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Preliminary Evaluation of the Present U.S.A. Sampling Scheme of Yellowtail Flounder for Estimating the Number at Age in the Catch Landed[1]

by

J. A. Brennan

National Marine Fisheries Service
Northeast Fisheries Center
Woods Hole, Massachusetts 02543

ABSTRACT

The U.S.A. procedure for estimating the numbers at age, $\hat{N}_a$, of yellowtail flounder landed monthly, is reviewed. Estimates of the precision of $\hat{N}_a$ are made from samples of the fish taken from the Georges Bank area, October-December 1972. Various combinations of number of samples (n) and number of fish measured/sample (m) which produce given degrees of precision in estimates, are listed. Both these data and data from the U.S.A. Albatross IV fall groundfish survey, 1972 suggest that considerable differences in length distributions exist from catches taken in close proximity.

INTRODUCTION

Age composition of yellowtail flounder caught by the U.S. fleet is presently estimated from samples taken at ports where the bulk of this species is landed. An attempt is made to sample catches taken monthly from each of the sampling areas 51, 52, and 53 (Figure 1). A more recent policy is to sample for market categories within sampling area as well as by month. The number of samples taken and the number of fish measured and aged per sample satisfy the ICNAF recommendation made at the June 1970 meeting, that a minimum of 200 fish be measured for every quarter of the year in each division for each 1,000 tons of yellowtail caught, and that sufficient number of fish be taken for producing age compositions of the landings. Presently, each sampling unit consists of a 125 lb. box of fish. The fish are separated by sex and measured; within each cm. interval a sub-sample is taken for ageing. Typically, a total of 25 males and 25 females are aged. About 5 samples are taken each month, depending on the landings recorded.

The present study examines the precision of the U.S. sampling scheme for estimating the age composition of the catch landed, by considering a small but representative situation, that of the yellowtail flounder taken from the Georges Bank area (ICNAF Subarea 5Ze) (Figure 1) during the fall quarter of 1972. It is assumed that a study of this situation will give a meaningful preliminary evaluation of the sampling procedure.

Procedure for estimating N_a, number at age.

In order to estimate numbers landed at age during a specified time interval, the following formula is used:

[1] Revision of Res.Doc. 74/29 presented to the Special Commission Meeting, FAO, Rome, January 1974.

$$\hat{N}_{ax} = \sum_{l=1}^{L} \hat{p}_{lx} * \hat{p}_{a/lx} * \hat{N} \qquad (1)$$

where $\hat{N}_{ax}$ = estimated number landed which are of age (group) a and sex x,

$\hat{p}_{lx}$ = estimated percent of landings which are of length (group) l and sex x,

$\hat{p}_{a/lx}$ = estimated percent of landings which are of age (group) a, out of those at length (group) l and sex x, and

$\hat{N}$ = estimated total number landed.

Determination of $\hat{p}_l$ (estimated percent at length (group)l and $p_{a/l}$ (estimated percent of age (group) a at length (group) l, and estimated variances of each.

Estimates of number at age, $\hat{N}_a$, are made for each month. The estimators used in this study are

$\hat{p}_{lx} = \bar{p}_{lx}$ = average percent at length (group)l and sex x over samples taken during the month,

$\hat{p}_{a/lx} = \bar{p}_{a/lx}$ = average percent of age (group)a at length (group)l and sex x over samples taken during the quarter,

$\bar{N} = Wt/\overline{wt}$ = weight landed/average weight of fish sampled during the month.

The percent at length (group) is assumed to be the same for males and females, so $\hat{p}_{lx} = \hat{p}_l/2$, where $\hat{p}_l = \bar{p}_l$, the average percent of males and females of length (group)l. The estimators $\bar{p}_{lx}$ and $\bar{p}_{a/lx}$, are assumed to differ negligibly from pooled estimators $\tilde{p}_{lx}$ (pooled over samples within a month) and $\tilde{p}_{a/lx}$ (pooled over a quarter). In most cases the coefficient of variation of the number of fish measured per sample was less than 10%, so evaluation of the sampling scheme using $\bar{p}_{lx}$ and $\bar{p}_{a/lx}$ should be valid for a situation where the alternate estimators were used.

Table 1 lists the length frequencies $\bar{p}_l$ by month and cm group for the samples taken during October-December, 1972, along with the estimated variance of each mean, the number of samples per month, and the average number of fish measured per sample.[1] The variance is estimated by

$$\hat{Var}(\bar{p}_l) = \frac{1}{n} * \frac{1}{(n-1)} \Sigma (p_{li} - \bar{p}_l)^2 ,$$

where p_{li} = percent at length l (estimated) in sample i, and (2)

n = number of samples

For us, $\bar{p}_{lx} = \bar{p}_l/2$ and $\hat{Var}(\bar{p}_{lx}) = \hat{Var}(\bar{p}_l)/4$.

Since the sampling procedure for lengths is not stratified by sex, estimates of the number of samples (n) and the number of fish/sample (m) needed to attain a given precision or coefficient of variation (c.v.) of the estimate $\bar{p}_l$ are of interest. As an illustrative example, Figure 2

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[1] Where m varies from sample to sample, $\tilde{m} = (M - \sum_{i=1}^{I} m_i^2/M/(n-1)$ (Davies, p. 131) for M = total number of fish samples and n = number of samples.

shows the relation between the number of samples (n) and the number of fish/sample (m) needed to achieve an estimate of p_1 which is within 24-40% of the population percent at length. (alpha = .05 and beta = .80). Specifically the curves plotted satisfy

$$c.v. = 12\% \text{ for } \bar{p}_1 \geq .29, \qquad (3)$$

$$= 20\% \text{ for } .10 \leq \bar{p}_1 \leq .28,$$

where $p_1^2 * (c.v.)^2 = \frac{\hat{s}_b^2}{n} + \frac{\hat{s}_{w_1}^2}{\tilde{n}\tilde{m}}$ and (see Cochrane, p. 224 f.)

