TAXONOMY AND COMPARATIVE MORPHOLOGY OF GIANT FRESHWATER STINGRAY *Himantura chaophraya* (MONKOLPRASIT & ROBERTS 1990) IN THE KINABATANGAN RIVER, SABAH.

ANSIR BIN SALIM

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30th July 2007

ANSIR BIN SALIM
PS03-005(K)-006

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ABSTRACT

TAXONOMY AND COMPARATIVE MORPHOLOGY OF GIANT FRESHWATER STINGRAY *Himantura chaophraya* (MONKOLPRASIT & ROBERTS 1990) IN THE KINABATANGAN RIVER, SABAH.

The *Himantura chaophraya*, belonging to the Dasyatidae family, is a giant freshwater stingray. It is the first species of freshwater stingray in Sabah found in the Kinabatangan River. However, the data on the taxonomy and biology of this species in the Kinabatangan River are very limited. Therefore, the present study was a follow-up effort to add to the existing data on the taxonomy and the biology of this species. Sampling was carried out for five months (March to July 2005) at the Lower Kinabatangan River from Kg. Batu Putih to Kg. Abai, including its tributaries and oxbow lakes. Two main fishing gears were used at selected sites: longlines and gill nets. Four fresh whole specimens were caught during field samplings. Additionally, two tail parts were obtained from local fishermen and one was loaned from the Sabah Museum. Data for morphological study and stomach content were obtained from fresh specimens. Taxonomical study includes morphometric data, meristic counts, squamation, skeletal characteristics and ventral lateral line canals. The squamation was conducted mainly on the tail and the sting. Data on food intake were obtained from a direct observation of the stomach content. The comparative analysis of morphometric measurements showed 77.8% of similarity with previous study. The analysis of the tail and skeletal parts has provided some new insights which were not recorded by previous studies. Specifically, the tail revealed some differences in the arrangements, shapes, and sizes between the dorsal and ventral surfaces at the bases towards the tip region of the tail according to body size. In addition, the skeletal showed a unique projection structure at the base of the interior ridge towards the anteroventral fenestra. Moreover, the biological study of the diet provided first-hand information on the type of food favoured by this particular species and thus, enlightening us on the relationship between food resources and its natural habitat. In conclusion, these taxonomical and biological findings will be useful to conservationists in coming up with the most suitable ways of ensuring the survival of the *Himantura chaophraya.*

KEYWORDS: Taxonomy, *Himantura chaophraya*, freshwater stingray, morphological measurement, squamation.

