

Fish Inventories at Southeast Coast Network Parks

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The aquatic resources found within the 20 parks in the Southeast Coast Network range from intermittent freshwater creeks to the Atlantic Ocean. The parks range in size from approximately 20 to 60,000 acres and in mission including those protecting cultural, historic and natural resources. The parks are found in North and South Carolina, Georgia and Florida, all southeastern states responsible for a large percentage of the fish diversity in the United States. Collectively, these parks would be expected to harbor a high diversity of fishes due to the wide range of habitats represented.

Although monitoring of biodiversity is a critical component of management plans, even basic species inventories for fishes are lacking for many of the parks in the Southeast Coast Network. Inventories are necessary as baseline data, and can be used to prioritize sites for monitoring programs. Several of the parks have been well studied and many records of fishes exist (i.e., Chattahoochee River National Recreation Area, Cape Canaveral National Seashore, Cape Lookout National Seashore) while others have apparently never been sampled for fishes (i.e., Charles Pinckney National Historic Site, Moores Creek National Battlefield, Kennesaw Mountain National Battlefield Park). The availability of data to construct expected lists of fishes also varies widely. The purpose of this study was to sample fishes in 12 parks to supplement existing data or to provide preliminary records of fishes where no records existed. From these data an expected list of fishes for all parks was generated.

Study Sites and Methods

All parks in the network except TIMU, COSW, FOSU, HOBE and CASA (Figure 1), were included for fish sampling, for a total of 12 parks sampled. Historical records of expected fish distribution were produced for FOSU, however.



Figure 1. Parks in the Southeast Coast Network.

The parks were surveyed for fishes from May - October 2003-2005. Effort varied by park size, diversity of habitats and availability of prior samples. Person hours ranged from 4 - 384 and 1-23 sites were sampled in each park (see site appendices and maps for each park). Methods varied according to habitat and included boat and backpack electrofishing, snorkeling, and seining (10 - 100' nets, depending on habitat). On one occasion a small trawl was used at Cape Lookout National Seashore. Most specimens were anesthetized using MS 222, fixed in 10% formalin and transported to Auburn University for identification. Very large specimens were photographed and released. On some occasions species were observed via snorkeling but specimens were not vouchered (see specimen and site photographs for each park). At each sampling location, latitude and longitude were taken with a GPS unit along with common locality data.

Introduced/Exotic status of fish species was determined using Fishbase (fishbase.org) and Dahlberg 1971a. Imperiled status was determined using state TES lists as well as the National Marine Fisheries Service list. Although images of specimens are provided for each park, photographs more suitable for public relations presentations can be found by searching Google Image or FishBase. All names and phylogeny follow Eschmeyer, 1998; Carpenter, 2002; and Nelson et al., 2004.

Results

The number of sites sampled for fishes varied according to park size and habitat heterogeneity, ranging from 1-23 (Table 1). The number of species collected was loosely correlated with the number of sites sampled, but this relationship was not as apparent with park size (Figs. 2 and 3). Park size may not necessarily reflect the presence or diversity of aquatic habitats. For example, Fort Matanzas, a relatively small park, was sampled at 11 sites due to a high diversity of aquatic habitat types, and a high number of species was documented.

Total numbers of in park records were compiled from collections, literature accounts or checklists and museum records. The availability of data varied greatly; some parks had apparently never been sampled or studied, while others had well-documented fish faunas. Regional checklists for marine fishes greatly increased the number of fish species expected for several parks. These lists were compiled from many

Table 1. Summary of fish data by park.

