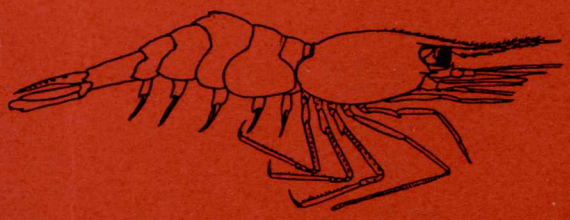
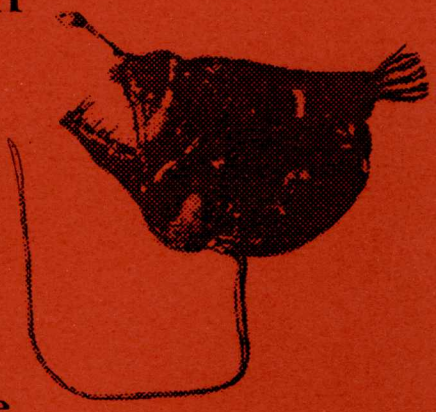
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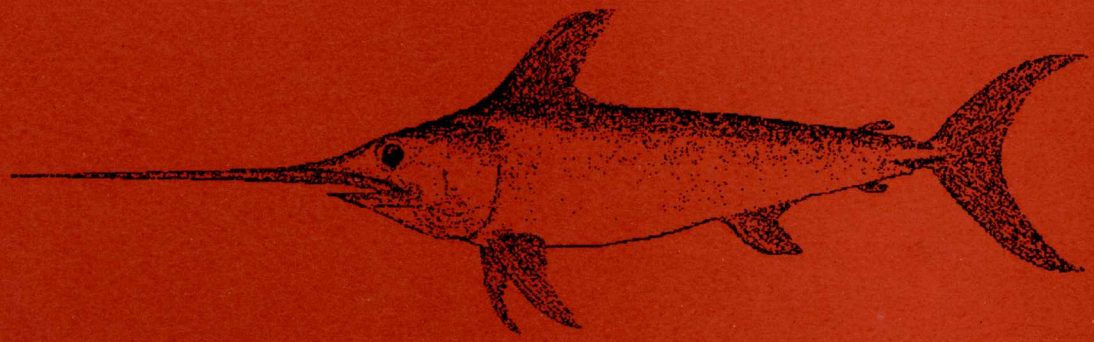
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D.W. Kulka
C.M. Miri
J.R. Firth



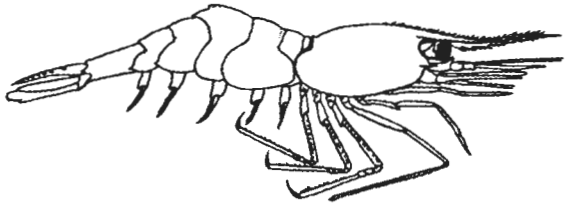
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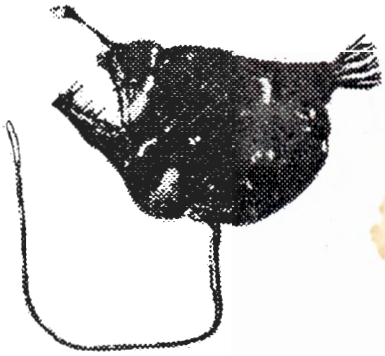
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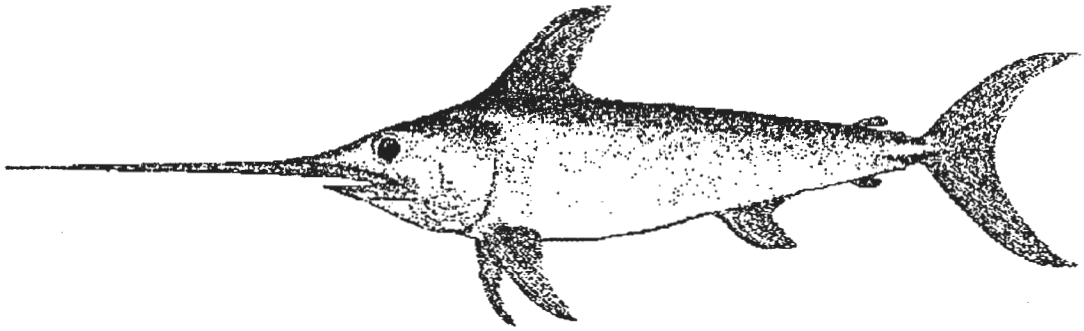
Observer Program Training Manual - Newfoundland Region



D.W. Kulka
C.M. Miri
J.R. Firth



A Science Manual for the 2000 Observer Program Training Course, St. John's, Newfoundland Canada



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Abstract

Objectives of the Fisheries Observer Program are to ensure compliance with Canadian fishery regulations and to provide information as input for the management of fish and invertebrate resources. The Observer Program addresses these objectives by acquiring detailed information about the fishing activities off Canada's shores. In doing so, it ensures compliance with fishery regulations and provides unbiased scientific, technical, and regulatory information as input into the management and development of fisheries along Canada's coast.

This document concentrates on the scientific duties of the fisheries observer. It is designed to be a training manual and field guide specifically for fisheries observers in the Newfoundland Region, but can be adapted to similar programs globally because of its general approach. Data collection formats are suitable for a variety of mobile and stationary gears, directed species, and fisheries. The concepts, guidelines and instructions imparted in this document can guide the observer on how a duty is to be carried out, a problem is to be resolved, or a form is to be filled. Included are sections describing briefing and debriefing procedures, how to collect set details and quantify catches, techniques of sampling, how to handle special projects and situations, and how to complete the various data collection forms. The final section presents a brief explanation on how fisheries managers use observer data, and why accuracy in the collection of information is essential.

Introduction

History

Effective management of marine fisheries resources depends on the availability of detailed and reliable catch, fishing effort, biological, technological, and regulatory data. Before the Observer Program, information on the size and age of fish caught by the Canadian fleet had been collected by technicians from fish landed in processing plants. Data from foreign vessels were scarce. Catch and fishing effort data were obtained from logs recorded by vessel captains, and purchase slip records at the point of landing. These sources were limited in scope, detail, and accuracy; particularly in terms of bycatch, discarding, and many details of the fishing and processing operation. Inaccuracy was a concern, because this landing or fishing log information was reported by individuals whose primary interest was fishing and processing fish, rather than collecting unbiased data. Also, precise location of fishing activity and fishing effort could rarely be determined. Other information relating to the fishing operation such as fish behaviour, fishing technology, production, marketing, fleet strategies, environmental influences, or regulatory issues were not collected. The Observer Program was implemented to provide broader based, more appropriate support to management.

The advantage of having observers as seagoing collectors of biological data and catch/effort information was recognized by Paulsen (1956) and others long before the existence of such a program. In 1976, ICNAF, the International Commission for the Northwest Atlantic Fisheries, then the regulatory body for Canadian Atlantic fisheries, placed observers on foreign fishing vessels operating within Canadian jurisdiction. By providing detailed resource assessment data and monitoring adherence to regulations, this experimental program demonstrated a requirement for an observer system to support fisheries' management. With extension of jurisdiction in the following year, came the responsibility of managing both domestic and foreign fishing activities. The Atlantic Observer Programs were implemented to provide field support for the management process.

In 1980, coverage was expanded to include the domestic offshore fleets, and later inshore activity. The Newfoundland Observer Program now covers offshore, nearshore, and inshore fisheries occurring from Davis Strait, NAFO Subareas 0, south to the Grand Banks, NAFO Division 3 (Fig. 1). The Scotia-Fundy Observer Program covers the Scotian Shelf fishery in NAFO Subarea 4, with overlapping responsibility in the Gulf of St. Lawrence. Kulka and Waldron (1983) describe the history and scientific accomplishments of the first four years of the observer programs that existed in the Newfoundland and Scotia-Fundy Regions. In 1981 and 1986, the Observer Program was expanded to the Gulf and Quebec regions respectively, with shared responsibility in the Gulf of St. Lawrence. In 1987, Atlantic coverage was expanded to 100% for the foreign fleet, the 2J3KL domestic Northern cod, and shrimp fisheries. In 1990, coverage was extended to 65 ft. vessels (i.e., the nearshore fleet). Although expansion of coverage was done mainly for political reasons, the data obtained from these and other fisheries were of considerable benefit to management. As data acquisition and surveillance tools, the observer programs are now an integral part of fisheries management.

Program Functions

The Newfoundland Observer Program provides scientific and technical data as input into the management of commercially important fish and invertebrates, and monitors compliance with Canadian fishery regulations. The scientific responsibilities of an observer include: collecting species-specific data for analyses of stock size and distribution; providing set-by-set catch/effort information; recording associated species bycatch and discard data; obtaining information on fishing patterns; collecting production, gear and other technical data; monitoring pollution in the vicinity of the assigned vessel; gathering information on the size and age of the catch; and sampling specimens of rare fish, invertebrates, marine mammals, and birds. Observers are also periodically requested to obtain specific information or samples for special research projects, such as monitoring stages of maturity in capelin or cod, or collecting shellfish specimens for toxicological assays. Such input allows Program managers to assess the status of commercially exploited stocks; investigate possible solutions to problems among competing sectors or between the oil and fishing industries; examine various biological problems regarding the ecology and life history of commercially important species; examine such technical issues as fishing gear capabilities and processing methodologies; and assist in the development of new fisheries.

Fishing operations of many countries directing for numerous species with a variety of fishing gears present a complex situation where, for the observer, a thorough knowledge of the fisheries and a good reference document is crucial. While in isolation at sea, an observer may encounter unfamiliar situations where the appropriate steps to be taken are not clear. This manual provides information and methods for solving most data acquisition problems, describes how to complete the various data sheets, and includes a full set of specifications and codes. Observers may be required to record the acquired data on paper, or in an automated format (i.e., direct entry into a laptop computer). Regardless, the methods and instructions remain valid.

This document concentrates on the scientific duties of a fisheries observer. It is designed as a training manual and field guide specifically for observers in the Newfoundland Region, but can be adapted to similar programs elsewhere because of its general approach. Data collection formats are suitable for a variety of mobile and stationary gears, directed species, and fisheries. Because of the complex nature of commercial fisheries, situations encountered by the observer rarely match the examples given in this manual. However, the concepts, guidelines and instructions presented in the following sections can aid an observer with performing a task, resolving a problem, or filling out a data sheet. Included in this document are sections describing Briefing and Debriefing procedures, set detail collection and catch estimation, random sampling, special projects and situations, and completion of the various data sheets. The last section presents a brief explanation on how fisheries managers use observer data, and why precision in the collection of observer information is essential. Listed references provide background material and elaborate on sampling techniques, species distribution, fishing gear, and other related topics. Regulatory and surveillance aspects of the Observer Program are presented separately in the At Sea Observer Operations Manual (DFO internal document).

Briefing

The task of getting data from a commercial operation at sea is a complex and challenging one. The observer is also operating in an isolated, unsupervised environment. The vessel's operation must be understood by the observer before the trip begins, and activities at sea must be planned. The briefing session provides this information, and prepares the observer for specific tasks and problem situations that may arise. The extent of briefing varies, depending on the type of trip and experience of the observer. For example, deployment to a shrimp or clam fishery would require considerably more preparation than a cod trip, because of the greater complexity of these operations. Table 1 summarizes the issues addressed during briefing.

The observer needs detailed information on the vessel and fishery to be observed. If the vessel has been observed previously, its specifications and design (e.g., accommodations, crew size, production areas, processing equipment, fish holding bins) are given. Pertinent regulations and past infractions or special problems encountered in the fishery are reviewed to alert the observer to situations that may arise during the trip. Historic catch rates, depths and areas fished, bycatch, discarding, and biological information about the relevant stocks are also reviewed.

Scientific responsibilities vary depending on type and circumstances of a particular trip (e.g., directed species, gear). Basic sampling requirements, including techniques for target species and special projects, are discussed. Data sheets (and/or computer) and the necessary tools such as a sampling board, knives, bags, are issued (Table 2), and must match trip requirements. A basic work plan for the trip is given in the Briefing Instructions handout.

Arrangements are sometimes made to have the observer interview another observer who has been previously deployed to the particular vessel or fishery. This situation is most desirable, but not often possible.

Deployment Initiation Procedures

Travel to another port to join an assigned vessel is often necessary, especially for domestic trips. For inshore deployments, not only points of embarkation and debarkation may change, but vessels also. For foreign deployments, several observers may occasionally be transported to fishing grounds on a single vessel, and then transferred at sea to fishing vessels via small craft. Regulations state that such transfers must occur only during daylight hours, and that safety standards are applied to boarding craft and over-the-side ladders.

An assigned vessel may be part of a fleet from any of about 10 countries. Production layout, fish catching design, and living conditions vary widely. Therefore, a detailed examination of working areas is essential (see Babin and Wood 1981, and Greenway 1981, for a description of vessel types). A report elaborating on the layout, specifications, and living conditions of the assigned vessel is provided during the Briefing session. Vessel specifications need only be verified and updated if some aspects have changed. The information collected during the current trip will be entered in the historical database for use on future deployments.

At the start of a deployment, appropriate contacts must be established, preliminary data obtained, and most importantly, a data collection strategy established. These actions will lay a foundation for all subsequent activities. Follow a procedure in collaboration with key ship's officers (many of whom on foreign vessels can communicate in English). At the beginning of a trip, locate optimal sites for making observations, and consult with the captain to select sampling locations. Choose areas where fish enter the processing room, so there is access to the catch before sorting by crew (Fig. 2); thereby allowing random sampling. Otherwise, culling of the catch may result in disproportionate amounts of small or large fish being observed. Special samples (e.g., discarded fish) may require alternate locations.

Thorough preparation is an important aspect of data acquisition. While steaming to fishing grounds, study all procedural outlines (e.g., memos, Briefing instructions). Become familiar with all aspects of the ship's fishing operations within the first two days of a trip. Establish and maintain a comprehensive pattern of observation, sampling, and recording Set & Catch details.

The following sections describe observer duties, and highlight potential problems and their solutions. In an unsupervised environment at sea, observer judgement, initiative, and adaptability are crucial to successfully applying the following techniques to various situations on board fishing vessels.

Techniques of Observing Sets

The mandate of an observer is to gather information pertaining to the fishing operation at sea. The most important aspect from a fisheries management perspective is determining how much the population is reduced by commercial activity. Quantifying fishing mortality for a particular operation entails estimating the amount and type of fish and invertebrates caught in each set, and the effort that went into capturing the fish. A fishing "set" is defined as the deployment and retrieval of gear resulting in a catch of target (directed) and incidental (bycatch) species. An "observed" set is one in which the observer directly weighs or otherwise estimates the weight and composition of the catch for both kept and discarded fish. The minimum standard required for the proportion of observed sets during a trip is 75%. However, it is prudent to maximize the number of observed sets, because catch data from fishing log records can be unreliable. One advantage of catch data based on direct observation over those obtained from vessel fishing logs is a more accurate estimate of "bycatch"; both for number of species caught and quantity of each species. "Bycatch" is comprised of all species caught, excluding the directed species. Historically, fishing logs had not given accurate breakdowns of bycatch species and quantities, especially for non-commercial species. Therefore, observers must provide a breakdown by weight of all species caught in each observed set.

Also, choosing which sets are to be observed is important. Equal proportions of day and night sets should be observed, because fish size, sex ratio, catch rates, and catch composition can vary diurnally. Some species may move upwards in the water column at night (and move back down during daylight hours), thereby being less susceptible to capture after dark.

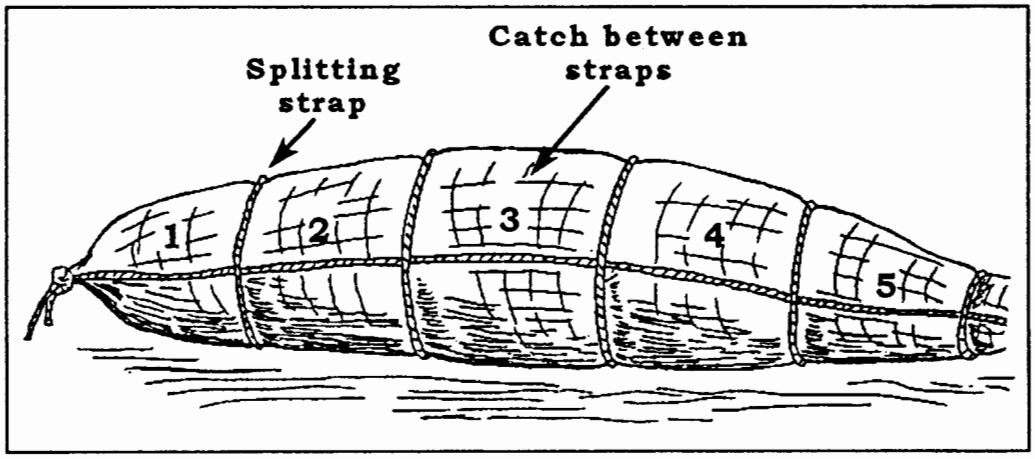
While observing a set, obtain the following data and records from the captain or designated crew:

1) starting position (cross-check with fishing log)
2) start and finish time (cross-check with fishing log)
3) depth fished
4) vessel side number (confirmation)
5) vessel horsepower (confirmation)
6) detailed data pertaining to gear and electronic equipment
7) fishing and production logs

The primary and most time consuming task is to estimate the amount of fish caught in the set, independent of log records. Designing a plan for observing and measuring fish is the first step. Determining locations for observing and estimating amount and composition of the catch depends on how it is handled once it comes on board the ship. Depending on the fishery and vessel being observed, the catch can be handled in one of two ways: either the catch is emptied from the net into an open bin on deck, where it can be quantified and its composition determined (before being processed and stored in the hold); or the catch is dumped directly into a hopper below deck, requiring a less direct approach to quantifying the catch.

Techniques of observing sets vary by species, gear, and vessel. Employ the most direct methods possible for the situation and wherever possible, use more than one method. Although the principles of observation are universal, techniques described in the following section refer to a specific example: redfish caught by otter trawl on a foreign vessel. Variations of these methods for other fisheries are described in the chapter, Observing and Sampling - Special Cases.

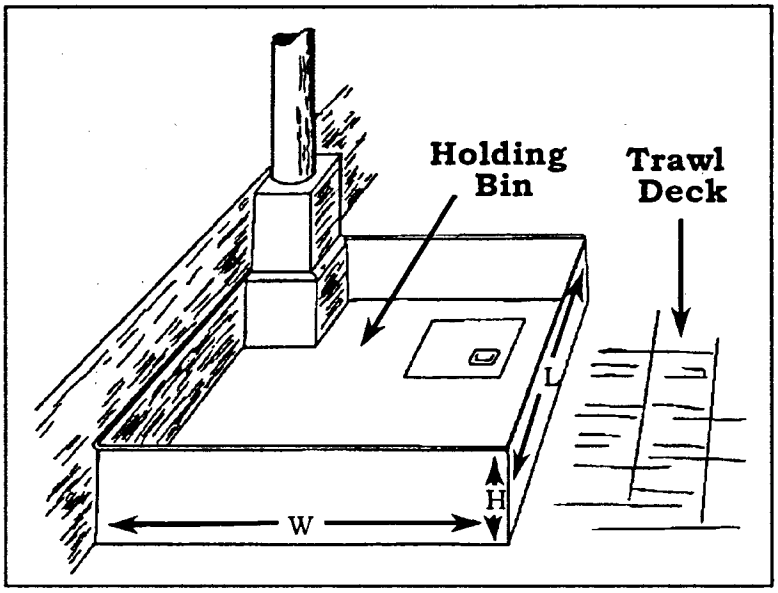
First, a strategy should be developed to best estimate the catch. It should account for configuration of the vessel, gear, and production layout. Once a strategy has been devised, observation of the catch begins when fishing gear comes on board; in this example an otter trawl. The otter trawl is a large, open-ended bag-shaped net deployed from the stern or side of a vessel, and dragged along the ocean floor or towed in midwater. Refer to the DFO At Sea Observer Operations Manual, Anon., (1964), Garner, (1967 and 1978), Kristjonsson, (1959 and 1971), and Thompson, (1978) for descriptions of otter trawls and other nets. Four methods can be used to estimate catch for otter trawl gear. The least accurate method provides a volumetric estimate of the filled codend. This approach does not give any information about species composition, but is particularly useful as a first estimate on vessels with limited access to the catch. For very large catches, counting the number of splitting straps (also known as strengthening ropes) on the codend, estimating the volume of fish (converted to weight) in each section between these straps, and multiplying this value by the number of filled sections can provide a preliminary estimate of catch (see Figure below). For converting fish volume to weight,



assume that one cubic meter of fish weighs 1000 kg. Estimate codend circumference, and use Appendix 1 to calculate cylindrical volumes for the codend or its sections. Volume of forward sections of the codend may be considerably smaller as the mass of the catch widens toward the codend. Where there are unequal volumes among sections of the net, take an average of the volumetric estimates between splitting straps when calculating total catch weight.

Choosing subsequent catch estimation procedures will depend on a vessel's production layout. Each ship presents a unique situation regarding handling a catch. A section on catch estimation techniques for Canadian vessels is presented later in the chapter,

Observing and Sampling - Special Cases, because of unique problems associated with the layout of domestic vessels. However, on most small craft and foreign vessels, the catch is first emptied from the net into holding bins on the trawl deck. Fish are kept there briefly before being moved to hoppers below or to the storage hold. With the captain's permission, a catch may be held on deck until holding bin observations are complete. These observations provide the best opportunity for eyeball estimation of total weight and species composition, because fish are exposed in these open hoppers. To avoid a hazardous situation when using this method, ensure that the next net has been shot away.



Volumetric Estimates of the Catch

Volumetric estimates of fish in holding bins (converted to weight) comprise a more accurate method for deriving total catch weight. To apply this technique, first calculate the weight capacity of the holding bin from its volume. If the bin is cubic or rectangular, multiply its length (L), width (W), and height (W) to derive volume (see Figure above). For example, if length of a rectangular bin is 8 m, width is 5 m, and height is 1 m, bin volume would be calculated as 8 x 5 x 1 = 40 cubic meters (m^3). However, bins or holding areas are rarely cubic or rectangular. If the holding area is odd-shaped, draw a diagram that separates it into symmetrical portions, calculate volume for each portion, then add these volumes. Several shapes usually have to be combined to approximate the volume of a fish bin. Appendix 1 illustrates odd-shaped areas and how to calculate their volumes.

To obtain good estimates of species composition by weight, determine weight per unit volume of a particular mix of fish. First, randomly select at least 5 baskets of fish from the catch: these should be representative of the observed species mix. Weigh each basket and calculate an average weight per basket of fish. Then calculate sample basket volume(s) with the following formula (App. 1):

$$V = \pi (r)^2 H \qquad \text{Equation 1}$$

where
- V = basket volume (cm^3)
- π = 3.14
- r = basket radius = 1/2 average diameter (cm)
- H = depth of basket (cm)

Note: Equation 1 yields sample basket volume in cubic centimetres. To convert cm^3 into m^3, divide volume (V) by 10^6.

The weight per volume (kg/m^3) varies with the species mix in a bin. For example, flatfish are more densely packed than cod, and thus are heavier per unit volume. Weigh new samples of fish and recalculate every time catch composition changes significantly.

Knowing volume of the bin (m^3), average weight per basket (kg), and average basket volume (m^3), total catch weight in a full bin can be calculated with the following formula:

$$C = \frac{B}{V} \times W \qquad \text{Equation 2}$$

where
- C = catch weight (kg)
- B = bin volume (m^3)
- V = sample basket volume (m^3)
- W = average weight of samples in baskets (kg)

For example, if total volume of the fish bin is 40 m^3, average weight per basket of a representative species mix is 40 kg, and average basket volume is 0.4 m^3 (from Equation 1), then the solution to Equation 2 is:

$$C = \frac{40}{0.4} \times 40 \text{ (kg)}$$

$$= 4000 \text{ kg}$$
$$= 4 \text{ mt}$$

Therefore, in this example, a 40 m^3 bin holds 4 tonnes of the observed species mix. If one net haul filled the bin 2½ times, the total catch estimate would be 2½ x 4 = 10 mt.

Species Composition of the Catch

Determine the species composition in the sample baskets above by calculating the percentage (using weight) of each species. Sort the fish in these baskets by species, weigh each species, and divide by sample weight. Then apply each of these percentages to the total catch estimate, to obtain weight of each species for this set. Note that less common species may not be present in this sample of baskets. Use a second observation method

to supplement the catch composition determined here, in order to view such infrequent species, estimate their catch weights, and add them to the species list for this set.

Observation of fish holding bins is another method to help determine species composition of a catch, and must be done carefully because certain species tend to accumulate at the top of the pile. Therefore, an estimate of catch composition based only on fish species in surface layers of a holding bin may be biased. For example, when redfish are brought to the ocean's surface, their air bladders expand with the decreasing external pressure, causing them to float to the top of the net. Redfish also become enmeshed in the netting, and tend to be emptied out last when a catch is dumped into a holding bin. If a catch consists of witch and redfish, then the witch would tend to fall to the bottom of the bin and be less visible. By observing only surface layers, the proportion of redfish in this catch may be overestimated. Also, less common species in a catch can be easily missed if covered over by a more numerous species. Species composition can also be determined by thoroughly examining total catch in the holding area or other accessible locations. Sorting through fish in an open hopper is one method for determining species in a catch.

Species composition can also be quantified by observing a catch as it passes through enclosed chutes onto conveyor belts in the processing area, where individual fish are exposed. This method should be used in conjunction with the bin sorting procedure. It is especially useful for spotting less common species that can be counted and their weight estimated. For species that cannot be identified immediately, have them put aside for identification later with Scott and Scott (1988). If they cannot be keyed out definitively during the trip, freeze and return a labelled specimen to the DFO Observer Program lab; otherwise, take a photograph of the specimen with a ruler beside it (for scaling).

The observer's preliminary estimates can then be compared to the captain's catch weights. Differences should be noted in the Comments section of the Set & Catch Record sheet (Fig. 7). Record catch weight estimates and species composition as in the following example:

Catch for Set 26 (Trawl Deck Estimate) - May 26, 1993

1.	Redfish (*S. mentella*)	55%	0.55 x 10 mt	= 5.5 mt
2.	Redfish (*S. marinus*)	3%		= 0.3 mt
3.	Witch	35%		= 3.5 mt
4.	Northern wolffish	2%		= 0.2 mt
5.	Striped wolffish	1%		= 0.1 mt
6.	Turbot	3%		= 0.3 mt
7.	Roundnose grenadier	1%		= 0.1 mt
8.	Black herring	2 specimens		= 3 kg
9.	Tapirfish	10 specimens		= 10 kg
10.	Red spiny crab	7 specimens		= 2 kg
11.	Atlantic halibut	1 specimen		= 50 kg

Total Catch is **10,065 kg**

Fish are handled by crew in several ways, depending on species and vessel capabilities. They can be processed with many methods and ultimately frozen, put on ice, made into meal, or discarded. If discarded, the amount of each species must be estimated and recorded separately. Only fish rejected whole are classified as discards. Discard estimation methods are described later in the section, Estimating Discards. When added to discard estimates, information on fish products stored in the vessel's hold can also be used to estimate catch. Techniques for estimating catch from production records are explained in the section, Catch Estimation from Production.

Processing room estimates of bycatch and discards usually lead to revisions of trawl deck estimates. Referring to the redfish example above, assume that 20 tapirfish were observed being discarded while the catch was being sorted. If half of the catch was observed while entering the processing room, then it can be estimated that 40 tapirfish were caught and discarded. The revised catch list would be:

Catch for Set 26 (Processing Room Estimate) - May 26, 1993

1.	Redfish (*S. mentella*)	5.5 mt
2.	Redfish (*S. marinus*)	0.3 mt
3.	Witch	3.5 mt
4.	Northern wolffish	0.2 mt (all discarded)
5.	Striped wolffish	0.1 mt
6.	Turbot	0.3 mt
7.	Roundnose grenadier	0.1 mt (all discarded)
8.	Black herring	3 kg (all discarded)
9.	Tapirfish	40 spec. x 1 kg = 40 kg (all discarded)
10.	Red spiny crab	2 kg (all discarded)
11.	Atlantic halibut	50 kg

New Total= **10,095 kg** (345 kg discarded)

Finally, before recording catch and discard data on the Set & Catch sheet, the estimates must be compared to those recorded in the International Production Log (Fig. 3; only for foreign vessels), and the International Fishing Log (Fig. 5). Blanks of these logs are distributed with the fishing license to vessels longer than 65 ft. As a condition of license, they must be filled out daily by the captain or a designate (Production Log), or set by set (Fishing Log). Each of these records provides important information for the observer. Production values (derived from volumetric estimates of product stored in the hold) are usually accurate, and provide useful information for estimating round weight of kept species. Product weight is multiplied by a product to round weight conversion factor to obtain round weight. The captain usually enters these values into the fishing log. Refer to the section, Catch Estimation from Production, for a detailed description of fish production at sea and conversion factor methodology.

With frozen products, the captain calculates amount of product on board by multiplying the number of frozen blocks of product by average block weight. For example, if 451

blocks of fish products were produced in a particular set, and each block averaged 15 kg, then product weight would be 6,765 kg (=451 x 15). After production values from the previous day have been recorded by the fishing master, compare them with observed estimates for corresponding sets. However, Production Log values are recorded daily rather than set-by-set. Therefore, apply product to whole weight conversion factors to the Production Log values, and compare these round weights with observed values of kept weight for the corresponding day. To accomplish this, make a list of conversion factors by species and product type. Factors used to convert Production Log figures to round weight estimates can be obtained from on board Conversion Factor experiments, from Table 3 (conversion factor data from observers), or from lists of conversion factors from previous trips. A list of factors for each product similar to the following would be compiled.

Production Log Conversion Factors used to Estimate Catch

Species	Process	Observer's Conversion Factor	Ship's Conversion Factor
Redfish (both species)	Fillet	3.0	2.8
Witch	Fillet	2.7	2.4
Turbot	Gutted, head off	1.5	1.5
Other	Meal	8.0	6.0

Using the same example, Figure 3 represents a Production Log record for May 26, the fishing day being verified. Apply the derived conversion factors to the Production Log values from May 26 as follows:

Revised Catch Estimates for Set 26 (from Production Figures) - May 26, 1993

Species	Product Weight (kg) (Production Log)		Conversion Factor		Whole Weight (kg)
Redfish	6,767	x	3.0	=	20,301
Witch	5,158	x	2.7	=	13,927
Turbot	600	x	1.5	=	900
Other	388	x	8.0	=	3,104
				Total	**38,232**

Therefore, the total catch for May 26 estimated from production figures is 38,232 kg or 38.2 mt. Discarded fish that are not recorded in the production values must be added to the total weight for each species.

In this example, three independent methods for estimating catch have been demonstrated. The resulting values should then be compared, and depending on the circumstances, best estimate of catch for each species can be derived. A final check should be done by comparing the observed set values with those recorded in the Fishing Log (Fig. 5). When differences occur, record observed figures on the Set & Catch sheet, while noting the nature of the discrepancies as a narrative in the Comments section. Try to resolve why the differences have occurred and adjust the values accordingly.

There exist considerable differences among fishing vessels in the disposition of the catch after it comes on board. Adaptation to each situation is required and modification of the techniques described above is often necessary. If, for instance, the catch is dumped directly below deck into a completely enclosed area where volumetric measurements are not possible, the observer would have to depend on bag size estimates and converted product volume estimates in determining total catch weight. Species composition estimates can be done only after the fish emerge onto open conveyor belts. A more detailed discussion of problems encountered in observing sets on domestic and specialized vessels is presented in the chapter, Observing and Sampling - Special Cases.

Estimating Discards

Discarding is the selective removal (by size, species, or other criteria) of whole fish from the catch for return to the sea. Dumping is the non-selective process of returning whole or partial (unculled) catches to the sea. Only fish rejected whole are classified as discards, not parts of fish disposed of during production. For convenience, both discarding dumping are referred to as discarding in subsequent sections. Discarding at sea was a substantial problem in the past. However, new regulations do not allow the discarding of most species. Fishing licenses specify discard regulations for a particular fishery.

Discarded or dumped fish are not recorded in landing records, and are usually under-reported in fishing logs. However, observers on commercial vessels can readily record amounts of discarded fish. In fact, the Observer Program is the sole source of reliable data on the discarding of fish or invertebrates. Given the importance of this information to scientific investigation and regulation of fisheries, weights of discarded fish or invertebrates must be estimated as accurately as possible.

Accurately estimating weight of discarded fish is difficult, because of the complexity of processing and discarding procedures. Factors such as vessel configuration, discard sites, processing area layout, crew habits, discard practices, and levels of discarding must be accounted for. Discarding may be handled by the crew in various ways on a particular vessel, and varies greatly between vessels. Hence, discard observation strategies must be tailored to individual vessels, and possibly to different production shifts on the same vessel.

In the process of culling fish, the crew may collect some of the fish in baskets for discarding later, throw the fish into a screw during processing (i.e., a "hacker" that discards fish overboard), toss the fish onto conveyor belts that may not be open for viewing, or do a combination of the above. In addition, individual crew members on the cutting line may discard whole fish into enclosed chutes. The collection of discard data requires considerable planning, and adequate allotment of observation time at each site, especially where discards are substantial.

Maximizing the amount of fish viewed, weighed, or counted provides the best representation of what is being discarded. The observer must choose a method that is the most suited for current circumstances. In some situations when amounts are small, the selected method may be as simple as weighing all of the discarded fish. However, when discarded amounts are large and discard sites numerous, less direct methods must be applied. Use the following guidelines when designing a discard estimation strategy.

Designing a Discard Estimation Strategy

a) Start by drawing a diagram of all locations of discard chutes, belts, or troughs in the processing area, and positions of crew members who would be discarding whole fish. Identify each site where fish can be counted. Combined with information on processing habits of the crew and previously observed discard levels, a diagram of discard sites is essential for devising the most efficient discard estimation strategy.

b) Wherever possible, combine discard sites to minimize the number of "ports" (i.e., locations at which discard observations will be made). The goal is to maximize the amount of fish viewed over the discard observation period. For example, when all discarded fish converge to one open discard chute, obtain estimates at that single location rather than at two or more conveyor belts that feed the chute. By watching a single location fed by two belts, twice the discard activity can be observed during the same amount of observation time (assuming that the discard rate is the same at each of the two belts). This approach applies not only to chutes and conveyor belts, but also to individual crew members who are discarding.

   On some vessels, the only opportunity to view discards may be at a location where "cutters" are processing and discarding fish, because enclosed belts prevent viewing discards. If so, it may be possible to view two or more crew members simultaneously. For example, crew numbers 1, 2 and 3 may be viewed together at this discard location, which would then be described as "Port #1" on the Discard Worksheet (Fig. 6).

   Processing and discard practices may also vary over the course of a trip. The discard strategy used must be adjusted to account for any changes in the composition or number of ports. For example, Port #1 had two crew members discarding fish during one set, but on a subsequent set, three cutters may discard fish at that location.

c) Time spent viewing discards should be greatest where the discard rate is highest. Culling of fish is usually higher at the beginning of a processing line (i.e., where cutters are working). Further along the line, crew may only sporadically discard unwanted fish because most have already been culled. Therefore, spend more time viewing discards at locations where cutters are processing fish, but ensure that every discard location is observed.

d) Every port may not be observable because of enclosures or other obstructions that prevent viewing. For example, the most effective discard estimation method may require an observer to view individual crew members who are discarding fish, but one or more crew may not be visible to the observer because they are standing behind machinery. Therefore, discards must be estimated for these unobserved crew members by using estimates obtained for the observed crew. Refer to Figure 6 and the Discard Worksheet section for methodology. Calculate a rate of discarding "per man-minute" only when there are unobserved crew.

e) Observation times for individual ports must be spread out over the entire processing period, because discard rates may vary over the course of processing. For example, discarding at the end of a processing period may increase if the trawl of the next set is being retrieved, since the crew must finish processing the remaining fish before starting on another catch. If a discard location is to be viewed for a total of 30 minutes, then observe this particular port for 10 minutes at three different times over the entire processing period. In this way, the discard estimate from the observed periods will be representative of the entire set for this discard location.

f) An effective strategy for estimating discards includes not only a practical method as outlined above, but also an appropriate period of time spent applying this method. Adopt a discard estimation method that maximizes the amount of discards viewed, counted, or weighed over the observation period. Then decide upon an appropriate amount of time to be spent observing discarded fish. The ideal situation would allow the most effective observation method to be used for the total processing period.

g) Do not invest a lot of time and effort in obtaining estimates of small amounts of discards (e.g., 20, 40, or 60 kg). Instead, make casual observations of discards (i.e., "eyeball" estimates) during processing. If these observations indicate that discarding is low, apply a more intense discard estimation strategy to several sets to verify the eyeball estimates. In such situations, restrict observation time to approximately 40% of the processing period. If the estimates derived from casual observations are comparable to the estimates obtained with a discard estimation strategy, continue to make casual observations of discards in subsequent sets. Occasionally use a more intense discard estimation strategy to verify the estimates derived from casual observations. Remain alert to any changes in discard amounts, rates, or practices. Note significant differences in discard practices between sets in which discard estimation methods were applied and sets for which only casual

observations were made.

h) Significant quantities of discards may be seen as:

i) Heavy discarding of many small fish during one set;

ii) A large amount of discarded fish accumulating over several sets, even if amounts in each set are small.

Casual observations of discard quantities and fish sizes can indicate whether discarding is significant or possibly a violation of fishery regulations. Be sure to record in detail all observations of this nature. Furthermore, the vessel's master is responsible under Canadian Fishery Regulations to maintain an accurate log of all fishing activities, including both kept and discard weights of every species caught. Compare observer estimates with the captain's logged estimates and note any differences. This information is very important for subsequent investigation (especially if such discarding occurs during one set), and may influence the decision of whether to initiate legal proceedings against the vessel's master.

i) When discarding is high, apply an appropriate discard estimation method as outlined in the section, Discard Estimation Methodology, and increase the time spent quantifying discarded fish. Reliability of the collected data is affected by the amount of discard observation time, and the number of discarded fish actually counted or weighed. For example, if 80% of the discarding process is observed, then these data can reliably be used to predict the unobserved 20%. An estimate obtained by viewing only 30% of the discarding process would be less reliable. More time must be allocated to estimating discards when discarding appears significant, or when a potential violation of fishery regulations arises. In a legal situation, the discard data must endure close scrutiny. If significant amounts are involved, take photographs showing locations of discarding, accumulation of large quantities at specific locations, and other relevant evidence. Pictures clearly demonstrate the problem for the Regional Violations Committee, and subsequently enhance the Crown's case during legal prosecution.

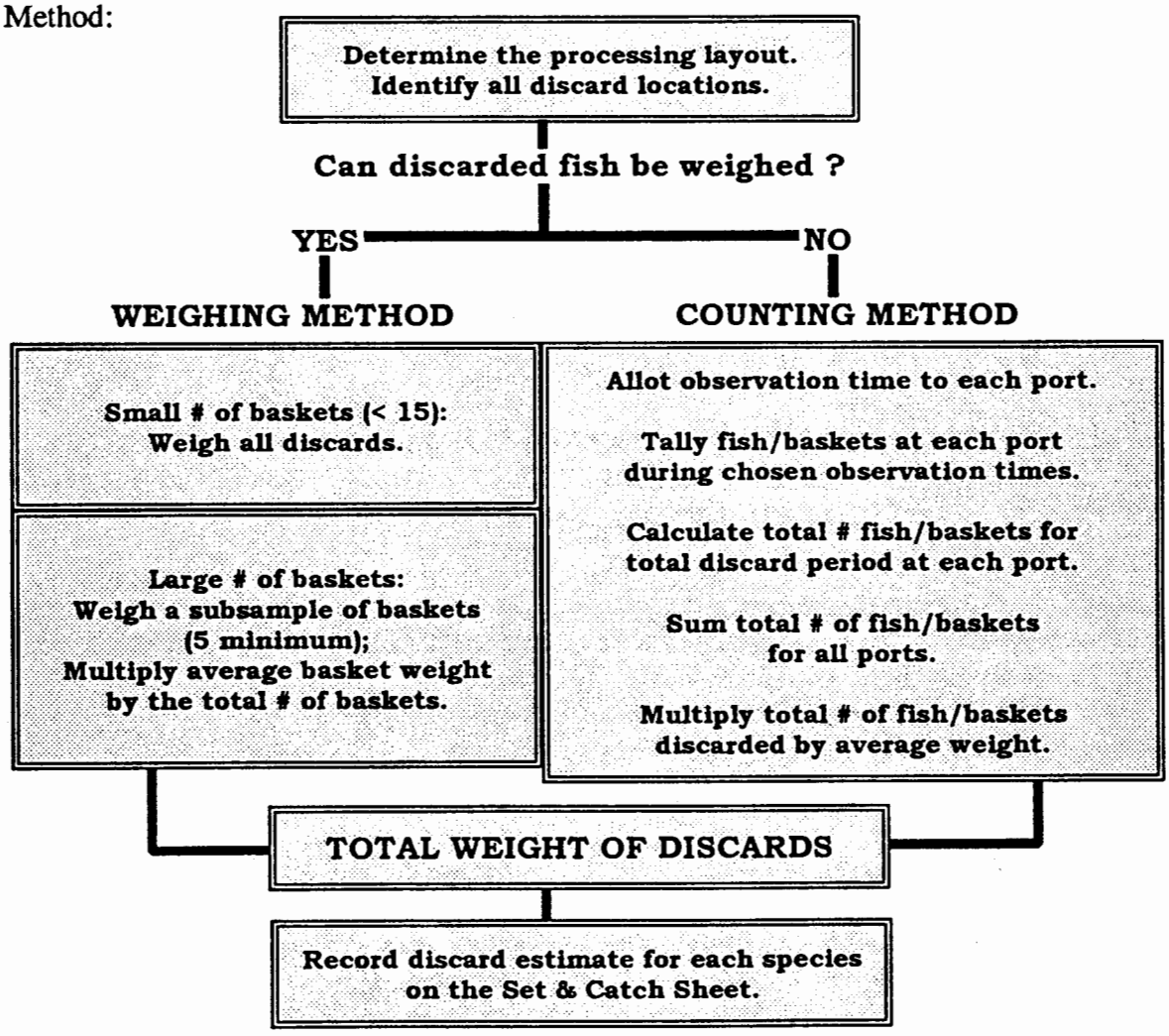
j) Sometimes a catch is dumped into holding bins containing unprocessed fish from the previous set, for which discard estimates have not yet been finalized. In this situation, discarded fish must be estimated over two or more sets, resulting in an overall total discard estimate. This total discard estimate may be divided equally between these sets, if there was no significant difference in catch weight for that species between the sets. Otherwise, the overall total estimate of discards must then be divided between the sets in proportion to the catch weight of that species for each set. For example, if 1,000 kg of a particular species were discarded over two sets, and each catch was 8,000 kg and 2,000 kg, respectively for that species, the estimates of discarded fish could be recorded as 800 kg for the larger set and 200 kg for the smaller set.

Observers provide "front-line" surveillance and collect unique scientific data on commercial discarding as input to effective fisheries management. Strive to obtain reliable information that represents what is actually being discarded. The degree of effort expended in obtaining discard estimates greatly influences the reliability of data on discarded fish. Also, consider the amount of effort that will be required to obtain representative estimates of discarding without jeopardizing other duties.

Discard Estimation Methodology

Estimating discards is accomplished by either weighing or counting fish, or a combination of both. When taking a sample of baskets in the Weighing Method or a sample of discarded fish in the Counting Method, ensure that fish in the sample are randomly collected. For example, if crew are putting aside discards for sampling, they may be selecting large or small fish. Casual observations of discarding during the set will indicate whether the fish obtained for the sample is representative of what is being discarded.

Choose a discard estimation method with the aid of the Discard Estimation Strategy flow chart below. First, determine whether discards can be weighed. If so, use the Weighing Method. If discards cannot be weighed or are not collected in baskets, use the Counting Method:



1. **Weighing Method:** This is the most direct and accurate method of estimating discard weight for each species. When amount of discards is small (e.g., less than 15 baskets), weigh all discards. If the number of baskets is large, weigh a subsample of baskets (minimum of 5). When the discards are mixed with fish offal, subtract offal weight. Calculate the average basket weight of discards by dividing the weight of this subsample by the number of baskets in the subsample. Finally, multiply this average basket weight of discards by the total number of baskets to find total discard weight. Record these weights and describe the discard estimation method used, in the Comments section of the Discard Worksheet (Fig. 6). However, do not complete the top section of this Worksheet when using this method.

If the entire discarding period cannot be observed, the total number of baskets discarded may be estimated by counting baskets for a portion of the discarding period, then extrapolating these counts to the total period. Clearly record all calculations on a Discard Worksheet. Refer to the following Counting Method instructions for estimating total discard weight of the species.

2. **Counting Method:** Although the following examples use the number and weight of discarded fish to illustrate this procedure, the Counting Method can also be applied when estimating the total number and weight of baskets discarded for each species.

The ideal (but rare) situation that demonstrates this method simply involves counting all discarded fish, then multiplying this number by the average weight of discarded individuals. The result is the total discard weight of that species for the set.

More typical circumstances involve discarding at one port or location, but the entire discarding period cannot be observed. In this situation, discard estimates can be obtained by counting the discards for part of the discarding period, then extrapolating these counts to the total period. For example, if 20 fish are counted during 30 minutes, and the total discarding time is 120 minutes, then the total number of discarded fish is estimated to be 80 as follows: $(120 \div 30) \times 20 = 80$. This total is then multiplied by the average weight of discarded individuals to obtain total discard weight for the species.

However, discarding usually occurs at several ports. If discard rates do not differ significantly between the different discard ports, allot equal observation time to each discard location. For example, if there are four crew members discarding fish through four holes in the cutting tables, the entire discarding period is estimated as 3 hours (180 minutes), and the time spent by the observer to gather information is 128 minutes; then assign 32 minutes ($128 \div 4 = 32$) per crew member to tally discard fish. Combine the observation of crew members where appropriate to maximize the amount of fish viewed during the discard observation period. Switch discard ports in a preassigned but unpredictable order. Referring to the single port method outlined above, the total number of discarded fish can be calculated at each port. These totals are added to provide total number of discards for that set. The total number for the set is then multiplied by the average discard weight to determine weight of discards for that species.

The average weight of discarded fish used in the Counting Method can be determined as follows:

a) Take a random sample of discarded fish from the set (i.e., representing what is being discarded), weigh the sample, and measure the length of fish in the sample. When obtaining a discard sample, use the appropriate sampling techniques for each species, as summarized in Table 4. Calculate average weight of discarded fish by dividing the discard sample weight by the number of fish in the sample. Due to the difficulty in obtaining accurate sample weights at sea, this method should only be applied when the sample weight is considered reliable. Note that accuracy of the discard sample weight is affected by reliability of the weighing scale and the vessel's motion.

b) Calculate the mean length of fish in the discard sample, and use the appropriate Length/Weight Table (supplied during Briefing) to determine average discard weight. Calculate mean length. Record lengths of fish in the discard sample on a Groundfish Length Frequency Sheet. Multiply the midpoint value of each length grouping by the number of fish in that grouping. Add these lengths across all groupings to obtain total length for this sample. Divide this total length by the total number of fish in the sample to determine mean length (i.e., the average length of discarded individuals). If the size range of discarded fish does not vary significantly between sets, the same average discard weight and length can be used in the Counting Method applied to subsequent sets. However, sets that are not sampled for weight and length should be observed for any changes in discard size, because significant changes require that new samples of discarded fish be taken for recalculation of average discard weight and length.

In summary, an efficient discard estimation strategy incorporates the following principles:

1. An effective discard estimation strategy maximizes the amount of fish/invertebrates viewed, counted, or weighed over the discard observation period.

2. The degree of effort (e.g., observation time) expended in obtaining discard estimates greatly influences the reliability of data on discarded fish/invertebrates. Judge the maximum amount of time that can be spent on estimating discards by considering the amount of effort that will be required to obtain representative estimates without jeopardizing other duties.

3. When obtaining fish for a discard sample, ensure that fish in the sample are randomly collected (i.e., representing fish sizes that are being discarded).

4. Note any significant differences in discard practices and rates between different discard ports for any set.

5. Note whether discard rates at each port change during the processing period for any set.

6. Observe the size of discards from sets that are not sampled for weight or length to see if their size range varies significantly between sets.

7. Determine whether discard practices differ significantly between sets in which a discard estimation procedure was applied and sets for which only casual observations of discards were made.

8. Ensure a complete understanding of all aspects of processing and discarding practices, including where, when, and how fish/invertebrates are being discarded. Observers are the sole collectors of reliable data on discarding for stock management (i.e., regulatory and scientific purposes).

Discard estimation methods can be modified for changing situations in order to obtain reliable estimates. The priority is to maximize the amount of fish viewed, counted, or weighed over the discard observation period.

It may be useful to compare the initial bag weight estimate with the weight of kept fish in the hold (a value supplied by the icer, converted to round weight). The difference should compare favourably with the estimate from the discard estimation procedure, providing that initial bag estimates are reasonable.

Discard Worksheet

After applying an appropriate discard estimation strategy to a set, complete the Discard Worksheet (Fig. 6) as follows:

Fill in Trip #, Set #, Vessel Name, and Date. Include this information on every Discard Worksheet when more than one is used for a particular set. Record the data on discarded fish or invertebrates in pencil.

Discard Port: A port is a location at which discard observations will be made. Observe all ports when possible, but ensure that all information and estimates determined for any unobserved ports are also recorded on this worksheet.

a) **No.:** Record the number of every discard observation location, including any unobserved ports. Use as many Discard Worksheets as necessary (4 ports maximum per worksheet).

b) **Type:** Describe the composition of each port for that set: e.g., a hacker; a conveyor belt; a discard chute; 3 crew combined. Include any unobserved ports, and provide a brief explanation (i.e., regarding why it was unobserved) in the Comments section of the Discard Worksheet. Again, changes in the composition or number of ports may occur between subsequent sets. Such changes must be clearly recorded on the worksheet.

c) **Obs #:** Observation times for individual discard ports must be spread out over the total discarding period for each set. Number each observation period sequentially for a particular port. Use as many Obs # rows as necessary by "blackening out" the Port Total row and recording below it.

Observed Discards: All data recorded under this header must have been directly observed and not estimated.

a) **# Fish/Baskets Discarded:** Refers to the number of fish or baskets of invertebrates that were seen to be discarded during a specified observation time. Record total number for each observation period under Total. If a hand-held counter is unavailable, tally all discards under Tallies and record the total number.

b) **Time:** As previously noted, allot a greater amount of observation time to locations where the discard rates are higher. Record the duration of each observation period in minutes.

Port Total:

i) Add the total number of discards or baskets viewed over all observation periods to obtain the Total for the particular port for that set.

ii) Sum all observation periods to obtain the total Time spent viewing discards at that port for the entire set.

Total Discards: All data recorded under this header are totals estimated at every port for the entire set.

c) **Discard Period:** Record the total amount of time (in minutes) during which fish or baskets of invertebrates were discarded at that port. Record the total period of discarding for any unobserved ports.

d) **# Fish/Baskets Discarded:** Estimate the total number of fish or baskets of invertebrates discarded (D) at that port:

$$D = (C \div B) \times A$$

For an unobserved port, record the discard estimate calculated from an average discard rate obtained for the observed ports (refer to Figure 6 for methodology).

Set Total:

i) Add the Total for every port to obtain the total number of discards observed in that set.

ii) Sum the total number discards (D) over all ports to obtain the total number of discards for that set (D_{total}). Be sure to include the calculated estimate for any unobserved ports.

Step-E Record the Total Number of fish or baskets of invertebrates discarded, D_{total}, for the set.

Step-F Record the Average Length of discarded fish (in cm) from that set. Calculate Average Length using a discard length frequency sample from the set, and circle "calculated" on the Discard Worksheet. If the size range of discards does not differ significantly between sets, use the average discard length calculated from a previous discard sample, circle "previous discard sample", and record the Set # from which Average Length was taken.

Step-G Record the Average Weight of discarded fish or baskets of invertebrates (in kg) from that set. If accurate discard sample weights could not be obtained, use the calculated mean length of the discard sample and determine the average discard weight from the Length/Weight Table for that fish species. When the discard size range does not change between sets, take average discard weight from the same set used in Step 'F' above (i.e., a previous discard sample in which Average Length was calculated). Circle the method that was used to determine Average Weight.

Step-H Calculate the Total Weight of fish or baskets of invertebrates discarded (H) for that particular set:

$$H = E \times G \quad \text{(in kg)}$$

Record this value in the Discard column of the Set and Catch Record sheet (Fig. 7).

