DRAFT: Bering Sea red king crab stock structure template

Katie Palof, Ben Daly, Cody Szuwalski, Hamachan Hamazaki

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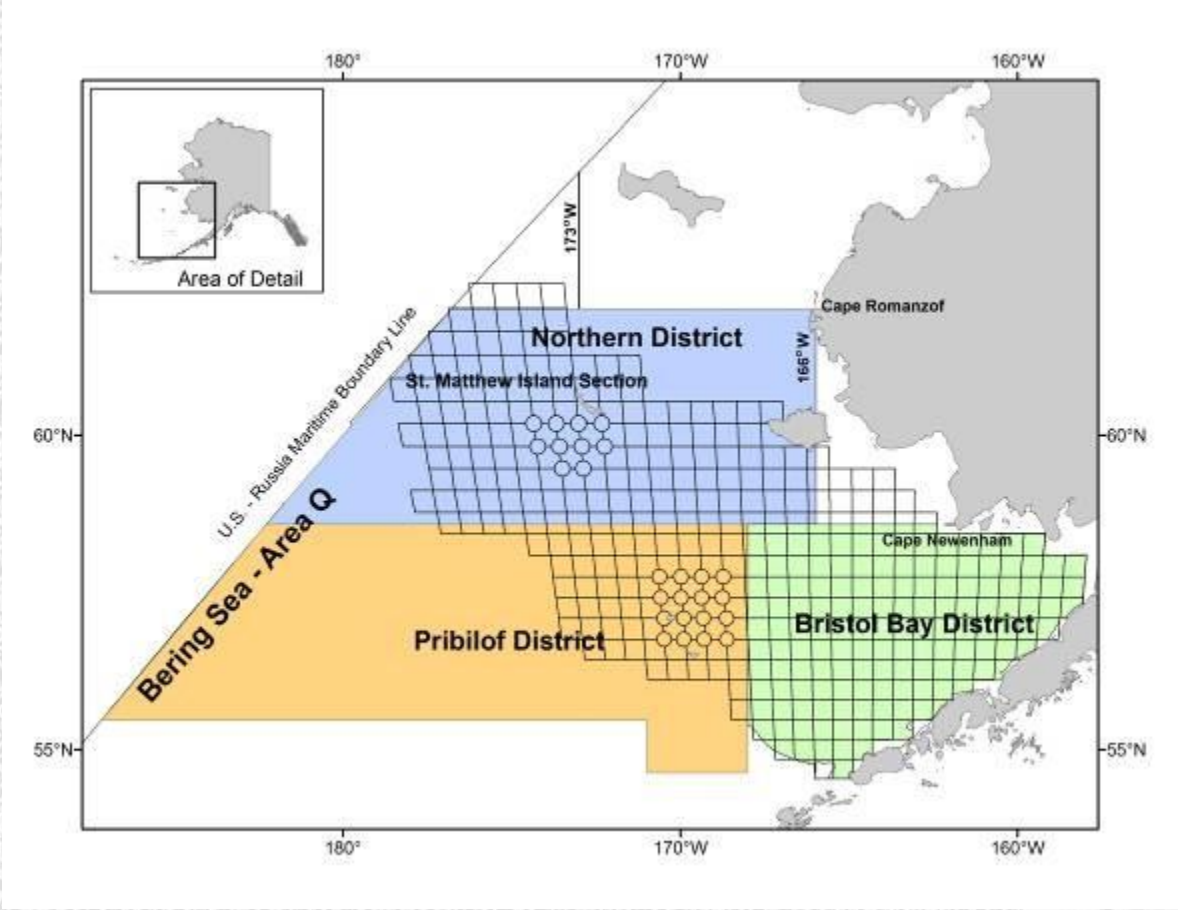
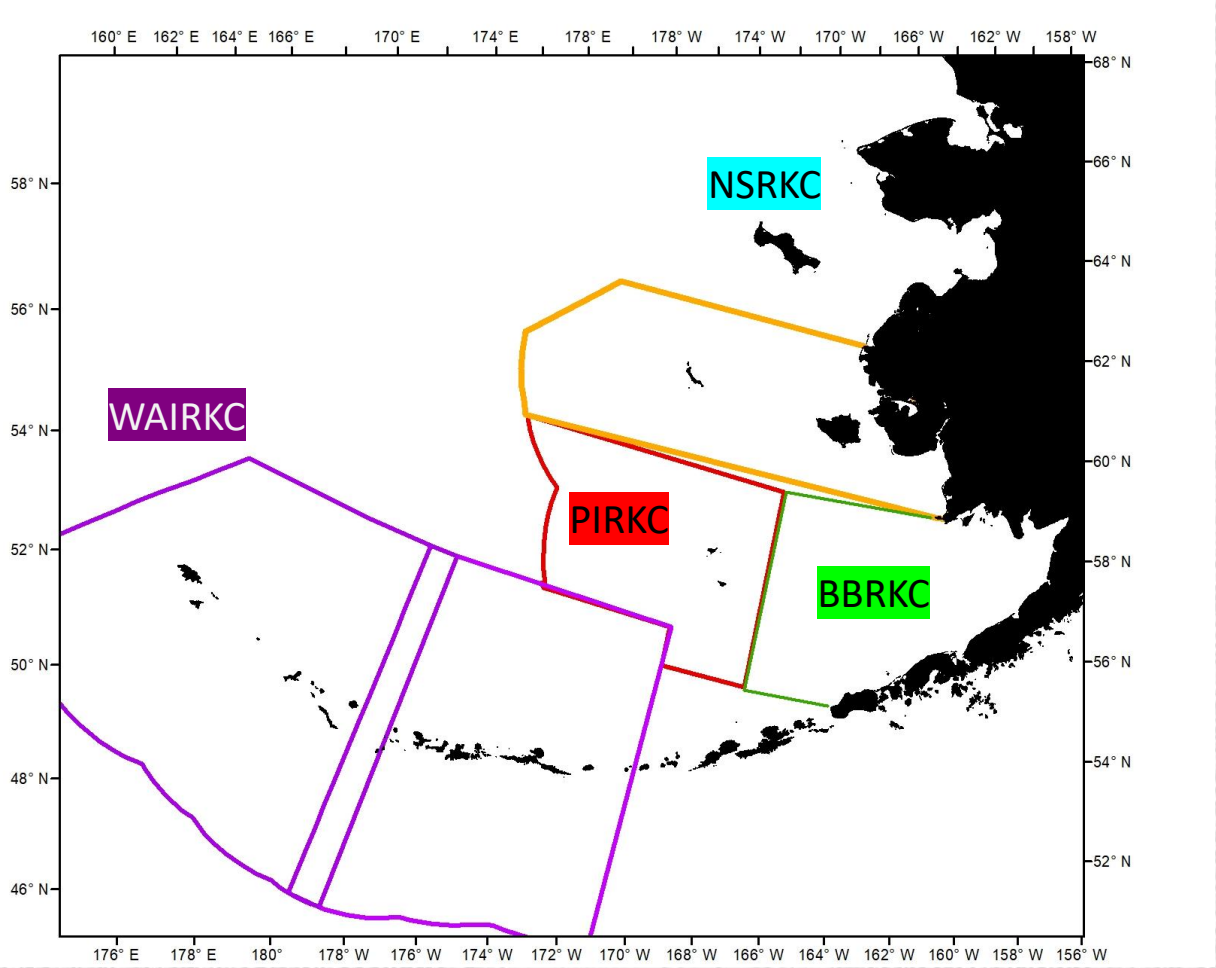
Stock structure template

