trematoda, Nematoda, Cestoda, Xenobalanus, Peru, Pacific.

Introduction

The dusky dolphin *Lagenorhynchus obscurus* (Gray, 1828) is the most heavily exploited cetacean in coastal waters off western South America (Read *et al.*, 1988; Van Waerebeek and Reyes, 1990, in press). Craniometric data and significant differences in adult size indicate that Peruvian dusky dolphins constitute a population reproductively isolated from these from New Zealand and southwest Africa, and possibly from Chile (Van Waerebeek, 1992). In order to estimate the impact fisheries is having on this species, biological parameters such as natural mortality and stock identity need to be assessed. In recent years, evidence for the important role of various helminth parasites, especially nematodes, as factors in the natural mortality of delphinids has been accumulating (Dailey and Perrin, 1973; Perrin and Powers, 1980; Dailey *et al.*, 1991).

Significant differences in the parasitic faunas of populations may indicate that these populations do not intermix, or hardly (FAO, 1978). Parasites as likely indicators of water masses, and thus biological tags, have first been successfully used in fishes, as reviewed by Möller and Anders (1983) and McKenzie (1983). Their value as stock indicators have also become increasingly apparent in several small toothed whales world-wide, such as in bottlenose dolphins *Tursiops truncatus* (Walker, 1981; Mead and Potter, 1990; Reyes, 1989; Van Waerebeek *et al.*, 1990), common dolphins *Delphinus delphis* (Walker *et al.*, 1984; Hochberg *et al.*, 1985), striped dolphins *Stenella coeruleoalba* (Dailey and Otto, 1982; Hochberg *et al.*, 1985), Pacific white-sided dolphins *Lagenorhynchus obliquidens* (see Dailey and Otto, 1982) and Dall's porpoises *Phocoenoides dalli* (see Walker, 1990).

The paucity of published data on parasites of *L. obscurus* and the urgent need for stock definition in this species has prompted the present study. Infestation by six helminths and one phoront is described for sizeable samples of Peruvian dusky dolphins, to provide a basis for future comparisons with conspecifics from other geographic areas. In an effort to reveal clues to potential parasite-caused mortality and to transmission means, the correlation between, at one side, size and sex of hosts and at the other side both prevalence and density of parasites was investigated.

Previous work

A thorough literature search revealed only a few incidental observations on parasites of *L. obscurus* since its description by J. E. Gray in 1828. Early records, especially those predating 1970, require host confirmation, considering that *L. obscurus* was commonly confused or even synonymized with the two other southern hemisphere *Lagenorhynchus* spp., namely the Peale's dolphin *L. australis* and hourglass dolphin *L. cruciger* (e.g. Bierman and Slijper, 1947, 1948; Hershkovitz, 1966).

The stomach nematode *Anisakis simplex* was first recorded in *L. obscurus* by Baylis (1932) and Johnston and Mawson (1942); the identification was subsequently confirmed by Dailey and Brownell (1972) and Davey (1971). Unspecified numbers of *Anisakis typica* in a *L. obscurus* specimen from Saldanha Bay, South Africa, are present in the collection of the British Museum (Natural History) (Gibson and Harris, 1979). Specimens of *Anisakis* sp., kept at the same museum and reportedly collected from '*L. obscurus* of Antarctic waters', may actually have been sampled from the hourglass dolphin, which is the only *Lagenorhynchus* species known to inhabit Antarctic waters (Brownell, 1974; Leatherwood and Reeves, 1983). The latter record therefore is considered *incertae sedis*.

Larval stages of the cestode *Phyllobothrium delphini* (Bosc, 1802) are typically concentrated in the blubber layer of cetaceans immediately adjacent to the genital slit (Dailey and Brownell, 1972). One dusky dolphin collected near Simonstown, South Africa, reportedly was infested with this parasite (Markowski, 1955; Gibson and Harris, 1979; Arvy, 1982). A second case involves a dusky dolphin caught off central Chile from which an estimated 130 cysts were recovered 'from the blubber between dorsal fin and flukes' (Fernández, 1987); to our knowledge this represents the only published account of parasites in the dusky dolphin for the Southeast Pacific region.

Markowski (1955) described the cestode *Trigonocotyle prudhoei* found in the intestine of a presumed *L. obscurus* specimen of the eastern Falkland Islands; he also reported a not further specified tetraphyllidean larva from another animal. Although the occurrence of the dusky dolphins around the Falkland Islands has been corroborated (Van Waerebeek, unpubl. data), this is true also for the hourglass dolphin (see Nichols, 1908) and the Peale's dolphin; the latter being the most abundant species (Webber and Leatherwood, 1990). For these reasons, the correct identification of the host species of *T. prudhoei* remains uncertain. While nothing has been published on the parasitology of New Zealand dusky dolphins, information for 16 specimens awaits processing (Cipriano, 1985).

