BEAVER SURVEY
YELLOWSTONE NATIONAL PARK
1998

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Summary. The second parkwide aerial count of active beaver (*Castor canadensis*) colonies was conducted in Yellowstone National Park in late October 1998. Flying time for the survey was 18.7 hours, slightly more than the 14.9 hours in 1996. Total number of colonies counted with a food cache was 51. Eighty percent of the beaver colonies were found at three locations: 1) the Madison-Grayling Creek-lower Gallatin River drainages; 2) the upper Yellowstone River from the Southeast Arm of Yellowstone Lake to Thorofare; and 3) the Bechler area. Average density of colonies per stream kilometer in these three areas was 0.23. The densest areas of beaver occupation in the park were found in the Yellowstone River delta and along a short section of the Madison River. Other locations where beaver colonies were found were Harlequin Lake, Shoshone Lake, Slide Lake, the Gallatin River, the Snake River, Outlet Creek, and Obsidian Creek. Beaver sign but no food cache was found at Heart Lake, the Lamar Valley, and Thorofare. Like the first survey in 1996, most observed beaver colonies were associated with willows (*Salix* spp.).

INTRODUCTION

In 1996, the first parkwide aerial survey of beaver colonies in Yellowstone National Park was conducted (Smith et al. 1997). Prior to this census, ground survey over a portion of the park was the primary counting methodology, although some, non-systematic aerial work had occurred (Consolo Murphy and Hanson 1993, Consolo Murphy and Tatum 1995).

Beaver in the park have been documented sporadically since the late 1800s, when beaver numbers were low in the Yellowstone region and all of North America due to fur trade exploitation (Schullery and Whittlesey 1992). A period of resurgence occurred in the 1920s, probably because of protection from harvest and abundant aspen supplies (Warren 1926). By the 1950s, a decline in aspen and other factors caused a beaver population decline (Jonas 1955). Since that time the beaver population has remained relatively low and has been mostly dependent on willow, a more stable, less-depletable food source (Jenkins and Busher 1979, Novak 1987).

Modern-day work on beavers began again in 1989. Consolo Murphy and Hanson (1993) and Consolo Murphy and Tatum (1995) used foot and horseback surveys from May through October in 1989 and 1994 to count a portion of the park's streamcourses, ponds, and lakes. In 1989 and 1994, 71 and 49 active beaver colonies, respectively, were recorded (Consolo Murphy and Hanson 1993, Consolo Murphy and Tatum 1995).

In 1996, Smith et al. (1997) conducted an aerial survey of the entire park in late October and early November, a time of year when beaver caches are mostly complete and readily visible (Payne 1981, Novak 1987). Dam and lodge building is also at a peak this time of year (Jenkins and Busher 1979). The survey was made difficult by early ice and snow, making viewing conditions less than optimal, but the number of active colonies (49-51) found in 1996 (Smith et al. 1997) was comparable to that found by Consolo Murphy and Tatum in 1994 (1995).

In 1998, another aerial survey was conducted to document beaver abundance and distribution and establish a population trend (this study, Figure 1). Population censuses every other year will allow managers to more quickly detect beaver population changes facilitating better understanding of beavers and their habitat use within Yellowstone National Park.

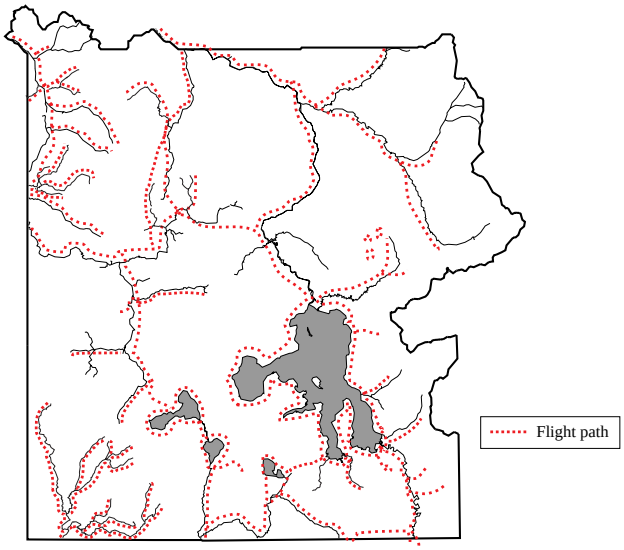

Figure 1. *Flight path for survey, October 1998.*

METHODS

I spotted active beaver colonies from a small fixed-wing aircraft (Supercub) flying at an altitude of 500 feet and at an air speed of 55 to 65 mph (Hay 1958, Payne 1981). I surveyed watercourses, ponds, and lakes of suitable gradient for beavers to dam. Every river system in the park was surveyed once, and in high-density beaver habitats repeated overflights were often necessary to locate every colony. The objective was not a systematic but a geographically complete survey.