- Established to guide decisions on splitting or lumping populations/stocks for both stock assessment and management
- Request from SSC – used in groundfish to help understand stock connectivity
- Bering Sea red king crab –
  - Bristol Bay, PIRKC, WAIRKC, Northern district, NSRKC
- Reference: Spencer, P. et al. 2010. Guidelines for determination of spatial management units for exploited populations in Alaskan groundfish fishery management plans. NPFMC Sept. 2010 plan team draft

Bering Sea stocks - Bristol Bay, PIRKC, WAIRKC, Northern district, NSRKC





2022 Tech Memo
NOAA trawl surveys

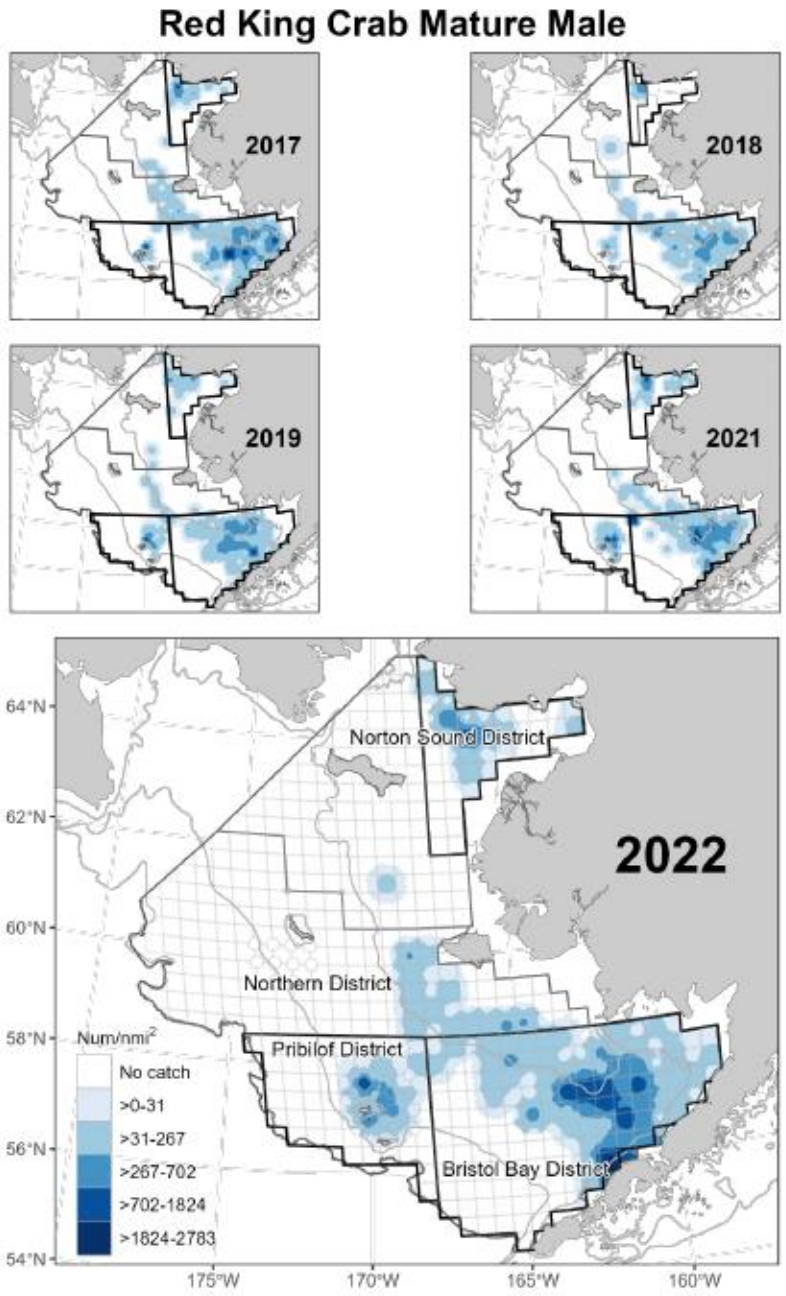


Figure 28. -- Estimated total density of mature-sized (≥ 120 mm carapace length in EBS and ≥ 94 mm in NBS) male red king crab (*Paralithodes camtschaticus*) for the past five survey years. Outlined areas depict management districts.

