

New England Fishery Management Council Habitat Committee Report

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Portland, ME

Michelle Bachman, NEFMC Staff

Jon Grabowski, Habitat PDT, GMRI

Chad Demarest, Habitat PDT, NEFSC

Outline

- Adverse effects determination
 - More than minimal/not temporary thresholds
 - Brief review – vulnerability assessment, simulated and realized SASI model outputs
- SASI analyses
 - LISA, EAP (see SASI Spatial Analysis document)
 - Z Net Stock
- Committee motions

Adverse effects determination

Each FMP must provide conclusions regarding whether and how each fishing activity adversely affects EFH

If effects are adverse, they should be minimized to the extent practicable

Definition of 'adverse' is based on a more than minimal/not temporary threshold

SASI Model Components

1. Vulnerability Assessment – based on structural features inferred to habitats defined by substrate/energy dominance
2. Combination of spatially-referenced substrate, energy, and area swept fishing effort data, conditioned by vulnerability parameters

Two types of SASI Model Outputs

- **Uniform simulated** – same amount of area swept in every cell – shows results of underlying Vulnerability Assessment. Six basic gear types. Maps at end of gazetteer.
- **Realized** – shows past distribution of area swept by gear type, and realized adverse effects by gear type. One year time step, ten gears, most 1996-2009. Maps in gazetteer.

Adverse effects determination using SASI

1. What does the vulnerability assessment tell us about the interaction between fishing gears and structural habitat?
 - All gear types have the potential for more than minimal adverse effects (i.e. susceptibility values > 0)
 - All gear types have the potential for generating adverse effects that are not temporary (i.e. recovery values > 0)

Adverse interactions by gear

Gear type	Total number of features	Features with both S and R greater than 0
Trawl	118	94 (80%)
Scallop dredge	118	94 (80%)
Hydraulic dredge	54	49 (91%)
Longline	118	67 (57%)
Gillnet	118	67 (57%)
Trap	118	67 (57%)

Adverse effects determination using SASI

2. Are uniform simulation Z_{∞} values for the gear type high or low relative to other gears?
 - Mobile gears have higher Z_{∞} values; especially hydraulic dredges
 - Fixed gears have lower range of Z_{∞} values
 - These values are directly related to vulnerability assessment results

Comparing magnitude of Z_{∞} estimates

Gear type	Maximum	25th %ile	50th %ile	75th %ile
Trawl	100.36	44.66	45.67	47.99
Scallop	75.90	47.12	48.12	48.82
Hydraulic	159.93	107.77	109.58	123.33
Longline	27.22	14.65	14.84	15.07
Gillnet	27.21	14.65	14.85	15.06
Trap	28.25	15.95	16.42	17.55

All Z_{∞} expressed as absolute values of equilibrium (year 11) adverse effect estimates when 100 km² area swept added to each cell in each year for all cells within the defined depth range for each gear type

Adverse effects determination using SASI

3. What is the actual magnitude of the effects of a particular gear type?
 - Some gears have a much higher range of realized Z values than other gears
 - Example – for mobile gears, total annual realized Z for generic otter trawls is an order of magnitude higher than scallop dredges, which is again higher than hydraulic dredges

Change in realized Z

Gear type	2003 total realized Z km²	2009 total realized Z km²
Generic otter trawl	105,208	66,680
Raised footrope	93	190
Shrimp trawl	4,232	3,408
Squid trawl	6,453	6,486
Scallop dredge (LA)	12,360	10,501
Scallop dredge (GC)	488	811
Hydraulic dredge	618	919
Longline	122	18
Gillnet	34	20
Trap	404	349

SASI Realized Z Conclusions

- Mobile gears comprise the majority of the adverse effects from fishing estimated in our region (99.5% in 2009)
 - Trawl gears 85%, dredge gears 14%
- Adverse effects from fishing by all gears have declined by 30% since 2003
 - Generic otter trawl adverse effects have declined by 35%
 - Limited access scallop dredge adverse effects have declined by 15%