$\hat{s}_b^2$ estimates the between sample component of the variance of $\bar{p}_1$, and $\hat{s}_w^2$ estimates the within sample component of variance. These estimates are included in the coding sheet of Figure 2. For $\bar{p}_1 \leq .10$, the coefficients of variation of the estimates could not be reduced much below 50% using the sample estimates $\hat{s}_b^2$ and $\hat{s}_w^2$. The specifications of (3) were selected arbitrarily to show the variation intrinsic to the system, and also to enable comparison with the n and m needed to achieve similar levels of precision in estimations of $p_{a/lx}$, the percent of age at length l and sex x. The outlying curves (11) and (14) represent data where there was an unusually large difference in the number of males and females in the samples, and where the distribution of both sexes combined varied considerably from sample to sample. This type of variation is perhaps characteristic of the species, but hopefully the more general case is represented by the other data (see Appendix for similar study on samples taken during January-March, 1972, yellowtail flounder, Georges Bank).

Table 2 lists the average percent of age at length by the intervals cited for the subsamples of the data used in the preceding analysis. The number of samples involved, as well as the average number of fish in each group, is included. Figures 3 and 4 illustrate the relationships of n (number of samples) and m (number of fish/sample) according to the specifications of (3). It seems apparent that the specifications of (3) would be met with a doubling in the number of samples (n) and a two to three times increase in the number of fish measured for each sex from each sample.

Estimated variance of $\hat{N}_a$, the estimated number at age.

Estimates of the precision of the estimated number at age for each sex were made using the formula:

$$Var(\hat{N}_a) = (Wt/\overline{wt})^2 * \sum_{l=1}^{L} \left[\bar{p}_{lx}^2 * Var(\bar{p}_{a/lx}) + \bar{p}_{a/lx}^2 * Var(\hat{\bar{p}}_{lx}) \right]$$

where the estimators used are as outlined previously. The term (Wt/wt) is assumed constant for this analysis. Table 3 lists the results of these calculations, along with the respective estimated numbers and approximate 95% confidence intervals on the estimated total number at age (beta = .80). Improvement in the precision of these estimates hinges on improvement in the precision of the estimators $\bar{p}_{lx}$ and $\bar{p}_{a/lx}$, for each length group and age group, so predictions of ranges of n and m needed to achieve a certain level of precision in the estimates were made.

Prediction of n (number of samples) and m (number of fish/sample) needed to attain specified levels of precision.

In order to determine the n (number of samples) and m (number of fish per sample) combinations for a given confidence level (alpha level) and a given probability of error (beta level), the following formula is used (Snedecor, p. 112):

$$(Z_a + Z_b)^2 * \frac{\hat{Var}(\hat{p}_1)}{n} = (d * \bar{p}_1)^2 \quad (4)$$

where Z_a, Z_b = are Student's-t variates corresponding to two-tailed significant levels for a and b, alpha and beta,

$\hat{Var}(\hat{p}_1)/n$ = estimated variance of $\bar{p}_1$

d = a preselected percentage difference between $\hat{p}$ and the population p which one would like to detect with probability (1-a).

$\bar{p}_1$ = estimate of population mean of length group 1.

The difference term d is assumed to be a normal variate.

$\hat{Var}(\hat{p}_1)/n$ is estimated as

$$\hat{Var}(\hat{p}_1)/n = \frac{\sum_{i=1}^{n} (p_{1i} - \bar{p}_1)}{n * (n-1)} = \frac{\hat{s}_b^2}{n} + \frac{\hat{s}_w^2}{n*m}$$

where $\hat{s}_b^2$ and $\hat{s}_w^2$ are as explained earlier, m = number of fish/sample, n = number of samples, and p_{1i} = percent of age at length, etc. of sample i. Table 4 lists the results of calculations made using (4) with various levels of alpha and beta for the 30-34 cm group of the October 1972 samples, and the 2-3 year old female fish of the 35-39 cm group. Without reducing the beta level of the first example, a considerable increase in the number of samples (over the present level n = 5) taken, is necessary in order to achieve the desired precision of $\bar{p}_1$ and also preselected alpha levels. The second example reflects a modest difference in the number of samples needed to achieve given alpha and beta levels, with a doubling of the number of fish aged. Again, a drop in the desired beta level is necessary to achieve feasible n and m values. Since in each example, and in the general case, n and m depend on both Var ($\bar{p}_1$) and $\bar{p}_1$, and since the coefficient of variation of $\bar{p}_1$ is not constant for all length groups 1, no single combination of n and m will satisfy a preselected d, alpha and beta for all $\bar{p}_1$. A suggested policy is to select a percent (either a percent at length, or a percent of age at length), such that it is desirable that the n-m combination calculated be valid for all percentages greater than the selected percent p, and perform the calculations for that percent. For example, if it is desirable that for a given d, alpha and beta, all length groups representing at least 20% of the distribution satisfy d, alpha and beta, then the n-m combination calculated for $\bar{p}_1$ = .20 will satisfy the requirements for $\bar{p}_1 \geq .20$. This is the general case.

Estimates of variability of length distributions of samples taken within close proximity.

