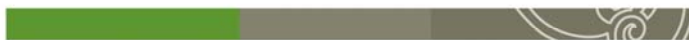


**Review of Impacts to Pasture Production by  
Black Swans (*Cygnus atratus*) and Canada Geese (*Branta canadensis*)  
in Northland**

Jim Coleman



**Landcare Research**  
Manaaki Whenua



**Envirolink Small Advice Grant NLRC67**

**Review of Impacts to Pasture Production by Black Swans**

**(*Cygnus atratus*) and Canada Geese (*Branta canadensis*) in**

**Northland**

J.D. Coleman

Landcare Research  
PO Box 40, Lincoln 7640  
New Zealand

Landcare Research Contract Report: LC0708/104

PREPARED FOR:  
Northland Regional Council  
Private Bag 9021  
Whangarei

DATE: April 2008



ISO 14001

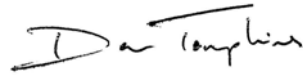
---

Reviewed by:

Approved for release by:



Bruce Warburton  
Research Leader  
Landcare Research



Dan Tompkins  
Acting Science Team Leader  
Wildlife Ecology and Epidemiology

---

© Landcare Research New Zealand Ltd 2008

This information may be copied and distributed to others without limitation, provided Landcare Research and the source of the information is acknowledged. Under no circumstances may a charge be made for this information without the express permission of Landcare Research New Zealand Limited.

---

## Contents

---

	Summary .....	5
1.	Introduction .....	7
2.	Background .....	7
3.	Objectives .....	7
4.	Methods .....	8
5.	Results .....	8
	5.1 Population size and trends in Northland .....	8
	5.2 Nature of damage .....	9
	5.3 Pasture loss/economic impact .....	10
	5.4 Need for improved management .....	11
6.	Conclusions .....	12
7.	Recommendation .....	13
8.	Acknowledgements .....	13
9.	References .....	13



---

## Summary

---

### Project and Client

The likely impact on pasture production of black swans (*Cygnus atratus*) and Canada geese (*Branta canadensis*) across Northland was reviewed for Northland Regional Council (NRC) by Landcare Research, in summer 2008.

### Objectives

- To review the likely impact of black swans and Canada geese on pasture production in Northland, and to determine the need, if any, for the improved local management of both species over and above that achieved through ongoing recreational and ‘special permit’ shooting.

### Methods

Information on the likely impact and economic costs of black swans and Canada geese on pasture production in Northland was obtained from the author’s databases and contract reports on both species, and from literature searches of published and unpublished material both within and outside New Zealand. Additional information on recent population counts of both species was gleaned directly from Fish and Game New Zealand, on recent/proposed legislative changes relating to both species from the Department of Conservation, and on the likely or perceived impact on the environment of both species in Northland from Victoria University of Wellington and NRC.

### Main Findings

- Trend count surveys in Northland in 2008 identified 10 326 black swans and 2066 Canada geese, and indicate Canada goose numbers are increasing rapidly. The relationship of these counts to absolute numbers in the region is unclear, but similar data for 2006 were challenged by some local landowners who argued they seriously underestimate local populations of both species.
- Both black swans and Canada geese graze pasture. Black swans have a strong preference for aquatic vegetation, and mostly eat pasture species only when the former is unavailable. Canada geese feed more widely and commonly on pasture, with greatest emphasis on newly sown fields adjacent to wetland/lake systems. Coupled with their strong social (flock) feeding behaviour, Canada geese are likely to impact on pasture production more heavily than black swans.
- The pasture species eaten by black swans and their daily intake have apparently not been documented either in New Zealand or elsewhere. Some data on daily intake of pasture exist for Canada geese in Canterbury high country but are superficial in nature and have little bearing on pasture intake by geese in Northland.
- Any evaluation of the level of competition for pasture with livestock by black swans and Canada geese must be based on robust population estimates of both species, on estimates of the amount of pasture eaten or fouled by them, on the species eaten, and on the effect on livestock of their direct interactions with black swans and Canada geese. **As none of these data are available for Northland, any defensible estimates of the impact of the black swan and Canada goose on Northland pasture are unlikely.**

- Present management of both species is based largely on recreational hunting and on the occasional special 'shoot' when local damage is perceived to be unacceptably high. Recent complaints by landowners to Northland F&G are rare and provide little support by themselves for improved local management of either species.
- Without a sound understanding of the impact of both species on agricultural and ecological values, it is difficult to argue for the improved management of either bird species. Black swans occur in high numbers throughout Northland but strongly prefer aquatic vegetation, and their overall impact across Northland on pasture is likely to be low. Conversely, Canada geese show a strong preference for pasture species, where they usually feed in tight flocks. Together with their increasing numbers, they appear to pose a greater long-term threat to farmers in Northland than do black swans. That said, both species feed in flocks and show clear site and field preferences and tenacity, resulting in some properties regularly containing large numbers of grazing birds while other properties are rarely if ever grazed. The small number of complaints by farmers relating to grazing of both the black swan and Canada goose appear to reflect this behaviour.

