

April 4, 2014

Dr. John Fear, Deputy Director
North Carolina Sea Grant
North Carolina State University
Box 8605
Raleigh, NC 27695-8605

In Re: FY 2013 Mini-Grant Application – Assessing Harvest Efficiencies and Consumer Demand for North Carolina Lionfish.

Good afternoon Dr. Fear,

Attached to this email is the above referenced proposal with modifications as suggested by the three reviewers. You will find the following documents in this attachment:

1. Letter from Debby Boyce indicating Janelle Fleming as Principal Investigator
2. Modified Proposal that includes information as outlined by the reviews of the proposal
3. CV of James Morris
4. CV of Debby Boyce
5. CV of Barry Nash
6. CV of Janelle Fleming

Thank you for your patience during this process. If you have any questions, please do not hesitate to call (252) 728-2265 or email beatem@carolinareefs.org.

Thank you,

Janelle Fleming
ECARA representative

Discovery Diving

SERVICE
AIR
RENTALS



Company, Inc.

DAILY CHARTERS
EQUIPMENT
INSTRUCTION

April 4, 2014

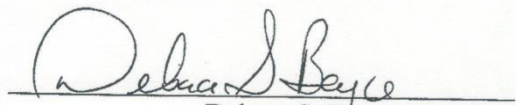
Dr. John Fear, Deputy Director
North Carolina Sea Grant
North Carolina State University
Box 8605
Raleigh, NC 27695-8605

In Re: FY 2013 Mini-Grant Application – Assessing Harvest Efficiencies and Consumer Demand for North Carolina Lionfish

Good afternoon Dr. Fear,

Thank you for the reviews provided on the above application. As noted earlier, Steve Broadhurst is no longer with the Eastern Carolina Artificial Reef Association (ECARA). I initially put my name down as the Principal Investigator, but felt the need to nominate Janelle Fleming as the Principal Investigator for this project as she will be directly involved with the field work.

Thank you,



Debora S. Boyce, President

FY 2013 MINI-GRANT PROGRAM



APPLICATION

1. Project Title Assessing Harvest Efficiencies and Consumer Demand for North Carolina Lionfish
2. Name of Applicant Janelle Fleming, Eastern Carolina Artificial Reef Association (ECARA) representative
3. Company (if applicable) ECARA 4. Telephone (252) 728-2265
5. Fax Number (252) 728-2581 6. E-mail Address beatem@carolinareefs.org
7. Address 414 Orange Street, Beaufort, North Carolina, 28516
8. Amount Requested \$8,960
9. Project Dates: Beginning April 30, 2014 Completion December 31, 2014
10. Other participant(s), affiliation & complete addresses (including zip code):

Debby Boyce, Discovery Diving Company, 414 Orange Street, Beaufort, North Carolina 28516
Dr. James A. Morris, Jr., NOAA National Ocean Service, 101 Pivers Island Road, Beaufort, North Carolina 28516
Libby Eaton, Bistro-by-the-Sea Restaurant, 4031 Arendell Street, Morehead City, North Carolina 28557
Barry Nash, North Carolina Sea Grant, 303 College Circle, Morehead City, North Carolina 28557

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

The invasive lionfish is now one of the most dominant predators on offshore artificial and hard bottom reefs in North Carolina. Lionfish overwinter off North Carolina at depths greater than 100 ft given the warming influence of the Gulf Stream current. They pose a significant threat to reef-fish communities throughout the region due to their high densities (up to 500 lionfish per hectare) (Morris and Whitfield 2009) and generalist dietary habits (Morris and Akins 2009). Negative impacts to the biodiversity of reef communities have been observed in many locations with lionfish consuming greater than 70 percent of the forage base on some reefs. A significant number of juvenile grouper and snapper are among the species consumed by lionfish and both are important to commerce. Gut analyses of lionfish captured in North Carolina have shown these predators are capable of consuming dozens of prey per day. Lionfish are long lived and are sexually mature as early as one year old. Fecundity is high resulting in millions of eggs produced by one female per year. Due to venomous spines and protective coloration, they have no significant natural predators in North Carolina.

