

**Center for Marine Sciences and Technology
Annual Report -- 2007-2008**

Submitted by Dr. David B. Eggleston, Director
June 2008

The principal mission of the Center for Marine Sciences and Technology (CMAST) is to discover innovative solutions to questions and problems in marine systems and provide effective communication of these discoveries, by promoting multidisciplinary studies among research scientists, educators and extension specialists from the participating NC State University colleges, enhancing interaction with other educational institutions and agencies concerned with marine sciences and coastal natural resources, and providing a focal point for citizen contact with NC State University's marine science and extension faculty. A description of CMAST research, extension and education activities and programs may be found on our web-site (www.cmast.ncsu.edu/) and via our newsletters.

The five university-wide strategic thrust areas are:

- *Providing leaders for the state, nation and the world* – CMAST Summer Fellows and Intern Program, Graduate & Undergraduate Training, and K-12 Educational Outreach is providing hands-on research and education experiences in the marine sciences.
- *Creating educational innovation* – By virtue of its location on the campus of Carteret Community College and its “2 +2” Program between CMAST/MEAS and the Carteret Community College’s “Applied Marine Biology & Aquaculture Program”, CMAST is uniquely qualified to expand its role as a branch campus of NCSU and meet the goals of the UNC Tomorrow Report.
- *Improving health and well-being* – CMAST faculty & staff are researching a wide range of topics that affect directly human health and well being, ranging from seafood safety to the effect of pharmaceuticals in the marine realm to improving water quality of coastal waters critical to tourism.
- *Fueling economic development* - CMAST faculty & staff are collaborating in a Phase II North Carolina Biotechnology grant to develop a business plan for a Center of Innovation in Marine Biotechnology to facilitate the transfer of ideas and knowledge to job growth.
CMAST is constructing a mariculture facility in Carteret County that will serve as a pilot demonstration facility for the transfer of mariculture technology to private industry as a means to diversify jobs and income in eastern NC, while simultaneously meeting growing demands for seafood.
- *Driving innovation in energy and the environment* – CMAST served as the lead institution in formulating the creation of a *Carolinas Marine Sciences Cooperative Institute* (CMSCI) in partnership with the National Oceanic & Atmospheric Administration (NOAA). The partnership will use the expertise and infrastructure of the marine science community in North Carolina to achieve proper stewardship of the nation’s ocean resources.

In partnership with the UNC-system and Duke University marine science programs, CMAST is a key partner and one of the leaders in the recent establishment of a North Carolina Environmental Observing Network System (NC-EONS) in Pamlico Sound. The purpose of NC-EONS is to enable scientific research for advising, protecting and sustaining our state's marine resources for the long term benefit of its citizens.

The CMAST Student Center and Sustainable House has been re-designed as a demonstration facility for the latest in "green" building technologies, hurricane protection and alternative energy as it pertains to coastal environments. The long-range plan is to couple private industry, NCSU Engineering, and Carteret Community College to conduct research and development, as well as job training in the rapidly growing "green" building industry.

The information below is for inclusion in college reports:

1. *Changes in Service Environment*

- Three initiatives are pending which could increase the size of our faculty and staff:
- Carolinas Marine Sciences Cooperative Institute, which is a partnership between NOAA and all marine science programs in the UNC-system plus Duke University Marine Lab.
- NCSU Marine Aquaculture Research Center in Marshallburg, NC could add one new faculty member support staff, and new facilities in Carteret County, NC.
- NC Marine Magnetic Resonance Imaging and Spectroscopy Facility in partnership with UNC/NCSU Department of Biomedical Engineering and NOAA Beaufort Laboratory on Piver's Island could add one new faculty member and support staff and new facilities in Carteret County, NC

2. *Compact Plan: Major initiatives from your Compact*

- CMAST did not submit a Compact Plan, however, Eggleston communicated with Deans Solomon, Arden and Wynne the need to consider linkages between PAMS, CVM, and CALS and CMAST-based programs.
- Eggleston communicated with Dean Vega of Engineering and met with Civil Engineering Department Head George List and faculty member Dr. Margery Overton to seek ways in which NCSU Engineering might become more actively involved in Marine Sciences in general and CMAST specifically.
- Eggleston provided input to NCSU's response to the UNC GA *UNC Tomorrow Report* via four means: (i) direct input to PAMS Dean's office, (ii) J. Rice's meeting with Provost Neilsen, (iii) Eggleston's participation in Provost Neilsen's Open Faculty Forum, and (iv) via Courtney Thornton, UNC GA Research office.

3. *Diversity: Initiatives and progress*

- CMAST is an equal opportunity employer
- Information about CMAST programs and employment opportunities are freely available through our web-site, newsletters, and by visiting our faculty, staff & students.
- CMAST faculty strive to integrate high school, community college, undergraduate and graduate students into research and extension programs.

4. *Instructional Program Advances*

- CMAST faculty offers a variety of hands-on workshops at CMAST or in the field.

