Two Cases of Micromelia in Little Penguins (*Eudyptula minor*)

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Introduction

Congenital musculoskeletal disorders are rare in birds and in this paper we present two cases of unilateral micromelia in wild juvenile little penguins (*Eudyptula minor*). The little, blue or fairy penguin (*Eudyptula minor*) is the world's smallest penguin species and is restricted in range to the warmer waters along coastal southern Australia and New Zealand (Stahel & Gales 1987). The breeding colonies at Penguin and Garden Islands are the species most northerly breeding sites and are in close proximity to major cities, industrial ports and a large naval base located on Garden Island. A small breeding colony on the mainland in Sydney harbour is listed as endangered due to its proximity to Australia's biggest city and busiest port. These urban populations are subject to increasing human interference which justifies monitoring of the major causes of mortality for the species (Obendorf and McColl 1980; Harrigan 1992; Renner 1998).

Case 1

A little penguin that was found by a member of the public on January, 1993 at San Remo, Phillip Island, Victoria. The bird had a markedly shortened left flipper (Figure 1) and was euthanatized by cervical dislocation by a wildlife carer. The bird's plumage and morphometry data were consistent with it being a sub-adult bird or recent fledgling. Post mortem radiographs demonstrated a normal right flipper and pectoral girdle and a markedly shortened and distorted left humerus (Figure 1).

Case 2

In December 2004 a juvenile little penguin with an abnormally small left flipper was found at the South Fathom Bank west of Garden Island, near Fremantle, Western Australia by a Department of Conservation and Land Management (CALM) wildlife officer. The bird was in good condition and bright and alert when presented to Murdoch University Veterinary Hospital for clinical examination. It had significant unilateral brachymelia of the left flipper (Figure 2), was markedly underweight (550 g, normal 1.0-1.5 kg), but otherwise the bird was behaving normally and was in otherwise relatively good body condition with sub-adult plumage. It had probably only recently fledged from the nearby Garden or Penguin Islands. There was normal deep pain sensation and motor control of the left flipper but with limited range of elbow and carpal joint flexion.

The bird was determined not suitable for rehabilitation and release into the wild or for zoological exhibition for that reason it was anesthetized for radiographic examination and then euthanasia. It was anesthetized by mask induction with isoflurane in oxygen and ventrodorsal and lateral radiographs were taken. These showed ateliosis of the humerus and metacarpophalangeal synostosis and ateliosis and phalangeal aplasia (Figure 3). The left clavicle was slightly thinner and radiographically less dense than the right and was also slightly deviated to the right side, presumably as a result of the differing muscle tensions placed on the left and right sides.

Immediately after radiography the bird was euthanatized with intravenous sodium pentobarbitonal via the metatarsal vein and a necropsy was performed. There were no other external abnormalities visible apart from the flipper malformation. Internal examination revealed normal visceral organs, except for a minor proventriculitis due to low numbers of *Contracaecum eudyptulae* which is a relatively common infection of penguins in the area (R Hobbs, oral communication, 2005).

Duplicate samples of kidney, liver and brain were also taken for heavy metal analysis[†]. Concentrations of cadmium in the kidney, liver and brain were 5.7, 3.7, 4.9 mg/kg (wet weight), respectively. Concentrations of mercury in the kidney, liver and brain were all below the limits of detection (<0.05 mg/kg wet weight) and concentrations of lead in the kidney, liver and brain were 1.25, 0.5, 1.75 mg/kg (wet weight), respectively. The liver selenium concentration was 1.30 mg/kg (wet weight). These results were less than or similar to values obtained from samples collected from 3 adult penguin carcasses collected from Penguin Island that had been necropsied for other reasons and published results for other waterfowl species in Australia[1].

Samples of brain and all ceolomic visceral organs were taken and fixed in formalin for routine paraffin embedding and histopathological examination. Abnormal lesions included a mild focal ulcerative, heterophilic, proventriculitis associated with the attachment of *C. eudyptulae.* Closer examination of the pectoral girdle and bones of the flippers was facilitated following dissection and thermal hydrolysis of soft tissues and ligaments. Boney abnormalities observed in radiographs were confirmed and hypoplasia of the wing-like procoracoid process on the medial aspect of the proximal surface of the left coracoid was also noted (Figure 3). The left scapula was normal.

