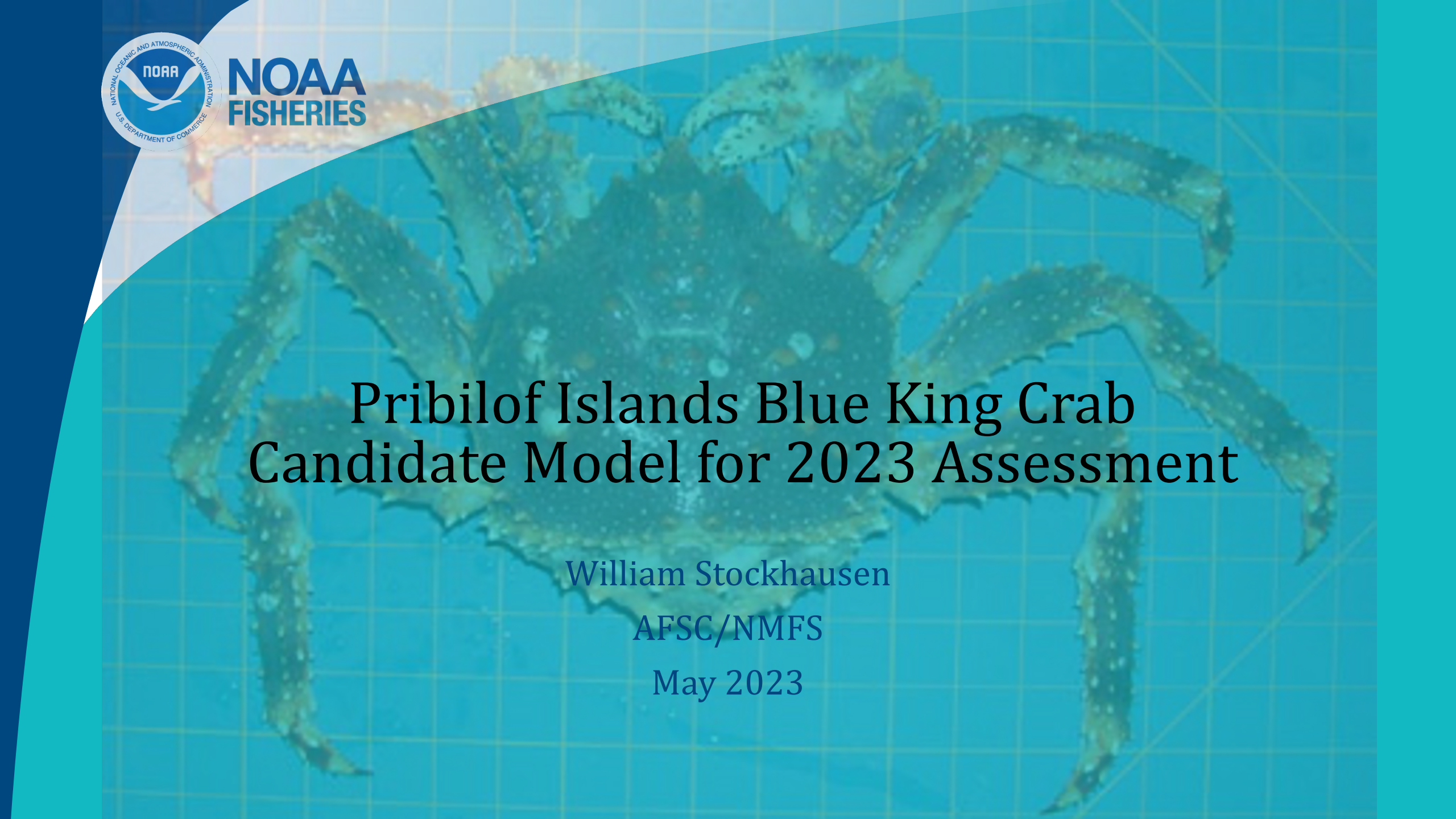


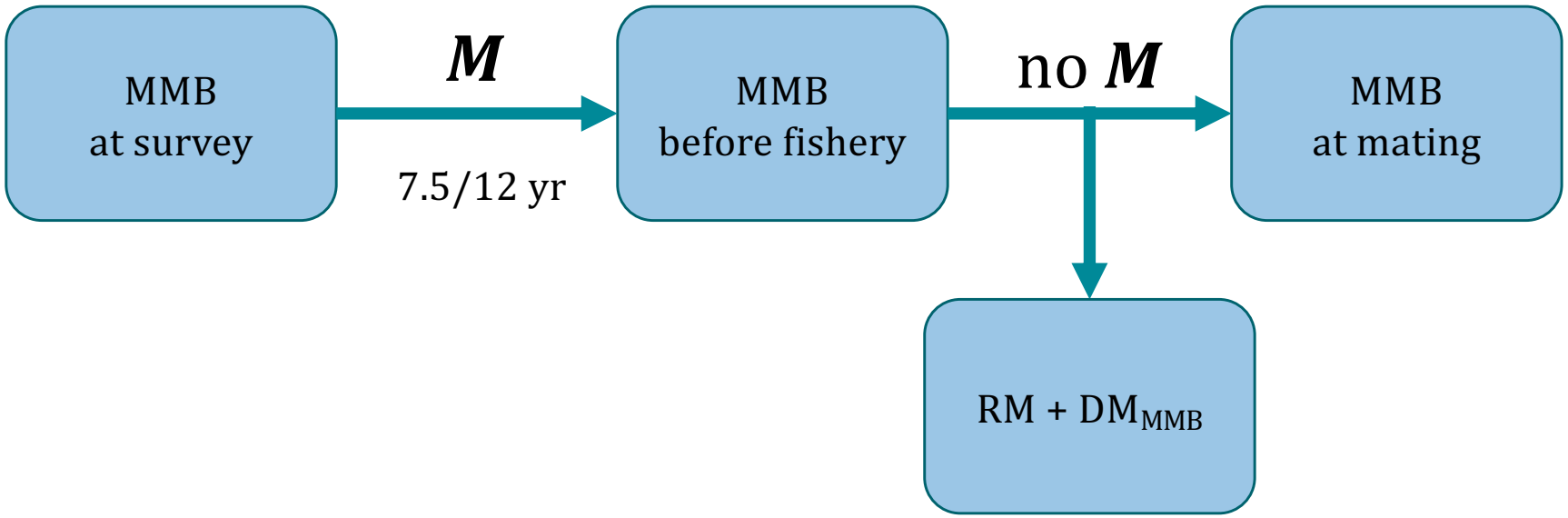
Pribilof Islands Blue King Crab Candidate Model for 2023 Assessment