My censusing unit was the beaver colony. Beavers cut woody vegetation each fall for storage near their lodge (Slough 1978). This woody vegetation is consolidated and stored in a floating mat, called a cache, located on the water surface near the lodge where the beavers winter (Jenkins and Busher 1979, Novak 1987). These caches are highly visible in the fall, especially overhead from slow-flying aircraft, hence the development of aerial survey techniques (Hay 1958). Caches also are known to denote a beaver family (Jenkins and Busher 1979). Detection of caches is, however, greatly enhanced after deciduous plants have shed their leaves and before snow and ice form on water surfaces. Often other signs of beaver presence are visible: cut willow shrubs, freshly peeled sticks that gleam white in the water, foraging trails on land, newly placed mud on dams and lodges, and brimming water levels in ponds. These all aid in detecting beaver presence and are used in addition to the food cache to determine beaver occupation. Once these

signs were used to locate a beaver area, a search for a cache ensued; if found, it was marked on a 1:125,000-USGS topographic map. If no cache was discovered but fresh sign was observed, the location was marked as such on the map.

RESULTS

The survey was conducted in three flights over a seven-day period in late October 1998. Survey dates were October 17, 22, 23, and totaled 18.7 hours. Observation conditions were excellent—deciduous leaf-fall was complete; no ice or snow impeded viewing; and overcast skies prevailed, reducing glare off the water.

The total number of active beaver colonies seen with a food cache was 51 (Table 1, Figure 2). Eighty percent (41) of the beaver colonies were found at three locations: 1) the Madison-Grayling Creek-lower Gallatin River drainages; 2) the upper Yellowstone River from the Southeast Arm of Yellowstone Lake to Thorofare; and 3) the Bechler River area in the southwest corner of Yellowstone National Park. The densest areas of beaver occupation were the Yellowstone River delta south of the Southeast Arm of Yellowstone Lake, and an 8.6 km-section of the Madison River. The density of beavers seen in both areas was 0.35 colonies/km of river surveyed. Other areas of beaver occupation were Harlequin Lake, Shoshone Lake, Slide Lake, the Gallatin River, the Snake River, Outlet Creek, and Obsidian Creek. Beaver sign without a food

Table 1. Number of active beaver colonies by area in Yellowstone National Park, 1996–1998.

Location	Number of Active Colonies		Kilometers of River/ Stream Surveyed	Colonies/km	
	1996	1998		1996	1998
Northwest					
Campanula/Gneiss/Duck creeks	7	6	25.6	0.27	0.23
Cougar Creek	4	7	27.2	0.15	0.26
Gallatin River	2	2	32.0	0.06	0.06
Harlequin Lake	—	1	—	—	—
Grayling Creek	3	0	27.2	0.11	0
Madison River	3	3	8.6	0.35	0.35
Southwest					
Bechler River	1	0	19.7	0.05	0
Boundary Creek	2	2	10.2	0.20	0.20
Falls River	—	2	32	—	0.06
Mountain Ash/Proposition Creek	7	6	31.8	0.22	0.19
Other Bechler	—	1	—	—	—
Southeast/Southcentral					
Snake River	3	2	49.3	0.06	0.04
Yellowstone River	15	14	40.0	0.38	0.35
Other					
Grouse Creek	1	0	—	—	0
Outlet Creek	—	1	—	—	—
Shoshone	—	1	—	—	—
Slide Lake	1	1	—	—	—
Willow Park	—	2	—	—	—
Total	49	51			

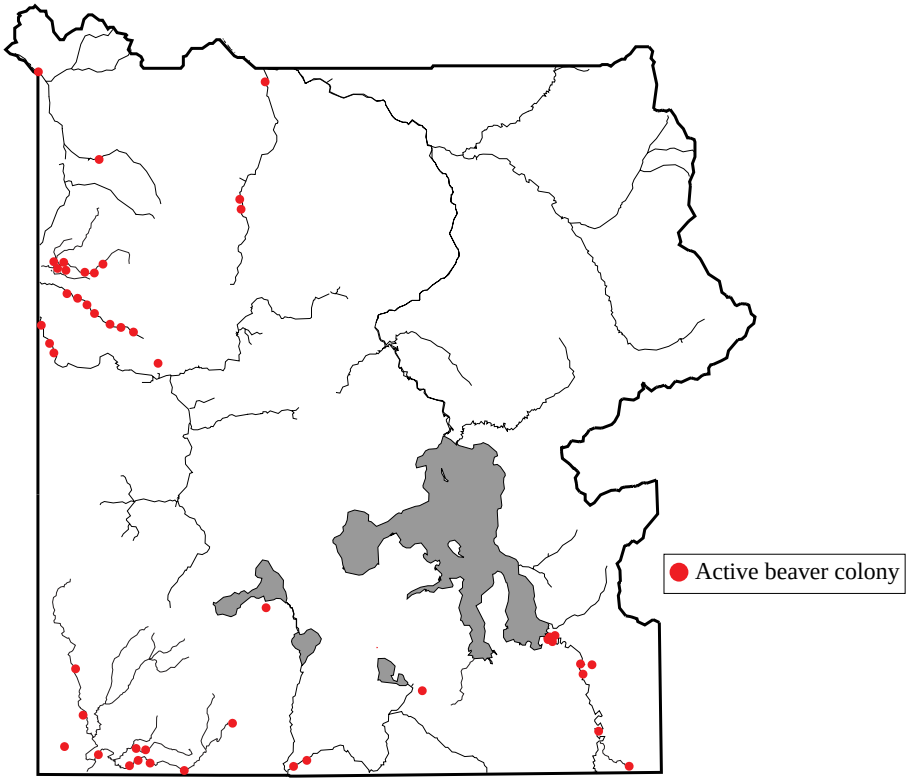

Figure 2. *Location of active beaver colonies in Yellowstone National Park, October 1998.*

