### BSAI CRAB STOCKS MANAGEMENT TIMING

- **Aleutian Islands golden king crab**
- **Pribilof Islands golden king crab**
- **Western Aleutian Islands (Adak) red king crab**

- **Assessed in May/June**
- **Triennial cycle, next assessment in 2023**

- **EBS snow crab**
- **Bristol Bay red king crab**
- **EBS Tanner crab**
- **Pribilof Islands blue king crab**
- **Pribilof Islands red king crab**
- **St. Matthew blue king crab**

- **Biennial cycle, next assessment in 2023**
- **Biennial cycle, next assessment in 2024**
- **Biennial cycle, next assessment in 2025**

- **Norton Sound red king crab**

- **Assessed in September/October**
- **Triennial cycle, next assessment in 2025**

- **Assessed in January/February**
BSAI CRAB STOCKS MANAGEMENT

Information available

Tier level

OFL

More information

Biomass estimate

Reliable stock recruitment relationship (S/R)

Tier 1

Estimated $F_{OFL}$ applied to model biomass

ABC buffer

10-20%

10-25%

25-40%

Life history information

Estimates of maturity, recruitment, mortality

Tier 2

$F_{OFL}$ is computed using the sloping control rule

Some limited life history information

Tier 3

Tier 4

No biomass estimate

Reliable catch information

Tier 5

$OFL = \text{average catch}$

Less information
MAY 2023 AGENDA

- AIGKC final assessment, OFL and ABC
- PIGKC final assessment, OFL and ABC
- WAIRKC final assessment, OFL and ABC
- Proposed model runs:
  - PIBKC
  - Tanner
  - Snow
  - BBRKC
- Unobserved mortality workshop scoping
- BSFRF research updates and spring BBRKC sampling
- Simpler models workshop report
- Bering Sea red king crab stock structure template
- Catch accounting and EM (informational)
- ABSC/NOAA collaboration on climate resilient fisheries (informational)
- ESP updates, GMACS updates
ALEUTIAN ISLAND GOLDEN KING CRAB (AIGKC)
FINAL ASSESSMENT 2023
GMACS assessment framework approved in Jan/Feb 2023

Changes in authorship – welcome Tyler Jackson (ADF&G) as primary author after Siddeek Sharif’s retirement this spring

Tier 3 annual stock assessment based completely on fishery-dependent data

OFL/ABC set for AIGKC stock but modeled as two separate stocks – EAG and WAG

Updates to input data

- 2022/23 retained catch (not completed at time of assessment)
- CPUE standardization updates – year effect (model 21.1e2) or year:block effect (model 22.1f)
- Industry- cooperative survey results for EAG

Model presented:

- Model 22.9c - 2022 accepted model (22_1e2) with modifications for GMACS transition
- Model 21.1e2 - Model 22.9c in GMACS (w/o Yr:Block)
- Model 22.1f - Model 22.1e2 (w/ Yr:Block)
- Models 22.1g and 22.1h – only for EAG with co-op survey 2015-2022
COOPERATIVE SURVEY (APPENDIX C)

- EAG cooperative survey from 2015 to 2022
- Current runs replace observer CPUE with this time series
- CPT discussed more appropriate way would be for this survey to be its own “fleet” in the model.
- More work expected in the future on these models, they are not ready for specifications.
Figure 22a, pg 82
### CPT RECOMMENDATIONS

#### 22.1e2

<table>
<thead>
<tr>
<th>Year</th>
<th>MSST</th>
<th>Biomass (MMB)</th>
<th>TAC</th>
<th>Retained Catch</th>
<th>Total Catch&lt;sup&gt;a&lt;/sup&gt;</th>
<th>OFL</th>
<th>ABC&lt;sup&gt;b&lt;/sup&gt;</th>
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<td>6.014</td>
<td>15.442</td>
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<td>13.600&lt;sup&gt;d&lt;/sup&gt;</td>
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<td>2.369&lt;sup&gt;*&lt;/sup&gt;</td>
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<td>12.069&lt;sup&gt;d&lt;/sup&gt;</td>
<td>2.291</td>
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<td></td>
<td>4.182&lt;sup&gt;d&lt;/sup&gt;</td>
<td>3.137&lt;sup&gt;d&lt;/sup&gt;</td>
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</table>

- **CPT recommended using model 22.1e2 for both areas**
  - Year:block standardization still under development
  - Tier 3 stock with stock status determined as a combined stock – Tier 3a

- **Buffer – 25% (same as 2022/23)**
  - Only assessment using only fishery CPUE as an index
  - Small number of vessels in fishery and limited spatial coverage compared to the stock
  - Retrospective patterns
PRIBILOF ISLANDS GOLDEN KING CRAB (PIGKC)

FINAL ASSESSMENT 2023
• Tier 5 stock

• Managed on calendar year basis (January 1 – December 31)

• Triennial assessment

• Guideline Harvest Level (GHL) of 59 t since 2015

• Participation is sporadic; CPUE data difficult to compare across vessels

• Updates to **input data**
  • Directed fishery retained and discarded catch through 2022
  • Bycatch estimates through 2022
Models presented:

- **Tier 5** – approach used since 2012
  - OFL = mean estimated total catch for 1993-1998
- **Tier 4** incorporating slope survey data
  - Random-effects approach using R package *rema*
  - Models fit with $M = 0.18 \text{ yr}^{-1}$ and $0.22 \text{ yr}^{-1}$
- **Tier 5 using Tier 4 approach for calculating OFL** – based on spiny dogfish example
  - OFL = average slope survey MMB 2002-2016 × $M$
  - Fit with $M = 0.18 \text{ yr}^{-1}$ and $0.22 \text{ yr}^{-1}$
CPT RECOMMENDATIONS