- Provide educational opportunities to students and employees at Carteret Community College, UNC Chapel Hill's Institute of Marine Science, Duke University's Marine Lab, NC Division of Marine Fisheries, and NOAA's Beaufort Laboratory.
- CMAST faculty offer in-house and teleconferenced courses to NCSU's main campus.
- CMAST hosts residents from the NCSU College of Veterinary Medicine and teaches a variety of short courses and workshops in support of the Veterinary Medicine Program.
 - Teach in MarVet 3 (<http://www.marvet.org/index.htm>) and Aquavet I.
 - Involve DVM students in research and marine animal pathology activities: dolphin rodeo, sea turtle laparoscopies, sea turtle trawl census, summer research mentoring, marine mammal strandings.
 - Dolphin and sea turtle health assessments (17 veterinary students and 3 residents involved in dolphin captures in April 2008; 25 veterinary students, 3 residents and 2 graduate students involved in sea turtle laparoscopies in May and October 2007), and strandings necropsies done; sea turtle trawl census and new summer research mentoring not done (but continuing with Hope Valentine's sea turtle bartonella work from 2 summers ago).
 - DVM Student Summer Research Projects – Coral Lipid Profiles as Markers of Health – Kelly Britt 3rd Year DVM student ; Bill Fish Head Anatomy – Michelle Mehalik 4th year DVM student
 - Manage Support for Aquatic Animal Medicine Fund for veterinary student and resident aquatic research projects. (Supported iguana ketoprofen pharmacokinetic study (Tuttle), shark propofol study (Cavin), shark parasitology investigation (Maclean) including medical illustration by veterinary student (Mehalick).
 - Facilitate provision of sea turtle and marine mammal carcasses for exotic animal pathology selective, marine mammal medicine elective, and WAAZM and/or Patheads workshops.
 - Conducted second sea turtle medicine senior block for full block of 6 students.
 - Updated and revised sea turtle and marine mammal lectures and labs for VMC953 based on current literature, additional clinical experience and student evaluations.
 - New lecture on fish diagnostics, anesthesia and euthanasia for Carteret Community College aquaculture program, class of 12 community college students.
- Lectures in support of NCSU courses TOX 701 unit on Liver and Kidney toxicity, TOX 495 unit on Endocrine Disruption, TOX 401 unit on Liver and Kidney toxicity.
- Hosted annual meeting of the Carolinas Chapter of the Society of Environmental Toxicology and Chemistry (48 participants). Poster and platform presentations (April 2008).
- Hosted two (2) Duke University undergraduate students (McNamara and Ziarko) for research rotations in Environmental Toxicology.
- Select (one of twelve) faculty participant in Nanonet Workshop, European Union and Natural Environment Research Council Knowledge Transfer Network, Hornton Grange, Conference Park, University of Birmingham, Birmingham, UK. November 11-12, 2007.
- Invited presentation given to the California Department of Toxic Substances Control on “Emerging Contaminants”: Nanotechnology Symposium II: Potential Hazards of Nanoparticles in the Environment. Sacramento CA, October 3, 2007.

- FS322 (39 students). Guest lecture and laboratory on aquatic muscle food quality and safety.
- ZO586 (20 students) Guest lecture on post-harvest handling and quality of aquatic fishery products.
- ZO/MEA 695 - Thesis Research
- ZO/MEA 699 - Thesis Preparation
- ZO/MEA 895 – Dissertation Research
- Presentation at NC State University’s Continuing Education Sportfishing School (Hatteras, NC) entitled “Fishery Management and Conservation” (June 2007; 40 students)
- Poster, program article, newspaper reports, and local television reports on scientific sampling of pelagic game fish at Big Rock Blue Marlin tournament, Morehead City, NC (June 2007)
- Fisheries Biology laboratory for 4-H middle school students (CMAST: Aug 2007; 20 students)
- Hosted 12 undergraduate NCSU students for Coastal Processes course (MEA459).
- Hosted ~ 15 undergraduate NCSU students for Ecology of Fishes field trip.

Mentoring Activities

- Mentor for Duke University’s “Preparing Future Faculty Program” – Elliott Hazen (9/07 – present)
- Mentor for *Marine Fisheries Management Fellow* – Timothy Ellis, (7/07 – present)
- Mentor for post-doctoral fellow – J. Christopher Taylor (5/06- 6/07)
- Mentor for Fisheries and Wildlife undergraduate intern – Adam Stephenson (summer 2007)
- Mentor for *Marine Fisheries Management Fellow* – Warren Mitchell (8/06 – 7/07)
- Buckel, J.A. and P.J. Rudershausen. 2007. Developing a defensible circle hook vs j hook study in the NC charter boat industry. Circle hook workshop.– 25 charter boat captains, billfish tournament directors, federal and state regulators. Nov. 2, 2007
- Rudershausen, P.J., J.A. Buckel, and R. Gregory. 2007. “Comparison of circle and j hooks in the bluewater troll fishery: pilot data”. Fin-addicts fishing club. December 4, 2007. 40 fishermen
- Buckel Laboratory. 2007. Seining and geocaching (treasure hunt with gps units). 5th graders from White Oak Elementary in Cape Carteret, NC. 100 students, total (25 per class), 2 classes per day for two days, Nov 1 and 2, 2007.
- Chuck Crapo, Ph.D. (Visiting Scientist). Host for Alaska Sea Grant Seafood Specialist. Dr. Crapo participated in the CMAST seminar series and visited with several local seafood businesses to learn about technology transfer in the mid-Atlantic region.
- Kristín Björnsdóttir (Ph.D. candidate). Co-direct along with Dr. Lee-Ann Jaykus the dissertation study on the “*Prevalence and characterization of toxigenic histamine-producing bacteria in fresh tuna.*”
- Matt Stallworth (CMAST Undergraduate Summer Scholar). Conduct a study (10-week) on isolation of histamine-producing bacteria in yellowfin tuna and mahi-mahi from mid-Atlantic and Hawaiian waters.
- Kayla Norman (West Carteret High School senior). Conduct a study (15-contact hour) on future demand and supply of seafood in North Carolina and the USA.

5. Research

Publications (46)

