Indices of relative abundance of yellowfin tuna derived from purse-seine catch and effort data

SAC-04-04c

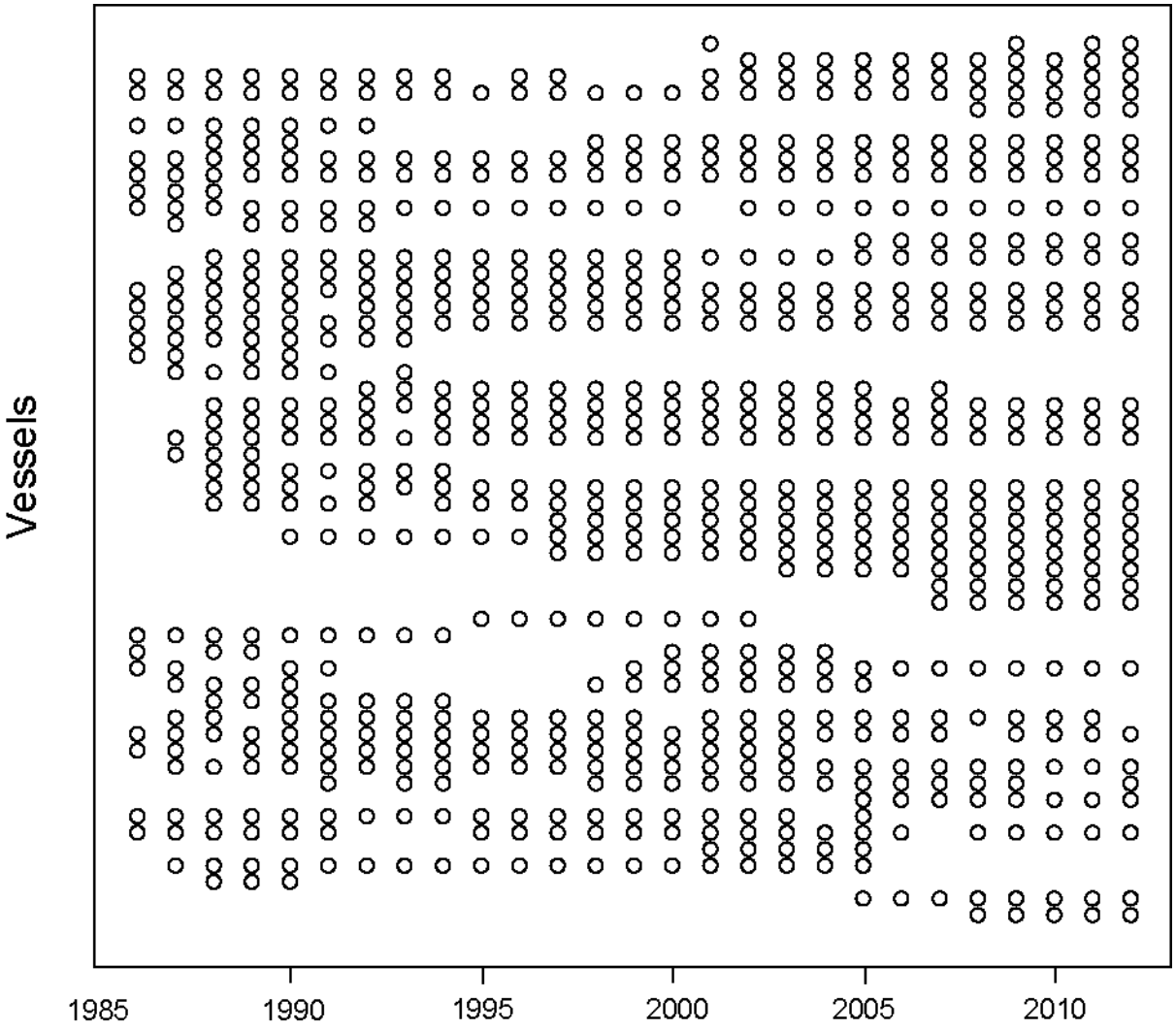
Background

- Indices of relative abundance are an essential component of contemporary stock assessments.
- Catch-per-unit-effort (CPUE) indices are standardized to avoid bias.
- In the current yellowfin assessment only longline indices are standardized.
- Because of the level of yellowfin catch and spatial distribution of effort, purse-seine CPUE may yield a useful standardized index.
- SAC-04-04c presents preliminary work standardization of purse-seine CPUE.

