NOAA FISHERIES
Alaska Region

Review of Scallop Essential Fish Habitat

John Olson
2020 Scallop Plan Team Meeting
Kodiak, AK
19 Feb 2020

The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) includes provisions concerning the identification and conservation of Essential Fish Habitat (EFH). The Magnuson-Stevens Act defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." The National Marine Fisheries Service (NMFS) and regional fishery management councils must describe and identify EFH in fishery management plans (FMPs), minimize to the extent practicable the adverse effects of fishing on EFH, and identify other actions to encourage the conservation and enhancement of EFH.

1. EFH Descriptions & Maps
2. Effects of Fishing on Habitat

EFH Species Descriptions

EFH Levels as defined by EFH Regulation (50 CFR Part 600)

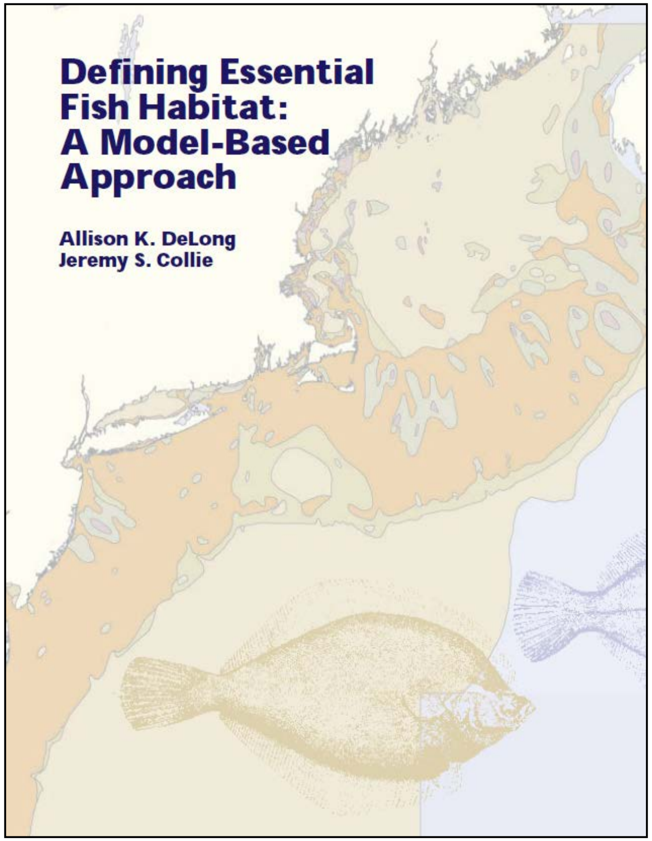
Level 1 - *Distribution data are available* for some or all portions of the geographic range of the species.

Level 2 - *Habitat-related densities* of the species are available

Level 3 - *Growth, reproduction, or survival rates* within habitats are available.

Level 4 - *Production rates* by habitat are available.

EFH Description/Map updates for the 2015 EFH 5-year Review



NOAA Technical Memorandum NMFS-AFSC-236

A Refined Description of Essential Fish Habitat for Pacific Salmon Within the U.S. Exclusive Economic Zone in Alaska

by
K. Echave, M. Eagleton, E. Farley, and J. Orsi

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Alaska Fisheries Science Center

June 2012

a generalized additive model (GAM) is a generalized linear model in which the linear predictor depends linearly on unknown smooth functions of some predictor variables, and interest focuses on inference about these smooth functions. GAMs were originally developed by Trevor Hastie and Robert Tibshirani[1] to blend properties of generalized linear models with additive models.

Data Sources

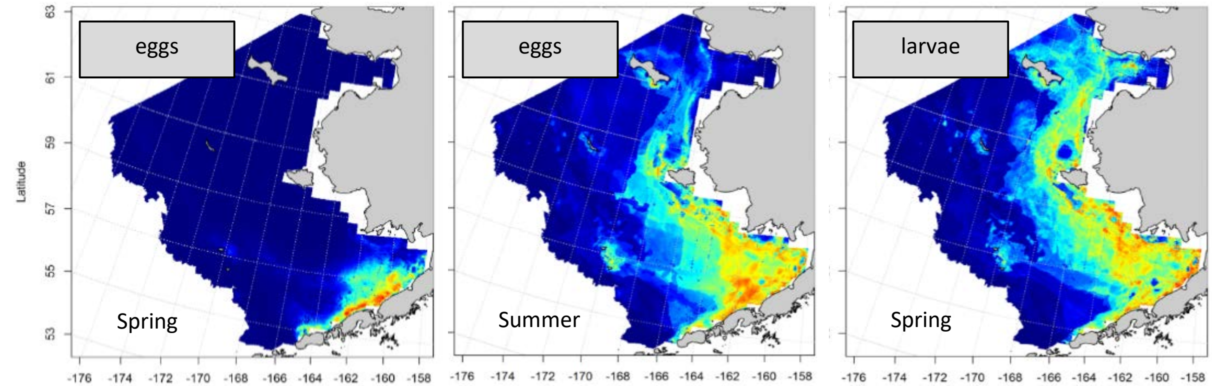
- Bottom trawl surveys (1982-2014)
  - CPUE (GAM, hurdle GAM, Maxent)
  - Adults
  - Settled juveniles
  - Summer only
- EcoFOCI data (1994-2015)
  - Presence only (MaxEnt)
  - Eggs
  - Larvae
  - Pelagic juveniles
  - All seasons
- Catch in areas database (2005-2013)
  - Presence only (MaxEnt)
  - Fall, winter, spring
  - Adults only

Variable	Unit	Definition	Interpolation method	Source	
Position	eastings, northings	Latitude and longitude of bottom trawl hauls in Alaska Albers projection corrected for the position of the trawl net relative to the vessel	--	DGPS collected at bottom trawl hauls	
Depth	m	Bathymetry of the seafloor based on digitized and position corrected NOS charts	Linear interpolation	Mean depth of bottom trawl hauls (modeling), Zimmermann et al. 2014	
Slope	percent	Maximum difference between a depth measurement and its adjoining cells	--	Zimmermann et al. 2014	
Bottom temperature	°C	Mean summer bottom temperature for the region measured during bottom trawl surveys from 1996-2010	Ordinary kriging	Temperature data collected at bottom trawl hauls	
Surface temperature	°C	Ocean current speed predicted from the ROMS model during the years 1970-2004 and averaged on a 10 km by 10 km grid	Inverse distance weighting	Danielson et al. 2011	1
Ocean color	$Carbon*m^{-2}*day^{-1}$	Net primary production in surface waters in May to September averaged by 1080 by 2160 grid cells then averaged across years (2002-2011)	Inverse distance weighting	Behrenfeld and Falkowski 1997	
Mean bottom ocean current	$m*sec^{-1}$	Seafloor ocean current speed predicted from the ROMS model during the years 1970-2004 and averaged on a 10 km by 10 km grid	Inverse distance weighting	Danielson et al. 2011	
Maximum tidal current	$cm*sec^{-1}$	Maximum of the predicted tidal current at each bottom trawl location over a 1-year cycle	Ordinary kriging	Egbert and Erofeeva 2000	
Mean surface ocean current speed	$m*sec^{-1}$	Surface ocean current speed predicted from the ROMS model during the years 1970-2004 and averaged on a 10 km by 10 km grid	Inverse distance weighting	Danielson et al. 2011	1
Mean surface ocean current direction	angle	Surface ocean current direction predicted from the ROMS model during the years 1970-2004 and averaged on a 10 km by 10 km grid	Inverse distance weighting	Danielson et al. 2011	1
Surface ocean current direction variability	--	Variability in surface ocean current direction predicted from the ROMS model during the years 1970-2004 and averaged on a 10 km by 10 km grid	Inverse distance weighting	Danielson et al. 2011	1
Coral presence or absence	--	Coral presence or absence in bottom trawl catch and raster of predicted presence or absence of coral	--	Catch data from bottom trawl hauls (modeling), Rooper et al. (2014) (prediction)	2
Sponge presence or absence	--	Sponge presence or absence in bottom trawl catch and raster of predicted presence or absence of Sponge	--	Catch data from bottom trawl hauls (modeling), Rooper et al. (2014) (prediction)	2
Pennatulacean presence or absence	--	Pennatulacean presence or absence in bottom trawl catch and raster of predicted presence or absence of Pennatulacean	--	Catch data from bottom trawl hauls (modeling), Rooper et al. (unpublished data) (prediction)	2

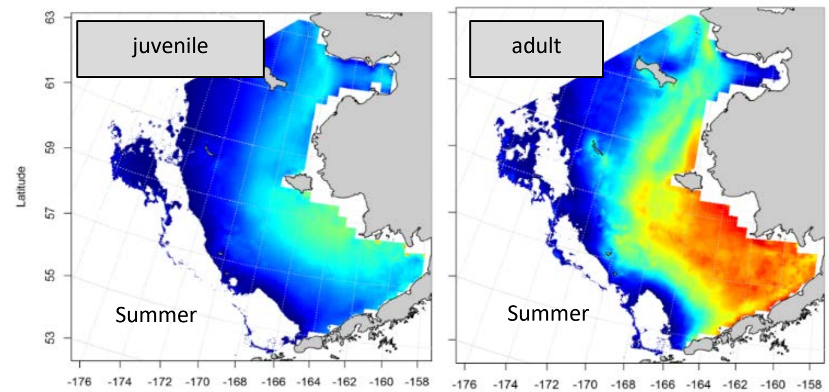
[1] Used to model egg, larval and early juvenile stages only

[2] Used to model bottom trawl survey data only

ichthyoplankton survey
MaxEnt - presence only
(probability)

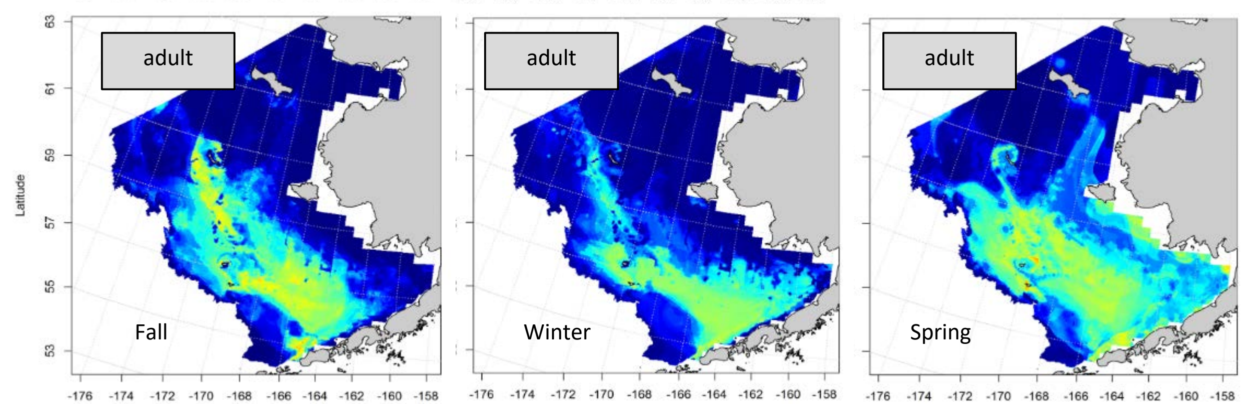


bottom trawl survey
GAM-abundance



yellowfin
sole

observer catch
MaxEnt-presence only
(probability)



EFH 5-year Review

SSC Comments April 2016

The SSC understands the Scallop Plan Team chair's decision not to consider an update to weathervane scallop EFH at this time. It may well be prudent to wait to reconsider scallop EFH in another 5 years after implementation of new statewide surveys. However, the SSC wishes to point out that there already exist some new, relevant data that could be considered. Jessica Glass conducted a multivariate analysis of community composition on weathervane scallop beds in Alaska. Results may help fine-tune scallop EFH definitions. Significant ($p<0.05$) spatial differences in community structure were most strongly correlated with sediment, depth, and dredging effort. Temporal changes were weakly, yet significantly, correlated with freshwater discharge and dredging effort.

