An Evaluation of Bridge Surveys for Monitoring River Otter Distribution in Ohio

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Abstract:

River otters (*Lontra canadensis*) were once prevalent in the landscape of North America, but were trapped to low population numbers by the early 1900's. Seventeen states and one Canadian province (Alberta) have successfully reintroduced river otters to their historical habitat. Biologists have carefully monitored the distribution and abundance of populations through the use of bridge surveys, public observation reports, snow-track surveys, and reports of road kill and incidentally trapped otters. Bridge surveys are the most common type of survey and are conducted at randomly generated sites once a year. This study looked at whether repeated visits would provide more data and therefore a better indicator of distribution and abundance of the river otter population in Ohio. Results showed an increase in sign presence detected on day 2 from day 1, but no increase in detection on day 3 from what was previously detected on days 1 and 2.

Introduction

The northern river otter (*Lontra canadensis)* is a native furbearer in the United States. Historically there were established populations of river otters throughout the majority of drainages in the United States and Canada before European settlement (Hall 1981). Early settlers made these otters an economically valuable commodity and trapped them solely for their fur. These settlers also had a great impact on the landscape of the United States. With an unregulated harvest of otters, decreasing water quality, increasing stream pollution, and deforestation during the late 1800's and early 1900's, otter populations began to decline, and in some areas were extirpated, from many North American landscapes. Otters were placed on the endangered species list in many places with a status of "protected" or even "endangered."

River otters are aquatic mammals generally found near water (Kurta 1995, Whitaker 1996). They are piscivorous animals, feeding mainly on fish, but have also been known to feed on small mammals, amphibians, crayfish, and other aquatic and terrestrial invertebrates. Otters feed mostly at night, but are crepuscular in nature and are mainly active in the early morning and late at night. Their den location is usually dependent on food availability, but they have large home ranges that may encompass up to 80 kilometers of a single stream. River otters make their dens in banks, often exploiting a cavity that a beaver (*Castor canadensis*) or muskrat (*Ondatra zibethicus*) has previously created (Kurta 1995). They make tunnel entrances aboveground and underground to the adjacent water. For grooming and toilet purposes they establish latrine sites on areas of the bank (Ben-David et al. 1998, Newman and Griffin 1994, Swimley et al. 1998). Young are born in litters of two-three kits in the early spring and adults will mate almost immediately after birth (Whitaker 1996). River otters exhibit delayed implantation and the embryo will remain in suspended development until the next spring. Young will generally remain with the adult through the fall.

The 1970's saw a shift in the concern of management techniques for furbearers, as well as other environmental concerns such as water quality and deforestation. In the 1980's some states took these concerns and the documented decline in otter populations and began to plan reintroduction projects. As early as 1982 Missouri had already established a program, releasing nineteen otters into their native habitat at the Swan Lake National Wildlife Refuge (Hamilton 1999). The outcome of the project was successful with many of the otters establishing territories in the initial release sites. Otters that strayed had a lower chance of survival and it took at least two years for reproduction to occur in many of the animals (Erickson and McCullough 1987).

Other river otter reintroduction projects began to take place across the United States. Pennsylvania started a project in 1982 in the northcentral and western portions of the state. The otters released were captured in the northeastern part of the state and then relocated (Serfass et al. 1996). The Oklahoma Department of Wildlife released otters in 1984 and 1985 despite the fact that otters did not historically occur in most areas of the state (Shackelford and Whitaker 1997). In Indiana otters had been protected since 1921 and were completely extirpated by 1942. In the mid-1990's Indiana officials released twenty-five wild-caught otters of the subspecies native to Indiana and monitored them using intraperitoneal transmitters. After several years the otters had successfully established home ranges and even reproduced (Johnson and Berkley 1999).