SASI Spatial Analyses

- Equal Area Permutation Approach (EAP)
- Local Indicators of Spatial Association (LISA)
- Both are based on the uniform simulation model outputs (Z_{∞})

SASI Spatial Analysis Objectives

1. Explore the spatial structure of the asymptotic area swept (Z^∞)
2. Define clusters of high and low Z^∞ for each gear type
3. Determine the levels of Z^∞ in present and candidate management areas relative to the model domain
4. Identify alternative management areas with Z^∞ values similar to or higher than the tested areas

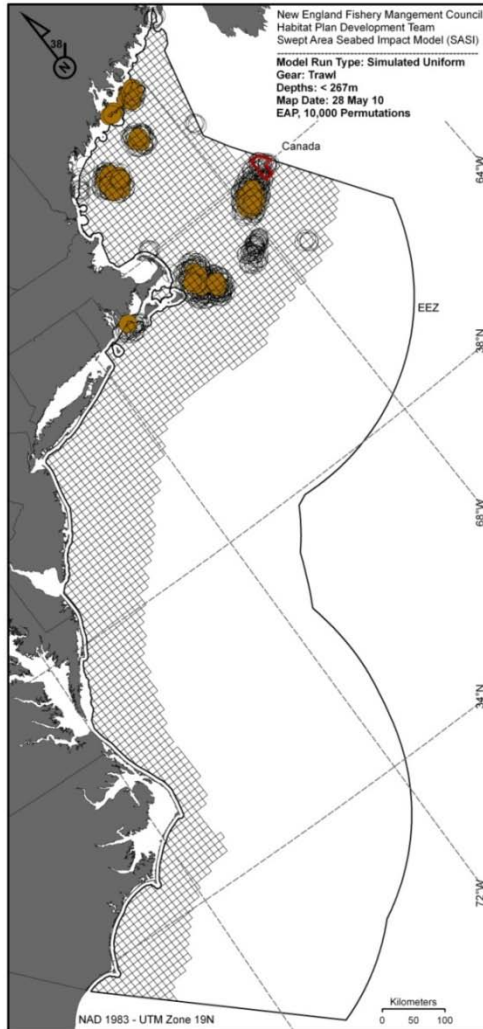
Evaluate Current Closed Areas

Committee asked the PDT to evaluate the appropriateness of the current boundaries of the closed areas

