Assessment of Pacific cod in the Aleutian Islands

NOAA FISHERIES
Alaska Fisheries Science Center

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November 13, 2019

Team and SSC comments

Comments on assessments in general (1 of 2)

- SSC1: “The SSC requests that all authors fill out the risk table in 2019, and that the PTs provide comment on the author’s results in any cases where a reduction to the ABC may be warranted (concern levels 2-4). The author and PT do not have to recommend a specific ABC reduction, but should provide a complete evaluation to allow for the SSC to come up with a recommendation if they should choose not to do so.”
  Response: The risk table is included here (see “Risk Table” subsection in the “Harvest Recommendations” section). No specific ABC reduction is recommended, but a complete evaluation is provided in order to allow the SSC to come up with a reduction if it chooses to do so.

Comments on assessments in general (2 of 2)

- SSC2: “The SSC recommends the authors complete the risk table and note important concerns or issues associated with completing the table.” *Response*: As noted in response to SSC1, the risk table is included here. Some concerns and issues associated with completing the table are noted in the subsection where the table appears.

Comments specific to this assessment (1 of x)

- BPT1: "The Team recommends investigating natural mortality to determine if there is a more appropriate value of M for this Tier 5 stock assessment. Potential sources of information are the GOA P. cod assessment, the prior for M currently developed for P. cod, and a prior for M using various approaches for estimating M (i.e., http://barefootecologist.com.au/shiny_m.html)." *Response:* Appendix 2A.4 contains an investigation of the natural mortality rate for this stock, including the value that was estimated in last year's GOA Pacific cod assessment, the prior distribution that was used in last year's EBS Pacific cod assessment, and the "Shiny" app recommended by the Team. See also response to comment SSC3.

Comments specific to this assessment (2 of 3)

