

Surveys

River Otter Status, Management, and Distribution in the United States: Evidence of Large-Scale Population Increase and Range Expansion

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Abstract

River otter *Lontra canadensis* populations in the United States have expanded during the past 50 y as a result of improvements in habitat quality and effective management programs implemented by state and federal agencies and native tribes. Periodic assessments of river otter status, population trends, and geographic distribution are needed to detect changes in populations, assess management approaches, and to identify and prioritize conservation efforts. We surveyed state wildlife agency experts to assess the current population and regulatory status of river otters in their jurisdictions. River otters were legally harvested in 40 states as of 2016. Twenty-two states reported increasing populations while 25 reported stable populations. Most states used multiple methods to monitor river otter populations including harvest-based surveys, presence-absence surveys, and empirically derived population model predictions; harvest-based surveys were the most commonly used monitoring approach. As populations have expanded, river otter reintroduction efforts have become less frequent; two additional states had conducted reintroductions since 1998 and only one state had conducted a reintroduction since 2010. We estimated that river otter distribution increased by 10.2% in the continental United States and by 13.7% in the contiguous United States during an 18-y period. Although populations may continue to increase numerically, river otters may be approaching their potential maximum geographic distribution in the United States.

Keywords: distribution; harvest; *Lontra canadensis*; management; restoration; river otter; United States

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Introduction

The river otter *Lontra canadensis* is an elusive species that can serve an important role in aquatic ecosystems as a top predator of fish and crayfish. River otters are also valued as a game species and furbearer (Melquist et al. 2003). River otters historically inhabited every major watershed in the contiguous United States and were extirpated from much of their historical range as a result of multiple factors including habitat degradation and destruction as well as unregulated harvest (Anderson 1977). By the early 1900s river otters had been completely extirpated from 11 states and had experienced severe population declines in 9 other states (Deems and Pursley 1978). The river otter was included as an Appendix II species under the Convention on International Trade in Endangered Species of Wild Fauna and Flora in 1977 as a result of concern that endangered otter species, such as *Pteronura brasiliensis*, could be misidentified as river otter because of a similar superficial appearance, which could lead to unintentional trade of endangered species; however, it is important to note that the river otter itself has never been considered a globally threatened or endangered species (Greenwalt 1977). Since inclusion under Convention on International Trade in Endangered Species of Wild Fauna and Flora, the U.S. Fish and Wildlife Service, through the Division of Scientific Authority, housed in the International Affairs Program, has routinely determined that the export of river otter pelts and products from the United States has not been detrimental to their viability, thus satisfying the conditions of the Convention on International Trade in Endangered Species of Wild Fauna and Flora agreement (Bowman et al. 2010).

Deems and Pursley (1978), estimated that river otters occupied 71% of their historical range during 1977; by 1998, river otter populations had expanded and were thought to occupy 90% of their prior range (Melquist et al. 2003). This continued numeric and geographic expansion was fostered by conservation management programs by state and federal agencies, natural dispersal and expansion of existing populations into increasingly suitable habitats, and reintroduction efforts by state wildlife agencies and conservation partnerships (Raesly 2001). Assessments of river otter populations within the contiguous United States have occurred periodically since their inclusion in Convention on International Trade in Endangered Species of Wild Fauna and Flora (e.g., Polechla 1990, Raesly 2001, Melquist et al. 2003). We surveyed state wildlife agency experts regarding 1) the legal status of river otters in their state, 2) the statewide river otter population trend, 3) the results of reintroduction efforts (if applicable), 4) the population status of river otters since reintroduction efforts, 5) the method(s) of river otter population monitoring, 6) how frequently adjustments are made to harvest regulations (if applicable), 7) and the geographic distribution of river otters in their state. Herein we provide an updated account, as of 2016, of river otter population status and distribution in the United States and discuss conservation priorities.