Park	# sites sampled	# sp. collected	# sp. in park	# expected	# TES	# exotic /introduced	% documented
CALO	23	48	310 (173)	210** (310)	0	0	– 56 ^t
CAHA	23	55	56	303	0	0	18
CANA	22	56	141	363	0	0	39
CHAT	8	32	53	89	1	12	62
CUIS	18	53	74	275	0	0	23
CHPI	1	3	3	18***	0	0	–
FOFR	4	21	21	169	0	0	12
FOMA	11*	55	68	67**	0	0	–
FOPU	9	34	38	164	1	0	23
FOSU	0	0	–	150	0	0	–
KEMO	3	11	11	25	0	0	44
MOCR	2	12	12	88	1	0	14
OCMU	3	31	31	84	0	6	37

* three sites sampled twice; 11 total samples

**number of expected less than in park. For FOMA, only 33 species are in common.

***no species in common, data from Ross moved from in park to expected

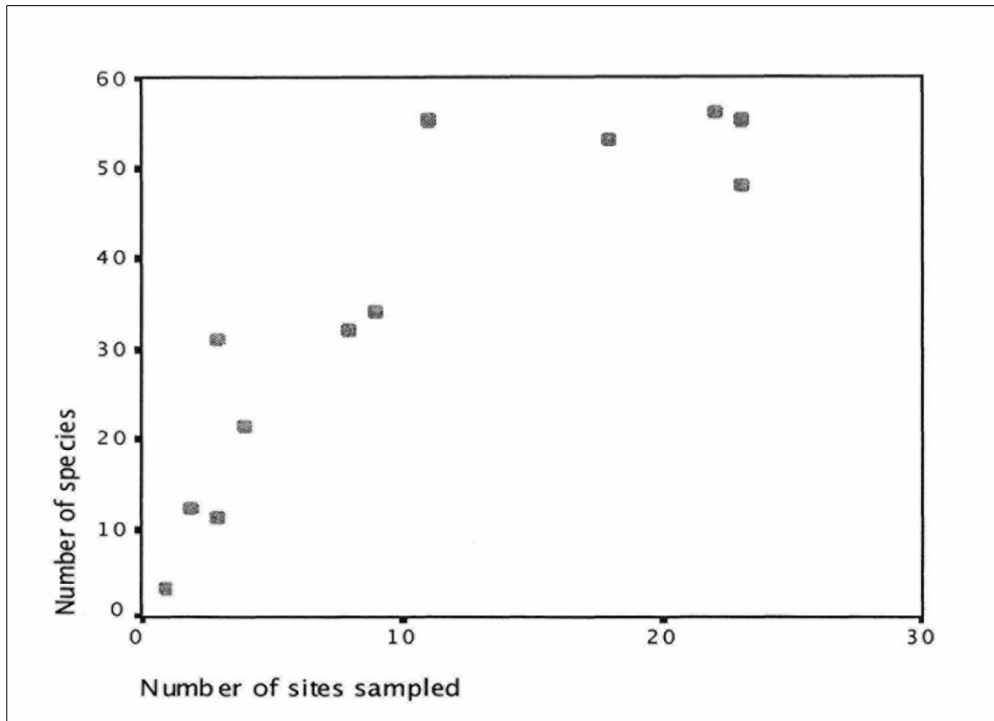


Figure 2. Relationship between number of sites sampled and number of species collected during current survey.

