Methods and criteria to evaluate the effects of fishing on EFH

Proposal from the SSC subcommittee

Background

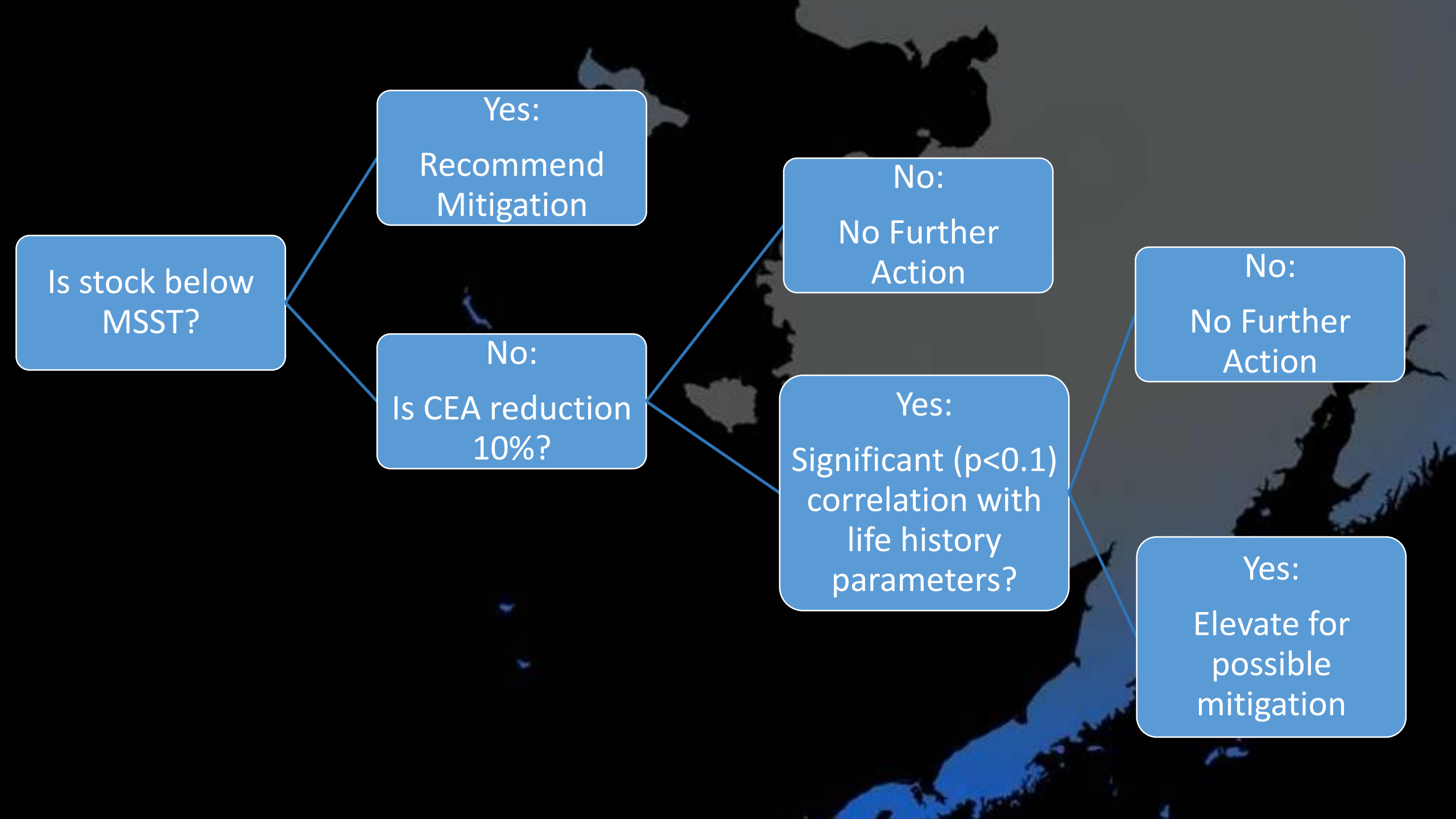
- MSA requires Councils to minimize adverse effects of fishing on EFH
- Council is currently considering new definitions of EFH
- Model-based definitions of EFH developed at AFSC
  - GAM
  - Hurdle GAM
  - MaxEnt
- Fishing Effects model for Alaska fisheries built on LEI and NEFMC SASI model
- SSC requested new criteria and methods to evaluate effects of fishing