Comments: Record in this space any comments on discarding (e.g., processing; practices; discards; calculations; unusual situations). Be as descriptive and detailed as possible. For any unobserved ports, ensure that all calculations to determine its discard estimate are clearly recorded (Fig. 6).

Catch Estimation From Production

On some commercial offshore trawlers, it is often not practical for observers to weigh catches of fish in the round form. Therefore, indirect methods of estimating size of the catch must be employed. Record of products, either from the production log or calculated volumetric measurements of fish in the hold can be used to derive an estimate of catch. Factors are applied to convert weights of stored product to whole weight estimates of the kept portion of the catch.

For larger vessels, production figures derived from volumetric estimates of the stored products are recorded in production logs provided by Canada. The observer can make use of this information by applying techniques described in the following sections to arrive at an independent estimate of catch derived from product weight. Estimating product volume then applying a valid conversion factor to each stored product type yields an estimate of round weight for each species kept. This is one of a series of steps used to estimate weight of the catch for each set (refer to other sections in Techniques of Observing Sets).

Reliability of catch figures derived from production depends on the precision of the product to whole weight conversion factor used, the accuracy of the estimate of average weight of product units, and accuracy in counting number of product units stored in the hold. Experimental procedures described below have been designed to be carried out by observers using the actual products produced at sea.

Conversion Factors

FAO compiled a list of whole to product weight factors ("Conversion Factors: North Atlantic Species," Anon. 1970), updated as "Quantity Conversion Factors: Atlantic Fish Species, Landed or Product Weight to Live Weight" Anon. (1980a). From this, a subset for the northwest Atlantic was published by ICNAF in Anon. (1980b). Conversion factors from these "official" FAO and ICNAF lists are often used by commercial factory trawlers to derive catch weights. As well, other unreferenced factors distributed by the fishing companies are in use by certain fleets. These factors are of uncertain origin with no basis in the scientific literature. Factors used for the same product, species, and processing machinery are often found to be different among companies or even among vessels of the same fleet. Hence, the requirement for observers to derive conversion factors through experimentation.

Descriptions of product types and factors affecting processing are given in Kreuzer (1974) and Kulka (1983a, b, and c). Prior to the conversion factor work done by observers, little was known about yield levels attained in production operations at sea. There are several factors that affect the amount of weight loss during processing, and a combination of these contribute to the observed variation. Size and condition of fish, size of the catch, specific subprocessing, differences in individual fish cutters techniques (hand processing), different machine types and condition of those machines are some of the factors that can lead to the observed differences in conversion factors between areas fished, time of year, and fleets. The most important of the above-mentioned effects are elaborated to provide a framework when designing a conversion factor experiment.

Production is very complex and often, in a single factory, various species may each be processed into a mix of products. Different machines or subprocesses may be used on a single product category. For example, fillets with skin on or off, trimmed fillets, or V-fillets may be produced from the same batch of fish. Each of these subprocesses could have different conversion factors due to differential removal of body parts. Whether a fillet is produced by hand or from a machine (or specific types of machines) can also have

an effect. Machines are usually more wasteful and certain models particularly if they are older or poorly tuned may be less efficient than others. Size of fish in a particular catch can also have an effect. For example, smaller fish passed through a machine designed for larger specimens could cause a reduction in yield. These are just a few examples of factors that affect yield. A summary of machines, production methods, and other aspects of production is outlined in Kulka (1986d). A summary of experimentally derived factors from Kulka (1983a, b, 1986) can be found in Table 3.

The following is a description of the methods used to derive conversion factors during production. The methods pay attention to practical detail. This approach is the key to gathering realistic data from uncontrolled conditions encountered in ships' factories. Certain portions of the following description are edited extracts of Kulka (1983c) which should be referred to for a more in-depth discussion of experimental technique.

Prior to performing experiments, it is important to study the factory operation; especially to observe and define the production subprocesses and the extent to which each is used. For example, if 30% of cod are produced as skinless, boneless fillet and the rest is skinless product for a particular set, this 70/30 ratio can be recorded on the Set and Catch sheet under the last section of the catch record (Fig. 7). Space is provided for a specific product code (see App. 2, Table 7) and percent of catch that went to that product. This must be recorded for each species and each set, regardless of whether it was observed or taken from the log.

By a series of observations throughout the trip, actual machine and factory capacities can be estimated and compared to theoretical capacities recorded in the processing machine manufacturer's handbook. Factors that limit maximum turnout should be noted as a narrative. Included should be information on how production figures, fishing log figures, and reported catches were derived. An accompanying diagram of the factory, showing layout of the various processing machines and a flowchart of processing routes, will also aid in the definition of factors that limit turnout, processing efficiency, and product yield. This should be done at the start of the trip so that the subsequent conversion factor experiments can be performed efficiently with a full understanding of the vessel's production operation.

The way in which various species are handled after they come on board can differ quite significantly among countries, fleets, or even individual vessels. Each process must be documented and accompanied by diagrams of fish showing details such as cut angles and extent of trimming. Figures 8a-8f illustrate various common fish processing cuts used, with descriptions. Factors which might adversely affect product yield should also be recorded. These may range from quality of fish, biological influences such as gonad size or fish size, quality and maintenance of equipment (poor quality leading to excessive waste) to extent of hand trimming. Finally, make a record of the conversion factors in current use by the vessel, and their origin. To ensure proper experimental procedures and sample selection, much of these data should be compiled during the first few days of the trip. Particular attention must be paid to such practical details such as convenient sampling position and observation points along the route of production.

Once practical aspects such as sample site selection are worked out, consideration can be given to the actual experimental steps. The aim is to extract a batch of whole fish from the catch, weigh them, turn them over to the production crew for processing in the normal manner, and then re-weigh the product. This process must reflect as much as possible the normal production sequence including a typical sample of fish that is being processed. Whole weight of the sample of fish divided by its product weight provides the estimate of conversion factor.

Previous work has determined that in most cases, 250 kg is a practical upper limit for conversion factor sample size. On some vessels, the limit may be lower and sample size will have to be adjusted accordingly. Samples larger than 250 kg may cause excessive disruption to the factory operation on some vessel while creating too much work for the experimenter, thus reducing monitoring effort. A sample of about 250 kg will delay regular production for only about 20-30 minutes, if properly planned.

For the sake of portability, it is sometimes necessary to use light, compact scales. Some accuracy in sample weights is sacrificed using portable models but practical matters such as sea transfer dictate that they be used. To overcome part of the problem, the ship's scale might be used to verify the first reading or if they are deemed reliable may be used for all experiments.

To simulate actual factory conditions, the sample of fish should be selected by factory personnel or should be composed of a typical range of fish sizes that go into the particular product. If the aim is to determine an average factor for a vessel, random size samples of a single species should be collected. However, most processing machines are restricted in the size of fish that they can process. With a random sample that includes all sizes of fish from a catch, some fish may fall outside the processing efficiency limits of the machine. When this occurs, the under- or over-sized fish should be removed, leaving a preselected size range conforming to the machinery and normal production. Complete randomness is not preserved by this subsampling method for testing of a particular machine but it does simulate actual conditions. It would reflect the normal processing sequence. This is the most logical approach for the singly deployed observer.

Most vessels carry several types of machines for a single process that together can handle the species and sizes of fish being caught. To determine an average conversion factor, regardless of machine or combination of machines used for processing, the randomly selected sample must be partitioned into size strata conforming to the capabilities of each machine being used. Each component of the original sample can then be put through the appropriate processing machine. For this approach, the experimenter would have to select a sufficiently large sample (about 250 kg) such that there are enough fish in the smallest component. Sending an insufficient number of fish through a machine could produce unreliable results given the considerable variability in the position of flesh cuts and subsequent proportion of parts removed. The sample components, once processed, can be recombined and weighed. This multi-machine approach has two drawbacks. First, it does not illustrate differences between machines. Second, two or possibly three machines would have to be monitored simultaneously. Considerable preparation, attention to detail, and a team of two would be necessary to perform this type of operation; hence, it would be used only in special cases. Both of the above methods will result in an average conversion factor for the size of fish in the sample. The first will yield da\ ' differences between machines.

A third, more specialized type of experiment would involve choosing a range of size selected samples to test the effect of fish size on magnitude of conversion factor. Each sample would comprise a very narrow range of fish size. Since variance is quite high, relatively large numbers of samples are necessary to define the relationship between size of fish and magnitude of conversion factor. Also of importance is fish size capacity of the production machines. Only when there are two observers per vessel can this type of experiment be conducted.

Samples thus obtained (random or size selected and weighing about 250 kg) must be carefully measured and counted. The preliminary length and weight data can then be recorded, with modifications, on a standard length frequency sheet. When measuring fish for a conversion factor experiment, it is not necessary to remove otoliths or sex the fish but the normal cm grouping should be used. After completing the frequency, calculate mean length of the sample. This information will later be transferred to the summary sheet.

Once the appropriate morphometric data have been recorded on the length frequency sheet, the production equipment selected for the experiment should be cleared of fish. The sample can then be passed through the machinery. It is important to monitor each stage carefully making sure no fish are added or removed on purpose. Any occurrences affecting yield should be recorded. Careful monitoring procedures and attention to detail are essential through all stages of the operation.

Since loss of product (for example fillets that fall off the conveyor) during normal processing is not unusual, it is important to count not only whole fish in the sample prior to processing but also the product units as they emerge from each stage. For example, if 80 fish comprise the sample, the count of fillet product must not exceed 160. Some fillets are lost during the processing. Number lost should be recorded for each experiment on the comments section of the Conversion Factor Data Summary Sheet (Fig. 9). This ensures that error will not be introduced into the results due to abnormal product loss or gain.

Practical problems related to processing by the crew can affect the outcome of the experiments. Any abnormalities in processing procedures should be noted on the summary comments section. Ensure that no special measures are taken by the crew during the experiment, such as tuning of machinery or more careful trimming procedures. The aim is to obtain an average value reflecting typical product yield, not the optimum yield. Before filleting, if there are intermediate processes such as heading and gutting, the intermediate product weights should be recorded. A separate experiment is thus created for each product substage. In this way, experimental efficiency is maximized. The final step is to divide whole weight by product weight for each stage to yield the conversion factor estimate for a particular experiment.

When the preliminary records are complete, the raw data, sample weight, counts, and mean size of fish (unsexed) can then be summarized onto the Conversion Factor Data Summary Sheet (Fig. 9). Include in the header and main body the following information: vessel name, vessel identifier (side number or CFV), species processed, flag of vessel (country code), sample number (consecutive sequence), set number, date, process method, whole weight of fish (kg), product weight (kg), number of fish in the sample, type of processing machinery, the area fished (NAFO Division), and type of sample (i.e., random, size selected). An additional category "problem type" may be included to

identify factors that may have adversely affected the experiment.

Conversion Factor Data Summary Sheet

The following describes in sequence how to code each category below the header (see App. 2,Table 6):

Trip: Fill in assigned trip number.

Side Number: Fill in side number of vessel.

Species Code: Code in species using Akenhead and LeGrow (1981).

Country: Code country of vessel with appropriate code from Appendix 2, Table 1.

Sample Number: Number the experiments consecutively. If an experiment has more than one result (i.e., serial experiments), each result must have a separate sample number.

Set Number: Record number of the set from which fish were taken. This information can be obtained from the appropriate Set & Catch Record sheet.

Date: Code year, month, and day for the set from which the fish were taken.

Year: 1993 = 93
Month: Jan. = 1; Feb. = 2, etc.
Day: day fished, 1-31

Process Method: Refer to Appendix 2, Table 7, for a complete list of processing codes. Detailed process descriptions can be found in Kulka (1983a).

Whole Weight: Record weight of whole fish used for the experiment, to the nearest kilogram. Subtract basket weight.

Product Weight: Code in weight of fish product (kg) obtained from original sample of whole fish.

Conversion Factor: This number is obtained by dividing the whole weight of the sample by the resulting product weight.

Example: Whole weight / Product weight

= 172 ÷ 106 kgs = 1.62 (Conversion Factor)

Five spaces are allotted for conversion factor. All factors are rounded to two decimal places. For example, 1.624 is coded as 1.62.

Number of Fish: Record the number of fish used in the experiment. This can be summed from the length frequency. This category is left blank when doing conversion factors on shrimp.

Mean Length: Determine the average length of all fish in the sample and record to the nearest cm. To determine average length, take the midpoint of the length grouping and multiply it by the number of fish in that grouping. Do this for each grouping, then add across all groupings. This will yield total length of all the fish. Divide that total by the number of fish in the sample to yield mean length. This category is left blank when doing conversion factors on shrimp.

Machine Type: Place the first letter of the brand name of the processing machine and the numeric designation in the space provided. For example, Baader 440 is coded as B 4 4 0. Hand processing is coded as 1 0 0 0. This category is left blank when doing conversion factors on shrimp.

Problem Type: Refer to Appendix 2, Table 6, for a complete list of problem types and codes.

NAFO Division: Code NAFO Division where the set occurred, i.e., 2J codes as 2 J.

Sample Type: This category refers to the type of sample selected for the experiment and is coded as follows:

1 = Random Sample: Refers to a sample representative of all the fish in the catch of the species being used in the experiment.

2 = Machine Random: Refers to samples of fish selected for a particular machine capable of processing a certain size range of fish. Within the size range of the machine, fish are selected so that they represent an average production run for that machine.

3 = Size Selected: This is a sample of fish with a very narrow size range (usually from 2-4 length groupings). This type of sample is obtained to determine the effect of fish size on the conversion factor.

Note: The following 3 codes are used to identify sample type for conversion factors for shrimp:

4 = Shrimp (Large): Is a sample of large-sized shrimp. One kilogram would contain 50-90 specimens.

5 = Shrimp (Medium): Is a sample of medium-sized shrimp. One kilogram would contain 90-150 specimens.

6 = Shrimp (Small, Industrial): Is a sample of small-sized shrimp. One kilogram would contain more than 150 specimens.

The following steps summarize the experimental procedures which will lead to a completed summary sheet:

1. Analyze the production layout in the factory and decide exactly how to obtain the sample. Note how many products are produced in the factory operation and distribute sampling effort appropriately.

2. Select and weigh a group of fish. Record numbers, lengths, and weight of whole fish on the length frequency sheet.

3. Check that the machine used for the experiment is completely clear of fish from the regular production before proceeding with the experiment. Note any lost product, and ensure that fish not included in the original sample do not become part of the product. The sample should be processed in the normal manner (i.e., with no special care taken or machine adjustments made to artificially improve yield). Distribute experiments over various shifts to allow for variation between factory personnel. The aim of the experiments is not to obtain values of optimum yield but rather an average figure reflecting typical factory conditions.

4. Count and weigh the product from the sample after the fish have passed through the machine. For a serial experiment record weight at each subprocess stage. For fillets, product weight would be recorded after heading, filleting, skinning, and trimming. Such serial experiments are useful in determining yield reduction attributable to each subprocessing stage.

5. Record problem type and provide comments for any unusual occurrences on the Conversion Factor Data Summary Sheet (Fig. 9) he relevant data.

By following the above procedure and observing and recording all anomalies, experiments can be run successfully.

An additional form, the Fillet Production Data Summary Sheet (Fig. 10), must be completed for experiments where fillet is the final product form. Filleting is a complex procedure; hence, this form is designed to capture the subprocessing details. It is not coded and each section must be filled in as specified. Record trip and set number, date, vessel, species processed, average fish length in the sample, the various machines used to derive the final product, area, depth, fish quality, condition (circle one for each category). Also, specify if trimming was done. This will complete the header. For the section, "Production Stage," determine the appropriate illustrated process that matches the product. Include all stages of the production. Specify for each stage the machine used, weight of the total amount of product produced from that set, and specify what percentage of the fish was processed in this manner.

Removal of additional flesh by hand in the post machine treatment can affect the yield significantly. It is, therefore, important to record extent of trimming. Indicate with a "yes" or "no" which parts were removed and the % of production for that set for which this was done. All the above information will be used to augment the experimental data obtained.

Product Form

After processing, the fish or invertebrates are packaged in a variety of ways. For example, shrimp are bagged or boxed, loosely frozen. Fish parts are often frozen into blocks. Vessel's crew make use of the average net package weight, for example, block weight to estimate amount of product for the Production Log (Fig. 3). However, if average weight of the block used to estimate product weight from a count of blocks is incorrect, this error would carry through to the catch weight estimate. Therefore, it is important to monitor values of block (or other product) weight used by the various fleets. Product may be made into a variety of sizes and forms, thus, separate experiments must be carried out for each different product. Ten product units are weighed for each experiment. Provide full details of subprocessing in a narrative section.

Estimating catch weight using production figures is a complicated and variable procedure requiring attention to detail. The following example illustrates how product block counts and conversion factors can be used to derive catch estimates. If 1000 blocks of skinless cod fillets weighing an average of 15 kg were produced from a particular set, a conversion factor can then be applied to the 15 x 1000 kg of product to estimate round weight of kept cod from that set. Usually, accurate block counts are required by the fishing companies for their own records, but when this information is not available, volume of the total blocks in the hold or processed for the day divided by average volume of an individual block will provide a block count estimate. An appropriate conversion factor for skinless cod fillets is 3.0. The calculation, 15 kg x 1000 blocks x 3.0, yields an estimate of 45 t of round cod plus any discarded fish for that set.

Observing and Sampling - Special Cases

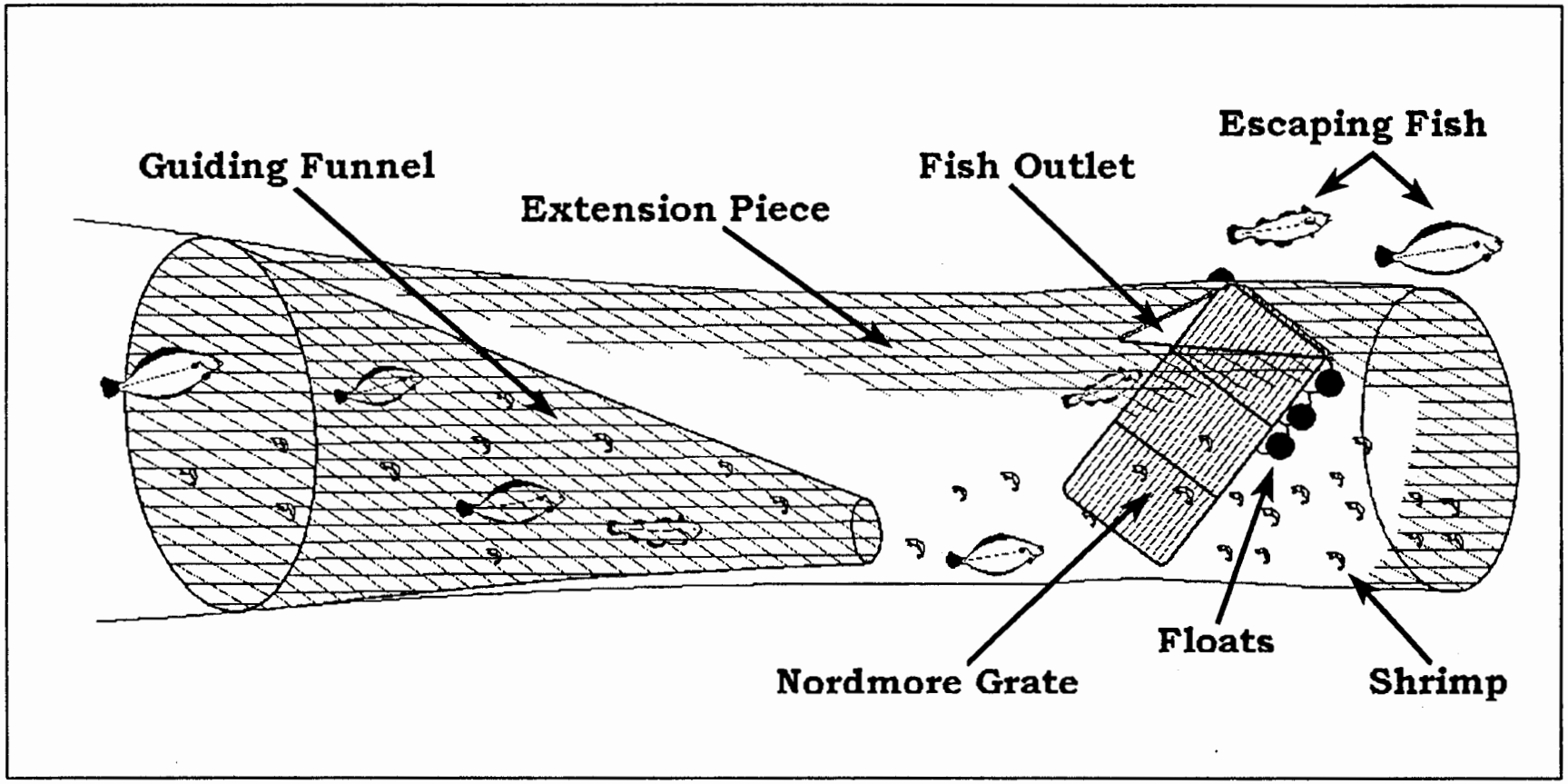
The example in the preceding sections outlines how to observe catches on a Russian stern trawler directing for redfish. However, different situations will arise during various deployments, and the same basic techniques can be modified for each situation. The following sections highlight different types of deployments, and outline supplementary methods to obtain the required data.

The Shrimp Fishery

Shrimp fisheries in eastern Canada have grown into a lucrative industry over the last decade, especially offshore from Cape Bonavista to Baffin Island. Annual removals of shrimp in these northern regions are approximately twenty-five thousand metric tonnes. There are at least fifteen shrimp species in Canadian Atlantic waters, but only two are fished commercially. The northern shrimp, *Pandalus borealis*, is the most important commercial species with large stock areas off Canada's east coast (Fig. 25). A close relative, *Pandalus montagui*, occurs in commercial quantities in the eastern Hudson Strait and Ungava Bay, and as a bycatch with *P. borealis*.

Rapid expansion of the shrimp fishery, and problems with discarding and overpacking of the product, resulted in more intensive efforts to monitor fishing activity. Although the basic operation of a shrimp trawler is very similar to that of a groundfish vessel, observation and data collection can sometimes be demanding. Processing and discard practices coupled with the high value of the product poses problems that are unique to shrimp trips. This section outlines the basic shrimp operation and describes circumstances that an observer may encounter.

A shrimp trawl is similar to that used for groundfish. Its codend consists of a small-mesh bag (minimum 40 mm mesh size), enclosed by a "strengthening" bag of larger mesh (e.g., 130-140 mm). Installed at an angle in the extension section of a shrimp trawl, the Nordmore grate is a rigid rectangular panel with vertical bars of a specific spacing. A funnel constructed of twine directs shrimp to the base of the grate. Fish larger than the grate's bar spacing exit through an escape hole in the top of the extension (see Figure next page). This grate was originally developed in Norway for their northern shrimp fishery to drastically reduce unwanted bycatch of finfish and the catch of small shrimp. The remaining bycatch typically includes juvenile groundfish such as turbot, redfish, skate, and cod. Sometimes another type of "size sorting" panel is used for the same purpose (e.g., a flexible mesh grate consisting of netting dipped in a hardener/resin), instead of the Nordmore grate. Regardless, no panel may be used for some sets during an observed trip.


Escaping Fish
Guiding Funnel
Fish Outlet
Extension Piece
Floats
Nordmore Grate
Shrimp

After a shrimp trawl is brought on board, its catch is dumped below deck into a holding tank filled with water. This procedure minimizes damage to shrimp, and allows some redfish bycatch to be floated off. The catch then enters the processing area through small hatches over a conveyor belt, where bycatch species are manually removed. Shrimp are then moved via conveyor belt to the "shakers": mechanical separators that sort shrimp by size. On some vessels, smaller shrimp may be sent to a second set of shakers for further size separation. These shrimp are collected and held in a water-filled tank. Small shrimp from two or more sets may accumulate in this tank before being processed, because the large, more valuable shrimp are processed first.

Classification of shrimp products is based on the number of shrimp comprising a kilogram. For example, product categorized as "90-120" has between ninety and one hundred and twenty shrimp per kilogram. Requirements for specific sizes of shrimp may vary among vessels, or during a trip, because of changing market demands. Fishing companies regularly inform captains of such changes.

After shrimp have been separated by the shakers, processing depends on whether they are to be cooked or frozen raw. Shrimp destined for cooking are moved via conveyor belt to a hopper that, when filled with approximately 50-70 kg of shrimp, automatically dumps them into a cooker containing salted water. After cooking for several minutes, the shrimp are dumped into another hopper filled with cold water. They then pass under a blower via conveyor for removal of excess water. Quality control is performed at the conveyor belt by factory crew who throw broken and defective shrimp into baskets for discarding or further processing as mixed product. The remaining cooked shrimp are moved by conveyor through a freezer tunnel, and then packaged into cartons or bags that are labelled according to size of the shrimp. These products are then stacked in the ship's hold for storage. Shrimp that will be frozen raw are moved via conveyor belt to a chemical bath containing agents that maintain the shrimp's colour. Further processing is the same as that for cooked shrimp.

Large, frozen raw shrimp (i.e., 50-90) is the highest grade product and is usually sold on Japanese markets. Vessels with a large portion of their catch destined for these markets may have a Japanese inspector on board. Small shrimp (i.e., usually 150^{+}) go into the lowest grade product, and in the past had been processed into peeled shrimp. They are presently frozen raw and bagged in large sacks (e.g., 16-20 kg) as "industrial shrimp." Given the numerous packaging sizes for shrimp products (e.g., 300 g, 1 kg, 5 kg, 18 kg) and the various size categories of shrimp, monitoring production requires a concerted effort.

Estimating Shrimp Catches

Obtaining accurate estimates of catch, bycatch, and discards of shrimp is difficult, due to complex processing procedures and discard practices that result from significant differences between the market value of large and small shrimp. Before estimating catch, the observer must have a thorough understanding of the catching and processing

operations. The more accurate catch estimation technique using volumetrics (see Techniques of Observing Sets: Volumetric estimates of catch) cannot be applied on most shrimp vessels, because the catch is dumped directly from the net into an enclosed holding tank filled with water. In addition, codend estimates on deck provide only a rough estimate of total catch.

The most effective method to estimate total catch weight of shrimp uses production figures that are converted to round weight, with discard estimates added. First, obtain the number of packages of each product type for a given set. Factory crew usually maintain accurate counts of boxes or sacks of shrimp products. Periodically verify that these counts are accurate by counting packages produced during an entire set, or by surveying the vessel's hold at the end of the day and comparing these counts to production figures logged for that day.

Fishing and production logs may not always be accurate. When calculating figures for these logs, many captains historically did not account for product "overpack" nor use a conversion factor. Although they now do so, the observer must know how the captain's fishing and production log figures were calculated. Record this information as a narrative.

With package counts known for every product in a given set, calculate round weight for each product type using the following equation:

# of product units x average unit weight x Conversion Factor = round weight (kg)

Multiply the number of units (boxes, sacks, etc.) by average unit weight to obtain total weight of each product type. Then multiply this figure by an appropriate Conversion Factor to estimate round weight of shrimp processed into each product. Add these round weights for all products produced in that set to obtain the total weight of kept shrimp. Do not deduct a percentage for moisture unless a product has been glazed (i.e., water added during or after freezing).

When industrial shrimp from two or more sets have been accumulating in a holding tank before processing, estimate round weight of these shrimp using the above equation. Then divide this figure into portions that represent round weight of industrial shrimp for each set, based on respective catch weights:

e.g., Industrial shrimp products produced from Set #6 and #7 weighed 500 kg (round). Shrimp catch weights for Set #6 and #7 were 1000 kg and 4000 kg, respectively. Therefore, add 100 kg and 400 kg to the combined round weights of all other product types in Set #6 and #7, respectively, to obtain total weight of kept shrimp for each set. Record these calculations in the Comments section of each Set & Catch Record sheet (Fig. 7).

In the previous equation, use the average unit weight obtained from experiments and not the net weight on a product label. Ensure that average unit weight includes "overpack. "Overpack" is the practice of adding more product to a package than is indicated on its label. For example, a box labelled 5 kg net weight may contain 5.4 kg of shrimp. Overpack amounts of 7% result in a large amount of shrimp that were not accounted for by the end of a trip, and overpack can be as high as 20% for some product types. Reasons for this practice include allowance for moisture and/or damaged shrimp, and market requirements. Buyers specify a minimum average weight greater than the weight shown on a package label for each product type. Record all reasons for overpack when it occurs. Also, weigh each product type regularly to monitor changes in overpack amounts.

The above methodology allows accurate estimation of round weight of kept shrimp using production figures in a given set. To obtain total catch weight of shrimp for that set, estimate the weight of discarded shrimp (see the next section, Estimating Shrimp Discards), and add the kept weight obtained above. Record total catch weight on the Set & Catch sheet.

Estimating Shrimp Discards

Estimating shrimp discards is a more complex procedure than that for groundfish because of numerous discard locations and discard methods used. The problem is greatest when industrial grade shrimp (i.e., small yet marketable shrimp whose numbers usually exceed 150 per kg) comprise a significant portion of the catch. The practice of discarding small shrimp is known as high-grading, and occurs because of their low market value. It is to the crew's advantage to have as much of their quota as possible comprised of the more profitable, larger shrimp. Hence, the potential for discarding smaller shrimp and for misreporting these discards is great.

The discard estimation strategy used to estimate shrimp discards for any set will usually be a combination of methods described previously in the section, Techniques of Observing Sets: Estimating Discards. As in all discard situations (regardless of species), the more time spent weighing, counting, or viewing discards results in a more reliable estimate. Therefore, dedicate more time to estimating shrimp discards when discarding is high.

First, examine the processing area and draw a diagram identifying all sites where discarding occurs. If a diagram has been provided from a previous trip, verify that it is correct. Throughout the trip, account for changes in the sites at which discarding occurs and methods of discarding. The potential for these types of changes is great on shrimp trips. Also, be aware that discarding may be unintentional or intentional. Unintentional discarding occurs as a result of normal processing operations (e.g., spillage from conveyors). However, deliberate dumping of large amounts of small shrimp may occur at some locations. In addition, discard locations that are normally only sites of unintentional discarding could become sites of intentional discarding (e.g., the deliberate overloading of conveyors resulting in excessive spillage).

Once it has been determined where discards will be observed, an estimate of discards must be obtained for each port (i.e., discard observation location). Three methods are available and the chosen one should be the most reliable for each location. The most accurate method is to weigh all discards. If this is not possible, obtain a rate of discarding with the "counting method". The least accurate method is to make casual observations ("eyeball estimates") of discarding. When using the counting method with shrimp, collect the shrimp in baskets as they fall from machinery, and count the number of baskets over time to obtain a rate of discarding. Account for shrimp that miss the baskets and adjust the estimate accordingly. The Discard Worksheet (Fig. 6) can be used to tally the number of baskets.

The following list identifies sites where discarding can occur. Also discussed are problems with obtaining estimates at these locations, potential changes to how discards are handled, and methods for obtaining estimates. Be aware of any discarding at locations other than those listed below.

Sorting Belt: On vessels fishing shrimp, nearly all bycatch species are discarded. Shrimp may be discarded incidentally, along with bycatch species that are being removed from the sorting belt as the catch enters the factory. Here, discarding can be highly variable depending on the composition and amount of bycatch. Estimates of discards at this location are usually restricted to eyeball estimates.

Quality Control: Shrimp discarding occurs as a result of quality control procedures when broken, blackhead, and soft shrimp are sorted on the processing line and discarded. Discard amounts are usually minor. This process normally occurs at the conveyor belt just before the shrimp enter blast freezers. The shrimp to be discarded can usually be collected in baskets or trays and weighed directly. On some vessels, these shrimp are not discarded but are frozen in bags and labelled as mixed product.

Spillage: Spillage along the processing line can occur at the machines and conveyor belts. When this occurs, shrimp ending up on the floor are washed into drains. This is the result of normal processing operations. Be aware that when catches contain a large portion of industrial grade shrimp, spillage may become excessive due to the processing system being forced to handle too much shrimp. Depending on circumstances, a counting method and/or eyeball estimate may be used here.

Conveyor to Conveyor: Shrimp discards can occur where one conveyor belt drops shrimp onto a second conveyor. Discarding may be high if the second belt is moving slower. This usually occurs at conveyors coming from, and going to the holding tank for industrial grade shrimp. Hoses may be placed at these locations to wash away shrimp falling to the floor. Collect and weigh discards or obtain a rate of discarding using the counting method.

Conveyor off Shakers: Shrimp are put through the "shakers": mechanical separators that sort shrimp by size. Conveyor belts then carry the sorted shrimp to different areas for

processing. The smaller shrimp (industrial grade) end up on a conveyor at the back of the shakers. These shrimp are carried to a holding tank to await processing. On some vessels, the conveyor belt carrying these small shrimp can be reversed or redirected, allowing the shrimp to be dumped to the floor or a discard chute. Close attention should be paid here because discarding periods may be erratic. It may be possible to collect and weigh the discards, or obtain a rate of discarding using the counting method.

Baffles on Shakers: Baffles or plates under the shakers direct sized shrimp onto conveyor belts. Moving the rear baffle forward in position causes small shrimp in the first section of the shakers to fall to the floor. Discarding at this location can be serious and highly variable. When discarding occurs here, place baskets under the shakers. Weigh the discards, or obtain a rate of discarding using the counting method.

Holding Tank for Industrial Shrimp: From the shakers, industrial grade shrimp are usually collected in a water-filled holding tank before being processed. Water in the tank makes it difficult to estimate amount of shrimp using the volumetric method. Due to the low value of industrial grade shrimp, this location is a potentially serious discard site. Two problems have been identified at this location. Left unattended, the tank overflows or the conveyor belt feeding it becomes blocked, resulting in lost shrimp. The second and more serious problem is the deliberate dumping of the contents of the bin by opening a gate to drain the tank. This is usually done when the observer is not present. When dumping is deliberate, the observer would have to be present 100% of the time to watch the tank. When leaving the factory during processing, see how much shrimp is in the holding tank. On return, check the tank again for any major differences. If processing has occurred, determine the amount of industrial shrimp produced, and compare this figure with the difference observed in the holding tank.

Canadian Vessels

Observing sets, collecting catch data, and sampling are often more difficult on domestic vessels than on foreign vessels. Determining detailed breakdowns of catches can be a problem, because the fish are dumped directly below deck through a large stern hatch into closed, irregularly-shaped bins. The manner in which the fish are handled causes problems in obtaining volumetric estimates of catch because of the irregular shape of the holding bins and confined working area. In certain cases, volume of the holding area can be derived by drawing a diagram, measuring all the dimensions, and then dividing the diagram into geometric subsections (refer to earlier sections in Techniques of Observing Sets). The volumes calculated for each subsection can then be added. Refer to Appendix 1 for an example of how to calculate volumes of odd-shaped areas. However, for preliminary catch estimates, the observer may have to depend more on a bag size estimate as the catch comes on board, and less on volumetric bin estimates where holding areas are irregularly shaped and catches are not held for a significant length of time.

The most important method of determining weight of major species on Canadian vessels is from volumetric estimates of iced fish. The captain or mate can be helpful in this regard because they are knowledgeable about storage hold volumes. By knowing the volume of iced, gutted fish in the hold and percent of ice mixed with the fish, round weight can be estimated by applying the appropriate volume to weight and product to round weight conversion factors. Measure the various ice holds, and determine how much they are filled each day (this factor must account for ice as part of the volume of stored fish).

A different approach is required for discarded species. Direct weighing of fish to be discarded is obviously the most accurate method and is to be used whenever possible; however, this is not often practical, particularly where catches and amount of discards are large. Alternatively, tallies of discarded fish can be obtained by observing the number or weight of fish, by species, going into the discard chutes (refer to Techniques of Observing Sets: Estimating Discards).

Sampling is also more difficult on Canadian vessels because the catch is dumped directly below deck and is processed very quickly. To avoid an improperly selected sample, be prepared to take the fish as it comes down into the holding area. Remove the sample from the catch as quickly as possible, before the crew cull the fish. If sampling the catch, do not remove fish after the crew have started sorting because it is possible that either all large or all small ones will be picked first and this could result in an unrepresentative sample. Landing samples should be taken from the conveyer belts after discards have been removed by the crew.

Pair Trawlers

The Spanish pair trawl fleet has not fished inside Canada's 200-mile zone since 1986, but observers may be required to cover some activity outside 200 miles. A pair trawler consists of two vessels that tow a single, large otter trawl. Only one observer is usually assigned per pair. Under these circumstances, detailed observations can be made only from one vessel. However, it is essential to record set and catch details from the log for sets on board the sister vessel. Obtain these data by contacting the sister ship by radio. It is also useful to observe the sets going to the other vessel through binoculars to verify the log values. Both vessels alternate catch processing; therefore, the observer can directly observe only 50% of the sets (i.e., one or two sets per day). Use observation methods outlined in the chapter, Techniques of Observing Sets. Extra time should be spent estimating discards, because these vessels usually discard all bycatch along with some of the main species when catches are large. Discards can be put aside, so weigh all discards. Otherwise, use the counting method for discards as outlined in the section, Estimating Discards.

When two observers are placed on a pair (one per vessel), the deployment is treated as one trip. Both observers will use the same trip number and alternate set numbers. The side number of only one ship must be recorded, and will identify effort for both vessels.

Catcher-Processor Fleet

Germany utilizes a catcher-processor fleet, consisting of smaller OT5 (500-999.9 GRT) vessels for catching fish and larger OT7 (2000+ GRT) vessels to process the catches. There can be as many as 10 catchers and one or two processors. After a set has been completed, crew on a catcher close off the codend, attach floats and a marker, and release (cut away) it into the water. A processor immediately intercepts it, dumps the fish into the hold and then processes the catch. It is most efficient to employ a team of observers, with the two or three leaders stationed on the processors. See Figure 11 for a diagrammatic representation of a catcher-processor operation.

A team of observers, one per vessel, is deployed to collect all of the required information. Observers on board the processors act as team leaders, coordinating assembly of the catch and effort record, effort from the catchers, catch from the processors. Observers deployed on board the catchers are responsible only for collecting set details because the codends do not normally remain on board these vessels for processing. If the catcher also processes some catches, those sets must be observed in the usual manner. The effort information collected from the catcher must be matched with catch estimates for each set, by the team leaders on the processors. The observer on the catcher is usually only responsible for recording the set data on the set and catch sheet, leaving catch details blank. Conversely, the team leaders on board the processor are responsible for collecting catch details (catch weight by species) for bags coming from catchers carrying an observer. Each bag must be treated as an entity. The set details would not be available to the team on the processors at this time; therefore, the data must be recorded on a special form illustrated in Figure 12. It allows for catch records of up to four bags. More than one form per day will be needed for larger catcher fleets. These data can then be matched and transferred to the appropriate set and catch sheets at the completion of the trip. Radio communication among vessels is essential in order to compile all of the information from the various sources.

The contents of several codends may be dumped into one hold on the processor. In this case, catch data for specific sets cannot be separated by the observer stationed on the processor. The resulting calculations of catch composition must be averaged for the combined sets. However, total weights of each of those sets can be estimated separately from bag size observations before mixing takes place. In this way, estimated relative compositions must necessarily be the same for these combined sets but their total weights would differ based on differing bag size. Methods outlined in the chapter, Techniques of Observing Sets, can be employed for estimating catch from each bag. In addition, processor observers are responsible for sampling the catches and carrying out conversion factor observations in the regular manner.

Gillnetters

Historically, gillnets have been used extensively in fisheries within Canada's 200-mile limit. Directed species included cod, white hake, and turbot. In recent years, gillnets have been replaced with other fishing methods, and fewer foreign gillnetters fish inside the 200-mile limit.

Gillnets are panels of netting suspended in the water column at various depths, depending on the fish species sought. Fish are caught when they swim into the netting and become entangled (refer to Kristjonsson 1959, Nedelec 1975, and the At Sea Observer Operations Manual for detailed descriptions of gillnet gear). However, a gillnet's ability to catch fish can be adversely affected if it remains in the water for extended periods, due to net saturation. In addition, fish quality degenerates with long periods of entanglement.

Gillnets catch fish in a very different way than the otter trawl discussed previously in this manual. As well, the otter trawl as a unit of gear does not change from set to set. Individual gillnets also remain unchanged, but the number and length of nets used can vary widely from set to set. In the gillnet fishery, a "set" is usually defined as the deployment and retrieval of a group of nets. However, all nets deployed at a certain time might not be hauled together. In this situation, a set consists only of those nets that are deployed and subsequently hauled at one time. The remaining nets in the water comprise another set (i.e., which are later hauled together). Therefore, the amount of fish caught per unit of time with a particular gillnet does not directly reflect relative abundance, unlike the otter trawl. A more appropriate catch per unit effort for gillnet gear is either catch per 100 nets (i.e., assuming equal net lengths), or catch per 1000 meters of net. Both measures of effort account for variability in the number and length of gillnets used from set to set.

Gillnets are deployed in one of two ways. One method involves small boats leaving a mothership, deploying their nets, and then returning later to haul them. This may occur once or twice a day. The second method entails a single vessel deploying and hauling nets. Differences in these two methods require different techniques of observation to estimate catch, bycatch, and discards. In both cases, the time required to haul gillnets can be many hours. If 100% observation of the hauling procedure is not possible, estimates of catch, bycatch, and discards have to be extrapolated to the entire hauling time using figures from the observed period. In addition, volumetrics and converted product weights should be used when possible to estimate catch (refer to the chapter, Techniques of Observing Sets). For both systems, clearly document methods used to obtain all estimates.

When small boats are used to deploy and haul gillnets, preliminary estimates of catch are obtained during offloading of the small boats at the mothership. The catch is often held in boxes or bins during processing, before being stored in the hold. Obtain a volumetric estimate of processed fish in the box, and multiply this weight by an appropriate Conversion Factor to calculate round weigl. of fish per box. Then count the number of boxes processed to obtain an accurate estimate of kept fish. Estimates of bycatch and

discards can be obtained only by observing the hauling of nets from one of the small boats. Amounts of discards and bycatch have to be extrapolated to the entire set, based on the number of nets observed relative to the number of nets hauled. Note that observations from the small boats should be done only when weather permits, and after consulting with the captain.

If nets are set and hauled from a single vessel, observation of their retrieval yields a preliminary estimate of catch, as well as estimates of bycatch and discards. If catch rates are low, estimate catch by counting fish, obtaining average weight per fish using a random sample, then calculating catch weight. Bycatch and discards might be thrown overboard upon removal from the net, or put into containers and dumped later. Ensure that estimates of catch, bycatch, and discards are the most accurate and objective possible.

As previously mentioned, number of gillnets hauled is matched to the catch for those particular nets. If all gillnets are deployed in one location and can be observed easily, one Set & Catch sheet should be used to record all the nets hauled and their associated catch. However, if several groups of gillnets are being deployed at different times or in separate locations, it may be easier to observe these groups separately, and complete a Set & Catch sheet for each group.

Some variables on the Set & Catch Record sheet have been modified, as described below (Fig. 13). Record details of the gillnets used.

Gear Type: Code 5 for gillnet gear.

Codend Mesh: Leave blank.

Body Mesh: Record the average mesh size of all gillnets hauled in the set (in mm).

Roller Size: Leave blank.

Chafing Gear: Leave blank.

Number of Windows: Leave blank.

Number of Gillnets: Record the number of gillnets that were hauled in a particular set. Corresponding amounts of fish removed from those nets would be recorded in BLOCK 4: Catch Record.

Ave. Length Gillnets: Record the average length of gillnets hauled in the set, to the nearest meter.

Data Source: Code 1 for an observed set, or 2 for an unobserved set. When only a portion of a set can be observed, that set is still considered to be an observed set.

Start Time: Record the time that the first gillnet for this set was put in the water, in UTC using the 24-hour scale: e.g., record 6hr 25min for 0625 hours UTC.

Duration: Duration is the average time any one net was in the water for that set. Record the following information in the Comments section of the Set & Catch Record sheet:

I. Time that the first net was put in the water.
II. Time that the last net was deployed.
III. Time that the first net was hauled.
IV. Time that the last net was hauled.

Using the above information, calculate Duration as follows:

A. Time elapsed between the deployment and hauling of the first net, to find the length of time that the first net fished.

B. Time elapsed between the deployment and hauling of the last net, to find the length of time that the last net fished.

C. A and B represent the maximum and minimum durations fished by nets in that particular set. Sum and average as follows:

$$\frac{A + B}{2} = \text{average length of time fished per net}$$

Record this value to the nearest 10th of an hour on the Set & Catch sheet.

Keeping track of times for nets being deployed and hauled can be very difficult when large numbers of nets are used or when number of nets deployed and hauled varies greatly.

Bear in mind that the number of nets hauled and the catch associated with them are the most important requirements for calculating catch per unit effort in the gillnet fishery. When problems arise in calculating Duration, the observer may estimate the duration. Explain how set Duration was obtained in the Comments section of the Set & Catch sheet.

Tow Speed: Code 0.0 because the gear is stationary when fishing.

Net Damage: For hauled gillnets, code 1 if no damage occurred. Also, code 1 for unobserved sets unless it can be verified by the crew that damage had occurred. If damage occurred that affected the ability of gear to catch fish, code 3. Describe the type and extent of damage in the Comments section of the Set & Catch sheet.

All other variables are filled in as described in the section, Set & Catch Record Sheet: Collecting Set Details.

Longliners

Fishing by longline, a method commonly used for the inshore and midshore fisheries, is also used to a limited extent offshore. Countries using this type of gear in addition to Canada are Japan, Faroe Islands, and Norway. The latter use longlines to catch cod and turbot. Japan and the Faroes use it to capture such large pelagic species as porbeagle, swordfish, and tuna.

The gear consists of long nylon lines with baited hooks. Longlines are set in various ways, depending on the species sought. The lines can be anchored on or near the bottom, a configuration used for cod. For large pelagics, the gear is generally set near the surface. The hooks may be attached directly to the main line or to a series of leaders, depending on the species sought. Refer to Kristjonsson (1959), Nedelec (1975), and the Observer Training and Operations Manual for more detailed descriptions and diagrams of longline gear. Record details of the gear used.

Fishing "effort" for longlines is defined as a combination of the number of hooks hauled and the average length of time that these hooks were in the water. Catch for a particular set is the amount of fish caught on all hooks that were hauled at one time. As with other fisheries, it is important to match effort with the corresponding catch. Therefore, catch per unit effort is defined as an average catch per hook or catch per thousand hooks over time fished.

One "set" usually consists of the deployment and hauling of a group of hooks. However, all hooks deployed at a certain time might not be hauled together. In this situation, a set consists only of those hooks that are deployed and subsequently hauled at one time. The remaining hooks in the water comprise another set (i.e., they are hauled later). A set is usually completed in a single day, but can extend beyond 24 hours.

Two systems are used to deploy and retrieve longlines. While the actual method of fishing longlines is the same, the two systems differ in how long the hooks remain on board between retrieval and redeployment. In the first system, all hooks are kept on board until

the set is complete, and then they are rebaited and set as a group. In the second system, each hook remains on board only long enough for its fish to be removed, rebaited, and redeployed. The second system requires that a hook be marked or identified as the first hook. Each time that the marked hook appears signifies the start of a new set. Therefore, fish that are landed between both appearances of this designated hook is the catch for that set.

The deployment and hauling operation for a set takes many hours. Observation of the entire deployment and retrieval operation is important, but give priority to the hauling portion of the set in order to estimate catch, bycatch, and discards. Ideally, the complete hauling operation should be monitored. When 100% observation is not possible, catch estimates for the observed portion of the set should be adjusted to total set length.

In a typical hauling operation, landed fish are taken off a hook and either held in a bin to await processing, or are processed immediately and held in a bin before being stored. Bycatch and discards are usually tossed overboard immediately.

Estimates of kept weight may be obtained with one of two methods. In the first method, fish are counted as they come on board, and an average weight per fish is obtained using a random sample. Multiply number of fish by the average fish weight to estimate kept weight for the set. This method can also be used to estimate bycatch or discard weights. If a random sample cannot be taken, make "eyeball" estimates of the average size of bycatch or discards.

A second method for estimating kept weight uses the volumetric technique (described in the chapter, Techniques of Observing Sets). Determine weight capacity of the holding bin where fish are held prior to processing or storage. Record how many times this bin was filled, and calculate the weight of kept fish. If processed fish were held in this bin, apply an appropriate Conversion Factor to calculate round weight of kept fish. As with other fisheries, monitor production weights and convert them to round weight as a final verification of catch estimates (see the section, Catch Estimation from Production).

As previously noted, data requirements for longline fisheries are different than those for otter trawls, making it necessary to record additional data and modify how some variables are to be completed on the Set & Catch Record sheet. These changes are described below (Fig. 14).

Gear Type: Code 7 for longline gear.

Codend Mesh: Leave blank.

Body Mesh: Leave blank.

Roller Size: Leave blank.

Chafing Gear: Leave blank.

Number of Windows: Leave blank.

Number of Gillnets: Leave blank.

Number of Hooks: Determine the number of hooks that were hauled in that set, then divide by 10: e.g., for 12,000 hooks hauled, divide 12,000 by 10 and record 1200.

Data Source: Code 1 for an observed set, or 2 for an unobserved set. When only a portion of a set can be observed, that set is still considered to be an observed set.

Start Time: Record the time that the first longline for this set was put in the water, in UTC using the 24-hour scale: e.g., record 15hr 00min for 1500 hours UTC.

Duration: Duration is the average time any one hook was in the water for that set. As described previously, one of two methods can be used for deploying and hauling longlines. Calculate Duration for each method as follows:

Method 1: All longlines are retrieved and stored on board the vessel between sets. Record the following information in the Comments section of the Set & Catch Record sheet:

I. Time that the first hook was put in the water.
II. Time that the last hook was deployed.
III. Time that the first hook was hauled.
IV. Time that the last hook was hauled.

Using the above information, calculate Duration as follows:

A. Time elapsed between the deployment and hauling of the first hook, to find the length of time that the first hook fished (A).

B. Time elapsed between the deployment and hauling of the last hook, to find the length of time that the last hook fished (B).

C. A and B represent the maximum and minimum durations fished by hooks in that particular set. Sum and average as follows:

$$\frac{A + B}{2} = \text{average length of time fished per hook}$$

Record this value to the nearest 10th of an hour on the Set & Catch sheet.

Although a set may exceed 24 hours due to fishing conditions, the above calculation should still be used. For example, if the first hook was deployed at 0400 UTC on November 2, and the last hook was deployed at 0700 UTC on November 2; the first hook was hauled at 1200 UTC, and the last hook was hauled at 0230 UTC on November 3:

A. First hook hauled - First hook put in the water
= 1200 - 0400 UTC
= 8.0 h

B. Last hook hauled - Last hook deployed + Fishing done on November 3
= 2400 UTC (Nov. 2) - 0700 UTC (Nov. 2) + 2.5 h (Nov. 3)
= 17.0 h + 2.5 h = 19.5 h total

C. $\frac{8.0 + 19.5}{2}$ = 13.75 h = the average time fished per hook

Record 13.8 (rounded to one decimal place) on the Set & Catch sheet.

Method 2: Unlike Method 1, gear is not stored on board the vessel between sets. Instead, longlines are hauled and redeployed continuously; each hook is baited and immediately reset. Duration is the time between appearances of a designated first hook. Make sure that this hook is marked for identification. Depending on fishing conditions, a set may exceed 24 hours.

Tow Speed: Code 0.0 because the gear is stationary when fishing.

Net Damage: For hauled longlines, code 1 if no damage occurred. Also, code 1 for unobserved sets unless it can be verified by the crew that damage had occurred. If damage occurred that affected the ability of gear to catch fish, code 3. Describe the type and extent of damage in the Comments section of the Set & Catch sheet.

Scallop Dredging

In the Newfoundland region, the offshore scallop fishery occurs mainly on St. Pierre Bank. Iceland scallops (*Chlamys islandica*) and Sea/giant scallops (*Placopecten magellanicus*) are caught, with the latter species comprising 10% of the catch.

Scallops are attached to rocks and other bottom debris. A scallop dredge consists of a rigid rectangular iron frame, to which a "bag" composed of 7 cm iron rings is attached. At the base of this frame or "mouth", sweep chains dislodge scallops as the dredge moves over the bottom, while other chains prevent rocks from entering the bag. One dredge is commonly used for fishing scallops, although some vessels may fish two dredges simultaneously. A single dredge is the gear towed on one warp or tow cable. When a second dredge is used, it is towed on a different warp. Size and configuration of a dredge varies a lot in the scallop fishery. Record detailed descriptions of scallop gear used.

Once a scallop dredge is brought aboard, its contents are dumped and sorted mechanically or by hand. Kept scallops are then processed at sea, or stored whole in trays, or in cages under running sea water. The main product is scallop "meat": the adductor muscle that is attached to both halves of a shell and closes it. Processing involves opening a shell and removing its meat by hand (a procedure called "shucking"). Meats are then bagged and stored on ice.