Scallop EFH Descriptions & Map – 2005/2010

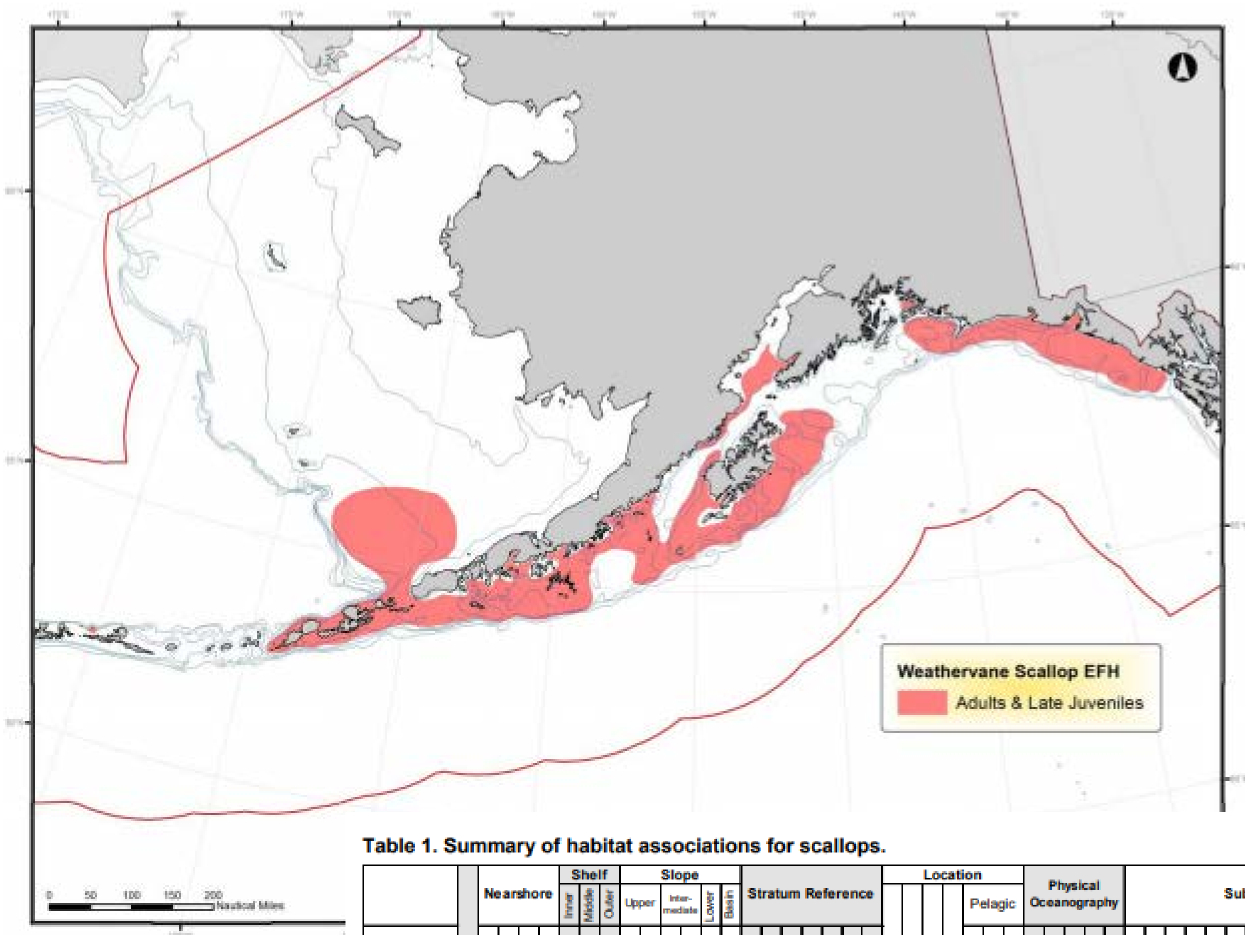


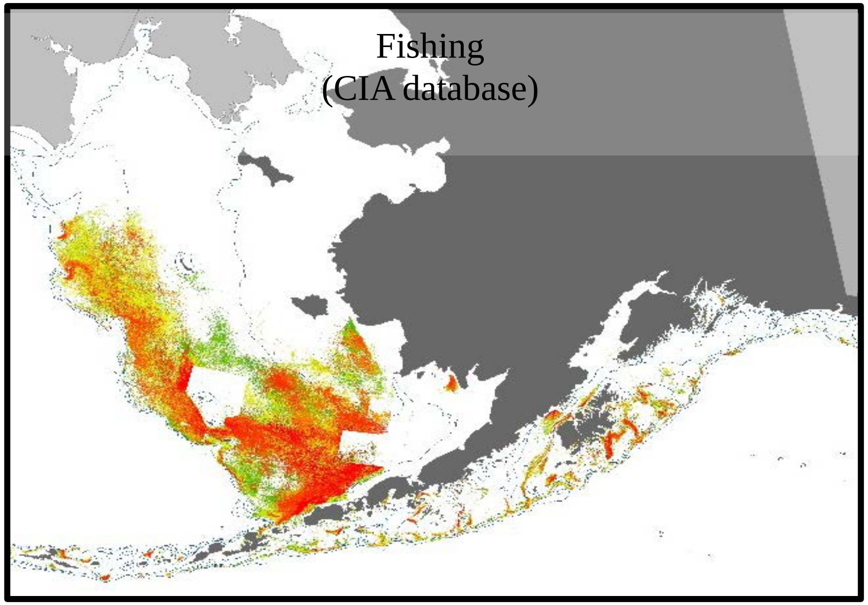
Table 1. Summary of habitat associations for scallops.

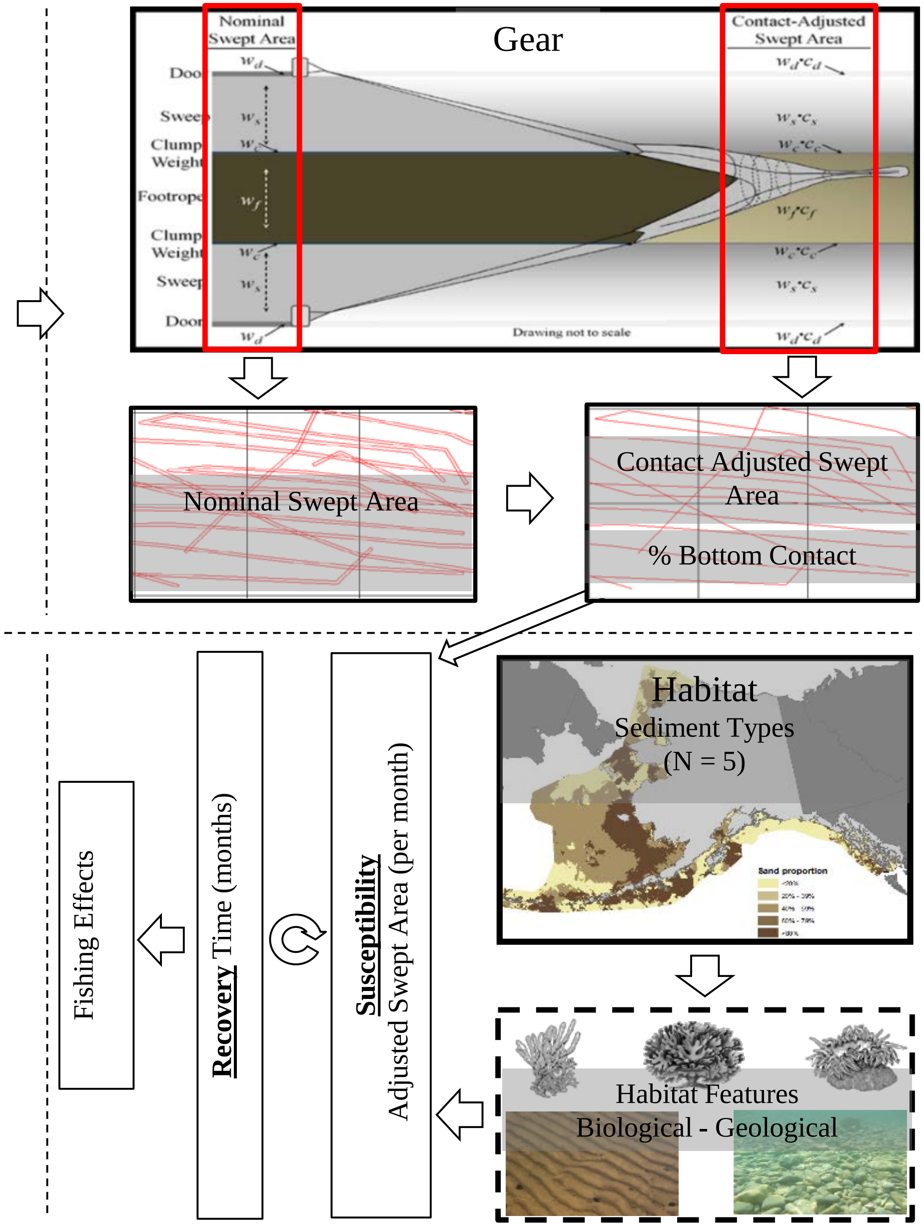
Species	Life Stage	Nearshore: Freshwater	Nearshore: Estuarine	Nearshore: Intertidal	Nearshore: Subtidal	Shelf: Inner 1-50m	Shelf: Middle 51-100m	Shelf: Outer 101-200m	Slope: Upper 201-300m	Slope: Upper 301-500m	Slope: Inter-mediate 501-700m	Slope: Inter-mediate 701-1000m	Slope: Lower 1001-3000m	Slope: Basin >3000m
Weathervane scallop	M					x	x	x						
	LJ					x	x	x						
	EJ					x	x	x						
	L					x	x	x						
	E					x	x	x						

Species	Life Stage	Stratum Reference: Shallows	Island Pass	Bay/Fjord	Bank	Flat	Edge	Gully	Location: Surface	Near surface	Semi-demersal	Demersal	Pelagic: 1-200m (epi)	Pelagic: 201-1000m (meso)	Pelagic: >1000m (bathy)
Weathervane scallop	M		x	x								x			
	LJ		x	x								x			
	EJ											x			
	L												x		
	E											x			

Species	Life Stage	Physical Oceanography: Upwelling areas	Gyres	Thermo/pycnocline	Fronts	Edges (ice, bath)	Substrate: Organic Debris	Mud	Sand	Gravel	Mud & sand	Mud & gravel	Sand & mud	Gravel & mud	Gravel & sand	Gravel & sand & mud	Gravel & mud & sand	Cobble	Rock
Weathervane scallop	M	x	x					x	x	x	x	x	x	x	x	x	x		
	LJ	x	x					x	x	x	x	x	x	x	x	x	x		
	EJ		x					x	x	x	x	x	x	x	x	x	x		
	L																		
	E																		

Species	Life Stage	Structure: Bars	Sinks	Slumps/Rockfalls/Debris	Channels	Ledges	Pinnacles	Seamounts	Reefs	Vertical Walls	Man-made	Community Associations: Red King Crab	Tanner crab	Shrimps	Octopi	Flatfishes	Pacific cod	Benthic invertebrates	Oceano-graphic Properties: Temperature (Celsius)	Salinity (ppt)	Oxygen Conc (ppm)	Life Stage
Weathervane scallop	M											x	x	x	x	x	x	x	1-9.6			M
	LJ											x	x	x	x	x	x	x				LJ
	EJ																					EJ
	L																					L
	E																					E





$$H_{t+1} = H_t(1 - I'_t) + h_t \rho'_t$$

H: habitat undisturbed from fishing

h: habitat disturbed from fishing

I': monthly impact rate

ρ': monthly recovery rate

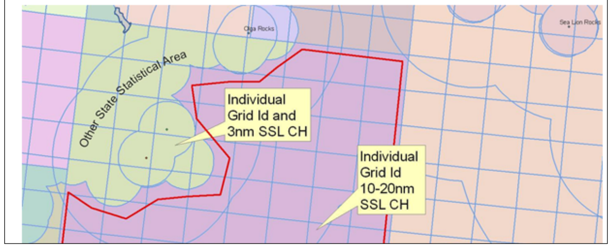
Accounting for overlapping fishing impacts with VMS

