NORTHEAST FISHERIES OBSERVER PROGRAM BIOLOGICAL SAMPLING MANUAL

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INTRODUCTION

The Northeast Fisheries Observer Program (NEFOP) collects, maintains and distributes data for scientific and management purposes in the northwest Atlantic Ocean. The Program is a component of the Northeast Fisheries Science Center (NEFSC) of the National Marine Fisheries Service (NMFS). For the year of 2004, NEFOP trained and deployed approximately 100 observers and provided coverage on a variety of fisheries averaging to about 8000 days at sea.

This guide is intended to serve as a general at-sea biological sampling reference for NEFSC fisheries observers. It contains summaries and tables designed to enable observers to quickly determine the correct biological sampling protocols and methods while at sea. While this manual provides identification criteria for selected species that have proved troublesome in the past, observers should mainly rely on the field guides issued in training for species identification.

Biological sampling is one of the most important functions of a fisheries observer. Information and samples collected by observers are often unobtainable by any other method. These data are used in scientific studies and can influence management regulations. It is therefore very important that observers have a thorough understanding of biological sampling principles and practices. Prior to deployment, especially in a new fishery, observers should review all biological sampling protocols and resolve any uncertainty with their supervisor or NEFOP staff.

In addition to this manual, the NEFSC Fisheries Observer Program Manual provides a detailed description of each data field collected. The NEFSC Fisheries Observer Program Training Manual is a textbook for observer trainees as well as a reference for experienced observers containing in-depth instruction on procedures and protocols relating to biological data collection as well as other aspects of the job, such as safety at sea.

This manual represents a revision of the biological sampling protocols described in the 1996 NEFSC Observer Program Manual. All figures contained in this version are from the 1996 edition unless otherwise noted. For documentation of other changes see Documentation of changes made to the NEFSC Biological Sampling Protocols, 2005.

OBSERVERS AT WORK

Observer collecting actual weights.

Observer measuring mesh size from a trawl net codend.

Observer recording data.

Observer lengthing monkfish.

Cover photos (left to right):Observer collecting samples from a harbor porpoise. An Observer discarding sampled catch. An observer lengthing flounder. All photos from NEFSC Observer Program photo files.

BIOLOGICAL SAMPLING PROTOCOLS: overview

Definitions

Observed Haul: A haul for which the observer collects weights for all species both kept and discarded. Collection of discard information includes everything brought up in the gear; plants, vertebrate and invertebrate animals, rocks and debris.

Sampled Haul: A haul for which the observer collects detailed biological information, such as length measurements and age structures, from certain species or portion of the catch.

Summary

Biological sampling involves collecting data on the species caught in order to aid in determining the effect of fishing effort on catch size and species distribution. These data are also useful in establishing length-weight relationships, aging, migration patterns, food habits, and other valuable biological information.

Biological sampling consists of the collection of the following information from both the kept and discarded catch:

- Actual weights
- Length frequencies
- Age structures
- Tissue and/or other samples, which may include specialty sampling requests

Biological sampling should generally occur after or during every or every other observed haul, as the instructions for each fishery specify. Sampling after every other observed haul is requested in order to allow adequate time to **thoroughly** sample hauls.

BIOLOGICAL SAMPLING: overview

BIOLOGICAL SAMPLING: overview

The tables and summaries included in this manual are designed to give the observer enough information to make decisions about which species to sample, and in what priority, on a per haul basis.

- Tables 1a-g. Length Frequency and Age Structure Sampling Priorities are organized by fishery (excluding the pelagic fisheries) and area, with species listed alphabetically. Each list includes fish, shellfish and squid species most likely to be encountered in the fishery, and gives a priority rating (1 = high, 2 = medium, 3 = low) to guide in choosing the order in which to sample species on a per haul basis.

- Table 2. Fish and Shellfish Sampling Requirements by Species for Domestic Fisheries lists the number of lengths, and the type and number of age structures to collect for each fish, shellfish and squid species which may be sampled from the non-pelagic fisheries.

- Table 3. Pelagic Species Sampling Requirements for Domestic Fisheries summarizes the sampling priorities and protocols for pelagic species.

- Table 4. Marine Mammal Biological Sampling Priorities summarizes the sampling priorities and protocols for incidentally taken marine mammals.

- The Sea Turtle and Sea Bird Biological Sampling Protocols section summarizes the sampling priorities and protocols for incidentally taken sea turtles and sea birds.

These tables are guidelines, and not absolute instructions. Every fishery, every trip, and every haul may be different. Thus, sampling procedures must be adapted by the observer to each unique situation.

Generally, only those species listed in Tables 2 & 3 should have length measurements and, where applicable, age samples collected, as these species are considered the commercially important (marketable) species taken by the specific gear in the designated area. However, significant quantities (catches) of targeted species or bycatch of

commercially important species which may not be listed in these tables may also be sampled. In general, the observer should attempt to obtain a large variety of kept and discard samples of the requested size (see Tables 2 and 3) from species in the same haul or statistical area. Sampling larger numbers of animals than requested produces data of little additional value.

When deployed in a pelagic fishery (*i.e.* pelagic drift gillnet, pelagic pair trawl, pelagic longline, etc.), the sampling priorities for pelagic species should be followed, as outlined in Table 3. This table should also be consulted regardless of the fishery, whenever pelagic species are caught.

Specialty sampling requests should also be accommodated whenever time and circumstances permit.

INCIDENTAL TAKE SAMPLING PRIORITIES FOR ALL FISHERIES

Marine mammals and **sea turtles** are high sampling priority species. However, additional work-up beyond minimum requirements, should occur only after the sampling of priority species listed in Tables 1a-g and/or Table 3 (*i.e.* cod, pollock, tunas, etc...) is completed. Once these data are collected, and if time permits, additional sampling should occur as outlined in the Marine Mammal Sampling Protocols and the Sea Turtle Sampling Protocols sections of this manual.

Incidentally taken dead **sea birds** are also high sampling priority species and should be identified, photographed, and checked for the presence of bands (tags). If present, the band number must be recorded. The band should be removed if possible. Once these data are collected, and if time permits, additional sampling should occur as outlined in the Sea Bird Sampling Protocols section of this manual. Any incidentally taken birds which are still alive need only be identified, recorded, checked for the presence of bands, photographed, and released as soon as possible.

GILLNET AND BEACH SEINE SAMPLING PRIORITIES

GILLNET

Limited fish sampling trips:

- A marine mammal, sea turtle, and debris haul watch is conducted during **every** haul.
- Kept catch weights will be recorded after each haul.
- Discarded catch is NOT recorded or sampled, except for animals that are recorded on an Individual Animal Log or incidental takes of marine mammals, sea turtles, or sea birds.
- Biological sampling of the **kept catch** should occur for the last haul of the trip (day trips) during the steam back to port or the last haul of the day (multi-day trips).

Complete fish sampling trips:

- **Every** haul is observed, *i.e.* complete catch information for both kept and discarded species is recorded.
- No marine mammal, sea turtle, and sea bird haul watches are conducted.
- The kept and discarded catch of all hauls should be biologically sampled, with **priority given to the discarded species**.

BEACH SEINE

- If gear is hauled onto the beach **all** hauls will be observed; kept and discarded catch should be biologically sampled with **priority given to the discarded species**.
- If gear is "fished-over" (a dory is used to check the gear while it is in the water), the observer will record and biologically sample the **kept catch** only.
- In **both** situations the observer will conduct a marine mammal, sea turtle, and debris haul watch.

If it is not possible to biologically sample a particular haul according to these instructions, the reason(s) should be noted in the comments section of the corresponding Haul Log.

Table 1a. Length frequency and age structure sampling priorities in gillnet and beach seine fisheries.

Species	Length Frequencies		Age Structures	
	Kept	Discard	Kept	Discard
Gulf of Maine (Statistical areas 511 - 515)				
Bass, Striped	2	2	-	-
Bluefish	3	3	3	3
Cod, Atlantic	1	1	1	1
Cusk	3	3	3	3
Dogfish, Spiny	2	2	-	-
Flounder, Am. Plaice	2	2	2	2
Flounder, Winter	2	2	2	2
Flounder, Witch	1	1	2	3
Flounder, Yellowtail	2	2	2	2
Haddock	1	1	1	1
Hake, Red	3	3	-	-
Hake, Silver	3	3	-	-
Hake, White	1	1	1	1
Mackerel, Atlantic	3	3	3	3
Monkfish	1	1	1	1
Pollock	1	1	1	1
Redfish	2	2	2	2
Skate, Barndoor	-	2	-	-
Skate, Little	2	2	-	-
Skate, Smooth	-	3	-	-
Skate, Thorny	-	2	-	-
Skate, Winter	2	2	-	-
Wolffish	2	2	-	-
George's Bank (Stat areas 522, 525, 526, 561, 562)				
Bluefish	3	3	3	3
Cod, Atlantic	1	1	1	1
Cusk	3	3	3	3
Dogfish, Spiny	2	2	-	-
Flounder, Am. Plaice	2	2	2	1
Flounder, Witch	2	2	2	2
Haddock	1	1	1	1
Hake, Red	3	3	-	-
Hake, Silver	3	3	-	-
Hake, White	1	1	1	1
Monkfish	1	1	1	1
Pollock	1	1	1	1
Redfish	2	2	2	2
Skate, Barndoor	3	3	-	-
Skate, Little	2	2	-	-
Skate, Rosette	3	3	-	-
Skate, Smooth	2	2	-	-
Skate, Thorny	-	2	-	-
Skate, Winter	2	2	-	-
Wolffish	2	2	-	-

Table 1a. (Con't) Length frequency and age structure sampling priorities in gillnet and beach seine fisheries.

Species	Length Frequencies		Age Structures	
	Kept	Discard	Kept	Discard
Cape Cod (Statistical area 521)				
Bass, Striped	3	3	-	-
Bluefish	3	3	3	3
Cod, Atlantic	1	1	1	1
Cusk	3	3	3	3
Flounder, Winter	2	2	2	2
Haddock	2	2	1	1
Hake, Red	3	3	-	-
Hake, Silver	3	3	-	-
Hake, White	1	1	1	1
Mackerel, Atlantic	3	3	3	3
Monkfish	1	1	1	1
Pollock	1	1	1	1
Redfish	2	2	2	2
Skate, Barndoor	-	2	-	-
Skate, Little	2	2	-	-
Skate, Smooth	-	2	-	-
Skate, Thorny	-	2	-	-
Skate, Winter	2	2	-	-
Tautog	3	3	-	-
Wolffish	2	2	-	-

Species	Length Frequencies		Age Structures	
	Kept	Discard	Kept	Discard
Southern New England (Statistical areas 537-539)				
Bass, Striped	3	3	-	-
Bluefish	3	3	3	3
Cod, Atlantic	2	2	2	2
Dogfish, Spiny	2	2	-	-
Flounder, Winter	3	3	3	3
Mackerel, Atlantic	3	3	3	3
Monkfish	1	1	1	1
Skate, Barndoor	-	2	-	-
Skate, Clearnose	3	3	-	-
Skate, Little	2	2	-	-
Skate, Rosette	3	3	-	-
Skate, Smooth	2	2	-	-
Skate, Thorny	-	2	-	-
Skate, Winter	2	2	-	-
Tautog	3	3	-	-

Species	Length Frequencies		Age Structures		Species	Length Frequencies		Age Structures	
	Kept	Discard	Kept	Discard		Kept	Discard	Kept	Discard
Mid-Atlantic (Stat areas 201, 393, 401, 611-616, 621, 622, 625, 626, 631, 632, 635, 636, 700-702, 707, 708)									
Alewife	3	3	-	-	Herring, Blueback	2	2	-	-
Bass, Striped	1	1	-	-	Lobster, American	2	1	-	-
Bonito	3	3	-	-	Mackerel, Atlantic	2	2	2	2
Bluefish	1	1	1	1	Mackerel, Spanish	2	2	-	-
Croaker, Atlantic	2	2	-	-	Menhaden, Atlantic	2	2	-	-
Dogfish, Spiny	1	1	-	-	Monkfish	1	1	1	1
Drum, Black	3	3	-	-	Scup	2	2	2	2
Drum, Red	2	2	-	-	Sea Bass, Black	2	2	2	2
Flounder Sand Dab	3	2	3	3	Shad, American	3	3	-	-
Flounder, Summer	1	1	1	1	Spot	3	3	-	-
Flounder, Winter	1	1	1	1	Sturgeon, Atlantic	1	1	-	-
Flounder, Yellowtail	1	1	1	1	Tautog	3	3	-	-
Herring, Atlantic	2	2	-	-	Weakfish	1	1	-	-

GILLNET AND BEACH SEINE SAMPLING PRIORITIES

OTTER and SHRIMP TRAWL SAMPLING PRIORITIES

- **Every haul** should be observed, *i.e.* complete catch information for both kept and discarded species is recorded.
- Collection of length frequencies and age structures should occur **at least** after every other observed haul.
- If catches are light and time permits, the observer should sample every haul.
- Otter trawl fishery: obtain actual weights for as many species as possible.
- Shrimp trawl fishery: obtain actual weights for all discarded species.

If it is not possible to biologically sample a particular haul according to protocol, the reason(s) should be noted in the comments section of the corresponding Haul Log.

Table 1b. Length frequency and age structure sampling priorities in the otter trawl fishery.

