GUIDELINES
for the
REINTRODUCTION OF BEAVER
into
SOUTHWEST MONTANA STREAMS

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SUMMARY

Beaver are considered a "keystone" species which can visit major effects on the landscape. They play a pivotal role in healthy riparian areas. For this and other reasons land managers often wish to plant beaver into streams.

Herein is a compilation of literature to establish guidelines and methods for successful reintroduction of beaver into southwest Montana streams. Numerous publications have addressed various aspects of beaver reintroductions, but none have addressed all in one place. That is the main purpose of this effort. Also, the history and ecology of beaver is discussed.

Factors important to and methods for evaluating beaver habitat are given. The best beaver habitat has a stream gradient of ≤6%; a valley width ≥150 feet; willow or aspen for winter food; materials suitable for dam and lodge construction; and is found on glacial till, granite or shist bedrocks.

At least 4 adult beaver, 2 of each sex, should be released at each transplant site. Sex of live beaver can be determined by palpating for the presence of testes and/or penis or baculum. Beaver which meet or exceed any of the following criteria are adult: weight ≥ 43.0 lbs.; length ≥42.0 inches overall; tail length and width ≥ 11.5 and 6.5 inches respectively; and zygomatic width of ≥3.7 inches. Animals that meet 2 or more of lower criteria for these measurements are probably adult. While working toward obtaining the proper number, sex and ages of beaver for transplanting, captive animals can be held for at least 10 days. Captive beaver must have water in which they can partially submerge themselves, shade, and food.

A common failure of transplants is that beaver move from release sites. A high success has been found when a site in suitable habitat is prepared beforehand. Preparation includes construction of a lodge and building a dam. It is best to transplant beaver in late summer or fall when they are naturally disposed to building and gathering winter food stores.

When transplanting beaver the manager must consider the social and political aspects. Beavers can be a serious problem in irrigation ditches and culverts and may be unwelcome on private lands. However, some private landowners are beginning to recognize the many beaver-related benefits to soil and water. This may open more doors to beaver management.

Beaver have been used to restore degraded riparian systems. It is possible to establish beaver in some areas with little or no food or construction materials by providing these to introduced animals until willow and/or other plants become established and vigorous.

TABLE OF CONTENTS

TABLE OF CONTENTS -- Continued.

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

The importance of riparian areas to local water regimes, vegetation, and wildlife habitats has been repeatedly shown (Retzer et al. 1956, Hill 1982, Apple 1985, Readeke et al. 1988, Medlin and Clary 1990, Hansen et al. 1991, others). Although the most productive and biologically diverse habitats in the west, they typically occupy less than one percent of the landscape (Hansen et al. 1989). Therefore the importance of and increasing focus on riparian areas is grossly disproportionate to their occurrence (Hansen et al. 1989).

Beaver (*Castor canadensis*) are an important member of the riparian fauna (Boddicker No Date, Apple et al. 1984, Naimen et al. 1988). Because of the major effects they can visit upon the landscape and the consequent affects on other species, they are termed a "keystone" species. Keystone species are, "a pivotal species upon which a large part of the community depends" (USDA Forest Service 1993:198). Speaking of biological communities, E.O. Wilson (1992:164) writes, "...there are little players and big players, and the biggest players of all are the keystone species." Other examples of keystone species in the pre-European west were Bison (*Bison bison*) and prairie dogs (*Cynomys ludovicianus*) (Knowles 1992).

Retzer et al. (1956), Munther (1981), Hill (1982), Naimen et al. (1988), Boddicker (No Date), and others give impressively long lists of the benefits of beaver to riparian habitats. These include but are not limited to the retention of sediment and organic matter, elevation of the water table, storage of water, creation and maintenance of wetlands which are rich in plant and animal species abundance and diversity, and enhancement of nutrient cycling. Scheffer (1941:320) noted that, "...to manage the beaver as a producer of fur is less important than to use it as a soil and water engineer." The important contribution beavers make to healthy riparian areas is not lost on most managers, and there are many unoccupied areas where it is desirous to introduce beaver.

The compilation of these guidelines resulted from management direction for the Elkhorn Mountains. South of Helena, Montana, they are managed cooperatively by the U.S. Forest Service, the Bureau of Land Management, and the Montana Department of Fish, Wildlife and Parks as the Elkhorns Cooperative Management Area (ECMA). Forest Service lands have been designated as a Wildlife

Management Unit (WMU), the only such designation in the National Forest System. Sustainable ecosystems are strong emphases in the ECMA; wildlife and recreation are also emphasized in the WMU.

The Elkhorn Landscape Analysis was undertaken to more fully understand the ecosystem, how it has been perturbed since the coming of European man, and how best to manage in the interests of sustainable ecosystems. The documentation of that analysis states (USDA Forest Service 1993:76) that it is desired to, "Sustain biodiversity: restore 'lost' habitats and attributes" and gives direction to "evaluate augmentation of prairie dogs and beaver". Therein lies the seed for the development of these beaver reintroduction guidelines.

Numerous studies discuss evaluating beaver habitat, ways to sex and age beaver, and methods to reintroduce beaver. However, none offer all of these in one place. There are two major portions to these guidelines. After a brief treatment of the history and ecology of beaver, there is 1) a section on evaluating beaver habitat and, 2) a section on other important aspects of transplanting beaver such as the sexes, ages, and numbers of beaver; when to transplant and; preparing the release site. Following these there is some discussion of the human dimension and how beaver can be used to restore degraded riparian areas.

HISTORY

Within the recent historic past beaver were much more abundant than today (Hill 1982, Naiman et al. 1988). During pre-settlement times they were found in nearly all aquatic habitats (Hill 1982, Naimen et al. 1988). Lewis and Clark frequently commented on the fantastic abundance of beaver noting that most side channels of the Missouri River were a maze of dams and ponds (Thwaites 1904).

The dawn of the fur trade heralded a dark era for beaver. In the intermountain west this colorful period began around 1800 and by 1850 was all but over. Although one of the most romantic periods in American history, its basis in the wanton exploitation of furs brought near or total extinction of beaver over much of its range (Naimen et al. 1988).

The changing whims of European fashion undermined the demand for beaver. Yet concomitant with the fall of fur demand was the settlement of the west. Indiscriminate resource abuse in the forms of mining, livestock overgrazing, and logging altered habitats so that beaver had little opportunity to recover. Moreover, human uses have usurped much of what had been the best beaver habitat in fertile, low gradient, broad valleys.

More recently the picture has brightened. Regulations governing the taking of beaver and more sensitive land management have made many previously unoccupied areas habitable by beaver. Indeed, beaver have increased in some areas to where they are unwelcomed by landowners and water users. Yet, even having increased many fold during this century, Naimen et al. (1988:753) point out that, "...for most of North America, the present population represents only a small fraction of earlier numbers." Consequently, there remain unoccupied areas of suitable beaver habitat.

A BRIEF DISCUSSION OF BEAVER ECOLOGY

The most obvious and critical factor in the ecology of beaver is water. Beaver are water obligates and nowhere exist without it. Nearly all freshwater habitats from lakes to rivers and streams are suitable so long as the water is not fetid, levels do not fluctuate grossly, it does not "freeze out", and there is adequate winter food (Retzer et al. 1956, Slough and Sadleir 1977, Hill 1982). Dams are built to stabilize water levels (Slough and Sadleir 1977). Wilsson (1971) showed that dam building behavior in beaver is stimulated by the sound of running water. Suitable dam building materials are essential. Commonly, beaver build dams using cuttings of trees although nearly anything will serve including sagebrush, rabbitbrush, corn stalks, barbed wire, rocks, and beer cans (Boddicker No Date, Apple et al. 1984).