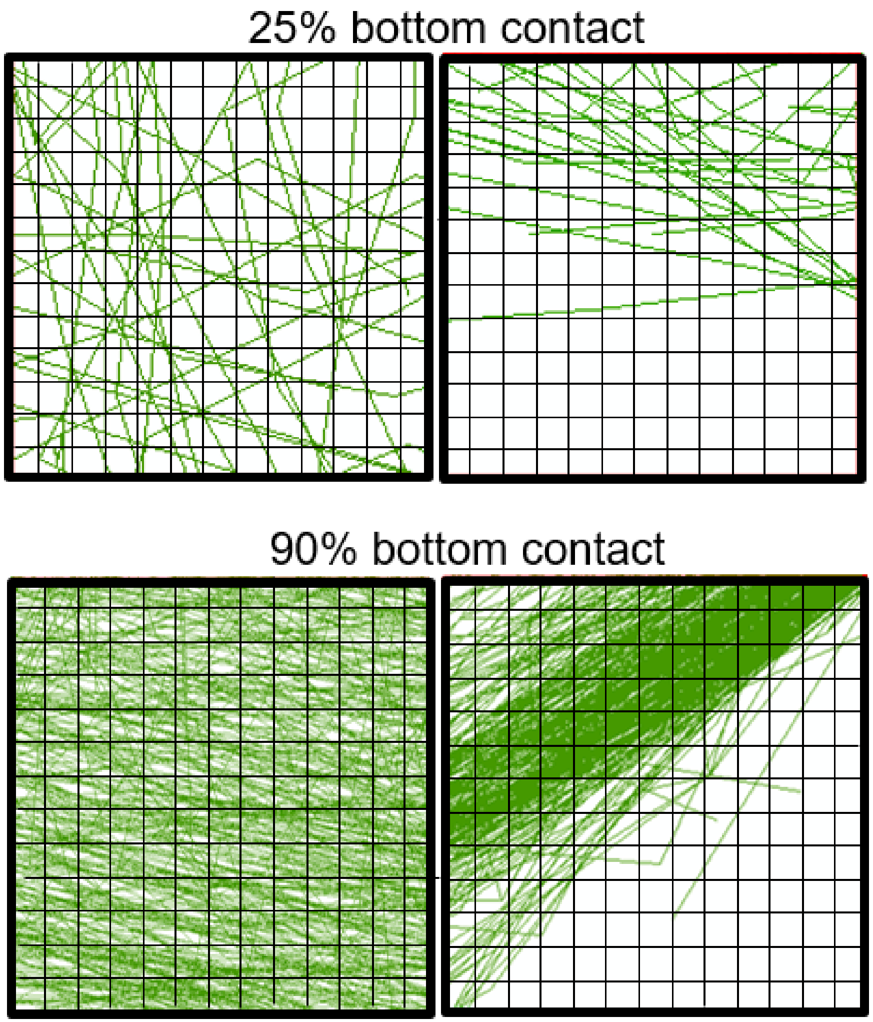
VMS-Observer Enabled Catch-In-Areas Database

Steve G. Lewis
GIS Coordinator/Analyst/DB
NOAA Fisheries, Alaska Region

In 2007, NMFS/Alaska Region began developing a fisheries harvest database that would integrate data acquired from onboard observers and data on vessel movements acquired by satellite through the Vessel Monitoring System (VMS). This VMS-Observer Enabled Catch-In-Areas (VOE-CIA) database is designed to increase the spatial resolution of the Catch Accounting System for both the observed and unobserved vessel fleet and thus to facilitate more accurate analysis of fisheries management issues.

The VOE-CIA database integrates catch data from the Catch Accounting System (which has the spatial resolution of a NMFS Reporting Area) into a database that resolves the GIS data into polygons with areas of approximately seven kilometers. In an unrestricted area, sixty four grid IDs fit inside one state statistical area. However, a given seven-kilometer polygon may be further divided into smaller polygons by the boundary of state statistical areas, the boundary of state and federal waters, or by the boundary of Steller sea lion critical habitat (broken out at 3, 10, and 20 nautical miles from one of 154 Steller sea lion rookeries or haulouts). Where confidentiality needs to be protected, a seven-kilometer polygon may be grouped with others into 20km polygons. Each polygon (the exact size of which will vary with latitude) and its subparts will have a distinct grid ID.



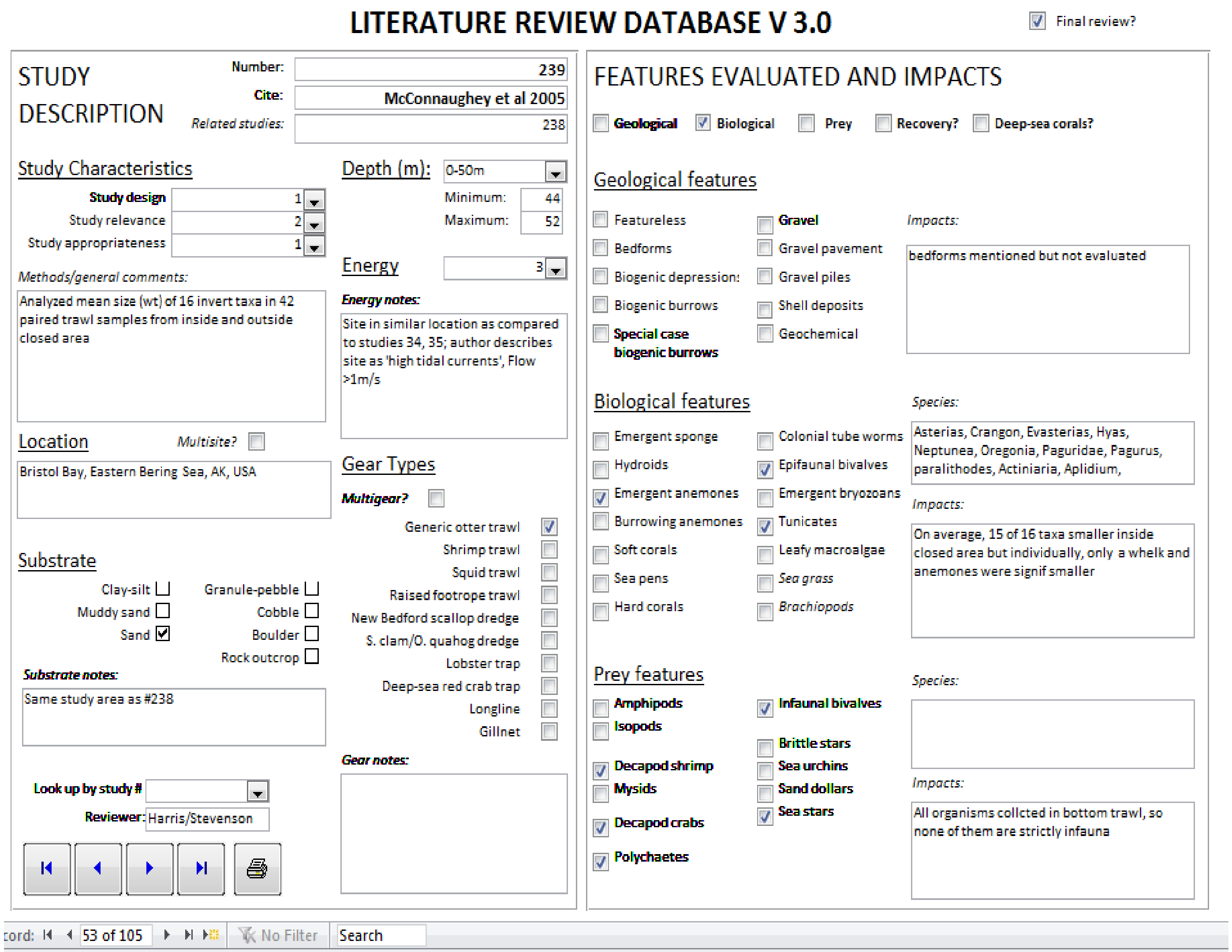


Improved gear descriptions

Fishery	Vessel type	Area	Gear	Target1	Target2	Vessel Length (ft)	Season	Depth Range (fath.)	Nom Width (m)
GOA Pollock Pelagic Trawl Sand Point	CV	GOA	PTR	P	all others	<75			50
GOA Pollock Pelagic Trawl	CV	GOA	PTR	P	all (but K, S)	≥75			75
GOA Slope Rockfish Pelagic Trawl	CV	GOA	PTR	K	S	≥75			75
GOA Slope Rockfish Pelagic Trawl	CP	GOA	PTR	K	W	all			100
GOA PCod Bottom Trawl Inshore	CV	GOA	NPT	C	B, P	≥75			90
GOA Deepwater Flatfish Bottom Trawl	CV	GOA	NPT	D	W, X	≥75			90
GOA Shallowwater Flatfish Bottom Trawl	CV	GOA	NPT	H	all others	≥75			90
GOA PCod Bottom Trawl Sand Point	CV	GOA	NPT	C	all others	<75			55
GOA Deepwater Flatfish Bottom Trawl CP	CP	GOA	NPT	D, W	X	all			193
GOA Shallowwater Flatfish/Cod Bottom Trawl CP	CP	GOA	NPT	H, C	L, all others	all			193
GOA Slope Rockfish Bottom Trawl CP	CP	GOA	NPT	K	S	all			75
BS Pollock Pelagic Trawl (incl Mothership)	CV	BS	PTR	P	B, all others	<125 ≥300	A	≥90	62
BS Pollock Pelagic Trawl (incl Mothership)	CV	BS	PTR	P	B, all others	<125 ≥300	A	60-90	58
BS Pollock Pelagic Trawl (incl Mothership)	CV	BS	PTR	P	B, all others	<125 ≥300	A	<60	50
BS Pollock Pelagic Trawl (incl Mothership)	CV	BS	PTR	P	B, all others	<125 ≥300	B	≥90	77
BS Pollock Pelagic Trawl (incl Mothership)	CV	BS	PTR	P	B, all others	<125 ≥300	B	60-90	73
BS Pollock Pelagic Trawl (incl Mothership)	CV	BS	PTR	P	B, all others	<125 ≥300	B	<60	64
BS Pollock Pelagic Trawl	CV	BS	PTR	P	B, all others	125-151	A	≥90	93
BS Pollock Pelagic Trawl	CV	BS	PTR	P	B, all others	125-151	A	60-90	87
BS Pollock Pelagic Trawl	CV	BS	PTR	P	B, all others	125-151	A	<60	75
BS Pollock Pelagic Trawl	CV	BS	PTR	P	B, all others	125-151	B	≥90	115

Impact = (Nominal area swept) x (Contact adjustment) x (Susceptibility)

Susceptibility/Recovery – 2015 EFH 5-year Review



LITERATURE REVIEW DATABASE V 3.0

☑ Final review?

STUDY DESCRIPTION

Number: 239
Cite: McConnaughey et al 2005
Related studies: 238

Study Characteristics

Study design 1
Study relevance 2
Study appropriateness 1

Methods/general comments:
Analyzed mean size (wt) of 16 invert taxa in 42 paired trawl samples from inside and outside closed area

Location

Multisite? ☐

Bristol Bay, Eastern Bering Sea, AK, USA

Substrate

Clay-silt ☐ Granule-pebble ☐
Muddy sand ☐ Cobble ☐
Sand ☑ Boulder ☐
Rock outcrop ☐

Substrate notes:
Same study area as #238

Look up by study #
Reviewer: Harris/Stevenson

Depth (m):

0-50m
Minimum: 44
Maximum: 52

Energy

3

Energy notes:
Site in similar location as compared to studies 34, 35; author describes site as 'high tidal currents', Flow >1m/s

Gear Types

Multigear? ☐

Generic otter trawl ☑
Shrimp trawl ☐
Squid trawl ☐
Raised footrope trawl ☐
New Bedford scallop dredge ☐
S. clam/O. quahog dredge ☐
Lobster trap ☐
Deep-sea red crab trap ☐
Longline ☐
Gillnet ☐

Gear notes:

FEATURES EVALUATED AND IMPACTS

☐ **Geological** ☑ Biological ☐ Prey ☐ Recovery? ☐ Deep-sea corals?

