MORPHOLOGICAL DESCRIPTION OF FISH EGGS OF TELAGA AIR, SARAWAK

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Bachelor of Science with Honours

(Aquatic Resource Science and Management)

2015

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This project report is submitted in partial fulfilment of the requirement of the Final Year Project II (STF 3015)
(Aquatic Resource Science and Management)

Faculty of Resource Science and Technology
UNIVERSITI MALAYSIA SARAWAK
2015

Declaration

I hereby declare that this thesis entitle "Morphological Description of Fish Eggs of Telaga Air, Sarawak" is based on my original work except for all the sources that has been cited and has been acknowledged in the references section. This thesis also has not been submitted to any other degree at other university or higher education institution.

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Acknowledgement

"In the name of Allah, the most Gracious and the most Merciful"

First and foremost, thanks to Allah for giving me health, patience, strength and capability for me to complete my final year project. I would like to extend many thanks to my supervisor, Dr Siti Akmar Khadijah Ab. Rahim for her guidance, encouragement, critical comment, recommendation, as well as advices throughout accomplishing my final year project. Thank you for responding to my questions and inquiries patiently as I am lacking in many way.

Apart from that, I would like to thank to all post-graduate senior, especially Norhakimi Muhamad who has help me and provide guidance and many valuable suggestion along this semester. Not forgetting my lab mates for sharing their knowledge, experience and supports during this study.

I would also like to say thank you to the Aquatic Department Lab Assistants especially Mr Zaidi, Mr Nazri, Mr Richard and other lab assistants for helping me in various ways and for guidance and assistance too. My appreciation also goes to all lecturers from Aquatic Science Department and other course mates for helping me either directly or indirectly during this project. Last but not least, many thanks to my beloved family especially my mom, when they also provide me with moral support and prayers.

Thank you.

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List of Abbreviation

ANOVA	Analysis of Variance
m	Meter
mm	Milimiter
µm	Micrometer
FE	Fish Eggs

Morphological description of fish eggs of Telaga Air, Sarawak

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ABSTRACT

Study of the fish eggs is also a part of ichthyoplankton study which was conducted at Telaga Air, Kuching Sarawak for six months (24th October 2012 until 26th March 2013). The objectives of this study were to identify the species/ family composition of fish eggs in Telaga Air as well as to document the meristic and morphometric characteristic of fish eggs and lastly to determine the density of eggs (per 100 m^3) according to different stations. The fish eggs samples were collected from 5 stations for each month using the plankton net with 1m diameter and 500 µm mesh size and a flow meter attached to the net's mouth. A total of 2,668 fish eggs were collected. The identified samples comprise 12 families of fish eggs. The most abundant fish eggs collected was Engraulidae (73.58%) and followed by Gerreidae (6.68%). In each station, at least 4 families and the highest were 8 families were identified. The highest number of fish eggs collected was on October 2012 and the least was on February 2013. For morphology of fish eggs, 1,959 were ellipsoidal which belongs to family Engraulidae and the other 709 were spherical that consist of many family.

Keywords: Fish Eggs, Density, Dominant, Shape, Family.

ABSTRAK

Kajian telur ikan merupakan sebahagian daripada kajian iktioplankton yang telah dijalankan di Telaga Air, Kuching Sarawak selama enam bulan (24hb Oktober 2012 hingga 26 Mac 2013). Objektif kajian ini adalah untuk mengenal pasti komposisi spesis / famili telur ikan di Telaga Air dan juga untuk mendokumentasikan ciri meristik dan morphometrik telur ikan dan akhir sekali untuk menentukan kepadatan telur (per 100 m^3) mengikut setiap stesen. Sampel telur ikan dikumpul daripada 5 stesen bagi setiap bulan menggunakan net plankton yang berdiameter1m dengan 500 µm mata jaring dan meter alir diletakkan pada permukaan mulut net. Sebanyak 2,668 telur ikan telah dikumpulkan. Sampel telah dikenal pasti, terdiri daripada 12 famili telur ikan. Telur ikan yang paling banyak diperolehi adalah Engraulidae (73.58%) dan diikuti oleh Gerreidae (6.68%). Di setiap stesen, jumlah minima adalh 4 famili dan yang paling tingg berjumlah 7famili. Bilangan tertinggi telur ikan yang dicatat adalah pada bulan Oktober 2012 dan yang paling minima ialah pada bulan Februari 2013. Bagi morfologi telur ikan, 1,959 adalah elipsoid yang terdiri daripada famili Engraulidae dan selebihnya 709 adalah sferikal yang terdiri daripada banyak famili.