1. Morley, J. W., **Buckel, J. A.** and Lankford, T. E. 2007. Winter energy storage dynamics and cohort structure of young-of-the-year bluefish (*Pomatomus saltatrix*) off North Carolina. *Marine Ecology Progress Series* 334:273-286.
2. Slater, J. J., Lankford, T. E. and **Buckel, J. A.** 2007. Overwintering ability of young-of-the-year bluefish (*Pomatomus saltatrix*): effects of ration and cohort on survival. *Marine Ecology Progress Series* 339:259-269.
3. Rudershausen, P. J., **Buckel, J. A.** and Williams, E. H. 2007. Discard composition and release fate in the snapper-grouper commercial hook and line fishery, North Carolina. *Fishery Management and Ecology* 14:103-113.
4. Schwenke, K. L. and **Buckel, J. A.** 2008. Age, growth, and reproduction of dolphinfish *Coryphaena hippurus* caught off the coast of North Carolina. *Fishery Bulletin* 106:82-92.
5. Tuomikoski, J. E., Rudershausen, P. J., **Buckel, J. A.** and Hightower, J. E. 2008. Effects of age-1 striped bass predation on juvenile fishes in Albemarle Sound. *Transactions of the American Fisheries Society* 137:324-339.
6. Bachelier, N. M., Paramore, L. M., **Buckel, J. A.** and Scharf, F. S. in press. Recruitment of juvenile red drum in North Carolina: spatiotemporal patterns of year-class strength and validation of a seine survey. *North American Journal of Fisheries Management*.
7. Rudershausen, P. J., Baker, M. S. and **Buckel, J. A.** in press. Catch rates, selectivity, and discard mortality among various mesh configurations in the South Atlantic Bight black sea bass (*Centropristis striata*) commercial trap fishery. *North American Journal of Fisheries Management*.
8. Rudershausen, P. J., Williams, E. H., **Buckel, J. A.**, Potts, J. A. and Manooch, C. H., III. in press. Comparison of reef fish catch-per-unit-effort and total mortality between 1970s and 2005-06 in Onslow Bay, NC. *Transactions of the American Fisheries Society*.
9. Bachelier, N. M., Hightower, J. E., Paramore, L. M., **Buckel, J. A.** and Pollock, K. H. in press. Changes in fishing mortality and selectivity of North Carolina red drum due to fishery regulations: estimates from an age-dependent tag return model. *Transactions of the American Fisheries Society*.
11. Choi, K., Law, J. M., **Harms, C. A.** and Lehman, W. 2007. Hypoxia-reperfusion triggers immunocompromise in tilapia (*Oreochromis niloticus*). *J Aquat Anim Health* 19:128-140.
12. Birkenheuer, A. J., **Harms, C. A.**, Neel, J., Marr, H. S., Tucker, M. D., Acton, A., Tuttle A. D. and Stoskopf, M. K. 2007. The identification of a genetically unique Piroplasma in North American river otters (*Lontra canadensis*). *Parasitology* 134: 631-635.
13. **Harms, C. A.**, Eckert, S. A., Kubis, S. A., Campbell, M., Levenson, D. H. and Crognale, M. A. 2007. Field anaesthesia of leatherback sea turtles (*Dermochelys coriacea*). *Vet Rec* 161: 15-21. Cover photo.
14. Braun-McNeill, J., Epperly, S. P., Owens, D. W., Avens, L., Williams, E. and **Harms, C. A.** 2007. Seasonal reliability of testosterone radioimmunoassay (RIA) for predicting sex ratios of juvenile loggerhead (*Caretta caretta*) turtles. *Herpetologica* 63: 275-284.
15. **Harms, C. A.**, and Stoskopf, M. K. 2007. Outcomes for adult laboratory ferret adoptions following gonadectomy in a veterinary student teaching exercise. *J Am Assoc Lab Anim Sci* 46(4): 50-54.

16. Rostein, D. S., **Harms, C. A.**, Lovewell, G. N. and Hohn, A. A. 2007. Gastric leiomyoma in a free-ranging Atlantic bottlenose dolphin (*Tursiops truncatus*). *Vet Rec* 160: 130-131.
17. Valentine, K. H., **Harms, C. A.**, Cadenas, M. B., Birkenheuer, A. J., Marr, H. S., Braun-McNeill, J., Maggi, R. G. and Breitschwerdt, E. B. 2007. *Bartonella* DNA in loggerhead sea turtles. *Emerg Infec Dis* 13: 949-950.
18. Epperly, S. P., Wyneken, J., Flanagan, J. P., **Harms, C. A.** and Higgins, B. 2007. Attachment of popup archival transmitting (PAT) tags to loggerhead sea turtles (*Caretta caretta*). *Herpetological Review* 38: 419-425.
19. Johnson, A. K., Law, J. M., **Harms, C. A.** and Levine, J. F. 2007. Multi-tiered health assessment of Atlantic menhaden in the Pamlico River, North Carolina. *J Aquat Anim Health* 19: 205-214.
20. Maclean, R. A., **Harms, C. A.** and Braun-McNeill, J. 2008. Propofol anesthesia in loggerhead (*Caretta caretta*) sea turtles. *J Wildl Dis* 44: 143-150.
21. **Harms, C. A.**, Lovewell, G. N. and Rotstein, D. S. 2008. Presumed hyperglycemic cataracts in a live-stranded minke whale (*Balaenoptera acutorostrata*) calf. *Mar Mam Sci* 24: 388-397.
22. Tuttle, A. D., Burrus, O., Burkart, M. A., Scott, P. W., Stoskopf, M. K. and **Harms, C. A.** 2008. Stomach prolapse through the gill slit in sand tiger sharks: 3 cases. *J Fish Dis* 31: 311-315.
23. Wolf, K. N., **Harms, C. A.** and Beasley, J. 2008. Evaluation of multiple clinical chemistry analyzers for sea turtle health assessment. *J Am Vet Med Assoc*, in press.
24. Chinnadurai, S. K. , van Wettene, A., Linder, K. E., **Harms, C. A.** and DeVoe, R. S. Secondary amyloidosis and renal failure in a captive California sea lion (*Zalophus californianus*). *J Zoo Wildl Med*, in press.
25. **McClellan-Green, P. D.**, Romano, J. and Oberdörster, E. (2007) Does gender really matter in contaminant exposure? A case for invertebrate risk assessment. *Environ. Res.* 104: 183-191.
26. Burger, J. Fossi, C., **McClellan-Green, P. D.** and Orlando, E. F. (2007). Assessment of approaches and methodologies for gender-related differences in wildlife and the environment. *Environ. Res.* 104: 135-152.
27. Romano, J. A., Rittschof, D., **McClellan-Green, P. D.** and Holm, E. R. (submitted). Variation in toxicity of copper pyriithione among populations and families of the barnacle, *Balanus amphitrite*. *Mar. Environ. Res.*
28. Blickley, T. M. and **McClellan-Green, P. D.** (in press). Toxicity of Aqueous Fullerene (nC₆₀) in Adult and Larval *Fundulus heteroclitus*. *Environ. Toxicol. Chem.* DOI: 10.1897/07-632.1
29. **McClellan-Green, P. D.**, Oberdörster, E., Zhu, S., Blickley T. M. and Haasch, M. L. (2007). Impact of Nanoparticles on Aquatic Organisms. In *Nanoparticles: Characterization, Dosing and Health Effects*. (Eds)N. Monteiro-Riviere and C. L. Tran, Taylor & Francis, CRC Press, New York, NY. pp 391-404.
30. Lead, J. R., Smith, E. L., Scott-Fordsmand, J. J., Baun, Handy, A., Slaveykova, R. D. Tyler, V. I., von der Kammer, C. R., Benedetti, F., Boxall, M., Brust, A. Cumpson, M., Fernandes, P., Hasselov, T., Henry, M., Holbrook, T. B., David, R. Rai, K., Armand, M. **McClellan-Green, P. D.**, Noel, N., Richard, O., Barry, P., John, G., Valsami-Jones, E., Vincent, B.. (submitted). Linking the physico-chemical characteristics and ecotoxicology of manufactured nanomaterials in aquatic and terrestrial environments. *Environ. Sci. Technol.*

