At-sea Observer Program
OPERATIONS MANUAL

Pêches et Océans

Fisheries and Oceans

Observer Operations Manual

A Training Aid and Field Reference

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Foreword

The topics included in this manual are based on the required knowledge and skills set out in the *National Course Training Standard (CTS)* and the *National Standards for Observer Training* in Canada. The purpose of this manual is to aid in training and to provide a reference during Observer deployments.

As a training aid, this manual supports the development of concepts that are fundamental to thoroughly understanding and effectively performing the job. It is written holistically whereby relationships between ideas, content and Observer duties are identified and described. Also, the Observer's perspective and particular relevance to fisheries management is emphasized. In addition to initial training this manual contributes to ongoing learning and the professional development of Observers throughout their careers.

As an at-sea reference, this manual is a resource that is readily accessible. It is a practical guide for carrying out all aspects of the job on a daily basis, but can also be used as a refreshing tool when long periods of time has elapsed between deployments of a similar nature. This manual provides recommendations and advice based on experience, that enables Observers to fulfill their duties in the most competent and professional manner possible. In addition, it stresses the importance of collecting quality data and promotes the role of this profession in fisheries management.

In addition to this manual, there are specialized training and deployment materials which provide Observers with details of fisheries being covered, management regimes in place and data collection requirements.

This manual is in the care and responsibility of the Observer and must be carried on all assignments.

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Unit 1: Acts and Regulations

Perspective

Acts and Regulations examines the composition, practical application and amending of fisheries legislation. In particular, it examines the designation, rights and duties of Observers.

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1.5 Amendment Process	Procedures required to amend regulations; and how their application can be changed.

1.1 Overview of Acts and Regulations

All fisheries in Canada are managed through the authority of Acts and Regulations. Stipulations and restrictions contained in the Acts and Regulations govern fish harvesting which in effect determines the direction of the surveillance and enforcement scheme.

Definitions

Act: a document that formally states the law.

An Act expresses the will of parliament and must be interpreted according to the intent of those who made it. To instate or amend an Act is a lengthy process usually taking two or three years and therefore Observers will seldom see major changes.

Regulation: *a legal instrument issued by Governor in Council to carry out the intent of an Act.*

A regulation must be made pursuant to an act. Regulations can be passed in eight to ten months by the Governor in Council (Cabinet) and are enacted as a result of a biological, economical, or sociological study. Regulations change periodically and must be regularly updated to ensure they are current.

Variation Order: *A change in the application of fisheries regulations intended to provide a timely response to a management issue concerning closed times, fishing quotas, and size and weight limit of fish size*

The legislative amendment process is lengthy and when situations arise that require immediate action, variation orders can be used. Variation orders refer to a change in the application of regulations normally brought about by an order from an RDG. There are exceptions in which a Fishery Officer

(Pacific herring and salmon) or a Director (British Columbia and sport fish other than salmon) may vary a close time or quota. Variations orders are intended to provide a timely response to a management issue concerning closed times, fishing quotas, and size and weight limits of fish.

When variation orders are issued notice must be given to the persons affected or likely to be affected by them. Notice can be given by announcements:

- Commercial or marine radios
- Publishing them in newspapers
- Designated publications
- Posting them in the area affected
- Transmitting them by electronic means
- Oral notice to those people affected

Many of the rules stipulated in Acts and Regulations are presently listed in licence conditions. They are designed to make the management of fisheries more flexible. This subject is discussed further in Unit 4.

Note: When queried, Observers may quote or explain regulations but must not interpret or pass judgement on them.

> ***Policy:** a high level written directive embracing the general goals and acceptable procedures of the Department of Fisheries and Oceans.*

Policies are adopted for the purpose of expediency and ease. DFO policies may be national or regional. National policy is national in scope and pertains to national or inter-regional issues, while regional policy reflects region specific issues. Policy establishes a doctrine or strategy of principles that the Department has officially adopted with respect to a particular subject, situation or development.

Canadian Acts and Regulations

In Canada there are many Acts and Regulations that govern fisheries under Canadian jurisdiction. The main Acts of concern for Observers are:

- Fisheries Act,
- Coastal Fisheries Protection Act,
- Territorial Sea fishing Zones Act,
- Oceans Act.

Canadian Acts Related to Marine Fisheries		
Title	**Date in Effect**	**Purpose**
Fisheries Act	23/04/93	Protect the inland and marine fisheries within Canadian waters.
Coastal Fisheries Protection Act	30/06/94	Protect the coastal fisheries, dealing with foreign national vessels fishing inside Canadian waters.
Territorial Sea and Fishing Zones Act	27/02/91	Defines the territorial sea, internal waters and fishing zones of Canada.
Oceans Act	31/01/97	Protects the living and non-living ocean resources of the waters of Canada extending out to the continental shelf.

Note: Reference to Acts in this manual refers to those available at the time of printing.

Fisheries regulations are made pursuant to Acts. Regulations that are of concern to Observers include:

- Atlantic Fishery Regulations,
- Marine Mammal Regulations,
- Fishery (General) Regulations,
- Pacific Fishery Regulations,
- Coastal Fisheries Protection Regulations,
- Foreign Vessel Fishing Regulations.

Canadian Regulations Related to Marine Fisheries

Title	Pursuant to	Last Update	Purpose
Atlantic Fishery Regulations, 1985	Fisheries Act	27/04/97	Regulate domestic fisheries on the east coast of Canada.
Coastal Fisheries Protection Regs.	Coastal Fisheries Protection Act	25/01/96	Regulate foreign national vessels fishing within Canadian waters.
Fishery (General) Regulations	Fisheries Act	31/05/95	Regulate domestic fisheries and protect fish habitat in Canadian waters.
Foreign Vessel Fishing Regs.	Fisheries Act	31/05/95	Regulate foreign national vessels fishing within Canadian waters.
Marine Mammal Regulations	Fisheries Act	26/01/94	Protect marine mammals within Canadian waters.
Pacific Fishery Regulations	Fisheries Act	27/04/97	Regulate domestic fisheries on the west coast of Canada.

Note: Reference to regulations in this manual refers to those available at the time of printing.

Positions of Authority

The main positions of authority within the Department respecting regulations are:

- Minister of Fisheries and Oceans
- Regional Directors- General (RDG)
- Fishery Officers

The Minister is a member of Parliament with the statutory authority to make decisions regarding national issues related to fisheries. An RDG is a public servant in charge of one of the five DFO regions of Canada, with specific authorities granted under the Acts and regulations. The RDG has the responsibility to manage the department at the regional level. The RDG has the authority to designate individuals as Fisheries Observers and assign their duties. Fishery Officers are peace officers designated by the Minister under the Fisheries Act and other Acts to enforce fisheries and other legislation. These positions of authority are generally applicable within the Department, however, the application of these authorities and responsibilities can be situation specific.

1.2 Structural Organization of Fisheries Regulations

Most regulations follows a simple rule of organizing topics from general to specific. The following table illustrates this organization as it applies to the Fisheries (General) Regulations. The two most important components of concern for Observers are the "interpretation" and the "application" components. The Act referenced at the beginning of a regulation indicates the Act the regulation was made under.

Structural Organization of Fisheries Regulations

Components	Description & Purpose	Example
Name of Regulation and an Identification number	Identifies the purpose, year, and publication number in the Canada Gazette.	*Fisheries (General) Regulations (SOR/93-53)*
Full Title of Regulations	Outlines the general intent of the Regulations.	*Regulations Respecting Fishing and Fish Habitat in General and the Payment of Penalty and Forfeiture Proceeds Under the Fisheries Act.*
Short Title	Short name for the Regulations for ease of citing.	*These Regulations may be cited as the Fisheries (General) Regulations.*
Interpretation (Definitions)	List of terms and their respective meanings specific to the regulations in which they are contained.	*"Act" means the Fisheries Act; "Department" means the Department of Fisheries and Oceans;*
Application	Specifies to what the regulations apply.	*Subject to subsection (2), Parts I to VIII apply in respect of (a) fishing and related activities in Canadian fisheries waters off the Atlantic, Pacific and Arctic coasts;*
Parts	Subdivides the regulations into major topics.	*Part I: "Periods of Time and Variation of Close Times, Fishing Quotas and Size and Weight Limits of Fish"*
Schedules	Summary reference of items mentioned throughout the regulations includes tables and diagrams.	*"Schedule I - Topside Chafers"*, and *"Schedule II - Fisheries Patrol Boat Pennant"*

1.3 Referencing Acts & Regulations

Acts and Regulations change periodically and Observers must ensure the version they are referencing is current. In addition, when referring to a particular section, the user must read it entirely. Regulations often have clarifying statements and exceptions which nullify specific situations as an irregularity. For example under the Fishery (General) Regulations, Section 55. (1) states:

> *Subject to subsection (2), no person shall, unless authorized to do so under a licence,*
>
> > *(a) release live fish into any fish habitat; or*
> > *(b) transfer any live fish to any fish rearing facility.*

In this instance, subsection (2) must also be read in order to determine the full intent of this section. Section 55 (2) continues, stating:

> *Subsection (1) does not apply in respect of fish that is immediately returned to the waters in which it was caught.*

When documenting an irregularity an Observer must ensure that the appropriate section of the regulation is cited. For example; when documenting an irregularity concerning the dumping of commercially caught fish, the proper citation of the regulation is:

> *Fishery (General) Regulations, Section 34 (2)*; [which states]:
>
> *No person who is fishing under the authority of a licence issued for the purpose of commercial fishing shall dump from a vessel any fish that has been caught in accordance with the Act and the Regulations made thereunder.*

1.4 Relevance of Regulations to Observers

There are four main aspects of the regulations that is of particular relevance to Observers. These are the legislation concerning:

- Designation
- Duties
- Rights
- Regulatory Measures

Designation of Observers

The authority for Observers and the designation thereof is found in the Fisheries Act and the Fisheries (General) Regulations (FGR). On February 1, 1991 the Observer program officially became part of the Fisheries Act by the following amendment:

> *the Governor in Council may make regulations respecting the designation of persons as Observers; their duties and their carriage onboard fishing vessels.*

Note: Upon boarding a vessel, Observers should introduce themselves and present their I.D. cards.

Under section 39 (1) FGR, the RDG has the authority to designate a person as an Observer and to assign duties to the Observer. Each Observer must be provided with a certificate of designation. The RDG may designate an Observer as any person who meets the following criteria:

- Does not hold a licence issued for the purpose of commercial fishing under the Act or any of the regulations made thereunder;
- Does not purchase fish for the purpose of resale; and
- Is not the owner, operator or manager of an enterprise that catches, cultures, processes or transports fish.

Duties of Observers

The duties of an Observer are contained in Section 39 (2) of the Fisheries (General) Regulations. This section states that the RDG shall assign Observer duties including the following:

- The monitoring of fishing activities, the examination and measurement of fishing gear, the recording of scientific data and observations and the taking of

samples;
- The monitoring of the landing of fish and the weight and species caught and retained;
- Conducting biological examination and sampling of fish.

Also refer to *Section 7.1 - Observer Duties* for more details of Observer responsibilities.

Rights of Observers

The right of an Observer to go onboard fishing vessels is specified in two sets of regulations. Masters of domestic vessels are required by FGR section 46 (2) (a) to permit an Observer to board their vessel; this requirement is reiterated in CFPR section 12 (1) (e) for masters of foreign vessels. The essence of both of these regulations is that masters of fishing vessels are required to allow an Observer to board their vessel upon the request of the RDG.

Assistance from Master

Fishing vessel masters are required to provide reasonable assistance to Observers onboard their vessels. This is expressed in FGR sections 46 (3) for masters of domestic vessels and in CFPR sections 12 (1) (h) and (i) for foreign masters. While the wording of these two regulations differ, the intent of both is to state that an Observer can expect the master to:

- Provide a suitable work area with a table and sufficient lighting,
- Give access to vessel records and logs pertaining to fishing activities,
- Provide position of the vessel in latitude and longitude,
- Facilitate the sending and receiving of messages with vessel communication equipment,
- Provide access to all areas of the vessel involved with fishing, processing and storage,
- Permit collection of samples,
- Provide storage facilities for samples,
- Assist in examination and measurement of fishing gear,
- Allow taking of photographs of fisheries operations,
- Permit collected data to be removed from the vessel, and
- Provide food and accommodations where more than 4

hours is spent aboard the vessel.

Lack of Assistance from Master

If in the event that a master fails to provide the assistance to the Observer outlined above, the Observer must fully document the situation following the format outlined in *Section 7.8 - Irregularities.*

Observers and Regulatory measures

Locating regulatory measures in the regulations and monitoring vessel compliance to them is a routine part of an Observers job. It is therefore very important that Observers know which measures apply in a given situation and their location in the regulations. Regulatory measures may also be contained in the conditions of licence and Observers will also have to review the licence in order to monitor compliance. For further information refer to *Section 2.3 - Regulatory Measures* and *Section 2.4 - Licences.*

1.5 Amendment Process

> ***Amendment:** a formal revision in the wording which indicates a change in intent of an Act, Regulation, Variation Order and Licence Condition.*

Observers are far removed from the legislative amendment process but will be notified of changes. Updated Acts and Regulations are posted on DFO's website at:

http://www.ncr.dfo.ca

Amendment of Acts and Regualtions

The process of amending Acts and Regulations can be achieved using these basic steps:

- Identification of an issue and/or problem,
- Inclusion of this issue in the Departmental Business Plan,
- Development of a Regulatory Impact and Analysis Statement, (RIAS)
- Ministerial approval of the Regulatory Impact and

Analysis Statement,
- Prepublication of the proposed amendment in the Canada Gazette,
- Actual amendment by Order and Council,
- Publication of the amendment in the Canada Gazette.

In addition, Variation Orders and Licence Conditions can be amended.

Unit 2: Fisheries Management

Perspective

Fisheries Management examines the need, objectives and rationale for managing fisheries. In particular it discusses specific regulatory measures that are currently being used to achieve broad goals and objectives.

2.1 Necessity of Fisheries Management	Defines fisheries management and the necessity to manage fishery resources.
2.2 Objectives of Fisheries Management	Biological, economical, and sociological goals of fisheries management and the development of current approaches to fisheries management.
2.3 Regulatory Measures	Rationale and application of various regulatory measures being utilized in fisheries management
2.4 Licences	Role of licences in fisheries management, the use of conditions of licence and the process by which licences are amended.
2.5 Management, and Conservation Harvesting Plans	Development and content of management and conservation harvesting plans.

2.1 Necessity of Fisheries Management

Fisheries management refers to all the actions and measures taken to sustain and conserve fisheries resources, and initiatives to enhance their utilization. Generally, fisheries are managed for two main reasons.

- Fish are a renewable resource and when managed wisely, can produce an indefinite supply. Without some form of management fisheries may disappear.
- Fish in the sea are not owned by an individual or country and cannot be managed or maintained by individuals. Restraint by one person simply makes more fish available to competitors.

Fisheries managers face the dilemma of trying to satisfy the various interests involved in fisheries. It is unlikely that all interests can be satisfied concurrently at a particular level of fishing. Fisheries managers have the responsibility to find a compromise between various interests and include it in management decision making.

2.2 The objectives of Fisheries Management

The concept of fisheries management is multi-faceted with many complex interactions and agendas within its various interest groups. The worth of management decisions are understood in different terms by different people. To harvesters it is measured in profits, job seekers relate to the numbers of jobs created and fisheries scientist are concerned with the level of fishing mortality. The traditional goals or objectives of fisheries management were difficult to define but broadly fell into three categories. These traditional objectives are discussed later in this section and include:

- Biological
- Economical
- Sociological

Recent stock collapses and closures have resulted in Canada changing the approach to managing and conducting fisheries. The revised approach involves working closely with industry to develop a responsible fishery involving a full partnership with user groups for co- management of the resource and shared commitment sustainability.

The objective is to conserve, and protect the fishery resource base and in partnership with the commercial, aboriginal and recreational users ensure a sustainable fishery and fishing industry.

In order to fulfill this objective, plans, policies and programs are implemented that protect the biomass stocks in order to assure future abundance, and provide for the fair distribution of harvestable surpluses among those dependent on the resource. A primary tool used is the development and implementation of integrated Fisheries Management Plans for each species, which incorporate input from all program areas (Science, Conservation and Protection, Aboriginal Affairs, International, and Policy).

Managing the resource means distributing access to different fish resources among the Canadians who benefit from these resources. Fish stocks are managed in a variety of ways, whether by allocating quotas to entire fleet sectors which then fish competitively, or by giving specific percentages of the quota to individuals or businesses in the form of Individual Quotas (IQs), Individual Transferable Quotas (ITQs), or Enterprise Allocations (EAs). However, the goal is always an equitable distribution of the resource with due regard to conservation for future generations.

Finally, as part of a new approach to managing the fishery, partnerships are being developed with industry. These partnerships will be built around formal agreements between the fishing industry and the Department. Under the agreements, DFO will retain core responsibilities for the conservation and sustainability of the resource, while industry will assume greater responsibility and accountability for management activities specifically related to their sector.

Biological goal

The biological objective is best and most simply stated by reiterating the aim of ICNAF (International Commission for the Northwest Atlantic Fisheries) in 1949 which was "to make possible the maintenance of a maximum sustained catch from the fisheries". This includes actions and measures that limit the amount of fish being removed in any one year and prevent fish from being caught at too young an age. In Canada, the biological objective is equated to the reference fishing level of $F_{0.1}$. This involves setting quotas at a certain percentage of the available biomass.

People primarily responsible for the biological objectives of fisheries management are DFO scientists, and interest groups such as the FRCC (Fisheries Resource Conservation Council).

Economical goal

The economical objective of fisheries management is in simplest terms: to maintain the greatest profit margin possible by getting back the greatest return for the investment. This means to keep catch as high as possible while keeping cost as low as possible. The economic objective of fisheries management can be equated to the concept of Maximum Economic Yield (MEY).

People primarily interested in the economic objective of fisheries management are harvesters and processors.

Sociological goal

The social objective of fisheries management is to maintain dependent communities and traditional ways of life by providing employment from the fishery. Employment from the fishery may result in direct jobs such as fishermen or plant workers, or indirect jobs related to servicing the fishing industry and community infrastructure.

It is impossible to have a set of management objectives and measures applicable to all fisheries at all times. At any given time one broad objective will dominate another. Economic objectives will dominate in certain fisheries, social objectives will predominate in other areas but when the resource itself is being threatened (i.e. over fishing or habitat destruction) conservation of the resource will be the main concern. Objectives of fisheries management must be tailored to the specific circumstances of a particular fishery while being based on a framework of broad management objectives.

2.3 Regulatory measures

Fisheries have been managed in some way, shape or form for many years. Some of the earliest records of fisheries management come from Egypt, Greece, and Rome where there were laws to control fishing. Prior to the 20th century, some people believed that fisheries resources were inexhaustible. However, people began recognizing that depletion of stocks was possible and management of fisheries was necessary. In the 1950's economists began to insist that economics should play a greater role in how fisheries should be managed. In the most recent years it became evident that due to the complexity of all stakeholders and various interests, fisheries managers had to take a more holistic approach to the management of marine resources.

Today in Canada there is a trend toward this approach whereby all interested parties have input into how the resource should be managed in the long term. Fisheries scientists provide the biological advice based on analysis and interpretation of data. Industry (harvesters and processors) offer input based on the economics such as the profits that can be made from fisheries resources. Interest groups including unions, committees, associations, and social scientists may advise on the social impact of fisheries management. Fisheries managers take all interests into consideration and make recommendations to the minister of Fisheries and Oceans as to how the fishery should be managed for a given stock in a given year.

Decisions and responsibilities regarding the management of Canadian fisheries rest with the fisheries management sector of DFO. The broad goals of fisheries management are achieved through the implementation of various regulatory measures. These fall into two categories:

- those that regulate fishing mortality by controlling catch composition and amount of fishing and;
- those that maintain the economic efficiency of the fishing industry.

Regulatory measures are implemented through monitoring, control and surveillance. This is done through an integrated approach involving the deployment of fisheries officers to air, sea, and land patrols; Observer coverage on fishing vessels; and remote electronic monitoring. In addition, catch quotas are also monitored through dockside monitoring.

Each regulatory measure of fisheries management has a rationale based on achieving or contributing to a broad goal(s) of fisheries management. A regulatory measure has its limitations and is ineffective when implemented independently of other measures. Instead, regulatory measures are used in conjunction with other measures to ensure fisheries are regulated in an orderly fashion that compliments the goals of fisheries management.

Regulatory measures used to manage Canadian fisheries:

- Catch Quotas
- Close Times & Areas
- Bycatch Restrictions
- Minimum Size Limits
- Gear Restrictions

Catch Quota

Catch quotas control the amount of fish taken by fishing. In the 1960's catch quotas became the primary regulatory instrument because it was easy to implement compared to a system of effort limitations which controlled the number of fishing days. Catch quotas were shared among countries or enterprises. Catch quotas are commonly calculated by a population assessment model called Virtual Population Analysis (VPA). This model is critically dependent on the assumed fishing mortality that occurred in the previous year.

A major disadvantage of catch quotas is the potential for misreporting without strict monitoring. Also, for biological considerations, this method of regulating amounts of fish taken is better suited to long lived as opposed to short lived species. For long lived species, errors in recommended catch quotas that are too large can be compensated by future reductions in catch quotas without seriously jeopardizing the health of a stock. Whereas for short lived species, errors in excessive catch quotas can have immediate and sometimes devastating consequences for the health of the stock.

Implementing catch quotas effectively requires using large amounts of reliable data to permit year-to-year adjustments in catch quotas. The Observer Program is an important source for such data. Observer data obtained through catch estimation, discard monitoring, and sampling provides data on catch (rate and amount), discards and populations dynamics. This data is important in determining fishing mortality and stock abundance which are major considerations in setting catch quotas.

Closed Times & Areas

Close times and areas are spatial restrictions on fishing implemented year-round or for specified time periods (seasons). This regulatory measure is relatively easy to apply and one of the most common techniques used to manage fisheries. Its objectives may be:

- Protect a stock from exploitation during part of its life cycle or during seasons of high vulnerability.
- Prevent over fishing of threatened stocks.
- Reduce conflicts between different gear sectors.

Observers verify vessel positions to ensure compliance to closed times and areas. Observers may support DFO enforcement by reporting fishing activity of other vessels seen fishing in an area during closed times or seasons. Observers may also be used to monitor bycatch levels and fish sizes in test fisheries to determine if areas under closure should be opened.

Bycatch Restrictions

Bycatch restrictions are used to limit the amount of certain species taken incidentally. These restrictions contribute to the biological goals of fisheries management. These limitations allow directing for one species without adversely impacting the health of other stocks. Bycatch restrictions are expressed as a percentages of the catch, or as a specified weight limitation that varies from species to species. Some bycatch species are not permitted to be retained. These are referred to as *prohibited species*. Highly sensitive bycatch limitations are usually implemented for species with low biomass levels and species under moratoria.

Observer estimates of bycatch may determine whether a fishery is opened or closed. Monitoring compliance with bycatch restrictions is a common part of an Observers daily duties and is done by:

- Identifying species
- Estimating catch
- Monitoring discards
- Monitoring production
- Verifying logbook entries
- Calculating bycatch amounts

Minimum Size

Minimum size limits of fish are intended to restrict the capture of small fish, protecting juveniles from premature exploitation. The objective is to allow capture only after fish have spawned at least once. Without such control the fish would be caught before they become mature and spawn.

Size limits are stated in terms of weights or lengths. They may be applied to individual fish or the composition of the entire catch. Individual size limits are most beneficial for species that can be returned to the water alive. By themselves, minimum size limits are not likely to meet biological or economical objectives of a particular fishery but maybe used in conjunction with minimum mesh size. Without minimum size limits there would be pressure to reduce mesh size or to ignore mesh regulation.

Monitoring fish size is a common part of an Observers daily duties. Observers monitor compliance with respect to minimum size restrictions by:

- Monitoring discards
- Monitoring production
- Identifying species
- Sampling

Observer determination of size composition of catches may justify DFO's decision to open or close a fishery.

Gear Restrictions

Gear restrictions are widely used regulatory measures to manage fisheries in Canada. Specific restrictions on gear can limit its usage in many ways. These restrictions can be used to control fishing effort, to reduce conflict among user groups or to improve selectivity.

Monitoring vessel compliance to regulatory measures concerning gear is a fundamental Observer duty. It requires knowledge of the gear and it's components, close examination and measuring gear, applying navigational and regulatory knowledge. Gear restrictions fall into the following categories.

- Gear type
- Gear configurations
- Selectivity devices
- Gear operations
- Gear amount

Gear type

Restrictions on gear type limits the type of gear that is permitted to catch certain species. For example; crab can only be harvested using crab pots.

Gear Configurations

Restrictions on gear configurations involves specific details on the construction and the design of gear. This include size limits (length, width, height, volume), mesh size and type, hanging ratio, type of material used in construction, escape mechanisms, mesh obstruction, and gear attachments and modifications.

Selectivity Devices

The mandatory use of selectivity devices is becoming more widespread with the prominence of conservation in fisheries management. Selectivity devices fall into two categories; those that select by species and those that select by size. The most common selectivity device used in otter trawls is the separator grate. This is commonly used in the northern shrimp fishery and sometimes used in groundfish fisheries to reduce bycatch (species selection). Additional separator grates may be used in shrimp trawls to sort by size but their use is not mandatory. Another type of selectivity device is the salmon deflector used in cod traps. They are installed near the mouth of the trap to prevent salmon from entering.

Gear Operations

Regulatory measures dealing with gear operations dictates how, when and where gear maybe used. It applies to both mobile and fixed gear. Restrictions on fixed gear includes; tending of gear, periods of use, and identification. For mobile gear such as otter trawls restrictions on gear operations includes areas where it maybe used and it's use in relation to fixed gear.

Gear Amount

Restrictions on gear amount controls the number of units of gear permitted to be used. This limits fishing effort by controlling the harvesting capacity of a gear sector.

2.4 Licenses

Licences have been widely used in Canada to limit access to a fishery by limiting the number of participants. They are used to allocate resources among user groups or to control harvesting capacity in order to increase economic efficiency. Licences are used in conjunction with the other regulatory measures to achieve broad goals of fisheries management. Observers often verify that the vessel has a valid licence.

> ***Fishing Licence:*** *a document that grants permission, for a specified period of time, to a person or organization to harvest certain marine species.*

Conditions of Licence

These specific conditions are known as the "Conditions of Licence" and are set out in section 22 (1) and (2) of the Fisheries (General) Regulations. They are applied to a licence group; and therefore will be the same for each licence of the same type. The purpose of licence conditions is to detail permitted activities while harvesting. This includes any condition that the Minister may specify respecting species, areas fished, vessels, gear, periods of time, reporting requirements, and catch details. Conditions of Licence allows DFO to include specific measures that can be instituted in a short time frame as opposed to changing the regulations which may take years. Conditions of Licence are adjusted annually to reflect changing circumstances and requirements. They can only include controls and restrictions as legislated by the Acts and Regulations.

Licence Amendments

Licence Conditions can be amended by the Minister during the fishing season for the purpose of conservation and protection to deal with a situation that requires immediate action. Licences that contain errors may be amended by a Fishery Officer, or by DFO licencing. Observers are only to verify that all licence amendments are attached to the licence.

2.5 Management and Conservation Harvesting Plans

The present approach to fisheries management is being manifested partially as Conservation Harvesting Plans (CHP's) which are derived from Integrated Fisheries Management Plans (IFMP's). These concepts have been a result of moving toward sharing the responsibilities of fisheries management between government and industry.

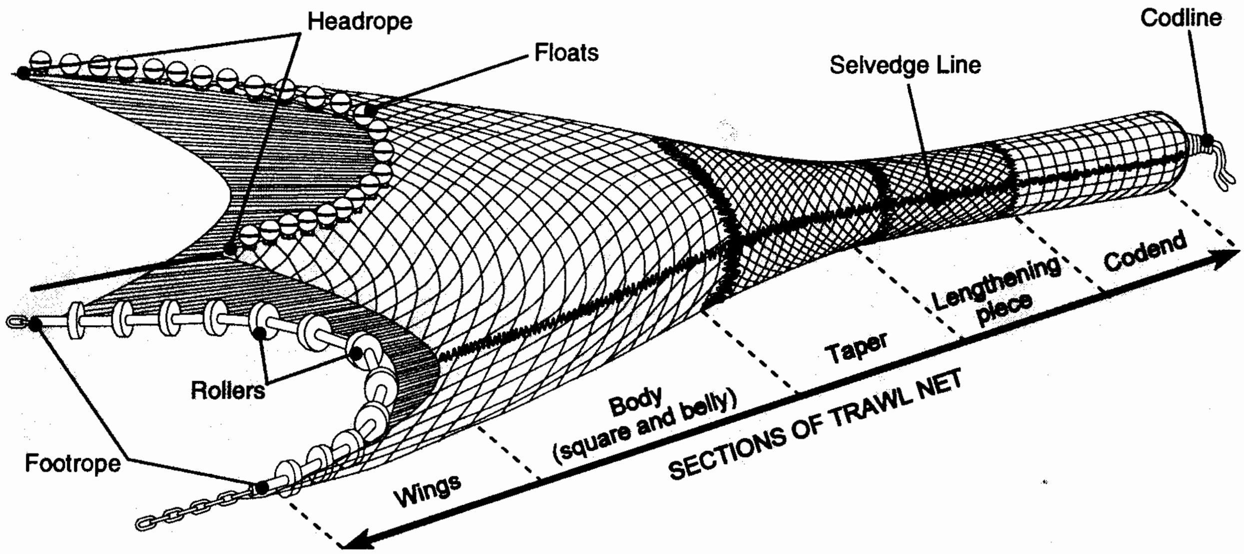
Integrated Fisheries Management Plans outline broad objectives such as the maintenance of sustainable fisheries. IFMP's are developed in consultation with all interest groups and are applied to a fishery sector such as groundfish. CHP's have very specific objectives governing the harvesting of the fishery they were developed to manage. CHP's are categorized according to criteria such as area, vessel type, and vessel size. Before CHP's can be put into management action they must receive approval by government and industry. CHP's contain very specific regulatory measures that may also be included as *conditions of license*. The result is implementing management objectives through regulatory measures on a fishery by fishery basis.

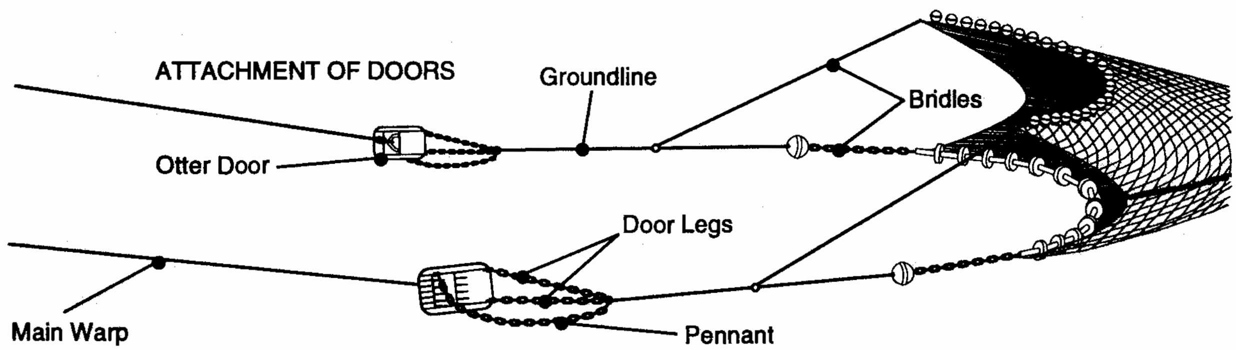
Unit 3 : Fishing Gear

Perspective

Fishing gear examines the various gear types encountered by Observers during their duties. This includes gear components, operations, enforcement and management issues and gear selectivity.

3.1 Trawl Nets	The various types of trawl nets are examined.
3.2 Longlines	Longline types are examined and distinguished.
3.3 Gillnets	Gillnet types are examined and distinguished.
3.4 Purse Seining	Purse seining operations are examined.
3.5 Trap Nets	Trap nets operations are examined.
3.6 Weirs	Weir fisheries are examined.
3.7 Tended Lines	Tended line fisheries are examined.
3.8 Harpoons	The harpoon fishery is examined.
3.9 Jigging	Jigging operations are examined and distinguished.
3.10 Trolling	Trolling operations are examined.
3.11 Crab Traps	Crab trap types are identified and fishing operations described.
3.12 Sablefish Traps	Sablefish trap operations are described.
3.13 Lobster Traps	The lobster trap fishery is examined.
3.14 Scallop Rakes	Inshore and offshore scallop rakes are described.
3.15 Clam Dredges	Clam dredging operations are described.
3.16 Legislation and Conditions of Licence Respecting Fishing Gear	Examines the legislation and regulatory requirements pertaining to gear.





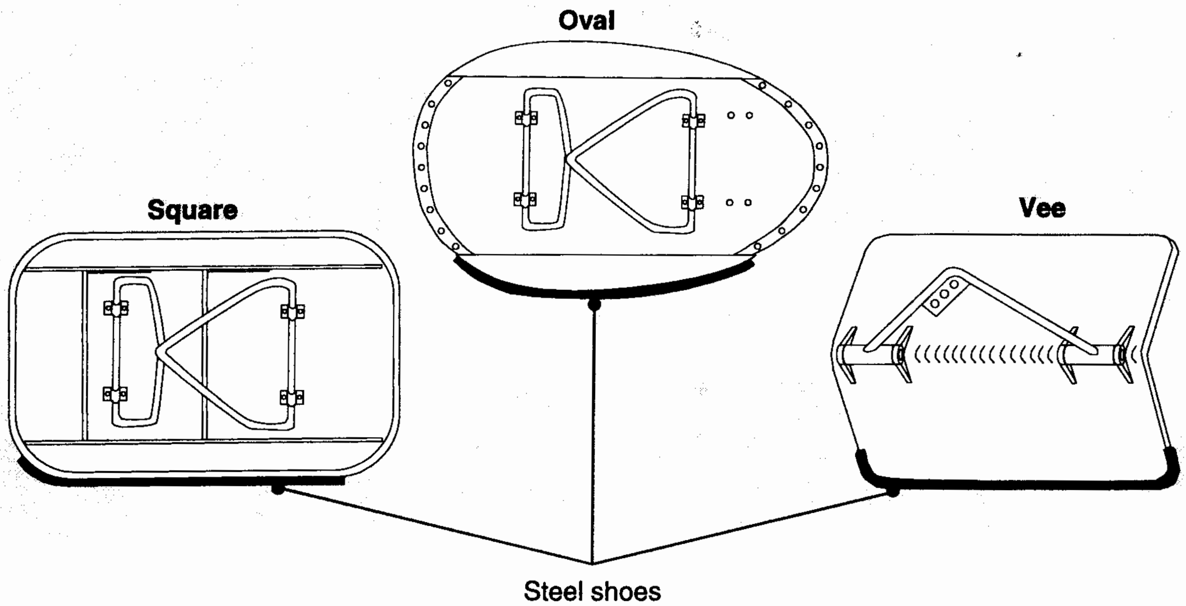
3.1 Trawl Nets

Trawl nets are the most common means of harvesting fish in Canadian waters. There are several types of trawl nets, each designed to accommodate a particular fishery. The types include; bottom otter trawl, shrimp trawl, midwater trawl, twin trawl, trouser trawl, pair trawl, Danish/Scottish seine, and beam trawl. The common components of the bottom otter trawl are described in detail. To avoid unnecessary repetition subsequent trawl types are described in how they differ from a bottom otter trawl. Trawl net attachments are components that may or may not be present in a trawl and are described separately from trawl types.

Bottom Otter Trawl

Bottom otter trawls are large bag shaped nets towed along the ocean floor. This gear type is used to direct for groundfish species and shrimp, although occasionally bycatches of small pelagic fish close to the bottom may also be captured.

TRAWL DOOR TYPES



Gear Construction

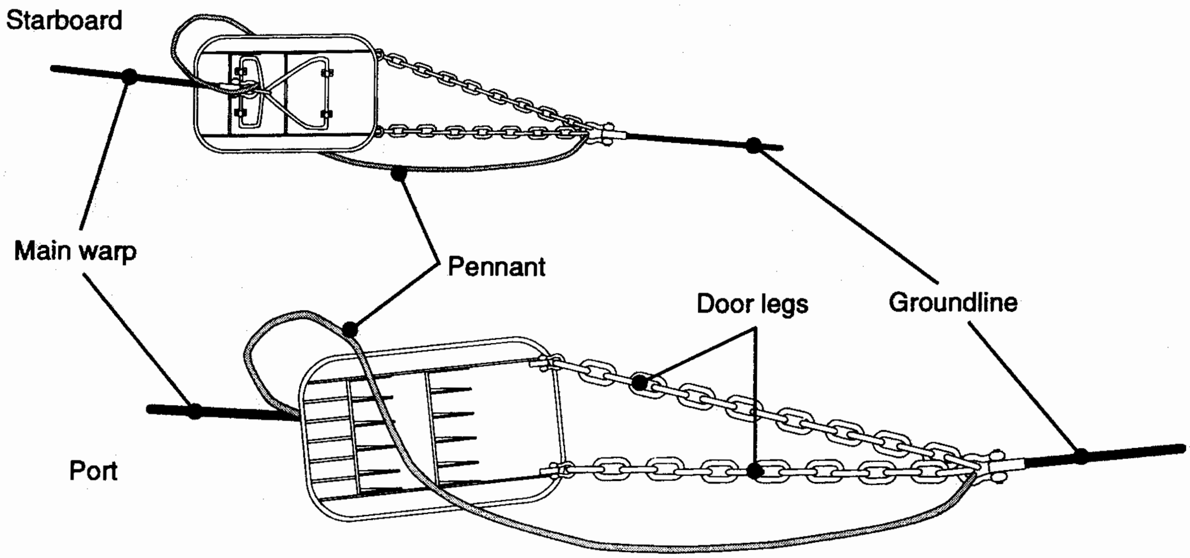
Bottom otter trawl construction is described in terms of the main components. Attachments and selectivity features may or may not be present on a bottom otter trawl, and are described separately. The following describes the main components of bottom otter trawls.

Trawl doors (also referred to as *otter boards*) provide a planing surface that, when towed through the water, creates force vectors which maintain a horizontal spread in the opened end of the trawl. There are three shapes of trawl doors common to Canadian fisheries; oval, rectangular and vee-shaped.

The *main warp* is the cable that connects doors to the main trawl winches on the vessel. The length of warp required during fishing operations is normally 3 times the fishing depth.

Door legs are chains connecting the doors to the groundline. They also serve to keep the doors upright and stable during fishing operations.

DOOR CONNECTIONS



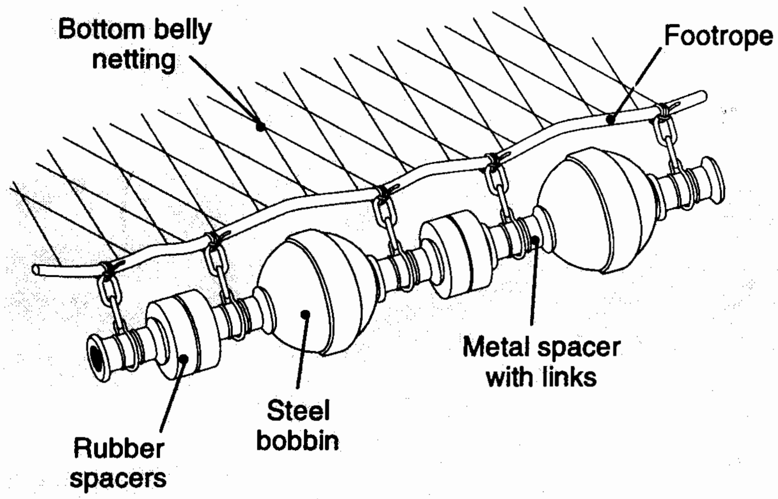
The *pennant* is a cable loosely attached at the point where the door legs meet the groundline, and to the inside of the doors. The purpose of the pennant is to facilitate the deployment and retrieval of the trawl.

Groundlines are cables which run from the point of the pennant attachment to the bridle connection. Groundlines are also referred to as *ground warps.*

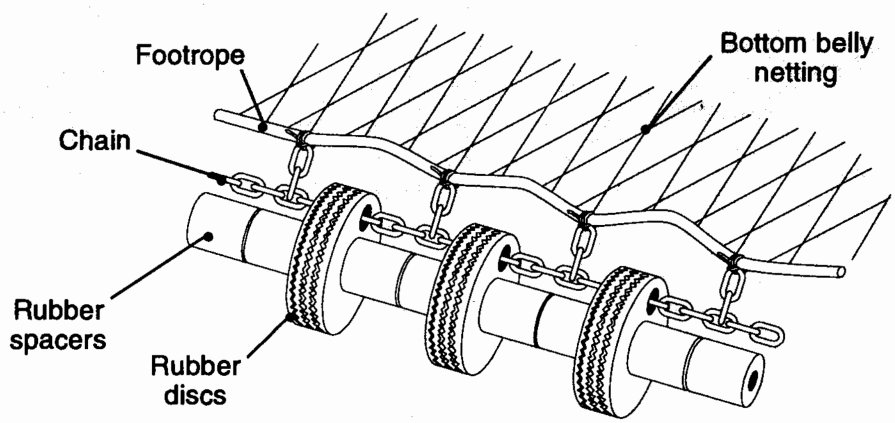
Bridles are cables that run from the groundline to the upper and lower wings of the trawl. These cables allow the net to open vertically as well as horizontally and may number two or more on each side. Bridles and groundlines are collectively referred to as *sweeplines.*

The *headrope* is a rope or cable to which the upper wings and the forward section of the square are attached. Floats attached to the headrope provide the lift necessary to maintain the vertical opening of the net.

The *footrope* is the bottom rope or cable to which the bottom wings and bottom bellies are attached. *Footgear* is comprised of rubber discs or steel rollers balls that are attached to the



STEEL ROLLER FOOTGEAR



ROCKHOPPER FOOTGEAR

footrope. They are used exclusively on bottom trawls to prevent damage to the trawl by lifting the footrope and netting off the bottom and for rolling over obstacles.

The *selvedge line* is the seam along each side of the trawl that separates the top from the bottom.

The *bottom* and *top wings* are sections of netting at the foremost part of the trawl net which define the outer perimeter of the trawl opening. Their purpose is to maintain the shape of the trawl and to herd fish into the opening of the net.

The *body* of the trawl is comprised of the square and the bellies. The *square* is a section of netting fitted between the first top belly and the two top wings. The *bellies* are one or more sections of the trawl located aft of the wings and square. Mesh sizes of the bellies may decrease with the taper of the net toward the codend. Bellies serve to guide the fish into the codend.

Section(s) of netting placed between the bellies and the codend of the trawl are referred to as *lengthening pieces*. They are used to extend the overall length of the trawl.

The *codend* is the after portion of the trawl in which fish are retained. A rope, called the codline, is used to close off the codend to prevent the escapement of fish.

Gear Deployment

The codend portion of the trawl is lowered over the stern or side of the vessel and released into the sea. Vessel speed is increased to create enough drag to pull the remainder of the net into the water. Bridles are then connected to the doors which are attached to the main warps. The warps are payed out until the trawl reaches the desired fishing depth. Once the trawl is deployed, the vessel is slowed to the required towing speed. This procedure is referred to as *shooting away*.

Gear Operations

The trawl opening is maintained by water force acting on the doors. Fish in the path of the gear are over taken and driven into the opening. This herding effect is aided by the ground warps which stir up the bottom and keep fish in front of the trawl. As the trawl advances, on the fish, the wings assist in guiding them to the main body. The main body of the trawl, consisting of; the square, bellies, lengthening piece and codend, form a funnel shaped structure enclosed at the end by the codend line. The shape is sustained by pressure from the water flow as it passes through the trawl. Alterations in the water flow will affect trawl performance. If mesh size is too small or the trawl is towed too fast, backwash occurs causing water to be pushed ahead of the trawl preventing fish from entering.

The towing speed can be adjusted to enhance trawl performance when directing for a particular species. An increased towing speed will expand the wing spread and decrease the headrope height while a reduction in towing speed will have the opposite effect.

The foot gear is a distinguishing component of the bottom trawl. This part of the trawl is constructed from rollers, spacers, wire and chain and facilitates movement across the ocean floor. The foot gear can be constructed to various specifications (larger/smaller rollers), depending on the bottom type and the directed fishery.

Method of Capture

As the trawl is towed through the water, fish are herded into the net opening by the wings. The fish pass through the body and are retained in the codend.

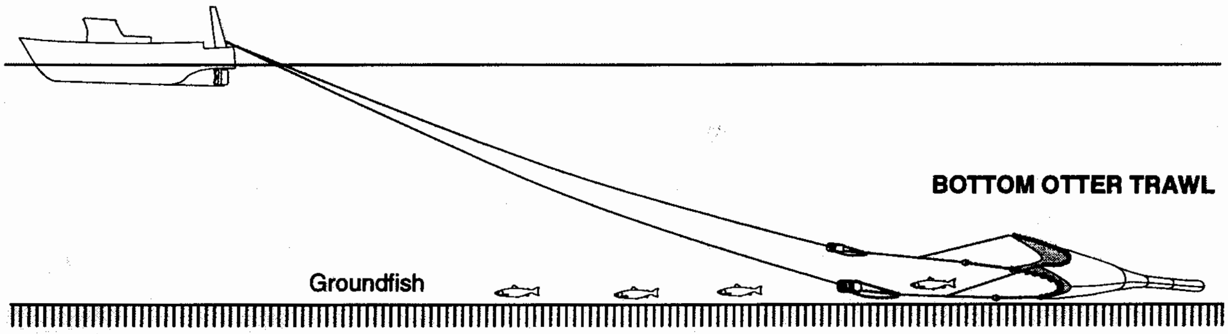
Gear Retrieval

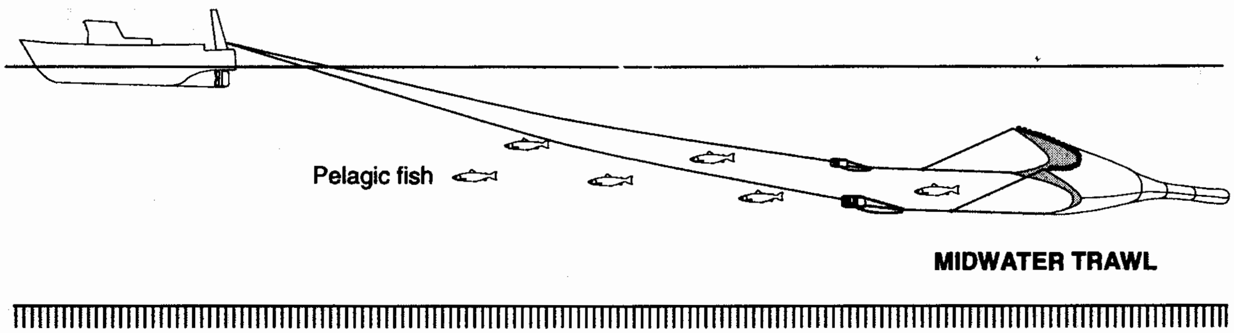
Haulback, the process of gear retrieval, begins by winching in the main warps. The warps are taken in until the doors reach the *gallows*. The pennants are removed from the doors and the strain is transferred to the sweepline winches located at deck level. The sweeplines are hauled back until the footgear is onboard, and the remainder of the net is then retrieved. The codend is hoisted and the catch is emptied into a holding bunker.

Conservation Features

Trawl selectivity is primarily determined by size and type of mesh. It can also be refined by the use of devices attached that help conserve fish stocks. These involve modifications and attachments that influence the capability of gear to retain species by size or type including:

- Sorting grids
- Separator panel
- Shortened lastridge ropes





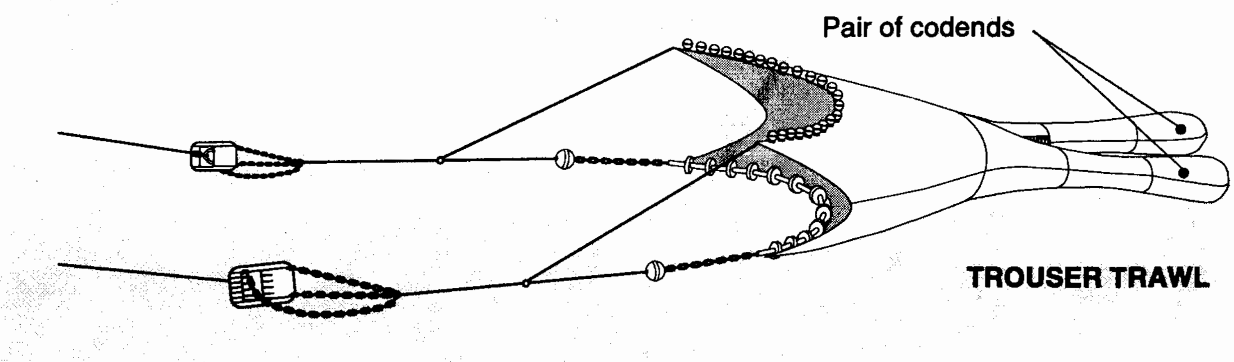
Shrimp Trawl

The shrimp trawl is a bottom otter trawl with a number of variations to accommodate the catching of shrimp. These include the use of small mesh in the body and codend, and the attachment of a separator grate.

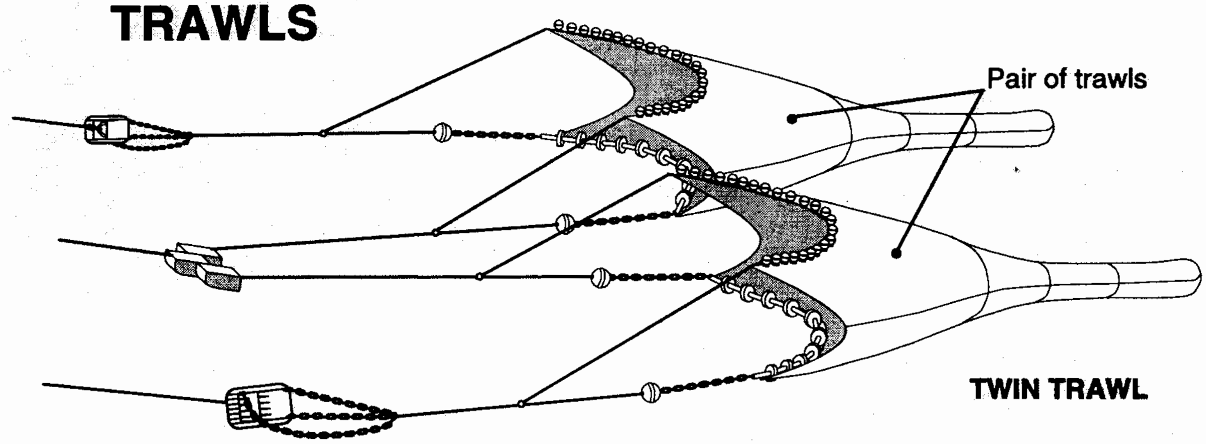
Midwater Trawl

Midwater trawls are similar to bottom otter trawls, but are designed to fish at varying depths in the water column. These trawls are normally used to direct for pelagic species. Groundfish that rise off the bottom may also be captured with this gear type.

The fishing depth is varied depending on the directed species. Midwater trawls are equipped with transducers (electronic devices attached to the headline) that transmit information on trawl depth and opening. The receiver, located on the bridge of the vessel allows the master to monitor trawl performance. Changes can be made in the fishing depth by adjusting the vessel speed and/or warp length.



TROUSER & TWIN TRAWLS

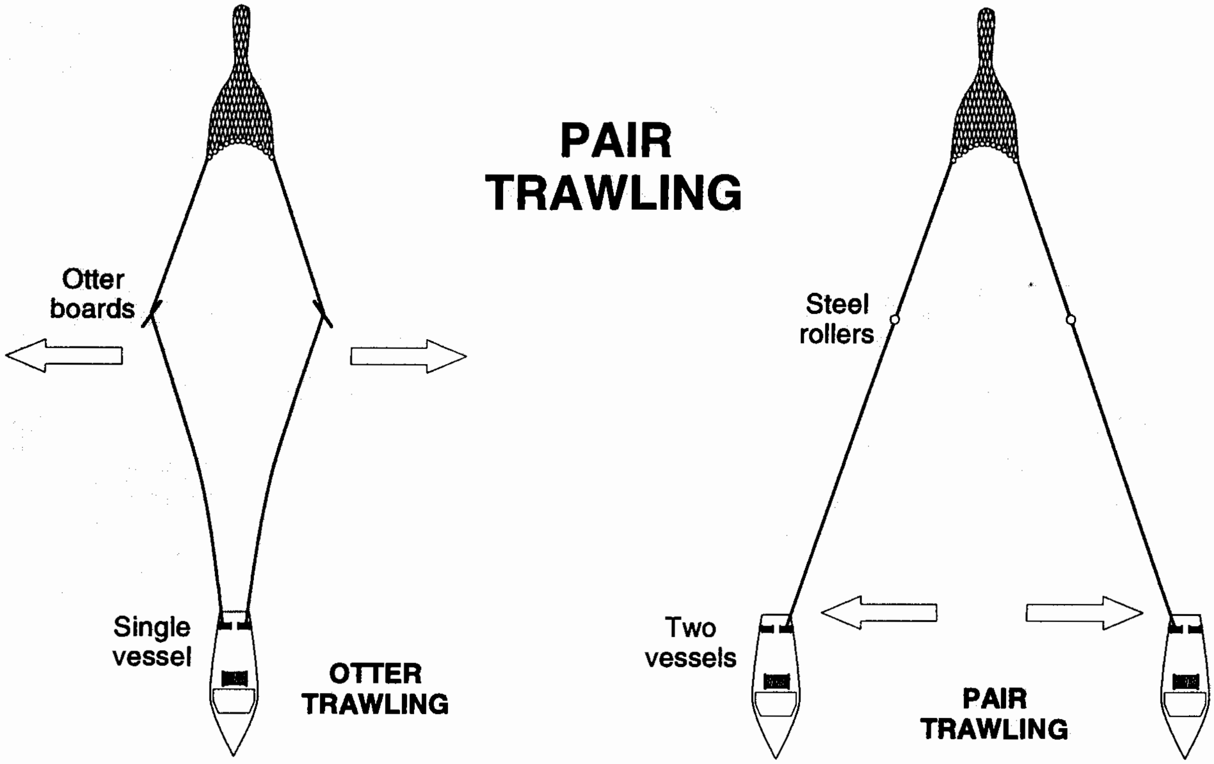


A midwater trawl can be distinguished from the bottom otter trawl by:

- Lack of footrope attachments
- Footrope and headline of equal length
- Extremely large mesh in wings
- Midwater doors (lacking shoes)

Twin and Trouser Trawls

Twin trawling uses two complete bottom otter trawls attached and towed side-by-side using a single set of doors. This is a relatively new fishing method and is presently being utilized in the northern shrimp fishery. *Trouser trawling* refers to the use of a double codend on one trawl net. This arrangement resembles a pair of trouser and is used to split the catch weight into two sections instead of the standard single codend.



Horizontal trawl opening is caused by water pressure forcing the otter doors apart.

Horizontal trawl opening is caused by two vessels maintaining distance apart.

Pair Trawling

Pair trawling is the operation of a single otter trawl using two vessels. This method of trawling does not require doors, as trawl spread is maintained by the vessels.

The trawl is shot away by one of the vessels, using a similar procedure described for otter trawls. Once the net is in the water and the bridles have been payed out, the second vessel comes along side and retrieves one of the bridles. The vessels steam in opposite directions as the warp is payed out. The brake is applied to the warps and the vessels proceed on opposite courses until gear spread is achieved. The brake is then released on the warp and the vessels continue to steam away from each other until they are ¼ of a mile apart. At this point they turn 90 degrees, let out the required amount of warp and continue at towing speed, on parallel courses.

Straight tows are preferred because it involves less maneuvering of the vessels. The masters must constantly monitor distance between vessels during the towing operation and close radio contact is maintained.

To retrieve the trawl, the warp of each vessel is hauled back until the bridles are on deck. The vessel that picked up the port bridle returns it to the first vessel with the aid of a heaving line. The trawl is then hauled back using the same procedure used for a single otter trawl.

This method of fishing provides economic and operational advantages:

- No doors reduces drag which results in better fuel consumption and less strain on vessel engines.
- Small vessels are able to tow larger trawls.
- Two vessels allows for a greater trawl spread, thus covering a larger area of fishing ground.

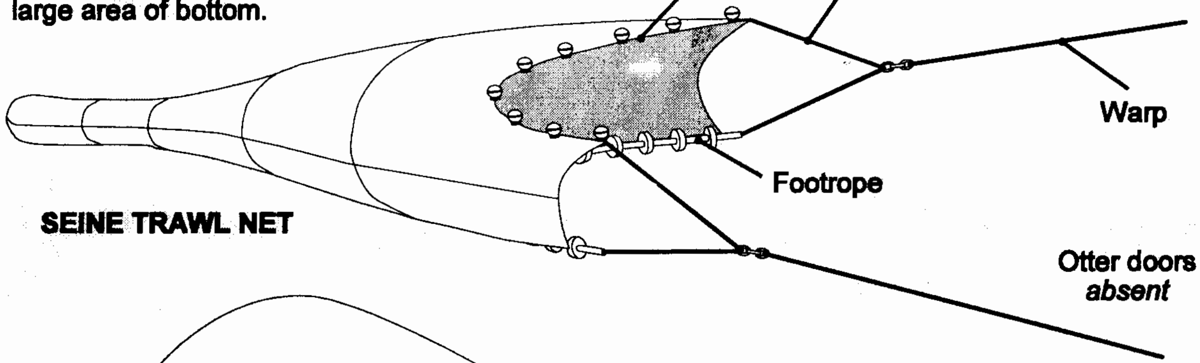
Danish/Scottish Seine

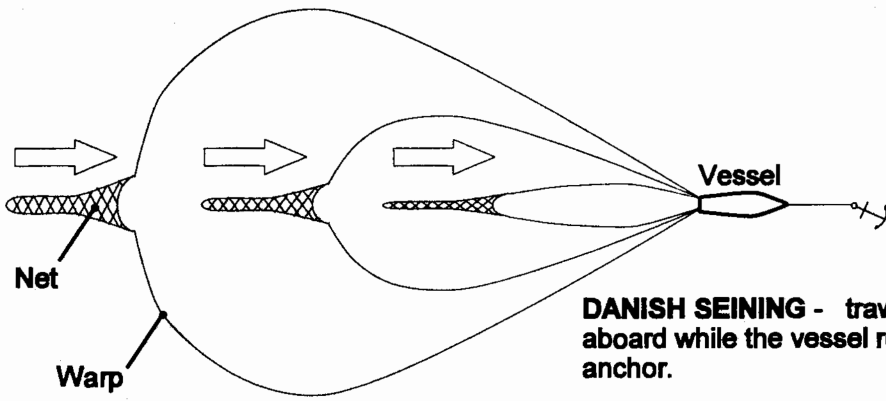
Danish and Scottish seines are similar to the bottom otter trawl but do not require the use of doors. Horizontal spread of fishing gear along the bottom is accomplished by deploying the main warps to encircle an area of bottom. Seine trawling is effective in the capture of groundfish such flatfish. The greatest difference is in the method of operation. *Scottish seining* involves the gear being towed slowly along the ocean floor as the net is closing, then winched aboard the vessel. In *Danish seining*, the vessel remains anchored in a fixed position while the gear is winched along the bottom.

Scottish Seining

Scottish seining, also referred to as fly dragging involves the warps and net being set in an encircling configuration. To commence, a buoy and highflyer are attached to the end of one warp and placed in the water. The vessel steams in a predetermined pattern paying out warp. When the first warp has been set, it is attached to the corresponding wing of the seine net and the second warp is attached to opposite wing. The seine net and second warp are dropped over the side and the vessel steams in an encircling pattern back to the highflyer while paying out the second warp. The ends of both warps are attached to the winch drum and the hauling process begins.

Seine trawl nets are deployed with the net at one end and the warps surrounding a large area of bottom.

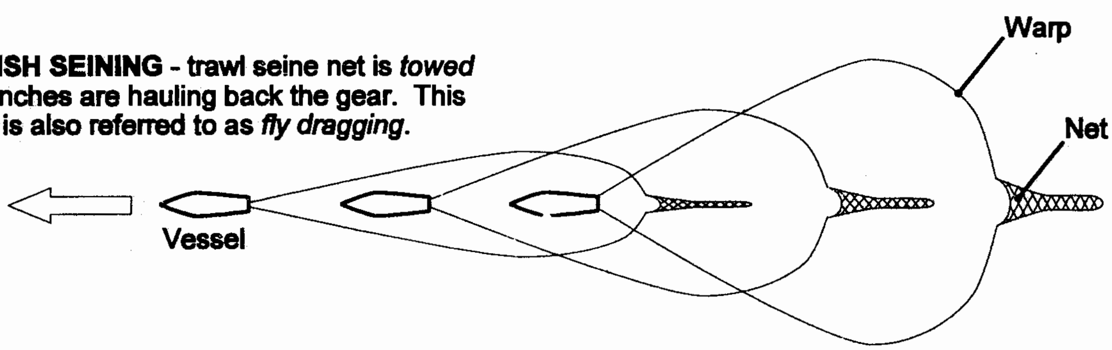




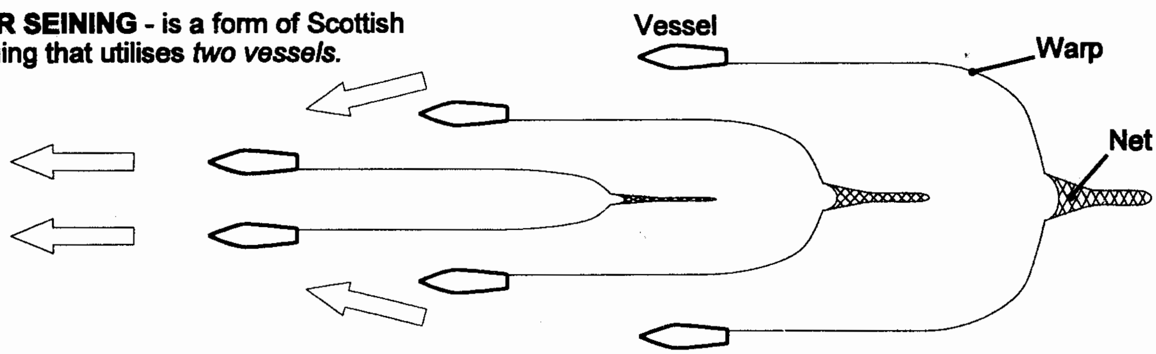
DANISH SEINING - trawl seine net is *winched* aboard while the vessel remains *stationary* at anchor.

DANISH & SCOTTISH SEINING

SCOTTISH SEINING - trawl seine net is *towed* while winches are hauling back the gear. This method is also referred to as *fly dragging*.



PAIR SEINING - is a form of Scottish seining that utilises *two vessels.*



During haulback the vessel tows the seine at a speed of 1.5 to 2 knots. The warps are wound on the drum and they come together, stirring up mud on the ocean floor and herding fish into the path of the net. Hauling is paused as the bridles are brought onboard. The bridles are then placed in a power block and haulback continues until the entire seine is on deck. Smaller catches may be hoisted directly onboard in a single lift, while larger catches may be bagged off into several lifts until the net is empty.

Pair seining is a variation of Scottish seining in which two vessels are used to shoot and haul one seine trawl. Pair seining and pair trawling both use two vessels and a similar gear type. The main difference between these is in the operation of the gear. Pair seining occurs when the warps are set out to encircle a specific area of bottom, then the two vessels steam together as the warps herd the fish into the trawl seine. *Pair trawling* differs in that the two vessels set out the gear then maintain a fixed distance while towing on parallel courses over a distance.

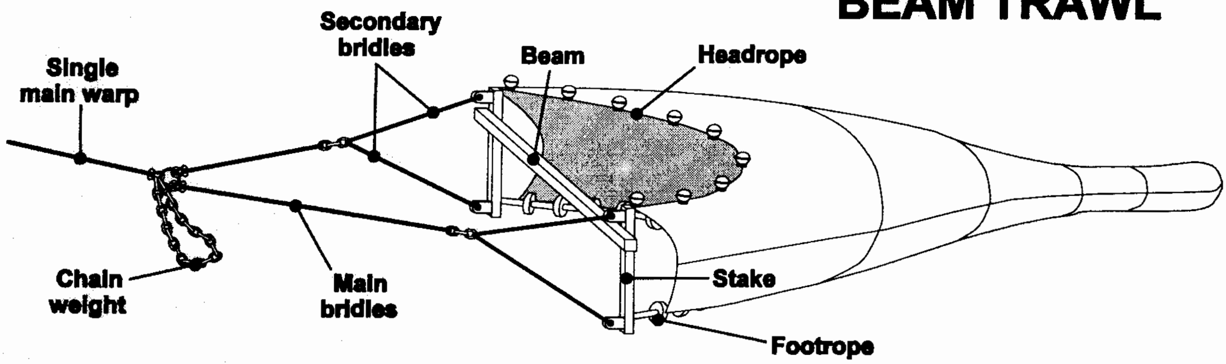
Danish Seining

Danish seining, also referred to as *anchor-dragging* operates in a similar fashion to the Scottish seine except the vessel remains stationary at anchor while the net is hauled on board. This method of fishing can be carried out with a small number of crew (2-3) and less horse power than dragging.

Beam Trawl

The beam trawl is similar to the bottom otter trawl, but the otter doors and dual warp system are absent. The horizontal opening of the trawl is maintained by a beam which is supported by a stake on each end. The headline is attached to the top of the stakes and equipped with several floats. The footrope, attached to the lower end of the stakes, is constructed of small rubber discs or large rubber rollers. The bridles connect the stakes to a single main warp that is lowered or hauled by the main winch. Weights are attached near the bottom of each stake and also at the point where the bridles are connected to the warp. These weights ensure that the trawl maintains proper ground contact while being towed. The main warp can be supported by various methods (A- frames, extended outriggers, booms) depending on the vessel. The trawl is pulled across the ocean floor at a speed of 1 to 2 knots.

BEAM TRAWL



To deploy a beam trawl, the codend is lowered into the water and vessel speed increased, causing the remaining net to be dragged overboard. The winch is braked when the wings are at the stern rail and the beam is attached to the stakes. The trawl, bridles and warps are let out until the gear is at fishing depth. This procedure is reversed for hauling back.

In past years, the beam was constructed from wood but new models are made of aluminum. The lighter weight aluminum beam lessens water turbulence and reduces fuel consumption. The beam trawl is used in Canadian waters primarily by small vessels directing for shrimp.

Due to its unique characteristics, a beam trawl has the following conservation features:

- Bycatch species are still alive when brought on board and can be released unharmed due to low towing speeds required for the gear.
- Less damage to the ocean floor because of lack of doors and heavy foot gear.
- Space between the footrope and footgear line allows ground fish to escape underneath the trawl.

Trawl Net Attachments and Modifications

In addition to normal trawl net components, attachments or modifications may be used to change trawl behavior. These include:

- Strengthening ropes
- Headline kites
- Ticklers
- Liners
- Chafers
- Separator grates
- Separator panels
- Electronic sensors
- Codend zipper
- Codend skirt
- Codend window

Strengthening Ropes

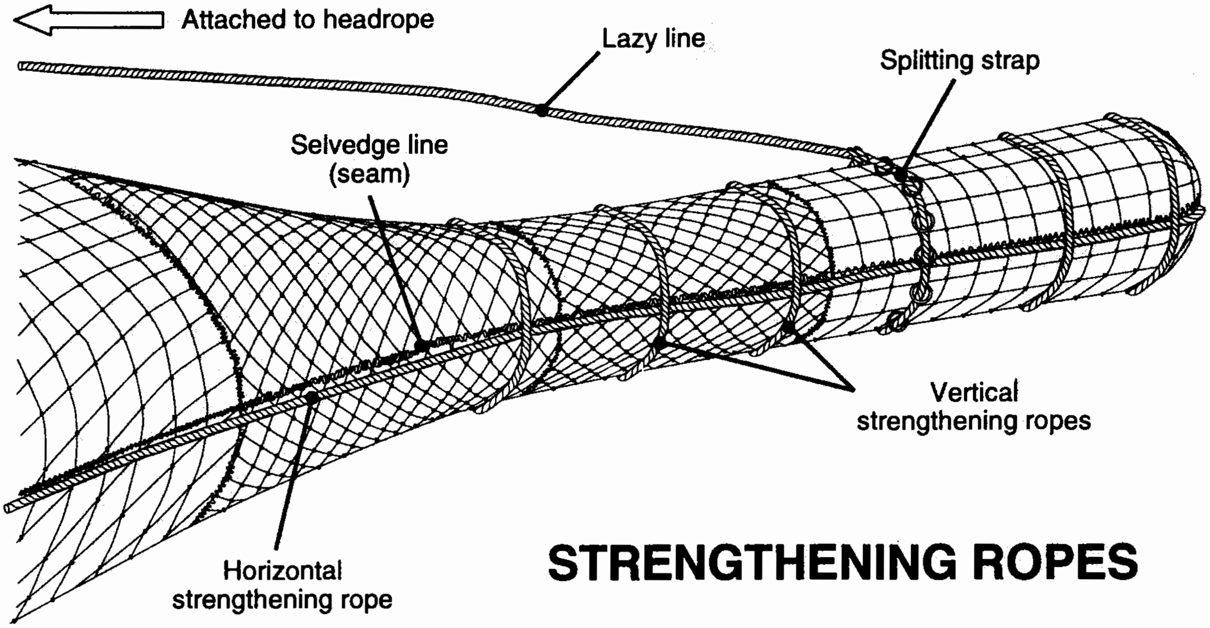
Vertical strengthening ropes, also referred to as *transverse straps*, encircle the codend and lengthening piece reinforcing the mesh. The straps are not attached directly to the meshes but are fed through loops of twine at intervals around the circumference of the trawl. The number of vertical ropes varies depending on the length of the codend and lengthening pieces.

Horizontal strengthening ropes, also referred to as *lastridges*, are attached along each side of the lengthening piece and codend at the point where the top and bottom panels are joined. These serve to strengthen the codend. Normally there are only two horizontal ropes but some trawls may have four or more for additional strength.

Shortened Lastridge Ropes

Shortened lastridge ropes attached to the selvedge line of a trawl net provide a practical method of improving selectivity in trawl nets. Without support, diamond shaped mesh tends to close as the strain of the catch in the codend pulls the mesh tight. When properly attached, lastridge ropes keep diamond meshes open during fishing operation which allows small fish to escape.

The main factor in selectivity of lastridge ropes is the hanging ratio. The higher the ratio, the higher the retention of small fish. If the ratio is too low, there occurs a higher escape rate of commercial size fish. In reference to lastridge ropes, hang



STRENGTHENING ROPES

Horizontal strengthening ropes are also referred to as *lastridge ropes*.

ratio refers to the length of the shortened lastridge rope divided by the corresponding stretched length of the underlying selvedge line to which it is attached. The strain of the catch is placed primarily on the lastridge ropes and the mesh of the codend does not take the full weight of the catch, thus codend mesh do not close as tightly.

Selectivity studies conducted by DFO in 1993-94, indicated that a hanging ratio of 85 % performed most favorably for trawls with 130 mm diamond mesh.

Headline Kite

The headline kite is a rectangular object made of aluminum, canvas, plastic or wood attached to the top square of the trawl near the headline. It is used to lift the headline thus providing a greater vertical opening. On occasions floats are added to the kite to enhance its performance.

Ticklers

Ticklers are short pieces or loops of hanging chain attached at intervals along the foot gear. The purpose of this attachment is to startle the fish causing them to rise off the bottom and into the trawl opening. Ticklers are normally used in fisheries where fish live close to or on the ocean floor, such as flounder.

Liner

A liner is a piece of small mesh netting fastened to the inside of a codend. It is used to retain fish that would otherwise escape from the codend. The use of liners is prohibited *except* when there is no restriction on mesh size.

