

Assessing the effects of deer browse on Mayne Island's Ecosystems

Prepared by Rob Underhill for the Mayne Island Conservancy Society

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1 Abstract

Increases in black-tailed deer (*Odocoileus hemionus*) populations in the Southern Gulf Islands, British Columbia are having a significant impact on plant structure and diversity (Gonzales and Arcese, 2008; Martin *et al.*, 2010; Clements *et al.*, 2011). This impact is particularly noticeable on Mayne Island, where non-native fallow deer (*Dama dama*) are also present after being introduced in the 1990's (Shackleton, 1999). Intense browsing by these two species has resulted in a reduction in palatable shrub species abundance and diversity. Our results indicate the combined browsing of deer populations on Mayne Island is resulting in a lack of recruitment of some palatable woody plant species, and a reduction in palatable woody species diversity and percent cover.

2 Introduction

Overabundance of large herbivores has been shown to decrease biodiversity at all trophic levels (McShea and Rappole, 2000). Biodiversity decreases directly as a result of intense browsing of palatable shrubs and herbaceous plants (Cardinal *et al.*, 2012), and indirectly as a result of habitat loss for songbirds and arthropods (Bressette *et al.*, 2012; Holt *et al.*, 2013). Increasingly, overabundant wild ungulate populations are being recognized for their role in declining understory plant diversity (Chollet *et al.*, 2013).

A recent study by Martin *et al.*, 2010 described the effects of deer relative abundance on shrub architecture and plant and bird diversity across the Gulf and San Juan Islands. However, Mayne Island was not one of the islands included in that study. The primary focus of this paper is to place the Mayne Island deer population in context to the findings of the Martin *et al.*, 2010 study, and to describe the effects of current deer density on shrub abundance and woody plant diversity at specific sites on Mayne Island.

In order to quantify the effects of deer browse we compared vegetation characteristics between three deer management conditions: fenced from deer, areas that have been hunted in recent years, and areas away from recent hunting. Areas where recent hunting has occurred were indicated by local hunter Bob Anderson. He and other select permitted hunters on Mayne Island have been targeting fallow deer specifically, and have culled approximately 600 individuals between 2003 and 2012 (personal communication Sean Pendergast, British Columbia Ministry of Forests, Lands and Natural Resource Operations, April 8th 2013). Oceanspray shape was used as an indicator of browse pressure. This shrub was recently used by Martin *et al.*, 2010 in a regional study in which they found deer relative abundance (as indicated by pellet group counts) and the ratio of oceanspray at 1m/2m was closely correlated. We also surveyed pellet group density, woody plant richness and percent cover.

3 Methods

3.1 Surveys

Two sets of surveys were completed on Mayne Island B.C. The first survey occurred on March 22nd and 23rd 2013 to measure plant diversity, oceanspray shape, and count deer pellets in 27 plots across eight locations on the island. The second survey occurred on April 19th, 2013 to measure oceanspray shape of 96 individual plants across four locations on the island.

3.1.1 Survey 1

Survey 1 was conducted on March 22nd and 23rd 2013 by two Mayne Island Conservancy Society Biologists Rob Underhill and Michael Dunn in collaboration with Professor Peter Arcese from the University of British Columbia and 17 students from his 3rd year wildlife management class. The eight survey locations were selected in advance to represent areas from three different deer management conditions; away from areas of active hunting (Not-hunted), near areas of active hunting (Hunted), and areas fenced to exclude deer (Fenced) (Table 1), (Figure 1).

Table 1. Survey 1 was conducted across eight locations on Mayne Island representing three different deer management conditions.

Management Condition	Location(s)
Away from areas of active hunting (Not-hunted)	Bennett Bay Hardscrabble Farm (outside fence) Hatake Farm (outside fence)
Near areas of active hunting (Hunted)	Henderson Community Park Lower Henderson Community Park Upper 270 Georgina Point Rd.
Fenced to exclude deer (Fenced)	Hardscrabble Farm (inside fence) Hatake Farm (inside fence)

