Veterinary Aspects of the Oiled Wildlife Response for Little Blue Penguins (*Eudyptula minor*) Following the Rena Grounding on Astrolabe Reef, Tauranga, New Zealand

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INTRODUCTION

Early on 5th October 2011, Rena, a 236 metre cargo vessel en route from Napier to Tauranga, North Island, New Zealand struck the Astrolabe Reef off Tauranga and became grounded. On 11th October 2011, Rena suffered further damage, developing a twenty degree list, dropping containers into the ocean and losing 350 tonnes of heavy fuel oil through significant cracks in the hull. This thick oil washed up for several days along the extensive Bay of Plenty region coastline with major impacts on the wildlife of the area.

The National Oiled Wildlife Response Team were mobilised immediately following the grounding and had an Oiled Wildlife Facility running within 36 hours, that was then scaled up or down and as needed over the course of the response. A total of 420 birds were being cared for in the Oiled Wildlife Facility at the height of the response, with cumulative totals of 383 little blue penguins (*Eudyptula minor*), 60 New Zealand dotterels (*Charadrius obscurus*), 4 pied cormorants (*Phalacrocorax varius*) and fewer numbers of pelagic sea bird species. Over the course of the response, 2062 dead birds were collected by field teams for identification and post mortem examination, of which 1376 were oiled, predominantly pelagic species such as petrels, shearwaters and albatrosses.

THE EFFECTS OF OIL ON WILDLIFE

Oil is toxic to living organisms, containing high levels of polycyclic aromatic hydrocarbons as well as heavy metals such as zinc, lead, copper and cadmium and other noxious additives. Birds exposed to oil can be affected both externally and internally. When birds come into contact with oil, it sticks to and mats the feathers, mechanically disrupting the complex structure required for waterproofing, thermoregulation and buoyancy (Leighton, 1993). Affected birds may have trouble swimming, flying or foraging and quickly become exhausted and unable to meet their metabolic needs (Mazek et al., 2002). Internal effects may occur secondary to preening of oiled plumage or consumption of oil contaminated prey. Reported pathological consequences include respiratory distress, seizures, haemolytic anaemia, gastrointestinal irritation and haemorrhage, liver and kidney damage, corneal ulceration and chemical burns to skin and mucous membranes as well as immunosuppression (Mazek et al., 2002; Balseiro et al., 2005). Clinically, affected birds are often hypothermic, hypoglycaemic, hypoproteinaemic and lethargic on initial presentation to an oiled wildlife facility. Sublethal effects such as decreased reproductive success may be seen in the longer term.

STABILISATION OF OILED LITTLE BLUE PENGUINS

In the case of the Rena spill, oiled little blue penguins presented to field stabilisation stations or at the Oiled Wildlife Facility in a range of states from 100% oiling to small patches of weathered oil on the plumage. In general, typical of the resilient and gregarious nature of the species, most little blue penguins were bright and alert despite often being heavily oiled. As the spill response continued, affected penguins were admitted that were increasingly emaciated and weak.

Initial veterinary stabilisation involved:

- Full physical examination including weight, body condition score, percentage oiled and categorisation of body regions affected by oil;
- All penguins had a temporary coloured and numbered plastic identification band applied to the wing (birds were microchipped and plastic bands were removed prior to release);
- Superficial decontamination of oil where possible, including flushing of the eyes and cleaning of the nares and oral cavity where required;
- Blood sample obtained from the ulnar or medial metatarsal vein for evaluation of packed cell volume, buffy coat, total plasma protein and blood glucose;
- Dosed with moxidectin (0.2mg/kg PO once) on entry for endoparasite prophylaxis and first dose of itraconazole (5mg/kg PO sid) for aspergillosis prophylaxis that was continued for the duration of captivity; and
- Dosed with an oral electrolyte solution (40-60mL/penguin) for initial rehydration

Following treatment, birds were moved into the “dirty” stabilisation tents where they were housed with up to five other little blue penguins in 1 x 1.2m plastic fruit crates modified to have a netted bottom to allow droppings to fall through and distribute weight to prevent the development of pododermatitis (Figure 1). All stabilisation tents were fitted with ducted heating and heat lamps to maintain the ambient temperature at 28-30°C to support those birds with ineffective thermoregulation (Figure 2). Oiled birds remained in the stabilisation tents, being treated and force-fed a salmo0n slurry mixture twice daily for at least two days, until they were deemed strong enough (through evaluation of mentation, weight, packed cell volume and total protein) to adequately cope with the stressful and demanding 30-45 minute process of oil decontamination, washing and rinsing. High mortality is associated with washing and rinsing birds that have not been appropriately stabilised (Mazet et al., 2002).