Chafers

A chafer is a codend attachment used to prevent wear and tear caused by contact with the ocean bottom and the deck of a vessel. Any type of device maybe use as a bottom-side chafer. The topside of a codend is not permitted to be obstructed, and regulations describe three topside chafers that are permissible:

- Regular (ICNAF)
- Modified Polish (Large-mesh)
- Multiple Flap

Regular Topside Chafer

A regular topside chafer consists of a rectangular panel affixed to the upper portion of the codend. The netting must have a mesh size equal to or greater than the mesh size allowed in the codend. The topside chafing panel must be 1½ times wider than the underlying codend mesh which it covers. The panel may be attached at the forward edge across the top of the codend and on the lateral edges along the side of the codend. The ends of the trailing edge of the panel may be attached no closer than 4 mesh from the codline and the trailing edge must not be attached, thus creating an opening for fish escapement. Where a splitting strap is attached to the codend, the leading edge of the panel may not extend more than 4 mesh forward of the strap. Where a splitting strap is not used the panel may not cover more than one-third of the codend.

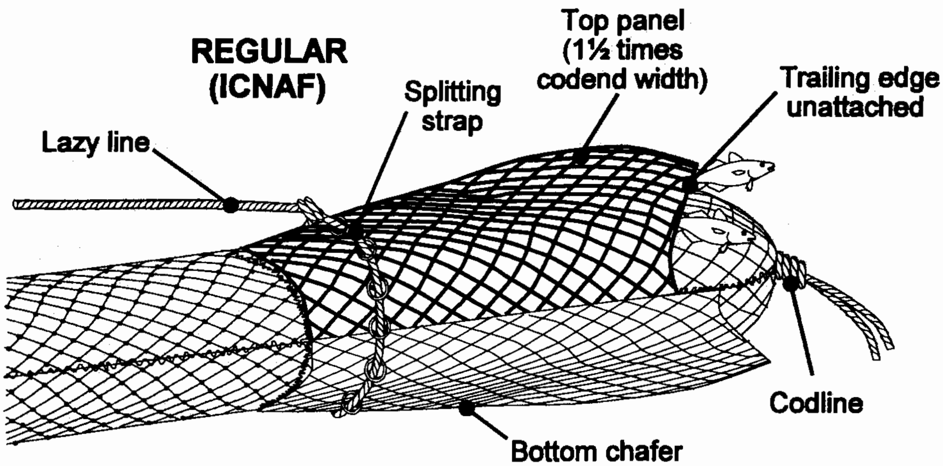
Modified Polish Topside Chafer

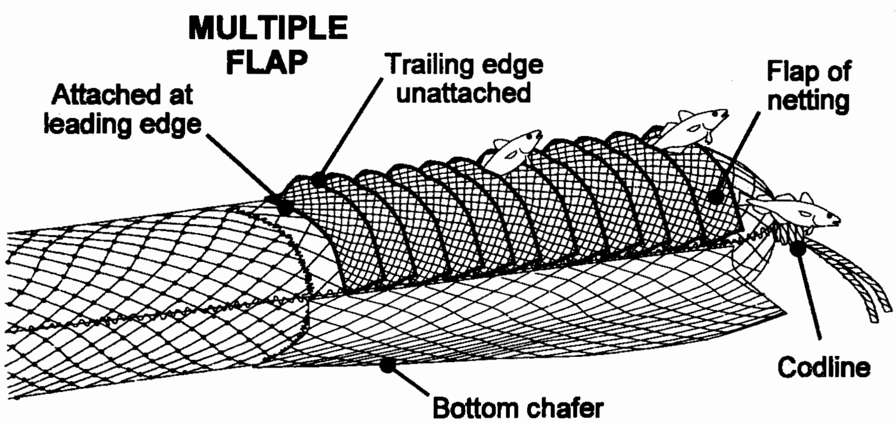
A modified Polish topside chafer, also referred to as *large mesh topside chafer*, is a rectangular panel of netting with a mesh size exactly twice as large as the underlying mesh. This panel is also attached at the rear portion of the codend. This chafer must be attached such that each mesh aligns with the outside edges of 4 underlying smaller mesh.

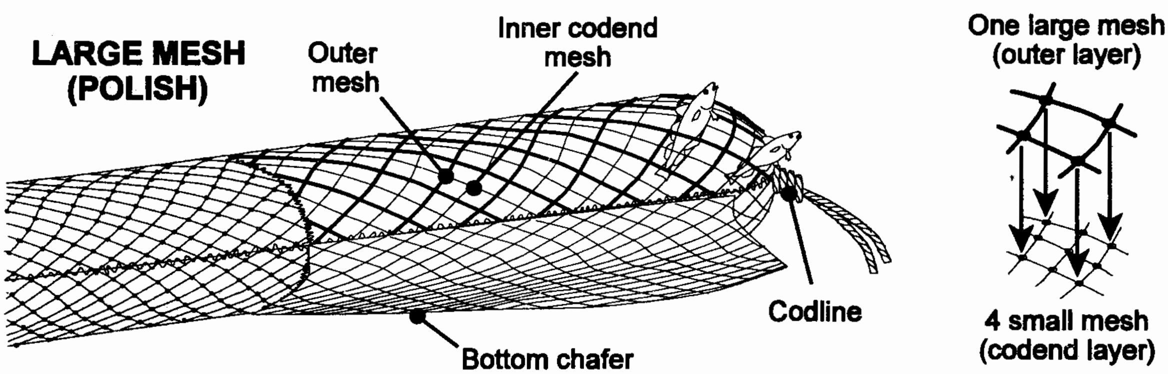
Multiple Flap Topside Chafer

The multiple flap topside chafer is a series of netting panels covering a maximum of two-thirds of the length of the codend. The netting flaps must be of at least the same size as the

CODEND TOPSIDE CHAFERS







codend mesh. Each flap of netting must be no more than 10 mesh long and at least the width of the codend. The net flaps are attached across the top of the codend by the leading edge with the opposite end trailing over the flap directly behind it.

Codend Cover

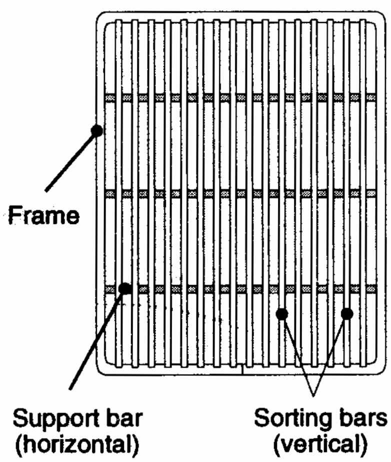
On occasions trawls may have a protective cover encasing the entire codend. This cover is constructed of heavy mesh larger than that used in the codend and essentially serves as a chafer. The allowable use of this arrangement is unclear and instances where mesh appears to be obstructed should be documented.

Separator Grates

Separator grates, also referred to as *sorting grids*, are designed to reduce bycatch of regulated species. Separator grates are positioned inside the lengthening piece and prevent undesired species or sizes of fish from entering the codend. There are two types of grates; bycatch reduction and size sorting grates.

Bycatch Reduction Grates

BYCATCH REDUCTION GRATE

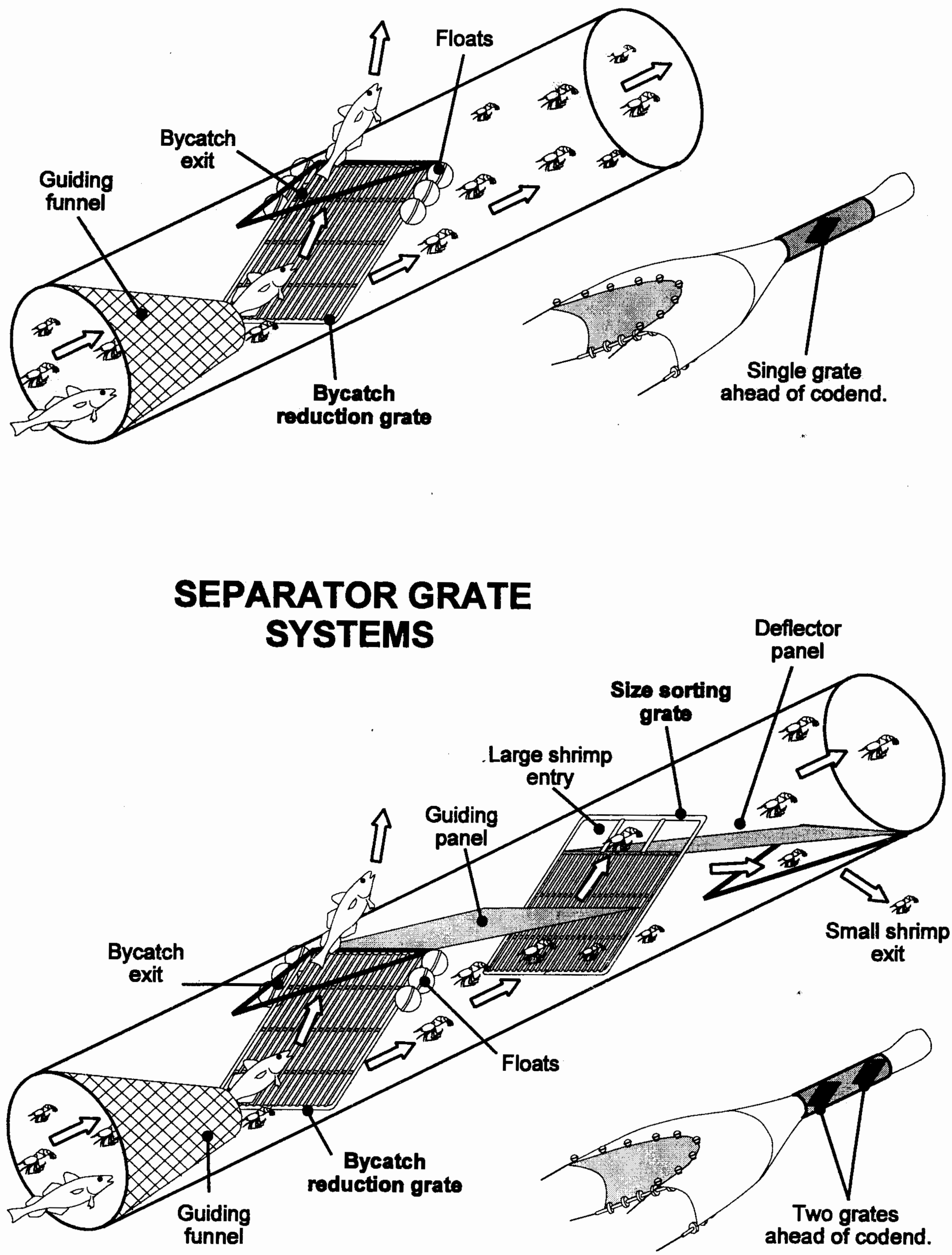


The purpose of a bycatch reduction grate is to decrease the amount of retained bycatch species that are larger in size than the directed species. This system consists of a funnel, a bycatch reduction grate and a release opening.

The *funnel* is a conical shaped piece of netting inserted in the lengthening piece forward of the grate. The catch passes from the opening of the net, through the funnel and are directed downwards to the lower section of the grate.

The *bycatch reduction grate* is a metal frame holding straight vertical bars spaced at equal intervals. The horizontal bars reinforce the entire structure. The vertical bar spacing requirements will depend on the directed fishery. The greater the distance between the bars, the greater the size of fish that will pass through into the codend. To function properly the grate must be inserted in the lengthening piece at a specified angle, normally 50°. Floats may be installed on either side or top of the grate to give the necessary lift. Separator grate requirements are normally a condition of licence and should be verified for bar spacing and installation requirements.

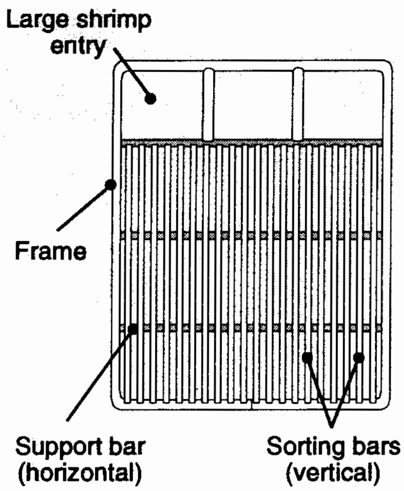
The *release opening* is located at the top of the lengthening piece, immediately forward of the sorting grate. The smaller size catch pass through the grate into the codend. Fish that are unable to pass between the vertical bars are directed upward


Floats
Bycatch exit
Guiding funnel
Bycatch reduction grate
Single grate ahead of codend.
SEPARATOR GRATE SYSTEMS
Deflector panel
Size sorting grate
Large shrimp entry
Guiding panel
Bycatch exit
Small shrimp exit
Floats
Bycatch reduction grate
Guiding funnel
Two grates ahead of codend.

and escape through the release opening. The size of the release opening must meet the criteria set out in the license.

Size Sorting Grate

SIZE SORTING GRATE



In recent years a separator grate capable of sorting by size has been introduced to the shrimp fishery. This arrangement includes a second grate in the lengthening piece inserted directly behind the bycatch reduction system. The size sorting system is similar to the bycatch grate with a few variations. This system includes a size sorting grate, two panels of netting and an escape exit.

Shrimp that pass through the bycatch reduction grate are directed to the bottom of the sizing grate by means of a *guiding panel.* Large shrimp are unable to pass through the bars of the *size sorting grate* and are guided upwards until they pass through the large shrimp entry portion of the grate. From here large shrimp pass directly to the codend where they are retained. Small shrimp pass through the vertical bars of the size sorting grate and are blocked from entering the codend by the *deflector panel.* The small shrimp are deflected down through the *small shrimp exit* hole in the bottom netting of the lengthening piece directly behind the size sorting grate.

Separator panel

A separator panel is a piece of netting attached horizontally inside the trawl. When properly in place, this panel divides the trawl into top and bottom portions. The purpose of the panel is to separate the catch by species based on differential fish behavior. Fish will swim in front of the footrope of a trawl until they tire and turn to swim into the opening of the net. Fish species having a tendency to turn 180° and go straight back into the net swim below the horizontal panel and into the lower section of the trawl. Fish having a tendency to swim up and then somersaulting backwards into the net swim above the panel and the upper portion of the trawl.

Depending on which species is to be released, a window is cut in the top or bottom netting of the trawl. A window cut in the bottom allows the fish that swim below the panel to escape, while the fish in the upper portion of the trawl are guided back to and retained by the codend. When the window is placed in the upper portion of the trawl the opposite portions of the catch are released and retained.

Electronic sensors

Electronic sensors are remote electronic devices that may be attached to the doors, headline, wings, codend or separator grate of a trawl. Signals from the sensors are relayed to a monitor on the bridge providing details of trawl performance including:

- Horizontal door spread
- Vertical opening of the trawl
- Horizontal opening of the trawl
- Fishing depth
- Catch weight
- Angle of grate

Codend sensors provide an indication of the amount of catch retained in the codend. This information can be used by the master to decide when to haulback the gear, so as to limit the amount captured and to prevent:

- Exceeding vessel hold capacity
- Crushing the catch
- Production backlogs
- Gear damage

In addition to trawl performance, electronic sensors can also provide water temperature at the actual fishing depth of the gear.

Codend zipper

A codend zipper is a device that enables the quick connection and separation of the codend from the remainder of the trawl. This consists of a rope threaded through a series of rings attached to the edges of the codend and the lengthening piece. Codend zippers are used in fishing operations that require *codend transfers*.

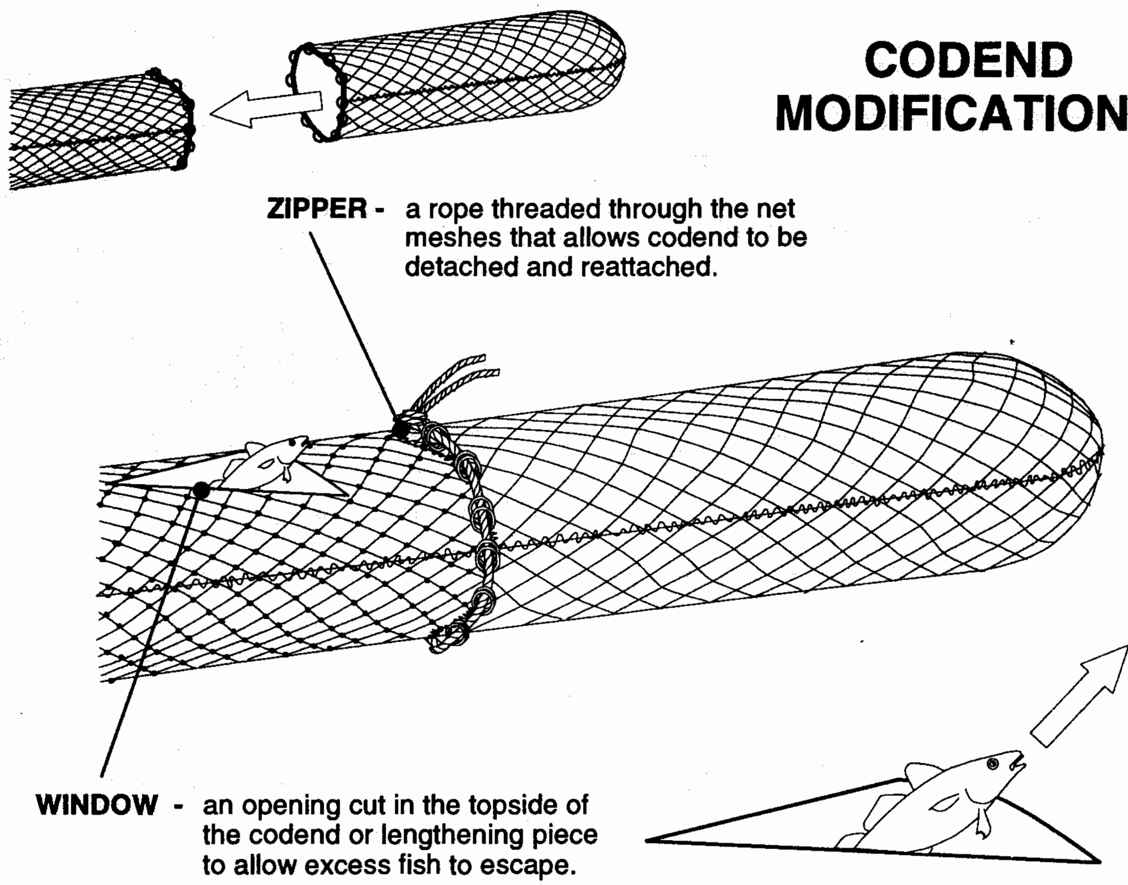
Codend skirt

A codend skirt is a small piece of netting attached near the codline. It plugs the small gap remaining in the codend opening after the codline has been tied. DFO policy allows for a skirt length of up to 70cm, attached 5 meshes or less from the codline.

Codend window

A codend window is an opening cut into the top part of the codend, forward of the codline. During fishing operations this hole is either left open or sewn shut with a light twine. When

CODEND MODIFICATIONS



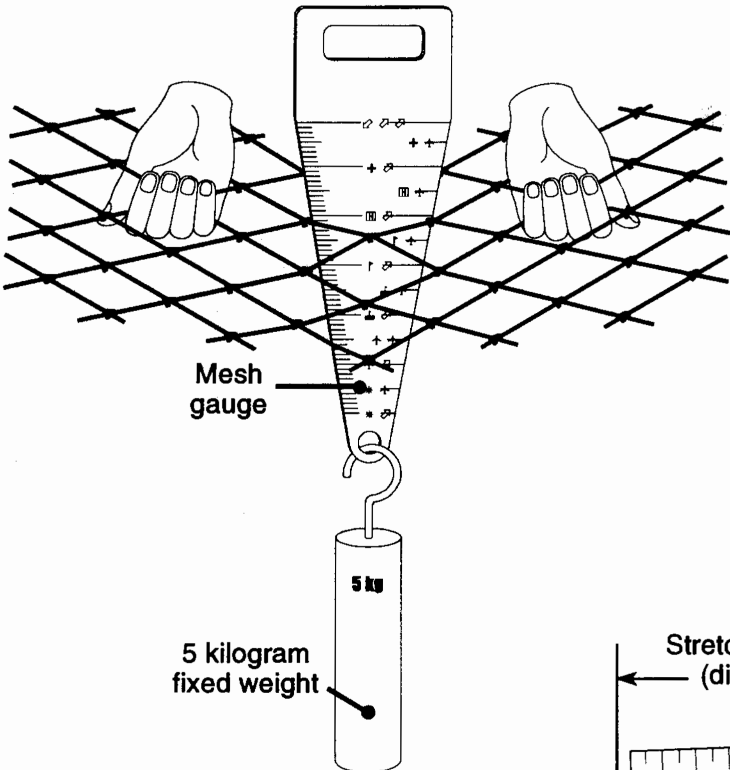
the codend fills as far as the window the strain of the catch breaks the twine, opening the window. Any fish caught subsequent to this simply exit unharmed through the window. The further the distance of the window from the codline, the more fish will be retained in the net.

Trawl Net Mesh

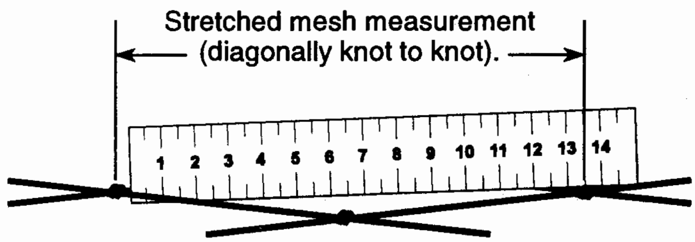
The regulation of mesh is an important means of controlling the selectivity characteristics of trawl nets. Mesh is regulated by size, shape and obstruction of mesh.

Mesh Size

In general smaller mesh size retains smaller fish thus minimum mesh sizes are set to aid the escapement of juvenile fish. Mesh sizes are regulated by conditions of license and vary depending on the fishery. Trawl net mesh are measured from one knot to the diagonally opposing knot of the same



TRAWL MESH MEASUREMENT

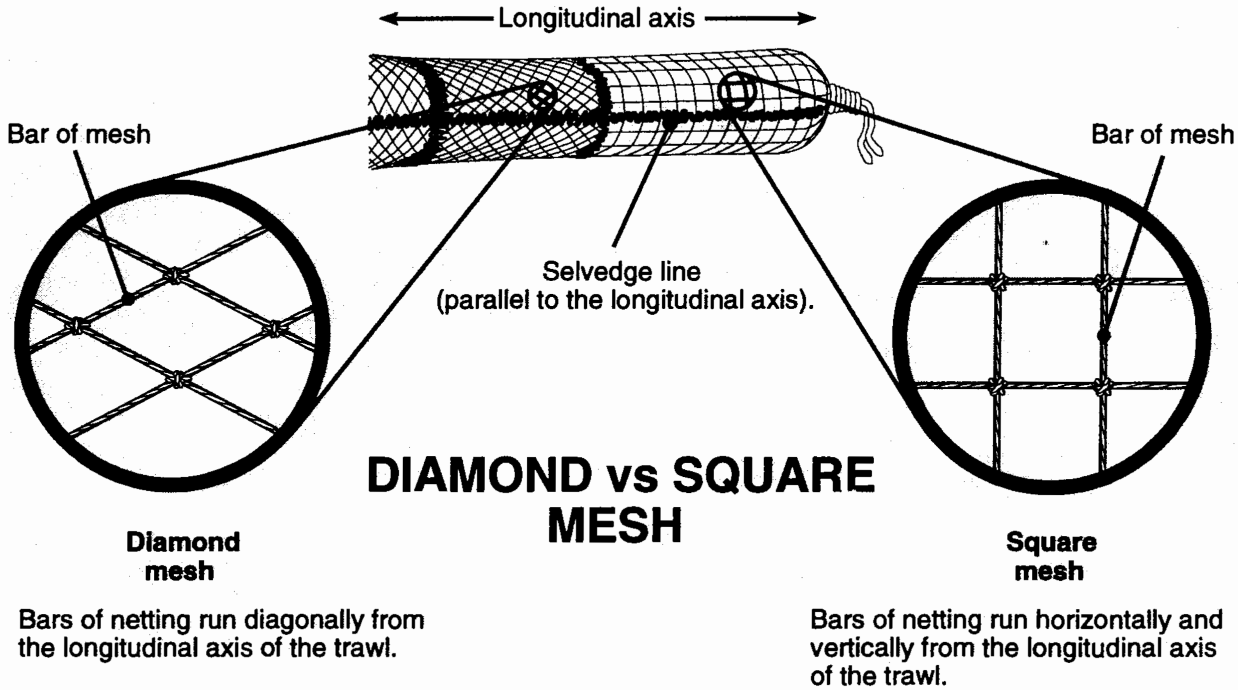


mesh. This is referred to as a "*stretched mesh measurement*".

In AFR (85), Section 2, mesh size of trawls is defined as

> *the average size of any 20 meshes that are measured by inserting into the meshes a flat wedge-shaped gauge having a taper of 2 cm in 8 cm and a thickness of 2.3 mm with a weight of 5 kg attached.*

Official measurements of trawl mesh must be done with a certified mesh gauge and weight; this is almost always conducted by a Fishery Officer. Measurements taken by Observers are most often taken with uncertified gauges or other measuring devices. In this case, documentation describing mesh size must reflect that these are *unofficial mesh measurements.*



Mesh Shape (diamond vs square)

Conventional *diamond mesh* was the only design used to construct trawls until the late 1970's when it was noted that the capture of undersize fish was increasing. A diamond mesh codend tends to elongate when stretched by the weight of the catch, thus constricting the mesh opening. As a result small fish are unable to escape.

Square mesh codends perform differently than diamond mesh in that the mesh tends to stay open under strain. Studies conducted by DFO revealed that square mesh codend allows a greater number of small fish to escape than a codend with an diamond mesh of an equivalent size.

Mesh Obstruction

Obstruction of trawl mesh to prevent the natural escapement of small fish is not permitted. Mesh obstruction occurs when mesh are either blocked or made smaller by attachments or modifications to the trawl. The regulations do not explicitly define all situations that constitute mesh obstruction and judgement is required to determine if mesh obstruction exists. The following situations and guidelines should be considered when assessing if a problem exists:

- Excessive strengthening ropes
- Splitting straps too short
- Liners
- Improper topside chafers
- Excessive floats on the codend
- Improper codend skirt

Excessive Strengthening Ropes

Mesh size becomes constricted when strengthening ropes are attached too closely together. Where the straps appear to be constricting the mesh this should be treated as a possible obstruction of mesh.

Splitting Straps Too Short

When splitting straps are too short, the codend cannot expand properly as it fills. As a result mesh in the vicinity of the splitting strap are constricted and thus prevents escapement of small fish. If catches are observed in which fish are concentrated ahead of the splitting strap and do not appear to flow freely into the codend, the catch is being obstructed from normal escapement.

Liners

A liner is a piece of small mesh netting fastened to the inside of a codend. It is used to retain fish that would otherwise escape from the codend. The use of a liner normally constitutes a deliberate attempt to block the escapement of juvenile fish.

Improper Topside Chafers

Chafer types (regular, large mesh or multi-flap) that do not meet regulatory requirements may obstruct mesh. The use of any material on the underside of the codend is permitted to be used as a bottom chafer.

Excessive Floats on the Codend

The use of floats on the inside or outside of the codend is normally an attempt to prevent this section of gear from twisting or striking the bottom. Excessive use of floats, either by numbers or method of attachment, may obstruct the mesh.

Improper Codend Skirt

Codend skirts that exceed DFO policy are considered an obstruction of mesh. When a codend skirt exceeds allowable dimensions it may take on the attributes of a liner, obstructing the escapement of fish from the codend.

3.2 Longlines

Longlining, as the name implies, involves the use of a longline with a series of baited hooks. Early longlining was highly labor intensive, with all aspects of fishing operations being completed by hand. Although this fishery is becoming more mechanized with the use of mechanical shooting, hauling and baiting equipment, this fishery still requires extensive manual labor. Longline gear is used to direct for groundfish and large pelagic species.

Gear construction

There are three types of longline gear used in the Canadian fisheries, *groundfish*, *off-bottom* and *pelagic*. Groundfish gear is fished directly on the bottom and is held in position by anchors attached to one or both ends of the mainline. This type of gear can be mo dified to fish off-bottom by the addition of floats along the mainline. Pelagic gear is fished up in the water column suspended from floats at the desired depth. This type of gear is used in the capture of large pelagic fish.

Groundfish gear is much smaller in scale than pelagic gear. While groundfish longlines normally do not exceed 4 kilometers in length, pelagic gear can extend up to 120 kilometers. The major components of longlines are: mainlines, gangions, hooks, anchors and gear markings.

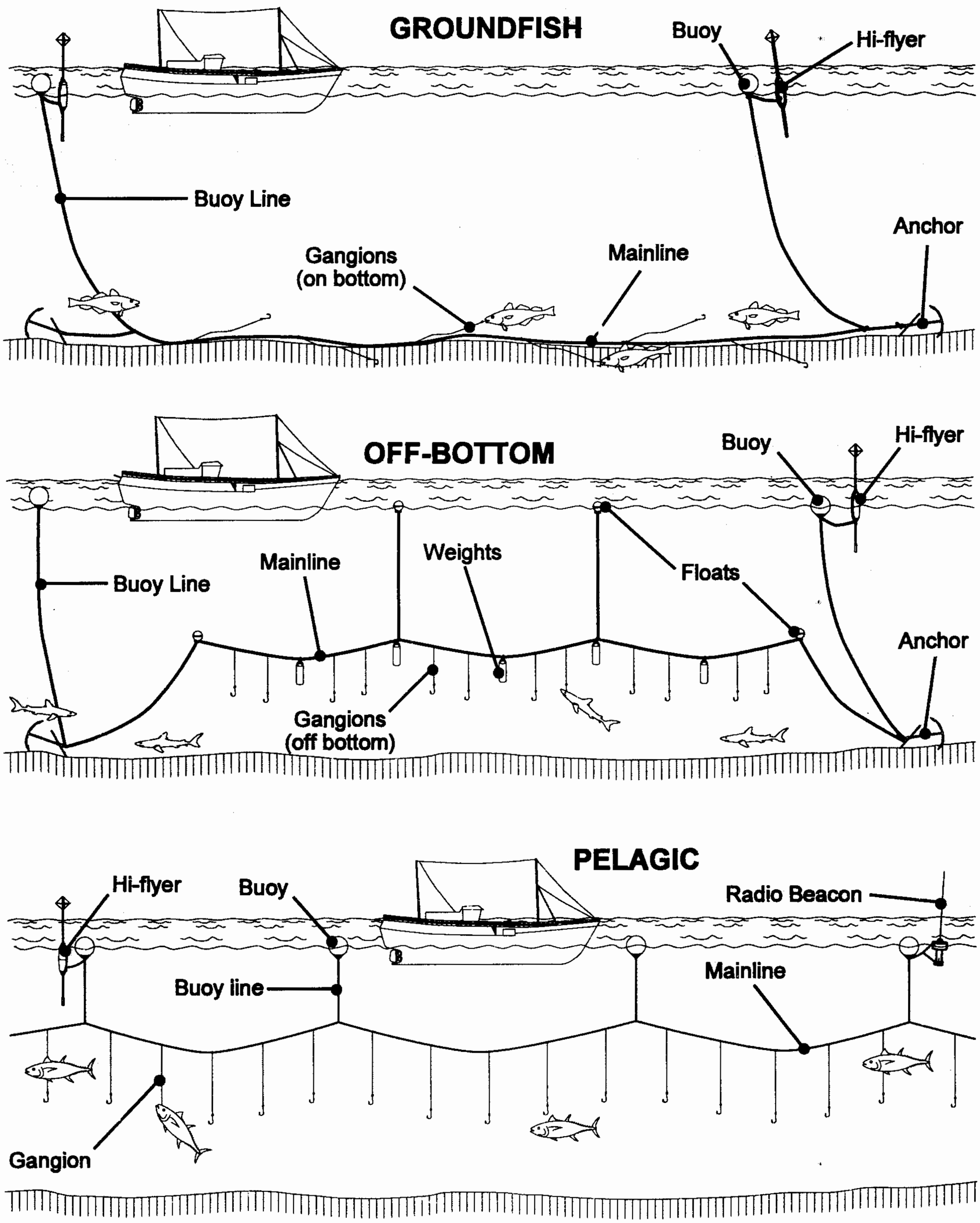
Materials used for mainlines are either braided rope or a heavy gauge nylon monofilament. The mainline of groundfish gear is normally in sections of 500 - 1000 meters. These sections are tied together to form a *string* of longline, up to 4 kilometers in length. The mainline of pelagic gear consists of a longer strings extending from 20 to 120 kilometers in length.

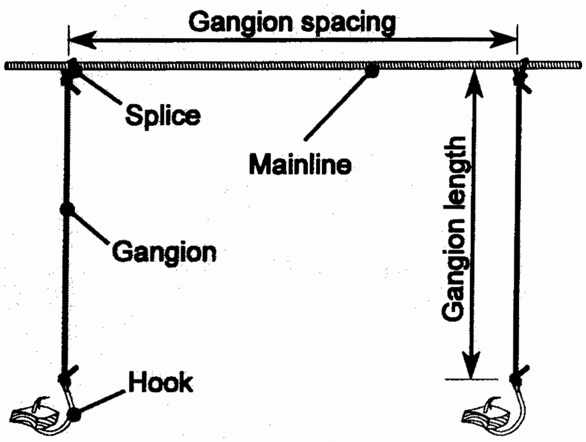
Mainlines are stored in sections called *tubs* or *skates*. They may also be stored as a single section rolled onto a drum or in a large bin.

Gangions

Gangions are the branch lines extending from the mainline, with a hook at the end. Gangions are either spliced into the mainline or attached with a *gangion snap*. Groundfish gangions range from 0.5 to 1.0 meters and are spaced along the mainline at 2 to 4 meter intervals. Pelagic gangions range from 2 to 40 meters and are spaced 40 to 100 meters apart.

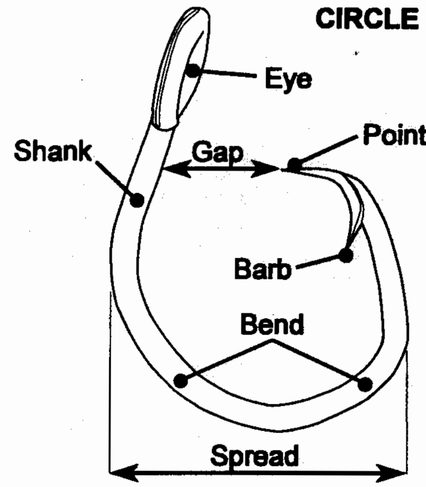
LONGLINE TYPES



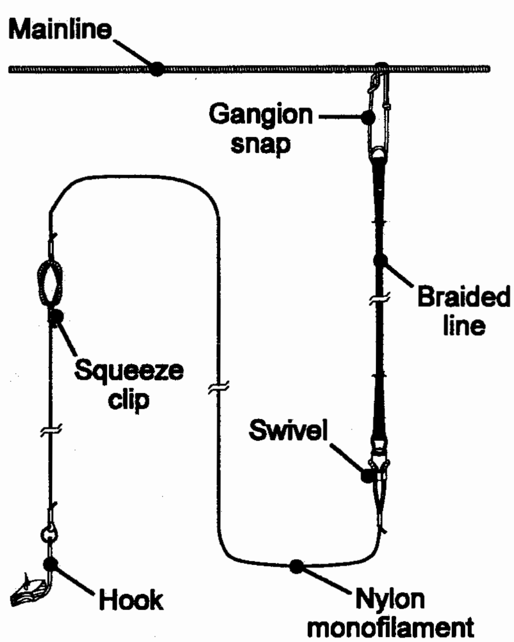


TYPICAL GROUNDFISH GANGION

CIRCLE HOOK

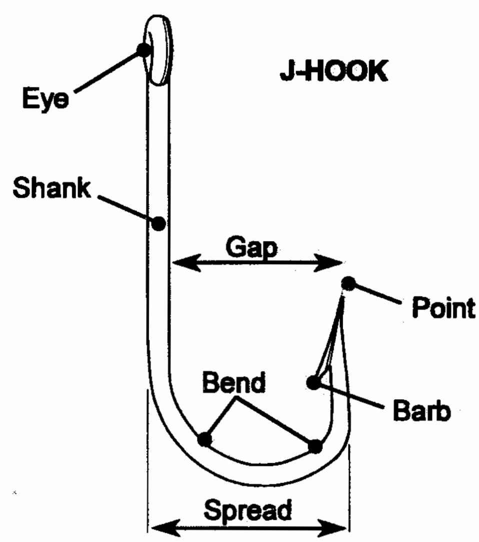


LONGLINE COMPONENTS



TYPICAL PELAGIC GANGION

J-HOOK



Hooks

Hooks are attached to the lower end of the gangion and are manufactured in various sizes and shapes for use in different fisheries. The two main shapes used to describe hooks are *J* and *Circle*. Hooks can be measured in terms of the *gap* or the *spread*. The gap is the shortest distance from the point to the shank. The spread is the maximum distance from the outer part of the shank to the outer curve of the hook.

Anchors (fixed gear only)

Anchors are attached at one or both ends of a fixed gear longline, and serve to hold the gear in place on the ocean floor. They may include the typical iron anchor, grapnels or weighted bags.

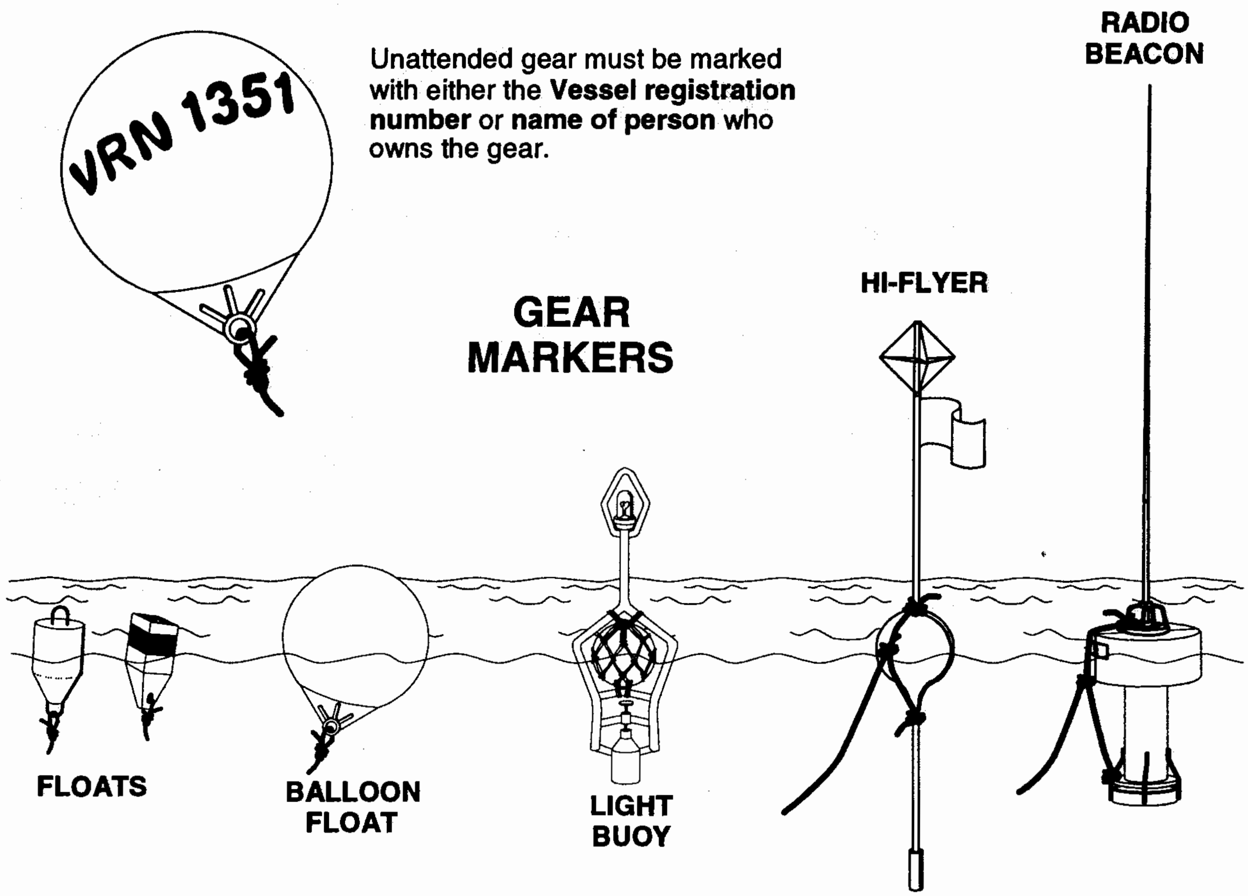
Gear Markers

Gear markers are used for the location of fixed and drift fishing gear. These include buoys, highflyers, radio beacons and light buoys. Under FGR Section 28, all gear other than mobile gear is required to be marked with the *vessel registration number* or the *name of the person who owns the gear*. This is normally done by marking one or more of the buoys attached.

Buoys, also referred to as *floats*, are varied in shape and construction. They are made from hard plastic, soft vinyl rubber or styrofoam. Buoys are used to mark gear or to provide buoyancy to sections of the gear where needed.

High flyers are marker buoys, deployed at various positions along the main line. High flyers equipped with radar reflectors are visible on radar, which warns vessels in the area that set gear is present. The radar reflector aids the master in locating the gear. If the mainline breaks during haulback the gear can be retrieved by locating another high flyer attached along the mainline.

Radio beacons are battery operated transmitters used to facilitate gear location over long distances. When used, they are attached intermittently along the mainline of a drifting pelagic longline. Each radio beacon transmits at a different frequency allowing their signal to be distinguished from other beacons. By setting a radio direction finder to the matching frequency, the bearing of a specific beacon can be determined.



Light buoys are equipped with a battery powered light which aids in locating gear during night fishing. Reflective tape, visible for up to a mile when hit with a spotlight, can be used as a substitute for a light buoy.

Gear Deployment

The longline is deployed from the stern of the vessel. The buoy is deployed first (along with the anchor for set gear) and baited hooks, high flyers, and floats are attached at desired intervals as the main line is payed out. The vessel steams at approximately 6 - 12 knots while the gear is being shot away. The length of line and number of hooks varies, depending on the fishery. Groundfish longliners set gear in units referred to as *strings* equipped with up to 2500 hooks. Each string may be up to 4 kilometers in length and up to 8 strings may be set to cover a desired fishing area. Pelagic longliners may deploy a single string of up to 120 kilometers in length equipped with as many as 2500 hooks.

Method of Capture

Fish are attracted to the hooks by bait or artificial lures, and become hooked by the mouth as they attempt to swallow. The capture of fish on longline gear is dependent on the depth at which the gear is fished. The fishing depth of groundfish longline is simply the distance from the surface to the bottom. Pelagic gear depth is the distance from the surface to the depth at which the hooks are suspended. Fishing depth in this case can be varied by changing:

- Buoyline length
- Gangion length
- Amount of sag in the mainline

Increasing the length of buoylines or gangions increases the fishing depth. Sag in the mainline is controlled by the spacing between the buoys. Buoys spaced farther apart tighten the mainline causing the gear to fish at a shallower depth. Conversely, buoys spaced closer together allow the mainline to sag which causes the hooks to reach deeper water.

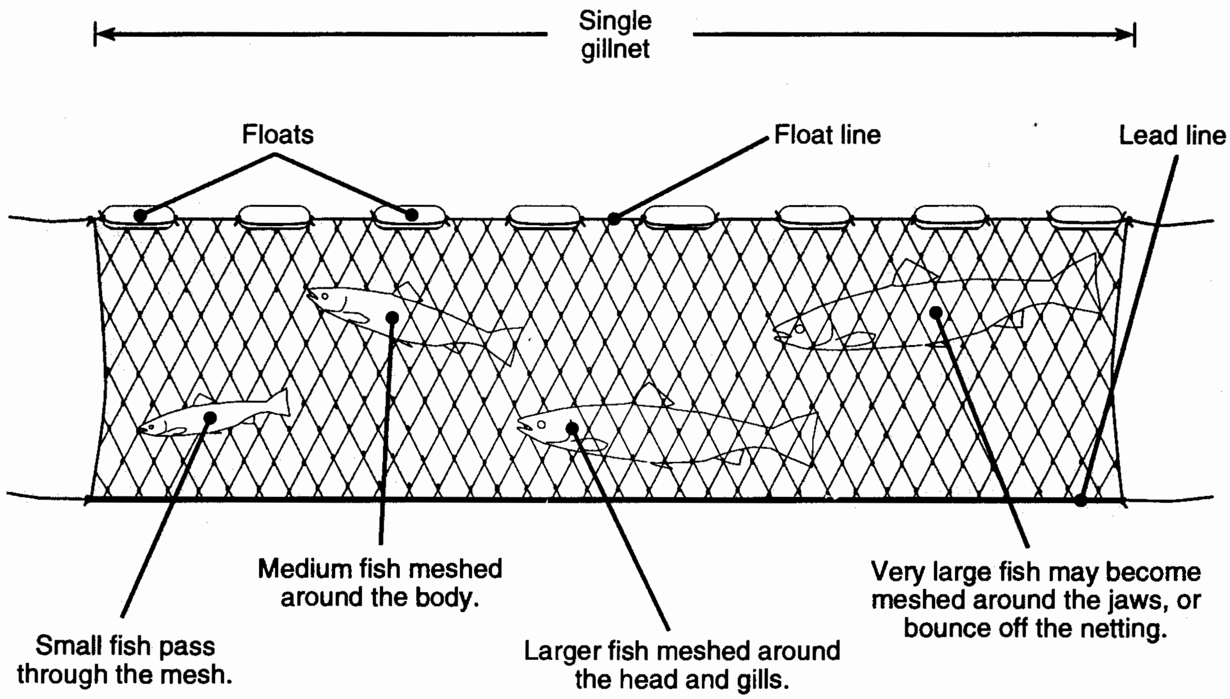
Gear Retrieval

Longlines are left in the water from several hours to a day before the retrieval process commences. This is referred to as *soak time.* Gear retrieval begins by locating the buoy at either end of the mainline, then hauling it and the buoyline onboard. The main line is fed into an automatic hauler and the gear is pulled in. On some smaller vessels the gear may be hauled by hand. As the main line comes onboard, fish are individually removed from the hooks.

Normally the haulback process includes the partial dismantling of the gear as it is brought onboard. Gear markers, buoylines, and anchors are removed from the mainline and stored separately. Where snaps are used to connect gangions to the mainline, they are separated and stored separately. Where gangions are spliced into the mainline they are left attached.

Conservation Features

Longlining is considered to be selective in the size of fish captured. Large hooks are intended to reduce the number of small fish caught. Also, fish captured on a longline are still alive and prohibited catches may be returned to the sea with a reasonable chance of survival.



3.3 Gillnets

Gillnets are used to direct for groundfish and small pelagic fish. The basic principle of gillnets is that fish swim into a wall of mesh netting and become entangled around the gills.

Gear Construction

The configuration of gillnets varies with the species being sought. Directing for groundfish requires the gear to be arranged to fish near the bottom, however directing for pelagic species requires the gear to be suspended up in the water column.

Floatline

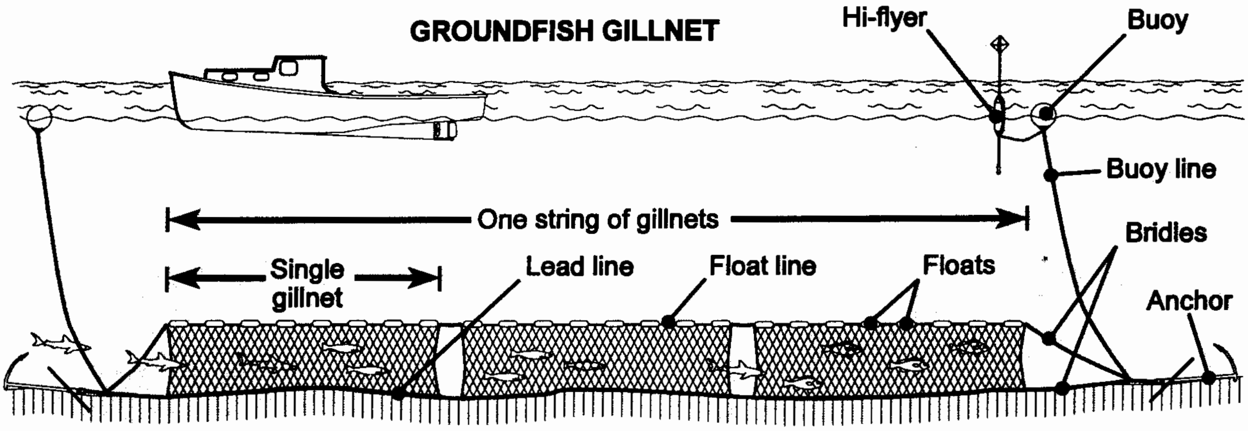
The floatline, also referred to as *headrope* is attached along the top of the net to provide support and buoyancy. It usually consists of a braided rope with floats attached at equal intervals, but can also be made of a foam core rope.

Leadline

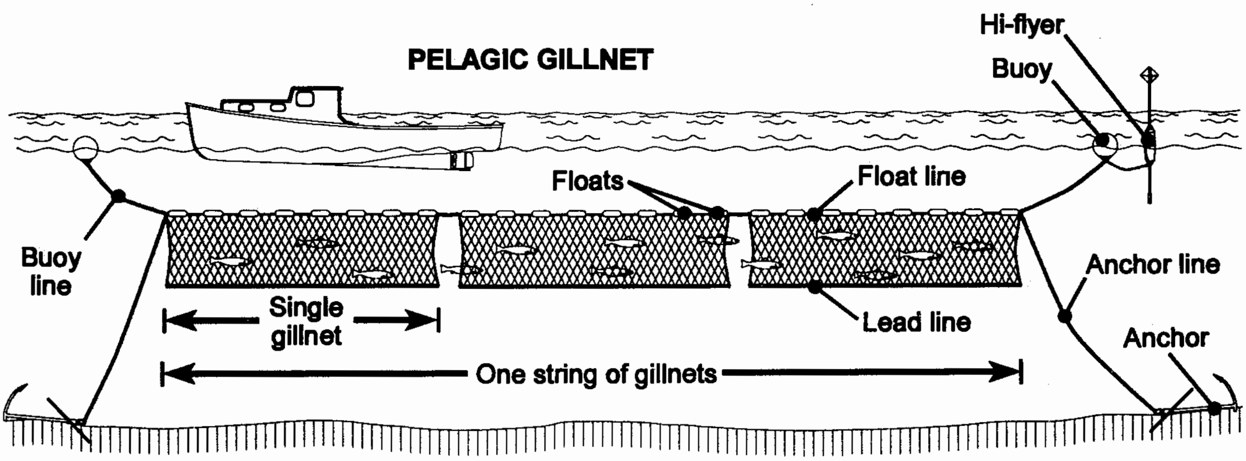
The leadline, also referred to as the *footrope,* is a weighted line attached along the bottom of the net to weigh down the bottom portion of the net. It usually consists of a lead core rope, but may consist of a braided rope with lead weights attached. Where tides are exceptionally heavy additional weights along the leadline may be necessary.

GILLNET TYPES

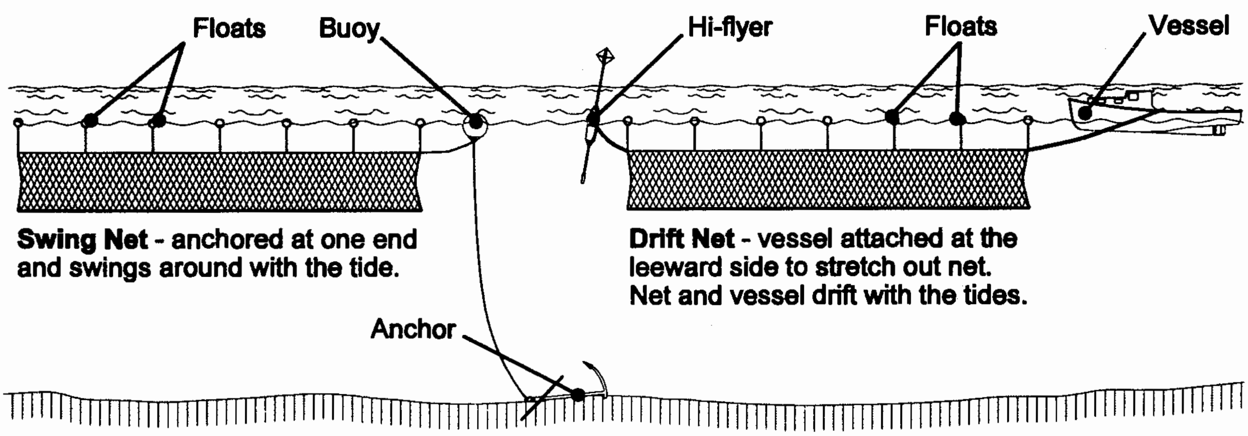
GROUNDFISH GILLNET



PELAGIC GILLNET



SWING & DRIFT GILLNETS



Netting

Rectangular sections of netting, also referred to as *webs*, are constructed of monofilament, a clear or colored nylon material which is difficult to see underwater. The top and bottom of the netting are sewn to the floatline and leadline respectively.

Anchor and Anchorlines

Anchors and anchor lines are attached to one or both ends of a string of gillnets to keep them stationary. Gear secured to the bottom by anchors is known as *fixed gear*.

Gear Markers

Gillnets are marked at each end by a float, a high flyer, or both. These facilitate locating gear and identification for regulatory purposes. (Refer to *3.2 - Longlines* for a more detailed description of floats and high flyers.)

Gear Deployment

Gear deployment differs with the type of gillnet being used. Gillnets can be categorized into two broad groups: fixed gear, and drift nets.

Fixed Gear Gillnets

Gillnets are set by first deploying the buoy and anchor followed by the net. Three to eight nets are generally joined together in a string, also referred to as a *fleet*. This provides greater fishing effort without requiring additional anchors and buoys. The gillnet can be set to fish at any desired depth by adjusting the length of the buoy and anchor lines.

Groundfish gillnets are set with the lead line directly on the bottom, while *pelagic gillnets* are set with the entire wall of netting up in the water column. *Swing nets* are a form of pelagic gear set with an anchor at one end only and the wall of netting swings with the tide.

Drift Nets

Drift nets are constructed from the same components as fixed gear gillnets, but the anchors are not required. One end of the net is attached to the vessel while the trailing end hangs freely in the water. The trailing end is equipped with a flag attached to a float and a light for identification purposes. Once the net is set, the vessel and gear drift until hauling operations commence.

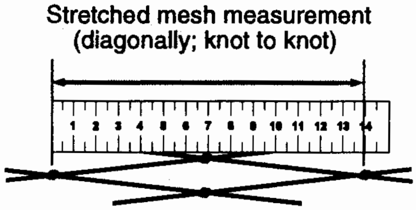
Method of Capture

Gillnets form a wall of netting which entangles fish that attempt to swim through it. Entanglement of fish depends on their size and the size of the mesh. Small fish may pass through the mesh, while medium fish pass partly through and become entangled around the body. Large fish become enmeshed around the head and gills. Very large fish may become tangled around the jaws or deflect away from the netting.

Gear Retrieval

At one end of the gear the buoy and buoy line are taken onboard. As the nets are hauled in the catch is shaken and pulled from the mesh. Most vessels use a drum or gurdy to retrieve the gear; however on some small vessels haulback is done by hand.

Conservation Features



Gillnets are selective in terms of mesh size; the larger the mesh the larger the size of fish retained. Mesh size is measured from the inside corner of one mesh to the diagonally opposite corner. Although not specified in the regulations, it is recommended that at least 20 meshes be measured to give a fair representation of the net mesh size.

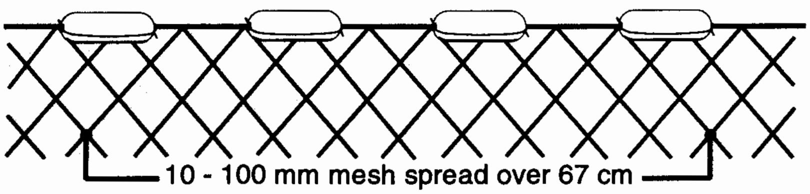
Hanging ratio is the proportion to which the original length of a net is attached to the head and foot rope. This proportion can be expressed as a percentage or a fraction. The hanging ratio used to construct nets affects the shape of meshes and the manner in which the net is suspended in the water. These two features combined can influence the selectivity of the gear.

Acoustic warning devices, also referred to as pingers, are small battery powered alarms attached to the gillnets. The purpose of these are to alert marine mammals in the vicinity of the gear to the presence of a potential hazard.

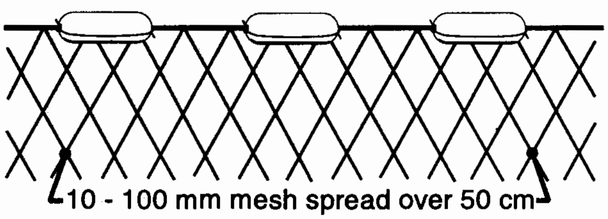
STRETCHED MESH PANEL

$$\frac{100\text{ cm}}{100\text{ cm}} = \mathbf{1.00 = 1}$$

HANG RATIO - the ratio between the length of netting and length of ropes to which it is attached.

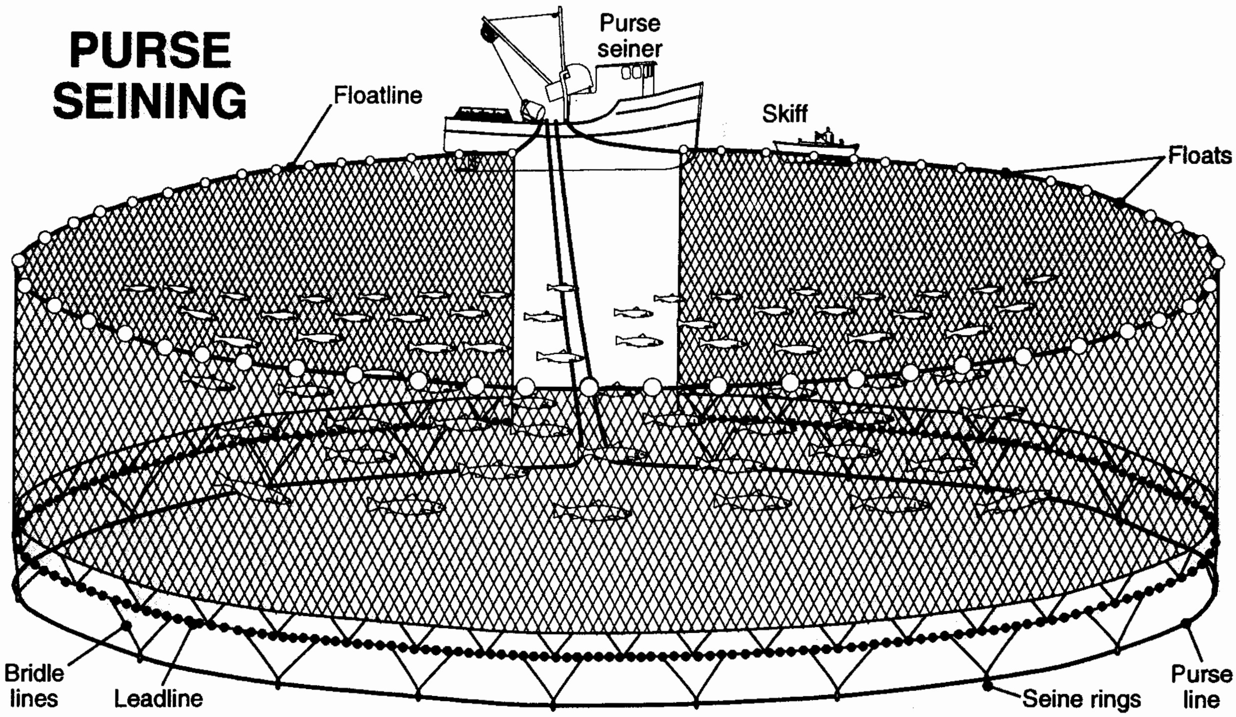


$$\frac{67\text{ cm}}{100\text{ cm}} = \mathbf{0.67} = \tfrac{2}{3}$$



$$\frac{50\text{ cm}}{100\text{ cm}} = \mathbf{0.50} = \tfrac{1}{2}$$

Hang ratios above shown at 67% and 50% of the stretched mesh measurement.



3.4 Purse Seining

Purse seining is a method of fishing that uses a wall of netting to encircle a school of pelagic fish. Extremely large sets of fish can be captured by this method, often in excess of 100MT.

Gear Construction

Purse seines consist of a large panel of netting equipped with floats on the top portion and a leadline on the bottom. Suspended from the leadline are a series of bridles and seine rings. A purse line is threaded through the seine rings.

Gear Deployment

A small, motorized boat called a skiff is carried on the stern of the seiner. For the setting operations, the skiff is deployed first. One end of the net is then lowered over the stern of the vessel and attached to the skiff. The seiner and the skiff then proceed to encircle the fish with the net.

On smaller seiners, a buoy may be used instead of a skiff. In this case a buoy, with the seine attached, is deployed and the seiner encircles the fish with the net.

Method of Capture

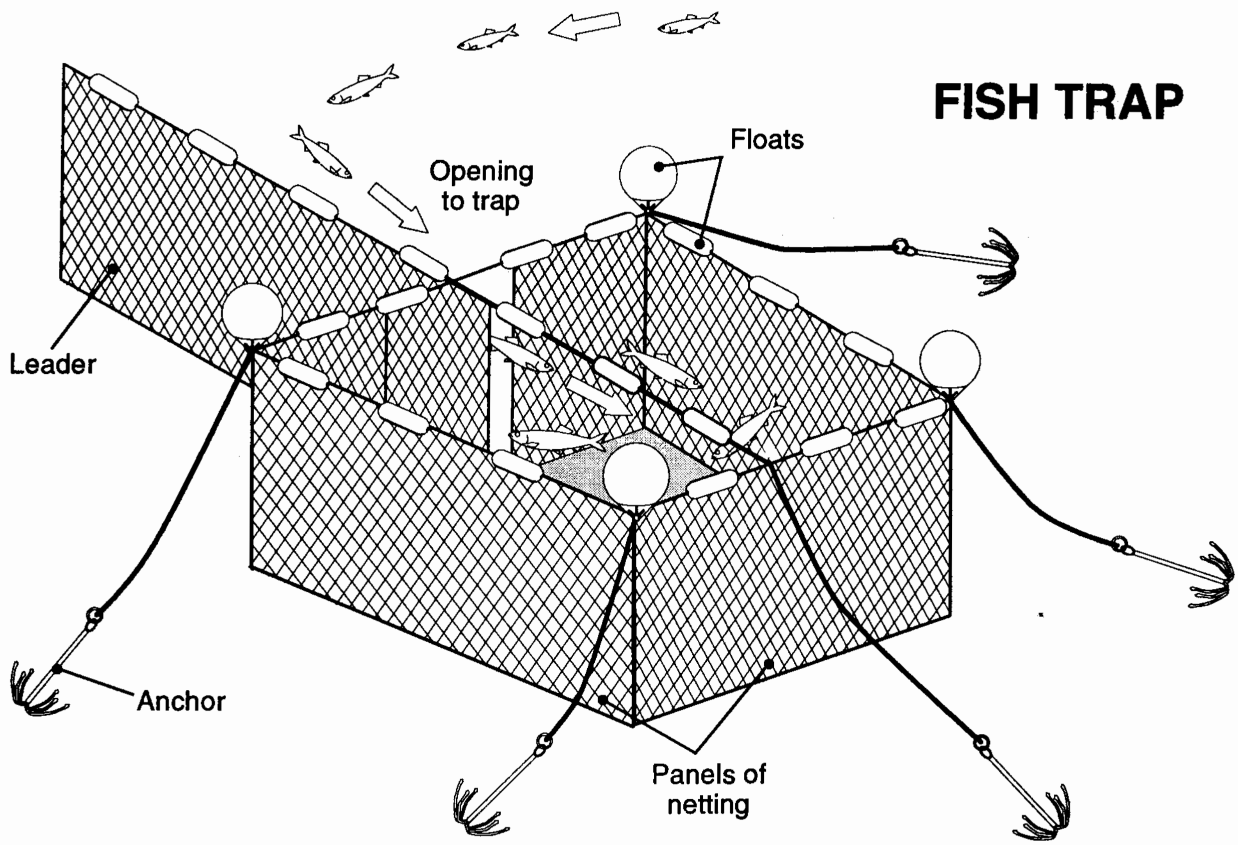
When fully deployed, the seine hangs in the water similar to a gill net. The mesh size is generally small enough that fish do not become entangled in the nets, rather they are contained by the encircling net. Floats keep the headline afloat while the leadline stretch the seine downward giving it a wall like appearance. Once the netting has totally encircled the fish, the purse line is winched in, closing the bottom of the seine.

Gear Retrieval

The seine is pulled aboard the seiner by the purseline and headline, reducing space inside the net and concentrating the fish. The catch is winched aboard with dip-nets or sucked onboard with a hydraulic pump system.

Conservation Features

This method of harvest allows live release of fish when the size composition or quality of the entire catch is poor. When the catch is brought along side the vessel, the fish are alive and still submerged in water. If the fish are too small or the catch is too large for the remaining hold capacity, the net can be let out to release all or part of the catch.



3.5 Trap Nets

Trap nets are fixed gear structures set in close proximity to the shore. The traps resemble an open topped box with a doorway cut in the side. Trap nets are used to capture groundfish and pelagic fish.

Gear Construction

The trap is constructed from synthetic fiber netting. Trap nets are shaped like a room, with a floor, four walls and a door. The walls of the trap are kept vertical in the water by floats placed along the top of the walls and lead weights at the bottom. The position and shape of the trap is maintained by anchored lines attached to the four corners. A door located at the front wall allows fish to enter. Extending outward from the center of the door is a wall of netting called the leader. The leader serves to guide the fish to the door of the trap.

Gear Deployment

The setting process starts by deploying the corner anchors in a predetermined location on the ocean floor. Next, the netting is lowered into the water and the anchors are shifted until the trap has acquired the desired shape. The leader is then deployed and held in position at its far end by an anchor or in some situations, fastened to the shore with ropes. Gear deployment usually requires two vessels.

Gear Operations

Fish are guided by the leader into the door of the trap. Once inside, they swim around in circles, avoiding the narrow door opening.

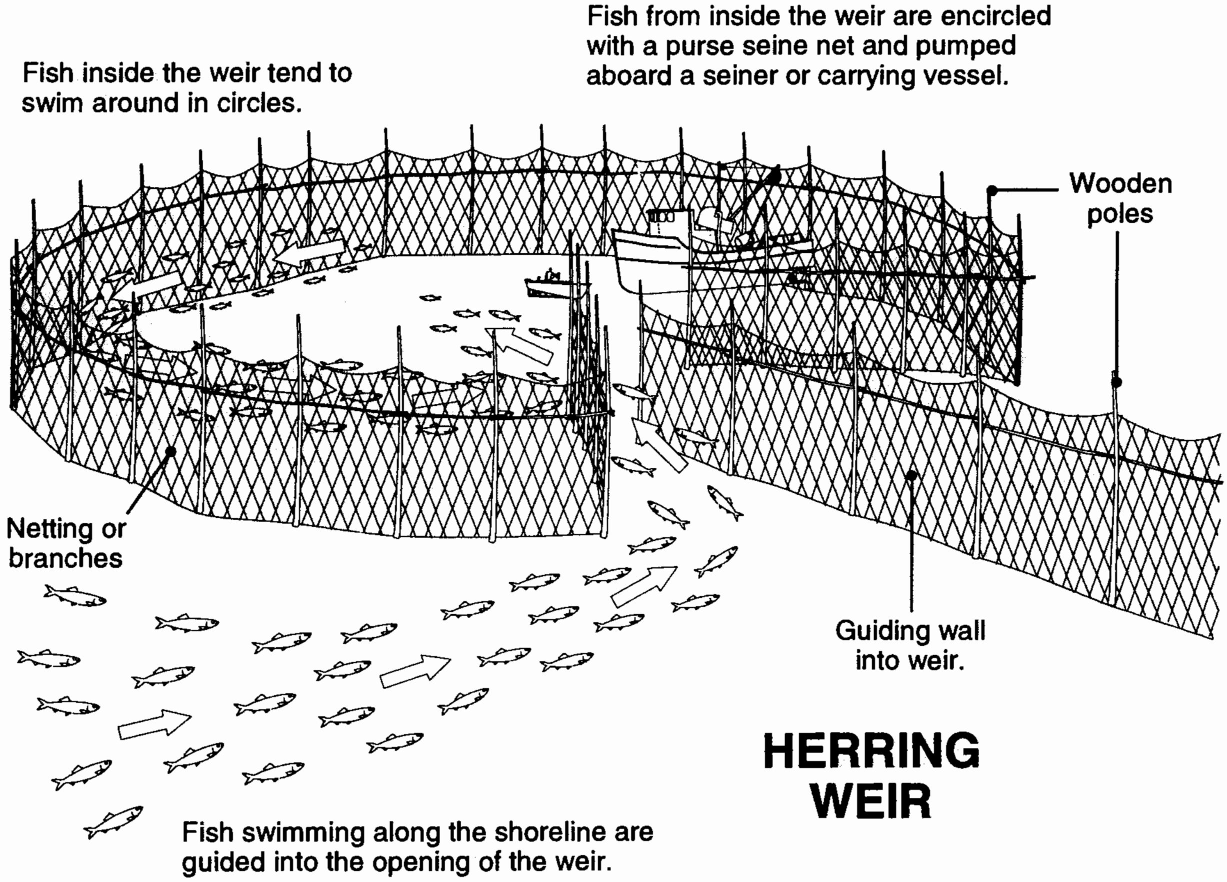
Gear Retrieval

The process of hauling a fish trap begins by closing off the door. The forward panels and floor of the trap are pulled up by ropes, closing the door and herding fish towards the back panel. Portions of the bottom and side panels are hauled onboard reducing the enclosure. When no more netting can be taken onboard the edge being hauled is held while the netting on deck is let back into the water. This process continues until the fish have been herded into one of the back corners known as the dry-up area. When they are sufficiently concentrated, the fish are then bailed aboard. Two vessels are normally required for this process. The main vessel hauls the net and the second vessel follows along the periphery to maintain tension on the nets between the two vessels to prevent fish escapement.

Conservation Features

Mesh size in the drying twine may be increased to release small fish. Fish are herded towards this part of the trap during the gear retrieval process, and smaller fish escape through the net while the larger fish are retained.

When directing for groundfish a *deflector panel* may be required to prevent the incidental capture of salmon. A deflector panel is a piece of netting covering the top portion of the door. This prevents fish swimming in the upper water column from entering the trap, while groundfish enter below the panel.



3.6 Weirs

Weir fishing works on the same basic principles as a trap net. Schools of fish swim along a leader that guides the fish into the doorway of an encircling corral. The weir structure is held in place by long poles driven into the seabed, whereas a trapnet is held in place by anchors and buoys. Weirs are used to direct for herring.

Gear Construction

The main body of the weir consists of a large heart-shaped fence constructed of poles, wire and netting. The poles are driven into the ocean bottom to firmly support the structure. There is a door located at the center of the front wall with a straight fence leading from it and extending to the nearby shore line. The inside of the weir is lined with a purse seine used to gather the catch for easy removal.

Gear Deployment

Once constructed, the weir is a permanently fixed structure.

The weir is considered to be fishing when the doorway netting is dropped open and fish can enter the weir.

