UNIVERSITY OF SOUTH FLORIDA

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June 8, 2012

Re: Application for Exempted Fishing Permits for NOAA MARFIN NA11NMF4330123

Dear South Atlantic and Gulf of Mexico Fishery Management Councils,

By way of this letter and attached documents, we request Exempted Fishing Permits for research conducted on vessels of opportunity to address the objectives in our NOAA MARFIN funded study NA11NMF4330123 (see attached proposal and statement of work). This work involves fishermen (list provided below) temporarily possessing goliath grouper (*Epinephelus itajara*) to collect tissue samples and data required to inform stock assessment. Fishing will take place on natural and artificial reefs in Florida state waters and adjacent federal waters. We have received a permit from Florida for state waters (12-1244D-SRP; see attached copy) and estimate our fishing/sampling effort will be 75% state / 25% federal in the Gulf and 50% state / 50% federal in the Atlantic. The study seeks to understand regional patterns, so will take place in all state and nearby federal waters from the Georgia to Alabama borders, however, the vast majority of sampling (80 - 90%) will occur in southeastern and southwestern sections of the state where goliath grouper populations are highest. The research and fishing will take place from the time this permit is approved (~ July 1, 2012) until the end of the study on August 24, 2014. If we require a one-year no cost extension to complete the research, we request the permit be extended to the new end date of the study.

Please find attached the names and addresses of the vessels and owners, as well as pertinent vessel documentation. The MARFIN proposal is also attached.

Sincerely,

Christopher D. Stallings, Ph.D.

We request Exempted Fishing Permits for the below fishermen to participate in our study.

Owner/ Captain	Vessel	ID	e-mail	Phone	Address
Ben Chancey	Chew On This	FL 0138 LD	captchancey@aol.com	239-470-4243	5952 SW 1st Ave Cape Coral, FL
Charles Guilford	Chrisma	1080158	charismacharters@mexicobeach.com	850-227-5124	P.O. Box 13335 Mexico Beach, FL 32410
Charles Guilford	Bottom Line	1085809			
Chris Johnson	Sea Squared	FL 6900 MN	seasquared@bellsouth.net	305-743-5305	479 90th St. Ocean, Marathon, FL 33050
Eric Alexander	Solo Lobo	FL 7418 GW	capteric@aol.cm	239-455-2140	550 Port-O-Call Way, Naples, FL 34102
Eric Alexander	Lobo Del Mar	FL 0556 CD			
Jack Carlson	Two Conchs	1229665	twoconchs@comcast.net	305-481-0495	11499 Over Seas Hwy Marathon, FL 33050
James Willis	Mr. Tarpon	FL 2848 PA	captjames@mrtarpon.com	941-628-4823	97 Barstow St. Port Charlotte, FL 33954
Jeff Shelar	catch em all	FL 4098 LD	jnsshelar@att.net	305-481-4568	400 23rd St. Ocean, Marathon, FL 33050
Mark Hubbard	Friendly Fisherman	917625	mhubbard@hubbardsmarina.com	727-393-1947	Johns Pass Boardwalk Madeira Beach, FL 33708
Mark Hubbard	Florida Fisherman 2	953498			
Mark Hubbard	Hub	651869			
Mark Quartiano	Striker 1	559695	mark@marktheshark.com	305-542-3474	1635 N. Bayshore Dr. Miami, FL 33132
Michael Avinon	Findictive	1127410	fibicator@hotmail.com	239-682-0559	12th Ave S & 8th St. S, Naples, FL 34102
Mike Colby	Double Hook	645647	captmike50@hotmail.com	727-461-4533	25 Causeway Blvd #44 Clearwater, FL 33767
John Mike Newman	Dykoke	1187541	dykoke@comcast.net	561-351-1904	19655 Riverside Dr. Tequesta, Florida 33469
Ralph Delph	Vitamin Sea	FL 2752 HK	fishdelph@aol.com	305-587-7696	1 Riviera Drive B.C.K., Key West, FL 33040
Ray Rosher	Miss Britt	1189202	ray@missbritt.com	305-788-3474	Bayshore Landing Marina 2550 S Bayshore Dr. Miami, FL 33133
Ray Rosher	Miss Britt	1077534			
Richard Bradley	Lagooner	FL 6457 MR	richard@lagooner.com	321-794-4028	204 Garfield Ave. Cocoa Beach, FL 32931
Robert Johnson	Jodie Lynn II	1110372	jlfishing@bellsouth.net	904-540-2628	57 Comares Ave. St. Augustine, FL 32080
Robert Johnson	Jodie Lynn	992609			
Scott Briegel	Seacat	FL 3422 HW	spbriegel@aol.com	561-379-6842	12983 67th St. N, West Palm Beach, FL 33412
Terry Gibson		FL 6139 NA	terry.gibson561@gmail.com	772-285-7683	2060 NE 23rd Terrace, Jensen Beach, FL 34957
Tom McLaughlin	Redemption Song	FL 5745 NF	reservations@anotherkeeper.com	941-830-8500	8200 Bay Pointe Dr. Englewood, FL 34224
Will Geraghy		FL 9774 GM	gslam101@yahoo.com	239-793-0969	550 Port-O-Call Way, Naples, FL 34102

Project Title: Regional age structure, reproductive biology and trophic patterns of adult goliath grouper in Florida

Project Synopsis: The main goal of this project is to provide critical information for stock assessment on regional age structure and reproductive biology of recovering goliath grouper populations of the southeastern United States. Since the closure of the goliath grouper fishery in the southeastern US in 1990, there has been significant recovery—this stands in stark contrast to other goliath grouper populations throughout the Caribbean which have been characterized by the IUCN as critically endangered. This proposed project will provide important information on adult goliath grouper non-consumptively including: 1. Regional age structure, 2. Regional reproductive state, and 3. Regional dietary patterns and ^{13}C and ^{15}N stable isotopes patterns, and 4. Movement patterns using tag returns. We will use dorsal fin rays for aging, supplied by selected fishermen who engage in catch-and-release of goliath grouper across 8 regions encompassing the entire state of Florida. We will also determine the efficacy and limitations of this method relative to otolith ageing by utilizing specimens of opportunity from various sources (fish kills, enforcement confiscations, and bycatch mortalities), although the comparisons made to date show a good relationship between otolith age and ray age (Murie et al. 2009). This work will require that we teach the cooperating fishermen how to remove dorsal fin rays, tag, and measure captured goliath grouper without harming the fish. Fisherman education will be done on site and an explanatory DVD showing the methods will be delivered to each participating fisherman. We will also investigate the regional reproductive patterns of goliath grouper using gonad biopsies and histological methods and regional dietary patterns using stomach contents and stable isotopes, all collected by the investigators using fisheries-independent methods.

Our proposed work addresses several aspects of MARFIN's second program priority focused on "Reef fish and other Fishery Resources Associated with Reef Environments," specifically 2.a.(1)(a), 2.a.(2), 2.a.(5)(a), 2.b.(3), and 2.b.(6). The information provided by this study will reduce goliath grouper stock assessment uncertainty by providing regional information on age structure and reproduction biology, will add to our regional diet and trophic pattern database (thus will improve the quality of our bioenergetics model), and may elucidate movements patterns within and among the different regions.

The proposed research involves collaboration among researchers at Florida State University and University of Florida representing interdisciplinary interests. Drs. Christopher Stallings and Christopher Koenig have extensive experience working on the ecology of reef fishes, particularly grouper life history and behavior. They devote a considerable amount of time working with state and federal fisheries management agencies to provide scientific underpinning to management decision-making. Stallings will have oversight of the project, including submission of required reports. Stallings and Koenig will be responsible for organizing and running field operations, acquisition and maintenance and supplies, and data analysis of population studies. Dr. Kevin Craig has expertise with foraging ecology and analysis of tag-recapture data (including cursory efforts with goliath grouper), and will assist Stallings with these aspects of the work. All project co-PIs will be responsible for developing a rapid response team for sampling adult goliath grouper killed in red tides or from enforcement confiscations. Stallings will be responsible for the dietary and stable isotope work. Drs. Debra Murie and Daryl Parkyn (UF) will be responsible for evaluating the validity and limits of determining goliath grouper ages from soft dorsal fin rays and will estimate reproductive parameters using biopsies and histology. All co-investigators will participate in field operations, data analysis, and in writing peer-review papers.

Project Title: Regional age structure, reproductive biology and trophic patterns of adult goliath grouper in Florida

Goals and Objectives of the Proposed Work

The primary goal of the proposed study is to provide demographic data on goliath grouper that can be used by stock assessment scientists to assess population recovery. Other goals include defining regional movement patterns and describing food web interactions for this species through trophic analyses.

The proposed work will be conducted throughout the coastal waters of Florida in eight regions which are equivalent to the Reef Environmental Education Foundation (REEF) zones, including: (1) Pensacola to Cape San Blas; (2) Cape San Blas to Tarpon Springs; (3) Tarpon Springs to Punta Gorda; (4) Punta Gorda to Tortugas; (5) Tortugas to Largo; (6) Largo to Jupiter; (7) Jupiter to Vero; (8) Vero Beach to Jacksonville (Figure 1).

Figure 1. Selected regions of Florida, coinciding with those of REEF (Reef Environmental Education Foundation).

We will collect samples from live animals using non-destructive sampling methods conducted by us and by cooperating fishers in each region whom we have trained. We will collect otoliths and fin rays from dead specimens obtained opportunistically (i.e., from mortalities due to red tide events, bycatch, enforcement confiscations) to validate ages by comparing fin ray and otolith samples. These age data are critical for assessing the status of this species, managed in the southeastern United States by the Gulf of Mexico Fishery Management Council (GMFMC) and the South Atlantic Fishery Management Council (SAFMC).

Objectives of the proposed work are:

1) To validate non-lethal methods of estimating age (using otolith and dorsal fin-ray samples) and examine the reproductive states of goliath grouper from dead fish (e.g., opportunistic sampling of mortalities due to red tide, fishery bycatch, and enforcement confiscations).

   To age (using dorsal fin ray samples) live goliath grouper collected non-destructively by catch-and-release fishers trained by us to measure, tag, and sample individual fish.

2) To conduct trophic studies of goliath grouper through targeted stomach content and stable isotope analyses using stable isotopes ^{13}C and ^{15}N.

3) To evaluate movement patterns of recaptured goliath grouper based on tag returns.

Identification of the Problem(s) and Need for Government Assistance.

***The fisheries involved*:** Catch of goliath grouper, *Epinephelus itajara,* has been prohibited in US waters since 1990, before which time there were both commercial and recreational fisheries for this species. Virtually all of the catch came from Florida.

***The specific problem*:** In the 1980s, the GMFMC and the SAFMC declared goliath grouper overfished (Sadovy and Eklund 1999). Both councils opted to close the fishery in 1990 (GMFMC 1990). Although this species continues to be listed as overfished in the National Marine Fisheries Service (NMFS) reports to Congress, the actual status of the adult population remains unknown, thus making it difficult for NMFS to develop management measures aimed at either rebuilding the fishery, ending overfishing, or both, as required by the Sustainable Fisheries Act (SFA). Regardless of this difficulty, commercial and recreational fishermen want NMFS to reopen the fishery at some level, while many other interested parties (including Environmental Defense, Gulf Restoration Network, the Ocean Conservancy, and Reefkeeper International) request that NMFS adhere to the SFA mandate.

At a SEDAR Data Workshop convened in St. Petersburg, FL, March 2003 by NMFS and the Fish and Wildlife Research Institute (FWRI), scientists and managers identified a list of research areas required to meet the SFA mandate for goliath grouper, which included: **(1) estimating regional densities through tag and re-sight methods; and (2) defining age structure of existing populations.** We recently completed a NOAA Cooperative Research Program-funded study in which we estimated regional densities of goliath grouper (Koenig et al. 2009). Here, we propose conducting a comprehensive study of age structure. A similar meeting convened on 6 August 2007 (FWRI, St. Petersburg, FL) to identify key data gaps for stock assessment revealed some uncertainty surrounding data quality of non-destructive sampling, particularly related to the limitations of dorsal fin ray aging needed to be addressed. We addressed this concern in a recent publication (Murie et al. 2009) based on studies funded in part by NOAA Fisheries Southeast Fisheries Science Center, and recognize the need to expand the study to improve the accuracy and precision of fin ray aging.

Our studies of juvenile goliath grouper (Koenig et al. 2007) confirmed the critical importance of mangrove as nursery habitat for this species by evaluating absolute population density, survival, age structure, home range, habitat association, habitat quality and recruitment to the adult population. This work was conducted entirely non-destructively and demonstrated the utility of using dorsal fin spines to determine age in juvenile goliath grouper (Brusher and Schull, 2009); using mark-recapture to determine density, growth, and habitat quality, and using telemetry to estimate survival and home range. We have modified these methods as appropriate to conduct similar studies of adult populations, given that adults are somewhat more difficult to catch and sample. Successful non-destructive sampling methods developed in our previous studies (Koenig et al. 2007, Koenig et al. 2009) can be used throughout the range of this critically endangered species (IUCN designation), and can be adapted for use on other Southeast US (SEUS) species that are presently considered threatened, such as Nassau grouper (*Epinephelus striatus*).

Our trophic studies for goliath grouper, limited to a few hundred individuals from South Florida, led to development of a preliminary bioenergetics model and identification of the trophic

position of goliath grouper (Koenig et al. 2009). We propose extending this work throughout the state to improve the model and gain a more comprehensive understanding of diet and trophic pattern. Adults captured for this work will be tagged and released, thereby improving possible contributions to our database on regional movement patterns.

***The sectors of the fisheries that are affected*:** There is currently no harvest allowed for this species in the United States. Despite the moratorium, a recreational catch-and-release recreational enterprise has developed, the magnitude and impact of which are currently unknown. There is also considerable recreational interest in consumptively harvesting for science and in allowing restricted recreational harvest on a regular basis. It behooves us to mention another, relatively unstudied user group having an economic interest in the living marine resource of the United States: that is, the diving community. Interest in underwater viewing of unexploited marine populations, especially including large animals such as goliath grouper, is on the rise (Williams and Polunin 2000). There is specific interest in this as it relates to goliath grouper, in so much as diving excursions in south Florida often specifically include visits to goliath grouper sites. Valuation of tourist-related activities (e.g., diving visits) in Florida is unknown at this time.

It is our intention to engage and train fishers involved in catch-and-release of goliath grouper to participate in sampling dorsal fin rays for aging, muscle tissue for stable isotope analysis, and tagging.

