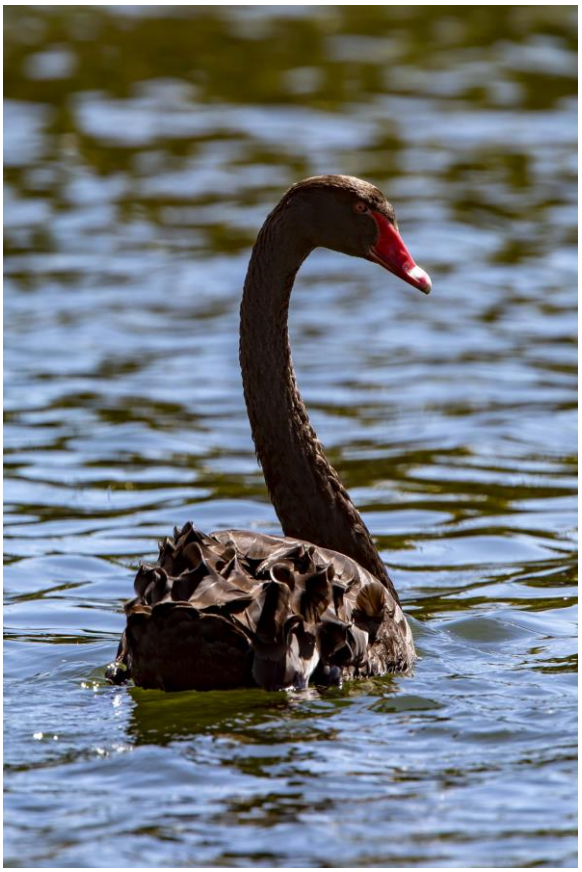
Adaptive Harvest Strategy for Black Swan (kakī anau*, Cygnus atratus*) in North Canterbury



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1.1	July 2023	Matthew Garrick	Original
1.2	September 2023	Matthew Garrick	Incorporated minor changes through peer review process
1.3	April 2024	Matthew Garrick	Hunting Frameworks, Wildlife Damage Control

Table of Contents **Page**

North Canterbury's black swan (kakī anau*, Cygnus atratus*) population has experienced significant changes over the last 170 years: beginning with a few migrants, reaching peak abundances of over 80,000, and declining to a contemporary population estimated near 6,000. Black swans are an important species that elicit a wide range of perspectives and values across various stakeholders. As such, there is a need to continually monitor and evaluate the biological and social aspects of black swans. This harvest strategy will guide management decisions considering population dynamics, harvest, and the complexities associated with human-swan conflict. This document will be used for internal Fish and Game processes as part of our statutory functions. It will also be considered as a part of a larger Te Waihora Management Plan.

2. Goal

A stable population of black swans that provides recreational, ecological, cultural, and aesthetic benefits while minimising human-swan conflict.

3. History

Black swans have undergone various changes in the relatively short history since humans have arrived in Aotearoa (New Zealand). A distinct species of black swan (*Cygnus sumnerensis*, Pouwa) that was larger, with reduced flight capability and longer legs, went extinct during the megafaunal hunting period (ca. 1280-1450 AD; Worthy and Holdaway 2002, Gill et al. 2010, Rawlence et al. 2017). Historical records show black swans were completely absent from New Zealand at the time of European colonisation, prior to human facilitated introduction of *Cygnus atratus* in the 1860s (Miers and Williams 1969). This is supported by strong mtDNA similarity between the south-eastern Australian population (where birds were sourced) and modern New Zealand black swans (Rawlence et al. 2017*a*, Rawlence et al. 2017*b*).

The earliest documented importations of black swans were in 1863 in Nelson (Sowman 1981). A swan committee was established in Christchurch to facilitate releases in the North Canterbury region, with the first swans received in 1864 (Lamb 1964). Early liberations of swans centred around the Avon River in an effort to suppress watercress, which people thought would grow indefinitely and hinder the ability of trout to establish (Lamb 1964). However, it is postulated that large numbers of black swans may have naturally dispersed to New Zealand from Australia in 1867, when many white-eyed ducks and silvereyes also arrived (Williams 1981). The expansion was rapid; in 1871 there were 300 black swans counted at the mouth of the Halswell River, and by 1900 they were considered common throughout New Zealand (Lamb 1964, Cheyne 1977). Regardless of origin of black swan in New Zealand, they were classed as native game under the Animals Protection Act of 1868 by the Colonial Government and have been hunted since the 1870s (McDowall 1994).