William Stockhausen

AFSC/NMFS

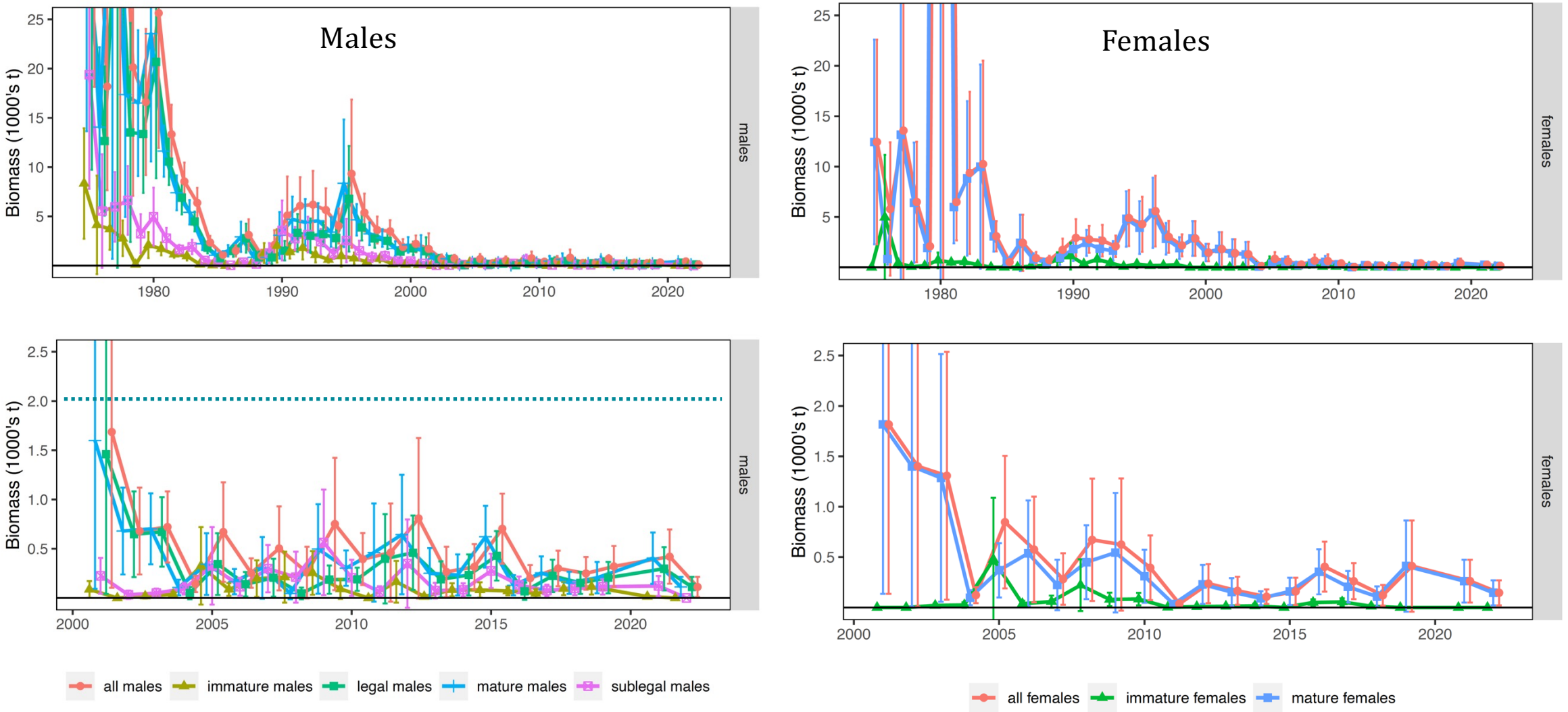
May 2023

Tier 4 Model for PIBKC Status Determination



- B_{MSY} = average MMB-at-mating
- status ratio = current MMB-at-mating/B_{MSY}

Survey Trends



Issues

- Design-based time series of survey MMB has large CVs
- Issues with VAST estimates given limited spatial size and island effects?
- Current approach: apply state-space random walk model to design-based estimates of MMB to capture time series trend with smaller CV's
  - "bespoke" ADMB code
- Proposed modification: use *rema*[*] R package to fit same model
  - developed for groundfish Tier 5 assessments
  - uses TMB rather than ADMB
  - larger user community for future development

[*] *https://github.com/JaneSullivan-NOAA/rema*
https://afscassessments.github.io/rema/

State-Space Random Walk Model

Observation model

$$ln(MMB_{s_y}) =< ln(MMB_s) >_y + \eta_y, \text{ where } \eta_y \sim N(0, \sigma^2_{s_y})$$

Process model for unobserved state ()

$$p(< ln(MMB_s) >_y \mid < ln(MMB_s) >_{y-1}) \sim N(0, \phi^2) \qquad \text{(random walk)}$$

Joint likelihood

$$\Lambda = \sum_y \left[ln(2\pi\phi) + \left(\frac{< ln(MMB_s) >_y - < ln(MMB_s) >_{y-1}}{\phi} \right)^2 \right] + \sum_y \left(\frac{ln(MMB_{s_y}) - < ln(MMB_s) >_y}{\sigma_{s_y}} \right)^2$$

