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A Brief History of Time at the National Marine Fisheries Service Panama City Laboratory (Apologies to Stephen Hawking)

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''The progress of the human race in understanding the universe has established a small corner of order in an increasingly disordered universe.'' Stephen W. Hawking, *A Brief History of Time*

We are sure that, over our brief history, research conducted by scientists and staff of this laboratory has produced a modicum of order in the human perception and use of local marine resources in our corner of the Gulf of Mexico. We are equally sure that such advances have initiated new disorder that we (or someone) will have to deal with in the future.

Laboratory Mission and Current Research Priorities

The Panama City Laboratory, located in Bay County, FL, is operated by the U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS), Southeast Fisheries Science Center. The NMFS mission is stewardship of the nation's living marine resources for the benefit of the nation. The Panama City Laboratory performs research relevant to the implementation of rational plans to manage marine fishery resources in waters from North Carolina through Texas, Puerto Rico, and the U.S. Virgin Islands. The current program encompasses a spectrum of research projects including basic fishery biology, ecology, routine monitoring and data collection, stock assessment, conservation, and habitat mapping. Our future is being shaped by ''ecosystem approaches to fishery management,'' a concept that is being refined within NMFS (Murawski, 2007).

In 2003, staff members were asked to create their own personal mission statement, resulting in this directive: *''To conduct innovative research for sustainable fisheries, and to collect and analyze data for the management of fishes and their habitats.''* Toward those ends, we provide research critical for the management of reef fishes (snappers, groupers, and tilefishes), coastal pelagic fishes (king and Spanish mackerels), sharks (coastal and pelagic species), and their inshore and offshore habitats (e.g., seagrasses, rocky reefs, and corals). The fisheries and habitats that we address are of major consequence and value to the southeastern U.S. economy. For example, the Laboratory is located in the heart of regional charter boat and recreational fishing activity, and the inshore and offshore seagrass beds and reef habitats required by many commercial and recreational fish species are found nearby. We provide observer coverage and derived data for management for the shark fisheries in U.S. Atlantic and Gulf of Mexico waters. We also conduct monitoring of fish populations and their habitats within enacted and proposed Marine Protected Areas (MPAs) from North Carolina to northwest Florida. We conduct research on use of critical habitat by Gulf sturgeon (*Acipenser oxyrhinchus desotoi*), designated a threatened species under the Endangered Species Act whose centers of abundance lie in Florida bays just east and west of Panama City, and by smalltooth sawfish (*Pristis pectinata*), an endangered species found mainly off southwest Florida. We assist the area coordinator for the Marine Mammal Health and Stranding Research network, as well as the local Sea Turtle Stranding and Salvage Network team.

A Brief History of the Laboratory

The Panama City Laboratory was originally established in 1966 as the Eastern Gulf Marine Laboratory of the U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife. It was housed in rental buildings near the St. Andrew's Marina in downtown Panama City. In 1970 the laboratory was assimilated into the U.S. Department of Commerce's newly formed NOAA, NMFS. Permanent laboratory facilities were constructed during 1970–72 on land across St. Andrew Bay from the marina in what is still unincorporated Bay County (Fig. 1). Laboratory directors have been Norman Vick (1966–70), Eugene Nakamura (1970–93), Dr. Churchill Grimes (1993–98), Dr. Herman Kumpf (1998–2002), William Fable, Jr. (2002), Dr. Pete Sheridan (2002–08), Dr. Theophilus Brainerd (2008), Dr. Tyrrell Henwood (2009), and Guy Davenport (2009–present). Former research programs included studies of benthic invertebrates, billfishes, artificial reefs, Gulf hydrography, coastal habitat

