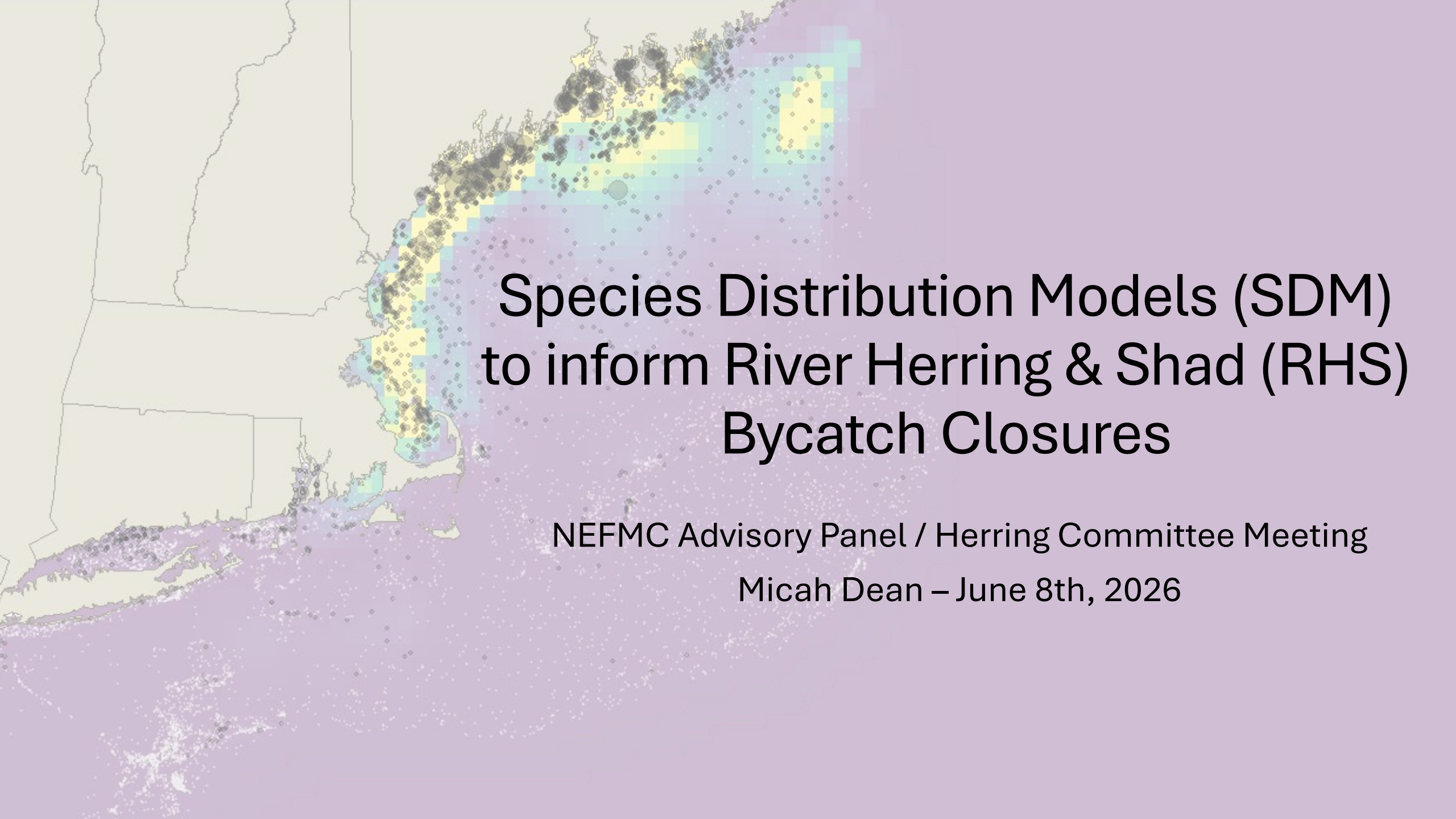




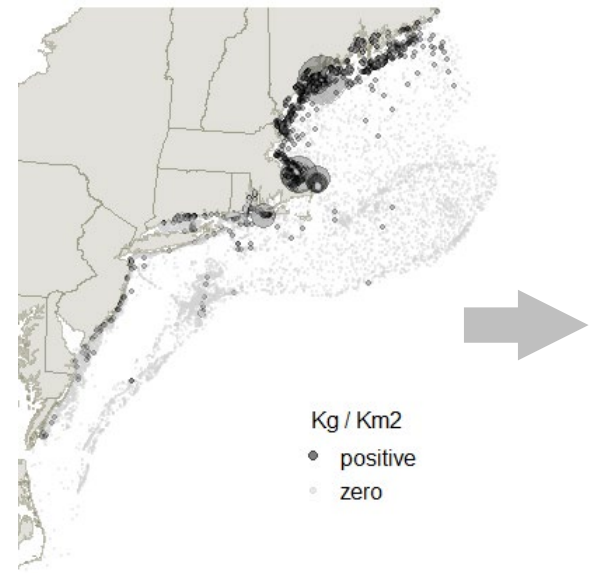
Species Distribution Models (SDM) to inform River Herring & Shad (RHS) Bycatch Closures

NEFMC Advisory Panel / Herring Committee Meeting

Micah Dean – June 8th, 2026

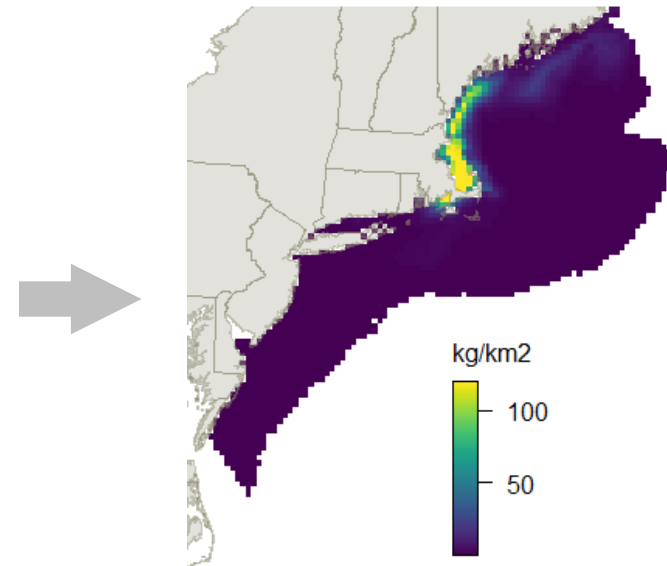
How Species Distribution Models (SDMs) work

