

NMFS Vessel Calibration Analysis  
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## **Background**

Bottom trawl surveys have been conducted by Northeast Fisheries Science Center (NEFSC) since 1963 to monitor changes in abundance and distribution of demersal and pelagic fisheries resources from the Gulf of Maine to Cape Hatteras. The lead survey vessel, FRV Albatross IV has come to the end of its operational life and was replaced by the FRV Henry B. Bigelow in the spring of 2009. In preparation for this changeover a series of experiments were designed to estimate conversion factors for the catch rates of the two vessels. In addition, changes to the fishing gear, tow duration, towing speed and operational protocols were also implemented for the Bigelow surveys. An expert panel was convened on 25–27 April 2007 to review the experimental designs. The actual experiments were conducted in the spring and autumn of 2008. Beginning in 2009 the bottom trawl surveys are being conducted by the FRV Henry B. Bigelow.

A second expert panel was convened on 11–13 August 2009 to review the results of these experiments and the subsequent analysis. The terms of reference are included here in the appendix. Presentations were given by NEFSC staff on the background for the changes, the experimental design and field data collection process, conversion factor analysis and an analysis of the age-frequency and size-at-age data. The latter study was focused on the possibility that changes in the fishing gear (and selectivity) could have an impact on the age/size frequency and the determination of growth characteristics. NEFSC staff were available to conduct additional analysis in response to the reviewers' requests. A consensus report was provided by the panel to NEFSC staff at the end of the meeting. In that report each of the terms of reference were addressed and a set of protocols were laid out on how to convert Bigelow catches to Albatross IV equivalent catches based upon the results of the analysis provided.

The purpose of this report is to summarize findings and recommendations that were not dealt with in the consensus report.

## **Individual findings**

The sample unit for the stratified random design used for the NEFSC surveys is the area of the bottom swept by the trawl during a single survey tow. This area swept is a function of the effective width of the trawl and the distance towed, either of which can vary from tow to tow. A standard area swept is defined for the ideal tow/sample unit. The number or weight of a species caught in a tow is usually expressed in terms of a standard area swept correcting for the actual area of tows that were smaller or larger than the defined standard area.

The analysis presented on the conversion factors for the catch rate data was conducted on the raw counts or weights from the tows by the two vessels. These data were uncorrected for deviations from the standard area swept. The analysis needs to be redone on the standardized data for converting Bigelow catches to Albatross equivalent catches. While I don't expect to see a general change in the results per se, using standardized tows could remove some of the variation in the data due to differences in area swept.

For a number of species, the Bigelow trawl caught larger numbers of small fish relative to those caught in the Albatross trawl (e.g., yellowtail flounder). The reasons for this difference were usually clear based upon the operating characteristics of the new trawl but this difference will pose problems in integrating the Bigelow series into the Albatross series. As I understand it, the Bigelow catches will be converted to Albatross equivalent catches for the next few years until an adequate time series of Bigelow surveys has accumulated. The immediate problem of doing this will be the down-weighting or elimination of estimates of small fish when Bigelow catches are converted to Albatross equivalent catches. Information on small fish catches from the Bigelow should not be ignored even though the analysis suggests that the Albatross might not have seen similar abundances of these sizes of fish. I recommend that NEFSC stock assessments provide the actual catch, size and age frequencies from the Bigelow surveys as well as the Albatross equivalents so that potentially important information on recruitment (or lack thereof) from the Bigelow survey can be made available. It may even be possible to integrate the Bigelow catches of small fish directly into the population models used in the stock assessment.

At some time in the future when the changeover is made from Albatross equivalent catches to using the Bigelow catches as is, the reintroduction of the small fish data as is from the Bigelow into the time series may cause issues for the population models being used. I recommend that simulation work be conducted in the near future to understand the potential impact of this change on the population models.

We discussed the issue of how to interpret catches of zero fish by one, the other or both vessels at some length but did not come to a full resolution. For the matter at hand, catches of zero by one or the other vessel but not by both were interpreted as indicating small scale spatial distribution while zero catches by both vessels were assumed to indicate unsuitable habitat. For some of the species that we looked at, the former seemed to be common for schooling species, however catch by one vessel and not the

other could also just reflect low densities compounded by catchability differences. Situations where neither vessel caught specimens of a certain species may also be due to low densities and not due to unsuitable habitat. What ever the underlying reasons, a zero catch from the Bigelow in the future will be interpreted as a zero catch for the Albatross equivalent catch. As far as I know this situation is typical for other trawl survey series where a new vessel has been introduced. In fact, for any trawl survey we usually do not categorize the zero catches except perhaps in a rough manner where a subset of strata are used to estimate abundance for a particular species because we know that species does not occur in all of the strata in the survey. While I don't see that much can be done about understanding the impact of the two kinds of zero catches on interpreting Bigelow catches in the future, the comparative survey data may actually provide a means of investigating the relationship between habitat and species abundance/distribution once more habitat information becomes available (e.g., multibeam, sidescan, video).

## Appendix: Terms of Reference

Evaluate the methodology for estimation of conversion factors for catch rates between the FRV Henry Bigelow and NOAA Ship Albatross IV in terms of

a.) Statistical appropriateness

- What constitutes a sufficient estimate of calibration effects in terms of precision, bias and other properties?
- (See also g.) below.)

b.) Number of treatment effects to be considered (e.g., time of day, depth)

- Are region-specific estimates feasible and/or necessary?

c.) Evaluation of calibration implications (if any) of paired tows collected as part of the shadow survey with those based on regional site specific stations.

d.) Treatment of matched tows and performance of alternative estimators when one vessel catches a given species but the other does not. (Consider application of zero-inflated, and other mixture distributions for estimation) (See also g.) below.)

e.) Performance of alternative estimators for species with low encounter rates and/or groups of species with potentially similar catchabilities (e.g. flounders, gadids, etc.)

f.) Estimators of length-specific conversion factors

- What are appropriate criteria for application?

g.) For each estimator, develop measures of uncertainty and advise on limits of applicability

- For which species are there insufficient data for any calibration?
- For species to be assessed this fall (butterfish, spiny dogfish), and that have typically relied on spring survey indices, what short-term solutions should be implemented to use the spring 2009 data collected by the Bigelow?
- For which species is the current proposed methodology adequate?
- For which species does the proposed methodology require adjustment, and what is required?
- What approaches are appropriate to deal with species or groups with insufficient information: ignore the potential difference, use a mixed category approach, or other approaches?
- Recommend approaches for dealing with uncertainty in back-transformations from Bigelow values to Albatross “equivalents.” Is a Taylor series expansion appropriate? (This will be most relevant for assessment applications in the next 10 or so years.)

h.) Develop recommendations for ongoing research to improve estimation for specific species groups (eg flatfish, pelagics) and potential effects of bottom type.

If time becomes limiting, priority consideration should be given to species managed under Fishery Management Plans (FMPs) where NEFSC trawl survey data are included in stock assessments.