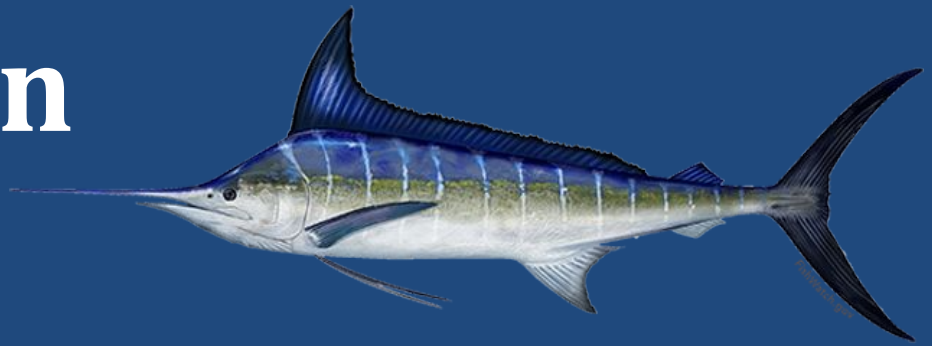
Striped Marlin (*Kajikia audax*) in the Eastern Pacific Ocean



Stakeholder Positions

- Recreational fishermen and sport fishing clubs
  - Advocate to ban harmful fishing practices and commercial catches
  - Mostly catch and release
- NGOs
  - Mitigate wasteful bycatch, conserve natural resources, and advocate for less harmful fishing practices
- Economists/trade experts
  - Advocate for both fisheries but acknowledges that recreational fishermen may spend more money per fish caught than commercial fishermen
- Commercial fishermen and communities
  - Sustain regional livelihoods
  - Wish to avoid bycatch
  - Secure nation's food security

Purpose Statement

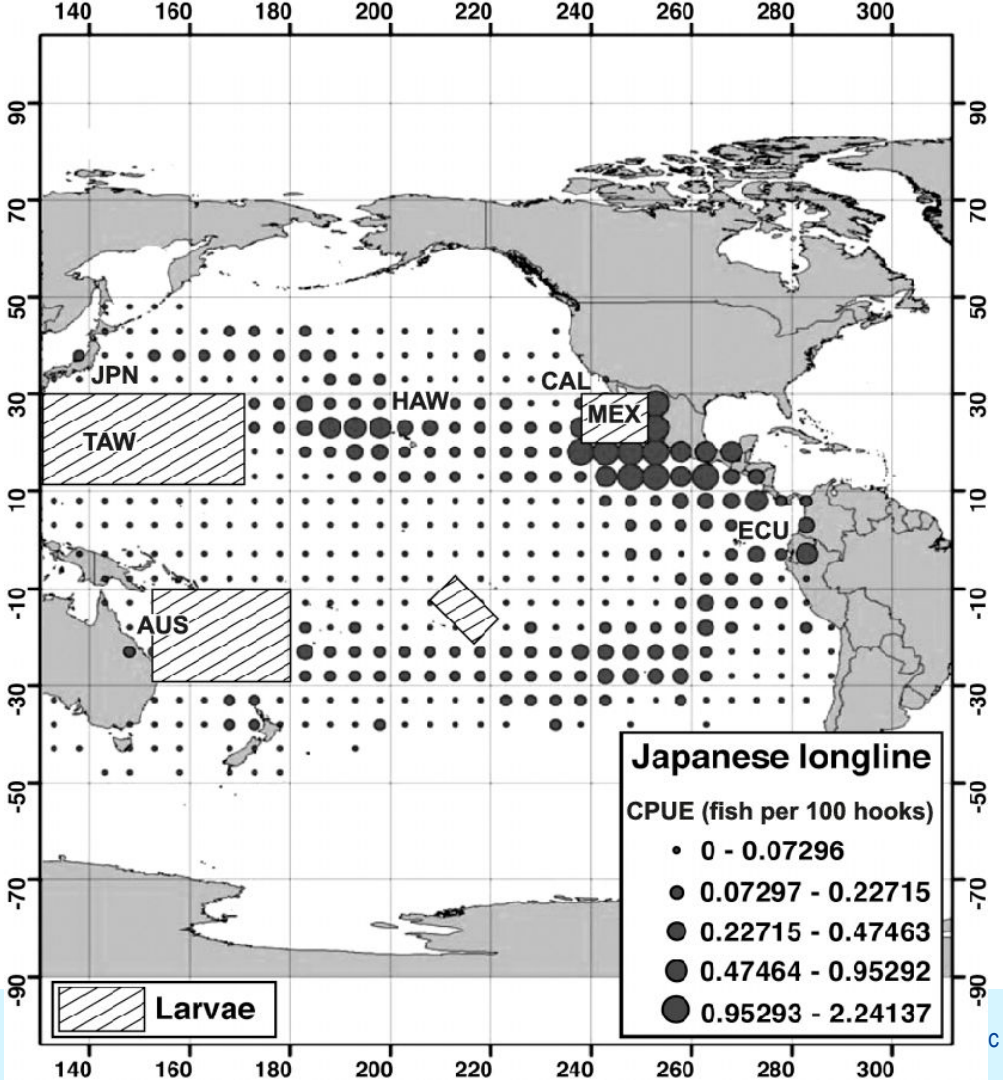
Given these diverse and contrasting perspectives… what responsibilities does NMFS have for managing Striped Marlin in the Eastern Pacific Ocean and how can they include all of these stakeholders interests in the most efficient way possible?