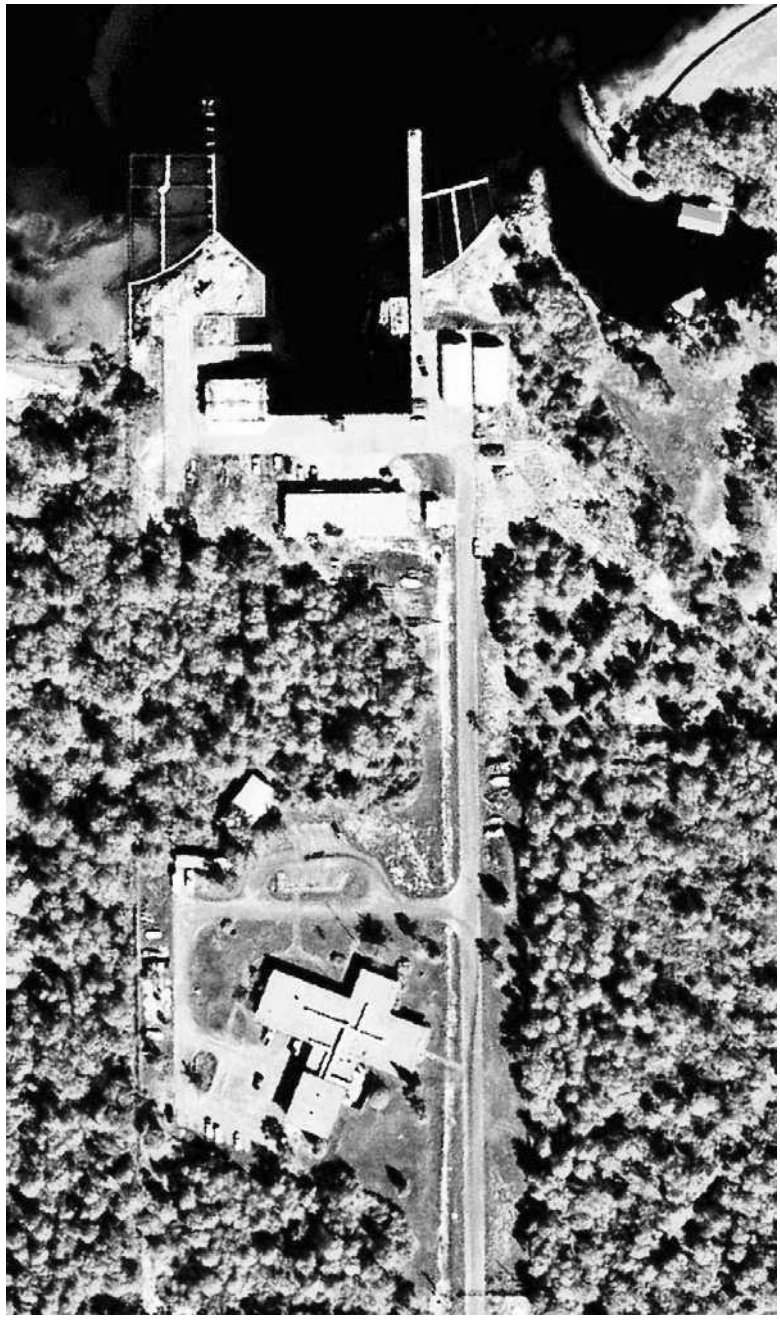

Fig. 1. Aerial view of the NMFS Panama City Laboratory in 2005 on St. Andrew Bay, FL to the Northeast.

alterations, fishing gear selectivity, sea turtle conservation, and invasive species. Staffing (Fig. 2) has been approximately 20 full-time federal employees and up to 20 contractors, part time staff, and student cooperators annually since 1972. We host one or two NOAA Corps officers, National Research Council postdoctoral associates, interns, and volunteers. We also host staff from the NMFS Southeast Fisheries Science Center in Miami and from the NMFS Southeast Regional Office in St. Petersburg. We work with a wide variety of agencies and organizations, be they federal, state, local, university, nongovernmental, or even international. Much of our work is at the request and for the support of the Gulf of Mexico, South Atlantic, and Caribbean fishery manage-

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Fig. 2. NMFS Panama City Laboratory staff, co-workers, and friends celebrate NOAA's 200th Anniversary in June 2007.

ment councils and the NMFS Highly Migratory Species Group, as directed by the Magnuson-Stevens Fishery Conservation and Management Act (as revised in 2007). We interact closely with the U.S. Fish and Wildlife Service, the Gulf States Marine Fisheries Commission, and the state fishery agencies themselves, particularly the Florida Fish and Wildlife Research Institute.