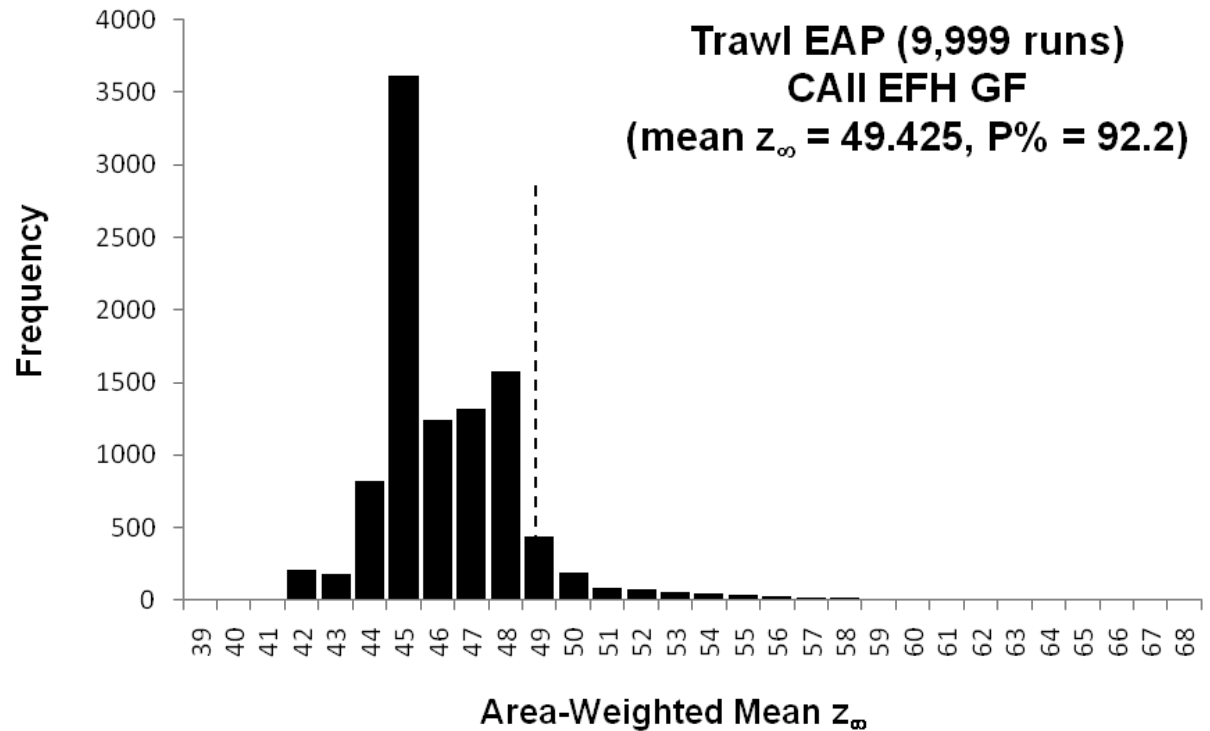
Analysis: Equal Area Permutation (EAP)

PDT Recommendation: High percentile areas are generally appropriate to obtaining goals; low percentile areas could be considered for elimination

Z_{∞} in Present and Proposed Management Areas



Equal Area Permutations (EAP)



Equal Area Permutation Results – Trawl

Closed Area		Tested area result			Permutation results		
		km ²	AWM z _∞	Sum z _∞	P% ≥ Mean z _∞	Areas with	99 th %
Groundfish (Amendment 13) EFH Closed Areas	Cashes L. EFH GF	443	51.437	588.06	96.00%	400	57.661
	Jeffreys B. EFH GF	499	57.667	510.13	99.10%	90	57.101
	WGOM EFH GF	2272	50.114	1777.55	95.10%	490	52.63
	CAII EFH GF	641	49.425	844.79	92.20%	780	56.567
	CAI N. EFH GF	1937	45.186	1287.93	12.80%	8721	53.15
	CAI S. EFH GF	584	46.085	609.67	50.30%	4970	57.101
	NLCA EFH GF	3387	46.787	2205.24	56.80%	4320	51.884
Multispecies mortality closures	Cashes L. Closed Area	1373	48.505	1186.07	83.00%	1700	54.314
	WGOM Closed Area	3030	49.874	2362.75	94.70%	530	52.037
	Closed Area II	6862	46.338	4354.63	41.10%	5891	50.912
	Closed Area I	3939	45.891	2556.1	34.20%	6581	51.589
	Nantucket Lightship	6248	46.466	4002.39	46.30%	5371	51.015

EAP Analysis

- Allows for comparisons between currently defined areas and any other areas within domain
- Tool for evaluating defined areas, NOT for identifying new areas
- Basis for the habitat impacts analysis in an EIS

Consider New Habitat Mgmt Areas

Committee asked PDT to suggest modifications to the boundaries of the existing closed areas, including the suggestion of any new closed areas and elimination of any closed areas

Analysis: Local Indicators of Spatial Association (LISA)