### **Recommendation**

- If concerns by farmers in Northland of black swan and Canada goose grazing escalate, their total offtake of pasture species also eaten by livestock should be determined. This would be a significant study, and should involve all major stakeholders.



---

## 1. Introduction

---

The likely impact on pasture production of black swans (*Cygnus atratus*) and Canada geese (*Branta canadensis*) across Northland was reviewed for Northland Regional Council (NRC) by Landcare Research, in summer 2008.

---

## 2. Background

---

Black swan and Canada goose numbers in Northland are sufficiently high for stakeholders to voice concerns over their impact on both Crown and privately owned lands. This is despite there being little published information on the environmental impacts of both species and their recognition by recreational hunters as a highly valued hunting resource.

Information relevant to the impact of black swans on terrestrial and aquatic ecosystems in Northland was reviewed by Landcare Research (JD Coleman) in 2006 for NRC. The project was funded by the Foundation for Research, Science and Technology (FRST) via its Envirolink programme for small advice grants (No. NLRC28). Subsequently, the views of local stakeholders on the research needs for the better management of black swans and Canada geese in the region were documented by Landcare Research (JD Coleman) in 2007 via an Envirolink programme for medium advice grants (No. NLRC33). Both these reports are publicly accessible on the web (<http://envirolink.govt.nz>).

The population trends, damage, and control of Canada geese across New Zealand and the management issues arising from their presence has recently been reviewed (Spurr & Coleman 2005), under funding from FRST via Non-Specific Output Funding associated with Programme C09X0209.

An application by NRC to FRST for a further Envirolink small advice grant to support a review of the likely impact of both species on local pasture production and the need, if any, for improved local control was approved in December 2007.

---

## 3. Objectives

---

- To review the likely impact of black swans and Canada geese on pasture production in Northland, and to determine the need, if any, for the improved local management of both species over and above that achieved through ongoing recreational and 'special permit' shooting.

---

## 4. Methods

---

Information on the likely impact and economic costs of black swans and Canada geese on pasture production in Northland was obtained from the author's databases and contract reports on both species, and from literature searches of published and unpublished material both within and outside New Zealand. Additional information on recent population counts of both species was gleaned directly from Fish and Game New Zealand (F&G; Rudi Hoetjes, Manager Northland Region), on recent/proposed legislative changes relating to both species from the Department of Conservation (Michael Gee, Senior Policy Analyst, Head Office), and on the likely or perceived impact on the environment of both species in Northland from Victoria University of Wellington (Murray Williams), and NRC (Don McKenzie).

---

## 5. Results

---

### 5.1 Population size and trends in Northland

#### **Black swans**

Black swan populations are monitored over 1–2 days each January in Northland by F&G from light aircraft flown over all estuaries and wetlands. Although counts provide estimates of population trends in the areas surveyed, their relationship to absolute numbers across the region is unclear.

Black swans are widely distributed throughout Northland. Prior to the 1980s, large groups of feeding birds were recorded but there were few local breeding populations. This has now changed, with birds breeding throughout the region. In 2008, highest numbers of black swan were counted by F&G on Kaipara (5000) and Parengarenga harbours (1530), and modest numbers on Lake Owhareiti (650), Houhora area/right side of SH1 (580), Te Paki/Te Werahi (530), Lake Omapere (400), Bob Haig's property (400), Lake Puheke/Rotokawau (250) and Lake Waipurera (230) (data from R. Hoetjes, pers. comm.). A further 756 birds were counted at 34 lesser sites throughout the region, with the wider than normal distribution apparently reflecting the wet summer experienced (R. Hoetjes, pers. comm.). An aerial inspection of black swan and Canada goose numbers and their distribution in April 2007 over coastal Aupouri Peninsula by the author of this report and NRC staff revealed that nearly all black swans seen were in or close to the mangrove stands bordering estuarine areas.