ABSTRAK

Himantura chaophraya,merupakan spesis ikan pari air tawar gergasi dari famili Dasyatidae. Ia merupakan spesis ikan pari air tawar yang pertama direkodkan di Sabah dan di temui di Sungai Kinabatangan. Walau bagaimanapun, maklumat taksonomi dan biologi spesis ini sangat terhad. Oleh yang demikian, kajian ini merupakan sebahagian dari usaha untuk menambahkan data yang sedia ada. Persampelan telah dijalankan selama lima bulan (Mac hingga Julai 2005) di kawasan hilir Sungai Kinabatangan dari Kg batu Putih ke Kg. Abai, meliputi anak-anak sungai dan tasi-tasik ladam. Dua kaedah penangkapan utama telah digunakan di lokasi yang telah ditetapkan: rawai dan pukat insang. Empat ekor spesimen segar telah berjaya ditangkap sepanjang tempoh persampelan. Selain dari itu, dua spesimen bahagian ekor diperolehi dari nelayan tempatan dan satu lagi spesimen bahagian ekor dipinjam dari Muzium Sabah. Data untuk kajian morfologi dan kandungan perut diperolehi daripada spesimen segar. Kajian morfologi merangkumi pengukuran morfometrik, pengiraan meristik, skuamasi, ciri-ciri tulang rangka dan saluran saraf ventral. Skuamasi lebih menumpukan kepada bahagian ekor dan duri. Pengambilan jenis makanan diperolehi dari pemerhatian secara langsung ke atas kandungan perut.Analisa perbandingan pengukuran morfometrik menunjukkan 77.8% persamaan dengan kajian lepas. Analisa bahagian ekor dan tulang rangka telah menyumbang beberapa penemuan baru yang belum pernah direkodkan sebelum ini. Khususnya, bahagian ekor menunjukkan beberapa perbezaan pada susunan, bentuk dan saiz antara permukaan dorsal dan ventral, bermula dari bahagian pangkal hingga ke hujung mengikut saiz badan. Manakala tulang rangka menunjukkan satu struktur unjuran unik pada dasar 'interior ridge' mengarah ke 'anteroventral fenestra'. Selain daripada itu, kajian biologi terhadap pemakanan spesis ini telah menjadi maklumat asas mengenai jenis makanan yang diambil. Seterusnya memberi petunujuk tentang hubungan antara sumber makanan dan habitat semulajadinya. Kesimpulannya, penemuan taksonomi dan biologi spesis ini akan berguna kepada ahli-ahli konservasi dalam mencari dan mengenalpasti kaedah terbaik bagi memastikan kelangsungan spesis Himantura chaophraya.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The Kinabatangan is the longest river in Sabah. Originating in the mountains and hills of southwestern Sabah, the Kinabatangan River flows 560 kilometres eastwards towards the Sulu Sea, draining a total catchments area of 16,800 kilometres square and covering almost 23 percent of the total land area Sabah (Payne, 1989; Vaz, 1998; Davison and Prudente, 2001). It is one of Borneo's few navigable rivers and large vessels can travel all the way to the village of Bukit Garam. There are also several navigable tributaries which include the Rasang, Menanggol, Tenegang Besar, Koyah, Pin and Lokan. As the massive river reaches the lowlands, it meanders through the lower Kinabatangan, a great floodplain laden with oxbow lakes, open swamps and distinctive vegetation. Natural habitats here include freshwater swamp forests and lowland dipterocarp forests–home to some of the largest and most diverse concentrations of wildlife species in Borneo today. Many rare and endangered animals are found here, such as the fascinating proboscis monkeys, herds of wild Asian elephants, the estuarine crocodiles and a spectacular assembly of birdlife. The lower Kinabatangan is not only the most productive wetland in Sabah, but also a natural heritage area of international significance (Vaz, 1998; Davison and Prudente, 2001). However, with regard to the present study, little information on the ichthyofauna is available.

1.2 Freshwater fish studies in Sabah

The initial freshwater ichthyofauna survey in Sabah was carried out by Vaillant (1893). The great ichthyofaunal study by Weber and de Beaufort 1916 resulted in the documentation of the majority of freshwater fishes. In the last two decades of year 2000, some important studies had been conducted; including those of Kinabalu Park

(Abdullah, 1990), Maliau Basin (Marsh, 1989), Tabin Wildlife Reserve (Taylor, 1989), the oxbow lakes at Sukau, Sandakan and at Rompong, Beaufort (Mani, 1992), Kinabatangan Basin (Lim and Wong, 1994), Tawau Hills Park (Nyanti *et al.*, 1995), Sayap-Kinabalu Park (Nyanti, 1995), Mount Trusmadi (Abdullah and Abdul Hamid, 1996), Segama and Kuamut, Lahad Datu (Martin-Smith *et al.*, 1998). The most recent studies were carried out at Klias and Binsulok (Mohd. Nazri *et al.*, 2000), Tabin Wildlife Reserve (Mohd. Nadzri *et al.*, 2001), Crocker Range Park (Khairul Adha *et al.*, 2002; Kavanagh, 2002; Mohd. Fairus *et al.*, 2004). However, the most comprehensive survey of freshwater ichthyofauna in Sabah was undertaken by Inger and Chin (1962, including a supplementary chapter by Chin in the 1990 and 2002 reprint). In their latest book, Inger and Chin (2002) described about 168 species of freshwater fishes; among them 62 species are endemic to Borneo and 29 species are endemic to Sabah (North Borneo).