Method of Capture

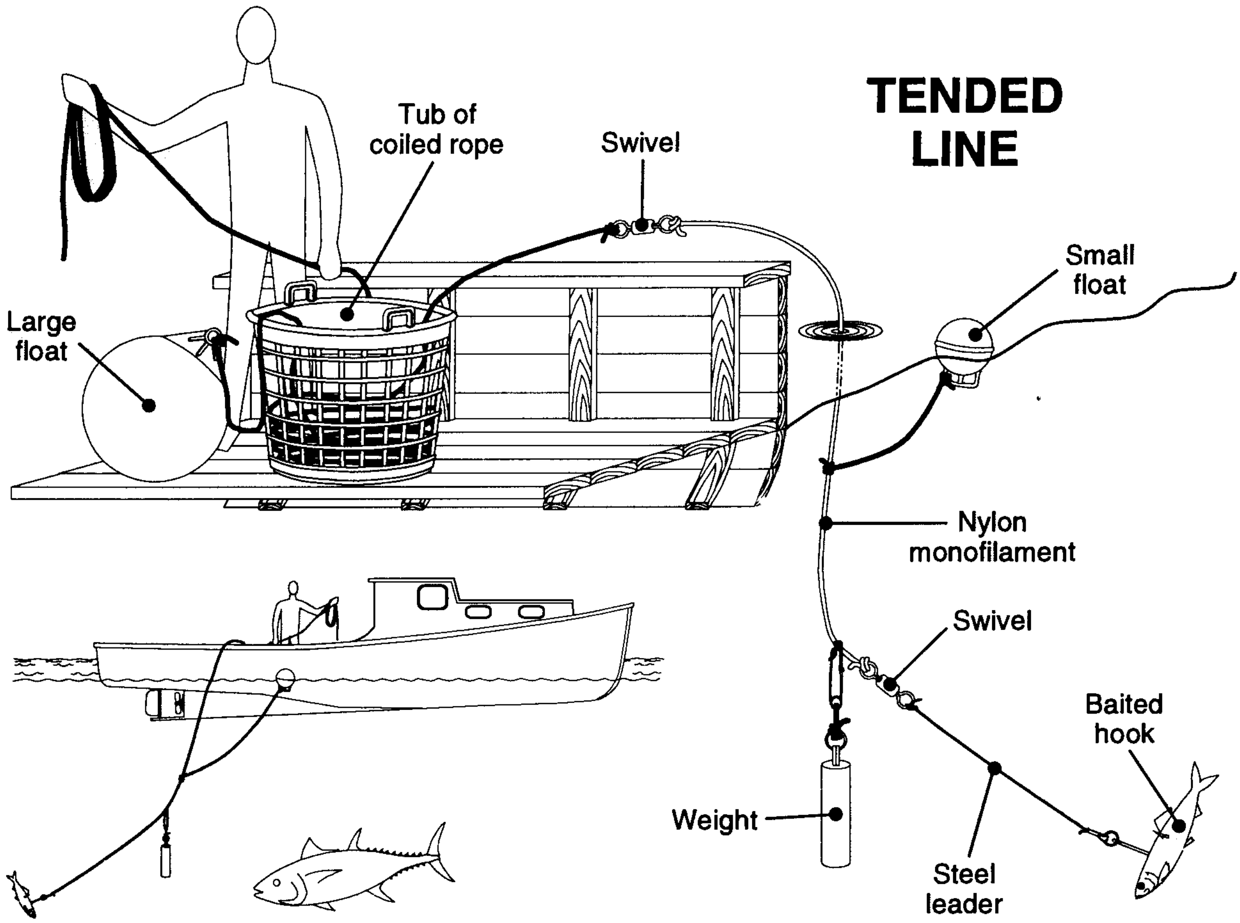
Fish come in contact with the lead wall and are directed into the main body of the weir through the door opening. The fish become disoriented inside the weir and swim in circles.

Gear Retrieval

Once sufficient fish have entered the weir, the doorway netting is raised, closing the entrance. The purse seine lining the weir is gradually hauled together and the fish are either pumped or bailed into a boat.

Conservation Features

Fish inside a weir are alive and can be sampled prior to harvesting. If the quality or size composition of the catch is undesirable, the entire catch may be released unharmed.



3.7 Tended Lines

Tended lines are a simple hook and line tied to a vessel used to direct for tuna. Once a fish is hooked the line, attached to a buoy is set free, letting the tuna swim and tire itself out before being retrieved.

Gear Construction

A line with a steel leader, float, weight and hook. One buoy per line must be on board the vessel when tended lines are used.

Gear Deployment

The hook and leader are lowered into the water, pulled down by the weight. A small float attached further up the mainline is used to maintain the desired fishing depth. The main line is payed out till it reaches the desired distance from the vessel and fastened alongside with breakable twine. The remainder of the main line and a large float are stored on deck until a fish is hooked. Due to regulatory restrictions, only two lines may be deployed at one time.

Method of Capture

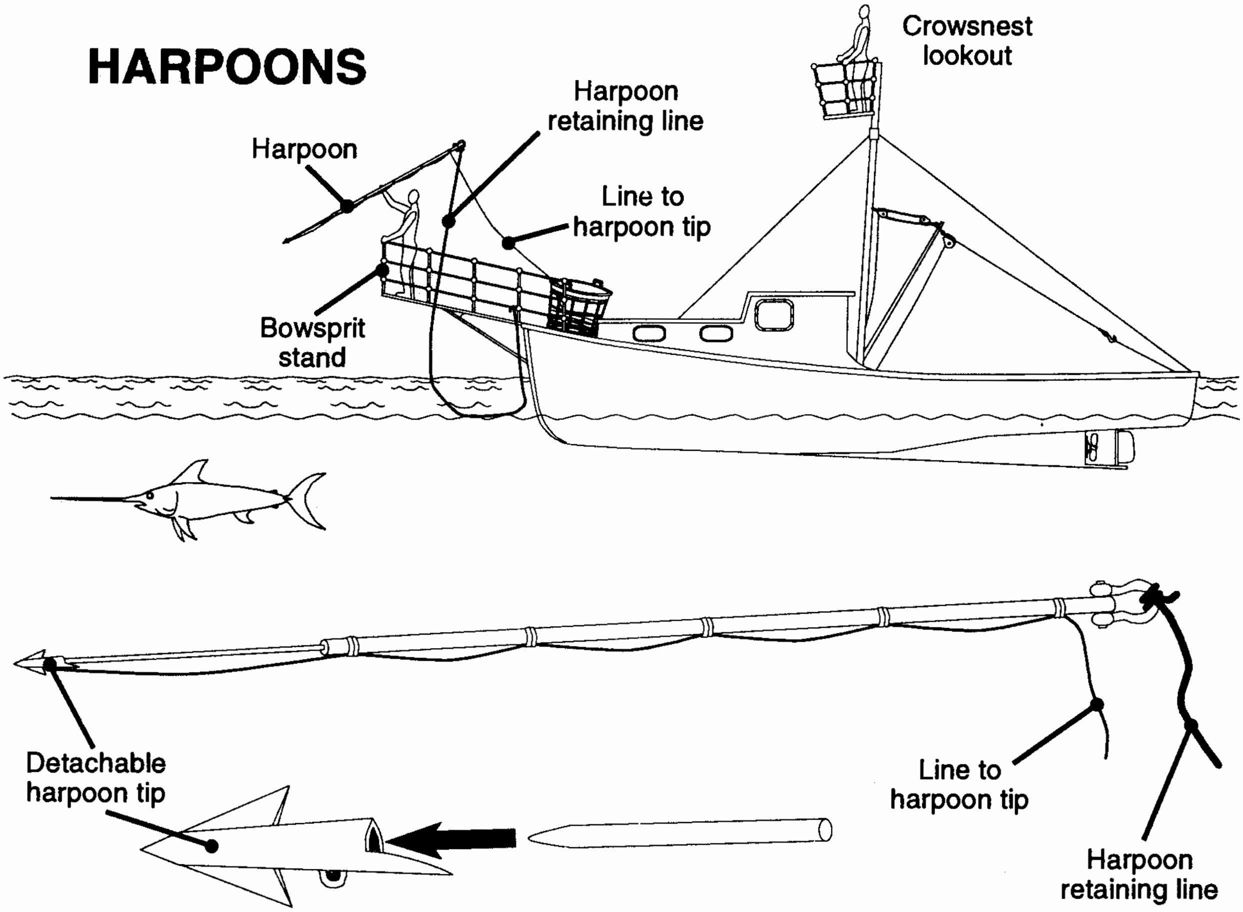
Tuna are attracted to hooks by bait or lures. When they take the hook the mainline is pulled overboard, snapping the breakable twine. The large float is thrown overboard with the remaining mainline. After taking the hook the fish swims away from the vessel dragging the gear. The gear is tracked by following the float as the fish continues to swim and tire.

Gear Retrieval

Once the fish has tired the float is picked up and the mainline hauled in until the tuna is brought alongside. It is then killed, either by gun or electric shock, and hoisted on board.

Conservation Features

Tended line selectivity depends on the hook size used.



3.8 Harpoons

Harpoons are barbed spears attached to ropes used to direct for large pelagic fish such as swordfish. Harpooning can be used either to capture fish, or as a precautionary measure to attach a second line to a large fish that has been brought alongside a vessel with another fishing gear.

Gear Construction

Harpoons are 3 to 4 meter length poles with a detachable barbed spear tip. The harpoon tip is attached to a line with a buoy at the opposite end. A retaining line is attached to the butt end of the harpoon shaft.

Gear Deployment

The harpoon is positioned at the front of the vessel, often from the end of a forward extension called a *bowsprit*. The vessel steams behind a suitable fish and the harpoon thrown into it, embedding the tip into the flesh.

Method of Capture

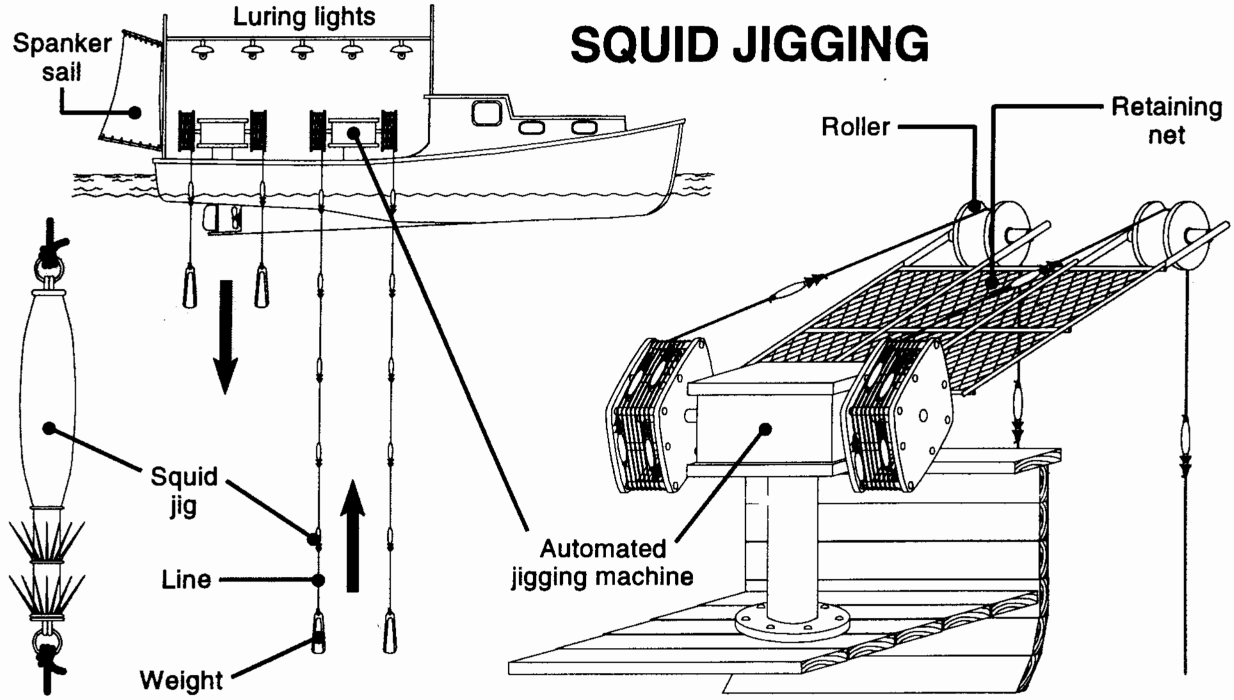
The tip of the harpoon is pulled from the shaft as the fish swims away. The harpoon shaft is retrieved while the fish tows the harpoon tip, line and buoy away. The gear is tracked by following the float as the fish continues to swim and tire.

Gear Retrieval

Once the fish has sufficiently tired, the vessel steams over and picks up the buoy. The buoy and the line are used to pull the fish alongside to be killed and hoisted aboard. Smaller fish are hand gaffed aboard, while larger fish may require the aid of a winch.

Conservation Features

The selectivity of the harpoon rests solely with the judgement of the person throwing it.



3.9 Jigging

Jigging by hand is one of the oldest forms of fishing. Hand held jigs are lure-like hooks moved up and down in the water in concentrations of fish. Fish attracted by the motions are hooked as they pass near the jigs. Automated jigging machines work on the same basic principles, however are much less labor intensive. Jigging is used to direct for groundfish, small pelagic fish and squid.

Gear Construction

Jigs are heavy metal lures with barbed hooks attached. The number of hooks on the lure varies from two to four. Squid jigs have a colored plastic lure with two rings of multiple barb-less hooks.

Gear Deployment

When jigging for groundfish, the jigs are lowered to just off the bottom. While directing for small pelagic fish or squid, the jigs are lowered down to the depth at which the desired species are located.

Method of Capture

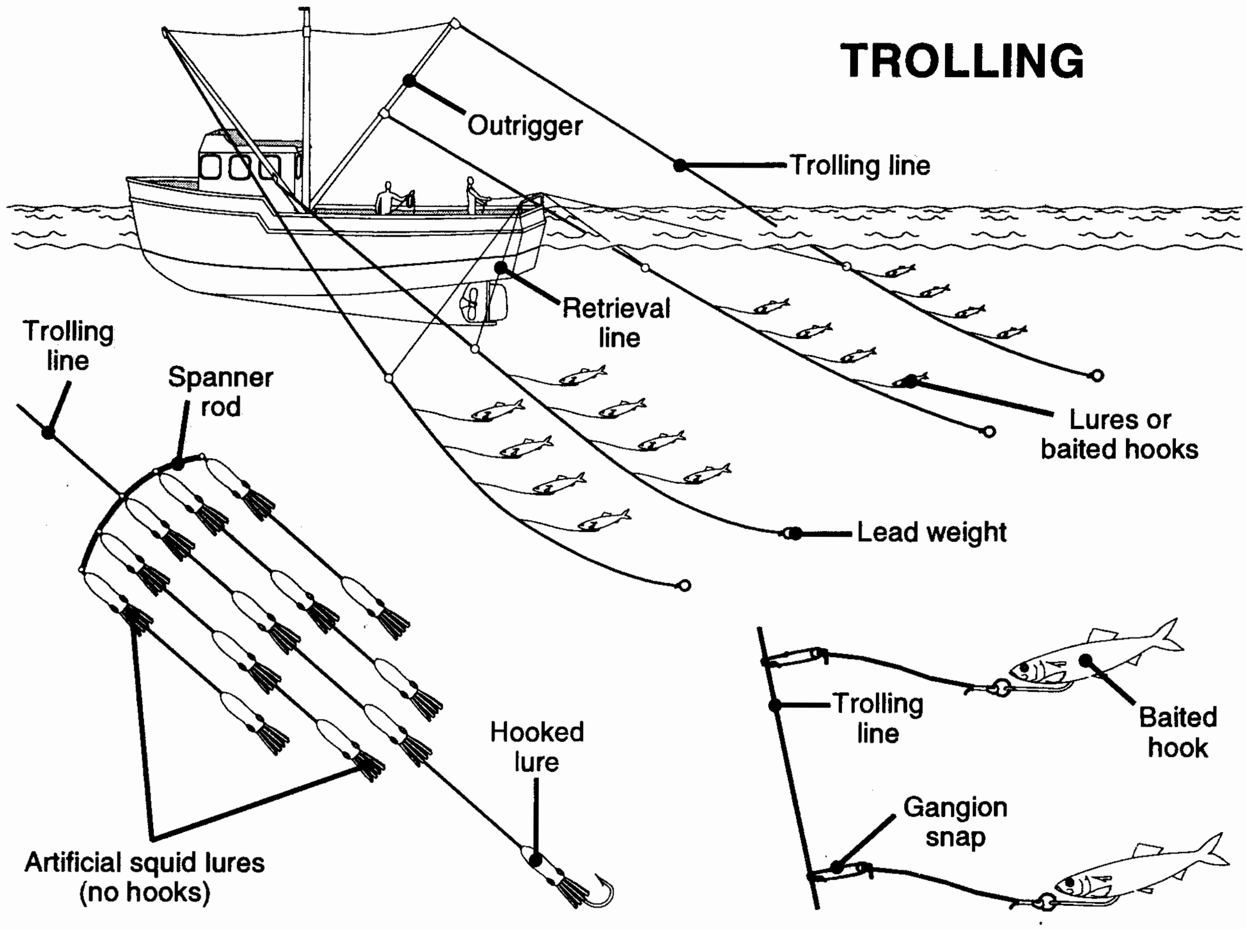
The hook is moved up and down in a series of motions, referred to as *jigging*. Fish are attracted to the lure and hooked as they approach. Jigging can be conducted manually or by machine. Manual jigging is sometimes assisted by the use of hand cranked reels. Electric or hydraulic motors can provide the same up and down movement as hand jigging, but is less labour intensive. The machines spool out the line until the jigger reaches the desired depth and begins jigging automatically. The fishing depth and jigging motion can be adjusted to suit a particular fishery.

Gear Retrieval

When jigging for groundfish, the jigs are hauled in when a change in tension on the line indicates a fish. In squid jigging the jigs are repeatedly deployed and retrieved whether or not tension is detected on the lines.

Conservation Features

Jigging is non-selective, normally catching any fish that wander close enough to be hooked on the jig. The only selectivity feature is the breaking point of the gear; fish above a certain size will break the lines.



3.10 Trolling

Trolling is the use of hook and lines being slowly towed through the water behind a vessel. The main types of species directed for with this gear type are salmon and tuna.

Gear Construction

A main fishing line constructed of stainless steel with gangions, lures and hooks attached at designated intervals along the line. A vessel can deploy a maximum of six main fishing lines at a time. *Angling* (rod and reel) can also be included in this category. The line is cast and pulled through the water as the vessel makes headway.

Gear Deployment

The vessel is equipped with two main poles, located midship, each approximately the length of the vessel. Some vessels may also have two shorter poles located at the bow of the vessel. These poles are lowered to a 45 degree angle during fishing operations. The main line is attached to the pole by pulleys. Lines are stored on separate spools called gurdies which are equipped with individually controlled clutch and brake mechanisms. For deployment, the lines are released off the gurdies as the vessel moves through the water.

Gear Operations

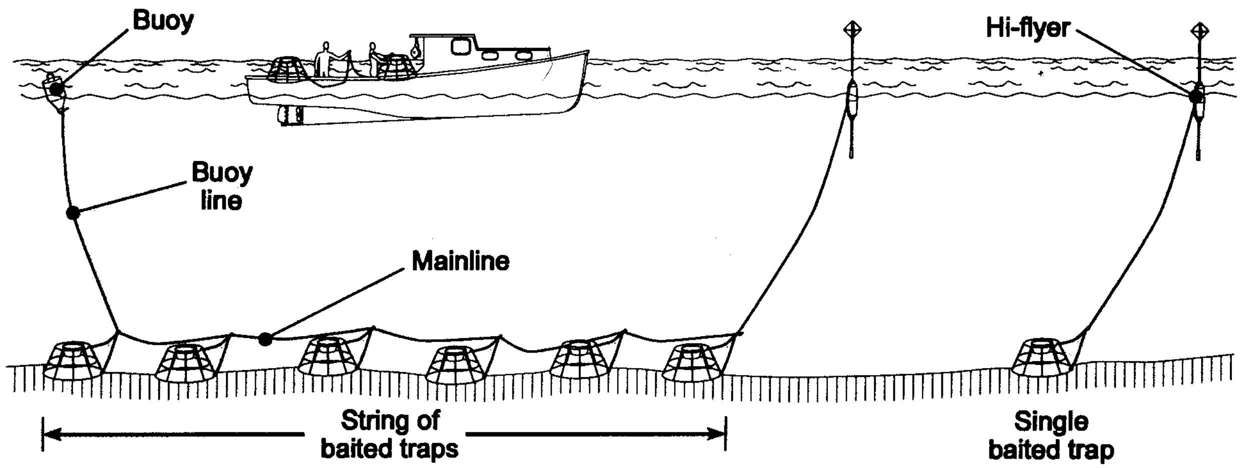
The fishing gear is towed slowly through the water attracting fish with baited hooks or lures. There may be different configurations of lures used, depending on the directed fishery. A common method used for tuna consists of a spanner rod (spreader bar) with squid lures, without hooks, arranged in 3 rows of 3-5 squid and a single trailing lure equipped with a hook. The configuration resembles a school of squid and the tuna are attracted to the trailing lure. Once a fish has been hooked, the line is pulled on board the vessel. The main strategy associated with this gear type is fishing depth. The fishing depth can be determined by the amount of main line let out and towing speed, and is adjusted according to the directed species.

Gear Retrieval

For mechanized trolling the lines are reeled in by engaging the mechanized gurdies. The fish is removed from the hook and the gear is reset. For angling, each rod is manually reeled in, the fish removed and the gear reset.

Conservation Features

The fishing gear can be operated at predetermined depths, permitting it to be species selective. The size and species of fish captured can also be regulated by the type and size of hooks used.



3.11 Crab Traps

A number of different styles of traps are used to direct for crab. The common principle behind these traps is that crabs are attracted by the bait, enter the trap and are unable to exit.

Gear Construction

The crab trap, also known as the *crab pot*, consists of a metal frame enclosed with netting. There are three basic shapes used in the construction of traps; square, conical and pyramidal.

Square Crab Traps

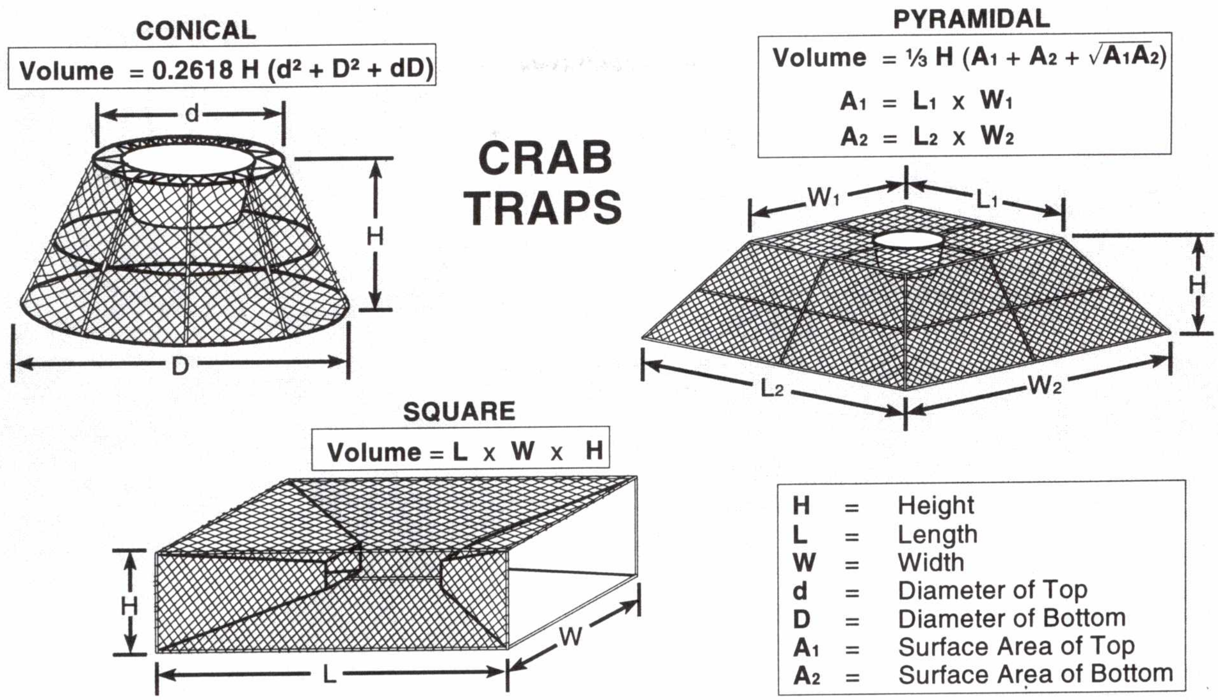
Square crab traps are actually rectangular in shape consisting of a frame constructed from metal rods and covered with polypropylene netting. The trap contains two entrances and a side panel to retrieve the catch.

Conical Crab Traps

Conical crab traps (also referred to as *Japanese traps*) consist of a frame constructed of metal rods covered with a single piece of nylon netting. The netting is permanently attached to the frame and is closed and opened with a draw string located at the bottom of the trap. Double rods are used for the base of the trap, which acts as a weight and provides structural support. The top contains one to four plastic cone shaped entrances allowing the crab to drop into the trap.

Pyramidal

Pyramidal crab traps have the shape of a truncated pyramid. The construction is similar to the conical, with a double rod base and the bottom can be opened and closed with a draw string.



Gear Deployment

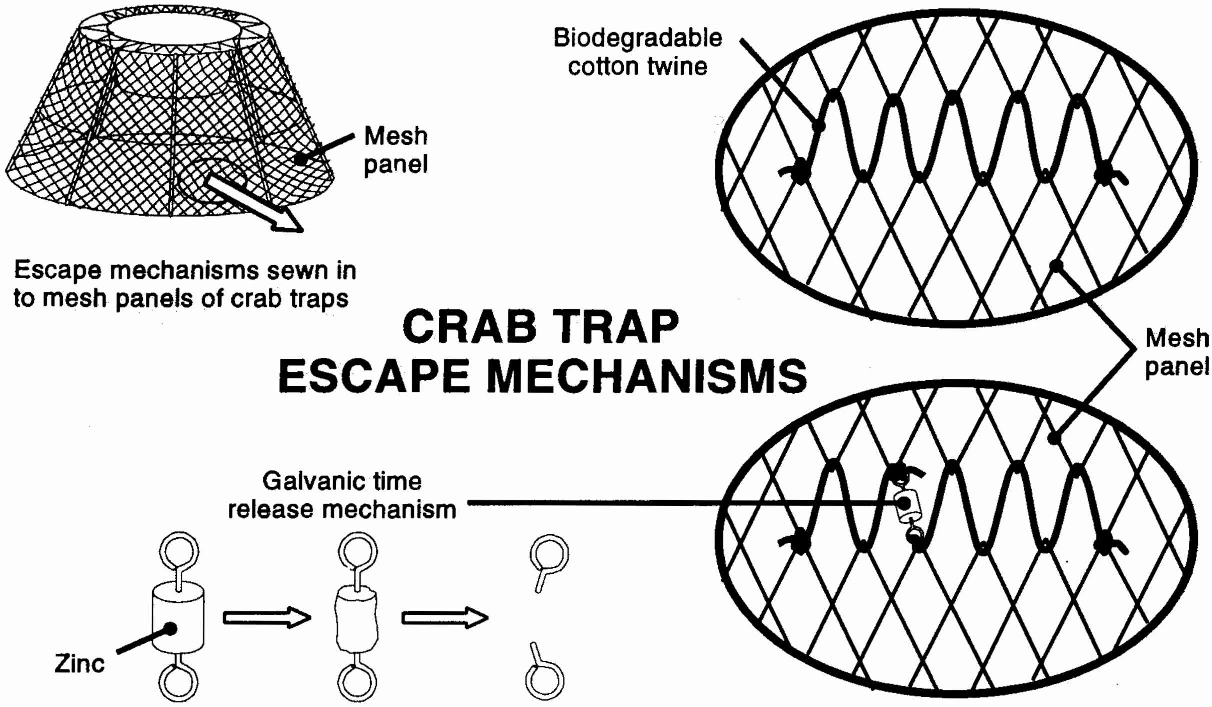
The traps are first baited with fresh or frozen mackerel, herring or squid. Normally two bait bags are hung in the trap to attract the crab and a combination of bait types can be used. When the desired fishing location is obtained the traps are released into the water. A floatline (length: 1½ times the water depth) is attached to individual traps with the other end of the line affixed to a balloon float at the surface. The buoyline is equipped with a sinker at the surface to prevent excess rope from free floating and becoming a hazard to navigation. A small float with approximately 1 meter of rope is attached to the balloon buoy and serves as a grab line for easy retrieval. Gear can be deployed individually or in strings of 5 to 10 traps.

Method of Capture

Traps are normally fished for 1 to 2 days, referred to as *soaktime.* This time can vary depending on weather conditions but there is no benefit to extend fishing time beyond 2 days because of bait decomposition. Crab are attracted to the bait and enter the trap through the entrances. Once inside the crab is unable to exit.

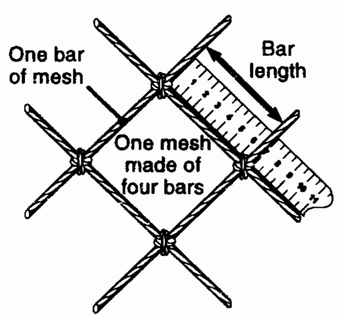
Gear Retrieval

The balloon float is located and the grab line is retrieved by aid of a grapnel hook. Both floats are brought on board and



the floatline is attached to a hydraulic winch. The traps are brought parallel to the side of the vessel and a crew member pulls it on deck.

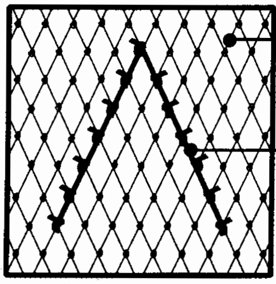
Conservation Features



Crab traps are restricted to a maximum exterior volume of 2.1 cubic meters. This restricts the amount of crab that can be taken by one trap.

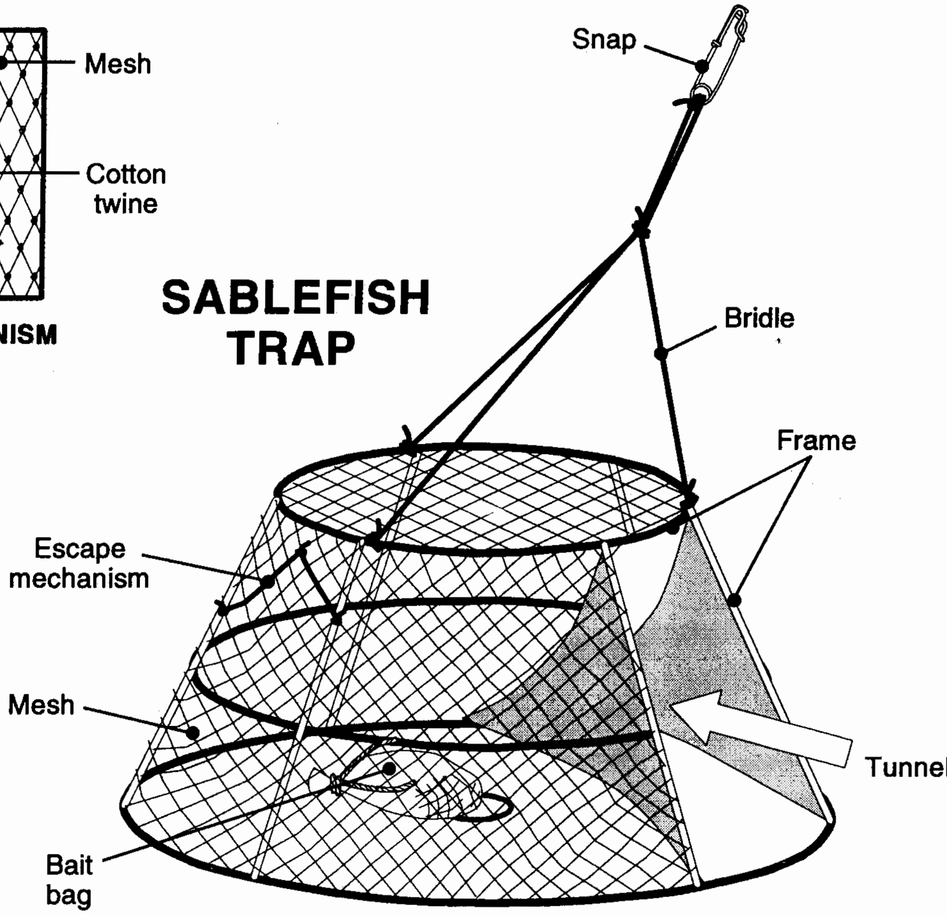
Crab traps are regulated by mesh size. Mesh size for crab traps is defined as the distance measured in a straight line inside the knots forming one side of a single mesh, also referred to as a *bar mesh measurement*. The average of 20 measured bars or mesh gives a reasonable representation of the overall mesh size. Crab traps are enclosed with square mesh netting and the bar mesh size must be 65 mm or greater. This allows for the escapement of small crab and bycatch species.

Biodegradable *escape mechanisms* may be mandatory on crab traps. The mechanism is installed in an unobstructed horizontal gap made by opening 5 meshes starting on the side, one vertical mesh up from the lower portion of each trap. The opening is laced together with a piece of cotton twine that will decompose over a period of time. This device is designed to prevent lost traps from ghost fishing. An alternative to the biodegradable mechanism is the galvanic time release mechanism. This device is installed by having each ring tied with twine and interlaced to each mesh of the opening and fastened at the extremities. The mechanism is timed to release in 100 days or less. Most fishermen prefer the biodegradable escape mechanism because of the lower price.



ESCAPE MECHANISM
(Detail)

SABLEFISH TRAP



3.12 Sablefish Trap

The sablefish trap uses bait to entice sablefish to enter and once captured the fish remains alive. The main purpose of utilizing this gear type is to facilitate the live capture of fish. The trap is similar in shape to the conical crab trap, however the sablefish trap has an opening in the side as opposed to the top.

Gear Construction

The trap consists of a conical shaped steel frame covered with a single piece of nylon netting. The netting is attached so that the top is permanently enclosed and the bottom can be opened and closed with a draw string. One side panel is left uncovered to accommodate the trap entrance. The entrance, contains a tunnel constructed of two pieces of knotless braided netting joined together. The tunnel extends into the center of the trap. When installed, the tunnel slopes downward with a 35 centimeter opening at the bottom.

Gear attachments include; anchors, buoys, buoylines, trap bridle, sinker, flagpole, groundline, becket and baitbag.

Gear Deployment

The anchor is deployed along with buoys, buoyline and sinker. The anchor weighs approximately 60 kilograms and is attached to the first becket on the groundline. The bouyline is also joined to this becket and is supported at the surface by a combination of 2 or 3 bouys. A sinker is affixed to the bouyline at the surface to prevent excess rope from free floating and becoming a hazard to navigation.

The remainder of the groundline (mainline) is then deployed along with the traps, fastened to beckets. Beckets are loops made from braided nylon rope spaced approximately 45 meters apart along the groundline. The anchor and buoy system is attached to the end of the groundline to complete the deployment procedure.

Method of Capture

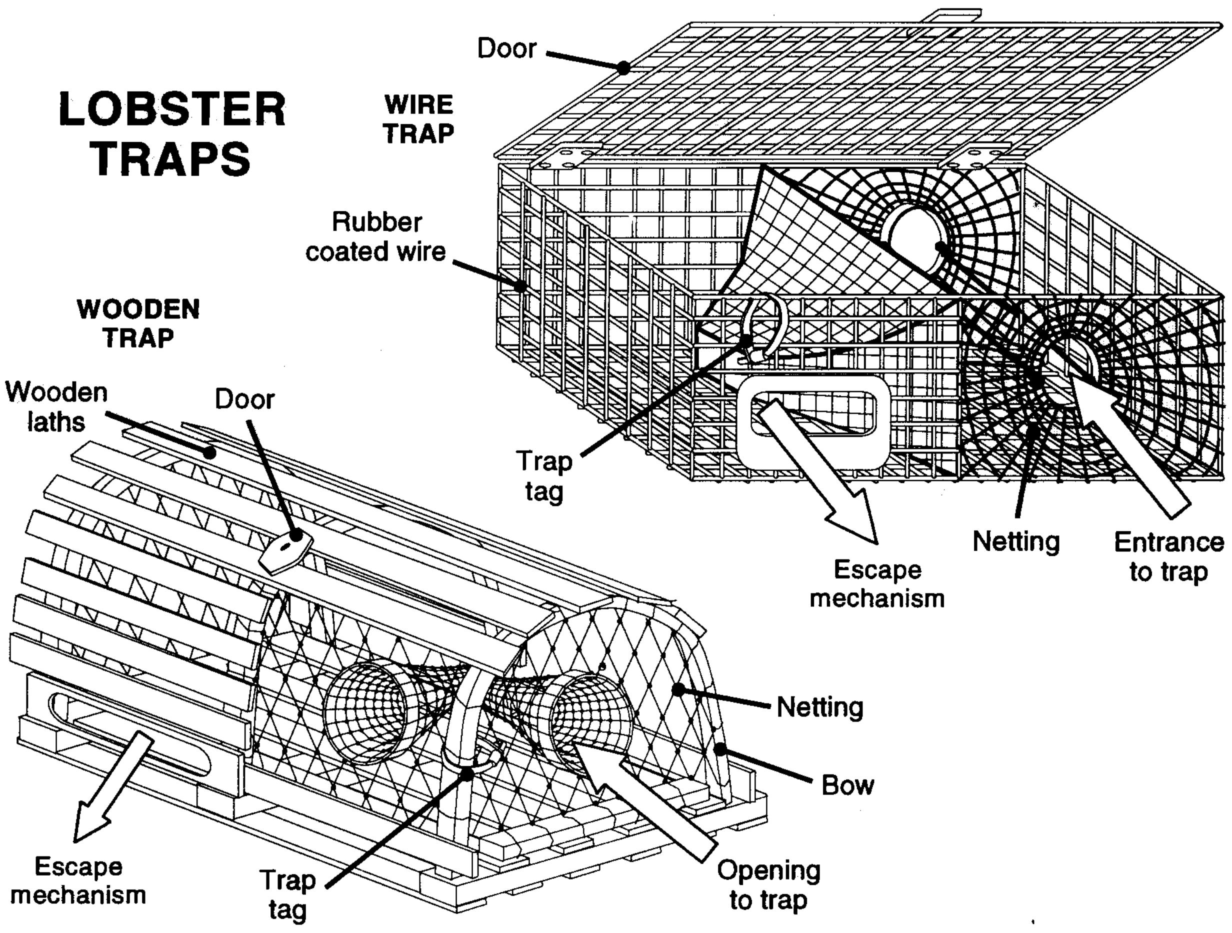
A bait bag, containing squid, is fastened to the bottom inside panel of the trap below the tunnel entrance. The sablefish are attracted to the bait and enter through the tunnel entrance. Once inside the trap the fish are unable to escape. Soaktime, can vary depending on weather conditions and area fished.

Gear Retrieval

The bouyline, with anchor and groundline attached, is retrieved and hooked up to the hauler. This hydraulic powered pulley brings the groundline on board and the traps are disconnected, the catch removed and the traps are made ready for the next set. The anchors and groundline are stored on a drum as the gear is brought on board.

Conservation Features

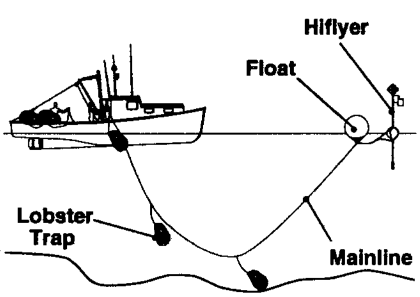
The traps are equipped with an escape panel that is designed to prevent *ghost fishing*. The escape mechanism is attached on the panel opposite the tunnel and consists of 12 meshes cut along the bar making a triangular opening. This opening is laced together with a piece of cotton twine that will decompose over a period of time allowing the panel to open.



3.13 Lobster Traps

The principle of the lobster trap is the same as a crab trap. Lobsters are attracted by the bait, enter the trap and are unable to exit.

Gear Construction



Lobster traps, also referred to as *lobster pots*, vary in design and size from region to region. Older styles used mainly for inshore fishing consist of a frame constructed from pieces of wood (laths) and cotton or nylon twine. Each trap is equipped with one or two openings allowing the lobster to enter but situated so escape is prevented. The common design of traps used today consist of a rectangular metal frame covered with wire mesh. Entrances are located on each side of the trap.

Gear Deployment

Traps are baited and positioned at the rail of the vessel. At the desired fishing location the traps are affixed to the mainline and dropped in the water along with an attached buoyline and buoy. The mainline is then payed out and traps are connected at intervals along the line. Traps can also be deployed individually (without mainline).

Method of Capture

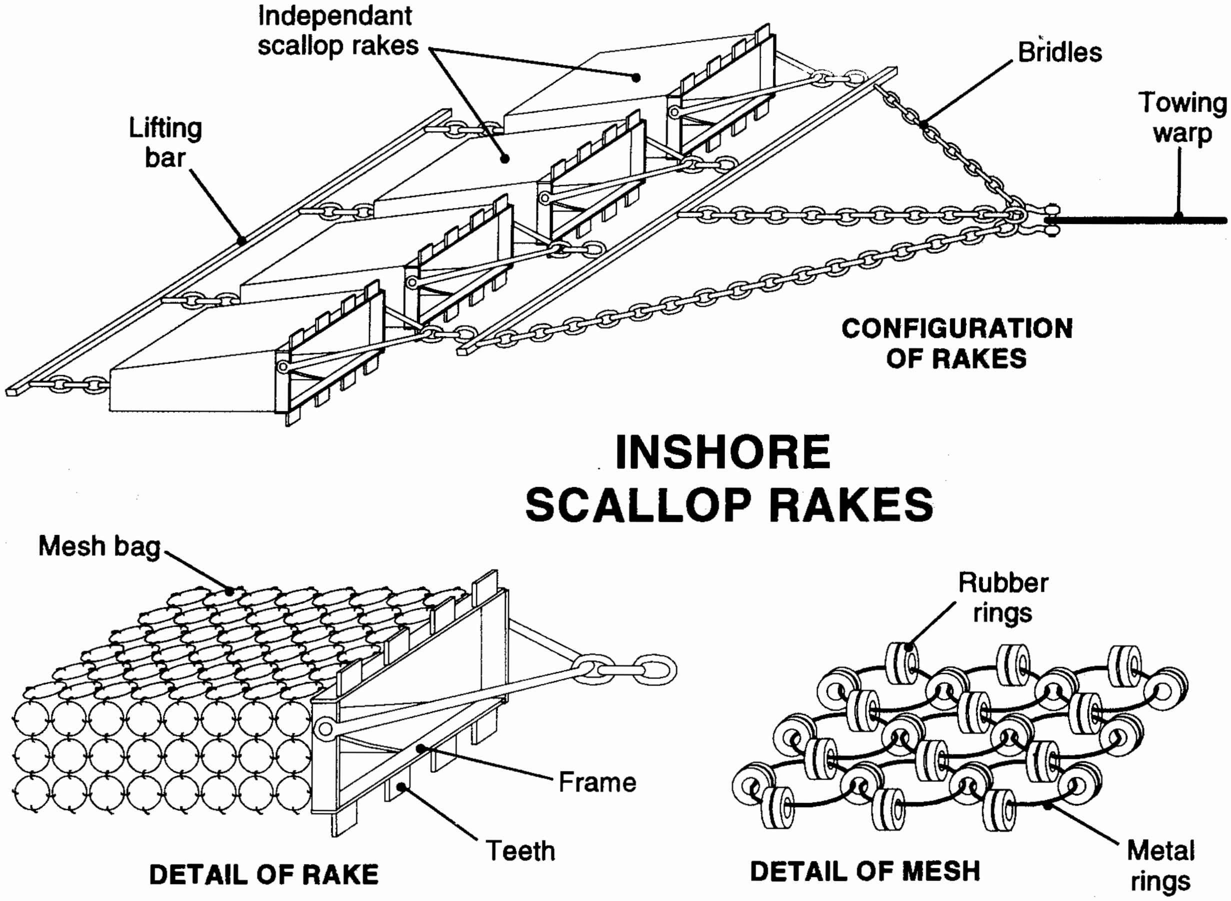
Lobsters are attracted to the bait, which may consist of herring, mackerel or flounder. They enter the funnel shaped entrance and drop into the trap. The narrow end of the funnel attached to the entrance is located near the top of the trap, preventing escape.

Gear Retrieval

The buoy is taken on board and the mainline is connected to the hauling winch. Traps are brought up to the side of the vessel and lowered on deck by the crew. The catch is removed and the traps are stored for the next deployment.

Conservation Features

The traps are equipped with escape mechanisms which are narrow openings that allow for escapement of undersized lobster.



3.14 Scallop Rakes

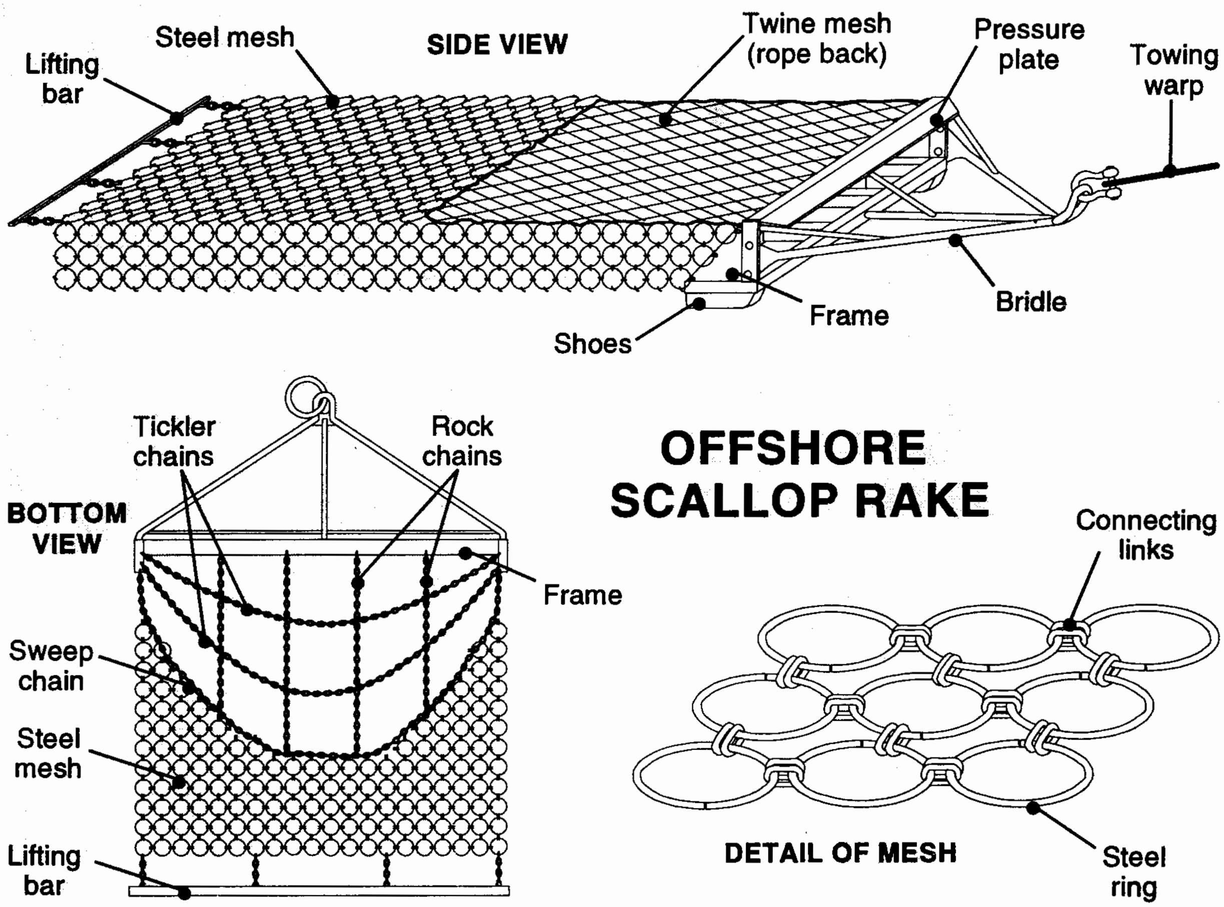
Scallop rakes are heavy chain metal bags towed along the bottom designed for the capture of scallops from the sea bed. This gear type varies from a single large rake to a number of smaller units towed parallel to each other.

Gear Construction

Scallop rakes consist of a bag-like net of steel meshes and twine meshes. The closed end of the net has a dumping bar attached and the open end of the net is attached to a steel rectangular frame. Inshore scallop rakes may be equipped with three or more small individual iron link bags attached to a single towing bar.

Gear Deployment

The rakes (also referred to as *drags* or *dredges*) are deployed from the side of the vessel by applying tension on the main warp attached to the forward end of the gear. The rake is then



swung out over the side of the vessel and the brake is released on the main warp allowing the rake to fall to the ocean bottom. Side trawling is gradually being replaced by stern trawling.

Method of capture

As the rakes are towed across the ocean floor, the pressure plate, located on the lower section of the rectangular frame, contacts the bottom. The bar stir scallops from the ocean floor and they are forced into the rake opening. The scallops are stored in the rear of the bag until the tow is completed.

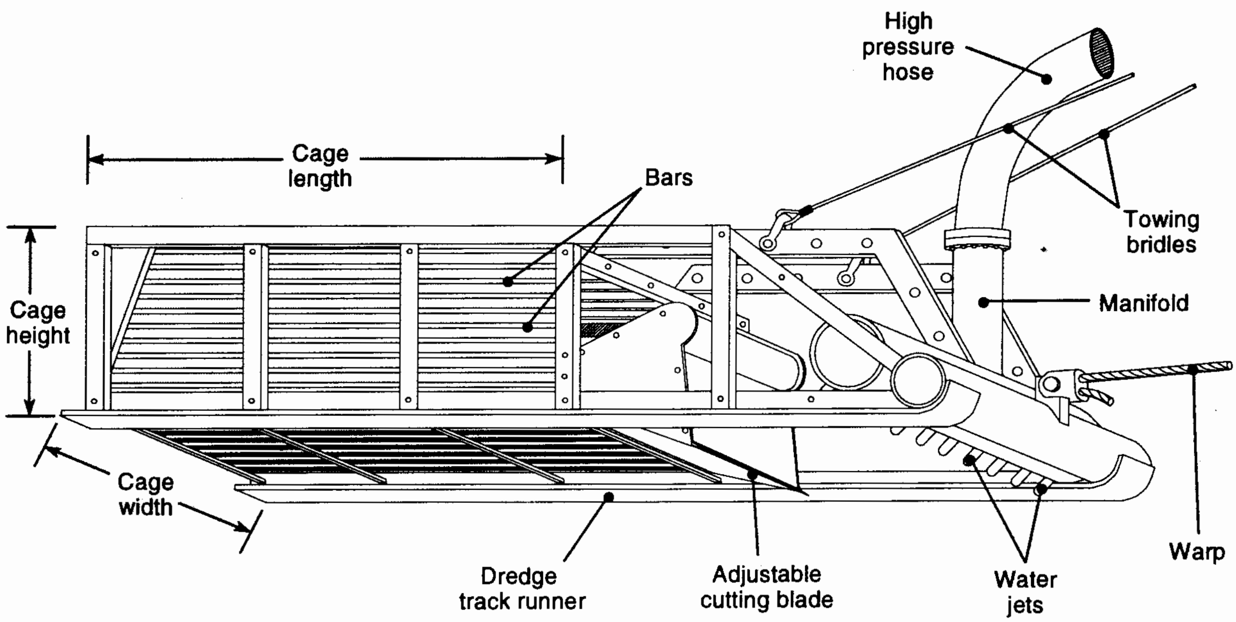
Gear Retrieval

The rakes are winched on board and the catch is released on deck.

Conservation Features

There have been experimental trips conducted by DFO to determine the percentage of groundfish bycatch released from the rake. The experiment involved increasing the mesh size in the rope back (twine section on upper portion of bag) to release ground fish without affecting the scallop catch.

Findings so far have been inconclusive.



3.15 Clam Dredge

A clam dredge is a large metal cage equipped with a cutting blade and a high pressure hose to dig into the substrate. This differs from a scallop drag, which fishes on the seabed.

Gear Construction

The main component is the cage which has attached a cutting bar, water jets, high pressure hose and main warp.

Gear Deployment

The dredge is lowered from the vessel into the water using the main warp. Due to the heavy weight of the dredge, it normally reaches the sea floor in less than a minute.

Method of Capture

The vessel hauls the dredge along the bottom at approximately 2 knots. A high pressured hose leading from the vessel to the dredge feeds a number of water jets. The jets are located at the front of the dredge and serve to provide a digging and churning action to uncover the clams. The clams are scooped up into the mouth of the dredge located directly behind the water jets.

Gear Retrieval

The gear is retrieved by winching in the main warp. This process generally takes 2 to 3 minutes to complete.

Conservation Features

Due to the slow towing speed required for this gear type, bycatch of groundfish species tends to be low.

3.16 Legislation and Conditions of Licence Respecting Fishing Gear

Gear Regulations		
Topic	**Regulation**	**General comments**
Mesh size	FGR 22 (1)(2)	Trawl nets
Mesh size	AFR 85 Part V 45(a)	Gillnets - herring
Mesh size	AFR 85 Part V 49(a)	Gillnets - mackerel
Mesh size	AFR 85 Part V 54(1)(a)	Crab traps
Mesh obstruction	FGR Part III 30.	Restriction of mesh size
ID of fishing gear	FGR Part III 27, 28	Requirements for marking gear
Spacing of gear	AFR 85 Part IV 36, 37	Maintaining distance from other fishing gear
Trap size restrictions	AFR 85 Part VI 54 (2)	Crab traps
Trap size restrictions	AFR 85 Part VI 61 (4)	Lobster traps
Tagging of gear	AFR 85 Part VI 56.	Crab traps
Tagging of gear	AFR 85 Part VI 62	Lobster traps
Topside chafers	FGR Schedule I	Requirements for construction and attachment

Unit 4 : Vessel Operations and Requirements

Perspective

A major Observer duty is to monitor the daily vessel operations. Efficient performance of this role requires familiarity with the working environment. This unit provides a general overview of all aspects of the vessel pertaining to Observer duties including; crew structure, vessel layout, production, safety, catch recording procedures, reporting requirements and the applicable regulations.

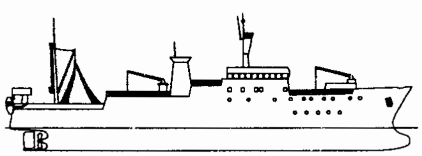
4.1 Daily Vessel Operations

Vessels operating in Canadian waters range from 3 meter wooden boats to steel hulled factory vessels of over 100 meters. For regulatory purposes fishing vessels may be grouped into categories based on gear sectors, fisheries or size.

It is important for an Observer to recognize the main types of vessels in order to efficiently perform their duties (ie. sighting a vessel in an area closed to that particular class). This section provides a guide to standard vessel characteristics and operations of vessels fishing in Canadian waters. Exceptions to these descriptions will be encountered. The following outlines the major vessel types giving a general and presents a general description of:

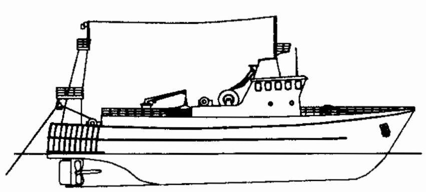
- directed fisheries,
- gear types used,
- production capabilities, and
- size and identifying features.

Factory freezer trawler



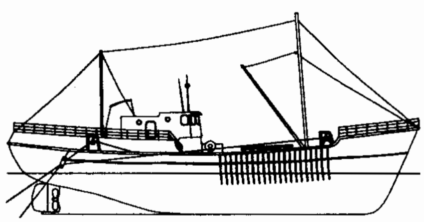
Factory Freezer trawlers (FFT's) use bottom, off-bottom and midwater otter trawls to direct for groundfish, squid, small pelagic fish and shrimp. Fishing activity can be determined by the presence of two cables (warps) extending from the stern of the vessel into the water. FFT's are capable of processing a large variety of frozen fish products at sea and may also produce fishmeal. Vessel hold capacities range from 200 - 1500MT of frozen product and from 100 - 200MT of fishmeal. Constructed of steel, FFT's range in length from 30 to over 100 meters in length. These vessels have a ramp at the stern for setting and hauling fishing gear. A large "A" shaped frame at the stern is used to hoist the gear.

Offshore stern trawler



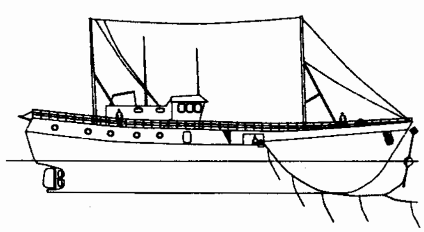
Offshore trawlers use bottom, off-bottom and midwater otter trawls to direct for groundfish, squid and small pelagic fish. Fishing activity can be determined by the presence of two cables (warps) extending from the stern of the vessel into the water. Fish processing on large offshore trawlers is done either by hand or with a limited amount of processing equipment such as gutting and deheading machines. Product types on these vessels is usually limited to round, gutted head-on, gutted head-off or products involving fairly simple cuts. Vessel hold capacities range from 80 to 180 MT with fish being stored on ice (hence these vessels are sometimes referred to as wet fish trawlers). These steel hulled vessels range in size from 30 to 50 meters. Like factory freezer trawlers, these vessels have a ramp at the stern for setting and hauling fishing gear and a large "A" shaped frame at the stern. When viewed externally, larger offshore trawlers without complex factories are indistinguishable from the smaller factory freezer trawlers.

Offshore side trawler



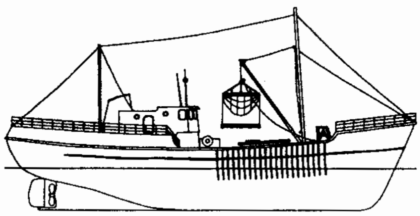
Offshore side trawlers were the main type of large vessel used to harvest offshore groundfish from the 1950's to mid 1960's; prior to the introduction of offshore stern trawlers. Processing on these vessels occurs on deck and is conducted by hand; thus product is normally limited to round and gutted head-on. Hold capacities range from 80 to 120 MT and fish are preserved on ice. Earlier side trawlers were constructed of wood; eventually being replaced with steel hulled construction. The vessel lengths were normally from 30 to 35 meters. Side trawlers are identified by a pair of steel horseshoe shaped "gallows" which may be located on each side of the vessel and are used for shooting and hauling a bottom otter trawl. Cables extending from the forward and aft gallows (normally on the starboard side) into the water indicates fishing activity.

Offshore longliner



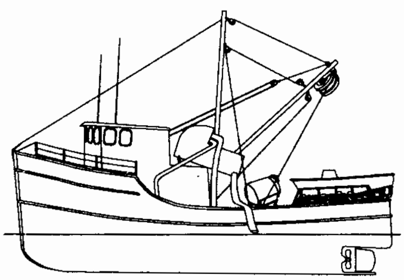
Large offshore longliners use either groundfish or pelagic longlines to direct for groundfish or large pelagic species. Production on longliners is labor intensive with most fish processing done by hand. Product types for groundfish includes round and gutted head-on; production of large pelagics includes these plus gutted head off and fillet. Hold capacities vary widely with smaller vessels capable of holding 75MT of iced fish and larger vessels with space for 350MT of frozen product. Large offshore longliners range from 20 to 50 meters and are wood or steel hulled. The gear retrieval area of these vessels may be left open to the weather or enclosed. Gear components such as highflyers and large floats are often stored on upper decks. Fishing activity is determined by observation of a mainline being shot away from the stern or hauled back on the starboard side of the vessel.

Offshore scalloper



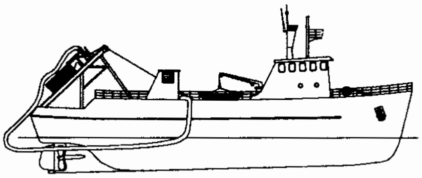
Offshore scallop draggers normally use two large scallop drags to direct for scallops. Production is very labour intensive. Scallops are hand picked into baskets from the deck and scallop meats are manually shucked. The meats are packaged in cloth bags and stored on ice in the hold. Due to production limitations vessels are unlikely to exceed 14 MT; per trip, however vessels have considerable larger capacity. Offshore scallop draggers are steel and wooden hulled vessels ranging from 30 to 35 meters in length. Most of these vessels are converted side trawlers although some stern trawlers are no being used. Fishing operations of the offshore scallop dragger is determined by observing a warp along each side of the vessel extending from each of the forward horseshoe shaped gallows.

Purse seiner



Purse seiners direct for smaller pelagic species (eg. capelin, herring, salmon) using a purse seine net. No processing of fish occurs on board; fish are placed in the hold round. Hold capacity ranges from 80 to 200MT of fish stored in seawater or ice-chilled seawater. Purse seiners range in size from 12 to 33 meters and are recognized by the nets stored at the stern. Larger seiners deploy a small skiff from the stern to assist in shooting out the gear. Fishing activity is determined by observing the skiff or a highflyer being deployed attached to one end of the seine net. The seiner then steams in a circle back to the starting point while its net flows over the stern. The seine is drawn in to the starboard side of the vessel and fish are pumped or dipped from the nets.

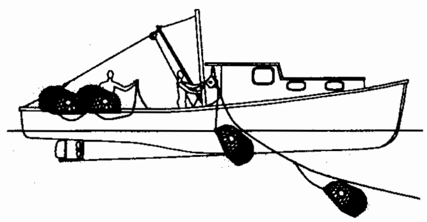
Offshore clam dredger



Offshore clam vessels use a dredge to direct for clams. Production capabilities is quite extensive, involving a production line that ends with packaged frozen products ready for market. These vessels are capable of holding 140 to 180MT in frozen storage. Steel hulled clam vessels, ranging in size from 45 to 60 meters, can be identified by steel framework at the stern used to hold a pair of dredges. Fishing operations can be determined by the presence of two warps trailing directly astern, and a large diameter (30cm) hose extending from either side of the vessel into the water.

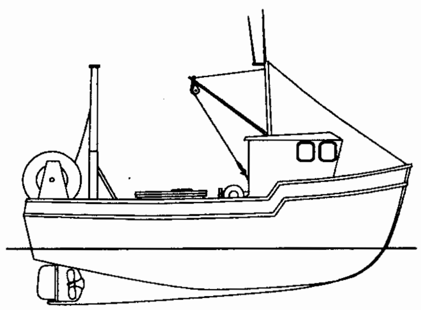
Small multipurpose vessels

Small multipurpose is a general category of those vessels less than 20 meters, encompassing a myriad of directed fisheries and gear types. These vessels are used to direct for:



- finfish of all types,
- lobster and crab,
- shrimp,
- scallops, and
- squid.

Gear types used are equally as varied including:

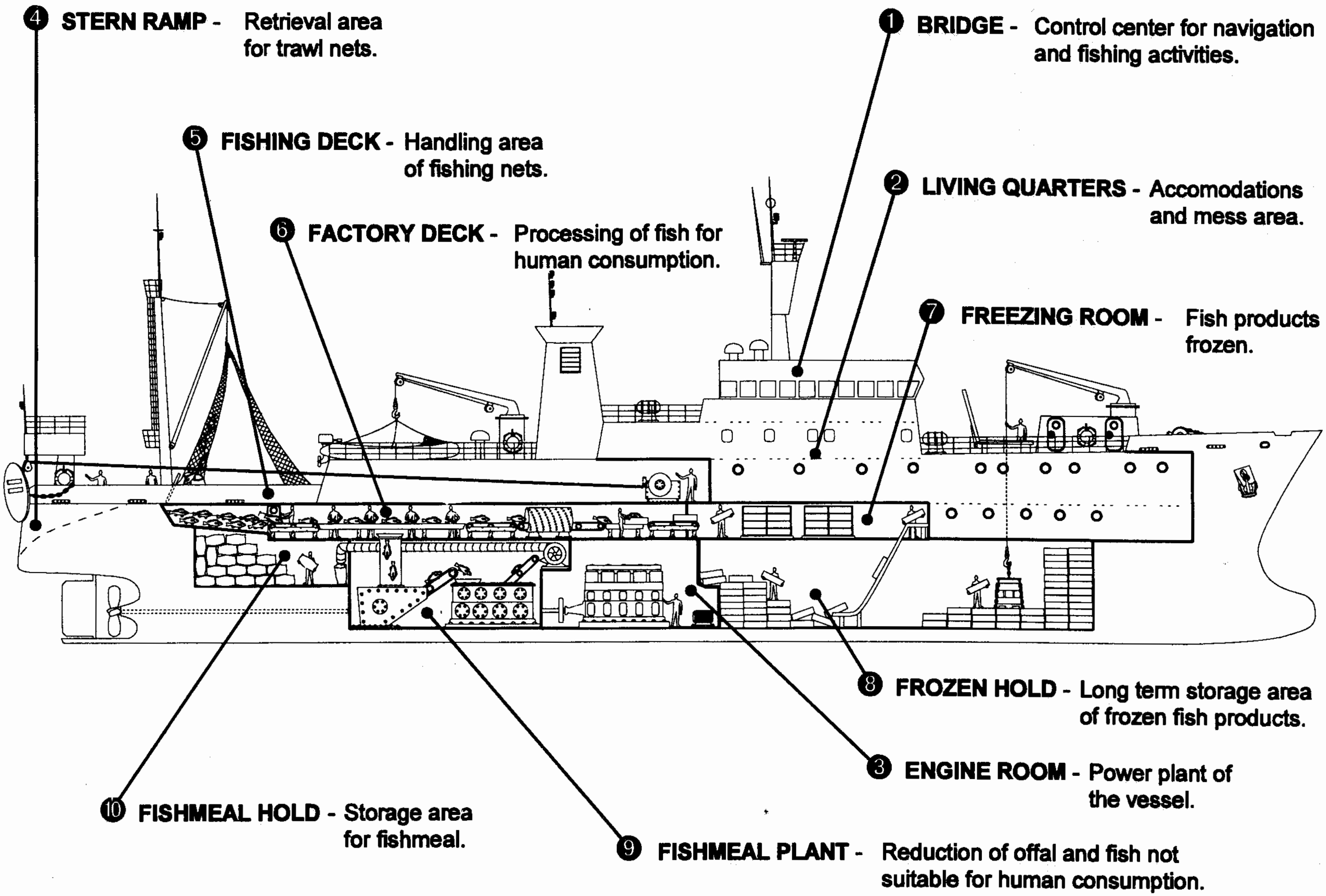


- trawl & seine nets,
- gillnets,
- longlines,
- tended lines,
- harpoons,
- handlines & jiggers,
- trolling gear,
- baited traps, and
- inshore scallop drags.

Small vessels range in size from 8 to 20 meters and are constructed of aluminum, steel, fiberglass or wood. Carrying capacities range from several MT of fish stored in baskets or pens to 60MT of product stored on ice in a hold. Due to the smaller size of these vessels, limited production is expected.

Small vessels may be categorized by the gear type for which they have been modified to use. Identifying features of some of the more common types are shown in the following table:

Small Multipurpose Vessels Distinguished by Gear Used	
Gear Type	**Identifying Features**
Trawl Nets	- net storage drum near stern. - "A" frame at the stern. - presence of otter boards (for otter trawls).
Gillnets	- highflyers, floats stored on deck. - roller or bar at the stern for shooting/hauling gear. - net storage drum.
Longlines	- highflyers, floats stored on deck. - roller along starboard rail (for gear haulback). - chute at the stern (for setting gear).
Scallop Drags	- reinforced vessel sides to withstand gear abrasion. - "A" frame at the stern.
Baited traps	- hanging hydraulic line hauler above starboard rail. - reinforced starboard rail for gear handling.
Harpoons	- bow extended forward with rails and pulpit. - masts rigged with crows nest lookouts.
Trollers	- 2 to 4 outriggers from each side of the vessel. - one or more lines trailing from each outrigger.



TYPICAL FACTORY FREEZER TRAWLER

Vessel layout

After boarding an assigned vessel an Observer must become familiar with the vessel. Layouts vary from a simple 8 meter longliner to a complex 100 meter factory freezer trawler. Large factory freezer trawlers generally have the following ten basic areas:

- Bridge - navigation and control center of vessel.
- Living Quarters - sleeping, eating and leisure area.
- Engine Room - power plant of the vessel.
- Stern Ramp - retrieval area for trawl nets.
- Fishing deck - gear handling area.
- Factory deck - fish processing area.
- Freezing Room - area where fish products are frozen.
- Frozen Hold - space where the frozen product is stored.
- Fishmeal Plant - reduction of offal and fish to fishmeal.
- Fishmeal Hold - storage area for fishmeal.

The Crew and Daily Schedules

Shortly after boarding, an Observer should introduce him/herself to the master of the vessel. A proper introduction to the master exhibits respect for the rank and shows professionalism.

> ***Crew roster:*** *a list describing the positions held by crew members and their respective responsibilities.*

Information must be obtained from vessel personnel such as production capacity, fishing gear specifications and vessel records. Initial enquiries should be directed to the vessel master who may refer the Observer to crew members with specialized duties and knowledge. A sample crew roster list is provided below using a foreign vessel as a model. The roster can vary depending on the vessel and fishery. An 8 meter dragger carries as few as 2 crew members while some factory freezer trawlers may have a complement of 100.

Crew Roster

Responsibilities of major positions held by personnel on a factory freezer trawler include:

- Master - overall command of the vessel.
- Engineer - Maintenance of engines and machinery.

- Navigation Officers - Vessel steaming and fishing operations.
- Radio Operator - Long distance communications to and from the vessel and radio equipment maintenance.
- Technolog- Daily operations of the fish factory and maintenance of production records (Referred to as a *factory boss* on domestic factory vessels).
- Bosun - Operational performance of the fishing gear. (Referred to as a *trawl master* on foreign trawlers).
- Helmsman - Steering the vessel.
- Deckhand - Shooting, hauling and maintenance of fishing gear. May also be required to perform the duties of a factory worker.
- Factory Worker - Processing of catch.
- Cook - Preparation of the meals.
- Stewards - Cleaning and assist in food preparation.

Daily Activity and Scheduling

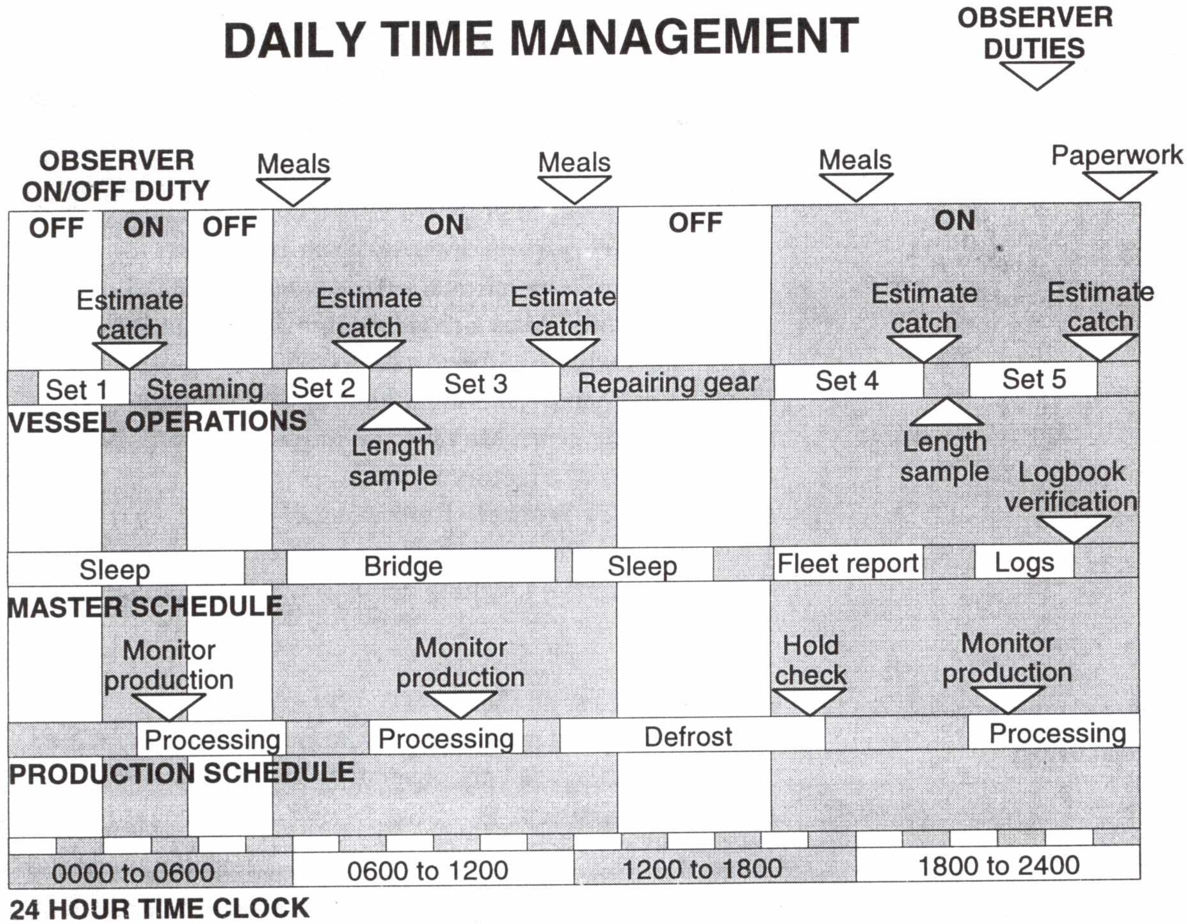
It is essential for an Observer to determine the operations schedule so that a monitoring strategy can be implemented. Scheduled activities vary depending on the size of the vessel and directed fishery.