31. Searcy, S. P., **D. B. Eggleston**, J. A. Hare. (2007). Is growth a reliable indicator of habitat quality and Essential Fish Habitat? *Canadian Journal of Fisheries and Aquatic Sciences* 64:681-691.
32. Searcy, S, **D. B. Eggleston**, J. Hare. (2007). Environmental influences on the relationship between juvenile and larval growth for Atlantic croaker, *Micropogonias undulates*. *Marine Ecology Progress Series* 349:81-88.
33. **Eggleston, D. B.**, E. G. Johnson, G. T. Kellison, G. R. Plaia and C. Huggett. (2008). Pilot evaluation of early juvenile blue crab stock enhancement using a replicated BACI design. *Reviews in Fisheries Science* 16 (1-3): 91-100.
34. Lipcius, R. N., **D. B. Eggleston**, S. J. Schreiber, R. D. Seitz, J. Shen, M. Sisson, W. T. Stockhausen and H. V. Wang. (2008). Importance of metapopulation connectivity to restocking and restoration of marine species. *Reviews in Fisheries Science* 16 (1-3): 101-110.
35. **Eggleston, D. B.**, D. M. Parsons, G. T. Kellison, G. R. Plaia and E. G. Johnson. (2008). Functional response of sport divers to lobsters with application to fisheries management. *Ecological Applications* 18:258-272.
36. Zohar, Y., A. H. Hines, O. Zmora, E. G. Johnson, R. N. Lipcius, R. D. Seitz, **D. B. Eggleston**, A. R. Place, E. Schott, J. Stubblefield and J. Sook Chung. (2008). The Chesapeake Bay Blue Crab: (*Callinectes sapidus*): A multidisciplinary approach to responsible stock enhancement. *Reviews in Fisheries Science* 16 (1-3): 25-35.
37. Drew, C. A. and **D. B. Eggleston**. (2008). Local juvenile fish densities in Florida Keys mangroves correlates with regional landscape characteristics. *Marine Ecology Progress Series* 362:233-243.
38. VanderPluym, J. L., **D. B. Eggleston**, J. F. Levine. Impacts of road crossings on fish movement and community structure. *Journal of Freshwater Ecology* (in press).
39. Moorman, M. C., **D. B. Eggleston**, C. B. Anderson, A. Mansilla and P. Szjener. The implications of North American Beaver and Trout invasion on native diadromous fish in the Cape Horne Biosphere Reserve, Chili. *Transactions of the American Fisheries Society* (in press).
40. Johnson, E. G. and **D. B. Eggleston**. (2008). Population density, loss and movement of blue crabs in salt marsh creeks of the Newport River estuary. *Marine Ecology Progress Series* (in press).
41. Nielsen, D., **D. P. Green** 2007. Developing a quality index grading tool for hybrid striped bass (*Morone saxatilis x Morone chrysops*) based on the Quality Index Method. *Intl. J. Food Science and Technology*. 42(1):86-94.
42. **Stoskopf, M. K.** and L. Posner Fish Anesthesia. In: Anesthesia and Analgesia for Laboratory Animals, edited by Richard Fish, Marilyn Brown, Peggy Danneman, and Alicia Karas. Elsevier (in press 2007.)
43. **Stoskopf, M. K.** (Editor) (2007) Wild Carnivore Medicine 2005. Course CD. NCSU EMC
44. Henson-Ramsey H, Kennedy-Stoskopf S, Shea D, Taylor SK, **Stoskopf MK.** (2007) A comparison of two exposure systems to apply malathion to *Lumbricus terrestris*. *Environmental Toxicology and Chemistry*. Bull Environ Contam Toxicol 78:427–431.
45. Smith, S. A., **M. K. Stoskopf**. 2007 The Art of Amphibian Science. *ILAR Journal* 48(3):179-182.
46. Gustafson, L., Showers, W., Kwak, T., Levine, J., **Stoskopf, M.** (2007) Temporal and spatial variability in stable isotope compositions of a freshwater mussel: implications for

biomonitoring and ecological studies. *Oecologia* 152:140-150.

