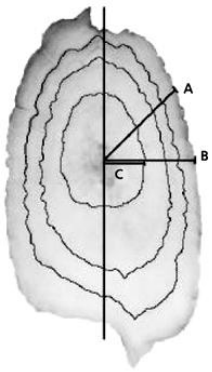
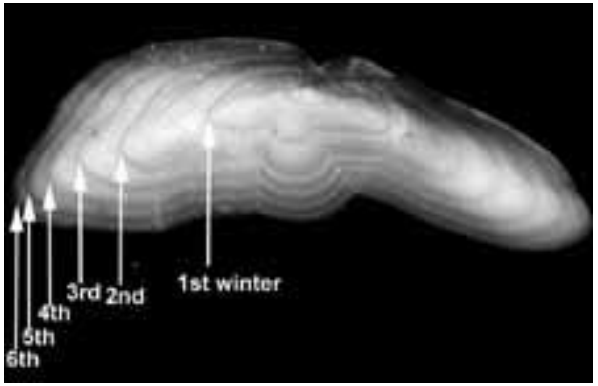
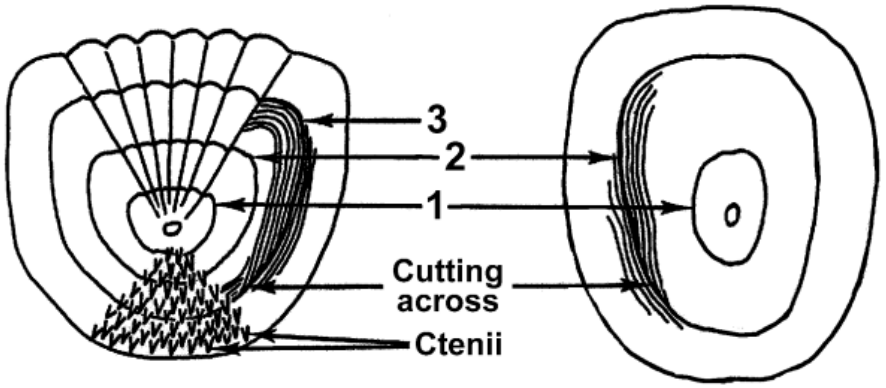
Age and growth Determination in fish







Growth

- Growth is a bio-energetic process and is defined as a change in its length and weight over a period of time. It indicates the health of the individual and of the population and has been extensively studied for a various species of fishes. The growth and age of a fish are closely related to each other and depends on several factors.

- The two parameters exhibit growth of a fish are length and weight. The growth in length indicates long term change, whereas growth in weight is more subject to seasonal variation.

- **Absolute growth**: means the highest or perfect growth of fish from embryonic to senescence period.

- **Relative growth**: means growth comparison from one life period to another. For obvious reasons growth is never similar during any two life periods.

- **Isometric growth**: means fish having equality of measure, having the plane of projection equally inclined to three perpendicular axes at right angles to one another. If the fish is following the cube law, the growth is called isometric.

- **Allometric growth**: it is lopsided growth. There may be various pattern of this type of growth. For example several fish grow more in length than width and weight.

Factors influencing growth of a fish

- Temperature
- Photoperiod
- Quantity and quality of food available
- Dissolved oxygen
- Ammonia in water
- Salinity
- Age and stage of maturity of fish
- Inter-specific and intra-specific competition
- Stocking density
- Disease

Condition factor or Ponderal Index

- The condition factor or Ponderal index, or co-efficient of correlation expresses the condition of a fish, such as the degree of well being, relative robustness, plumpness or fatness in numerical terms. The condition factor used to determined from length and weight of the fish.
- **Ponderal index or condition factor** $K=100W/L^3$

  Where **L is length in cms** and **W is weight of fish in grams**. The cube of length is taken because the growth in weight is proportionate to the growth in volume.

- Condition factor is generally used by fish biologist as an indication of the health of a fish population.

- A high value of K shows that plenty of food is available to support both somatic and gonadal development of fish.

- The value of K differ with season and influenced by maturity and spawning. The value of K is maximum during spawning season.