***How the problem prevents the fishing industry or management agencies from using or effectively managing the fishery resources*:** The goliath grouper population of the SEUS is clearly recovering after 19 years of protection, which has prompted renewed interest in the fishery. The questions are: (1) how much recovery has occurred? (2) is there a sustainable fishing level for this species; and (3) are there better economic uses of this marine resource? The NMFS does not have adequate data to address these questions and thus cannot satisfy the SFA mandate to develop a rebuilding plan.

***Need for government assistance*:** Federal funding is appropriate for this study because the costs of collection and analyses of these data are beyond the scope of university resources, commercial or recreational fishing organizations, and state agencies, and fall within the mandate of the federal government to facilitate the collection of data needed to manage these resources. In addition, most habitat for adult goliath grouper in the SEUS falls within federal waters. While we will draw heavily on the support resources available to us through the Florida State University and existing equipment purchased with other federal grants, we need additional funds to conduct the fieldwork and ensure seamless integration among these projects. We request government assistance to cover the salaries, supplies, and travel expenses of this multi-investigator, multi-institution, multi-year proposal associated with conducting field census surveys and compiling data bases.

NOAA's Marine Fisheries Initiative (MARFIN) is an appropriate source of funding for this type of project because of the tight linkages to management of reef fish stocks in the southeastern United States and the acute need to resolve the now politically charged issue of population recovery in this species. There is much misinformation about the ecology of goliath grouper circulating among fishing groups, so the involvement of many prominent fishermen in the research process will help dispel these misconceptions and foster a trust in the scientific method. Several prominent figures in the spearfishing community have already helped us in our field

work on goliath grouper and continue to disseminate our research findings. We will seek funding elsewhere to define the diving community's economic interest in goliath grouper.

***Project Impacts, Results or Benefits Expected*:** Results from the proposed study will provide critical information for the management of goliath grouper in the southeastern United States. Ultimately, they will provide a means of improving regulations (and presumably compliance with those regulations) by improving the decision-making capability of resource managers. With competing interests to either reopen the fishery at some level or declare the species endangered, the management arena has become politically charged and begs for better scientific knowledge. These results will make a significant contribution to that knowledge, specifically on goliath grouper life history data necessary for stock assessment and will provide data on essential spawning habitat. Data following from this project will provide sufficient information for developing spatially explicit models of how the distribution and abundance of species will be affected over time by fishing and by large-scale natural and-or anthropogenically induced events.

***Dissemination of Project Results (including outreach)*:** Co-investigators in this project routinely give talks at scientific meetings; to environmental groups; to fishing and diving clubs; on radio, television, and websites; and to state and federal natural resource management agencies, including the GMFMC, the SAFMC, the FWRI, and Marine Fisheries Commission. These communications have proved excellent venues for sharing research results. Information will reach the public through these venues as well as through websites maintained by the principal investigators. Also, we will include fishermen (commercial, recreational and for-hire) in the field work, and many have already offered the use of their vessels and time for this work. Finally, results will be published in peer-review journals.

The proposed research complements and extends research we have conducted in this field and in this geographic area for the past two decades. We have made considerable progress in the areas of life history and behavioral ecology of dominant reef fish species toward the development of effective management models. These include:

(1) Spatial and temporal aspects of spawning for gag, red grouper, scamp (Coleman *et al.* 1996);
(2) Spatial and temporal aspects of gag juvenile recruitment along the west Florida coast (Koenig and Coleman 1998); (MARFIN. NA77FF0546);
(3) Description of goliath grouper use of, and recruitment from, mangrove habitat in southwestern Florida (Koenig et al. 2007);
(4) Demographic changes (age structure, size structure, proportion of males) of gag (and other reef fish species inside and outside of no-take marine reserves (Koenig et al. in prep.; current support from MARFIN);
(5) Habitat characterization of offshore spawning sites for gag, red grouper, and scamp (supported by Sea Grant, Pew Fellows Program);
(6) Population density, demographics, and predation effects of adult goliath grouper (CRP Project NA05NMF4540045, 2006 - 2009 (Koenig and Coleman, Florida State University); and see Mann et al. 2009, Murie et al. 2009;
(7) Spatial and temporal aspects of bycatch of juvenile gag and their prey by inshore trawling fisheries (NA08NMF4270414; Stallings et al. 2010, Stallings 2010);
(8) Non-consumptive investigations of reproduction for stock assessment of goliath grouper (current support from MARFIN)

***Participation by persons or groups other than the applicant, including federal, state, and local government activities and related federal assistance*:** Others participating in the proposed work (other than Florida State University scientists, C. Stallings, C. Koenig, and K. Craig) are Debra Murie and Daryl Parkyn (University of Florida). Furthermore, the NMFS has contributed significantly to several of our previous projects dealing with recruitment of reef fishes (MARFIN 94MF029-G(RF)) and other aspects of grouper biology and management (including awards NA90AA-H-MF748, NA77FF0546, NA57FF0055, NA05NMF4540045, and NA08NMF4270414). Their insights, cooperation, and recommendations will be valuable to this project, and specifically to goliath grouper research in an effort to develop fishery-independent information on reef-associated habitats and fauna. This research relates to the characterization of fish habitat and fish communities along the continental shelf.

During the course of our goliath grouper studies we have tagged over 2200 adults and over 2500 juveniles. Responses from fishermen from all 8 regions Florida (Figure 1) with extensive knowledge of natural reef systems and goliath grouper habitat use have provided information through tag observations and indicated a significant level of interest in participating in our studies. We have remained in contact with many of these people, who have offered to take us out on their boats and to conduct sampling for us, following training sessions that we will provide. Among those fishermen who have contributed significantly to our research in the past and agree to continue helping us are captains D. Demaria, T. Grogan (owner of Spearfishing Magazine, the Spearboard website, and a strong proponent of using science to resolve fishery problems), and Rich Johnson (prominent in the Caloosa Dive Club, Lee County, FL, offshore of which is the center of adult goliath grouper population abundance). Many others have also asked to help—many of these people catch and release goliath grouper for sport.

The Gulf Restoration Network and the Pew Environment Group will help with out-reach to the general population. This project is intended to complement our ongoing work conducted under the auspices of National Marine Fisheries Service to evaluate grouper habitat and life history in the Gulf of Mexico and South Atlantic regions.

***Project management*:** The proposed research involves collaboration among researchers at Florida State University and University of Florida representing interdisciplinary interests. Stallings and Koenig have extensive experience working on the ecology of reef fishes, particularly grouper life history and behavior. They devote a considerable amount of time working with state and federal fisheries management agencies to provide scientific underpinning to management decision-making. Stallings will have oversight of the project, including submission of required reports. Stallings and Koenig will be responsible for organizing and running field operations, acquisition and maintenance and supplies, and data analysis of population studies. Craig has expertise with foraging ecology and analysis of tag-recapture data (including cursory efforts with goliath grouper), and will assist Stallings with these aspects of the work. All project co-PIs will be responsible for developing a rapid response team for sampling adult goliath grouper killed in red tides or from enforcement confiscations. Stallings will be responsible for the dietary and stable isotope work. Debra Murie and Daryl Parkyn (UF) will be responsible for evaluating the validity and limits of determining goliath grouper ages from soft dorsal fin rays and will estimate reproductive parameters using biopsies and histology. All co-investigators will participate in field operations, data analysis, and in writing peer-review papers.

***Monitoring Project Performance*:** Project performance will be monitored internally for the science through monthly communication of the co-PIs. Maranda Marxson, FSU Coastal and Marine Laboratory Fiscal Office, will handle project administration. All of the research activities will be conducted on-site and will require little technical support from the University. Julie Wammack (FSU Office of Sponsored Research) serves as liaison between FSU and the granting agency for financial considerations. Reports will be submitted semi-annually to Robert Sadler (NMFS, SERO) and whoever serves as the NMFS contact for grant support.

STATEMENT OF WORK Three years

Applicant: Christopher Stallings

***Co-PIs*:** Christopher Koenig, Kevin Craig, Debra Murie, and Daryl Parkyn

Proposed Budget Period: Three-year project 8/1/2011-7/31/2014

Project Title: Regional age structure, reproductive biology and trophic patterns of adult goliath grouper in Florida.

Scientific or technical objectives and procedures

The objectives of the proposed work are:

1) To validate non-lethal methods of estimating age (using otolith and dorsal fin-ray samples) and examine the reproductive states of goliath grouper from dead fish (e.g., opportunistic sampling of mortalities due to red tide, fishery bycatch, and enforcement confiscations).

2) To age (using dorsal fin ray samples) live goliath grouper collected non-destructively by catch-and-release fishers trained by us to measure, tag, and sample individual fish.

3) To conduct trophic studies of goliath grouper through targeted stomach content and stable isotope analyses using stable isotopes ^{13}C and ^{15}N.

4) To evaluate movement patterns of recaptured goliath grouper based on tag returns.

Rationale and Methodology for Each Objective

Objective 1: To validate non-lethal methods of estimating age (using otolith and dorsal fin-ray samples) and examine the reproductive states of goliath grouper from dead fish (e.g., opportunistic sampling of mortalities due to red tide, fishery bycatch, and enforcement confiscations).

Age and reproductive parameters of fish populations provide essential information requisite for estimation of population parameters such as age and growth, reproductive potential, recruitment and mortality rates due to fishing and natural causes. Age and reproductive biology data are also essential in assessing the recovery of fish stocks under protection (conservation closures or regulations) due to over-fishing and habitat loss. Our goal is to increase our knowledge of the age structure and reproductive biology of goliath grouper (*Epinephelus itajara*), a protected species in south Florida, to aid in its recovery and management plans. We will use samples of dead fish to validate non-lethal methods; these fish will be obtained through opportunistic

sources (killed by red tide, longline bycatch, and confiscated illegally harvested fish). These data are critical for assessing the status of this recovering species.

***Rationale*:** The age structure of fish populations provides essential information required to estimate population parameters such as growth, reproductive potential, recruitment rates, and mortality rates due to fishing and natural causes. Age composition data are essential for assessing the relationship between anthropogenic impacts on populations (e.g., overfishing and habitat loss), subsequent fishery regulations intended to promote recovery (e.g., conservation closures, fishery or individual fishery quotas), and population status.

Currently, the most common method of aging and determining the reproductive status of marine fish requires the fish to be sacrificed. This is particularly the case for aging, since the otoliths or "ear stones" must be removed from the skull of the fish. For fish species that are protected because of their endangered/threatened status or due to overexploitation, the lethal aging process (using otoliths) is contradictory to the aim to conserve these populations. It is therefore difficult to justify the sacrifice of *large numbers* of protected fish species, such as goliath grouper in the United States. However, information on their age allows estimates of mortality (death rates), growth, age composition, and hence production and projected recovery rates. Personnel at state and federal fisheries agencies, as well as university and research groups, are therefore under increasing pressure to try to reduce the impact of their own research sampling; sampling that is necessary for assessing the status of the stocks.

To date, the most conventional way of non-destructively sampling fish for age has been to use their scales. Scales can be collected without killing the fish and with minimal damage to its external appearance. Scales have more commonly been used to age fish species that have relatively short life spans and rapid growth (e.g., salmon, herring: maximum 5-6 years of age) (Chilton and Beamish 1982). In relatively long-lived (e.g., > 10 years) fish, however, scales often underestimate the age of the fish (Beamish and Harvey 1969, Chilton and Beamish 1982). The direct relationship (1:1) between otolith ages and scale ages for fish may differ even after the first few years of life. For example, in studies on sheepshead (*Archosargus probatocephalus*) in the Gulf of Mexico, scale ages start to underestimate otolith ages after only 3 years of age, although sheepshead live to at least 15 years (Dutka-Gianelli and Murie 2001). Scales may therefore be helpful in aging short-lived species and the juveniles of relatively long-lived fish species but would not be helpful in aging older fish (Chilton and Beamish 1982).

As an alternative to using scales, we have started to examine the use of finrays as a primary method for non-lethal aging of protected fish species, such as goliath grouper. Fish can be aged by using fin-ray sections, taken usually from their dorsal or pectoral fins. This is also a non-destructive method of aging a fish, since the fin samples can be taken from live fish that can then be released. Finrays have been used to age a diverse group of fish species (Table 1), primarily (although not exclusively) from cold temperate regions where the annular rings in the aging structures (whether otoliths, scales, or finrays) are relatively wide and distinct. In contrast to scales, the finray method of aging fish has been used to age relatively old fish (e.g., most notably sturgeon and lingcod) (Table 1).

Table 1. Examples of fish species that have been aged using sections of fin structures, along with their maximum observed age. FW = freshwater and M = marine.

Common name (species)	Locality	Max age (Yrs)	Reference
Albacore tuna *(Thunus alalunga)*	M	12	Beamish (1981)
Arctic grayling *(Thymallis arcticus)*	FW	11	Sikstrom (1983)
Chum salmon *(Oncorhynchus keta)*	M	5	Bilton and Jenkinson (1969)
Gag grouper (*Mycteroperca microlepis)*	M	17	Debicella (2005)
Goliath grouper (*Epinephelus striatus*)	M	17	Murie et al (2009)
Kelp greenling *(Hexagrammos decagrammus)*	M	16	Murie & Parkyn (unpub. data)
Lake sturgeon *(Acipenser fulvescens)*	FW	152	Anonymous (1954)
Lingcod *(Ophiodon elongatus)*	M	21	Chilton and Beamish (1982)
Pacific cod *(Gadus macrocephalus)*	M	8	Beamish (1981)
Sockeye salmon *(Oncorhynchus nerka)*	FW & M	4	Bilton and Jenkinson (1969)
Walleye pollock *(Theragra chalcogramma)*	M	9	Beamish (1981)
White grunt (*Haemulon plumieri*)	M	18	Murie and Parkyn (1999)
White sturgeon *(Acipenser transmontanus)*	FW & M	104	Rein and Beamesderfer (1994)
White sucker *(Catostomus commersoni)*	FW	14	Beamish and Harvey (1969)

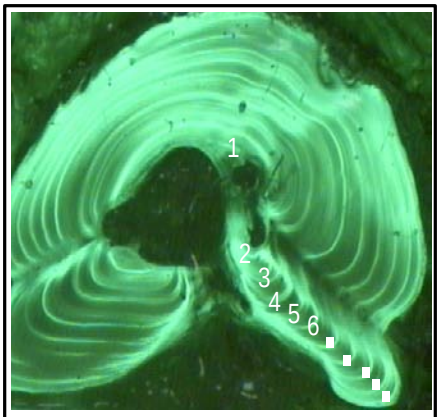

Figure 2. Cross-section of a dorsal finray of an 11-year old gag showing annuli on the inner, oblique edge of the finray structure.

