# STUDY ON THE POPULATION BIOLOGY OF SOLDIER CATFISH (*Osteogeneiosus militaris,* Linnaeus 1758) IN THE COASTAL AREA OF PENANG.

**By**

**RADZIAH BINTI JANTAN**

**UNIVERSITI SAINS MALAYSIA**

**2014**

# STUDY ON THE POPULATION BIOLOGY OF SOLDIER CATFISH (*Osteogeneiosus militaris*, Linnaeus 1758) IN THE COASTAL AREA OF PENANG.

**by**

**RADZIAH BINTI JANTAN**

Thesis submitted in fulfillment of the requirements for the Degree of Master of Science

**UNIVERSITI SAINS MALAYSIA**

**FEBRUARY 2014**

## ACKNOWLEDGEMENT

Pertama sekali, ucapan syukur tidak terhingga ke hadrat Illahi kerana dengan –Nya saya dapat juga menyiapkan desertasi ini. Terlalu banyak dugaan serta cabaran dalam proses menyiapkan penyelidikkan serta tesis ini. Saya tidak dapat menyangka akhirnya dapat juga impian ini direalisasikan. Sepanjang proses penyediaan tesis ini, dorongan, sokongan, doa serta kritikan yang membina yang banyak saya perolehi dari kedua ibu bapa tercinta yang saya anggap sebagai tulang belakang kerna mereka sentiasa setia berada bersama dikala jatuh bangunnya saya iaitu emak, Pn. Nor'aini Manap dan ayah, En. Mohd Yusof Jani, Mak Nah serta ahli keluarga di kampong. Tunjuk ajar yang tidak putus-putus dari dua orang insan yang saya gelarkan mentor serta sifu iaitu penyelia saya, Dr. Mansor Mat Isa dan Dr. Khairun Yahya bagi memastikan produk yang dihasil adalah yang terbaik. Tanpa peluang serta kepercayaan yang diberikan oleh Dr. Mansor dan Dr. Khairun, tidak mungkin saya mampu mencapai impian ini. Jutaan ribuan terima kasih saya ucapkan. Antara nama-nama lain yang turut menyumbang jasa dalam kejayaan desertasi ini termasuklah Dr. Amiruddin Shah serta pensyarah-pensyarah di USM khususnya di PPSK yang sudi memberikan nasihat disaat saya menemui jalan buntu. Kepada rakan-rakan yang sentiasa bersama ketika jatuh bangun saya, terima kasih saya ucapkan; Rabiatul Adawiyah Abdul Mutalib, Khairani Amir, Kak Zue, Mohd Asyraf Osman, Farah Alia Nordin, Ayun, Shafiq, Fatin, Aleeyanie, Kak Ayu, Adib, Farah, Sham, Ruziah, Asyraf, Shafikah, Aziella, Wan Neeza dan Azman Aziz. Tidak dilupakan Universiti Sains Malaysia, Perpustakaan Hamzah Sendut II serta warga Pusat Pengajian Sains Kajihayat USM, terutamanya En. Nazri dan Miss Shantini, yang banyak meyediakan kemudahan sepanjang penyelidikan saya ini dijalankan. Tanpa bantuan

kewangan USM Fellowship dari IPS USM serta Research University Grant Universiti Sains Malaysia 304/PBIOLOGI/638147, penyelidikan ini tidak dapat dilaksanakan.

## TABLES OF CONTENTS

## LIST OF TABLE

## LIST OF FIGURE

## LIST OF PUBLICATION

1. **Radziah, J.**, Mansor, M. I., and Khairun, Y. (2012). Length-weight relationship of Ariidae collected from southwest Penang coastal waters. South China Sea 2012 conference: sharing knowledge, resources and technologies for sustainable South China Sea at University of Malaya, 21-24 October 2012, Kuala Lumpur, Malaysia.