In northern latitudes beaver food habits vary through the year. When woody species are utilized as food, it is the cambium layer that is sought. Beaver typically eat the bark of woody species in a "corn on the cob" fashion. Bradt (1938, cited in Slough and Sadleir 1977) listed favorite beaver foods in order of preference as: 1) aspen (*Populus tremuloides*), 2) willow (*Salix* spp.), 3) cottonwood (*P. balsamifera trichocarpa*) and, 4) alder (*Alnus* spp.). However, Retzer et al. (1956) noted that beaver used alder and bog birch very little on their Colorado study areas. In preparation for winter these foods are stored in submerged caches. During summer beaver may shift largely to feeding on herbaceous species including sedges, forbs, reeds, a number of aquatic plants (the root stalks of water lily are favored), corn, and alfalfa (Boddicker No Date, Retzer et al. 1956).

Beaver are gregarious and live in colonies. The colony is familial and typically consists of an adult mated pair, two to four young of the year, two or three yearlings, and perhaps one or more 2.5 year old (Hill 1982). Beaver are monogamous and produce 1 litter/year (Hill 1982). In Montana, breeding usually occurs between January and March (Hill 1982). Gestation is 98-110 days (Hill 1982). Beaver of both sexes disperse from the natal colony when they reach 2 years old (Hill 1982, Harris

1991). Dispersal occurs in the spring and summer. Bradt (1938) opines that dispersal occurs in the early spring before the new kits are born. However, Yeager and Rutherford (1957) state that dispersal occurs in late spring and summer. Most activity in beaver is crepuscular or nocturnal, little activity occurs during the day (Hill 1982).

Dens are either constructed lodges or excavated in the banks of watercourses and lakes. Entrances are typically and preferably submerged which points to the importance of stable water levels.

Major predators of beaver include the wolf (*Canis lupis*) and Coyote (*C. latrans*) (Jenkins and Buxher 1979). Mech (1970) and Paridiso and Nowak (1982) noted that beaver can be a major food item for wolves.

EVALUATING STREAM HABITAT FOR BEAVER

A number of studies propose models for evaluating stream suitability for beaver (Retzer et al. 1956, Yeager and Rutherford 1957, Slough and Sadleir 1977, Howard and Larson 1985, Dieter and McCabe 1989, others). Although sometimes looking at different variables, each analyzed the basic beaver habitat components of suitable water, food, and building materials. The following compiles from the literature habitat variables known to be important wherever beaver are found plus other habitat considerations specific to southwest Montana streams.

The character of a stream changes as it winds its way from its headwaters to its mouth. Therefore it is not practical to evaluate an entire stream for beaver habitat, but rather certain sections of it. Yet by virtue of the inherent difficulty in classifying natural systems, the definition of a stream section remains subjective. Retzer et al. (1956:6) offered that, "A section was fairly uniform through-out in its physical makeup." Slough and Sadleir (1977:1332) explained, "The classification units are individual lakes, and stream sections of uniform gradient and width including land within 30 m of the shoreline." To be considered in determining stream sections are stream gradient, valley width, bedrock and soils, vegetative bank cover, and the presence of building materials. The literature does not suggest a minimum length for a stream section. MacDonald (1957) showed that in high quality habitat a beaver colony may be able to meet their construction and food needs within an 80 yard radius of a pond. In poorer habitats or narrower valley bottoms a stream section would of necessity be longer than that which would harbor a beaver pond.

The following discusses 12 variables helpful in determining if a section of stream is capable of supporting beaver. These include both physical attributes of the stream section (gradient, stream

width, etc.) and streamside vegetation. Social and political aspects of introducing beaver are discussed separately.

Previous Beaver Occupancy

Signs of previous beaver occupancy are often good indicators of suitable habitat. Howard and Larson (1985) found beaver occupying the best habitats for at least 28 years. Marginal habitats were periodically occupied and often revisited. It was their observation that marginal habitats were selected by naturally dispersing beaver only after prime habitats were filled. Commonly, on such sites beaver would remain for 1 or 2 years and then abandon them when local food sources became depleted. Following recovery of food plants beaver may reoccupy them. Cyclical beaver occupancy may still prove beneficial to the landscape. For this reason, "marginal" habitats should not be rejected out of hand.

Different than the cyclical occupation of marginal sites, Howard and Larson (1985) noted several instances of suitable long-term sites unused for 1 or 2 years and then reoccupied. Although offering no explanation for the phenomenon, they thought that variables critical to site longevity may also be critical to site selection by beaver.

In the eventuality of consideration for beaver re-introduction, the reason for the local extinction should be identified and corrected if necessary and possible.

Indications of previous beaver occupancy include the presence of part or all of old dams and lodges, beaver cuttings, collapsed bank dens leaving noticeable depression furrows on the bank, and old beaver runways. Jonas (1955) describes and provides photographs useful in determining beaver occupancy. In areas where beaver have not been present for many decades, remains of dams and/or lodges may be completely grown over and appear as humps or small, low ridges. Usually, even where no water currently runs, the tell-tale location of these artifacts in drainage or valley bottoms may indicate previous beaver occupancy.

Water

Water is the prerequisite of beaver habitat (Bodickker No Date, Slough and Sadleir 1977, Hill 1982). Jonas (1955:170) points out that, "If the amount of water available for beaver at any time of the year diminishes below a certain point, it would be impossible for them to carry on normal activities." Boddicker (no date) points out that drainages with fluctuating water flows are less attractive to beaver but that once established their activities

can buffer fluctuations. Although beaver can apparently survive water-short periods through physiological and habit adaptions (Bodickker No Date), it seems universally agreed that a relatively stable water level is important to beaver (Retzer et al. 1956, Slough and Sadleir 1977, Hill 1982, others).

Some streams are ephemeral and a site visitation at the wrong time of year may lead one to an erroneous conclusion. Moreover, in areas where water is diverted for irrigation, streams can be severely dewatered. Although Howard and Larson (1985) imply that beaver prefer larger streams, Hill (1982:262) points out that beaver will make use of, ...small seepages that have adequate flow for damming." Harris and Aldous (1946:350) state that, "The water supply must at least equal that which will flow freely through a one-inch pipe." In view of this it is possible to employ beaver in the creation of productive riparian areas along streams which have seasonally low flows.

Water depth in ponds is important to beaver. <u>After damming</u> it must be sufficient to accommodate lodges or bank dens and allow for movement to food caches during winter (Slough and Sadleir 1977). Dieter and McCabe (1989) found water depth significantly greater at den sites than at random sites. Deeper water provides places for winter food caches. Yeager and Rutherford (1957:287) found that, "Wintering groups appear to take advantage of the deepest water, generally characteristic of the 'mother' pond...". Moreover, increased water depth lessens the chance that the pond will freeze solid in winter (Retzer et al. 1956, Yeager and Rutherford 1957, Hill 1982).