The Facility

This is the *only* NMFS research facility on the Florida Gulf coast and is thus uniquely positioned to address living marine resources and their environments in the eastern Gulf of Mexico. The facility itself is located on a bay system with clear, clean water close to the bay's inlet from the Gulf of Mexico. The facility boat basin contains two permanent docks, a boathouse, a ramp, and a protective seawall. Sections of the dock have been modified to support turtle pens for holding sea turtles for conditioning and shrimp turtle-excluder device testing. These annual tests are conducted in the clear water–sandy bottom areas off Panama City in coordination with our sister facilities in Pascagoula, MS, and Galveston, TX. The facility is located minutes from the northeastern Gulf of Mexico, providing easy access for our 36-foot research vessel *Harold B* (Fig. 3) and numerous smaller boats. We have a large main building holding offices and laboratory space at relatively high elevation (15 feet above sea level), along with two hazmat buildings for storage of preserved samples. Our library maintains subscriptions to a wide variety of journals and fishery articles for immediate access and in support of the research scientists at the laboratory. The facility also hosts an unmanned National Weather Service ''Notice to Mariners'' radio tower.

Significant Contributions to Science in the Gulf of Mexico and Beyond

Over time, the Laboratory has been noted for its contributions to a variety of fisheries and fishery-related topics (Fig. 4; publications are available from http://www.sefc.noaa.gov/labs/panamacity.htm). In the 1970s and 1980s, investigations into billfish life history and fisheries were begun, and the impacts of coastal land development and submerged habitat alterations to water quality, benthos, and fishery and forage organisms were described. The 1980s saw ex-

Fig. 3. NMFS Panama City Laboratory 36 fit R/V HAROLD B in action.

panded knowledge of sea turtles and their interactions with fishing gear as well as the beginning of an enormous compendium of research into life history of coastal pelagic fishes (such as mackerels) and reef fishes (such as snappers and groupers) that continues today. In fact, aging determinations made by the facility are crucial to the variety of fish stock assessments that are required of NMFS and are conducted for regional fishery management councils and commissions. The 1990s ushered in the beginnings of our shark population assessment group, which has made critical progress in the new millennium toward understanding and managing sharks and their fisheries. We recently began assessing fish population densities in MPAs in both Gulf of Mexico (gag grouper spawning aggregations) and southeastern U.S. waters (deepwater grouper and tilefish habitat), as these reserves become important components of our habitat conservation and fisheries management toolboxes.

The following publication sections also highlight our continued development and use of advanced laboratory and field sampling technologies that keep NMFS in the forefront of fisheries research. As examples, we currently employ satellite tags, acoustic tags with mobile or stationary receiver arrays, remotely operated vehicles, high-definition underwater video cameras, multibeam acoustic mapping systems, computer hardware and software, and precision microscopes with video systems to collect data and information.

Most Recent Publication by Each Current Staff Member (in bold)

Allman, R. J., and **L. A. Goetz**. 2009. Regional variation in the population structure of gray snapper, *Lutjanus* griseus, along the west Florida shelf. Bull. Mar. Sci. 84:315–330.

Baremore, I. E., **K. I. Andrews**, and **L. F. Hale**. 2009. Difficulties associated with modeling growth in the Atlantic angel shark (*Squatina dumeril*). Fish. Res. 99:203–209.

Baremore, I. E., D. M. Murie, and **J. K. Carlson**. 2010. Seasonal and size-related differences in diet of the Atlantic angel shark *Squatina dumeril* in the northeastern Gulf of Mexico. Aquat. Biol. 8:125–136.

