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An economic perspective on reducing adverse fishing effects:

SASI and the Northeast U.S.

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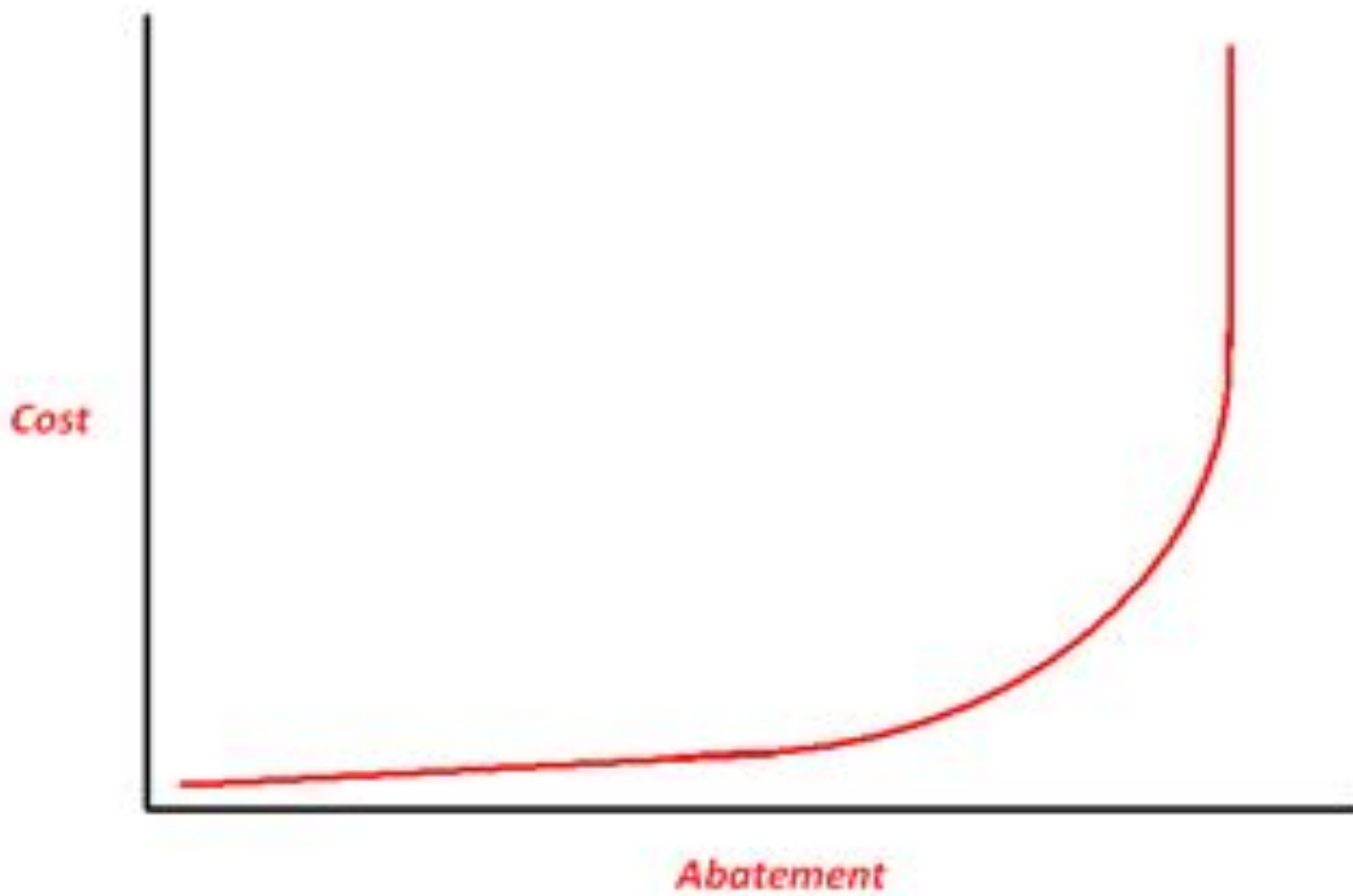
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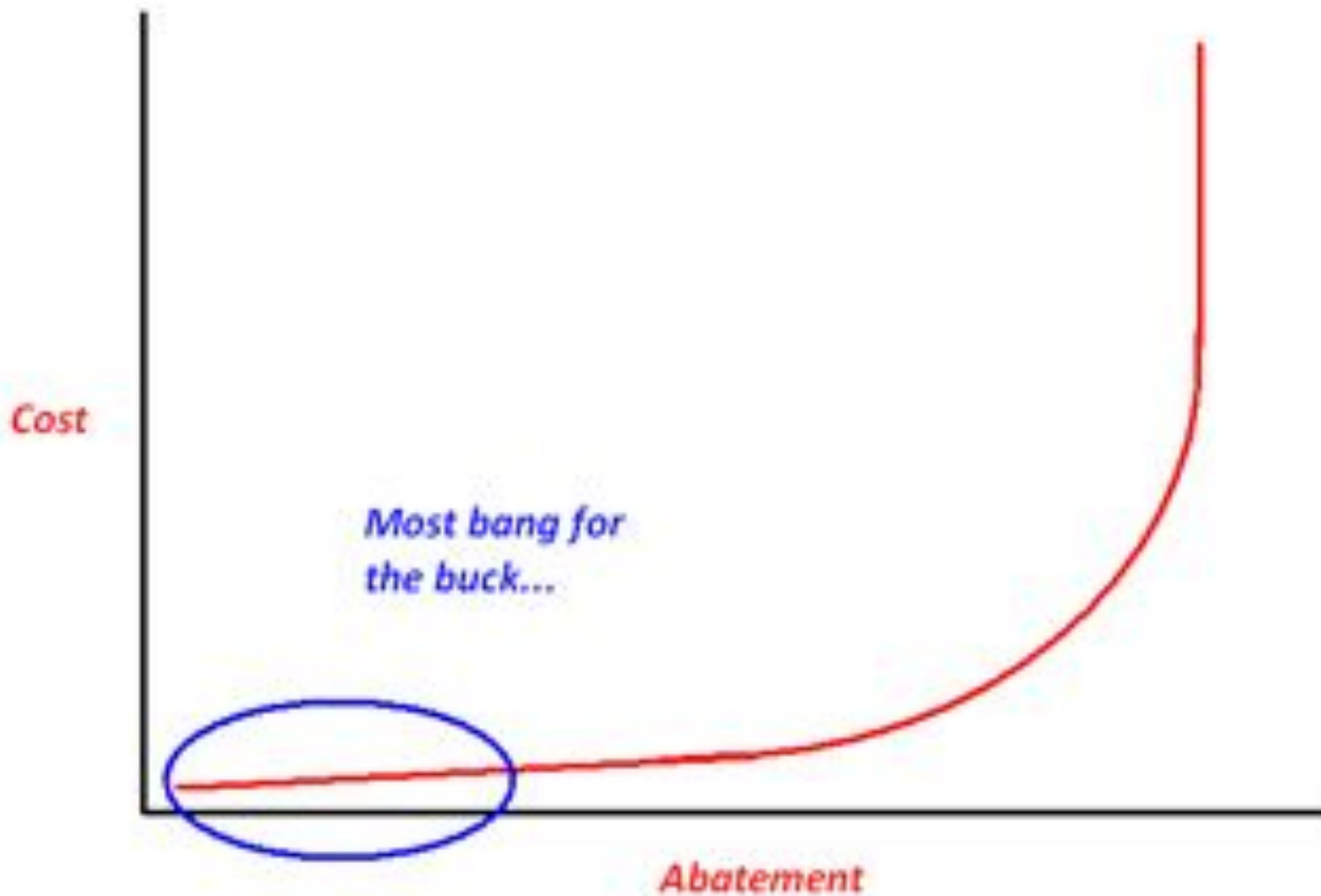
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MSA: “...minimize to the extent practicable adverse effects on ... habitat caused by fishing...”

