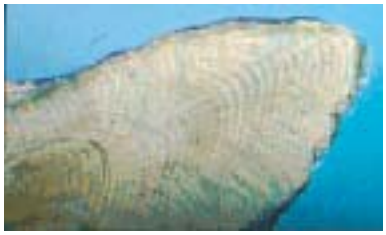
# Influence of Hydrology on Life-history Parameters of Common Freshwater Fishes from Southern Florida

**Fishes are essential to the successful functioning of wetland food webs in southern Florida through their roles as prey and predators. Any changes that reduce the population sizes, community composition, or availability of aquatic animals will affect all facets of the ecology of these wetlands. In particular, small and medium-size fishes are important food items for most wading bird species. For this reason, fishes have been recognized by the multi-agency groups responsible for guiding the Everglades restoration process as a key indicator group by which to measure restoration success.**



Despite the importance of fish for management, gaps in baseline knowledge remain. Basic demographic information, termed life-history parameters, is needed to make predictions about their resilience under alternative management scenarios. These parameters include growth rate, age at maturation, fecundity and life expectancy. However, basic life-history parameters remain to be characterized, even for abundant fish species. Adding to the challenge, life-history characteristics of important Everglades species are known to be plastic in response to environmental conditions and survivorship and recruitment schedules are certain to be influenced by variation in hydroperiod. We intend to study the effect of hydroperiod on recruitment, size/age structure, growth, and fecundity, which, in turn, determine fish population dynamics.

At present, data on fish reproduction, age and growth, and other life history characteristics are confined to a few species from a limited area of long-hydroperiod marsh in central Shark River Slough. As we continue the analysis and synthesis of data from the long-term fish collections, life-history information will help explain patterns of fluctuations in the time series. Accurate life-history data are also very important in building credible simulation models like ATLSS. Without empirical life-history data from a range of environments, the model will be simplistic and inadequate.

## Study Design

To document the life history parameters of Everglades fishes, we divided target fishes into small- and large-bodied fishes. Small-bodied fishes are typically short-lived and are most common in shallow marsh habitats. Large-bodied fishes are generally long-lived and are common in canal habitats and other deepwater areas. The present study takes advantage of existing or newly funded fish studies in south Florida. These include the throw-trap program for small-fish monitoring, and an electrofishing study of larger native and introduced species in canals. Age and growth information has been collected for a few of the target species, but reproductive characteristics of most south Florida populations have not been investigated previously. For aging fishes, a standard method is to count daily and annual rings deposited on otolith bones (and other hard structures). However, environmental variation can affect the pattern of otolith ring deposition, so calibration of otolith ring deposition is an important first step in using ring counts to age fish.

The present work involves counts of daily rings on otoliths from small fishes and of annual rings on otoliths from large fishes, as well as size-frequency analyses of all target fishes. Ultimately, the results will allow us to create an age-at-size table for each species, and to estimate growth in two different seasons. Furthermore, we will be able to construct life-tables for the species under different conditions in the Everglades. In addition to our own field fish collections, we will analyze past data from extensive spatial and temporal marsh and canal study collections for reproductive analyses of fecundity, size at maturity, seasonality of reproduction, and sex ratios.

**SMALL FISHES:** Investigations on small fishes is beginning in the spring 2000. For small-bodied species, we will establish age-to-size relationships for three marsh fishes not yet studied: Sailfin Molly (Poecilia latipinna); Flagfish (Jordanella floridae); and Spotted Sunfish (Lepomis punctatus). These relationships will be estimated at one representative short (at Shark Valley) and one representative long hydroperiod location (at Shark River Slough).

For small fishes, we will conduct experimental rearing of each species to a known age in field cages in anticipation of otolith removal and interpretation. In past efforts, this approach has demonstrated a very high fidelity of daily ring deposition in Sailfin Mollies up to the age of 21 days. This result needs to be repeated and expanded to other species.

We will document reproductive phenology and output in six marsh fish species: Least Killifish (Heterandria formosa); Bluefin Killifish (Lucania goodei); Golden Topminnow (Fundulus chrysotus); Eastern Mosquitofish (Gambusia holbrooki); Sailfin Molly; and Flagfish.

**LARGE FISHES:** For large-bodied fishes, we are establishing age-to-size frequencies and reproductive phenology for five target species, including one non-indigenous fish, the Spotted Tilapia (Tilapia mariae), and four native fishes, Florida Gar (Lepisosteus platyrhincus), Yellow Bullhead (Ameiurus natalis), Warmouth (Chaenobryttus gulosus), and Spotted Sunfish (Lepomis punctatus). All five species are common to abundant in many south Florida freshwater habitats and most are predators that prey on other fishes and various crustaceans (i.e., crayfish and shrimp).

Quarterly sampling of fishes began in January 2000 in three major south Florida waterways: Canal L-31W, Tamiami Canal (C-4), and Snake Creek Canal (C-9). Reaches sampled in the first two canals have direct surface water connections to adjacent marsh habitats. The C-9 reach is located in a heavily-disturbed urban area and is not associated with a natural marsh.


In the field, the length and weight of all target fishes are recorded. A subset of fishes representing various size classes are sacrificed and the heads are removed and preserved on ice for later otolith removal. The bodies are preserved in formalin for later analysis of gonad condition.

To document changes in size with age and to aid in interpretation of otolith work and size frequency results, we recently have begun experimental rearing of three of the five target fishes: Florida Gar, Warmouth, and Spotted Tilapia.

**Applications**

By applying the fish models to restoration alternatives and predicting fish-community responses, we can choose the alternatives that result in biotic characteristics that approximate historical conditions. The iterative process of evaluating and testing the fish-community simulation model in ATLSS also helps identify important data gaps to guide future research. One of the most obvious gaps is the absence of good life-history data, critical to model performance, for most of the fishes. The benefits to restoration would arise by having more confidence in improved tools, like the ATLSS models and performance measures from conceptual models, that are used to evaluate alternatives for ecological effects of the Central and Southern Florida Project Restudy, C-111 Project, and Modified Water Deliveries Plan to Shark Slough.

In addition to the application of the life-history data to modeling and to interpretation of the data time-series, these data represent new information about the adaptations of many of these species in wetland habitats that form the southern extent of their geographic ranges. These also represent the first life-history data for some of the most abundant introduced species in Florida, and may identify vulnerable life stages for controlling these species. The publications resulting from this work will be scientifically significant for those reasons.

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The Critical Ecosystem Studies Initiative supports studies conducted to provide physical and biological information, simulation modeling, and planning that are critical for achieving South Florida ecosystem restoration