



Fisheries-dependent distribution models for Bristol Bay red king crab

Emily Ryznar and Mike Litzow

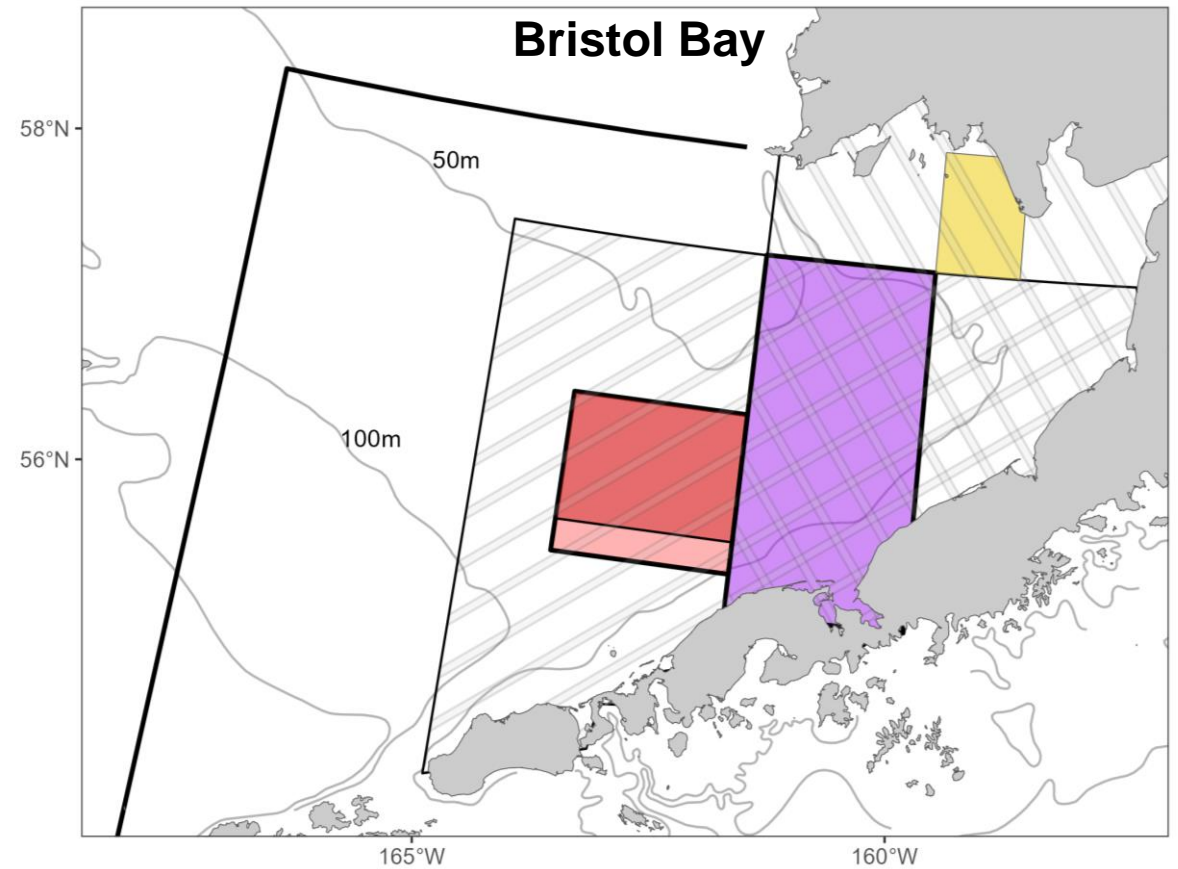
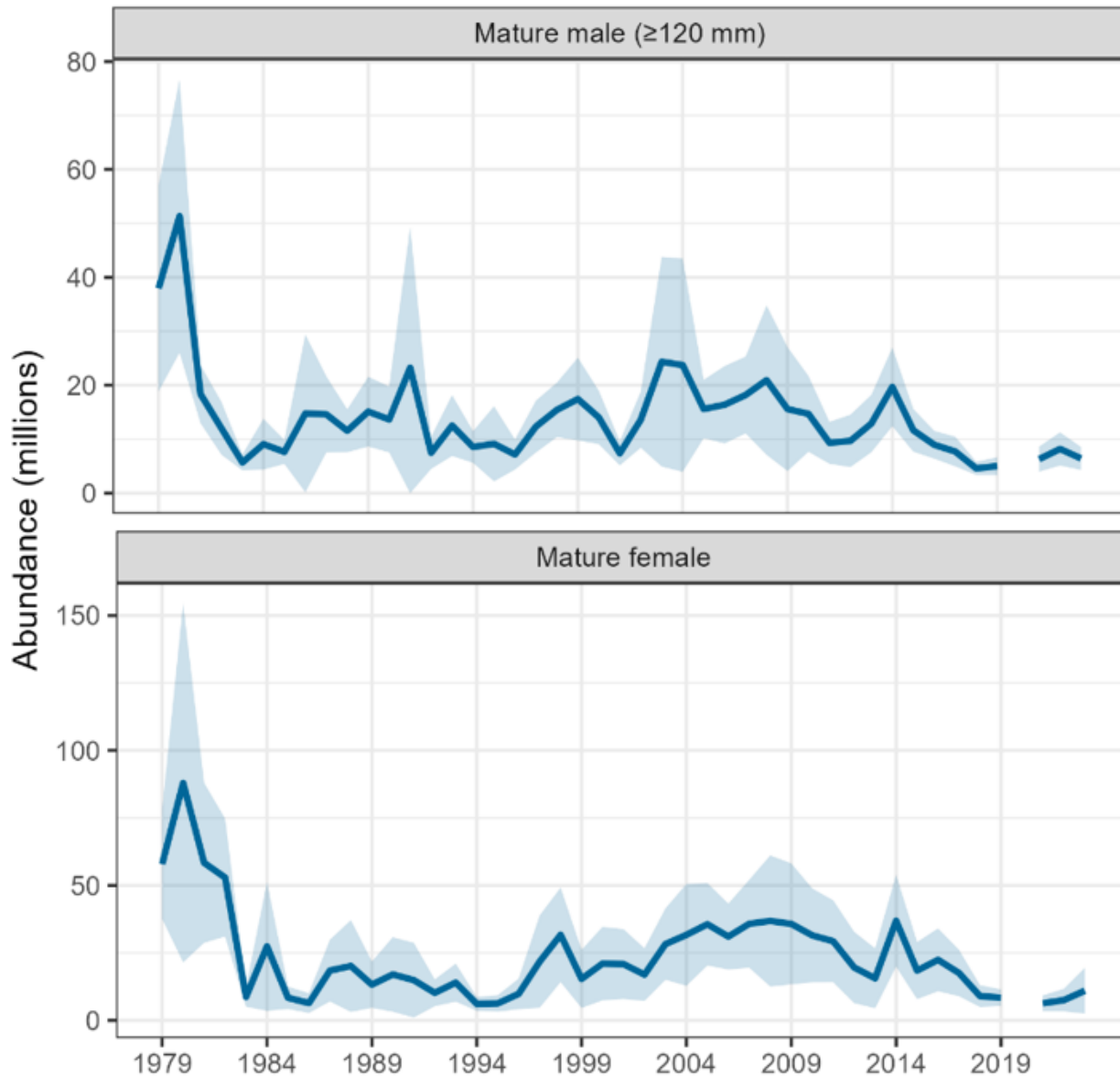
NOAA AFSC – Kodiak Laboratory

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Motivation



Objectives

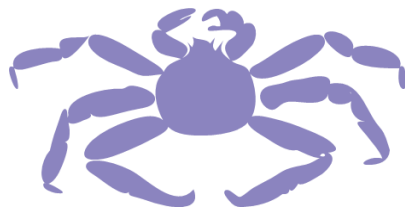
1. Fill in data-poor seasons for BBRKC with fisheries-dependent data
2. Build dynamic distribution models to:
 - Evaluate if BBRKC bycatch in non-pelagic trawl (NPT) groundfish fisheries can be predicted; (“Bycatch”)
 - Assess important BBRKC legal male fall habitat in relation to conservation areas; (“Fall distribution”)