Species	Length Frequencies		Age Structures	
	Kept	Discard	Kept	Discard
Gulf of Maine (Statistical areas 511-515)				
Bluefish	3	3	3	3
Cod, Atlantic	1	1	1	1
Cusk	2	2	1	1
Dogfish, Spiny	2	2	-	-
Flounder, Am. Plaice	1	1	1	1
Flounder, Winter	2	2	2	2
Flounder, Witch	1	1	1	2
Flounder, Yellowtail	1	1	2	2
Haddock	1	1	1	1

Species	Length Frequencies		Age Structures	
	Kept	Discard	Kept	Discard
George's Bank (Statistical areas 522, 525, 526, 561, 562)				
Bluefish	3	3	3	3
Butterfish	3	3	3	3
Cod, Atlantic	1	1	1	1
Cusk	2	2	1	1
Dogfish, Spiny	2	2	-	-
Flounder, Am. Plaice	2	2	2	2
Flounder, Sand Dab	2	2	2	2
Flounder, Summer	2	2	2	2
Flounder, Winter	1	1	1	1

Hake, Red	3	3	-	-
Hake, Silver	3	3	-	-
Hake, White	1	1	1	1
Herring, Atlantic	2	2	-	-
Monkfish	1	1	1	1
Pollock	1	1	1	1
Redfish	2	2	2	2
Skate, Barndoor	-	2	-	-
Skate, Little	2	2	-	-
Skate, Smooth	-	3	-	-
Skate, Thorny	-	2	-	-
Skate, Winter	2	2	-	-
Wolffish	2	2	-	-

Flounder, Witch	2	2	2	2
Flounder, Yellowtail	1	1	2	2
Haddock	1	1	1	1
Hake, Red	3	3	-	-
Hake, Silver	3	3	-	-
Hake, White	1	1	1	1
Herring, Atlantic	2	2	-	-
Lobster, American	2	2	-	-
Monkfish	1	1	1	1
Ocean Pout	2	2	-	-
Pollock	1	1	1	1
Redfish	2	2	2	2
Skate, Barndoor	-	2	-	-
Skate, Little	2	2	-	-
Skate, Smooth	-	2	-	-
Skate, Thorny	-	2	-	-
Skate, Winter	2	2	-	-
Squid, Atl. Long-fin	3	3	-	-
Squid, Short-fin	3	3	-	-
Wolffish	2	2	-	-

Table 1b. (Con't) Length frequency and age structure sampling priorities in the otter trawl fishery.

Species	Length Frequencies		Age Structures	
	Kept	Discard	Kept	Discard
Cape Cod (Statistical area 521)				
Bluefish	3	3	3	3
Butterfish	3	3	3	3
Cod, Atlantic	1	1	1	1
Cusk	2	2	1	1
Flounder, Sand Dab	2	2	2	2
Flounder, Summer	1	1	1	1
Flounder, Winter	1	1	1	1
Flounder, Yellowtail	1	1	1	1
Haddock	2	2	1	1
Hake, Red	3	3	-	-
Hake, Silver	3	3	-	-
Hake, White	1	1	1	1
Herring, Atlantic	2	2	-	-
Mackerel, Atlantic	3	3	3	3
Monkfish	1	1	1	1
Pollock	1	1	1	1
Redfish	2	2	2	2

Species	Length Frequencies		Age Structures	
	Kept	Discard	Kept	Discard
Southern New England offshore (Statistical area 537)				
Bluefish	3	3	3	3
Bonito	3	3	-	-
Butterfish	3	3	3	3
Cod, Atlantic	2	2	2	2
Dogfish, Spiny	2	2	-	-
Flounder, Sand Dab	2	2	2	2
Flounder, Summer	1	1	1	1
Flounder, Winter	1	1	1	1
Flounder, Yellowtail	1	1	2	2
Hake, Red	3	3	-	-
Hake, Silver	2	2	-	-
Herring, Atlantic	2	2	-	-
Mackerel, Atlantic	2	2	2	2
Monkfish	1	1	1	1
Ocean Pout	3	3	-	-
Scup	1	1	1	1
Sea Bass, Black	1	1	1	1

Skate, Barndoor	-	2	-	-
Skate, Little	2	2	-	-
Skate, Smooth	2	2	-	-
Skate, Thorny	-	2	-	-
Skate, Winter	2	2	-	-
Squid, Atl. Long-fin	2	2	-	-
Squid, Short-fin	2	2	-	-
Tautog	3	3	-	-
Wolffish	2	2	-	-

Skate, Barndoor	-	2	-	-
Skate, Clearnose	3	3	-	-
Skate, Rosette	3	3	-	-
Skate, Little	2	2	-	-
Skate, Smooth	3	3	-	-
Skate, Thorny	-	2	-	-
Skate, Winter	2	2	-	-
Squid, Atl. Long-fin	1	1	-	-
Squid, Short-fin	2	2	-	-
Tautog	3	3	-	-

Table 1b. (Con't) Length frequency and age structure sampling priorities in the otter trawl fishery.

Species	Length Frequencies		Age Structures	
	Kept	Discard	Kept	Discard
Mid-Atlantic offshore (Statistical areas 616, 622, 623, 626, 627, 632, 636)				
Alewife	3	3	-	-
Bluefish	3	3	3	3
Butterfish	3	3	3	3
Dogfish, Spiny	2	2	-	-
Flounder, Sand Dab	2	2	2	2
Flounder, Summer	1	1	1	1
Hake, Red	3	3	-	-
Hake, Silver	2	2	-	-
Herring, Atlantic	1	1	-	-
Herring, Blueback	3	3	-	-
Mackerel, Atlantic	2	2	2	2
Monkfish	1	1	1	1
Scallop, Sea	3	3	3	3
Scup	1	1	1	1
Sea Bass, Black	1	1	1	1
Shad, American	3	3	-	-
Skate, Barndoor	-	2	-	-

Species	Length Frequencies		Age Structures	
	Kept	Discard	Kept	Discard
Mid-Atlantic inshore (Statistical areas 538, 539, 611-615, 621, 625, 631, 635)				
Alewife	3	3	-	-
Bass, Striped	1	1	-	-
Bluefish	1	1	1	1
Croaker, Atlantic	3	3	-	-
Dogfish, Spiny	1	1	-	-
Drum, Black	3	3	-	-
Drum, Red	3	3	-	-
Flounder Sand Dab	1	1	1	1
Flounder, Summer	1	1	1	1
Flounder, Winter	1	1	1	1
Flounder, Yellowtail	1	1	1	1
Herring, Atlantic	2	2	-	-
Herring, Blueback	2	2	-	-
Lobster, American	2	1	-	-
Mackerel, Atlantic	2	2	2	2
Mackerel, Spanish	3	3	-	-
Menhaden, Atlantic	3	3	2	2

Skate, Clearnose	2	2	-	-
Skate, Little	2	2	-	-
Skate, Rosette	2	2	-	-
Skate, Smooth	3	2	-	-
Skate, Thorny	-	2	-	-
Skate, Winter	3	3	-	-
Squid, Atl. Long-fin	1	1	-	-
Squid, Short-fin	2	2	-	-
Weakfish	3	3	-	-

Monkfish	1	1	1	1
Scup	2	2	2	2
Sea Bass, Black	1	1	1	1
Shad, American	3	3	-	-
Skate, Clearnose	2	2	-	-
Skate, Little	2	2	-	-
Spot	3	3	-	-
Tautog	3	3	-	-
Weakfish	1	1	-	-

OTTER and SHRIMP TRAWL SAMPLING PRIORITIES

OTTER and SHRIMP TRAWL SAMPLING PRIORITIES

Table 1c. Length frequency and age structure sampling priorities in the shrimp trawl fishery**.

Species	Length Frequencies		Age Structures		Species	Length Frequencies		Age Structures	
	Kept	Discard	Kept	Discard		Kept	Discard	Kept	Discard
Massachusetts, New Hampshire and Maine									
Cod, Atlantic	*	1	*	1	Monkfish	1	1	1	1
Flounder, Am. Plaice	*	1	*	1	Ocean Pout	*	1	*	1
Flounder, Sand Dab	*	2	*	2	Pollock	*	1	*	1
Flounder, Winter	*	1	*	1	Redfish	*	1	*	1
Flounder, Witch	*	1	*	1	Skate, Barndoor	-	2	-	-
Flounder, Yellowtail	*	1	*	1	Skate, Little	2	2	-	-
Haddock	*	1	*	1	Skate, Smooth	-	3	-	-
Hake, Red	*	3	*	-	Skate, Thorny	-	2	-	-
Hake, Silver	*	2	*	-	Skate, Winter	2	2	-	-
Hake, White	*	2	*	2	Wolffish	3	3	-	-
Herring, Atlantic	2	2	-	-					
Lobster, American	2	1	-	-					

* As of 1 January 1994, regulations mandate the use of a Nordmore Grate in all Shrimp Trawl gear which reduces finfish bycatch. Since none of these species may currently be kept, measurement of **all** discards should occur when time permits.

** All weight measurements for discarded species should be actual in this fishery.

The following two shrimp species, which are not contained in *Atlantic Coast Fishes* (Peterson, 1986) issued to observers in training, may be encountered in the shrimp trawl fishery.

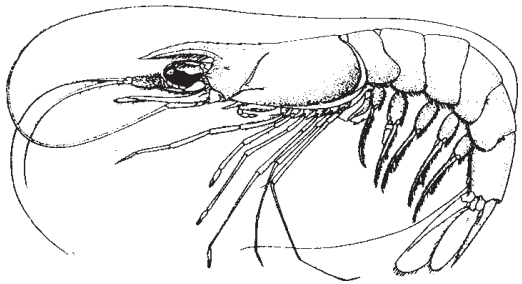


Figure 1. Royal red shrimp *Pleoticus robustus*

- color variable from mostly opaque white to salmon, pink and red
- eyes large with scale-like dorsal projection
- carapace and abdominal segments covered with short hairs; abdominal segments 3-6 have mid-dorsal ridge ending in small spine or tooth
- rostrum medium long, reaching to about the end of antennular peduncle; with ridge and 10-12 spines extending onto carapace
- antennular flagella both long but unequal in length
- carapace length to 42 mm males, 61.5 mm females; total length to 173 mm males, 219 mm females
- benthic, occurring on silty bottoms of upper continental slope 180-730 m, usually below 250 and above 500 m, water temp. 5-15 °C
- commonly encountered from 35° N (Cape Hatteras) south, occasionally extend to 43° N (Scotian Shelf)

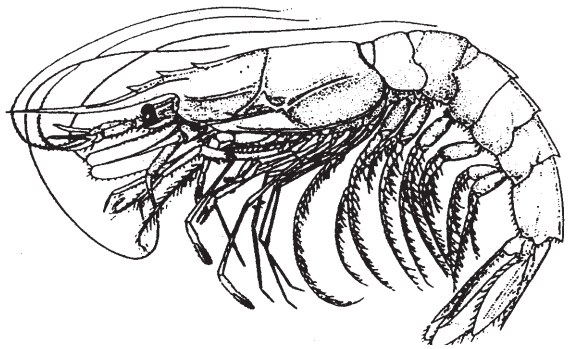


Figure 2. Scarlet shrimp *Plesioenaeus edwardsianus*

- color is a brilliant crimson red; gold setae fringes
- several lateral ridges on carapace, one with single anterior spine
- long, sharply pointed rostrum equal to at least half the carapace length; 3 dorsal spines
- upper antennular flagellum very short, other flagellum very long, up to 3 times total body length
- abdominal segments 3-6 with dorsal ridge, forming short spine at the end of each segment
- a very large species, carapace length to 55 mm males, 104 mm females; total length to 193 mm males, 334 mm females
- benthic, inhabiting muddy bottoms of continental slope, mostly 400-900 m, water temp. 4-8 °C
- encountered from 47° N (Gulf of St. Lawrence) to Gulf of Mexico

SCALLOP FISHERY SAMPLING PRIORITIES

- **Every haul** should be observed, *i.e.* complete catch information for both kept and discarded species is recorded, during on-watch periods.
- Collection of length frequencies should occur at least after **every other observed haul**.
- At minimum, **half** of the hauls should be observed and **one quarter** of the hauls should be biological sampled during a trip.
- At approximately the midpoint of the trip, the observer should switch watches in order to ensure collection of data most representative of the entire trip.

SCALLOP SHELL HEIGHT FREQUENCIES

- A random sample of at least 100 scallops should be collected and measured **from each disposition** (*i.e.* kept and discarded).
- Collect shell height frequencies from **only one dredge** per haul.
- Sample alternate dredges (*i.e.* port and starboard) each time biological sampling of scallops is conducted.
- Generally, scallop shell height frequency sampling should be the first priority for all hauls, with finfish sampling being second priority.
- For **at least** one haul per watch, finfish sampling should be first priority.

FINFISH SAMPLING

- Collect finfish length frequencies and age structures as a first priority for at least one haul per watch, and on additional hauls, as time permits.
- If a haul has an exceptionally large amount of finfish bycatch, finfish sampling should become first priority for that haul.
- Collect finfish length frequencies and age structures from **both dredges** per haul.

VOLUMETRIC MEASURES OF SCALLOP MEATS

- **On the first haul of each watch only**, the volume of meats corresponding to the length frequency sample from the **kept** portion of the catch (whole scallops) should be measured.
- The volume of this sample must represent the meats of **all kept and measured** animals.

If it is not possible to biologically sample a particular haul in the manner outlined above, the alternate sampling method followed should be recorded in the comments section of the corresponding Haul Log.

