The Downtown Review

Volume 2 | Issue 2 Article 3

May 2016

The Ecological Impacts of Non-Native Species on River Otter Populations

Nadia Swit
Cleveland State University

Recommended Citation
Swit, Nadia. "The Ecological Impacts of Non-Native Species on River Otter Populations." *The Downtown Review*. Vol. 2. Iss. 2 (2016) .
Available at: https://engagedscholarship.csuohio.edu/tdr/vol2/iss2/3

INTRODUCTION

Biological invasions have been proven a considerable threat to biodiversity in invaded habitats. Interactions between the invaded species and the introduced species can be very complex, influencing community structure, modifying and altering habitats, and even negatively impacting trophic levels within the ecosystem. Biological homogenization is often the result after invasive species have impacted the environment (Crait & Ben-David, 2007; Wangelar et al., 2010). Competition and predation with native species can deplete food sources or even eliminate keystone species, while habitat structure can be altered through the non-indigenous species outcompeting local flora or fauna, or even providing opportunities for other species to occupy the altered niche left behind from native die-off. Non-native invasive species have also been proven one of the main drivers behind environmental change in freshwater ecosystems, making inland waters especially vulnerable (Barrientos et al., 2014). However, while non-native species are generally viewed as being destructive, other studies have shown how they can also have positive impacts on native biota (Barrientos et al., 2014).

One keystone species that has been impacted by the introduction of non-native species is the river otter. Due to their piscivourous and food-dependent nature, otters can serve as effective bio-indicators for lake health through their linking of aquatic and terrestrial systems: these constraints also make otters a useful indicator of wetland and waterway health (Wengeler et al., 2010). In both Europe and North America there have been invasive species that have affected otter populations both positively and negatively. The population dynamics of two different otter subspecies, the North American river otter (*Lontra canadensis)* and the Eurasian otter (*Lutra lutra*), are reviewed in order to determine how invasive species are effecting population growth and success, as both positive and negative interaction types would be important in developing procedures for otter conservation.

NORTH AMERICAN ECOLOGY

Yellowstone National Park

Otter home ranges have been shown to follow stream drainage patterns, and are more likely to be found with increasing woodland and watersheds containing larger streams and reservoirs (Jeffress et al., 2011), although otters can also prefer different habitat types depending on location. High urban and agricultural land use decreases biodiversity near watersheds, which could consequently impact otters (Jeffress et al., 2011). Otters also appear to have a threshold on high human densities (Jeffress et al., 2011). With these particularities for habitat preference influencing otter occurrence, an accidental or intentional introduction of a species can have profound consequences on ecosystem interactions.

One such example is the introduction of the lake trout (*Salvelinus namaycush*) to Yellowstone National Park (YNP), Wyoming in the 1890s. While these trout were present throughout the park in different lakes, certain consequences of their invasion in Yellowstone Lake (YL) were reported in the 1980s (Wengeler et al., 2010). These trout were a predatory threat to the native Yellowstone cutthroat trout (*Onocorhynchus clarki bouvieri*) as well as several other native fish species, and this predation competed with the native otter population as the cutthroat trout is a main staple in their diet. In Yellowstone Lake, then, increased predation by the lake trout could have significant implications for other fish populations, which in turn would also affect otter foraging.

Ecological behaviors of the lake trout also make it difficult for them to be maintained naturally through predation. These trout usually inhabit mid-water pelagic areas of the lake, which are out of range of normal otter foraging (Wengeler et al., 2010). Therefore, while these trout can serve as prey, the otters would more likely choose a food source that is easier to obtain – i.e., the native species. In the study conducted by Wengeler et al. (2010), otter scat was evaluated at two lake sites, Yellowstone Lake and Lewis Lake (LL) in order to determine if lake trout was at all present and at what quantities relative to other prey. The undigested components were evaluated and stable isotopes were analyzed from fish muscle tissue and related to the levels in the otter scat. It was found that diets between the two lakes were markedly different, with YL containing more native species in addition to the lake trout, while LL contained mostly non-natives. In YL, the longnose sucker (*Catostomus catostomus*) was being eaten in higher percentages compared to the more abundant lake trout. Likewise, in LL, otter fecal matter contained high amounts of the the longnose sucker despite the fish not being in that system. This suggested that otters were leaving their own habitat and traveling to other systems that supported the longnose sucker to forage there (Wengeler et al., 2010). In both cases, lake trout was found in only a very small portion of scat samples. These results indicated that rather than hunting and consuming lake trout, which was in abundance in both lake systems, the otters chose to rely on other food sources, such as the longnose sucker and other native fish. The declining population of cutthroat trout would also have been a motivating force behind relying on other native sources, including some arthropod and bird species.