<u>Stream Gradient</u>

Stream gradient is one of the most important habitat considerations for beaver and is addressed in virtually all discussions of their ecology. Beaver favor streams with low gradient (Retzer et al. 1956, Hill 1982, Howard and Larson 1985), the lower the better. Retzer et al. (1956) found that 70% of stream sections occupied by beaver were below 6% gradient but that gradients up to 12% were used Few beaver occupied streams with gradients steeper than 12% (percent gradient means how many units of vertical drop per 100 horizontal units. Example: a drop of 6 feet in 100 feet of stream length would be a 6% gradient). In contrast to these studies, Bodickker (No Date) felt that slope itself was not a limiting factor to beaver occupancy. He observed beaver occupying sites of approximately 30% slope and felt the reason other similar sites remained unoccupied was because of a lack of suitable vegetation for dam building and food. However, beaver dams on such steep gradients are highly susceptible to breaching in the face of high runoff.

Valley Width

Valley width refers to the width of the floodplain. Hall (1960, cited in Slough and Sadleir 1977) found 90% of all beaver cuttings within 30 m of the water although Bradt (1938 cited in Slough and Sadleir 1977) reported cutting distances up to 200 m. Estimating that many small mountain streams are ≤5 m in width and allowing 30 m from each bank would mean beavers can efficiently exploit valleys at least 65 m, or about 210 feet, wide. This agrees with Retzer et al. (1956) who found 67% of occupied stream sections had valley widths >150 feet. Hill (1982) noted that beaver prefer relatively flat terrain of fertile valleys that produce their preferred winter foods. Perhaps an important consideration of a wide floodplain is that an elevated water table due to beaver dams may encourage woody riparian species to grow providing beaver with more food and building material.

Although wide valleys are preferred, beaver commonly inhabit valleys narrower than 150 feet. Chi square analysis of Retzer et al.'s (1956) data show beaver occupied stream sections with ≤60 ft. valley width less than their availability (χ^2 5 DF=23.67, P=.0003) while stream sections with >60 ft. valley widths were or had been occupied in nearly exact proportion to their availability (χ^2 3 DF=.06741, P=.9954). Therefore, a valley width of at least 60 ft. is warranted.

Stream Width

In Massachusetts, Howard and Larson (1985) found that the best beaver habitat was on wide streams. Based on the reported mean and standard deviation in their work, the larger streams they studied would have been just over 5½ m wide. Retzer et al. (1956) also report having measured stream width but apparently it did not figure prominently in their analysis because it is not mentioned further. River width was not a significant factor at den sites in Dieter and McCabe's (1989) North Dakota study. Harris (1991) did not find stream width to be significant in the selection of settlement sites by dispersing beaver. Because most streams in southwest Montana mountains are relatively narrow, because only the Massachusetts study thought it important, and because beaver will use nearly any dammable water, stream width is not thought to be a major consideration in the selection of sites for introduction of beaver in mountain habitats.

Foods

In Montana, winter foods are often the limiting factor for beaver. Winter foods are woody species, most commonly aspen and willow, that can be stored for later consumption. Jonas (1955), Retzer et al. (1956), and Slough and Sadleir (1977), each list

various foods eaten by beaver. Beaver strongly prefer aspen and willow with cottonwood and alder next. Retzer et al. (1956) observed that aspens grow best on south-facing slopes with abundant light. They suggested that compass orientation of valleys may be an important consideration if aspen propagation were desired. Jonas (1956:169) thought that, "Willows and poplars are probably the only plants upon which beaver will establish a colony limited only to those particular species of food." He further observed that the species of willow was of little import; beaver were thought to feed on all species in Yellowstone National Park. Other winter foods eaten by beaver include birch, chokecherry, wokas, lodgepole pine, Douglas fir, Engelmann spruce, and shrubby cinquefoil.

Yeager and Rutherford (1957) summarized the food requirements of beaver. They noted that Bailey (1927) and Bradt (1947) found captive animals survived well on one one-inch aspen per day. Also, Warren (1940) noted that on an aspen-only diet a single beaver required about a ton of trees annually. MacDonald (1946) noted each beaver felled the equivalent of 158 two-inch aspen per year. Each such tree is termed a "food unit". MacDonald (1946) determined the acreage of aspen and willow stands of differing quality required to sustain a colony of 6 beaver for a year (Table 1). It should be borne in mind that these acreages are for aspen- and/or willow-only diets and that beaver eat other foods. Therefore sites with less than the acreages given in Table 1 may still be tenable by beaver.

Table 1. Carrying capacity by acreage and food types, North Park, Colorado expressed as acres per colony per year[1] (from MacDonald 1946).

	Good	Average	Poor
Food Type[2]	Tall, ave. 40'; closed stand	Med., ave. 30'; ½-closed stand	Low, ave. 20'; open stand
Aspen	4	6	8
Willow	12	18	25

[1] Subject to modification as more extensive data become available.
[2] In the absence of competition from livestock and big game.

In wide valley bottoms beaver may find enough food near their lodge, although aspen and willow further than 100 yards should not be considered available when evaluating food sources for potential colonies (Yeager and Rutherford 1957, Hall 1960). In narrow valleys where foods are restricted to belts along the stream, no restriction is placed on the length of stream along which a beaver will forage (Yeager and Rutherford 1957).

However, beaver prefer foods to be adjacent to or upstream of ponds created by their dams because moving branches against the current is difficult (Bodickker No Date).

During summer, herbaceous foods can make up a major portion of the beaver's diet (Jenkins and Busher 1979). Yeager and Rutherford (1957) state that herbaceous foods may make up one sixth of the annual beaver diet. Summer foods include not only those also eaten in winter, but a variety of roots and tubers as well. Water lily, potamogeton, sagittaria, and elodea are known favorites (Bradt 1938 cited in Munther 1981, Bodickker No Date). Howard and Larson (1985) speculated that such summer foods are more important than previously thought and that beaver may continue to feed on submerged roots and tubers through the winter.

Beaver have been known to cut winter food species faster than they can replace themselves, thus leading to the abandonment of the colony (Scheffer 1941). However, Patic and Webb (1953) noted that often the foods regenerate and after a few years the beaver may reoccupy the site. Managers should consider that such periodic occupation by beaver may still yield benefits to riparian areas.

Cover and Construction Materials

Often, species used for food are also important cover components and provide building material as well. Willow and aspen are the most important plant in this regard. Although cover is an important consideration in prospective beaver sites, Retzer et al. (1956) found that beaver had a tendency to avoid deeply wooded and shaded areas. In New York, Patric and Webb (1953) found beavers reluctant to pass through the fringes of conifers to obtain hardwoods that lay beyond. Hence, heavy conifer cover as found in thick spruce bottoms is not thought to be good beaver habitat.

Dams are built in streams to regulate and stabilize water levels. Materials used in dam construction are also used in building lodges. The presence of suitable dam and lodge building materials is probably an important cue for dispersing and/or transplanted beaver in selecting a site. The lack of suitable construction materials can be a regulating factor to beaver occupancy as shown by Apple et al. (1984) and Apple (1985). As with food, beaver use construction materials found adjacent to or upstream of the pond (Bodickker No Date).

Harris (1991) found that sites chosen by dispersing beaver for settlement had significantly higher values for overstory tree cover, shrub cover, and willow cover than did random sites. Dieter and McCabe (1989) noted significantly higher values for

percent overstory among four understory measurements at den sites. Scheffler (1941:321) thought that one reason for the failure of colonies to settle upon liberation was, "Lack of shelter; open meadow without concealing shrubbery." Boddicker (No Date:3) felt the reason many sites were not occupied was because of, "... a lack of vegetation to eat and/or utilize in dam building."