Table 1d. Length frequency and age structure sampling priorities in the scallop fishery.

Species	Length Frequencies		Age Structures	
	Kept	Discard	Kept	Discard
Flounder, NK	3	3	2	2
Flounder, Summer	2	2	1	1
Flounder, Yellowtail	2	2	1	1
Monkfish	2	2	1	1
Scallop, Sea	1	1	-	-
Skate, Barndoor	-	2	-	-
Skate, nk	3	3	-	-

LOBSTER AND CRAB POT FISHERY SAMPLING PRIORITIES

- **Every haul** should be **both** observed, *i.e.* complete catch information for both kept and discarded species is recorded, and biologically sampled.
- Conduct sampling for **each pot**, when possible.
- Lobster pot fishery: **every individual lobster** caught should be biologically sampled when possible.

If it is not possible to biologically sample a particular haul according to protocol, the reason(s) should be noted in the comments section of the corresponding Haul Log.

CRAB CATCH ESTIMATION AND SUB-SAMPLING

Following are some suggested methods to collect **crab counts and weights** in the lobster, crab and fish pot fishery. These suggested methods are listed in order of preference. While the observer may choose to use a method other than those listed below, or make another judgement on what to sample due to time or other constraints, any sub-sampling or catch estimation method used must be recorded in the comments section of the corresponding Haul Log or Crustacean Sample Log. These methods may be applied to both the kept and discarded catch.

Crab sampling of the species listed in Table 1e should occur **following lobster sampling**, as time/conditions permit. However, when the captain targets crabs with (a) particular trawl(s), crab sampling becomes equal in priority to lobster sampling.

Per Trawl Methods

1 The crew sorts all crabs to be kept into totes to be weighed (total kept weight) by the observer. The crew sorts crabs to be discarded into totes to be weighed (total discard weight) by the observer. The observer randomly fills a tote, each, from both the kept and discarded catch to be sampled.

2 The crew places crabs into the hold while randomly selecting some to fill a tote for the observer to weigh and sample.

The observer, using a clicker, counts the number of crabs placed in the hold. The total number of crabs caught (which includes those in the subsample tote) are divided by the number of crabs in the subsample tote. The quotient is multiplied by the weight of the tote to yield an estimated total kept weight. The observer also samples the crabs in the tote. Follow these procedures for weight determination and length frequency sampling of discards.
Example: 300 crabs are placed in the hold, and 50 crabs are counted in the tote. The actual sample weight of the tote is 100 lbs:
[(300 + 50) ÷ 50] * 100 = 700 lbs total kept catch

3 The crew places crabs into the hold while randomly selecting some to fill a tote for the observer to sample. The observer estimates the pounds of crabs placed in the hold. This estimated weight is added to the actual tote weight (sample weight) to yield an estimated total kept weight. The observer also samples the crabs in the tote. Follow these procedures for weight estimation and length frequency sampling of discards.

Per Day Methods

1 Following one haul selected randomly each day (this haul should not routinely be the last haul of the day), the crew places all of the kept crabs into totes to be weighed and sampled by the observer. Follow these procedures for weight determination and biological sampling of discards. For the remaining hauls of each day, the observer estimates the kept and discarded crab catch weights, but does not conduct any sampling.

2 Follow the methods of number 2 or 3, above, for one haul per day.

Table 1e. Length frequency and age structure sampling priorities in the lobster, crab and fish pot fishery.

Species	Length Frequencies		Age Structures	
	Kept	Discard	Kept	Discard
Gulf of Maine (Statistical area 515)				
Crab, Jonah	2	2	-	-
Crab, Red	2	2	-	-
Crab, Rock	2	2	-	-
Lobster, American	1	1	-	-
Wolffish	3	3	-	-

NOTE: When crabs are the target of (a) particular trawl(s), the crab priority will be the same as lobster.

BOTTOM LONGLINE FISHERY SAMPLING PRIORITIES

- **Every haul** should be observed, *i.e.* complete catch information for both kept and discarded species is recorded.
- Collection of length frequencies and age structures should occur **at least** during/after every other observed haul.
- If catches are light and time permits, the observer should sample every haul.
- If commercially important bycatch is caught in significant quantities, yet the species are not listed in Table 1f, refer to Table 2. Fish and Shellfish Sampling Requirements By Species For Domestic Fisheries.

If it is not possible to biological sample on a particular haul, the reason(s) should be noted in the comments section of the corresponding Haul Log.

For biological sampling priorities in the pelagic longline fishery see Table 3. Pelagic Species Length Frequency Sampling Requirements for Domestic Fisheries.

Table 1f. Length frequency and age structure sampling priorities in the bottom longline fishery.

Species	Length Frequencies		Age Structures		Species	Length Frequencies		Age Structures	
	Kept	Discard	Kept	Discard		Kept	Discard	Kept	Discard
Gulf of Maine (Statistical areas 464, 465, 467, 511-515) and Georges Bank (Statistical areas 521, 522, 525, 526, 541-543, 561, 562)									
Cod, Atlantic	1	1	3	2	Hake, White	1	1	1	1
Cusk	1	1	2	2	Monkfish	1	1	1	1
Haddock	1	1	3	2	Pollock	1	1	3	2
Hake, Red	2	2	-	-	Wolffish	2	2	-	-
Hake, Silver	2	2	-	-	Skate, nk	2	2	-	-
Skate, Barndoor	-	1	-	-					
Skate, Thorny	-	1	-	-					

Species	Length Frequencies		Age Structures	
	Kept	Discard	Kept	Discard
Southern New England (Statistical areas 533, 534, 537-539)				
Cod, Atlantic	1	1	3	2
Flounder, Summer	1	1	1	1
Hake, Red	2	2	-	-
Monkfish	1	1	1	1
Skate, Barndoor	-	1	-	-
Skate, nk	2	2	-	-

Species	Length Frequencies		Age Structures	
	Kept	Discard	Kept	Discard
Mid-Atlantic (Statistical areas 611-616, 621-629, 631-639)				
Flounder, Summer	1	1	1	1
Hake, Red	2	2	-	-
Monkfish	1	1	1	1
Tilefish	1	1	1	1
Skate, nk	2	2	-	-

BOTTOM LONGLINE FISHERY SAMPLING PRIORITIES

PURSE SEINE and PAIR TRAWL SAMPLING PRIORITIES

- **Every haul** should be observed, *i.e.* complete catch information for both kept and discarded species is recorded.
- Collection of length frequencies and age structures should occur after every observed haul.
- Collect 10 baskets of fish, obtain actual weights and calculate percent composition's for both the kept and discard species on every haul.

If it is not possible to biologically sample a particular haul according to protocol, the reason(s) should be noted in the comments section of the corresponding Haul Log.

Table 1g. Length frequency and age structure sampling priorities in the purse seine and pair trawl fisheries.

Species	Length Frequencies		Age Structures		Species	Length Frequencies		Age Structures	
	Kept	Discard	Kept	Discard		Kept	Discard	Kept	Discard
Gulf of Maine (Statistical areas 511-515)					**George's Bank (Statistical areas 522, 525, 526, 561, 562)**				
Bluefish	3	3	3	3	Bluefish	3	3	3	3
Cod, Atlantic	1	1	1	1	Butterfish	3	3	3	3
Cusk	2	2	1	1	Cod, Atlantic	1	1	1	1
Dogfish, Spiny	2	2	-	-	Cusk	2	2	1	1
Flounder, Am. Plaice	1	1	1	1	Dogfish, Spiny	2	2	-	-
Flounder, Winter	2	2	2	2	Flounder, Am. Plaice	2	2	2	2
Flounder, Witch	1	1	1	2	Flounder, Sand Dab	2	2	2	2
Flounder, Yellowtail	1	1	2	2	Flounder, Summer	2	2	2	2
Haddock	1	1	1	1	Flounder, Winter	1	1	1	1

Hake, Red	3	3	-	-
Hake, Silver	2	2	-	-
Hake, White	2	2	1	1
Herring, Atlantic	1	1	-	-
Monkfish	1	1	1	1
Pollock	1	1	1	1
Redfish	2	2	2	2
Skate, Barndoor	-	2	-	-
Skate, Little	2	2	-	-
Skate, Smooth	-	3	-	-
Skate, Thorny	-	2	-	-
Skate, Winter	2	2	-	-
Wolffish	2	2	-	-

Flounder, Witch	2	2	2	2
Flounder, Yellowtail	1	1	2	2
Haddock	1	1	1	1
Hake, Red	3	3	-	-
Hake, Silver	2	2	-	-
Hake, White	2	2	1	1
Herring, Atlantic	1	1	-	-
Lobster, American	2	2	-	-
Monkfish	1	1	1	1
Ocean Pout	2	2	-	-
Pollock	1	1	1	1
Redfish	2	2	2	2
Skate, Barndoor	-	2	-	-
Skate, Little	2	2	-	-
Skate, Smooth	-	2	-	-
Skate, Thorny	-	2	-	-
Skate, Winter	2	2	-	-
Squid, Atl. Long-fin	3	3	-	-
Squid, Short-fin	3	3	-	-
Wolffish	2	2	-	-

PURSE SEINE and PAIR TRAWL SAMPLING PRIORITIES

PURSE SEINE and PAIR TRAWL SAMPLING PRIORITIES

Table 1g. (Con't) Length frequency and age structure sampling priorities in the purse seine and pair trawl fisheries.

Species	Length Frequencies		Age Structures	
	Kept	Discard	Kept	Discard
Cape Cod (Statistical area 521)				
Bluefish	3	3	3	3
Butterfish	3	3	3	3
Cod, Atlantic	1	1	1	1
Cusk	2	2	1	1
Flounder, Sand Dab	2	2	2	2
Flounder, Summer	1	1	1	1
Flounder, Winter	1	1	1	1
Flounder, Yellowtail	1	1	1	1
Haddock	2	2	1	1
Hake, Red	3	3	-	-
Hake, Silver	3	3	-	-
Hake, White	1	1	1	1
Herring, Atlantic	1	1	-	-
Mackerel, Atlantic	1	1	3	3
Monkfish	1	1	1	1
Pollock	1	1	1	1
Redfish	2	2	2	2

Species	Length Frequencies		Age Structures	
	Kept	Discard	Kept	Discard
Southern New England offshore (Statistical area 537)				
Bluefish	3	3	3	3
Bonito	3	3	-	-
Butterfish	3	3	3	3
Cod, Atlantic	2	2	2	2
Dogfish, Spiny	2	2	-	-
Flounder, Sand Dab	2	2	2	2
Flounder, Summer	1	1	1	1
Flounder, Winter	1	1	1	1
Flounder, Yellowtail	1	1	2	2
Hake, Red	3	3	-	-
Hake, Silver	2	2	-	-
Herring, Atlantic	1	1	-	-
Mackerel, Atlantic	1	1	2	2
Monkfish	1	1	1	1
Ocean Pout	3	3	-	-
Scup	1	1	1	1
Sea Bass, Black	1	1	1	1

Skate, Barndoor	-	2	-	-
Skate, Little	2	2	-	-
Skate, Smooth	2	2	-	-
Skate, Thorny	-	2	-	-
Skate, Winter	2	2	-	-
Squid, Atl. Long-fin	2	2	-	-
Squid, Short-fin	2	2	-	-
Tautog	3	3	-	-
Wolffish	2	2	-	-

Skate, Barndoor	-	2	-	-
Skate, Clearnose	3	3	-	-
Skate, Rosette	3	3	-	-
Skate, Little	2	2	-	-
Skate, Smooth	3	3	-	-
Skate, Thorny	-	2	-	-
Skate, Winter	2	2	-	-
Squid, Atl. Long-fin	1	1	-	-
Squid, Short-fin	2	2	-	-
Tautog	3	3	-	-

PURSE SEINE and PAIR TRAWL SAMPLING PRIORITIES

Table 1g. (Con't) Length frequency and age structure sampling priorities in the purse seine and pair trawl fisheries.

