APPENDIX J

ANNOTATED BIBLIOGRAPHY OF NEARSHORE AND ESTUARINE FISHERIES

ANNOTATED BIBLIOGRAPHY:

Nearshore and Estuarine Fisheries Data
North Carolina and South Carolina Inlets
(With Emphasis on Inlets of the Cape Fear Region)

Prepared for
Village of Bald Head Island Shoreline Protection Project

1. **Birkhead, W.A. et al. 1979.** Ecological monitoring in the lower Cape Fear estuary, 1971-1976. Report 79-1. Carolina Power and Light Company, Raleigh, North Carolina. 292 pp.

   Carolina Power and Light Company. 1979. Brunswick Steam Electric Plant, Ocean Larval Fish, November 1976-August 1978. Environmental Technology Section. 119 pp.

   Carolina Power and Light Company. 1985. Brunswick Steam Electric Plant, Cape Fear Studies, Interpretive Report. Environmental Technology Section. 93 pp.

   Carolina Power and Light Company. 1992. Brunswick Steam Electric Plant, 1992 Biological Monitoring Report. Environmental Technology Section. 60pp.

   Location of Studies: Lower Cape Fear River Estuary, NC.

   Synopsis of Studies: As part of Carolina Power and Light's NPDES Permit NC0007064, CP &L, now Progress Energy, embarked on a multi–decade, comprehensive biological monitoring program to describe the offshore concentrations and changes in density over time of commercially important taxa in the nearshore and estuarine environments of the Cape Fear River Estuary. Beginning in 1971 and continuing through 1992, fish and invertebrate taxa were sampled, identified and monitored for changes in abundance, seasonality, or recruitment to the estuary via impingement resulting from the normal operations and modification of the Brunswick Electric Steam Plant's (BESP) water intakes. More than 40 taxa (CP&L, 1979) of fish and invertebrates were identified with 9 (CP&L,1992) commercially significant species (Atlantic menhaden, bay anchovy, spot, croaker, southern flounder, brown shrimp, pink shrimp, white shrimp, and blue crab) studied in 5 different locations throughout the Cape Fear River Estuary. Conclusions (as of the 1992 biological monitoring report) were that the normal operations of the BESP have not adversely affected the typical species composition,

seasonal occurrence, and spatial distribution of dominant fish and shellfish in the Cape Fear Estuary.

2. **Hackney, C.T., M. Posey, S. Ross, and A. Norris. 1996.** A Review and Synthesis of Data on Surf Zone Fishes and Invertebrates in the South Atlantic Bight and the Potential Impacts from Beach Renourishment. For Wilmington District, US Army Corps of Engineers, Wilmington, North Carolina.

   Location of Study: South Atlantic Bight (SAB) (Cape Hatteras, NC to Cape Canaveral, FL) with special emphasis on North Carolina.

   Synopsis of Study: The paper provides a thorough review of fishes and benthic invertebrates most common in the surf zone along the South Atlantic Bight. The study identified 130 different taxa found in the surf zone of the SAB with 40 of those occurring in North Carolina. Discussion of life histories of 9 fish species and 5 invertebrate groups that are important to humans for food and recreation as well as other important species found in the surf zone of the SAB and to provide recommendations on future management and biological monitoring needs as they relate to repeated beach renourishment of the barrier islands of the Southeastern United States.

3. **Markovsky, W.C. 2004.** The role of the Cape Fear River discharge plume in fisheries production: aggregation and trophic enhancement. A Thesis submitted to the University of North Carolina at Wilmington. Department of Biological Sciences. 86 pp.

   Location of Study: The Cape Fear River and nearshore waters, NC.

   Synopsis of Study: The thesis study examined the effects of small river plumes such as the Cape Fear River on the overall abundance of larval fish abundance compared to the less turbid waters of the adjacent waters and to compare this with other known plume effects of larger rivers like the Mississippi River. Conclusions of this study suggest that smaller river plumes also have higher concentrations of ichthyoplancton possibly suggesting greater larval aggregation compared to the adjacent waters but more research is needed to fully understand these processes. Note that sampling included a station west of Bald Head Island in the mouth of the Cape Fear River.