Recommendation: focus attention on high vulnerability clusters

Z^∞ Spatial Structure and Clusters

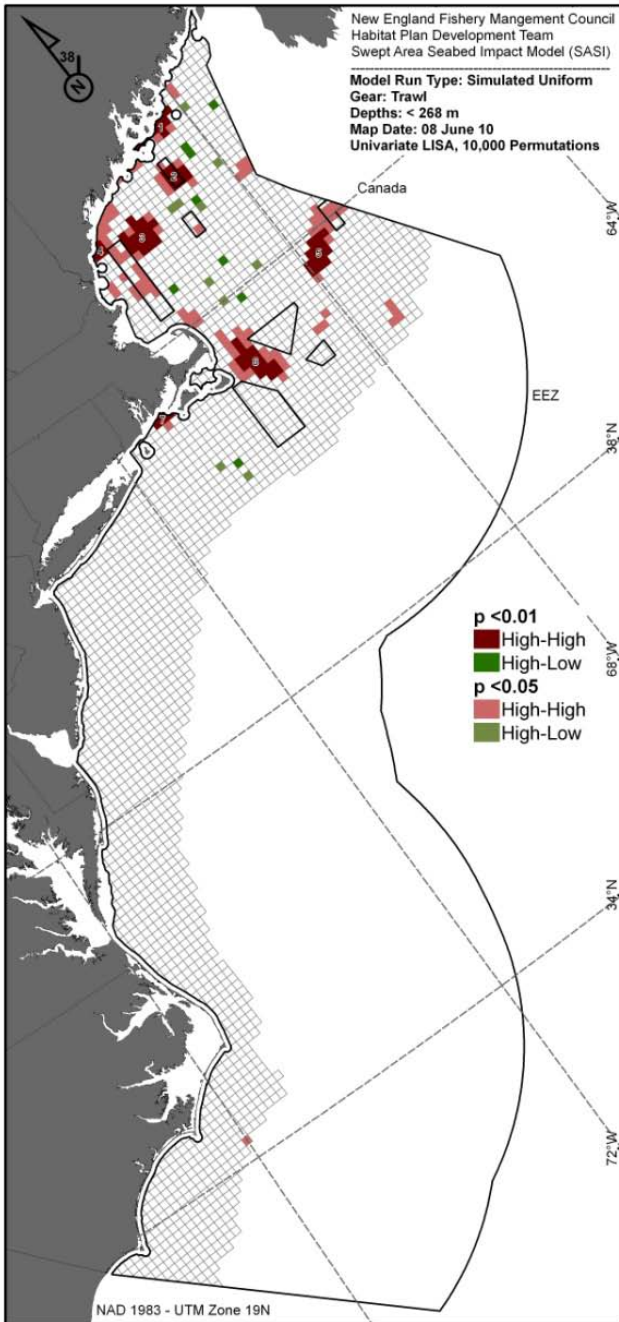
Local Indicators of Spatial Association (LISA) statistics including Moran Scatterplots and Local Moran's I were used to explore the spatial structure of Z^∞ and to delimit clusters of model cells with statistically high and low Z^∞ (Anselin 1995).

$$I_i = \frac{x_i}{Q_i^2} \sum_{j=1, j \neq i}^n w_{i,j} x_j, \quad \text{where} \quad Q_i^2 = \frac{\sum_{j=1, j \neq i}^n w_{i,j}}{n-1} - \bar{X}^2$$

The neighborhood weights, $w_{i,j}$, were determined using Queen Contiguity (the 8-neighbor rule)

1	2	3
8	x_i	4
7	6	5

LISA Analysis - Trawl



Gear	Global Morans I	p
Trawl	0.4790	≤ 0.0001
Dredge	0.5075	≤ 0.0001
H. Dredge	0.8264	≤ 0.0001
Gillnet	0.4080	≤ 0.0001
Longline	0.4100	≤ 0.0001
Trap	0.6775	≤ 0.0001

