Diseases and lesions in the long-beaked common dolphin (*Delphinus capensis*) from the Southeast Pacific

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ABSTRACT
Miscellaneous lesions of the head, skull, teeth, trunk, appendages, skin and genital tract were observed in 94 out of 931 long-beaked common dolphins (*Delphinus capensis*) caught off Peru in 1985-2000. Several study subsamples were defined, depending on field sampling protocol, whether opportunistic or dedicated. Fourty dolphins showed at least two types of injuries or disease, affecting one or more organs. Some of the lesions were extensive and probably caused severe stress to the individuals. Violent, fisheries-related interactions were thought to have caused most of the traumas encountered. Prevalences of malformations and traumas of the skull were 2.9% and 1.9%, respectively. Lytic cranial lesions were present in 31.1% of dolphins (n= 103) and accounted for 84.2% of all skull injuries. Prevalence of *Crassicauda* sp. bone damage was 25.7% (n= 101) and was similar in both sexes and age classes. Infestation by *Crassicauda* sp. and tooth infections were responsible for, respectively, 78.8% and 6.1% of the lytic lesions. Adult dolphins showed a high prevalence of worn and broken teeth (36.8%, n= 19) as well as damaged alveoli (20%, n= 70). Prevalence of a condition referred to as 'paired teeth' varied between 4.5% (n= 22) and 20% (n= 10). Lesions of the head, body and appendages were observed in 11 dolphins and included traumas, congenital and acquired deformations, chronic fibrotic reaction of the subcutaneous tissue of the tailstock and chronic mastitis. Ovarian cysts suggestive of Graafian follicle cysts were observed in a lactating female. Prevalence of ovarian cysts was 4.2% (n= 24). Chronic orchitis with severe fibroplasia affected a mature dolphin which also had lysis in at least one caudal vertebra. Prevalence of orchitis was 1.3% (n= 78). Two immature dolphins suffered vesicular lesions of the penis, suggestive of herpesvirus (prevalence 16.7%, n= 12). Prevalence of cutaneous lesions, including punctiform-, coronet- and rounded marks, as well as dark circles and scars, depending on the sample varied between 3.6% (n= 56) and 44.4% (n= 27). One dolphin showed an abnormal pigmentation on one flipper, reminiscent of partial albinism.

KEYWORDS: LONG-BEAKED COMMON DOLPHIN, DISEASES, SOUTH PACIFIC OCEAN, OVARIAN CYSTS, ORCHITIS, SKULL LYSIS, *CRASSICAUDA* SP., SKIN LESIONS, MALFORMATIONS, TRAUMAS.

INTRODUCTION

As part of a comprehensive study of the biology of common dolphins (genus *Delphinus*) in Pacific South America, we investigated the occurrence of diseases and lesions in various organs and tissues, as well as congenital malformations. The chief purpose of the present study was to document base-line pathology and epidemiological information for the long-beaked common dolphin (*Delphinus capensis*), which is currently lacking; and search for diseases with the potential for a significant adverse impact on population abundance.

In the Southeast Pacific Ocean, the long-beaked common dolphin is known to inhabit neritic waters characterised by strong upwelling off Peru and Chile, south to at least 28ºS (Sanino *et al*., 2003; CEPEC, unpublished data). It is one of several delphinids that has suffered high levels of mortality in various types of fisheries in coastal Peru from about 1990 till date (Van Waerebeek and Reyes, 1994; Van Waerebeek *et al*., 1994, 1997, 1999, 2002). In contrast, short-beaked common dolphins (*Delphinus delphis*) are only occasionally landed. Off Peru, their habitat is essentially oceanic which puts them only infrequently in the path of fisheries operating on the continental shelf, resulting in comparatively low mortality levels and very few specimens to necropsy.

For *D. capensis*, to date we have documented infections by morbilliviruses, poxviruses and *Brucella* sp. (Van Bressem and Van Waerebeek, 1996; Van Bressem *et al.,* 1998, 2001a). Lesions of the skull as well as genital and lingual warts, possibly caused by papillomaviruses, were also reported in the Peruvian population (Van Bressem *et al.*, 1996, 2001b). Helminth parasites of *D. capensis* will be discussed separately.

This paper describes congenital and acquired lesions of the skull, head, trunk and appendages as well as of the skin and genital tract in *D. capensis* from coastal Peru. It aims to improve our knowledge of the pathological factors that may influence modal health, net recruitment and, thus indirectly, population size, and to stimulate further research into possible implications for management matters. Published information on diseases in common dolphins world-wide is reviewed as to broaden perspectives.

MATERIAL AND METHODS

Practically all study specimens of *D. capensis* were captured by fishermen, either in drift gillnets, purse-seine nets, or were harpooned, in coastal waters off Peru in the period 1985-2000. Specimens were collected or examined in a 1,050 km coastal strip, stretching from Playa Chucho, Paracas (13°48'S, 76°24'W), in southcentral Peru, to Parachique (05°34'S, 80°52'W), northern Peru. Biological and pathological data and samples were collected at the wharves where the dolphins were landed, or while beach-combing. A total of 931 individuals were examined, including one female landed still alive and euthanized, 869 fresh carcasses (most dead less than 24hours, condition 2; see Geraci and Lounsbury, 1993) and miscellaneous remains (conditon 3-5) of another 61 individuals. Different sample subsets depended on the unpredictable availability of carcasses and organs, as well as on the variable field conditions and research priorities of the scientists. Population biologists closely examined any aberrant morphology to evaluate for possible population-linked traits with taxonomic value, before classifying it as a congenital malformation or other pathology.

Dolphin specimens

Maturity, an important factor in epidemiological considerations, was recorded as accurately as possible. Dolphins were considered cranially mature when the supra-occipital suture showed advanced fusion, or when advanced fusion was observed in at least two of six indicative cranial sutures (Van Waerebeek, 1992, 1993).

Females were classified as sexually mature if the ovaries showed at least one corpus luteum (CL) or corpus albicans (CA), or if lactation or pregnancy (visible foetus) was evident (Van Waerebeek *et al.,* 1994). Field results were double-checked in the laboratory for 17 females by transverse sectioning of ovaries according standard techniques (e.g. Perrin *et al.,* 1976). The sexual maturity of 59 males was examined by histology of testes and epididymides (Hohn *et al*., 1985). In the absence of histological results, males were considered sexually mature if seminal fluid was detected in at least one freshly cut epididymis during macroscopical examination in the field. When sexual maturity status could not be determined directly, it was inferred based on a preliminary approximation for the mean standard body length (SL) at sexual maturation for this population; i.e. males below 215cm and females below 200cm were assumed immature (CEPEC, unpublished data).

Skulls and teeth

The crania of 106 specimens (75 complete skulls, 31 calvaria) of long-beaked common dolphins landed, or washed ashore, on the Peruvian coast in 1986-2000, were examined for the presence of bone lesions and abnormalities. The sample included 71 cranially adult dolphins (nine females, 32 males and 30 of unknown sex), 22 immatures (two males, two females and 18 of unknown sex) and 13 specimens of undetermined maturity. Skulls are deposited at the *Museo de los Delfines* (Pucusana, Peru) and ACOREMA's research collection (Pisco, Peru).