Observed
CPUE

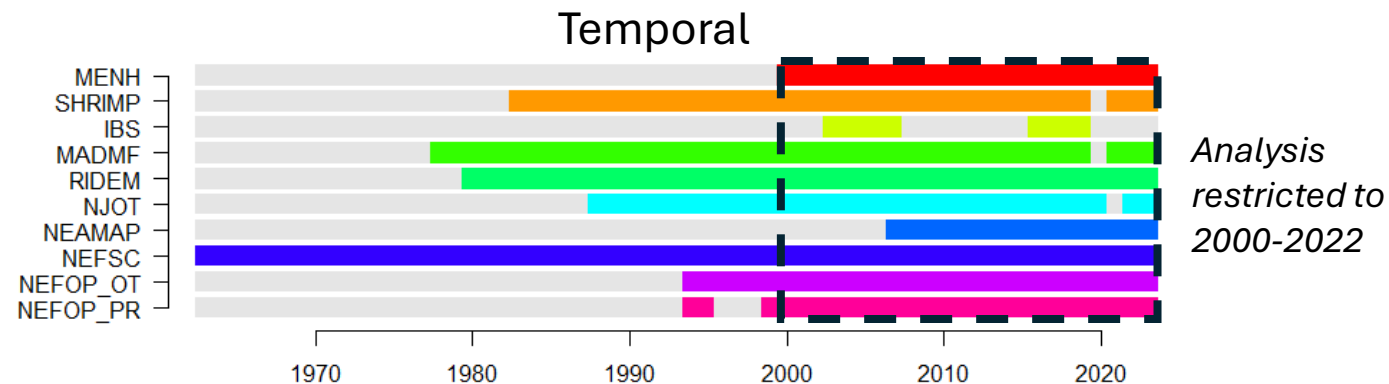


SDM

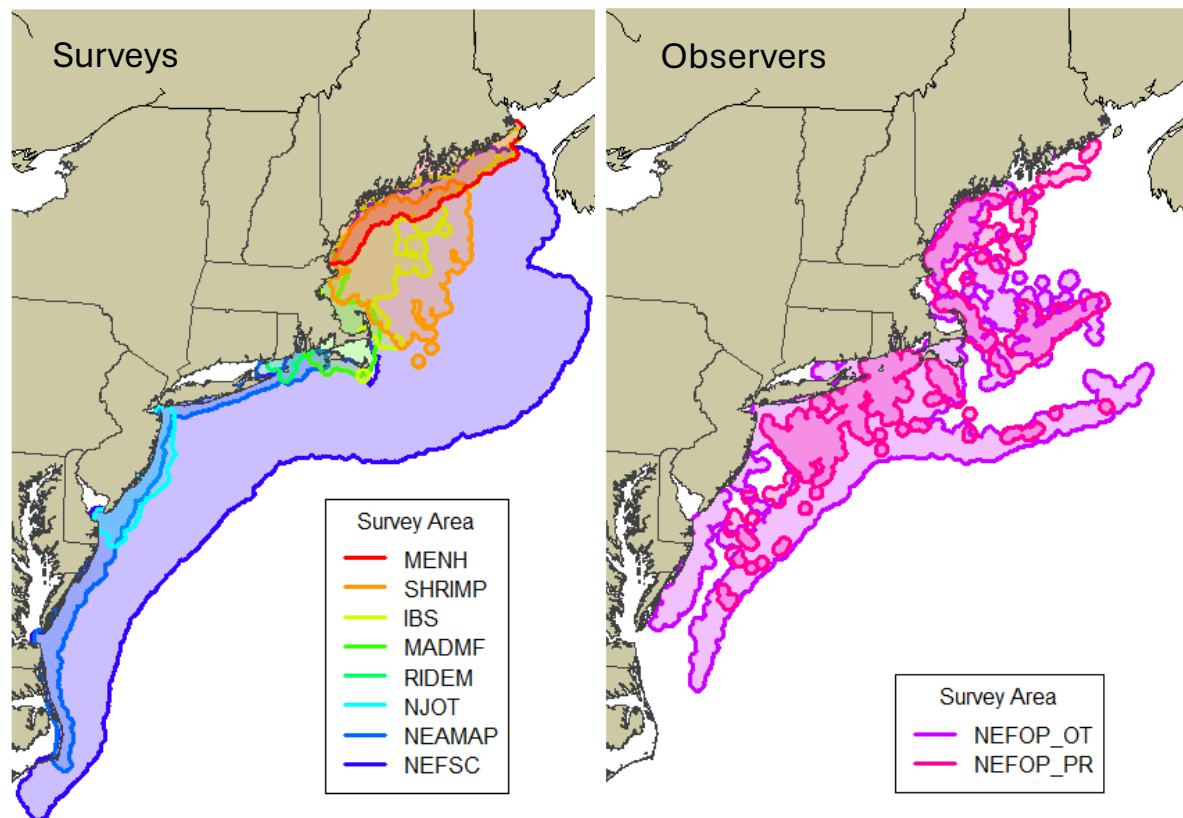
Predicted
Abundance



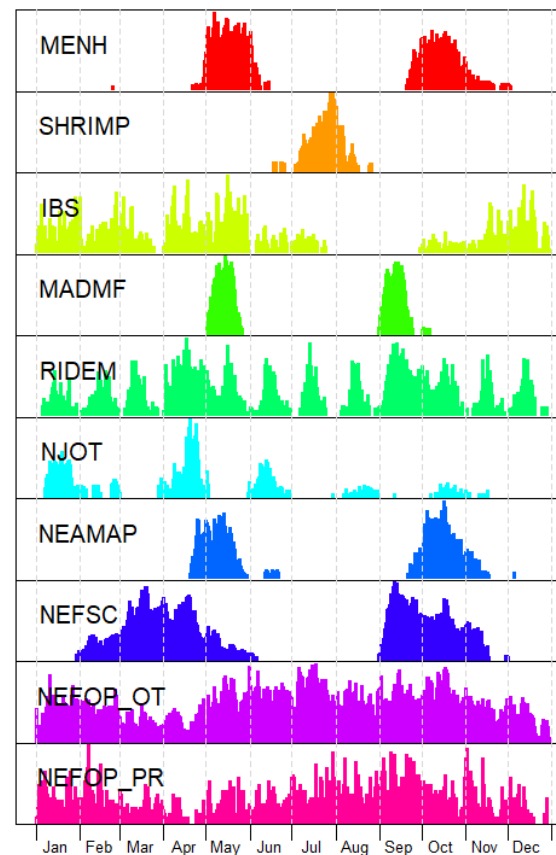
Dataset Extents



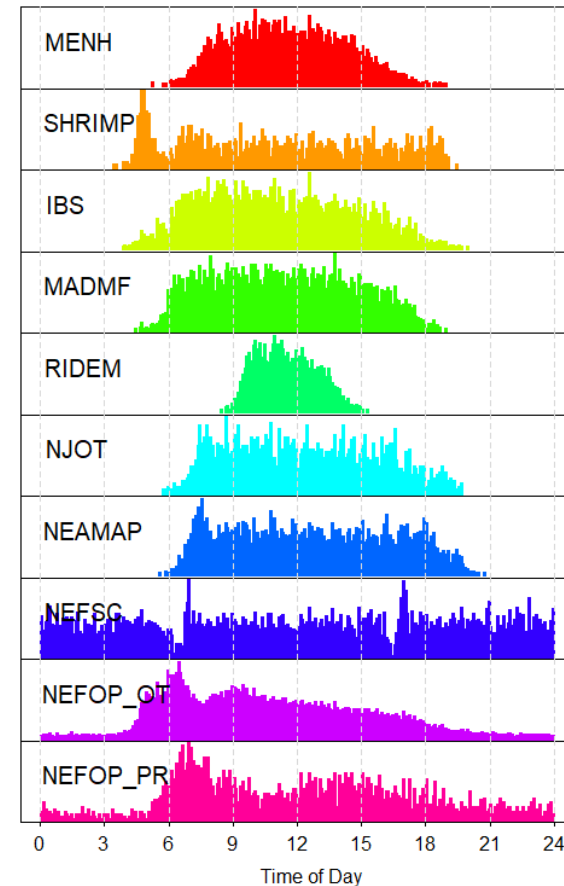
Spatial



Seasonal



Diel



Sample Sizes

N = 81,458 { 90% for training
10% for testing

SOURCE	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
MENH	0	1	0	33	1770	298	0	0	214	1384	224	13	3937
SHRIMP	0	0	0	0	0	40	918	483	0	0	0	0	1441
IBS	467	374	310	493	625	135	126	0	0	124	290	522	3466
MADMF	0	0	0	0	2187	0	0	0	2026	36	0	0	4249
RIDEM	230	246	263	703	459	305	289	274	703	498	264	276	4510
CTLISTS	0	0	0	637	864	827	4	0	769	731	110	5	3947
NJOT	447	100	25	601	26	263	1	58	4	61	8	0	1594
NEAMAP	0	0	0	186	1357	63	0	0	164	1626	100	0	3496
NEFSC	16	1013	3372	3164	1042	40	0	0	3498	2839	1035	13	16032
NEFOP_SMBT	2563	2454	1828	1720	3381	3809	4578	3369	3575	4321	2659	2054	36311
NEFOP_MWT	220	220	139	63	190	150	265	283	378	243	205	119	2475
Total	3943	4408	5937	7600	11901	5930	6181	4467	11331	11863	4895	3002	81458

% Positive

- Alewife = 26%
- Blueback herring = 13%
- American shad = 15%
- Atlantic herring = 29%

SOURCE	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Total
CTLISTS	185	195	187	189	186	187	112	186	153	191	76	167	191	196	194	199	192	142	164	198	0	135	165	3947
IBS	0	0	0	121	811	868	340	347	0	0	0	0	0	0	0	0	259	324	350	46	0	0	0	3466
MADMF	190	194	189	189	182	186	195	202	201	197	192	195	192	197	202	193	187	195	188	192	0	191	200	4249
MENH	78	132	119	112	121	107	163	162	158	170	171	169	185	182	190	203	201	221	213	219	91	207	188	3937
NEAMAP	0	0	0	0	0	0	0	116	231	254	237	235	238	235	236	234	235	179	238	234	120	237	237	3496
NEFOP_SMBT	166	255	364	485	1073	1016	983	668	704	1802	1834	2735	1531	2191	2476	1920	2784	4544	3525	2607	444	773	1431	36311
NEFOP_MWT	2	2	1	28	90	232	69	47	126	192	350	219	376	262	177	33	91	67	19	16	11	9	56	2475
NEFSC	777	813	798	737	767	747	825	811	705	740	734	696	725	747	701	741	716	477	557	696	129	664	664	16032
NJOT	76	72	76	85	86	85	75	71	84	91	66	82	69	82	73	72	63	60	67	30	25	0	60	1594
RIDEM	157	157	170	166	165	183	172	193	212	205	211	212	206	215	203	192	211	218	204	205	218	217	218	4510
SHRIMP	54	54	54	60	48	67	41	73	59	75	72	76	80	74	65	40	70	73	81	105	0	60	60	1441
Total	1685	1874	1958	2172	3529	3678	2975	2876	2633	3917	3943	4786	3793	4381	4517	3827	5009	6500	5606	4548	1038	2493	3279	81458

Model Selection

Candidate Variables

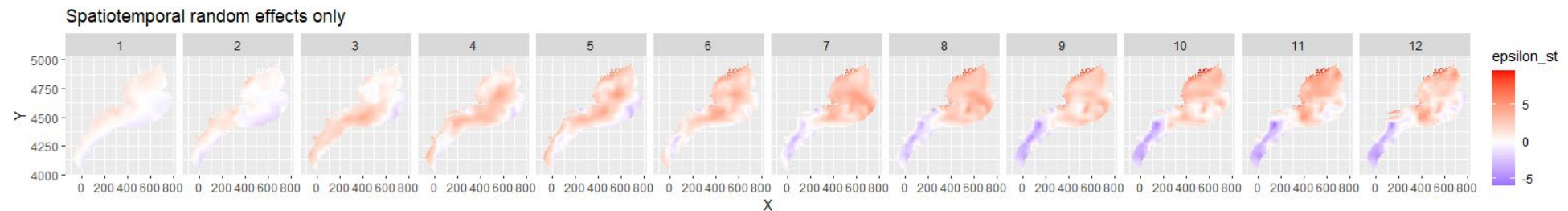
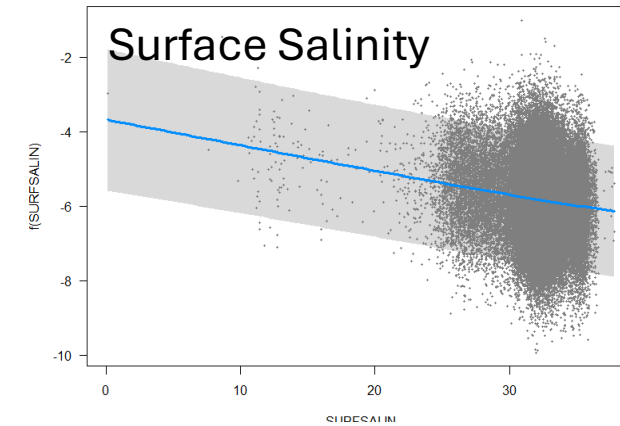
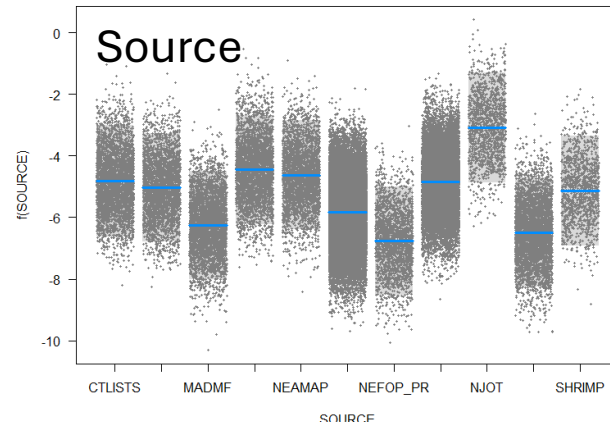
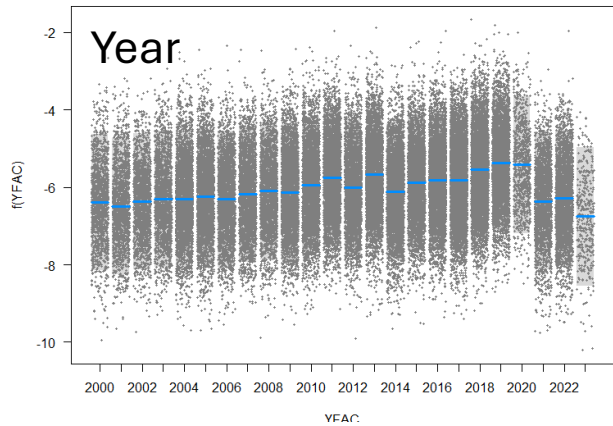
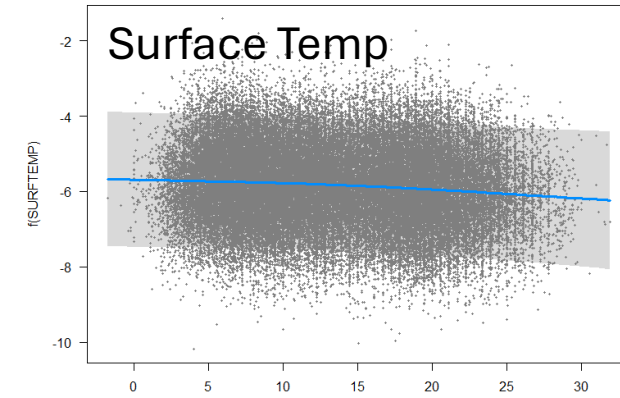
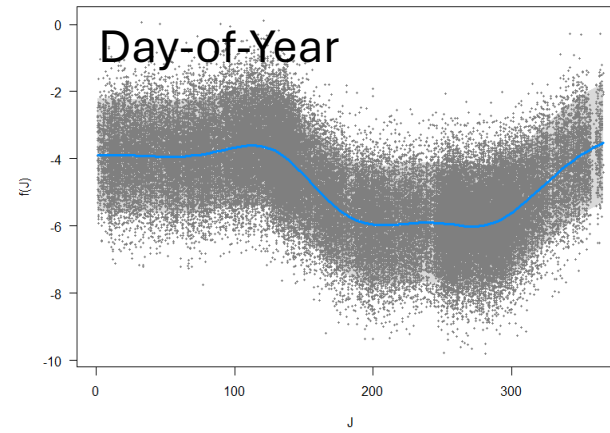
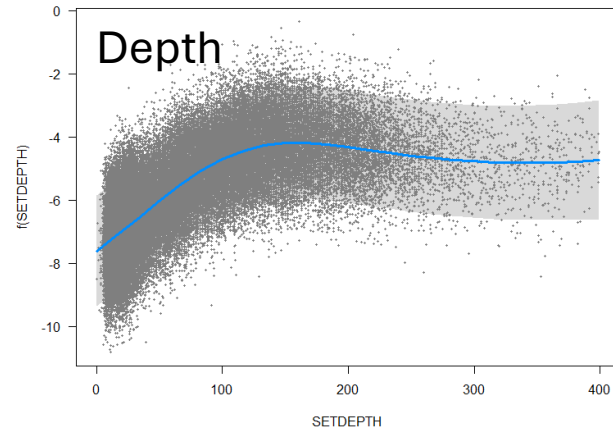
- Factors - Source, Season
- Random effects - Year
- Continuous - Depth, SurfTemp, BotTemp, SurfSal, BotSal, DistShore, Month, DayOfYear
- Spatial random effects – Spatial, Spatial:Year, Spatial:Month

Selected Models

- Alewife ~ Source + Year + SurfTemp + Depth:DayOfYear + SurfSalin:DayOfYear + Spatial:Month
- Blueback ~ Source + Year + Depth + SurfTemp + BotTemp:DayOfYear + Spatial:Month
- Am Shad ~ Source + Year + Depth:Season + SurfTemp:DayOfYear + Spatial:Month