Figure 1. Oiled penguins housed in a net-bottomed crate.

Figure 2. Crates in stabilisation/rehabilitation tent with ducted heating and radiant heat lamps to support thermoregulation of penguins. This image is from a clean tent, hence personnel are not wearing personal protective equipment.

After decontamination, penguins entered the "clean" rehabilitation tents where they recovered from the washing process. They were given an oral electrolyte solution by crop tube and force-fed a salmon slurry mixture twice daily, eventually weaning onto whole anchovies, in a thermostat- controlled tent with ducted heating and radiant heat lamps. Usually by the next day, the birds were begun on a daily routine of swimming in large above-ground pools with close monitoring until they regained their waterproofing (Figure 3). Once waterproof and deemed healthy, usually one week after the washing process, the penguins were moved into large purpose-designed outdoor aviaries with tube matting floors and built-in pools (Figure 4). In the aviaries the birds were only disturbed for feeding and treatment twice daily and cleaning once daily.

Figure 3. Penguins swimming in pools to encourage re-waterproofing following oil decontamination.

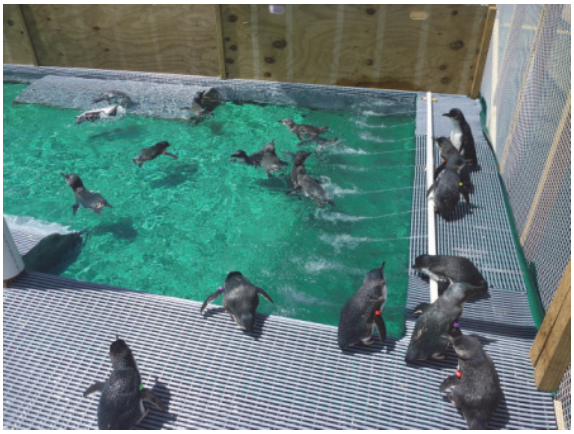

Figure 4. Purpose-designed aviary with tube-tread matting and circulating pool for swimming.

Once the birds are through the initial stabilisation, washing and rehabilitation stages of the response, it is the secondary effects of prolonged captivity that become more prevalent. In the case of the Rena response, penguins were rehabilitated and ready to be released weeks to months before their environments were satisfactorily clean of oil contamination and the risk of further oil spillage and re-contamination was low. Due to the strong philopatry of little blue penguins (Hull et al., 1998), the decision was made to house the rehabilitated birds in purpose-built aviaries at the Oiled Wildlife Facility until their environments were declared safe for them to return.

SECONDARY EFFECTS OF PROLONGED CAPTIVITY ON LITTLE BLUE PENGUINS

Although some of the species held at the wildlife facility can cope well with the captive environment, ultimately long term care can be detrimental to all wildlife species. The risk of injury or secondary disease increases with the time animals are kept in captivity. Such complications commonly include aspergillosis and pododermatitis but keel injuries, feather damage, capture myopathy, habituation and loss of fitness should also be considered. (Walraven, 2004)

Aspergillosis prevention is a major priority in the medical management of oiled aquatic birds. Although *Aspergillus* sp. are ubiquitous organisms, aquatic birds in captivity seem to be at particular risk, exacerbated by stress and immunosuppression in addition to poor ventilation, inadequate hygiene and warm temperatures favouring the multiplication of the organism and production of infective spores (Mazet et al., 2002).