Bedrock and Stream Substrate

Bedrock and stream substrates are important considerations because they bear directly on the stability of beaver dams. Stream channels, and consequently dams, are most stable in glacial till, schist, and granite rock types; moderately stable in rhyolite; and unstable in shale (Retzer et al. 1956, Yeager and Rutherford 1957). In Massachusetts, Howard and Larson (1985) showed that beaver preferred poorly drained soils. Harris (1991) found that dispersing beaver settled in sites with rocky substrate but that these were not different than random sites.

Elevation

Elevation is considered because it has been suggested that short growing seasons and heavy snowfall at higher elevations may be detrimental to beaver. Scheffer (1941:322) thought that, "Elevation too great in regions of heavy snowfall" was a major reason for the failure of beaver transplants and suggested 6,000 feet a maximum elevation in eastern Oregon. Yeager and Rutherford (1957) noted low winter temperatures and slow growth of foods are influences of high elevation. Hill (1982) citing Rutherford (1955) suggested that food intake may be restricted at higher elevations due to ice which may in turn affect the reproductive performance of adult beaver. However, Hill (1982) noted beaver 300 m [975 ft] above timber line in Alaska. He also observed (p. 262) beaver, "...thrive in small irregular pockets, heads, and drainage depressions at and above 3000 m [9,750 ft] where aspen is available." Yeager and Hill (1954:465) noted, "...good evidence of 60 animals per stream mile along Chavez Creek...at an elevation of about 10,000 feet." Elevations of 61 streams studied by Retzer et al. (1956:6) were, "...generally above 8,000 feet in elevation...". They further noted (p. 8), "Beavers are not limited by altitude" and found them in willow fields above 11,000 feet. They thought that beavers did not occupy some such sites that appeared favorable because the ponds may freeze solid in winter. In view of the number of successful colonies at high elevation, provided that other habitat considerations are met, altitude is not considered detrimental to a successful beaver colony.

Cattle Grazing

Munther (1981:237) noted that, " Both cattle and beaver find wide, gentle gradient, depositional steams in depositional lands a preferred habitat." Intense cattle grazing can have negative effects on riparian health and hence its suitability for beaver, principally through removal of overstory cover and food shrubs (Yeager and Hill 1954, Yeager and Rutherford 1957, Dieter and McCabe 1989). Kovalchick and Elmore (1991:23) noted that, "Improper cattle grazing has severely effected the stability of riparian zones, especially those once dominated by willows."

Degraded riparian areas may be restored by employing beaver (see below). However, this may call for the exclusion of livestock and/or planting of willows (Scheffer 1941, Munther 1981, Apple et al. 1984, Apple 1985).

Den and Lodge Sites

Harris (1991) noted that logjams were often used as dens by dispersing subadult beaver. Although no other study reviewed mentioned the presence of such assumed temporary dens, these investigators may not have thought of it. The presence of logjams or similar structures may be an important factor in the selection of a settlement site by dispersing or released beaver. Harris and Aldous (1946) noted increased success to beaver transplants when beaver were provided with a constructed lodge.

Watershed Size

In Massachusetts, Howard and Larson 1985) found watershed size above the dam were positively related to colony site longevity. However, they cautioned that this applied to only relatively small watersheds (<750 ha or 1,853 acres). Retzer et al. (1956) speculated that stream sections with more than a mile of stream above them were less suitable because the concentration of floodwaters could breech dams. This was especially so in soils and rock types of low stability. It is advised that the manager consider watershed size above prospective release sites and the potential for floods catastrophic to beaver dams.

Summary of Habitat Evaluation

The suitability of a section of stream for the introduction of beaver is dependent on both abiotic physical attributes and vegetation for food, cover, and construction materials. A summarization of the most important parameters follows:

- Stream Gradient -- less than 12%, less than 6% best.

♦ **Valley Width** -- greater than 60 feet, greater than 150 feet best.

♦ **Food** -- particularly willow (at least 12 acres) or aspen (at least 4 acres) within 100 yards of the stream.

♦ **Construction Materials** -- Sufficient sturdy material for construction of dams and lodges.

♦ **Bedrock and Soils** -- Glacial till, granite, or shist but not shale.

HANDLING AND TRANSPLANTING BEAVER

The identification of suitable habitat is the first step in successful beaver reintroduction. Once suitable sites are located, beaver must be livetrapped and moved to it. However, many attempted reintroductions prove unsuccessful because beaver move away from reintroduction sites. There are a number of examples of transplanted beaver moving from 5 to over 20 miles from release sites (Denny 1952, Hodgdon and Hunt 1953, Hibbard 1958, Berghofer 1961, Knudsen and Hall 1965, Harris 1991).

Many transplants into suitable habitat have been unsuccessful because there was no knowledge of or little thought given to three important factors: 1) the age, sex, and number of introduced beavers, 2) release site preparation and, 3) time of year of release.

Whenever possible, beaver should be trapped from areas where they are not wanted. This serves both to help eliminate a problem and provide animals for transplanting. In areas where beaver are wanted or causing no harm, caution and discression must be excercised so that live-trapping for transplanting purposes does not eliminate beaver locally. In drainages where beaver densities are low, the trapping of breeding adults could have negative impacts.

Age, Sex, and Numbers of Beaver Used in Transplants

Rasmussen and West (1943:311) noted that planting unsexed animals is, "...neither economical nor desirable." Scheffer (1941:326) recommends, "A 'plant' consists ideally of a minimum of four beavers, two of each sex, not counting the kits." Very young beaver are unable to establish a colony and 2 year old animals are natural dispersers (Hill 1982, Harris 1991). Moreover, although some beaver are sexually mature at 2, most are not until 3 years old (Larson 1967, Hill 1982). Therefore, animals ≥3 years old are needed for successful colony establishment. Live

beavers can be aged with certainty by weight and various body measurements. Appendix A discusses how to age live beavers.

Beavers have no external genitalia so determination of sex must be done by palpation for the presence or absence of the penis or baculum and/or testes. Teats are evident on females only while they are nursing (Wilsson 1971). Appendix A discusses sex determination in beavers.

Many authors recommend a minimum of 4 adult beavers, 2 of each sex, be released at a transplant site (Scheffer 1941, Rasmussen and West 1943). It is often necessary that beavers be kept in captivity while other adult beavers of the appropriate sex are caught. Rasmussen and West (1943:312-313) discuss holding captive beaver for as long as 10 days as follows:

> Holding live beavers to obtain pairs and numbers for transplanting and transporting them should be done in specially designed holding pens and crates to insure success. Beavers held for transplanting should have access to water to enable them to partly submerge at all times as a necessity in performing certain body functions.
>
> Care must be taken in preventing the beavers from becoming chilled or overheated while being transported to new sites. Kits are particularly susceptible to extremes in temperatures and all ages are sensitive to excessive exposure to heat and sunlight.
>
> A temporary collapsible holding pen was constructed which measured 6 feet by 4 feet by 4 feet. The top was left open, or shaded with shrubbery when in use. All four sides were made of 20-gauge sheet metal, and were held together at the corners by means of iron rods pushed through a series of hasps and eyes. The bottom consisted of an angle iron frame covered with netting, and was made to fit in flanges formed by turning in the bottoms of the four sides. The bottom screen must be very heavy, comparable to material used in screening gravel. This pen was placed in a stream or pond in such a way that several inches of water was present along one side or in the corner while the remainder of the pen was dry. As many as 16 have been successfully held in such a pen. The dimensions of the pen and its collapsible nature were designed in order that it might be hauled dismantled in the bottom of a pick-up truck.

