INSTREAM FLOWS FOR BEAVER POPULATIONS: EFFECTS OF A MIDWINTER DRAWDOWN OF THE SNAKE RIVER AND DROUGHT IN GRAND TETON NATIONAL PARK

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Objectives

In 1976 and 1977, much of the western United States experienced severe drought conditions and by mid-winter of 1976-77, streams, lakes, and ponds in northwest Wyoming were noticeably affected. In apparent anticipation of water shortages for summer irrigation needs, the Bureau of Reclamation administering the Jackson Lake Dam in Grand Teton National Park reduced daily discharge to nearly 100 cfs in early February of 1977 and maintained abnormally low discharges until May of 1977. This compares with a mean February discharge of 606 cfs for the previous 20 years (U.S. Geological Survey, 1957-1977). The consequences of a mid-winter drawdown on fish and wildlife populations requiring relatively stable winter stream flows are generally unknown but it was immediately apparent that aquatic mammals in the park, especially beavers, were adversely affected (Mr. Peter Hayden, NPS Biologist, GTNP, Personal Communication, March 25, 1977). Meaningful assessment of this perturbation and the drought that continued through the summer of 1977 was possible since background data on beaver populations in the park were available (Collins, 1976a).

It was hypothesized that the mid-winter drawdown resulted in: (1) extensive territory abandonment and subsequent movements; (2) heavy mortality related to stress and predation; (3) reduced reproductive performance of the population; (4) temporary changes in the distribution of beaver colonies on the upper portion of the Snake River below the Jackson Lake Dam. The anticipated significance of this study was to: (1) provide interpretive data on stream flow effects; (2) delineate management implications with regard to adaptability of beaver populations to perturbations of flow regimes; (3) provide baseline data on minimum flow needs for aquatic mammals.

Procedures

Colony abundance was necessarily determined by intensive survey of the study area on foot and from a raft. Since population density on the Snake River floodplain varies seasonally, it was necessary to census the population continuously throughout the study period. Presence of frequently marked scent mounds, fresh cuttings of woody vegetation, and actual beaver sightings are some of the signs of an established colony though transients on the floodplain may leave the same signs but do not establish a colony. Therefore, colonies were recorded as established only after the dwelling was located.

Colony sizes were determined by live trapping and subsequent observations for untrapped animals. Live trapped beavers were categorized into age classes on the basis of weight and other body dimensions or directly when birthdates were known. It was assumed that a colony consisted of a single mated pair and that all other individuals in the colony were offspring less than three years of age.

Beavers were captured for marking using Hancock or Bailey live traps with castor scent as a lure and aspen often used as bait. Traps were set one hour before sunset, were checked several times through the night, and were closed at sunrise. Live trapped beavers were weighed, sexed by palpation for a baculum, and tagged on each ear with a No. 4 Monel metal tag stamped with a number and information identifying the investigator. Weight, tail length, and tail width were measured for age correlation and behavior, reproductive condition, and other characteristics or distinguishing marks were noted.

Colonies on the first several miles of the Snake River below the Jackson Lake Dam were intensively trapped and observed to determine the reproductive success of these colonies which should have been the most severely affected by the drawdown. Kits are trappable after two to four weeks of age and are frequently observed feeding away from the dwelling after one month. These methods determine realized production, not fertility, since post-natal kit mortality is unknown and would be very difficult to assess. The presence of young in a dwelling can be determined from their vocalizations (whining) as early as the first of June.

Due to the beaver's motility and annual dispersal of large numbers of young, it is difficult to assess mortality at the colony level. However, it can be assumed that only the two year olds will disperse each year and that adults and kits found in a colony one year should still be present the following year. This assumption permits an assessment of mortality for these age classes if these individuals in a colony were previously marked or were otherwise known. Information on age classes and number of individuals derived from previous studies was used to estimate mortality in specific colonies. Even so, it is impossible to attribute the loss of individuals in a colony to any one mortality factor or to a major catostrophic event such as the mid-winter drawdown of the Snake River. Also, the possibility exists that the disappearance of adults or young from a colony represents dispersal under unusual circumstances.

Results:

The effects of drought and mid-winter drawdown of the Snake River on beaver colony abundance are reflected in Tables 1 and 2. The mid-winter drawdown at the dam should have most severely affected those colonies in the first several miles to the confluence with Pacific Creek and the Buffalo River. Though the number of colonies in this section did not change from 1976, one long-established colony did disappear and was replaced by another. The total loss of known beavers including yearlings to mortality and dispersal between fall, 1976 and summer, 1977 was 13 to 24 or 54 percent of the beavers in this section. The probable loss of known non-yearling

beavers in this section to mortality was 8 of 17 or 47 percent. It was apparent that reproduction in these colonies was as good or better than 1976, despite the drawdown occuring at the time of breeding. Even though these colonies immediately below the dam were probably forced to seek refuge elsewhere after the drawdown, the distribution of these colonies on the floodplain remained the same in 1977 and the position of territorial boundaries also remained unchanged.