Unlike previous reports of high mortality and outbreaks of aspergillosis in oiled penguins brought into captivity (Carrasco et al., 2001; Balseiro et al., 2005; Xavier et al., 2007), few little blue penguins died in care or were euthanased (18/379; 4.7% of penguins with a recorded fate). Of these only 2/18 had post mortem signs of aspergillosis. This may in part be due to prophylactic daily treatment with itraconazole of all rehabilitating little blue penguins, a common practice in facilities housing aquatic birds (Mazet et al., 2002). Furthermore, outdoor housing in aviaries with natural air flow may have aided alleviation of spore build-up. The resilient nature of the species and apparent increased tolerance to stress may also have contributed to the low incidence of aspergillosis when birds of other, more highly strung species such as New Zealand dotterels and a white fronted tern (*Sterna striata*) in identical circumstances succumbed to infection more frequently (Figure 5).

In contrast, the development of pododermatitis was a major problem with little blue penguins in the Rena response. Although the aetiology is multifactorial, it is thought to be principally related to excessive pressure or trauma causing inflammation and avascular necrosis of the plantar surface of the foot, secondary to prolonged periods of standing, poor substrate or excessive body weight (Reidarson et al., 1999; Erlacher-Reid et al., 2011). Little blue penguins are largely visual hunters, therefore spending most daylight hours at sea foraging (Ropert-Coudert et al., 2006). Although the aviaries were equipped with large circulating pools for swimming, most penguins chose not to swim. As a result, spending the majority of the day on land, albeit padded tube-tread matting, it is not hard to understand why plantar pressure sores developed so readily. Furthermore, in the months of rehabilitation, little blue penguins are normally feeding chicks and foraging extensively to build-up fat stores to prepare for fasting during the moult which may take up to 2.5 weeks (Gales and Green, 1990). This was taken into account in the management of the penguins in captivity, as they were fed to mimic normal ecology, keeping in mind that excess body weight was probably exacerbating and

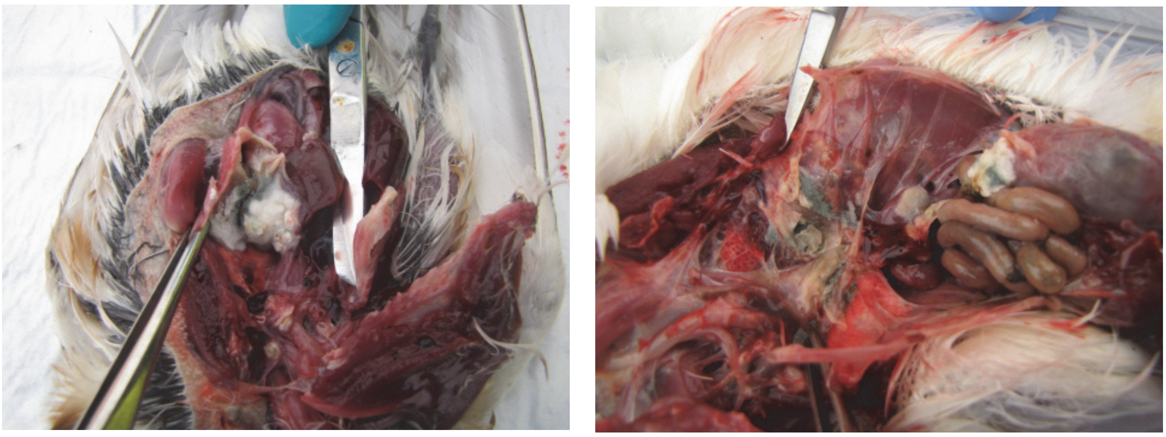

Figure 5. *Aspergillus* spp pneumonia and airsacculitis in a dotterel (left) and white fronted tern (right) that died in care during the Rena Oiled Wildlife Response.

accelerating the development of pododermatitis. However, moulting abnormalities associated with prior insufficient nutrition would likely be more costly to the bird and require longer periods of captivity.

The feet of all penguins in aviaries were assessed by veterinarians and given a score between 0 and 5 signifying the severity of pododermatitis lesions (modified from Degernes, 1994)(Figures 6a, 6b and 6c).