Discussion

The little, blue or fairy penguin (*Eudyptula minor*) is the world's smallest penguin species and is restricted in range to the warmer waters along coastal southern Australia and New Zealand.[2] The breeding colony of approximately 1000–1200 little penguins nesting on the central part of Penguin Island (32º17' S, 115º41' E) and nearby Garden Island near Perth are the species most northerly breeding sites and are in close proximity to major cities, industrial ports and a large naval base located on Garden Island. Artificial nest boxes placed on Penguin Island have been used by penguins for breeding activity[3,4] as sand on the island is too soft for burrows and penguins here naturally nest in limestone caves, rock crevices and under natural bushes.[5] Other seabird species that breed on Penguin Island include silver gulls (*Larus novaehollandiae*), bridled terns (*Sterna anaethetus*) and more recently the Australian pelican (*Pelecanus conspicillatus*).

A small breeding colony of little penguins on the mainland in Sydney harbour is listed as endangered due to its proximity to Australia's biggest city and busiest port. These urban penguin populations are subject to increasing human interference which justifies monitoring of the causes of mortality for the species.[6-8]

This paper describes two cases of naturally occurring, probably congenital, developmental skeletal abnormalities in wild little penguins. Congenital musculoskeletal disorders have not been observed in past surveys of the causes of mortality in this species[6-8] but during the summer of 1971-2 a chick with "no sign of any flippers and with no scars" was found on the beach at Wilson's promontory in Victoria.[9] The conjecture that this bird had complete agenesis of both pectoral limbs was supported by body measurements indicating that it had recently fledged. The same authors also had observed sibling chicks in a nest at Lawrence Rocks, Victoria that both had bill abnormalities.[9] One had scissor-bill deformity and the other had an incompletely developed, shortened rhamphotheca. A

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scissor-bill deformity and a ventral body wall defect have also been observed in penguin chicks in Victoria (Dr R. Norman unpublished) and in 2004 a pelican chick with a beak deformity was noticed on Penguin Island (Dr Nick Dunlop, personal communication, 2004).

These cases probably represent rare events and are likely to be of no great consequence to the survival of any species if they are due to random non-heritable genetic defects that occur during limb bud development. However, another possible primary cause for such lesions is exposure to teratogenic toxins and this alone should warrant ongoing monitoring of breeding populations of little penguins and other species of high conservation status, especially those close to potentially contaminated major industrial areas such as Cockburn Sound near Penguin Island.[10]

Micromelia is relatively rare but recognized as a naturally occurring lesion in poultry[11-13] and a syndrome associated with a lethal genetic mutation is recognized in turkeys.[14] The organophosphate pesticides diazinon and metathion[15-17] as well as cadmium, selenium and possibly other heavy metals are known to be teratogenic in a wide range of bird and animal species and have been reported as a cause of micromelia.[18-20] This was the main reason for determining selenium, cadmium, mercury and lead concentrations in the tissues from the second case. However, the data generated and the unilateral nature of the condition in this penguin, suggests that a systemic toxicosis was unlikely.

Hyperthermia is also recognized as being teratogenic in eutherian mammals.[21] This is considered to be due to thermal induced apoptosis of cells during organogenesis. Avian embryos are subject to greater variations in temperature than mammals and depending on the stage of incubation can be very resistant to periods of hypothermia.[22,23] Embryonic stress, expressed as an increase in heart rate, occurs with even mild increases in ambient temperature and irreversible arrythmias and mortalities occur quickly in chicken embryos at 46-47°C.[23-25]

Given that the optimum incubation temperature of Sphenisciformes is lower than that for other birds[22] penguin embryos may have a lower tolerance to thermal stress than chicken embryos. It is not unusual for maximum daily temperatures in Perth to reach over 40°C in the middle of summer and previous research has shown that temperatures inside nest boxes placed in areas with no shade cover on Penguin Island can reach over 40°C even when the ambient temperature is much lower.[4]

Heat stress and mortalities do occur in moulting penguins on Penguin Island during the hottest days in summer (Dr B. Cannell unpublished data). This is because during their annual moult in late summer moulting birds are restricted to the island and do not swim and feed as they would normally do during the day. Given that the incubation period of the little penguin is 33-37 days and that fledgling normally occurs by 7 to 8 weeks of age, the bird we examined most likely hatched in October from an egg laid in September of 2004. Although neither were exceptionally hot months with maximum daily temperatures of 24.9-29.5°C[‡], high environmental nestbox temperatures cannot be ruled out as a possible cause of the lesion if the egg was laid in a nestbox with little shade.

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[‡] http://www.bom.gov.au/climate/dwo/

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