Geological features

☐ Featureless
☐ Bedforms
☐ Biogenic depressions
☐ Biogenic burrows
☐ **Special case biogenic burrows**
☐ **Gravel**
☐ Gravel pavement
☐ Gravel piles
☐ Shell deposits
☐ Geochemical

Impacts:
bedforms mentioned but not evaluated

Biological features

☐ Emergent sponge
☐ Hydroids
☑ Emergent anemones
☐ Burrowing anemones
☐ Soft corals
☐ Sea pens
☐ Hard corals
☐ Colonial tube worms
☑ Epifaunal bivalves
☐ Emergent bryozoans
☑ Tunicates
☐ Leafy macroalgae
☐ *Sea grass*
☐ *Brachiopods*

Species:
Asterias, Crangon, Evasterias, Hyas, Neptunea, Oregonia, Paguridae, Pagurus, paralithodes, Actiniaria, Aplidium,

Impacts:
On average, 15 of 16 taxa smaller inside closed area but individually, only a whelk and anemones were signif smaller

Prey features

☐ **Amphipods**
☐ **Isopods**
☑ **Decapod shrimp**
☐ **Mysids**
☑ **Decapod crabs**
☑ **Polychaetes**
☑ **Infaunal bivalves**
☐ **Brittle stars**
☐ **Sea urchins**
☐ **Sand dollars**
☑ **Sea stars**

Species:

Impacts:
All organisms collcted in bottom trawl, so none of them are strictly infauna

cord: 53 of 105 No Filter Search

Grabowski, J. H., M. Bachman, C. Demarest, S. Eayrs, B. P. Harris, V. Malkoski, D. Packer, and D. Stevenson. 2014. Assessing the vulnerability of marine benthos to fishing gear impacts. Reviews in Fisheries Science & Aquaculture 22:142-155.

Habitat (sediment type)

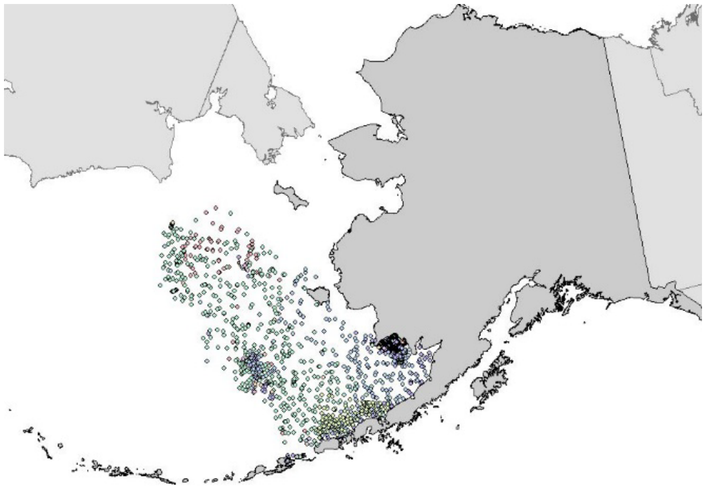
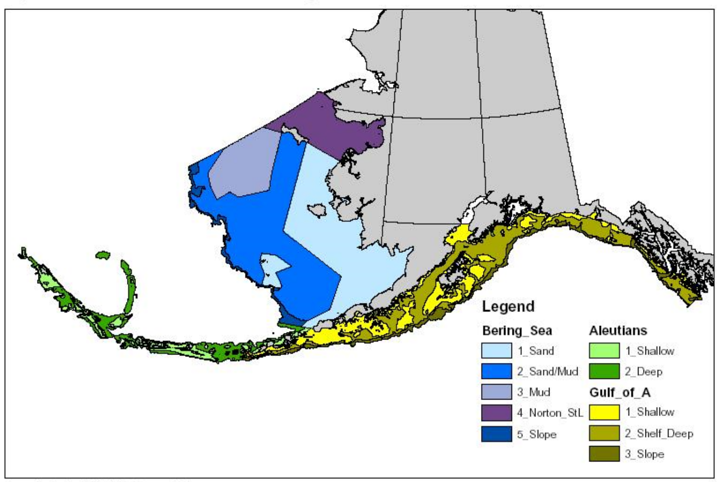
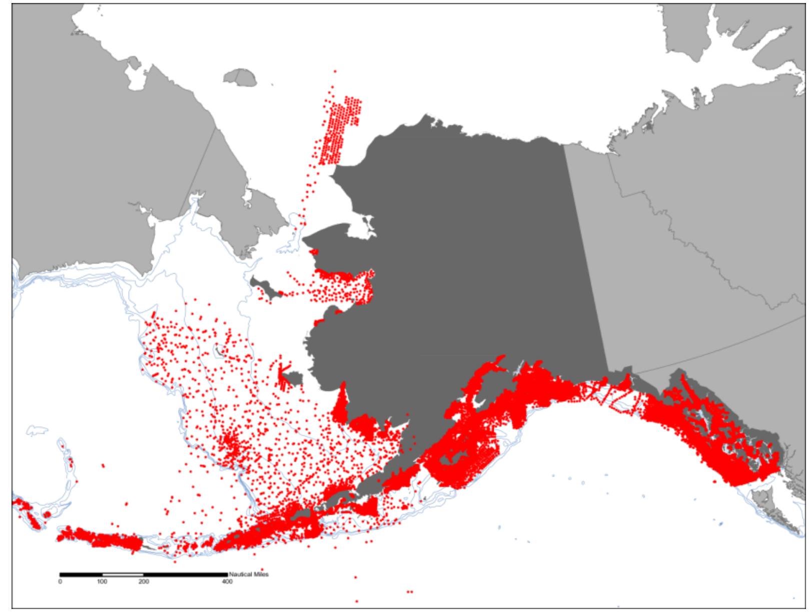


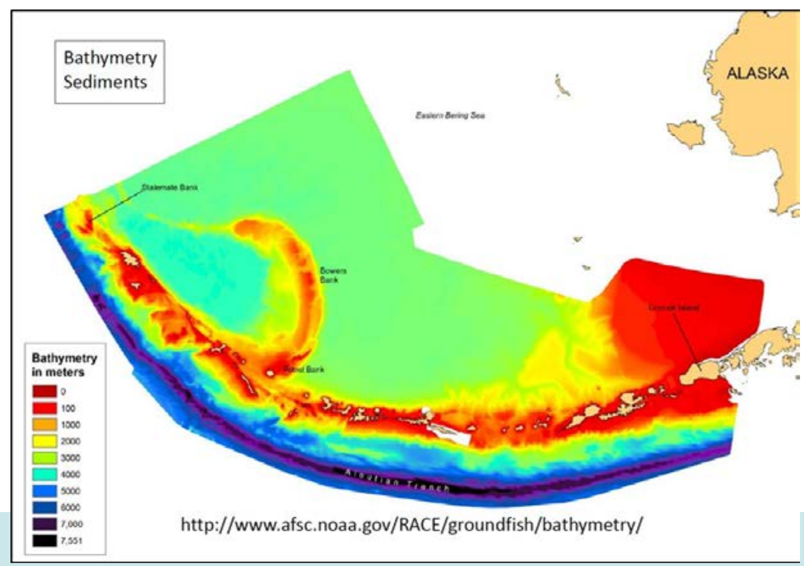
Figure B.2-1 Habitats Used for Evaluation of Fishing Activities



Appendix B - Draft EFH EIS - January 2004



250,000+ points with 6,000+ sediment Descriptions coded into 5 sediment classes: Mud, Sand, Granule/Pebble, Cobble, Boulder



Susceptibility

Susceptibility code	Susceptibility
0	0 – 10%
1	10 – 25%
2	25 – 50%
3	>50%

Feature Class	Feature	Mud	Sand	Gran-Peb	Cobble	Boulder
G	Bedforms		2			
G	Biogenic burrows	2	2			
G	Biogenic depressions	2	2			
G	Boulder, piled					2
G	Boulder, scattered, in sand					0
G	Cobble, pavement				1	
G	Cobble, piled				3	
G	Cobble, scattered in sand				1	
G	Granule-pebble, pavement			1		
G	Granule-pebble, scattered, in sand			1		
G	Sediments, suface/subsurface	2	2			
G	Shell deposits		1	1		
B	Amphipods, tube-dwelling	1	1			
B	Anemones, actinarian			2	2	2
B	Anemones, cerianthid burrowing	2	2	2		
B	Ascidians		2	2	2	2
B	Brachiopods			2	2	2
B	Bryozoans			1	1	1
B	Corals, sea pens	2	2			
B	Hydroids	1	1	1	1	1
B	Macroalgae			1	1	1
B	Mollusks, epifaunal bivalve, *Modiolus modiolus*	1	1	2	2	2
B	Mollusks, epifaunal bivalve, *Placopecten magellanicus*		2	1	1	
B	Polychaetes, *Filograna implexa*		2	2	2	2
B	Polychaetes, other tube-dwelling			2	2	2
B	Sponges		2	2	2	2

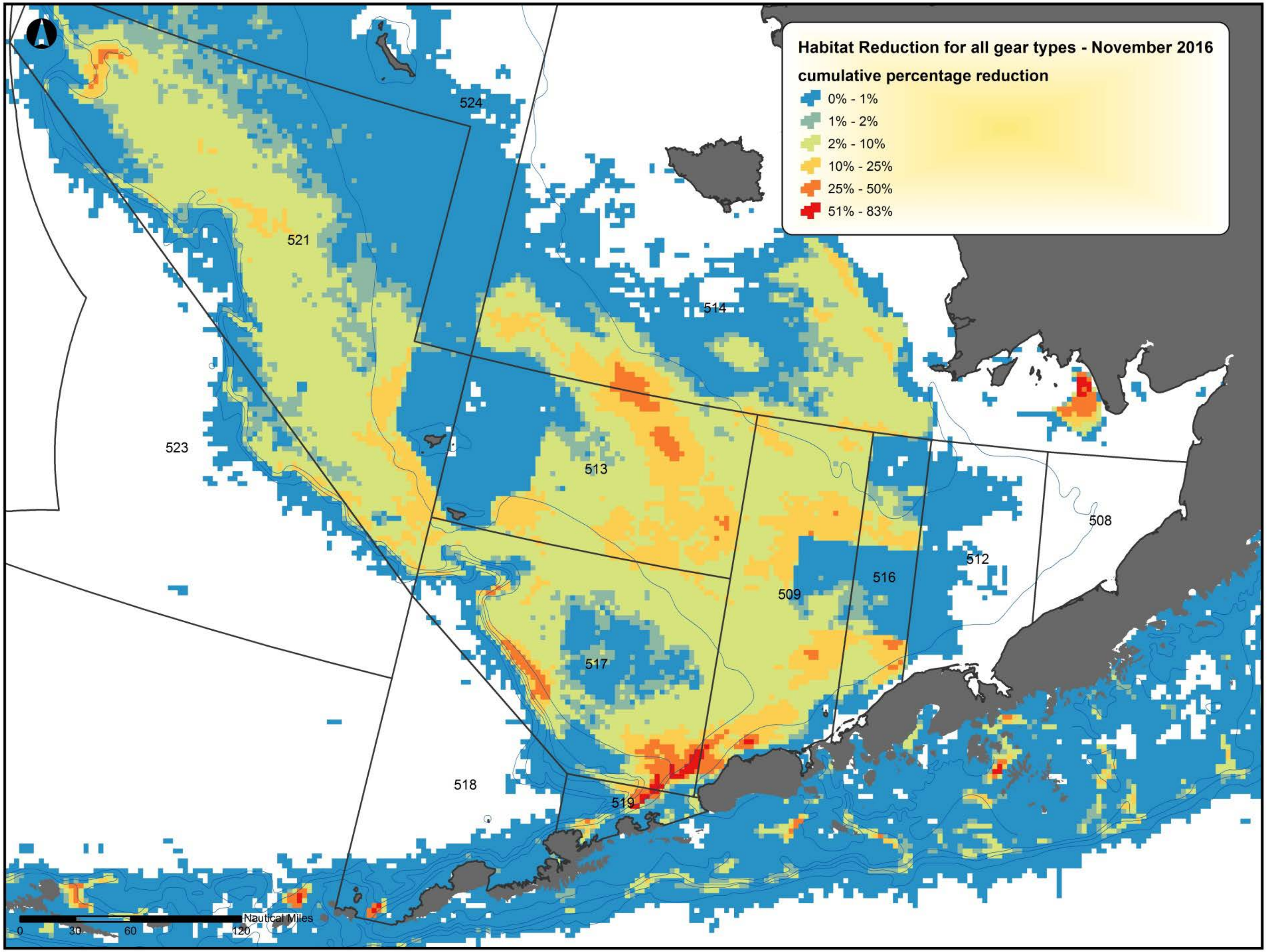
Adapted from the SASI model (NEFMC, 2011)

