Biological Data Collection Methods for Nearshore Fisheries

EDF
ENVIRONMENTAL DEFENSE FUND™
Finding the ways that work

Fishery Dependent Monitoring

I. Biological Data

- Immediate and intensive sampling
- Local life history parameters
- Only priority species

II. Surveys

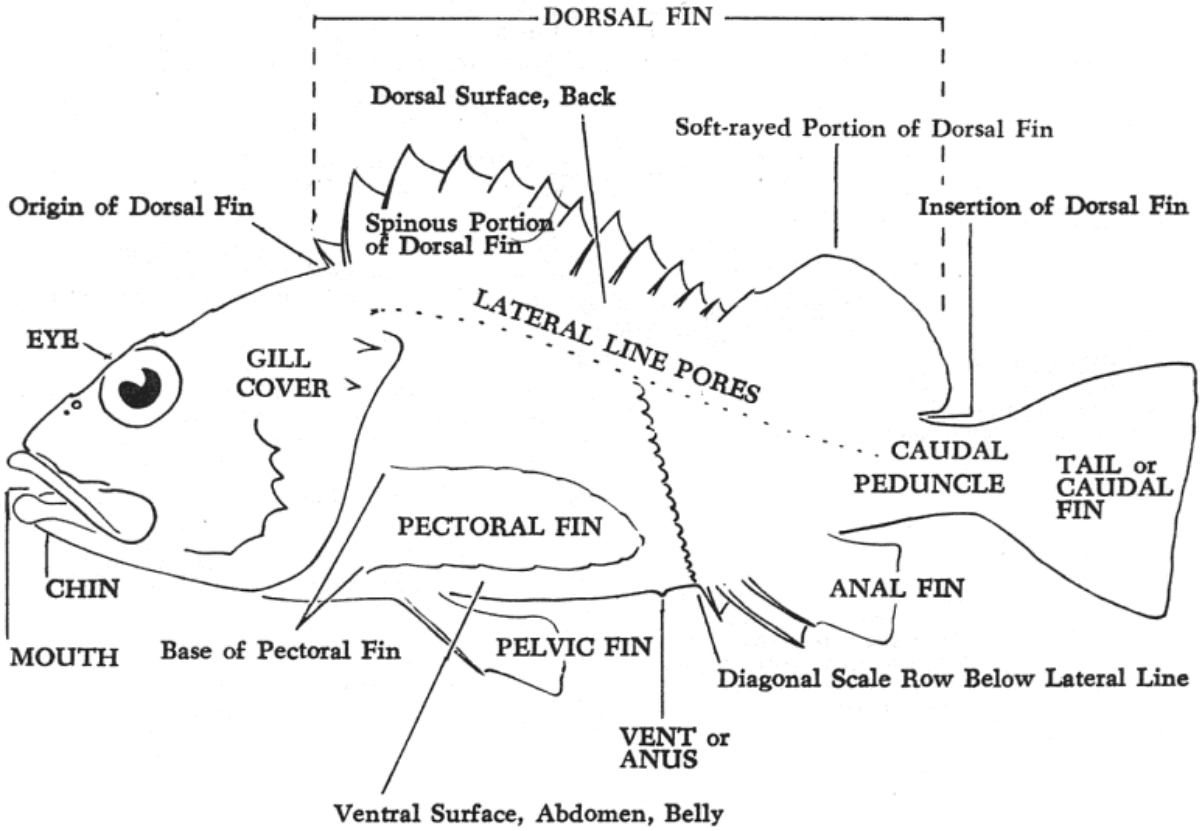
- Year a round sampling
  - At-sea
  - Landings
  - Markets

Biological

I. Biological Data

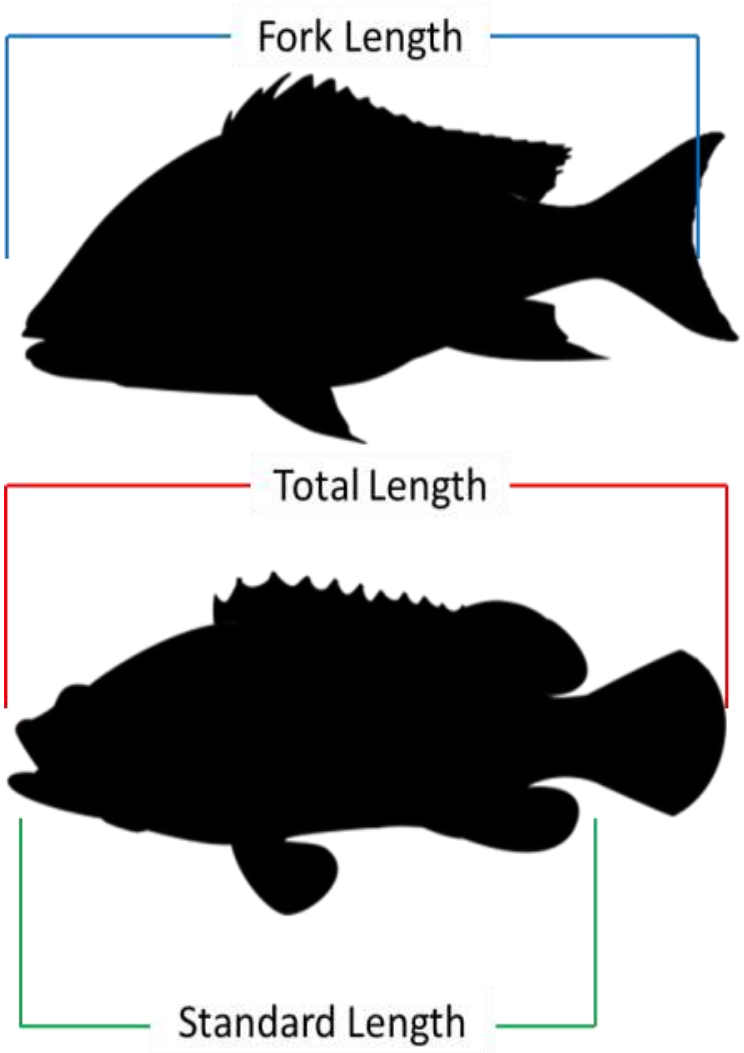
- Biometric
  - Individual characteristics of fish: fish length, fish weight, coloration
- Reproductive
  - Attributes of the population that are important for reproduction
- Biological Samples
  - Collection of samples