Grants (62 active grants; Total of \$3,016,536)

1. **Buckel, J. A.**, Hightower, J. Pollock, K. and Scharf, F. Does density-dependent mortality occur in an estuarine fish? NC Sea Grant. 2/08-1/10. \$155,000.
2. Lankford, T., Jr., **Buckel, J. A.** Coastal patterns of juvenile bluefish recruitment in the Middle- and South-Atlantic Bights. Bluefish Research Program (NOAA/NMFS/CMER) at Rutgers University. 10/07-9/08. \$90,000 (\$37,943 to NCSU)
3. **Buckel, J. A.**, Burgess, T., Ng, A., Williams, E. and Rudershausen, P. Pilot survey of deepwater reef fishes off North Carolina using a two-stage, adaptive design. NC Sea Grant Fishery Resource Grant. 4/07-3/08. \$46,572.
4. **Buckel, J. A.** and Burgess, T. Novel approach to estimating relative long-term survival of black sea bass and red porgy in the North Carolina reef fishery. NC Sea Grant Fishery Resource Grant. 4/07-3/08. \$53,930.
5. Rudershausen, P. J., Gregory, R. and **Buckel, J. A.** A Comparison Between Circle and 'J' Hook Performance in the Wahoo, Yellowfin Tuna, and Mahi Troll Charter and Recreational Fishery of North Carolina: a workshop. NC Sea Grant Fishery Resource Grant.. 11/07. \$10,000.
6. Mitchell, W. A., Taylor, J. C., **Buckel, J. A.** and Hightower, J. E. Feasibility of using hydroacoustics to estimate river herring run size in Albemarle Sound, NC. NC Sea Grant Fishery Resource Grant. 8/07-7/08. \$75,896.
7. **Buckel, J. A.** Using biological and habitat data to identify strategic habitat areas for juvenile fish in Albemarle Sound, North Carolina: Marine Fisheries Fellowship. NC Division of Marine Fisheries Conservation Fund. 1/08-12/08, \$18,000.
8. Martin, G. B., Shertzer, K., **Buckel, J. A.** and Taylor, J. C. Fishery Indices for the Southeast Atlantic: Biological indicators of coastal and estuary-dependent fishery production in the US South Atlantic. 5/06-4/08. NOAA Fisheries and the Environment (FATE). \$124,729.
9. **Buckel, J. A.** and Thigpen, J. Enhancing the quality of North Carolina's Fisheries Extension and Applied Research Products. 5/1/04-6/30/09. National Sea Grant. \$169,130.
10. **Buckel, J. A.**, Hightower, J. and Pollock, K. Factors influencing escapement of red drum in North Carolina: a conventional tag and telemetry approach. 2/06-1/08. NC Sea Grant. \$166,668.
11. **Buckel, J. A.** and Taylor, J. C. Development and Validation of Recruitment Indices For Multiple Recreational Fish From Long-Term Ichthyoplankton Data Collected From Beaufort Inlet, North Carolina. NC Department of Environment & Natural Resources. \$18,000. 1/07-12/07.
12. Lankford, T., Jr., and **Buckel, J. A.** Coastal patterns of juvenile bluefish recruitment in the Middle- and South-Atlantic Bights. Bluefish Research Program (NOAA/NMFS/CMER) at Rutgers University, \$90,000 (\$36,000 to NCSU). 6/06-5/07.
13. **Buckel, J. A.** and Hodson, R. Marine Fisheries Management Fellowship: A cooperative agreement between North Carolina Division of Marine Fisheries and North Carolina Sea Grant. 2/06-1/08. \$53,492
14. **Buckel, J. A.** and Voiland, M. Marine Fisheries Management Fellowship: A cooperative agreement between North Carolina Division of Marine Fisheries and North Carolina Sea Grant. 2/08-1/10. \$53,492.

15. **Buckel, J. A.**, Cox, J. and Ng, A. Atlantic bluefin tuna feeding ecology and potential ecosystem effects during winter in North Carolina waters. NC North Carolina Sea Grant Fisheries Resource Grant. 9/1/04-8/31/07, \$57,887.
16. **Buckel, J. A.** Scientific sampling of blue marlin, yellowfin tuna, wahoo, and dolphin captured during the Big Rock Blue Marlin tournament. Big Rock Blue Marlin tournament committee (June 2007, \$8,000)
17. **Harms, C. A.**, Maggi, R. G. and Breitschwerdt, E. B. Bartonella prevalence in stranded marine mammals along the North Carolina coast: bacterial load, tissue localization. (NOAA National Marine Fisheries Service, Prescott Grant Program) \$99,392. pending
18. **Harms, C. A.** Sub-contract to UNC-Wilmington, Koopman, H. Development of Assessment and Screening Tools for Acoustically-Associated Physiological Trauma in Odontocetes (Office of Naval Research) \$8216. pending
19. **Harms, C. A.** Survey of Near-shore Loggerhead Sea Turtles (*Caretta caretta*) in North Carolina for Evidence of Infection with *Chlamydia/Chalmydophila* spp., *Mycoplasma* spp. and *Mycobacterium* spp. (CVM State Research Grant) \$3200 (pending).
20. **Harms, C. A.** Dolphin necropsy contract. 2006-2007 (NOAA National Marine Fisheries Service) \$24,898.
21. **Harms, C. A.** Field anesthesia of leatherback sea turtles for the purpose of conducting electroretinograms. 2006 (WIDECAS—Wider Caribbean Sea Turtle Conservation Network) \$8456.
22. **Harms, C. A.**, Lewbart, G. A. and Stoskopf, M. K. 2006-2007. Improving live marine mammal stranding response in North Carolina through rapid diagnostic capability and short term holding capacity. (NOAA, National Marine Fisheries Service, Prescott Grant Program) \$56,930.
23. Stoskopf, M. K., **Harms, C. A.**, Lewbart, G. and Kennedy-Stoskopf, S. 2005-2007. Aquarium health management. North Carolina Aquariums, North Carolina Department of Environment and Natural Resources. \$156,095.
24. Lewbart, G. A., Christian, L. S. and **Harms, C. A.** 2005-2008. Veterinary medical services rendered to the Museum of Natural Sciences. North Carolina Department of Environment and Natural Resources. \$60,000.
25. **Kennedy-Stoskopf, S.** University Extension, Engagement, and Economic Development Grant “*Science Matters*” (\$10,000, 7/1/07-6/30/08)
26. **McClellan-Green, P.** University of North Carolina at Charlotte (North Carolina Sea Grant Sub-Contract), “Hypoxia Impacts on Sustainable Oyster Populations,” \$99,997(17,000), March 2006-April 2009.
27. **McClellan-Green, P.** Florida Fish and Wildlife- Analysis of Queen Conch (*Strombus gigas*) Neuropeptide Expression, \$10,000. (no timeline).
28. **McClellan-Green, P.** NSF, Biological Oceanography - A multidisciplinary approach to quantify multiple stressors resulting in reproductive failure of queen conch (*Strombus gigas*), a keystone species in coral-reef ecosystems.” \$319,201, July 1, 2008-June 30, 2011. (Pending).
29. **Eggleston, D. B.**, C. Cudaback & L. Xie. NC Sea Grant. “Oyster dispersal and meta-population dynamics in Pamlico Sound: Part I, larval dispersal”. \$98,364/2 years.
30. **Eggleston, D. B.** NC Sea Grant. “Oyster dispersal and meta-population dynamics in Pamlico Sound: Part II, settlement, survival and spawning potential”. \$141,749/2 years.

