Hoko Game Management Unit
Population Estimate

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INTRODUCTION

I used an aerial mark-resight population estimate for elk within the Hoko Game Management Unit (GMU), GMU 601. This technique utilized a helicopter for marking elk with paintballs and for conducting subsequent flights to count the number of marked and un-marked elk. The population was then estimated using a Lincoln-Peterson estimator that compares the number of marked elk with the number of unmarked elk.

STUDY AREA

The Hoko GMU is located in the extreme northwest section of the Olympic Peninsula. It is bounded to the north by the Makah Reservation, on the south by the Hoko-Ozette Road, on the west by Olympic National Park between Ozette and the Makah Reservation, and on the east by the Straight of Juan de Fuca between the Mouth of the Hoko River and the northeast corner of the Makah Reservation.

The majority of lands within the Hoko are privately owned industrial timberlands. The Washington Department of Natural Resources also owns land in the Hoko, of which the largest block is located in the Carpenter Creek area. A minor amount of land within the Hoko is developed either as small residential areas, isolated homes, or small ranching operations (primarily fenced pastureland for livestock grazing). These developments are primarily located along Highway 112 between the mouth of the Hoko River and the Makah Reservation and along the Hoko-Ozette Road.

Intensive timber harvest has converted what was historically extensive old growth to second growth forests with stand conditions ranging from grass-forb following clearcutting to closed-sapling-pole sawtimber (Hall et al. 1985). Timber harvest occurs in second growth stands at 50-70 years, thus, these stands never attain old growth characteristics. The only old growth habitat available to elk (optimal habitat) is found outside of the Hoko in Olympic National Park (west side) and on the southwest corner of the Makah Reservation. While timber harvest has resulted in the loss of quality optimal habitat, the older second growth stands probably provide adequate hiding and resting cover for elk and recently clearcut areas probably provide adequate foraging habitat.

Intensive timber harvest has resulted in high road densities. Prior to 1987, the majority of roads on industrial timber lands were open to public access, resulting in reduced elk use of available habitat near heavily traveled roads, increased disturbance of wintering and calving elk, and increased vulnerability of elk to tribal and state hunting. Since 1987,

roads on industrial timberlands have been closed to the public. Tribal and state hunting is allowed, however access is limited to non-motorized transportation from locked gates along Hwy. 112 and the Hoko-Ozette Road. This has resulted in a corresponding increase in the elk use of available habitat near many roads, a decrease in disturbance during the wintering and calving season, and a decrease in vulnerability associated with hunting.

Elk extensively use the riparian and wetland habitats associated with the Hoko, Sekiu, Sooes, Big, and Ozette Rivers and their tributaries. Because the majority of these areas fall within privately owned industrial timberlands, habitat alterations may temporarily displace herds but there has not been substantial losses of habitat or displacement of herds due to development. However, development along the Hoko and Big Rivers adjacent to the Hoko-Ozette Road has led to habitat loss, disturbance, and displacement of herds in these areas.

METHODOLOGY

Marking

Elk were marked by WDFW and MNR personnel using a Bell Long Ranger Helicopter. The marking crew included the pilot, shooter, and data recorder. The information recorded included the total number of elk in the group, number of antlerless and antlered (spike and branch bulls), and location of the herd.

Elk were marked with red non-toxic oil-based paintballs on their backs and rumps, with the target area being the rump. Satisfactory marks were defined as a minimum of two marks in the rump patch. Elk not marked satisfactorily were not included in the marked sample.

Elk mark-resight population estimates were conducted simultaneously by the Point no Point Treaty Tribes and WDFW in the Dickey GMU (602) to the south. Blue oil-based paintballs were used in this unit to provide data on elk movements across GMU boundaries.

Sample Size

A population reconstruction estimate based on known elk harvest data and a spring composition flight in 1998 yielded a population estimate of 203 elk. The Makah Tribe felt that this was an underestimate of the actual population size and that actual population size was approximately 300 elk. The target sample-size for marking was set at 20% of 300 elk, or 60 elk, roughly 90% antlerless and 10% antlered.

Re-survey Flights

Two re-survey flights were conducted for marked elk, separated by 12 days. The time required to survey the GMU was 4 hours. One survey occurred during the first 4 hours of light (A.M.) and one occurred during the last 4 hours of light (P.M.).

The GMU was divided into 2 separate areas, the north and south half. The north half was defined as the area north of the Sekiu Mainline/Sekiu River Road and east of the Makah Reservation. The south half was defined as the remainder of the GMU south of the Sekiu Mainline/Sekiu River Road and the Makah Reservation. The north half of the GMU was searched first on the first re-survey flight and the south half was searched first on the second re-survey flight.

The re-survey flight was conducted with a Hughes 500D Helicopter. Re-surveys were conducted by a pilot, WDFW, and Makah NR personnel. The information recorded for each group was time of day, location, total number of elk, total number of antlerless and antlered, and total number of marked antlered and antlerless.

Data Analysis

I tested the assumptions of homogeneity across the classes of antlerless and antlered elk and the two re-sight surveys, using contingency tables and chi-square tests for homogeneity ($p = 0.05$). This analysis was conducted to determine if classes and survey flight data could be pooled. I used a modified Lincoln-Peterson estimator to calculate the abundance and confidence intervals for each class of elk (antlered and antlerless) (Gove 1994).

RESULTS

Number of elk marked

Marking occurred between March 22-24, 2000. The composition of marked elk included 92% antlerless and 8% antlered elk (Table 1).

Table 1. Number of antlerless and antlered elk marked in the Hoko GMU 601, Olympic Peninsula, Washington, Spring 2000.

