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**Proposal Cover Sheet**

**Term: Fall \_\_X\_\_ Spring \_\_\_\_\_ Year \_\_2011\_\_\_\_**

**Instructor \_Demers\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Name: \_\_\_\_\_\_\_Adam Will\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Present Year in Education (e.g., freshman, sophomore, etc.): \_Junior\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

E-mail Address: \_\_\_\_\_\_\_akwill@eagle.fgcu.edu\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Major \_\_\_\_\_\_\_Environmental Studies\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Have you identified a research mentor for a senior thesis (if applicable)?

\_\_\_\_\_ Yes \_\_\_X\_\_ No.

If yes, please identify.

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Title of Proposal:**

Affects of Different Stimuli on Common Striped Mullet (*Mugil cephalus)* as Potential Deterrents from Hazardous Underwater Structures

Keywords (3-5)

Hazardous, Entrain, Impinge, Deterrent

**Checklist:**

All required portions of the first submission are included \_\_X\_\_\_ Yes \_\_\_\_\_ No

I had an external reviewer read the proposal \_\_\_\_\_ Yes \_\_\_\_X\_ No

If Yes, who \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ When \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

I authorize the use of this proposal as an example in future courses \_\_X\_\_\_ Yes \_\_\_\_\_ No

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**Affects of Different Stimuli on Common Striped Mullet (*Mugil cephalus)* as Potential Deterrents from Hazardous Underwater Structures**

Proposal by Adam Will

**Abstract**

Underwater structures, such as hydroelectric turbines and cooling towers pose a threat to marine life because they contain hazardous moving parts and create massive changes in water pressure (Čada, 2001). Anadromous and catadramous species of fish are threatened by these structures as they are sometimes passed through dangerous moving parts and massive water pressure changes (Čada, 2001). This poses a threat to the environment as it can upset the balance of an ecosystem, causing either a bottom-up or top-down effect. Studies show that different fish species respond to different stimuli, which can be used to deter fish from hazardous areas. Research of fish deterrents in Florida species is lacking and, as we continue to advance technologically and harness natural energy, more study of our impact is needed. This study is designed to gather information on the affects of different stimuli on stress levels of the common striped mullet (*Mogil cephalus),* a species commonly found in both marine and estuarine environments, as both of these environments are candidates for hydroelectric turbines and cooling towers for nuclear power plants. Specimens will be exposed to some stimuli which have been tested on other species; bubble sheets, acoustic sound waves, strobe lights, and a hybrid of bubble sheets and sound waves. The effectiveness of each deterrent will be measured as the concentration of cortisol in a blood sample as a stress-level indicator. The hypothesis is that the hybrid of bubble sheets and sound waves will cause the highest amount of cortisol concentration within plasma as a stress indicator and therefore considered the most effective fish deterrent tested.

**Introduction**

Anadromous and catadramous species of fish must pass from freshwater to saltwater as part of their life-cycle, and they often encounter underwater man-made obstacles on the way (Čada, *et al,* 2006). Two examples of these underwater obstacles are hydroelectric turbines and cooling towers for nuclear power plants, both of which utilize running water. These structures are extremely hazardous to anadromous and catadramous species of fish because they are sometimes passed through these obstacles that contain large moving parts and massive water pressure changes (Čada, 2001).

A major environmental issue for hydroelectric power production is injury and mortality to fish that pass through the turbines (Čada, *et al,* 2006). This most often occurs when fish are entrained, or sucked through theses structures. Most devices which utilize natural running water have screen nets which prevent entrainment, but can cause fish to become impinged (Scruton, *et al,* 2003).

The modalities that most often affect fish behavior are sound, light, chemicals, temperature, and pressure (Bullen, 2004). Fish deterrent systems are routinely used in management applications to help guide fish away from potential barriers or sources of mortality (Richards, Chipps, and Brown; 2007). Many kinds of fish deterrents have been tested, and some utilized in real-life scenarios, but one definitive result in the testing of fish deterrents is the fact that nearly all fish in past studies behave differently to different stimuli.