The Ohio Department of Natural Resources (ODNR) Division of Wildlife began a reintroduction program in 1986. Between 1986 and 1993, 123 otters were trapped in Louisiana and Arkansas and released at four different sites in eastern Ohio. Twenty-four otters were released at Killbuck Creek (Wayne and Holmes Counties), twenty-six at Little Muskingum River (Washington County), forty-eight at Grand River (Trumbull and Ashtabula Counties), and twenty-five at Stillwater Creek (Harrison County). By 2002 a population of 2,100 otters had been established and the species was removed from Ohio's Endangered Species list (Mountz and Dwyer 2002). The latest data in the fall of 2006 showed a population estimate of >6,100 otters (Figure 1) and presence in at least fifty-two watersheds throughout the state (Figure 2) (Dwyer 2006).

After the otters were released in all of these states it was important to monitor their populations and verify that populations were self-sustaining. Many different techniques were applied to this crucial part of the reintroduction, including public observation reports, helicopter snow-track surveys, annual bow hunter surveys, reports of road kill and incidentally trapped otters, and bridge surveys. The most common technique was the observation of latrine sites that the otters use for grooming and/or as toilets. Latrine sites are an area where vegetation has been flattened and are generally found along stream banks at high points. Latrines may contain piles of runny vomit that is greenish black in color and composed of parts of crayfish and fish scales. They may also contain droppings that will have undigested parts of crayfish, fish bones and fish scales (Anon 2). Male otters may also use latrine sites as a place to scent-mark their social status (Rostain et al. 2004). A study in south-central Alaska suggested that otters prefer sites that have large rocks, shallow, vegetated slopes, shallow, tidal slopes, and high over story cover. They also stated that removal of feces and direct observation have led to the theory that visitation to these latrine sites is very high (Ben-David et al. 1998).

Previous studies have shown that there may be typical habitat characteristics that river otters seem to prefer when choosing locations for latrine sites. In Pennsylvania a study addressed latrine site selection by otters in typical habitats. Searching visually, biologists categorized areas as latrine sites or non-latrine sites. They measured variables such as diameter of the latrine, distance from the center of the latrine to the nearest water, and height of the latrine above the water level. They chose thirty variables from a previous study they had performed and evaluated them at both latrine and non-latrine sites. Subsequently, they determined which variables were most likely to be associated with latrine sites and with non-latrine sites to be able to better predict which areas are more likely to be latrine sites. They determined that latrine sites were most often associated with tributary streams, beaver activity, fallen logs, rock formations, backwater sloughs, points of land, vertical banks, and coniferous trees. Pools, islands, and logjams did not fit into the model but they still seemed to have some relevance in trying to identify a latrine site. It was concluded that these characteristics may be better visual cues when trying to find latrine sites (Swimley et al. 1998). Another study done in south-central Alaska tested the relationship between latrine sites and present vegetation (Ben-David et al. 1998). Biologists predicted that the composition of plants and nitrogen content of plant tissue would be affected by fertilization by otters, depending on the food that the otters were consuming. They sampled fur and feces of the otters and the vegetation that was present at latrine sites. The vegetation samples from the latrine sites were much higher in Nitrogen content than those collected from non-latrine sites. These results indicated that the river otters were in fact contributing to the fertilization of vegetation along these sites as part of their scent marking rituals (Ben-David et al. 1998).

A study in Massachusetts also addressed characteristics that were prevalent at latrine sites. A different set of characteristics was found to be common at latrine sites that included beaver bank dens, points of land, beaver lodges, mouths of permanent streams, isthmuses, and coniferous trees (Newman and Griffin 1994). Coniferous trees prevent the accumulation of snow on the ground in the winter which is attractive to otters. They may also provide benefits year-round in that they can create a thermal escape for otters and the needles that fall off can create a litter that otters may find a softer and more absorbent area for grooming.

Many departments used bridge surveys as their primary method of latrine observations. This technique was established in Oklahoma after the release of their first otters in 1984 and 1985 (Shackelford and Whitaker 1997). They chose random survey sites at bridge crossings over perennial streams. Biologists would visit each station once during the months of January or February. This time is selected because it is during otters' breeding season and they are the most active. The biologist would walk along one side of the stream 100 meters in each direction (upstream and downstream) and look for otter sign. The sign they were searching for included latrines, scat, tracks, haul outs, river bank dens, bedding sites, scrapes, scent posts, and diggings. The population abundance of river otters was then estimated by comparing the data from year to year (Shackelford and Whitaker 1997). Other states, Ohio included, have used different variations of these bridge surveys to determine relative abundance and distribution of their respective river otter populations.

