# A preliminary assessment for Pribilof Islands red king crab

Cody Szuwalski

B. SSC comments

That the assessment author and other red king crab assessment authors (BBRKC) review the existing growth data and review potential additional sources of growth information.
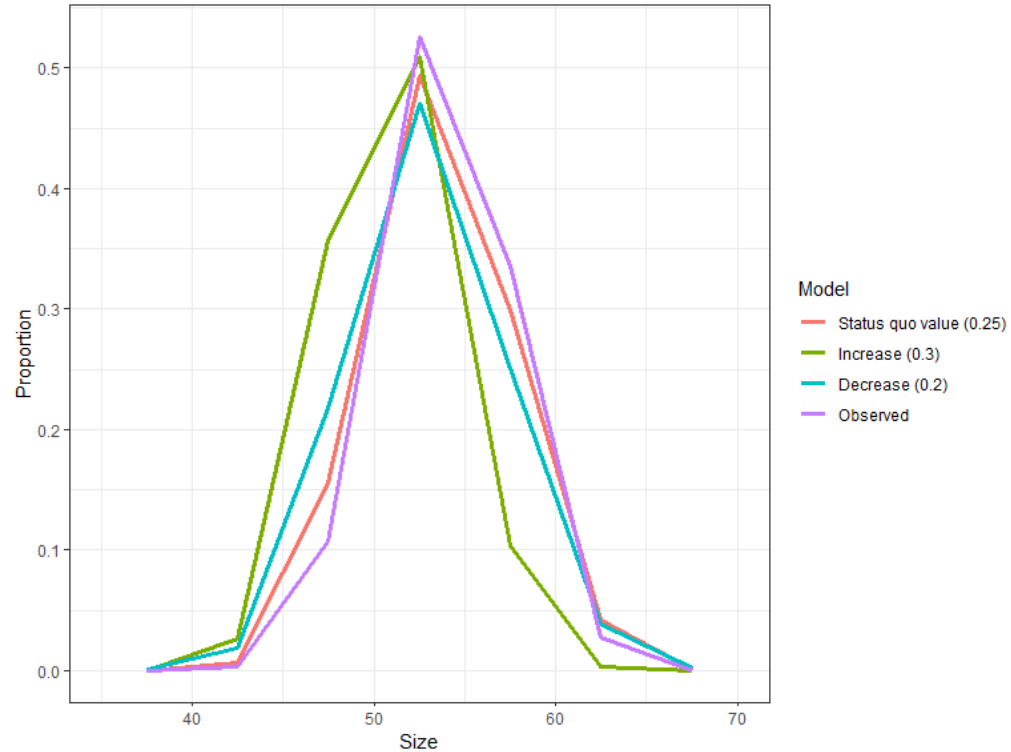
Tagging data were provided from the Kodiak lab and used to inform the estimation of growth in this assessment. The data were not fit within the assessment, but used as priors as has been done historically for both PIRKC and BBRKC. The average growth increment across years time at liberty for the first molt (if present) was used as a prior on the molt increment within the assessment. Discussion from the plan team about the relative pros and cons of fitting these data within the assessment given they are primarily from Bristol Bay would be useful.
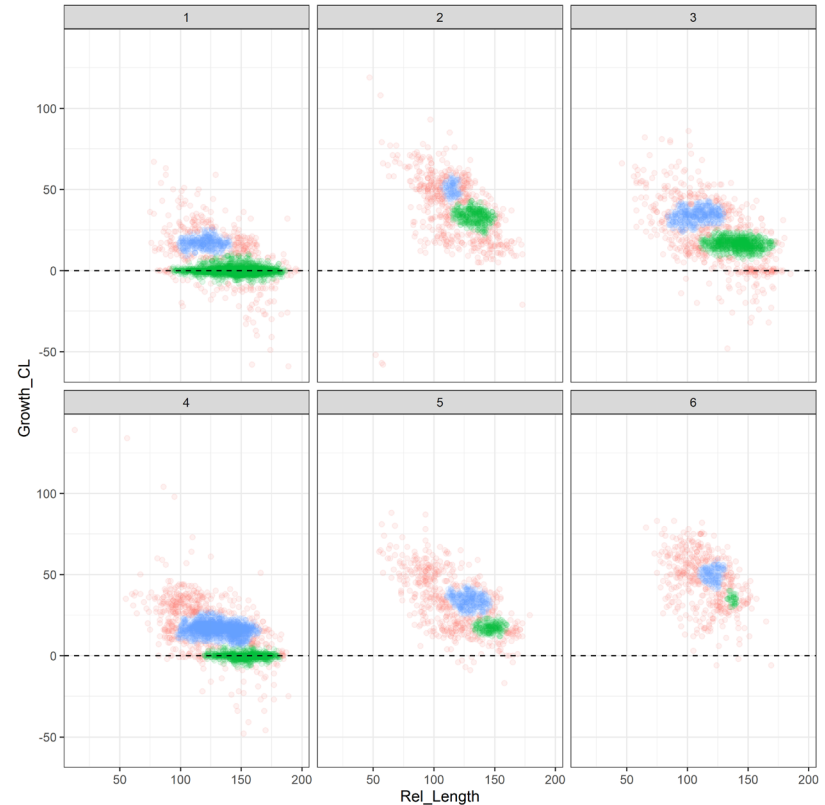
B. SSC comments

The CPT also recommended that the author examine whether the standard deviation around the growth increment matches the spread around the tagging data for BBRKC.

The input variability for the growth increment was similar to that observed in the tagging data (). Sensitivities are included to the specified growth increment variability. Ultimately the status quo specifications seem appropriate for the assessment until a decision is made on whether or not to fit the tagging data inside the assessment model.

C. GMACS Assessment scenarios

Models

Six assessment variants were considered this year:

22.1: accepted model from 2022

25.1: Same data from 22.1, but updated GMACS model

25.2: 25.1 + ADFG pot survey

25.3: 25.2 + down size comps + prior on growth increment

25.3a: 25.3 + smaller variability in growth

25.3b: 25.3 + larger variability in growth

Recommendations for GMACS in September

Bringing forward models 25.1 and 25.3a for consideration in September seems reasonable. Incorporating the ADFG data changed the model output substantially even when adjusting the weighting schemes and prior specifications, but including as many data sources as possible seems prudent when working with a small population with sparse data. More discussion on the treatment of the pot survey data and tagging data would be useful from the CPT. Given limited resources going forward and the lack of a fishery for PIRKC in the foreseeable future, discussion about the continuation of a model-based assessment for PIRKC may also be warranted.