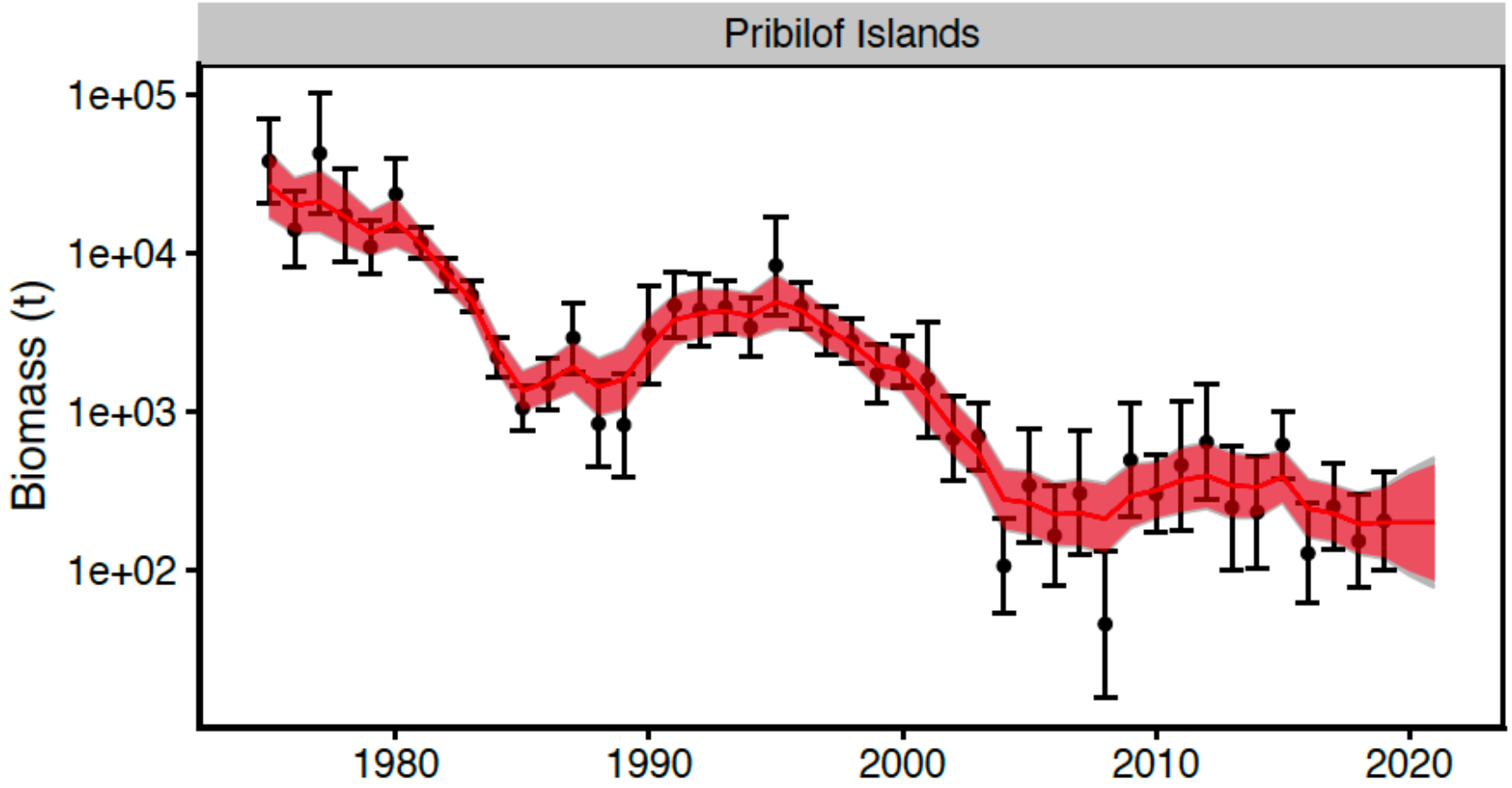
Parameters

λ , where $\phi^2 = exp(2 \cdot \lambda)$: fixed parameter characterizing scale of process error

$< ln(MMB_s) >_y$: random effects representing the state

Comparison between ADMB and rema

model	objective function	max gradient	estimate	std err
ADMB	28.3803	4.5486e-08	0.4332	0.0779
rema	28.3492	7.2188e-15	0.4331	0.0779