Lionfish pose a unique threat to artificial reefs. By design, artificial reef programs provide habitat and nursery grounds for economically and ecologically important species such as grouper and snapper. Lionfish settle on artificial reefs at a higher rate than natural reefs, a likely function of high rugosity (complexity) and height compared to natural reefs. The high affinity of lionfish to artificial reef structures suggests a large number of juvenile lionfish are found around bridge pilings, seawalls, and artificial reefs throughout the Southeast U.S., Gulf of Mexico, and Caribbean (J. Morris, pers. obs).

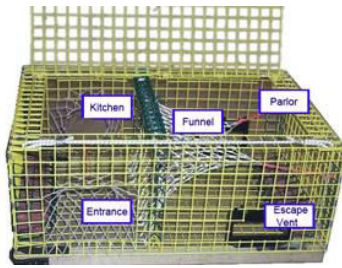
Presently, there is no commercial fishery for lionfish because they are difficult to capture with standard commercial gear. To date, the only effective method for collecting lionfish has been through spearfishing and hand-netting. These methods are labor intensive and costly. Also, lionfish cannot be captured via hook and line fishing. Several studies have attempted to develop trapping methods specifically for lionfish based on conventional gear; however, none have been successful at developing devices specifically for lionfish. Furthermore, bycatch of other reef fish is high making conventional trapping impractical. Lionfish are being landed regularly as bycatch in the Florida Keys spiny lobster fishery. It is believed that lionfish are recruiting into and around the spiny lobster trap because of the structural attributes of the trap. In this study the traps will not be baited, which may reduce the bycatch of other reef fish.

We propose to test two trapping methods for lionfish off North Carolina: the Maine lobster trap and a Crab Pot Christmas Tree (CPCT) concept. The Maine lobster trap is larger than the spiny lobster trap providing additional structure and a larger funnel. Due to their size, a larger trap design is needed. The CPCT idea is based on developing a lionfish attracting device that can be deployed away from the reef. The CPCT provides a high relief (reef height) and complexity (lots of folds and corners) that may attract lionfish out away from the reef and to the device.

The CPCTs are manufactured in Eastern North Carolina (<http://www.crabpottrees.com/>). This business represents a fishing industry business that transitioned to constructing yard and home seasonal decorations due to hardships in the commercial fishing industry. If CPCT are useful as lionfish attracting devices, this could result in the sales of CPCTs to commercial fishermen and divers. Once it is determined that lionfish are attracted to the CPCT, we will then address harvest techniques. We envision a net or wire mesh that is pulled around the CPCT when hauled. Lionfish attracting devices are in high demand throughout the Southeast U.S., Gulf of Mexico, and Caribbean as managers are seeking new and more efficient methods to control lionfish.

12. Purposes (objectives) of the project:

To evaluate potential trapping methods for Lionfish in North Carolina as an effort to create a viable trap design. We propose to test two methods: the Maine lobster trap (MLT) and a crab pot Christmas tree (CPCT).



Maine lobster trap



CPCT (lights will be removed)

In addition, we will ascertain consumers' preference for lionfish as an exotic food source in a restaurant setting to determine if Carteret County would support a commercial market for the species. A nascent market for lionfish has developed among some high-end restaurants in the Triangle.

13. Anticipated outcomes of the project:

We will obtain preliminary data on the catch rate of lionfish using the two methods described above. This information will be used to determine if either or both of these concepts are viable and if additional testing is warranted. The potential for these concepts to have an impact on invasive lionfish control is significant. At present, there are no lionfish attracting devices or trap targeted trapping technique that is being used by reef managers. Should either of these concepts prove useful, the impact could be very high on this invasive species problem. Further research is anticipated to develop the most viable trap design and to grow the burgeoning commercial demand for lionfish as an exotic food.