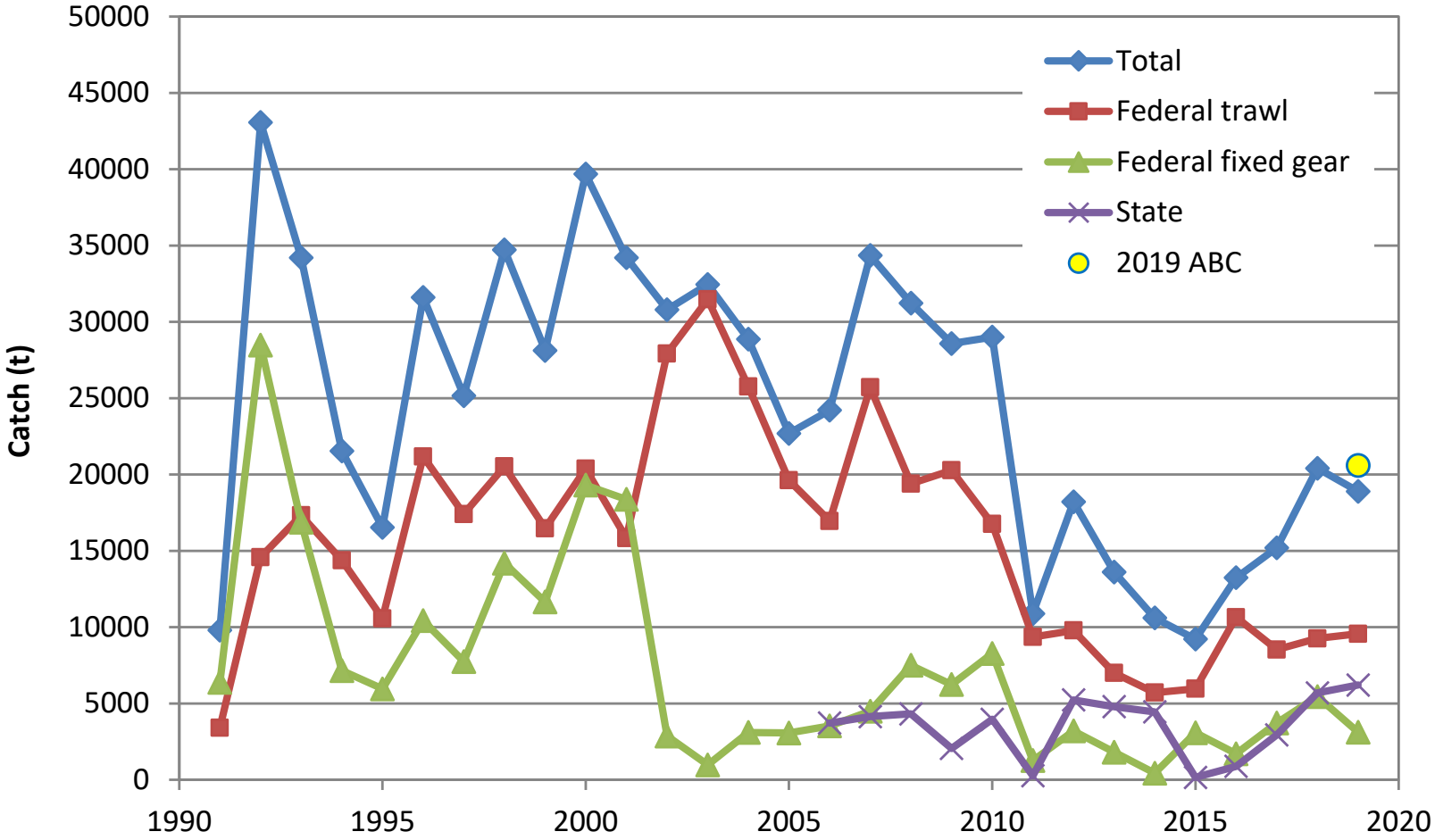
- BPT2: “Given the continued concerns of the EBS Pcod assessment, the Team recommends continued focus on the EBS P. cod assessment and giving a lower priority to developing an age-structured AI P. cod model. Progress on the EBS and GOA P. cod assessments may provide useful insights into developing an age-structured assessment for AI P. cod.” *Response:* See response to comment SSC5.
- SSC3: “The SSC agreed with the PT’s recommendation to revisit the sources of information determining natural mortality in this assessment since genetic studies do not suggest that cod in the AI are similar to the BS, which is the source of the current value for natural mortality. Further, the general priors developed for both the BS and GOA Pacific cod stocks suggest a much higher value of M.” *Response:* Given the SSC’s view that the estimate of M for the EBS stock may not be a good estimator of M for the AI stock, the practice of setting M for the AI stock equal to the estimate from the current year’s EBS assessment has been discontinued, pending development of a more suitable estimator.

Comments specific to this assessment (3 of 3)

- SSC4: “The SSC encouraged the author to explore the VAST model as an alternative for future apportionment calculations, noting potential issues with estimating spatial processes around a chain of islands.” *Response:* Use of the VAST model will be explored for this assessment once the AFSC survey group feels that it is ready for use in the context of the AI bottom trawl survey.
- SSC5: “The SSC disagreed with the PT recommendation to continue to delay new modelling efforts for the AI, and instead requests that an age-structured model be developed.” *Response:* Age-structured models are presented in Appendix 2A.4, along with responses to 5 additional Team comments and 4 additional SSC comments.