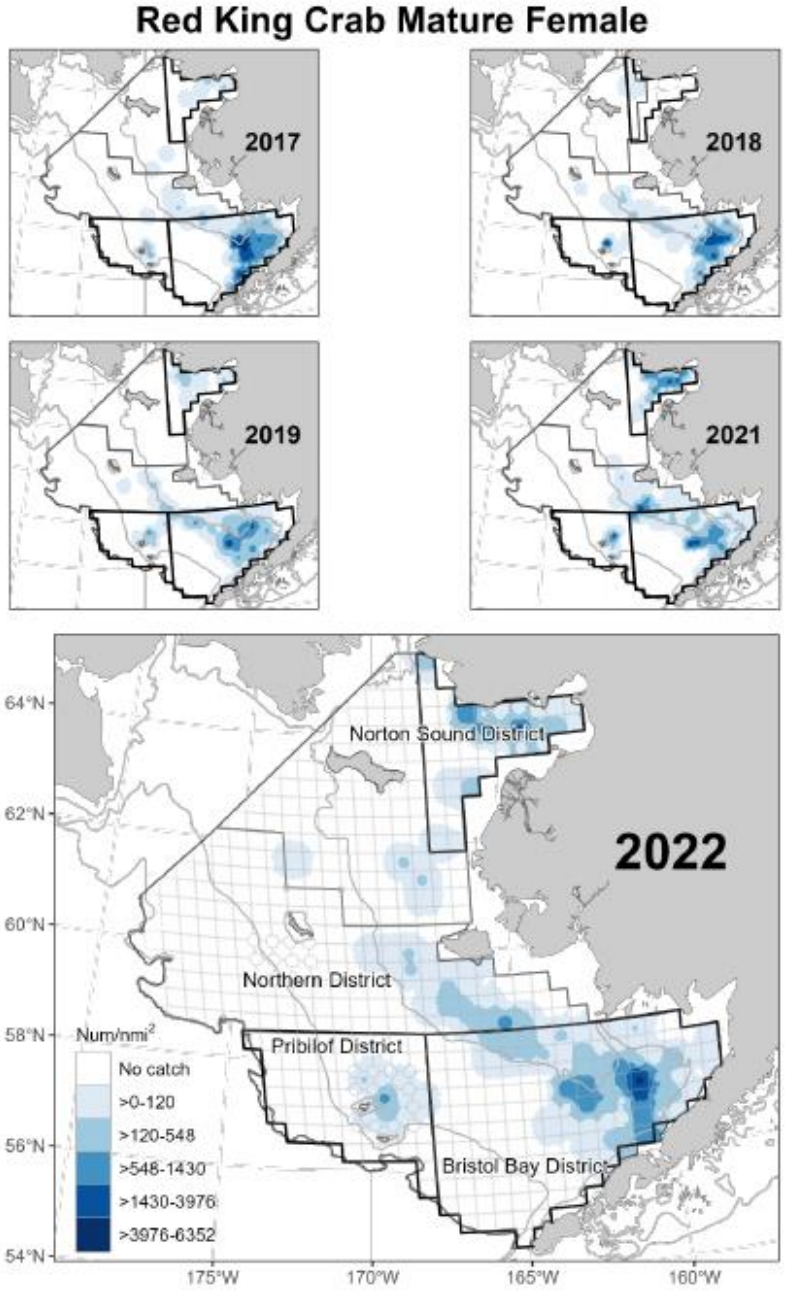


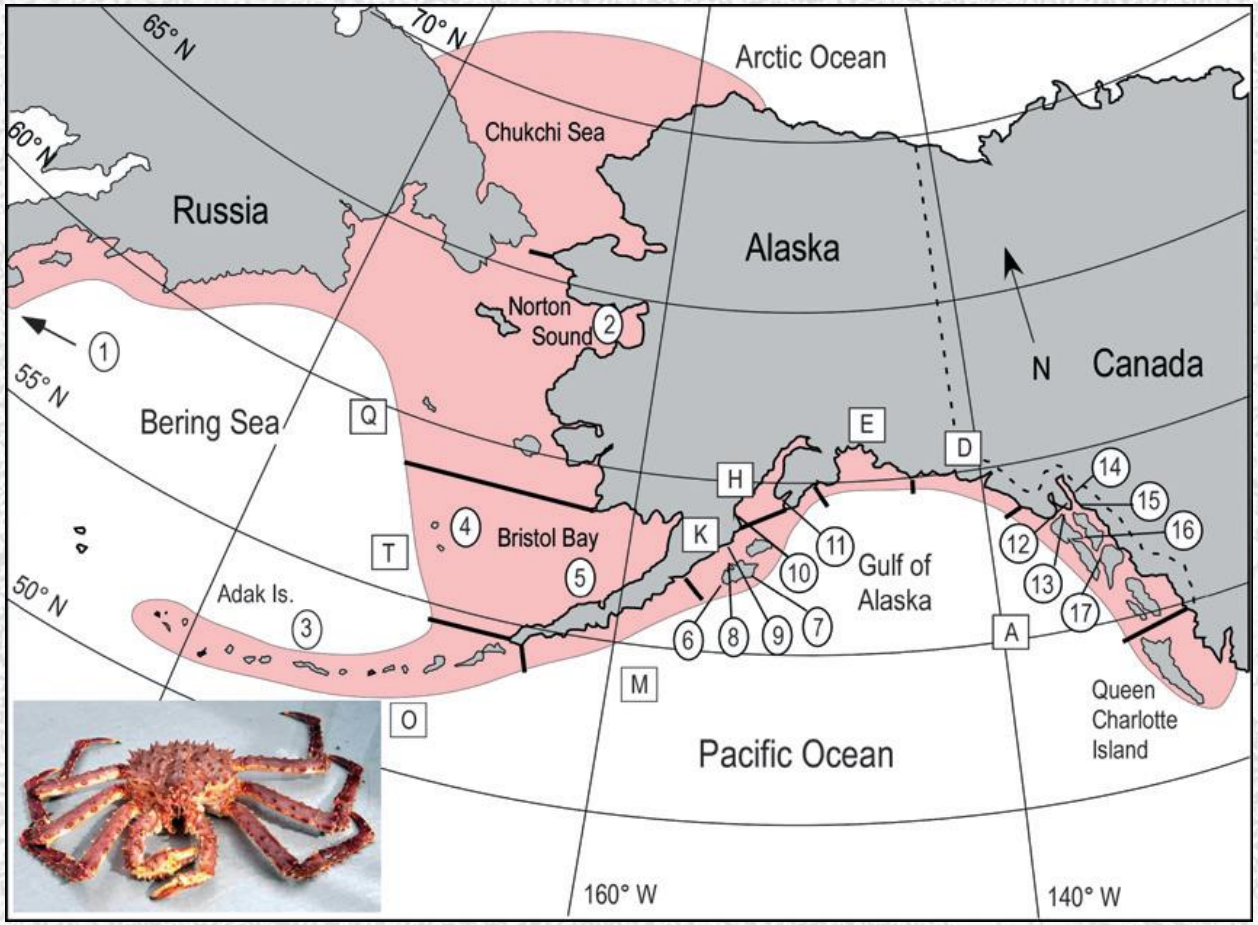
Figure 30. -- Estimated total density of mature female red king crab (*Paralithodes camtschaticus*) for the past five survey years. Outlined areas depict management districts. In years when a subset of stations were resampled, the resample stations replace data from the original stations.

