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SOME ASPECTS OF THE BIOLOGY AND POPULATION DYNAMICS OF THE DOMINANT FISH SPECIES IN KEDUNGOMBO RESERVOIR, CENTRAL JAVA, INDONESIA

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By

ENDI SETIADI KARTAMIHARDJA

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SOME ASPECTS OF THE BIOLOGY AND POPULATION DYNAMICS OF THE DOMINANT FISH SPECIES IN KEDUNGOMBO RESERVOIR, CENTRAL JAVA, INDONESIA

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ENDI SETIADI KARTAMIHARDJA

JUNE 1993

Chairman : Assoc. Prof. Dr. Hj. Mohd. Zaki Mohd. Said

Faculty : Faculty of Fisheries and Marine Science

The study was aimed to investigate some aspects of the biology and population dynamics of dominant fish species, namely *Oreochromis mossambicus* (Peter), *Puntius gonionotus* (Bleeker), *Puntius bramoides* (Cuvier & Valenciennes), *Mystacoleucus marginatus* (Cuvier & Valenciennes), and *Channa striatus* Bloch in the Kedungombo Reservoir, Central Java, Indonesia.

Gillnet sampling in six sub-fishing areas of the reservoir once a month for a 12 month period and catch assessment survey (CAS) at three fish landing sites were carried out. Length-based methods for fish population study were adopted.

Results of the study showed that the dominant species were distributed all over the reservoir, except *C. striatus* which were distributed in a restricted area. The riverine species were concentrated in the upper portion of the reservoir. The species richness and diversity of the fish community were high in the upper portion of the reservoir. Based on the values of the index of preponderance, *O. mossambicus* and *M. marginatus* were classified as planktivores; *P. gonionotus* and *P. bramoides* as herbivores; and *C. striatus* as a carnivore. Food competition occurred between *O. mossambicus* and *M. marginatus*, and between *P. gonionotus* and *P. bramoides*. However, the food competition among other species was considered low.

O. mossambicus reproduced at intervals of about three months and their reproduction occurred extensively during high water level. Reproduction of *P. gonionotus, P. bramoides* and *M. marginatus* started from December until March when the water level of the reservoir began to rise. In *C. striatus* reproduction occurred during high water level. Fecundity of *O. mossambicus*, *P. gonionotus, P. bramoides, M. marginatus* and *C. striatus* were between 178-1,574; 25,980-86,916; 42,454-99,659; 4,702-15,681; and 2,585-12,880, respectively. The fecundity was highly correlated with total length, body weight, and gonad weight and it increased with the increase in total length, body weight and gonad weight.

Length-weight relationship of the species showed that *O. mossambicus*, *P. gonionotus* and *P. bramoides* grew isometrically and *M. marginatus* and *C. striatus* grew allometrically.

Von Bertalanffy growth parameters, L∞ and K of *O. mossambicus*, *P. gonionotus, P. bramoides, M. marginatus* and *C. striatus* were 31.5 cm and 0.57 yr^{-1}; 41.90 cm and 0.54 yr^{-1}; 31.24 cm and 0.86 yr^{-1}; 19.40 cm and 1.21 yr^{-1}; and 66.93 cm and 0.40 yr^{-1}, respectively.

Recruitment patterns of the five dominant fish stocks showed two peaks of recruitment, particularly in *O. mossambicus*, *M. marginatus* and *C. striatus* stocks.

Exploitation rate of *O. mossambicus* and *C. striatus* stocks were at an optimum level and the other fish stocks were considered below optimum level. Relative yield per recruit of the stocks showed the maximum at 0.48 for *O. mossambicus*, 0.52 for *P. gonionotus*, 0.50 for *P. bramoides*, 0.55 for *M. marginatus* and 0.52 for *C. striatus.*

The fish yield of the reservoir was estimated to be 430.962 mt annually or 88 kg/ha/yr.

Abstrak tesis yang dikemukakan kepada Senat Universiti Pertanian Malaysia sebagai memenuhi keperluan untuk Ijazah Master Sains.

