Review of 2024/25
AIGKC TAC

ADF&G presentation to AIGKC industry, 17 June 2024

Join by ZOOM:
https://us02web.zoom.us/j/84844930746?pwd=NxHteo3qZzQL7falGa2v9yy2aAijmT.1

Meeting ID: 848 4493 0746
Passcode: 704559
2024 Stock Assessment model

- 3 model scenarios
  - 2023 assessment model with updated data, truncated crab below model smallest size bin, 2 selectivity periods in pre-rationalized directed fishery

- CPT + SSC: Endorsed scenario 23.1 (truncated small crab)
  - Better fit to total catch size comps
  - 25% buffer on ABC: same as last year, same issues as last year
    - Fishery-dependent data, retrospective patterns in EAG, poor fits to EAG CPUE indices for post-rationalization period
Federal 2024/25 OFL + ABC

ABC = 6.159 mill lb total male catch
  • including bycatch mortality of males in all fisheries
  • based on a 25% buffer on OFL

OFL = 8.212 mill lb total male catch

Stock estimated at 108% of $B_{MSY}$ in 2023/24
Stock projected to be at 99% of $B_{MSY}$ in 2024/25

Area-specific OFL/ABC

**EAG:** OFL: 6.23 mill lb; ABC: 4.67 mill lb

**WAG:** OFL: 1.98 mill lb; ABC: 1.49 mill lb
## Million lb

<table>
<thead>
<tr>
<th>Year</th>
<th>MSST</th>
<th>Biomass (MMB\text{mat}ing)</th>
<th>TAC</th>
<th>Retained Catch</th>
<th>Total Catch</th>
<th>OFL</th>
<th>ABC</th>
</tr>
</thead>
<tbody>
<tr>
<td>2021/22</td>
<td>12.917</td>
<td>27.761</td>
<td>5.930</td>
<td>5.950</td>
<td>6.737</td>
<td>10.620</td>
<td>7.434</td>
</tr>
<tr>
<td>2022/23</td>
<td>12.857</td>
<td>29.983</td>
<td>5.051</td>
<td>5.223</td>
<td>5.758</td>
<td>8.292</td>
<td>6.219</td>
</tr>
<tr>
<td>2024/25</td>
<td>12.725</td>
<td>25.107</td>
<td></td>
<td></td>
<td></td>
<td>8.212</td>
<td>6.159</td>
</tr>
</tbody>
</table>

2024/25 OFL 11% decrease from last year
2023/24 Season CPUE
Retained catch (million lb)

- **EAG**
- **WAG**

Data points for years 1996 to 2023.
2023/24 Season Harvest
Retained Catch by Statistical Area

Observer Pots

Landed lb (mil)
- 0.25
- 0.50
- 0.75

Vessel
- 103
- 5992
- 20556
- 35767
- 37887

Tyler Jackson presentation to CPT, May 2024
EAG proportion effort by lat/long

Yellow = greater
Blue = lesser

Produced by Tyler Jackson
Would like to see strong CPUE with high or increasing extent index.

In recent years, high CPUE with low extent implies CPUE improvement not necessarily indicative of population growth.
WAG proportion effort by lat/long

Yellow = greater
Blue = lesser

Produced by Tyler Jackson
Low CPUE, ~low extent

Potential for improved fishing in non-core areas?

Produced by Tyler Jackson
Harvest Strategy

Stock threshold for opening the fishery

- MMA is $\geq 25\%$ of $\text{MMA}_{\text{AVG1985-2017}}$

Exploitation rate on mature-sized ($\geq 116$ mm CL) male abundance

- Increases linearly up to 15% (EAG) or 20% (WAG) with increasing MMA up to the 1985-2017 average
- 15% (EAG) or 20% (WAG), when MMA $\geq 1985$-2017 average

Harvest capped at 25% of legal male abundance

Calculate the number of animals for harvest:

**EAG**

<table>
<thead>
<tr>
<th>MMA (current year)</th>
<th>TAC computation</th>
<th>25% Legal Cap</th>
</tr>
</thead>
<tbody>
<tr>
<td>$&lt; 0.25 \times \text{MMA}_{\text{AVG1985-2017}}$</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>$\geq 0.25 \times \text{MMA}<em>{\text{AVG1985-2017}}$, but $&lt; \text{MMA}</em>{\text{AVG1985-2017}}$</td>
<td>$0.15 \times \text{MMA}/\text{MMA}_{\text{AVG1985-2017}} \times \text{MMA}$</td>
<td>$0.25 \times \text{LMA}$</td>
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<td>$0.25 \times \text{LMA}$</td>
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**WAG**