Table 1: Summary of available data on stock identification for Bering Sea red king crab

Factor and criterion	Justification
Harvest & Trends	
Fishing mortality (5-year average percent of Fabc or Fofl)	bbrkc - close to Fofl last 3 years fisher was open, fishery closed in 21/22 & 22/23 wairkc/pirkc - fishery closed.
Spatial concentration of fishery relative to abundance (Fishing is focused in areas << management areas)	Fishery in BBRKC typically occurs in the center of the stock boundaries (Figure 4)
Population trends (Different areas show different trend directions)	
Barriers & phenotypic characters	
Generation time (e.g., >10 years)	?
Physical limitations (Clear physical inhibitors to movement)	Norton Sound and Aleutian island chain. Biogeographical boundary at Samalga Pass attributes divergence between WAI population and southeastern Bering SEA (BB and PI)
Growth differences (Significantly different LAA, WAA, or LW parameters)	Growth differences exist in NS, not sure if we have information for other stocks
Age/size-structure (Significantly different size/age compositions)	Figure 5 shows comparison of size compositions for bbrkc, pirkc, and northern district crab.
Spawning time differences (Significantly different mean time of spawning)	??
Maturity-at-age/length differences (Significantly different mean maturity-at-age/ length)	BB and NS clear differences due to growth and size differences.
Morphometrics (Field identifiable characters)	?
Meristics (Minimally overlapping differences in counts)	?

Factor and criterion	Justification
Behavior & movement	
Spawning site fidelity (Spawning individuals occur in same location consistently)	??
Mark-recapture data (Tagging data may show limited movement)	Some tagging available for BBRKC stock (need a summary of this)
Natural tags (Acquired tags may show movement smaller than management areas)	??
Genetics	
Isolation by distance (Significant regression)	Present when compared to all Alaska samples (including SE Alaksa, $p < 0.01$). Just Bering Sea samples did not show significant IBD but there is some relationship ($p = 0.064$).
Dispersal distance (<<Management areas)	Genetic data suggests gene flow between most of the Bering Sea – excluding NS and WAI red king crab which appear to be more genetically distinct.
Pairwise genetic differences (Significant differences between geographically distinct collections)	None significant within the southeastern Bering Sea.

Genetic studies



- Samples from Grant and Cheng 2012
- Note:
  - One sample from both PIRKC and BBRKC
  - No samples from Northern district crab

