THE POINT OF ORIGIN AND THE PROBABLE ORDER OF APPEARANCE OF SCALES IN THE INDO-PACIFIC CHUB MACKEREL, *RASTRELLIGER NEGLECTUS*, IN THE GULF OF THAILAND

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ABSTRACT

Scale sampling area on the body of Indo-Pacific chub mackerel, *Rastrelliger neglectus*, was determined on the basis of the size of scale radii and the number of circuli. In other words, it sufficed to locate the point of origin and the probable order of appearance of scales by means of the above two criteria. As a result, the most suitable area was found to be just below the pectoral fins. It is recommended strongly that no scale sample above the lateral line be collected for the purpose of study and analysis, since they all are rather irregular and of very small size.

INTRODUCTION

A major importance in using fish scales for biological research and analysis is to study age and growth of the individuals. The age and growth are extremely valuable indices of the environmental conditions of fishes, and their determination plays an important part in the management of the fisheries and in fish cultural practices. An analysis of age composition is basic to a study on the relation between the strength of year classes and the abundance of fish. This knowledge facilitates further investigations on the factors of abundance, and makes possible a forecast of the prospects of fishing in future years. Age determinations permit studies on variation in growth rates with species, latitudes, and different bodies of water, and again facilitate investigations of the factors involved.

A knowledge of age and growth is also important in systematics, taxonomy and racial investigations, especially where results depend on the dimensional relationships of different parts of the body.

Because of the above mentioned facts, although the scale study of the tropical species of fish has long been a complex problem,

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it is of great importance and necessity now to initiate the scale study of fish of economical importance in the Gulf of Thailand. This report is therefore preliminary in nature and its objective is to find the most suitable area on the body of the Indo-Pacific chub mackerel, *Rastrelliger neglectus*, where good and reliable scale samples should be taken. In other words, it suffices to locate the region of first occurrence of the scales.

GENERAL ACCOUNT ON FISH SCALE FORMATION

As it is generally known, the species that inhabit the temperate waters and undergo an annual cycle of growth are most apt to reflect this growth on their scales. In tropical waters where seasonal difference in growth are not marked the zones of growth on the scales if present are poorly defined.

Seasonal and annual increase in body length may be reflected on the scales. Once the full complement of scales has been formed their number remains practically fixed. Since the growing body remains completely covered, the scales must of necessity increase in size. During this period of growth the scales add their circuli or growth rings to the margin. In many species the distance between the circuli varies with the intensity of growth. In such instances when growth slows down, the circuli become weak, close set and discontinuous. In some species arrested growth is indicated only by a discontinuity or break in the ridges. Cessation of body growth ultimately ends in suspension of scale formation.

In the temperate zone pronounced retardation of growth takes place normally once a year, usually in the fall, followed by a period of complete rest. When growth is resumed, the new more or less complete circulus or wide-spaced circulus forms the margin of the area of retarded growth (Annulus). Thus each year a growth zone, bordered by discontinuous or approximated circuli, develops on the scales, the number of these zones representing the age of the fish in years.

Any marked retardation or cessation of body growth irrespective of the cause will be registered on the scales when normal growth is resumed. If such an occurrence takes place at a time other than that of annulus formation an extra or accessory check will be left on the scales. Such a mark may result from a disease, parasitization, an injury, starvation, sexual maturation, pollution, drop in temperature, or any other prolonged unfavorable change in the external and internal conditions of life. An accessory mark need not necessarily be found on all scales of an individual. When a group of lost scales is being replaced the growth of the scales adjacent to the denuded area is usually retarded until the fast-growing replacement scales assume a normal growth. Scales remote from the denuded area are not affected. An accessory mark is not always recognizable as such so that erroneous estimates of age and growth may be obtained. An identifiable accessory mark

common to most of the scales testifies to the occurrence of some untoward event in the life of the individual; if found on only a few scales a local body disturbance is indicated.

In maintaining coverage of the body the scales have been found to grow at an approximately fixed ratio with the fish. The growth of the scales, therefore, is more or less a replica of that of the body.