Various methods of non-obstructive deterrents have been tested in research experiments including strobe lights, bubble sheets, electro-shock, and acoustic sound waves (Gibson, Myers, 2002). These devices were tested on different species of fish, most of the time yielding results often based on the species of the fish. Strobe lights yielded fluctuating successful and unsuccessful results in lab tests, often depending upon the species of fish (Gibson, Myers, 2002).

Acoustic fish deterrents use high-frequency infrasound waves to discourage fish from entering hazardous areas. Acoustic fish deterrents are one of the more effective methods of deterring fish (Gibson, Myers, 2002). Bubble sheets are simple air pumped from an estuarine floor to form a barrier. In theory, bubble sheets are supposed to form a barrier between fish and hazardous areas, but have been only mildly successful in tests. There has been some research done on the effects of hybrid fish deterrents, which have been relatively successful (Bullen, Carlson, 2004).

**Research Objective**

Based on previous research, there is little or no testing of deterrents on striped mullet. The purpose of this study will be to determine which of the aforementioned fish deterrents will be the most affective on the common striped mullet, a euryhaline migratory species, within mildly turbid estuarine systems commonly found in Florida. The choice of striped mullet is due to the fact that it is commonly found in both marine and estuarine areas in Florida, where there are cooling towers for nuclear power plants as well as potential future sites for areas which can house hazardous underwater structures.

**Methods**

Methods taken from *Stress Response and Avoidance Behavior of Fishes as Influenced by High-Frequency Strobe Lights* ( Richards, Chipps, and Brown, 2007)

This study will be done to evaluate Florida striped mullet (*Mugil cephalis*) juvenile sensitivity to strobe lights, bubble sheets, acoustic deterrents, and a hybrid acoustic bubble sheet, by measuring plasma cortisol concentrations. All experiments will be conducted in the dark from 2000 to 600 hours (Richards, Chipps, and Brown; 2007).

**Animal Collection and Acclimation**

The mullet (N=200) will be purchased from a local live bait dealer (possibly Estero Outfitters) and then transported to Florida Gulf Coast University utilizing three standard 5-gallon buckets filled with water from the initial holding tanks and fitted with mobile aerators. Specimens will be purchased for each individual test. In each trial, a total of 70 fish will be purchased, in order to ensure that at least 25 will be suitable for each the control and test groups. This will allow a margin of 10 fish to be unsuitable for each of the tests. Fish will then be slowly acclimated to laboratory conditions, by mixing water from the laboratory recirculating system with water from the transport buckets (Richards, Chipps, and Brown; 2007). Saline and O2 conditions will be adjusted according where the fish were caught by the local dealer, in order to limit stress levels in fish by mimicking their native environment. Water temperatures will be monitored daily (Richards, Chipps, and Brown; 2007), but should have little variation as the tank will be indoors.

Fish will then be added to the laboratory recirculating tank and maintained for 3-5 days before any experiments are performed. The recirculating system will be drained, disinfected, refilled with an identical solution, and allowed to condition for 1 week at the end of each experiment (Richards, Chipps, and Brown; 2007). Any dead, sick, or lethargic fish will be removed using dip nets maintained in disinfectant (Richards, Chipps, and Brown; 2007).

**Experimental Design**

Fish will be tested in increments of 25 fish per experiment, including 25 fish as a control. Two cubicle 200-L tanks will be used to evaluate the effects of the aforementioned experimental fish deterrents on plasma cortisol response in striped mullet. One tank will be used as a control and one tank will be outfitted with a different deterrent for each test.

**Experiment 1: Strobe Light**

The strobe light test tank will have a strobe light on one side, and the flash rate will be set according to the manufacturer (Richards, Chipps, and Brown utilized a strobe light with a flash rate of 86 flashes per minute). The light will be lowered into the water and held at the midlevel of the tank. Dimensions of the strobe light’s location as well as brand and name will be recorded.

**Experiment 2: Bubble Sheet**

The tank testing the bubble sheet will have a powerful air pump attached to an aerator hose to ensure a steady stream of bubbles for an efficient bubble sheet. The model of the air pump as well as its measured PSI for the test will be recorded.

