An Analysis Of Population Dynamics Of Deer And Sheep on Galiano Conservancy Association's DL57 Through The Implementation Of A Pellet Group Study

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Abstract

Through pellet group sampling on Galiano Conservancy Association's DL57 site, we determined which of deer or sheep herbivory is having a larger negative impact on the various ecosystem types in the study area. Our methods used six randomly selected transect lines ranging from 50 m to 200 m and were arbitrarily located throughout the study site. Our data yielded that deer had a pellet group density of 0.3 pellet groups/m^2 and sheep pellet groups had a density of 0.2 pellet groups/ m^2. From this data we concluded that deer are having a larger negative effect on the ecosystem communities of the study site. As well, we determined that the young forest ecosystem is the most used by deer and sheep; therefore, it is inferred to be the most negatively affected ecosystem. In order to establish a management plan for deer and sheep populations, we recommend collecting a broader range of data over multiple seasons and years to adequately understand the herbivory dynamics on DL57. Depending on the results of future data collection, it could be determined if population reductions would be the most efficient method for restoring the site.

Introduction

The population of deer has increased dramatically in range and abundance in the recent decades. In North America, not only have deer been introduced in many states, but also to islands with ideal conditions (Cote *et al*., 2004). The most obvious factor that contributes to this rapid growth of deer populations is due to increased forage. Furthermore human activities such as agricultural and silvicultural factors have impacted and improved the deer habitat. Tree planting after logging as well as newly forested landscaped provide abundant, high-quality food for the deer, which leads to increases in the deer habitat carrying capacity. Additionally, with the decrease in predators, ungulate populations increase rapidly towards and beyond the carrying capacity of available forage (Cote *et al*., 2004).

Ungulates can significantly alter forest communities through direct browsing on leaves, stems flowers and fruits; this affects the growth, reproduction and survival of plants (Cote *et al.,* 2004). Browsing of the reproductive parts reduces fruit and seed production (Allison, 1990), which further reduces recruitment. Trees with a history of browsing have an increased chance of being browsed again. The consumption of tree seedlings alters forest structure and recruitment (Rooney & Waller, 2003); other species may defer flowering when browsed (Cote et al., 2004). Where deer are abundant, herbaceous plants preferred by deer tend to be smaller, less likely to flower and less likely to survive. Furthermore, deer browse evergreens in the winter, when other food becomes scarce (Cote et al., 2004).

Deer also have indirect effects such as the degradation of wildlife habitat (Rooney & Waller, 2002). Herbivores can alter resource quality for other herbivores indirectly through "sequential herbivory" (Rooney & Waller, 2002), where they are able to exert cascading effects on other herbivores by modifying the composition and physical structure of habitats (Cote *et al.,* 2004). Browsing by deer also has effects on the population and the community composition of many invertebrates, birds and small mammals. Heavy browsing reduces the vegetative cover and complexity in the area which inevitably leads to reduced habitat availability for

other animals (Cote *et al,* 2004). This modifies species abundance and diversity; deer can further have an impact on trophic interactions among species. These kinds of effects on the interactions within the food web may be particularly important in ecosystems where several species of large herbivores coexist (Cote et al, 2004).

In this study we determine the abundance of both deer and sheep using pellet group counting. Pellet group counting is the process of using fecal pellet-group counts to estimate the actual or relative numbers of big game animals in a certain area (Neff, 1968). Although there are many uncertainties (Fuller, 1991; Eberhardt & Van Etten, 1956), this method has been verified as advantageous, cost-effective census method for general forestry and wild-life management purposes (Bennett et al., 1940; Campbell et al., 2004; Neff, 1968). Pellet group counting for a population sampling is an advantageous method because it provides a persistent record of the presence of deer; visual or track counts solely depend on the current activity of the deer which may be impacted by the presence of the observer and weather condition (Eberhardt et al., 1956). Furthermore, pellet group counts also reveal deer movement, various forest types and subtypes utilization (Bennett et al.,1940), as well as habitat types and seasonal use patterns (Neff, 1968). Forest types in this study included old, young and mature forests, grass dominated logged roads, and marsh wetlands.

The objective of this study is to determine which of the two herbivorous species is significantly impacting the ecosystems through pellet group sampling. From previous studies on the design of pellet-group sampling, we design this experiment based on the most effective approach (Neff, 1968). Using this sampling method, we aim to determine the distribution of deer and sheep in the site according to the four different ecosystems; mature forest, young forest, logged and grazed areas and marsh wetlands. Using this information we aim to locate the source of impact on herbivory on a land conservancy on Galiano Island.