Response data

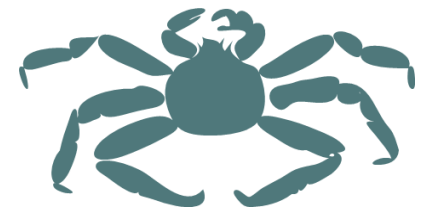
BBRKC bycatch

- Response: bycatch occurrence and abundance in fall-winter-spring flatfish trawl fisheries
- Data source:
 1. Groundfish observer data
- Years: 1998-2022
- Sex-maturity categories:
 1. Legal males
 2. Immature males
 3. Mature females
 4. Immature females



BBRKC fall distribution

- Response: BBRKC occurrence and abundance
- Data source:
 1. Crab fishery observer data (directed and bycatch)
 2. Directed fishery logbook data
- Years: 1998-2022
- Sex-maturity categories:
 1. Legal males



Covariates

BBRKC bycatch

- Environmental:
 - SST
 - Bottom temperature
 - Ice % cover
 - Sediment
 - Depth
- Biological:
 - BBRKC, yellowfin, and rock sole survey abundance
 - Yellowfin + rock sole fishery cpue
- Other:
 1. Yellowfin + rock sole quota
 2. Elevated sweep
 3. Bycatch prediction period



BBRKC fall distribution

- Environmental:
 - SST
 - Bottom temperature
 - Ice % cover
 - Sediment
 - Depth
 - Slope
 - Tidal maximum
 - Current speed/direction
 - Wind speed/direction
- Biological:
 - BBRKC survey abundance
 - BBRKC bycatch in flatfish trawl fisheries



Species distribution modeling



1) Fit models with 80% of the data

- Framework: delta models
- Occurrence and abundance modeled separately
- Algorithm: Boosted Regression Trees (BRTs)

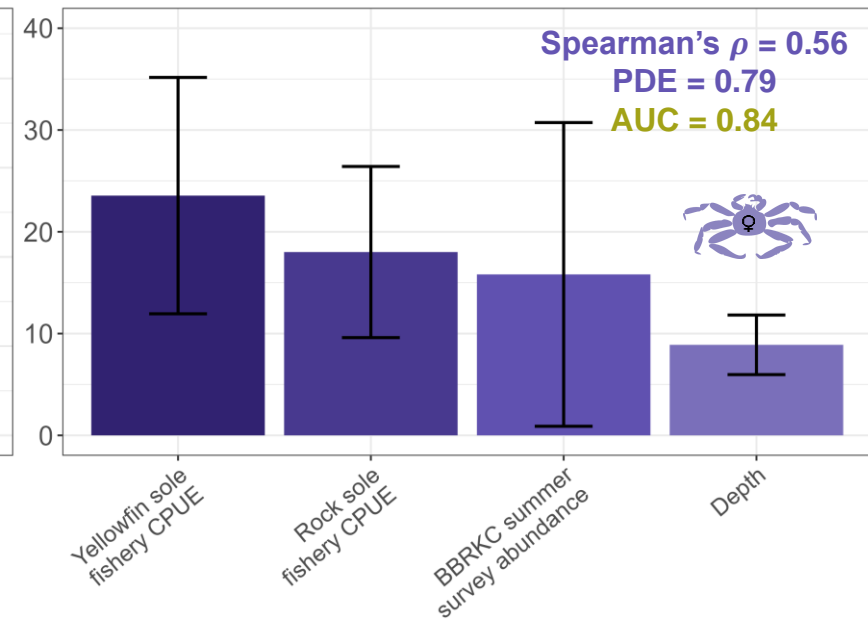
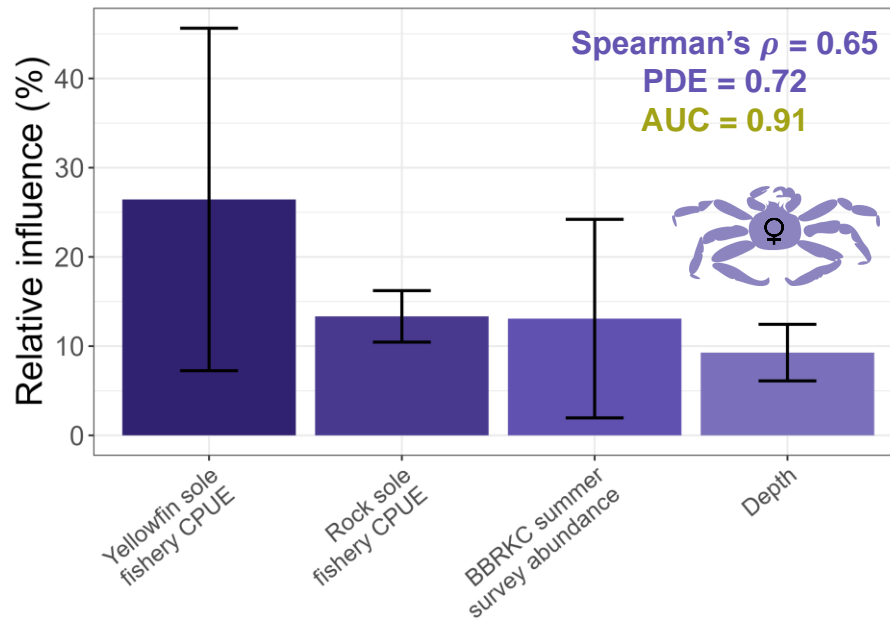
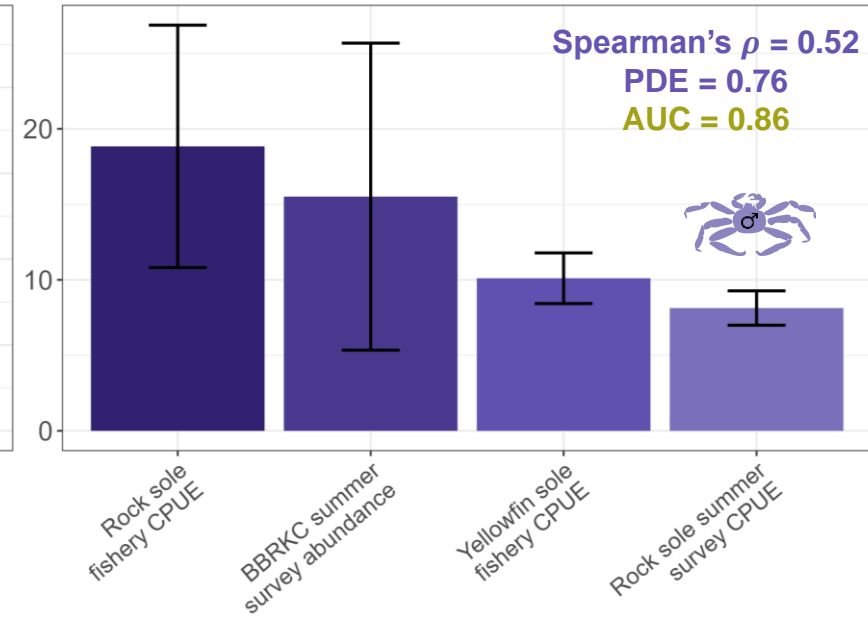
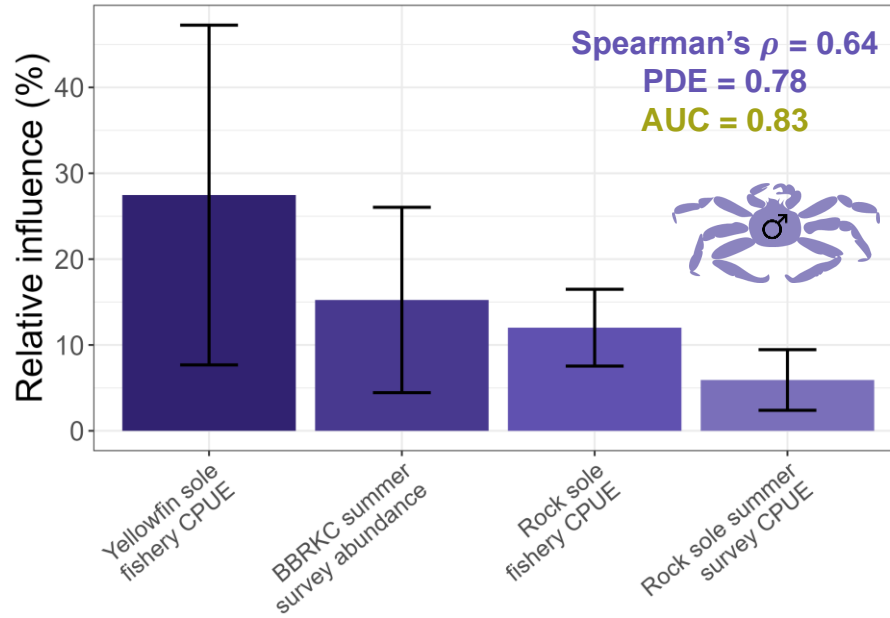
2) Test model performance on remaining 20% of the data

