SUMMER HOME RANGE SIZE AND HABITAT USE BY RIVER OTTERS IN OHIO

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ABSTRACT: Reintroduced river otters (*Lontra canadensis*) are an important component of Ohio's biological diversity, and are a key indicator of wetland and watershed health and quality. However, few data are available on their home range sizes and habitat use. We monitored river otters using radio-telemetry in the Killbuck Watershed, in northeastern Ohio, during 2002 and 2003 to determine home range and habitat use. Overall, mean home range size was 802.4 ha (range = 84.5–3,376.3, SE = 448.2) for female river otters and 1,101.7 ha (range = 713.8–1,502.6, SE = 102.2) for male river otters. Home range size of female and male river otters did not differ in 2002 ($P = 0.763$), but males had larger home range size than females during 2003 ($P = 0.001$). Based on compositional analysis, habitat use differed in proportion to availability of the 5 habitat types available in the study area (marsh, wet meadow, riparian/floodplain, open water, and flooded upland) ($P < 0.0001$). Overall, river otters used marsh habitat with a diverse association of floating aquatics and emergent vegetation in greater proportion than was available. Knowledge and understanding of river otter habitat use and home range size in Ohio will help managers identify habitats suitable for river otters in the Midwestern United States.

Key words: Habitat use, home range, Killbuck Watershed, *Lontra canadensis*, radio-telemetry, river otter.

River otters (*Lontra canadensis*) are a native Ohio furbearer and are also an important indicator of riparian health. At one time, river otters were established throughout most of the major drainages in North America (Hall 1981, Schwartz and Schwartz 1995, Whitaker and Hamilton 1998). Prior to the 1900s, river otters occurred in northern Alaska and from eastern Newfoundland to the Aleutian Islands, extending into the southern states of Florida and Texas, but remained absent from arid portions of the southwestern states (Chapman and Feldhamer 1982, Stone and Sheean-Stone 1992). Unregulated trapping, water pollution, and destruction of habitat caused serious declines in river otter populations throughout large portions of the species' former range (Berg 1982, Stone and Sheean-Stone 1992).

Implementation of reintroduction programs in many portions of the United States has facilitated reestablishment of river otters. Several states have conducted studies and surveys to determine post-release survival and movements of river otters. However, there is a lack of long-term studies or any systematic effort to determine the status of reintroduced river otter populations. Since the release program ended in Ohio in 1989, monitoring the distribution

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and range expansion of river otters has consisted primarily of observational reports, surveys of bow hunters, bridge surveys, and aerial surveys.

Terrain, topography, habitat, and food resources are important variables that determine home range size. Most crucial is the type of habitat, which can influence prey availability and cover components. Optimal quality habitat for river otters in Ohio is described by McDonald (1989) as water systems with clean water that are highly productive, and bordered by large tracts of forest. Long, meandering waterways, riparian forest, abundant stream structure (e.g., logjams, fallen trees, debris piles), and a variety of aquatic conditions (e.g., oxbows, flooded timber, backwater, emergent vegetation) also are considered important river otter habitats (Larsen 1983, Melquist and Hornocker 1983, Woolington 1984, Melquist and Dronkert 1987, McDonald 1989, Beck 1993). Determining habitat use of river otters in Ohio is important for developing general conservation strategies management strategies for the species (Swimley et al. 1998). Although, various surveys have provided a general indication of distribution of river otters in Ohio, little information is available about their habitat use, home range, movement, and activity patterns in the state. The objectives of our study were to: (1) describe home range and habitat use of river otters in the Killbuck Watershed, Ohio; and (2) determine if home ranges and habitat use differed by gender and age.