Estimates of n and m for given d, alpha and beta levels depend on the estimates $\hat{s}_b^2$ and $\hat{s}_w^2$, the between and within sample contributions to the estimated variance. They also reflect the homogeneity of samples taken within close proximity. To get an unbiased estimate of the amount of sample to sample variation to expect from such samples, length data from yellowtail flounder samples taken by U.S. Albatross IV fall groundfish survey, 1972 was examined. Table 5 lists the results of calculations of $\hat{s}_b^2$ and $\hat{s}_w^2$ made for the different length groups. Figure 1 shows the strata (13-23, 25) used in the analysis. The lack of consistency in the results for the different length groups, with respect to the ratio $\hat{s}_b^2/\hat{s}_w^2$, gives an indication of the complexity of the system. It would be difficult to suggest to commercial samplers any n - m combinations based on these data (number of samples - number of fish per sample), which might achieve a modest degree of precision for all length groups.

Bibliography

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Table 1. Average percent in length group and estimated variance of that percent for yellowtail flounder samples taken from the Georges Bank (ICNAF 5Ze) catch, October-December, 1972. n = number of samples, $\bar{m}$ = number of fish/sample.

length interval	October $\hat{p}_1$	October $\hat{Var}(\hat{p}_1)$	November $\hat{p}_1$	November $\hat{Var}(\hat{p}_1)$	December $\hat{p}_1$	December $\hat{Var}(\hat{p}_1)$
30-34 cm.	.176	.00157	.213	.00057	.098	.00203
35-39 cm.	.664	.00113	.639	.00063	.494	.0081
40-44 cm.	.127	.00012	.134	.000123	.308	.00869
45-49 cm.	.0336	.000047	.014	.000016	.094	.000159
≥ 50 cm.	.0099	.0000095	.0114	.000018	.0024	.000006
n	5		5		5	
$\bar{m}$	125		125		100	

Table 2. Average percent of age at length (group) by sex and age group, estimates of variance and coefficients of variation for samples of yellowtail flounder caught in the Georges Bank (ICNAF 5Ze) area, October-December, 1972. n = # samples, $\tilde{m}$ = number of fish/sample.

	males				females			
Age 2-3	$\bar{p}_{a/lx}$	$\hat{V}(\bar{p}_{a/lx})$	c.v.	$\tilde{m}$	$\bar{p}_{a/lx}$	$\hat{V}(\bar{p}_{a/lx})$	c.v.	$\tilde{m}$
30-34 cm.	.87	.0058	.09	7	.97	.00096	.03	2
35-39 cm.	.66	.0040	.03	15	.79	.0031	.07	11
40-44 cm.	.20	.0059	.38	4	.28	.0034	.21	9
45-49 cm.					.085	.0045	.79	3.5
≥ 50 cm.								
n	13				13			
Age 4-5	$\bar{p}_{a/lx}$	$\hat{V}(\bar{p}_{a/lx})$	c.v.	$\tilde{m}$	$\bar{p}_{a/lx}$	$\hat{V}(\bar{p}_{a/lx})$	c.v.	$\tilde{m}$
30-34 cm.	.06	.0016	.67	7	.03	.0009	1.00	2
35-39 cm.	.28	.0022	.17	15	.21	.0029	.26	11
40-44 cm.	.71	.0105	.14	4	.59	.0037	.10	9
45-49 cm.					.564	.014	.21	3.5
≥ 50 cm.					.50	.05	1.41	2
n	13				13			
Age ≥ 6	$\bar{p}_{a/lx}$	$\hat{V}(\bar{p}_{a/lx})$	c.v.	$\tilde{m}$	$\bar{p}_{a/lx}$	$\hat{V}(\bar{p}_{a/lx})$	c.v.	$\tilde{m}$
30-34 cm.								
35-39 cm.								
40-44 cm.	.09	.0083	1.01	4	.12	.0026	.42	9
45-49 cm.					.28	.0103	.36	3.5
≥ 50 cm.					.50	.05	1.41	2
n	13				13			

Table 3. Estimated number at age ($\hat{N}_a$) for yellowtail flounder samples taken October-December 1972, Georges Bank, along with associated statistics by age group, for males and females separately and for both combined. C.V. = coefficient variation. C.I. = confidence interval.

	October		November		December	
Ages 2-3	Male	Female	Male	Female	Male	Female
$\hat{N}_{ax}$	13,996	13,021	7,525	7,940	3,624	7,293
$\hat{Var}(\hat{N}_{ax})$	431,702	333,680	96,545	59,285	54,586	405,716
C.V. $(\hat{N}_{ax})$	.046	.044	.041	.031	.064	.087
$\hat{N}_a$	27,017		15,465		10,917	
C.V. $(\hat{N}_a)$	.032		.026		.062	
95% C.I.	(25,263 - 28,770)		(15,070 - 16,255)		(9,560 - 12,274)	
Ages 4-5	Male	Female	Male	Female	Male	Female
$\hat{N}_{ax}$	7,105	5,131	3,844	2,573	1,758	5,252
$\hat{Var}(\hat{N}_{ax})$	159,542	170,547	43,445	43,871	51,467	212,079
C.V. $(\hat{N}_{ax})$	.056	.080	.054	.081	.129	.088
$\hat{N}_a$	12,236		6,417		7,010	
C.V. $(\hat{N}_a)$	.047		.046		.073	
95% C.I.	(11,087 - 13,385)		(5,826 - 7,008)		(5,983 - 8,037)	
Ages ≥ 6	Male	Female	Male	Female	Male	Female
$\hat{N}_{ax}$	561	1,103	375	376	204	1,036
$\hat{Var}(\hat{N}_{ax})$	14,077	7,415	5,517	1,779	6,238	22,130
C.V. $(\hat{N}_{ax})$	.21	.078	.198	.112	.387	.143
$\hat{N}_a$	1,664		751		1,240	
C.V. $(\hat{N}_a)$	.088		.114		.136	
95% C.I.	(1,371 - 1,957)		(580 - 922)		(903 - 1,577)	

Table 4. Examples showing number of samples (n) and number of fish per sample (m) required to achieve given alpha and beta levels, and detect a difference of d*p (±).