> ***Watch:*** *A nautical term referring to work schedules onboard a vessel.*

Daily vessel activities that influence monitoring strategies are:

- Shooting and hauling of fishing gear - Set information must be collected including positions, depths, times and estimates of catch.
- Production schedules - Monitoring of catch as it is processed and stored in the hold.
- Crew work schedule - Monitoring a cross section of crew work activity to avoid biased information.
- Logbook completion times - Monitoring records of vessel catch and effort on a timely basis.
- Hail times - Monitoring of catch and effort reports transmitted from the vessel.
- Meal times - Observers do not work a fixed watch and must vary monitoring duties according to meal times.

DAILY TIME MANAGEMENT



Fishing Strategy

> ***Fishing Strategy:*** *Predetermined fishing tactics used by master to capture fish.*

Observer duties include documentation of fishing strategies used during a deployment. Three major influences on fishing strategies are:

- DFO imposed trip limits
- Company imposed strategy
- Master's initiative

DFO Imposed Trip Limits

DFO implements various restrictions on species and areas permitted to be fished throughout a given year. These limits can apply to closed areas, bycatch limits (species/size), and trip limits.

Company Imposed Strategy

Company imposed strategy should be obtained from the master at the initial stages of a deployment and confirmed through direct observation of fishing operations. Companies, associations and individual license holders may designate the species and area to be fished. These instructions may be complex containing a list of several species and amounts to be captured in various areas. The criteria used to develop these instructions is governed by company quotas and market demands. Masters of foreign fishing vessels may be provided with a *production plan.* This plan outlines the desired product types and amounts required to meet market demands and to make the trip profitable.

Once the quotas have been issued for a particular year, market demands become the main factor in how the fish will be harvested. Market demands can affect fishing strategies by:

- Emphasizing the need for better quality to receive higher prices.
- Providing incentives for masters to fish illegally.
- Licence holders requesting the master to change fishing area and directed species any time throughout a trip.

The demand for high quality products in the marketplace can also affect the master's fishing strategy. The impact of quality demands may result in the following:

- Shorter tows to avoid large sets of fish. Excessive weight in the codend will cause damage to the fish.
- Shorter trips to ensure top quality of the catch. This will be apparent on vessels that use ice to preserve the catch.
- Fully processing one set before bringing the next set on board. This will avoid the fish laying in the processing room too long and prevent damage to the catch by dumping the next set on top of it.

Masters own initiative

The master uses several sources of information when deciding where fishing operations should be conducted. Factors considered by the master are: historical catches, water depth, diurnal movements, currents & tides, weather conditions, ice conditions, water temperature, bottom type, and fleet information.

Historical Catches

Masters depend on their experience and information obtained from colleagues to determine where catch rates have been favorable. Captains may refer to old charts, logs and data stored on plotters.

Fishing Depth

Fish concentrate at different depths and move up and down in the water column. Masters can vary fishing depths to control the amount of bycatch captured. Fish intermingle with other species at various depths or may be separated by a depth contour. Fishing depths and concentrations of fish can be observed on fish sounding monitors.

Diurnal Movement

Fish movements affected by daily rhythms are referred to as diurnal movements. Masters use this knowledge to direct for species at different times of the day. For example fish may move up in the water column during hours of darkness, and closer to the bottom during daylight hours.

Currents & Tides

Prevailing currents and tides affect fishing gear performance. Masters consider direction and speed of water flows before deployment of fishing gear.

Weather Conditions

Adverse weather conditions restrict vessel capability to operate. Strong winds affect the direction in which a vessel may shoot or haulback fishing gear and extreme conditions can result in the ceasing of fishing operations. Masters rely on weather forecasts to plan ongoing fishing activities.

Ice Conditions

Heavy ice prevents fishing activity in a desired area. Masters monitor ice conditions to determine available areas.

Water Temperature

Fish species may stratify by temperature gradients. In some fisheries Masters rely heavily on water temperature data to determine area and depth of fishing activity. Sources of temperature data include temperature probes and satellite transmitted information.

Bottom Types

Fish species seek different bottom types. Bottom types can be described by texture (smooth or rough) and composition (sand,

Suggestion: *If the rollers or door* *shoes of a bottom otter trawl are shiny this indicates a rocky bottom*

mud or rock). The bottom type can be determined by viewing the fish sounder and charts. Bottom composition can be determined by referring to charts or by examining gear. Fishing gear that comes in contact with the sea bed may pick up samples of its composition.

Fleet Information

Masters use information from other vessels to locate concentrations of fish. Information obtained may include positions, water temperatures, fishing depths, catch rates and bycatch levels.

Over-side-sales

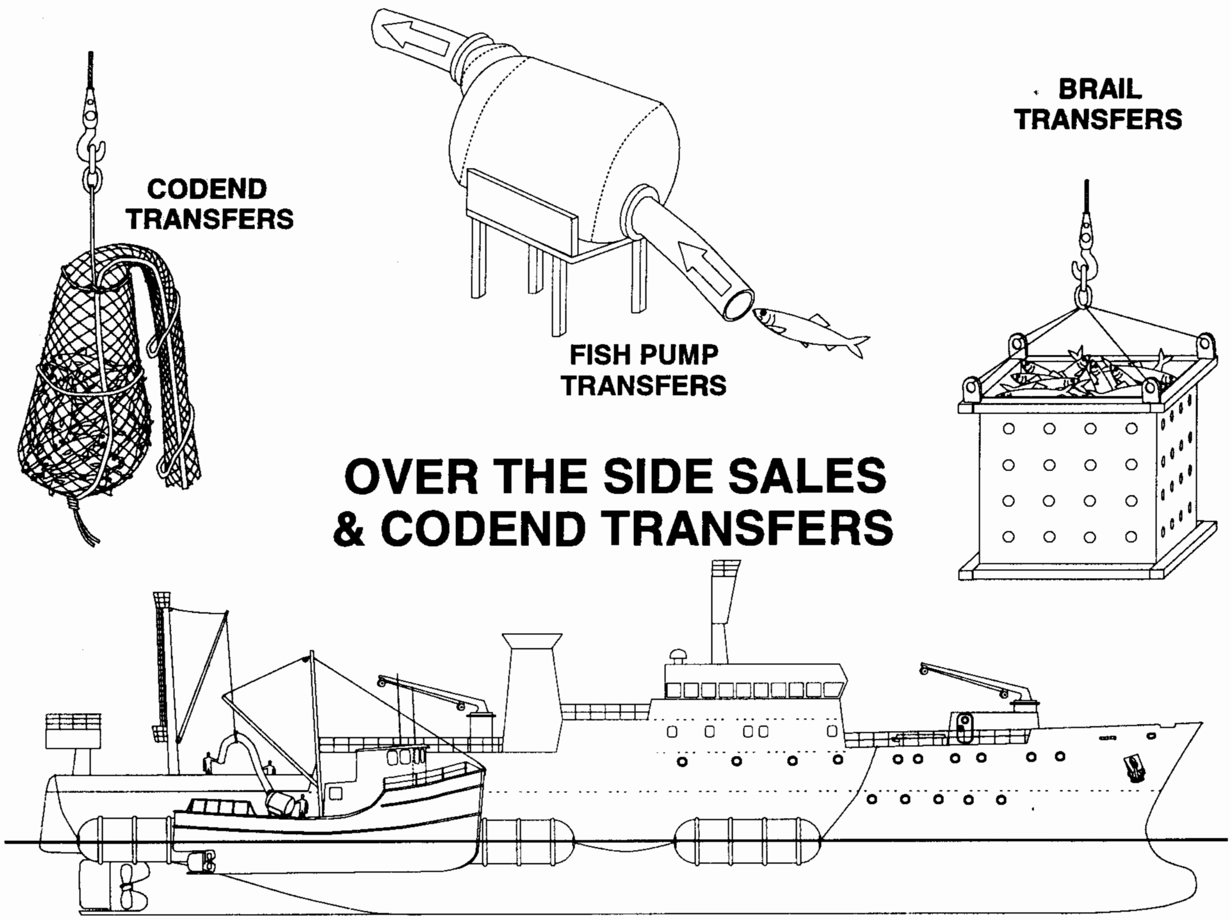
***Over-side-sales:** fish being caught by one vessel and sold directly to a second vessel designed for the purpose of processing, storing fish or transporting fish.*

The over-side-sales (OSS) program involves a foreign buyer (factory ship) and a domestic fishing fleet, utilizing small vessels (ie. seiners, gillnetters). The factory ship anchors in a sheltered bay or near the coastline in close proximity to the fishing activity. Once the fish are caught by the domestic fleet the catch is taken to the buyer and off-loaded. Since the factory ship is foreign, licence conditions stipulate that the operation must be monitored by a representative of DFO. Fisheries that involve the OSS program may include herring, capelin, mackerel, Greenland halibut and squid. Duties of Observers assigned to a receiving vessel include the following:

- Monitoring round fish received
- Monitoring the processing operation
- Logbooks verification
- Collecting biological samples
- Recording set and catch information
- Monitoring off loading of processed fish

Codend transfers

***Codend transfer:** The removal of the codend from a trawl of one vessel and transporting, in the sea, to another vessel.*



Codend transfers are used in joint venture fishing operations which involve a catcher and a processor vessel. The catcher, using a trawl net, conducts normal fishing operations to harvest the fish. When the tow has been completed the trawl is hauled back and preparations are made to transfer the codend.

The gear is hauled back to the lengthening piece, leaving the codend trailing behind in the water. At this point the crew wrap a heavy cable around the forward portion of the codend, closing it off and taking the weight of the catch on the attached cable. A choke strap is sometimes used instead of the cable. The choke strap is permanently attached to the codend by chain links spliced into the rib lines of the trawl. The cable or choke strap is then tied to the vessel and the codend is unzipped. For this operation the codend is attached to the trawl with a zipper, a rope threaded through the net meshes, which allows for easy detachment and reattachment. A *transfer line* is fastened to the choke strap and payed out around the stern of the vessel with the end attached to the rail. This line will be linked with a line from the processor when the vessels are in position.

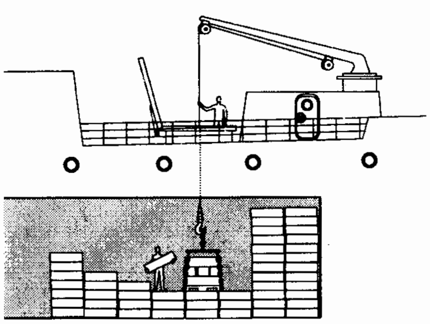
From the processor a long cable is lowered over the stern and out behind the vessel. A light poly rope equipped with a buoy is attached to the end of the cable allowing for easy retrieval. The catcher vessel approaches the cable ensuring that the buoy is on the starboard side. A grappling hook is used to retrieve the poly line from the water and end of the cable is brought on board the catcher vessel. The cable is then attached to the transfer line by means of a shackle or G-hook and the combined rigging is thrown overboard. The codend is released and drops back free from the vessel.

By means of a winch, the codend is pulled through the water and up the stern ramp of the processor. Hooks from two heavy lifting winches are attached to the choke strap and the codend is brought on deck.

This process is conducted while the vessels are approximately 200 meters apart. Good ship handle becomes vital so that the codend or cables do not become caught in the propeller.

Transshipments

Transshipment: *Offloading of fish products to a second vessel.*



The transshipping of fish products usually occurs by foreign vessels. Transshipments allow vessels to remain on the fishing grounds for extended periods. Transport vessels travel throughout the fleet and receive product from the trawlers. Transshipping operations are regulated by condition of licence and it is the Observer's duty to monitor compliance with these conditions. The conditions include the following:

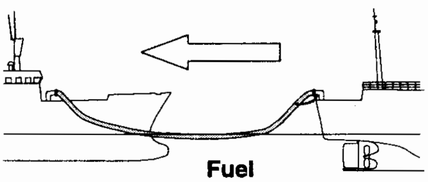
- Transport vessel must be licensed to transship.

- 72 hour notice prior to transshipment.
- Completion of transshipment log.

Transshipments can run continuously 24 hours a day and may include products being off loaded simultaneously fore and aft. Where an Observer can not monitor the entire process, they should:

- Conduct a hold check prior to transshipment.
- Calculate rate of off loading and extrapolate over entire operation time (number of boxes per pallet per hour).
- Conduct a hold check after transshipment.

At-Sea Fuel Transfer



At-sea fuel transferring is conducted by vessels that remain at sea beyond the limits of their fuel capacity. When fuel transferring operations occur, the Observer must monitor the process, paying special attention to the following:

- Verify that the tanker has a licence to transfer fuel at-sea.
- Review assigned vessel's licence with respect to fuel transfer requirements.
- Document any fuel spillage into the sea.

If a spill does occur, the Observer should document the situation and notify Fisheries and Oceans as soon as possible. Information transmitted should include:

- Name/ side# of vessel.
- Time/position of spill.
- Area affected.
- Weather conditions
- Sea state.
- Estimate of quantity

In addition to the notification message, the Observer should attempt to obtain a sample of the polluted sea water and determine if the master of the vessel has completed the fuel transfer check list as required by Coast Guard

Weather

Weather conditions can adversly impact on fishing activities. Observers may be required to document weather conditions.

Descriptions of weather states include; wave height, wind speed, temperature, visibility and the Beaufort scale.

Wave height

Wave height is described in terms of meters, from the highest peak of a wave to its lowest trough.

Wind speed

Nautical references to windspeed are normally expressed in knots or the Beaufort scale.

Temperature

The standard unit of temperature in Canada is degrees Celsius. To convert degrees Fahrenheit to degrees Celsius subtract 32, multiply by 5 and divide by 9. To convert degrees Celsius to degrees Fahrenheit multiply by 9, divide by 5 and add 32.

Visibility

Visibility is the range of vision made in reference to a type of precipitation (ie. Clear, haze, fog, mist, drizzle, rain, snow, or hail). Range can be described in terms of nautical miles, or meters when visibility is extremely limited.

Marine Forecasts

Marine forecasts include four types of severe weather warnings. These warnings are described as follows:

Severe Weather Warnings

Warning type	Expected windspeed (knots)	Expected wave height (meter)
Small Craft Warning	20 -33	2-3
Gale Warning	34-47	6-9
Storm Warning	48-63	9-16
Hurricane Force Warning	64+	16+

Beaufort scale

The Beaufort scale indicates the force of wind by conventional numbers, invented by Admiral Sir Francis Beaufort and internationally used since 1874. The Beaufort force is estimated from the appearance of the sea surface according to the following table.

Beaufort Scale				
Force	**Sea State**	**Appearance of Sea**	**Wind speed (knots)**	**Wave height (meters)**
0	Calm	Sea like mirror	0	0
1	Light Air	Ripples with the appearance of scales are formed without foam crests	1 - 3	0.1
2	Light Breeze	Small wavelets; crests have a glassy appearance and do not break	4 - 6	0.2 - 0.3
3	Gentle Breeze	Large wavelets; crests begin to break; foam of glassy appearance; some scattered white norses	7 - 10	0.6 - 1
4	Moderate Breeze	Small waves, becoming longer, fairly frequent white norses	11 - 16	1 - 1.5
5	Fresh Breeze	Moderate waves; many white norses are formed (chance of some spray)	17 - 21	2 - 2.5
6	Strong Breeze	Large waves; white foam crests everywhere (probably some spray)	22 - 27	3 - 4
7	Near Gale	Sea heaps up, white foam from breaking waves begin to be blown in streaks	28 - 33	4 - 5.5
8	Gale	Moderately high waves; sages of crests begin to break into the spindrift; foam blown in well marked streaks along the direction of wind	34 - 40	5.5 - 7.5
9	Strong Gale	High waves; dense streaks of foam along the wind; crests begin to topple, tumble and roll over; spray may affect visibility	41 - 47	7 - 10
10	Storm	Very high waves with long overhanging crests; foam in great patches blown in dense white streaks along wind; sea surface takes a white appearance; tumbling becomes heavy and shock like; visibility affected	48 - 55	9 - 12.5
11	Violent Storm	Exceptionally high waves (medium sized ships may be lost to view behind waves); sea covered with long white patches of foam; everywhere edges of crests are blown into froth	56 - 63	11.5 - 16
12	Hurricane	Air is filled with foam and spray; sea completely white with driving spray	64+	16+

4.2 Navigation

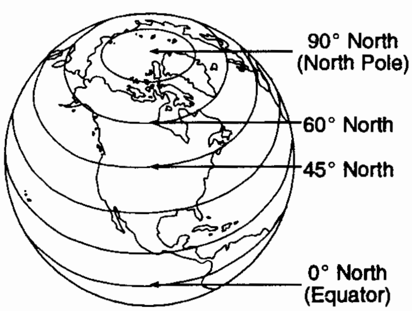
> ***Navigation**: determining of vessel's position, speed and course by using charts, and electronic aids.*

This section provides Observers with information on the basic concepts of navigation. These concepts include:

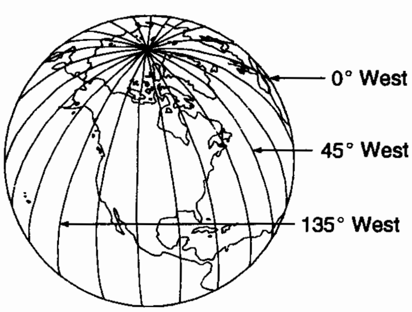
- Geographic structure of the Earth
- Nautical measurements
- Charts
- Geographic routes
- Determining position
- The compass
- Electronic navigational equipment

Geographic Structure of the Earth

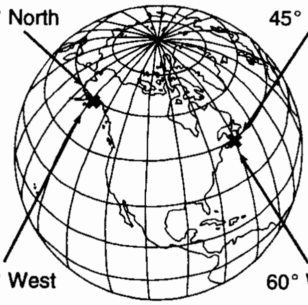
The Earth is a celestial body that is almost spherical in shape. The axis of rotation is an imaginary straight line through the Earth, upon which it spins. The extremities of this axis, where it meets the Earth's surface, are called geographic or true poles (North and South Poles).



> ***Equator**: a great circle around the Earth's surface that is perpendicular to the rotation axis. It divides the Earth into two equal parts, the Northern and Southern hemisphere.*



The parallels of latitude are smaller circles, parallel to the Equator, that are centered on the axis of rotation and are numbered from 0 to 90, both North and South of the Equator. The Equator is latitude zero (0°). Latitude is, therefore, the angular distance from the Equator measured North or South along a meridian. Latitude is normally measured in degrees, minutes and seconds, or in degrees, minutes and decimal fractions of a minute. A degree of latitude is equal to 60 nautical miles and 1 minute of latitude is equal to 1 nautical mile.



***Meridian**: any semi-circle along the Earth's surface whose extremities are the two poles.*

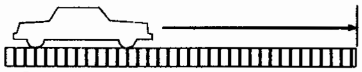
The original meridian, also referred to as the prime meridian, which has a longitude of 0, is the meridian that passes through Greenwich, England. Longitude is, therefore, the angular distance from the original meridian, measured East or West along the Equator, from 0 to 180. The length of a degree of longitude, measured along a parallel, decreases from 60 nautical miles at the equator to 30.13 nautical miles at latitude 60 degrees.

Position

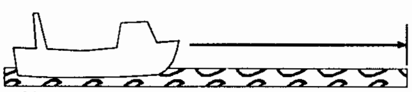
A vessels position can be expressed in degrees of latitude and longitude. Latitude defines how far north or south a vessel is situated from the equator, while longitude defines angular distance east or west from the Prime Meridian. By using these two lines of reference a unique position for anywhere on the globe can be described.

Nautical Measurements

Nautical measurements include:



1 Statute (land) mile = 1.609 Kilometers



1 Nautical mile = 1.852 Kilometers

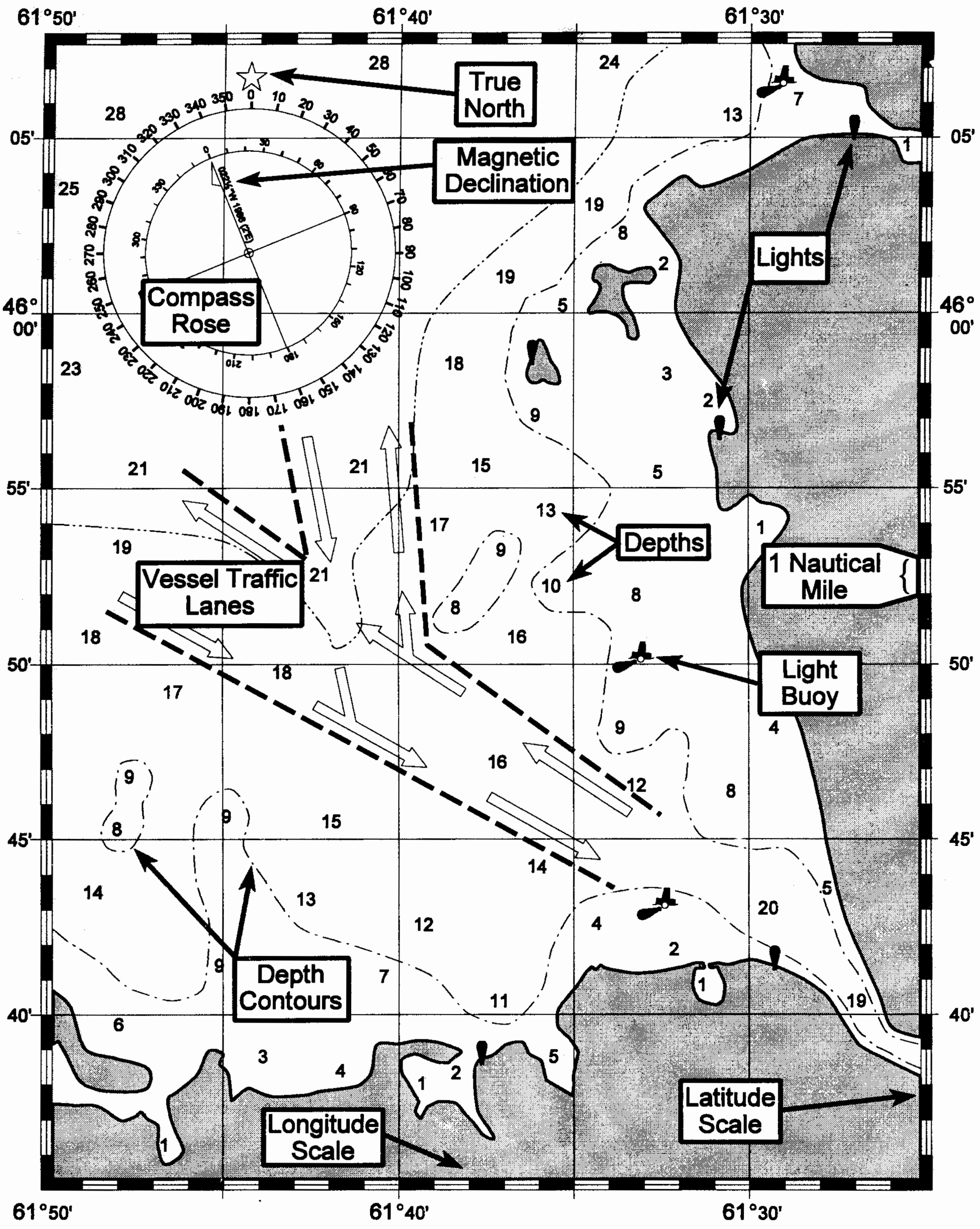
- *Nautical mile*: The distance covered by a minute of arc along a meridian (60 min.= 1 degree). A nautical mile is equal to 6,080 feet or 1,852 meters.
- *Knot:* A measure of speed corresponding to one nautical mile per hour.
- *Fathom:* A measure of water depth equivalent to six feet or 1.83 meters.

Charts

***Chart** - A reproduction of the earth's surface designed for convenient use in navigation. Readily permits the graphic solution of navigational problems, such as distance and direction or determining position in latitude and longitude.*

The projection of a sphere on a flat surface creates distortion on a generally large scale. Different types of projections include Conical and Mercator.

CHARTWORK

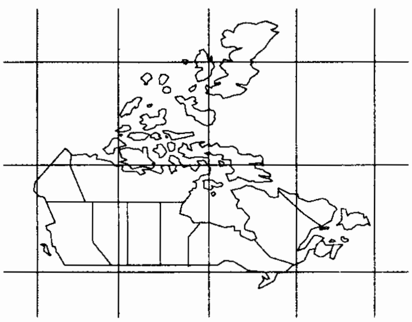

61°50'
61°40'
61°30'
True North
Magnetic Declination
Compass Rose
Lights
Depths
1 Nautical Mile
Light Buoy
Vessel Traffic Lanes
Depth Contours
Longitude Scale
Latitude Scale
05'
46° 00'
55'
50'
45'
40'

Conical projection

Conical projection charts represent a portion of the earth's surface, presented such that the lines of longitude converge towards the poles. The most common type of this chart is the Lambert Conformal Projection. This type of projection is used for marine navigation at higher latitudes, near the poles.

Selected lines of latitude and longitude are subdivided by degrees and minutes for easy plotting of positions. Positions are determined by using the closest graduated lines to the area being plotted. Distances are obtained by measuring nautical miles along the same latitude as the two points in question. This is necessary because the degrees in latitude represented on the chart become slightly compressed as they approach the poles.

Mercator projection



Mercator projection charts represent a portion of the earth's surface, presented such that the lines of longitude and latitude are shown as parallel. This is the most common type of chart used for marine navigation.

Positions are determined by using scales along the edges of the chart. Latitude scales are shown on the right and left side of the chart, while the longitude scale is shown along the top and bottom edges. The scales are graduated into degrees and minutes. Distances are obtained by using the latitude scale. Caution must be exercised to measure nautical miles along the same latitude scale as the two plotted points in question. As with Lambert projection, the degrees in latitude represented on the chart become compressed as they approach the poles.

Chartwork

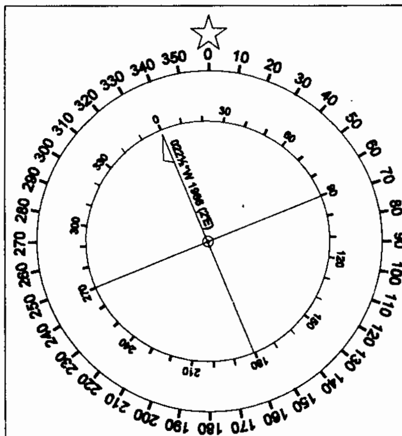
To begin using a chart, it is important to be aware of the information that is displayed on a typical chart. Knowing where to look and how to interpret the information can be a great asset to the Observer.

DEPTH CONTOURS		
1 fathom line	······················	dots only
10 fathom line	—·—·—·—·—·—	dash and one dot
20 fathom line	—··—··—··—··—	dash and two dots
100 fathom line	······················	dots only
200 fathom line	—··—··—··—··—	dash and two dots

UNDERWATER FEATURES	
	Pipeline
	Abandoned cable
	Underwater cable
+++	Sunken wreck
+	Sunken rock (2 meters or less)

COMMON CHART SYMBOLS

MARITIME BOUNDARIES	
– – – – – – – – – – – – –	Maritime limit in general
+ – + – + – + – + – + – +	International boundary
	Limit of fishing zone
– + + – + + – + + – + + –	Territorial waters
	Prohibited area



Compass rose

SHORE BASED REFERENCE POINTS	
⊙Tr	Tower
⊙Chy	Chimney; stack
⊙ Fs	Flagpole
	Light
	Piers

SEA REFERENCE POINTS
Buoy
Buoy with light
Floating beacon
Fog signal

PILOTAGE SYMBOLS	
	Pilot station
	Anchorage
2C	Calling in point for vessel traffic

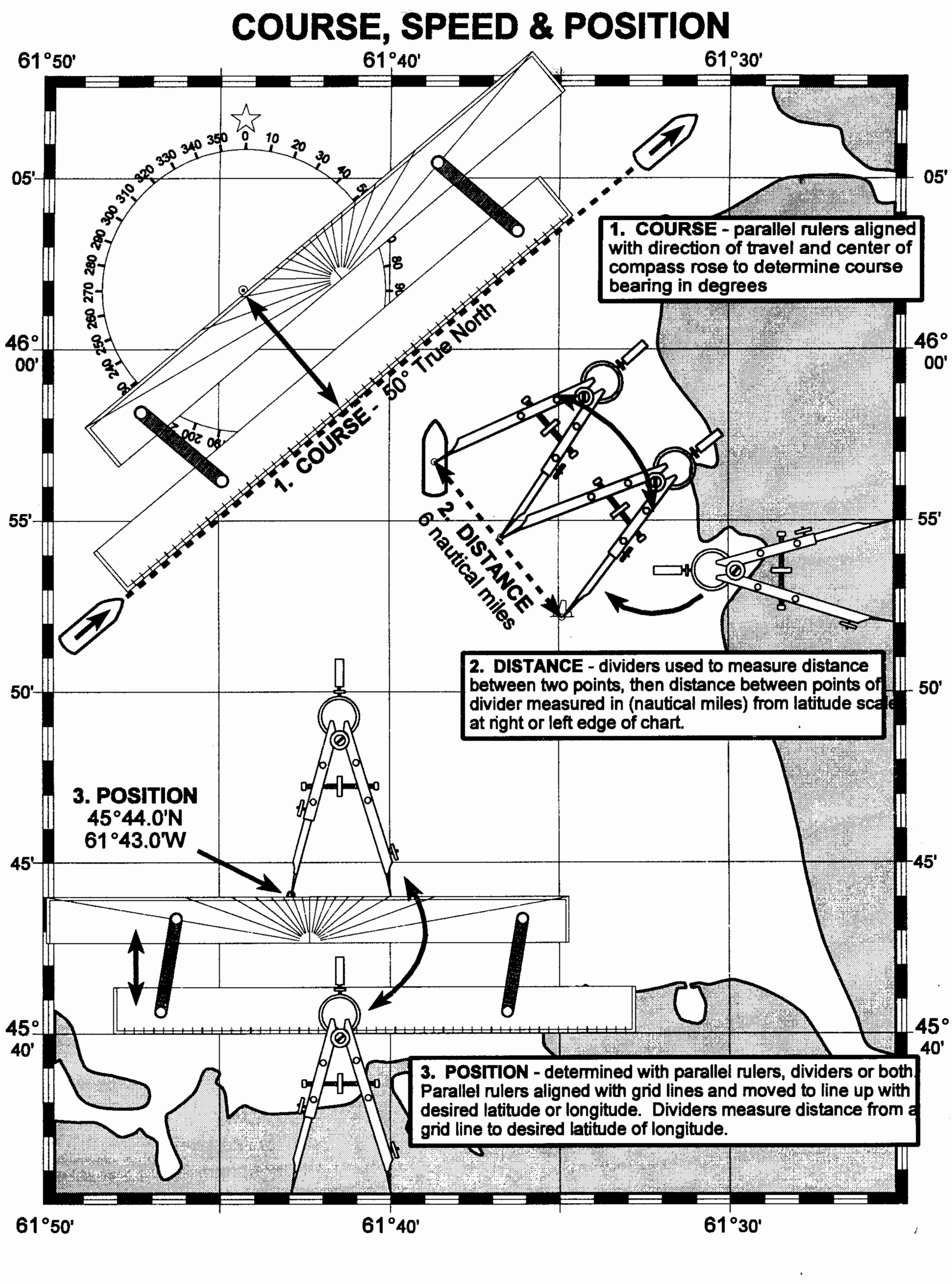
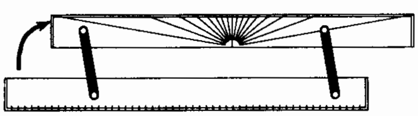
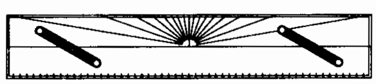

COURSE, SPEED & POSITION
61°50'
61°40'
61°30'
05'
46° 00'
55'
50'
45'
45° 40'
1. COURSE - 50° True North
2. DISTANCE 6 nautical miles
1. COURSE - parallel rulers aligned with direction of travel and center of compass rose to determine course bearing in degrees
2. DISTANCE - dividers used to measure distance between two points, then distance between points of divider measured in (nautical miles) from latitude scale at right or left edge of chart.
3. POSITION
45°44.0'N
61°43.0'W
3. POSITION - determined with parallel rulers, dividers or both. Parallel rulers aligned with grid lines and moved to line up with desired latitude or longitude. Dividers measure distance from a grid line to desired latitude of longitude.

Chart Information	
Item	**Description**
Chart number	All charts are cataloged and issued by number.
Regional name	Geographical area included on chart.
Depth of water	Recorded in fathom/feet or meters.
Scales	Representative measurement expressed as a ratio.
Projection used	Conical, Mercator, etc.
Water current	direction and strength of prevailing currents.
Dates	dates of first edition and latest reprints.

The lower left hand margin indicates the dates of issue and numbers of notices to mariners. Notices to mariners contain corrections to the chart.



Parallel rulers



The main instruments used in chart work are parallel rulers and dividers. Parallel rulers consist of two bars of equal size joined so that when one is held in place on the chart and the other moved, it moves parallel to its original direction. Parallel rulers can be used to:

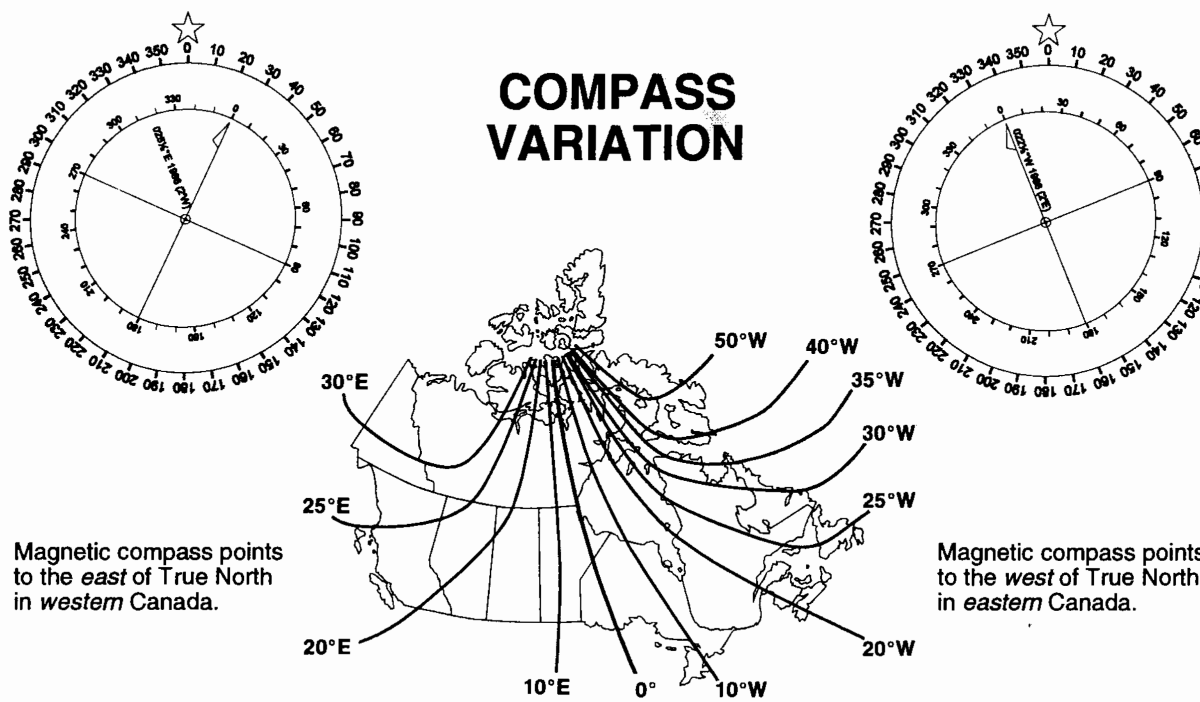
- Transpose lines parallel to themselves,
- Draw course lines
- Measure course direction
- Measure position

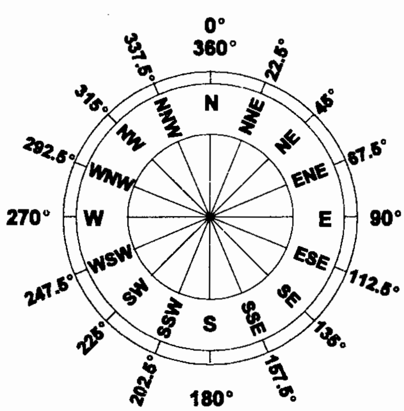
Dividers are used to measure distances and to determine the latitude and longitude of a given point on a chart.

The Compass

The Earth is similar to a giant magnet whose magnetic poles are not in the same place as its geographic poles. The gyro compass points to the True (geographical) North, the magnetic compass points to the North (or South) Magnetic Pole.

The North Magnetic Pole is located at approximately 70° North Latitude and 97° West Longitude, while the South Magnetic Pole is at 72° South Latitude and 154° East Longitude. Note that the magnetic poles move from year to





COMPASS DIRECTIONS

year, and the actual positions of these can vary significantly from positions shown on out-of-date charts.

> ***True North****: the point where all meridians join at the North Pole.*

The three compass headings are:

- *True:* The horizontal angle between True North and the direction of travel of the vessel.
- *Magnetic:* The horizontal angle between Magnetic North and the direction of travel of the vessel.
- *Compass:* The horizontal angle between the Compass North and the direction of travel of the vessel.

Other terminology associated with the use of compasses include:

- *Declination:* The angle formed between the magnetic meridian and the geographic meridian.
- *Deviation* : The angle formed between 0° on the compass and the magnetic meridian of the vessel
- *Error* : The algebraic sum of the deviation and declination.

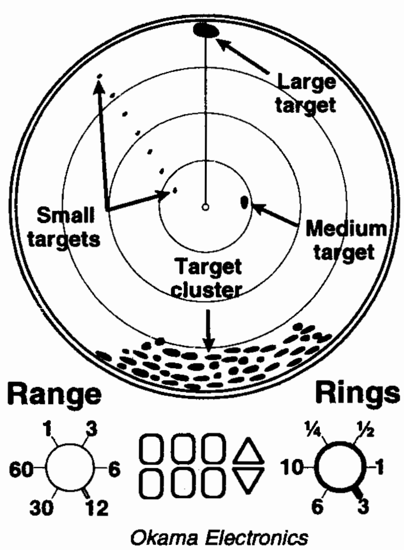
Electronic Navigation Equipment

Observers must not alter the navigation equipment on board an assigned vessel. The master may permit the Observer to press a button to display latitude and longitude, but this should be the extent of equipment operations for the Observer.

Electronic navigation instruments used on fishing vessels include;

- Radar.
- Loran C.
- Satellite Navigation (Sat-Nav).
- Global positioning system (GPS).
- Echo sounders.
- Sonar

Radar



The word RADAR is an acronym of Radio Detection and Ranging. The basic principle of radar is the property of reflectivity of objects to radio waves. Radar enables reflective objects to be revealed and the position becomes known. From this position, radar can provide information on distance and direction of the target being displayed.

Radars have a number of *range scales*, the distance from the center to the outside edge of the display screen, such as .5, 1, 2, 4, 8, 16, and 24. To help the navigator determine distances of objects, most radars have *range rings* or a variable range ring. The range rings can be set at a desired distance, such as 2 nautical miles, and the distance between each ring will represent that distance. It is important for the Observer to know which setting the rings are on when interpreting information from the screen. The variable range ring is a spot of light on the screen that can be set at a given distance and the scale is displayed by a digital read out on the radar screen.

Sea clutter

Sea clutter is caused by the radar signals being reflected by sea waves. It normally affects the area immediately surrounding the vessel and is displayed on the radar as a cluster of targets. This can cause problems because targets such as buoys and small vessels can be hidden in the cluster and go undetected. To alleviate this problem, radars are equipped with controls that help cut down the sea clutter displayed on the screen.

False echoes

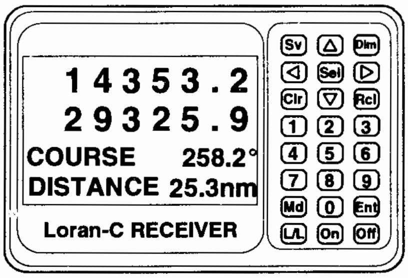
False echoes are images that appear on the screen occasionally. They appear to be real targets but experience will enable an Observer to readily detect them. False echoes maintain a fixed relationship with respect to the true image, they have more of an arch like appearance than the true image and they have a tendency to smear.

Radar heading

The radar heading can be set on true or relative bearings. Relative bearing is when the screen is aligned so that 000 degrees is dead ahead and therefore all radar bearings are relative. True bearings will display the vessel's actual heading with North at the top of the screen.

LORAN C

Loran C (long range navigation) is a radio navigation system that operates from low-frequency pulses over a long range.

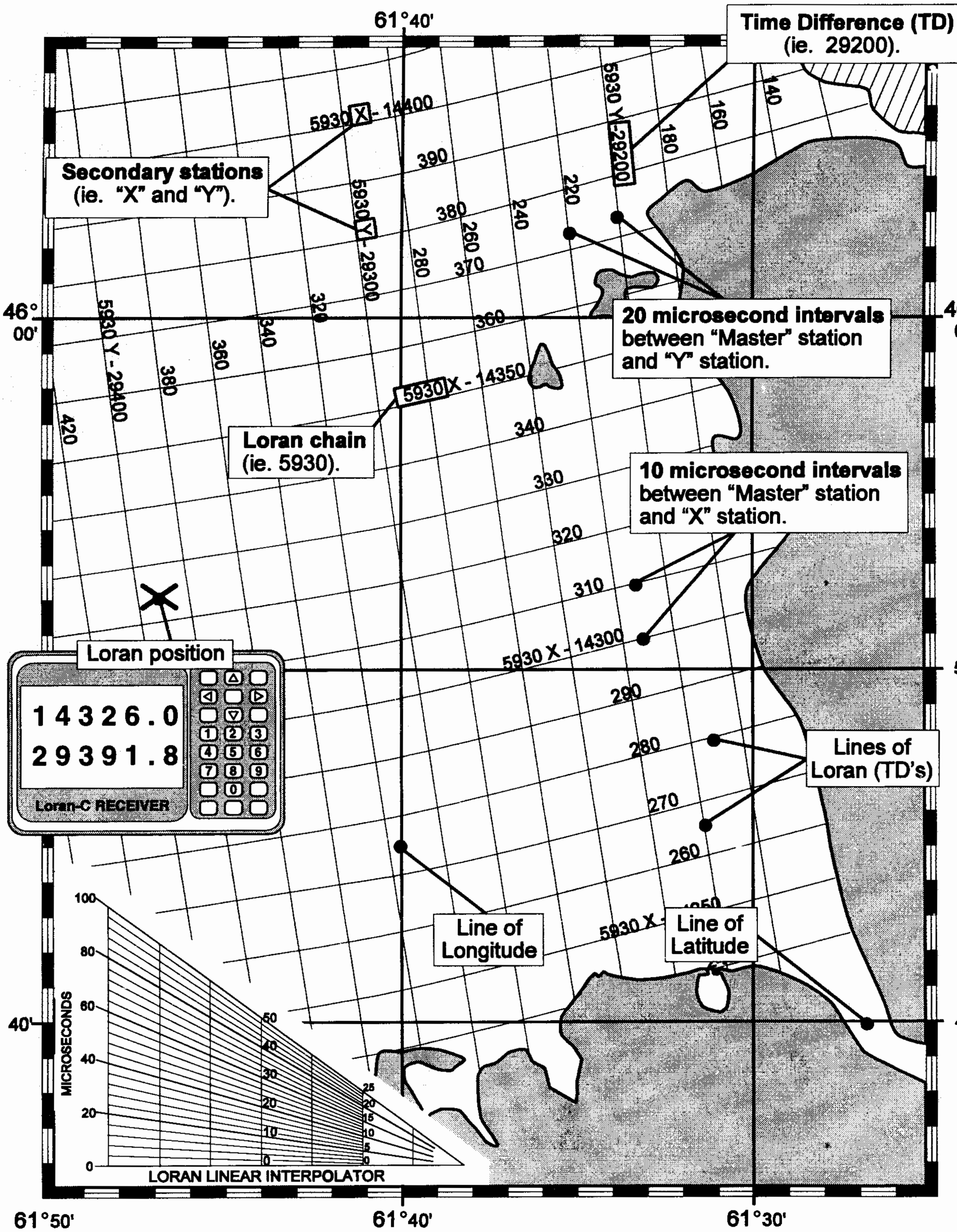


This system measures the difference in reception times of two pulses generated simultaneously by two widely separated transmitters. Time Differentials (TD's) are measured in micro-seconds.

The loran C receiver normally provides two time differences. It calculates the difference in arrival times between the main signals selected by the navigator. The time difference grid is printed on the chart. To obtain a position, plot the time difference displays on the receiver's screen and mark them on the chart. One corner of the loran C chart provides a loran guide. Loran C has been in use since the late 1950's.

On most receivers, the L/L gives the position in latitude and longitude. This is made possible by a computer program that calculates the position from the intersection of the two time differences.

LORAN-C CHART

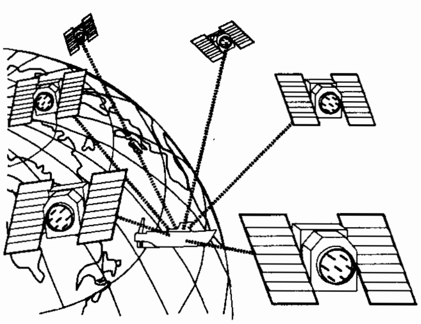


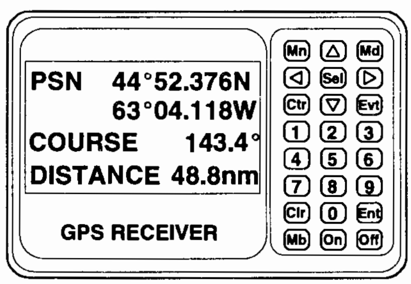
Satellite-Navigation (Sat-Nav)

A Sat-Nav unit receives information on the vessel's position from a system of low orbiting satellites. Satellite fixes are at infrequent intervals due to the relatively low number of satellites and the low level of orbit. The position is expressed by the unit in latitude and longitude at the time of the fix. The Sat-Nav unit then calculates vessel position by taking into account vessel speed and course until the next satellite fix is received. The Observer should use caution when using position information in the interval between satellite fixes. During these times errors of a nautical mile or more are possible. Sat-Nav has been in use since 1967.

Global Positioning System (GPS)

GPS is a form of satellite navigation. It differs from Sat-Nav in that there are more satellites and they are at a higher orbit. This gives a continuous flow of information to the vessel





Global positioning (GPS) includes three components:

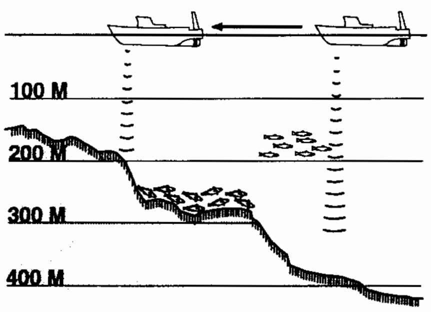
- Satellites
- Land base stations
- Receivers

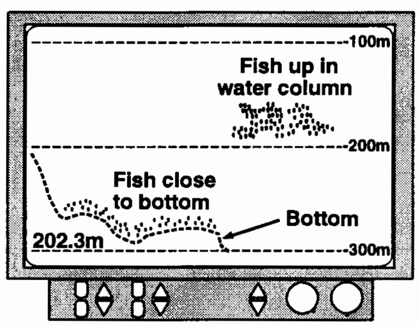
A constellation of 18 satellites reside in six circular orbits at an altitude of 20,000 km and a revolution period of 12 hours. At any location and time, there will be between 4 and 8 satellites over the horizon. Information from 3 satellites is sufficient to give a position, however a 4th satellite is required to give a position with certainty.

The land base control component of GPS is formed by five land stations, placed around the globe, that receive signals from all satellites on a continuous basis to measure and predict their orbits.

GPS units are able to determine latitude, longitude and altitude on a continuous basis by interacting simultaneously with a number of satellite. When a GPS is operating correctly, it is the most accurate navigation system available. A typical GPS can provide a position within 10 to 20 meters, velocity within 0.1 knots and time to a microsecond. GPS has been in use since the late 1980's.

Echo Sounders





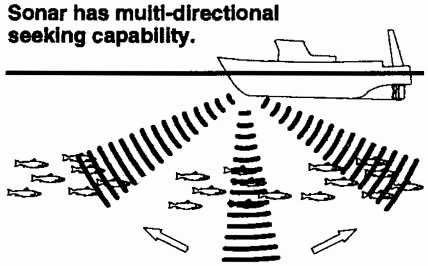
An echo sounder is mainly used on board vessels to measure water depth. Its operation is based on the echo phenomenon, in which short sound waves are transmitted vertically towards the bottom at the rate of five to six hundred pulses per minute. The sea bottom reflects these waves back to the vessel, where they are recorded at the same level as the source of the transmission. Since the speed of sound in water is known, the depth is calculated by the sounder when it multiplies the speed by half the time elapsed between emission and reception of the sound waves. This time lapse is converted to a readout in units of depth usually displayed in Fathoms or Meters. There are two types of echo sounders, sonic and ultrasonic. Sonic operates in the audible range of about 20 to 20,000 Hertz. Ultrasonic uses higher frequencies which reduce interference from ship noise and provide a more accurate reading.

Echo sounders (also referred to as *fish finders*) are used extensively by masters in determining the presence of fish. Echo sounders give an indication of fish that have passed directly beneath the vessel.

In addition to finding fish, masters use the echo sounder to navigate. Frequently, trawls are towed along a certain depth contour and the sounder is relied on to maintain this depth. The echo sounder can also be utilized to check positions obtained from other sources. Once a position is plotted, the depth recorded on the chart should correspond to the read out on the sounder. Differences may indicate a problem with one of the instruments.

SONAR (Sound Navigation Ranging)

Sonar has multi-directional seeking capability.

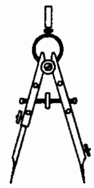


Sonar operates on the same principles as an echo sounder, except that signal direction from the vessel can be rotated horizontally 360°. Distance and bearings of underwater objects up to 2 miles from the vessel can be obtained as the sonar transducer is rotated. The signal can be angled downwards to track underwater objects approaching the vessel.

Sonars are used to locate schools of fish. This system provides the master with the size of the school and direction from the vessel.

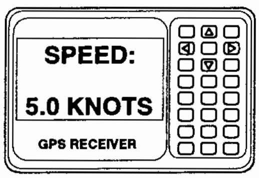
$$\text{TIME} = \frac{\text{DISTANCE}}{\text{SPEED}}$$

$$\text{2 hours} = \frac{\text{10 nautical miles}}{\text{5 knots}}$$



$$\text{DISTANCE} = \text{TIME} \times \text{SPEED}$$

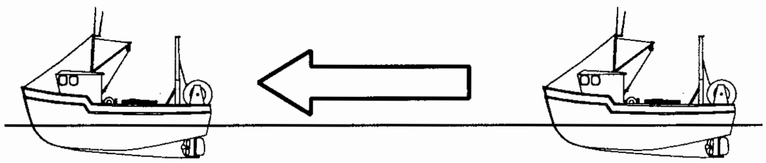
$$\text{10 nautical miles} = \text{2 hours} \times \text{5 knots}$$



$$\text{SPEED} = \frac{\text{DISTANCE}}{\text{TIME}}$$

$$\text{5 knots} = \frac{\text{10 nautical miles}}{\text{2 hours}}$$

TIME, SPEED & DISTANCE CALCULATIONS



Time, speed, and distance formulas

Knowing how to apply time, speed, and distance formulas to daily fishing operations can assist the Observer in monitoring duties. A few applications of these formulae are;

Departed port at 0600 and steamed 10 knots for 6 hours, steering a course of 090 degrees. When fishing operations commenced, the Observer should be able to determine if the navigation equipment is showing the correct bearings. The above information can be used to calculate the distance the vessel has traveled. Knowing the direction of travel, the Observer can plot the distance on the chart using dividers to determine the approximate position of the vessel. This is referred to as *dead reckoning*.

If the towing speed is unobtainable, it can be calculated by noting the duration of the tow and the distance traveled.

If the vessel is operating in close proximity of a closed area, these formulas can assist the Observer in determining if an irregularity exists.

Coastal Navigation

For fisheries conducted in close proximity to the coast line, Observers should be familiar with the use of bearings to verify positions. A bearing is the direction of an object from the vessel. Bearings are measured clockwise, in degrees (000° - 360°), from the reference direction. There are four types of bearings;

- *True bearing:* A bearing on an object with true north as the reference direction An object east of this reference point is bearing 90 degrees.
- *Magnetic bearing*: A bearing on an object with magnetic north used as the reference direction. The difference between a true and magnetic bearing is the magnetic variation for the area. A magnetic bearing must be converted to true before plotting it on a chart. Variation for a particular area is recorded on the chart.
- *Compass bearing*: A bearing on an object with compass north used as the reference direction. A compass bearing must be converted to true before plotting it on an chart. Deviation and variation must be applied to the compass bearing to calculate a true bearing. The Observer must be aware that deviation changes with the vessel's heading and a new calculation must be completed. Deviation values for a particular heading can be obtained by referring to the deviation table, normally posted near the compass.
- *Relative bearing:* A bearing on an object with the ship's heading used as the reference direction. Relative bearings must be converted to true before plotting on a chart.

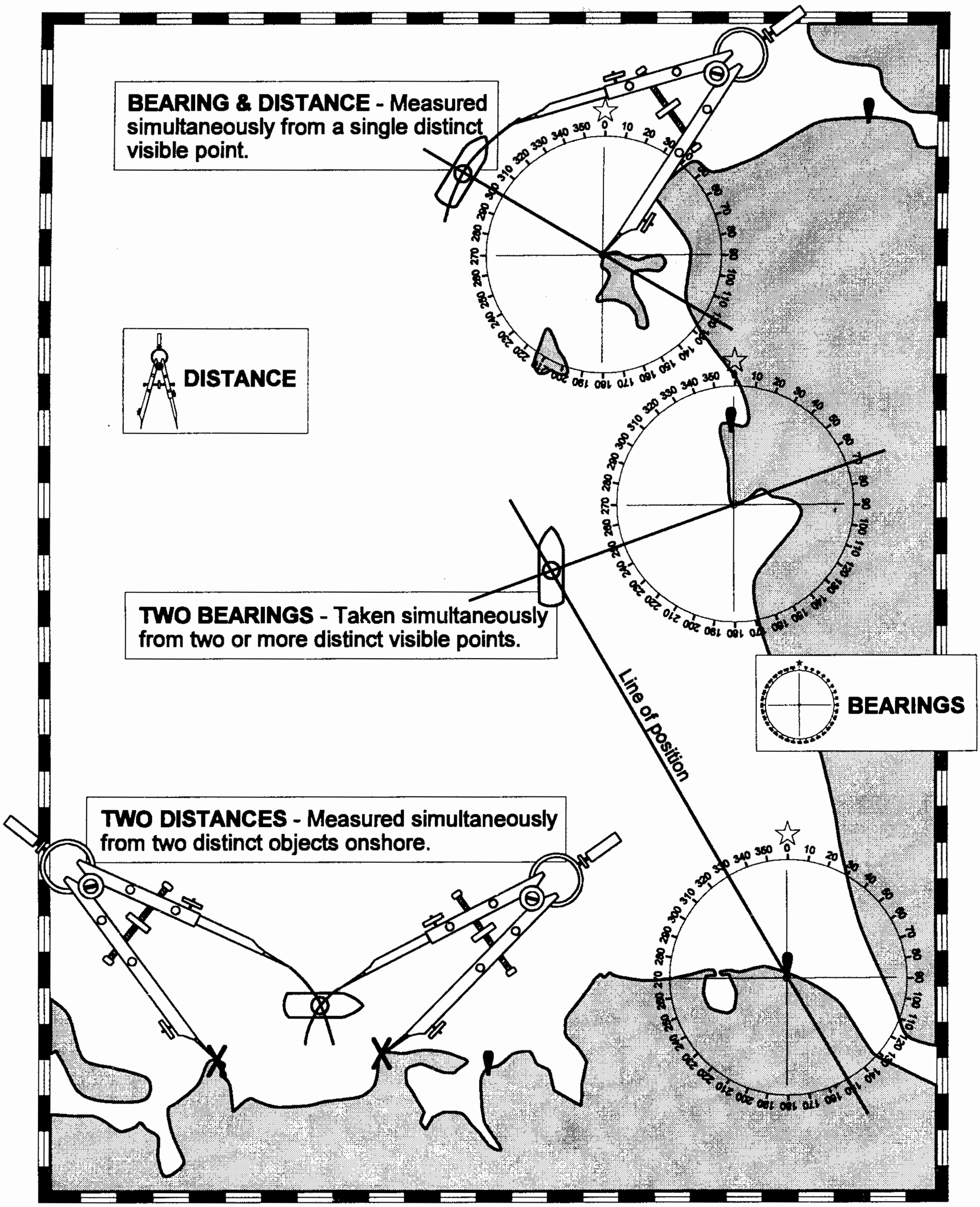
Converting to true

Converting from compass to true is also referred to as correcting, because it is a correcting of errors created by variation and deviation to derive the true bearing. The following procedure is used to convert to true:

Compass +/- Deviation = Magnetic +/- Variation = True

When going from compass to true always add east and subtract west. The reverse procedure is applied when going from true to compass.

POSITIONS FROM BEARINGS & DISTANCE



To help remember this procedure, the first letter of each main word (C=compass) can be used for other words to create a sentence. One of the more common sentences is;

Can **D**ead **M**en **V**ote **T**wice at elections (*at elections* helps remember to add east.)

Methods for taking bearings

Bearings can be taken in the following ways:

- Bearing Ring
- Hand-bearing Compass
- Pelorus
- Radar

Bearing Ring

A rotating ring equipped with a sight that can be attached to a flat-topped compass. The Observer must move the ring until the object is visible through the sight and then record the bearing.

Hand-bearing Compass

The compass is held by hand and the object is sighted and the bearing is recorded.

Pelorus

Consists of a compass card and a sighting device which are mounted on a pivot in the center of the compass. The card may also be locked in position so that it reads the same as the vessel's compass. To operate, rotate the sighting mechanism until the object is visible through the sight. The compass bearing is then read from the pelorus card.

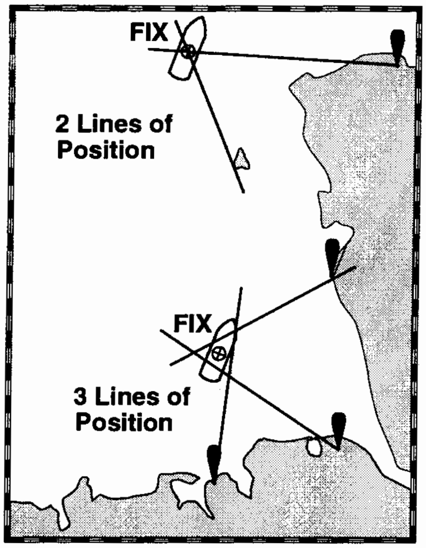
Radar

Obtain and identify object(s) on the radar screen. Place the cursor on the object and record the bearing and distance of the object. Using this method, a position can be determined with one bearing. The radar can also be used to obtain a position by using only the distances of two or more known objects.

Obtaining a Fix with Bearings

Once the Observer has obtained a bearing (converted to true), it must then be plotted on the chart which can be done by using the following method;

- Locate on the chart the object that the bearing was obtained from. Clearly mark the object with a dot to indicate it's position.



- Place the parallel rulers on the compass rose, with one end of the ruler at the center of the rose and the other end on the degrees of the bearing.
- Walk the parallel rulers across the chart until one edge of the ruler is lined up with the mark indicating the object.
- Draw a line with pencil from the mark and extend it past the general location of the assigned vessel.

This line on the chart is referred to as a *line of position* (LOP) and it indicates that the vessel must be somewhere along this line. In order to determine the position (fix) of the vessel, an Observer must have two or more lines of position. A fix can be obtained by plotting a second LOP (bearing from a second object) and where these two lines cross indicates the position of the vessel.

A position can be determined with one bearing taken from the Radar. Draw a LOP on the chart using the procedure described above. With the dividers, measure the distance using the scale located at the side of the chart (latitude scale). Once the dividers are spread to the required distance, place the point of the dividers on the object and with the leaded end, make a mark on the LOP. This mark will indicate the position of the assigned vessel.

The radar can also be used to obtain a position by using only the distances of two or more known objects. When the dividers have been spread to indicate the required distance, place the pointed end on the object and rotate the dividers to make an arch on the chart with the leaded end. This procedure is repeated for the second object and where the arches intersect will indicate the position (fix).

4.3 Production

Monitoring production can be very straight forward to complex, depending on the type of fishery. An inshore vessel crew will dress the fish on deck by hand and then store the catch in the hold for icing. A factory freezer trawler may produce several product types, using various machinery with freezing and packing involved before the product is stored in the hold. This section deals with the different;

- Product types
- Processing procedures
- Recording procedures

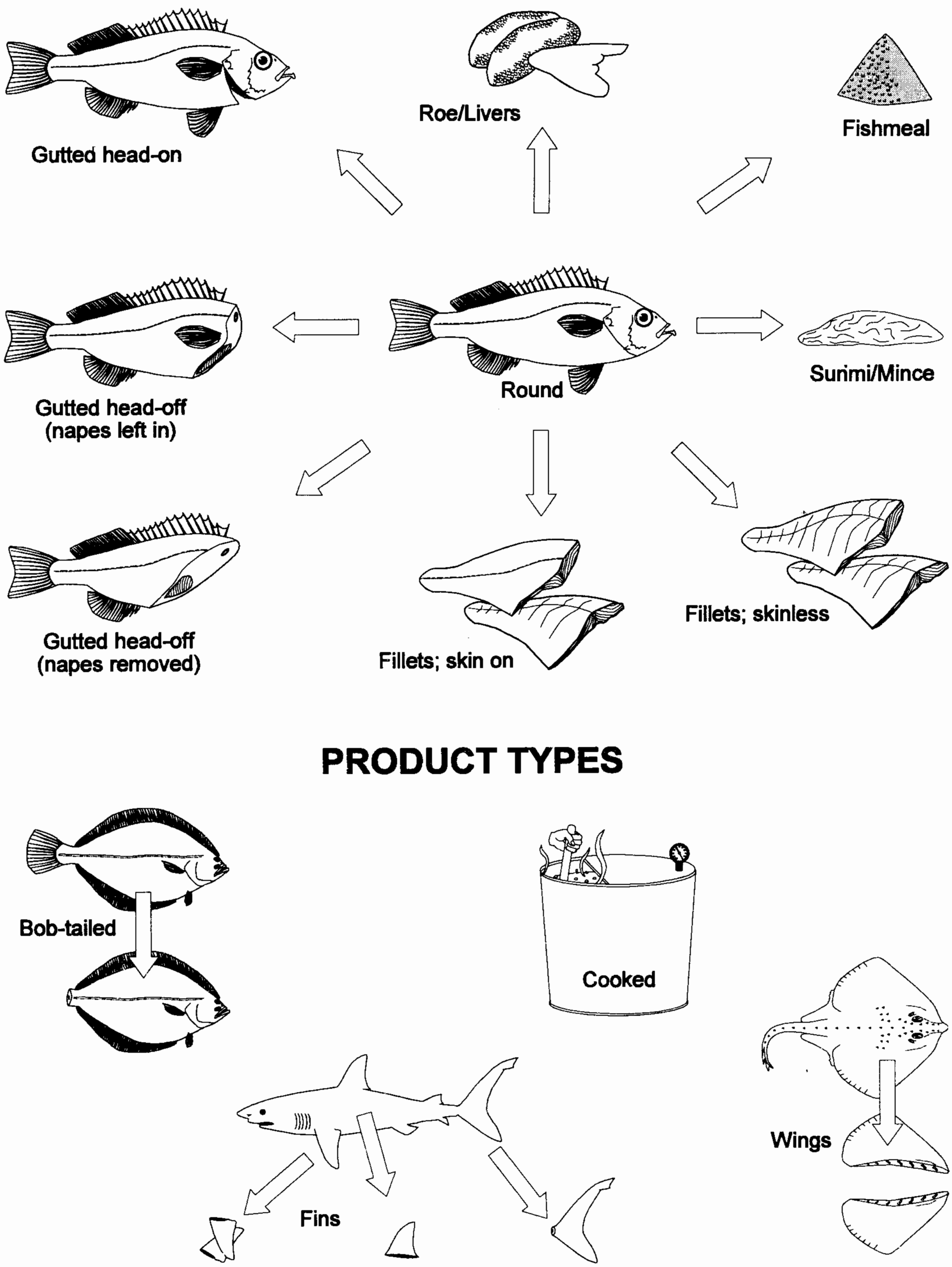
Product Types

For the domestic fishery most crews process the catch for the purpose of preserving it until the vessel returns to port. Further processing and packaging is done at shore based processing plants. Exceptions to this would be found in the offshore shrimp and clam fisheries where the at-sea processing operations are more complex. The following list contains product types an Observer will encounter while monitoring the Canadian domestic fishery:

Domestic Products Types

- Gutted: groundfish trawlers
- Gutted head-off: groundfish trawlers (rare for domestic production)
- Cooked frozen: offshore shrimp vessels
- Raw frozen: offshore shrimp vessels
- Meats: scallops and clams
- Tail off (bobtailed): flounders
- Tails: monkfish (angler)
- Wings: skate
- Round: applies to any species unprocessed prior to storage in hold.

A larger variety of product types are produced by foreign vessels fishing in Canadian waters. The foreign factory freezer trawlers prepare the catch for market on board therefore a more extended processing procedure is required. Product types an Observer can encounter include:


Gutted head-on
Roe/Livers
Fishmeal
Gutted head-off
(napes left in)
Round
Surimi/Mince
Gutted head-off
(napes removed)
Fillets; skin on
Fillets; skinless
PRODUCT TYPES
Bob-tailed
Cooked
Wings
Fins

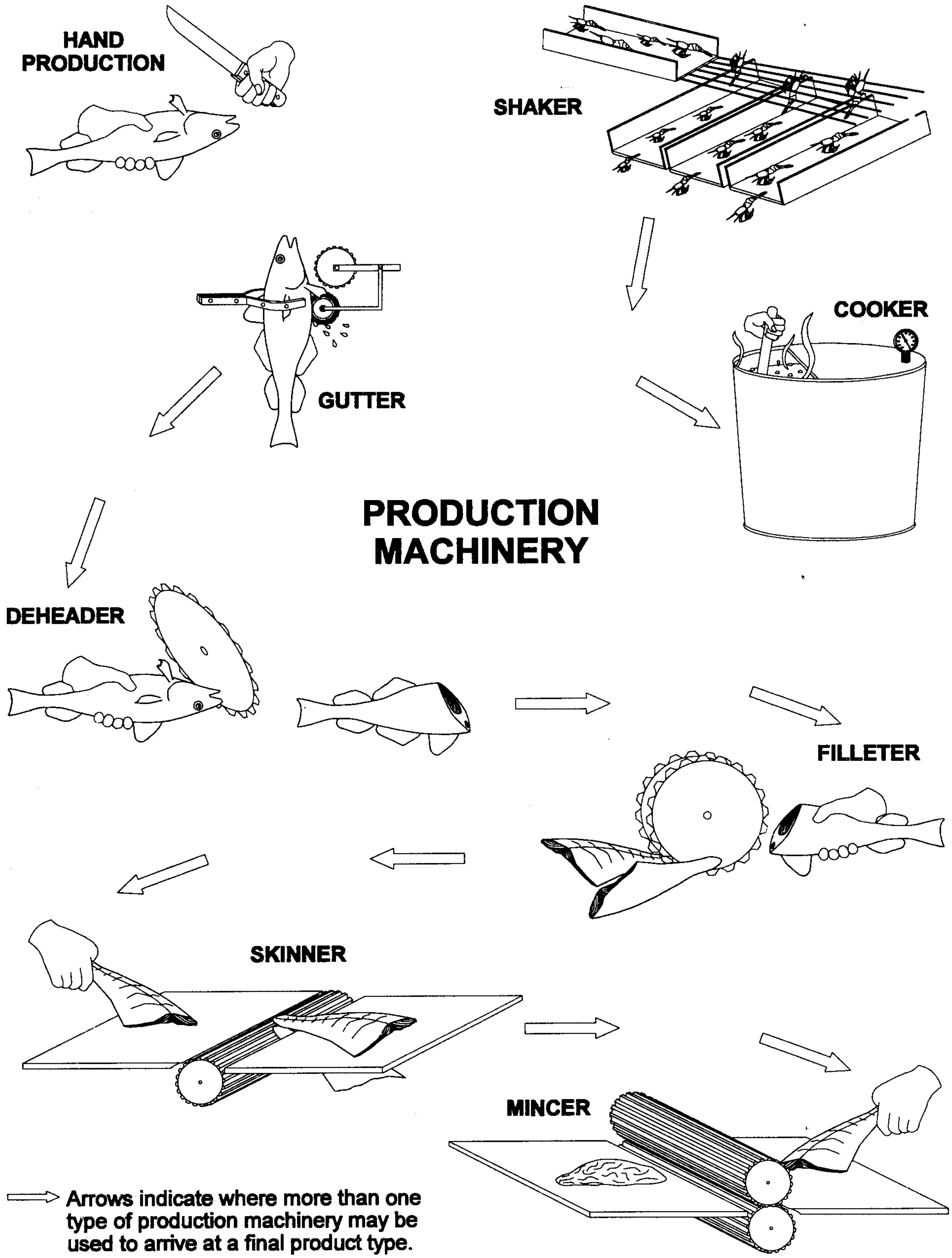
Foreign Product Types

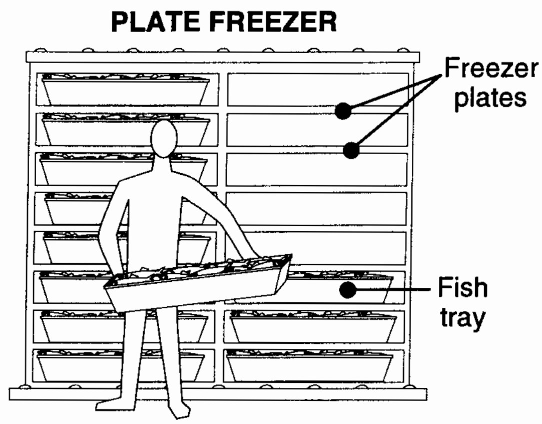
- Gutted head-off: groundfish
- Gutted, head and tail off, fins trimmed: large shark, swordfish
- Gutted, head on, fins trimmed: tuna
- Canned product: livers (also frozen)
- Fillets skin on: groundfish
- Fillets skin off: groundfish
- Fins: shark
- Oil: by product - various species
- Meal: offal and round - various species
- Raw frozen: shrimp
- Round frozen
- Surimi: pollock
- Minced: various species
- Salted: various species
- Pickled: herring

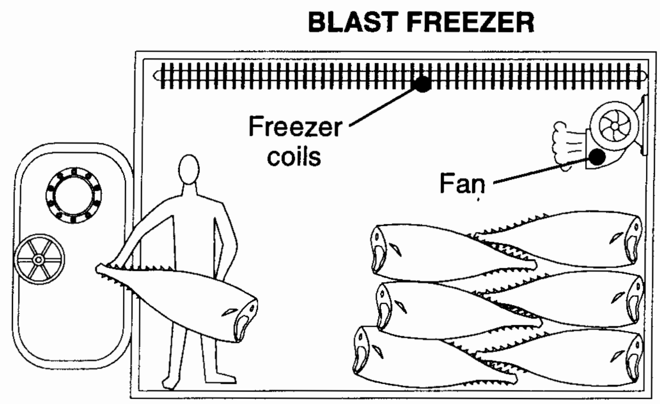
Production Process

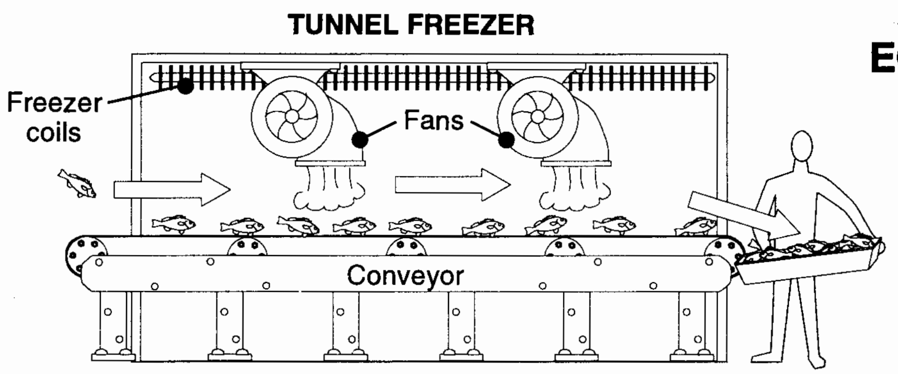
There are numerous processing methods used to process fish. The best means of understanding each type is to see it in operation, but this is only possible once the Observer is deployed. The following table gives a summary of production machinery encountered in Canadian fisheries and provides a general description of their use and purpose.