Kata kunci: Ikan Telur, Kepadatan, Dominan, Bentuk. Famili.

1.0 Introduction

Fish eggs are categorised as ichthyoplankton and most pelagic eggs are distributed in or just below the photic zone, for examples within the upper 150 to 200 m of depth (Ahlstrom and Moser, 1976). The fish eggs are passive and drift in the ocean along with the water currents. Out of about 12,000 teleosts, about 9,000 (75%) produce pelagic (buoyant) eggs and the eggs are spawned, fertilized, and float individually (although a few species have floating egg masses), usually near the surface (Miller and Kendall, 2009).

Fish Database of Taiwan (2014), reported that most fish eggs are spherical and their shape and size depend on species. The size of the fish eggs also differs in each mature stage. The identification methods of the fish eggs were usually based on molecular and visually identification. Previous study by Matarese & Sandknop (1984) had identified the fish eggs based on characters such as size and possession of oil globules which are important for all types of eggs; perivitelline space and chorion sculpturing which are more important in pelagic eggs, while in demersal eggs special coatings, chorion thickness, or nature of egg deposition may be more useful.

According to Jeyaseelan (1998), the ichthyoplankton generally are in small sizes which for fish eggs is only 0.5mm and the sizes is depend on the species and stage of development. Studies on the distribution and abundance of the ichthyoplankton provide very important information to the fishery biologist and fishermen regarding spawning locales and seasons, as well as improved understanding of reproductive dynamics (Sanches et al., 1999).

Nguyen (2000), did a study on composition, abundance and distribution of fish eggs in South China Sea; Vietnamese Waters. Corrêa et al. (2011), studied the temporal distribution of fish eggs as well as the correlation between environmental parameters and the abundance of ichthyoplankton species. In Malaysia, there is still lack of study on fish eggs; the data about the diversity of ichthyoplankton are limited to access and beyond this, there is no study that documented the details on the morphology description and identification of fish eggs especially in Sarawak water. Thus, the objective of this study is to identify the species/ family composition of fish eggs in Telaga Air. Besides that, this study also was carried out to document the meristic and morphometric characteristic of fish eggs and lastly to determine the density of eggs (per 100 m^3) according to different station.

2.0 Literature Review

2.1 Fish Eggs

According to Matarese and Sandknop (1984), in both freshwater and marine environments there are wide varieties of egg types that exist among the teleost fishes. The eggs may be found at the open sea (pelagic) and nonadhesive or demersal and either adhesive or not. With aid of a variety of specialized structures they were able to float and attach. Many inshore species have demersal eggs, which are often attached to rocks, shells, or seaweed (Ahlstrom and Moser, 1980). As for pelagic eggs, they freely float in the water column.

2.2 Fish Eggs Study in South China Sea

There was study conducted by Southeast Asian Fisheries Development Center (SEAFDEC) on ichthyoplankton survey in South China Sea. The survey involved Gulf of Thailand and East Coast of Peninsular Malaysia, South China Sea of Western Philippines and South China Sea of Vietnamese Waters and most of study done related to the composition and distribution of fish larvae in South China Sea. Meanwhile, South China Sea of Vietnamese Waters are the only study related to the fish eggs.

