FISHERY RESOURCE GRANT PROGRAM APPLICATION 2008

1. Title **Pilot survey of deepwater reef fishes off North Carolina using a two-stage, adaptive design: Part 2 – use of Chevron trapping.**

2. Name of applicant Tom Burgess
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8. Fishery district (to be sampled) - Southern **9.** Priority - Fisheries equipment or gear
10. License # 267559 **11.** Amount requested $ 51,120.
12. Project dates: Begin 5/15/08 Completion 4/30/09
13. List previous funding, by grant number, of other FRG projects — completed and still in progress.
06-FEG-05; completed 07-FEG-01; in progress 07-FEG-15; in progress
14. Other participant(s), affiliation & complete addresses (including zip code):

a. Paul Rudershausen 303 College Circle, Morehead City, NC 28557
b. Dr. Jeffrey Buckel 303 College Circle, Morehead City, NC 28557
c. Warren Mitchell 303 College Circle, Morehead City, NC 28557
d. Elliott Hazen DUML, Pivers Island, Beaufort, NC 28516
e. Erik Williams National Marine Fisheries Service, 101 Pivers Island Rd., Beaufort, NC 28516

15. Brief summary of the situation or problem to be addressed:

Project Overview

This is a proposal to demonstrate a fishery-independent sampling technique that can help determine the relative abundance and species composition of a deepwater reef fish complex that is difficult to quantify. Data will be collected inside- and adjacent to the Snowy Wreck Marine Protected Area (MPA). This will serve two purposes: 1) demonstrate the effectiveness of a sampling technique that can be used to census the deepwater reef fish complex anywhere in the U.S. South Atlantic, using an alternate gear type (trapping) as used in an associated project in 2007 (hook and line), and 2)incorporate the first stage of a before-after control-impact (BACI) type sampling design to compare information on relative abundance and composition of fishes inside and outside the MPA before it is closed to reef fishing.

The status of reef species in U.S. South Atlantic deep waters (>70 m) is difficult to assess. Landings of fishes such a snowy grouper and blueline tilefish are intermittent, scattered across a geographically wide area, and thus difficult to representatively sample. There are also inherent challenges in collecting reliable fishery-dependent data through commercial and recreational logbooks and landings. Progressively more restrictive quotas to end overfishing of deepwater species often result in landings that do not reflect the true stock status of these species. Thus, catch quotas have placed an increasingly greater emphasis on collecting fishery-independent data that samples populations of deepwater reef species. Fishery-independent samples of deepwater reef species in the U.S. South Atlantic, however, are difficult or impossible to obtain because of the lack of funded survey programs operating in deepwater. Due to difficulties in obtaining information truly representative of population parameters of deepwater species, it is important to investigate novel means by which these fishes can be most effectively sampled in this region. The National Oceanic and Atmospheric Administration has recently called for the development of new, advance technologies to assess fish stocks.

The Fishery Resource Grant project # 07-FEG-15 was funded to investigate a novel fishery-independent approach to predict catch-per-effort of deepwater reef fishes from fish acoustic (SONAR) information collected with scientific-grade SONAR equipment. Collection of acoustic and catch-per-unit-effort (CPUE) (hook and line) data inside the Snowy Wreck Marine Protected Area (MPA) was completed October 16th, 2007 (see Table 1 and Figure 1). Quantitative analysis of acoustic data (using *Echoview* software) has recently been commenced. The goal of the forthcoming analysis for 07-FEG-15 is to develop a mathematical model that predicts CPUE (proxy for fish abundance) as a function of intensity (db/m^2) of backscattered acoustic energy. In advance of modeling, a preliminary visual inspection of the raw data indicates that CPUE is related to the size of acoustic marks (Figure 1). Thus, use of high-end SONAR gear shows promise of being able to predict

relative abundance (CPUE) of deepwater reef fishes from a much larger number of fish aggregations where acoustic data were collected but were not fished. The predicted CPUE information can then be used as a tool for fishery-independent monitoring of deepwater species in the U.S. South Atlantic.

The preliminary analysis also indicates that the forthcoming model predicting deepwater hook-and-line CPUE from acoustic data may have high variability associated with it (error bars, Figure 1). Thus, there is reason not only to strengthen the existing relationship by gathering more hook and line data but also to investigate other gears that can more effectively sample deepwater and be used to develop a reliable acoustic energy-CPUE relationship. Chevron traps may be this gear. Chevron traps have been used as part of the fishery-independent MARMAP program to sample reef fishes in the U.S. South Atlantic. The intent of 07-FEG-15 and the proposed work is to develop models to the extent that managers can feel confident in collecting acoustic data that can be used to reliably predict the abundance of important deepwater reef fishes.

Amendment 14 to the South Atlantic Fishery Management Council's (SAFMC) snapper-grouper fishery management plan will establish MPAs along the continental shelf break in the U.S. South Atlantic. It is the intent of Amendment 14 to help reduce overfishing of more common deepwater species (snowy grouper, for example) and serve as refuge for rare species such as speckled hind and Warsaw grouper. The largest and most northerly of these areas is the Snowy Wreck MPA. In the years or decades ahead, any evaluation into the effectiveness of the MPA will best be made by having data by which to compare average reef fish acoustic energy (dB/ m2) from both inside and nearby outside the MPA.