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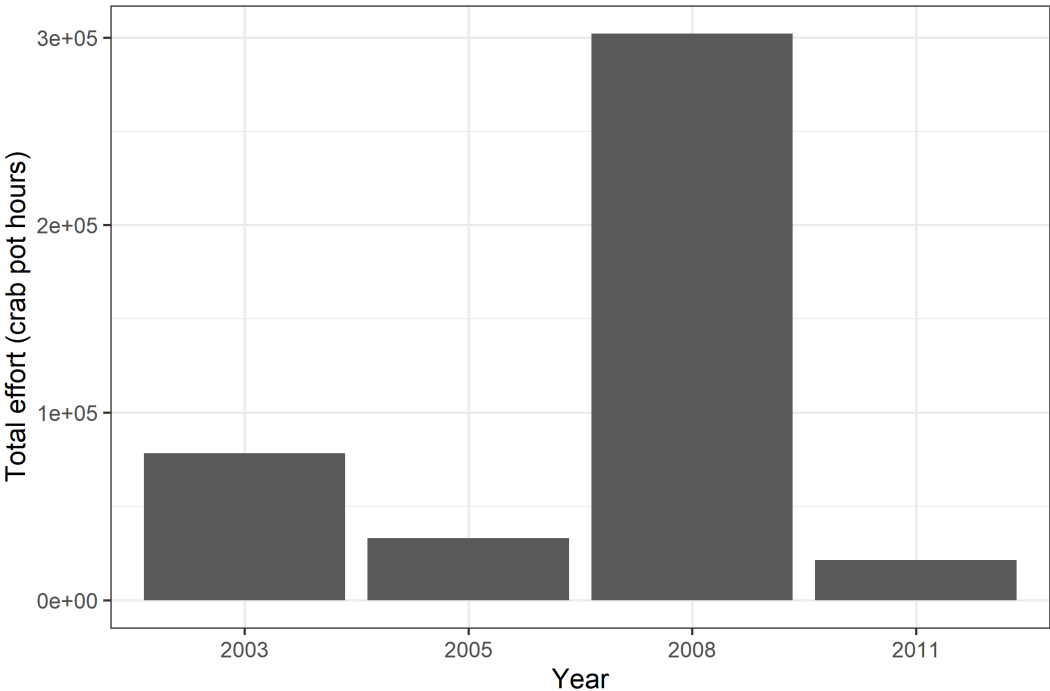
25.2: 25.1 + ADFG pot survey

25.3: 25.2 + down_wt size comps + prior on growth increment

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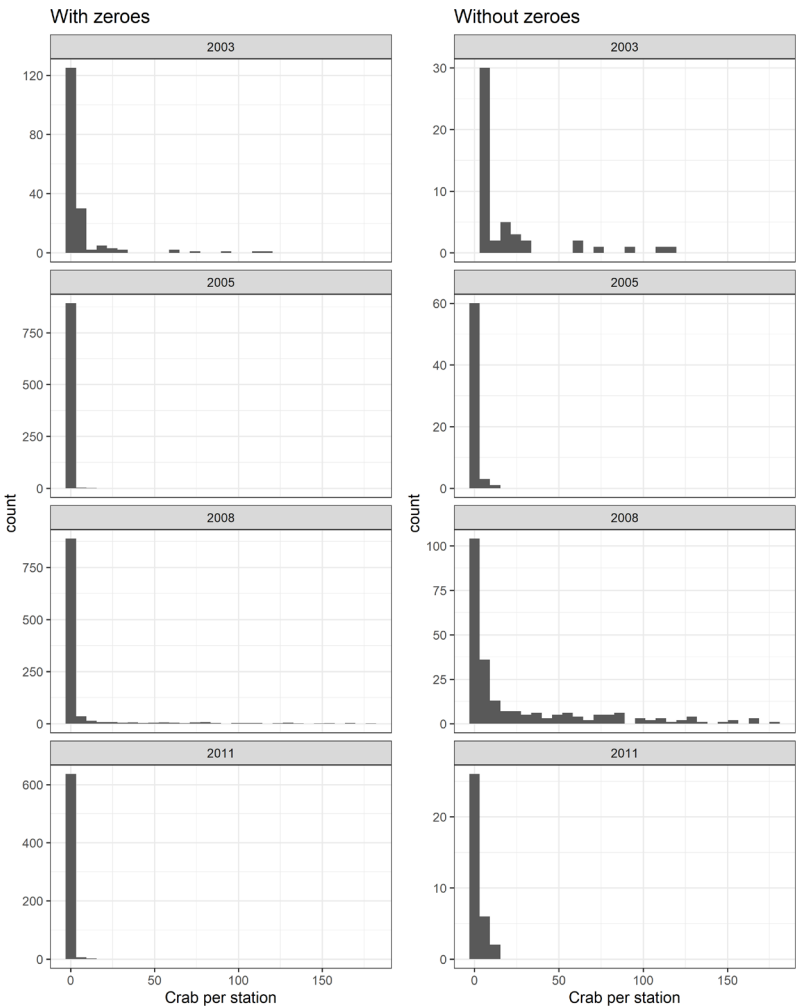
25.2: 25.1 + ADFG pot survey

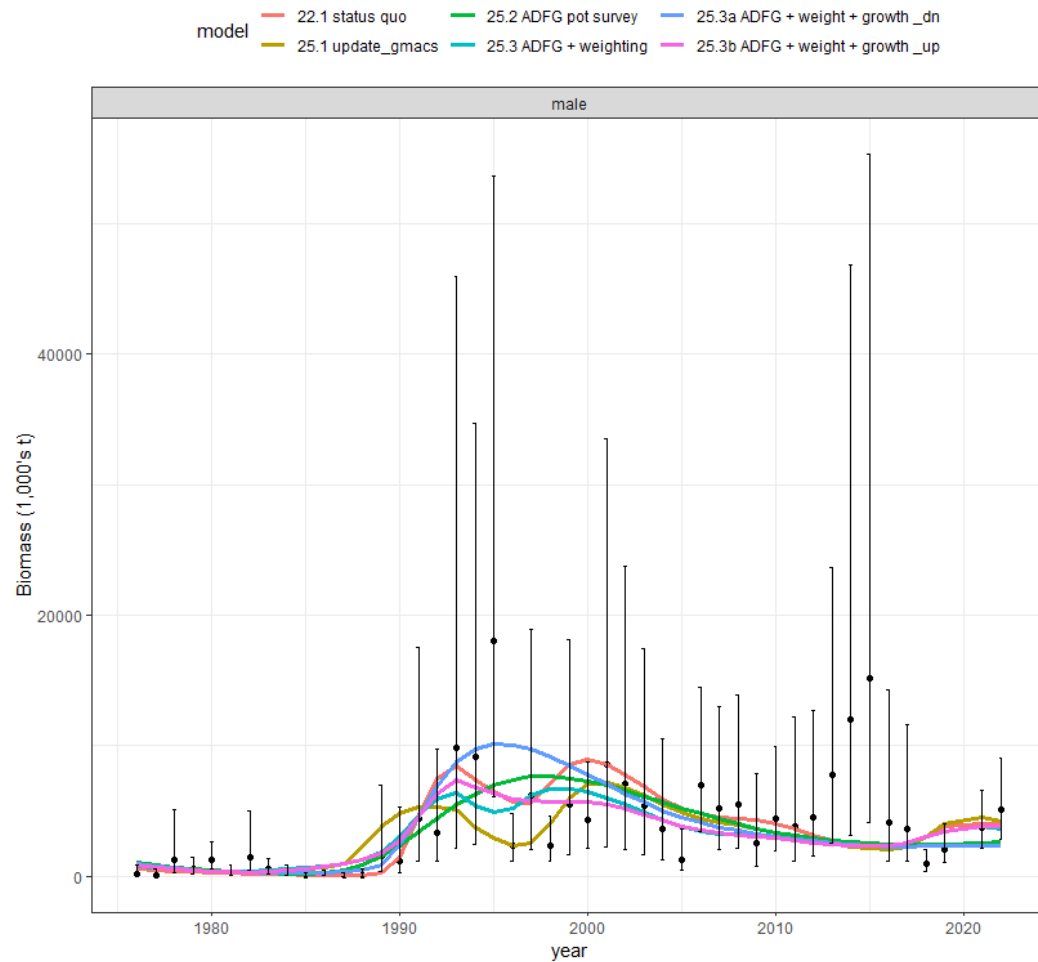25.3: 25.2 + down size comps + prior on growth increment