Recent (post-1995) annual trend counts of black swan numbers undertaken by F&G in Northland have varied from 4176 in 1996 to 15 145 in 2003, and totalled 10 326 birds in 2008 (R. Hoetjes, pers. comm.).

#### **Canada geese**

Canada goose populations are monitored by Northland F&G using the same trend count flights as used for black swan (R. Hoetjes, pers. comm.). Geese were first recorded in the area

in 1995 (100), and numbers have rapidly increased to 2066 in 2008. In this year, geese occurred at 16 sites (far fewer than for black swan), with 350 birds recorded at Mt Camel, 340 at Bob Haig's, 320 at Ngataki/Houhora, 280 at Sweetwater ponds and wetlands, and 250 at Te Paki/Te Werahi. Trend counts generally indicate highest numbers in the region in each annual survey occurring at Mt Camel.

## 5.2 Nature of damage

### Black swans

Feeding studies of black swans indicate they show a clear preference for submerged plants in shallow fresh or saline lakes over plants in wetlands or pasture and that they spend most of their time feeding/loafing in aquatic environments (Sagar et al. 1995). However, black swans are frequently recorded grazing in loose flocks on lakeside pasture throughout both New Zealand and Australia, especially when aquatic plants are reduced in availability due to high water levels or when aquatic weed beds die off (Sagar et al. 1995; Williams 1977, 1979). Losses of aquatic weed beds have occurred increasingly frequently in New Zealand over the last two decades (Sagar et al. 1995), forcing black swans to feed on land, where they may especially damage germinating grasses and clovers. However, the range and relative proportions of pasture species eaten by black swans has not been documented in New Zealand or elsewhere (M. Williams, pers. comm.), and only rarely for other species of swan. Thus, while black swans may, on occasion, compete directly for pasture with grazing livestock, **such competition, although considered significant by some farmers, does not appear to have been investigated.**

Black swans spend a far greater proportion of the day feeding than most other waterfowl, with the percentage feeding increasing steadily throughout the day until dusk but few feeding at night (Bimler 1983; Hamilton et al. 2002). Like Canada geese, black swans are considered to have a fairly inefficient digestive system, being largely unable to digest fibre, and thus need to feed extensively to obtain sufficient sustenance.

### Canada geese

By comparison with black swans, Canada geese commonly feed in tight flocks on both native and introduced grasslands, where grasses form a staple food (White 1986). As a consequence, they have long been considered to compete directly and significantly with livestock. Goose damage to pasture is of greatest concern in late summer – early autumn, as at this time farmers are trying to maintain autumn pasture for overwintering stock. In spring, geese show preferences for growing-pasture and greenfeed crops (Holloway et al. 1997). Their high numbers in the South Island and social feeding behaviour have led to several limited studies of their impacts on grazing lands in South Island high country areas. These studies are discussed below. However, again, **no studies have been undertaken of the plant species eaten and relative proportion of each on farmland in Northland or elsewhere in New Zealand (M. Williams, pers. comm.), or of their competition there with livestock for pasture.** What is known is thought to be obsolete due to changes in bird habits, control practices, and farming practices (Holloway et al. 1997).

Canada geese exploit lakes and fields adjacent to lakes with similar intensity (Potts & Andrews 1991). Irrigated pasture and emergent resown pasture are most preferred, and such fields often contain most local birds. These feeding preferences and patterns result in a small percentage of farmers 'hosting' most geese and incurring most of their damage, while many farmers in the same general area rarely if ever have geese grazing on their property. For

example, only 15–20 of 300 farm managers in the South Island high country reported unacceptable numbers of geese and levels of damage in the mid-1980s (White 1986). Similar large but well-separated flocks of geese occur in Northland; in a flight over the Aupouri Peninsula in April 2007 to check for black swans and Canada geese, the author recorded c. 600 geese on one property at the southern end of the Peninsula and only several small flights of less than 100 birds elsewhere. Such patterns of goose dispersion, like those of black swan, may be influenced by weather patterns, with geese being widely distributed during wet years and more confined to damper or irrigated pastures during dry years (as appeared to be the case for both species in 2008; R. Hoetjes, pers. comm.). A dramatic example of weather-driven feeding patterns occurred in the Wairarapa in 2005, when many of the new pastures sown following widespread flooding provided unique local grazing opportunities for geese and damage reached record levels (W. O'Donnell, Greater Wellington Regional Council, pers. comm.).