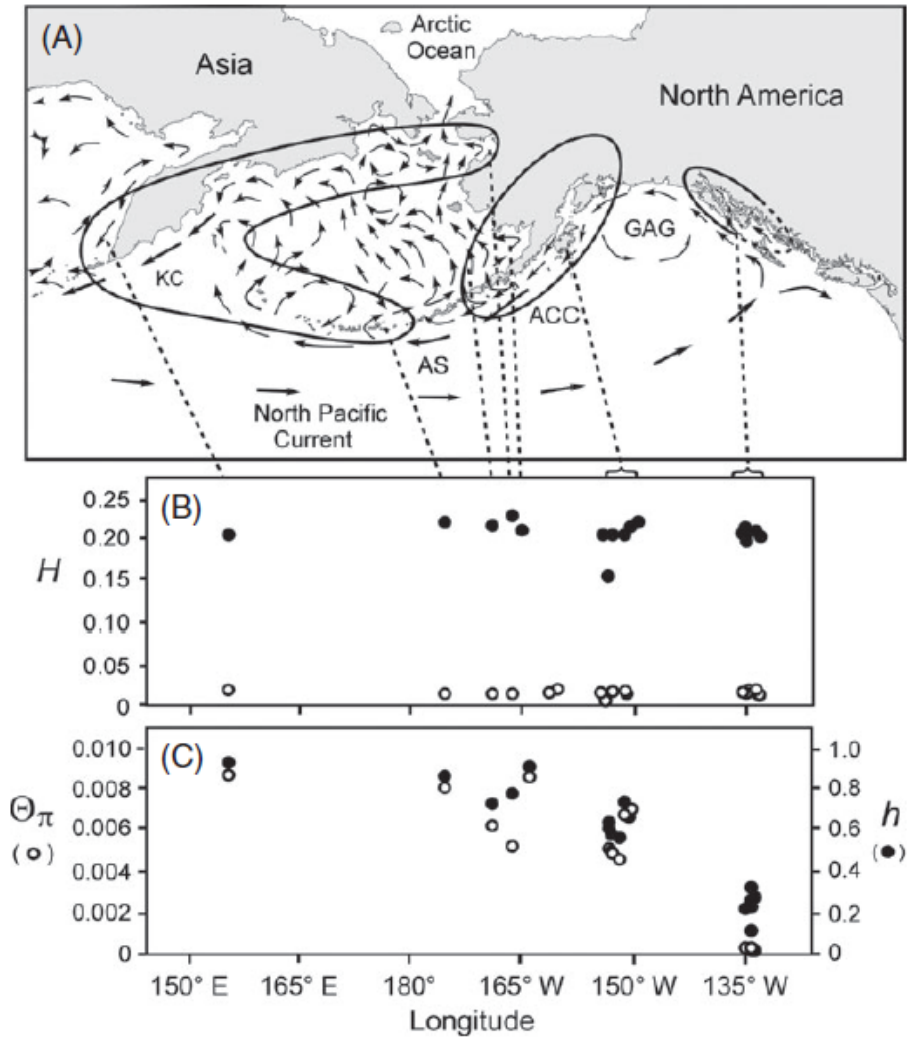


Figure 2 (a) Map of the North Pacific Ocean and Bering Sea showing generalized current patterns and three major population groups of red king crabs. (b) Average heterozygosity of 15 single nucleotide polymorphisms (closed circles) and average heterozygosity of 38 allozyme loci (open circles). (c) Mitochondrial DNA haplotype diversity (closed circles) and nucleotide diversity (open circles). KC, Kamchatka Current; AS, Alaska Stream; ACC, Alaska Coastal Current; and GAG, Gulf of Alaska Gyre.

Genetic results

- 3 main groupings
- NSRKC and WAIRKC – isolated genetically
- Bristol Bay
  - Groups with PIRKC and GOA
  - May have undergone a bottleneck? (samples 1989 and 2008)
- Could be isolated stocks, does not reflect contemporary genetic gene flow
- Greater detailed sampling needed

Non –genetic information

- Size compositions, growth, recruitment pulses
- Physical barriers or oceanographic barriers
  - Aleutian Islands Samalga Pass
  - Norton Sound general current flow