General Production Machinery	
Type	**Description**
Knife/circular saw	The saw consists of a circular blade positioned in a table in such a manner that only half the blade is visible at the top. Fish are positioned on a conveyor belt which passes along side of the blade cutting the fish at the desired length.
Gutting/heading machine	Fish are fed into rotating slots carry the fish through the machine. The machine is equipped with a blade and brush mechanism.
Filleting machine	This machine can be adjusted to accommodate various sizes of fish. The fish are placed on a belt that carries the fish through a cutting mechanism that removes the fillets and discard the carcass.
Meal plant machinery	An accumulation of machinery designed to transform fish and fish parts into fish meal. The raw product is passed through various machines that grind, press and dry resulting in a flour like product.
Wash tank	The wash tank process rids the fish of dirt, blood, etc., before they are frozen or iced in the hold. The wash tanks vary in structure (tank/drum) but all types work on the principal of forced water passing over the fish.
Scales	There are generally two types of scales used by vessels operating in Canadian waters; digital and lever. Digital scales can be partially motion compensated. Lever scales are operated by sliding a given weight along a graduated bar located at the top of the scales. Once this bar is perfectly balanced the weight of the object can be determined.
Strapper	The strapper consists of an elevated platform with two openings of equal distance apart that allows the strapping to pass through. The box of product is placed on the platform and a lever or switch is activated causing the strapping to tightly encircle the box.
Cookers	This machine is used to cook shrimp at sea. The cookers are kept at 103°c and shrimp are cooked for approximately 3 minutes.
Shakers	Sorting tables equipped with vertical bars spaced to separate the shrimp by size. The shaking motion causes the shrimp to fall through the spaces in the bars and are collected by chutes.
Freezers	There are three types of freezers commonly used to chill fish products before they are placed in a refrigerated holds; plate, blast and tunnel. Plate freezers consist of horizontal or vertical metal plates between which product is placed. Blast freezers are small rooms into which products are placed to be frozen by chilled circulated air. Tunnel freezers have a slow moving conveyor which passes through a freezing room.


HAND PRODUCTION
SHAKER
COOKER
GUTTER
PRODUCTION MACHINERY
DEHEADER
FILLETER
SKINNER
MINCER
Arrows indicate where more than one type of production machinery may be used to arrive at a final product type.







FREEZER EQUIPMENT

Freezers

Freezers are designed to chill a product from an unfrozen state to a frozen state in as short a time as possible. Three types of freezers commonly encountered on factory vessels include, blast freezers, tunnel freezers and plate freezers. Once fish is frozen it is moved to a *freezer hold.* Freezer holds are designed for long term storage of fish.

Product Glazing

Prior to being placed in freezer tunnels, the fish is sprayed with water to prevent dehydration (freezer burn) of the product. When removed from the tunnel there is a thin coating of ice present on the product, referred to as *glazing.* This glazing will help preserve the product while it is stored in the refrigerated hold.

On board most factory freezer trawlers the factory boss can provide the Observer with a percentage used to account for glazing weight. This percentage must be subtracted from the gross weight to determine the net product weight.

Production Capacity

> ***Production capacity** : The maximum amount of product, by weight, capable of being produced in a given time period.*

Production capacity describes the maximum amount of product that can be produced by a series of machines towards a final product. Production capacity of single piece of machinery is expressed in terms of kilograms per minute, or kilograms per hour (eg. a filleting machine capable of producing 20kg/minute, or 1200kg/hour). The production capacity of an entire factory process is expressed in terms of metric tons per day (eg. 35MT/day of frozen production).

Limiting Factor

A factory production line refers to a number of different types of machinery acting on a raw material to arrive at a finished product. The machinery along the production line with the least production capacity is referred to as the *limiting factor*. The point in the production line where the limiting factor occurs is also referred to as the *bottleneck*.

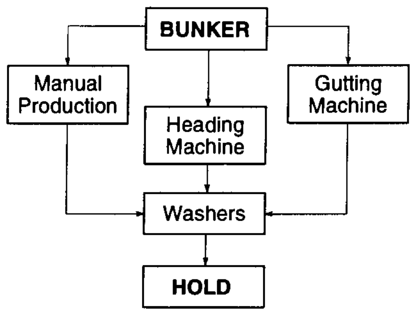
To properly monitor production, the Observer must determine production capacity. The capacity can be obtained from the master, factory boss, or technolog. This topic is most important when dealing with large offshore trawlers but knowing the productivity capabilities on smaller vessels can be beneficial to the Observer and is easily determined through observation.

Benefits of knowing the factory capacity;

- If the vessel captures more fish than it can produce, the crew may attempt to discard excess fish.
- Logbooks may reflect greater quantities than the factory can produce for a given time period.
- Observer estimates may be refined by comparing them to production results.
-

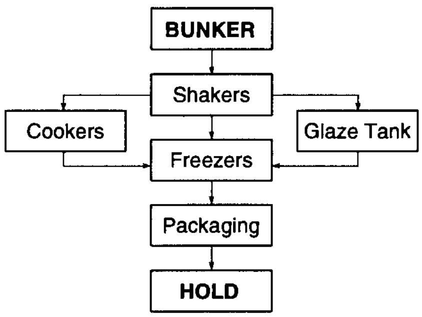
Groundfish production

The machinery utilized in processing will vary depending on



the vessel size and the directed fishery. For most domestic groundfish fisheries the processing is done by hand. The fish are dressed by cutting the belly flaps and cleaning out the entrails (referred to as gutting). The fish are then washed and "iced" in the hold. The larger offshore groundfish vessels may have one or more gutting and heading machines which dress (rip+gut) the fish automatically; it may only require one crew member to operate.

Shrimp production



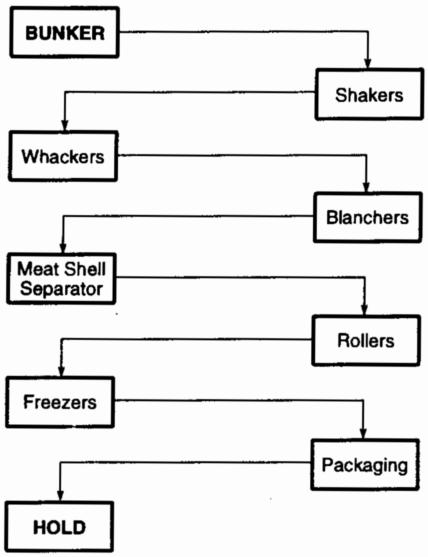
Fisheries such as offshore shrimp and clams have a complex processing operation. Once the shrimp are brought on board they are dumped in a holding tank filled with water. From the tank the shrimp pass through shakers that sort the catch by size. Shrimp are processed in to three product forms, depending on size; premium (large), cooked (medium), and industrial (small). The size is determined by number of shrimp per kilogram.

The medium size shrimp are placed in cookers for approximately 3 minutes at 103°C. Once the cooking is completed the shrimp move along a conveyor belt leading into the tunnel freezer which is kept at - 32°C and the shrimp are individually frozen. The shrimp are carried from the freezer by conveyor belts and taken to the packing area where they are boxed and stored in the hold.

The large shrimp are directed by chutes to a separate holding tank where further processing is conducted. After the damaged, small and undesirables are culled out, the remaining shrimp are placed in a hopper filled with a preserving chemical mixture. This mixture enhances the colour and appearance of the shrimp primarily for the Japanese market. The product is then packed in 1 kilogram boxes, frozen and stored in the holding area.

The small shrimp, referred to as industrial, are frozen raw. Some vessels run the raw shrimp through the tunnel freezer where they are individually quick frozen, packed in 20 kilogram sacks and stored in the hold. Other procedures include placing raw shrimp in plate freezers where they are frozen in blocks. The blocks are then stored in the hold.

Clam production



The processing of clams involves various types of machinery to produce the desired product. The clam first travels along a conveyor belt leading to the shaker. The shaker removes all the undesirable material from the catch, such as shells, rocks, and bycatch. From the shaker the clam is carried by conveyor belt to the shucking house where the product passes under a crush roller and the shells are broken. The clam is then passed through a blanch tank for approximately 1 minute before it is taken to the whackers which smash the clam's shell into small pieces. The next step is to pass the clam through the separator where the shell is removed from the meat. The meat is then fed into a second shaker which separates the mantle from the tongues. From here the tongues are passed through rollers that removes the gut content. After this step the unmarketable tongues are discarded by hand and the kept tongues go through a scrubber to remove bacteria. The final stages involves the tongues passing through the freezer tunnels and on to the packing area.

Other Species Production

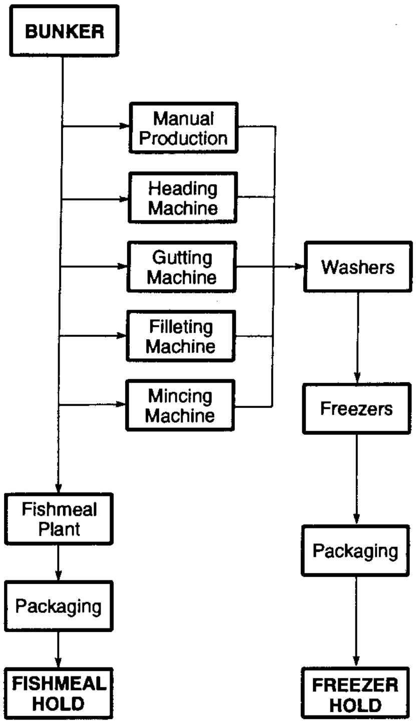
The remaining domestic fisheries, such as scallop, crab, lobster, herring, in shore shrimp, shark, tuna, swordfish and salmon, do not require complex processing machinery since the product is prepared for market at an on shore processing plants. There are various methods used to store the product until it can be delivered to the plant. These methods are designed to maintain the best quality of the product. A few examples are as follows;

- Crab: stored in pans and covered with ice.
- Lobster: stored in holding tanks filled with water.
- Swordfish: dressed and quick frozen
- Scallops: shucked, placed in bags and iced.

Factory freezer trawlers

Factory Freezer vessels have a more complex processing operation because of the varied product types prepared for market on board the vessel.

The catch is emptied from the codend into a holding bunker. The fish are released gradually from the bunker and placed on a conveyor belt leading to the cutting area. At the cutting area the fish heads are removed using a circular saw or a knife. From this area a chute leads to an offal bunker located in the fish meal plant below the factory deck. Heads and entrails are



fed into this chute along with unmarketable bycatch and damaged fish. Once the bunker is full to a sufficient level, the contents are passed through the meal plant machinery. The offal is pressed until the moisture is removed and dried. The end result is a powdered product which is packed in bags and stored in the holding area. Bags of fishmeal generally weigh 30 to 50 kilograms.

The fish chosen for further processing is taken from the cutting area by conveyor belts and fed through washers. The fish are then placed in freezer trays, weighed and placed in holding racks. Once the racks are full they are put into the tunnel freezers. The frozen product is removed from the freezers to the packing area where it is boxed, labeled, strapped and placed on chutes or conveyor belts leading to the freezer hold below deck.

4.4 Safety

Soon after boarding an assigned vessel, it is essential for the Observer to determine the emergency station procedures. The master will be able to advise which life boat station to report to in case of abandoning ship and the duties during a fire or de-icing the ship. The Observer should become familiar with the best escape route from all areas of the vessel in case of an emergency, and the location of fire extinguishers. It is also important to know the various horn signals that indicate man overboard, abandon ship and fire.

Safety procedures

All aspects of the Observer's duties require familiarity with safety procedures; from transferring at sea to monitoring factory production. Safety aspects are subdivided into sections as follows; evaluation of vessel safety, transfers at sea, deck safety and fish factory safety.

Evaluation of vessel safety

When the Observer arrives at dock to board an assigned vessel it is advisable to do a quick inspection to evaluate the safety situation. Observers must keep in mind that some working conditions may be unfavorable and good judgement and common sense must be exercised. If the Observer has serious concerns about the condition of the vessel or the behavior of the crew, they should contact their employer prior to sailing.

Transfer at sea

The Coastal Fisheries Protection Regulations and the Fishery (General) Regulations directs the master to take all reasonable precautions to ensure the safety of an Observer boarding or disembarking the vessel at sea. DFO normally requests that the master give the Observer reasonable notice of transfer times.

Transfers at sea are at the Observer's discretion. On occasion, the master may try to pressure an Observer to transfer in adverse conditions to suit the vessels operating schedule. As well an Observer may not use sound judgement because they want to return to port. The following should be considered when deciding to transfer:

- Weather conditions/visibility
- Transfer craft
- Time of transfer (day light vs night)
- Condition of pilot ladder

- Distance of transfer

Deck safety

Suggestion: The Observer should monitor at a safe distance until the shooting and hauling procedures have been completed.

The fishing deck is a dangerous area and safety precautions must be taken. Cables, ropes and other gear components are under extreme tension during shooting and haul back operations. It is advisable that the Observer remain at a safe distance until these procedures have been completed. Also, hard hats and floatation devices should be worn at all times while on deck. Other tips to enhance safety on the job are:

- Avoid stepping in the center of coiled wire
- Be aware of high tensioned wires
- Be conscious of free moving deck objects during adverse weather conditions
- Keep a safe distance from the open stern until a safety gate has been secured
- Exercise caution when examining large fish
- Be aware of slippery decks, ice, grease, etc.
- Refrain from lifting heavy objects or if required exercise proper lifting methods (lift with legs not back).

Factory safety

Factory machinery and working space vary greatly, depending on the size of the vessel and the directed fishery. The factory can be a place of high activity and the Observer should exercise safety precautions. Some safety concerns are:

- Loose clothing around machinery
- Spines and teeth of fish when examining catch
- Knives stuck in cutting boards
- Working alone on deck or in fish hold
- Shifting product in fish hold

Emergency situations

The Observer must consider the possibility of an emergency situation and have a plan of action if such a situation occurs. In order to formulate a sound plan the following must be considered.

Escape routes

Knowledge of the route to the deck or bridge area from any location on the vessel can be valuable during an emergency situation. On smaller inshore vessels this can be a very simple matter, but the larger offshore trawlers and factory freezer trawlers can present a problem if the Observer is not prepared. Larger vessels have a ship's diagram located in the alley ways showing the layout and emergency exits.

Lifeboat stations

The Observer will normally have an active role in lifeboat drills but it is important to know the assigned station. For larger vessels, the Observer should inquire from the master about lifeboat procedures and assignments.

Firefighting stations

The Observer should become familiar with the firefighting equipment and make a note of its location. Inquiries should be made concerning firefighting procedures and assignments.

Emergency sound signals

There are predetermined sound signals to indicate a fire, man overboard, lifeboat stations and abandoned ship. Most larger vessels have these posted by each bunk and the Observer should make a point of becoming familiar with them.

Safety Checklist

The following checklist will assist the Observer in ensuring that all safety concerns have been addressed:

__Suggestion:__ Observers should always note escape routes, emergency signals and stations.

- Location of vessel safety items
  - Life raft and rings
  - Flares and EPIRB's
  - Fire extinguisher
  - First aid equipment
- Observer Personal Responsibilities
  - Immersion Suit
  - Escape route
  - Duties during fire /de-icing
  - Life boat station
- Vessel Safety Procedures
  - Survival craft assignments
  - Fire/emergency/abandon ship signals
  - Procedures for making distress call
  - Action required of individuals in an emergency
  - Procedures for rough weather at sea
  - Procedures for anchoring
  - Procedures for recovering a person overboard
  - Procedures for fighting a fire

4.5 Logbooks

The information recorded in the logbook, if accurate, provide important data that can be used in fisheries management. As specified under section 61 of the Fisheries Act, the master is required to maintain a true and up to date record on his fishing activity and catch in the logbook.

One of the Observer's main duties is to monitor the fishing activity and address any discrepancies noted in logbook completion. It is not so important, from the Observer's perspective, that the appropriate spaces are completed correctly but that the information itself is correct. When checking logbooks Observers apply a combination of skills including; species identification, estimation, production monitoring and navigation.

Three types of logbooks used by vessels fishing under the Canadian jurisdiction are;

- Fishing Log.
- Production Log.
- Transshipment Log.

The most common logbook used in the domestic fleet is the fishing log. Although the format of this log will vary from vessel to vessel, the required information remains basically the same. Fishing and production logs are used on factory freezer trawlers and possibly transhipment logs as well. All three types of logbooks have a header; a section for catch information and a comment section. The header contains general information such as the vessel name and side number, fishing division, directed species, and fishing status. Catch information requirements vary for each type of log and will be discussed under their respective headings. The comment section, located at the bottom of each page contains information such as; reasons for long delays between sets, fish lost due to gear problems and fish dumped due to contamination or safety considerations. This information should be reviewed to ensure it is completed correctly.

Observers are not permitted to write in vessel logbooks. This is the responsibility of the master, however logs may be completed by designated crew members.

Fishing Log

The fishing log consists of the following sections:

- Positions
- Time
- Depth
- Catch

Positions

Start positions for each set must be entered in the logbook. Some logs may have a field for the end position also. Coordinates are normally entered in latitude and longitude, although some masters on smaller domestic vessels record the position in TD's (LORAN C). Refer to section *4.2 - Navigation* for a more detailed description of navigational techniques.

Time

The time must be entered for the start and end of each tow. For foreign fisheries the time is entered in UTC (universal time coordinated) and local time is normally used for logbooks on domestic vessels. UTC is measured in 15° of longitude for 1 hour, with the starting point at the meridian of Greenwich (0°). Halifax, N.S., situated at 63° 36' W longitude, is + 4 hours from the meridian of Greenwich. When dealing with local times the Observer must be aware of *daylight saving time*. This is an adjustment of time which takes advantage of daylight hours. The time is put ahead on the first Saturday of April (spring ahead) and returned to its original time on the last Saturday of October (fall back).

Depth

The fishing depth is recorded in fathoms for most domestic logs. Depths are recorded in meters on some larger domestic vessels and on most foreign fishing vessels (1 fathom = 1.828 meters). The Observer should check with instrumentation on the bridge to ensure that the correct depth is being entered.

Catch

The catch includes estimates of all kept and discarded species on a set by set basis. In the foreign logbook round weights are recorded in kilograms. The majority of domestic logbooks have the weights recorded in pounds and it is permissible to enter either round or dressed weight (1 kilogram = 2.204 pounds).

The ability of an Observer to estimate and identify species plays a crucial part in monitoring this section of the logbook.

Observers should be continuously enhancing techniques to develop confidence in this area. When checking logbook entries, a comparison is made between the captain's and Observer's estimates. For information on estimating, refer to sections *6.1* to *6.4* dealing with catch estimation procedures.

The fishing logbooks used by foreign vessels have an additional section on converted production weights. The information includes the round weight, by species, processed for human consumption (round, gutted head-off, fillets, etc.) and reduction (fish meal). The species weight processed for human consumption can be obtained by taking the processed weight for each product type from the production log and applying the appropriate *conversion factor* (CF). The weight of round fish reduced can be determined by applying the appropriate CF to the weight of meal produced from round fish in the production log.

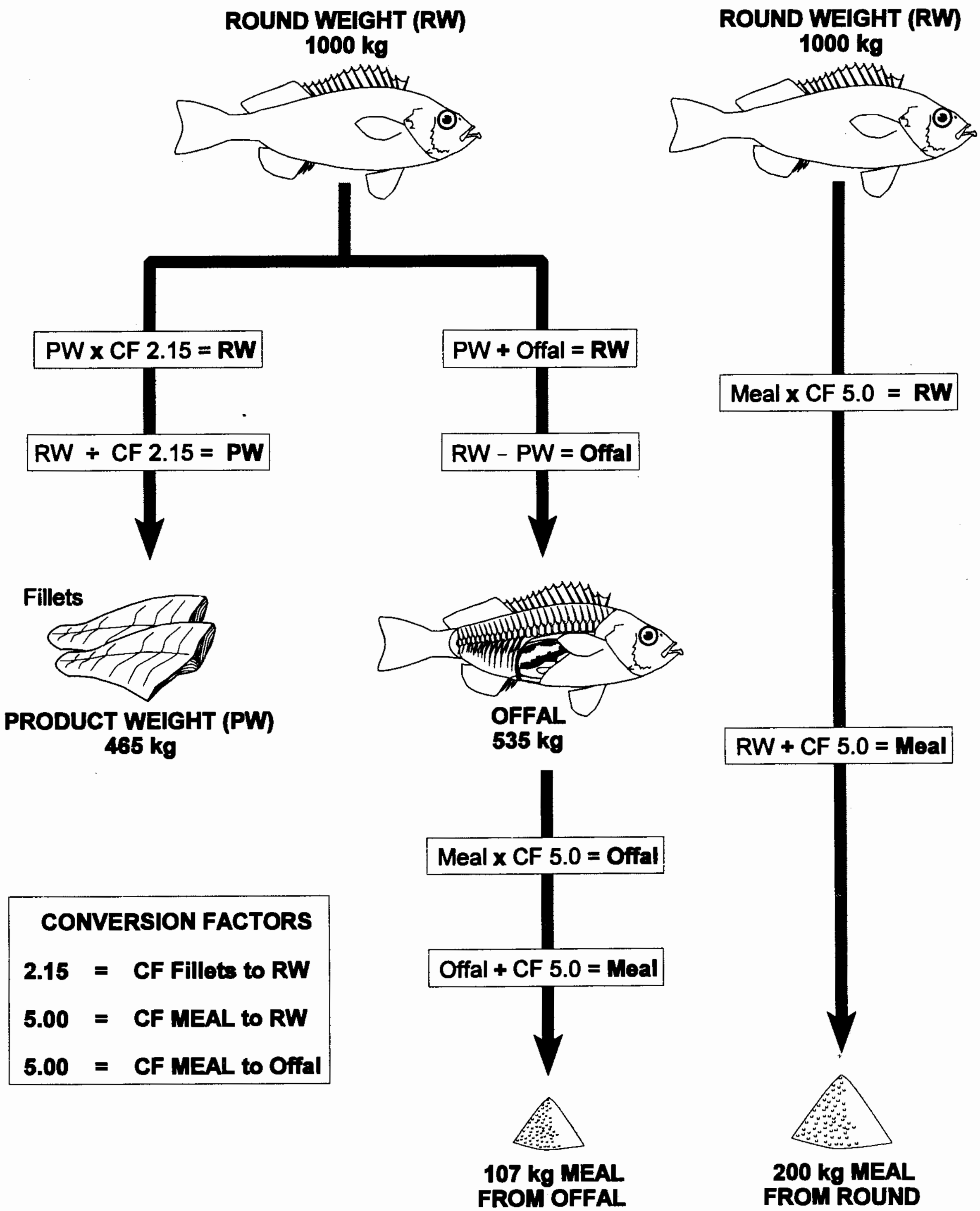
Production Log

Production logs are required on all foreign vessels and some domestic vessels fishing in Canadian waters. All production results must be entered in the production log on a daily basis. The product weights are entered in kilograms by species. To check these entries the Observer must convert product weight to round weight in order to compare it with the estimated catch. Most vessels have their own CF for each product form and species. An Observer must address situations where a CF being used by the vessel is too high or low. In order to determine the accuracy of a CF the Observer may be required to conduct a CF study. The study is conducted in the following manner:

- Weigh several baskets of round fish and record the results.
- Have the crew process the fish and weigh the resulting product.
- Divide the round weight by the product weight to obtain the CF

Round weight ÷ Product weight. = CF

USING CONVERSION FACTORS (CF)



Conversion factors are applied in the following way;

A CF of 1.6 for silver hake (gutted head-off) x 15,000 kilograms of product = 24,000 kilograms of round weight. (1.6 x 15,000 = 24,000). The weight of product for a given amount of round weight can be determined by doing the opposite calculation (24,000 ÷ 1.6 = 15,000).

The next section of the production log deals with the amount of fish meal produced from offal and round fish. Offal is left over parts of fish after product has been removed (ie. heads, guts, fins, tails, etc.). Fish oil is a by-product and not considered a part of offal. The Observer has to closely monitor this process to ensure that the correct weight and source of the fishmeal is recorded. After reduction it is impossible to determine its origin (offal, round fish, species). Prohibited bycatch can be hidden through reporting as offal.

The amount of meal produced from offal is calculated by subtracting processed weight from round weight and dividing by the CF for meal. Using the values in the example above, the following weight of meal would be produced from offal. In this example the CF for meal is 5.0.

  24,000 kilograms round weight
- 15,000 kilograms product weight
= 9,000 kilograms offal

(offal) 9,000 ÷ 5.0 CF = 1800 kilograms meal

The amount of meal produced from round fish is determined by dividing the weight of round fish by the CF for meal.

(round fish) 15,000 kg. ÷ 5.0 = 3,000 kg. (meal)

When checking this section of the logbook, the Observer should consider the following: Are?

- Recorded fish meal weights for offal representative of the products produced.
- Round bycatch weights hidden by recording it as offal.
- Recorded fish meal weights for round fish representative of the days catch.

Unit 5 : Sampling and Fisheries Science

Perspective

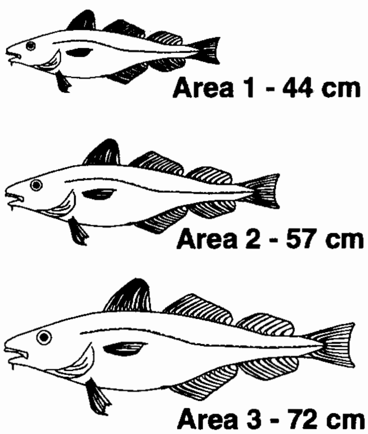
Sampling and Fisheries Science deals with the procedures used by Fisheries and Oceans scientists to assess fish stocks and the role observer collected data plays in the assessment process. This unit introduces accepted scientific methods of identifying and sampling fish, including biological data recording procedures.

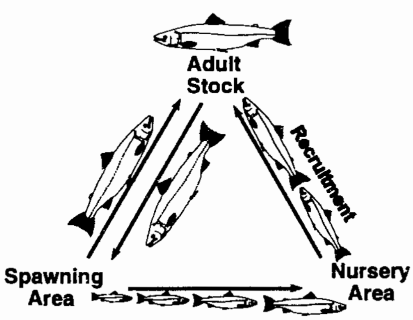
5.1 Fish Populations	An insight into information considered by scientists when evaluating fish populations.
5.2 Fisheries Science	Scientific terminology and procedures used to assess stocks.
5.3 Species Identification	Scientific terminology and procedures used to identify fish species.
5.4 Sampling Methodology	Collection and organization of raw data.
5.5 Special Requirements	Collection and preservation of specimens and related data.

5.1 Fish Populations

> *Stock: a collective group of a single fish species, dwelling in a defined geographical area thus determined to interact reproductively and from a similar line of descent.*

THREE YEAR OLD FISH FROM DIFFERENT STOCKS





This section covers material that gives an insight to information that must be considered by scientists when evaluating fish populations for the purpose of Fisheries management. Having an understanding of this information will provide the observer with a better appreciation and respect for his/her work, particularly with respect to various data as input in to the management model.

Fish stocks are normally separated by a physical boundary. For example, 3M cod on the Flemish Cap are considered to be a separate and distinct group of fish from cod in surrounding waters. However, Greenland Halibut are thought to be the same stock because this deep water species is not divided by the greater depths as are the cod. In the Canadian Atlantic there are more than a dozen different stocks of cod.

Many commercial species of marine fish migrate great distances, hundreds, even thousands, of kilometers each year. Adults migrate between spawning and feeding grounds and back again in a regular cycle. Larvae drift from spawning grounds to settle in nursery areas.

> ***Migration:** a species changing habitat at certain seasons in relation to changing water conditions or spawning activities.*

At any given time, a stock of fish is made up of several year classes. As each year class gets older the number of fish are reduced by natural mortality and fishing mortality, but the surviving fish increase in size. A knowledge of the age composition of a fish stock is essential to any study of population dynamics and to fish management. For this reason, fish otoliths (earbones) are collected in order to age the fish.

Recruitment: *the addition of juvenile fish to the adult population.*

In terms of the fishery, recruitment refers to fish of sufficient size to be captured by fishing gear. These fish are said to be recruited to the fishing gear. Recruitment, or year class strength may vary enormously from year to year and it is not very clearly related to the size of the spawning stock. The variation of year class strength is the other main factor, in addition to fishing, controlling the abundance of fish stocks. The variation in stock size so caused may be large, and are superimposed on those due to changes of fishing effort, etc. It is for this reason that the scientific advice sometimes proposed an increase in a TAC at the same time as it calls for a reduction of fishing effort. Varying recruitment is also the main reason for changes of recommended TACs from one year to the next.

Apart from these short term fluctuations, the main problem concerning recruitment is the extent to which it depends on stock size. Clearly, if there are no spawning fish, there can be no recruits, but the relationship between spawning stock and subsequent recruitment is hardly ever clear, because of all the short term fluctuations. If recruitment does decline when spawning stock size is reduced too far, this opens up the possibility of catastrophic stock collapse at high fishing mortality levels, rather than just progressive depletion.

Natural Variability: *the fluctuation in the proportion of young fish that survive from year to year.*

There is a significant year to year variability in the proportion of young which survive, leading to considerable fluctuation in year class strength. In some instances, these fluctuations can be so pronounced that a large year class or year classes can sustain a fishery for several years. A large year class can have a dramatic impact on the future of fish available to be harvested as that year class reaches a harvestable size. By monitoring this process of natural variability scientists can predict future trends in fish harvesting.

5.2 Fisheries Science

The following text introduce the scientific terminology and procedures used by Fisheries biologist for stock assessment and give advice on Total Allowable Catches (TAC) used to manage the fisheries.

> ***Stock Assessment:*** *an estimate of population growth, mortality and the status of a fish stock.*

In order to provide advice on TACs, fisheries scientists need to discover the current condition of the stock. They also need to find out what would be the optimal state of the stock. Unfortunately it is impossible to count directly how many fish are in the sea, so the problem of estimating these numbers (population dynamics) has to be approached indirectly. To achieve this scientist require extensive data on the stock in question.

Important types of data are those which describe the commercial fishery. The weight of fish caught and where they are caught are certainly the most crucial items of data to be collected as this defines mortality due to fishing (effort). Also of importance is the estimate of the amounts of fishing in each region.

For accurate assessments to be possible, the total commercial catch from any one fish stock must be sub-divided into the numbers of fish caught at each age (year class). This can be done if the participants of a particular fishery measure samples of their commercial catch regularly and find the ages of representative samples of the fish at each length. The measures give an estimate of the numbers of fish of each length caught. Then, knowing the fish ages, such numbers of fish at each length can be converted into numbers of fish at each age. It is possible to determine ages of many fish species through the collection of otolith and scales.

In order to be able to predict future catches, scientists have to be able to estimate how many fish at each age are in the sea now and what proportion of each age group will be caught each year.

Another feature of fish stocks is the large variation in the number of fish entering the fishery each year. These two features make a knowledge of the current age structures of the population.

Every year scientists from DFO give advice about the status of the fish stocks. In order to formulate this advice, raw data must be analyzed to obtain answers for the numerous questions that arise. The main goal is to provide an accurate stock assessment. To accomplish this, information on catch, effort, fish size and age must be collected for a particular stock area. There are several commercial sampling programs used by DFO in the collection of these data:

- Observer program
- Port technicians
- Sentinel fishery

All sources mentioned above are important, but only the Observer Program, in conjunction with research survey data, can provide complete information for the purpose of assessing the stocks. The Observer Program, through direct observations of the fishing activities of many vessels, allows for a wide range of adequate volumes of reliable scientific and technical data to be collected.

The data collected by the observer is delivered to the Observer contractor who is responsible for debriefing the observer. During the debriefing session, the data package is visually edited and corrections are made. It is very important to ensure that the data is accurate. Once this process has been completed, the data is entered on the data base, editing takes place. The DFO scientific staff then have access to the data. Some uses to which the Observer Program scientific data are currently being applied are:

- Assessment of fish stocks
- Analysis of fishing effort, bycatch and discards
- Development of new regulations
- Analysis of current gear types
- Analysis of production methods and product quality
- Fish and fishery distributions

> ***Surplus Production Model:*** *a biological theory that attempts to explain the effects of fishing in terms of the relationship between catch rate and fishing effort.*

The advantage of the surplus production model is its simplicity. The only data required are measures of the total catch and of total effort or catch per unit of effort. There are several disadvantages to using this model. The main advantage is that it does not distinguish between the effects of recruitment, growth, natural mortality and fishing mortality. A second disadvantage is that the model ignores the learning factor in the development of a new fishery. Catch rates can be distorted as fishers become familiar with new grounds. Catch rates can also become distorted by improvements in fishing technology. Since catch rates is merely a measure of local density, any spatial changes will also distort the results. However, this model is particularly useful for species such as tuna which can not be readily aged, or for redfish for which aging can be difficult.

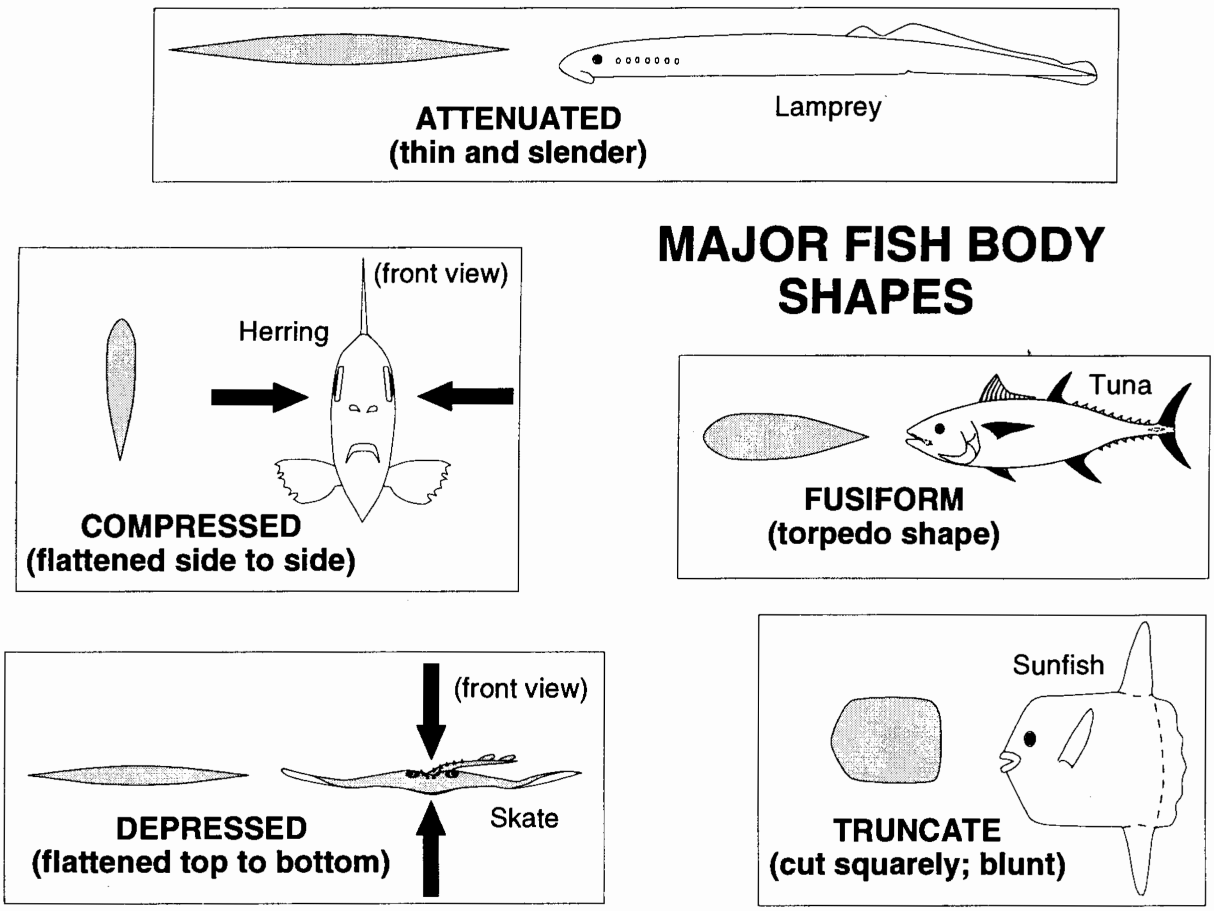
> ***Analytic Model:*** *a biological theory on the effects of fishing that takes into account what happens to a year class of fish from the time it is recruited to the fishery until the last fish from that year class has died.*

Five main factors are considered when using this model: number of fish recruited in to the fishery each year, the rate at which fish are caught, the range of sizes (age) of fish that are caught, the rate at which fish die from natural causes and the pattern of growth of the individual fish.

Each stock is made up of year classes. Analytic models examine what happens to a year class from the time it recruits to the fishery until the last fish of that year class has died.

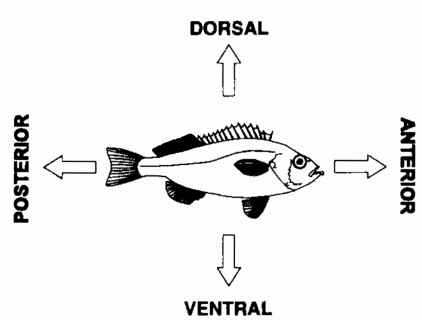
> ***Yield per recruit:*** *the average yield to be expected under any given pattern of fishing from an individual fish recruited into the fishable population.*

If an estimate of the recruitment has been determined, this can be used to estimate the total yield. Assuming that recruitment will be at the average level of recent years, total yield and yield per recruitment will change in a similar manner. This advise is often expressed in terms of the fishing mortality which will produce the maximum yield per recruitment or some variant of this. The nature of the yield per recruitment curve varies among species and among stocks.



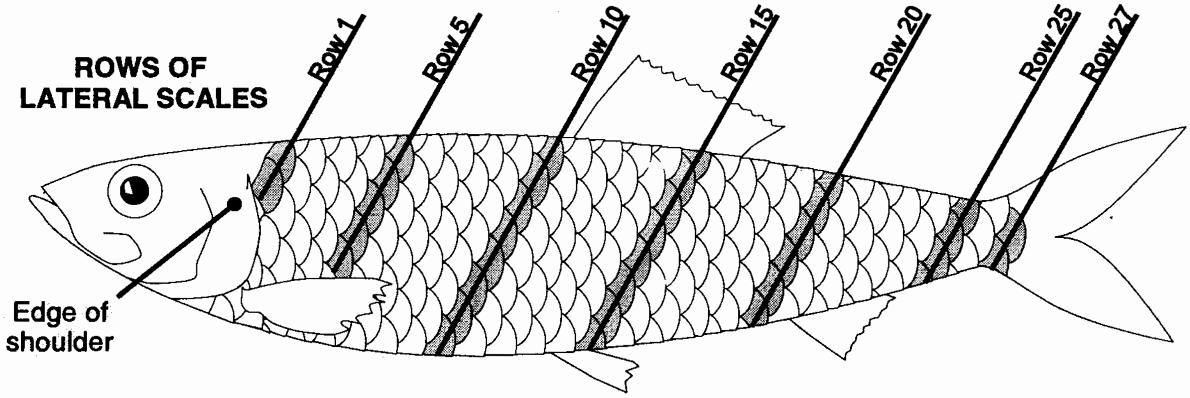
5.3 Species Identification

Species identification is a fundamental skill for observers and must be done on a set-by-set basis. Before completing the crucial catch data sheet, observers must be able to identify the fish and invertebrate species caught.

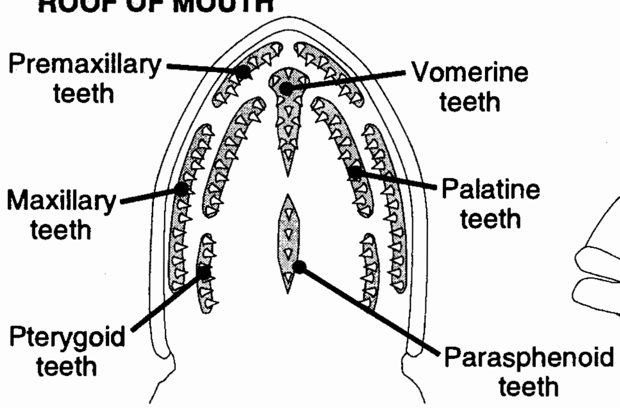


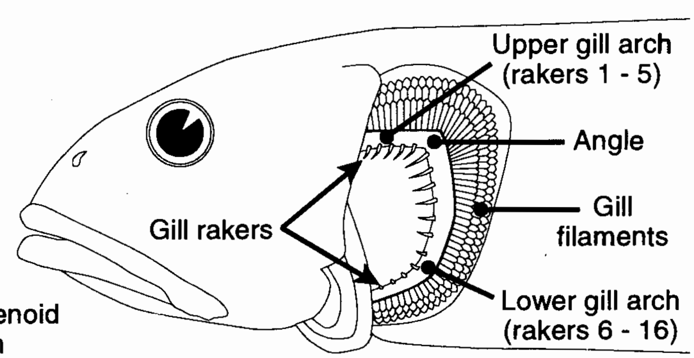
The authoritative references for identifying fish in Canadian marine waters are: *Atlantic Fishes of Canada* (Scott and Scott, 1988) and *Pacific Fishes of Canada* (Hart, 1973). Taxonomic keys for identifying shrimp, lobsters and crabs are given in *Decapod Crustacea of the Atlantic Coast of Canada* (Squires, 1990).

Species identification uses accurate and technical terms that describe the animal's external and internal anatomy. It is therefore imperative that this terminology be understood. In



FEATURES OF BONY FISH





addition, to effectively use taxonomic keys, a basic understanding of taxonomic structures is required.

External Anatomical Characteristics

To effectively use a fish identification guide, observers must be familiar with anatomical terminology used to differentiate between specimens. The following general categories cover various aspects of external features used in species identification.

- body shapes
- fins
- external features of Bony Fishes
- external features of Crustacea

Basic Taxonomic Structure

Taxonomy is the study of the classification of organisms according to their similarities and differences. The main taxonomic divisions in descending order are kingdom, phylum, class, order, family, genus and species. A species is a group of organisms capable of breeding among themselves but not with organisms of other groups. This is not to be confused with the term "stock", which denotes a group of animals of the same species that cannot breed due to geographical separation.

Taxonomic divisions start with very general categories and branch to specific groupings. For example, the kingdom Animalia (animals) contains multicellular organisms whose primary mode of nutrition is ingestion. Within the animal kingdom is the phylum Chordata (chordates: animals with a hollow nerve cord and elastic rod or notochord along its dorsal side, and gill slits). Chordata contains the sub-phylum Vertebrata (vertebrates: animals with a skull surrounding a well developed brain, and a skeleton of cartilage or bone). Vertebrata contains the class Chondrichthyes (cartilaginous fish), which includes the order Squaliformes (sharks). These sharks include the family Squalidae (dogfish-like sharks), and finally the dogfish-like sharks contain the genus-species *Squalus acanthias* (spiny dogfish).

Scientific names are always written in Latin. In scientific literature, a species name is normally prefixed by the genus, and both of these are italicized (*Squalus acanthias*). The genus name (*Squalus*) is prefixed with an uppercase letter, while the species portion of the name (*acanthias*) is always indicated in lowercase. It is also common to see the genus name abbreviated to a single capital letter (*S. acanthias*).

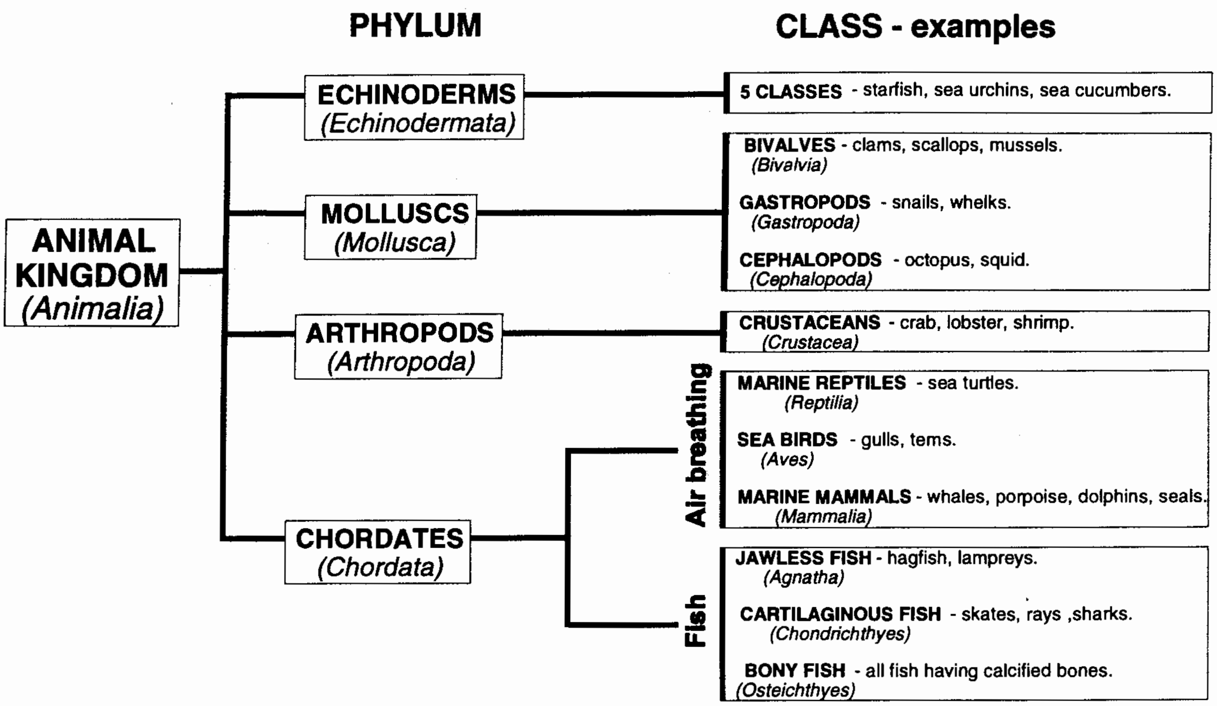
Classification of Marine Animals

The majority of marine animals belong to the following phyla:

- Mollusca
- Arthropoda
- Echinodermata
- Chordata (subphylum Vertebrata)

Molluscs

The phylum Mollusca (molluscs) contains bilaterally symmetrical, unsegmented animals with a shell secreted by a mantle, and a muscular foot; all with various modifications.



They are marine, freshwater or terrestrial, soft bodied, often with one or more hard shells. The phylum Mollusca contains over 100,000 species, of which the majority are in the classes:

- Bivalvia (bivalves)
- Gastropoda (gastropods)
- Cephalopoda (cephalopods)

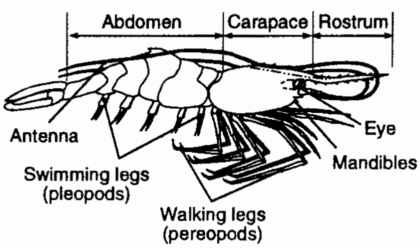
The class Bivalvia (clams, oysters, mussels, scallops, etc.) contains animals with “two valves”or shells which are hinged at the dorsal edge. These organisms are strictly aquatic, are laterally compressed, lack a distinct head, and are generally stationary filter feeders. They also have a hatchet shaped foot that is not well developed but used as a crawling surface. However, a few are capable of escape swimming, such as scallops. Bivalvia contains about 15,000 species.

The class Gastropoda (snails, whelks, limpets etc.) means a “stomach-foot”. The foot is highly modified in different species for a creeping type of locomotion. Gastropods usually have an asymmetrical spiral shell, and a head with one or two pairs of tentacles. There are about 80,000 species of gastropods.

The class Cephalopoda (squid, octopods, etc.) have a "head-foot" usually with eight or ten tentacles, a mouth with two beak-like jaws, and an ink sac. They have highly developed eyes and nervous system, swim rapidly by expelling water from the mantle cavity, or crawl along the bottom. The shell may be reduced and internal (squid), absent (octopus), or completely developed (nautilus). Cephalopoda contains only 650 living species, as compared to more than 7500 fossil forms.

Arthropods

CRUSTACEAN FEATURES



Arthropoda is the largest phylum of the animal kingdom, containing over 800,000 described species, the majority being terrestrial insects. Arthropods are segmented animals with paired appendages, a jointed chitinous exoskeleton and a complete digestive tract.

The majority of marine arthropods belong to the class Crustacea (lobsters, crabs, shrimp, etc) accounting for about 31,300 species. Crustaceans have typically two pairs of antennae, one pair of mandibles and two pairs of maxillae. The thoracic segments have paired appendages, and the abdominal segments are with or without appendages.

Echinoderms

The phylum Echinodermata (starfish, sea urchins, sea cucumbers, etc.) contains about 6,000 described species, and are exclusively marine. Echinoderms are recognizable by their pentaradial symmetry (the body can be divided into five parts arranged around a central axis), although this feature may not be readily apparent. Symmetry may also be present in multiples of five: for example, a starfish having 10 arms. They have an endoskeleton of calcareous ossicles and spines, and usually have numerous ventral tube feet connected to a coelomic water-vascular system (locomotary).

Chordates

The phylum Chordata (chordates) includes animals having an axial skeleton in the form of a notochord (a stiffened rod) in lower forms and a hollow nerve cord towards the dorsal side. The subphylum Vertebrata contains chordates having a segmented vertebral column or backbone formed of bone or cartilage. A skull surrounds a well developed brain and usually a tail is present. Vertebrates contain air breathing animals (reptiles, birds and mammals) adapted to life in the sea and water breathing animals (fish) fully evolved to life in the aquatic environment.

Air Breathing Marine Vertebrates

The three air breathing vertebrate classes adapted to the marine environment are:

- Reptilia (reptiles)
- Aves (birds)
- Mammalia (mammals)

The class Reptilia includes seven species of marine turtles with limbs modified to serve as flippers. While sea turtles spend the majority of their life cycle at sea, they must still come ashore to breed, laying eggs in excavated nests at the head of beaches.

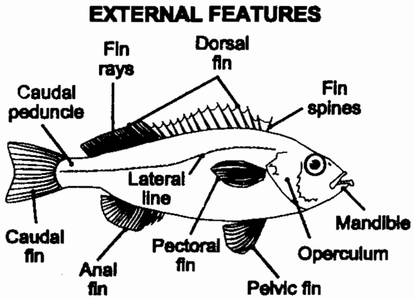
The class Aves includes many species of birds modified to life in the marine environment, however like sea turtles, they must return to land to nest. Seabird nesting colonies are concentrated in coastal areas.

The class Mammalia (mammals) includes species adapted to the marine environment. Like terrestrial mammals, they nurture their young with milk secreted by the mother. They usually have four limbs, modified as fins for the aquatic environment. Marine mammals breathe air but are capable of remaining underwater for extended periods, some species for up to an hour. Cetaceans (whales, dolphins and porpoises) are the most highly adapted mammals to the marine environment, living their entire life cycle in the sea and feeding diversely on fish, seals and plankton. The suborder Pinnepedia (aquatic carnivores including seals) are less adapted to the marine environment, returning to land to breed and give birth. They feed primarily on fish.

Fish Species

Bony fish comprise about 40% of living vertebrate species, and are fully adapted to the marine environment. Three classes of fish are:

- Agnatha (lampreys and hagfish)



- Chondrichthyes (cartilaginous fish)
- Osteichthyes (bony fish)

The class Agnatha (lampreys and hagfish) has 64 species. These eel-like aquatic vertebrates have no limbs, bones, scales, paired fins, or fin rays and have a jawless mouth. They do have dorsal and caudal fins, and the hagfish also has an anal fin. Considered to be the most evolutionarily primitive of the fishes, they have only rudimentary vertebrae.

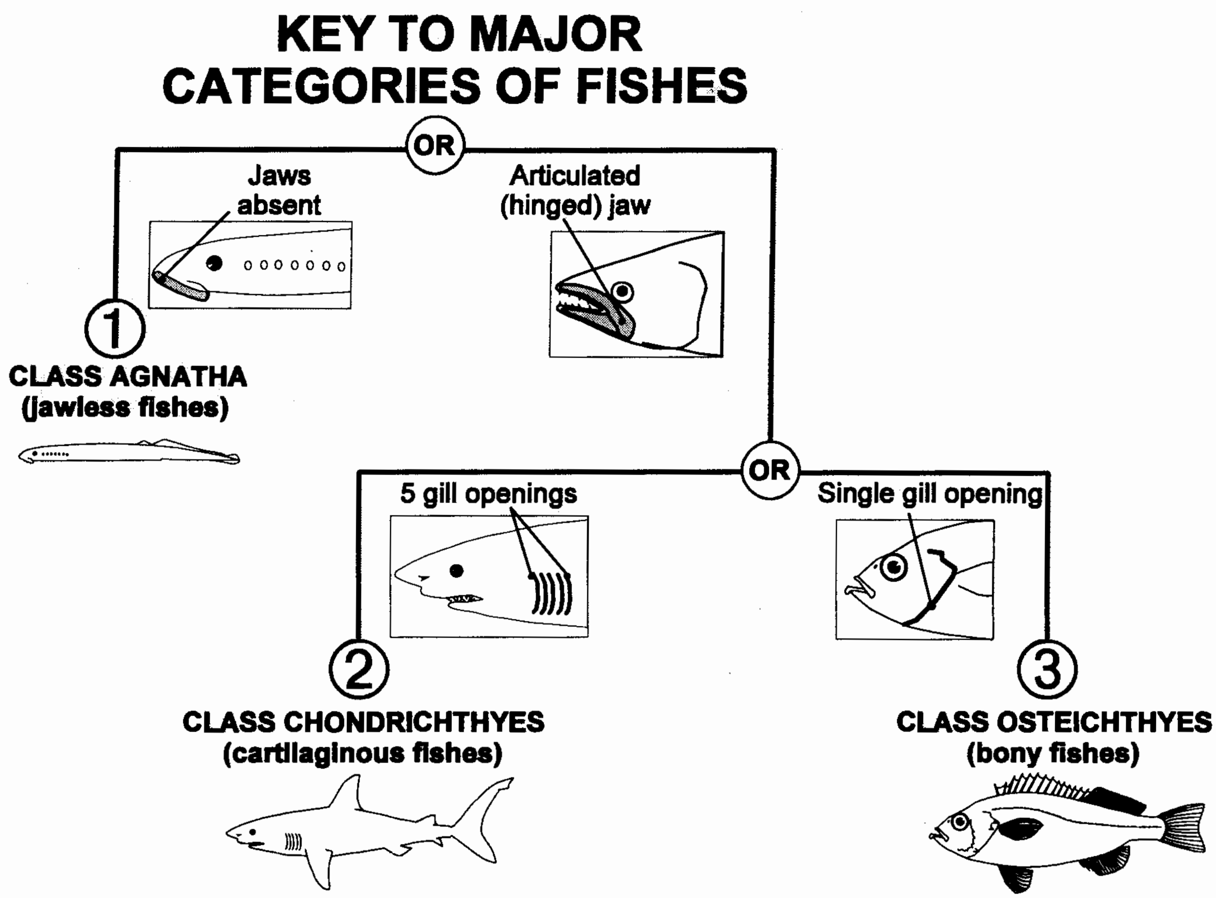
The class Chondrichthyes (sharks, rays, skates and chimaeras) contains about 2,000 species with skeletons solely composed of cartilage. The intestine contains a spiral valve, with intestine and urogenital ducts discharging into one external opening (the cloaca). Males have pelvic fins modified into claspers for transferring sperm to females. These fish have scales (never overlapping) and lack an air bladder.

Sharks feed on other fishes, crustaceans, mollusks and in some cases plankton. Skates and rays are flattened dorsoventrally and have crushing teeth to feed on shellfish.

The class Osteichthyes contains fish with bony skeletons (except in sturgeons and gars), usually with scales and an air bladder. They number about 30,000 species. Bony fish vary widely in feeding practices; including carnivory, herbivory and filter feeding.

Body forms have extensively adapted to different modes of life. Fish that feed at or near the bottom tend to reduce or lose their swim bladders and are frequently flattened. Flounders are flattened laterally and swim sideways across the bottom. Angler fish are flattened dorsoventrally and have a large mouth facing upwards to capture fish as they swim overhead.

Swordfish have a prominent rostrum or "sword" to stun or kill fish for food. Tuna and mackerel-like fish are highly streamlined, fast, powerful swimmers.



Using a Dichotomous Key

Dichotomous keys assist those who wish to identify a particular specimen. Keys consist of a series of choices in the form of couplets numbered in the left-hand margin. To use a key, compare the characteristics of the specimen in question with the first statement given in a key. If the statement agrees, follow the indication given at the end of that statement, which will be either a species name or the number of the next couplet. If the statement is not in agreement, proceed to the second part of the couplet. Continue this in this way until the specimen is identified.

Dichotomous keys outline very general characteristics common to a class. Gradually, through the process of elimination of divergent characteristics, identification keys narrow down to more specific physical characteristics that are common to order, family, genus and eventually to only those characteristics that distinguish one species from another.

5.4 Sampling Methodology

Observer data is important to the science of fisheries management. Sometimes it is the only data that exist for a certain fishery. Except for fisheries research surveys, observer data is the only data collected under conditions where collecting unbiased quality data is the prime objective.

Observers contribute to the scientific study of fish populations by collecting data through sampling. Scientists analyse and interpret these data to gain an understanding of, and determine the overall health and state of various stocks so that they can make decisions regarding the management of the resource. Management decisions are only as good as the data on which they are based. Reliable data comes from employing scientific methodology during the data collection process.

The premise of any scientific study is to accurately assess what one is studying. When scientific studies involve something in a small controlled environment such as a laboratory, this can be easily achieved. However, when a study involves something very large and complex such as marine fish populations, it is more difficult to observe and measure. Instead of looking at the whole, portions that represent the whole are studied. This is made possible by taking samples or subsamples of a particular stock.

Sampling Area

Observers should become familiar with their working environment shortly after arriving onboard the vessel. This includes identifying an appropriate sampling area. The master of a vessel is required to provide a suitable area for an Observer to conduct sampling, but sometimes these areas are less than ideal.

Before any samples are taken, the Observer should assess the processing operations to determine the optimum location for sampling. When choosing a sampling area, an Observer should look for a location with:

- Minimal interference with vessel operations
- Easy access to unsorted fish
- Space to store data sheets and small sampling equipment

- A place to measure fish
- A place to hang weight scales
- Sufficient lighting

Random Sampling

To sample randomly means that every fish in the population (the catch in this case) has an equal chance of being taken for the sample, which must be representative of the unsorted catch. This basic principle helps to eliminate bias from the collection process. Observers must employ care, diligence, and follow scientific methodology when collecting samples. This can be challenging in a less than ideal environment, such as on a vessel, where the prime objective is to catch fish. There are many things that can bias collected samples and, as a result, Observers are faced with the task of either eliminating or accommodating for these factors.

Applying Random Sampling Techniques

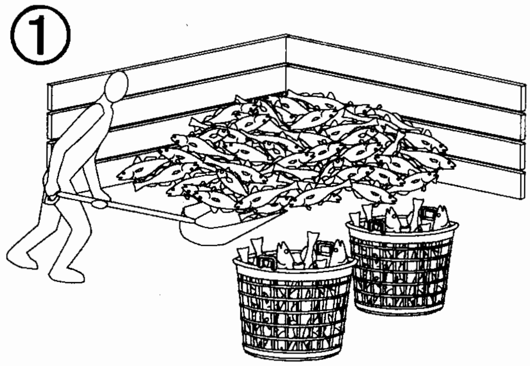
There are general guidelines to follow when collecting specimens/individuals for a sample. Observers should ensure that:

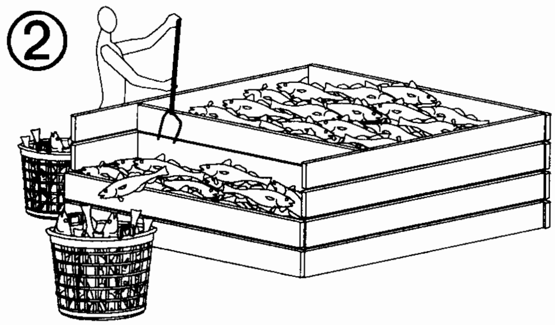
- They have access to the catch before any sorting occurs. After sorting has occurred in which some individuals are removed, what is left is not representative of the population.
- Hand-picking samples is avoided. There exists a subconscious tendency to select large or otherwise obvious individuals.
- If fish dumped into a holding bin form observable layers according to their shape or size, then subsamples must be taken at different depths in the storage bin.

An observer must apply random sampling techniques based on various harvesting and fish handling methods. Harvesting methods can be grouped into two categories that affect random sampling techniques. They are *total catch retrieval* and *intermittent catch retrieval.*

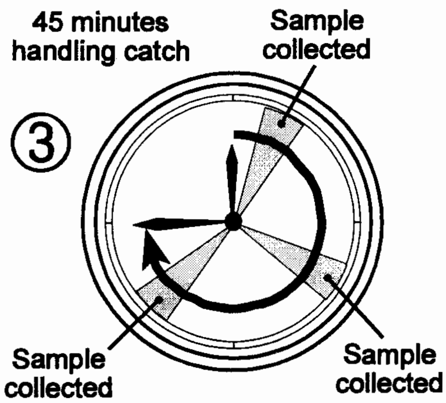
Total Catch Retrieval

Total catch retrieval occurs when the total catch is taken onboard in a short period of time and dumped into a holding area. Harvesting methods to which this applies are:





RANDOM SAMPLING TECHNIQUES



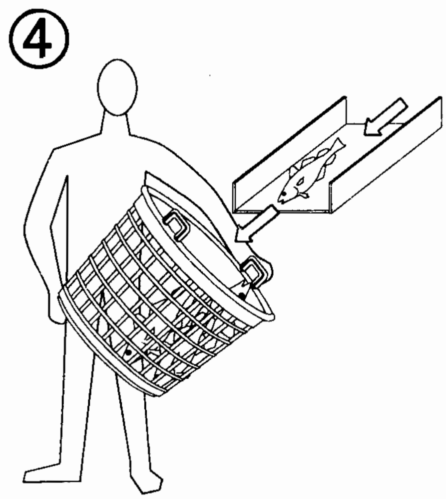
❶ **Scooping** - use scoop or shovel to avoid selective hand picking of fish.

❷ **Section of bunker** - section off a portion of catch in the bunker and collect fish from the top to the bottom. Repeat process in several sections of the bunker.

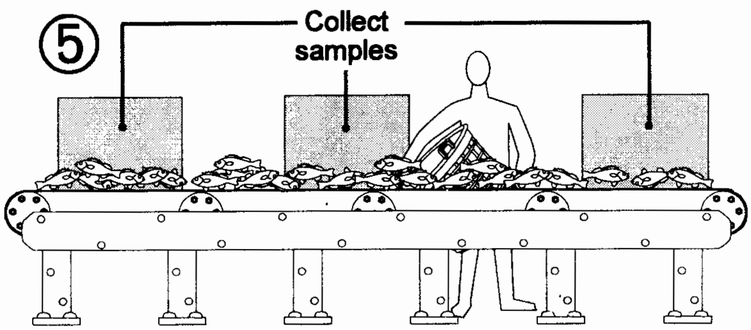
❸ **Varied times** - collect sample at various times throughout the catch handling period.

❹ **Basket collection** - collect several full baskets of fish as it exits the holding bunker.

❺ **Sections of conveyor** - remove all of the desired species from several sections of a conveyor belt.



***Note** - random sampling techniques can be used simultaneously (ie. Collecting fish from *sections of conveyor* at *varied times*).



- Trawling
- Seining
- Scallop dragging
- Clam dredging
- Stationary fish traps

Collection of a random sample from the catch may be accomplished by selecting:

- All fish from a predetermined section of a conveyor belt before sorting
- Fish from different layers in a fish holding bin
- Fish as it exits the holding bin

Intermittent Catch Retrieval

Intermittent catch retrieval occurs when catch is brought onboard over a period of time. Gear types to which this applies are:

- Longlines
- Gillnets
- Baited traps
- Scuba diving
- Harpoons

Samples from intermittent catch are collected over a period of time as the catch is brought onboard. To collect a random portion, the times of collection are varied throughout the retrieval process. To accommodate for visual bias, Observers must have a pre-determined plan of collection. Examples of these are to select:

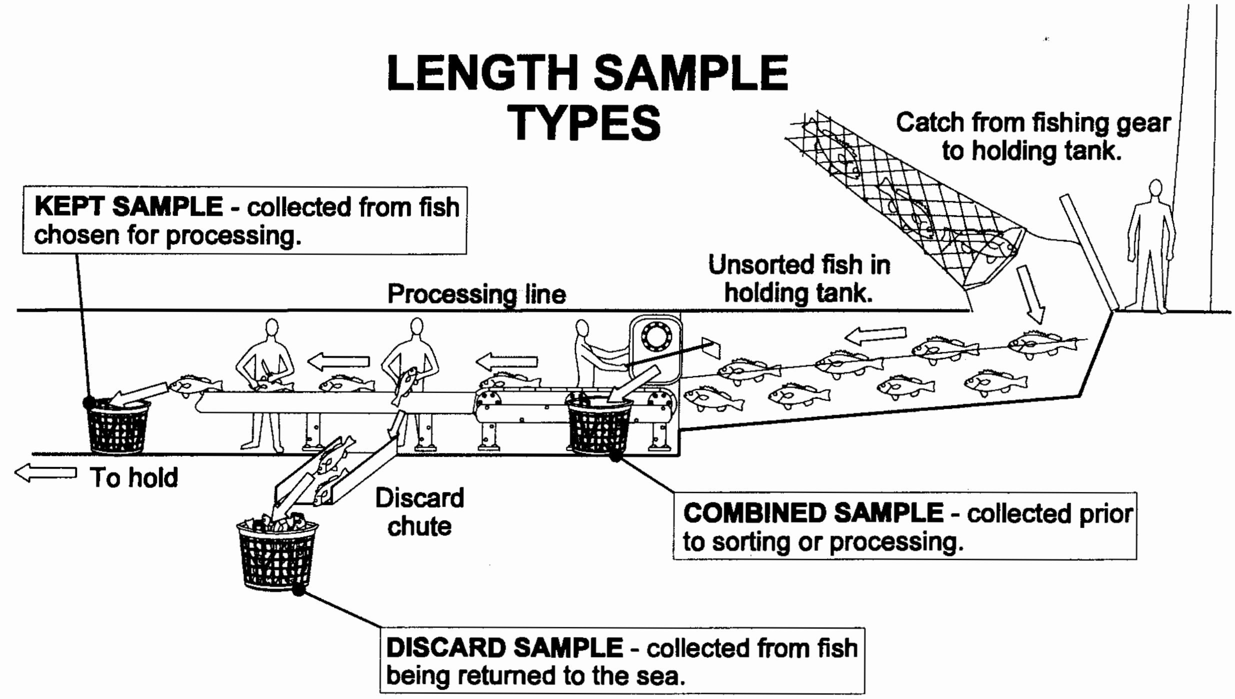
- Every third fish as it comes on board
- Collect all individuals from a specified section of gear

Types Of Samples

There are three types of samples that an Observer may be required to measure:

- Catch (kept + discards)
- Discards
- Landings (kept)

Catch equals the entire contents of the net (or other fishing



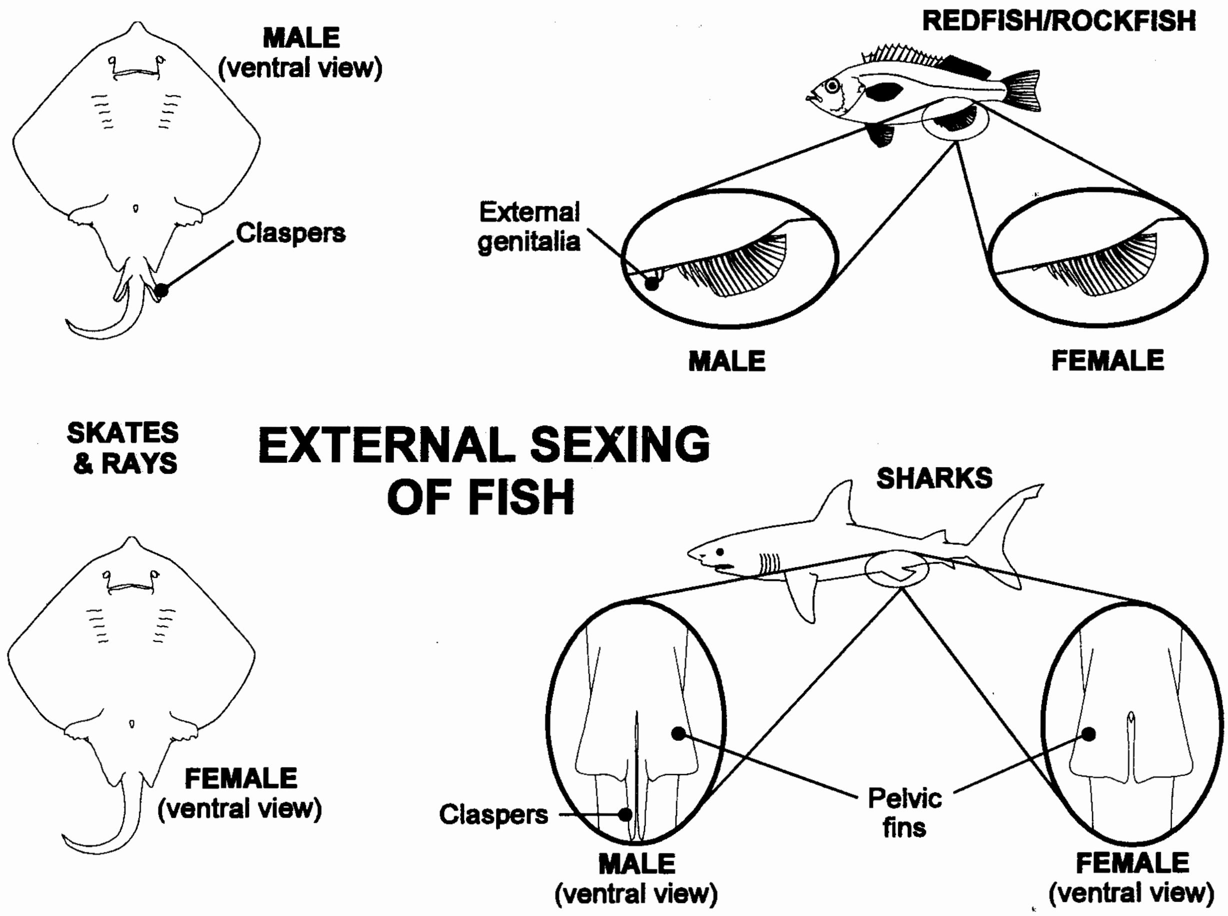
gear) for the sampled species before being sorted in any way. Scientists are interested in these samples because they represent what is being removed from the population by the specific fishery.

