COMMON OCEANS

Project: Sustainable Management of Tuna Fisheries and Biodiversity Conservation in the ABNJ

Harvest Control Rules and Management Strategy Evaluation

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Components of a Harvest Strategy

- **Objectives**
  - What the strategy is designed to achieve
- **Monitoring**
  - ***Time series*** of indicators of stock and/or fishing
- **Assessment**
  - May be stock assessment or simpler analysis
- **Harvest Control Rule**, or decision rule
  - An agreed specification of ***how the output of monitoring and assessment will change the level of fishing***
- **Implementation**
  - Management measures designed to achieve the specified change in fishing mortality. i.e. ***the proportion of the population killed by fishing.***

Types of Harvest Control Rules

Empirical

Use empirical reference points from fishery history (e.g. CPUE 2001-2004), or empirical "proxies" for model-based reference points (CPUE of average size fish in catch based model estimate of reference point).

Model-based

Use quantities estimated from a stock assessment model (e.g. B_{MSY}, F_{MSY}) as reference points.

Example of a Simple Harvest Strategy

Conceptual Specification:

TAC next year = TAC this year + an adjustment based on change in CPUE

(i.e. adjust TAC upward if CPUE goes up
and adjust downward if CPUE goes down)

Mathematical Specification (determines the exact response):

$$TAC(t+1) = \alpha TAC(t) + (1-a)TAC(t)\ [(CPUE(t)/CPUE(t-1)]$$

Where α is a parameter that determines the extent of adjustment

Key Concepts:

DATA: log books from fleet(s) ASSESSMENT: standardization of CPUE

CRITERION: above mathematical specification plus a specific value for α

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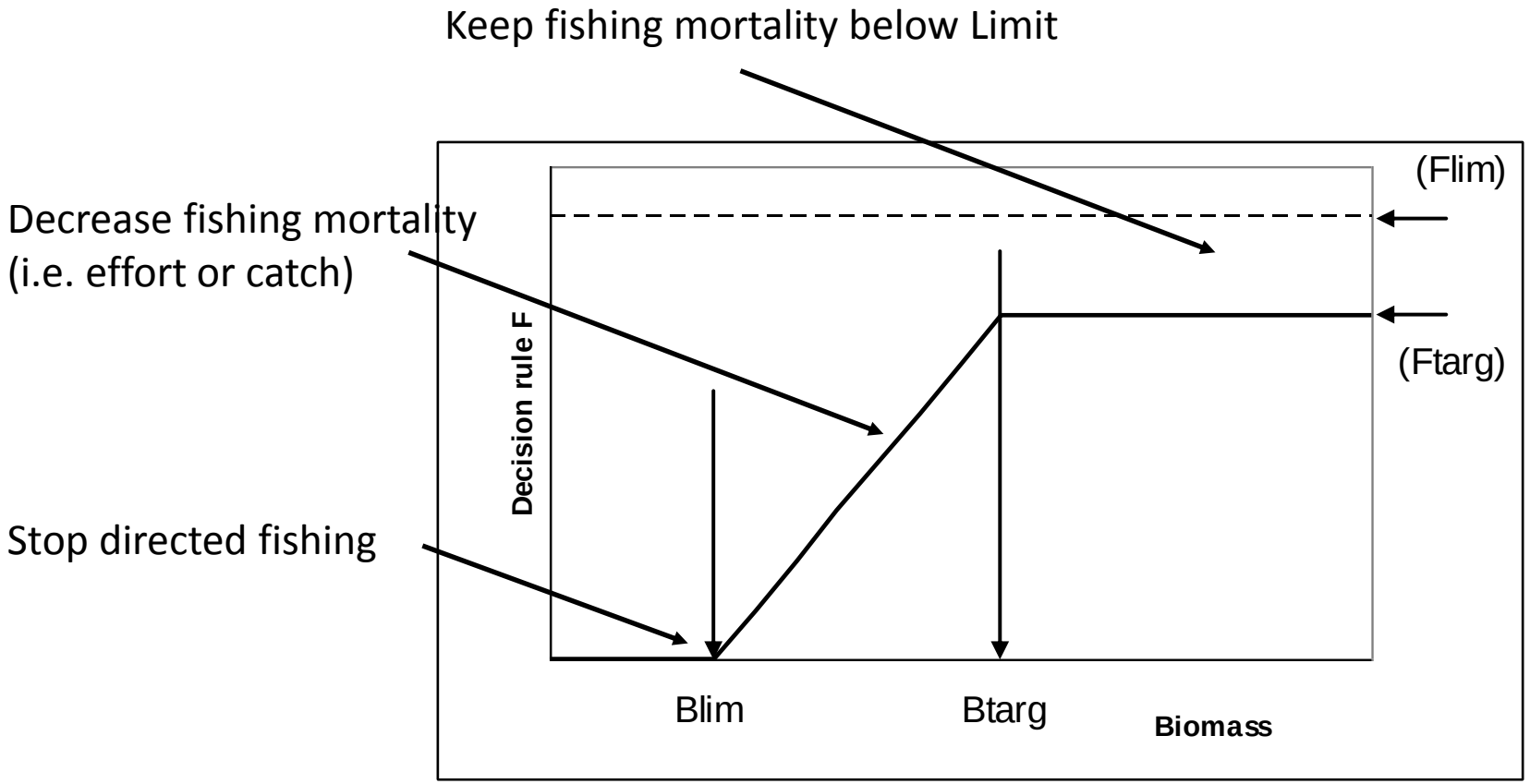
Model Based Harvest Strategy



