GASTROINTESTINAL PARASITES AND PREY ITEMS FROM A MASS STRANDING OF FALSE KILLER WHALES, *Pseudorca crassidens*, IN RIO GRANDE DO SUL, SOUTHERN BRAZIL

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(With 1 figure)

ABSTRACT

The gastrointestinal tract of 14 false killer whales, 6 males and 8 females, stranded in June 1995 in southern Brazil, with total standard lengths from 338 to 507 cm, were analysed for endoparasites and food items. A pregnant female had a male foetus of 77.5 cm. Parasites were found in all 14 false killer whales. The nematode *Anisakis simplex* (Rudolphi, 1809) was found in the stomach of 57% of the animals and the acanthocephalan *Bolbosoma capitatum* (Linstow, 1889) Porta, 1908 was present in the intestine of all specimens and showed densities up to 600 m^{-1}. An unidentified cestode (Tethrabothridae) was found also in the intestines of 14% of the individuals. The high infections of *B. capitatum* and *A. simplex* were not directly related with the cause of death. In the stomachs of four females, beaks of at least eight specimens of the oceanic and epipelagic species *Ommastrephes bartramii* (Lesueur, 1821) were found, with mantle lengths ranging from 189.8 to 360.9 mm. The distribution of *O. bartramii* in the coast of Rio Grande do Sul is consistent with false killer whales feeding in continental shelf waters.

Key words: parasites, food items, *Pseudorca crassidens*, mass stranding

RESUMO

Parasitas gastrointestinais e itens alimentares de um encalhe massivo de falsas orcas, *Pseudorca crassidens*, no Rio Grande do Sul, sul do Brasil

O trato gastrointestinal de 14 falsas orcas, 6 machos e 8 fêmeas, encalhadas em junho de 1995 no sul do Brasil, com comprimentos totais de 338 a 507 cm, foi analisado quanto à presença de endoparasitas e itens alimentares. Uma fêmea grávida apresentava um feto de 77,5 cm. Parasitas foram encontrados em todas as 14 falsas orcas. O nematóide *Anisakis simplex* (Rudolphi, 1809) foi encontrado no estômago de 57% dos animais e o acantocéfalo *Bolbosoma capitatum* (Linstow, 1889) Porta, 1908, estava presente no intestino de todos os espécimes, com densidades de até 600 parasitas/m^{-1}. Um cestóide não identificado (Tethrabothridae) também foi encontrado nos intestinos de 14% dos indivíduos. As altas infecções por *B. capitatum* e *A. simplex* não estavam diretamente relacionadas à causa da morte. Nos estômagos de quatro fêmeas foram encontrados bicos de pelo menos oito espécimes de lulas oceânica e epipelágica *Ommastrephes bartramii* (Lesueur, 1821), com comprimentos de manto variando entre 189,8 e 360,9 mm. A distribuição de *O. bartramii* na costa do Rio Grande do Sul é consistente com a alimentação de falsas orcas em águas da plataforma oceânica.

Palavras-chave: parasitas, alimentação, *Pseudorca crassidens*, encalhe massivo.

INTRODUCTION

The distribution of the false killer whale, *Pseudorca crassidens*, has been reported from all tropical, subtropical and warm temperate seas, and largely determined from stranding records. The species habitat is assumed to be primarily oceanic (Leatherwood & Reeves, 1983). In the western Atlantic records are known from Cape Hatteras, North Carolina, USA, to Tierra del Fuego, Argentina (Stacey *et al.,* 1994).

Mass strandings are common for the species, and have been reported by many authors (*e.g.* Stacey *et al.,* 1994), although their causes remain unknown (Odell *et al.,* 1980). In some cases the number of stranded individuals is very high: from 50 to 835 on 14 mass strandings in southern Africa (Ross, 1984) and 129 in Tierra del Fuego, Argentina (Mariano *et al.,* 1992). Most of the mass stranding studies for false killer whale are related to morphometric and osteological data, remaining scarce those related with feeding habits, health conditions and the possible effects of parasitism as a predisponent factor for the strandings (Odell *et al.,* 1980; Morimitsu *et al.,* 1987). In some massive strandings infections by parasites in the lungs, pterigoids sinuses and tympanic cavities have been interpreted as the main cause of mortality (Odell *et al.,* 1980; Morimitsu *et al.,* 1987).

In Brazil stranding records of false killer whales are known from the northeast to the southern regions and have included only single animals up to recently (Pinedo *et al.,* 1992). The only massive stranding, involving five individuals, was reported by Soto *et al.* (1994) and occurred in Rio Grande do Sul, southern Brazil. No parasites or food items were reported.