Barnett, B. K. 2008. Distinguishing red snapper, *Lutjanus campechanus*, nursery regions in the

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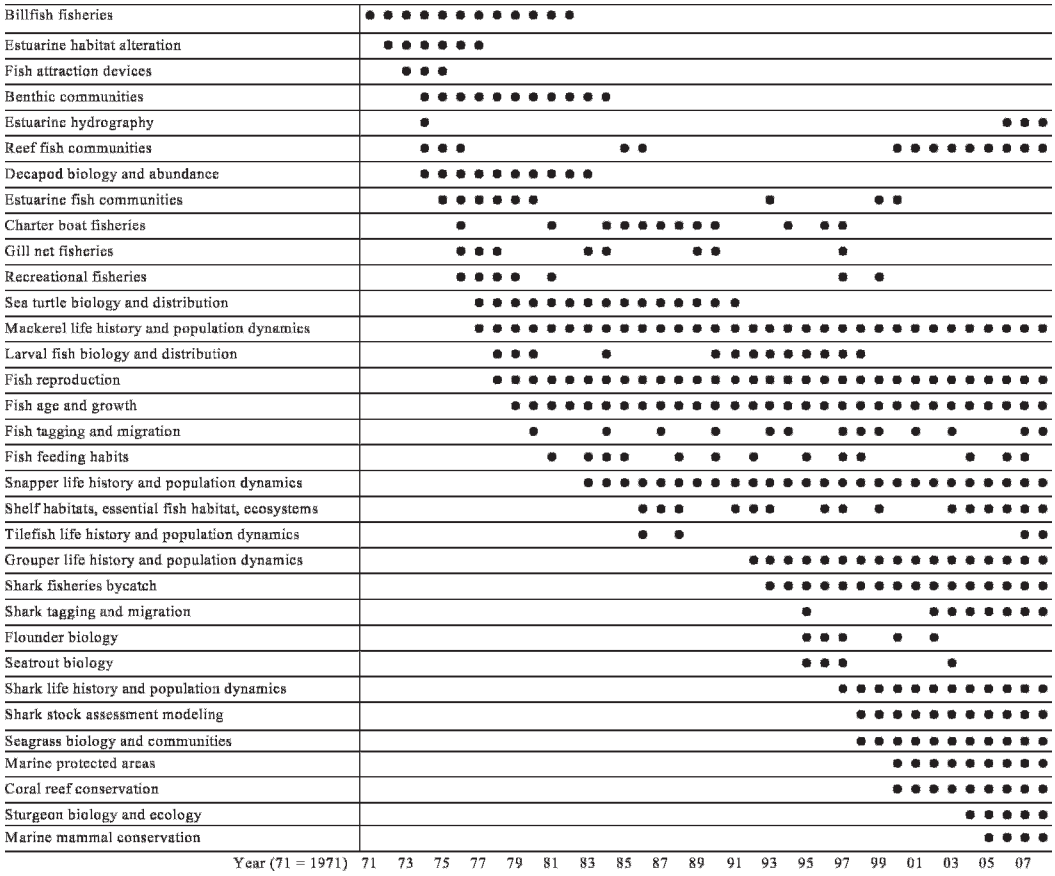

Fig. 4. NMFS Panama City Laboratory research topics over time (1971–2008).

northern Gulf of Mexico with otolith elemental and stable isotope signatures. Unpubl. M.S. thesis, University of West Florida, Pensacola, FL.

Brooks, E. N., J. E. Powers, and **E. Cortés**. 2010. Analytic reference points for age-structured models: application to data-poor fisheries. ICES J. Mar. Sci. 67:165–175.

Brusher, J. H., and J. Schull. 2009. Non-lethal age determination for juvenile goliath grouper (*Epinephalus itajara*) from southwest Florida. Endangered Species Res. 7: 205–212.

