Student Grant Proposal

Determining the Most Effective Way of Removing Nonnative Fish Species in High Mountain Lakes

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This research will examine a wide range of known treatment options and the associated costs and time involved to remove nonnative fish species from high mountain lakes. Fisheries managers will be able to identify potential methods to use and the associated costs and time all in one place. Another advantage fisheries managers will have from this report is being able to see the pros and cons of each method. By using a simple comparison of various methods costs, time, pros and cons fisheries managers will be able to effectively choose a treatment option.

The goals of this study are:

1. Determine the effectiveness of piscivores in high mountain lakes
    a. Longevity of commonly used piscivores in high mountain lakes
    b. Effective size to transplant to a lake
2. Alternative methods
3. How to choose appropriate lakes for treatment
4. Observe how to monitor populations of nonnative species
5. Population dynamics

Importance

This research will also benefit me as student. Through this study, I will be able to further my knowledge of predator/prey interactions. After receiving my B.S. in Fisheries Sciences, I plan obtaining my M.S. in predator/prey interactions. With having previous experience I can become more competitive with potential projects. I will also be able to apply knowledge gathered from this study with my Masters research.

Funding

My funding for this research will com solely from the Student Grant Proposal (SGP) committee. Through my budget I do not see a need for any additional funding to support this project. The funding I obtain through the SGP will help me acquire equipment needed to accomplish my research goals and objectives. The funding I receive from the Student Grant Proposal committee will not only benefit me but directly benefit the University of Idaho. The University of Idaho will benefit from the items that will be donated to various departments on campus.

Objectives

Many high mountain lakes were stocked with eastern brook trout (*Salvelinus fontinalis*) by the U.S. Forest Service in the early 20th century (Pfeifer 2007). When these lakes were stocked with fish, little was known how successful the introduction of fish would become. Today many of these stocked lakes contain stunted populations of brook trout because of the large population present. As a result of high populations of brook trout in these lakes, local populations of native species (i.e. zooplankton, invertebrates, and amphibians) have been devastated. Another issue with a large population of stunted brook trout populations is unsatisfied anglers. This has led to a push for fisheries managers to address the problem and look for solutions.

One technique that has been attempted to eliminate and or control brook trout in mountain lakes is the introductions of tiger muskellunge (F1 hybrid, a male northern pike *Esox lucius* and a female muskellunge *E. masquinongy*) (Hand et al 2012). Tiger Muskellunge males are functionally sterile and females have reduced reproductive capabilities. The introduction of tiger muskellunge as a control agent in Idaho by Idaho Department of Fish and Game (IDFG) was first used in 1998 and 1999 in Ice Lake and Lower Rainbow Lake (Hand et al 2012). In 2006 IDFG designed a high mountain lake management protocol to use tiger muskellunge to help restore native amphibian populations around high mountain lakes and to remove nonnative fish populations. For most lakes where brook trout were introduced they continue to maintain self-sustaining populations. For some lakes the brook trout populations are subject to stunting due to high densities of fish and relatively low productivity indicative of the mountain lakes (Hand et al 2012).

The objectives of this study are:
6. Determine the effectiveness of piscivores in high mountain lakes
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7. Alternative methods
8. How to choose appropriate lakes for treatment
9. Observe how to monitor populations of non native species
10. Population dynamics

The main objective of this study is to determine how effective the presence of a piscivore is at removing introduced species from high mountain lakes. For this objective, I also will obtain data on the longevity of various piscivores in high mountain lakes, and the most effective size of piscivores to stock in a lake. This information will be useful to managers so they know how often they should reintroduce piscivores and what size should be released into a lake.

The second objective of this study is to analyze alternative methods of restoring a high mountain lake to a more natural state. For lakes that contain outlets it is important to look into other methods so fragile ecosystems downstream are not impacted by a fierce piscivore.

The third objective of this study is to determine appropriate lakes a piscivore treatment. It is important to know if a lake will recover to a natural state by use of a piscivore before money is wasted. By evaluating similarities between current lakes using a piscivore as a control agent I will be able to create a model for managers to determine if their lake is appropriate for this procedure.

The fourth of objective is to monitor how a treat is effecting both native and non-native populations in an area. It is important to not only observe how fish populations are being affected but also monitor amphibian and reptile populations in the area. A fierce piscivore will attack anything that goes by its mouth. By monitoring local populations of reptiles and amphibians, managers will be able to access the risks a piscivore treatment may have on terrestrial species.