Scallop dredges are towed for short periods of time, resulting in many sets per day. Therefore, it is not practical to gather information on a set-by-set basis. Instead, determine a specific time period to collect the data. For small vessels, each day may be appropriate; for larger vessels, scallop processing may follow the crew's shift (e.g.,
6 hours, 12 h). Complete a Set & Catch Record sheet for this time period (Fig. 7), if fishing remains in the same location. Otherwise, fill out a new Set & Catch sheet when fishing location changes during a shift. Record the total number of tows in the Comments section of a Set & Catch sheet. Set Duration is the total time that a dredge spent fishing during the specific time period. When two dredges are used, determine the total time fished by each dredge, then add both values to obtain set Duration. Record Start Time, Start Latitude, and Start Longitude of the first tow for each processing period on a Set & Catch sheet.

For dredge fisheries, catch and fishing effort is represented by catch per surface area fished. In order for fisheries scientists to calculate surface area fished, the following data are required from the observer:

Duration: Length of time that a dredge was towed.

Tow Speed: Speed at which a dredge was towed.

Dredge Width: Width of the section of a dredge in contact with the ocean's bottom.

Note that information on Dredge Width will change when a particular dredge is modified, or a different dredge is used. For every dredge fished, record Dredge Width, # of Tows, and Total Duration of Tows (i.e., add the length of time for each tow per dredge) in the Comments section of a Set & Catch sheet.

Example (1): one dredge fished; 10 tows
Dredge Width = 200 cm

Total Duration of Tows: 4 tows of 12 minutes each = 48 min.
+ 6 tows of 15 minutes each = 90 min.
Total Duration of Tows = 138 min.

Example (2): two dredges fished simultaneously; 10 tows
Dredge Width for Dredge #1 = 120 cm
Dredge Width for Dredge #2 = 200 cm

Duration of Tows: (10 tows of 15 min. each) x 2 dredges (#1&2)
Duration of Tows = 300 min.

one dredge fished; 5 tows
Dredge Width for Dredge #3 = 180 cm

Duration of Tows: 3 tows for Dredge #3: 1 tow of 10 min.
+ 2 tows of 12 min.
= 34 min.

Dredge Width for Dredge #4 = 240 cm

Duration of Tows: 2 tows of 15 min. each for Dredge #4
= 30 min.

Therefore, Total Duration of Tows = 300 min. + 34 min. + 30 min.
= 364 minutes for Example (2)

Record 6.1 hours for Duration on the Set & Catch sheet.

Although Example (2) is a rare occurrence for a given set, it illustrates how to record information when Dredge Width changes.

Estimates of catch, bycatch, and discards must be obtained for each processing period recorded on a Set & Catch sheet. Review methods described in the chapter, Techniques of Observing Sets.

Estimate kept weight for scallops using one of the following methods, depending on which group the scallops represent:

A) Processed scallops: total weight of meats produced x an appropriate Conversion Factor = round weight

Conversion Factors: Iceland scallops C.F. = 9.2
Sea/giant scallops C.F. = 8.3

B) Whole scallops in trays: # of trays x average weight of scallops per tray

C) Whole scallops in cages: Use volumetric techniques with each cage (see App. 1).

Lastly, add discard estimates and estimated kept weights, in order to obtain total catch weight of scallops.

Estimate bycatch by observing the dumping and sorting of dredge contents. Closely monitor processing operations for any discarding of whole scallops or products. Obtain the best possible estimate of scallop discards.

Clam Dredging

The offshore clam fishery on the southeast Grand Banks started in 1989. Annual removals of two clam species are approximately eighty-five hundred metric tonnes. Stimpson's surf clam (*Mactromeris polynyma*) make up the majority of the catch, averaging 7800 t per year over the last four years. Greenland cockles (*Serripes groenlandicus*) and Propeller clams (*Cyrtodaria siliqua*) compose the rest, although the latter species is not kept.

Clams are buried in sand and mud. A hydraulic dredge is used to extract them. While moving over the bottom, a blade mounted on a large rectangular frame cuts about 20 cm into the bottom. Hydraulic hoses jet water through an attached manifold to separate sand from the clams, which are retained by a steel grid. Record detailed descriptions of clam gear used.

Clams are processed at sea, with two products being produced. The main product is clam meat: a muscle (called the "foot") used in locomotion. These clam meats are partially cooked in the shell, removed, then frozen and glazed (i.e., a film of water is added to a frozen product). On some vessels, clam meats can be sorted by size, and larger meats may be discarded because of lesser value. The second product is the mantle: a thin sheet of tissue lining both halves of the clam shell. Mantles are partially cooked in the shell, removed, and frozen. Unlike clam meats, mantles are not always processed.

One dredge is commonly used for fishing clams. However, some vessels may fish two dredges simultaneously. A clam dredge is towed for 7-15 minutes, resulting in many sets per day. Therefore, it is not practical to collect data on a set-by-set basis. Furthermore, clam processing is based on a specific time period (e.g., usually six hours), with production figures being logged at the end of each crew shift. Complete a Set & Catch Record sheet for this time period (Fig. 7), if fishing remains in the same location. Otherwise, fill out a new Set & Catch sheet when fishing location changes during a shift. Record the total number of tows in the Comments section of a Set & Catch sheet. Set Duration is the total time that a dredge spent fishing during the specific time period. When two dredges are used, determine the total time fished by each dredge, then add both values to obtain set Duration. Record Start Time, Start Latitude, and Start Longitude of the first tow for each processing period on a Set & Catch sheet.

Estimates of catch, bycatch, and discards must be obtained for each processing period recorded on a Set & Catch sheet. Review methods described in the chapter, Techniques of Observing Sets. Estimate catch by using production figures for the processing period.

To calculate round weight of clams:

boxes of meats produced x weight of product per box x a valid Conversion Factor

Ensure that box counts are accurate, and periodically verify whether the average weight of product per box is correct (e.g., reflecting any changes in overpack). If a valid Conversion Factor could not be obtained, use the factor generated from clam meat "yield" studies to calculate round weight from product weight. When calculating catch estimates, do not use weight of mantles produced, because a Conversion Factor for clam meats already includes mantles.

When a catch is brought on board, estimate any unprocessed species that is subsequently discarded (e.g., bivalves, finfish), and record weights (kg) in the Discard column of a Set & Catch Record sheet. With all species that are processed, "discards" are defined as the discarding of clams that are dead. Most bivalves survive when they are returned to the sea within a reasonable amount of time. Therefore, clams (i.e., of a species being processed) discarded whole shortly after sorting are not "discards". Estimate the weight of these live clams, and record in the Comments section of a Set & Catch sheet. For processed species, true "discards" are clams that remain on board for extended periods, and are then tossed overboard dead; and clams that are subsequently discarded during processing (i.e., whether whole or just meats). Record these discards in the Discard column of a Set & Catch sheet. Obtain the best possible estimate of discards, and document all estimates as described in Techniques of Observing Sets: Estimating Discards.

Set & Catch Record Sheet

Information gathered by the methods described in the chapters, Techniques of Observing Sets and Observing and Sampling - Special Cases, are recorded on the Set & Catch Record sheet (Fig. 7). This data sheet is a complete record of the catch and associated effort, constituting *the most important information collected by observers.* It must accurately reflect *all* fish and invertebrate species caught, what species are *discarded,* and how the catch is *processed.* It includes vessel and gear specifications, location, and time spent fishing. Such information is used to address many fisheries management issues as illustrated in the chapter, Discussion.

Collecting Set Details

Data on the Set & Catch Record sheet can be collected from several sources. For example, Side number, vessel horsepower, and gear size (vessel class) can be obtained during the Briefing session. The observer should verify vessel information with that given in documents on board ship. The captain can supply information on average vessel tow speed, latitude, longitude, and depth. Verify this information from readouts of electronic gear on the bridge. For unobserved sets, set and catch data can be taken from the fishing log. *It is especially important that an accurate estimate of effort (i.e., time spent fishing) is recorded for all sets.* Regardless of the source of these data, the observer must ensure the accuracy of all information collected.

All variables must be precisely coded (refer to code lists in App. 2). Leading zeros are not required in the recorded data. The data for Year and Trip # at the top of each Set & Catch Record sheet will not be computerized, but must be recorded on every Set & Catch sheet. The remainder of the Set & Catch form is organized into four "blocks":

1) vessel data;
2) gear data;
3) effort data; and
4) the catch record.

Organization of these blocks is also related to the frequency with which each variable may change during a trip. *When all variables within a block do not change between sets, leave the entire block blank.* Such variables will automatically be coded at the time of computerized data entry. Methods for completing each of the blocks for otter trawl gear are illustrated in the Set 26 redfish example (May 26, 1993; Fig. 7) used in the previous chapter. For gillnets and longlines, see the examples in Figures 13 and 14, respectively.

BLOCK 1: Vessel Data

Fill in all variables in this block for Set #1, then leave it blank for the remaining sets of the trip. *If data changes for one or more variables,* then Block #1, as well as 2, 3 and 4 must be completed.

Trip Number: Record the assigned trip number.

Year: Record the last two numbers in the current year: e.g., write 93 for 1993.

Country: Determine the flag state (national registry) of a vessel: e.g., code 34 for Russia (see Country codes; App. 2, Table 1).

Trip Type: Record the trip type specified during the Briefing session (see Trip Type codes; App.2, Table 1).

Quota: Determine which country's quota will be fished and record the appropriate country code corresponding to quota origin (App. 2, Table 1).

Vessel Side Number: Determine the side number of the vessel from the vessel license or the Vessel Specifications sheet. The format is alpha-numeric and between 2 and 10 digits long: e.g., record MB 45172 for the Russian vessel, MSX YUSKA. Do *not* write in hyphens, and *distinguish between letters and numbers by using the following recording configurations.*

letter O = Ø	letter I = I	letter Z = Z
zero = 0	letter L = L	number 2 = 2
	number 1 = 1	

Example: FØ1742

Vessel Horsepower: Record the brake horsepower of the vessel from the Vessel Specifications sheet: e.g., write 2600 for a horsepower of 2600 Bhp.

Vessel Class: Vessel class is based on Gross Registered Tonnage (GRT), the official weight of a vessel fully loaded with cargo as recorded in Lloyds Register of Shipping. Determine GRT of the vessel from the Vessel Specifications sheet, and record the corresponding tonnage class code: e.g., code 7 for a vessel tonnage of 2,200 GRT (see Vessel Class codes; App. 2, Table 1).

Fishing Gear Type: Record the appropriate gear code for the type of fishing gear used in the set: e.g., code 1 for a stern trawler using an otter trawl (see Gear Type codes; App. 2, Table 1). Note that for shrimp trips, record 17 in this field and list the different types of shrimp trawls used in the Comments section of the Set & Catch sheet for Set #1.

BLOCK 2: Gear Data

Fill in all variables relevant to the particular fishery for Set #1, then leave the entire block blank for the remaining sets of the trip. *If data changes for one or more of the applicable variables,* then Block #2, as well as 3 and 4 must be completed.

Codend Mesh Size: Mesh size may change as a result of use (stretching) or repair of damaged netting. Measure average mesh size of the codend (in millimeters with the gauge supplied) approximately every week, and when the gear is changed or extensive damage is repaired: e.g., record 120 for a codend mesh averaging 12.0 cm (120 mm). In certain fisheries (e.g., shrimp, capelin, grenadier), a bag or liner is used inside the main codend. In this case, measure mesh size of the smallest mesh in the codend (i.e., its liner).

Body Mesh Size: (*or* **Crab Pot Mesh Size**)

Trawl gear: Measure average mesh size of the net body (in millimeters) approximately every week, and when the gear is changed or extensive damage is repaired: e.g., record 125 for a body mesh averaging 125 mm.

Gillnet gear: Record the average mesh size of all gillnets hauled in that set. Remeasure the mesh when any changes occur with the gear.

Crab pots: Obtain crab pot mesh size from the Captain and record in mm. *If unavailable or different crab pot mesh sizes are used, leave this variable blank and explain in the Comments section.* Convert inches to millimeters using the following:

5 ¼ inches = 133mm
5 ½ inches = 140mm
5 ¾ inches = 146mm
6.0 inches = 152mm

Roller Size: Record the *diameter* (not the radius or circumference) in centimeters of the solid rubber disc (roller) or steel sphere (bobbin) on bottom trawl footgear at the beginning of each trip and when the gear is changed: e.g., record 25 for a 25-cm roller.

Topside Chafing Gear Type: With three types of legal topside chafing gear for bottom trawls (*midwater* trawls do *not* have topside chafers), determine the topside type used for the set and record the appropriate chafer code (see Topside Chafer codes; App. 2, Table 1): e.g., code 4 for multiple flap chafing gear. "Other" (code 5) indicates that an illegal topside chafer was used. In some fisheries (e.g., capelin, grenadier), a liner is used inside the codend. The codend is *not* considered a topside chafer.

Number of Windows: Windows are holes cut in the codend mesh of a trawl at one or more locations to limit the catch size. *Record the number of windows, and indicate in the Comments section when a window is used.* Code 0 when windows are absent. Note that for a trawl equipped with a Nordmore grate or other "size sorting" panel, the opening above the grate does *not* qualify as a window. However, true windows are sometimes used further down the codend, and must be recorded.

Number of Gillnets: **(*or* Grate Bar Spacing)**

Gillnet gear: One Set & Catch sheet is filled out to record catch and effort from the *gillnets that were hauled in a particular set.* Record the number of gillnets in this group. Instructions for collecting and recording gillnet fishery data are given in the chapter, Gillnetters.

Trawl gear: For a trawl equipped with a grate (e.g., Nordmore grate), record the distance between the vertical bars of the grate (i.e., its "bar spacing") in millimeters. When another type of "size sorting" panel is used (e.g., a flexible mesh grate), record its Mesh Size to the nearest mm, and describe in detail this sorting panel in the Comments section. Be sure to *record in the Comments section for each set whether a grate or sorting panel was used.*

Ave. Length of Gillnets: **(*or* Footrope Length)**

Gillnet gear: Record the average length of *gillnets hauled in the set* to the nearest meter.

Trawl gear: For a shrimp trawl, record the length of its footrope to the nearest meter.

Number of Hooks: **(*or* Temp. at Fishing Depth)**

Longline gear: Record the *total number of hooks that were hauled in the set.* Instructions for collecting and recording longline fishery data are given in the chapter, Longliners.

Trawl gear: For a shrimp trawl, record the water temperature at fishing depth in ° Celsius (to one decimal place) when available. Otherwise, note in the Comments section why temperature was not available. *When there is any change in water temperature or its availability, Block #2 must be completed each time* (do *not* fill in only this specific variable). Record a negative temperature with a "minus sign", but do not write the "plus sign" of a positive temperature, and never record "leading zeroes" for temperatures between -0.9° C and +0.9° C:

e.g.,a water temperature of -2.6° C is recorded as -26
a temperature of +2° C is recorded as 20
a temperature of +0.9° C is recorded as 9

Number of Pots: Trap gear: Record the number of *pots hauled in the set* for crab, lobster, or cod fisheries.

BLOCK 3: Effort Data

Some variables pertaining to fishing effort will always change between sets. Therefore, *fill in all variables in this block for every set* during the trip.

Set Number: Record the number 1 for the first set of each trip and number all subsequent sets consecutively, regardless of whether they were observed or not. For unobserved sets, obtain catch and fishing effort data (e.g. set location, fishing duration, gear type/amount) from the vessel fishing log. These data are most easily obtained the day after an unobserved set occurs.

Directed Species: *On foreign vessels, the species named on the license for that day* is the Directed Species, even when other species may dominate in some sets. Record the appropriate species code from Akenhead and LeGrow (1981) for vertebrates, or Lilly (1982) for invertebrates. *On Canadian vessels,* the captain is *not* restricted by license to fish for a particular species. Before each set begins, consult with the captain to determine the main species sought and record this as the directed species.

Data Source: Code 1 for an observed set, or 2 for an unobserved set. Detailed catch estimates may not be possible for every set when there are many sets per day. However, 100% observation is expected when only two or three sets are fished each day.

Start Latitude: The first two digits of this field are used to record degrees, and the last two digits are for minutes. Do not put N or W to the right of this position: e.g., record 47°40' for starting latitude 47°40'N.

Bottom trawl gear: Catch fish only on the ocean's floor. Therefore, start position for this net is when the winches have stopped paying out the main warp (i.e., which allows the net to carefully descend the final meters to the bottom), and *not* where it is shot away from the vessel.

Midwater trawl gear: Start position is when the net reaches the desired fishing depth; usually signalled when the winches have stopped.

Start Longitude: Use the same procedure above to record longitude: e.g., record 48°25' for starting longitude 48°25'W.

Unit Area: Determine Unit Area from the starting position of the set: e.g., code 326 for position 47°40'N, 48°52'W.

NAFO Division: Determine in which NAFO Division the set occurred, using start latitude and longitude. Record the appropriate NAFO Division code (see NAFO Div.codes; App. 2, Table 1): e.g., code 32 for fishing commencing in 3L.

Avg. Fishing Depth: Record the average fishing depth to the nearest meter: e.g., write 530 for an average depth of 530 m.

In/Out 200 Mile-Limit: If the starting position of a set is inside Canada's 200-mile zone, record 1; if outside, record 2.

Month: Record the numerical code for the month in which a set occurs: e.g., code May as 5.

Day: Record the calendar day on which a set commences, based on time in UTC (Universal Time Coordinate): e.g., record 26 if a net starts to fish at2330 h UTC on May 26 and fishes into the following day.

Start Time: Record the moment that a net effectively starts to fish, in UTC using the 24-hour scale: e.g., write 16hr 00min for a net starting to fish at 1600 hours UTC.

Bottom and midwater trawls: Start Time is usually when the winches stop paying out the main warp.

Duration: *Duration of a tow is the time during which the gear is effectively fishing.* To determine fishing duration for gear types not listed below, refer to the appropriate chapter.

Bottom trawl gear: A net is effectively fishing when the winches have stopped paying out the main warp (i.e., Start Time). End time is signalled when the winches start to take back the net.

Midwater trawl gear: Start Time is when the net reaches the desired fishing depth (usually signalled when the winches have stopped), and End Time is when the winches start to take back the net.

When a net stops fishing, note the time and subtract start time from end time. Record fishing duration to the nearest tenth of an hour using the time conversion chart below (one decimal place is provided on the Set & Catch sheet): e.g., record 3.8 (i.e., 3.75 hours rounded off to the nearest tenth) if fishing started at 1600 and stopped at 1945 hours. This indicates that the net had fished for three hours and forty-five minutes.

Set duration conversions from hours/minutes to decimal hours:

5 min. = 0.1 hours	*35 min. = 0.6 hours*
10 " = 0.2 hours	*40 " = 0.7 hours*
15 " = 0.3 hours	*45 " = 0.8 hours*
20 " = 0.3 hours	*50 " = 0.8 hours*
25 " = 0.4 hours	*55 " = 0.9 hours*
30 " = 0.5 hours	*60 " = 1.0 hours*

Ask the crew to note any actions that may affect gear fishing time. For example, an otter trawl may be raised off the bottom for a period of time prior to being brought on board the vessel, to allow the previous catch to be completely processed. Bottom gear may also be temporarily positioned in midwater to avoid a rocky or uneven bottom, in order to prevent serious net damage.

Such actions will affect fishing duration. Therefore, note the amount of time during which the trawl was not actively fishing, and subtract this time from total duration of the set.

Avg. Tow Speed: Record the average tow speed of the vessel to the nearest tenth of a knot (one decimal place is provided on the Set & Catch sheet): e.g., write 3.0 for a vessel averaging 3 knots during a tow.

Net Damage: Observe and record all net damage. If no damage has occurred, code 1. Also, code 1 for unobserved sets unless it can be verified by the crew that damage had occurred. If net damage does not result in the loss of fish, record 2: e.g., tears in the wing or square. If damage results in the loss of fish, record 3. Large tears in the codend will result in loss of some of the catch, or badly twisted gear will prevent fish from being caught. When net damage is 2 or 3, describe the type and extent of damage in the Comments section of the Set & Catch sheet.

BLOCK 4: Catch Record

Some variables in this block will always change between sets. Therefore, *fill in all variables for every set* during the trip.

The following is the final catch estimate for the Set 26 redfish example, to be recorded as the Catch Record on the Set & Catch Record sheet.

Final Estimate for Set 26 (incorporating all methods) - May 26, 1993

1. Redfish (*S. mentella*)	5,500 kg	
2. Redfish (*S. marinus*)	300 kg	
3. Witch	3,500 kg	
4. Northern wolffish	200 kg	(discarded)
5. Striped wolffish	100 kg	
6. Turbot	300 kg	
7. Roundnose grenadier	100 kg	(discarded)
8. Black herring	3 kg	(discarded)
9. Tapirfish	40 kg	(discarded)
10. Neolythodes (crab)	2 kg	(discarded)
11. Atlantic halibut	50 kg	

Species Name: *Print the common name (in full) of every species caught, with the directed species recorded first followed by the bycatch in order of abundance.* Include such species as Atlantic halibut, large pelagic fish, marine mammals (e.g., seals, dolphins), birds, and invertebrates (e.g., crabs, scallops, squid, sea cucumbers). For sea cucumbers, code 8311 for the common Cucumaria sp. (large, black, football-

shaped), or 8293 for the infrequently-encountered Psolus sp. (smaller, scarlet/orange, dome-shaped). Return frozen specimens of unidentified fish or invertebrates to the Fisheries Observer Program laboratory. These will be coded in later.

Species Code: Record the appropriate species code listed in Akenhead and LeGrow (1981) for fish, or Lilly (1982) for invertebrates.

Kept Weight: Record *round weight* in kg to a 5-digit maximum. If weight exceeds five digits, split this amount and record on an adjacent line with the species code written twice.

Discard Weight: *Only fish rejected whole are classified as discards, not parts of fish discarded during production.* Record round weight in kg to a 4-digit maximum. If this estimate exceeds 9999 kg, split this amount and record on an adjacent line with the species code written twice. With significant amounts of discards, include a full description of method(s) used to obtain discard weights in the Comments section. Ensure that final kept and discard weights are the "best" possible random, objective, independent estimates.

Dir. Sp.: Code 1 for the main species sought in the set, as previously recorded for Directed Species.

Processing: Code up to three separate product types made from the kept portion of each species. If more than three processes are used on a given species, record the additional products in the Comments section.

The **Percent (%)** values must add up to 100 per kept species: e.g., if 80% of kept redfish was converted to skinless, trimmed fillet with bones left in, code 203 for this process and record 80 under %. If the remaining 20% of redfish in that set was gutted with head off and belly flaps removed, code 104 and record 20 under % (see Conversion Factor Process Code list; App. 2, Table 7). These are "final" products of a main process.

Record any byproducts (produced from another process) in the Comments section only: e.g., heads and bodies are byproducts of a topside filleting process using turbot.

Comments: Record comments as required. Explain any unusual occurrences or deviations from standardized collection methods.

Precision is essential in filling out all Set & Catch sheets. In addition to checking over each sheet upon completion, review all data sheets at the end of each day in order to detect mistakes. A complete check of the accumulated information is done during the Debriefing session.

Blocks 1-4 were designed to facilitate data entry for subsequent computer analyses. There is an additional box that will not be computerized, but does provide pertinent information to DFO. It will also aid the completion of data summary sheets and error-checking. Complete the following Variables:

Observer:	Full name
Vessel:	Full name
Avg. Fishing Depth:	Record only when average fishing depth in fathoms was used to convert to meters for Ave. Depth.
Local Time:	Record Nfld. local time using 12-hour scale (a.m./ p.m.).
Statistical Area:	Record an appropriate statistical area for the fishery in that set. (Note that the information for this Variable will be computerized.)

Sampling

Length and age samples from commercial catches are important as input to fisheries management. The Observer Program is an opportune agency for gathering such data. The following condensed extract from Kulka and Waldron (1983) describes the benefits of sampling at sea:

The need for observers at sea as collectors of biological data, particularly length and age samples, was recognized long before the existence of the Observer Program. Paulsen (1956) noted the following: "The method (shore sampling) does not offer a reliable substitute for sampling at sea by means of observers. The sampling of observers, although more expensive (in money and time), must continue to be our main way of studying size-distributions." More recently, T. Williams stated in Gulland (1977) that "Large, well-equipped laboratories, complete with costly research vessels and highly-qualified staff, attempt to carry out quantitative studies of fish stocks without utilizing the enormous amount of information relatively cheaply obtainable from the operations of the commercial fishing fleet. A properly organized program of work at sea on commercial fishing vessels and onshore at processing plants provides the basic data for removals by the fishery and also information on the abundance, distribution, migrations, and mortality of the exploited fish stocks." Certainly the benefits of an in situ data collection program has long been recognized.

The Observer Programs for the Atlantic regions collect not only biological but surveillance and technological data as well. Such an approach is efficient because each task performed by the observer requires only a portion of the working day. Hence, all aspects, including sampling, can usually be done by a single observer per vessel. Age, length, and other demographics can be extracted in a detailed manner and can even be taken from portions of the catch such as discards, landings, or size-culled fish. Extensively sampled sets can be combined into any specified strata, properly weighted at each level to yield an age or length structure of the caught portion of the population. Length-age sampling of catches at a rate of 1 set per day, which can easily be achieved in conjunction with collection of catch and effort, surveillance, and other data, allows for this estimation of catch demographics.

Observer deployment strategy is determined by four factors. In order of importance they are: fleet surveillance needs, the acquisition of catch and effort data, attainment of representative biological samples from the offshore sector, and collection of other biological and technological data. Deploying observers to cover surveillance needs is largely a random process with the general aim of obtaining roughly equal coverage per stock except in special cases where surveillance requirements are greater. This strategy fits in very well with the sampling needs.

The attainment of representative samples from commercial catches is an art and is a particularly difficult process when the populations and their parameters are unevenly distributed, and always changing. Fish populations exhibit annual and other cycles but with many anomalies. This biological pattern affects the work of anyone studying living populations. The job of the observer is further complicated because he/she is working alone on a constantly moving platform where the primary aim of the vessel is to catch and process fish and where little emphasis is placed on estimating and understanding fish population parameters. The observer must thoroughly understand the concept of random sampling and apply it by using a series of techniques outlined in this manual to yield data representative of the catch. Also, each vessel presents a unique set of logistical problems which must be overcome in order to obtain valid samples.

Techniques of Sampling

This section concentrates on practical aspects of sampling at sea, that is, how the observer can adapt the prescribed sampling requirement to conditions on a commercial fishing vessel. A more complete discussion of the theory of sampling and details of sampling methodology can be found in Gulland (1966).

It is necessary to be thorough and precise when removing and measuring fish from a catch. Prior to sampling, assess the vessel layout and processing system to determine optimum sampling locations and the most efficient sample removal procedure. In consultation with the vessel's captain or processing supervisor, choose a sampling station where fish can be randomly removed from the catch, with minimum interference to production. Culling by the crew (i.e., size or species related removal of fish from a catch) may not be obvious. Therefore, carefully study the processing operation and design a strategy that eliminates logistical problems potentially affecting quality and randomness of the sample. An ideal location for obtaining a sample is the position closest to where fish enter the processing area before being handled (e.g., chutes from holding bins). Taking a sample at such a location also provides an opportunity to monitor catch composition and some aspects of discarding.

Choice of sampling site is important to ensure that samples obtained are representative of the catch. For example, the shape of the sample frequency of a particular species (i.e., representing all sizes of fish sampled) should be similar to the shape of the length frequency distribution of the total catch of that species. However, the crew will often separate size groups of fish for differential processing. Samples must be obtained before separation. Any samples taken from the size-selected groups would not be representative of the population of the catch. Similarly, if fish are selected from only one area of the holding bin, they may be missing a size-range found in the catch. To overcome this problem, a randomizing technique can be used in the selection of baskets (usually about 5 to 8) so that fish are removed before crew handle the catch. This is accomplished by selecting baskets of fish at various intervals during the processing period.

The following excerpt is a modified version of sampling described in an early version of the American Observer Program manual (unpublished) and may help to define random sampling more clearly:

The basic method to be used when sampling length frequency distribution is the simple random sample; that is, every individual in the population (the catch in this case) has an equal chance of being selected. This would involve taking enough fish randomly so that more than 250 fish are taken of that species being sampled. In any type of random sampling, certain forces work against the achievement of a true random sample. There exists a subconscious tendency to select larger or otherwise obvious individuals. In addition, fish within a pile or in a trawl may stratify according to girth or size, further decreasing the chance of obtaining a true representation of the population in the sample. The effects of these tendencies may be reduced by selecting a number of smaller subsamples from the various locations within the pile to be sampled, and by taking every individual at these locations.

Care in sample selection is particularly important on Canadian vessels where the fish are dumped directly into a holding area in the processing room and within minutes are being handled and sorted by the crew. On Canadian vessels, to obtain length data that is representative of the catch, immediate sample selection is essential. This is accomplished by removing fish from the processing room storage area before the crew starts to move fish to the cutting boards. Time will be limited, but it is important to remove the sample from various places in the holding bin to ensure that a representative sample is selected. On certain vessels, such as side trawlers, the sampling may have to be done on the trawl deck. The above procedures would still apply.

Three types of samples can be removed from catches at sea: catch, landings, and discards. This contrasts with sampling at shore processing plants where only landing samples can be obtained. Frequencies from unculled catches (catch samples) are the most useful forms of length data because they represent total removals including discards (all fish which were captured in a particular set). A landings sample represents that portion of the catch retained on board for processing after size-selective discarding takes place. Historically, discard samples contained whole fish of noncommercial sizes, which were dumped overboard. Presently, samples of undersized fish may be required. The ideal strategy when discarding occurs is to obtain both a catch sample and a discard sample. This would enable an estimate of the size composition in the catch of the species being sampled, and yield information on the discarded portion.

Figure 2 illustrates a typical processing room layout that might be found onboard a foreign vessel, with potential sampling points. The sampling site should be spacious enough to set up sampling equipment and with the catch easily accessible. A sample size of 200 to 400 fish is optimal depending on species and must be taken according to standard procedures summarized in Table 4. This table lists, for all major commercial species, codes, methods of measurement (e.g., total length, fork length, etc.), and indicates whether the species should be sexed. Length frequencies are kept separate by sex for species where males and females grow at significantly different rates, and where sex ratios in the population vary by area and biological season. When catches contain sufficient amounts of two commercial species, it may be possible to sample both if time permits.

The following steps can then be used to produce the sample record. First, determine total weight of selected fish, in kilograms. When using a hanging balance in a heavy swell, allow the dial to swing back and forth several times to determine the midpoint of the dial movement to ensure that an accurate value is read. Ensure that the scale is well maintained as it can deteriorate rapidly in the salty, moist environment of the processing room. Next, place each fish on its side on the scaled measuring board (ventral side down for flatfish) with the tip of the snout touching the head of the board. The value inscribed between marks on the measuring strip where the end of the tail rests signifies the length in cm (Table 4 lists the appropriate body length measurements for each species).

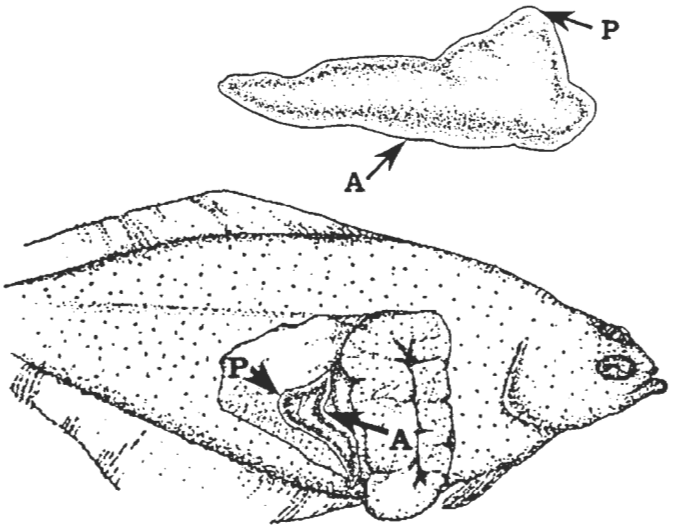
Recording of data can be done in several ways but the final result must be coded on the Length Frequency Sheet (Figs. 18-20 & 23; depending on species). If available, these data may be entered into a computer in summary form after sampling. Attached to some of the

sampling boards are demarcated white strips useful for recording lengths in a one-person operation. By marking length group tallies onto the strips, handling of a clipboard with tally sheet under wet conditions can be avoided.

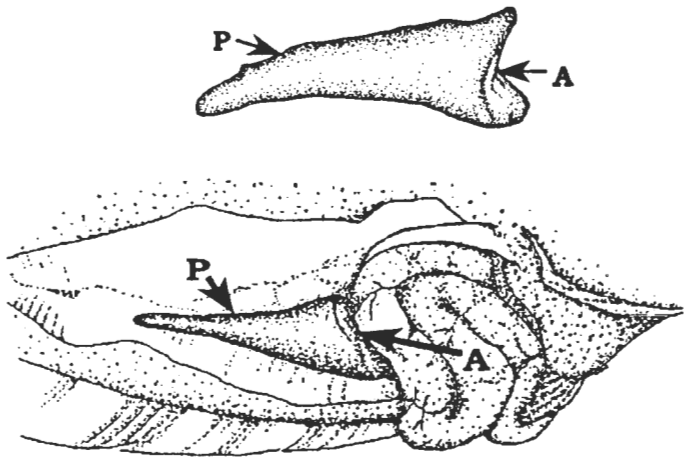
The next step, if required, is to determine the sex of each fish. Use the following diagrams of dissected fish as an aid to differentiate the sexes of commercial species. Care must be taken in locating the gonads that are embedded in mesentery (i.e., transparent connective tissue attaching intestines to the dorsal portion of the gut cavity). Flatfish gonad location and configuration are different from roundfish species (see diagrams on next page), and must be analysed by cutting back from the midpoint of the gut cavity:

Flatfish

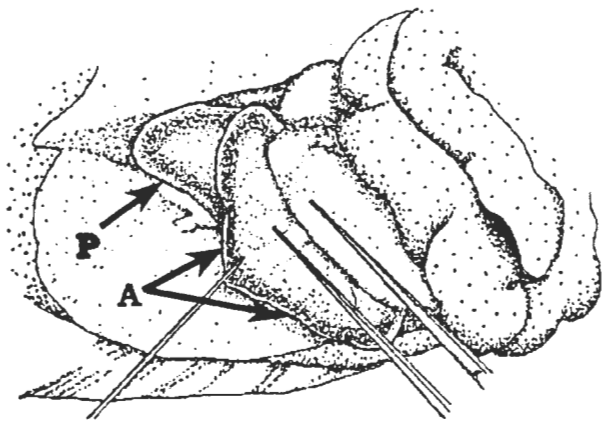
Male: triangular, sharp anterior edge (A), short posterior end (P).



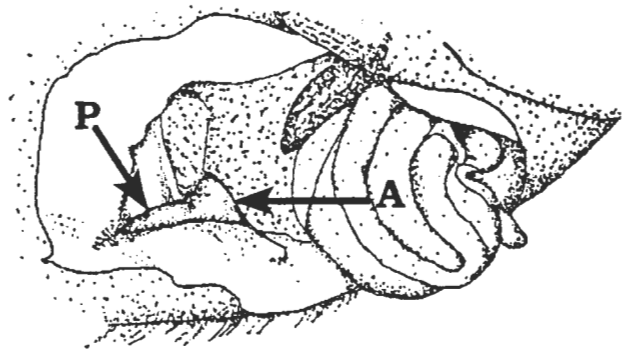
Female: elongated triangular, rounded anterior edge (A), elongated posterior end (P).



Male: maturing plaice gonad with the leading edge (A) flipped up to show its sharp edge.



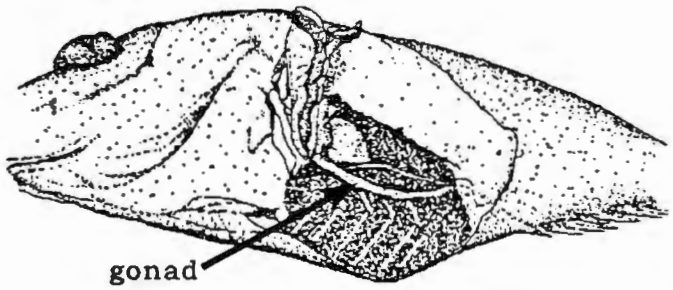
Female: immature turbot gonad with its rounded anterior edge (A), elongated posterior end (P).



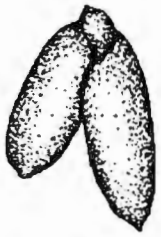
Roundfish

Male: long, string-like, irregular.





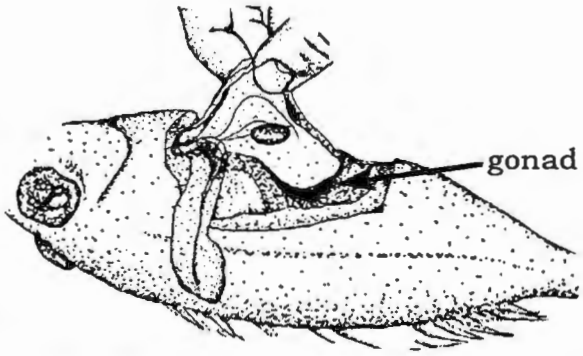
Female: short, fat, cigar-shaped.





immature

mature



Colour is variable but males are usually white or grey, while females are orange or pink. Immature gonads can be very tiny, sometimes less than 1 cm in length. A fully mature gonad can fill most of the gut cavity. Mature female flatfish gonads extend back from the gut cavity through most of the length of the fish.

Once sex has been determined, the length for each fish can be recorded on the tally sheet in the appropriate columns. If the species is not sexed, tallies are made in the left column. Figure 18 illustrates how the tally sheet for groundfish species is completed. Refer to Table 4 for a list of length and sexing requirements per species. In the example, witch is the sampled species. Each crossed set of tally marks represent five fish that have been measured. The length grouping for witch and all other groundfish species is 1 cm. For example, if the flatfish being measured is 45 cm long, it would be recorded in the 45 cm length grouping.

For aging purposes, bony white structures called otoliths (i.e., ear bones) are removed from the otic capsules located on the underside of a skull. This procedure is done only on a small portion of the measured fish, a stratified subsample. A stratum is an assemblage of the population elements of non-overlapping groups in which the variation among individuals within a group is less than that among individuals in the population as a whole. The stratum, in this case, is all individuals in a particular size grouping from which a subsample of fish are to be selected for otolith removal. In the example of witch measurements (Fig. 18), the first fish in each 1-cm length category (by sex) in the sample would have its otoliths removed and placed in a labeled envelope if one fish per length grouping were to be sampled for age. Length of the sampled fish should be recorded on its otolith envelope. Otoliths from this fish would then represent that length grouping with respect to age.

The following sections summarize sampling procedures specific to each of the major commercial species. The basic unit used when determining distribution of sampling intensity is the stock, and there are usually several stocks per species. Specific sampling requirements for each stock are outlined during the Briefing session (see the chapter, Briefing, and Table 1).

To aid in the identification of fish species at sea with *Atlantic Fishes of Canada* (W.B. Scott and M.G. Scott, 1988), a pictorial description of important anatomical terms is enclosed on pg. 182&183, with an extensive **GLOSSARY** of definitions on pg. 107 .

Groundfish Species

The observer may be requested to sample catch, landings, or discards of groundfish species. Sampling "undersized" fish is also a possibility. Groundfish of sizes too small for commercial markets were discarded in the past; they are now classified as "undersized" fish and are retained on board the vessel, although they remain unprocessed. Detailed sampling instructions will be given during the Briefing session. Note that if quantities of a directed species are insufficient for sampling, then sample a major bycatch species.

Atlantic cod (*Gadus morhua*), Haddock (*Melanogrammus aeglefinus*), White Hake (*Urophycis tenuis*)

Length: Collect unsexed fork lengths in 1-cm length groupings, to a maximum of 250 fish.

Otoliths: Collect all otoliths in 1-cm length groupings. Briefing Instructions will specify the number of otoliths required for a particular trip.

Extract otoliths by cutting down at a 45° angle through the skull just behind the eyes. For very large cod with a skull too hard to cut through with a knife, insert the tip of the blade into the middle of the skull behind the eyes, and work the knife from side to side until the skull cracks open. Alternatively, in large fish, cut through the otic capsules underneath the head, near the gills. Be sure to clean each otolith by rubbing it gently between thumb and forefinger before placing the pair in a labelled otolith envelope.

Blue Hake (*Antimora rostrata*)

Collect sexed total lengths (1 cm grouping) from all vessels at all locations. No otoliths are required.

Redfish (*Sebastes marinus*, *S. mentella* or *S. fasciatus*)

S. mentella is the dominant redfish species in most Canadian Atlantic waters. For set observations and sampling, only the first two species (*mentella* and *marinus*) will be differentiated since the third, *S. fasciatus*, is almost identical in appearance to *S. mentella*. Only *S. mentella* samples are required, so the two species must first be separated. Key

characteristics for identifying *S. mentella* are a sharp bony projection on the front of the lower jaw, bright red color, and proportionately large eyes. *S. marinus* is somewhat more orange in color, has a small or almost non-existent bony projection on the jaw, and its eyes are relatively small (see the species identification handout, or Scott and Scott (1988)).

Length: Collect sexed fork lengths of *S. mentella*. Take a minimum of 400 fish per sample.

Sex: Redfish males and females grow at different rates; therefore, they must be sexed. Paired gonads are located in the dorsal and posterior part of the gut cavity near the backbone (embedded in the transparent connective tissue). The male gonad is grey-white, firm, narrow, elongated, and has sharp edges, while the female gonad is darker colored, pliant, more rounded, shorter, and has no sharp edges. Small eggs can be seen inside the maturing female gonad.

Otoliths: Collect all otoliths in 1-cm length groupings per sex. Extract otoliths by cutting down at a 45° angle through the skull just behind the eyes. Be sure to clean each otolith by rubbing it gently between thumb and forefinger before placing the pair in a labelled otolith envelope.

Flatfish

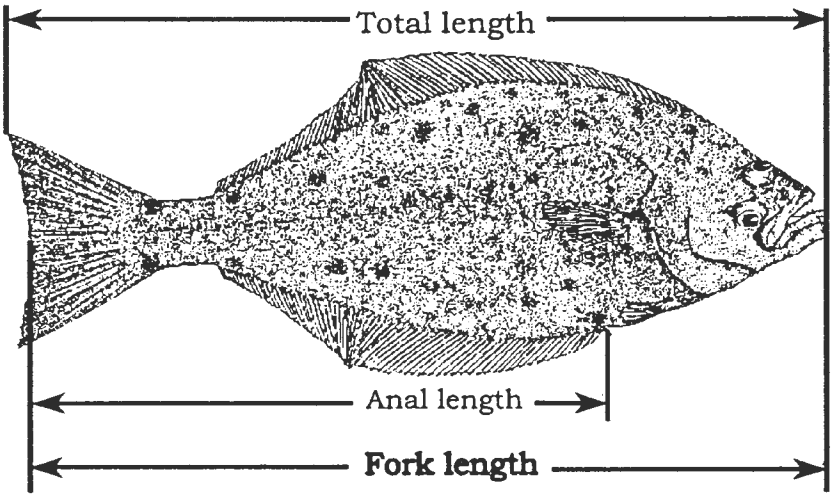
This section refers to the commercial species of pleuronectids (i.e., righteye flounders): Atlantic halibut (*Hippoglossus hippoglossus*), turbot/Greenland halibut (*Reinhardtius hippoglossoides*), witch flounder (*Glyptocephalus cynoglossus*), American plaice (*Hippoglossoides platessoides*), and yellowtail (*Limanda ferruginea*). All flatfish must be sampled by species (see the species identification handout, Scott and Scott (1988), and Table 4).

Atlantic halibut

Length: Collect all possible sexed fork and anal lengths in 1-cm length groupings. Anal length (from the first anal fin ray to the fork of the tail; see below) is recorded to the nearest centimeter on an otolith envelope. Do not sample fish under 81 cm (fork length) on Canadian vessels, in accordance with species conservation measures and the Atlantic Fishery Regulations. Only Canadian vessels are not permitted to retain Atlantic halibut under 81 cm.

Sex: Flatfish males and females grow at different rates; therefore, they must be sexed. Gonads of all flatfish species are similar (see diagrams on pg. 71). The male gonad is usually white, firm, located laterally, and generally smaller than the female gonad. The female gonad is often orange or pink, soft, triangular, and elongated posteriorly (more so in mature individuals).

Otoliths: Collect all otoliths in 1-cm length groupings per sex. Extract otoliths by cutting vertically (i.e., not at an angle) directly behind the eyes on the lateral ridge of the head. Because flatfish skulls are twisted, the otoliths lie one over the other directly behind the brain, instead of side-by-side. Be sure to clean each otolith by rubbing it gently between thumb and forefinger before placing the pair in a labelled otolith envelope.



Turbot/Greenland halibut

Collect sexed fork lengths and otoliths in 1-cm length groupings, to a maximum of 250 fish. Sex identification and otolith extraction methods are similar to those of Atlantic halibut. Turbot otoliths are extremely thin and brittle. Care must be taken in their extraction. Be sure to clean each otolith by rubbing it gently between thumb and forefinger before placing the pair in a labelled otolith envelope.

Witch flounder

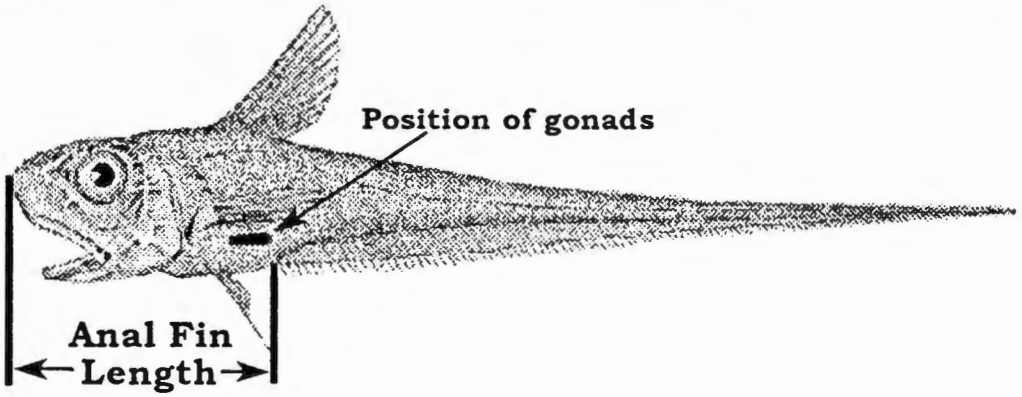
Collect sexed total length samples and otoliths in 1-cm length groupings. Sex identification and otolith extraction methods are similar to those of Atlantic halibut. Be sure to clean each otolith by rubbing it gently between thumb and forefinger before placing the pair in a labelled otolith envelope.

American plaice and yellowtail

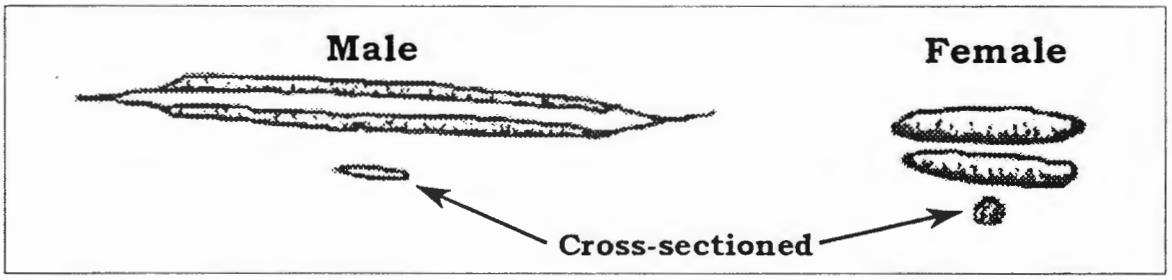
Collect sexed total length samples in 1-cm length groupings, to a maximum of 250 fish. Sex identification is similar to that of Atlantic halibut. No otoliths are required.

Grenadiers

Three species of grenadier commonly occur in the Northwest Atlantic, and are abundant at depths greater than 500 m: roundnose (*Coryphaenoides rupestris*; the dominant species), roughhead (*Macrourus berglax*), and common (*Nezumia bairdi*). Separate the species before sampling (see the species identification handout, or Scott and Scott (1988)). Only roundnose and roughhead grenadier samples are usually required.



Length: Collect sexed anal fin lengths (see above diagram; 0.5-cm length grouping; Table 4). Total length is not measured, because grenadiers have very fragile tails that frequently break off. Take a minimum of 400 fish per sample, every second day. Complete Grenadier Length Frequency Sheets (Fig. 20) according to the section, Groundfish Length Frequency Sheet, and Grenadier Length Frequency Specifications (App. 2, Table 4). No otoliths are required.



Sex: Sexing grenadier is difficult, since commercial catches contain mainly immature fish. Mature individuals tend to migrate to oceanic depths. Gonads of both sexes may be only 1-2 cm long in the most immature specimens. Gonad location is similar to that of redfish. The male gonad is usually grey-white, firm, small, narrow, elongated, and somewhat flattened. The female gonad is soft, often larger than the male gonad, more rounded, and short. Its colour is also somewhat darker than the male's, but colour is not a reliable indicator of sex (as with immature individuals of all species).

Groundfish Length Frequency Sheet

As described in the chapter, Discussion, length and age samples of catch are important for assessing the status of fish stocks. Groundfish length information is recorded on an Observer Program Sampling Frequency sheet (Fig. 18 & 19). Use either a Sexed or Unsexed length frequency sheet, depending on the groundfish species sampled (see Summary of Length Measurements and Sexing Requirements per Species, Table 4). Because sampling conditions in the fish processing area are often less than ideal, the original datasheets containing groundfish length frequency tallies can become soiled; they should be designated as "scratch" or working copies. In the "header" section of working copies, record only the following data: Set No., Species, Trip No., Use, Sample Wt.. Transfer all length frequency data (especially tallies) accurately to clean/ final copies. *Include every working/ scratch copy of each length frequency sheet in the completed trip package.*

In the header section of final copies, all variables must be precisely coded in pencil (see code lists in App. 2, Table 2), as per the following:

Set No.: Record the set number from which a sample was taken.

Species: Record the species sampled for that length frequency, using an appropriate species code listed in Akenhead and LeGrow (1981).

Sex: Record a value only for sexed species. If only males are sampled, code 1 in the top space under "M", and leave the female slot blank. Otherwise, code 5 for female "F" length frequencies.

Trip No.: Obtain from Trip Number on the Set & Catch sheet.

Use: Determine the type of sample taken for length frequencies. Code each sample as **C**, **D**, or **L** using the following criteria:

C (catch = kept + discards): Catch equals the entire contents of the net for the sampled species before being sorted in any way.

D (discards): Discards are whole fish that are sorted/culled from the catch for discarding overboard: e.g., usually small fish that are difficult to process or have no commercial value. When whole fish are processed as meal, they are not referred to as discards but rather as part of the landings.

L (landings or kept): Landings are fish that remain after discarding, and are processed and stored in the ship's hold. When no discarding occurs in a set, all fish are regarded as catch and not as landings.

Sample Wt.: Record the total weight of all fish on that length frequency sheet. Be sure to subtract the weight of baskets used in weighing these fish.

 # Otoliths: On Sexed Frequency sheets, record the number of otolith pairs extracted from fish in the length frequency sample: e.g., given 20 length groupings in a male length frequency and 24 length groupings in a female length frequency, with one pair of otoliths extracted per length grouping; record 20 in the top space under "M", and 24 under "F".

On Unsexed Frequency sheets, record the number of otolith pairs collected in the top space.

Len. Grp. =1 Sampled fish lengths (i.e., total or fork measurements) are grouped into 1-cm intervals (see Summary of Length Measurements and Sexing Requirements per Species, Table 4). Tally the sampled fish in groups of five for ease of enumeration later.