Carlson, J. K., M. R. Heupel, **D. M. Bethea**, and L. D. Hollensead. 2008. Coastal habitat use and residency of juvenile Atlantic sharpnose sharks (*Rhizoprionodon terraenovae*). Estuar. Coasts 31:931–940.

Cook, M. C., G. R. Fitzhugh, and J. S. Franks. 2009. Validation of yellowedge grouper, *Epinephelus flavolimbatus*, age using nuclear bomb–produced radiocarbon. Environ. Biol. Fish. 86:461–472.

DeVries, D. A. 2007. No evidence of behavior-related size or sex selectivity in hook-and-line sampling of the protogynous *Pagrus pagrus* (Sparidae). Fish. Bull. 105:582–587.

Harter, S. L., M. M. Ribera, A. N. Shepard, and J. K. Reed. 2009. Assessment of fish populations and habitat on Oculina Bank, a deep-sea coral marine protected area off eastern Florida. Fish. Bull. 107:195–206.

Lombardi-Carlson, L., G. Fitzhugh, C. Palmer, **C. Gardner**, **R. Farsky**, and M. Ortiz. 2008. Regional size, age, and growth differences in red grouper (*Epinephelus morio*) along the west coast of Florida. Fish. Res. 91:239–251.

Natanson, L. J., S. P. Wintner, F. Johansson, A. Piercy, P. Campbell, A. De Maddalena, **S. J. B. Gulak**, B. Human, F. Cigala Fulgosi, D. A. Ebert, F. Hemida, F. H. Mollen, S. Vanni, G. H. Burgess, L. J. V. Compagno, and A. Wedderburn-Maxwell. 2008. Ontogenetic vertebral growth patterns in

the basking shark *Cetorhinus maximus*. Mar. Ecol. Prog. Ser. 361:267–278.

Porch, C. E., **G. R. Fitzhugh**, M. W. Jackson, **M. S. Duncan,** and L. A. Collins. 2007. Age- and size-based estimates of batch fecundity for red snapper (*Lutjanus campechanus*) in U.S. Gulf of Mexico waters. Amer. Fish. Soc. Symp. 60:229–243.

Satterwhite, M. C. 2007. RNA:DNA as an indicator of nutritional condition and growth in larval naked goby, *Gobiosoma bosc*. Unpubl. M.S. thesis, Louisiana State University, Baton Rouge, LA.

Whitfield, P. E., J. A. Hare, **A. W. David, S. L. Harter,** R. C. Muñoz, and C. M. Addison. 2007. Abundance estimates of the Indo-Pacific lionfish *Pterois volitans/miles* complex in the western North Atlantic. Biol. Invasions 9:53–64.

25 Critical ''Blasts from the Past'' (including why they were, and are, valuable to NMFS)

Lindall, W. N., Jr., and L. Trent. 1975. Housing development canals in the coastal zone of the Gulf of Mexico: ecological consequences, regulations, and recommendations. Mar. Fish. Rev. 37(10):19–24. (One of the first reports to predict the effects of rampant coastal development and habitat loss on estuarine productivity—still a NMFS concern)

May, N., L. Trent, and P. J. Pristas. 1976. Relation of fish catches in gill nets to frontal periods. Fish. Bull. 74:449–453. (An early validation that drivers external to the water column affect fish catches)

Trent, L., E. J. Pullen, and R. Proctor. 1976. Abundance of macrocrustaceans in a natural marsh and a marsh altered by dredging, bulkheading, and filling. Fish. Bull. 74:195–200. (An early quantification of declines in shrimp and crab densities due to marsh development, leading to long-running and current NMFS efforts to document the comparative values of coastal habitats)

Ogren, L. H., J. W. Watson, Jr., and D. A. Wickham. 1977. Loggerhead sea turtles, *Caretta caretta*, encountering shrimp trawls. Mar. Fish. Rev. 39(11):15–17. (Recorded sea turtle behavior when captured by shrimp trawls and initiated the long-running and current agency effort to develop effective turtle excluder devices)