Tooth alveoli were checked in 103 specimens including 70 adults (32 males, 9 females, 29 of unknown sex), 22 juveniles (2 males, 2 females, 18 of unknown sex) and 11 dolphins of unknown maturity. Teeth were examined opportunistically in 23 dolphins, of which 20 were adults (3 females, 10 males, 7 of unknown sex), one immature

and two specimens of undetermined cranial maturity, the latter three of unknown sex. Prevalence rates in this sample should be considered approximate as the presence of teeth was not systematically recorded during the examination of the skulls. The presence of 'paired teeth' (a congenital malformation, see below) was checked also in 10 fresh dolphins (nine males, one female) caught off Cerro Azul in 1993 and one skull (MFB-221) of this sample was collected.

External lesions of the head, trunk and appendages

The complete, fresh carcasses of 861 long-beaked common dolphins were examined by at least one of the authors in 1985-1994. This sample was divided in two subsamples, depending on the scientists (data collectors), sampling periods and the ports where the animals were landed. Prevalence rates were estimated separately for each subsample.

"*Subsample A"*. The external features of 315 dolphins (135 females, 180 males) caught off central Peru (all but one) and Chimbote (09º05'S, 78º36'W) in 1985-1989 were examined by two of us (KVW and JCR), and lesions and abnormalities were recorded.

"*Subsample B"*. The external features of 546 dolphins (191 females and 355 males) caught off central and northern Peru in 1990-1994 were examined by several CEPEC scientists. More attention was given to any kind of aberrations and injuries in this period than in the former one.

Cutaneous lesions

Though dolphins were examined for injuries since 1985, cutaneous marks were not recorded systematically until late 1989. In 1991, we started to routinely examine and describe skin lesions (excluding tooth rakes) in *D. capensis*. The present study sample was divided into three subsamples considering the focus on the type of data, the scientists who collected them, the sampling periods and the ports where the animals were landed.

"*Subsample C"*. The external features of 315 dolphins (135 females, 180 males) caught off central Peru (all but one) and Chimbote in 1985-1989 were examined by KVW and JCR. During this period skin marks were reported opportunistically.

"*Subsample D"*. Twenty-seven freshly dead dolphins (11 females, 16 males) caught off Ancon (11º47'S, 77º11'W), central Peru, in 1991-1992 were visually checked by one of us (AGG) for the overall presence of skin injuries. However, natural history and monitoring, not skin pathology, were the research priorities and few lesions were photographed. Some unconscious bias to examine positive specimens may have occurred, therefore the estimated prevalence rate is an upper boundary indication.

"*Subsample E"*. The integument of a random sample of 56 dolphins (12 females, 44 males) taken off central and northern Peru (Culebras; two specimens) in 1993-1994, were inspected by MFB, KVW, KOS and AGG in great detail in search of tattoos, herpesvirus skin lesions and other skin marks. This unbiased sample provides a precise prevalence rate estimate.

Genital tract

"Subsample F". The ovaries of 24 females (14 mature, 10 immature) landed at ports of central and northern Peru in 1987-1993 were directly checked for the presence of diseases and abnormalities. The ovaries of 18 of these specimens were also examined by histology. The uterus of two mature females were also examined for lesions. The testes of 78 males (42 immature, 35 mature, one of unknown maturity) from central and northern Peru in 1987-1994 were examined directly. Sections of the testes of 60 specimens were also examined histologically. The penis of 12 dolphins were checked in the context of a study of genital warts (Van Bressem *et al.*, 1996). Prevalence rates were determined.

"*Subsample G"*. Standardised specimen datasheets and miscellaneous data on file at the CEPEC field station (Pucusana, Peru) relating to 65 females (51 immature, 14 mature) and 61 males (45 immature, 16 mature), captured off central Peru in 1985-1992, were examined for references to lesions of the genital tract.

Laboratory protocols

Representative tissue samples were fixed in a 10% buffered formaldehyde solution, dehydrated in a graded series of ethanol and embedded in paraffin wax. Tissue sections (5 µm) were stained with haematoxylin and eosin (HE). Ultrathin sections of skin lesions from five long-beaked common dolphins (*Subsample D*) were screened for virus particles by transmission electron microscopy (TEM), following methodology described in Van Bressem *et al*. (1993a).

Statistical testing

We examined whether the prevalence of the lesions varied with sex and sexual or cranial maturity (as a proxy for age). To determine whether the prevalence of skull injuries and malformations was related to the age of the animals we split the sample into cranially mature and immature individuals. Specimens for which we could not establish with certainty that the alterations observed where pathological were excluded from statistical tests, which explains some differences in sample sizes. Significance of differences in prevalence (α= 0.05) was verified with chi-square contingency tests or one-tailed Fisher's Exact tests (Swinscow, 1981).

RESULTS

With few exceptions, earlier studies of diseases in *Delphinus* spp. world-wide (Table 1) covered small samples, including many observations based on single individuals, and thus lacked epidemiological perspective.
Miscellaneous lesions of the skull, teeth, head, trunk, appendages, skin and genital tract were observed in 94 out of 931 dolphins. Twenty-three specimens had at least two types of lesions that affected one or more organs/tissues (Table 2). When previously published data on tattoo skin disease and warts were pooled with the present findings, the sample size increased to 40 (Table 2). A large, both sexually and cranially mature, male (KVW-2403) had injuries in at least six different organs (Table 2). Violent interactions with fishing gear or other human activities, including harpooning, were the main cause of severe traumas observed in the skull, head, trunk and appendages (see below) in a least 75% (n =8) of affected dolphins.

Lesions of the skull

Osteomyelitis.
Acute or chronic bone infection characterised by bone destruction and new bone formation is observed in two mature dolphins of unknown sex (Table 3). An area of *ca.*50mm diameter of irregular new bone, including two thorn-like protuberances and a 7x7mm fenestration, is visible on the left pterygoid and palatine of one skull (KVW-2401). Further, 55mm of the outer edge of the left maxillary at the base of the rostrum is deformed by bone lysis .

Another skull (KVW-2400) shows a large area (35 x 24mm) of bone destruction on the latero-dorsal side of its left mandible, behind the tooth row. The bone lining the cavity has a rough aspect and presents several longitudinal depressions, each about 4mm deep.

Osteolysis.
Bone dissolution that, with the exception of one case, did not seem related to *Crassicauda* sp. nematode infection was detected in five dolphins (Table 3).

In a cranially mature male (JAS-17), a channel-like fistula is apparent in the left maxillary, from the dorsal surface of alveolus #16 traversing vertically the maxillary to open ventrally. Adjacent lytic lesions on the ventral side of both maxillaries and on the right premaxillary are likely the continuation of the fistula. Several alveoli on the left maxillary are occluded and, at two sites, the interalveolar septa has disappeared being replaced by spongiform bony tissue. The fistula and other lytic lesions likely originated from caries and spreading infection. A small channel (40x50mm large) exists in the left maxillary of a mature male (RBC-19), opening on the dorsal side of alveolus #33 and perforating the bone through to the ventral side. Also this lesion was probably caused by tooth infection.