Species Total Weight: Record total weight of the species sampled (in kg) from the Catch Record on the Set & Catch sheet. This value depends exclusively on Use for the length frequency sample:

If Use = **C**, then Species Total Weight = kept weight + discard weight

If Use = **D**, then Species Total Weight = discard weight

If Use = **L**, then Species Total Weight = kept weight

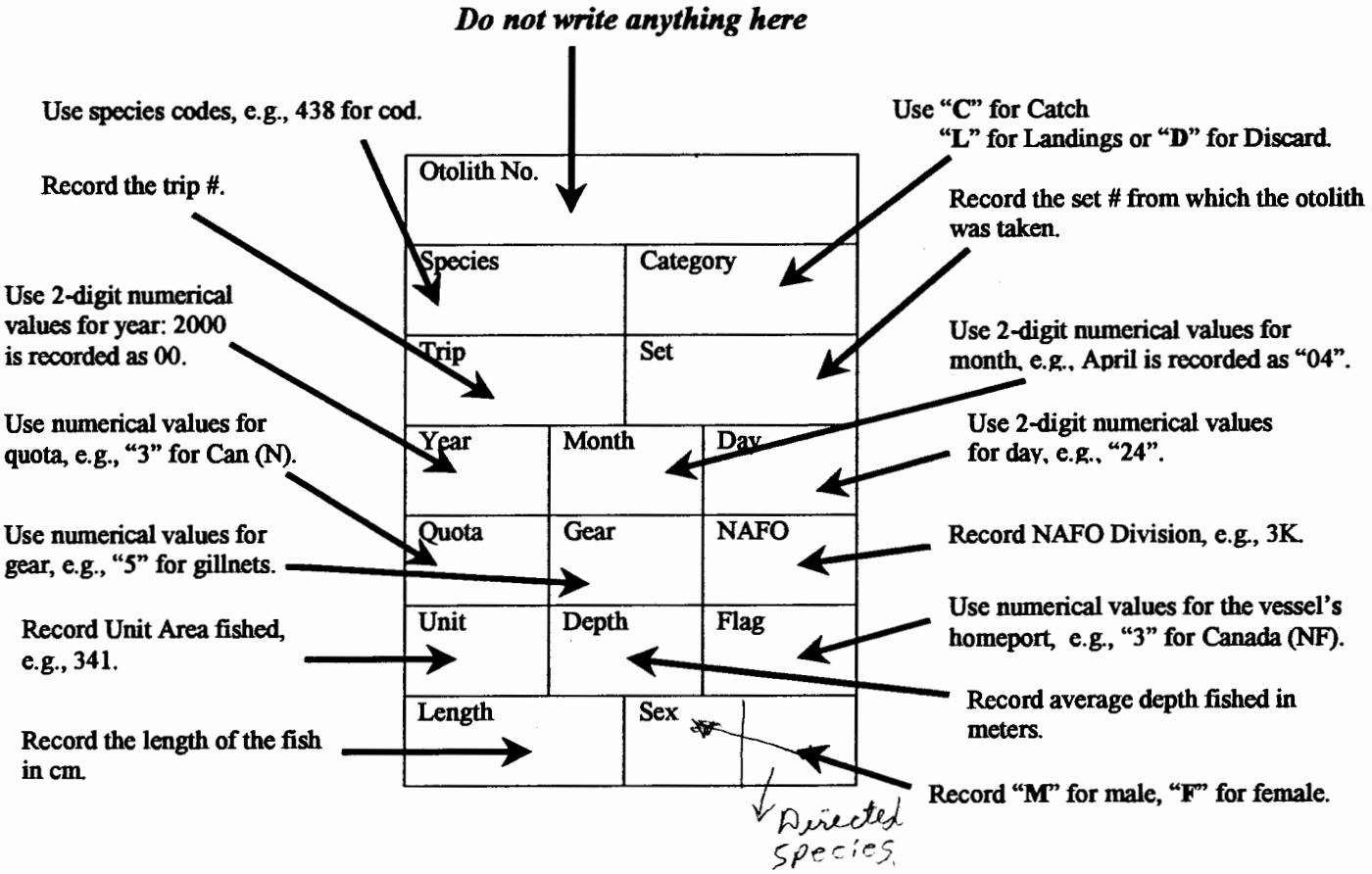
Regular/ Leave blank.
Dockside/ Leave blank.
Port Leave blank.

The "tally" section of a Sexed Length Frequency sheet has a repeated pattern of 0 - 9 (Fig. 18). The space to the left of these numbers is used for recording an additional digit. This format provides a "floating" start length, which is necessary for the wide range of sizes encountered when measuring fish in 1-cm intervals. Estimate length of the smallest fish in the groundfish sample, and record this number using the 0 - 9 values. Then consecutively number 1-cm intervals until a wide enough range has been listed to include all lengths of fish in the sample. *Be sure to write in each first digit of every number for the whole size range used.* Also, leave blank intervals at the beginning and end of this frequency range, so that any lengths outside of these listed values can be recorded.

After completing the "tally" section, add the number of fish measured per column, and record **Total # Fish** below it. This will aid error-checking of tallies.

Note that for **Atlantic halibut**, record the **AL** (Anal Length) measurement *on the same line to the right* of each **FL** (Fork Length) measurement.

Otolith Envelope



Do not record anything in the field **Otolith No.**. This field is completed at DFO.

Otoliths have to be sorted *by trip.*
Otoliths have to be sorted *by species.*
Otoliths have to be sorted *by set.*
Otoliths have to be sorted *by sex.*
Otoliths have to be sorted *by size* (smallest to largest starting with males, then smallest to largest females).

Do not let the envelope flap get sealed; do not tape nor staple it down; just tuck it inside.

Category C - catch sample is the first sample before anyone touches it.
L - after sorted - landed sample
D - discards

Grenadiers

Follow the Groundfish Length Frequency Sheet instructions above to fill out the header portion of a Grenadier Length Frequency Sheet.

Len. Grp.: Sampled anal fin lengths are grouped into 0.5-cm intervals (see Summary of Length Measurements and Sexing Requirements per Species, Table 4): e.g., code 5 for grenadier. Tally the sampled fish in groups of five for ease of enumeration later.

Capelin (*Mallotus villosus*)

Capelin from the Div. 2+3K Labrador Shelf stock and the 3LNØ Grand Bank stock are not normally measured at sea by observers. Instead, two random samples of 225 whole capelin per week, per unit area, per gear type, are to be collected on different days. Freeze each sample as soon as possible, in two plastic bags with an identification tag in between both bags, then tie off with another tag. Print the following in pencil on both tags: Year, Trip #, Set #, Date, Latitude and Longitude, Vessel Name, and Gear Type. Make a list of all capelin samples collected, recording Vessel Name, Trip #, and Set #. When specified during the Briefing session, at-sea sampling of gonad volume for the 3LNØ Grand Banks stock will be required to determine roe content.

Capelin tags: Capelin tagging experiments are ongoing in the 3LNØ area. Place each recovered capelin tag in a brown envelope, and record all pertinent information; including Latitude and Longitude, Date, Length, and Sex of the fish.

Large pelagics: Swordfish, tunas, sharks

The principal commercial species in the Canadian northwest Atlantic are: swordfish (*Xiphias gladius*), albacore (*Thunnus alalunga*), bigeye tuna (*Thunnus obesus*), bluefin tuna (*Thunnus thynnus*), yellowfin tuna (*Thunnus albacares*), and sharks (porbeagle, *Lamna nasus*). These species undergo annual migrations from the south, and are caught during the summer in the Canadian Atlantic (primarily on the Scotian Shelf and Grand Banks). Commercial vessels directing for large pelagic species usually use longlines with baited hooks.

Relatively few large pelagic fish are caught per set. Therefore, obtain measurements for all fish whenever possible. Complete a Set & Catch Record sheet (Fig. 7) for each set, following instructions in the chapter, Observing and Sampling - Special Cases, Longliners. Fill out a separate Large Pelagics Length Frequency Sheet (Fig. 23) for each species sampled, using the procedures described below.

Bycatch

Large pelagics also occur as bycatch in some groundfish fisheries. The most common bycatch species are Greenland shark (*Somniosus microcephalus*) from the Grand Banks northward, the deepwater black dogfish (*Centroscyllium fabricii*) from Georges Bank northward, and the migratory spiny dogfish (*Squalus acanthias*) off Newfoundland during summer. Ensure that every large pelagic species is listed in the Catch Record section of a Set & Catch sheet.

Obtain measurements for each large pelagic specimen whenever possible, and record them on a Large Pelagics Length Frequency Sheet (Fig. 23). Otherwise, estimate the variables required, and clearly label these data as estimates. If Length Frequency sheets are not available, record all data in the Comments section of a Set & Catch sheet. Transfer these data accurately onto a Large Pelagics Length Frequency Sheet after completing the trip. Do not fill in a Large Pelagics Length Frequency Sheet for dogfish sharks.

Large Pelagics Length Frequency Sheet

Follow instructions for coding the header of a Groundfish Length Frequency Sheet (Fig. 18) to fill out the header portion of a Large Pelagics Length Frequency Sheet (Fig 23). Record only one species on each length frequency sheet.

Mesh Size: Record Codend Mesh of trawl gear from the Set & Catch sheet. Otherwise, record Body Mesh of gillnets. Record only if a large pelagic species is caught by gear with netting.

Fish Number: Starting with the first fish of each sampled species, number the measured specimens consecutively throughout the trip.

Species Code: Code the species being sampled: e.g., code 565 for bluefin tuna. Refer to the vertebrate species coding manual of Akenhead and LeGrow (1981).

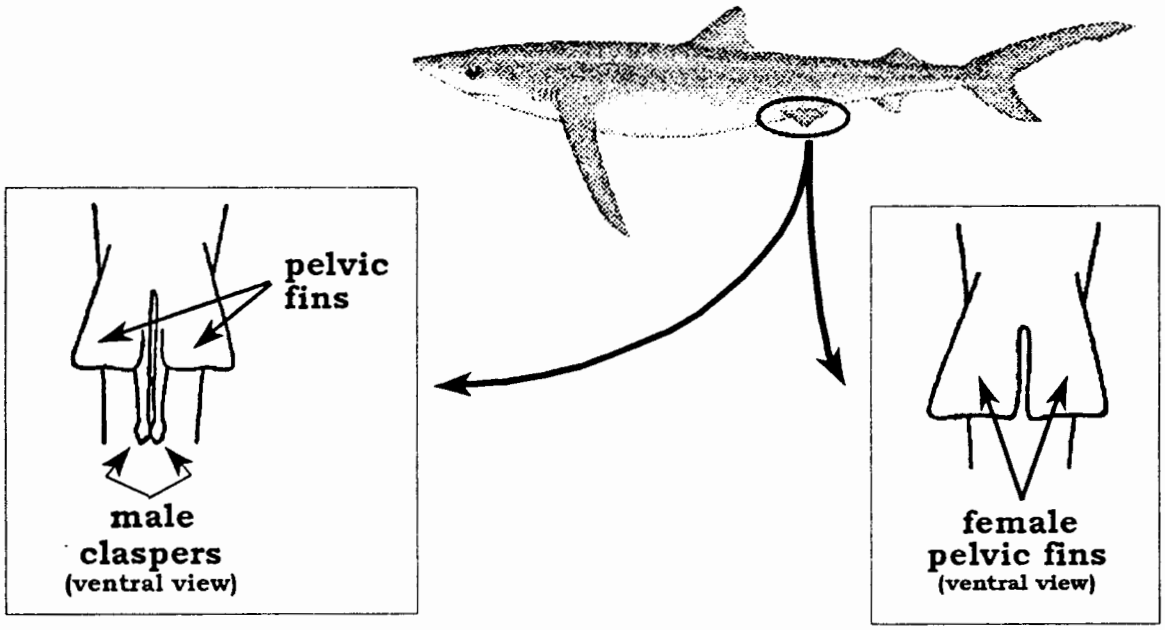
Sex: Code _M_ for male, _F_ for female, or leave blank if sex is unknown. Determing the sex of tuna and swordfish requires examination of their gonads, due to a lack of reliable external sexual characteristics. The following guidelines apply to all large pelagic species (Clay and Hurlbut, 1991):

> *"The gonads of bluefin tuna are normally paired structures that originate at the vent and extend anteriorly. Each gonad is held in place by mesentery (thin connective tissue) and generally has fatty deposits associated with it. A spent or unripe giant bluefin (the most common in Canadian Atlantic waters) has a gonad about 60 cm long and 6 cm in diameter. The fatty tissue associated with the gonad can be 1 to 3 times the size of the gonad.*
>
> *The gonads are generally removed during the butchering process, with the rest of the viscera. This can make finding the gonads a difficult process. Once located, the gonad should be*

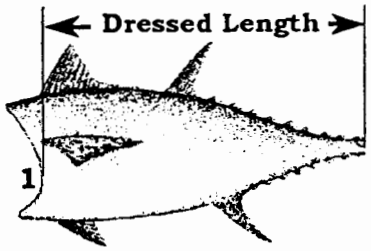
examined in cross section using a sharp knife. It is important that the gonad and not the fatty tissue be examined.

The ovary appears round in cross section and has a single, large irregular central lumen (cavity). The inner surface of this cavity is convoluted and the tissue often appears slightly granular. The testis appears flattened or triangular in cross section, it has no central lumen, although small ducts may be present. The tissue is relatively smooth and homogeneous in texture."

In addition, mature sharks (and skates) have a reliable external sexual characteristic: A male has "claspers" which extend posteriorly (i.e., inner portions of its paired pelvic fins modified into rigid finger-like projections used in copulation; see below); whereas the female has unmodified pelvic fins.



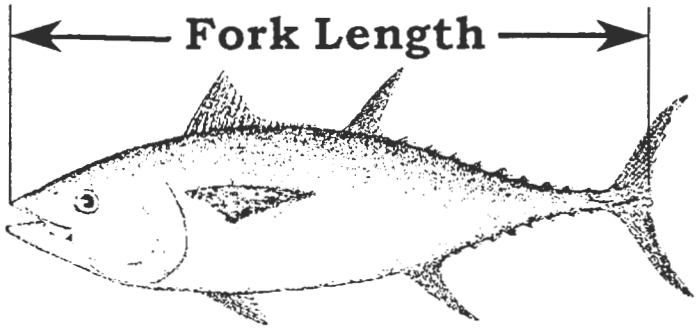
Dressed Length: Measure in a straight line (to the nearest centimeter) from the midline posterior edge of the "cleithral arch" to the stump of the "caudal peduncle". Take this measurement only if the fish is gutted, with head and tail removed: e.g., record 152 for a gutted, headless and tailless 202-cm bluefin tuna.



Cleithral arch (**1**) = vertical bone in pectoral girdle which supports the posterior edge of the gill opening.

Caudal peduncle = location of minimum body depth just anterior to the tail fin.

Fork Length: Measure in a straight line (to the nearest centimeter) from the tip of the upper jaw to tip of the shortest ray of the tail fin (i.e., to fork of tail): e.g., record 187 for a 187-cm whole bluefin tuna.



For Greenland and Basking sharks, measure Total Length to the nearest centimeter (i.e., a straight line measurement from the most anterior point of the head to the most posterior point of the tail). Record this data in the Fork Length column of the length frequency sheet, and write Total Length above the Fork Length header.

Round Weight: Weigh (to the nearest kilogram) the whole fish, before processing: e.g., record 118 for a 118-kg bluefin tuna.

Dressed Weight: Weigh (to the nearest kilogram) a processed fish. Take this measurement only if the fish is gutted, with head and tail removed: e.g., record 99 for a gutted, headless and tailless 160-kg bluefin tuna.

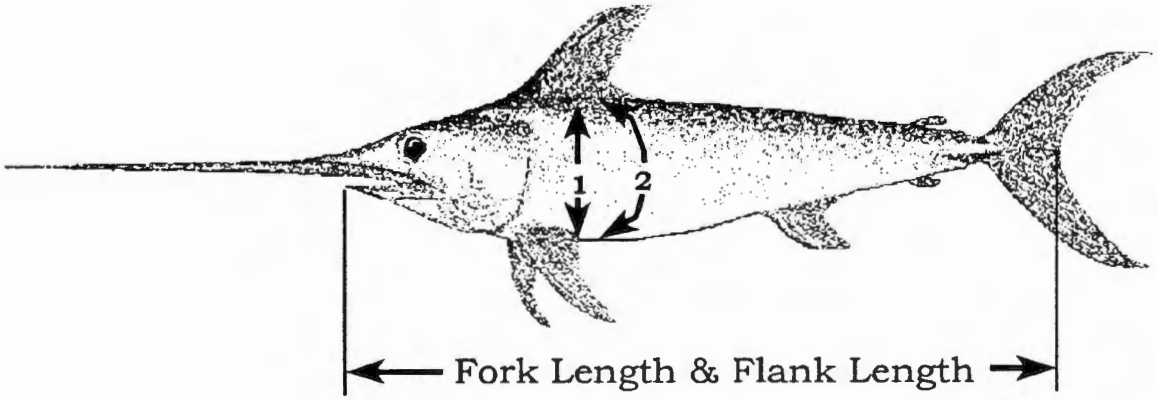
Swordfish

In addition to the above measurements, record the following data to the nearest centimeter for swordfish on the back of its Large Pelagics Length Frequency Sheet. Ensure that swordfish Fork Length is measured from the tip of the bottom jaw in a straight line to tip of the shortest ray of the tail fin (i.e., to fork of tail).

Flank Length: Following the body curve or contour of a swordfish (i.e., along the midline of its side), measure from the tip of the bottom jaw to tip of the shortest ray of the tail fin.

Maximum Depth: Measure in a straight line the depth of the body at its widest point (i.e., maximum diameter and not circumference; No. **1**). This measurement must be perpendicular to the fork length.

1/2 Maximum Girth: Following the contour of a swordfish at the widest portion of its body (No. **2**), measure from the base of the dorsal fin to the midventral point (i.e., halfway around the fish; under the pectoral fin). This measurement must be perpendicular to the fork length.



Invertebrates

To aid in the identification of shrimp and crab species with *Decapod Crustacea of the Atlantic Coast of Canada* (H.J. Squires 1990), an extensive **GLOSSARY** of important anatomical definitions is enclosed on pg. 110- 111 .

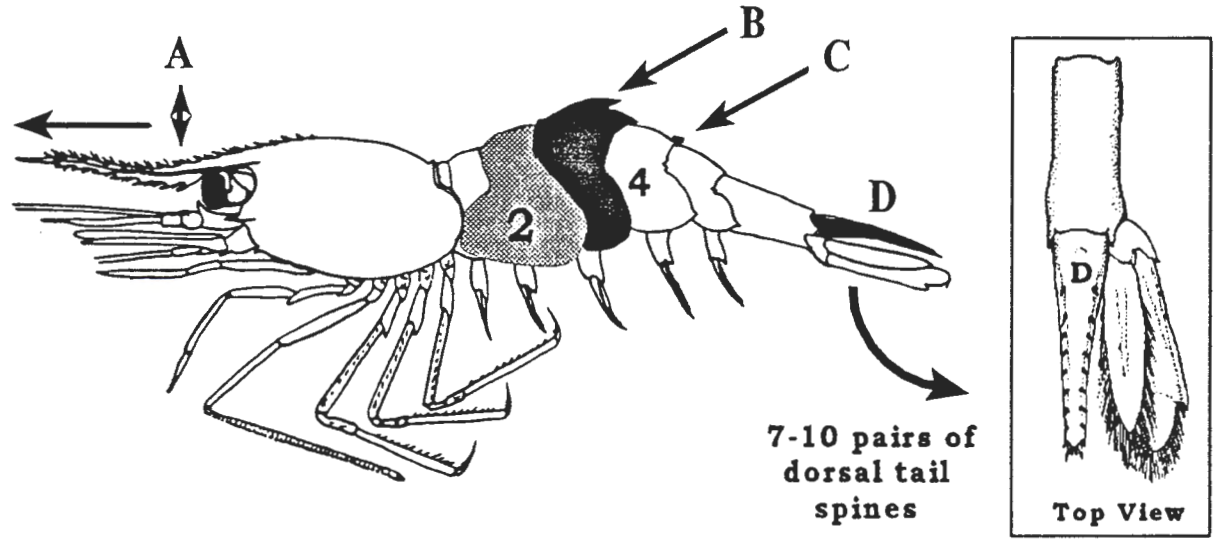
In addition, a pictorial description of the two main northwest Atlantic shrimp species is given in the following section, and a pictorial Identification Key of crab species frequently found in northwest Atlantic waters is provided on pg. 184- 186. Also, an Identification Key to Newfoundland sea cucumbers is given on pg. 187.

Shrimp Length Frequency Sheet

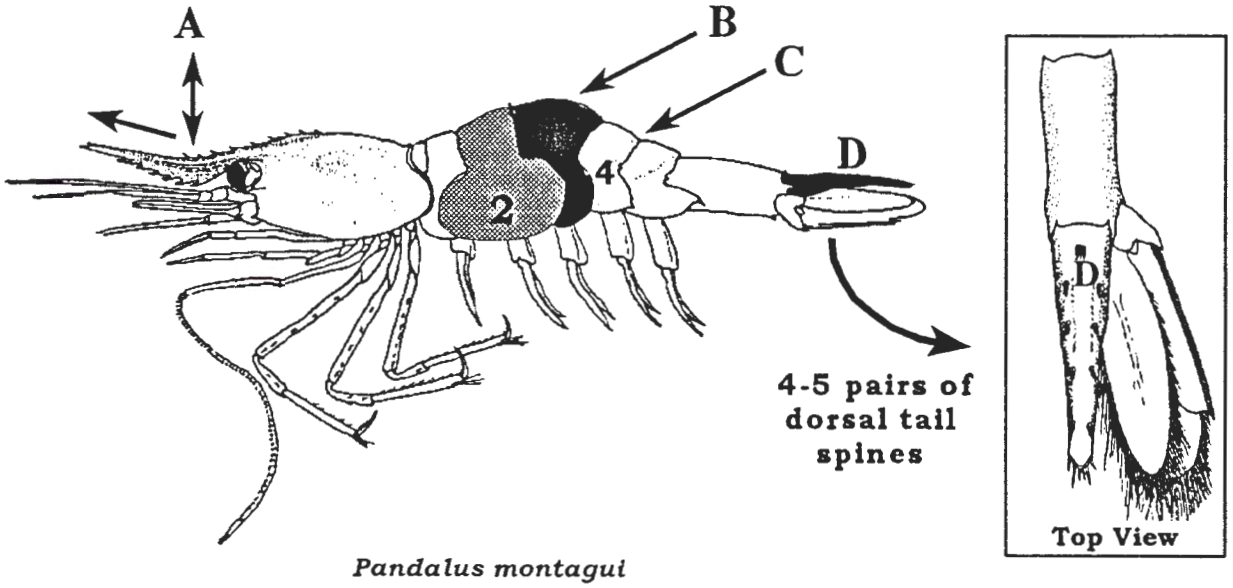
This section describes how to complete the Shrimp Length Frequency sheet (Fig. 24).

Species: (maturity) Record a maturity code for *Pandalus borealis* or *P. montagui* (use table ***Pandalus Shrimp Maturity Codes***). Refer to the following section Identification of Shrimp Maturity Stages to determine an appropriate maturity code. Several key characteristics that differ between *P. borealis* and *P. montagui* are illustrated below:

(A) Rostrum length, depth of its "blade", and angle of rostral upturn;
(B) Presence or absence of "hook" on curve of 3rd abdominal segment;
(C) Presence or absence of "spine" on edge of 4th abdominal segment;
(D) Numerous or few "spine pairs" along length of "telson" on tail.
(2) All *Pandalus* species have a "saddle-shaped" 2nd abdominal segment.



Pandalus borealis



Pandalus montagui

Trip: Record the trip number.

Set: Record the set number from which the sample was taken.

Year: 1993 = 93

Samp. Wt.: Record total weight of the shrimp sample (i.e., approx. 300 shrimp) to the nearest 1/10 of a kilogram (e.g., record 2.7 for a sample weight of 2.65 kg). Write this value on all Shrimp Length Frequency sheets in that set. Use a separate sheet for each shrimp maturity code (refer to the section Identification of Shrimp Maturity Stages).

Prior to weighing the sample, pour off excess water and subtract bucket weight. Do not include weights of Soft Shell Tally (SST) shrimp: i.e., shrimp with shells too soft to be measured for length.

Sample Type: Record the type of sample taken for length frequencies:

Commercial catch: Code 2 for a random sample of the total catch (i.e., what comes up in the net before sorting) from a vessel in a commercial fishery.

Discard: Code 4 for a random sample of the discards (i.e., shrimp that are sorted from a commercial catch and then discarded overboard).

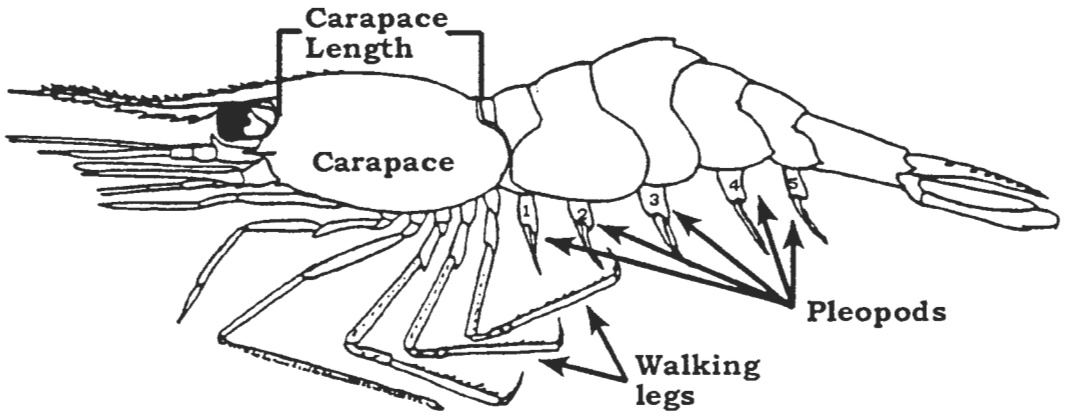
HR/FR: Record headrope length and footrope length of the shrimp trawl to the nearest meter: e.g., code 75/84 for a net with a 75-m headrope and 84-m footrope.

SST: Tally all sampled shrimp with shells too soft to be measured. Do not include broken or damaged shrimp in this count. Do not include Soft Shell Tally (SST) shrimp in the shrimp length groupings, nor in Sample Weight.

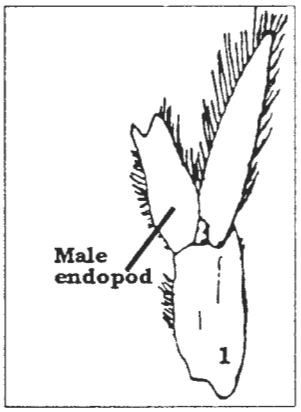
Identification of Shrimp Maturity Stages

Pandalus borealis is a protandric hermaphrodite: it lives the first 3 or 4 years as a male, then goes through a transitional stage and finishes its life as a female. The presence of external eggs (found on ovigerous shrimp) indicates a female stage. For non-ovigerous shrimp, use the following definitions/diagrams and the enclosed table ***Pandalus Shrimp Maturity Codes*** to determine an appropriate maturity code for the variable Species.

Whole shrimp: The first pair of swimmerets (i.e., pleopods) is on the abdomen, located behind the last pair of walking legs. The pleopod portion farthest from the body has two parts. The shorter is the endopod.

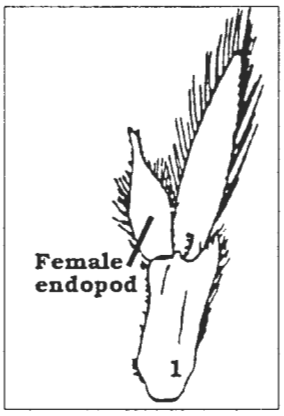


Use only the 1st pleopod for endopod identification.



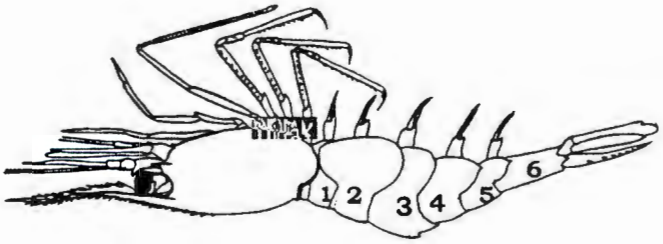
Male: The endopod is deeply notched. Males will also generally be smaller, because *Pandalus* is protandric.

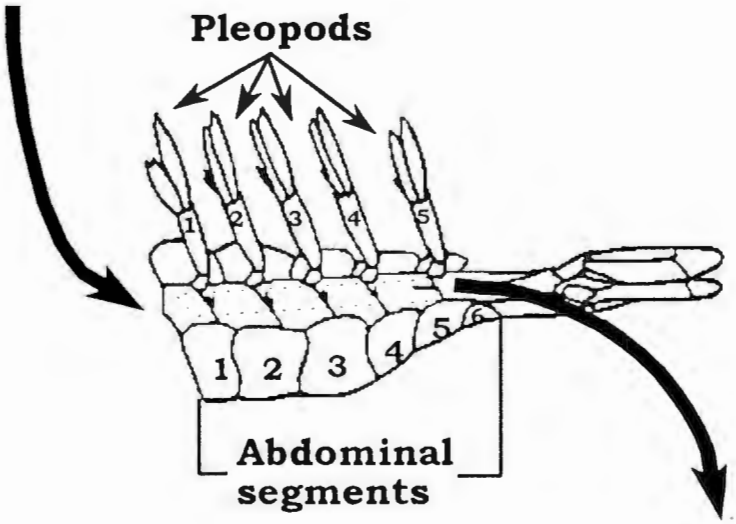
Female: The endopod is pointed. Some females do not produce eggs every year. Others are either carrying eggs for the first time or have laid eggs at least once before.



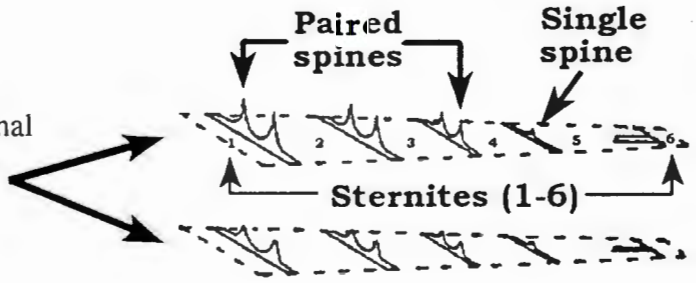
Female spawning stages:

Sternal ridges connect pleopods in the same pair (i.e., on an abdominal segment; see next page). The presence of sternal spines on each ridge indicates the spawning stage as follows:

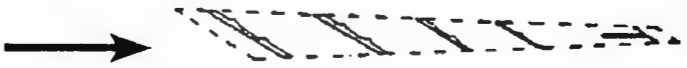




FE-1: A first-time spawner. Sternal spines are either prominent or reduced.



FE-2: Has spawned at least once before. Sternal spines are remnant or not visible.



Head Roe (HR): When head roe are present, the developing ovary under the carapace appears green.

Pandalus Shrimp Maturity Codes		
Description:	***P. borealis* Codes:**	***P. montagui* Codes:**
Male	**9801**	**9812**
FE-1 with head roe, with spines	**9806**	**9815**
FE-1 no head roe, with spines	**9807**	**9816**
FE-2 with head roe, no spines	**9809**	**9817**
FE-2 no head roe, no spines	**9810**	**9818**
Ovigerous (external eggs)	**9811**	**9819**

Crabs

The crab fishery is concentrated along the northeast and southeast coasts of Newfoundland and Labrador, with a small inshore fishery (inaugurated in 1995) operating in nearshore areas of the island. Snow crab (*Chionoecetes opilio*) is presently the only species of commercial value, with landings of 37,816t in 1996 (i.e., an increase of 18.2% over 1995). The fishery is prosecuted by several fleet sectors: full-time, large (>40 gross tons) and small supplementary vessels (<40 gross tons); and vessels under 35 feet. Vessels are licensed by NAFO Division boundaries, and are restricted to fishing Snow crab management areas within their Division (see the Annual Snow Crab Management Plan of DFO's Resource Management Branch for quotas per fleet sector by management area, trap limits, seasons, etc.).

An important condition that must be determined in snow crabs is Bitter Crab Disease ("BCD visual"): a fatal disease caused by a microscopic parasite that readily infects healthy crabs. It is highly contagious to crabs; *never* allow blood or body fluids from BCD crabs to contaminate surrounding waters (note that it is completely harmless to humans). To visually detect a crab with BCD, it must be extremely sick (i.e., otherwise an infected crab appears symptom-free). The crab's carapace shell would have an orange-pink colour (especially along its edges), a chalky white underside, and often pinkish leg joints with red streaks. The crab looks like it has been cooked, is in a weakened state and may appear lifeless. The highest reported disease levels are in NAFO Division 3K, but diseased crabs have been found in Div. 3L and 2J. It is presently unknown how seriously BCD is affecting Newfoundland and Labrador snow crab stocks.

Crab Research Sampling Sheet

Refering to Figure 35, follow the detailed crab sampling instructions in Appendix 2: Table 10, and complete the Crab Research Sampling sheet using the codes specified.

With sampling or species identification enquiries, contact Fisheries and Oceans personnel in the Crab Research Section (@ 772-2886 or 772-2077; FAX: 772-4105).

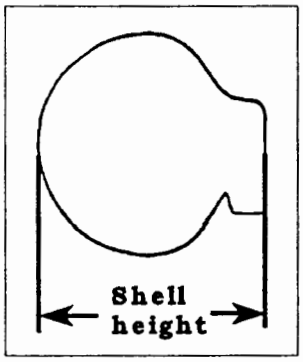
Squid (*Illex illecebrosus*)

The only commercial species of squid in Canadian waters north of 43° latitude is *I. illecebrosus*, the northern short-finned squid. Refer to the Species Identification handout to differentiate squid species.

Collect *I. illecebrosus* samples, up to a maximum of 40 kg per set or 80 kg per week. Ensure that samples are random if these maxima are being reached. Freeze each sample per set in a plastic bag tied off by a tag labelled with: year, trip number, set number, set date, latitude, longitude, and vessel name.

Scallops

Frequency Distributions



Collect a random sample of Iceland scallops (*Chlamys islandica*) in a basket, weigh (in kg), and subtract weight of the basket. Measure and record shell height (in mm) of all live scallops in this basket on a Scallop Shell Height Frequency sheet (Fig. 26). Count all live broken, unmeasurable scallops and record on the frequency sheet. Weigh all broken scallops, cluckers (i.e., a dead, empty scallop with both halves of its shell still attached at the hinge), shells, and debris in the basket, and subtract this weight from the basket weight to obtain sample weight. Ensure that sample weight is only the weight of measured scallops. Record set location information for each sample on its frequency. Do frequencies for catch, landed (retained), and discarded scallops. Do at least one frequency each day. If fishing area changes, take samples more frequently to ensure that every fishing area has been sampled. When possible, do shell height frequencies of catch, landed, and discards for Sea/giant scallops (*Placopecten magellanicus*).

Meat Yield Samples

Collect a random sample of 150 live Iceland scallops, let them drain for 30 minutes and weigh (in kg). Measure the shell heights (in mm) of all scallops. Clearly label a Scallop Shell Height Frequency sheet (Fig. 26) as "Meat Yield Sample # __" and keep separate from other frequency sheets. Shuck all scallops, cleaning out all meat from both shells. Put these meats in two or three plastic bags. Label each bag with a tag showing "Meat Yield Sample # __". Record all data regarding this and other samples on the record sheet. Freeze all samples and return to the Fisheries and Oceans laboratory. If fishing the same area, do one meat yield sample each week. Ensure that a meat yield sample is done for every area fished.

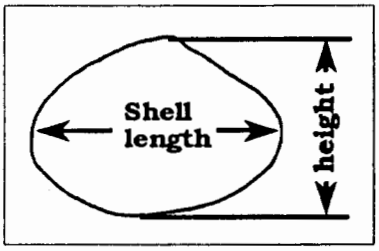
Gonad Samples

Collect a sample of Iceland scallops immediately after the catch comes onboard. Cut open and identify 10-12 scallops of each sex. Male gonads are white and creamy in colour and females are red to orange. Remove the gonads with scissors and place them in bottles of Bouin's preservative. Use a fresh batch of Bouin's for each sample. Store males and females in separate bottles. Large gonads should be slit to allow better penetration of preservative. Label each bottle with Trip Number, Set Number, Date, Latitude/Longitude, and Sex. Allow the samples to sit for 24 hours in Bouin's, then pour off the Bouin's, wash the samples in alcohol for several minutes, and discard the alcohol. Finally, cover the gonads in fresh 70% alcohol and store. Collect gonad samples once each week. Record information for every sample on the Scallop Gonad Samples sheet (Fig. 28).

Clams

Frequency Distributions

Collect a random sample of 250-300 live Stimpson's surf clams (*Mactromeris polynyma*) per day, and measure shell length and height (in mm) with a measuring board. Weigh only the measured sample (in kg), and fill in all variables on a Clams Frequency Sheet (Fig. 29). Do frequencies for catch, landed (retained), and discarded clams.



If the vessel is retaining and processing Greenland cockles (*Serripes groenlandicus*), follow the clam frequency sampling procedure above. Sample cockles at a rate proportionate to their catch rate (e.g., if Greenland cockles comprise 10% of production, then 10% of samples taken should be cockles).

Frozen samples

Collect and freeze approximatley 300 live clams per week. Note that if the vessel is fishing Area-319, collect only 50 clams. If fishing area changes regularly, take samples more frequently to ensure that every fishing area has been sampled. Put samples in cabbage bags, with labels inside and outside of the bag showing Trip Number, Set Number, Date, Latitude and Longitude. Record Date, Set Number, Species, Statistical Area, and Latitude/Longitude for each sample on the List of Clam Samples sheet (Fig. 30). Also, note the number of boxes or bags for each sample.

Yield Factor

A "yield" factor represents the proportion of whole clams that is comprised of meats. Randomly collect 200 live clams prior to processing. Weigh this sample and subtract weight of the container (in kg). Although the ideal yield study would allow meats from the same 200 clams (sampled initially) to be weighed, this pro edure is not practical in a factory situation. Therefore, take a random sample

of 200 clam meats and weigh them prior to glazing at the end of processing. Divide meat weight by round weight to calculate the "yield" factor. Do one yield sample for each product produced (e.g., meats, mantles) every week.

A yield study also generates an additional factor for converting clam meat weights to round weights. This factor is used to calculate round weight from product weight for catch estimates. To obtain this factor from the yield sample, divide round weight by meat weight.

Conversion Factor Experiment

A Conversion Factor represents the relationship between whole clams and how much product is produced from them, while accounting for processing procedures (e.g., meats damaged or lost by production machinery, quality control). Conversion Factor experiments for clams are difficult to conduct by one observer, due to several characteristics of clam vessels: Clams are processed on a continuous basis; production is a very complex system; and individual products produced are very small (i.e., clam meats). However, if circumstances permit, do one Conversion Factor experiment per week on each product produced, following guidelines in the chapter, Techniques of Observing Sets, section Conversion Factors. If a valid Conversion Factor can be obtained, use it to calculate round weight from product weight when estimating catch weight. Otherwise, use the factor generated from clam meat "yield" studies.

Live/Clucker Ratios

An estimate of the number of cluckers (i.e., a dead, empty clam with both halves of its shell still attached at the hinge) is required for determination of mortality rates. Weigh a random sample of clams (one basket, in kg) as they come on board. Count the number of live clams, cluckers, and single shells in this basket and record the data on a Clam Live/Clucker Ratios sheet (Fig. 31). Do one sample per day.

Clam Grading

Get a quantitative estimate of the proportions of Grades "A", "B", yellow meats, orange meats, and mantles produced. Record this data each day using a Clam Grade Percentages sheet (Fig. 32).

Marine Mammal Observation and Sampling

Commercial fishing vessels provide an opportunity for observing marine mammal activity. Marine mammal observations include sightings when the animals are not brought on board the vessel, and those when animals are caught in fishing gear and brought on board. As a fisheries observer, attention is usually focused on what is happening on the boat. However, there is considerable potential for data collection (observations) from the sea around the vessel. Data on seals and cetaceans (i.e., whales; including dolphins, porpoises) are scarce in the offshore fishery. All observations recorded by an observer are valuable to marine mammal research.

Sightings

turtles, especially Harbour Porpois

Describe all sightings of seals, dolphins, whales, and other marine mammals on a "Marine Mammal and Turtle Sighting Record" (Fig. 36). Identify observed mammals using the *Whale and Seal Identification Key* (by Dr. Jon Lien, p.188), and include all possible information on the sighting (i.e., number of animals, their activities, etc.). Note that data on "ANIMAL CONDITION" is critically important to scientists estimating species mortality in a given fishery.

Collection *ALso see Harbour Porpoise Bycatch memo for details.

Canadian regulations state that live mammals brought on board a vessel must be returned quickly and humanely to the sea. Only dead seals, porpoises, etc. are to be collected. The Department of Fisheries and Oceans has made arrangements with many fishing companies for the collection of whole seals. When boarding a vessel, ask the captain whether this arrangement has been made for his vessel. If so, permit the crew to collect the seal specimen. Otherwise, collect the specimen yourself. Ensure that the following instructions are complied with for each whole seal, regardless of who collected the animal.

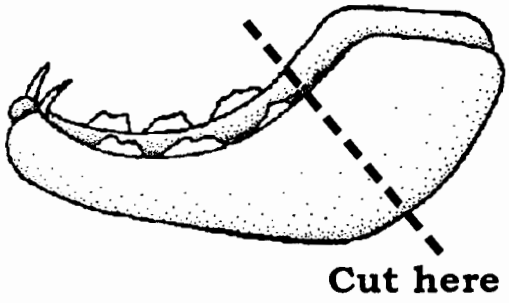
When an animal comes on board, bring it to Fisheries and Oceans whenever possible. Attach a tag by piercing the hind flipper and tieing tag wire tightly through it. Label the tag with Trip #, Set #, Date, and Specimen #. Also record this information on a Seal Record sheet (Fig. 37). Do not take measurements on whole specimens that will be brought to DFO.

If an animal cannot be kept due to limited freezer space or warm air temperatures preventing storage on deck, complete a Seal Record sheet. Record Trip #, Set #, Date, Specimen #, Species, Sex, Length (total, straight line to the nearest 0.5 cm), Girth (maximum girth to the nearest 0.5 cm), and Weight (nearest kg). When Length, Girth, and Weight cannot be measured because of the mammal's size or poor working conditions on the vessel, size estimates should be done. Clearly record the numbers as estimates rather than measurements. Also record the number of individuals for each species caught and every Specimen Tag # (of kept specimens) in the Comments section of the Set & Catch Record sheet (Fig. 7).

After completing a Seal Record form, obtain the lower jaw and stomach from any seals that cannot be kept whole. Use the following procedures only if weather and boat conditions allow safe collecting.

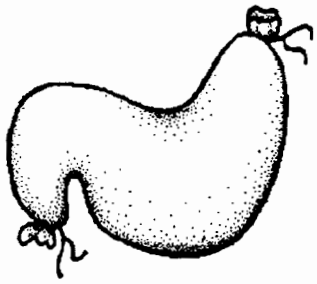
Jaws

Jaws provide much information on seal biology. For example, a tooth pulled from the lower jaw has growth rings for age determination. Cut out the lower jaw well back behind the front canine tooth (see diagram). After removal, clean off excess soft tissue, put the jaw in a specimen bag labelled with Trip #, Set #, Date, Seal #, and Observer's Name. Freeze immediately. Collect the jaw even if the stomach cannot be obtained.



Stomachs

Stomach contents are important indicators of feeding behaviour and seal parasite infestations. Collect the stomach (i.e., irrespective of fullness) only if a lower jaw is taken from the same seal. First, tightly tie off the tubes leading to and from the stomach with string or wire to prevent leakage, then cut it out (see diagram). Put the stomach in the same bag as the jaw bone and freeze immediately. Ensure that the bag label has all the required information.



When in port at the end of a trip, immediately contact Fisheries and Oceans personnel in the Marine Mammals Section (@ 772-5430 daytime; 772-2033 Security Guard after hours) to arrange pickup of all specimens.

Debriefing

Debriefing is the last stage of an observer's deployment, occurring soon after the trip. The Debriefing session is usually half a day at the observer contracting company. The primary goals of debriefing are to ensure a high quality trip package, and provide timely feedback to the observer.

Debriefing begins with an observer checking codes and information on all data forms, reviewing catch and effort sheets, and finalizing trip reports before meeting with a Debriefer. The observer and Debriefer then discuss the trip, using relevant Briefing Instructions as a guide. Methods used for data collection are reviewed to verify their appropriateness, and to ensure the observer's understanding of tasks required for that trip. Furthermore, the observer can offer detailed suggestions or comments to improve methods for data collection, based on his or her experiences at sea.

Various administrative details are covered during debriefing. These include submitting trip expenses, providing the trip activities report, returning sampling equipment, and restocking the observer field kit.

Problems with fulfilling trip requirements are also discussed, as well as those related to enforcement, sampling, crew cooperation, observer accomodations, etc. Observer input on such issues can be incorporated into subsequent Briefings for similar trips, and may prove important to the success of future deployments.

Discussion

The Observer Program contributes in many ways to the management of Canada's fisheries. It ensures compliance with fishery regulations, and provides scientific information as direct input into the development and management of Canada's fisheries. In a practical and cost-effective manner, it provides an unprecedented view at first hand of the commercial fisheries, while providing unbiased technical, regulatory, economic, and scientific information to both the federal Fisheries department and private industry. Previously unobtainable, this information makes a significant contribution to fisheries management.

The Department of Fisheries & Oceans' ability to manage the fisheries is enhanced by the information collected through the Observer Program. This information is used to address a wide range of management questions. Data are used as input to stock assessments; to define fishery dynamics and distributions; to quantify and monitor catch, effort, bycatch, and discard levels; to investigate interactions, and solve problems that occur among various fisheries' sectors, or between the oil and fishing industries; to examine a variety of biological or technical problems, such as production methods and product types, potential markets, gear modifications and their effect on catch and bycatch levels; and to provide input to life history and ecological studies of target species. The above functions are just some of the Observer Program deliverables that are an integral part of the management of Canada's fisheries.

Data Utilization

Without effective management, fishery resources might otherwise suffer reduction or extinction. In order for effective management to be realized, both the commercial fisheries and the fish populations themselves must be understood. This is accomplished in part by analyzing information collected from the fishery. An essential element of sound management is quality of the data used as input, and a primary source of reliable data is the Observer Program.

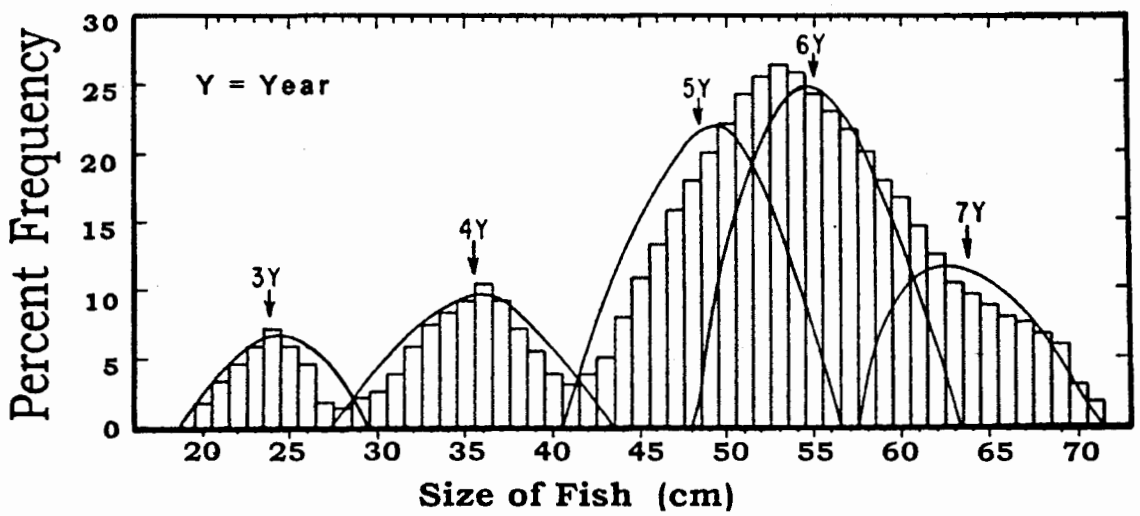
The collection of fisheries data is a primary function of the Observer Program. Interpretation and analysis of these data is a complex procedure. There are many stocks of fish distributed over a large area, with many interactions that can affect the fishery. This type of complex biological system requires a large sample size (i.e., a program involving high coverage levels) to obtain a reasonable degree of reliability in the data. Even when dealing with a small portion of the fishery (e.g., a single stock), the biological picture is still complex. For example, concentrations of fish within the stock may contain different species, size ranges, and sex ratios that move and change over time, reflecting a complex community structure. Hence, it would require extensive coverage, and the attainment of many samples over the entire spatial and temporal extent of the fishery, to obtain a true picture of the population; in particular, that portion of the stock removed by the fishery. Through direct observations of the fishing activities of many vessels, the Observer Program allows for adequate volumes of reliable scientific and technical data to be collected, and an adequate view of commercial fisheries.

The following examples illustrate some of the ways in which observer data are used. Catch, effort, fish size and age are essential input to stock assessments. Fisheries scientists must determine the weight and numbers of fish removed from the population by the fishery. Combined with data from other sources, catch weights, fish measurements, and aging structures (usually otoliths) collected by observers are used to estimate removals. By combining size and age information with weight of fish caught, scientists can determine the numbers in each year-class (i.e., fish born in the same year) that are removed by the fishery. From this can be derived estimates of fishing mortality, a key parameter in determining population size, and estimating how many fish can be removed in the year without diminishing the stock size. Estimating population size by using year-class and calendar year is known as Virtual Population Analysis. There are also other methods for estimating fish population size.

A simplified example illustrates the stock assessment procedure from a commercial fisheries' point of view. If, in the second quarter of a year, 10,000 metric tonnes of fish in a particular stock were caught, the scientist would combine and weight (by area) all length frequencies collected from that stock in that time period. This would yield a frequency that represents the proportion of fish sizes removed from the stock by the fishery in that quarter.

Fish are said to be recruited to the gear when they are large enough to be caught. A frequency of recruited fish might look like the size distribution illustrated below:

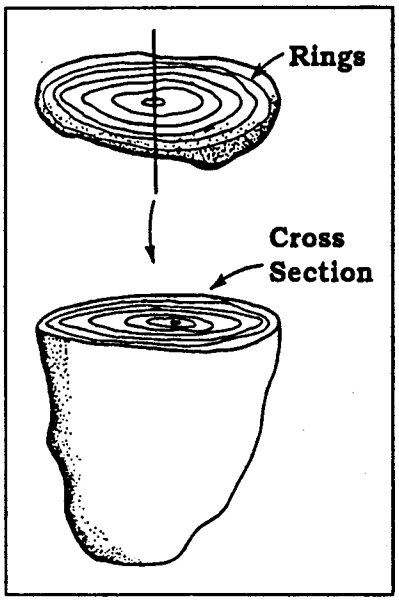
Note that the youngest year-classes are missing from this catch frequency, because one- and two-year-olds are able to escape the gear due to their small sizes. By calculating the



overall average weight of fish in this "combined" length frequency, the total number of fish caught for the whole fishery can be estimated (i.e., Catch weight ÷ Average weight of a fish). If the overall average weight per fish in that quarter is 2.50 kg, the total number of fish caught is calculated as 10,000 mt x 1000 kg/2.50 kg = 4,000,000 fish. The combined length frequency can then be adjusted proportionally to the total number of fish caught, to give an estimated length frequency (i.e., number of fish caught for each

length group) for the entire fishery for that quarter.

Age of fish can be determined from otoliths or other hard structures (e.g., scales), which are collected during sampling of fish lengths. Determining year-class is similar to aging a tree with growth rings (see right), and is done by examining otoliths under a microscope. An age-length key is then used to estimate age composition of the entire fishery. The following example illustrates the basic use of an age-length key. From the example above, 4,000,000 fish were calculated to have been taken in the fishery. If a subsample of 35 fish were aged for a particular size group in the length frequency, and it was found that 25 were five years old and 10 were six years of age, one could extrapolate that 25/35 x 4,000,000 = 2,857,143 fish in that size group were of age five, and 1,142,857 were of age six. This procedure could be done for each size group, and the number of fish removed by the fishery in each age class could then be determined.



If a time series (i.e., over many years) of numbers of fish removed at each age is available, and natural mortality (i.e., mortality due to factors other than fishing) is known, these numbers can then be put through a series of calculations called a Cohort Analysis, to determine total mortality and population size of the exploited stock. Other information (e.g., catch rates) that reflects abundance can be incorporated into this analysis to further refine the estimates. Decisions can then be made concerning amounts of fish to be removed in the following year, without seriously reducing the stock. This amount is referred to as the Total Allowable Catch, and is divided into quotas for the various eligible countries, and into allocations for Canadian fishing companies. A more in-depth discussion of biological and other aspects of fisheries management can be found in Everhart et al. (1975), Gulland (1977), Ricker (1975), Troadec (1983), and Rivard and Doubleday (1983).