31. **Eggleston, D. B.** NC Sea Grant, FRG Program. “Oyster dispersal and meta-population dynamics in Pamlico Sound: Part II, settlement, survival and spawning potential”. \$50,568/1 yr.
32. **Eggleston, D. B.** & E. Balance. NC Sea Grant, FRG Program. “Oyster settlement and reef mapping in Pamlico Sound”, \$40k/2 yrs
33. **Eggleston, D. B.**, NOAA, University of Maryland, BCARC. Blue crab (*Callinectes sapidus*), an integrated research program of basic biology, hatchery technologies, and potential for replenishing stocks. \$125k/2 yrs.
34. **Eggleston, D. B.** NOAA, University of Maryland, BCARC. Blue crab (*Callinectes sapidus*), an integrated research program of basic biology, hatchery technologies, and potential for replenishing stocks. \$95,625/1 yr.
35. **Eggleston, D. B.** and H. Daniels. NC Sea Grant/Blue Crab Research Grant Program. “Blue crab stock enhancement: further progress in freshwater pond rearing”. \$19,000/1 yr.,
36. **Eggleston, D. B.** & W. Phillips. NC Sea Grant/Blue Crab Research Grant Program. “Blue crab dependence on SAV nurseries in Albemarle Sound”. \$72,208/2 yrs.
37. **Eggleston, D. B.** UNC General Administration, “Initiation of an Inter-Institutional Environmental Observation Network System for North Carolina (NC EONS)”, \$36,000/1 yr. PI.
38. **Eggleston, D. B.** NC Sea Grant/Blue Crab Research Grant Program. “Timing and route of movement in mature female blue crabs in the White Oak River, NC”, \$69,992/1 yr.,
39. **Eggleston, D. B.** NOAA/National Sea Grant. “NMFS-Sea Grant Fellowship in Population Dynamics”. \$113,976/3 yrs.
40. **Eggleston, D. B.** & J. K. Craig. Environmental Defense Fund. “Abiotic drivers of fishery-dependent and –independent catch efficiency in the North Gulf of Mexico”, \$64,551/2 yrs.
41. **Eggleston, D. B.**, D. Bohnenstiel & T. Kellison. NSF, Biological Oceanography. “Reef noise, marine reserves and recruitment in coral reef fishes: Part 1 patterns”. \$662,291/3 yrs., PI w/ D. Bohnenstiel (pending).
42. **Eggleston, D. B.**, G. T. Kellison & C. Cox. NURP/NURC-Wilmington. “Scuba diver behavior and the management of diving impacts on coral reefs. \$106,333/2 yrs. PI, (pending).
43. **Green, D. P.** Cornell University “*An internet training program on sanitation, good manufacturing and hygienic practices for food processors, wholesalers and warehouses*” (\$8,970 sub-award of \$444,655 prime, USDA-CSREES Integrated Research, Education and Extension Grants Program, 9/1/05-8/31/2008).
44. **Green, D. P.** Fresher Than Fresh Inc. “*On-going verification of a U.S. Food and Drug Administration (FDA) approved Hazard Analysis and Critical Control Point (HACCP) plan for modified atmosphere packaging (MAP) of fresh fish*” (\$15,132, 3/1/2004-2/28/2008).
45. **Green, D. P.** NCSU Internationalization Seed Grant “*American-Danish collaboration for the advancement of trans-Atlantic fisheries research and academic exchanges in the North Atlantic region*” (\$4,000, 9/12/06-6/30/2007)
46. **Green, D. P.** NC Sea Grant Program “*Development of Marine Industries and Processing Systems: Seafood Science and Technology Program*” (\$78,078, 2/1/2006-5/31/2007).
47. **Green, D. P.** NC Sea Grant Program “*Assisting coastal processors add value to North Carolina seafood*”. (\$8,117, 2/1/06-5/30/07).

48. **Green, D. P.** NC Sea Grant Program “*Enhancing quality of wild-caught shrimp in batch-process handling*” (\$6,748, 5/1/2006-6/30/2007).
49. **Green, D. P.** NC Sea Grant Program “*Producing farmed hybrid striped bass for year round markets*” (\$19,643, 5/1/2006-10/31/2007).
50. **Green, D. P.** PENDING - National Fisheries Education & Research Foundation “*A rapid method to quantify toxigenic histamine-producing bacteria in fish*” (\$19,520, 1/1/2008-12/31/2008).
51. **Green, D. P.** PENDING - NC Sea Grant Program “*Development of Marine Industries and Processing Systems: Seafood Science and Technology Program*” (\$80,000, 2/1/2008-1/31/2009).
52. **Green, D. P.** PENDING – Univ. of Florida “*Advancing Alliance for Education and Training to Assure Safety of Seafood Commerce in USA*” (\$40,000 sub-award of \$599,928 prime, USDA Integrated Research, Education and Extension Cooperative Grants, National Food Safety Initiative, 9/01/2008-8/31/2011).
53. **Green, D. P.** PENDING – NC Biotechnology Center “*Development of molecular diagnostic tools for prevention of human disease caused by scombrototoxic fish poisoning*” (\$75,000, 7/1/2008-6/30/2009).
54. **Stoskopf, M. K.** Non-lethal Molecular Diagnostics Sampling of Captive Red wolves. US Geological Survey \$11,786
55. Harms, C. A., Lewbart, G. A., **Stoskopf, M. K.** Improving Live Marine Mammal Stranding Response in North Carolina through Rapid Diagnostic Capability and Short-term Holding Capacity. National Marine Fisheries Service. \$56,930
56. **Stoskopf, M. K.** Evaluation of the Red Wolf Adaptive Management Plan Project. U.S. Geological Survey. \$33,018
57. **Stoskopf, M.** The geographic relationship of mortality events of carp species in North America and its association with cofactors of water quality, temporal factors and viral and bacterial diseases. U.S. Dept. of Interior \$84,906
58. **Stoskopf, M.**, Macdonald, J. 4.7 T MRI Magnet Upfit. NC Biotechnology Center \$160,000
59. **Stoskopf, M.**, Harms, H., Lewbart, G., Kennedy-Stoskopf, S. Aquarium Health Management DENR ~\$ 88,000
60. **Stoskopf, M.** Red Wolf Adaptive Management USDI, Geo Sur. ~\$20,000
61. **Stoskopf, M.**, Acton A. Noninvasive wildlife health Morris, ~\$49,000
62. **Stoskopf, M.**, Acton, A. Noninvasive wildlife health EPA ~\$ 49,000

