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Review of Information Relevant to the Impact of Black Swan in Northland

Introduction

Black swans (*Cygnus atratus*) occur throughout Northland and are common on and about coastal lagoons, estuaries, and lakes. They are a highly prized game bird, listed on the First Schedule of the Wildlife Act 1953, with the Department of Conservation being responsible for authorising hunting seasons for the species, and Fish and Game New Zealand (F&G) responsible for issuing hunting licences and enforcing the regulations of the Wildlife Act. Despite their value as a hunting resource, there are public concerns based largely on anecdotal information that implicate black swan in New Zealand in the loss of aquatic weed (macrophyte) beds, eutrophication of water systems and consequent algal blooms likely to affect aquafarming, the overgrazing and fouling of farmland (Williams 1979; Sagar et al. 1995), competition for food with native wading birds in estuarine habitats, and the dispersion of avian diseases. Documentation of such concerns is scattered in a small number of formally published scientific papers and several unpublished reports, and is not easily accessible.

Landcare Research was requested to provide advice to the Northland Regional Council (NRC) on the likely environmental impacts of black swan on wetlands, pasture, and harbour margins throughout Northland. Such advice is required to underpin an evaluation of the need for a comprehensive plan for the local management of the species. Black swan are not presently listed within the current NRC Regional Pest Management Strategy (and cannot be as long as they remain on the first schedule of the Wildlife Act 1953).

Black swan population location and size

General

- Black swans were introduced from Australia in the 1860s and spread very rapidly throughout New Zealand in the late 1800s (Heather & Robertson 2005).
- Greatest numbers occur on large lowland or coastal lakes and lagoons, and on estuaries, with Lake Ellesmere, Lake Wairarapa, and the Waikato and Rotorua lakes containing the largest breeding populations, and Kaipara Harbour, Farewell Spit, and the Invercargill estuary being most highly favoured by non-breeding and moulting birds (Sagar et al. 1995; Heather & Robertson 2005).
- Black swans are moderately sedentary, with regional populations, largely confined to major nesting areas and coastal feeding and moulting areas (Heather & Robertson 2005).

Northland

- Prior to the 1980s, Northland contained large flights of black swan, but few local breeding populations. At that time, the birds concentrated on the Kaipara and Hokianga harbours, which acted as refuges (Williams 1977).
- This distribution has changed, with birds now more widely distributed throughout the region. Most populations of black swan in the Northland Region in 2006 occurred at

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Houhora Harbour (3400), Lake Owhareiti (1150), Parengarenga Harbour (1115), Ngataki/Houhora (400), Poutu Lakes and surrounds (385), and Lake Puheke/Rotokawau (160). A further 281 birds were counted at seven lesser sites throughout the region, i.e. Mathews irrigation dam, Waitangi and coastal wetlands, Henderson Bay ponds, Lake Omapere, Te Paki/Te Werahi, Lake Waipurera, and Jacks Lake (R. Hoetjes, F&G, pers. comm.). The Houhora Harbour count may also include birds residing mainly in Rangaunu Bay (D. Foster, NRC, pers. comm.).

- Limited annual trend counts of black swan undertaken by F&G in Northland in late January from 1988 to 1995 varied between 3000 and 3700 (R.Hoetjes, pers. comm.). More recently, and following the establishment of a more complete trend counting regime, populations have varied from 4176 in 1996 to 14 358 in 2002. Populations post-2002 declined sharply with the crash of the region's largest population based on Lake Omapere, following the loss of macrophytes in that lake and their replacement by blue-green algae. Thereafter, regional trend counts have varied from a low of 3676 in 2005 to a high of 6891 in 2006.
- The bulk of birds lost from Lake Omapere in 2002 appeared to turn up at Glorit, south-east Kaipara Harbour (and just south of the Northland Region in the Auckland Regional Authority area), where trend counts skyrocketed in the following year by approximately the same number lost from Lake Omapere, and have remained high ever since (R. Hoetjes, pers. comm.).
- Presently, black swan in the Northland, Waikato and Rotorua regions are believed to be one highly mobile meta-population, which shifts about these three regions in response to food availability (M Williams, Victoria University, pers comm.).