Worldwide information concerning parasite species on false killer whales has been provided from compiled lists (*e.g.* Baylis, 1932) or from single strandings (*e.g.* Zam *et al.,* 1971). From these sources, a great diversity of parasite species are related to the species (Baylis, 1932; Davey, 1971; Zam *et al.,* 1971; Dailey & Brownell, 1972).

MATERIAL AND METHODS

In June 20, 1995, during a beach survey in Rio Grande do Sul, southern Brazil (29°20'S to 33°45'S), as part of a long term monitoring program for marine mammals, 14 false killer whales, 6 males and 8 females, were found dead, stranded along 50.8 km of beach (*ca*. 33º00'S, 52º40'W). The longer distance among the individuals of a group of 12 animals was 900 m. Two additional females were located at 1.1 km and at 48 km north of this group. All individuals presented the same degree of decomposition and the time of death was estimated in approximately 24 hours considering: estimated temperature in the beach (*ca*. 7ºC), perfect external conditions of the bodies, coloration and internal organs. External measurements were taken in a straight line, point to point, with a caliper, except the total standard length, which was taken with a plastic tape parallel to the body axis. All measurements were read to the nearest centimeter (Table 1).

The gastrointestinal tracts of all 14 individuals were inspected for parasites and food items. At the stranding sites, the stomachs and intestines were removed and the three stomach compartments (fore, main and pyloric) were opened and washed on a sieve of 1mm mesh to separate helminths. The total intestine was removed, measured with cloth tape and sectioned at each full meter along the entire length. Intestine lengths ranged from 20 to 31.7 m (Fig. 1). Due to the large size of the predominant helminth species (about 7.5 cm), on each cut made its density was estimated with naked eyes. Based on this evaluation segments showing higher densities, equivalents to the 1st (duodena), 7th, 8th, 9th and last meter (large intestine), were collected. In the laboratory, the parasites present in each one of these meters were carefully removed from the mucosa and counted. For one false killer whale, the segment correspondent to the 5th meter was also collected.

The parasites were washed, counted, fixed in AFA (Dailey, 1978) and stained according to Amato & Boeger (1991). The identification was based mainly on Petrochenko (1971), Davey (1971) and Schmidt (1986). The parasitological indices, prevalence and mean intensity (M.I.) found on the segments sampled were calculated according to Margolis *et al.* (1982).

The size of cephalopods was estimated from rostral length measurements on the upper and lower beaks, with mantle lengths being estimated from regressions relating rostral length with dorsal mantle length (Lab. Recursos Demersais, unpublished data).

TABLE 1

External measurements (cm) and sex of 14 false killer whale stranded in Rio Grande do Sul, southern Brazil.

	Colection number (LMM - FURG)													
Measurements	**1703**	**1707**	**1709**	**1710**	**1711**	**1712**	**1713**	**1714**	**1715***	**1716**	**1717**	**1718**	**1719**	**1720**
Total length	406	415	457	439	440	453	488	507	422	407	456	459	424	398
Blowhole to base of dorsal fin	126	135		128.8	132.5	125	135	136	128	122	133	140	135	124
Dorsal fin height	29	29	31	29.2	25.5	34	34	46	25	27	39.5	27	28	
Dorsal fin base	46	41	61	66.2	54	53.4	82	76	50	50	60	56	59	48
Anterior length of flipper	52.5	45	53.1	49.3	51,5	50	59	62	47	47.5	63	58	43.5	47
Maximum width of flipper	19.5	18.8	21.4	18.4	20,9	19	25	25	17.5	20	23	22.5	17	19
Tip of beak to end of gape	41	37	37.2	35.5										
Tip of upper jaw to center of anus		280	302		282	309	323	348	286	273.3	303	302	287	273
Tip of upper jaw to center of genital slit		245	254		298	288.5	270	289	270	257	257	253	271	255
Tip of upper jaw to leading edge of dorsal fin	175	182	177.7	168.7	170	165	184	182	172	169	180	178	170	157
Tip of upper jaw to center of blowhole	51	42	47				52	135	44	47.5	47	39	35	34
Sex	femal e	female	male	female	female	female	male	male	female	female	male	male	female	male

*Pregnant female, foetus length = 77.5 cm.