- Practicability undefined in rulemaking
- Implies a need to balance trade-offs
- Benefits of abating adverse effects are not directly quantifiable
- Research insufficient to quantify relationship between adverse effect and fishery productivity
- Adversity of effects are stock-specific
- Regulations typically stock- and even fishery-independent



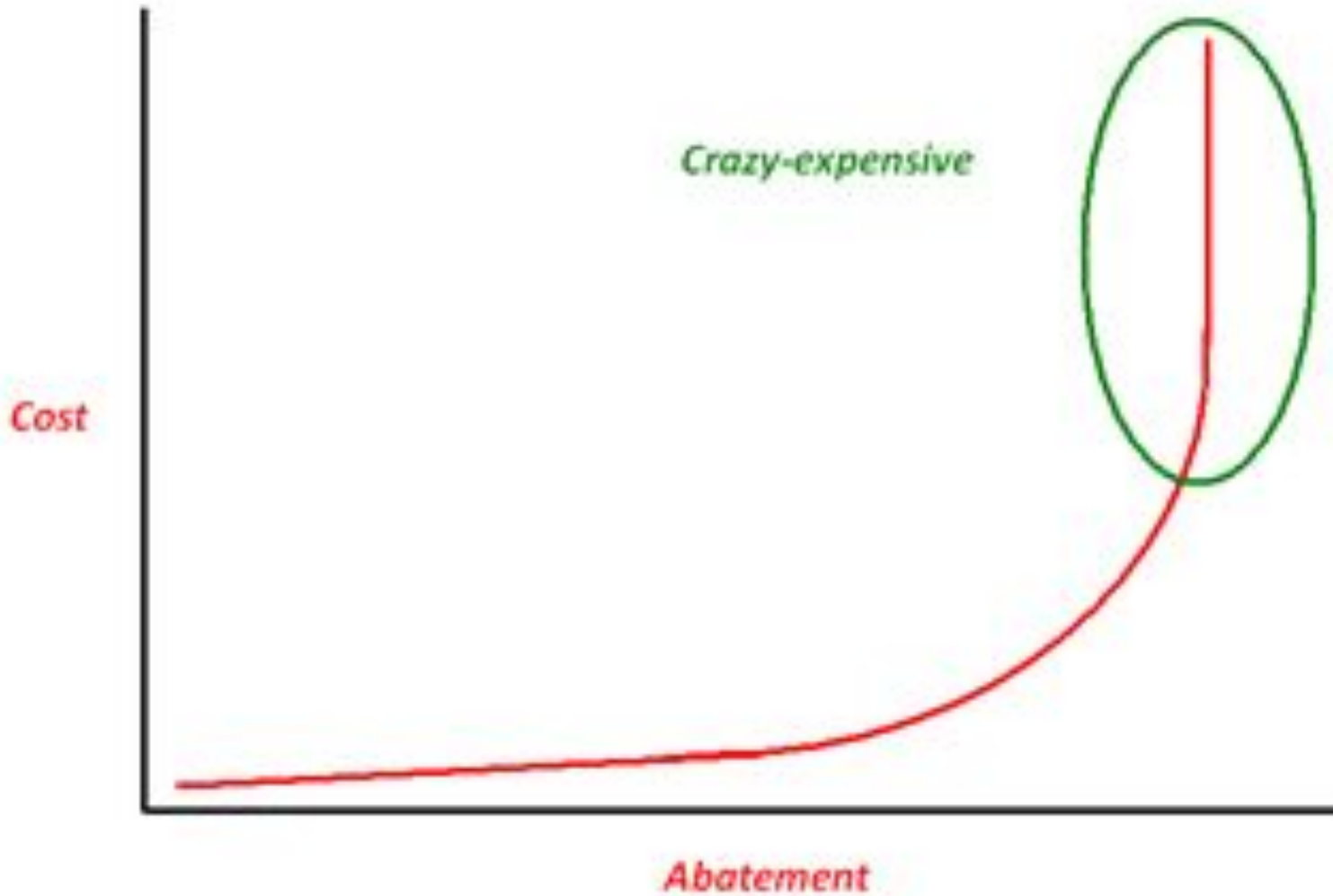




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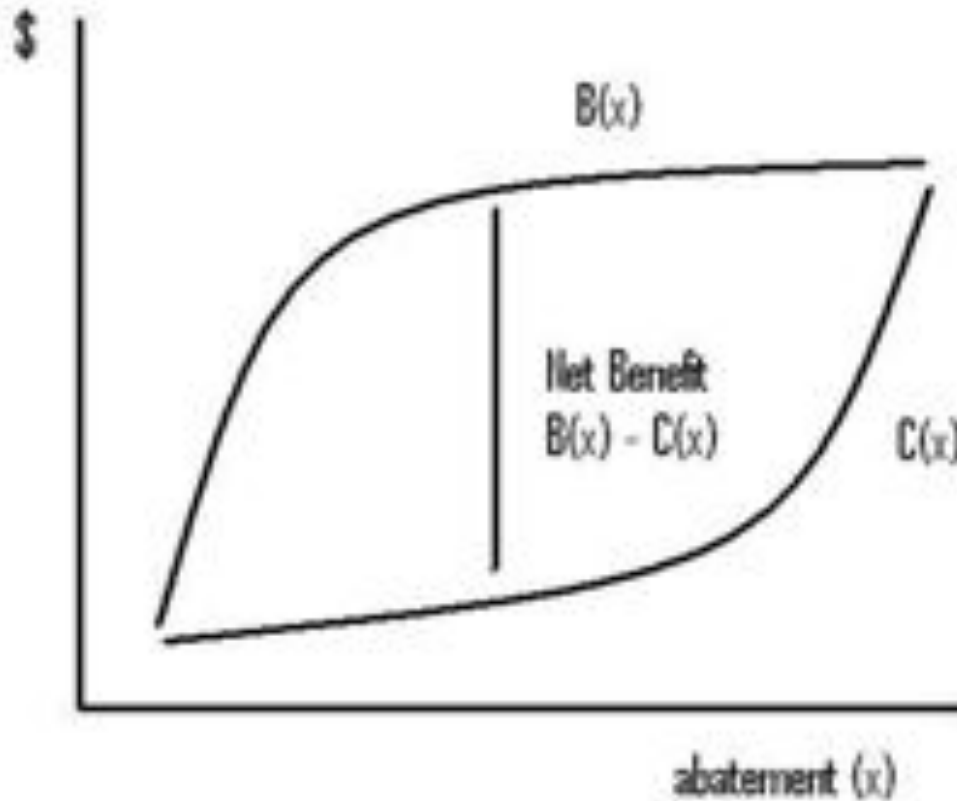
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In the absence of market failure, when you set
 $MB = MC$ you ***SAVE THE WHOLE WORLD***



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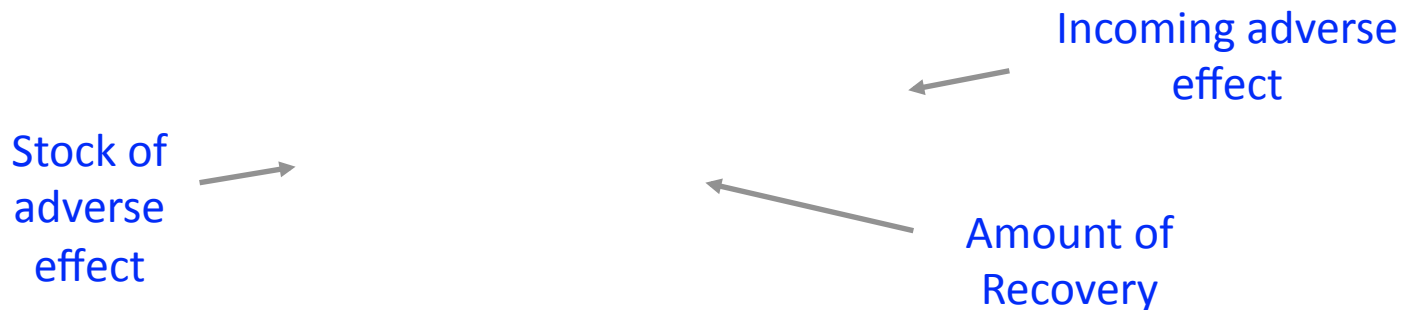


ABATING ADVERSE EFFECT AS A BENEFIT

Z = swept area seabed impact (SASI) in units of contact- and vulnerability-adjusted area swept (km^2)

X = amount of adverse effect that decays annually

Y = amount of adverse effect that is added annually



The model is indexed across units of fishing effort (j) by nine fishing gear types (i) and a matrix of habitat types determined by combinations of five substrates (k), two energy environments (l) and 27 individual habitat features (m)



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ESTIMATING BENEFITS

- Z_{net} is the sum of Z values for each gear type (i) and parcel (p) from year 1 through the terminal year of recovery (year n).
- It is a non-discounted net present value estimate of Z
- To abate adverse effects, **reduce Z_{net}**