Questions for Plan Teams

- Are the assessment cutoffs correct?
  - Core area = upper 50th percentile of predicted abundance or suitable habitat
  - Impact threshold for further impact assessment: 10% reduction in habitat
  - P-value of 0.1 for significance of correlation with time trend in habitat disturbance in core area
  - Evaluating cumulative habitat disturbance across EBS, AI, and GOA
    - Should assessments be based on regional boundaries for the stock or species?
      - E.g., Bristol Bay red king crab

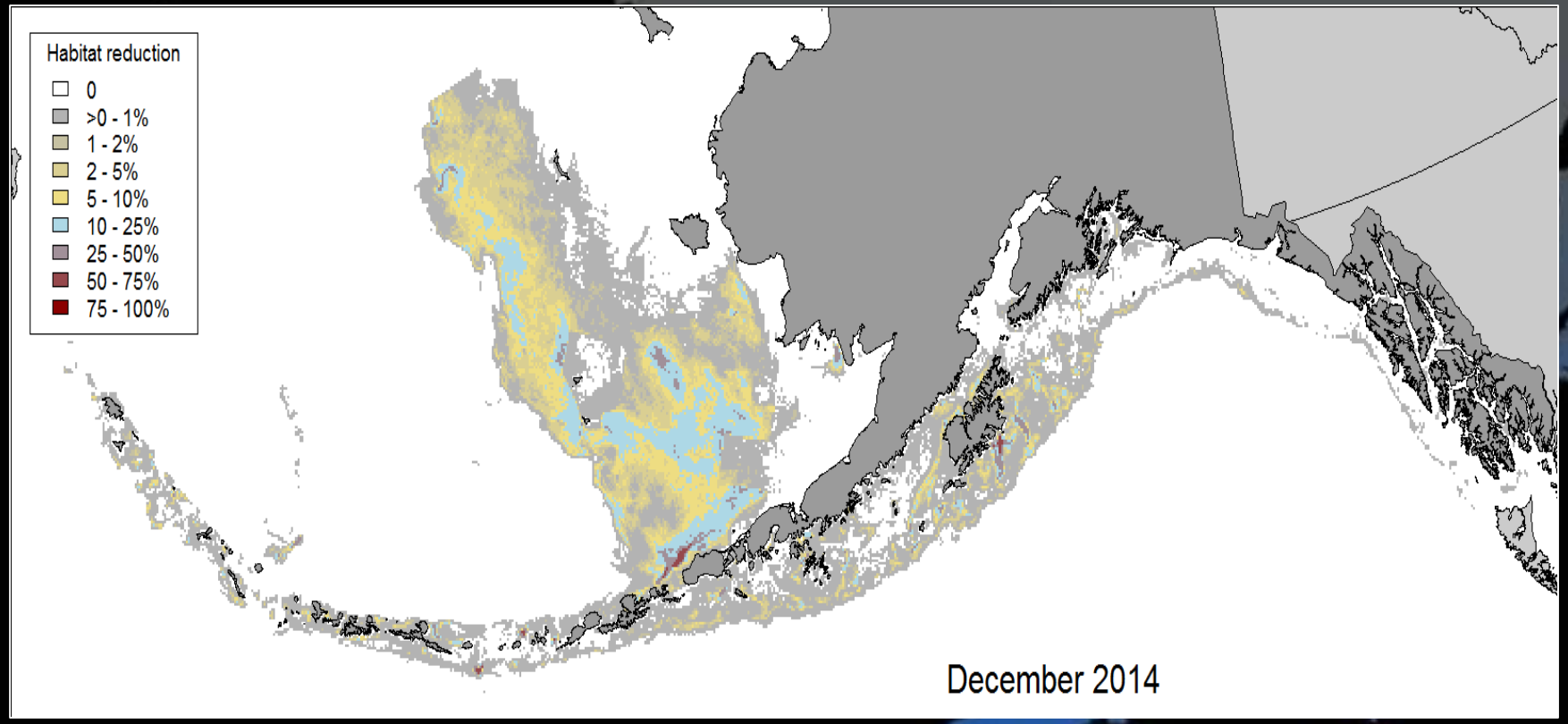
Questions for Plan Teams

- What seasons should be used for the analysis?
  - Summer only – best data, broadest distribution
  - Seasonal based on MaxEnt for non-summer + GAMs for summer
  - Average cumulative impacts over seasons by converting GAMs to MaxEnt for summer

