Northern Estuaries Performance Measure
Fish

Last Date Revised: March 7, 2007

Acceptance Status: Under development

1.0 Desired Restoration Condition

Provide conditions conducive to a healthy, well balanced estuarine fish community. Restore estuarine fish assemblages with relative abundance and distribution, taxonomic composition, diversity and representation of life stages characteristic of targeted salinity regimes for each estuary.

1.1 Predictive Metric and Target

(See NE Salinity Envelop – St. Lucie and Caloosahatchee Estuaries).

1.2 Assessment Parameter and Target

The targets are as follows:

- Caloosahatchee Estuary – Maintain or enhance suitable habitat for juvenile fish, adult spawning sites and larval recruitment sites.

St. Lucie Estuary – Maintain or enhance suitable habitat for juvenile fish, adult spawning sites and larval recruitment sites..

2.0 Justification

At least 70% of Florida's recreationally important fishes depend on estuaries for at least part of their life histories. The Caloosahatchee and St. Lucie Estuaries, Indian River and Lake Worth Lagoons, and Loxahatchee River and Estuary provide habitat and nursery grounds for a variety of fish communities.

Juvenile Fish

Seagrass communities provide critical refugia for juvenile fish such as redfish, grouper, snook, spotted seatrout, and gray, mutton, yellowtail, and lane snappers. Seagrass loss and alterations in salinity zonation diminish the habitats suitable as nursery grounds for juvenile fish. The distribution of juveniles of these species indicates the distribution of natural salinity and temperature conditions in seagrass beds. Stenohaline reef fishes (gag and red grouper and lane, yellowtail, and mutton snapper) require higher salinities in the estuary during early recruitment and development in the dry season. Estuarine juvenile fish (sheepshead, snook, and gray snapper) can withstand major shifts in salinity and thus are not good barometers of salinity impacts.

Fish Reproduction and Egg/Larval Survival

Spawning adults and larval fish are often much better indicators of negative water management impacts on indigenous fish populations. Spotted seatrout, red drum, snook, weakfish, sand seatrout, silver perch, hardhead catfish, toadfish, black drum and toadfish all spawn within the estuary. Their larvae are much more sensitive to water quality conditions, than their juvenile stages. Larval fish populations have revealed a direct association with salinity and nutrient levels in estuaries throughout the country and are good indicators of the ability of

estuaries to support reproducing populations of indigenous species. Spawning sites can be mapped and monitored remotely and larvae can be captured at strategic sites based on salinity and nutrient models.

Freshwater Species

Emergent herbaceous bank vegetation is an important habitat for a variety of fish species indigenous to the freshwater tributaries. These include centrarchids: bass, *Micropterus salmoides*, sunfishes, *Lepomis spp*; eleotrids: sleepers, *Dormitator, Eleotris, Gobiomorus*; the opossum pipefish, *Microphis brachyurus lineatus* (listed as a species of concern by National Marine Fisheries Service). This habitat is at times treated with herbicides by most flood control districts as it includes panic grasses, *Panicum spp*., along with smart weed, *Polygonum spp*.

3.0 Scientific Basis

3.1 Relationship to Conceptual Ecological Models

The indicator for this performance measure is an ecological attribute (fish abundance) in the following conceptual ecological models:

Regional Models (RECOVER 2004b)

St. Lucie Estuary and Indian River Lagoon
Loxahatchee
Lake Worth Lagoon
Caloosahatchee Estuary

Ecological Model for Hypothesis Clusters (RECOVER 2005)

Fish Abundance Conceptual Ecological Model (see Figure 1 below)

3.2 Relationship to Adaptive Assessment Hypothesis Clusters

Ecological Premise: Prior to upstream water management (and post-inlet construction), the Northern Estuaries exhibited an ecologically appropriate range of salinity conditions, with fewer salinity extreme events, supported broader coverage and higher diversity of SAV, oysters, fish and other epibenthic communities.

