

# A Holistic, Ecosystem Approach to Investigating Tropical Multispecies Reservoir Fisheries

YAP SIAW-YANG

Zoology Department, University of Malaya  
Kuala Lumpur, Malaysia

Increasing numbers of reservoirs are being constructed or projected for rivers in the tropics and subtropics. The fisheries generated in such impoundments provide many employment opportunities in rural areas. It is important that the aquatic resources be managed carefully. However, the various native and introduced fish species which populate these impoundments constitute a difficult management problem.

A holistic, ecosystemic investigation of the multispecies fishery in Bukit Merah Reservoir, Malaysia was made during the period 1978 to 1980. This was the first comprehensive analysis for resource management purposes of a multispecies reservoir fishery in Southeast Asia. It demonstrates the need for sound biological and ecological understanding of the resources as a basis for management decisions.

## Methodology

The methods used for the investigation included a number of standard field-based methods, e.g., catch sampling, as well as standard laboratory methods, such as those used to analyze fish stomach contents. Important in the context of a holistic approach were the analytical methods used to obtain and synthesize information, such that a trophic model of the investigated reservoir could be constructed and the state of the fishery assessed. These methods were:

- Estimation of growth parameters of important fish species from tagging data and from length-frequency data using the ELEFAN I method (see ICLARM Newsletter, July 1980, p. 13-15).
- Estimation of total mortality, also from length-frequency data using the ELEFAN II method (see ICLARM Newsletter, July 1981, p. 10-13).

- Estimation of recruitment and population sizes using a length-structured version of Virtual Population Analysis.
- Yield-per-recruit analysis of dominant fish species to estimate optimum mesh sizes and sizes at first capture.
- Construction of a trophic model of Bukit Merah Reservoir using the method of Pauly (1982, SCS/GEN/82/41, p. 92-98).

This author was introduced to these methods at ICLARM's headquarters during a one-month visit in 1981. Subsequent work with the methods proved them ideally suited to the data collected from Bukit Merah Reservoir.

Table 1 gives the main characteristics of the major groups of fish in the Reservoir (herbivores, detritivores and piscivores) as estimated by analysis of data on major representative species of these three groups.

A simplified version of the trophic model of the Reservoir is also given (Fig. 1).

The Bukit Merah study results, together with other works on tropical Asian reservoirs, allowed a review of many previously unanswered or superficially explored issues concerning reservoir fisheries management. Full discussion is given in my

Table 1. Major characteristics of herbivores, detritivores and piscivores in Bukit Merah Reservoir, as obtained by using data from representative species (*Osteochilus hasselti* (A), *Labiobarbus festiva* (B) and *Oxyeleotris marmorata* (C), respectively).

Species group	A	B	C
Asymptotic length (cm)	27.8	31.0	35.0
Growth constant (K)	1.15	1.35	0.93
Total mortality (Z)	3.30	2.80	4.28
Natural mortality (M)	2.12	2.22	1.68
Fishing mortality (F)	1.18	0.58	2.61
Annual recruitment (No. fingerlings)	$2.3 \times 10^6$	$2.1 \times 10^6$	$4.4 \times 10^4$
Maximum sustainable yield (tonnes)	12.3	11.1	1.5
Optimum size at first capture (cm)	10	13	8

## Findings

Altogether, fishing contributes about M\$4.50/day, or about 37% of the income of fishermen around the lake, with paddy cultivation and rubber tapping contributing the rest, or M\$9.30.<sup>1</sup> At present, the annual fish yield from Bukit Merah Reservoir is rather low, averaging 37 kg/ha. Forty-eight species of fish belonging to 14 families are caught in the Reservoir. Carps dominate, contributing 37% of the total fish catch.

thesis.<sup>2</sup> The issues concerned include (1) the ecological factors contributing to low fish yields from tropical reservoirs, especially the paucity of indi-

<sup>1</sup>US\$1 = M\$2.33.

<sup>2</sup>The full report of this work is contained in "Fish Resources of Bukit Merah Reservoir" by Yap Siaw-Yang. 1982. Department of Zoology, University of Malaya, Kuala Lumpur. 400 p. Ph.D. Thesis.

genous lacustrine biota, degradation of ecosystems, oligotrophic conditions, detritus deficiency, predation pressure; (2) fisheries resources assessment methodology and management theory; (3) the impact of introduced fish species and culture fisheries in tropical Asian reservoirs; (4) the enhancement of indigenous fish species in Asian reservoirs; and (5) land-water interactions.

#### Invaluable Contribution

It was concluded that the ecosystemic approach can provide an invaluable con-

tribution to the management of these reservoirs, especially in relation to the environmental, biological and technological interactions affecting the stability of the resource community structure.