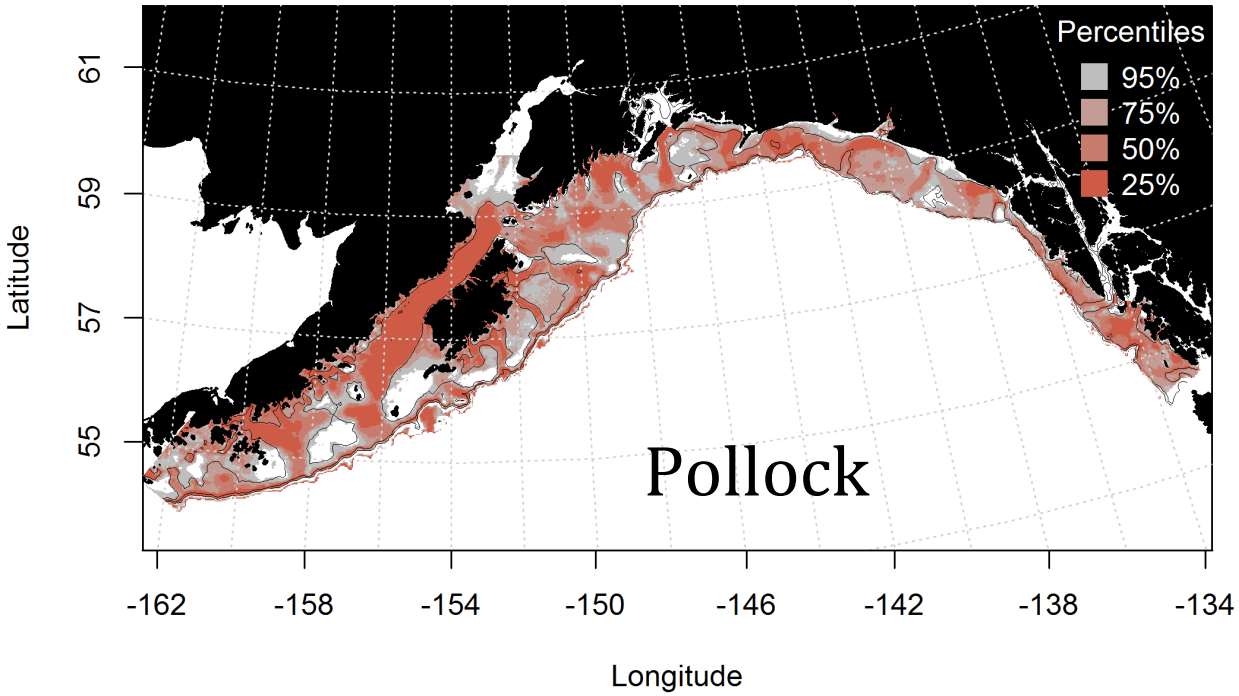

Is stock below MSST?
Yes:
Recommend Mitigation
No:
Is CEA reduction 10%?
No:
No Further Action
Yes:
Significant (p<0.1) correlation with life history parameters?
No:
No Further Action
Yes:
Elevate for possible mitigation