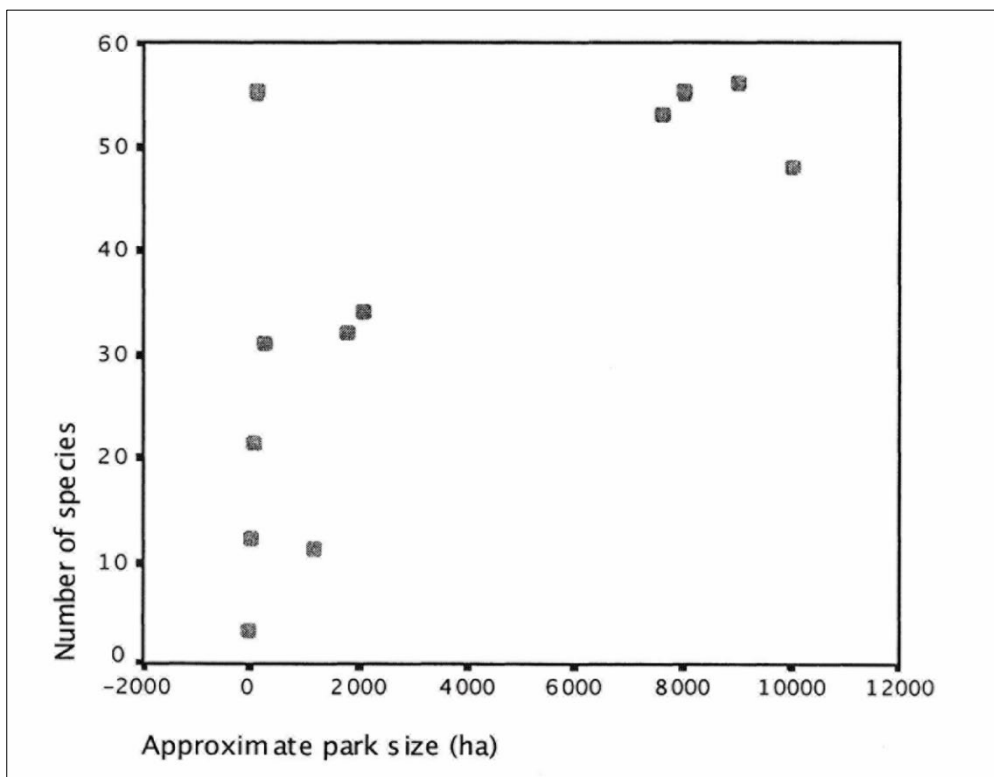


Figure 3. Relationship between park size and number of species collected during current survey.

years of data and numerous collections made with a variety of gears. The availability of museum records for the construction of expected lists also varied by park (see individual databases by park, attached).

No federally protected species are known from the parks studied. However, three parks have records of species of concern at the state or federal level. Two of the freshwater parks had several introduced or exotic species documented from within the park (Table 2). Lists of in park and expected species, data for fish collections, museum records, site maps, references on fishes, site and specimen photographs are on individual CDs for each park (attached).

Table 2. List and locality of in park TES species.

Park	Locality
CHAT	<i>Cyprinella callatenia</i> this record is from Couch et al.; museum record was not found, so exact locality is unknown.
FOPU	<i>Acipenser oxyrinchus oxyrinchus</i> NMFS species of concern, 2004 photo record from NPS Savannah River 32.031833N, -80.89633W
MOCU	<i>Etheostoma collis</i> N.C. state and federal species of concern 34.4598705N, -78.1129698W

Results by Park

Cape Lookout National Seashore (CALO)

This large (>10,000 ha) park includes a variety of marine habitats as well as freshwater ponds and outlets. The park has been extensively sampled previously, and 840 museum records from 6 museums were compiled. We found 997 expected records from 9 museums, and four literature sources of relevant fish distributions. In particular, 92 freshwater ponds were sampled by Schwartz (1982). Habitats sampled in this survey included surf (beach), tidal creek, marsh, mudflat, sandy bay/grass bed, pier and freshwater pond. Forty-eight species of fishes were collected during this survey, and species richness per site ranged from 1 (Long Point beach) -16 (night sample in bay and grass beds near environmental center). As expected with such a large prior database, our sampling did not add new records for the park. The in park species list is 310 if all records from Ross (1977) are included, and 173 if the records from this checklist are included as expected rather than in park records. Since the work is a comprehensive checklist, including samples from in and out of the park, it is difficult to tease out in park records. If the records are included as expected, documentation of in park species is 56%.

Cape Hatteras National Seashore (CAHA)

Cape Hatteras is a large (>14,000 ha) park with a variety of marine and freshwater habitats included within its boundaries. All representative habitats were sampled, for a total of 23 sites. Far fewer in park museum and literature records were found for CAHA than for the neighboring CALO. Fifty-five species were collected during the current survey, and 56 are known from in the park. Species richness ranged from 2 (marsh pond) - 20 (sound). Documentation of in park species relative to expected species is 18%.