However, socioeconomic conditions may also pose serious constraints to optimal development of reservoir fisheries. In the case of Bukit Merah, there are no relevant data and a complementary study is needed to identify such constraints. An adaptive and pragmatic management policy will ensure the sustainability of the resources. ●

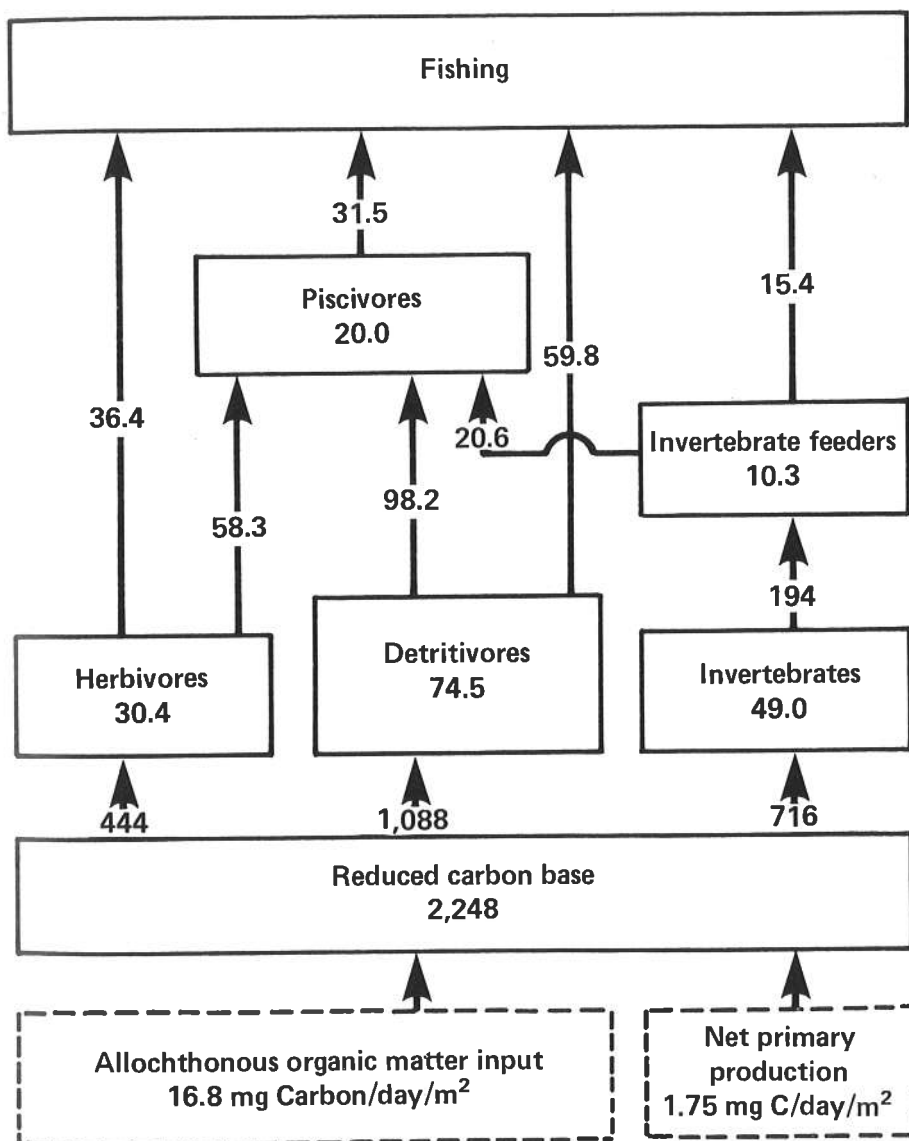


Fig. 1. Simplified trophic model of Bukit Merah Reservoir, Malaysia. Except for the lowest level, which expresses carbon inputs, the numbers in the boxes refer to annual mean standing stocks in tonnes, wet weight, while the numbers along the arrows express annual flows in tonnes.

Republic of the Philippines  
Ministry of Transportation  
and Communications  
BUREAU OF POSTS  
Manila

#### SWORN STATEMENT (Required by Act 2580)

The undersigned, J.L. Maclean, Australian, editor, ICLARM Newsletter, published quarterly in English at Metrobank Plaza, Buendia Ave. Ext., Makati, Metro Manila, after having been duly sworn to in accordance with law, hereby submits the following statement of ownership, management, and circulation, etc., which is required by Act 2580, as amended by Commonwealth Act No. 201.

Editor: J.L. Maclean. Address: Metrobank Plaza, Buendia Ave. Ext., Makati, Metro Manila. Business Manager: Angelito O. del Mundo. Owner: International Center for Living Aquatic Resources Management (ICLARM). Publisher: ICLARM. Printer: Emiluz Printing Industries. Office of Publication: ICLARM.

ICLARM is a nonstock, nonprofit corporation. Total number of copies printed and circulated of the last issue dated January 1983.

1. Sent to paid subscribers . . . . . 200
  2. Sent to other than paid subscribers. . . . . 2,400
- Total. . . . . 2,600

(Sgd.) J.L. Maclean, Chief Editor

SUBSCRIBED AND SWORN to before me this 29th day of April 1983, at Makati, Metro Manila, the affiant exhibiting his Passport No. P 726793, issued at Sydney, Australia, on November 2, 1979.

(Sgd.) Vitaliano N. Aguirre II  
Officer Administering Oath