**KAJIAN POPULASI BIOLOGI IKAN DURI TEGAR MISAI (*Osteogeneiosus militaris*, Linnaeus 1758) DI KAWASAN PERRSISIRAN PANTAI PULAU PINANG**


## ABSTRAK

Satu kajian ke atas biologi populasi ikan duri marin daripada famili Ariidae telah dijalankan di kawasan pinggir pantai Pulau Betong di Pulau Pinang telah dikaji. Kajian tersebut telah dijalankan dari Februari 2009 sehingga Ogos 2010. Kajian ini melibatkan beberapa aspek biologi seperti hubungan antara panjang dan berat (LWR), kondisi ikan (Kn), tabiat pemakanan, biologi pembiakan dan maklumat pertumbuhan. Persamaan LWR bagi ikan betina, jantan dan yang belum matang adalah $W=0.01L^{3.095}$; $W=0.027L^{2.763}$ dan $W=0.013L^{2.975}$, masing-masing. Nilai Kn adalah melebihi 1 menunjukkan *O. militaris* dari kawasan Pulau Betong berada dalam keadaan yang baik. Analisa panjang salur pemakanannya pula menunjukkan *O. militaris* adalah omnivor (GIT = 1.62). Jenis makanan yang dijumpai di dalam perut *O. militaris* termasuklah panaeids, ophiurids, holothuroids, *Setipinna spp*., bivalvia, ketam brachyuria, rangka ikan, nematodes, telur ikan, isopoda and otolith ikan dan organism yang tidak dapat dikenalpasti,. Keputusan daripada kajian pembiakan pula menunjukkan musim bertelur *O.militaris* adalah berlaku sepanjang tahun. Walau bagaimana pun kemuncak bagi aktiviti pembiakan bagi spesies ini dijumpai berlaku pada Jun - Julai 2009, Disember 2009 - Februari 2010. Panjang badan pada tahap kematangan pertama populasi *O. militaris* adalah 25.5 cm SL. Julat diameter telur pula adalah dari 4.5-11.5 mm per ovary di peringkat kematangan 3 dan 19-39 biji telur per ovary bagi peringkat kematangan 3 sehingga 18-49 biji telur per ovary bagi peringkat kematangan 4. *O. militaris* mengambil masa selama 10 tahun untuk mencapai panjang 37.03 cm. Penganggaran parameter

pertumbuhan dan kematian bagi *O. militaris* ialah $L_{max}$=30.88 cm; $L\infty$=37.03 cm; Lc=21.40 cm; $K$=0.37 year$^{-1}$; $\phi'$ =2.64; $Z$=1.23 years$^{-1}$; $M$=0.75; $F$=0.49. Kadar ekspoitasi yang dianggarkan ialah $E$ =0.39 atau 39%, rendah dari B'/R ($E_{0.1}$=0.41) atau dari nilai Y'/R ($E_{max}$=0.49).

# STUDY ON THE POPULATION BIOLOGY OF SOLDIER CATFISH (*Osteogeneiosus militaris*, Linnaeus 1758) IN THE COASTAL AREA OF PENANG


## Abstract

A study on population biology of marine catfish of the family Ariidae, *Osteogeneiosus militaris* was conducted from Pulau Betong in southwestern part of Penang. The study was conducted from February 2009 to August 2010. This study includes the biological aspects such as length-weight relationship (LWR), relative condition factor (Kn), feeding habits, reproductive biology and growth determination. The LWR equation obtained for female, male and immature *O. militaris* were $W=0.01L^{3.095}$; $W=0.027L^{2.763}$ and $W=0.013L^{2.975}$, respectively. The value of Kn is more than 1 showing that *O. militaris* in Pulau Betong were having a good body condition. Analyses of the gastro-intestinal tract length shows that *O. militaris* having omnivorous feeding habits (GIT=1.62). The food items found in the stomach of *O. militaris* comprised of, panaeids, ophiurids, holothuroids, *Setipinna spp*., bivalves, brachyurans crab, fish skeleton, nematode, fish eggs, isopoda, fish otolith and unidentified organism. Result from the reproductive biology shows that the spawning period for *O.militaris* occurred throughout the year. However, spawning peak for this species were detected in June - July 2009 and December - February 2010. Length at first maturity for population of O. militaris in Pulau Betong is at 25.5 cm SL. The oocytes diameter ranged from 4.5-11.5 mm and the fecundity were ranged from 19-39 eggs per ovaries in stage 3 and from 18-49 eggs per ovaries in stage 4. *O. militaris* takes about 10 years to attains the length size of 37.03 cm. Growth and mortality parameter estimation for *O. militaris* were $L_{max}$=30.88 cm; $L\infty$=37.03 cm; Lc=21.40 cm; $K$=0.37 year$^{-1}$; $\phi'$ =2.64; $Z$=1.23 years$^{-1}$; $M$=0.75; $F$=0.49.