BEBERAPA ASPEK BIOLOGI DAN DINAMIK POPULASI SPESIES IKAN DOMINAN DI TASIK KEDUNGOMBO, JAWA TENGAH, INDONESIA

OLEH

ENDI SETIADI KARTAMIHARDJA

JUN 1993

Pengerusi : Profesor Madya Dr. Hj. Mohd. Zaki Mohd. Said

Fakulti : Fakulti Perikanan dan Sains Samudera

Kajian ke atas beberapa aspek biologi dan populasi dinamik dari spesies ikan dominan, iaitu *Oreochromis mossambicus* (Peter), *Puntius gonionotus* (Bleeker), *Puntius bramoides* (Cuvier & Valenciennes), *Mystacoleucus marginatus* (Cuvier & Valenciennes), dan *Channa striatus* Bloch telah dijalankan di Tasik Kedungombo, Jawa Tengah, Indonesia.

Pensampelan ikan dijalankan dengan menggunakan jaring insang di enam kawasan tangkapan untuk seluruh tasik setiap bulan dalam jangka masa 12 bulan dan bancian perkiraan tangkapan (catch assessment survey) di tiga kawasan pendaratan ikan. Kaedah yang dipakai dalam kajian populasi dinamik berdasar kepada frekuensi panjang ikan.

Hasil kajian menunjukkan bahawa ikan-ikan dominan didapati berkeliaran di seluruh tasik, kecuali *C. striatus* yang berkeliaran di kawasan yang terhad. Ikan riverin (sungai) berkumpul di kawasan hulu tasik. Nilai kekayaan spesies dan diversiti tertinggi dari komuniti ikan terdapat di bahagian hulu tasik.

Sesuai dengan nilai dari indeks preponderan, *O. mossambicus* dan *M. marginatus* diklasifikasikan kepada planktivor; *P. gonionotus* dan *P. bramoides* sebagai herbivor; dan *C. striatus* sebagai karnivor. Persaingan makanan berlaku di antara *O. mossambicus* dan *M. marginatus*; dan antara *P. gonionotus* dan *P. bramoides*. Bagaimanapun persaingan makanan di antara seluruh spesies ikan adalah rendah.

Pembiakan *O. mossambicus* terjadi setiap tiga bulan dan pembiakan ini secara ekstensif berlaku selama paras muka air tasik tinggi. Pembiakan *P. gonionotus, P. bramoides* dan *M. marginatus* bermula pada bulan Disember hingga Mac di mana pada waktu itu paras muka air tasik mulai naik. Pembiakan *C. striatus* terjadi selama paras muka air tinggi. Fekunditi mutlak *O. mossambicus*, *P. gonionotus, P. bramoides, M. marginatus* dan *C. striatus* secara berturut adalah di antara 178-1,564; 25,980-86,916; 42,454-99,659; 4,702-15,681; dan 2,585-12,880. Fekunditi mempunyai hubungkait yang sangat rapat dengan panjang keseluruhan, berat tubuh dan berat gonad.

Fekunditi bertambah dengan meningkatnya panjang keseluruhan, berat tubuh dan berat gonad.

Hubungan panjang berat menunjukkan bahawa *O. mossambicus*, *P. gonionotus* dan *P. bramoides* membesar secara isometrik, sedangkan *C. striatus* dan *M. marginatus* membesar secara allometrik. Parameter pertumbuhan von Bertalanffy, $L\infty$ dan K dari *O. mossambicus*, *P. gonionotus*, *P. bramoides*, *M. marginatus* dan *C. striatus* secara berturut adalah 31.5 cm dan 0.57 th^{-1}; 41.90 cm dan 0.54 th^{-1}; 31.24 cm dan 0.86 th^{-1}; 19.40 cm dan 1.21 th^{-1}; dan 66.93 cm dan 0.40 th^{-1}.

Rekruitmen stok ikan memperlihatkan dua puncak, terutamanya pada stock *O. mossambicus*, *M. marginatus* dan *C. striatus*. Kadar eksploitasi dari stok *O. mossambicus* dan *C. striatus* berada pada paras optimum dan kadar eksploitasi stok ikan lainnya berada pada paras di bawah optimum. Hasil relatif dan biomass relatif per rekruitmen menunjukkan nilai maksimum 0.48 pada *O. mossambicus*; 0.52 pada *P. gonionotus*; 0.50 pada *P. bramoides*; 0.55 pada *M. marginatus* dan 0.52 pada *C. striatus*.

