INTEGRATING SOCIOECONOMICS INTO ECOLOGICAL MODELING PLATFORMS

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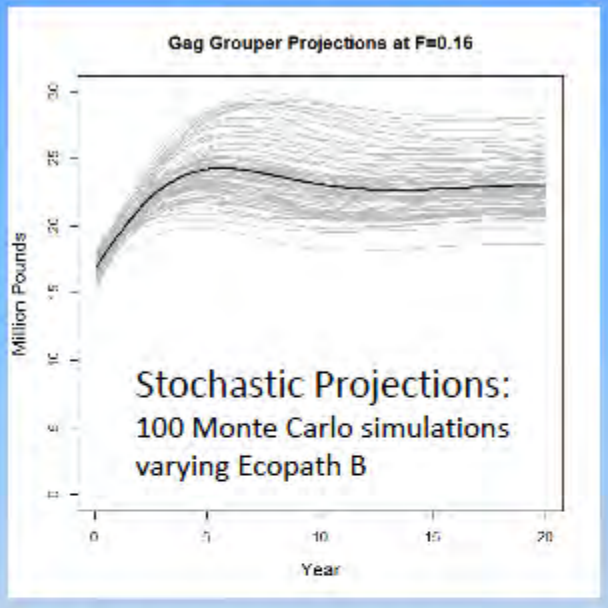
GoM Hypoxia/Diversions Workshop
July 14-16, 2014 – Stennis Space Ctr

Atlantis – Management Strategy Evaluation

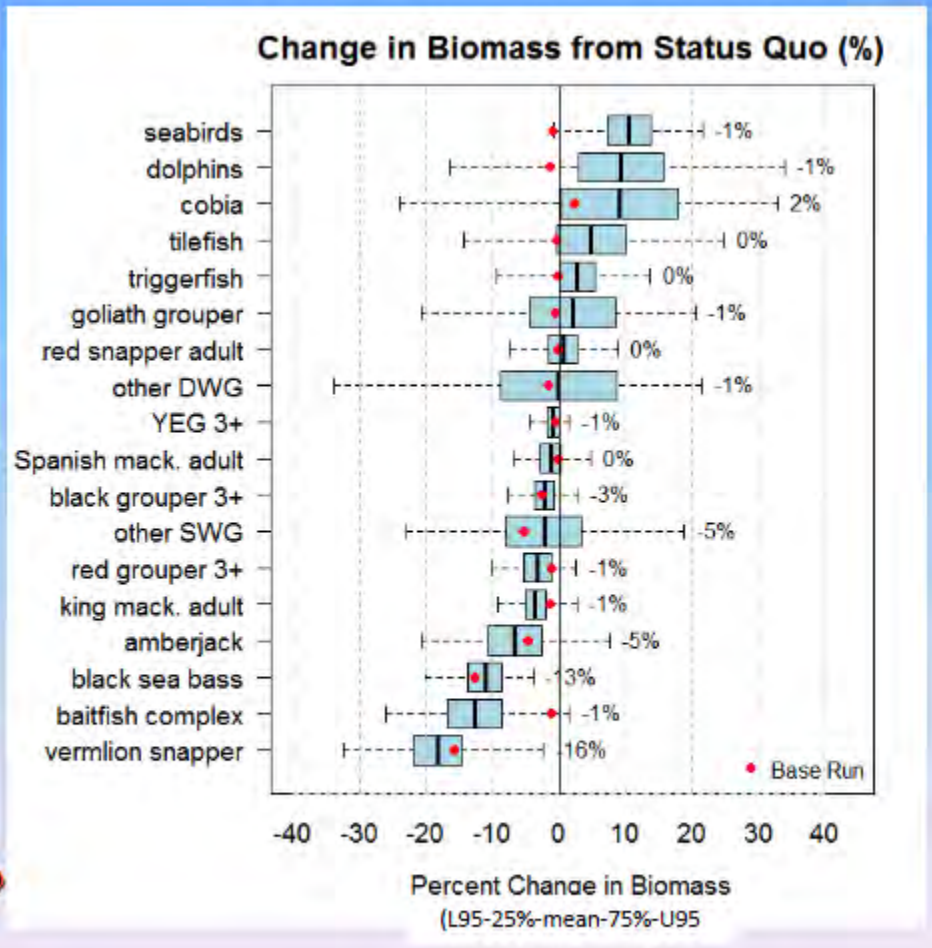
- *Ecopath with Ecosim (EwE)*
  - *Policy*
    - *Fixed Policy*
    - *Policy Optimization*
    - *Management Strategy Evaluation (MSE)*
  - *Socioeconomics*
    - *Simple Bioeconomic model*
    - *Value Chain*
  - *Ecospace – for considering jurisdictional issues*

- *Atlantis*
  - *Policy and Economics*
    - *Management Strategy Evaluation (MSE)*
    - *Flexible modules for fisheries management*
    - *Flexible modules for socioeconomics*
    - *Spatial – for considering jurisdictional issues*