Nguyen (2000), did a study on composition, abundance and distribution of fish eggs and fish larvae in South China Sea; Vietnamese Waters. The objectives of his study on fish eggs and larvae (FE - FL) was to identify spawning period and ground of fishes, especially the economical fish species, to serve for fisheries. From the result from his study, the most abundant fish eggs and larvae were Engraulidae, accounted for 8.5% total of eggs and 23.8% total of larvae. According to Nguyen (2000) the abundance of ichthyoplankton is rather relatively high, the distribution occurred mainly in the areas of along the coastal, near estuaries and around the islands.

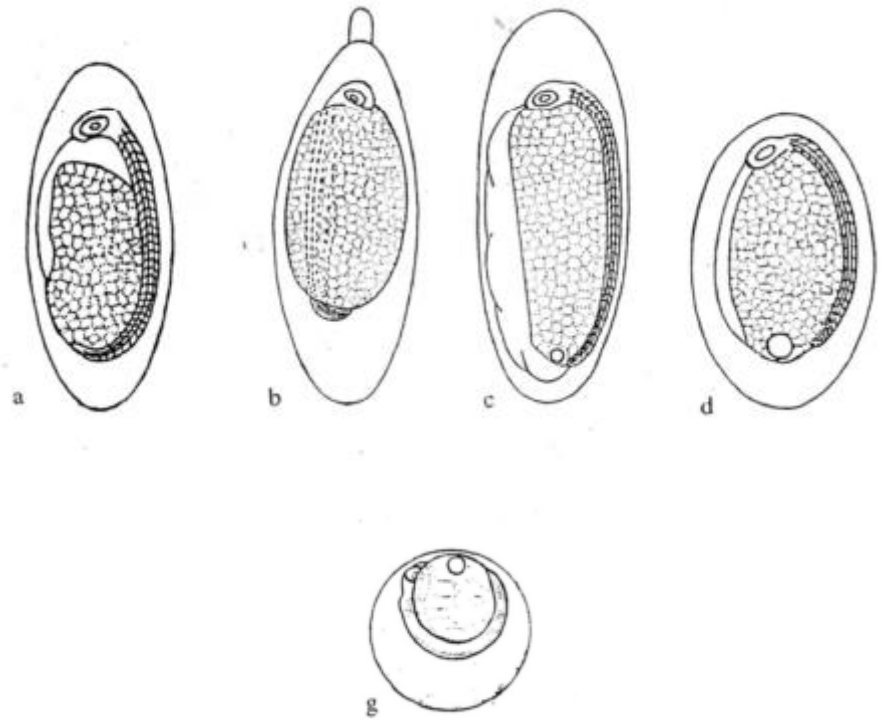

Figure 1: The fish eggs of Engraulidae and Clupeidae; a. Eggs of *Stolephorus zollengeri*, b. Eggs of *S. commersooni*, c. Eggs of *S. heterolobus* sp. and g. Clupeidae (Nguyen, 2000)

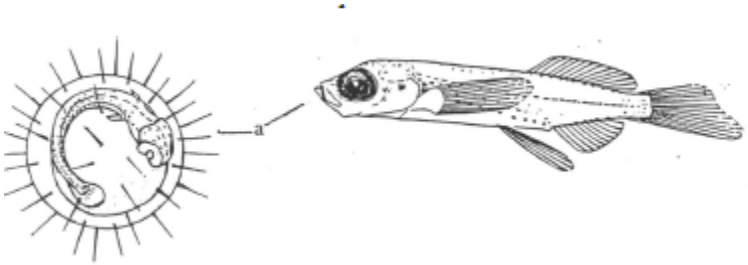

Figure 2: The fish eggs and larvae of Exocoetidae (Nguyen, 2000)

2.3 Characteristic and Structure

The Fish Database of Taiwan stated that the structure of fish eggs from external to internal is egg membrane, perivitelline space, vitelline membrane, and ovoplasm. Figure 3 shows the general structure of fish eggs.