Some fishes show no definite annuali on their scales; others have no scale at all. The egg and growth of these species may usually be determined from other structures such as the otolith, operculum, fin-spine, vertebra or other bony parts. These structures sometimes reveal the year marks much more clearly than the readable scales.

MATERIALS AND METHODS

One sample of the Indo-Pacific chub mackerel, *Rastrelliger neglectus*, having a size of 17.4 cm. and collected from the Bangkok Fish Wholesale Market was used.

The fish's body was divided lengthwise into three rows; one row above the lateral line and the other two rows below the lateral line. Then, it was divided vertically into 10 columns starting from the edge of the gill cover to the last finlet on the caudal penduncle. Thus, the intersection of rows and columns yielded 30 divided square areas on the fish's body. Each area was numbered consecutively from 1 to 30 (Fig. 1). Five scale samples from each area were taken and mounted all on one slide, that is the serial number on each slide corresponds to one divided square area on the fish's body, so as to facilitate later checkings. Both sides of the fish's body were studied and compared. The scales present right on the lateral line, mid-dorsal line and on the ventral portions of the fish were ignored.

Using a microprojector with magnification of 100 times, the approximate position of the focus centre of the projected scale was marked on a millimeter paper, and each circulus starting from focal circulus to the last circulus at the outer edge of the scale was marked. Then, from the marked millimeter paper, the distance from the centre of focus to periphery of the scale (scale radii) and the number of circuli could easily be determined. In this case, the scale radii and the number of circuli used were means of the five scale samples for each divided square area on the fish's body. To approximate the centre of a focus two diameters were drawn across the focus which was of elliptic form. From the intersection of the two diameters the circuli were marked along the antero-lateral axis to the periphery of the scale.

RESULTS

Total scale radii measured in millimeter from the centre of focus along the antero-lateral axis to the periphery of the scale were plotted on the ordinate against columns on the abscissa to form a curve showing variations

of scale size from the anterior end (edge of the gill cover) to the posterior end (last finlet) along the body length of the fish (Fig. 2). It should be kept in mind that the theory being used was based on a fact that the first occurrence of scales was in a region where the scales with the largest radii were found. From the graph it could be noted that the trends of both sides of the fish were quite similar. The scale radii of rows II and III being approximately equal throughout, the body length of the fish were much greater than those of the row I, although the scale samples from the areas 24 and 25 of row III on the left side of the fish's body were missing, probably due to handling of the fish or the fishing gear. In other words, the scale size of rows II and III from columns I through X was larger than that of the row I. Considering the trends of rows II and III alone, it was apparent that the curves dropped abruptly from columns I to II, and then, continued on decreasing very slightly, if not leveling out at all, towards the posterior end of the fish. This meant that the scales at the anterior end of these two rows were largest in size, which approximately corresponded to the divided square area number 11, 12, 21 and 22 on the body of the fish. Consequently, the point of origin of the scales was believed to have started at the area 21 which had the greatest radii, and then the probable order of appearance of scales in these two rows seemed to move along parallelly towards the posterior end (caudal penduncle) of the fish's body.

Now, in considering the row I on the graph, it appeared that the scale radii were greatest about the caudal penduncle areas above the lateral line. Although the scale size in this row seemed to differ slightly throughout the body length of the fish, the order of appearance of scales tended to go from the posterior towards the anterior ends of the row. This was reasonable since, according to Van Oosten (1929), in teleosts the first scales to appear are those in close relation to the lateral line, although additional centres of origin of secondary importance also occur in some species as, for example, the brook trout *(Salvelinus)*, marine herring *(Clupea)*, alewife *(Pomolobus)*, cutthroat trout *(Salmo)*, black crappie *(Pomoxis)*, and smallmouth bass *(Micropterus)*. As a result, the scales covered the whole body of the fish following through the direction as just described.