Fish Anatomy



A spiny-rayed fish, *Sebastes*, naming fins and general body areas.

Length



Fork Length (FL): From the tip of the snout to the end of the middle caudal fin rays

Total Length (TL): From the tip of the snout to the top of the longer lobe of the caudal fin, usually measured with the lobes compressed along the midline. This is a straight-line measure, not measured over the curve of the body.

Standard Length (SL): From the tip of the snout to the base of the caudal fin.

Preferred measurement is total length, in cm.

Weight

Preferred unit of weight is grams

Initial Data to Observe

- Species
- Length (cm) ± 0. 1
- Weight (g) ± 0.01

Now you can start to collect samples

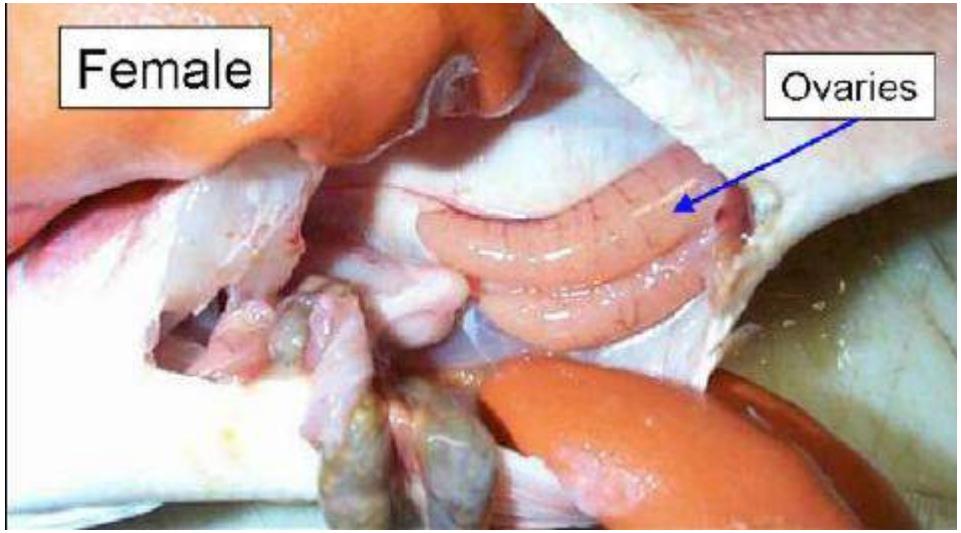
Biological

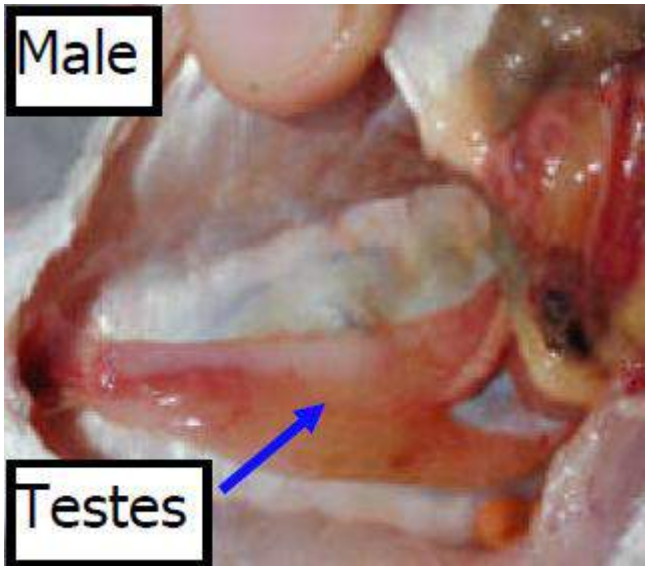
- Biological Data
  - Biometric
    - Individual characteristics of fish
  - Reproductive
    - Attributes of the population that are important for reproduction
  - Biological Samples
    - Collection of samples

Reproduction

- Primary sexual characteristics
  - Male or female gonads
- Secondary sexual characteristics
  - Distinct coloration patterns or size difference between sexes

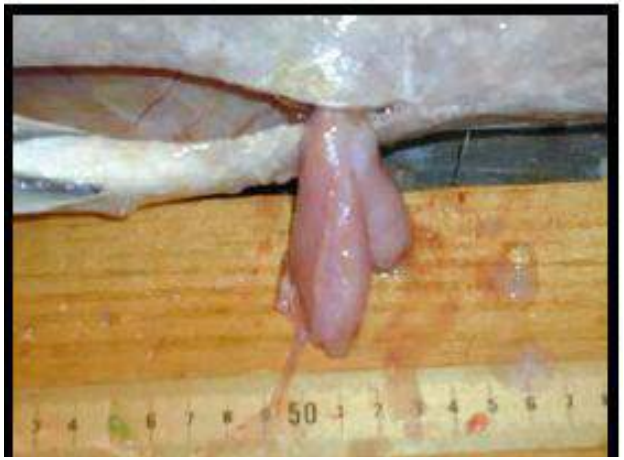
Reproduction





Gonad Removal & Assessment

1. Use a sharp knife and insert its tip just inside the anus.
2. Make a shallow cut through the ventral abdomen up to the base of the pelvic fin.
3. The gonad will be the only bi-lobed organ in the abdominal cavity dorsal to the anus, and will be attached to the upper-rear abdominal wall.
4. Grab the two lobes and carefully pull them away from the abdominal wall.



