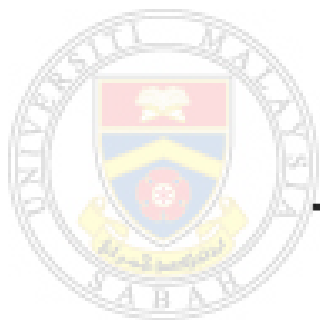


**POPULATION SIZE, SOCIAL STRUCTURE AND
RESIDENCE PATTERN OF IRRAWADDY
DOLPHINS (*Orcaella brevirostris*) IN COWIE
BAY, SABAH, MALAYSIA.**



TEOH SHU WOAN

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**BORNEO MARINE RESEARCH INSTITUTE
UNIVERSITI MALAYSIA SABAH
2013**

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TEOH SHU WOAN

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UNIVERSITI MALAYSIA SABAH

**THESIS SUBMITTED IN FULFILLMENT FOR
THE DEGREE OF MASTER OF SCIENCE**

**BORNEO MARINE RESEARCH INSTITUTE
UNIVERSITI SABAH MALAYSIA
2013**

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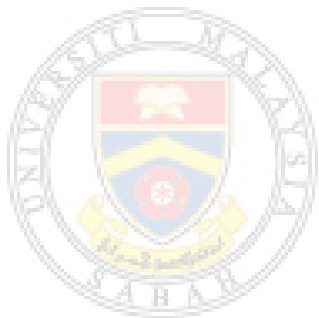
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DECLARATION

I hereby declare that the material in this thesis is my own except for quotations, excerpts, equations, summaries and references, which have been duly acknowledged.

19 November 2013

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CERTIFICATION

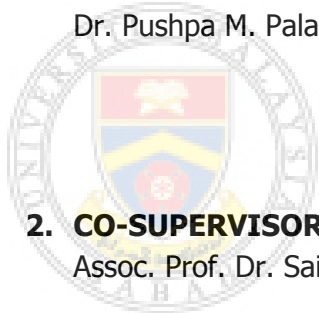
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brevirostris*) IN COWIE BAY, SABAH, MALAYSIA.**
DEGREE : **MASTERS OF SCIENCE (MARINE SCIENCE)**
VIVA DATE : **29 OCTOBER 2013**

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As with most graduate studies, the route to completing this was full of trials and tribulations. I would not have been able to accomplish this without receiving much needed encouragement and support.

Deepest gratitude goes to my parents and my two younger sisters. Their unconditional love, encouragement, and understanding have made this journey so much more meaningful. Thank you for having faith in me.

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ABSTRACT

Irrawaddy dolphins (*Orcaella brevirostris*) in Cowie Bay, southeast of Sabah were first recorded in 1999. This study was aimed at collecting baseline data on the population size, social structure and residence pattern of the Irrawaddy dolphins in the bay. Boat surveys were conducted monthly during neap tide, from October 2009 until September 2010. Data for population size were collected using line transect distance sampling and photo-identification mark-recapture methods and were analysed using DISTANCE 6.0 and MARK 6.1 programs. Data for social structure and residence pattern were collected using photo-identification as well; and were analysed using SOCPROG 2.4 program. Twenty-seven individuals had permanent marks that enabled them to be identified. The population size estimated via DISTANCE 6.0 was negatively biased due to the low number of detections (N=5, 95%CI=2 – 12; CV=0.46). CAPTURE within program MARK 6.1 estimated the population size to be very small (N=31, 95%CI=28 – 34; CV=0.06). Associations between individual dolphins were non-random, preferred companionships and long-term companionships were present among the individuals. Standard deviation of the observed half weight index was significantly larger than standard deviation of the random half weight index ($p=0.0009054$). The social structure was driven by stable associations over time, and it was a closed population. More than half ($n=15$) of the identified individuals were commonly seen (7 months or more) throughout the sampling period in the study area. Results indicate that the Cowie Bay population of Irrawaddy dolphins is small, and are resident.