Recently, warm temperate and subtropical fishes, such as white grunt and gag grouper in Florida, have been aged using finrays and show distinct annuli in their fin-ray structures (Figure 2) (Murie and Parkyn 1999, Debicella 2005). For gag in particular, it was observed that finray ages were unbiased for older aged gag (12 years maximum age available in samples) (Debicella 2005). ***Using gag as a model species, preliminary finray aging of goliath grouper (Figure 3), based on a small number of paired samples (finrays/otoliths),also indicated that finray aging may be unbiased at least up to age 17 in goliath grouper (oldest fish available in sample; Murie et al. 2009).*** This is in contrast to using spines of goliath grouper, which have been shown to be useful in aging juveniles only (0-6 years) (Brusher and Schull 2009) but are unreadable in older goliath grouper (D. Murie, pers. obs.).

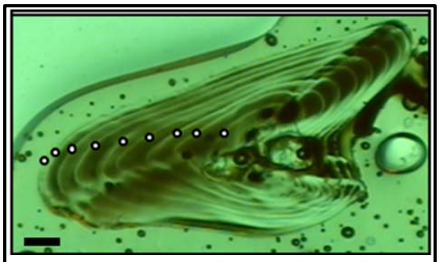
Figure 3. Cross-section of a dorsal finray of a 9-year old goliath grouper.

As with otoliths, the finray method of aging fish can also be validated. Validation assesses the *accuracy* of the method (i.e., does the age determined by a specific method reflect the true age of the fish?) (Chilton and Beamish 1982). For white grunt and gag, and preliminarily for goliath grouper, validation methods have shown that the deposition of one annulus in the otolith of a fish is correlated to the deposition of one annulus in its finrays. One potential disadvantage of using finrays rather than otoliths is the accumulation of annuli on the edge of the finray in relatively very old fish (e.g., >20 years), making it difficult to

distinguish and count each individual annulus (Beamish 1981, Cass and Beamish 1983). The age at which this accumulation occurs is species-specific, however, and may not occur within the range of age determination required for management. For example, lingcod are routinely and reliably aged up to ~20 years of age before the accumulation of annuli on the edge interferes with accurate age estimates, although there are very few lingcod >10 years taken in the fishery (McFarlane and Leaman 1983). To date, paired otolith and finray samples available for goliath grouper have been limited to fish mostly <10 years of age, with low replication of paired samples available for older fish (Murie et al. 2009). It will therefore be imperative to compare finray ages with otolith ages from the same fish (aged independently) over a larger age range to indirectly validate the finray aging method for goliath grouper. This is especially important to estimate for fish in the older age classes since goliath grouper have been aged to a maximum of 37 years, although the majority of fish (90%) were <24 years of age in a study by Bullock et al. (1992).

Assessing the reproductive capacity of fish populations is important to proper long-term management of these resources (Goodyear 1993; Myers and Barrowman 1996). Current management practices in United States domestic marine fisheries require that managers determine what level of fishing pressure leads to recruitment-overfishing (i.e., the adult stock fished beyond the point where it can replace itself under natural spawning conditions; Powers 1996). However, this often necessitates an in-depth knowledge of a stock's reproductive biology at a time when the stock is perceived as being at great risk. Although there is indication that the US stock of goliath grouper is undergoing a recovery from the time of the harvest ban in 1990 (Porch et al. 2006), the current lack of data on the goliath grouper's life history parameters makes it difficult to determine both the level of the stock's recovery and the level of harvest it can sustain, if any.

Goliath grouper are managed based on a Spawning Potential Ratio (SPR) of 50% yet there are no current estimates of reproductive parameters and little is known about their basic reproductive biology. The ovarian structure and oogenesis pattern of goliath grouper has not yet been described (Sadovy and Eklund 1999). The parameters necessary to estimate fecundity differ depending on oogenesis pattern. If they are batch spawners with indeterminate fecundity, fecundity estimates will need to be based on size/age at first maturity, batch fecundity, spawning frequency, and seasonal spawning duration (Hunter and Macewicz 1985). In contrast, if they have determinate fecundity or synchronous oogenesis then fecundity can be estimated based on size/age at first maturity and the standing stock of oocytes at the beginning of the spawning season, after accounting for atretic losses (Murua et al. 2003). Variability of fecundity and how a stock's reproductive output is affected by fishing pressure will also differ depending on the oogenesis pattern (Lowerre-Barbieri et al. 1998).

Sexual pattern (hermaphroditic or not) can also affect how vulnerable a species is to fishing pressure. Sequential hermaphrodites may be more vulnerable to overfishing than gonochorists if there is sex-specific fishing mortality rates (Coleman et al. 1996). Although there have been some indicators that goliath grouper may be protogynous hermaphrodites, the data are inconclusive. Goliath grouper testes have been reported as having a lumen and peripheral, sperm-collecting sinuses like the males of most protogynous hermaphrodites (Smith 1971) and at least one testis has been reported to have a few regressed oocytes (Bullock and Smith 1991). However, Bullock et al. (1992) collected males and females with substantially overlapping age compositions (males 3-26 years and females from 0-36 years). In addition, they did not find any sexual differences in growth pattern. Lastly, they report that males matured at slightly smaller and younger ages than females. None of these patterns are what would be expected if goliath grouper are in fact demonstrating sequential sexuality with a terminal male phase.

Given the importance of understanding reproductive parameters for management, there is a clear need to develop and evaluate non-lethal methods for their estimation, and to identify, if there are any key parameters which cannot be estimated this way. To determine maturity, sex ratios and oogenesis pattern it will be necessary to collect gonadal tissue both within and outside of the spawning season. Ovarian biopsies have been successfully used in aquaculture to collect ovarian samples (Garcia 1989) and would be expected to work equally well with goliath grouper. Catheterization of fish to assess sex and gonad development is also used in a number of fish species; we are currently using this method successfully in greater amberjack (*Seriola dumerili*) (Murie et al. unpubl. data). Surgical techniques are also being developed to collect gonadal tissue from fish with undeveloped gonads (Chris Koenig, pers. obs.). It is important to evaluate these non-lethal techniques before determining whether there is a need to sacrifice fish.

Estimation of sexual maturity plays a vital role in fisheries science because it is closely linked to stock productivity (Hunter and Macewicz 2003). This parameter is especially important for estimates of SPR, as it plays a critical role regardless of whether the analysis is egg- or biomass-based. These parameters have been estimated for goliath grouper but only at a time when the species was severely overfished. Long-term shifts in maturation to smaller and younger individuals have been extensively documented for overexploited fish stocks (Law 2000). To understand both the level of the stock's recovery as well as its vulnerability to fishing, it will be necessary to have a current estimate of size- and age-at-maturity.

***Fish Collections*:** Goliath grouper to be used to address Objective 1 will be obtained in collaboration with state and federal fisheries agencies that confiscate fish due to regulatory management of a protected species, from fish killed and scavenged during red tide events, and from fish killed incidentally as bycatch and retained by onboard federal observers in other monitored fisheries sectors. In addition, non-lethal samples of finrays and gonad samples and biopsies will be collaboratively sampled by investigators and trained fishers (see Objective 2). All fish will be measured for total length, fork length, and weight, as possible. Paired samples of sagittal otoliths and finrays (dorsal, pectoral, pelvic, and anal) will be collected from all dead goliath grouper. Finrays available from all body positions will be assessed for readability. Ideally, paired aging structures from goliath grouper spanning the entire length range of the species, and therefore the potential age range, will be available for the study. Gonad samples will be obtained from dead fish (opportunistic sampling of fish from red tides kills, confiscation, or confiscated bycatch) and non-lethal gonad biopsies will taken by investigators during field sampling.

***Aging Structures and Methods*:** Otoliths and finrays will be prepared for ageing following the preliminary protocol outlined in Murie et al. (2009). Specifically, sagittal otoliths will be prepared for aging using a thin-sectioning method (Chilton and Beamish 1982). With this method, the whole otolith is cleaned and attached to a glass slide. The otolith is then thin-sectioned (~0.5 mm thick) and mounted on a glass slide and examined for annuli (rings) under transmitted light, using either a compound microscope or a stereomicroscope depending on the size of the otoliths. Soft finrays (rays 3-7) of the dorsal, anal, pectoral, and pelvic fins will be removed from the fish by cutting across the basal structures of the fins. The finrays will then be cleaned of any tissue or fat and allowed to air-dry. Dried finrays are epoxied in resin, thin-sectioned (~0.5-0.8 mm thick) and mounted on glass slides. Finray sections are examined using a compound microscope with a green-filter to enhance contrast.

***Marginal-Increment Analysis*:** The marginal increment is the distance between the last annulus and the edge of the aging structure, therefore representing the most recent growth of the fish. The amount of the marginal increment (growth) on finrays will be compared to the marginal increment observed on sectioned otoliths to determine if the annuli and the amount of growth on the edge of all of the aging structures can be interpreted in a similar manner. This will aid in final interpretation of the aging structures and therefore age estimates. Marginal increments from otoliths and finrays will be measured using a MOTIC® digital image processing system. This system captures images from a microscope and displays the image on a video monitor. Measurements will be made using the calibrated, digital-caliper software. The relative amount of marginal increment (growth) in each structure will be calculated as the index of completion (Tanaka et al. 1981). The index of completion for the finrays of each individual fish will be correlated with the index of completion for its otolith. This will be examined to determine whether the rate of deposition of marginal material in the otoliths and finrays occurs in a synchronous manner.

***Comparative Age Estimates*:** After establishing the final aging criteria for finrays (i.e., where is the first annulus, what constitutes a true annulus, etc.), all aging structures will be read independently by two experienced readers. Finrays will be aged prior to establishing otolith ages to avoid reader bias in aging older fish. Between-reader precision (i.e., reproducibility) will be estimated for each aging structure to assess the difficulty of reading the structures. Between-structure estimates of precision will be used to indirectly validate the finray aging method with respect to the otolith aging method. This is estimated by comparing the ages determined from different structures for individual fish (agreement or disagreement) and then calculating the percent agreement among the sets of ages for all fish combined (Sikstrom 1983). These comparisons can also be visualized by plotting the fin-ray age as a function of sectioned-otolith age for each fish. A line denoting the ideal 1:1 relationship is used for reference (Beamish and Harvey 1969, Sikstrom 1983). Precision will also be determined by calculating the coefficient of variation (CV) (Kimura and Lyons 1991), average percent error (APE) (Beamish and Fournier 1981), and the concordance correlation (*rc*) (Lin 1989) between readers and between the two aging methods. Lower values for CV and APE represent greater precision and can be compared to aging precision of other fish species (e.g., Kimura and Lyons 1991). The concordance correlation ranges from 0 (no reproducibility) to 1.0 (perfect reproducibility) and has been determined to be more robust than the CV (Lin 1989, 2000). Age estimates from otoliths and finrays will also be compared quantitatively using a test of symmetry to determine systematic aging differences between structures (Bowker 1948; Hoenig et al. 1995). If a significant difference is detected, then the test of symmetry will be repeated assuming symmetry for the most extreme cases until no bias can be detected (Hoenig et al. 1995). This latter method can be used to detect the age(s) where the method becomes unreliable.

***Reproductive Analyses*:** Gonads obtained in relatively good condition from field collections will be weighed and gonadosomatic indices (GSI = gonad weight/fish length or estimated body weight) will be estimated on a monthly basis. Maxima in GSI values for each sex indicate peaks of spawning activity. Gonads will be subsampled for histological analysis by taking samples from the proximal, medial, and distal portion of the gonad. This is necessary because protogynous hermaphroditic fishes may initiate male tissue at various levels within the female ovary. Gonad biopsies (from live fish; Obj 2) and gonad subsamples will be processed using standard histological techniques and slides will be evaluated microscopically. Tissue samples will be immediately fixed in 10% neutrally-buffered formalin. After a minimum of 24 hrs fixation, the samples will be washed and then stored in 70% ethanol. Samples will be processed at the Louisiana State University histological lab. Tissue samples

will be embedded in paraffin, sectioned to 3-5µm thickness, stained with hemotoxylin, and then counterstained with eosin. Histological anlaysis will be used to evaluate oogenesis pattern and developmental stage (Wallace and Selman 1981; Hunter et al. 1992) based on six stages of oocyte development: primary growth, cortical alveoli, yolked, germinal vesicle migration (GVM), germinal vesicle breakdown (GVBD) and hydrated. GVM, GVBD and hydrated all indicate that an individual is close to ovulation or spawning and can be used to indicate active spawners. Testicular samples will be analyzed for remnant ovarian structures, such as ovarian wall, lamellar structure, or regressing oocytes.

Target sample sizes for non-lethal gonad biopsies will be a minimum of 10 fish of both sexes with developed gonads (collected during the spawning season), and an additional 10 fish of both sexes from undeveloped fish each year. It may be possible to collect additional samples from incidental fish kills if the decay is minimal. However, for histological analysis the tissue must be collected and fixed soon after death.

***Age- and Size- of Sexual Maturity*:** We will integrate ages and sizes obtained when sampling goliath grouper for gonads or gonad biopsies to model maturity ogives for each sex. Age- and size- of 0%, 50%, and 100% maturity will be predicted from ogives.

Objective 2: To age (using dorsal fin ray samples) live goliath grouper collected non-destructively by catch-and-release fishers trained by us to measure, tag, and sample individual fish.

***Capture Methods*:** For our sampling we have developed methods to capture goliath grouper at depth and transfer them safely onto a research vessel for sampling. We capture fish using large circle hooks, 600 lb test monofilament leader, a 2 kg lead weight, and cut or live bait. The gear is attached to a 1.0 cm diam. braided nylon hand line and suspended above the bottom by a 60 cm diameter float. The fish are allowed to fight the float until exhaustion (about 3 to 5 minutes) before being hauled to the surface. We vent captured fish either at the surface if caught at depths < 25 m, or *in situ* at about 10 m if caught at depths > 25 m. When fish reach the surface, they are guided onto a stretcher that is then hoisted above the gunwale with two davits. The fish's gills are bathed with seawater by a hose attached to an overboard submersible 12 VDC pump; the eyes are covered to protect them from direct sunlight while the fish is held in place with velcro straps for sample collection (Figure 4).

Figure 4. Goliath grouper on stretcher above boat gunwale and below two davits. The fish's eyes are protected from direct sunlight and a gill irrigation hose is in its mouth.

The fishers will be instructed in our methods (and told not to capture them in depths greater than 25 m), but they will likely catch the fish using their own methods. We will suggest, however, that they allow the fish to tire before bringing them alongside their boat for sampling and tagging.