- Tier 4 and Tier 4/5 approaches not justified at this time
  - Tier 4 does appropriately increase uncertainty as most recent fishery-independent data ages
  - But without any new survey data since 2016 uncertainty will continue to increase monotonically
  - Revisit these approaches when new data become available
- Continue with Tier 5 approach
  - Provides management consistency
  - Appropriate for stock without good fisheries-dependent or fisheries-independent data
- 25% buffer
  - Consistent with other Tier 5 stocks
  - In place since 2014, no new information to motivate change
  - Tier 5 OFL = 95t, ABC = 71t
- SSC recommends Tier 4/5 approach
  - Tier 5 status with B calculated from survey biomass (mean 2002-2016 survey MMB)
  - Retains 25% ABC
  - Tier 4/5 OFL = 113.7t, ABC = 85.3t
- Total catch below OFL in 2020-2021 (2022 not yet summarized); overfishing did not occur
WESTERN ALEUTIAN ISLANDS RED KING CRAB (WAIRKC)
FINAL ASSESSMENT 2023
• Fishery closed since 2003/04
• Triennial assessment
• Tier 5 stock
• OFL based on estimated total catch during 1995/96 – 2007/08
STOCK STATUS DISCUSSION

- Extremely low fishery and survey CPUE since 2002 indicate the stock is severely depressed
- Formal overfished declaration not possible for Tier 5 stock
- Conservation measures such as habitat protection could be evaluated
  - Author notes habitat disturbance in areas of Petrel Bank with historical RKC occurrence
CPT RECOMMENDATIONS

- **75% buffer**
  - In place since 2017
  - No new information
  - Stock severely depressed

Values in t

<table>
<thead>
<tr>
<th>Fishing Year</th>
<th>MSST</th>
<th>Biomass (MMB)</th>
<th>TAC</th>
<th>Retained Catch</th>
<th>Total Catch</th>
<th>OFL</th>
<th>ABC</th>
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<td>2024/25</td>
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<td>2025/26</td>
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<td></td>
<td>56</td>
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</table>

- Total catch below OFL in 2020/21, 2021/22, 2022/23; overfishing did not occur
PRIBILOF ISLANDS BLUE KING CRAB (PIBKC): PROPOSED MODEL RUNS 2023

- Tier 4 stock, biennial assessment
- Author proposed moving current model to R package *rema*
- Change to modeling platform, not model structure
- Fits to survey data very similar for *rema* version
- CPT supports bringing forward *rema* version in September
TANNER CRAB: PROPOSED MODEL RUNS 2023

- Model exploration on growth, selectivity, VAST vs design based survey estimates, time-varying mortality
- Extensive work by the author on these explorations
- Recommended models:
  - Base model
  - Model with VAST survey estimates
- Future work includes continuation of work on a number of subjects including time varying natural mortality and work on selectivity
Stable model in GMACS since 2018

Directed fishery was closed in 2021/22 and 2022/23 season due to low mature female abundance.

Low recruitment in recent years (last 8-12 years), projected decline in biomass without a large recruitment event

Model explorations around a few themes:
- GMACS updates, start year for model (1975 vs 1985), natural mortality, Q for NMFS trawl survey, sensitivity to female resample data

Recommended models:
- Base model
- Base model with estimated M
- Model with data start in 1985 (vs. 1975)
SNOW CRAB: PROPOSED MODEL RUNS 2023

- Past problems:
  - Convergence issues and bimodality in management quantities
  - Multiple plausible modeled population trajectories for stock collapse
  - Inability to fit survey index and size compositions
  - Retrospective patterns
  - Unrealistic biology (e.g. probability of terminal molt)
  - Unrealistic catch advice

- Response:
  - Let the biology lead modeling decisions
  - Think outside historical decisions
Five models presented:

- Status quo
- Research model
- Two bridging models
  - Combine aspects of research model with status quo
- Tier 4 fallback approach
  - $B_{MSY}$ proxy = mean survey biomass of >95mm carapace width males 1982-2021
  - $F_{MSY}$ proxy = $M$ of 0.27 yr\(^{-1}\) based on assumed maximum age of 20 years
CPT RECOMMENDED MODELS 2023

- Status quo
- Focused bridging model
  - $M$ time-invariant except for 2018-2019
  - Only to be brought forward in September if convergence issues can be addressed
- Tier 4 fallback
BALANCE OF CPT REPORT
Collaborative Pot Sampling (CPS) of Bristol Bay red king crab

- Cooperative ADF&G, NOAA, BSFRF effort
- 2 vessels, ~ 25 days each, March-early April
- Goals:
  - Winter distribution data
  - Tagging data to connect winter and summer distribution
- 636 potlifts
- 10,191 RKC captured
- 100 satellite tags deployed
- Distribution data publicly available:
  https://github.com/AFSC-Shellfish-Assessment-Program/CPS1
BSFRF update

**COLLABORATIVE POT SAMPLING**

- Catch 23% female, 77% male
- Molt timing or distribution difference?
- Tags currently popping up (coinciding with summer survey)
- Tentative plans for two more years
UNOBSERVED CRAB MORTALITY: NEXT STEPS

- SSC recommends working group (October 2022): “to develop a framework for how to estimate the magnitude of unobserved mortality for crab stocks and how these estimates may be utilized in BSAI crab assessments”
- Supported by Council (December 2022)
- CPT discussion:
  - Possible use of unobserved mortality estimates inside and outside assessments (e.g. for conservation)
  - Could review available data and guide future research
  - Could guide planned research on fishing interactions with specific life history stages (Erin Fedewa, AFSC)
  - Suggested initial interagency working group with subsequent public workshop
  - Possible expertise / personnel / groups to include were discussed
  - Tentative start date: early 2024
QUESTIONS?

- Thanks to all CPT members and crab authors.