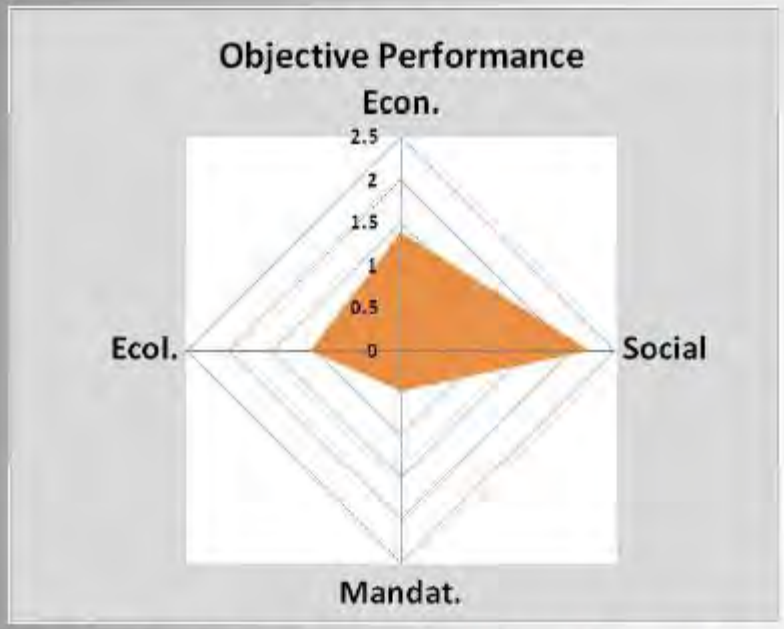
EwE – Fixed Policy

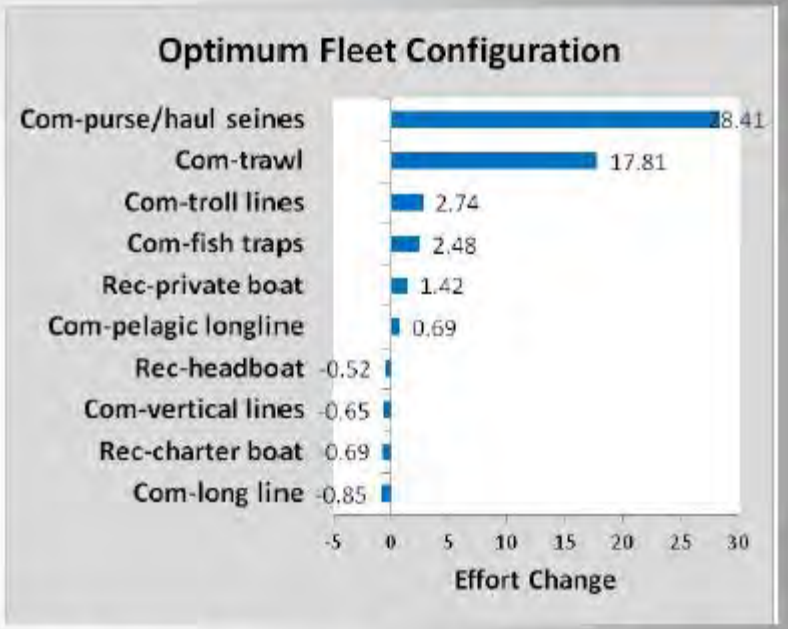


- Year 10 biomass ≈ 23 mp
- Projected biomass from single species model is 22-30 mp under F of .14-.19
- Potential for impact on vermilion snapper, black sea bass, and GAJ
- Modest impacts on other species



EwE – Policy Optimization

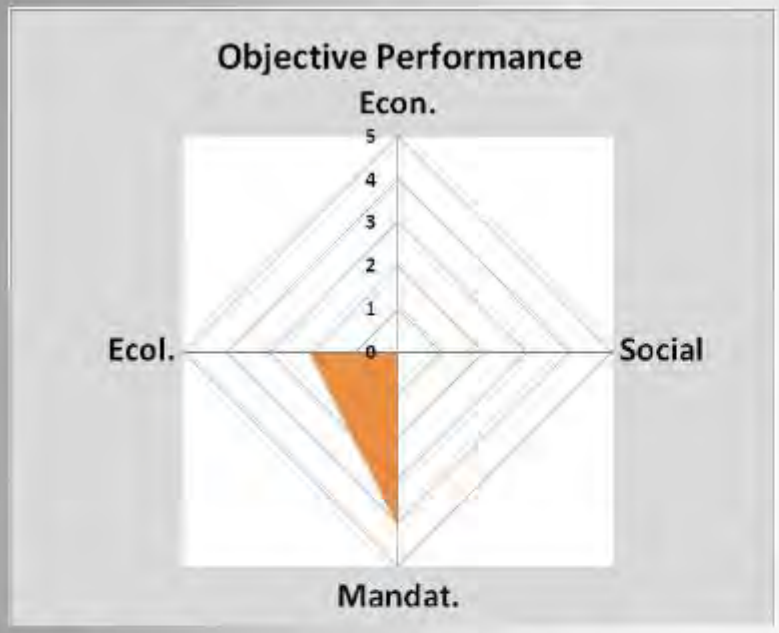


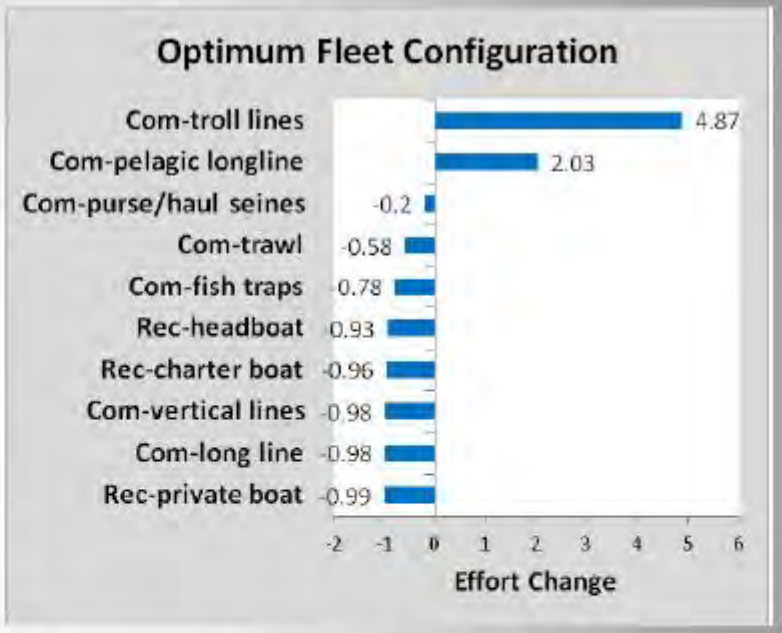


- Maximizing economic value of the fishery results in a loss of mandated biomass (gag) and ecosystem structure (reef fish biomass)

- Optimizes towards purse seines and shrimp trawls
- Sees shrimp and sardines as species with high potential yield
- Optimum purse seine effort is appx historic high in 1980s

