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PROPER CONSTRUCTION AND SET UP OF MALAYSIAN FISH AGGREGATING DEVICES (UNJAM)

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PROPER CONSTRUCTION AND SET UP OF MALAYSIAN FISH AGGREGATING DEVICES (UNJAM)

By

SAKRI BIN IBRAHIM

A Thesis Submitted in Fulfilment of the
Requirements for the Degree of Doctor of Philosophy
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This work is dedicated to beloved wife:

Saidah @ Rohani Ibrahim

and sons:

Mohd. Hafizuddin

&

Ahmad Fadhli

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LIST OF ABBREVIATIONS

Wt	=	Weight of Sandbag
T	=	Rope Tension
F	=	Frictional Force
W'	=	Vertical Component of T
K	=	Fixing Coefficient
w	=	Weight of Tension Meter
r	=	Readings Registered on the Balance
t	=	Readings Registered on the Tension Meter
A	=	Total Area of Model Water
m	=	The Cost of Catching a Unit Quantity of Fish (in $)
mF	=	The Cost of an Unjam (in $)
MFAD	=	The Total Cost of All Unjams (in $)
Mo	=	The Basic Cost Incurred for Installing All the Unjams (in $)
C	=	The Number of Fish Caught at the Unjam
NF	=	The Number of Unjams in the Model Water
Ng	=	The Total Quantity of Fish in the Model Water
E	=	The Catching Efficiency
S	=	Area for One Unjam
Se	=	Area of the Effective Range of an Unjam
	=	$\pi(\text{Radius})^2$
k	=	Density Coefficient of Fish Population Defined as k = Ng/A
	=	Quantity of Fish Per Unit Area

W = Width of Model Water

L = Length of Model Water

v = Speed of Water Current

V = Average Cruising Speed of Fish

S = Step-Length of Fish

R = Radius of the Effective Range

Abstract of thesis submitted to the Senate of Universiti Pertanian Malaysia in fulfilment of the requirements for the degree of Doctor of Philosophy.

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July, 1991

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Faculty : Fisheries and Marine Science

This study was carried out with an objective of improving the durability of unjams and determining the rational arrangement and optimum density of unjams. Several experiments were conducted in coastal waters of Terengganu in the South China Sea to determine a safe anchoring power of unjams and parameters required for the development of mathematical models that could produce an optimum trapping efficiency.

Experiments on anchoring power showed sandy bottom giving the highest value of fixing coefficient (0.953), followed by muddy bottom (0.903), and sandy-mud bottom (0.731). This value was found to be higher for two sand-bags tied one behind the other than for two sandbags tied in one lump. The unjam's anchor was found to have a

reserved fixing force of 67.34 kg, which is 93.86% in excess of what was required to anchor an unjam in place.

Utilizing the required parameters; current pattern in the area, effective ranges of the unjams, and fish movement pattern, three mathematical models were developed.

The Linear model was found to be unrealistic and invalid.

The Non-Linear model enables the derivation of optimum catching efficiency graphically. With an area of model water of 30 km x 10 km and two different effective ranges of 0.18 km and 1.6 km, the number of unjams required were found to be 256 and 14 respectively, and the cost of catching a unit quantity of fish, m, was found to be 0.2714/k and 0.003892/k respectively.

The Uni-Directional Random Walk model involved the development of a mathematical model. The results of computer simulations of the model showed that, when the effective range was 0.18 km, 75 unjams were needed with a total trapping probability of 0.272 and a total cost of $19,836. When the effective range was 1.6 km, 27 unjams were needed with a total trapping probability of 0.558 and a total cost of $7,356. The total trapping probability estimated here is found to be fairly high. However, this value could be reduced if a lower percentage of trapping is considered.

Abstrak tesis yang dikemukakan kepada Senat Universiti Pertanian Malaysia sebagai memenuhi keperluan untuk Ijazah Doktor Falsafah.