Management measures

- A range of different management measures can be used to achieve the same objective
  - Catch Controls, Effort Limits, “technical measures”
- Each will have advantages and disadvantages
  - Cost, effectiveness, uncertainties, efficiency, monitoring requirements, robustness
- Formalising how they will be implemented allows their ***potential performance*** to be evaluated ***BEFORE implementation***
- Choose the one most likely to succeed

Benefits of formal Harvest Strategies

- Agreed and transparent basis for management
- Greater understanding of cumulative effects of management decisions, impacts of uncertainty and potential risks
- Experience demonstrates improved outcomes for stocks, fisheries and communities.
- Provide the basis for prospective evaluation of likely performance through management strategy evaluation

Management Strategy Evaluation

What is Management Strategy Evaluation?

- A strategic risk assessment tool
- Prospective evaluation of alternative management strategies though simulation modelling in virtual world
- Selection of management strategies that are most likely to meet management objectives and "robust" to major uncertainties
- Two components
  - Consultative process
  - Technical implementation

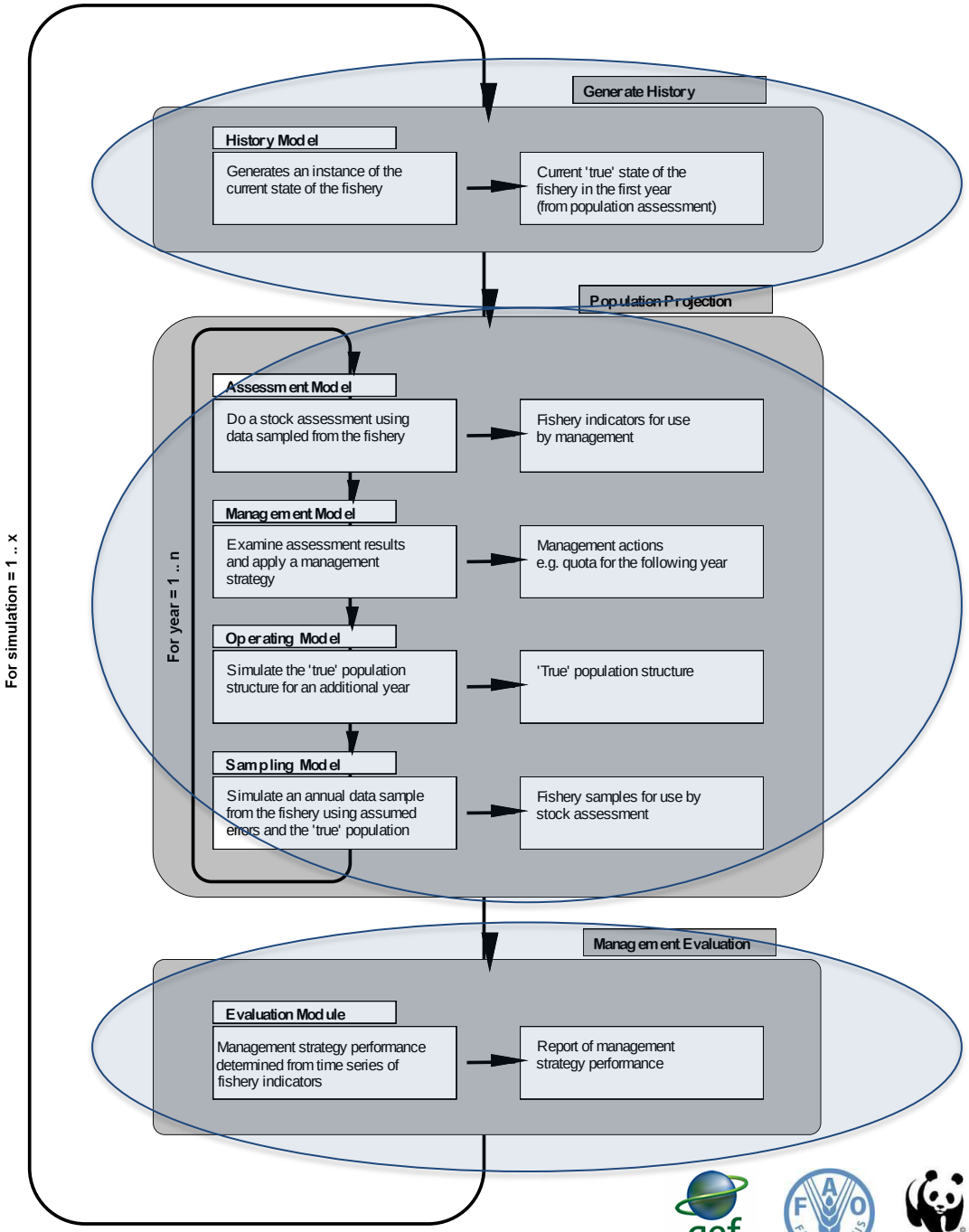
MSE Consultative process

- Facilitate specification of quantitative objectives for management goals and practical, feasible management strategies
- Elicit conceptual models of fishery and stock dynamics
- Reporting, interpretation, discussion and direction to technical process
- Final selection and implementation

MSE Technical Process

- Construction of "**Operating Model**" of stock and fishery dynamics = "virtual fishery"
- Operating model is "**conditioned**" to fishery specific data
- Construction of "**observation**", "**assessment**" and "**management**" models based on feasible alternatives = "management strategies"
- Management strategies are "**evaluated**" in the operating model.
- **Iterative process**: involves several iterations of feedback and refinement based on initial results

Simulation Evaluation



Operating model

Dynamics of “alternative realities”
Provides the “true” values for comparison with the “estimated” values from the projection model.

Projection model

Simulates the population, fishery monitoring and management cycle into the future; including uncertainty in each component.
Reports “estimated” values to evaluation model.

Evaluation model

Summarises performance of strategies against objectives = **performance measures**

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Why do Management Strategy Evaluation?