While streams and ponds in GTNP were drying up in the summer of 1977 due to the continued drought, the Snake River flow remained relatively high due to high discharge rates at the Jackson Lake Dam. Abundance of beaver colonies on the Snake River floodplain between the dam and park headquarters, 26 miles downstream, increased to a new four year high as new colonies, probably those abandoning from adjacent streams and ponds, took up residence in previously unoccupied, marginal areas. When Snake River flow was drastically reduced in September, 12 colonies on the floodplain were forced to abandon resulting in the lowest colony abundance observed since censuses were initiated (Table 2). The drought of 1977 was, however, more severe for colonies on unimpaired streams and ponds as 31 percent of these colonies were forced to abandon in the study area in 1977 compared to a 24 percent loss of colonies on the regulated Snake River. The total loss of 28 colonies represents 28 percent of the population under study, 140 or more beavers, and was directly attributable to the prevailing drought conditions. The drought has contributed greatly to the loss (either dispersal or mortality) of a large proportion of the 101 ear tagged beavers in the park with 67 of the ear tagged sample of beavers "missing" in September, 1977.

Discussion

With a loss of 57 percent of known beavers from the first several miles of the Snake River below the Jackson Lake Dam between fall of 1976 and summer of 1977, it would appear obvious that some of these losses would be attributable to the midwinter drawdown. However, losses associated with this perturbation were possibly restricted to the first several miles below the dam and would therefore have little effect on the entire Snake River population. Complete data on colony abundance were available for the entire Snake River in the park and there was no indication that the drawdown effected colony abundance below Pacific Creek. Insufficient pre-drawdown data on the structure and size of colonies below Pacific Creek do not permit an assessment of these parameters after the drawdown.

The hypotheses proposed at the initiation of this study proved only partially correct, a major difference being the successful reproduction of colonies immediately below the dam. There were no overall changes in colony abundance but there were substantial losses in known individuals to either mortality or dispersal. Any changes in distribution immediately after the drawdown were not measurable in June, at which time distribution and territorial boundaries were consistent with 1976 measurements. The rejection of these hypotheses points to the exceptional adaptability of beaver populations in a very dynamic environment. The adaptive capabilities of a species often determines the responses of the species population to manage-

ment practices. The data presented here suggest that beaver populations are exceptionally adaptable to at least short term manipulations in stream flow. Not only can the population adjust to a 50 fold seasonal change in flow but they can successfully breed under adverse conditions. However, long term changes in flow pattern such as that caused by the drought of 1977 does result in significant population change. The drought conditions of 1977 and the associated habitat abandonment verified that territorial boundaries do not expand and contract with changes in population density and that the carrying capacity of the Snake River floodplain is regulated by stream flow and dictated by the availability of denning sites (Collins, 1976b).

Conclusions

The midwinter drawdown of the Snake River in 1977 did not change beaver colony abundance and only temporarily changed the distribution of colonies immediately below the Jackson Lake Dam. The drawdown possible contributed to the 54 percent loss of known beavers below the dam but the drawdown did not effect breeding. The long term drought in the study area resulted in a loss of 28 percent of the population under study (28 colonies and at least 140 beavers), a proportionally higher loss of colonies on streams other than the Snake River, and caused a temporary swelling of colony abundance on the snake River floodplain to the highest levels observed in four years of censuses. Beavers in the park exhibited exceptional adaptability in coping with drastic changes in flow regimes.

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Table 1. Structure of beaver colonies immediately below the Jackson Lake Dam before and after a mid-winter drawdown of the Snake River, 1976-77. Beavers classified as kits in 1976 are classified as yearlings in 1977.

Colony No.	1976			1977			Loss of known beavers	Loss of non-beavers
	Adults	Yearlings	Kits	Adults	Yearlings	Kits		
3	2	1	2	2	0	3	3	2
5	2	2*	2	2	1	2	1	1
6	2	2	3	0	0	0	7	5
7	2	2	2	2	2	3	2	0
Total	8	7	9	6	3	8	13	8

Loss of known beavers including 1976 yearlings = 13/24 = 54%.

Loss of known beavers excluding 1976 yearlings = 8/17 = 47%.

*Two 1976 yearlings at colony 5 were still with colony 5 in July, 1977 at the age of 25 months.

Table 2. Changes in beaver colony abundance in sample areas of Grand Teton National Park. Numbers in parentheses are colony site numbers.

Habitat source	No. of colonies summer, 1976	Abandoned colonies September, 1976	No. of colonies October, 1976	Abandoned colonies Oct.-June, 1976-77	New colonies Oct.-June, 1976-77	No. of colonies summer, 1977	Abandoned colonies June-Sept. 1977	No. of colonies Sept. 24, 1977
Snake River Floodplain	44	4 (66, 75, 95, 96)	40	2 (62, 6)	11*	49	12**	37
Buffalo River	4	0	4	0	0	4	2 (81, 37)	2
Pacific Creek	5	0	5	0	0	5	3 (9, 84, 94)	2
Arizona Creek	6	0	6	0	0	6	2 (85, 88)	4
Willow Flats	10	0	10	3 (106, 108, 79)	0	7	4 (2, 78, 59, 36)	3
Other Lakes and Ponds	23	0	23	2 (38, 39)	0	21	3 (41, 80, 93)	18
Other Streams	8	0	8	1 (77)	2 (105, 12A)	9	2 (61, 115)	7
Totals	100	4	96	8	13	101	28	73

* New colonies (4A, 6A, 27A, 56A, 75A, 95A, 109, 111, 112, 113, 114)

**Colonies abandoning (4A, 20, 27A, 32, 43, 56A, 60, 72, 74, 98, 109, 111)