Within North Canterbury, swan numbers built up to the point that they were considered a nuisance to farmers at the time, and the North Canterbury Acclimatisation Society sought permission from the Government to harvest and sell swan eggs – receiving blanket approval for this activity in 1916 (A.R. 1916). The North Canterbury Acclimatisation Society harvested and sold swan eggs well into the 1960s until the Wahine storm destroyed many of the submerged aquatic vegetation beds and greatly reduced the capacity of the lake to support historic swan numbers (Williams 1979). The peak population of swans was estimated at around 80,000 in the 1950s and stabilised at around 10,000 in the two decades after the Wahine storm (Gerbeaux 1989). Modern swan count data from the Christchurch City Council indicates swan populations within the greater Christchurch City Area have maintained similar levels when including count data from the Avon-Heathcote estuary and other wetlands (Andrew Crossland, unpublished data).

Active culling to alleviate farmers' complaints has been an ongoing, controversial feature in swan management around Te Waihora (Lake Ellesmere). Culling on pastures surrounding the lake continued after the Wahine storm until at least 1976, when the Wildlife Service threatened to take control of the birds if the Acclimatisation Society did not stop relying on lethal control methods (McDowall 1994). Crop depredation issues have persisted on private land around the lake's margins, particularly during winter and spring when heavy rains result in ephemeral wetlands in developed farmland. In the last 15 years, NCFG issued swan cull permits during spring to manage crop depredation issues. In 2016, an extended swan season was initiated around the lake that ran in August and September that allowed a harvest of 20 swans per day per person. This was reeled back in 2022 to August only and was removed entirely in 2023 due to the lack of compatibility with harvest monitoring and that hunting of swans that were initiating nests was not conducive to a sustainable hunting season.

Swans continue to be a minor, yet valued game bird in hunters' bags across many Fish and Game regions. This plan aims to adhere to an ideology described by Murray Williams (1981): "Because of their delayed maturity and small clutch size, swans cannot withstand heavy hunting. It is better to regard them solely as a "bonus" bird rather than as a major game species."

4. Population Definition

The NCFG region stretches just south of the Rakaia River to just north of the Waiau River and west to Arthur's and Lewis Passes (Figure 1). Although management occurs at the regional scale, swan management is driven by the status of swans in the Greater Christchurch area, inclusive of Te Waihora, Wairewa (Lake Forsyth), and the Avon-Heathcote estuary.

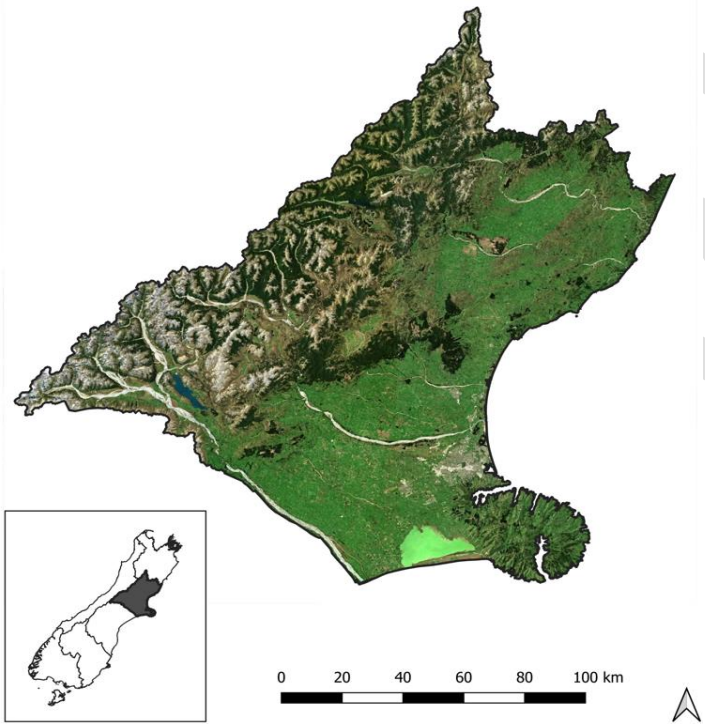

Figure 1. North Canterbury Fish and Game Council Region

5. Population Status and Trends

Fish and Game survey data suggests the population has been relatively stable around the long-term average of ~6,000 birds but has varied between ~4,500 to ~10,000 birds (Figure 2). However, swans have remained well below historical population levels since the Wahine storm of 1968, which destroyed many of the submerged aquatic vegetation beds that are important for swan foraging (Williams 1979, Gerbeaux 1989). However, the current Fish and Game survey methodology may be failing to capture local movements of swans away from Te Waihora to nearby habitats in response to lake level management and disturbance on colonial nesting areas (Garrick et al. 2023, Andrew Crossland, unpublished data).