Materials and methods

- Data used in the analysis
  - IATTC observer data for Mexican and Venezuelan vessels (size-class 6).
  - Data set was limited to vessel making a minimum of 5% of their sets per year on tunas associated with dolphins, with a minimum of 3 years in the database.
  - Time period of the analysis: 1986-2012.

Vessel time lines



Materials and methods

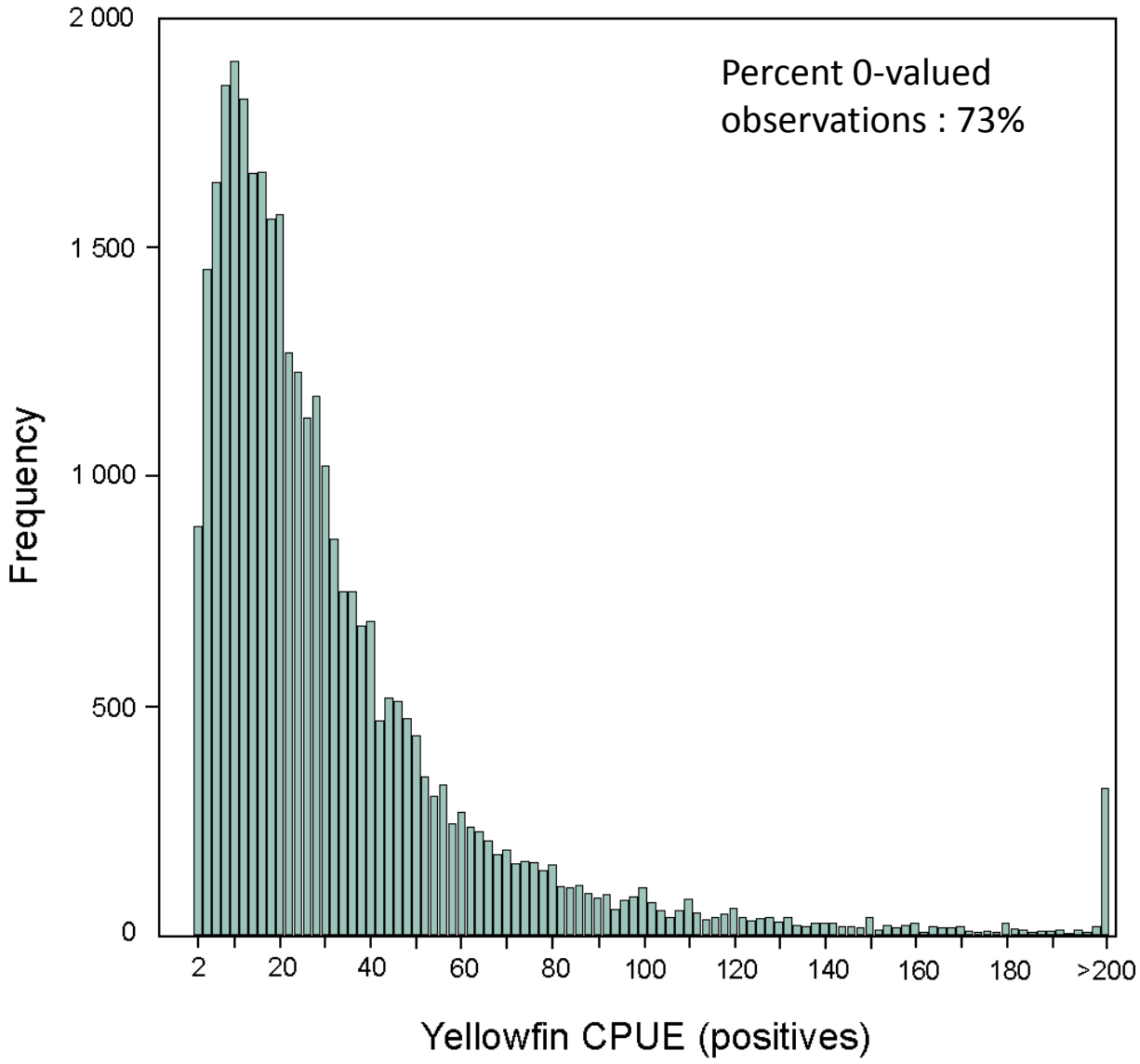
- Variables used in the analysis

  - CPUE = metric tons yellowfin catch per day of fishing

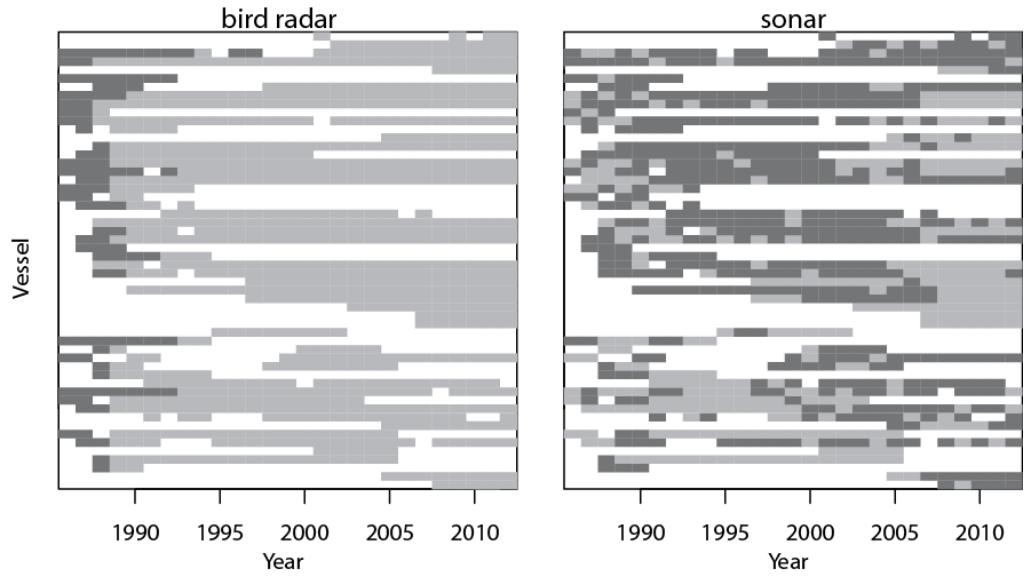
  - Explanatory variables
    - Year-quarter
    - Latitude, longitude
    - Vessel and gear characteristics
      - vessel capacity, year of construction, vessel ID
      - presence/absence of bird radar, sonar
      - number speedboats