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ABSTRAK

SAIZ POPULASI, STRUKTUR SOSIAL DAN CORAK KEPENDUDUKAN LUMBA-LUMBA EMPESUT DI TELUK COWIE, SABAH, MALAYSIA

Lumba-lumba empesut (Orcaella brevirostris) di Teluk Cowie, tenggara Sabah, telah pertama kali direkodkan pada tahun 1999. Kajian ini bertujuan untuk mengumpul data asas berkenaan saiz populasi, struktur sosial serta corak kependudukan lumba-lumba empesut di dalam teluk tersebut. Tinjauan bot telah dijalankan setiap bulan dari Oktober 2009 hingga September 2010 ketika pasang surut perbani. Data saiz populasi dikutip dengan menggunakan kaedah persampelan jarak garisan transek dan identifikasi foto serta dianalisa dengan menggunakan program DISTANCE 6.0 dan program MARK 6.1. Data struktur sosial dan corak kependudukan juga dikutip dengan menggunakan kaedah identifikasi foto dan dianalisa dengan menggunakan program SOCPROG 2.4. Dua puluh tujuh individu yang mempunyai tanda kekal telah dikenalpasti. Anggaran saiz populasi DISTANCE 6.0 terpinjang secara negatif disebabkan bilangan pengesanan yang rendah ($N=5$, $95\%CI=2 - 12$; $CV=0.46$). CAPTURE dalam program MARK 6.0 telah mengganggu saiz populasi yang kecil ($N=31$, $95\% CI=28 - 34$; $CV=0.06$). Perhubungan di antara individu lumba-lumba adalah tidak rawak, di mana terdapat pasangan pilihan serta pasangan jangkamasa panjang di antara individu. Sisihan piawai 'half weight index' yang diperhatikan adalah lebih signifikan daripada sisihan piawai 'half weight index' rawak (nilai $p = 0.0009054$). Struktur sosial ditentukan oleh perhubungan yang stabil merentasi masa, dan adalah merupakan populasi tertutup. Lebih dari setengah ($n=15$) dari individu yang dikenalpasti biasa ditemui (7 bulan atau lebih) di sepanjang masa persampelan di kawasan kajian tersebut. Keputusan menunjukkan bahawa populasi lumba-lumba empesut Teluk Cowie adalah kecil dan merupakan populasi residen.

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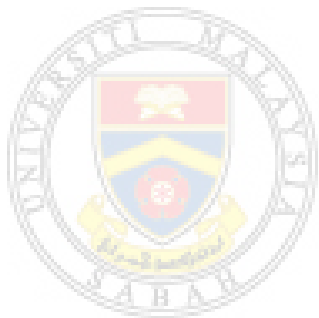
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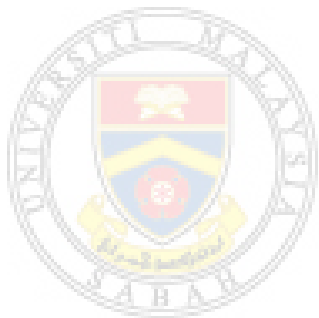
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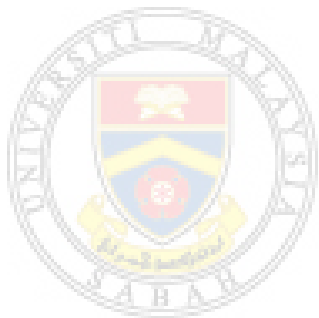
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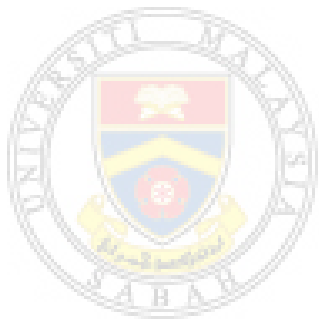
km	kilometre
cm	centimetre
km²	squared kilometre
m	metre
ftu	formazin turbidity unit
ntu	nephelometric turbidity unit
ppt	parts per thousand
ha	acres
c.	circa
GPS	global positioning system
km/hr	kilometres per hour
mm	millimetres



