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The Feasibility of River Otter Reintroduction in Northern Utah

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THE FEASIBILITY OF RIVER OTTER REINTRODUCTION IN NORTHERN UTAH

by

Joel P. Bich

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Joel P. Bich

TABLE OF CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

The Feasibility of River Otter Reintroduction in Northern Utah

by

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Utah State University, 1988

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The purpose of this thesis is to document river otter (Lutra canadensis) distribution and reintroduction potential in northern Utah. Distribution was studied using data from 3 sources: 1) otter sighting records from Utah Division of Wildlife Resources; 2) surveys of Utah furbearer trappers and natural resources personnel; and 3) searches of streams for otter sign. Potential for river otter habitat/reintroduction was evaluated by assessing food, cover, and reintroduction attributes. Streams were ranked using an evaluation system based on data from the otter literature.

Forty-six positive otter sightings were made in Utah by trappers, natural resources personnel, and the public, 1964-1988. Only 1.3% of 844.4 km of northern Utah streams had otter sign during winter and summer searches.

General characteristics of northern Utah streams such as habitat type and stream gradient are suitable for river

otters. However, stream alterations and livestock grazing have negatively impacted potential otter habitat. Ninety-four percent of the studied streams are presently unacceptable for reintroductions. Escape cover is the most limited habitat attribute, but food appears to be available in adequate quantities.

We recommend no otter reintroductions be made until riparian zones are rehabilitated and protected. Reestablishment of stream bank vegetation is essential to provide escape cover for reintroduced otters. We also recommend control of pollution inputs and no further construction of reservoirs. Surveys of otter distribution and evaluation of potential reintroduction should be done on the Colorado River drainage in Utah.

(67 pages)

INTRODUCTION

River otters occurred historically over much of the North American continent (Hall and Kelson 1959). They were found in all major waterways of the United States and Canada until at least the eighteenth century (Toweill and Tabor 1982). Their distribution has been reduced significantly because of human settlement and consequent habitat change as well as possible overharvest in some areas (Toweill and Tabor 1982). River otters are extirpated in 6 states and rare in 10, and are protected in 18 states and 1 Canadian province (Toweill and Tabor 1982, Deems and Pursley 1983, Appendix A). Otters are rare and have been totally protected in Utah since 1899 (Rawley 1982).

River otters have apparently never been abundant in Utah (Figure 1, Table 1). In 25 exploratory, trapping, and military expeditions between 1540 and 1872, only Peter Skene Ogden reported otters in Utah (Rawley 1985). In 1826, 3 otters were taken from the Raft River; in 1829, 6 otters were trapped from the Bear River and Clarkston Creek in Cache County.

River otters were observed more recently on the Colorado River at Glen Canyon, before the construction of the Glen Canyon Dam (Gregory 1938). Otters were probably present in the late 1940's on the Raft and Colorado Rivers (Berryman 1949). Early otter distribution in Utah

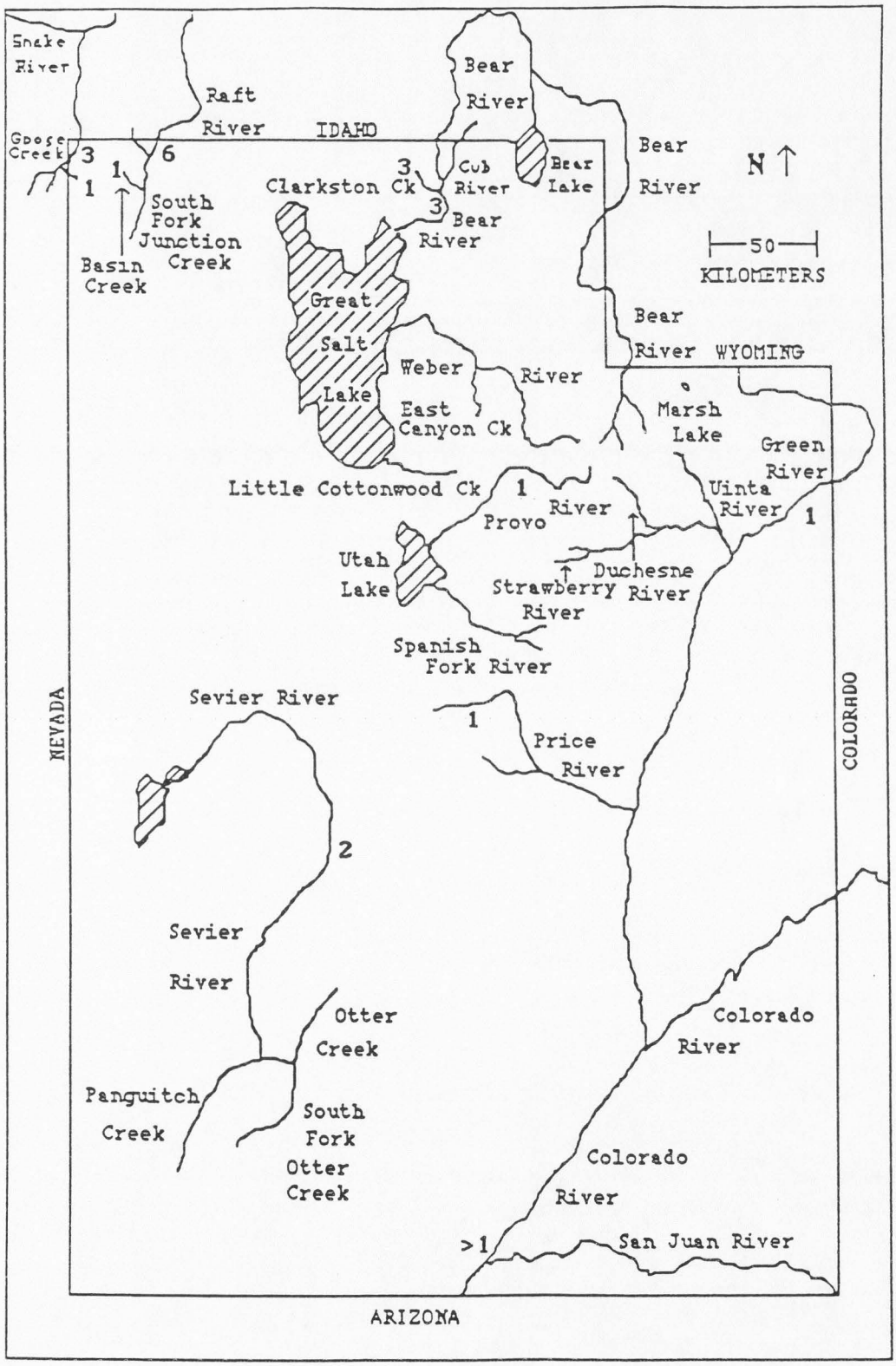

Figure 1. Distribution of river otters in Utah from historical records.

Table 1. Number of river otters in Utah from historical records.

Drainage/ River	1826	1829	1927	1948	1953	1957	1959	Early 1960's	Late 1960's
Snake/									
Raft	2				3		1		
Basin						1			
Goose					1			2	
Devil's									1
Bear/									
Bear		3							
Clarkston		3							
Colorado/									
Colorado			>1						
Green				1					
Price									1
Sevier					2				
Provo/									
Provo					1				

included the Colorado River drainage, and the Wasatch, Uinta, and Raft River Mountains (Durrant 1952). Three otters were removed from the Raft River in 1953 by the Utah Division of Wildlife Resources (UDWR).

The last river otter captured in Utah was from the Price River near Scofield Reservoir in the late 1960's (M. Moretti pers. comm.). No substantiated records of otters in Utah exist from this capture to 1979. Since 1979, otter sightings have increased but no attempts have been made to compile and analyze them. River otters have never been included in furbearer harvest records of UDWR. No systematic data collection on otter biology has been done in Utah.

GOAL AND OBJECTIVES

The goal of this study is determine the feasibility of river otter reintroduction in northern Utah.

Objective 1: Document present otter distribution in northern Utah.

Objective 2: Determine otter habitat needs.

Objective 3: Evaluate the potential of northern Utah streams for otter reintroduction.

STUDY AREA

The Utah portions of the Bear, Weber, and Raft Rivers, and Goose Creek were studied (Fig. 2).

The Bear and Weber drainages head in the Uinta Mountains of Summit County, Utah at elevations exceeding 3300 m. Headwater streams are high gradient and oligotrophic, and contain predominantly trout (Salmonidae) and mottled sculpin (Cottus bairdi). Associated vegetation consists of quaking aspen (Populus tremuloides), Engelmann spruce (Picea engelmannii), Douglas-fir (Pseudotsuga mensiesii), ponderosa pine (Pinus ponderosa), and lodgepole pine (Pinus contorta) forests and willow (Salix spp.) and sedge (Carex spp.) meadows. The lower valley portions contain trout, suckers (viz., Utah sucker [Catostomus ardens] and mountain sucker [Pantosteus platyrhynchus]), and mottled sculpin; the extreme lower sections support fewer trout and more Cyprinids e.g., carp (Cyprinus carpio). The lower Bear River contains warm water game fishes such as largemouth bass (Micropterus salmoides), black crappie (Pomoxis nigromaculatus), channel catfish (Ictaluras punctatus), and black bullhead (Ictaluras melas). Vegetation consists of narrow bands of river hawthorne (Crateagus rivularis), red-osier dogwood (Cornus stolonifera), cottonwood (Populus spp.), willow, and grasses (Gramineae). The Bear River in Utah spans

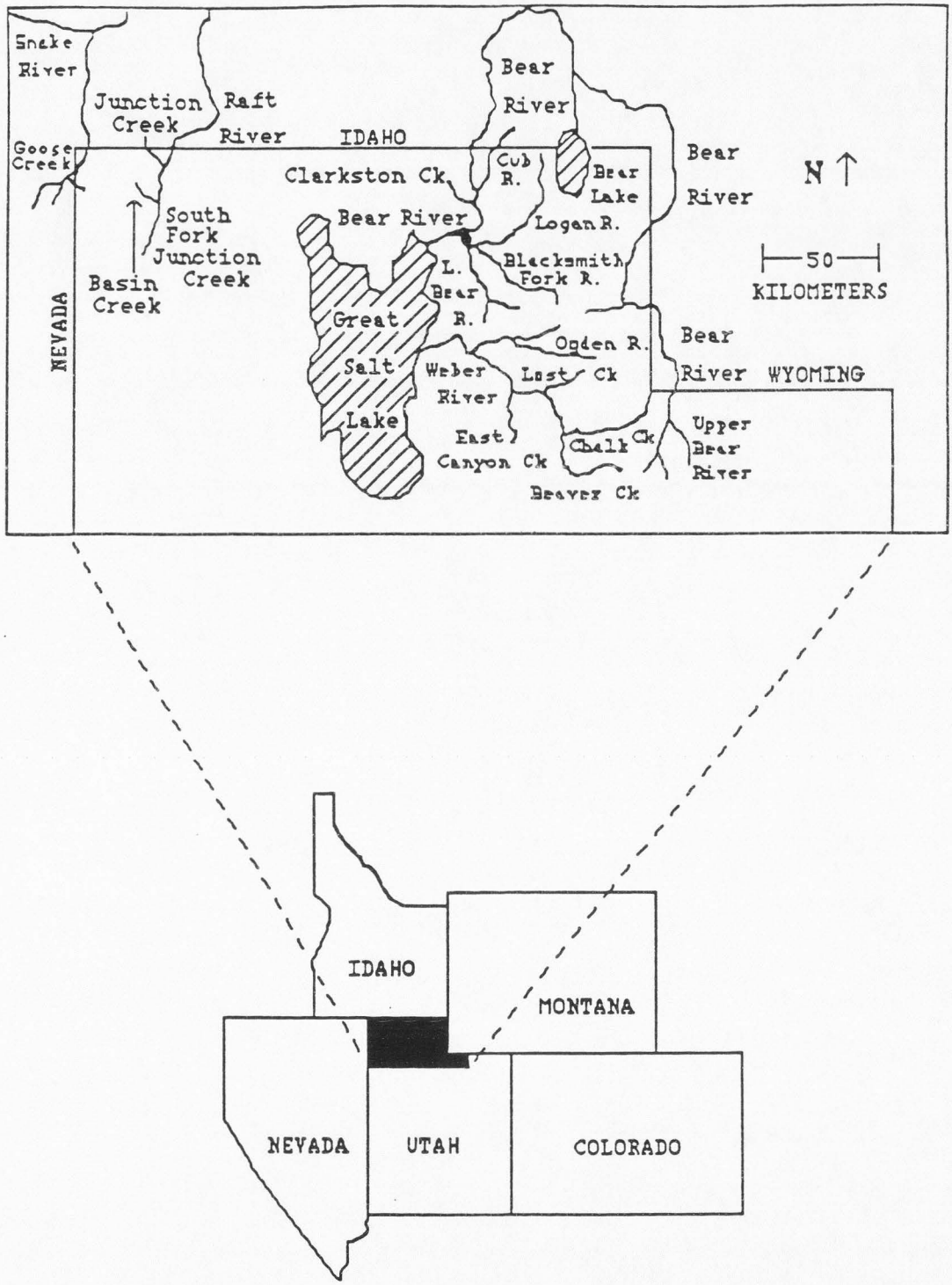

Figure 2. Map of the study area (Utah portions of streams shown).

