

Cape Cod National Seashore and Northeast National Parks and National Historical Sites

Progress Report, FY 2000

Patterns and processes for freshwater fish distribution in northeastern National Parks: inventory, monitoring, and a model of governing processes

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Project Overview

Project Justification. Freshwater fish provide recreation for both anglers and non-anglers. In addition, freshwater fish act as key predators in many aquatic food webs. However, hydrologic alterations, acid rain, nutrient loading from adjacent development, exotic fish introductions, and recreational fishing pressure in both freshwater and estuarine habitats complicate the management of these resources. Furthermore, comprehensive and current fish inventories for North Atlantic Region parks are lacking.

Project Goal. Thus, an urgent need exists for park-wide inventories to form the basis for long-term monitoring programs, to describe present trophic structure in aquatic habitats, and to identify problems facing the sustainability of the ecosystems that support freshwater fish communities.

2000 Field Season Goals. The main objectives for the 2000 field season were to:

- Sample fish, zooplankton, and benthos in all Cape Cod National Seashore kettle ponds to document fish community assemblages and trophic relationships
- Survey fish species in other sites (Roosevelt-Vanderbilt, Saratoga, Morristown, Marsh-Billings-Rockefeller, St-Gaudens, Weir Farm, Minuteman, Saugus Ironworks)

Methods

(A) CaCo Kettle Ponds Fish Communities

Objective: *Sample fish, zooplankton, and benthos in all Cape Cod National Seashore kettle ponds to document fish community assemblages and trophic relationships*

- (i) Yellow perch in CaCo indicator ponds. Our goal in this first type of sampling was to determine when to sample ponds to obtain data that reflect similar conditions in all ponds.

Yellow perch is the single species found in the majority of the ponds, and consequently our sampling focus was on the juveniles and adults of this species. To determine when to sample, we needed to assess when larval yellow perch transform into juvenile fish and move from the pelagic to the littoral habitat. We did this by beach seining 33 m of littoral habitat in 6 indicator ponds every 10 days from May through July, 2000. These indicator ponds represented a range of pond sizes, morphologies, and fish communities.

- (ii) Fish communities in all CaCo kettle ponds. Our goal in the fish community sampling was to document species identity, relative abundance, and size distribution of all species in all 20 Cape Cod National Seashore kettle ponds. Based on our 1999 sampling, we decided to use 5 gears to sample freshwater fish communities in 2000. This range of gear should cover all sizes of active and stationary fish in all habitats.

Fyke net: Fixed net that targets medium and large fish actively swimming in the littoral (inshore) zone (5 nets set for 4-8 h in each of the kettle ponds).

Minnow trap: Fixed gear that targets actively swimming small fish in the littoral (inshore) zone (15 traps set for 4-8 h in each of the kettle ponds).

Beach seine: Active gear that targets swimming and stationary small, medium, and large fish in the littoral (inshore) zone (1-3 33 m beach seines undertaken in each kettle pond twice during the summer of 2000).

Snorkel: Active gear that targets swimming and stationary small, medium, and large fish in the littoral (inshore) zone (1 33 m transect swum in each kettle pond).

Trammel net: Fixed net that targets medium and large fish actively swimming in the transitional zone between the littoral and pelagic littoral (3 nets set of 1", 1.5", 2" mesh for 4-8 h in each of the kettle ponds)

To accomplish our 2000 goals, over 5 weeks in July and August, 2000, each pond was sampled using a standard suite of gear (5 fyke nets, 3 trammel nets, 15 minnow traps, a 100 m snorkeling transect, and 1-3 33 m beach seine(s)).

This sampling was repeated over seven weeks in October-November, 2000.

- (iii). Food resources for fish in CaCo kettle ponds. To sample food resources, in 2000, three zooplankton, three benthic invertebrate, and three vegetation invertebrate samples were taken concurrent with each fish sample during both the summer and fall fish samples. In addition to these prey samples, diets of yellow perch were quantified via stomach pumping during the summer sampling and diets of all major species were quantified during the fall sampling, 2000.
- (iv) Abiotic conditions in CaCo kettle ponds. Water quality (temperature, pH, dissolved oxygen, conductivity), vegetation (type and density), and pond morphometry data were collected at all 20 kettle ponds during both the summer and fall samples, 2000.
- (v) Predator-prey interactions and food webs. In late summer/early fall, 2000, predators were targeted in 5 ponds via angling. Diets were quantified via gastric lavage.
- (vi) Community patterns. Using multivariate statistics (principal components analysis, multiple regression, discriminant analysis), we sought to document patterns of species richness.

