

Poststratified estimators of total catch for the purse-seine fishery port-sampling data

SAC-02-10



Why consider poststratification?

- Tuna stock assessment presently uses large areas formed from sampling areas.
- Because of recent changes in the purse-seine fishery, it is useful to be able to consider alternative spatial partitions of the eastern Pacific in the assessments.
- To use alternative assessment areas, we need to make modifications to the methodology used to estimate fishery totals.



Outline of presentation

- Background
 - Port-sampling data
 - Sampling and stock assessment areas
 - Example of estimators currently used to compute fishery totals
- Two poststratified estimators of fishery totals
- Method for selecting an estimator
- Future work



Background: port-sampling data

Purse-seine port-sampling data collected since 2000

- To obtain a representative data set, the purse-seine fishery is divided into categories ('strata'):

Area

Month

Mode of fishing

Type of vessel	Type of set
small purse-seiner	floating-object
"	unassociated
"	dolphin
large purse-seiner	floating-object
"	unassociated
"	dolphin



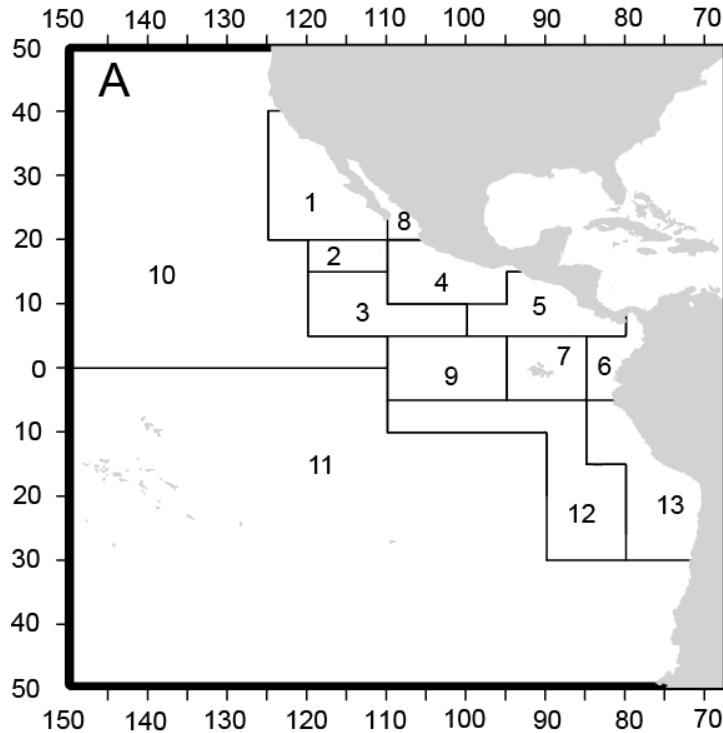
Background: port-sampling data

- Stratified two-stage sampling plan:
 - vessel wells;
 - fish within a well.
- Vessel wells:
 - sampled opportunistically;
 - only sampled if all the fish in the well were caught in the same stratum.
- Fish within a well:
 - individual fish selected from an opportunistically-established starting point during unloading;
 - approximately 50 fish of each species are measured for length;
 - independent of the measured fish, several hundred fish are counted for species composition.

