



UNIVERSITI PUTRA MALAYSIA

**EFFECT OF LIGHT ON SQUID BEHAVIOUR
AND ITS APPLICATION FOR SQUID NET
FISHING IN MALAYSIA**

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MASTER OF SCIENCE

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1996



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**Thesis Submitted in Fulfillment of the Requirements for the Degree
of Master of Science in the Faculty of Fisheries and Marine Science,
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May 1996



DEDICATION

This work is dedicated to my parents,
grandmother and grandfather.



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GLOSSARY

Local Name	Common Name	Scientific Name
Sotong Torok, Sotong Ketupat	Mitre Squid	<i>Loligo chinensis</i>
Sotong Mabang	Big Fin Reef Squid	<i>Sepioteuthis lessoniana</i>
Sotong Jarum	Siboga Squid	<i>Loligo sibogae</i>
Pukat Tunda	Trawl	
Pukat Sotong	Squid Net	
Candat	Squid Jig	
Pukat Jerut	Purse Seine	
Bubu	Trap	

Abstract of thesis submitted to the Senate of Universiti Pertanian Malaysia in fulfillment of the requirements for the degree of Master of Science.

**EFFECT OF LIGHT ON SQUID BEHAVIOUR AND ITS
APPLICATION FOR SQUID NET FISHING IN MALAYSIA**

by

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May 1996

Chairman : Dr. Hj. Sakri Bin Ibrahim

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This study was carried out with the objectives of understanding the behaviour of squid in response to artificial light, determining the effects of different characters of light on squid net fishing and estimating the distribution pattern of underwater light which is currently employed by Malaysian fishermen. The experiments on squids were conducted in confinement and open waters. The distribution pattern of underwater illuminance was estimated by theoretical model.

Experiment in confined floating cage showed the response of big fin reef squid (*Sepioteuthis lessoniana*) and mitre squid (*Loligo chinensis*) to the different characters of artificial light. These two species prefer to remain in the underwater illuminance ranging from 1.5 to 22.5 and 1.5 to 25.0 lux, respectively, with the majority of both species occurring at 2.5 to 10.0 lux. However, big fin reef squid



demonstrated a considerably stronger phototaxis animal than mitre squid. This was supported by the open water study in which big fin reef squid would swim up to the water surface with active movement, while mitre squid prefer to remain at the sea bottom.

Studies on the effect of different characters of artificial lights used by fishermen indicated no significant difference between CPUE and the different types and intensities of fishing lamp. It is recommended that the intensity of light source for Malaysian squid netting boats should be reduced and the present type fishing lamp should be replaced by high pressure mercury lamp. The use of red and white spotlight lamps are also recommended.

Results on the estimation of a theoretical model also confirmed that the current usage of attracting light system was in excess of the optimum level of light intensity for Malaysian squid fishing grounds. The efficiency of lamp and the height of light sources installed on the boat should be considered for lighting management.



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**KESAN CAHAYA TERHADAP TINGKAH LAKU SOTONG DAN
PENGUNAANNYA UNTUK PERIKANAN PUKAT SOTONG DI
MALAYSIA**

Oleh

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Kajian ini dilakukan untuk memahami tindak balas sotong terhadap cahaya tiruan, menentukan keberkesanan perbezaan sifat-sifat cahaya terhadap perikanan pukak sotong dan menganggarkan corak taburan pencahayaan dalam air (underwater illuminance) yang digunakan oleh nelayan di Malaysia. Beberapa percubaan telah dilakukan di semua kawasan kajian dan menganggarkan mengikut teoritik model.

Kajian di dalam sangkar terapung menunjukkan bahawa tindak balas sotong mabang dan sotong ketupat/torok terhadap beberapa perbezaan sifat cahaya. Dua spesis ini lebih cenderung berada di dalam air yang bercahaya dalam lingkungan 1.5-22.5 dan 1.5-25.0 lux tetapi kebanyakan dalam lingkungan 1.5-10.0 lux. Walau bagaimanapun terdapat perbezaan dari segi kecenderungan tingkah laku fototaksis iaitu sotong mabang didapati mempunyai sifat sebagai haiwan yang lebih



kuat tingkah laku fototaksis berbanding sotong ketupat/torok. Kenyataan ini disokong oleh kajian yang telah dilakukan di dalam laut yang menunjukkan bahawa sotong mabang akan berenang menuju ke arah permukaan air dengan pergerakan yang aktif, manakala sotong ketupat/torok lebih cenderung berada di dasar lautan.

Kajian mengenai kesan perbezaan sifat-sifat cahaya tiruan yang digunakan oleh nelayan terhadap kecekapan penangkapan menunjukkan bahawa tiada perbezaan yang nyata di antara tangkapan per unit usaha (CPUE) dan bot-bot yang menggunakan beberapa kuasa lampu dan jenis-jenis lampu yang berbeza. Kajian ini menunjukkan bahawa kuasa lampu yang digunakan oleh nelayan sekarang harus ditukar kepada lampu jenis raksa bertekanan tinggi. Lampu kuasa tinggi warna merah dan putih harus digunakan pada masa sekarang.

Keputusan yang terdapat daripada anggaran corak taburan pencahayaan dalam air juga menunjukkan bahawa nelayan menggunakan kuasa lampu yang melebihi keperluan untuk kawasan menangkap sotong di perairan Malaysia. Efisiensi lampu dan ketinggian lampu di atas bot juga perlu diambil kira dalam pengurusan lampu untuk pukat sotong.