ESTIMATING COSTS OF ABATEMENT

X is calculated as trip-level net revenue

- Gross revenue minus trip costs
- Calculated for each trip
- Summed for each gear type and parcel (spatial unit)



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ENVIRONMENTAL
IMPACT
COEFFICIENT



BENEFIT
ESTIMATE



COST ESTIMATE



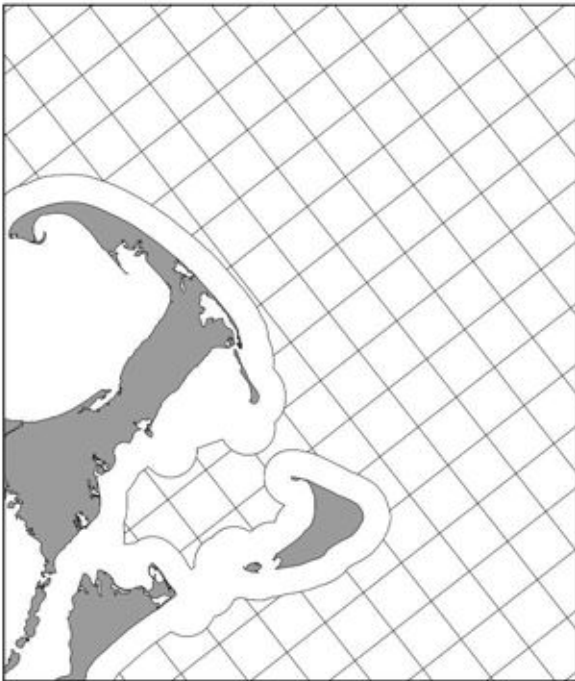
Formally:

Znetip is the stock of quality-adjusted area swept (km²) that has had its functional value as structure-forming habitat reduced as a result of fishing by gear type *i* at parcel *p*,

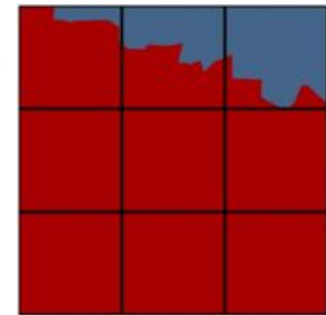
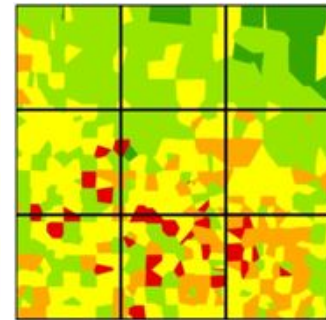
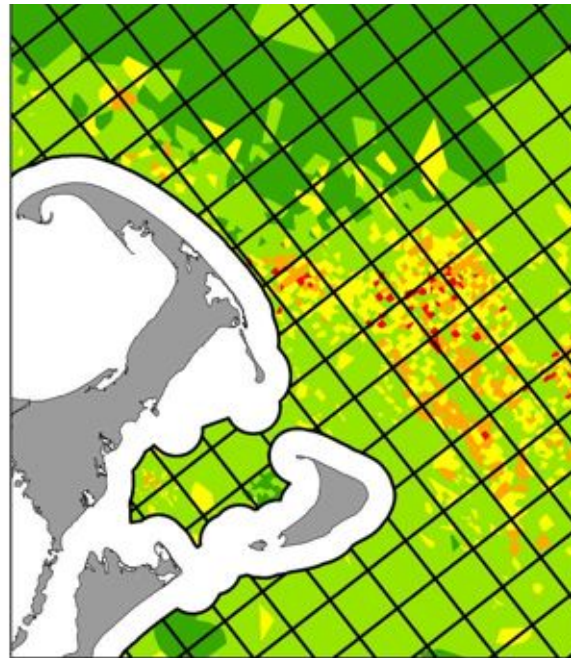
and

xip is the net revenues (\$) from fishing by gear type *i* at parcel *p*

Fishing effort is assigned to 100-km² structured grid, which can be scaled up or down if needed:



The overlay of structured grid cells retains underlying substrate and energy information:





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- Znet captures the magnitude of adverse effect at the trip level
 - Allows for comparisons across areas, gear types, years
 - Reductions in Z equal abated adverse effects
- e captures the cost (\$) associated with each unit of abated adverse effect (Znet)

This allows for evaluation of trade-offs associated with habitat management measures in different areas and for different gear types



gear	<i>e</i>	Znet	<i>X</i> (\$1K's)			
mean	<i>stddev</i>	mean	<i>stddev</i>	mean	<i>stddev</i>	
g. otter trawl	0.91	0.57	693.7	886.8	898.6	1,097.5
shrimp trawl	1.28	0.71	406.2	623.7	374.0	562.9
squid trawl	0.67	0.44	284.2	396.5	545.0	728.5
raised trawl	0.47	0.19	92.7	46.6	203.3	91.5
scallop dr, la	0.1	0.13	159.7	147.7	2,713.7	2,673.3
scallop dr, gc	0.16	0.32	24.5	33.5	252.6	344.2



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Three primary management tools (NRC)

- Closed areas (durable, seasonal, etc)
- Gear modifications
- Effort reductions

How cost-efficient are these tools for minimizing adverse effects in the Northeast US?