Northern Estuaries Fish Hypotheses

Hypothesis 1 - Changes in the salinity envelope in the northern estuaries will have the least detrimental effect if they mimic natural climatically driven salinity regimes (ex. wet season vs. dry season), and if salinity shifts are more gradual and extreme rapid changes are avoided.

Rationale. Estuarine populations of stenohaline fishes are most sensitive to atypical salinity regimes as either larvae (spotted seatrout), juveniles (tropical reef fish: yellowtail, lane and mutton snapper) or adults (spawning spotted seatrout and common snook). Therefore the timing and severity of salinity fluctuations becomes an important factor in reproduction and growth. Euryhaline fish populations that often associate with oligohaline habitats show a positive association with increased freshwater flows relative to food availability (ex. feeding adult common snook).

Hypothesis 2 - Natural healthy soft sediments support healthy estuarine fish communities while excessive accumulations of anoxic muck can have a negative influence on the community.

Rationale. Soft sediment (mud) fish communities have a positive association with healthy fine sediments, mud and their benthic animal communities as a food source (primarily gerreids, mugilids and engraulids) and habitat source (gobioid fishes). Benthic soft sediment invertebrate communities support the largest biomass component of indigenous St. Lucie/Loxahatchee River fish communities. On the contrary, abiotic fine sediments ("muck") do not support this same soft sediment (mud) fish community and can create a bottom devoid of life often accompanied by anoxic conditions.

Hypothesis 3 - Riverine and estuarine sediment composition and dynamics dictates recruitment success in centropomids, gerreids, and gobioids dependent on the northern estuaries.

Rationale. Sediment deposition and distribution is directly associated with stream configuration (ex. meander vs straightened) and topography, flow dynamics, water depth and stream bank location and proximity, thus directly influencing the population status of fish species that associate with shallow marginal sediment deposits (centropomids, gerreids, and gobioids).

Hypothesis 4 - Healthy oyster bed habitat is essential for the survival of oyster dwelling fish. Population dynamics in *Gobiosoma bosc* (Gobiidae) is influenced by: (1) oyster reef structure; (2) live versus dead oyster reef structure; (3) age and degradation/deterioration of oyster reef systems.

Rational. *Gobiosoma bosc* plays an major trophic role in northern estuaries due to its numerical dominance of riverine ichthyoplankton and as the major vertebrate species directly associated with oyster reefs as critical habitat, feeding and spawning sites. G*obiosoma bosc* is a major prey item for planktivorous fishes, chaetognaths, ctenophora, and as an adult prey for juvenile gray snapper *Lutjanus griseus*.

Hypothesis 5 - Estuarine seagrass and nearshore hard bottom dependent populations of juvenile tropical reef fish (lutjanids, serranids, scorpeanids, gobiids, blenniids and labrisomids) show a positive relationship with salinity, ex. higher densities at higher salinities,

Rationale. Spawning populations of seagrass/Reef associated marine/mesohaline/polyhaline fish species are most affected by atypical (aseasonal) reduced salinities during their spawning period. Life history, growth and mortality of marine/mesohaline/polyhaline seasgrass/reef associated fish species are negatively influenced by atypical/aseasonal reduced salinities.

Hypothesis 6 - Healthy freshwater emergent herbaceous vegetation has a direct relationship to oligohaline fish. Population dynamics, distribution and survival in syngnathids (opossum pipefish, *Microphis brachyurus lineatus*), eleotrids (fat sleeper, *Dormitator maculatus*; spinycheek sleeper, *Eleotris pisonis*) , poeciliids and centrarchids are influenced by freshwater emergent vegetation species distribution quantity and vegetative structure.