      - presence/absence of ring stripper, power block diameter
      - net length and depth, dolphin safety panel length

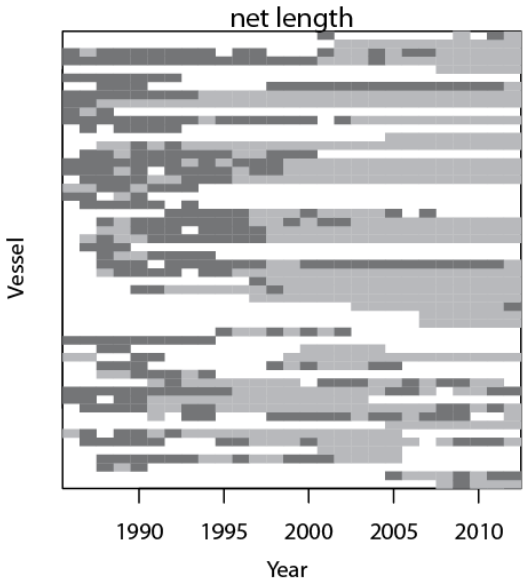
  - Data unit used in the analysis: 1° area - month - trip

Distribution of CPUE



Gear characteristics time lines





Materials and methods

- Trend estimation
  - Delta-lognormal generalized additive models fitted to the data:

    (i)

    $$\text{logit}(p) = \text{constant} + \text{year-quarter effect} + \text{smooth(days)} + \text{smooth(lat,long)}$$

    $$\log(CPUE_{+}) = \text{constant} + \text{year-quarter effect} + \text{smooth(lat,long)}$$

    (ii)

    $$\text{logit}(p) = \text{constant} + \text{year-quarter effect} + \text{smooth(days)} + \text{smooth(lat,long)} + \text{gear} + \text{vessel effect}$$