Cape Canaveral National Seashore (CANA)

Cape Canaveral National Seashore is the southernmost park in the network, and is among the best sampled for fishes of any network park. Gilmore (1977) provided an extensive list for the Indian River Lagoon (expected species, although some sites were in park but cannot be teased out of the checklist), and studies by Snelson and others contributed numerous in park records. The current study documented 65 species from 22 sites, and species richness ranged from 2 (freshwater pond) - 26 (Eldora fishing pier). Several species (i.e., *Etheostoma fusiforme*, *Umbrina coroides*) were not previously documented in park, but are on the expected species list. In park documentation for this park is 39%.

Chattahoochee River National Recreation Area (CHAT)

This 1,847-ha park encompasses much of the Chattahoochee River mainstem and numerous tributaries. Fishes within and expected in the park have been well documented by several comprehensive studies and checklists (Gilbert, 1969; Swift et al., 1986; Hess, 1980; Couch et al., 1995). In addition, 598 expected records from five museums were detected. The current survey sampled 2 mainstem and 6 tributary sites and yielded 32 species. Of the total in park records, one species is listed as threatened by the state of Georgia (*Cyprinella callitaenia*), and 12 species are introduced or exotic (*Cyprinus carpio*, *Cyprinella lutrensis*, *Catostomus commersoni*, *Ameiurus*

melas, *Ameiurus playcephalus*, *Oncorhynchus mykiss*, *Salmo trutta*, *Salvelinus fontinalis*, *Monopterus albus*, *Micropterus dolomieu*, *Micropterus punctulatus*, *Perca flavescens*). Species richness ranged from 3 (tributary) - 17 (mainstem) and in park documentation is 62%. Threats to conservation of aquatic diversity in this park include water quality issues due to the urban setting, and effects of flow alteration due to hydroelectric dams.

Cumberland Island National Seashore (CUIS)

Cumberland Island is a relatively large (>7500 ha) and well-studied park. Habitats range from freshwater lake and outflow, marsh, tidal creek, marsh ponds, surf (beach) and jetty. There are numerous literature reports as well as museum records for this park as well as for expected records. The current survey documented 53 species at 18 sites, with species richness ranging from 2 (Brickhill River) - 23 jetty). In park documentation for this park was 23%. Threats to aquatic diversity in this park stem from the impact of the wild horse population (Levin et al. 2002). Although an artificial structure, the park jetty should be protected, as it harbors a high diversity of fishes, included some unique to this site.

Charles Pinckney National Historic Site (CHPI)

The aquatic resources of this small park are limited to part of a small tidal creek in an urban setting. The park has not been previously sampled, and very few museum records for comparable habitat were found. We documented three species for this park. The tidal creek seems to receive runoff from roads, lawns and other urban structures, possibly impacting water quality and species diversity.

Fort Frederica National Monument (FOFR)

This relatively small park has not been previously sampled for fishes; however, numerous collections have been made on St. Simons Island. The habitats at FOFR are restricted to marsh associated with a tidal river, high marsh (bloody marsh site) and a moat wetland (some small wells had no fishes). The large number of museum and literature records include some species that would be very rare (but possible) in the park. The current survey documented 21 species from four sites in the park. Species richness ranged from 3-11.

Fort Matanzas National Monument (FOMA)

For its size (121 ha) this park contains a remarkable diversity of aquatic habitats, from temporary freshwater ponds, marsh ponds, marsh, riverine, jetty, grass bed, surf (beach) and sandy bay. The Matanzas inlet is one of the last remaining undredged inlets on the Florida coast, and the area is part of an estuarine reserve. Remarkably little literature was found for this park, although a moderate number of museum records were detected. Our survey documented 55 species at 11 sites and species richness ranged from 4 - 26. An indication that more sampling is needed to fully inventory fishes in this park is that the in park and expected lists only have 33 species in common, but have virtually the same number of fish species (68 and 67).

Fort Pulaski National Monument (FOPU)

Fort Pulaski is positioned at the mouth of the Savannah River. In addition to this habitat the park has a vast expanse of marsh and tidal creek within its boundaries, as well as a moat and several ditches. During the current survey we sampled nine sites encompassing all habitat types within the park.

Thirty-four species were documented in the current survey and the total in park species list (literature and museum record) is 38. The expected species list, from literature and museum records, includes 164 species. The percent documented by in park records is 23. *Acipenser oxyrinchus oxyrinchus* was documented from within the park as a photo voucher of a specimen that washed up on shore. This species is on the National Marine Fisheries list of species of concern.