Non-helminth parasitic organisms described from *L. obscurus* include *Candida* spp. yeasts in two captive animals from South Africa (Fothergill and Jogessar, 1986) and poxvirus encountered in tattoo skin lesions of several Peruvian specimens (Van Bressem *et al.*, 1993).

Material and Methods

A total of 321 fresh dusky dolphins (162 females, 145 males and 14 of unknown sex), landed at the fish terminals of Pucusana (12°30′S), Cerro Azul (13°00′S) and Ancón (11°47′S) on the central Peruvian coast, were examined for the presence of helminth parasites in the period 1985–90. The integument of a parallel sample of 707 dusky dolphins was checked for ectoparasites, in particular for the (aberrant) sessile barnacle *Xenobalanus globicipitis* (Crustacea: Cirripedia), a common phoront of cetaceans (reviews by Arvy, 1982; Rappé and Van Waerebeek, 1988). Given their high visibility it is assumed that whale-lice (Amphipoda: Cyamidae) would have been noticed if present, although in the early stages of the study amphipods were not specifically searched for. These tiny crustaceans were retrieved with some frequency from other small odontocetes that were also observed.

Dusky dolphin skulls from Peru ($N=240$) and northern Chile ($N=26$), representing all sex and age classes, were inspected for characteristic bone lesions commonly associated with infestations of *Crassicauda* nematodes (Dailey and Perrin, 1973; Perrin and Powers, 1980; Raga *et al.*, 1982). The Chilean specimens were studied at the collections of the Instituto de Investigaciones Oceanológicas, Universidad de Antofagasta (Antofagasta, Chile) and the Departamento de Ciencias del Mar, Universidad Arturo Prat (Iquique, Chile).

Left and right pterygoid and maxillary sinuses of 97 fresh dolphin heads were thoroughly flushed over a recipient; the contents was subsequently decanted over a 0.425 mm mesh sieve to retain parasites. The density of the digenetic trematode *Nasitrema* sp. was scored as: 0=not present, 1=low

(1–5 specimens), 2=moderate (6–15), and 3=high (>15). Sinus mucosa were then carefully inspected for other parasites, in particular *Crassicauda* sp. which often is partly buried in the cranial tissues (Raga *et al.*, 1982).

The presence of plerocercoid larvae of the cestode *Phyllobothrium delphini* could be verified only when dolphins were butchered locally, which happened infrequently as reflected in the small sample size (N=20). Geraci *et al.* (1978) found 80% of *P. delphini* larvae from Atlantic white-sided dolphins *Lagenorhynchus acutus* concentrated in the blubber adjacent to the ano-genital slit; because of time constraints we limited examination to this area. The blubber was cut in 1 cm-wide longitudinal slices to reveal the plerocercoid cysts and a relative appreciation of infestation rate (severe, light or absent) was assigned.

The digestive tract and its contents was studied in 218 dusky dolphins. Forestomach, main stomach, pyloric stomach, duodenal ampulla and intestine were flushed with seawater, inspected and sorted separately. Special care was taken to count all parasites in the stomach chambers and in a pre-determined length of intestine (usually 1 m). Food items encountered have been reported by McKinnon (1988). At least one, but usually both kidneys and the pancreas were sliced and checked macroscopically. Heart, lungs and liver were rarely available for study because these organs were routinely sold.

Most dolphins were examined an estimated 6 to 18 hours post-mortem and many of the parasites were still alive when collected. Depending on the uniqueness of the sample and the need for further identification, either all, some or none of the parasites were retained. Helminths were processed following Dailey (1978) and were stored in 70% ethylalcohol at the Centro Peruano de Estudios Cetológicos (CEPEC) in Pucusana, Peru, or at the Museo de Historia Natural Javier Prado, in Lima. Relevant biological data of all dolphins examined are kept on file at CEPEC. The systematics of helminths follows Price (1932), Yamaguti (1971), and Davey (1971).