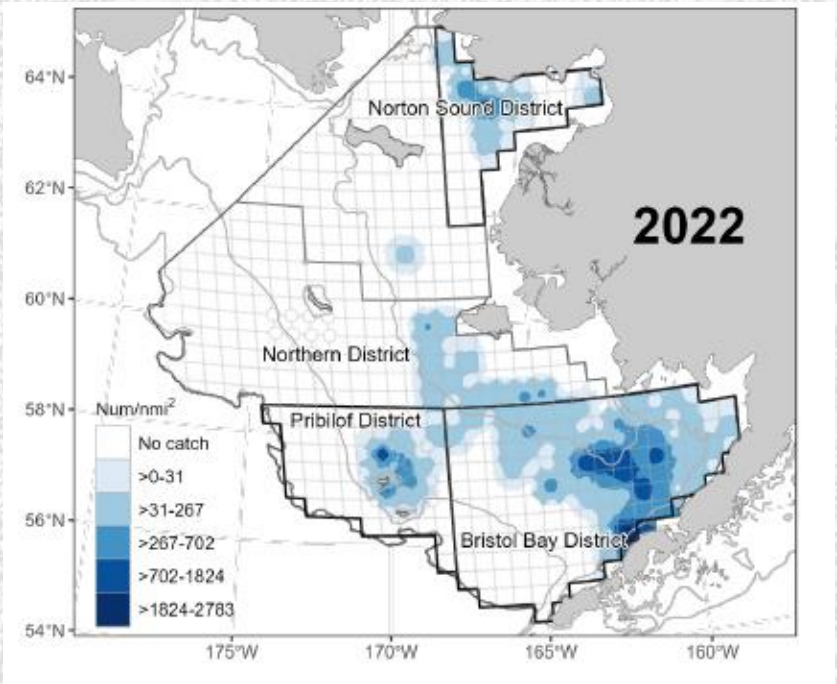
Historic management units

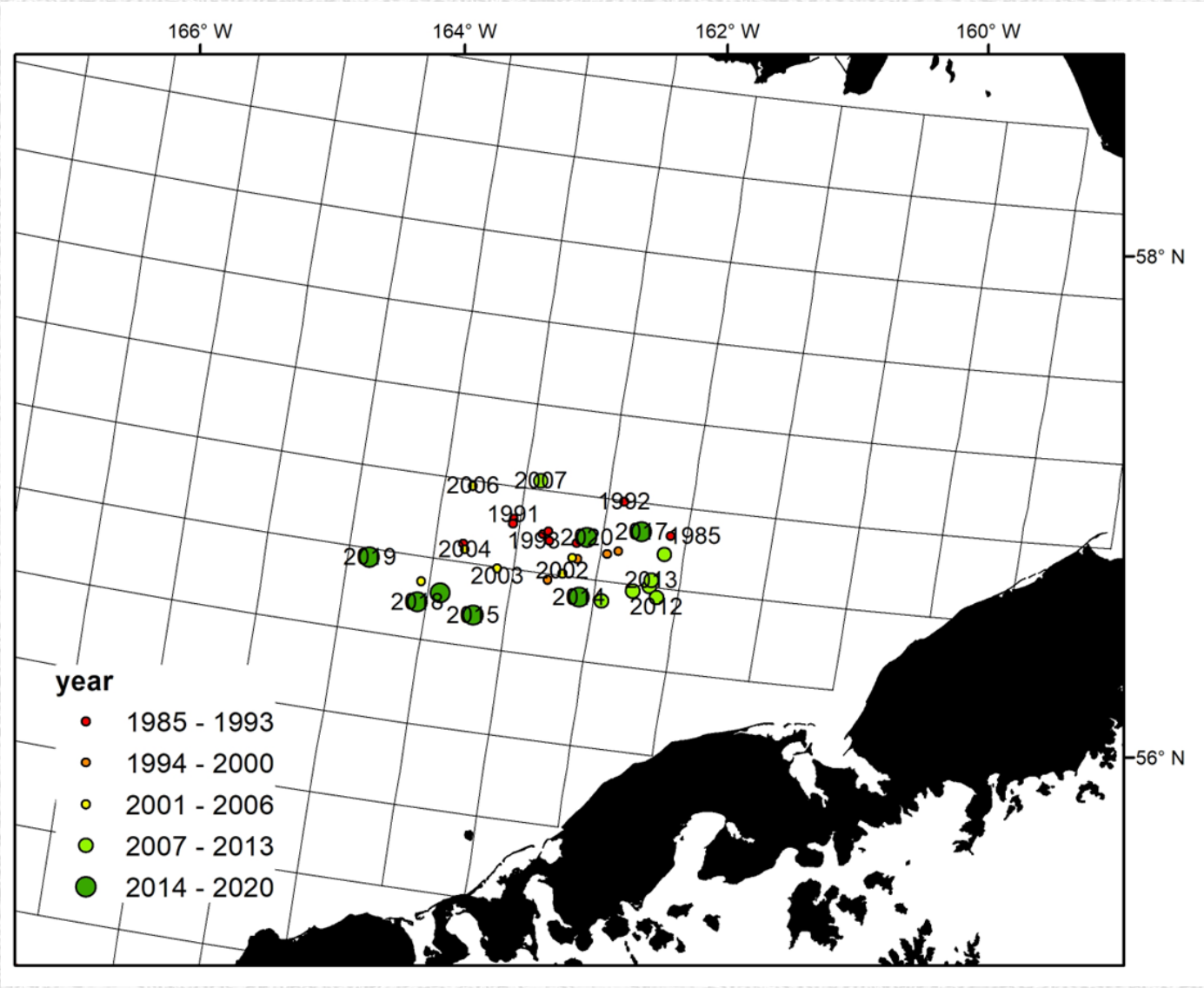
- Historic fishing areas
- Landmark boundaries

Fishery centroids

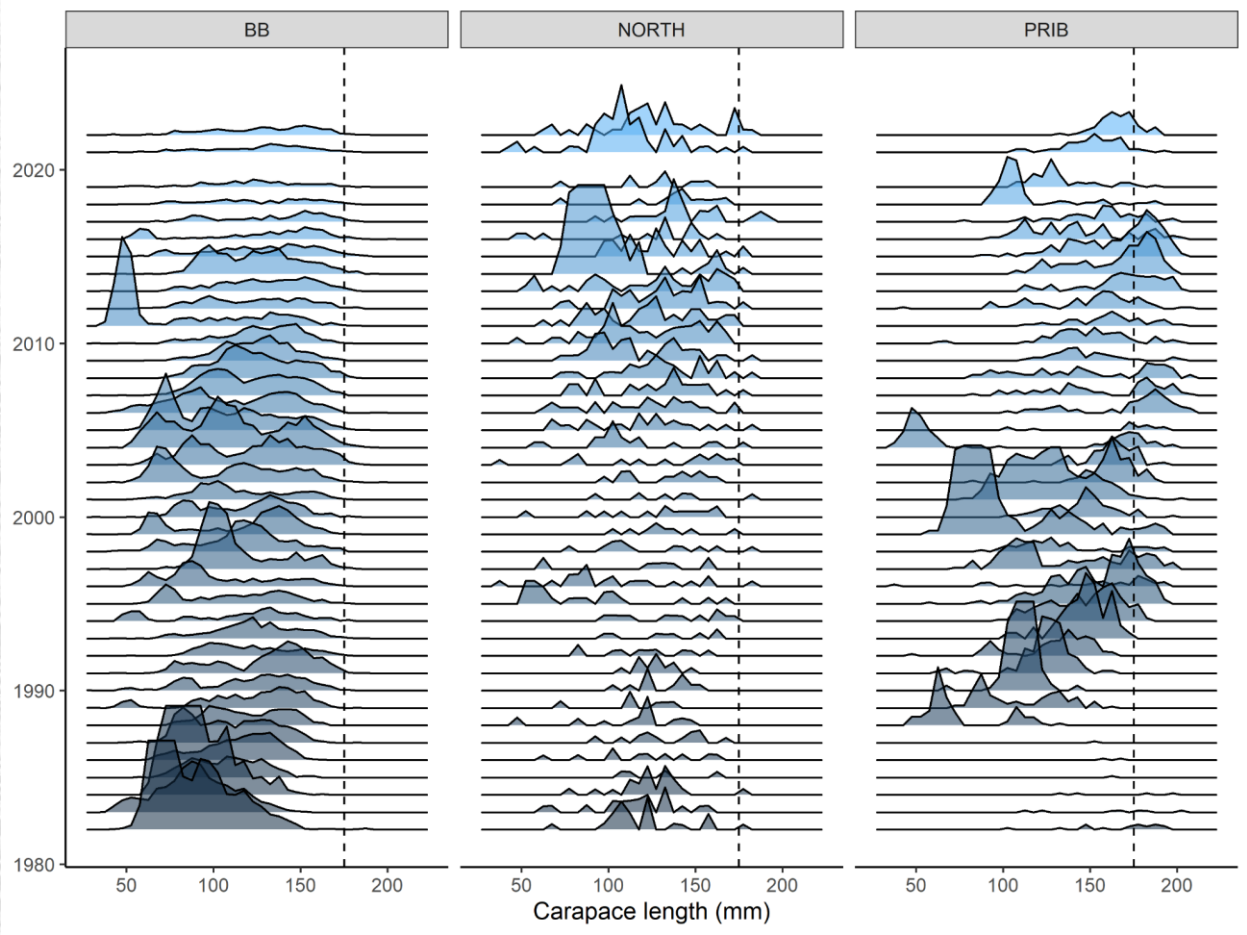
(right) BBRKC weighted centers of catch over time, fishery was closed in 2021/22 and 2022/23 seasons (Source: September 2021 CPT presentation by B.Daly, ADF&G).