Fin ray removal methods: The co-principals and trained students on this project will sample dead goliath grouper when such specimens become available from environmental events (red tide, severe cold fronts, etc.) or from bycatch or confiscations from poachers. We will remove all dorsal fin rays

at their point of articulation with pterygiophores (fin supports) and will also remove both saggital otoliths from the otic capsules of the cranium. The co-principals will also travel to the eight regions of the state and capture adult goliath grouper and sample fin rays, gonad biopsies and stomach contents (Obj 3).

Cooperating fishers will be trained to remove goliath grouper fin rays 5, 6, and 7 down to their base (see Murie et al. 2009). They will also be asked to take a small piece (< 1 g) of muscle tissue at the base of the fin rays or just below for stable isotope analysis (Obj 3) using a 2mm biopsy punch. Finally, fishers will be instructed how to preserve fin rays and muscle tissue in salt (NaCl), and send to our laboratory. All captured goliath grouper will be tagged and released unharmed.

Fisher support: We have identified a number of fishers throughout the State of Florida who express considerable interest in participating in the proposed studies. Most of these responded through the FWC tagging hotline to report goliath grouper sightings. We have worked with FWC over at least the past 10 years to obtain information on tagged and untagged fish, and have responded personally to every fisher calling in. We will select 30 to 40 volunteers to support our sampling effort statewide, identifying at least 3 samplers per zone. Samplers will be instructed in safe handling of goliath grouper (for the fisher and for the fish) to ensure fish survival. They will also learn how to collect data, including measuring fish length; removing, labeling, storing, and shipping dorsal fin rays; tagging and releasing the fish. They will be expected to send coordinates of each sampled and tagged fish and a digital image of the finray area of the sampled fish. We will supply the fishers with a DVD and paper document for their reference that explicitly demonstrates each component of the sampling procedure. Cooperating fishers will be supplied with all the necessary tools and materials to do the sampling and tagging along with instructions on how to send the samples and data to our laboratory.

In addition to the volunteer samplers, we will also sample regionally, using resources (boats, truck, materials, etc.) from FSUCML to do so. We will base our sampling locations on data collected in work reported in Koenig et al. (2009).

Fishers who agree to help us sample and tag goliath grouper will be compensated for each fish sampled. In addition they will be periodically updated as to our findings. Because fishers will be catching and tagging goliath groupers they will likely recapture either fish that have been tagged by us (over 2200 adults tagged to date around Florida) or fish tagged as part of this proposed effort. Thus, tagging and recapture locations will be added to our goliath grouper tagging database and we will continue to analyze movement patterns (Obj 4).

Objective 3: To conduct trophic studies of goliath grouper through targeted stomach content and stable isotope analyses using stable isotopes ^{13}C and ^{15}N.

We will continue developing our trophic analysis of adult goliath grouper by sampling stomach contents of captured live fish from the 8 designated zones of Florida (capture methods described in Objective 2). Diet analyses are conducted on captured fish by inserting a large (15 cm diameter) stainless steel tube into the grouper's mouth to hold the jaws open, and reaching down the esophagus and into the stomach with a gloved hand to retrieve gut contents. In some circumstances we will use a lavage method which entails forcing a low-pressure water current into the captured fish's stomach,

then collecting the stomach contents expelled with the water. The stomach contents are bagged separately for each fish in 10% formalin to arrest digestion and preserve tissue. In the laboratory, the contents are blotted dry, weighed, measured, identified to the lowest possible taxon, and enumerated.

These data will be used in the bioenergetics model developed by Dr. Paul Richards (NMFS-Miami) from our existing dietary data (270 juveniles and adult stomachs, sampled mostly from south Florida during our NOAA CRP-funded study). The model includes (1) dietary mass and composition, (2) feeding patterns, and (3) overall energetic needs for growth and reproduction. This is an important component to the study because it will address potential misconceptions about the relationship between goliath grouper recovery and the decline in other fishery resources. Such a bioenergetics model in combination with adult population size estimates will allow development of realistic estimates of the regional impact of the goliath grouper population on forage species. Richards used a generalized bioenergetic model such that,

$$dB/Bdt = C - (E + U + M) \qquad \text{(equation1)}$$

(e.g., Kitchell et al. 1977) where B is body mass, *dB/Bdt* is the specific growth rate in body mass in units of body mass change mass^{-1} (t^{-1}), C is total specific consumption rate in mass of all prey, E is mass lost to egestion, U is mass lost to excretion, and M is mass lost to metabolic costs. We propose to directly estimate total C for each region. Because measures of basic physiologic rates (e.g., E, U, and M) of goliath grouper are not currently available, we will estimate the approximate value of the sum of E, U and M. First, we will estimate growth rate using known growth in length and body mass to length estimates (Bullock et al. 1992), modified by our measurements by region (see above on measuring age and length). Then we can calculate the approximate value of the sum of E, U, and M by rearranging eq. 1. With estimates of the sum of E, U, and M at different ages and sizes, we can develop a general allometric relationship between age (or size) and E, U, and M combined. Given these relationships, we can calculate a consumption rate (C) for any size, or a growth rate (*dB/Bdt*) for any consumption rate.

Richards could also estimate total consumption rate (C) using maximum and minimum boundaries for E, U, and M from the literature on other groupers or other similar fish. Total C could be estimated for each region, broken down by region j and prey species (or functional group) i such that,

$$C_j = C_j \cdot e_{ji} \qquad \text{(equation2)}$$

where e_{ji} is the proportion of grouper diet by region j and prey functional group i, and C_j is total consumption by region j.

Because our initial studies of diet were restricted to south Florida (Koenig et al. 2009), we cannot validly extrapolate to other regions of the fish's range. This proposed study will provide dietary data from all parts of the state so the impact of the recovered goliath grouper population on prey species can be estimated.

A second component of the trophic analysis of goliath grouper is stable isotope analysis of tissue samples to determine long-term trophic status of this species on a regional basis. While stomach content analysis provides an instantaneous picture of diet and a list of prey species, stable isotope

analysis provides an integrated view of the trophic patterns of the animal. For example, if a predator is routinely feeding on herbivores throughout its range, that will show up in the pattern of ^{13}C and ^{15}N isotopes, regardless of its location. Stable isotopes (particularly those of C and N) have been used by trophic ecologists to trace food webs within and between ecological systems (Peterson and Fry 1987, Wada et al. 1991). Such isotopes are an inherent part of all biological material but occur in varying proportions in various biological systems due to metabolic fractionation which occurs during carbon fixation in plants, and because plants take up inorganic constituents from different reservoirs which vary in isotopic composition. Because naturally occurring isotopes remain relatively constant in proportion as they are passed from one trophic level to the next, they serve as natural tracers in ecological food webs.

We propose to run both ^{13}C and ^{15}N analyses on goliath grouper muscle samples collected opportunistically. The ratio of carbon isotopes gives valuable information about food web sources (Fry 1984, Wada et al. 1991). While ^{13}C reflects diet after multiple trophic transfers, ^{15}N shows a 3‰ increase per trophic level up the food web, so information about the trophic level of the prey can be obtained to aid in the interpretation of trophic dynamics and in tracing carbon flow. Thus, the isotopic signatures of carbon and nitrogen reflect the trophic position of the fish. Therefore, we will collect muscle tissue samples in all regions, those where we have a good estimate of diet and those where we have a poor estimate due to present low population density, and use these data to evaluate goliath groupers trophic level throughout all regions. Similar isotopic signatures over all regions can be interpreted as goliath grouper feeding at similar trophic levels throughout all regions.

Objective 4: To evaluate movement patterns of recaptured goliath grouper based on tag returns.

As stated earlier, we have tagged over 2200 adult and over 2500 juvenile goliath grouper, mostly in south Florida where the population densities are greatest. Most of the juveniles were tagged prior to 2004, so are now adults. Therefore the population of tagged fish is fairly high in Florida, but the vast majority are in south Florida. In this project, cooperating fishers will be tagging regionally, so there is a chance we can get good information about regional movement patterns. There is good evidence from our earlier work (Koenig et al. 2009) that adult goliath grouper are strongly site oriented, except during the spawning season, a time when they may migrate hundreds of kilometers to spawning sites. It would be valuable to know the seasonal patterns of movement of fish in the warm temperate portions of the state.

We will mail posters advertizing our tagging program to marinas, tackle shops, etc. to encourage fishers to report tagged fish. We will further encourage fishers who have recaptured tagged fish advertizing that each tag return will count as one lottery ticket for a drawing when the project is finished. Also, the cooperating fishers will be given a lottery ticket for each fish sampled and tagged in addition to a monetary payment for sampling ($10.00/ sampled fish).

Expected results

***Collection of goliath grouper otoliths and finrays*:** We expect to collect samples from dead goliath grouper (as we did in the past) from a variety of sources. Three sources have been identified in this proposal (red tide, longline bycatch, and enforcement confiscations).

Non-lethal aging validation: Based on previous experience with the groupers, gag and goliath

grouper (Debicella 2005, Murie et al. 2009), we expect that fin rays will provide a useful, non-destructive method for aging goliath grouper and become a significant aid in assessing the age structure and age-dependent life history parameters critical to restoration and management of this protected species.

***Capture methods*:** We have already developed reliable capture methods using circle hooks and hand lines. Of course, volunteer fishers will use hook and line and will likely prefer their own methods. As long as those methods are not injurious to the fish or dangerous to the fisher, we will have no objection. But we will show them our methods and explain potential problems with other methods of capture. We expect to get widespread cooperation among fishers and will provide them with periodic updates on our findings.

***Fisher support*:** Because we are constantly asked by fishers if they can contribute to our research on goliath grouper and because we have a database of over 100 of those fishers, we expect no problems in getting widespread support and cooperation.

***Diet and stable isotope analyses*:** Because we have experience in collecting stomach contents from both juveniles and adults and in running stable isotopes (e.g., Chasar et al. 2005, Nelson et al. 2009) we do not expect to have difficulties in doing this.

***Location of administrative offices, location of the project*:** The Administrative Offices for this project are located at Florida State University, Coastal and Marine Laboratory (FSUCML), St. Teresa, FL. The project will be conducted largely offshore throughout reef areas of the West Florida Shelf and the Atlantic coast of Florida. Analyses will be conducted at the institutions carrying out the various objectives of this proposal. These include FSUCML, for contacting volunteer fishers, coordinating volunteer activities, analyzing stable isotopes and stomach contents, University of Florida (UF) for validating finray aging through comparison of otoliths and finrays from fish of opportunity and finray aging of goliath grouper collected by volunteers. Researchers from both institutions will be on call to collect otoliths and fin rays from dead goliath grouper and will cooperate in fishing operations in the various regions of the state.

***List all project personnel and responsibilities of each*:** Co-PIs on this project are: Christopher Stallings, Christopher Koenig, Kevin Craig, Debra Murie, and Daryl Parkyn. Stallings will be responsible for oversight on the grant and will be responsible for the diet analyses, stable isotope work, and for contacting volunteers. Craig has experience with foraging ecology and analysis of tag-recapture data (including cursory efforts with goliath grouper), and will assist Stallings with these aspects of the work. All co-PIs will be responsible for collecting samples of opportunity from red tide events, confiscations, and long-line bycatch. Murie and Parkyn (UF) will be responsible for age and growth analyses from finrays and otoliths and reproductive parameters from histological work. Stallings, Koenig, Craig, Murie, and Parkyn will be responsible for conducting field activities, coordinating with volunteer fishermen, and study design. All personnel listed will be involved in field operations, data analysis, and writing of peer-review papers.

Milestone Table

	Purchase supplies	Contact & organize fishers	Collect samples of opportunity	Field work	Lab work	Data analysis	Submit reports	Present @ meetings	Peer-reviewed publication
Aug-11	X	X	X						
Sep-11	X	X	X						
Oct-11	X	X	X	X					
Nov-11	X	X	X						
Dec-11			X			X			
Jan-12			X	X			X		
Feb-12			X		X				
Mar-12			X		X				
Apr-12			X	X	X				
May-12			X		X				
Jun-12			X		X	X			
Jul-12			X	X	X		X		
Aug-12	X	X	X		X				
Sep-12	X	X	X		X			X	
Oct-12	X	X	X	X	X				
Nov-12			X		X			X	
Dec-12			X		X	X			
Jan-13			X	X	X		X		
Feb-13			X		X				
Mar-13			X		X				
Apr-13			X	X	X				
May-13			X		X				
Jun-13			X		X	X			
Jul-13			X	X	X		X		
Aug-13	X	X	X		X				
Sep-13	X	X	X		X			X	
Oct-13	X	X	X	X	X				
Nov-13			X		X				
Dec-13			X		X	X			
Jan-14			X	X	X	X	X		
Feb-14			X		X	X			
Mar-14			X		X	X		X	
Apr-14			X	X	X	X			
May-14			X		X	X			
Jun-14			X		X	X			X
Jul-14						X	X		X

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Hoenig, J.M., M.J. Morgan, and C.A. Brown. 1995. Analysing differences between two age determination methods by tests of symmetry. Can. J. Fish. Aquat. Sci. 52: 364-368.

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Koenig, C.C., F.C. Coleman, A.M. Eklund, J. Schull, and J. Ueland. 2007. Mangroves as essential nursery habitat for goliath grouper, *Epinephelus itajara*. Bull. Mar. Sci.80:567-586.

Koenig, C.C., F.C. Coleman, P. Richards, K. Kingon. 2009. Population density, demographics. spawning biology and predation effects of adult goliath grouper, *Epinephelus itajara*, in Florida. Final report to NOAA MARFIN.

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Murie, D.J., D.C. Parkyn, C.C. Koenig, F.C. Coleman, J. Schull and S. Frias-Torres. 2009. Evaluation of finrays as a non-lethal ageing method for protected goliath grouper *Epinephelus itajara* in Florida. Endang. Species Res.

Peterson, B.J. and B. Fry. 1987. Stable isotopes in ecosystem studies. Annu. Rev. Ecol. Syst. 18: 293 - 320. Rien, T.A., and R.C. Beamesderfer. 1994. Accuracy and precision of white sturgeon age estimates from pectoral fin rays. Trans. Am. Fish. Soc. 123: 255-265.

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Sikstrom, C.B. 1983. Otolith, pectoral fin ray, and scale age determinations for arctic grayling. Prog. Fish-Cult. 45: 220-223.

Stallings, C.D., F.C. Coleman, C.C. Koenig, and D.A. Markiewicz. 2010. Energy allocation in juveniles of a warm-temperate reef fish. Environmental Biology of Fishes 88: 389-398.

Stallings, C.D. 2010. Experimental test of preference by a predatory fish for prey at different densities. Journal of Experimental Marine Biology and Ecology 389: 1-5.

