Seedling Ratio Index monitoring on Secretary Island

Assessing the response of the forest understorey to deer control between 2006 and 2010

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Cover image - Judas deer at Mahoe Stream on Secretary Island, April 2009 (Dave Crouchley)

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Seedling Ratio Index Monitoring on Secretary Island

Assessing the response of the forest understorey to deer control between 2006 and 2010

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Summary

Re-measurement of 17 Seedling Ratio Index (SRI) transects established in November 2006 was carried out in November 2010 on Secretary Island in Doubtful Sound, Fiordland National Park. The transects were established in areas of moderate to high deer numbers to provide short to medium term vegetation outcome monitoring for the deer eradication programme that began in November 2006. The method measures the ratio of tall to short seedlings in the forest understorey along with browse levels on different species, and plants were grouped in species palatability classes for analysis. Browse on species across all palatability groups declined to negligible levels, with a dramatic decline in browse for the 'Preferred' and 'Not Selected' palatability groups between 2006 and 2010. The SRI score increased significantly for the 'Preferred' species group and increased slightly for the 'Not Selected' species group indicating the beginning of recovery in the understorey of the plant species of those groups. The SRI score for the 'Avoided' species group remained unchanged at a level indicating healthy levels of regeneration for the species in that group. During this period a total of 651 deer were shot on the island which has left only a few individuals still present. The results are consistent with predictions from 2006 and indicate the recovery of deer palatable species in the understorey on Secretary Island in areas of previously moderate to high deer numbers. Considerable further improvement in understorey condition can be expected if deer remain at current levels or are successfully eradicated.

1. Introduction

Secretary Island is a large (8,140ha.), steep and rugged island in Doubtful Sound in Fiordland National Park. This island, along with Resolution Island (21,000ha.) in Dusky Sound, is currently the focus of large scale pest control operations with the aim of zero density of red deer (*Cervus elaphus scoticus*) and stoats (*Mustela erminea*).

Seventeen Seedling Ratio Index (SRI) transects were established in November 2006 on Secretary Island immediately prior to the beginning of deer control operations on the island. The transects were established to provide short to medium term vegetation outcome monitoring for the deer control operations. The SRI transects were re-measured in November 2010. During this period a total of 651 deer were shot on the island which left only a few individuals remaining, probably less than 30.

The SRI method is designed as a simple and relatively low cost method for monitoring ungulate impacts on forest understory condition in the short to medium term (Sweetapple and Burns, 2002; Sweetapple and Nugent, 2004). The method is appropriate for assessing vegetation outcomes of deer control in this context. The limitation of the method is that it does not provide information on long term trends in forest structure and composition. A network of permanent forest plots on Secretary Island (see Monks et al., 2005) is designed to measure such trends.

2. Objectives

To assess the short term response of the forest understorey on Secretary Island after a large decline in the deer population.

3. Methods

3.1 Study Area

Secretary Island is a steep, rugged island of 8140ha. in Fiordland National Park. It rises to 1196m above sea level making it the third highest island in New Zealand behind North and South Islands. The island was deer free until the late 1950's or early 1960's and a small resident population was confirmed as present by 1970 (Crouchley et al., 2007).

The island has a diverse range of plant communities but is mostly forested. The vegetation on the island and impacts of deer on the islands vegetation have a long history of study due to the fact that the island was deer free until the late 1950's or early 1960's (e.g. Wardle, 1963; Wardle et al., 1970; Mark et al., 1991).

3.2 Field Methods

Twenty transect start locations with restricted random bearings were plotted in locations of accessible terrain spread over three areas known to contain preferred deer habitat. Seventeen of these were measured. Field methods followed Knightbridge (2003). Transects were 400m long (20 plots 20m apart) and the transect start locations were marked permanently.

On each of twenty plots per transect; seedlings less than 30cm high (Short) were recorded as present in a 0.49m radius circular plot and seedlings between 30cm and 2m high (Tall) were recorded as present in a 1.41m radius circular plot. Species recorded (target species) were all species capable of growing above 30cm tall without support.

Ungulate browse was scored on target species within the 1.41m radius plot between 15cm and 2m using the following categories (0=no browse; 1=1-10% of stems with some browse observed; 2=11-25%; 3=26-50%; 4=51-75%; 5=76-100%).