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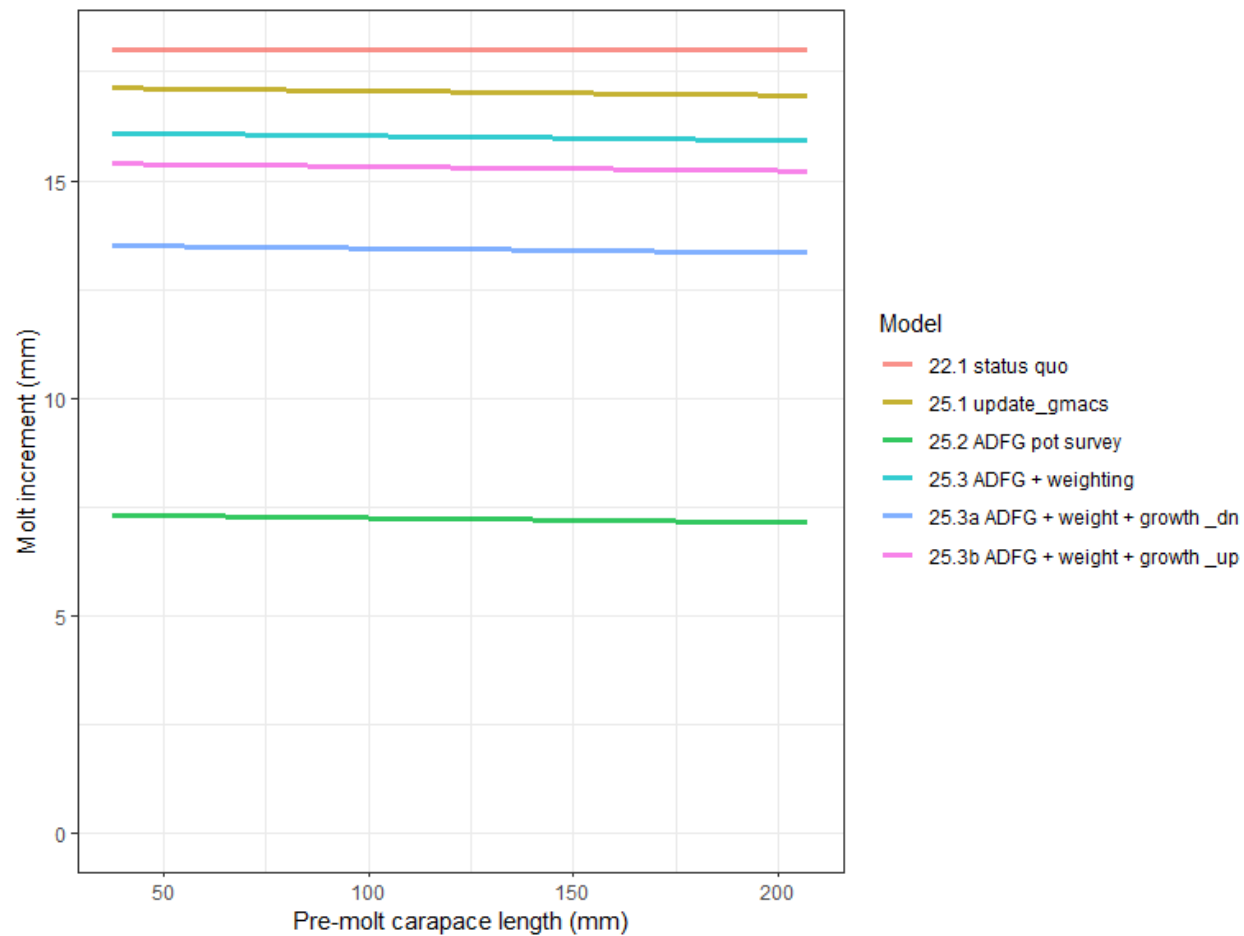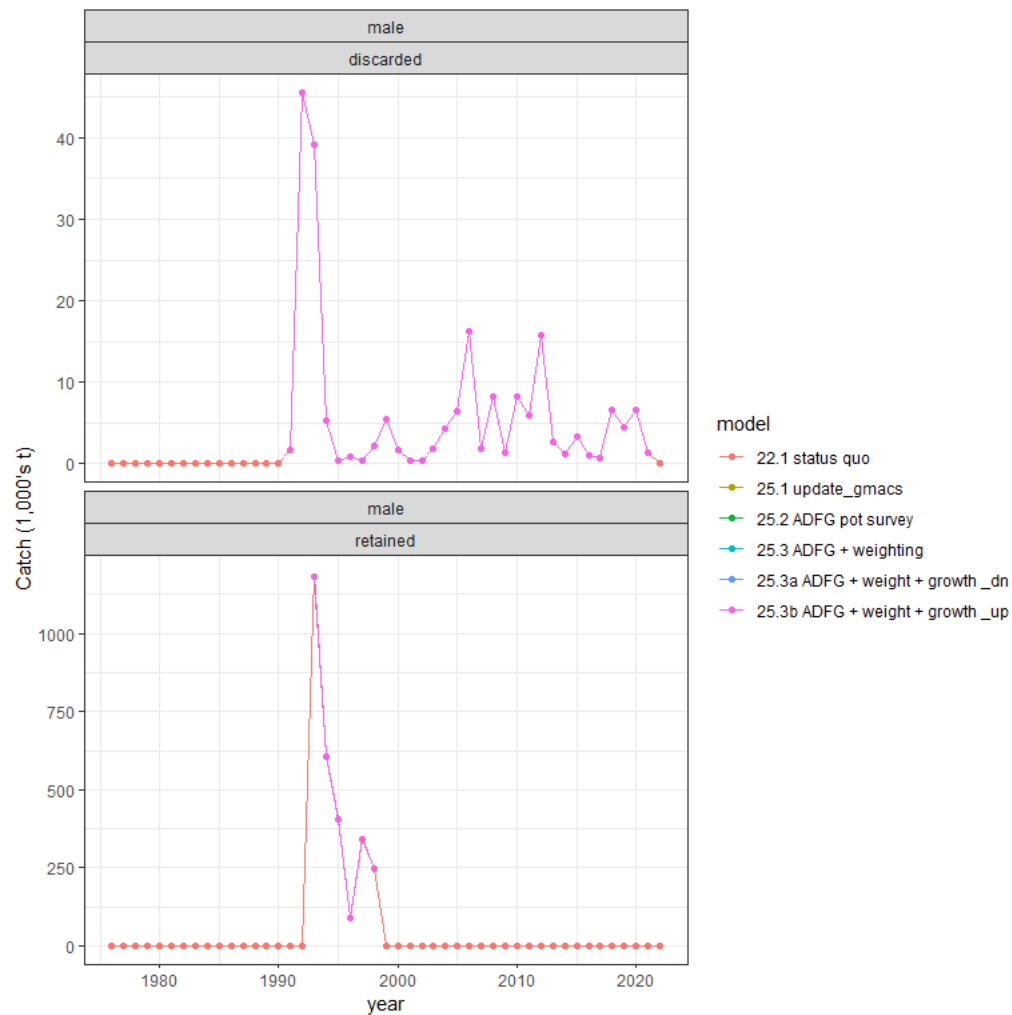
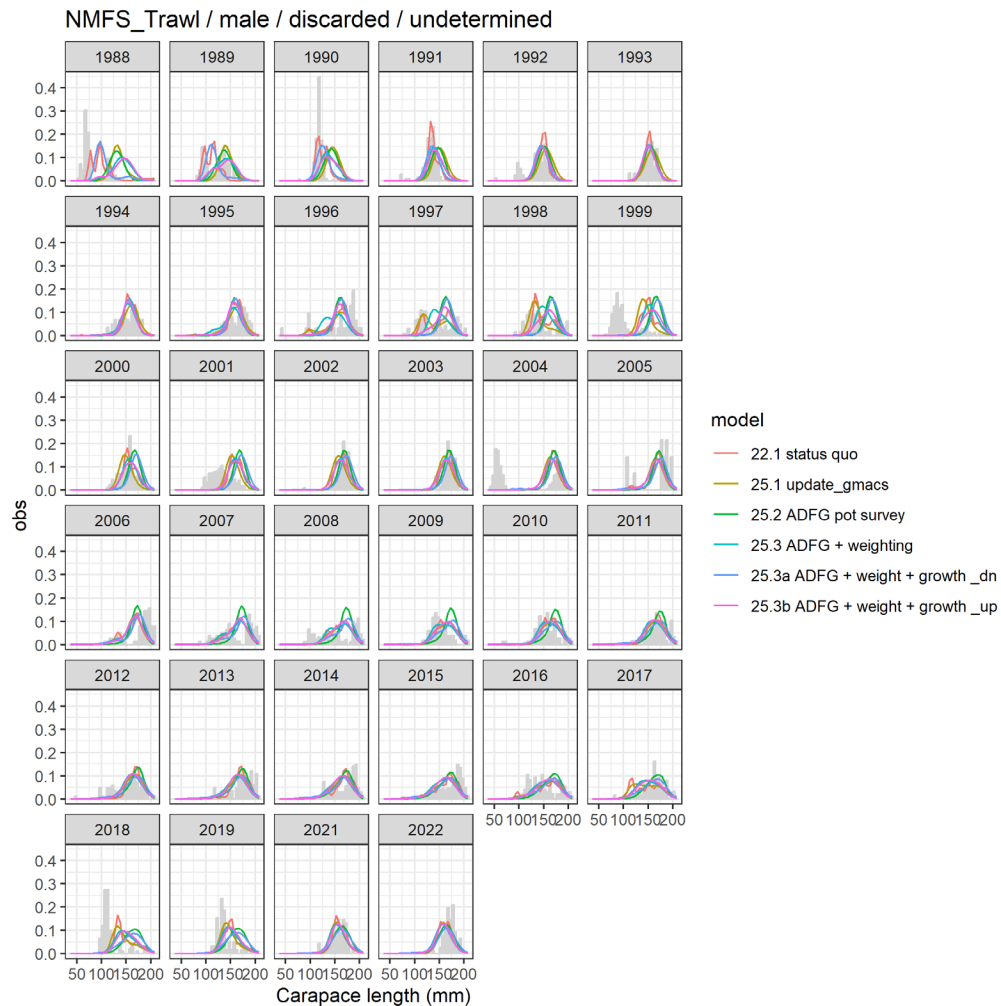Model