Species	Length Frequencies		Age Structures	
	Kept	Discard	Kept	Discard
Mid-Atlantic offshore (Statistical areas 616, 622, 623, 626, 627, 632, 636)				
Alewife	3	3	-	-
Bluefish	3	3	3	3
Butterfish	3	3	3	3
Dogfish, Spiny	2	2	-	-
Flounder, Sand Dab	2	2	2	2
Flounder, Summer	1	1	1	1
Hake, Red	3	3	-	-
Hake, Silver	2	2	-	-
Herring, Atlantic	1	1	-	-
Herring, Blueback	1	1	-	-
Mackerel, Atlantic	1	1	2	2
Monkfish	1	1	1	1
Scallop, Sea	3	3	3	3
Scup	1	1	1	1
Sea Bass, Black	1	1	1	1
Shad, American	3	3	-	-
Skate, Barndoor	-	2	-	-

Species	Length Frequencies		Age Structures	
	Kept	Discard	Kept	Discard
Mid-Atlantic inshore (Statistical areas 538, 539, 611-615, 621, 625, 631, 635)				
Alewife	3	3	-	-
Bass, Striped	1	1	-	-
Bluefish	1	1	1	1
Croaker, Atlantic	3	3	-	-
Dogfish, Spiny	1	1	-	-
Drum, Black	3	3	-	-
Drum, Red	3	3	-	-
Flounder Sand Dab	1	1	1	1
Flounder, Summer	1	1	1	1
Flounder, Winter	1	1	1	1
Flounder, Yellowtail	1	1	1	1
Herring, Atlantic	1	1	-	-
Herring, Blueback	1	1	-	-
Lobster, American	2	1	-	-
Mackerel, Atlantic	1	1	2	2
Mackerel, Spanish	3	3	-	-
Menhaden, Atlantic	3	3	2	2

Skate, Clearnose	2	2	-	-
Skate, Little	2	2	-	-
Skate, Rosette	2	2	-	-
Skate, Smooth	3	2	-	-
Skate, Thorny	-	2	-	-
Skate, Winter	3	3	-	-
Squid, Atl. Long-fin	1	1	-	-
Squid, Short-fin	2	2	-	-
Weakfish	3	3	-	-

Monkfish	1	1	1	1
Scup	2	2	2	2
Sea Bass, Black	1	1	1	1
Shad, American	3	3	-	-
Skate, Clearnose	2	2	-	-
Skate, Little	2	2	-	-
Spot	3	3	-	-
Tautog	3	3	-	-
Weakfish	1	1	-	-

PURSE SEINE and PAIR TRAWL SAMPLING PRIORITIES

TABLE 2. FISH & SHELLFISH SAMPLING REQUIREMENTS BY SPECIES PER STATISTICAL AREA

SPECIES NAME	LENGTH TARGET	LENGTH TYPE	SEXING NECESSARY?	SCALE TARGET	OTOLITH TARGET
Alewife	100	FL	-	-	-
Bass, Striped	100	FL	-	-	-
Bluefish	100	FL	-	25	-
Butterfish	100	FL	-	-	20****
Cod, Atlantic	100	FL	-	-	20
Clam, Surf	30*	S	-	-	-
Crabs	100	C	YES	-	-
Croaker, Atlantic	50	TL	-	-	-
Cusk	100	TL	-	-	20
Dogfish, Spiny	100	TL	YES	-	-
Drum, Black	50	FL	-	-	-
Drum, Red	50	FL	-	-	-
Flounder, Am. Plaice	100	TL	-	-	20
Flounder, Sand Dab	100	TL	-	20	-
Flounder, Summer	100	TL	-	25	-
Flounder, Winter	100	TL	-	-	20
Flounder, Witch	100	TL	-	-	20
Flounder, Yellowtail	100	TL	YES	10/SEX	-
Haddock, Large	100	FL	-	50	50
Haddock, Scrod (43-51 cm)	50	FL	-	25	25
Hake, Red	100	TL	-	-	-
Hake, Silver	100	FL	-	-	-
Hake, White	100	TL	-	-	20
Herring, Atlantic	50	NL	-	-	-

Herring, Blueback	100	FL	-	-	-
Lobster, American	100	C	YES	-	-
Mackerel, Atlantic	100	FL	-	-	20****
Mackerel, Spanish	100	FL	-	-	-
Menhaden	50	FL	-	-	-
Monkfish (over 40 cm)	100	O	-	-	15 (vertebrae)
Monkfish (under 40 cm)	100	O	-	-	10 (vertebrae)
Ocean Pout	100	TL	-	-	-
Pollock	100	FL	-	-	20
Quahog, Ocean	30*	S	-	-	-
Redfish	100	FL	YES	-	10/SEX
Scallop, Sea	100	S	-	-	-
Scup	100	FL	-	25	-
Sea Bass, Black	100	TL	-	25	-
Shad, American	100	TL	-	-	-
Spot	100	FL	-	-	-
Skate, nk**	100	TL	-	-	-
Squid, Atl. Long-fin	100	ML	-	-	-
Squid, Short-fin	100	ML	-	-	-
Tautog	100	TL	-	-	-
Tilefish	100	FL	-	-	20***
Weakfish	100	FL	-	-	-
Wolffish	100	TL	-	-	-

* If size distribution is variable, length target is 50.
** See Tables 1a-g for listing of priority species.
*** Bottom Longline fishery only.
**** Heads may be collected in lieu of otoliths.

LENGTH TYPE CODES:
TL= Total Length — S = Shell, width or height
FL = Fork Length — C = Carapace, width or length
NL =Natural Length — ML = Mantle Length
O = Lower jaw to tip of tail, with jaw pushed down

TABLE 2. FISH & SHELLFISH SAMPLING REQUIREMENTS BY SPECIES PER STATISTICAL AREA

LENGTH MEASUREMENT ILLUSTRATIONS

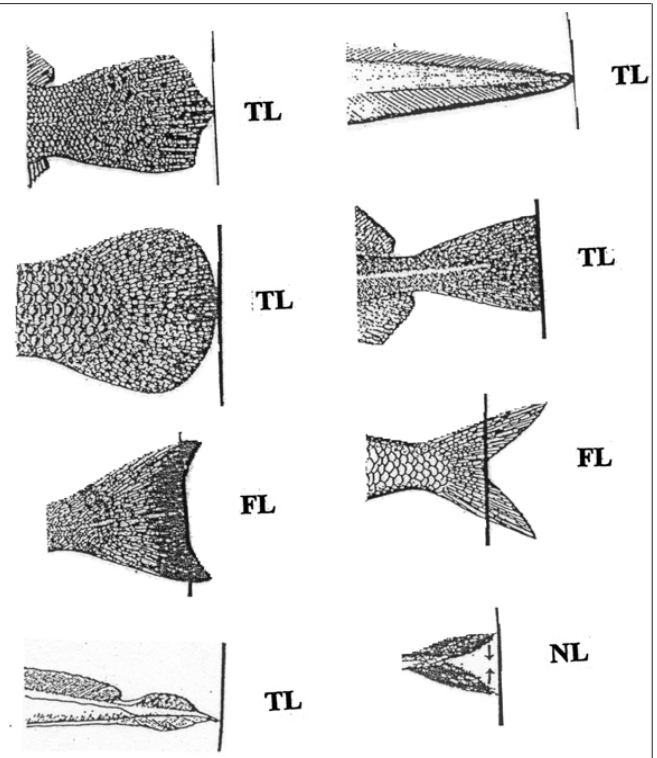


Figure 3. Length types illustrated on different fish tails.

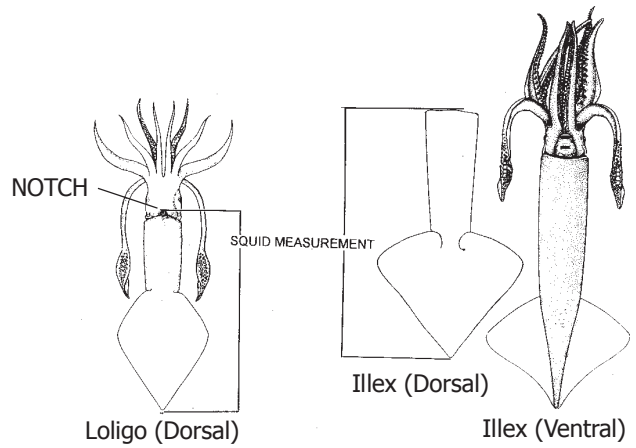


Figure 4. Squid mantle length illustrations.

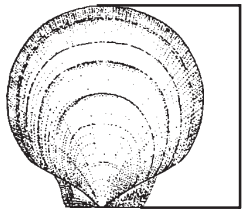


Figure 5. Scallop shell height illustration.

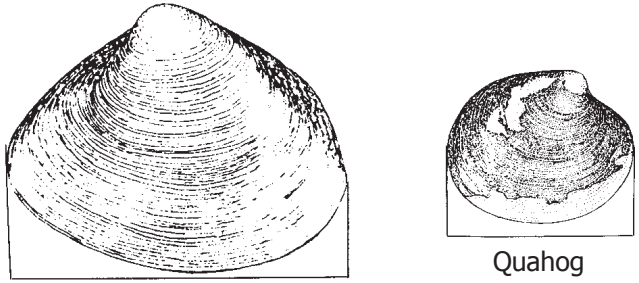


Figure 6. Clam shell width illustrations.

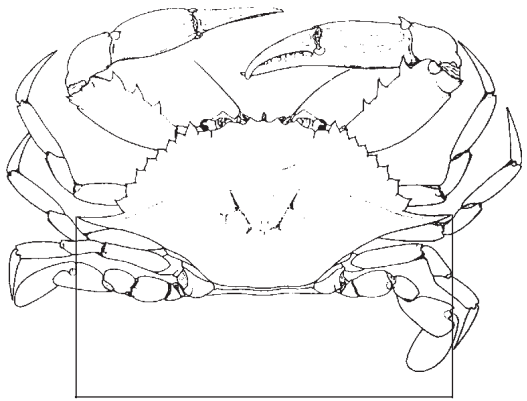


Figure 7. Crab carapace width illustration.

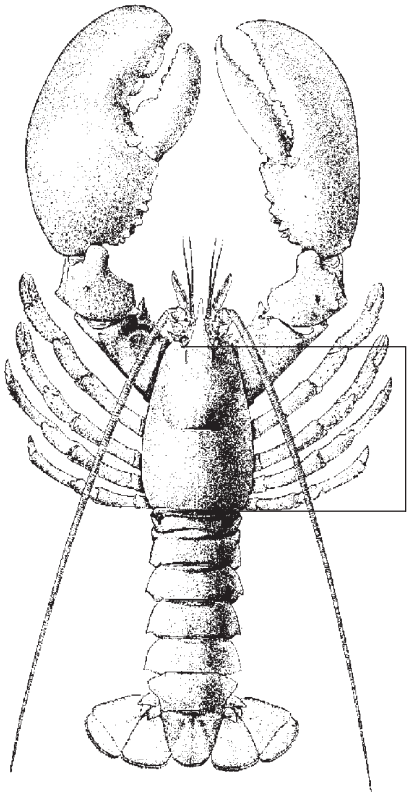


Figure 8. Lobster carapace length illustration.

LENGTH MEASUREMENT ILLUSTRATIONS

OTOLITHS

Figure 9. Examples of otoliths from a variety of fish.

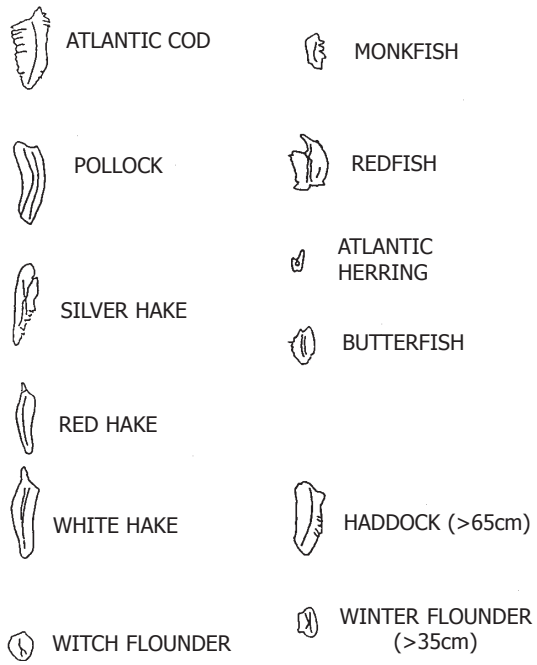
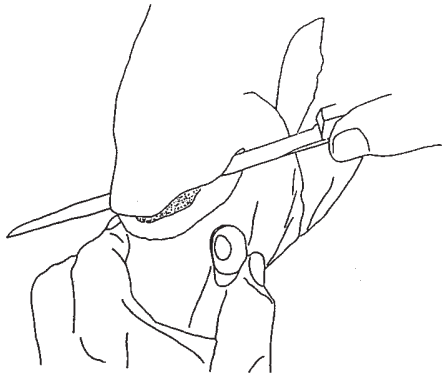


Figure 10. Standard method of dissecting a fish skull to remove otoliths.

Location and direction of initial cut.



Location of otoliths within the skull.