This is a proposal to use a novel census technique for deepwater reef fishes and lay the framework for a BACI sampling design by sampling inside (experimental site) and adjacent to (control site) an MPA before its closure. Sampling inside and outside the MPA now will allow a future study to make a similar spatial comparison of CPUE and acoustic backscatter after the MPA has been closed for some years.

16. Purposes (objectives) of the project:

a) Develop a predictive model to estimate abundance of deepwater reef fishes from acoustic (SONAR) and trap data.

b) Augment existing model development (for 07-FEG-15) by collecting more hook and line data.

b) Compare model fits between hook-and-line sampling (07-FEG-15, current proposal) and trapping (current proposal).

c) Compare estimates of acoustic data collected from shelf break samples in Snowy Wreck MPA to those collected at a control site as a "before" snapshot.

17. What work do you intend to do, and how do you plan to accomplish it?

The acoustic sampling in Snowy Wreck MPA conducted in 2007 indicated that the greatest percentage of deepwater reef biomass was concentrated along a roughly two mile-wide swath at the continental shelf break (as opposed to off the break in deeper water). This appears to typify other areas of shelf break habitat in North Carolina. For this reason, our acoustic and trap sampling in 2008 will focus specifically on the shelf break area (~60-120 m deep) within the MPA and in two control areas immediately adjacent to the MPA. Each of the two control areas will be immediately adjacent (southwest and northeast) of the MPA. Each of the two control areas will have SW-NE axes 7.5 nm in length. Since the MPA has a SW-NE axis of 15 nm, the total shelf break distance sampled during each transect inside it will equal that sampled in both control areas.

Before the start of sampling in 2008, an EFP permit will be requested and received from the National Marine Fisheries Service so that chevron traps may be legally deployed to collect CPUE data. The application for the EFP to deploy traps will contain language that the fish will not be sold.

We will make 16 day trips (~2 per month) from roughly May through November, 2008. Half of the sixteen trips will be spent collecting acoustic data. The 30 x 2 nm box will be sampled with acoustics in a direction parallel to the break at 0.25 nm intervals; one 30 nm transect will be sampled each of these eight days.

The remaining eight days will be spent trapping on a subset of marks identified from the previous day's acoustic sampling. The methods of chevron trapping will follow the MARMAP survey as closely as possible, including trap and mesh size, bait type, and soak time (90 minutes per trap). Due to required soak times and the distance of the MPA offshore, time constraints will allow us to soak 12 traps per day (96 for the study). Each 30 nm transect will be divided into 2.5 nm subsections. Four subsections will be randomly selected to fish with

traps. One subsection will be randomly selected within each of the control areas and two within the MPA. If no marks were identified in a randomly chosen subsection, another subsection will be randomly chosen. With each of subsection, three acoustic marks will be randomly selected to fish with traps. Such a stratified random sampling design using 2.5 nm subsections will ensure that trap soak times are limited to 90 minutes while also sampling the MPA and both control areas in one day. Any free time during days spent acoustic sampling or trapping will be used to gather hook and line CPUE data to add to the current predictive model.

Upon retrieval of each trap, fish will be identified and measured (total length, mm). Live fish will be tagged (internal anchor tags) and released. Such auxiliary data on locations of fish captures and recaptures may provide fisheries managers with valuable information on fish movement within the MPA. Persons reporting tagged fish will be able to use the same phone number as established for tagging project 07-FEG-01. Tags will be reimbursed through December, 2010. Dead and badly pressure-traumatized fish will be provided to the NMFS Beaufort lab for their studies of reef fish age and growth.

Acoustic energy data will be used to develop a predictive model with CPUE data from traps. Estimates of CPUE will be made for those sites where aggregations of fish are determined using SONAR but no trapping took place. Relative abundance (measured by CPUE) will then be estimated with associated variances. Predictive models will be compared between hook and line data gathered from both studies (07-FEG-15 and this proposal) and trap data gathered from this study. Average acoustic energy (a proxy for biomass; dB/m^2) will be compared between the MPA and the combined control sites.

18. Explain how the expected results will address the problem and/or enhance fishery resources.

Over the history of the South Atlantic Bight reef fishery, the stock status of the deepwater snapper-grouper complex has been largely unknown. This project will demonstrate a portable fishery-independent approach to more effectively census deepwater reef fishes in the U.S. South Atlantic. If the technique, hook and lining and/or trapping in combination with SONAR, works as a way to estimate CPUE over large areas, it may prove to be a valid new fishery-independent monitoring tool for the US South Atlantic.

