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Jason Martz

University of Nebraska-Lincoln

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Management of Invasive Bullfrogs

By

Jason Martz

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Management of Invasive Bullfrogs

Jason Martz

University of Nebraska-Lincoln, 2014

The purpose of the paper was to look at control methods that are being used currently in the field to control the bullfrogs. Also, to see the future of management and control of the bullfrog. Investigate to see if these plans could possibly be used in Lincoln, NE in places like Pioneers Park. The bullfrog has outcompeted many native species when it invades an ecosystem. It is considered one of the worst invaders in the world. Once established it is very hard to eradicate. So it is important to understand and investigate control being used currently. Literature review was used to investigate the current control methods being used. Many management plans are focused on population control so this should be the ultimate goal for managers.

Introduction:

The introduced bullfrogs (*Lithobates Catesbeianus*) have become widely established in the Western United States and are thought to be an important predator of native amphibian species throughout the Western United States (Adams and Pearl 2007). Bullfrogs have been able to outcompete various native *Rana* species. Bullfrogs are considered among the most successful vertebrate invaders and are considered by the IUCN to be among the one hundred worst invaders in the world. The conspicuousness and natural history of bullfrogs make their introduction an obvious hypothesis to explain declines in indigenous species (Adams and Peral 2007). The absence of knowledge regarding their impact as invasive species has resulted in little progress toward development of effective control efforts.

Introduced populations are hard to control because of their high mobility, generalized eating habits, and high reproductive capacity. Some of the bullfrogs population dynamics make management options extremely limited (Witmer and Snow 2010). When some control methods are attempted, problems can be exacerbated because incomplete removal may actually increase their abundance by increasing the survival, which serve as pray.

The bullfrog has invaded spots around Lincoln, NE like Pioneers Park. It is important to understand and investigate what control methods are being used. The purpose of this paper is to research and investigate current control methods that are being used in the field. To see what control methods can be used for future management decisions and possible ones for Pioneers Park.

Literature review:

Management of bullfrog populations is difficult, in part because bullfrogs are interspersed with sensitive native species in aquatic habitats (Witmer and Snow 2010). Adult frogs are removed by trapping or hand capture, and tadpoles are destroyed by draining ponds or chemical treatment with limited success. Their management or removal has not generated much financial support because their data from their economic impacts is lacking compared to other invasive according to Adams and Pearl. There are methods though that can be done that help in control efforts.

Study done of bio-manipulation of permanent water bodies was explored (Louette 2012). Bio manipulation of permanent water bodies already inhibited by the fish were explored. Experiments were performed in small and shallow ponds. Effects of complete drawdown and predation of non-indigenous bullfrogs were investigated (Louette 2012). The results showed that the presence of pike lead to a decline in bullfrog tadpoles.

Reduction in tadpoles could be assigned to both indirect and direct effects induced by pike (Louette 2014). The study shows that bio manipulation of water bodies can be a candidate for effective and sustainable control of invasive bullfrogs. Wetland creation and restoration, and enhancement projects offer the chance to manipulate wetland characteristics in ways that promote indigenous versus invasive species (Adams and peral 2007). In a 2004-2005, a study was done on the distribution of bullfrogs along a 98-km reach of Trinity River in California below Lewiston dam to identify habitat characteristics associated with bullfrogs. Regression techniques were used to model the distribution of bullfrogs in relation to environmental conditions.

Try to minimize or reduce habitat conditions which favor bullfrog persistence or eliminate bullfrogs. Goal for Trinity River in California was to inform restoration mangers of

specific habitat conditions to modify in order to reduce distribution and bullfrogs along the river floodplain. In the end help refine management strategy to improve conditions for native species. Current management goals of restoring salmonid habitat and returning the river to a more natural hydrologic condition should aid in control of bullfrogs and improve conditions for native amphibians (Fuller et al 2011). Pond training is another form of bio manipulation or habitat modification that can be explored.

Study done in California explored pond draining and the study induced one hundred percent mortality in the tadpole life stage of bullfrogs to simulate the effects of pond draining. The number varied for the draining period from 0.1 to 1 (a pond draining frequency of 0.1 corresponds to draining a pond once every ten years). The consequence of pond draining was the complete annihilation of a bullfrog generation (Doubledee et al 2007).

Hunting is another method that can be used to control bullfrogs one of the methods being shooting. The same study done in California that explored pond draining also explored shooting. There were two measurements that were used to account for effort: the additional mortality imposed on the adult bullfrog population and the period of each shooting event (Doubledee et al 2007). Imposing additional mortality on adult bullfrogs every other year, decreased the equilibrium population density. Shooting frequencies greater than every other year caused fluctuations in the bullfrog population, with larger shooting mortalities resulting in larger fluctuations (Doubledee et al, 2007).

Another method that could be used would be something like trapping. Most if not all successful bullfrog eradication efforts have involved closed and man-made systems (Khars 2006). Stock tanks can be used that are securely fenced pumped dry during the summer, eliminating every bullfrog with confidence. If reintroduction can be prevented, this method can

be very effective in regaining aquatic habitat for native species recovery. When it comes to cost efficient programs for alien species there needs to be development of adequate removal methods in combination with insights in population size and dynamics (Louette et al 2014).

Double fyke nets were used in a study done by Gerald Louette et al. Tadpole populations size in ten small shallow water bodies were assessed. Two population size estimates methods were used. The catch depletion and mark-recapture method catchability in the nets in small shallow ponds proved to be consistent. Insights in population size of invasive species are crucial with regard to their management. Information with an effective capture gear can help with a cost-efficient approach in management.