- AUC (occurrence)
- Spearman's ρ (abundance)
- Percent deviance explained (PDE; abundance)

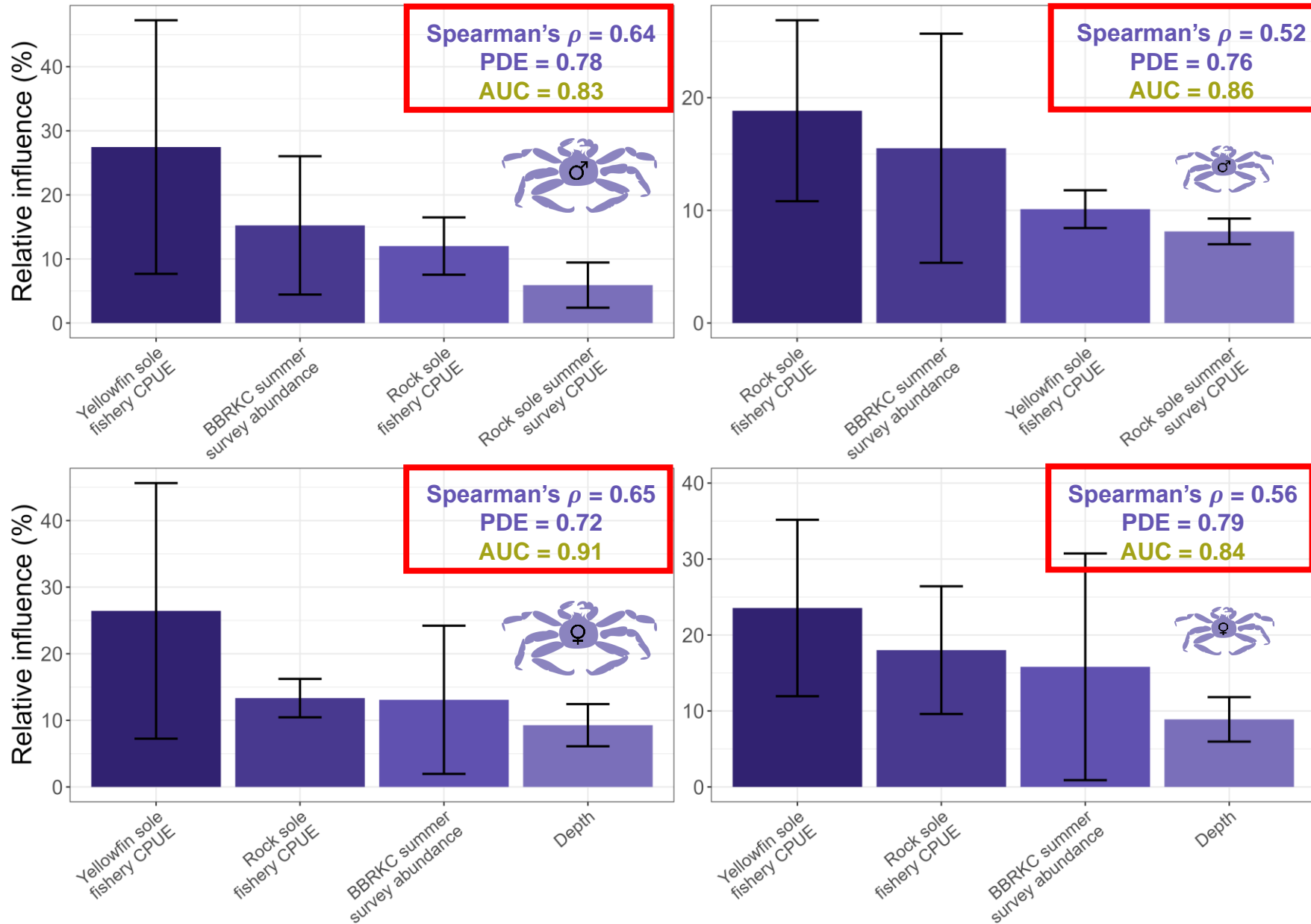
3) Evaluate covariate importance

- Relative % influence for occurrence and abundance

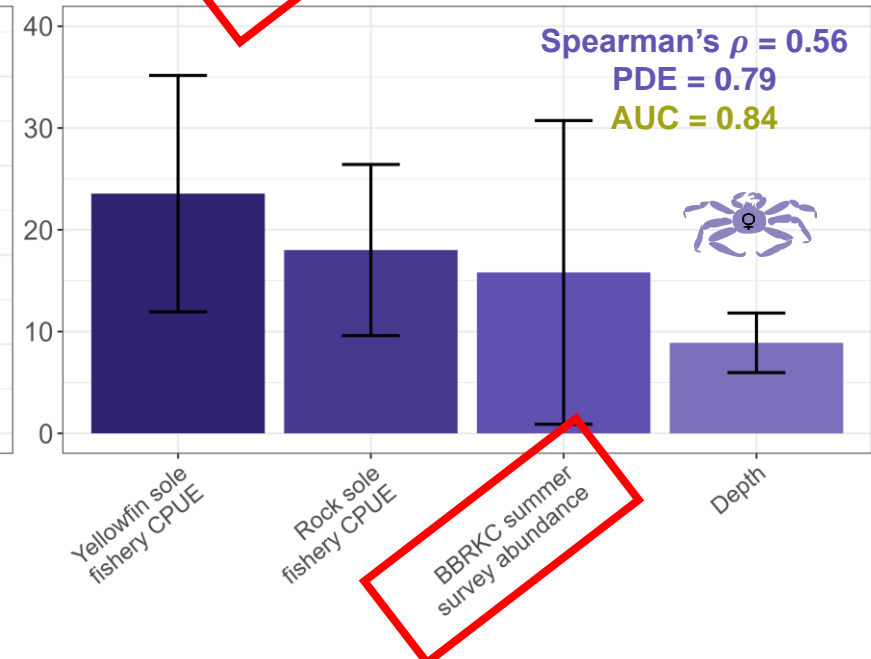
