An Application of Otolith Elemental Fingerprinting in Tampa Bay, Florida

By Janet Ley (Presenter), Carole McIvor, Ernst Peebles and Holly Rolls
Overview

• Red drum & Snook: ecological similarities
• Status of Tampa Bay fisheries for Snook and Red drum
• Juvenile habitat issues
• Research question: Are some nurseries consistently better than others?
Life History: tidal tributary nurseries

- Spawning: offshore, in passes
- Larvae develop in marshes near the mouth of the Bay
- Juveniles move upstream into tidal tribs
  - Grow up fast!!
  - Tidal tributaries are nurseries
- Move into the Bay as they grow
- Prime fishery species

Red drum: age 0 juvenile
Snook: age 0 juvenile
Gulf Coast Fisheries for Snook

- Recreational only, since 1957
- Gulf Coast, 2004
  - 1.5 million anglers targeting snook
  - Doubled since 1980s
  - 2 million fish caught
    - 97% released alive
    - 2% die after release
    - 112,615 fish killed
      - 27% age 4
      - 36% age 5
      - 21% age 6

Most recent stock assessment: 2005
Gulf Coast Fisheries for Snook

• Management
  • Seasons:
    • 7 Closed months: Jan, Feb, May, Jun, Jul, Aug, Dec
    • 5 Open months: Mar, Apr, Sept, Oct, Nov
  • Size limits:
    • Slot 28 to 33 in. TL
    • Age range 4 to 7
  • Bag limits:
    • 1 fish
  • Snook stamp
    • $2 permit to keep a snook

• Status of the stocks: overfished
  • Goal of 40% SPR
  • As of 2005, Gulf coast: 25% SPR
  • Improving, but still not at the goal
Gulf Coast Fisheries for Snook

- Despite tough regulations, stocks have not recovered to desirable levels
- Why?
- **Habitat loss and degradation**
- Juveniles: a critical stage
  - 10 years of FIM
  - First year of life in tidal trib: boom & bust
  - Does a boom year for recruits produce strong subsequent year classes in the Bay?
    - 3 yr olds, 3 years later?

**Snook Small Seines**
Tidal trib

**Snook Large Seines**
Bay

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Gulf Coast Fisheries for Red drum

- Recreational only, since 1988
- Gulf Coast, 2007
- 2 million anglers targeting RD
- Doubled since the 1990s
- 3 million fish caught
  - 85% released alive
  - 5% die after release
- 577,500 fish killed
  - 46% age 1
  - 37% age 2
  - 9% age 3

- 92%
Gulf Coast Fisheries for Red drum

- **Management**
  - **Seasons:** no closed seasons
  - **Size limits:** Slot 18 to 27 in. TL
    - 1 to 3 years old
  - **Bag limits:** 1 fish
- **Status of the stocks:** *overfished*
  - Based on stocks in bays & estuaries
    - up to 4 yr old
    - **Aim:** 40% escapement
    - **As of 2007, 37%**
    - **Forecast:** declining due to demand
  - Age 5 yr, & older: in Gulf
    - Unlikely to encounter rec anglers
    - Most survive
Gulf Coast Fisheries for Red drum

• Like snook, despite tough regulations, stocks have not recovered to desirable levels
• Why?
• Habitat loss and degradation
• Juvenile: critical stage
  • 13 years of FIM monitoring
  • First year of life in tidal tribs: boom & bust
  • Does a boom year for recruits produce strong subsequent year classes in the Bay?
    • 2 yr olds, 2 years later?
    • No: a disconnect
• Catch & release recreational fisheries
• Increasing demand
• Tough regulations
• Still, overfished
• Why not recovering?
  • Young do recruit to tidal tribus
  • But enough may not survive to replenish the Bay stocks
  • Probably due to habitat factors in their nursery
A “good” nursery should produce relatively more fish that move into the Bay:

• “NURSERY PERFORMANCE”

Critical questions:

• Is a particular tidal tributary a “good” nursery for snook & red drum?
• Do many of the young produced there eventually move into Tampa Bay?