STUDY AREA

Our study was centered on the Killbuck Wildlife Management Area (WMA), which encompasses 2,234 ha in northeastern Ohio. The 132-km Killbuck Creek flows through the WMA and drains a watershed of 157,730 ha. This area is located in a glacial outwash valley with elevations ranging from 256 m at the floor of the Killbuck Creek to 305 m on adjacent hillsides. Over half of the WMA consists of palustrine emergent, palustrine scrub-shrub, and palustrine forested wetlands (Cowardin et al. 1979), which flood during some portion of the year. Killbuck WMA was acquired in 1969 by the state of Ohio and represents the largest remaining wetland complex in the state outside of the Lake Erie marsh region. Several marshes adjacent to the Killbuck Creek are managed by draw-down techniques; however, others in the area are void of any type of water management structures.

Fish species inhabiting Killbuck Creek include northern pike (*Esox lucius*), common carp (*Cyprinus carpio*), various species of suckers (*Catostomidae* spp.), bullheads (*Ameiurus* spp.), and various sunfishes and bass (Centrarchidae). Beaver (*Castor canadensis*) populations have increased in the area, creating suitable habitat for a diversity of wildlife species (e.g., furbearers, waterfowl, waterbirds, shorebirds, fish, frogs, turtles, and songbirds). Killbuck WMA is open to the public year-round, with hunting, trapping, fishing, and bird watching being the most popular activities.

METHODS

Trapping

We trapped river otters in the Killbuck Watershed, primarily on the Killbuck WMA, using Victor No. 1.5 padded Soft Catch® (Woodstream Corporation, Lititz, Pennsylvania, USA) and No. 11 double longspring offset foothold traps (Sleepy Creek Manufacturing, Berkeley Springs, West Virginia, USA). Soft Catch® traps were modified by the addition of 2-1.5 coil springs (those used on tradional 1.5 coil spring traps, which are stronger than springs used on Soft Catch traps) and reinforced base plates. All traps also were equipped with 90-cm chains attached to the bottom center of base plates, and chains were modified by adding 5 swivels to prevent chains from binding when river otters rolled while in the trap (Serfass et al. 1996). We anchored traps using wooden stakes, and the area surrounding each

trap site was cleared of debris that could entangle captured river otters (Serfass et al. 1996, Bowyer et al. 2003). During cold weather, traps were attached to a piece of 11 gauge wire that acted as a slide to allow the trapped river otters to leave the water. Traps were set in shallow water adjacent to the shoreline at places river otters frequently came ashore (e.g., latrine sites). We used a combination of lures, such as crayfish and fish oils, as well as some commercial river otter lures. During 2001 and 2002 trapping was initiated in September, when the majority of young river otters are able to survive autonomously (Serfass et al. 1996), and continued through December. Trapping was terminated when overnight temperatures dropped below -5° C.

We guided captured otters river otters into transport boxes to facilitate weighing for determining the correct dosage of anesthetic. We anesthetized trapped river otters with ketamine hydrochloride at an intended dosage of 22 mg/kg (Melquist and Hornocker 1979, McDonald 1989, Testa et al. 1994). We examined immobilized river otters for overall physical condition and possible injuries associated with foothold traps; they also were injected with vitamin B and vaccinated against Diptheria, Hepatitis, Leptosporosis, Parainfluenza, and Parvo Virus. An AVID (American Veterinary Identification Devices, Norco, CA) passive integrated transponder (PIT) tag was inserted under the skin at the base of the tail of each captured river otter as a method for permanent identification (Bowyer et al. 2003). A veterinarian implanted them with an intraperitoneal Advanced Telemetry Systems (ATS) M1200 radio transmitter (30 mm × 100 mm, approximately 90 g; Advanced Telemetry Systems Inc., Isanti, MN) using procedures outlined by Kollias (1999). Transmitters were equipped with a motion-sensitive mortality switch that activates after about 8 hours of non-activity. Following surgery, we held river otters in transport cages to ensure that they were in good health before releasing them at their respective capture sites. All river otters released showed no adverse effects from the procedures. The West Virginia University Animal Care and Use Committee approved the protocols used in this study (01-0714).