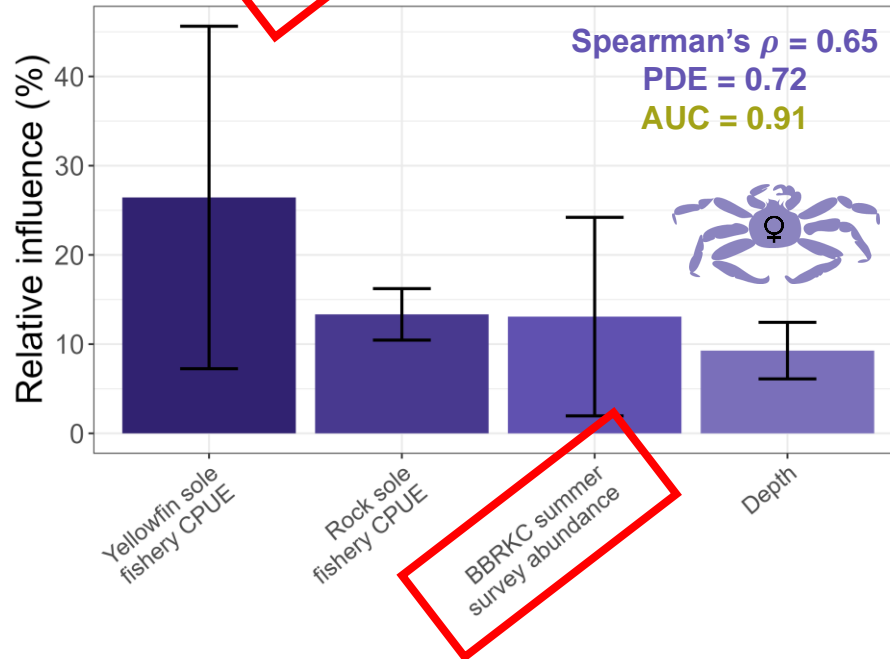
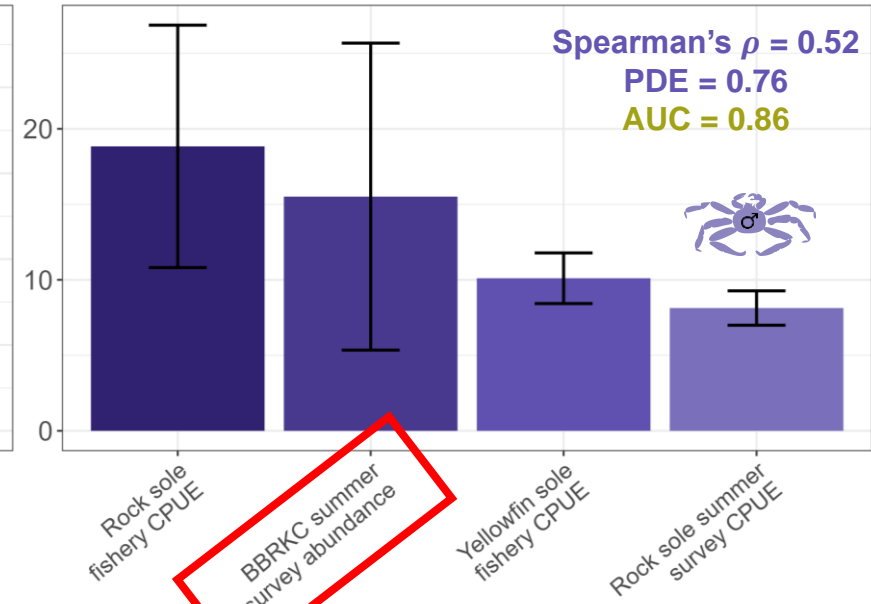
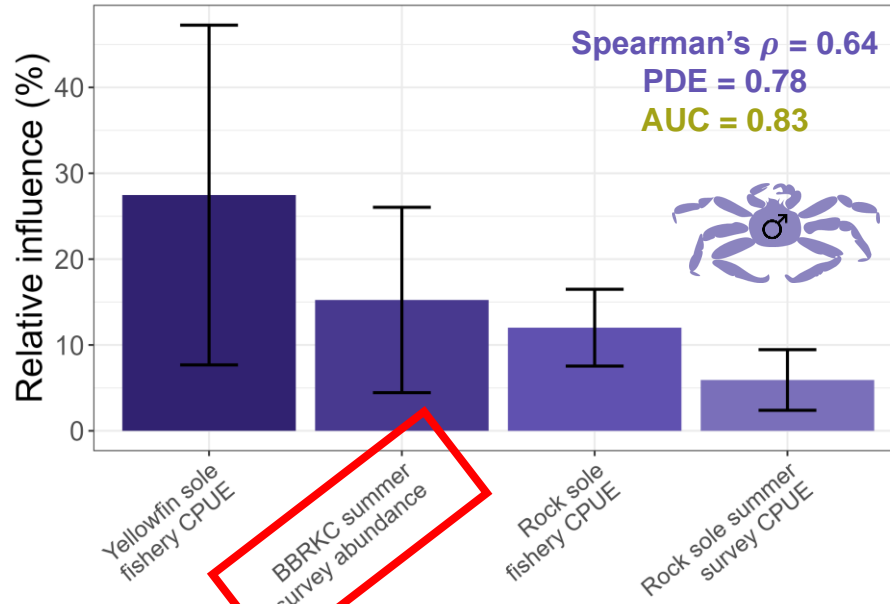
BBRKC bycatch can be reasonably predicted



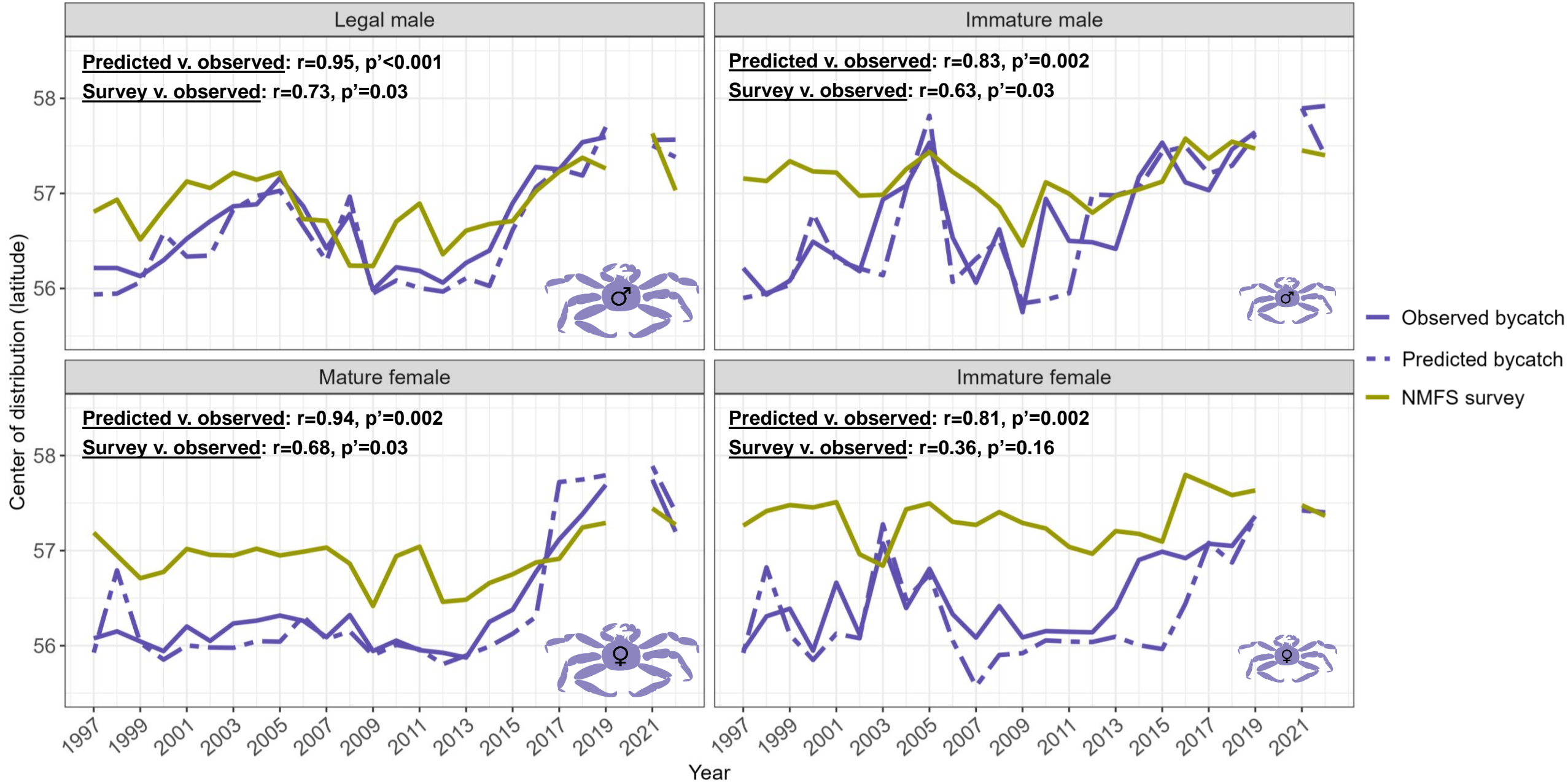
BBRKC bycatch can be reasonably predicted