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<td>0</td>
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<tr>
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<td>$0.20 \times \text{MMA}/\text{MMA}_{\text{AVG1985-2017}} \times \text{MMA}$</td>
<td>$0.25 \times \text{LMA}$</td>
</tr>
<tr>
<td>$\geq \text{MMA}_{\text{AVG1985-2017}}$</td>
<td>$0.20 \times \text{MMA}$</td>
<td>$0.25 \times \text{LMA}$</td>
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</table>

MMA = mature-sized male ($\geq 111$ mm CL) abundance
LMA = legal-size male ($\geq 136$ mm CL) abundance
Sloping control rule

Exploitation rate on mature male abundance (MMA)

\[
\text{MMA/MMA}_{\text{AVE}}
\]

Graph showing the exploitation rate on mature male abundance (MMA) against \(\text{MMA/MMA}_{\text{AVE}}\). The graph includes two lines:

- **WAG**: Dotted line
- **EAG**: Solid line

The graph illustrates how exploitation rate changes with respect to the ratio of mature male abundance to its average value.
Where are we on the control rule for 2024/25 TAC setting?
## Numbers for TAC computations

<table>
<thead>
<tr>
<th></th>
<th>EAG</th>
<th>WAG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current year MMA</td>
<td>5.821</td>
<td>2.596</td>
</tr>
<tr>
<td>Average MMA&lt;sub&gt;1985-2017&lt;/sub&gt;</td>
<td>5.019</td>
<td>3.645</td>
</tr>
<tr>
<td>MMA/MMA&lt;sub&gt;AVE&lt;/sub&gt;</td>
<td>116%</td>
<td>71%</td>
</tr>
<tr>
<td>Exploit. rate on MMA</td>
<td>0.15</td>
<td>0.14</td>
</tr>
<tr>
<td>Exp on MMA</td>
<td>0.873</td>
<td>0.370</td>
</tr>
<tr>
<td>Current year LMA</td>
<td>4.139</td>
<td>1.645</td>
</tr>
<tr>
<td>25% exp on LMA</td>
<td>1.035</td>
<td>0.411</td>
</tr>
<tr>
<td># animals for TAC calc</td>
<td>0.873</td>
<td>0.370</td>
</tr>
<tr>
<td>L wt lb (23/24 FT)</td>
<td>4.307</td>
<td>4.022</td>
</tr>
<tr>
<td><strong>TAC (million lb): FT ave wt</strong></td>
<td>3.76</td>
<td>1.49</td>
</tr>
</tbody>
</table>

25% legal cap not limiting TAC in either area
Computed TACs relative to ABC

• Combined computed TAC: 5.248 million lb
• Combined ABC: 6.158 million lb

• Computed TACs less than ABC by 0.910 million lb

• Is this enough to account for anticipated bycatch mortality in the directed and groundfish fisheries?
  • What are the estimates of bycatch mortality?
Bycatch mortality: area specific

Assume average from past 5 years:
• 8% for both areas

Assume average from past 10 years:
• 82,000 lbs for EAG
• 12,000 lbs for WAG
## Bycatch mortality: area specific

### EAG: 2024/25 maximum total fishery mortality relative to avoiding ABC = 4.673 million lb

<table>
<thead>
<tr>
<th>Assumptions</th>
<th>Mortality (million lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assume mean mortality in groundfish fisheries, 14/15-23/24 =</td>
<td>0.08</td>
</tr>
<tr>
<td>Remaining for directed (incl. bycatch mort), mill lb (ABC-Subtotal) =</td>
<td>4.59</td>
</tr>
<tr>
<td>Assume ave (lb discard mort)/(lb retained) in directed fishery, 19/20-23/24 =</td>
<td>0.077</td>
</tr>
<tr>
<td>Maximum TAC = (remaining for directed)/(1+0.077) =</td>
<td>4.26</td>
</tr>
</tbody>
</table>