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LIST OF SYMBOLS

°C	degree Celsius
%	percentage
≤	less than or equal to
>	more than



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CHAPTER 1

INTRODUCTION

1.1 Irrawaddy Dolphin in General

The Irrawaddy dolphin, *Orcaella brevirostris* (Owen in Gray, 1866) is one of the six subspecies of river dolphins which remain extant today (Beasley, 2007). They are described as facultative river dolphins due to their ecological flexibility that allows them to inhabit both marine and freshwater environments (Leatherwood and Reeves, 1994). The distribution of Irrawaddy dolphins is somewhat wide but patchy. They are found in shallow waters, from the Western Bay of Bengal to Gulf of Thailand, south to Kalimantan and east to Philippines. Three known populations of Irrawaddy dolphins occur in Asia's major freshwater systems, the Ayeyarwady River (Myanmar), Mekong River (Vietnam, Cambodia and Lao PDR) and Mahakam River (Kalimantan). Another three occur in brackish/freshwater bodies, Songkhla Lake (Southeast Thailand), Malampaya Sound (Palawan, Philippines) and Chilika Lake (East India) (Stacey and Arnold, 1999; Smith and Jefferson, 2002).

Quite often, the narrow home range of Irrawaddy dolphins overlaps areas of intensive use by humans. This puts them at an increased risk of population extirpation, and even extinction. The most dominant threats faced by Irrawaddy dolphins are gillnet entanglement and habitat degradation caused by forestry practices, mining, and damming (Smith and Jefferson, 2002; Smith *et al.*, 2007).

Irrawaddy dolphins were classified as *Data Deficient* (DD) on the International Union for Conservation of Nature (IUCN) Red List in 1996. With more information available in the last few years, their status is now classified as *Vulnerable* (VU). Five subpopulations of Irrawaddy dolphins have been classified as *Critically Endangered* (CR) following surveys which indicated noticeably low population sizes, significant range declines as well as a high exposure to threats. Those subpopulations are in Ayeyarwady River (Myanmar), Mekong River (which spans through Cambodia, Lao PDR and Vietnam), Malampaya Sound (Philippines),

Songkhla Lake (Thailand), and Mahakam River (Indonesia) (Smith, 2004; Smith and Beasley, 2004a; 2004b; 2004c).

1.2 Current Status of Cetacean Research in Malaysia

In Peninsular Malaysia, the Department of Fisheries Malaysia, University Malaya, Malaysian Nature Society, Maritime Institute of Malaysia and World Wide Fund for Nature Malaysia are involved in recording, rescuing and gathering scientific information from stranded or incidentally caught dugongs and cetaceans. The recently established MareCet is a non-profit, non-governmental organization that focuses on research and conservation of marine mammals in Malaysia. The Institute of Ocean and Earth Science-Universiti Malaya and Malaysia Nature Society are collaborating on two cetacean projects. In East Malaysia, Universiti Malaysia Sabah continues to receive non-financial support and collaboration from various government agencies (Department of Fisheries Sabah, Department of Fisheries Malaysia, Sabah Wildlife Department, Sabah Parks, and Sarawak Forestry Corporation), Universiti Malaysia Sarawak, World Wide Fund for Nature-Malaysia Sabah and the private sector (Borneo Divers and Sea Sports (Sabah) Sdn Bhd as well as Matakang Island Resort) in studying, documenting, and protecting the endangered animals (Jaaman, 2010). Universiti Malaysia Sarawak together with Sarawak Shell Berhad and Sarawak Forestry founded the Sarawak Dolphin Project. Supported by SALCO, Ocean Park Foundation Hong Kong, Permai Rainforest Resort, Piasau Boat Club) and the Ministry of Science, Technology and Innovation Malaysia, this project carries out conservation-based research on coastal dolphins in Sarawak (<http://www.ibec.unimas.my/SDP2008/>).

1.3 Legal Status of Cetacean Conservation

Irrawaddy dolphins throughout Asia are at great risk of population extirpation and perhaps extinction. Their vulnerability stems from the fact that their habitat requirements are tied to marine and freshwater environments which are subjected to intensive human use and abuse (Smith and Jefferson, 2002).