The purpose of this report is to compile information for managers about the current status of Striped Marlin throughout the Pacific, with a particular focus on the EPO.

This report will conclude with potential areas of focus for managers.

Biology

- Fast Maturation
  - Half of all females mature by age 2 and typically live around 8-10 years
- Horseshoe-like distribution within the Pacific (see next slide)
- Site fidelity and batch spawners
- Known areas of spawning and peak spawning months
  - Refiallgo Islands, Mexico, Ogasawara Islands, Japan, off the coast of Taiwan, and off the Eastern Coast of Australia
  - May-July
- Epipelagic
  - Spend a majority of their lives within the first 10 m of water column
  - Dive to depth at forage with deepest depth recorded at 532m
- Low thermal tolerances
  - Enjoy warm waters between 20-30℃ with highest catch per unit effort (CPUE) recorded within the 20-25℃ isotherm
  - Sea surface temperature (SST) fluctuations within ENSO events can alter distributions



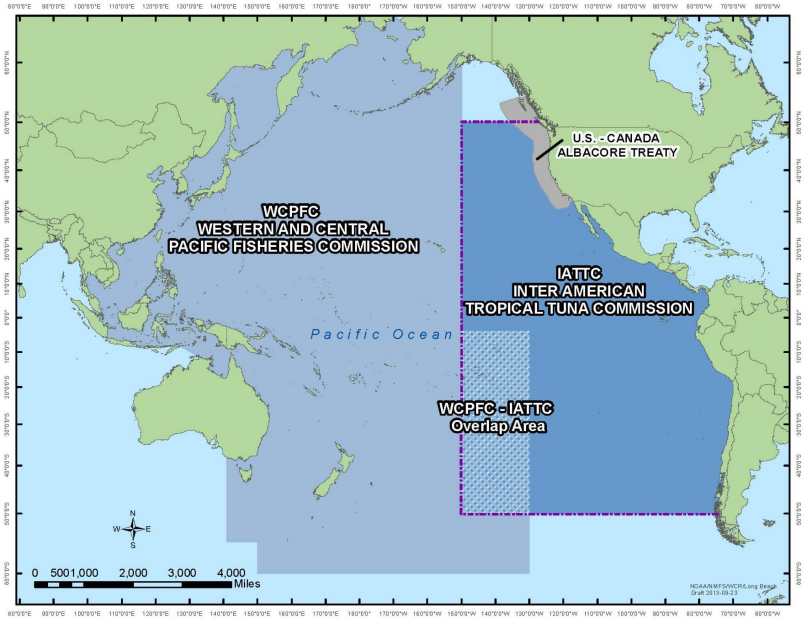
McDowell & Graves, 2008

Resource Distribution and Use

- 3 known genetically differentiated spawning stocks in the Pacific
  - Do not follow IATTC and WCPFC jurisdictional boundaries
- Active recreational fishery in the EPO
  - Hook and line, spears, rod and reel
  - Catch and release
  - Private charters and commercial passenger fishing vessels
  - Mexico, Southern California, and Central America
- Active commercial fishery in the EPO
  - Longline, purse-seine, gill nets
  - Mostly bycatch of other fisheries (tuna and swordfish mostly)
  - Japan, China, and Taiwan