Harvesting

- Harvesting (shooting) of black swan in Northland was limited prior to the 1980s (Williams 1977). This has now changed. Estimated numbers harvested annually by game bird hunters varied between 82 and 590 over the period 1994–2001. Harvest rates rose sharply from 531 in 2001 to 2750 in 2002 (in line with the high numbers present on Lake Omapere at that time), and have varied between 920 and 2285 in the three subsequent years (R. Hoetjes, pers. comm.).
- In addition, 250–300 black swan were shot in a one-off organised hunt on Lake Omapere in 2002, and probably <200 birds taken out-of-season on permits issued to aquatic farmers and landowners in recent years to disperse feeding flocks (R. Hoetjes, pers. comm.).

Life history

Breeding

- Black swan begin breeding when 2–4 years old. Breeding varies from July to October for solitary pairs nesting about small ponds with stable water levels, and from September to January for colonial breeders nesting about larger more fluctuating water bodies. Nests are normally within 100 m of lake or estuarine shorelines (Heather & Robertson 2005).
- Pairs lay up to 10 eggs (a mean of about six), with larger clutches of up to 13 thought to be laid by more than one hen. Cygnets hatch after 32–43 days, and are guarded by parents throughout their development on adjacent water systems (Heather & Robertson 2005).

Dispersal

- Most young birds remain near to or on their natal lake. Of those that disperse, most (7 out of 8) appear to remain on water systems within 50 km of natal areas (Williams 1977).

Such patterns appear to be disrupted, and birds disperse further, when food is in short supply (Williams 1977).

- Outside of the breeding season and during moulting, birds may form loose feeding flocks of up to several thousand on large water systems.

Feeding

- Black swan feed mainly in fresh and brackish water on submerged aquatic plants belonging to the family Hydrocharitaceae and on filamentous algae, and in estuaries on salt-tolerant plants such as seagrass and sea lettuce (Sagar et al. 1995). They show a clear preference for submerged aquatic plants over wetland plants, feed down to c. 1 m beneath the water, and eat c. 50 g dry weight of food per day (Mitchell & Wass 1974).
- Black swan also commonly graze on lakeside pasture grasses and clovers throughout New Zealand, especially when aquatic plants are not available due to high water levels or when aquatic weed beds have been destroyed (Sagar et al. 1995). Black swan spend a far greater proportion of the day feeding than most other waterfowl, with the percentage of individuals feeding increasing steadily throughout the day until dusk (Bimler 1983; Hamilton et al. 2002). Like Canada geese, black swan are considered to have a fairly inefficient digestive system, and thus need to feed extensively.
- Fluctuations in food availability, resulting from high lake levels (Williams 1969), the spasmodic destruction by storms of aquatic weed beds, or lake eutrophication may lead to malnutrition and the reduction or absence of breeding and feeding populations of black swans (Hughes et al. 1974; Sagar et al 1995), e.g. the destruction of reed beds about Lake Ellesmere in 1968 by the 'Wahine' storm, led to the local population of black swan falling from 40 000–80 000 birds in the 1960s to <20 000 in the 1970s, due to breeding failure, poor cygnet survival, increased adult mortality, and dispersal (Sinclair & Byrom 2006; Williams 1979).

Survival

- Nest and cygnet survival may also be reduced by predation (especially from black-backed gulls), by flooding (Guiler 1966), and by interference from livestock on breeding grounds (Miers & Williams 1969; Williams 1979).
- Annual survival rates of adult black swan, based on 15 years' data from Lake Wairarapa, average c. 84% (Barker & Buchannan 1993).

Environmental impacts

The major concerns arising from the presence of black swan in Northland appear to be:

- The grazing of the birds resulting in the *destruction of lake weed beds* and the subsequent eutrophication of lakes. Eutrophication of freshwater lakes throughout New Zealand is relatively commonplace, and while it may result from the overgrazing of weed beds by black swan, it also occurs in their absence due to human-induced nutrient enrichment, i.e. fertiliser runoff (Sagar et al. 1995). Such eutrophication may lead to the shading and eventual suppression of lake macrophytes and of the black swan populations that feed upon them (McKinnon 1989). A summary of data from five New Zealand studies on this species indicates that stands of both freshwater macrophytes and seagrasses are able to withstand and increase in biomass under high swan grazing pressures of 10–20/ha (summarised in Sagar et al. 1995). However, McKinnon & Mitchell (1994) demonstrated that in seven small lakes in the southern South Island, winter black swan numbers but not their summer numbers were significantly correlated with the biomass of aquatic macrophytes.