approximately 325 km with an additional 300 km in its major tributaries: the Malad River (75), Cub River (25), Logan River (70), Blacksmith Fork River (40), Little Bear River (65), and Woodruff Creek (25). The Weber River is approximately 180 km in length with an additional 281 km contributed by the Ogden River (89), East Canyon Creek (61), Lost Creek (45), Chalk Creek (62), and Beaver Creek (24). These streams total 1,086 km in Utah. The Bear and Weber Rivers drain into the Great Salt Lake at 1280 m elevation and stream flows average 54 and 16 cms, respectively (ReMillard et al. 1986). Fifteen reservoirs have been constructed on these streams in Utah (Appendix B). Reservoirs typically are devoid of shoreline vegetation, are managed as trout fisheries, and experience severe water level manipulation and heavy summer recreational use.

The Raft River heads in the Raft River Mountains in west Box Elder County, Utah at 2400 m elevation. Sixty-seven kilometers of its length are within the state, including Junction and Basin Creeks. Riparian vegetation is primarily willow, dogwood, and grasses. Goose Creek originates in Nevada and flows through 9 km of hay meadows in Utah. Discharge for these streams usually varies from 1-2 cms. Only 1 reservoir, Johnson Reservoir, exists on the Utah portion of these streams. The Raft River and Goose Creek flow north into Idaho and the Snake River.

METHODS

RIVER OTTER DISTRIBUTION

Sightings

I gathered UDWR records of otter sightings from regional offices and the computerized system for significant observations of wildlife. Sightings were grouped into 3 classes based on subjective evaluation of sighting description and observer experience: positive, possible, and questionable. Only sightings rated "positive" were used. I interviewed observers and made on-site inspections to verify otter sightings made during this study.

Questionnaires

I used two questionnaires to gather information on otter distribution in Utah. A survey was incorporated into the UDWR harvest questionnaire for furbearer trappers (Appendix C). The questionnaire was mailed to all holders of Utah trapping licenses during 1987. A separate questionnaire was sent to natural resources personnel in state and federal agencies in Utah (Appendix D).

Sign Surveys

I surveyed northern Utah streams for river otter sign during winter and summer, 1987. Positive otter locations

were defined by the presence of otter tracks, scats, and other sign on the stream bank. The winter survey was conducted on streams with relatively large amounts of riparian vegetation or recent otter sightings. During summer, survey sections were randomly chosen (Figure 3) and additional areas were searched whenever possible. Conditions for locating sign were subjectively assessed.

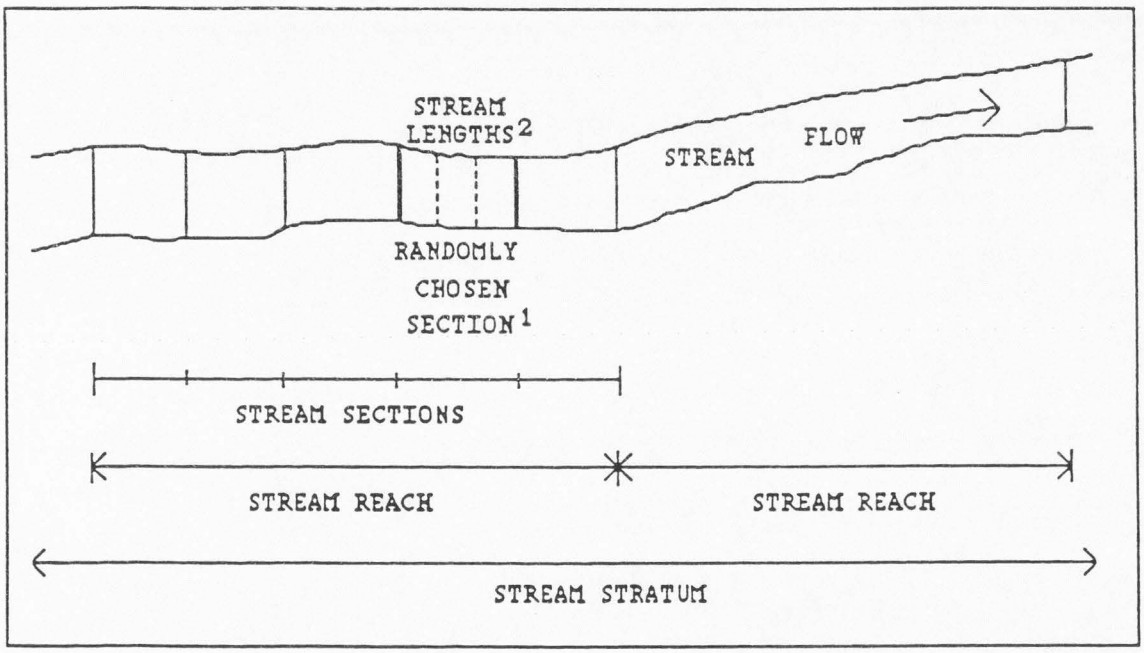

Figure 3. Sampling framework for evaluation of potential of northern Utah streams for river otter habitat/reintroduction.
[1]Sign surveys were on randomly chosen sections.
[2]Habitat measurements were on stream lengths.

RIVER OTTER HABITAT/ REINTRODUCTION EVALUATION

Sampling Framework

I measured habitat attributes during the summer, 1987, within the sampling framework (Figure 3). Each stream was

divided into 1-5 homogeneous strata based on stream gradient, floodplain type, and vegetative characteristics (Appendix E). For example, I used 2 strata to separate a low gradient, valley stretch with tree cover from a high gradient, mountainous stretch with shrub cover. Then, strata were subdivided into stream reaches of equal length to allow proportional sampling. Reaches were 5 km in length for the Weber and Bear drainages, but 1 km in length for the Snake drainage to allow increased sampling because of the Snake drainage's short length and recent otter documentation (Bradley 1986). Each reach was divided into 5 sections of equal length (1 km for the Bear and Weber, 0.2 km for the Snake drainage). One section in each reach was chosen at random and sub-divided into 3 stream lengths of equal size (333 m for Weber and Bear, 67 m for Snake drainage). It is at this level that habitat attributes were measured. Sampling was limited to streams below 2600 m elevation.

General

I classified five stream characteristics: stream gradient, meander ratio, habitat type, type of adjacent agriculture and intensity of livestock grazing, and presence of stream alteration. Percent stream gradient (elevational drop divided by stream length X 100) and meander ratio (stream length divided by straight-line distance) were calculated from 1:24,000 U.S. Geological

Survey maps. Habitat type was classified as mountain stream, valley stream, beaver pond, or wetland. Agricultural type was classified as pasture, hay land, or crop land and grazing intensity was classified by visually estimating the amount of vegetative use by livestock: light (0-25%), moderate (26-50%), heavy (51-75%), or extreme (>75%) (Platts et al. 1987). Stream alteration was noted by identifying evidence of mechanical straightening or deepening of the stream channel, or stream bank degradation.

Specific

I evaluated streams for potential to support otters by assessing food, cover, and reintroduction possibilities (Figure 4). The category "food" included prey abundance and foraging conditions, "cover" included escape cover and denning cover, "reintroduction" included characteristics that may promote successful establishment of an otter population.

Food.--I evaluated potential food by assessing prey abundance and foraging conditions. Estimates of stream fish biomass, and fish distribution and abundance data from UDWR personnel were used to estimate prey abundance. Stream fishes were sampled using backpack or boat electrofishing gear. Streams were blocked on each end of 161 m sections and fishes collected and weighed from 2 consecutive electrofishing passes. Game fish, because of

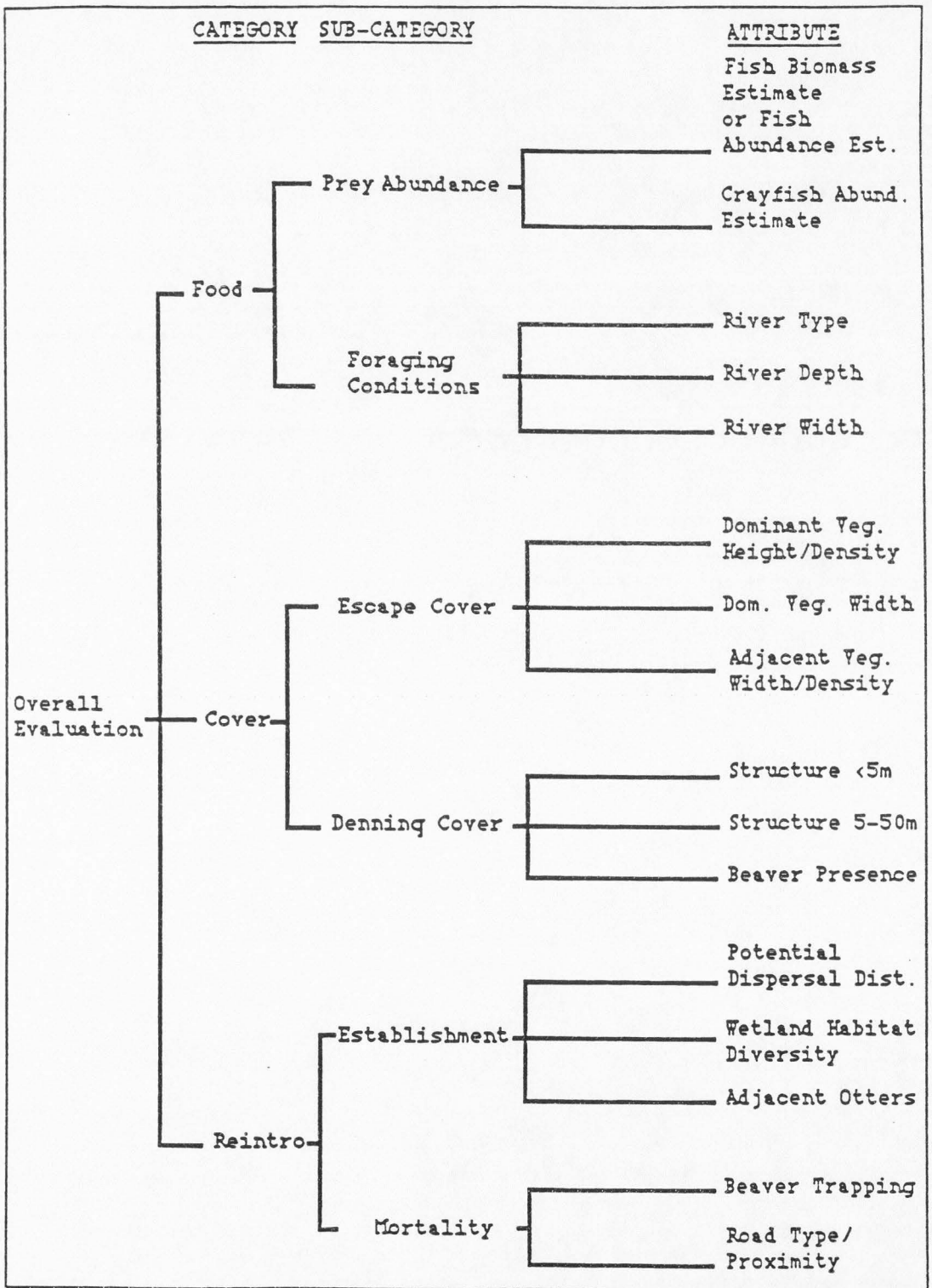

Figure 4. Flow chart of variables measured for evaluation of potential of northern Utah streams for river otter habitat/reintroduction.

faster swimming abilities, were considered less available to otters than nongame fish, thus gamefish biomass was multiplied by a factor of 0.66 and nongame fish biomass by 1.00 (Mack 1985).