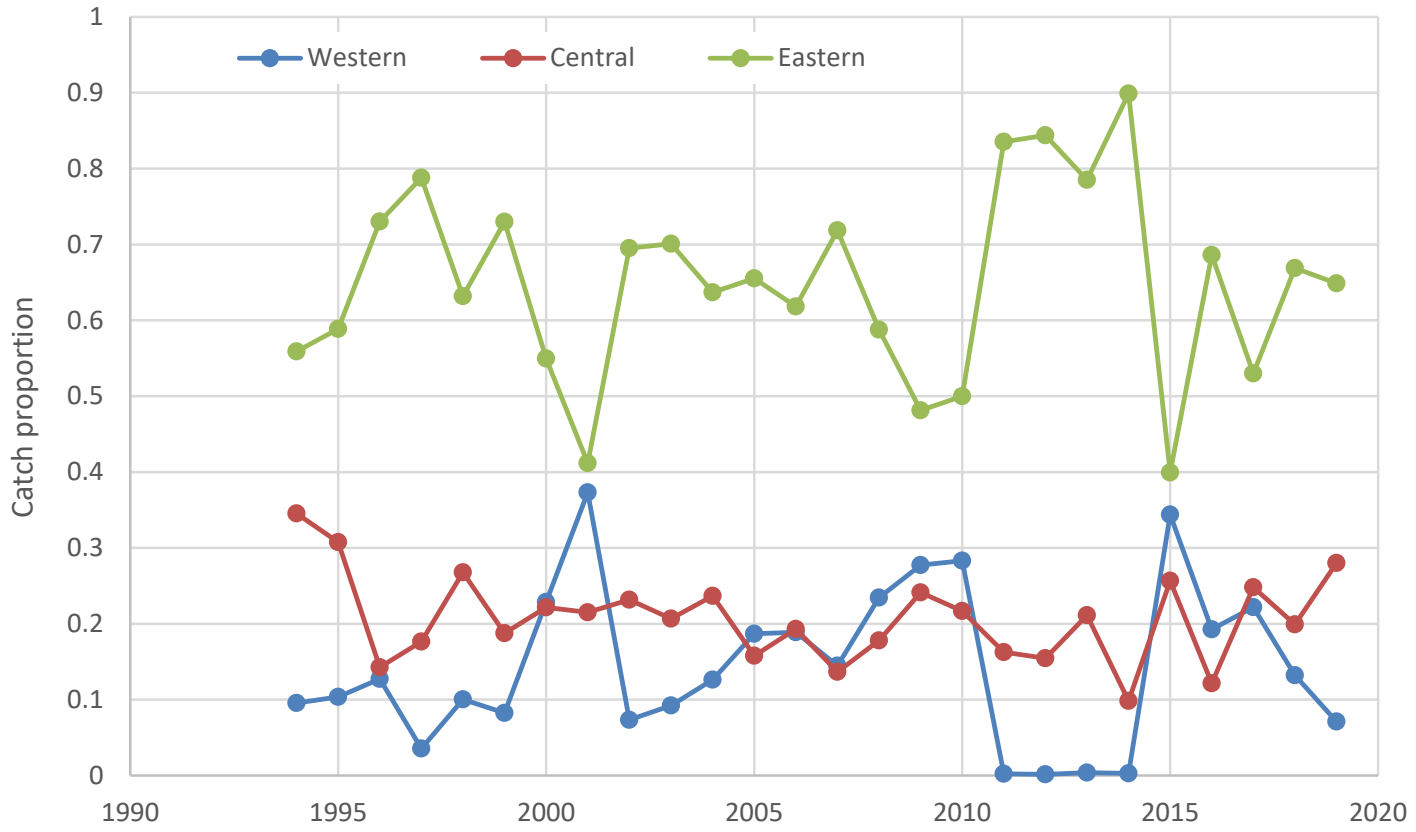
Data highlights

Catch history (2019 data are incomplete)