4. **Moser, M. L., and S. W. Ross. 1993.** Distribution and movements of shortnose sturgeon (Acipenser brevirostrum) and other anadromous fishes of the lower Cape Fear River, North Carolina. Final Report to the U.S. Army Corps of Engineers, Wilmington, North Carolina.

   Moser, M.L. and S.W. Ross. 1995. Habitat use and movements of shortnose and Atlantic sturgeons in the Low Cape Fear River, North Carolina. Transactions of the American Fisheries Society. 124 (2): 225-235.

   Location of Studies: Cape Fear River, NC.

   Synopsis of Studies: To provide life history, distribution of and habitat requirements of shortnose and Atlantic sturgeons as well as other anadromous fish species known to occur in the Cape Fear River such as striped bass and American shad.

5. **Versar, Inc. 2003.** Effects of dredged material beach disposal on surf zone and nearshore fish and benthic resources on Bald Head Island, Caswell Beach, Oak Island and Holden Beach, NC; Interim study findings, Volume I Text. Report prepared for Frank Yelverton, USACE Wilmington District. 61pp.

   Versar, Inc. 2003b. Effects of dredged material beach disposal on surf zone and nearshore fish and benthic resources on Bald Head Island, Caswell Beach, Oak Island and Holden Beach, NC; Interim study findings, Volume II Figure and Tables. Report prepared for Frank Yelverton, USACE Wilmington District. 321pp.

   Versar, Inc. 2004. Year 2 recovery from impacts of beach nourishment on surf zone and nearshore fish and benthic resources on Bald Head Island, Caswell Beach, Oak Island, and Holden Beach, NC. (Final study findings). Report prepared for Frank Yelverton, USACE Wilmington District. 54pp.

   Location of Studies: Bald Head Island, Caswell Beach, Oak Island, and Holden Beach, NC.

   Synopsis of Studies: A two-year study evaluating the water quality and biological effects of large scale beach disposal that was conducted as part of the Cape Fear River navigational channel deepening project. Fish sampling results reported between 39 and 92 nekton species identified between the surf zone and nearshore waters depending on the sampling gear type used (haul seine, otter trawl and gillnet). Results of this sampling documented similar surf zone species as those found in the South Atlantic Bight study by Hackney et al. 1996. The final report of the two year study indicated no immediate impacts in fish abundances and diversities among disturbed, undisturbed, and reference stations at any beach.

6. Ross, S. W. and John Bichy. 2002. Checklist of the Fishes Documented from the Zeke's Island and Masonboro Island Components of the North Carolina National Estuarine Research Reserve. The National Estuarine Research Reserve Technical Report Series 2002:2 31pp.
Location of Study: Masonboro Island and Zeke's Island, NC.

Synopsis of Study: This report establishes baseline data to document the two Reserves (Masonboro Island and Zeke's Island) ichthyofauna and is to serve as a benchmark to measure future changes. This effort documents 155 and 103 fish species, representing 58 families, so far recorded from Masonboro Island and Zeke's Island NCNERR components, respectively.

7. Ross, S. W. and Johnny E. Lancaster. 1996. Movements of juvenile fishes using surf zone nursery habitats and the relationship of movements to beach nourishment along a North Carolina beach: Pilot project. Final Report to NOAA Office of Coastal Resource Management and the U. S. Army Corps of Engineers (Wilmington District) for NOAA Award No. NA570z0318. 31p.

Location of Study: Masonboro Island and Carolina Beach, NC.

Synopsis of Study: This study showed that two dominant fishes, Florida pompano and Gulf kingfish, using the surf zone as a nursery area exhibited a strong fidelity to small areas of the beach. Since these fishes are quite mobile, this suggests that resources at most beach locations where they initially settle are not limiting or that predation pressures are not high enough to cause large scale movements during the nursery period. Through the use of small coded wire tags it was determined through consistent recaptures of individuals in the same vicinity that large sections of the surf zone are functionally independent habitats.

8. Hettler Jr., W. F. and C. J. Chester. 1990. Temporal distribution of ichthyoplankton near Beaufort Inlet, North Carolina. Marine Ecology Progress Series 68:157-168.

