

Sea Sampling Program of the Northeast Fisheries  
Center, Woods Hole, Massachusetts

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INTRODUCTION

Analytical assessment requirements for marine fish stocks have greatly increased in recent years. This is particularly true for "traditional" species such as cod, haddock, and yellowtail which have been heavily fished in recent years; implementation of the Fishery Conservation and Management Act of 1976, PL 94-265, has stimulated renewed interest in the exploitation of these and other species. This has resulted in requirements for more detailed assessments, which necessitates expansion of the existing commercial data base. Additional data are needed relative to species and size composition of the catch, catch per unit effort, and discard by area and gear type. To date, this information has generally been secured from interviews and occasionally from vessel logbooks; the former are subject to errors and omissions due to the inability of the captain to recall all of the details of a particular trip, while logbook reporting has historically been sporadic, depending upon the port and the conditions within the fishery.

A potential additional source of information consists of observations aboard commercial vessels (sea sampling) during actual fishing operations. The potential of this approach is obvious in that it provides the opportunity for collecting detailed catch and effort information on a per-tow basis by species, area, and gear type. Length-frequencies of both marketable catch and discard, samples for ageing purposes, and other biological observations may be obtained as desired; at the same time, the opportunity exists for a mutual exchange of information between the sampler and vessel personnel.

It should be emphasized that the need for accurate discard information is critical. Data reported by Anderson (MS 1975) indicates that discard of silver hake (whiting) in the Gulf of Maine whiting, redfish, and shrimp fisheries averaged 7,200 (metric) tons from 1970 to 1974 - approximately equal to average USA reported landings (7,700 tons) during the same period. As this discard consisted of age 0 and 1 fish, the obvious implication is that this discard reduced recruitment and biomass substantially in the early 1970's (Anderson and Almeida MS 1978). Similarly, data collected during northern shrimp gear evaluation trials in 1973 indicated that, at least during summertime, by-catch and discard of finfish in directed northern shrimp fishing operations may equal or exceed the total shrimp catch (Northern Shrimp Scientific Committee MS 1978). Sissenwine et al (MS 1978) reported discard of yellowtail flounder averaging 2,700 tons and 3,800 tons annually from the Georges Bank and southern New England stocks, respectively, for the 1961-1977 period; averaged over both stocks, this discard amounted to 28% by weight

of the total landings during this period. Again, the implication is that recruitment potential may have been significantly reduced. Serchuk et al. (MS 1978) noted that "informal reports by fishermen suggest that considerable quantities of scrod cod were discarded in 1977"; however, no information was available concerning the exact amount or age composition of these discards, necessitating assumption of a range of options in the 1977 assessment.

In spite of its obvious importance the available discard data base for the New England - Middle Atlantic area is meager. An intermittent sea sampling program had existed for yellowtail flounder since the early 1960's; however, this was discontinued in 1975. Some data has also been collected in conjunction with other activities, e.g., northern shrimp gear - evaluation and resource monitoring studies (Northern Shrimp Scientific Committee, MS 1978); also some information is available from occasional trips aboard groundfishing vessels (Serchuk, MS 1978). Discard information has also been obtained from a limited number of interviews by NMFS port agents and state extension agents. Data from sea sampling sources are without continuity and in some cases port interview discard data are not readily available. The need is therefore evident for a comprehensive, continuous sea sampling program, that will provide a continual flow of discard data, as well as the additional data previously mentioned, for storage in computer mode and use in analytical assessment work.

The purpose of the present document is to review a program currently under development at the Woods Hole Laboratory (NEFC) for sea sampling work

with particular reference to sampling design and procedures for processing, coding, and storage of the resultant data. The document is intended to provide information and guidance to persons engaged in sea sampling activities so as to facilitate orderly development of the data base as the program develops.

#### GENERAL PROCEDURES

A program coordinator<sup>1</sup> designated at NEFC will supervise the execution of the program. The coordinator will be responsible for contacting vessel captains and arranging for trips, securing personnel from the NEFC and other organizations to act as sea samplers, ordering supplies and equipment, and supervising the processing, coding, and storage of the resultant data. The coordinator will also be responsible for developing files of trip reports and supplementary information and for performance of such other duties as the Chief of the Fishery Analysis Investigation at the Northeast Fisheries Center (NEFC) may direct.

#### Ports and Vessels

Sea sampling trips will be made primarily from major commercial ports (e.g., Portland, Maine, Gloucester, Boston, New Bedford, and Provincetown, Massachusetts, and Point Judith, Rhode Island). Trips will also be made from smaller ports (e.g., Newburyport or Chatham, Massachusetts, and

<sup>1</sup>  
Presently Paul Wood

Boothbay Harbor, Maine). An attempt will also be made to expand the program to the Middle Atlantic region. Vessel captains and/or vessel owners will be informed of the program and invited to participate. Those indicating a desire to participate will be contacted by the program coordinator or his representative.