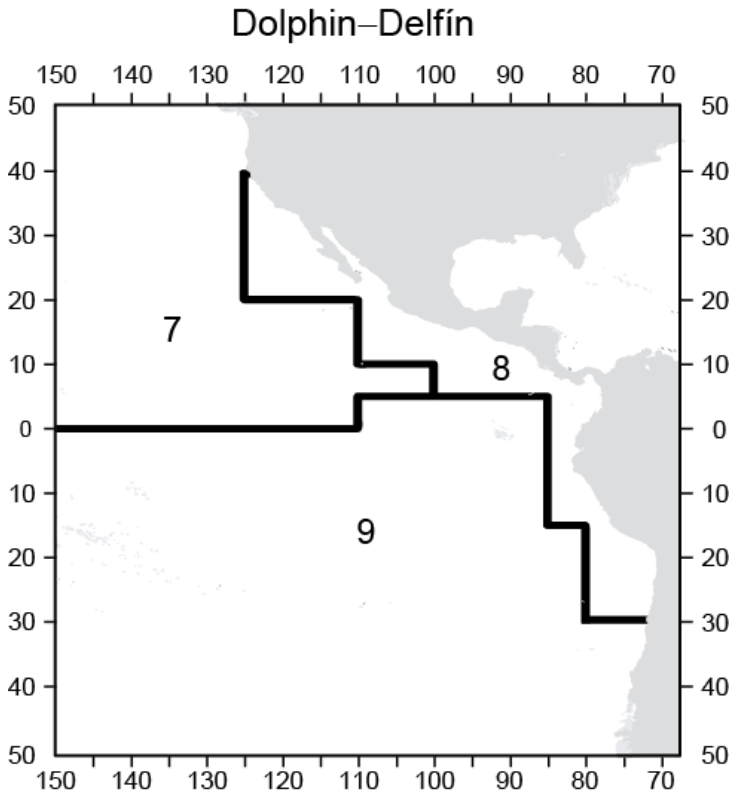
    $$\log(CPUE_{+}) = \text{constant} + \text{year-quarter effect} + \text{smooth(lat,long)} + \text{gear} + \text{vessel effect}$$

  - Models fitted separately to data of Mexican and Venezuelan vessels, by stock assessment area.

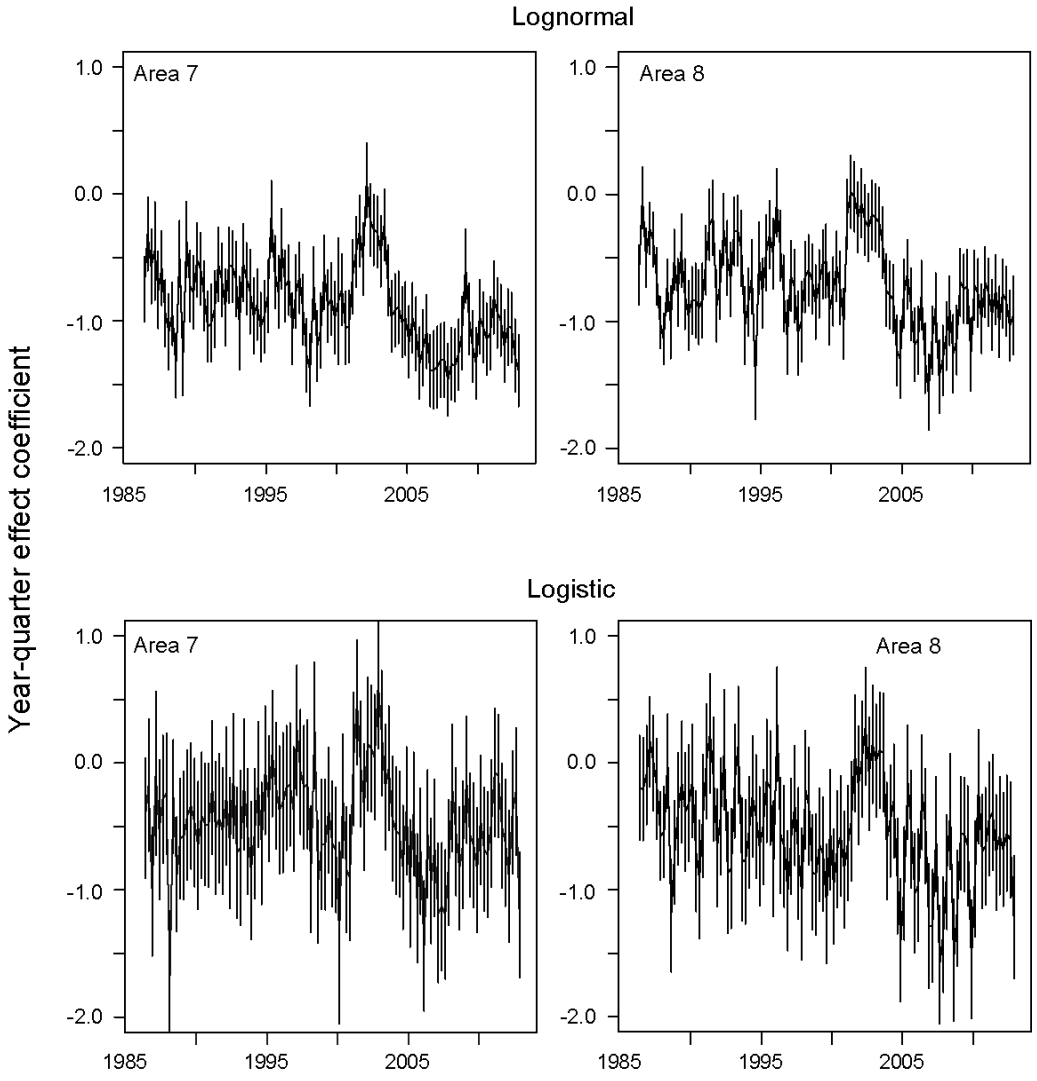
  - Standardized trends computed from model coefficients by partial dependence.