### WAG: 2024/25 maximum total fishery mortality relative to avoiding ABC = 1.485 million lb

<table>
<thead>
<tr>
<th>Assumptions</th>
<th>Mortality (million lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assume mean mortality in groundfish fisheries, 14/15-23/24 =</td>
<td>0.01</td>
</tr>
<tr>
<td>Remaining for directed (incl. bycatch mort), mill lb (ABC-Subtotal) =</td>
<td>1.47</td>
</tr>
<tr>
<td>Assume ave (lb discard mort)/(lb retained) in directed fishery, 19/20-23/24 =</td>
<td>0.077</td>
</tr>
<tr>
<td>Maximum TAC = (remaining for directed)/(1+0.077) =</td>
<td>1.37</td>
</tr>
</tbody>
</table>

WAG full computed TAC = 1.49
Thoughts on the WAG

• CPUE past 3 seasons lowest since 2005
• Computed TAC exceeding area-specific ABC

• WAG harvest control rule caps out at 20% (EAG=15%)
  • Historical exploitation estimates in WAG support this
  • Historical exploitation rates likely too high
Estimates of recent fishing mortality above that which is advised by $F_{OFL}$ control rule

Suggests that we may have been harvesting too aggressively

Figure 30: Kobe plot for model WAG 23.1. Bolded line indicates the tier 3 $F_{OFL}$ control rule.
Realized exploitation rate on MMA*

Ave past 10 yrs:
- EAG = 15%
- WAG = 20%

* Calculated from retained catch data and model 23.1 model estimates
Historical Pot Lifts

- **EAG**
- **WAG**

Pot lifts vs. Years

- X-axis: Years from 1996 to 2023
- Y-axis: Pot lifts from 0 to 120,000

Graph showing the historical pot lifts for EAG and WAG from 1996 to 2023.
At-sea observer legal crab

Average wt (lbs)

EAG
WAG
Landed crab ave wt

EAG crab generally larger
Landed crab ave wt
WAG core vs non-core

Non-core WAG harvest (west 174 E)
More fishing in non-core area in 2017-2019

Generally larger crab encountered in non-core area (observer data)
WAG Recruits

- Low estimated recruits in past 3 years
- Decreasing trend in sublegal crab in fishery
Fewer legal males relative to mature males in WAG

- Harvest strategy: we hit “MAX TAC” in WAG more often
Thoughts on WAG fishery.....

• Both areas generally harvested at maximum exploitation rates allowed by harvest strategy
  • Given 2024 model estimates of MMA, WAG harvested above 20% in some years

• WAG: more gear, larger area, lower catch rates (CPUE ~half), higher exploitation rate, proportionately fewer legal males

• We’ve been hitting the WAG hard
  • Past 3 seasons have the lowest CPUE since rationalization
  • Decreasing ave wts + low recruitment (model estimates) + low sublegal crab (fishery CPUE)
  • Consider reduced exploitation rate.... EAG ramp?
Model performance
• Conflicting trends 2017-2021
• 2022-2023: model estimate ~flat
• Fit is not great
Model performance

Retrospective patterns persist in **EAG**

- Generally, more uncertainty in EAG terminal year estimates
- Conflicting signals between CPUE and size comp data
- Same model scenario, peeling back terminal year data and rerunning model, and repeat

2024 AIGKC SAFE; Jackson 2024
Model estimates: scenario 23.1

EAG

Millions of crabs

MMA

LMA
2021/22 - 2023/24 lowest CPUE in post-rationalization period
Model estimates capturing CPUE trend in recent years well
Model estimates: scenario 23.1

WAG population estimates on overall decreasing trend and recent abundances at the lowest since the 90s.
<table>
<thead>
<tr>
<th>Reference points</th>
<th>EAG</th>
<th>WAG</th>
<th>Notes/Concerns</th>
</tr>
</thead>
<tbody>
<tr>
<td>2024/25 ABC</td>
<td>4.67</td>
<td>1.49</td>
<td></td>
</tr>
<tr>
<td>ABC reduced for bycatch</td>
<td>4.26</td>
<td>1.37</td>
<td>ABC minus bycatch in directed + GF. Was used in WAG in 2022 + 2023</td>
</tr>
<tr>
<td>2023/24 TAC</td>
<td>3.72</td>
<td>1.81</td>
<td>EAG: full computed WAG: ABC minus bycatch</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2024/25 TAC Options</th>
<th>EAG</th>
<th>WAG</th>
<th>Notes/Concerns</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full computed</td>
<td>3.76</td>
<td>1.49</td>
<td>Will exceed WAG area-specific ABC with bycatch.</td>
</tr>
<tr>
<td>Full computed 15% ramp BOTH areas</td>
<td>3.76</td>
<td>1.12</td>
<td>11% exploit. rate in WAG</td>
</tr>
</tbody>
</table>

