Survival and Seasonal Movements During River Otter Restoration Efforts in West Virginia

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Abstract: During 5 February–1 April 1987 we released 13 (8 males:5 females) radio-equipped river otters (*Lutra canadensis*) into the West Fork River, Lewis County, West Virginia. Survival through 4 November 1987 was 56.7% (N = 75). After 10 months, dispersal extended 27.2 km upstream and 23.4 km downstream from the release site. Seasonal movements for the surviving otters varied from 7.1 km to 57.4 km for females (N = 2) and 11.1 km to 52.0 km for males (N = 5). Inter- and intrasexual ranges overlapped 0%–100% each season. Movements illustrated the importance of available refugia on the stream system in this restoration effort.

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Results of a river otter restoration feasibility study completed in West Virginia in 1976 by the West Virginia Department of Natural Resources (WVDNR), Wildlife Resources Division (Bottorff et al. 1976) suggested sufficient suitable river otter habitat existed in the state. Between 1984 and 1986, 34 otters from North Carolina, South Carolina, and Virginia were moved to the Little Kanawha River system, West Virginia (Schreckengast 1988). The West Fork River system juxtaposed to the Little Kanawha River drainage was chosen as the secondary waterway to receive otters in 1987 and provided another opportunity for a study of dispersal and survivorship of translocated otters in the state. Our primary objective for the 1987 otter restoration study was to determine their dispersal and seasonal movements.

Methods

The study area was contained in 3 west central counties of West Virginia: Lewis, Harrison, and Upshur. The West Fork River flows approximately 188 km

north through Lewis, Harrison, and Marion counties where it converges with the Tygart River to form the Monongahela River. Stream width ranges from 5.5 m in riffled areas during low flow (Koryak and Reilley 1984) to 21.0 m (unpubl. stream data, WVDNR Div. Water Resourc. 1964–84). Average depth on the main river varies from 0.76 m to 1.82 m with a maximum depth of 3.04 m (unpubl. stream data, WVDNR Div. Water Resourc. 1964–1984). The river has an extensive tributary system originating from 6 counties; 185 streams flow a total of 1,335 km through this 2,069-km^2 watershed (Evans et al. 1982). The main river is a sand and gravel based stream of moderate gradient with an average slope of 0.4 m/km (Koryak and Reilley 1984).

Six large tributaries and 2 lakes were present in the study (Fig. 1). Stonecoal Lake (223 ha) has channelized sections and is used to augment water levels of the West Fork River. Stonewall Jackson Lake (1072 ha) was constructed in 1988 on the West Fork River to produce a new water quality/flood control reservoir. Farm and strip mine ponds (250 ponds; 30.4 ha) are scattered throughout Lewis County. Eight Soil Conservation Service impoundments comprise another 15.3 ha of wetland surface area (Evans et al. 1982).

A preponderance of nongame fish (Cyprinidae, Catastomidae, and Percidae) were present along with moderate to high numbers of gamefish species (*Lepomis* spp., *Micropterus* spp., *Ictalurus* spp. and *Esox musquinongy* (unpubl. stream data, WVDNR Div. Water Resourc. 1964–84). Evidence of mussels (Mollusca) was observed on the river banks of the main river channel. Furbearers presently associated

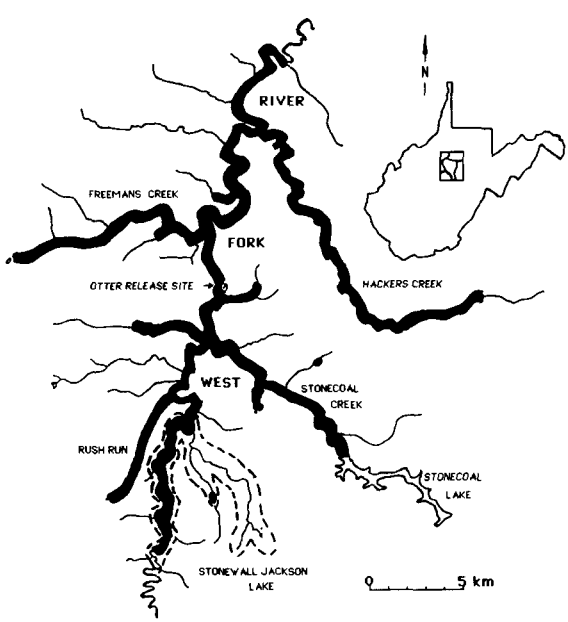

Figure 1. Area travelled and occupied (darkened areas) by 7 radio-equipped river otters, West Fork River, West Virginia, February–November 1987.

with the West Fork River system include mink (*Mustela vison*), muskrat (*Ondatra zibethicus*), beaver (*Castor canadensis*) and raccoon (*Procyon lotor*).