1.3 Freshwater Elasmobranch in Kinabatangan River

However, none of the above studies had ever recorded or even mentioned in scientific literature, the existence of freshwater elasmobranch species (sharks, rays and sawfishes) in Sabah (Manjaji, 2002a). In contrast, Sabahan villagers and fishermen living along Kinabatangan River have traditionally known that elasmobranch exists in their river. They were able to distinguish several ray species and to generally describe the declining trend of this fauna, particularly in the case of the sawfishes (Manjaji, 2002b).

The species of interest in this study was first recorded along Kinabatangan River (east coast) and Padas River (west coast) by Manjaji (2002b) during her 18-month elasmobranch biodiversity study in Sabah from January 1996 – June 1997. This joint venture with members of the IUCN Sharks Specialist Group (SSG) definitely identified the presence of a rare giant freshwater stingray known as

Himantura chaophraya (Figure 1.1). Manjaji (2004) did a revision study on *Himantura*, in the Indo-Pacific region and this resulted in the documentation of the taxonomy and the phylogenetic systematic among 23 members of the genus. It was found that the *Himantura chaophraya* specimens from the Kinabatangan River and Padas River possessed the same characteristics as the species described by Monkolprasit and Roberts (1990).

The *Himantura chaophraya* belongs to a group of large rays species. In fact, it is one of the largest living dasyatids ever recorded from the Chaophraya River, where it was first formally described by Monkolprasit and Robert (1990). It reaches a size of up to 200 cm disk wide, and 600 kg in weight. Characterized by a broad but thin oval disk, a prominent snout tip, a long slender whip-like tail without coetaneous fold, small eyes, and black marginal coloration on the ventral surface of disk (Monkolprasit and Roberts, 1990; Compagno and Cook, 1995). They are widely distributed in tropical Indo-Pacific region, and found mainly in fresh water (Monkolprasit and Roberts, 1990; Moyle, 2004). In Australia, the *Himantura chaophraya* has been positively identified in the Gilbert River (Queensland), the Daly and South River, East Alligator Rivers and Pentecost Rivers (Last and Stevens, 1994), Fly River (New Guinea), Mahakam Basin (Western Borneo), and several rivers of Thailand (Last and Stevens, 1994), including the Chaophraya, Nan, Mekong, Bongpakong, Tachin and Tapi Rivers (Compagno and Cook, 1995). In Malaysia, this species was recorded in Endau River drainage (Ng and Tan, 1999) and currently in Kinabatangan and Padas River (Manjaji, 2002b). As far as this study is concerned, there is no information on the diet of this species found in the available literatures. Closely related species, for example, *Himantura signifer* Compagno and Roberts (1982) usually feed on crustaceans and probably other invertebrates.

However the species is now classified as endangered due to threats from human activities and its own conservative life cycle traits. Most stingrays grow slowly, mature at relatively late ages; have a small number of the offspring and high natural mortality. These characteristics result in a very low rate of population increase with little capacity to recover from over fishing (either direct or indirect) and other human activities, including pollution and habitat destruction. However, information on the population status is seriously limited (Compagno and Cook, 1995; Cavanagh *et al.* 2003). Similarly, the information on its basic taxonomy and biology, and knowledge of habitat requirement are still lacking. This is because of the limited number of specimens found in museum collections due to its big size which make its quite taxing to preserve (Pogonoski *et al.*, 2002). Thus, further research is urgently needed to ascertain the status and possible threats to this species where ever its habitat is. Manjaji (2002b) concluded that the freshwater elasmobranch (including *Himantura chaophraya*) from Kinabatangan River of Sabah were very vulnerable due to the nature of their biology and habitat requirements; lends support to current conservation efforts for the rivers. Strategies for the conservation and management of critical freshwater, estuarine and near shore areas can now be better developed and supported.