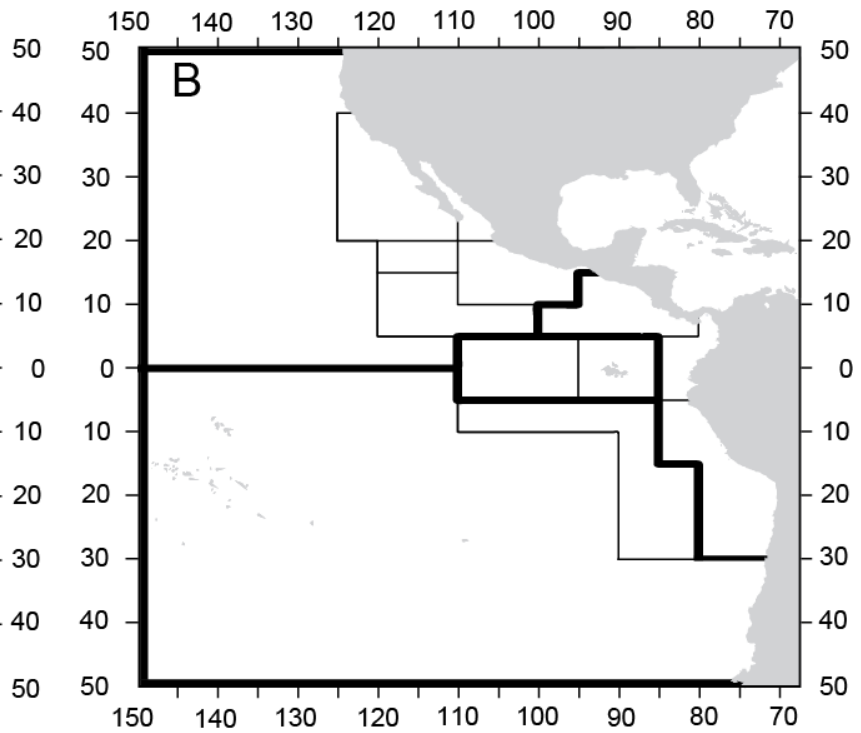


Background– sampling and assessment areas

Spatial strata for collection of port-sampling data

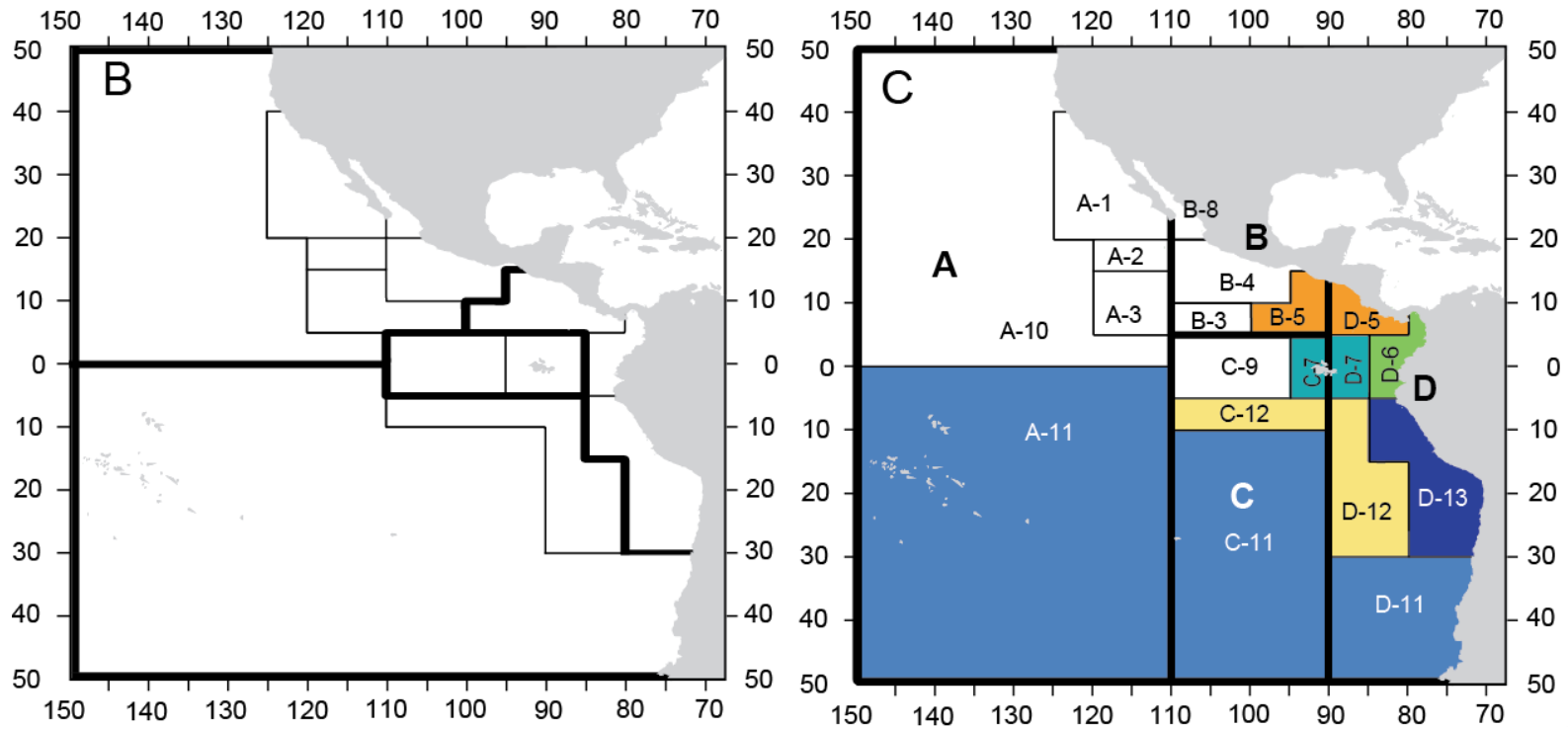


Bigeye stock assessment areas floating-object sets



Background— sampling and assessment areas

- Alternative assessment areas may have boundaries that cross sampling areas.