Tanaka, K., Y. Mugiya, and J. Yamada. 1981. Effects of photoperiod and feeding on the daily growth patterns in otoliths of juvenile *Tilapia nilotica*. Fish. Bull., U.S. 79: 459-465.

Wada, E.H., H. Mizutani, and M. Minagawa. 1991. The use of stable isotopes for food web analysis. Critical Rev. in Food Sci. and Nutrition. **30**(3):361-371.

Williams, I. D., and N. V. C. Polunin. 2000. Differences between protected and unprotected reefs of the western Caribbean in attributes preferred by dive tourists. Environmental Conservation 27:382-391.

NAMES, ADDRESSES, AND TELEPHONE NUMBERS OF PRINCIPAL INVESTIGATORS

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EDUCATION

2007	**Ph.D. Zoology**, minor **Environmental Statistics,** Oregon State University
2002	**M.S. Biology,** San Francisco State University
1999	**B.S. Biology,** East Carolina University

PROFESSIONAL EXPERIENCE

2009 – present	**Assistant in Research,** FSU Coastal and Marine Laboratory, St. Teresa, FL
2007 – 2009	**Postdoctoral Associate,** FSU Coastal and Marine Laboratory, St. Teresa, FL
2002 – 2007	**Research Assistant,** Oregon State University, Corvallis, OR Caribbean Marine Research Center, Lee Stocking Island, Bahamas
2002 – 2007	**Teaching Assistant,** Oregon State University, Corvallis, OR Courses: Marine Ecology Laboratory, Introduction to Biology Laboratory
2001 – 2002	**Research Biologist,** California Dept. of Transportation, San Francisco, CA
2001	**Scientific Aide,** California Dept. of Fish and Game, Healdsburg, CA
1999 – 2002	**Teaching Assistant,** San Francisco State University, San Francisco, CA Courses: Human Biology Laboratory
1998 – 1999	**Research Assistant,** East Carolina University, Greenville, NC Friday Harbor Laboratories, Friday Harbor, WA
1998	**Biological Technician** (GS-4), U.S. Forest Service, Carson, WA

RESEARCH GRANTS (Stallings as lead PI unless denoted *)

2009 – 2010	**North Gulf Institute**. Nearshore reefs as secondary nursery habitat for gag (Co-PI's: C. Koenig, Felicia Coleman)	$36,350
2008 – 2010	**NOAA Saltonstall-Kennedy**. Indirect effects of the bait-shrimp fishery on juvenile gag grouper. (Co-PI's: F. Coleman, C. Koenig)	$76,847
2008 – 2011	**Florida Fish and Wildlife Conservation Commission**. Faunal communities of the Big Bend seagrass meadows. (Co-PI: C. Koenig)	$55,802
2008	**North Gulf Institute**. How does the proximity to salt marsh habitat affect prey communities of late-state juvenile gag in seagrass meadows? (Co-PI: Felicia Coleman)	$14,600
2008	**Florida State University Research Foundation** – Equipment and Infrastructure Enhancement Grant (PI: Dean Grubbs*)	$20,500
2006	**National Science Foundation**. Synthesis of local demography and regional connectivity in a marine fish metapopulation. (served as graduate student coauthor with PI: M. Hixon*)	$500,000
2001	**Myers Oceanographic and Marine Biology Trust**	$1,000
2000	**Sigma Xi Grant-in-Aid of Research**	$800

AWARDS AND FELLOWSHIPS

2009	Florida Sea Grant, Newell Seminar Scholarship ($855)
2006	Society for Conservation Biology Best Student Paper finalist ($100)
2005	WSN Best Student Paper (Mia Tegner Award), honorable mention
2002 – 2003	Thompson Coral Reef Graduate Fellowship ($13,900)
1994 – 1995	Josie Ruth Wheeler Carr Scholarship ($4000)
1994	John A. Holmes Scholar
1994	North Carolina Scholar

RELEVANT PUBLICATIONS

2010 **Stallings**, **C.D.**, F.C. Coleman, C.C. Koenig, and D.A. Markiewicz. Energy allocation in juveniles of a warm-temperate reef fish. *Environmental Biology of Fishes* 88: 389-398.

2010 **Stallings, C.D.** Experimental test of preference by a predatory fish for prey at different densities. *Journal of Experimental Marine Biology and Ecology* 389: 1-5.

2010 Christie, M.R., D.J. Johnson, **C.D. Stallings**, and M.A. Hixon. Self recruitment and sweepstakes reproduction amid extensive gene flow in a coral-reef fish. *Molecular Ecology* 19: 1042-1057.

2009 **Stallings, C.D.** Fishery-independent data reveal negative effect of human population density on Caribbean predatory fish communities. *PLoS One* 4(5): e5333.

2009 **Stallings, C.D.** Predator identity and recruitment of coral-reef fishes: an indirect effect of fishing? *Marine Ecology Progress Series* 383:251-259.

2008 **Stallings, C.D.** Indirect effects of an exploited predator on recruitment of coral-reef fishes. *Ecology* 89: 2090-2095.

INVITED SEMINARS

2010 College of Marine Science seminar, University of South Florida
2010 Biology Department seminar, Western Washington University
2010 NOAA Science Discussion Seminar Series, Northwest Fisheries Science Center
2009 Colloquium Series, Dauphin Island Sea Lab
2009 Biology Department seminar, University of Florida
2008 Conservation Lecture Series, FSU Coastal and Marine Laboratory
2007 Zoology Department seminar, Oregon State University
2007 PISCO lunch seminar, Oregon State University
2007 Biology Department seminar, Florida State University
2007 National Science Board poster session, Oregon State University
2006 Department of Biology, Lewis and Clark College
2005 Teacher Workshop, Lee Stocking Island, Bahamas

CONTRIBUTED PAPERS

2010 Benthic Ecology Meeting, Wilmington, NC
2009 Northern Gulf Institute, Mobile, AL (poster session)
2008 Western Society of Naturalists, Vancouver, British Columbia
2008 International Coral Reef Symposium, Ft. Lauderdale, FL (poster session)
2006 Western Society of Naturalists, Redmond, WA
2006 Society for Conservation Biology, San Jose, CA
∗ ***Student Awards finalist***
2005 Western Society of Naturalists, Monterey, CA
∗ ***Best Student Paper, honorable mention***
2005 Oregon State University Graduate Student Symposium, Newport, R
2003 Western Society of Naturalists, Long Beach, CA
2003 Annual Conf of Research Advances in Fisheries, Wildlife, and Ecology, Corvallis, OR

PROFESSIONAL SERVICE

2009 – present Science Diving Control Board, Florida State University (FSU)

2003 – present **Session organizer and/or session chair for several scientific societies** (e.g., Society for Conservation Biology, Mote International Symposium in Fishery Ecology, Western Society of Naturalists

Active **Journal Referee (**several leading journals focused on fisheries, marine ecology, and conservation biology)

CURRICULUM VITAE

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PERSONAL INFORMATION

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EDUCATION

Florida Atlantic University, Boca Raton, FL. BS Biology 1965-67, MS 1967-69
Florida State University, Tallahassee, FL. Ph..D. Biology 1970-75

ACADEMIC POSITIONS:

1999-present	Department of Biological Science, FSU. Research Associate
1987-1999	Department of Biological Science, FSU. Associate in Research.
1978-1980	Department of Biology, College of Charleston. Associate Professor
1975-1978	Department of Biology, College of Charleston. Assistant Professor

STUDENT COMMITTIES AND COURSES:

1997-present	FSU. Graduate committees: Ph.D. candidates – FSU, Biology, 3; FSU, Oceanography, 1; M.S. candidates – FSU, Oceanography 1; U. Hong Kong, Biology, 1.
1986-1997	FSU. 1. Graduate committee: Ph.D. candidates, 2. Courses: Biology of Fishes, Fisheries Ecology, Summer Science & Math Camp for high school students, Saturday-at-the-Sea middle school
1975-1980	College of Charleston, Department of Biology, Charleston, SC. Directed M.S. research; 7 graduated. Courses (Graduate): Physiological Ecology of Marine Organisms, Biological Oceanography, Marine Biology Seminar. Courses (Undergraduate): Biology of Fishes, General Biology, Senior Seminar.

PROFESSIONAL COMMITTEES:

1997-2000	Gulf of Mexico Fishery Management Council Reef Fish Stock Assessment Panel
1996-1999	SAFMC Snapper-Grouper Committee member
1994-1997	GMFMC Special Reef Fish Scientific and Statistical Committee

RECENT RESEARCH ACTIVITIES (2001 to present):

- NOAA MARFIN. With F.C. Coleman, David Mann, and Kevin Craig. 2010 – 2012. $300,000. The recovering goliath grouper population of the southeastern US: non-consumptive investigations of reproduction for stock assessment.
- NOAA MARFIN. With F.C. Coleman. 2007-2009. $300,000. Estimating natural mortality and spillover in Madison Swanson Marine Reserve in the NE Gulf of Mexico.
- NOAA Cooperative Research Program. with F. C. Coleman. 2005-2006. $370,000. Distribution, abundance, diet, and bioenergetics of goliath grouper (*Epinephelus itajara*) in Florida waters.
- NOAA MARFIN. with F.C. Coleman. 2003-2005. $375,000. Reef fish demographics and seasonal movements in and around Gulf marine fishery reserves, Madison Swanson and Steamboat Lumps.
- NOAA Cooperative Research Program. with F.C. Coleman and P.J. Hanson. $330,583. Gag (*Mycteroperca microlepis*) recruitment processes using otolith chemical and genetic markers
- National SeaGrant Program. with F.C. Coleman. 2000 – 2002. $200,000. Experimental studies in west Florida shelf-edge marine reserves of the effects of fishing on grouper demographics.
- NOAA Sustainable Seas Expedition to the *Oculina* Banks on the East Florida shelf. September 2001. Shelf-edge mapping and habitat characterization.
- NOAA Sustainable Seas Expedition to the West Florida Shelf-edge MPAs. June 2001. Shelf-edge habitat mapping and characterization.

RECENT PUBLICATIONS (2000 – present)

Koenig, C.C., F.C. Coleman, and K. Kingon. In press. Recovery of the goliath grouper (*Epinephelus itajara*) population of the southeastern U.S. Proc. Gulf Carib. Fish. Inst., vol. 62.

Reed, J.K., **C.C. Koenig**, and A. Shepard. 2007. Impacts of bottom trawling on a deep-water Oculina coral ecosystem off Florida. Bull Mar Sci. 81(3):481-496.

Koenig, C.C., F.C. Coleman, A.M. Ecklund, J. Schull, and J. Ueland. 2007. Mangroves as essential nursery habitat for goliath grouper, *Epinephelus itajara*. Bull. Mar. Sci.80:567-586.

Brooke, S., **C.C. Koenig**, and A.N. Shepard. 2006.Oculina Banks restoration project: description and preliminary assessment. Proc. Gulf and Caribb. Fish. Inst. 57:607-620.

Heppell, S.S., S.A. Heppell, F.C. Coleman, and **C.C.Koenig**. 2006. Models to compare management options for a protogynous fish. Ecological Applications, 16(1):238-249.

Koenig, C.C., A.N. Shepard, J.K. Reed, F.C. Coleman, S.D. Brooke, J. Brusher, and K. Scanlon. 2005. Habitat and fish populations in the deep-sea *Oculina* coral ecosystem of the Western Atlantic. American Fisheries Society Symposium 41: 795-805.

Scanlon, K.M., F.C.Coleman, and **C.C.Koenig**. 2005. Pockmarks on the outer shelf of the northeastern Gulf of Mexico: Gas-release features or habitat modification by fish. American Fisheries Society Symposium 41:301-312.

Reed, J.K., A.N. Shepard, **C.C. Koenig**, K.M. Scanlon, and R.G. Gilmore, Jr. 2005. Mapping, habitat characterization, and fish surveys of the deep-water *Oculina* coral reef marine protected area: a review of historical and current research. Proceedings of the Second International Symposium on Deep Sea Corals. Sept. 9-12, 2003. Erlangen, Germany. Springer-Verlag.

Johnson, A.G. and **C.C. Koenig**. 2005. Age and size structure of the fishery and juvenile abundance of gag (*Mycteroperca microlepis*) from the northeastern Gulf of Mexico. Proc. 47th Gulf and Carib. Fish. Inst. pp.906 – 914.

Fitzhugh, G., **C.C. Koenig**, F.C. Coleman, C.B. Grimes, and W. Sturges III. 2005. Spatial and temporal patterns in fertilization and settlement of young gag (*Mycteroperca microlepis*) along the West Florida Shelf. Bulletin of Marine Science.

Chasar, L.C., J.P. Chanton, **C.C. Koenig**, and F.C. Coleman. 2005. Evaluating the effect of environmental disturbance on the trophic structure of Florida Bay, USA: multiple stable isotope analysis of contemporary and historical specimens. Limnology and Oceanography 50(4):1059 – 1072.

Hanson, P.J., **C.C. Koenig**, and V.S. Zdanowicz. 2004. Elemental composition of otoliths used to trace estuarine habitat of juvenile gag (*Mycteroperca microlepis*) along the west coast of Florida. Marine Ecol. Progr. Ser. 267:253-265.

Coleman, F.C., P.B. Baker, and **C.C. Koenig**. 2004. A review of Gulf of Mexico Marine Protected Areas: Successes, failures, and lessons learned. Fisheries 29:10-21.

Reed, J.K., A.N. Sheppard, **C.C. Koenig**, K.M. Scanlon, and R.G. Gilmore. 2004. Mapping, Habitat Characterization, and Fish Surveys of the Deep-water *Oculina* Coral Reef Marine Protected Area: A Review of Historical and Current Research. Pp 443-465. In: A. Friewald and J.M. Roberts, eds., Cold-Water Corals and Ecosystems. Springer-Verlag, Berlin.

Scanlon, K.M., **C.C. Koenig**, F.C. Coleman, and M. Miller. 2003. Importance of geology to fisheries management: examples from the northeastern Gulf of Mexico, pp 95-99 In: D. Stanley and A. Scarborough-Bull (eds.). Fisheries, Reefs, and Offshore Development. Am Fish. Soc. Symp. 36.

Strelcheck, A. J., G. R. Fitzhugh, F. C. Coleman, and **C. C. Koenig**. 2003. Otolith-fish size relationship in juvenile gag grouper (*Mycteroperca mircolepis*) of the eastern Gulf of Mexico: a comparison of growth rates between laboratory and field populations. Fishery Research 60:255-265.

Koenig, C.C., F.C. Coleman, C.B. Grimes, G.R. Fitzhugh, C.T. Gledhill, K.M. Scanlon, and M. Grace. 2000. Protection of essential fish spawning habitat for the conservation of warm temperate reef fish fisheries of shelf-edge reefs of Florida. Bull. Mar. Sci. 66:593-616.