To investigate the correlation between prevalence of parasites and body length of dolphins (as a measure of age), the latter were grouped into 10 cm interval classes. The null hypothesis of no difference in infestation prevalence between length classes and between sexes was verified with Chi-square Goodness-of-Fit tests. For classes with $N \geq 10$, standard errors (SE) of incidence levels were calculated according to the normal approximation rule for proportions (Wonnacott and Wonnacott, 1969) which, especially for larger samples, provides fairly reliable confidence levels even with non-parametric distributions. Where feasible, classes were pooled to meet the requirement of minimum sample size. Unless stated otherwise, the term significance is used in its statistical meaning at the α=0.05 level.

Results

Nematoda

Crassicauda sp.

A single skull in a large combined sample from Peru and northern Chile (N=267) showed evidence of *Crassicauda* infestation. A small area of typical basket-like bone lesions was visible on the ventro-orbital part of the frontale of this subadult specimen (No. AGG-063, CEPEC collection). However, Walker and Cowan (1981) warned that the presence of *Crassicauda* roundworms in the cranial sinuses of the common dolphin did not always result in skull lesions. On the other hand, at no instance did we encounter this nematode in the sinus system of fresh *L. obscurus* heads (N=97), nor did we see it in the blubber-muscle interface of the ventral body wall (slit over at least 50 cm to allow evisceration) in many hundreds of animals. In sharp contrast, KVW collected an adult *Crassicauda* roundworm from the pterygoid sinus of a 143 cm immature female (No. PBB 91/01, graciously provided by Dr P. B. Best, South African Museum, Cape Town), one of only two dusky dolphin carcases examined from South Africa.

Anisakis sp.

A further unidentified stomach nematode belonging to the genus *Anisakis* was detected in 87 of 218 (40%, SE=3.3%) dusky dolphins examined, mostly in the forestomach (N=75), less often in the main (N=9) and pyloric (N=7) stomachs. The average number of roundworms in infested dolphins was 2.96 (SD=3.41; N=82; range 1–17) and no difference between sexes was detected (Mann-Whitney, Z=0.909, p>0.05). The prevalence was independent from both standard length (chi-square=5.15; df=7; p=0.64) and sex of the dolphins (chi-square=1.17; df=1; p=0.28) (Fig. 1). The minimum recorded body length at infestation was 146 cm.

Halocercus sp.

Although the lungs were not normally examined, ten lungworms belonging to the genus *Halocercus* (Pseudaliidae) were found in the forestomach of a 186.5 cm male. The lungworms may have been ingested during a death struggle (by suffocation or drowning), in which the larynx may dislodge from the lower nasal passage allowing direct contact with the naso-pharynx, and/or post-mortem migration

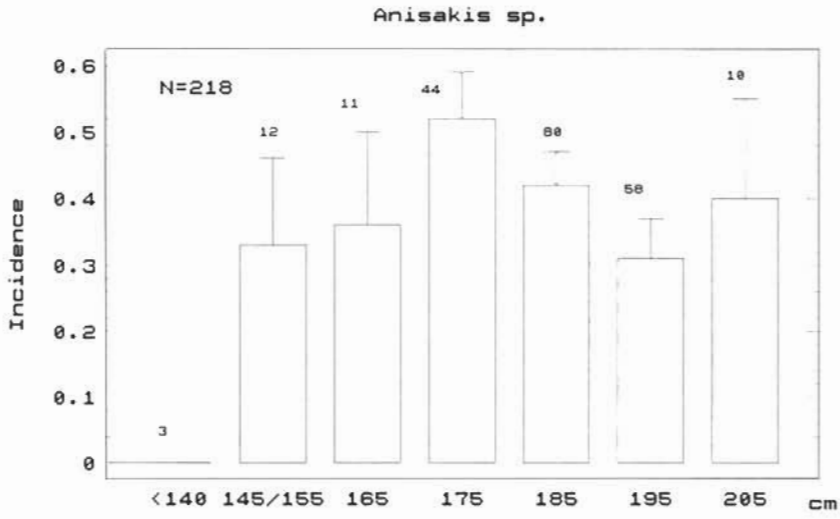

Figure 1. Incidence of the stomach nematode *Anisakis* sp. plotted against standard length class marks (in cm) of Peruvian dusky dolphins ($N=218$). Class sizes and error bars (+1 standard error) are indicated.

of the nematodes. Contamination of the sample was excluded.

Trematoda

Nasitrema sp.