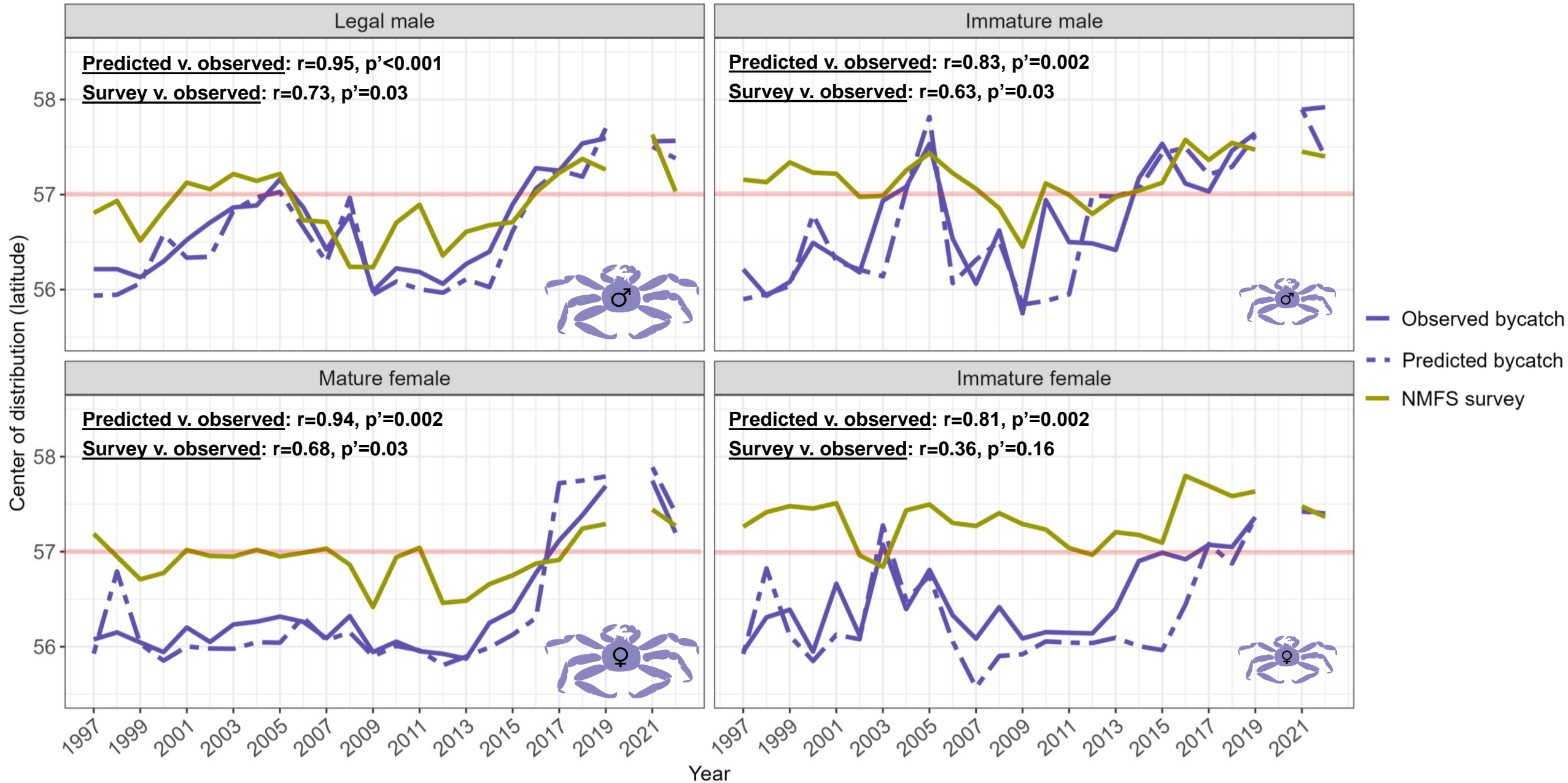
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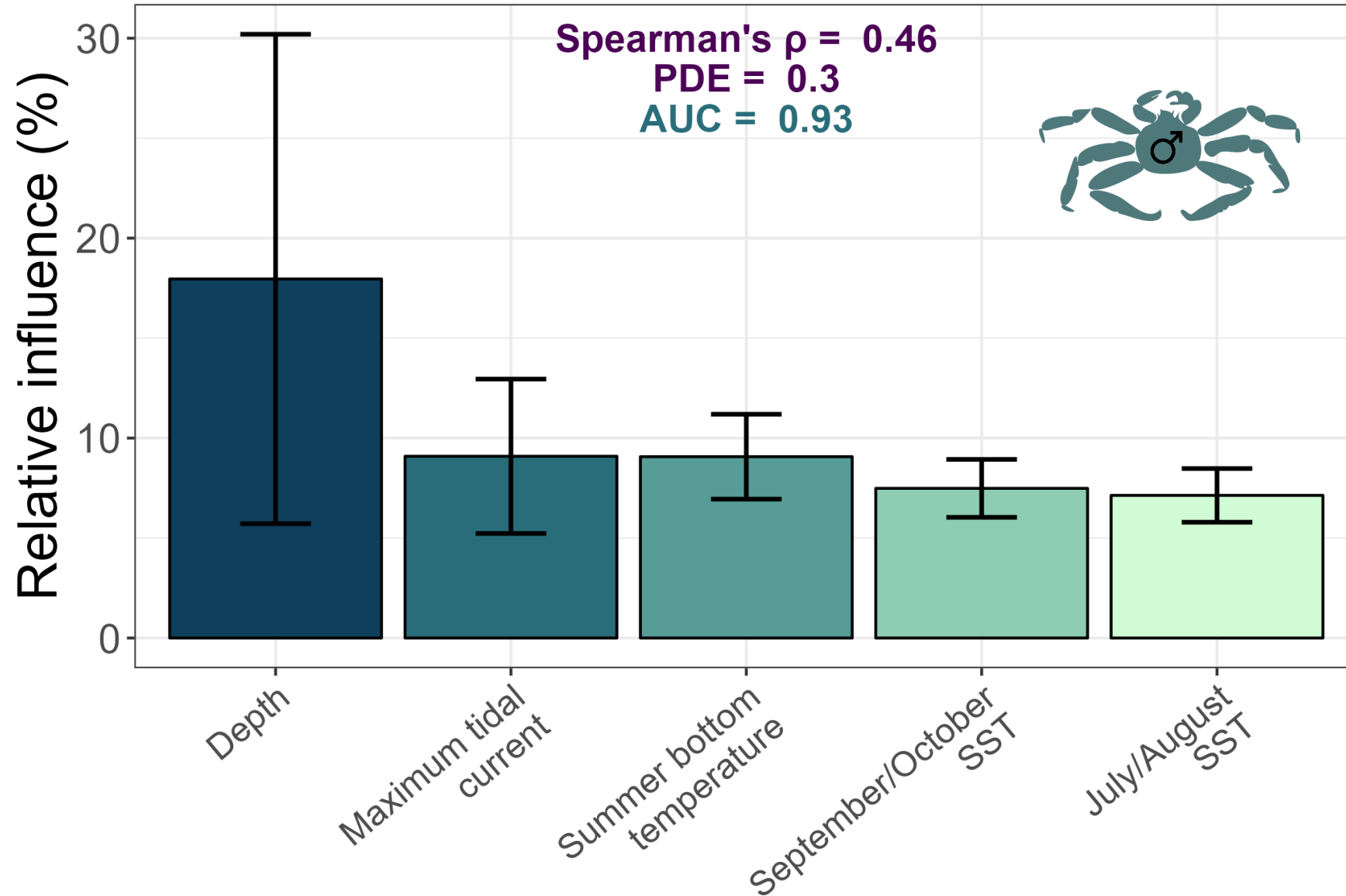
NMFS summer survey tracks bycatch latitude