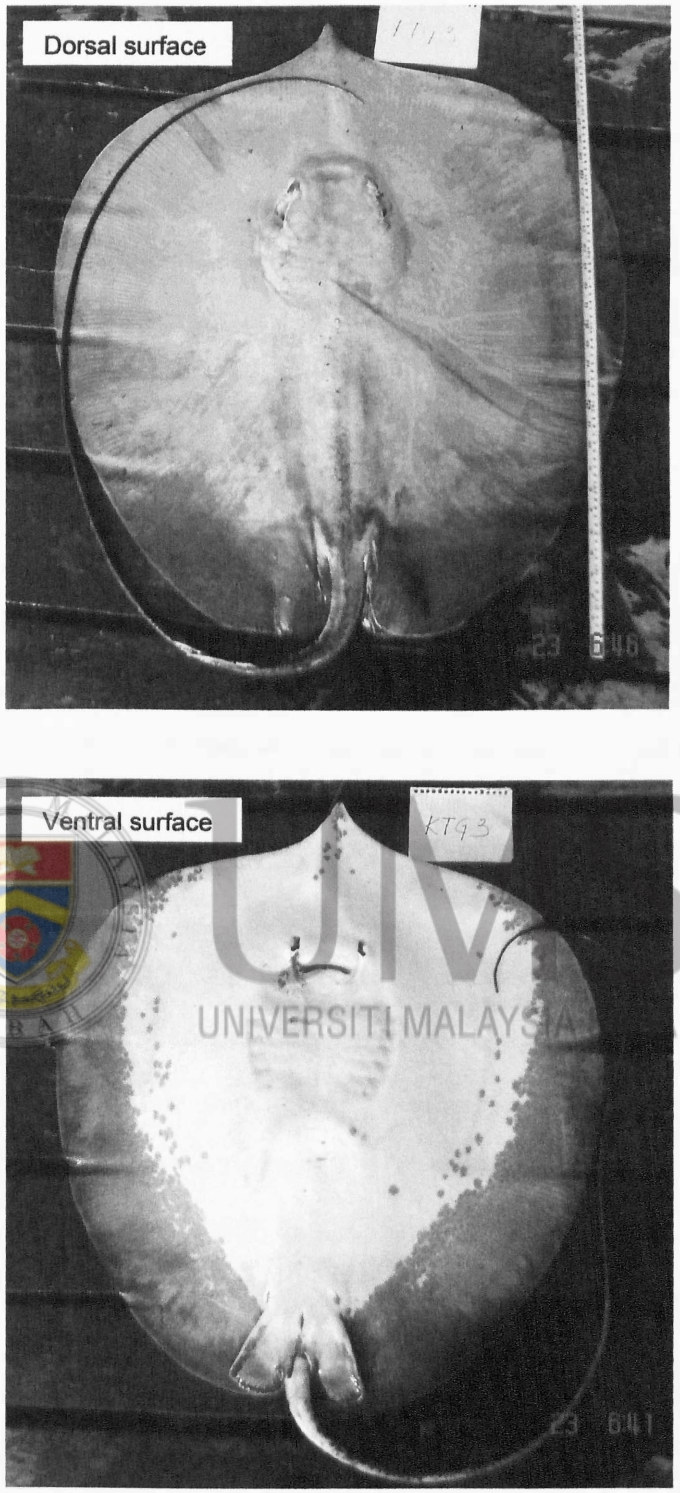

Figure 1.1 Dorsal and ventral surface of *Himantura chaophraya* (N05°33, E118°20')

1.4 Aim and objectives

This project was conducted with the aim to study the taxonomy and the biology of *Himantura chaophraya* (freshwater-stingray) from the Kinabatangan River. The taxonomic information includes the description of both external and internal morphological characters of this species. The data were obtained from morphological measurements (morphometrics), meristic counts, squamation, skeletal characteristics and ventral lateral line canals.

