2025 Re-evaluation of the recruits-per-spawner and CalCOFI SST relationship in Pacific sardine

Presentation for the PFMC SSC CPS subcommittee

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Background: 2013 workshop

- Explored many model and data configurations and options
- Selected a GAM to assess the relationship between recruits-per-spawner and sea-surface temperature (SST)
- Spawners were represented by age 2+ biomass
- Spawner and recruit data were assembled from stock assessments 1984-2008
- The index of SST comes from CalCOFI quarterly survey estimates

Context

- The purpose of this analysis is to assess the relationship between recruits-per-spawner and the CalCOFI SST
- Use the best selected models from the 2013 workshop and apply the same method with updated data sets for biomass, recruitment, and CalCOFI SST

Data: biomass and recruits

- Recruits/spawner data for 1984-2004 were appended with the most recent stock assessment estimates of age 2+ biomass and recruits from 2005-2023 (Kuriyama et al, 2024)
- Two recruits/spawner time series:
  - one time series patching together the 1984-2023 data
  - one with only the most recent stock assessment data from 2005-2023.

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Data: sea-surface temperature (SST)

- Reported workshop values slightly different from [current] standard generation methods

- Replaced workshop SST with reported SST from recent stock assessments and values generated consistent with the current method (Ed Weber)

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GAM models

- Fitting to a log(recruits/spawner)
- Three GAM types:
  - Configuration L – SST as a linear covariate:

    $$\alpha + s(S_y, k = 3) + \beta T_y + \varepsilon_y$$

  - Configuration G (consistent with the model chosen in the 2013 workshop) – smoothed SST (non-linear covariate):

    $$\alpha + s(S_y, k = 3) + s(T_y, \text{k=3}) + \varepsilon_y.$$

  - Configuration B – no SST covariate:

    $$\alpha + s(S_y, k = 3) + \varepsilon_y.$$

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Results

Analysis	Time series	GAM type	GAM	N	Resid. DF	EDF of SST	AIC	R^2 adjusted	Squared Pearson corr. (R^2)
New	1984-2023	B	no SST covariate	40	38	0	122.2	0.11	0.13
New	**1984-2023**	**G**	**smooth SST covariate**	**40**	**35.5**	**1.89**	**106**	**0.44**	**0.49**
New	1984-2023	L	linear SST covariate	40	36.69	1	112.7	0.32	0.36
New	2005-2023	B	no SST covariate	19	17	0	66.49	-0.04	0.02
New	2005-2023	G	smooth SST covariate	19	15.33	1.67	63.42	0.18	0.3
New	2005-2023	L	linear SST covariate	19	16	1	65.18	0.07	0.17
Workshop	**1984-2008**	**G**	**smooth SST covariate**	**25**	**21.73**	**1.27**	**44.49**	**0.741**	**0.762**
Workshop	1984-2008	L	linear SST covariate	25	22	0	44.68	0.731	0.762