fits to the observed mature male biomass at survey.
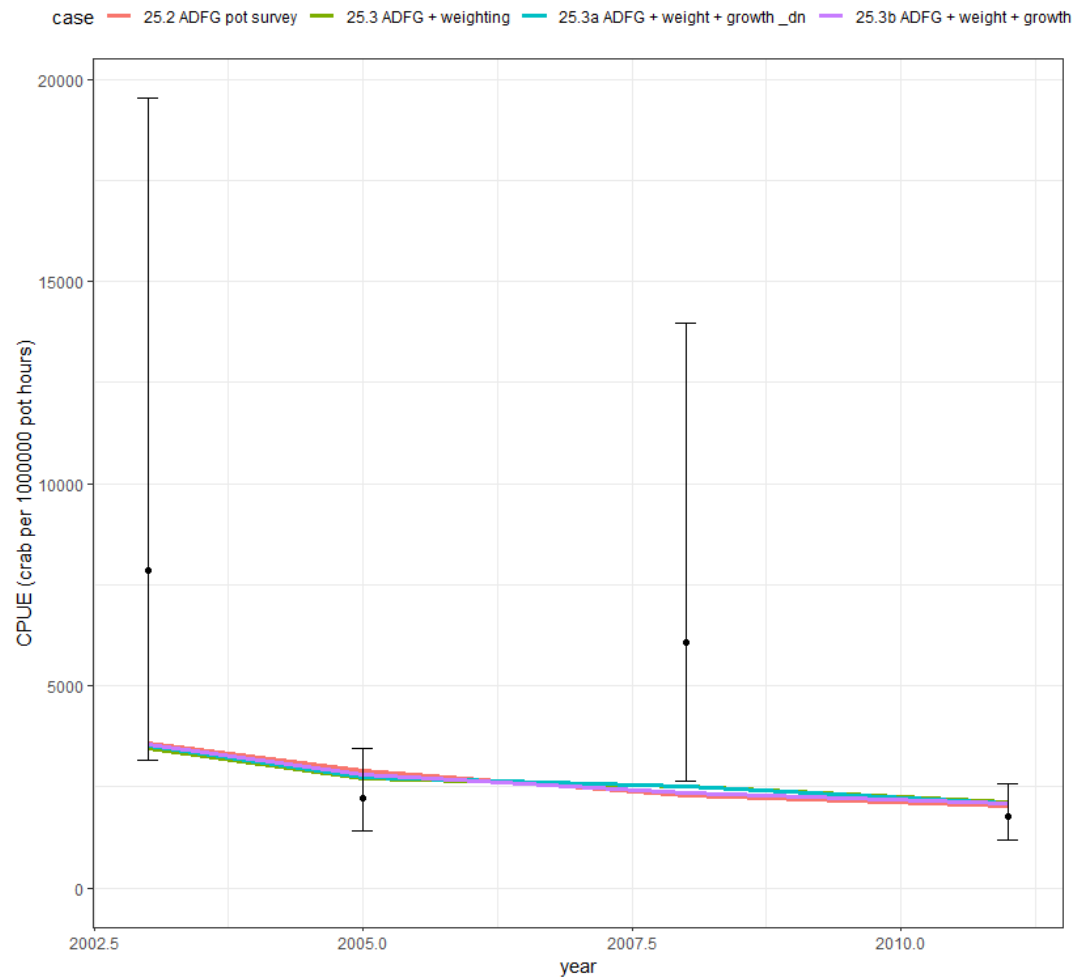
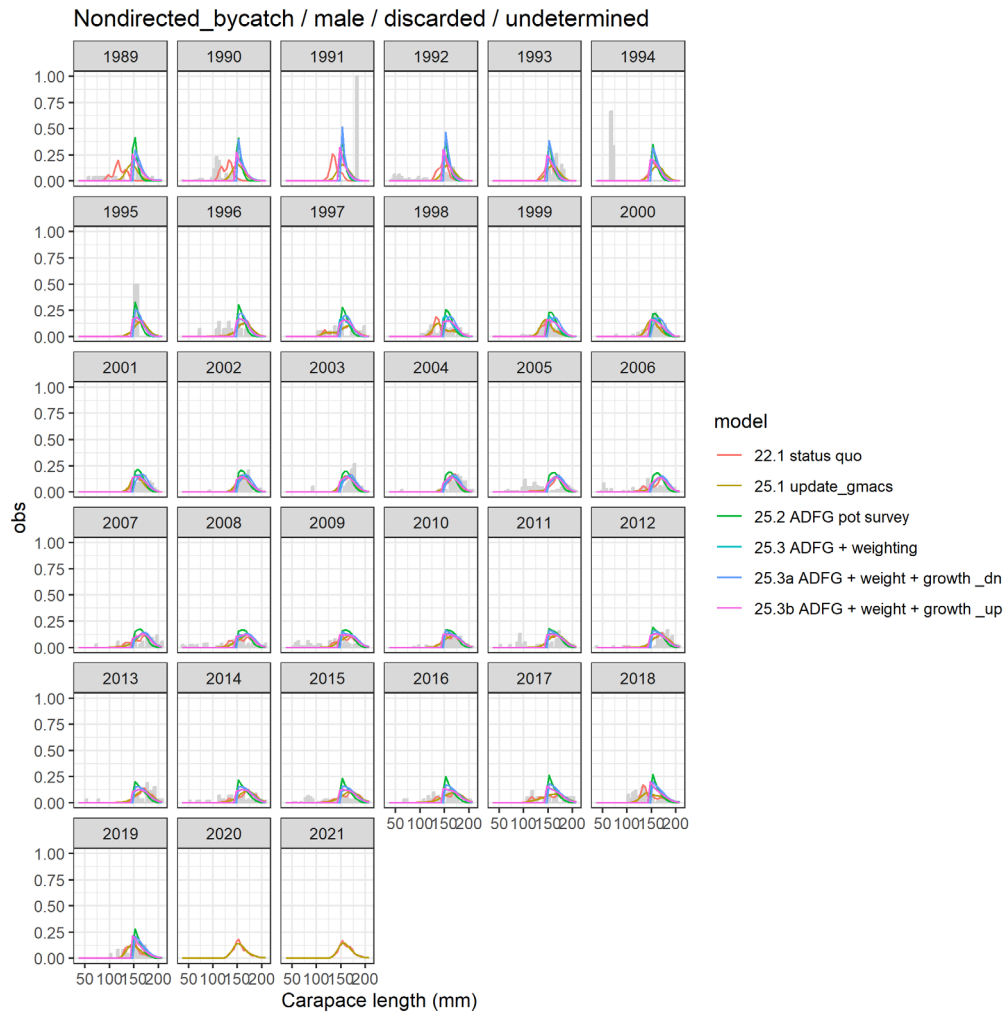Model fits to the ADFG pot survey data.