Live beavers may be safely handled for purposes of palpation and measurements either by use of a guide pole as described by Bodickker (No Date, see Appendix A) or the use of some kind of a bag. Whitelaw and Pengelley (1954) describe a specially made canvas bag for handling beaver in Hancock traps. On beaver over

30 pounds they also partially anaesthetized the animal. Caution should be exercised when handling live beaver because they can move quickly and may bite.

It may be desirable to mark beaver for individual recognition. This can help in determining if transplanted beaver stay at a release site or, if observed away from the site, where it came from. Miller (1964) discusses a system for marking beaver so that they can be identified in the field.

When to Transplant

Beaver should be moved in the late summer or early fall when they are disposed to repairing dams and lodges and building a winter food cache (Apple et al. 1984). In southwest Montana this period may last from July through September. Rassmussen and West (1943) successfully transplanted beaver in Colorado during these months. The importance of winter food stores to beaver survival was previously discussed. Wilsson (1971) suggest that beaver do not begin storing food until after lodge and dam building activities are finished. Beaver need about 10 to 12 weeks to complete building and food storage tasks (B. Giddings, Pers. Comm. July 1993). Wilsson (1971) noted cuttings for food storage during mid-winter thaws, and successful transplants of beaver in February. In light of this, transplants as late as through October may yet allow beaver time to accomplish building and food storing tasks. However, transplants no later than the end of September are preferable.

Release Site Preparation

As noted above, beaver are notorious for moving away from release sites. This can be minimized by moving more than one or two beaver as also noted above. Moreover, Harris and Aldous (1946) write of high success rates in establishing beaver by doing some site preparation prior to releasing beaver. They noted that among 259 beaver released at unprepared sites few established themselves while among 136 beaver released at 36 prepared sites beaver became established at all but 3 sites.

Suitable release sites are prepared for beaver by construction of a lodge and a small dam which backs up water to hide the entrance to the lodge. Lodge and/or den sites are known to be important habitat cues to dispersing beaver. Harris (1991) noted that dispersing beaver chose log jams as temporary lodges. The construction of a dam and the consequent sound of running water likely stimulates beaver into building behaviors (Wilsson 1971). Therefore, providing these two elements, a lodge and a dam, lead to the unprecedented success of Harris and Aldous (1946) in

establishing beaver. Appendix B describes the preparation of a release site as per Harris and Aldous (1946).

Trapping Beaver

Trapping beaver is an activity at which one becomes proficient with experience. If the manager is not an experienced beaver trapper it is recommended that the services of someone who is be retained. This is usually not difficult as there are generally trappers in any southwest Montana community. Also, the Montana Trappers Association may be contacted. Their members have been trapping and transplanting beaver for the Forest Service for several years.

Beaver can be live-trapped using snares (Bodickker No Date) or live traps. The Hancock Live Trap (Hancock Trap Co., Box 268, Custer, SD 57730; ph. 605-673-4128) is a wire clamshell affair which has been used with satisfaction by the Montana Department of Fish, Wildlife and Parks, the U.S. Forest Service and many others. Harris and Aldous (1946) recommended this trap and it was also used by Whitelaw and Pengelley (1954). In August of 1992 each trap cost $135.00.

SOCIAL AND POLITICAL CONSIDERATIONS

Although beaver are known to be beneficial to the landscape in many ways, they are often unwelcome guests in some areas. This is particularly true in urban and agricultural settings. Yeager and Rutherford (1957:278) noted that, "...accruals from beaver habitation tend to favor them in wildlife and sportsmen's circles, and discredit them among agriculturists and stockmen." Harris (1991) reports private landowners unhappy with colonization by beavers which moved away from transplant sites. Therefore, it behooves the manager to be aware of landowner concerns and keep them abreast of activities which may affect them. These issues are systematically addressed in the National Environmental Protection Act (NEPA) process (Munther 1984). When reintroducing beaver, it may be necessary to prepare an Environmental Assessment (EA). The individual manager will need to determine if an EA is necessary.

Some private landowners are becoming aware of the benefits of having beaver on their land. They are not only becoming more tolerant of beaver but encouraging their presence (Naiman et al. 1988). This may provide the manager with more opportunities for beaver management.

Until viable colonies have become established, trapping beaver should not be allowed in areas where they have been transplanted. Such changes in trapping regulations need to go through the

channels from local MDFWP biologist, to the regional game manager to the regional supervisor. There is perhaps the need for a written policy regarding season closures prior to moving beaver. It may be that a something like a 3 or 5 year closure is in order, or that trapping would be permitted at the discression of the local MDFWP biolcgist. This requires coordination with and the support of the Montana Department of Fish, Wildlife and Parks and the Montana Trappers Association.

SUMMARY OF BEAVER TRANSPLANTING

Successful transplanting of beaver requires that, a) habitat and environmental conditions be suitable, b) the site be prepared for beaver, c) proper numbers, sexes, and ages of beaver moved and, d) consideration be paid to social and political factors. Reference to some of these can be found in Retzer et al. (1955), Yeager and Rutherford (1957), and Munther (1984). Appendix C gives a checklist based on the current work for the manager to refer to in evaluating transplant sites and in moving beaver to them. It is important to remember that this checklist is only a guide and does not necessarily dictate criteria that must be met. It is recognized that there must be flexibility for the exercise of individual professional judgement, and that each proposed site is likely to have its own character.

USING BEAVER TO RESTORE DEGRADED RIPARIAN SYSTEMS

Some degraded riparian habitats may be restored by reintroducing beaver. Such streams may have suitable water, gradient and other factors for beaver, but lack winter food and construction materials. Apple et al. (1984) and Apple (1985) reported improvement in several severely gully-cut cold desert streams by introducing beaver and providing them with dam construction materials.

On their Wyoming study area they first excluded cattle to help with riparian recovery. Beaver were then brought in along with several pickup loads of 10-13 cm cut aspen. They suggested that the aspen be left on the bank. Beaver soon made use of the materials and built several stable dams. Perhaps the supplied aspen was also being used as food, but in one instance introduced beaver were supplied with wired together tires placed in the stream as a dam and a successful colony was established. Beaver were known to feed on herbaceous vegetation.

Recovering riparian systems showed willow growth averaging 1.6-2.0 m high after three years (Apple et al. 1984). Moreover, water levels were more stable throughout the year and sediment was being trapped. On Apple et al's. (1984) Wyoming study area,

the regrowth of willows allowed for the discontinuance of delivering construction materials after two years.

Bodickker (No Date) points out that in some areas beaver may have to be provided with food for winter caches during October an-d November until willow or other food sources have recovered.

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APPENDICIES

APPENDIX A

Determining the Sex and Age of Live Beaver

The sex and age of beavers is an important consideration in transplanting efforts. Scheffer (1941) recommends that a minimum of 4 beaver, two of each sex be used in transplants. He and other authors recommend that adult beaver be used. Herein are criteria from the literature on how to determine the sex and age of beaver.