Recovery

Recovery code	τ
0	<1 year
1	1 – 2 years
2	2 – 5 years
3	>5 years

Feature Class	Features	Mud	Sand	Gran-Peb	Cobble	Boulder
G	Bedforms		0			
G	Biogenic burrows	0	0			
G	Biogenic depressions	0	0			
G	Boulder, piled					3
G	Boulder, scattered, in sand					0
G	Cobble, pavement				0	
G	Cobble, piled				3	
G	Cobble, scattered in sand				0	
G	Granule-pebble, pavement			0		
G	Granule-pebble, scattered, in sand			2		
G	Sediments, suface/subsurface	0	0			
G	Shell deposits		2	2		
B	Amphipods, tube-dwelling	0	0			
B	Anemones, actinarian			2	2	2
B	Anemones, cerianthid burrowing	2	2	2		
B	Ascidians		1	1	1	1
B	Brachiopods			2	2	2
B	Bryozoans			1	1	1
B	Corals, sea pens	2	2			
B	Hydroids	1	1	1	1	1
B	Macroalgae			1	1	1
B	Mollusks, epifaunal bivalve, *Modiolus modiolus*	3	3	3	3	3
B	Mollusks, epifaunal bivalve, *Placopecten magellanicus*		2	2	2	
B	Polychaetes, *Filograna implexa*		2	2	2	2
B	Polychaetes, other tube-dwelling			1	1	1
B	Sponges		2	2	2	2

Adapted from the SASI model (NEFMC, 2011)
Recovery codes: 0: < 1 year; 1: 1–2 years; 2: 2–5 years; 3: >5 years
Blank spaces are habitat features not associated with the given sediment class
G is Geological features and B is Biological features


Habitat Reduction for all gear types - November 2016
cumulative percentage reduction
0% - 1%
1% - 2%
2% - 10%
10% - 25%
25% - 50%
51% - 83%
524
521
514
523
513
508
512
516
509
517
518
519
Nautical Miles
0
30
60
120

Habitat Reduction, all gears

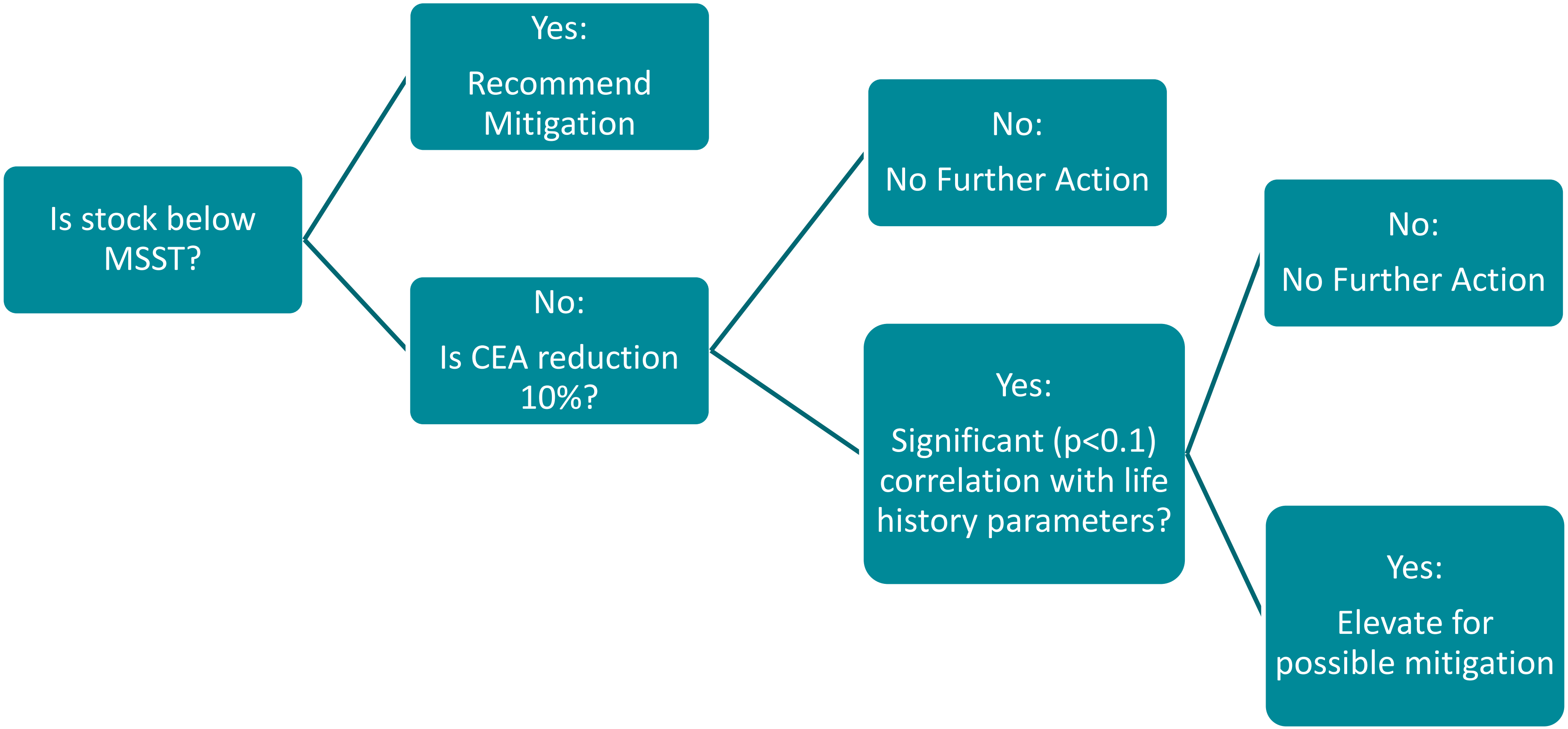
Example output

Stock Author Review – 2017 EFH 5-year Review

Methods to evaluate the effects of fishing on Essential Fish Habitat

Proposal from the SSC subcommittee

DRAFT 9/16/16


Is stock below MSST?
Yes:
Recommend Mitigation
No:
Is CEA reduction 10%?
No:
No Further Action
Yes:
Significant (p<0.1) correlation with life history parameters?
No:
No Further Action
Yes:
Elevate for possible mitigation

Ecosystem Considerations Fishing Effects indicators

Area Disturbed by Trawl Fishing Gear in Alaska

Contributed by John V. Olson, Habitat Conservation Division, Alaska Regional Office, National Marine Fisheries Service, NOAA
Contact: john.v.olson@noaa.gov
Last updated: October 2019

Description of indicator: Fishing gear can impact habitat used by a fish species for the processes of spawning, breeding, feeding, or growth to maturity. This indicator uses output from the Fishing Effects (FE) model to estimate the area of geological and biological features disturbed over the Bering Sea domain, utilizing spatially-explicit VMS data. The time series for this indicator is available since 2003, when widespread VMS data became available.

Status and trends: The percent of area disturbed due to commercial fishing interactions (pelagic and non-pelagic trawl, longline, and pot) decreased steadily from 2008 to the present in the Bering Sea, with slightly decreasing or steady trends in the Gulf of Alaska and Aleutian Islands (Figure 100).

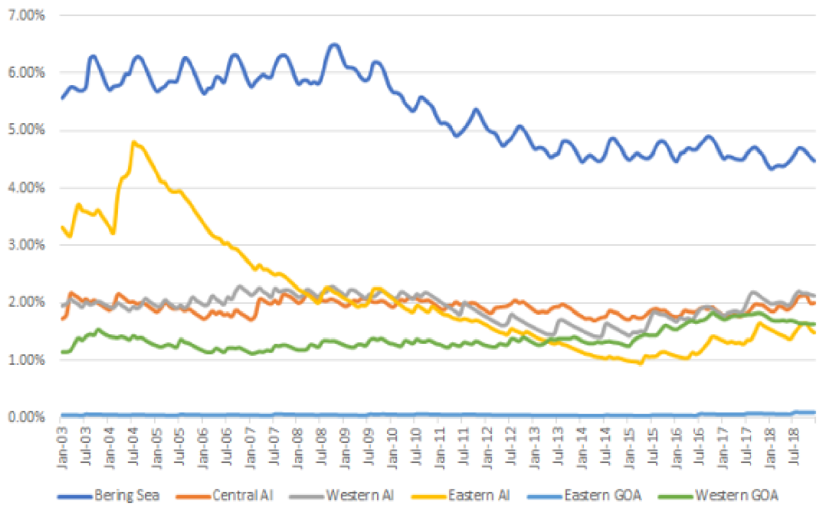


Figure 100: Percent habitat disturbance, all gear types combined, from 2003 through 2018.

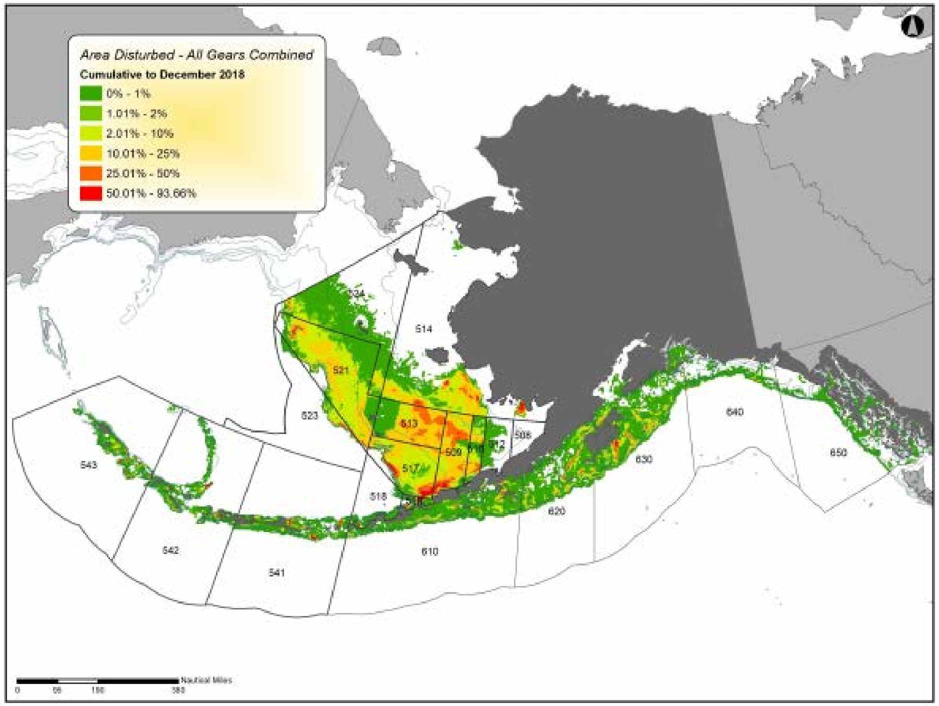


Figure 101: Map of percentage area disturbed per grid cell for all gear types. Effects are cumulative and consider impacts and recovery of features from 2003 to 2018.

Scallop FMP (2014)

4. Habitat Objective: To protect, conserve, and enhance adequate quantities of essential fish habitat (EFH) to support scallop populations and maintain a healthy ecosystem Habitat is defined as the physical, chemical, geological, and biological surroundings the support healthy, self-sustaining populations of living marine resources. Habitat includes both the physical component of the environment which attracts living marine resources (e.g. salt marshes, sea grass beds, coral reefs, intertidal lagoons, and near shore characteristics) and the chemical (e.g. salinity, benthic community) and biological characteristics (e.g. scallop life stage histories, oceanography) that are necessary to support living marine resources. The quality and availability of habitat supporting the scallop populations are important. Fishery managers should strive to ensure that those waters and substrate necessary to scallops for spawning, breeding, feeding, or growth to maturity are available. It is also important to consider the potential impact of scallop fisheries on other fish and shellfish populations. Scallop EFH is described in Appendix D of this FMP.

Those involved in both management and exploitation of scallop resources will actively review actions by other human users of the management area to ensure that their actions do not cause deterioration of habitat. Any action by a State or Federal agency potentially affecting scallop habitat in an adverse manner may be reviewed by the Council for possible action under the Magnuson-Stevens Act. The Council will also consider the effect on scallop habitat of its own management decisions in other fisheries.