Model estimates of molt increment at size (colored lines).

Model fits to non-directed bycatch data (top) and retained catch data (bottom).
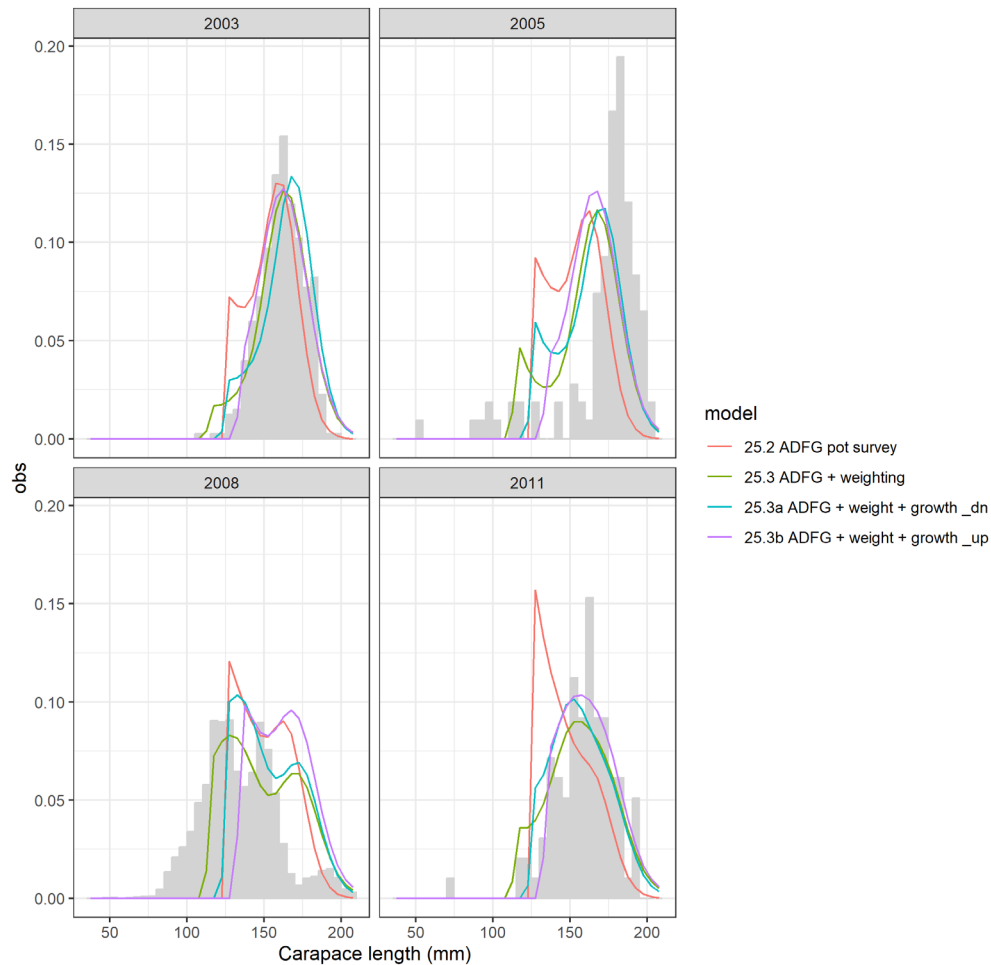
Model fits (lines) to the NMFS bottom trawl survey size composition data (grey bars).
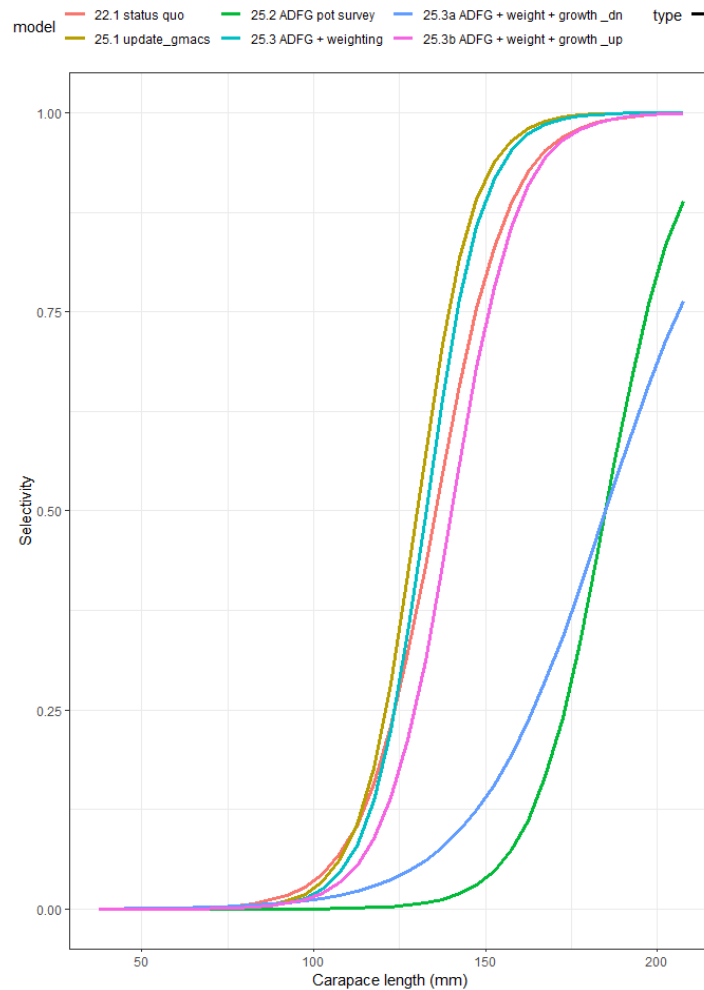
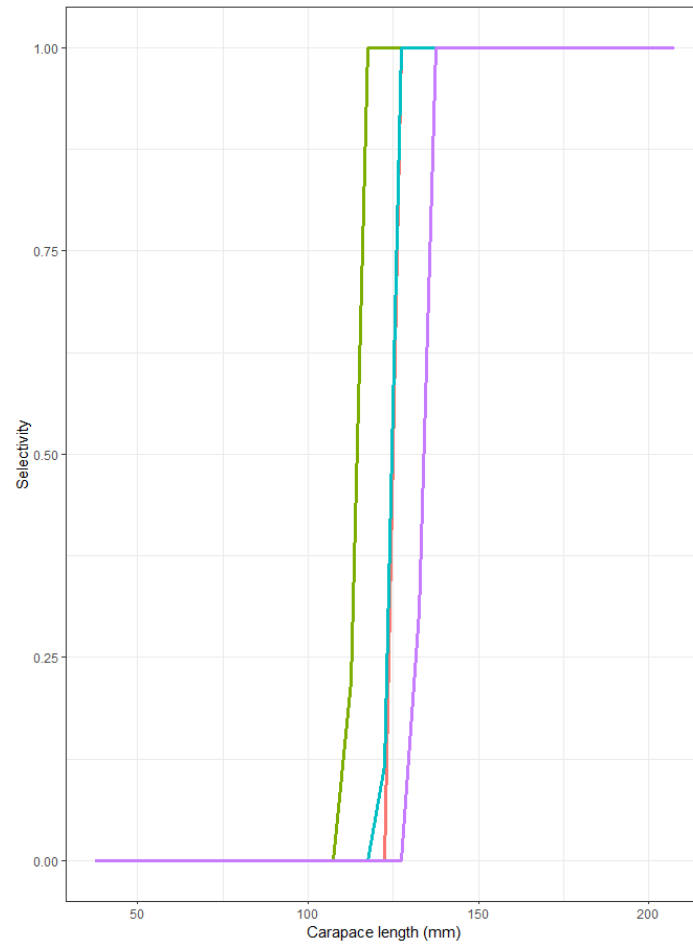Model fits (lines) to the non-directed bycatch size composition data (grey bars).