Hasil ikan dari tasik dianggarkan sebanyak 430.962 mt se tahun atau 88 kg/ha/th.

CHAPTER I

INTRODUCTION

Background

In Indonesia, man-made lakes or reservoirs are among the most important areas besides natural lakes, rivers and swamps for fisheries development. The reservoir area tends to increase from year to year as a result of damming of rivers for irrigation and hydroelectric power. At present, the total area of reservoirs is 53,000 ha and is expected to reach 500,000 ha by the year 2000 when the construction of another 124 dams are completed (Direktorat Sungai dan Rawa, 1984).

Development of reservoir may result in a number of consequences such as loss of settlement area, impoundment of agricultural land and forest and creation of river basin. The loss of settlement causes serious problems if the reservoir is built in an area with dense population such as in Java Island. However, with a proper management plan the development of reservoir can also provide employment through fisheries activities.

Inland water fisheries of Indonesia which include reservoir fisheries, play an important role contributing 281,264 mt or 42% of the total fish production of Indonesia. In inland waters, capture fishery is the most

dominant and it contributes about 74% of the total inland fish production involving 461,619 fishermen (Directorate General of Fisheries, 1991).

The fish production of the Indonesian reservoirs varied from 15 to 380 kg/ha/yr with an average of 177 kg/ha/yr (Baluyut, 1984). The exploitation of the fish resources tend to increase from year to year but the catch per unit effort (CPUE) shows a declining trend since last year. The decline of the CPUE is probably due to the absence of the proper management programme which is usually based on knowledge of the fish stock. Unlike the marine fisheries sector, information on biology and population dynamics of fish stocks of the reservoirs is scarce.

Research Problems and Objectives

The damming of rivers can affect physical, chemical, biological and social aspects of the environment. Impounded river basin can change fish composition, behaviour, and other biological aspects which can be reflected on fish production of the reservoir. The change in environmental condition is often unsuitable for indigenous fish which may consequently result in poor fish production. In optimalisation of the fish resources, a management plan should be developed.

The objectives of the reservoir fisheries management are to increase yield and to maintain a steady state of harvest of fish at a level near the optimum production of the reservoir. Raat (1990) stated that fisheries management is a form of human action in the aquatic ecosystem. As such, a programme for the management process should include the socio-economics, political, institutional and biological features. Knowledge in biology and population dynamics of fish stocks is important for managing the fisheries resources properly. Since the Kedungombo reservoir is a new reservoir, ecological and biological aspects of the fish stock are poorly known. Therefore, a regular and systematic study of the reservoir to estimate the magnitute of harvest, biotic communities, fish populations and their dynamics are necessary.

The objectives of this study are as follows:

1. to investigate the biological aspects of the dominant fish species, i.e. structure of fish community, food and feeding habits, sex ratio, gonado-somatic index (GSI), fecundity, length-weight relationship and condition factor,
2. to estimate population parameters of the dominant fish species, i.e. growth, mortality, recruitment and exploitation rate, and
3. to estimate fish yield based on knowledge of catch per unit effort (CPUE), fishing effort, catch by species and the number of fishermen.

CHAPTER II

LITERATURE REVIEW

Role of Reservoir for Fisheries

The study on the possible use of reservoir for fishery purposes began in the early 1920s (Bhukaswan, 1980). Due to the rapidly increasing demands for protein particularly in developing tropical countries, and for sport fishing in developed countries, scientists have been focusing on optimising the use of reservoirs for fishery purposes.

Although the reservoir construction is not primarily for fishery purposes, fishery development of the reservoir can play an important role in meeting the growing demand for fish. The fisheries potential of reservoirs can be easily exploited for economic purposes. The fishery can be developed on the basis of an orderly economic and scientifically conceived programme (Lagler, 1969). In Ubolratana Reservoir in Thailand, for example, the reservoir fishery yielded about US$ 1.2 millions a year in comparison with US$ 1.0 million from electric generation (Fernando, 1980a). Another example is the development of aquaculture and fisheries in Saguling and Cirata Reservoirs in West Java. Fisheries development in these reservoirs have assisted the resettlement programme by providing employment for 3000

families from inundated areas (Costa-Pierce *et al.*, 1988; Costa-Pierce and Sumarwoto, 1990). Thus, reservoirs which are increasing in number can be utilised not only for important source of animal protein but also for providing employment, particularly, to the population from inundated areas (Thia-Eng, 1986).