As a consequence of their relatively poor digestive system (see above), Canada geese and black swans have substantial faecal outputs (up to 0.5 kg/day wet weight for geese), particularly when compared to stock, producing three times more faecal material than sheep for the same intake of food. For this reason, perceptions of goose intake, particularly, based on numbers of droppings may greatly inflate their damage (White 1986). Further, such droppings foul pasture and fouled areas are avoided by stock (Leathers & Costello 1986; White 1986; Sagar et al. 1995). However, droppings may also be beneficial, leading to compensatory pasture growth later in the year (White 1986), and forage around fresh droppings remains edible to stock when pasture is in short supply despite their preferences for non-fouled forage (White 1986).

### **5.3 Pasture loss/economic impact**

#### **Black swans**

A black swan eats c. 0.25 kg of fresh aquatic forage (or 0.018 kg dry matter) per kilogram of body weight per day (Mitchell & Wass 1996), or for adult birds which typically weigh 4–5 kg, roughly 1.0–1.25 kg per day, i.e. c. 0.1 kg/day dry weight. Based on the goose/livestock relationship developed by White (1986, see below), this suggests that 14–17 black swans equal one stock (ewe) equivalent when birds are feeding on similar pasture to stock. However, this may inflate real pasture losses, as birds preferentially feed away from pasture on most days. Calculations of pasture loss to black swans therefore requires estimates of their 'actual time' feeding on pasture (see above) and this has not been determined. Alternatively, estimating the amount of pasture eaten, based on the amount of aquatic forage eaten, is likely to seriously underestimate the former; feeding mute swans in Britain have a higher rate of intake when feeding on pasture compared with that when feeding on aquatic material due to the lower digestibility (higher levels of fibre) of the former (Seers 1989). Such differential intake of pasture and aquatic plants is likely to hold for black swans as well.

#### **Canada geese**

Preliminary attempts to quantify the agricultural damage caused by geese in the South Island high country were made by Leathers and Costello (1986), White (1986), and Harris et al. (1987) and summarised in Spurr & Coleman (2005). Leathers and Costello (1986) calculated a weighted average annual loss per goose of about \$7 (range approximately \$2–\$14; \$14.80 in 2007 dollars), based on surveys of farmer estimates of goose numbers on their property.

White (1986) obtained a similar figure, and calculated that adult geese eat 0.3–0.4 kg of dry pasture matter per day, with 4–5 geese equal to one stock unit. However, he added a cautionary note by suggesting such data are influenced by season, the age of the pasture sward, flocking behaviour, and goose interactions with livestock. Farmer estimates of goose damage per farm ranged from \$1,375–\$47,500 (\$2,907–\$100,147 in 2007 dollars). However, losses estimated by a computer-based feed budgeting model were substantially lower, for unexplained reasons (Leathers & Costello 1986; White 1986).

In a more recent study, Canada geese significantly reduced pasture production adjacent to Lake Grassmere, inland Canterbury (Win 2001; Win & Hickling 2001). Daily pasture intake by geese in a 69-ha study area ranged from 90 kg in spring to 490 kg wet weight in autumn. The difference in monthly dry-matter production in goose-grazed and ungrazed pasture ranged from less than 100 kg/ha in winter to 900 kg/ha in late summer – early autumn, and was positively correlated with the number of geese present. Densities of grazing geese ranged from 3.7/ha in spring to 20.2/ha in autumn (Win & Hickling 2000).

Although there have been few studies of the economic impacts of geese, anecdotal accounts of goose damage to pasture and crops abound, further indicating that losses of pasture and crops can be significant (e.g. de Lacy 1984; Ward 1984; Costello et al. 1988; B. Abernethy, Fish & Game; R. Grigg, Barrosa Station, Mt Somers; C. Pedersen, Federated Farmers; and W. O'Donnell, Greater Wellington Regional Council, pers. comm.).

As well as damaging pasture, Canada geese may also damage crops, e.g. turnips sown for winter fodder (Leathers & Costello 1986; White 1986; Potts & Andrew 1991). Large numbers of geese have also been reported to feed on spilled grain in stubble fields (White 1986; Potts & Andrew 1991; Holloway et al. 1997), and on emergent autumn-sown cereals (C. Pedersen, Federated Farmers, pers. comm.). However, goose damage to crops is apparently generally minor. Only 2% of 100 arable farmers surveyed in Canterbury in summer 2000 reported damage by Canada geese (Coleman & Spurr 2001), with both observations involving grazing on emergent peas.

