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OCCURRENCE OF PEDUNCULATE BARNACLES (*Conchoderma virgatum*) (CIRRIPEDIA: THORACICA) ON MAGELLANIC PENGUINS (*Spheniscus magellanicus*)

Ocurrencia de lepas pedunculadas (*Conchoderma virgatum*) (Cirripedia: Thoracica) en pingüinos de Magallanes (*Spheniscus magellanicus*)

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Abstract.- Magellanic Penguins (*Spheniscus magellanicus*) breed in Argentina, Chile and the Falkland (Malvinas) Islands, and seasonally migrate towards the coasts of Uruguay, Brazil and Peru. We report the finding of pedunculate barnacles *Conchoderma virgatum* (Cirripedia: Thoracica) on the body surface of seven out of 62 Magellanic Penguins. These birds were beach-cast along the coast of São Paulo state (23º57'S; 46º23'W), Brazil, on winter 2008 and winter 2010. Barnacles were attached on the surface of the flippers, feet and lower chest, and in some cases the barnacle had over 40 grouped individuals, some measuring up to 4 cm. Affected penguins had low body mass (range = 1.6 – 2.05 kg) and were in generally poor health (cachexia, anemia and dehydration). The barnacles were considered to have occurred secondarily to the poor health status of the examined penguins. **Key words.-** *Spheniscus*, *Conchoderma*, penguin, parasite, Brazil

Resumen.- Pingüinos de Magallanes (*Spheniscus magellanicus*) son nativos de Argentina, Chile y de las Islas Malvinas (Falkland), y estacionalmente migran hacía las costas de Uruguay, Brasil y Perú. En este trabajo se reporta el hallazgo de percebes pedunculados *Conchoderma virgatum* (Cirripedia: Thoracica) sobre la superficie del cuerpo de siete pingüinos de Magallanes. Las aves fueron encontradas en las playas a lo largo de la costa del Estado de São Paulo (23º57'S, 46º23'O), Brasil, en los inviernos de 2008 y 2010. Los crustáceos estaban en la superficie de las aletas, pies y abdomen, y en algunos casos, los percebes tenían más de 40 individuos agrupados, algunos midiendo hasta 4 cm. Los pingüinos afectados tenían masa corporal baja (rango = 1.6 – 2.05 kg) y se encontraban en un mal estado de salud (caquexia, anemia y deshidratación). Se considera que los percebes observados ocurrieron posteriormente y de modo secundario al mal estado de salud de los pingüinos examinados. **Palabras clave.-** *Spheniscus*, *Conchoderma*, pingüino, parásito, Brasil.

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INTRODUCTION

The Magellanic Penguin (*Spheniscus magellanicus*) breeds in Argentina, Chile and the Falkland (Malvinas) Islands (latitudes greater than 41°25'S), and Atlantic populations will seasonally migrate northwards towards the coasts of Uruguay and Brazil, often reaching southeastern Brazil (22°17'S) and exceptionally animals have been reported as far as northeastern Brazil (2°52'S) (Williams & Boersma 1995, García-Borboroglu *et al*. 2010). Among the ectoparasites known to occur on Magellanic penguins and its sympatric penguin species are fleas (*Listronius robertsianus*, *Parapsyllus* spp.), lice (*Austrogoniodes* spp.) and ticks (*Amblyomma parvitarsum*, *Ixodes uriae*, *Ornithodoros* spp.) (Clarke & Kerry 1993, Becker *et al.* 1997, Karesh *et al.* 1999, Keymer *et al.* 2001, Brum & Becker 2002). In this paper we report the occurrence of pedunculate barnacles attached to the body surface of beach-cast Magellanic penguins on the southeastern coast of Brazil.

METHODS

Magellanic penguins (*Spheniscus magellanicus*) found beach-cast along the coast of São Paulo state, Brazil, are regularly admitted for rehabilitation at the Centro de Triagem de Animais Selvagens Refúgio Mata Atlântica LELLO-UNIMONTE, Centro Universitário Monte Serrat (São Vicente, SP, Brazil – 23º57'S; 46º23'W). This institution received 42 animals in 2008, 2 animals in 2009, and 18 animals from January through September 2010; all birds were juveniles, as determined from plumage (Williams & Boersma 1995). All penguins were subject to complete physical examination and treated through standard rehabilitation protocols (Cranfield 2003; Silva-Filho & Ruoppolo 2007). Externally attached organisms were carefully searched for, photographed, collected in ethanol 70 %, examined under stereoscope microscopy and classified according to the current literature (Anderson 1994).