- **RELATIVE** performance of alternative strategies
- **Trade-offs** across management objectives
  - Yield, efficiency, stability, conservation risk
- Testing "**multiple plausible realities**"
- **Sensitivity and robustness** to known uncertainties (alternative reality scenarios)
- Identify **monitoring** and **implementation priorities** and **cost-efficiency**

Management Strategy Evaluation

- Direct implementation of Precautionary Approach
- Explicitly participatory, iterative process
- Facilitates dialogue between decision-makers, stakeholders and science advisors
- Continuous learning and improvement for management and science – cost-benefit analyses for monitoring and research priorities

Summary

- Experience demonstrates formal harvest strategies a a central component of effective fisheries management
- Management Strategy Evaluation is a strategic risk assessment tool
  - test and select a management strategy that is most likely to meet the stated objectives of the Commission
  - a low probability of undesirable consequences

➢ Practical implementation of the Precautionary approach

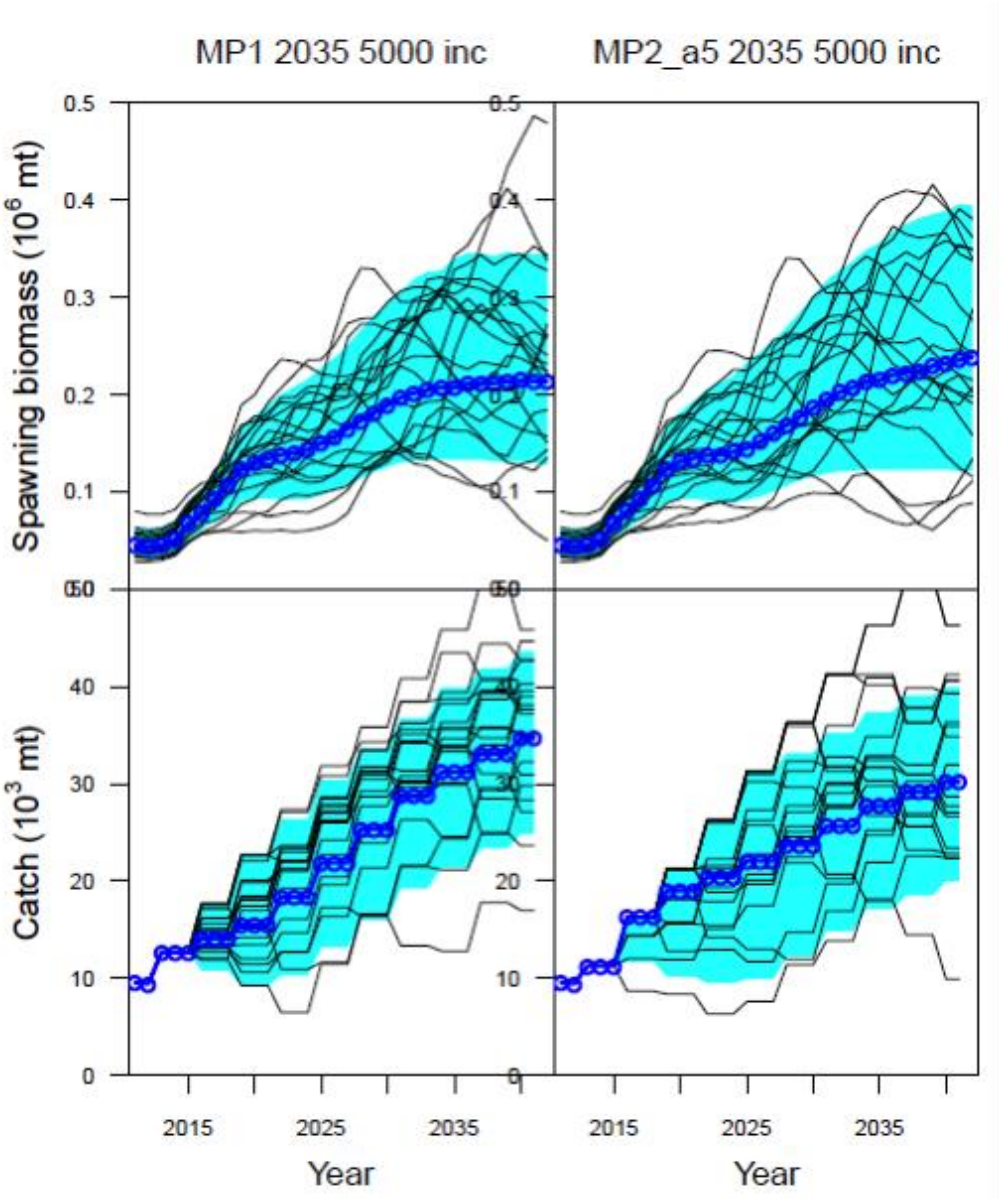
Questions, Comments?