Relating pasture consumption by grazing black swans or Canada geese (based solely on number of birds present and daily rates of intake) to loss of pasture to livestock is particularly difficult. Consumption of small amounts of plant tissue during periods of active pasture growth are likely to have lesser consequences for landowners (due to compensatory growth) than consumption after plant growth has ceased, when any pasture eaten directly reduces that available to livestock (Mitchell & Wass 1966). This relationship has been largely ignored in studies on food intake by black swans and Canada geese.

## **5.4 Need for improved management**

### **Farmer complaints**

Complaints by landowners over 2001–07 to the Northland branch of F&G of the harmful grazing activities of game birds have included six for black swans (none in the last four years) and eight for Canada geese. All of the latter come from one property owner (M. Gee, DOC, pers. comm.). When compared with the number of similar complaints received over the same period for pūkekō (78), paradise shelduck (70), and other game birds (23), landowner concerns for black swans and Canada geese seem very low.

### Current management

Active management of black swans and Canada geese in Northland is limited to recreational shooting of both species under the game bird licence system, and, where unacceptable damage is deemed to have occurred, to occasional shooting under special permits. Recent changes in the status of the black swan (now declared a native bird) and a possible change in status of the Canada goose (currently under Ministerial review) may affect both future recreational and special permit shooting but this is currently unclear.

Game bird hunting returns for Northland, recovered from a random sample of licence holders, indicate that the number of black swans annually harvested since 2000 has varied considerably, rising from 531 in 2001 (when the trend count was 9656) to 2750 in 2002 (when the trend count was 14 358), and included 1563 birds in 2007. Using the same approach, 1000 Canada geese were estimated to have been harvested in 2007 (Barker, national game bird hunter survey results 2007, unpubl. report). A comparison with earlier harvests indicates there was no change in the harvest of either species over either the most recent 5-year (2003–07) or 2-year (2006–07) intervals, despite there being weak evidence of a reduction in hunting effort (days hunted) in the province over the 2006–07 period.

---

## 6. Conclusions

---

- Trend count surveys in Northland in 2008 identified 10 326 black swans and 2066 Canada geese, and indicate Canada goose numbers are increasing rapidly. The relationship of these counts to absolute numbers in the region is unclear, but similar data for 2006 were challenged by some local landowners who argued they seriously underestimate local populations of both species.
- Both black swans and Canada geese graze pasture. Black swans have a strong preference for aquatic vegetation, and mostly eat pasture species only when the former is unavailable. Canada geese feed more widely and commonly on pasture, with greatest emphasis on newly sown fields adjacent to wetland/lake systems. Coupled with their strong social (flock) feeding behaviour, Canada geese are likely to impact on pasture production more heavily than black swans.
- The pasture species eaten by black swans and their daily intake have apparently not been documented either in New Zealand or elsewhere. Some data on daily intake of pasture exist for Canada geese in Canterbury high country but are superficial in nature and have little bearing on pasture intake by geese in Northland.
- Any evaluation of the level of competition for pasture with livestock by black swans and Canada geese must be based on robust population estimates of both species, on estimates of the amount of pasture eaten or fouled by them, on the species eaten, and on the effect on livestock of their direct interactions with black swans and Canada geese. **As none of these data are available for Northland, any defensible estimates of the impact of the black swan and Canada goose on Northland pasture are unlikely.**
- Present management of both species is based largely on recreational hunting and on the occasional special ‘shoot’ when local damage is perceived to be unacceptably high. Recent complaints by landowners to Northland F&G are rare and provide little support by themselves for improved local management of either species.

- Without a sound understanding of the impact of both species on agricultural and ecological values, it is difficult to argue for the improved management of either bird species. Black swans occur in high numbers throughout Northland but strongly prefer aquatic vegetation, and their overall impact across Northland on pasture is likely to be low. Conversely, Canada geese show a strong preference for pasture species, where they usually feed in tight flocks. Together with their increasing numbers, they appear to pose a greater long-term threat to farmers in Northland than do black swans. That said, both species feed in flocks and show clear site and field preferences and tenacity, resulting in some properties regularly containing large numbers of grazing birds while other properties are rarely if ever grazed. The small number of complaints by farmers relating to grazing of both the black swan and Canada goose appear to reflect this behaviour.

---

## 7. Recommendation

---

- If concerns by farmers in Northland of black swan and Canada goose grazing escalate, their total offtake of pasture species also eaten by livestock should be determined. This would be a significant study, and should involve all major stakeholders.