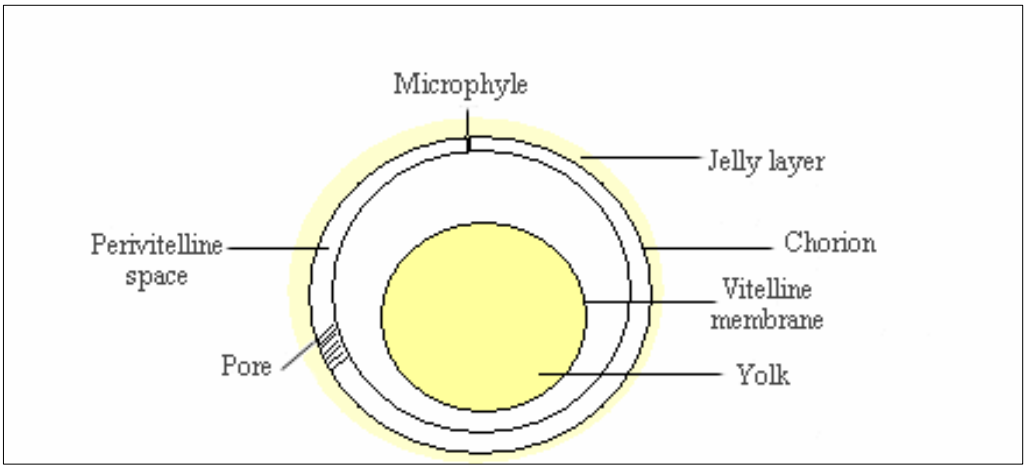

Figure 3: The general structure of fish egg. (Sources: Taiwan Fish Database)

The jelly layer and chorion are parts of egg membrane. The eggs capsule or chorion represent a mechanical barrier and provides protection for the developing egg from external environmental condition (Pelster, 2008). Egg mass includes yolk and nucleus. There are high contains of nutrient in yolk as it important for fish egg embryo development stage. Oil globule, yolk bubble, and yolk are the substances contained in the yolk. In 1980, Ahlstrom and Moser conducted a study in identifying pelagic eggs that are collected on ichthyoplankton surveys for the purpose of determining distribution and spawning biomass of target species and the result they obtained were that planktonic marine fish eggs are usually globular in shape and range in size between 0.5 and 5.5 mm. But the fish eggs also in globular, spherical and elliptical The results also shown that over 40% of the kinds of pelagic eggs are below 1.0 mm in diameter, 30 % are between 1.0 and 1.5 mm, 15 % are between 1.5 and 2.0 mm, and that about 14% are over 2.0 mm in diameter.

2.4 Identification of Fish Eggs

By using the visual method, under the microscope the following morphological characters can be used for identification: (1) egg shape; (2) egg size; (3) thickness and colour of egg membrane or chorion, and special structure on egg membrane surface, and other ornamentation; (4) presence or absence of oil globule, its position, number, colour, size etc.; (5) the size of perivitelline space; (6) colour of yolk, and with bubbles and segments or not; (Matarese & Sandknop, 1984).

Ahlstrom and Moser (1980) stated that characters of importance in identifying pelagic marine fish eggs can be as characters independent of the embryo and characters associated with the developing embryo which include egg shape, egg size, character of chorion, character of yolk, presence or absence of oil globules, and width of perivitelline. In Ahlstrom and Moser (1980) studies, the characters for identification can be summarised as following:

1) *Egg shape* : spherical, globular, ellipsoidal, off-round;
2) *Egg size* : range size 0.5mm to 5.5 mm, majority are in the size range 0.6 mm to 1.6 mm;
3) *Chorion* : ornamented or smooth, striated or wrinkled, types of ornamentation, thickness;
4) *Inner membrane* : presence or absence and location within egg;
5) *Yolk* : segmented or homogenous, nature of segmentation;
6) *Previtteline space* : width;
7) *Oil globules* : number, sizes;
8) *Embryonic characters* : state of development at blastopore closure, changes in pigmentation, and various anatomical

features such as eyes, mouth, fins, digestive tracts, position of anus, and heart.