EwE – Policy Optimization

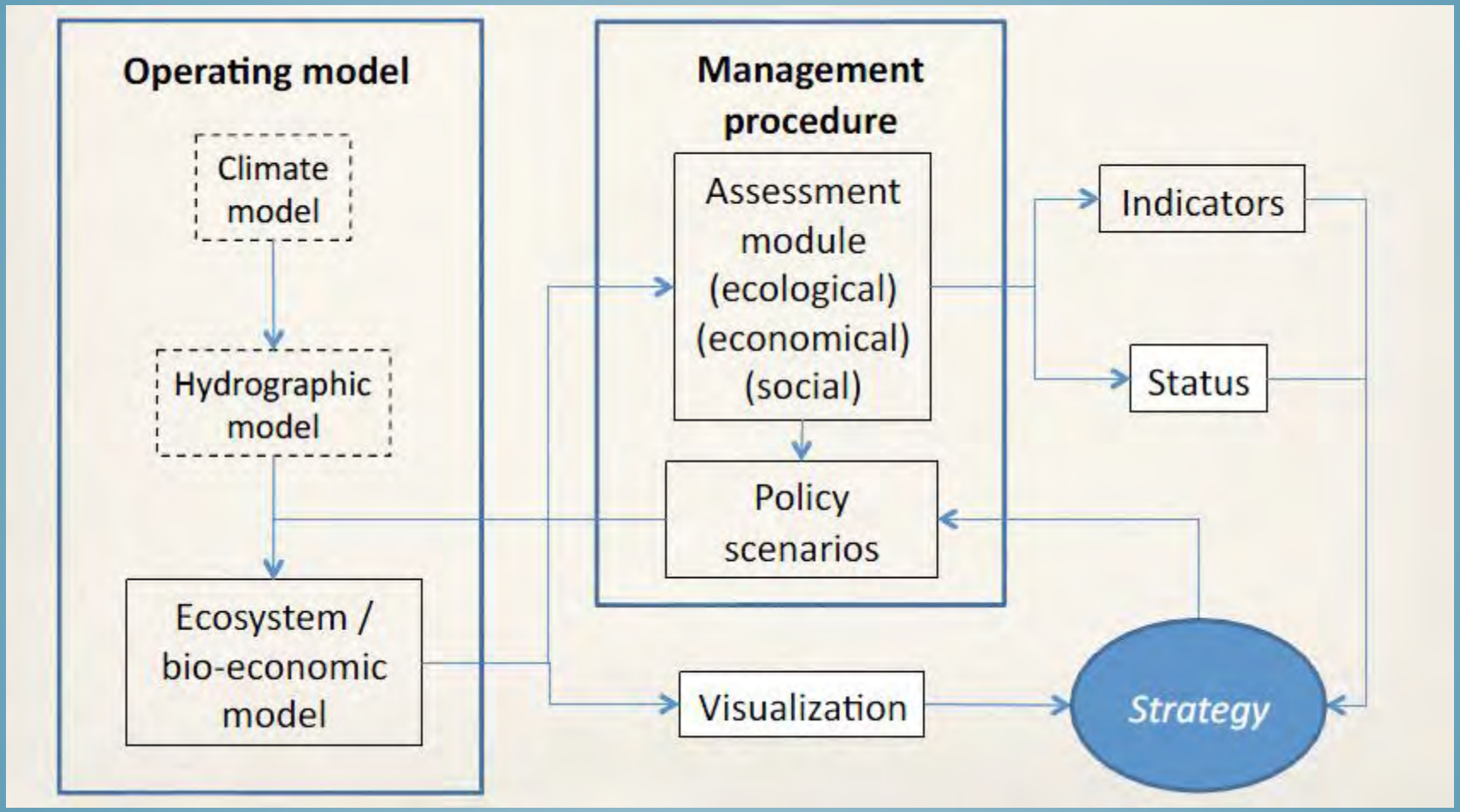




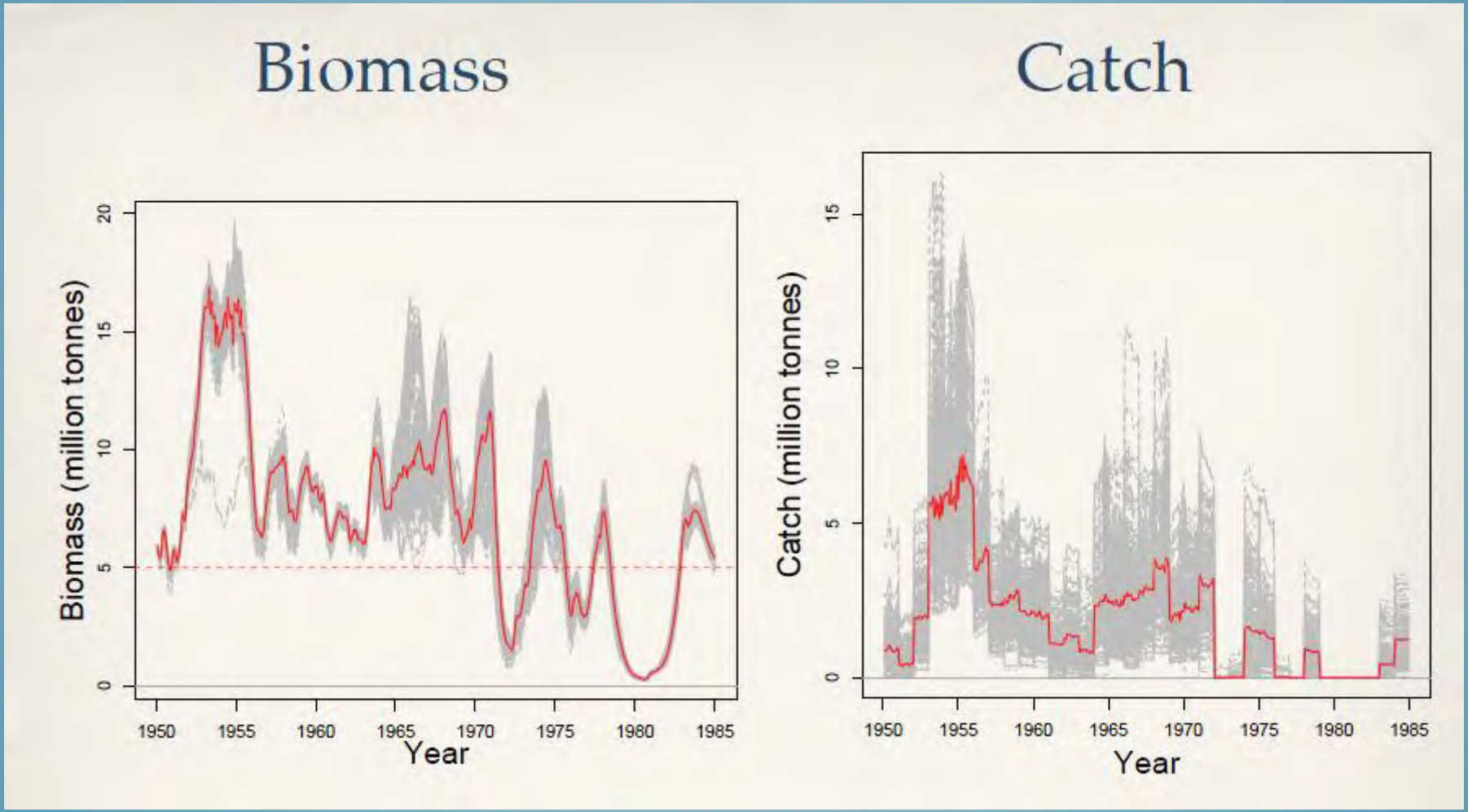
- Management performance heavily favors conservation at severe loss to socio-economic value