Some Aspects of Fish Biology

The information on fish biology for Asian reservoirs is scarce compared with the tropical reservoirs of Africa as well as America. However, data from several Asian reservoirs have been reviewed by Fernando (1984) and Fernando and De Silva (1984). The recent information on limnology, biology, resource, management and fish culture of Asian reservoirs has been highlighted by De Silva (1988a).

Taxonomy of Dominant Fish Species

Comprehensive work on taxonomy of freshwater fish fauna of Indonesia had been done by Weber and de Beaufort (1913; 1916; 1922; 1936) on the Fishes of Indo-Australian Archipelago. Their references were mostly based on the work of Pieter Bleeker who began to study fish fauna of Indonesia in 1844. Later, Saanin (1968) published the keys for identification

of fish species in Indonesia. Other references on Indonesian freshwater fish, particularly to the native species of Sundaland (Sumatera, Java and Kalimantan), comprised of the works of Smith (1945), Inger and Chin (1962), and Mohsin and Ambak (1983). Recently, Trewavas (1982; and 1983) reviewed the taxonomy of tilapiine species. According to these references, the five dominant fish species inhabiting Kedungombo Reservoir in Central Java, Indonesia were classified as follows:

Phylum Chordata

Class Teleostomi

Order Perciformes

Family Cichlidae

Genus *Oreochromis*

Species *Oreochromis mossambicus* (Peters)

Chromis niloticus Muller & Peters, 1844.

Chromis (*Tilapia*) *mossambicus* Peters, 1852.

Chromis mossambicus Gunther, 1862.

Tilapia natalensis Boulenger, 1899.

Tilapia mossambica Boulenger, 1899.

Sarotherodon mossambicus Bell-Cross, 1976.

Oreochromis mossambicus Trewavas, 1981.

Indonesian vernacular name of the species is "Mujair".

Order Cypriniformes

Family Cyprinidae

Genus *Puntius*

Species *Puntius gonionotus* (Bleeker)

Barbus gonionotus Bleeker, 1850.

Barbus javanicus Bleeker, 1855.

Puntius javanicus Bleeker, 1855.

Barbus koilometopon Bleeker, 1857.

Systomus (*Barbodes*) *javanicus* Bleeker, 1860.

Puntius (*Barbodes*) *javanicus* Bleeker, 1863.

Indonesian vernacular name of the species is "Tawes".

Species *Puntius bramoides* (Cuvier & Valenciennes)

Barbus bramoides Cuvier & Valenciennes,1842.

Barbus wadon Bleeker, 1850.

Barbus erythropterus Bleeker, 1850.

Barbus amblycephalus Bleeker, 1855.

Barbus macropthalmus Bleeker, 1855.

Systomus (*Barbodes*) *erythropterus* Bleeker, 1860.

Systomus (*Barbodes*) *bramoides* Bleeker, 1860.

Puntius (*Barbodes*) *amblycephalus* Bleeker, 1863.

Puntius (*Barbodes*) *bramoides* Bleeker, 1863.

Barbus bramoides Gunther, 1868.

Indonesian vernacular name of the species is "Lelawak".

Genus *Mystacoleucus*

Species *Mystacoleucus marginatus* (Cuvier & Valenciennes)

Barbus obtusirostris van Hasselt, 1823.

Barbus marginatus Cuvier & Valenciennes, 1842.

Systomus (*Barbodes*) *marginatus* Bleeker, 1860.

Puntius (*Barbodes*) *obtusirostris* Bleeker, 1863.

Barbus obtusirostris Jordan & Seale, 1908.

Indonesian vernacular name of the species is "Genggehek" or "Wader".

Order Channiformes

Family Channidae

Genus *Channa*

Species *Channa striatus* Bloch

Ophiocephalus striatus Bloch, 1793.

Ophiocephalus wrahl Lacepede, 1802.

Ophiopcephalus planiceps Cuvier & Valenciennes, 1831.

Ophiocephalus sowarah Bleeker, 1845.

Ophiocephalus cyanospilus Bleeker, 1853.