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Adequacy of US sampling scheme for estimating
catch at age for two stocks

by

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Abstract

Calculations of the coefficient of variation (CV) of the estimated numbers at age of 1973 USA yellowtail flounder catches and October-December, 1972, USA haddock catches, both species taken from the Georges Bank area, were made to determine whether the accuracy of the estimated numbers at age satisfied the desired level as specified by the Working Group on Minimum and Desirable Level of Sampling at the Annual Meeting, June 1974. The calculations indicated that the yellowtail flounder sampling was adequate, with the CV of estimated numbers at age satisfying the specified level of 12% for the USA, but that the estimates of catch at age of the older (≥ 12 years) haddock did not satisfy the required level of CV of 10%.

Introduction

At the June 1974 Annual Meeting, the Working Group on Minimum and Desirable Levels of Sampling recommended a certain minimum level of sampling which it felt would achieve a satisfactory level of accuracy in estimates of number at age (ICNAF Redbook 1974, page 134). Specifically, the Group recommended that a nation which caught $q\%$ of the quota of a certain stock should have a level of sampling which would yield a CV of $10/\sqrt{q}\%$ on its estimated number at age for the year,

$$\text{where } CV = \frac{S.D.(\hat{N}_A)}{\hat{N}_A} \quad \text{and}$$

\hat{N}_A = estimated number of age A fish landed, and

S.D. (\hat{N}_A) = standard deviation of the estimate \hat{N}_A .

If this level of accuracy were met by all countries fishing the given stock, the total estimated numbers at age would have a CV of 10%.

The present paper lists desired and observed coefficients of variation of estimated numbers at age for the two stocks: yellowtail flounder taken from Georges Bank in the fall quarter of 1973, as reviewed by Brennan (ICNAF Res. Doc. 74/29); and haddock taken from Georges Bank, as reviewed by Brennan (ICNAF Res. Doc. 74/112).

Methods and materials

In 1972, the US fishery for yellowtail flounder in ICNAF Subarea 5Ze took approximately 99% of the annual catch from the area. According to the recommendation of the Working Party, its estimates of number at age should have a coefficient of variation (CV) of about 10%. Using the estimates of number at age and CV of each estimate as calculated in ICNAF Res. Doc. 74/29 on the catches taken in October-December, 1972 (30% of the US annual catch), the desired levels of CV on the catch at age data were calculated (Table 1). If p% of the annual catch at a certain age were taken in a particular month, the estimated catch at age for that month should have a CV of $10/\sqrt{p}$ %. Using the same argument, if s% of the catch in that month were males, the CV of the estimated number of age of males should be $10/\sqrt{ps}$ %, in order to achieve a CV of 10% on the estimated annual catch at age. Table 1 shows that in every case the observed CV of the estimated number at age was less than the desired level, indicating that the sampling of yellowtail was more than adequate to meet the objective of the Working Party. As outlined in Res. Doc. 74/29, that level of sampling consisted of 5 length samples of 125 fish each per month, and from each of these samples an age sample comprising 25 males and 25 females.

Similar calculations were performed on estimates of number at age of haddock caught during 1973. These estimates and estimates of CV were taken from Res. Doc. 74/119. The US catch of haddock from Georges Bank constituted approximately 74% of the "quota." Accordingly, the CV on the estimates of number at age should be about 12%. Table 2 lists the monthly CV's desired in order to achieve this 12% level on the total catch. The desired and observed levels of CV for large haddock and scrod catches are also listed. The calculations indicated a need for greater sampling of the older (≥ 12 years) fish, and a possible inadequacy in the sampling of the 4-5 age group. During that year an average of 3 length samples of large haddock and 3 of scrod per month were taken, with an average of 102 large haddock per sample and an average of 92 scrod per sample. The number of fish aged per sample each quarter were as follows:

<u>Quarter</u>	<u>No. fish aged/sample</u>
1	16
2	23
3	14
4	10

Results and conclusions

Calculations made of the coefficient of variation of estimated numbers at age of US haddock catches in 1973 and yellowtail flounder catches in October-December, 1972, both taken from ICNAF 5Ze, indicated that the sampling of yellowtail flounder satisfied the desired level of accuracy as specified by the ICNAF Working Party, but the sampling of older (≥ 12 years) haddock needs to be increased to achieve the level of accuracy specified.

Literature cited

Brennan, J. A. Preliminary Evaluation of the Present US Sampling Scheme of Yellowtail Flounder for Estimating the Number at Age in the Catch Landed. ICNAF Res. Doc. 74/29.

Report on Sampling of Commercial Landings of Haddock Taken from Georges Bank, 1973. Res. Doc. 74/119.

ICNAF Report of Working Party on Minimum and Desirable Levels of Sampling. ICNAF Redbook 1974, page 134.

Table 1. Desired and observed coefficients of variation of estimated number at age (\hat{N}_A) of yellowtail flounder catches taken from Georges Bank, October-December, 1972. Data taken from ICNAF Res. Doc. 74/29. \hat{N}_{Am} = estimated number of males at age A. \hat{N}_{Af} = estimated number of females at age A.