Since the size of the scale radii varied throughout the body of the fish, it was therefore of interest to learn about variations in number of circuli also. From the graph (Fig. 3), again it was apparent that the rows II and III had higher number of circuli than that of the row I. Their trends were in agreement with those of the previous scale radius curves, except that the number of circuli of the row III dropped significantly at the columns VIII, IX and X; that was at the areas 28, 29 and 30 on the fish's body. However, reasons for the drop of

number of circuli in the said areas were probably due to the fact that the scale samples taken were in the caudal penduncle area where scale growth retardation was observed in this particular species, and furthermore, this row was quite close to the ventral portion where irregular scales were frequently found. The highest number of circuli was found to be also in the area 21 on the fish's body where the largest scales were found previously by means of scale radius curves. This finding should be representative to the species since, the trends of both sides of the fish were similar. The number of circuli in row II seemed to be predominant throughout the body length of the fish, except for the area 11 being just above the area 21 which was the point of origin of scales as indicated previously by the scale radius curves. Since the order of appearance of scales above the lateral line (row I) based on the size of scale radius went from the posterior towards the anterior ends of the fish, the number of circuli therefore decreased accordingly in the same direction. This knowledge gained on the variations in the number of circuli certainly helped confirm the finding of the point of origin and the order of appearance of scales fround previously. The order of appearance of scales above the lateral line (row I), shown by the scale radius curves in which the difference was not so distinct throughout the body length of the fish was clarified by the scale circulus curves. The point of origin of scale and the development of scale pattern of the Indo-Pacific chub mackerel in the Gulf of Thailand were presented in Fig. 4.

From these two criteria, the scale radius and the number of circuli, used in finding out the point of origin and the order of appearance of scales in the chub mackerel, it is now very important that the scale samples to be taken for studies and analysis of this particular species of economical importance be collected from the area 21 on the fish's body, or at least, from the areas adjacent to it and just below the pectoral fins. No scale sample above the lateral line should be taken at all since they all are irregular and of very small size. Fig. 5 shows the exact location on the body of the fish where the scale sample should be taken.

SUMMARY AND CONCLUSIONS

The objective of this study was to find a location on the body of the Indo-Pacific chub mackerel, *Rastrelliger neglectus*, where good and reliable scale samples should be collected for the purpose of studies and analysis. In other words, it sufficed to find the point of origin of scales as well as its probable order of appearance.

The two criteria used to determined the point of origin and the probable order of appearance of scales were scale radii (distance from the centre of focus to scale periphery) and the number of circuli.

It was found that the point

of origin of scales where the good and reliable scale samples should be taken was in the area just below the pectoral fins, and the probable order of appearance of scales started out from this area towards the caudal penduncle where it crossed the lateral line and proceeded towards the anterior end of the fish's body.

In this particular species, it is recommended strongly that no scale sample above the lateral line be collected, because they all are rather irregular and of very small size.

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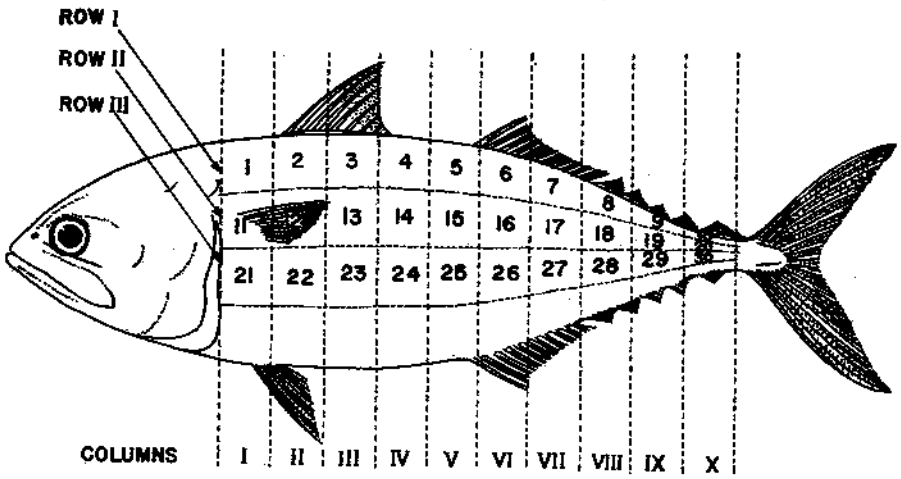


Figure 1 - Assignment of scale sampling areas on the body of Indo-Pacific chub mackerel