The example above is just one aspect of fishery management, namely stock assessment, which utilizes observer data. The program also provides requisite scientific, regulatory, and technical input to other aspects of management. Information about the amount of effort spent on catching the fish is also very useful for assessing condition of a stock. If, for example, a catch of cod in NAFO Division 3L was 860 metric tonnes over 43 days and 645 observed hours, then catch per unit effort (i.e., a measure of fish density) would be 1.33 tonnes per hour. If catch rate was observed to decline steadily over several years to less than half, this might reflect a decrease in fish population size, if other indicators showed a similar decrease.

This analysis can be considerably strengthened if the measure of density is augmented by information on the spatial extent of the fishery and the stock. The Observer Program is

the only source of detailed, geographically-defined information on commercial fisheries. Observers collect catch and effort information on a set-by-set basis, including geographical position of each set, and this allows a definition of the extent of a fishery, density of fish, and other spatially-related information.

Seasonal fluctuations in fish abundance can also be defined when a fishery occurs over several months. For example, the 2J+3KL cod fishery executed along the shelf edge experiences very high catch rates in winter, and declines rapidly in the late spring and summer. This pattern reflects the inshore migration of cod from offshore breeding grounds. As recorded by observers, north to south movement of the fishing fleet during the winter fishery also suggests a southerly movement of cod before inshore movement for the summer period. Thus, observer catch and effort data can be useful as relative indices of fish abundance, and provide information on fish movements.

Foreign fleets fishing in Canada's 200-mile zone are effort-regulated: a given number of days for fishing are specified on each license; thereby providing Canada with a degree of control over the foreign fishery. To ensure compliance with Canadian regulations, foreign fisheries must be monitored. Observer data can be used to confirm catch and effort information reported by other countries. If discrepancies occur, Canadian Fisheries Officers can take appropriate action. Observers are introduced to fisheries regulations, and given some insight into interpretation of Acts, regulations, and policies. In the presence of knowledgeable observers, vessel captains are less likely to use illegal fishing gear, fish in the wrong NAFO Division, target the wrong commercial species, or otherwise breach Canadian laws. Regulations were designed to protect fish stocks by controlling foreign fisheries within the 200-mile limit. Observers play an important role in ensuring that these regulations are adhered to.

The following are a few examples of how observer data can benefit private industry. Observer information on commercially underutilized species, fishing strategies, fleet activities, fishing locations, species distributions, product types, and market destinations, are collected on foreign vessels and can be used by Canadian industry to develop new fisheries. For example, deepwater fisheries for turbot and grenadier have been expanded in recent years. Observer data can be analysed to determine where catch rates of target species are highest, and bycatch of unwanted species are lowest. The effects of gear modifications can be observed in the working environment. For example, the Observer Program has provided information on the effects of "windows" (i.e., holes cut into the body of an otter trawl net), square mesh on escapement, and specific trawl configurations necessary to fish grenadier at great depths. For the shrimp fishery, observer information on groundfish bycatches was used to define bycatch management areas on the Labrador Shelf. In addition, observer information was used to quantify the effectiveness of "excluding" equipment such as the Nordmore grate, which is designed to prevent groundfish species from entering the catch in a shrimp trawl.

The above are just a few examples of how the Observer Program can contribute to fisheries management, and why it is crucial that accurate data be recorded by observers.

Acknowledgements

The authors wish to thank the many individuals who contributed to this document, particularly observers and the observer management team who, with their extensive experience at sea, have provided very valuable input and feedback. We would also like to thank various individuals in the Science and Enforcement Branches of Fisheries and Oceans Canada (NWAFC, St. John's, NF), who provided information on methodology and reviewed the manuscript. This is a manual with input from many sources.

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GLOSSARY

Bias(ed): Not random, nor objective. Influenced by human choice or prejudice (e.g., subconsciously choosing large/colourful/unusual fish in a catch). A biased sample is not representative of the original catch or population from which it was taken.

Bobbins: Steel spheres attached to a bottom trawl footrope.

Briefing: Before a trip begins, the Briefing session prepares an Observer for specific tasks, problem situations that may arise, etc. Data sheets and necessary tools are also issued.

Bycatch species: All species in a catch, except the directed species.

Chafer: One or several panels of netting installed on the topside and/or underside of a bottom trawl's codend; protects a fish-laden codend bag from abrasion and tears during tows over rough/uneven bottoms. *Any reference to "chafer" in this Science Training Manual means only a topside type* (e.g., Set & Catch Record Sheet).

Chutes: A ramp or open-ended steel channel, usually enclosed, on which fish/invertebrates/discards/offal pass from one location to another on a vessel (e.g., processing room to the outside of a ship's hull).

Clucker: A dead, empty scallop or clam with both halves (valves) of its shell still attached at the hinge.

Conversion Factor (CF): A coefficient that when multiplied by processed weight equals round weight of the fish/invertebrates.

Conveyor: An automated belt that carries fish/invertebrates/packaged products from one location to another in a vessel's processing area.

Culling: Sorting a catch according to specific criteria (e.g., species, individual size or condition).

Cutters: Crew in a vessel's factory area who are processing (and possibly discarding) fish.

Debriefing: Soon after a trip ends, the Debriefing session ensures a high quality trip package, covers administrative details, and provides feedback to an Observer.

Directed species: The main species targetted by the fishing effort of a vessel.

Discard port: A location at which discard observations will be made by the Observer during processing operations.

Discarding "per man-minute": During processing, discards must be estimated for unobserved crew members by using discard estimates obtained for the observed crew. A rate of discarding *(=number of fish discarded per man-minute)* is first calculated for observed crew, then multiplied by the Total Discard Period *(in man-minutes)* for all unobserved crew at a discard port, to estimate the number of fish discarded at that unobserved location.

Discards: Only fish rejected whole are classified as discards; *not parts of fish disposed of during processing.*

Dumping: A nonselective process of returning whole or partial (unsorted) catches to the sea.

Duration: The time during which gear is effectively fishing. Duration depends on the type of fishing gear used in a set. For *bottom trawls*, Start Time is when the winches have stopped, and End Time is signalled when the winches start to take back the net. For *midwater trawls*, Start Time is when the net reaches the desired fishing depth (usually signalled by the winches stopping), and End Time is when the winches start up again.

Glazing: A film of water is added to a frozen product during processing.

Hacker: A rotating screw in a vessel's factory area that discards whole fish or their body parts through the ship's hull during processing.

Highgrading: The deliberate discarding of less profitable individuals that results from significant differences between the market value of large and smaller (but legal-sized) animals. It often occurs with shrimp, crabs, or lobsters, but highgrading can also occur in other fisheries. Note that relevant market values may not be driven by size criteria.

HR/FR: **H**ead **R**ope/**F**oot **R**ope of a shrimp trawl (their lengths must be measured in meters).

Industrial shrimp: Small shrimp (e.g., usually 150^{+}/kg) that comprise the lowest grade product in the shrimp fishery. Industrial shrimp are usually frozen raw and bagged in large sacks.

Invertebrate: An animal lacking an internal skeleton of cartilage or bone; no backbone present.

Length grouping: Or **stratum:** All individuals in a particular size group from which a subsample has/will be taken for length measurements, otolith removal, etc. A stratum contains individuals of non-overlapping groups, in which variation between individuals within each group is less that that between individuals in the general population.

Mantle: A thin sheet of tissue lining both halves of a bivalve shell (e.g., clam; scallop).

Meat: *Scallops*:the adductor muscle that is attached to both halves (valves) of a shell and closes it. *Clams:* the muscle (called a foot) used in locomotion.

Nordmore Grate: A rigid rectangular panel with vertical bars of a specific spacing (19 - 28mm), installed at an angle (45° - 48°) in a net's extension section. A twine funnel directs shrimp to the base of the grate. Fish larger than the grate's bar spacing exit through an escape hole in the top of the net's extension. The Nordmore grate (originally developed in Norway) or other type of *size sorting panel* is used in a shrimp trawl to drastically reduce unwanted bycatch of finfish and the catch of small shrimp.

Overpack: The commercial practice of adding more product to a package than is indicated on its label (e.g., in the shrimp, scallop, or clam fishery).

Random sampling: To sample randomly means that every fish/invertebrate in the population (e.g., a catch; a species held for Length Frequency data; a discard species) has an equal chance of being taken for the sample, which is therefore representative of the original group.

Rock Hopper: A type of bottom trawl footgear containing rubber discs (instead of steel spheres or "bobbins").

Rollers: Solid rubber discs attached to a bottom trawl footrope.

Set: The deployment and retrieval of gear resulting in a catch of directed and bycatch species. ***An observed set:*** the observer directly weighs or estimates weight and composition of a catch for both kept and discarded fish. ***A logged set:*** as a result of not directly viewing the hauling and processing of a catch, the observer obtains directed and bycatch data for that set from a vessel's fishing log.

Shakers: Mechanical separators that sort shrimp by size. Baffles or plates under the shakers direct sized shrimp onto conveyor belts before processing occurs.

Shucking: Opening a scallop or clam shell and removing its meat by hand.

Species composition: Determine the percentage of each species by weight in a given volume of space (e.g., basket; fish holding bin).

Splitting strap: A rope installed at a 90° angle to the length of a codend, and encircles the net. Larger codends may have more than one splitting strap spaced along its length.

SST: Soft Shell Tally shrimp are those sampled for a length frequency, but are only counted because their shells are too soft to be measured. *They are not broken or damaged shrimp.*

Subsample: A portion of individuals randomly collected from a group (e.g., a catch; a population; a species) for measurement.

Trough: A long shallow open gutter generally attached to cutting tables where crew process (and possibly discard) whole fish.

Volumetrics: Weight estimation methods involving calculating the volume of fish/ invertebrates or individual species in a container (e.g., codend; holding bin; basket) and converting it to weight.

Window: A hole cut in the codend mesh of a trawl to limit catch size. The opening above a Nordmore grate/sorting panel in a shrimp trawl *is not a window.*

Units of Measurement:

Π = pi = 3.14
1 cm = centimeter = 0.393 inches
$cm^3 = \frac{V \text{ (volume)}}{10^6}$ to calculate Volume in m^3 (cubic meters)
1 knot = 1 nautical mile/hour
1 fathom = 6 feet or 1.8 meters
1 m = meter = 3.28 feet or 0.55 fathoms
1 nautical mile = 1.15 miles
1 km = kilometer = 0.62 miles
1 kg = kilogram = 2.2 pounds

External body structures (& positioning) to help identify fish and sharks:

Abdomen: Lower surface of the body, especially between the pectoral fins and the anus or vent.

Abdominal fins: Pelvic fins located on the abdomen, far away from the head (e.g., herring; trout).

Adhesive disc: Pelvic fins modified to form a ventral adhesive disc between pectoral fin bases; used to cling to rocks, lobster pots, and other solid objects (e.g., lumpfish; snailfish).

Adipose fin: Lacking fin rays, a fleshy fin on the back behind the dorsal fin (e.g., salmon; smelt; lanternfish).

Anal fin: A fin on the median ventral line behind the anus or vent.

Annulus: (plural **annuli**.) Mark (or marks) formed on a fish scale or otolith each year.

Anterior: Front or towards the front. Opposite of posterior.

Anterolateral: Front edge and at the side.

Antero-posterior axis: An imaginary straight line passing through a body from front-to-back.

Anus: **Vent:** The external opening of the alimentary/food canal.

Apical: At the tip.

Barbel: An elongated, hair-like projection; usually around the mouth, chin, or snout (e.g., cod; sturgeon; freshwater catfish).

Bifurcate: Divided into two branches.

Branchial: Of the gills.

Buccal: Of the mouth.

Caruncles: Naked fleshy outgrowths (e.g., deepsea angler; triplewart seadevil).

Caudal: Pertaining to the tail or caudal fin.

Caudal peduncle: Fleshy end of the body behind the anal fin and before the caudal or tail fin.

Chin: Anterior ventral portion of the lower jaw.

Claspers: Modified inner portions of male pelvic fins used for sperm transfer to female (sharks; skates; rays; chimaeras).

Cloaca: A chamber at the end of the gut into which ducts from the kidney and gonads empty, and has one external opening (e.g., sharks; skates; rays); instead of separate anal and genital openings.

Concave: Hollow and curving inwards, like the inside of a hollow cave.

Convex: Curving outwards like the outer surface of an eyeball.

Ctenoid scales: Scales of most spiny-rayed fish having posterior edges with needle-like projections (rough to the touch): e.g., redfish; bass.

Cycloid scales: Scales of soft-rayed fish having smooth posterior edges (smooth to the touch): e.g., salmon; trout.

Denticulate: Having fine tooth-like projections.

Dermal: Pertaining to the skin.

Distal: Towards the tip or away from the point of attachment. Opposite of proximal.

Dorsal: Located on the side of an animal which is normally directed upwards with respect to gravity. Opposite of ventral.

Dorsal fin: Fin on the back, usually central in position.

Dorsolateral: Upper surface and at the side.

Dorsoventrally flattened: The body of a fish/invertebrate compressed from top-to-bottom (e.g., monkfish; skates; house pillbugs/"carpenters").

Esca: Silvery fleshy appendage or bulb (the "lure") at the tip of an illicium or "fishing rod" (e.g., monkfish; blacktail netdevil; triplewart seadevil).

Finlets: Small separate fin or fins following the dorsal and anal fins (e.g., mackerel; tuna).

Fork Length: (FL) Straight-line measurement from the most anterior part of the head (with its jaws closed) to the shortest fin ray of the tail (i.e., to fork of tail or caudal fin).

Gill arches: Bony supports of the gills.

Gill rakers: A series of tooth-like bony projections along the anterior edge of gill arches.

Head Length: (HL) Measurement from the most anterior part of the head (with its jaws closed) to posterior edge of the operculum.

Heterocercal: The tail or caudal fin whose upper lobe is larger than the lower lobe; unequally lobed (e.g., shark; sturgeon).

Homocercal: The tail or caudal fin whose upper and lower lobes are more or less equal; equally lobed (e.g., cod; redfish; salmon).

Ichthyology: The scientific study of fish.

Illicium: Modified 1st dorsal fin ray (the "fishing rod") on the head of anglerfish and relatives (e.g., monkfish; deepsea angler; blacktail netdevil).

Isthmus: A fleshy structure beneath the head and between the gill openings.

Jugular fins: Pelvic fins located before the point of attachment of pectoral fins (e.g., cod; haddock; hake; monkfish).

Keel: A sharp compressed edge on each side of the lateral surface of the caudal peduncle (e.g., mackerel; tuna; swordfish; some sharks).

Lateral: At the side.

Lateral line: Series of pore-like openings (to sensory canal) along both sides from front-to-back.

Laterally compressed: The body of a fish/invertebrate compressed from side-to-side (e.g., Atlantic halibut; yellowtail flounder; hatchetfish; "sea lice" amphipods).

Luminescent: Producing light (e.g., photophores on lanternfish).

Mandible: The lower jaw.

Maxillary: The posterior part of the upper jaw.

Median: The middle line.

Mouth:
- **inferior:** Mouth below snout; snout obviously overhanging mouth (e.g., grenadier; sturgeon; shark; chimaera).
- **oblique:** Line of mouth (when closed) at 45^0 angle or greater (e.g., pomfret; silver hatchetfish; triplewart seadevil).
- **subterminal:** Mouth slightly overhung by snout, *not quite terminal* (e.g, eelpout; blue hake).
- **terminal:** Tips of upper and lower jaw forming the foremost part of the head (e.g., tuna; trout).
- **ventral:** Mouth on ventral surface of head (e.g., skate).

Operculum: Bony covering of the gill cavity.

Orbit: The bony eye socket.

Otic: Pertaining to the ear.

Otoliths: Are small, hard, white structures made of calcium carbonate and have a unique size and shape for most species. They are located in the otic cavity of the inner ear of bony fishes, and aid in positioning a fish relative to gravity.

Papilla: A small fleshy projection.

Pectoral fins: The most anterior or uppermost of the paired fins; usually dorsal to pelvic fins.

Pelvic axillary process/scale: A slender tab of tissue (finger-like) or scale at the base of the pelvic fins (e.g., herring; salmon; trout).

Pelvic fins: The most ventral of the paired fins; positioned on ventral body surface.

Peritoneum: The membranous inner lining of the abdominal cavity (where digestive organs are).

Photophore: An organ that produces light; usually on the abdomen or head (e.g., lanternfish). The position and number of photophores varies with each species.

Placoid scales: **Denticles:** Tooth-like scales of primitive fish (e.g., sharks; skates; some chimaeras) composed of dentine, with a pulp cavity. Each scale has a basal plate buried in the skin, with a raised portion exposed outside of the skin (anvil-shaped).

Posterior: Rear or towards the rear. Opposite of anterior.

Posteroventral: Lower part to the rear.

Premaxillary: The anterior part of the upper jaw.

Proximal: Towards the point of attachment. Opposite of distal.

Ray: A segmented rod that supports the membrane of a fin; "fin rays".

Rostrum: A bony extension of the snout (e.g., swordfish).

Scute: A bony or horny plate (e.g., sturgeon).

Serrate: Saw-toothed; like a saw.

Snout: That part of the head in front of the eyes.

Soft dorsal: The dorsal fin or portion of it having soft rays only.

Spine: A fin ray without obvious segments, more or less stiffened, and sharpened at its apex.

Spinous dorsal: The dorsal fin or portion of it having spiny rays only.

Spiracle: An opening in the head anterior to and above the opercular opening (e.g., hagfish; lamprey; shark; skate).

Standard Length: (SL) Measurement from the most anterior part of the head (with its jaws closed) to the posterior edge of the last whole vertebra in the backbone.

Swim bladder: Air bladder: A sac filled with air or other gases lying beneath the backbone. Functions include hydrostatic balancing and sound reception.

Symphyseal knob: The point of junction of two bones of the lower jaw in front forming a long, sharp tip of the chin (e.g., Atlantic/deepwater redfish *Sebastes mentella*). Very poorly developed/blunt on the golden redfish *Sebastes marinus*.

Teleost: A name applied to fish having a skeleton made of bone (e.g., eels; herring; trout; cod); in contrast to having a skeleton made of cartilage (e.g., sharks; skates; chimaeras).

Thoracic fins: Pelvic fins located on the chest or thorax (in front of the abdomen) below the pectoral fins (e.g., redfish; mackerel; tuna).

Total Length: (TL) Straight-line measurement from the most anterior part of the head (with its jaws closed) to the tip of the longest fin ray of the tail.

Truncate: As if cut off.

Ventral: Located on the side of an animal which is normally directed downwards with respect to gravity. Opposite of dorsal.

External body structures to help identify shrimp, crabs, and lobsters:

Abdomen: The flexible part of the body behind the carapace: the "tail" or hind part in shrimp & lobsters; is held under the carapace in crabs (narrow in males, wide in females).

Antenna: Outer sensory appendage at the front of the body.

Appendage: Any considerable projection from the body. Usually segmented. There is frequently one symmetrical pair per body segment in shrimp, crabs, and lobsters.

Bifurcate: Divided into two branches.

Carapace: Rigid shell of chitin covering the head and thorax or fore part of the body. Its structure, ridges or grooves, and absence or presence/number of spines are unique to each species.

Carina: A ridge on the carapace.

Chela: Claw; usually with rows of teeth.

Endopod: Flattened *inner* branch of a pleopod/swimmeret; usually shorter than the exopod.

Exopod: Flattened *outer* branch of a pleopod/swimmeret; usually longer than the endopod.

HR: **H**ead **R**oe are bluish-green eggs developing under a shrimp's carapace in its head; the stage before a female becomes "ovigerous".

Orbit: Cavity at front of the carapace containing the eye.

Ovigerous: Female carrying eggs on the pleopods/swimmerets.

Pereopod: One of five pairs of "walking" legs attached ventrally to segments of the thorax.

Pleopod: One of five pairs of appendages attached ventrally to the first 5 segments of the abdomen: swimmerets. Each usually has an inner (endopod) and outer (exopod) branch. The 1st pleopod is often modified in structure according to sex.

Rostrum: Anterior extension of the front of a carapace between the eyes. Its structure and absence or presence/number of dorsal spines are unique to each species. "Nose".

Segment: A unit in a repetitive series of similar structures ("segmentation"). Usually along the antero-posterior axis of the body, or along the axis of an appendage.

Serrate: Saw-toothed or with fixed spines along the edge.

Somite: A body segment.

Spine: A sharp, needle-like projection.

Suborbital spine: Spine on lower rim of the orbit.

Supraorbital spine: Spine near front of carapace above the eye.

Tail fan: Telson with an uropod at each side of it. *See uropod.*

Telson: Last or 7th segment/somite of abdomen, bearing the anal opening. Usually tapered, its number of dorsolateral and terminal spines is unique to each species. *See tail fan.*

Tubercle: Small, rounded protuberance or bulge.

Uropod: One of a pair of appendages attached to the 6th abdominal segment/somite. Each uropod has an inner (endopod) and outer (exopod) branch. *See tail fan.*

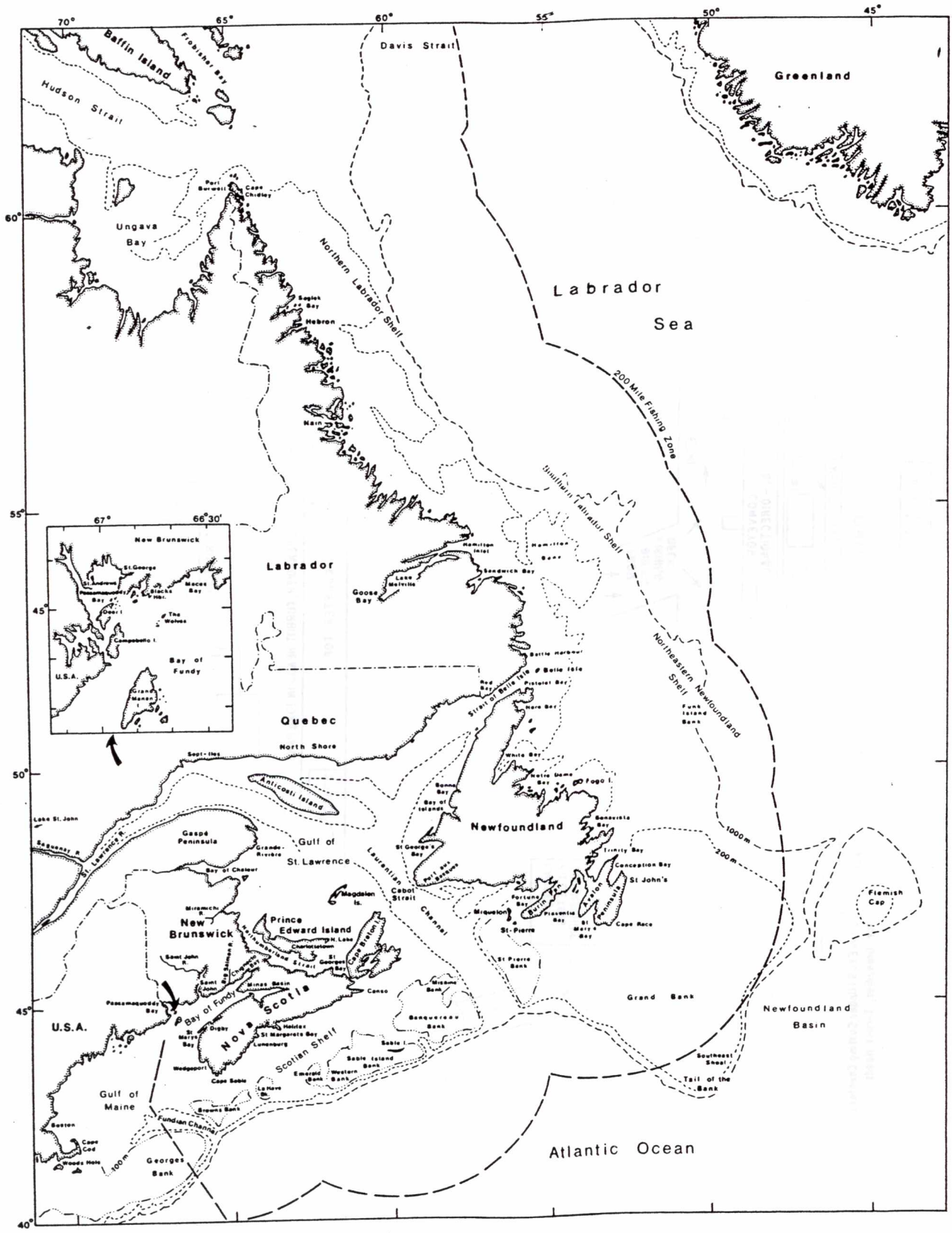


Fig. 1. Canadian Atlantic area showing major fishing banks and Canada's 200-mile limit (----).

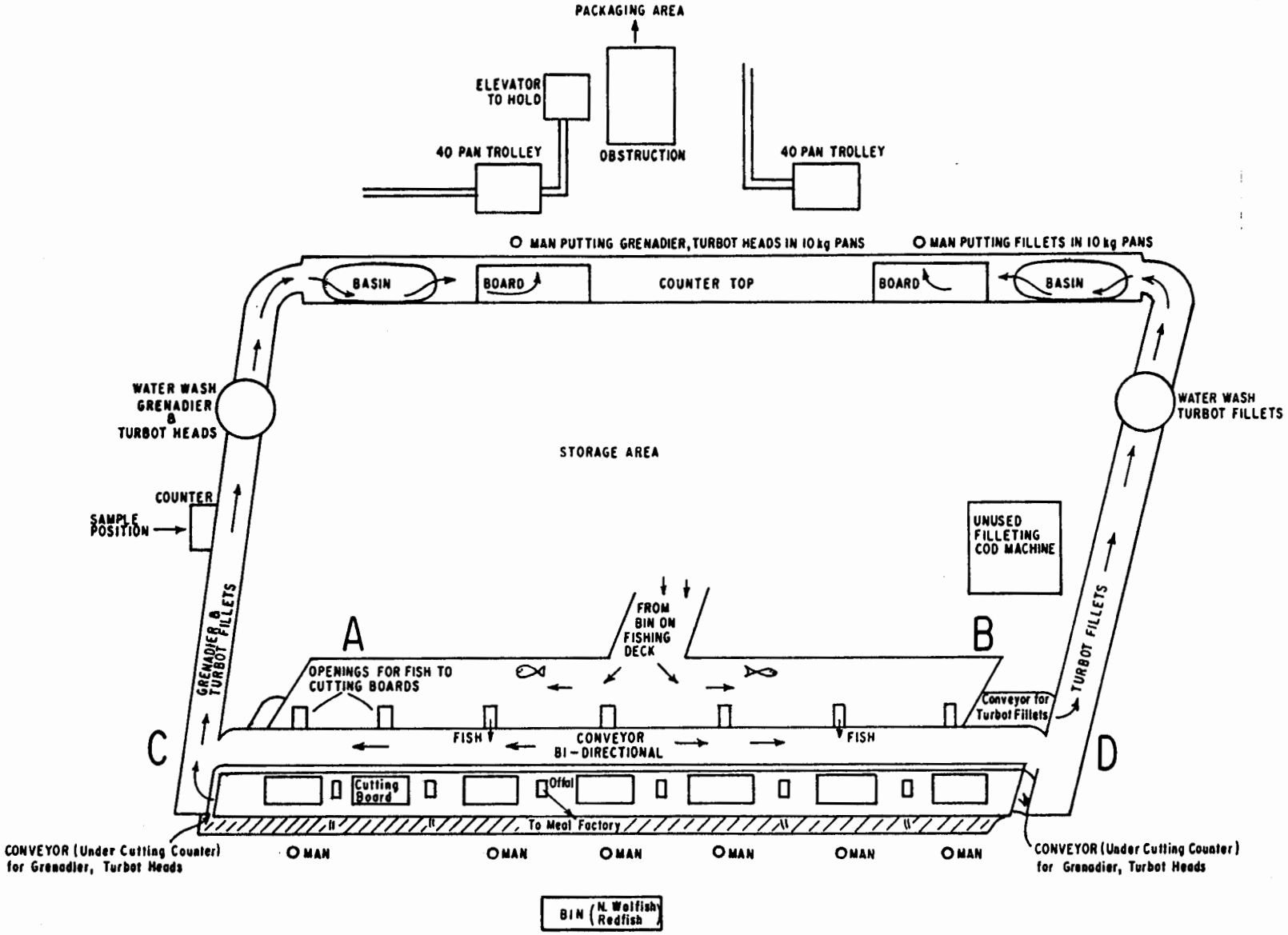


Fig. 2. Layout of the processing area on the Kuprin, showing possible sampling positions: A, B, C, D.

PRODUCTION LOG

VESSEL NAME 200	SIDE NUMBER 201	CANADIAN LICENCE NUMBER 202	DAY 203	MONTH 204	YEAR 205
MXS YUSKA	MB451712	146321	26	05	93

PRODUCT FORM	PRODUCT WEIGHT BY SPECIES (KILOGRAMS)													
	COD (101)	REDFISH (103)	AMERICAN PLAICE (112)	SILVER HAKE (104)	TURBOT (113)	CAPELIN (340)	SQUID (ILLEX) (504)	WITCH	OTHER					
ROUND - FROZEN 206														
ROUND - FROZEN (COOKED) 207														
GUTTED HEAD ON - FROZEN 208														
GUTTED HEAD OFF - FROZEN 209														
GUTTED HEAD OFF - TRIMMED - FROZEN 210					600			5158						
SKINLESS FILLETS - FROZEN 211		6767												
SKIN ON FILLETS - FROZEN 212														
SPLIT FISH (PRIOR TO ADDITION OF SALT) 213														
PICKLED FISH 214														
CANNED PRODUCTS 215														
OIL 216														
OTHER (SPECIFY) 217														
MEAL PRODUCED FROM ROUND FISH 218									388					
MEAL PRODUCED FROM OFFAL 219									150					
TOTAL														

REMARKS 220	CANADIAN FISHERY OFFICER'S SIGNATURE 221	MASTER'S SIGNATURE 222
	J. Doe	

Fig. . International production log.

Port Sailed:	Date of Sailing:	Time of Sailing:
Port at Which Catch Landed:	Date of Landing:	Time of Landing:
Name of Buyer:		Number of Crew: (including Captain)

Name of Vessel:			CFV Number:		Trip Number:
Type of Fishing Gear Used:	DATE		NOON POSITION (GMT)		
	Day	Month / Year	Latitude	Longitude	Unit Area
Mesh Size:					

TOW OR SET NO	POSITION AT START OF TOW		Time Gear Shot	Hours and Minutes Gear Fished	Time Gear Returned to Deck	No. Of Nets or Hooks Hauled	Depth In Fathoms	Main Species Sought	ESTIMATE OF AMOUNTS OF FISH CAUGHT (POUNDS)								
	CO-ORDINATES	Unit Area								COD	HADDOCK	REDFISH	PLAICE	TURBOT	POLLOCK		SHRIMP
1	Lat / Long								Kept / Discarded								
2	Lat / Long								Kept / Discarded								
3	Lat / Long								Kept / Discarded								
4	Lat / Long								Kept / Discarded								
5	Lat / Long								Kept / Discarded								
6	Lat / Long								Kept / Discarded								
7	Lat / Long								Kept / Discarded								
8	Lat / Long								Kept / Discarded								

REMARKS:	Captain's Name: (please print)
	Captain's Signature:

Government of Canada
Fisheries and Oceans

Gouvernement du Canada
Pêches et Océans

(CONFIDENTIAL WHEN COMPLETED)

169-64

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INTERNATIONAL FISHING LOG

VESSEL NAME 01	SIDE NUMBER 02	CANADIAN LICENCE NUMBER 03	IF NOT FISHING TODAY, GIVE REASONS AND COMPLETE STATUS CODE 12	STATUS CODE 13
MXS YUSKA	M 8 4 5 1 7 2	1 4 6 3 2 1		

DATE			NOON POSITION (GMT)			MAIN SPECIES SOUGHT THIS DAY	
DAY 04	MONTH 05	YEAR 06	LATITUDE 07	LONGITUDE 08	NAFO DIVISION 09		CODE 11
26	05	93	47 30 N	48 30 W	3L	REDFISH	

SET 20	TIME TOW BEGAN (GMT) 21	TIME TOW FINISHED (GMT) 22	HOURS FISHED 23	DEPTH (METERS) 24	POSITION AT START OF TOW: LATITUDE 25	LONGITUDE 26	NAFO DIVISION 27	TYPE OF GEAR 28	NUMBER OF NETS OR LINES HAULED 29	MESH SIZE 30		COD (101)	REDFISH (103)	AMERICAN PLAICE (112)	SILVER HAKE (104)	TURBOT (118)	CAPELIN (340)	SQUID (ILLEX) (504)	WITCH	OTHER	
1	1220	1520	3	510	47 35	48 20	3L	BT	1	120	KEPT 40		6000						5000	200	
											DISCARDED 41										
2	1660	1920	3:20	540	47 40	48 25	3L	BT	1	120	KEPT 40		5300						3400	100	
											DISCARDED 41										
3	2010	2200	1:50	515	48 05	49 10	3L	BT	1	120	KEPT 40		7700						4600	200	
											DISCARDED 41										
4											KEPT 40										
											DISCARDED 41										
5											KEPT 40										
											DISCARDED 41										
6											KEPT 40										
											DISCARDED 41										
7											KEPT 40										
											DISCARDED 41										
										TOTAL	KEPT 42										
											DISCARDED 43										

ROUND WEIGHT (KILOGRAMS) PROCESSED TODAY FOR HUMAN CONSUMPTION 51		19000						13000		
ROUND WEIGHT (KILOGRAMS) PROCESSED TODAY FOR REDUCTION 52									500	
TOTAL 53										

REMARKS:	CANADIAN FISHERY OFFICER'S SIGNATURE 55	MASTER'S SIGNATURE 56
3 sets were done on May 26th. No morning tows due to repairing of gear. 54	J. Doe	

Fig. . International fishing log.

Observer Program Discard Worksheet

Page ____ of ____

Date: ____/____/____ (dd / mm / yy)

Trip #: Set #: Vessel Name:

Discard Port			Observed Discards			Total Discards	
			A		B	C	D
			# Fish/Baskets Discarded		Time (min.)	Discard Period (min.)	# Fish/Baskets Discarded D=(C ÷ B)x A
No.	Type	Obs #	Tallies	Total			
1	3 crew portside	1		18	10	Comment:	
		2		13	12		
		3		21	10		
Port Total				52	32	80	130
2	2 crew starboard	1		19	15	Comment:	
		2		9	10		
Port Total				28	25	95	106
3	*2 crew aft unobserved		See the COMMENTS			Comment: * Could not see the crew because they were behind me.	
			Section below for the				
			estimate for this Port.				
Port Total						60	66
						Comment:	
Port Total							
SET TOTAL				80			302

E. TOTAL # fish/baskets discarded = 302 (= D_{total})

F. Average length of discarded fish = 39 cm.
(calculated from previous discard sample: Set # ____)

G. Average weight of discards/baskets = 0.532 kg.
(calculated/from Length/Weight Table)

H. **TOTAL WEIGHT OF DISCARDS** = 161 kg. (= E x G)
(Record on the Set & Catch Record.)

Comments:

Note: Calculate a rate of discarding "per Man-Minute" only when there are unobserved crew.

The estimate for Port #3: A rate of discarding "per Man-Minute" was calculated for the observed crew:

Port #1: 3 crew × Total discard period (80 min.) = 240 Man-Minutes

Port #2: 2 crew × Total discard period (95 min.) = 190 Man-Minutes

Therefore, Total Man-Minutes for observed ports = 430 Man-Minutes

Total discards for Ports #1 & 2 (236) ÷ Total Man-Minutes (430) = 0.55

Number of fish discarded per Man-Minute = 0.55

Port #3 (unobserved): 2 crew × Total discard period (60 min.) = 120 Man-Minutes

Therefore, Port #3 Total Man-Minutes (120) × Observed discard rate per Man-Minute (0.55) = 66

Estimated number of fish discarded at Port #3 = 66 fish

Year: _____ **Nfld. Observer Program Set & Catch Record** Trip #: _____

Trip Number		Set Number	
Year		Directed Species	
Country		Data Source	
Trip Type		Start Latitude	
Quota		Start Longitude	
Vessel Side Number		Unit Area	
Vessel Horsepower		NAFO Division	
Vessel Class		Avg. Fishing Depth (m)	
Fishing Gear Type		In / Out 200-Mile-Limit	
Codend Mesh Size (mm)		Month (1-12)	
Body Mesh Size (mm)		Day (when gear is set)	
Roller Size (cm)		Start Time (UTC)	hr min
Topside Chafing Gear Type		Duration (one decimal)	.
Number of Windows		Avg. Tow Speed (knots)	.
Number of Gillnets *or* Grate Bar Spacing (mm)		Net Damage (describe in comments)	
Avg. Length of Gillnets *or* Footrope Length (m)		Observer: _____	
Number of Hooks *or* Temp. at Fishing Depth		Vessel: _____	
Number of Pots		Avg. Fishing Depth: _____ (fathoms)	
		Local Time: _____	
		Statistical Area: _____	

Catch Record Species Name	Species Code	Kept Weight (kg)	Discard Weight (kg)	Dir Sp	Processing (Codes and Percent) Code 1	%	Code 2	%	Code 3	%
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										

Duration for fixed gear. Show all calculations.

Start Time: (circle one) *Actual* *Estimated*

Type of Gear: (circle one) *Gillnets* *Longlines* *Pots*

First set: **Time:** _____ **Date:** _____
First hauled: **Time:** _____ **Date:** _____

Duration (First): _____ **hrs** ____ **min** = ___ .___ **hrs** (change to 1 decimal place)

Last set: **Time:** _____ **Date:** _____
Last hauled: **Time:** _____ **Date:** _____

Duration (Last): _____ **hrs** ____ **min** = ___ .___ **hrs** (change to 1 decimal place)

$$\frac{\{\text{Duration (First): } ___.___ \text{ hrs} + \text{Duration (Last): } ___.___ \text{ hrs}\}}{2} = ___.___ \text{ hrs}$$

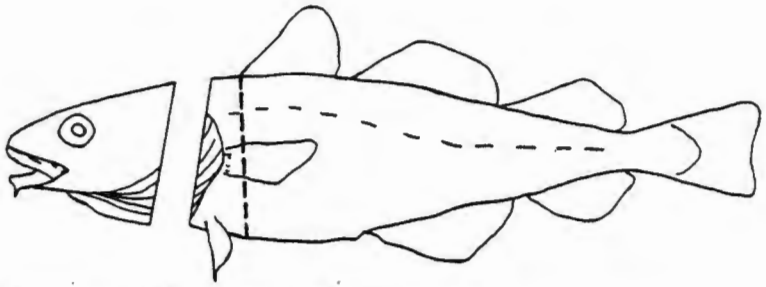
Duration for seine gear.

Time spent searching: _____ **hrs** ____ **min**

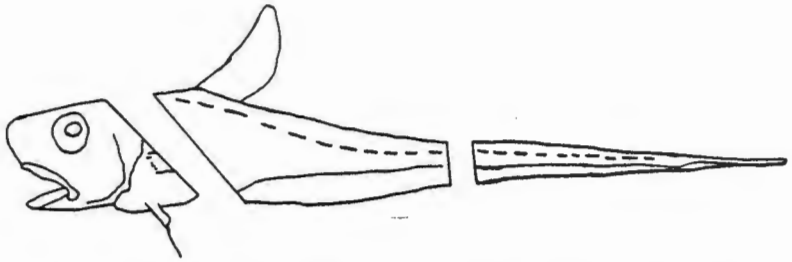
Time spent pumping out the seine: _____ **hrs** ____ **min**

Time spent pursing the seine: _____ **hrs** ____ **min**

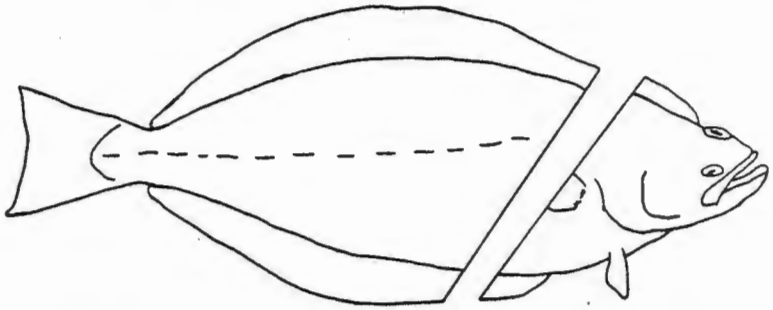
Comments:



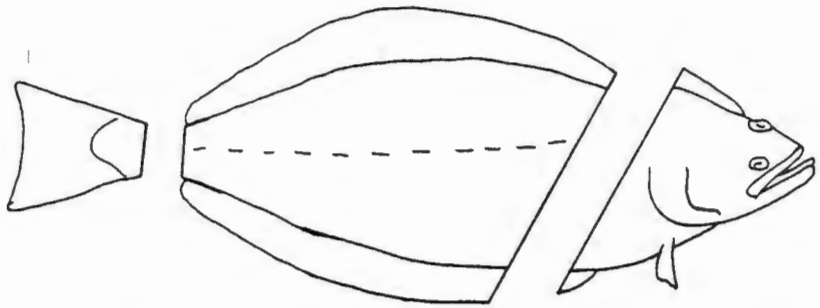
Atlantic cod: 103 - Gutted, head off, single cut.
106 (dotted line) - Gutted, head off, collar bone out, single cut.



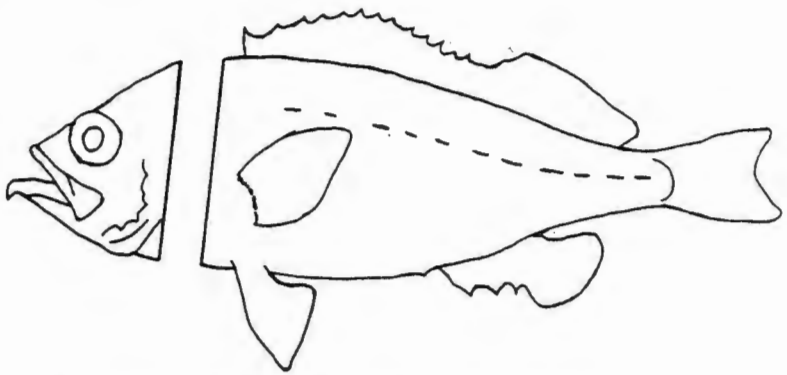
Roundnose grenadier: 120 - Gutted, head off, tail off, collar bone out, single cut.



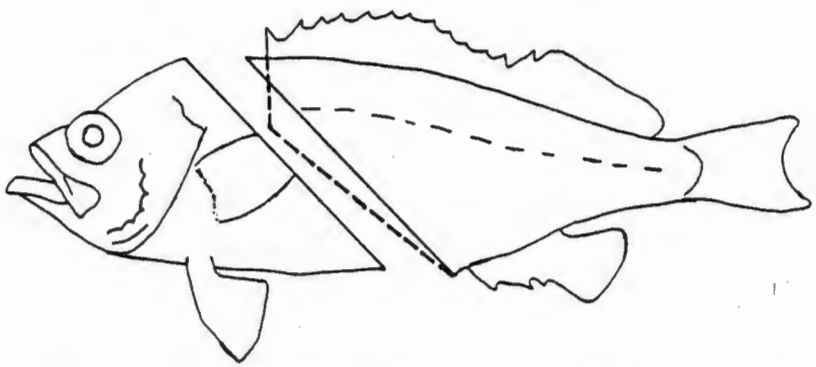
Greenland halibut: 106 - Gutted, head off, collar bone out, single cut.



Greenland halibut: 120 - Gutted, head off, tail off, collar bone out, single cut.



Redfish (unspecified): 103 - Gutted, head off, single cut.



Redfish (unspecified): 104 - Gutted, head off, collar bone out, diagonal cut (single).
104 (dotted line) - Gutted, head off, collar bone out, diagonal cut (double).

CONVERSION FACTOR DATA SUMMARY

Page 1 of 1

VESSEL NAME JELYNYK SPECIES NAME COD TRIP NO. 2,1,1 (1-3)

Side No. B,M,4,7,8,3,0 (4-13) SPECIES CODE 4,3,8 (14-17) COUNTRY 1,6 (18-19)

3 SAMPLE NUMBER	3 SET NUMBER	6 YY	3 DATE MM	4 DD	4 PROCESS METHOD	5 WHOLE WEIGHT	3 PRODUCT WEIGHT	3 CONVERSION FACTOR	4 NO. OF FISH	2 MEAN LENGTH	3 MACHINE TYPE	1 PROBLEM TYPE	SAMPLE NAFO DIV.	SAMPLE TYPE	COMMENTS
1	24	93	7	18	213	258	82	3·15	207	58	B 190		2J	1	
2	37	93	7	21	213	226	69	3·27	220	52	B 190		3K	1	

Fig. . Observer Program conversion factor data sheet.

FILLET PRODUCTION DATA SUMMARY

TRIP NO. 211 SET NO. 24 DATE (DMY) 18 07 93

VESSEL JELYNYK
LOCATION 2J
DEPTH 353

SPECIES COD
FISH QUALITY: FRESH / MEDIUM / SOFT
FISH CONDITION: LEAN / NORMAL / FAT

FISH LENGTH (cm) 58
SAMPLE WEIGHT (kg) 172 IN 106 OUT
NO. FISH 100

GUTTING MACHINE
HEADING MACHINE
FILLETING MACHINE B 190

OTHER
TRIMMING

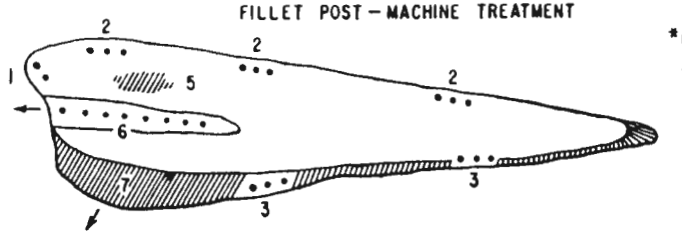
PRODUCTION

	PRODUCTION STAGE	PROCESS CODE	MACHINE	Kg.	% OF SET
1	GUTTED	100			
2	GUTTED HEAD OFF	110		247	5
3	SKIN ON, BLOOD SPOTS, FIN BITS NOT REMOVED (DIRECTLY OFF THE FILLETING MACHINE)	207			
4	SKINLESS, BLOOD SPOTS, FIN BITS NOT REMOVED	206			
5	*SKIN ON, BLOOD SPOTS, FIN BITS REMOVED, NOT TRIMMED	215			
6	*SKINLESS, BLOOD SPOTS, FIN BITS REMOVED, NOT TRIMMED	213	B 190	4200	85
7	*SKIN ON, TRIMMED (PERIFERAL FLESH REMOVED)	205			
8	*SKINLESS, TRIMMED (PERIFERAL FLESH REMOVED)	203			
9	*SKIN ON, BONELESS	212			
10	*SKINLESS, BONELESS	210	B190	494	10
11	*SKIN ON, BONELESS, TRIMMED (PERIFERAL FLESH REMOVED)	202			
12	*SKINLESS, BONELESS, TRIMMED (PERIFERAL FLESH REMOVED)	200			

*PROCESSES 5–15 ALL HAVE BLOOD SPOTS AND FIN BITS REMOVED / SKIN IS SHADED AREA

	PRODUCTION STAGE	PROCESS CODE	MACHINE	Kg.	% OF SET
13	*V. FILLET, SKINLESS	310			
14	*V. FILLET, SKINLESS, TRIMMED (PERIFERAL FLESH REMOVED)	300			
15	*OTHER (DRAW DIAGRAM AND DESCRIBE)				

FILLET POST – MACHINE TREATMENT



*REMOVAL OF BLOOD SPOTS AND FIN BITS IS NOT DEFINED AS TRIMMING. TRIMMING IS REMOVAL OF PERIFERAL FLESH AS SHOWN IN SHADED AREA (7)

	POST – MACHINE PROCESSING	PARTS REMOVED (YES/NO)	% OF SAMPLE	COMMENTS
1	HEAD BONES	Y	100	
2	DORSAL SPINES	Y	100	
3	ANAL SPINES	Y	100	
4	SKINNING DEFECTS	Y	100	
5	BLOOD SPOTS	Y	100	
6	* VERTEBRAL REMNANTS (BONELESS PRODUCT)	N		
7	* PERIFERAL TRIMMING * (TRIMMED PRODUCT)	N		
8	OTHER			

**SPECIFY LIGHT OR HEAVY TRIMMING

*BONELESS PRODUCT IS REMOVAL OF WEDGE (6)

121

Fig. . Observer Program fillet production data summary.

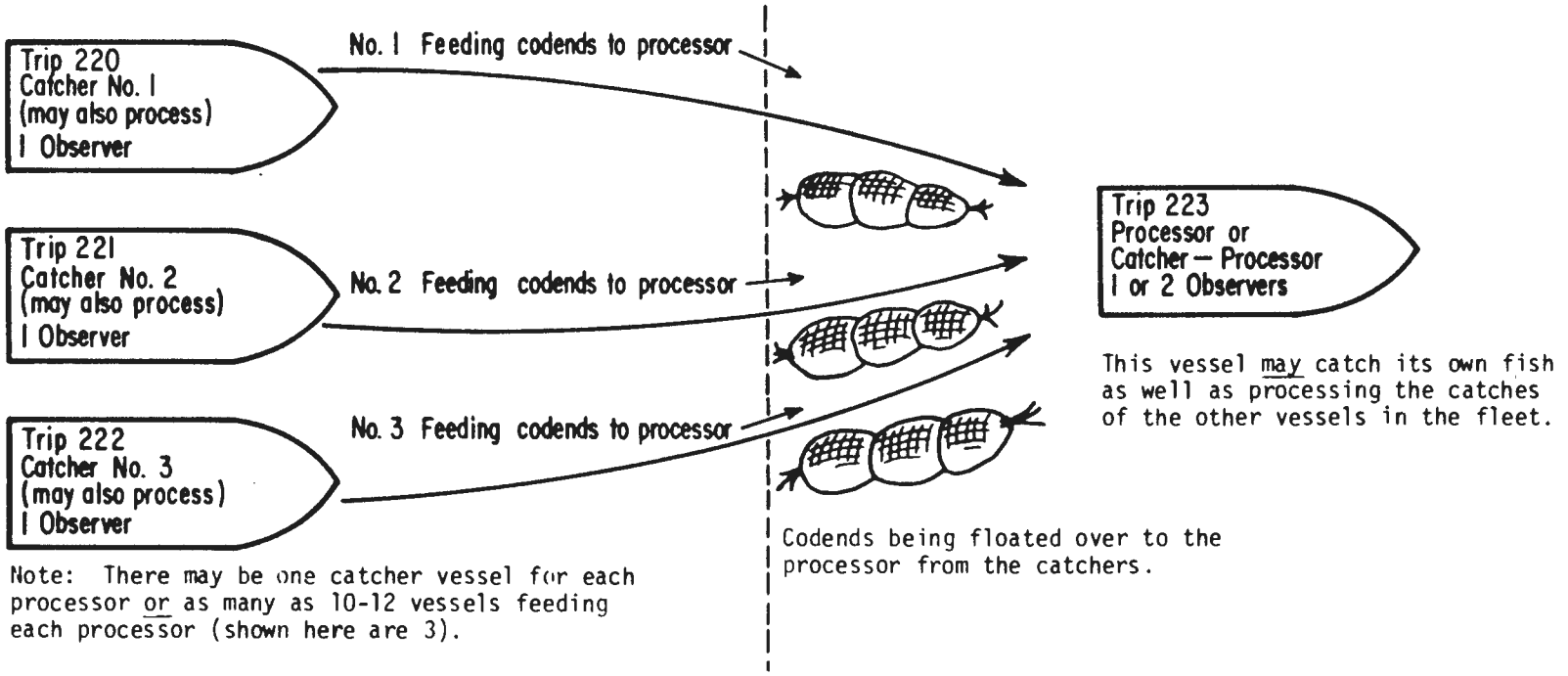


Fig. . Catcher-processor data collection methodology.

