

CalCOFI and Rockfish Management

Stock Assessment

- Many rockfishes were heavily fished from the 1950's-1990's off the west coast of the U.S. (Fig. 1).
- In southern CA two stocks, bocaccio (*Sebastes paucispinis*) and cowcod (*S. levis*) (Fig. 2), were formally declared overfished and stock sizes have been assessed several times since the early 2000s.
- Bocaccio and cowcod larval abundances from CalCOFI sampling (1951-present) are used to generate estimates of spawning output that are directly input in the stock assessments.
- CalCOFI data allows stock assessment scientists to track bocaccio and cowcod spawning output through time (Fig. 3).



Fig. 1. Cowcod caught on a recreational fishing trip in the 1970s. Photo provided by John Butler.

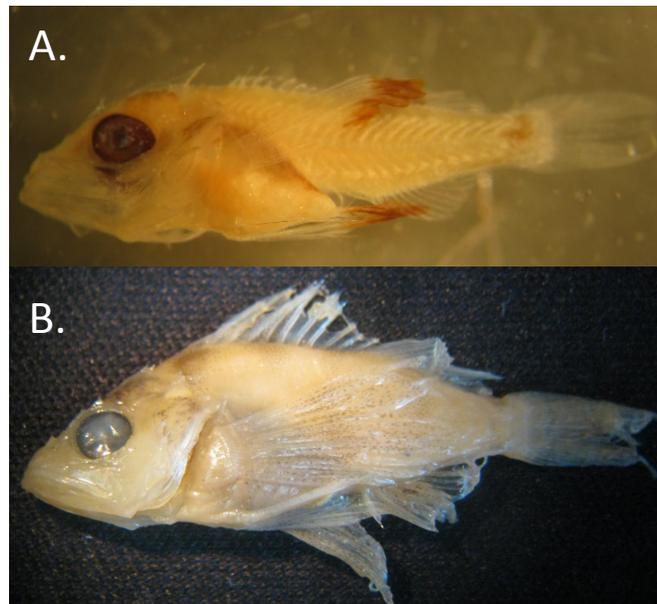


Fig. 2. Larval A. bocaccio and B. cowcod from CalCOFI samples.

