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RICE-FISH CULTURE *in* CHINA



EDITED BY
Kenneth T. MacKay

INTERNATIONAL DEVELOPMENT RESEARCH CENTRE

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The Role of Fish in Controlling Mosquitoes in Ricefields

Wu Neng, Liao Guohou, Lou Yulin, and Zhong Gemet⁵⁷

Starting in 1983, investigations were made for 5 years on the effect of controlling mosquitoes after rearing fish in ricefields. In 1987, further financial support was obtained and the research began to have economic impact.

Experiment Sites

The test site was in Quangzhou County in northeast Guangxi. More than 26 700 ha of ricefields were suitable for fish culture (about 80% of the total cultivated land). Traditionally, farmers stock 6 000–9 000 common carp and 150–1 500 grass carp per hectare of ricefield after the rice is transplanted. No additional feed or management was used, and fish yields were about 150 kg/ha. However, because weeds were decreased and rice yields were increased, this type of cropping system has expanded. By 1987, rice–fish culture was practiced on half of the ricefields that were suitable for fish-rearing.

An isolated village in Quangzhou County was selected as an experimental site to study changes in mosquito population density in ricefields. The village had 127 ha of ricefields, and 90% of these fields were used for fish. The fish fingerlings were stocked into middle-rice fields after the rice seedlings were transplanted. When rice was harvested, the fish had grown to about 100 g and could be used as food or grown longer in the pond.

Methods

Mosquito Density in Ricefields

The main species of mosquitoes in the district are *Anopheles sinensis*, the main vector of local malaria, and *Culex tritaeniorhynchus*, the vector of Japanese encephalitis. Density measurements were taken once a week for a month before and after the fish were stocked. Larva and adult mosquitoes were also examined in a control village with no fish.

Frequency of Mosquito Biting

Mosquitoes were attracted to a special mosquito net 0.5 h after sunset in the fields adjacent to both the experimental village and the control village.

⁵⁷ Guangxi Institute for Prevention and Cure of Parasitic Diseases, Nanning, Guangxi Zhuang Autonomous Region.

Table 1. The relationship between the annual incidence of malaria and the area of rice-fish culture in Quangzhou County.

	Rice-Fish Area to Total Rice Area (%)	Annual Incidence of Malaria (1:100 000)	
		Quangzhou	Entire District
1978	0	11.6	6.6
1979	11	4.7	8.7
1980	25	2.4	23.7
1981	29	0.5	34.3
1982	35	0.6	35.4
1983	35	0.5	22.6
1984	34	0.4	14.0
1985	34	0.1	6.9
1986	43	0.1	6.5
1987	43	0.1	7.0

Age-Class Distribution of Larva (Pupa)

Larva numbers of each age-class were recorded throughout the year at both the experimental site and the control site. The distribution of mosquitoes in each age-class was evaluated and the differences were calculated.

Incidence of Malaria

The spread of fish culture in ricefields over the past 10 years in Quangzhou County was traced. The incidence of endogenous malaria was recorded over the same period and compared with the whole district.

Results and Discussion

Density of Mosquitoes

Compared with the control, the density of larva and adult mosquitoes was remarkably lower when the fish were reared in the ricefields. A comparison of the frequency of mosquito biting in the two locations also showed that contact between humans and mosquitoes was greatly reduced in the village where a large area of the ricefields was used for fish culture.

Natural mortality of mosquito larva is density dependent. The degree of the effect depends on the stage at which mortality occurs. If natural predators consume

mosquitoes during the early stages of growth, increased survival is likely to make up for early losses. If mortality takes place in later stages, it is impossible to make up for the loss. This will greatly affect the density of adult mosquitoes. In the fish-rice field, the ratio of old larva and pupa was much lower than in the control field. This suggests that because the fish feed on old larva and pupa, density-dependent survival has no effect. Therefore, it is reasonable to suggest that fish are an effective biological control method for mosquitoes.

Incidence of Malaria

One of the most important criteria for judging the control of mosquitoes is the incidence of diseases spread by the mosquitoes. Table 1 shows the increased area of rice-fish fields in Quangzhou County and the annual incidence of endogenous malaria within the county and within the whole district. As the area of rice-fish culture has increased in Quangzhou County, the annual incidence of malaria has decreased (correlation coefficient -0.9225). Although other measures were taken to prevent malaria in Quangzhou County (e.g., inspection and control of sources of infection), the relative number of cases was much lower than in other counties in the district.