6. Extension

In addition to presentations by faculty, staff and students within the US and on the international stage, CMAST has numerous recent and exciting extension programs, including:

Marine Science and Education Partnership (MSEP)

- CMAST is a key member of MSEP, which is a coalition of directors of marine science institutions and agencies, and other leaders in Carteret County, whose goal is to use science, technology and education to enhance the climate for marine-related businesses and industry in rural areas of NC. MSEP contributed \$127 million and 3,162 jobs to Carteret County in 2004.

Seafood Technology

- A pamphlet *North Carolina Seafood and You: A Good Match for Your Health* was written for use by the Carteret Catch™ marketing program during the 20th Annual North Carolina Seafood Festival.
- NCSU Seafood Currents, Vol. 1. Launched quarterly online newsletter and contributed two articles.
- Tradewinds. Contributed two articles in Vol. 12, No. 3 for the North Carolina Fisheries Association.
- Wrightsville Beach magazine. Feature article in August 2007 issue on marine biotechnology as part of an invited roundtable discussion at the North Carolina Aquarium – Fort Fisher.

Workshops organized and presentations given

- North Carolina Aquaculture Development Conference. Provided CMAST tour and gave presentation to 30 participants on value-added product development for aquaculture species.
- National Fisheries Institute “2007 *Seafood in Perspective Technical Conference*.” Served on organizing committee, chaired session and gave presentation with 120 individuals participating.
- CMAST seminar series. Gave presentation *Practical Guide to Seafood Traceability* to group of 20.
- Seafood HACCP Alliance HACCP Workshop, 2007. Participated in workshop with 25 individuals receiving HACCP certification from the Association of Food and Drug Officials (AFDO).
- NC CES Carteret County-ServSafe Workshop, 2007. Participated in workshop; a presentation was given on “*Managing Seafood Safety in Food Service and Retail Establishments*” for 20 participants.
- UNC Seafood Quality and Safety for Environmental Health Specialists. 2007. Gave presentation on “*Seafood-borne parasites as potential pathogens of humans*” for 40 participants during workshop.

Fisheries and Aquaculture Research

- Demand for fisheries products is increasing rapidly while supplies decline. Fisheries and aquaculture research has identified (i) information leading to sustainable fisheries and habitat management in NC, (ii) novel techniques for aquaculture of fish and blue crabs, and the technology transfer of these techniques for commercialization and job growth, and (iii) technical support and education for commercial and recreational fishers in NC.

Environmental and molecular toxicology

- Escalating coastal development brings the need for novel and rapid means of detecting degraded habitat and water quality, and the technology to reduce negative impacts. Environmental and molecular toxicology has identified novel techniques for rapidly assessing water quality and the health of marine organisms, as well as the source of bacterial contaminants. For example, rapid bacterial source tracking is critical in helping to maintain swimming beaches that support coastal tourism economies.

Veterinary Medicine

- CMAST provides the only veterinary college in the U.S. with a coastal presence and, in addition to training students, provides innovative surgical repair and medical treatment to injured sea turtles and marine mammals in support of the mission of NOAA, the NC Aquarium System and the Sea Turtle hospital on Topsail Island. In addition, veterinary medicine provides novel techniques that support the detection and treatment of disease in NC's aquaculture industry.
 - Innovations in clinical service (new techniques, methods, clinical trial protocols):
 - Unit attending veterinarian for CMAST and PAFL.
 - Primary clinical contact for 3 NC Aquariums with monthly site visits and continuing, facilitated Aquariums' successful 5-year re-accreditation with the American Zoos and Aquariums Association (AZA).
 - Primary clinical contact for Karen Beasley Sea Turtle Rescue and Rehabilitation Center with monthly site visits.
 - On call to NMFS for marine mammal strandings conducted about 34 marine mammal necropsies, including some beach responses with euthanasia.
 - Sloth annual physicals for Museum of Natural Sciences.
 - Clinical support for NMFS sea turtle health assessments and NMFS lionfish research facility.
 - Representation on the NMFS Marine Mammal Unusual Mortality Event (MMUME) Working Group (Kennedy-Stoskopf).

Distance Education and high-speed internet communications

- CMAST provides high speed internet service (1 gigabyte/sec.) that supports teleconference and distance education activities in the Carteret County area from the community college to our research university partners.

K-12 Education

- Research on the blue crab and oysters has provided hands-on research experiences and teacher support for fifth-grade to high school students throughout eastern NC. These hands-on research opportunities have benefited students from economically depressed areas with little opportunity for hands-on research and jobs in science.
- Graduate students working with blue crabs (Erika Millstein) and endangered NC freshwater mussels (Jennifer Hurley) shared their work with students visiting the NC Museum of Natural Sciences, Fall and Spring semesters 2007-2008.

7. Initiatives and public service activities

CMAST Research & Extension Activities help eastern NC by:

- Supporting tourism by keeping the animals at the NC Aquariums healthy and responding to the health needs of sea turtles and marine mammals on our coast.
- Supporting eastern North Carolina businesses by conducting and supporting conferences and meetings that draw people to the coast.