In such contacts the purpose of the program (i.e., to provide additional biological information for assessment purposes) will be stated and mention made as to the type of data required and input needed from the captain and crew, e.g., loran bearings of tow location, estimates of haul weight by species, etc. The captain will also be informed that all information obtained will be confidential and will be utilized for research purposes.

Vessels for sea sampling work logically divide themselves into three classes:

Class 1: "Day-trippers" operating out of almost all ports, including primarily smaller (<60 GT) vessels. Those engaged in groundfish operations usually depart prior to sunrise to operate on inshore grounds one or two hour's steam from port, returning late the afternoon of the same day.

Class 2: This group typically includes small and medium (61-125 GT) vessels which may remain up to seven days at sea depending on weather and availability of the species sought. There is considerable overlap between the above two groups on a seasonal basis, e.g., many of the smaller Gloucester boats

will operate on a daily basis during wintertime but will remain at sea for extended periods in spring and summer.

Class 3: This group consists primarily of larger (>125 GT) vessels operating out of major ports (e.g., Boston and New Bedford). Such vessels typically remain at sea for over a week and range over the Gulf of Maine, Georges Bank and areas further east.

### SEA SAMPLING PROCEDURES

#### General

The primary responsibility for staffing this program will rest with the Northeast Fisheries Center. Insurance requirements dictate the need for government or government affiliated (e.g., CETA program) personnel. Special arrangements may be necessary in some cases, e.g., under certain CETA programs personnel may participate only on day-trips as no overtime compensation is possible. Supplies and equipment (Appendix I) will be provided by the coordinator or by the personnel involved. The coordinator will also notify the NMFS Statistics Branch Fisheries Management Supervisor<sup>2</sup> prior to any sea sampling activity in order that he may in turn notify the appropriate port agents.

On one-day sampling trips, the sampler should be "on duty" during all tows if at all possible. On trips lasting for several days, the sampler should make an attempt to be "on duty" for 6-hour shifts (or longer) during both night and day, assuming, of course, that the vessel is fishing on a 24-hour basis. Information secured during these periods can be used to prorate values for the remainder of the trip as necessary. Hail weights

<sup>2</sup>Presently Ronnee Schultz

and other information are logged by tow in the wheelhouse and can provide information on tows conducted while the sampler is not on duty.

#### Data Requirements

The information required consists of (1) catch/effort data (including discard) by species and area, and (2) length-frequency samples of the discard (and of the marketable catch as time permits). Catch/effort data should be entered by tow on the New England Fishing Log Form (Appendix II): hail weights by species and market category can be obtained from the captain and/or crew members after the catch is processed. Length-frequency data should initially be recorded on the aluminum punch strips provided.

#### Notes on Random Sampling<sup>2</sup>

When sampling a mixed catch for species composition or length-frequency distribution, sampling should be random, that is, every individual in the population should have an equal chance of being selected. If the marketable catch is being sampled, and this catch has been sorted by species and market category, then a stratified random sample is required. In a sorted catch of a given species, the "strata" would consist of the market categories recognized; therefore samples should be taken within all market categories if a sorted marketable catch is being sampled.

<sup>2</sup>Abstracted from Mayo, R.K. and W.L. Cain. MS 1978. Sampling for species composition and length and age frequency of the catch. In NMFS Manual for Observers Aboard Foreign Fishing Vessels, Part II, Biological Sampling, Section 2, p. 1-6.

In any type of random sampling, certain built-in biases tend to work against selection of a truly random sample. Whether sampling for species composition from a mixed pile or for length distribution within a particular species or market category, a subconscious tendency exists to select larger or otherwise more obvious individuals. In addition, fish may stratify to some degree within the trawl according to size or girth, further increasing the opportunity for bias. The effects of these factors may be reduced by selecting a number of smaller subsamples from various locations within the pile to be sampled (or baskets from each market category if the catch has been sorted), and by selecting every individual at each of these locations. For example, to determine species composition of the discard from a large mixed catch in the checker after removal of marketable fish, three or four subsamples should be taken from different locations, including all fish from the top to the bottom; these would be combined in a bushel basket and species composition then determined. Similar procedures could be used for large piles of individual species.

#### Catch and Effort Data

Information on tow location and duration, catch by species, discard, and other information should be entered on the New England Fishing Log Form. These forms should be completed by item number as follows:

1. Vessel name and registration number
2. Gear
3. Mesh size
4. Trip number (by the sampler)

- 5-6. Date and time (24-hr. basis) of sailing and return to port
- 8-9 . Date and time of tow
10. Position (enter fishing grounds and LORAN bearings)
11. Depth fished in fathoms (should be average depth for the tow, usually calculated by averaging depth at beginning and end of tow)
13. Total time net on bottom.
14. Breakdown by species - enter hail weights of fish retained for market by species and market category (provided by the captain and crew) and number of bushels of discard by species. If a length-frequency sample is taken of any component of the catch, a notation to this effect should be made in the appropriate column on the form. Note also that one log form may be used for each tow when tows contain a large number of species.