EFH and FE Model Descriptions

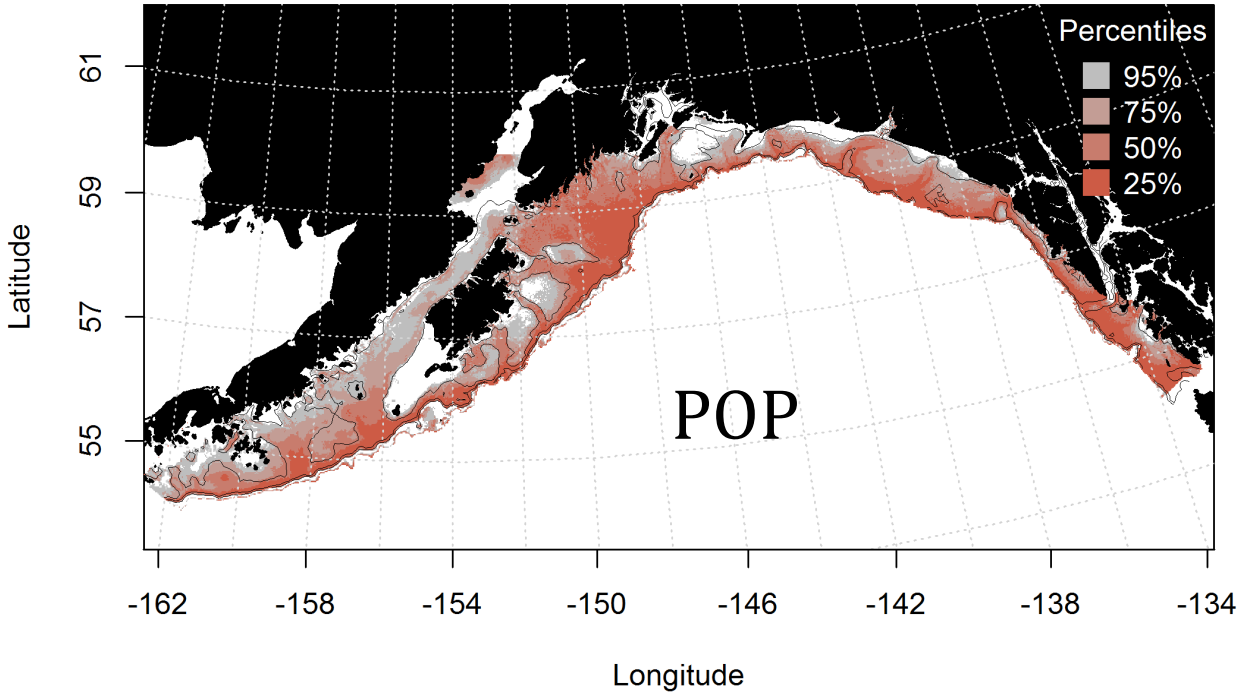
Fishing Effects Model



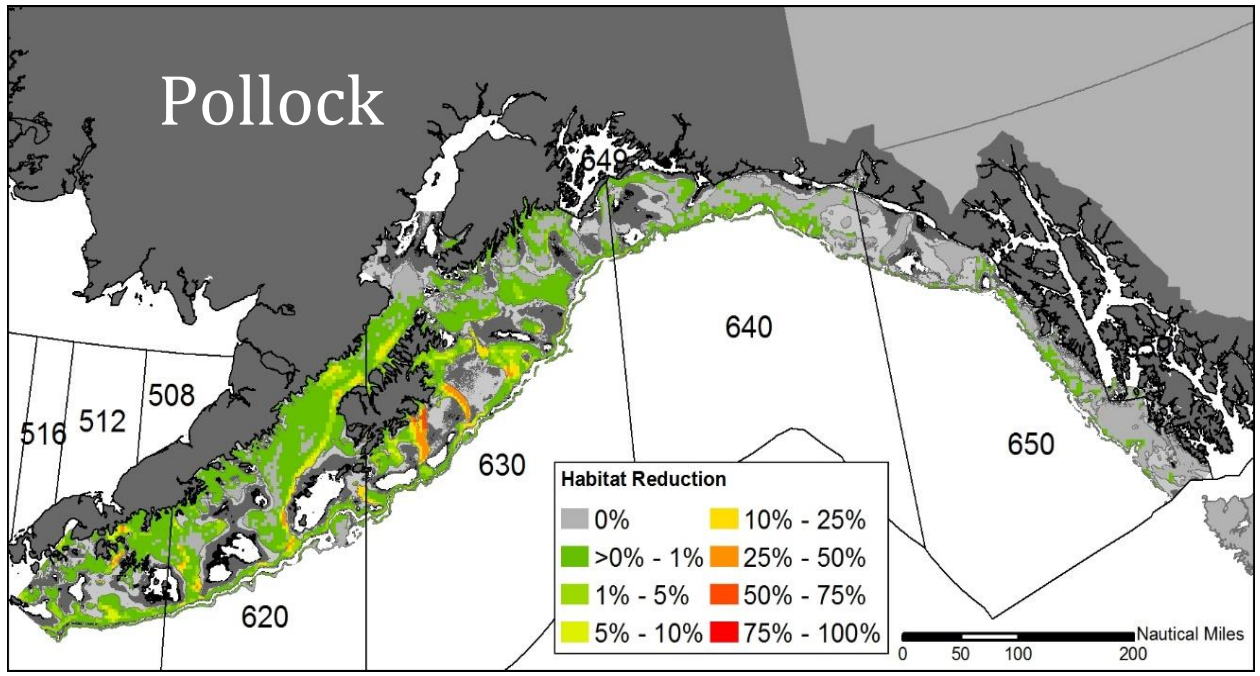