Importance

This research will also benefit me as student. Through this study, I will be able to further my knowledge of predator/prey interactions. After receiving my B.S. in Fisheries Sciences, I plan obtaining my M.S. in predator/prey interactions. With having previous experience I can become more competitive with potential projects. I will also be able to apply knowledge gathered from this study with my Masters research.

I will also be able to further my knowledge with population dynamics using scales to age fish and then use a growth regression model to see when the most growth occurs. This is beneficial to me since I also want to incorporate population dynamics into my M.S. project. This will project will give me valuable research experience that I will be able to apply to my M.S. degree as well as my future career in fisheries management.

This study will provide high mountain lake fisheries managers valuable information on effective ways to restore high mountain lakes to a more natural state, find the most cost effective way, and examine pros and cons of various methods.

Fisheries managers will benefit from this study by knowing effective ways to restore high mountain lakes to a more natural state. By examining different practices (i.e. gill nets, piscicides, and piscivores), managers will be able to appropriately choose a method of removing nonnative fish species. After a treatment method is chosen, a manager will be able to model potential effects to the ecosystem (e.g. terrestrial species near by the lake, and/or terrestrial/aquatic species in the watershed).

The University of Idaho will benefit from this research by being able to set up additional projects based on the findings. These new research projects could potentially turn into a M.S. project. The additional information that can be generated from continuing the research can help build a better model in predicting the best method a fisheries manager can use to restore a high mountain lake.

Methods

A literature review will be conducted on the history of the lakes within the study area. Information gathered through the literature review will be what was native to the lake, what has been introduced into the lake, and management strategies. Interviews with the fisheries managers for the lakes in the study area will supplement information obtained during a literature review.

The best way for me to gather information on the effectiveness of the piscicides rotenone or antimycin will be gathered through a literature review. Since these chemicals are very dangerous to handle it will be best to conduct research through a combination of literature review and interviewing fisheries managers who have used them.

Nonlethal age structures will be removed from both prey and predator fish. One scale will be removed from just below and behind the dorsal fin. Stolarski and Hartman (2008) found that scales are a very accurate nonlethal way to age brook trout. Each scale will be mounted a microscope slide so the annuli can be counted to determine age. A growth regression model can also be calculated based on the growth rings on the scale. The growth regression model will provide information on what age the fish are growing most. The removal of age structures will also allow me to conduct a mark recapture study to estimate the population size of a species. Then using a Lincoln-Peterson model I can estimate the population.

I will use IDFG's gastric lavage pump to collected stomach contents from captured piscivores to evaluate their diets. Gastric lavage samples will be performed as outlined in Foster (1977) with one change fish will not be anesthetized. Samples will be preserved in a Whirl-Pak with formalin. A dietary analysis will be conducted to determine the impact piscivores are having on native terrestrial species. Diet analysis will also provide information on how effective the piscivore is at removing introduced species of fish.

Timeline

- March 2012-May 2012 extensive literature review
    - Literature review will encompass a variety of used methods (i.e. piscicides, gill nets, and piscivores) to see what has worked and why it worked at various locations. The literature review will be a key component for obtaining information on the piscicides since I will not be using them. Along with a literature review during this time, I will also be interviewing state and federal fish managers who have used these various methods for additional data.
- April 2012
    - Contact IDFG to assist with their fisheries managers using these methods trying to restore high mountain lakes to a more natural state.

- May 2012-August 2012 sample lakes with IDFG
  - During this time, I will be collecting age structures (fin rays) from the nonnative fish that are being removed. I will also be collecting gastric lavage samples from any piscivore captured during this time.
- September 2012-November 2012
  - I will analyze age structures and gastric lavage samples collected during the summer. From the collected age structures, I will obtain data on the abundance of the various age classes present in a lake and growth rate between years. From the collected gastric lavage samples, I will look at the diet composition of the piscivores to see what their main prey item is.
- December 2012-January 2013
  - During this time I will resample lakes to see how the diet composition of piscivores changes during periods of ice over.
- February 2013
  - I will analyze collected gastric lavage samples from the ice covered lakes and make a new model for diet composition
- March 2013-April 2013
  - During this time, I will finalize my findings in report form and prepare to present my findings to the University of Idaho.

References

Foster, J 1977. Pulsed Gastric Lavage: An Efficient Method of Removing the Stomach Contents of Live Fish. The Progressive Fish-Culturist 39(4): 166-169.

Moore et al 2012. 2009 Clearwater Region Annual Fishery Management Report. Idaho Department of Fish and Game.

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Stolarski,J,T. and Kyle J. Hartman. 2008. An Evaluation of the precision of fin ray, otolith, and scale based age determinations for brook trout. North American Journal of Fisheries Management.28:17-90-1795