Discard should be measured by species on a bushel basis using the wire baskets provided. In the case of large catches it may not be feasible to tally the total discard on a bushel basis and the captain's estimate (bushels) should be used, at least until sufficient experience is gained. In the case of large mixed catches a random one bushel sample should be taken by subsampling as discussed above and examined to estimate relative percentages discarded by species; these percentages may then be applied to the total number of bushels discarded to estimate the number of bushels discarded by species.

If discard data for certain tows are not available (e.g., for tows on extended trips during the period that the sampler is off duty) an overall estimate may be obtained by the formula:

$$\frac{\text{Total hours fished (all tows)}}{\text{Hours fished (on-duty tows)}} \times \text{species discard (on-duty tows)}$$

In addition to catch and effort data and discard, length-frequency samples should be taken of the discard (and also of the marketable catch, time permitting). Length-frequency sampling of the discard is critical in that it will provide the only basis for determining age composition of this component; however, sampling of the marketable catch will also be useful for supplementing onshore sampling activities. Amount sampled will vary with the size of the fish; for larger groundfish, e.g., large cod a minimum of two two-bushel samples should be taken at random from different locations within the checker; for smaller groundfish, e.g., scrod cod or haddock, at least two one-bushel samples should be taken and combined for length-frequency measurements. For smaller fish which are being discarded, a one-bushel sample should suffice. (In some cases it may be necessary to subsample a one-bushel basket using a plastic pail and prorating by the number of pails in a one-bushel basket). The sample should be adequate to provide a representative length-frequency distribution of the species in question for that particular tow; consequently, sampling intensity will necessarily vary according to the size distribution involved. As many tows as possible should be sampled; however, it should

not be necessary to sample every species discarded during each tow. (In fact, sampling activities on a per-tow basis will usually have to be limited in practice so as not to interfere with activities of the crew.) The sampler should plan his work so as to secure an adequate representation of the species discarded during a given trip, beginning with species of major importance and proceeding to other species as time permits.

All species except Atlantic herring should be measured to the nearest cm, using the measuring boards and punch strips provided. Atlantic herring should be measured to the centimeter below the actual length. Species with a forked caudal fin (e.g., cod) should be measured in terms of fork length; species with a rounded caudal fin (e.g., flounders) should be measured in terms of total length. Atlantic herring should be measured in terms of natural length, that is, greatest total length with the caudal fin lobes in their natural position.

Normally, length-frequency data will be recorded on the aluminum punch strips provided. These should be labelled in the upper right-hand corner (species and market category, if any, vessel, date, and tow number).

#### DATA REPORTING AND PROCESSING

Upon completion of the trip, the sampler will be responsible for preparation of a brief report describing the trip and summarizing the information collected. For day trips, this could amount to a one-page memorandum providing general observations, i.e., location fished, number of

tows, species taken and discarded, and other information on long-term trends, past discard, etc., provided by the captain. For longer trips, a trip report should be completed in the format of current NMFS cruise reports. The number of length-frequency samples should also be recorded by species and market category, if applicable.

The sampler should also complete the following:

1. The NMFS Interview Record Form (Appendix III). This should be used to summarize data over all tows for the trip including total haul weight landed by species and bushels discarded by species. Data should be recorded as per instructions provided in the "Manual for Sampling, Interviewing and Coding for the Northeast Region" (revised 4/74) by Ronnee L. Schultz. Data will be taken from the New England Fishing Log Forms and should agree with the summarized tow haul figures for each species.
2. Length-frequency sample forms (Appendix IV). A separate form should be completed for each sample taken, by transposing the measurements punched on the aluminum strips to the forms provided using the plastic overlays.

Trip information included on the NMFS Interview Record Form will be punched and stored in INTVCARD format in accordance with normal ADP procedures at Woods Hole (total trip data, effort data by area, individual species weights, and discard weights will be available in separate INTVCARD

formats). Individual tow records as recorded on the New England Fishing Log Forms will not be stored in computer mode but will be retained on file at NEFC.

Length-frequency data will also be processed in accordance with current ADP procedures at Woods Hole, but each record will be indexed in order that it may be clearly identified as originating from the sea sampling program. Discard samples will be stored in a separate file to minimize risks of accidentally including these data in routine biostatistical analyses involving landed market categories.