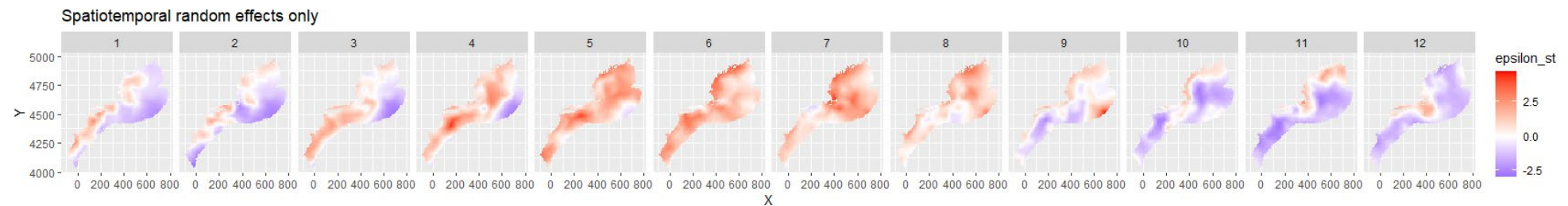
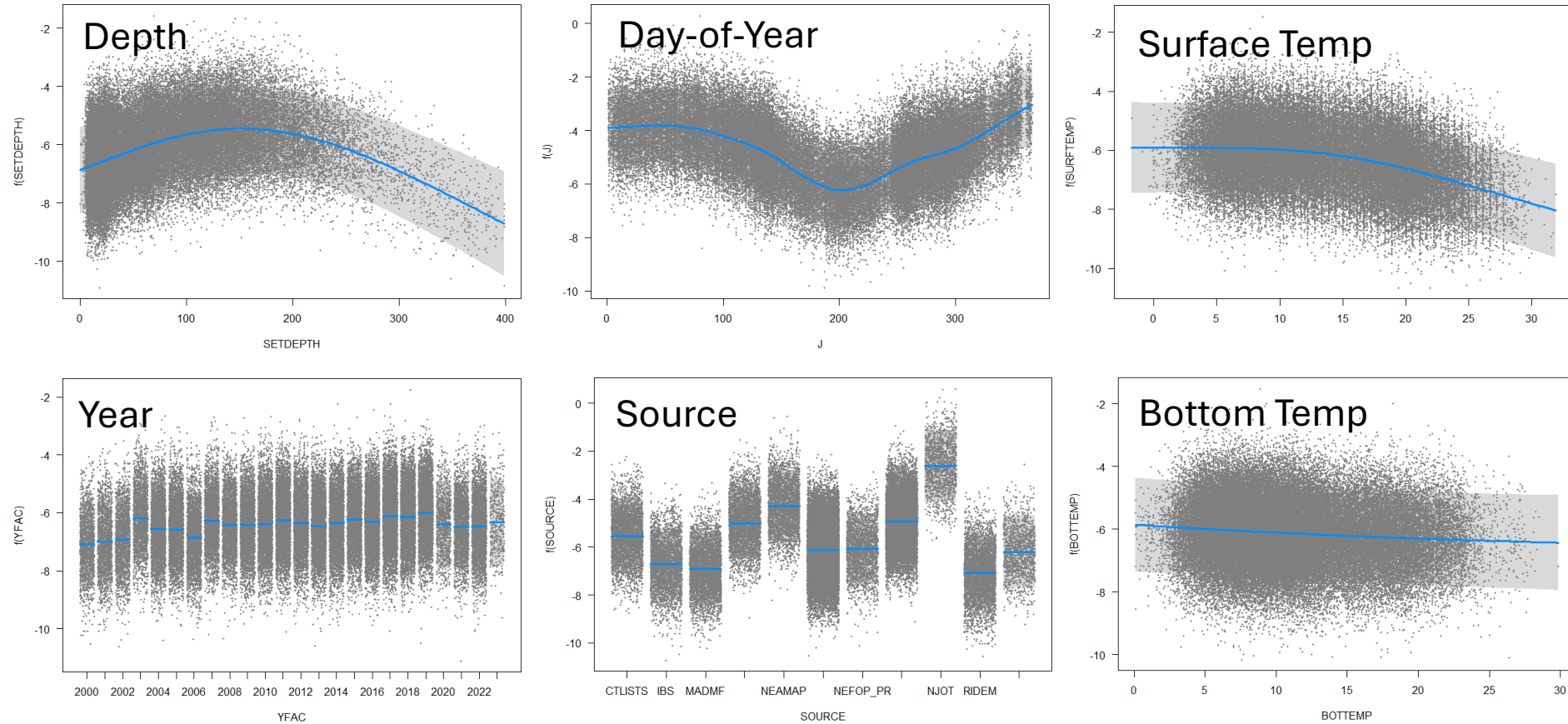
Marginal Effects of Predictors

Alewife



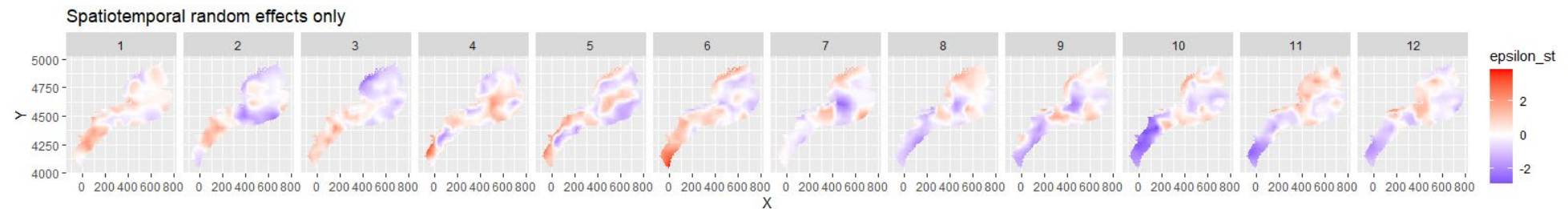
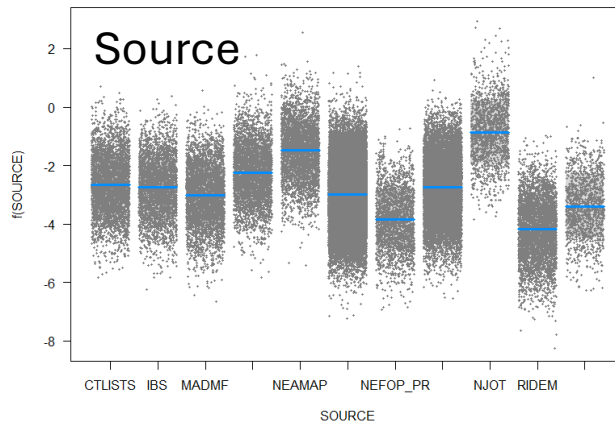
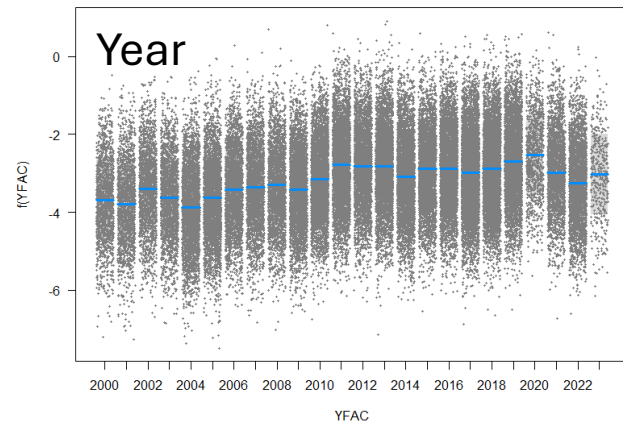
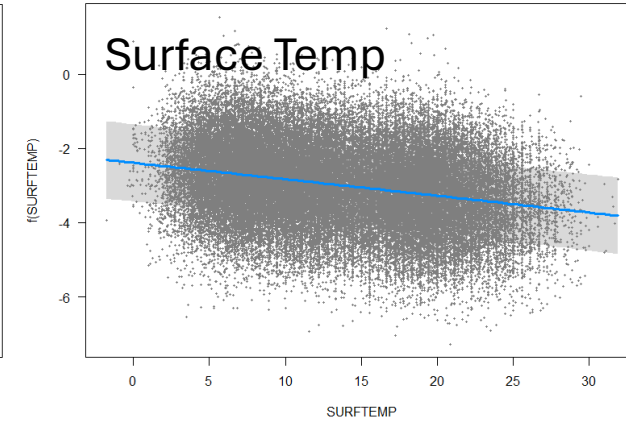
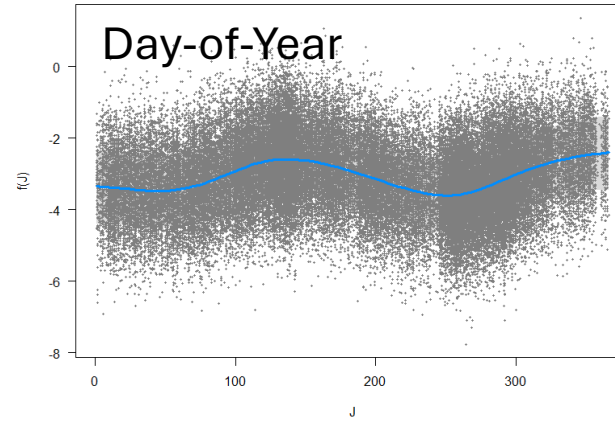
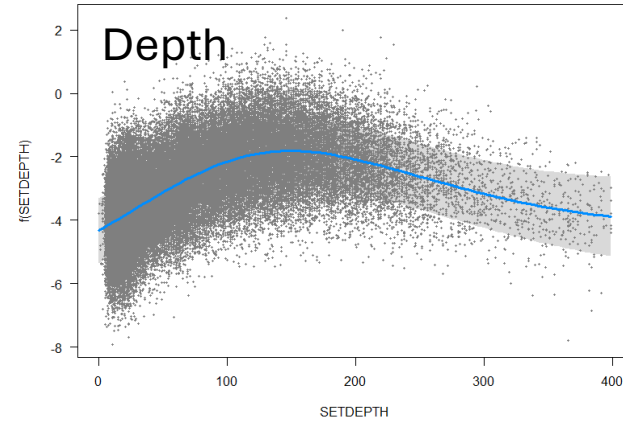
Marginal Effects of Predictors

Blueback



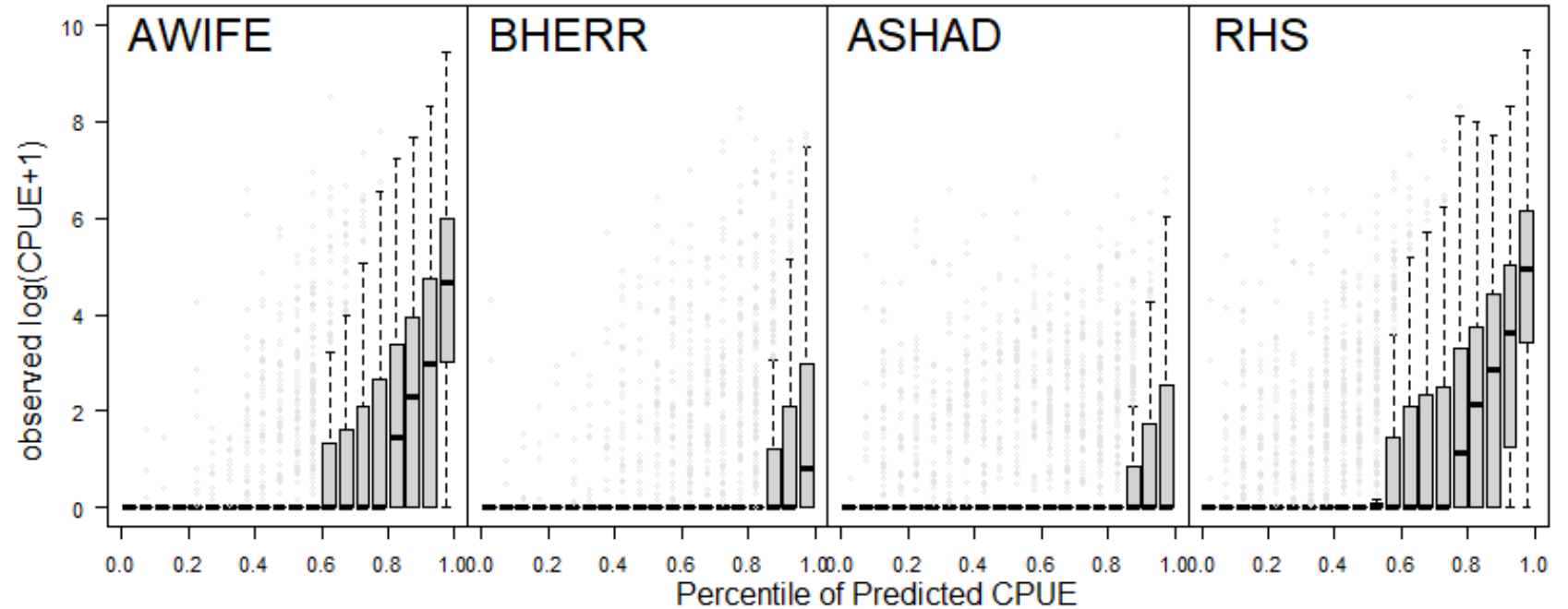
Marginal Effects of Predictors

Am Shad



Comparison to Test Dataset

- How well does the SDM predict RHS catch rates?