Year: 1993

Observer Program Set&Catch Record

Trip #: 319

Trip Number	19-22	319	4	Set Number	23-25	73	3
Year	1-2	93	2	Directed Species	81-84	438	4
Country	3-4	3	2	Data Source	80	1	1
Trip Type	89-90	1	2	Start Latitude	60-63	47 ° 52 '	4
Quota	87-88	3	2	Start Longitude	64-67	47 ° 57 '	4
Side Number	5-14	127168	10	Unit Area	55-57	326	3
Vessel Horsepower	15-18	700	4	NAFO Division	53-54	32	2
Vessel Class	26-27	4	2	Average Depth (m)	68-71	356	4
Gear Type	28-29	5	2	In/Out 200 Miles	48	1	1
Codend Mesh (mm)	30-32		3	Month (1 - 12)	51-52	7	2
Body Mesh (mm)	33-35	152	3	Day	49-50	23	2
Roller Size (cm)	36-38		3	Start Time (UTC)	72-75	6 hr 25 min	4
Chafing Gear	39		1	Duration (nearest 1/10)	76-79	12 . 5	4
Number of Windows	99		1	Tow Speed (knots)	58-59	0 . 0	2
Number of Gillnets	40-42	40	3	Net Damage	47	1	1
Ave. Length Gillnets (m)	91-93	90	3				
Number of Hooks (x 10)	43-46		4				
Number of Pots	94-97		4				

Observer Name: John Smith
Vessel Name: Belle Islander
Local Time: 3:55 Fishing Day: 23
Average Depth: 196 (fathoms)
Record comments on the reverse side.

Catch Record Species Name	Species Code	Kept Weight kg (5)	Discard Weight kg (4)	Dir Sp	Processing (Codes and Percent) Code 1	%	Code 2	%	Code 3	%
1 cod	438	1100	75	1	100	100				
2 turbot	892	75			110	100				
3 striped wolffish	700		11							
4 roughhead grenadier	474		6							
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										

Total Bycatch = _____ kg

125

Year: 1993 **Observer Program Set&Catch Record** Trip #: 219

Trip Number	19-22	219	4	Set Number	23-25	6	3
Year	1-2	93	2	Directed Species	81-84	438	4
Country	3-4	3	2	Data Source	80	1	1
Trip Type	89-90	1	2	Start Latitude	60-63	45 ° 59 '	4
Quota	87-88	3	2	Start Longitude	64-67	51 ° 50 '	4
Side Number	5-14	029096	10	Unit Area	55-57	314	3
Vessel Horsepower	15-18	464	4	NAFO Division	53-54	35	2
Vessel Class	26-27	3	2	Average Depth (m)	68-71	75	4
Gear Type	28-29	7	2	In/Out 200 Miles	48	1	1
Codend Mesh (mm)	30-32		3	Month (1 - 12)	51-52	5	2
Body Mesh (mm)	33-35		3	Day	49-50	28	2
Roller Size (cm)	36-38		3	Start Time (UTC)	72-75	15 hr 00 min	4
Chafing Gear	39		1	Duration (nearest 1/10)	76-79	5 . 1	4
Number of Windows	99		1	Tow Speed (knots)	58-59	0 . 0	2
Number of Gillnets	40-42		3	Net Damage	47	1	1
Ave. Length Gillnets (m)	91-93		3				
Number of Hooks (x 10)	43-46	1200	4				
Number of Pots	94-97		4				

Observer Name: Jane Pearson
Vessel Name: Raiv
Local Time: 12:30 Fishing Day: 3
Average Depth: 41 (fathoms)
Record comments on the reverse side.

Catch Record Species Name	Species Code	Kept Weight kg (5)	Discard Weight kg (4)	Dir Sp	Processing (Codes and Percent) Code 1	%	Code 2	%	Code 3	%
1 cod	438	600		1	100	100				
2 thorny skate	90		87							
3 haddock	441	3			100	100				
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										

Total Bycatch = _____ kg

Observer Program Sampling : Sexed Frequency

Set No	Species	Sex (M F)	Trip No.	Use	Samp.Wt	# Otoliths (M)	# Otoliths (F)	Len. Grp
								1

Male						Female					
0			1			0			1		
1			2			1			2		
2			3			2			3		
3			4			3			4		
4			5			4			5		
5			6			5			6		
6			7			6			7		
7			8			7			8		
8			9			8			9		
9			0			9			0		
0			1			0			1		
1			2			1			2		
2			3			2			3		
3			4			3			4		
4			5			4			5		
5			6			5			6		
6			7			6			7		
7			8			7			8		
8			9			8			9		
9			0			9			0		
0			1			0			1		
1			2			1			2		
2			3			2			3		
3			4			3			4		
4			5			4			5		
5			6			5			6		
6			7			6			7		
7			8			7			8		
8			9			8			9		
9			0			9			0		
0			1			0			1		
1			2			1			2		
2			3			2			3		
3			4			3			4		
4			5			4			5		
5			6			5			6		
6			7			6			7		
7			8			7			8		
8			9			8			9		
9			0			9			0		
0			1			0			1		
1			2			1			2		
2			3			2			3		
3			4			3			4		
4			5			4			5		
5			6			5			6		
6			7			6			7		
7			8			7			8		
8			9			8			9		
9			0			9			0		
0			1			0			1		

Species Total Weight _____

Observer Program Sampling : Unsexed Frequency

Set No	Species	Trip No.	Use	Samp.Wt	# Otoliths	Len. Grp

5			46			87		
6			47			88		
7			48			89		
8			49			90		
9			50			91		
10			51			92		
11			52			93		
12			53			94		
13			54			95		
14			55			96		
15			56			97		
16			57			98		
17			58			99		
18			59			100		
19			60			101		
20			61			102		
21			62			103		
22			63			104		
23			64			105		
24			65			106		
25			66			107		
26			67			108		
27			68			109		
28			69			110		
29			70			111		
30			71			112		
31			72			113		
32			73			114		
33			74			115		
34			75			116		
35			76			117		
36			77			118		
37			78			119		
38			79			120		
39			80					
40			81					
41			82					
42			83					
43			84					
44			85					
45			86					

Species Total Weight _____

GRENADIERS

ROUGH HEADED ☐ ROUNDNOSE ☐

FISHERIES and OCEANS — **OBSERVER DATA SHEET**

(1) Card	(2-5) Set No.	(6-7) Country	(8-11) Species	(12) Sex	(13-15) Trip No.	(16-23) Vessel Side No.	(24) Ton.
☒	114	34	481	M 1 / F 5	58	MB240	7

(25-26) Gear Type	(27-29) Mesh Size	(30-32) NAFO Div.	(33-34) Unit Area	(35-38) Latitude	(39-42) Longitude	(43-46) Time (UTC)	(47) Use
1	70	3K	46	5044	4944	920	C

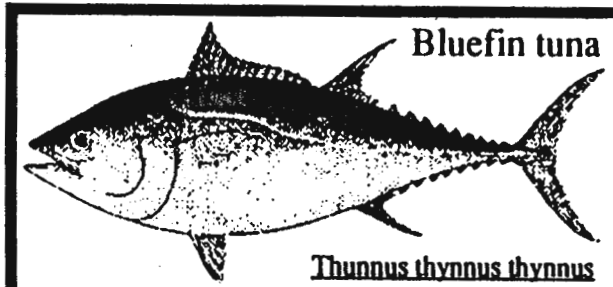
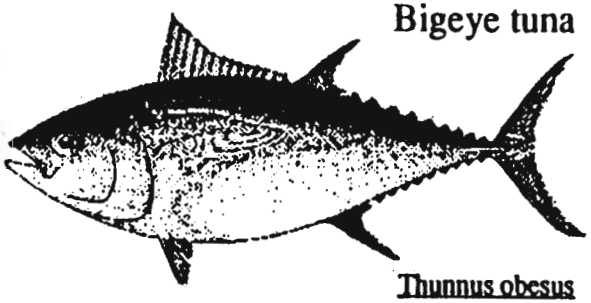
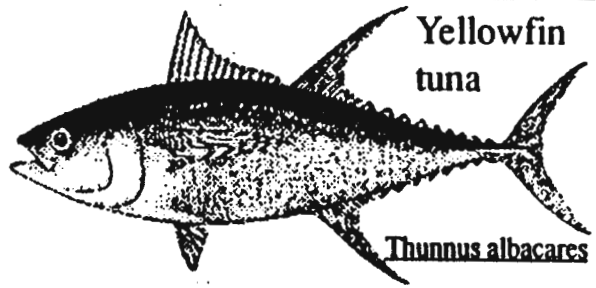
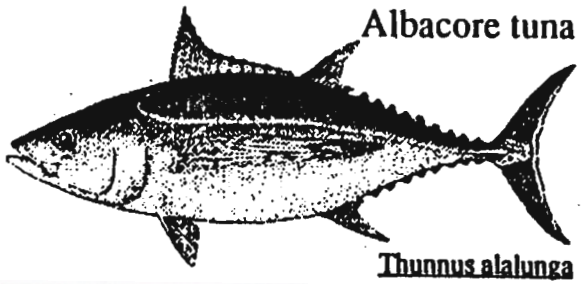
(48-49) Year	(50-51) Month	(52-53) Day	(54) Qtr.	(55-57) Port	(58-61) Depth (m)	(62-67) Species Total Weight	Collector / No. in Sample
93	9	4	3	20	1250	4000	John Smith / 404

(68-71) Sample Wt. (kg)	(72-74) No. Otoliths M / F	(75) Len. Grp.	VESSEL	COUNTRY
129		5	Andrey Markin	Russia

Anal Fin Length	Total Male	Total Female	MALE	FEMALE	Anal Fin Length	Total Male	Total Female	MALE	FEMALE
005					195		2		II
010					200				
015					205		1		I
020					210				
025					215		1		I
030					220				
035					225				
040					230				
045					235				
050	2		II		240				
055	2		II		245				
060	2		II		250				
065	2		II		255				
070	2	2	II	II	260				
075	6	3	𝍸 I	III	265				
080	10	6	𝍸 𝍸	𝍸 I	270				
085	30	12	𝍸 𝍸 𝍸 𝍸 𝍸 𝍸	𝍸 𝍸 II	275				
090	16	13	𝍸 𝍸 𝍸 I	𝍸 𝍸 III	280				
095	25	25	𝍸 𝍸 𝍸 𝍸 𝍸	𝍸 𝍸 𝍸 𝍸 𝍸	285				
100	16	25	𝍸 𝍸 𝍸 I	𝍸 𝍸 𝍸 𝍸 𝍸	290				
105	16	23	𝍸 𝍸 𝍸 I	𝍸 𝍸 𝍸 𝍸 III	295				
110	13	20	𝍸 𝍸 III	𝍸 𝍸 𝍸 𝍸	300				
115	16	15	𝍸 𝍸 𝍸 I	𝍸 𝍸 𝍸	305				
120	11	15	𝍸 𝍸 I	𝍸 𝍸 𝍸	310				
125	7	3	𝍸 II	III	315				
130	14	5	𝍸 𝍸 IIII	𝍸	320				
135	11	2	𝍸 𝍸 I	II	325				
140	4	2	IIII	II	330				
145	1	8	I	𝍸 III	335				
150	3	10	III	𝍸 𝍸	340				
155									
160									
165		2		II					
170									
175									
180									
185									
190									

TOTAL MALE 209
TOTAL FEMALE 195
TOTAL 404

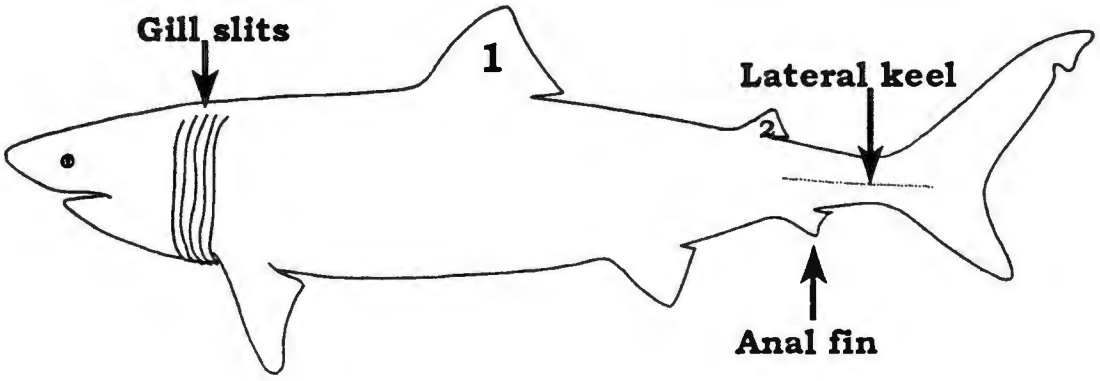
Fig. . Observer Program length frequency sheet for grenadiers.

SPECIES	Gill Raker Range	Pectoral Fin Length	Liver	Maximum Length	Maximum Weight	Finlet Colour
 Bluefin tuna *Thunnus thynnus thynnus*	34 - 43	17 - 22 % of fork length Short	Bottom surface streaked. Three lobes equal or mid-lobe slightly longer.	305cm	1500kg	Dusky yellow edged with black.
 Bigeye tuna *Thunnus obesus*	23 - 31	22 - 31 % of fork length Medium	Bottom surface streaked. Three lobes equal or mid-lobe slightly longer.	235cm	200kg	Bright yellow edged with black.
 Yellowfin tuna *Thunnus albacares*	26 - 35	22 - 31 % of fork length Medium	Bottom surface smooth. Right (viewed from top) lobe longer than other two.	210cm	180kg	Bright yellow edged with black.
 Albacore tuna *Thunnus alalunga*	23 - 31	> 30 % of fork length Long	Bottom surface streaked. Three lobes equal or mid-lobe slightly longer.	130cm	40kg	Anal finlets dark, 1 or 2 may have yellow center. Dorsal finlets may have yellow in center.

Synopsis of some identification characters of four tuna species within the Canadian EEZ.

Basking shark
(Cetorhinus maximus)

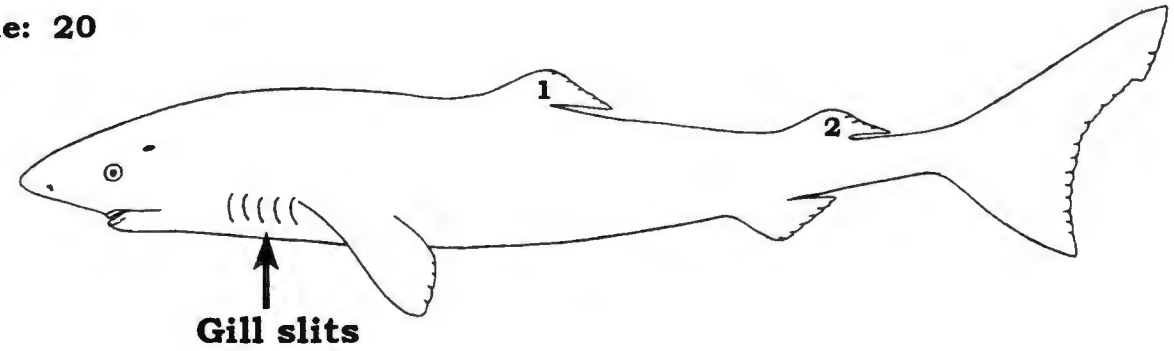
Code: 48



Gill slits enormous: they seem to sever the head from its body.
Caudal peduncle has large, lateral keels.
1st dorsal fin triangular (1), and much larger than 2nd dorsal fin (2).
Anal fin present.

Greenland shark
(Somniosus microcephalus)

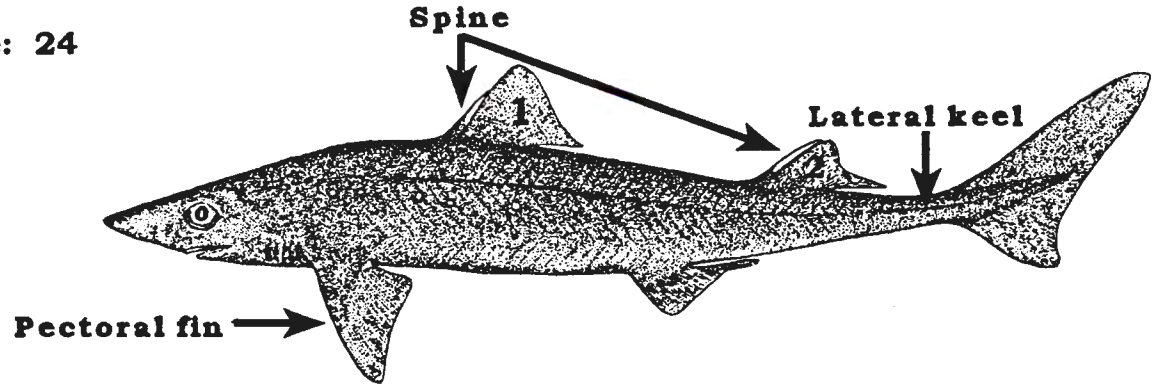
Code: 20



Gill slits average.
No keels on caudal peduncle.
1st and 2nd dorsal fins about equal in size.
Anal fin absent.

Spiny dogfish
(Squalus acanthias)

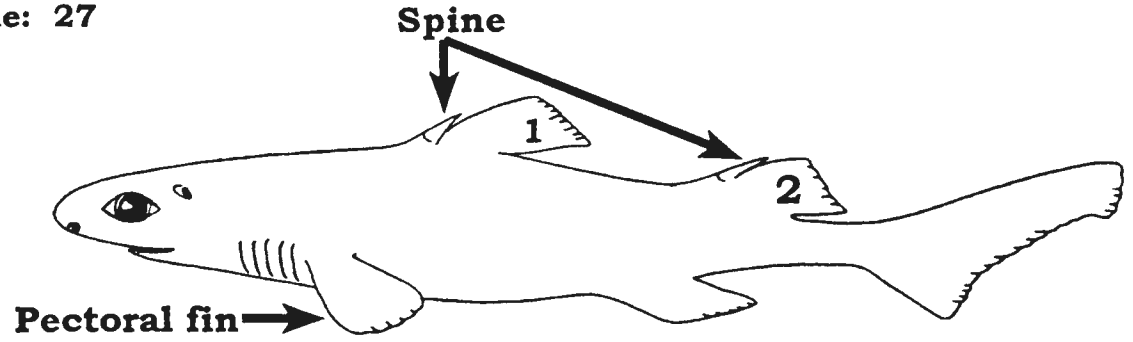
Code: 24



Caudal peduncle has lateral keels.
1st dorsal fin larger (1) than 2nd dorsal fin (2).
Pectoral fins long and narrow.
Eye average size, relative to the head.
Stout, sharp spine anterior to each dorsal fin.
Anal fin absent.

Black dogfish
(Centroscyllium fabricii)

Code: 27



No keels on caudal peduncle.
2nd dorsal fin larger (2) than 1st dorsal fin (1).
Pectoral fins short and square.
Eye large, relative to the head.
Stout, sharp spine anterior to each dorsal fin.
Anal fin absent.

LENGTH FREQUENCY SHEET (LARGE PELAGICS)

FISHERIES and OCEANS **OBSERVER DATA SHEET**

(1) Card	(2-5) Set No.	(6-7) Country	(8-11) Species	(13-15) Trip No.	(16-23) Vessel Side No.	(24) Ton.
☒	20	3	565	410	13158 1	5

(25-26) Gear Type	(27-29) Mesh Size	(30-32) NAFO Div.	(33-34) Unit Area	(35-38) Latitude	(39-42) Longitude	(43-46) Time (UTC)	(47) Use
7		3M		4323	4540	615	C

(48-49) Year	(50-51) Month	(52-53) Doy	(54) Qtr.	(55-57) Port	(58-61) Depth (m)	(62-67) Species Total Weight	Collector	No. in Sample (All in Set)
93	6	24	2	3	45	270	John Smith	2

PAGE 1 OF 1 (Use separate page for each species)

VESSEL: Aquatic Pioneer

COUNTRY: Canada (NF)

FISH NUMBER	SPECIES CODE	SEX (M OR F)	DRESSED LENGTH (cm)	~~FORK~~ TOTAL LENGTH (cm)	ROUND WEIGHT (Kg)	DRESSED WEIGHT (Kg)
1	565	M	152	187	118	99
2	565	F	180	209	152	132

Fig. . Observer Program length frequency sheet for large pelagic species.

SPECIES(6-8)	TRIP(14-16)	SET(17-18)	YEAR(20-21)
9801	253	8	93
		SAMP. WT(68-72) 2.7	SAMPLE(73) TYPE 2
HR/FR 75/84			

S.S.T.

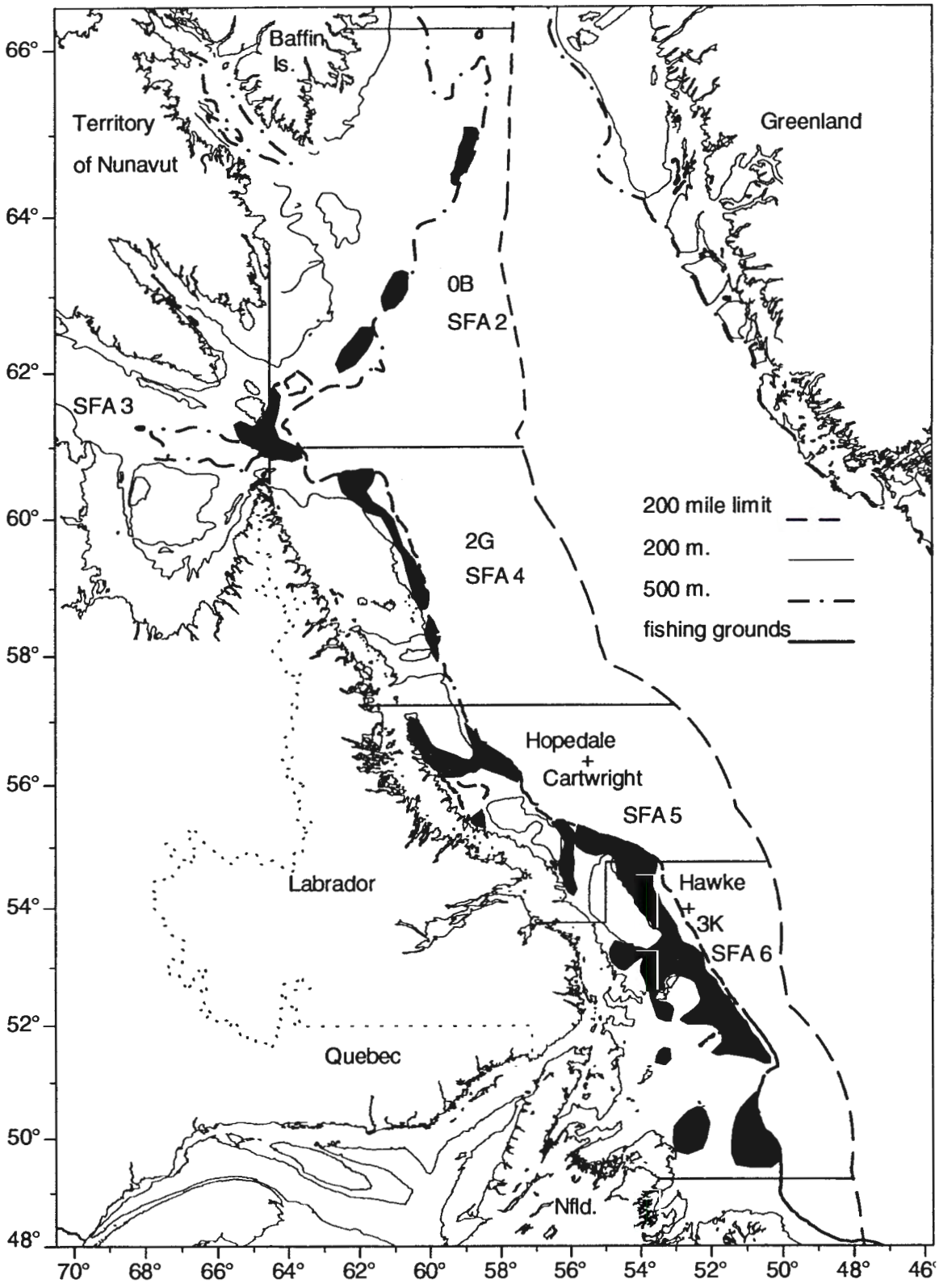
L.mm	NO.	
7·0		
7·5		
8·0		
8·5		
9·0		
9·5		
10·0		
10·5		
11·0		
11·5		
12·0		
12·5		
13·0	1	I
13·5		
14·0	2	II
14·5	6	𝍸 I
15·0	13	𝍸 𝍸 III
15·5	19	𝍸 𝍸 𝍸 IIII
16·0	23	𝍸 𝍸 𝍸 𝍸 III
16·5	26	𝍸 𝍸 𝍸 𝍸 𝍸 I
17·0	28	𝍸 𝍸 𝍸 𝍸 𝍸 III
17·5	24	𝍸 𝍸 𝍸 𝍸 IIII
18·0	21	𝍸 𝍸 𝍸 𝍸 I
18·5	24	𝍸 𝍸 𝍸 𝍸 IIII
19·0	13	𝍸 𝍸 III
19·5	21	𝍸 𝍸 𝍸 𝍸 I
20·0	14	𝍸 𝍸 IIII
20·5	30	𝍸 𝍸 𝍸 𝍸 𝍸 𝍸
21·0	15	𝍸 𝍸 𝍸
21·5	7	𝍸 II
22·0	4	IIII
22·5		
23·0	2	II
23·5		
24·0		
24·5		
25·0		
25·5		
26·0		
26·5		
27·0		
27·5		
28·0		
28·5		
29·0		
29·5		
30·0		
30·5		
31·0		
31·5		
32·0		
32·5		
33·0		
33·5		
34·0		
34·5		
35·0		
35·5		

SPECIES(6-8)	TRIP(14-16)	SET(17-18)	YEAR(20-21)
9806	253	8	93
		SAMP. WT(68-72) 2.7	SAMPLE(73) TYPE 2
HR/FR 75/84			

S.S.T

L.mm	NO.	
7·0		
7·5		
8·0		
8·5		
9·0		
9·5		
10·0		
10·5		
11·0		
11·5		
12·0		
12·5		
13·0		
13·5		
14·0		
14·5		
15·0		
15·5		
16·0		
16·5		
17·0		
17·5	1	I
18·0		
18·5		
19·0	1	I
19·5	2	II
20·0	4	IIII
20·5	2	II
21·0	13	𝍸 𝍸 III
21·5	10	𝍸 𝍸
22·0	6	𝍸 I
22·5	7	𝍸 II
23·0	7	𝍸 II
23·5	5	𝍸
24·0	4	IIII
24·5	7	𝍸 II
25·0	3	III
25·5	1	I
26·0		
26·5		
27·0	1	I
27·5		
28·0		
28·5		
29·0		
29·5		
30·0		
30·5		
31·0		
31·5		
32·0		
32·5		
33·0		
33·5		
34·0		
34·5		
35·0		
35·5		

Fig. . Observer Program length frequency sheet for shrimp.



Shrimp stock areas

SCALLOP SHELL HEIGHT FREQUENCY

Vessel	1-2	Trip	3-5	Set	6-8	Grid	9-10	Stn.	11-14	Trans.	15-17
Year	18-19	Mo	20-21	Day	22-23	Lat.	24-28	Long.	29-33	Dur.	34-36
Tow Dist.	37-39	Depth.	40-43	Gear	44-47	Div.	48-49	Unit area	50-52	Stratum	53-55	Sample type	56
Btm. type	57	Btm. temp.	58-60	Spp	61	Cond.	62	Catch wgt.	63-68	Sample wgt.	69-74	Broken shells	75-77

L mm	No.		L mm	No.		L mm	No.		L mm	No.	
1			51			101			151		
2			52			102			152		
3			53			103			153		
4			54			104			154		
5			55			105			155		
6			56			106			156		
7			57			107			157		
8			58			108			158		
9			59			109			159		
10			60			110			160		
11			61			111			161		
12			62			112			162		
13			63			113			163		
14			64			114			164		
15			65			115			165		
16			66			116			166		
17			67			117			167		
18			68			118			168		
19			69			119			169		
20			70			120			170		
21			71			121			171		
22			72			122			172		
23			73			123			173		
24			74			124			174		
25			75			125			175		
26			76			126			176		
27			77			127			177		
28			78			128			178		
29			79			129			179		
30			80			130			180		
31			81			131					
32			82			132					
33			83			133					
34			84			134					
35			85			135					
36			86			136					
37			87			137					
38			88			138					
39			89			139					
40			90			140					
41			91			141					
42			92			142					
43			93			143					
44			94			144					
45			95			145					
46			96			146					
47			97			147					
48			98			148					
49			99			149					
50			100			150					

{ = ___ { = ___ { = ___ { = ___

TOTAL = ____

SCALLOP DENSITY EXPERIMENT

Fishing trip # _____ Observer _____ (trip)

				ICELAND			SEA			
Samp. #	Date	Time	Area	Good Wt.	Good #	Broken Wt.	Good Wt.	Good #	Broken Wt.	Rocks, Shells, etc.
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
TOTALS										
AVERAGE										

COMMENTS: Volume of one basket =
Volume of one cage =
Number of baskets per cage =
Total cages landed =

TOTAL LANDED WEIGHTS (kg.)

ICELAND - good scallops
- broken scallops

SEA - good scallops
- broken scallops

Rocks, shells, etc

SCALLOP GONAD SAMPLES

VESSEL _____ OBSERVER _____ (TRIP)

SAMPLE #	DATE	SET #	AREA	LAT.	LONG.	DEPTH	TIME	NO. MALES	NO. FEMALES

(pg.___ of ___)

CLAMS - OBSERVER FREQUENCY SHEET

Species	Vessel	Trip	Set

Year	Month	Day	Latitude	Longitude

Div.	Unit area	Sample type	Sample weight	

Length	Height	Length	Height	Length	Height	Length	Height

LIST OF CLAM SAMPLES

VESSEL _____ TRIP _____ OBSERVER _____

DATE	SET	SPECIES	AREA	LAT/LONG	NOTES

LIVE / CLUCKER RATIOS

VESSEL _____ TRIP _____ OBSERVER _____

SET	DATE	AREA	BASKET WEIGHT	NO. LIVE	NO. CLUCKERS	NO. SHELLS

CLAM - GRADE PERCENTAGES

VESSEL _____ TRIP _____ OBSERVER _____

DATE	TOTAL PRODUCT (kg)	% GRADE"A"	% GRADE"B"	% YELLOW	% ORANGE	% MANTLE	% BITS	% COCKLES	% MIXED

CRAB RESEARCH SAMPLING													
SPECIES 8213			CFV			TRIP			SET				
TRAP NO			SEX 1			YEAR 2000			FEMALES				
WIDTH	SHELL	BCD	CLAW HT.		WIDTH	SHELL	BCD	CLAW HT.		WIDTH	SHELL	BCD	CLAW HT.

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Department of Fisheries and Oceans Canada
Newfoundland Fisheries Observer Program

MARINE MAMMAL & TURTLE SIGHTING RECORD

Year: _____ **Trip #:** _____ **Observer Name:** _____

Latitude: (deg. & min.)	**Longitude:** (deg. & min.)	**Month:** (01, etc.)	**Day:** (01, etc.)	**Time:** (UTC)	**Species Code:***	**No. seen:**	**Animal ** Condition:**	**Comments: *** (swimming/ feeding/ Set # when mammal caught/ etc.)**

* **TURTLE SPECIES CODES:** **9701**= Leatherback; **9702**= Loggerhead; **9703**= Green; **9704**= Ridley; **9700**= unidentified marine turtle (ns).

* **OTHER SPECIES CODES:** **1078**= Harbour Porpoise. *For all other species,* see "**Marine Vertebrate & Invertebrate Species Codes**" (yellow cover).

** **ANIMAL CONDITION: Must be coded for every observed turtle & mammal** (whether caught or not). **See back of sheet for Codes.**

*** **COMMENTS:** Be sure to also record **all "caught" turtles & mammals** from the **Set&Catch Record** sheet, and write in its **Set #** here.

SEAL RECORD

Trip # _____ Species _____ **Collections**

Set # _____ Sex _____ Whole Seal: YES / NO

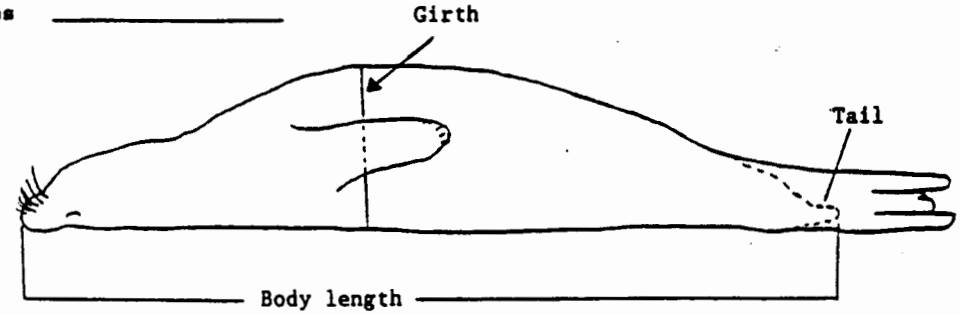
Observer _____ Length _____ cm Collector : Observer Vessel

Date _____ Girth _____ cm Jaw : YES / NO

Position: Lat. _____ Weight _____ kg Stomach : YES / NO

Long. _____ *Seal # _____

Directed Species _____



Weight: ACTUAL or ESTIMATED

Length: ACTUAL or ESTIMATED

COMMENTS: _____

_____

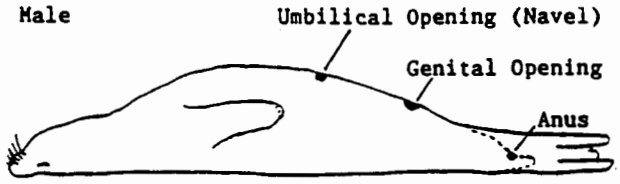
_____

_____

_____

SEXING GUIDE

Male



Description: Run your finger along the midline. A male will have a genital opening ~ 1/3 of the way between the anus and anterior flippers. Do not confuse it with the umbilicus (navel) which is about ½ of this distance and is smaller in diameter. The female genital opening is next to the anus.

Female

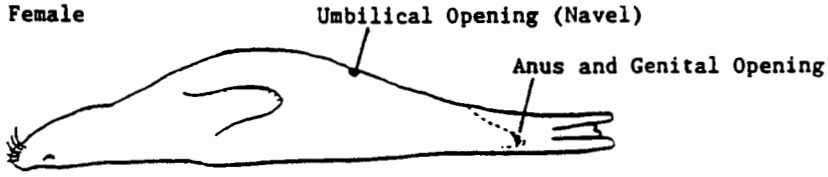


Table 1. Summary of Briefing procedures. Many Briefing details are fishery-specific.

Materials

Equipment (see Table 2)
Data Forms

Information

Vessel Specifications
Electronic Gear Specifications
Vessel Conditions
Travel Arrangements

Background Information:
- Stock; fishery; gear; quotas; catch rates; length of tows; methods that worked for other Observers; etc.

Requirements/Training

Basic Requirements:
- Sampling Requirements:
  - Target Species
  - Bycatch
  - Sample Collections
- Catch Estimates
- Discard Estimates
- Conversion Factors
- Fish Product Weights
- Marine Mammal Observations

Special Projects/Sampling Methods
Surveillance Requirements

Problems

Previous Deployments
Sampling
Vessel Accomodations
Fishery-specific Problems
Past Infractions
Other Regulatory

Handouts

Briefing Instructions
Instructional Memos

Table 2. Observer equipment list for sea duty.

Manuals/References

Newfoundland Observer Program Training Manual - Science
At-Sea Observer Program Operations Manual - Canada
Atlantic Fishes of Canada (Scott and Scott 1988)
Vertebrates Code Book (Akenhead and LeGrow 1981)
Invertebrates Code Book (Lilly 1982)
Departmental Acts and Regulations Manual
Whale and Seal Identification Key (Dr. J. Lien)

Binders

Memo Binder
Seawatch Binder

Safety Equipment

Survival Suit & Carry Bag
Divers Gloves
Safety Helmet
First Aid Kit
Flashlight
Safety Glasses & Case

General Equipment

Observer Identification Vest
Calculator
Kitcase
Canvas Bag
Briefcase
Canvas Bag for Measurement Board
Mesh Measurement Gauge
Math Set
Divider File or File Folders
Sleeping Bag

Biological Equipment

Measurement Board a) Regular
Measurement Board b) Grenadier
Weight Scales (5 kg & 90 kg)
Vernier Calipers
Measurement Tape (15 m)
Knife
Knife Case
Disposable Camera
Stone
Steel
Tweezers, Scissors, Scalpel & Blades
Cotton Gloves, Fireball Gloves, Surgical Gloves
Apron & Sleeves
Plastic Bags and Tags
Note pad, pencils, pens, markers, ruler, tape, stapler & staples,etc.

Table 3. Product to whole weight conversion factors (derived from Observer CF experiments; or from STACAC-1984 as designated by *). Note that "trimmed" only refers to the removal of additional peripheral flesh by hand. Also, "boneless" refers to fillets with a V-shaped cut that removed any bones or spines at the pectoral fin area.

Species	Product form	Conversion Factor	Yield (% of Whole Weight)
Atlantic cod:	Gutted.	1.22	82
	Gutted, gilled.	1.24	81
	Gutted, head off.	1.56	64
	Gutted, head off, collar bone out, single cut.	1.69	59
	Gutted, head off, diagonal cut.	1.91	52
	Gutted, head off, soundbone removed, fresh (split fish).	1.67	60
	Fillets.	3.2*	-
	Fillets, skinless.	3.20	31
	Fillets, skinless, trimmed.	3.32	30
	Fillets, boneless.	3.40	29
	Fillets, skinless, boneless.	3.65	27
	Fillets, skinless, boneless, trimmed.	3.88	26
	V-cut fillets, skinless.	3.67	27
American plaice:	Gutted.	1.13	89
	Gutted, head off.	1.4*	-
	Fillets.	4.0*	-
Witch (Greysole):	Gutted.	1.1*	-
	Gutted, head off.	1.25	80
	Fillets.	4.0*	-
Greenland halibut: (turbot)	Gutted.	1.09	92
	Gutted, head off.	1.46	69
	Gutted, head off, tail off.	1.49	67
	Fillets.	2.42	41
	Fillets, skinless, trimmed.	2.96	34
	Topside fillet.	5.50	18
	Chunked (steaks).	1.62	62
	Heads.	3.22	31
	Bodies.	2.44	41
Redfish:	Gutted.	1.16	86
	Gutted, gilled.	1.20	83
	Gutted, head off.	1.52	66
	Fillets.	3.3*	-
	Fillets, skinless.	4.32	23
Haddock:	Gutted.	1.2*	-
	Gutted, head off.	1.6*	-
	Fillets.	3.2*	-

Species	Product form	Conversion Factor	Yield (% of Whole Weight)
	G.H.T	1.2	
Monkfish:	Gutted, head off.	3.4*	-
	Tails.	3.5*	-
Roundnose grenadier:	Gutted.	1.2*	-
	Gutted, head off, tail off.	2.41	42
	Fillets.	3.2*	-
White hake:	Gutted.	1.2*	-
	Gutted, head off.	1.49	67
	Gutted, head off, collar bone out, single cut.	1.86	54
	Fillets.	3.2*	-
	Split, head off.	1.58	63
Capelin:	Smoked or dried whole.	1.5*	-
Tuna:	Dressed, head off.	1.3*	-
	Fillets or blocks.	3.0*	-
	Canned meat.	2.3*	-
Swordfish:	Dressed, head off.	1.3*	-
Porbeagle:	Gutted, head off, tail off, fins off.	1.47	68
Skate:	Dressed, head on.	1.1*	-
	Wings, skin on.	4.0*	-
	Wings, skin off.	7.7*	-
Shrimp:	Cooked, frozen.	1.00	1
	Peeled, fresh or frozen	4.1*	-
	Head off.	1.77	57
Lobster:	Cooked, frozen whole in shell	1.3*	-
	Meat, fresh or frozen	4.3*	-
	Canned meat.	4.7*	-
Snow crab:	Meat, fresh or frozen	5.0*	-
	Canned meat.	5.9*	-
	Au gratin, frozen.	1.5*	-
Squid:	Tubed.	2.10	4
	Gutted.	1.1*	-
	Dried.	4.0*	-
Scallop: Iceland	Meats, fresh or frozen	9.20	-
Sea/giant	Meats, fresh or frozen	8.30	-

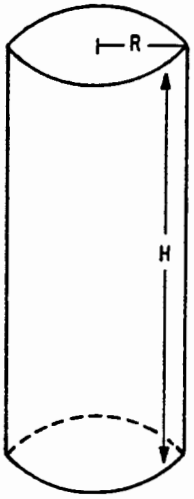
Table 4. Summary of length measurements and sexing requirements per species.

Species	Code	Length measurement	Length grouping (cm)	Sexed
Atlantic cod (*Gadus morhua*)	438	Fork	1	No
Redfish (*Sebastes mentella*)	794	Fork	1	Yes
American plaice (*Hippoglossoides platessoides*)	889	Total	1	Yes
Yellowtail (*Limanda ferruginea*)	891	Total	1	Yes
Witch/Greysole (*Glyptocephalus cynoglossus*)	890	Total	1	Yes
Turbot/Greenland halibut (*Reinhardtius hippoglossoides*)	892	Fork	1	Yes
Atlantic halibut (*Hippoglossus hippoglossus*)	893	Fork & Anal fin	1	Yes
Roundnose grenadier (*Coryphaenoides rupestris*)	481	Anal fin	0.5	Yes
Roughhead grenadier (*Macrourus berglax*)	474	Anal fin	0.5	Yes
Blue hake (*Antimora rostrata*)	432	Total	1	Yes
White hake (*Urophycis tenuis*)	447	Total	1	No
Haddock (*Melanogrammus aeglefinus*)	441	Fork	1	No
Pollock (*Pollachius virens*)	443	Fork	1	No
Silver hake (*Merluccius bilinearis*)	449	Fork	1	Yes
Shrimp (*Pandalus borealis*)	8111	Carapace Length	0.5mm	Maturity Stage
Crabs (*Chionocetes opilio*)	8213	Carapace Width	1mm	Males only
Clams (Stimpson's surf clam & Greenland cockle)	4377 4343	Length & Height	1mm	No
Scallops (Iceland scallop: 4167) & Sea/giant scallop: 4179)	2 1	Height	1mm	No

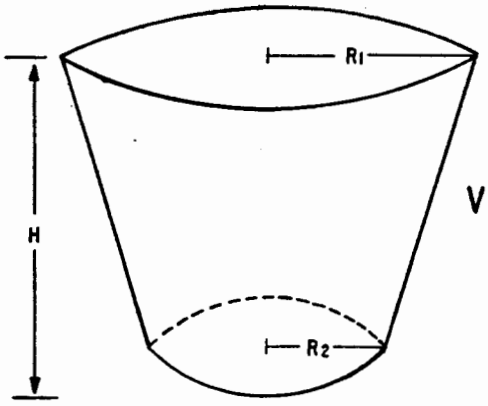
APPENDIX 1

Volumes of Fish Holding Bins

Most bins and fish holding areas on commercial fishing vessels are irregular in shape, making it difficult to calculate total bin volume. Therefore, "break up" a holding bin into sections, as illustrated in the following example. Calculate the volume of each section using the equation provided, then add these volumes to obtain total volume of the holding bin.

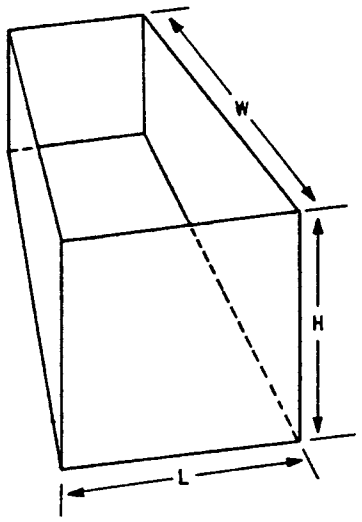


$$V = \pi R^2 \times H$$

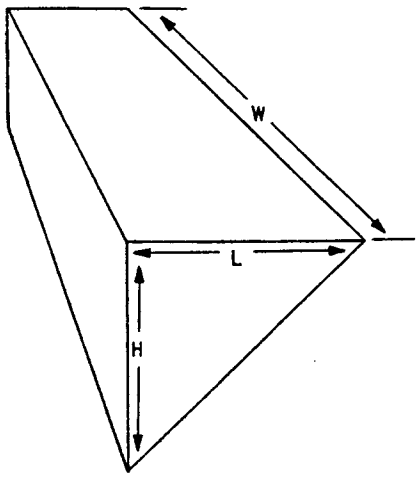


$$V = \pi \left(\frac{R_1 + R_2}{2} \right)^2 \times H$$

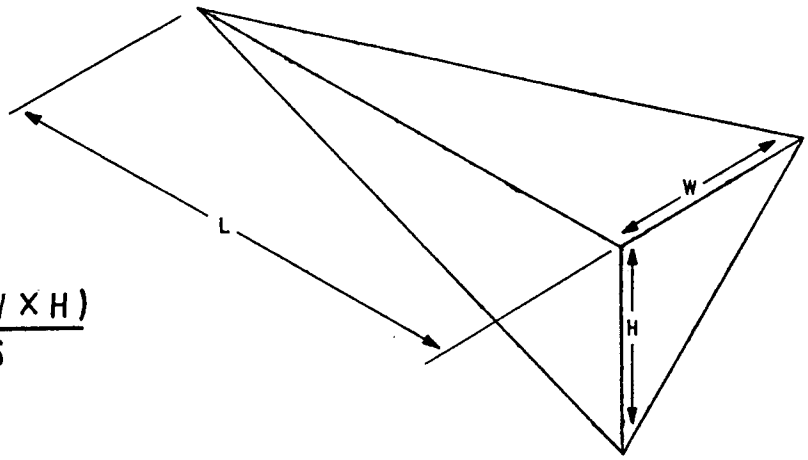
$V = L \times W \times H$



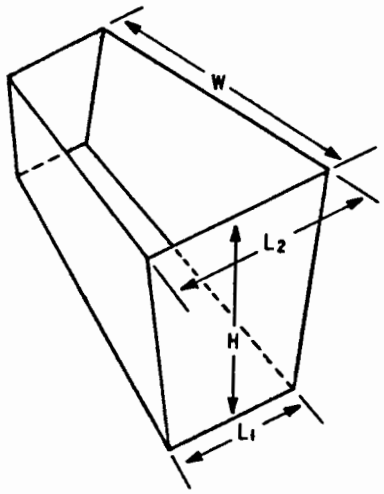
$V = \frac{L \times W \times H}{2}$



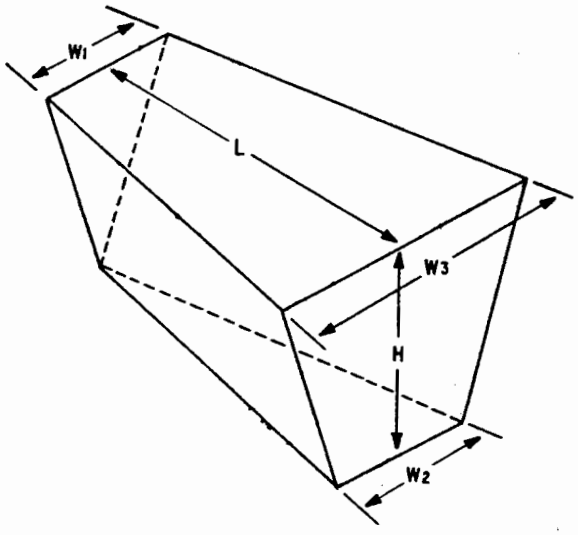
$V = \frac{(L \times W \times H)}{6}$



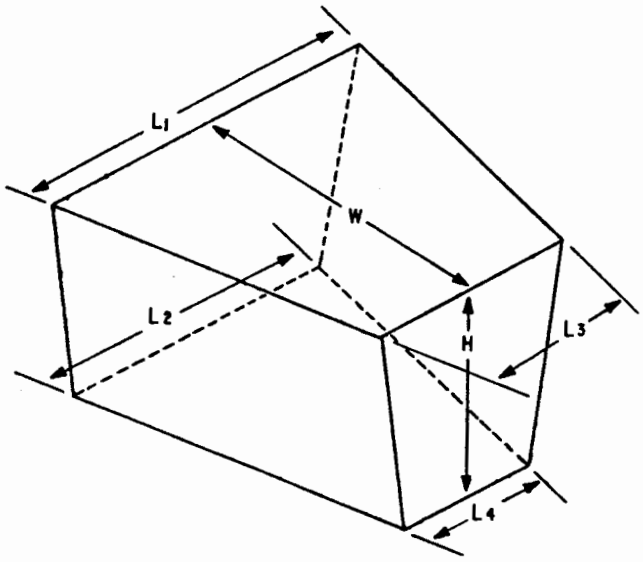
$$V = \frac{(L_1 + L_2)}{2} \times H \times W$$



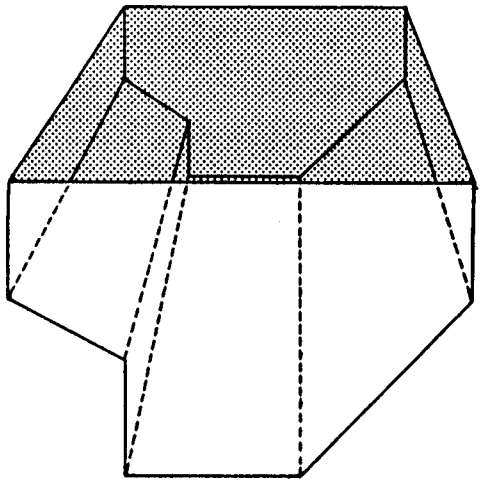
$$V = \frac{(W_1 + W_2 + W_3)}{4} \times H \times L$$



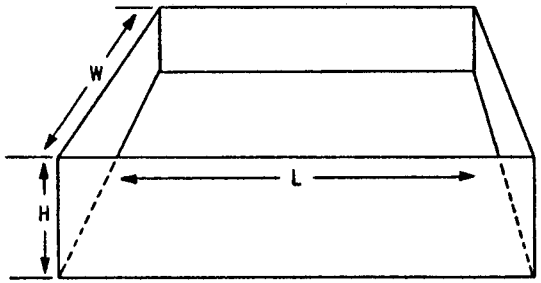
$$V = \frac{(L_1 + L_2 + L_3 + L_4)}{4} \times H \times W$$

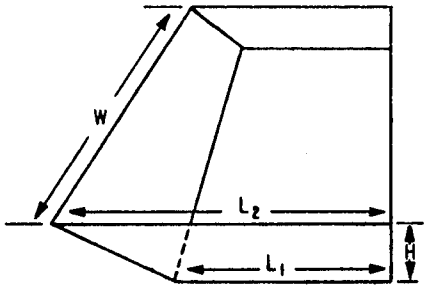


$V_T = V_1 + V_2 + V_3 + V_4$

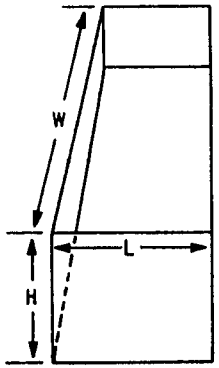


$V_1 = L \times W \times H$ →

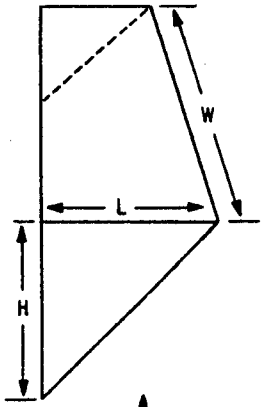




$V_2 = \frac{(L_1 + L_2)}{2} \times H \times W$



$V_3 = L \times W \times H$ →



$V_4 = \frac{L \times W \times H}{2}$

Appendix - 2

Data Sheets Specifications and Codes

APPENDIX 2: TABLE 1

Set & Catch Record Sheet Specifications

The following "Blocks" are based on the frequency with which each Variable may change during a trip. Note that all values under **Digits (Column #)** are for electronic database users only; Observers are to ignore this middle column of information.

BLOCK 1: Fill in all of its Variables for Set #1, then leave blank for the remaining sets of this trip. If data changes for one or more Variables, then Blocks **#1, #2, #3, and #4** must be completed.

BLOCK 2: Fill in all Variables relevant to the particular fishery for Set #1, then leave it blank for the remaining sets of this trip. If data change for one or more of the applicable Variables, then Blocks **#2, #3, and #4** must be completed.

BLOCK 3: Data for some of its Variables will always change for each set. Therefore, fill in all of its Variables for every set during the trip.

BLOCK 4: Data for some of its Variables will always change for each set. Therefore, fill in all of its Variables for every set during the trip.

BLOCK 1

Variable Name	Digits (Col#)	Codes and Notes
Deployment # Trip Number	4 (19-22)	Record the trip number.
Year	2 (1-2)	1993 = 93
Country	2 (3-4)	Code flag state (national registry) of the vessel:

Bulgaria	= 1
Canada (Maritimes & Quebec)	= 2
Canada (Newfoundland)	= 3
Cuba	= 4
Denmark (Faroes)	= 5
Denmark (Greenland)	= 6
Denmark (mainland)	= 7
Estonia	= 32
France (metro)	= 8
France (St. Pierre & Michelon)	= 9
Germany	= 10
Iceland	= 12
Italy	= 13

APPENDIX 2: TABLE 1 cont.