In a mature dolphin of indeterminate sex (AGG-621), a 20 x 10mm lytic lesion on the ventral side of the right maxillary communicates with the palatine sinus. Its aetiology is unknown but *Crassicauda* sp. infestation was excluded on the basis of its appearance.

In another mature dolphin of unknown sex (MFB-174), a 24mm-wide area of bone erosion and a perforating fistula is present on the ventral side of the left maxillary, under the left palatine keel. The bony tissue lining the basket-like lesion is irregular. The appearance suggests *Crassicauda* sp. as primary cause, possibly exacerbated by bacteral infection. A small, 8mm wide, fistula is seen 60mm closer to the neurocranium.

In an immature skull of indeterminate sex (MFB-756), the distal extremities of the premaxillaries are partially dissolved and slightly deformed over a 71mm distance. The origin of this lesion is unknown.

Crassicauda sp. cranial bone lesions.
The adult roundworm *Crassicauda* sp., one of the two largest nematode species parasitising cetaceans, infests the cranial sinuses. Crassicaudids are associated with round, lytic bone lesions with a basket-like appearance, most commonly observed in the pterygoids (e.g. Geraci and St Aubin, 1987). Such lesions were found in 18 adults, five immatures and three dolphins of unknown maturity (Table 3). Ninety-six percent of the 26 *Crassicauda* sp. infested dolphins showed perforated, misformed, or otherwise weakened pterygoid bones. Besides, the frontal, alisphenoid, palatine, maxillary and exoccipital bones were occasionally affected. *Crassicauda* injuries were extensive in three of the five immatures and in four of the 18 infested adults.

Congenital and acquired malformations
In a cranially mature female (JCR-1351), the distal half of the rostrum is curved upwards, its extremity forming an approximate 45° angle relative to normal rostrum axis. The mandible is 1cm shorter than the maxillaries and premaxillaries (inferior brachygnatism) and the tooth rows are oriented laterally, especially on the maxillaries. The skull of a mature male (RBC-21) shows a slight lateral deviation of the distal extremity of the mandible. In a mature female (MFB-191), an unusual 50 x 3 x 2mm crest is present on the distal half of the left maxillary.

Traumatic lesions

In a mature specimen of unknown sex (MFB-741), the ventral side of the proximal extremity of the left mandibular ramus is thicker than the surrounding bone and presents a dark line laterally, presumably a line of re-ossification. The ramus had likely suffered a fracture which subsequently healed.

Two abnormal holes (diameters 15mm and 5mm) with irregular edges perforate the occipital bone, close to the left condyle in the skull of a mature male (KVW-994). No other abnormal apertures are visible. These lesions are thought to have been inflicted either by gunshots or a pointed, spear-like object, but did not kill the animal. It died later from another encounter with fisheries.

Epidemiology

Lesions and abnormalities of the skulls (not including those of the alveoli and teeth) were observed in 36 of 103 dolphins (35%). The skulls of the four males and females cranially immature were healthy. Prevalences of malformations and traumas were 2.9% and 1.9%, respectively. Lytic lesions, including those caused by *Crassicauda* sp. and associated with osteomyelitis were seen in 32 of 103 dolphins (31.1%) and accounted for 84.2% of all injuries. Prevalence of osteolysis and osteomyelitis was similar in cranially adult females (22.2%, n= 9) and males (22.6%, n= 31) and sexes were pooled for further analysis. Prevalence of these lesions was similar (χ^2= 0,331, 1 df, P= 0,56) in adults (33.8%, n= 68) and immatures (27.3%, n= 22). Prevalence of *Crassicauda* sp. cranial bone damage was 25.7% (n= 101). However, this should be considered a minimum rate, as pterygoids were missing or broken in at least three 'negative' specimens. There was no significant difference (Fisher's, P= 0.8) in prevalence of crassicaudiasis between cranially adult females (25%, n= 8) and males (19.4%, n= 31) and sexes were pooled. Prevalence of *Crassicauda* injuries was similar in cranially immatures (22.7%, n= 22) and adults (27.3%, n= 66). *Crassicauda* sp. infestation caused 78.8% (n= 33) of the observed lytic lesions.

Dental and periodontal diseases

Teeth are broken or damaged in nine individuals (7 adults, 2 unknown maturity). Four of these show also lesions of the alveoli. In a large, cranially adult male, 21 teeth are severely worn and broken.

One to four sets of 'paired teeth' (two teeth, typically of unequal size, inserted in parallel at a single alveolus locus) were observed on both maxillaries in two of 10 freshly dead dolphins. Two paired teeth are also noted on the right maxillary of an adult specimen but not in cranial material of 21 other dolphins.

The alveoli of 16 dolphins are enlarged or partially/totally filled by new, cancellous bone formation. Both maxillaries and mandibles are affected. The number of occluded alveoli per individual varies from 1-60.

Dental and periodontal infections were responsible for at least 6.1% of all the lytic lesions of the skull. Prevalence of acquired lesions of the teeth was 39.1% in 23 specimens and 36.8% in 19 adults. Prevalence of paired teeth varied between 4.5% (n= 22) and 20% (n= 10). Partially or fully occuded alveoli were observed in 16 of 103 (15.5%) dolphins. Fourteen were cranially adult while the maturity of the two others is unknown. Prevalence of lesions of the alveoli was 20% in 70 adults. Two of nine (22.2%) adult females and 11 of 32 (34.4%) adult males were affected.

Lesions of the head, trunk and appendages

"Subsample A".

Backbone and appendages. Serious injuries and deformations of the backbone, dorsal fin and flippers were observed in four of 315 (1.27%) long-beaked common dolphins examined in 1985-1989 (Table 3). In a 184.5cm female (KVW-522) the distal end of the right mandibular ramus had been fractured and subsequently healed. The tip of the dorsal fin had been chopped off, and the remaining part healed, in a mature male (KVW-568). Another mature male (KVW-582) showed a seriously twisted dorsal fin. A 171.5 cm female (KVW-1426) had a posterior and lateral deformed spine (scoliokyphosis).

Mastitis. A nodule, field-labelled 'cyst ano-genital', was sampled from tissues associated with the mammaries of a pubescent female (KVW-523). Microscopically, there was an inflammation of the acinar and ductular tissue associated with diffuse, focally severe lympho-plasmacytic infiltrate. Several large granulomas containing hyaline material and numerous giant cells were observed. There was no evidence of any remnants of parasites. The lesion was diagnosed as a chronic mastitis and could have been caused by a parasitic (e.g. *Crassicauda* sp.) or a bacterial infection.

"Subsample B".