Model fits (lines) to the ADFG pot survey size composition data (grey bars).

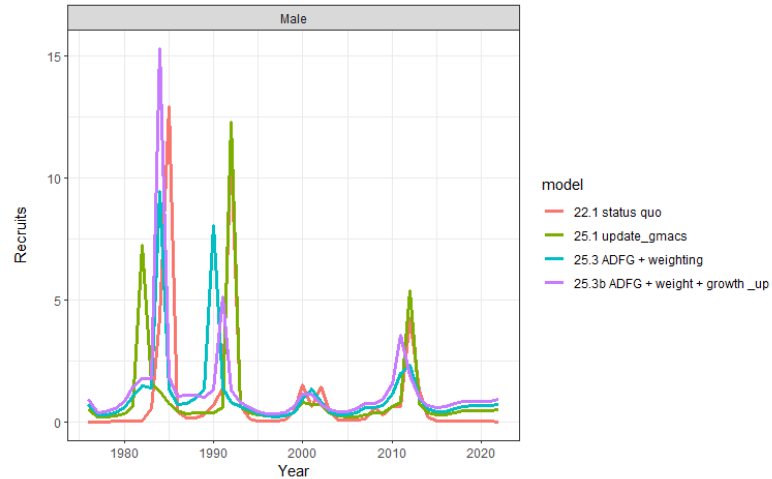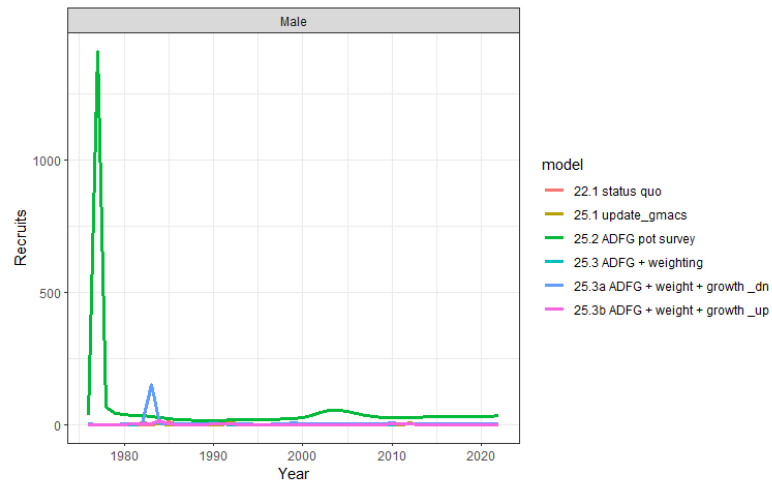Estimated NMFS bottom trawl survey selectivity (lines) at size (x-axis)