Water quality on the West Fork River had been adversely affected for nearly a century due to acid mine drainage, runoff from refuse dumps, and lands disturbed by surface coal mining (U.S. Army Corps Engr. 1979). However, the WVDNR (1986) now lists the river as a high quality stream with respect to its sport fishery. High quality stream criteria in West Virginia are streams stocked with trout or supporting native trout populations and warmwater streams over 8 km long with desirable fish populations and public utilization (WVDNR 1977–79). Mercury levels have been tested in largemouth bass (*Micropterus salmoides*), white crappie (*Pomoxis annularis*), and redhorse (*Moxostoma erythrurum*) and were measurably low (0.04–0.11 mg/kg; Kain et al. 1982).

Fourteen river otters (8 males:6 females) were obtained from inland coastal marshes in North Carolina (6) and from inland coastal marshes of Maryland (8) between 1 January and 30 March 1987. Otters were transported to West Virginia in rubberized wire cages partially filled with hay. In West Virginia, the otters were held overnight and provided with fresh fish and water.

The following day otters received surgical implants of radio transmitters (Telonics Inc., Mesa, Ariz.) by professional veterinarians. Transmitters were cylindrical, encased in biologically inert material, and weighed 108.8 grams ± 0.9 grams. Transmitters were soaked in a sterilizing solution for ≥ 10 minutes prior to implant. The animals were anesthetized in a veterinarian's office with a mixture of ketaset and rompun (0.65 cc to 1.1 cc/animal). Body mass (kg), total length (mm), hind foot length (mm), ear length (mm), tail length (mm) and sex were recorded. Fingerling tags (size No. 1) were used on each ear for identification. Age estimates were subjective based on animal size and tooth wear (Melquist and Hornocker 1983). Otters were released within several hours after recovery from the anesthesia. Telemetry was initiated immediately upon release. Homing was used to locate the animals daily, first by vehicle during long range tracking and then by foot to confirm the location. Locations were described, and time, activity, and visual sightings were recorded. U.S. Geologic Survey (USGS) topographic quads were used to record locations.

Dispersal distances (km of stream) were determined by use of a rotometer on 1:24,000 and 1:100,000 USGS topographic maps from all data points collected during a season. Fall movements were calculated to indicate changes in range but should not be considered as complete values due to low sample sizes of locations. Dispersal was considered as linear stream distance from the release point to the farthest points on the river system.

Results

Survivorship

The 14 river otters (8 males:6 females) were released on the West Fork River system between 5 February and 1 April 1987. Thirteen (8 males:5 females) of 14

otters contained implanted radio transmitters. The non-telemetered female was never observed after release. Five mortalities (3 males:2 females) were initially recorded. Two other animals (females) remained unaccounted for on 4 November 1987. Seven otters (5 males:2 females) survived through 4 November 1987, and 2 pups were observed with 1 translocated female (F10) from May through September 1987. Only one pup was observed with this female in November. The fate of the second pup is unknown. The field season was concluded 4 November 1987.

The 5 bodies of radio-equipped otters were recovered within 20 days post-release. Three of the dead otters (1 male:2 females) were recovered 4, 9, and 10 days post-release <1 km from the release site, and 2 others (males) traveled 27 km and 34 km of stream before being recovered 14 and 20 days post-release, respectively. No evidence of shooting, road kill, or predation was present, and necropsies were inconclusive.

Four of 5 (80%) radio-marked otters from North Carolina were alive at the end of the 10-month study. Fate of the 1 unmarked otter from North Carolina was unknown. Three of the 8 radio-marked otters from Maryland released between 21 March and 1 April also survived through early November. Contact with a fourth Maryland otter was lost shortly after release day and regained 1 month later. The otter was monitored for 2 days before being lost for the remainder of the study. Assuming this animal and the other Maryland otter were dead, survivorship of Maryland stock was 37.5%, and survivorship for all telemetered otters was 7 of 13 animals (56.7%).

Release Site Affinity

All otters were released at 1 location on the West Fork River. Three surviving otters used den sites 0.2–1.0 km upstream of the release site during their first 16 days on the river. In the subsequent 3 months, Male M50 was located at the release area on 3 occasions. Male M60 remained in the release area throughout March and twice revisited the site in April. In April, 2 otters (M60 and M920) of separate release dates were together at the release site.

One female (F97) utilized a den within 0.2 km of the release site for 2 days. This otter moved downstream and remained within 3.2-km straight-line distance of the release area. Male (M790) stayed within a 6.5-km radius of the release area. Another male (M830) moved downstream and established a den site for the next month 3.8 km straight-line distance from the release site.