Of a total of 97 fresh heads inspected, 76 (78.3%) had pterygoid and maxillary sinuses infested with *Nasitrema* sp. (Fig. 2). For 72 dolphins with information available, the infestation rate was scored 'low' in 58% of cases, 'moderate' in 22%, and 'high' in 19%; interestingly females appeared more prone to heavy infestation than males (Mann-Whitney, $Z=2.48$, two-tailed $p=0.013$). When present, flukes were almost always seen in both left and right cranial sinuses. The smallest animal with *Nasitrema* measured 162.5 cm. For dolphins above this length no significant differences were detected in parasite prevalence between length groups (chi-square=8.3; df=7; $p=0.31$) nor between sexes (chi-square=0.38; df=1; $p=0.54$). Also, no macroscopically visible tissue damage could be associated with this parasite. Modal length of the flukes was smaller than the one registered for *N. globicephalae* in Burmeister's porpoise *Phocoena spinipinnis* of the same waters (Reyes and Van Waerebeek, 1990) and their specific identity is currently under study.

Braunina cordiformis Wolf, 1903

The stomach fluke *B. cordiformis* was recovered from 18 of 212 (8.5%, SE=1.9%) digestive tracts examined. It was usually found in the pyloric stomach ($N=14$), much less (once) in the main stomach and in the duodenal ampulla (twice). Densities of *B. cordiformis* averaged 2.17 flukes per infested host (SD=2.26; range 1–10) and were independent of the sex of the latter (Mann-Whitney, $Z=0.516$, $p>0.05$). The smallest infested dolphin measured 152 cm. The incidence rate was heterogeneously distributed over length classes (chi-square=11.7; df=3; $p=0.008$). Maximum incidence (33%) occurred in dolphins 160–170 cm of length with a downward tendency in larger animals until the flukes were entirely absent in dolphins of 200–210 cm class (Fig. 3). Frequency of occurrence of *B. cordiformis* was equal for both female and male dusky dolphins (chi-square=0.01; df=1; $p=0.91$).

Pholeter gastrophylus (Kossack, 1910)

The trematode *P. gastrophylus* was retrieved from 17 stomachs out of 212 (8.0%, SE=1.9%). Density was very low, usually one or two flukes, and was independent of the sex of the host (Mann-Whitney, $Z=0.885$, $p>0.05$). Typically the pyloric stomach was affected ($N=13$), occasionally the main stomach ($N=3$) and only very rarely was *P. gastrophylus* detected in both stomach compartments. The smallest individual in which this worm was found measured 152 cm. The null hypothesis of zero difference in prevalence between length classes could not be rejected (chi-square=1.77; df=3; $p=0.62$) (Fig. 4); also, males and females were equally often parasitized (chi-square=0.14; df=2; $p=0.70$).

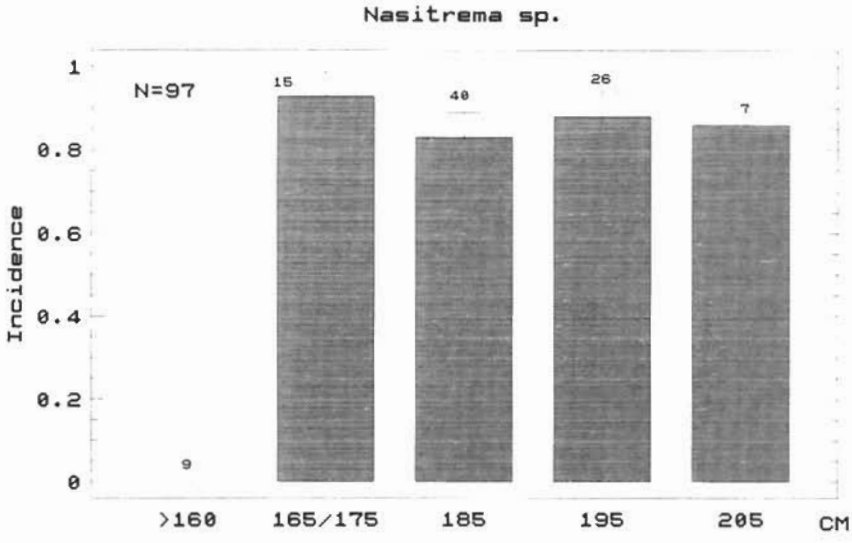

Figure 2. Incidence of the trematode *Nasitrema* sp. plotted against standard length class marks (in cm) of dusky dolphins from Peru ($N=97$). Error bars (+1 SE) are indicated for classes with $N>10$.