- This means some modification to the estimators of fishery totals is necessary.

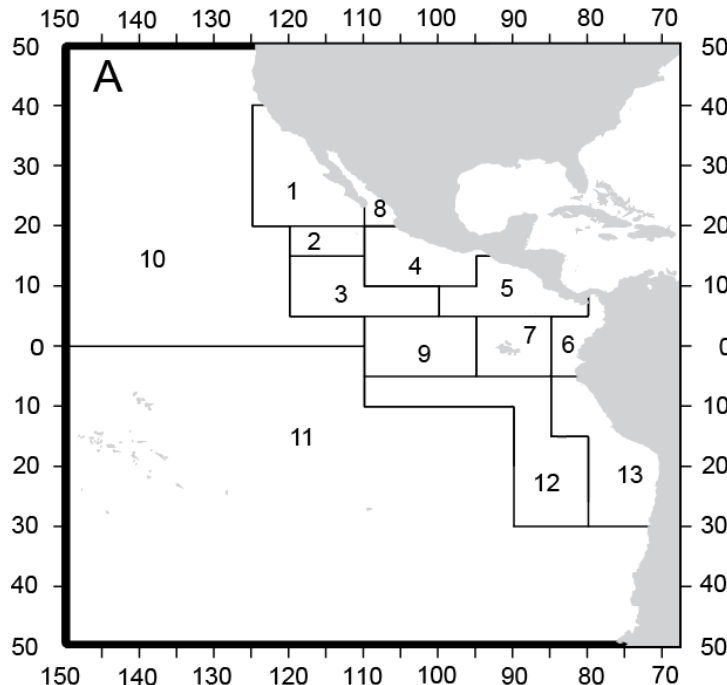


Background: estimators currently used

Example: current estimator of species catch (in weight)

$$\widehat{W}_{hi} = W_h \hat{p}_{hi}$$

$$= W_h \frac{\left[\sum_{j=1}^q W_{hj} \cdot \text{estimate of the prop. of species } i \text{ in well } j \right]}{\left[\sum_{j=1}^q W_{hj} \right]}$$