Sex Determination

The sex of beaver can be accurately determined by palpation for the penis, *os penis* or baculum, and testes, and by looking for teats (Bodickker No Date, Rasmussen and West 1943, Larson and Taber 1980). The following cites directly from these sources.

Boddicker (No Date:3):

> Beaver, "...should be sexed to ensure a proper variety is moved. That can be done after the beaver is attached to the guide pole. One person handles the guide pole, another person can hold the tail, stretch the beaver out and pinch just forward of the cloaca. The penis and baculum are evident as a tough cord about 3/8" thick with a terminal short hard bone or baculum which is lacking on the females."

Bodickker recommended the use of snares in live capturing beaver. The guide pole was a sturdy 6 foot pole with a hook attached. The hook could be placed under the snare loop, the snare wire unwrapped from its anchor and wrapped around the guide pole to easily handle the beaver.

Rasmussen and West (1943:314):

> Couch (1937, p. 16) says "noting whether there are four mammae present or determining of the presence of the male organ by feeling are the surest means of sex identification." Bradt (1938, p. 142) says "the male beaver has a small os penis about 1 inch in length which may be felt by inserting the finger into the genital opening just ventral to the anus. After some practice I was able to determine the sex readily by this method except in the case of animals less than one year old. In the latter, the openings are so small that the insertion of the finger is not practical."

> The male organ in beavers contains a bone of the visceral skeleton known as the *os penis*. This is approximately an inch in length and 1/8 inch in diameter in the average sized male, and makes possible detecting the presence of the organ. The organ can be felt along the median dorsal line, immediately anterior to the external opening of the anal pouch, between the large castor glands. It is more difficult when the animal has swollen castor glands, or if the anal pouch contains amounts of body wastes. It works equally well with kits and with adults, although kits are much more difficult to sex than adults by the internal method.
>
> In the field the sexing was done by placing the beaver in a carrying case or sack where it was held with the head downward. The animal is grasped at the base of the tail with the left hand to prevent its moving and the fingers of the right hand were used to determine the presence or absence of the structure. If the animal was relaxed the organ was readily located. If the muscles were rigid it was more difficult, but with practice there was never any question. It is believed this method is perfectly reliable, can be readily learned, and easily applied.

Four mammae on female beaver are usually evident only if she is suckling young (Wilsson 1971).

Larson and Taber (1980:172):

> Live adult beaver may be sexed, but only with experience, by palpation, for the testes and penis, with its baculum. The presence or absence of testes may be determined as follows: Place the beaver in a normal standing position, with head covered. Place 1 hand so that it lies lateral to the pubic symphysis with the finger tips anterior to the pubis and resting on the soft abdomen. Press lightly and draw the hand posteriorly. If the animal is a male, the testis can be felt as it slips anteriorly under the finger tips. If no testis is felt, a check may be made by palpation for the os penis, or baculum. This is done by placing the thumb and forefinger immediately posterior to the pubic symphysis and passing them back toward the vent between the castor glands. Care must be taken not to misinterpret concretions in the castors. Another difficulty lies in the variability of the position of the penis. It may be at one side and in close proximity to the castors in old males: in young males it is always in a median position (Osborn 1955). Kennedy (1952) recommended palpation by an insertion of the index finger into the cloaca and urogenital orifice. The finger is passed anteriorly into the

vestibule or cavity that exists between the castor glands. About 2.5 cm from the external opening the finger, moved from side to side in the male, will contact the penis. This method was first described by Bradt (1938). Figure [1] illustrates the appearance and location of beaver genitalia."

The testes in beaver lay external to the pubis bone about 1-2 inches on either side of the ventral center line (Fig.2). It is suggested that those wishing to become proficient at sexing beaver dissect a specimen of each sex to become familiar with the internal sexual anatomy.

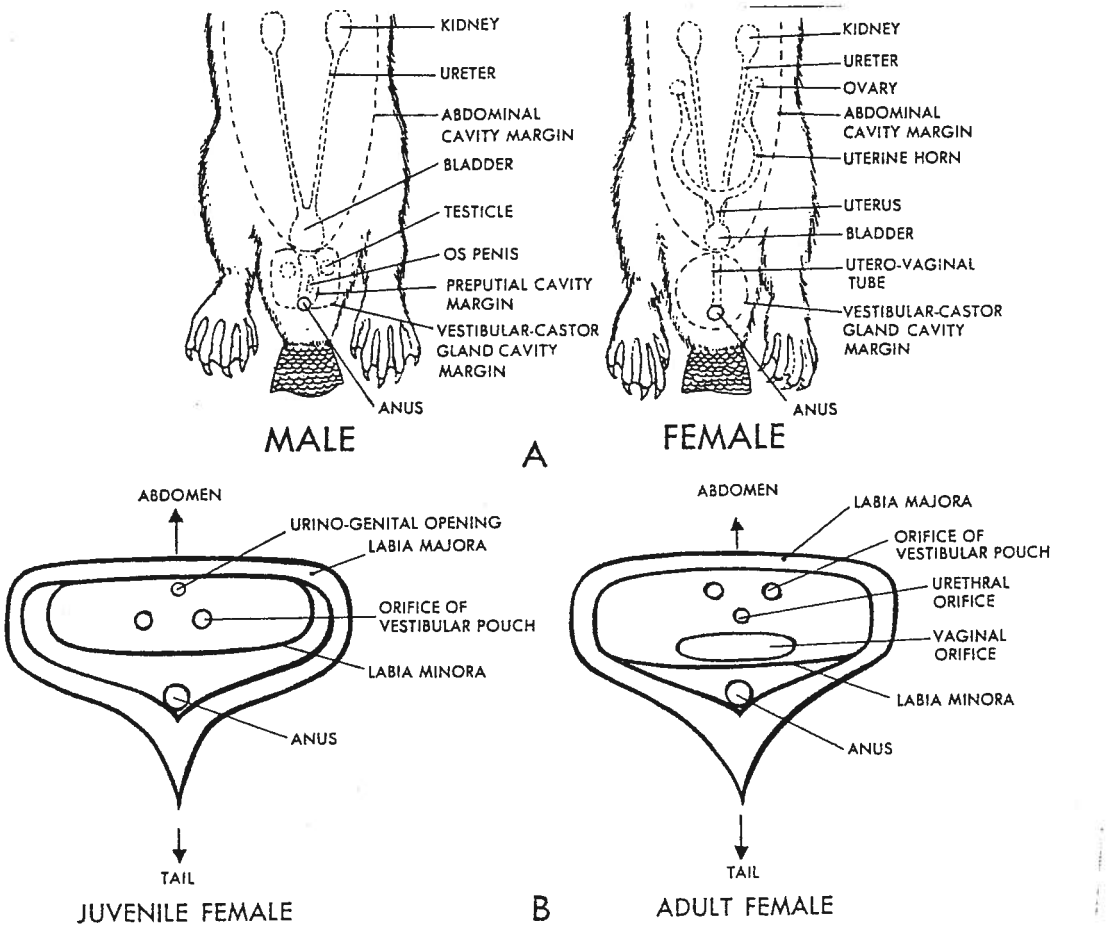

Fig. 1. Some age and sex characteristics of beaver. *A* Schematic representation of penis and testes in the vestibularcastor cavity of male *Left* and normal position of the uterus of the female *Right*. Dissection is required to identify these organs. *B* Diagrammatic representation of the anal-urogenital opening when stretched laterally as by the forefingers. This procedure can be performed on live or dead beaver (from Larson and Taber 1988, sketches by G.J. Knudson *in* Thompson 1958)).