Otter reintroduction projects have been so successful that in many places populations have become a nuisance. The first state to implement a regulated trapping season for otters was Missouri in 1996 (Hamilton 1999). Biologists predicted before the initial release that a regulated trapping season would be an option in the future to control and manage otters if they flourished and became destructive. Within ten years of the initial reintroduction they were receiving reports that otters were causing property damage. The Conservation Commission critically reviewed the scientific information on the populations of river otters in the state and after careful consideration approved the first regulated trapping season. It was decided that a regulated trapping season was the best tool available to manage the otter population in order to keep them from becoming a nuisance to the public (Hamilton 1999).

Trapping has also been an important management tool for wildlife populations in Ohio. Ohio has successfully used trapping and hunting to reestablish self-sustaining populations of wildlife, including white-tailed deer (*Odocoileus virginianus*) and Canada geese (*Branta canadensis*) (Anon 1). Trapping is an effective management technique for capturing and relocating animals, as well as being used to maintain current population levels. Otters were removed from Ohio's endangered species list in 2002 (Mountz and Dwyer 2002) and by 2005 there were numerous nuisance reports from areas with thriving populations. After careful evaluation Ohio has currently held two limited otter trapping seasons. Three different zones were established (Figure 3) with different bag limits and trapping was highly regulated. Trappers were required to tag all otters caught and turn in carcasses for evaluation by the ODNR Division of Wildlife. The successful implementation of this program and cooperation from trappers has proved to alleviate nuisance problems as well as maintain a healthy population level.

With the implementation of a trapping season and the increase in population size of otters in Ohio it is important to have an accurate monitoring program. Ohio currently uses bridge surveys to document river otter populations, as well as observations from trappers and other outdoorsmen. Standard protocol for each bridge site is one visit per year, and at the simplest level a presence or absence of otters is recorded. The objective of this study was to examine the effectiveness of bridge surveys by increasing the level of visitation to see if more data could be obtained to be used in distribution estimates. Better population estimates will provide better information to biologists to set bag limits for the trapping seasons. Bag limits are crucial to maintaining a viable population. Bag limits that are too high may negatively effect a population and bag limits that are too low may allow a population to grow to unmanageable proportions.

Methods

Site Description:

Bridge surveys were conducted in the Killbuck Creek Watershed that is part of the Killbuck Marsh Wildlife Area in northeastern Ohio. The Killbuck Creek Watershed is 129 kilometers northeast of Columbus, 89 kilometers south Cleveland, 56 kilometers southwest of Akron, and 56 kilometers southeast of Mansfield. The area is located in portions of Ashland, Holmes, and Wayne counties. This was one of the four original release sites for river otters in Ohio and was chosen because of its accessibility and its proximity to Columbus. Bridge sites were provided by ODNR Division of Wildlife staff from their generation of random sites at the beginning of their observations.

Locations:

For Ohio's monitoring program, one hundred-eighty bridge sites were originally selected throughout twelve watersheds in eastern Ohio, with fifteen locations in each watershed. For this study a total of fifteen bridge sites were used in the Killbuck Creek Watershed (Table 1). ODNR Division of Wildlife staff used ArcView GIS software to display rivers, roads, streams, and watersheds. From this data, all road-stream intersections were identified as prospective bridge sites and each was numbered. The numbers were then randomly ordered and the first fifteen sites were selected. If a site was within an urban area, within three km of a previous site, or generally unsuitable then the next randomly ordered bridge was selected for use in the study.