Example 1.	$\bar{p}_1$	$\widehat{Var}(\bar{p}_1)$	d(±)	(1-alpha)	beta	n	m
30-34 cm October	.176	.00157	.10	.95	.95	>100	125
			.20			84	125
			.50			15	125
			.10	.95	.90	>100	125
			.20			68	125
			.50			12	125
			.10	.95	.80	>100	125
			.20			52	125
			.50			10	125
			.10	.90	.95	>100	125
			.20			70	125
			.50			13	125
			.10	.90	.90	>100	125
			.20			56	125
			.50			10	125
			.10	.90	.80	>100	125
			.20			41	125
			.50			9	125
			.10	.95	.95	>100	150
			.20			100	50
			.50			18	50
			.10	.95	.90	>100	50
			.20			83	50
			.50			15	50
			.10	.95	.80	>100	50
			.20			63	50
			.50			12	50
			.10	.90	.95	>100	50
			.20			85	50
			.50			15	50
			.10	.90	.90	>100	50
			d(±)	(1-alpha)	beta	n	m
			.20	.90	.90	68	50
			.50			12	50
			.10	.90	.80	>100	50
			.20			50	50
			.50			9	50

..continued

Table 4. (continued)

Example 2.	$\overline{p}_{a/1x}$	$\hat{V}(\overline{p}_{a/1x})$	d(±)	(1-alpha)	beta	n	m
35-39 cm Ages 2-3 females	.66	.0040	.10 .20 .50	.95	.95	>100 47 9	15 15 15
			.10 .20 .50	.95	.90	>100 38 7	15 15 15
			.10 .20 .50	.95	.80	>100 [illegible] 6	15 15 15
			.10 .20 .50	.90	.95	>100 39 8	15 15 15
			.10 .20 .50	.90	.90	>100 32 7	15 15 15
			.10 .20 .50	.90	.80	87 23 5	15 15 15
			.10 .20 .50	.95	.95	>100 42 8	30 30 30
			d(±)	(1-alpha)	beta	n	m
			.10 .20 .50	.95	.90	>100 34 7	30 30 30
			.10 .20 .50	.95	.80	>100 26 6	30 30 30
			.10 .20 .50	.90	.95	>100 35 7	30 30 30
			.10 .20 .50	.90	.9[illegible]	>100 28 6	30 30 30
			.10 .20 .50	.90	.80	78 21 5	30 30 30

Table 5. Estimates of mean percent at length, associated variance components, number of tows (n) and number of fish/tow taken by U.S. Albatross IV fall groundfish survey, 1972.

Coding

$\bar{p}_l$ = mean percent at length group l (estimated mean),

$\hat{V}(\bar{p}_l)$ = estimated variance of p_l, $\hat{V}(\bar{p}_l) = \frac{\hat{s}_2^2}{s} + \frac{\hat{s}_1^2}{s*\tilde{n}} + \frac{\hat{s}_o^2}{s*\tilde{n}*\tilde{m}}$,

$\hat{s}_o^2$ = estimated error variance,

$\hat{s}_1^2$ = estimate of the tow to tow component of variance $V(\bar{p}_l)$,

$\hat{s}_2^2$ = estimate of the stratum to stratum contribution to the variance of $\bar{p}_l$.

$\tilde{n}$ = "average" number of tows/stratum (See Davies, p. 131),

$\tilde{m}$ = "average" number of fish measured per tow (See Davies, p. 131),

s = number of strata, and

l = length group (as noted).

length interval	$\bar{p}_l$	$\hat{V}(\bar{p}_l)$	$\hat{s}_o^2$	$\hat{s}_1^2$	$\hat{s}_2^2$	$\tilde{n}$	$\tilde{m}$	# strata
30-34 cm.	.39	.0132	.1757	.0459	.0923	4	27	8
35-39 cm.	.22	.00114	.1893	.0568	(-.007)	4	27	8
40-44 cm.	.13	.00395	.0723	.0472	.0200	4	27	8
45-49 cm.	.02	.00001	.0224	(-.00075)		4	27	8
⩾ 50 cm.	.016	.00010	.00568	.00	.00072	4	27	8

