Biological response to changes in climate patterns: Gray snapper population explosion in Texas bays and estuaries

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*Lutjanus griseus* (Linnaeus, 1758)

Gray snapper, Mangrove snapper
Mango snapper, Pensacola snapper

http://fishbase.sinica.edu.tw/tools/aquamaps/receive.php
Early Life History
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- Summer spawner
  - June to Sep.
- Offshore
  - At night, synchronous with moon phase
- Juveniles (12-52 mm)
  - Overwinter in estuaries
  - Thermal limit ~11-14 °C
- Euryhaline (1-66 °/00)
- Structure oriented
Local Population Structure

- Numbers increasing ++
  - Targeted in late summer/fall
  - Around structure, esp. in areas near deeper water
- Not currently regulated
  - No size / bag limits
- Most fish 0.5 – 1.5 lb. range
  - 2 to 3 yr. olds
  - Migrate offshore ~ 4 yr. Live 25+ yrs. (L8 ~ 35 in.)

Photos courtesy D. Sikes (Caller-Times)
Methods

- Routine Monitoring (Fishery-Independent)
  - Bag Seines, Otter Trawls, Gill Nets
  - 1982 to present
  - All major bay systems (Sabine to Lower LM)

- Environmental Observations
  - Temp, Salinity, D.O.

- Evaluate time series of gray snapper catch and try to relate it to environmental driver
Gray Snapper Catch 1982-2007

Results

N = 2,953
Results

Bag Seine

Otter Trawl

Gill Net
Temperature

EOF Mode 1, explaining 96.4% of the total variation;
Component loading scores range from +0.976 to +0.985
Temperatures’ Effect on Snapper

![Graph showing the effect of temperatures on snapper over the years.](image)

- **Summer Maximum**
- **Winter Minimum**
- **Lower Lethal Limit**

Legend:
- Sabine-Neches
- Trinity-San Jacinto
- Lavaca-Colorado
- Guadalupe
- Mission-Aransas
- Nueces
- Laguna Madre
Temperatures’ Effect on Snapper
Other “Tropical” Species and Temperature

Common Snook (*Centropomus unidecimalis*)

*** Lower Laguna Madre Gill Net Data
Other “Tropical” Species and Temperature

![Graph showing annual abundance estimates for Common Snook and Tarpon from 1978 to 2008.]

- **Common Snook** (Centropomus unidecimalis)
- **Tarpon** (Megalops atlanticus)

*** Lower Laguna Madre Gill Net Data
Temperature’s Effect Not Always Positive

Southern Flounder (*Paralichthys lethostigma*)

![Graph showing annual abundance estimate for Southern Flounder using coast-wide gill nets between 1982 and 2008. The graph indicates that the temperature's effect on abundance is not always positive.]
WHY ???
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Vostok, Antarctica, ice-core CO$_2$ Record

Source: Jean-Marc Barnola et al.

http://solarscience.msfc.nasa.gov/SunspotCycle.shtml
Fundamental Cycles in Solar Activity

87 Year Gleissberg Cycle
11 Year Sun Spot Cycle
From 1750 to 2010, the 87 Year Cycle should nearly complete 3 full cycles.
Detrended Sun Spot Activity (Base Period = 132 months)
Sun-Climate / NAO Linkage

1831-1910: "Normal" Period

1911-1960: Increased Activity Period

1961-1980: Decreased Activity Period

1981-2007: Record Activity Period

Positive Phase of the NAO:
- Stronger than usual subtropical high and a deeper than normal Icelandic low.
- Results in mild, wet winter conditions over the Eastern U.S.

http://www.ldeo.columbia.edu/res/pi/NAO/
The “thermal opening” of Texas estuaries has allowed gray snapper (as well as many other tropical species) to proliferate locally.

This species should remain abundant until winter-minimums “close” the estuary.

Temperatures in the upcoming decade should be “normal” to cooler-than-expected.

Because the source population remains in the Gulf, they should be able to “weather” the next series of polar fronts!!

- But estuarine abundance levels should return to Pre-1993 levels.