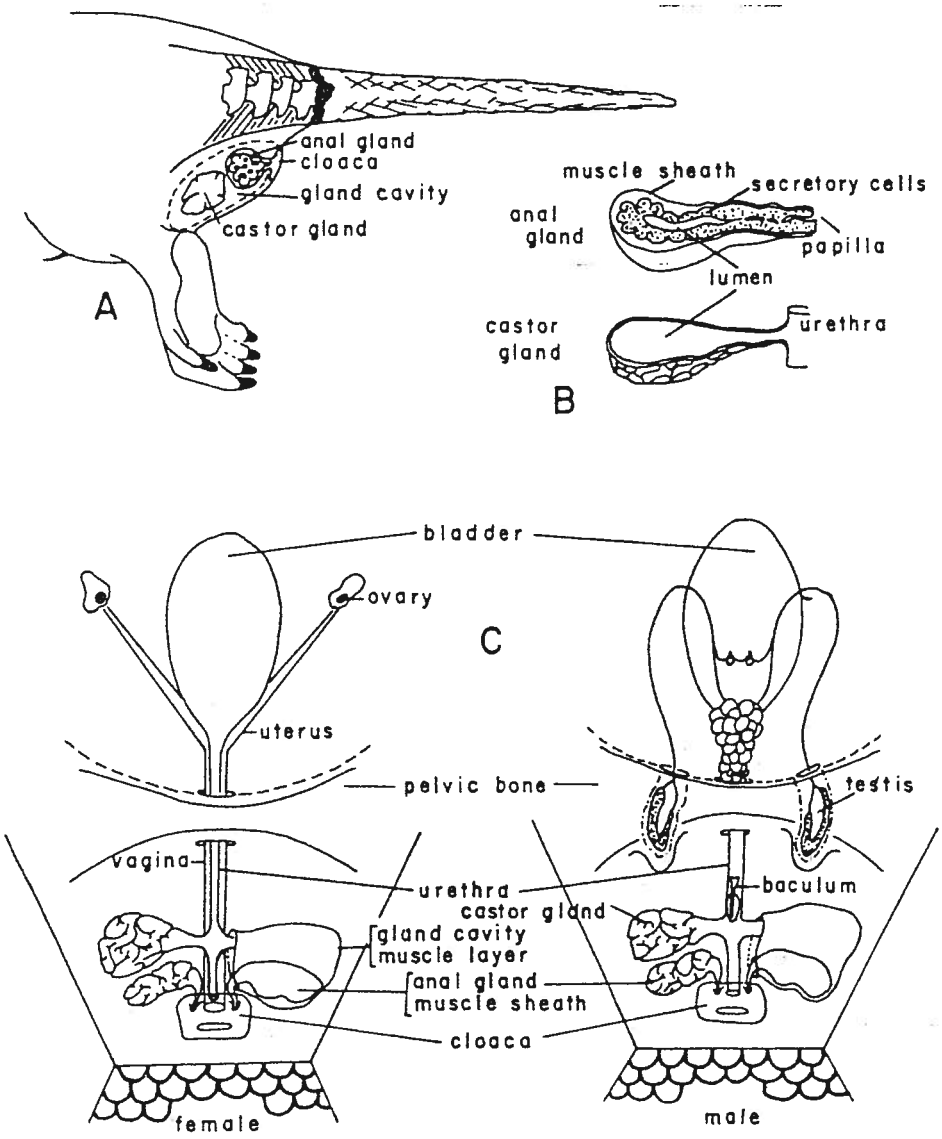

Fig. 2. The anal gland and castor gland of beaver: A, the position of glands in the subcutaneous cavity; B, longitudinal section of an anal and a castor gland: C, ventral view of anatomical relationships of the anal gland and castor gland to other structures, including sex organs, in the beaver (from Svendsen 1978).

Age Determination

Successful transplanting of beaver requires moving adult animals, i.e. beaver ≥3 years old. Most commonly there are 4 age classes of beaver (Osborn 1953):

Kit -- 0 to 1 year old
Yearling or Juvenile -- 1 to 2 years old
2 year old or Subadult -- 2 to 3 years old
Adult -- 3 years old and older.

Accurate aging of beaver requires sacrificing the animal. Dead beaver can be aged by inspection of the teeth and dental cementum annuli (van Nostrand and Stephenson 1964, Larson and van Nostrand 1968). Other, less accurate and now dated methods for aging involving skull measurements and appearance, stretched skin size, weights, and measurements of the baculum of males (Friley 1949, Osborn 1953, Cook and Maunton 1954, and Buckley and Libby 1955).

Currently there are no methods to positively age live beaver. However, beaver can be placed into one of the above 4 age classes with some certainty based on weight, total length, tail length, tail width, and zygomatic width (Patic and Webb 1960). However, regional and seasonal differences can be significant (Cook and Maunton 1954). Patic and Webb (1960) thought that the product of tail length and width could be used to effectively separate beaver into age classes, but the sizes they report for New York beaver are considerably smaller than reported by Osborn (1953) for Wyoming beaver. In light of the paucity of more regional-specific information, Osborn's (1953) data is assumed to be applicable to Montana beavers.

The following presents data from the literature on beaver measurements and some suggested criteria for determining adult beaver. When available, the manager should use regional-specific data.

Table 2 summarizes Osborn's (1953) data on Wyoming beaver. He divided his sample into two groups based on whether he had prepared and measured the skull or not. Measurements did not differ and have been combined here. Standard deviations of the combined groups were calculated using standard statistical procedures (Steel and Torrie 1976:245). Also, Osborn reported weights of skinned carcasses but provided average percentage of whole weight for each age class in each group. Weights in table 1 are calculated whole weights. The means are correct; ranges and standard deviations may be slightly in error but still useful. Skinned carcass weights ranged from 84.22 to 86.96 percent of the whole weight. This percentage agrees with the 85 percent reported by both Longly and Moyle (1963) for Minnesota beavers and Larson and Van Nostrand (1968) for beavers from Maryland.

Other authors have published data which may be useful in aging Montana beavers. Buckley and Libby (1955:499) thought that weights among 4 age classes of Alaska beavers were, "Kits, 10 to 21 pounds; yearlings, 22 to 31 pounds; two-year-olds, 32 to 40 pounds; and adults, 41 pounds and over." Patic and Webb (1960:39) found, "Numerous beavers weighing 35.0 to 49.0 pounds were known to be adults...". Table 3 summarizes age and weight information of Nostrand and Stephenson (1964). Beaver can weigh up to 85 pounds (Hill 1982) although that is unusual. Cook and Maunton (1954) report a New York beaver weighing 73.25 pounds. Two beaver from the Canyon Ferry Wildlife Management Area in Southwest Montana (Table 4) were correctly sexed using above methods and aged by body measurements. Ages were confirmed by inspection of the dental cementum (Larson and van Nostrand 1968).

Table 2. Selected measurements (sample size, mean, range, and standard deviation in inches and pounds) of Wyoming beaver (from Osborn 1953).