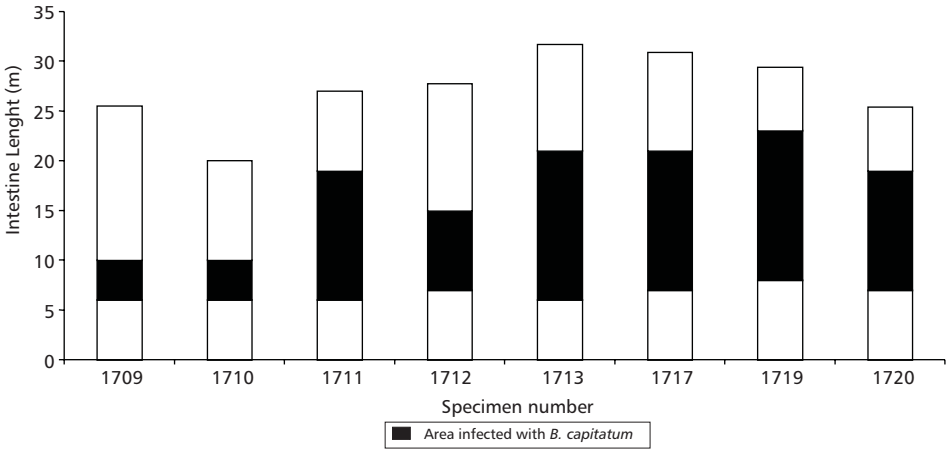

Fig. 1 — Total length of intestine and infected regions by *Bolbosoma capitatum*, in false killer whales stranded in Rio Grande do Sul, southern Brazil.

The biological material collected from all the false killer whales stranded was placed at Laboratório de Mamíferos Marinhos (LMM), Oceanography Department at Fundação Universidade do Rio Grande (FURG).

RESULTS

The total standard length of the 14 false killer whales, 6 males and 8 females, varied from 398 cm to 507 cm (Table 1). One animal (LMM1715) was a pregnant female with a male foetus (77.5 cm). All individuals were probably sexually mature, based on the average lengths of attainment of sexual maturity for Eastern North Atlantic and Western North Pacific stocks (Perrin & Reilly, 1984).

Gastrointestinal parasites

Three species of endoparasites were found in the gastrointestinal tracts of the specimens sampled: *Anisakis simplex* (Rudolphi, 1809) (Nematoda: Anisakidae), *Bolbosoma capitatum* (Linstow, 1889) Porta, 1908 (Acanthocephala: Polymorphidae) and an unidentified cestode (Tetrabothridae). Their prevalences and mean intensities of infection are showed in Table 2.

In the stomach, the nematode *A. simplex* was found in the fore and main compartment, with higher number of worms counted in the former. No ulcerations in the mucosa were macroscopically observed. The acanthocephalan *B. capitatum* occurred from the 6th to the 20th meter of the intestine (Fig. 1), with estimated higher densities in the 7th, 8th and 9th meters. A partial occlusion of the intestinal lumen was observed in these segments. Parasites infecting the first meter of the intestine (duodena) were found only in one individual. Tetrabothridae were collected in 2 false killer whales, from the 1st and 5th meters of the intestine, respectively. In all specimens no helminths were found in the last meter of the intestine. For *B. capitatum*, no differences were found on the mean intensity of infection, by sex of the hosts ($n_{males} = 6$, $n_{females} = 6$, Mann-Whitney test, $\alpha = 0.05$). Due to the low prevalences observed, statistical analyses were not performed for *A. simplex*.

Prey items

Only cephalopod remains (beaks or eye lens), from at least 8 specimens, were found in 4 stomachs (LMM 1703, 1707, 1712, 1715 – all females) of the 14 analysed stomachs. Three of them contained beaks of *Ommastrephes bartramii* (Lesueur, 1821) (Ommastrephidae) (Table 2) and 2 contained fragments of unidentified crustaceans. These fragments were not considered remains of primary intake but probably result of incidental intake.

DISCUSSION

Parasites are frequently found in cetaceans under natural conditions. The mortality of the host depends of the parasites pathogenicity, organ affected, degree of damage and immunological responses of the host.

TABLE 2

Cephalopods preyed by *Pseudorca crassidens* found stranded in Rio Grande do Sul, southern Brazil, and lengths of beaks and mantle. (LMM/FURG = collection number; N = number of individuals of each cephalopod species found; URL = upper rostral length; LRL = lower rostral length; EML = estimated mantle length). Beaks and mantle lengths in milimeters.

LMM-FURG	Cephalopod species	N	Range		
			URL	LRL	EML
1703	*Ommastrephes bartramii*	3	7.8-8.3	4.2	189.8-321.2
1707	*Ommastrephes bartramii*	2		6.2-7.6	273.3-331.8
	Teuthoidea unidentified	1			
1712	Cephalopoda unidentified	1			
1715	*Ommastrephes bartramii*	1	9.5		360.9

TABLE 3

Prevalence (P), mean intensity of infection (IMI) and total of helmints (N) collected from 14 false killer whales, *Pseudorca crassidens*, stranded in Rio Grande do Sul, Brazil.