Variable Name	Digits (Col#)	Codes and Notes
Country (cont'd.)		Japan = 14 Latvia = 31 Lithuania = 33 Norway = 15 Poland = 16 Portugal = 17 Romania = 18 Russia = 34 Spain = 19 UK = 21 USA = 22 Israel = 23 Ireland = 24
Trip Type	2 (89-90)	Domestic vessel-Domestic quota = 1 Foreign vessel-Foreign quota = 2 Resource Short Plant Program = 3 Charter = 4 Over The Side Sales = 5 Inshore/Offshore = 6 Research = 7 Experimental (Exploratory) = 8 NAFO shrimp trip (Norwegian) = 10
Quota (Country)	2 (87-88)	Determine which country's quota will be fished and record the appropriate "Country" code corresponding to quota origin (see Country code list above).
Vessel Side Number	10 (5-14)	Record vessel side number. Note: (1) Do not write in hyphens when recording side number: MB-140 is recorded as MB140. (2) *Distinguish between letters and numbers in the side number using the following:* Letter O=Ø Letter I=I Letter Z=Z Zero =O Letter L=L Number 2=2 Number 1=1 Example: FØ1742
Vessel Horsepower	4 (15-18)	Record vessel brake horsepower (Bhp) from the Vessel Specifications sheet.

APPENDIX 2: TABLE 1 cont.

Variable Name	Digits (Col#)	Codes and Notes
Vessel Class	2 (26-27)	Vessel class is based on gross registered tonnage (GRT):

Tonnage	Code
0-24.9	1
25-49.9	2
50-149.9	3
150-499.9	4
500-999.9	5
1000-1999.9	6
2000+	7

Fishing Gear Type	2 (28-29)	Code gear type:

Otter trawl (stern)	= 1
Otter trawl (side)	= 2
Danish seine	= 3
Cod trap	= 4
Gillnet (fixed)	= 5
Clam dredge	= 6
Longline (line trawl)	= 7
Handline (jigger)	= 8
Scottish seine	= 9
Purse seine	= 10
Rake and tong	= 13
Bar seine	= 14
Gillnet (drift)	= 15
Midwater trawl	= 16
Shrimp trawl	= 17
Pair trawl	= 18
Longline and gillnet	= 20
Automatic jigger	= 22
Scallop dredge	= 23
Off bottom box trawl (Japan)	= 24
Pots (crab; lobster; cod)	= 64
Capelin trap	= 65
2 "twin" trawls (shrimp; etc.)	= 66
Norwegian seine	= 97

APPENDIX 2: TABLE 1 cont.

BLOCK 2

Variable Name	Digits (Col#)	Codes and Notes
Codend Mesh Size	3 (30-32)	Record average mesh size of codend in mm.
Body Mesh Size/ Crab Pot Mesh Size	3 (33-35)	Record average mesh size of net body in mm for otter trawls; record average mesh size of gillnets. Obtain crab pot mesh size from the Captain and record in mm. *If unavailable or different crab pot mesh sizes are used, leave this Variable blank and explain in Comments.*
Roller Size	3 (36-38)	Record *diameter* in cm of a solid rubber disc (roller) or steel sphere (bobbin) on a bottom trawl's footrope.
Topside Chafing Gear Type	1 (39)	Code *topside* chafer type on a bottom trawl's codend: No Topside Chafer = 0 Multiple Flap = 4 other = 5 Regular Topside Chafer = 6 Modified Polish = 7
Number of Windows	1 (99)	Record number of windows used, *and indicate in Comments when a window is used.* No window = 0; One window = 1 etc.
Number of Gillnets/ Grate Bar Spacing	3 (40-42)	Record number of gillnets hauled in that set. Record distance between the vertical bars (i.e. "bar spacing" in mm) of a Nordmore grate or other type of "size sorting" panel when used on a trawl. *Record in Comments for each set whether a grate or sorting panel was used.*
Avg. Length of Gillnets/ Footrope Length	3 (91-93)	Record average length of gillnets used in that set to nearest meter. Record length of footrope to the nearest meter for shrimp trawls.
Number of Hooks/ Temp. at Fishing Depth	4 (43-46)	Record *total number of hooks hauled* in that longline set. For shrimp trawls, record water temperature at fishing depth in °Celsius (to one decimal place) when available. Otherwise, record in Comments why temperature was not available. *When there is any change in water temperature or its availability, Block #2 must be completed each time.* e.g., water temperature of -2.6°C record as -26 temperature of +0.9°C record as 9
Number of Pots	4 (94-97)	Record number of pots hauled in that set.

APPENDIX 2: TABLE 1 cont.

BLOCK 3

Variable Name	Digits (Col#)	Codes and Notes
Set Number	3 (23-25)	Start at No. 1 for each trip and number sets consecutively; regardless of whether sets are observed or logged.
Directed Species	4 (81-84)	Code species sought for that set (see vertebrate species code list of Akenhead and LeGrow 1981, or invertebrate codes of Lilly 1982).
Data Source	1 (80)	Observed = 1; Logged = 2
Start Latitude	4 (60-63)	Record position in degrees and minutes. Note: Starting position is where the gear effectively starts to fish. *For bottom and midwater trawls,* record the position where the winches stop paying out the main warp.
Start Longitude	4 (64-67)	Record position in degrees and minutes. *Use the same criteria as for* Start Latitude.
Unit Area	3 (55-57)	Record unit area using starting position of the set: e.g., write 3 2 6 for 47°40'N; 48°25'W.
NAFO Division	2 (53-54)	Code NAFO Division using start latitude and longitude of the set: Ungava Bay (S of 61°) = 6 Hudson Strait (N of 61°/W of 64°30') = 7 Baffin Island-Subarea Zero = 9 Division 1A = 11 Division 1B = 12 Division 1C = 13 Division 1D = 14 Division 1E = 15 Division 1F = 16 Division 2G = 21 Division 2H = 22 Division 2J = 23 Division 3K = 31 Division 3L = 32 Division 3M = 33 Division 3N = 34 Division 3Ø = 35 Subdivision 3Pn = 36 Subdivision 3Ps = 37 Division 4R = 41

APPENDIX 2: TABLE 1 cont.

Variable Name	Digits (Col#)	Codes and Notes
NAFO Division (cont'd.)		Division 4S = 42 Division 4T = 43 Subdivision 4Vn = 44 Subdivision 4Vs = 45 Division 4W = 46 Division 4X = 47 Division 5Y = 51 Division 5Ze = 52 Division 5Zw = 53
Avg. Fishing Depth	4 (68-71)	Record average fishing depth to the nearest meter.
In / Out 200-Mile-Limit	1 (48)	Based on starting position of the set: In = 1; Out = 2
Month	2 (51-52)	Jan = 1; Feb = 2 etc.
Day	2 (49-50)	The calendar day on which the set commenced (1-31).
Start Time	4 (72-75)	The moment that a net effectively starts to fish. Record in UTC using the 24-hour scale. Note: *For bottom and midwater trawls,* record the time when the winches stop paying out the main warp.
Duration	4 (76-79)	Record duration of the tow (from Start Time to End Time) in tenths of an hour to one decimal place: e.g., duration of 3h and 45 min is 3.75h; rounded off to the nearest tenth is 3.8. Record 3 hours as 3.0. Note: *For bottom and midwater trawls,* Start Time is when the winches stop paying out the main warp, and End Time is when the winches start to take back the net.
Avg. Tow Speed	2 (58-59)	Record the vessel's average tow speed to the nearest 10th of a knot: e.g., 4.2 knots is recorded as 4.2; 3 knots as 3.0.
Net Damage	1 (47)	Code net damage: No damage = 1 Damage: no fish loss = 2 Damage: fish loss = 3

APPENDIX 2: TABLE 1 cont.

BLOCK 4

Variable Name	Digits (Col#)	Codes and Notes
Species Name		Print full name of every species caught, with the *Directed Species recorded first, then bycatch in order of abundance.*
Species Code	4 (101-104)	See species code list.
Kept Weight	5 (105-109)	Record *round weight* in kg. If it exceeds 5 digits, split this amount and record on a second line.
Discard Weight	4 (110-113)	Record *round weight* in kg. If it exceeds 4 digits, split this amount and record on a second line.
Dir. Sp.	1 (114)	Code 1 for the main species sought in the set (i.e., that species being directed for, even when other species dominate).
Processing Code 1	3 (115-117)	Use a Conversion Factor Processing Code (App. 3; Table 7) to indicate the product type made from the *largest portion* of this species' kept weight.
Percent (%) 1	3 (118-120)	Estimate the percentage of total kept weight (whole fish) that was processed with Proc. Code 1.
Processing Code 2	3 (121-123)	Use a Conversion Factor Processing Code to indicate the product type made from the *second largest portion* (or remainder) of this species' kept weight.
Percent (%) 2	3 (124-126)	Estimate the percentage of total kept weight that was processed with Proc. Code 2.
Processing Code 3	3 (127-129)	Use a Conversion Factor Processing Code to indicate the product type made from the *third largest portion* of this species' kept weight.
Percent (%) 3	3 (130-132)	Estimate the percentage of total kept weight that was processed with Proc. Code 3.

APPENDIX 2: TABLE 1 cont.

Blocks 1-4 were designed to facilitate data entry for subsequent computer analyses. There are two additional boxes that will *not* be computerized, but do provide pertinent information to DFO. They will also aid the completion of data summary sheets and error-checking. Complete the following Variables:

Observer:	Full name
Vessel:	Full name
Avg. Fishing Depth:	Record only when average fishing depth in fathoms was used to convert to meters for Ave. Depth.
Local Time:	Record Nfld. local time using 24-hour scale ~~(a.m./ p.m.)~~.
Statistical Area:	Record an appropriate statistical area for the fishery in that set. (Note that the information for this Variable will be computerized.)

APPENDIX 2: TABLE 2

Groundfish Length Frequency Specifications

Variable Name	Digits (Col#)	Codes and Notes
Set No.	4 (2-5)	Record the set number from which a sample was taken.
Species	4 (8-11)	Code the species sampled for the length frequency (see species code list of Akenhead and LeGrow 1981).
Sex	1 (12)	Record 1 under **Male**, and/ or 5 under **F**, if measured. If the species is sexed, use an appropriate code(s) on a Sexed Frequency sheet only when a specific gender(s) is present in the sample. *Write in each first digit of every number for the whole size range used.* Use an Unsexed Frequency sheet when necessary (see Table 4).
Trip No.	3 (13-15)	Record the trip number.
Use	1 (47)	Specify whether the fish taken for measurement were: **C** = *Catch:* All fish of the sampled species in the net. **D** = *Discards:* Fish sorted/culled from the catch for discarding overboard. **L** = *Landings:* Fish kept for processing after the catch is sorted and discards removed.
Samp. Wt.	4 (68-71)	Record *actual round weight* of all fish in the sample (in kg; subtract basket weight). *Do not estimate sample weight.* If measured weight is unavailable, leave blank and explain why in Comments.
# Otoliths	3 (72-74)	Record the number of otolith pairs extracted from fish in the sample, *separating males* (**M**) *and females* (**F**) *for the Sexed Length Frequency.*
Len. Grp. =1	(75)	1 cm length grouping is used for groundfish species.
Species Total Weight	6 (62-67)	Record *total weight* of the species sampled in kg, *depending on Use* for the length frequency sample: Use = **C**: Species Total Wt = *kept weight + discard wt.* Use = **D**: Species Total Wt = *discard weight* Use = **L**: Species Total Wt = *kept weight*
Regular/ Dockside/ Port		Leave all three variables blank.

Note: Add the number of fish measured per column, and record **Total # Fish** below it.
Atlantic halibut: Record **AL** (Anal Length) measurement *on the same line to the right* of each **FL** measurement.

APPENDIX 2: TABLE 3

Shrimp Length Frequency Specifications

Variable Name	Digits (Col#)	Codes and Notes
Species	4 (6-9)	Record *maturity code* of the species sampled. Only two species, *Pandalus borealis* and *P. montagui*, are to be sampled. Refer to the section Identification of Shrimp Maturity Stages in the Sampling chapter to determine the appropriate maturity codes.
Trip	3 (14-16)	Record the trip number.
Set	3 (17-19)	Record the set number from which the sample was taken.
Year	2 (20-21)	1993 = 93
Samp. Wt.	5 (68-72)	Record the total weight of a shrimp sample (i.e., approximately 300 shrimp) to the nearest 1/10 of a kilogram. Write this value on all Shrimp Length Frequency sheets in that set. *Use a separate sheet for each shrimp maturity code* (see Identification of Shrimp Maturity Stages): e.g., record 2.7 for a sample weight of 2.65 kg. Pour off excess water, weigh and subtract bucket weight. *Do not include weights of SST shrimp* (i.e., Soft Shell Tally shrimp are those with shells too soft to be measured for length).
Sample Type	1 (73)	Record the type of sample taken for length frequencies: *Commercial Catch:* Code 2 for a random sample of the total catch (i.e., what comes up in the net before sorting) from a vessel in a commercial fishery. *Discard:* Code 4 for a random sample of the discards (i.e., shrimp that are sorted from a commercial catch and then discarded overboard).
HR/FR (Headrope/Footrope)	6 (55-57/ 58-60)	Record *headrope length and footrope length* of a shrimp trawl to the nearest meter: e.g., code 75/84 for a net with a 75-m headrope and 84-m footrope.
SST (Soft Shell Tally)		Tally all sampled shrimp with shells too soft to be measured. Do not include SST shrimp in the shrimp length groupings, nor in Sample Weight. *Broken or damaged shrimp are not part of a soft shell count.*

APPENDIX 2: TABLE 4

Grenadier Length Frequency Specifications[1]

Variable Name	Digits (Col#)	Codes and Notes
Len. Grp.	1 (75)	Length grouping code is 5 = 0.5 cm

[1]Note: Refer to the Groundfish Length Frequency Specifications (App. 2: Table 2) to fill out the remaining header portion of a Grenadier Length Frequency Sheet.

APPENDIX 2: TABLE 5

Large Pelagics Length Frequency Specifications[1]

Variable Name	Digits (Col#)	Codes and Notes
Mesh Size	3 (27-29)	Record average mesh size of codend in mm for otter trawls; record average mesh size of gillnets. Leave blank if the large pelagic specimen(s) is a directed species.
Fish Number	4 (81-84)	Starting with the first fish of that species, *consecutively number measured specimens throughout the trip.*
Species Code	4 (85-88)	Record a species code using Akenhead and LeGrow 1981.
Sex	1 (89)	M = Male F = Female Blank = unsexed
Dressed Length	5 (120-124)	Record dressed length to nearest cm, *only if the fish is gutted with head and tail removed* (Fig. 34).
Fork Length	5 (95-99)	Record fork length to nearest cm (Fig. 34). *For Greenland and Basking sharks,* measure Total Length.
Round Weight	5 (110-114)	Record round weight to nearest kg.
Dressed Weight	5 (115-119)	Record dressed weight to nearest kg, *only if the fish is gutted with head and tail removed.*

[1]Note: Refer to the Groundfish Length Frequency Specifications (App. 2: Table 2) to fill out the header portion of a Large Pelagics Length Frequency Sheet. Record only one species on each length frequency sheet. Obtain additional measurements for swordfish following the instructions and diagrams in the chapter, Techniques of Sampling: Large Pelagics.

APPENDIX 2: TABLE 6

Conversion Factor Data Summary Specifications

Variable Name	Digits (Col#)	Codes and Notes
Trip No.	3 (1-3)	Record the trip number.
Side Number	10 (4-13)	Record vessel side number. Note: (1) Do not write in hyphens when recording side number: MB-140 is recorded as MB140. (2) *Distinguish between letters and numbers in the side number using the following:* Letter O=Ø Letter I=I Letter Z=Z Zero =O Letter L=L Number 2=2 Number 1=1 Example: FØ1742
Species code	4 (14-17)	Code the species used in this experiment (see vertebrate species code list of Akenhead and LeGrow 1981, or invertebrate codes of Lilly 1982). *Use a separate sheet for each species.*
Country	2 (18-19)	Code flag state (national registry) of the vessel: Bulgaria = 1 Canada (Maritimes & Quebec) = 2 Canada (Newfoundland) = 3 Cuba = 4 Denmark (Faroes) = 5 Denmark (Greenland) = 6 Denmark (mainland) = 7 Estonia = 32 France (metro) = 8 France (St. Pierre & Michelon) = 9 Germany = 10 Iceland = 12 Italy = 13 Japan = 14 Latvia = 31 Lithuania = 33 Norway = 15

APPENDIX 2: TABLE 6 cont.

Variable Name	Digits (Col#)	Codes and Notes
Country (cont'd.)		Poland = 16 Portugal = 17 Romania = 18 Russia = 34 Spain = 19 UK = 21 USA = 22 Israel = 23 Ireland = 24
Sample Number	3 (20-22)	Start at No. 1 for each trip and *number experiments consecutively.* Note that an experiment can involve a processing method that produces several products from the same fish. *In this case, assign a separate sample number to each product.*
Set Number	3 (23-25)	Record the set number from which fish were taken for this experiment.
Date	6 (26-31)	Record the date of the set from which fish were taken for this experiment. Year (Y): 1993 = 93 Month (M): Jan = 1 Feb = 2 etc. Day (D): calendar day (1-31)
Process Method	3 (32-34)	Record the Processing Code that describes what was done to the fish (see *Conversion Factor Processing Codes:* App. 4, Table 7).
Whole Weight	4 (35-38)	Record the total weight of whole fish used in this experiment (in kg; subtract basket weight).
Product Weight	4 (39-42)	Record the total weight (in kg) of fish product produced from the original sample.

APPENDIX 2: TABLE 6 cont.

Variable Name	Digits (Col#)	Codes and Notes
Conversion Factor	5 (43-47)	A Conversion Factor is used to calculate round weight of kept fish from product weight. *To obtain a C.F., divide whole weight by product weight for each experiment.* Example: $\frac{\text{Whole weight}}{\text{Product weight}} = \frac{172 \text{ kg}}{106 \text{ kg}}$ $= 1.62 =$ Conversion Factor Round off all Conversion Factors to two decimal places. e.g., 3.7 is recorded as 3.70; 2 is 2.00
No. of Fish	3 (48-50)	Record the number of fish used in this experiment. Leave blank when doing conversion factor experiments with shrimp.
Mean Length	3 (51-53)	Record the *average length of all fish used in this experiment* to the nearest cm. Leave blank when doing conversion factor experiments with shrimp. *To calculate average length* (Fig. 33): multiply the midpoint of each length group (stratum) by the number of fish in that stratum. Repeat for every stratum. Then add these totals over all strata, and divide by the number of fish in the sample.
Machine Type	4 (54-57)	Select the *dominant machine used* during processing, and record the first letter of its brand name and the full numeric designation. List the remaining machine types used in the Comments section. Leave blank when doing conversion factor experiments with shrimp. e.g., Baader 440 is coded as B440 Circular Saw (of any brand) is coded as C100 Processing by hand is coded as 1000
Problem Type	2 (58-59)	Record all problem types using the following codes. Note that *"trimming" only refers to the removal of additional peripheral flesh by hand.* 2 = Minor adjustments to processing equipment by the crew, to increase product yield (machines adjusted more finely than the standard).

3 = Major adjustments to processing equipment by the crew, to increase product yield.

4 = More careful removal of fin bits and blood spots than the standard, to increase product yield.

5 = Reduced trimming on top quality products, to increase yield.

6 = Minor adjustments to processing equipment and more careful removal of fin bits and blood spots, to increase product yield.

7 = Major adjustments to processing equipment and more careful removal of fin bits and blood spots, to increase product yield.

8 = Minor adjustments to processing equipment and reduced trimming.

9 = Major adjustments to processing equipment and reduced trimming.

10 = Product loss of less than 1% of the standard yield for this processing equipment.

11 = Product loss of 1-3% of the standard yield for this processing equipment.

12 = Product loss of greater than 3% of the standard yield for this processing equipment.

13 = Product loss of less than 1% of the standard yield throughout the trip, resulting from improperly adjusted processing equipment or crew interference.

14 = Product loss of 1-3% of the standard yield throughout the trip, resulting from improperly adjusted processing equipment or crew interference.

15 = Product loss of greater than 3% of the standard yield throughout the trip, resulting from improperly adjusted processing equipment or crew interference.

16 = Poor quality fish (i.e., fish "gone soft" from extended deck storage) that jammed processing equipment and reduced product yield.

APPENDIX 2: TABLE 6 cont.

Variable Name	Digits (Col#)	Codes and Notes
Problem Type (cont'd.)		17 = Addition of product by crew during an experiment, resulting in an artificially increased yield.
		18 = Enlarged gonads in the fish being processed, possibly resulting in reduced product yield.
		19 = Full stomachs in the fish being processed, possibly resulting in reduced product yield.
		20 = Over- or undersized fish are forced through processing equipment, resulting in reduced product yield.
		22 = Excessive removal of meat during processing, resulting from improperly adjusted or ageing equipment.
		23 = Not the dominant process for this trip.
NAFO Div.	3 (60-62)	Record NAFO Division as *alpha-numeric* using start latitude and longitude of the set from which fish were taken for this experiment.
		e.g., Div. 6 is written as 6B Div. 9 as 0 (= Baffin Island-Subarea Zero) Div. 37 as 3Ps etc.
Sample Type	1 (63)	1 = Random 2 = Machine random 3 = Size selected 4 = Large shrimp (50-90) 5 = Medium shrimp (90-150) 6 = Small shrimp (150+)
Comments		Comment on *any* aspect of processing or experimental procedure that may have affected the resultant Conversion Factor(s).
		For each product with a calculated Conversion Factor: ***List all machine types used, including hand-processing.***

Note that there are two additional Variables, Vessel Name and Species Name, that will not be computerized. ***Print the full name for each Variable.***

APPENDIX 2: TABLE 7

Conversion Factor Processing Codes

The following descriptions only refer to the *parts of fish that have been removed* during processing.

003- LIVE RSW
001 - Whole (frozen or iced).
002 - Bled (whole).
010 - Head off, unspecified cut.
011 - Head off, single cut.
012 - Head off, collar bone out, single cut.
013 - Head off, V-cut.
014 - Head off, wedge-cut.
015 - Head off, round-cut.
099 - Fins trimmed.

100 - Gutted.
103 - Gutted, head off, single cut.
104 - Diagonal cut (single or double), gutted, head off, belly flap removed.
106 - Gutted, head off, collar bone out, single cut.
107 - Gutted, head off, V-cut.
108 - Gutted, head off, wedge-cut.
109 - Gutted, head off, round-cut.
110 - Gutted, head off, unspecified cut.

118 - Gutted, tail off.
119 - Chunked.
120 - Gutted, head off, tail off, collar bone out.
121 - Gutted, head off, tail off, collar bone out, fins trimmed.
122 - Gutted, gilled, tail off, fins trimmed.
126 - Gutted, head off, fins trimmed.
127 - Gutted, gilled, tail off.
128 - Gutted, head off, tail off, fins off (Porbeagle).
129 - Gutted, gilled.
130 - Gutted, head off, soundbone removed, fresh (split fish).
135 - Gutted, head off, soundbone removed, salted (split fish).

Note: All 200 Series processes (except 206, 207, 208) have fin bits and blood spots removed by hand. This is *not* defined as trimming. *"Trimmed" only refers to the removal of additional peripheral flesh by hand,* to yield a uniformly thick product with no ragged edges. Also, "boneless" refers to fillets with a V-shaped cut that removed any bones or spines at the pectoral fin area.

200 - Fillets, skinless, boneless, trimmed.
201 - Fillets, scaled, boneless, trimmed.
202 - Fillets, boneless, trimmed.
203 - Fillets, skinless, trimmed.
204 - Fillets, scaled, trimmed.
205 - Fillets, trimmed.

206 - Fillets, skinless. Fin bits and blood spots have not been removed.
207 - Fillets. Fin bits and blood spots have not been removed.
208 - Fillets, skinless, boneless. Fin bits and blood spots have not been removed.
210 - Fillets, skinless, boneless.
211 - Fillets, scaled, boneless.
212 - Fillets, boneless.
213 - Fillets, skinless.
214 - Fillets, scaled.
215 - Fillets.

Note: All 300 Series V-cut fillets result from a process involving the removal of a large portion of the belly flap and spines. *"Trimmed" is the same as for the 200 Series.*

300 - V-cut fillets, skinless, trimmed.
301 - V-cut fillets, scaled, trimmed.
302 - V-cut fillets, trimmed.
310 - V-cut fillets, skinless.
311 - V-cut fillets, scaled.
312 - V-cut fillets.

Note: The 400 Series applies mainly to Greenland halibut (turbot). *"Trimmed" is the same as for the 200 Series.*

403 - Topside fillet only, skinless, trimmed.
405 - Topside fillet only, trimmed.
413 - Topside fillet only, skinless.
415 - Topside fillet only.

503 - Livers.
504 - Bodies (gutted, head off, topside fillet removed: e.g., *turbot*).
505 - Head only (e.g., *turbot*).
506 - Bodies and livers.
510 - Tail off (bobtailed).
511 - *Skate* wings.
512 - Tails (usually *monkfish*).
513 - *Skate* bodies.
600 - Cooked, peeled, frozen *(shrimp).*
610 - Cooked, frozen *(shrimp).*
611 - Raw, frozen *(shrimp).*
612 - Industry *(shrimp).*

700 - Tubed *(squid).*
799 - Oil (reduction).
800 - Meal.
801 - Canned product *(whole fish).*
802 - Minced *(fillet trimmings).*
803 - Fins only.
898 - "Blanched" meats *(clams).*
899 - Meats *(scallops).*
900 - Crew consumption.
901 - Bait.
902 - Cooked, glazed meats *(clams).*

APPENDIX 2: TABLE 8

Scallop Shell Height Frequency sheet

Variable Name	Digits (Col#)	Codes and Notes
Vessel	2 (1-2)	Vessel number will be provided during Briefing.
Trip	3 (3-5)	Record the trip number.
Set	3 (6-8)	Record the set number from which a sample was taken.
Grid	2 (9-10)	*Leave blank.*
Stn.	4 (11-14)	*Leave blank.*
Trans.	3 (15-17)	*Leave blank.*
Year	2 (18-19)	1993 = 93
Mo	2 (20-21)	Jan = 01, Feb = 02 etc.
Day	2 (22-23)	The calendar day on which the set commenced (1-31).
Lat.	5 (24-28)	In degrees and minutes to 1 decimal: eg. 47°30'30" = 47305
Long.	5 (29-33)	In degrees and minutes to 1 decimal: eg. 57°45'30" = 57455
Dur.	3 (34-36)	Record *duration* of the tow (from start to finish) in minutes.
Tow Dist.	3 (37-39)	*Leave blank.*
Depth	4 (40-43)	Record average fishing depth to the nearest meter.
Gear	4 (44-47)	Scallop dredge. Coding to be announced.
Div.	2 (48-49)	Record NAFO Division as *alpha-numeric with only two digits,* using start latitude and longitude of the set: e.g., 3Ps = 3P
Unit area	3 (50-52)	Leave blank.
Stratum	3 (53-55)	Record stratum fished, using a *scallop stratum chart* provided during Briefing.

APPENDIX 2: TABLE 8 cont.

Variable Name	Digits (Col#)	Codes and Notes
Sample type	1 (56)	Specify whether the scallops taken for measurement were: *Landed* (6): Scallops kept for processing after the catch is sorted. *Catch* (7): A subsample of scallops from the dredge before sorting. *Discard* (8): Scallops sorted from the catch for discarding overboard.
Btm. type	1 (57)	*Leave blank.*
Btm. temp.	3 (58-60)	*Leave blank.*
Spp.	1 (61)	Sea/giant scallop (Placopecten magellanicus) = 1 Iceland scallop (Chlamys islandica) = 2
Cond.	1 (62)	1 = live 2 = cluckers: *A "clucker" is a dead/empty scallop with both shells still attached at the hinge.*
Catch wgt.	6 (63-68)	Record total weight *(= kept weight + discard weight)* of the catch in kg to 2 decimal places.
Sample wgt.	6 (69-74)	Record whole weight of scallops in the sample (in kg; subtract basket weight). *Only include scallops that are measured for the frequency.*
Broken shells	3 (75-77)	Record the number of *broken, unmeasureable shells* in the sample. If no broken shells are present, record 000.

APPENDIX 2: TABLE 9

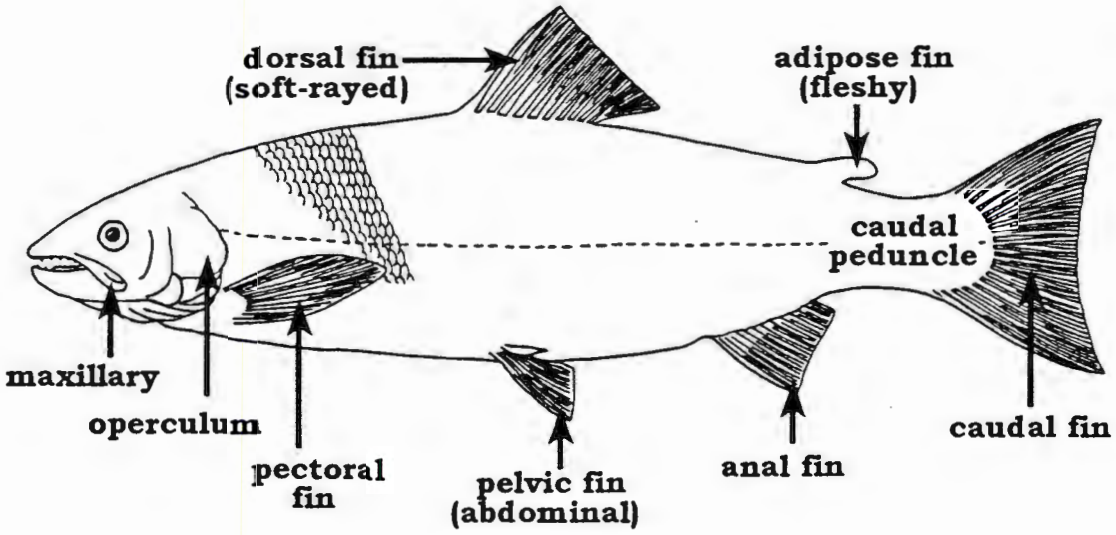
Clams Frequency Sheet

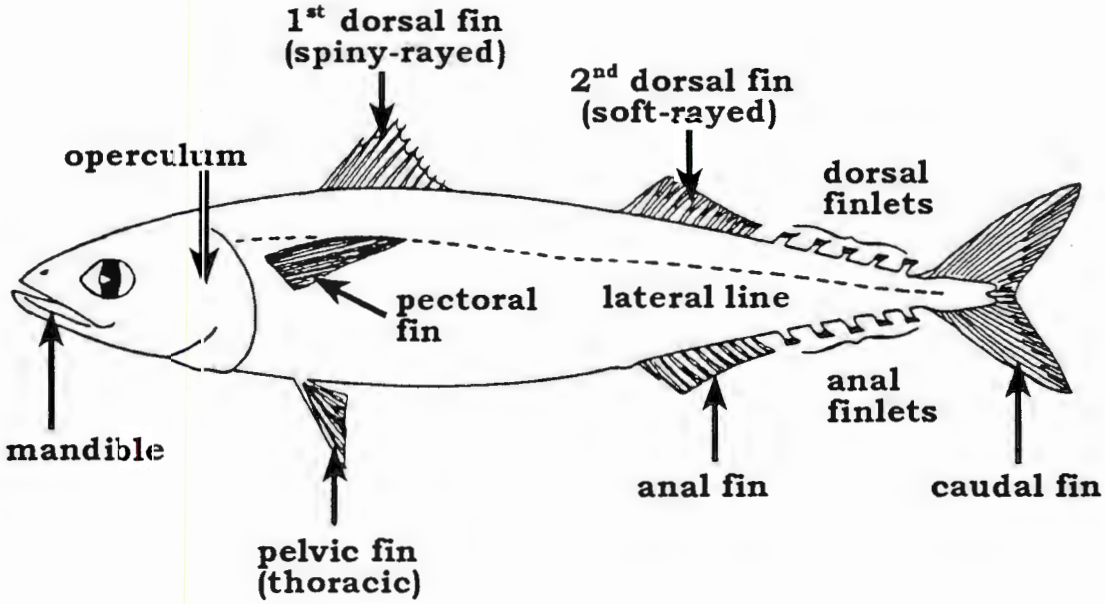
Variable Name	Digits (Col#)	Codes and Notes
Species	4 (1-4)	Stimpson's surf clam (Mactromeris polynyma) = 4377 Greenland cockle (Serripes groenlandicus) = 4343
Vessel	3 (5-7)	Concordia = 100 Atlantic Vigour = 101
Trip	3 (8-10)	Record the trip number.
Set	3 (11-13)	Record the set number from which a sample was taken.
Year	2 (14-15)	1993 = 93
Month	2 (16-17)	Jan = 01, Feb = 02 etc.
Day	2 (18-19)	The calendar day on which the set commenced (1-31).
Latitude	5 (20-24)	In degrees and minutes to 1 decimal: eg. 47°30'30" = 47305
Longitude	5 (25-29)	In degrees and minutes to 1 decimal: eg. 57°45'30" = 57455
Division	3 (30-32)	Record NAFO Division as *alpha-numeric*, using start latitude and longitude of the set: e.g., 3Ps
Unit Area	3 (33-35)	Record the unit area using starting position of the set: e.g., 319
Sample Type	2 (36-37)	Specify whether the clams taken for measurement were: *Catch* (2): A subsample of clams from the dredge before sorting. *Landed* (3): Clams kept for processing after the catch is sorted. *Discard* (4): Clams sorted from the catch for discarding overboard.
Sample Weight	5 (38-42)	Record round weight of measured clams in the sample (in kg to 2 decimals). *Only include clams that are measured for the frequency.*
Length	3 (61-63)	Measure the anterior-posterior axis in mm (*the largest distance on shell:* i.e., end to end).
Height	3 (64-66)	Measure the dorso-ventral axis in mm (*distance from hinge to opening:* i.e., a smaller distance than length).

APPENDIX 2: Table 10

Crab Research Sampling Sheet

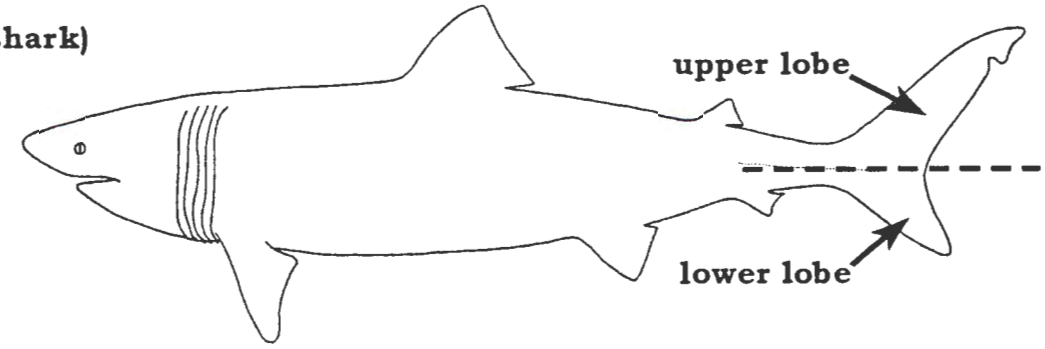
Variable Name	Codes and Notes
Species	Snow crab *(Chionoecetes opilio)* = 8213
CFV	**Record the side number (CFV)** of the vessel.
Trip	**Record the assigned trip number.**
Set	**Record the set number**. (same as **Set Number** on the Set & Catch Record)
Trap no.	Number consecutively for each trap sampled in a fleet. **Note: Never subsample a trap**. Randomly select and measure all male crabs from a trap. Do not select traps from the end of a fleet; start sampling after the 5th trap has been hauled.
Sex	1 = Male **(sample males only)**
Year	2000 = 2000
Females	**Count and discard all females** from the sampled trap and record the total number of females at the top of the sampling sheet.
Width	**Measure carapace width to the nearest mm** (lateral distance on the shell from a top view using the "0" mark on calipers): e.g., a crab of 95.8 mm = 96.
Shell Condition	Record a shell condition code, using one of the following: **1 = Soft** Claw easily bent by thumb pressure, claw iridescent on the outer edge; carapace shell without calcareous growth and brightly colored. (pinkish white on underside) **2 = New-Hard** Claw not easily bent by thumb pressure, claw iridescent on the outer edge; carapace shell with very little calcareous growth and shell bright color. **3 = Old-Hard** As in Code 2 but claw not iridescent, carapace shell color faded with larger calcareous growths and scarring.
Bitter Crab	Record whether sampled crabs have Bitter Crab Disease (a fatal disease caused by a microscopic parasite that readily infects healthy crabs), using the following description: **1 = infected** Carapace shell has an orange-pink color, the underside is chalky white and looks as if the crab has been cooked; leg joints are often pinkish with red streaks; the crab is usually in a weakened state and may appear lifeless.
Claw Height	Leave blank.


dorsal fin
(soft-rayed)
adipose fin
(fleshy)
caudal
peduncle
maxillary
operculum
pectoral
fin
pelvic fin
(abdominal)
anal fin
caudal fin


1st dorsal fin
(spiny-rayed)
2nd dorsal fin
(soft-rayed)
operculum
dorsal
finlets
pectoral
fin
lateral line
anal
finlets
mandible
anal fin
caudal fin
pelvic fin
(thoracic)

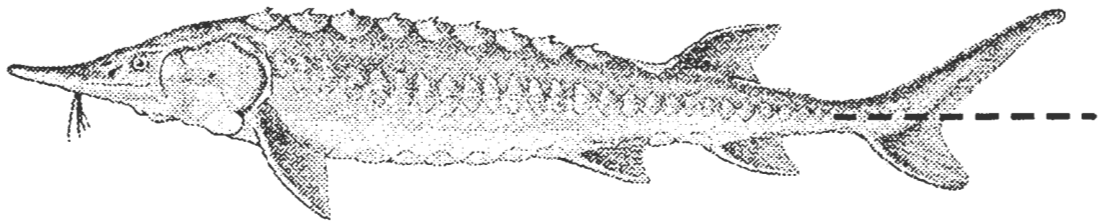
heterocercal tail

(Basking shark)



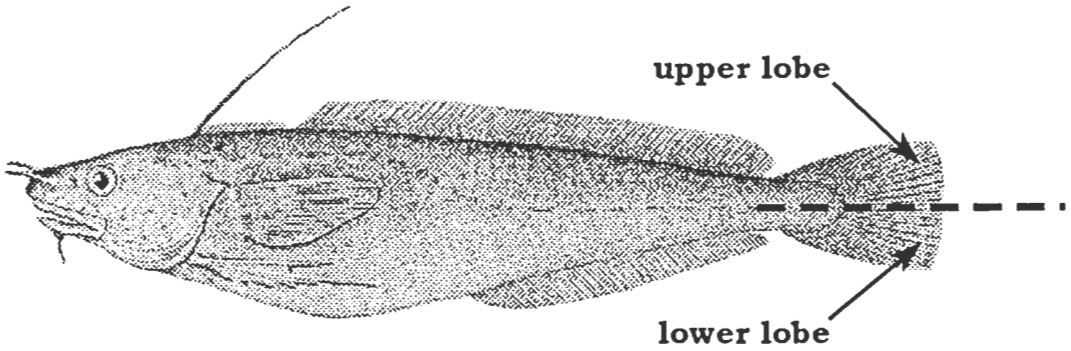
heterocercal tail

(Atlantic sturgeon)



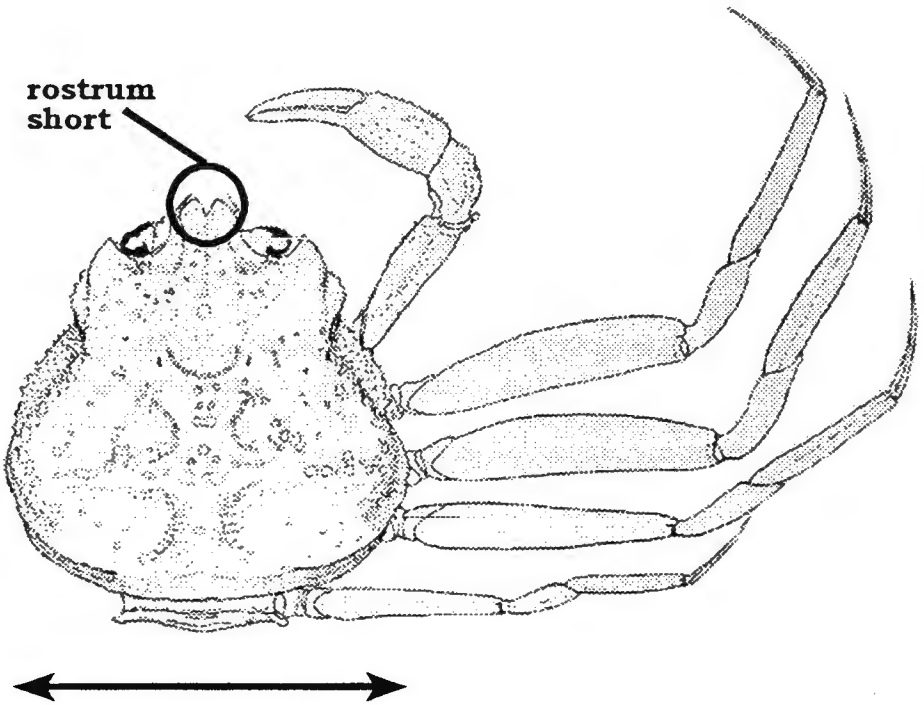
homocercal tail

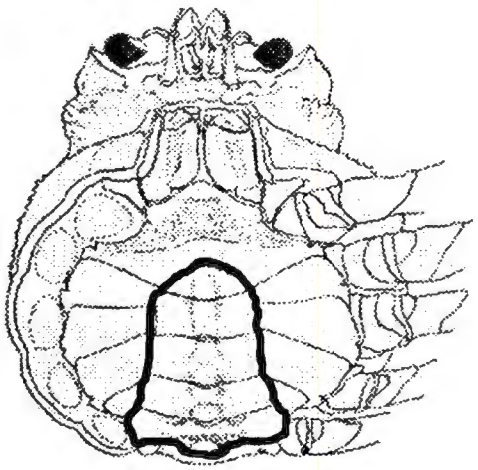
(Threebeard rockling)



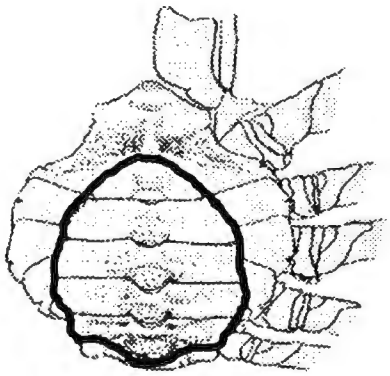
Snow crab
(Chionoecetes opilio)

Code: 8213





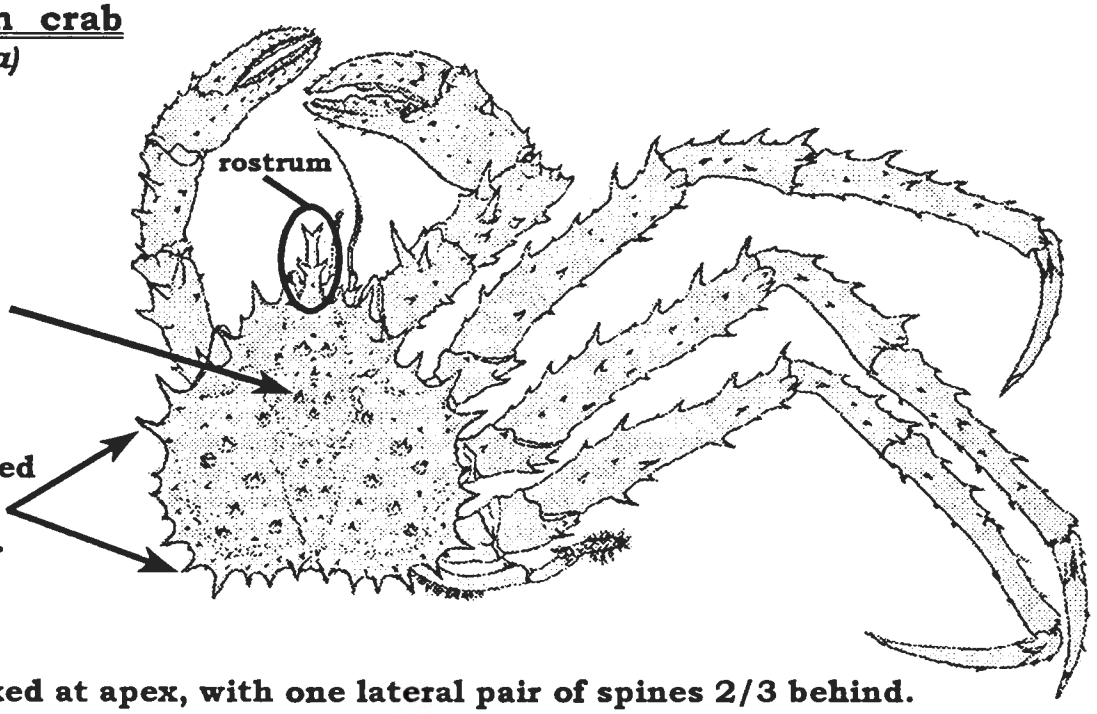
male
abdomen
(ventral view)



female
abdomen
(ventral view)

Spiny brown crab
(Lithodes maja)

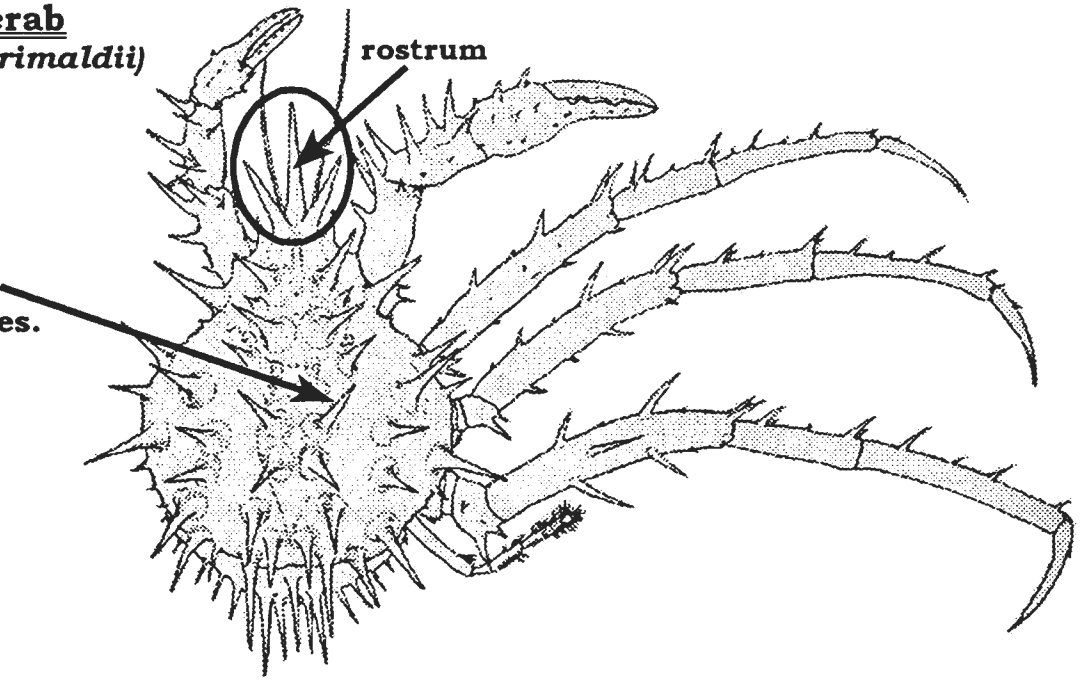
Code: 8196



Rostrum: forked at apex, with one lateral pair of spines 2/3 behind.

Spiny red crab
(Neolithodes grimaldii)

Code: 8200

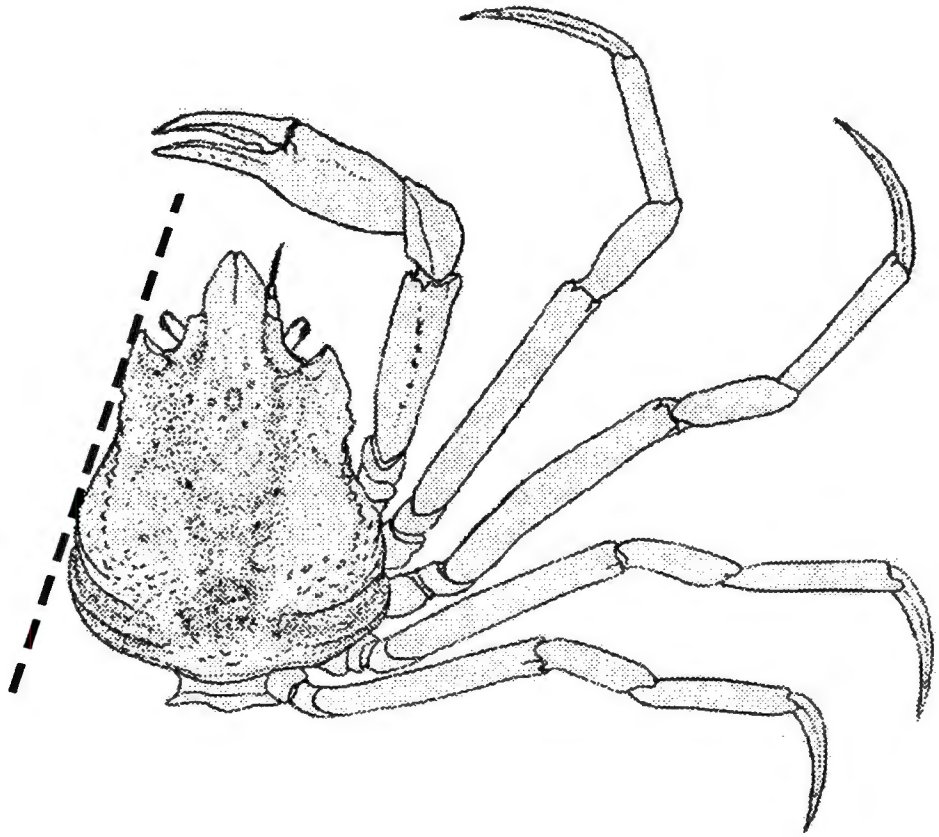


Rostrum: single strong spine, with 2 spines at its base.

Toad crab
(Hyas araneus)

Code: 8217

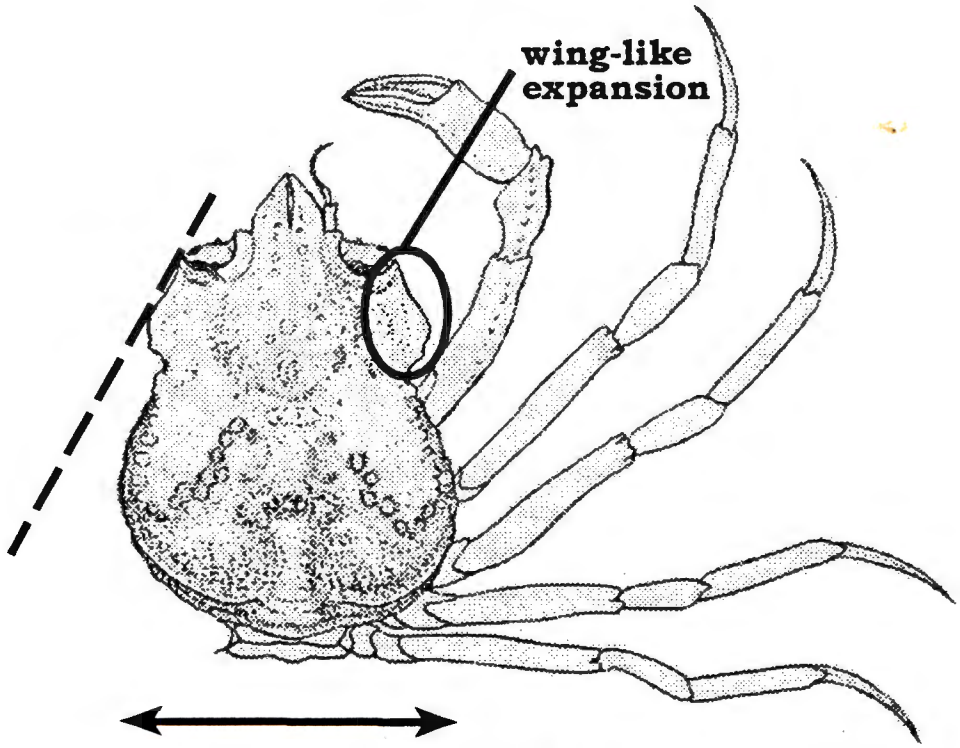
Carapace longer than its width.