I also used estimates of crayfish abundance to assess prey availablility. Crayfish abundance was qualitatively classified using observations during the otter sign survey and recent records of crayfish distribution (Johnson 1986) as: abundant (observed frequently), common (listed in distribution records and observed infrequently), or absent (not listed in distribution records or observed).

Foraging conditions were evaluated by classifying river type (pool, run, riffle), river width, and river depth.

Cover.--I quantified escape cover and denning cover. Escape cover was defined as dominant bank vegetation within 5 m of the stream. Average heights and widths of escape cover and adjacent cover (5-50 m from the stream) were estimated. Relative density was estimated to be high if ground cover was $\geq$50% or low if <50%. I evaluated potential denning cover by counting structural materials (rocks >1.0 m in width, timber, brushpiles, and logjams) within 5 m and 5-50 m from the stream. Because otters often use beaver dens (Melquist and Hornocker 1983, Bradley 1986), presence of beavers (from a sign survey) was used as an additional measure of denning cover.

Reintroduction.--I evaluated potential for reintroduction in part by determining the length of the stream drainage from maps. Diversity of wetland habitats was identified by counting the number of marshes, oxbows, stream channels, beaver ponds, and lakes within 500 m of the stream. The presence of adjacent otter populations was determined from the otter sign survey. The potential for otter mortality was evaluated using the number of beavers trapped annually per county from the Utah furbearer harvest report (Bates 1987) and a classification of the road type and proximity.

Analysis.--All habitat attribute data were measured or converted to an ordinal scale. Attributes such as presence/absence of beaver were binary, and attributes such as width of escape cover were measured and converted to a multistate scale, i.e., <5 m, 5-10 m, and >10 m. Ranks were developed from the otter literature according to the following scale: good = acceptable otter habitat, probability of successful reintroduction high; fair = moderate otter habitat, probability of successful reintroduction moderate; poor = unacceptable otter habitat, probability of successful reintroduction low. Analysis of potential otter habitat/reintroduction was hierarchical (Figure 4). Attributes were measured at each stream length, given a rating (Table 2), and then combined in stepwise fashion and evaluated (Appendix F). The final

Table 2. Attribute ratings for evaluation of potential for river otter habitat/reintroduction.

	Rating		
Attribute	Good	Fair	Poor
Fish (kg/km)	>116	62-116	<62
Fish abundance	game/nongame	nongame	game
Crayfish abundance	abundant	common	absent
River type	pool, run	riffle	dry
River width(m)	>10	5-10	<5
River depth(m)	>0.6	0.2-0.6	<0.2
Dominant vegetation height (m)/ density[1]	W Tud Tus S>1.0d G≥0.4d G≥0.4s F≥1.0	Tnud S>1.0d G≥0.4d G≥0.4s F≥0.4-0.9d	Tnus Ss G≤0.3d F≤0.3s F≤0.3d F0.4-0.9s
Dominant veg. width (m)	>15	5-15	<5
Adjacent veg. width(m)/ density[1]	F>15d G>15d T>15 S>15	F,G,T, or S: 5-15d F,G,T, or S: >15s	none F,G,T,or S <15s F,G,T,or S <5s or d
Struct. 0-5 m^2	>10, >2	5-10, 1-2	<5, <1
Struct. 5-50 m^2	>20, >4	10-20, 2-4	<10, <2
Beaver presence	present	absent	---
Potential dispersal (km)	>200	100-200	<100
Wetland diversity	≥2	1-2	0
Adjacent otter population	Present	absent	---
Road type/ proximity (m)[3]	I>500 S>500 Co>100 G>100	Ci≥500 I100-500 S100-500 Co50-100 G≤10	Ci<500 I<100 S<100 Co<50
Beavers trapped/ county/year	0	1-50	>50

[1]W = willows, T = trees, S = shrubs, G = grass, F = forbs; u = understory, nu = no understory; s = sparse; d = dense.

[2]First number is for 333 m lengths, second number is for 67 m lengths.

[3]I = interstate or federal; S = state; Ci = city; Co = county; G = gravel.

evaluation incorporated all sub-category, category, and overall ratings for each stream (Appendix G).

Validation.--I did not use habitat preference analyses because few otter locations were identified by the sign survey. However, measurements of habitat attributes at otter sign locations were used to help validate my habitat evaluation procedure. By definition, if my model is correct, the areas where otters are located should rate "good" or at least "fair". I used expert opinion as an independent check on the methodology.

RESULTS

RIVER OTTER DISTRIBUTION

Sightings

Eighteen positive sightings of otters (1979-1988) were found in UDWR files (Appendix H). Sightings occurred on 10 rivers in 8 counties (Figure 5).

Questionnaires

Fifty-three of 1,342 harvest questionnaires mailed to Utah trappers on 17 April 1987 were not delivered because of incorrect or changed addresses; 1,289 were used for the analyses. Six hundred-seventy (52%) trappers completed and returned the survey and of these, 547 (82%) answered the river otter section. Twenty-six (4.7%) trappers reported first-hand evidence of otters in Utah, 27 (4.9%) second-hand evidence, and 495 (90.4%) no evidence. The first-hand reports contained 22 positive otter sightings on 16 rivers and lakes in 12 Utah counties from 1964 to 1987 (Figure 5, Appendix H).

Of 57 questionnaires mailed to natural resources personnel in 8 agencies on May 8, 1987, 29 (52.7%) were returned; 2 were not delivered. Six persons (20.7%) reported positive otter sightings and 23 (79.3%) reported no sightings. All sightings occurred in 1986

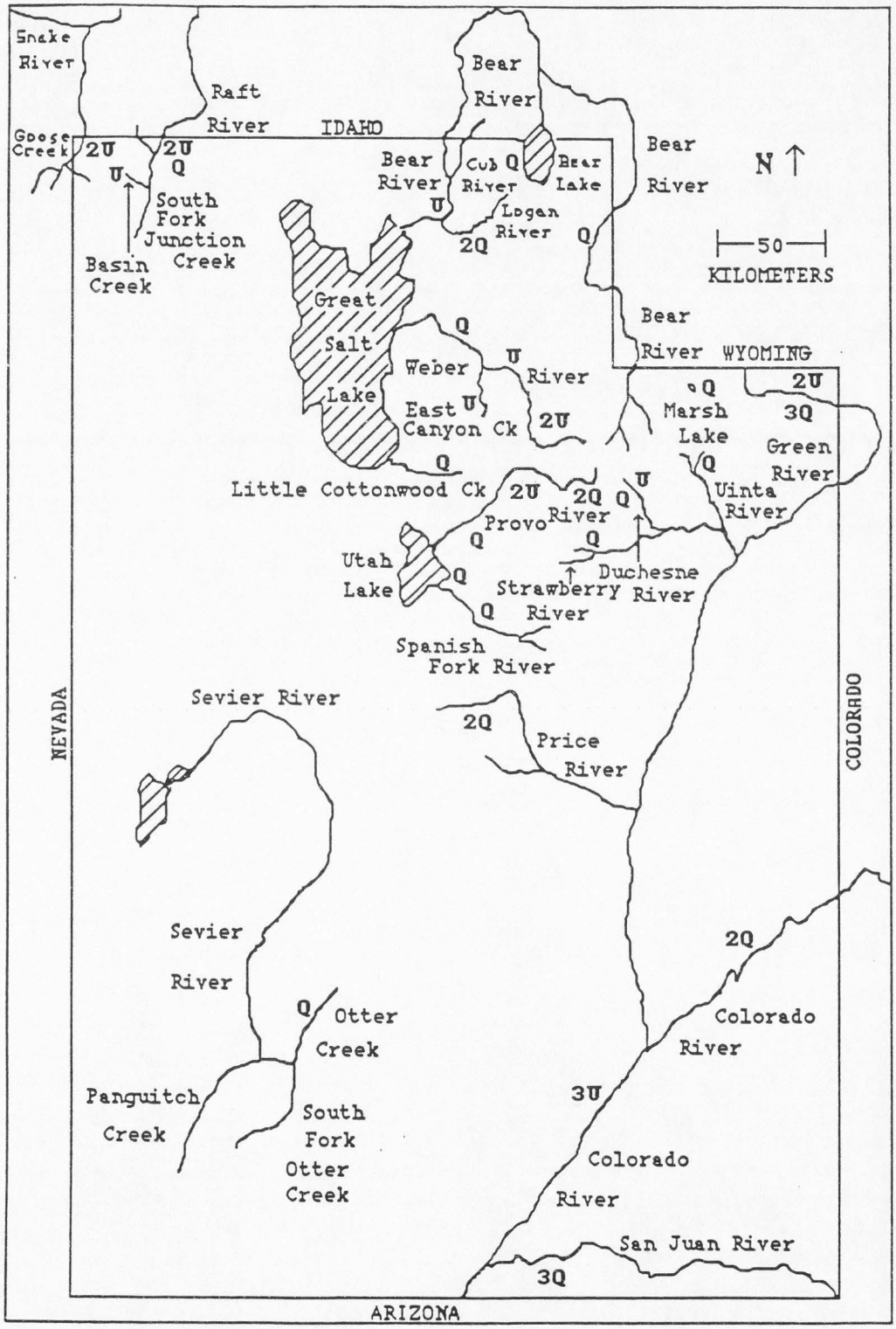

Figure 5. Number of recent sightings of river otters in Utah. Sightings are designated as "U" (from UDWR records) or "Q" (from this study's questionnaire)

on 4 rivers in 4 counties (Appendix H). A total of 28 sightings were reported on questionnaires (Figure 5).

Sign Surveys

A total of 844.4 km of northern Utah streams was searched for otter sign during winter and summer, 1987 (Appendix I). Otter sign was found on 11 stream sections (Table 3, Figure 6), comprising 1.3% of the total stream distance searched.

Table 3. Number of locations with river otter sign found during winter and summer surveys, 1987.

			No. of Sign Locations	
River	County	Stratum	Winter	Summer
Raft	Box Elder	1	3	0
Junction	Box Elder	1	0	1
Goose	Box Elder	1	2	2
Weber	Summit	4	1	1
East Canyon	Summit	2	0	1

From January to May, 407.2 km of 24 northern Utah streams were surveyed for river otter tracks, scats, and other sign. Six otter locations were found on 3 streams, representing 1.5% of the stream distance searched in winter.