Discards are whole fish that are sorted from the catch by the crew for discarding overboard. Discards represent the marketable and regulated (prohibited) portion of the catch. When whole fish are processed as meal, they are not referred to as discards but rather as part of the landings.

Landings are fish that remain after discarding, and are processed and stored in the hold of the ship. They represent the kept portion of the catch, except in the following situation: when no discarding occurs in a set, all fish are regarded as catch and not as landings.

Sexing Fish

Observers may be required to measure separately male and female fish in a sample. For some species, there are differences between the growth rates of males and females. This information is utilized by scientists studying population



dynamics of a species to predict:

- Growth rates,
- Future stock size,
- Species abundance.

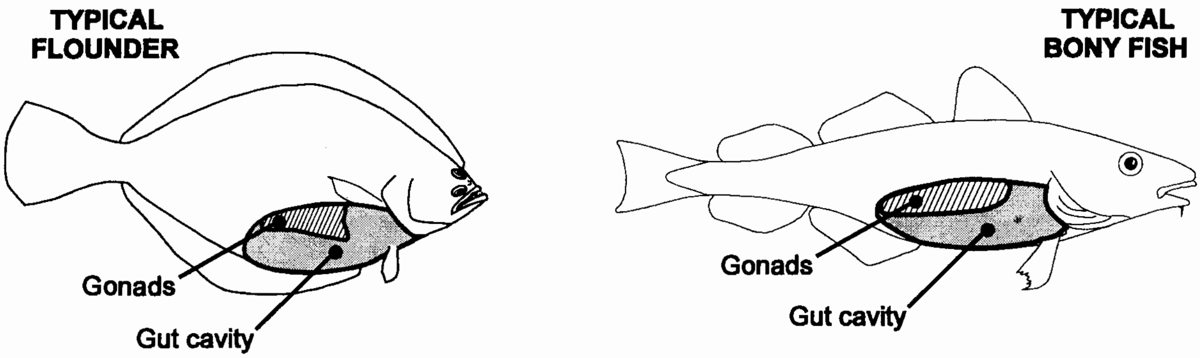
External Sex Characteristics

The gender of some fish can be determined by external anatomy; such as the presence of claspers in sharks, dogfishes and skates. Some arthropods can be sexed using external features; such as ventral symmetry or asymmetry in crabs and shape of the first pleopods or presence of head roe in shrimp.

Internal Sex Characteristics

The sex of some fish must be determined by examination of internal anatomy. This can be done by cutting open the fish, locating and distinguishing between male and female gonads.

LOCATION OF GONADS IN BONY FISH



Gonads are typically located in the posterior-dorsal portion of the gut cavity.

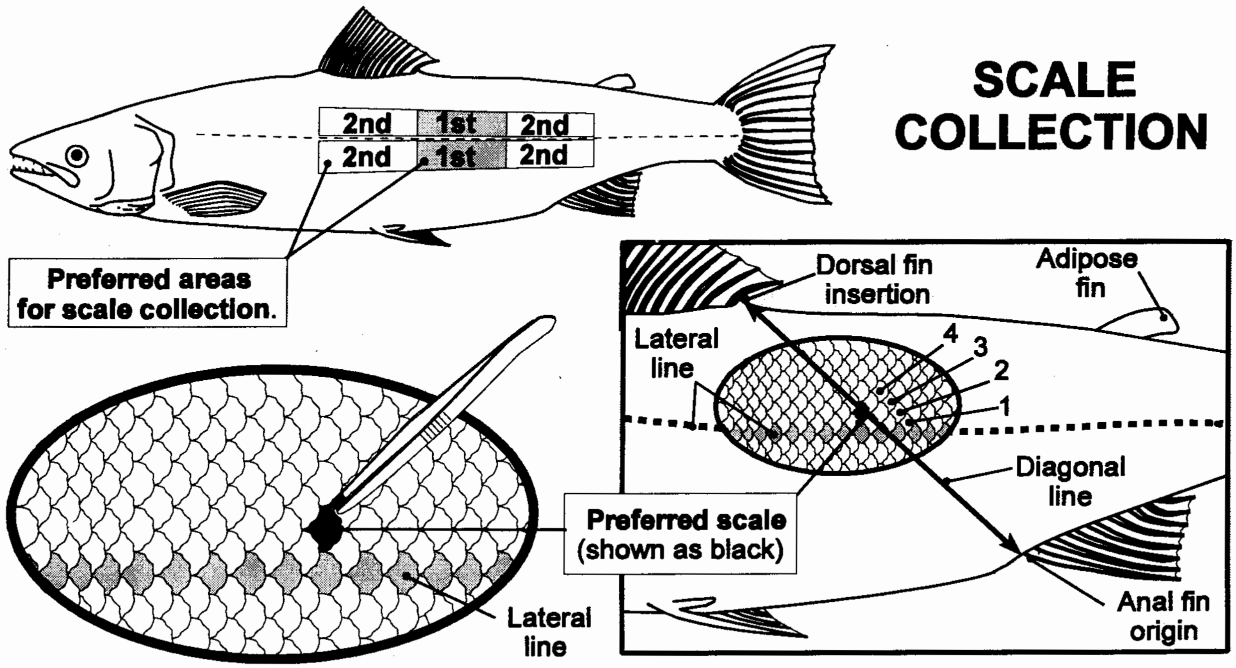
Gonads are reproductive organs and in most bony fish are located in the dorsal portion of the gut cavity near the backbone. Male and female gonads have distinguishing characteristics that identify them. Sex determination may be difficult depending on:

- Age/maturity of the fish,
- Gonad maturity in terms of the reproductive cycle,
- Species of fish.

Male gonads are usually white or grey in color, while female gonads are orange or pink. Flatfish and roundfish have different identifying characteristics in their gonads. Male gonads in flatfish are triangular in shape and have a sharp front edge, while in roundfish the male gonad is elongated, stringy and irregular. Female gonads in flatfish are elongated and triangular with a rounded front edge, while in roundfish the female gonad is fat and cigar-shaped.

Aging Structures

Aging structures are extracted from fish to determine age. This information is used to study a fish population by

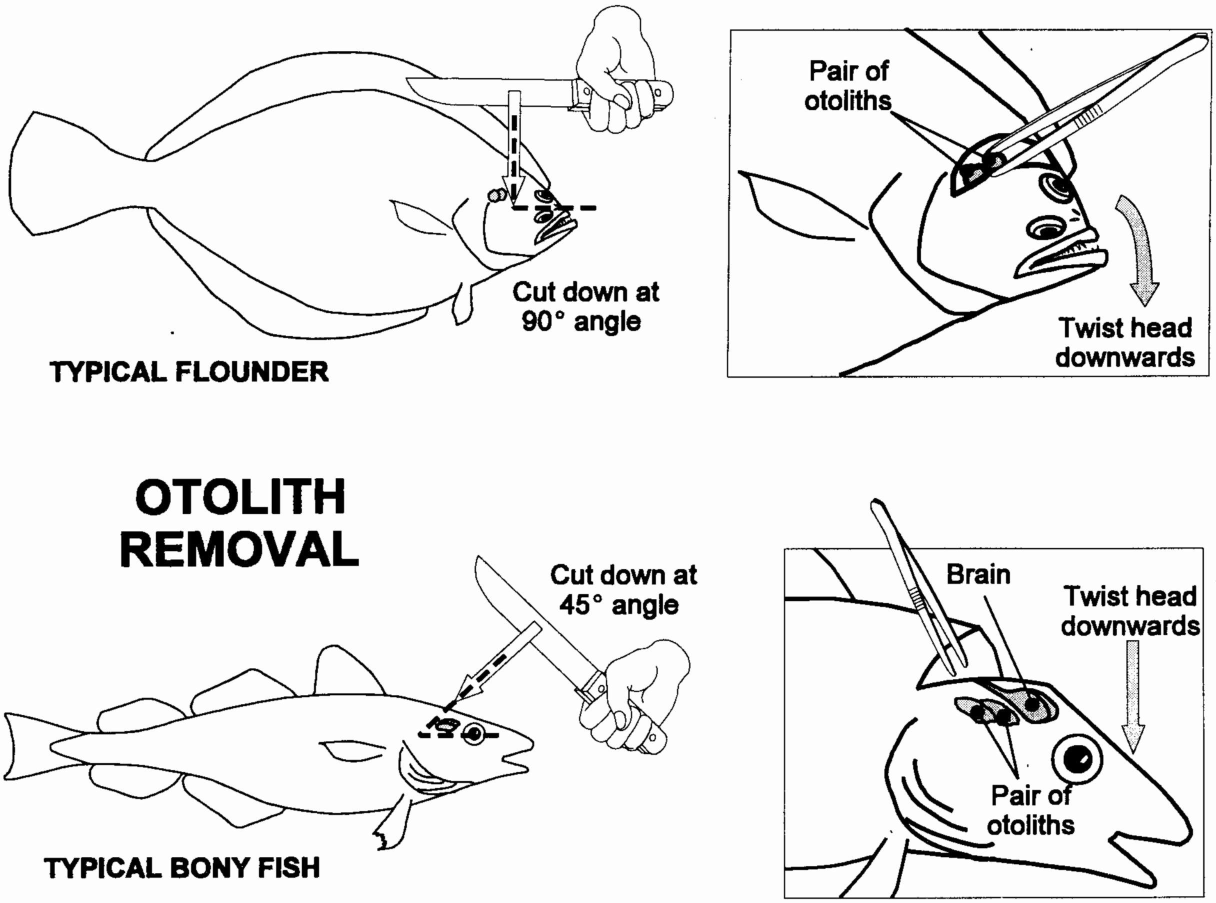


estimating the age composition of a given stock and looking at the age-length relationship. There are three aging structures that Observers collect:

- Otoliths,
- Scales,
- Fin rays.

Otoliths

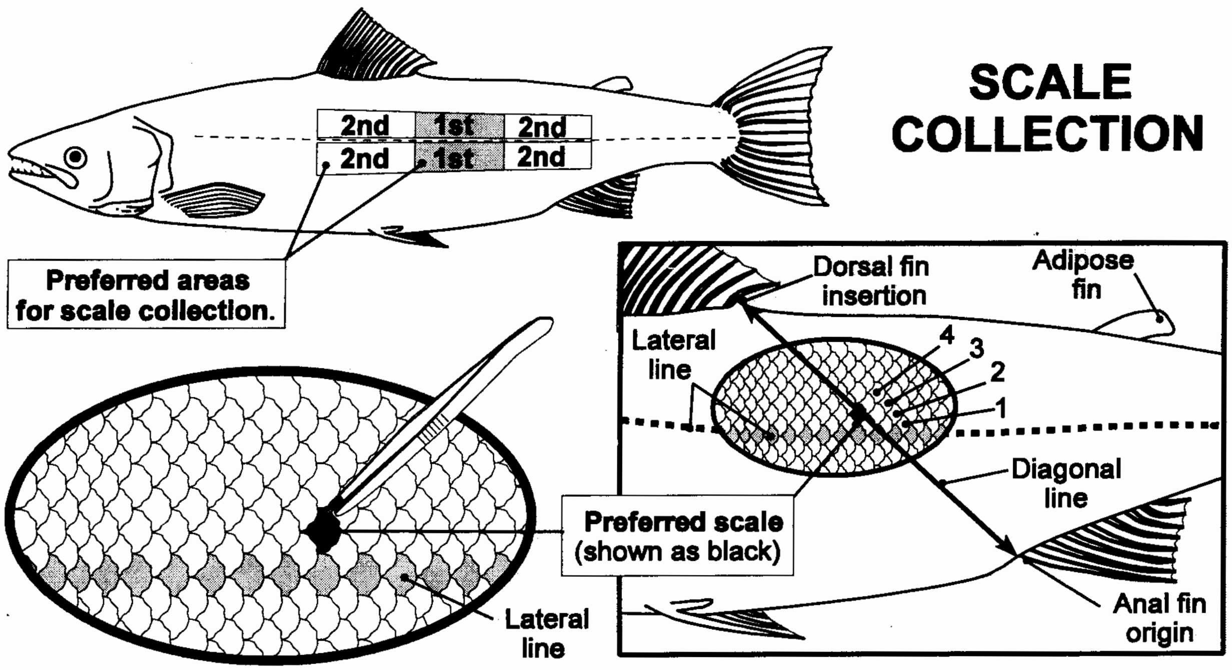
Otoliths are small, hard, white structures made of calcium carbonate and have a unique size and shape for most species. They are located in the otic cavity of the inner ear of bony fishes and aid in positioning the fish relative to gravity. In flatfish, because the head is twisted during early development, the otoliths are positioned one on top of the other directly behind the brain. In round fish, they are positioned side-by-side. Otoliths are extracted by cutting into the skull and otic cavity of the fish. The angle of cut varies among species. After cutting into the otic cavity, carefully remove the exposed otolith with tweezers. Clean the otolith by rubbing it gently between thumb and forefinger. Place each pair of otoliths in an envelope and label it with the following information:



- Trip number
- Set number
- Species
- Sex
- Length
- Weight
- Date of capture
- Position of capture (latitude and longitude)

Otoliths are brittle and require care to preserve and keep them intact. As otoliths are collected they should be stored in a protective location to prevent unnecessary damage.

An alternative to storing otoliths in envelopes is to use vials containing a glycerine solution. Glycerine clears the otoliths, a process which highlights the annual rings, allowing age to be



determined. The process of clearing takes approximately 3 months for otoliths that are immediately placed in the solution. For otoliths that have been stored in envelopes and dried, the required soak time is increased up to 6 months.

Scales

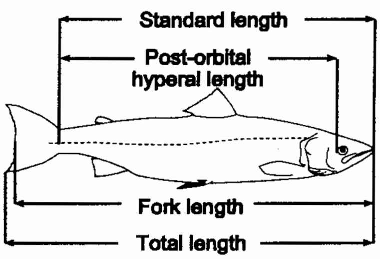
Scales are small thin bony structures or horny overlapping plates protecting the skin of fish. Scales have growth rings that can be examined to determine the age of fish. Collecting scale samples rec uires several steps. First wipe the central flank of fish clean of slime and water. Choose scales from immediately above or below the lateral line, avoiding scales directly on the lateral line. Grasp the lower edge of the scale with tweezers and extract. Place collected specimens in a scale envelope for storage and label with the same information as for otoliths.

Finrays

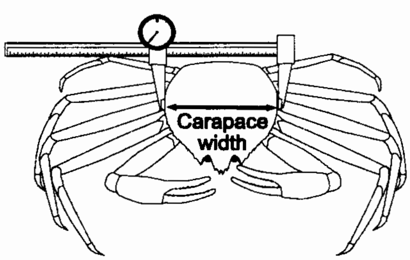
Fins are flattened appendages used for propelling, steering and balance. They are composed of membrane and rays, which are segmented rods used for support. The rays have growth rings that can be examined to determine the age of the fish. Collecting finray samples involves cutting the fins away from the body without damaging any part of them. Finrays are stored in small envelopes and label with the same information as for otoliths.

Types of Length Measurements

LENGTH MEASUREMENTS



SHELLFISH MEASUREMENTS



Depending on the species sampled, measurements have to be taken and recorded in different length groupings. A length group is a range of measurement intended to be representative of growth rate patterns and is used to study the relationship between length and age.

The length group that a particular species is in depends on its size at maturity. Large fish such as turbot and cod are measured to the nearest centimeter in 1-centimeter groups, whereas shrimp and crabs are measured in 1-millimeter groups. Length data is recorded on a data sheet that organizes the information into groups or strata. Each fish that is measured has its individual length recorded as a tally in the appropriate stratum. The result is information organized based on the frequency occurrence in the population that the sample was taken from. This is known as a length frequency distribution. All length frequency distributions for a given time period from a specific population can be combined to show a very accurate picture of that population.

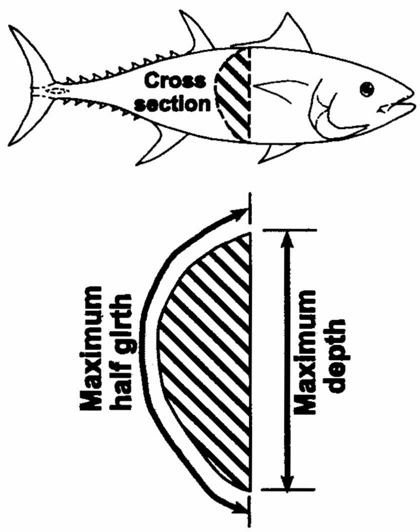
The types of length measurements taken are requested by DFO scientists, and include:

- Fork length
- Total length
- Standard length
- Anal fin length
- Carapace length and width (crabs, shrimp)
- Shell height and width (clams, scallops)

Fork length measurements are taken on species with concave tails such as redfish (rockfish) and halibut. Fork lengths are usually measured in centimeters.

Total length measurements are taken on species with convex tails such as flounders. Total lengths are usually measured in centimeters.

An *anal fin length* is the distance from the tip of the snout to the first ray of the anal fin. Anal fin length measurements are taken when an accurate total or fork length is not available: e.g., when measuring a fish with its tail removed, or when the tails are fragile and commonly broken off. An *anal length* is the distance from the first ray of the anal fin to the shortest ray of the tail. It is used to determine the overall lengths *after* processing: e.g., measure Anal length on halibut that have been gutted with their heads removed. This method allows checking for compliance with minimum size limits. Both types of lengths are usually measured in centimeters.



Carapace length measurements are taken on shrimp and lobster. Carapace length is the shortest distance from the inside edge of the eye socket to the posterior dorsal edge of the carapace. Carapace width refers to the longest distance across the widest portion of the carapace. This type of measurement is taken on crab. Carapace measurements are usually measured in millimeters.

Shell height refers to the maximum distance from the hinge to the outer limit of the shell surface. Shell width refers to the distance across the widest part of a shell measured perpendicular to the shell height axis. Both these types of measurements are taken on bivalves such as scallop and clams and are measured in millimeters.

Specialized Measurements

Observers are occasionally required to collect special measurements in addition to regular length frequency measurements. These include:

- Claw thickness
- ½ maximum girth
- Maximum depth
- Flank length
- Dressed length

Claw thickness refers to the maximum vertical thickness of a pincer claw measured from the dorsal to ventral portion. This type of measurement is taken on snow crab and measured in millimeters.

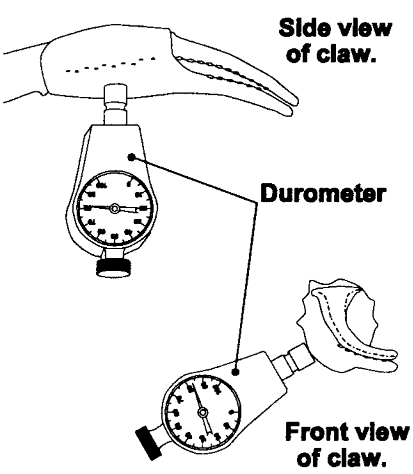
Flank length, dressed length, maximum depth and ½ maximum girth are measurements taken on large pelagic fish.

Sampling tools

Observers require specialized tools to carry out their sampling. Depending on the type of deployment, these include:

- Weighing scales
- Measuring board (off-set & non off-set)
- Baskets
- Calipers
- Measuring tapes
- Tweezers
- Knife
- Clipboard
- Durometer

SHELL HARDNESS

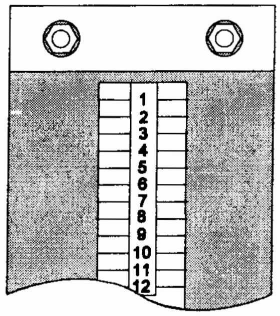


Weighing scales are spring type and should be properly maintained and regularly calibrated with a known weight to ensure their accuracy. Scales should be stored in a dry area to avoid corrosion.

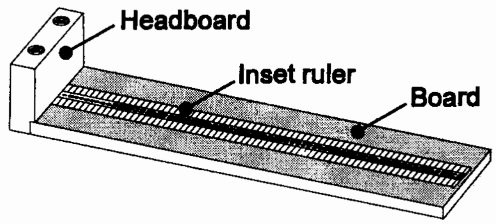
The type of measuring device used depends on length groupings required for the species being measured. For species with a length grouping of 1-centimeter, observers will need a measuring board. A measuring board consists of a ruler embedded in a board and a headpiece. The snout of a fish is placed up against the headpiece and the length is read from the ruler. There are two types of measuring boards; off-set and non off-set.

Off-set measuring boards have a ½ centimeter added to the ruler portion of the board. This means that a fish measured as 50 cm is actually somewhere between 49.5 and 50 centimeters. Lengths are rounded to the nearest centimeter. An off-set board allows for rapid length collection by allowing quick rounding of measurements. Basically the measurement visible beyond the tail is recorded. Non-offset boards are more time consuming to use, requiring a mental rounding of measurements taken.

Inset ruler set ½ cm away from the headboard.

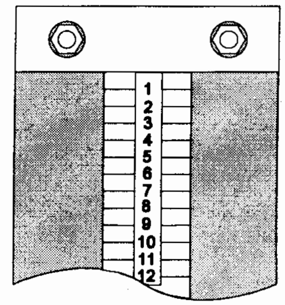


OFFSET MEASURING BOARD



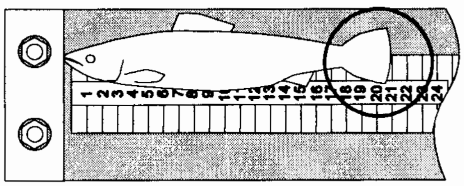
MEASURING BOARDS

Inset ruler aligned with headboard.

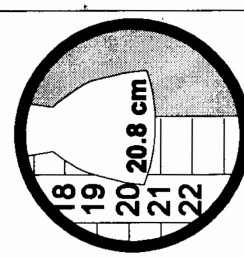


NON-OFFSET MEASURING BOARD

OFFSET

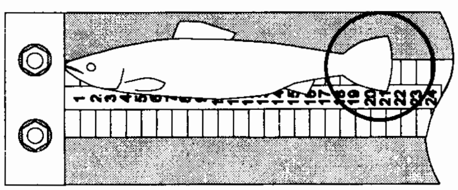


Measurement is rounded to the nearest centimeter by reading the first uncovered centimeter.

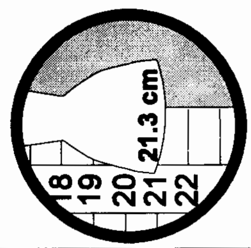


21.3 cm fish → Rounded to 21 cm

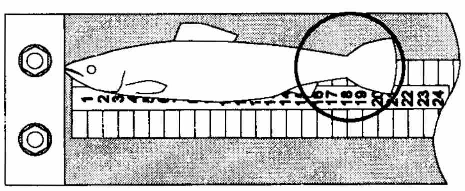
NON-OFFSET



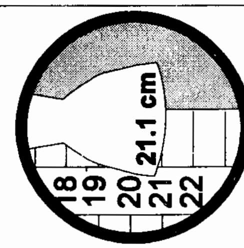
Measurement is rounded to the nearest centimeter by reading the centimeter closest to the tail edge.



OFFSET

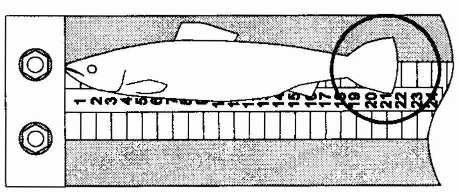


Measurement is rounded to the nearest centimeter by reading the first uncovered centimeter.

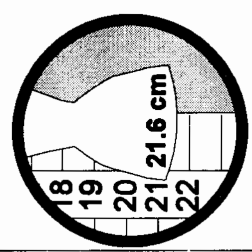


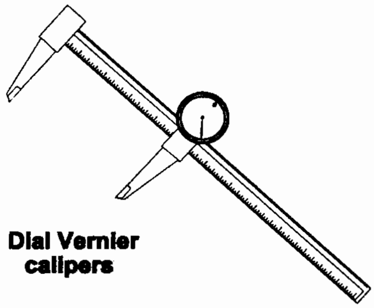
21.6 cm fish → Rounded to 22 cm

NON-OFFSET



Measurement is rounded to the nearest centimeter by reading the centimeter closest tc the tail edge.





Calipers are required for length groupings measured in millimeters or ½ millimeters (shrimp, crab, clam or scallop). Calipers allow for very exact measurements. Three types of calipers used by Observers are:

- Regular Vernier
- Dial Vernier
- Electronic

When measuring large pelagics (tuna, shark, or swordfish) that cannot be laid on a board, a measuring tape or stick must be used. Measurements for large pelagics are taken to the nearest centimeter. This may be expressed in either centimeters or as .00 of a meter i.e 1.36 meters.

Durometers are used to assess the shell condition of crab. Shell condition can determine whether or not crab fisheries are opened or closed. Soft shells occur when crab are preparing for molting and this condition can have a direct impact on its market value.

Observers may also require accessory tools to carry out their sampling requirements, such as tweezers, knife and sharpening stone.

5.5 Special Requirements

Occasionally, the Science branch of DFO may request Observers to collect data that is not a part of normal sampling duties. When this situation arises briefing instructions will include a detailed explanation of the requirements.

Collecting Fish Specimens

Three situations requiring the collection of whole fish specimens are:

- Specific requests by DFO,
- Unidentifiable species,
- Rare species.

During the course of a deployment Observers are unable to perform all of the necessary analysis required of catches. Collection of specimens by Observers at sea allows for further analysis to be performed by shore based DFO personnel.

Rare specimens and unidentifiable species may be encountered during a deployment. These should be brought ashore where possible to add to the DFO specimen base and to ensure accurate identification. When it is not feasible to return these specimens to shore, photographs should be taken if possible and document distinguishing features.

Preserving Fish Specimens

Fish specimens collected at sea require some form of preservation to allow transportation to shore for further analysis. Preserving agents and methods include:

- Salt
- Ice
- Freezing
- Chemical

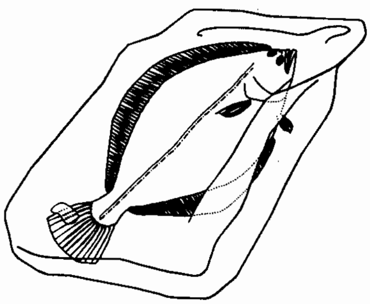
Salting

Fish can be preserved by salting. Salt should be inserted into the gill chamber and the body cavity. The whole body can then be rolled in salt and placed in a waterproof plastic bag or container. This method will preserve a specimen for a short term, until more permanent arrangements can be made. Transportation from a vessel to shore will require a sealed waterproof container.

Icing

A second short term method of fish preservation is to preserve a specimen on ice. Fish on ice will remain at or near 0°C. Fish may be preserved using this method for as long as there is a ready supply of ice (2-3 weeks). Transportation from a vessel to shore will require a sealed waterproof container. Properly iced in a cooler, a specimen will last up to 48 hours.

Freezing



Freezing is the most useful preservation method when facilities are available. Larger specimens may have to be placed in a vessel hold, but a galley freezer can be considered for smaller specimens. Fins and thinner portions of a fish become brittle as they freeze, so care must be taken during handling. Samples stored in the freezer hold of a vessel should be placed in a location that is readily accessible upon trip completion. Preserved by this method, a specimen may last indefinitely as long as its temperature is kept below the freezing point. Transportation to a shore based facility should be done as quickly as possible before complete thawing occurs.

Chemical

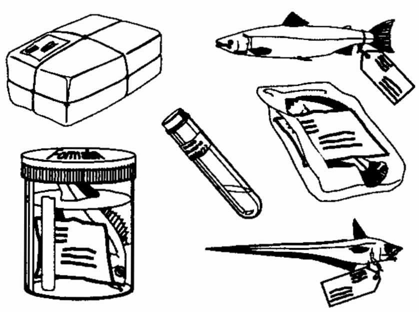
Chemical preservatives offer an alternative to long term fish preservation when freezing is not available. A 10% formalin solution can be used to preserve fish specimens for an indefinite period of time. Full strength commercial formalin requires dilution. The desired strength of the chemical preservative can be obtained by adding one part commercial formalin with 9 parts water.

Small fish (less than 20 centimeters) are preserved by immersion in the prepared solution. Larger fish require a slit made into the abdomen to allow the preservative to uniformly saturate body tissues. Ethyl alcohol may be used instead of formalin, but is less effective. Storage and transportation of specimens preserved in chemical solutions require an airtight and waterproof container.

Chemical preservatives present certain hazards that must be taken into consideration. Handling preservatives away from the processing areas of a vessel prevents contamination of fish destined for human consumption. Ensuring that storage containers do not leak prevents contamination of surrounding areas. Fishing vessels present an additional hazard as an unstable workplace, especially in foul weather. Secure storage of containers holding toxic preservatives and chemically preserved specimens prevents breakage and contamination. Use of plastic containers is preferable to glass because they are shatter resistant. A broken glass container releases not only the chemicals it contains as a contaminant, but sharp pieces as well.

Labelling Specimens

Proper labeling of collected specimens is required to ensure that the information derived from onshore analysis can be correlated to data collected at sea. Information collected at sea should include;



- Trip number
- Set Number
- Time and date of capture
- Location of capture (latitude and longitude)
- Depth of capture
- Name of collector
- Name of vessel
- Method of capture
- Species

Labels must be affixed to a specimen or attached in such a manner that it is readily apparent to which sample the recorded information belongs. The label itself must be able to withstand moisture into which it is placed. Pencil or permanent markers will not run or fade as will ink pens.

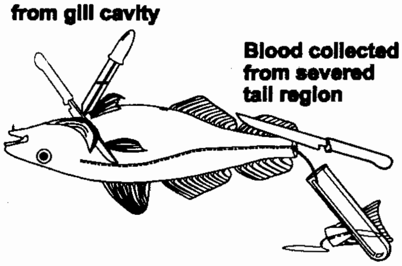
Organ And Tissue Samples

Observers may be asked to collect various organ and tissue samples for DFO research. These types of samples include:

- Blood,
- Stomach,
- Tissue.

Blood Samples

Blood samples are more easily collected from fish that are still alive. Two locations suitable for blood collection are the gill cavity and the caudal region of a fish. Blood pools in the gill cavity after the throat of a fish is slit. Blood may be drawn out with a syringe or eyedropper. A severed caudal region of a



fish supplies a flow of blood. Blood can then be collected into a test tube.

Blood collected from fish is suitable for various types of analysis, including DNA testing. A blood sample collected from one fish may be contaminated by blood from another fish. Cross contamination of blood samples is prevented by use of sterilized or disposable collection equipment.

Stomach

Fish stomach contents provide information on feeding habits. To collect a stomach, first squeeze the contents of the esophagus down into the stomach. A cinch tag placed around the esophagus prevents food from exiting the upper portion of the stomach. The lower portion of the stomach has a natural valve that seals in food from the opposite end. Snip the esophagus in front of the tag and snip the pyloric caeca (located at the posterior region of the stomach). Remove the stomach sample and preserve. Use of chemical preservatives can be enhanced by injecting the chemical directly into the stomach with a syringe. This allows the preservative to act from the exterior and the interior of the stomach.

Tissue Samples

Tissue samples require minimal space and still provide ample material for study by DFO scientists. The use of disposable sterile scalpels prevents cross contamination of tissues. Frozen preservation of the samples is preferable in order not to contaminate the sample with chemicals.

Marine Mammals

Commercial fishing vessels provide an opportunity for observing marine mammal activity. Marine mammal observations include sightings when the animals are in their natural habitat as well as when they are incidentally caught in fishing gear and brought on board. Observations recorded by Observers are valuable to marine mammal research.

Marine mammal data requested by DFO may include all sightings of seals, dolphins, whales and other marine mammals. Specific information recorded includes:

- Species,
- Number of animals observed,
- Activities of animals observed,

- Position and time of sighting,
- Weather and sea state conditions,
- Remarks - animal dead, animal caught in fishing gear, etc.

When a dead mammal is brought on board a vessel, DFO may request that it be brought ashore for research purposes. If an Observer is unable to collect the whole animal, an attempt should be made to obtain as much information as possible.

Unit 6 : Catch and Effort

Perspective

Observer estimates provide a record for weights of fish captured. These figures are viewed as independent of amounts recorded by vessel masters in logbooks and hails which may contain bias due to economic reasons. Where a fishery is controlled by quota or bycatch limits, it can be opened and closed based on Observer reported catch and effort data. Estimates are used by DFO scientists to ascertain catch rates and contribute information for stock assessments. This unit identifies methods used to estimate total catch, species composition, discards and production. Regulations pertaining to catches are also accented.

6.1 Catch and Effort	This section introduces preliminary catch and effort terminology.
6.2 Catch Estimation	Methods used to determine the combined weight of the entire catch of a set.
6.3 Determining Catch Composition by weight	Manner in which the weight of the total catch is apportioned to the various species of a set.
6.4 Discard Estimation	Methods used to estimate the amounts of catch returned to the sea.
6.5 Estimates from Monitoring Production	Techniques of monitoring production to estimates various aspects of catch.
6.6 Bycatch Restrictions	Bycatch restrictions and calculations of bycatch percentage.
6.7 Small Fish Protocol	Calculating percentage of small fish set-by-set and on a daily basis
6.8 Enforcement and Management Issues Respecting Catch	Regulatory requirements concerning limits on the type and amount of catches of fish.

6.1 Catch and Effort

The mandate of an Observer is to gather information pertaining to the fishing operation at sea. The most important aspect from a stock assessment perspective is determining fishing mortality or how much the population is reduced by commercial activity. Quantifying fishing mortality for a particular operation entails estimating catch and recording the effort expended to catch the fish. Effort consist of such things as the type of gear being used, the amount or size of gear and how long the gear was fishing. For bottom trawls, a net is effectively fishing when the winches have stopped paying out the warp (i.e. start time). End time is signalled when the winches start to take back (haul) the net.

> ***Catch and Effort:*** *the amount and type of fish and invertebrates caught in each set, and the effort that went into capturing the fish.*

Observers collect catch and effort information on a set-by-set basis. Usually this information is based on direct observations while sometimes Observers have to rely on logbook entries to collect catch and effort data.

> ***Set:*** *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. It is prudent to maximize the number of observed sets, because catch data from fishing log records may be unreliable and is often not as detailed as Observer collected data. When Observers record set information based on logbook figures it is referred to as a *logged set*. 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:*** *all species caught, excluding the directed species.*

The most critical concern of Observer data is that it meet the scientific and surveillance needs.

The following text describe methods of estimating aspects of catch. For simplicity these methods will be discussed individually however in practice they cannot be separated. Catch is estimated through a process that draws on the various methods.

6.2 Catch Estimation

The methods of estimation used in a particular situation will depend on the type of gear used, the vessel layout, processing procedures and catch size. An entire set hauled back at one time (i.e. otter trawl retrieval) allows an initial bag estimate to be obtained. Intermittent catch retrieval (i.e. longlining) requires monitoring over a period of time to arrive at an estimate. Vessel layout also affects where the catch can be viewed as it is being handled by the crew. An open deck bin allows direct viewing of the catch, while an enclosed bunker forces the Observer to monitor catch as it enters or exits the bunker. Catch size will also determine the estimating method required. A catch of 100 kilograms can be weighed, while a larger catch may require one or several methods to obtain a reasonable estimate.

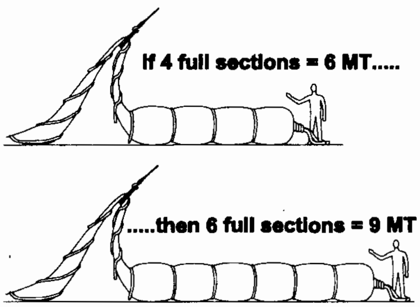
> ***Total catch:*** *is everything that is caught in a set.*

Estimating total catch may require several of the following methods:

- Initial/visual estimate
- Volumetric estimate
- Weighing
- Counting

Initial/visual Estimates of Total Catch

Initial/visual estimates are primarily used in fisheries employing trawl nets, but can also be used in situations where total catch is retrieved in a short time period (e.g. purse seining, fish traps).



> ***Initial catch estimate:*** *An estimate made when the catch is first hauled on board.*

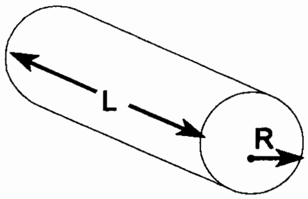
Initial estimates are obtained using reference points only after Observers have experience doing codend or gear volumetrics and fish densities. With experience, reference points may be used to roughly calculate volume of filled codends, seines or traps and apply a density factor to estimate total catch weight.

This method is the least accurate, and should only be used to provide a preliminary rough estimate of catch.

Volumetric calculation of a codend

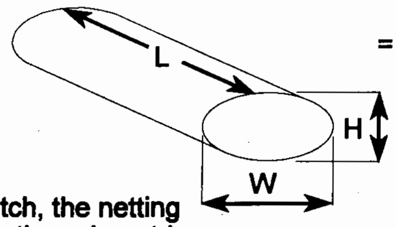
Methods used to determine catch weight in the occupied portion of a codend are the same as for volumetric estimates described in the following section *(Volumetric Estimates of Total Catch)*. However, due to unique and sometimes irregular shapes of codends, several volumetric calculations may be required. Codend shapes are determined by size of the catch. A small catch loosely fills the codend whereas a large catch tightly packs the codend, forming a cylinder. Extremely large catches may create bulges in this cylindrical form. The diagram on the following page depicts a variety of shapes of filled codends.

Cylinder Volume $= \pi R^2 \times L$



Ellipsoidal Volume $= \frac{W}{2} \times \frac{H}{2} \times L \times \pi$

$= (0.78545)\ W \times H \times L$

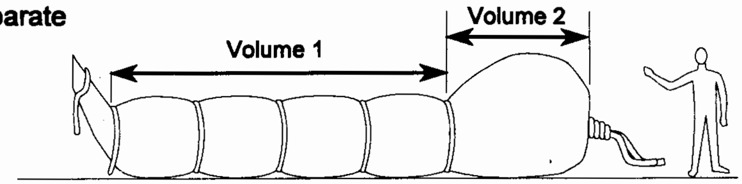


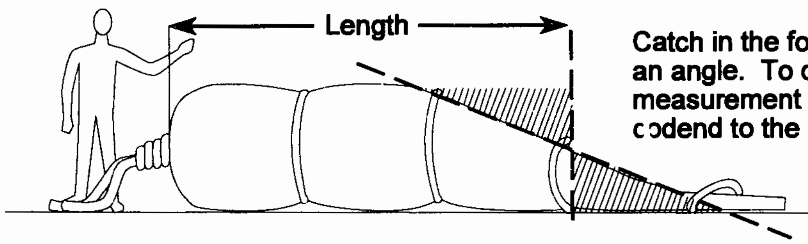
Codend shapes vary with amount of catch, the netting materials used and size of the net. Use the volumetric shape that most closely resembles the filled portion of the codend.

CODEND ESTIMATIONS

Total volume = Volume 1 + Volume 2

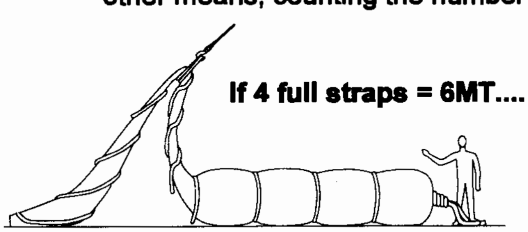
Non-uniform codends - calculate separate volumes if codend shape is irregular.

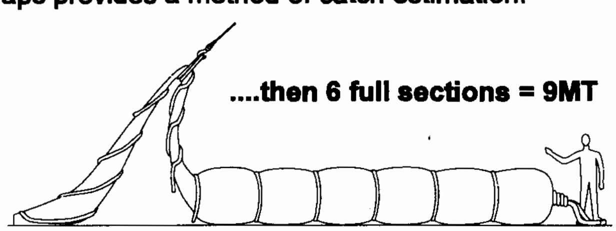




Catch in the forward part of codend settles on an angle. To compensate for this the length measurement is taken from the end of the codend to the mid point of the forward angle.

Visual estimation - if codend sections are uniform and catch can be verified by other means, counting the number of straps provides a method of catch estimation.



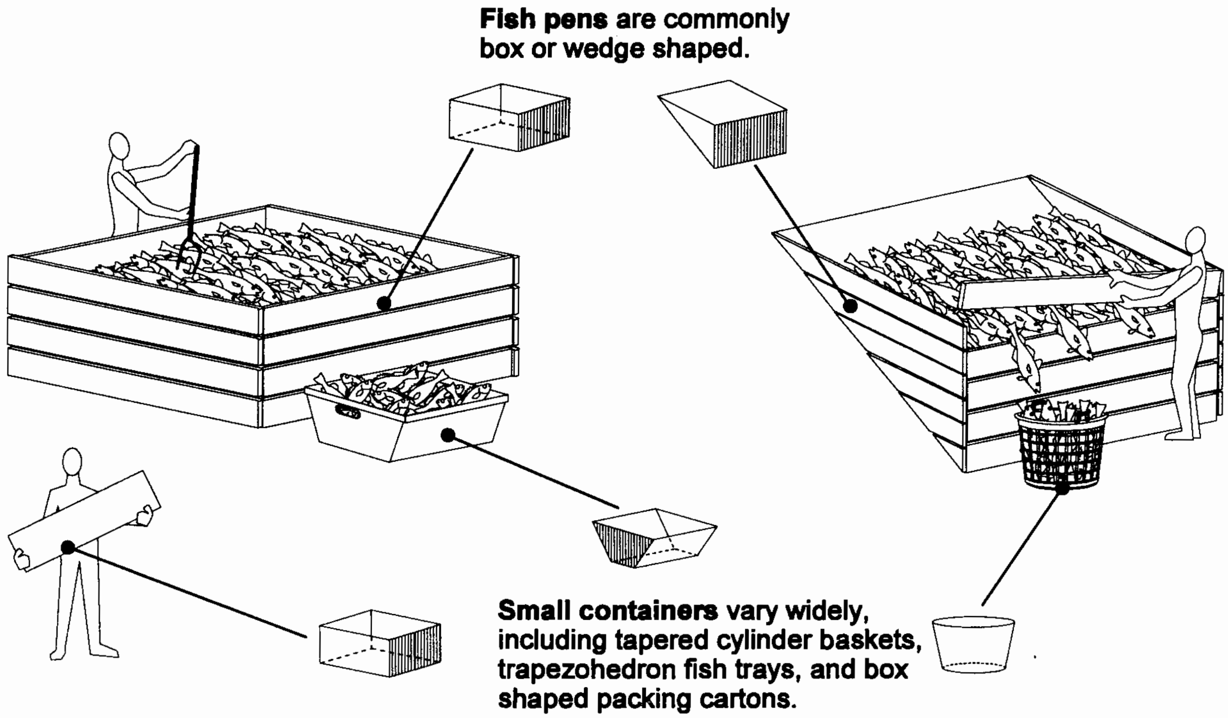


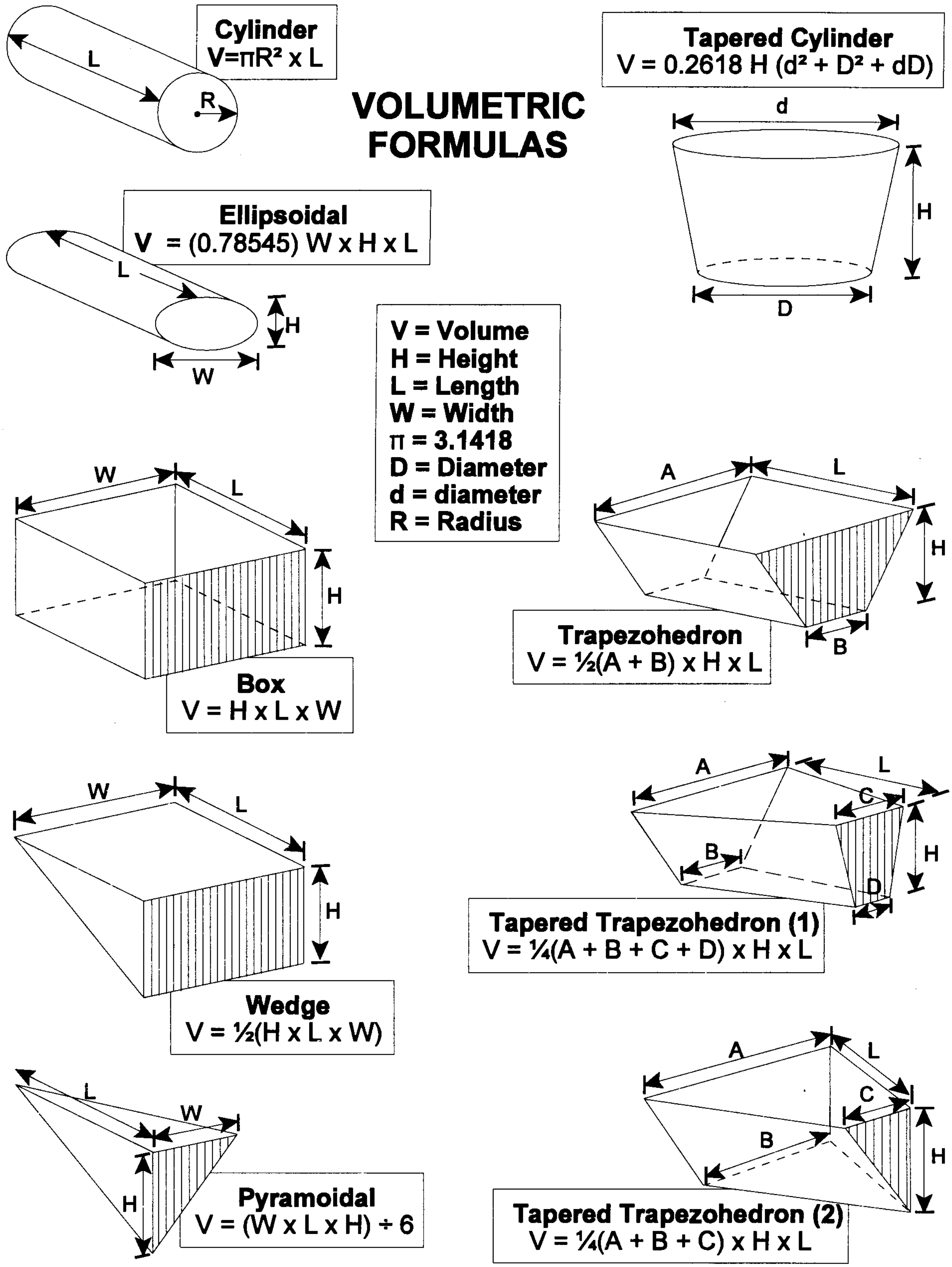
Volumetric Estimates of Total Catch

> ***Volumetric estimates:*** *The use of volume and density factors to calculate the weight of fish in a given space.*

Volumetric estimation can provide an accurate estimate of total catch. The degree to which this method can be used depends on vessel layout. Some vessels have an open deck bin where the catch is kept prior to processing. These bins are normally rectangular and their volumes can be easily determined. The catch may be dumped into a bunker located below deck. These bins are usually irregular in shape, which necessitates a more complex calculation but volume can still be readily obtained. There are occasions when the bunker is enclosed except for small openings for fish to exit onto conveyor belts. In this situation, it will not be possible to calculate volume unless the master can provide blueprints indicating bunker measurements. To obtain an estimate using this method, an Observer must calculate volume of the bunker occupied by a catch and multiply it by a density factor. (*See Determining density*).

COMMON VOLUMETRIC SHAPES FOUND ON FISHING VESSELS





VOLUMETRIC FORMULAS
Cylinder
V=πR² x L
L
R
Tapered Cylinder
V = 0.2618 H (d² + D² + dD)
d
H
D
Ellipsoidal
V = (0.78545) W x H x L
L
H
W
V = Volume
H = Height
L = Length
W = Width
π = 3.1418
D = Diameter
d = diameter
R = Radius
W
L
H
Box
V = H x L x W
A
L
H
B
Trapezohedron
V = ½(A + B) x H x L
W
L
H
Wedge
V = ½(H x L x W)
A
L
C
B
H
D
Tapered Trapezohedron (1)
V = ¼(A + B + C + D) x H x L
L
W
H
Pyramoidal
V = (W x L x H) ÷ 6
A
L
C
B
H
Tapered Trapezohedron (2)
V = ¼(A + B + C) x H x L

Determine volume

Measure the bunker and calculate its volume using a volumetric equation appropriate for that shape. If the bunker has an irregular shape, it must be divided into portions. An Observer must calculate the volume for each portion and add these results together to obtain the bunker volume. If a bunker is rectangular, the equation is:

Length x Width x Height = Volume

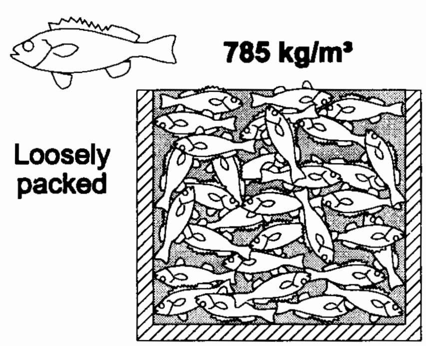
For example, if length is 8 meters, width is 5 meters, and height is 1 meter, bunker volume would be:

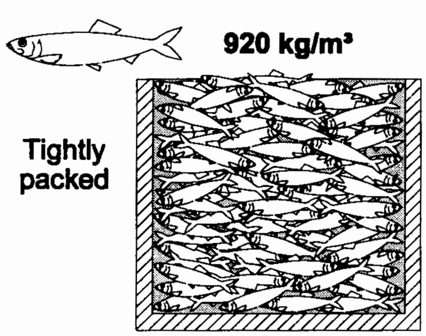
8m x 5m x 1m = 40 cubic meters

Refer to the page on *Volumetric Formulas* for other equations. When estimating catch, Observers must calculate volume of space occupied by the catch only.

Determining density

Density is mass per unit volume and is most often calculated in kilograms per cubic meter. Calculate density as follows:





- Weigh a minimum of 5 baskets of a representative mix of fish from the catch and calculate average weight of fish per basket. Observers must deduct basket weight in their calculations:

  34 + 36 + 39 + 32 + 34 = 175 kilograms

  175 kilograms ÷ 5 = 35 kg

  Therefore, average basket weight is 35 kilograms.

- Calculate volume of the basket (a tapered cylinder) using the following formula:

  Volume = 0.2618 x H ($d^2 + D^2 + Dd$)

  d = top diameter = 42 centimeters = 0.42m

  D = bottom diameter = 36 centimeters = 0.36m

  H = height = 40 centimeters = 0.40m

$Dd = D \times d = 1512$ centimeters = 0.1512m

Therefore, volume of the basket is $0.0478m^3$

Note: Centimeters have been converted to meters for calculations in *Step 1* in the figure *Volumetric Estimation.*

- Density is calculated as follows:

  Density = Average Basket Weight $\div$ Basket Volume

  = 35 kg $\div 0.0478m^3$

  = 732 kilograms per cubic meter

  Therefore, density is $732kg/m^3$

Density (expressed as *kilograms per cubic meter* or *kg/m^3*) varies with species or mix of species in a bunker. For example, flatfish are more tightly packed than cod and therefore have a higher density per volume of space. As a result, Observers should calculate density each time catch composition significantly changes.

Determining catch weight

Density of catch can be applied to a known volume to determine catch weight. Using the values calculated above, the catch weight (for a full bunker) would be:

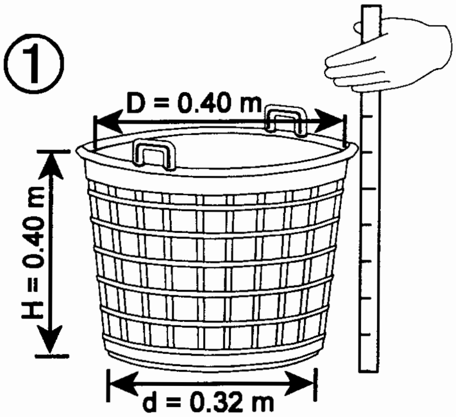
Catch weight = Bunker volume x Density

Catch weight = $40m^3 \times 732\ kg/m^3 = 29{,}280$ kg

Therefore, a bunker of $40m^3$ can hold 29,280 kg of fish whose density is 732 kg/m^3.

If a catch has not completely filled the bunker, an Observer must estimate percentage of the bunker that is occupied by the catch. This method of estimation can be applied to codends, deck bins, fish bins and fish holds.

①

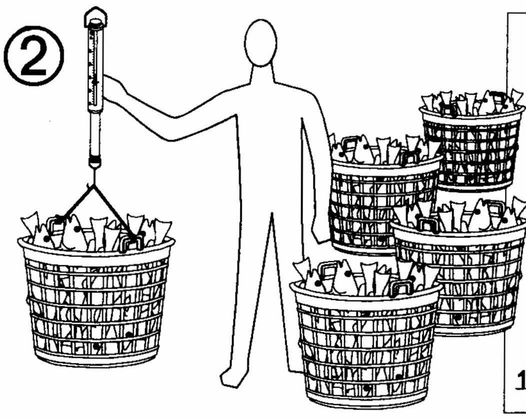


BASKET VOLUME = $0.2618\ H\ (d^2 + D^2 + dD)$

= $0.2618 \times 0.40m \times (0.40m^2 + 0.32m^2 + 0.40m \times 0.32m)$

= $\mathbf{0.0409\ m^3}$

②



BASKET WEIGHTS

36 kg
+38 kg
+37 kg
+35 kg
+39 kg
185 kg total

AVERAGE BASKET

$\frac{185\ kg}{5}$ = **37.0 kg**

VOLUMETRIC ESTIMATION

1. Calculate volume of basket (cubic meters).
2. Fill basket with fish and determine weight of fish (kilograms). Repeat 5 to 10 times and calculate the average weight per filled basket. Subtract weight of basket when doing calculations.
3. Calculate density of fish (kilograms per cubic meter).
4. Calculate volume of holding bin (cubic meters).
5. Use density and volume of holding bin to calculate bin capacity (kilograms).

③

Average basket = 37 kg

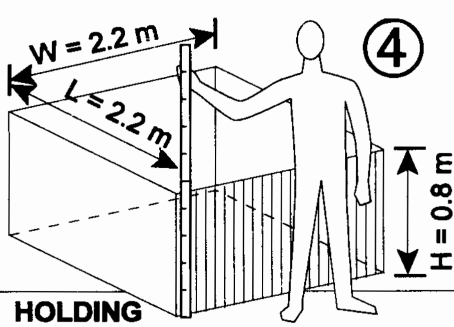
Basket Volume = $0.0409\ m^3$

DENSITY = $\frac{\text{kilograms}}{\text{meters}^3}$

= $\frac{37\ kg}{0.0409\ m^3}$

= $\mathbf{905\ kg/m^3}$

④



HOLDING BIN VOLUME = H x L x W

= 0.8m X 2.2m X 2.2m

= $\mathbf{3.872m^3}$

⑤

Density = $905\ kg/m^3$

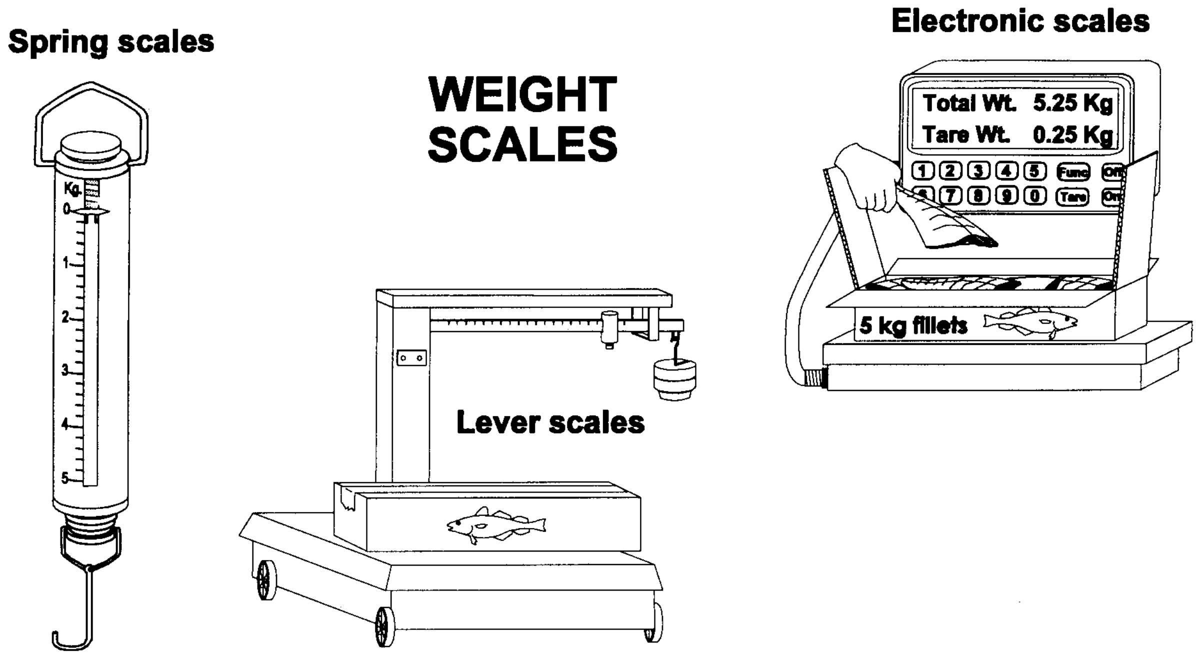
Bunker = $3.872\ m^3$

CAPACITY = Density X Volume

= $905\ kg/m^3 \times 3.872\ m^3$

= **3504 kg**

ESTIMATED HOLDING BIN CAPACITY IS 3504 KILOGRAMS.



Weighing Total Catch

Weighing the entire catch is only practical for small catches or when crew weigh all the catch. Weighing total catch is the most accurate and preferred method an Observer can use. Reliable catch information is greatly affected by accuracy of weight scales.

Scales

Scale accuracy can be determined with use of a known weight and adjustments must be made when necessary. Scales should be checked on a regular basis and calibrated if necessary. Observers should avoid using scales that cannot be checked. Scales commonly used by Observers are:

- Lever
- Electronic
- Spring

Lever Scale

A lever scale is a mechanical device that consists of a lever, pivot and fulcrum that measures weight using the principle of counterbalance. A measurement is fine tuned by moving a weight along a linear gauge. This scale is calibrated by placing a known weight on its platform and setting counterbalance weights to match the known weight.

Calibration screws are then adjusted until the linear gauge rests level.

Electronic Scale

This scale measures weight by a force acting on a load cell. A load cell is a device consisting of flexible metal strips and a strain gauge located beneath the weighing platform. Electronic scales used at sea also contain a reference cell that compensates for vessel movement. This scale provides a digital readout of weight. An electronic scale may be tared; a process by which the digital readout is adjusted to compensate for weight of a container on the platform. This device can be quite sensitive and requires frequent calibration.

Spring Scales

A spring scale is a mechanical device that measures weight by a force acting on the tension of a spring. Spring scales are usually issued to Observers because they are relatively inexpensive and portable. To adjust this scale, a set screw is turned until a known weight value is indicated on the gauge. These scales require frequent greasing to prevent corrosion by saltwater.

Counting Method

This method requires counting individual fish, obtaining an average weight per fish and multiplying the total number by average weight. To determine an average weight per fish, an Observer should weigh 5 baskets of fish (Be sure to subtract basket weight), count the number of fish in baskets and divide weight into the number of fish. For example:

5 baskets x 30 kg = 150 kg

150 kg ÷ 60 fish = 2.5 kg

Therefore, the average weight per fish is 2.5 kg

This method is best applied to fisheries in which the catch is intermittently retrieved. To ensure accuracy, Observers should monitor the entire haulback process. When 100% monitoring is not possible, estimates can be made by extrapolating data obtained from the observed period. For example: if an Observer estimates that there were 5200 kg of catch during 7 hours of monitoring haulback, and the total haulback period was 10 hours, then total catch can be extrapolated as follows:

Total catch = Catch per hour x total haulback period (catch per hour = Observer estimate ÷ number of hours monitored)

catch per hour is: 5200 ÷ 7 = 742.85 kg/hour

Total catch is 742.85 x 10 = 7428.5 kg

Counting can also be applied to containers such as full baskets, freezer trays, or dip nets with which an average weight can be calculated.

6.3 Determining Catch Composition By Weight

Historically, fishing logs have 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.

> ***Catch composition:*** *A list of all species in a catch and their respectives weights.*

The species in a set can be divided into two categories; a directed species and the bycatch species. The *directed species* is the targeted catch, and under normal fishing operations constitutes the majority of fish in a set. *Bycatch species*, also referred to as *incidental catch*, are all other species caught while fishing for a directed species.

> ***Directed species:*** *The main species targetted by fishing efforts of a vessel.*

Observer data on catch composition is used to monitor compliance with regulatory measures and provide important biological information. There are several methods used to determine species caught and estimate their respective weight.

- Weighing method
- Visual observation
- Subsampling
- Counting

Weighing Method for Catch Composition

Methods to determine catch composition vary depending on fishing gear used, directed species, vessel layout, etc. The most reliable method is to sort the entire catch by species and weigh each species. However, this method is not practical in most situations. If an opportunity arises (during handling or processing) in which one or more species are separated from the catch by crew and put aside or thrown into baskets, an Observer should weigh whatever species has been put aside. If a special surveillance situation arises (e.g., monitoring for an infraction of fishing regulations), the Observer may want to separate regulated species from the catch and weigh them directly.

> ***Bycatch:** all species caught in a set, excluding the directed species.*

Visual Observation of Catch Composition

Observation of a catch during gear retrieval and catch processing allows visual observations of all species present in the catch. These observations permit an Observer to make a rough estimate of percentage of each major bycatch species. Weight of each species can then be calculated by multiplying total catch weight by each percentage. An Observer must view the entire catch, in order to avoid under- or overestimating species weights and neglecting species present in small quantities. Depending on the mixture of species in a catch, different species in a bunker will layer (stratify) differently according to their size and shape. For example, in a trawl catch of a mix of redfish/rockfish and flatfish, viewing the codend would result in an overestimation of redfish. This is because redfish air bladders greatly expand as a catch is hauled to the water's surface, which causes individual redfish to rise to the top of a codend. Furthermore, the spiny fin rays of redfish become enmeshed in trawl netting, causing redfish to form the outermost layer in a codend and subsequently being last to be dumped out of the net. Consequently, once this catch is dumped into a bunker, flatfish would layer on the bottom of the bin with redfish piled on top. Therefore, all layers of a bunker must be examined very carefully. As a catch enters the processing area from a bunker, an Observer can expand the species list by readily viewing rarely occurring species, and estimate total weights of certain species present in small quantities (<1 - 20kg).

Subsampling for Catch Composition

> ***Subsampling:*** *Ramdomly collect a portion of individuals from a group (e.g., a catch; a population; a species) for measurement.*

When a catch is too large for weighing all individuals of each species, Observers should subsample the catch to determine species caught by weight. This method is more accurate when larger portions of a catch are subsampled. The subsampling method requires removal of 5-10 baskets of fish from a catch. This must be done randomly so that the mixture of species in the subsample mirrors the composition of the catch. Weigh the entire subsample, then sort it by species and weigh each species. Divide individual species weights by total subsample weight to obtain the percentage of each species in the subsample. Multiply each percentage by total catch weight (previously calculated) to obtain total weight of each species in the catch (for example, see the diagram *Catch Composition by Subsampling*). Note that rarely occurring species in a catch may not be present in the subsample, and consequently must be added to the species list and their weights estimated (e.g., using visual observation of catch composition).

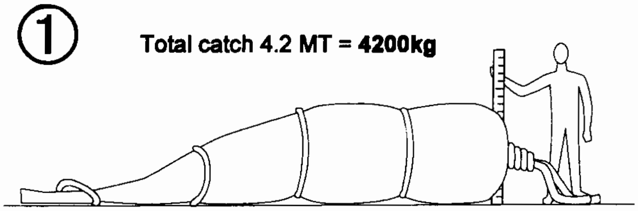
Counting Method For Catch Composition

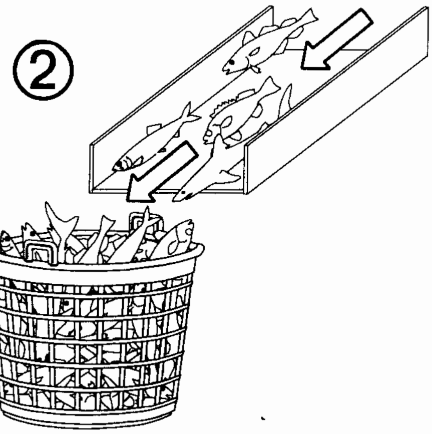
In fisheries where the catch is brought on board intermittently (e.g., longline; large pelagics), the counting method is often used to obtain estimates of weight caught for the directed species. If the number of bycatch species is not large, this method can also be used to determine catch composition by weight. As fishing gear is retrieved, individual species can be readily identified. Count the individuals of each species. Then take a random sample of each species and calculate an average weight per fish. Multiply average weight by the number of fish counted to determine a total weight for each species. If the entire gear retrieval cannot be observed, estimate catch for the unobserved period by extrapolating data collected during the observed period. (Refer to *Counting Method* in 6.1).

When bycatch is sorted and put in baskets by the crew, weigh these baskets. If the number of baskets is large, count the number of baskets and multiply by average basket weight to determine weight caught per species. When bycatch is separated from the main species caught, subtract the sum of bycatch weights from total catch weight to determine weight of the main species. In rough weather, basket weight can be estimated using basket weights calculated per species during previous sets.

The following table summarizes methods of estimating catch composition.

Methods of Determining Catch Composition	
Method	**Determining catch composition by:**
1. Weighing	Sorting the catch and weighing each species.
2. Observations	Observations made during gear retrieval and catch processing.
3. Subsampling	Obtaining a subsample and extrapolating to the entire catch.
4. Counting	Estimating weight caught by species using counting/weighing.





CATCH COMPOSITION BY SUBSAMPLING

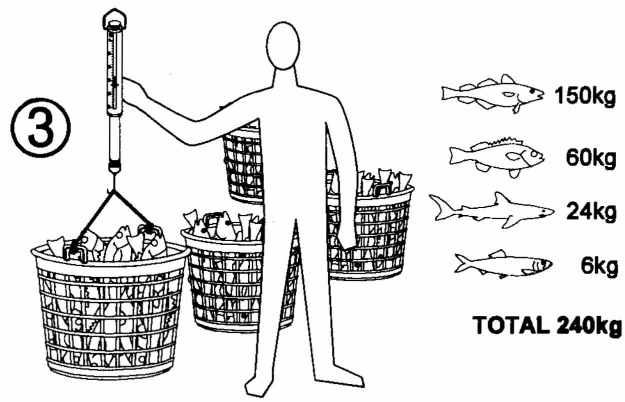
❶ Estimate total catch weight.

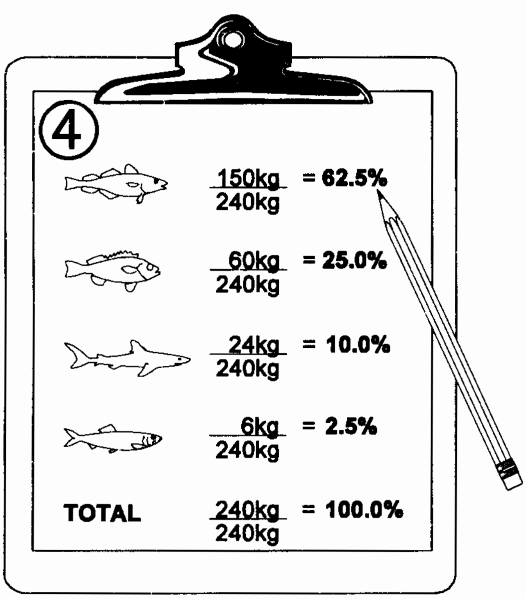
❷ Collect a random sample of a representative mixture of fish from the catch.

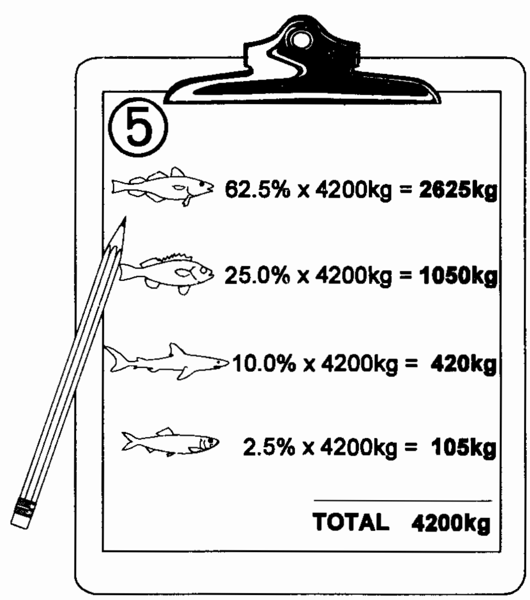
❸ Separate all species and determine weight of each.

❹ Calculate percent of each species.

❺ Multiply each percentage by the total catch weight, to obtain total weight of each species in the catch.







6.4 Discard Estimation

> ***Discards:*** *Whole (round) fish removed from the catch and returned to the sea.*

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.

- Draw a diagram of all locations of discard chutes, belts, or troughs in the processing area, and positions of crew members who will discard
- Identify each site where fish can be counted. Wherever possible, combine discard sites to minimize the number of *ports* (i.e., locations at which discard observations will be made).
- Time spent viewing discards should be greatest where the discard rate is highest.
- Estimates discards for these unobserved crew members by using estimates obtained for the observed crew.
- Observation times for individual ports must be spread out over the entire processing period, because discard rates may vary over the course of processing.
- Adopt a discard estimation method that maximizes the amount of discards viewed, counted, or weighed over the observation period.
- 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., initial/visual estimates) during processing.
- Casual observations of discard quantities and fish sizes can indicate whether discarding is significant or possibly a violation of fishery regulations. Significant quantities of discards may be seen as:

- Heavy discarding of many small fish during one set;
- A large amount of discarded fish accumulating over several sets, even if amounts in each set are small.

- When discarding is high, apply an appropriate discard estimation method and increase the time spent quantifying discarded fish.
- If catch is dumped into a bunker containing unprocessed fish from the previous set, for which discard estimates have not yet been finalized, discarded fish must be estimated over two or more sets, resulting in an overall total discard estimate.

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. If discards can be weighed, weigh them. If not, use the counting method.

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.

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. Refer to the following Counting Method instructions for estimating total discard weight of the species.