Weathervane Scallop SAFE (2019)

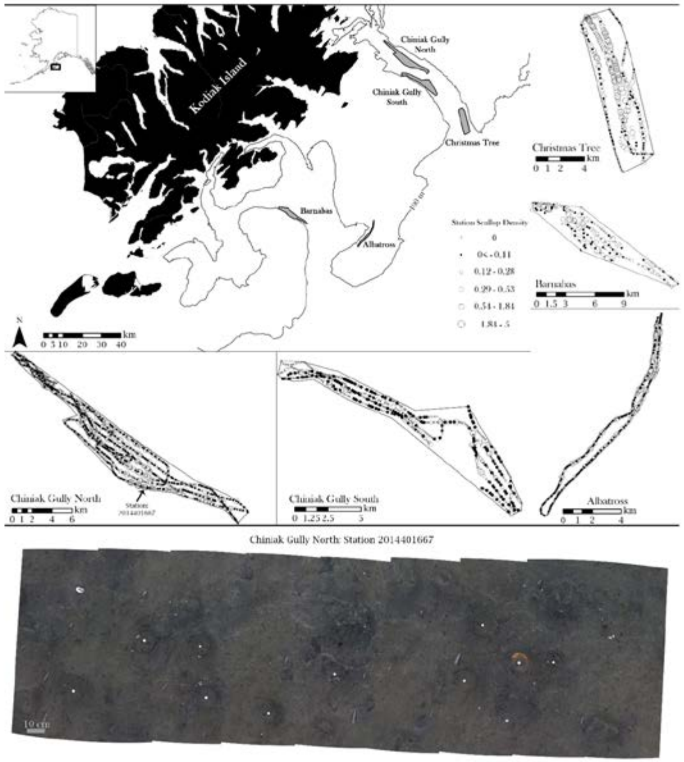
Ecosystem Effects on the Stock

Weathervane scallops are distributed in dynamic relationship to other benthic marine organisms as well as the non-living components of the marine ecosystem off Alaska. Spatiotemporal ecosystem dynamics, therefore, influence the abundance and distribution of scallops and other benthic community organisms. A recent study by Glass and Kruse (2017) provides analyses of continental shelf benthic communities off Alaska in areas historically and currently targeted by the commercial Weathervane scallop fishery. Based on observer records of bycatch from 1996–2012 the researchers found significant changes in community composition associated with a temperature regime shift in 1998. Differences in community structure in the Kodiak Northeast and Yakutat management districts were correlated with abiotic ecosystem features such as depth and sediment size. Species distribution models (SDM) were developed for most managed groundfish and crab species in Alaska as part of the Essential Fish Habitat (EFH) 5-year review (Simpson et al 2017). Scallops, however, were not included in this modeling effort due to a lack of data for SDMs.

Fishery Effects on Ecosystem

The Alaska weathervane scallop fishery occurs in continental shelf waters at depths 40–150 m in three main areas: the eastern Gulf of Alaska between Prince William Sound and Cape Spencer; around Kodiak Island; and in the eastern Bering Sea (Figure 1-1). There is strong evidence that scallop dredging reduces diversity, at least in the near term, however, the level of impact and the recovery rate tend to vary among habitat types (Collie et al. 2000; Kaiser et al. 2006). Past studies on the effects of scallop dredging in the Gulf of Alaska have found differences in community abundance and diversity for areas either open or closed to dredging (Stone et al. 2005). More recently, Glass and Kruse (2017) found evidence of recovery from disturbance by fishing gear in the Bering Sea scallop bed through increases in sessile benthic organisms during a period of decreased fishing activity. A Fishing Effects (FE) model was developed to assess the effects of fishing on managed species as part of the 2017 EFH 5-year review (Simpson et al 2017). However, catch data for scallops was not available. For the 2022 EFH 5-year review, model authors will seek to include scallop fishery data into the FE model to estimate habitat reduction across modeled scallop habitat.

Batter et al 2020. An Optical Assessment of Weathervane Scallop Density and Abundance off Kodiak Island, AK.



D8

Spatiotemporal Variability of Benthic Communities on Weathervane Scallop Beds off Alaska

Jessica R. Glass, Gordon H. Kruse

First published:29 August 2017 | https://doi.org/10.1080/19425120.2017.1370041

Subject editor: Anne Hollowed, Alaska Fisheries Science Center, Seattle

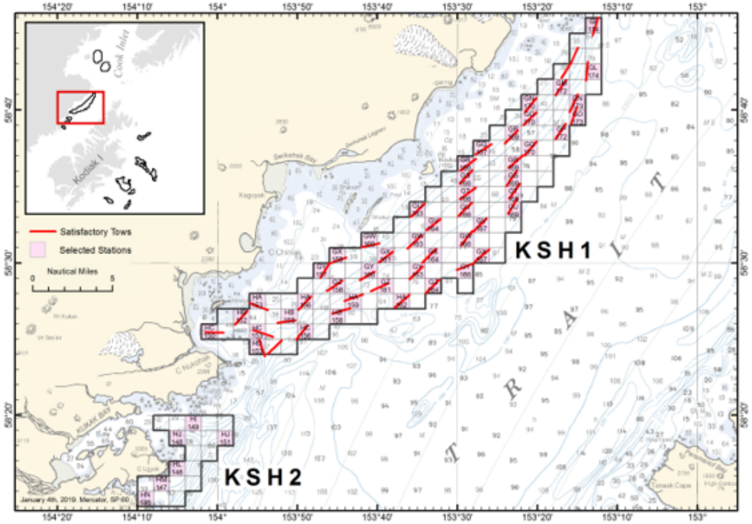


Figure 2-2 Sample locations in Kodiak Shelikof District bed KSH1 during the 2018 weathervane scallop survey. Red lines indicate successful dredge tow tracks in sampled stations. Pink cells were the randomly selected dredge location.

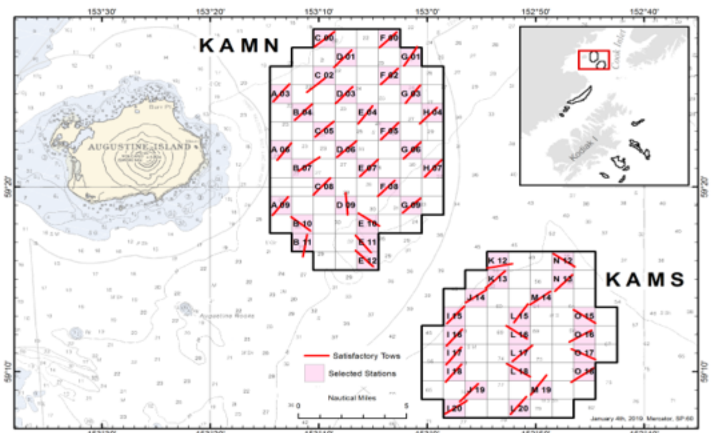


Figure 2-3 Sample locations in the Kamishak District beds KAMN and KAMS during the 2018 weathervane scallop survey. Red lines indicate successful dredge tow tracks in sampled stations. Pink cells were the randomly selected dredge locations.

Conclusions

Over 400 SDMs define groundfish EFH by species and life stage throughout the AI, BS, and GOA.

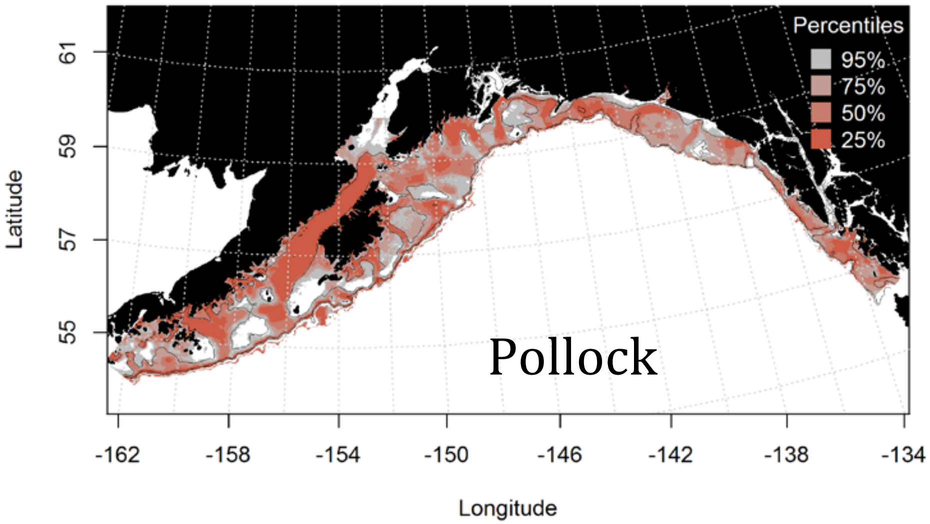
Models being developed for Arctic cod and tanner crab will improve Arctic EFH.

Even salmon have EFH described on more than survey and fishery points!

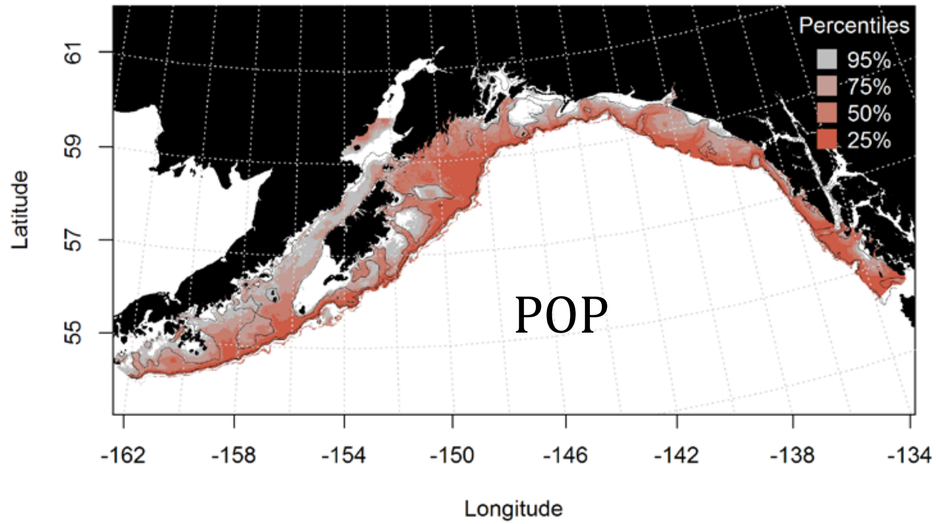
Scallops are the only FMP species still described solely by catch and survey data.

Is there enough new information to develop enhanced EFH for scallops? (pitch for data recovery project)

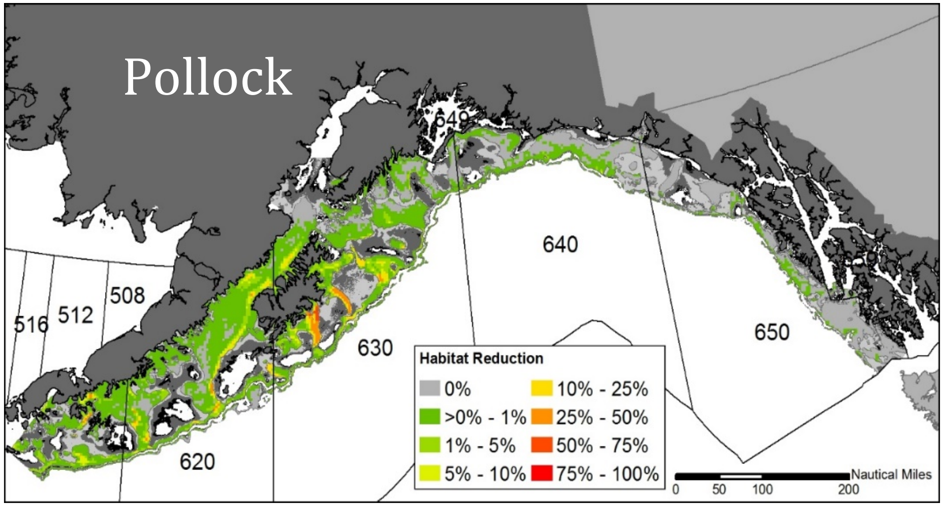
Percentiles of abundance



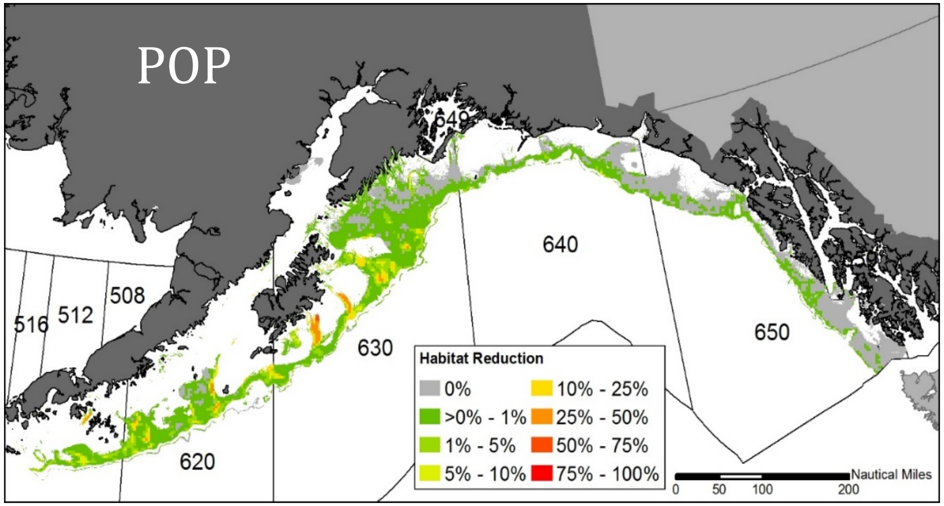
Core EFH area defined as 50% cumulative distribution