Naughton, S. P., and C. H. Saloman. 1981. Stomach contents of juveniles of king mackerel (*Scomberomorus cavalla*) and Spanish mackerel (*S. maculatus*). Northeast Gulf Sci. 5(1):71–74. (First in a long series of papers to examine fish food habits, incidentally supplying data that can be used for retrospective and predictive efforts to examine ecosystem effects of fishing and climate change)

Renfro, W. C., and H. A. Brusher. 1982. Seasonal abundance, size distribution, and spawning of three shrimps (*Penaeus aztecus, P. setiferus, P. duorarum*) in the northwestern Gulf of Mexico, 1961–1962. U.S. Department of Commerce, NOAA Technical Memo. NMFS-SEFC-94. Galveston, TX. (Texas–Louisiana shelf-wide survey of commercial shrimp that provided data necessary for implementation of the Shrimp Fishery Management Plan [FMP] for the Gulf of Mexico Fishery Management Council in 1981)

Johnson, A. G., W. A. Fable, Jr., M. L. Williams, and L. E. Barger. 1983. Age, growth, and mortality of king mackerel, *Scomberomorus cavalla*, from the southeastern United States. Fish. Bull. 81:97–106. (One of the first in a long series of reports examining the life histories of coastal pelagic fishes, providing data for the Coastal Migratory Pelagics FMP of 1982, and demonstrating advanced ageing technologies)

Finucane, J. H., and L. A. Collins. 1984. Reproductive biology of cero, *Scomberomorus regalis*, from the coastal waters of south Florida. Northeast Gulf Sci. 7:101–107. (First in a long series of articles documenting reproduction in coastal pelagic and reef fishes that provide data required for accurate stock assessments)

Grimes, C. B., K. W. Able, and R. S. Jones. 1986. Tilefish, *Lopholatilus chamaeleonticeps*, habitat, behavior and community structure in Mid-Atlantic and southern New England waters. Environ. Biol. Fish. 15:273–292. (One of the earliest uses of submersibles in the Southeast to document deep-water reef fish ecology and habitat)

Able, K. W., D. C. Twichell, C. B. Grimes, and R. S. Jones. 1987. Sidescan sonar as a tool for detection of demersal fish habitats. Fish. Bull. 85:725–736. (An early demonstration of advanced habitat survey technology for fishery management that continues to be used today)

Grimes, C. B., C. F. Idelberger, K. W. Able, and S. C. Turner. 1988. The reproductive biology of tilefish, *Lopholatilus chamaeleonticeps* Goode and Bean, from the United States Mid-Atlantic Bight, and the effects of fishing on the breeding system. Fish. Bull. 86:745–762. (An early demonstration that a temporally and spatially intense fishery can lead to rapid [<10 yr] detrimental alterations in fish reproduction and mating systems)

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Fable, W. A., Jr. 1990. Summary of king mackerel tagging in the southeastern USA: mark–recapture techniques and factors influencing tag returns. Amer. Fish. Soc. Symp. 7:161–167. (A summary of tagging experiments and results from North Carolina around the Gulf to Yucatán that affected the implementation of the Coastal Migratory Pelagics FMP)

Grimes, C. B., and J. H. Finucane. 1991. Spatial distribution and abundance of larval and juvenile fish, chlorophyll and macrozooplankton around the Mississippi River discharge plume, and the role of the plume in fish recruitment. Mar. Ecol. Prog. Ser. 75:109–119. (Early consideration of the water column as a distinct habitat not linked to a substrate, and documentation of the importance of river discharge to fishery production in offshore waters)

Shaffer, R. N. 1993. A bibliography of research on St. Andrew Bay, its tributaries, and the nearby coastal waters of Bay County, Florida. U.S. Department of Commerce, NOAA Technical Memo. NMFS-SEFSC-320. Panama City, FL. (Even our librarians get into the act—an annotated bibliography that continues to accumulate and distribute valuable information today)