Backbone and appendages. Injuries and serious, externally visible deformation of the spine and tailstock were observed in two of 546 (0.37%) dolphins examined in 1990-1994 (Table 3). The first case, an immature female (AGG-405), had a large nodule on the left side of the tailstock and suffered severe kyphosis at thorax height. Microscopically the nodule showed a mass of subcutaneous fibrous tissue containing a sparse infiltrate of inflammatory cells. Some muscle tissue was caught up in the general inflammatory reaction and fibrosis, but there was no evidence of any 'primary" muscle disease. The lesion was diagnosed as a chronic fibrotic reaction due to an infection or trauma. This animal suffered also a severe poxvirus infection, evidenced by an unusually high density of tattoo skin lesions spread over its entire body. The second case, a mature male (KVW-2403), had a large nodule on

the right side of the tailstock. Upon exposing the vertebrae, a large lytic lesion involving at least one caudal vertebra was observed. The same animal suffered a chronic orchitis (see below). Prevalence of large tailstock lumps is 0.37%.

Severely torn tissues, apparently with dislocated glenoid articulation, in at least one of the flippers was reported in two mature dolphins (RBC-21,-22) landed together, presumably from the traumatic net-entanglement that caused their death.

Rostrum . Fibrous tissue (5mm) was seen protruding on the left side of distal extremity of the beak as well as on the left mouth gape in an adult male (MFB-189). We believe these were healed lesions. Inferior brachygnatism (i.e. maxillaries longer than the mandible) was observed in a female of unknown sexual maturity (MFB-220). This female presented another congenital malformation i.e. four sets of paired teeth on both maxillaries.

Cutaneous lesions

"Subsample C".

Tattoo marks were detected in at least one specimen. Tattoo marks were distributed over the entire body surface of a cranially immature female caught in January 1986. This case is the earliest confirmed report of tattoo skin disease in cetaceans from Peru.

Scars were seen in a male and a female. A 'white area (3.5 cm) underside of left fluke' in a female (JCR-1573) may represent a scar or a discoloration of other origin.

"Subsample D".

Punctiform marks. Dark points perceptible by the touch, with or without a pit in the centre were observed in 12 (7 females, 5 males) of 27 (44.4%) dolphins caught off Ancon in 1991-1992. All were immature but two females (AGG-566 of 198cm and AGG-576 of 199cm) of unknown maturity. The marks were restricted to the head in three cases and generalised in the others. Poxvirus particles were found by TEM in samples of skin marks described as 'tenuous points with a faint depression' scattered on the whole body of an immature male (AGG-573; D. Dekegel and G. Van Heule, pers. comm. to MFB, May 1991), which did not have typical tattoos. Punctiform marks of the other dolphins were not examined by TEM.

Rounded marks. Many tenuous rounded marks distributed on the whole body were observed in an immature male (AGG-567). Unidentified parasites and virus particles were observed by TEM in samples of these lesions (D. Dekegel and G. Van Heule, pers. communication to MFB, May 1991).

"Subsample E".

Punctiform marks. These marks were reported in three of 56 (5.35%) dolphins caught off Cerro Azul, Pucusana and Culebras in 1993-1994. The positive specimens included two males and a female, all likely immature.

Coronet marks. One to three coronet marks were observed on the belly of two of 56 (3.6%) dolphins caught off Cerro Azul in 1993. The female and male affected were likely immature.

Rounded marks. A few, or several (20-30), dark rounded marks up to 10mm in diameter were noticed ventrally and on the flanks of seven of 56 specimens (12.5%). All marked dolphins were males and two of them were sexually mature.

Dark circles. Some to several dark circles measuring about 2mm in diameter were observed on the belly and flanks of five of 56 (8.93%) dolphins. All were males and included one adult, three immature and one of unknown maturity. The adult male (MFB-229) had a very high number of these lesions, a low density of tattoo marks and was noticeably thin. Because of their location, appearance, density and epidemiological features we believe that the rounded marks and the dark circles are the same lesions at different stages. No further research was carried out to determine their aetiology.

Non-linear, fibrous scars. Whitish-grey non-linear scars were observed in 15 of 54 (27.8%) dolphins. All but one dolphin (a 221cm male of unknown maturity) were confirmed or presumed sexually immature. Prevalence of scars appeared to be higher in females (36.4%, n= 11) than in males (25.6%, n= 43) but not significantly so ($\chi^{2=}$ 0,5, df= 1, P= 0,48). The scars were present on the head, flanks, flippers and tailstock and occurred in low numbers (one to four). Scar size varied between 28x15mm and 85x30mm. A small abscess was associated with one scar in a female (MFB-225). Their appearance suggested that they had not been caused by bites or tooth rakes from conspecifics or other large animals.

Anomalous pigmentation. White spots were observed on the distal extremity of the left flipper of an immature male (MFB-675). The skin was otherwise smooth and looked healthy. These spots evoked piebaldness, a genetic melanization defect also known as partial albinism (Comings and Odland, 1966, Van Waerebeek, 1992). Prevalence of this defect was 1.8% (n= 56).

Genital lesions

"Subample F".

Ovarian cysts. In the field a large (19x17x15mm) cyst was found on the left ovary of a lactating dolphin (MFB-191). After slicing the ovary, several smaller cysts were detected (Table 3), all of which contained a gelatinous material. A

corpus luteum (10x10mm) was also present and contained a similar (grey: check) gelatinous mass. Microscopically, several cysts of variable size lined by thin layers of epithelium with abundant basophilic cytoplasm were observed. The cysts were suggestive of Graafian follicle cysts. No abnormal cystic structures were noticed in the ovaries of 23 other females. Prevalence of ovarian cysts in this sample was 4.2% (n= 24).

Orchitis. Two abscesses affected the right testis of a sexually mature male (KVW-2403) (Table 3). Microscopically, a sample of one contained a large lesion consisting of marked fibroplasia and mild diffuse lympho-plasmacytic inflammatory cell infiltration. Many seminiferous tubules were degenerated or necrotic and mineralised. Degenerate and necrotic tubules contained large numbers of macrophages and neutrophils. A few necrotic ductules were mineralised. The lesion was diagnosed as a chronic orchitis with severe fibroplasia. This dolphin presented also a hard mass on the right side of its tailstock (see above). Prevalence of orchitis was 1.3% in this sample (n= 78).

Vesicular lesions of the penis. Several congested zones and some small vesicles were present on the penis of an immature dolphin (MFB-510). A white and ulcerated vesicle was visible at the basis of the penis of another immature animal (MFB-675) (Table 3). Macroscopically, the vesicles did not resemble the genital warts previously described in this species (Van Bressem *et al.*, 1996) but resembled genital herpesvirus lesions. Prevalence of the disease was 16.7% (n= 12) .

"Subsample G".
There was no mention of lesions of the genital tract in the available database relating to the 65 females and 61 males examined on the central Peruvian coast in 1985-1992.

DISCUSSION

During this study miscellaneous lesions were observed on the skull, teeth, head, trunk, appendages, skin and genital tract of *D. capensis* from Peru. Though some of these were severe, none seemed lethal in the short-term. The highest prevalence of lesions was observed in the teeth (39.1%), skull (35%), penis (16.7%) and skin (up to 44.4% depending on the type). Fourty dolphins had at least two types of injuries that affected one or more organs. Multiple lesions of various organs have been described in the harbour porpoise (*Phocoena phocoena*), short-beaked common dolphin, striped dolphin (*Stenella coeruleoalba*), bottlenose dolphin and Risso's dolphin (*Grampus griseus*) from British waters (Baker 1992; Baker and Martin, 1992) as well as in beluga (*Delphinapterus leucas*) from the St Lawrence estuary (De Guise *et al.* ,1995) to cite a few.