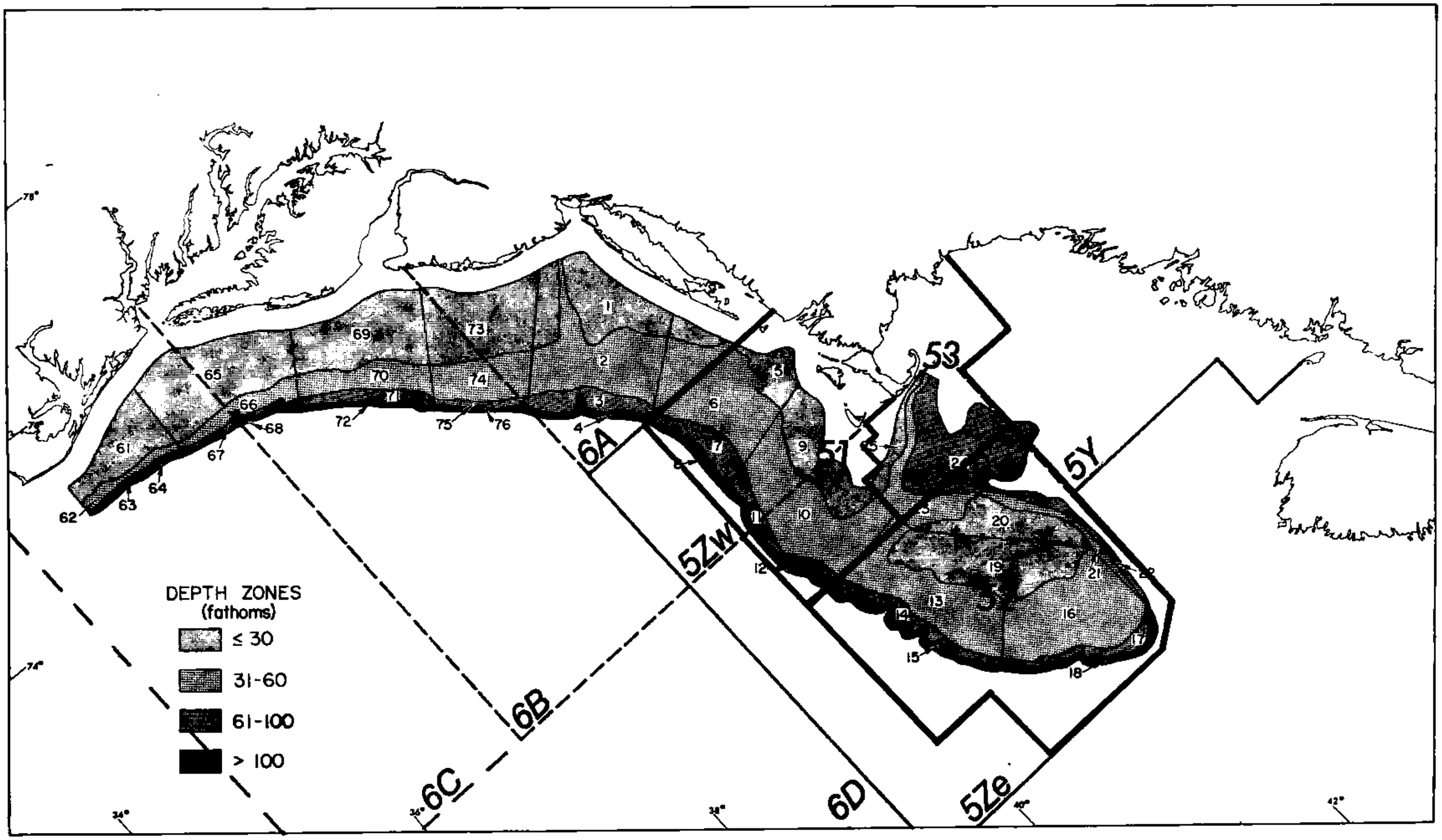

Fig. 1. Northwest Atlantic Ocean partitioned into ICNAF Subarea 5 and Statistical Area 6. Sampling strata for US-USSR joint groundfish surveys. Strata 1-23, 25 were used for pooled estimates of abundance for Div. 5Z; only US survey data was used for estimating the decline in biomass.