Study Site

The study site was located on Galiano Island along the south coast of British Columbia on a 76-hectare section of land designated as DL57. The land is owned by the Galiano Conservancy Association. The site has seen a variety of anthropogenic changes. The site contains a variety of buildings in various states of upkeep. As well, the land has been logged and had a temporary site mill site, where milled lumber still resides. The site is made of a combination of ecological communities, which consists of marsh wetland, forest/ wetland complex, pond, cliff, coastal bluff, mature forest, young forest, logged and grazed, rural residential and industrial mill site. The site has a variety of shrubbery, grasses and multiple tree species. The area has a diverse range of wildlife, such as deer, feral sheep and a great diversity of bird species.

Methods

To conduct a study of deer and sheep abundance on DL57, six transects were selected across the study site. These transects were chosen at random from sixteen transects established for a previous study conducted on the site. These transects ranged from less than 50m to approximately 500m in length and were spaced 100m apart from east to west. Two people were assigned to each transect and were provided a compass, 50m tape measure, a wooden stake, a deer and sheep pellet identification sheet and a data collection sheet.

Transects were set in a north-south alignment with the starting point located at the northern end of the transect. At the north end of the transect, a 50m tape measure was laid on the ground directly south. The assigned people(observers) were then assigned three random distances within 25m for which they were required to collect pellet data. The observers started at the north end of the transect and went to each location(Neff, 1968). At the provided data collection locations, the observers created a circular plots with an area of 9 m^2 (Neff, 1968). To create the plots observers placed a stake in the ground at the data collection point along the transect and attached a 1.72m long rope to the top of the stake. The other end of the

rope was held by an observer while they walked in a circle around the stake observing the amount and type of pellet groups present in the circle plot. During this time the other observer recorded the pellet data. If there were any pellet groups that were questionable in which species they were from, the data collectors were to take a picture and present it to those running the study for confirmation on species. Pellet groups were defined as a groups of pellets that were consisted of 5 or more pellets grouped in one location together and of similar size(Freddy and Bowden, 1983). As well, the identification of deer versus sheep was required. Sheep were defined as oval in shape, generally larger than deer pellets and may be clumped together in a ball shape rather than spread out as is seen with deer.

Following data collection at the required locations and reaching the 25m point of the transect, observers again use the random data collection points starting at 25m and working their way towards 50m. At the point when observers reached 50m, they moved the tape measure another 50m and repeated the previously stated process. The length of transects for the study were aimed to be a maximum of 200m in length, but due to topography constraints some transects ranged in length from 50m to 200 m(Neff, 1968).

Deer population estimates for the site were later calculated from the pellet groups per m^2 data calculated for deer use. This was done using equation 1. It is suggested that a defecation rate of 15 pellet groups per day for each deer represents a population on good winter range, and was therefore used in this analysis(Neff, 1968). As well a pellet decay rate of 272 days was used(Liang *et al*., 2003). As well, the deer pellet density was converted into a unit of pellet groups per acre.

Eqn 1: $D_a = D_s / (p \bullet t)$

D_a : deer density
D_s: Deer pellet count
P : rate of defecation
t : rate of pellet decay

Results

Deer and sheep data was combined and analyzed to find the ecosystem community type which had the highest concentration of pellets groups/ m^2. By calculating the total number of pellet groups per ecosystem type relative to the area covered by the study, this was determined. The results indicated that the young forest ecosystem type had the highest concentration of pellet groups/ m^2, with a concentration of 0.5/ m^2.

Deer and sheep data were again combined and analyzed to identify the ecosystem community type that had the highest quantity of pellet groups in combination of both species. This was used as an indicator of the total use of an ecosystem type, therefore the ecosystem type with the highest amount of pellet groups was considered to be of the highest use. After reviewing the data, deer and sheep used the logged and grazed ecosystem community more in combination than any other ecosystem type.

Deer pellet groups accounted for 66% or 73 of the 110 pellet groups found on site. These pellet groups were found distributed across four of the ecosystem communities of the site. These were marsh wetland, logged/grazed, mature forest and young forest. The highest quantity of deer pellet groups, 31 pellet groups, was found in the mature forest community. Sheep pellets accounted for 34% of the pellet groups or 37 pellet groups. Of the 37 groups, 59% of these were located in the logged and grazed ecosystem communities.