Tracking movement from nursery to Bay

• How?
  • Artificial transmitters & tags?
  • Natural tags
  • Genetics
  • Internal chemical “tags”: otoliths
• Otolith: Ear bone
• Whole, sectioned
• Rings added daily
• Annual patterns, like tree rings
  • Winter: opaque
  • Summer: transparent
• Count the rings: age the fish
A natural tag:  

**Otolith elemental fingerprint**

- Otolith bonus
- Chemicals in each ring
  - Permanently stored
  - Water mass the fish was living in when it was formed!!
- Used to “track” a fish’s movement among habitats during its lifetime
- **Otolith chemistry:** what tidal tributary did an adult in TB grow up in?
- A new technology
- Does it work for Red Drum and Snook?
1. Do snook juveniles differ between Florida’s coasts?
   - Yr 0 to 1 Snook
   - Gulf: Charlotte Harbor
   - Atlantic: Tequesta
   - Each coast had a distinct fingerprint

2. Do adult snook in Florida Bay come from east or west coast stocks?
   - Where do they “nursery”?
   - The answer is not clear from her data

Use multivariate statistics to identify patterns based on several elements
For Red Drum, Patterson 2004
Do red drum juveniles differ between Florida’s coasts?
Yr 0 to 1 Red drum

Atlantic vs. Gulf stocks
Gulf: Louisiana, Alabama, Cedar Key, Tampa Bay, Charlotte Harbor
Atlantic: South Carolina, Georgia, Indian River
BUT, what is this 3rd group?
**Tampa Bay:**

- The only site sampled > 1 year
- In 1982 & 1998, TB was like other Gulf sites

**1999:**

- Tampa Bay grouped with Cedar Key 99
- Why?
- El Nino: 1999 very rainy **dry** season
- Account for year to year variation!
Do juveniles differ in Everglades-related habitats?

- Florida Bay, Biscayne Bay, Keys, Dry Tortugas, 10,000 Islands
- Gray Snapper
- Lara, Jones et al. 2008

Differences between areas < 50 km apart
Our study objectives:

1. Find out if otolith chemical fingerprints can be distinguished for juveniles in tidal tributaries around Tampa Bay
2. Determine if adult fish sampled in Tampa Bay “nurseried” in particular tidal tributaries
3. Determine if fingerprints and nursery-use differ among years
4. Explore environmental factors leading to variation
Phase 0: Otolith fingerprint

- Testing this concept in Tampa Bay
- FIM archived samples from:
  - Regular FIM collections
  - Tidal Tribs studies, 2005-current
  - Juvenile snook
    - n = 400+
  - Juvenile red drum
    - n = 400+
- A TEST:
  - 2005 Red drum sub-sample
  - Otoliths processed whole by USF Marine Science labs
Phase 0: Otolith fingerprint: 2005 recruits

- Preliminary test procedures:
  - Extraction of otoliths from 24 red drum juveniles
  - Cleanse
  - Dissolve whole otolith
  - Mass spectrophotometer
  - 19 elements
Phase 0: Otolith fingerprint: 2005 red drum

National Fish Habitat Action Plan:
Grant obtained March 2009
Phase 1: Otolith fingerprint: 2006 recruits

- Final project procedures:
  - Extraction, cleanse
  - Section
  - Laser ablation
  - Plasma
  - Mass spectrophotometer
  - 31+ elements
A key question: consistency among years?

Samples from 40+ tribs:

- 2007
- 2008
- 2009
• Otolith cores: laid down in first year of life
• Retains the fingerprint of the nursery
• Sample from core to edge with laser
Phase 4: Environmental factors & otolith variation

• Sources of variation in water & otolith chemistry in tidal tributaries around Tampa Bay?
• Relate to patterns in:
  • Geology/Sediments
  • Freshwater inflow
  • Access to the Bay
  • Land use & runoff
National Fish Habitat Action Plan

USGS

Mclvor, Ley, Peebles, Rolls

Final report 2012