Age	Total Length	Tail Length	Tail Width	Weight*
Juvenile ≈1 yr old	n=56 33.1 27.5-37.7 2.25	n=56 8.9 7.1-10.2 .64	n=56 3.9 3.1-5.0 .45	n=55 18.5 10.3-29.2 3.08
Subadult ≈2 yrs old	n=63 39.1 36.6-41.9 1.27	n=63 10.3 9.2-11.3 .48	n=62 5.2 4.6-6.2 .37	n=62 31.1 23.0-42.8 3.7
Adult ≥3 yrs old	n=69 42.6 39.4-47.2 1.81	n=69 11.1 10.2-12.5 .55	n=69 5.9 5.0-7.9 .53	n=63 41.1 28.8-54.9 5.40

* Calculated from skinned weights, see text.

Table 3. Ages and weights (pounds) of beaver from Ontario and Wisconsin (from Nostrand and Stephenson 1964).

Age	1-2	2-3	3+
Sample Size	9	9	5
Mean	23.6	28.7	33.2
St. Dev.	5.37	3.43	4.48
Range	17.2-30.0	24.0-34.0	27.0-38.5

Table 4. Measurements (in inches and pounds) of 2 beaver from Canyon Ferry Wildlife Management Area, Montana in May 1993.

Age Sex	Total Length	Tail		Zygomatic Width		Weight
		Length	Width	Unskinned	Skull	
1/F	35.5	9.25	4.25	3.5	---	22.0
2/M	36.0	10.0	4.75	3.6	3.4	27.5

Table 5 gives measurements from the literature useful in determining if live Montana beaver are adult. Although zygomatic width is given, it is considered the least useful in the field because of small differences between age classes and its uncertain application to Rocky Mountain beaver. Weight, total length, and tail length and width are suggested as the most useful and perhaps easiest data to gather in the field. Tail length and width were shown to vary considerably in different areas and other than Patic and Webb (1960) there are no other data on unskinned zygomatic arch width. The "likely" class criteria in table 4 is one standard deviation less than the mean for adult beaver. About 15% of 2 year old beaver were at or above these values, while about 85% of adult beaver were at or above these measurements. It must be born in mind that one is more likely to catch a 2 year old beaver because of their higher occurrence in a population. It is suggested that a beaver meet at least 2 of the measurement criteria in the "likely" class (eg. weight ≥35 lbs. *and* total length ≥ 40") to be considered adult.

Table 5. Suggested measurements for determining adult beaver.

Likelihood of Adult Beaver	Weight[1]	Total Length[1]	Tail Length[1]	Tail Width[1]	Zygo-matic Width
Certain	≥43.0#	≥42.0"	≥11.5"	≥6.5"	3.7"
Likely[2]	≥35.0#	≥40.0"	≥10.5"	≥5.5"	3.6"

[1] Suggested as most useful criteria, see text.
[2] At least two of the criteria should be met in order to consider an animal an adult.

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APPENDIX B

Notes on the Preparation of Artificial Dam and Lodges for Beaver from Harris and Aldous 1946

The following two paragraphs are quoted from Harris and Aldous (1946) regarding a successful method of getting transplanted beaver to stay at release sites.

"After a desirable planting site has been located, it is necessary to choose the place to build a house and dam. It must be remembered that beaver prefer to float their food downstream, hence the food supply should be above the dam site. A stretch of stream bed without too much drop and with sloping banks provides an ideal construction site. Mark the spot where the dam is to be built and make an estimate as to how far a small handmade dam will back the water. A line level or an abney level is useful in determining the desired height of the dam.

At a point approximately one-third the distance between the site for the dam and the greatest distance the water will be backed, a trench about 12 inches wide by 14 inches deep is dug from the creek bed up the slope of the bank for several feet. If possible, the mouth of the trench should be near a clump of brush, or a tree or stump. This additional cover at the entrance to the lodge seems to give the beaver greater sense of security. The trench must be so constructed that when the dam is built the impounded water will completely cover the entrance, and the upper end of the trench will be enough above the water level to allow the animals to build the temporary dam higher if they so desire. The upper end of the trench should be enlarged to a width of about three feet by 18 to 20 inches deep. This will provide a suitable temporary lodge compartment. The sod and the dirt taken from the trench and the house should be carefully set aside for use in recovering the structure. After the excavating is completed, the trench and house should be covered with old lumber or dead sticks cut to fit the width of the trench; this then is completely covered with sod and dirt. It is well to pile brush around and over the trench and house to form a barrier against livestock. Sticks that might be eaten by beaver should be avoided in this construction. The dam is built next and the water backed up until it completely covers the entrance to the trench. Having the entrance to the lodge under water is essential and should never be neglected. A small spillway at one end of the dam and a small check dam below the main dam completes the construction. The small check dam gives the beaver additional swimming space and may temper their desire to tour. Under average conditions, two men can prepare a house and dam of this type in two to six hours. A few pieces of aspen or willow placed in the water at the head of the dam will provide food for

a few days or until the beaver become established in the new surroundings. The beaver should be released near the opening of the trench and will usually enter the latter without hesitation. It is well to be sure they find the entrance to the new lodge. If they climb out of the water or start up or down the stream they should be herded back to the dam until they find the entrance to the trench. Within a couple of weeks, new improvements will have been made according to the beavers' idea of how a home should be built and the colony will be firmly established."

Literature Cited

Harris, D., and S.E. Aldous. 1946. Beaver management in the northern Black Hills of South Dakota. J. Wildl. Manage. 10(4):348-353.

APPENDIX C

Checklist of Guidelines for Transplanting Beaver Into Southwest Montana Streams

The following is a summation of things that should be considered when transplanting beaver.

HABITAT EVALUATION

Stream Gradient -- Less than 12% OK, less than 6% best.

Valley Width -- At least 60 feet, but more than 150 feet best.

Food -- Winter foods, particularly aspen (about 4 acres) and/or willow (about 12 acres) are present or provided.

Construction Materials -- Suitable materials for building dams and lodges are present or provided.

Bedrock and Soils -- Stable enough to hold dams. Shale bedrock is bad.

Other Considerations -- Does cattle grazing need to be excluded? Is the watershed above the dam so big that the dam may be washed out?

SITE PREPARED FOR BEAVER OCCUPATION

A temporary, artificial lodge and dam should be constructed, see Appendix B.

NUMBER, SEX, AND AGE OF BEAVER MOVED

At least 4 adult beaver, 2 of each sex should be moved. See Appendix A for sex and age criterion. The sex of beaver can be determined by palpation for the presence or absence of male genitalia. Measurements useful in determining if beaver are adult are given below.

Suggested measurements for determining adult beaver.

Likelihood of Adult Beaver	Weight[1]	Total Length[1]	Tail Length[1]	Tail Width[1]	Zygomatic Width
Certain	≥43.0#	≥42.0"	≥11.5"	≥6.5"	3.7"
Likely[2]	≥35.0#	≥40.0"	≥10.5"	≥5.5"	3.6"

[1] Suggested as most useful criteria, see text.
[2] At least two of the criteria should be met in order to consider an animal an adult.

WHEN TO TRANSPLANT BEAVER

Beaver should be moved from summer to early fall. In southwest Montana this can range from July through September.

SOCIAL AND POLITICAL CONSIDERATIONS

Does the project have the support of landowners and others that may be effected? Does an Environmental Assessment (EA) need to be prepared?