Proportion of habitat reduction



Example map for December 2014

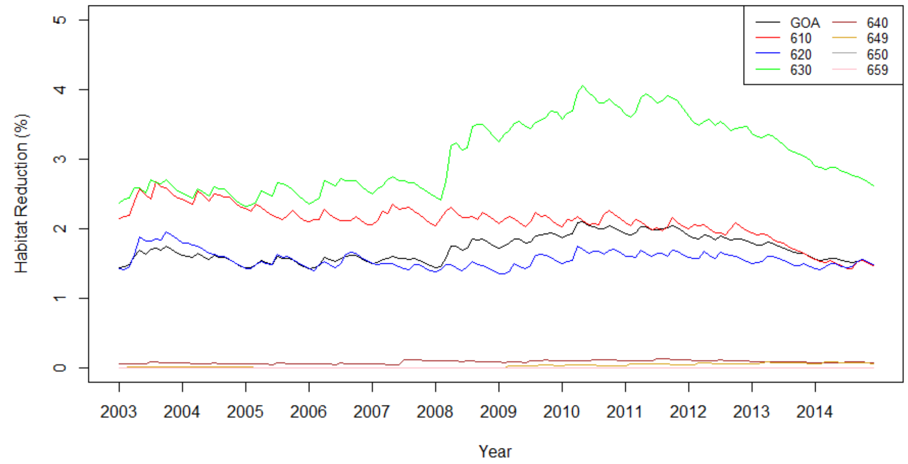


Monthly proportion of habitat reduction (2003-2014)

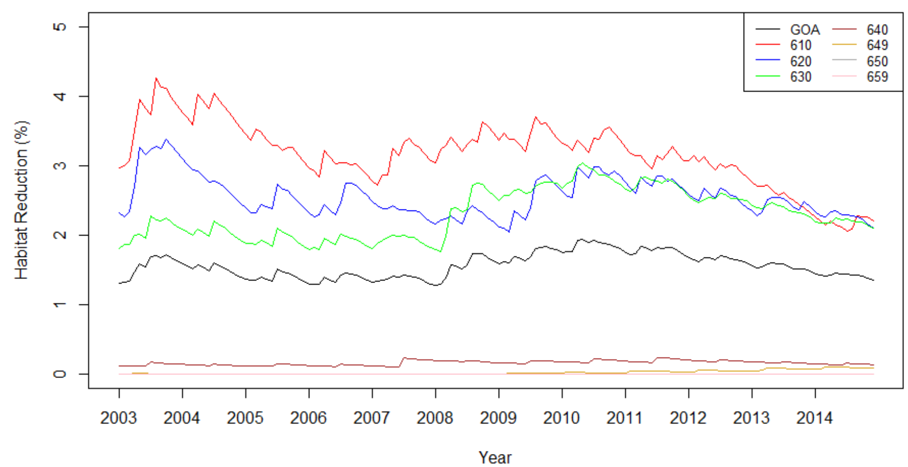
species	Jan-03	Feb-03	Mar-03	Apr-03	May-03	Jun-03
alaska skate	0.015072	0.015238	0.015307	0.015497	0.015896	0.015454
aleutian skate	0.030762	0.031581	0.034609	0.03401	0.033244	0.032472
arrowtooth flounder	0.024122	0.024701	0.027073	0.027118	0.027671	0.027084
atka mackerel	0.019402	0.019593	0.02083	0.020922	0.021332	0.020864
bigmouth sculpin	0.027292	0.028309	0.029771	0.029318	0.029178	0.028668
blackspotted rockfish	0.012141	0.012206	0.012462	0.012744	0.012565	0.012245
dover sole	0.027229	0.026911	0.028724	0.030118	0.032297	0.031532
dusky rockfish	0.008501	0.008506	0.008943	0.008796	0.008592	0.008352
flathead sole	0.031171	0.031774	0.034327	0.034812	0.036687	0.035777
golden king crab	0.01376	0.013862	0.013781	0.013571	0.013193	0.012873
great sculpin	0.029272	0.03033	0.03721	0.036513	0.03625	0.035605
greenland turbot	0.021942	0.022081	0.022184	0.023647	0.02504	0.024442
harlequin rockfish	0.041663	0.04316	0.046849	0.04602	0.044958	0.043865
kamchatka flounder	0.012634	0.012702	0.012817	0.013232	0.01335	0.013083
mud skate	0.028584	0.029611	0.031817	0.031306	0.030646	0.029994
northern rock sole	0.014667	0.015245	0.018632	0.018363	0.018231	0.017844
northern rockfish	0.017787	0.018239	0.021624	0.021322	0.020901	0.020338
octopus	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

No area exceeds 5% habitat reduction

Pollock



POP



Correlations:

- Proportion of habitat disturbed: Annual values calc'd as average across months (Jan-Dec)
  - pollock: 610-630 (W/CGOA)
  - POP: GOA wide
- Stock indices:
  - Growth-to-maturity: time trends in growth/maturity
  - Spawning success: recruitment
  - Breeding success: spawning distributions
  - Feeding success: feeding distributions

Correlations: pollock

- Growth-to-maturity
  - Growth: weight-at-age anomalies from Shelikof straight acoustic survey, lagged 1 year (habitat impact year prior influences weight the beginning of following year observed in survey)
    - p= 0.12,
  - Maturity: length at age at 50% maturity from Shelikof acoustic survey, lagged 1 year
    - p = 0.61

- Spawning success: log-recruitment, lagged 1 year
  - p = 0.99

Correlations: POP

- Growth-to-maturity
  - Growth: mean size-at-age from AFSC bottom trawl survey for most frequent ages (3-15), annual estimates of LVB parameters from bottom trawl survey
  - Maturity: only 2 years of data…

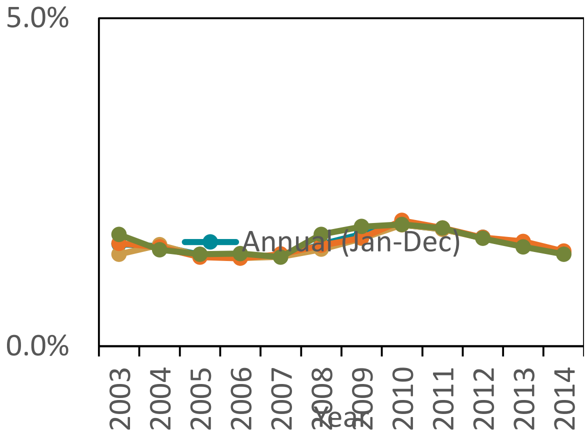
- Spawning success: recruitment, not lagged

- Breeding success/spawning distribution: assume spawning biomass proportional to distribution

- Feeding success/feeding distribution: assume total biomass proportional to distribution

Correlations: POP

- No p-values < 0.1



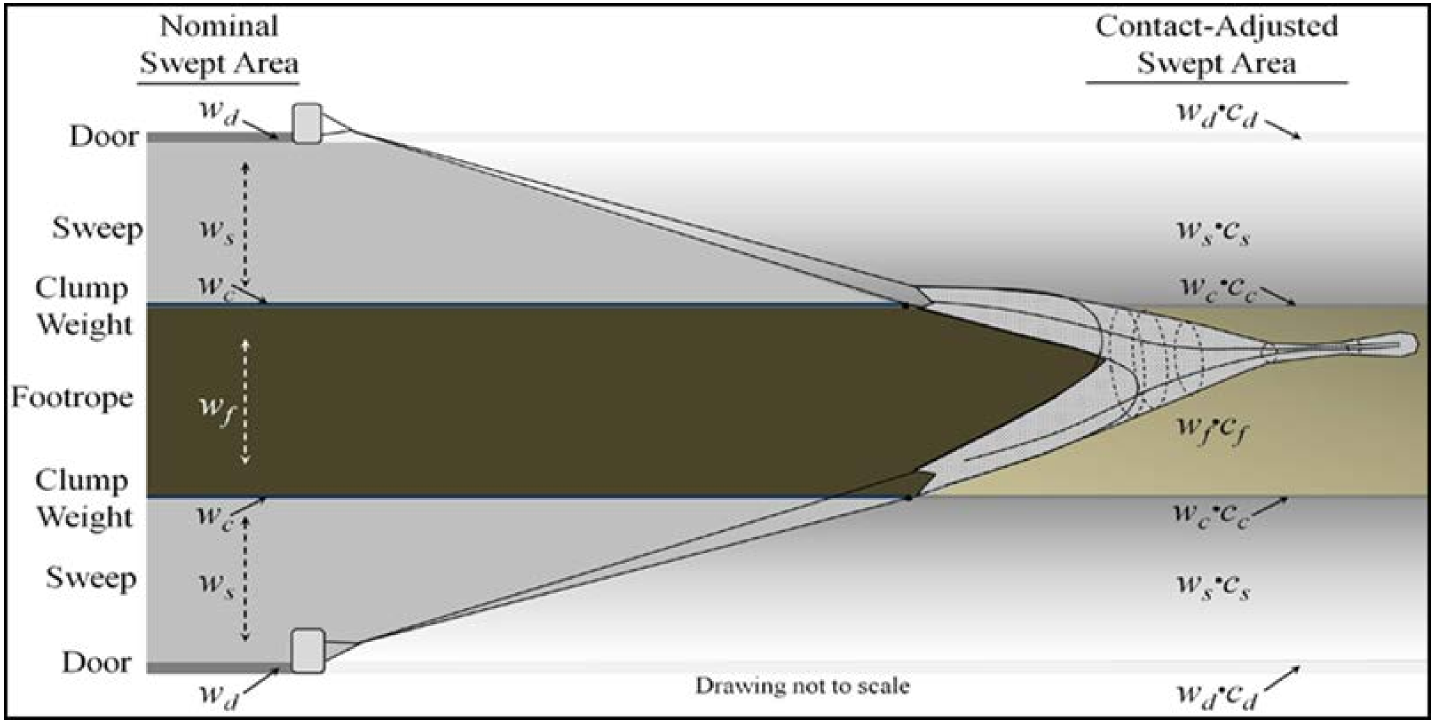
		ρ	p-value
Average size-at-age	age-3	-0.49	0.33
	age-4	-0.25	0.63
	age-5	-0.56	0.24
	age-6	-0.58	0.23
	age-7	-0.20	0.71
	age-8	-0.71	0.11
	age-9	-0.25	0.63
	age-10	-0.60	0.21
	age-11	0.02	0.97
	age-12	-0.40	0.43
	age-13	-0.38	0.46
	age-14	0.42	0.41
	age-15	-0.14	0.79
LVB params	L_∞	0.56	0.33
	κ	-0.64	0.24
	t_0	-0.64	0.24
SAFE output	Spawning biomass	0.43	0.17
	Total biomass	0.37	0.24
	Recruitment	0.33	0.30

Correlations: overall

“The purpose of this criterion is not to determine whether any correlation is statistically significant, but rather to provide an objective threshold to ensure that a “hard look” has been taken for each species, as appropriate. Because multiple parameters will be examined for correlation to habitat reduction, it is possible that spurious significant ($p > 0.1$) correlations will be found. Whenever significant correlations are found, the expert judgement and opinion of the stock assessment authors will be important to determine whether there is a plausible connection to reductions in EFH as the cause, or if the result is spurious. If stock assessment authors determine that the correlation between the impacts to the CEA and life history parameter(s) suggest a stock effect, then they will raise that potential impact to the attention of the Plan Teams, SSC, and Council.”