Data collection:

Surveying and data collection was done in accordance with the Ohio Division of Wildlife's River Otter Bridge Survey Protocol (Unpublished Report 2004). Streams were surveyed 300m upstream and downstream on both sides of the stream and the entire area was surveyed in the same day. Data recorded included date, bridge number, detectibility index, otter sign found, sign type, distance (m) to first sign, and comments. The detectibility index calculates the percentage of the streambank that has suitable conditions for observing otter sign. The index is recorded on a scale of 0 to 10 with each point representing a 10% increase of suitable conditions. Zero is the lowest meaning that there are no suitable conditions, and 10 is the highest meaning that the whole bank is made of mud and sandbar and has potential for showing sign. There are four different types of sign that can be recorded: tracks, scat, fish kill remains, and latrines. If any of these signs were found then the distance from the bridge to that sign was also recorded. Once otter sign was detected the survey was complete. If no otter sign was detected the entire 1200m of bank was surveyed.

Other special conditions are also accounted for in the protocol. If the survey must be terminated due to weather then the whole area must be surveyed again as soon as conditions permit. If a survey must be terminated for any reason and no otter sign has been found then the survey must be finished the next day. Surveying should not be done within three days of a rainfall or snow event to allow time for the otters to track up the banks. Under normal conditions each site would be visited once during the year during the months of late December through late February or early March, depending on the weather. Otters are the most active during this season and conditions are the most suitable for detecting sign. For this study each site was visited for three consecutive days instead of the typical one day. This method was chosen to account for travel time and location. The sites are spread out over the watershed and it was more efficient to visit the same sites in the same general location for three consecutive days. Due to time, weather, and personal conflicts data collection was completed between March 24, 2006 and April 16, 2006. A total of twelve days were spent surveying streams and collecting data.

Presence and absence data collected was translated to give a percentage of otter sign present in the watershed. Percentages were calculated as the number of bridge sites that were recorded as having otter sign present in relation to all bridge sites that were surveyed.

Results

For each of the fifteen sites a presence/absence of otter sign was recorded as well as the detectibility index of each site for all three days of visitation (Table 2). The weather was fair to decent on most days with partly cloudy to clear skies. The first three consecutive days from March 24, 2006 through March 26, 2006 had some light rain.

A percentage of sign presence was calculated for each visit and a visual analysis was performed to compare the percentages across days. If sign was detected the first day it was included as presence for the percentage of day 1. The percentage of sign presence for the first day of visitation was 13%. Any sign detected on day 2 that was not detected on day 1 was added to the percentage for the total on day 2. This shows the change in percentage of detection between one and two days of visitation. The percentage for the presence of new otter sign on the second day of visitation was 7% which was then added to the total percentage from day 1 to give a two day detection of 20%. Any sign that was detected on day 3 that was not detected on days 1 or 2 was added to the total percentage from day 2. This shows the change in percentage of detection between two and three days of visitation. The percentage for the presence of new otter sign on the third day of visitation was 0% which was then added to the total percentage from day 2 to give an overall detection of 20%.

Discussion

Detection of river otter sign was lowest on the first day of visitation, increased on the second day of visitation, and remained constant on the third day of visitation. This follows the prediction that an increase in visitation would provide more data to be used in the estimation of otter distribution and abundance. However, data only shows an increase over a second day of visitation and not a third day of visitation.

The small sample size is a limitation to this study and something that can be addressed in the future. Due to time and travel restrictions it was not feasible to have a larger sample size for this project. This is also something to take into consideration for professionals conducting these observations. Bridge surveys are a time consuming process and if extra visitation is not going to show a significant contribution to the estimation and distribution efforts of the river otter population in Ohio then it may not be optimal to do more than one visitation to each site per year. A possible combination of bridge surveys with another method of detection may produce better results of actual abundance and distribution that can be obtained in a timely and efficient fashion. Having more than one method may provide the opportunity to collect different types of data at the same time which would give a more in depth look at the population and abundance actually present.

Techniques currently in use to determine distribution and abundance of otters that could be used in conjunction with bridge surveys are fecal sampling (Dallas et al. 2002, Gallant et al. 2007, Hung et al. 2004, Prigioni et al. 2006) and collection of hair samples (Depue et al. 2007, Mowat and Paetkau 2002). These non-invasive molecular techniques can provide information on DNA and relatedness which can then be translated into sex ratios, abundance, and distribution of individual animals (Depue et al. 2007, Hung et al. 2004). In areas of known populations of European otters (*Lutra lutra*) fecal collection has proved to be an accurate method of sampling (Prigioni et al. 2006). Fecal sampling and collection of hair samples allows biologists and technicians to collect field samples in a relatively short amount of time and conduct primary analysis in the laboratory. These are a benefit over bridge surveys as an observation method because it makes weather less of a factor in the integrity of the samples observed and collected.