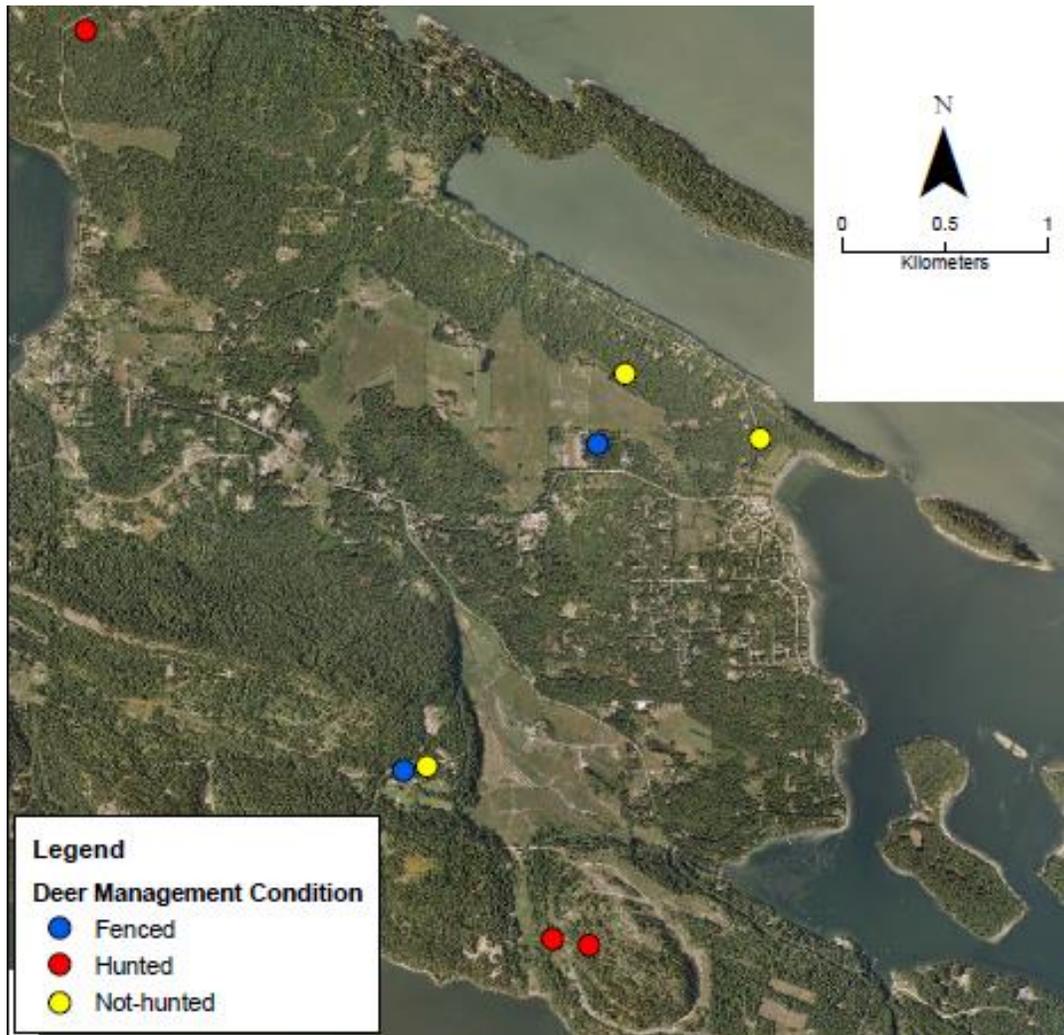


Figure 1. Survey 1 locations on Mayne Island showing deer management conditions: near areas not open to hunting (Not-hunted), near areas open to hunting (Hunted), and areas fenced to exclude deer (Fenced).

Within each of the eight survey locations, plot centers were selected randomly. Each plot was circular with a radius of 10m (314m²). For each plot the following information was recorded:

1. Estimate of canopy cover (%).
2. Presence of all woody palatable plant species within plot (Table 2).
3. Estimate of percent cover for each palatable plant species within the plot.
4. Number of deer pellet groupings along four line transects originating from plot center. Each line transect was 2m wide by 50m long. Therefore 400m² was surveyed for pellet groupings at each plot.
5. The diameter of the nearest oceanspray individual to plot center was measured at heights of 0.5m and 1.5m.