The exploitation rate estimated from length converted catch curve ($E$ =0.39 or 39%) lower than the B'/R ($E_{0.1}$=0.41) or in Y'/R ($E_{max}$=0.49).

# CHAPTER 1: INTRODUCTION

## 1.1 General Overview

Fishery sector is one of the important contributors to Malaysia's economy's growth. Many sectors gain advantages from the marine resources directly or indirectly. Young (2006) reported that fisheries sector in Malaysia not just contributed 1.54% to Gross Domestic Production (GDP) and has been recognized as the major animal protein source. Malaysia Adult Nutrition Survey (MANS) (2008), also reported that fish has been highly consumed daily by urban and rural Malaysian adults (Nurnadia *et al.*, 2011).

According to the Fishery Department of Malaysia (2007), 80.5% of the fishery sources for fish as food come from the marine capture fishery and follow with 19.5% from the aquaculture sector. Generally marine resources are renewal resources. However this resource is overexploited which cause depleted (King, 1995; Kolbert, 2008). Thus it will take longer time for the fish stock to recovery back to its nature state.

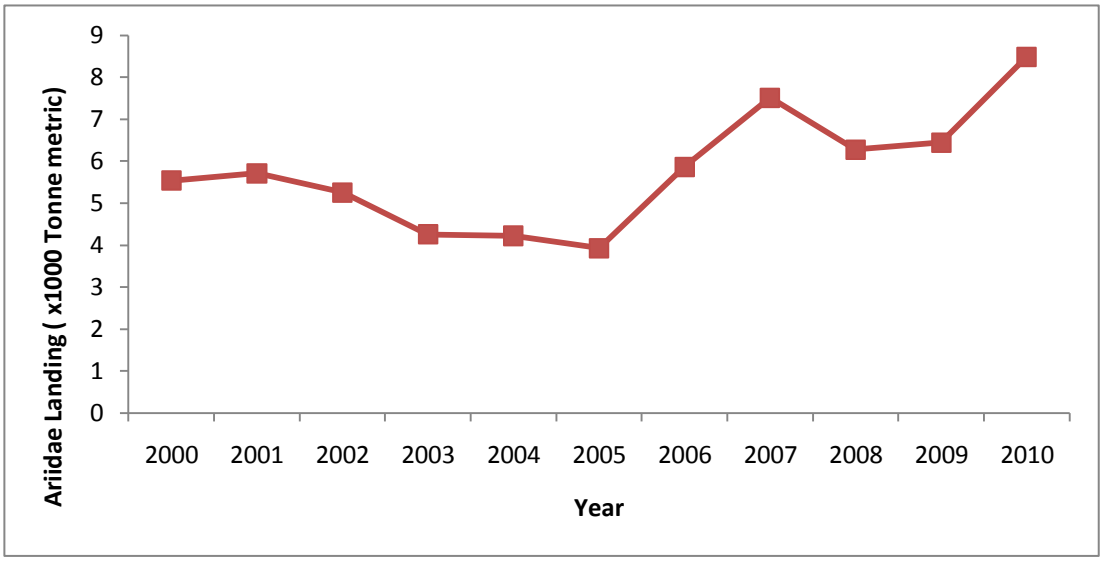
Marine catfishes of the family of Ariidae are among the fish landed in Malaysia. Ariidae inhabits in estuarine and marine environment in tropical and subtropical region (Giarrizzo and Saint-Paul, 2008; Yáñez-Arancibia and Lara-Dominguez, 1988). They are characterized as eurythermal and euryhaline species where some live primarily in sea and some strictly in freshwater with little tolerance to brackish or marine condition (Yáñez-Arancibia and Lara-Dominguez, 1988). They are locally abundant in mangrove areas,

large rivers, and in turbid waters (Kent and Niem, 1999). The distribution of Ariidae are widespread in continental shelves of Atlantic, Indian and Pacific oceans (Acero and Betancur, 2007; Ferraris, 2007; Nirchio *et al*., 2010).