Maturity Stages

A) Ovaries

Stage	Macroscopic features	Histological features
1. Immature	Ovary thin & firm, pale or translucent pink. No oocytes visible. Difficult to distinguish Stage 1 ovaries from Stage 2.	Ovary compact, lamellae ordered, tunica tight. Previtellogenic oocytes. No evidence of previous reproductive activity.
2. Resting	Ovary more rounded, pale pink or red. No oocytes visible. Approx. 1/4 – 1/3 length of body cavity.	Previtellogenic oocytes dominate. Soon after spawning the ovary has empty lamellae, much vascular tissue, yellow- brown bodies, loose tunica. This evidence of prior spawning gradually diminishes until ovary similar in appearance to late Stage 1.
3. Developing	Ovary enlarged, pale orange or pink, blood vessels noticable. Oocytes visible, small. Approx. 1/3 – 2/3 length of body cavity.	Previtellogenic oocytes dominate early before the growth of cortical alveoli stage oocytes, which mark the start of this stage.
4. Developed	Ovary enlarged, orange or yellow but not speckled. Oocytes large, clearly visible.	Tunica expanded, thin. Lumen reduced. Lamellae contain yolk globule stage oocytes.
5. Spawning	Ovary much enlarged, translucent pale orange. Hydrated, clear oocytes visible giving speckled appearance. Eggs may be extruded with pressure to abdomen. Blood vessels prominent.	Oocytes in yolk globule and hydrated stages of development. Post ovulatory follicles present if spawning has recently occurred.
6. Spent	Ovary bloody and flaccid.	Tunica loose, lamellae disordered, much vascular tissue. > 50 % of vitellogenic oocytes are atretic.

B) Testes

Stage	Macroscopic features	Histological features
1. Immature	Testis small and ribbon-like, translucent white. Sex not easily distinguished.	Testis composed mainly of connective tissue. Radial sinuses poorly developed. Spermatogonia and spermatocytes dominate. Previtellogenic oocytes may be present*
2. Resting	Testis greyish.	Central sinus small compared to later stages. Spermatogonia, spermatocytes and connective tissue dominate. Radial sperm sinuses poorly developed.
3. Developing	Testis enlarged, creamy white. 1/2 – 2/3 length of body cavity.	Radial sperm sinuses more prominent but contain few spermatozoa. Spermiogenesis underway, spermatocytes dominate.
4. Developed	Testis large, opaque, creamy white.	Spermatocytes and spermatids dominate. Many spermatozoa within radial sperm sinuses. Central sperm sinuses large.
5. Spawning	Testis large, firm, creamy white. Milt released with slight pressure.	Central and radial sperm sinuses enlarged and filled with sperm. Spermatids and spermatozoa dominate.
6. Spent	Testis flaccid and reduced in size. Whitish grey and bloody.	Connective tissue dominates. Residual spermatozoa present. Sperm sinuses reduced in size.

Determining Maturity Stage:
Color, size of the gonad in relation to the body cavity, and fish length are the most helpful criteria for identifying maturity stages.

U = Undetermined

- In a substantial number of cases, either sex or maturity can not be determined from the observation.
- It is essential to record this as an unknown sex or maturity, rather than to leave the fish out of the sampling, since omission will bias population estimates in an unpredictable way.
- It is therefore recommended to augment the scales for sex and maturity with a code for unknowns.

IM = Immature

(Gonads are barely visible)

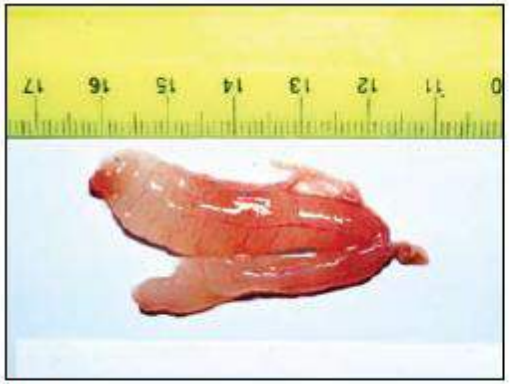


Plate 1

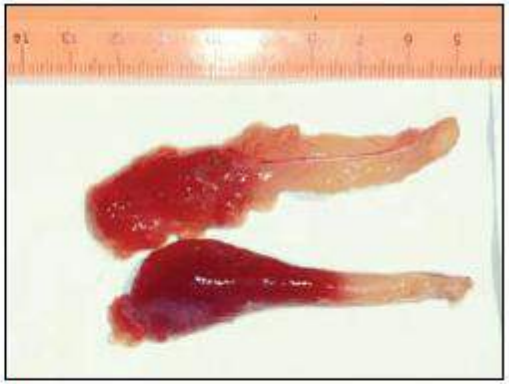
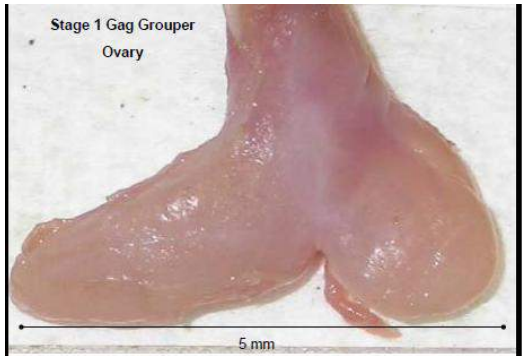