Catch proportions by subarea

- Western area was closed from 2011-2014; 2019 data are incomplete



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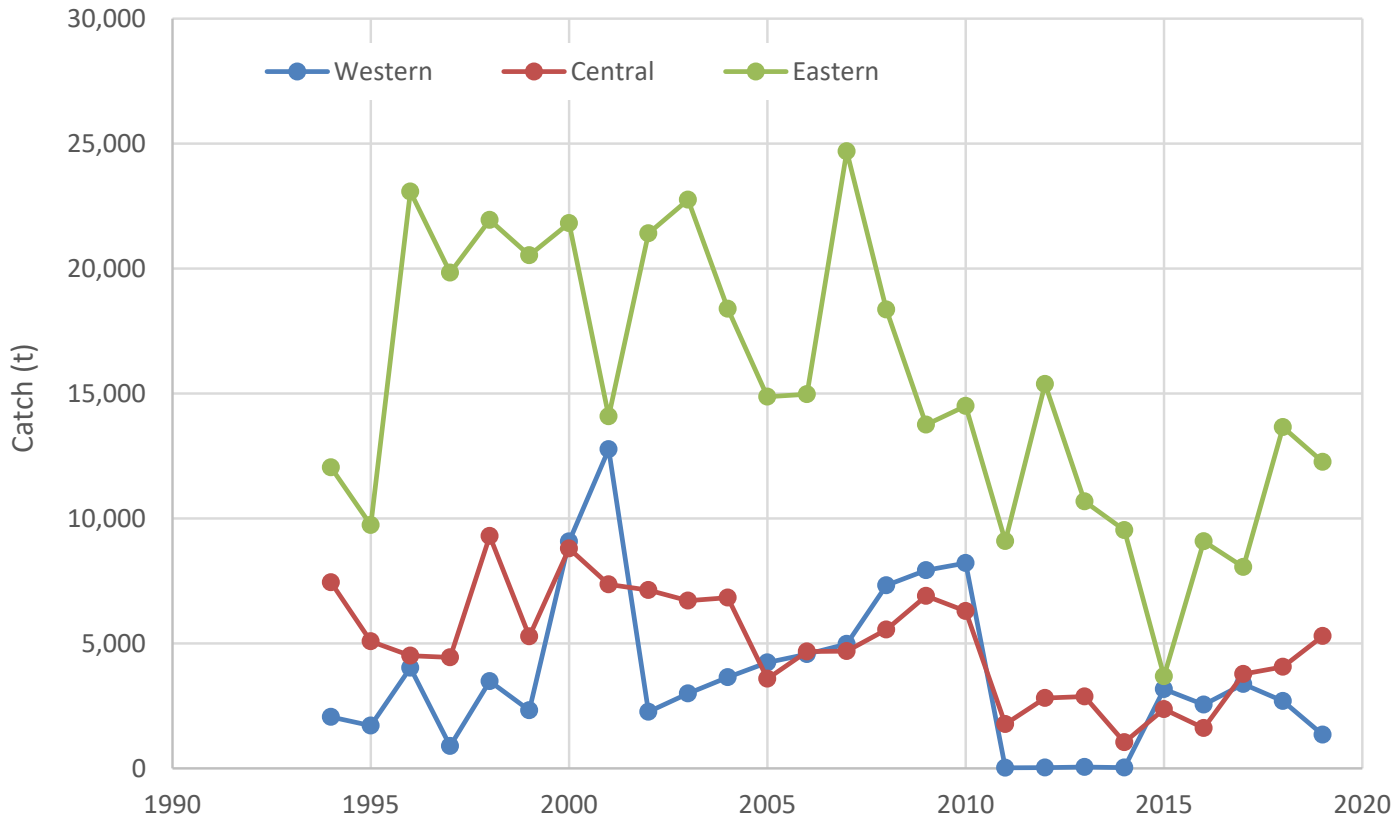