Method for Determining Growth

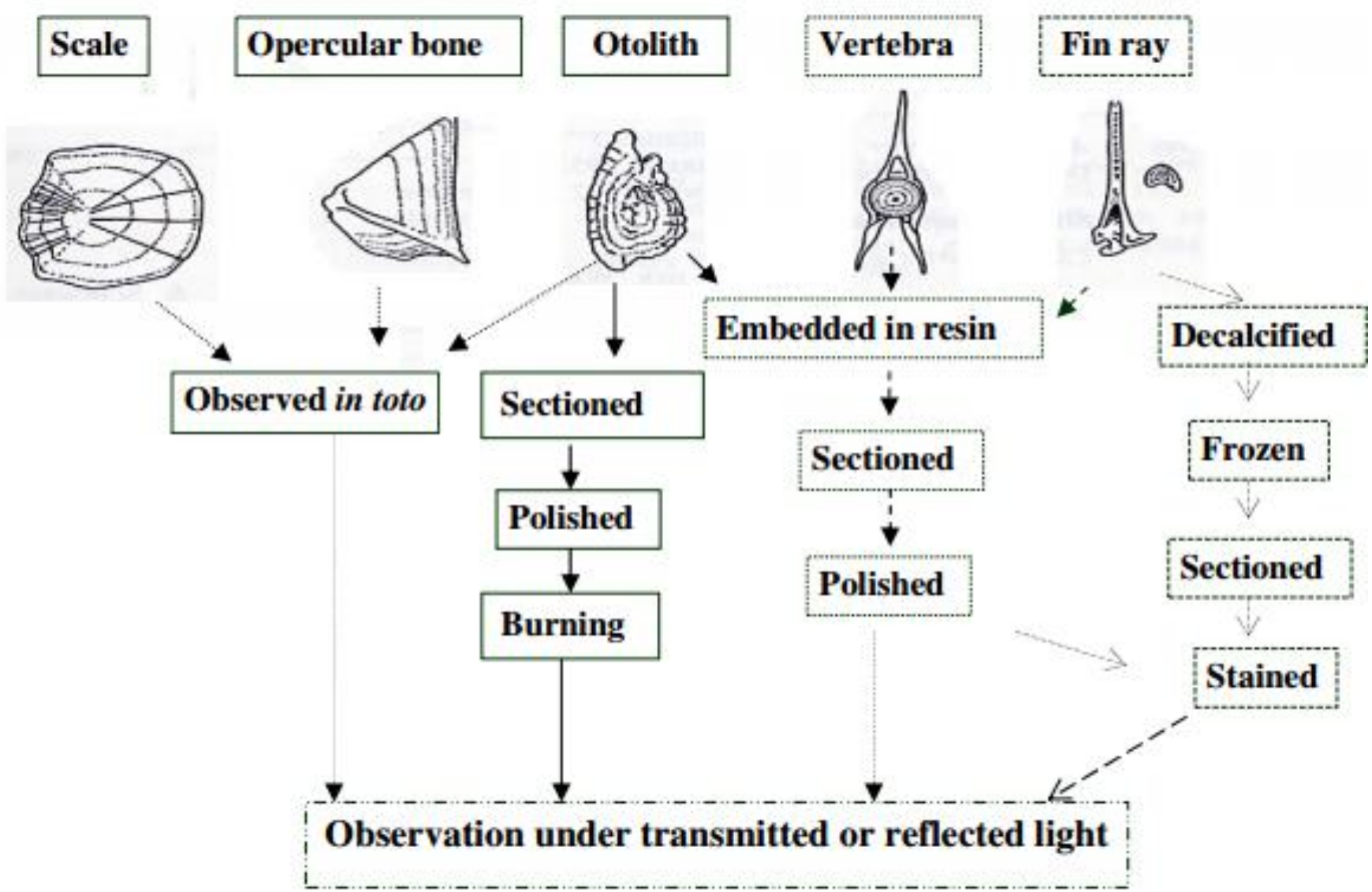
- **Direct method**: Growth rate of a fish can be determined directly by rearing the fish under controlled conditions. For this eggs or larvae of known age are kept in experimental pond. Length and weight of each are measured at known intervals of time for calculating growth rate.

- **Fish marking and tagging**: in this method fishes are marked or tagged after the length and weight for identification and are than released in the natural habitat. After the few months these fishes are recaptured and measured again. The change in size during the interval gives the growth rate.