Methods

We contacted wildlife management agencies from all states in the contiguous United States during 2016 via email (Figure S1, *Supplemental Material*), and Alaska via phone, targeting agency personnel that were responsible for river otter management. We asked each agency expert to report 1) the legal status of river otters in their state, 2) the statewide river otter population trend, 3) the results of reintroduction efforts (if applicable), 4) the population status of river otters since reintroduction efforts, 5) the method(s) of river otter population monitoring, 6) how frequently adjustments are made to harvest regulations (if applicable), 7) and the geographic distribution of river otters in their state. Potential responses concerning legal status included regulated harvest, no harvest, state threatened, or state endangered. Responses for population trends included increasing, stable, or decreasing (although we did not specify the timeframe). Questions concerning river otter reintroductions assessed the purpose(s) (e.g., reestablish extirpated populations, bolster existing populations, or expand river otter range beyond current distributions) and outcomes (e.g., expanding, stagnant or geographically restrained, decreasing, or unknown) of reintroduction efforts. Methods of population monitoring included bridge surveys (presence vs. absence track surveys conducted at bridge crossings), harvest surveys, bow-hunter surveys, camera surveys, winter track surveys, population models from harvest data, harvest effort, and agency field questionnaires (for detailed descriptions of these methods, we direct readers to Chillelli et al. [1996], Roberts et al. [2008], and Roberts [2010]). We categorized the frequencies of regulatory review within state agencies into the following: never, every 4–5 y, every 2–3 y, annually, and immediately as needed. We tallied responses to these questions and reported frequency of responses. We assessed geographic distribution in each state based on a county basis; Alaska does not have county jurisdictions, so we gathered information via a phone interview to assess geographic distribution (Alaska Department of Fish and Game, personal communication). When river otter presence was unknown in a county, which could occur where there is no harvest or monitoring effort (i.e., arid or remote regions), we recorded presence in those counties as ‘unknown.’ When estimating occupied range area or river otters, we only summed the area of the counties with known presence and excluded those counties that are listed as unknown (Table S1, *Supplemental Material*). To compare estimates of occupied area in 1998 with our survey results, we digitized published maps depicting river otter distribution during 1998 (Melquist et al. 2003) using ArcMap (ESRI 2011).

Results

We received responses from all 48 contiguous states and interviewed agency personnel in Alaska; not all responses were complete (Table S1). Based on this 2016 survey, 22 states reported increasing populations, 25



states reported stable populations, and 2 states (Arizona and Washington) reported an uncertain population trend (Table 1). River otters were legally harvested in 40 states, while closed harvest seasons existed in 9 states; Arizona, California, Colorado, Nebraska, New Mexico, Rhode Island, South Dakota, Utah, and Wyoming (Table 1).

States reported a variety of methods that were used to monitor river otter populations. Most ($n = 31$, 63.3%) states used multiple methods to monitor river otter populations. Harvest-based surveys were the most commonly used monitoring approach, being used by 35 states (Table 1). Catch-per-unit effort, population models, and presence vs. absence indices, such as bowhunter surveys and track surveys, were used less frequently (Table 1). Only four states—Nevada, Rhode Island, Utah, and Wyoming—did not report any monitoring efforts.

As of 2016, 23 states had conducted river otter reintroductions. Ten states indicated that they had reintroduced river otters to establish populations that had been extirpated (Table 1). The remaining states indicated that they reintroduced river otters to expand populations in their state beyond their current range, including three states that indicated that reintroductions were also used to reestablish extirpated populations and seven states that used reintroductions to bolster populations where they already existed (Table 1). Only one state, Utah, had conducted river otter reintroductions since 2010. Twenty-one of the 23 states (91.3%) that implemented reintroductions reported that populations were increasing or had reached population goals, and 2 states (Minnesota and North Dakota) indicated that populations were stagnant or geographically restrained (Table 1).

Harvest regulations are reviewed frequently by most states that allow harvest (Table 1). Only three states (Illinois, Kentucky, and North Dakota) did not provide a response to our question about regulation review frequency (Table 1). Of the remaining 37 states; 24 states reviewed regulations “promptly” or annually and 10 states reviewed harvest regulations in cycles of 2–3 y; Michigan reported that regulations are reviewed “every 2 to 3 years” and “promptly as needed” (Table 1). Two states (Connecticut and Tennessee) reported that regulations are reviewed “every 4 to 5 years.” South Carolina and Texas reported that harvest regulations are “never” reviewed.

We estimated the county-level geographic distribution occupied by river otters in the continental United States during 2016 to be approximately 7,422,120 km²—75% of the total land area and 94% of the available total water area. Within the contiguous United States, we estimated that the county-level geographic distribution occupied by river otters to be approximately 5,686,140 km²—70% of the total land area and 90% of the total water area. (Figure 1). River otters were reported to be ubiquitous throughout Alaska south of the Brooks Range (Alaska Department of Fish and Game, personal communication). Based on maps published by Melquist et al. (2003), we estimated that during 1998, river otters occupied approximately 6,736,558 km²—nearly 65% of the land

area of the contiguous United States—and that the potential river otter range was 7,485,065 km². Similarly, we estimated that river otters occupied approximately 5,000,550 km²—nearly 63% of the land area of the contiguous United States—and that the potential river otter range was approaching 5,556,200 km². Comparisons between our survey and published reports from 1998 (Melquist et al. 2003) indicated that changes in river otter distribution occurred primarily in the contiguous United States and that river otters had expanded their range by approximately 13.7% during an 18-y period (Table 2). We estimated that river otter range in the continental United States expanded by 10.2% during this period (Table 3).