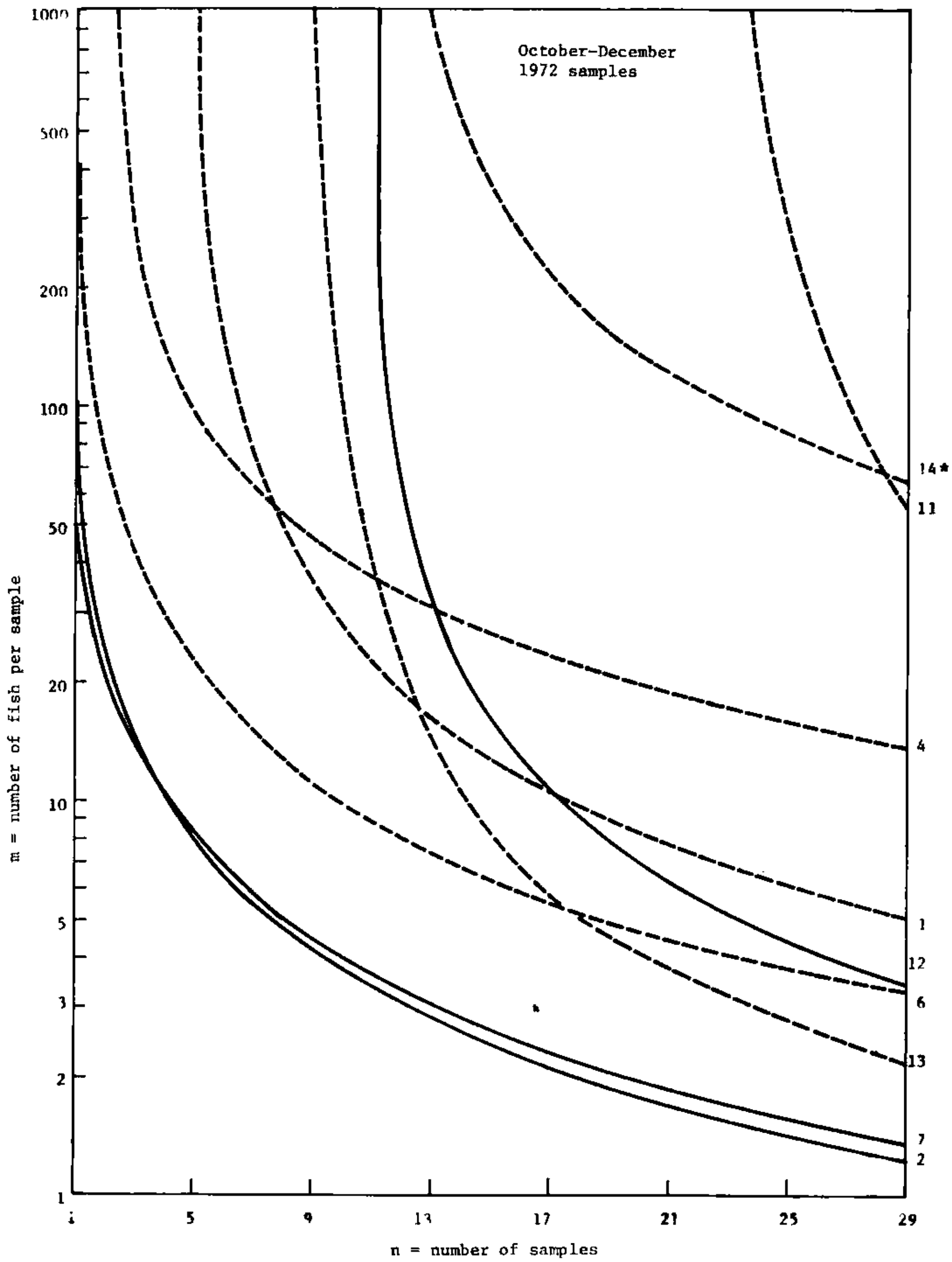

Fig. 2. Relation of n (number of samples) and m (number of fish/sample) needed to achieve coefficients of variation of .12 (——) and .20 (---) for percent at length yellowtail data.

<u>CODING:</u>

	month	$\bar{p}_1$	$\hat{Var}(\bar{p}_1)$	$\hat{s}_b^2$	$\hat{s}_w^2$	n	$\tilde{m}$	length
1	October	.176	.00157	.0067	.1421	5	125	30-34 cm
2	October	.664	.0011	.0039	.2227	5	125	35-39 cm
3	October	.127	.00012	(-)	.1105	5	125	40-44 cm
4	October	.039	.000047	.00005	.0229	5	125	45-49 cm
5	October	.01	.0000095		.0123	5	125	≥50 cm
6	November	.213	.00057	.0015	.1678	5	125	30-34 cm
7	November	.639	.00063	.0013	.2318	5	125	35-39 cm
8	November	.134	.000123	(-)	.1160	5	125	40-44 cm
9	November	.014	.000016	(-)		5	125	45-49 cm
10	November	.0012				5	125	≥50 cm
11	December	.098	.00203	.00923	.1097	5	100	30-34 cm
12	December	.494	.0081	.0387	.2180	5	100	35-39 cm
13	December	.308	.00869	.0421	.1614	5	100	40-44 cm
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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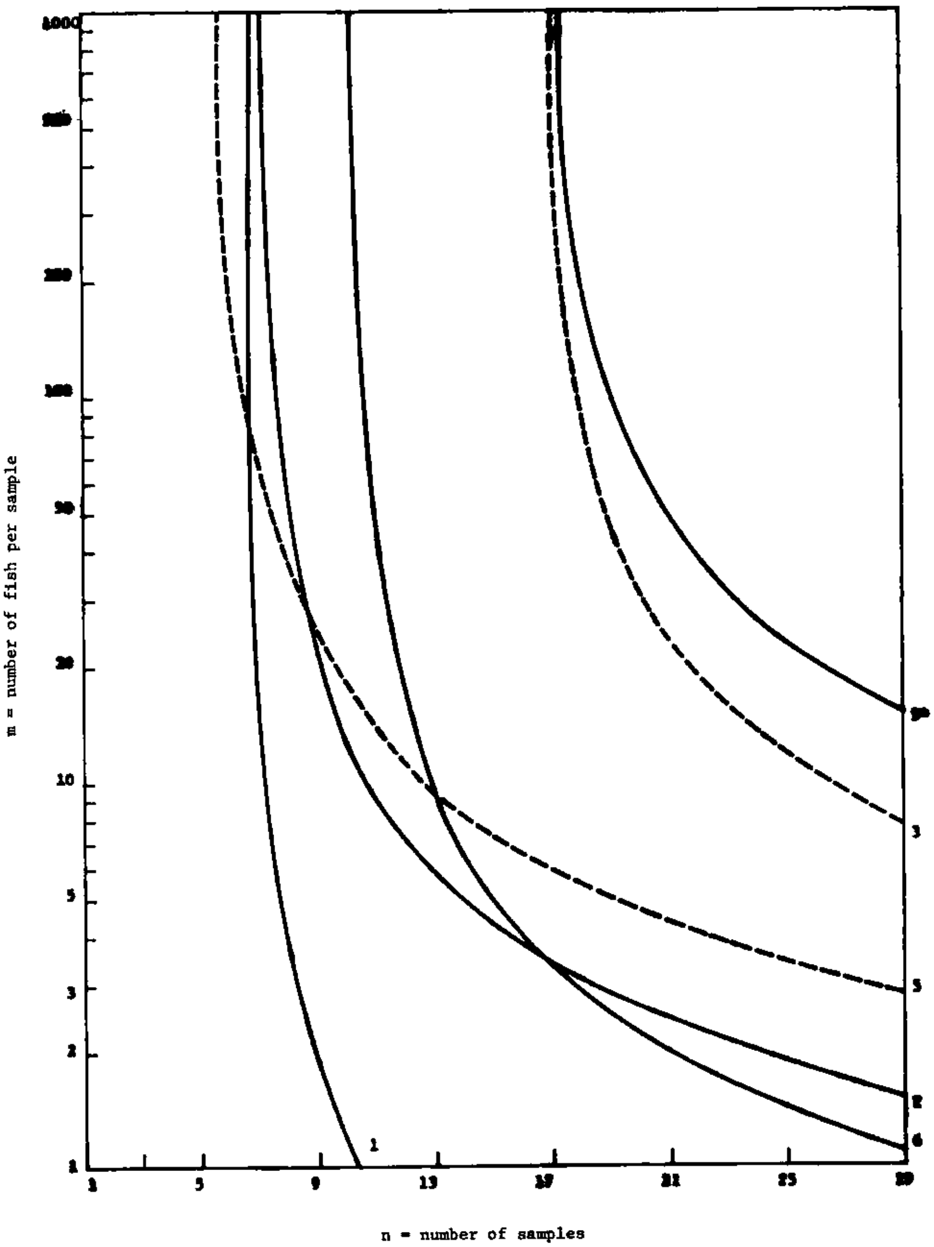


Fig. 3. Relation of n (number of samples) and m (number of fish/sample) needed to achieve coefficients of variation of .12 (——) and .20 (---) for percent of age at length male yellowtail flounder samples, October-December, 1972.