- Providing high speed internet backbone that supports education in the Carteret County area from the community college to our research university partners.
- Supporting NC by reaching out to the nation and the world through collaborative efforts to solve problems that occur not only in our backyard but on every corner of this planet.
- Employing eastern North Carolina citizens in both permanent and temporary positions; the training provided to temporary employees has allowed them to secure permanent jobs in related fields (e.g., NC Division of Marine Fisheries).
- Providing recreational and commercial fishers in eastern NC with assistance on Fishery Resource Grant projects and outreach products that extend research results.

8. Students

Kristín Björnsdóttir (Ph.D. student, NCSU, D. Green advisor).
 Erika Millstein (MS student, NCSU, D. Eggleston Advisor)
 Ray Mroch (MS student, NCSU, D. Eggleston advisor)
 Michelle Moorman (MS student, NCSU, D. Eggleston advisor)
 Christina Durham (MS student, NCSU, D. Eggleston advisor)
 Geoff Bell (Ph.D. student, NCSU, D. Eggleston advisor)
 Brandon Puckett (Ph.D. student, NCSU, D. Eggleston advisor)
 Mary Radlinksi (Ph.D. student, NCSU, D. Eggleston advisor)
 T. Michelle Blickley (Ph.D student, Duke University, P. McClellan-Green advisor)
 Kyle Adamski (MS student, NCSU, J. Buckel advisor)
 James Morley (Ph.D. student, NCSU, J. Buckel advisor)
 Nathan Bachelier (Ph.D. student, NCSU, J. Buckel advisor)
 Chris Butler (MS student, NCSU, J. Buckel advisor)
 Harvey Walsh, (MS student, J. Buckel Co-advisor)
 Heather Henson-Ramsey (PhD, NCSU –2002-2007, Major advisor, Dr. Michael Stoskopf)

9. Fund-Raising: Private fund-raising successes

- Two fund-raising campaigns were targeted: (1) license plate program for “Sustainable Fisheries” and (2) donor for CMAST student/faculty housing.
 - Obtained over 600 signatures in support of our license plate campaign were obtained during the Raleigh Salt Water Fishing & Boat Shows during January-February 2007. Local delegates were ready to sponsor bills introducing these plates to state legislature. License Plate Program stalled by UNC-GA. because of concerns that others would follow.
 - Two prospective donors were contacted via NCSU College Relations.
 - Both fund-raising opportunities advertised on web-site and in various presentations to local civic groups by Director.

10. Administration: Achievements and staff changes

Key administrative achievements include (1) upgraded web-site, (2) re-designed LAN and phone system, (3) publication of newsletters, (4) increased operating budget, (5) safety plans and

procedures on-line, (6) funding for upgrades and security of Fisheries & Oceans warehouse, (7) hosting Congressional Delegation, (8) new architectural renderings and design of CMAST housing, (9) placement of NCSU logo signage on both the street frontage side and the water frontage side of the CMAST building, (10) improvement of CMAST HVAC system with the replacement of the mechanical chillers, (11) construction of a new boat shelter providing protection of state research vessels from the environment, and (12) construction of new canoe/kayak racks.

11. Recommendations and concerns for the future

- Three major concerns and recommendations for CMAST remain:
 - Funding of student /faculty housing to provide visiting faculty, staff and students economical, safe and convenient accommodations which, in turn, will increase use of the facility, interaction with main-campus, and promote educational activities.
 - Increase resident faculty, which will increase the critical mass necessary to promote multi-disciplinary research programs, economic growth via biotechnology, and provide courses for undergraduate and graduate students.
 - Provide state-appropriated operating budget.

12. Providing world leaders

All faculty at CMAST interact with and are recognized for their excellent scholarly activities by colleagues throughout the world.

13. Impacting energy and the environment

- The principal mission of the Center for Marine Sciences and Technology (CMAST) is to discover innovative solutions to questions and problems in marine systems and provide effective communication of these discoveries. An emerging mission is to become a model for the latest technology in sustainable coastal building and alternative energy.
- Examples of CMAST support for sustaining the environment may be found in the research, education and extension/outreach examples found throughout this report.
- An example of our commitment to energy may be found in the revised design of the CMAST student/faculty house, which has been approved by NCSU as a LEED building, and through the planned use of wind turbines from PacWind Inc. to generate electrical power and as a demonstration facility.

14. Improving health and well-being

- CMAST researchers are improving (1) seafood safety, (2) water quality, (3) aquatic animal health, as well as providing research in support of (4) sustainable coastal ecosystems and fisheries through the research described throughout this report.
- Seafood safety and quality workshops provide North Carolina businesses, regulatory personnel and citizens with science-based technical information and training. Our programs were expanded to include new rules and record-keeping requirements under the Bioterrorism and Preparedness Act of 2002. Education programs continue to be offered

in HACCP compliance, traceability and authenticity, quality control and value-added product development. Impacts of these programs are greater compliance with current state and federal health regulations, dollars saved due to improved processes, market growth and job creation. Participants are able to make more informed decisions based on up-to-date information provided. The NCSU Seafood Lab has provided training for over 700 individuals in HACCP since 1997 who receive non-degree certificates from the Association of Food and Drug Officials (AFDO). The demand for seafood safety and quality education and training programs remains strong; with growing interest in areas of value-added product development and traceability.

- Provide cutting edge clinical expertise that raises the national standards for veterinary care. Develop and improve telemedicine and record systems to support our clinical management of the NC Aquariums. Improve the standard of care in the practicing community of North Carolina, the USA, and the World by providing professional development opportunities for veterinarians. Provide a leadership role in Department, CVM, VTH, NCSU, and national and international organizations. Contribute time and talents to the wider community.
- Provide data necessary to produce and implement fishery management plans for state- and federally-managed species (e.g., blue crab and red drum).

15. Creating educational innovation

CMAST faculty, staff and students are creating educational innovation through hands-on, inquiry-based education, (2) web-based teaching tools, and (3) providing hands-on experience for young people.