- Grade 0: Normal feet, no sign of abnormality.
- Grade 1: Superficial abnormality of the plantar foot surface, seen clinically as shiny, flattened epithelium, or hypertrophy of the epithelium. Mild and localised without swelling, rarely associated with lameness.
- Grade 2: Smooth, more extensive, often circumscribed areas on the plantar foot surface extending deeper than those lesions described as grade 1. Mild and localised, sometimes associated with lameness.
- Grade 3: Necrotic plug of tissue within the lesion, often with associated heat, pain and swelling of the foot. Often associated with lameness.
- Grade 4: Cellulitis often with secondary infection and involvement of deeper tissues such as tendons sheaths. Often a marked lameness.
- Grade 5: Osteomyelitis.

Birds with lesions scored 3 or greater were separated and given injectable sedation for surgical debridement due to the field setting and lack of access to gaseous anaesthesia. Butorphanol (4mg/kg IM) and either tiletamine/zolazepam (0.05-0.15mg/kg IM) or midazolam (0.1-0.5mg/kg IM) were given as a treatment trial. Penguins receiving butorphanol and the high end of the range of tiletamine/zolazepam had mild sedation, mild ataxia and were more suitable candidates for debridement than penguins receiving butorphanol with midazolam or low doses of tiletamine/zolazepam. The tiletamine/zolazepam dose is lower than previously reported for other penguin species and may be increased for field situations in the future (Thil and Groscolas, 2002). The procedure included surgical debridement of necrotic tissue and flushing of the area with a dilute chlorhexidine solution. Affected birds were given amoxicillin with clavulanic acid (125mg/kg PO bid) and meloxicam (0.2mg/kg PO sid) prior to and following surgery until resolution of the lesions and lameness. These birds were also preferentially swum in the large pools with no opportunity to haul-out for at least 6 hours per day. Following the development of pododermatitis in these birds, tube-tread matting was replaced with a softer grade and a rotating roster of enforced swimming periods for all penguins in aviaries was instituted to prevent the progression of milder lesions with success, similar to previous reports (Table 1) (Reidarson et al., 1999). Post-treatment pododermatitis score data were available only for birds undergoing intensive care at that time, including those with severe bumblefoot on pre-treatment scoring. All other penguins not recorded in the post-treatment group had a score of 2 or less, or had been released.

Figure 6a. Grade 1 pododermatitis.

Figure 6b. Grade 2 pododermatitis.

Figure 6c. Grade 3 pododermatitis.

Grade	Pre-treatment (30 November)	Pre-treatment		Post-treatment (6 December)	Post treatment
0	86	33.9%		23	37.7%
1	83	32.7%		13	21.3%
2	56	22%		16	26.2%
3	29	11.4%		9	14.8%
4	0	0%		0	0%
5	0	0%			0%
	254 penguins	100%		61 penguins	100%

Table 1. Proportion of severity of pododermatitis lesions in penguins prior to and following husbandry changes and increased swimming time and frequency. The 193 penguins not recorded in the post-treatment group had a pododermatitis score of two or lower, but specific data were not available.

RELEASE OF LITTLE BLUE PENGUINS

After the environment in the locality of where the penguins were found had been certified as sufficiently clean of oil, penguins were able to be released after passing several criteria (NOWRT, 2011):

1. Plumage is of sufficient quality for survival in the wild.
2. Birds have successfully completed a 6 hour water proof test
3. BMI (body mass/ body length) = 2.5 or greater
4. Pododermatitis score of 2 or lower
5. PCV 38-52%
6. Total Protein 25-60 g/L.
7. Buffy Coat less than 2%.
8. After a basic clinical examination the bird will be deemed to be of good general health and fitness by the attending veterinarian.
9. Disease screening results from a random sample of 60 penguins will be free of *Salmonella* spp. and *Yersinia* spp. on cloacal culture.
10. Demeanor – alert and responsive.
11. The animal is exhibiting signs of normal behavior including preening, walking, swimming and eating normally.
12. The individual is free of any temporary identification band.
13. The individual has a permanent identification transponder inserted subcutaneously on the back between the scapulae.

Prior to release, the penguins' salt glands needed to be reactivated by gradually increasing the level of salt to that equivalent to seawater (3% or 30g/L) in their pools in 1% intervals over the course of a week. Post-release monitoring is continuing for little blue penguins in the Bay of Plenty region.

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