Stock Status

- WCPFC/WCPO: overfished and experiencing overfishing
  - Last stock assessment: 2019 by ISC
- SW Pacific/WCPFC: likely overfished and close to undergoing overfishing
  - Last stock assessment: 2019 by WCPFC
- IATTC/EPO: not overfished or experiencing overfishing
  - Last stock assessment: 2010 by IATTC with a follow up in 2013



Stock Status

Region:	EPO	WCPO
Year assessment finalized	2010	2019
F_{MSY}	2031 mt	0.60
F_{year}	1625 mt	0.80
B_{MSY}	1246 t	2604 mt
B_{year}	1488 t	981 mt

Current Management

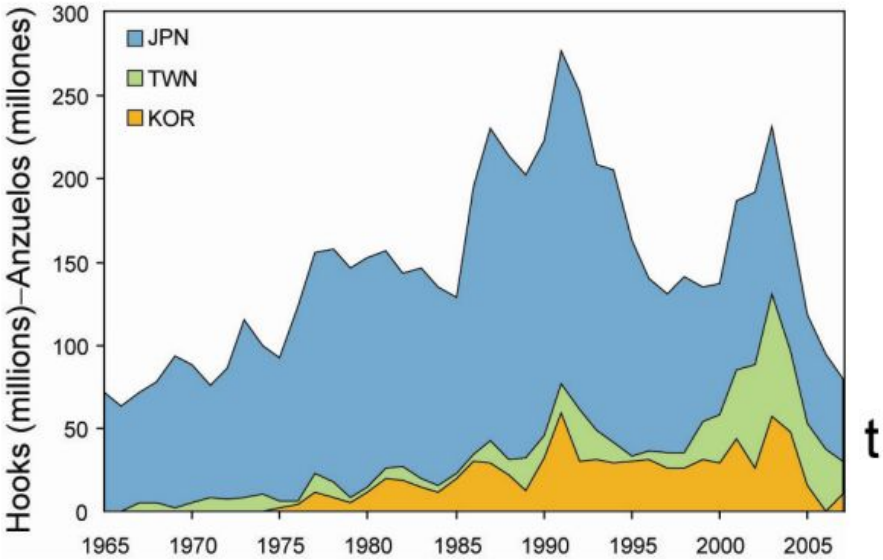
International

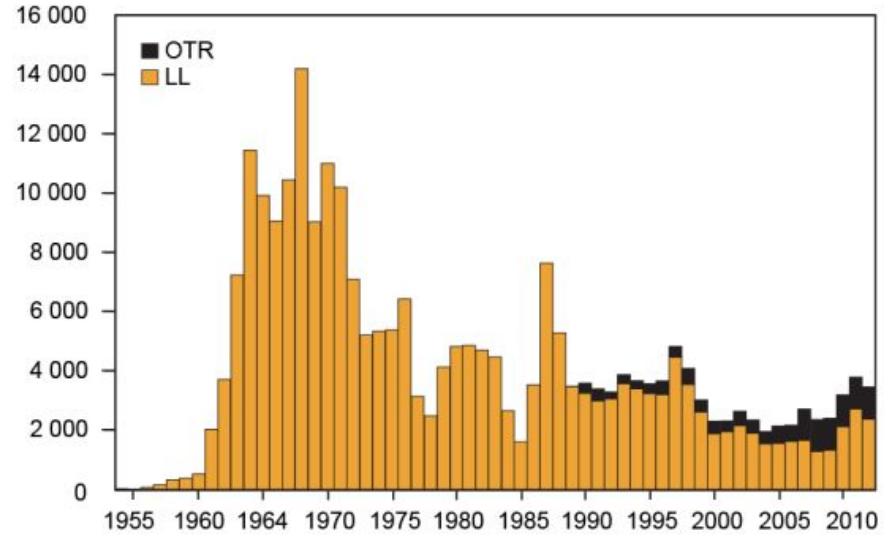
- IATTC in EPO
  - No policies in place specifically regarding SM
- WCPFC in WCPO
  - 2010-01 Conservation Management Measure to reduce highest catch rates from 2000-2003 by 20% in the years 2013 and beyond
  - Follow-up in 2019 indicated there needed to be a further reduction up to 60% given increased fishing effort and decreased recruitment levels