NMFS summer survey tracks bycatch latitude

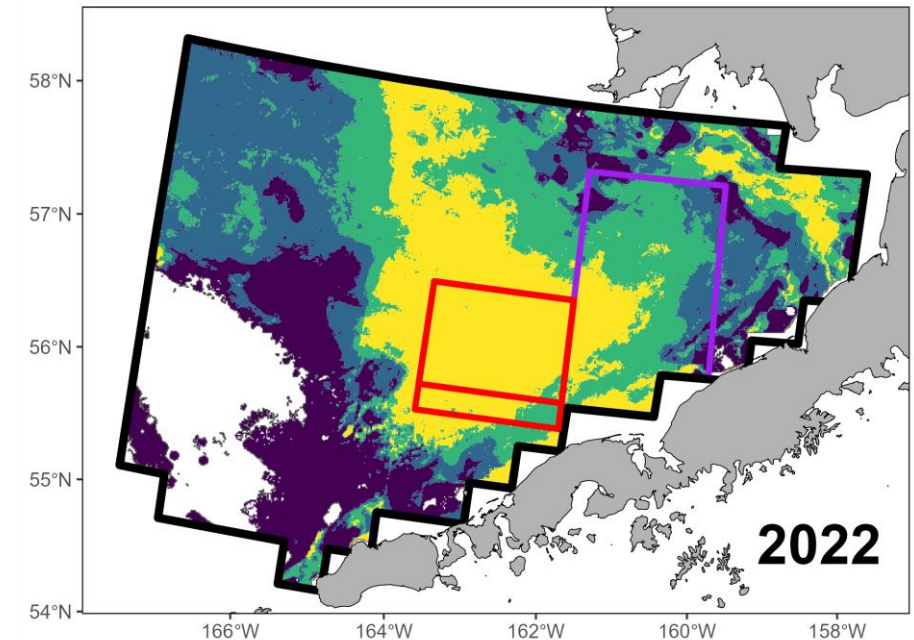
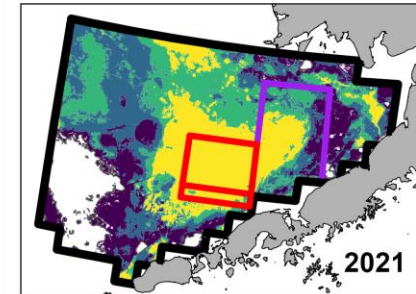
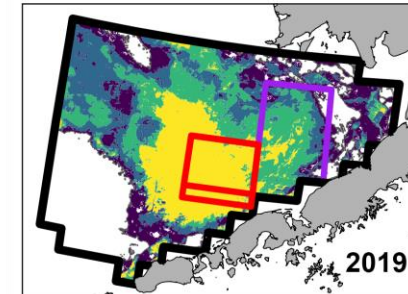
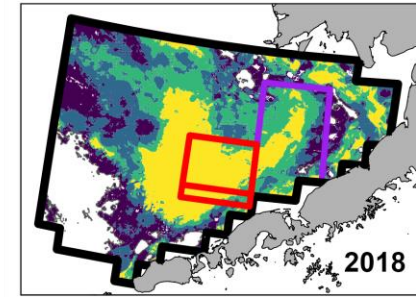
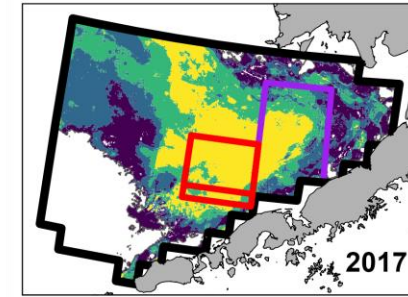


Environmental variables are more important for legal male fall distribution than biological variables



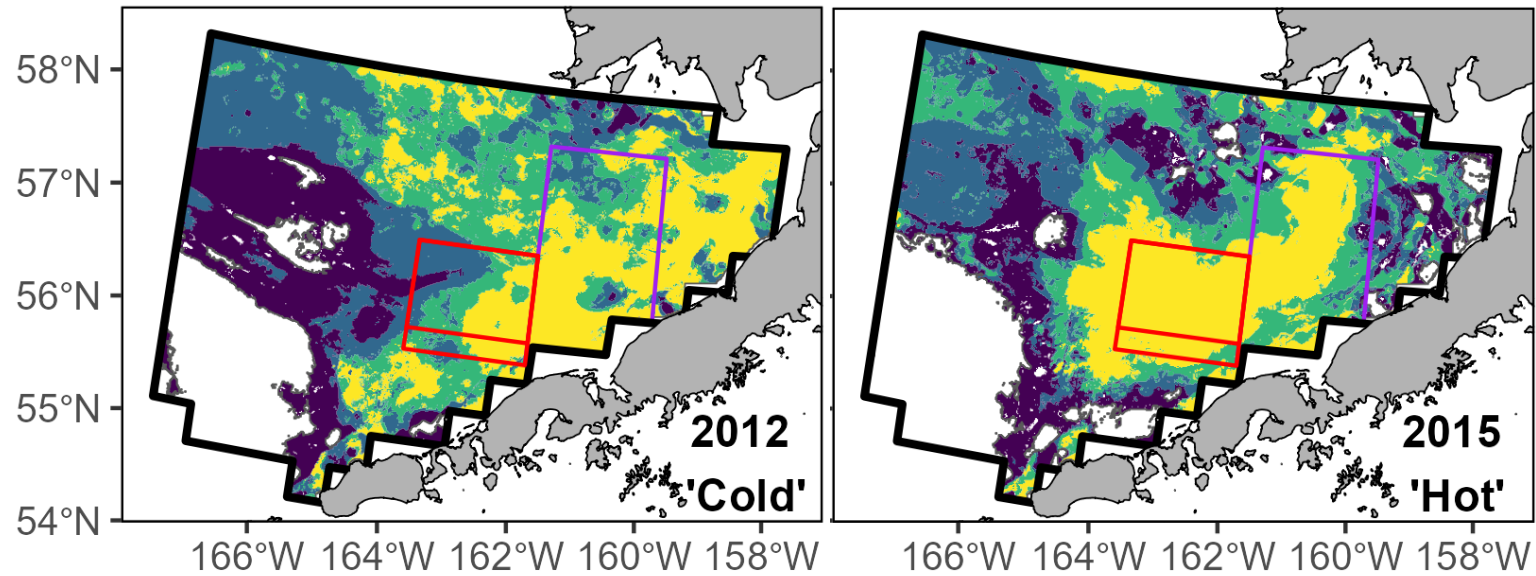
Legal male encounter hotspots centered around RCKSA and area 512, but vary temporally