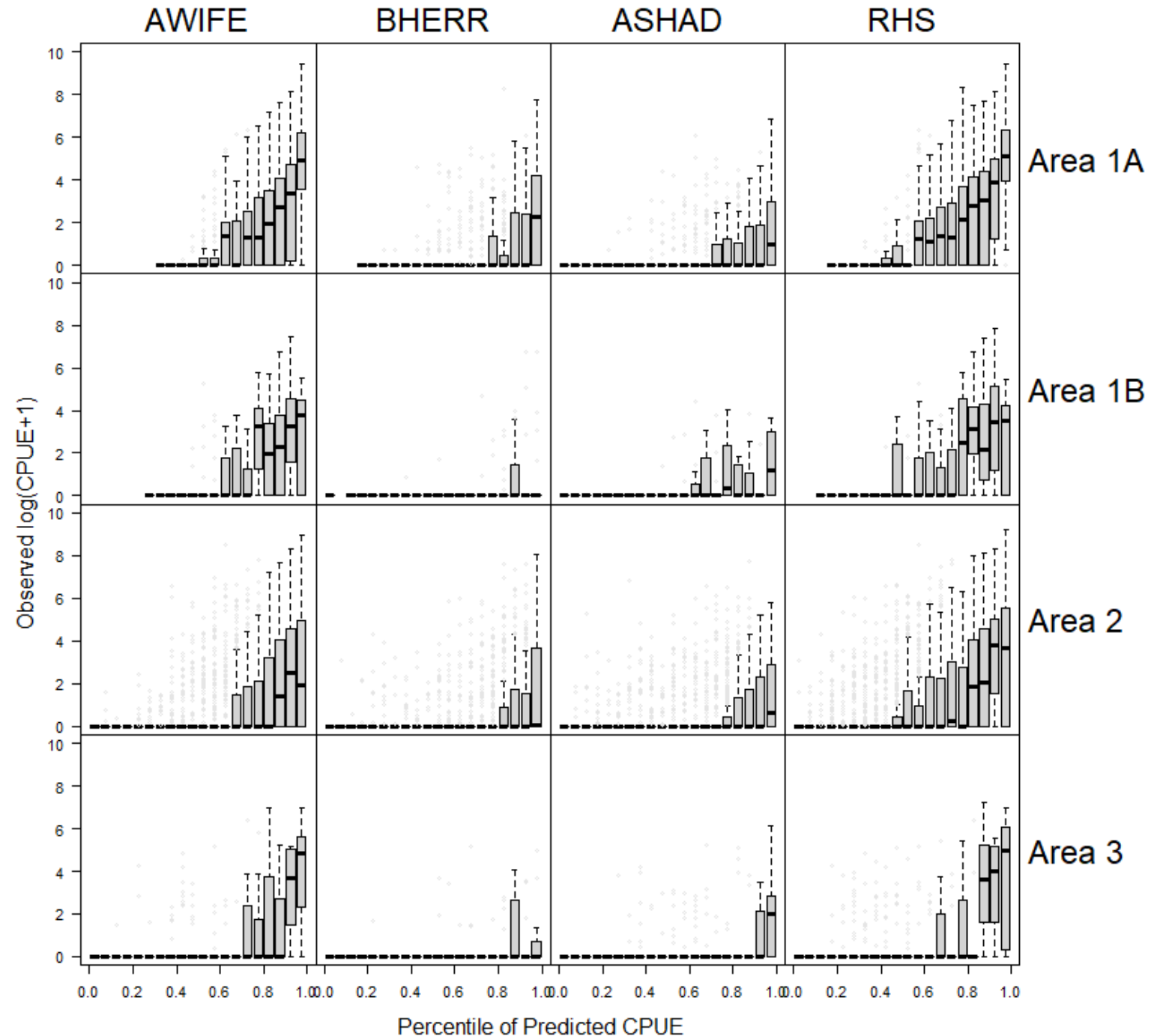


Strong relationship
between observed and
predicted CPUE

Comparison to Test Dataset

- How well does the SDM predict RHS catch rates?

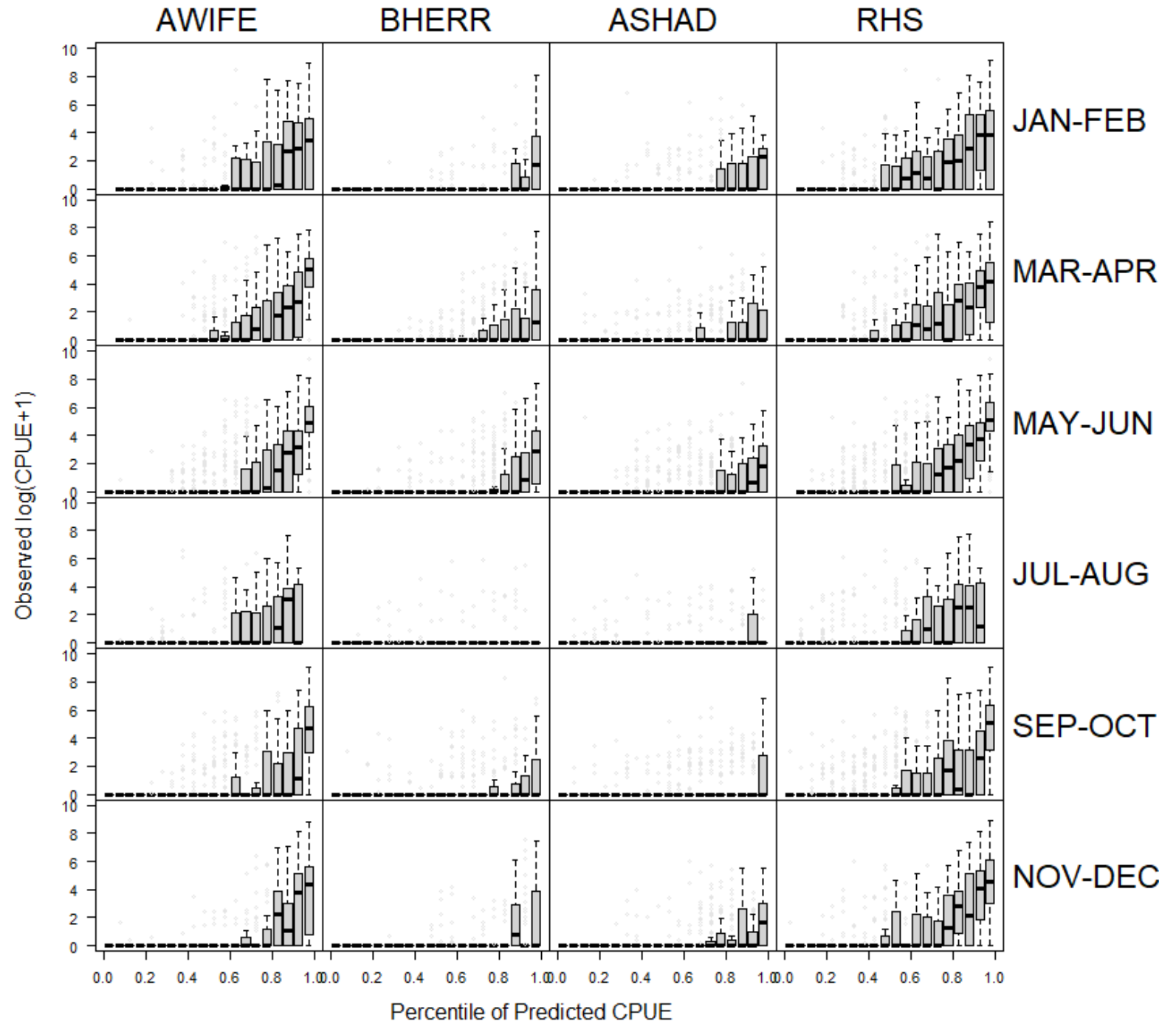
Relationship is present in each management area



Comparison to Test Dataset

- How well does the SDM predict RHS catch rates?

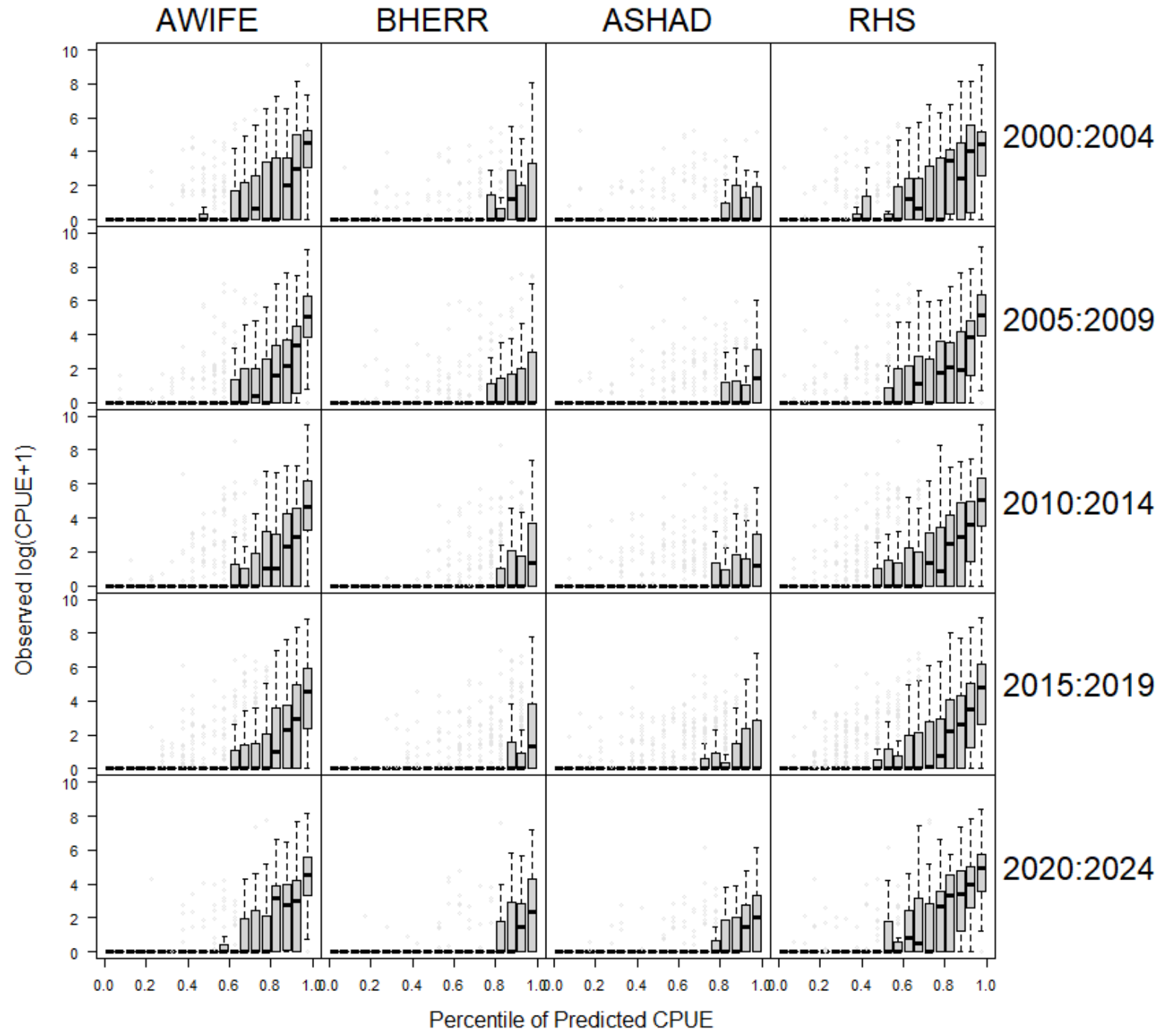
Relationship is stable across all seasons



Comparison to Test Dataset

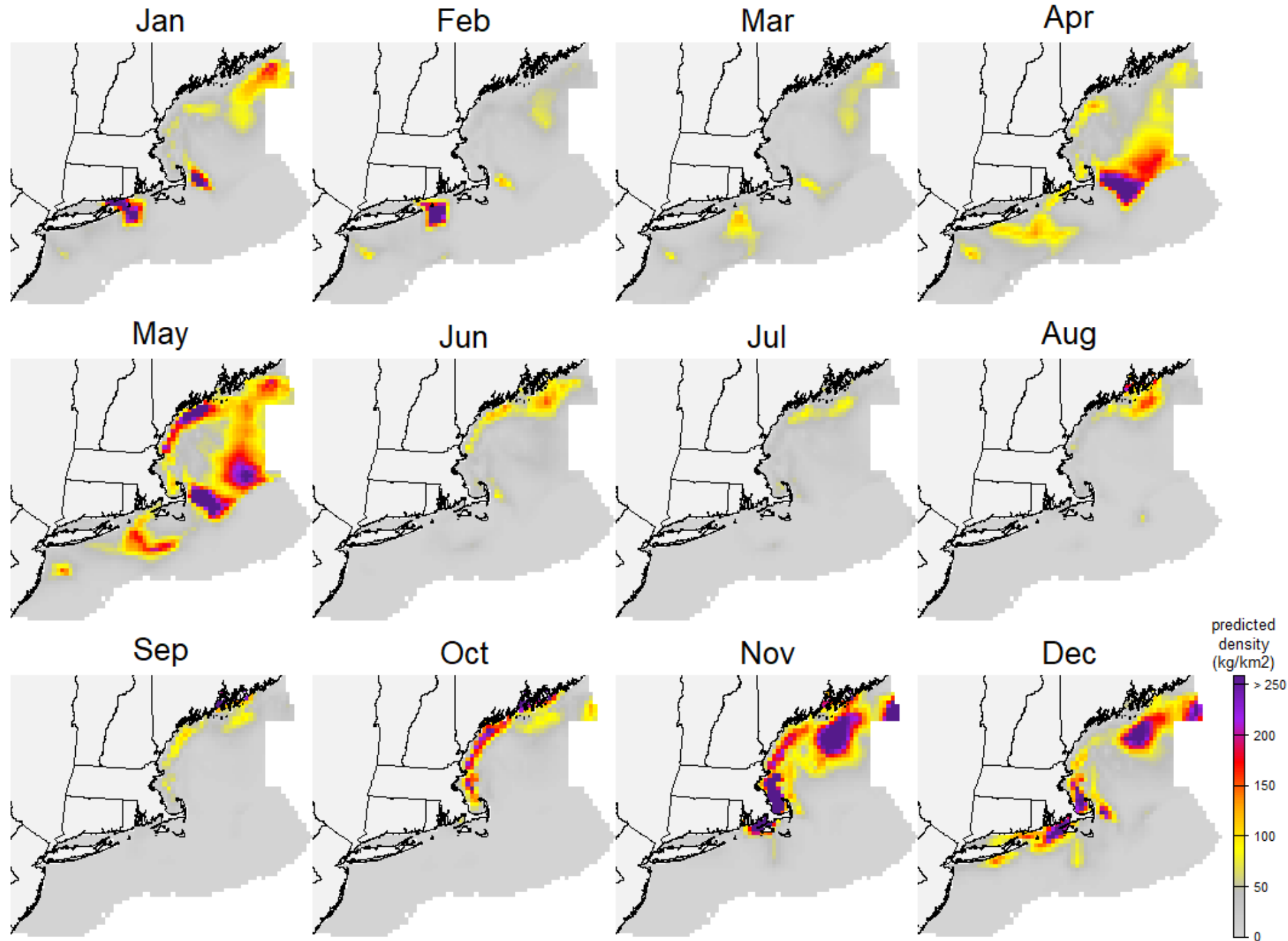
- How well does the SDM predict RHS catch rates?