Osteolysis was the most common lesion in the skull of *D. capensis* from Peru. Infestation by *Crassicauda* sp. and tooth infections were responsible for 78.8% and 6.1% of observed osteolysis, respectively. The aetiology of the remaining osteolytic injuries is unknown. Prevalence of *Crassicauda* sp. was 25.5%, much lower than that observed in offshore bottlenose dolphins (*Tursiops truncatus*) (68.8%, n= 16) from the same region (Van Waerebeek *et al.*, 1990) but higher than that reported in dusky dolphins (*Lagenorhyncus obscurus)* (range 0.37%, n= 267 - 4.3% n= 46) from Peruvian and Chilean waters (Van Waerebeek *et al*., 1993; Montes-Iturrizaga, 2003). Interestingly, prevalence of *Crassicauda* – linked skull damage did not vary with cranial maturity status in *D. capensis* and extensive lesions were observed in both mature and immature specimens. Prevalence of these lesions lowered with age in spotted dolphins (*Stenella attenuata*) from the Eastern Tropical Pacific, a fact that was attributed to mortality caused by *Crassicauda* sp. infestation in young dolphins (Perrin and Powers, 1980). It is possible that the alterations caused by this nematode did not cause a significant mortality in *D. capensis.* Alternatively, heavily infested young dolphins may die but infestation of mature dolphins that had escaped it in their childhood may result in a similar prevalence among both age classes.

Adult dolphins showed a high prevalence of worn and broken teeth as well as lesions of alveoli. The latter are likely a consequence of tooth decay and loss as discussed by De Smet (1977). The loss of a high number of teeth with resulting damages to the alveoli and, eventually, lysis of surrounding bone tissue, as seen in some dolphins (JAS-17 and RBC-19), probably caused considerable physiological stress. De Smet (1977) reported that tooth lesions were common in a sample of 12 *T. truncatus* originating from different ocean provinces or kept in captivity. Worn and missing teeth were also described in five of 32 (juveniles and adults) *P. phocoena* from British waters (Baker and Martin, 1992). Periodontal disease was also observed in *T. truncatus, L. obscurus*, short-finned pilot whale (*Globicephala macrorhynchus*), long-finned pilot whale (*G. melas*), Risso's dolphin (*Grampus griseus*) and Burmeister's porpoises (*P. spinipinnis*) from Peruvian waters (Montes-Iturrizaga, 2003).

Cranial bone fractures were found only in the mandible and were uncommon (prevalence: 1.33%, n= 75). This injury may have been inflicted by a conspecific or by violent interaction with fishing gear. Mandible fractures have been described in *P. phocoena* and *T. truncatus* from the North Sea as well as in the *T. truncatus*, *G. macrorhynchus* and dusky dolphin from the SE Pacific (Van Bree and Duguy, 1970; Montes-Iturrizaga, 2003). Prevalence of these fractures varied between 3.2% in 31 *L. obscurus* and 7.3% in 55 *T. truncatus* (Montes-Iturrizaga, 2003).

Other traumas of the skull, body and skin in several specimens of Peruvian *D. capensis* likely were caused by fisheries interactions. In dolphin KVW-994, bone perforations were possibly inflicted by a lance-like object or a gun. Perforation of the skull by a gunshot was observed in a *D. delphis* from Senegal that had managed to survive the wound (Cadenat, 1959 *in* Van Bree and Duguy, 1970) as well as in a *L. obscurus* from Peru (Montes-Iturrizaga, 2003). Two other dolphins of present study (RBC-21 and -22) probably hurt flippers while attempting to escape the nets that eventually killed them. Dolphins KVW-522, KVW-568 and MFB-189 likely succeeded to escape an earlier capture but not without injuring flippers, dorsal fin and rostrum. One female (AGG-405) showed a chronic subcutaneous fibrotic reaction on the tailstock, possibly due to some net-caused trauma. In at least another 11 dolphins, scars observed on the appendages and head may have been the remnants of wounds inflicted when struggling to free themselves from fishing devices. Undocumented, white-grey scars seen on the back of several *D. capensis* caugth off Ancon in 1991-1992 are believed to be the result of healed harpoon wounds (Garcia-Godos, CEPEC, unpublished data). Traumas due to fishing devices likely result in the death of several dolphins that were injured but managed to escape. Therefore, total fisheries-caused dolphin mortality is thought to be higher than the tallying of landed specimens can account for. Captures of long-beaked common dolphins in industrial purse-seine nets, including from directed sets, were very frequent in coastal Peru till at least 1994.

Malformations of the skull and trunk were observed in several dolphins but their prevalence in the population was low. The most striking malformation was the likely congenital curvature of the rostrum of female JCR-1351. However, though it had probably reduced the ability of the dolphin to catch its prey and may have stunted its growth, the deformation was not lethal. Other congenital malformations of the skull and teeth were less spectacular and likely of little consequences for the dolphins' survival. Two individuals (KVW-582 and -1426) showed malformations of the dorsal fin and backbone. Its is unknown whether these were congenital or acquired. Deformities of the dorsal fin and backbone have been reported from other small cetaceans such as the killer whale *Orcinus orca*, common dolphin (likely *D. delphis*), *T. truncatus* and Hector's dolphin *Cephalorynchus hectori* (Visser, 1998; Berghan and Visser, 2000; Wilson *et al.*, 1997). Classification and possible origins of backbone deformities in cetaceans are discussed in Berghan and Visser (2000).

Chronic mastitis, possibly from a parasitic (e.g. *Crassicauda* sp.) or bacterial infection, was observed in a pubescent female. Acute and chronic mastitis have been described in several odontocetes including *D. delphis*, Atlantic white-sided dolphin (*Lagenorhynchus acutus*), *S. coeruleoalba*, *T. truncaus*, *D. leucas* but not in *D. capensis* (Sweeney and Ridgway ,1975; Geraci *et al.*, 1978; Di Guardo *et al.*, 1995; De Guise *et al.*, 1995, Kuiken *et al.*, 1994). The disease was caused by the nematode *Crassicauda grampicola* in *L. acutus* while *Aeromonas hydrophila* and *Edwardsiella tarda* were isolated in a *D. leucas* and *T. truncatus*, respectively. *Crassicauda* sp. have not been extracted from the mammary glands of Peruvian small cetaceans, but few mammaries were examined in any detail (Van Waerebeek, unpublished data).