Preliminary results presented to SSC CPS Subcommittee

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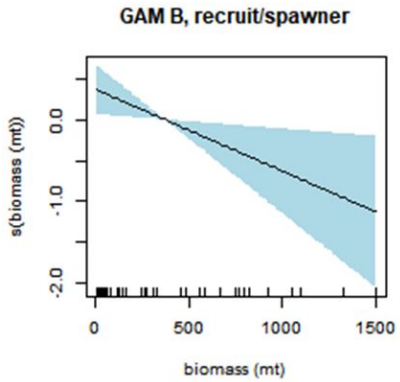
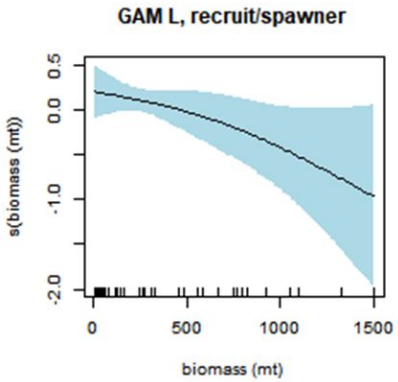
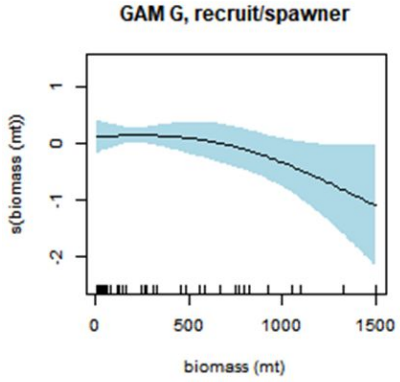
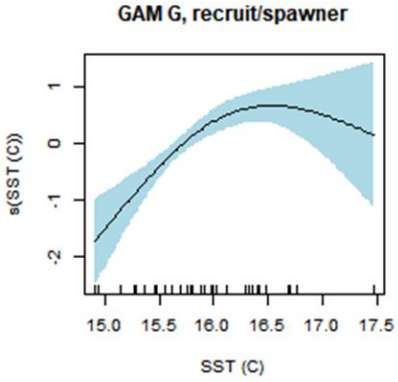
Results

Extended time series (1984-2023)

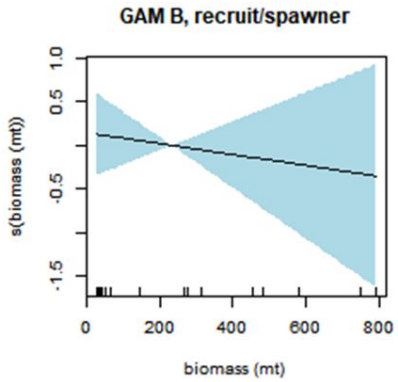


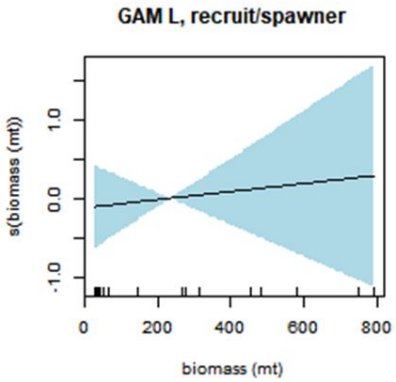


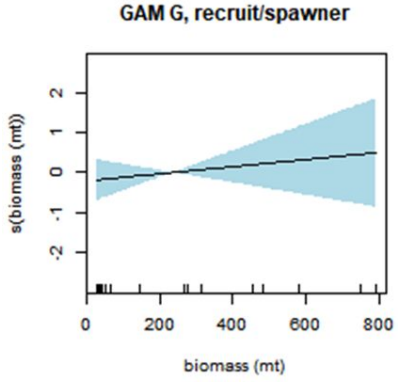


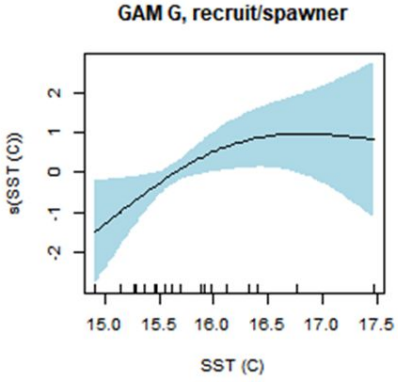


Short time series (2005-2023)









Preliminary results presented to SSC CPS Subcommittee

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Conclusion

The best fitting model is still the GAM with CalCOFI SST as a smoothed covariate (model G) for the extended time series (1984-2023).

The adjusted R^2 shows a decrease in the amount of variance explained in recruits/spawner by CalCOFI SST compared with the workshop findings.

The recent time series (2005-2023), which uses biomass and recruits generated in a consistent manner from the 2024 benchmark assessment, shows a much lower R^2 than the extended time series. However, AIC still suggests this is better than no SST covariate.

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Questions or discussion

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