Domestic

- Magnuson-Stevens Act (MSA)
- CA Department of Fish & Wildlife
  - 1 SM per day per recreational fishermen
  - Mexico: 1 billfish per day per recreational fishermen
- Pacific Fishery Management Council & their HMS Fishery Management Plan (2004)
  - Banned sale of SM on West Coast
- Billfish Conservation Act (2012) + amendments (2018) (BCA)
  - Prohibits sale and possession of billfish products
  - Allows domestic landings and sales within the Pacific Island region

Fishing Effort in the EPO





Hinton, 2009

Trends in Fishing Effort in the EPO

- Increases in recreational trips, catches, and landings due to lesser incentive for commercial fishermen from BCA
- Decreases in domestic commercial catch likely due to decreased valuation from the BCA
- Commercial and recreational catches are known to be inversely related
  - 2007: simultaneous record low commercial catch of 1400t and record high recreational catch of 58,000 individuals
- Since 2010 increases in LL fishing effort in the Northern EPO but SM bycatch remains relatively constant (Hinton et al., 2010)
- Since 1997 catches of SM within the EPO have displayed a decreasing trend in annual average catch averaging 1400-1500t in 2007 (Hinton et al., 2010)

U.S. Commercial Fishing Effort in the EPO

Table 1: Summary of Striped Marlin bycatch within different commercial fisheries and regions

Location and Gear	Years	Coordinates	Total Caught	Number Kept	Number Returned		Catch per 1,000 Hooks
					Alive	Dead	
Striped Marlin							
Hawaii SSLL	2004-2019	East of 140W°	165	30	89	46	0.047
Hawaii DSLL	2004-2019	East of 140W°	744	431	127	186	0.199
US WC EEZ DGN	2001-2020						*.3752
Outside US WC EEZ DSLL	2019-2020	Equator & 35N° between US & Mexico's EEZs & 140W°	48	3	26	19	0.069
WC EEZ SSLL and DSLL	2019		0	0	0	0	0

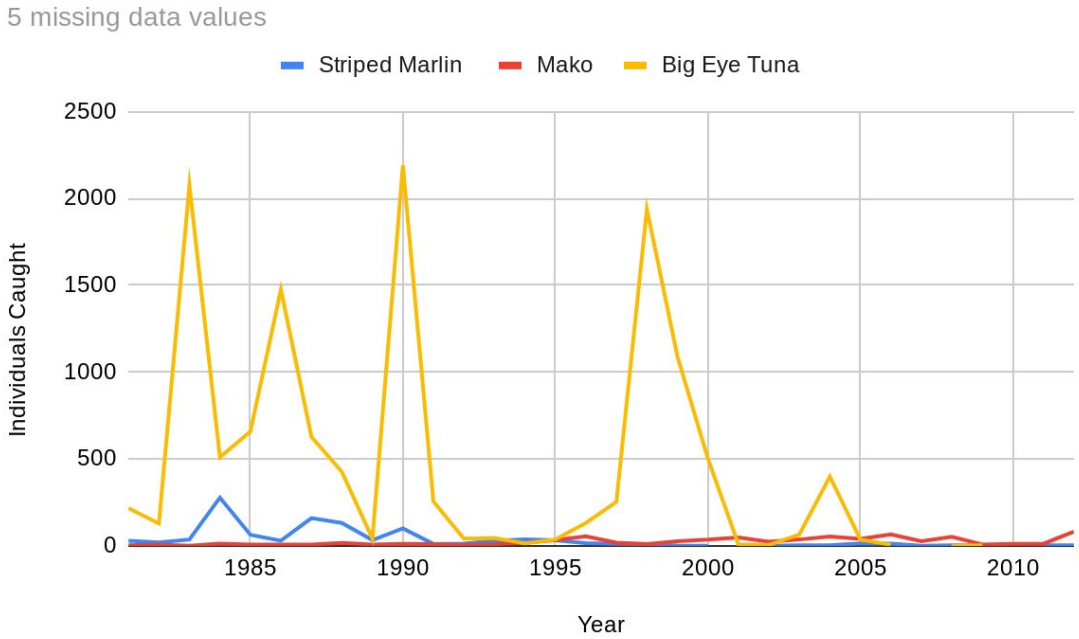
*DGN measures CPUE per 1000 sets rather than per 1000 hooks for LL CPUE