Radio-telemetry

We monitored river otters with an ATS R2000 receiver for up to a 2-year period, on the ground using an omni-directional “whip” antennae (non-directional) mounted to the roof of a vehicle via a magnet. After a signal was detected, we used a 3-element Yagi antenna (directional) to obtain bearings to estimate the location of a river otter. Each river otter was located approximately 3–4 times per week. We obtained locations throughout the summer, May through September 2002 and 2003, using ground tracking methods. We took telemetry locations as close to the animal as possible and times between bearings were minimal (usually <5 min) between bearings (White and Garrot 1990). We determined river otter locations by triangulation with $\geq$2 bearings. When river otters could not be located from the ground, we searched for them via a Bell 206 helicopter or a Partenavia PA-68 fixed wing, twin-engine plane equipped with twin 4-element Yagi antennas.

We attempted to monitor river otters 2 times each week. Once a month we attempted to monitored each every 3 hours for a 24-hour period. Only data for river otters with >30 locations were used to determine home range and habitat selection (Aebischer et al. 1993).

Data Analysis

Universal Transverse Mercator (UTM) locations of river otters were estimated with the program LOCATE II (Nams 1990). Locations were then entered into Animal Movement Analysis Extension (Hooge and Eichenlaub 1997) in ArcView® (Environmental Systems Research Institute, Redlands, California, USA). Core home range size was determined using the 50% Adaptive Kernel Method (AKM) and the 95% AKM home range estimates (Worton 1989). We compared river otter home range size, using 2-way analysis of variance (ANOVA) to determine if differences existed between gender and years. Assumptions of normality were

tested using the PROC Univariate procedure in SAS (SAS Institute, Inc. 2000); we used Bartlett's test to evaluate homogeneity of variance assumptions. We used logarithmic and square root transformations to convert dependent variables (home range) that did not meet assumptions of homogeneity. Statistical tests were considered significant if $P < 0.05$.

Habitat was categorized into 5 groups: 1) open water (deep water habitats with no vegetation), 2) marsh (diverse associations of floating aquatics and emergent vegetation with standing water), 3) wet meadow (homogenous stands of emergent vegetation), 4) floodplains/riparian (low-lying area adjacent to aquatic system prone to flooding), and 5) flooded upland (upland fields adjacent to aquatic systems that are prone to flooding), using Ohio wetland inventory digital quadrangle maps (1995) provided by Ohio Division of Wildlife. We calculated total number of river otter locations in each of the different habitat types. We used log-ratio compositional analysis for overall comparisons of habitat composition in river otter home ranges (Aebischer et al. 1993). A residual matrix was constructed from the matrix of log-ratio differences and was computed with Wilks' λ to test for randomization among habitat use. We then constructed a matrix ranking habitat types and assigned differences among habitat type ranks (Aebischer et al. 1993). We also used the Neu et al. (1974) technique involving use of a Bonferroni-Z statistic to estimate habitat use. This technique is used to analyze utilization-availability data in conjunction with a chi-square test (Neu et al. 1974).

RESULTS

Home Range

During fall and winter of 2001 and 2002 we captured and radio-tagged 17 river otters (n = 8 and 9, respectively). We acquired adequate locations (>30) from 6 river otters (3 female, 3 male) during 2002, and 9 river otters (4 female, 5 male) during 2003 to estimate home range sizes and habitat use (Table 1). We monitored 4 river otters (2 female, 2 male) during both years.

Overall, mean home range size was 802.4 ha (range 84.5–3,376.3, SE = 448.2) for females and 1,101.7 ha (range 713.8–1,502.6, SE = 102.2) for males. Mean home range did not differ ($F_{1, 14} = 0.10$, $P = 0.763$) between genders in 2002 ($F_{1, 14} = 0.10$, $P = 0.763$), but the home range of males was larger than for females during 2003 ($F_{1, 14} = 21.1$, $P = 0.001$). Mean female home range size was greater in 2002 than in 2003 ($F_{1, 14} = 15.15$, $P = 0.003$), but home range size of males did not differ between years ($F_{1, 14} = 0.25$, $P = 0.628$) (Table 2).