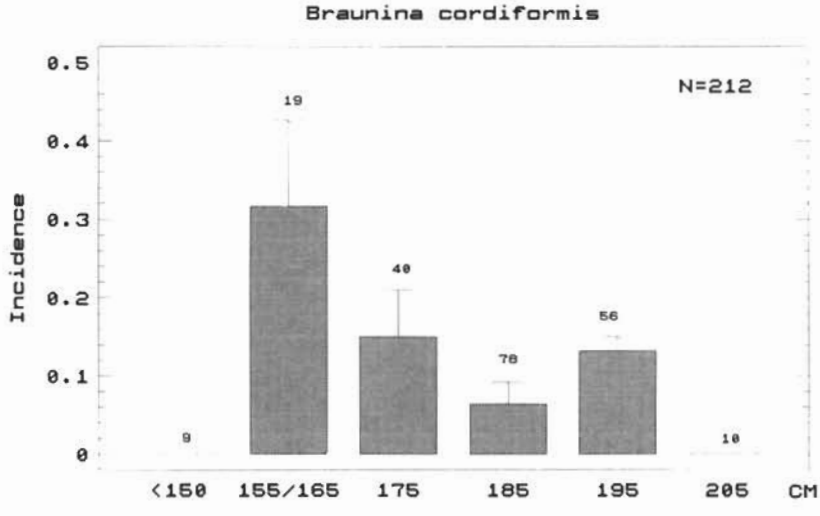

Figure 3. Incidence of the stomach trematode *Braunina cordiformis* plotted against standard length class marks (in cm) of Peruvian dusky dolphins ($N=212$). Error bars are plus 1 SE.

Cestoda

Phyllobothrium delphini (Bosc, 1802)

A high proportion of dusky dolphins (14 out of 20 or 70.0%) had its ventral blubber infested with larvae of *P. delphini* (Fig. 5). The smallest specimen in which this cestode was encountered measured 175 cm, however no dolphins less than 170 cm were examined. Frequency of occurrence did not differ between length classes (chi-square=0.007; df=2; $p=0.99$) or between sexes (chi-square=0.05; df=2; $p=0.83$), but small sample sizes limit this conclusion.

Unidentified cestods

Adult tapeworms of unknown taxonomic status were retrieved from the intestine of a single 197 cm female, out of a total of 27 dusky dolphins for which at least 1 m of intestine was flushed over a

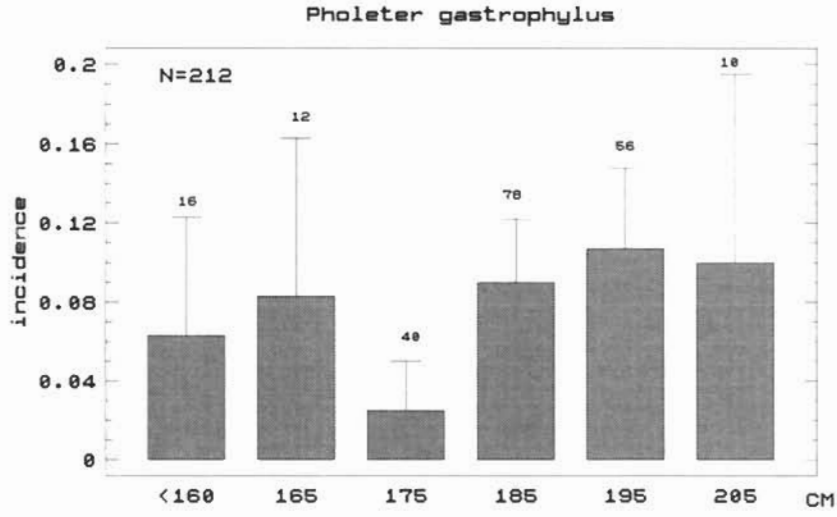

Figure 4. Incidence of the stomach fluke *Pholeter* sp. plotted against standard length class marks (in cm) of Peruvian dusky dolphins (N=212). Error bars are plus 1 SE.