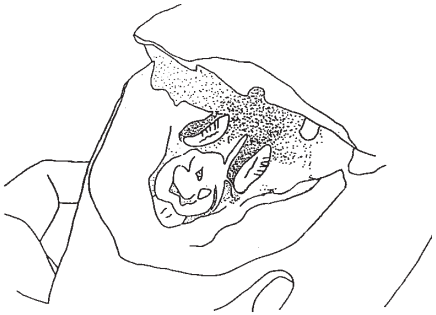
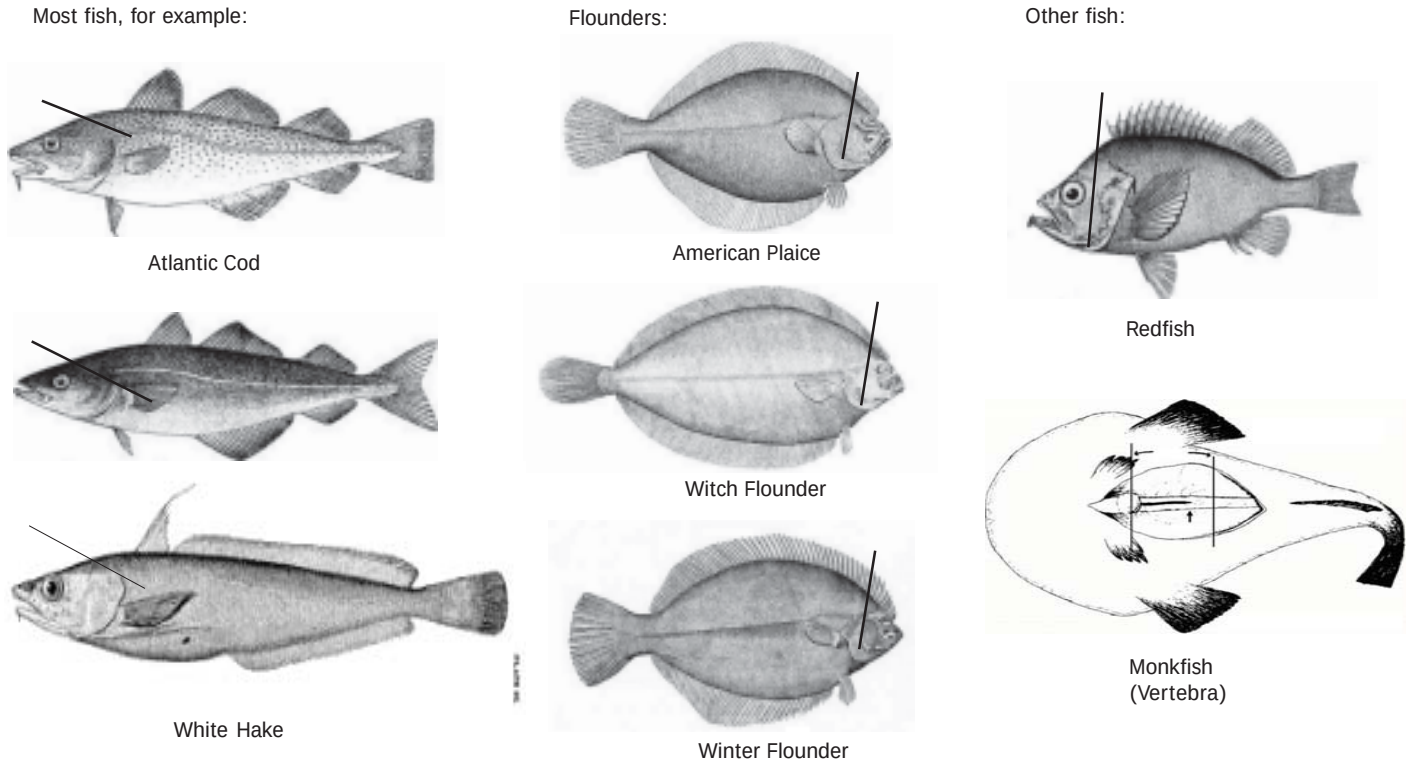


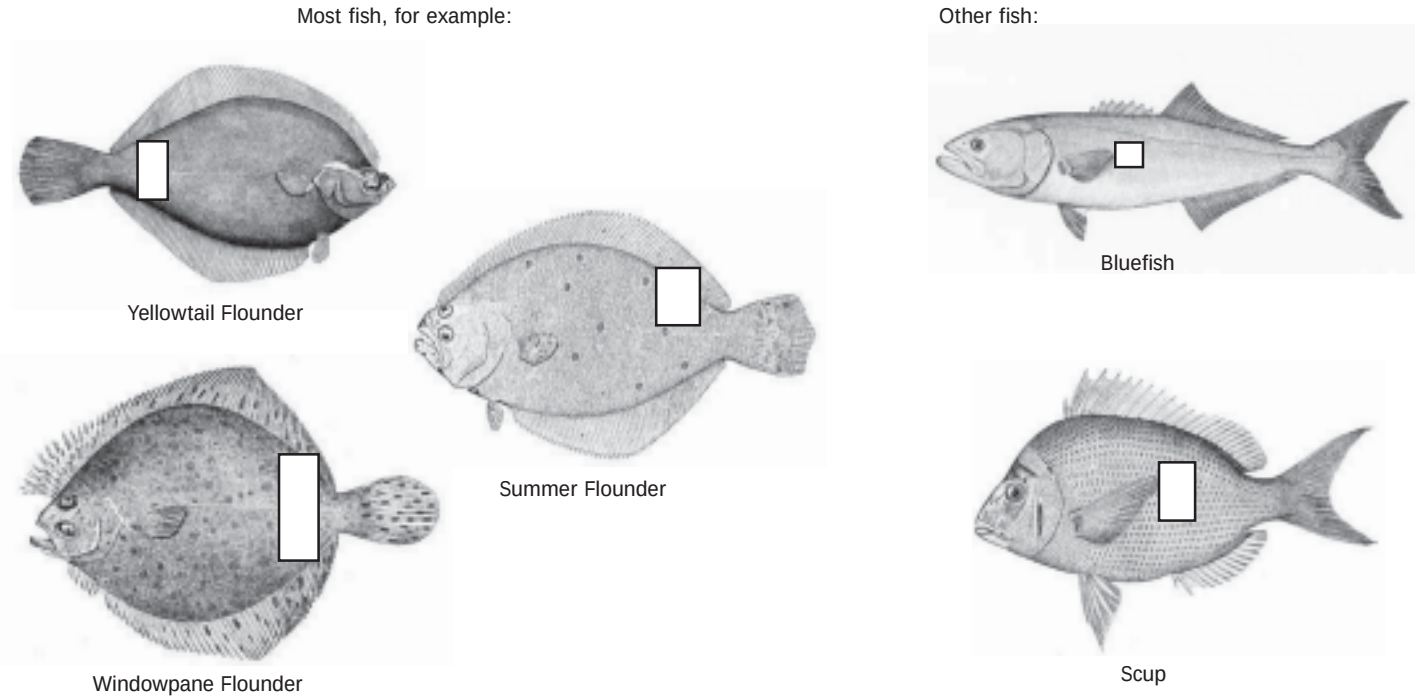
Figure 11. Location and angle of the necessary cut to remove otoliths/vertebrae from various fish.



AGE STRUCTURE SAMPLE COLLECTION

SCALES

Figure 12. Location from which to collect scales from various fish.

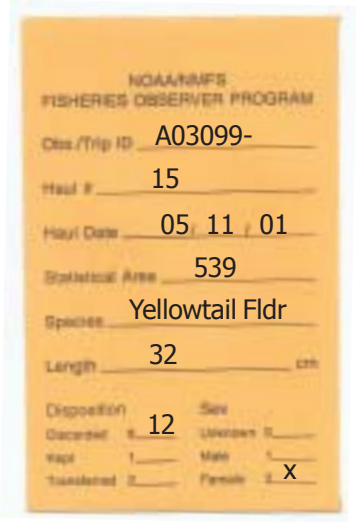


General considerations for age structure sample collection:

Otoliths: Exercise care when cutting the fish to remove the otoliths so as not to shatter them. Shattered otoliths are of little value.

Scales: Do your best to remove mucus, debris and epidermis from the fish before collecting scales. Only scales collected from the proper locations can be used for aging.

Figure 13. Age structure envelope.



- Every envelope must have a liner.
- Sample envelopes containing age structures from the same species and disposition codes should be grouped together. Each group of envelopes should contain a header envelope. All of the required information should be filled out on the header envelope and each envelope following the header should only contain the length of the species sampled.

Disposition: Record appropiate kept or discarded fish disposition **code** in the space provided. The code must match the fish disposition code as recorded on accompanying length frequency log.

TABLE 3. PELAGIC FISH SAMPLING REQUIREMENTS BY SPECIES

SPECIES NAME	SAMPLE PRIORITY CODE	TARGET SAMPLE SIZE (per haul)	LENGTH TYPE(S) (#1, #2)	LENGTH CODE	SEXING NECESSARY?	AGE STRUCTURE TYPE(S) TO COLLECT
Swordfish	1	100	LJFL, CK	C	Yes	Head, Anal Spines*
Tuna, Bluefin	1	all caught	FL, PFL	S	Yes	Head, Caudal Vertebrae
Bonito	2	50	FL, PFL	S	Yes	Head, Caudal Vertebrae
Marlin, Sailfish, Spearfish, NK	2	50	LJFL, PFL	C	No	Head, Dorsal Spines
Shark, NK	2	100	FL, TL	S	Yes	Vertebral Centra
Tuna, Albacore	2	100	FL, PFL	S	Yes	Head, Caudal Vertebrae
Tuna, Bigeye	2	100	FL, PFL	S	Yes	Head, Caudal Vertebrae
Tuna, Blackfin	2	all caught	FL, PFL	S	Yes	Head, Caudal Vertebrae
Tuna, Yellowfin	2	all caught	FL, PFL	S	Yes	Head, Caudal Vertebrae
Dolphinfish (Mahi Mahi)	3	20	FL	S	No	-
Escolar	3	20	FL	S	No	-
Louvar	3	20	LJFL	S	No	-
Mackerel, NK	3	20	FL	S	No	-
Oilfish	3	20	FL	S	No	-
Opah	3	20	TL	S	No	-
Ray, NK	3	20	TL, DW	S	Yes	-
Sturgeon, NK	3	all caught	FL	S	No	-
Tuna, Little (False Albacore)	3	50	FL, PFL	S	Yes	Head, Caudal Vertebrae
Tuna, Skipjack	3	50	FL, PFL	S	Yes	Head, Caudal Vertebrae
Wahoo	3	20	FL	S	No	-

SAMPLE PRIORITY CODES
1 = HIGH
2 = MEDIUM
3 = LOW

LENGTH CODES
S = STRAIGHT
C = CURVED

LENGTH TYPE CODES	
FL = Fork Length	TL = Total Length
PFL = Pectoral Fin to Fork Length	CK = Cleithrum to Keel Length
LJFL = Lower Jaw to Fork Length	DW = Disk Width

*** SWORDFISH SAMPLES**

The **base** of the anal spines must be present. This does not require the cutter to have to cut into the meat of the fish but should be cut off flush with the body.

Include a **DRESSED CARCASS WEIGHT** when possible.

It is only necessary to collect samples from large swordfish:

Males > 230 cm LJFL (along with 2-3" sample of gonad)

Females > 250 cm LJFL (visual ID of sex determination is ok)

TABLE 3. PELAGIC FISH SAMPLING REQUIREMENTS BY SPECIES

PELAGIC FISH SAMPLING

Length measurement and age sample parts illustrations for pelagic fish. Shaded areas indicate TAG RECAPTURE samples.

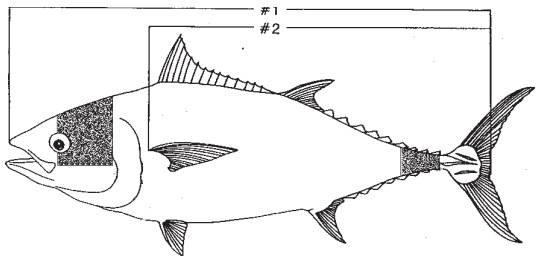


Figure 14.
TUNA measurements in order of importance:
#1: Tip of upper jaw to fork (straight); #2: Anterior pectoral fin to fork (straight).

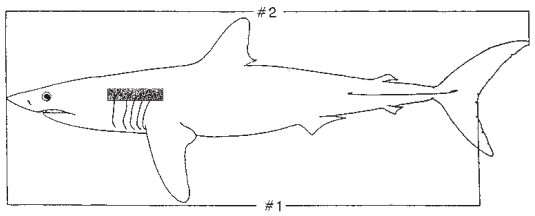


Figure 15.
SHARK measurements in order of importance:
#1: Tip snout to fork (straight); #2: Tip of snout to tip of upper caudal lobe (straight).

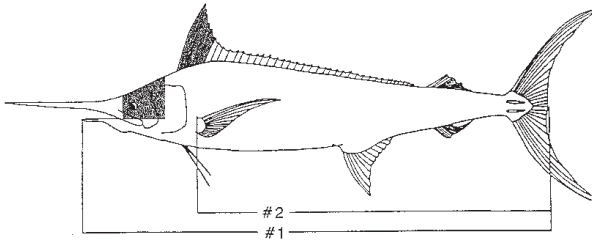


Figure 16.
BILLFISH measurements in order of importance:
#1: Tip of lower jaw to fork (curved); #2: Anterior pectoral fin to fork (curved).

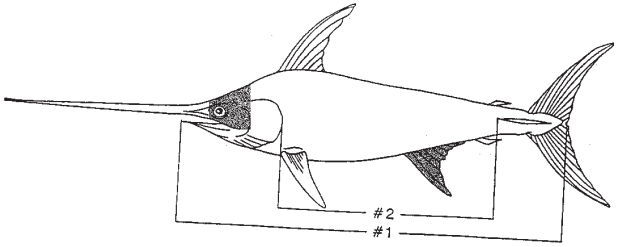


Figure 17.
SWORDFISH measurements in order of importance:
#1: Tip of lower jaw to fork (curved); #2: Cleithrum to the anterior origin of the caudal keel (curved).

Fish Tagging

- Tag and release live animals only.
- Be sure to tag the animal with the correct tag; **tags used on billfish and tunas are different than tags used on sharks**.
- See Table 3 and above illustrations for samples to collect from tag recapture animals.
- **All** tag recaptures should be fully sampled if possible (*i.e.* weather permitting and without interfering with the processing of a kept fish).

Animals to tag:

Billfish/Tunas:

swordfish	yellowfin tuna
blue marlin	albacore tuna
white marlin	bigeye tuna
sailfish	blackfin tuna
bluefin tuna	skipjack tuna

Sharks: Identifiable species ONLY, excluding dogfish.