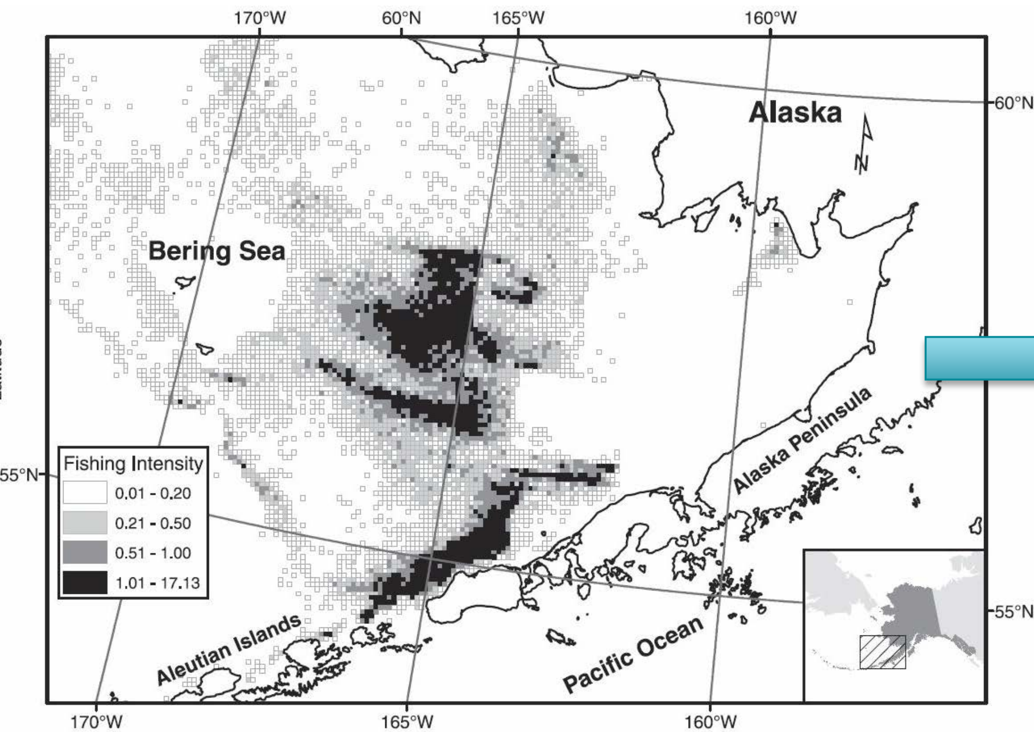
- Martin and I took a “hard look”, no significant correlations found, no concerns at this time

Nominal Area Swept

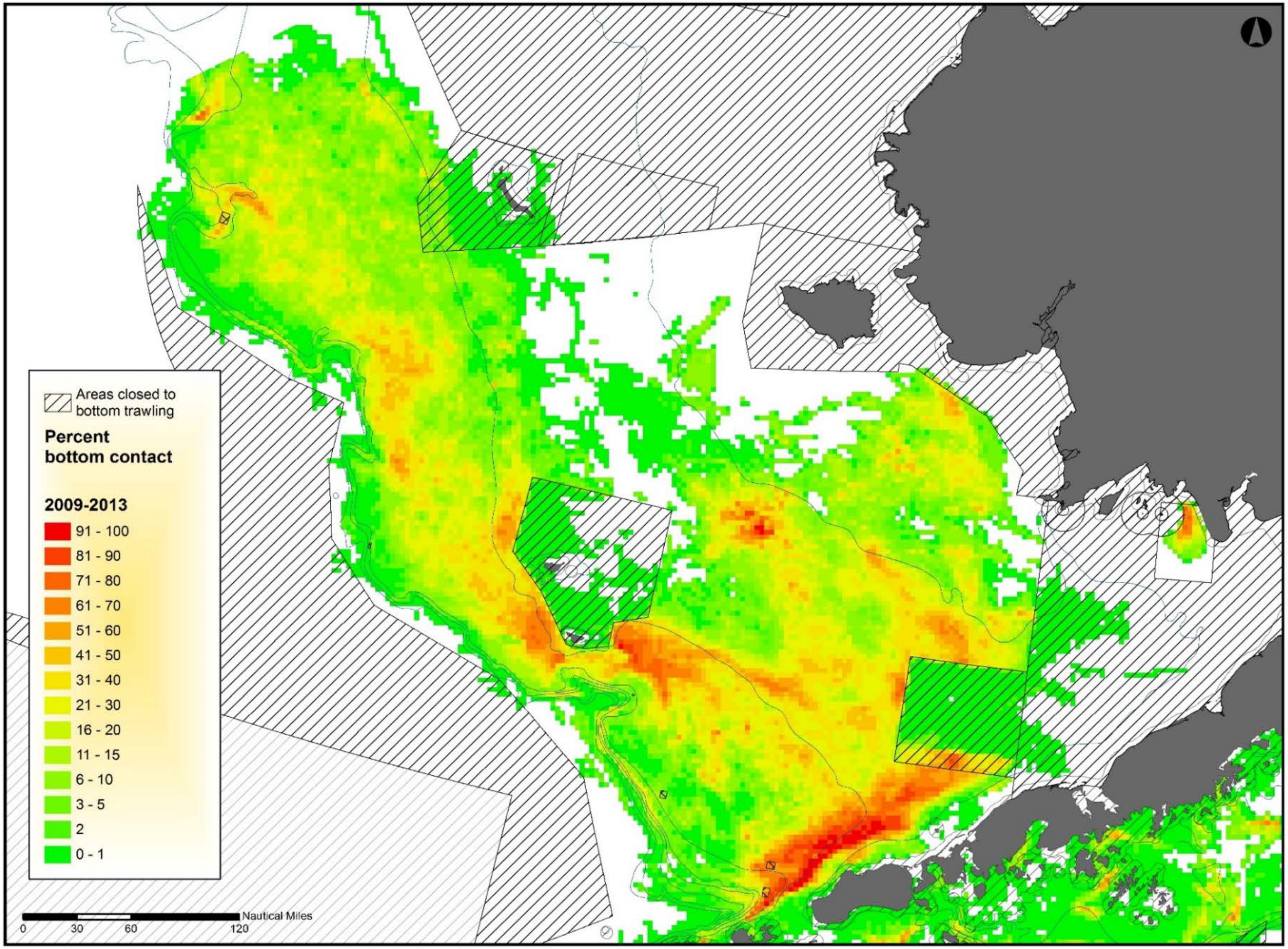


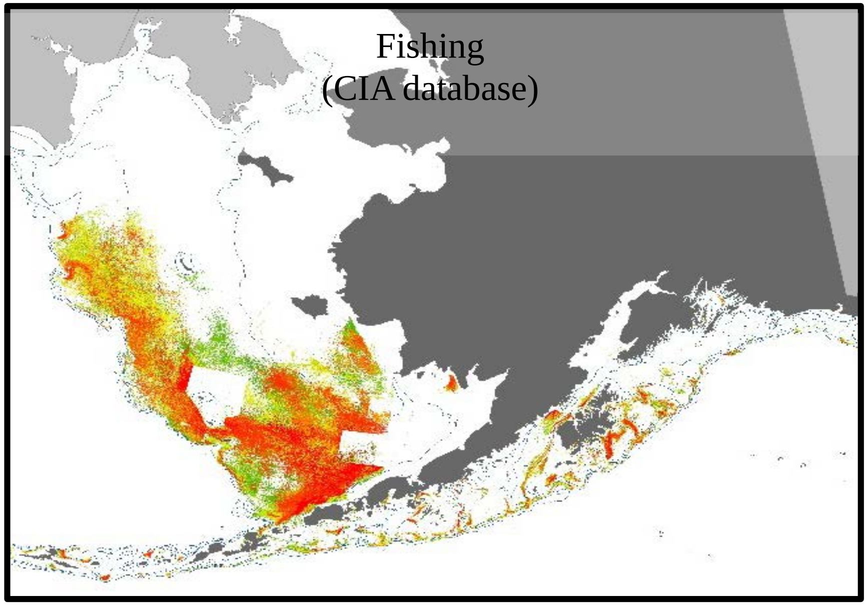
Impact = (Nominal area swept) x **(**Contact adjustment) x (Susceptibility)

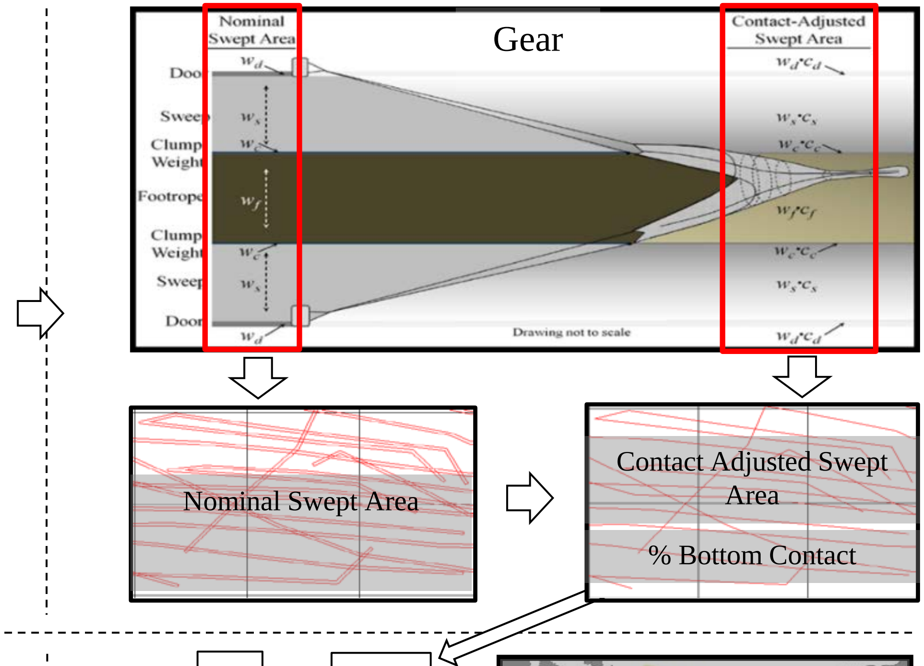
Increasing spatial resolution

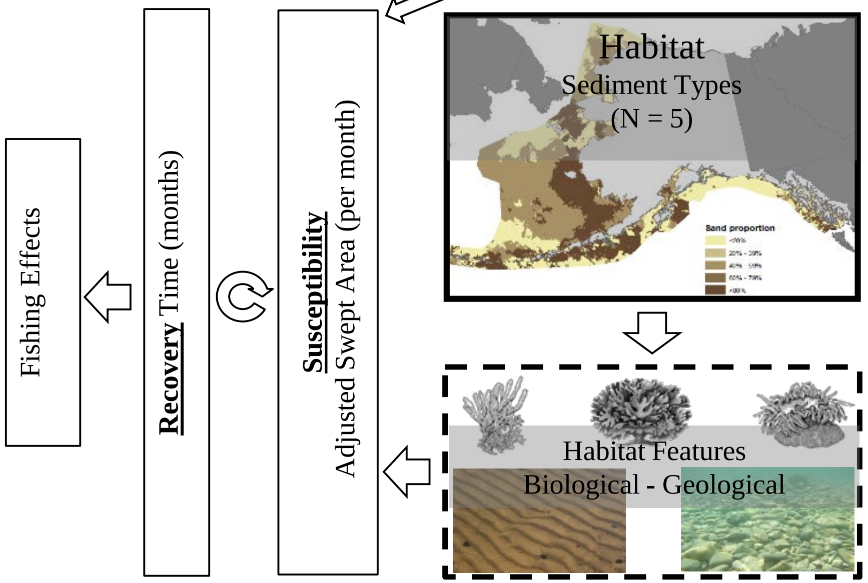


Bottom Contact









$$H_{t+1} = H_t(1 - I'_t) + h_t\rho'_t$$

H: habitat undisturbed from fishing
h: habitat disturbed from fishing
I': monthly impact rate
ρ': monthly recovery rate