(bottom) mature males from NOAA tech memo



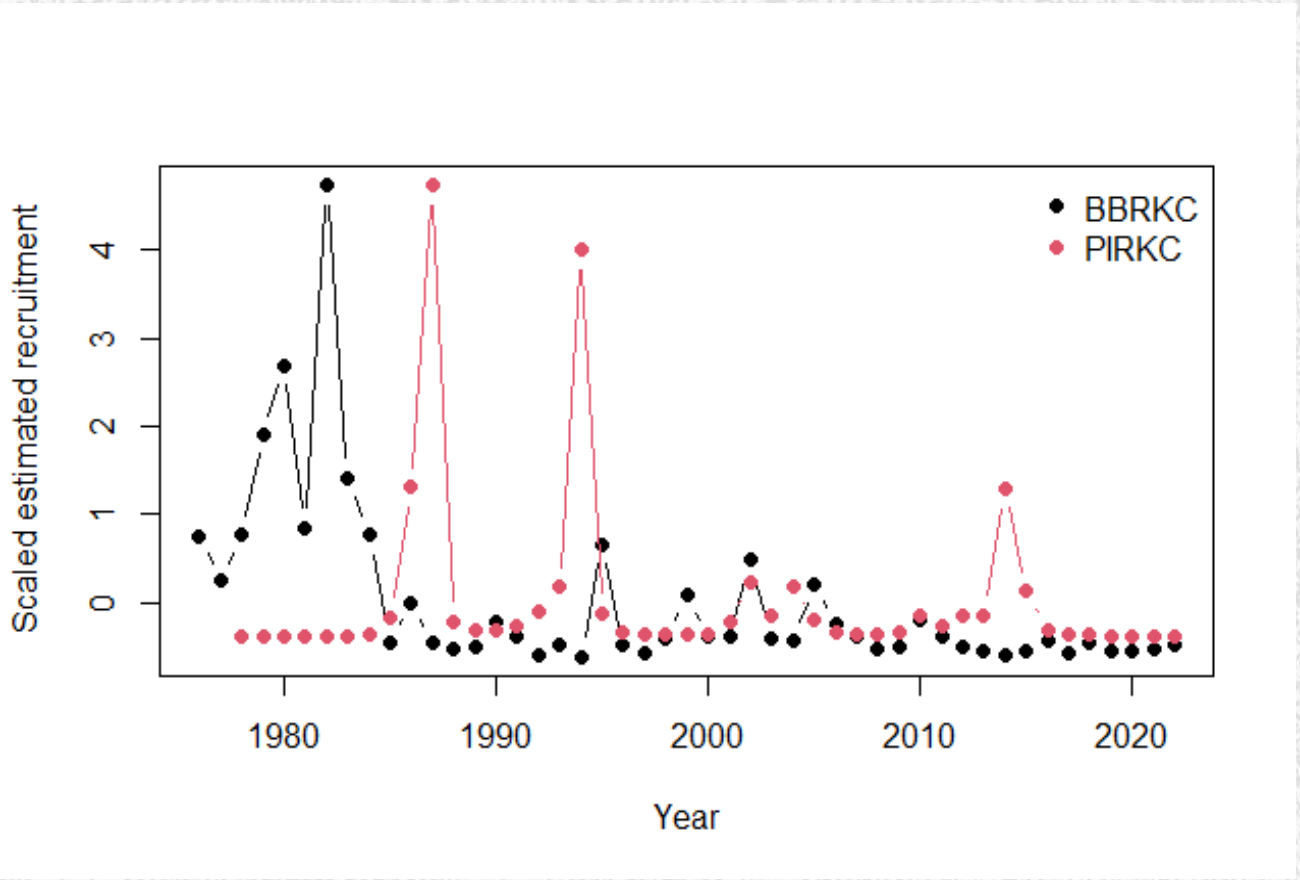


Survey size composition



- Not on the same scale
- Hard to determine potential linkages

Scaled estimated recruitment from the stock assessments for BBRKC and PIRKC. PIRKC is advanced 2 years to account for the difference in size ranges modeled in each assessment. BBRKC starts at 67.5 mm carapace length; PIRKC starts at 37.5 mm carapace length. (Source: C. Szuwalski)