Discussion

As per the North American Model of wildlife conservation, river otters are held in the public trust by the “government” and are managed by state and federal agencies as well as by native tribes (Mahoney and Geist 2019). Agency-enforced regulations include restrictions on harvest, harvest season length, harvest methods, and bag limits. Based on our survey, river otters were harvested in 40 states during 2016. Within states that harvested otters, regulations concerning river otter harvest seasons were reviewed and adjusted regularly. The continued expansion of river otter populations where they are managed by regulated harvest is likely enhanced by the frequency of these regulatory reviews.

River otter reintroductions were widespread during the late 20th century (Raesly 2001). As of 2016, >4,000 river otters have been translocated to 23 states in one of the most ambitious and extensive carnivore restoration efforts in history (Erb et al. 2018). Our survey indicated that <50% of the river otter reintroductions implemented in the United States were in areas where otters had been extirpated. Other restoration efforts were conducted to bolster existing river otter populations and to expand otter distributions and provide connectivity within states that had existing, but not ubiquitous, river otter populations (Table 1). The majority of these projects were implemented in the mid-1980s and were completed by the late 1990s; only two states (New York and Pennsylvania) were actively engaged in reintroductions during 1998 (Raesly 2001). As of 2016, only two additional states had conducted reintroductions (New Mexico and North Dakota) since Raesly’s (2001) previous assessment and Utah was the only state that had reintroduced river otters since 2010. The cessation of wide-scale reintroduction activities may suggest that the majority of suitable habitats are currently occupied by established river otter populations. Raesly (2001) determined that, although it is preferable to acquire river otters from proximal populations to maximize genetic similarity and retain subspecies integrity, most jurisdictions used the most easily obtained river otters, often from Louisiana, during reintroduction projects. The overall impacts, or extent, of genetic infusion from distant populations that were sourced for these reintro-

Table 1. River otter *Lontra canadensis* population and regulatory status, population monitoring methods used, intent and outcome of reintroduction efforts, and frequency of harvest regulation reviews in 49 states (Hawaii excluded) within the United States in 2016.

State	Population trend	Harvest status	Population monitoring method(s) used	Intent of reintroduction	Success of reintroduction	Frequency of harvest regulations review
Alabama	Increasing	Regulated trapping season	Harvest surveys, Road-kill surveys	Not applicable	Not applicable	Annually
Alaska	Stable	Regulated trapping season	Harvest surveys, harvest effort, population models	Not applicable	Not applicable	Adjustments made promptly as needed
Arizona	Uncertain	No trapping season	Latrine-site surveys, nuisance reports	Reestablish an extirpated population	Population increasing	Not applicable
Arkansas	Stable	Regulated trapping season	Harvest surveys	Not applicable	Not applicable	Annually
California	Stable	No trapping season	Camera surveys	Not applicable	Not applicable	Not applicable
Colorado	Increasing	No trapping season	Track surveys	Establish in unoccupied portion of state	Population increasing	Not applicable
Connecticut	Stable	Regulated trapping season	Harvest surveys, harvest effort	Not applicable	Not applicable	Four to five years
Delaware	Increasing	Regulated trapping season	Harvest surveys	Not applicable	Not applicable	Adjustments made promptly as needed
Florida	Stable	Regulated trapping season	Harvest effort	Not applicable	Not applicable	Adjustments made promptly as needed
Georgia	Stable	Regulated trapping season	Harvest surveys	Not applicable	Not applicable	Two to three years
Idaho	Stable	Regulated trapping season	Harvest effort	Not applicable	Not applicable	Two to three years
Illinois	Increasing	Regulated trapping season	Harvest surveys, population models	Establish in unoccupied portion of state and bolster existing populations	Goal fully met	No response
Indiana	Increasing	Regulated trapping season	Harvest surveys, harvest effort, bowhunter surveys	Reestablish an extirpated population	Goal fully met	Annually
Iowa	Stable	Regulated trapping season	Harvest surveys, population models, bowhunter surveys	Establish in unoccupied portion of state and bolster existing populations	Goal fully met	Annually
Kansas	Increasing	Regulated trapping season	Harvest surveys, harvest effort, bowhunter surveys	Reestablish an extirpated population	Population increasing	Annually
Kentucky	Increasing	Regulated trapping season	Harvest registration only	Establish in unoccupied portion of state	Population increasing	No response
Louisiana	Stable	Regulated trapping season	Harvest surveys	Not applicable	Not applicable	Annually
Maine	Increasing	Regulated trapping season	Harvest surveys, population models	Not applicable	Not applicable	Annually; Adjustments made promptly as needed
Maryland	Increasing	Regulated trapping season	Harvest surveys, population models, bowhunter surveys	Establish in unoccupied portion of state	Goal fully met	Two to three years
Massachusetts	Stable	Regulated trapping season	Harvest surveys, harvest effort	Not applicable	Not applicable	Adjustments made promptly as needed
Michigan	Stable	Regulated trapping season	Harvest surveys, harvest effort	Not applicable	Not applicable	Two to three years; Adjustments made promptly as needed