Percentiles of abundance



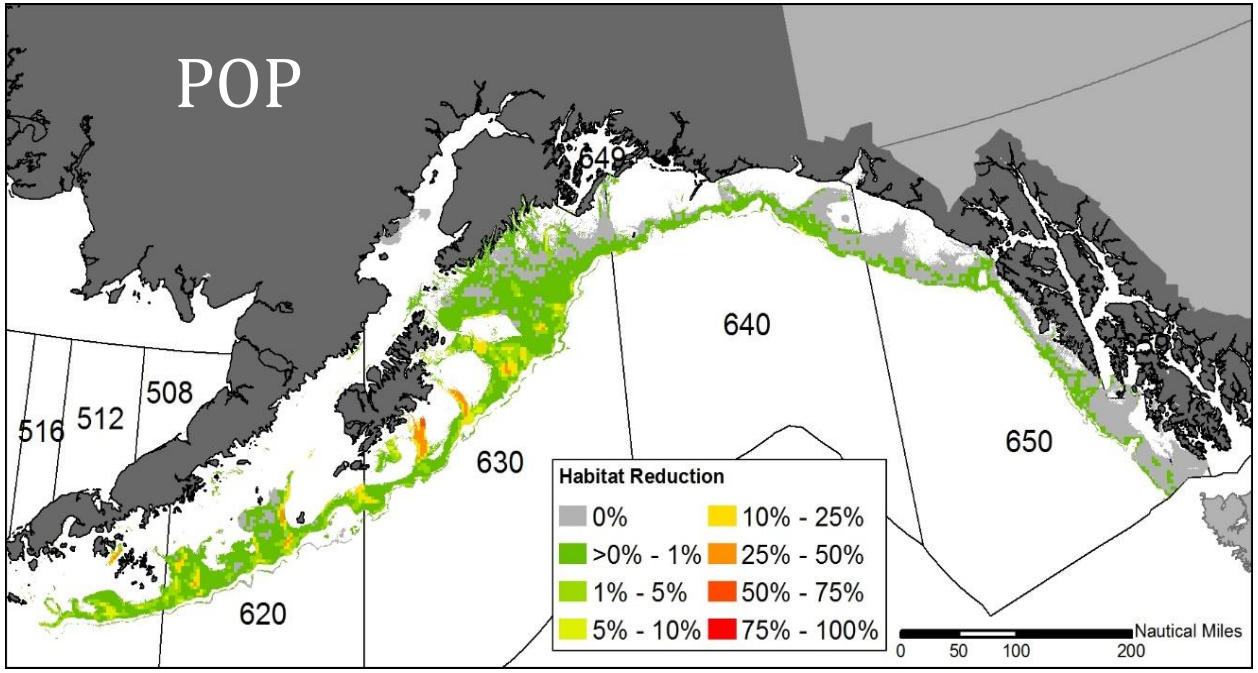
Core EFH area defined as 50% cumulative distribution