Furthermore, the presence of the invasive lake trout to lake systems in YNP can continue to cause issues for the resident otter populations. Despite their utilization of other food sources in response to declining cutthroat, lake trout also feed on longnose sucker. Further depletions of food sources can greatly restrain otter diet and may force them to turn to lake trout as an alternative. However, otters were shown to resort to other native species before consuming non-natives (Wengeler et al., 2010). In addition to the loss of cutthroat eggs in the riparian system, which contain high amounts of nitrogen, the nutrient cycling of the lake would also change for both aquatic and terrestrial fauna. The riparian vegetation in many coastal systems have changed to nitrogen fixing species in response to decreased cutthroat populations (Wengeler et al., 2010). Ecological changes initiated by the incorporation of an invasive species can have further impacts on habitat structure, producing consequences for organisms across multiple trophic levels.

Figure 1. North American river otter (*Lontra canadensis)* (Munroe, n.d.).

INVASIVE IMPACT ON NUTRIENT CYCLING

With decreased otter populations, social latrine sites would also decline in number. In a study by Crait and Ben-David (2007), vegetation samples at latrine sites were evaluated to see how fecal deposits could affect growth. It was found that social latrine sites would then decrease the amount of nutrients deposited around vegetation along bank areas, also impacting habitat and tropic structure (Crait & Ben-David, 2007). Nutrient transport mediated by otter post-foraging activities create a route for fish nutrients into riparian forests, further emphasizing the link otters provide between aquatic and terrestrial life (Crait & Ben-David, 2007; Wengeler et al., 2010). However, fecal deposition or urine did not assure greater nitrogen availability as the nutrient could be lost through several processes.

Plant diversity can also change between latrine and non-latrine sites, although fertilization by otter scat caused higher growth rates in riparian vegetation, also causing “hot spots” of concentrated nutrients (Crait & Ben-David, 2007). These nutrient-rich patches could increase heterogeneity within the system. Unfortunately, the increase in lake trout also decreased otter interactions and involvement around the lake. This also reduced latrine sites, which in turn resulted in decreased nutrient sourcing for vegetation. Thus, the subsequent decrease in cutthroat would reduce the quantity and distribution of cutthroat predators, most importantly the otter (Crait & Ben-David, 2007). The elimination of otter populations would allow more invasive species to succeed in the area and continue to further alter the habitat. Instead of just impacting otter foraging behavior, then, the lake trout also affects other habitat structure and function, however indirectly.

EUROPEAN POPULATIONS

While the two aforementioned studies described non-native impacts on otter species in North America, the Eurasian otter has also been significantly impacted by introduced species. However, more so than the selected studies in North America, some non-native species have shown to have a more positive impact in regards to otter population and survival. For example, in several countries in Europe, otters have been reportedly shifting their diet to include more non-native species. However, not all nonindigenous fish species are included in this change, and are being preyed on less than expected in England and Iberia (Balastrieri et al., 2013). Contrastingly, introduced species such as the largemouth bass (*Micropterus salmoides*) and pumpkinseed (*Lepmos gibbosus*) in Italy, have replaced native fauna and have become an established component of the food chain and a prey source for the Eurasian otter. Other species include ruffe (*Gynmnocephalus cernuus*), common carp (C*yprinis carprio*) and rainbow trout (*Onchorynchus mykiss*) (Balastrieri et al., 2013). However, these fish have also had a much longer time to establish themselves in the area, and are within otter foraging ranges, which further increases their chance of consumption.