- Effort reduced for all fleets that catch reef fish or their prey
- Effort increase in pelagic gear removes competitors

EwE – MSE


Operating model
Climate model
Hydrographic model
Ecosystem / bio-economic model
Management procedure
Assessment module (ecological) (economical) (social)
Policy scenarios
Indicators
Status
Visualization
Strategy

EwE – MSE


Biomass
Biomass (million tonnes)
0
5
10
15
20
1950
1955
1960
1965
1970
1975
1980
1985
Year
Catch
Catch (million tonnes)
0
5
10
15
1950
1955
1960
1965
1970
1975
1980
1985
Year

EwE – Simple Economics

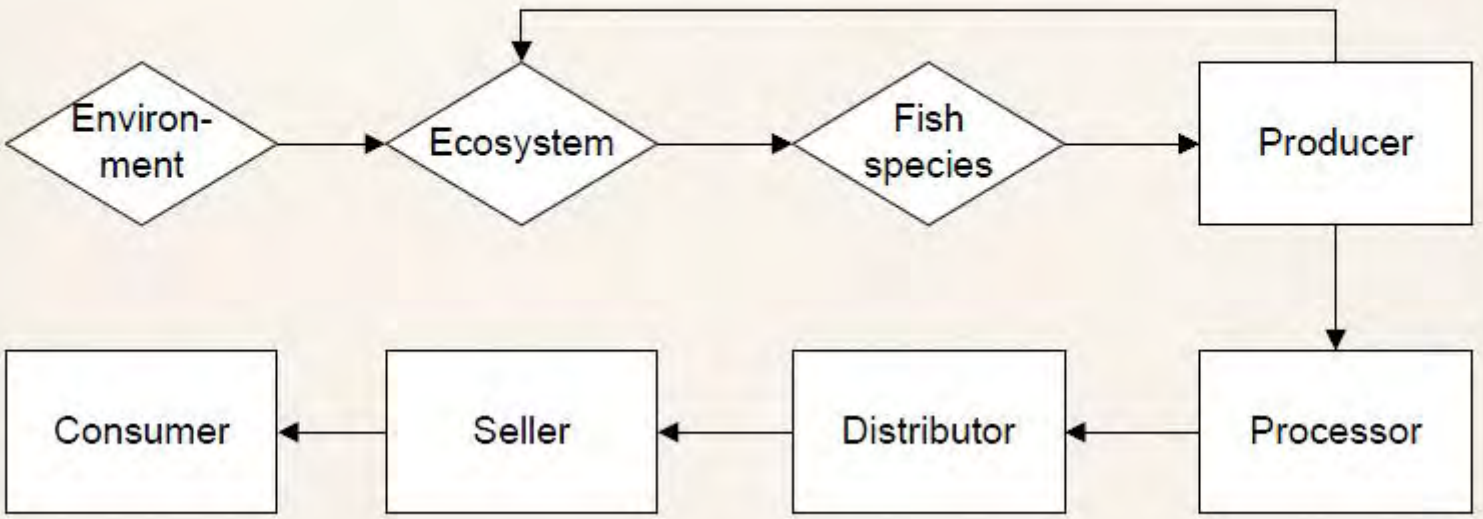
- Off-vessel prices
- Used to capture landing value of fisheries
- Simple cost accounting

	Group name	Tuna boats (USD/t/km²)	Seiner (USD/t/km²)	Dragger (USD/t/km²)
⊟	Apex			
1	Apex predators (tuna, ...)	4,500		
2	Juv. apex			
3	Mesopelagics			
4	Epipelagics (mackerel, flyingfish)		1,500	
5	Benthic fish			
6	Benthopelagics			
7	Zooplankt.large			
8	Benthos			1,800

	Fleet name	Fixed cost (%)	Effort related cost (%)	Selling related cost (%)	Profit (%)	Total value (%)
1	Longliners	0.000	40.00	40.00	20.000	100.000
2	Seiners	0.000	40.00	40.00	20.000	100.000
3	Draggers	0.000	40.00	40.00	20.000	100.000

EwE – Value Chain

- Consider ecological, social, and economic consequences (and drivers)



EwE – Value Chain

Production and Revenue

Topic	Parameter	Symbol	Units
Identity	Name		
	Nationality		
Products	Agricultural [1])	R_a	$/t
	Energy	R_e	$/t
	Industrial	R_i	$/t
	Services	R_s	$/t
Subsidies	Energy	U_e	$/t
	Other	U_o	$/t