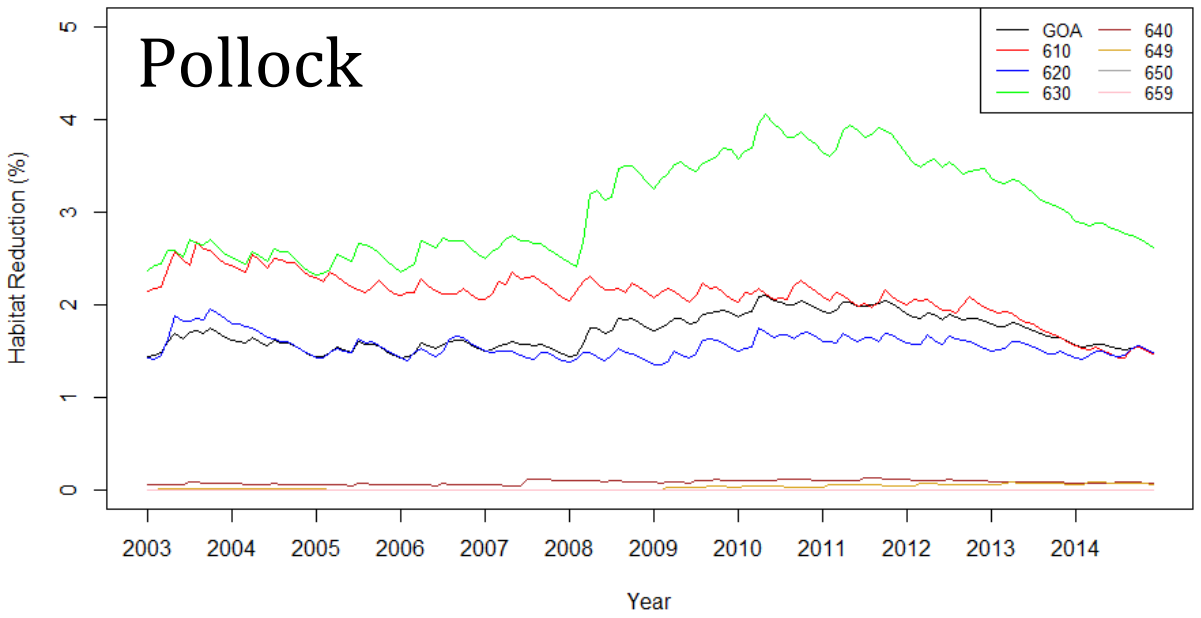


Proportion of habitat reduction



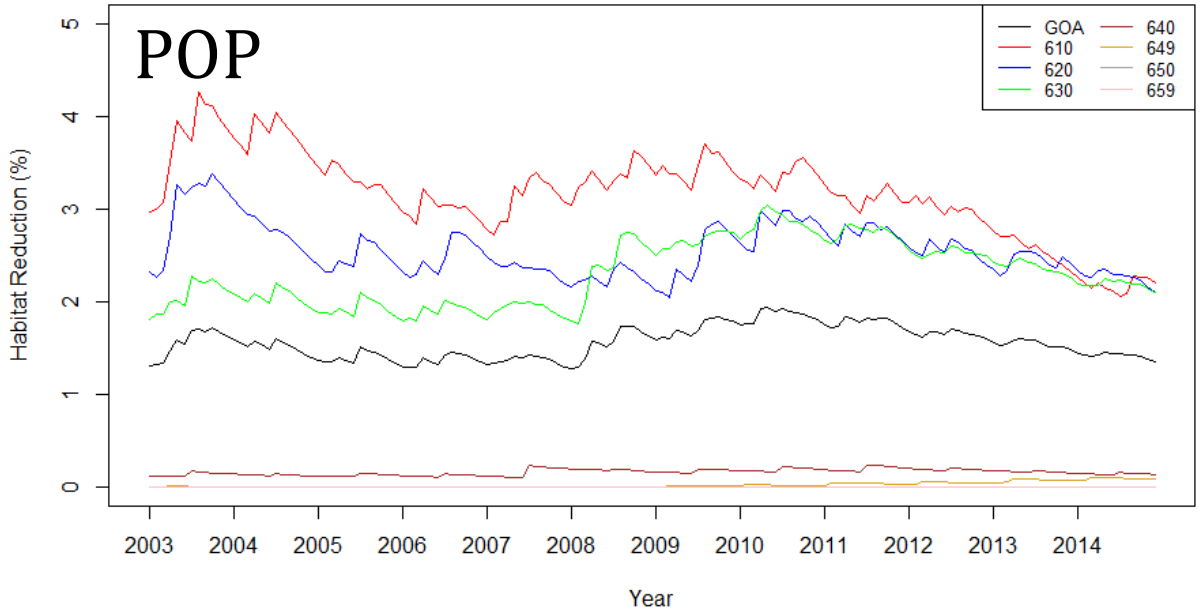
Example map for December 2014





Monthly proportion of habitat reduction (2003-2014)

No area exceeds 5% habitat reduction



Further guidance on what to do with this:

"Any stocks for which the proportion of habitat disturbed by fishing in the CEA is ≥10% will be subject to additional analyses."