Figure 2. Eurasion otter (*Lutra lutra*) sleeping on Loch Spelve Isle of Mull, Inner Hebrides, Scotland (McCombe, 2014).

Invasive Species in Otter Diet

In a study looking at feeding adaptations of otters in response to temporal and spatial distributions of non-native species throughout Europe (Balastrieri et al., 2013), data was analyzed using a Random Forest Regression (RFR) to calculate the percentage relative frequency (%RF) of fish species in otter diet. It was found that the proportion of non-native species were consumed at different rates between countries, and that the majority of otter diets consisted of native fish, even in areas with an established population of non-indigenous species. Patterns revealed that a minimum threshold of fish density was required before predator-prey interactions were established between invaders and otters, suggesting that some time was needed for the latter to establish itself in the aquatic system in order to become a resource for native predators (Balastieri et al., 2013).

Additionally, non-native fish consumption was higher in areas altered by humans, including dams and fish farms. Ultimately, though, otters would resort to consuming these non-native species only if natural alternative resources were low (Balastieri et al., 2013). This correlates with the findings from the North American otters in YNP, who consumed lake trout only when necessary. No such relationship resulted between the species to change its trophic niche to include the consumption of non-native fish. However, unlike the lake trout, none of the non-native examples provided in the Balastieri et al. study (2013) indicated the invasive impact of the non-indigenous species and any possible effects they might have had on native fish populations.

Diet Limitations

Contrary to the selective predation of the Eurasian otter on nonindigenous species, otter populations in the Mediterranean catchment of the Iberian Peninsula have adapted their trophic niche to include non-native species, especially the red-swamp crayfish (*Procambarus clarkii*) (Barrientos et al., 2014). Introduced in the early 1970s for aquaculture purposes, the crustacean was not detected in the area until the mid-1980s. Otter spraint was analyzed and statistical tests were used to determine species abundance in the matter. While results from Barrientos et al. (2014) showed that native fish species still comprised a major part of the diet, red-swamp crayfish proved to be an important prey year-round, especially during the summer drought when many fish species cannot survive (Figure 3). Even though the crayfish provides less energy, these otters currently prefer to feed on crayfish over other prey and the cost-benefit ratio of foraging can be favorable to otters (Barrientos et al., 2014). However, following consumption, trophic diversity and niche breadth decreased due to prey favorability, which contrasts with variability in diet before crayfish introduction in 1980.

While it is beneficial for otters to have this abundant resource in the constraining summer season, as it can enhance occupied areas and increase survival, such dependence on the red-swamp crayfish could also prove to be negative in the future if the species population drastically declines. This speciation can prove lethal to the otters as their trophic niche has narrowed to mainly include this species type. Thus, maintaining healthy prey populations has been a major concern in otter conservation (Barrientos et al., 2014).