Cost

Topic	Parameter	Symbol	Units
Pay/share	Worker, female	P_s and S_s	$/t or %
	Worker, male	P_h and S_h	$/t or %
	Owner, female	P_f and S_f	$/t or %
	Owner, male	P_m and S_m	$/t or %
Input	Agricultural [1])	I_a	$/t
	Capital	I_c	$/t
	Energy	I_e	$/t
	Industrial	I_i	$/t
	Services	I_s	$/t

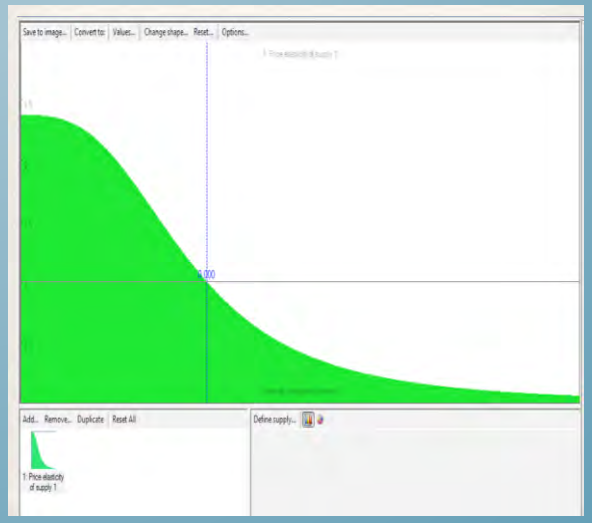
Observer	Cost [2])	C_o	$/t
	Coverage rate [2])	O_r	Prop.
Management	Cost	C_m	$/t
License	Cost	C_l	$/t
Certification	Cost	C_c	$/t
Taxes	Environmental	T_e	$/t
	Export	T_x	$/t
	Import	T_i	$/t
	Production	T_p	$/t
	VAT	T_v	$/t
	Licenses	T_l	$/t

[1]) For processors only
[2]) For producers only

Social

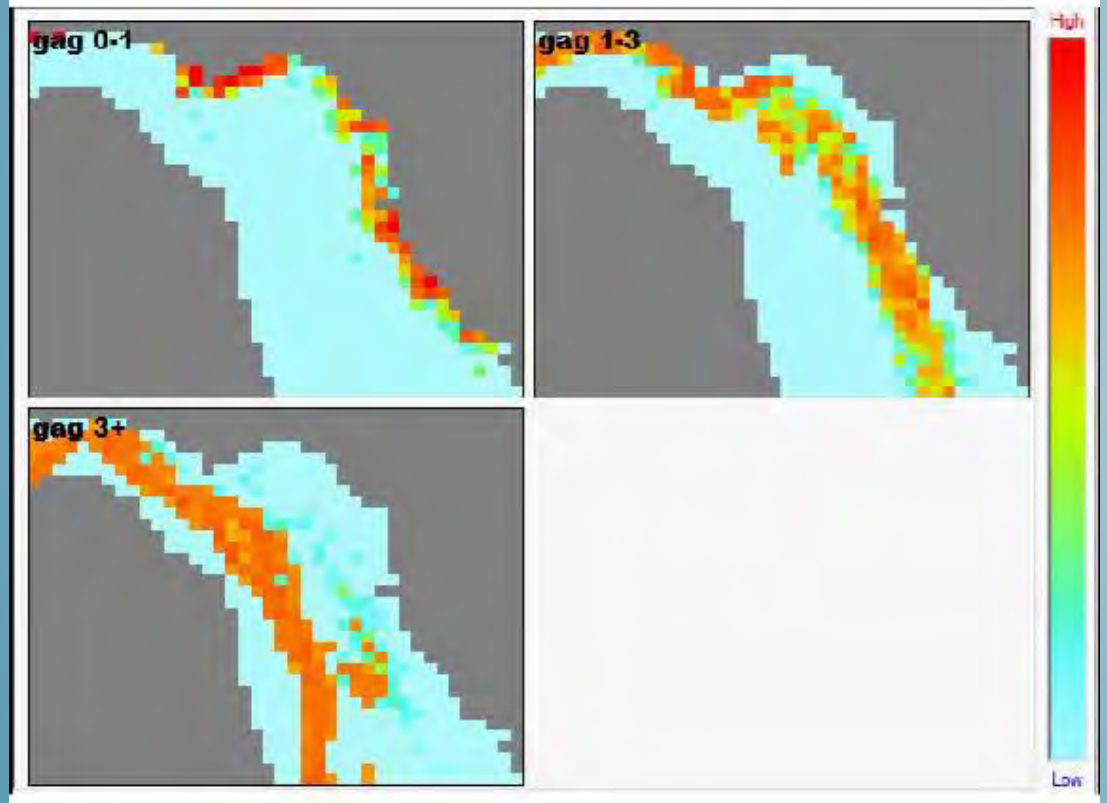
Parameter	Symbol	Units
Worker female	J_s	#/t
Worker male	J_h	#/t
Owner female	J_f	#/t
Owner male	J_m	#/t
Female worker dependents	D_s	#/worker
Male worker dependents	D_h	#/worker
Female owner dependents	D_f	#/owner
Male owner dependents	D_m	#/owner

Price elasticity



EwE – Ecospace

Predict Spatial Distribution Patterns



- Consider jurisdictional issues

- Consider changes in cost of fishing effort

Atlantis – Fisheries Module

Multiple fleets (33) each considering

- *gears (availability, selectivity, creep, incidental impacts, gear interactions)*
- *targeting (& byproduct) and bycatch*
- *discarding (high grading, size, waste)*
- *effort allocation (access, ports, exploration, displacement, CPUE & cost based, market forces, behavioural types – risk averse, risk shy, individualists)*
- *compliance (differential levels & take-up, behaviour & practices which effects harvest model, reporting veracity)*

Atlantis – Management/Policy

Management levers

- *trigger points (allowances for mixed-species fisheries, EPBC)*
- *quotas (TAC, regional, companion, basket, ITQ)*
- *seasonal access*
- *zoning (different fleet access, MPA, seasonal)*
- *gear (bycatch mitigation, gear limitation & modification)*
- *size limits*
- *changing gear (& transferability)*
- *days at sea*
- *trip limits*