There are still other factors to take into consideration when using fecal samples and collection of hair samples though, and not all research has shown these to be overall effective methods (Dallas et al. 2002, Gallant et al. 2007). There is not a defined proportion of scat deposited in the water in relation to scat deposited on land and this could alter the results of a population estimate (Gallant et al. 2007). False negatives can be obtained when it is concluded that otters are not present on a section of stream when the otter simply did not defecate on that stretch of riverbank, which is also true for bridge surveys. In addition, hair from multiple animals could be collected at the same location and only one hair can be used for DNA typing to prevent false analysis, but this could also lead to a misrepresentation of the actual populatioin (Depue et al. 2007). The analysis of fecal and hair samples can be very costly, and further evaluation of this method in comparison or conjunction with other methods would still need to be taken into consideration for individual studies (Dallas et al. 2002, Hung et al. 2004).

There are other observation and sampling techniques that are used to monitor and determine otter distribution and abundance that have not been found to be as accurate on an individual use basis. These may also be able to be used in conjunction with bridge surveys, and include visual and track censuses (Ruiz-Olmo et al. 2001) and scent stations (Robson and Humphrey 1985). Track censuses are conducted in much the same way as bridge surveys, but involve taking length measurements of tracks detected and using the measurements to differentiate individual otters (Ruiz-Olmo et al. 2001). Scent stations are used to lure animals in to collect their tracks, but have not been shown to be an effective lone observation technique as otters quickly lose interest in the attractants (Robson and Humphrey 1985).

Another factor to take into consideration is the actual process that was used for this research. While each bridge site was visited for three consecutive days this may have also created problems for analysis. For each site that had sign present on multiple days all of that sign may have been able to be found on the first visit. For example, at a bridge site where there was a presence of sign on all three days all of the sign may have been visible on the first day. These surveys are designed so that as soon as the first sign is detected the survey is complete. If sign is detected on the first bank that is observed and the survey is complete then sign that may be present on the other banks will not be observed on day 1. However, the sign found on day 1 is not recorded on day 2, so the next sign detected on the second bank on the second day is recorded as presence when it may have actually been present on day 1. To better account for this accumulation of sign, it may be more efficient to visit each site on a weekly basis to allow time for new sign to accumulate, or it may be beneficial to survey the entire 1200m of bank at each site on each day. This will account for all sign that is present so that it is not misrepresented as new sign on days 2 and 3.

Finally, the time of year that the surveys were conducted and the weather conditions may have played a role in the lack of presence detected. Surveys for this study were conducted later in the season than normally recommended. While this time period was approved for this study, it may show that the time period that was previously selected is the optimal time to complete the surveys. Late December to early March was chosen for a reason, because river otters are the most active and the conditions are the most suitable for detection. The later it gets in the season it may be that the otters were not as active, and while sign was not detected at a particular bridge site otters may still have been present at that location. Also, the first three consecutive days of surveying had a light rain. As this was not a large rainfall event, surveys were still conducted. However, no sign was detected during this time and this could be attributed to it being washed away by the accumulation of water from the light rain.

Conclusions

The heightened visitation of bridge sites for observation of river otter sign was able to show an increase in detection over multiple days. While the data of the study represents this trend, the small sample size and small amount of presence found at the selected sites are not sufficient to make a firm conclusion. At this point it is not recommended that the bridge surveys be increased until further evaluation is conducted.

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Literature Cited

Anon 1. No safety in numbers for Ohio’s 4,300 otter. USA Today. Life Section. Monday, January 24, 2005

Anon 2. Techniques to avoid trapping river otters. Ohio Division of Wildlife and the Ohio State Trapper’s Association publication. <http://www.dnr.state.oh.us/wildlife/PDF/pub407.pdf>

Ben-David, M., R.T. Bowyer, L.K. Duffy, D.D. Roby, and D.M.Schell. 1998. Social behavior and ecosystem processes: river otter latrines and nutrient dynamics of terrestrial vegetation. Ecology 79(7):2567-2571.