Johnson, A. G., W. A. Fable, Jr., C. B. Grimes, L. Trent, and J. V. Perez. 1994. Evidence for distinct stocks of king mackerel, *Scomberomorus cavalla*, in the Gulf of Mexico. Fish. Bull. 92:91–101. (First use of genetic [electrophoretic] information to separate fish stocks for use in Gulf FMPs)

Coleman, F. C., C. C. Koenig, and L. A. Collins. 1996. Reproductive styles of shallow-water groupers (Pisces: Serranidae) in the eastern Gulf of Mexico and the consequences of fishing spawning aggregations. Environ. Biol. Fish. 47:129–141. (Early investigation of the impacts of fishing on spawning aggregations and a call for use of marine protected areas [MPAs] to provide stock protection)

Johnson, A. G. 1996. Use of otolith morphology for separation of king mackerel (*Scomberomorus cavalla*) and Spanish mackerel (*Scomberomorus maculatus*). Gulf Mex. Sci. 14:1–6. (Development of advanced technology [computer-assisted scanning and digitization of fish otoliths] that continues as an important component of our stock assessment toolbox)

Carlson, J. K., and G. R. Parsons. 1997. Age and growth of the bonnethead shark, *Sphyrna tiburo*, from northwest Florida, with comments on clinal variation. Environ. Biol. Fish. 50:331–341. (First of a continuing series of projects that develop life history information for sharks in order to improve stock assessments and the Consolidated Atlantic Highly Migratory Species FMP)

Trent, L., D. E. Parshley, and J. K. Carlson. 1997. Catch and bycatch in the shark drift gillnet fishery off Georgia and east Florida. Mar. Fish. Rev. 59(1):19–28. (First foray into monitoring shark fisheries which continues today via fishery-wide observer programs)

Carlson, J. K. 1999. Occurrence of neonate and juvenile sandbar sharks, *Carcharhinus plumbeus*, from the northeastern Gulf of Mexico. Fish. Bull. 97:387–391. (First documentation of shark nursery areas in the northeast Gulf of Mexico, a project that continues today in multiple locations)

Cortés, E. 1999. A stochastic stage-based population model of the sandbar shark in the western North Atlantic. Amer. Fish. Soc. Symp. 23:115–136. (First foray into developing and improving models for population dynamics of sharks, a focal point for current research)

Kumpf, H., K. Steidinger, and K. Sherman. 1999. The Gulf of Mexico large marine ecosystem: assessment, sustainability, and management. Blackwell Science, Malden, MA. (A compendium that provides the basis for the current NMFS emphasis on ecosystem approaches to fishery management)

Koenig, C. C., F. C. Coleman, C. B. Grimes, G. R. Fitzhugh, K. M. Scanlon, C. T. Gledhill, and M. Grace. 2000. Protection of fish spawning habitat for the conservation of warm-temperate reef-fish fisheries of shelf-edge reefs of Florida. Bull. Mar. Sci. 66(3):593–616. (First mapping of critical fisheries habitat using advanced technologies [sidescan sonar plus seismic and echo-location sensors] to delimit active and proposed MPAs)

Allman, R. J. and C. B. Grimes. 2002. Temporal and spatial dynamics of spawning and growth of gray snapper (*Lutjanus griseus*) from the West Florida shelf as determined from otolith microstructures. Fish. Bull. 100:391–403. (Advanced technology used to improve age and growth analyses and to examine factors affecting recruitment)

DeVries, D. A., C. B. Grimes, and M. H. Prager. 2002. Using otolith shape analysis to distinguish eastern Gulf of Mexico and Atlantic Ocean stocks of king mackerel. Fish. Res. 57:51–62. (Proving there is more than one way to use an otolith [via scanning hardware and software] for stock assessment)

Literature Cited

Murawski, S. A. 2007. Ten myths concerning ecosystem approaches to marine resource management. Mar. Policy 31:681–690.

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