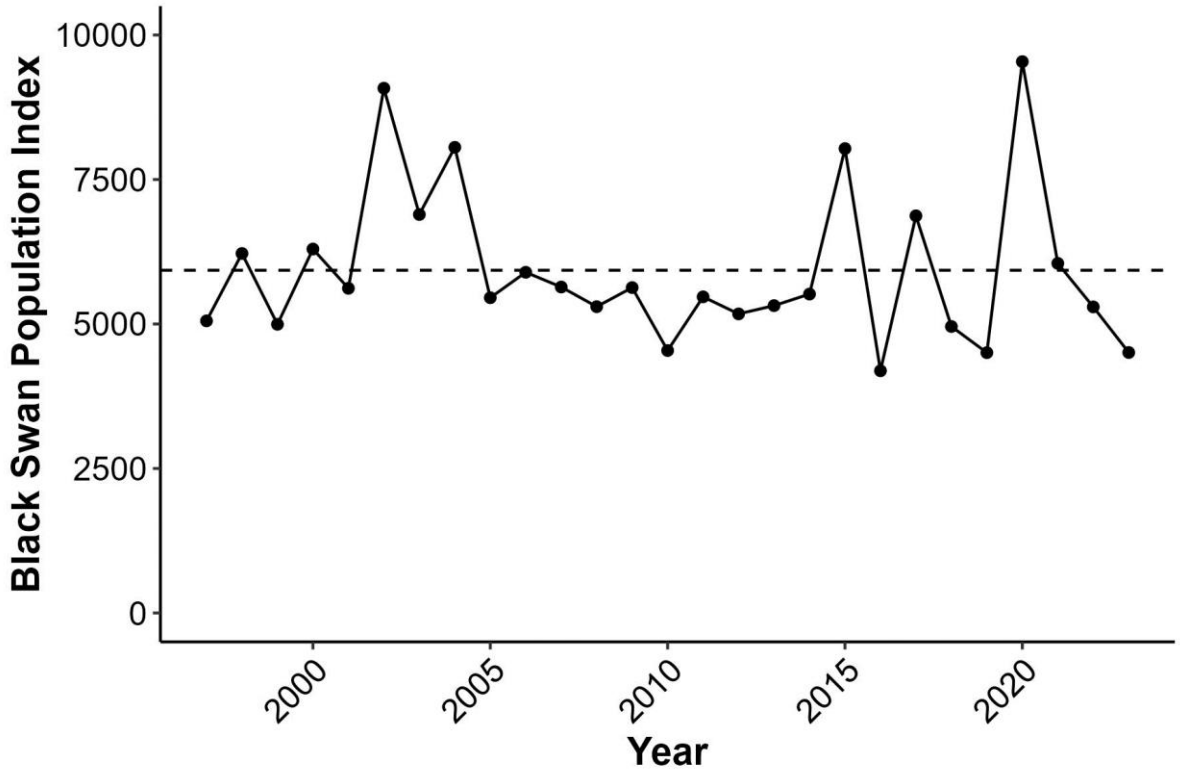

Figure 2. North Canterbury Fish and Game summer population index of black swans 1997-2023, with a dashed line representing the long-term average.

A recent population model that included multiple demographic parameters (i.e., survival of adults and juveniles, nesting propensity, and nest success) showed black swan populations appear to be stable around Te Waihora (Herse et al. 2022). However, there may be significant yearly variation. For example, lake openings to the sea are driven by lake water level thresholds (NWCO 1990). This strategy can lead to spring openings that leave swan nests with extensive mudflats between them and the water margin, which can lead to large-scale nest failure or abandonment (Les Brown, Personal Communication). Disruptive events appear to redistribute swans within the Greater Christchurch City area on a seasonal basis (Andrew Crossland, unpublished data) and may destabilise the local swan population by significantly reducing recruitment in successive years.