As for the biological information, emphasis is given to the food and feeding data. The examination of the stomach content was used to discover the type of food intake which provided clues to the feeding behavior of *Himantura chaophraya*. To achieve this aim, three main objectives were set up for this study. They are:

i) To describe the morphological features of the *Himantura chaophraya* from the Kinabatangan River.

ii) To compare some of morphological characters with previous study of the *Himantura chaophraya* from the Kinabatangan River.

iii) To describe the pattern of tail squamation of the *Himantura chaophraya* from the Kinabatangan River.

iv) To examine the stomach content of the *Himantura chaophraya* from the Kinabatangan River.

A better understanding of the taxonomy and biology of this species could lead to strategic conservation, management and protection efforts of this threatened stingray species and related group of fishes in the Kinabatangan region.

Murray, Fly River basin, New Guinea, which appeared to be similar to the illustration by Annandale (1910) of the *Trygon fluviatilis*. Zorzi and Compagno (1988) finally reviewed all freshwater records of dasyatid stingrays including: (a) the Ganges River, base on Annandale (1910); (b) Lake Murray and Lake Boset, Fly River Basin, New Guinea, based on photographs published by Compagno and Roberts (1982); (c) the Mekong River, based on a short article and a photograph of a 242 kg giant stingray with a 2.4 m disc width, published in the "Bangkok Post" in 1983; (d) The Mahakam River basin, Borneo, based on a specimen deposited by Roberts in the California Academy of Sciences and concluded strongly that all these specimens resembled Annandale's (1910) illustration of the *Trygon fluviatilis*.

During the 1980's, Roberts began accumulating evidence of the existence of large stingrays in the rivers of Thailand. Most of these accounts came from newspaper articles and photographs, and were summarized by Monkolprasit and Roberts (1990). Since 1987, three intact specimens of "fluviatilis-like" stingray were obtained from the Chao Phraya River in Thailand, upon which Monkolprasit and Roberts (1990) based their description of the *Himantura chaophraya*. These specimens very strongly resembled the illustration by Annandale (1910) of the *Trygon fluviatilis* from the Ganges. Whether these are the same species as named by Hamilton-Buchanan (1822) and illustrated by Annandale (1910) cannot be determined since there are no known specimens from the Ganges or coastal India which can be used as comparisons. While existing uncertainties are still waiting for ultimate resolve to compare them with, several new taxa were added or misidentified. These included (1) the *Dasyatis fluviorum* - a stingray from the South Alligator River, in Australia's Northern Territory which was photographed by Merrick and Schmida (1984), originally described from the Brisbane River by Ogilby 1908 (Last and Stevens, 1994; Pogonoski *et al.*, 2002); (2) the *Trygon polylepis* Bleeker,

1877 from Batavia (=Java) Indonesia and (3) the *Urogymnus laevior* Annandale ,1909 from Malabar Coast, India.

2.2 Classification

The classification of the *Himantura chaophraya* for this study is based on Nelson (1994):

Kingdom: Animalia

Phylum: Chordata

Class: Chondrichthyes (cartilaginous fishes)

Subclass: Elasmobranchii ("plated gills")

Superorder: Rajimorphii (Batoidea)

Order: Myliobatiformes (rays)

Family: Dasyatidae

Genus: *Himantura*

Species: *Himantura chaophraya* Monkolprasit & Roberts, 1990

The provisional classification of Nelson (1994) further cuts the batoid into four suborders, 12 families, 62 genera and about 456 species.

2.2.1 Order: Myliobatiformes (rays)

Rays of this order have large pectoral fins that combine with the head to form a broad disc, with a slender tail that usually has strong stinging spines. The caudal and dorsal fins are reduced or absent. Nelson (1994) included eight families into this order: Dasyatidae, the stingrays; Potamotrygonidae, river stingrays; Urolophidae, round stingrays; Gymnuridae, butterfly rays; Hexatrygonidae, sixgill rays; Myliobatidae, eagle and bat rays; Rhinopteridae, cownose rays (sometimes considered to be part of the preceding family); and Mobulidae, mantas or devil rays.