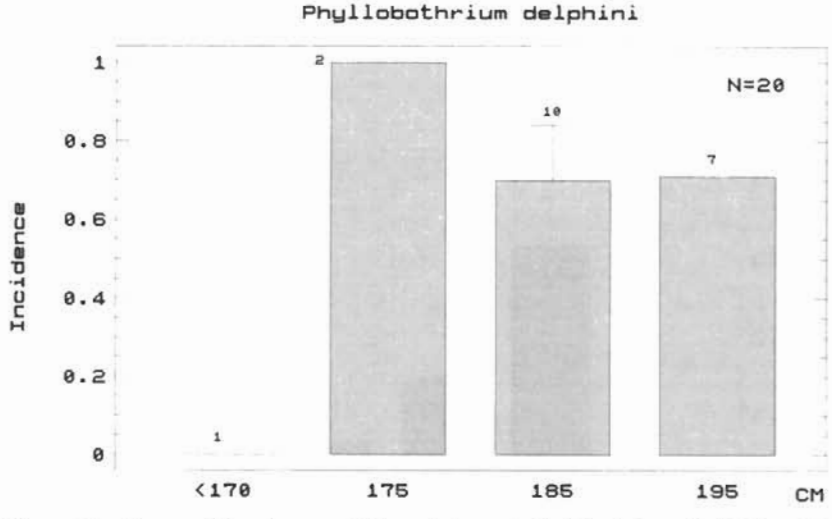

Figure 5. Incidence of the plerocercoid larval stage of *Phyllobothrium delphini* found in blubber, plotted against standard length class marks (in cm) of Peruvian dusky dolphins (N=20). Error bars are plus 1 SE.

fine-mesh sieve (incidence 3.7%, SE=3.6%). This is the first account of adult tapeworms from *L. obscurus*.

Cirripedia

Xenobalanus globicipitis Steenstrup, 1851

X. globicipitis was found attached to flukes, flippers and dorsal fin, but not to any other body part. Overall incidence of this phoront was 275 out of 707 or 38.9% (SE=1.8%) and although initial data suggested an increase in prevalence in larger animals, the differences between length classes were not statistically meaningful (chi-square=6.9; df=6; p=0.33) (Fig. 6). In addition, a Spearman rank correlation coefficient rejected any association between the size of the dolphins and the number of *X. globicipitis* specimens they carried (r_s=0.123; N=174; p=0.105).

One hundred and forty-one of 348 females (40.5%) and 134 of 359 males examined (37.3%) hosted at least one barnacle, which means that

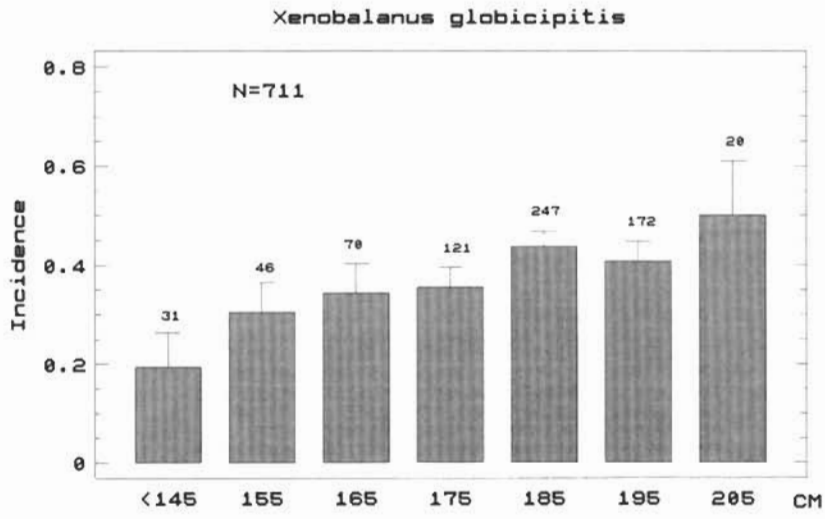

Figure 6. Incidence of the barnacle *Xenobalanus globicipitis* plotted against standard length class marks (in cm) for 711 dusky dolphins from Peru. Error bars are plus 1 SE. A significant correlation ($p=0.001$; $r=0.95$) exists between both variables.

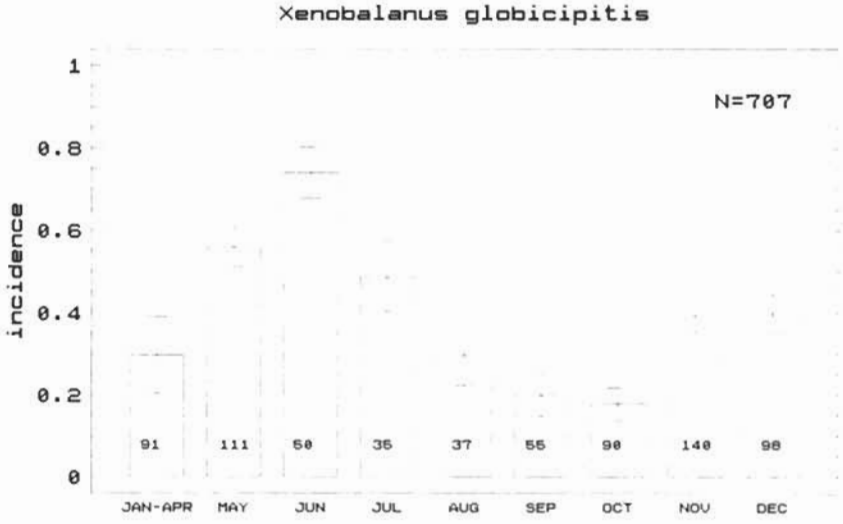

Figure 7. Seasonal variation in incidence rates of *Xenobalanus globicipitis* in the dusky dolphin from Peruvian waters. Error bars (± 1 SE) and sample size by month are shown (data for January–April were combined).