Ariidae are normally caught by gill nets, trammel nets and barrier nets thus it contribute to the socio – economics of the artisanal fisheries. Even though Ariidae is not in the group of the high demand of fishes in the market in contrast to other commercial fishes like lutjanids, carangids, serranids and the catfish-ell like (*Plotosus* sp.) but Ariidae is considered the cheapest and affordable sources of protein for the middle to poor class consumer. In India, Ariidae are among the important commercial fishes (Jayaram, 1986; Vidthayanon, 1998; Jalal *et al*., 2012). According to Menon (2004), Ariidae are utilized in various form of fresh, processed, dried and salted.

In Figure 1.0 (a) shows landing trend of ariids in Malaysia for eighteen years and there is no sign of drastic drop for marine catfish. However there was a decrease in the annual catch of marine catfish in Penang (Figure 1.0 (b)), especially in 2005 then followed with high quantity of catch in 2007. This might be due tsunami phenomena occurred in 2004. Such incident requires knowledge on the biological information of that certain species in order to understand more about the behavior and causes of the sudden incident.

a)




b)

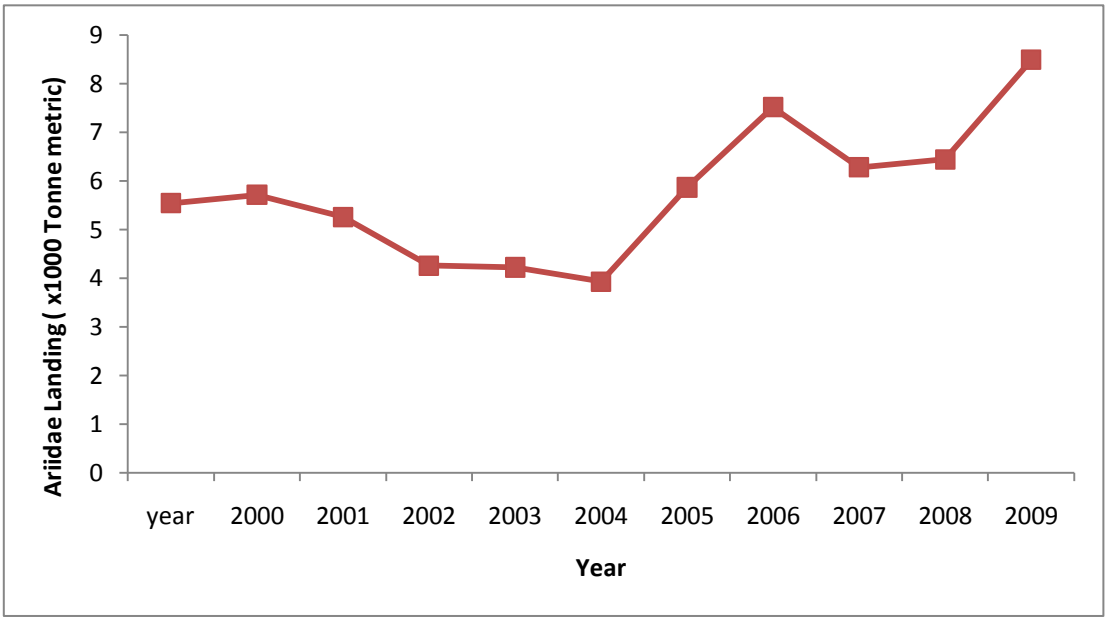



Figure 1.0 Landing trend of Ariidae from 2000 to 2010 in Malaysia waters; a) West coast Peninsular Malaysia; b) Penang waters.

As the world starting to change rapidly through the climate, environment and resources thus this also give significant effect on the species. The results can be seen in the size of the population either the species can tolerate with the changes or extinct. Apart from that, human activities such over-fishing, habitat destruction and pollutions give a significant contribution on the changes of growth in the species population size (Cheung *et al*., 2009).

Information on biological aspects of species is a major concern and fundamental for future management purposes. This information includes the diet of the species, the spawning season, age at the first maturity, type of growth models and the status of the population. Apart from that length – weight relationship (LWR) provide fundamental information on the fish biology. LWR parameters are used to generate other components of population dynamics which in return used for fish management program. All the biological information is used for the conservation and management program of the species. Furthermore in aquaculture sectors, the information is used to show the performance of the fishes.