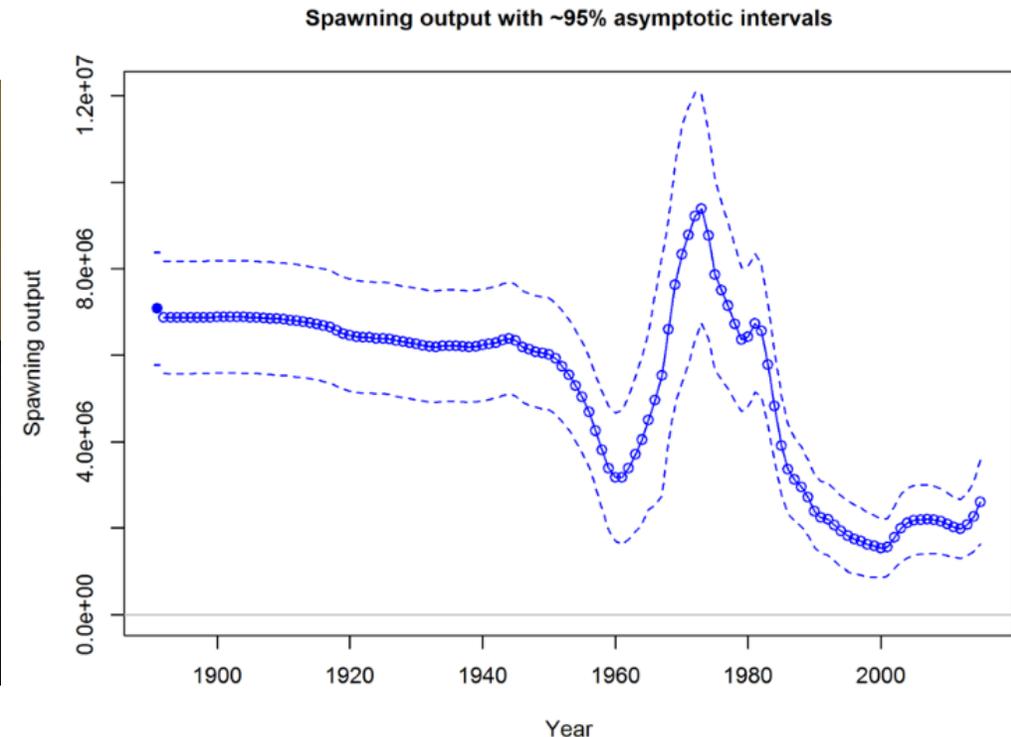


Fig. 3. Bocaccio spawning output estimates based on CalCOFI larval abundances from "Status of Bocaccio, *Sebastes paucispinis*, in the Conception, Monterey and Eureka INPFC areas for 2015" by He et al. 2015.

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Marine Protected Areas

- In response to overfishing, two large marine protected areas, the Cowcod Conservation Areas (CCAs), were established in 2001 (Fig. 1).
- Within the CCAs fishing deeper than 36 m is prohibited to protect adult rockfish habitat.
- CalCOFI measures rockfish spawning output within and outside the CCAs (Fig. 2) before and after 2001.
- We examined spawning output between 1998 and 2013 for 4 species that were and 7 that were not targeted by fishing.
- Spawning output increased at a greater rate in than out of the CCAs for $\frac{3}{4}$ of fished rockfishes but none of the unfished rockfishes (Fig. 3).
- CalCOFI data indicates that the CCAs are assisting rockfish rebuilding.

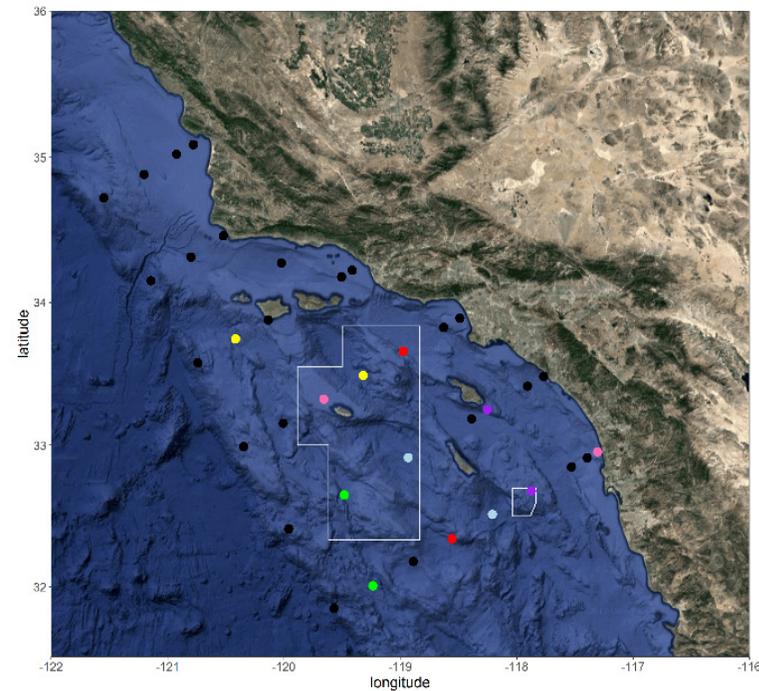


Fig. 1. CalCOFI stations used to evaluate CCA (white boxes) efficacy. Colors describe stations with similar environmental conditions inside vs. outside of the CCAs.