Explicitly considers costs of data collection, regulation, incentive alternatives

Atlantis – Socioeconomic Module

Dynamic structure (feeds back to harvest model) levers

- *characterize using (vessel size, number crew, size, fuel expenditure, gear, held quota, efficiency, capacity, trip length, home port, maintenance costs, target species composition)*
- *social and economic factors influencing hierarchy of "annual plan" / seasonal / "day-to-day" trip decisions (effort allocation)*

Model implentation

- *Simple: economic indicators driving functional forms through to*
- *Complex: an investment/disinvestment; operation of the quota lease market; "friendship" networks; sector interplay; port size related to landings*

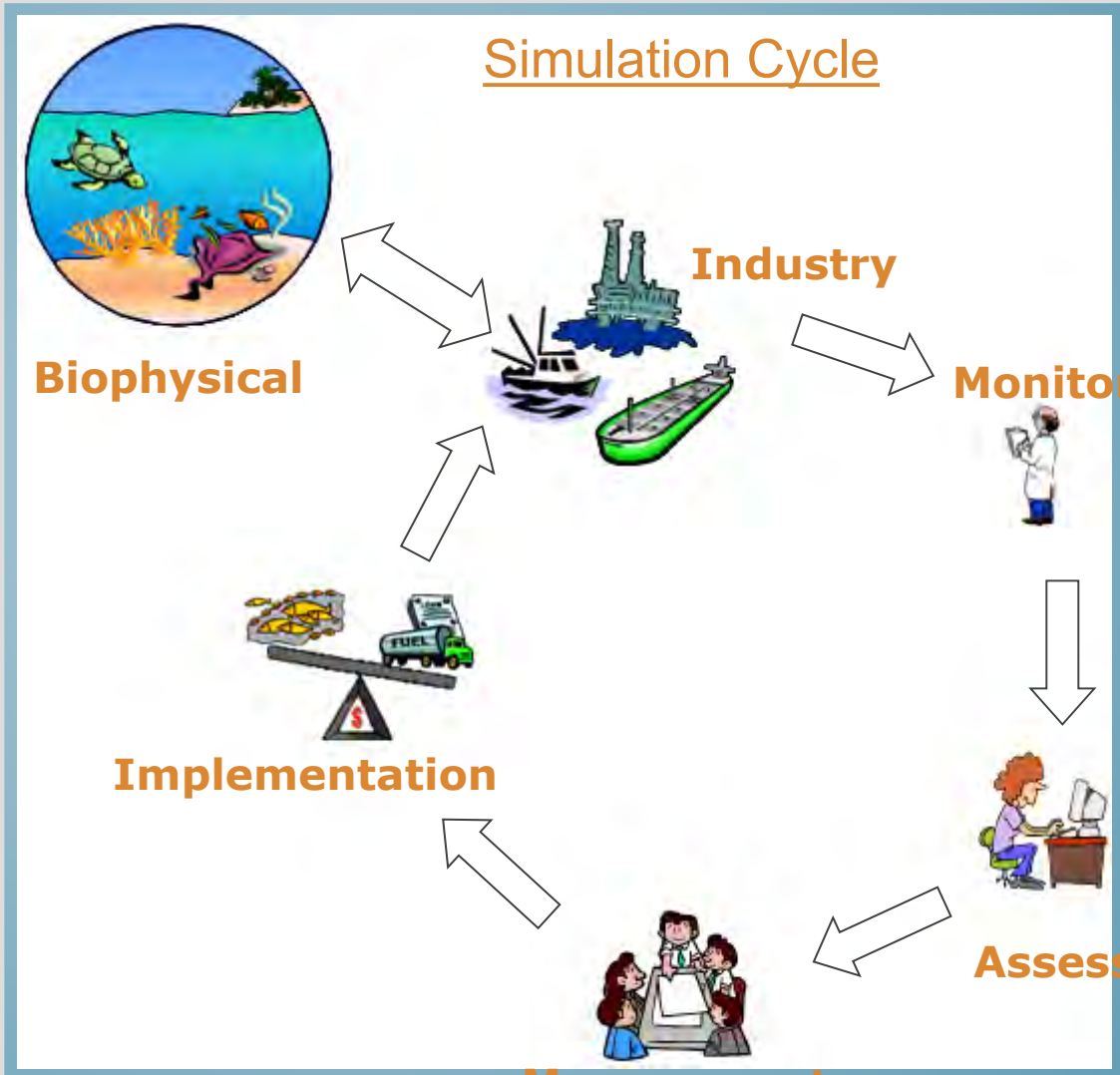
Useful for "unexpected" behaviour generation (e.g. compliance issues)