Dispersal Distance

Spring movements were 7.1 km to 57.4 km and summer movements were 8.8 km to 20.5 km (Table 1). Utilized waterways included the main body of the West Fork River, lower order tributaries, and strip mine and farm ponds. Intrasexual range overlap was prevalent in late spring and summer and continued into autumn for radio-marked male otters. Radio-marked female otters lacked intrasexual range overlap in summer and autumn. Seasonal intersexual range overlap ranged from 0% to 100% among the study animals.

Range extensions in the summer season occurred on 31 July and 18 August

Table 1. Spring and summer movements for 7 otters, West Fork River drainage, West Virginia, March–August 1987.

Sex and ID	N[a]	Total (km)	Tributary length (km)	Main river (km)	Ponds
		Spring: 1 March–31 May 1987			
M50	138	52.0	12.4	39.6	none
M60	176	31.3	18.4	12.9	1-strip mine
M830	138	11.1	1.4	9.7	none
M920	131	31.3	18.4	12.9	1-strip mine
M790	20	b	1.9	b	1-farm pond
F10	185	7.1	2.7	4.4	none
F97	215	57.4	32.5	24.9	none
		Summer: 1 June–31 August 1987			
M50	181	20.5	0.5	20.0	none
M60	181	20.5	0.5	20.0	none
M830	181	20.5	0.5	20.0	none
M920	181	20.5	0.5	20.0	none
M790	215	13.0	13.0	0	none
F10	186	12.5	0	12.5	none
F97	215	8.8	4.2	3.6	none

[a]Sample size of locations for the season.
[b]Sample size too small to determine where the otter could have traveled this season on the main river.

1987 for 1 male (M790) and 26 June for 4 males (M50, M60, M830, M920), and 1 female (F97). Flow augmentation occurred on Stonecoal Creek with water releases from Stonecoal Lake of 14–26.3 CFS between 21 July and 2 August 1987 where 1 male (M790) resided. A thunderstorm on 25 July 1987 affected only the Freemans Creek tributary system and the West Fork River below the mouth of this creek. The 4 males located in the area (M50, M60, M830, and M920) moved upstream 2.4 km from the mouth of Freemans Creek where flows were unaffected by the thunderstorm runoff. On 27 July they returned to their former summer range below the mouth of the creek. One female (F97) moved temporarily into an intermittent tributary until high water receded on Freemans Creek on 27 July. The female (F10) with 2 pups expanded her summer range downstream, likely in response to human disturbance on 4 July 1987, but 11 days later returned to her previous range.

During autumn all otters continued use of their summer range and had movements between 6.8 km and 20.1 km. By 4 November 1987, total dispersal distances of all radio-marked otter based on the outermost stream locations was 27.2 km actual stream distance upriver and 23.4 km downstream of the release site (Fig. 1).

Discussion

Survival and Mortality

The restoration effort on the West Fork River drainage appears successful. The survival rate of telemetered otters (56.7%) in this study was not significantly different

from the survival rates of otters previously introduced into West Virginia (54%, $N = 34$, Schreckengast 1988) or Oklahoma (60%, $N = 10$) (Hoover et al. 1984). However, survival was lower than in Missouri (81%, $N = 31$, Erickson and McCullough 1987) and Tennessee (100%, $N = 4$, Griess and Anderson 1987) and also lower than the reintroduction of captive bred Eurasian otters (*L. lutra*) on the River Black Bourn in England (100%, $N = 3$, Jeffries et al., 1986). Survival rates were higher in our study than releases attempted in Arizona (20%, $N = 10$) which experienced a high degree of mortality in their early program efforts (unpubl. data cited by Erickson and McCullough 1987).

Hoover and Barnes (1988) developed a model from clinical examination of otters prior to release with reasonable estimates of river otter health and translocation survival. Omentum fat deposits were examined during transmitter implanting on our otters. Two otters with low or no omental fat died within 9 days post-release and a male otter with a discolored liver died 20 days post-release. Precautions to assess and insure the health of translocated animals prior to release utilizing professional veterinary assistance, can be an important link for maximizing survivorship in transplant programs.

Home Range and Populations

Studies in riverine habitat of Idaho (Melquist and Hornocker 1983) and marine coastal habitat in Alaska (Woolington 1984) indicated no seasonal pattern to movement length. Woolington (1984) did indicate that the movements of an adult male were larger in spring than any other season and larger than relatively stable movements of radiomarked family groups. Foy (1984), working in a Texas coastal marsh, suggested a sinusoidal pattern of home range size through the seasons, with a maximum size in spring and minimum in summer; our study most closely supported Foy (1984).