Unpublished data: personal communication with NOAA NMFS SFD HMS

U.S. Commercial Fishing Effort in the EPO

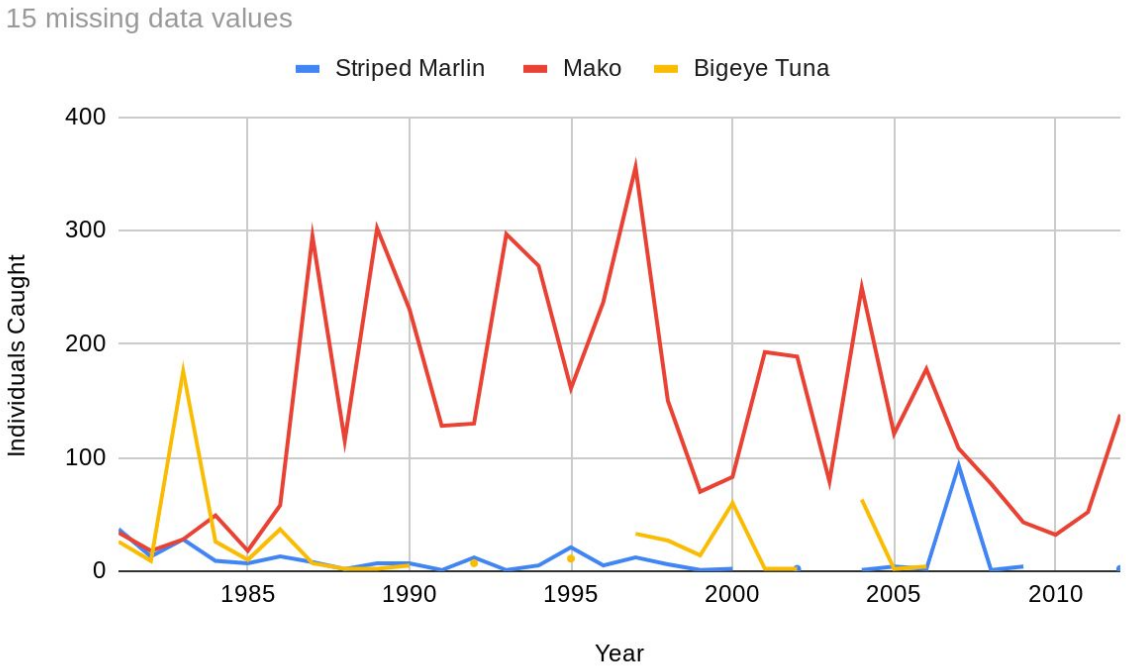
- Hawaii SSLL and US WC EEZ DGN datasets have similar catch rates and fish at similar latitudes (North of 30° latitude)
- Hawaii DSLL and Outside US WC EEZ DSLL datasets have similar catch rates and fish at similar latitudes (South of 30° latitude)
- Hypothesis: Commercial catch rates of SM are based on fishing area and latitude fished more so than fishing gear and depth
- Hawaii LL fleet showing evidence of fishing within the EPO all the way up to the US EEZ and landings back in the Hawaiian Islands
    - Hypothesis: BCA restrictions encourage Hawaii fleets to focus LL effort in the EPO and land back in the Hawaiian Islands (WCPO)