Although many eggs can be visually identified based on their appearance (size and shape), and the presence of features such as oil globules, this is not possible for all species (Lelièvre et al, 2012).

2.5 Environmental Parameter

Environmental parameters; temperature, water salinity, pH, dissolved oxygen and turbidity might influence the density and abundance of fish eggs.

2.5.1 Temperature and Salinity

An essential aspect of fish reproduction is that eggs and larvae be placed in favourable habitats that will maximise the probability of survival through the planktonic phase (Laprise and Pepin, 1995). Laprise and Pepin (1995) also stated that favourable habitats have been defined by both their biological; high abundance of food, low abundance of predators; and physicochemical characteristics which is suitable salinity-temperature conditions.

Centre for Environment, Fisheries and Aquaculture Science of Lowestoft (2000), on their fish egg development and mortality studies in Irish Sea stated that the absolute temperature change that most eggs can tolerate is roughly the same, plus or minus about 6˚C and in open seas and ocean, it is rarely expected that rapid changes of temperature caused the direct lethality of the fish egg mortality.

The optimum temperature and salinity are varying between the species. From Laprise and Pepin (1995) studies the result shown that in 1990 the highest abundances of all species were associated with the warmest and less saline waters. But in 1991, fish eggs of all species were also associated with the warmest waters but with the most saline waters. Thus, it suggests that temperature was the most important factor explaining the distribution of eggs.

2.5.2 Oxygen Concentration

The dissolved oxygen may also affect the fish eggs. According to Centre for Environment (2000), majority of the pelagic fish eggs drift in the upper water column where oxygen saturation is sufficient to meet the demands of development. The concentration of oxygen is considered as a limiting factor for the successful production of fish eggs.

2.5.3 Turbidity

Maryland Department of Chesapeake Bay Affairs (1964) stated that turbidity and siltation are causing damage and harm to aquatic life and the turbidity may regard as the restriction of light penetration resulting alone from suspended inorganic particulate matter. As citated by Maryland Department of Chesapeake Bay Affairs (1964); according to Wilson (1960) siltation that caused turbidity often cause damage to eggs in spawning gravel by interference with gaseous exchange through the chorion and Jackson (1963) writes that silt that coating the fish eggs caused the eggs suffocates which it keep out the oxygen or by reducing the flow of water-containing oxygen to past through the eggs.

3.0 Materials and Methods

3.1 Source of the fish eggs

The samples were obtained from Telaga Air, Sarawak with five different stations. The coordinates of the sampling sites was recorded by using Global Positioning System (GARMIN GPSmap62s).