From June to September, 437.2 km of 21 rivers were searched for otter sign. Five otter locations were

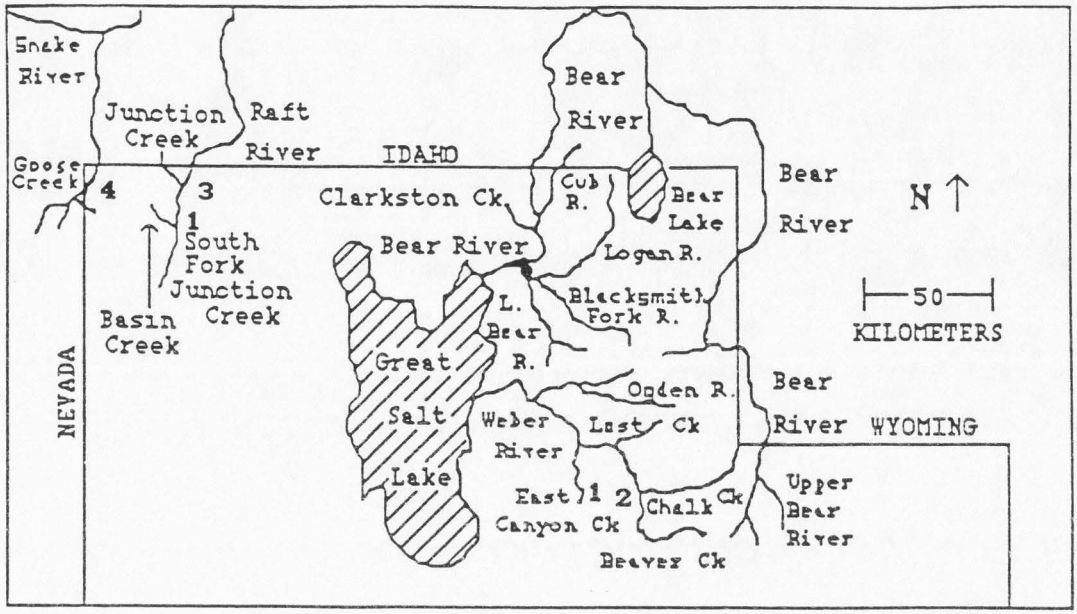

Figure 6. Number of locations with river otter sign in northern Utah from winter and summer surveys, 1987.

identified on 4 streams (Table 3), representing 1.1% of the stream distance searched in summer.

RIVER OTTER HABITAT/ REINTRODUCTION EVALUATION

Habitat attributes were measured on 257 stream sections (771 stream lengths) on 22 streams for a total of 213.8 km (Appendix E).

General

Information on stream gradient, meander ratio, habitat type, adjacent agricultural type/intensity, and stream alteration were used to help classify otter habitat potential. Seventy-seven percent of 34 stream strata had stream gradients <1%, 19% 1-2%; and 5% >2%. Streams above

2600 m were not included because otters rarely occupy high elevation areas except during dispersal (Melquist and Hornocker 1983). Twenty-three percent of meander ratios were <1.25; 21% 1.25-1.50; 26% 1.51-1.75; 4% 1.76-2.00; 7% 2.01-2.50; and 19% >2.50.

Habitat types consisted of 72% valley streams, 25% mountain streams, 2% wetlands, and 1% beaver ponds. Land use adjacent to streams was 86.3% agricultural. Seventy-four percent of the agriculture was livestock grazing, 23% hay land farming, and 3% crop land farming. Fifty percent of the livestock grazing was heavy, 20% light, 19% moderate, and 10% extremely heavy. Physical stream alteration occurred on 50% of the study area, but varied by drainage: Weber 79%, Bear 38%, and Snake 6%.

Specific

We electrofished 29 stretches on 9 streams during August and September, 1987 (Appendix J) and estimated fish standing crops (Appendix K).

I compiled habitat attribute data by stream section and stratum (Tables 4 and 5). Only 15.6% of 257 stream sections were rated good, 48.6% fair, and 35.8% poor. Food potential was rated 48.2% good, 40.9% fair, and 10.9% poor, cover 36.2% good, 6.2% fair, and 57.6% poor, and reintroduction 9.7% good, 40.5% fair, and 49.8% poor.

Overall ratings for the Weber River drainage by stratum were 8.3% good, 41.7% fair, and 50.0% poor (Figure

Table 4. Ratings of river otter habitat/reintroduction by percent of stream sections.

Stream drainage	No. of stream sections	Food			Cover			Reintroduction			Overall		
		Good	Fair	Poor	Good	Fair	Poor	Good	Fair	Poor	Good	Fair	Poor
Weber	69	53.6	27.5	18.8	39.1	4.3	56.5	0.0	13.0	87.0	10.1	33.3	56.5
Bear	134	56.7	37.3	6.0	38.8	6.7	54.5	9.0	40.3	50.7	17.2	48.5	34.3
Snake	54	20.4	66.7	13.0	25.9	7.4	66.7	24.1	75.9	0.0	18.5	68.5	13.0
Totals	257	48.2	40.9	10.9	36.2	6.2	57.6	9.7	40.5	49.8	15.6	48.6	35.8

Table 5. Ratings of river otter habitat/reintroduction by percent of stream strata.

Stream drainage	No. of stream strata	Food			Cover			Reintroduction			Overall		
		Good	Fair	Poor	Good	Fair	Poor	Good	Fair	Poor	Good	Fair	Poor
Weber	12	50.0	33.3	16.7	41.7	0.0	58.3	0.0	8.3	91.7	8.3	41.7	50.0
Bear	17	47.1	41.2	11.8	35.3	11.8	52.9	0.0	23.5	76.5	5.9	47.1	47.1
Snake	5	20.0	60.0	20.0	0.0	0.0	100.0	20.0	80.0	0.0	0.0	80.0	20.0

7). Likewise the Bear River drainage was rated 5.9% good, 47.1% fair, and 47.1% poor (Figure 8), and the Snake River drainage zero percent good, 80% fair and 20% poor (Figure 9). Ratings for individual stream stratum are given in Appendix L.

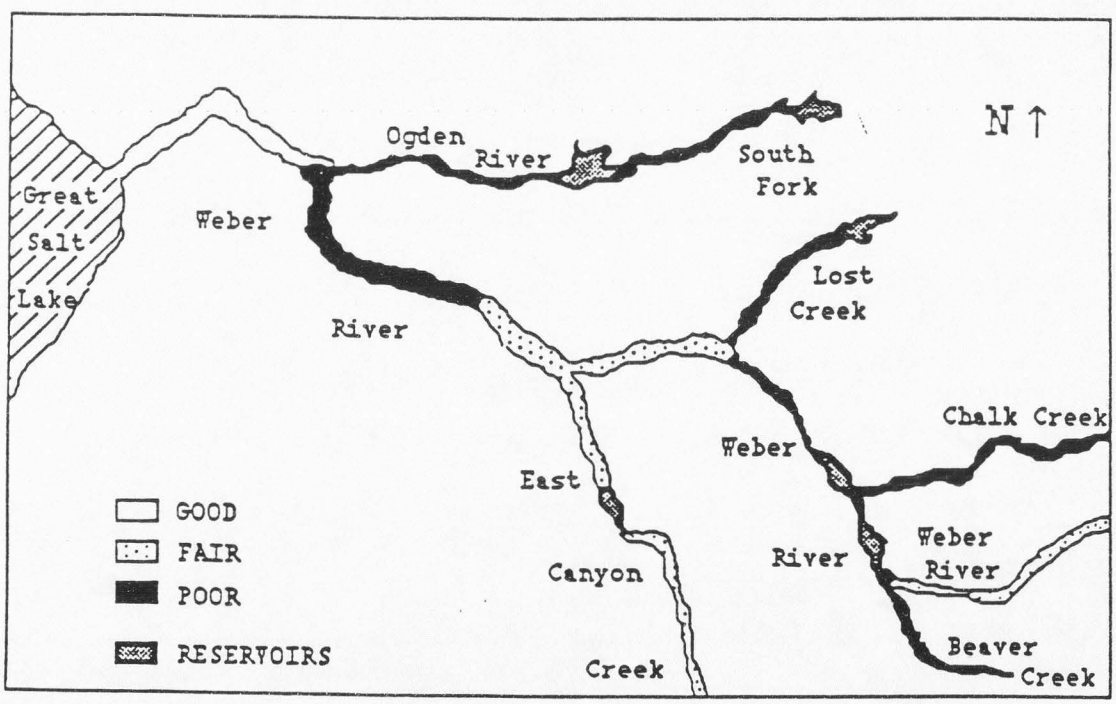

Figure 7. Potential for reintroducing river otters in the Weber River drainage, Utah.

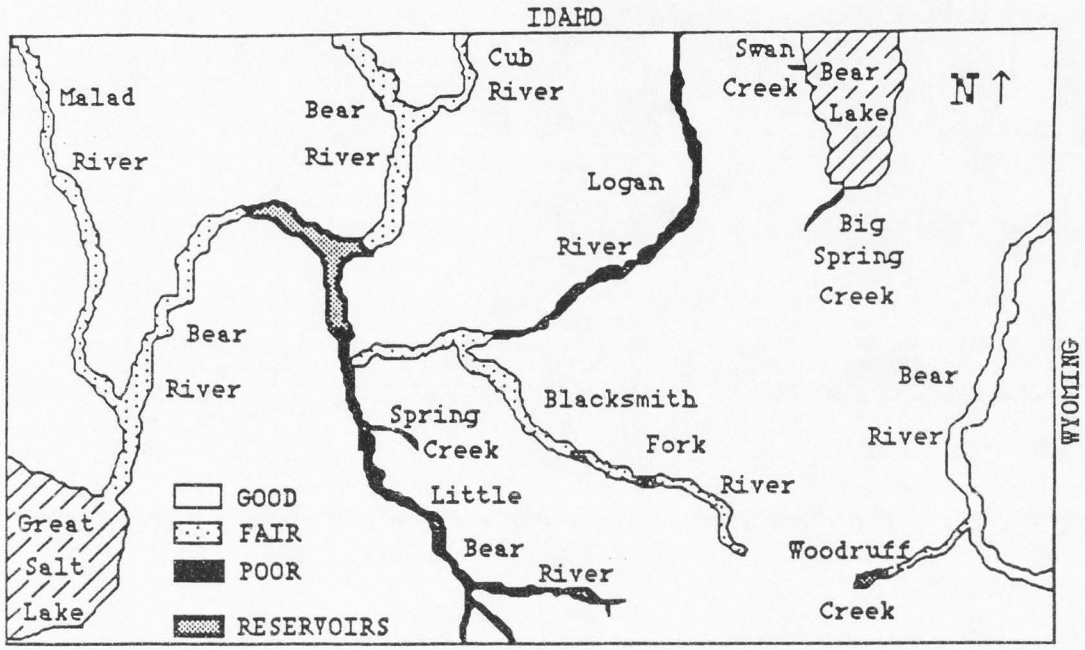

Figure 8. Potential for reintroducing river otters in the Bear River drainage, Utah.