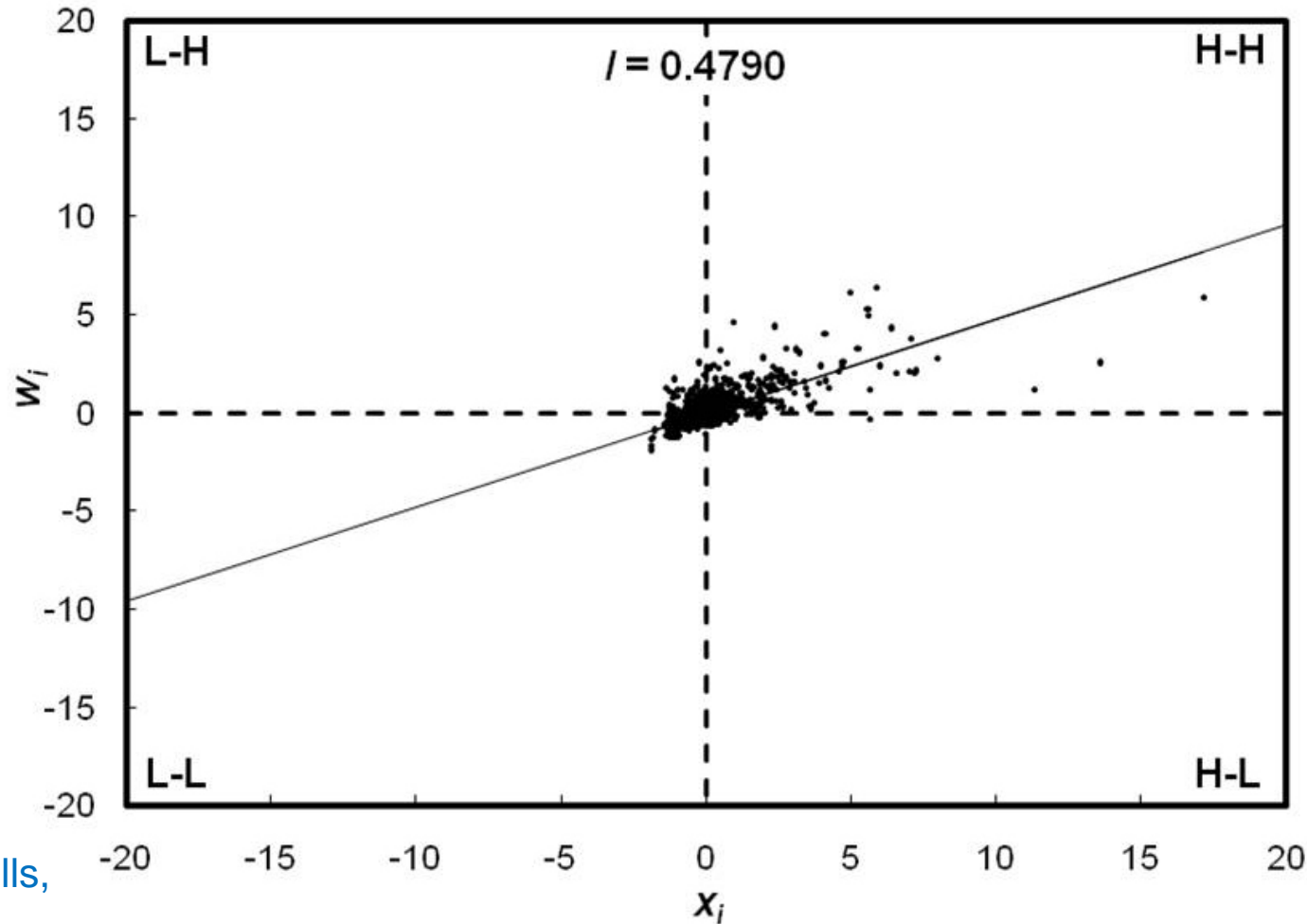
Cluster	Trawl
Not Significant	76.27%
High-High	6.79%
Low-Low	14.98%
Low-High	1.24%
High-Low	0.72%