Table 1. Continued.

State	Population trend	Harvest status	Population monitoring method(s) used	Intent of reintroduction	Success of reintroduction	Frequency of harvest regulations review
Minnesota	Stable	Regulated trapping season	Harvest surveys, harvest effort, population models, winter track surveys	Establish in unoccupied portion of state	Population stagnant or geographically constrained	Annually
Mississippi	Stable	Regulated trapping season	Harvest surveys	Not applicable	Not applicable	Annually
Missouri	Stable	Regulated trapping season	Harvest surveys, harvest effort, population models, bowhunter surveys	Establish in unoccupied portion of state and bolster existing populations	Goal fully met	Adjustments made promptly as needed
Montana	Increasing	Regulated trapping season	Harvest surveys, harvest effort	Not applicable	Not applicable	Annually
Nebraska	Increasing	No trapping season	Bridge surveys, camera surveys	Reestablish an extirpated population	Population increasing	Not applicable
Nevada	Stable	Regulated trapping season	No monitoring	Not applicable	Not applicable	Two to three years
New Hampshire	Stable	Regulated trapping season	Harvest surveys, harvest effort	Not applicable	Not applicable	Two to three years
New Jersey	Stable	Regulated trapping season	Harvest surveys, harvest effort	Not applicable	Not applicable	Two to three years
New Mexico	Increasing	No trapping season	Camera surveys	Reestablish an extirpated population	Population increasing	Not applicable
New York	Increasing	Regulated trapping season	Harvest surveys, harvest effort, population models, bridge surveys, winter track surveys	Establish in unoccupied portion of state and bolster existing populations	Population increasing	Adjustments made promptly as needed
North Carolina	Increasing	Regulated trapping season	Harvest surveys, harvest effort	Establish in unoccupied portion of state and bolster existing populations	Goal fully met	Adjustments made promptly as needed
North Dakota	Stable	Regulated trapping season	Historically used camera surveys, winter track surveys, population modeling	Reestablish an extirpated population	Population stagnant or geographically constrained	No response
Ohio	Increasing	Regulated trapping season	Harvest surveys, harvest effort, bowhunter surveys, bridge surveys, camera surveys	Reestablish an extirpated population	Goal fully met	Annually
Oklahoma	Increasing	Regulated trapping season	Harvest surveys, harvest effort, bowhunter surveys	Reestablish an extirpated population	Goal fully met	Annually
Oregon	Stable	Regulated trapping season	Harvest surveys, harvest effort	Not applicable	Not applicable	Two to three years
Pennsylvania	Stable	Regulated trapping season	Harvest surveys, population models	Establish in unoccupied portion of state	Goal fully met	Annually
Rhode Island	Stable	No trapping season	None reported	Not applicable	Not applicable	Not applicable
South Carolina	Stable	Regulated trapping season	Harvest surveys	Not applicable	Not applicable	Never
South Dakota	Increasing	No trapping season	Incidental harvest and road-kill surveys	Reestablish an extirpated population	Population increasing	Not applicable
Tennessee	Increasing	Regulated trapping season	Harvest surveys	Establish in unoccupied portion of state	Population increasing	Four to five years

Table 1. Continued.