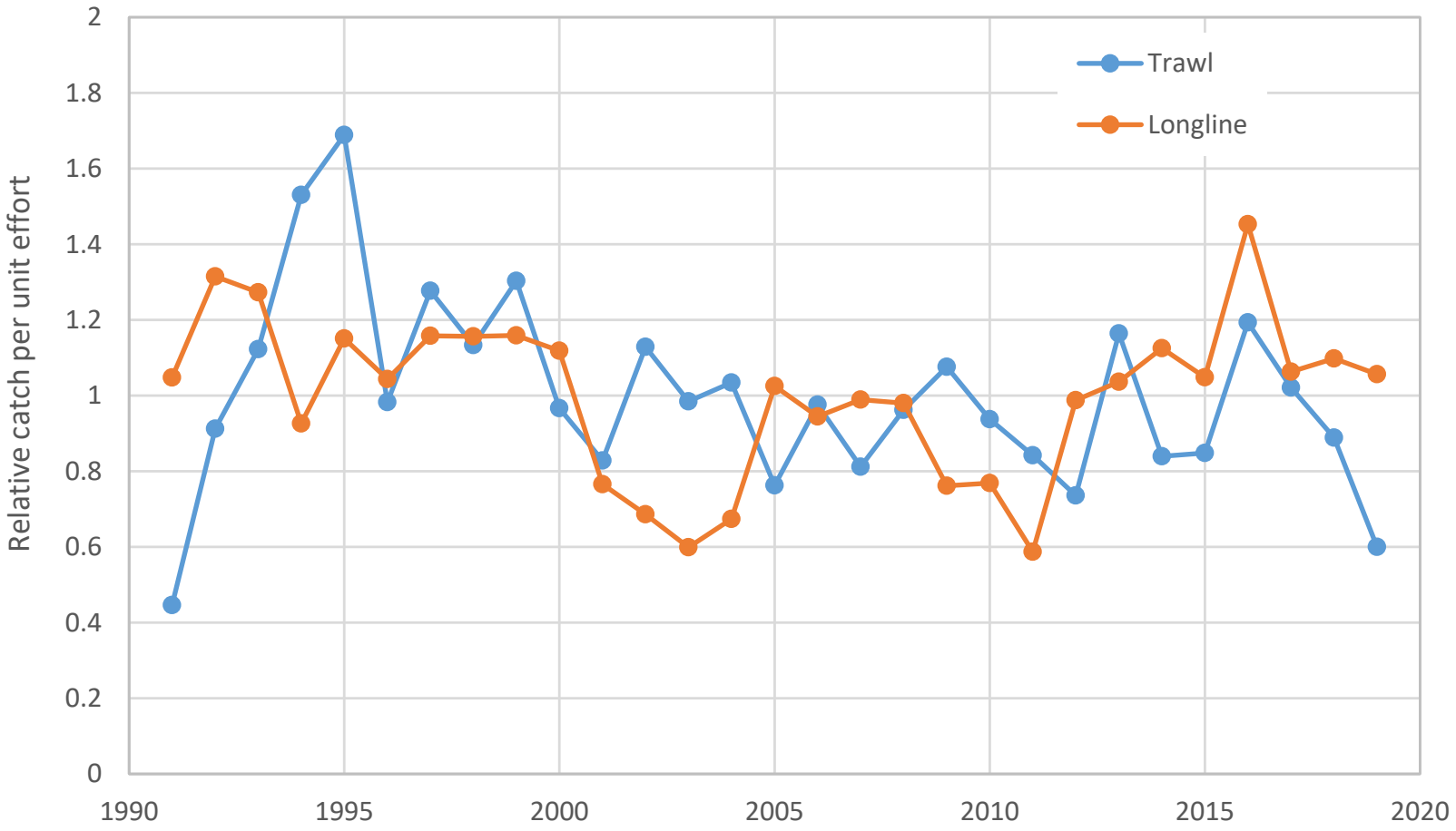
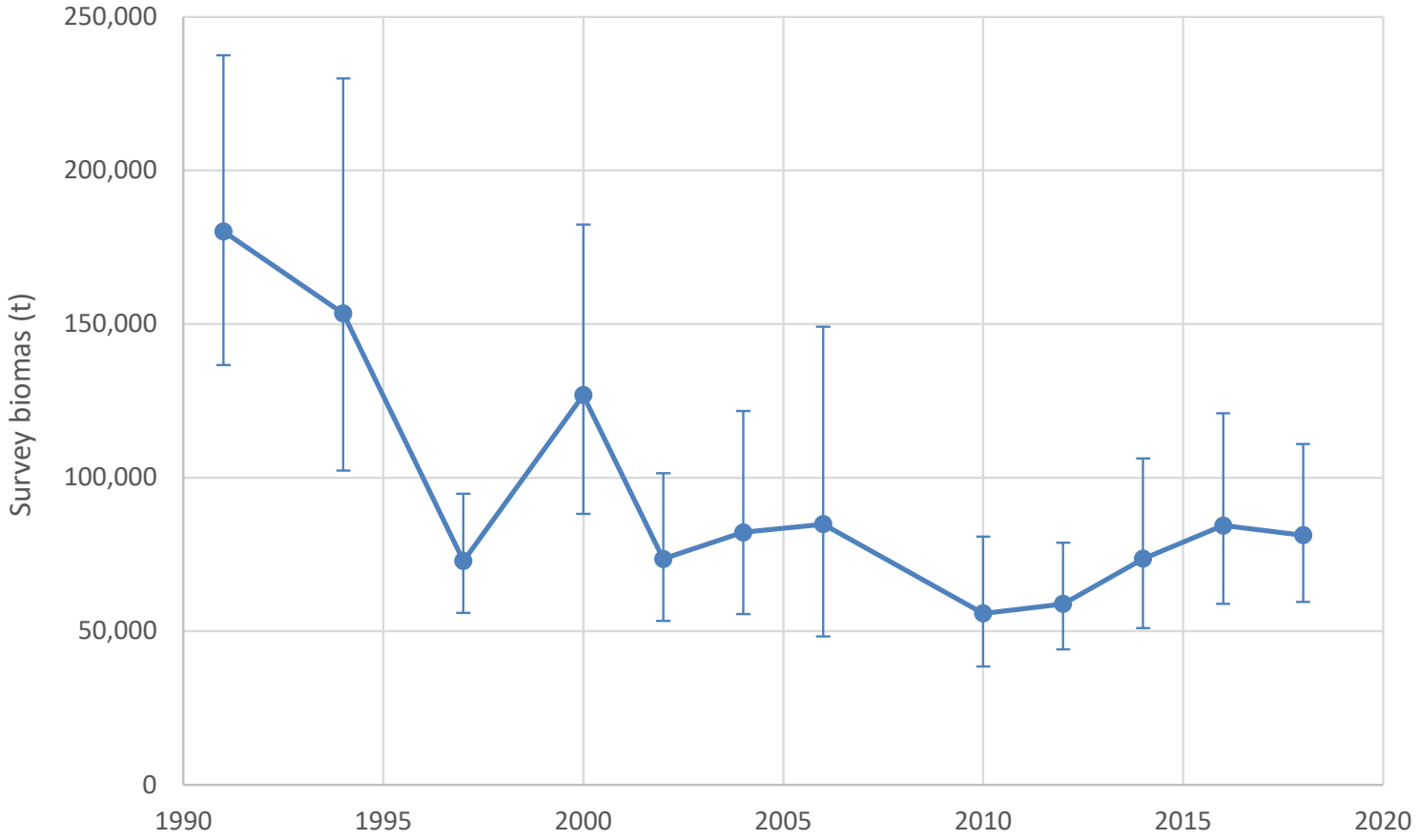