Cysts of the ovary, possibly Graafian follicle cysts, were found in a lactating female. Prevalence of ovarian cysts was 4.2% (n= 24, *subsample F*) in *D. capensis*, similar to that observed in *L. obscurus* from the same region (3.06%, n= 98; Van Bressem *et al*. 2000 [*sample I*]). Ovarian cysts, including Graafian follicle cysts and luteinized cysts, have also been observed in *L. obliquidens*, *D. leucas* and *S. coeruleoalba* (Harrison *et al.*, 1972; De Guise *et al.*, 1995; Munson *et al.*, 1998). The aetiology of Graafian follicle cysts is not known in dolphins. In cattle, they are caused by an abnormal surge or release of luteinizing hormone (McEntee, 1990; Kennedy and Miller, 1993).

The chronic orchitis in adult male KVW-2403 may have caused the bone lesions observed in the caudal vertebrae. Indeed, bacterial and fungal diseases of the urinary tract and testes are common sources of infection in animals suffering vertebral osteomyelitis (Kornegay and Barber, 1980). Interestingly, *Brucella* sp. are one of the infectious agents that can lead to vertebral osteomyelitis in humans and dogs (Kornegay and Barber, 1980; Rajapakse 1995) as well as orchitis in mammals. *Brucellae* are known to circulate among Peruvian *D. capensis* (Van Bressem *et al.*, 2001a) and would be a plausible cause for the orchitis and the vertebral lesions in KVW-2403. Among small cetaceans, orchitis is described only from Amazon river dolphin (*Inia geoffrensis*) and *T. truncatus* (Simpson and Gardner, 1972; Sweeney and Ridgway, 1975). Vertebral osteomyelitis was reported from a captive *T. truncatus* (Alexander *et al.*, 1989).

The aetiology of vesicular lesions of the penis found in two immature *D. capensis* during this study (16.7% prevalence, n= 12, *subsample F*) is unknown, but herpesviruses are possible agents. Members of the *Alphavirinae* subfamily cause vesicles, pustules and shallow ulcers in the genital tract of humans, bovines and horses (Whitley *et al.*, 1990; Fenner *et al.*, 1993). Herpesviruses were also briefly reported in lesions of the cervix and penis of harbour porpoises (Ross *et al.*, 1994).

Besides tattoo skin lesions reported on earlier (Van Bressem and Van Waerebeek, 1996), several other skin defects were observed during the present study, however the aetiology of most remains indeterminate. Poxvirus particles were observed by TEM in 'punctiform marks' sampled in an immature male from *subsample II*. These marks may have been ring lesions, the early form of tattoos (Geraci *et al.*, 1979). In cetaceans poxvirus particles have always been associated with tattoo lesions and ring lesions (Geraci *et al.*, 1979; Flom and Houk, 1979, Van Bressem *et al.*, 1993a). Tattoos and 'punctiform marks' occurred together in some specimens (see Table 2). Herpes-like virus particles were found in skin marks described as 'black points' that occurred on the rostrum of two *L. obscurus* (Van Bressem *et al.*, 1994). They may have caused some of the 'punctiform marks' observed in *D. capensis* during this

study. It is possible that lesions of at least two different aetiologies were included under the term 'punctiform marks' in 1991-1992. This could partly account for the subsequent differences in prevalence of these marks between *subsample II* (44.4%) and *III* (5.35%). Rounded marks were detected in *subsamples II* and *III*. Unidentified parasites and virus particles were visible by TEM in samples of these marks taken in one dolphin. The examination of more samples by this technique is necessary to determine the aetiology of the skin marks other than tattoos. The location, appearance, density and epidemiological features of the rounded marks and dark circles observed in *subsample III* suggest that they are the same lesions at different developmental stages.

Long-beaked common dolphins from the SE Pacific were affected by organic, congenital, traumatic and infectious diseases. Some of these were severe and probably caused considerable stress. Of all diseases encountered, morbillivirus(es), poxvirus(es) and *Brucella* sp. infections appear to have the highest potential for significant adverse impact on population abundance by increasing natural mortality and/or by negatively affecting reproduction (Van Bressem *et al*., 1999). Interactions with both artisanal and industrial fisheries on the continental shelf are responsible for the large majority of human-induced mortality, and are thought to be the principal cause of debilitating physical traumas in this dolphin population. The feasibility to apply fishing gear modifications and other potential by-catch mitigation measures should be re-evaluated in the region as a relevant marine mammal conservation issue.

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Species	Type of Disease	Ocean province	Source
	Organic diseases (minus bones)		
D. delphis ponticus	Fibroma on surface of right testis	Black Sea	Birkun *et al*., 1998
D. delphis	Multicentric cholangiocarcinoma	Coasts of UK	Baker, 1992
D. delphis	Cystic pancreas	Coasts of UK	Baker, 1992
D. delphis	Interstitial nephritis	Coasts of UK	Baker, 1992
D. delphis	Hydrocephalus	Coasts of UK	Baker, 1992
D. delphis	Vaginal calculi	NE Atlantic; coasts of UK; NE Pacific	Sawyer and Walker, 1977; Baker, 1992; Lopez and Benavente, 1993
D. delphis	Gastric leiomyoma	NE Pacific	Cowan *et al*., 1986
D. delphis	Cardiac lesions	NE Pacific	Cowan *et al*., 1986
D. delphis	Arterisclerosis	NE Pacific	Cowan *et al*., 1986
D. delphis	Vaginal mass	NE Pacific	Benirscke *et al*., 1984
D. delphis	Epididymal abcess associated with *Monorygma* sp.	NE Pacific	Cowan *et al*., 1986
D. delphis	Leydig cell tumour (testes)	NE Pacific	Cowan *et al*., 1986
D. delphis	Gastric ulceration	NE Pacific; coasts of UK	Cowan *et al*., 1986; Baker, 1992
	Osteopathology		
D. delphis	Malformations of the cranium	Port Philip Bay, Australia (Indian Ocean)	Dixon, 1984
D. delphis	Fibrous osteodistrophy	NE Pacific	Flom *et al*. 1978
D. capensis	*Crassicauda* sp. lesions in pterygoids, frontals, alisphenoids, palatines, maxillaries and exoccipitals	SE Pacific	Van Bressem *et al*., 2001b; Montes-Iturrizga, 2003; this paper
D. capensis	Osteomyelitis in pterygoid, palatine, mandible	SE Pacific	Van Bressem *et al*., 2001b; Montes-Iturrizga, 2003; this paper
D. capensis	Osteolysis of the maxillaries and premaxillaries	SE Pacific	Van Bressem *et al*., 2001b; Montes-Iturrizga, 2003; this paper
D. capensis	Traumas (healed fracture and perforations)	SE Pacific	Van Bressem *et al*., 2001b; Montes-Iturrizga, 2003; this paper
D. capensis	Congenital and acquired malformations (maxillaries, premaxillaries and mandibles)	SE Pacific	Van Bressem *et al*., 2001b; Montes-Iturrizga, 2003; this paper
	Dental and periodontal diseases		
D. capensis; D. delphis	Broken, worn and missing teeth	Coasts of the UK; SE Pacific	Baker 1992; Montes-Iturrizga, 2003; this paper
D. capensis	Paired teeth	SE Pacific	Montes-Iturrizga, 2003; this paper
D. capensis	Occluded alveoli	SE Pacific	Montes-Iturrizga, 2003; this paper
	Infectious diseases		
D. capensis; D. delphis	Morbillivirus infection	E. Pacific; North Atlantic; Mediterranean Sea; coasts of NW Europe	Duignan *et al*., 1995; Reidarson *et al*., 1998; Van Bressem *et al*., 1993b 1998; Visser *et al*., 1993
D. delphis ponticus	Morbillivirus infection	Black Sea	Birkun *et al*., 1998
D. capensis	Tattoo skin disease (poxvirus)	SE Pacific	Van Bressem and Van Waerebeek, 1996
D. capensis	Genital warts (possibly papillomavirus)	SE Pacific	Van Bressem *et al*., 1996
D. capensis; D. delphis	*Brucella* sp. infection	SE Pacific, NE Atlantic, North Sea, Mediterranean Sea	Ross, H.M. *et al*., 1996; Jepson *et al.* ,1997; Van Bressem *et al*., 2001a
D. delphis	Dolphin rhabdovirus-like virus (DRV) infection	likely coasts of NW Europe (specific origin not given)	Osterhaus *et al*., 1993
Delphinus spp.	Bacterial pneumonia	SE Pacific; NE Pacific; coasts of UK	Sanino *et al. 2002*; Cowan *et al*., 1986; Baker, 1992
Delphinus spp.	Bacterial enteritis	Unknown (captive individual)	Sweeney and Ridgway, 1975