6. Management Objective

Maintain a January swan population of 4,500 – 7,500 across the North Canterbury Region through the use of traditional egg harvest, hunting regulations, habitat management, and conflict abatement. This goal represents 75% to 125% of the long-term annual population index.

Swan counts by NCFG are, on average, 48% lower than the Christchurch City Council (Andrew Crossland, unpublished data), which is attributed to detection probability, as well as differences in survey methodology (i.e., multiple observers counting flocks of swans from the ground and double counting). NCFG survey methodology is being revised to both increase detection probability and precision. Because of this, the population objective will likely need to be revised in the near future.

7. Population Monitoring Strategy

Monitoring is conducted through annual aerial surveys flown in January during the wing moult period that assess population status through counts of adults and cygnets in important wetland sites across North Canterbury. Over 95% of swans in North Canterbury are found within Te Waihora, Wairewa, and the Avon-

Heathcote estuary system. Additionally, Ngāi Tahu collects nesting data in association with cultural harvest activities that could be used in conjunction with the population index to inform population status and swan management strategies (Herse et al. 2021, Herse et al. 2022).

8. Traditional Egg Harvest

Swan egg harvest is an important mahinga kai activity that provides a connection to Te Waihora for Ngāi Tahu. Integrating egg harvest frameworks into Fish and Game management regimes empowers local iwi and supports Ngāi Tahu engagement with nature while also benefitting swan populations in North Canterbury through the collection of more data to inform management decisions and swan population status (Herse et al. 2021, Herse et al. 2022). Mahinga kai practitioners' general approach to egg harvesting is to have a minimal impact on swan recruitment (Herse et al. 2021). However, egg harvesting activities can also provide an important method of indirect population control that is more culturally appropriate than culling operations should swans exceed population goals (Herse et al. 2021). Facilitating and integrating all traditional game bird harvest activities (including paradise shelduck (pūtangitangi, *Tadorna variegata*) moult harvest) will be a major component of a larger Te Waihora management plan that will be co-designed between NCFG and Te Rūnanga o Ngāi Tahu.

9. Harvest Management Strategy

Approximately 82% of black swan harvest in North Canterbury occurs on or around Te Waihora. Fish and Game's hunter harvest survey developed by Barker (1991) has seen regular season (May-end of July) black swan harvest vary annually, between a low of 280 in 2016 to a high of 3,174 in 1993 (Figure 3).