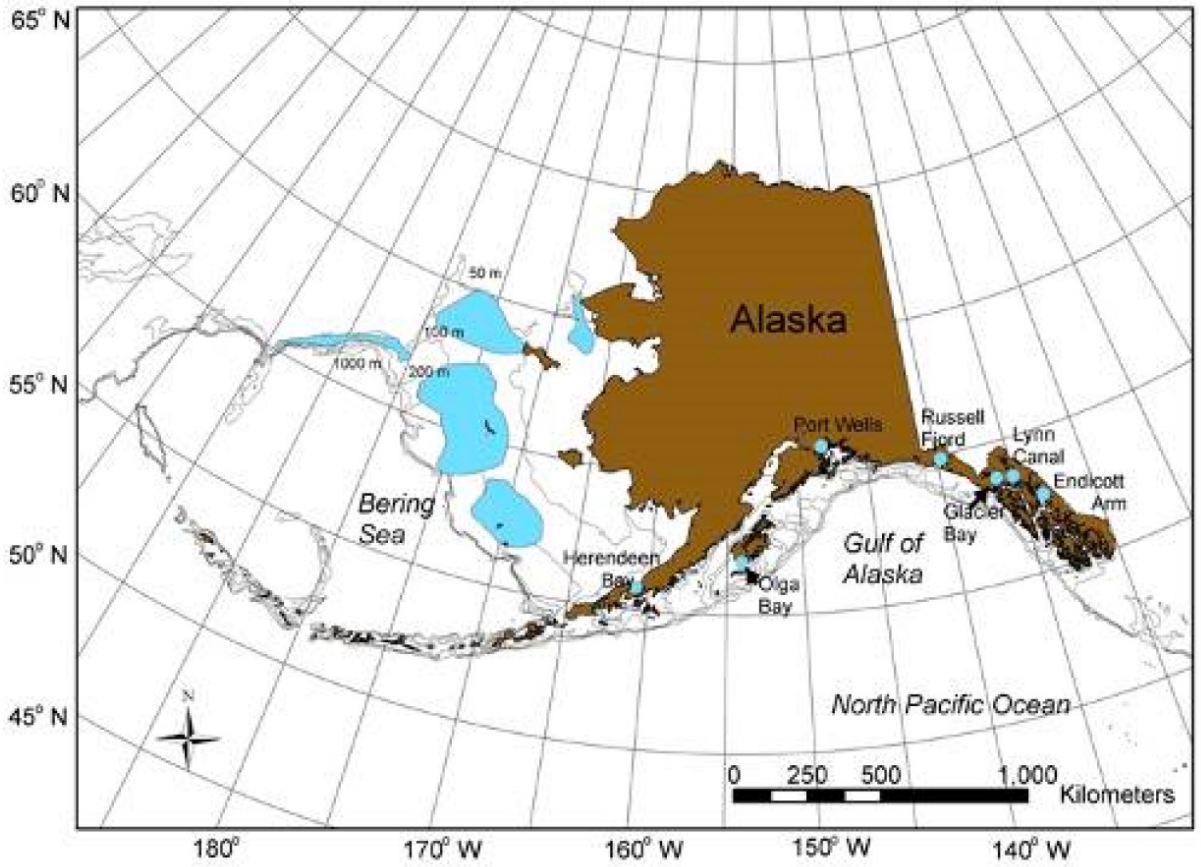


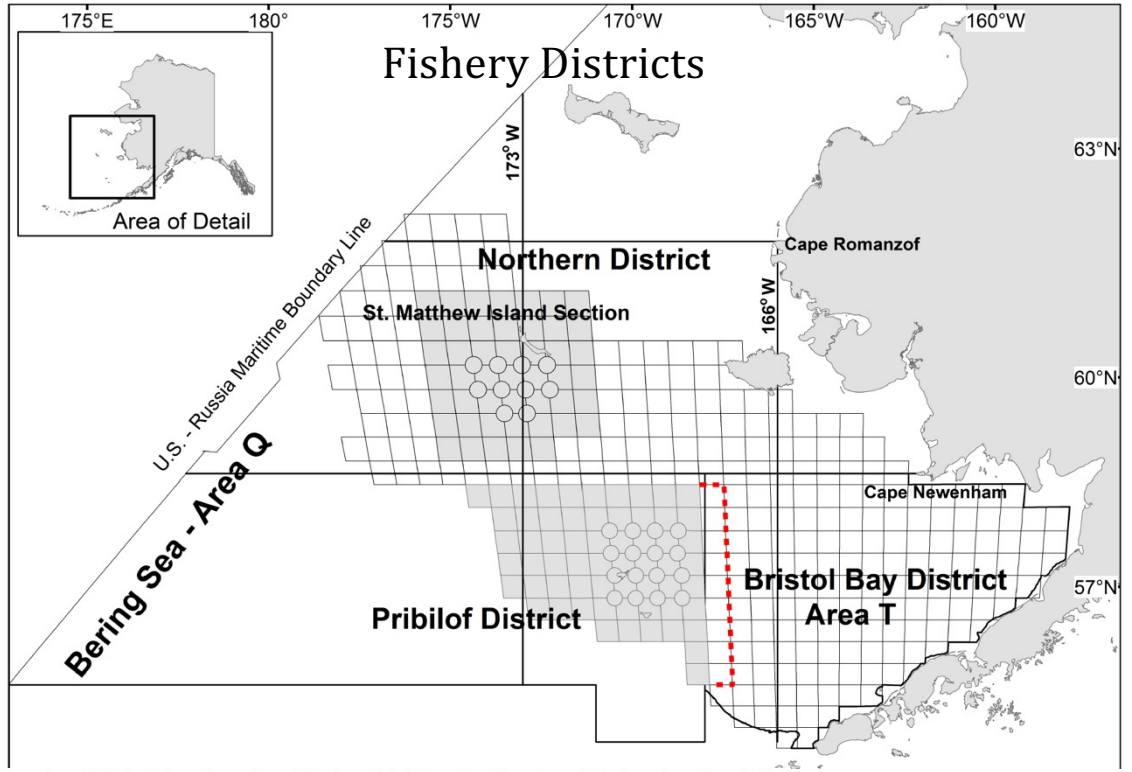
Discussion

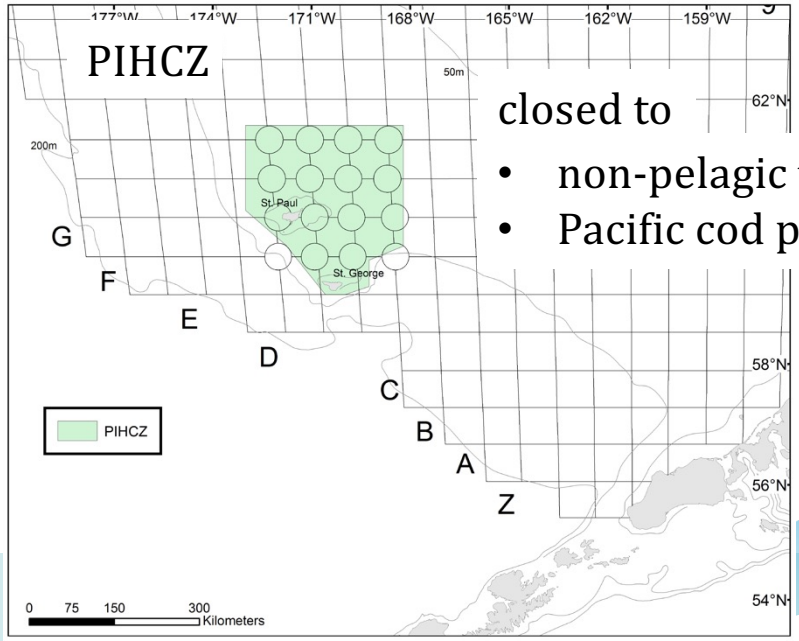
- Differences between ADMB and *rema* results are negligible
- *rema* package is standard model framework adopted for groundfish Tier 5 stock
  - TMB has better performance than ADMB for random effects models
  - larger user community
  - support for future development (diagnostics, etc.)

- Recommendation: adopt *rema* package in favor of ADMB code for PIBKC assessment
  - proposed is NOT a change in model structure

Stock Distribution







closed to

- non-pelagic trawl gear
- Pacific cod pot gear