14. Methods: What work do you intend to do, and how do you plan to accomplish it?

We propose to deploy the MLT and CPCT at three reef sites off North Carolina. Sites will be selected based on lionfish densities to ensure that the possibility of lionfish entrapment is high, but generally, these sites will include **an artificial reef, a natural, rocky reef bottom, and a flat, sandy area**. **Depths of the sites will vary between 90 and 120 feet**, based on previous assessments of lionfish abundance (D. Boyce, personal observation).

A series of **five MLTs and CPCTs will be chained** together and spaced approximately 30-50 feet apart along the reef. The MLT distance will vary in order to randomly sample the reef. Prior to deployment of the MLTs, divers will assess the densities of lionfish using standardized lionfish monitoring methods (Morris 2012). After deployment, divers will verify the position of the trap to the reef to ensure that the trap is in close (between 20-30 ft) proximity to the reef. The MLT and CPCTs will be deployed for at least **48 hours with a maximum of one week, weather depending**. After 48 hours, divers will observe (count and identify the number of fish inside and around) the MLT and CPCT and record video prior to hauling. For the MLTs, all catch will be quantified to the lowest possible taxon. Video images will be used to assess the success of the CPCTs as attracting devices. The experiment will be replicated at least twice during the summer season, weather depending. The objective of this experimental design is to determine if either of these trapping/aggregating approaches may be worth pursuing on a larger scale.

In addition, the following outreach efforts will be made to promote awareness of lionfish in North Carolina: 1) Findings will be submitted to local, national and international trade publications; 2) Findings will be profiled on the ECARA website, including videos/photos of lionfish capture and culinary preparations developed by the Bistro Restaurant; 3) **A demonstration of trap design and capture methods** will be held during the 2014 "If You Can't Beat 'Em, Eat 'Em" lionfish tournament; 4) Findings will be summarized for future ECARA outreach presentations to dive clubs, fishing clubs, trade shows, and the North Carolina Seafood Festival. Libby Eaton, owner of Bistro-by-the-Sea carries liability insurance for all tastings.

15. Briefly outline who will be responsible for each aspect of the work plan. (Attach letters from cooperators outlining their participation.)

Janelle Fleming will be responsible for project execution and oversight.

Debby Boyce will be responsible for providing vessel resources (Outrageous Diving Inc.) and MLTs.

Dr. James Morris will be responsible for experimental design, data collection, interpretation, and report writing. In addition, this work will aid in the PhD research efforts of a graduate student, Alex Bogdanoff, who is beginning his graduate studies during the summer of 2014 at North Carolina State University.

Libby Eaton and Barry Nash will be responsible for supervising the consumer sensory evaluation. Barry Nash will compile the panelists' responses and summarize the data.

16. Briefly summarize the qualifications of each participant:

Janelle Fleming has over 20 years of experience in marine biology, physical oceanography, and diving off North Carolina.

Debby Boyce has over 20 years of experience managing a dive shop in Eastern North Carolina.

Dr. James Morris has over 10 years of experience investigating invasive lionfish.

Libby Eaton is co-owner of Bistro-by-the-Sea Restaurant and has 20 years of experience managing restaurants.

Barry Nash has 28 years of experience developing new foods and conducting sensory evaluations on product prototypes.

17. Budget and costs.

- a. Personnel costs (time x unit cost) See Match (Itemized in Budget Justification)
- b. Travel (trip or mileage x unit cost) N/A
- c. Supplies \$700 (Itemized in Budget Justification)
- d. Equipment (items more than \$500) \$1800 (Itemized in Budget Justification)
- e. Contractual \$6000 (Itemized in Budget Justification)
- f. Other costs (Consumer Sensory Test) \$460 (Itemized in Budget Justification)
- g. Total project costs **\$8960**

18. Budget justification and/or explanation:

See itemized budget below. All funds requested are required to complete project goals. Working offshore in an underwater environment requires vessel support and specialized equipment. Staffing and additional equipment is provided through match.