The presence/absence of deer pellets was recorded for the 1.41m radius plot in 2010 but not 2006.

3.3 Data Analysis

Each species recorded was assigned a palatability class based on Forsyth et al. (2002), with some species reassigned to a class based on local knowledge. The SRI was calculated for each species palatability group on each transect as follows: SRI=(∑Tall-∑Short)/(∑Tall+∑Short), where ∑=the sum of species within a palatability group for each transect for each height class (Tall/Short).

The mean SRI for all transects was then calculated and plotted with 95% confidence intervals for each palatability class in each year. Mean browse scores for each palatability class on each transect were calculated then averaged across all transects and plotted with 95% confidence intervals for each year.

Species palatability data from the 2006 measurement (Clayton, 2007) was updated to reflect the revisions we made to the classes.

Data analysis and graphics were carried out using Microsoft Excel and R version 2.9.2 (R Development Core Team, 2009).

4. Results

In Figure 1 and 2 below the palatability classes are as follows: A=avoided, NS=not selected, P=preferred. In Forsyth et al. (2002) P=preferred; plant species eaten more than expected from their availability, NS=not selected; plant species eaten in proportion to their availability, and A=avoided; plant species proportionately less eaten than available based on a three-way classification of ungulate preference.

Seedling ratios can range between -1 and 1 with values well below zero indicating a low proportion of seedlings in the tall category, values near zero demonstrating an even presence of seedlings in the short and tall categories, and values well above zero indicating a greater proportion of tall seedlings.

In an area where a deer population is unmanaged seedling ratios of 'preferred' and 'not selected' species would be expected to be below zero indicating poor regeneration, while 'avoided' species would be expected to have positive seedling ratios. After sustained deer control the seedling ratios of 'preferred' and 'not selected' species would be expected to increase towards or above zero indicating healthy regeneration potential in the understory. Browse scores would be expected to decrease with sustained deer control.