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- Closed areas – costs are related to differential catch rates between fishable and off-limits parcels (redistribution of effort)
- Gear modifications - direct costs plus those associated with gear selectivity/catchability
- Effort reduction - costs associated with foregone yield but have second-order effects
 - May be hard to decouple from biological objectives
 - May result in increased CPUE/profits

Minimizing Z_{net} is conditioned on achieving OY and effort reductions are not viable regulatory options in the US



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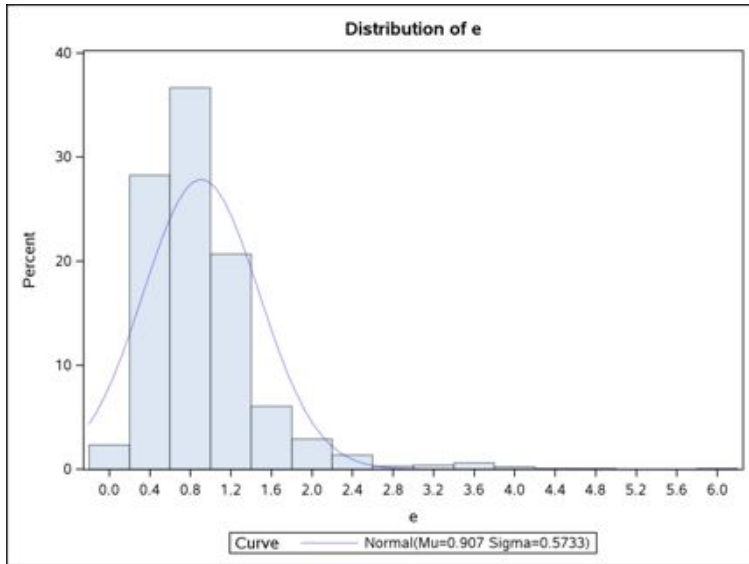


ABATEMENT BY AREA CLOSURE

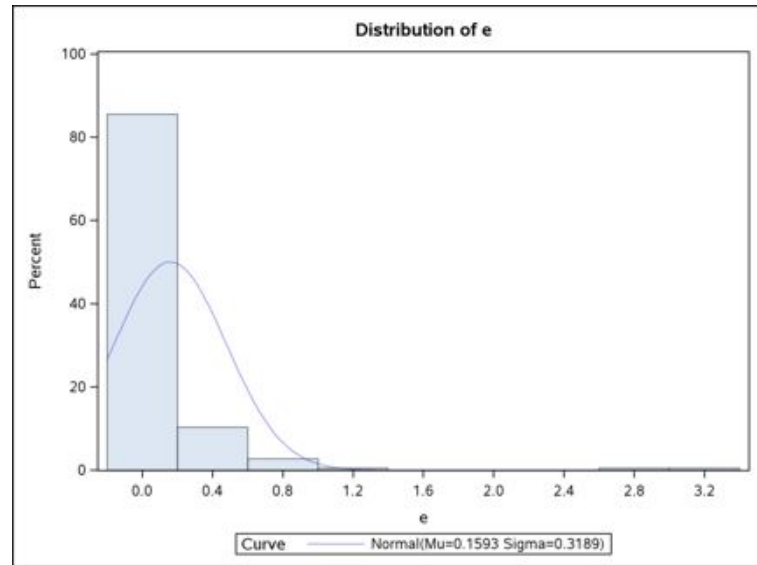
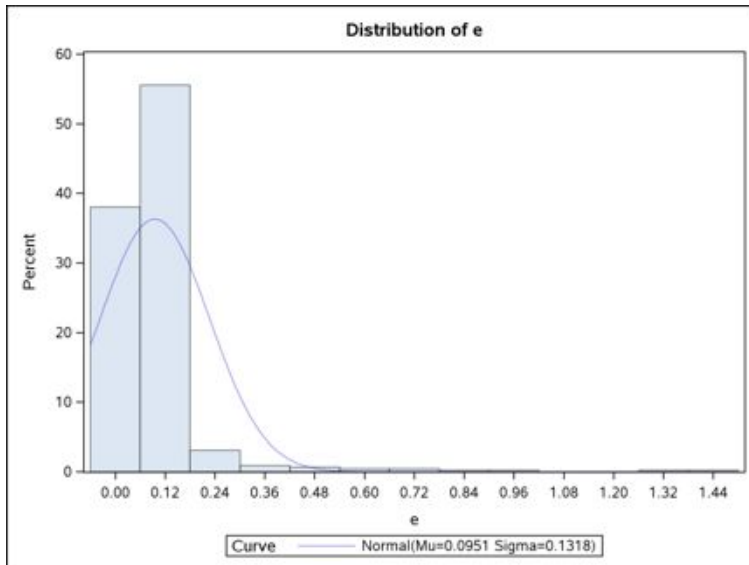
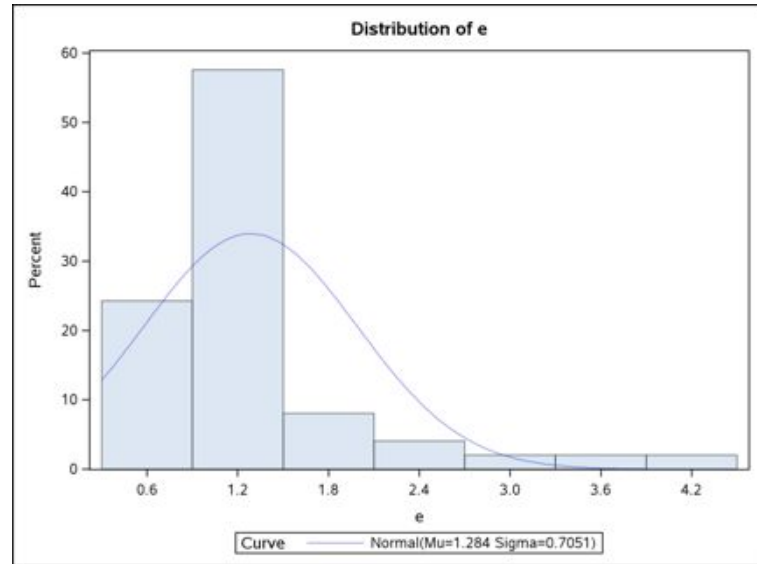
- Given OY (eg. quota, TAC, DAS, etc) fishing effort will go to where it's most profitable
- By definition, closure directs effort to less profitable areas, increasing bottom contact time