Date	Antlerless Marked	Antlered Marked	Total Marked
3/22 – 3/24/2000	47	4	51

Number of elk re-sighted

The two re-sight surveys were conducted on March 29 and April 11, 2000. The first survey was conducted during the PM and the second survey was conducted during the AM. Weather conditions did not significantly affect elk sightability during the re-survey flights.

The total number of elk observed during the re-survey flights was 291, with 44 elk having marks. The total number of marked and unmarked elk observed during each survey are listed in Table 2.

Table 2. Re-survey number, number of marked elk available, number of marked elk observed, number of unmarked elk observed, and total number of elk observed on each re-survey and for re-surveys combined in the Hoko GMU 601, Olympic Peninsula, Washington, Spring 2000.

Resurvey Number	Marked Elk Available	Marked Elk Observed	Unmarked Elk Observed	Total Elk Observed
1	51	30	116	146
2	51	14	136	150
Total	**51**	**44**	**252**	**296**

Population Estimate

As a result of homogeneity testing, I was able to pool all classes of elk for re-survey 1 ($x^2_{(2)} = 4.75$, $p > 0.05$), but not for re-survey 2 ($x^2_{(2)} = 7.36$, $p < 0.05$). Homogeneity testing also indicated that I was unable to pool re-survey 1 and 2 ($x^2_{(1)} = 7.48$, $p < 0.01$).

The population was estimated in three ways. I estimated each class separately (Table 3) and by pooling all classes of elk (Table 4) for re-survey 1 and estimated each class separately for re-survey 2 (Table 5). The estimate for re-survey 1 calculated for each class separately yielded the lowest population estimate and the lowest variance. The next estimate based on pooling the classes from re-survey 1 resulted in a slightly higher population estimate and variance. The final estimate based on re-survey 2 resulted in the highest population estimate and variance.

Table 3. Lincoln Peterson elk population estimate in the Hoko GMU 601, Olympic Peninsula, Washington, Spring 2000. Each class estimated separately using re-sight 1.

Estimate	Antlerless	Antlered	Total
N (Population)	222	12	234
Variance	1,259	32	1,291
95% CI	153-292	1-23	164-304

Table 4. Lincoln Peterson elk population estimate in the Hoko GMU 601, Olympic Peninsula, Washington, Spring 2000. Both classes pooled using re-sight 1.

Estimate	Antlerless	Antlered	Total
N (Population)	223[a]	19[a]	242
Variance	na	na	1,442
95% CI	na	na	167-316

[a]Number in classes estimated by multiplying the total by the proportion seen in each class using herd composition data from the single flight with the greatest number seen (Marking flight on 3/24/2000).

Table 5. Lincoln Peterson elk population estimate in the Hoko GMU 601, Olympic Peninsula, Washington, Spring 2000. Each class estimated separately using re-sight 2.

Estimate	Antlerless	Antlered	Total
N (Population)	507	6	513
Variance	15,543	4	15,547
95% CI	262-751	2-10	268-757

Discussion:

I believe that the population estimate contained in Table 4 (242 elk) is the best estimate of the elk population for the Hoko GMU. This estimate and measures of dispersion are similar to that derived for Table 3 for which the population was estimated separately for antlered and antlerless. Additionally, homogeneity testing indicated that I could pool both classes of elk for population estimation.

The estimate of 242 elk is probably an underestimate of the actual population in this GMU. I calculated a population estimate utilizing the methodology outlined in Eberhardt et al. (1998) which utilized the number of marked groups (those with radiocollared individuals), number of groups observed during re-sight surveys, and average group size of marked groups. The population estimate derived by this methodology indicated a population size of 270 elk. Additionally, I reconstructed the population utilizing known group size data for known marked herds with radiocollars, marked herds with paintballs without radiocollars, and group size data for other groups that are known to be present in the study area but not collared or paint marked (these groups were seen during reconnaissance prior to radiocollaring and paintball marking). Reconstruction indicated approximately 297 elk in the Hoko GMU.

I have not calculated confidence intervals for the population estimate proposed by Eberhardt et al. (1998) at this time. However, I have reported this estimate and the reconstructed estimate for comparison with that obtained with the Lincoln-Peterson estimator. The Lincoln-Peterson estimate, in my opinion, is a conservation estimate of the total population size in the Hoko GMU and will probably ensure that management decisions are conservatively based. Thus, ensuring that the population does not decline (e.g. overharvest of cow elk).

The goal established by the Makah Tribe and Olympic Peninsula Elk Management Group was to reach a population level of 400-500 in the Hoko GMU. To facilitate an increased population in the Hoko GMU the harvest of cow elk has been restricted since 1997 by the Makah Tribe and WDFW. The Makah Tribe has requested that other tribes hunting in this GMU honor the closure of cow elk hunting. This request has been met for the past two hunting seasons. The Makah Tribe requests that cow hunting by all user groups be restricted in future seasons until population goals have been reached. Additionally, the Makah Tribe requests that future cow harvest be carefully tailored to ensure that the population does not significantly decline from desired levels (implement limited permit hunting).

The population in the Hoko GMU has probably not reached carrying capacity presently. Spring calf/cow ratios have remained consistently within normal population parameters. However, past harvest patterns may be limiting growth of some groups as much of the habitat within their home range has reached the stem exclusion stage. The Makah Tribe has began a long term study of elk within the Hoko GMU. Currently research is

establishing home range sizes for 7 herds, landscape level habitat use, mortality sources, identity of calving areas, and response to hunting and land use disturbance. The next phase of research scheduled to begin in 2001 will analyze microhabitat use and investigate habitat limitation (at the herd and landscape levels), particularly during the fall-winter season when forage is believed to be limited.

Literature Cited

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