Total Amount Requested = \$8960.00

\$6000.00 - Total Boat Fuel and Expenses (Contracted through Discovery Diving/Outrageous Diving)

3000.00 - Boat Fuel - 500.00 x 6 days

600.00 - Daily Boat Insurance - \$100.00 x 6 days

600.00 - Daily Boat Dockage - \$100.00 x 6 days

900.00 - Daily Boat Maintenance - \$150.00 x 6 days

150.00 - Daily Boat License - \$25.00 x 6 days

150.00 - Daily Boat Inspections - \$25.00 x 6 days

600.00 - Daily Boat Crew - 100.00 x 6 days

\$700.00 - Supplies

400.00 - Four sets of Marker Buoys, weights, and lines

200.00 - Lines, Clips, Rigging, Etc...

100.00 - Gloves for Fish Handling

\$1800.00 - Equipment

1000.00 - 10 Main Lobster Traps (MLTs)

800.00 - Lift Bags (Standard and Pillow)

\$460.00 - Consumer Sensory Evaluation

\$99.00: One chef @ \$16.50/hr. for six hours (to prepare 120 dishes [appetizer, salad, entrée] for 40 people)

\$186.00: Two servers @ \$15.50/hr. each for three hours each (2 servers x \$15.50 x 6 hours)

\$49.98: One employee @ \$8.33 for six hours (to assist chef in preparing food and in cleanup)

\$50.00: Estimated cost of non-seafood ingredients

\$75.00: Facility utilities

Total Match = \$41,330.00

James Morris/NOAA Match: \$2750.00

2100.00 - Labor support = 1 technician for 60 hours (salary)

450.00 - Crab pot Christmas trees (150.00 x 3)

200.00 - Tackle (buoys, line, etc...)

Janelle Fleming/ECARA Match: \$2180.00

2100.00 - Labor Support = 1 technician for 60 hours (salary)

80.00 - Research placards

Debby Boyce/Discovery Diving Company (Outrageous Diving) Match: \$36,400.00

25000.00 - Labor Support = 12 Divers for 60 hours (salary)

5400.00 - Labor Support = 1 Boat Captain (Outrageous Diving @ 900.00 x 6 days)

3000.00 - SCUBA Equipment (Cylinders, Air, Nitrox @ 500.00 x 6 days)

2000.00 - Boat fuel and expenses already spent

1000.00 - Collection Equipment (Spears and Bags)

19. Names and contact information for three potential reviewers for the application:

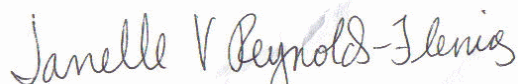
Already determined

20. Literature Cited:

Morris, J.A., Jr. and P.E. Whitfield. 2009. Biology, Ecology and Control Management of the Invasive Indo-Pacific Lionfish: An Updated Integrated Assessment. NOAA Technical Memorandum NOS NCCOS 99. 57 pp.

Morris, J.A., Jr. and J.L. Akins. 2009. Feeding ecology of invasive lionfish (*Pterois volitans*) in the Bahamian archipelago. Environmental Biology of Fishes 86: 389-398.

Morris, J.A., Jr (ed.) 2012 *Invasive Lionfish: A Guide to Control and Management*. Gulf and Caribbean Fisheries Institute Special Publication Series Number 1, Marathon, Florida, USA 113 pp.



Signature _____ Date 4/4/2014

Return to: Susan White, Executive Director at snwhite3@ncsu.edu

Mail to: North Carolina Sea Grant, North Carolina State University, Box 8605, Raleigh, NC 27695-8605.

Dr. James A. Morris, Jr.