* Green circles indicate recommended TACs
Millions of crabs

WAG

- MMA (2024 model)
- MMA (2023 model)
- LMA (2024 model)
- LMA (2023 model)
Historical EAG TAC buffering

• Implemented a **20% buffer** on EAG computed TACs to reflect model uncertainty (2018-2021)
  • Retrospective bias (Mohns Rho values)
  • Historical model bias: 20% approximated mean overestimation of terminal year
  • Poor CPUE fits

• Decreased to **10% buffer** in 2022 to reflect uncertainty in change in estimated size-at-maturity used in assessment
  • Increase in size-at-maturity means fewer animals in population are “mature” thereby reducing absolute population abundance used to calculate TAC (i.e. lower TAC)
  • Disconnect between what is used in assessment (full-area 116 mm) vs area-specific (EAG: 108 mm)
    • Likely/possible that assessment underestimates number of mature animals in EAG...... thus the reduction in buffer
    • We gave the fleet the benefit of the doubt
      • 2023 implement full computed TAC in EAG
Change in estimated size-at-maturity

Change to larger estimated **size-at-maturity** (116 mm vs 111 mm CL) in 2022 (and later) assessments*

- Predicts fewer animals in population are mature

Stock-wide usage of 116 mm CL size-at-maturity may:
- *Underestimate* EAG MMA
- *Overestimate* WAG MMA

* This analysis is being revisited with the existing data.
Final TAC recommendations

**EAG 3.76**: full computed *(1% increase from last year)*
- Equates to 15% exploitation on MMA
- Have used 20% and 10% buffers in past due to high model retrospective pattern + poor model fit to CPUE data
  - Some stability in recent retrospective peels
- Status quo TAC seems reasonable given last year fishery performance

**WAG 1.12**: full computed *(38% decrease from last year)*
- EAG 15% ramping control rule
- Conservation concern: continued low CPUE, high exploitation, low recruitment, possible overestimate of MMA
- Equates to 11% exploitation on MMA *(last year was 14%)*
Total fishery mortality

• EAG 3.76 and WAG 1.12 = 4.88 mill lb
• Combined ABC: 6.158 million lb
• 4.88 safely accounts for bycatch
  • Allows room for TF: 170,000 lbs
• TAC = 79% of ABC (80% last year)
• Total fishery mortality = 90% of ABC
  • 5.52 mill lb
    • TAC: 4.88 mill lb
    • Bycatch: 0.38 mill lb directed + 0.09 mill lb groundfish
    • Test fishery: 0.18 mill lb (0.17 ret + 0.01 bycatch)
Summary

2023/24 CPUE

• EAG: flat from prior season, near timeseries high, causes for large increase unclear
• WAG: flat from prior season, past 3 seasons lowest in rationalized timeseries

Assessment model estimates

• EAG has higher uncertainty
  • Conflicting signals between CPUE and size comps
  • Large retrospective pattern
• WAG has less uncertainty but greater conservation concern
  • Low CPUE, high exploitation, low recruitment, decreasing ave wts

TACs relative to last year

• EAG: up 1% (full computed)
• WAG: down 38% (full computed at 15% ramp)
Industry Cooperative Survey
Future of survey

• Important to keep the survey going...
• Will eventually be incorporated in the assessment model with continued refinements
• Likely yields more accurate depiction of population trends
  • Trends in CPUE (avoids hyperstability)
  • Size composition information
2024 EAG survey stations
Research Priorities (not ranked)

- WAG survey
- Movement via tagging studies
  - E.g., Core vs non-core movement in WAG
- Growth + molt probabilities via tagging studies
- Handling mortality rate: is assumed 20% reasonable?
- More weight measurements in WAG for L-W regression
- Size-at-maturity estimation in space/time
  - More chela measurements on small crab
  - Better understand size at “functional maturity”
- Environmental monitoring (temperature measurements)
- Small mesh pots (recruitment)
- Larval drift (population connectivity, stock structure)