LISA Moran Scatterplot

Low Z cells,
High Z
Neighborhood

High Z cells,
High Z
Neighborhood

Trawl



These are on
maps

Low Z cells,
Low Z
Neighborhood

High Z cells,
Low Z
Neighborhood

LISA Analysis

- Enables the Council, Ctte and public to understand the spatial structure of the SASI outputs in terms of clustering
- Highlights areas that contain concentrated clusters of model grid cells with significantly greater adverse effect accumulation
- Points towards the “right” areas to focus attention on, but DOES NOT adequately define boundaries for management—will need refinement based on other inputs

LISA Conclusions

- Seven significant clusters emerge
- GOM clusters near known geomorphic features; some overlap with existing habitat closure areas
- GB clusters near higher-energy gravel, cobble and boulder dominated habitats; little overlap with existing habitat closure areas
- Results should be treated as first-pass; data issues influence cluster size and in certain cases areas suspected to contain vulnerable substrates are not highlighted—some interpretation required

Considering practicability of management options

**Committee asked PDT to provide them
with a metric for understanding and
analyzing tradeoffs**

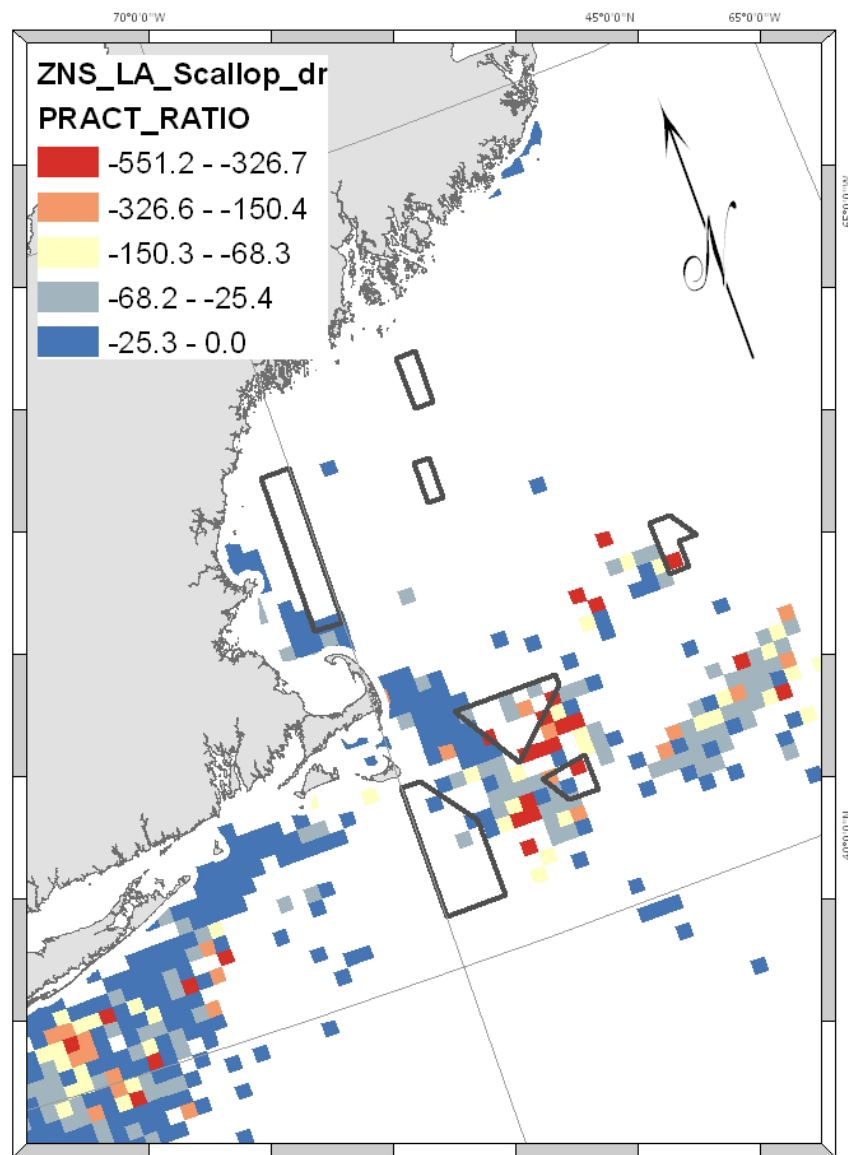
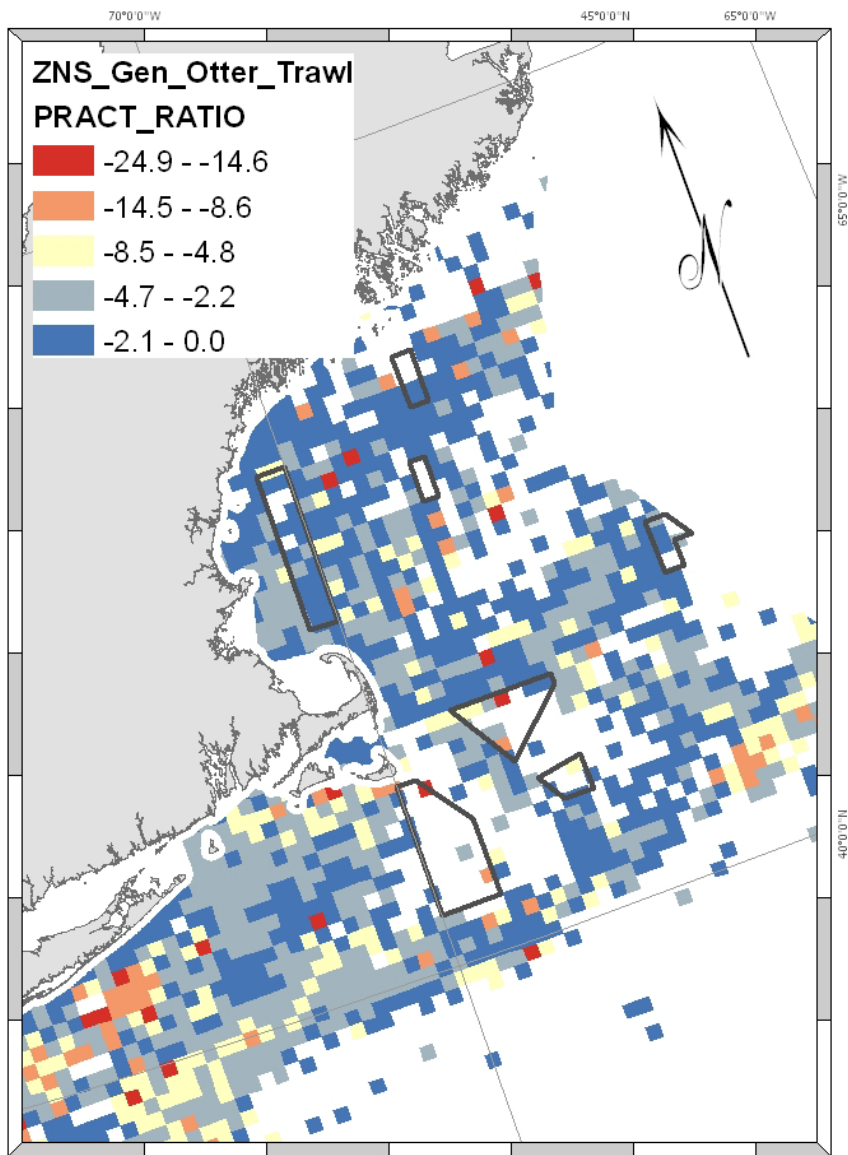
Analysis: SASI Z Net Stock model, which
combines an instantaneous version of
realized adverse effect with revenue data

Z Net Stock

Z Net Stock quantifies the total adverse effect for each fishing trip by summing the magnitude of the adverse effects across all years until the features affected are estimated to have recovered.