CODING:

	Age (a),	sex (x)	$\overline{P}_{a/lx}$	$\widehat{Var}(\overline{p}_{a/lx})$	$\hat{s}_b^2$	$\hat{s}_w^2$	n	$\tilde{m}$	length (l)
1	2-3	male	.87	.0058	.0746	.0469	14	7	30-34 cm
2	2-3	male	.66	.0040	.0467	.2009	15	15	35-39 cm
3	2-3	male	.20	.0059	.0271	.1512	11	4	40-44 cm
4	4-5	male	.06	.0013	.0116	.0464	14	7	30-34 cm
5	4-5	male	.28	.0022	.0196	.2009	15	15	35-39 cm
6	4-5	male	.71	.0105	.0777	.1512	11	4	40-44 cm
	2-3	female	.97	.00096	(-)	.0363	11	2	30-34 cm
7	2-3	female	.79	.0031	.0346	.1307	15	11	35-39 cm
8	2-3	female	.28	.0034	.0285	.2022	15	9	40-44 cm
9	2-3	female	.085	.0045	.0426	.0400	12	3.5	45-49 cm
	4-5	female	.03	.0009	(-)	.0368	15	2	30-34 cm
10	4-5	female	.21	.0029	.0317	.1300	15	11	35-39 cm
11	4-5	female	.59	.0037	.0278	.2490	15	9	40-44 cm
12	4-5	female	.564	.0140	.1298	.1337	12	3.5	45-49 cm
13	4-5	female	.50	.0500	.1700	.1667	5	2	≥50 cm
14	≥6	female	.12	.0026	.0272	.1061	15	9	40-44 cm
15	≥6	female	.28	.0103	.0872	.1275	12	3.5	45-49 cm
16	≥6	female	.50	.0500	.1670	.1667	5	2	≥50 cm