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:

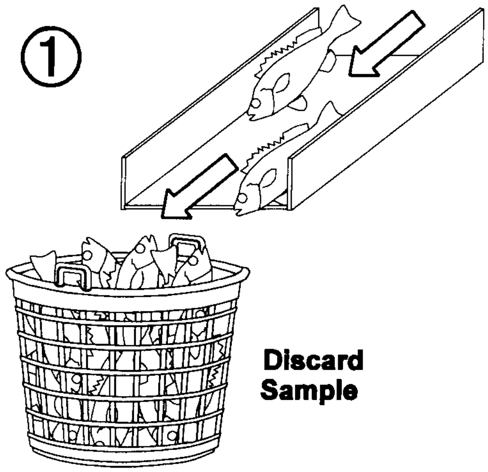
$$(120 \div 30) \times 20 = 80$$

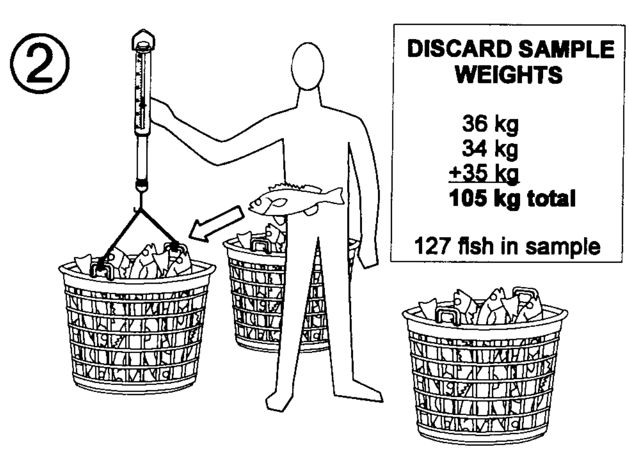
Therefore, 80 fish would be discarded over 120 minutes.

This total is then multiplied by the average weight of discarded fish 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.

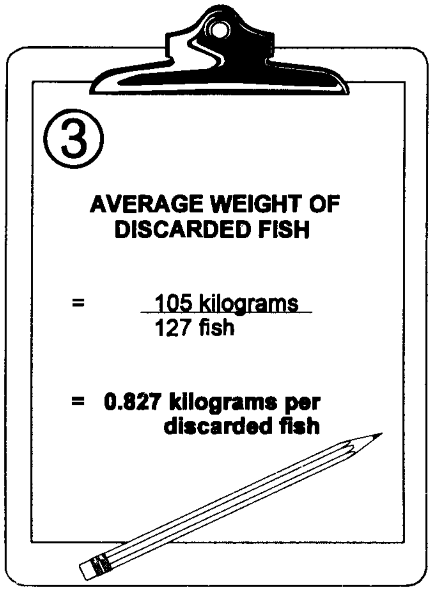
Combine the observation of crew members where appropriate to maximize the amount of fish viewed during the discard observation period. Switch discard ports in a preassigned but unpredictable order. Referring to the single port method outlined above, the total number of discarded fish can be calculated 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.

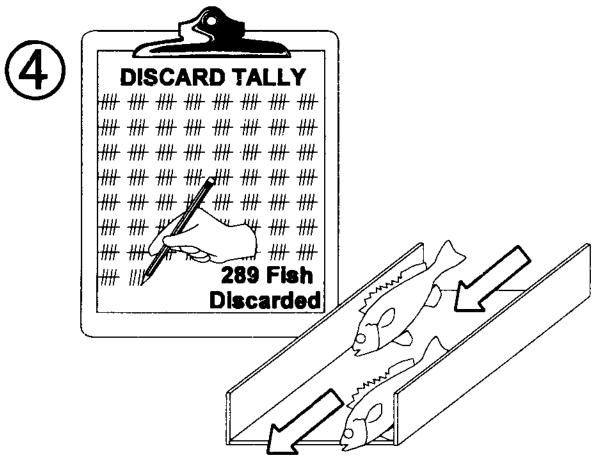


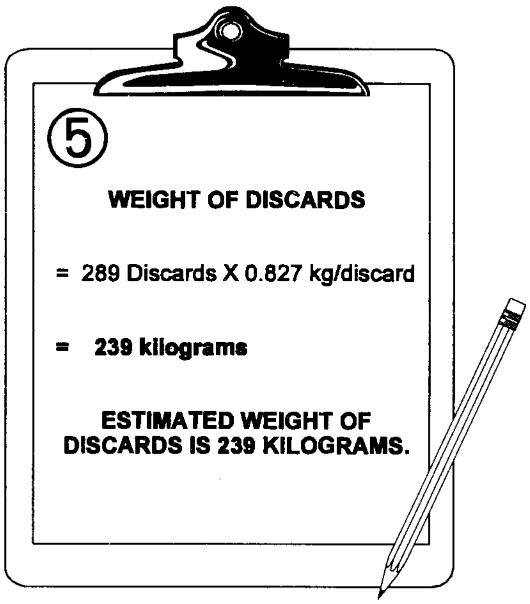


DISCARD TALLY ESTIMATION

1. Collect random sample of fish being discarded.
2. Count fish and weigh entire sample of discarded fish.
3. Divide the total weight of collected sample by the number of fish to determine the average discard weight.
4. Count the number of fish being discarded during entire processing period..
5. Multiply the total number of fish discarded by the average discard weight.







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

- 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.
- 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.
- Calculate the mean length of fish in the discard sample, and use the appropriate Length/Weight Table (if available) to determine average discard weight.
- Record lengths of fish in the discard sample on a Groundfish Length Frequency Sheet.
- Multiply the midpoint value of each length grouping or stratum by the number of fish in that stratum.
- Add these lengths across all strata 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:

- An effective discard estimation strategy maximizes the amount of fish/invertebrates viewed, counted, or weighed over the discard observation period.
- The degree of effort (e.g., observation time) expended in obtaining discard estimates greatly influences the reliability of data on discarded fish/invertebrates.
- 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).

- Note any significant differences in discard practices and rates between different discard ports for any set.
- Note whether discard rates at each port change during the processing period for any set.
- 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.
- 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.
- Ensure a complete understanding of all aspects of processing and discarding practices, including where, when, and how fish/invertebrates are being discarded.

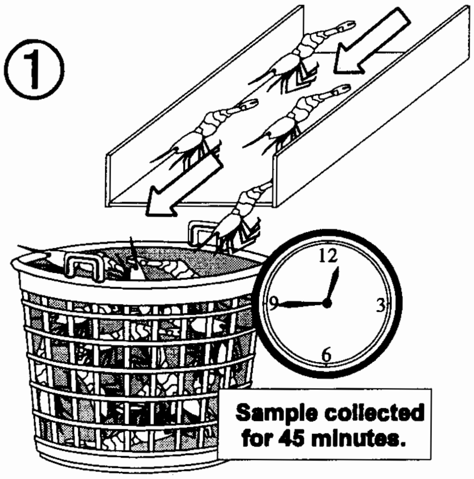
Discard estimation methods can be modified for changing situations in order to obtain reliable estimates. The priority is to maximize the amount of fish viewed, counted, or weighed over the discard observation period.

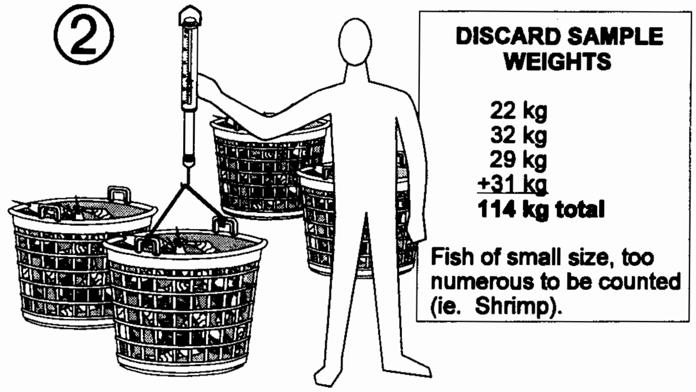
It may be useful to compare the initial bag weight estimate with the weight of kept fish in the hold (a value supplied by the icer, converted to round weight). The difference should compare favourably with the estimate from the discard estimation procedure, providing that initial bag estimates are reasonable.

Discard Monitoring - Shrimp Fishery

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 (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.

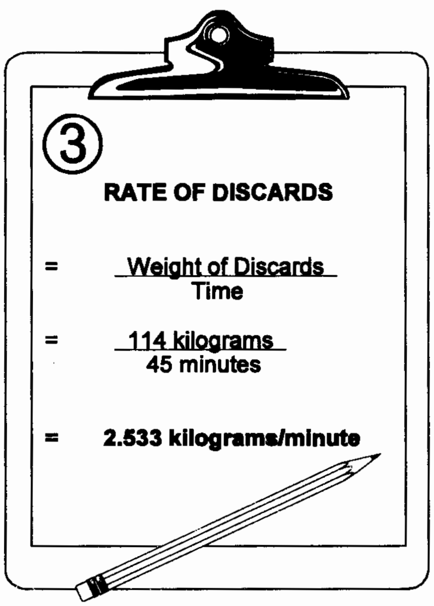
The discard estimation strategy used to estimate shrimp discards for any set will usually be a combination of methods As in all discard situations (regardless of species), the more time spent weighing, counting, or viewing discards results in a more reliable estimate. Therefore, dedicate more time to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

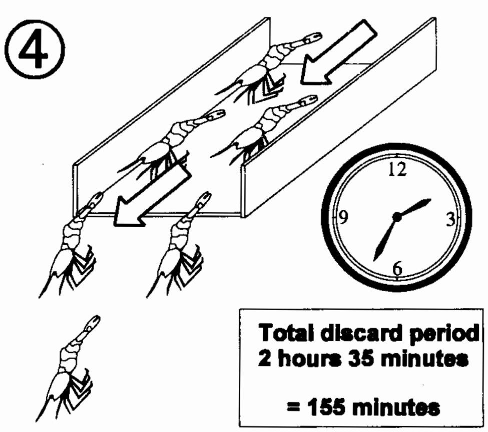


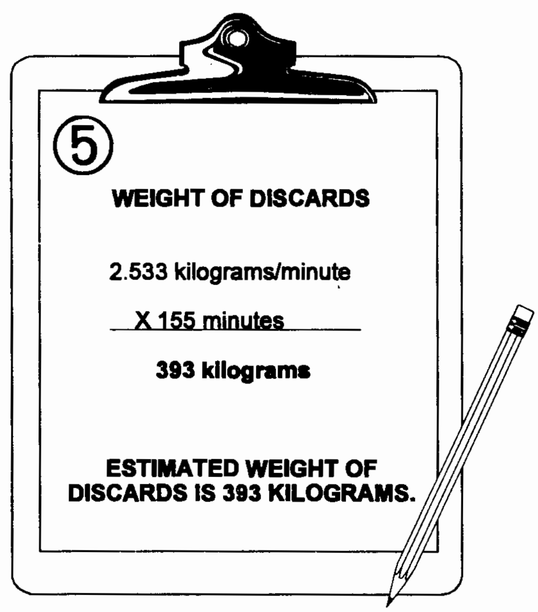


DISCARD RATE ESTIMATION

1. Collect random sample of fish for a measured period of time.
2. Weigh collected sample of discarded fish.
3. Divide the total weight of collected sample by the time taken to collect the sample to give the rate of discards.
4. Determine total discard period in minutes.
5. Multipy rate of discards by the total discard period to give the total amount discarded.







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. The least accurate method is to make casual observations (initial/visual estimates) of discarding. When calculating a rate of discarding, collect discarded shrimp in baskets for a port and record the time spent collecting the discarded shrimp. Divide the weight of shrimp collected by the time spent collecting to obtain a rate of discarding. Multiply the discard rate by the total time discarding occurred at that port to obtain total discard weight for the port. Account for shrimp that miss the baskets and adjust the estimate accordingly. Obtain the total discard weight for the set by adding together the discard estimates for each port.

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.

- Emptying of codend
- Sorting Belt
- Quality control

- Spillage
- Conveyor to Conveyor
- Conveyor off Shaker
- Baffles on shaker
- Holding tanks for Industrial shrimp
- Discard chutes

Emptying of codend.

When shrimp are emptied into a water-filled holding tank, bycatch species are mixed in with them (e.g. juvenile turbot, redfish cod etc.). Most redfish bycatch floats to the top of the holding tank. Prior to processing, redfish are scooped from the tank and discarded. A quantity of shrimp may also be discarded with the redfish and the Observer must monitor this procedure closely to obtain a discard estimate. Only a visual estimate may be possible in this situation.

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 initial/visual 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, obtain a discard rate /or initial/visual estimate at this location.

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.

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.

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.

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

Discard chutes

The Observer should determine the locations of any discard chutes prior to processing. If a discard chute is not enclosed, collect and weigh discarded shrimp or obtain a rate of discarding.

Discard Monitoring Snow Crab and Lobster

Discard monitoring for the crab fishery requires close observation of the processing operation due to the regulatory requirements for discarding all female crab, all crab less than 95 mm in width and the mandatory retention of all crab greater than 95 mm. There also exists an agreement between DFO and Industry that permits the discarding of soft-shelled snow crab, also referred to as *white crab.*

A soft-shelled crab is one that has just moulted and possess a soft, clean and pinkish shell with a hardness of less than 68 on a durometer. Crab contain very little meat at this stage, the shell is mostly occupied by water. For this reason they are not commercially valuable and to retain them would be an unnecessary waste of the resource. White crab should be returned to the water in a manner that causes the least harm to the crab.

When crab are brought on board, discards are culled and placed in pans. To determine the average weight per pan the Observer must weigh a minimum of 5 to 10 pans and divide the total weight by the number of pans weighed. Discard weight is obtained by multiplying the total number of pans discarded by the average weight of one pan.

Observers are required to sample crabs culled for discard. Data collected from these samples will include; carapace width, carapace condition and occurrence of missing legs and claws. This information is necessary in order to determine compliance with regulations.

While monitoring compliance with size restrictions, the Observer must be aware of *highgrading*. Highgrading is the discarding of legal size crab due to conditions that render them less valuable commercially. Conditions that would encourage the practice of highgrading include; missing legs or claws, economics, poor appearance of shell and decalcification of the shell. The latter condition occurs in old crab causing the shell to become brittle and soft. Economic conditions refers to a lower price for smaller yet legal crab. This provides an incentive to discard the less valuable product.

Discarding of lobsters normally occurs to comply with regulatory measures. It is prohibited to retain any lobster that is seeded, v-notched or undersized. Estimates are permitted to be recorded by number of individuals discarded. Observers can readily obtain discard data by counting individuals discarded during haul back operations.

The following table summarizes methods of discarding.

Methods of Estimating Discards

Method	Determining weights of:
Visual	Estimates made through casual observations.
Tally	Moderate amounts of discards that can be readily counted and where the average weight of individual fish can be determined.
Weighing	Small amounts of discards that can be readily collected.

6.5 Estimates from Monitoring Production

Monitoring production is a vital part of an Observer's job and when properly conducted can assist in fine tuning estimates and verifying logbook entries. Significant discrepancies between observed estimates and logged figures should be investigated to examine the accuracy of the Observer's estimating methods or to determine potential misreporting.

Production methods vary amongst vessels; ranging from gutting and icing fish on small vessels to a large array of packaged products on a factory freezer trawler.

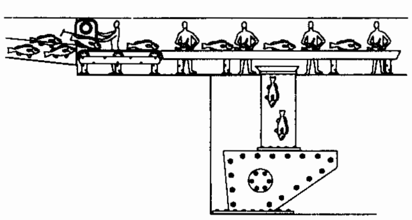
Enhancing Estimates

Monitoring the flow of production can provide several opportunities to enhance estimates. Catch can be estimated as soon as it is retrieved. This estimate can be fine tuned during the sorting, processing, packaging and storing process. The opportunities available will depend on the complexity of the production process. There are main areas along a production line where estimates can be readily obtained These areas include:

- holding bunker
- processing/sorting area
- tray filling/weighing stations
- freezers
- packing area
- fish holds

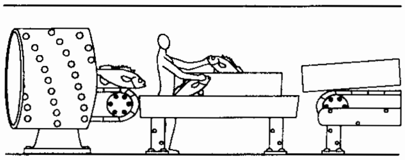
Holding bunkers and sorting area

A volumetric computation of the bunker capacity will provide a reasonable estimate. As the catch passes through the access chutes or conveyor belts leading to the processing area, an estimate of individual species can be obtained by weighing and tallying. Obtaining estimates of production in these areas is discussed in detail in *6.2 Catch Estimation* and *6.4 Discard Estimation.*



A reduction chute is present on vessels that have the capacity to produce meal. It is usually located near the holding bunker where the initial sorting of fish occurs. Observers can obtain an estimate of weight by species sent for reduction.by tallying fish as they flow along the chute.

Tray filling/weighing stations



This procedure pertains mainly to factory freezer trawlers where the fish are packed in trays for freezing. The Observer can determine the weight of fish in each tray by subtracting the tray weight from the weight of a full tray. These trays are shelved on trollies and placed in blast freezers. By closely monitoring this process the Observer can make an estimate of kept weight by species. The Observer must keep in mind that the fish are processed (ie: gutted head-off) and a conversion factor is required to calculate round weight. Conversion factors (C.F.) is dealt with in detail under *Verification of Product Weight.*

Weight per tray x Number of tray = Total product weight

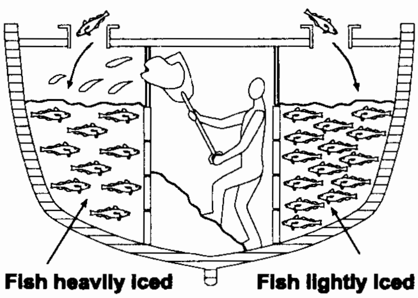
Freezers

Determining the holding capacity of freezers can assist the Observer in fine tuning estimates of produced fish. As indicated above, trays are shelved on trolleys and placed in blast freezers. By monitoring the number of trays per trolley and determining the number of trolleys per freezer, the capacity can be calculated using simple multiplication.

Packing area

Once frozen, blocks of product are removed from the freezers and packed in boxes. The average product weight should be determined by weighing approximately 10 boxes (see PWAs in the section on *Verification of Product Weight*). Once the average weight of product per box is known, an estimate can be made by counting the number of filled boxes and multiplying by the average weight per box.

Fish holds



The procedure used to perform a hold check will depend on the vessel type. The majority of domestic wet fish trawlers store the catch in *pens.* Determining the capacity of these pens will provide the Observer with an estimate of kept weight. The Observer can determine the pen capacity by:

- Volumetric calculations (subtract ice from the total pen capacity)
- Comparing pen capacity with previous estimates
- As a check, inquire from master the pen capacity

There are several other methods used in the domestic fishery for fish storage. On board some wet fish trawlers the catch may be stored in boxes and preserved with ice. To perform a hold check the Observer must determine the average weight of fish per box and multiply by the number of boxes in the hold. This procedure of storing the catch is also used in the crab fishery.

In large pelagic fisheries the catch is individually frozen and staked in the hold. In this situation, the Observer can only verify the number of fish processed. If the fish are of uniform size, an average weight can be applied to the number of fish. The average weight would be calculated from data obtain during earlier sampling duties.

Hold Checks - Factory Freezer Trawlers

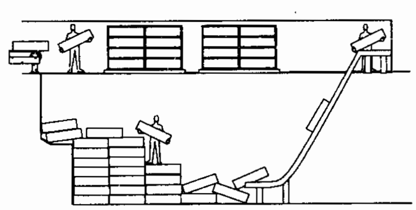
Hold checks on a factory freezer trawler can be conducted in two ways. The boxes (product) can be counted or the hold capacity can be determined through volumetric calculations.

Counting

This method can be used if the hold is empty upon boarding the vessel or if the product can be easily accessed for an accurate count. When a count can be made, the figure obtained should be multiplied by the average weight of product per box to determine the total weight of product. The proper Conversion Factor must then be applied to the product weight to obtain round weight. The average product weight per box must also be verified to ensure the accuracy of this procedure. Throughout the deployment the observer should periodically conduct product weight analysis (PWA).

Volumetric calculations

The Observer must first obtain the total bale capacity; the area in the hold that can be filled with packaged product. This can be accomplished in the following way:



- The hold capacity can be obtained from the vessel's capacity plans and/or documentation papers.
- The average number of units per cubic meter can be determined by selecting a sample test area and determining the length, width, and height of that area. The volume of the sample area is calculated by multiplying length x width x height. The number of units (boxes) per sample area should be counted.
- The average number of boxes per m^3 can then be

determined by dividing the number of boxes in the sample area by the volume of the sample area.

- The total volume of product in the hold must then be determined. This can be done by calculating the volume of unused space in the hold and subtract it from the total hold volume.
- The occupied volume can then be multiplied by the average number of boxes per m^3 to determine the total number of boxes in the hold. For example:

  Average number of boxes per m^3 = 21

  Volume of hold occupied by cargo = $1200m^3$

  Therefore, number of boxes in hold:

  = 21 boxes/m^3 x $1200m^3$
  = 25,200 boxes

- The number of boxes in the hold is then multiplied by the average weight of product per box to give the weight of the product in the hold. For example:

  Average box weight = 30

  Hold weight = 25,200 boxes x 30 kilograms

  = 756,000 kilograms

Factory freezer trawlers may also be equipped with fishmeal plants. Meal is packed in bags and stacked in a dry, unrefrigerated hold. The Observer should make several bag counts per day when meal is being produced. To ensure an accurate estimate, PWAs should be conducted periodically throughout the deployment.

Verification of Product Weight

When monitoring production there are two main concerns that the Observer must pay particular attention to; the accuracy of recorded product weight and the accuracy of conversion factors. Counting boxes of product is of little value to the Observer unless the actual weight of product is known. This also applies to inaccurate Conversion Factors, which can result in over/under reporting of species catch weight.

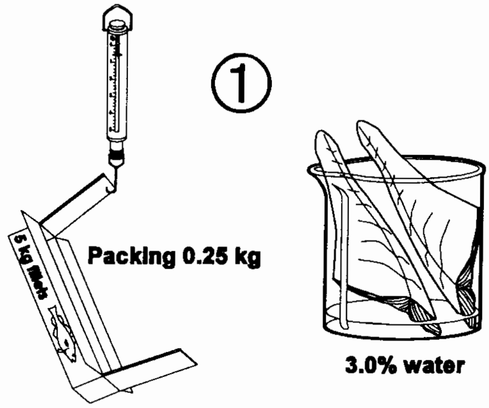
Product Weight Analysis (PWA)

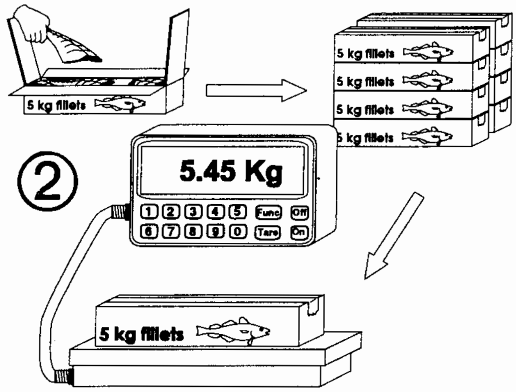
After processing, fish are packaged in boxes or bags of various sizes; typically with net weight stamped on each box. The amount of product packed into a container of a given size may differ with the stamped weight on the box. To verify the actual weight of product contained in a package an Observer must determine the weight of packaging materials and percent of water and subtract it from the total package weight. This is referred to as product weight analysis (PWA).

Packing materials include everything used to parcel the fish, including cardboard cartons, plastic wrap, burlap bags and the wire, string, tape or packing bands used to reinforce them. The Observer should weigh 10 complete sets of empty packaging materials and determine the average weight. Packing materials usually remain constant, but if it changes Observers should factor the difference in the PWAs.

On factory freezer trawlers frozen blocks of fish are glazed with water to enhance their preservation. The amount of weight added to the product by this procedure must be taken into consideration when conducting PWAs. A percentage of water content is usually provided to the Observer during briefing or can be obtained from the technologue or factory boss on board the vessel.

Gross product weight includes the amount of product, plus water content and packing material. *Net product weight* is the weight of the product itself. The purpose of a PWA is to determine the average net weight for a particular species and product type. To conduct a PWA, a random sample of at least 10 packages of product are weighed. The average weight of the product is calculated to provide the *average net weight.* From this figure the weight of the packaging material is subtracted, resulting in the weight of product in the package. Where the product is frozen and glazed, water content must be subtracted to determine the *average net product weight.*





PRODUCT WEIGHT ANALYSIS

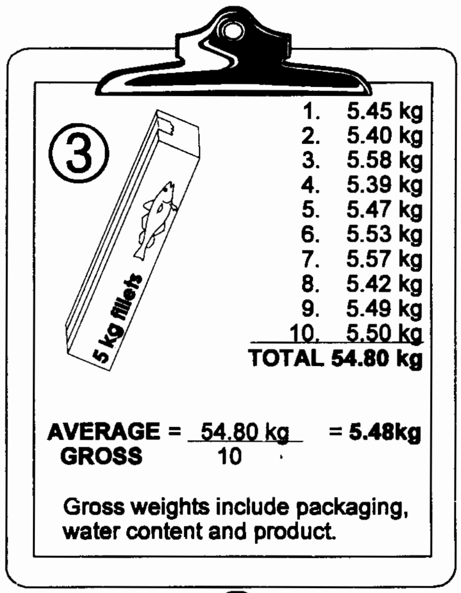
❶ Determine the average weight of **packing materials** and **water content**.

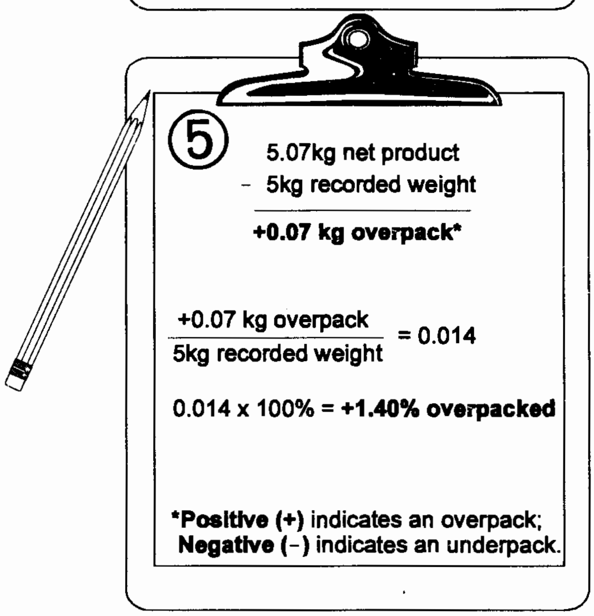
❷ Collect and weigh **random sample** of 10 units of packaged fish.

❸ Calculate average **gross weight** of packaged fish.

❹ Subtract packing material and water content from the gross weight to determine the **net weight** of packaged fish.

❺ Calculate the amount of **over/under packing**.





Conversion Factor Study (CF)

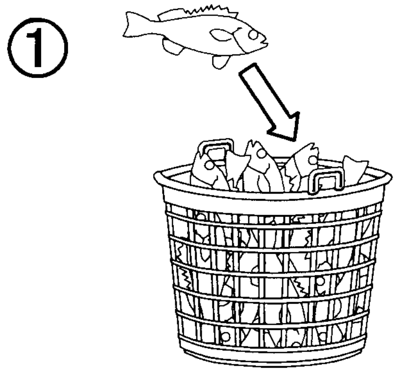
> ***Conversion factor:*** *a coefficient that when multiplied by the processed weight equals the round weight of the fish.*

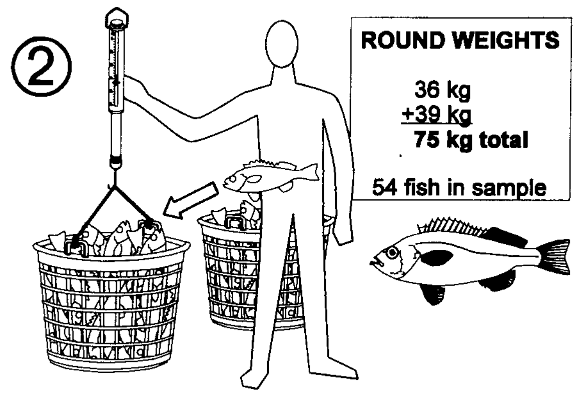
When there is reason to question the exactness of a CF being used, the Observer must verify CF accuracy. A CF study is conducted using the following procedure;

- A random sample of the species in question is collected and the number of individuals and total sample weight is determined.
- The fish in the sample are then processed by the crew.
- The finished product is collected at the end of the processing line, the individual fish recounted and the product weighed.
- The CF is calculated by dividing the round weight (sample weight) by the product weight

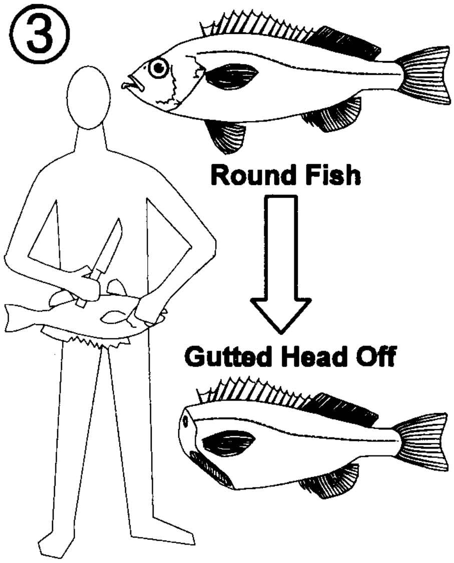
The counting of individual fish does not enter directly into the CF calculation but serves to confirm that no fish were added or lost from the initial sample.

Observers must evaluate the results and compare findings with the CF used by vessel personnel. A difference in CF values can result in over- or under-recording species catch weight. (Round weight) .

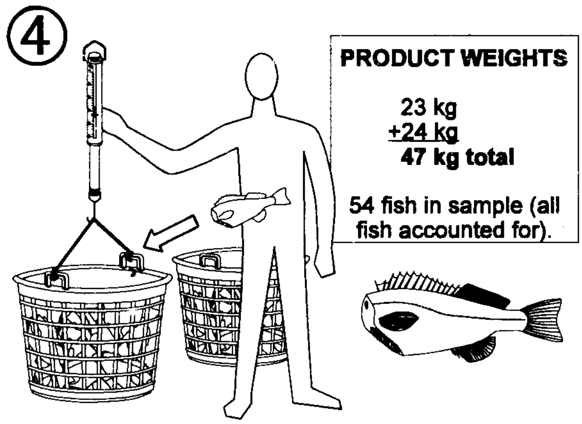


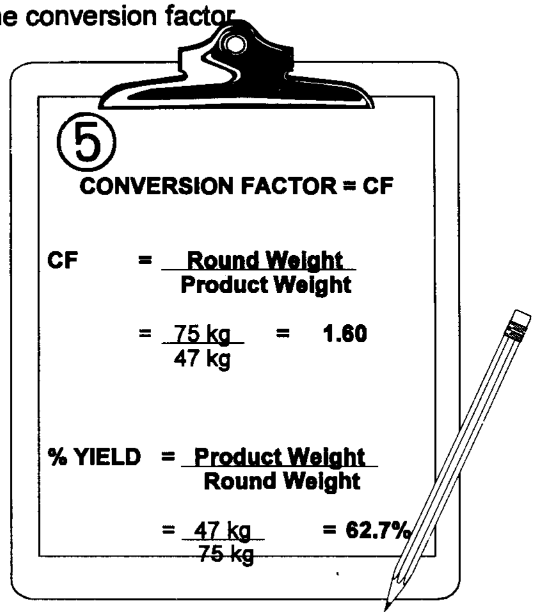


CONVERSION FACTOR STUDY



1. Collect random sample of fish from the catch to be processed.
2. Count fish and weigh entire sample prior to processing (round weight).
3. Allow crew to process fish. Verify that crew handle fish according to observed standard practices.
4. Collect and count the finished product. Weigh entire sample to determine processed weight.
5. Divide round weight by the processed weight. The result is the conversion factor.





6.6 Bycatch Regulations

Bycatch limits are a management tool used to reduce the amount of incidental catch. These limits can be imposed by; gear sector, fishing area, vessel sector and fishing season. When bycatch restrictions are implemented it is the Observer's duty to provide DFO with current catch data, either at the end of a deployment or throughout a trip via sitreps.

Bycatch limits may be expressed as a:

- Fixed weight limit
- Percent of total catch
- Percent of directed species
- Percent of licensed species
- Percent of retained catch
- Percent by fishing area and gear type

Bycatch Restrictions (Weight per species)

Bycatch limits are used as a management tool to allow a directed fishery for one species without adversely impacting on the health of other species stocks. These limits may be set using fishery specific criteria. For example, foreign fisheries conducted in Canadian waters, the bycatch is determined as a percentage of the licensed species. Limits set for domestic fisheries may be expressed as a percentage of the total catch on board.

Observer estimates play a vital role in enforcing bycatch restrictions and care must be exercised to ensure accuracy. Bycatch calculations should be conducted by the Observer on a daily basis to determine if the assigned vessel is within the required limits.

Calculating bycatch

Formulas for the calculation of bycatch percentage are fishery specific and will be provided to the Observer during briefing. Observers will have to follow established criteria when calculating bycatch percentages. The following indicates examples of criteria that may be applicable:

- Licensed species totals are based on the amounts taken under the authority of the licence.
- Bycatch limit calculations are based on the stock area for the licensed species except where specified

otherwise.

- A calculation must be completed individually for each species (unless otherwise stated)
- Calculations are based on round weights
- Calculations are based on weights retained on board the vessel

The Observer should be issued a copy of the license at the briefing or view the license on board the assigned vessel. Bycatch limits are listed in the license. For example:

> *When fishing for any other species of groundfish in Divisions 4VW you are permitted to take an amount each of cod and haddock that does not exceed 10% of the total amount of groundfish on board your vessel that is not cod or haddock.*

NOTE: For some regions, the bycatch calculation is completed by DFO. The Observer is responsible for providing accurate information required for the calculation.

6.7 Small Fish Protocol

Since the decline in groundfish stocks, management measures have been increased to restrict the capture of juvenile groundfish species. Minimum size limits have been assigned to selected species and if the capture of undersized fish exceeds a given percentage of the catch, the fishery could be closed. It is the Observer's responsibility to monitor the percentage of small fish in the catch. Information on size limit, target species and allowable percentage will be provided prior to the Observer's deployment.

To determine the levels of small fish in a catch requires the following preliminary information:

- Determine the total weight of sampled species for the set.
- Collect a random sample of the species being monitored (usually between 100-200 fish) and weigh it.
- Measure each fish and sort as small or large based on

the size limit for the species being monitored.
- Count the number of small fish and the number of large fish.

Percentage per set

The percentage of small fish for a set can be calculated as follows:

- Calculate the total number of fish in the set, by multiplying the number of fish in the sample by the ratio of total catch for sampled species in the set divided by the weight of the sample.
- Determine the percentage of small fish by dividing the number of small fish in the sample by the total number of fish in the set (# of small + # of large)

Percentage per day

To determine the percentage of small fish for a day:

- Where all sets were sampled, divide the total number of small fish by the total number of fish.
- Where not all sets were sampled, the total number of fish and the total number of small fish have to be extrapolated over the total catch of the species. The results obtained in the previous step have to be multiplied by the ratio of total catch of that species in sets sampled.

NOTE: For some regions, the calculation is completed by DFO. The Observer is responsible for providing accurate information required for the calculation.

The following table and calculations provide an example of small fish percentage calculations.

Small Fish Calculations					
Set #	**1**	**2**	**3**	**4**	**5**
# of fish in sample	230	250	240		
# of small fish in sample	60	20	40		
weight of sample	150	180	200		
total weight of sample species	2000	3500	4000	3000	5000

Set # 1: # of Small fish: 60 x (2000 ÷ 150) = 800
Total # of fish: 230 x (2000 ÷ 150) = 3067

Set# 2: # of Small fish: 20 x (3500 ÷ 180) = 389
Total # of fish: 250 x (3500 ÷ 180) = 4861

Set # 3: # of Small fish: 40 x (4000 ÷ 200) = 800
Total # of fish: 240 x (4000 ÷ 200) = 4800

If there were only 3 sets for the day the percentage of small fish would be:

1989 ÷ 12728 = 15.6%

Where: 12728 is the total number of fish in sets 1, 2 and 3 (3067 + 4861 + 4800) and 1989 is the total number of small fish in these sets (800 + 389 + 800 = 1989).

Since two sets (4 & 5) were not sampled, the figures from sampled sets have to be extrapolated over the total catch for the species.

Small fish per day = 1989 x (17500 ÷ 9500) = 3664
Total fish per day = 12728 x (17500 ÷ 9500) =23446

Where: 17500 = total species weight for the day, and 9500 = total species weight for sets 1, 2 and 3.

Therefore the percentage of small fish for the day would be:

3664 ÷ 23446 = 15.6%

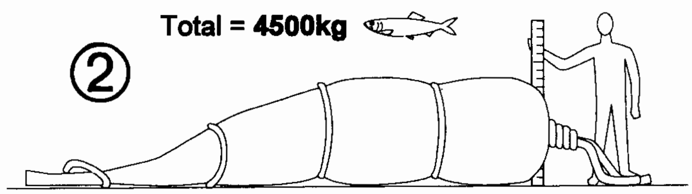
EXTRAPOLATION OF CATCH SIZE COMPOSITION

1. Collect a weighed random length frequency sample.
2. Determine weight of the same species for the entire catch from which the sample was collected.
3. Calculate the coefficient by dividing the total catch by the sample weight.
4. Multiply the coefficient by each length grouping to yield the number of fish in each length class for the entire catch.

① **LENGTH FREQUENCY**

Sample weight 72kg

cm	Tally	#
25		0
26	~~||||~~ |||	8
27	~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ |	26
28	~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ||	32
29	~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ |||	48
30	~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ||	52
31	~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~	45
32	~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ||	32
33	~~||||~~ ~~||||~~ ||	12
34	|||	3
35	|	1
	Total	259



③

$$\frac{\text{4500 kg Total}}{\text{72 kg sampled}} = \textbf{Coefficient 62.5}$$

Each fish in this sample represents 62.5 fish from the entire catch.

④ **CATCH SIZE COMPOSITION**

cm	# fish	x	coefficient	=	Total
25	0	x	62.5	=	0
26	8	x	62.5	=	500
27	26	x	62.5	=	1625
28	32	x	62.5	=	2000
29	48	x	62.5	=	3000
30	52	x	62.5	=	3250
31	45	x	62.5	=	2813
32	32	x	62.5	=	2000
33	12	x	62.5	=	750
34	3	x	62.5	=	188
35	1	x	62.5	=	63
	Total fish in catch				16189

6.8 Enforcement and Management Issues Regarding Catch

In order to monitor catch on an assigned vessel, the Observer must be familiar with the respective legislation. Knowing the applicable legislation will enable the Observer to collect the required data to properly document a given situation. The table below lists the legislation pertaining to catch.

Legislation Regarding Catch		
Topic	**Regulation**	**General content**
Regulated species	AFR85 Schedule I, Part II	List of species - domestic
Retention of fish	AFR85, 93.3	Mandatory retention of fish
Dumping	FGR, 43. (2)	Prohibited to dump fish
Prohibited species	FGR, 33. (2) (a) (b) CFPR, 20.	Requirements for returning prohibited species to the sea.
Straddling stocks	CFPR, 21.(2)	Definition and list of species
Tagging	AFR85, 85.(1) to (5)	Tagging of salmon
Tagging	AFR85, 104.(1) (1.1) (2)	Tagging of tuna
Size limits	AFR85, Part V, 44. (1)(2)	Herring length restriction
Size limits	AFR85 Part V, 48. (1)	Mackerel minimum size
Size limits	AFR85, Part VI, 51.1 (3)	Clam shell width
Size limits	AFR85, Part VI, 53. (b)	Crab shell width
Size limits	AFR85, 59. Part VI, (1)(2)	Lobster carapace length
Size limits	AFR85, Part VI, 64. (1)	Scallop meat count
Size limits	AFR85, Part VII, 79.	Salmon minimum size
Bycatch limits	FGR, 22	Conditions of licences

Unit 7: Operational Procedures

Perspective

Operational procedures deals with those aspects of an Observer's job that are not specifically dealt with in other units but are essential to Observers in effectively carrying out their duties. As the name suggest, operational procedures involves a predetermined plan of conduct and action on a daily basis that impacts greatly on an Observer's job performance.

7.1 Observer Duties	Outlines Observer duties contained in the standards for Observer training in Canada.
7.2 Professionalism	The importance and implications of Observer demeanor.
7.3 Situation Reports	The content, purpose and usage of Observer data sent from sea.
7.4 Communication Procedures	Radio communication, communication systems and confidentiality of information.
7.5 Trip Report	The content and purpose of trip reports and suggestions for trip report completion
7.6 Time Management	Effective time management and it's impact on an Observer's job. Practical suggestions on how Observers can maximize their use of time.
7.7 Daily Note Taking	The purpose and importance of note taking and suggestions for completing notebooks on a daily basis.
7.8 Irregularities	The importance of proper documentation of irregularities.
7.9 Courtroom Presentation	Observers as a witness in the courtroom.
7.10 Briefing and Debriefing	Definitions of briefing and debriefing and describe the importance of each.

7.1 Observer Duties

The duties of an Observer are contained in Section 39 (2) of the Fisheries (General) Regulations. This section states that the RDG shall assign duties to an Observer which include the following

- The monitoring of fishing activities, the examination and measurement of fishing gear, the recording of scientific data and observations and the taking of samples.
- The monitoring of the landing of fish and the verification of the weight and species of fish caught and retained.
- Conducting biological examination and sampling of fish.

In addition to these duties, a detailed list of Observer duties is contained in the Canadian Standards on *Training and Certification of At-Sea Fisheries Observers* (CAN/CGSB-190.1). This appendix states that At-Sea Fisheries Observers shall record and report on all aspects of vessel activity. Their duties include:

- Reporting data pertaining to the adherence of vessels to Canadian laws, particularly the Acts and Regulations governing fishing activities in Canadian Waters.
- Preparing an orderly documentation of information related to suspected infractions of Fishery legislation and present oral and documented evidence as a witness in a court of law.
- Collecting detailed biological and fishery data.
- Reporting information on fishing effort and catch.
- Reporting on the technological characteristics of fishing gear and processing methods.
- Making independent observations of catch. navigational and fishing aids, and fish holding areas.
- Collecting data relating to the processing and marketing of fish.
- Reporting on fishing patterns and the relationship of these patterns to catch.
- Collecting regulatory and scientific data on fisheries in Canadian waters and fisheries waters adjacent to Canada.
- Performing other tasks such as collecting hydrological

and fish habitat data.
- Monitoring vessel trans-shipment and vessel off-loading.
- Monitoring dumping of harmful and polluting material into the ocean.

Observer Duties during DFO Boardings

Observer's have a role in assisting Fishery Officers in carrying out inspections at sea or in port. There are two types of inspections; routine and requested. *Routine inspections* occur as part of DFO's ongoing enforcement and surveillance scheme. It involves inspections of fishing vessels at sea. A *requested inspection* occurs when Observers detect a serious irregularity and request Fishery Officers to board and inspect the vessel. Observers will likely encounter Fishery Officers doing inspections and will be expected to assist when necessary. Providing assistance to Fishery Officers necessitates that Observers have their work up to date. This could include having documentation of an irregularity in order to brief Fishery Officers or to have paperwork completed to that point in the deployment.

When a vessel is boarded by DFO Fishery Officers, either at sea or in port, the Observer should meet the boarding party and introduce them to the vessel master. To gain insight into the fishing activities of the vessel, a member of the boarding party will likely question the Observer. Any data collected by the Observer or other deployment details are to be made available to the boarding party upon request. All regulatory concerns should be discussed with the boarding party, preferably in private.

Observers must offer assistance to the boarding party during an inspection but must not interfere with their actions or decisions. If there is a disagreement with the judgement of the boarding party the matter must be discussed *in private*. The final decision to take further enforcement action during an inspection lies solely with the boarding party.

7.2 Professionalism and Objectivity

***Professionalism:** a combination of attitude, behaviour, competency and skill shown in the workplace.*

Professionalism impacts on every aspect of the job. It may determine the reception Observers get on a vessel and the degree of respect Observers receive. In addition, professionalism is important because professional behavior reflects positively on DFO and other Observers.

***Objectivity:** the ability to assess all perspectives of a situation in a non-biased manner.*

Objectivity is vital for reasons that include:

- Much of the information collected by Observers is scientifically based and must be unbiased.
- Information collected by Observers may be used in court where only facts are considered and opinions are generally not permitted.
- Information submitted by Observer often result in fisheries being opened or closed. Bias could adversely affect the economics of a fishing enterprise or the conservation of a fish stock.

Objectivity impacts on an Observer's job in that, allowing personal opinions to influence the collection of information invalidates that information. Allowing opinion to impair judgement reduces the reliability and credibility of work produced.

Observers are a liaison between fishermen and DFO and are on the front lines of action in the fishing industry. As perceived representatives of DFO, Observers must uphold in utmost fairness all that DFO represents. To promote respect among fishermen concerning the rules and regulations intended to conserve and protect their livelihood fishermen must understand and respect all aspects of the Observer program.

To achieve professionalism Observers should follow the *Observer Code of Conduct.* This code defines objectivity, professionalism, integrity and conflict of interest. Included are suggestions on how to avoid or diffuse confrontations and/or stressful situations.

Observer Code of Conduct

The Observer Code of Conduct is contained in the national standards for Observer training in Canada. Specific standards apply to the following:

- Professionalism
- Gratuties/bribes
- Use of alcohol and drugs
- Conflict of interest
- Confidentialty of information
- Observer identification cards
- Reliability and secrecy undertaking

Professionalism

Standards on Observer professionalism requires that Observers conduct themselves at all times in a professional manner. They must avoid any behaviour that could adversely affect the confidence of the public in the integrity of the Observer Program. They are thus expected to conduct themselves in an honest, professional, businesslike manner in all situations and shall refrain from engaging in any illegal actions or other activities that would reflect negatively on themselves or their profession. They must report objectively any suspected irregularities observed and submit an authentic verifiable data package and trip report. Any deliberate misrepresentation or fabrication of data or trip information constitute grounds for revocation of certification and dismissal.

Gratuities/Bribes

Observers must not accept any gratuity in the form of an object or a consideration that would place the Observer in a compromising position. Gratuities include, but are not limited to money, fish products, free trips, alcoholic beverages. Any offer which may be perceived to be a bribe, even presented in a joking or non-serious manner shall be reported immediately to the employer.

Use of Alcohol and Drugs

Observers are strictly prohibited to consume or be under the influence of alcoholic beverages or illegal drugs while on deployment. Infractions constitute grounds for immediate dismissal.

Conflict of Interest

Observers must disclose in writing any conflicts of interest to their employer as soon as they become aware of the conflict. Observers are considered to be in a conflict of interest situation if they:

- Hold a commercial fishing licence.
- Are involved in the purchase of fish for the purpose of resale.
- Are an owner, operator or manager of an enterprise that catches, cultures, processes or transports fish.
- Accept a deployment to a vessel owned or operated by the Observer's immediate family (i.e. parents or siblings) or extended family (uncles or aunts).

Confidentiality of Information

All information collected by Observers during the course of their employment is the property of Fisheries and Oceans. Observers must ensure that all information obtained in the course of his/her work is treated as strictly confidential and not divulged in any manner what so ever without the prior written consent of DFO. All collected data, photographs and literature shall be turned over to the employer at the completion of a deployment.

Observer Identification Cards

Observers are issued an identification card, also referred to as a *Certificate of Designation.* Observer identification cards are for official use only, and must be returned to DFO upon request.

Reliability and Secrecy Undertaking

Observers must pass an enhanced reliability check and also maintain this reliability status. They must also sign an *Undertaking of Secrecy* to ensure confidentiality of data collected.

General

While on fishing vessels Observers must not consume species for which that vessel has a prohibition to catch and retain. They must conform to the standards of the workplace including dress codes, hats or hair nets in processing plants, designated smoking and eating areas, safety requirements, etc.

7.3 Situation Reports

> ***Situation Report:*** *a standarized summary report consisting of detailed information on fishing activity, recorded in a pre-determined format, that is transmitted at regular intervals to appropriate authorities.*

Situation reports generally contain:

- Observer's name
- Trip number
- Vessel name
- Date
- Summary of catch for a specified period of time
- Irregularities noted during period of report
- Other requested information (discards, small fish, ice conditions)

Situation reports are generally encoded which allows for the discreet transmission of information. This is important to prevent public broadcasting of catch rates, positions, and irregularities. Situation reports provide current information used to manage fisheries on a day to day basis. They also alert DFO Conservation and Protection to irregularities, allowing for immediate action. Observers must ensure accuracy of data prior to transmitting of situation reports.

Routing Situation Reports to DFO

Situation reports are transmitted from a vessel by various telecommunication technologies. (refer to section *7.4 Communication Procedures*). The master of the vessel is required to assist the Observer with communications. This can be done by preparing radio equipment for the Observer to transmit verbally or by sending the message via fax, telex, Imarsat, etc. on the Observer's behalf. It is the Observer's responsibility to ensure their messages have been transmitted.

Routing of Situation Reports can be region specific. Messages sent from sea may be received directly by DFO or via a company under contract to provide Observer services. Situation reports recieved by designated shore personnel are decoded and checked for obvious deletions, omissions or discrepancies. When the information arrives at DFO it is forwarded to appropriate personnel.

Utilization of Situation Reports

Problems reported by Observers may require immediate action against a vessel, captain and crew. It is therefore extremely important for Observers to employ care, attention and diligence in preparing and sending situation reports. The information is received by Conservation and Protection where it is checked for irregularities that may require prompt action. DFO quota monitoring personnel utilize the information to monitor quotas, catch rates, bycatch levels, discarding and small fish occurrence. Sending regular information:

- Prevent quotas from being drastically exceeded.
- Prevents serious irregularities from being unnoticed until irreparable damage is done.
- Notifies appropriate authorities of extreme cases where the Observer's well being may be jeopardized.

For Observers, sending regular messages from sea is their only link to the world in an otherwise isolated environment.

Situation reports must be regarded in the same confidential manner as all other information collected by Observers and cannot be divulged in any way.

7.4 Communication Procedures

While carrying out their duties Observers often require the use of communication equipment. This may be to transmit situation reports, to arrange for transfers, to discuss a problem with the employer, to notify DFO of a major irregularity or in rare situations where their safety is threatened.

There is a variety of equipment available to establish communication from ship to shore such as:

- Radiotelephone
- Telex
- Fasimile
- Cellular phones
- Satellite phones
- Inmarsat

Observers may encounter pressure from captains to use the cheapest method, or be told to wait a certain amount of time. If they feel they have to wait an unreasonable amount of time and believe the captain and crew are not extending reasonable assistance, they should report an irregularity for lack of cooperation.

If Observers have difficulties communicating from their assigned vessel they may be able relay information through another Observer. Although with the variety of communication means available today this will seldom be necessary.

Radiotelephones

The most common type of communication equipment used by Observers is the radiotelephone. The Department of Communication (DOC) requires that everyone using a radiotelephone possess a valid Radiotelephone Operator's Restricted Certificate.

Observers must comply with and respect accepted protocol for radio use set out by DOC. When talking on radiotelephones Observers should speak slowly and clearly. If reception is poor or there is interference Observers should use the phonetic alphabet and when necessary repeat items. When transmitting long messages Observers should pause periodically to ensure information is being received. All calls are made over open airwaves and Observers must use discretion when transmitting sensitive information.

Radio Frequency Bands

The three main frequency bands used for voice communications are Medium Frequency (MF), High Frequency (HF), and Very High Frequency (VHF). VHF is normally used for communication between vessels in line of sight and close proximity. HF or MF is used for greater distances. The frequency and normal operating ranges for radio communications are:

- HF 3 to 30 MHZ; 320 to 1600 km
- MF 300 to 3000 kHz; 160 to 400 km
- VHF 30 to 300 MHZ; 16 to 80 km

Radio transmitting and receiving can be adversely affected by atmospheric conditions, equipment capability, weather, time of day, etc. This type of communication therefore has some limitations.

Phonetic Alphabet

The phonetic alphabet is an internationally recognized compilation of words whereby each word represents a letter of the Roman alphabet. This representation is intended to minimize misunderstandings during verbal communications. Observers routinely reference the phonetic alphabet when using the radiotelephone.

Phonetic Alphabet			
A - Alfa	H - Hotel	O - Oscar	V - Victor
B - Bravo	I - India	P - Papa	W - Whiskey
C - Charlie	J - Juliett	Q -Quebec	X - X-ray
D - Delta	K - Kilo	R - Romeo	Y - Yankee
E - Echo	L - Lima	S - Sierra	Z - Zulu
F - Foxtrot	M - Mike	T - Tango	
G - Golf	N - November	U - Uniform	

Time Zones

Radio communications between different time zones uses internationally accepted time called *Universal Time Coordinated (UTC).* This is based on the time in Greenwich, England and was originally called *Greenwich Mean Time (GMT).* For the sake of brevity, the letter "Z" (Zulu) is used during radio communications to indicate UTC. UTC remains constant year round.

Where radio operations are conducted entirely within one time zone, local time may be referenced. Local time may be *Standard Time* or *Daylight Savings Time.* Most time zones operate on *Daylight Savings Time (DST)* during the summer. This occurs when one hour is added to local standard time every spring, usually the first Sunday of April. In the fall this hour is subtracted and time zones convert back to standard time, usually the last Saturday of October. Standard time zones used by Observers across Canada include:

Newfoundland Standard Time (NST)	UTC minus 3 ½ hours
Atlantic Standard Time (AST)	UTC minus 4 hours
Eastern Standard Time (EST)	UTC minus 5 hours
Pacific Standard Time (PST)	UTC minus 9 hours

Radio Distress Calls

Radio traffic to and from vessels is normally controlled by the master or vessel personnel. However emergency situations may arise compelling an Observer to transmit an emergency message on behalf of the vessel. The Canadian Coast Guard provides 24-hour monitoring on VHF Channel 16 (156.8 MHZ) and on MF 2182 kHz.

Confidentiality of Transmitted Messages

Rules concerning confidentiality of Observer collected information applies to all messages that are transmitted from a vessel. Observers should bear in mind that all transmissions on radiotelephone are broadcasted over open airwaves. Therefore confidential information such as vessel positions, catch rates, catch composition and irregularities observed must be encoded.

7.5 Trip Report

> ***Trip Report:** an Observer's written account summarizing all aspects of a deployment related to fishing operations and fishing activity.*

Trip reports are intended to create a detailed record of information that can be stored for use later. They include detailed information specific to the trip and the vessel being observed and is not always recorded on a standardized data collection form. Information recorded in a trip report often consist of narratives. Narratives should be written as if it were explaining something to someone who is not at all familiar with the topic. This means stating ideas as clearly and as simply as possible. As well, legibility of hand writing is essential. This requires taking time and exerting a conscious effort to ensure neatness is achieved. Information commonly found in trip reports include:

- Deployment summary
- Record of total catch
- Gear information
- Details of irregularities.

Work on a trip report should begin as early in the deployment as possible. Observers may not know when a trip will terminate and cannot get information once they have left the vessel. On foreign vessels Observers are usually given a short notice even though the master is required to give a 4 hour notice. The best approach to take when completing a trip report is to get as much information as quickly as possible. Even if only in note form it is still accurate information that can be used to complete the trip report. Observers should aim to gather relevant information for the trip report as part of a daily routine and whenever the opportunity arises. They should always verify vessel information received during a briefing such as a factory diagram. Vessels sometimes undergo major renovations or change ownership.

While compiling a trip report, Observers must keep all collected data in a secure location and bear in mind that *all* the information they collect is to be kept confidential. An

Observer may only reveal the contents of a trip report to authorized DFO personnel and Observer Program contractors unless given specific instructions to do otherwise. Observers should also be aware that portions of information contained in a trip report may also be accessed by any person or group under the *Freedom to Information Act*.

7.6 Time Management

In order to keep pace with all the demands placed on their time Observers must employ time management techniques. Time management is the planned use of ones time to minimize wasted time, so as to maximize efficiency and productivity of the task at hand. There are four main benefits that can be derived from effective time management. They include;

- Decreased work related stress
- Increased productivity
- Progression toward short and long term goals
- Balance between personal and professional life.

> ***Time Management:*** *the planned use of ones time to minimize wasted time so as to maximize efficiency and productivity.*

The nature of an Observer's job makes time management challenging. Observers have to work around erratic schedules and have difficulty sticking to any type of routine. The pace of work and working conditions varies with each deployment. Some deployments require covering many vessels in a short period of time. Other times it may be slower paced single-vessel deployments in excess of 50 days. In addition, Observers are challenged with working virtually unsupervised and in isolation.

Steps to Managing Time

Effective time management for Observers requires a thorough understanding of the job and, in particular, understanding the requirements of a specific deployment. This can be achieved by continually making efforts to improve job performance and by being very thorough during briefing and debriefing sessions. A complete understanding of the work can help Observers determine how their time is spent on a specific task and how to be more efficient. Anything that takes time to do has the potential of wasting time. Even small amounts of time add up. For example, 30 seconds saved every five minutes adds up to 1 hour of time saved over a 10 hour work day. Over a 50 day deployment that translates into one extra week of work time. When Observers know how their time is used they can begin to employ time management techniques to improve work habits.

Some time management techniques include:

- Establishing goals and priorities
- Adequate planning
- Instituting self-discipline
- Avoiding interruptions
- Effectively using down time
- Eliminating time wasters

Establishing goals and priorities

Establishing goals and maintaining sight of them gives Observers direction and purpose. The primary goal of every deployment is to collect the information required for a complete data package. Once this has been achieved, secondary goals of collecting additional information or spending extra time monitoring fishing activities can be pursued. Prioritize work according to whether it is contributing to the goals or not. For extended deployments Observers should also include personal goals such as a specific amount of time set aside each day to exercise, read or engage in a hobby. This helps create a needed balance between personal and professional life.

Adequate Planning

Planning should be done on a trip basis; what worked successfully on one deployment may not be as successful on another.

Planning should begin with pre-trip organization before an Observer sails. This involves:

- Reviewing mistakes made on the last deployment and measures taken to ensure they are not repeated.

- An inventory check of necessary tools and papers.
- A review of written briefing instructions and briefing notes to ensure the deployment requirements are clearly understood.

If after briefing something is unclear have the matter clarified as soon as possible.

Planning also involves organization at the very beginning of the trip. Closely examine the vessel layout and begin formulating a work strategy for various duties. Areas of concern include fishing deck, fish handling areas, factory, fish storage areas, bridge and other areas pertinent to Observer's work. At the beginning of the trip Observers should devise a trip plan outlining all duties to be completed and their corresponding deadlines. This plan may consist of a list of duties to be completed on a daily, weekly and on a per-trip basis. The list should be checked several times a day to ensure all duties are being done.

The most challenging part of planning is maintaining organization and order throughout the trip. Maintaining organization is done one day at a time. At the beginning of each day prepare a "to do" list of things needed to be done for that day and plan a schedule accordingly. A daily plan can include: regular daily duties, weekly duties scheduled for a particular day and small portions of the trip report. At the end of each day compare the "to do" list with work completed and plan for the next day. This provides structure where by deviations, potential problems or other unexpected occurrences that negatively impact the quality of work can be identified in time to take corrective action.

As part of the trip plan, progress reports should be conducted to ensure that focus is maintained on the end results. Progress reports could include data quality check for missing or inaccurate information. They are very useful for monitoring trip report completion, taking stock of work completed and noting work missing from the total data package.

Self-evaluation checks will help prevent repetitive mistakes from recurring on subsequent trips and increase quality of work and efficiency in use of time. After de-briefing, at the end of the trip, Observers should do a self evaluation of the trip regarding how effectively time was managed. This could include such questions as:

- Were the goals met?
- Was all required work done?
- Was work always completed on time?
- Were mistakes corrected from previous trips?

Trip planning can be simplified with the following aids to planning and organizing:

- Block style monthly calendar outlining duties to be completed with appropriate deadlines and visible at all times.
- Daily/weekly/trip list of prioritized duties carefully prepared and visible at all times.
- Desk or suitable work space where paperwork can be comfortably completed.
- Tools necessary to fulfill job requirements.
- Expandable file folder for keeping completed paperwork organized.

Self-discipline

Self-discipline is an essential skill for Observers and is the key to making time management techniques work. Lack of self-discipline often results in procrastination which waste a lot of time and results in poor quality work. When duties are delayed until the last minute they are often completed under pressure when people are tired. When this happens, tasks take longer to complete, more mistakes are made and consequently more time is needed to fix them. There is no place for procrastination in the job of an Observer. As the nature of the job dictates, observations of events can only occur as they unfold, otherwise the opportunity is lost. Conquering procrastination requires taking control instead of being controlled. Bad habits must be replaced with good ones. Observers must set deadlines and stick to them; nothing creates a sense of urgency like a deadline. Avoid, when possible, leaving tasks unfinished. However, if a task has to be left unfinished return to it as soon as possible and leave it in good condition so it can be easily addressed later.

Avoiding Interruptions

Interruptions waste significant time. Interruptions may consist of visitors or self made distractions. Visitors from the crew may be an attempt to socialize and are hard to resist. While a necessary part of life, socializing causes interruptions that waste time. They last longer than expected and result in time lost regaining concentration and momentum. There is a time and place for everything, an Observer must decide when to socialize. To avoid interruptions by drop in visitors, keep the cabin door closed so as to not extend an invitation or politely ask visitors to leave.

Self-made distractions may include a cluttered desk with many papers competing for attention, visual distractions such as pictures or audio distractions such as music or radio. One way to deal with self-made distractions is to make a conscious effort to recognize them and avoid allowing them to happen.

Effective Use of Down Time

Down time is created by events that are not a normal part of every day fishing activity. These may include traveling, standby, awaiting departure, riding out a storm or repairing gear or mechanical parts at sea. With good organization and self-discipline down time can be taken advantage of to get ahead in work or to catch up if the deployment has been very busy. Time traveling to meet a vessel or steaming to and from fishing grounds can be used to plan for the trip or prepare for a debriefing. Time awaiting departure of a vessel or in port for vessel repairs or crew rest is an excellent opportunity to bring work up to date, resolve questions about the deployment by phoning the employer or catch up on rest. Time spent riding out a storm is time that can be used to; complete unfinished paperwork, conduct quality checks or progress reports and catch up on rest.

Eliminating Time Wasters

The identification of wasted time can result in its solution. For example, lack of planning can be eliminated simply by planning and interruptions can be eliminated by not allowing them to happen. In many cases, the solutions are general but it is the specific actions taken that will ensure that time wasters are eliminated. Very often it is a matter of consciously adopting good habits and practicing them until they become the norm.

7.7 Daily Note Taking

Note taking is essential and should be a routine part of an Observer's daily duties. All notes should be recorded in the field notebook. Notebooks should remain in the Observer's possession at all times so that events can be recorded as they occur and security of the data can be maintained.

The purpose of notebooks is to create a chronological record of daily activities, events and observations. Information can be gathered and stored for possible transference to applicable data forms. Notebooks also provide a duplicate record for verifying data sheet entries. In addition, notebooks serve as a reference for the Observer to recall events in a detailed chronological order for possible use in court. Notebooks should be used only for official information.

Content

Notebooks may be used to compile the following information:

- Official information only
- Date
- Vessel activity, movement, and noon-time position
- Observer travel and itinerary details
- Details required to complete all data sheets,
- Catch and fishing details on a set-by-set basis
- Details of suspected irregularities (see section *7.8 Irregularities*)
- Information useful for completing the trip report
- Measurements of gear, fish hold and hoppers
- Weather/ visibility conditions
- Other miscellaneous items such as radio messages transmitted or received

Format

The notebook must be used constantly and consistently. To some degree, an Observer's ability, efficiency and character are reflected in the notebook through the degree of organization, neatness and relevancy of material. Notes are of little value if they are not accurate, legible and meaningful. Observers should use the following suggestions as format guidelines for daily entries in their notebooks:

- Notebooks must be neat, concise, informative, and well

organized (i.e. chronological).
- Notes must be accurate, legible, and comprehensible.
- Notes must be in ink in the recorder's own handwriting.
- If a change is necessary, draw a single visible line through the words so that they are still legible.
- Initial the start and end point of any corrections.
- If possible, use only one type of pen to take notes.
- Entries concerning different events should be on separate pages or separated by a line.
- There should be no blank pages.
- Abbreviations must be explained and consistent to avoid confusion.
- Notebook covers should be labeled to indicate the period of time covered.
- Notebooks must be kept in a secure place.
- Notes should be written as soon as reasonably possible after the event concerned.
- Include notes to accompany photographs that were taken of a particular situation.

7.8 Irregularities

Observers are required to monitor, document and report irregularities. When an irregularity has been noted Observers must follow a procedure to ensure that the irregularity is properly identified, documented, notification given to the vessel master and if necessary the irregularity is reported to DFO.

Identifying an Irregularity

Fisheries are governed through the implementations of regulatory measures contained in the Acts, regulations, policies and conditions of licence. Contravention of these regulatory measures is termed an *Irregularity*. In monitoring and observing fishing activity Observers apply knowledge of regulatory measure gained through training and briefing to detect possible irregularities. When an irregularity is identified the Observer should proceed to document it.

Documenting an Irregularity

The conditions at the scene of an irregularity can be fast moving, complex and chaotic. Many tasks need immediate attention and must be performed without hesitation. A large amount of information must be gathered while documenting an irregularity and must be done as the incident unfolds. The basic questions that need to be answered are:

- *What?* What was the irregularity? What were the circumstances leading up to the irregularity? What happened? What was the result of the irregularity?
- *Who?* Who was involved? Who witnessed the irregularity? Who was informed?
- *Where?* Where did the irregularity occur or where the Observer first noted the irregularity? Give the location as area (division- with latitude and longitude), a specified location onboard the vessel or elsewhere i.e. wharf, plant.
- *When?* Include details such as date, time and in reference to a particular event (i.e. after the trawl had come onboard, during processing in factory or through daily check of logbook entries).
- *Why?* Why did the incident occur?
- *How?* How was the irregularity committed? How did the witnesses act or react to the irregularity? How did the Observer become aware of the incident?

If possible, details of an irregularity should be recorded on the scene; otherwise they may be forgotten. However, there are times where notes cannot be taken immediately. A general rule accepted by the courts is that notes be taken within 24 hours of the observance. The following guidelines are recommended when documenting an irregularity.

- Record all pertinent details so that situations can be reconstructed.
- Re-check the circumstances surrounding the irregularity.
- Clarify specifics of the irregularity.
- Attribute information to it's source.
- Record notes as detailed as possible and at the time they occur.
- Do not invent details or speculate about an incident, record only the facts.

- Record the names of everyone in the vicinity of the incident.
- Record attitudes of suspects and witnesses.
- Identify physical evidence (e.g. logbooks).
- Take photographs if possible.
- Use diagrams or sketches to aid in recalling facts.
- Record oral statements using quotation marks to indicate exact quotes.

Notification of Irregularities

The master of a fishing vessel has the basic right to receive notification of a possible irregularity occurring on the ship he commands. Otherwise it may be perceived as entrappment. The Observer must notify the vessel's master of a detected irregularity. Without providing notification to the master, preventable violations might be repeated and the Observer's role as a deterrent to such violations undermined. In addition, DFO's ability to charge and convict violators could be compromised. A judge may sympathize with a master who was not notified of an irregularity.

Care should be taken in considering all relevant facts prior to notification since mistakes threaten the credibility both of Observers and DFO. The action of notification should be a statement of fact based on sound observation. It is not advice, a warning or a threat. The vessel master can choose to heed or ignore the Observer; but they are responsible for the consequences.

Documentation Of Irregularities	
Irregularity	**Specific Points To Include In Documentation**
Misreporting Amounts of Catch	- Amounts of fish logged or hailed vs amounts observed. - Observer method of catch estimation. - Master's stated method of catch estimation. - Observed vs recorded discrepancies at trip completion.
Misreporting Area of Capture	- Observed positions of capture vs logged positions. - Observed estimates by area vs logged estimates by area.
Close Times & Areas	- Positions fished while inside the closed area. - Time/dates & duration of time spent fishing inside closed area. - Observed estimates of fish captured within the closed area. - Other vessels fishing in or near the closed area.
Dumping, Discarding, or Highgrading	- Amounts and method of fish discarded/dumped. - Observer method of estimation. - Reason for discarding/dumping.
Exceeding Bycatch or Catch Limits	- Applicable bycatch/catch weight or percentage limits. - Calculated bycatch or catch weight levels. - Vessels fishing in the area. - Lack of action by the master to avoid exceeding the limits.
Retention of Prohibited Catch	- Location on the vessel where prohibited catch noted. - Species/number/amount of prohibited catches retained.
Gear Resrtictions	- Description of prohibited gear being used. - Effect of prohibited gear on capture of fish. - Duration of time prohibited gear observed to be in use. - Amount of fish captured while using prohibited gear.
Gear Conflict	- Time and position of gear conflict observed. - Description of gear and entanglement. - Position/depth/times of start & end positions of sets with conflict. - Gear markings observed on radar. - Identification and number of vessels in the area of conflict.
Vessel Licence Conditions	- Identification numbers of applicable documents. - Applicable sections of licence.
Habitat Violations	- Description of pollutants or physical damage. - Estimate of amount of pollutants or damage. - Presence of fish (to identify affected area as fish habitat).
Obstruction or failure to assist Fishery Observers	- Description of obstruction or failure to assist. - Description of request for assistance.

Who to notify

The master has ultimate responsibility for a ship and is the person who should be notified of an irregularity. Generally, vessels are controlled by one master but occasionally Observers will encounter vessels in which one individual is responsible for navigation while another handles fishing activity. If the Observer is unsure as to whether the navigation captain or the fishing master has the ultimate authority, both should be notified of an apparent irregularity.

There are some instances whereby other crew members can be informed of irregularities as well. Observers should be guided by common sense in this matter. For example, when closely approaching fixed gear or a closure line it may not be reasonable for the Observer to locate the captain as the problem occurs. Instead, the mate on watch should be alerted to the impending problem so that it may be avoided. The captain should still be located and informed as soon as reasonably possible.

Dealings with an incapacitated master presents a special problem. If an Observer's judgement suggest that due to intoxication or illness, a captain will not understand the notification, then the person next in command should be informed. As soon as the Observer feels the master is capable of comprehending the message, the notification should be repeated.

If Observers encounter an unreasonable, hostile or violent response while attempting to give notification of an irregularity, they should not continue. Even if incomplete, the notification should be considered as given, the situation documented and a report made to DFO. In the event of a threat of violence to the Observer, DFO should be immediately notified.

How, When, and Where to give Notification

Training, briefing instructions and discretion will enable the Observer to determine whether or not to notify a captain of an irregularity. Under no circumstances should an Observer ignore a situation that warrants notification. Conversely, minor problems should not be exaggerated to the point they jeopardize the working relationship with a captain and crew.

Giving notification of an irregularity requires a large measure of judgement, tact and diplomacy. The Observer must approach the master in a calm, reasonable, competent manner. Notification of an irregularity may upset the harmony on a ship and precipitate an angry reaction. It is therefore not a step to be taken lightly or casually. Calmness, flexibility and professionalism by the Observer will help in communicating the message.

Observers must never overstep their authority to threaten action they are not empowered to carry out. They are not enforcement officers and cannot carry out any such duties. By giving notification the Observer is indicating that a violation may have taken place. More precise enforcement action must be left to a Fishery Officer who has the power to gather or seize evidence, take formal statements and is trained in the formal laying of charges. The Observer's information and documentation will greatly assist a Fishery Officer in determining the appropriate course of action.

While giving notification of a possible irregularity the Observer should not read from the regulations but explain the nature of the irregularity. Quoting regulation section numbers may unnecessarily dramatize the situation. However, if requested the master should be shown the appropriate regulation.

When a language barrier exist, a crew member may assist in interpretation or if necessary drawings and dictionaries can be used. Whether or not further action results, the Observer must undertake all effort to ensure the notification is understood.