Fishery CPUE (2019 data are incomplete)



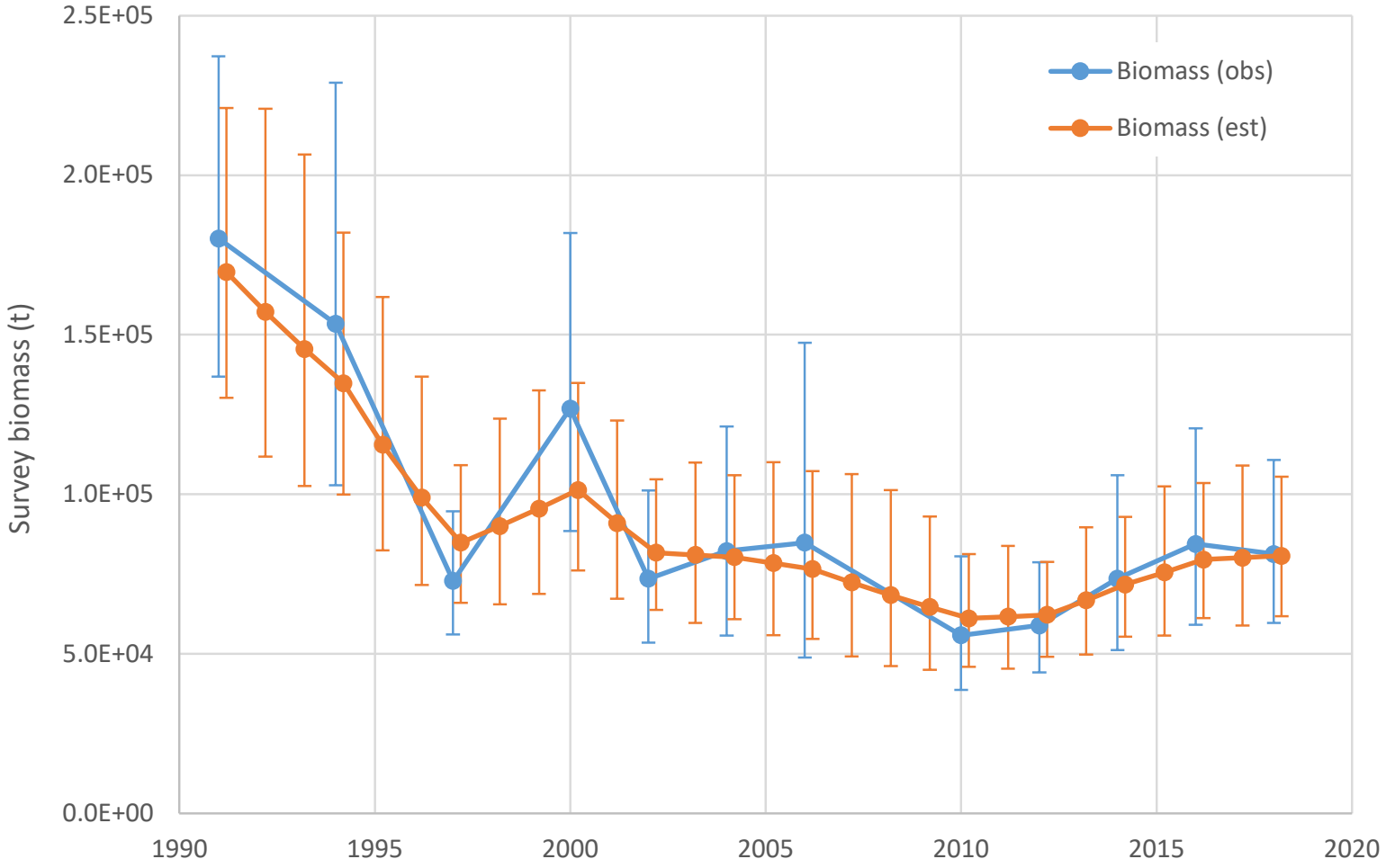
Trawl survey biomass

- 2018 is down 4% from 2016, up 46% from 2010, down 14% from mean



Results

Fit to survey biomass: figure



Fit to survey biomass: statistics (with previous)

- Log-scale process error standard deviation: 0.16 (0.17)
- CV of log-scale process error standard deviation: 0.36 (0.37)
- Root-mean-squared error: 0.105 (0.103)
- Average log-scale standard error (data): 0.180 (0.182)
- Mean normalized residual: 0.054 (0.054)
- Standard deviation of normalized residuals: 0.633 (0.625)
- Correlation (data:model): 0.972 (0.975)

Risk table: assessment

- This stock been assessed using Tier 5 methodology since 2013
- The standard Tier 5 random effects model fits the survey data quite well
- One feature of the model presented in Appendix 2A.4 is a positive retrospective pattern (ρ=0.206), meaning that, on average over the past 10 assessment years, the model's estimates of female spawning biomass in the terminal year would have exceeded the model's current estimate of female spawning biomass in that year by about 20%
  - This may suggest that the model could benefit from further development, although it should also be noted that Hurtado-Ferro et al. (2015) determined that this level of retrospective bias does not rise to the level that should be cause for concern
- Assessment considerations were rated as level 1

