AGE DETERMINATION IN FISHES

E. M. Abdussamad

Pelagic Fishery Resources Division
ICAR- Central Marine Fisheries Research Institute

26

Fisheries management relies on the proper understanding the fish population dynamic. It includes determining the biological parameters, including size at maturity, duration of spawning season, mortality estimates, age and growth. Accurate information on age of fish is an important pre-requisite for extracting precise information on growth, mortality, recruitment and other fundamental population parameters of fishes for stock assessment. The outcome of conventional age estimates using length frequency data depends upon the sample quality, selectivity of the fishing gear etc. The stock assessment results may therefore be affected and sometimes give results which is having no bearing on reality. The hard parts of the fishes also grow with the fish and the growth process may left some inscription on such parts and if that can be interpreted properly, will get precise idea on growth. These inscriptions may result from either changes in the environment which the fish inhabits, or food availability, or physiological states of the fish. However, free swimming fishes always lives in ideal conditions and do not leave any environment related markings in their skeletal structures. So interpretation of hard part inscriptions need utmost care.

Ageing Techniques

There are four approaches to age the fish.

i. Direct observation of fish in confinement or marking/tagging recapture technique

This is the oldest technique described initially by the fish culturists. Tagging and marking experiments are conducted as the data collected are useful in estimating the population size, mortality rates and migration. Tagging does not enable individual fish to be aged unless the age of the fish at tagging is known. The method is very useful for fish living in areas where the growth is continuous throughout the year. It is useful when large numbers of fish recaptured at annual intervals are available. However, cultivated or tagged fish seldom have the same growth rate as that of the wild or untagged fish. Tagging or marking of fish usually involves considerable time and recapturing is not assured.

ii. Injection (chemical marker) technique

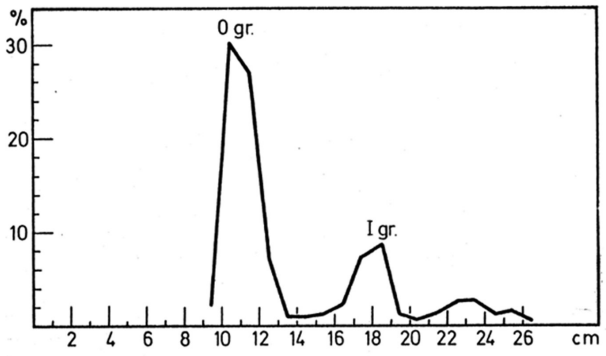
Artificial time markers can be introduced into skeletal structures by injecting chemicals into fish. The initial works were based on the use of lead acetate but this is toxic and tetracycline is now commonly used. It has the advantage of being an antibiotic drug, stable in solid form. Tetracycline is readily absorbed by vertebrate animals and deposited in bony structures where calcification is taking place. In teleost fish, the tetracycline is laid down as a narrow ring timing the point of injection. The areas in which tetracycline is deposited in skeletal tissue appears fluoresce yellow under ultraviolet light, enabling them to be detected easily. However this is not a popular technique.

iii. Analysis of length frequency data of fish

Length frequency data are used in various analytical, graphical and software assisted techniques to estimate the age, growth and other population parameters. The common methods employed are:

1. Petersen method

This is a single sample method and is very simple, fastest but most inaccurate method of ageing fishes. This method can be used only with species which have a restricted spawning season so that the fish bred in a single season can be identified as a single mode in a polymodal length distribution. The mode with the lowest value is identified as 0-year group fish. Subsequent modes will be 1-year group, 2-year group fish and so on. The method can be very good for young fish but becomes increasingly less useful for older fish as the growth rate slows down and the modes merge. In practice length-frequency distributions of fish caught over the shortest time period possible are plotted; the shorter the time period the more precisely the modes will be defined. A regular sequence of such length frequency distributions enables the progression of the modes to be followed.



2. Monthly modal progression analysis

Length frequency data collected at random from the commercial and experimental fishing are used to estimate the age of the age and growth of the fish.

3. Scatter diagram technique of monthly modal length

By plotting the monthly modal values of the length frequency data of fish as a scatter diagram, growth as well as the number of broods recruiting per year can be estimated.

4. Bhattacharya method

This is a graphical method of splitting a composite distribution into separate normal distributions, i.e. when several age groups or cohorts of fish are represented in the same sample. (For details consult FAO Fisheries Technical Paper No. 306.1 ,Rev.)

5. Probability paper/plot method

This method aims to resolve the normally distributed components of a length frequency distribution.

iv. Age determination using hard parts of fish

Fishes grow continuously, but growth rate varies over time and season and also depending on the characteristics of the habitat they lives. Hard parts like bones, spine, otoliths, scales etc. also increase in size with the fish. Hard part grows by deposition of different minerals in a biological matrix. Any changes in growth rates may be reflected as zones or bands in the hard parts. By tracking down these inscriptions age of the fishes can be determined. During slow growth phase rings/bands will be laid close together, whereas during fast growth phase they will be laid far apart.

Among skeletal structures, otoliths and scales are most widely used as they are easy to collect and store. The opercular bones of the head, pectoral and pelvic girdles dorsal spine etc. were also widely used.

Otoliths

There are three pairs of otoliths in teleost fishes. These are three-dimensional structures but do not necessarily grow at the same rate equally in all dimensions. But there will be some species specific pattern in otoliths, which consists of number of concentric shells with different radii. Depending on the amount of organic material in each shell or zone, its appearance will vary from extremely opaque to completely hyaline. For reading otoliths it is usually preferable to identify and count the opaque zones, as characteristic growth patterns if any will usually appear and also more visible in the opaque zones. Among the three, Sagittal otoliths are generally used for age determination as they are the largest and easy to collect and process. They are located in the sacculus of the inner ear.

Scales

Scales vary in shape depending on the fish and body shape. Scales at the shoulder of the fish between the head and the dorsal fin is best suited for age determination. Scales are almost two-dimensional structures. The anterior part is formed of a series of sclerites which should extend in a regular pattern from the centre of the scale. The structural discontinuities used for age determination result from irregularities in the pattern of the sclerites; they may be slightly distorted or they may be slightly closely spaced than the majority of the sclerites; usually the discontinuities are narrow and they are usually called 'rings'.

Scales are thin structures they need no preparation before viewing; the scales should be cleaned before they are stored. For reading, the slide with mounted scales is placed on the stage of a low-power microscope. The magnification used depends upon the size of the scale; in general, the lowest possible magnification is the best because it enables the whole scale pattern to be seen.

Estimation of Growth Parameters

Growth parameters estimated from the age-length data developed from hard part imaging and will be used in the conventional length based stock assessment for precision.