Dallas, J.F., K.E. Coxon, T. Sykes, P.R.F. Chanin, F. Marshall, D.N. Carss, P.J. Bacon, S.B. Piertney, and P.A. Racey. 2002. Similar estimates of population genetic composition and sex ratio derived from carcasses and faeces [sic] of Eurasion otter *Lutra lutra*. Blackwell Science Ltd. 12(1)275-282.

Depue, J.E. and M. Ben-David. 2007. Hair sampling techniques for river otters. Journal of Wildlife Management 71(2):671-674.

Dwyer, C.P. 2006. Population assessment and distribution of river otters in Ohio. 2006 Wildlife Research Report. Ohio Department of Natural Resources, Division of Wildlife, Columbus, USA. 29-32.

Erickson, D.W. and C.R. McCullough. 1987. Fates of translocated river otters in Missouri. Wildlife Society Bulletin 15(4):511-517.

Gallant, D., L. Vasseur, and C.H. Bérubé. 2007. Unveiling the limitations of scat surveys to monitor social species: a case study on river otters. Journal of Wildlife Management. 71(1):258-265.

Hall, E.R. 1981. The mammals of North America. John Wiley & Sons, New York, New York, USA.

Hamilton, D. 1999. Controversy in times of plenty. Missouri Conservationist online. <http://www.mdc.mo.gov/conmag/1999/11/40.htm>

Hung, C.M., S.H. Li, and L.L. Lee. 2004. Faecal [sic] DNA typing to determine the abundance and spatial organisation [sic] of otters (*Lutra lutra*) along two stream systems in Kinmen. Animal Conservation 7(3)301-311.

Johnson, S.A. and K.A. Berkley. 1999. Restoring river otters in Indiana. Wildlife Society Bulletin 27(2):419-427.

Kurta, Allen. 1995. Mammals of the Great Lakes region: revised edition. The University of Michigan Press, Ann Arbor.

Mountz, V. and C. Dwyer. 2002. River otters making a comeback in Ohio. Ohio Department of Natural Resources. <http://www.dnr.state.oh.us/news/jan02/0110ottercomeback.htm>

Mowat, G., and D. Paetkau. 2002. Estimating marten *Martes Americana* population size using hair capture and genetic tagging. Wildlife Biology 8(3)201-209.

Newman, D.G. and C.R. Griffin. 1994. Wetland use by river otters in Massachusetts. Journal of Wildlife Management 58(1):18-23.

Prigioni, C., L. Remonti, A. Balestrieri, S. Sgrosso, G. Priore, N. Mucci, and E. Randi. 2006. Estimation of European otter (*Lutra lutra*) population size by fecal DNA typing in Southern Italy. Journal of Mammalogy 87(5):855-858.

Robson, M.S. and S.R. Humphrey. 1985. Inefficacy of scent-stations for monitoring river otter populations. Wildlife Society Bulletin 13(4):558-561.

Rostain, R.R., M. Ben-David, P. Groves, and J.A. Randall. 2004. Why do river otters scent-mark? An experimental test of several hypotheses. Animal Behaviour 68(4): 703-711.

Ruiz-Olmo, J., D. Saavedra, and J. Jiménez. 2001. Testing the surveys and visual track censuses of Eurasian otters (*Lutra lutra*). Journal of Zoology, London 253(3):359-369.

Serfass, Thomas L., Robert P. Brooks, Thomas J. Swimley, Larry M. Rymon, and Arnold H. Hayden. 1996. Considerations for capturing, handling, and translocating river otters. Wildlife Society Bulletin 24(1):25-31

Shackelford, J. and J. Whitaker. 1997. Relative abundance of the northern river otter, Lontra canadensis, in three drainage basins of southeastern Oklahoma. Proceedings of the Oklahoma Academy of Science 77:93-98.

