RELATION BETWEEN EXPLOITATION AND PRODUCTION IN EXPERIMENTAL POPULATIONS OF *POECILIA RETICULATA*

Makoto Nagoshi, Takeshi Kanda and Kenji Horiya

Faculty of Fisheries, Mie University, 2-80, Edobashi, Tsu 514, Japan

INTRODUCTION

Concerning exploitation, conservation and management of fish resources, it is important to know their population dynamics in nature. Recently many experimental studies have been performed fairly extensively over this subject, Silliman et al. (1957, 1958), Silliman (1948, 1968, 1970, 1972, 1975a, 1975b, 1975c), Rose (1959), Breder and Coates (1932), Nagoshi et al. (1972), Tatsukawa (1974).

But little has been studied about the effect of exploitation upon fluctuation and productivity of fish populations. In order to account for the effect of exploitation upon the fish population, guppy, *Poecilia reticulata*, reared in laboratory were chosen as experimental organisms.

The biomass and the number of individuals at two different developmental stages were counted at two-week intervals and the effect of exploitation upon the relationships between numbers of adults and progeny and productivity of the populations was discussed. This paper presents the results obtained from an experiment conducted during July 1969 to November 1975, 331 weeks. The results of this experiment during the first 100 weeks have been reported by Nagoshi et al. (1972).

MATERIALS AND METHODS

This experiment was carried out at the Faculty of Fisheries, Mie University during 331 weeks from July 1, 1969 to November 4, 1975. The materials and methods of this experiment have been minutely detailed by Nagoshi et al. (1972).

Six glass aquaria measuring 24 by 45 by 30cm with water up to the depth of 24cm (volume of about 26 liters) were used up to week 217, and from week 218 they were exchanged for acrylic aquaria of the same dimensions.

Before the 134th week the number of fish and the individual weight of fish in each population were measured every week. After week 139 the measurement was performed biweekly and the replacement of water was also carried out biweekly. From week 135 to 138, all the populations were retained under a starved condition and no replacement of water was made because an inevitable incident.

Apart from this period, food was given all the populations twice a day. All the

1 Present address: Faculty of Agriculture, Kyushu University, Hakozaki, Higashi-ku, Fukuoka 812, Japan
populations were fed 1.0 g of commercial aquarium food, pellet-shaped dry food, per day up to week 189, and from the 190th week they were fed 0.5 g of the dry food and 2.0 g of fresh oligochaetes, *Tubifex* sp. As 2 g of the oligochaetes contained about 0.5 g dry matter, the given amount of oligochaetes was equivalent to that of the dry food in terms of dry weight.

The mean of daily water temperature in each aquarium was maintained at 25°C with a variation of ±0.3°C throughout the experiment. The other experimental apparatus, the conditions of breeding, water temperature and light, and the methods of measurement and exploitation were fixed from the beginning of this experiment as shown in the previous paper (NAGOSHI et al. 1972).

After separation by sex and stage of maturity all fish were weighed on a direct reading balance until week 203, but after this week all fish except the fry were weighed, because the total weight of fry was a negligible amount if compared with the total weight of population.

The removal of fish at three different rates in the test population was carried out at intervals of four weeks. All fish removed were preserved in 5-percent formalin. The first exploitation was performed from the 47th to 63rd week, the second from the 92th to the 132nd week, and the third from the 163rd to the 273rd week.

The six populations were divided into three groups: population A and D exploited at the rate of 10% throughout all the exploitation periods; B and E at the rate of 33% during the first exploitation and at 20% during the second and third exploitation periods; C and F were unexploited during the whole experiment as a control for the other four populations.

**RESULTS**

1. **Fluctuation in Number**

   The fluctuation in the numbers of adults, immatures and fry are shown in Fig. 1a-b. After week 50, the fluctuation of the adult number in each population represents a periodicity showing a peak once a year, six peaks for six experimental years. But, in the population B, C and F the last two peaks were not clear. The cause of periodicity remains as a subject to be analyzed in future. The fluctuation in total number showed a similar trend in the six populations. These fluctuations seemed to be reflected in changes of age composition. Observing the fluctuation of the numbers at different stages, in many cases the number of fry rapidly increased first, followed by the increases in immatures and adults with a time lag in each population. After the adult numbers attained a peak the fry sharply declined in numbers. If the adult number decreased at some level, the fry increased in number, accompanied with an increase of biomass of population.

   According to SILLIMAN (1958), test populations demonstrated violent changes in population size and composition, coinciding with changes in exploitation rate, and this