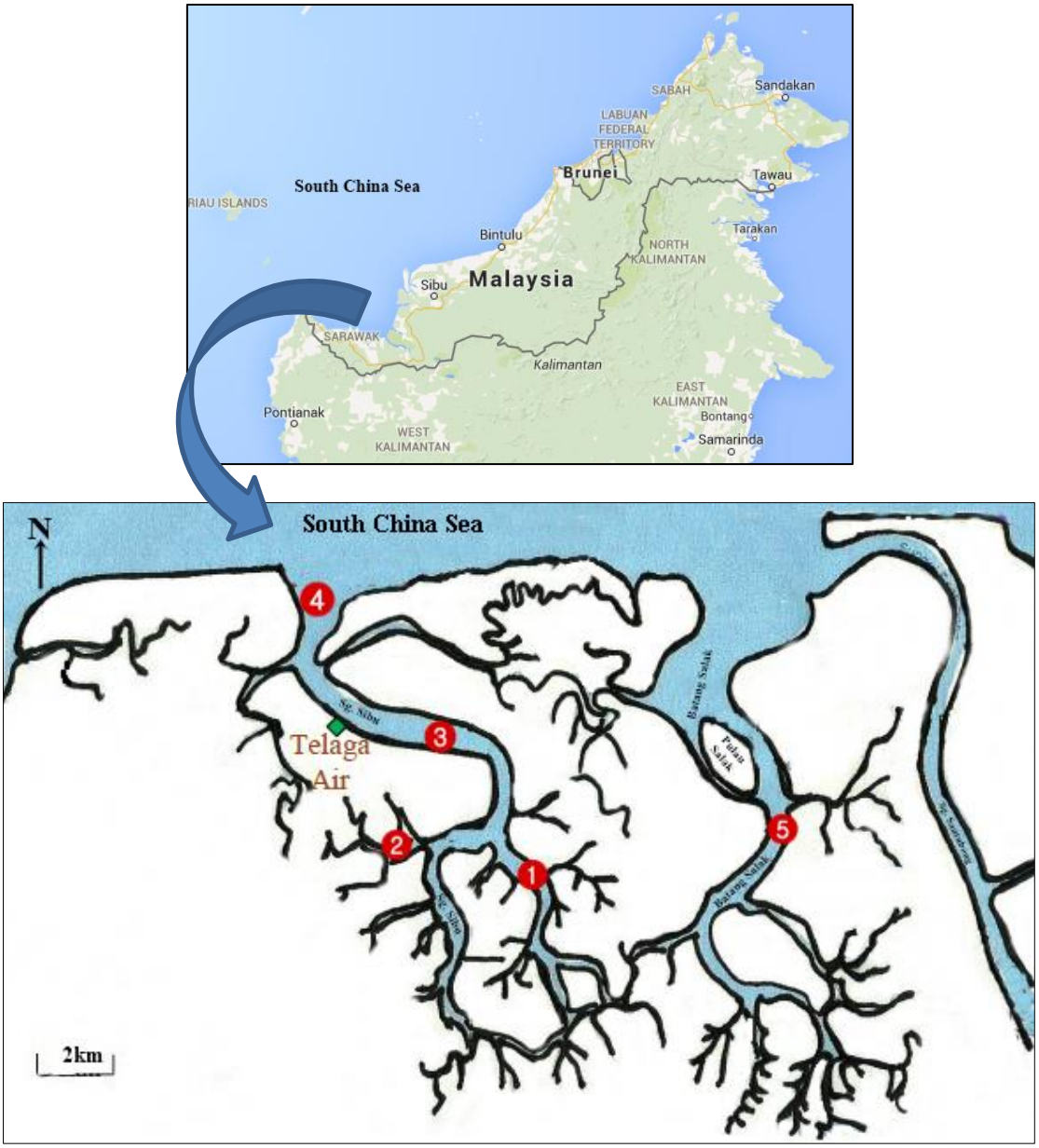

Figure 4: Sampling location for the fish eggs at Telaga Air which comprised of five stations

(● = sampling stations)

The sampling was already conducted for six months which started from 24th October 2012 until 26th March 2013 by post-graduate student, Norhakimi bin Muhamad.

3.2 Field Sampling

3.2.1 Fish Eggs Sampling

At each station, plankton nets with a 1 meter opening diameter, 2 meter length with mesh-size of 500 µm was used. The mouth of the net was attached with a flow meter to calculate the volume of water filtered during sampling. The egg samples obtained were preserved in 10% buffered formalin diluted with seawater and been brought back to laboratory for further processes.

3.2.2 Water Parameter

The parameters of water such as depth, dissolved oxygen, temperature, turbidity, salinity and pH were measured using the appropriate portable apparatus. The measurement of depth was using the depth finder (SPEEDTECH), dissolved oxygen using the D.O meter (EXTECH instrument SDL 150), pH and temperature using pH meter (HANNA Lustmen 212), turbidity using turbidity meter (LT Lutron, TU- 2016) and salinity using the salinity refractometer (ATAGO, MASTER-S/ mill α).

3.3 Laboratory Works

Samples were processed in the Invertebrates Laboratory of Faculty Resources Science and Technology at the Universiti Malaysia Sarawak (UNIMAS).