Plate 2

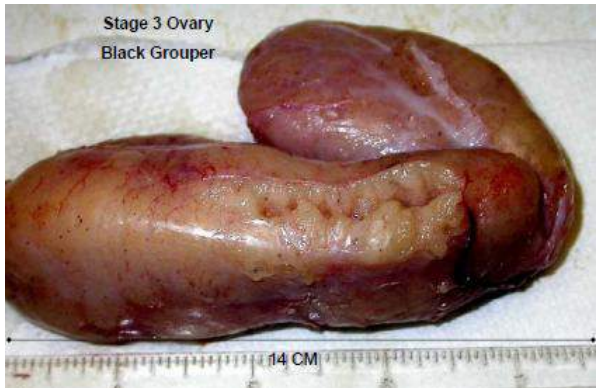


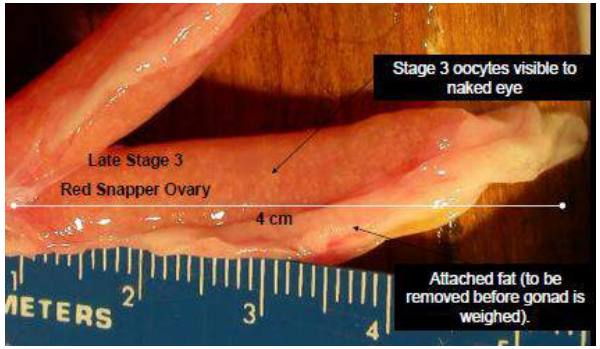
Females: Ovary thin & firm, pale or translucent pink. No oocytes visible.

Males: Testis small and ribbon-like, translucent white. Grouper gonads outside of the spawning season can be very small, especially in males.

M = Mature

(Enlarging/developing; eggs/sperm are beginning to be produced)





Females: Ovary enlarged, pale orange or pink, blood vessels noticeable.
Oocytes visible, small.
Approx.1/3 – 2/3 length of body cavity.

Males: Testis enlarged, creamy white.
1/2 – 2/3 length of body cavity.

G = Running Ripe

(Gravid; gonads are full of eggs/sperm and are ready to spawn)

Females: Ovary enlarged, orange or yellow but not speckled.
Oocytes large, clearly visible

Males: Testis large, opaque, creamy white.

SW= Spawning

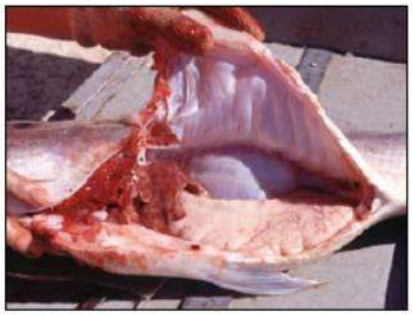


Plate 15

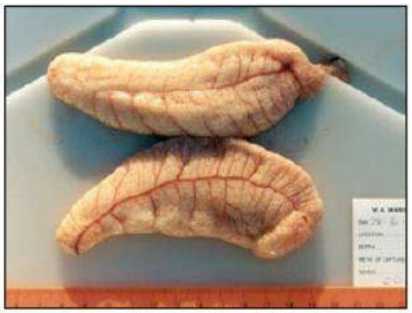


Plate 16

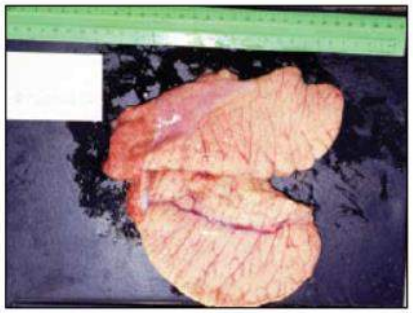


Plate 17

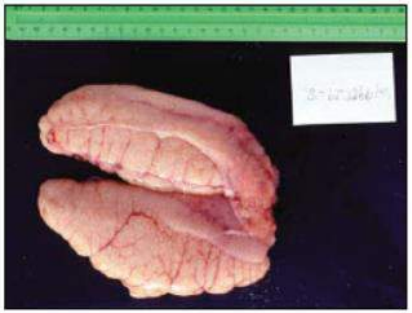


Plate 18

Females: Ovary much enlarged, translucent pale orange. Hydrated, clear oocytes visible giving speckled appearance. Eggs may be extruded with pressure to abdomen. Blood vessels prominent.

Males: Testis large, firm, creamy white. Milt released with slight pressure.