Table 2. List of palatable woody shrub species detected in survey 1.

trailing blackberry	black-cap raspberry	red alder
snowberry	salmonberry	willow sp.
Nootka rose	Pacific crap apple	black hawthorn
Orange honeysuckle	bigleaf maple	bitter cherry
Western red huckleberry	arbutus	Himalayan blackberry
baldhip rose		

3.1.2 Survey 2

Survey 2 was conducted on April 19th, 2013 by MICS staff biologists Rob Underhill and Michael Dunn with the assistance of volunteers Lauren Underhill and Dan Stewart. Four locations were surveyed representing three different deer management conditions: away from areas where hunting is permitted (Not-hunted), near areas where hunting is permitted (Hunted), and areas that have been fenced to exclude deer (Fenced) (Table 3).

Table 3. Survey 2 was conducted across four locations on Mayne Island representing three different deer management conditions.

Management Condition	Location(s)
Away from areas of active hunting (Not-hunted)	Bennett Bay Hatake Farm (outside fence)
Near areas of active hunting (Hunted)	Henderson Community Park
Fenced to exclude deer (Fenced)	Hatake Farm (inside fence)

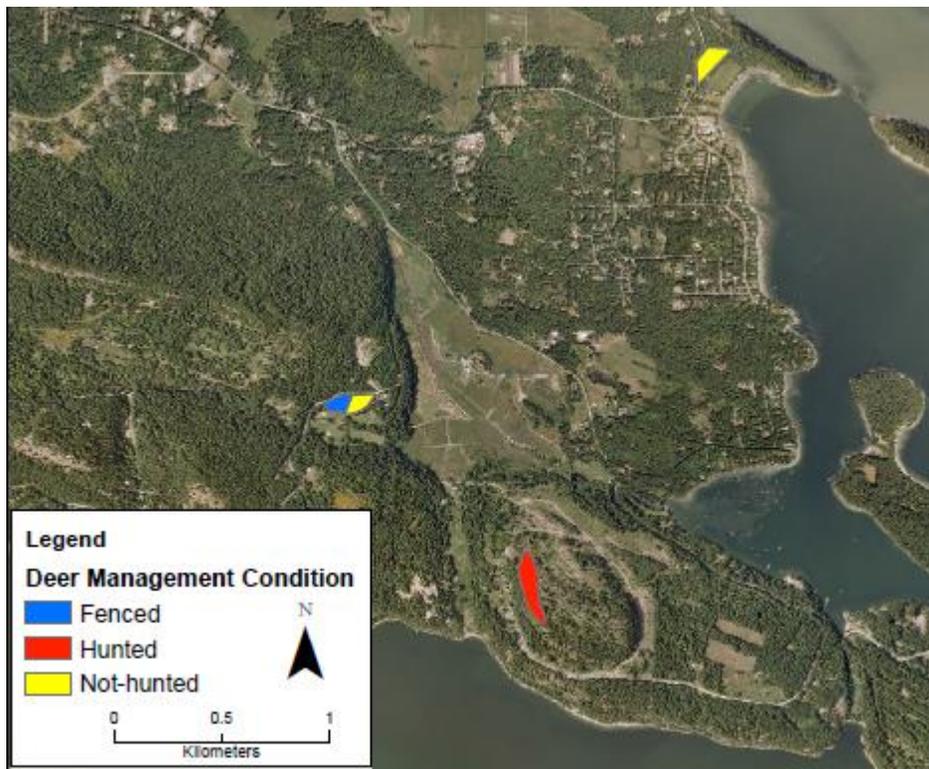


Figure 2. Survey 2 locations on Mayne Island showing three deer management conditions: near areas not open to hunting (Not-hunted), near areas open to hunting (Hunted), and areas fenced to exclude deer (Fenced).

Prior to arriving on site, survey boundaries were delineated based on physical landmarks such as paths, fences, or roads. Within each of the four survey areas, the diameter of every oceanspray present was measured at 1m and 2m in height.

4 Results

4.1 Pellet Group Observations

We observed significantly more pellet groupings per 400m² in plots located in areas away from active hunting than in plots located near areas of active hunting (Figure 3) (P-value = 0.007). The highest number of pellet groupings/400m² was observed at Bennett Bay (n = 5, mean = 19.8 +/- 8.9).