DIVING EXPERIENCE:

Systems:

- Open-circuit SCUBA (Air [47 yrs], Nitrox [13 yrs], Trimix [13 yrs.])
- FSU's ROV operation and maintenance: DOE mini-phantom 300
- Nuytco DeepWorker submersible: operation trained

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PROFESSIONAL PREPARATION

North Carolina State University	B.S. Biology/B.A. Chemistry	1991
University of Washington	M.S. Fisheries	1995
Duke University	Ph.D. Ecology	2001

APPOINTMENTS

2007-present	Assistant Scholar Scientist, Florida State University
2002-2007	Assistant Research Scientist, Duke University (joint)
2002-2007	Postdoctoral Associate, North Carolina State University (joint)

PUBLICATIONS (5 MOST RELEVANT)

- **Craig, J.K.**, P.C. Gillikin, M.A. Magelnicki, and L.N. May, Jr. 2010. Habitat use of cownose rays (*Rhinoptera bonasus*) in a highly productive, hypoxic continental shelf ecosystem. *Fisheries Oceanography* 19:301-317.
- D.L. Breitburg, **J.K. Craig**, R.S. Fulford, K.A. Rose, W.R. Boynton, D. Brady, B.J. Ciotti, R.J. Diaz, K.D. Friedland, J.D. Hagy, D.R. Hart, A.H. Hines, E.D. Houde, S.E. Kolesar, S.W. Nixon, J.A. Rice, D.H. Secor, T.E. Targett. 2009. Nutrient enrichment and fisheries exploitation: interactive effects on estuarine living resources and their management. *Hydrobiologia* 629:31-47.
- **Craig, J.K.**, J.A. Rice, L.B. Crowder, D.A. Nadeau. 2007. Density-dependent growth and survival in juvenile estuarine fishes: an experimental approach with spot (Leiostomus xanthurus). *Marine Ecology Progress Series* 343:251-262.
- **Craig, J.K.**, B.J. Burke, L.B. Crowder, and J.A. Rice. 2006. Prey growth and size-dependent predation in juvenile estuarine fishes: experimental and model analyses. *Ecology* 87:2366-2377.
- **Craig, J.K.**, L.B. Crowder, and T.L. Henwood. 2005. Spatial distribution of brown shrimp (Farfantepenaeus aztecus) on the northwestern Gulf of Mexico shelf: effects of abundance and hypoxia. *Canadian Journal of Fisheries and Aquatic Sciences* 62:1295-1308.

OTHER PUBLICATIONS

- **Craig, J.K.**, and L.B. Crowder. 2005. Hypoxia-induced habitat shifts and energetic consequences in Atlantic croaker and brown shrimp on the Gulf of Mexico shelf. *Marine Ecology Progress Series* 294:79-94.
- Huang, L., M.D. Smith, **J.K. Craig**. 2010. Quantifying the economic effects of hypoxia on a shrimp fishery. *Marine and Coastal Fisheries: Dynamics, Management and Ecosystem Science* 2:232-248.
- K.A. Rose, S.E. Sable, A.T. Adamack, C.A. Murphy, S.E. Kolesar, **J.K. Craig**, D.L. Breitburg, P. Thomas, M.H. Brouwer, C.F. Cerco. 2009. Does hypoxia have population-level effects on coastal fish? Musings from the virtual world. *Journal of Experimental Marine Biology and Ecology* 381:S188-S203.

- E.L. Hazen, **J.K. Craig**, C.P. Good, and L.B. Crowder. 2009. Vertical distribution of fish biomass in hypoxic waters on the Gulf of Mexico shelf. *Marine Ecology Progress Series* 375:195-207.
- Qian, S.S., **J.K. Craig**, M.M. Baustian, N.N. Rabalais. 2009. Bayesian hierarchical modeling approach for analyzing observational data from marine ecological studies. *Marine Pollution Bulletin* 58:1916-1921.

SYNERGISTIC ACTIVITIES

- Associate Editor, *Transactions of the American Fisheries Society* (2005-present)
- Editorial Board, *Fishery Bulletin, U.S.* (July 2008-present)
- Proposal Panel Reviewer, NOAA Coastal Hypoxia Research Program (2006, 2010)
- Proposal Panel Reviewer, Ecology and Oceanography of Harmful Algal Blooms (2008)
- Member, Fishery Management Plan Advisory Committee (2003-2005)
- Instructor, Marine Ecology, Fisheries Ecology; Duke University Marine Laboratory
- Instructor, Living Marine Resource Ecology, Marine Conservation; Florida State
- Advisor for ten undergraduate student projects (FSU, Duke, NC State)
- Member: Estuarine Research Federation, American Fisheries Society, Ecological Society of America, American Society of Limnology and Oceanography

COLLABORATORS AND OTHER AFFILIATIONS

Denise Breitburg, Smithsonian Environmental Research Center
Jeff Chanton, Florida State University
Felicia Coleman, Florida State University
Richard Fulford, University of Southern Mississippi Gulf Coast Research Laboratory
Chris Koenig, Florida State University
James Nance, NOAA Galveston Laboratory
Mark Peterson, University of Southern Mississippi Gulf Coast Research Laboratory
Kenneth Rose, Louisiana State University
Fred Scharf, University of Wilmington
Martin Smith, Duke University
Tim Targett, University of Delaware
Peter Thomas, University of Texas

GRADUATE ADVISORS AND POSTDOCTORAL SPONSORS

Master's: Dr. Chris Foote, University of Washington
Doctorate: Dr. Larry Crowder, Duke University
Postdoctoral: Dr. Jim Rice, NC State University

THESIS ADVISOR AND POSTGRADUATE SCHOLAR SPONSOR

Mollie Taylor (M.S. Candidate, FSU, Major Advisor)
Travis Richards (M.S. Candidate, FSU, Major Advisor)
Chelsie Wagner (M.S. Candidate, FSU, Major Advisor)
Natalie Byars (Ph.D. Candidate, FSU, Committee Member)
Margaret Miller (M.S. Candidate, University of Delaware, Committee Member)

DEBRA J. MURIE

Associate Professor, Fisheries and Aquatic Sciences
School of Forest Resources and Conservation, University of Florida

PROFESSIONAL PREPARATION

Fisheries & Oceans Canada	Fellow	1992-94	Fisheries
University of Victoria	Ph.D.	1991	Biology
University of Guelph, Guelph, Ontario	M.Sc.	1984	Zoology
University of Victoria	B.Sc. Hons.	1981	Biology

APPOINTMENTS

2006 – present	Associate Professor, University of Florida
1996 – 2006	Assistant Professor, University of Florida
1994 – 1995	Fisheries Scientist, B.C. Blackcod Association/Fisheries & Oceans Canada
1992	Fisheries Biologist, Haida Tribal Fisheries Program, Haida Gwaii

ABBREVIATED LIST OF RECENT RELEVANT PUBLICATIONS

Baremore, I., **D.J. Murie** and J. Carlson. 2010. Seasonal and size-related differences in diet of the Atlantic angel shark *Squatina dumerl* in the northeastern Gulf of Mexico. Aquatic Biology 8:125-136.

Effitre, J., L.J. Chapman, and **D.J. Murie**. 2009. Fish condition in introduced tilapias of Ugandan crater lakes in relation to deforestation and fishing pressure. Environmental Biology of Fishes 85: 63-75.

Murie, D.J., D.C. Parkyn, C.C. Koenig, F.C. Coleman, J. Schull and S. Frias-Torres. 2009. Evaluation of finrays as a non-lethal ageing method for protected goliath grouper *Epinephelus itajara.* Endangered Species Research 7: 213-220.

Murie, D.J., D.C. Parkyn, W.F. Loftus and L.G. Nico. 2009. Variable growth and longevity of yellow bullhead (*Ameiurus natalis*) in the Everglades of south Florida, USA. Journal of Applied Ichthyology25: 740-745.

Murie, D.J., D.C. Parkyn, L.G. Nico, J.J. Herod, and W.F. Loftus. 2009. Age, differential growth and mortality rates in unexploited populations of Florida gar, an apex predator in the Florida Everglades. Fish. Manage. Ecol. 16: 315-322.

Baremore, I.E., **D.J. Murie** and J.K. Carlson. 2008. Prey selection by the Atlantic angel shark *Squatina Dumeril* in the northeastern Gulf of Mexico. Bull. Mar. Sci. 82: 297-313.

Berens, E.J., and **Murie, D.J.** 2008. Differential digestion and evacuation rates of prey in a warm-temperate grouper, gag (*Mycteroperca microlepis*) Goode & Bean). J. Fish. Biol. 72: 1406-1426.

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Parkyn, D.C., **D.J. Murie**, J. Harris, D.E. Colle, and J. Holloway. 2007. Seasonal movements of Gulf of Mexico sturgeon in the Suwannee River and estuary. American Fisheries Society Special Publication 56: 51-68.

Lindberg, W.J., T.K. Frazer, K.P. Portier, F. Vose, J. Loftin, **D.J. Murie**, D.M. Mason, B. Nagy, and M. Hart. 2006. Density-dependent habitat selection and performance by a large mobile reef fish. Ecological Applications 16(2): 731-746.

Murie, D.J., and D.C. Parkyn. 2005. Age and growth of white grunt (*Haemulon plumieri*): a comparison of two populations along the Florida west coast. Bulletin of Marine Science 76(1): 73-93.

Murie, D.J., and D.C. Parkyn. 2002. Comparison of total mortality of white grunt from the head-boat fishery on the Gulf coast of Florida during spawning and postspawning seasons. North American Journal of Fisheries Management 22: 806-814.

Dukta-Gianelli, J., and **D.J. Murie**. 2001. Age and growth of sheepshead, *Archosargus probatocephalus* (Pisces: Sparidae), from the northwest coast of Florida. Bulletin of Marine Science 68: 69-83.

PROFESSIONAL COMMITTEES

2006-2010	Publications Overview Committee and POC Subcommittee for the Marine and Coastal Fisheries Journal, American Fisheries Society
2008-2011	President-Elect, President, and Past-President, Florida Chapter of the American Fisheries Society
2004-2010	President-Elect, President, and Past-President, Marine Fisheries Section, American Fisheries Society
1998-pres	Appointed Member, Finfish Stock Assessment Panel, Gulf of Mexico Fisheries Management Council (GMFMC)
2000-pres	Member, Otolith Working Group for the Gulf States Marine Fisheries Commission
2005-pres	Scientific Programme Adviser, International Foundation of Science, Stockholm, Sweden

GRADUATE COMMITTEES

Supervision of 9 Master's Theses and 6 Dissertations. Membership on 32 Graduate Student Committees.

CURRENT GRANTS

- Release mortality of Gulf of Mexico greater amberjack from commercial and recreational hand-line fisheries: Integration of fishing practices, environmental parameters, and fish physiological attributes. NOAA/NMFS MARFIN; 2009-2011; $272,544 (PI).
- Trophic Coupling and Habitat Connectivity among Coral Reef, Mangrove, and Seagrass Fishes of the Virgin Islands National Park (VIIS) and Coral Reef National Monument (VICR). USGS State Partnership Program; 2007-2011; $214,922 (PI).
- Seasonal Movement and Mixing Rates of Greater Amberjack in the Gulf of Mexico and Assessment of Exchange with the South Atlantic Spawning Stock. NOAA/NMFS CRP; 2007-2011; $321,940 (PI).

DARYL C. PARKYN

Research Associate Professor, Fisheries and Aquatic Sciences
School of Forest Resources and Conservation, University of Florida

PROFESSIONAL PREPARATION

University of Victoria	Ph.D.	1998	Biology
University of Alberta	B.Sc.	1984	Zoology

APPOINTMENTS

2006 – present	Research Associate Professor, University of Florida
2000- 2006	Research Assistant Professor, University of Florida

PUBLICATIONS

Murie, D.J., **D.C. Parkyn**, C.C. Koenig, F.C. Coleman, J. Schull and S. Frias-Torres. 2009. Evaluation of finrays as a non-lethal ageing method for protected goliath grouper *Epinephelus itajara.* Endang. Species Res. 7: 213-220.

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Harris, J., **D.C. Parkyn**, and D.J. Murie. 2005. Distribution of Gulf of Mexico sturgeon in relation to benthic invertebrate prey resources and environmental parameters in the Suwannee River estuary, Florida. Trans. Am. Fish. Soc. 134: 975-990.

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Sherwood, E.T., D.J. Murie, and **D.C. Parkyn**. 2004. Post-release rate of loss of juvenile red drum stocked out-of-season in the Chassahowitzka National Wildlife Refuge, Florida. N. Am. J. Fish. Manage. 24: 1469-1479.

Parkyn, D.C., J.D. Austin, and C.W. Hawryshyn, C.W. 2003. Acquisition of polarised light orientation in salmonids under laboratory conditions. *Animal Behaviour* 65: 893-904.

Murie, D.J., and **D.C. Parkyn**. 2002. Comparison of total mortality of white grunt from the head-boat fishery on the Gulf coast of Florida during spawning and postspawning seasons. North American Journal of Fisheries Management **22**: 806-814.

Parkyn, D.C., D.J. Murie, and E.T. Sherwood. 2002. Salinity preference in hatchery-reared red drum. The Scientific World Journal **2:** 1326 -1331.

Parkyn, DC and Hawryshyn, CW (2000). Spectral and ultraviolet-polarisation sensitivity in juvenile salmonids: a comparative analysis using electrophysiology. *Journal of Experimental Biology.* **203:** 1173-1191.

Parkyn, DC and Hawryshyn, CW. (1999). Ethambutol affects the spectral and polarisation sensitivity of on-responses in the optic nerve of rainbow trout. *Vision Research.* **39**: 4145-4151.

Murie, DJ, **Parkyn, DC**, Clapp, BG, and Krause, GG. (1994). Observations on the distribution and activities of rockfish, *Sebastes* spp., in Saanich Inlet, British Columbia, from the *Pisces IV* submersible. *Fishery Bulletin.* **92:** 313-323.

Parkyn, DC and Hawryshyn, CW (1993). Polarized-light sensitivity in rainbow trout (*Oncorhynchus mykiss*): Characterization from multi-unit responses in the optic nerve. *Journal of Comparative Physiology* A. **172:** 493-500.

CURRENT AREAS OF RESEARCH

- Patterns of movements of fishes using tagging and telemetry
- Environmental physiology
- Age and growth of fishes
- Foraging and bioenergetics
- Molecular approaches to quantifying diet

GRADUATE COMMITTEES

Supervision of 6 Master's Theses (4 completed); Membership on 20 M.S. Graduate Student Committees; 7 Ph.D. committees.