Table 1. Number of locations per river otter in the Killbuck Watershed, Ohio, USA, during 2002 and 2003.

River otter ID	Gender	Tracking period	Year	No. of locations
064	Female	May–August	2002	52
185	Female	May–August	2002	38
222	Female	May–August	2002	47
245	Male	May–August	2002	34
325	Male	May–August	2002	43
405	Male	May–August	2002	47
064	Female	May–August	2003	49
185	Female	May–August	2003	63
222	Female	May–August	2003	59
634	Female	May–August	2003	56
325	Male	May–August	2003	55
405	Male	May–August	2003	31
652	Male	May–August	2003	48
673	Male	May–August	2003	56
753	Male	May–August	2003	52

Table 2. Home ranges of river otters in the Killbuck Watershed, Ohio, USA, during 2002 and 2003

Year	Gender	Home range	SE (95%)	Core	SE (50%)
2002, 2003	Female, Male	962.0	211.1	202.6	48.2
2002	Female, Male	1,297.7	445.9	298.8	100.3
2003	Female, Male	738.2	177.4	138.5	35.9
2002, 2003	Female	802.4	448.2	182.1	101.6
2002	Female	1,608.9	911.4	381.0	193.1
2003	Female	197.4	56.4	33.0	12.4
2002, 2003	Male	1,101.7	102.2	220.5	29.4
2002	Male	1,608.9	911.4	381.0	193.1
2003	Male	1,170.9	77.8	222.9	23.1

Overall, mean core home range size was 182.1 ha (range = 10.4–724.4, SE = 101.6) for females and 220.5 ha (range = 101.9–368.7, SE = 29.4) for males. Mean core home range size did not differ between genders in 2002 ($F_{1, 14} = 0.82$, $P = 0.384$), but was greater for males than females during 2003 ($F_{1, 14} = 8.35$, $P = 0.015$). Mean female core home range size was greater in 2002 than in 2003 ($F_{1, 14} = 11.15$, $P = 0.007$), but there was no difference between core home range size of males between years ($F_{1, 14} = 0.03$, $P = 0.864$).

Habitat Use

Based on the results of compositional analysis, river otter habitat use differed among the 5 habitat categories (Wilks' $\lambda_4 = 0.20$, $P < 0.0001$), with occupation of habitats occurring in the following order: marsh > flooded upland > riparian/floodplain > wet meadow > open water. Marsh and riparian/floodplain habitats occurred in home ranges in greater proportion than other habitats.

Similarly, we detected differences in use among the 5 habitat types using the Neu et al. (1974) technique ($\chi^2_4 = 399.9$, $P < 0.0001$) (Table 3). Marsh habitat was used in greater proportion than availability, wet meadow in proportion to availability, and open water, riparian/floodplain, and flooded upland in lower proportion than availability.

Table 3. Confidence intervals (CI) of habitat use for river otters in the Killbuck Watershed, Ohio, USA, during 2002 and 2003

	Use: 95% CI		Available: 95% CI		
Habitat	Upper	Lower	Upper	Lower	Use vs. Availability
Open Water	0.0644	0.0362	0.1193	0.0995	Less
Marsh	0.5684	0.5042	0.3401	0.2849	More
Wet Meadow	0.0730	0.0429	0.0500	0.0500	Same
Riparian/Floodplain	0.2336	0.1813	0.3379	0.2808	Less
Flooded Upland	0.1708	0.1251	0.2454	0.1921	Less

In 2002 and 2003, female river otters were located ($n = 364$) in marsh areas most frequently (58%), followed by riparian/floodplain areas (18%). Male river otters also were most frequently located ($n = 417$) in marsh areas (57%), followed by riparian/floodplain areas

(21%). For both female and male river otters, the fewest locations occurred in open water areas and wet meadows (Table 4).