(B) Survey of fish in other NHS

Objective: Survey fish in other park sites to document 80-90% of species present (Roosevelt-Vanderbilt, Saratoga, Morristown, Marsh-Billings-Rockefeller, St-Gaudens, Weir Farm, Minuteman, Saugus Ironworks)

All sites except Saugus were sampled for 3-7 days in September through November, 2000. (By agreement, Saugus fish species will be identified through published reports.) First, habitat types were identified and quantified. Then a sampling plan was proposed that either (a) sampled repetitive units of each habitat type at each site until no new species were added or (b) that sampled 25-50% of each habitat type at each site.

Streams were sampled by electrofishing 25 m units or fyke and minnow traps if the stream was too deep for electrofishing. Ponds were sampled using fyke nets, trammel nets, and/or minnow traps.

Results

(A) CaCo kettle ponds fish communities

Objective: Sample fish, zooplankton, and benthos in all Cape Cod National Seashore kettle ponds to document fish community assemblages and trophic relationships

- (i) Yellow perch in CaCo indicator ponds. By early July, 2000, juvenile perch were observed in most ponds and fish community sampling commenced in all ponds.
- (ii) Fish communities in all CaCo kettle ponds. All 20 ponds were sampled both in summer and fall, 2000. Between 2-12 fish species were caught. These were the same as reported in 1999. All fish were identified to species, measured, and scales and diets collected. For example, 534 and 500 perch diets were collected in summer and fall, 2000, respectively. These data are currently being analyzed.
- (iii) Food resources for fish in CaCo kettle ponds. Sixty zooplankton, 60 benthos, and 60 vegetation samples were collected in each pond in summer and fall, 2000, for a total of 120 samples of each prey type (6 per pond). These data are currently being analyzed.
- (iv) Abiotic conditions in CaCo kettle ponds. Continuously recording temperature records were recorded from each pond. In addition, 2 sets of water quality reading were taken in each season in 2000. Vegetation and pond morphometry was also mapped.
- (v) Predator-prey interactions and food webs. Largemouth bass, smallmouth bass, and chain pickerel were caught and diets were assessed in 2000. 200-400 diets of pumpkinseed and killifish were also collected to examine food webs. Some fish have also been retained for isotope analysis. These data are currently being analyzed.
- (vi) Community patterns. Patterns of 1999 data were assessed and presented at the annual meeting of the American Fisheries Society in St. Louis in September, 2000. A final analysis and manuscript preparation is currently underway.

(B) Inventory of fish in other NHS

Objective: Survey fish species in other parks to document 80-90% of fish species present (Roosevelt-Vanderbilt, Saratoga, Morristown, Marsh-Billings-Rockefeller, St-Gaudens, Weir Farm, Minuteman, Saugus Ironworks)

All sites were sampled (except Saugus) for 3-7 days in September through November, 2000. Data are currently being analyzed and the final report compiled.

Future plans for completion

Field work for both the Cape Cod National Seashore kettle ponds and other parks inventory was completed in November, 1999.

Data analysis is currently underway.

We hope to have the:

- Monitoring report completed by April 1, 2001
- Cape Cod kettle ponds data analyzed by July 1, 2001
- Report and publications for the Cape Cod kettle ponds completed by December 31, 2001

Volunteer Involvement and Partnerships

- Several park volunteers helped with fish and other aquatic data collection.

Partnerships

- Massachusetts Cooperative Fish and Wildlife Research Unit (USGS-BRD, University of Massachusetts-Amherst-Department of Natural Resources Conservation, Massachusetts Division of Fisheries and Wildlife, Massachusetts Division of Marine Fisheries, Wildlife Management Institute).

Educational and Interpretive Products

- Interpretive tools related to fish identification and habitat use will be developed.

Public Information Products

- Presentation to NPS inventory and monitoring workshop, May 2000 on inventory philosophy and sampling design

Scientific Publication Plans

- Based on the data we plan to collect and analyze in 2001, a number of peer review papers will be prepared for scientific journals and presented at scientific meetings.
- A technical presentation was also made. The following is the citation for that presentation.

Carey, M.P and M.E. Mather. 2000. Relationships between fish assemblage patterns and environmental and biological variables: predicting fish assemblage structure. Contributed paper, annual meeting, American Fisheries Society, St. Louis, Missouri.