CA CPFV Recreational Catch in Mexico



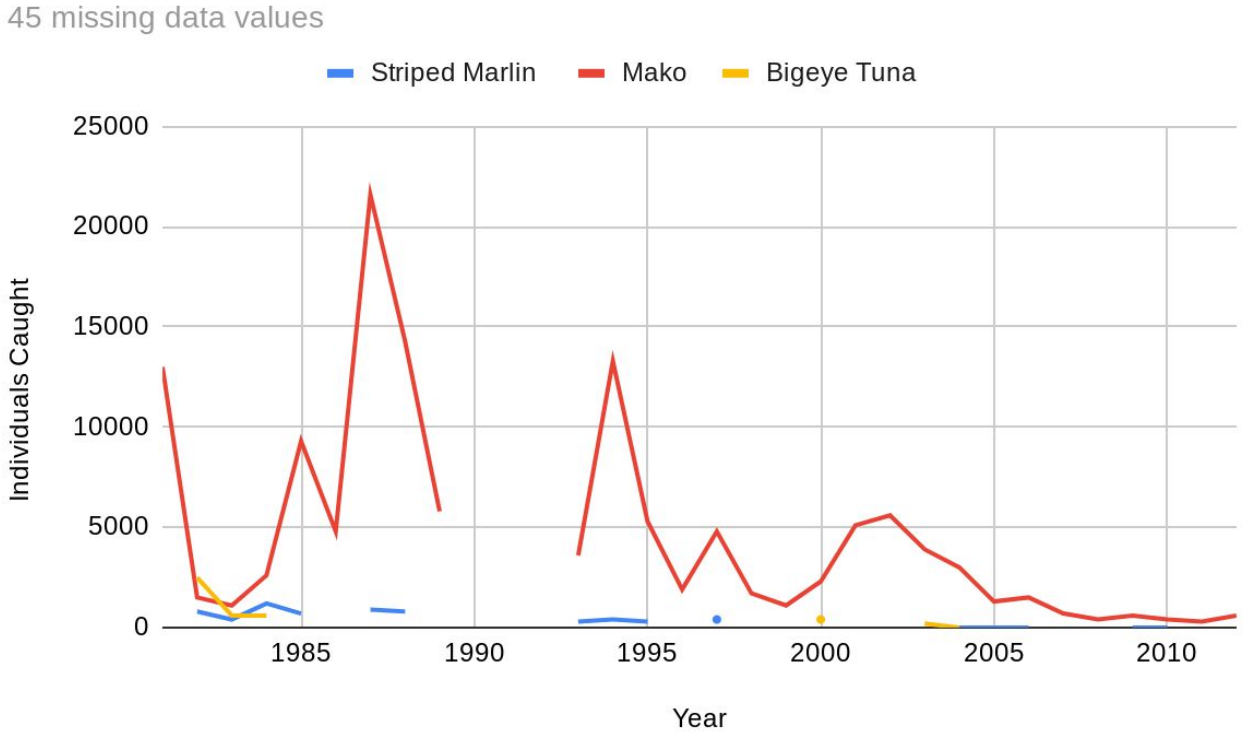
PFMC SAFE Report, 2012

CA CPFV Recreational Catch in California



PFMC SAFE Report, 2012

West Coast Recreational Private Fleet



PFMC SAFE Report, 2012

California Private Vessels in U.S. and Mexico's EEZ

Location	United States EEZ								
Year		2018			2019			2020	
Species	Kept	Released Alive	Total	Kept	Released Alive	Total	Kept	Released Alive	Total
Striped Marlin	20	0	20	6	18	24	0	13	13
Dorado	3149	126	3275	65	0	65	1458	383	1841
BET	0	0	0	0	0	0	0	0	0
Shortfin Mako	199	458	657	148	142	290	15	48	63

Location	Mexico EEZ								
Year		2018			2019			2020	
Species	Kept	Released Alive	Total	Kept	Released Alive	Total	Kept	Released Alive	Total
Striped Marlin	0	0	0	0	0	0	0	0	0
Dorado	888	178	1066	120	11	131	1698	513	2211
BET	0	0	0	0	0	0	0	0	0
Shortfin Mako	0	0	0	0	0	0	0	28	28

Management Options

- Mitigating commercial bycatch through management of fishing gear, times, areas, etc.
  - Balance between mammals, turtles, birds, and fish species
  - Different hooks, depths, times, areas, etc.
- Spatiotemporal closures to specific fisheries
  - Protection of spawning grounds and seasons or other ecologically significant times and areas
- Strengthen international reporting of recreational catches and landings
  - Inconsistencies can cause misinformation and mismanagement
  - Lots of inconsistencies within the private recreational fishing fleets within US and Mexico → what does this mean for other countries within the EPO?

Areas for Future Research

- Completion of a more recent stock assessment in the EPO
  - Given fast maturation status of SM, more than 10 since last assessment, and the status of the most current assessments performed in the Pacific Ocean
  - Would give a better understanding to NMFS about their role in management
  - Sensitive to the other responsibilities that lie within the IATTC/EPO
- Explore more selective fishing gear and practices to minimize SM bycatch and reduce fishing mortality associated with angling
- Spatiotemporal closure
  - Both ecologically and economically efficient areas to close to commercial fishing as a means of increasing SM biomass
- Establishing international reporting and compliance for recreational catches, landings, and monitoring

Questions or Comments?