RESULTS

Seven out of the 62 Magellanic penguins (10.8%) admitted presented pedunculate barnacles attached to their bodies. Six of these cases were admitted during the austral winter in 2008 (19/07/2008 – 06/09/2008), and one case in winter 2010 (16/07/2010). Table 1 summarizes the major clinical findings of the studied penguins, and Figure 1 illustrates the observed barnacles.

The affected animals were found beach-cast alive but in very poor health condition. They were taken into rehabilitation but perished shortly after (mean ± SD = 1.4 ± 1.8 days). In all cases animals presented with apathy, prostration, hypothermia, dehydration and pale mucosae. Body mass was considerably lower in affected animals (mean ± SD = 1.79 ± 0.14 kg) than in those unaffected (2.15 ± 0.44 kg) (Mann-Whitney test: W=187.5; P=0.013). All animals were cachectic, with the absence of fat deposits and considerable atrophy of the pectoral muscles. For three of the affected animals it was possible to perform microhematocrit and total plasmatic protein (see Table 1). Lice infestation (*Austrogoniodes* sp.) concurred in three of these animals. Other relevant concurrent macroscopic findings included the amputation of tarsal phalanxes due to unrelated trauma (cases 1 and 6), and edema of the metacarpal-ulnar articulation compatible with recent luxation or subluxation (case 7).

Pedunculate barnacles *Conchoderma virgatum* (Spengler, 1790) (Cirripedia: Thoracica) were observed in variable number and size. The barnacles were still alive upon arrival and were easily hand-removed. Two

Table 1. Summary of the clinical findings on Magellanic penguins presenting with pedunculate barnacles (*Conchoderma virgatum*).

Case	Date of entry	Date of death	Body mass	Hematocrit	Plasma protein	Lice	Barnacles	
							Infestation	Distribution
1	19/07/2008	21/07/2008	1.8 kg	7 %	4 g/dl	-	H	Fl, Ft, Ch
2	09/08/2008	09/08/2008	2.05 kg	-	-	Present	M	Fl, Ft
3	30/07/2008	31/07/2008	1.6 kg	8 %	4 g/dl	-	H	Ft, Ch
4	23/07/2008	25/07/2008	1.7 kg	-	-	-	M	Fl, Cht
5	19/07/2008	24/07/2008	1.8 kg	10 %	4 g/dl	-	M	Fl
6	06/09/2008	06/09/2008	1.8 kg	-	-	Present	M	Fl, Ft
7	16/07/2010	16/07/2010	1.8 kg	-	-	Present	L	Ft

Infestation: H=High, M=Moderate, L=Low
Distribution: Fl=flipper, Ft= feet, Ch=chest

Figure 1. Pedunculate barnacles (*Conchoderma virgatum*) on the body surface of Magellanic penguins (cases 1 and 7).

penguins had more than 20 barnacle individuals («high» infestation), four had between 2 and 20 individuals («moderate»), and one had a single individual («low»). In one case, more than 40 individuals were present (case 1). Barnacles were found on the flippers, feet or lower chest. The length of the crustaceans (peduncle and *capitulum*) ranged from 0.9 cm up to 4 cm. No significant skin lesions, scars or inflammation were observed on the implantation sites, and it was impossible to determine whether the barnacles had installed on previously existing lesions or on healthy skin.

DISCUSSION

Barnacles have been reported attaching to the body surface of marine vertebrates such as whales, dolphins, manatees, sea snakes, turtles and fish (Balakrishnan 1969, Hastings *et al.* 1972, Anderson 1994, Yamato *et al.* 1996, Frick *et al.* 1998, Jesús 2001, Toth-Brown & Hohn 2007), as well as on isopod invertebrates (Hastings *et al.* 1972) and ship hulls (Gollasch 2002, Farrapeira *et al*. 2007). Among penguins, there are few published reports. *Lepas australis* has been reported on Snares Penguins (*Eudyptes robustus*) from Snares Islands (Horning 1982), Macaroni Penguins (*Eudyptes chrysolophus*) from Bird Island (Barnes *et al.* 2004), and a Northern Rockhopper Penguin (*Eudyptes moseleyi*) from Gough Island (Reisinger & Bester 2010).