Method for Determining Age

- **By counting rings or annuli on Bones**
- **By counting rings or annuli on Otolith**
- **By counting rings or annuli on Scales**

Preparation modes for each hard structure



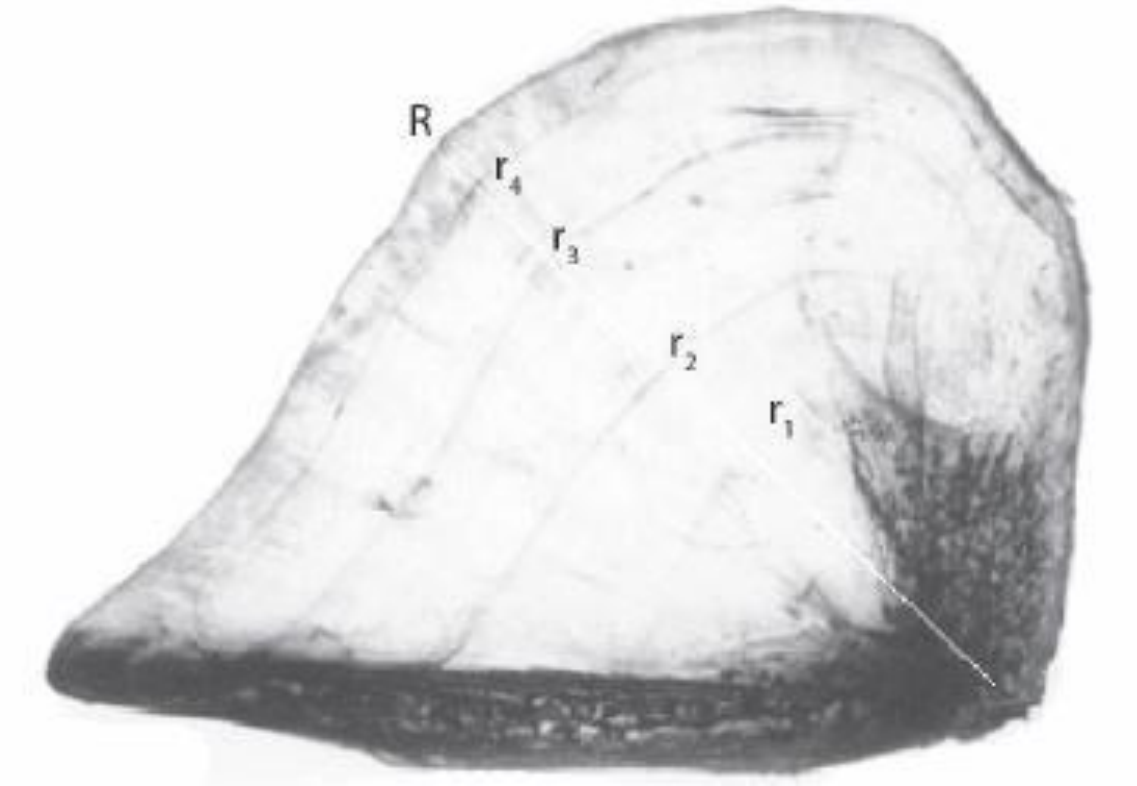
By counting annuli on Bones

- The choice of calcified structures for aging varies among species, a structure used in one species may not be the same structure used in another.

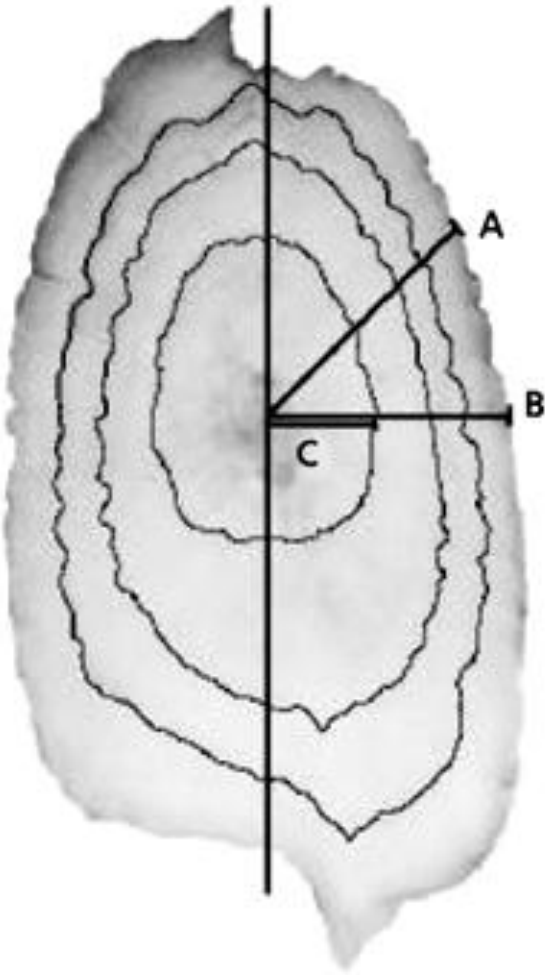
- Not all bony structures lay down growth rings equally. Such bony structures used for age estimation are vertebrae, opercula, fin rays, pectoral spines, among others.

