Fisheries and Oceans Canada
Pêches et Océans Canada

Canadian Stock Assessment Secretariat
Research Document 99/167
Not to be cited without
permission of the authors[1]

Secrétariat canadien pour l'évaluation des stocks
Document de recherche 99/167
Ne pas citer sans
autorisation des auteurs[1]

An Evaluation of Inseason Echosounding Estimates of British Columbian Herring Biomass

R. W. Tanasichuk
Department of Fisheries and Oceans
Pacific Biological Station
Nanaimo, B. C.
V9R 5K6

[1] This series documents the scientific basis for the evaluation of fisheries resources in Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

Research documents are produced in the official language in which they are provided to the Secretariat.

[1] La présente série documente les bases scientifiques des évaluations des ressources halieutiques du Canada. Elle traite des problèmes courants selon les échéanciers dictés. Les documents qu'elle contient ne doivent pas être considérés comme des énoncés définitifs sur les sujets traités, mais plutôt comme des rapports d'étape sur les études en cours.

Les documents de recherche sont publiés dans la langue officielle utilisée dans le manuscrit envoyé au secrétariat.

ISSN 1480-4883
Ottawa, 1999

Canada

ABSTRACT

Peak inseason echosounded biomass, estimated from colour echograms, was tested as a measure of prefishery biomass. Prefishery biomass was estimated as the sum of catch, as determined from sales slips, and spawner biomass, as estimated by the escapement stock assessment model. Results of simple linear regression analyses showed there was no relationship between echosounded and prefishery biomass estimates. Therefore, the current inseason echosounding methodology does not provide any basis for modifying the fishing quota as determined using the current stock assessment methodology.

RÉSUMÉ

La biomasse maximale en cours de saison estimée par échosondage, à partir d'échogrammes couleur, a été évalué en tant que mesure de la biomasse d'avant la pêche. Cette dernière a été estimée comme étant la somme des captures, déterminées à partir des bordereaux de vente, et de la biomasse des géniteurs, estimée à l'aide du modèle d'évaluation de l'échappée. De simples analyses de régression linéaire ont montré l'absence de relation entre les estimations de la biomasse obtenues par échosondage et la biomasse d'avant la pêche. Par conséquent, les résultats de cette méthode de détermination par échosondage en cours de saison ne justifient pas de modifier le quota de pêche tel que déterminé par la méthode actuelle d'évaluation du stock.

INTRODUCTION

Inseason management of the British Columbian herring roe fishery includes a number of activities. One of these is echosounding surveys by test seiner and DFO vessels to locate fishable concentrations of herring and to estimate biomass. Inseason biomass estimates currently have no effect on the quota. It is set several months before the fishery and is based on the recommended harvestable surplus (e.g. Schweigert et al. 1999) and fishing plan considerations addressed in the Herring Working Group meetings.

Recently, there has been some suggestion that the inseason echosounded biomass estimates should be used to modify the quota. This implicitly assumes that the echosounded biomass is an accurate measure of prefishery biomass. The goal of this study was to evaluate the accuracy of inseason echosounded biomass estimates. This was evaluated previously by S. Farlinger and G. Thomas (DFO, Pacific Region) for Central Coast, North Coast and Queen Charlotte Islands herring stocks for 1981-86. This report updates their results and documents the analysis in a Canadian Stock Assessment Research Document.

MATERIALS AND METHODS

This analysis consisted of comparing peak (maximum) daily inseason echosounded biomass with prefishery biomass estimates by year. Vessels conduct surveys under the direction of the On-grounds Fishery Manager using various types of echosounders. These include those used on commercial fishing vessels and Simrad EK-500 sounders on some DFO vessels. The overall strategy appears to be to monitor the biomass of the aggregations which may be fished, and the biomass in the major stock assessment region. The acoustic biomass estimates from the vessels are tallied daily and ultimately recorded in the Records of Management Strategy (RMS). These document all aspects of the management of fisheries and exist as unpublished reports by major stock assessment region and fishing season.