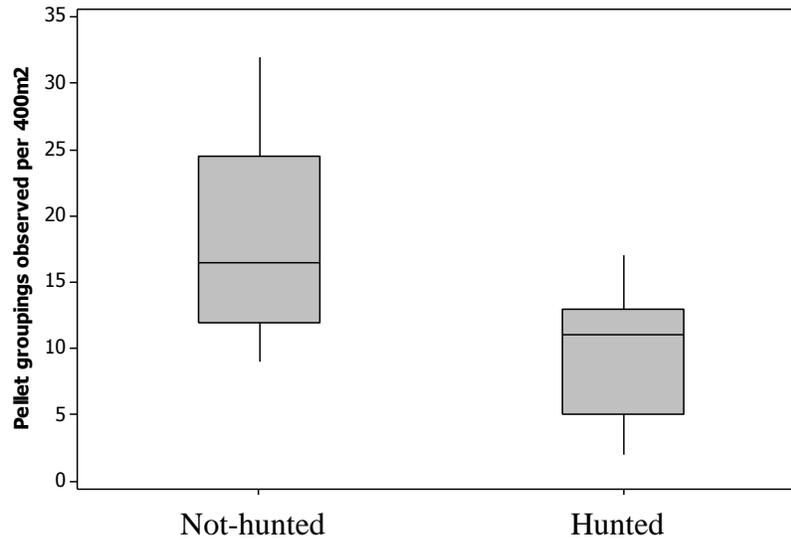


Figure 3. A comparison between the number of pellet groupings observed per 400m² in areas not near areas of active hunting (n = 9, mean = 10 +/- 5) vs. areas near active hunting (n = 12, mean = 18 +/- 8).

Palatable woody plant species richness shows a 22% correlation to pellet group density (Figure 4). Pearson test for no correlation between pellet groupings/400m² and palatable species richness P-value = 0.014. Therefore species richness and pellet group density are correlated.

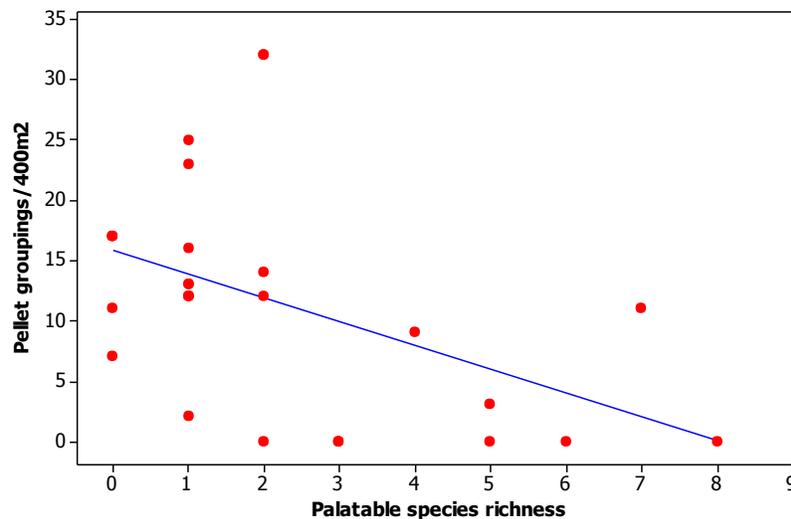


Figure 4. Correlation between palatable woody plant species richness and observed pellet groupings per 400m² for 27 plots across Mayne Island (R² = 22%, P-Value = 0.014).

4.2 Palatable Species Richness and Percent Cover

Percent cover of palatable woody plants was significantly higher in fenced plots than non-fenced plots, but no significant difference was detected between plots near areas Hunted and areas Not-hunting (Figure 5).