Poststratified estimators

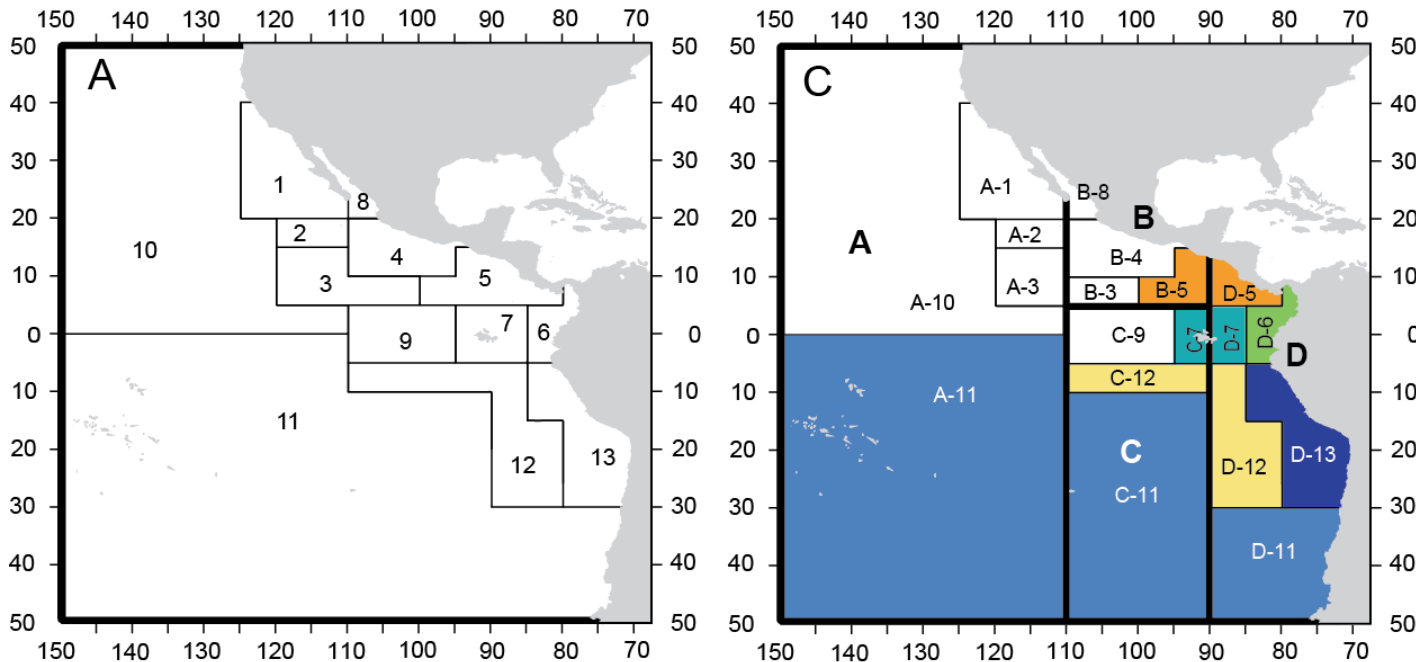
- Assume that poststrata have already been defined.
- Two different ways to approach modifications to the current methods for estimating fishery totals:
 - 1) Assume both the sample strata and the poststrata need to be taken into consideration;
 - 2) Assume that only the poststrata are important.



Poststratified estimators

1) Estimator of species catch considering both sampling strata and poststrata:

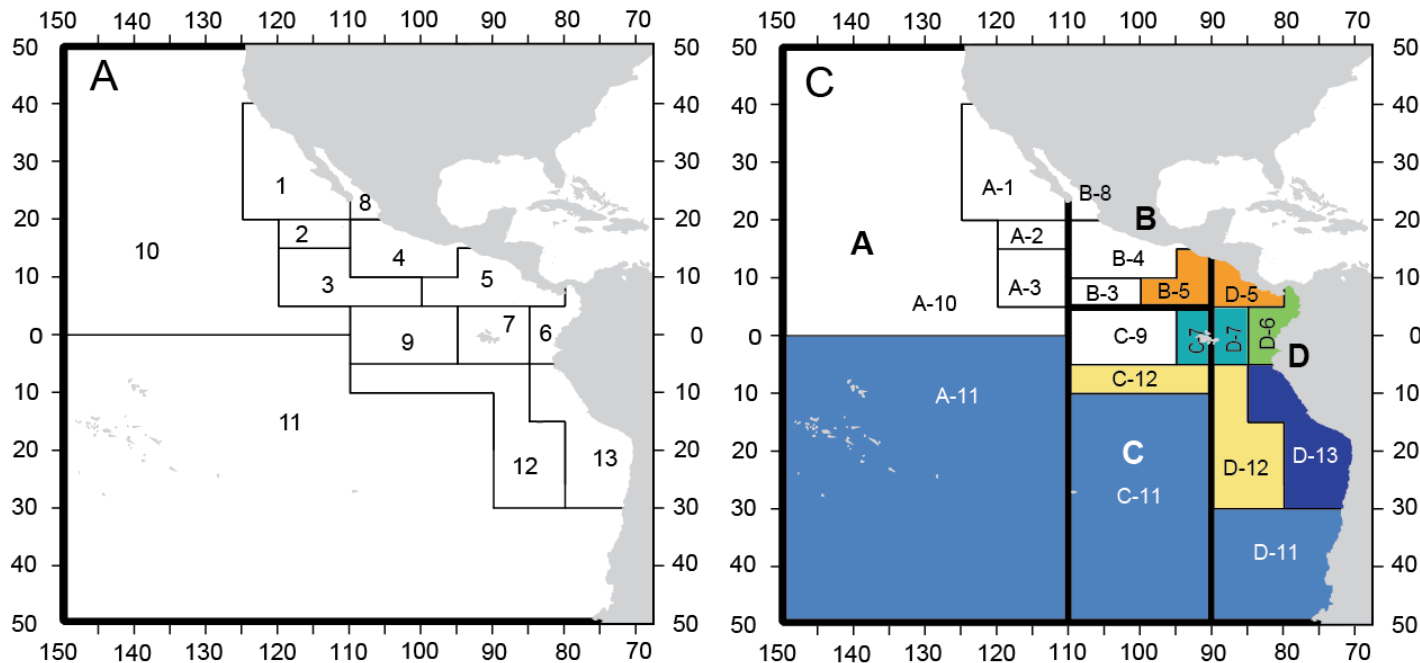
$$\hat{W}_{ps-l; ci} = \sum_{h: hnc} W_{hnc} \frac{[\sum_{j \in hnc} W_{hj} \cdot g_1(\dots)]}{[\sum_{j \in hnc} W_{hj}]} \quad (3)$$



Poststratified estimators

2) Estimator of species catch considering only poststrata:

$$\widehat{W}_{ps-II; ci} = W_c \frac{\left[\sum_{j=1}^{q^*} W_{cj} \cdot g_1(\dots) \right]}{\left[\sum_{j=1}^{q^*} W_{cj} \right]} \quad (4)$$



Selecting an estimator

- Select an estimator based on results of generalized linear model (GLM) analyses of sample average weights and species fractions.
- For example, for average weight, fit the following two models (with weights equal to well catch) :
 - mean(*average weight*) = overall mean + poststratum effect
 - mean(*average weight*) = overall mean + poststratum-sample stratum effect
- Compare model fits by AIC.
- Logistic regression can be used to fit similar models to the species fractions.
- In addition, GLM analyses will be used to explore sample stratum effects within each poststratum.



Future work

- Estimation of fishery totals for different poststratifications:
 - Determine poststrata (e.g., from spatiotemporal analysis of length-frequency distributions and CPUE trends; BET-01-02a);
 - Conduct GLM analyses to select estimator;
 - Estimate fishery totals for poststrata.
- Other work:
 - Treatment of catch with missing/insufficient samples;
 - Variance estimation for fishery totals;
 - Evaluate options for the pre-2000 purse-seine and pole-and-line data.