Materials and methods

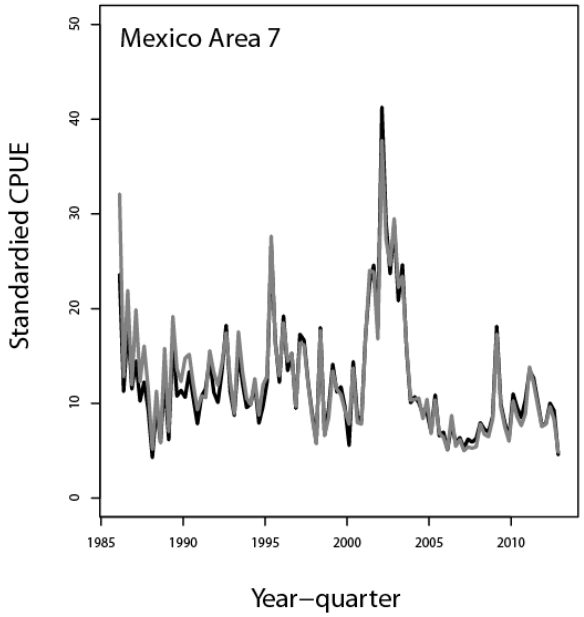
- Purse-seine dolphin-set stock assessment areas

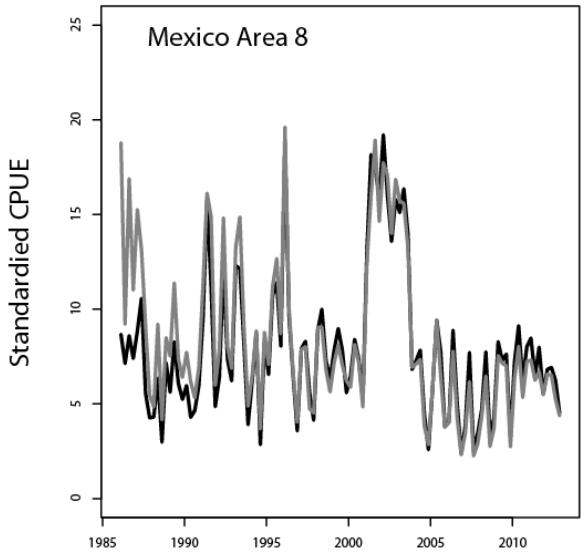


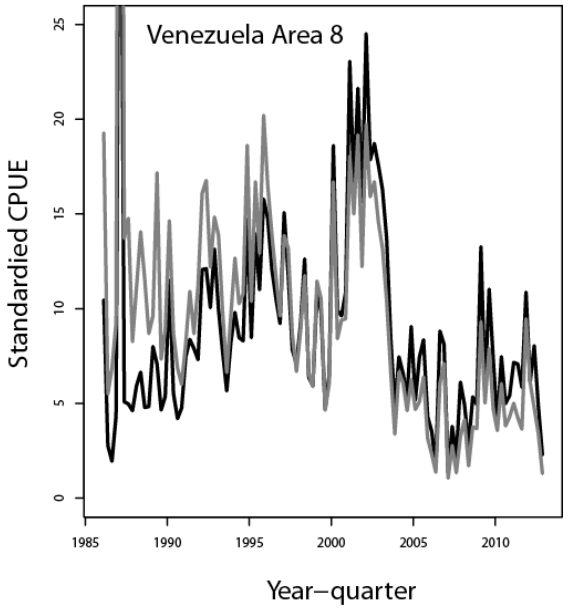
Results: year-quarter effect coefficients