"Stock assessment authors will next examine indices of growth-to-maturity, spawning success, breeding success, and feeding success (e.g., time trends in size-at-age, recruitment, spawning distributions and feeding distributions.) to determine whether there are correlations between those parameters and the trends in the proportion of the CEA impacted by fishing. If a correlation exists (negative or positive), the authors will next determine whether the correlation is significant at a p-value of 0.1. A p-value of 0.1 has been recommended to minimize the likelihood of Type II error."

- It was requested of Martin and I that we do the correlation analysis for GOA pollock and POP as examples

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)
    - $\rho = 0.12$, p-value > 0.1
  - Maturity: length at age at 50% maturity from Shelikof acoustic survey, lagged 1 year
    - $\rho = 0.61$, p-value > 0.1

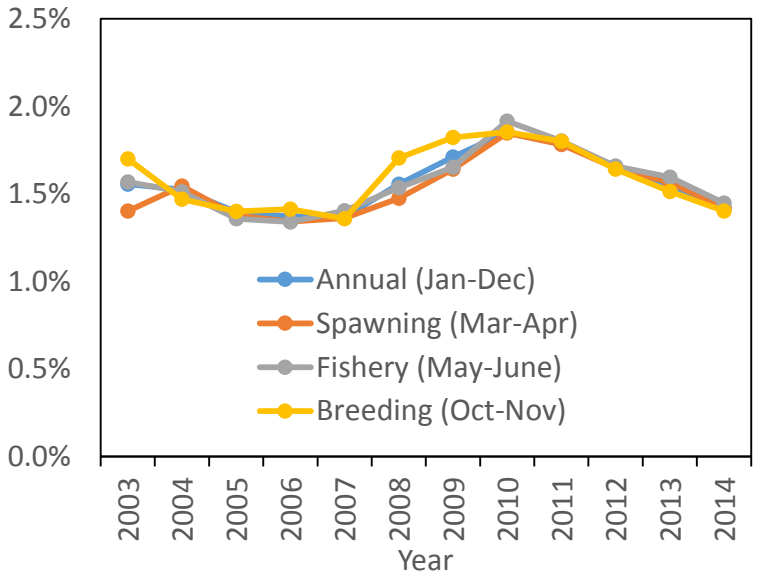
- Spawning success: log-recruitment, lagged 1 year
  - $\rho = 0.99$, p-value > 0.1