Various studies have been done on Ariidae species from different part of the region. For instances many researches on marine catfishes biology come from the Indian waters includes study on barbells of *Arius thalassinus* (Kapoor and Bhargava, 1967), biology information of *Tachysurus tenuispinis* in Visakhapatnam (Dan, 1977) and *A. caelatus* and *O. militaris* from Mumbai (Raje, 2006). Another study was conducted to find out the

vulnerability of catfish in terms of the diet, growth and reproductive biology to the fishing activities in Mumbai (Raje and Vivekanandon, 2008). Gunamickrama (2009) conducted a morphometric analysis study on *Arius jella* from five different estuaries in Sri Lanka.

Other researches on Ariidae in another part of the region such as in New Guinea and Australia (Kailola, 1990), Colombia (De la Hoz, 2009; Duarte, 1999), Mexico (Tenorio – Colin *et al*., 2010; Yáñez-Arancibia and Lara-Dominguez, 1988), Malaysia (Lim 1994; Jalal *et al*., 2012; Mansor *et al*., 2012; Singh, 2003), Brazil (Barbieri *et al*., 1992; Giarrizzo *et al*. 2006; Haimorici and Velasco, 2000), Philippine (Garcia, 2010), Venezuela (Etchevers, 1978) and Africa (Ecoutin *et al*., 2005; Harrison, 2001).

Ecology study have been done on three marine catfishes (*A. felis*, *A. melanopus* and *Bagre marinus*) in tropical coastal ecosystem in southern Gulf of Mexico to find out the distribution and abundance, feeding habits, and spawning season has been conducted by Yáñez-Arancibia and Lara-Dominguez (1988). Singh (2003) study the biology of the estuarine Ariidae in Matang mangrove and generated a taxonomy key for the eight species. Warburton (1978) estimated the age and growth of marine catfish by using the otolith. Among other studies covered on Ariidae includes feeding analysis (Tommaso and Saint – Paul ,2008), reproductive biology (Mansor *et al*., 2012) and parasits in Ariidae (Lim, 1994). Phylogenetic study on Ariidae is controversial due to the number of species and genera uncertain thus many researches were covered to entangled the issues (Tenorio – Colin *et al*., 2010; Sczepanski *et al*., 2010).

## 1.2 Objectives of study

The fluctuation trends on Ariidae landing give the significance starting point to initiate the study on the biology information for the management and conservation purposes. Apart from that, the information regarding the information on population biology of *Osteogeneiosus militaris* in southwest Penang coastal waters somehow still scanty.

The main objectives of the present study include:

1) To study the length-weight relationships and condition factors for soldier catfish, *Osteogeneiosus militaris*.
2) To study the diet of the soldier catfish, *O. militaris* and their relation between length, sex and season
3) To determine the spawning season, fecundity, sex ratio and length at 1$^{st}$ maturity of *O. militaris*.
4) To determine the growth parameters, mortality rate, recruitment pattern, length at 1$^{st}$ capture and the exploitation rate of *O. militaris*.

# CHAPTER 2: LITERATURE REVIEW

## 2.1 Family Ariidae

Catfishes belong to order Siluriformes contain about 3088 species of 36 families (Burton, 1996; Acero and Betancur, 2007). Ariidae can be found in tropic of areas of South America, Africa and Asia (Burton, 1996; Acero and Betancur, 2007; Ferraris, 2007). Only Ariidae and Plotosidae are predominantly marine family. Marine catfish from the family Ariidae contain 133 species and 26 genera.

Ariidae is one of the earliest catfish family found in the fossil record (Kailola, 1990; Burton, 1996). The ability to adapt very wide range of salinity is one of the remarkable characters that contribute to their abundance and global distribution. Another modification that contributed the success of its existence is the oral incubation during the spawning season by male (Kailola, 1990; Bruton, 1996). Among other reproductive behavior such guarding nesting site and burrowing the fertilized eggs, this method allow Ariidae species to disperse effectively to wide range of space and habitat.

Cylindrical body shape in cross section, naked skin, complete lateral line, has pairs of whiskers or barbells and dorsal and pectoral fin equip with sharp spine are few characters belong to the marine catfish. Catfishes show greatest adaptation to the stagnant condition. The carnivores species of catfish which lives at the bottom and muddy areas, they often have small eye and used barbells to detect foods, danger and other stimuli. As a bottom dweller, their swim bladder is reduced and depressed body form (Marshall, 1971).