NOAA Center for Coastal Fisheries and Habitat Research
101 Pivers Island Road, Beaufort, North Carolina 28516
Tel. 252.728.8782 james.morris@noaa.gov



James is an Ecologist with NOAA's National Ocean Service, National Centers for Coastal Ocean Science. His research focuses on coastal marine ecology with expertise in marine aquaculture and invasive species. Past research includes laboratory and field experiments on aquaculture environmental interactions, candidate species, finfish reproduction, and invasiveness of marine organisms. James leads a Coastal Aquaculture Planning and Environmental Sustainability (CAPES) research team, has investigated the biology and ecology of invasive lionfish, studied the propagation of invasive colonial tunicates, assisted with development of an early detection and rapid response program for marine invaders in South Florida, and has cultured many species of marine fishes and multiple species of bivalves.

Education

Bachelor of Science in Biology (1999), East Carolina University, Greenville, North Carolina
Master of Science in Biology (2001), East Carolina University, Greenville, North Carolina
Ph.D. in Biology (2009), North Carolina State University, Raleigh, North Carolina

Professional Experience

Marine Ecologist (2001-Present) NOAA National Ocean Service/NCCOS/CCFHR, Beaufort, NC
National Research Council Post Doctoral Advisor (2011-present)
Graduate Student Advisor (2009-present)

Awards and Fellowships

Presidential Early Career Award for Scientists and Engineers (2011) (Awarded by President Barack Obama)
NOAA National Ocean Service Employee of the Year (2010)
Kenneth R. Keller Excellence in Dissertation Research Award, North Carolina State University (2009)
Meritorious Service Award, American Fisheries Society, Tidewater Chapter (2006)
East Carolina University Sigma Xi Helms Research Award (Graduate) (2003)
Oak Ridge Institute of Science and Education Postgraduate Fellowship (2001)
East Carolina University Edward P. Ryan Scholarship in Marine Sciences (1999 & 2000)

Relevant Publications (selected from over 35)

Morris, J.A., Jr., (Ed.). 2012. Invasive lionfish: A guide to control and management. Gulf and Caribbean Fisheries Institute. Special publication Series Number 1, Marathon, Florida, USA. 113 pp. *Published in English, Spanish, and French.*
Morris, J.A. Jr., K.W. Shertzer, and J.A. Rice. (2011) A stage-based matrix population model of invasive lionfish with implications for control. *Biological Invasions* 13:7-12.
Morris, J.A., Jr., A. Thomas, A. Rhyne, N. Breen, L. Akins, and B. Nash. (2011) Nutritional properties of the invasive lionfish: A delicious and nutritious approach for controlling the invasion. *AAFL Bioflux* 4(1): 21-26.
Morris, J.A., Jr., C.V. Sullivan, J.J. Govoni. (2011). Oogenesis and spawn formation in the lionfishes *Pterois miles* and *Pterois volitans*. *Scientia Marina* 75(1): 147-154.
Morris, J.A., Jr. and J.L. Akins. 2009. Feeding ecology of the invasive lionfish in the Bahamian archipelago. *Environmental Biology of Fishes* 86:389-398.

DEBORAH SUE BOYCE

Address 414 Orange St.
Beaufort, NC 28516

Education B.A. Mathematics & Computer Science, East Carolina University, 1979
B.A. Physiology, East Carolina University, 1979

Research Interests

SCUBA diving education, outreach, entrepreneurship, and artificial reef development and awareness.

Professional Experience

1976-present CEO-Discovery Diving Company, Inc. A five-star PADI rated SCUBA Diving retail store, charter and educational training business.

2007-present President and Director, Eastern Carolina Artificial Reef Association. Coordinated fund-raising opportunities for ECARA, sinking artificial reefs and advertising for the 1st and 2nd annual, "If you can't beat 'em, eat 'em" Lionfish Spearfishing tournament in Beaufort, NC.