S = Spent

(spawning has already occurred)

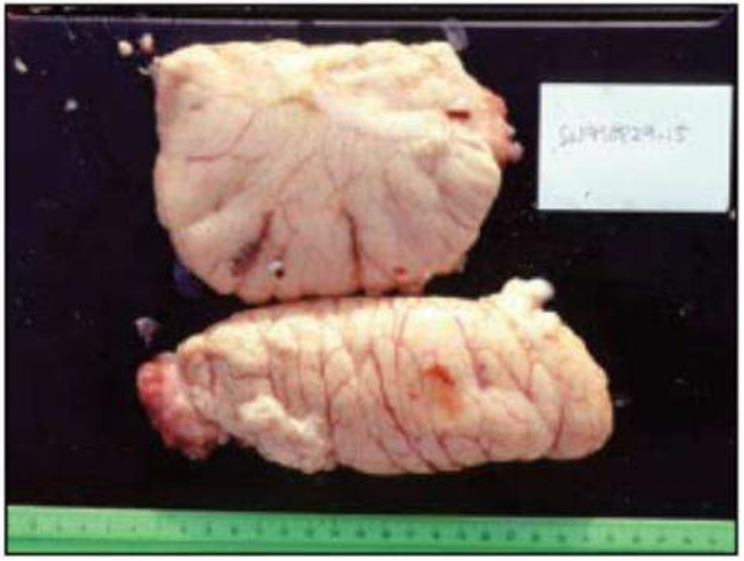


Plate 27

Females: Ovaries shrunken, with few residual eggs, reddish orange-bloody, slimy and flaccid with prominent blood vessels.

Males: whitish grey with reddish tinges. Flaccid and reduced in size.

Biological

- Biological Data
  - Biometric
    - Individual characteristics of fish
  - Reproductive
    - Attributes of the population that are important for reproduction
  - Biological Samples
    - Collection of otoliths

Periodic Structures

Types: otoliths, scales, bones, spines, rays, teeth

- Preferred structure varies with animal

  finfish→ otoliths

- Information:
  - Temporal and spatial variability of growth at different scale (daily and year)
  - Overall Age

Otolith Removal and Storage

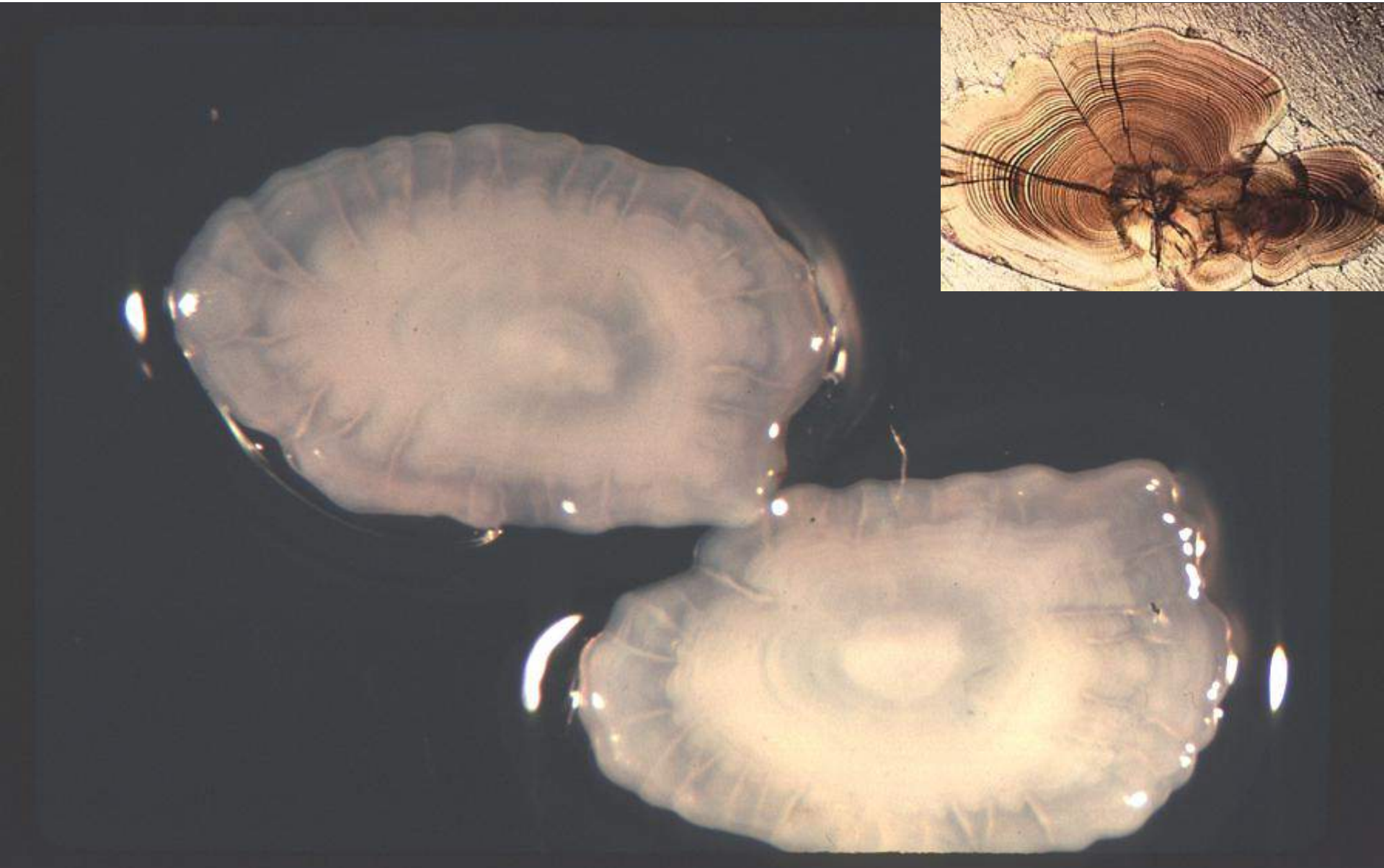
- Composition affects storage and degradation
- Removal can be done in several ways
- Storage of otoliths and other structures