Understanding parcel-level adverse effect (benefit) and net revenue (cost) is critical

Gen. otter trawl



Squid trawl

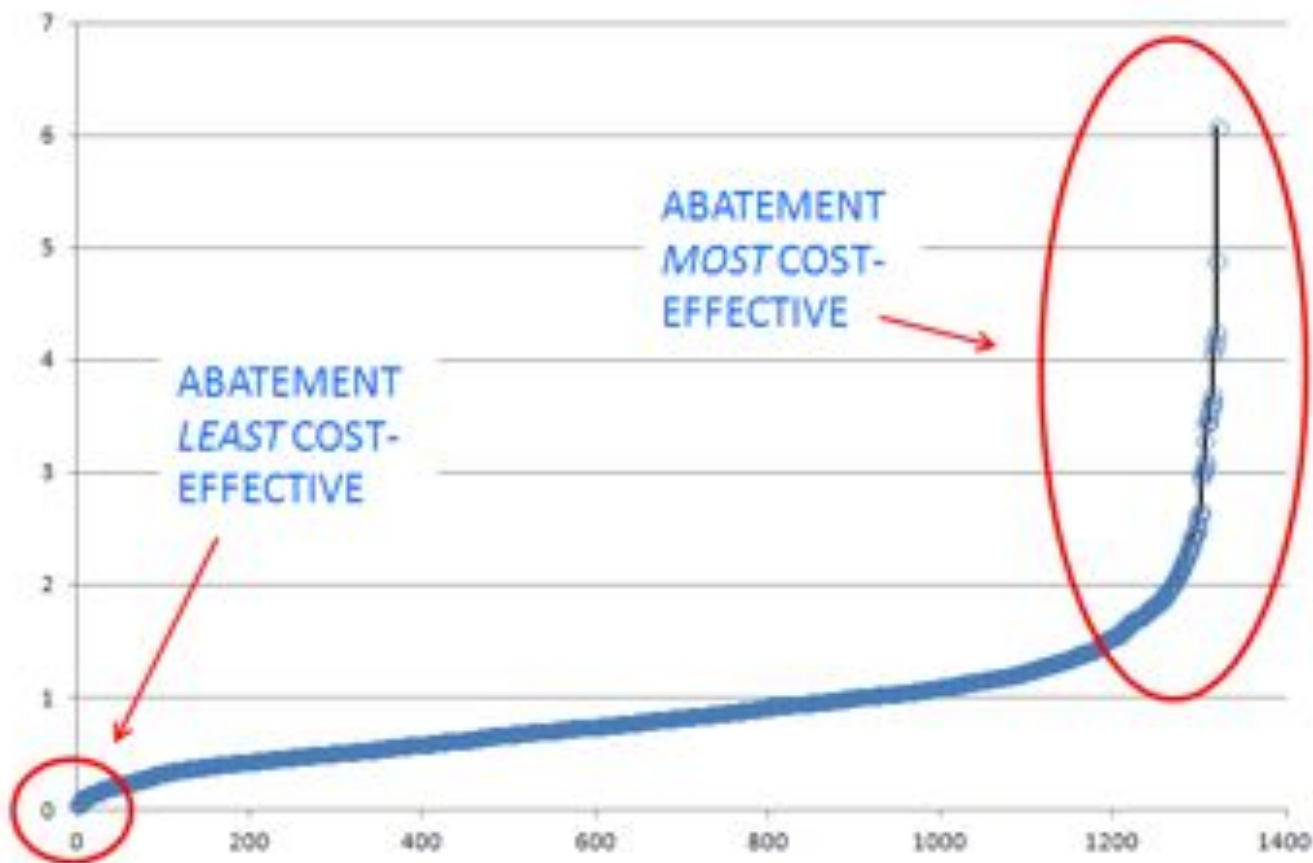


LA scallop dredge

GC scallop dredge

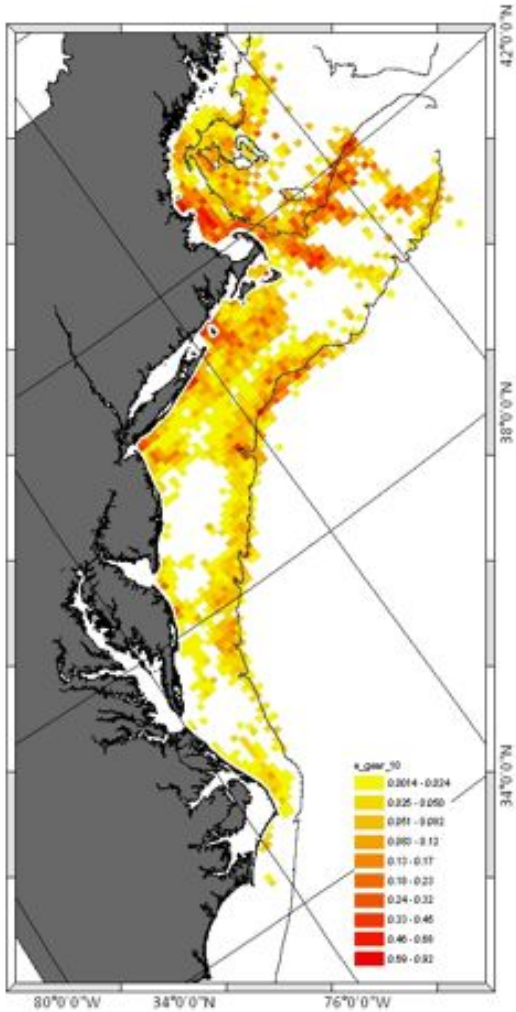


e for generic otter trawl gear (y-axis) by parcel (x-axis)