These are all warm water fishes that seldom enter cold waters and are usually found close to shore. Potamotrygonidae is found in rivers of South America. Some dasyatids of the genera *Dasyatis* and *Himantura* appear to be permanent residents of fresh water in Africa, Asia, and New Guinea. The various stingrays and the butterfly rays live on the bottom, often concealing themselves in sand or other fine materials. Their food is shellfishes and bottom-living fishes. The tail spines are typically barbed and grooved along the edges. The venom produced in the groove can make a wound caused by the spine to be both painful and dangerous.

2.2.2 Family: Dasyatidae (stingrays)

The Family Dasyatidae is the largest and one of the most diversified ray groups of the Order Myliobatiformes. The Dasyatidae is circumglobal in all temperate and tropical seas, and some species enter tropical and warm-temperate rivers and lakes (Compagno, 1999b). There are six genera and more than 62 species in the Dasyatidae as recognized by Compagno (1999b). Further studies are needed to clarify the taxonomic limits of the Dasyatidae (McEachran *et al.*, 1996).

Dasyatids have a circular or longitudinally oval disk and bluntly rounded or truncate snout. Dasyatids may have small denticles or small to large thorns covering the disk. The pelvic girdle lacks the prepelvic process found in potamotrygonids, or there may be a low, blunt process instead of the high, sharp process of the potamotrygonids. The tail of dasyatids ranges from short to greatly elongate and may be more than twice as long to somewhat shorter as the snout-vent length. The sting is located behind the pelvic fins. The caudal fin may be reduced to a fin fold or completely lost. Adults vary from less than 1 m to more than 4 m long (Compagno, 1999a). Dasyatids like most elasmobranchs have a high level of urea as an osmoregulatory agent and a prominent rectal gland used for salt excretion.

Several species in the genera *Dasyatis* and *Himantura* enter rivers. For example, the Atlantic stingray, *Dasyatis sabina,* commonly enters fresh waters in southeastern North America although it does not penetrate far upstream (Schmid *et al.,* 1988). Some tropical dasyatids have only been found in fresh water in Asia, Africa, New Guinea, and Australia. Roberts and Karnasuta (1987) described *Dasyatis laosensis*, an endemic stingray, from the Mekong River on the border between Laos and Thailand. Endemic stingrays from African freshwaters such as *Dasyatis garouaen*sis from the Niger basin, Lagos Lagoon in western Nigeria, and the Cross River in Cameroon were reported by Compagno and Roberts (1984). They also reported a second freshwater species, *Dasyatis ukpam*, from the Cross River in Nigeria, the Ogowe River, and the lower Congo River. In his recent study, Schwartz (2005) found that species like *Urogamus ukpam*, which frequent freshwaters, posses total stinging spine serrations of 21-50 and hypothesized that a total stinging spine serration below 25 indicates a freshwater species.

2.2.3 Genus: *Himantura* (whip-tail stingrays)

The whip-tailed stingrays, genus *Himantura* Müller and Henle 1837, consists of marine, brackish, and fresh water species, and are found in the Atlantic, Indian and Pacific oceans (Nelson, 1994). Their distribution is however, confined to tropical and subtropical water, with most species known only from a limited range (Compagno and Cook, 1995; Compagno and Roberts, 1982; Last and Stevens, 1994; Zorzi 1995). Coastal stingrays primarily occupy demersal habitats, with many species occurring in aggregations indicating their social nature (e.g. Homma *et al.*, 1994). Compagno and Roberts (1982) reported on *Himantura krempfi* from fresh water near Phnom Penh, Kampuchea, and *Himantura signifer* from rivers in Kapuas River of western Borneo, Sumatra, Perak River of western Malay Peninsula, and Thailand.