Location of Study: Beaufort Inlet, NC

Synopsis of Study: This study provides a database on the species, numbers, and sizes of larval/early juvenile fishes in a North Carolina inlet throughout the entire year. Species were classified into 3 main temporal assemblages: winter and early spring, late spring, and summer. All species collected during winter were advanced post flexion larvae or juveniles, while many of the spring/summer species were pre-flexion and flexion larvae. At total of 74 species or genera representing 34 families were collected during the study. Anchovy dominated the non-winter catches.

Variability in observed total fish densities between hauls within collections was high. About one-third of the species found in the collections later utilized nearby marshes as a nursery habitat.

9. **Hettler Jr., W. F. and D. L. Barker. 1993.** Distribution and abundance of larval fishes at two NC Inlets. Estuarine, Coasts and Shelf Science. 37, 161-179.

   Location of Study: Oregon Inlet, NC and Ocracoke Inlet, NC.

   Synopsis of Study: Oregon Inlet and Ocracoke Inlet were quantitatively sampled for larvae at new moon monthly intervals during 1988-89. Stations inside of both inlets were sampled both during day and night at single stations. Oregon inlet, located in a more temperate marine province, was expected to have a different taxonomic community than Ocracoke Inlet, but, of 77 taxa collected from both inlets, 54 occurred at both inlets. Documented differences in lowest and highest abundances were reported for each inlet with Oregon Inlet lowest occurring in Feb. and highest in late August. Ocracoke Inlet had it's lowest in November highest in June. The highest percentage of larval abundance differed at each site with the majority of larvae capture near the bottom at Oregon Inlet and near the surface at Ocracoke Inlet. Most larvae were caught at night at both sites. Twenty-one species were significantly different in mean length between the two inlets.

10. **Hettler Jr., W. F. and Jonathan A. Hare. 1998.** Abundance and size of larval fishes outside the entrance to Beaufort Inlet, North Carolina. Estuaries, Vol 21, No. 3, 476-499pp.

    Location of Study: Beaufort Inlet, NC.

    Synopsis of Study: Sampling of seven (7) ocean-spawned, estuarine-dependent fishes (Atlantic menhaden, spot, Atlantic croaker, pinfish, Gulf flounder, summer flounder, and southern flounder) was conducted on two transects, one on either side of Beaufort Inlet, North Carolina during the winter immigration season. Larval densities and lengths varied greatly between species and locations either inside or outside the inlet. Larval densities also varied greatly both inside and outside the inlet depending upon the direction of the wind component. Distance, direction to the inlet from offshore shelf spawning areas and water temperature all play a role in overall densities outside the inlet. Patterns in larval density outside of Beaufort Inlet were complex and apparently influence by both physical processes that supply larvae to the nearshore region and nearshore physical dynamics.

11. **Weinstein, M.P., Sidney L. Weiss, Ronald G. Hodson, and Lawrence R. Gerry. 1980.** Retention of three taxa of postlarval fishes in an intensively flushed tidal estuary, Cape Fear River, North Carolina. Fisheries Bulletin. Vol. 78, No. 2.

    Location of Study: Cape Fear River, NC.
    Synopses of Study: Fixed nets were used to sample postlarvae of spot, Atlantic croaker, and flounders over several 24-hour periods in the Cape Fear River, near Wilmington, North Carolina. Results of this study indicate that that postlarva of these species exhibit behavioral patterns with respect to photoperiod and tide which are instrumental in enabling these organisms to maintain selected positions in the estuary and avoid being flushed seaward. By migrating to the surface at night, both spot and flounders make apparent use of tides to augment lateral migration into the marsh. However, Atlantic croaker tended to remain more toward the bottom and accumulated in larger numbers in deep water at the head of the estuary.

12. **Hare, J. O., J.A. Quinlan, F.E. Werner, B.O. Blanton, J.J. Govini, R.B. Forward, L.R. Settle, and D.E. Hoss. 1999.** Larval transport during winter in the SABRE study area: results of a coupled vertical larval behavior-three-dimensional circulation model. Fisheries Oceanography. 8(2): 57 7

    Location of Study: Beaufort Inlet, NC.