PEMBINAAN DAN PEMASANGAN WAJAR ALAT PENGUMPULAN IKAN MALAYSIA (UNJAM)

oleh

SAKRI BIN IBRAHIM

Julai, 1991

Penyelia : Profesor Madya Dr. Mohd Azmi Ambak

Fakulti : Perikanan dan Sains Samudra

Kajian ini dijalankan dengan objektif untuk meningkatkan ketahanan unjam dan menentukan penyusunan rasional serta kepadatan optimum unjam. Beberapa ujikaji telah dijalankan di perairan pantai Terengganu di Laut China Selatan untuk menentukan kuasa menyauh yang selamat bagi unjam dan parameter yang diperlukan untuk pembentukan model matematik yang boleh menghasilkan satu kecekapan memerangkap yang optimum.

Ujikaji tentang kuasa penyauh menunjukkan bahawa dasar berpasir memberikan pekali ikatan yang tertinggi (0.953), diikuti oleh dasar berlumpur (0.903), dan dasar pasir-berlumpur (0.731). Nilai ini didapati lebih tinggi bagi dua beg pasir yang diikat satu di belakang yang lain berbanding dengan dua beg pasir yang diikat dalam satu

longgok. Sauh unjam didapati mempunyai daya ikatan simpanan sebanyak 67.34 kg, iaitu 93.86% melebihi daripada apa yang diperlukan untuk menyauh satu unjam.

Dengan menggunakan parameter perlu; corak arus di kawasan kajian, jarak berkesan unjam, dan corak pergerakan ikan, tiga model matematik telak dibentuk.

Model Linear didapati tidak realistik dan tidak sah.

Model Non-Linear membolehkan penghasilan pekali menangkap yang optimum secara grafik. Bagi satu perairan model yang mempunyai keluasan 30 km x 10 km dan dua jarak berkesan yang berlainan iaitu 0.18 km dan 1.6 km, bilangan unjam yang diperlukan didapati sebanyak 256 dan 14 masing-masing, dan kos menangkap satu unit kuantiti ikan, m, didapati sebanyak 0.2714/k dan 0.003892/k masing-masing.

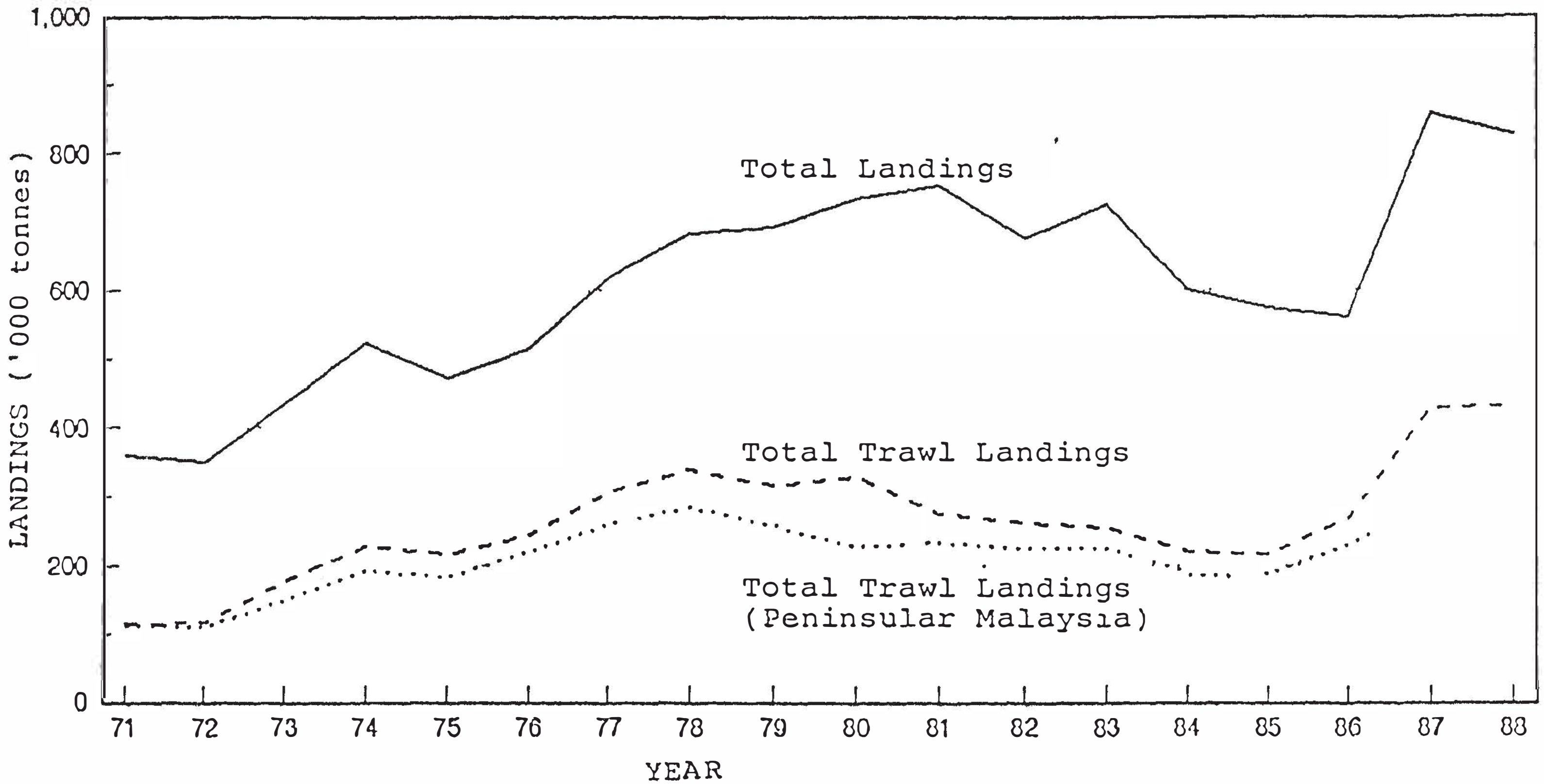
Model Uni-Directional Random Walk melibatkan pembentukan satu model matematik. Keputusan simulasi komputer ke atas model menunjukkan bahawa, apabila jarak berkesan ialah 0.18 km, 75 unjam diperlukan dengan kebarangkalian memerangkap keseluruhan 0.272 dan kos keseluruhan sebanyak $19,836. Apabila jarak berkesan ialah 1.6 km, 27 unjam diperlukan dengan kebarangkalian memerangkap keseluruhan 0.558 dan kos keseluruhan sebanyak $7,356. Nilai kebarangkalian memerangkap keseluruhan yang dianggarkan di sini didapati agak tinggi. Namun begitu, nilai ini boleh dikurangkan jika suatu peratus memerangkap yang lebih rendah diambilkira.