CURRENT GRANTS

Release mortality of Gulf of Mexico greater amberjack from commercial and recreational hand-line fisheries: Integration of fishing practices, environmental parameters, and fish physiological attributes. NOAA/NMFS MARFIN; 2009-2011; $272,544 (Co-PI).

Trophic Coupling and Habitat Connectivity among Coral Reef, Mangrove, and Seagrass Fishes of the Virgin Islands National Park (VIIS) and Coral Reef National Monument (VICR). USGS State Partnership Program; 2007-2011; $214,922 (Co-PI).

Seasonal Movement and Mixing Rates of Greater Amberjack in the Gulf of Mexico and Assessment of Exchange with the South Atlantic Spawning Stock. NOAA/NMFS CRP; 2007-2011; $321,940 (Co-PI).

UF UNIVERSITY of FLORIDA

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Monday, August 09, 2010

Christopher Stallings
Reef Fish Ecology Group
Florida State University Coastal and Marine Laboratory
3618 Highway 98
St. Teresa Beach, FL 32358 USA
Phone: 850-697-4103
Fax: 850-697-3822

Statement of Intent/Intent to Collaborate

Re: Non-lethal Aging and Reproductive Biology of Goliath Grouper

The University of Florida is pleased to participate as a sub-awardee under the referenced research project. The University of Florida portion of this project totals $110,146 and is under supervision of Dr. Debra Murie, as the Principal Investigator.

We appreciate this opportunity to work with you in this important project. If additional information is needed, please do not hesitate to contact us.

Sincerely,

Department Head Signature

UF Authorized Official Signature

Brian C. Miller
Assistant Director of Research

Principal Investigator Signature

THOMAS A. WARREN
LAW OFFICES
POST OFFICE BOX 1657
TALLAHASSEE, FLORIDA 32302
2032-D THOMASVILLE ROAD
TALLAHASSEE, FLORIDA 32308
(850) 385-1551
FAX (850) 385-6008
tw@nettally.com

August 10, 2010

To Whom It May Concern:

I have been a long-standing fisherman of the northern Gulf waters of the Florida Panhandle. I am and have been concerned about the state of the overall fish stocks in these waters.

I am currently interested in the Goliath Grouper research being conducted by FSU researchers, Chris Stallings and Chris Koenig, and I would be glad to help with their studies on the regional age structure of the fish which involves the capture, collection of fin rays, tagging and releasing. If selected to participate, I understand that I will be instructed on the appropriate procedures for this sampling.

If you need more information from me regarding this matter, please do not hesitate to ask.

Sincerely,

Thomas A. Warren

August 8, 2010

Dr. Koenig:

Please consider this Email correspondence as a vehicle to formally offer my services to assist you in your upcoming research on Goliath Grouper. As you are aware, I am an accomplished scuba diver with over 35 years of diving experience. My career includes research diving with your previous projects and also with Harbor Branch Oceanographic Institute (HBOI) as well as considerable time as a spearfisherman, both Commercial and Recreational and I also taught Scuba Diving as a PADI Diving Instructor. I have a B.S. Degree from Florida Tech in Biological Oceanography and a Master's degree in Environmental Engineering from the University of Florida and was employed in the Fish Biology Department of HBOI for approximately 4 years. I am currently employed full time at the South Florida Water Management District.

I am willing to assist as both a boat crew member and diver and feel confident that I can adhere to any scientifically valid protocol for data collection that may be required for your continued research.

Best wishes in your continued research efforts.

Sincerely,

Jim

James Fyfe
Engineering Specialist 4
Environmental Resource Compliance
(561) 682-2788

Indigo Press

www.indigopress.net/e-mail - indigocontact@earthlink.net

Local (239)472-0491 Fax (239)472-1426

Indigo Press L.L.C.
P.O. Box 977
Sanibel, FL 33957

Charles Sobczak, President
Molly Heuer, Admin. Asst.

August 11, 2010

Dr. Chris Koenig & Dr. Christopher Stallings
Reef Fish Ecology Group
Florida State University Coastal and Marine Laboratory
3618 Coastal Highway 98
St. Teresa Beach, FL 32358

Dear Dr. Koenig and Dr. Stallings,

I wanted to get this letter to you in strong support for your continued work on the future of the goliath grouper (*Epinephelus itajara*) in the Gulf of Mexico and hopefully throughout its former range. I have worked with Dr. Koenig in the past on several occasions when he was doing research on the sexes and the fecundity of the species and will certainly support him and his team on this new phase of research.

Although I am a recreational fisherman and not a licensed captain, I am willing to offer my help and the use of my vessel, a twenty-four foot twin engine catamaran, in any upcoming offshore expeditions that involve the goliath grouper. Having fished in Lee County for the past twenty-five years I know that this area has seen a tremendous growth in the local goliath populations. As a result I consider this region to be the seeding area for the eventual return of this fish throughout the entire greater Caribbean basin. The goliath grouper is a keystone species and losing such a magnificent fish for future generations to enjoy would be completely unacceptable in my view.

I will be at your disposal in any tagging or other scientific studies you might need and please feel free to contact me should you have any further concerns or questions. I can be reached at any of the numbers above and my personal cell phone number is 239-850-0710.

Yours Truly,

Charles Sobczak
President, Indigo Press L.L.C.

Caloosa Dive Club, Inc.
PO Box 152940
Cape Coral, FL 33915-2940

Aug. 9, 2010

To Whom It May Concern:

My name is Richard Johnson and I am a longtime member of the Caloosa Dive Club of Southwest Florida. Our club is over 35 years old and we have over 150 members.

We are involved in all underwater activities and are very interested in helping researchers gather data on the local fisheries.

Goliath grouper are high on our list because of their potential to help our tourist industry. There is no other fish in this part of the country which has the draw of a 300-500 lb. grouper.

I own a 32 foot boat and have taken Dr. Koenig out on several occasions for his research and am anxious to continue helping him in any way I can.

Sincerely,

Richard Johnson
Caloosa Dive Club of SW Florida

Special Activity License

Florida Fish and Wildlife Conservation Commission
Division of Marine Fisheries Management
620 S. Meridian St., Mail Station 4B3, Tallahassee, Florida 32399-1600
Ph: 850-487-0554 • Fax: 850-487-4847

Issued To: Christopher C. Koenig
Florida State University, Coastal and Marine Lab
3618 Coastal Highway 98
St. Teresa, FL 32358

License Number: SAL-12-1244**D**-SRP
Effective Date: 06/01/2012
Expiration Date: 01/25/2013

This is an amendment and supersedes license # SAL-12-1244C-SRP issued on May 17, 2012. Changes are indicated in **underlined boldface** type.

Authorized Activities:

1) Authorized to temporarily possess Goliath grouper (*Epinephelus itajara*) with waiver of seasonal, fishery and area closures, size and bag limits. Goliath grouper must be released alive and unharmed once they have been measured, catalogued, photographed, tagged, gonads biopsied, fin rays samples taken, and stomach contents collected via lavage method. All other prohibited species incidentally harvested must be returned to the water immediately.

2) Authorized to permanently retain any Goliath grouper (*E. itajara*) that die as a direct result of SAL-related activities, with waiver of seasonal, fishery and area closures, size and bag limits. Carcasses must be tagged and are to be chilled or frozen as soon as possible. Immediately upon storage, the tag number, date, time, and location of storage must be reported to the FWC Division of Law Enforcement Regional Communication Center for the appropriate region where storage is made. Notification must also be given to the FWC Division of Law Enforcement Regional Communication Center when the carcass has been removed from storage.

Authorized Locations: All state waters of Florida, with the following exceptions:

1) This license does not authorize any activity outside of state waters.
2) This license does not authorize any activity within any state park, unless a research/collecting permit has been obtained from the Florida Department of Environmental Protection, Division of Recreation and Parks.
3) This license does not authorize any activity within any federal park.
4) This license does not authorize any activity within the following areas of the Florida Keys National Marine Sanctuary (FKNMS): Western Sambo and Tortugas North Ecological Reserves; Cheeca Rocks, Eastern Dry Rocks, Hen and Chickens, Newfound Harbor Key, Rock Key, and Sand Key Sanctuary Preservation Areas (SPAs); or Eastern Sambo Research Only Area.
5) This license does not authorize any activity within any Manatee Limited Entry Area (No Entry or Motorboat Prohibited Zones – list attached to this license).

Licensee Signature _____ Date 4 JUNE 2012

Not valid unless signed. By signature, confirms that all information provided to issue the license is accurate and complete, and indicates acceptance and understanding of the provisions and conditions listed below. **Any false statements or misrepresentations when applying for this license may result in felony charges and will result in revocation of this license.**

Authorized by: Kyle Miller, Environmental Specialist II for: Nick Wiley, Executive Director

Authorizing Signature _____ Date June 1, 2012

License Conditions and Provisions

Purpose: Collection of marine organisms for scientific research purposes pursuant to 68B-8, F.A.C.

Project Title: Regional age structure, reproductive biology, and trophic patterns of adult goliath grouper in Florida.

Law Enforcement Notification: The holder of a SAL must notify the nearest Commission Law Enforcement Dispatch Center not later than 24 hours prior to conducting activities under a SAL. Notification may consist of a float plan detailing locations, dates, and times of activities. Deviations from the float plan are permitted only after 24-hour advance notification to the nearest Commission Law Enforcement Dispatch Center. Float plans are valid for the duration of the SAL unless rescinded by the SAL holder.

Authorized Personnel: Michael Avinon, Eric J. Alexander, **Francis Bacheler**, Richard Bradley, Michael Bresette, Scott Briegel, Alicia J. Brown, Jack Carlson, Jason Cartwright, Dinorah H. Chacin, Ben Chancey, David Clark, Mike Colby, Felicia C. Coleman, **Ralph Delph**, **Joseph Drew**, Robert Ellis, John P. Fish, James L. Fyfe, Will Geraghy, Jonathan Gorham, Tony Grillo, Jeff Guertin, Charles E. Guilford, Brittany J. Hall, **Brian Holland**, Mark Hubbard, **Chris Johnson**, Robert A. Johnson, Kelly C. Kingon, Christopher C. Koenig, Brandon Lawson, **Mykeldavid Lee**, Justin P. Lewis, James Locascio, **William McClure**, Tom M. McLaughlin, Cody Mott, John M. Newman, David Niebch, Jason Offerman, Christopher L. Peters, Mark F. Quartiano, Thomas Quartiano, **Gary Radke**, Justin Rieger, Ray Rosher, Jeff Shelar, Joseph Smirnov, Christopher D. Stallings, Orian E. Tzadik, Julie L. Vecchio, Ryan Wallach, Stephen Weege, Ryan Welsh, **Matthew D. West**, James R. Willis.

Release Policy: No marine organism that has been maintained in captivity may be released unless the release is authorized by a SAL or the release is conducted in accordance with the "Florida Fish and Wildlife Conservation Commission Policy on the Release of Marine Organisms". A copy of this policy is included with this license. If policy conditions for release cannot be met, organisms may not be released in any location and must be maintained in captivity for the duration of their lifespan.

Authorized Gear: Hook and line only.

In waters of the FKNMS, the temporary or permanent placement of any structure or equipment on the sea floor (cages, quadrats, transect lines, tiles, mooring blocks, cinder blocks, settlement plates, etc.), or use of any equipment to alter the sea floor (corers, sediment grabs, dredges, and other sampling devices), must be authorized by the FKNMS. The use of traditional fishing gear does not require authorization.

Prohibited Activities:

1) The following are considered prohibited species and may not be harvested or possessed unless authorized by a Special Activity License issued specifically for activities involving prohibited species:
    a. Invertebrates: conch, queen (*Strombus gigas*): coral, fire (Genus *Millepora*); coral, hard and stony (Order Scleractinia); live rock (non-aquacultured); sea fan, common (*Gorgonia ventalina*); sea fan, Venus (*Gorgonia flabellum*); starfish, Bahama (*Oreaster reticulatis*); urchin, longspine (*Diadema antillarum*).
    b. Finfishes: bonefish (Family Albulidae); grouper, Goliath (*Epinephelus itajara*); grouper, Nassau (*Epinephelus striatus*); spearfish, longbill (*Tetrapturus pfluegeri*); spearfish, Mediterranean (*Tetrapturus belone*); spearfish, roundscale (*Tetrapturus georgei*); sturgeon (Family Acipenseridae).
    c. Sharks and rays: dogfish, spiny (*Squalus acanthias*); mako, longfin (*Isurus paucus*); ray, manta (Genera *Manta* and *Mobula*); ray, spotted eagle (*Aetobatus narinari*); sand tiger (*Odontaspis taurus*); sand tiger, bigeye (*Odontaspis noronhai*); sawfish, largetooth (*Pristis pristis*); shark, Atlantic angel (*Squatina dumeril*); shark, basking (*Cetorhinus maximus*); shark, bigeye sixgill (*Hexanchus nakamurai*); shark, bigeye thresher (*Alopias vulpinus*); shark, bignose (*Carcharhinus altimus*); shark, Caribbean reef (*Carcharhinus perezii*); shark, Caribbean sharpnose

(*Rhizoprionodon porosus*); shark, dusky (*Carcharhinus obscurus*); shark, Galapogos (*Carcharhinus galapagensis*); shark, great hammerhead (*Sphyrna mokarran*); shark, lemon (*Negaprion brevirostris)*; shark, narrowtooth (*Carcharhinus brachyurus*); shark, night (*Carcharhinus signatus*); shark, sandbar (*Carcharhinus plumbeus*); shark, scalloped hammerhead (*Sphryna lewini*); shark, sevengill (*Heptranchias perlo*); shark, silky (*Carcharhinus falciformis*); shark, [bluntnose] sixgill (*Hexanchus griseus*); shark, smalltail (*Carcharhinus porosus*); shark, smooth hammerhead (*Sphyrna zygaena*); shark, tiger (*Galeocerdo cuvier*); shark, whale (*Rhincodon typus)*; shark, white (*Carcharodon carcharias*).

2) Special Activity Licenses do not authorize any collection of marine mammals or marine turtles. The collection of any other marine organism identified as a Florida Endangered and Threatened Species will be permitted pursuant to the provisions of Chapters 68A-27 and 68B-8, F.A.C.
3) Marine organisms harvested pursuant to a SAL may not be sold or consumed unless specified otherwise on this license.

General License Conditions:

1) Authorized personnel conducting activities pursuant to a Special Activity License (SAL) must have the original license or a copy authenticated by the Florida Fish and Wildlife Conservation Commission (FWC) with all attachments specified on the license, in his/her possession while conducting any activities requiring the SAL.
2) Special Activity Licenses may be suspended or revoked if authorized personnel listed on the permit have violated FWC rules or policies, terms or conditions of the license, or have submitted false or inaccurate information on their application.
3) Special Activity Licenses are non-transferable.