Unless the irregularity is urgent, the Observer should approach the captain at a time when attention is not diverted elsewhere. Avoid if at all possible, times such as shooting or hauling of the trawl or during difficult maneuvers. The master should be approached while alone or in the presence of another officer rather than in the middle of a crowd. Consideration of the severity of an irregularity should indicate to an Observer whether to interrupt a conversation or activity. Observers should not interrupt a master's sleep or meals to talk about trivial matters when the mate or other crew members are available to solve the problem. Clerical errors and minor omissions in logs such as a missing side number are examples of this.

Normally the Observer will notify a captain as soon as possible after an irregularity has occurred. If however, the irregularity is repeated and the master has already been notified in that regard, then the Observer is under no obligation to repeat the notification. The timing of the notification should be commensurate with its severity. Fishing in a closed area for example, may necessitate immediate notification while log problems can usually await a convenient time for both captain and Observer.

What to Notify

The Observer should be flexible on clerical errors and minor omissions in logbooks and trivial problems in which there is an absence of intent. A more casual approach can be used for these unless their frequency is such that regulations are compromised through sloppiness. In general, these minor problems fall outside the general rule of one notification for each irregularity.

Follow up Documentation

In addition to documenting the apparent irregularity, the Observer must also document details on notification of the irregularity to the master. This should include the place and time, an indication of the people present and a record of the remarks and reactions made as a result. A position in latitude and longitude at the time of notification is not essential provided that such information is provided for the irregularity. For the purposes of this or any other documentation, there is no such thing as an "off the record" comment.

Reporting an Irregularity

After the Observer has identified, documented and notified the master of the irregularity they should report it in an appropriate manner. Reporting an irregularity can occur in a number of ways. A report can be sent by the Observer from sea, a request can be made for an inspection or it may be included as a narrative in the trip report.

The Observer's notification to a master often leads to the resolution of the problem. For irregularities that are immediately corrected such as logbook procedures, unintentional misrecording or adherence to policies, the Observer need not report these trivial matters from sea. However, all such events should be documented in the notebook. In addition, if the problem has been satisfactorily remedied it is not necessary to request a boarding.

For more serious problems where actual damage may have occurred (avoidance of fixed gear, closed areas, etc) a boarding request should be made regardless of the action taken following notification. If a situation escalates to extreme proportions where the Observer is threatened or otherwise endangered they may request an immediate or priority boarding.

7.9 Courtroom Presentation

After termination of the deployment where an irregularity was noted, the Observer's role may continue as a key witness in the subsequent formal investigation by Fisheries Officers. This involves pre-trial responsibilities and testifying in court (personal appearance in the courtroom, giving testimony and cross-examination)

Pre-trial responsibilities

The most obvious and important pre-trial responsibility is proper documentation of the irregularity while deployed as an Observer. See the previous section for documenting irregularities. In addition, the Observer's pre-trial responsibilities include:

- Organizing, compiling and writing complete and accurate reports on each incident regardless of the apparent chances of a subsequent trial.
- Reviewing notes and all other pertinent material prior to court and prior to the pre-trial conference with the Prosecutor.
- Attending a meeting with the investigating Fishery Officer.
- Attending a pre-trial conference with the Prosecutor.
- Becoming totally familiar with and confident in the material likely to be the object of testimony.

Testifying in Court

The purpose of witnesses are to present evidence in court. The guilt or innocence will be determined by the courts. The Court's impression of the Observer begins as that person walks to the stand and takes the oath. The attitude of the Observer towards the court is reflected in their manner and bearing. Observers must appear on time for the trial. After taking the oath, the witness remains standing in the majority of Canadian courts unless the judge directs otherwise or it is essential to sit for health reasons. The Observer should refrain from fidgeting thereby appearing confident, not only in attitude, but also in the testimony itself. Even though questioned by counsel, the Observer should direct all answers to the magistrate or judge, addressing him/her as "Your Honor". Observers should remember this point when defense Counsel employs tactics designed to intimidate. Observers should use the following suggestions when giving evidence in Court:

- Tell the truth, no case is worth perjury.
- Speak loudly, clearly, slowly.
- Understand the question and wait for the full question before answering.
- Give only facts that you know, never give opinions.
- Remain calm at all times, don't hurry, worry or panic.
- Avoid allowing cross-examination to upset you.
- Tell the events chronologically and in your own way.
- Don't volunteer additional information, yet don't conceal or distort facts.
- Provide an answer for all questions even if it means having to say "I don't know".
- Don't hesitate to correct an error or mistake.
- Examine exhibits carefully before testifying as to their identity.
- Be serious at all times to show respect for the justice system.

Personal appearance in the courtroom

Observers on the witness stand must leave a positive, favorable impression. Cleanliness, neatness and concern for the details of their appearance are essential. The basic nature of testimony is not affected by outward appearances, however, the weight which is given to that testimony by the judge or jury may be greater or lesser depending upon their impression of the Observer's appearance.

Cross-examination

The points emphasized in the preceding section apply throughout the whole course of the witness' testimony. They are especially relevant to cross-examination due to the intent and subsequent nature of the process itself. The purpose of cross-examination is "...to weaken, qualify or destroy the case of the opponent; and to establish the party's own case by means of his opponent's witness" (Daniel A. Bellemare). Observers should keep the following suggestions in mind as they are being cross-examined:

Cross-Examination Techniques

Technique	Purpose	Witness' Response
Rapid fire questions	Confuse the witness and force inconsistent answers	Remain calm and take time to consider the question and the answer
Condescending counsel	To give the impression the witness is inept, answers lacks confidence, and the witness may not be reliable	Be firm, decisive
Friendly counsel	To lull the witness into a false sense of security where they may give answers favorable to the defense	Stay alert and bear in mind facts of the case
Badgering, belligerent	To anger the witness so they lose their sense of logic and calmness	Stay calm and speak deliberately
Mispronouncing witness' names	Distract witness's attention from testimony to irrelevant errors that may lead to errors in testimony	Ignore the mispronunciation and concentrate on questions and answers
Suggestive questions	Attempts to confuse or lead the witness	Disregard suggestions and concentrate on facts while answering questions
Demanding "yes" or "no" answer to unclear questions	To prevent all mitigating and pertinent details from being considered by the court	Explain the answer and if interrupted by the defense counsel pause until the court instructs you to answer in your own words.
Reversing witnesses words	To confuse the witness so as to demonstrate a lack of confidence in the witness	Listen intently and correct counsel when they make a mistake
Repetitive questions	To obtain inconsistent or conflicting answers from the witness	Listen carefully and state "I have just answered that question"
Conflicting answers	To show inconsistency in the investigation	Remain calm. Unless exact answers can be truthfully given, use the term approximately, and refer to notes if necessary.
Staring	To provoke the witness into offering more than the question called for	Wait for the next question
Long oratory with implied questions	To evoke statements that may be irrelevant and confuse the issue	Ask for the question to be repeated or explain the evidence clearly

7.10 Briefing and De-briefing

> ***Briefing:*** *an informative session that marks the beginning of a deployment to prepare an Observer for their work assignment.*

In a briefing session details of the deployment will be outlined such as:

- Name and type of vessel
- Fishery the vessel will be involved in
- Type of gear the vessel will likely use
- Vessel's ETD and port of departure
- Approximate length of the deployment
- Monitoring requirements
- Sampling requirements
- Regulatory measures pertaining to the fishery

It is usually during briefing that Observers are issued the necessary papers and equipment to carry out their assignment. During a briefing session an Observer must ensure that:

- They have all the necessary equipment and data forms to carry out their work.
- Trip logistics are in place.
- They completely understand every aspect of their assignment.
- They know what will be expected in their data package at the end of the trip.

> ***De-briefing:*** *a reporting session that marks the end of a deployment in which the Observer reports on all aspects of their deployment.*

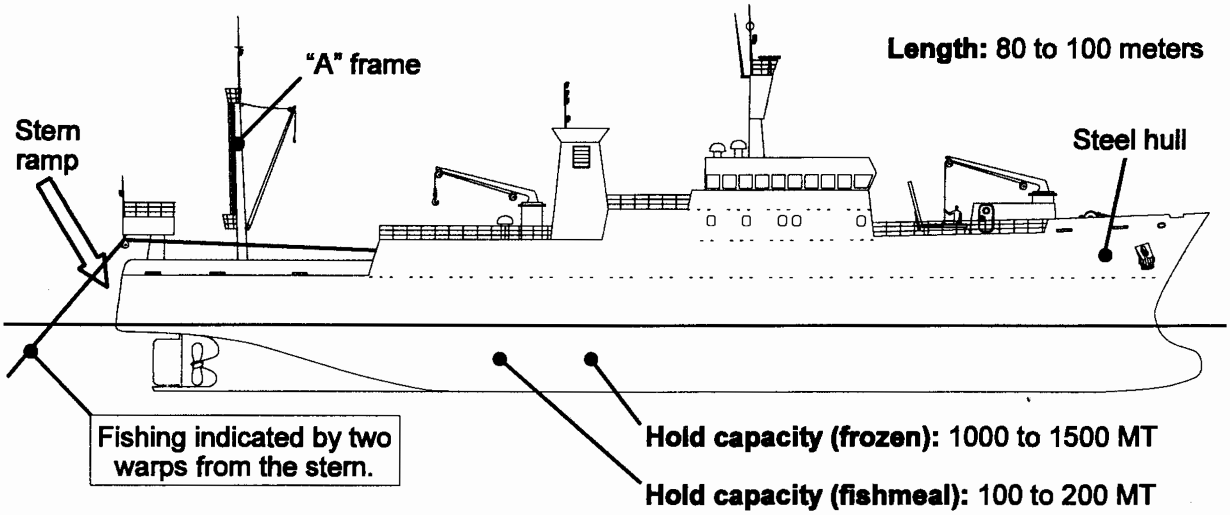
The de-briefing session is a check point for quality of the data package. To ensure a smooth de-briefing session Observers must employ care and diligence throughout their deployment in preparing for a de-briefing.

In a de-briefing session an Observer must be totally prepared to submit a completed data package. To do this Observers must:

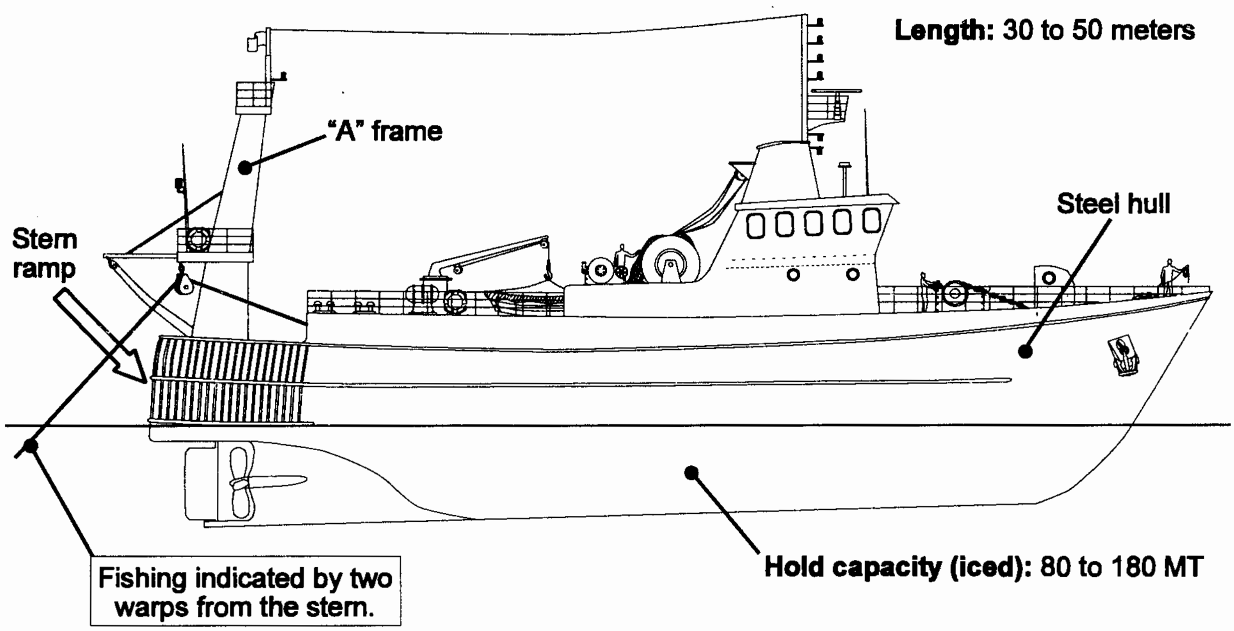
- Have all administrative papers completed.
- Have all data sheets completed.
- Have their papers in an orderly and organized fashion.
- Ensure that all catch figures are balanced across the various sheets.
- Have the trip report completed.

Appendixes

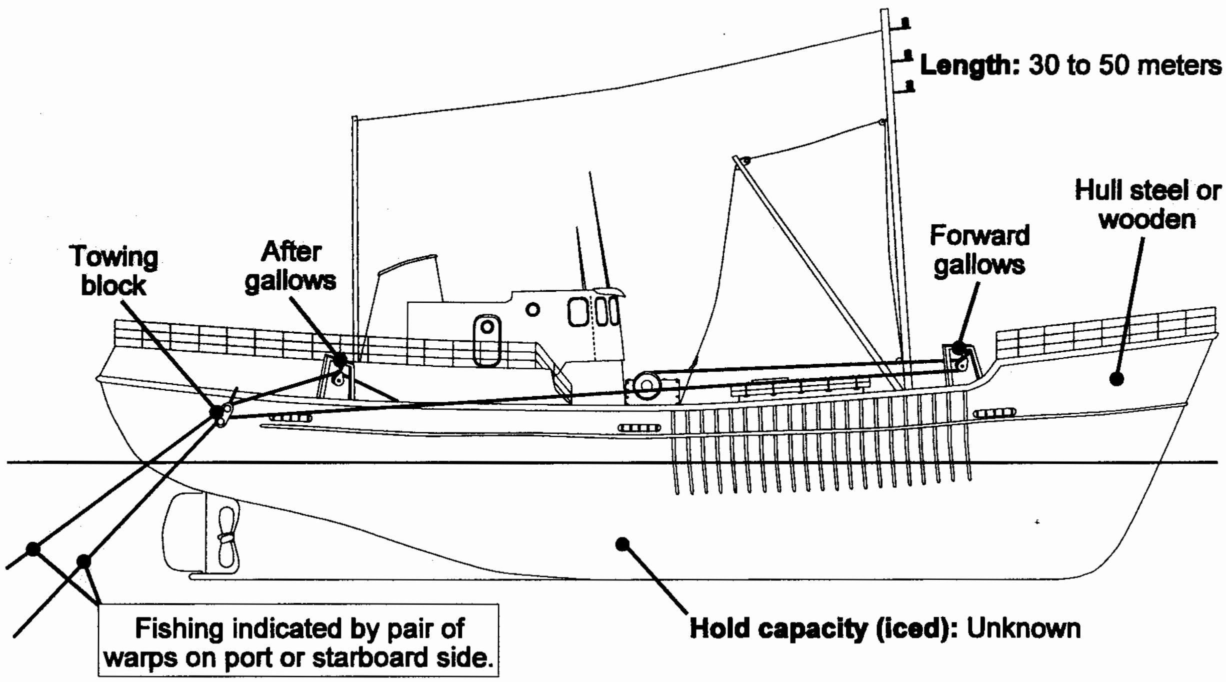
FACTORY FREEZER TRAWLER



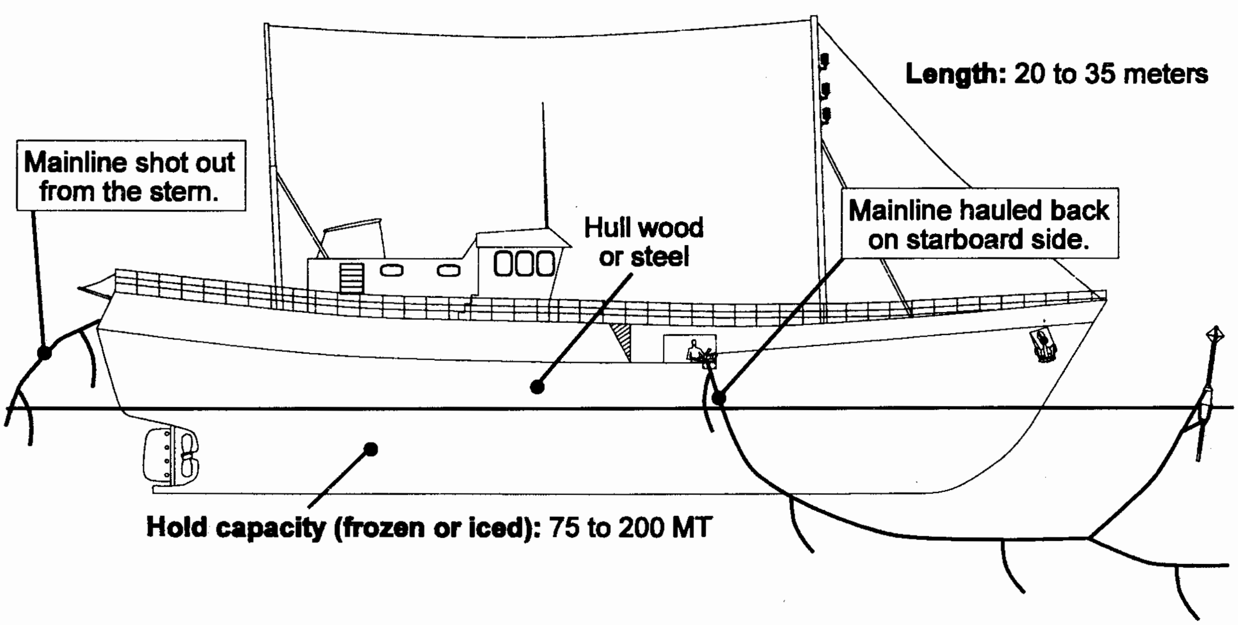
OFFSHORE STERN TRAWLER



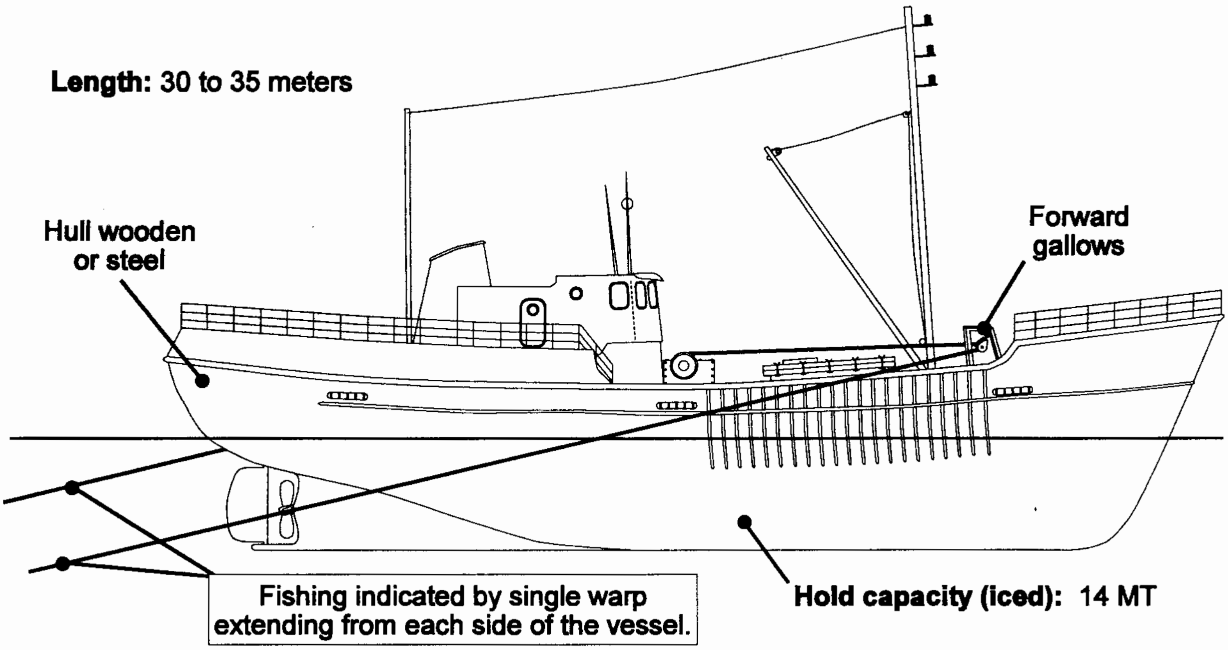
OFFSHORE SIDE TRAWLER



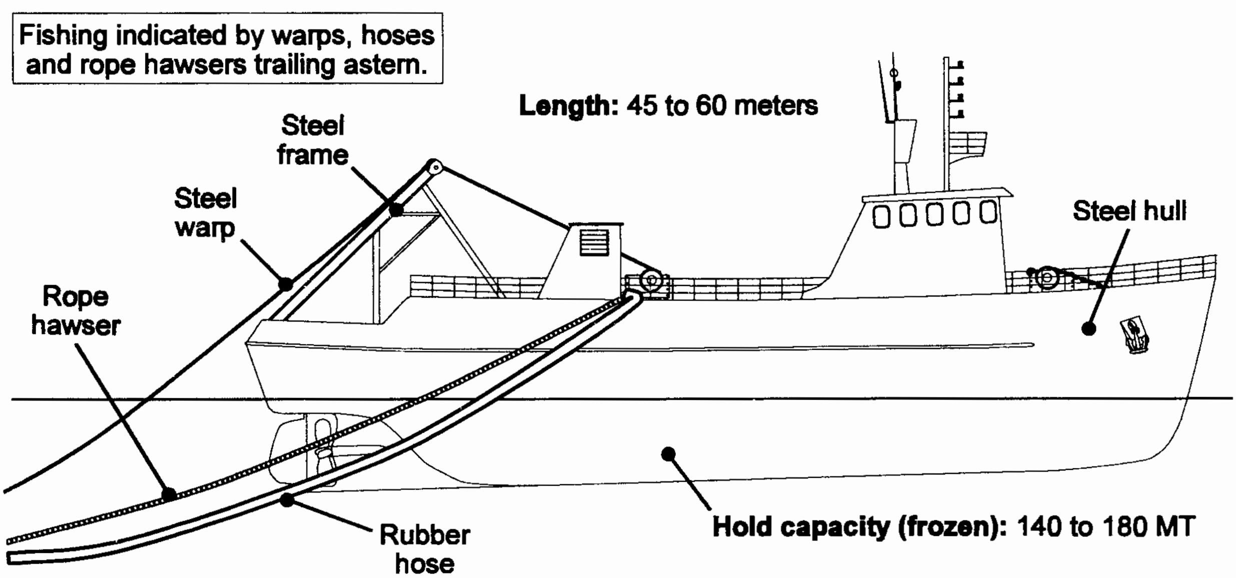
OFFSHORE LONGLINER



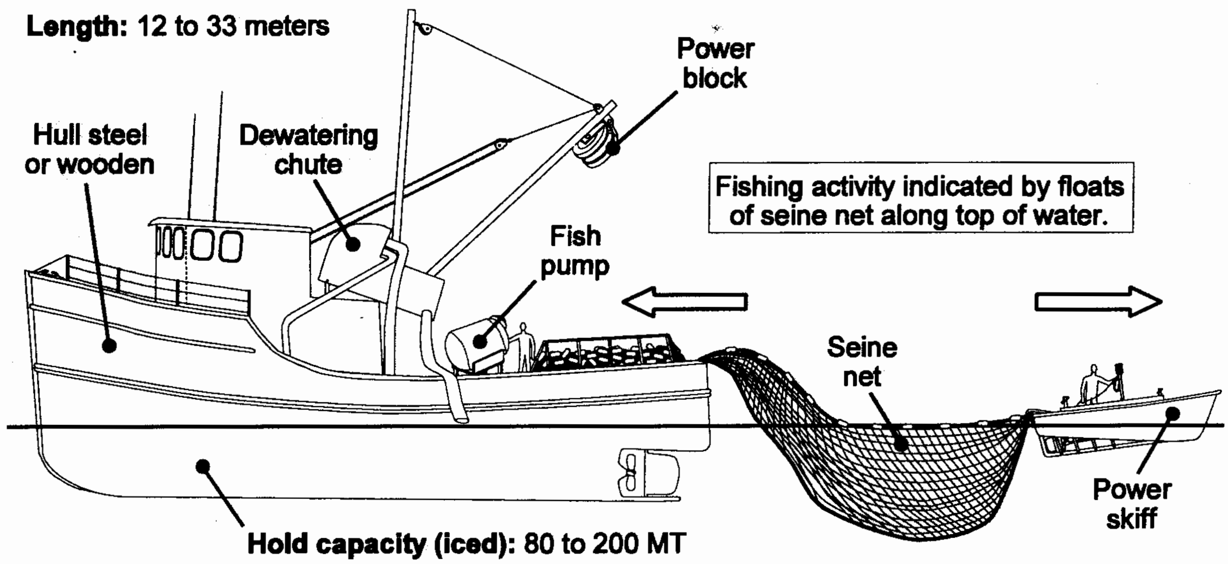
OFFSHORE SCALLOPER



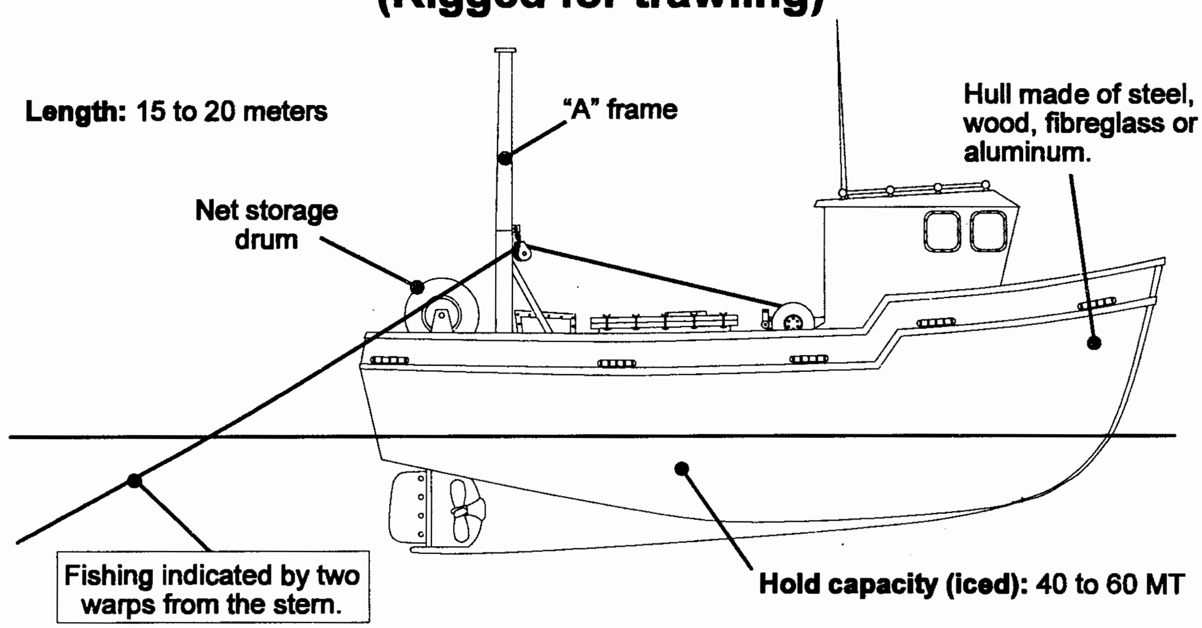
OFFSHORE CLAM DREDGER



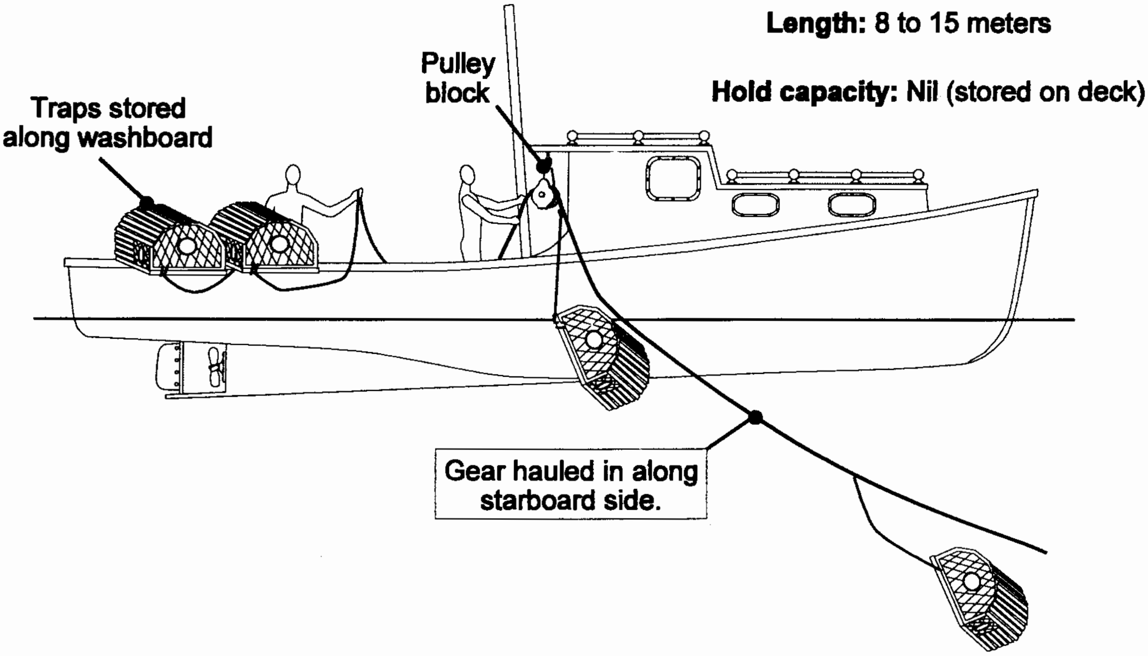
PURSE SEINER



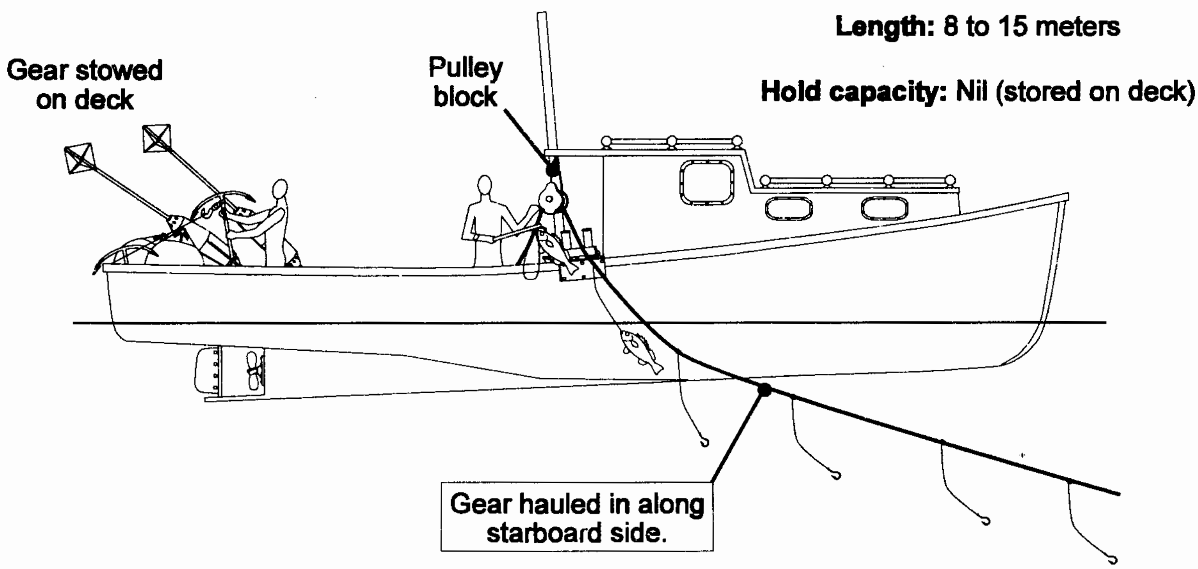
SMALL MULTIPURPOSE VESSEL (Rigged for trawling)

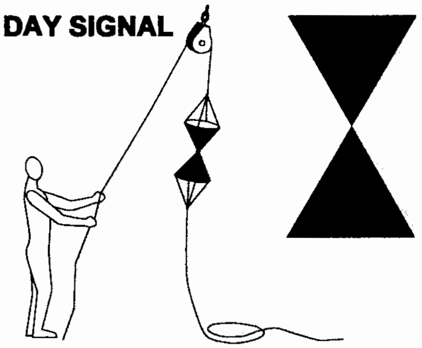


SMALL MULTIPURPOSE VESSEL (Rigged for hauling baited traps)

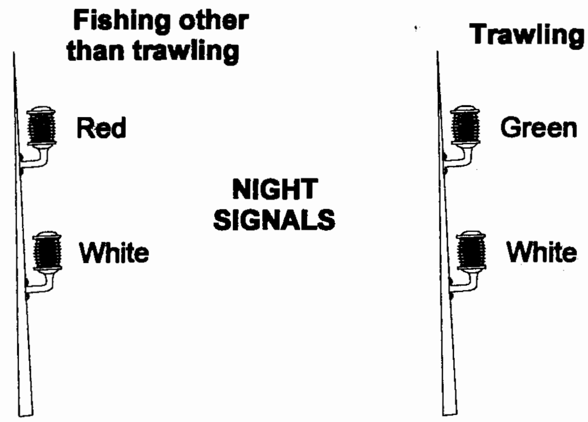


SMALL MULTIPURPOSE VESSEL (Rigged for hauling longline)

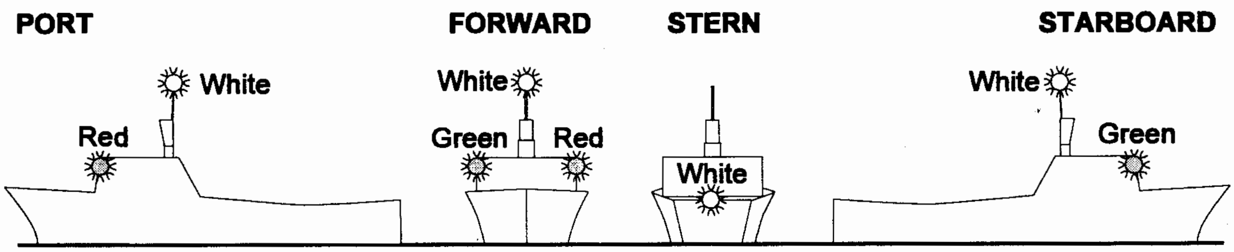


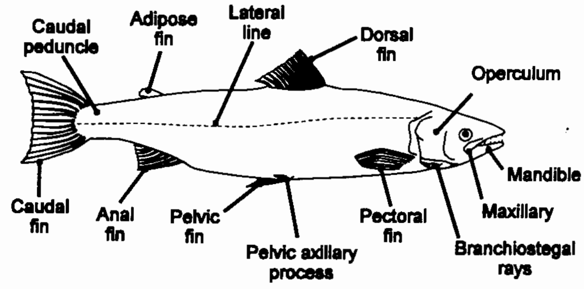


Fishing activity indicated by two cones point to point.

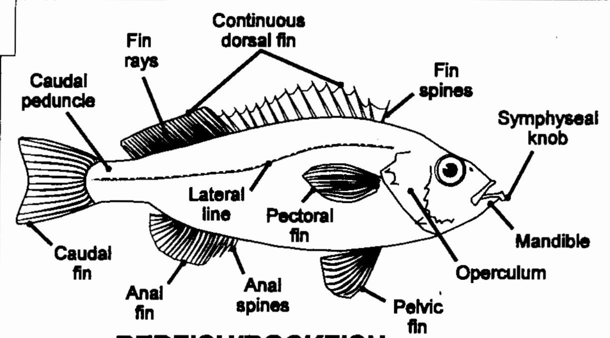


NAVIGATION LIGHTS & FISHING SIGNALS

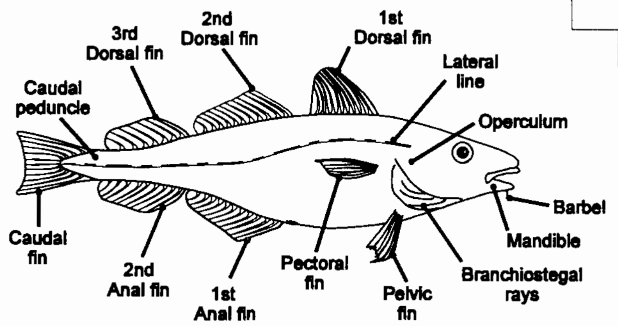




SALMONIDS



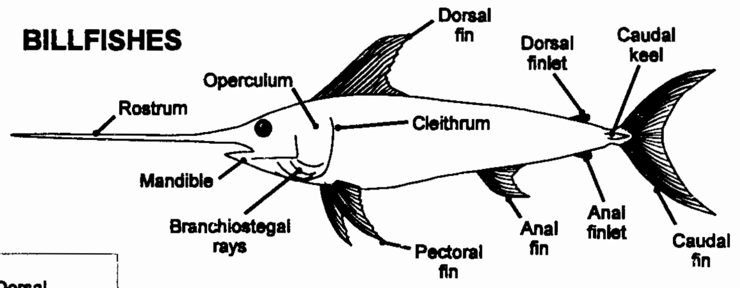
REDFISH/ROCKFISH

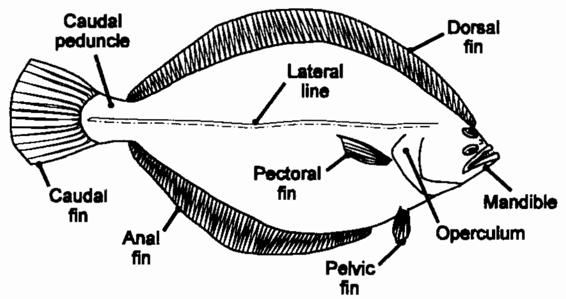


COD-LIKE FISH

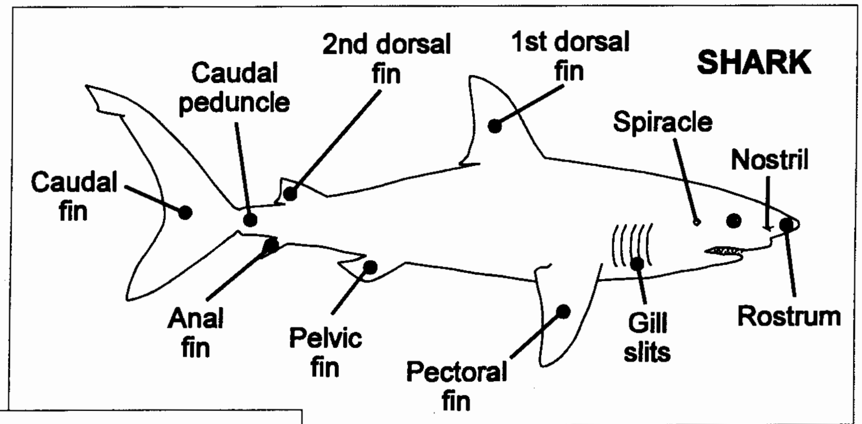
EXTERNAL FEATURES OF TYPICAL BONY FISH

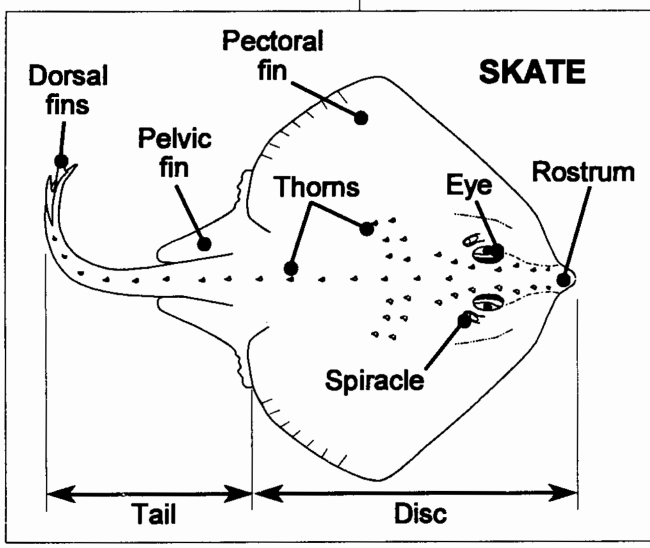
BILLFISHES





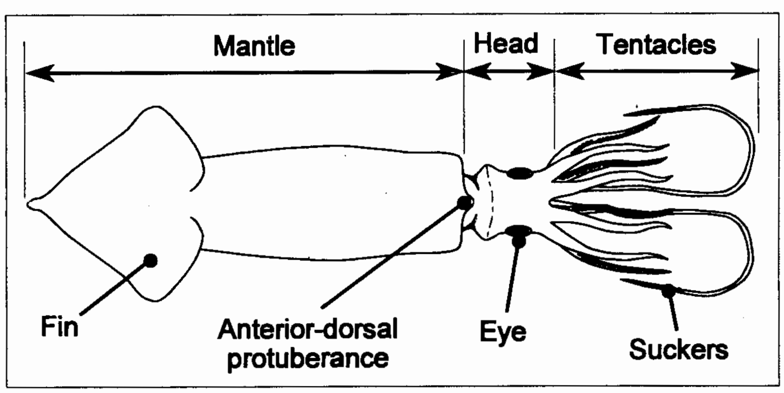
FLOUNDER-LIKE FISH



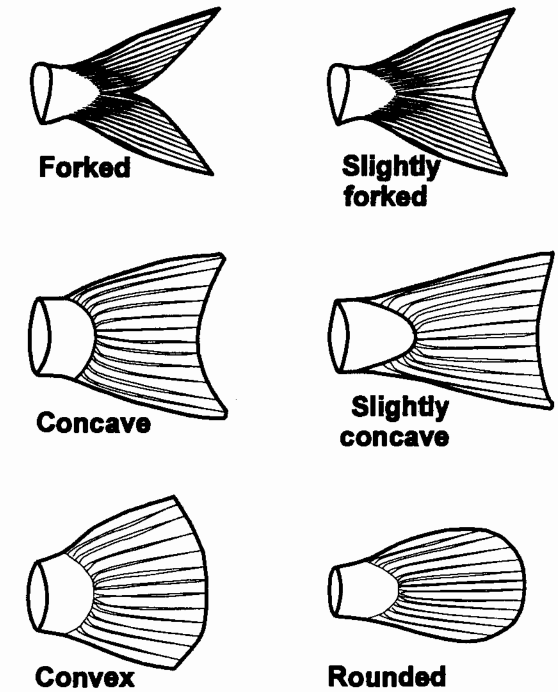


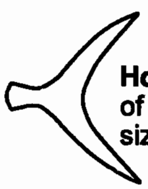
EXTERNAL FEATURES OF CARTILAGINOUS FISH

EXTERNAL FEATURES OF SQUID



ANTERIOR EDGE OF CAUDAL (TAIL) FIN



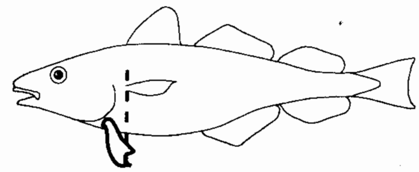


Homocercal - upper and lower lobes of the tail are of approximately equal size.

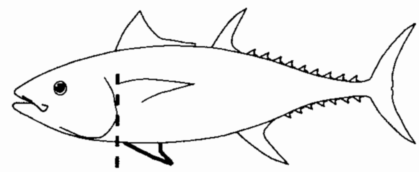
SHAPE OF CAUDAL (TAIL) FINS

Heterocercal - upper lobe of the tail is larger than the lower lobe.

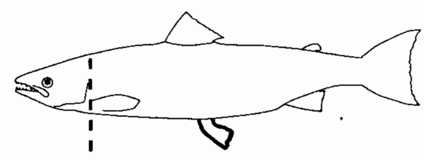
POSITION OF PELVIC FINS



Jugular pelvic fins - located ahead of the pectoral fins.



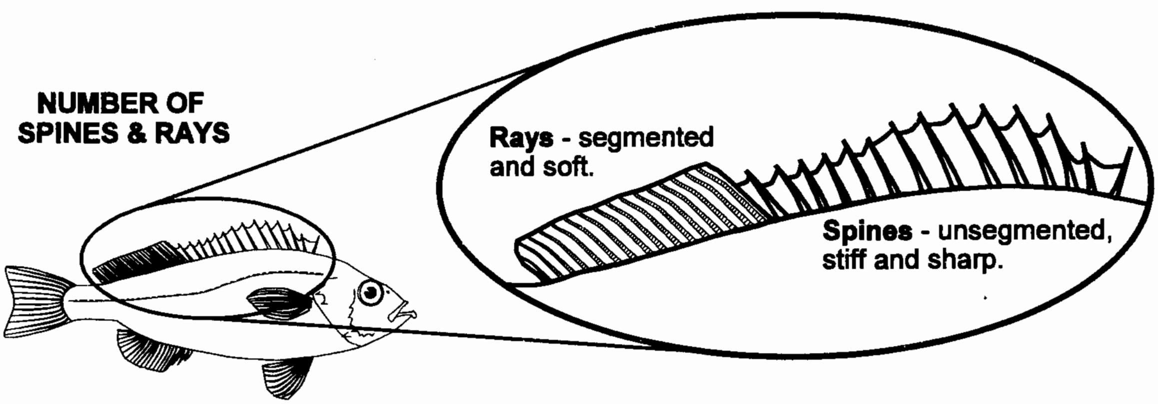
Thoracic pelvic fins - located towards the head, below and behind the pectoral fins.

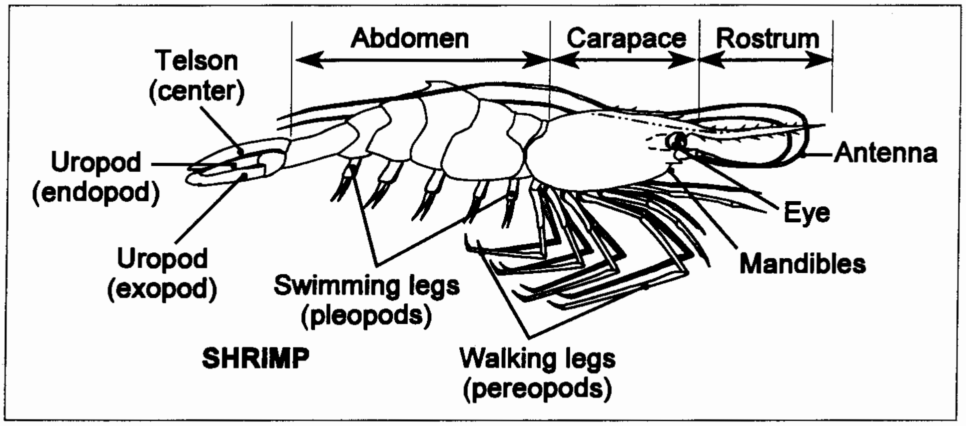


Abdominal pelvic fin - located on the abdomen distant from the head.

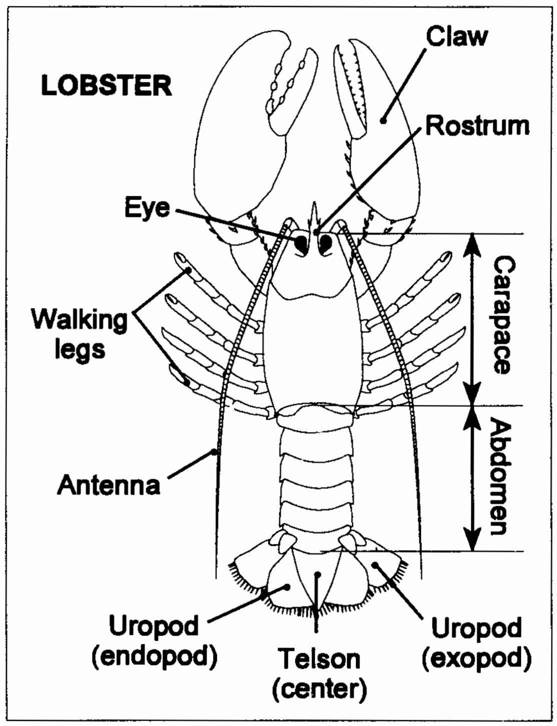
CHARACTERISTICS OF FISH FINS

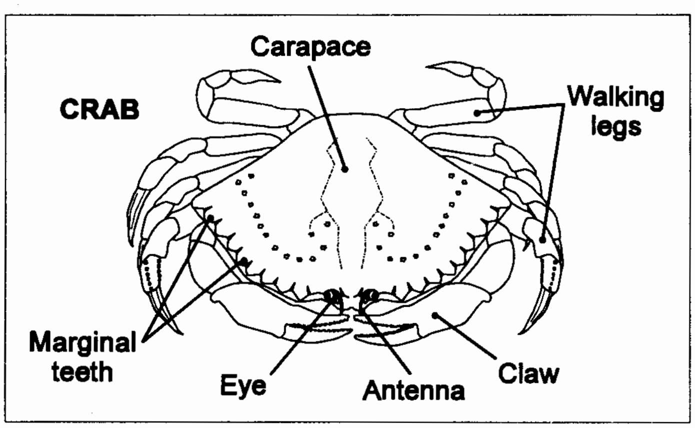
NUMBER OF SPINES & RAYS



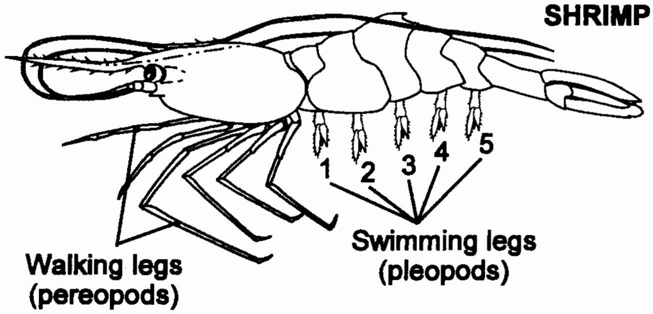


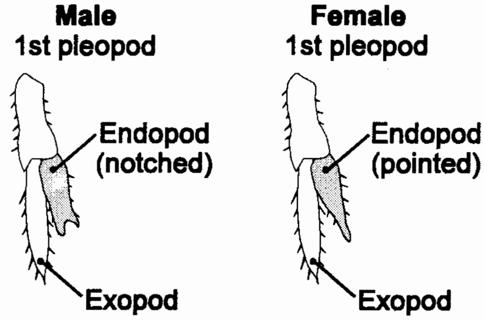
EXTERNAL FEATURES OF TYPICAL CRUSTACEANS





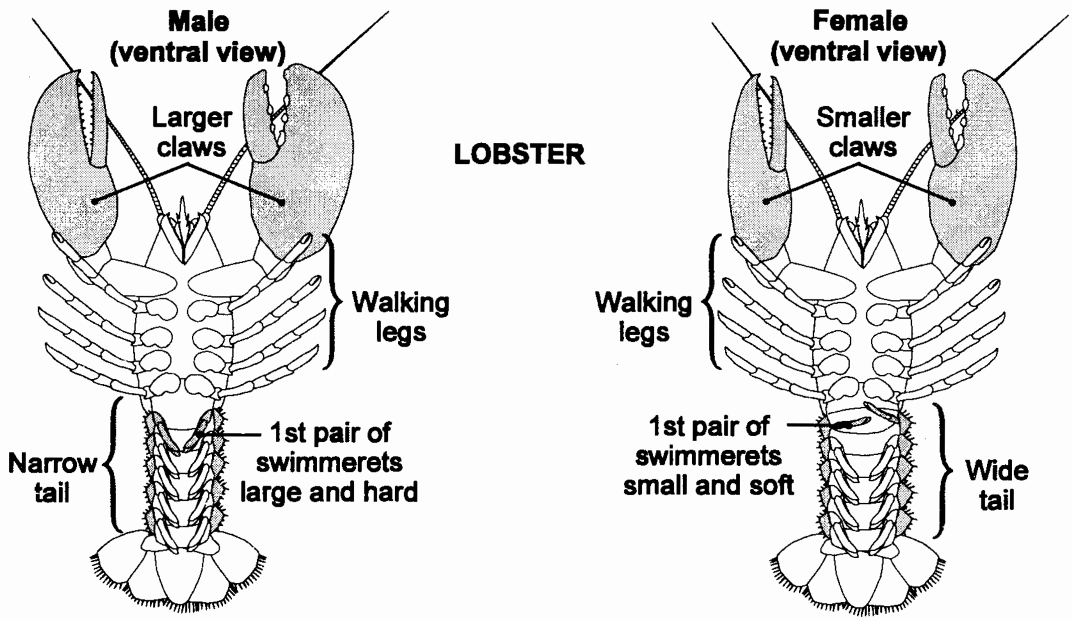
SHRIMP



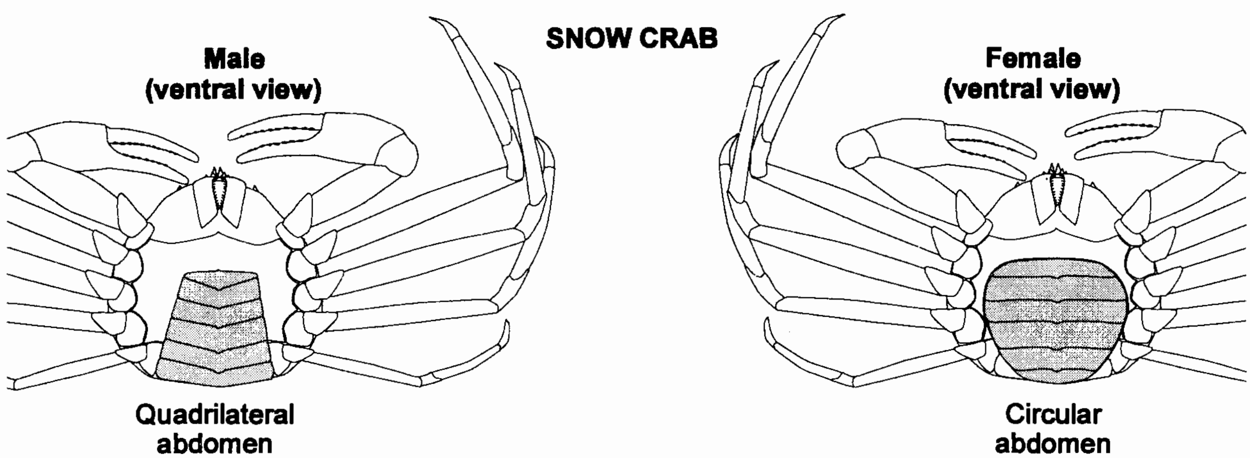


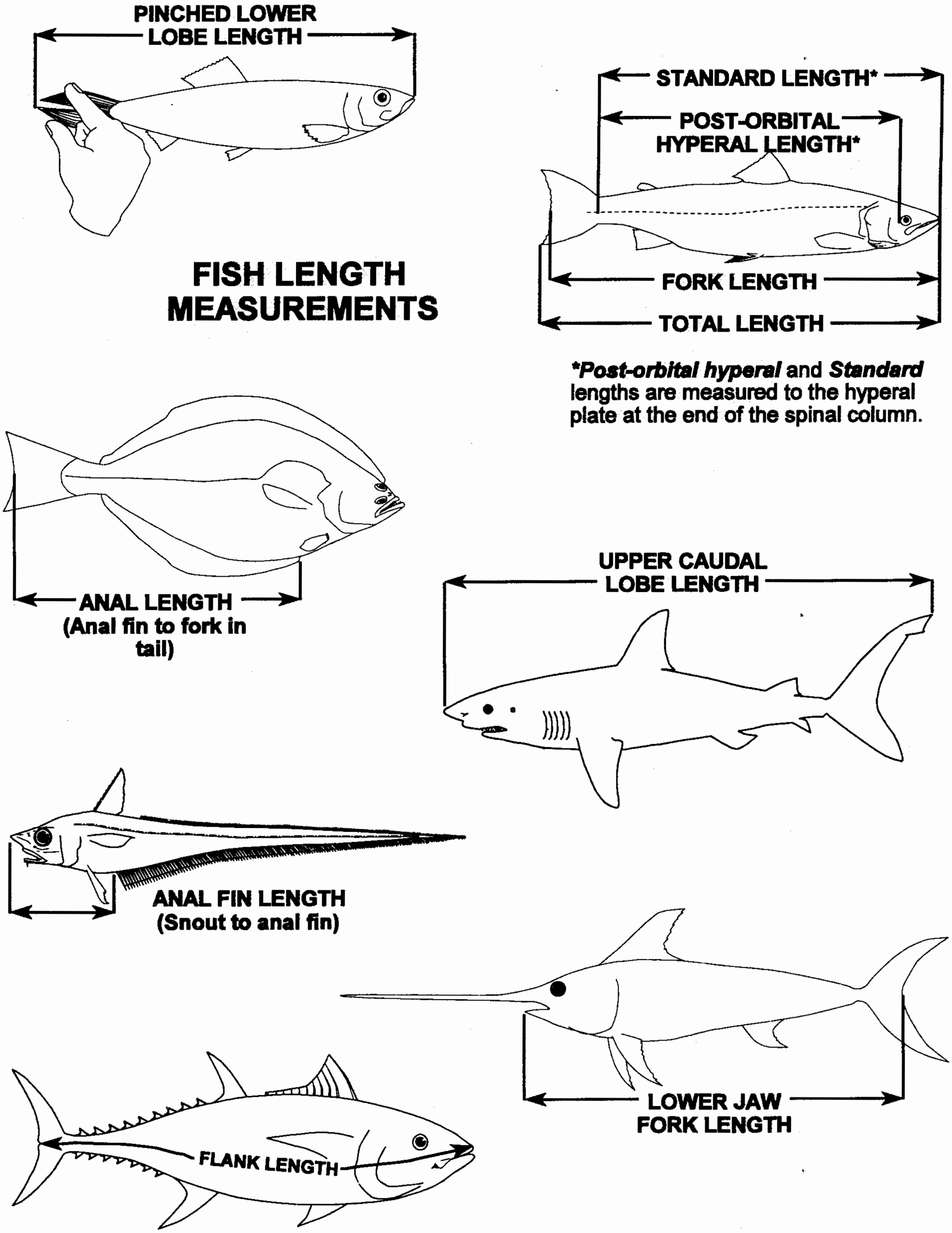
SEX DETERMINATION OF CRUSTACEANS

LOBSTER

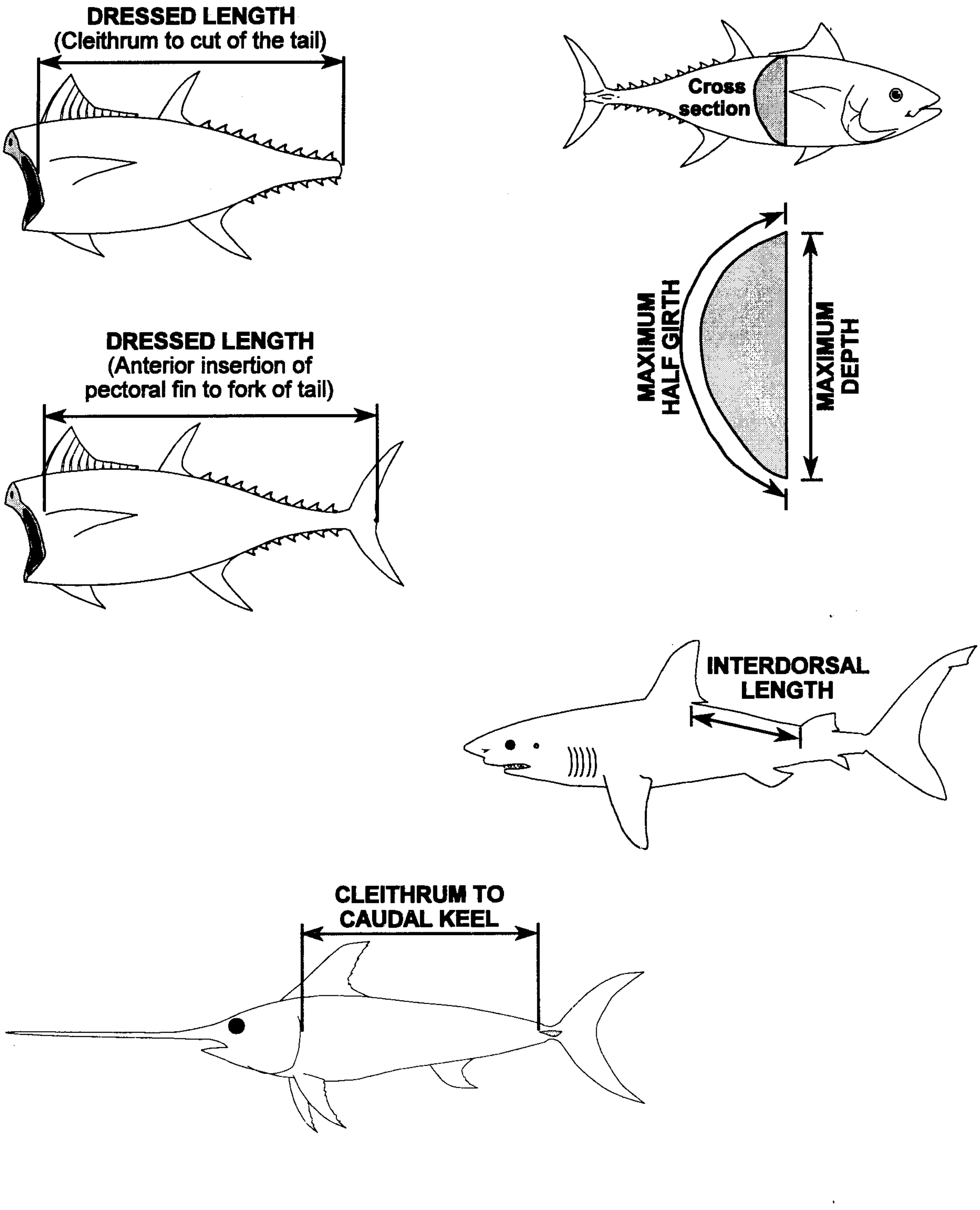


SNOW CRAB



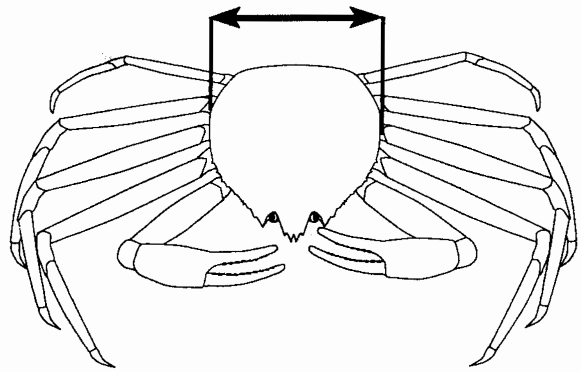

PINCHED LOWER LOBE LENGTH
STANDARD LENGTH*
POST-ORBITAL HYPERAL LENGTH*
FISH LENGTH MEASUREMENTS
FORK LENGTH
TOTAL LENGTH
*Post-orbital hyperal and Standard lengths are measured to the hyperal plate at the end of the spinal column.
ANAL LENGTH (Anal fin to fork in tail)
UPPER CAUDAL LOBE LENGTH
ANAL FIN LENGTH (Snout to anal fin)
LOWER JAW FORK LENGTH
FLANK LENGTH

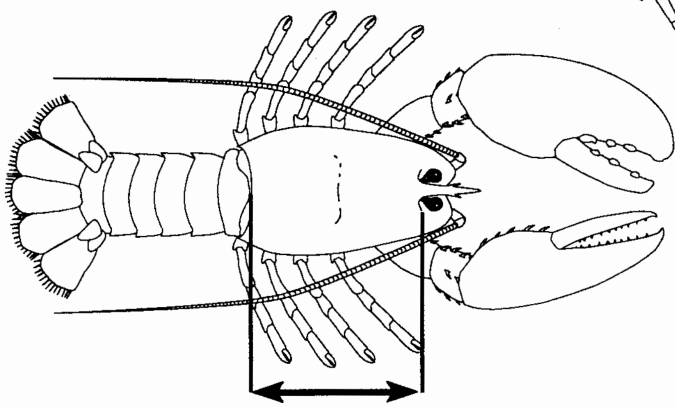
SPECIALIZED MEASUREMENTS OF LARGE PELAGIC FISH



SHELLFISH MEASUREMENTS

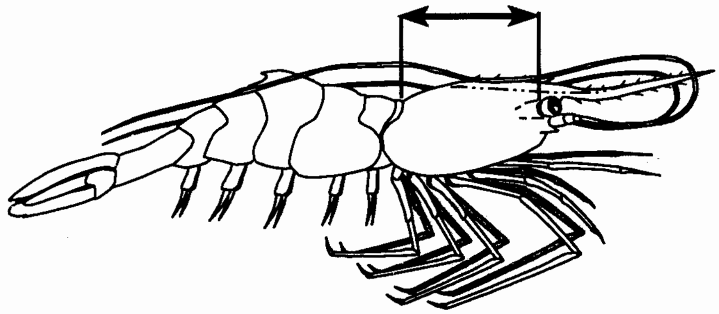
CARAPACE WIDTH



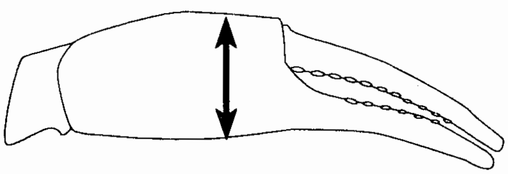


CARAPACE LENGTH

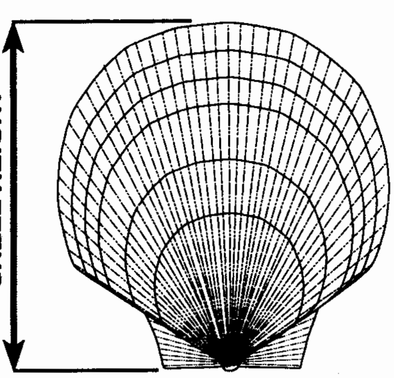
CARAPACE LENGTH



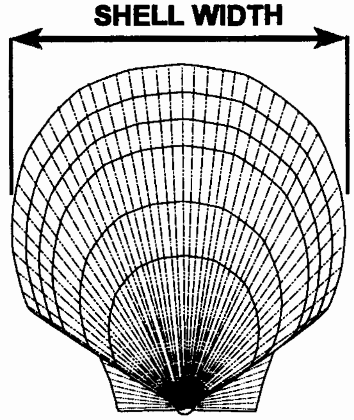
CLAW HEIGHT



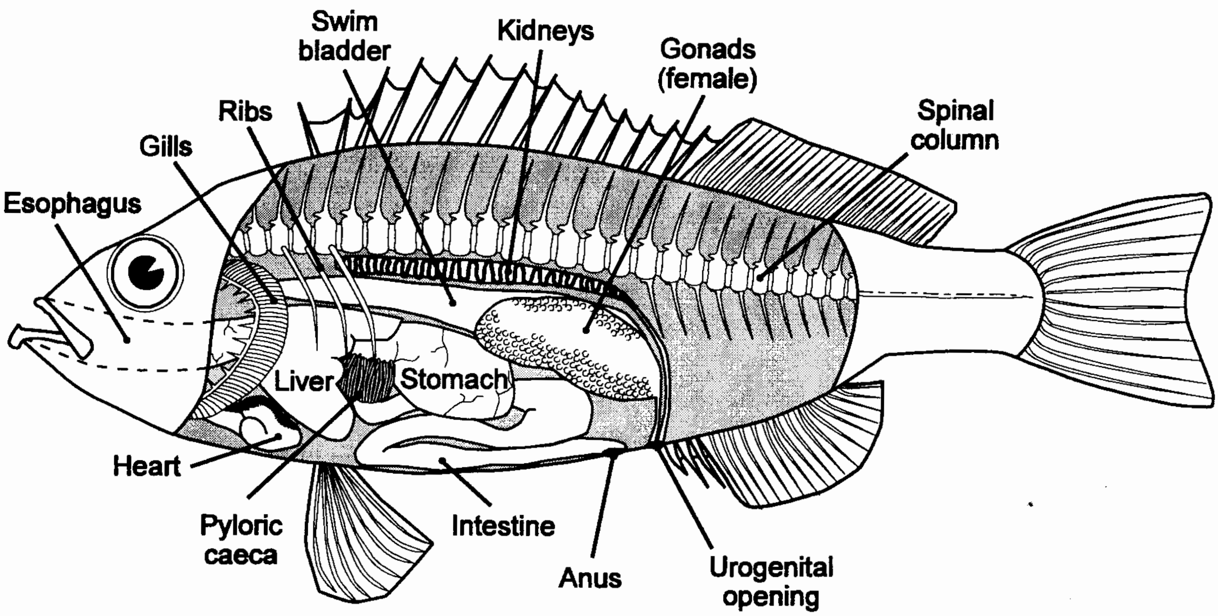
SHELL HEIGHT



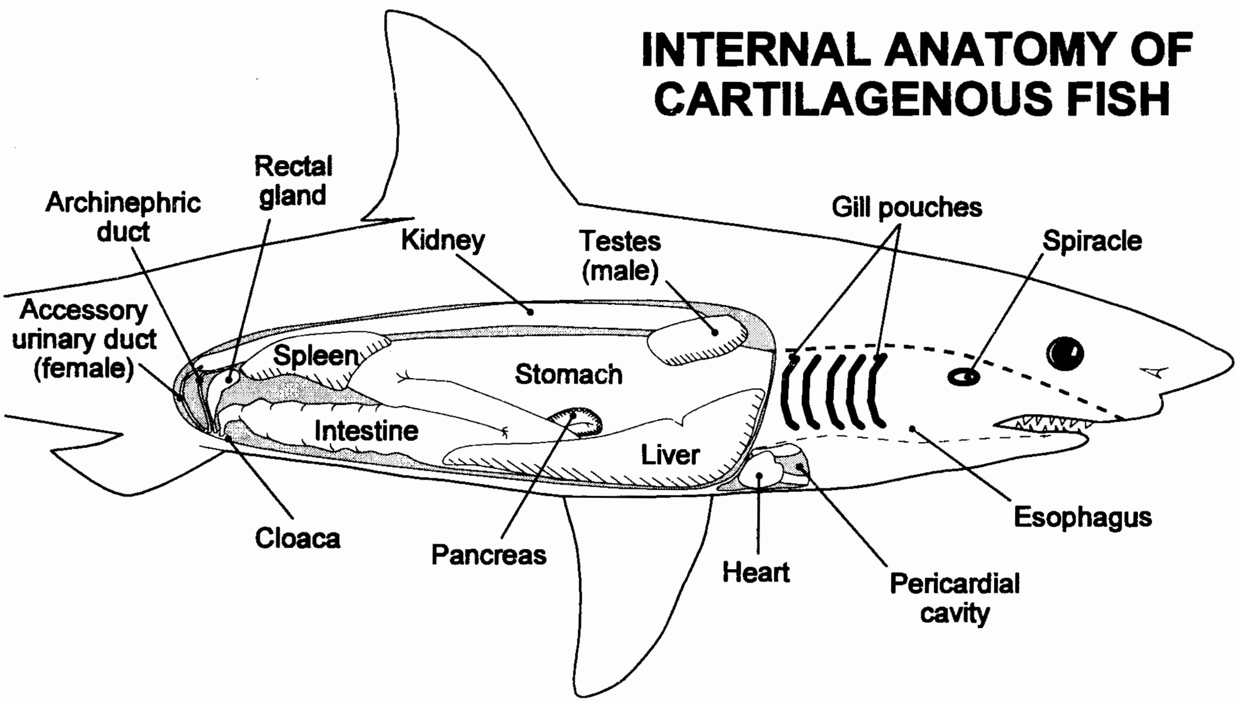
SHELL WIDTH



INTERNAL ANATOMY OF BONY FISH



INTERNAL ANATOMY OF CARTILAGENOUS FISH



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