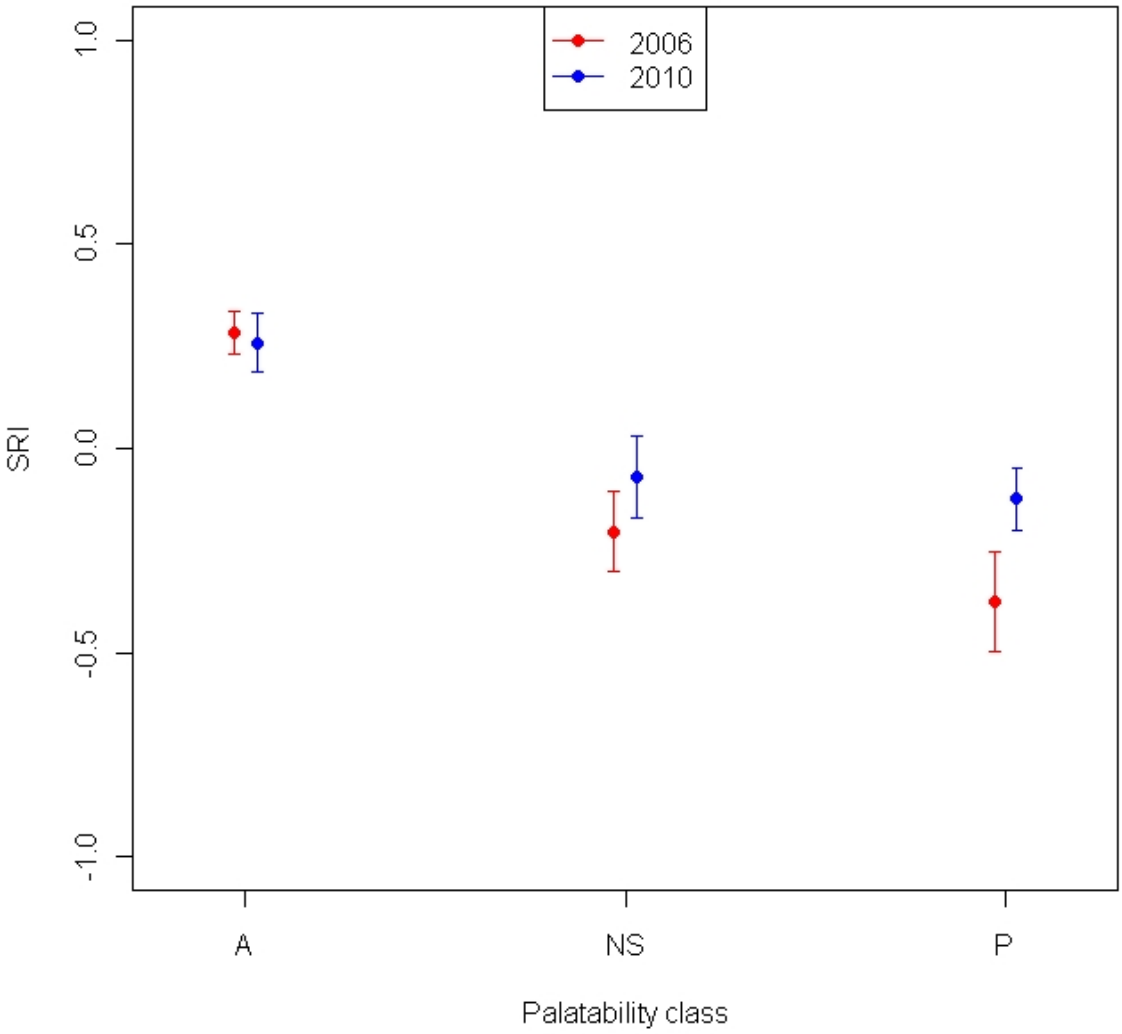

Figure 1. Mean Seedling Ratio Index score (SRI) and 95% confidence intervals for groups of species in palatability classes on Secretary Island in 2006 and 2010.

The mean SRI score for the 'Preferred' species group increased significantly towards zero between 2006 and 2010, while the mean SRI score for the 'Avoided' species group remained almost the same and was well above zero in both years. The mean SRI score for the 'Not Selected' species group increased towards zero, but not significantly.

The mean browse score for all species groups fell to negligible levels between 2006 and 2010. The decline in mean browse scores was most dramatic in the 'Preferred' and 'Not Selected' species groups, whereas in the 'Avoided' species group browse was very low to start with in 2006.