Tagging information

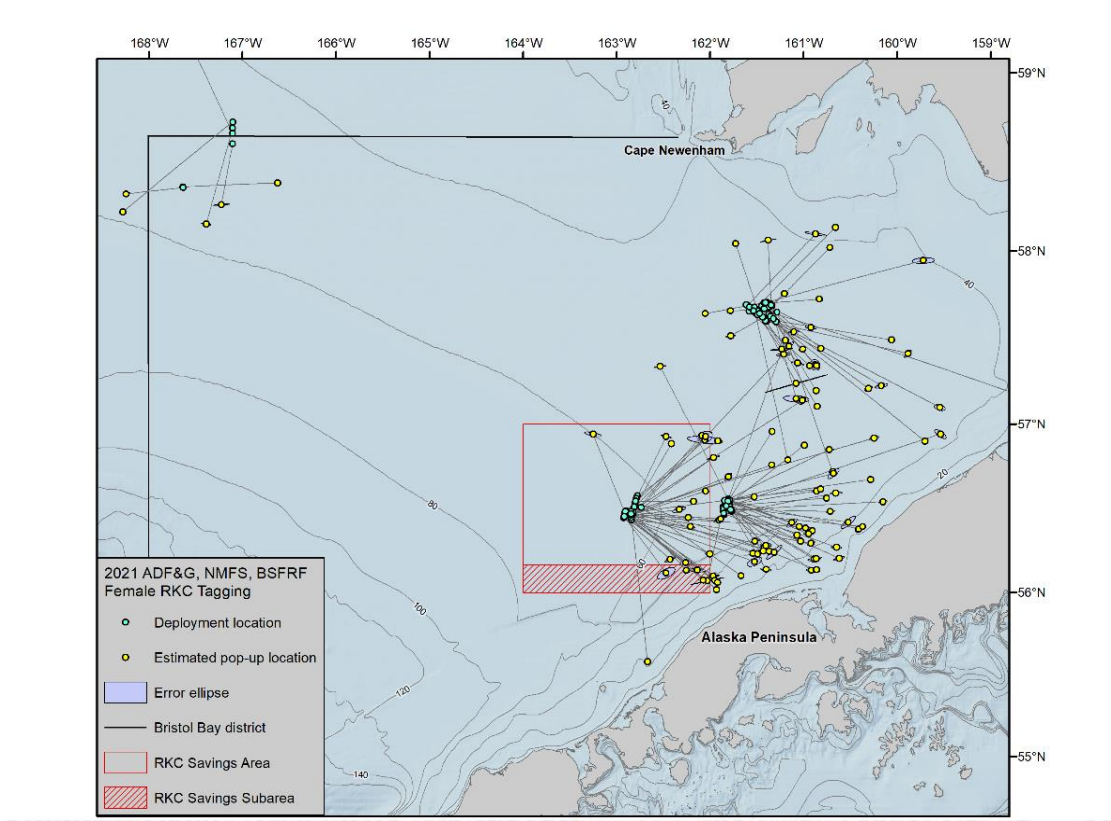


Figure 3-1 Movement of female crab from fall (November 2021) to spring (late-April/early-May 2022) based on pop-up satellite tag results from the ADFG/NMFS/BSFRF study

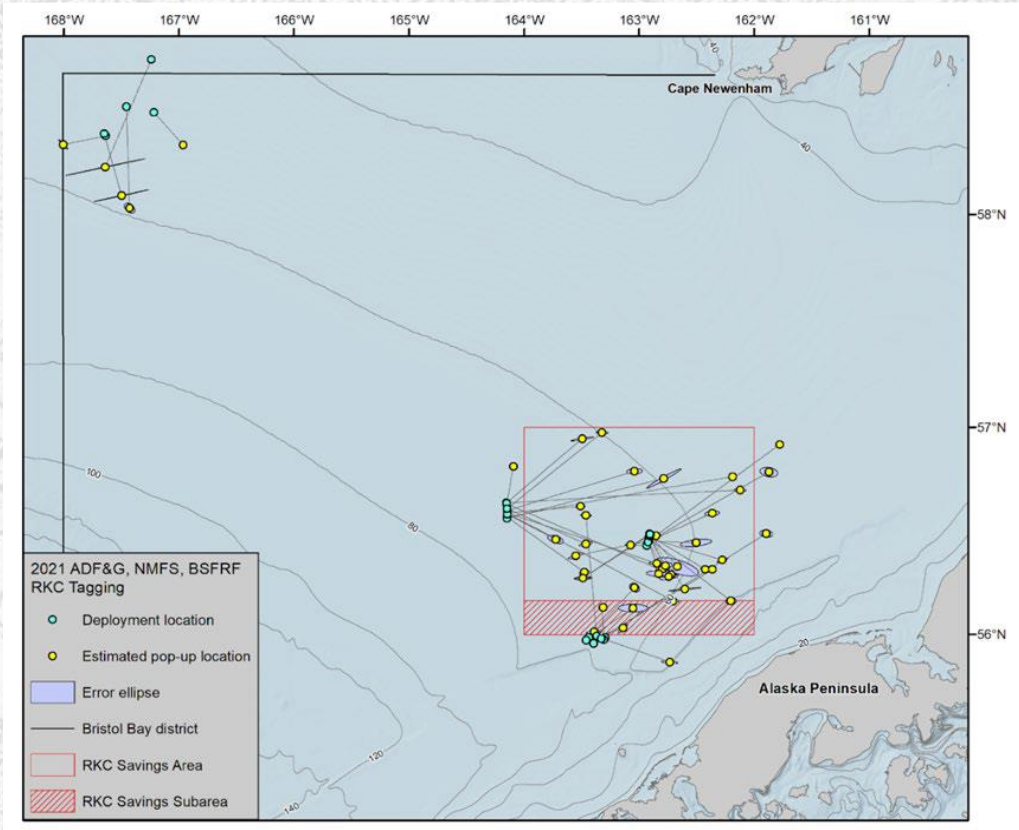


Figure 3-2 Movement of male crab from fall (November 2021) into winter (January 2022) based on pop-up satellite tag results from the ADFG/NMFS/BSFRF study

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Future work / next steps

- Draft form of this document
  - Focus on Southeastern Bering Sea stocks
    - NS and WAI distinct stocks based on genetics and growth, size, etc.
  - Improved plotting of available survey data – specifically for PIRKC, BBRKC, northern district
  - Summary of tagging data that exists around Bristol Bay
  - Objective of determining if Northern district red crab are part of the functional BBRKC stock? Or alternative objective for this area
- Future work
  - Increased genetic sampling around Bristol Bay
  - Oceanographic information and potential larval flow?