Otoliths

Three pairs of otoliths in each fish:

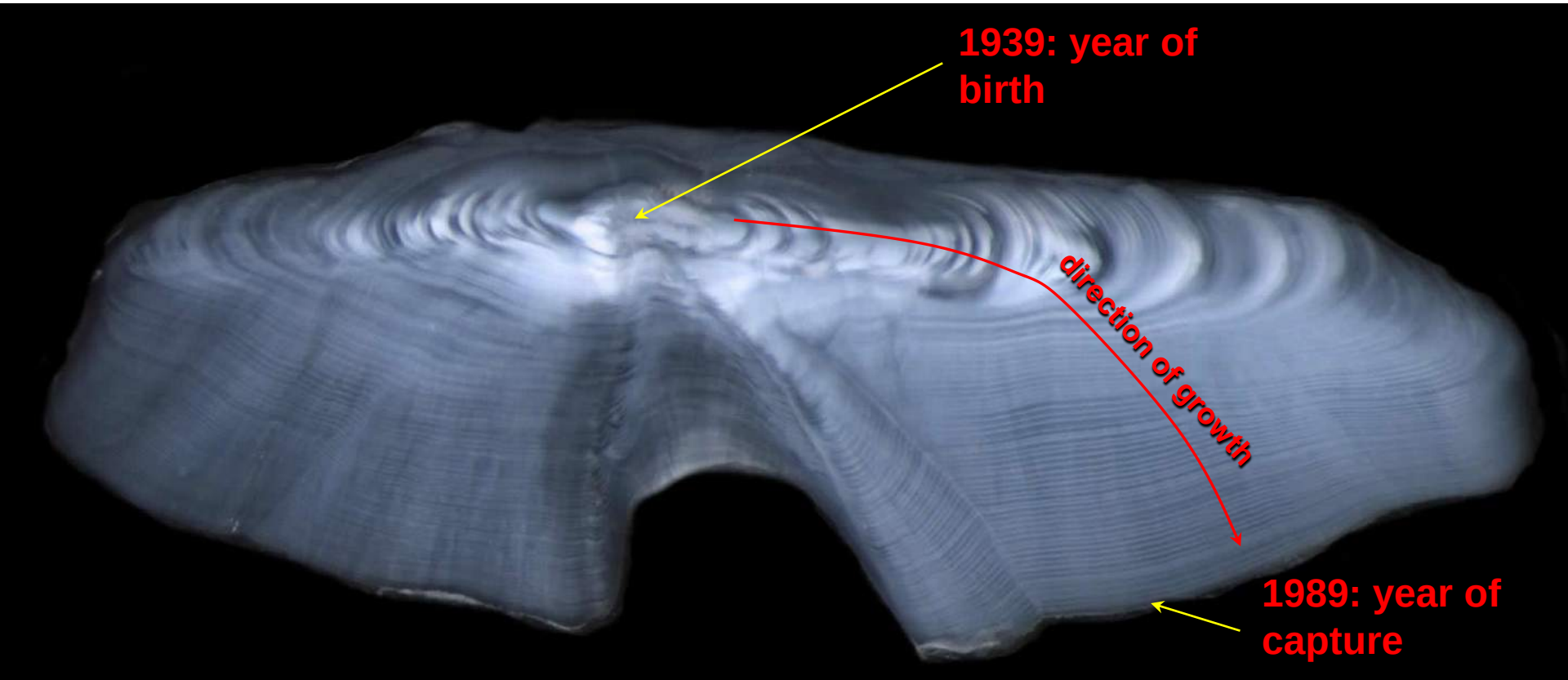
- 1 large pair (the sagittae)
- 2 small pairs (the lapilli and the asteriscii)

Whole Otolith



Otoliths

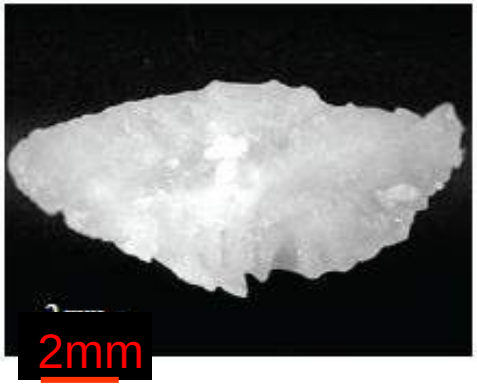
- Done in the lab
- Growth increment formation
    - Opaque zone: fast growth, low protein
    - Translucent zone: slow growth, high protein



Diversity of Otoliths

Lane snapper (*Lutjanus synagris)*
Distribution: North Carolina, Bermuda, and northern GOM to southeastern Brazil
Specimen length: 33 cm FL

Mutton snapper (*Lutjanus analis)*
Distribution: Massachusetts, Bermuda, and northern GOM to Brazil
Specimen length: 46.8 cm FL

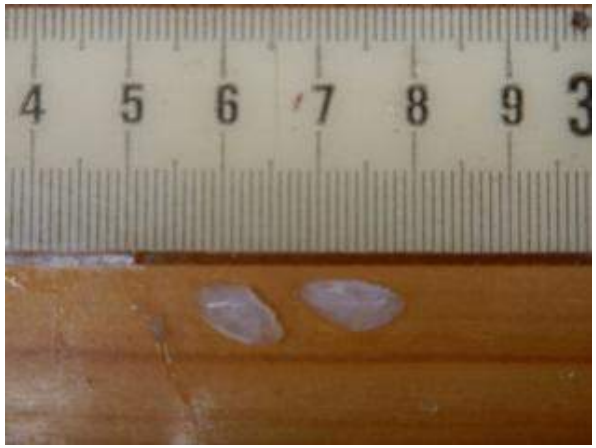


Rock hind (*Epinephelus adscensionis)*
Distribution: Massachusetts, Bermuda, and northern GOM to southern Brazil
Specimen length: 37.0 cm TL

Collection

- At- sea
- At dock from MA fishers
- Fish markets

Use methods that do not impair the quality of fish for resale.