Results: standardized trends



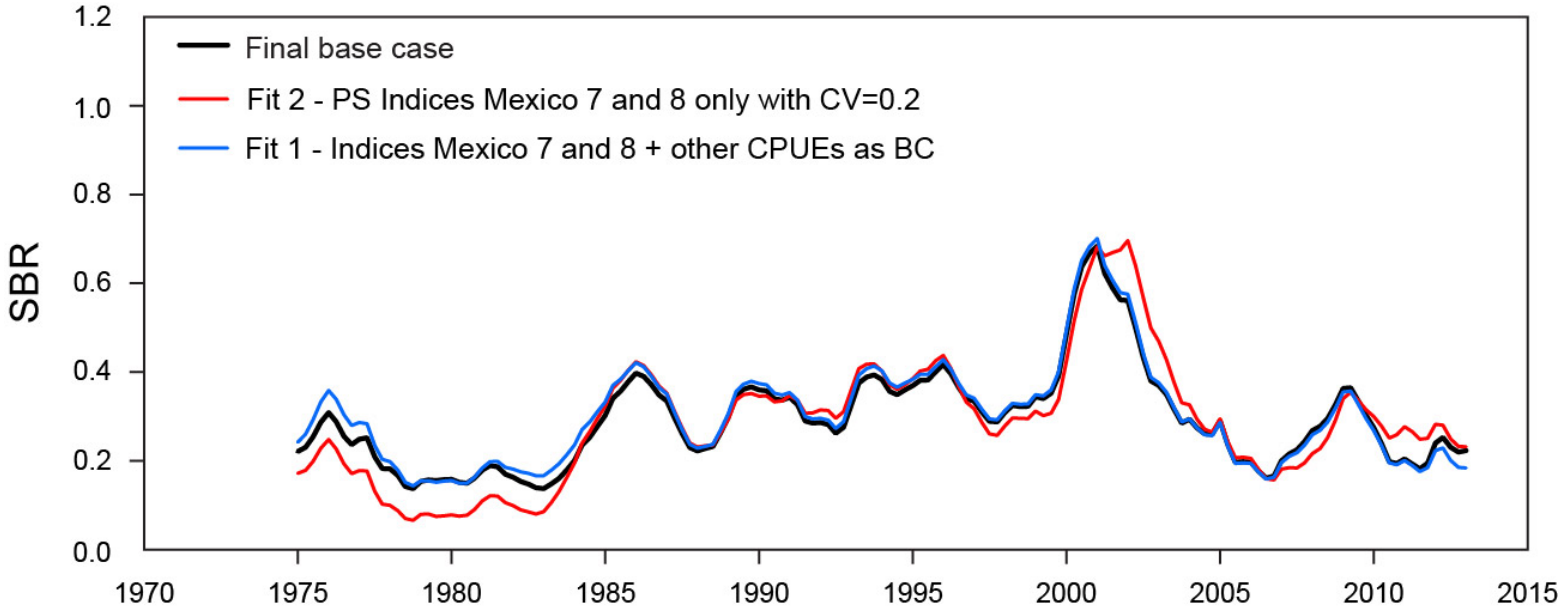




Black: GAM without gear and vessel predictors

Gray: GAM with gear and vessel predictors

Effect on yellowfin spawning biomass ratio



Summary and future work

- Summary
  - Observer data of Mexican and Venezuelan vessels were used to compute standardized purse-seine indices for 1986-2012.
  - Estimated trends showed a general decline, except around ~2001-2003.
  - Standard errors for year-quarter effect coefficients were large.
  - Percent deviance explained and residual diagnostics indicated model fit could be improved.

- Future work
  - Explore alternative ways of computing days fishing.
  - Explore other distributional models for CPUE data.