Another method to control bullfrogs would be direct removal. Direct removal techniques can be hampered by strong density dependence (Adams and Peral 2007). Demographic perturbation analysis of data from invaded ponds in British Columbia suggest that direct removal efforts should target juveniles and tadpoles that transform after one instead of two winters. Study done on bullfrogs on Vancouver Island estimated the post metamorphic survival of bullfrogs using capture mark recapture methods and assessed the spatial and temporal variation in these survival rates. Life stages that strongly influence population growth rates were identified. Targeting these is considered the most effective way to control populations (Govindarajulu 2005). For the mark capture-mark-recapture studies the bullfrogs were captured by hand from a canoe between the months of May and October.

The design of effective control programs of an invasive species is often hampered by the lack of demographic information on these populations (Govindarajulu 2005). Cost of control at a given life stage will vary depending on methods used, habitat characteristics, and population density. Demographic modeling using population matrix models is a useful tool in control

efforts. Identifies life stages with the strongest influence on population dynamics. Most current control efforts have focused on removing tadpoles and breeding adults. This model shows it might not be the most effective model.

Model suggests culling of metamorphosis in fall is most effective method of decreasing bullfrog population growth rate. Seines was used as a primary method in a study done in Sycamore Canyon, Arizona to remove tadpoles. Each pool was seined multiple times on a visit until fewer than ten were caught per sweep. Adult and metamorphic bullfrogs were removed by hand capture and shooting. A BB gun was used for most of the summer. It was effective on smaller frogs and larger frogs although the larger frogs were often able to escape into the water and prevent confirmation of their removal (Khars 2006).

Another possible method could be something called a dispatch method. Study done evaluated the effects of carbon dioxide on pre and prometamorphic bullfrog larvae. Bullfrogs are a model organism for evaluating potential suppression agents because they are a successful invader worldwide (Lambertz et al 2014). The experimental trials estimated that 24-h 50% and 99% lethal concentration. Values for bullfrog larvae were 371 and 549mg/CO₂ respectively. Overall the larvae succumbed to experimental conditions had a lower body condition index than those that survived (Lmbertz et al 2014). Findings suggest that carbon dioxide treatments can be lethal to bullfrog larvae under controlled laboratory conditions.

Currently there are no management actions that have been conducted to control bullfrog populations in Pioneers Park (Unpublished works 2012). Some feasible management plans could be culling bullfrogs at metamorphic and adult stages, draining permanent water sources, the removal of dams from ponds, and to continue with the status quo (unpublished works 2012). When it comes to cull metamorphosis and adults, managers beginning in April will capture them

using two seine nets (Unpublished works 2012). Adults can be removed until hibernation begins in late October or early November. This will be conducted every year on all ponds and wetlands so you can control bullfrogs.

Captured bullfrogs are euthanized using a double pith method or a carbon dioxide chamber (unpublished works 2012). Drying and freezing ponds will kill all tadpoles present but it will also kill any fish and turtles present in the ponds as well (unpublished works 2012). When you remove dams the water bodies will be replaced by wetlands that support native frogs. Removal of dams requires heavy machinery. Doing nothing on the hand may leave bullfrog population unchecked and lead to loss of vulnerable species in Pioneers Park 2012).

Material and Methods:

Literature review to investigate the various control methods being used around the Western United States. See what plans are most viable for future control methods and ones that can possible be used at places like Pioneers Park,

Results:

There are many control methods that are used. All of the control methods would have to be considered in an integrated pest management plan. Since complete eradication is not possible population control would be the best way to go about it. Carbon dioxide was shown to be effective against tadpole survival under lab conditions. Bio manipulation or habitat modification in places like California has shown to have positive effects.

It is important to understand the population dynamics so we can understand life cycles and know when the best time to cull is. Make sure these programs are cost efficient and effective

for future control options. Some control methods for Pioneer's Park could be pond draining or culling.

Discussion:

Since population control is the best way to go since it is hard to completely eradicate once established. Removing tadpoles by culling at metamorphosis and adult stages is a good way to go. When draining ponds you must be sure non-target species are not affected. When it comes to using carbon dioxide to suppress larvae more research out in the field will have to be done. Use habitat modification in other places to make sure indigenous species persistence is maintained.

Understanding population dynamics is important to understand life stages for future control methods. Since there are no current management plans being used in pioneers park methods like habitat modification, direct removal, or trapping would have to be researched more to see if they would be viable and don't effect native species

Summary and conclusions:

The bullfrog is one of the worst invaders in the world that outcompetes and is a predator of many native species. There are few efficient and effective control methods. So it is important to understand the current control methods being used in the field for future directions. Since it has also has invaded places like Pioneers Park in Lincoln, NE, it is important we look at control, methods being used and the research and results that are found to see if they would be viable to implement. Current methods such as hand or net capture, shooting and gigging, can be labor intensive and often fail to reduce bullfrog's numbers (Snow and Witmer 2010).

Things like culling at metamorphosis and adult stages has seem to found success. Habitat modification in places like California has been shown to be able to promote indigenous species abundance. Pond draining can help with removing tadpoles but it must not effect non target species. More research with carbon dioxide could be used for further consideration out in the field. Goal for managers should aim at population control because of the difficulties that comes complete eradication.

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