Table 4. Number of locations (% in parentheses) of radio-tagged river otters in each of 5 habitat types in the Killbuck Watershed, Ohio, USA, during 2002 and 2003

	No. Locations (% of Total Locations)					
Gender	Open Water	Marsh	Wet Meadow	Riparian/Floodplain	Flooded Upland	Other
Female	26 (7)	212 (58)	21 (6)	64 (18)	41 (11)	364
Male	4 (1)	238 (57)	28 (6)	89 (18)	58 (11)	417
Totals	30 (4)	450 (57)	49 (6)	153 (20)	99 (13)	781

DISCUSSION

Home Range

Home range sizes of river otters in our study were similar to those reported in other studies (Larsen 1983, Melquist and Hornocker 1983, Erickson et al. 1984, Foy 1984, Melquist and Dronkert 1987). River otter home range and habitat use studies have been conducted in several habitat types, including high elevation areas, coastal marshes, and inland wetland complexes (Larsen 1983, Melquist and Hornocker 1983, Woolington 1984, Erickson et al. 1984, Foy 1984, Mack 1985)). Typically, home ranges are larger in higher elevation areas then in low-lying areas that have an abundance of wetland complexes, where food and shelter are more evenly distributed (Allen 1987, Melquist and Dronkert 1987, Mitsch and Gosselink 2000). River otter home range estimates vary from 184–461 ha in coastal Texas (Foy 1984) to 900–2,500 ha in coastal southeastern Alaska (Larsen 1983). Erickson et al. (1984) reported river otter home ranges at Swan Lake National Wildlife Refuge in Missouri to be 400-1,900 ha. An annual home range as large as 23,100 ha was documented by Reid et al. (1994) in Alberta, Canada. Home range size for river otters in our study ranged from 85–3,376 ha.

The smallest home range size in our study was exhibited by a female river otter that was observed with pups several times throughout the season (2003). Most of her locations were associated with several dens in close proximity of each other. In contrast, the largest home range size (3,376 ha) in this study was exhibited by a female river otter that was observed multiple times during the field season (2002) without pups. This particular female river otter was located several times moving with some of the male river otters that also were radio-tagged. Typically, male river otters have larger home ranges then females (Ellis 1964, Melquist and Dronkert 1987, Reid et al. 1994), and lactating females usually have the most restricted home ranges (Polechla 1990).However, some studies detected no difference in home range sizes between females and males (e.g., Sjøasen 1997, Johnson and Berkley 1999).

Habitat Use

Habitat use of river otters in our study was comparable to other studies that have evaluated river otter habitat use (Mack 1985, McDonald 1989). The majority of our river otter locations for both females and males were in marshes. In Colorado and Ohio, Mack (1985) and McDonald (1989), respectively, showed that during summer month's river otters often occupied in beaver impoundments and marsh areas. These impoundments have reduced

current velocities, reduced silt loads, and increased organic matter, allowing for clearer water (Brayton 1984, Naiman et al. 1986, Naiman et al. 1988). The clearer water allows river otters to feed more effectively (McDonald 1989). In Idaho during summer months, river otters occupying valley stream habitats were located 47% of the time in swamps/backwater sloughs, followed by mudflats and associated open marshes (Melquist and Hornocker 1983). In addition, river otters used open water areas least during spring and summer months (Melquist and Hornocker 1983). In Massachusetts river otter latrines were most frequently detected in beaver impoundments during summer months (Newman and Griffin 1994). The marsh habitats used by river otters in our study typically had a high density of vegetative structure, which provided habitat for a variety of prey species. In addition to foraging, these areas also provided river otters denning and resting areas.

During our study we located female and male river otters in floodplains/riparian areas. Riparian/floodplains provide important structure (e.g., overhanging, vegetated banks and logjams) for use by river otters for denning and resting. Moreover, these structures allow prey species, such as carp (*Cyprinus carpio*), crayfish (*Cambaridae*) and frogs (*Ranidae*) to congregate (CITATION), creating foraging areas for river otters during the summer months.

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