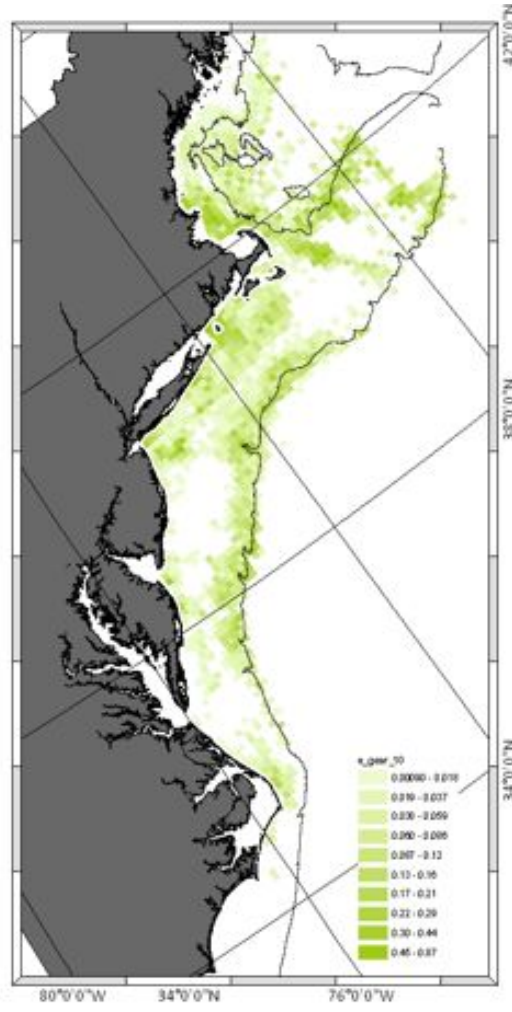


Gen. otter trawl gear

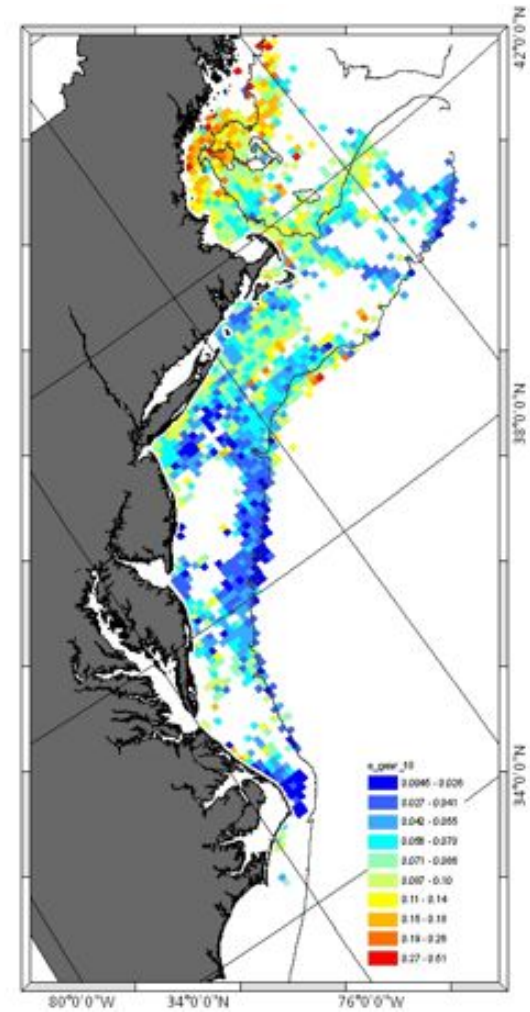
znet (benefit)



x (cost)