---

## 8. Acknowledgements

---

I thank Rudi Hoetjes of Fish and Game for access to data on trend counts of the black swan and Canada goose, and Bruce Warburton, Dan Tomkins, and Christine Bezar for comments on the text.

---

## 9. References

---

- Bimler AM 1983. The behavioural ecology of the population of black swan *Cygnus atratus* Latham on a Manawatu dune lake. PhD thesis, Massey University, Palmerston North. 290 p.
- Coleman JD 2006. Envirolink Small Advice Grant NLRC28: Review of information relevant to the impact of black swan in Northland. Landcare Research letter. 6 p.  
(<http://www.envirolink.govt.nz/reports/documents/218-Nlrc28ReviewOfBlackSwan.pdf>)
- Coleman JD 2007. Envirolink Medium Advice Grant NLRC33: Outcomes from a workshop on the environmental issues associated with black swan (*Cygnus atratus*) populations on the Aupouri Peninsula in Northland. Landcare Research Contract Report LC0607/159. 8 p.
- Coleman JD, Spurr EB 2001. Farmer perceptions of bird damage and control in arable crops. *New Zealand Plant Protection* 54: 184–187.
- Costello EJ, Ackroyd P, Hide RP, Hughey KFD 1988. Property rights and Canada goose management. Report to Department of Conservation. Centre for Resource Management, Lincoln College, Lincoln. 19 p.

- de Lacy H 1984. Shoot-outs not enough to quell goose problem. *New Zealand Farmer* 105 (23): 22–23.
- Hamilton AJ, Taylor IR, Hepworth G 2002. Activity budgets of waterfowl (Anatidae) on a waste-stabilisation pond. *Emu* 102: 171–179.
- Harris PS, Potts KJ, Costello EJ 1987. An assessment of the economic impact of Canada goose grazing on Grassmere Station using a farm management modelling technique. Centre for Resource Management Report, Lincoln University. Lincoln.
- Holloway JDR, Scott RR, Wilson K-J 1997. Management of the Canada goose in the South Island of New Zealand. Unpublished report, Lincoln University, Lincoln. 14 p.
- Leathers KL, Costello EJ 1986. The economics of Canada goose management in New Zealand: a preliminary analysis. Report to New Zealand Wildlife Service. Centre for Resource Management, Lincoln College and University of Canterbury. 55 p.
- Mitchell SF, Wass RT 1996. Quantifying herbivory: grazing consumption and interaction strength. *Oikos* 76: 573–576.
- Potts KJ, Andrew JJ 1991. Canada geese feeding on farmland in North Canterbury high country. Science and Research Series 39. Department of Conservation, Wellington. 22 p.
- Sagar PM, Schwarz A-M, Howard-Williams C 1995. Review of the ecological role of black swan (*Cygnus atratus*). NIWA Science and Technology series 25. 34 p.
- Seers J 1989. Feeding activity and body condition of mute swans *Cygnus olor* in rural and urban areas of a lowland river system. *Wildfowl* 40: 88–98.
- Spurr EB, Coleman JD 2005. Review of Canada goose population trends, damage, and control in New Zealand. Landcare Research Science Series 30. 31 p.
- Ward T 1984. Canada geese: beautiful pests. *New Zealand Farmer* 105(6): 21–22.
- White EG 1986. Canada geese in New Zealand. Information Paper 4, Centre for Resource Management, Lincoln College, Lincoln. 40 p.
- Williams M 1977. Locations of recoveries of black swans, *Cygnus atratus* Latham, banded at Lake Whangape and Lake Ellesmere, New Zealand. *Australian Wildlife Research* 4: 289–299.
- Williams M 1979. The status and management of black swans *Cygnus atratus* Latham, at Lake Ellesmere since the ‘Wahine’ storm, April 1968. *New Zealand Journal of Ecology* 2: 34–41.
- Win A 2001. Seasonal grazing of Canada goose (*Branta canadensis*) on high country farmland, Canterbury, New Zealand. MSc thesis, Lincoln University, Lincoln. 110 p.
- Win A, Hickling GJ 2000. Seasonal grazing by Canada geese (*Branta canadensis*) on South Island high-country pasture. *New Zealand Plant Protection* 53: 445.
- Win A, Hickling G 2001. Seasonal grazing by Canada geese (*Branta canadensis*) on South Island high-country pasture. Proceedings of the 12th Australasian Vertebrate Pest Conference, 21–25 May 2001, Melbourne, Australia. Pp. 292–296.