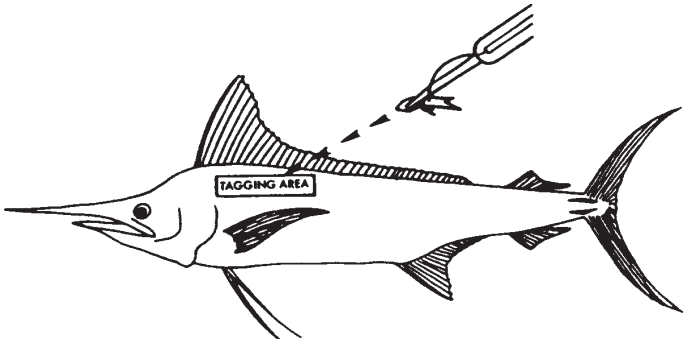


Figure 18. Tagging location for billfish and tunas.

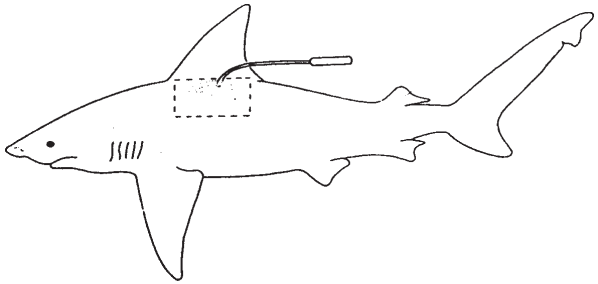


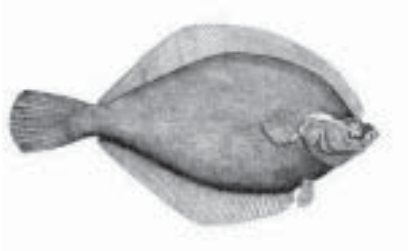
Figure 19. Tagging location for sharks.

SEX DETERMINATION: groundfish

YELLOWTAIL FLOUNDER *Pleuronectes ferrugineus*

Female: The anterior edge of the ovary is rounded, and extends back toward the caudal fin, forming a balloon or sac-like structure. In mature fish the ovary extends back to a minimum of one half of the body cavity. Depending on maturity stage, the ovaries will appear light pink (immature) to bright orange (ripe) in color.

Male: The testis is tapered at the anterior edge. It is triangular in shape, and does not extend as far back as the ovary. It extends back toward the caudal fin about twice the distance of the width of the front edge. In mature fish the testis will not extend back any further than the pectoral fins. Depending on maturity stage, the testis will appear clear and transparent (immature) to opaque and white (ripe) in color.



REDFISH *Sebastes* sp.

Redfish are live-bearers, so the stage of maturity for females and males are offset. Females will ripen in the winter, when males rest.

Female: The ovaries are paired and sac-like, or balloon-like in shape. After the eggs are fertilized, the eyes of the larvae can been seen as black dots. Redfish eggs are green in color.

Male: There are greater than two fat bodies present which are sac-like, segmented or lumpy. These may look like the testes, but the testes are paired, consist of smooth tissue and are firmer than the fat bodies. The coloration is light tan when resting and off-white when developing and ripe. Males over 20 cm also have an external copulatory organ, which is located near the vent. If the organ is not seen, it will be necessary to cut open the fish to verify the sex.

SHARKS Elasmobranchii

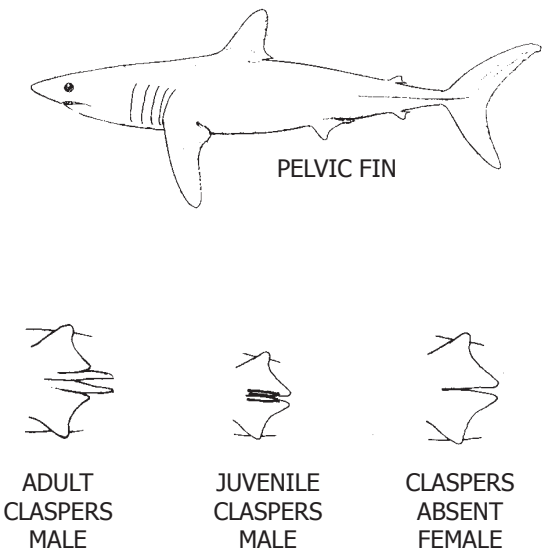


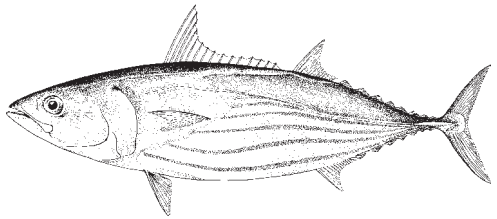
Figure 20. Sex determination in sharks. Top figure: location of the pelvic fins. Bottom figures: ventral view of the pelvic fins, and location (or absence) of the claspers.

TUNAS *Euthynnus, Thunnus* sp.

See sex determination of **swordfish** section (next page).

Female: Same characteristics as swordfish ovaries.

Male: The testes are usually elongated and uniform in shape throughout. They are flatter and thinner when compared to the swordfish testes. Generally, there is more fatty or connective tissue associated with the tuna testes than with the swordfish testes.



SEX DETERMINATION: sharks/ tunas

SEX DETERMINATION: swordfish

SWORDFISH *Xiphias gladius*

Female:

The most prominent characteristics of female swordfish gonads are:

- oval shape (cigar or sausage shaped)
- rough (striated) external appearance
- in a cross section, the presence of a lumen (opening) near the center

Color: variable, ranges from gray (indicating immature egg production) to orange (indicating near spawning)

Generally, swordfish and tuna over 250 pounds are female.

Figure 21. Cross section (left) and whole (right) views of female swordfish gonads. Courtesy of U.S. National Marine Fisheries Service, Southeast Fisheries Science Center.

Male:

The most prominent characteristics of male swordfish gonads are:

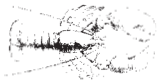
- triangular in shape (cross section), solid
- thin, elongated, and slightly compressed (smooth and flat)
- a raised center ridge

Color: white to pink

Figure 22. Cross section (left) and whole (right) views of male swordfish gonads. Courtesy of U.S. National Marine Fisheries Service, Southeast Fisheries Science Center.

SEX DETERMINATION: crustaceans

AMERICAN LOBSTER *Homarus americanus*



Female: The first pair of swimmerets are thin and filament-like.

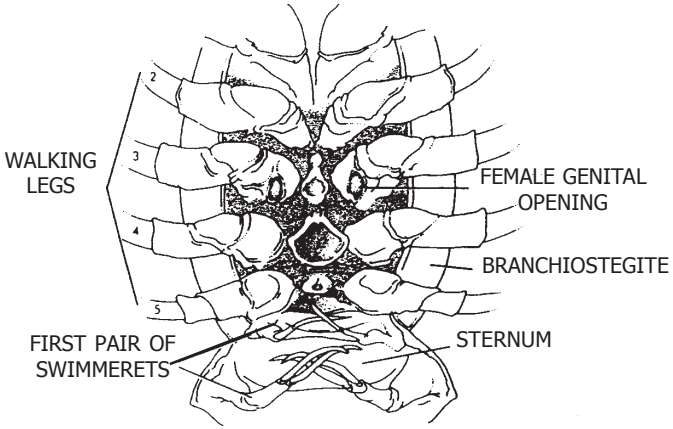


Figure 23. Ventral view of **female lobster**. Note the relatively large genital opening on the third pair of walking legs.

Male: The first pair of swimmerets are thick in shape and firm in texture.

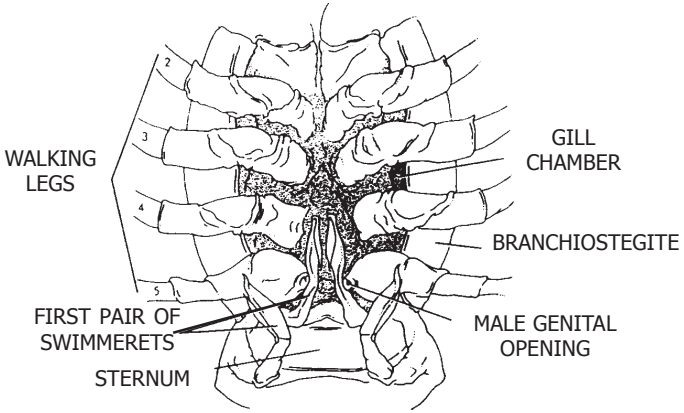
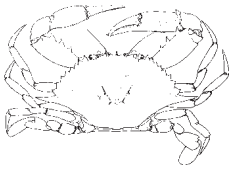


Figure 24. Ventral view of **male lobster**. Note the small genital opening on the fifth pair of walking legs.

CRABS Brachyura



Female: The abdomen is "U" shaped.

Male: The abdomen is "V" shaped.

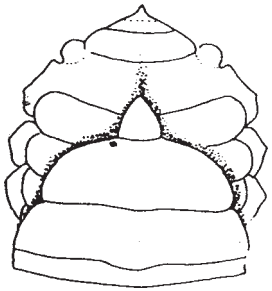


Figure 25. Ventral view of **female crab** abdomen.

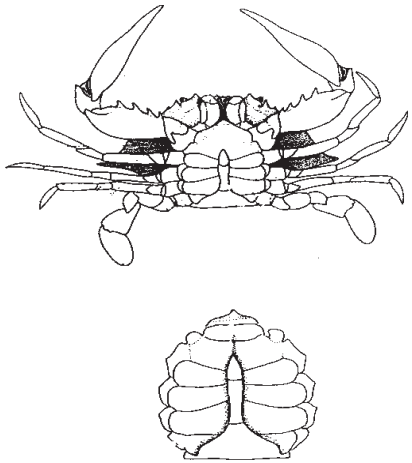


Figure 26. Ventral views of **male crab** abdomen.

SEX DETERMINATION: crustaceans

TABLE 4. MARINE MAMMAL SAMPLING REQUIREMENTS BY SPECIES

SPECIES	WHOLE +	DNA SAMP (FINCLIP/ SKIN)	STD MEAS	HEAD/ JAW	STOM	BLUB	MUSC	REPR TRACT	FETUS	LIVER	HEART	KIDNY	ADD MEAS
Porpoise, Harbor	1	1	1	1	1	1	1	1	1	2	-	-	-
Dolphin, Bottlenose	1	1	1	1	1	1	1	1	1	1	1	3	1
Dolphin, White-sided	1	1	1	1	1	1	-	-	-	-	-	-	-
Dolphin, Common	1	1	1	1	1	1	1	1	1	-	-	-	-
Whale, Pilot, NK	-	1	1	1	1	1	1	1	-	1	2	2	-
Dolphin, Spotted, NK	1	1	1	1	1	1	1	-	1	-	-	-	-
Dolphin, Striped	-	1	1	1	1	1	-	-	-	-	-	-	-
Dolphin, Risso's (Grampus)	-	1	1	1	1	1	2	3	-	-	-	-	-
Seal, Gray	1	1	1	1	1	1	1	-	-	-	-	-	-
Seal, Harbor	1	1	1	1	1	1	1	-	-	-	-	-	-
Seal, Harp	1	1	1	1	1	1	1	-	-	-	-	-	-
Seal, Hooded	1	1	1	1	1	1	1	-	-	-	-	-	-
Whale, Beaked, NK	1	1	1	1	1	1	1	1	1	1	1	-	-

** Please note that species are in order of priority from top to bottom and samples are in order of priority from left to right.

+ if whole animals cannot be retained, collect head after performing minimum sampling requirements.

MINIMUM REQUIREMENTS

Live animals: Photograph and return to the water.

Dead animals:
1. Obtain DNA sample
2. Tag
3. Identify & Photograph
4. Body Measurements: 7 for cetaceans, 4 for pinnipeds
5. Body Temperature
6. Sex Determination
7. Note any Marks or Scars

After sampling of the catch according to Tables 1a-g and Table 3 is completed, additional marine mammal measurements and sampling should occur as outlined in Table 4.

Figure 27. Cetacean body measurements

A. Total Length: snout tip to fluke notch
B. Flipper Length
C. Flipper Width, maximum
D. Height of Dorsal Fin
E. Fluke Width, from tips of flukes
F. Girth at Axilla
G. Blubber Thickness
H. Body Temperature

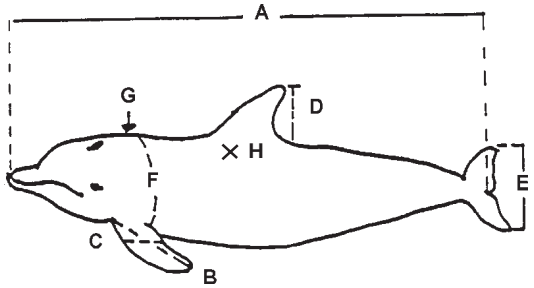
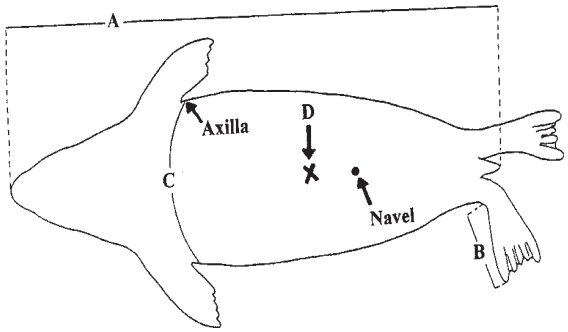


Figure 28. Pinniped body measurements

A. Total Length - snout to tip of tail
B. Rear Flipper Length
C. Girth and Axilla
D. Blubber Thickness (ventral) and Body Temperature (dorsal)



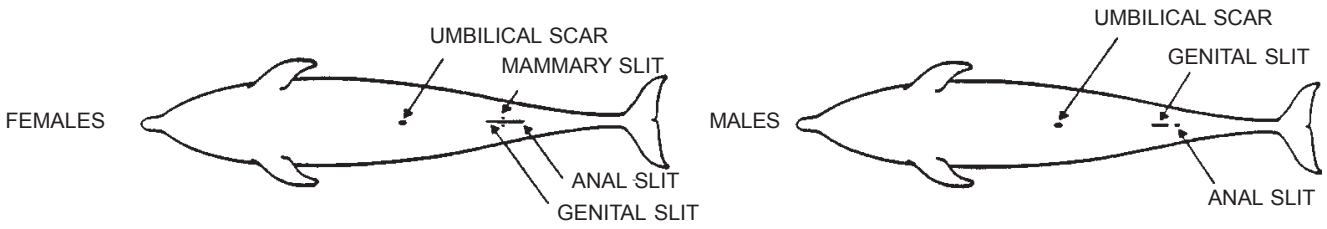


Figure 29. External sex characteristics of cetaceans.