Parasites	P (%)	IMI	N
A. simplex	57.14	12	96
B. capitatum	100	639.13 m^{-1} of intestine	7669.5
Tetrabothridae	14.2	–	–

Andrade *et al.* (1998) observed heavy infections by the digenean *Hadwenius pontoporiae* (Raga *et al*., 1994), in the intestines of 53 franciscanas, *Pontoporia blainvillei* (Gervais & d'Orbigny, 1844), incidentally caugth in gill nets in southern Brazil. However, the specimens showed a good corporal condition, including the presence of food items in their stomachs.

Species of the genus *Bolbosoma* (Porta, 1908) are often found infecting the intestines of cetaceans, with high prevalences (about 100%) and intensities (11.200 parasites m^{-1} of intestine) (Skjarbin, 1975 in Dailey, 1985). According to Dailey (1985) these infections should not be directly interpreted as the cause of death. As an example, from a mass stranding of 6 false killer whale, *Pseudorca crassidens*, in Florida, Odell *et al.* (1980) recorded that although the intestines of all specimens were heavily infected by thousands of *Bolbosoma capitatum*, the cause of death was found to be pneumonia. In the present study we also believe that the cause of death was not directly related with the parasite infections.

False killer whales prey mainly on a variety of fishes and squids and feeding occurs during day and night (Stacey *et al.*, 1994). In Southern Brazil, previous analyses in the stomach of 4 stranding false killer whales, 2 of them with food items (male and sex undetermined individual), revealed the presence of otoliths and bones of coastal fishes (Sciaenidae and Serranidae). Cephalopods were not found (Pinedo & Rosas, 1989).

Around the world oceanic squids have been recorded as false killer whale preys (Stacey *et al.*, 1994). In analyses in the stomachs of 21 false killer whale stranded in Tierra del Fuego (9 males and 12 females), the ommastrephid squid *Illex argentinus* (Castellanos, 1960) was the most important prey eaten, and was only found in the stomachs of females (Koen-Alonso *et al.*, 1992). In subtropical and temperate waters of southern Brazil *Illex argentinus* and *Ommastrephes bartramii* (Lesueur, 1821) are epipelagic species, the former dominant and occurring at 50-800 m (Haimovici & Perez, 1991). In Rio Grande do Sul *I. argentinus*, and other ommastrephid species, were recorded by Santos & Pinedo (1994) in 3 stomachs of the long finned-pilot whale, *Globicephala melas* (Traill, 1809). In the present study the finding of *O. bartramii* in the stomachs of false killer whales stranded is consistent with feeding in continental shelf

waters. Also, some parasite species found are known to be oceanic and confirm the information obtained from the stomachs.

Although a higher number of stomachs of false killer whales should be inspected for food items along the continental platform of the Western South Atlantic, the similar finding of ommastrephid squids only in the female stomachs of Tierra del Fuego and Rio Grande do Sul, could be suggesting a differential feeding ground, or prey selection, by sex.

Biological and ecological information relating to the acantocephalans found in cephalopods is not available. Although numerous samples of large ommastrephids have been examined for parasites, acanthocephalans are not commonly found (Hochberd, 1990). However, larval stages of *Anisakis simplex* have been found paraziting *Ommastrephes bartramii* in different geographical areas, including the Western South Atlantic (Gaevskaya *et al.*, 1986, *apud* Hochberd, 1990). Although in this area the parasite life cycle is not completely known, the adult worms of *A. simplex* occur in the stomach of many cetacean species, which get infected after eating fishes or squid infected (Hochberd, 1990).

From an ecological point of view, the occurrence of some parasite species might be revealing important data on the distribution and habitat of the stranded animals. Some acanthocephalan and helminths of the Tethrabothridae family have been recorded only in oceanic cetaceans (Baylis, 1932). The acanthocephalan *Bolbosoma capitatum* is known to infect oceanic cetaceans, such as the sperm whale, *Physeter macrocephalus* (Baylis, 1932; Andrade *et al.*, 1998) and the long-finned pilot whale, *Globicephala melas* (Baylis, 1932; Machado Filho, 1964; Raga & Balbuena, 1993). As these species are also squid eaters, the presence of *B. capitatum* could be revealing the provenience and possible prey items of the specimens stranded. In the case of the nematode *Anisakis simplex*, it should not be considered as a good biological marker due to its low specificity and wide distribution.

According to Sergeant (1982) the stress could be included as one of the physiological mechanims responsible for mass strandings in cetaceans. In this study, the high infections of *B. capitatum* and *A. simplex* and the finding that most stomachs were empty were interpreted as possible coadjutant factors to the stress and debilitation condition of the animals. The stress causes immunopression and consequently the increase of parasite infrapopulations tends to occur. Therefore, before considering the parasitological levels as cause of death, ideally a complete investigation on the levels usually found for the species, by geographic region, together with an evaluation of their pathogenic effects should be performed.

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