Fall Red King Crab Legal Male Encounter Probability

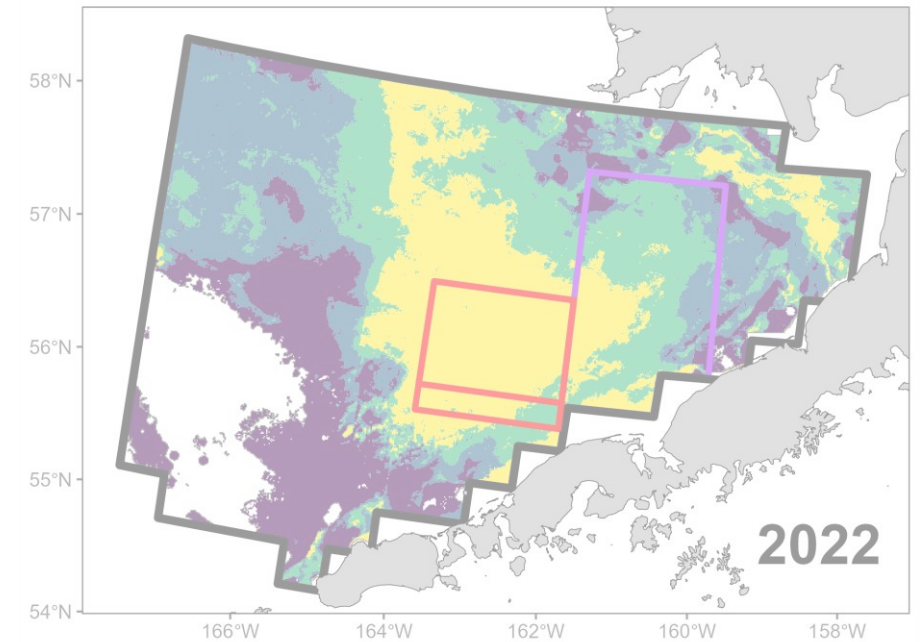
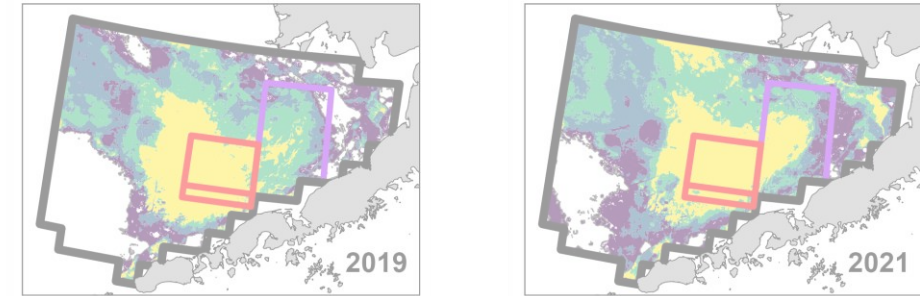
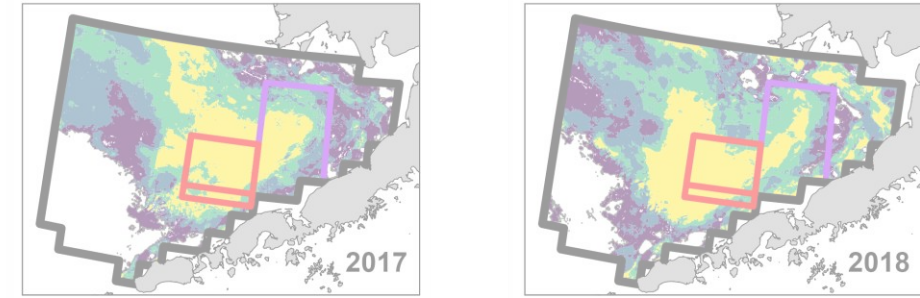


Percentiles 95% 75% 50% 25%

Legal male encounter hotspots centered around RCKSA and area 512, but vary temporally