Relationship is stable over time



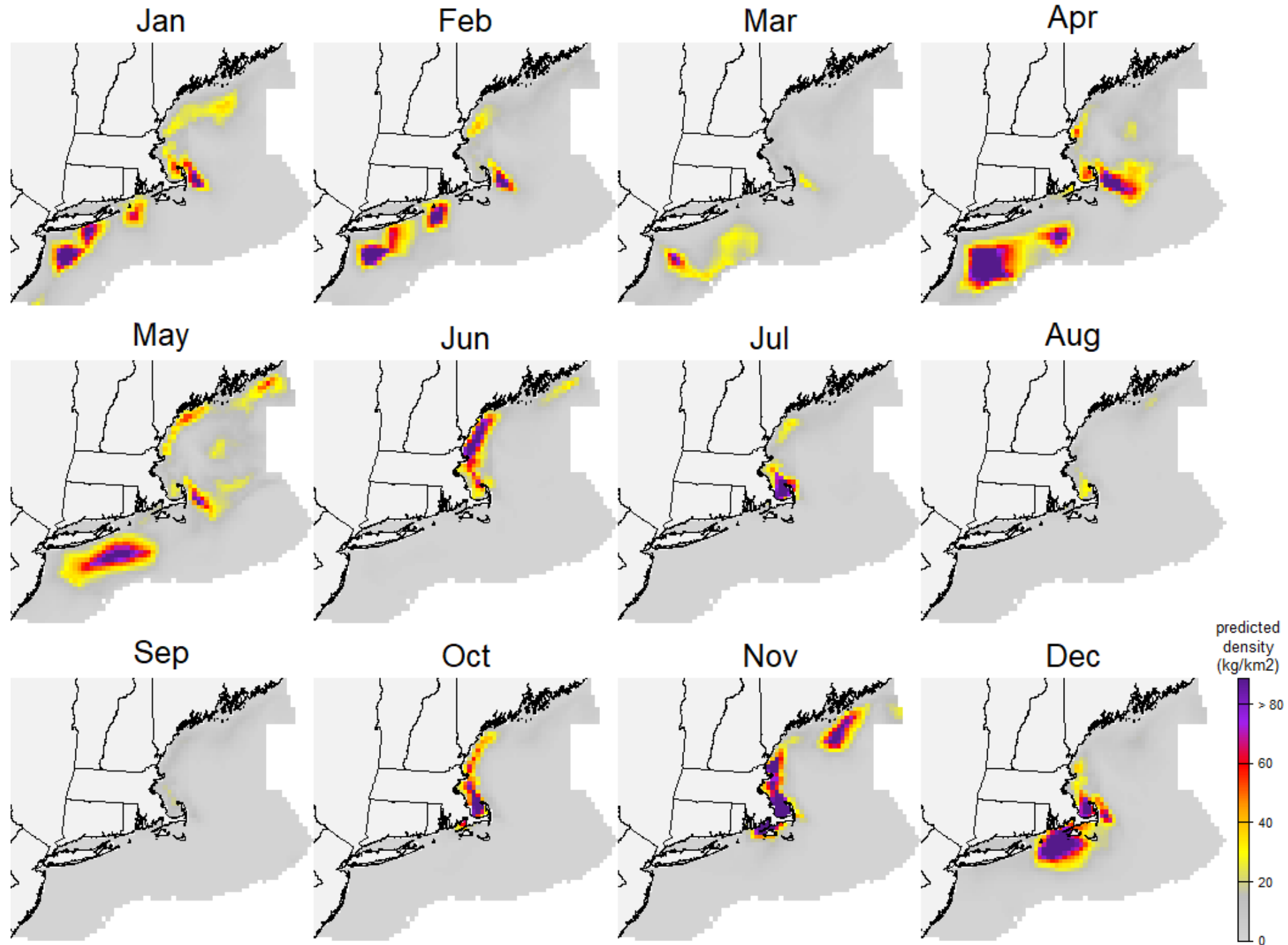
Model Predictions

- Alewife
- Predicted Abundance (kg/km²)



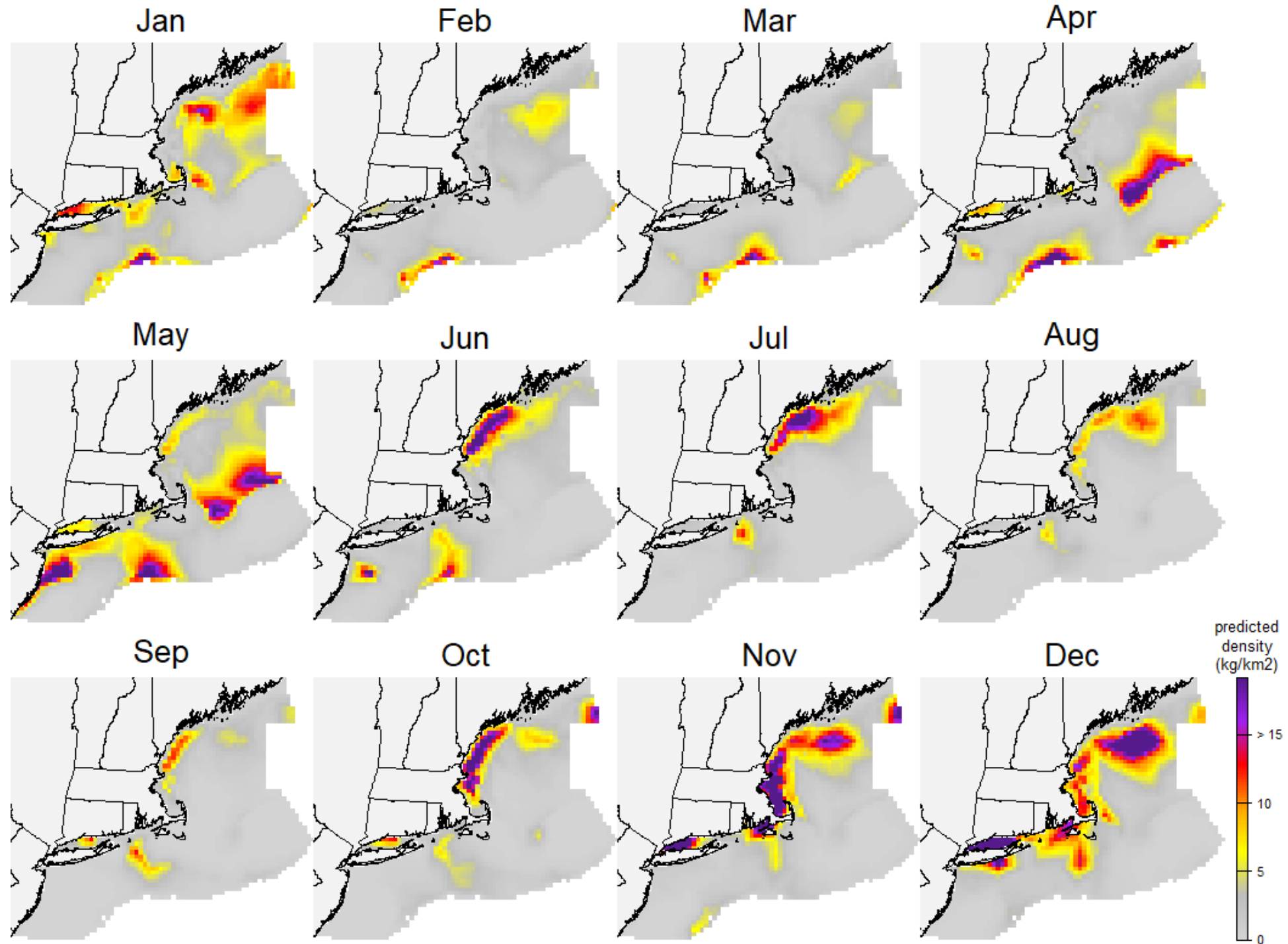
Model Predictions

- **Blueback Herring**
- Predicted Abundance (kg/km²)



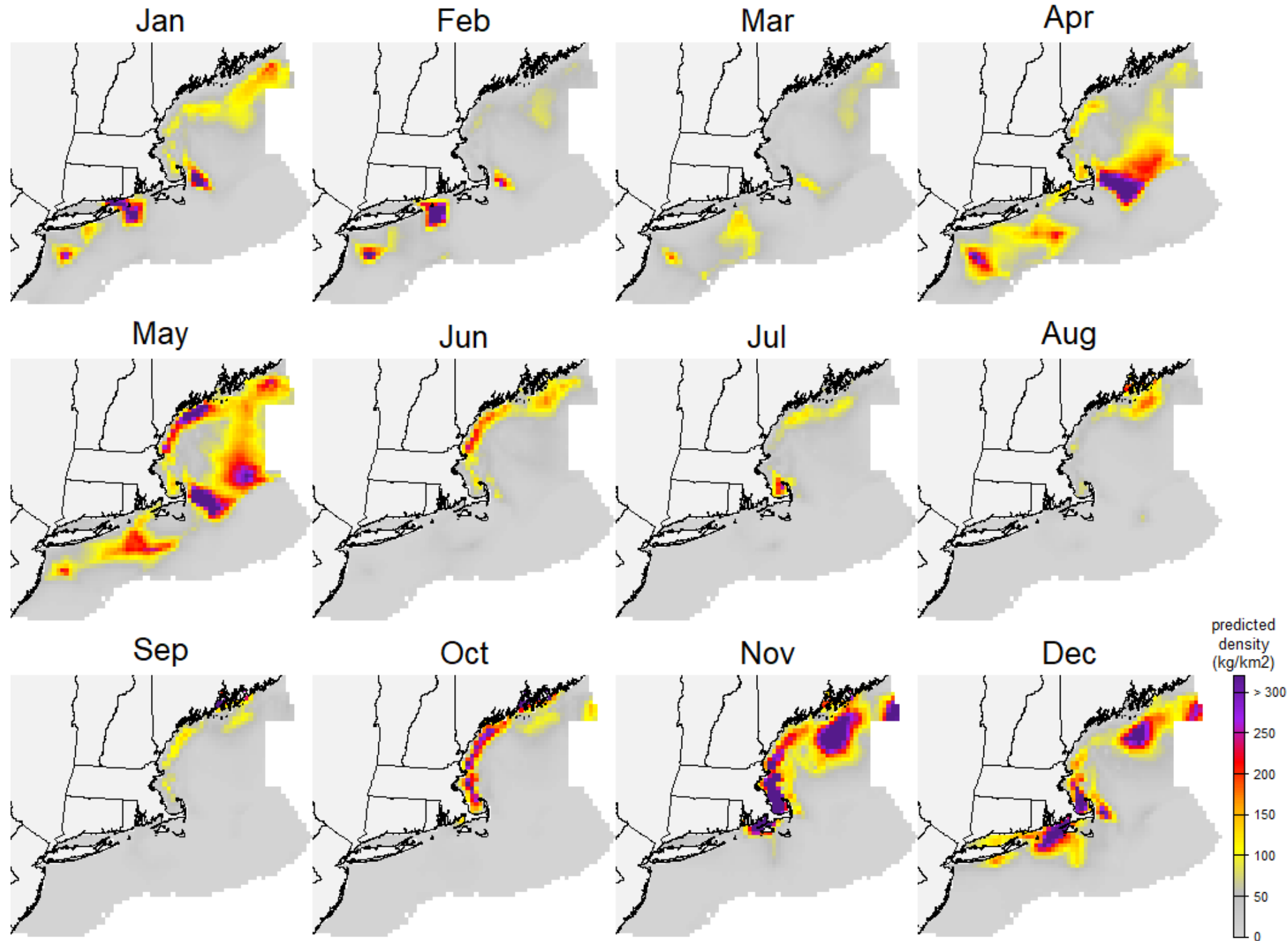
Model Predictions

- American Shad
- Predicted Abundance (kg/km²)