CHAPTER I

INTRODUCTION

Malaysian Fishery

The total marine fish landings in Malaysia from 1971 to 1988 showed a fluctuating pattern (Fig. 1). The total catch peaked in 1981, afterwhich it experienced a downward trend but later, with the introduction of deep-sea fishing programme by the government, it peaked again in 1987. Before the introduction of the deep-sea fishing programme in 1985, fishing operations were mainly restricted to near-shore areas. In the pre-1985 period, the total trawl landings peaked in 1980 and has been experiencing a decreasing trend eversince. Although the total trawl landings has been experiencing a downward trend after 1980, the total marine landings by other gears continued to increase and peaked in 1981. Since then the total catch has been decreasing from 792,354 metric tons in 1981 to 606,044 metric tons in 1986 (FAO Yearbook, 1986). The importance of trawling as a major contributor to the total catch has declined since 1977 when its share was 53.7 percent. In 1983, the share was a modest 37.1 percent (Table 1). In the west coast of Peninsular Malaysia, the trawl catch rates in 1978 was reduced to 1/5 of that in 1970 in the same fishing grounds (Lui, 1981).



(Source: Ministry of Agriculture
Malaysia 1972-1989)

Fig. 1. Total Marine Fish Landings in Malaysia.

The landing contributions of gear groups in Peninsular Malaysia were dominated by trawl nets and purse seines. In 1983, these two dominant gears landed 66.5 percent of the total marine fish landings, while gillnets landed 10.0 percent. Other gears contributed 23.5 percent. The contribution of hook and line gears has increased sharply from 3.3 percent in 1980 to 5.6 percent in 1986. The gaining of importance of hook and lines is probably a result of the installation of Fish Aggregating Devices (FAD) by various government agencies as well as individual fishermen.

In 1988, the total estimated number of fishing gears operated were 22,345 units in Peninsular Malaysia. Gillnets represent the largest group with 10,047 units. Trawls come next with 6,292 units, and 5,153 units (23.06 percent) are unjam-associated fishing gears (Ministry of Agriculture Malaysia, 1989).