CHAPTER I

INTRODUCTION

Background of the Study

World Squid Production (*Loligo spp.*)

Squid fishing has been one of the most important fishery industry in the world. According to the FAO Yearbook of Fishery Statistics (FAO, 1995), the total world squid catch (*Loligo spp.*) in 1993 was 230,558 metric tons. The catch of squid (*Loligo spp.*) by different countries in 1990, 1991, 1992 and 1993 were shown in Table 1. According to the table, the species are mainly caught by fishermen in South East Asian countries such as Thailand, The Philippines, Malaysia and Indonesia. The catch in 1993 increased considerably compared to previous years. Fishermen in all parts of the world catch squid by trawling, seining, trap fishing, pot fishing, gill net fishing, squid net fishing and jigging (Shabalin, 1991, Boongerd & Chitrapong, 1990; Rathein, 1987; Boongerd & Chitrapong, 1986 and Fujiishi, 1986).



Table 1
World's Squid (*Loligo spp.*) Catch by Countries in Metric Tons
(FAO, 1995a)

Countries	1990	1991	1992	1993
Greece	6,788	4,410	1,366	1,711
Indonesia	22,050	14,084	18,365	13,170
Italy	8,154	11,300	9,047	7,958
Japan	8,811	3,007	1,032	834
Malaysia	13,600	13,310	13,720	13,890
Mexico	620	645	350	572
Peru	6,448	780	750	1300
Philippines	26,574	26,672	39,402	55,790
Spain	5,510	4,156	4,480	4,400
Thailand	64,370	69,367	64,774	65,500
Venezuela	1,944	2174	944	1383
Others	54,967	84,158	58,720	64,050
Total	219,836	234,063	212,950	230,558

Status of Squid Fisheries in Malaysia

Squid resources play a very important role in the Malaysian national economy. The estimated annual landings of squid (*Loligo spp.*) in the Peninsular Malaysia increased from approximately 9,062 tons in 1982 (Malaysia, 1983) to 13,890 tons in 1993 (Malaysia, 1994), an increase of 53% over a ten year period. It accounts for 2% of the Malaysian total fisheries resources landings. The export value is 123,206,000 US dollars in 1993 (FAO, 1995b).

Three main important species of squid captured by Malaysian fishermen are mitre squid "Sotong Torok or Sotong Ketupat" as is known locally (*Loligo chinensis*), siboga squid "Sotong Jarum" (*Loligo sibogae*) and big fin reef squid "Sotong Mabang" (*Sepioteuthis lessoniana*). Except for big fin reef squid (*Sepioteuthis lessoniana*) which could be found throughout the year, the annual fishing season for squid fisheries is usually from March to September. This period coincides with their spawning season which occurs during those months (Chikuni, 1984).

Squid Fishing Gears in Malaysia

In Malaysia, squid is mainly landed by trawls, squid nets, squid jigs purse seines and traps (Sakri et al., 1995 and Mohd. Noor, 1985). With the exception of trawls, all other gears are usually operated at night time with the use of artificial light onboard of the fishing boat (Ashirin & Ibrahim, 1992).

Bottom trawl or Pukat tunda as is known locally is well known as the most efficient and popular method employed by Malaysian fishermen in many states (Abu Seman, 1980). However, in contrast to other methods it provides a very low quality of squid catch due to their mode of operation. Normally, for the trawling

operation, fishermen will tow the gear from early morning until before sunset. Species caught by this gear is mainly mitre squid (*Loligo chinensis*).

Squid net or Pukat sotong as is known locally is the most advance technique and one of the most popular squid fishing gears in Malaysia especially in the states of Kelantan and Terengganu. The gear is operated only at the night time especially during the moonless night (after or before new moon) by taking advantage of squid response to artificial light. This type of gear provides a very high efficiency for catching squids and can become the most popular method in the near future.

Squid jig or Candat as is known locally is a traditional small scale fishing gear used by fishermen in the states of Terengganu, Kelantan and Pahang. Both artificial and fresh baited jigs are usually employed to capture mainly mitre squid (*Loligo chinensis*) and big fin reef squid (*Sepioteuthis lessoniana*).

Purse seine or Pukat jerut as is known locally is the surrounding gear which utilized the aggregation of target species for capturing. The main target species of this gear is fish, however squid are also caught especially mitre squid (*Loligo chinensis*) and siboga squid (*Loligo sibogae*).

Trap or Bubu is as known locally is a portable fishing gear normally used for capturing big fin reef squid (*Sepioteuthis lessoniana*) and cuttle fish (*Sepia sp.*). They had been initially introduced by fishermen in the states of Kedah, Kelantan and Perlis.

Operation of Squid Nets

The tonnage of boats used for squid net fishing ranges between 15-40 GRT. They are fitted with a 15-30 HP electric generator for lighting 20-40 lamps (400-500 watts) which are installed on both sides of the boat (Plate 1). The lamps serve two functions; to attract squids from the surrounding waters (attracting light system) and to concentrate squids in a small area (controllable light system).

The net used to capture squids is known as "squid held cast net" which is a modification of a simple cast net, but large in size and more complicated in its operational system. The net has a dimension of 8-15 m depth and 5-8 m in diameter. The 2.4 cm mesh size of synthetic fiber is used as the main net with the polyethylene for the bottom salvage and codend.

The typical operational systems of squid net fishing are as follows;

1. The boat will sail to squid fishing ground.
2. Attract squids from wide areas by using attracting lamps.
3. The net will be set up.
4. For 30-40 minutes, the squids will be concentrated to the surface layer by using controllable lamps.
5. For a few minutes, the net will be dropped and haul up onboard.
6. The attracting lamps will be turned on again.
7. The catch will be sorted by size and preserved for a few days.



Plate 1. Squid Netting Boats