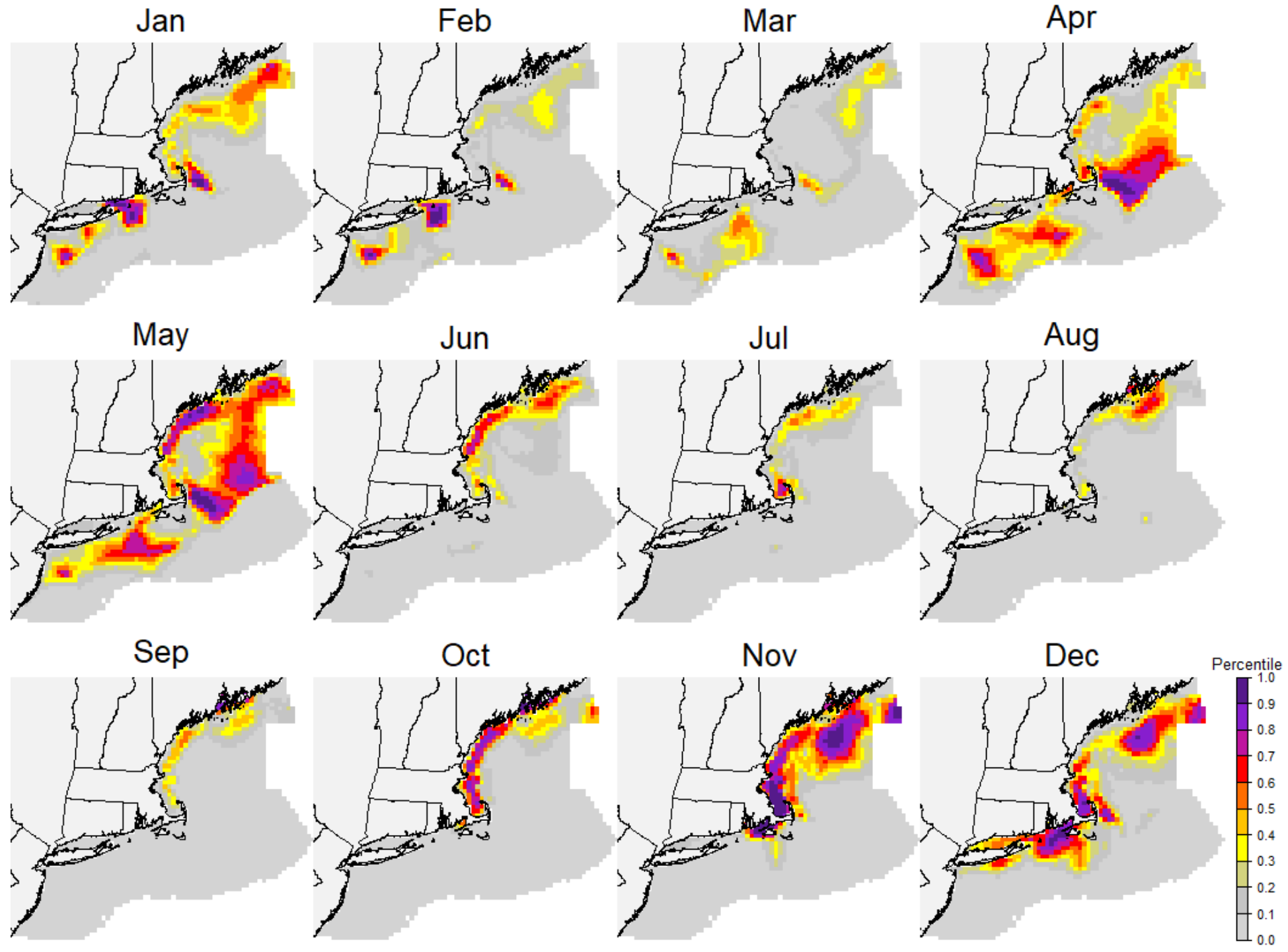
Model Predictions

- All RHS
- Predicted Abundance (kg/km²)