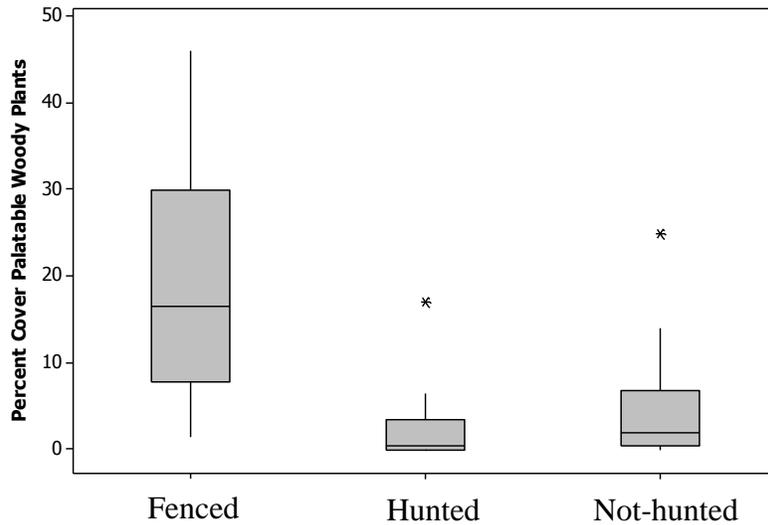


Figure 5. A comparison of palatable woody plant percent cover between three deer management conditions on Mayne Island: near areas not open to hunting (Not-hunted) (n = 12, mean = 4.9 +/- 7.5), near areas open to hunting (Hunted) (n = 9, mean = 2.8 +/- 5.7) , and areas fenced to exclude deer (Fenced) (n = 6, mean = 19.2 +/- 15.6).

Our survey location at Hatake Farm afforded us the opportunity to compare two areas immediately adjacent to each other in the same continuous forested area, but bisected by a fence. Palatable woody shrub diversity was significantly different inside vs. outside the fence with an average of 5.33 palatable species observed inside the fence and 1.33 species observed outside the fence (Figure 6).

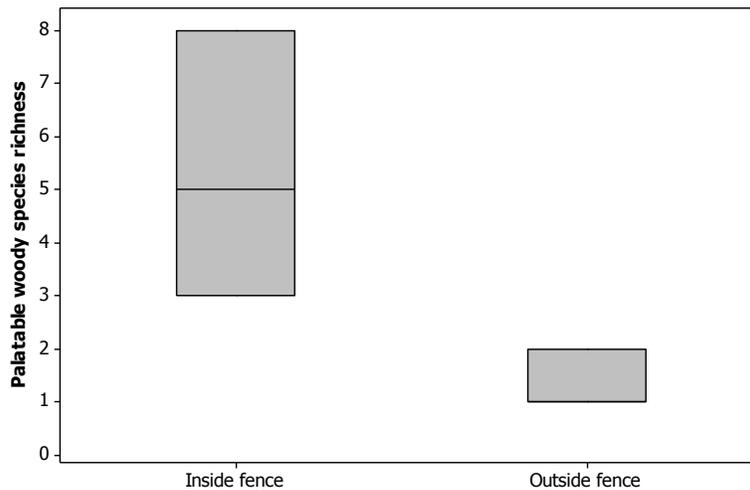


Figure 6. A comparison of palatable woody shrub species inside (n = 3, mean = 5.33 +/- 2.51) and outside (n = 3, mean = 1.33 +/- 0.58) a deer exclosure fence at Hatake Farm

4.3 Oceanspray Shape

Oceanspray shape was variable within survey locations but more noticeably between different deer management conditions (Figure 7). The highest level of deer browse on oceanspray was observed within survey locations in Not-hunted areas (mean = 0.33 +/- 0.25). Oceanspray within Fenced sites were much less umbrella shaped (mean = 0.78 +/- 0.32).