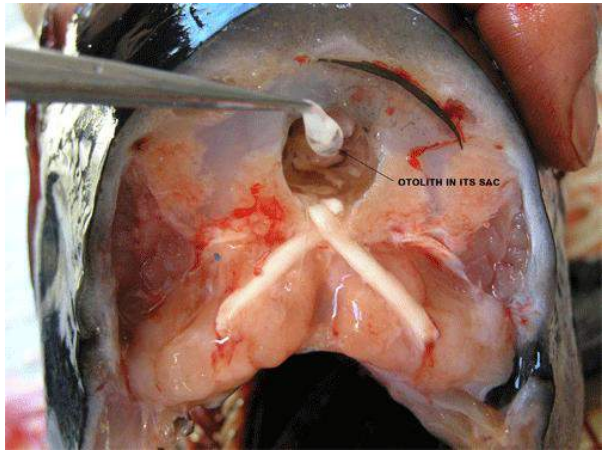


Extraction

"Migraine" Method

"Scalp" Method

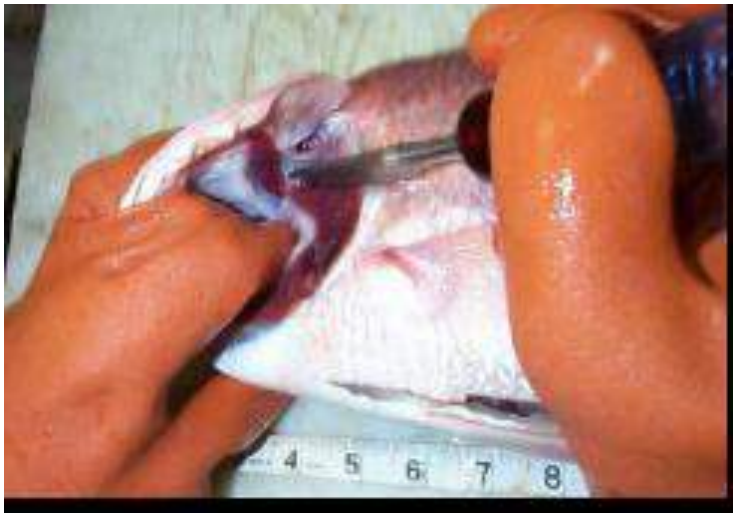
"Chop" Method



Removal

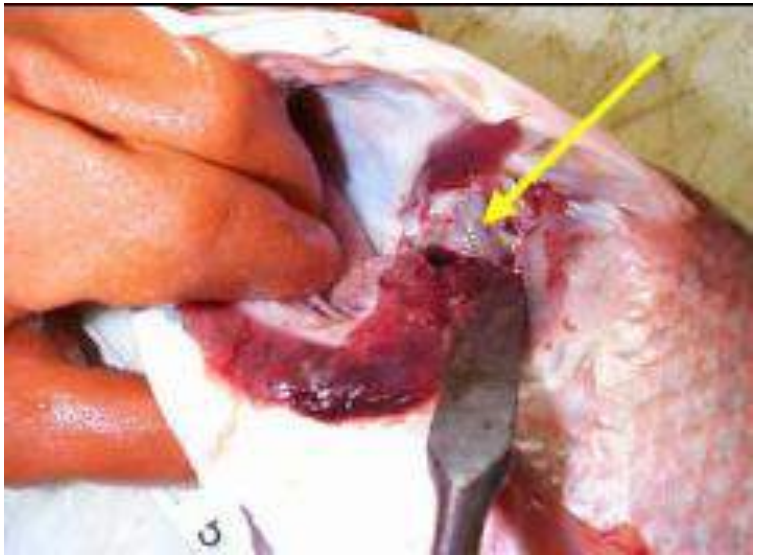
“Gill" Method

1. Cut the operculum to fold forward and open it wide towards the anterior end of the fish.
2. Cut away the gill arches at their insertion.