Ages 2-3	Month		
	Oct	Nov	Dec
% landed	.16	.08	.06
desired CV (\hat{N}_A)	.25	.35	.41
observed CV (\hat{N}_A)	.03	.026	.06
desired CV (\hat{N}_{Am})	.36	.49	.71
observed CV (\hat{N}_{Am})	.04	.04	.06
desired CV (\hat{N}_{Af})	.36	.48	.50
observed CV (\hat{N}_{Af})	.04	.03	.09

Ages 4-5	Month		
	Oct	Nov	Dec
% landed	.14	.07	.08
desired CV (\hat{N}_A)	.26	.37	.35
observed CV (\hat{N}_A)	.05	.05	.07
desired CV (\hat{N}_{Am})	.35	.48	.69
observed CV (\hat{N}_{Am})	.06	.05	.13
desired CV (\hat{N}_{Af})	.41	.59	.40
observed CV (\hat{N}_{Af})	.08	.08	.09

Ages ≥ 6	Month		
	Oct	Nov	Dec
% landed	.14	.06	.10
desired CV (\hat{N}_A)	.27	.41	.32
observed CV (\hat{N}_A)	.09	.11	.14
desired CV (\hat{N}_{Am})	.47	.58	.79
observed CV (\hat{N}_{Am})	.21	.20	.39
desired CV (\hat{N}_{Af})	.33	.58	.35
observed CV (\hat{N}_{Af})	.08	.11	.14

Table 2. Desired and observed coefficients of variation of estimated numbers at age (\hat{N}_A) of haddock catches taken from Georges Bank, 1973. Data taken from ICNAF Res. Doc. 74/. \hat{N}_{AL} = estimated number of large haddock at age A. \hat{N}_{AS} = estimated number at age A of scrod. Asterisk(*) indicates observed C.V. greater than desired C.V.

Ages 2-3	MONTH											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
% landed	.04	.02	.06	.03	.06	.26	.17	.13	.09	.12	.01	.01
desired C.V. (\hat{N}_A)	.60	.85	.49	.69	.49	.24	.29	.33	.40	.35	1.20	1.20
observed C.V. (\hat{N}_A)	.09	.32	.27	.07	.08	.09	.11	.10	.31	.17	.85	.68
desired C.V. (\hat{N}_{AL})	---	2.06	---	8.46	---	---	1.26	---	---	3.06	1.20	1.9
observed C.V. (\hat{N}_{AL})	---	.15	---	.85	---	---	.66	---	---	.73	.85	.77
desired C.V. (\hat{N}_{AS})	.60	.93	.49	.69	.49	.24	.30	.33	.40	.36	---	1.55
observed C.V. (\hat{N}_{AS})	.09	.38	.27	.07	.08	.09	.11	.10	.31	.18	---	1.00
Ages 4-5												
% landed	.09	.11	.02	.04	.12	.19	.24	.08	.03	.03	.01	.03
desired C.V. (\hat{N}_A)	.40	.36	.85	.60	.35	.28	.24	.42	.69	.69	1.20	.69
observed C.V. (\hat{N}_A)	.27	.24	.28	.23	.20	.28	.27	.46*	.60	.47	.33	.43
desired C.V. (\hat{N}_{AL})	.40	.40	.93	.64	.38	.36	.34	---	---	.73	1.20	.69
observed C.V. (\hat{N}_{AL})	.27	.23	.28	.25	.22	.25	.36*	---	---	.51	.33	.43
desired C.V. (\hat{N}_{AS})	3.52	.80	2.11	1.67	.90	.45	.33	.42	.69	2.18	---	---
observed C.V. (\hat{N}_{AS})	1.20	.72	1.00	.58	.42	.37	.40*	.46*	.60	1.05	---	---

Table 2. (cont'd)

Ages 10-11	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
% landed	.09	.10	.07	.10	.19	.24	.06	---	---	.06	.05	.05
desired C.V. (\hat{N}_A)	.40	.38	.45	.38	.28	.24	.49	---	---	.49	.54	.54
observed C.V. (\hat{N}_A)	.18	.13	.11	.11	.10	.19	.31	---	---	.15	.12	.27
desired C.V. (\hat{N}_{AL})	.40	.38	.45	.38	.28	.25	.49	---	---	.50	.54	.54
observed C.V. (\hat{N}_{AL})	.18	.13	.11	.11	.10	.20	.31	---	---	.15	.12	.27
desired C.V. (\hat{N}_{AS})	---	3.11	4.40	6.61	2.09	.94	---	---	---	2.09	---	---
observed C.V. (\hat{N}_{AS})	---	.98	1.08	1.34	.71	.62	---	---	---	1.09	---	---
Ages ≥ 12	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
% landed	.12	.13	.12	.08	.16	.15	---	---	---	.08	.09	.06
desired C.V. (\hat{N}_A) ¹	.35	.33	.35	.42	.30	.31				.42	.40	.49
observed C.V. (\hat{N}_A)	.46*	.39*	.45*	.41	.38*	.48*				.55*	.51*	.60*

¹ $\hat{N}_A = \hat{N}_{AL}$