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

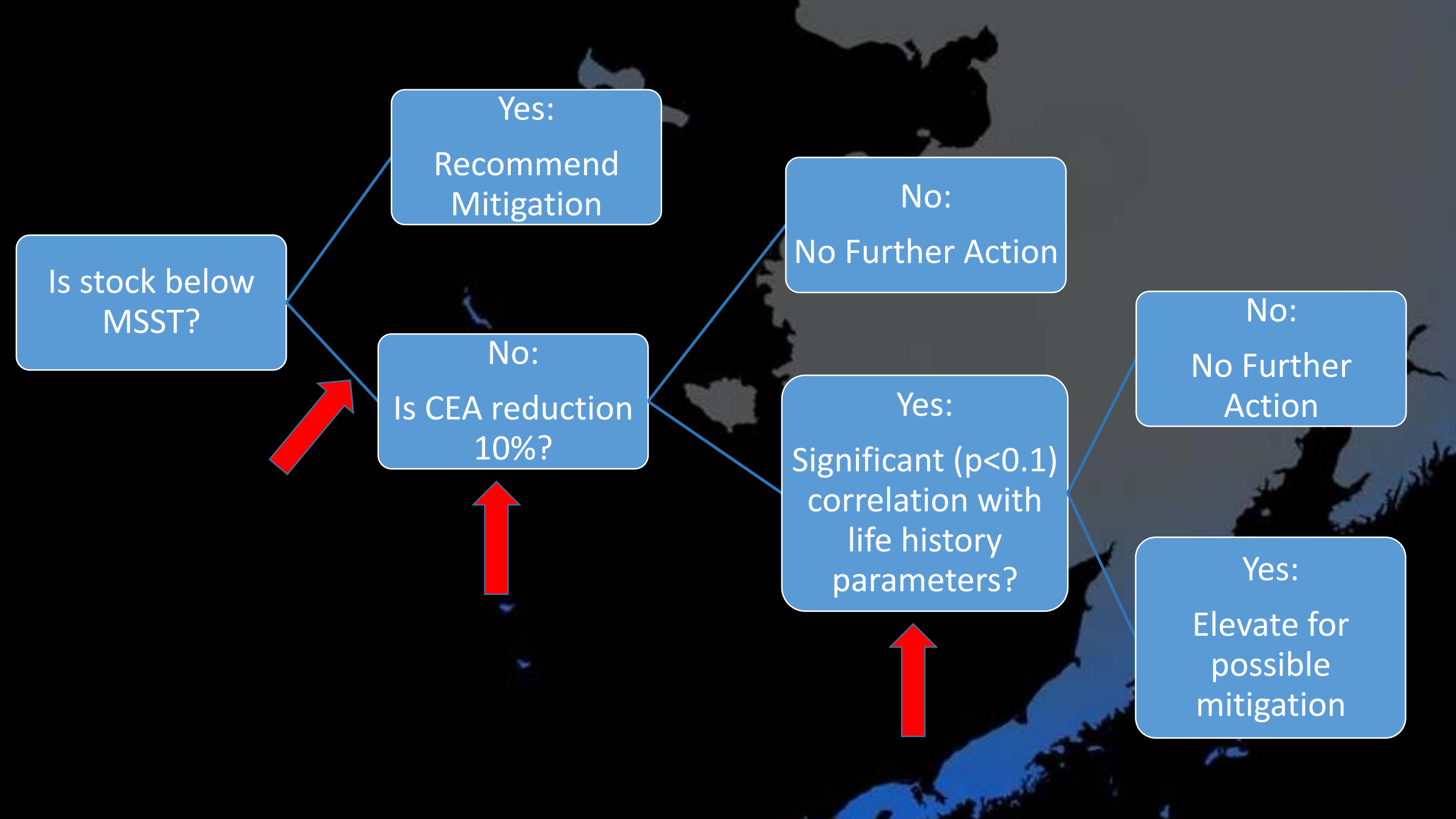


		ρ	*p*-value
Average size-at-age	age-3	-0.49	0.33
	age-4	-0.25	0.63
	age-5	-0.56	0.24
	age-6	-0.58	0.23
	age-7	-0.20	0.71
	age-8	-0.71	0.11
	age-9	-0.25	0.63
	age-10	-0.60	0.21
	age-11	0.02	0.97
	age-12	-0.40	0.43
	age-13	-0.38	0.46
	age-14	0.42	0.41
	age-15	-0.14	0.79
LVB params	L_∞	0.56	0.33
	κ	-0.64	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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Elevate for possible mitigation

Hierarchical Impact Assessment

1. MSST – If stock is below MSST, recommend mitigation
2. Core EFH Area – CEA is predicted 50% population quantile from EFH models
   - Evaluating cumulative habitat disturbance across EBS, AI, and GOA
   - Should assessments be based on regional boundaries for the stock or species?
   - 50% chosen to avoid missing some important areas without washing out potential impacts if using larger area
   - Is the 50% threshold the right one?
   - Continue if CEA habitat reduction is 10% or more
   - Is 10% habitat reduction threshold reasonable?

Hierarchical Impact Assessment

3. Correlation of CEA reduction to life history parameters
   - Size at age, recruitment, spawning distribution, feeding distribution, etc.
   - Summer and non-summer

- What seasons should be used for the analysis?
  - Summer only – best data, broadest distribution
  - Seasonal based on MaxEnt for non-summer + GAMs for summer
  - Average cumulative impacts over seasons by converting GAMs to MaxEnt for summer

Hierarchical Impact Assessment

3. Correlation of CEA reduction to life history parameters
   - Are correlations significant at $p<0.1$
     - Chosen to address possibility of Type II error *not* to determine significance of correlation
   - Is p-value of 0.1 reasonable?