Fort Sumter National Monument (FOSU)

Fort Sumter was not sampled in the current survey, as the gear we used was not appropriate for Charleston Harbor. Expected museum records were compiled, and produced a list of 150 fish species.

Kennesaw Mountain National Battlefield Park (KEMO)

This park includes small tributaries to the Chattahoochee River, and one intermittent stream in the Etowah River drainage. Three sites were sampled during the current survey, and were the first in park records for this park. A total of 11 species were documented, and sampling represented 44% of expected fish species.

Moore's Creek National Battlefield (MOCR)

Moore's Creek is a large, deep, swampy tributary to the Black River (Cape Fear River drainage). No previous fish sampling was apparent (perhaps due to the extreme difficulty in sampling), and the current survey of two sites yielded 12 species. The expected list was generated from a few museum records and mostly from checklists of the Cape Fear River (Hocutt et al. 1986; NCDEWQ).

Etheostoma collis, a North Carolina and federal species of concern, was documented from the park.

Ocmulgee National Monument (OCMU)

The freshwater aquatic habitats in this park include swamp, stream and riverine systems. No in park records were discovered, and the current survey documented 31 species of fishes. The expected list was generated from checklists from Georgia Department of Natural Resources, and Dahlberg and Scott 1971 and museum records. Introduced/exotic species from within the park include: *Cyprinus carpio*, *Ictalurus punctatus*, *Pylodictis olivaris*, *Lepomis megalotis*, *Micropterus cataractae*, and *Pomoxis annularis*.

Discussion

The documentation of species occurring within the boundaries of parks in this study, using a combination of field collection, literature accounts and museum records, fell far short of the 90% goal set by NPS. The reason for this may lie partly in the way expected records were compiled. For freshwater fishes, records from within the waterbody drainage were included (unless the species were physiographically restricted outside the region of the park). Technically, most fishes within a drainage could be found throughout the system, even if moving through to areas of suitable habitat. The inclusion of all drainage records could inflate the number of expected species for which detection probabilities are very low. Marine species lists were inflated relative to our collections for two reasons: collection gear and mobility of marine fishes. For our collections, we used gear that sampled fishes within (or very close to within) actual park boundaries. For this reason, detection probabilities of very large species (e.g., sharks), rare species, and species that only occasionally use

inshore habitat were very low (or even zero). Expected lists based on collections made from a variety of gears, including trawling areas offshore, technically include species that could possibly use the park, per se, but would not be expected in collections made on only one occasion. Many marine species are highly mobile, and would only be sporadically expected in samples. These problems could be remedied by including detection probabilities/catchability into monitoring programs.

In spite of these issues, the data presented in this report offer baseline inventories for fishes in 12 parks in the Southeast Coast Network. These data should be expanded into monitoring programs that incorporate detection probabilities (gained by repeated sampling) and seasonal variation. Monitoring programs will not only document presence or absence of species in parks but will also provide information of populations trends both spatially and temporally. Parks in need of additional sampling have also been identified (CAHA, FOMA, FOFR, FOPU, MOCR). Fort Matanzas, in particular, has high aquatic habitat diversity relative to its size, is part of a larger refuge system and may harbor many more species than documented.

Urban parks (especially CHAT and OCMU) may provide restoration opportunities, and monitoring data will be a critical component of such conservation efforts. Monitoring data are also critical for marine parks facing impacts from horse populations and increasing use by humans. In particular, the impacts of vehicular traffic on beach areas to fishes should be addressed. The effects of marine reserves are another target for monitoring effects (e.g., Cape Canaveral/ Merritt Island, Fort Matanzas).

The linkage between protected land and the protection of aquatic habitat and associated biodiversity has yet to be fully explored, particularly in marine systems. Both the direct (protection of marsh used as nurseries by fishes) and indirect (food web effects) effects of protected land areas need further exploration. Inventory and monitoring efforts provide the first steps in this conservation process.

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