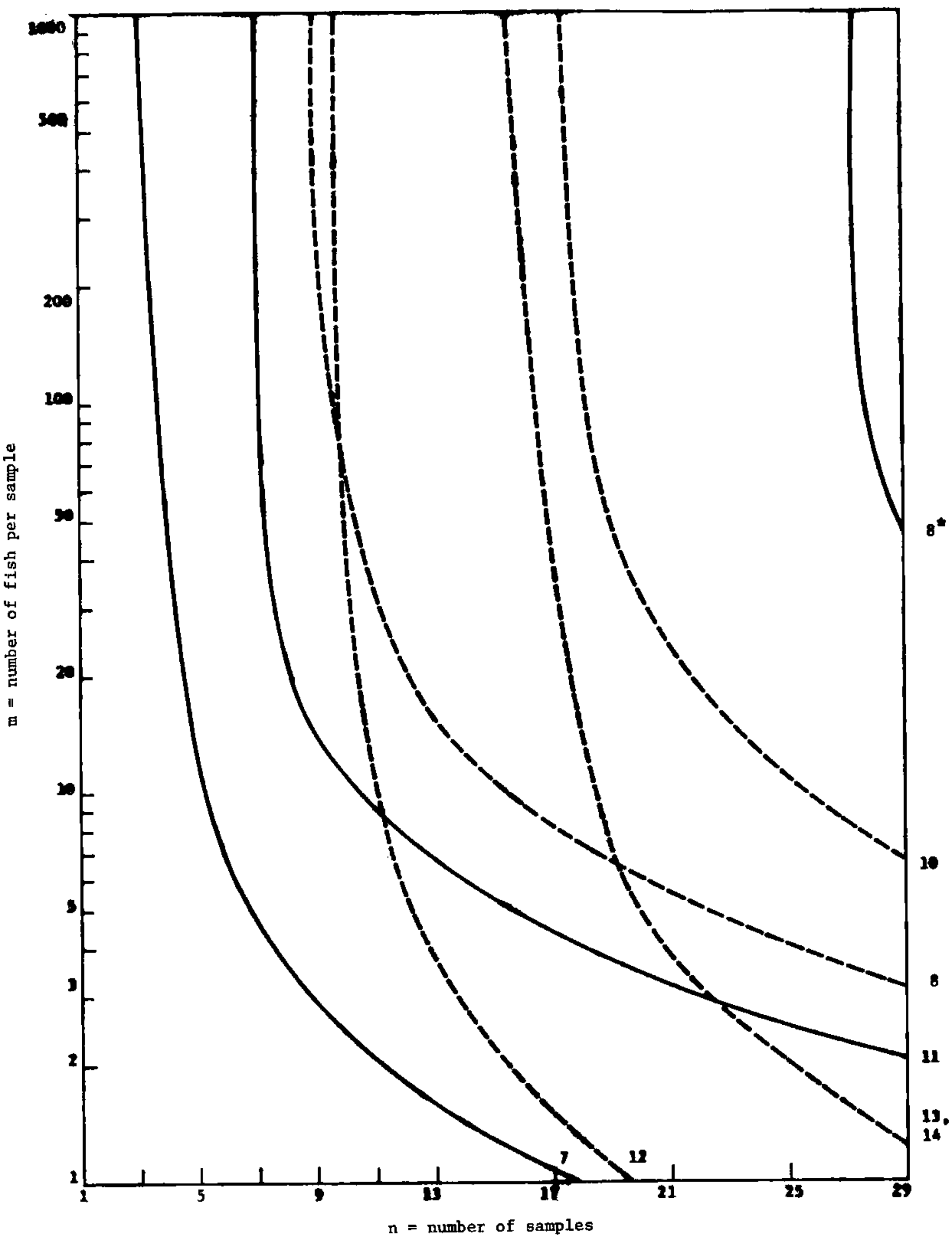
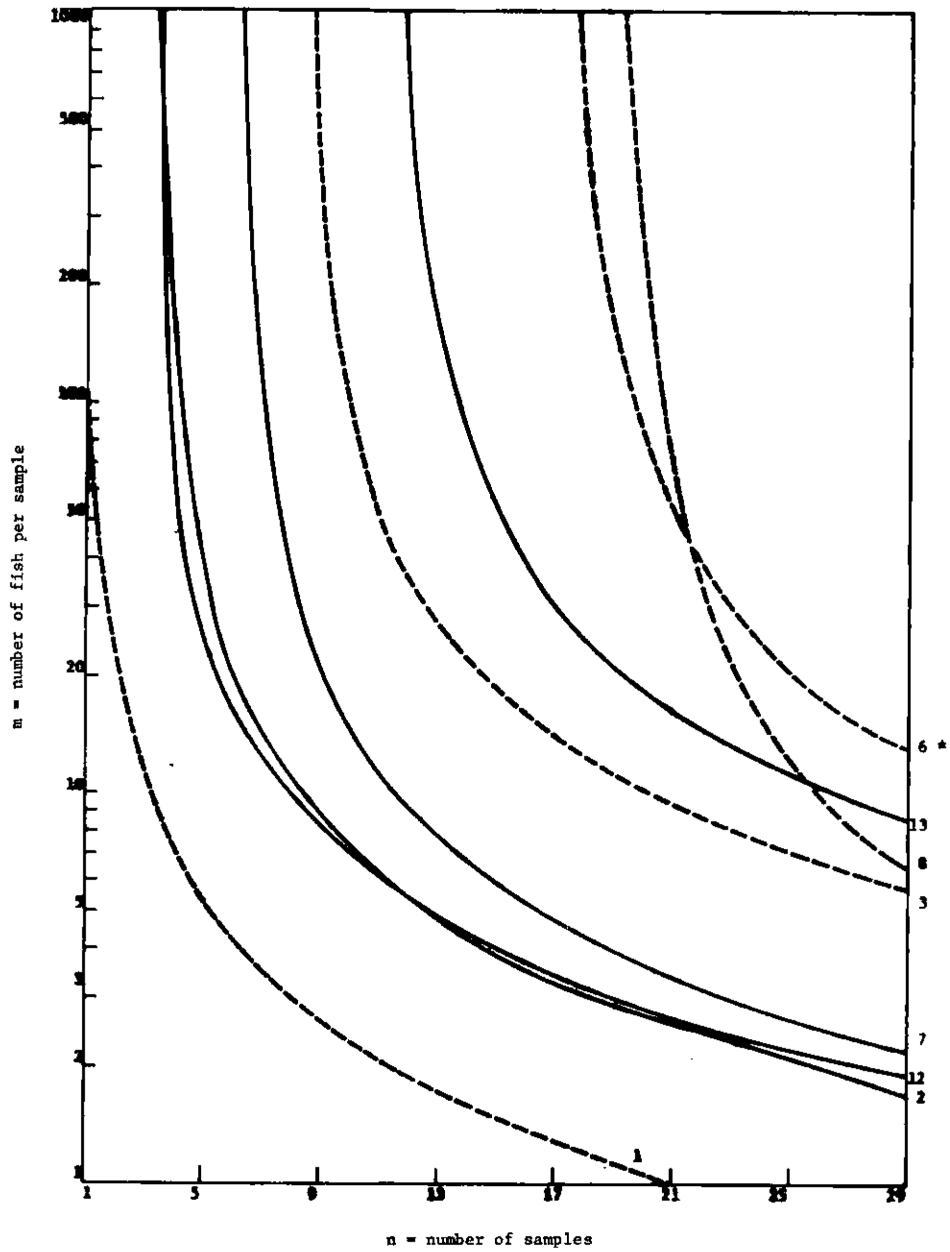


Fig. 4. Relation of n (number of samples) and m (number of fish/sample) needed to achieve coefficients of variation of .12 (——) and .20 (---) for percent of age at length female yellowtail flounder samples, October-December 1972.

<u>CODING:</u> same as Fig. 3.



Appendix Fig. 1. Relation of n (number of samples) and m (number of fish/sample) needed to achieve coefficients of variation of .12 (——) and .20 (---) for percent at length for yellowtail flounder samples taken January-March, 1972.

CODING:

	month	$\bar{p}_1$	$\hat{Var}(\bar{p}_1)$	$\hat{s}_b^2$	$\hat{s}_w^2$	n	m	length (l)
1	March	.132	.0007	.0054	.1097	9	120	30-34 cm
2	March	.581	.0022	.0196	.2076	9	120	35-39 cm
3	March	.221	.0019	.0169	.2319	9	120	40-44 cm
4	March	.058	.0008	.0069	.0340	9	120	45-49 cm
5	March	.007	.000016	.000097	.0056	9	120	≥50 cm
6	February	.147	.0028	.0158	.1241	6	120	30-34 cm
7	February	.547	.0051	.0288	.2129	6	120	35-39 cm
8	February	.228	.0072	.0422	.1166	6	120	40-44 cm
9	February	.049	.00073	.0041	.0310	6	120	45-49 cm
10	February	.013	.000086	.00045	.0076	6	120	≥50 cm
11	January	.096	.0007	.0036	.0887	6	102	30-34 cm
12	January	.560	.0027	.0137	.2217	6	102	35-39 cm
13	January	.307	.0031	.01669	.1948	6	102	40-44 cm
14	January	.031	.00012	.00044	.0285	6	102	45-49 cm