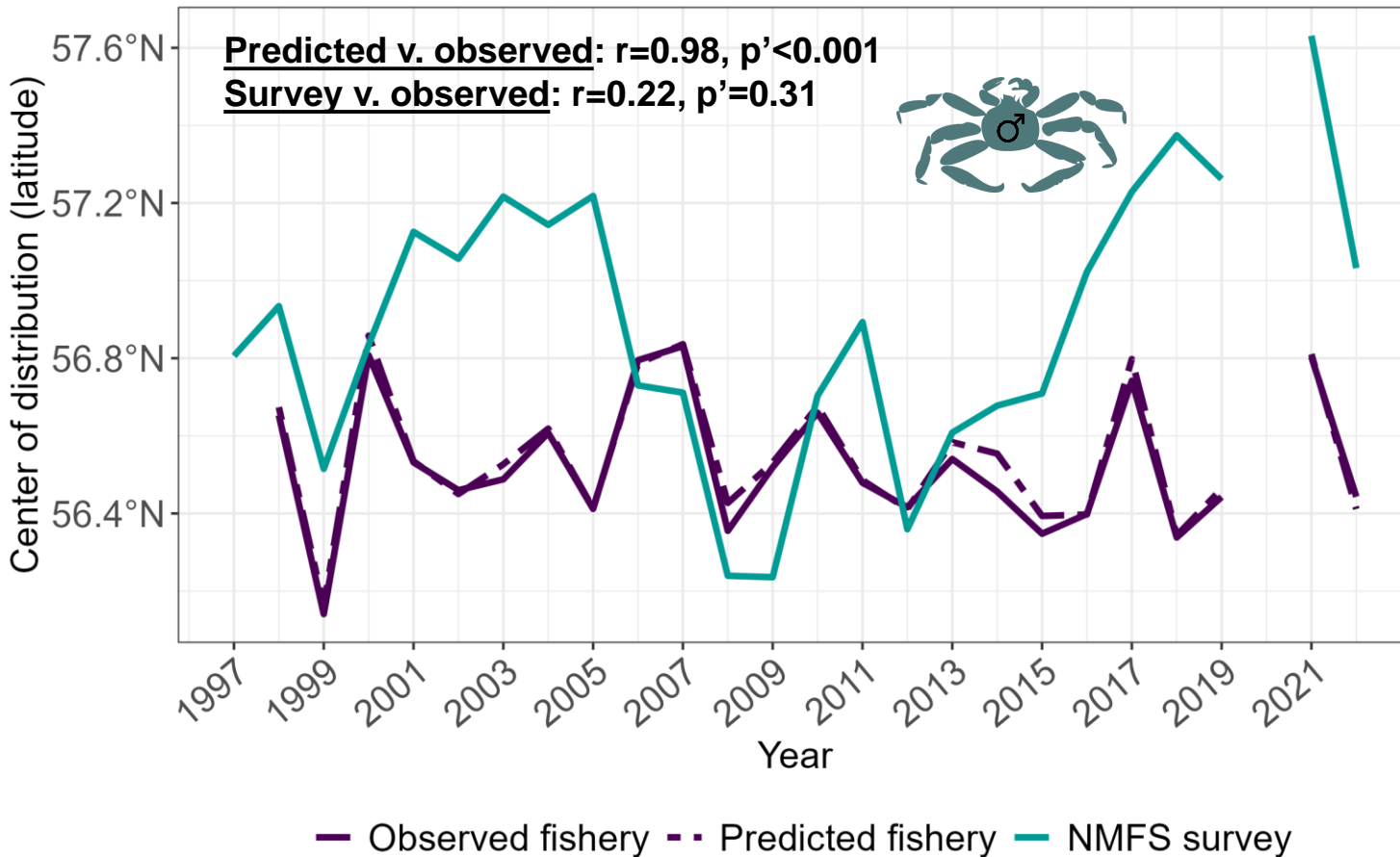
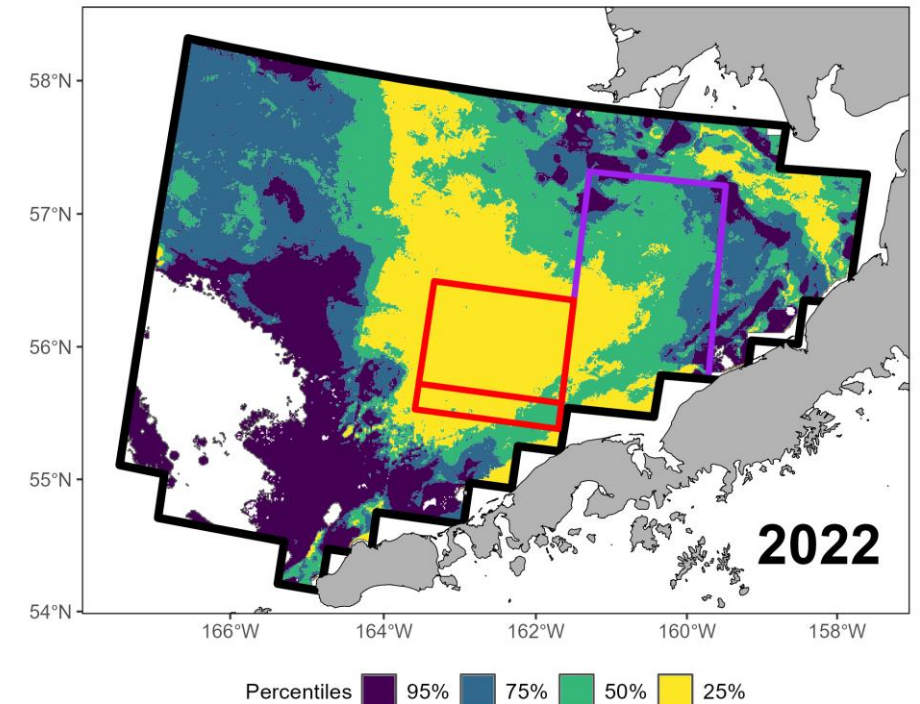
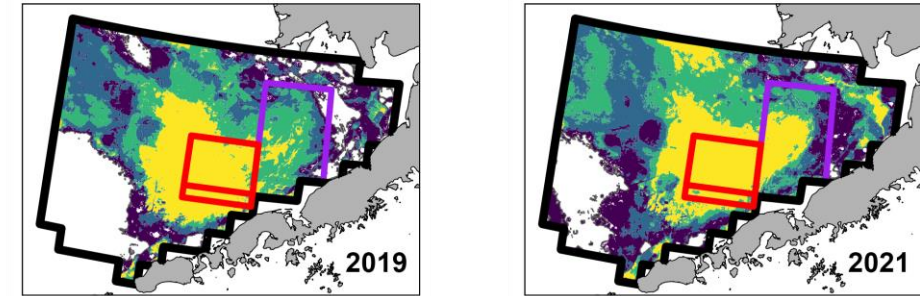
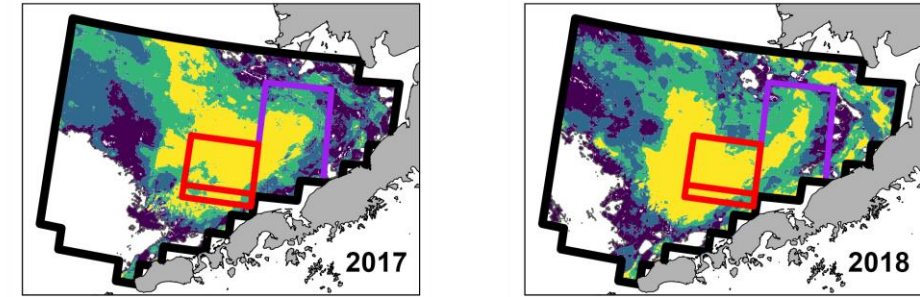
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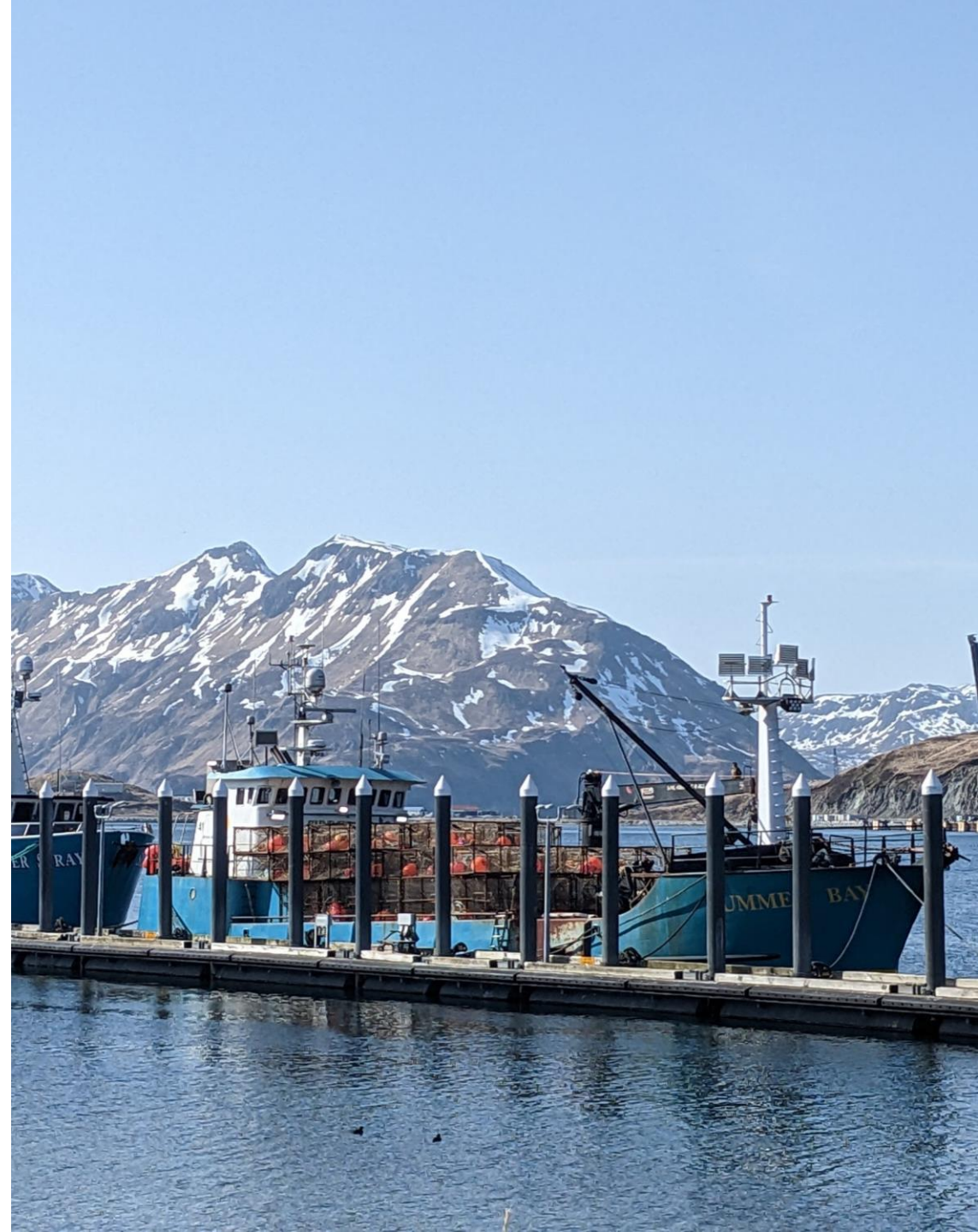
Legal male encounter hotspots centered around RCKSA and area 512, but vary temporally

Fall Red King Crab Legal Male Encounter Probability



Conclusions

- **Bycatch can be predicted**
 - Summer survey and target fishery data more important than environmental variables
 - Evidence bycatch and survey distribution has changed since RKCSA was established in the 1990s
- **Fall legal male distribution is centered around conservation areas**
 - Environmental covariates more important than biological
 - Ongoing tagging work will further inform distribution





Thank you!



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