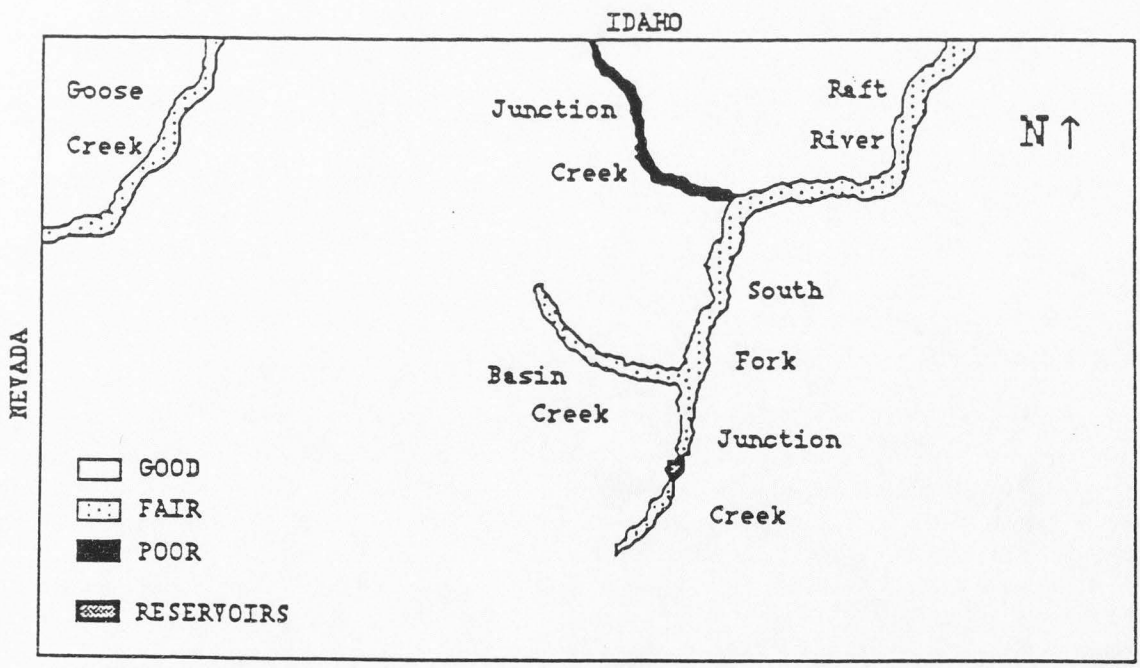

Figure 9. Potential for reintroducing river otters in the Snake River drainage, Utah.

Validation

Ratings of habitat attributes were tabulated for otter locations by stream section. For all otter locations (n = 11), food was rated good for 6 locations, and fair for 5, cover was rated good for 8, fair for 1, and poor for 2. Expert opinion verified that the procedure incorporated the present state of knowledge of otter ecology and appeared suitable for evaluating potential reintroduction sites (pers. comm. T. Beck, P. Bradley, and W. Melquist). However, differences of opinion existed about the importance of certain attributes and attribute levels.

DISCUSSION

RIVER OTTER DISTRIBUTION

Sightings

Some otter sightings may be suspect because of observer error even though only "positive" sightings were compiled. Yearly comparisons should be treated with caution because of changing numbers of people afield. Increasing pubic awareness of wildlife may affect the number and validity of sightings. Most of the sightings I investigated during this study could not be verified. Certainly some otter sightings are not reported. Nonetheless, the otter sightings reported to UDWR have increased greatly since 1985.

Questionnaires

Trapper questionnaires have been utilized to gather information about otter status, distribution, and management (Zackheim 1982). Otter sightings from trappers are probably more reliable than those from the general public. Information from personnel of natural resources agencies is assumed to be valid. Surveys of trappers and natural resources personnel showed a trend similar to the sightings data from UDWR.

Sign Surveys

Otter sign surveys have been used extensively in recent years for assessing otter distribution and general habitat use and for estimating relative abundances (Mowbray et al. 1976, MacDonald et al. 1978, Jenkins and Burrows 1980, Zackheim 1982, Edwards 1983, Christensen 1984, Bradley 1986, Anderson and Woolf 1987). My winter and summer sign surveys each covered approximately half of the study area (with considerable seasonal overlap). Conditions for locating sign were better in the winter than summer (Appendix M). However, any family groups or heavy use areas probably would have been discovered in either season. Sign from individual, transient otters may have been missed.

Conclusions

Sighting data from UDWR records and questionnaires from this study suggest otters have increased recently in Utah. However, few otter locations were discovered during the sign survey (n = 11). Only Goose Creek and 1 section (1 km) on the Weber River showed sign of otters during both winter and summer. The Weber location consisted of one animal only for each season. Sighting locations were rarely on the same river stretch over several years. Since no evidence of otter family groups was found during this study, reproducing populations of otters probably do not presently exist in northern Utah. Individual animals may

be dispersing from other areas. For example, otters on Goose Creek are probably dispersing from established otter populations in Nevada (Bradley 1986). The number of otters and population stability in Utah are presently unknown. However, a minimum of 2 and 3 otters were present on the Weber and Snake drainages, respectively, during this study.

RIVER OTTER HABITAT/ REINTRODUCTION EVALUATION

General

General characteristics of the study area are conducive to otter inhabitation. Low gradient, valley stream habitats were preferred by otters in Idaho (Melquist and Hornocker 1983). Seventy-two percent of the study area was composed of valley streams and 95% was less than 2% stream gradient. However, stream alteration has impacted 80% of the riparian zone of the Weber River alone. Meander ratios also reflect stream alterations. Meander ratios less than 1.5 are considered "straight" and are rare for "natural", low gradient streams (Rayner 1972, Dunne and Leopold 1978). Forty-three percent of the study area was characterized by meander ratios <1.5. Stream gradients were slightly underestimated and meander ratios overestimated because of recent straightening of stream channels not recorded on maps.

Although otters coexist with cattle (Bradley 1986), livestock grazing has severe impacts on riparian zones

(Marcuson 1977, Knopf and Cannon 1982, Kauffmann et al. 1983). This is a serious problem on the study area. Sixty-nine percent of all livestock grazing was classified as heavy or extremely heavy.

Of the 11 locations where I found otter sign, all had stream gradients of $\leq$0.78% and meander ratios 1.13-1.62. Ten were valley streams (1 beaver pond), 9 had no stream alteration, and 5 of 7 in livestock range were lightly or moderately grazed. Although this sample size is small, the results are consistent with otter habitat use in Idaho, Arizona, and Nevada (Melquist and Hornocker 1983, Christensen 1984, Bradley 1986).

Specific

Food.--Otters require an abundant and available supply of fishes (and to a lesser extent crayfish and other aquatic invertebrates, small mammals and birds) and suitable foraging conditions (USFWS 1985). Fish were the most important prey item of otters in the western United States as measured by frequency of occurrence in scats or digestive tracts. Fish comprised 93-99% of otter diets in Montana (Greer 1955, Zackheim 1982); 80% in Oregon (Toweill 1974); 93-100% seasonally in Idaho (Melquist et al.1980); and 100% in Colorado (Mack 1985). Crayfish were also important prey where they occurred (Lagler and Ostenson 1942, Grenfell 1974, Zackheim 1982).

Since fish are the most important otter prey, a measure of the fish population has been used as an estimate of otter prey abundance (Melquist and Hornocker 1983, Bradley 1986, Mack 1985). Catchability of fish varies because of different swimming abilities. Otters selected slower suckers over faster trout (Ryder 1955, Erlinge 1968). Trout were utilized an estimated 0.66 less than suckers (Mack 1985). Foraging conditions are important in evaluating potential food for otters, e.g., river pools were preferred for foraging (Christensen 1984).

Captive European otters ate from 1.0-1.5 kg fish/day (Erlinge 1968, Wayre 1979). Free ranging otters may consume the equivalent of 15-20% body weight per day as food (Chanin 1985). Wild female river otters needed an estimated 1,000 kg fish/year (2.74 kg/day) for annual bioenergetic requirements (males needed slightly less) (Mack 1985). The minimum fisheries for otters was estimated as 116 kg/km (1,000 kg X 1/0.43 (the reciprocal of estimated sustained yield of stream fishes) divided by 20 km (mean home range of otters)) (Mack 1985). In my study, 48.2% of the stream sections exceeded this minimum level and 40.9% met moderate requirements (1.50-2.74 kg/day). Estimates of fish standing crops were conservative because all fish in a sampled stretch were not captured. Food, then, appears to be available in ample supplies to support otters. Using an annual food requirement of 2,326 kg, the Weber River proper is

estimated to contain enough forage for an adult female otter in 2.1-5.5 km (annual requirement (kg) divided by standing crop (kg/km)). The Blacksmith Fork River contains enough food for an otter in 12.5-17.5 km, the Logan River in 4.5-21.3 km, and the Raft River in 24.7 km. Over 100 km would be needed on high mountain streams such as West Fork of the Bear River (Utah Division of Wildlife Resources 1985), and on smaller streams such as Middle Fork of the Ogden River. Possible sources of bias may result from the following assumptions: 1) data on otter metabolic requirements from the literature are accurate; 2) fish are the sole prey of otters; 3) prey abundance and vulnerability are constant throughout the year; 4) prey availability determines home range size; and 5) sampling techniques accurately estimated the fish populations in this study.

Crayfish also contribute to the prey base. I found 9 otter scats on the banks of Goose Creek, South Fork Junction Creek, and the Raft River; all contained crayfish remains. The native crayfish (Pacifasticus gambelii) is widespread in the Weber, Bear, and the Snake River drainages in Utah (Johnson 1986, pers. observ.). It is apparently absent from the lower sections of the Bear and Weber River. An introduced crayfish, Orconectes virilis, exists in many reservoirs in northern Utah and may be expanding its range (Johnson 1986).

Cover.--Otter cover is often classified in general terms such as meadow marsh, canebrake, etc. (Foy 1984); forest stream, backwater slough, feeder stream, etc. (Melquist and Hornocker 1983); or willow swamp, virgin cypress swamp, etc. (Humphrey and Zinn 1982). Otters used vegetated stream banks with both canopy cover and ground cover more than other cover types (Christensen 1984). Significant differences existed in otter use of various categories of bank cover, meander ratio, bank height, bank slope and grazing regime (Bradley 1986). Scat locations of European otters were highly correlated with dense vegetation on stream banks (0-5 m from the stream) as well as behind the banks (5-50 m) (Bas et al. 1984). Otters used vegetation and geomorphic features as cover (Melquist and Hornocker 1983). Riparian vegetation adjacent to water is a key component of otter habitat (Melquist and Dronkert 1987).

Escape cover is used by otters as shelter from weather, predators or disturbances, as well as for feeding, grooming and other social activities. Poor cover may limit use of an abundant food source while good cover may allow use of an area with much human activity (Melquist and Hornocker 1983; MacDonald et al. 1978). Escape cover was rated poor for over half (50.2%) of the stream sections, 36.6% fair, and only 13.2% good. Loss of stream bank vegetation is striking in many areas. Seventy percent of the bank vegetation of the Weber River was lost due to

agriculture between 1938 and 1967 (Barton et al. 1971). Otters used dense bank vegetation in greater proportions than its occurrence (Jenkins and Burrows 1980, Zackheim 1982, Melquist and Hornocker 1983, Bas et al. 1984). Bank cover removal was detrimental to European otter populations (MacDonald and Mason 1976). In this study area, adequate escape cover is largely lacking, and may be the most important limiting factor to otter inhabitation.

Denning cover is necessary for otter resting and pup rearing. Otters do not appear to excavate their own dens but rely on existing cavities (Toweill and Tabor 1982). Beaver dens and lodges provided many otter denning sites (38% Melquist and Hornocker 1983; 100% Bradley 1986). Talus rock, logjams, brush/log piles and other materials were also important (Melquist and Hornocker 1983). Otter-beaver commensalism may exist because of beaver enhancement of otter prey numbers and riparian vegetation (Bradley 1986). Beaver were present on 9 of 11 locations where otter sign was found. Since beavers occurred on 46.1% of the stream sections studied, a large number of otter dens could be provided by beavers.