The cases examined in this study occurred during episodes of exceptionally high numbers of Magellanic Penguins becoming beach-cast on the Brazilian coast. Five cases occurred in 2008, when an estimated total of 4500 penguins were beach-cast either dead or severely debilitated on Brazilian beaches, many of which in the lowest latitudes than ever recorded for the species; food deprivation and long term stress were considered likely to be involved, possibly in association with low sea surface temperature anomalies and decreased fish availability in the Patagonian sea (García-Borboroglu *et al.* 2010). An additional case occurred in 2010, when at least 1350 penguins were reported stranded along Brazilian beaches (Andréa C. Adornes, pers. comm.); anomalous low sea surface temperatures and sea storms were also reported in this period, and the very poor body conditions and high parasite loads were coherent with long-term food deprivation (Vanstreels *et al.* unpubl. data).

All affected birds were highly debilitated, in poor body condition, anemic and dehydrated. While there are no established reference values for these species, it is known that clinically healthy penguins have much higher values of hematocrit (45-50%) and total plasmatic protein (5-6 g/dL) (Cranfield 2003), further indicating the poor health status of the examined birds. Considering how the barnacles could easily be hand-removed and were within reach of the bird's beak and, in most cases, their size certainly led to discomfort and poor streamlining, it may be concluded that the penguins only failed to remove the barnacles through preening due to their severe health debilitation. The life cycle of these barnacle species implies that implantation can only take place in the cyprid larval stage, when the swimming nektonic larva will actively select a surface and metamorphose into a sessile juvenile barnacle (Anderson 1994). Once cyprid implantation is complete, there is no translocation of the juvenile or adult barnacles and their growth rate is only about one to two millimeters per day (Anderson 1994). It is thus clear the studied barnacles took several days to weeks to reach their observed size, and it is reasonable to conclude that otherwise healthy birds would have promptly removed the barnacles before such long period.

Algae are known to occur on the feathers of Galápagos Penguins (*Spheniscus mendiculus*) (Boersma 1975) and African Penguins (*Spheniscus demersus*) (Randall & Randall 1984). Randall and Randall (1984) suggested that algal colonization may damage the feathers, affecting waterproofing and streamlining. Those authors observed a low frequency of algae-covered juveniles (< 1%), and witnessed algal removal during preening behavior and algal die-off after short periods out of water, and concluded that penguins have both active and passive strategies to avoid excessive algal fouling. Our findings suggest that algae and barnacles may represent similar situations for the penguins, as these epibiotic organisms seem to be more likely to occur on debilitated individuals, which fail to remove the algae through preening. A similar dynamic has been suggested to occur on dolphins, as unusually high incidences of barnacles and other epizoites are found on the most debilitated individuals during die-offs (Aznar *et al.* 1994). No significant skin lesions were found in the barnacles' implantation sites, suggesting these do not have direct health implications for their hosts. It should be emphasized that barnacles are suspension feeders and only rely on vertebrate hosts as fixation points (Anderson 1994). However, considering how smaller flipper bands are and yet have been shown to affect streamlining considerably and result in higher swimming energy costs and behavioral changes (Culik *et al*. 1993, Fallow *et al*. 2009), it may be expected that large barnacle infestations affect streamlining significantly and indirectly contribute to the animals' debilitation.

Magellanic penguins are known to travel up to 2700 km in their seasonal migration (Pütz *et al*. 2000), and in exceptional cases there have been records of individuals as far as New Zealand and Antarctica (Barbosa *et al.* 2007) or Northeastern Brazil (García-Borboroglu *et al*. 2010). It has been suggested that exceptionally far-reaching migrations of subtropical penguins may be associated with difficulty to find prey in the regular feeding grounds (Culik *et al.* 2000, García-Borboroglu *et al.* 2010). In fact, the animals herein reported were at least 2600 km from the closest Magellanic penguin breeding colony (Complejo Islote Lobos; 41°25'S, 65°01'W) (Boersma 2008) and were found in years when atypically high numbers of Magellanic Penguins were reported on the coast of Brazil. If these exceptionally far-reaching vagrant individuals may act as effective phoretic hosts for sessile organisms such as pedunculate barnacles, these episodes may represent additional opportunities for these organisms to disperse over wide distances, as has been shown to occur through ship hulls and whales (Gollasch 2002, Bianucci *et al.* 2006).

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