Deer and sheep pellet groups were as well quantified to a unit of pellet groups/ m^2 for each species. Both deer and sheep were found to have the highest pellet group densities in the young forest ecosystem type. Deer and sheep had pellet group concentrations of 0.3/ m^2 and 0.2/ m^2 respectively.

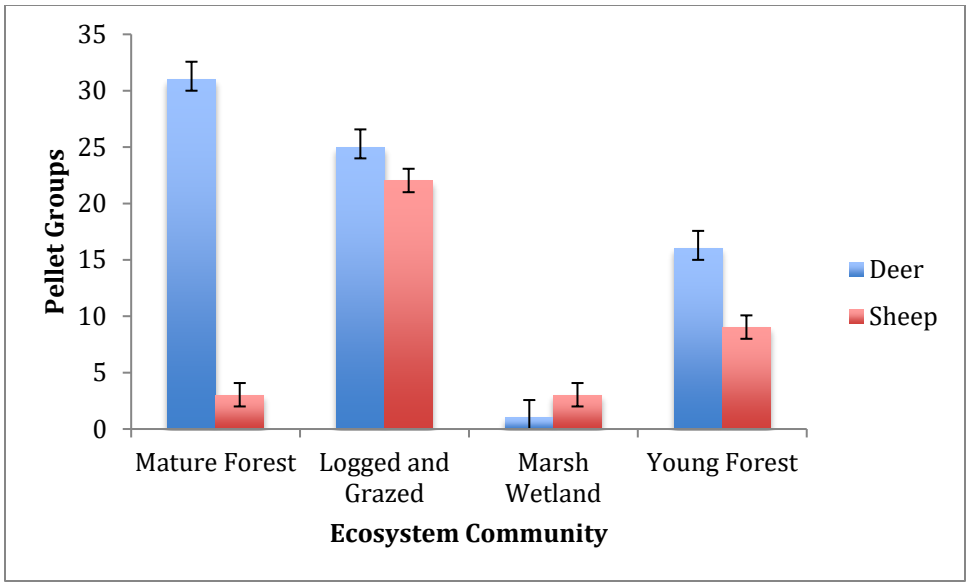

Figure 1. Total deer and sheep pellet groups by ecosystem community type with standard deviation bars.

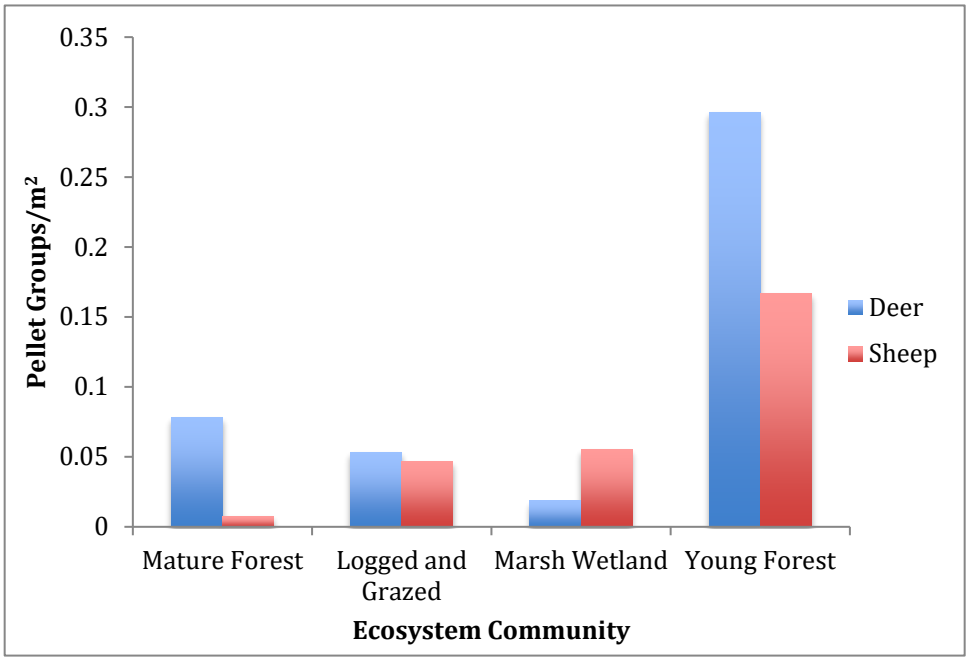

Figure 2. Deer and sheep pellet group concentrations per m^2 by ecosystem community type.