**Experiment 3: Acoustic Deterrent**

The acoustic deterrent will emit a low-frequency sound, which will be recorded in decibels as well as frequency. The speaker used will be an underwater low-frequency speaker.

**Experiment 4: Hybrid Deterrent**

The final, hybrid test will be a combination of the acoustic and bubble sheet deterrents, which will match the specifics from the initial experiments of the two.

Each of the experimental test methods will be allowed to run for 1 h, after which two individuals from both the control and test groups will be removed for blood collection (Richards, Chipps, and Brown; 2007). Fish will be anaesthetized in a solution of benzocaine. A blood sample of 0.5 mL will be withdrawn by caudal venipuncture (Sloman, *et al,* 2000). Fish remaining in the tanks will be exposed to an additional 3 hours of darkness (control) or testing, in which the same procedure will be used to obtain blood samples after a total of 7 hours (Richards, Chipps, and Brown; 2007). Samples will be centrifuged at 3,500 revolutions/min (Richards, Chipps, and Brown; 2007) for 3 min, and plasma will be extracted and stored at -800C pending analysis (Richards, Chipps, and Brown; 2007). This will test the hypothesis that cortisol concentration will be higher in fish that are exposed to stimuli, but fish exposed to a hybrid bubble sheet and acoustic deterrent will be the highest.

**Expected results**

It is expected that there will be higher cortisol concentrations in the blood samples from the specimens that were exposed to the hybrid deterrent than the other deterrents, and that the lowest cortisol concentration will be in the control sample.

**Expected Time Table**

2 months of planning and material collection

2 months data collection and preparation between experiments

1 month data analysis and report

Assistance will initially be required from an experienced biologist to take samples from specimens as well as handling benzocaine as an anesthetic. Assistance may be required in initial tank setup as well as setting up equipment for experiments.

**References**

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Adam Will

**Contact Information:**

9420 Ivy Brook Run # 307 Phone:(352) 634-2288

Fort Myers, FL 33913 e-mail: akwill@eagle.fgcu.edu

**Education:**

2007-Present:  *B.A. Environmental Studies* (in progress), Florida Gulf Coast University

Fort Myers, FL (expected graduation: Spring 2013)

2005-2007 Academy of Environmental Science, Public School Program, Crystal River,

FL, General Education, High School focused on Environmental Programs,

Graduated May 2007

2003-2007 Crystal River High School, Crystal River, FL, General Education,

Graduated May, 2007

**Related Skills and Experience:**

* Intern one semester at the Crystal River Preserve State Park (funded and run by Florida DEP)

>Mostly grounds maintenance

>Work in the wooded areas

>Learned some of the laws and regulations of Florida State Parks

* Intern one semester at Homosassa Springs State Wildlife Park

>Worked animals

>Weighed out and prepared some foods for resident animals

>General grounds maintenance

* Environmental Biology of Southwest Florida
* Simulation and Modeling
* Intro to Environmental Science
* Intro to Environmental Policy
* Environmental Philosophy
* Environmental Chemistry
* Environmental Humanities
* African Environments
* Behavioral Ecology
* Marine Systems
* Coastal Zone Management
* Integrated Ecosystems Management (currently attending)
* Some skills with pH meter, refractometers, photometers, turbidity meters, Secchi disk

**Research Interests:**

* Ecosystem interactions
* Humans as a part of the ecosystem
* Minimization of Human impact
* Strength of Marine systems through biodiversity

**Employment**

* Vapiano, Fort Myers, FL

>Head line-cook

>Started as a dishwasher in Sep. 2008, was promoted to cook in Nov. 2010

>Promoted to head line cook Feb 2011

>Sep. 2008-Present

* Barnes and Noble, Estero, FL

>Barista in Cafe

>Made coffee drinks, worked POS position

>Dealt with some customer service

>Dec. 2008-Sep. 2009

* Riverside Crabhouse, Homosassa, FL

>Busser

>Cleaned tables

>Aided servers however and whenever possible

>July 2006-July 2008

* Will Construction Corp. Homosassa, FL

>Demolition

>Jobsite cleanup

>July 2004- July 2007