Figure 30. External sex characteristics of pinnipeds.

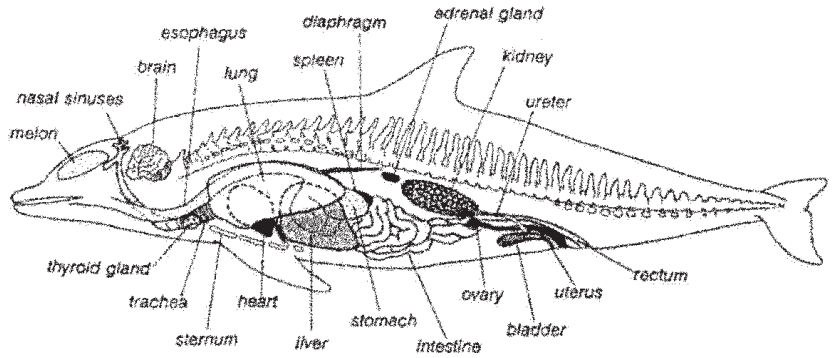


Figure 31. Internal organs of cetaceans.

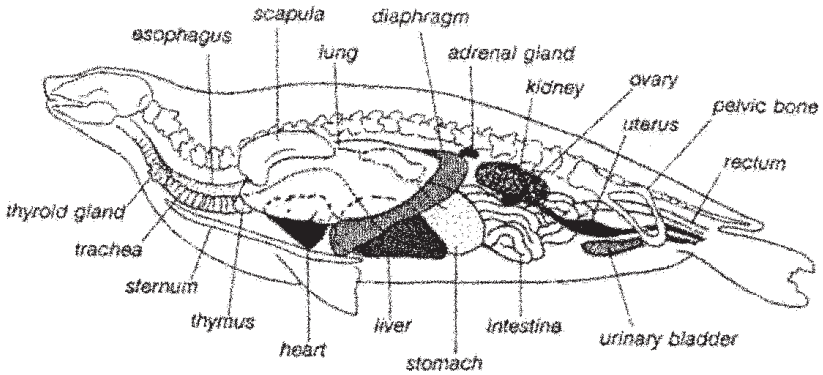


Figure 32. Internal organs of pinnipeds.

SEA TURTLE and SEA BIRD SAMPLING PROTOCOLS

SEA TURTLE SAMPLING PROTOCOLS

Minimum requirements:

1 Identify and photograph.
2 Note any new or old injuries and scars.
3 Obtain 3 body measurements and 6 identification criteria.
4 Tag with inconel tag(s) on rear flipper(s): 1 for dead sea turtles, 2 for live sea turtles>26 cm carapace length.
5 Scan for PIT tags on flippers and all soft tissues.

After sampling of the catch according to Tables 1a-g and/or Table 3 is completed, the following additional samples should be collected.

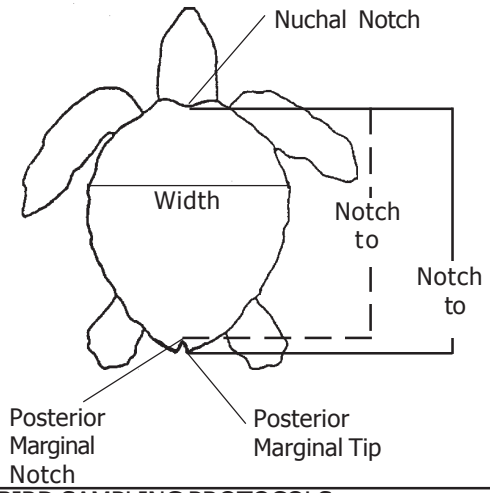
Live animals: Biopsy/tissue (genetic) sample from turtles larger than 25 cm carapace length.

Dead animals (in priority order):

1 Whole
2 Biopsy/tissue (genetic) sample

Biopsy Location: Dorsal surface rear flipper 5-10 cm from trailing edge and close to body. **One biopsy per rear flipper**.

Figure 33. Sea turtle measurements.



SEA BIRD SAMPLING PROTOCOLS

Minimum requirements:

1 Identify and photograph.
2 Check for the presence of bands.

After sampling of the catch according to Tables 1a-g and/or Table 3 is completed, retain dead, fresh whole birds if caught in the area between Maine-New Jersey. Breast feathers may be collected if whole bird cannot be retained.

Do not assume that an inactive turtle is dead. The onset of rigor mortis is often the only definitive indication that a turtle is dead.

RESUSCITATION:

1 Place the turtle right side up (on the bottom shell or plastron).
2 Elevate the hindquarter several inches for a period of 2 up to 24 hours.
3 Place turtle in the shade and kept moist.
4 Touch the eye and pinch the tail (reflex test) periodically to see if there is a response.

Those that revive and become active should be released over the stern of the boat when fishing gear is not in use, when the engine gears are in neutral position, and in areas where they are unlikely to be recaptured or injured by vessels. Sea turtles that fail to respond to the reflex test or fail to move within several hours (up to 24, if possible) should be returned to the water in the same manner.

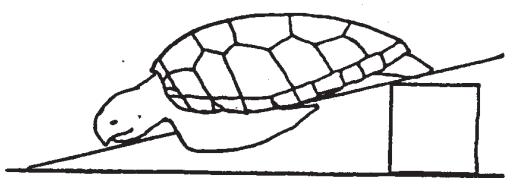


Figure 34. Proper positioning of turtle for resuscitation.

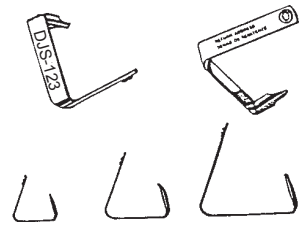
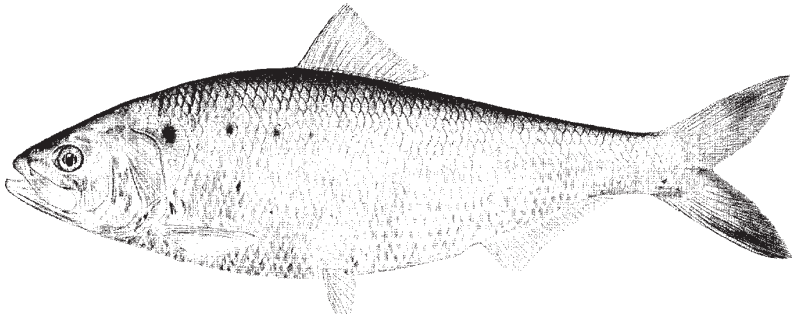


Figure 35. Inconel turtle tags.

SELECTED SPECIES ID'S: shad

The following selected species identification section contains descriptions of some of the more commonly misidentified Atlantic species. It should be used as a supplement to the field guides distributed in training.

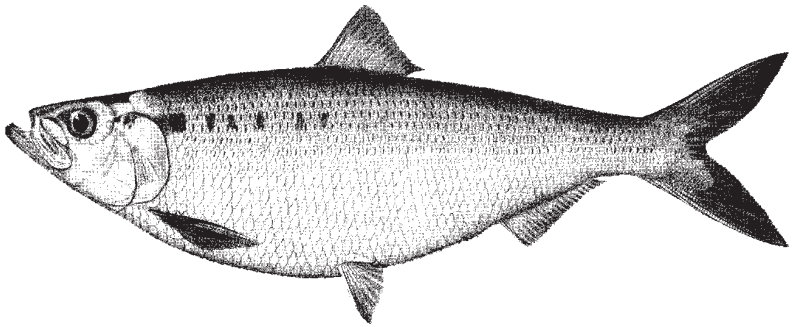


AMERICAN SHAD *Alosa sapidissima*

Key characteristics

- tip of the lower jaw is entirely enclosed within the tip of the upper mouth when closed
- longer mouth than hickory shad
- upper jaw reaches below the rear edge of the eye
- spots are circular shaped

VS.

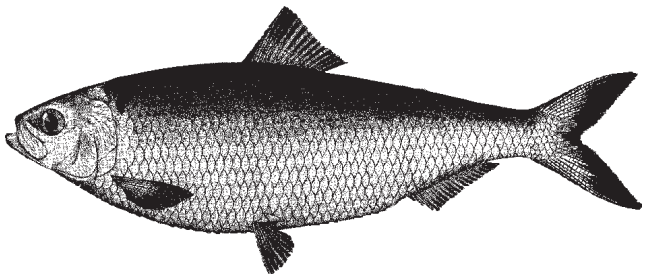


HICKORY SHAD *Alosa mediocris*

Key characteristics

- tip of the lower jaw projects beyond the upper jaw when mouth is closed
- shorter mouth than American shad
- upper jaw reaches the middle of the eye
- spots are oval shaped

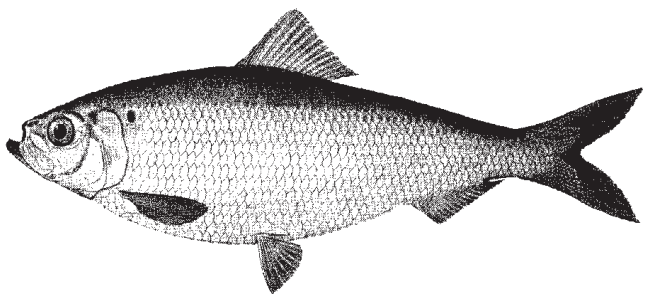
Figure 36. American shad (top) and hickory shad (bottom). Source: *Fishes of Chesapeake Bay* by E. O. Murdy et al., published by Smithsonian Institution Press.



BLUEBACK HERRING *Alosa aestivalis*
Key characteristics:

- peritoneum (belly lining) is black or sooty colored
- back is blue-green in color
- eye width = distance between the front of the eye to the tip of the snout
- body shape is slightly more slender than the alewife

VS.

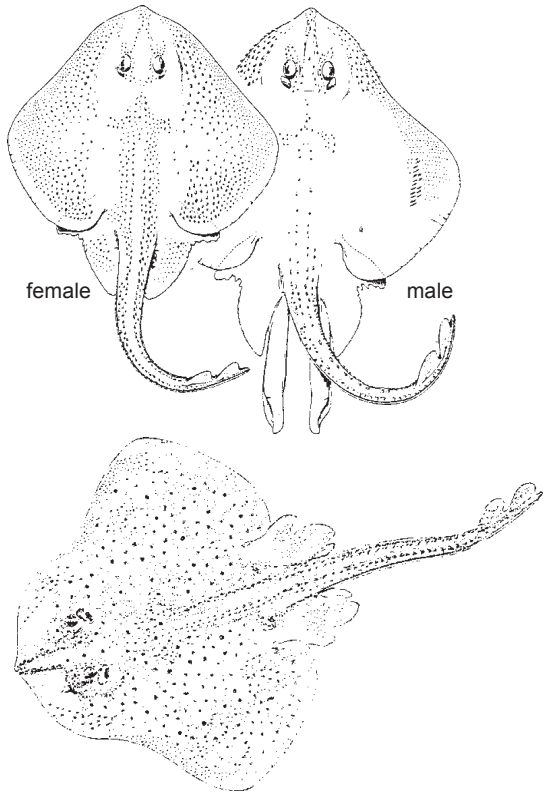


ALEWIFE *Alosa pseudoharengus*
Key characteristics:

- peritoneum (belly lining) is pale gray or pink
- back is gray-green in color
- eye width > distance between the front of the eye to the tip of the snout
- body shape is slightly deeper than the blueback

Figure 37. Blueback herring (top) and alewife (bottom). Source: *Fishes of Chesapeake Bay* by E. O. Murdy et al., published by Smithsonian Institution Press.

SELECTED SPECIES ID'S: skates



LITTLE SKATE *Leucoraja erinacea*
Key characteristics:

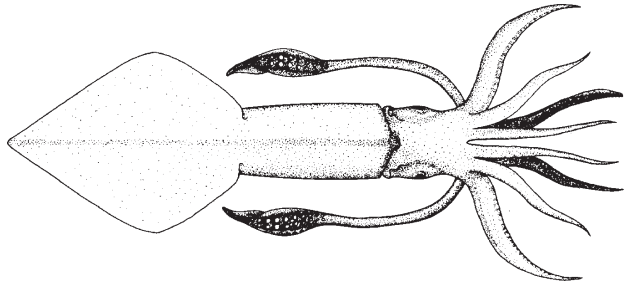
- maximum length 54 cm
- matures at a smaller size than winter skates
- animals 35 cm and over will be sexually mature, males will have large claspers that extend well beyond the posterior edge of the disk, females will have a granular patch on the bottom of the animal, in front of the tail

VS.