After calculating the total number of deer pellets for the study site, the deer density was calculated per acre. Using the variables previously stated, the estimated deer density for the study area was 0.3 deer per acre. This places an estimate of the deer population of DL57 to be approximately 56 deer.

Discussion

Given the scale at which we have data, there are more deer than sheep on DL57. The majority of deer pellets were found on the forested slopes while sheep pellets were found on the flat open areas. In areas where both deer and sheep pellets were found, both native and invasive shrubs and grasses (native and invasive) were observed to be no higher than ankle high. This implies that the herbivore pressure from deer and sheep is suppressing forest recruitment. If the deer and sheep were to be removed from the area, we could infer that native species of plants could begin to regrow. At the same time an abundance of invasive species could also start to regrow. It is unknown whether if the deer and sheep were removed, invasive species would take over the entire DL57 site. We can say confidently that if deer and sheep were removed from the area that the forest composition, native versus invasive species abundance and growth height, would be altered.

Challenges that impacted our ability to answer our research question include, short transects, unclear definition of random versus clustered pellet groups, not randomly distributed pellet plots and varying quality of our data. The procedure that was used to measure out the six transect lines was by shooting a bearing, following it with the 50m transect line, collecting data from the six plots, and then shooting another 50m transect at the 50m mark following the same bearing. This process was repeated numerous times to add up to our 50-200m long transects. In theory, re shooting a bearing and following it over and over should keep the transect lines consistently running along the same bearing. We recognize that there is more margin of error and a chance of going off bearing with our procedure and

thus our transect lines may not have been perfectly straight. The implication of this is that it would be that it could difficult for the conservancy to identically repeat this experiment (laying out the same transect) in the future.

Assigning two people per transect, using circular plots and having a clear data sheet were aspects of our experiment that made data collection fast and efficient. Included in our field notes was a deer and sheep pellet identification sheet that was also beneficial because it served as a reference to identify the type of pellets observed but it lacked clarity in terms of defining what a random versus clustered pellet group was. As a result of not including this clarity, our experiment sustained observer bias differing from each transect line. This problem could have been avoided by conducting a more thorough training before data collection so that our experiment method could be used consistently. Additional observer bias could have occurred because the plots that we used on every 25m section of our transects (at 3m, 10m, and 23m) although initially randomly generated numbers, were not randomly distributed. We used the same 3m, 10m and 23m plots on every 25m of transect line. If the conservancy were to do this experiment in the future, we would suggest randomly generating the numbers for the distances of the three plots per 25m of transect line, this way observer bias could be minimized. We acknowledge that both situations where observer bias occurred in our experiment could have altered our recorded data and ultimately our overall conclusions.

The conservancy has recently created paddocks on the site to capture the sheep. We feel that additional research should have been done prior to the implementation of the paddocks, to study distribution of deer and sheep on the DL57 site in every ecosystem community. Longer transects with more plots could run through the rural residential cultivated, coastal bluff old growth forest, forest wetland, and cliff old growth forest areas. These areas were not included in our experiment and therefore we feel that our findings were not a complete representation of the impacts of deer and sheep on the entire DL57 site. This research should have been done before the removal of sheep so that a complete distribution of both deer and sheep in the area is known. The conservancy could have then analyzed each area individually, identified the magnitude of effect for

deer and sheep in that specific area. This information would allow the conservancy to infer the ramifications that could occur, in terms of the specific types of native and invasive species in each area, their interactions with one another and what could happen if the deer and sheep were to be removed. We then think it would have been appropriate for the conservancy to begin removal of sheep and deer, if the findings conclude that this action would be the most efficient way to restore the DL57 conservancy land.

Conclusion

Until further data on the abundance of deer and sheep is collected across a broad range of conditions, seasons and years on different areas of the island, the managers of the Galiano Conservancy Association will have to continue monitoring the population and not implement management efforts. This will ensure that deer and sheep impacts on herbivory and the estimates of the population are not poor estimates, and do not compromise the quality of conservancy's decisions to manage wildlife rationally and objectively.

More research is needed to determine the deer and sheep abundance within the various ecosystems on the island to fully justify our conclusions. Understanding the utilization of the different habitats by sheep and deer are essential for wildlife management and we need to determine the impacts on the various ecosystems types. Furthermore, repeating this experiment will need to occur over many years to comprehend deer and sheep utilization over time.

If the future research and results determine that the removal of deer and sheep is deemed to be effective, this approach should be carried out in order to preserve the ecological integrity on Galiano Island.

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