Table 1. World-wide review of diseases reported in *Delphinus delphis* and *D. capensis.*
Abbreviations are: NE= northeast, SE= southeast, NW= northwest

Specimen number		Day	Month	Year	Locality	Sex	SL	Cranial maturity	Sexual maturity	Organs affected	Lesions
AGG	591	18	2	92	Ancon	F	152.5	indet	imm	Skin	Tattoos, punctiform marks
AGG	405	5	9	91	Ancon	F	167.5	indet	imm	Body, skin	Chronic fibrotic reaction on tail stock, kyphosis, tattoos
AGG	603	25	2	92	Ancon	F	171	indet	imm	Body, skin	Punctiform marks on the whole body, very thin animal
KOS	123	19	6	93	Cerro Azul	F	174.5	indet	indet	Skin	Tattoos, three scars on tailstock
KVW	522	11	1	87	Pucusana	F	184.5	indet	imm	Flipper, skin	Scar, broken and healed ramus
AGG	575	17	11	91	Ancon	F	186	indet	imm	Skin	Tattoos, punctiform marks on the whole body
AGG	592	18	2	92	Ancon	M	191.5	indet	imm	Skin	Tattoos, punctiform marks on the whole body
MFB	219	15	5	93	Cerro Azul	M	192	indet	imm	Teeth, skin, genital slit	Tattoos, scar, genital papilloma, paired teeth
MFB	226	4	6	93	Cerro Azul	M	>194	indet	indet	Skin	Tattoos, dark circles
AGG	735	27	2	93	Culebras	F	196.2	indet	indet	Skin	Tattoos, punctiform marks on the head
MFB	265	8	8	93	Cerro Azul	M	197	indet	indet	Skin	Tattoo, one abcess on the belly containing *Monorygma* sp., one scar on the right side
AGG	576	17	11	91	Ancon	F	198	indet	indet	Skin	Remains of tattoos, punctiform marks on the whole body
KOS	94	2	6	93	Cerro Azul	M	198	indet	imm	Skin	Tattoos, scar
AGG	606	1	3	92	Ancon	M	199.5	indet	imm	Skin	Tattoos, punctiform marks all over the body
MFB	269	8	8	93	Cerro Azul	M	199.5	indet	indet	Skin	Tattoos, punctiform marks on belly
MFB	312	27	10	93	Cerro Azul	M	200	indet	indet	Skin	Tattoos, dark circles, scar
MFB	675	9	7	94	Cerro Azul	M	200.5	indet	imm	Skin, penis	Tattoos, vesicular lesions on penis, anomalous pigmentation on flipper
MFB	86	26	3	93	Cerro Azul	M	200.7	indet	imm	Skin	Coronet marks, scar
MFB	220	15	5	93	Cerro Azul	F	202	indet	indet	Teeth, beak, genital slit	Inferior brachygnatism, paired teeth, genital papilloma
MFB	510	18	5	94	Cerro Azul	M	207	indet	imm	Penis, skin	Tattoos, rounded skin marks, vesicular lesions on penis
MFB	87	26	3	93	Cerro Azul	F	209.9	indet	indet	Skin	Tattoos, scar
MFB	508	17	5	94	Cerro Azul	M	210.5	indet	imm	Skin	Tattoos, rounded marks.
MFB	191	13	5	93	Cerro Azul	F	211.5	mat	mat	Skull, ovary	Crest on rostrum, multicystic ovary
MFB	259	8	8	93	Cerro Azul	M	214	indet	imm	Skin	Tattoos, dark circles
MFB	229	6	6	93	Cerro Azul	M	224.5	mat	mat	Skin, body	Dark circles, tattoos, emaciated
MFB	142	15	4	93	Cerro Azul	M	226.5	mat	mat	Skull, alveoli, skin	Tattoos, lesions of alveoli, extensive *Crassicauda* sp. lesions in pterygoid
KVW	2404	31	5	94	Pucusana	M	228.5	mat	mat	Teeth, skin	Broken teeth, rounded skin marks, lingual warts
RBC	21	26	3	93	Chimbote	M	234	mat	mat	Skull, alveoli, flipper	Insertion of flipper broken, lesions of alveoli, congenital malformation of the beak
AGG	761	12	8	93	Chimbote	M	236.5	mat	mat	Skin	Tattoos on the belly, punctiform marks on back
KOS	90	1	6	93	Cerro Azul	F	239.5	mat	mat	Skull	Lesions of the alveoli, broken teeth
RBC	17	26	3	93	Chimbote	M	240	mat	mat	Skull, alveoli	Lesions of the alveoli, *Crassicauda* sp. lesions in pterygoid
MFB	529	22	5	94	Cerro Azul	M	240.5	mat	mat	Teeth, genitals	Paired teeth, genital papilloma
KVW	2403	31	5	94	Pucusana	M	241.0	mat	mat	Teeth, alveoli, skull, body, body, skin, testes	Lump on tailstock, orchitis, round skin marks, *Crassicauda* sp. lesions in pterygoid, broken teeth, lesions of alveoli
RBC	19	26	3	93	Chimbote	M	241.5	mat	mat	Skull, alveoli	Lesions of the alveoli, lysis in maxillary
ACO	63	1	8	98	Paracas	M	245	mat	indet	Alveoli, teeth	Lesions of the alveoli and teeth
JAS	17	24	6	93	Pucusana	M	247.5	mat	mat	Skull	Lesions of the alveoli, lysis of maxillaries and premaxillary
MFB	149	17	4	93	Cerro Azul	M	252	mat	mat	Alveoli, teeth	Lesions of alveoli and teeth
KVW	2400	25	10	93	Chancay	indet	indet	mat	indet	Skull, teeth	Osteomyelitis, broken teeth
MFB	174	25	4	93	Cerro Azul	indet	indet	mat	indet	Skull, teeth	Lysis, broken teeth
MFB	741	13	1	95	Matacaballo	indet	indet	mat	indet	Skull, alveoli	Healed fracture of mandibule, *Crassicauda* sp. lesions, lesions of alveoli

Table 2. Multiple lesions in *Delphinus capensis* from Peruvian waters. Specimens (n=40) are ordered by standard body length.
Abbreviations used : SL= standard body length, imm= immature, mat= mature, indet= indeterminate.

