Chapter IV

DISCUSSION

The effect of temperatures on growth of mullet (Mugil dussumieri Val.), seabass (Lates calcarifer [Bloch.]) and spinefoot (Siganus virgatus Cuv. & Val.) in the laboratory condition were studied at the three temperature levels i.e., higher than the ambient (33.0 ± 0.2°C), equal to the ambient (28.0 ± 0.2°C) and lower than the ambient (23.0°C). When the temperature was changed to higher or lower than the ambient temperature, fishes would adapt themselves to stay in the new temperature and their adaptation would take a period of time depending on each species and temperature. In 1974 Sylvester studied the rate of acclimation of Mugil cephalus L. It was found that the fish that lived in 25°C, when the temperature was changed to 27°C or 29°C, would take 7 days to be completely acclimated to the new temperature. However when the temperature was changed to 23°C or 15°C, they required 11 days for the complete acclimation as well. Fisher (1957) and Kinne (1967) noted that the complete acclimation to the new temperature was the change in response mechanisms and adaptation in the regulation of the metabolic systems in their bodies but the efficiency of the adaptation depended on each species. In 1971 Anonymous indicated that the species of fish in arctic and tropical zone

had a narrow range of thermal tolerance whereas those in temperate zone could adapt themselves to live in a wide range of temperature.

The three kinds of fishes to be studied in this experiment are mullet, seabass and spinefoot. They are marine fishes indigeneous to the tropical zone. They distributed widely, from the tropical area to the area close to the temperate zone. When the temperature was changed to the level higher than ambient temperature, fishes would increase their activities and metabolisms which could be observed from the the increase of swimming rate but when the temperature was lower than the ambient temperature the swimming rate would decrease. The results of this observation corresponded to the experiment of Brett and Higgs in 1970 and Winslade in 1974. The increasing of metabolic rate could be observed from oxygen consumption or the movement of operculum which would increase in order to let more water pass through the gill or the measurement of the oxygen uptake from dissolved oxygen (Davison et al 1959, Prichard 1955, Rajagopal and Krammer 1974). In 1973 Jones studied the relationship between the oxygen comsumption and the swimming rate of yellow perch at 25°C, 15°C and 10°C. He found that the oxygen consumption was high at 25°C. When the temperature was lowered, the oxygen comsumption declined also. At 10°C the swimming rate was minimum and the oxygen consumption decreased too. In the laboratory, the oxygen was given saturately to the fishes all through the experiment.

When fishes were completely acclimated to the environment, their lethal temperature would change according to the acclimated temperature level. The range of the lethal temperature might be narrow or wide depending on each species.

The food consumption rates of fishes in this experiment at 33.0 ± 0.2°C were maximum and they were frequently hungry. At 28.0 ± 0.2°C and 23.0°C, the food consumption rate decreased according to the decreasing temperature. This corresponded to the experiment of Andrew and Stickney in 1972 who studied the channel catfish at 18, 22, 26, 30 and 34°C. The results at 26, 30 and 34°C showed the increasing of feeding rate from 2 to 4 and 6% of food consumption, besides the rates of food passing through the alimentary cannal were different. The experiments of Magnuson in 1969 and Edward et al in 1971 was to measure therate of food passing through the alimentary cannal of plaice fish at 1, 5, 8, 14 and 20°C. They found that the stomach was empty within 36, 22, 16, 12 and 9 hours, respectively. In 1970 Brett and Higge studied the rate of digestion of sockeye salmon at 3, 5, 10, 15, 20 and 23°C. After maximum feeding, the digestion rates were different in accord with the different temperatures. The digestion rate increased with the increasing temperature. The above mentioned correspond to the results of this experiment about the growth of mullet, [illegible] and spinefoot since the food consumption rate increased at the high temperature (33.0 ± 0.2°C) and decreased at the lower

temperature (23.0°C). The food conversion ratio were also affected by the temperature. At the lower temperature, the food conversion ratio was high but when the temperature was increased, the ratio decreased. Owing to this, fishes at the lower temperature had less weight gain.

Concerning the growth of mullet (Mugil dussumieri Val.) rates at three temperature levels were compared, it was found that there were no differences among the three growth rates and when the growth rates were compared in pairs of temperature, they were not different also.

When the growth rates of seabass (Lates calcarifer [Bloch.]) at three temperature levels (23.0, 28.0 ± 0.2°C and 33.0 ± 0.2°C) were statistically analysed. The result showed that there were differences on growth of seabass at the three temperature levels. When the growth rates were compared in pairs of temperature, there were differences in all pairs except between 28.0 ± 0.2°C and 33.0 ± 0.2°C which had no statistical difference. This resulted from a wide range of optimum temperature of seabass which also caused a wide distribution of them from the tropical zone to the temperate zone. It can be concluded from this part of the experiment that the temperature at 33.0 ± 0.2°C had the possibility of being a suitable temperature for the growth of white seaperch when comparing with other temperature levels.

The study on growth of spinefoot (Siganus virgatus, Cuv. & Val.) in the laboratory, the growth rates of them at three temperature levels were compared by statistical method. It was found that there were differences among growth rates of the three levels of temperature. When the growth rate were compared by pairing. There were differences in all pairs except the pair of 23.0°C and 28.0 ± 0.2°C that there were no statistical differences. The growth rates at 23.0°C and 28.0 ± 0.2°C were nearly the same but it was found to be different in the comparison of the growth rates at three levels of temperature. This was because the growth rates at 23.0°C and 28.0 ± 0.2°C were different from the growth rate at 33.0 ± 0.2°C. However, it can be concluded that the maximum growth rate of spinefoot was at 33.0 ± 0.2°C. This revealed that the suitable temperature for the growth of spinefoot was at high temperature.

This experiment corresponded to the experiment of Brown in 1946 which showed that temperature is an important growth factor of the fish. In 1969 Brett et al and in 1974 Shelbourn et al studied the growth of sockeye salmon at different temperature levels from 1-24°C. It was found that the best temperature for the growth of sockeye salmon was between 5-15°C. If the temperature was higher or lower than this range, their growth rates would decrease. In 1955, Gibson and Hirst had studied the growth of guppie and found

that the maximum growth of them was at 23.0°C. When the temperature was higher or lower than 23.0°C the growth rate of guppie would decline. The important experiments which could be compared with this experiment on the effect of temperature on growth rate of mullet, seabass and spinefoot were done by Kramer and Smith in 1960 and Strawn in 1961 who had studied the growth rate of large mouth bass fry at 15.0, 20.0, 22.5, 25.0, 27.5 and 30.0°C. They found that the maximum growth rates of large mouth bass fry were at 27.0°C and 30.0°C. In 1969 Onchi showed that the maximum growth rate of the fish depended on the optimum temperature of each species.

The difference of growth rate was apparently not due to the effect of food or oxygen and salinity but it was the effect of temperature, since food was given in excess and salinity and oxygen were kept constant in all aquariums.

The different mortality rates of the three species of fish in this experiment depended on the temperature. Their mortality in low temperature was less than in high temperature. This may be due to the disease problem. Katz 1971 (From Menasveta in 1972) found that the increase of water temperature in the Columbia river was a major cause of fish desease break out. In this experiment fin rod were observed sometime in the treatment of high water temperature (33.0 ± 0.2°C).

The accumulation of metabolic products of the fish in water was caused by different conditions especially the temperature of water of the experimental unit set which will also cause the variation of growth and mortality of the fish (Brown 1946). In 1969, Savitz showed that the nitrogen excretion rate of the fish was high at the high temperature and the rate would decline correspondingly with the decreasing of temperature. Thus temperature was one of the most important factor for the growth and mortality of the fish.