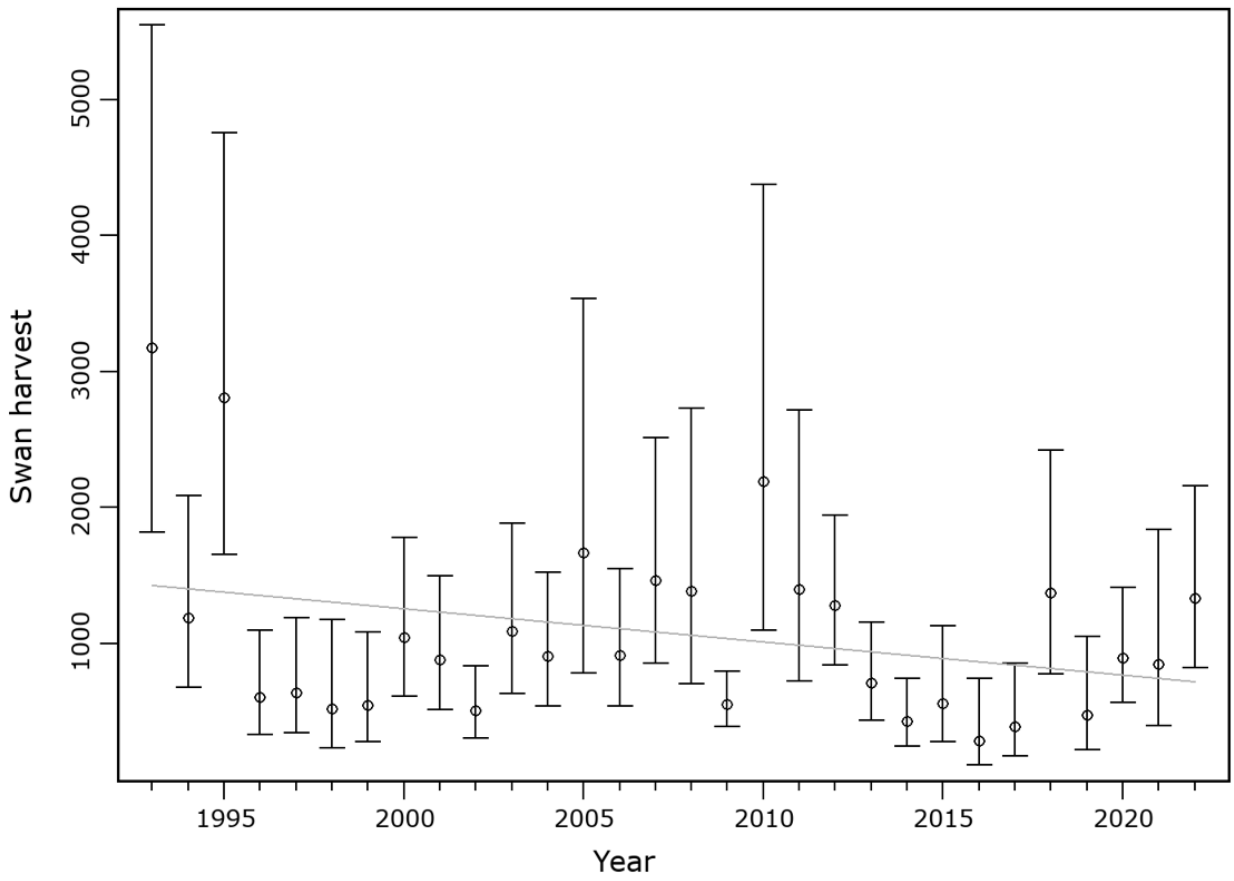

Figure 3. Annual black swan harvest in North Canterbury estimated from the hunter harvest phone survey.

Between 2015-2021, assuming hunters that shot three or more swans would still have shot two swans if the bag limit was two, a bag limit of two would encompass 75% of swan harvest (Table 1). Because so few people shoot three or more swans, the total harvest only increases by 25% with a bag limit of five.

Table 1. Cumulative percentage of black swan harvest by theoretical bag limit in North Canterbury based on hunter harvest data 2015-2021.

Bag limit	Cumulative Harvest
1	49%
2	75%
3	87%
4	96%
5	100%

Seventeen of the last 30 years' harvest has been <1,000 swans during the regular game bird season, with the long-term average being 1,066 birds. Given a bag limit of two encompasses the majority of swan harvest, there is little need from a hunter-harvest perspective for a higher bag limit. Reducing the bag limit from two to one would reduce total harvest by 35%, should swans reach a lower population threshold where NCFG would look to see an increase in populations.

10. Regulatory Frameworks

The adaptive harvest strategy consists of three pre-defined regulatory packages (Figure 4, Table 2):

Liberal regulations (Green): A daily bag limit of two swans per day during the game bird season and traditional egg harvest that restricts population growth past desired population levels (>125% of mean). Permits to reduce swan numbers (i.e., shooting swans over decoys) may be granted outside of the main nesting season in August and September.

Moderate regulations (Blue): A daily bag limit of two swans per day during the game bird season and traditional egg harvest that restricts population growth past desired population levels (>125% of mean).

Restrictive regulations (Yellow): A daily bag limit of one swan per day during the game bird season and traditional egg harvest that does not restrict population growth. This represents 50% to 75% of the long-term population index.

Closed regulations (Red): A daily bag limit of 0, and traditional egg harvest is extremely limited. This represents 50% or less of the long-term population index.

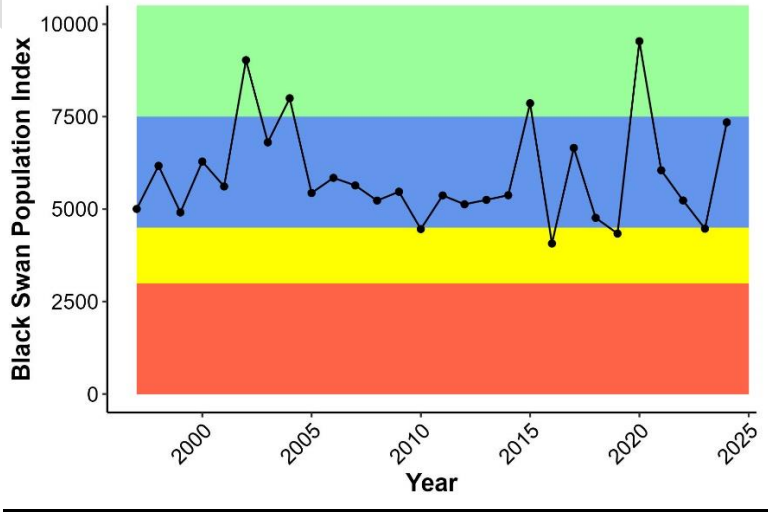

Figure 4. Adaptive Management Frameworks for black swans in North Canterbury. Colours represent different regulation frameworks - red - closed, yellow – restrictive, blue – moderate, and green - liberal.