Reintroduction.--Population establishment requires adequate dispersal areas. Home ranges for wild otters varied from 8-78 km in stream length while dispersal distances for young otters approached 200 km (Melquist and Hornocker 1983). Home ranges for released otters varied from 5-71 km (Mack 1985). The Bear, Weber, and Snake

drainages are of adequate size to support otter populations.

Otter habitat improves with increasing diversity of wetland habitats (USFWS 1985). Only 19.4% of the sections were good for wetland habitat diversity, 43.6% were fair, and 37.0% were poor. This may be a concern as female otters often used sloughs, backwaters, and side channels for rearing young (Melquist and Hornocker 1983).

Otter mortality unrelated to reintroduction efforts is poorly documented. However, human activity is often the most serious cause (Toweill and Tabor 1982). Man-related factors (road-kill, shooting, and domestic dogs) were responsible for 6 of 9 otter deaths in Idaho (Melquist and Hornocker 1983). Road type/proximity varied: the Bear drainage was 32.1% good, 43.3% fair, and 24.6% poor; the Weber was 17.4% good, 33.3% fair, and 47.8% poor; and the Snake was 24.1% good, 74.1% fair, and 1.8% poor. Poor ratings indicate high potential for road-kill and other mortality associated with high human populations. Trapping is also a cause of mortality, even where otters are only taken incidental to beaver trapping (Zackheim 1982). Road-kill and beaver trapping were the most important conflicts influencing the success of otter reintroductions (Jalkotsky 1982). Beaver trapping activity is high in most northern Utah counties (Bates 1987) and would be a deterrant to successful otter transplants.

Validation.--The habitat values for locations where I found otter sign were 100% good or fair for food, and 82% good or fair for cover. This validation is weak because of small sample size (n = 11). Otters can presumably pass through "poor" areas (leaving sign) that would skew the results. Expert opinion, though qualitative, supported the model.

This evaluation assumes that all important aspects of otter ecology have been considered. It does not predict otter use of specific habitats, but evaluates overall reintroduction possibilities. It can be viewed as a hypothesis of characteristics necessary for successful otter reintroductions. Further research will undoubtedly alter attributes and attribute levels used. Use of this model outside the study area may require adjustments. Reintroduction considerations unrelated to otter biology such as land ownership, future land developments, etc. may need to be considered.

Conclusions

Evaluation of the potential of northern Utah streams to support river otters identified "good" streams as suitable for reintroduction. Only 2 river strata were rated good: Weber River stratum 1 and Bear River stratum 4. Weber River stratum 1, however, is only 25 km in length and is flanked by a 30 km stretch of poor habitat and the Great Salt Lake. Bear River stratum 4 in Rich County

(approximately 100 km in length) is the best candidate for otter reintroduction. However, beaver trapping is heavy and would need to be limited. Escape cover is the most poorly represented habitat component and riparian vegetation rehabilitation would be beneficial. Further research should be done to assess seasonal fluctuations in prey availability. Sections of the Bear River in Wyoming and Idaho should be evaluated before a reintroduction is considered.

MANAGEMENT CONSIDERATIONS

Otter reintroduction is not recommended at this time in northern Utah. The Bear River in Rich County can be considered for future reintroductions if beaver trapping is restricted and if the suitability of the Wyoming and Idaho portions of the drainage is evaluated. Rehabilitation of vegetative cover and further study of prey availability are also recommended.

Further damage to the riparian zones of all drainages should be curtailed. Serious threats to riparian wildlife species include degradation of streams and stream banks by livestock grazing, physical alteration for flood control or development, as well as non-point source pollution e.g., agricultural run-off, and point source pollution, e.g., domestic waste, and chemical dumping. Regulations to restrict stream alteration, grazing of riparian zones, as well as to prohibit all pollution inputs should be developed.

Northern Utah streams need rehabilitation. Stream bank vegetation should be planted and/or protected from livestock grazing. Rehabilitation of stream fisheries will benefit otters. Programs for landowner education need to be developed. Use of the Conservation Reserve Program and Plant Materials Program of the Soil Conservation Service and Agricultural Stabilization and Conservation Service should be emphasized in all contacts with landowners.

These programs allow for setting aside land for soil conservation and for financial help in establishing vegetative cover. Purchase or lease of riparian lands by the state would allow enhanced use and management for wildlife.

Several reservoirs are proposed on the Bear River drainage (Appendix B). Because construction of reservoirs results in the loss of stream area to inundation, it would be detrimental to existing otters and limit the potential for future reintroductions.

Surveys will need to be conducted to determine the distribution of otters in the rest of the state, especially the Colorado River drainage. Otter sightings in 1988 (N. Bouges, pers. comm.) suggest this as a high priority area. The rare Lutra canadensis sonora may exist in this drainage. Streams should be surveyed for otter sign in winter. The state of Colorado has shifted emphasis of their otter reintroduction program to streams in the southern part of that state (T. Beck, pers. comm.). Because of similarity between stream drainages in southern Utah and southern Colorado we recommend these drainages be evaluated for reintroduction.

LITERATURE CITED

Anderson, E. A., and A. Woolf. 1987. River otter habitat use in northwestern Illinois. Illinois Acad. Sci. 80:107-114.

Barton, J. R., D. A. White, P. Winger, and E. Peters. 1971. The effects of highway construction on the hydrology and hydrobiology of the Weber river near Henefer. Utah Div. of Fish and Game and Utah Dept. of Highways. 106pp.

Bas, N., D. Jenkins, and P. Rothery. 1984. Ecology of otters in Northern Scotland. V. The distribution of otter (Lutra lutra) faeces in relation to bankside vegetation on the River Dee in summer 1981. J. Appl. Ecol. 21:507-513.

Bates, B. 1987. Utah furbearer harvest and recommendations, 1986-1987. Utah Div. Wildl. Res. Fed. Aid Proj. No. W-65-R-D-A-7-35. 36pp.

Berryman, J. H. 1949. Facts of interest about Utah mammals. Utah Fish and Game Bull. 7(1):6-8.

Bradley, P. V. 1986. Ecology of river otters in Nevada. M.S. Thesis. Univ. of Nevada, Reno. 99pp.

Chanin, P. 1985. The natural history of otters. Facts on File, Inc. 179pp.

Christensen, K. M. 1984. Habitat selection, food habits, movements, and activity patterns of reintroduced river otters (Lutra canadensis) in central Arizona. M.S. Thesis. Northern Arizona State Univ., Flagstaff. 72pp.

Deems, E. F. Jr., and D. Pursley. 1983. North American furbearers, a contemporary reference. Worldwide Furbearer Conference, Inc. 233pp.

Dunne, T., and L. B. Leopold. 1978. Water in environmental planning. W. C. Freeman and Company. San Francisco, CA. 818pp.

Durrant, S. D. 1952. Mammals of Utah. University of Kansas Publ. Museum of Natural History. 549pp.

Edwards, T. L. 1983. River otter abundance, distribution, and habitat use in Louisiana. M.S. Thesis. Northeast Louisiana University. New Ibena, LA. 42pp.

Erlinge, S. 1968. Food studies on captive otter Lutra lutra. Oikos 19:257-270.

Foy, M. K. 1984. Seasonal movement, home range, and habitat use of river otter in southeastern Texas. M.S. Thesis. Texas A&M Univ., College Station. 102pp.

Greer, K. R. 1955. Yearly food habits of the river otter in the Thompson Lakes region, northwestern Montana, as indicated by scat analyses. Am. Midl. Nat. 54:299-313.

Gregory, H. E. 1938. The San Juan Country: a geographic and geologic reconnaissance of Southeastern Utah. U.S. Geol. Surv. Prof. Papers No. 188. 123pp.

Grenfell, W. E., Jr. 1974. Food habits of the river otter in Suisin Marsh, central California. M.S. Thesis. California State Univ., Sacramento. 43pp.

Hall, E. R., and K. R. Kelson. 1959. The mammals of North America. Ronald Press Co., New York. 1083pp.

Humphrey, S. R., and T. L. Zinn. 1982. Seasonal habitat use by river otters and Everglades mink in Florida. J. Wildl. Manage. 46:375-381.

Jalkotsky, M. G. 1982. Reintroduction of river otter in Kananaskis County, Alberta. M.S. Thesis. Univ. of Calgary, Alberta. 165pp.

Johnson, J. E. 1986. Inventory of Utah crayfish with notes on current distribution. Great Basin Naturalist 46:625-631.

Jenkins, D., and G. O. Burrows. 1980. Ecology of otters in Northern Scotland. The use of faeces as indicators of otter (Lutra lutra) density and distribution. J. Anim. Ecol. 49:755-774.

Kauffmann, J. B., W. C. Krueger, and M. Varva. 1983. Impacts of cattle grazing on streambanks in N. E. Oregon. J. Anim. Ecol. 49:755-774.

Knopf, F. L., and R. W. Cannon. 1982. Structural resilience of a willow riparian community to changes in grazing practices. Pages 198-207 In J. A. Peek and P. D. Dalke, eds. Wildlife-Livestock Relationship Symposium: Proc. 10. Univ. of Idaho. For., Wildl., and Range Exp. Station. Moscow. 614pp.

Lagler, K. F., and B. T. Ostenson. 1942. Early spring food of the otter in Michigan. J. Wildl. Manage. 6:244-254.

MacDonald, S. M., and C. F. Mason. 1976. The status of the otter in Norfolk. Biol. Conserv. 19:119-124.

-----, -----, and I. S. Coghill. 1978. The otter and its conservation in the River Teme catchment. J. Appl. Ecol. 15:373-384.

Mack, C. M. 1985. River otter restoration in Grand County, Colorado. M.S. Thesis. Colorado State Univ., Fort Collins. 133pp.

Marcuson, P. E. 1977. The effects of cattle grazing on brown trout in Rock Creek, Montana. Montana Dept. Fish and Game. Spec. Rept., Fed. Aid Project F-20-R-21-11a. 23pp.

Melquist, W. E., and M. G. Hornocker. 1983. The ecology of river otters in west central Idaho. Wildl. Monogr. 83. 60pp.

Melquist, W.E., and A. E. Dronkert. 1987. River otter. Pages 627-641 In M. Novak, J. A. Baker, M. E. Obbard, and B. Malloch (eds.) Wild furbearer management and conservation in North America. Ontario Trappers Association, Canada.

Melquist, W. E., J. S. Whitman, and M. G. Hornocker. 1980. Resource partitioning of sympatric mink and river otter populations. Pages 187-220 In J. A. Chapman and D. Pursley (eds.) Worldwide Furbearer Conference Proceedings. R. R. Donnelly and Sons, Inc., Falls Church, Virginia.

Mowbray, E. E., J. A. Chapman, and J. R. Goldsberry. 1976. Preliminary observations on otter distribution and habitat preferences in Maryland with descriptions of field sign. Trans. Northeast Fish Wildl. Conf. 33:125-131.

Platts, W. S., C. Armour, G. D. Booth, M. Bryant, J. L. Bufford, P. Cuplin, S. Jensen, G. W. Lienkaemper, G. W. Minshall, S. B. Monsen, R. L. Nelson, J. R. Sedell, and J. S. Tuhy. 1987. Methods for evaluating riparian habitats with applications to management. U.S. Dept. of Agriculture, Forest Service, Intermountain Research Station, Gen. Tech. Rep. INT-221. 177pp.

Rawley, E. V. 1982. Species plan for Utah's furbearer and big game mammal resources. Utah Div. Wildl. Res. Publ. No. 82-9. 137pp.