WINTER SKATE *Leucoraja ocellata*
(Big skate)
Key characteristics:

- maximum length 109 cm
- matures at a larger size than little skates
- animals < 54 cm will be sexually immature, males will have small claspers that rarely extend beyond the posterior edge of the disk, females do not have a granular patch on the bottom of the animal

Figure 38. Little skate (top) and winter skate (bottom). Source: *Fishes of the Gulf of Maine* by H.B. Biegelow & W.C. Schroder, U.S. Fish and Wildlife Service.

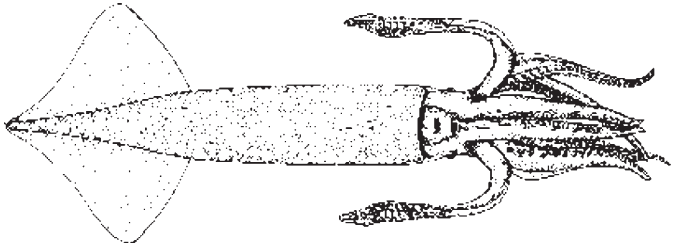


dorsal view

LOLIGO SQUID *Loligo pealei*
(Long-finned squid)
Key characteristics:

- fins elongated, about 1/2 of mantle length
- color: white to purple, occasionally some reddish-brown, darker on dorsal side

VS.



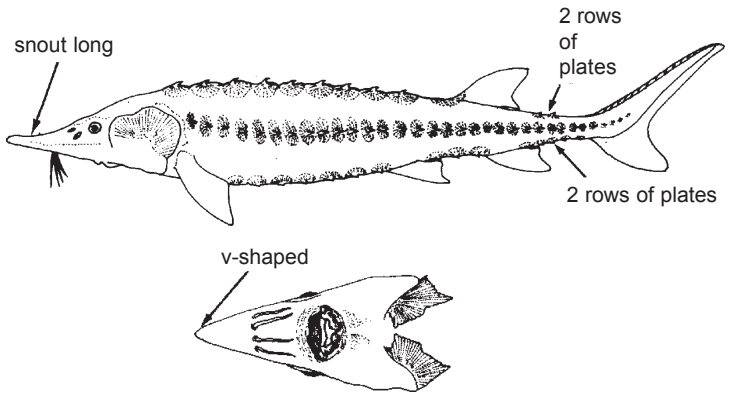
ventral view

ILLEX SQUID *Illex illecebrosus*
(Short-finned or Boreal squid)
Key characteristics:

- fins shortened, about 1/3 of mantle length
- color: reddish-brown, darker on dorsal side

Figure 39. Loligo squid (top) and illex squid (bottom). Source: *FAO Species Identification Sheets for fishery purposes. Western Central Atlantic (fishing area 31). Vol. 6*, UNFAO.

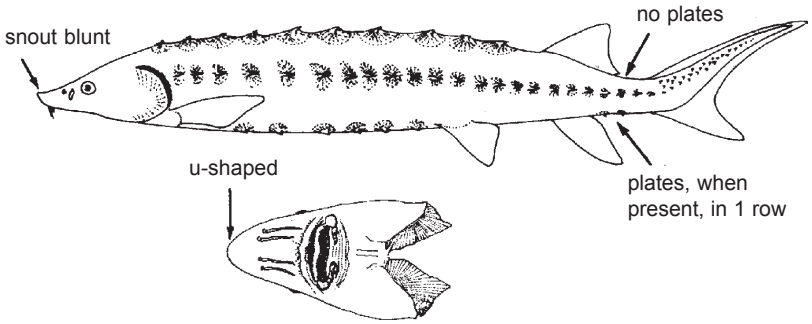
SELECTED SPECIES ID'S: sturgeon



ATLANTIC STURGEON *Acipenser oxyrhynchus*
Key characteristics:

- post-dorsal and post-anal plates in pairs
- snout v-shaped (upturned in juveniles)
- barbel length greater than 1/2 width of mouth
- male average length 198 cm, female average length 244 cm

VS.

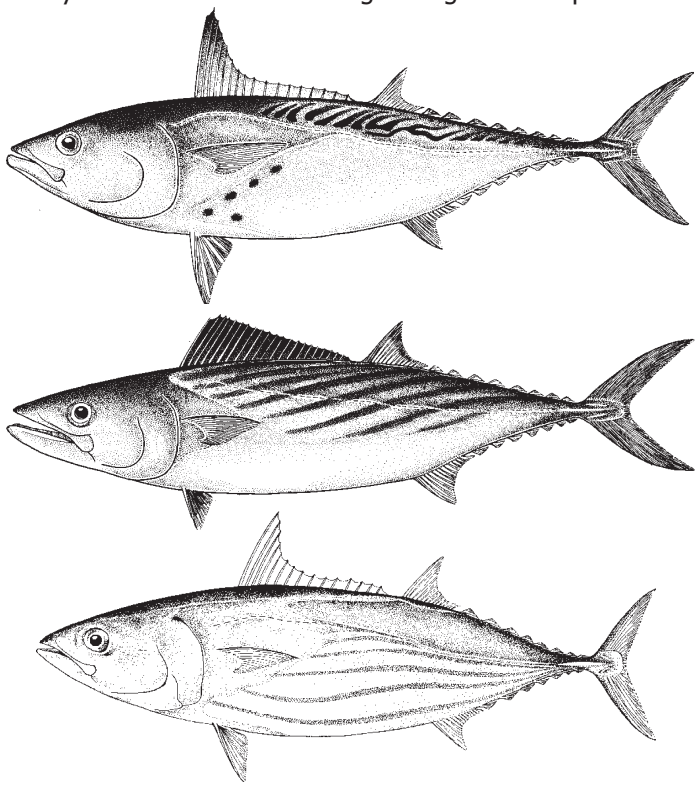


SHORTNOSE STURGEON *Acipenser brevirostrum*
Key characteristics:

- post-dorsal plates usually absent
- post-anal plates, when present, in 1 row
- snout u-shaped
- barbel length less than 1/2 width of mouth
- maximum length 102 cm

Figure 40. Atlantic sturgeon (top 2) and shortnose sturgeon (bottom 2). Source: *FAO Species Identification Sheets for fishery purposes. Western Central Atlantic (fishing area 31). Vol. 1*, UNFAO.

The key characteristics for distinguishing these 3 species are the body markings.



LITTLE TUNNY* ***Euthynnus alletteratus*** **(False albacore)**

- markings: a series of dark, wavy lines above the lateral line
- 4-5 dark spots below pectoral fin

*note that the name 'little tuna' may also be used by fishermen to refer to other Euthynnus species

VS.

ATLANTIC BONITO ***Sarda sarda***

- markings: a series of dark, longitudinal stripes on the upper half of the fish

VS.

SKIPJACK TUNA ***Euthynnus pelamis***

- markings: a series of dark, longitudinal stripes on the lower half of the fish

Figure 41. Little tunny (top), Atlantic bonito (middle) and skipjack tuna (bottom). Source: *FAO species catalogue. Vol. 2. Scombrids of the World. An annotated and illustrated catalogue of tunas, mackerels, bonitos and related species know to date* by B.B. Collette & C.E. Nauen, UNFAO.

CATCH ESTIMATION GUIDELINES

Accurate weights are extremely important. It will be possible to obtain actual weights in most situations. In rare cases, *i.e.* extremely large catches, rough weather, etc., it may be necessary to estimate the catch or a portion of the catch.

- Dressed vs. Round weights: Get round weights unless they are landing parts of a particular species, for example: monkfish livers, monkfish tails, skate wings, shark fins.
- Kept vs. Discarded catch: The following techniques can be used to estimate weights for both the kept and discarded portions of the catch. However, usually weight estimation will only be necessary for a kept species. If you are recording discards, ask the crew to throw the discards aside in totes or baskets for you to weigh at the end of the haul.
- Remember to subtract the weight of the basket or tote, *i.e.* the subsampling unit, from all weight calculations.
- Obtain a catch estimate from the captain if there is no other way of estimating a weight.

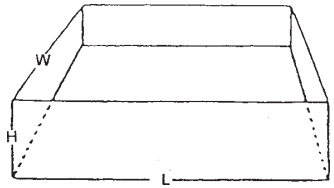
A Estimation Based on Basket or Tote Counts

1 The catch is separated into totes by species. For each species:
2 Get an average weight per tote by actually weighing some totes (A).
3 Count the total number of totes; make sure that all of the totes are filled to approximately the same level (B).
4 If the last tote is not full, weight it (C).
5 To calculate the total catch, multiply the number of totes by the average weight of a tote and add the remainder (A x B + C).

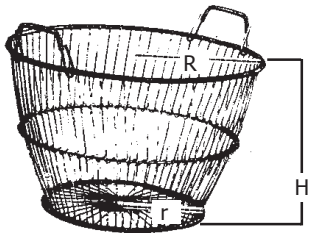
B Estimating Large Catches Using Volume and Density Measures

1 Calculate the volume of the fish bin or hold.
Rectangular bin/hold*: Volume A (V cubic feet) = height of fish (H feet) x width (W feet) x length (L feet)

2 Calculate the volume of a basket or tote (the subsampling unit).
Rectangular tote*: Volume B (V cubic feet) = length (L feet) x width (W feet) x height of fish (H feet)
Basket*: Volume B (V cubic feet) = pi (π) [top radius^2 (R^2 feet) + (top radius x bottom radius (Rr feet)) + bottom radius^2 (r^2 feet)] x height (H feet) / 3



$V = L \times W \times H$



$V = \pi \, [R^2 + Rr + r^2] \, H / 3$

Figure 42. Mathematical formulas for calculating the volume of a fish tote (left) or basket (right).

3 Weigh tote(s) full of fish (weight of subsample in pounds). Calculate the average weight per tote.
Weight B (lbs) = weight of tote #1 (lbs) + weight of tote #2 (lbs) + weight of tote #3 (lbs) + etc... / number of totes weighed

4 Calculate the density of the fish in the subsample by dividing the weight of the subsample by the volume of the tote.
Density B (lbs/cubic foot) = Weight B (lbs) / Volume B (cubic feet)

5 Calculate the total catch weight by multiplying the volume of the bin by the density of the fish.
Total catch weight (lbs) = Volume A (cubic feet) x Density B (lbs/cubic feet)

6 Take a subsample of the catch and calculate the percent of catch for each species.
Percent of species a = weight of species a (lbs) / total weight of subsample (lbs)

7 Calculate the estimated total catch weight by species by multiplying the percent of catch by the total catch weight.
Weight of species a (lbs) = Percent of species a (%) x Total Catch Weight (lbs)

*examples of calculating volume for odd shaped containers can be found in the NEFSC Observer Program Training Manual

SUBSAMPLING AND RANDOM SAMPLING GUIDELINES

The keys to successful subsampling are:

- **A sufficiently sized sample.** Collect as large a sample as possible, but at least 1/5 of the entire catch amount.

- **A randomly selected sample.** Each fish from the entire catch should have an equal chance of being selected for the subsample. No "favoritism" is given to "exceptional" fish (*i.e.* particularly large or small fish), as it must be equally likely that these, as well as the "typical" members, will be chosen.

Some other basic guidelines:

- Collect subsamples from **at least three different parts of a large pile**. The greater the range of fish sizes, and the greater the diversity in species composition, the greater the number of subsamples to collect, as time and conditions permit.

- Instead of a few, large subsamples, **collect more, smaller subsamples from different areas of a pile** or different times during the crew's sorting procedures.

- Ensure collection of fish from the **bottom, middle, and top layers** of a pile. Scoop a basket to be filled from the top of a mixed pile of fish, down to the deck, and back to the top.

- When selecting individual fish, choose them in a **systematic, and non-calculated manner**, until an adequate subsample size is obtained.

In every subsampling situation, the methods used should be recorded in the Comments section of the corresponding Haul Log.

Example: A large otter trawl catch, which consists mainly of the target species, loligo squid, is brought aboard the vessel and dumped on deck into a rectangular holding area confined by 4 peg boards. The crew sorts the catch in the following manner: the pile is picked through and all species other than squid are removed. Species to be kept are sorted into totes by species. Species to be discarded are thrown into a separate tote, as requested by the observer. Because of the large volume, the observer must sample the squid differently from the rest of the catch.

l The observer weighs all totes of the kept species other than squid to obtain actual weights for these species.

2 The observer then identifies the priority* species requiring further sampling (length measurement and age structure collection) and begins measuring fish, randomly chosen from the tote(s). While conducting length frequencies, the first one to three fish (depending on the sample size and time available) at each unique length are sampled for age structures, as appropriate.

3 The observer takes a subsample of the squid catch by filling 5 totes of squid from the total catch, making sure to collect animals from different parts of the pile. The observer estimates the total catch weight of squid based on tote counts (method A on the previous page).

4 The observer then obtains a complete sample, 100 lengths*, of squid randomly chosen from the totes.

5 After sampling of the kept catch is completed, the observer sorts the tote of **discarded catch** by species. All animals are weighed to obtain actual weights for all species.

6 Appropriate numbers of length frequency and age structures are collected from all of the required* (priority) species of the discarded catch, as described in #2.

* See Tables 1a-f. Length Frequency & Age Structure Sampling Priorities by Fishery, & Table 2. Groundfish & Shellfish Sampling Priorities by Species.

revised 06/01/05