Swimley, T. J., T.L. Serfass, R.P. Brooks, and W.M. Tzilkowski. 1998. Predicting river otter latrine sites in Pennsylvania. Wildlife Society Bulletin 26(4):836-845

Unpublished Report 2004. River Otter Bridge Survey Protocol. Ohio Division of Wildlife. Columbus, Ohio.

Whitaker, J. O. Jr. 1996. National Audubon Society field guide to North American mammals. Alfred A. Knopf, New York.

Tables and Figures

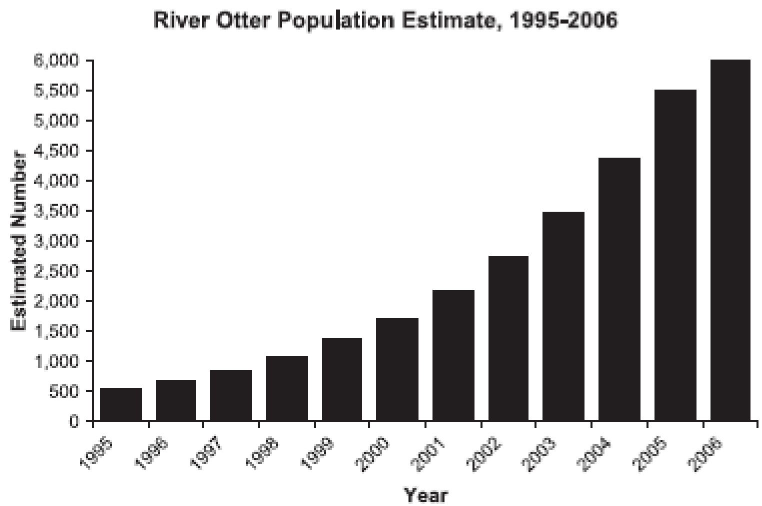

Figure 1. Population growth of river otters in Ohio from 1995-2006 by estimation from bridge surveys, observation reports, and population modeling (ODNR Division of Wildlife).

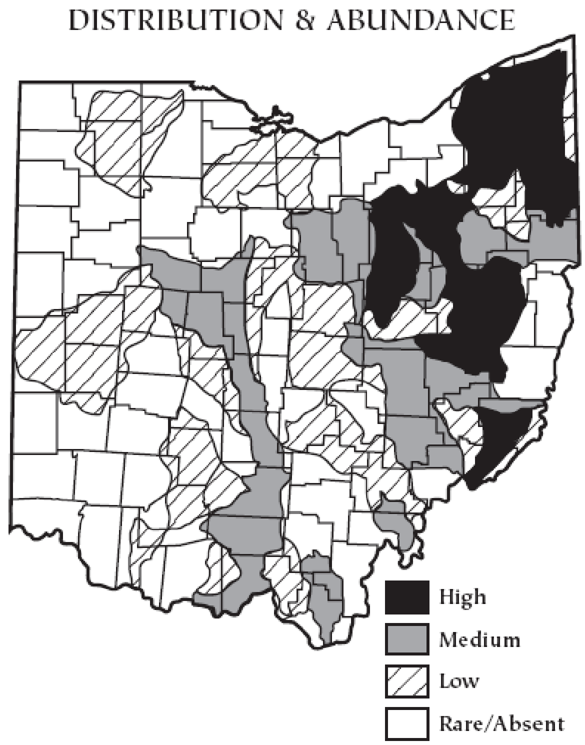

Figure 2. Distribution and abundance of river otters in Ohio by watershed in 2006 (ODNR Division of Wildlife)