3.3.1 Sample Processing

The fish eggs were sorted out from the other aquatic organisms such as zooplankton, seaworm, jellyfish and any other debris according to their morphology and sizes. Later, the fish eggs samples were maintained in 10% buffered formalin and stored in small glass bottles labelled according to date, location and station of sample collection prior to identification and measurement of fish eggs. The stereomicroscope was attached with a camera Moticam were used in order to photograph the morphology structure of fish eggs and the diameter of fish eggs was measured using the Moticam ruler. Measurement of the egg size based on egg diameter in millimetre (Usman et al., 2013).

3.3.2 Identification of Fish Egg

The fish eggs were identified to the family level using the appropriate literature based on key identification from Ahlstrom and Moser (1980), Matarese and Sandknop (1984), "Manual of fish eggs and larvae from Asian Mangrove water" by Jeyaseelan (1998) and Okiyama (2014). The total number of individual of fish eggs were counted according to their family. The identification of the fish eggs was done based on their morphological characteristics and diameter.

3.3.3 Density of Fish Eggs

The number of the fish eggs were also counted according to the stations for the density and the volume of 100 m^3 of filtered water was calculated, using the formula as showed below;

Density of fish eggs (per 100m^3):

$$\frac{number\ of\ fish\ eggs}{volume\ of\ water} = \frac{x}{100\ (m^3)}$$

3.4 Data Analysis

3.4.1 Correlation between Water Parameters and Fish Eggs Density

The correlation between the density of fish eggs from each months and water parameter was determined through the Pearson's Correlation Coefficient using GraphPad Prism Version 5.01.

4.0 Results

4.1 Morphology Structure of Fish Eggs

A total of 2,668 totals of fish eggs were collected from October 2012 until March 2013. Figure 5 shows the morphology of fish eggs based on the egg shape, number of oil globule and the segmentation of yolk.

The fish eggs were divided into two different shapes which were ellipsoidal and spherical. Based on the each shape, the fish eggs divided into several categories based on the present of oil globules and the segmentation the egg yolk. The yolk can be segmented or unsegmented and oil globules can range in number from none or one to many.