## Literature Cited

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Appendix I. Checklist of sea sampling supplies and equipment

Basket, wire, 1-bushel capacity	( 2)
Basket, wire, 2-bushel capacity	( 2)
Pails, plastic	( 4)
Measuring board (cm)	( 1)
Clipboard, aluminum, w/cover	( 1)
Rain gear	( 1 set)
Gloves	( 1 set)
Aluminum punch strips	(50)
Plastic overlay for punch strips	( 1)
Punch	( 1)
New England Fishing Log Forms	(25)
Length-Frequency forms	(50)
Interview Record Forms	(10)
Blank paper, pencils, etc.	

1. VESSEL NAME		2. KIND OF GEAR		3. MESH SIZE (Stretch)			
4. TRIP NO.		5. VESSEL SAILED (Month, Day, Year, Time)		6. VESSEL LANDED (Month, Day, Year, Time)			
7. WATCH		8. DATE	9. TIME	DATE	TIME	DATE	TIME
10. POSITION WHILE FISHING: (Enter Latitude & Longitude, Unit Area, Loran Bearings, or Fishing Grounds by Name)							
11. DEPTH FISHED IN FATHOMS							
12. NUMBER OF TOWS PER WATCH							
13. TOTAL TIME NET ON BOTTOM		HRS.	MIN.	HRS.	MIN.	HRS.	MIN.
14. BREAKDOWN BY SPECIES	MARKET FISH	HADDOCK	LARGE (lbs.)				
			SCROD (lbs.)				
		YELLOWTAIL (lbs.)					
	OTHERS (Name & weight)						
	15. TOTAL HAIL PER WATCH OR TOW						
	ESTIMATED DISCARDS	HADDOCK (bushels)					
		YELLOWTAIL (bushels)					
		OTHERS (Name & bu.)					
16. TOTAL DISCARD							

COMMENTS (Continue on reverse if more space is required) (If reverse side is used for comments adjust carbon as necessary to make sure Comments appear on both copies.)

Appendix. III. Interview Record Form.

NEW ENGLAND STATES  
NATIONAL MARINE FISHERIES SERVICE  
INTERVIEW RECORD — CONFIDENTIAL

VESSEL			DATE			PORT			GEAR		
VESSEL CODE			DATE SAILED: TIME			DATE LANDED: TIME			STUDY YES.		
MESH SIZE		TRIP TYPE		TIME LOST		DAYS AB		TOTAL HAIL		COLL.	
GROUND				GROUND				GROUND			
AREA	POSITION		DEPTH	AREA	POSITION		DEPTH	AREA	POSITION		DEPTH
DY. & NT.	DAY ONLY	NT. ONLY	DY. & NT.	DAY ONLY	NT. ONLY	DY. & NT.	DAY ONLY	NT. ONLY	DY. & NT.	DAY ONLY	NT. ONLY
NO. TOW	DUR. TOW	TIME DAY	NO. TOW	DUR. TOW	TIME DAY	NO. TOW	DUR. TOW	TIME DAY	NO. TOW	DUR. TOW	TIME DAY
COD, LARGE	0811										
COD, MKT.	0813										
COD, SCROD	0814										
HADDOCK LARGE	1470										
HADDOCK SCROD	1475										
REDFISH	2400										
YELLOWTAIL	1230										
FLUKE	1219										
BLACK BACK	1200										
LM. SOLE	1201										
DAB	1240										
GRAY SOLE	1220										
WHITE. RND.	5090										
POLL. DRN.	2691										
HERRING	1685										
SHRIMP	7360										
SEA SCALLOP	8009										
UNC. FOOD	5260										
UNC. REDUCT.	5290										
DISCARD	9										

Appendix IV. Length-Frequency Sample Form.

Interview		Code	Column	LENGTH SAMPLE												Column 28-29				
				Card Sequence																
Vessel				1		6		1		6		1		6		1		6		31-33
Date Landed				2		7		2		7		2		7		2		7		34-36
Date Sailed				3		8		3		8		3		8		3		8		37-39
Year			1-2	4		9		4		9		4		9		4		9		40-42
Area			3-6	5		0		5		0		5		0		5		0		43-45
Quarter			7	6		1		6		1		6		1		6		1		46-48
Month			8-9	7		2		7		2		7		2		7		2		49-51
Species/cat			10-13	8		3		8		3		8		3		8		3		52-54
Gear			14-16	9		4		9		4		9		4		9		4		55-57
Port			17-19	0		5		0		5		0		5		0		5		58-60
Sample No.			20-21	1		6		1		6		1		6		1		6		61-63
Depth			22	2		7		2		7		2		7		2		7		64-66
Sampling Meth.			23	3		8		3		8		3		8		3		8		67-69
Sex			25	4		9		4		9		4		9		4		9		70-72
Catch-Locale				5		0		5		0		5		0		5		0		73-75
Effort			Total																	76-80
Age Samples	No. Scales			Start L - F Columns with 1,16,31,46,61,76,91,106,121,136,151,etc.																
	No. Otoliths																			
Sample Wt.																				