Estimated ADFG pot survey selectivity (lines)

Estimated recruitment by model. Bottom figure excludes two models that had a different scale than the rest so the remaining models can be compared.
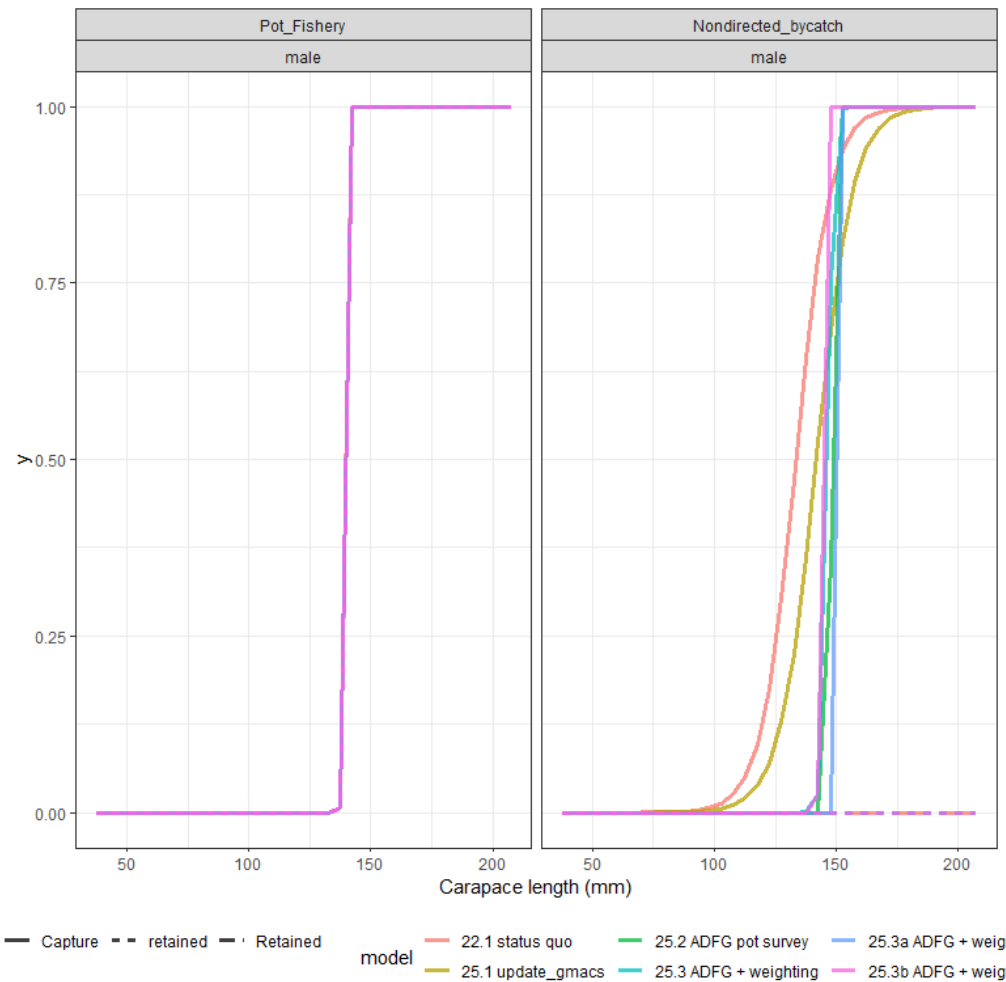
Estimated selectivities by fishing fleet and sex for capture and retained catches.
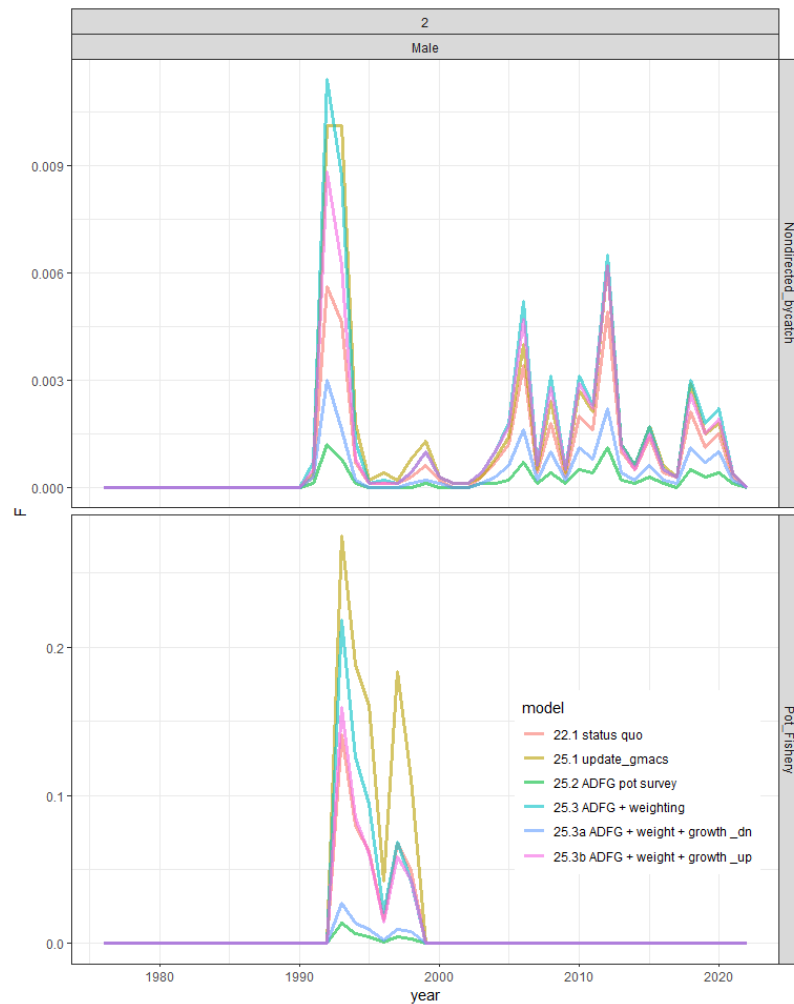
Estimated fishing mortalities for the directed and non-directed fisheries.
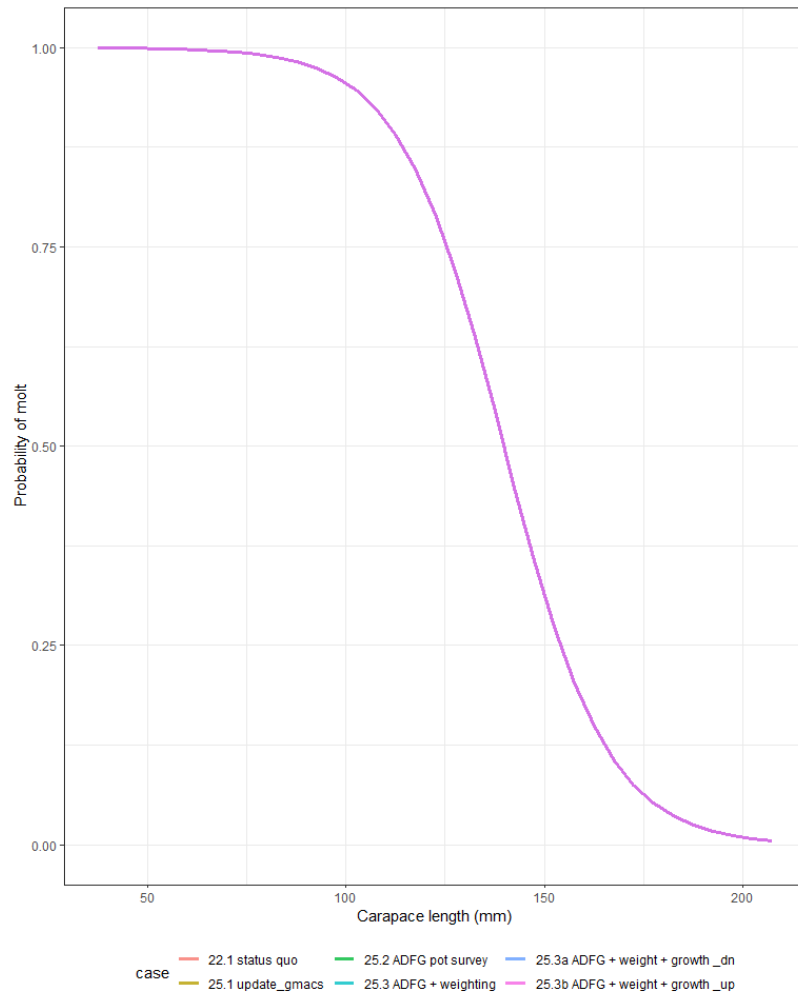
Probability of molting. Probability of molting at size was specified based on BBRKC for all models.