sexes are equally likely to be carrier (chi-square=0.47; df=1; $p=0.49$); neither did infestation density differ between sexes (Mann-Whitney, $Z=0.052$, $p=0.96$).

Figure 7 illustrates prevalence rates plotted against the months of the year. The temporal distribution is bimodal with peaks of occurrence in June and December, seasonal fluctuations which are highly significant (chi-square=43.2; df=8; $p<0.0001$).

Discussion

Lagenorhynchus obscurus constitutes a new host record for the trematode genera and species *Nasitrema*, *Braunina cordiformis* and *Pholeter gastrophylus* and for the nematode genus *Halocercus*. It is also the first time the cirriped *Xenobalanus globicipitis* is reported from one of the southern hemisphere *Lagenorhynchus* dolphins.

Of all parasites registered, only the incidence of *B. cordiformis* was significantly correlated with

length class, above a certain minimum size at which infestation first occurs. *B. cordiformis* was found less often in the larger animals. It seems highly unlikely that this could be due to increased mortality among mature dolphins as no associated lesions were recognized, which is in agreement with Woodard *et al.* (1969) who believed *Braunina* did not cause any serious pathology. We suggest that animals may progressively acquire immunity against the fluke, effectively preventing re-infection.

With the exclusion of *Nasitrema*, that more often heavily infested female dolphins than males, no sex-linked variation was noted in either incidence or density for any of the parasites.

The absence of *Anisakis* sp. and *Phyllobothrium delphini* in juvenile dusky dolphins (few neonates were examined) is concordant with the parasites' life cycle passing through an intermediary host, either a cephalopod or fish, on which the cetacean final host predates (Cowan, 1967; Smith, 1983; Raga *et al.*, 1986). Juveniles can be expected to remain free of infestation until after weaning. An alternative, transplacental route was first suggested by Baylis and Daubney (1925) for lung nematodes. It remained speculative until Dailey *et al.* (1991) presented firm evidence of such a method of transmission in the bottlenose dolphin and suggested a potential loss of large numbers of cetacean calves from verminous pneumonia. From our data there was no indication that any of the helminths encountered could be transmitted *in utero*, however, it is acknowledged that lungworms should be investigated. Additional documentation from large numbers of perinatal and juvenile dolphins would clarify the exact timing of first infestation for all helminths.

The almost complete absence of roundworms of the genus *Crassicauda* in *L. obscurus* from Peru is remarkable. This nematode was also not encountered in the Burmeister's porpoise, a strictly neritic odontocete, and in the inshore form of the bottlenose dolphin from the same study area (Reyes and Van Waerebeek, 1990); Van Waerebeek *et al.*, 1990). In contrast, 68.8% ($N=16$) of the Peruvian offshore population of bottlenose dolphins was infested with *Crassicauda* in cranial sinuses and/or blubber-muscle interface (Reyes, 1989; Van Waerebeek *et al.*, 1990). Assuming that the main transmission route is through ingestion of prey, it thus appears that the occurrence of *Crassicauda* roundworms in these toothed whales is somehow related to the feeding on offshore prey species. Otoliths of mesopelagic fishes such as myctophids and bathylagids were the most common items in the stomachs of offshore bottlenose dolphins (Van Waerebeek *et al.*, 1990) but were absent from dusky dolphins, inshore bottlenose dolphins, and Burmeister's porpoises (McKinnon, 1988; Reyes and Van Waerebeek, 1990; Van Waerebeek *et al.*, 1990). Similarly, the presence of *P. delphini*, typically found in offshore bottlenose dolphins but not in the inshore form, not in Burmeister's porpoises in Peru (Reyes, 1989; Van Waerebeek *et al.*, 1990; Reyes and Van Waerebeek, 1990) is probably related to some pelagic element in the Peruvian dusky dolphin's diet. A prime suspect, because of its significance in the diet (McKinnon, 1988), is the jumbo-flying squid *Dosidiscus gigas*. Generally, more directed research needs to be done to elucidate the life-cycles of these parasites and identify intermediary host species.