Z Net Stock Results (avg per trip)

Gear type	Mean Z net stock	Mean Value	Mean practicability ratio
Generic otter trawl	3.91	\$6,559	2.93
Shrimp trawl	1.31	\$1,536	1.56
Squid trawl	3.96	\$11,016	4.26
Raised footrope trawl	0.85	\$2,394	3.95
Scallop dredge-LA	2.10	\$42,961	93.02
Scallop dredge-GC	0.17	\$2,091	19.45
Hydraulic dredge	0.16	\$11,782	90.69
Longline	0.05	\$2,594	2,092
Gillnet	0.0	\$2,780	7,867
Trap	0.01	\$1,975	2,018



ZNS Analysis

- Captures the magnitude of adverse effect at the trip level
 - Allows for comparisons across areas, gear types, years
- Practicability ratio captures the amount of benefit (revenue) generated per unit of adverse effect (ZNS)
- Allows evaluation of the trade-offs and opportunity costs associated with habitat management measures in various areas and for different gear types.

ZNS Conclusions

- Based on actual data; gaps where no fishing occurs
- For a given unit of adverse effect (one sq km Z):
 - trawl gears produce on average approx. \$2K-4K;
 - dredge gears an order of magnitude greater (~\$90K),
 - fixed gears three orders of magnitude greater (~\$2-7 mil)
- Areas with high practicability ratios appear to cluster spatially, LISA analysis may assist decision-making

Management measures

- NRC highlights three classes of management measures for minimizing adverse effects:
 - area closures
 - gear modifications
 - fishing effort reductions
- The impact of gear modifications such as ground cable restrictions and sweep configurations may be modeled in SASI
 - For example, SASI estimates that a 30% reduction in the length of ground cables would reduce total area swept by 20%

Committee Motions (10 June 2010)

Motion 3

Recommend to the Council that the Habitat Committee and PDT's work plan include development of the following concepts [Motions 1 and 2].

Motion 1 Gulf of Maine

- Status Quo.
- Keep all current areas closed and propose four new habitat management areas for the south of Mount Desert Island Cluster, Jeffreys Bank Cluster, Cape Neddick Cluster, Platts/New Ledge Cluster.
 1. That the size of these areas be identified in areas bounded by straight lines with three options – clustered squares where $p=0.01$, $p=0.05$, or 90% of $p=0.01$.
 2. Management options to include a range of alternatives from complete closure to gear modifications such as reduced rockhopper size and shortened legs for trawl vessels, and appropriate measures for other gears.
 3. Request PDT to further analyze grid cells in the WGOM and CL closures that don't cluster in the LISA analysis.
 4. Propose that the Ammen Rock area (Cashes Ledge) and the Sliver (overlap between SBNMS and WGOM closed area) be dedicated habitat research areas.
 5. Propose that the analysis of all alternatives proposed for the GOM include CPUE for both revenue and landings.
- No closure alternative to reduce Z (adverse effect) by maximizing CPUE in areas indicated by SASI.

Motion 2 Georges Bank/S. New England

- Status Quo.
- Propose elimination of Closed Area I, Closed Area II, and NLCA habitat management areas.
- Propose new habitat management areas for the Great South Channel Cluster, Georges Shoal Cluster, and Browns Bank Area Cluster.
 1. That the size of these areas be identified in areas bounded by straight lines with three options – clustered squares where $p=0.01$, $p=0.05$, or 90% of $p=0.01$.
 2. Management options to include a range of alternatives from complete closure to gear modifications such as reduced rockhopper size and shortened legs for trawl vessels, and appropriate measures for other gears.
 3. Propose that a 100 km² block in each of the areas proposed to be opened would remain closed as a habitat research area, as determined by the PDT.
 4. Propose that the analysis of all alternatives proposed for GB include CPUE for both revenue and landings.
- No closure alternative to reduce Z (adverse effect) by maximizing CPUE in areas indicated by SASI.