Model predicted mature male biomass at mating time in tonnes.

The harvest control rule for PIRKC is calculated based on a **tier 4** rule that uses the specified **natural mortality** as a fishing mortality target and defines the proxy for B_{MSY} **as 35% of the average MMB over the years 2000-prese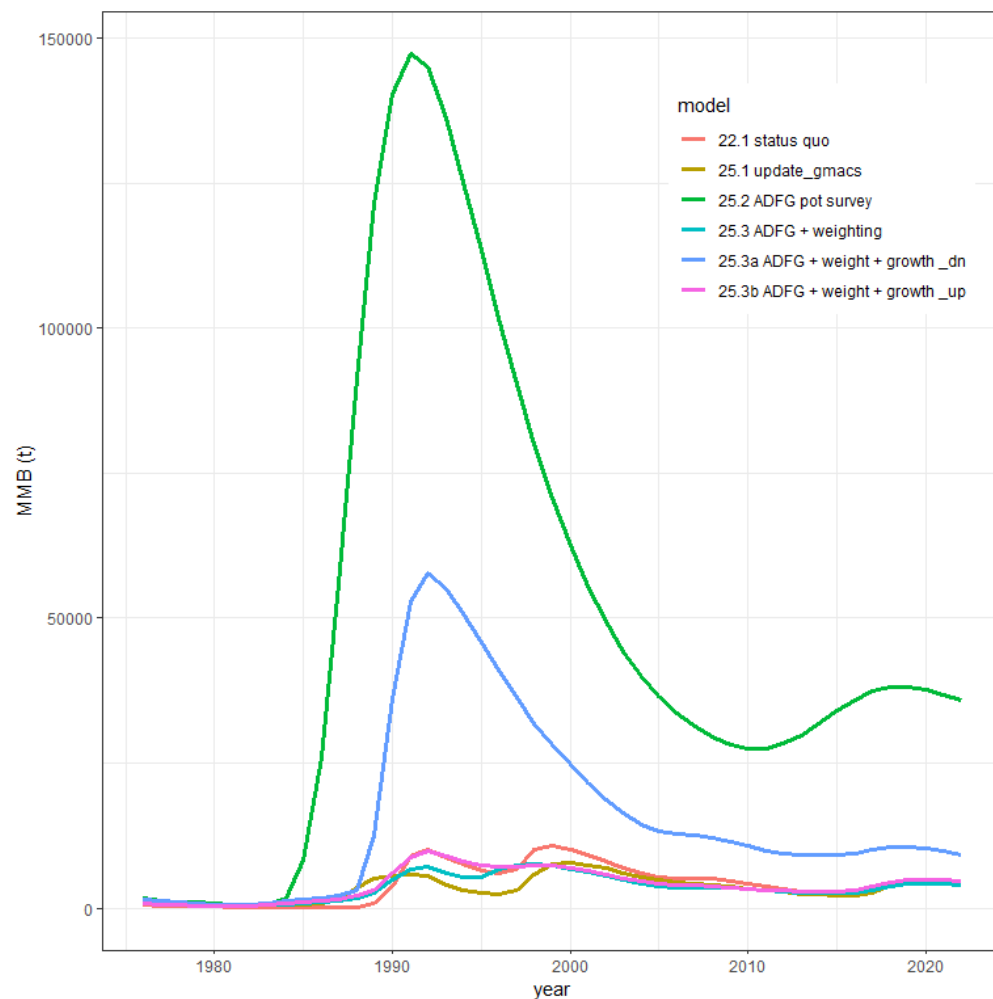nt** minus 1 (provided the stock remains unfished). These management targets are then used in the harvest control rule below to calculate an OFL.

$$F_{OFL} = \begin{cases} Bycatch\,only & if\,\frac{MMB}{MMB_{MSY}} \leq 0.25 \\[2em] \frac{\lambda M(\frac{MMB}{MMB_{MSY}} - \alpha)}{1 - \alpha} & if\,0.25 < \frac{MMB}{MMB_{MSY}} < 1 \\[2em] \lambda M & if\,MMB > MMB_{MSY} \end{cases}$$

Where MMB is the mature male biomass projected to the time of mating, MMB_{MSY} is 35% of the average mature male biomass over the years 2000-present, M is natural mortality, and α determines the slope of the descending limb of the HCR (here set to 0.1). The differences in estimated MMB resulted in large variability in the OFLs among models (). The current status of PIRKC from all models is more than twice the biomass targets, so the full FMSY proxy was applied to calculate the OFL, which ranged from 685-6328 tonnes.

	MMB	BMSY	Status	OFL	FMSY
22.1 Status quo	3616.74	1708.83	2.27	685.07	0.21
25.1 update_gmacs	4033.78	1506.56	2.87	764.06	0.21
25.2 ADFG pot survey	33410.19	12931.42	2.77	6328.42	0.21
25.3 ADFG + weighting	3632.48	1352.01	2.88	688.05	0.21
25.3a ADFG + weight + growth _dn	8564.54	4342.78	2.12	1622.26	0.21
25.3b ADFG + weight + growth _up	4270.39	1484.35	3.09	808.88	0.21

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Recommendations for GMACS in September

1. Bring forward models 25.1 and 25.3a

2. ADFG data substantial change, but not unreasonable

3. How to treat tagging data?

4. Do we bother doing GMACS assessments for this stock?