Although the prevalence of diphyllobothric tapeworms is usually low in cetaceans (J. A. Raga, pers. comm.), the fact that only one meter of intestine was usually examined in this study may have underestimated the true prevalence; the cited prevalence of 3.7% should therefore be considered a minimum rate.

The cranial nematode genus *Stenurus* was not encountered in the Peruvian dusky dolphin while it was, by far, the most common parasite (92.7% incidence) in the Burmeister's porpoise from the same waters (J. C. Reyes and Van Waerebeek, unpubl. data). *Stenurus* sp. may be host-specific or the phenomenon may be explained by the divergent feeding habits of these cetaceans. *Stenurus globicephalae*, however, has been reported from the Atlantic white-sided dolphin *Lagenorhynchus acutus* (Gibson and Harris, 1980, cited in Arvy, 1982).

The possibility that *Crassicauda* sp. may be a common parasite in the southwest African population (Van Waerebeek, 1992), much in contrast with Peruvian animals, underscores the potential of numerical comparisons of parasite loads as a means to help distinguish breeding groups.

Larger *L. obscurus* specimens appeared to be somewhat more frequently infested with *X. globicipitis*, although the correlation between incidence and body length proved not significant. It would be worthwhile to repeat the test with bigger samples of the smallest and largest length classes, as to reduce spread estimators. Bushuev (1990), in a study of southern minke whales *Balaenoptera acutorostrata*, likewise concluded that infestation did not depend on age. Alongside the fact that larger (older) dolphins neither host greater numbers of *X. globicipitis*, it suggests that the latter remain attached only for relatively short periods or, at least, removals equal new barnacle settlements. Heldt (1950) claimed that these phoronts attain the adult stage barely two or three months after attachment, however based on little evidence. Unlike in minke whales where females are more often infested (Bushuev, 1990), no sex-related differences exist in *L. obscurus*. This may be

explained by partial sexual segregation of minke whales during summer (i.e. males migrate to higher latitudes; see Stewart and Leatherwood, 1985) while no latitudinal separation occurs in the dusky dolphin, as known from catch compositions. One should ask whether such an explanation holds for other cetaceans. It is clear that much more work is required to elucidate cetacean-*Xenobalanus* ecological interactions.

The clear six-month phase in peak occurrence suggests seasonally controlled swarming of nauplius larvae. Both peaks fall within the period of strongest upwelling that occurs off Peru from May to December (Brainard and McLain, 1987). The recorded prevalence in our study species (38.9%) is significantly higher than the 2.9% (1 of 34) in bottlenose dolphins (Van Waerebeek *et al.*, 1990) or even the 23.8% (10 of 42) in Burmeister's porpoises (Huamán and Reyes, 1986; Reyes and Van Waerebeek, 1990). The probability of becoming infested with *X. globicipitis* probably varies considerably with time spent by the host species in the various water strata (depth, distance from the coast, upwelling, etc.). Significant variation by area was detected for the minke whale in the Antarctic (Bushuev, 1990). From the above we conclude that *X. globicipitis* can serve as a sensitive ecological marker on a small temporal scale, i.e. months, but exactly the high 'resolving power' makes it unreliable as an indicator of breeding populations.

Surprisingly, whale-lice (Cyamidae) were not found associated with the dusky dolphin on any occasion either during or after the collecting period. In contrast, cyamids were occasionally retrieved from much smaller samples of Burmeister's porpoises and bottlenose dolphins in the same area (Reyes and Van Waerebeek, 1990). Cipriano (1985) reported cyamids for two of 15 dusky dolphins examined from New Zealand waters.

Acknowledgements

We are indebted to M. Chandler, L. Chávez, M. Echegaray, A. C. Lescrauwaet, Dr A. J. Read and J. S. McKinnon who assisted with field work over varying periods of time and to Dr P. J. H. van Bree and B. A. Luscombe for logistical and moral support throughout the study.

Dr M. Dailey, Dr J. A. Raga, Dr C. Smeenkj and Dr J. H. Stock are thanked for making many helpful suggestions to improve the manuscript. Funding was received with thanks from the Leopold III-Fonds voor Natuuronderzoek en Natuurbehoud, the Whale and Dolphin Conservation Society, IUCN/UNEP (Burmeister's Porpoise Project), the Consejo Nacional de Ciencia y Ecología (CONCYTEC) of Peru and the Van Tienhoven Foundation. The Statgraphics programme was generously donated by Steve Denison (Chameleon Clothing Co.).

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