Organs/ tissues affected	Specimen number		Day	Month	Year	Locality (collected)	Sex	SL (cm)	Sexual maturity	Cranial maturity
Skull										
Crassicauda sp. lesions in pterygoids, frontals, left palatine & right alisphenoid	ACO	17	29	5	98	Playa Chucho	indet	145	indet	imm
Crassicauda sp. lesions in pterygoids, left frontal & right palatine	JAS	26	25	10	93	Chancay	indet	indet	indet	imm
Crassicauda sp. lesions in pterygoids, right alisphenoid & frontal	KVW	2381	15	1	93	Pacasmayo	indet	indet	indet	imm
Crassicauda sp. lesions in left pterygoid	ACO	21	29	5	98	Lagunilla	indet	indet	indet	imm
Crassicauda sp. lesions in both pterygoids	LAS	5	6	8	99	Salaverry	indet	indet	indet	indet
Crassicauda sp. lesions in right pterygoid	JAS	175	27	11	99	Sechura	indet	indet	indet	indet
Crassicauda sp. lesions in right pterygoid	MFB	770	22	1	99	Puerto Rico	indet	indet	indet	indet
Crassicauda sp. lesions in pterygoids	MWC	26	15	12	87	Peru	indet	indet	indet	mat
Crassicauda sp. lesion in left pterygoid & exoccipital	MFB	159	21	4	93	Chimbote	F	228	mat	mat
Crassicauda sp. lesions in pterygoids	KVW	2425	5	11	95	Pimentel	indet	indet	indet	mat
Crassicauda sp. lesions in pterygoids	AGG	619	22	10	92	Huarmey	indet	indet	indet	mat
Crassicauda sp. lesions in pterygoids	KVW	2382	17	1	93	Santa Rosa	indet	indet	indet	mat
Crassicauda sp. lesions in left frontal	KVW	2426	5	11	95	Santa Rosa	indet	indet	indet	mat
Crassicauda sp. lesions in left maxillary & right pterygoid	MFB	137	15	4	93	Cerro Azul	M	237.5	mat	mat
Crassicauda sp. lesions in left pterygoid	KVW	643	27	7	87	Pucusana	F	215	indet	mat
Crassicauda sp. lesions in left pterygoid	KVW	2423	5	11	95	San Jose	indet	indet	indet	mat
Crassicauda sp. lesions in left pterygoid	MFB	142	15	4	93	Cerro Azul	M	226.5	mat	mat
Crassicauda sp. lesions in pterygoid	MFB	109	30	3	93	Cerro Azul	M	231	mat	mat
Crassicauda sp. lesions in pterygoids	KVW	2399	25	10	93	Chancay	indet	indet	indet	mat
Crassicauda sp. lesions in right pterygoid	KVW	2000	27	12	89	Sechura	indet	indet	indet	mat
Crassicauda sp. lesions in right pterygoid	KVW	2391	22	1	93	Besique	indet	236	indet	mat
Crassicauda sp. lesions in right pterygoid	RBC	17	26	3	93	Chimbote	M	240	mat	mat
Crassicauda sp. lesions in right pterygoid	KVW	2403	31	5	94	Pucusana	M	241	mat	mat
Crassicauda sp. lesions in pterygoids	MFB	250	13	6	93	Cerro Azul	indet	indet	indet	pub
Congenital malformation of the skull	JCR	1351	15	4	88	Pucusana	F	207	imm	mat
Crest on the rostrum	MFB	191			93	Cerro Azul	F	211.5	mat	mat
Healed fracture of left mandible; *Crassicauda* sp. lesions in left pterygoid	MFB	741	13	1	95	Matacaballo	indet	indet	indet	mat
Osteolysis in left maxillary	RBC	19	26	3	93	Chimbote	M	241.5	mat	mat
Osteolysis in max. and R. premaxillary; *Crassicauda* sp. lesions in pterygoids	JAS	17	24	6	93	Pucusana	M	247.5	mat	mat
Osteolysis in the left maxillary	MFB	174		4	93	Cerro Azul	indet	indet	indet	mat
Osteolysis of the maxillary and premaxillary	MFB	756	16	7	98	Pucusana	indet	indet	indet	imm
Osteolysis of the right maxillary	AGG	621	26	10	92	Casma	indet	indet	indet	mat
Osteomyelitis and osteolysis of left pterygoid and palatinum	KVW	2401		4	94	Chancay	indet	indet	indet	mat
Osteomyelitis and osteolysis of left mandible	KVW	2400	25	10	93	Chancay	indet	indet	indet	mat
Slight lateral deviation of the snout	RBC	21	26	3	93	Chimbote	M	234	mat	mat
Traumatic lesion in the occipital	KVW	994	13	12	87	Pucusana	M	229	imm	mat
Head, trunk and appendages										
Chronic fibrotic reaction on tail stock and deformation of vertebral column	AGG	405	5	9	91	Ancon	F	167.5	imm	indet
Deformation of the backbone	KVW	1426	16	6	88	Pucusana	F	171.5	indet	indet
Deformation of the dorsal fin	KVW	582	19	6	87	Pucusana	M	244	mat	indet
Healed fracture of the flipper	KVW	522	11	1	87	Pucusana	F	184.5	indet	imm
Healed lesion of dorsal fin	KVW	568	2	5	87	Pucusana	M	234	mat	indet
Healed lesions of the rostrum	MFB	189	13	5	93	Cerro Azul	M	232	mat	mat
Inferior brachygnatism	MFB	220	15	5	93	Cerro Azul	F	202	indet	indet
Insertion of flipper broken	RBC	21	26	3	93	Chimbote	M	indet	mat	mat
Insertion of flipper broken	RBC	22	26	3	93	Chimbote	F	indet	mat	mat
Mastitis	KVW	523	11	1	87	Pucusana	F	191	pub	indet
Nodule on tail stock	KVW	2403	31	5	94	Pucusana	M	241	mat	mat
Genital tract										
Chronic orchitis	KVW	2403	31	5	94	Pucusana	M	241	mat	mat
Ovarian cysts	MFB	191	13	5	93	Cerro Azul	F	211.5	mat	mat
Vesicular lesions on the penis	MFB	510	18	5	94	Cerro Azul	M	207	imm	indet
Vesicular lesions on the penis	MFB	675	9	7	94	Cerro Azul	M	200.5	imm	indet

Table 3. Lesions of the skull, head, trunk, appendages and genital tract found in 51 *Delphinus capensis* from Peruvian waters. Abbreviations used: SL= standard body length, imm= immature, mat= mature, pub= pubescent, indet= indeterminate.