Reporting Requirements: A SAL holder for scientific research activities must submit the following documentation to fulfill reporting requirements:

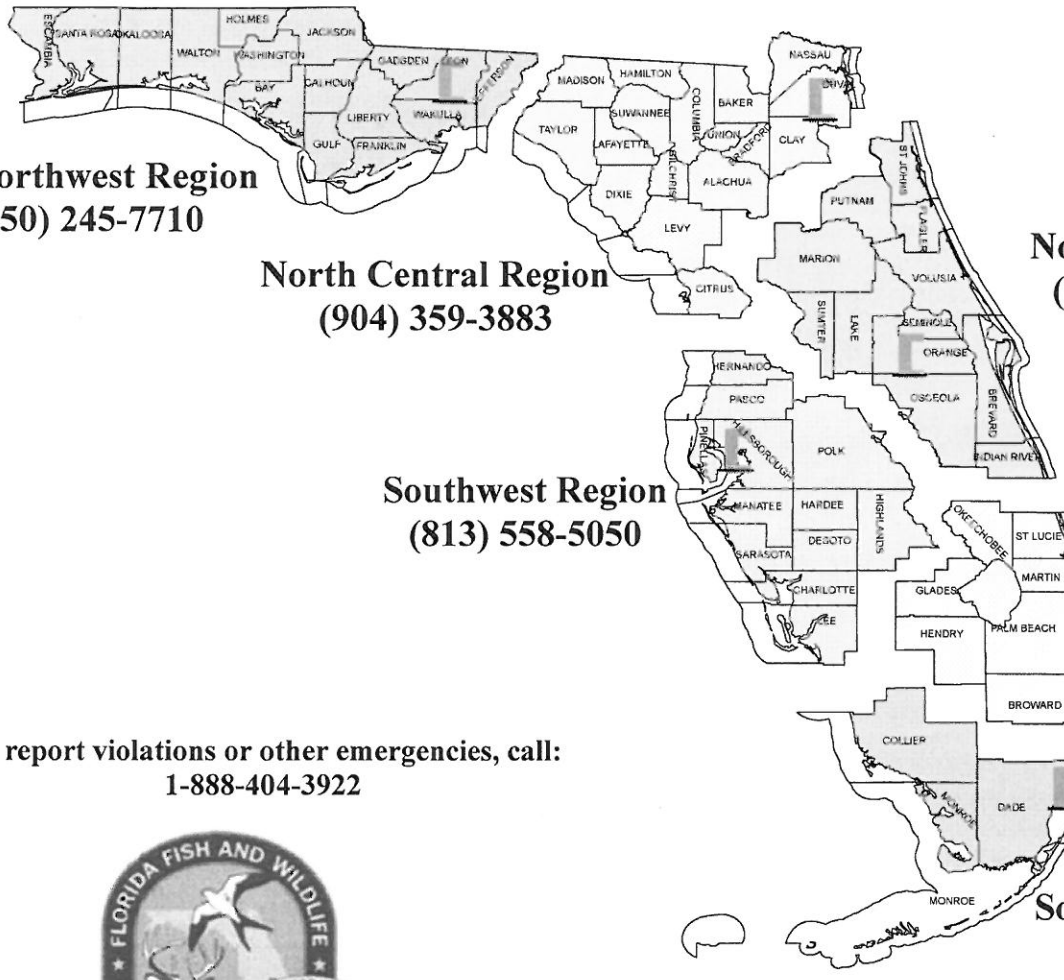
1) An activity report detailing all SAL-related harvest or sampling activities that resulted in the permanent retention of marine organisms. The activity report is a report other than any publications or technical, monitoring, or final reports. The activity report must include common and scientific names of the marine organisms harvested (both targeted and incidental), numbers and sizes harvested, locations of harvest by county, and disposition of all marine organisms harvested. The activity report for a Scientific Research SAL involving prohibited species must also include the specific harvesting gear used. If mortality of a prohibited species occurred during harvest or subsequent possession, the report must indicate the cause of death if known. If SAL-related activities did not result in the permanent retention or mortality of any marine organism, the SAL holder must submit a statement to that effect.
2) A copy of any publications, technical, monitoring, or final reports that were generated as a result of work conducted pursuant to the SAL. These reports must include the notation that research was conducted pursuant to the specific Commission Special Activity License.

Attachments to Follow:

- FWC Division of Law Enforcement, Special Activity License Notification Locations & Numbers
- FWC Policy on the Release of Marine Organisms
- Manatee Limited Entry Areas

A person whose substantial interests are affected by FWC's action may petition for an administrative proceeding (hearing) under sections 120.569 and 120.57 of the Florida Statutes. A person seeking a hearing on FWC's action shall file a petition for hearing with the agency within 21 days of receipt of written notice of the decision. The petition must contain the information and otherwise comply with section 120.569, Florida Statutes, and the uniform rules of the Florida Division of Administration, chapter 28-106, Florida Administrative Code. Upon such notification, the Licensee shall cease all work authorized by this license until the petition is resolved. The enclosed Explanation of Rights statement provides additional information as to the rights of parties whose substantial interests are or may be affected by this action.

FWC Division of Law Enforcement
Regional Communication Center Contact Information



Northwest Region
(850) 245-7710

North Central Region
(904) 359-3883

Northeast Region
(407) 275-4150

Southwest Region
(813) 558-5050

South Region Alpha
(561) 625-5128

South Region Bravo
(305) 470-6863

To report violations or other emergencies, call:
1-888-404-3922

The numbers listed are manned 24 hours daily. If SAL holders need to provide information via fax, please request the fax number from dispatcher.

0 50 100 200 Miles

The holder of a SAL must notify the nearest Commission Law Enforcement Dispatch Center not later than 24 hours prior to conducting activities under a SAL. Notification may consist of a float plan detailing locations, dates, and times of activities. Deviations from the float plan are permitted only after 24-hour advance notification to the nearest Commission Law Enforcement Dispatch Center. Float plans are valid for the duration of the SAL unless rescinded by the SAL holder.

FWC-DMF/M/kpm
Rev. 09/2010

POLICY ON THE RELEASE OF MARINE ORGANISMS

Florida Fish and Wildlife Conservation Commission
Division of Marine Fisheries Management
September 2009

For purposes of this policy, marine organisms are defined as an organism, including anadromous and catadromous organisms and plants that has a natural portion of its life cycle that is dependent upon marine or estuarine waters, but excluding striped bass (Morone saxatilis), American eels (*Anguila rostrata*), non-living shells, marine reptiles, marine mammals, and birds.

The Florida Fish and Wildlife Conservation Commission (FWC) authorizes certain conservation-related activities for research, educational, exhibitional, stock enhancement, and stock restoration purposes, and authorizes the collection of broodstock for commerce aquaculture production purposes. The FWC recognizes the conservation value and economic importance of these activities, but also recognizes there are risks associated with allowing these activities to include the release of marine organisms that have been held in captivity. These risks include (but are not limited to):

- The introduction or spreading of diseases that affect marine organisms.
- The potential for adversely impacting the genetic diversity of wild stocks.
- Human consumption of marine organisms that have been treated with chemicals while in captivity and then released into the wild.
- Behavioral conditioning of predatory marine organisms held in captivity that may result in those organisms learning to associate humans with food when released into the wild.

This FWC policy has been established to prohibit the release or minimize the risks associated with the release of marine organisms into the wild that were collected pursuant to special authorization from the FWC.

This policy does not regulate the release of organisms harvested as broodstock or wild stock, bred or reared in captivity, and subsequently released for scientific research, stock enhancement, or stock restoration purposes. The release of marine organisms associated with these activities requires a Stock Collection and Release SAL, and the release requirements for this SAL may be found in FWC Rule 68B-8.010, F.A.C.

This policy does not prohibit the release of marine organisms that are temporarily possessed in order to conduct field activities such as identification, measuring, weighing, cataloguing, photographing, tagging, etc., where such activities do not result in retaining the organisms in captivity or releasing them outside of the immediate area where field activities are being conducted.

This policy does prohibit the release of all broodstock, broodstock progeny (offspring), or wild-born marine organisms collected, maintained, bred, or reared in captivity for commerce aquaculture production purposes. Broodstock harvested for purposes of commerce aquaculture production do not need to be rotated with wild stock to preserve the genetic integrity of the captive-reared stock, and do not necessitate their release.

This policy does prohibit the release of any non-indigenous marine organism, irregardless if it was originally collected pursuant to special authorization from the FWC.

This policy does prohibit the release of finfish maintained in captivity for longer than 30 days.

This policy does not prohibit the release of finfish maintained in captivity for 30 days or less provided that the Captivity Requirements and Release Requirements established by this policy are strictly adhered to.

This policy does not prohibit the release of invertebrates that have been maintained in captivity regardless of the length of time, provided that the Captivity Requirements and Release Requirements established by this policy are strictly adhered to. Invertebrates do not contract finfish diseases, and the possibility of introducing or spreading invertebrate diseases should be greatly minimized with the institution of requirements for containment, feeding, treatment and release. Typical health problems with invertebrates in captivity consist of shell rot or opportunistic bacterial and protozoan infections due to an inappropriate pH balance or food source, and do not require chemicals for disease control to treat the problem.

Captivity Requirements

Finfish that have been retained in captivity for 30 days or less, and invertebrates that have been retained in captivity regardless of the length of time, may be released provided the organisms have been maintained according to the following requirements:

- Containment System Preparation - Prior to the introduction of marine organisms that are targeted for release into a containment system, the system must be thoroughly cleaned (including filter change) to prevent the spread of disease. When adding new organisms to a closed containment system, cleaning is not required if the system previously held, or currently holds, organisms originating from the same genetic unit (or same county if the genetic unit is not known), and the same coast in Florida. When adding new organisms to a flow-through containment system, cleaning is not required if the system previously held or currently holds organisms originating from the same genetic unit or county, and the same coast in Florida into which the water is being discharged.
- Containment System Inhabitants – All marine organisms targeted for release must be maintained with species originating from the same genetic unit (or same county if the genetic unit is not known), and the same coast in Florida.
- Food Source – Fresh-caught food that is given to all marine organisms held in the same containment system as the organisms targeted for release must originate from Florida and from the same coast where the organisms were harvested. Frozen food or commercially processed dry food such as pellets, flakes, wafers, etc., are acceptable food sources regardless of their origin.
- Treatment Chemicals – Marine organisms targeted for release may not be treated with chemicals such as malachite green, marine ich treatment chemicals, copper sulfate, antibiotics, formalin or anesthetics (MS-222, clove oil, quinaldine, etc), unless use of such chemicals is in compliance with established Food and Drug Administration (FDA) guidelines or are veterinarian-prescribed. This does not include chemicals used to maintain water chemistry (to control pH, ammonia, or nitrite levels) and does not include vitamins or other nutritional supplements. Chemicals that are not approved by the FDA

or prescribed by a veterinarian may not be used on any organisms targeted for release. Any organisms treated with veterinarian-prescribed chemicals may not be released until the withdrawal period specified by the veterinarian has expired.

Release Requirements

Marine organisms that were collected pursuant to special authorization from the FWC and have been maintained in accordance with the Captivity Requirements may be released provided they are released in the same genetic unit (or same county if the genetic unit is not known), and the same coast, from where they were collected. Organisms may not be released if they have external lesions or abnormalities, appear to be sick or exhibit abnormal behavior, or were originally harvested from areas where the presence of a disease in the same species targeted for release has been observed.

FWC Manatee Protection No Entry and Motorboats Prohibited Zones in Effect as of Oct. 2009

County	*Restriction and Location*	*Citation in Fla. Admin. Code*
Brevard County	No Entry Zones (November 15 – March 31)	
	Reliant (formerly OUC) Power Plant (Indian River)	68C-22.006(2)(a)1., FAC
	FPL Power Plant (Indian River)	68C-22.006(2)(a)2., FAC
	Motorboats Prohibited Zone (Year-round)	
	C-54 Canal (off the Sebastian River)	68C-22.006(2)(b)2., FAC
	Motorboats Prohibited Zone (November 15 – March 31)	
	Reliant (formerly OUC) Power Plant (Indian River)	68C-22.006(2)(b)1., FAC
Broward County	No Entry Zones (Year-round)	
	FPL Port Everglades Power Plant	68C-22.010(1)(a)1., FAC
	FPL Lauderdale Power Plant	68C-22.010(1)(a)2., FAC
Citrus County	No Entry Zones (November 15 – March 31)	
	Blue Waters area of the Homosassa River (2 zones)	68C-22.011(1)(m), FAC
Collier County	No Entry Zone (Year-round)	
	Basin off of Henderson Creek	68C-22.023(1)(a), FAC
Dade County	No Entry Zones (Year-round)	
	Virginia Key Area	68C-22.025(1)(e)1., FAC
	Black Creek Canal	68C-22.025(1)(e)2., FAC
	No Entry Zones (November 15 - April 30)	
	Biscayne Canal	68C-22.025(1)(f)1., FAC
	Little River	68C-22.025(1)(f)2., FAC
	Coral Gables Canal	68C-22.025(1)(f)3., FAC
	Motorboats Prohibited Zone (Year-round)	
	Fisher Island Area	68C-22.025(1)(d), FAC
Hillsborough County	No Entry Zone (November 15 - March 31)	
	TECO-Big Bend Power Plant	68C-22.013(2)(a), FAC
Indian River County	No Entry Zone (November 15 – March 31)	
	Vero Beach Power Plant	68C-22.007(1)(e), FAC
Lee County	No Entry Zone (November 15 – March 31)	
	FPL Tice Power Plant (Orange River)	68C-22.005(2)(a), FAC
Palm Beach County	Motorboats Prohibited Zone (November 15 - March 31)	
	FPL Riviera Beach Power Plant	68C-22.009(1)(e), FAC
Sarasota County	No Entry Zone (Year-round)	
	Pansy Bayou	68C-22.026(2)(c), FAC
	No Entry Zone (November 15 – March 15)	
	Warm Mineral Springs / Salt Creek	68C-22.026(3)(b), FAC
St. Lucie County	No Entry Zone (Year-round)	
	Harbor Branch Canal Basin	68C-22.008(2)(a), FAC
	Motorboats Prohibited Zone (November 15 - March 31)	
	Moore's Creek	68C-22.008(2)(b), FAC
Volusia County	Motorboats Prohibited Zone (October 15 - April 15)	
	Blue Spring	68C-22.012(2)(d), FAC