    Synopsis of Study: Two surveys of larval abundance and water flow were performed within the estuarine region near Beaufort Inlet, North Carolina. Each survey extended over 2 full semidiurnal tidal cycles and included measurements of larvae concentration and velocity distribution at several locations. A net ingress of larvae from the open ocean into the estuary was observed during both surveys. Most larvae entered the estuary over the eastern and central portions of the inlet, where the subtidal flow was up-estuary. However, the mean circulation played a minor role in the net movements of larvae into the estuary. Net up-estuary transport of larvae was principally due to variation of larval abundance with tidal flow; with abundance during flood tide usually far exceeding ebb tide abundance. This mode of transport was likely driven by a behavioral response to tidal flow in which larvae tended to descend to the bottom on falling tides and reside throughout the water column on rising tides.

13. **Hare, Jonathan A., John A. Quinlan, Francisco E. Werner, Brian O. Blanton, John J. Govoni, Richard B. Forward, Lawrence R. Settle, and Donald E. Hoss. 1999.** Larval transport during winter in the SABRE study area: results of a coupled vertical larval behavior-three dimensional circulation model. Fisheries Oceanography. 8(Supplemental 2), 57-76.

Location of Study: Circulation Model using fictitious locations between Cape Romain, SC and Cape Hatteras, NC (South Atlantic Bight Recruitment Experiment [SABRE])

Synopsis of Study: Three dimensional circulation model was used in conjunction with larval fish vertical behavior models to study the interaction between larval vertical distribution, advection and the outcome of larval transport along the central portion of the east coast of the United States. Vertical behavior models were developed for Atlantic menhaden and spot. The purpose of the model was to investigate the transport pathways of Atlantic menhaden and spot larvae from offshore spawning grounds to estuarine nursery habitats. Both physical (e.g. wind) and biological (e.g. changes in larval behavior) events were responsible for many of the observed patterns in larval transport. Overall, larval transport was determined by circulation but was modified by larval vertical distributions.

14. **Blanton, J. O., Francisco E. Werner, Andras Kapolnai, Brian O. Blanton, David Knott, and Elizabeth L. Wenner. 1999.** Wind-generated transport of fictitious passive larvae into shallow tidal estuaries. Fisheries Oceanography. 8(Supplemental 2), 210-223.

Location of Study: Model depicting the North Edisto Inlet, SC.

Synopsis of Study: Both field and model results indicate that wind stress with an onshore component efficiently transports particles and larvae toward inlets where they can be transported by flood tide into estuarine environments. Peak abundance of larval white shrimp and blue crab megalopae are associated with certain wind directions. Passive particles were initially distributed uniformly in a zone of the continental shelf which extended 20 km offshore and 20 km alongshore in either direction. Each simulation was conducted for five tidal cycles (2.5 days) under constant wind stress. These simulations indicated that larvae are withdrawn from the continental shelf into the inlet from a narrow zone parallel to the shoreline but extending less than 5 km offshore. The withdrawal zone changed to one directly offshore of the inlet only for a wind direction that pointed directly toward the inlet mouth. Under downwelling-favorable winds, particles originating in the surface accumulate along the downwind boundary and drift shoreward with time causing a pooling of larvae along the coast. This scenario is repeated with less efficiency for upwelling-favorable winds with particles originating near the bottom.

15. Allen, Dennis M. and D. Lynn Barker. 1990. Interannual variations in larval fish recruitment to estuarine epibenthic habitats. Marine Ecology Progress Series. Vol. 63: 113-125.

Location of Study: North Inlet Estuary, SC.

Synopsis of Study: More than 45 species of fish were collected during epibenthic sled trawls from the North Inlet estuary in South Carolina between 1981 and 1985. Two distinct periods of larval fish recruitment were identified: summer in which gobies and anchovies were most abundant and winter, in which spot and croaker dominated. Arrival dates were consistent during all years of collections. It was also reported that during extended periods of low salinity in the winters of 1983 and 1984, winter taxa were significantly more abundant than in other years. Low salinity conditions represented extreme changes for an otherwise high salinity estuary, yet no notable differences in the taxonomic composition, ranks, or timing of arrivals were observed between the 4 winters sampled. Further, size distributions of larval fishes were very similar at all locations. These observations suggest that factors controlling larval fish recruitment and fluctuations in abundance were operating on a large spatial scale. Major ecosystem level disturbances such as extreme reductions in salinities during some winters did not appear to alter temporal patterns of larval fish recruitment as much as the magnitude of utilization of epibenthic habitats.