Pre-fishery biomass estimates are the sum of commercial catch and spawner biomass. Commercial catch is known accurately from sales slips. Spawner biomass estimates are from the escapement stock assessment model used for B. C. herring (Schweigert et al. 1999). Spawns are surveyed to estimate the number of eggs deposited by spawn location and summed for each stock assessment region. A relative fecundity of 200 eggs x g^{-1} and an assumed 50:50 sex ratio is used to estimate the biomass of spawning fish from the estimated number of eggs deposited. In some instances, analyses were for more than one fishing area within a major stock assessment region. This reflected historic fishing locations. The fishing areas are defined in Table 1. Because inseason echosoundings are reported in tons, prefishery biomass (tonnes) was converted to tons by multiplying it by 1.1.

I restricted analyses to 1980-98. DFO vessels have always been dedicated to sounding. Since 1980, test seiners have been as well. Consequently, the same compliment of sounding vessels was used from 1980 through to the most recently documented fishing season (1998). However, echosounding personnel changed between years because different commerical vessels are used and because of crew rotation on DFO vessels.

RESULTS

Plots of peak inseason echosounded biomass against pre-fishery biomass are shown in Fig. 1. Results of linear regression analysis for the major fishing areas are summarised in Table 2. There were no instances of statistically significant regression slopes. Intercepts were significantly greater than 0 for all areas.

DISCUSSION

It appears that there is no quantitative information in the inseason echosounded biomass. I found no significant positive slope for any regression which would suggest that echosounded biomass estimates pre-fishery biomass in a meaningful way. Statistically it is incorrect to consider the slopes based on predictive linear regression techniques. A functional regression approach (Ricker 1973) should have been used because inseason echosounded biomass (the X or independent variable) is measured with error. However, echososounded biomass is also affected by natural variability. Therefore, the Wald or Nair-Bartlett arithmetic mean regression should be applied. Unfortunately, Ricker criticised the Nair-Bartlett approach for being biased and I found no description for calculating confidence limits for the slope estimated using Wald's procedure. I suggest however that the scatterplots of the data show that peak echosounded biomass does not vary with pre-fishery biomass.

The question remains however regarding the accuracy of the prefishery biomass estimates themselves. Commercial catch is likely estimated very accurately because landings are weighed at the plants. There are unquantified errors associated with the spawn surveys and some question about how well spawning populations are sampled in some areas (Tanasichuk 1997). Catch curves (Tanasichuk 1999) suggest, in instances where sampling is unbiased, that annual biomass estimates are reasonable relative to each other because year-class size declines realistically over time.

In conclusion, inseason echosounded biomass, as it is currently estimated, cannot be used as a quantitative measure of prefishery biomass.

ACKNOWLEDGEMENTS

I thank Dennis Chalmers for technical information on inseason echosounding.

REFERENCES

Ricker, W. E. 1973. Linear regressions in fishery research. J. Fish. Res. Board Can. 30:409-434.

Schweigert, J., C. Fort and R. Tanasichuk. 1999. Stock assessment for British Columbia Herring in 1998 and forecasts of potential catch in 1999. Can. Stock Assess. Sec. Res. Doc. 99/21. 69p.

Tanasichuk, R. 1997. The effects of sampling time on the age-composition of herring test fishing samples. Can. Stock Assess. Sec. Res. Doc. 97/140. 13p.

Tanasichuk, R. W. 1999. Natural mortality rates of adult Pacific herring (*Clupea pallasi*) from southern British Columbia. Can. Stock Assess. Sec. Res. Doc.

Table 1. Major fishing areas.