19. Explain how the expected results will be made available to the fishing industry:
a) Results will be presented to a meeting of the South Atlantic Fishery Management Council.
b) The project write-up will be submitted for publication in a peer-review journal.
c) Results will be presented at the 2009 North Carolina Fisheries Forum.
d) Results will be provided to North Carolina Fisheries Association so that they may publish results in *Tidelines.*

20. Briefly outline who will be responsible for each aspect of the work plan (attach letters from cooperators outlining their participation):
a. Tom Burgess will coordinate and captain sixteen fishing trips aboard his 43 foot vessel.
b. Paul Rudershausen will attend the 16 trips to collect acoustic and trap data.
c. Dr. Jeffrey Buckel will provide technical assistance to the analysis of data and assist with final report.
d. Warren Mitchell will be involved in analyzing acoustic data, model development, comparing acoustic energy between MPA and control samples, and writing the final report
e. Elliott Hazen will be involved in analyzing acoustic data and writing the final report.
f. Erik Williams will conduct- and compare appropriateness of model fits.

21. Briefly summarize the qualifications of each participant:
a.Tom Burgess has 25 years of experience commercially fishing for reef species.
b. Paul Rudershausen has 5 years experience in remote field collection and applied fisheries research.
c. Dr. Jeff Buckel is an associate professor at CMAST, N.C. State University.
d.Warren Mitchell has 5 years experiencing analyzing fisheries acoustic data.
e. Elliott Hazen has 5 years experiencing analyzing fisheries acoustic data.
f. Erik Williams has 10 years experience as a stock assessment biologist

22. Budget and costs:

a. Personnel costs (time x unit cost)

Person(s)	Purpose	Unit	Total cost
Burgess	Boat use for field work; includes fuel, bait for traps, ice, etc.	$1600/day, 16 days	25,600.
Rudershausen	Attendance to field trips	$15/hour, 16 hours per day, 16 days	3,840.
Mitchell	Attendance to field trip to set-up SONAR and observe data collection	$15/hour, 16 hours per day, 2 days	480.
Hazen	Attendance to field trip to set-up SONAR and observe data collection	$15/hour, 16 hours per day, 2 days	480.
Mitchell	Analysis and interpretation of acoustic data with ES 60 software	$20/hr, 225 hours for acoustic data analysis	4,500.
Hazen	Consultation with Mitchell on analysis and interpretation of acoustic data with ES 60 software	$20/hr, 2 weeks of consultation for analysis of acoustic data	1,600.
Rudershausen	Compilation of catch-effort data	$20/hr, 40 hours	800.
Rudershausen	Writing of Introduction section of final report	$20/hr, 40 hours	800.
Mitchell and Hazen	Writing of Methods, Results, and Discussion and figure preparation for final report	$20/hr, 120 hours per person, 240 hours total	4800.

b. Supplies/Equipment

Supply	Purpose	Unit	Total cost
Laptop computer	Video field sampling with ES 60	(one)	2,000.
Chevron traps (4)	To collect catch-effort and species composition data	$750. per trap, includes traps, buoys, and line sufficient to fish in waters ~90 m deep; traps will be fished in groups of three, plus one extra in case of loss	3,000.
Tag reimbursements	Rewards for returned tags	$5 per tag, assumed 10% return rate on 1000 tags	500.
Laboratory supplies	NMFS Biological Sampling of reef fishes supplied from field collection	Includes scalpels, aprons, slides, otolith cutting tools, and microscope supplies	1,000

c. Travel

Persons	Purpose	Unit	Total cost
Rudershausen	Travel to Sneads Ferry	$0.50/mile, 130 miles, 8 trips	520.
Buckel and Mitchell	Travel to South Atlantic Fishery Management Council meeting to present findings	$1,500, includes transportation, meals and lodging	1,200.

Total project costs $51,120.

23. Budget justification and/or explanation:

-Mr. Burgess's boat was outfitted to accommodate the Simrad transducer in the collection of data for 07-FEG-15

-Mitchell and Hazen's attendance to two days each will assure that data is collected in a methodologically sound fashion.

-A main objective of this project is to develop a mathematical relationship between acoustic energy and trap-derived CPUE data. Fieldwork for 07-FEG-15 has provided us a good idea of the commute and sampling times to the MPA area; sixteen trips balances a financially restrained budget but also the need to collect enough acoustic and trap data to develop the relationship.

-Simrad acoustic gear (ES 60 transceiver and transducer) that was purchased through 07-FEG-15 will be used for this project.

-No fish caught as part of this study will be sold.

-The laptop computer used for video compilation, data analysis, and presentations will be retained for research use in Dr. Buckel's N.C.S.U. lab.

Signature _____ Date _____

Return to: Fishery Resource Grant Program, N.C. Sea Grant, NC State University, Box 8605, Raleigh, NC 27695-8605
Additional copies of this application are available at www.ncseagrant.org

Sea Grant
North Carolina

Table 1. Absolute and percent abundance of the five most common reef fishes collected by hook and line inside the Snowy Wreck MPA from June through October, 2007.

Species	Number caught	Percent of total catch from study
Red porgy	23	24.5
Snowy grouper	15	16.0
Scamp	11	11.7
Knobbed porgy	6	6.4
Speckled hind	6	6.4

Figure 1. Average hook and line catch-per-unit-effort (hour of bottom time) (+/- S.E.) of reef fishes (all species combined) as a function of qualitative size of acoustic marks inside the Snowy Wreck Marine Protected Area (from project 07-FEG-15).