- Preparation for bony parts involves first cleaning by soaking the structure in bleach or boiling to remove soft tissues. Depending on the size, shape, and structure of the calcified aging part it may be examined whole or more likely, sectioned.

Opercular Bone



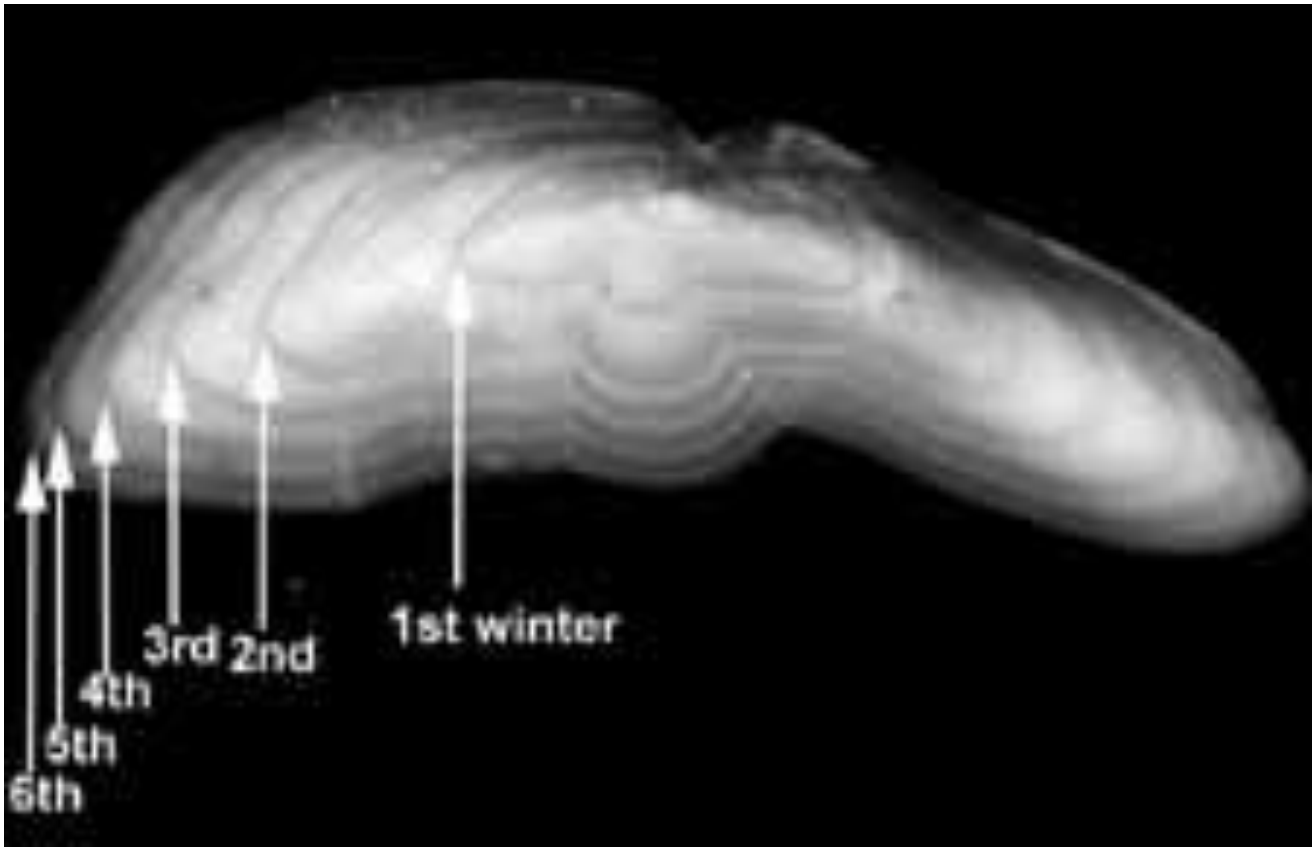
Pectoral Spine



By counting annuli on Otolith

- Otoliths are the earbones of a teleost (bony) fish and are present in pairs; fish have three pairs, the lapilli, the sagittae and the astersci.
- These three pairs of otoliths in teleost fishes differ in form, function, size, shape, and ultrastructure.
- Otoliths are generally easier to read than scales and are more accurate, being internal and never reabsorbing like scales.
- Often the sagittae are analyzed for growth as they are the largest of the three otoliths and therefore easiest to remove.
- When preparing to analyze otoliths, generally if the otolith is <300 mm than it can be analyzed intact, when >300 mm otoliths contain too much three dimensional material and must be sectioned to analyze it more clearly.

Otolith



By counting annuli on Scales

- Scales are the most widely used aging structure because of their non-lethal ease of collection.
- Counting the number of annuli (rings) on a scale provides the fish age and the spacing between rings is proportional to the growth of the fish.
- The general process for scale age analysis preparation is as follows.
- During collection, it is important to make sure to sample the same area on the same side of each individual. Insert the scale into a scale envelope, then press on acetate slides or it can be washed in distilled water and rubbed between the fingers. Mount the scale on glass slides and dry in moderate heat, 37˚C or 100˚ F.
- The annuli may be counted using a microscope, microfilm reader, or other such magnification device.