- The deposition by black swan of *high levels of nitrogen and phosphorus* in faeces in lakes and on farmland. While faecal nitrogen and phosphorus levels derived from black swan are of concern, outputs documented in the few studies (5) undertaken indicate that such nutrients are likely to be only a small fraction of the total nutrient pool, e.g. for Lake Ellesmere, black swan contribute <1% of the annual input of nitrogen and phosphorus (Mitchell & Wass 1974; Sagar et al. 1995). Nutrient inputs from black swan may, however, be proportionately greater in small bodies of water with low nutrient inflows. Faecal nutrient output by black swan is about half that produced by Canada geese (summarised in Spurr & Coleman 2005).
- The invasion and sometimes severe *damage of pasture* (particularly young grass) adjacent to lakes and lagoons, when aquatic weed is not available (Williams 1977, 1979). Black swan undoubtedly eat grasses and clovers and may pull up germinating pasture, thus competing directly with livestock, but such competition does not appear to have been investigated in New Zealand. At such times, faeces are deposited on farmland where it both fouls pasture and repels sheep (Sagar et al. 1995). However, such droppings may be beneficial, by leading to compensatory pasture growth later in the year.
- The *excretion of faecal coliform bacteria* (i.e. *Escherichia coli*) by black swan (together with that from other sources) into water systems used for aquaculture (R Hoetjes pers. comm.). However, while the ability of black swan outside New Zealand to disperse coliform bacteria has been documented, their role in dispersing this bacterium within New Zealand remains unproven.
- The ability of black swan to *carry a range of significant diseases* – including aspergillosis, which may kill severely malnourished birds (Williams 1969), and *Actinobacillus*, which may be transmitted to livestock (Onderka & Kierstead 1979) – and their potential to transmit these diseases to other waterfowl. There is no record of black swan being involved in any major disease-driven die-off of waterfowl in New Zealand (J McKenzie, Massey University, pers. comm.). However, black swan exceed all other waterfowl in the overlap of their feeding grounds with migratory and resident waders, and as such, may become key hosts in the early transmission of bird influenza Strain H5N1, in the unlikely event that it should enter New Zealand via migratory waders (M. Williams pers. comm.). Such a spread would mimic that recorded in Europe, where H5N1 is mainly associated with Anseriform birds – ducks, geese and swans, which are particularly susceptible to the virus (http://www.birdsaustralia.com.au/new.html).
- The ability of black swan, when in high numbers, such as on moulting grounds, to *restrict the habitat for native wading birds*. Selective grazing by black swan is likely to alter the weed bed composition, and could encourage the growth of uneaten nuisance species at the expense of weed species favoured by both black swan and native bird species (Sagar et al. 1995).
- *Nuisance values* arising from their presence in lakeside urban gardens and parklands. Breeding males can act aggressively towards humans, faecal contamination of urban lake shorelines can be extensive, and some garden plants are eaten (Sagar et al.1995).

Control methods used/available for use

- Between c. 900 and 2750 black swan have been shot throughout Northland under licence each year during the shooting season for the last four years, with the number strictly controlled through daily bag limits and locally varying seasons, determined from local population trends (Heather & Robertson 2005). Such shooting is recreational, but clearly kills some birds and disperses others, and recreational hunters may be used to target areas or farming operations perceived to be at risk from the activities of black swan.

- Small numbers of birds are shot under special permits to protect aquatic and terrestrial farming operations, and similarly may be used to control black swan numbers in urban park lands.
- Elsewhere in New Zealand, black swan 'drives' occur where swans are herded towards shooters for their destruction (Williams 1979). Such shooting appears to focus on young of the year rather than older birds.
- Habitat destruction – the destruction by cutting, burning or heavy grazing of stands of rushes along lake margins reduces favoured nesting habitats and may force birds to disperse (Williams 1979).

Review conclusions

- While much anecdotal information exists on the role of black swan in the environment, little research relevant to this review has been undertaken.
- The effect of black swan on NRC's aquaculture and agriculture, and on the natural environment should be further investigated before local management plans for the species are developed.
- The nutrient input from black swan into lakes should be assessed on a case-by-case basis.
- The impact of black swan on pasture should be assessed in a similar manner to that undertaken for Canada goose in Canterbury high country.
- A research project to determine key research gaps into the environmental impacts of black swan in Northland could be the subject of a medium-level Envirolink ($20,000) grant. Such a project should include a workshop of all key stakeholders in Northland to document all their perspectives of black swan in the region, the ranking of future research needs and management options and their social acceptability, and a more detailed identification of research gaps than that presented here.

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