-----. 1985. Early records of wildlife in Utah. Div. of

Rayner, J. N. 1972. Conservation, equilibrium, and feedback applied to atmospheric and fluvial processes. Assoc. of Amer. Geographers. Commission of College Geography Res. Paper No. 15. 23pp.

ReMillard, M. D., L. R. Herbert, G. W. Sandberg, and G. A. Birdwell. 1986. Water resources data, year 1986. U.S. Geol. Surv. Water Data Rep. UT-86-1. 404pp.

Ryder, R. A. 1955. Fish predation by the otter in Michigan. J. Wildl. Manage. 19:497-498.

Toweill, D. E. 1974. Winter food habits of river otters in western Oregon. J. Wildl. Manage. 38:107-111.

Toweill, D. E., and J. E. Tabor. 1982. River otter. Pages 688-703. In J. A. Chapman and G. A. Feldhamer (eds.) Wild mammals of North America. Johns Hopkins Univ. Press. 1147pp.

USFWS. 1985. Habitat suitability index model: river otter. Unpublished draft. U.S. Dept. Int., Fish Wildl. Serv., Div. Ecol. Serv. 51pp.

Utah Division of Wildlife Resources. 1985. West Fork Bear River environmental assessment study. Resource Analysis Section. Salt Lake City, UT. 90pp.

Wayre, P. 1979. The private life of the otter. B. T. Batsford, Ltd., London, U.K. 112pp.

Zackheim, H. S. 1982. Ecology and population status of the river otter in southwest Montana. M.S. Thesis. Univ. of Montana, Missoula. 100pp.

APPENDICES

APPENDIX A. RIVER OTTER STATUS IN THE U.S. AND CANADA[1]

Rare	Protected[2]	Trapped
Arizona	Arizona	Alabama
Colorado	California	Alaska
Illinois	Colorado	Arkansas
Iowa	Idaho	Connecticut
New Mexico	Illinois	Delaware
Ohio	Iowa	Florida
Oklahoma	Missouri	Georgia
Tennessee	New Jersey	Louisiana
Utah	New Mexico	Maine
West Virginia	North Dakota	Maryland
	Ohio	Massachusetts
	Oklahoma	Michigan
	Pennsylvania	Minnesota
Absent	Rhode Island	Mississippi
	Tennessee	Montana
Indiana	Utah	Nevada
Kansas	West Virginia	New Hampshire
Kentucky	Wyoming	New York
Nebraska		North Carolina
South Dakota	Prince Edward Island	Oregon
North Dakota		South Carolina
		Texas
		Vermont
		Virginia
		Washington
		Wisconsin
		Alberta
		British Columbia
		Manitoba
		New Brunswick
		Newfoundland
		Northwest Territories
		Nova Scotia
		Ontario
		Quebec
		Saskatchewan
		Yukon Territory

[1]from Toweill and Tabor (1982), Deems and Pursley (1983).
[2]river otters are not officially protected in 5 states where they are absent.

APPENDIX B. EXISTING AND PROPOSED RESERVOIRS

Drainage/ Stream	Existing	Proposed	County
Bear/			
Bear	Whitney		Summit
Bear	Cutler		Cache
Bear		Honeyville	Box Elder
Bear		East Promontory	Box Elder
Bear		Smithfield	Cache
Bear		Barrens	Cache
Malad		Washakie	Box Elder
Logan	"First Dam"		Cache
Logan	"Second Dam"		Cache
Blacksmith Fk	"Second Dam"		Cache
Blacksmith Fk	"Third Dam"		Cache
Blacksmith Fk		Mill Creek	Box Elder
Little Bear	Hyrum		Cache
Little Bear	Porcupine		Cache
Little Bear		Avon	Cache
Weber/			
Weber	Echo		Summit
Weber	Rockport		Summit
Weber	Smith and Moorehouse		Summit
Ogden	Pineview		Weber
S Fk Ogden	Causey		Weber
Lost	Lost Creek		Morgan
East Canyon	East Canyon		Morgan
Raft/			
S Fk Junction	Johnson		Box Elder

APPENDIX C. SAMPLE OF TRAPPER QUESTIONNAIRE

Please mark the appropriate box that applies to you.

☐ I have not seen first-hand evidence of river otters in Utah.

☐ I have not seen evidence of otters in Utah but know someone who has. Indicate persons name _____ address _____ phone # _____

☐ I have seen river otters or their sign in Utah. For each sighting of an otter or otter sign (tracks, scats, slides, etc.), please fill out the following:

	Type of Sign	Month, Year	Name of River or Lake	Approximate Location	Sighting was positive, possible, or questionable	Other Information
1.						
2.						
3.						
4.						
5.						
6.						

Please indicate the streams, rivers or lakes that you trap near _____, and the approximate number of river miles you regularly trap _____. (answers will remain confidential).

Feel free to add any further information or concerns about river otters in Utah. Please contact us if you see an otter, fresh tracks, or other sign (530-1296).

APPENDIX D. SAMPLE OF NATURAL RESOURCES PERSONNEL QUESTIONNAIRE

Dear Natural Resources Personnel:

We are currently conducting a study on the status of river otters in Utah. To accompany a field survey to determine present distribution of river otters, this questionnaire is designed to gather information on river otter sightings. We have noticed an increase in the number of otter sightings over the last few years, though many are questionable, and would like to find out if any personnel in your agency have seen evidence (or know of someone who has) of river otters in Utah. We would appreciate your routing this form to the appropriate personnel in your office. It is important that we get your response, even if you know of no otter sightings.

	Type of Sign	Month, Year	Name of River or Lake	Approximate Location	Sighting Reliability*	Person Who Made Sighting and Affiliation
1.						
2.						
3.						
4.						
5.						
6.						

*1 = positive, 2 = possible, 3 = questionable

Please indicate the river drainages that you regularly work on _____

☐ Check if no one in your office has knowledge of river otter evidence in Utah.

Feel free to add any further information about river otters in Utah. We are very interested in knowing about river otter sightings in the future (530-1296).

Sincerely,

Joel P. Bich

APPENDIX E. LOCATIONS OF STREAM STRATA AND SECTIONS[1]

Stream	Stratum	Location	Number of Sections
Weber	1	Ogden Bay-1900 West	5
Weber	2	1900 West-Gateway	6
Weber	3	Gateway-Taggarts	7
Weber	4	Taggarts-Hwy 189	10
Weber	5	Hwy 189-Middle Fork	7
East Canyon Ck	1	Weber R.-Reservoir	4
East Canyon Ck	2	Reservoir-Headwaters	5
Beaver Ck	1	Weber R.-Kamas Hatchery	4
Lost Ck	1	Weber R.-Reservoir	4
Chalk Ck	1	Weber R.-Wyoming	9
Ogden	1	Weber R.-Pineview Res.	3
S Fk Ogden	1	Pineview Res.-Causey Res.	5
Bear	1	Corrine-Cutler Dam	14
Bear	2	Cutler Dam-Mendon Road	12
Bear	3	Horshoe Bend-Idaho	12
Bear	4	Wyoming-Wyoming	20
Bear	5	Wyoming-Hayden ForK	7
Malad	1	Bear R.-Idaho SL	17
Woodruff	1	Bear R.-Reservoir	5
Big Spring Ck	1	Bear L.-Headwaters	2
Swan Ck	1	Bear L.-Headwaters	1
Cub	1	Bear R.-Idaho	5
Spring Ck	1	Little Bear R.-Hwy. 89	2
Little Bear	1	Mendon Road-Wellsville Ck	4
Little Bear	2	Wellsville Ck-Porcupine Res.	7
Logan	1	200 N.-600 W., Logan	5
Logan	2	600 W.-Idaho	12
Blacksmith Fk	1	Logan R.-Canyon Mouth	3
Blacksmith Fk	2	Canyon Mouth-Headwaters	6
Raft	1	Idaho SL-Junction Ck	11
Junction Ck	1	Raft R.-S Fk Junction Ck	7
S Junction Ck	1	Junction Ck-Headwaters	14
Goose Ck	1	Idaho SL-Nevada	9
Basin CK	1	S Junction Ck-Headwaters	13
		Total	257

[1]Sections on the Raft River, Junction, South Fork Junction, Goose, and Basin Creeks were 0.2 km in length, others were 1 km.

APPENDIX F. STEPWISE RATING METHODS

Step 1. Each attribute (Table 2) was rated for each stream length (Figure 3). For example, dominant vegetation width (m) greater than 15 was assigned a rating of good, 5-15 equaled fair, and less than 5 equaled poor.

Step 2. Each sub-category (prey abundance, foraging conditions, escape cover, denning cover, establishment, and mortality) was rated for each stream length (Appendix G). For example, if prey abundance was rated poor and foraging conditions fair, then the sub-category prey availability was rated poor.

Step 3. Each category (food, cover, and reintroduction) was rated for each stream length (Appendix G). For example, if the sub-category escape cover rated good, and sub-category denning cover rated fair, then a rating of good was assigned to the category cover.

Step 4. Each stream section was given a rating for each category (food, cover, and reintroduction). Ratings were based on the median value of category ratings for each trio of stream lengths from Step 3. For example, if the category ratings from Step 3 were good, fair, fair, then the stream section was rated fair.

Step 5. Each overall value (included all 3 categories) was rated for each section (Appendix G). For example, if food was rated poor, cover good, and reintroduction good, then an overall value of fair was assigned to this stream section (section is equivalent to reach).

Step 6. Overall values were assigned for each stratum or stream. Ratings were based on the median value (from Step 5) of the overall ratings of all reaches in that stratum or stream. For example, if 5 reaches had overall values from Step 5 of good, poor, good, poor, and poor, the median value was poor. If a tie for the median value occurred, it was arbitrarily given a rating of fair.

APPENDIX G. SUB-CATEGORY, CATEGORY, AND OVERALL RATINGS[1].

Attribute		Sub-category
Fish Biomass or Fish Abundance	Crayfish Abundance	Prey Abundance
G	G	G
G	F	G
G	P	G
F	G	G
F	F	F
F	P	F
P	G	F
P	F	P
P	P	P

River Type	River Depth	River Width	Foraging Conditions
G	G	G	G
G	G	F	G
G	G	P	F
G	F	G	G
G	F	F	F
G	F	P	F
G	P	G	F
G	P	F	P
G	P	P	P
F	G	G	G
F	G	F	F
F	G	P	P
P	G	G	P
P	G	F	P
P	G	P	P
F	P	G	F
F	P	F	F
F	P	P	P
P	F	G	P
P	F	F	P
P	F	P	P
F	F	G	F
F	F	F	F
F	F	P	P
P	P	G	P
P	P	F	P
P	P	P	P

APPENDIX G. (CONTINUED).

Attribute			Sub-category
Vegetation	Veg. Width	Adjac. Veg.	Escape Cover
G	G	G	G
G	G	F	G
G	G	P	G
G	F	G	G
G	F	F	F
G	F	P	F
G	P	G	F
G	P	F	P
G	P	P	P
F	G	G	G
F	G	F	F
F	G	P	F
P	G	G	P
P	G	F	P
P	G	P	P
F	P	G	F
F	P	F	P
F	P	P	P
P	F	G	F
P	F	F	P
P	F	P	P
F	F	G	F
F	F	F	F
F	F	P	F
P	P	G	F
P	P	F	P
P	P	P	P

Struct.<5m	Struct.5-50m	Beavers	Denning Cover
G	G	G	G
G	G	F	G
G	F	G	G
G	F	F	G
G	P	G	G
G	P	F	G
F	G	G	G
F	G	F	G
P	G	G	G
P	G	F	G
F	P	G	G
F	P	F	F
P	F	G	G
P	F	F	G
F	F	G	F
F	F	F	G
P	P	G	G
P	P	F	P
P	P	P	P

APPENDIX G. (CONTINUED).