Examples from CCSBT

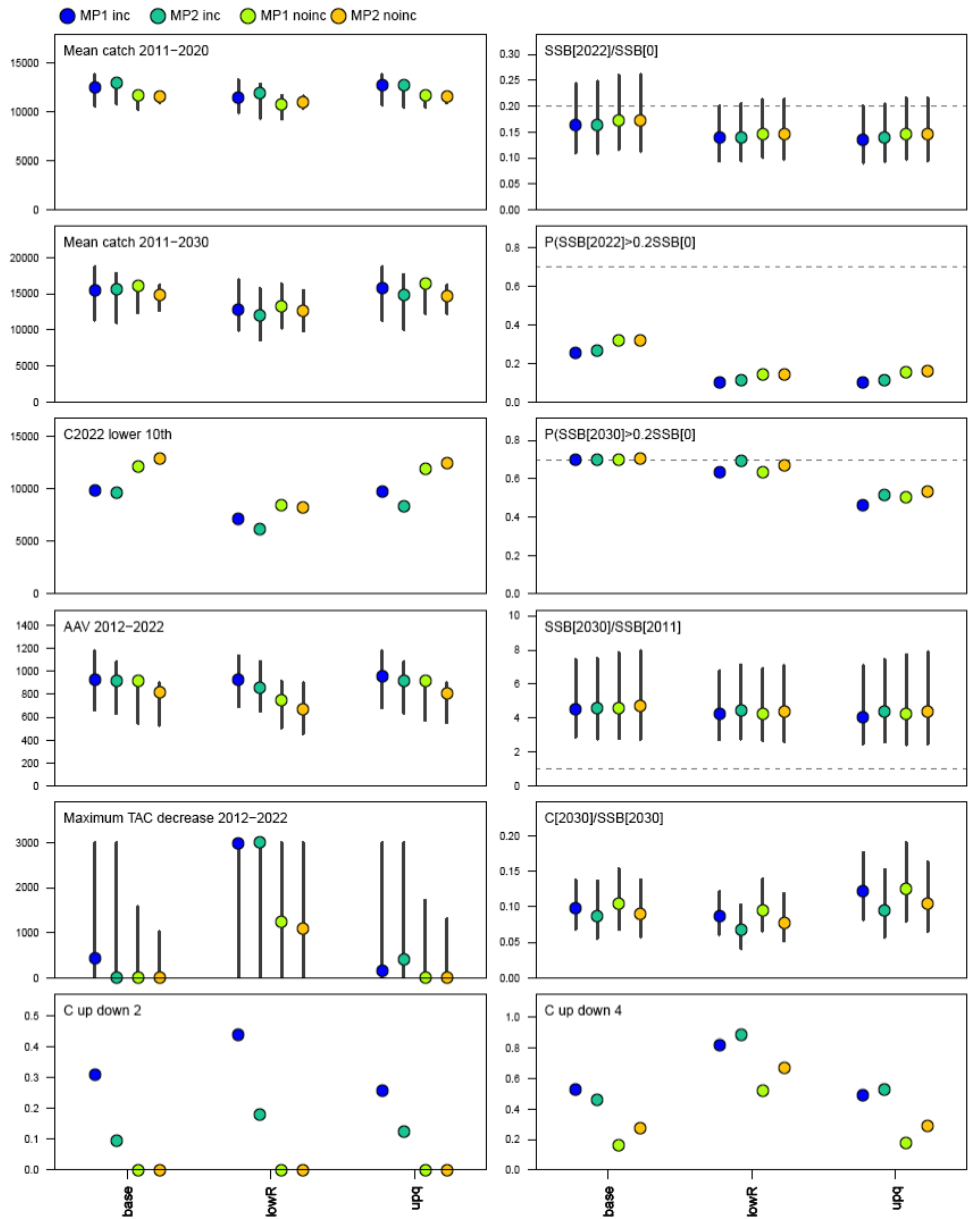
Objectives and performance measures

- Rebuild the spawning stock biomass to 20% of unfished level by 2035 with a 70% probability
- 1st test was ability to meet this objective.
- 2nd test was performance against range of catch, CPUE and TAC variability and size of TAC changes.
- Final test between 2 candidates was robustness to “worst case scenarios”.