Toad crab
(Hyas coarctatus)

Code: 8218

Carapace longer than its width.



Carapace wider relative to *Hyas araneus*.

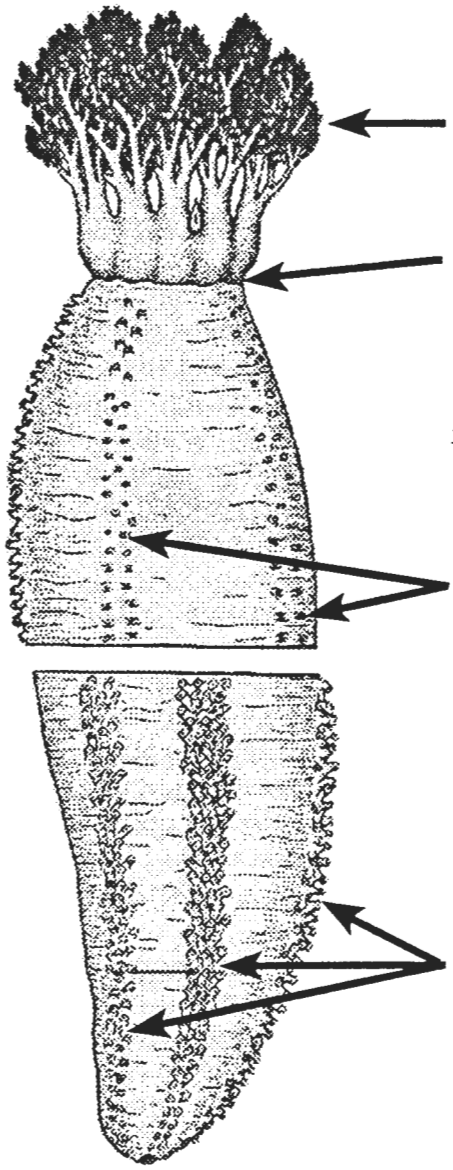
Nfld. sea cucumber
(Cucumaria frondosa)

Code: 8312

Large size.
"Football" -shaped.
Colour usually black, dark green, or brown.

Feeding tentacles usually held inside when disturbed.

Inshore and offshore.



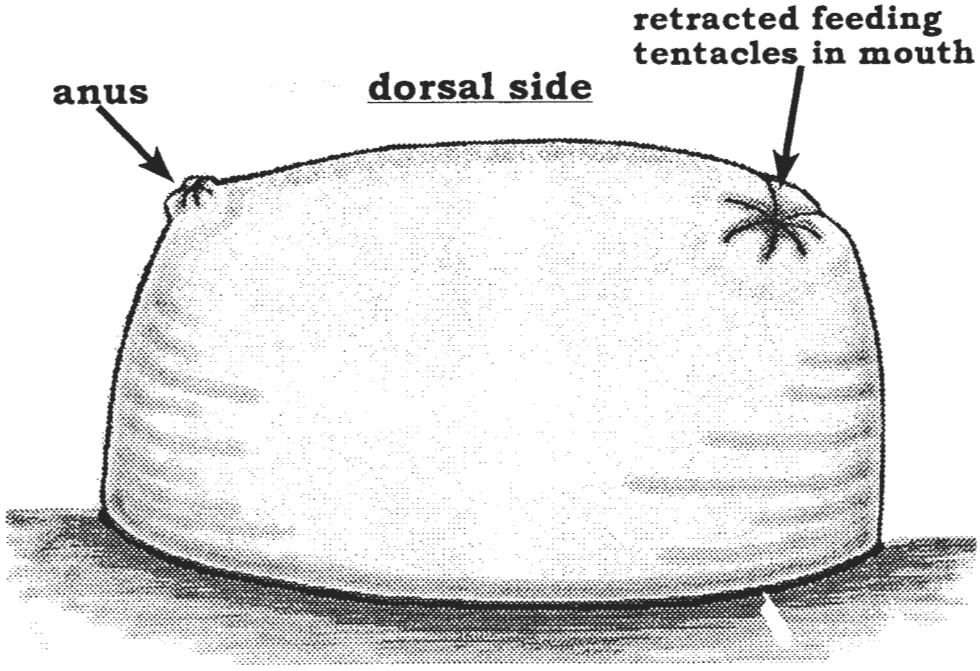
Nfld. sea cucumber
(Psolus fabricii)

Code: 8295

Small size.
"Dome" -shaped.
Colour usually red, or orange.

Feeding tentacles usually held inside when disturbed.

Inshore.



WHALE & SEAL IDENTIFICATION KEY

Wet and Fat:
Whales and Seals of
Newfoundland and Labrador
Canada

by

Dr. Jon Lien
(Drawings by Don Wright)

Whale and Seabird Associations

Newfoundland and Labrador has one of the largest seabird populations in the world. Our offshore waters are rich fishing grounds that attract between 35-45 million birds a year! There are over twenty major breeding colonies for seabirds in Newfoundland and Labrador, such as Witless Bay, Baccalieu Island and Funk Island. The productive fishing grounds that attract birds also attract marine mammals. To describe the seabirds of Newfoundland and Labrador in any detail would require another entire field guide, but we can take a look at the interactions of whales and seabirds.

Even if you don't see any whales on an excursion, you are bound to observe some form of marine bird life. Groups of circling seabirds may also be your first clue that whales are in an area. Both marine birds and mammals are attracted by the presence of schooling bait, such as capelin or squid. Plunge-diving gannets, or swarms of raucous gulls can be seen and often heard over long distances; aim your boat or binoculars in their general direction and watch closely!

Whale and seabird associations are very well known, and have been recognized for centuries. Whalers would use feeding seabirds as a clue to the presence of whales. Fishermen also use whale and seabird feeding activity as an indicator of where to set their nets.

All the observed interactions between different seabirds and cetaceans are probably due to the presence of shared prey. However, some species are seen together more often than others. Both diet requirements and feeding methods may be important factors in these associations.

In the North Atlantic, humpbacks, minkes, pothead whales, and common dolpins are most often recorded with one or more seabird species.

Humpback whales feed primarily on capelin off Newfoundland and Labrador. Groups of whales often herd the fish into tight schools and then lunge towards them, through the surface of the water pushing fish ahead of them. Gulls and shearwaters can often be seen diving for leftovers as humpbacks lunge-feed. Puffins, guillemots, and auks feed by making relatively deep dives from the surface. They too can be seen feeding on capelin in the same areas as humpbacks. Sometimes when whales are lunge-feeding, seabirds are accidentally swallowed with the gulps of fish.

Minke whales often feed by driving fish to the surface from deeper waters. This brings them within range of surface-feeding birds, such as kittiwakes, terns, gulls, shearwaters, and petrels, which are usually recorded with feeding minkes.

Pothead whales and common dolphins also feed by herding schools of bait into tight concentrations. This makes the prey more accessible to diving birds such as gannets, murres, puffins, and guillemots. Dolphins often breach during feeding, which may be used partially to herd or stun fish. This breaching activity may also attract seabirds to the feeding sites. Scavenging gulls and shearwaters can be seen taking stunned and injured fish left by the dolphins.

Whale faeces are another food source for surface-feeding seabirds and scavengers. Petrels and pothead whales are often associated in this manner.

Other North Atlantic species such as blues, finbacks, orcas, and sperm whales are not as regularly associated with seabirds. These whales use different feeding methods and/or prey on bait species which are not as useful to seabirds. However, killer whales have been known to eat seabirds; a different type of interaction altogether!

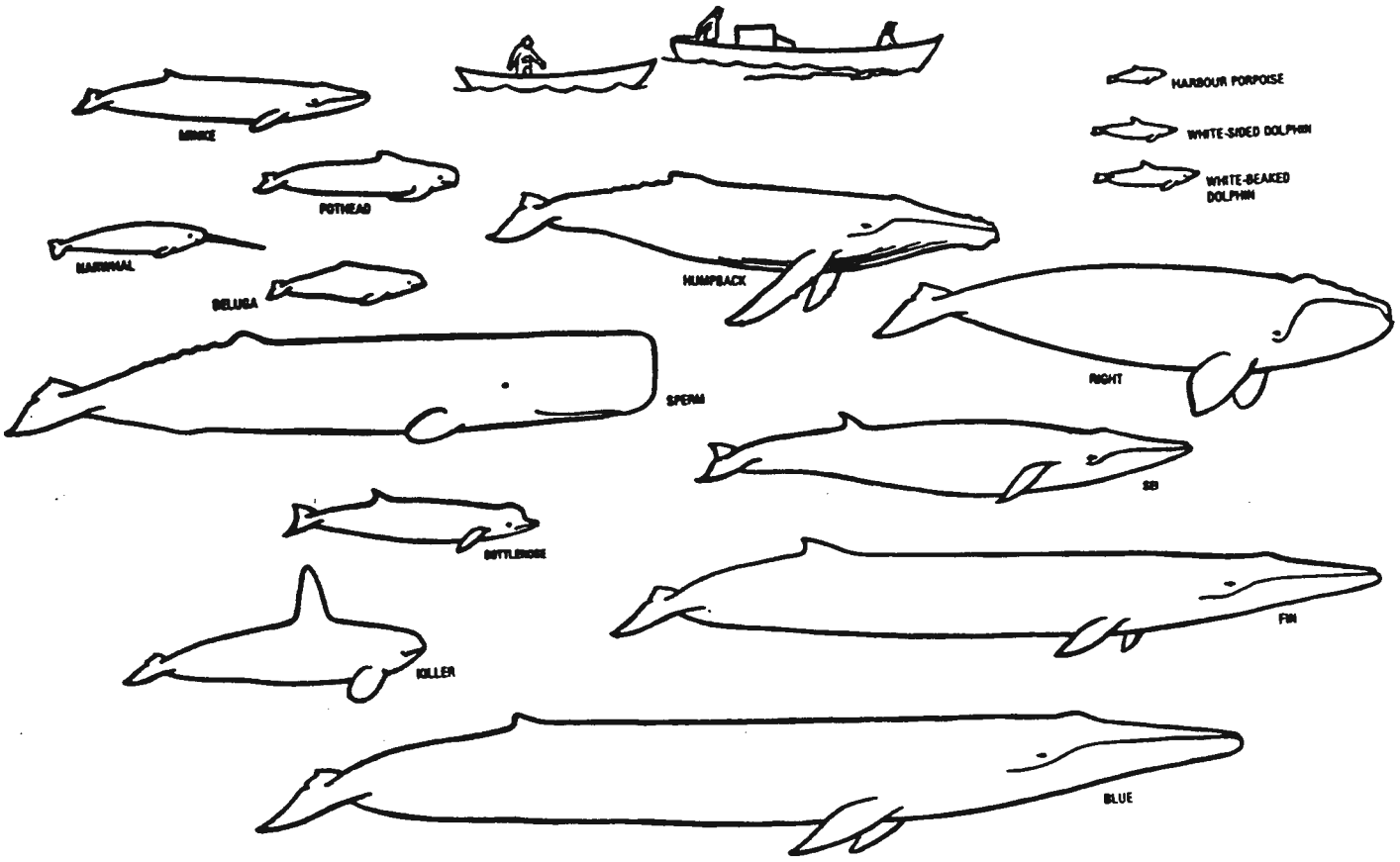
Who benefits from these associations? It seems to be mostly the seabirds. Whales feeding at the surface in an area provide visual clues to birds of the presence of a relatively unpredictable and patchily distributed food supply. Whales that lunge-feed, or concentrate bait at the surface seem to provide an opportunity for birds to feed more easily.

However, some researchers say whales may also benefit, by using feeding seabirds as a prey indicator. Gannets and kittiwakes are the seabirds most commonly associated with whale species. It is interesting to note that they are both white birds, and easily visible at a distance. Many whale species spy-hop when far out at sea, and plunge diving gannets, or swarms of feeding kittiwakes could serve as possible clues to a prospective meal.

Whatever the causes, accidental or intentional, whale - seabird interactions are a fascinating part of whale-watching. So bring along a bird field guide too, and enjoy the birds.



Whales of Newfoundland and Labrador



Key information in identifying large whales

	Humpback	Sei	Fin	Blue	Sperm	Right
Shape of Blow						
Dorsal fins						
Flukes on Dive		Not visible	Not visible			

Humpback Whale *(Megaptera novaeangliae)*

Common names: Hump, Trouble, Keporkak

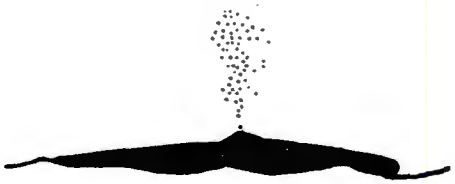
Identification

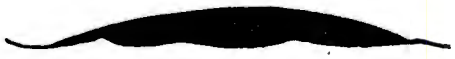
- commonly seen inshore in summer especially when capelin abundant
- most sightings from May-September — some winter sightings
- usually seen singly, or in small loose groups (2-8 animals)
- 35-40 ft. (11-13m) long — young animals from 25 ft. (8m)
- most notable are the long, white flippers about one third of the body length
- robust body with broad, rounded head
- wart-like kobs on the head distinguishable at close range
- baleen is dark
- back is black — undersides are mostly white
- dorsal fin located about two-thirds of the way back is variable in shape
- frequently the dorsal fin appears to be on a hump — conspicuous when diving
- blow bushy, balloon-shaped — often seen first — then the back
- after a series of 5-10 blows — a terminal dive sometimes occurs
- on most terminal dives the tail flukes can be seen clearly above water
- fluke pattern can be used to identify individuals like finger prints
- may be seen lunge feeding, breaching, flippering or lob-tailing



Blue Whale *(Balaenoptera musculus)*

Common name: Sulphur-bottom, the Biggest Kind











Identification

- uncommon but regular sightings in some areas
- seen singly, in pairs, or small groups
- the largest baleen whale — the largest animal that has ever lived
- males from 70-85 ft. (21-26m) — females from 75-90 ft. (23-28m)
- very broad 'U'-shaped head — all dark grey with central ridge
- long streamlined body
- coloration is pale blue-grey to dark and black
- coloration is mottled with irregular spots
- flippers are short — about one-tenth of body length
- flippers are dark on top, light underneath
- dorsal fin is far back and very small
- often, fin only visible just before animal is about to dive
- flukes are large and all dark
- when resurfacing, blow is a slender vertical column up to 30 ft. (9 m) tall
- head and blow hole may remain visible when small dorsal fin appears if the animal is moving slowly
- if the animal is moving more rapidly, the dorsal fin is only seen on about one blow in five
- flukes sometimes raised just above water in a terminal dive
- flukes at a 60 degree angle, not straight up in the air

Identification of stranded animals

- the most positive trait — its large size
- dark baleen plates on both sides
- broad 'U' shaped head
- dark, mottled coloration may be intact on fresh specimens
- there are from 55-58 ventral grooves that extend to the navel

Fin Whale *(Balaenoptera physalus)*

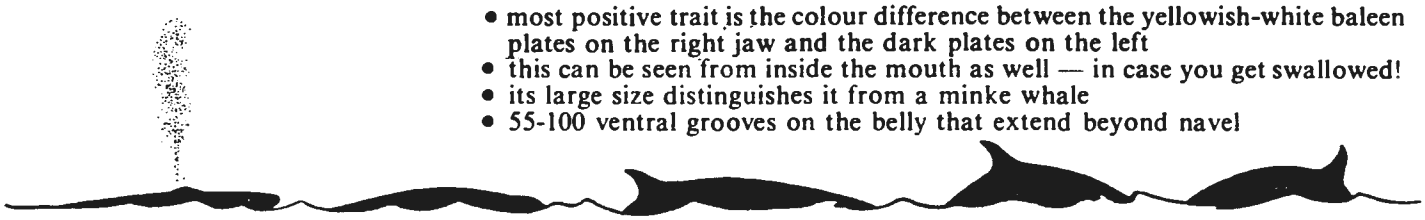
Common names: Finback, Finner

Identification

- commonly seen offshore and inshore in most areas
- usually in small groups (2-8) — single animals also seen
- very large baleen whale — 60-75 ft. (18-23m) long
- head is wedge-shaped with a distinctive ridge in centre
- right lower jaw and front baleen is white — left lower jaw and baleen is dark
- colour is dark or dark grey on back — belly is light
- behind the head, a pale grey 'V' on the back can sometimes be seen
- flippers are dark on top, light underneath
- flippers comparatively small — about one-ninth of body length
- streamlined body shape — the fin is a sleek, fast swimming whale
- dorsal fin is curved and rather pointed
- fin located about two-thirds of the way back
- minke whales have a similar dorsal fin shape but are a much smaller animal
- dorsals on blue whales appear similar but the fin is smaller and the blue is larger and mottled in colour
- on resurfacing the head appears first — immediately blows
- blow is very tall (15 ft. — 4.5m) and column-shaped
- after blowing, a long back appears — followed after a period by the dorsal fin
- after 5-8 blows a terminal dive is made
- often there is a marked arch to the back
- flukes are almost never exposed in air during a terminal dive

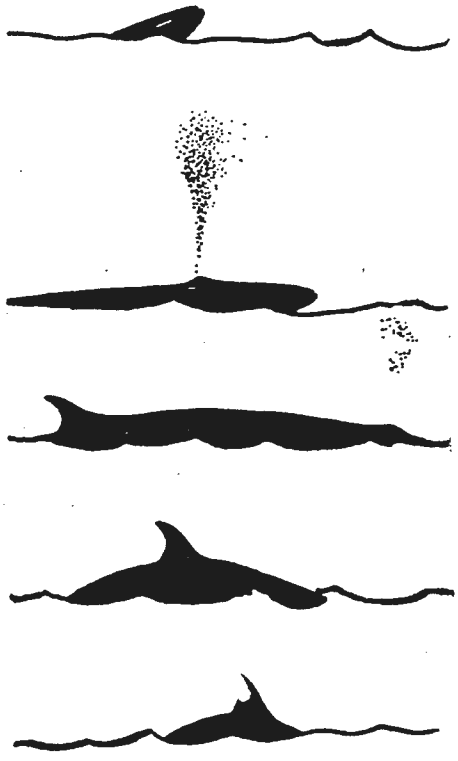
Identification of stranded animals

- most positive trait is the colour difference between the yellowish-white baleen plates on the right jaw and the dark plates on the left
- this can be seen from inside the mouth as well — in case you get swallowed!
- its large size distinguishes it from a minke whale
- 55-100 ventral grooves on the belly that extend beyond navel



Sei Whale *(Balaenoptera borealis)*

pronounced 'say'

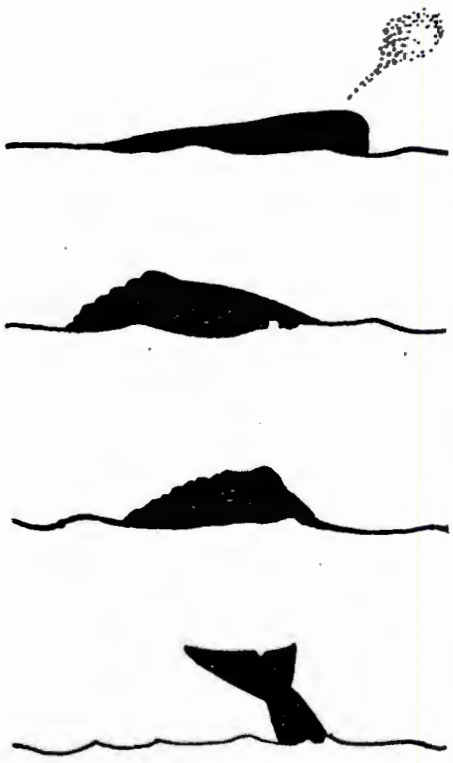


Identification

- commonly seen in small numbers in summer off Newfoundland
- offshore stock is present year round in the Labrador Sea
- often seen singly, or in groups of 2-10
- length under 50 ft. (15m) — average about 44 ft. (13.5m); streamlined body
- not as slender as a fin whale — not as robust as a minke
- head is flat and wedge-shaped with central ridge
- line of mouth arched; coloration on both sides of head is dark
- can be distinguished from fin whales by approaching on right side of whale - fins have white on right lower jaw, sei do not
- baleen plates are dark-black with white bristles
- coloration of back is dark grey — sides are dark — underside is lighter grey
- there may be lighter spots on the back and sides
- flippers are all dark — relatively small
- dorsal fin is fairly large, located less than two-thirds of the way back
- shape of dorsal fin is similar to fin whale but typically more hooked — dorsal
- fin is located farther forward than dorsal of fin or blue
- flukes are all dark
- when surfacing to blow, head may be seen
- often head, back and dorsal fin all appear at about same time, just after the blow
- blow is cone shaped - like fin or blue blow but not as high
- may blow several times and then dive for short period
- 5-6 blows may occur followed by longer dive
- in terminal dive there is generally less arching of the back than a fin
- in terminal dive sei whales appear to sink; flukes do not show above water

Sperm Whale *(Physeter catadon)*

Common name: Moby Dick



Identification

- largest toothed whale
- common offshore species in deep water - inshore sightings are infrequent
- seen in groups or singly
- sexually dimorphic — males are large, 40-55 ft. (12-17m)
- females from 25-38 ft. (7.5 - 12m)
- head is square and appears above water when the animal blows
- blowhole is well forward on head and located to left of midline
- coloration is dark brown/grey — body has a wrinkled appearance
- males commonly have many scars on body
- flippers are short and robust
- dorsal hump appears as a low fat fin
- many females have a distinct callus on the forward portion of hump — this is lacking in males
- series of lumps or knuckles behind the dorsal hump
- tail flukes are large and powerful - all dark
- when surfacing the blunt head appears above water
- blow is directed forward and to the left
- blows tend to be very noisy
- head and blow are sighted first, then the back is visible
- usually the animal lies at the surface, quite stationary
- blows for 10 minutes or so — often blows 20-50 times before diving
- when diving the head disappears
- back is arched so that the dorsal lump and knuckles are exposed
- dives are usually nearly vertical
- flukes are lifted into the air
- dives are deep and may last a long time (from 30-60 minutes)

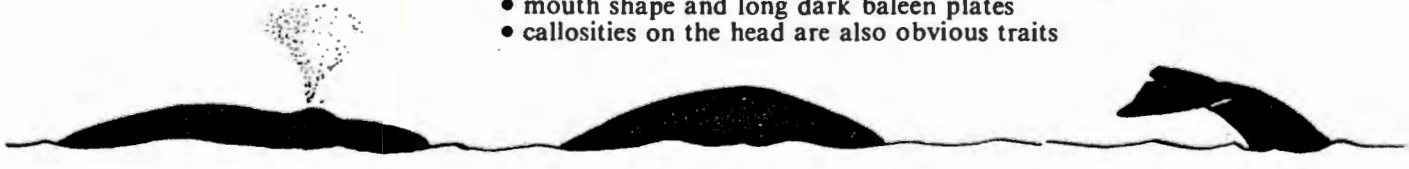
Right Whale *(Eubalaena glacialis)*

Identification

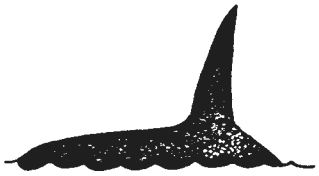
- very rare in Newfoundland and Labrador waters
- occasional reports of sightings in Trinity Bay and Bonavista Bay
- may occur elsewhere
- recent sightings in our waters have been of individuals
- in other areas small groups are common
- large baleen whale about 50 ft. (15m) long
- large head (25 percent of body length)
- series of lumps or callosities on head, in front of blowhole
- callosities are light coloured — may protrude as far as 4 in. (10 cm)
- two blow holes are widely separated
- if feeding, the head and long baleen plates (up to 7 ft./2m) may be visible at the surface
- baleen is light in front, dark in back
- the body is round and stocky with a broad fat back
- no ventral grooves and the dorsal fin is absent
- color is black but there may be light scars
- may be white patches under the chin and around the navel
- calves are often much lighter than adults
- because of the wide separation of the blowholes, when the whale resurfaces two distinct low, bushy spouts appear in a 'V' shape
- after blowing at the surface for 5-10 minutes, the animal dives
- when diving, the tail flukes are thrown high in the air
- flukes have pointed tips, a deep notch and are dark below

Identification of stranded animals

- most positive traits are absence of a dorsal fin and throat grooves
- mouth shape and long dark baleen plates
- callosities on the head are also obvious traits



Key information in identifying medium-sized whales

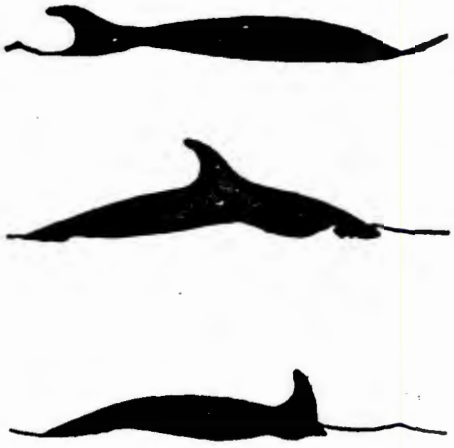
	Fin Shape	Coloration	Group Size
Pothead		All dark	Large
Minke		All dark	Single or several animals
Bottlenose		All dark	4-10 animals
Killer		White patch visible	4-10 animals

Key information in identifying small whales

	Group Size	Dorsal Fin	Coloration
Harbour porpoise	Single animal, pairs or small group	Present	Black back
White-sided dolphin	Larger group	Present	Black back
White-beaked dolphin	Larger group	Present	Patches of white or grey in front and back of dorsal
Beluga	Single animal, pairs or small group	None	White
Narwhal	Single animal, pairs or small group	None	Mottled

Minke Whale *(Balaenoptera acutorostrata)*

Common names: Mink Whales, Herring Hog, sometimes Grampus

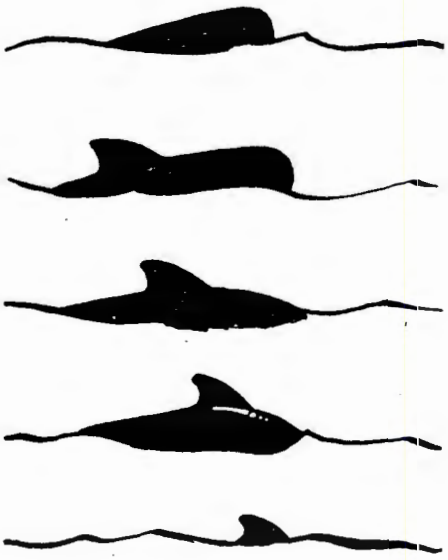


Identification

- a common whale in all waters around Newfoundland and Labrador
- the smallest baleen whale
- maximum length is 30 ft. (9m) — more commonly 24-26 ft. (7-8m)
- usually seen close to shore and singly
- may be seen offshore and in small groups
- a narrow, triangular shaped head, with a central ridge
- head is black — shading to white under lower jaw
- baleen is white
- flippers are about 10 percent of body length
- conspicious band of white on each flipper
- back is black with occasionally visible broad light band from behind the flippers up the side
- dorsal fin is tall, extremely pointed and hooked slightly backward - located in last one-third of the back
- underside is light grey/white
- about 60 throat grooves which end well before navel, just after the flippers
- flukes are dark on top - light on the bottom
- when resurfacing the pointed head often can be seen followed quickly by blow
- blow is low and inconspicuous
- commonly blows several times and then submerges
- on resurfacing often moving in a different direction
- blow and dorsal fin visible at the same time
- usually 2-6 blows, and then a dive for 2-4 minutes
- in a terminal dive the back is sharply arched
- flukes do not come above water
- may sometimes be seen lunge-feeding, but more often dive for fish

Pothead Whale *(Globicephala melaena)*

Common names: Pilot Whale, Blackfish



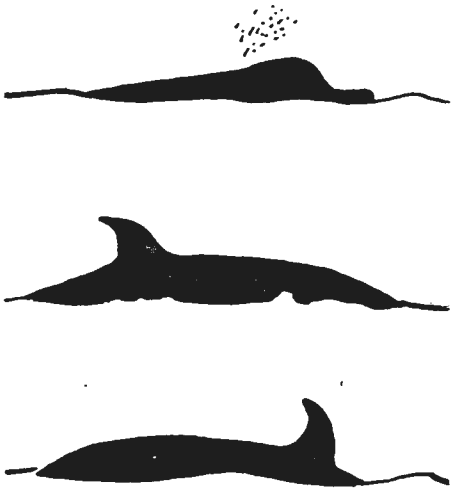
Identification

- commonly seen inshore in summer where squid are abundant
- always seen in groups from 5-200 animals
- groups of 20-50 animals are most common inshore
- groups consist of animals of both sexes and of various sizes
- during summer this includes newborn calves 5-6 ft. (1.5-1.8 m)
- large males may reach 20 ft. (6 m)
- females are smaller — 14-18 ft. (4.5-5.5m)
- head is visible when animal blows
- head is thick and bulbous — shaped like a pot
- toothed whale — 20-22 teeth in upper jaws
- coloration is black except for light grey anchor-shaped pattern under the head and a light band extending along the belly
- newly-born young are noticeably lighter in colour and mottled
- usually individuals surface to blow at different times
- flippers are long and distinctly pointed
- the dorsal fin is heavy with a long base — low in profile
- the blow can be seen close up but is inconspicious at a distance
- in resurfacing usually the 'pothead' can be seen
- blowing in a group is irregular
- it is difficult to follow the blowing pattern of any one animal
- a group may spend a period blowing, and then change behaviour for a while with little time spent at the surface
- on occasion, spy-hopping, lob-tailing and breaching can be seen
- young animals sometimes swim on their back or sides at the surface, rapidly flapping their flippers in the air

Identification of stranded animals

- in Newfoundland waters, potheads mass strand fairly commonly and several individuals may be found on a beach in the same area

Northern Bottlenose Whale *(Hyperoodon ampullatus)*



Identification

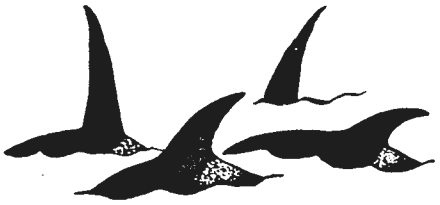
- common in deep water (around 3000 ft./1000m) off Labrador
- in summer there are some sightings in inshore Labrador waters
- unusual in water shallower than 600 ft. (180m)
- a medium-sized whale — average length is about 30 ft. (9m)
- seen in groups, often densely packed
- solitary animals, probably males, are also seen
- blunt forehead and beak
- bulbous forehead is most pronounced in males and large females
- there is a noticeable neck line — robust body
- flippers relatively small and dark
- dorsal fin is sickle-shaped — located about two-thirds back
- there is no notch in the flukes
- coloration is variable — calves are dark-brownish in colour
- patchy areas of lighter colours develop with age
- extremely large animals may have light-coloured heads
- in general, appear a light chocolate brown
- flippers, flukes, and dorsal all remain dark
- often resurfaces sharply so that the head and beak are visible
- a low, bushy blow (3-6 ft./1-2m)
- whale usually stays at the surface between blows
- head, back and dorsal exposed at the same time
- after several minutes (as long as 10) at surface, animal dives for a long period,
- frequently as long as 30 minutes
- in a terminal dive, flukes are thrown high in air

Identification of stranded animals

- most positive traits are unnotched tail fluke
- only two teeth in lower jaw
- two throat grooves forming a 'V' shape on the chin
- the bulbous head and beak are distinct
- mass strandings have been recorded

Killer Whale (Orcinus orca)

Common names: Orca, Blackfish





Identification

- sightings are infrequent but small numbers are usually seen during summer months throughout Newfoundland and Labrador waters
- from ice entrapments, they are known to occur around here in winter as well
- usually seen in small groups of from 3-10 animals
- robust body with a round blunt head
- length of males up to 32 ft. (10m), females to 27 ft. (7m)
- head is black with oval white patch just above and behind eye
- underside of head is white
- flippers are large and round — black
- very large, triangular dorsal fin
- dorsal fins of females and immature animals less than 3 ft.tall (1m)
- dorsal on males enormous — up to 6 ft. (1.8m) tall
- black back in front of dorsal fin
- behind dorsal fin is greyish saddle visible in photographs or at close quarters
- there is enough variation in eye patch, saddle and dorsal fin to make some individuals recognizable at a distance
- white pattern from underside of head continues on the belly then divides and extends up the sides of the animal
- most conspicuous field traits are large dorsal fin of males and patches of white
- the group tends to resurface together for a series of 4-6 short shallow dives
- blows are visible as well as head and eye patch
- may move fast — speeds up to 50 kph have been recorded
- spy-hopping, breaching or lob-tailing are seen on occasion

Identification of strand d animals

- most positive traits are the white patches
- 10-12 large teeth on each side of both jaws
- large dorsal fins

Harbour porpoise *(Phocoena phocoena)*

Common names: Puffin Pig, Puffins, Common Porpoise

Identification

- the smallest cetacean — 4-6 ft. (1.2-1.8m) in length
- perhaps most commonly seen cetacean in Newfoundland and Labrador
- waters
- seen inshore in small groups, in pairs or single animals
- females with young are also seen
- groups do not appear to move in formation
- only brief glimpses of the animal are possible
- very small chunky body
- usually shy and difficult to approach
- coloration is dark grey or black on back
- light grey patches on sides — white under chin and on belly
- small flippers on the sides all dark
- flippers located completely in white portion of side coloration
- dorsal fin is broad and fairly heavy
- fin roughly triangular with a concave trailing edge
- fin appears large when scaled to portion of visible back
- flukes are dark on both sides
- usually resurfaces for series of blows each 15-20 seconds — then dives for 3-6
- minutes
- blows are commonly heard in calm weather but not seen

Identification of stranded animals

- most positive traits are small robust body
- small teeth (22-28 per jaw)



White-sided Dolphin *(Lagenorhynchus acutus)*

Common names: Jumper, Squidhound

Identification

- very active, fast-moving dolphin
- usually seen in groups of 20-50 animals
- larger groups are occasionally seen offshore
- seen inshore during summer — offshore during other times of year
- other times of the year seen offshore
- may be seen associated with potheads or white-beaked dolphins
- feeding on squid
- fast swimming and acrobatic — often seen in low breaches
- small beak, but well pronounced — always dark
- lower jaw and chin white up to eye — grey above eye
- back is black
- yellow stripe on side beginning at dorsal
- darker yellow on top, lighter on bottom
- brighter yellow can often be seen when animal surfaces to blow
- flippers are all black - roughly triangular and pointed
- dorsal is large, hooked backward and pointed
- below yellow on side is band of grey — belly is white
- flukes are dark
- resurfaces as a group swimming quickly
- blows several times per minute
- may be confused with white-beaked dolphin — look for colour on side
- of white-sided dolphins

Identification of stranded animals

- yellowish colour on sides darkens in death
- coloration is best identification characteristic to avoid confusion with
- white-beaks
- known to mass strand

White-beaked Dolphin *(Lagenorhychus albirostris)*

Common names: Squidhound, Jumper

Identification

- common dolphin in Newfoundland and especially Labrador waters
- seen inshore in summer
- from ice entrapments known to occur here in winter also
- seen in small groups of 5-25 animals
- larger groups of over 100 also reported
- mature animals 9-10 ft. (2.7-3.0 m)
- some groups of slightly smaller animals
- the beak is short but distinct — often is white or pale grey
- flippers, dorsal fin and flukes are dark
- lighter grey areas appear on the sides just before dorsal fin and on back just after dorsal
- dorsal fin is triangular in shape with rounded tip
- underside from end of mouth to flukes is light grey
- seen in groups that do not leap from the water
- while moving rapidly, surfacing members of a group breach irregularly over several minutes
- look carefully at the head and beak — some white-beaked dolphins have
- white upper beak and white below — on white-sided dolphins the top of the beak is always black, white below
- pigmentation on sides and back are also useful in distinguishing two species

Identification of stranded animals

- known to be entrapped in groups in ice
- best characteristic for separating white-beaks from white-sides is the pigmentation of the head and beak
- white-beaked dolphins have 22-28 teeth per side per jaw
- white-sided dolphins have 30-40 teeth per side per jaw

Common Dolphin *(Delphinus delphis)*

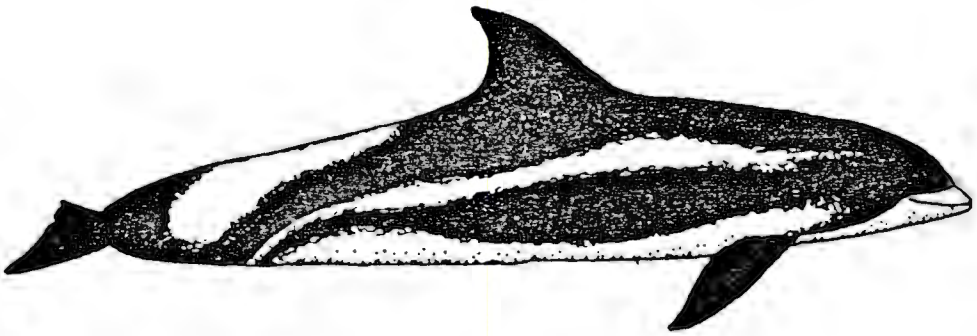
Common names: Saddleback dolphin

Identification

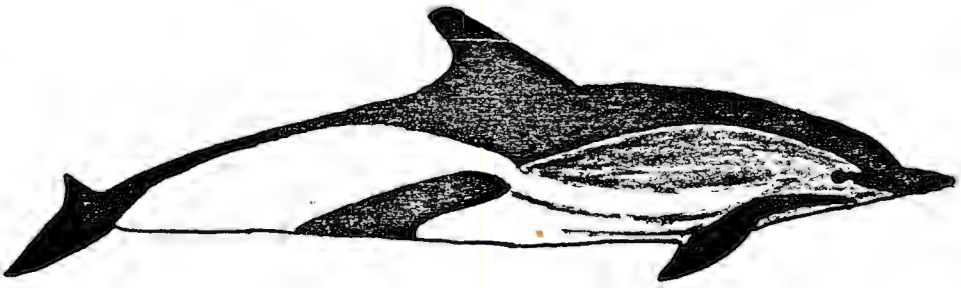
- seen offshore in large groups of 50 to several hundred animals
- very fast swimmers
- often seen breaching and playing in the bow and wake waves of ships
- mature animals 6-8 ft. (2-5 m)
- males slightly larger than females
- black, V-shaped saddle with downward point directly below dorsal fin most useful field mark
- distinct "hourglass" pattern on sides
- the forward region tan or yellow, the posterior half grey
- prominent dorsal fin triangular
- fin varies from all black to grey-white
- long, pointed beak, black eye mask
- black stripe from flipper to jaw distinctive

Identification of stranded animals

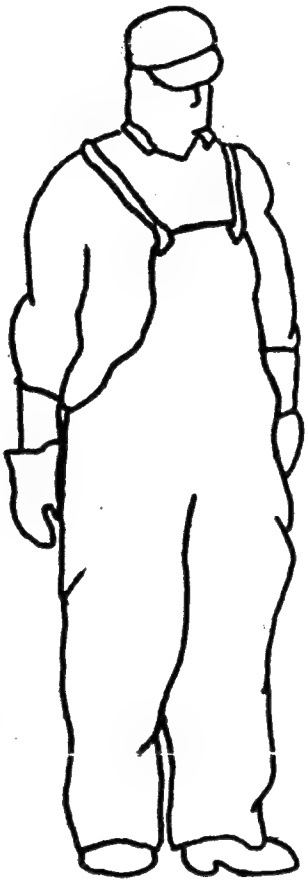
- black saddle, eyemask, and jawstripe most distinctive
- not known to mass strand
- 40-55 teeth per side per jaw

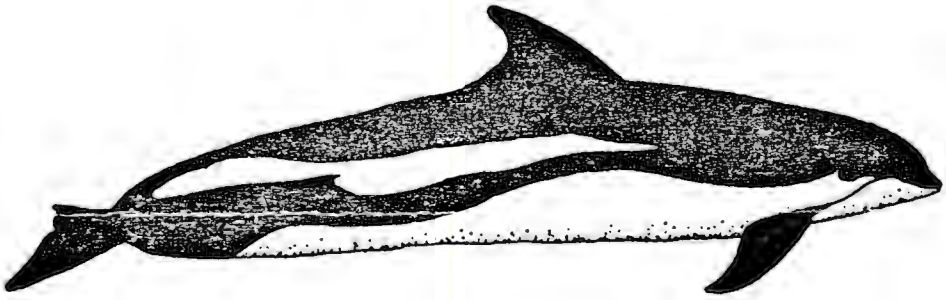


White beaked dolphin

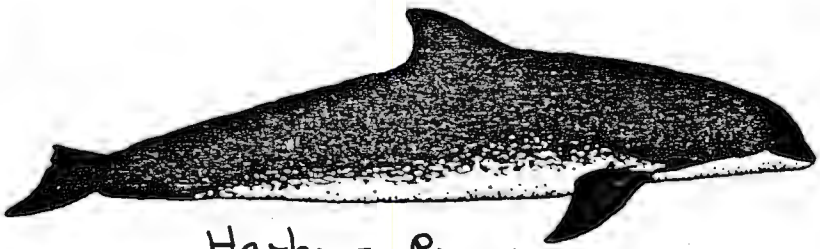


Common dolphin





White-sided dolphin



Harbour Porpoise

Beluga Whale *(Delphinapterus leucas)*

Common names: White Whale, Sea Canary

Identification

- extralimital sightings of single animals or small groups
- infrequent around Labrador and rare near the Island
- seen in groups of 3-15
- seasonally in larger groups when in normal range
- maximum overall length is 16 ft. (5m) — commonly 11-13 ft. (3.5-4 m)
- most distinctive identifying mark is all white body colour — absence of a dorsal fin
- rounded bulbous forehead
- distinct 'neck' line
- robust body shape
- flippers are relatively small and well-forward
- no dorsal fin — instead a narrow ridge composed of small bumps
- newborn calves (5 ft., 1.5 m) are brown
- gradually they lighten in color and become white by their 6-7th year
- on surfacing swim slowly, blowing several times a minute
- blows tend to be inconspicuous
- dives last 5-15 minutes

Identification of stranded animals

- most positive traits are the color and absence of a dorsal fin

Narwhal *(Monodon monoceros)*

Common name: Unicorn whale

Identification

- an arctic whale rarely seen in Newfoundland waters
- on occasion seen off Labrador in summer months
- usually seen in groups of 10 or more
- sightings and strandings in Newfoundland have been only of single individuals
- narwhals reach a maximum length of 16 ft. (5m)
- mature males are easily identified by a long tusk (up to 10 ft., 3m)
- tusk grows from the front left of the upper jaw
- females seldom have tusks
- immature males may have short tusks
- tusks have spiral twist
- head is blunt — body is cylindrical
- young animals are dark grey
- with age, animals develop numerous spots over back
- underside is light
- no dorsal fin on back
- a series of low bumps may be visible on lower back

Identification of stranded animals

- most positive trait is the tusk (in males)
- tusk develops from one of the two teeth in the upper jaw
- absence of dorsal fin and coloration are also useful

Introducing Seals

There are three main divisions of pinnipeds; the true seals (phocidae), the walrus (odobenidae) and the sealions and fur seals (otariidae - both eared seals). There are 34 species of seals world-wide. This guide will deal with 6 species of true seals found in Newfoundland and Labrador waters, and the walrus which occasionally strays this way. Eared seals do not occur in the North Atlantic.

The true seals have sleek, compact bodies with flipper-like fore-limbs. Their hind-limbs are used for propulsion in swimming but are useless for walking on land. Therefore, when on land, they use a caterpillar-hitch movement, much like an inchworm. Since progress on land is rather awkward, it is rare to find seals far from the sea where they are most at home.

These seals give birth on specific breeding grounds and then mate after the pups are weaned. Most females have only one pup although twins have been reported. For reproduction some seals form pairs. In other species, mating occurs in groups with dominant, territorial males fathering the most pups.

Seals are carnivorous, opportunistic eaters, feeding on a wide variety of fish, mollusks and crustacea. They usually eat 6-10 percent of their body weight each day. Their weight will fluctuate seasonally — for example, ringed seals will show a weight gain of 31-34 percent in the winter and a weight loss of 18-30 percent in the spring.

Seals are known for their ability to dive to considerable depths and stay submerged. They have remarkable breathing and circulatory adaptations that enable them to do this. Dives to 940 ft. (300m) have been recorded for hooded seals who can decrease their heartbeat from 100 beats/minute to 10 beats/minute and stay down for up to 18 minutes.

Key to Seals

Key features to note when you first spot a seal are its relative size and the shape of its head. Use the key to the seals to narrow down your choices. Other clues to notice are whether the animals are sighted in small or large groups and whether they are on ice, in water, or on land. Once you have a general idea of what species you are seeing, turn to that section for key identification and comparison information.

Comparison of head shapes and nostrils —

left — Harbour seal
right — Gray seal





Harp

The main predator of seals throughout history has been man. Seals are hunted for their fur, blubber (for oil), and meat.

Seal Sighting

Unlike whales, which are usually glimpsed only momentarily while blowing or diving, seals can often be seen resting in full view. This gives the observer a much better chance to identify the animal. Many species are highly social and haul-outs of hundreds of animals may be seen, especially during moulting. Again viewing conditions can vary greatly and distance, weather and sea-state all affect how much information you can obtain to determine the species.

Seals typically observe a daily pattern; they haul out at dawn, return to sea at dusk and feed at night. Good times of day to view them are about half-way through the haul-out period, around noon. Mid-low tide would be your best chance if there are tidal restrictions in the area.

Seals on land are very skittish, and almost always head for the water at the first sign of human activity. Sneaking up on seals takes patience and practice! Stay low to the ground, and downwind. On cloudy days seals seem more wary, as their vision is poorer with less light. On sunny days, they are more likely to sleep soundly and are easier to approach. During moulting season, seals generally haul out in larger groups and seem less susceptible to disturbances. Seals in the water will often show great curiosity for humans and boats, and may approach quite closely.

In the spring if you overly disturb the seals a mother may desert her pup. Even if a pup appears to be alone its mother may be close by, so do not pet or handle it.

Harbour Seal (bay seal, ranger, dotter)



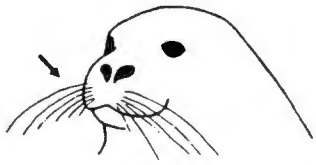
Ringed



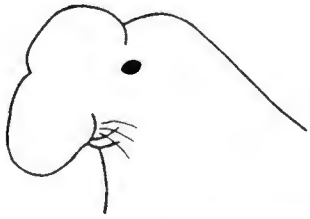
Harbour



Grey



Bearded



Hood (male with inflated hood)



Hood (female)

Harp Seal *(Phoca groenlandica)*

Common names: Harp, Whitecoat, Raggedy Jackets, Beaters, Bedlamers, Kairulik

Identification

- seasonally abundant off Newfoundland and Labrador and Gulf of St. Lawrence
- in spring, seen in large groups on ice, as seals congregate to pup and mate
- migrate and feed in loose groups of up to several hundred
- may be very lively, leaping and playing in small groups
- adults average length is 5.5 ft. (1.7m)
- head is small in relation to body
- pointed nose, low sloping forehead, large eyes
- head dark in colour
- coloration is basically light white or tan with dark patches
- in adults dark patches produce black horse-shoe shaped band or 'harp' on the
- back and sides
- males show the most pronounced harp
- females have paler harp and head
- newborn pups (to two weeks) are snow white (whitecoats)
- this coat partially moulted from 2-4 weeks (raggedy jackets)
- yearlings fully moulted have short silvery coat with dark spots along side and
- back (beaters) and are in the water
- immature harps with spotted coat more than one year old (bedlamers)

Identification of dead animals

- if coat is intact, most positive trait on adults is presence of harp

Hooded Seal *(Cystophora cristata)*

Common names: Hood, Bladdernose, Blueback, Netsivak

Identification

- common near edge of pack ice from Newfoundland to Davis Strait
- solitary except during the mating season in April and May
- large herds are formed in mating season
- large seal — 9-10 ft. long (2.7-3m)
- weight between 400-725 lbs. (180-330 kg)
- males (dogs), are larger than females
- the head of males is unusual, a hood-like sac on top of the muzzle
- can be inflated in the form of a large crest
- also an inflatable red nasal membrane through which they can blow out
- one nostril much like a balloon
- coats of adults are distinctive blue-grey in colour — covered in dark,
- uneven blotches
- face is solid black
- blotches less distinctive in water and when wet
- pups ("bluebacks") have silver grey coat with cream-white belly

Identification of dead animals

- most positive traits are the size, coloration and presence of hood on males
- skull has very short cranium with long, wide snout compared with other seals

Gray Seal *(Halichoerus grypus)*

Common names: Jar seal, Netsiak

Identification

- common in several areas of Newfoundland and Labrador
- seen in large groups during January-March breeding season
- smaller groups and individuals at other times
- sexually distinguishable — males to 8 ft. (2.4m) and 375-600 lbs. (170-300 kg)
- females to 7 ft. (2m) and 230-400 lbs. (100-180 kg)
- most obvious feature of head is a lengthened snout with wide muzzle
- general shape is that of horse or moose head without ears
- roman nose or horsehead shape is most conspicuous in males
- female's nose is more slender
- head fairly small in comparison to body
- fur coloration is variable — females often quite light in neck and dark on back
- males generally darker
- both sexes have irregular spots of light and dark
- to differentiate between gray and harbour seals in water compare relative size and examine head shape and nostrils
- gray seal has parallel slits separated by a large gap
- harbour seal has inclined slits joined at the base
- gray seals often swim "crocodile-like" with nostrils and eyes protruding slightly above the water's surface
- their exhalation is unusually loud, and can be heard over some distance
- males have massive shoulders with folded, scarred skin over chest area

Identification of dead animals

- most positive trait is the horse-head shape
- nostrils are parallel slits
- skull characterized by high, wide snout compared to other seals
- five claws are conspicuous on foreflipper

Harbour Seal *(Phoca vitulina concolor)*

Common names: Common Seal, Spotted Seal, Kassigak
Dodder (adult), Ranger (immature)

Identification

- common throughout Newfoundland and southern Labrador waters
- typically seen near shore
- may be resting close to mainland on islands
- usually alone in the water
- when resting, may be seen in small groups
- adults 5-6 ft. (1.5-1.8 m) — maximum weight 250 lbs. (115 kg)
- small head, large eyes
- short muzzle — nostrils form broad 'V' shape
- very stout, cylindrical body
- basic coat colour varies from light grey to tan, to even reddish-brown
- with dark spots
- spots are smaller and fewer on underside
- coat colour in water appears darker, and dark spots may not be visible
- daily habits are usually tied to the tidal cycle — haul out on ledges to rest and bask at low tide — disperse and hunt for food at high tide

Identification of dead animals

- body traits previously described will help

Bearded seal *(Erignathus barbatus)*

Common names: Square flipper, singing seal, Oogruk or Ugjuk, Lassies

Identification

- seen in Labrador in association with moving pack ice
- most often seen singly on ice floes
- hauled out beside escape hole or lead
- usually a solitary animal — does not form herds
- the largest of the arctic seals — 7.5 ft. (2.3m) long — weighs about 500 lbs. (230 kg)
- head unusually small for massive body
- long, bushy moustache of yellowish bristles
- coloration is uniform light to dark grey fur
- some tan to brown variations
- pups dark brown with a distinctive light face mask, and 1 to 4 light bands across head and back
- blunt, square fore flipper
- very vocal underwater — can often be heard but not seen in open water — ice areas
- songs are heard from March-July and consist of long, wavering warbles followed by short low moans

Identification of dead animals

- small head with bristle moustache and large body
- blunt fore flippers — third digit is longest — on other seals first digit is longest
- uniform coloration

Ringed Seal *(Phoca hispida hispida)*

Common names: Jar Seal, Netsiak

Identification

- common in Labrador and northern Newfoundland waters
- usually seen alone — sometimes in loose groups
- about 4 ft. (1.4m) long — males slightly larger
- weight averages about 110 lbs. (50 kg.)
- one of the smallest seals
- body round
- small head with less evidence of a neck than other species
- coloration on fur shows obvious grey-white rings on dark gray back
- silver colored belly
- pups have white woolly coat shed by 6-8 weeks
- always show preference for ice
- seen swimming among ice floes in summer, in leads in fall

Identification of dead animals

- most positive traits are small size and presence of ringed coloration on
- back with light belly