Atlantis – Management Strategy Evaluation

Manager Roles

DEFINE OBJECTIVES

PERFORMANCE MEASURES



Modified from E. Fulton

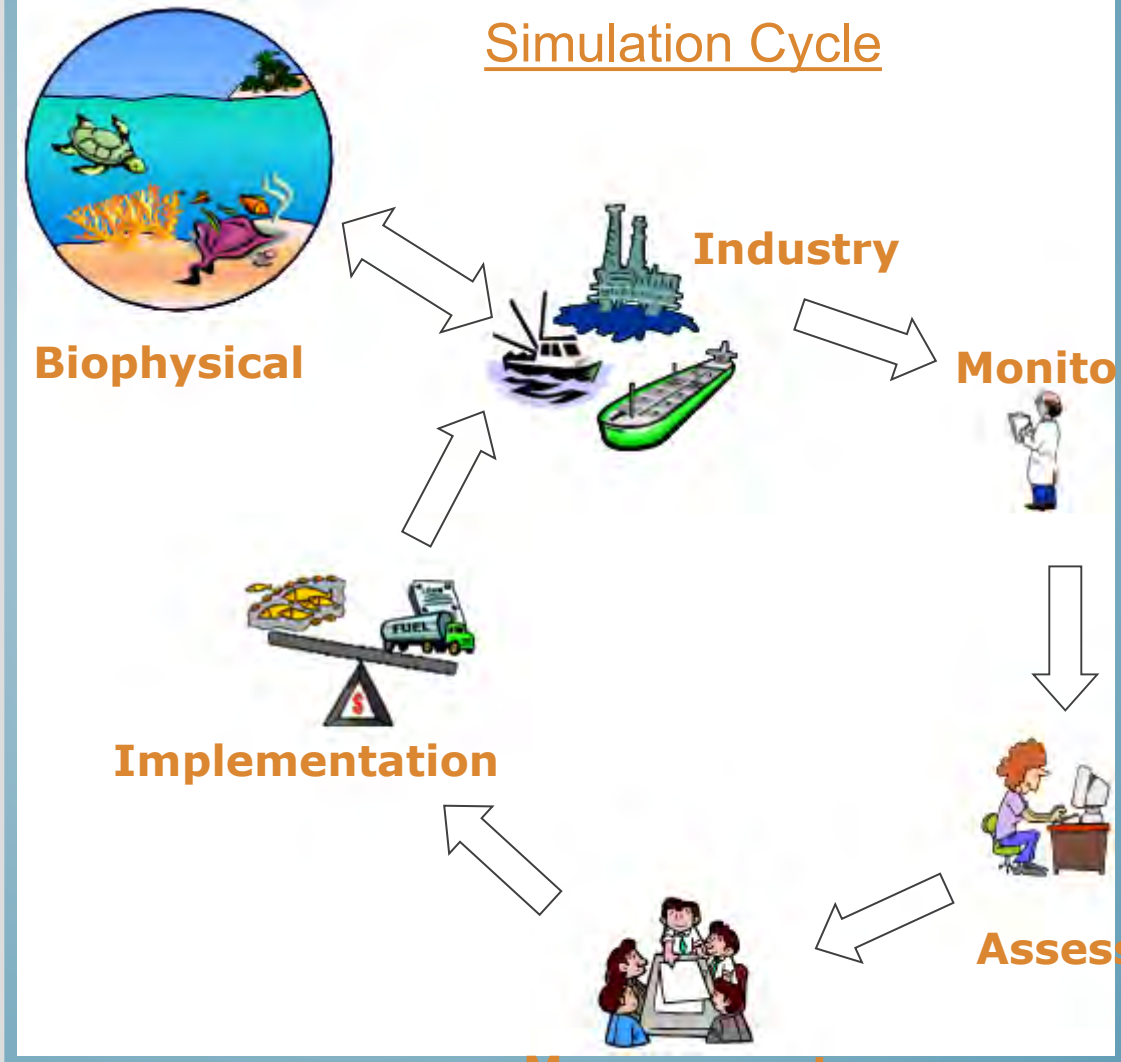
Atlantis – Management Strategy Evaluation

Manager Roles

DEFINE OBJECTIVES

PERFORMANCE MEASURES

Simulation Cycle



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Atlantis – Management Strategy Evaluation

Manager Roles

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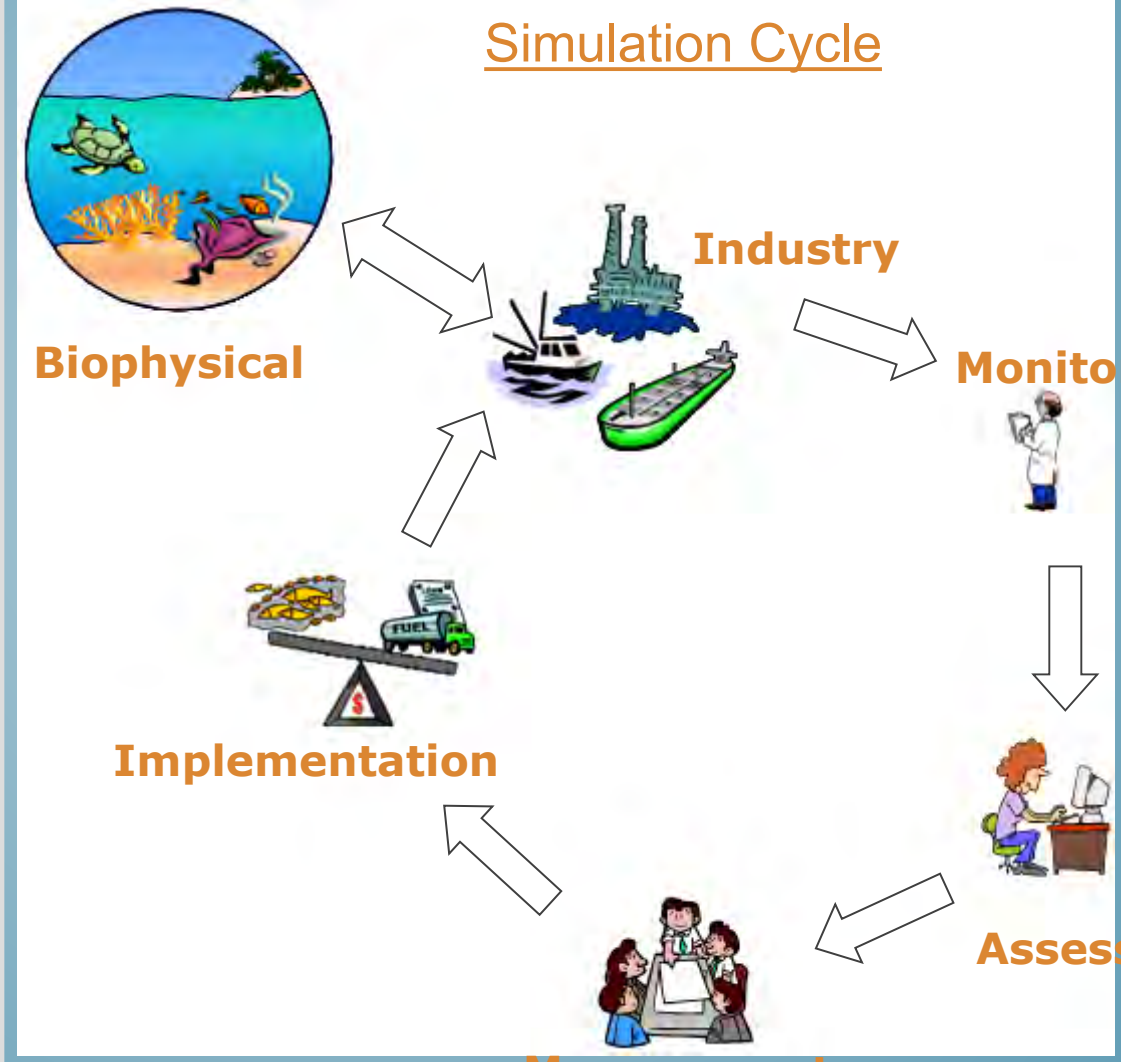