Major stock assessment region	Major fishing area
West Coast Vancouver Island	Barkley Sound
Strait of Georgia	Strait of Georgia
Central Coast	Central Coast
North Coast	Port Simpson/Big Bay, Kitkatla
Queen Charlotte Islands	Juan Perez Sound/Skincuttle Inlet

Table 2. Simple linear regression statistics for regressions of pre-fishery biomass against peak inseason echosounded biomass. PS/BB is Port Simpson/Big Bay. JP/S is Juan Perez Sound/Skincuttle Inlet.

	Slope				Intercept			
Area	Coefficient	Std. error	t-value	p	Coefficient	Std. error	t-value	p
Barkley	0.27	0.19	1.40	0.18	18340	3631	5.05	0.0002
Georgia	0.31	0.18	1.73	0.10	53595	11702	4.58	0.0004
Central	0.31	0.37	0.84	0.42	26226	8270	3.17	0.006
Kitkatla	-0.30	0.49	-0.60	0.56	8858	2608	3.40	0.004
PS/BB	0.12	0.46	0.26	0.80	20534	5546	3.70	0.003
JP/S	0.66	0.38	1.76	0.10	8236	4022	2.04	0.06

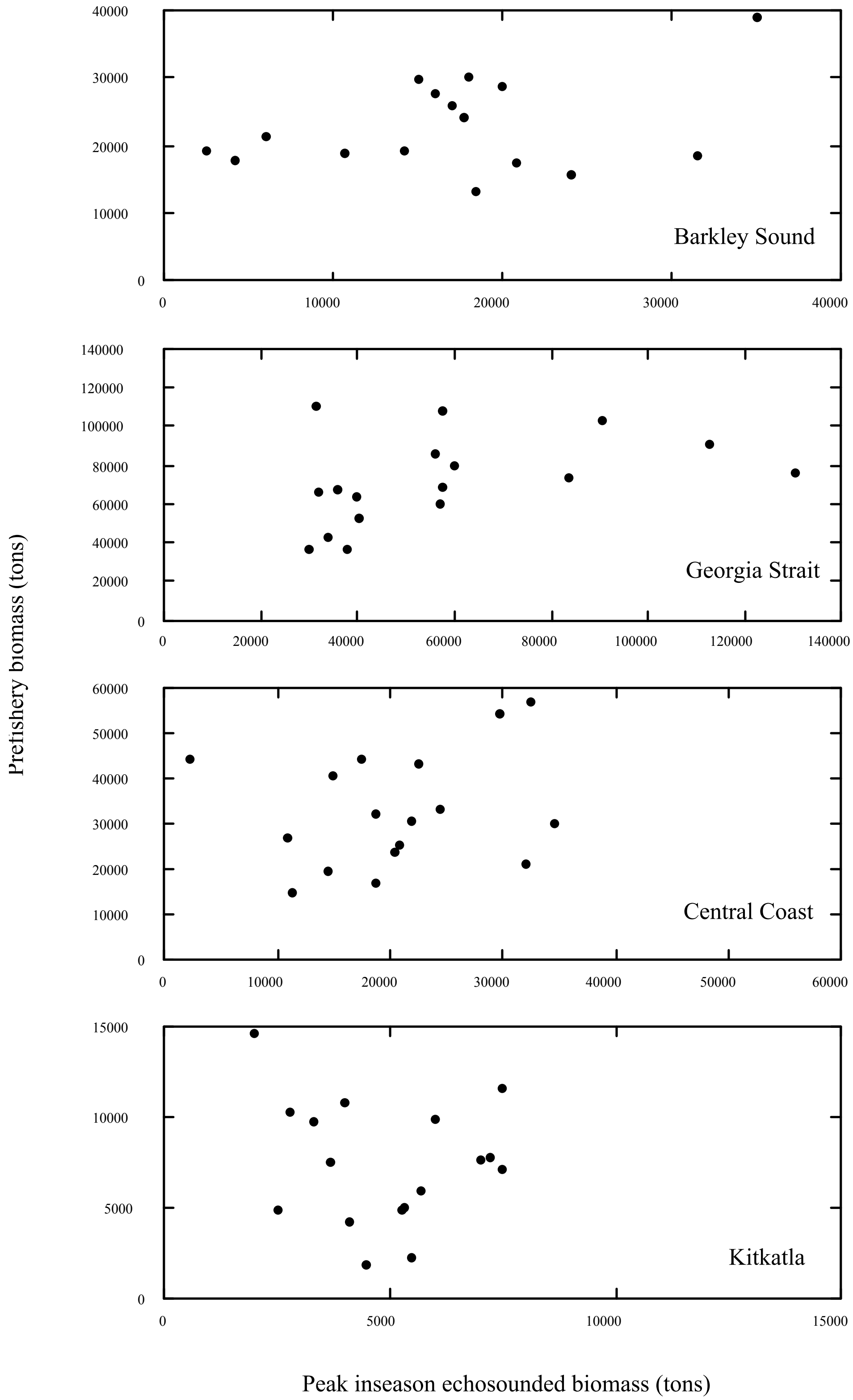
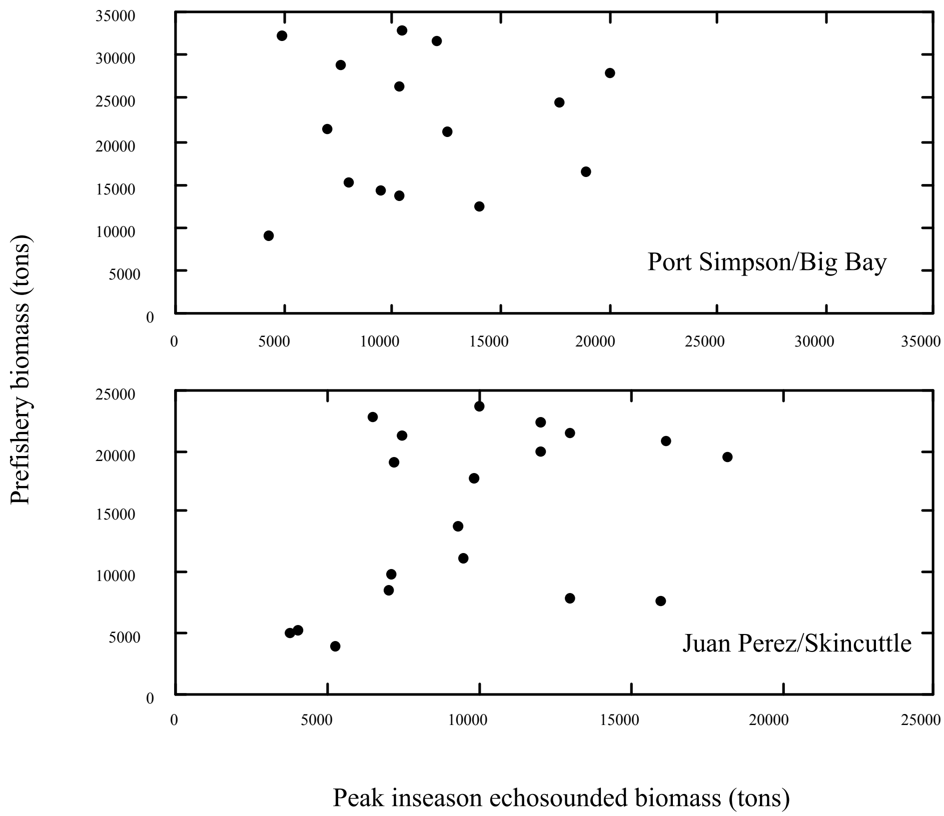


Fig. 1. Peak inseason echosounded biomass versus pre-fishery biomass for major fishing locations, 1980-1998.



Prefishery biomass (tons)
Port Simpson/Big Bay
Juan Perez/Skincuttle
Peak inseason echosounded biomass (tons)

Fig. 1 cont.