One exception to this pattern was the female (F10) which had pups in a den during the spring season and maintained her smallest movements of 3 seasons during spring. Once the pups emerged, her summer and fall movements expanded over the boundaries of her spring range. This trend has been apparent in Idaho and Alaska (Melquist and Hornocker 1983, Woolington 1984). No intrasexual range overlap was apparent from spring through autumn for 2 of the female otters (F10 and F97). In *L. lutra*, Erlinge (1984) reported little or no overlap of breeding female's ranges while intrasexual overlap was extensive for males. The data suggest seasonal movements of otters on the West Fork River are similar to those exhibited by *L. lutra*.

Tributaries to the West Fork River vary in water quality and were explored by each of the surviving otters shortly after release. All otters investigated at least 1 of the major tributaries in the vicinity of the release site in the spring. The main body of the river provided 5 otters with their summer range. One otter remained completely within a tributary system during the summer and portions of the spring and fall. Two of the summer ranges which included tributaries were rated as high quality streams. One exception involved one male otter (M790) who was twice located in a tributary that emptied from a landfill site. Spring use of low quality tributaries may

have been related more to exploration of new habitat than preferred use of the waterway.

Extreme flow changes induced by water releases or thunderstorm runoff were related to range expansions of the otters. Movements into stream habitat less affected by the flow changes represent outliers in the ranges, but illustrate the importance of available refugia in the drainage. Schreckengast (1988) suggested otters may move into smaller tributaries to feed during periods of extremely high water and our results support this movement behavior. Tributaries also can serve as corridors to dispersal as evidenced by movements of 2 male otters (M880 and M990) in this study. Tributary values related to stream quality, dispersal corridors, and distribution of refugia represent important considerations in translocation efforts to a river system.

One male (M790) existed entirely within the Stonecoal Creek system from 29 May to 4 November 1987. As this stream was maintained primarily by water releases during the drier seasons, flow rates fluctuated based on water augmentation needs of the West Fork River at the Harrison Power Station. In considering rivers for reintroductions, those waterways under the influence of water control structures should not be eliminated from consideration.

Release Strategy Recommendations

The concept of hard release (Jalkotzky 1982) was applied during the otter releases in this program. No post-release care was provided to reduce any stresses that may be associated with acclimation to a new environment. For apparently healthy animals, the option has provided satisfactory survival. Soft release is another option (Berg 1982, Jalkotzky 1982, Jeffries et al. 1986). In Britain, soft release has met with success in releasing captive-raised otters into available habitat, and has been implemented in U.S. translocation programs (Griess and Anderson 1987). Removing stresses of locating a new protected den site and food source through a soft release procedure, particularly for animals in questionable health, should increase survival of translocated otter.

Reintroductions have illustrated that most animals remain relatively close to the release area within the drainage, at least within the first year post-release, while varying percentages of the numbers released usually can be expected to disperse (Erickson and McCullough 1987). Dispersal range followed patterns for otters in the 1984–86 restoration efforts (Schreckengast 1988) on the adjacent Little Kanawha River drainage in westcentral West Virginia. Other reintroductions in Missouri, Pennsylvania, Tennessee, Great Britain, and the province of Alberta, Canada also report most animals having low initial dispersal from the release site (Jalkotzky 1982, Serfass and Rymon 1985, Jeffries et al. 1986, Erickson and McCullough 1987, Griess and Anderson 1987). Stocking adjacent watersheds in the same year with sufficient numbers of animals and adjacent to already stocked watersheds should improve the speed with which a regionally dynamic system can be established for otter populations in West Virginia. Ideally, each drainage would support an effective population of at least 50 animals (Lehmkuhl 1984). West Virginia's drainage basins

will likely sustain subpopulations of smaller size due to stream sizes and water quality in the drainages.

While Berg (1982) recommends even sex ratios or ratios favoring females, sex ratios of reintroductions have been determined by what animals can be procured and which animals survive the initial release period. In addition, single group releases or multiple releases at a site as otters became available have been implemented in the various programs. In all the reported otter programs the largest proportion of surviving otters remained relatively close to the release area. This would indicate that the variables (sex ratio and release strategy) within the realm of the variety of situations that have been encountered have all resulted in surviving otters establishing a favorable social system towards re-establishing a population on the release areas. As Erickson and McCullough (1987) stated, "From the standpoint of populations, absolute distances moved by animals are probably less important than movements in relation to those of other otters." Most of these programs and this study indicate inter-and intrasexual range overlap on a seasonal, if not on an annual basis, supports the presence of favorable social system establishment. Observed matings, male:female interactions during the breeding season based on telemetry locations, and ultimately the observed production of young have reinforced the success of this project and potential successes of reintroduction efforts throughout the country (Serfass and Rymon 1985, Erickson and McCullough 1987, Griess and Anderson 1987, Tango, 1987).

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