State	Population trend	Harvest status	Population monitoring method(s) used	Intent of reintroduction	Success of reintroduction	Frequency of harvest regulations review
Texas	Stable	Regulated trapping season	Harvest surveys	Not applicable	Not applicable	Never
Utah	Stable	No trapping season	No current monitoring	Establish in unoccupied portion of state and bolster existing populations	Population increasing	Not applicable
Vermont	Increasing	Regulated trapping season	Harvest surveys, harvest effort, population models	Not applicable	Not applicable	Adjustments made promptly as needed
Virginia	Increasing	Regulated trapping season	Harvest surveys, harvest effort	Establish in unoccupied portion of state and bolster existing populations	Population increasing	Two to three years
Washington	Uncertain	Regulated trapping season	Harvest surveys, harvest effort	Not applicable	Not applicable	Two to three years
West Virginia	Stable	Regulated trapping season	Harvest surveys, population models, bridge surveys	Reestablish an extirpated population	Goal fully met	Annually
Wisconsin	Increasing	Regulated trapping season	Harvest surveys, harvest effort, population models, bowhunter surveys, bridge surveys, camera surveys, winter track surveys, field-staff questionnaire	Not applicable	Not applicable	Annually
Wyoming	Increasing	No trapping season	No systematic monitoring effort	Not applicable	Not applicable	Not applicable

Table 2. Estimated range of river otters *Lontra canadensis* in the United States during 2016 compared with 1998 (estimated from Melquist et al. 2003), excluding Alaska.

Year	Estimated range
1998	5,000,550 km ²
2016	5,686,140 km ²
Percent change	13.7

duction efforts are unknown, but our results suggest that range expansion has occurred nevertheless.

River otters are challenging to monitor because of their secretive nature and the fact that they naturally occur at relatively low densities on the landscape. Although state wildlife-management agencies use a variety of techniques to monitor changes in river otter population size and distribution, regulated harvest-management programs provide the foundation for the much of the population monitoring that occurs. Of the 40 states that incorporate harvest management programs, the majority used data from regulated harvest seasons (e.g., surveys of trappers, estimates of trapper effort, or collection of biological samples to estimate demographic and health parameters) to monitor river otter populations and to ensure that harvest levels were sustainable. For many furbearers, including river otter, harvest-based data are the only information available with sufficient sample sizes large enough for robust analyses (White et al. 2015). Chilelli et al. (1996) encouraged jurisdictions to standardize monitoring methodology. Two decades later, there is still considerable variation in monitoring methods and effort across jurisdictions. Some variation is to be expected because each jurisdiction has different resources and priorities for wildlife programs. As populations grow and expand, it is reasonable to assume that some jurisdictions may shift monitoring resources toward less secure species. Jurisdictions that have harvest are afforded more monitoring opportunities through harvest-dependent data sources, such as catch-per-unit effort, distribution of harvests, and sex and age-structure of harvests. We reiterate Chilelli et al. (1996) and suggest that jurisdictions that allow harvest should collect information on the distribution of harvest, some measure of participation or effort, and, ideally, some estimate of age-structure of the harvest. These harvest-dependent data can be synthesized in appropriate population models to yield a wealth of information on population status and trends (Roberts 2010). In the absence of harvest-dependent data, presence-absence data (such as track surveys), can indicate population distribution and trajectories (Roberts et al. 2008).

Table 3. Estimated range of river otters *Lontra canadensis* in the United States during 2016 compared with 1998 (estimated from Melquist et al. 2003).