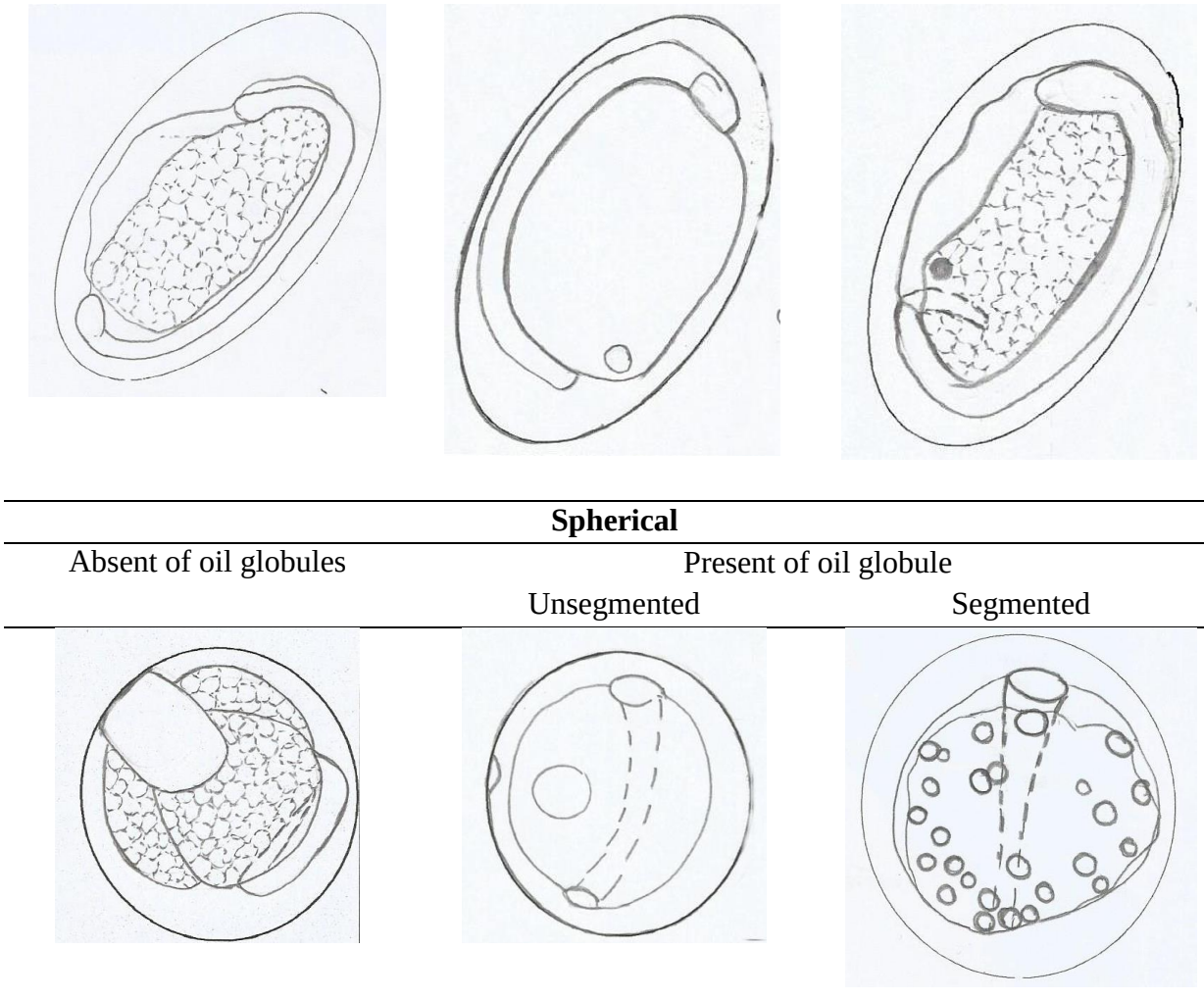

Figure 5: The general morphology structure of fish eggs according to shapes, oil globules and segmentation of yolk.

From the total of 2,668 fish eggs collected, 1,959 were ellipsoidal which belongs to family Engraulidae and the other 709 were spherical that consist of many family. The ellipsoidal shape was all belong to the family Engraulidae. Based on Table 1, the fish eggs of Engraulidae family have different segmentation of yolk and also the absent or present of the oil globules. Clupeidae and Callionymidae family were spherical in shape and they have no oil

globules present. Meanwhile, Sphyraenidae, Cynoglossidae, Gerreidae, Labridae, Soleidae and Mugilidae with the same shape have oil globules in them.

Table 1: The morphology characteristic of fish eggs of each family

Shape	Oil Globule	Yolk	Family	Diameter (mm)
Ellipsoidal	Absent	Unsegmented	-	-
		Segmented	Engraulidae	0.973-1.10
	Present	Segmented	Engraulidae	0.973-1.11
		Unsegmented	Engraulidae	0.973-1.23
Spherical	Absent	Segmented	Callionymidae	0.8
		Unsegmented	Clupeidae	0.68-0.72
	Present	Segmented	Sphyraenidae	0.6
			Cynoglossidae	0.8- 1.11
		Unsegmented	Gerreidae	0.76
			Labridae	0.8
			Soleidae	0.7-0.8
			Mugilidae	1.09

Based on Figure 6(a), (b) and (c), the eggs of Engraulidae are ellipsoidal in shape with the range size of 0.97-1.23mm. Although they are in the same shape, the Engraulidae eggs have different segmentation of yolk and also the present of the oil globule. From figure 6(b) and 6(c) are both of the eggs having one oil globule and the difference is the segmentation of the yolk; (b) the yolk are segmented as there are two different layer of the yolk, (c) unsegmented as it only has one layer.