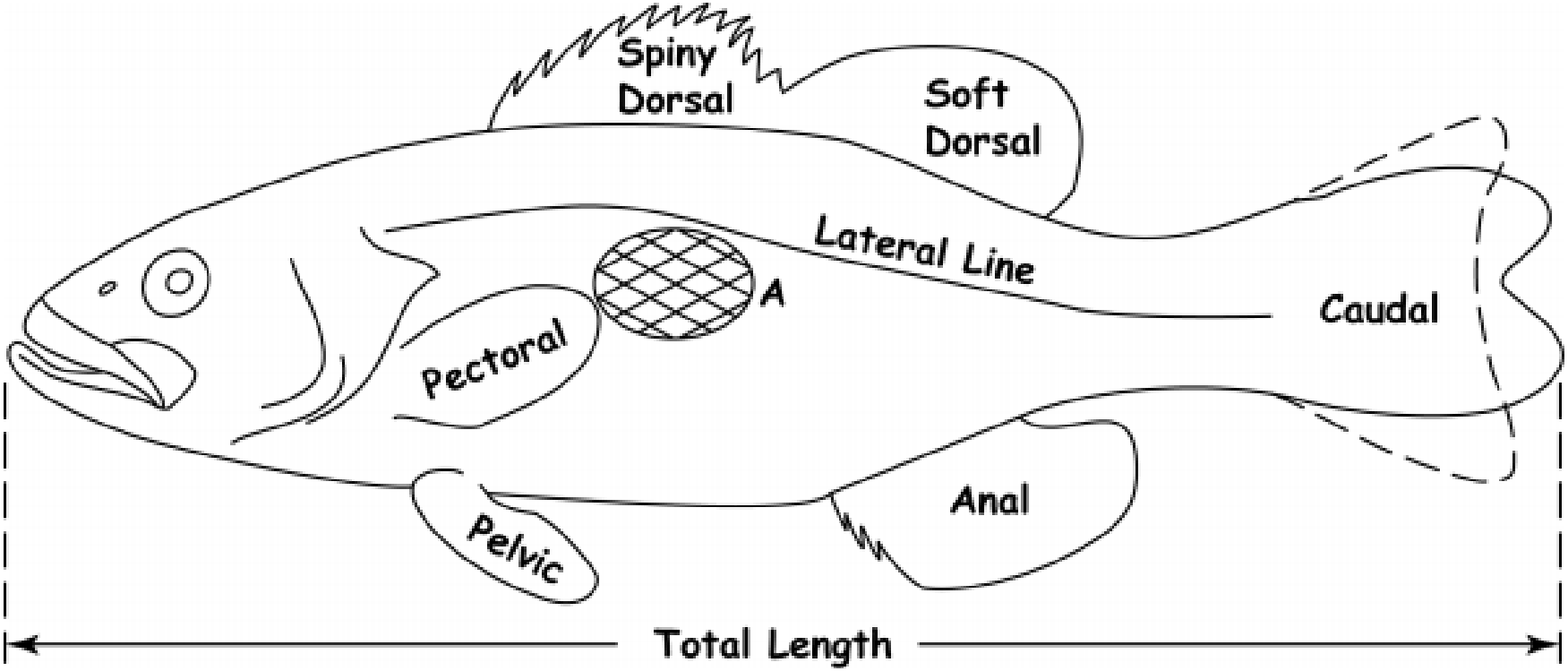


Figure 9.2–Area for taking scale samples from a spiny-rayed fish.