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Atlantis – Management Strategy Evaluation

Manager Roles

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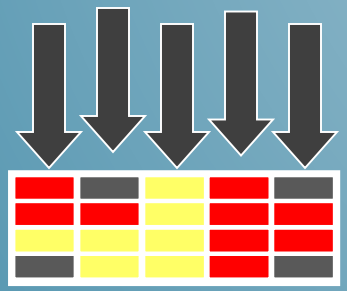


Simulation Cycle

Biophysical

Industry

Monitoring

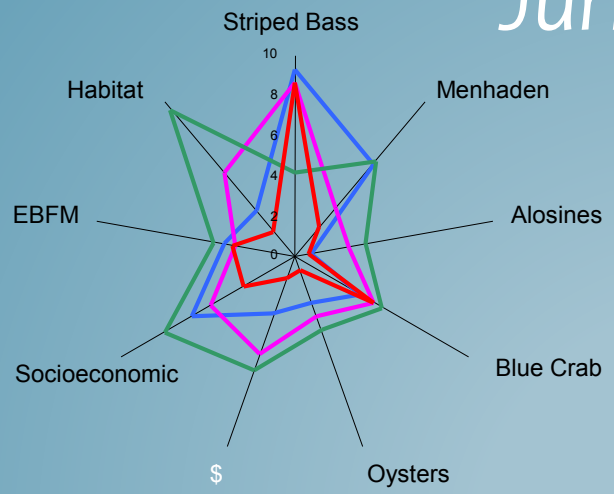
Implementation

Assessment

Management

Modified from E. Fulton

Atlantis Spatial Visualization – Accounting for Jurisdictions



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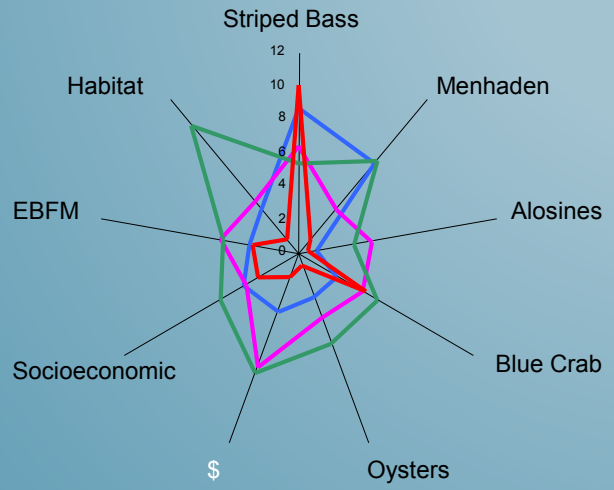
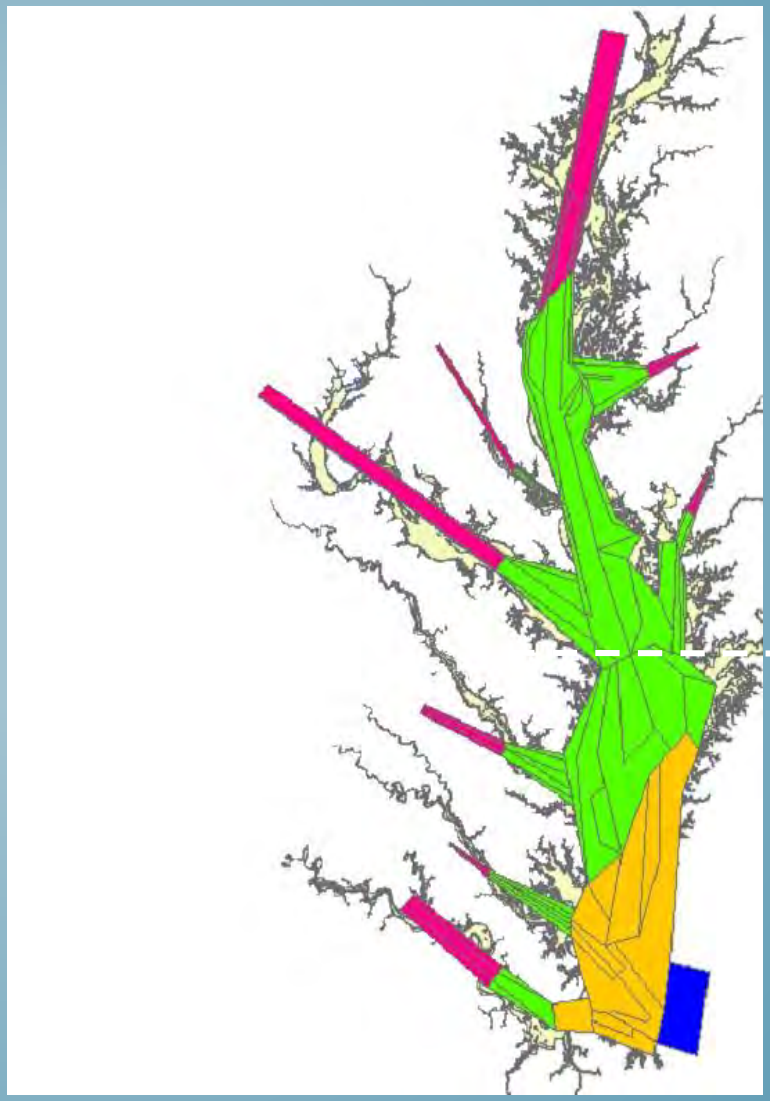
VA





For Illustrative Purposes Only -- Not Based on Actual Modeling Results