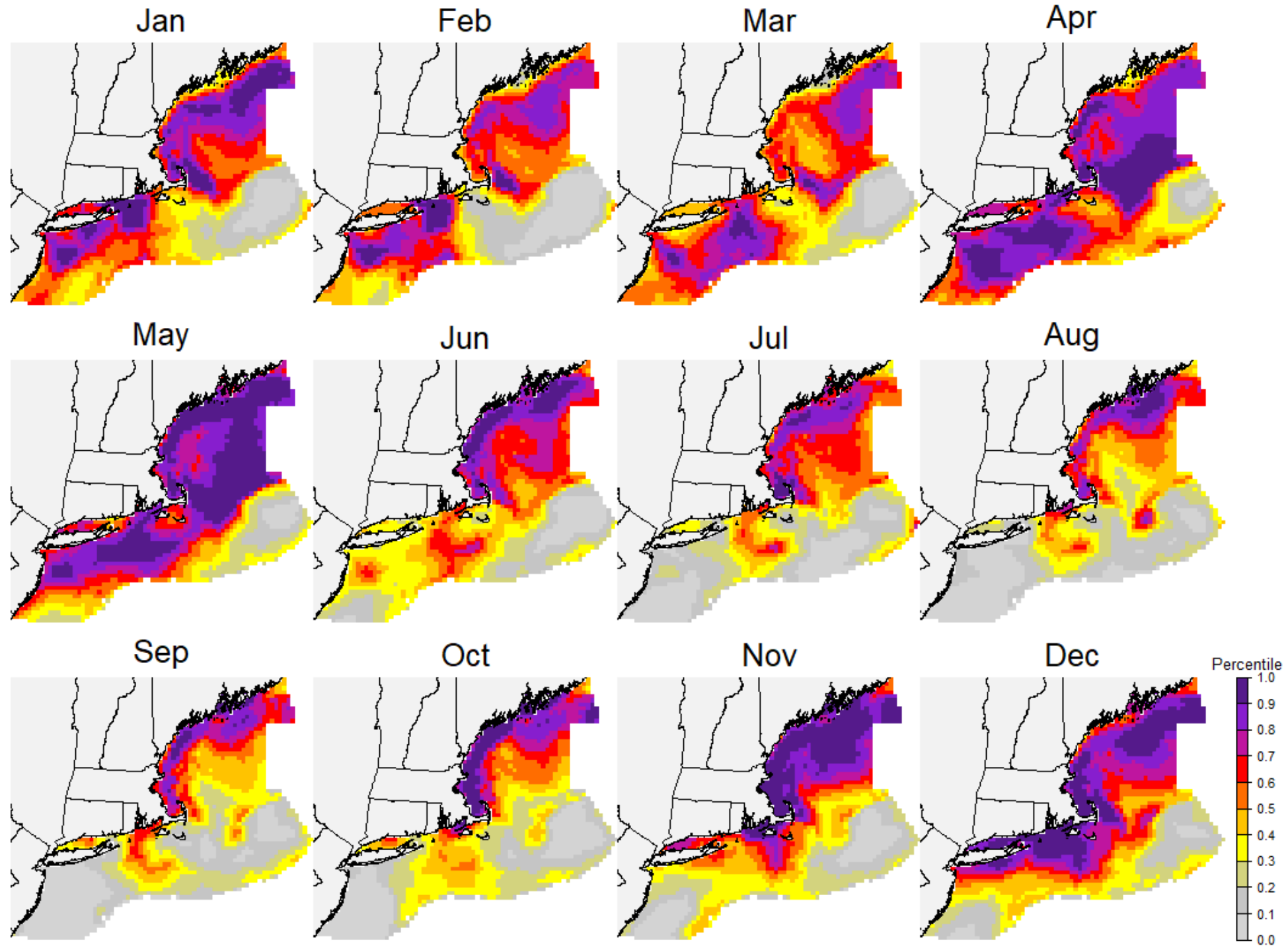
Model Predictions

- All RHS
- Biomass Percentiles



Model Predictions

- All RHS
- Area Percentiles

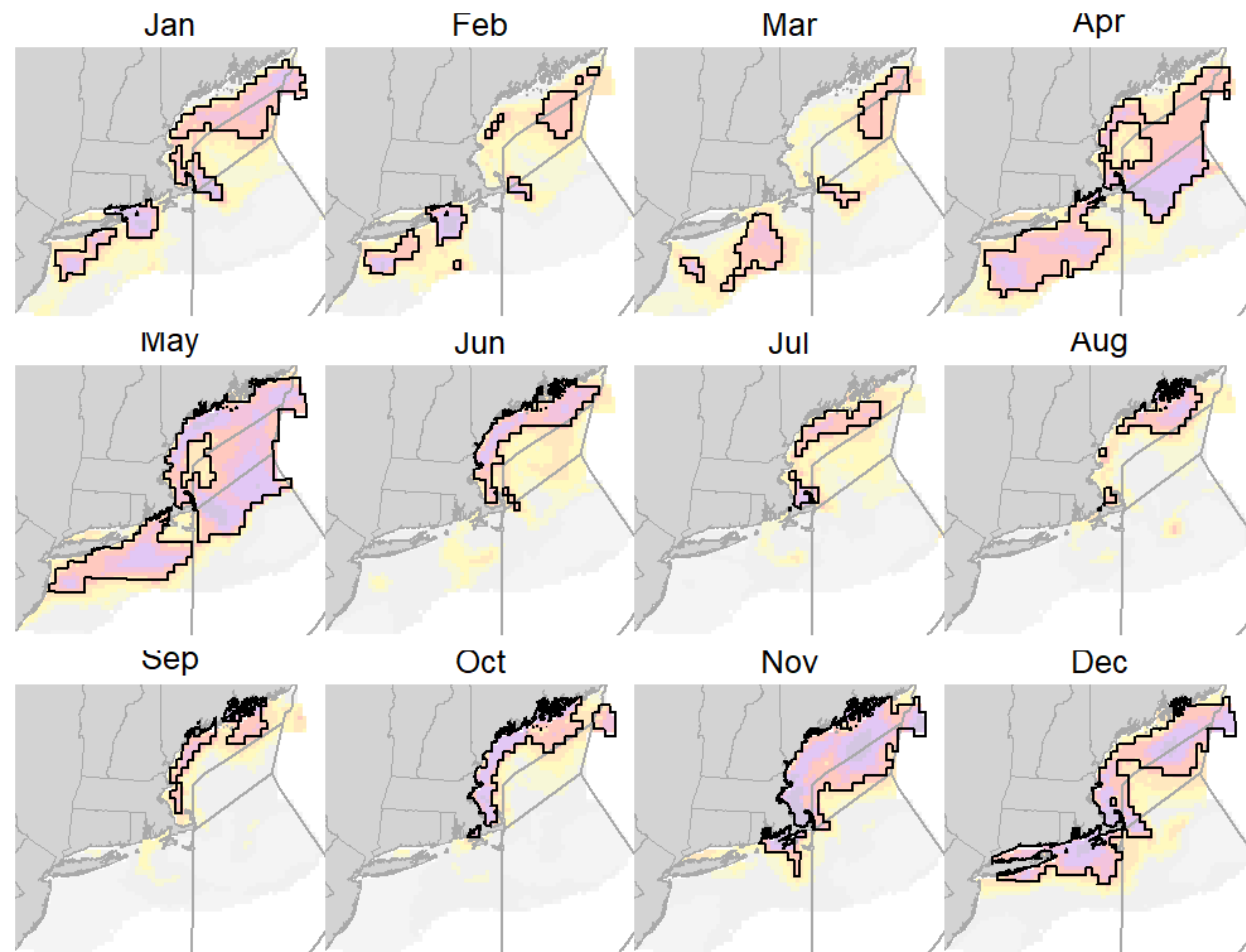


Evaluation Metrics for Closure Alternatives

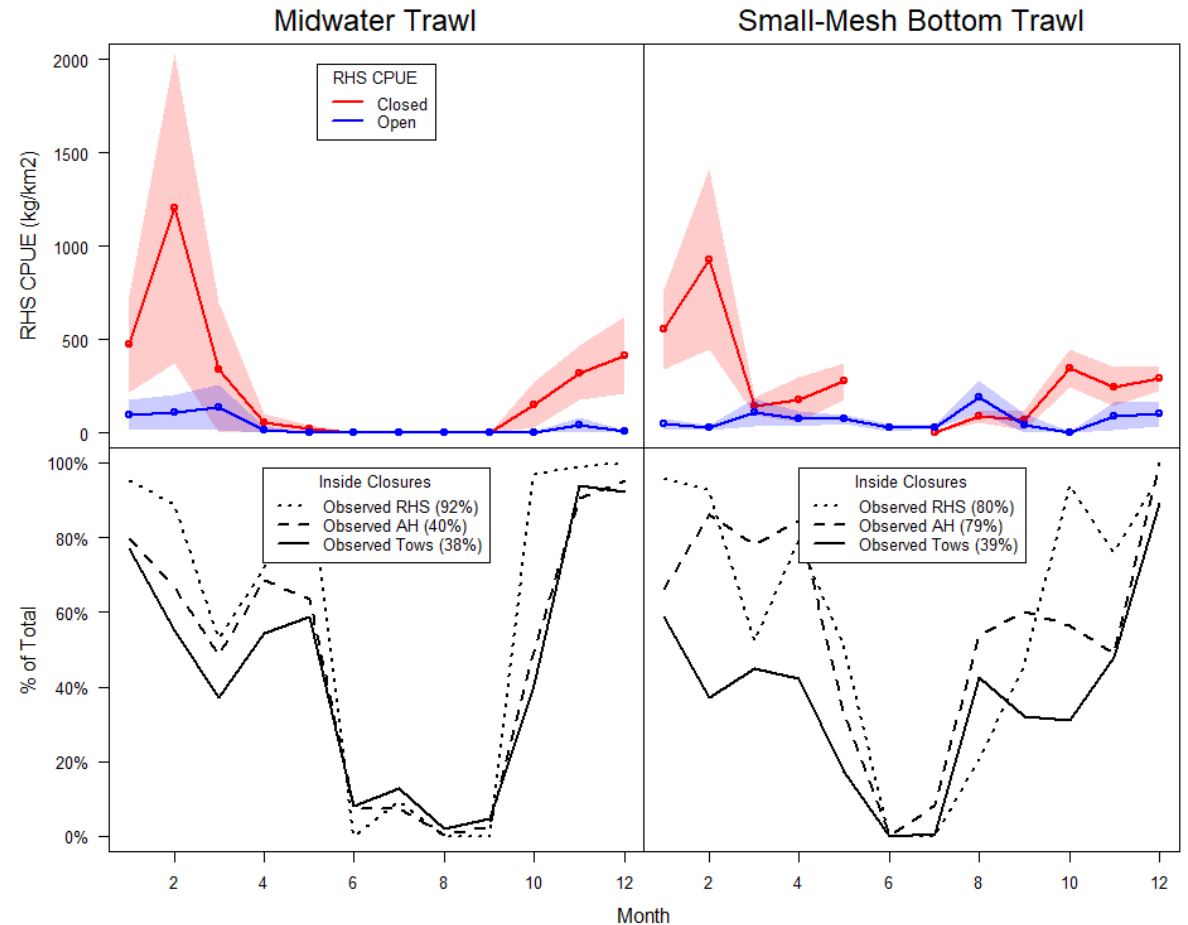
- Dataset = Observed Fishery Tows with Atlantic Herring 2000-2022
 - CPUE of RHS species – closed vs open
 - % of total observed RHS catch in closed area
 - % of total observed Atl Herring catch in closed area
 - % of observed tows in closed area

Hypothetical Closure Scenario

Dataset = RHS area percentiles
Threshold = 0.80 (top 20 % of areas)
Boundaries = 10-min squares