Examples from CCSBT



Examples from CCSBT



Examples from CCSBT

Base

Tuning Year	Max Incr	Incr	MP #	Year B_t	$P[B_t > 0.2B_0]$	$P[B_{2035} > 0.2B_0]$	$P[B_t > 0.1B_0]$	$P[B_t > 2B_{2011}]$	$\frac{B_{2025}}{B_{2011}}$	$\bar{C}_{2013-2025}$	$B_{10^{th}\%}$	$C_{10^{th}\%}$	Up then down 2x 1)	Up then down 4x 2)	TAC Smth 3)	P[C_t> C_{2011}] 4)	P[B_t> B_{2011}] 5)	C_t/B_t 10th 6a)	C_t/B_t 50th 6b)	C_t/B_t 90th 6c)	P[B.↓] 7)
2035	3000	Yes	1	2022	23%	70%	92%	91%	3.13	16,100	90,300	11,500	16%	40%	0.25	100%	100%	0.08	0.12	0.17	0.23
2035	3000	No	1	2022	32%	70%	95%	94%	3.39	14,600	96,600	15,300	0%	9%	0.33	100%	100%	0.07	0.12	0.19	0.27
2040	3000	Yes	1	2025	32%	67%	92%	91%	3.08	16,400	90,300	14,200	13%	36%	0.25	100%	100%	0.08	0.12	0.18	0.23
2035	5000	Yes	1	2022	22%	70%	94%	92%	3.18	15,700	92,300	10,300	30%	55%	0.44	100%	100%	0.09	0.13	0.18	0.14
2035	5000	Yes	2	2022	23%	70%	93%	92%	3.07	17,100	91,200	9,500	8%	46%	0.47	98%	100%	0.07	0.12	0.20	0.18
2035	5000	No	1	2022	29%	71%	98%	96%	3.42	15,000	101,600	11,500	0%	24%	0.52	100%	100%	0.09	0.13	0.18	0.23
2035	5000	No	2	2022	28%	70%	95%	94%	3.23	16,000	94,800	12,600	0%	31%	0.51	100%	100%	0.08	0.12	0.19	0.23
2030	3000	Yes	1	2020	16%	83%	95%	94%	3.36	14,400	94,700	9,000	31%	53%	0.28	99%	100%	0.07	0.10	0.14	0.05
2030	3000	Yes	2	2020	18%	84%	95%	94%	3.29	15,100	94,600	10,500	10%	46%	0.28	96%	100%	0.06	0.09	0.14	0.09
2030	3000	No	1	2020	21%	87%	98%	97%	3.62	13,300	101,300	8,800	0%	21%	0.33	100%	100%	0.06	0.09	0.13	0.00
2030	3000	No	2	2020	21%	83%	96%	95%	3.48	14,000	98,400	12,300	0%	27%	0.32	100%	100%	0.06	0.09	0.14	0.18

Examples from Australian Tropical Tuna Fishery

Objectives and performance measures

- **Target** = MEY, on average over 30 yrs
  - Proxy = CPUE in "good years" early in fishery
- **Limit** = >½ MSY, 90% of the time
  - Proxy = 20% of estimated B_0 from regional stock assessment
- **HCR** = empirical, CPUE + size, plus operational constraints
- **Inputs** = longline CPUE and size monitoring of catch
- **Development** = 2006-2008 in direct consultation with industry and management
- **Implementation**
  - 2008-2014 for billfish; not for tuna.
  - Ceased and reversed overfishing.
  - Improved economic performance; met federal policy requirements
  - Form of HCR and specifics of CPUE standardization being reviewed