Unjam has been utilized traditionally by Malaysian fishermen and many unjams are found installed in coastal waters of Malaysia. In Terengganu, a state located on the east coast of West Malaysia, an average of 300 unjam groups could be found in 200 square nautical miles of coastal waters, and many pelagic and benthic fishes associate with unjams (see Chapter 8).

In Malaysia, the most important unjam-associated fishing gear is the hook and lines. In 1983, there were

2,875 units of the gears contributing to 5.0 percent of the total catch. Other unjam-associated fishing gears are purse seines, bagnets, and liftnets. In terms of the total catch, purse seines led the group by commanding 32.4 percent, with 2,447 units of fishing gears. Then came the bagnets with 2.9 percent of the total catch, and the liftnets, with 2.1 percent of the total catch. With a total of 42.4 percent of total landings, unjam-associated fishing gears are in fact very important in Malaysian fisheries.

Table 1

Marine Fish Landings by Gear Group in 1983 and 1988 (in brackets) for Peninsular Malaysia

Gear Groups	Catch in '000 tons	%of total catch	Estimated no. of gears operated
Trawls	225.70 (394.20)	37.10 (56.76)	6038 (6292)
Purse seines	179.35 (164.35)	29.40 (23.72)	743 (731)
Gillnets	61.10 (43.90)	10.00 (6.32)	10337 (10047)
Shellfish collection	44.36 (1.53)	7.30 (0.22)	1308 (74)
Lines	30.28 (21.79)	5.00 (3.14)	2875 (1764)
Other seines	18.00 (14.31)	3.00 (2.06)	1704 (696)
Bagnets	15.55 (38.26)	2.90 (5.51)	1138 (765)
Traps	15.48 (7.05)	2.50 (1.02)	965 (563)
Liftnets	13.04 (5.23)	2.10 (0.75)	655 (86)
Push/scoop nets	3.70 (2.00)	0.61 (0.29)	490 (659)
Barrier nets	0.81 (1.08)	0.13 (0.16)	104 (288)
Miscellaneous	1.71 (0.34)	0.26 (0.04)	695 (280)
Total	609.06 (694.45)	100.00 (100.00)	27051 (22345)

(Source: Ministry of Agriculture Malaysia, 1984 and 1989)

An Unjam

Fishermen have learned from experience that the best fishing and most desirable fish can be found around flotsams, reefs, and sunken boats in the ocean. FADs are strategically placed at the surface, and on the seabed to attract fish. While there are large variations in its design and material, the traditional FAD is basically one of two types:

a) placed on the bottom, called 'artificial reef',

b) moored with the attracting structure at the water surface and/or midwater, referred to as 'unjam'.

The traditional artificial reefs have been constructed with stones and logs, while modern FADs are of concrete, steel, rubber, and even discarded boats and cars.

The moored types are traditionally moored bamboo rafts or bamboo buoys and referred to by different names in different countries; 'Unjam' in Malaysia, 'Payaw' in the Philippines, 'Rumpon' in Indonesia, and 'Tsukegi' in Japan. They are now partly replaced with synthesized and more durable types and some of them are also anchored in midwater.

The use of moored FADs is based upon the concept that pelagic fishes are attracted to floating objects, much in the same way as reef fishes are attracted to artificial benthic habitats (Uda, 1933; Kimura, 1954; Kojima, 1956;

Inoue et al., 1963, 1968; Gooding, 1965; Gooding and Magnuson, 1967; Greenblatt, 1979).

As a management tool, FADs should be accessible to the target population of fishermen and located in an upwelling zone or along a migratory pathway of fishes. A combination of artificial reefs with FADs could enhance several types of fisheries in the same area. FADs might also be used to shift a fishery closer to market or to a safer location. Landings of migratory pelagic species could be increased by locating FADs in areas where bottom-dwelling fish are exploited, providing an alternative catch to preserve the livelihood of artisanal fishermen (Sainsbury et al., 1988).

Preston (1982) noted that in being anchored in known locations, FADs can improve the economics of a given fishing operation by:

1) reducing time and fuel spent in fish searching;

2) improving catch per unit of effort due to increased vulnerability or availability of the targeted species;

3) improving the value of the catch, in terms of species or size composition, and;

4) serve to increase the safety factor in small scale coastal fishing operations.