Service

2004-present NOAA Artificial Reef Developers Group

North Carolina Sea Grant Curriculum Vitae

NAME: J. Barry Nash

Professional Address: North Carolina Sea Grant, 303 College Circle, Morehead City, NC 28557

Telephone: 252/222-6337 **Fax:** 252/222-6308

E-mail: barry_nash@ncsu.edu **Website:** www.ncseagrant.org

EDUCATION

North Carolina State University	MS - Food Science & Technology	1984
North Carolina State University	BS - Food Science & Technology	1980
Lenior Community College	AA - General Science	1979

PROFESSIONAL EXPERIENCE

1997 – Present	Seafood Technology & Marketing Specialist	North Carolina Sea Grant
1992-1997	Research & Development Project Manager	GoodMark Foods, Inc.
1986-1992	Senior Food Technologist	Ralston Purina Company
1985-1986	Research Scientist III	ConAgra, Inc.

PROFESSIONAL OVERVIEW

Maintain an economic development program for the North Carolina seafood industry that addresses the commercialization of value-added products, regulatory compliance, manufacturing, and direct marketing.

SELECTED PUBLICATIONS

Kros, John, William Rowe and Barry Nash. 2013. *A Supply Chain Analysis of North Carolina's Commercial Fishing Industry*. North Carolina Rural Economic Development Center and North Carolina Sea Grant, UNC-SG-13-01.

Garrity-Blake, Barbara and Barry Nash. 2012. *An Inventory of North Carolina Fish Houses – A Five-Year Update*. North Carolina Sea Grant, UNC-SG-12-06.

Nash, Barry and Susan Andreatta. 2011. *New Business Models for Small-Scale Fishermen and Seafood Processors*. North Carolina Sea Grant, UNC-SG-11-05.

Andreatta, Susan, Barry Nash and Gretchen Martin. 2011. *Carteret Catch™: Raising Awareness of Local Seafood through Community and Business Partnerships*. Human Organizations. 70(3): 279-288.

Nash, Barry. 2010. *Ready-To-Sell: Developing Value-Added Seafood Products*. North Carolina Sea Grant, UNC-SG-BP-10-01.

SELECTED GRANTS & CONTRACTS

- Creamer, Nancy; co-PIs: Alice Ammerman, Gary Bullen, Rudi Colloredo-Mansfeld, Diane Ducharme, Carolyn Dunn, Rob Handfield, Leslie Hossfeld, Ray McKinnie, Tom Melton, Barry Nash, John O'Sullivan, Matt Poore, Michelle Schroeder-Moreno, and Steve Washburn. 2012. *An Integrated Project to Enhance Food Security and Sustainability through the Development and Evaluation of Supply Chains from Local Farmers and Fishers to Two Large-Scale Models of Local Food Distribution*. Sub-award of \$14,400 under a \$3,971,56 Agriculture and Food Research Initiative grant from the United States Department of Agriculture.
- Kros John, William Rowe, Barry Nash, and James Kleckley. 2012. *A Value-Added Business Analysis for the North Carolina Commercial Fishing Industry*. North Carolina Rural Center: \$100,000.
- Nash, Barry and Barbara Garrity-Blake. 2011. *An Inventory of Fish Houses along Coastal North Carolina: An Update*. North Carolina Sea Grant: \$5003.
- Nash, Barry and David Green. 2010. *Assessing the Shelf Life of Value-Added Blue Crab Products* Department of Food Science & Technology, Virginia Polytechnic & State University: \$5,478.
- Green, David and Barry Nash (cooperators). *Analysis of Processing Costs and Market Viability for Various Tilapia Products*. 2009. Award of \$61,262 to Virginia Polytechnic & State University by the United States Department of Agriculture. Sub-award of \$20,685 to Outer Banks Fisheries, LLC subcontracted to the North Carolina State University Seafood Laboratory.