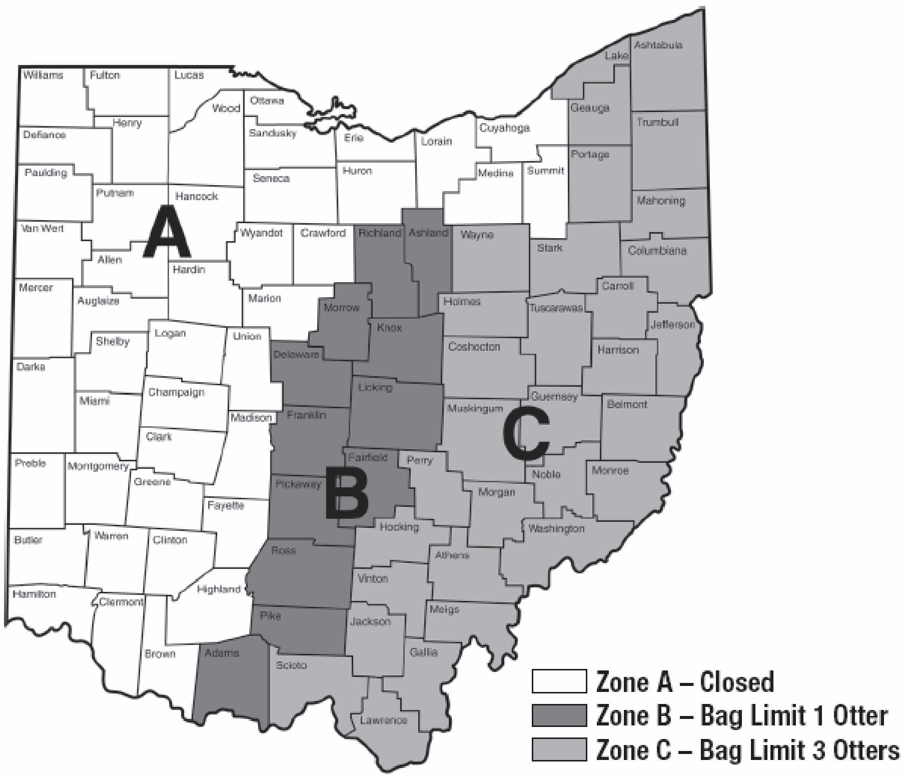

Figure 3. River otter trapping zones and bag limits in Ohio, 2005-2007 (ODNR Division of Wildlife).

Table 1. Location of bridge sites used in Killbuck Creek watershed in 2006 for the observation of river otter sign.

Bridge site	County	Nearest city/town	Stream/road intersection
62	Wayne	SE of Rittman	Steiner Road/Township Highway 108 and Little Chippewa Creek.
63	Wayne	N of Orrville	North Crown Hill Road/Township Highway 47 and Chippewa Creek.
65	Wayne	SE of Kidron	State Highway 250 and Little Sugar Creek
69	Holmes	S of Trail	State Highway 515 and Trail Creek
70	Holmes	E of Walnut Creek	Township Highway 444 and Walnut Creek
76	Ashland	N of Ashland	County Road 956 and Lang Creek
77	Ashland	NE of Ashland	Township Highway 1275 and Katotawa Creek
78	Wayne	E of Congress	State Highway 604 and Killbuck Creek
79	Ashland	SE of Rowsburg	Township Highway 1550 and Muddy Fork Creek
80	Ashland	S of Ashland	State Highway 60 and Newell Run
81	Ashland	SW of Ashland	State Highway 63 and a tributary of Black Fork Mohican River
82	Ashland	NE of Perrysville	Township highway 2475 and Honey Creek
84	Wayne	SE of Mohicanville	County Road 2575 and Lake Fork Mohican River
87	Holmes	SE of Millersburg	County Road 58 and Lower Sand Creek
88	Holmes	S of Holmesville	State Highway 83 and Martins Creek

Table 2. Presence (1) and absence (0) of river otter sign at selected bridge sites, and detectibility index recorded on a scale of 0 to 10 with each point representing a 10% increase of suitable conditions of stream bank for viewing otter sign at Killbuck Creek Watershed, March-April 2006.

Bridge site	Day 1	Day 2	Day 3	Detectibility index
62	0	0	0	5
63	0	0	0	3
65	0	0	0	3
69	0	1	0	4
70	1	0	1	5
76	0	0	0	4
77	0	0	0	7
78	0	0	0	5
79	0	0	0	6
80	0	0	0	5
81	0	0	0	4
82	0	0	0	3
84	0	0	0	4
87	0	0	0	7
88	1	1	1	6