Table 2. Regulatory packages for black swans in North Canterbury.

"MANAGEMENT TOOLS"	Closed Season	Restrictive Season	Moderate Season	Liberal Season
	Increase Population	***Increase Population***	***Maintain Population***	***Reduce Population***
Justification	Black swan below objective based on available biological data, comments from hunters, public, and landowners, as well as field and staff observations. Crop depredation minimal, should be addressed through a wildlife damage control programme. Non-lethal tools primarily, however, unique situations may be addressed using kill permits. Egg harvest limited.	Black swan below objective based on available biological data, comments from hunters, public, and landowners, as well as field and staff observations. Crop depredation expected to be minimal, should be addressed through a wildlife damage control programme. Non-lethal tools primarily, however, unique situations may be addressed using kill permits. Sustainable egg harvest is to be conducted at Ngāi Tahu's discretion.	Black swan at objective based on available biological data, comments from hunters, public, and landowners, as well as field and staff observations. Manageable depredation on crops to be expected, should be addressed through a wildlife damage control programme. Non-lethal tools primarily, however, chronic depredation issues may be addressed with kill permits. Population growth is to be limited through egg harvest conducted by Ngāi Tahu.	Black swan above objective based on available biological data, comments from hunters, public, and landowners, as well as field and staff observations. Frequent depredation on crops to be expected, should be addressed through a wildlife damage control programme. Chronic depredation issues may be addressed with kill permits. Population growth is to be limited through a combination of kill permits and egg harvest conducted by Ngāi Tahu.
Summer Population Index (2-year average)	<3000	3,000-4,500	4,500-7,500	7,500+
Regular Season Days	—	Full season	Full season	Full season
Bag Limit	—	1/day	2/day	2/day

11. Wildlife Damage Control

Development of farmland around the margins of Te Waihora and Wairewa has led to increased use of paddocks by swans, particularly during spring. Dispersion methods will be clearly outlined in the Game Bird Depredation Plan; however, culling will be limited to small numbers of swans (≤5) per day for the purpose of dispersal when populations are <7,500 swans. When populations are below 7,500 swans, no decoys or calls will be allowed with permits. Use of decoys and calls to reduce populations may be allowed through

the depredation program when populations exceed 7,500 swans. Permits to reduce swan numbers (i.e., culling over decoys) will only be issued outside of the main nesting season (August- September).

12. Information Needs

- Swan monitoring has been limited in recent years to annual surveys post-breeding. There is limited modern understanding of the basics of swan biology – survival rates, emigration/immigration rates, local movements, nesting ecology (i.e., age of first nesting, factors affecting nesting propensity, cygnet survival, fledging rates, etc.). A modern banding program would allow a better understanding of many facets of swan ecology and also allow more information to inform harvest regulations (yearly estimates of harvest rates).
- Historic banding data suggested 25-50% of 2- to 5-year-old swans dispersed throughout the country, particularly to Otago and Southland, but also to Wellington, Hawkes Bay, and Eastern Fish and Game regions in the North Island (Williams 1977). These dispersions happened before swans first attempted to nest at ~five years of age (Williams 1979), which made Te Waihora an important source population for other regions. Given that this data is over 50 years old, it may be time to reinvestigate historical questions. Modern technological advancements (GPS/GSM transmitters) would allow for extensive investigation of swan movements and behaviour beyond what was possible half a century ago.
- The importance of Te Waihora to black swans in North Canterbury cannot be understated. A better understanding of how lake water level management, particularly lake openings to the sea, effect swan ecology is needed. Especially in regard to movements and distributions, foraging, and nesting.
- Submerged aquatic vegetation is the primary food source for swans on the lake. Vegetation beds have largely deteriorated since the Wahine storm of 1968. Still, a better understanding of the current extent of vegetation beds is necessary to estimate the biological carrying capacity of the lake. Additionally, identifying the effect of local land-use changes on publicly managed land and the consequences for swan habitat use.

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