Compared to the freshwater population, there is very little information on coastal Irrawaddy dolphins. Thus far, only one comprehensive study to estimate

abundance has been conducted in the mangrove channels of the Sundarban Delta, Bangladesh (Smith *et al.*, 2006). Prior to that study, there were only reports of species occurrence in Anderson, 1879; Mözer Bruyns, 1966; Kasuya and Haque, 1982; Sarkar and Sarkar, 1988 (Smith *et al.*, 2006).

Irrawaddy dolphins were transferred from Appendix II to Appendix I in the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in 2004 during the 13th Conference of Parties (COP13). This puts them in a better position in terms of species trading; where it can only be carried out under exceptional circumstances. Trade of live individuals are forbidden.

In Sabah, the Wildlife Conservation Enactment 1997 provides protection only for a few species of aquatic mammals. Only the Dugong (*Dugong dugon*) is listed in Schedule I Part I, where hunting is forbidden. If a person commits an offence relating to a species listed in Part I of Schedule I, a fine of fifty thousand Malaysian Ringgit (RM50,000) or a term of imprisonment of not less than six months but not exceeding five years or both will be implemented. Twelve other aquatic mammals are listed in Schedule II Part I. They are the Sei Whale (*Balaenoptera borealis*), Bryde's Whale (*Balaenoptera edent*), Killer Whale (*Orcinus orca*), Short-Finned Pilot Whale (*Globicephala macrohynchus*), Pygmy Sperm Whale (*Kogia breviceps*), Grey Dolphin (*Grampus griseus*), Bottlenose Dolphin (*Tursiops truncates*), Indo-Pacific Humpback Dolphin (*Sousa chinensis*), Irrawaddy Dolphin (*Orcaella brevirostris*), Finless Porpoise (*Neophocaena phocaenides*), Fraser's Dolphin (*Lagenodelphis hosei*), and Long Snouted Spinner Dolphin (*Stenella longirostra*). These animals may be hunted in limited numbers, provided one possesses a permit issued by the Director of the Sabah Wildlife Department. If an offence is committed relating to a species listed in Part I of Schedule II, a fine of thirty thousand Malaysian Ringgit (RM30,000) or imprisonment of three years or both will be implemented. It would be a great boost to the conservation of Irrawaddy dolphins and other aquatic mammals in general if the twelve aquatic mammals listed in Schedule II can be transferred to Schedule I.

1.4 Significance and Objectives of the Study

Prior to this study, marine mammal surveys have been conducted in Cowie Bay. The first survey took place in July 1999, followed by another in February 2000 and October 2002 (Jaaman, 2010). From July 2003 to December 2004, Jaaman (2010) carried out a study in Cowie Bay and its tributaries to assess the distribution, group size and behaviour of Irrawaddy dolphins and Indo Pacific Humpback dolphins. Influential physical and biological components of the environment were also identified (Jaaman, 2010). However, assessment of the Irrawaddy dolphin population size was not carried out. The current study investigated the population size of Irrawaddy dolphins in Cowie Bay using line transect distance sampling and photo-identification mark recapture methods. The information collected can be used as a baseline for future studies which are similar, as well as to monitor trends in abundance. Photo-identification data was used to investigate association patterns among the individual dolphins. Temporal variations in the association patterns of Irrawaddy dolphins were assessed and the type of association that best described their social structure was determined by fitting the data into mathematical models. In the event that a management strategy is planned, the information obtained can be an important source of reference. Residence levels and resident rates of Irrawaddy dolphins in Cowie Bay were examined using sighting data of identified individuals, to determine long term residence patterns.

Here are the specific objectives of the study:

- (a) To determine the population size of Irrawaddy dolphins in Cowie Bay, Sabah.
- (b) To determine the social structure of Irrawaddy dolphins in Cowie Bay, Sabah.
- (c) To determine the residence patterns of Irrawaddy dolphins in Cowie Bay, Sabah.