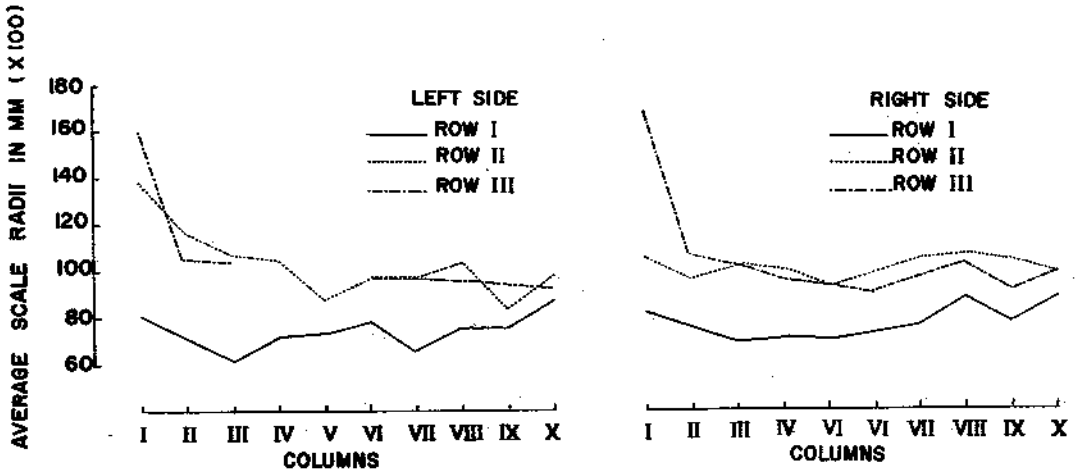


Figure 2 - Variation in scale radius on the body of Indo-Pacific

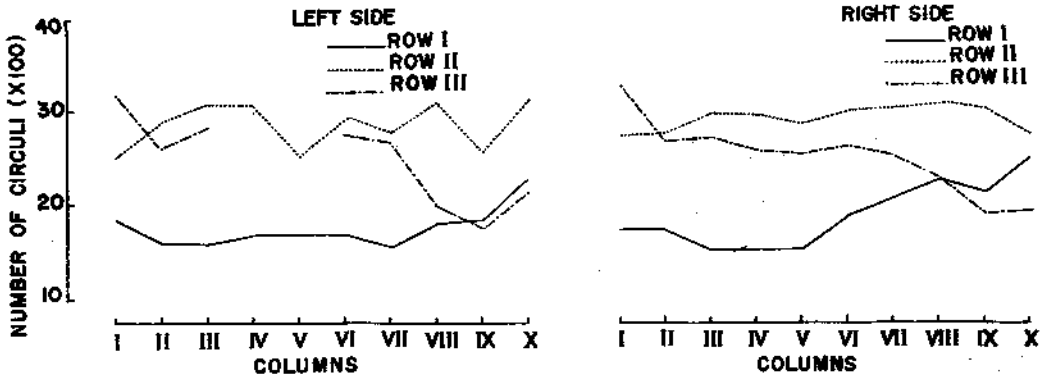


Figure 3 - Variation in number of circuli on the body of Indo-Pacific chub mackerel