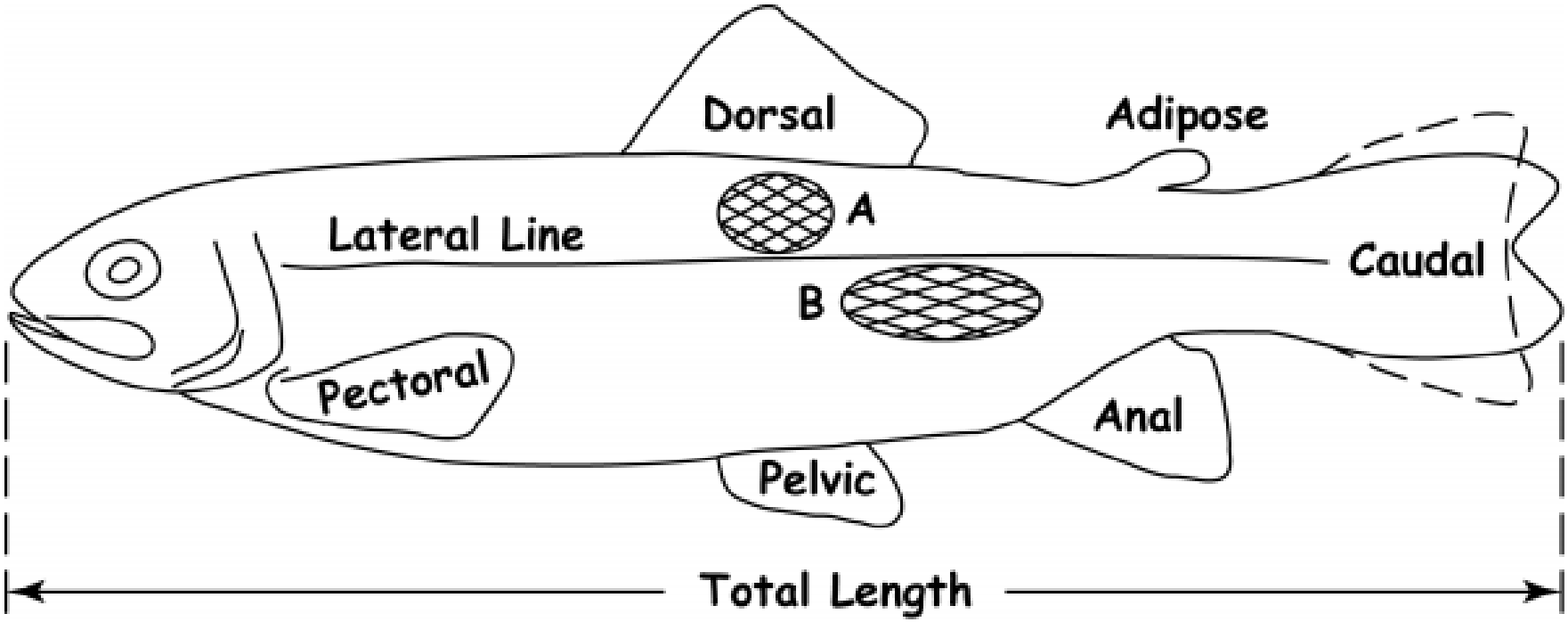
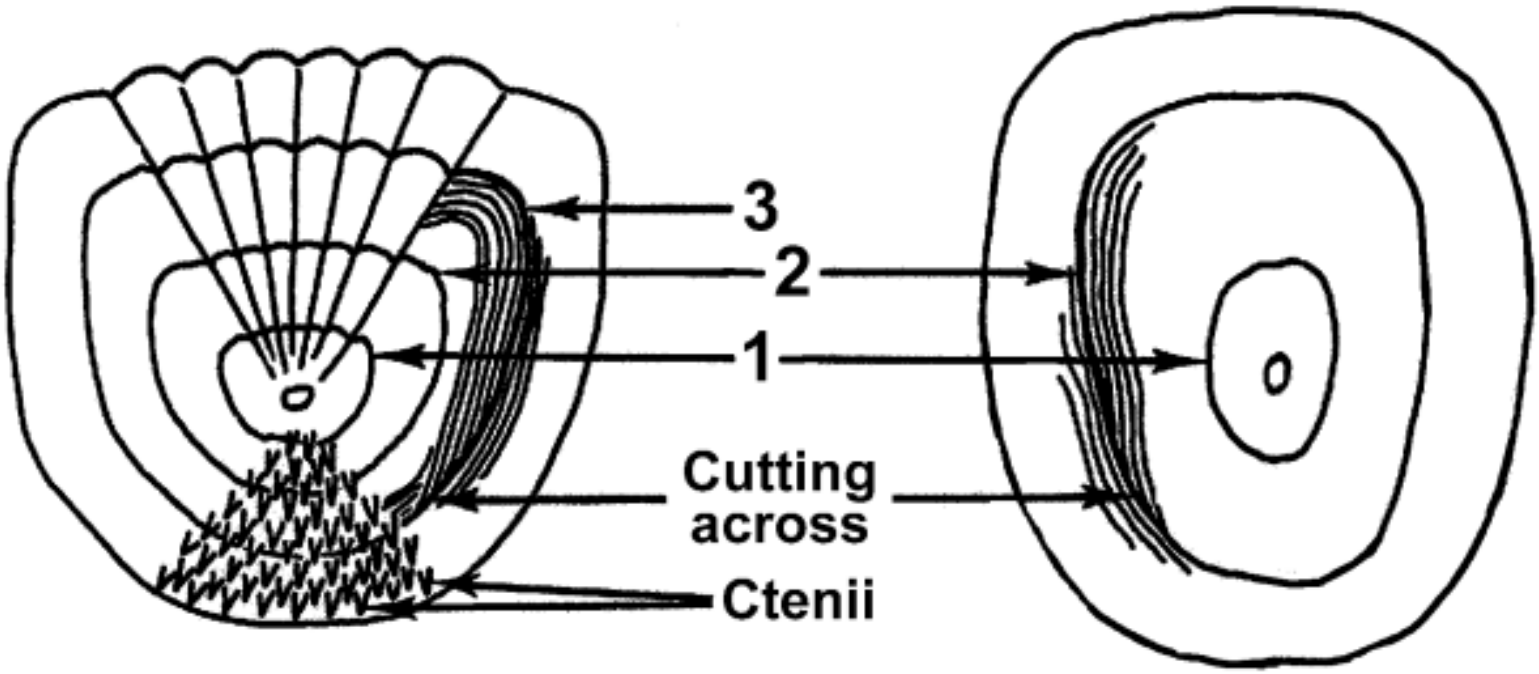


Figure 9.3–Areas for taking scale samples from most soft-rayed fish (A) or trout (B).

Scales



- The age of fish can be accurately determined using a scale. The relationship between body length and scale length (or radius) may be plotted as graph using body length on X-axis and scale length on Y-axis. The following formula used to depict the relationship.

$$\text{Log } L = \log c + n \log S$$

L= body length

S= scale length

c= intercept on the line on the axis of ordinate

n= slope

After the age of the fish has been determined by counting annuli, the fish length at each year can be back calculated by measuring the radius from the focus of the scale to each annulus. Thus the length of a fish at ‘n’ years

$$Ln = a + (L-a)(Vn)/Vr$$

Ln= calculated length of the fish at n year

L= length of the fish at the time of capture

Vn= radius (distance from the focus to the nth annulus)

Vr= scale radius (distance from the focus to edge of the scale)

a= a constant that often approx fish length at the time of scale formation