## Living Marine Resources

## NOAA FISHERIES

The Heartbeat of Ocean Observations

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## NOAA Fisheries Mission

Stewardship of living marine resources through science-based conservation and management and the promotion of healthy ecosystems.

## Case for incorporating environmental data into stock assessments

With Magnuson-Stevens Act we have largely ended overfishing, identified and protected critical habitat

One might consider our job as done, but ...
we and the species on which we work live in a dynamic environment

Aim of our 'Next Generation' of population assessments is to explicitly consider environmental factors

## Some examples

- 1. Satellite derived indices of red tide severity
- 2. Modeling recruitment
- 3. Poleward shifts in swordfish distribution
- 4. Oxygen minimum zones and habitat compression


## Red Tide



## Red tides (Karenia brevis) in Gulf of Mexico



- Dinoflagellate, Karenia brevis
- brevetoxin paralyzes, suffocates fish and mammals; bioaccumulates by ingestion
- First recorded by Hernan De Soto 1500's
- 1946-47 bloom estimated kill of 500 million fish
-Human health concern
- shellfish and beach closures
- Large research initiatives (EcoHab, FWRI, etc.)

NMFS survey in 2005 sampled during the red tide event. One station was close to a very high in red tide measurement.


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## By September red tide was everywhere sampling extended

Karenia brevis Counts, September 26-30, 2005


Red tide overlaps the core grouper distribution, particularly the inshore regions


NMFS longline survey stations

Karenia brevis Counts, September 26-30, 2005


FWRI red tide Data

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## SeaWiFS satellite-derived indices of red tide probability

## 2005 Bloom

2010 No red tide

Avg probability


Avg se


Avg probability


Avg se


Including the index greatly improves population modeling and explains what was otherwise unexplained declines ( $20 \%$ of the population, or 8 million gag and red grouper combined) in 2005


Walter et al 2013

## 2005-06 Red and G2.̧g Grouper indices ~ 50\% decline

$\curvearrowleft$ Video
$\curvearrowleft$ Comm LL
$\pm$ Comm HL
$\simeq \mathrm{HB}\left(18{ }^{\prime \prime} \mathrm{MSL}\right)$
米 HB(20" MSL)
geto-MRFSS

## Red snapper stock:recruitment



## Stock - recruitment relationship



## We know where the currents are...

## (www.hycom.org)

- Data-assimilative hydrodynamic model (HYCOM)

...and we know where the eggs are released and where the larvae settle...




## Spawning time:

May 1 - Oct 31
Spawning frequency:
every 5 days
Pelagic larval duration:
26-30d



## ...so we can model recruitment events



## Oceanographic currents

## 2008 - bad year

Larvae advected away from settlement areas

## 2012 - good year

Larvae advected towards settlement areas



## Larval transport in good vs. bad years



## Red snapper 2012 assessment




Karnauskas et al. 2013.

## Effect on stock assessment model

## -Integrating environmental factors into stock assessment reduces "cone of uncertainty"



## Atlantic swordfish distributions



## A HYPOTHESIS OF A RECENT POLEWARD SHIFT IN

## THE DISTRIBUTION OF NORTH ATLANTIC SWORDFISH

## VERSION 1.0

## DRAFT

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## This study sought to address three questions:

- (1) is there sufficient evidence to conclude that there has been a recent poleward shift in the Swordfish distribution in the north Atlantic;
- (2) if so, can this shift be quantified and are we making progress by accounting for it within the stock assessment model; and
- (3) assuming number one is true, is this poleward shift unidirectional, or are we merely observing an abbreviated section of a reoccurring decadal cycle, the direction of which could change again sometime in the future?

Month


## Change in CPUE Coincident with switching in AWP and the AMO



# Expanding Oxygen Minimum Zones, Iropical Pelagic Predators, and the Atlantic LL Eisheries that Exploit them: 

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## Tropical tunas and billfish have high a performance physiology



- They are all obligate ram ventilators;;
- They requite large amounts of dissolved oxygen; and,
- Start exhibiting physiological stress below DO concentrations of about $3.5 \mathrm{mLL} \mathrm{L}^{-1}$, the hypoxic threshold used in this study:



## Compression Impacts and the Stiock Assessment Process



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Aim of our 'Next Generation' of population assessments is to explicitly consider environmental factors

Partnerships with OOS are critical for this to succeed