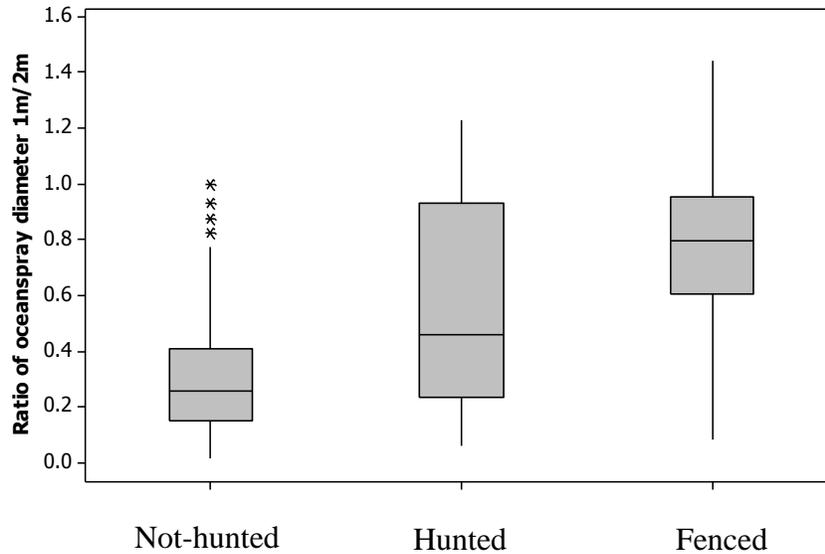


Figure 7. A comparison of oceanspray shape between three deer management conditions on Mayne Island: near areas not open to hunting (Not-hunted) (n = 47, mean = 0.33 +/- 0.25), near areas open to hunting (Hunted) (n = 23, mean = 0.54 +/- 0.36), and areas fenced to exclude deer (Fenced) (n = 26, mean = 0.78 +/- 0.32).

Our survey location at Hatake Farm afforded us the opportunity to compare oceanspray shape inside a fenced area to that immediately outside, with the fence bisecting a large patch of oceanspray (Figure 8). The mean ratio of oceanspray diameter at 1m/2m in height within the fenced area (mean = 0.78 +/- 0.32) was more than double that of oceanspray exposed to deer browse (mean = 0.31 +/- 0.25) (P-Value = <0.001).

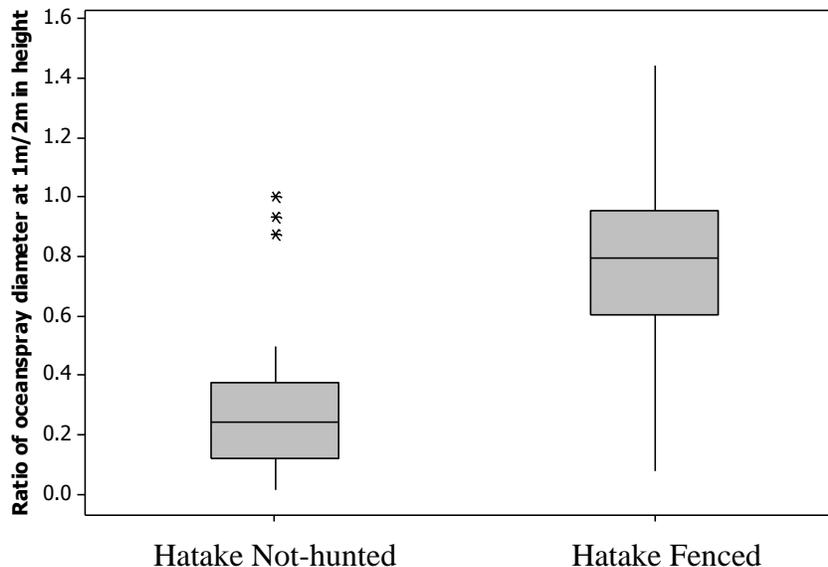


Figure 8. A comparison of oceanspray shape within a continuous forested area at Hatake Farm in which one half is open to deer (n=30, mean = 0.31 +/- 0.25) while the other half is fenced (n=26, mean = 0.78 +/- 0.32).

Comparing our oceanspray shape observations with those made by Martin *et al.*, 2010 on islands throughout the San Juan and Southern Gulf Islands, we see that oceanspray in areas Not-hunted on Mayne Island have similar shape to those found on islands with high deer density such as D'Arcy (1.05 +/- 0.11 deer/Ha) and Sidney (1.14 +/- 0.10 deer/Ha) (Figure 9).