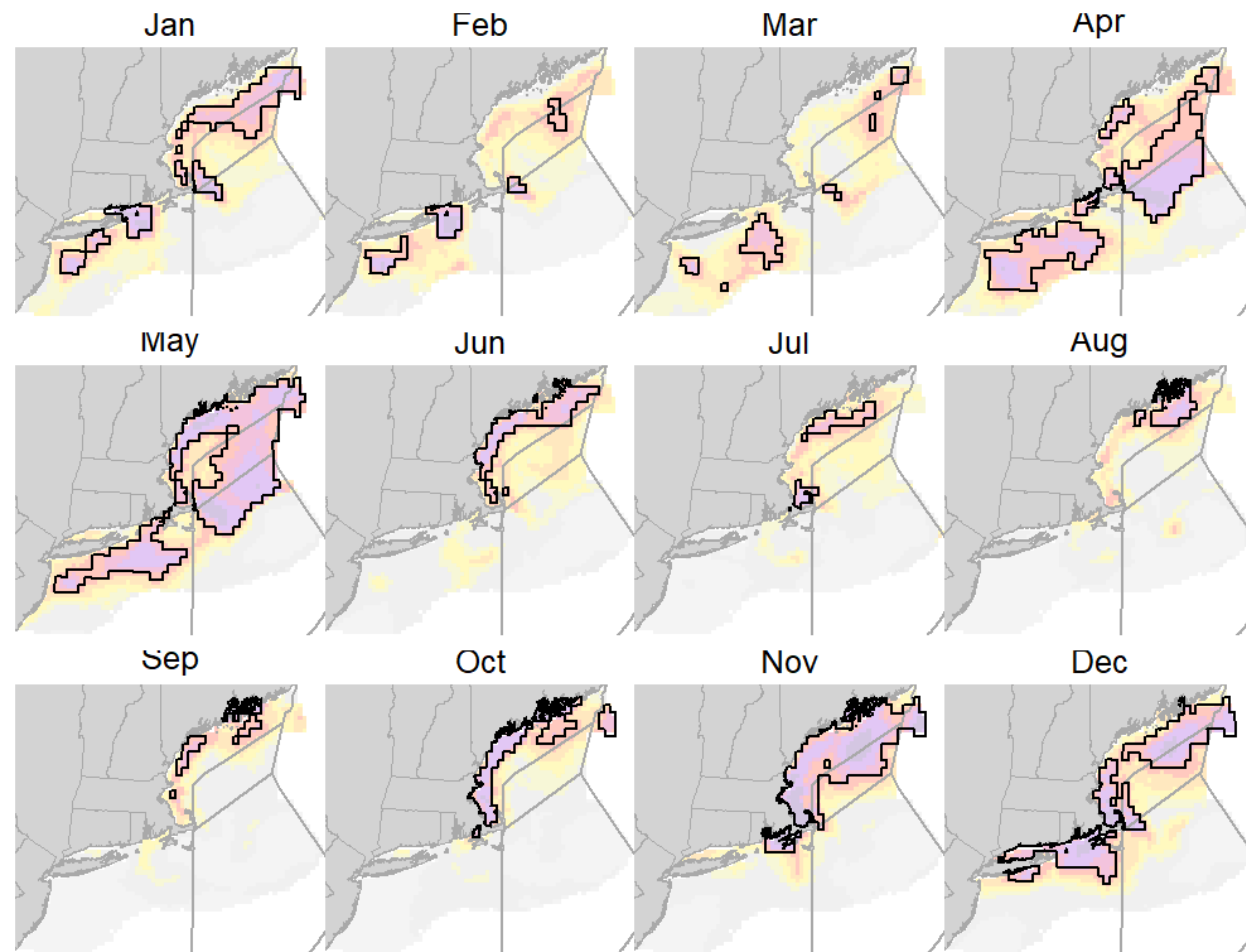


sq10; thresh = 0.8

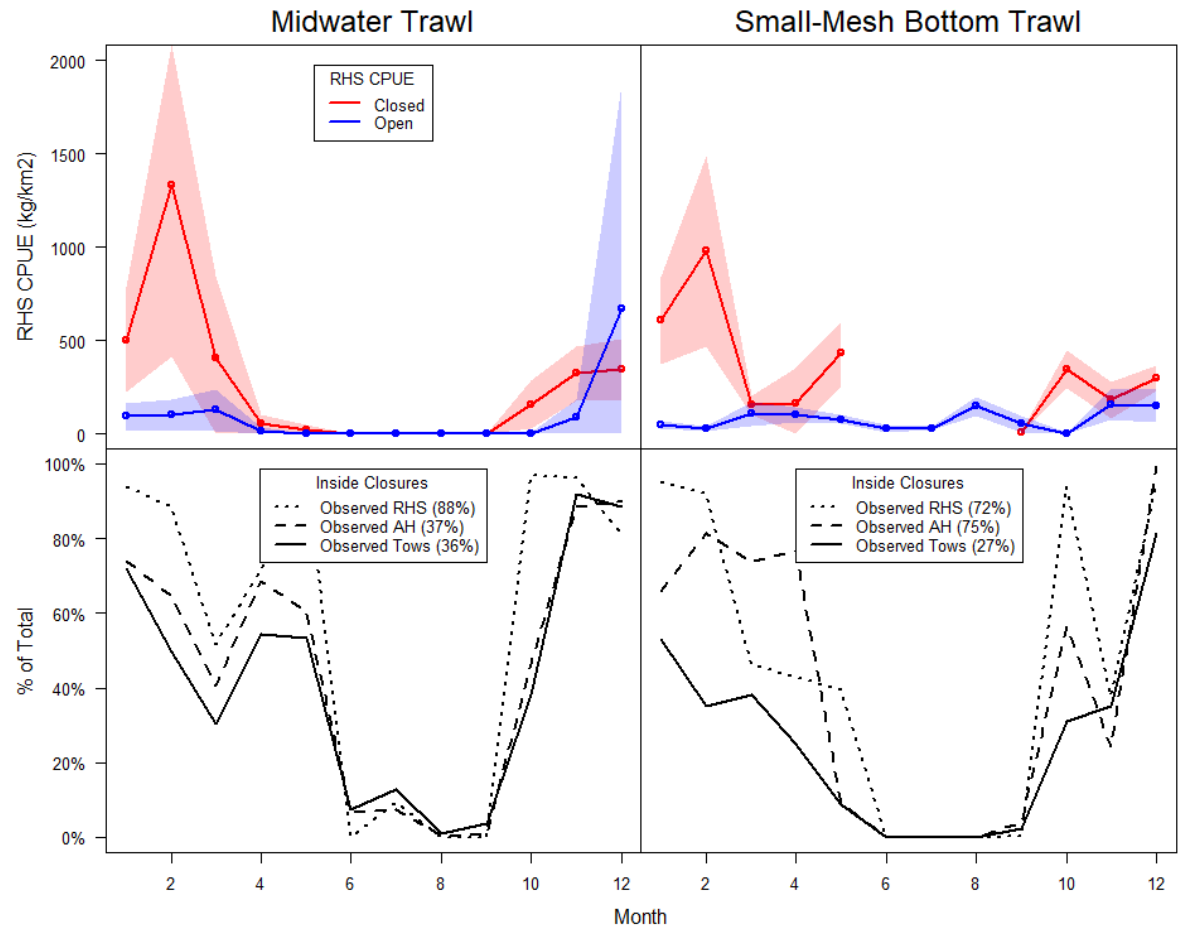


Hypothetical Closure Scenario

Threshold = 0.85 (top 15% of areas)
Boundaries = 10-min squares

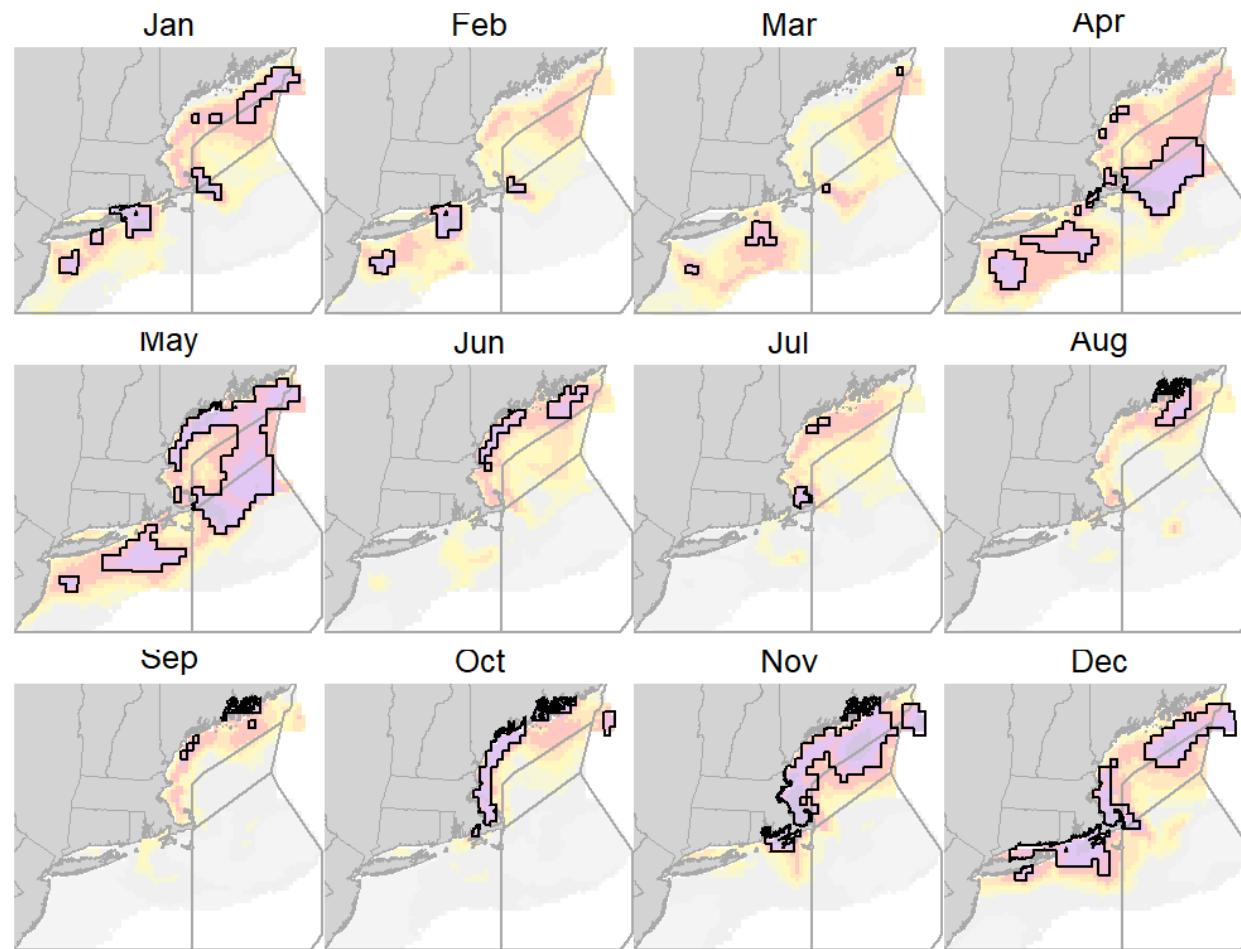


sq10; thresh = 0.85

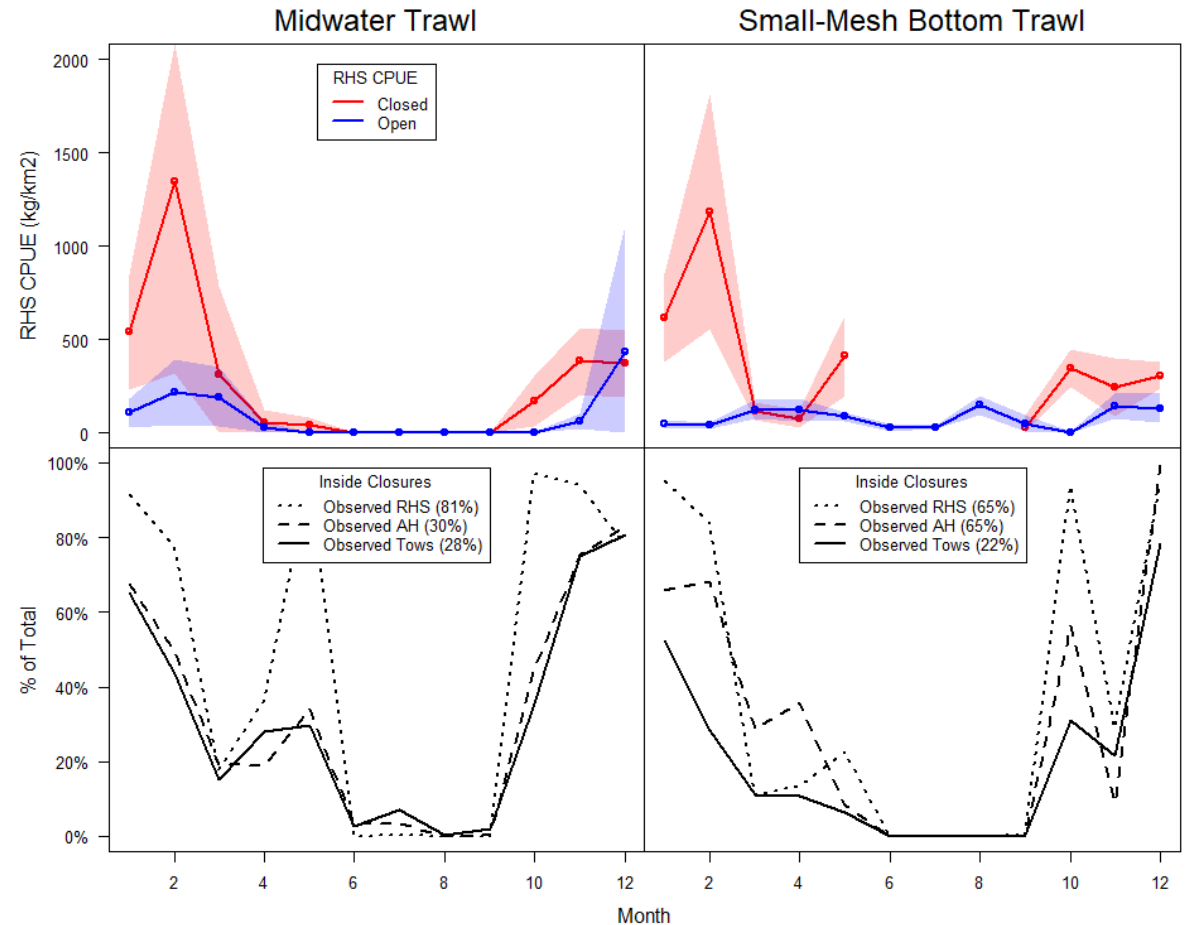


Hypothetical Closure Scenario

Threshold = 0.90 (top 10 % of areas)
Boundaries = 10-min squares

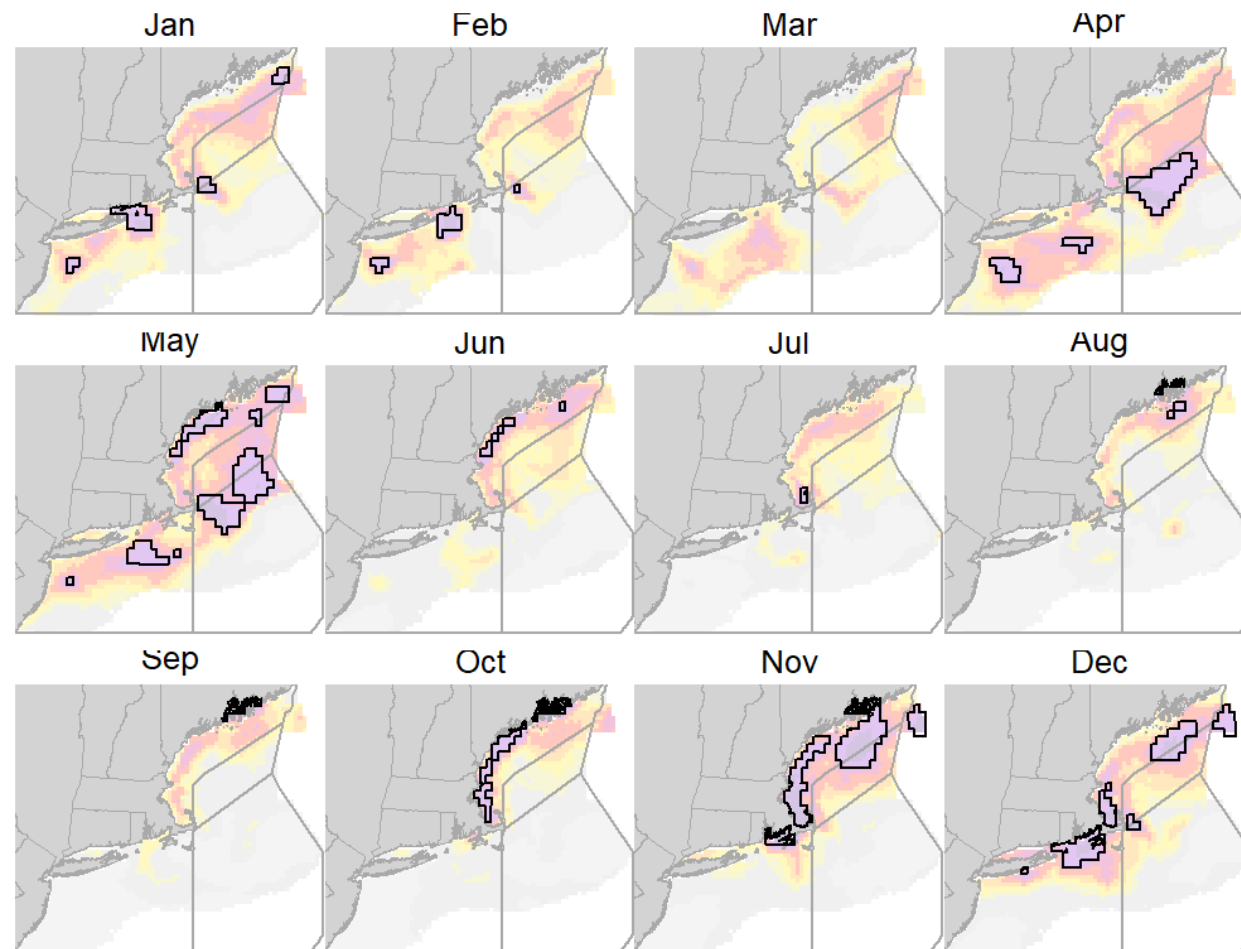


sq10; thresh = 0.9

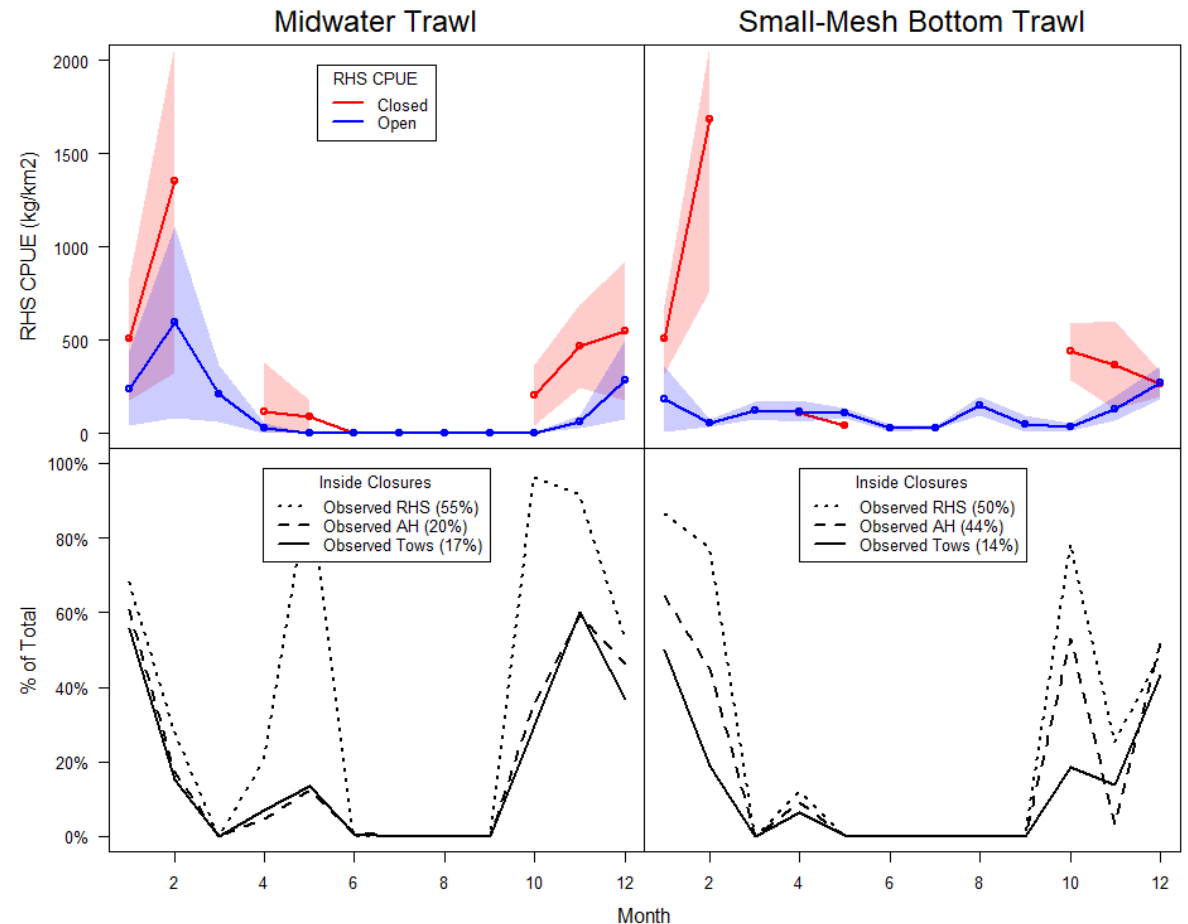


Hypothetical Closure Scenario

Threshold = 0.95 (top 5 % of areas)
Boundaries = 10-min squares



sq10; thresh = 0.95



Next Steps

- Finalize models
 - Is abundance better than %-occurrence?
- Finalize evaluation metrics
 - Just *directed* herring fishery (> 2000 lbs)?
 - % of Atlantic Herring affected (from SDM)?
 - Account for existing closures?
- Develop closure alternatives
 - 30-minute squares?
 - Custom polygons/rectangles?
 - Focus on winter only?

Existing Closures

- Midwater Trawl
 - Area 1A – Jan to Sep
 - State Waters – ME to NJ
- Bottom Trawl
 - Area 1A – Jan to May
 - State Waters – ME, NH, NJ
 - Groundfish closed areas
 - Habitat management areas