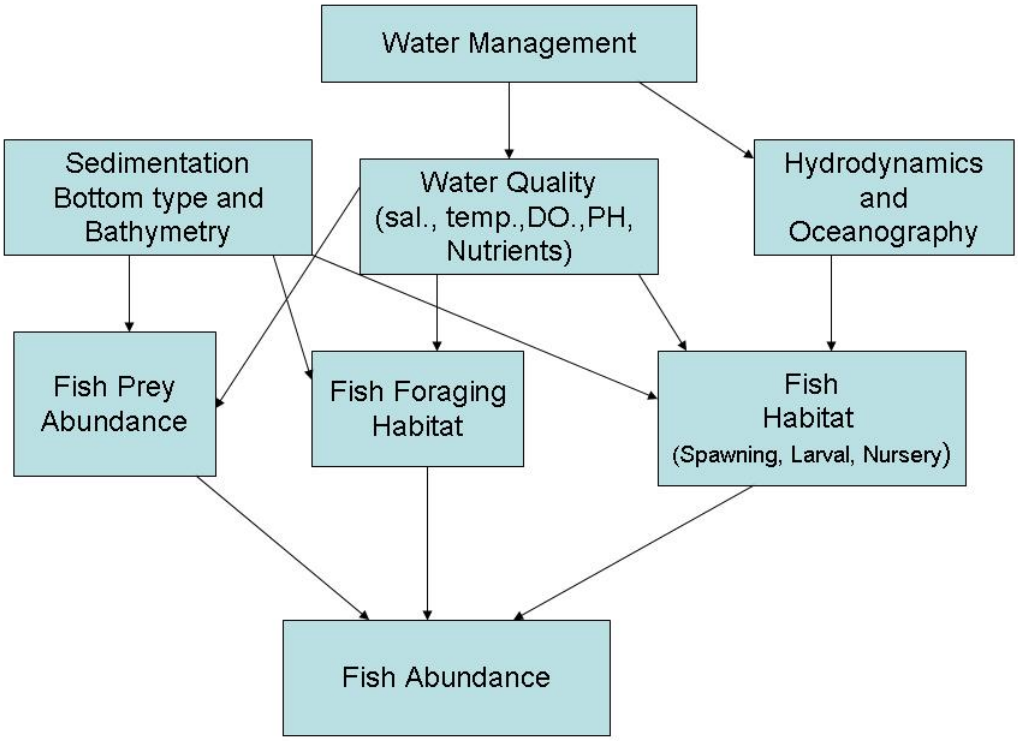

Figure 1 – FISH ABUNDANCE CONCEPTUAL ECOLOGICAL MODEL

4.0 Evaluation Application

4.1 Evaluation Protocol

(See NE Salinity Envelop – St. Lucie and Caloosahatchee Estuaries).

4.2 Normalized Performance Output

(See NE Salinity Envelop – St. Lucie and Caloosahatchee Estuaries).

4.3 Model Output

(See NE Salinity Envelop – St. Lucie and Caloosahatchee Estuaries).

4.4 Uncertainty

(See NE Salinity Envelop – St. Lucie and Caloosahatchee Estuaries).

5.0 Monitoring and Assessment Approach

5.1 MAP Module and Section

See *CERP Monitoring and Assessment Plan: Part 1 Monitoring and Supporting Research* - Northern Estuaries Module section 3.3.3.7 (RECOVER 2004a).

5.2 Assessment Approach

NA

6.0 Future Tool Development Needed to Support Performance Measure

6.1 Evaluation Tools Needed

Active and passive acoustic arrays, acoustic/planktonic transects.

6.2 Assessment Tools Needed

7.0 Notes

This Performance Measure supersedes and addresses NE-14 Northern Estuaries Fish Communties (Last Date Revised: Sep 21, 2005).

8.0 Working Group Members

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9.0 References

RECOVER. 2004a. CERP Monitoring and Assessment Plan: Part 1 Monitoring and Supporting Research. Restoration Coordination and Verification Program, c/o United States Army Corps of Engineers, Jacksonville District, Jacksonville, Florida, and South Florida Water Management District, West Palm Beach, Florida.

RECOVER. 2004b. Draft Conceptual Ecological Models. In: RECOVER. CERP Monitoring and Assessment Plan: Part 1 Monitoring and Supporting Research, Restoration Coordination and Verification Program, c/o United States Army Corps of Engineers, Jacksonville District, Jacksonville, Florida, and South Florida Water Management District, West Palm Beach, Florida, Appendix A.