e

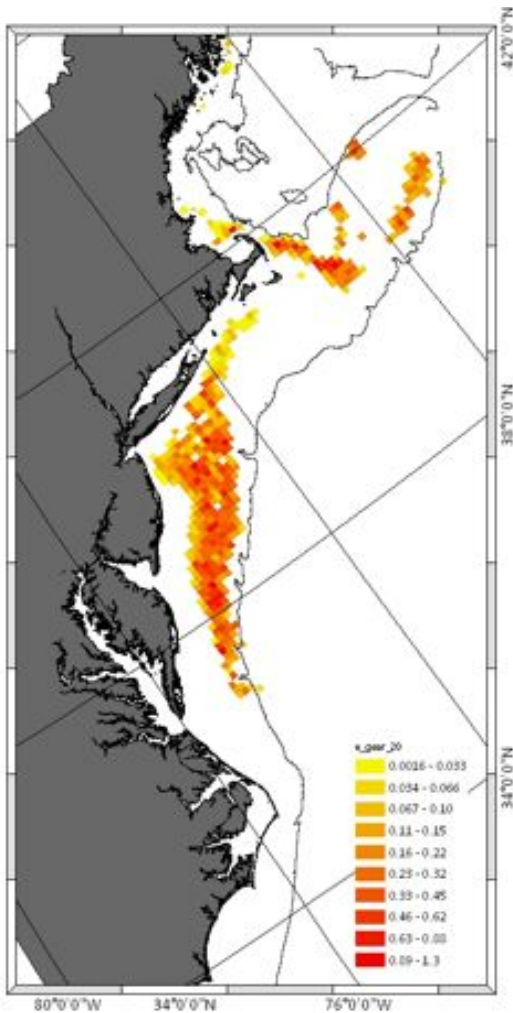


LA scallop dredge gear

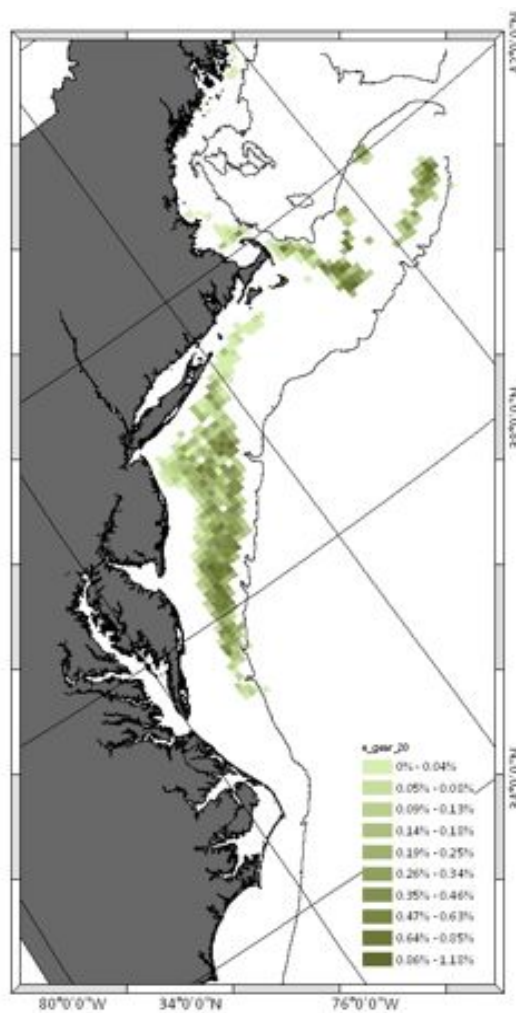
znet (benefit)

x (cost)

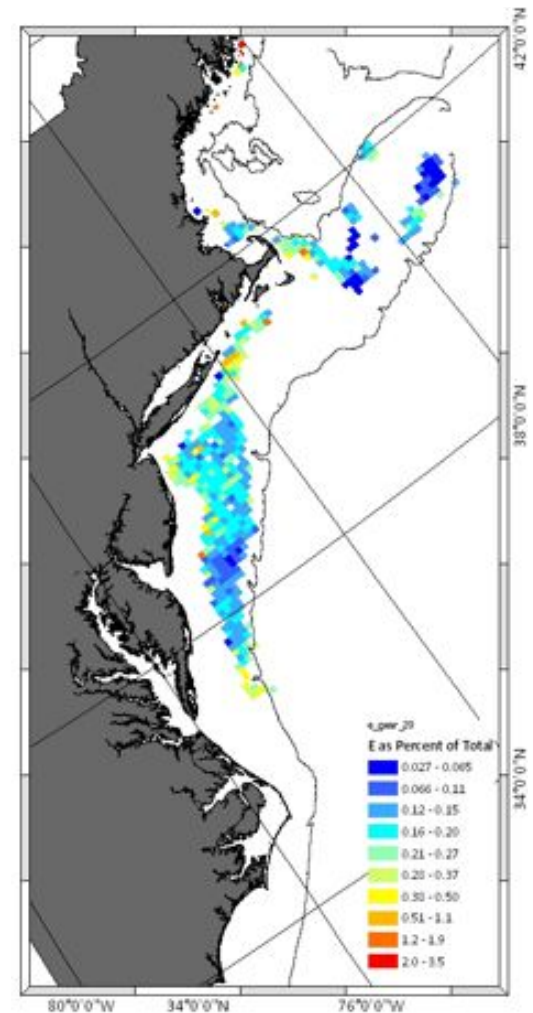
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ABATEMENT THROUGH GEAR MODIFICATIONS

For harvesting bottom-dwelling finfish,
wholesale gear substitution will result in orders-
of-magnitude reductions in Z

- to generate a dollar of profit, otter trawls produce ~600 times more Z (adverse effect) than gillnets*
- Comes at a cost: catch composition, bycatch, protected resources*
- Besides gillnets, some other bottom-contact gears are also highly habitat-efficient*



Within-gear gear modifications could be explored

- Ground cable lengths have increased by > 15% between 2003 and 2009 on observed tows*
- Costs to ground cable reduction include reduced CPUE through reduced herding effect*

reduction in ground cable length	resulting reduction in area swept
10%	-6.55%
20%	-13.09%
30%	-19.64%
40%	-26.18%
50%	-32.73%
60%	-39.27%
70%	-45.82%
80%	-52.36%
90%	-58.91%



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Footrope configurations:

- Changing from a cookie or chain sweep to a raised footrope sweep would reduce area swept by ~30%*
- Eliminating large-diameter rockhopper gear may alter fishing behavior, keeping gear off most vulnerable habitats*
- Costs include gear selectivity (esp. flatfish) and decreased fishable bottom*



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Cost-efficiency

- Thinking in terms of costs and benefits will lead to **different regulatory solutions** than when only considering one or the other

- Are *benefits of abatement by closure outweighed by adverse effects from fishing in less profitable areas? Do we understand adverse effects well enough to estimate marginal benefits?*

- Are *gear modifications/substitutions more cost-effective than area closures? Do we understand herding and selectivity well enough to estimate marginal costs?*



Questions?