Attribute			Sub-category
Dispersal Area	Habitat Interspersion	Adjacent Otters	Establishment
G	G	G	G
G	G	F	G
G	F	G	G
G	F	F	G
G	P	G	G
G	P	F	F
F	G	G	G
F	G	F	G
P	G	G	G
P	G	F	F
P	G	P	F
F	P	G	F
F	P	F	F
P	F	G	F
P	F	F	P
F	F	G	F
F	F	F	F
P	P	G	P
P	P	F	P

Number of Beavers Trapped/County/Year	Road Type/ Proximity	Mortality
G	G	G
G	F	G
G	P	F
F	G	F
F	F	F
F	P	P
P	G	P
P	F	P
P	P	P

APPENDIX G. (CONTINUED).

Sub-Category		Category
Escape Cover	Denning Cover	Cover
G	G	G
G	F	G
G	P	P
F	G	G
F	F	F
F	P	P
P	G	P
P	F	P
P	P	P

Prey Abundance	Foraging Conditions	Food
G	G	G
G	F	G
G	P	F
F	G	F
F	F	F
F	P	P
P	G	P
P	F	P
P	P	P

Establishment	Mortality	Reintroduction
G	G	G
F	G	F
P	G	P
G	F	F
F	F	F
P	F	P
G	P	P
F	P	P
P	P	P

APPENDIX G. (CONTINUED).

Category			
Food	Cover	Reintroduction	Overall Evaluation
G	G	G	G
G	G	F	G
G	G	P	F
G	F	G	G
G	F	F	F
G	F	P	P
G	P	G	F
G	P	F	F
G	P	P	P
F	G	G	G
F	G	F	G
F	G	P	F
P	G	G	F
P	G	F	F
P	G	P	P
F	P	G	F
F	P	F	F
F	P	P	P
P	F	G	F
P	F	F	P
P	F	P	P
F	F	G	F
F	F	F	F
F	F	P	P
P	P	G	P
P	P	F	P
P	P	P	P

[1]G = good probability of successful otter reintroduction;
F = fair probability of successful otter reintroduction;
P = poor probability of successful otter reintroduction.

APPENDIX H. RIVER OTTER
SIGHTINGS INFORMATION

Source	Stream	County	Date[1]
UDWR Records	Weber	Summit	1987
	Weber	Summit	1986
	Weber	Morgan	1985
	East Canyon	Summit	1986
	Bear	Cache	1985
	Colorado	San Juan	1986
	Colorado	San Juan	1988
	Colorado	San Juan	1988
	Raft	Box Elder	1986
	Raft	Box Elder	1985
	Basin	Box Elder	1985
	Goose Creek	Box Elder	1986
	Goose Creek	Box Elder	1985
	Provo	Wasatch	1987
	Provo	Wasatch	1985
	Duchesne	Duchesne	1985
	Green	Daggett	1979
	Green	Daggett	1979
Trapper Questionnaires	Provo	Utah	4-87
	San Juan	San Juan	3-87
	Duschene	Duchesne	1-87
	Spanish Fork	Utah	11-86
	Weber	Weber	10-86
	San Juan	San Juan	Fall-86
	Garfield	Duschesne	9-86
	Logan	Cache	2-86
	Provo	Wasatch	1-86
	Bear	Rich	9-85
	Otter	Piute	8-84
	S Fk Junction	Box Elder	2-84
	San Juan	San Juan	8-80
	Utah Lake	Utah	3-80
	Bear Lake	Rich	1980
	Green	Daggett	7-78
	Logan	Cache	1973
	Raft	Box Elder	1969
	Pondtown	Carbon	1964
	Pondtown	Carbon	1964
	Strawberry	Wasatch	unknown
	Marsh Lake	Summit	unknown
Natural Resources Questionnaires	Green	San Juan	10-86
	Green	San Juan	10-86
	Provo	Wasatch	10-86
	East Mill	Salt Lake	9-86
	Colorado	Grand	5-86
	Colorado	Grand	Spring-86

[1]included through March, 1988.

APPENDIX I. RIVER OTTER SIGN SURVEY INFORMATION

Stream	Location	Survey Length (km) Winter	Summer[1]
S. Junction	Raft R. to Lynn Res.	16.1	14.7
Goose	Idaho to Nevada	9.0	7.2
Basin	S. Junction Ck to Tom Sherry Ck	6.1	3.5
Grouse	Lynn Road to first crossing (S.)	3.9	---
Raft	Lower narrows to S. Junction Ck	5.6	4.0
Raft	Idaho to lower narrows	4.0	3.4
Blacksmith	Millville to canyon mouth	6.6	---
Blacksmith	Anderson Ranch to Sheep Ck	1.1	---
Blacksmith	Anderson Ranch to Rock Ck	5.6	---
Blacksmith	Hyrum Park to Left Hand Fork	1.6	---
Logan	Mendon Rd to Valley View Hwy.	19.6	15.6
L. Bear	Paradise to Avon	5.5	---
L. Bear	"The Island"	7.9	---
E. L. Bear	Porcupine Res. to Cinnamon Ck	2.4	---
Spring	2000 W. Logan to Hwy. 89	1.3	---
Cub	Richmond to Lewiston (bridges)	9.0	4.0
Big Spring	Bear Lake up 0.8 km	0.8	---
Swan	Bear Lake up 0.8 km	0.8	---
Laketown	1.6 km above reservoir up 3.2 km	3.2	---
Genes	Woodruff to Woodruff Ck	1.9	---
Woodruff	Genes Ck to Woodruff Reservoir	15.8	10.8
Bear	Bear R. Station to Hayden's Pass	38.6	---
Bear	Rich County	76.4	59.8
Bear	Cutler Dam to Mendon Road	24.0	12.0
Bear	Cache County	58.5	46.5
Beaver	Democrat Alley to Weber River	4.2	3.2
Weber	Mountain Green to Petersen	7.6	5.6
Weber	Peterson to Milton	8.2	6.2
Weber	Morgan fairgrounds to Taggart's	8.4	6.4
Weber	Echo Res. to I-15, Hoytsville	8.0	6.0
Weber	Thousand Peaks to Hidden Lake	5.8	4.8
Weber	Brown's Canyon to Beaver Creek	4.7	3.7
E. Canyon	Morgan Road to White's Crossing	11.4	---
E. Canyon	E. Canyon Res. down 2.1 km	2.1	---
E. Canyon	Hwy. 65 to Mormon Flat	4.7	3.7
E. Canyon	Mormon Flat to "Kokanee Bridge"	4.3	3.3
Provo	Jordanelle bridge up 5.1 km	5.1	---
S. Provo	Willow Hollow to Mill Hollow	7.4	---
	Totals	407.2	224.4

[1]Summer sign survey additionally covered each stream section from Appendix D.

APPENDIX J. LOCATIONS OF ELECTROFISHING STATIONS

River	Stratum	County	Location
Raft	1	Box Elder	upper narrows
Goose	1	Box Elder	Bedke Ranch
S Fk Junction	1	Box Elder	S. of Oakley Rd Crossing
Weber	1	Weber	900 S., Ogden
Weber	2	Weber	Weber Canyon mouth
Weber	3	Morgan	near Enterprise
Weber	3	Morgan	confl. Stoddard Slough
Weber	3	Morgan	near Mountain Green
Weber	4	Summit	near Hoytsville
Weber	4	Summit	Bowl Ranch near Peoa
Gertson	1	Weber	100 m above diversion
Mid Fk Ogden	1	Weber	lower
Mid Fk Ogden	1	Weber	upper
Ogden	1	Weber	below Ogden Canyon mouth
Ogden	1	Weber	Ogden Canyon
Logan	1	Cache	W. end of 200 S., Logan
Logan	1	Cache	300 S. 500 E., Logan
Logan	2	Cache	below first dam
Logan	2	Cache	below second dam
Logan	2	Cache	Gus Lind Flat
Logan	2	Cache	Chokecherry Campground
Logan	2	Cache	Woods Camp
Blacksmith Fk	1	Cache	E. of Zollinger's
Blacksmith Fk	1	Cache	2600 S. near Hyrum
Blacksmith Fk	2	Cache	mouth of canyon
Blacksmith Fk	2	Cache	Pioneer Campground
Blacksmith Fk	2	Cache	below Hyrum City Park
Blacksmith Fk	2	Cache	above second dam
Blacksmith Fk	2	Cache	Anderson Ranch

APPENDIX K. ESTIMATES OF FISH STANDING CROPS

Stream-Stratum	n	Average Available Fish[1] (kg/km) Game	Nongame	Total
Raft-1	1	14.64	79.51	94.15
Goose-1	1	0.00	14.90	14.90
S Junction-1	1	0.29	6.48	6.77
Weber-1	1	0.31	586.68	586.99
Weber-2	1	46.84	10.29	57.13
Weber-3	3	190.27	233.58	423.85
Weber-4	2	366.60	461.46	828.06
Gertson-1	1	10.53	0.00	10.53
Mid Fk Ogden-1	2	17.10	0.39	17.49
Ogden-1	2	130.33	36.21	176.54
Logan-1	2	149.19	368.57	517.76
Logan-2	5	103.33	6.07	109.40
Blacksmith-1	2	109.51	23.59	133.10
Blacksmith-2	5	176.53	9.69	186.22

[1]Available game fish = standing crop biomass X 0.66; available nongame fish = standing crop biomass X 1.00.

APPENDIX L. RATINGS OF STREAM STRATA[1]

Stream-Stratum	Ratings			
	Food	Cover	Reintroduction	Overall
Weber-1	G	G	F	G
Weber-2	F	P	P	P
Weber-3	G	G	P	F
Weber-4	G	P	P	P
Weber-5	F	G	P	F
East Canyon-1	G	P	P	F
East Canyon-2	G	G	P	F
Ogden-1	F	P	P	P
S Fk Ogden-1	G	G	P	P
Chalk-1	P	P	P	P
Lost-1	P	P	P	P
Beaver-1	F	P	P	P
Bear-1	G	P	F	F
Bear-2	G	P	F	F
Bear-3	G	F	P	F
Bear-4	G	G	F	G
Bear-5	P	G	P	P
Little Bear-1	F	P	P	P
Little Bear-2	F	P	P	P
Blacksmith Fk-1	G	P	P	P
Blacksmith Fk-2	G	G	P	F
Logan-1	G	G	P	F
Logan-2	F	P	P	P
Woodruff-1	G	G	P	F
Cub-1	F	P	F	F
Malad-1	F	P	F	F
Big Spring-1	F	F	P	F
Spring-1	F	P	P	P
Swan-1	P	G	P	P
Goose-1	F	P	F	F
Junction-1	P	P	G	P
S Fk Junction-1	F	P	F	F
Raft-1	F	P	F	F
Basin-1	F	P	F	F

[1]G = good probability of successful otter reintroduction;
F = fair probability of successful otter reintroduction;
P = poor probability of successful otter reintroduction.

APPENDIX M. CONDITIONS DURING SIGN SURVEYS

Condition Rating[1]	Distance Surveyed (km)		Percentage of Total Surveyed	
	Winter	Summer	Winter	Summer
Excellent	103.2	14.0	25.3	3.2
Good	247.3	107.1	60.7	24.5
Fair	43.5	257.1	10.6	58.8
Poor	14.2	59.0	3.4	13.5
Totals	407.2	437.2	100.0	100.0

[1]Excellent = mammal sign obvious, new snow 1-3 days previous or predominance of mud substrate; good = mammal sign easy to find, old snow or mud substrate on greater than one-half of streambank; fair = mammal sign difficult to find, no snow or little mud substrate; poor = mammal sign nearly impossible to find, no snow and predominance of rock or gravel substrate.