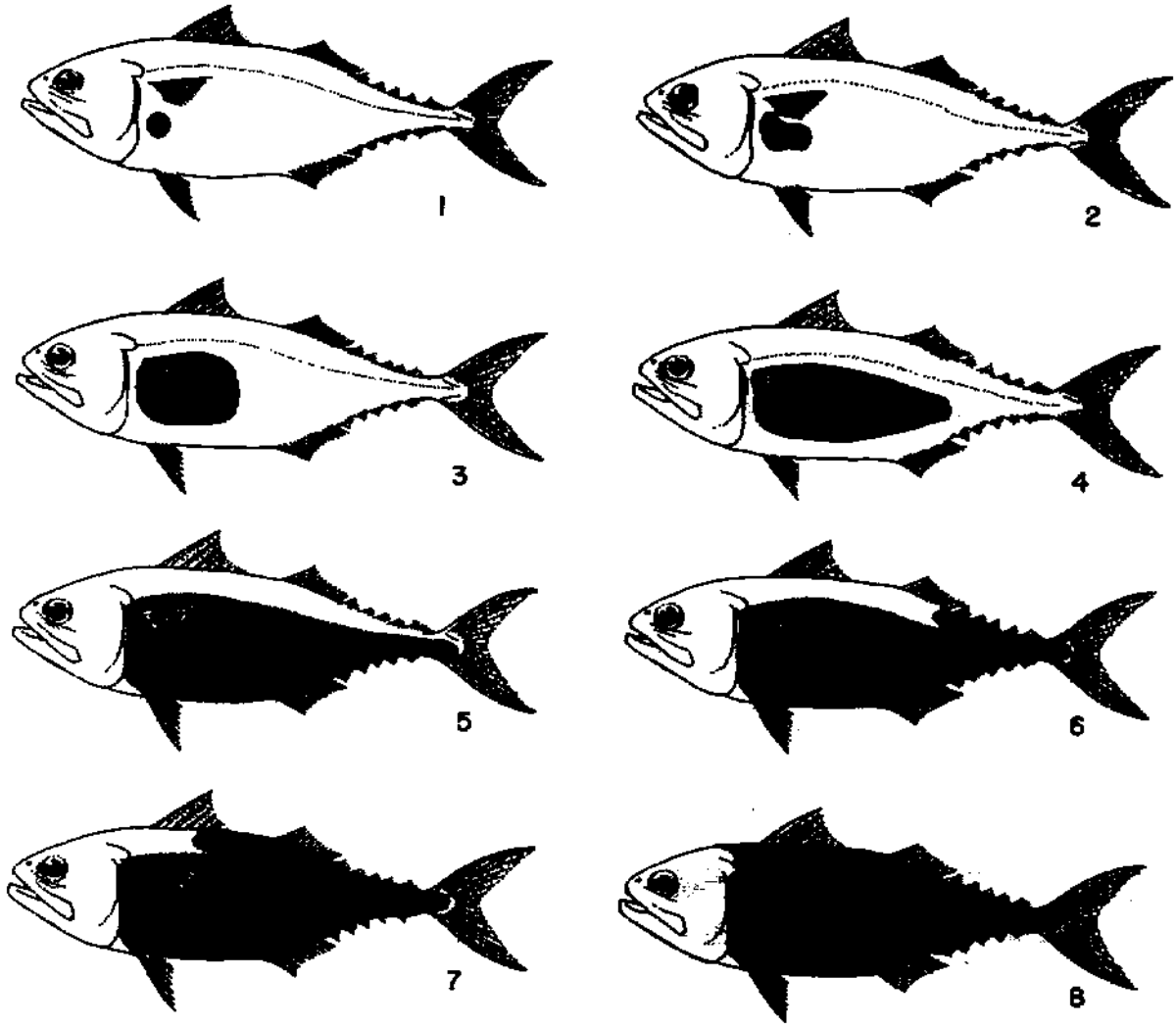
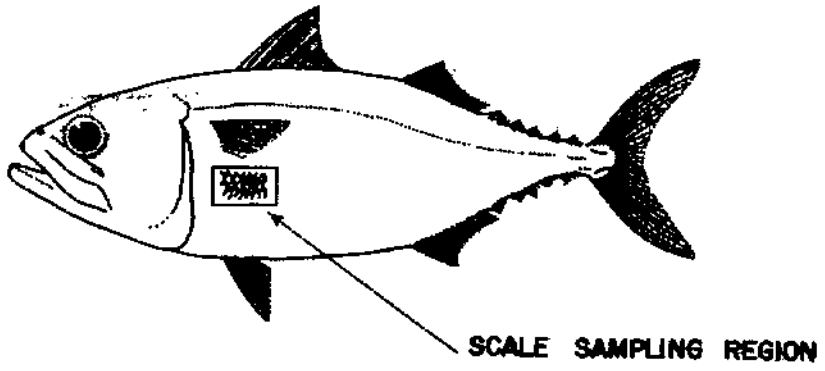


Figure 4 - The point of origin and probable order of appearance of scales in the Indo-Pacific chub mackerel



Fi Figure 5 - Recommended scale sampling region on the the body of Indo-Pacific chub mackerel