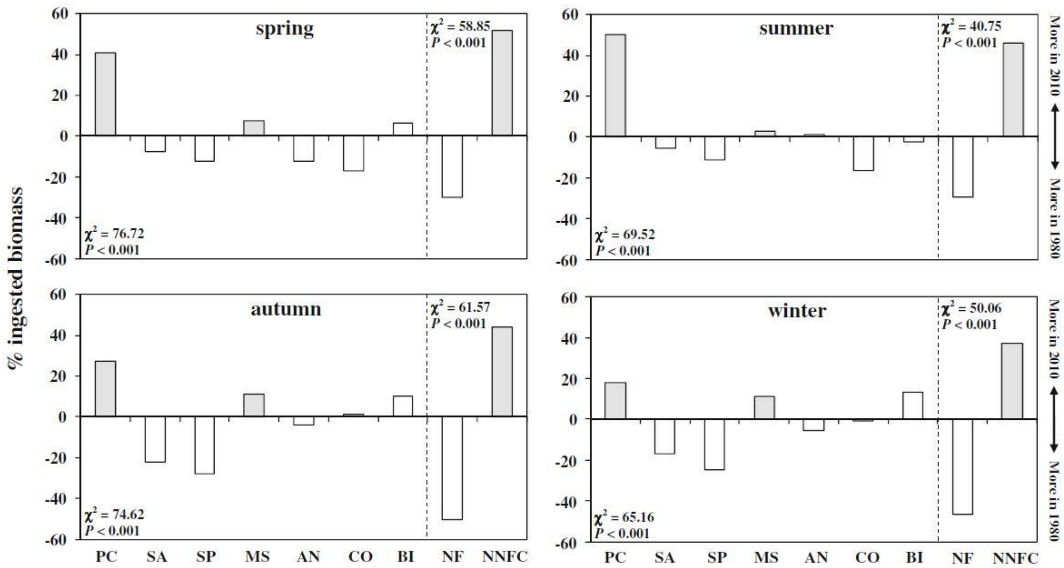

Figure 3. Results from Barrientos et al. (2014). Graphs give the percentage of change in the ingested biomass of Eurasian otter for main prey categories between 1980 (introduction) and 2010 (drought). Statistical methods were used to evaluate abundance, with chi square tests and significance levels shown for each season. Columns in grey are non-native species. Codes for prey categories (left to right): *PC P. clarkia; SA S. alburnoides; SP S. pyrenaicus; MS M. salmoides; AN* Anura*; CO* Colubridae*; BI* Birds*; NF* Native Fishes*; NNF* Non-native fishes and crayfish. More non-native biomass was consumed in 2010 compared to that in 1980. (Barrientos et al., 2014, p. 1576)

CONCLUSIONS & FUTURE WORK

The aforementioned studies have shown the different impacts and interactions that non-native species can have with river otter assemblages in parts of North America and in Europe. While the effects of invading or non-native species can be observed, it is difficult to predict the impact such disturbances can have due to varying community responses and allochthonous inputs into the system. These inputs can include moisture, temperature, light and any other nutrients (Crait & Ben-David, 2007). Invasive species can have even greater effects on aquatic systems as they are more likely to accumulate toxins, siltation, and other forms of degradation than terrestrial systems (Wengeler et al., 2010).

Ultimately, new foraging habits and strategies may be required by otters in response to new and changing food sources (Balestrieri et al., 2013), especially considering native fish populations can decline. Major conservation efforts are needed to improve native fish populations and maintain non-native species, even when they have shown to be a food source for otters. Moreover, the implications caused by otter population decline and possible extinction due to further invasive species encroachment can have far more severe consequences on habitat biodiversity and dynamics in both aquatic and terrestrial ecosystems alike.

REFERENCES

Balestrieri, A., Remonti, L, Vezza, P., Prigioni, C., & Copp, G. H. (2013). Do non-native fish as prey favour the conservation of the threatened indigenous Eurasian otter? *Freshwater Biology*, 58(5), 995-1007. doi:10.1111/fwb.12102

Barrientos, R., Merino-Aguirre, R., Fletcher, D., & Almeida, D. (2014). Eurasian otters modify their trophic niche after the introduction of non-native prey in Mediterranean fresh waters. *Biological Invasions*, 16(8), 1573-1579. doi:10.1007/s10530-013-0622-9

Crait, J. R., & Ben-David, M. (2007). Effects of river otter activity on terrestrial plants in trophically altered Yellowstone Lake. *Ecology*, 88(4), 1040-1052.

Jeffress, M. R., Paukert, C. P., Whittier, J. B., Sandercock, B. K. & Gipson, P. S. (2011). Scale-dependent factors affecting North American river otter distribution in the midwest. American *Midland Naturalist*, 166(1), 177-193.

McCombe, R. (2014). Eurasian otter sleeping on Loch Spelve Isle of Mull [Photograph]. Retrieved from photography.nationalgeographic.com

Munroe, M. (n.d.) River otter, North American otter: Lontra canadensis pacfica [Photograph]. Retrieved from www.centalbiodiversity.org

Wengeler, W. R., Kelt, D. A., & Johnson, M. L. (2010). Ecological consequences of invasive lake trout in river otters in Yellowstone National Park. *Biological Conservation*, 143, 1144-1153. doi:10.1016/j.biocon.2010.02.012