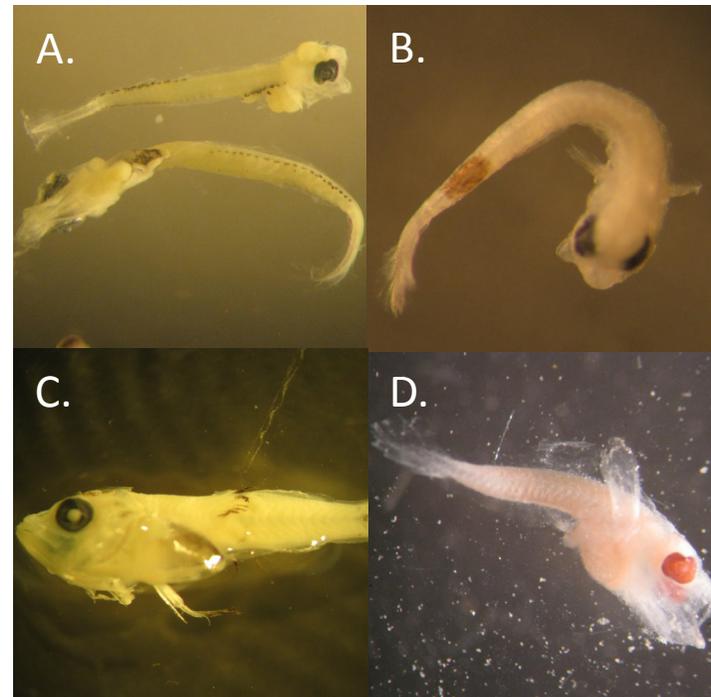


Fig. 2. Rockfish larvae for species that are not targeted by fishing: A. shortbelly & B. whitespeckled; and are targeted by fishing: C. bocaccio & D. cowcod

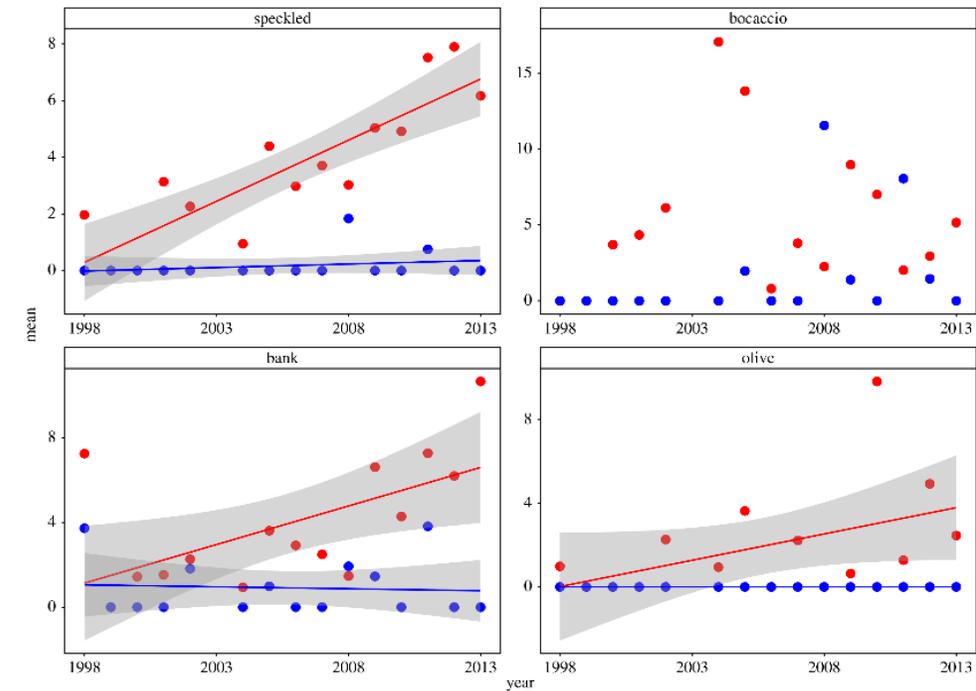


Fig. 3. Mean larval abundances for rockfishes that were historically targeted by fishing inside (red) and outside (blue) of the CCAs. From Thompson et al. 2017 Royal Soc Open Sci 4:170639.