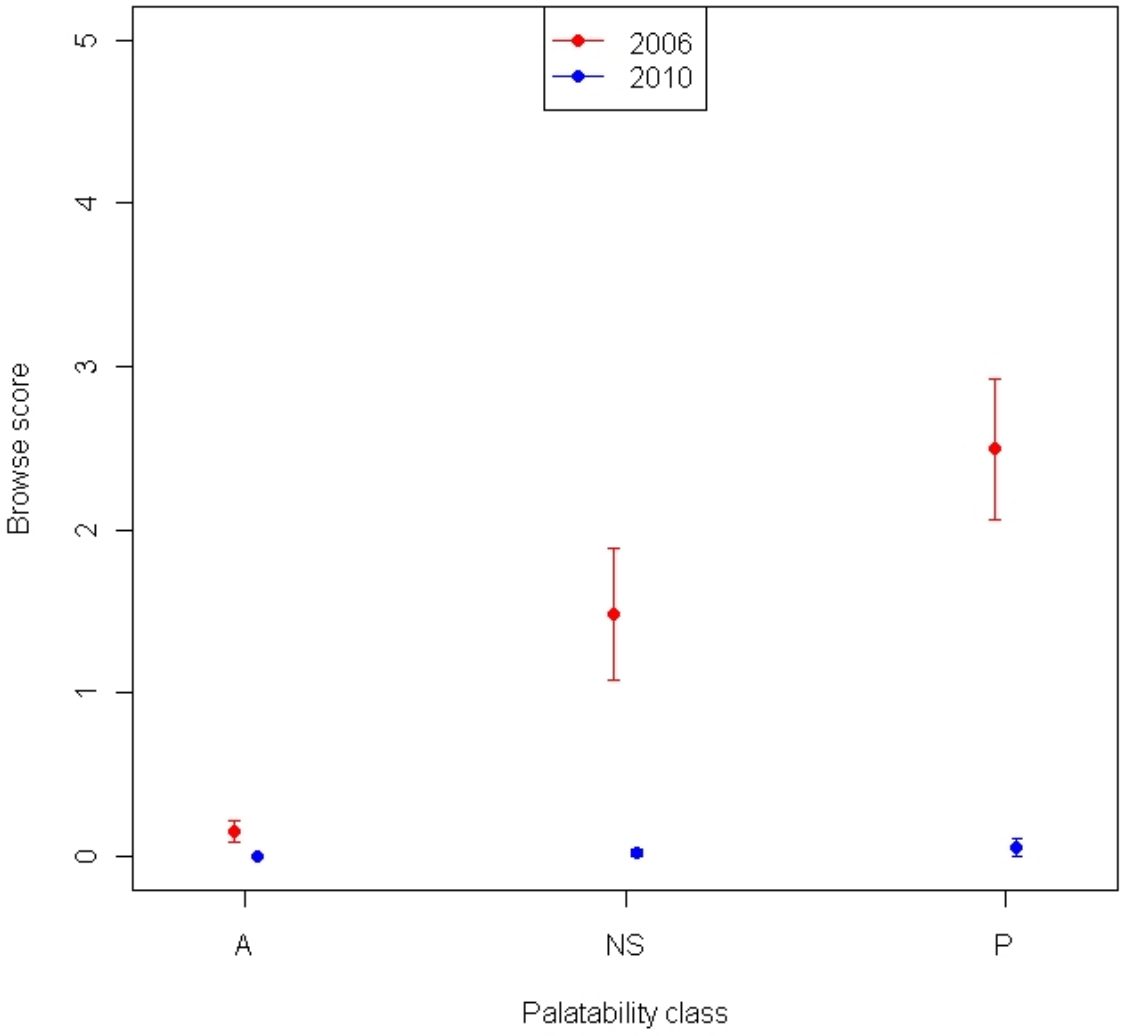

Figure 2. Mean browse scores and 95% confidence intervals for groups of species in palatability classes on Secretary Island in 2006 and 2010.

5. Discussion

The highly positive results above are in line with the predictions and targets in Clayton (2007). With such a dramatic decrease in the deer population expected pre-control, it was predicted that browse levels would decrease to zero for all species and SRI values for highly and moderately palatable species would be significantly improved. It was also expected that there would be a lag effect between the cessation of browsing by deer and the recovery and growth of seedlings and saplings in the understorey. This would suggest there is significant potential for the SRI scores of 'Preferred' and 'Not Selected' species to further improve providing deer are kept at near zero density on the island.

The understorey vegetation of Secretary Island has been severely browsed by deer as their numbers built up on the island since the 1970's (e.g. Mark et al., 1991; Monks et al., 2005). Deer control measures implemented between 1970 and 1987 were never intensive or widespread enough to have a major impact on the total population on the island. After that time only limited aerial commercial hunting was continued (Crouchley et al., 2007). Deer numbers were likely to have been close to carrying capacity by the time the Department of Conservation began deer eradication in late 2006.

Monks et al. (2005) suggested that a gradual increase in palatable plant species in the understorey was to be expected with deer eradication on Secretary Island and that the observed shift in dominance to deer-avoided plant species between 1975 and 2003 was likely to be temporary in this case. The results here suggest this process is beginning although a re-measurement of both the SRI transects and the 20x20m permanent forest plots on the island would be required to confirm this.

This work compliments other vegetation monitoring measuring the outcome of deer control on Fiordland islands. In addition to the SRI transects Secretary Island has 43 permanent 20x20m forest plots (Monks et al., 2005), and 30 Wraight grassland transects (Lake and Ewans, 2005); Resolution Island (c. 21000 ha.) has 20 SRI transects (Ewans, 2010), Coal Island (c. 1200 ha.) has 20 SRI transects (Geoff Rogers, pers. comm., 17/6/2008); and Anchor Island (1380 ha.) has 9 permanent 20x20m forest plots (Ewans, 2008).

6. Conclusions

With the removal of most of the deer off Secretary Island plant species palatable to deer in the forest understorey appear to be beginning to recover in areas of previously moderate to high deer numbers. Considerable further improvement in understorey condition can be expected if deer remain at current levels or are successfully eradicated.

7. Recommendations

- Secretary Island is managed to become and remain deer free.
- The SRI transects are re-measured shortly before, or after, the 20x20m permanent forest plot network (between 2013-15) to allow comparisons of the two methodologies in terms of cost and information obtained.
- The results presented here are compared with results from other Fiordland Islands e.g. Coal Island and assessed for publication potential.

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Appendix 1. Map of Seedling Ratio Index transects start points