HONORS

- The Sea Grant Association's 2010 *Superior Outreach Programming Award* for the South Atlantic region.
- North Carolina State University Alumni Association's 2003 *Outstanding Outreach and Extension Award*
- 2003 *Award for Excellence* from North Carolina State University's Office of Research and Graduate Studies
- 2001-2002 *Outstanding Extension Service Award*
- 2001 North Carolina Association of Cooperative Extension Specialists' *Extension Education Award*

JANELLE V. REYNOLDS-FLEMING

Address 3103 Mandy Lane
Morehead City, NC 28557
janelle.fleming@gmail.com
<http://www.unc.edu/~janelle>

Education Ph.D. Marine Sciences, University of North Carolina-Chapel hill, May 2003
M.S. Computational Math with minor in Oceanography, Texas A&M, 1996
B.A. Mathematics, Wesleyan College, *cum laude*, 1994

Research Interests

Measurement and modeling of circulation and transport in coastal and estuarine waters as they pertain to hydrodynamic/biological/geological couplings. Scientific diving, education, and public outreach.

Professional Experience

- 2006-present CEO-Seahorse Coastal Consulting, Morehead City, NC. Coordinate business development and financial aspects of Seahorse Coastal Consulting, a company that specializes in software development for storm surge forecasting, energy system modeling, scientific data analysis, scientific diving and marine science education and outreach.
- 2009-present Representative, Eastern Carolina Artificial Reef Association. Coordinated fundraising opportunities for ECARA, including annual dinner and the 1st and 2nd annual, "If you can't beat 'em, eat 'em" Lionfish Spearfishing tournament in Beaufort, NC.
- 2006-present Research Assistant, UNC-Institute of Marine Sciences. Coordinated instrument deployment and analysis as part of the Coastal Barrier Monitoring project on Camp Lejeune. Incorporated modeling data into ADCIRC/SWAN model of the region.
- 2007 Interim director, Institute of the Environment Morehead City Field Site, Morehead City, NC. Directed the undergraduate research experience for 11 UNC undergraduates. This included designing environmental field trips, coordinating class schedules, independent research projects, and Capstone research project.

Awards

- 2004 ASLO DIALOG VI participant
- 2004 ERF/NOAA travel award to present research at ECSA/ERF conference in Ballina, Australia
- 2002 NSF East Asia Summer Experience (June-August 2002)
- 2001 ERF travel award to present research at ERF conference in St. Pete Beach, FL
- 2001 AGU travel award to present research at IAPSO/IABO conference in Mar del Plata, Argentina.
- 1999-2002 EPA Star Fellow – 3 year fellowship

Selected Refereed Publications

Reynolds-Fleming, JV, RA Luettich and JG Fleming (2013) Comparative Hydrodynamics during events along a barrier island: Explanation for Overash. *Estuaries and Coasts*, Volume 36, Issue 2, 334-336.

Reynolds-Fleming, JV and JG Fleming (2005) Coastal circulation within the Banks Peninsula region, New Zealand. *New Zealand Journal of Marine and Freshwater Research* 39(1): 217-225.

Reynolds-Fleming, JV, and RA Luettich, Jr. (2004) Wind-driven lateral variability in the upper Neuse River Estuary. *Estuarine Coastal and Shelf Science*, 60:395-407.

Reynolds-Fleming, JV, JG Fleming, and RA Luettich (2002) A portable, autonomous vertical profiler for estuarine applications. *Estuaries*, 25(1):142-147.

Luettich, RA, SD Carr, JV Reynolds-Fleming, CW Fulcher and JE McNinch (2002) Semi-diurnal seiching in a shallow, micro-tidal lagoonal estuary. *Continental Shelf Research*, 22:1669-1681.

Popular Articles

Reynolds-Fleming, JV (2013) If you can't beat 'em, eat 'em. *Carolina Salt* 5:16.

Reynolds-Fleming, JV and DR Schiel (2004) Where do larvae come from and where do they go? *NIWA Water & Atmosphere* 12(1):5.