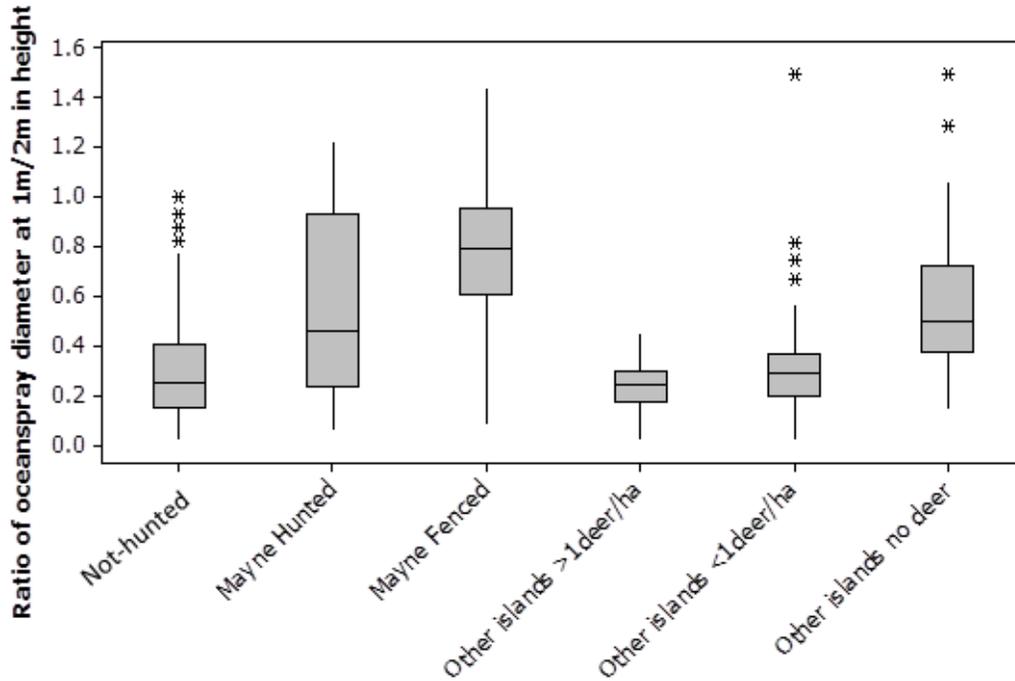


Figure 9. A comparison of Oceanspray shape between different management conditions on Mayne Island and other islands in the Southern Gulf and San Juan Islands. Oceanspray shape data for islands other than Mayne Island was supplied by Dr. Peter Arcese from the University of British Columbia. Islands were grouped based on deer density estimates made by Martin *et al.*, 2010.

5 Discussion

Resources were not available to conduct an island-wide survey, therefore results should not be used to estimate total deer abundance on Mayne Island. However, results from both pellet count and shrub shape surveys indicate a relative abundance at survey locations ranging from 0.5 – 2 deer/Ha when compared to results obtained by Martin *et al.*, 2010. This abundance of deer is considered too high if the goal is to maintain historic plant and animal diversity within the ecosystems of Mayne Island. Our palatable woody plant richness and percent cover estimates support other regional studies that show levels of deer relative abundance have increased to the point where deer browse is now significantly and directly impacting local plant structure and diversity, and likely indirectly impacting the wildlife that rely on those plant communities.

The effect of current deer abundance is evident in the difference in plant diversity between fenced and non-fenced sites. For example, the iconic arbutus tree (*Arbutus menziesii*) is one of the dominant overstory species on sunny, well drained sites (Figure 10), yet outside of deer excluding fences you would be hard pressed to find even a single sapling within browse height. Inside fenced areas arbutus seedlings are commonly found in high numbers following disturbances (personal observation). A similar story can be told for red flowering currant (*Ribes sanguineum*) and oceanspray (*Holodiscus discolor*), as well as the wide range of palatable flowering plants found in our Garry oak meadows such as great camas (*Camassia leichtlinii*), chocolate lily (*Fritillaria affinis*), and fawn lily (*Erythronium oregonum*). During two years working as a biologist on Mayne Island I have observed just ten red flowering currants growing in the wild. Of those ten, five are within fenced areas, two are growing off the side of a cliff, one is found in the middle of a blackberry patch, and the remaining two are on level ground in an unfenced area; but have been browsed to a height of approximately six inches.

Although palatable species such as arbutus and oceanspray are still present in large numbers on Mayne Island, without the survival of young plants these and other species will be drastically reduced in abundance over time. As existing mature plants die, there will be no new generation with which to replace them. In addition, the plants and animals that rely on historic patterns of forest succession and plant community structure will be negatively affected through loss of food and habitat.

The observations collected during this study and others across the region outline a clear choice: either we begin to manage local deer populations in such a way that they are consistently maintained at lower densities, or we accept the loss of some plants and the animals that rely on them from our local ecosystems.



Figure 10. Abundant arbutus saplings within the fenced area at Hatake Farm, April 2013.

6 References

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