Year	Estimated range
1998	6,736,558 km ²
2016	7,422,120 km ²
Percent change	10.2

River Otter Presence in the 48 Contiguous United States

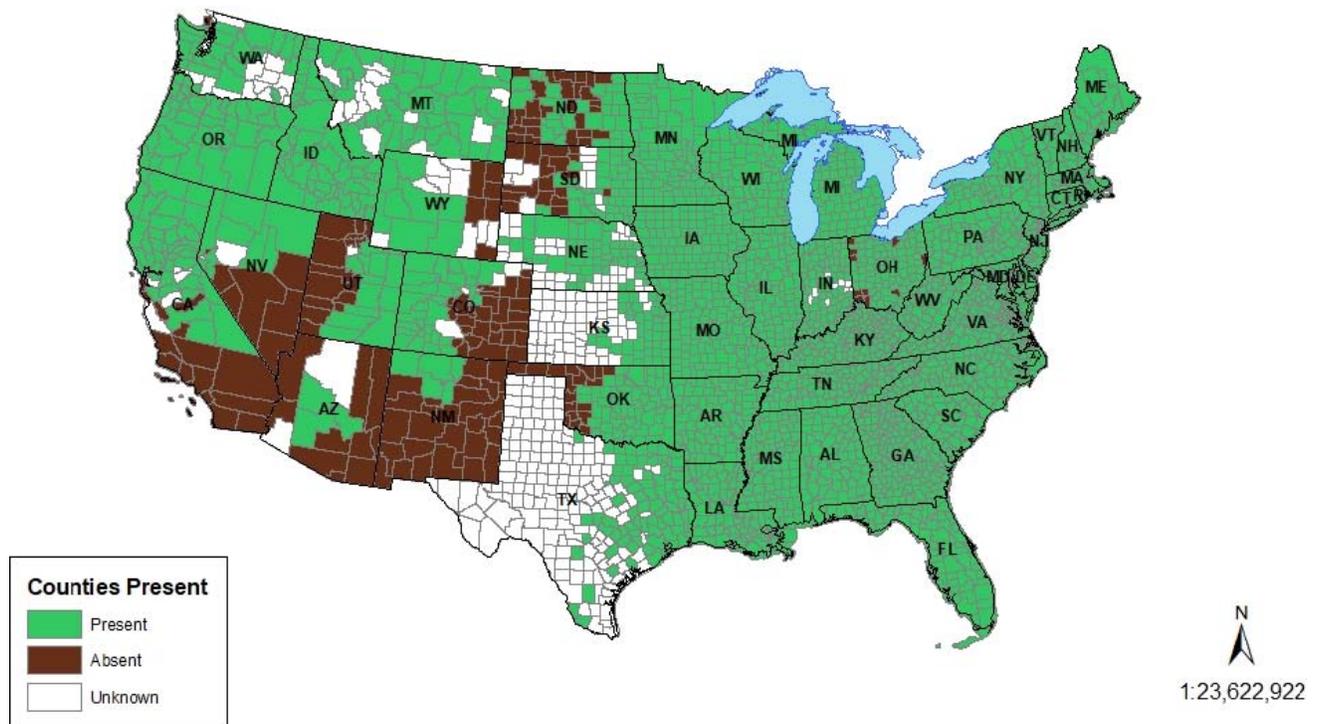


Figure 1. County-level distribution of river otter *Lontra canadensis* in the United States estimated by state wildlife agencies in 2016 (Alaska does not have county-level data and there is no occurrence in Hawaii).

Results from this 2016 assessment provide the most recent account of river otter status and distribution in United States to our knowledge. We found that river otters have expanded their range significantly in the contiguous United States since the last assessment in 1998 (Melquist et al. 2003). Although methodologies and sampling scales differed from the approach used in our assessment, comparisons of land areas occupied during each period provided a coarse-scale basis for estimates of population expansion or retraction during an 18-y period. Given the large extent of the species' range, we were limited to county-level inference. Although is unlikely that river otters inhabit the entire county, we believe this to be a sufficient and consistent with other species assessments. It is also possible that we underestimated the geographic extent of the range given that presence is unknown in some counties, particularly in arid regions, and these areas were excluded from our estimate. Similarly, it is possible that false-negatives occurred, particularly at lower population densities. Nevertheless, these results provide an empirical, albeit coarse, contemporary estimate of river otter range in the United States. Melquist et al. (2003) suggested that in 1998, as a result of wetland conservation and restoration efforts, river otters had expanded and inhabited approximately 90% of their former range. Our area estimates of river otter distribution in the contiguous United States during 2016 (e.g., 5,686,140 km²) were strikingly similar (i.e., only 2.3% greater) to what Melquist et al. (2003) suggested as 'potential' range in their 1998 assessment

of 5,556,200 km². This expansion was facilitated by restoration programs as well as natural dispersal and expansion of established populations.

River otters have a high dispersal capacity and are capable of extensive long-distance movements over land, including mountainous terrain and across watersheds (Magoun and Valkenburg 1977, Melquist and Hornocker 1983). Although populations may continue to increase numerically, river otters may be approaching their potential geographic distribution in the United States. Continued monitoring of the population status and distribution at state and national levels would likely detect any significant changes should they occur.

Supplemental Material

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Figure S1. Example questionnaire distributed to state wildlife agencies in 2006.

Found at DOI: <https://doi.org/10.3996/102018-JFWM-093.S1> (599 KB PDF).

Table S1. River otter *Lontra canadensis* status and management questionnaire responses by state agencies

in the United States during 2016 (Hawaii excluded). Description of metadata is included.

Found at DOI: <https://doi.org/10.3996/102018-JFWM-093.S2> (38 KB XLSX).

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