cache was recorded at Heart Lake, Lamar Valley, and Thorofare. Counting sites with beaver sign but no cache raised the number of beaver sites parkwide to 54. On the northern range, there was only one colony with a cache and one other area with beaver sign (in the Lamar Valley).

Beaver activity was again located at sites where there was willow. No sites were found with aspen as a primary food source. One site in the Lamar Valley was located where there was evidence of cottonwood cutting. At Harlequin Lake, lodgepole pine (*Pinus contorta*) was the only species of woody vegetation observed to have been cut.

Colonies were located in areas where there was a gentle stream gradient and when on major rivers, located in a backwater where the current was not as swift.

Discussion

The most striking result of the 1998 beaver survey was that the total number of colonies (51) was very close to the number of colonies (49) found in the 1996 survey (Smith et al. 1997). Hence, parkwide the beaver population was stable in the latter 1990s. There was also very little movement in site locations for beaver lodges. Where beavers were located in 1996 they were found again in 1998; 90 and 80 percent of the beaver colonies were located in three areas in 1996 and 1998, respectively. This is consistent with their reliance on willow as a food source, rather than on foods that are more subject to depletion (Jonas 1955, Novak 1987). Where beaver co-occur with willow in Yellowstone, willow is abundant (Smith et al. 1997), and

because willow is a hardy, resprouting shrub (Despain 1990), beavers have not depleted the willow supply. Based upon this, I predict the Yellowstone beaver population to remain stable into the indefinite future.

If it assumed that there were six beavers/ active colony, as is average in North America (Jenkins and Busher 1979, Novak 1987), then the estimated number of beavers parkwide was 306 in 1998. No demographic study on beavers has ever been conducted in Yellowstone, so this is a bold assumption that may or may not be accurate. Beaver living on willow typically have smaller families and lower productivity than beavers living on aspen or cottonwood (Jenkins and Busher 1979, Novak 1987), so this assumption needs testing.

Beavers are not abundant or widely distributed in Yellowstone National Park (Consolo Murphy and Hanson 1993, Smith et al. 1997). Where they do occur, however, their densities are comparable to other beaver populations in North America that subsist on willow (Jenkins and Busher 1979, Novak 1987). The Yellowstone River delta just south of the Southeast Arm of Yellowstone Lake has been shown to be a very densely populated beaver area, as is the area around Cougar Creek near West Yellowstone. Most of the rest of Yellowstone is not high-quality beaver habitat due to high gradients and predominantly coniferous vegetation (Smith et al. 1997).

As in 1996, there were almost no beavers associated with large lakes. One colony in 1998 was located on Shoshone Lake, but it was not on the lakeshore; rather it was in the willows associated with Moose Creek. No active lodge was observed on Heart Lake, but there were two old lodges observed in the bog there, as well as beaver sign on Beaver Creek. The closest active colony to that area that I found was on Outlet Creek. Inactive beaver lodges were observed on Beula and Robinson lakes in the southwest corner of the park. A lack of beaver occupation on the large lakes of Yellowstone has been reported before (Warren 1926, Jonas 1955, Consolo Murphy and Hanson1993), although there was one large colony reported by Jonas (1955) on Stevenson Island in Yellowstone Lake.

Conclusions and Recommendations

This was the second parkwide aerial survey of Yellowstone National Park's beaver population (Smith et al. 1997). Repetition of the census makes it easier for managers to analyze beaver population trend and distribution. Future aerial surveys should be conducted every other year to monitor population trend and distribution and test whether the predictions (e.g., stable beaver population subsisting on willows) from these early studies are correct.

Other work that should be considered would be an experiment to estimate the error rate of aerial censusing techniques. Ground surveys have been found to be more accurate, but these tests were conducted in non-mountainous terrain so the results may not be useful for Yellowstone National Park (Robel and Fox 1992). Ground surveys have also been found to be too intensive to efficiently cover a large area, but knowledge of how ground and aerial census techniques compare would be valuable. Preliminary work with the Gallatin National Forest indicates that aerial census in mountainous country is as accurate as ground surveys (D. Smith and D. Tyers, unpublished data).

Besides censusing beavers, managers should consider gathering other population data on beavers in YNP. Demographic data on beaver families would be most useful

because the actual average colony size is unknown. Live trapping (i.e., with Hancock traps) and marking a sample of the beaver population would be the most efficient and effective way to determine this, and it would also allow for other data to be gathered. Information on beaver reproduction, age structure, sex ratio, and condition could be collected. These data would be as valuable in the long term to better understand the ecological role of beaver in YNP.

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