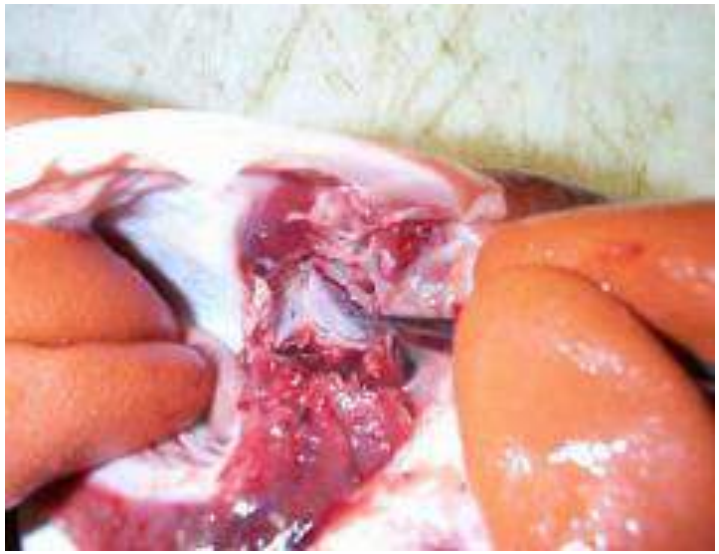


3. Scrape away tissue from the otolith capsule, the capsule will feel like a large knob or protrusion.

Removal

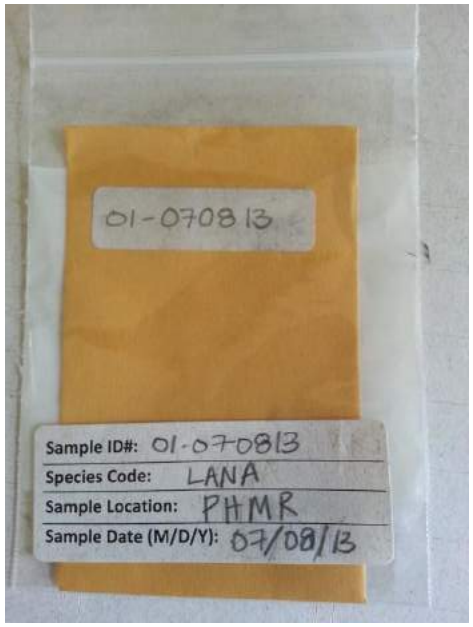


4. Open the capsule with a chisel, the large sagittal otoliths can be easily removed with forceps.



5. Rub off any attached membranes from the otolith, rinse with fresh water and pat dry.

Storage



Sample ID #: **number of fish sampled for date sampled (M/D/Y)**

1. If the otolith is small, place in 2ml centrifuge tube
2. If the otolith is large, place in a coin envelop
3. Both will have a sample ID tag
4. Place sample into larger bag with a label with all the sampling detail

Sampling

Objective is to carry out a large scale sampling effort to collect all of these samples:
• Across a large scale
• Organize sampling efforts
• Repeating collection effort
• This will include sub-sampling the fish populations for length classes that are not represented in the catch.

Example:
Nassau Grouper: 29 max age, 122.0 cm max length; **10 fish from each 5 cm length class. For example, 0-5cm, 5-10cm, 10-15cm, etc.], for a total of 240.**

Mutton Snapper: 29 max age, 94.0 cm max length; **10 fish from each 3 cm length class [3-6 cm, 6-9 cm, etc], for approximately 330 fish.**

Lane Snapper: 10 max age, 60.0 max length; **10 fish every 2 cm [2-4, 4-6, 6-8, etc], for approximately 310 fish.**

White Grunt: 26 max age, 53.0 cm max length; **10 fish from each 3 cm length class [3-6 cm, 6-9 cm, etc], for approximately 330 fish.**

Biological Datasheet

Biological data and samples

- length-age
- weight-age
- age-maturity and reproduction data for stock assessments

BIOLOGICAL SAMPLES

Port/Landings Nar PHMR

Date (M / D/ Y) : 7/8/2013

observers: jane doe

Fishing Are: PHMR zone 1 and 4

Species Name (CODE)	Total Length (TL) in mm	Fork Length (FL) in mm	gutted (g) whole (w)	Weight (g)	Maturity Undetermined= U Immature = IM Mature=M Gravid=G Spawning= SW Spent=S	Gonad Weight (g)	Sex Female= F Male=M	Biological Otolith = O Fin Clip = F	Sample ID number of otoliths sampled-Date (M/D/Y) 01- Jul0813
LSYN	210	195	w	210	IM	2.4	F	O	01- Jul0813
LANA	320	305	w	200	M	3.6	M	O	02- Jul0813
LSYN	480	440	w	260	S	1.8	M	O	03- Jul0813
LSYN	325	300	w	215	S	2	M	O	04- Jul0813

Fishery Dependent Monitoring

I. Biological Data

- Immediate and intensive sampling
- Local life history parameters
- Only priority species (Land and Mutton snapper and Nassau grouper)

II. Surveys

- Year a round sampling
- Direct monitoring involves subsampling of the catch and landings
  - At-sea, either onboard vessel or on the water monitoring
  - Landings
  - Markets

At-Sea Surveys

Data collected in an at-sea survey include:

- Length and weight of target species;
- Catch composition;
- Number of species in catch;
- Total weight of catch
- Sex and maturity;
- Gear and total fishing time;
- Species composition of the discards;
- Collection of biological samples such as otoliths and gonads

Landings

Data collected in a landings surveys include:

- Length and weight of target species, catch composition;
- Number of species in catch;
- Total weight of catch
- Sex and maturity;
- Collection of biological samples such as otoliths and gonads;
- Gear and total fishing time;
- other biological characteristics (otolith collection, gonad somatic index, etc.) by size groups.

Sample size and schedule

The sampling schedule should be set up in advance, with vessels chosen at random. On each visit, the observer records the following:

- Boat identification
- Biological observation (Length-weight of catch, sex and maturity, biological samples)
- Fishing effort (e.g., number of crew, area fishes, latitude/longitude of fishing area, hook/traps set, hours at sea)
- Days since last fished
- Boats not fishing, to estimate the local fishing effort
- Market data (prices, etc.)

Ideally, monitoring activities would take place every day of the week that fish are landed and markets are open, considering monetary restraints it is likely sampling will only take place only once a week or less frequently. We recommend a minimal sample size of monitoring landing, market and at-sea once per week.