Risk table: population dynamics

- Although the long-term (1991-2018) survey biomass trend is downward, the trend since 2010 has been largely positive
- The model presented in Appendix 2A.4 projects female spawning biomass to be above $B_{40\%}$ by approximately 2%, and at $B_{40\%}$ in 2021
- Population dynamics considerations were rated as level 1

Risk table: environmental/ecosystem (1 of 2)

- Summary of Appendix 2A.5 (by Elizabeth Siddon):
  - Pacific cod are a large component of the apex predator guild in the Aleutian Islands ecosystem
  - In 2018, the condition of Pacific cod (length/weight residuals) was strongly negative, continuing a trend since 2010
  - In 2018, the biomass of the apex predator foraging guild in the WAI reached its lowest level of the time series, driven by cod declines
  - In 2018, the biomass of the apex predator foraging guild in the CAI decreased only slightly from 2016, but both years were below the long-term mean
  - In 2018, the biomass of the apex predator foraging guild in the EAI increased from a low in 2012, driven by Pacific cod

Risk table: environmental/ecosystem (2 of 2)

- Summary of Appendix 2A.5 (by Elizabeth Siddon):
  - Parakeet and Least auklet reproductive success suggests zooplankton availability was sufficient to support chick rearing
  - Murre and puffin reproductive success suggest that forage fish prey were insufficient to support chick rearing at Buldir with mixed results at Aiktak
  - Indicators of crustacean zooplankton abundance were low during the previous heatwave (2014-2016)
  - Steller sea lion trends continued relatively steep declines in the WAI, a less steep decline in the CAI, and improvement in the EAI
  - Jellyfish abundance peaked during the previous heatwave; jellyfish may act as both predator and competitor, particularly for pre-settlement and juveniles
- Environmental/ecosystem considerations were rated as level 2

Risk table: fishery performance

- Since 1991, fishery CPUE shows less of a long-term trend than survey biomass, although since about the early 2000s both time series are essentially trendless
- Trawl fishery CPUE has declined markedly since 2016, while survey biomass in 2018 was nearly unchanged from 2016
- There does not appear to have been any unusual spatial patterns of fishing, or changes in the percent of TAC taken
- The winter fishery targets spawning populations of Pacific cod
- Pacific cod aggregate to spawn, implying that a reduction in stock size is unlikely to cause lower CPUE
- Rather, hyper-aggregation may exist, in which higher CPUE is observed under low stock sizes
- Fishery performance considerations were rated as level 1

Risk table: summary and issues

- Summary

Assessment-related considerations	*Population dynamics considerations*	*Environmental/ ecosystem considerations*	*Fishery Performance considerations*	*Overall score (highest of the individual scores)*
Level 1: Normal	Level 1: Normal	Level 2: Substantially increased concerns	Level 1: Normal	Level 2: Substantially increased concerns

- Issues: same as those identified for EBS Pacific cod

ABC recommendation

- Rather than having each assessment author determine the appropriate reduction in isolation, the SSC has volunteered to take responsibility for determining those reductions
- This seems a preferable course of action, as it should tend to increase consistency across assessments
- Therefore, no reduction is recommended here
- The recommended ABCs for 2020 and 2021 are both 20,600 t, representing the maximum permissible level under Tier 5

Summary table

Quantity	As estimated or *specified last* year for:		As estimated or *recommended this* year for:	
	2019	2020	2020	2021
M (natural mortality rate)	0.34	0.34	0.34	0.34
Tier	5	5	5	5
Biomass (t)	80,700	80,700	80,700	80,700
F_{OFL}	0.34	0.34	0.34	0.34
$maxF_{ABC}$	0.255	0.255	0.255	0.255
F_{ABC}	0.255	0.255	0.255	0.255
OFL (t)	27,400	27,400	27,400	27,400
maxABC (t)	20,600	20,600	20,600	20,600
ABC (t)	20,600	20,600	20,600	20,600
Status	As determined *this* year for:		As determined *this* year for:	
	2017	2018	2018	2019
Overfishing	No	n/a	No	n/a

- "Harvest limit" in the Western subarea set equal to 15.7% of ABC