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Composition, Distribution and Abundance of Fish Eggs and Larvae in the Philippine Pacific Seaboard and Celebes Sea with Focus on Tuna Larvae (Family: Scombridae)

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ABSTRACT

This study covers fish larval survey conducted by the Philippine multi-purpose vessel MV DA-BFAR in the Pacific seaboard and Celebes Sea in May to June 2010. The composition, distribution and abundance of fish eggs and fish larvae are described based on 40 sampling stations. There were 87 families identified and 8.8% of the total samples were *Scombridae* (tunas and mackerels). Of the tunas and mackerels, 39% were yellowfin (*Thunnus albacares),*21% skipjack (*Katsuwonus pelamis*), 15% bigeye (*Thunnus obesus*) and 15% mackerels. Majority of these species were under preflexion stage.

Attempt was also made to compare the composition and distribution of tuna larvae according to four geographical areas(Batanes-Polilio Island, Catanduanes-Eastern Samar, Siargao-Davao, and Mindanao-Celebes Sea).

INTRODUCTION

The Coral Triangle (spanning six countries ,Indonesia, Malaysia, Papua New Guinea, Philippines, Solomon Islands, and Timor-Leste) is the spawning and nursery ground for four principal market tuna species that populate the Western and Central Pacific Ocean (WCPO) – yellowfin (*Thunnus albacares*), albacore (*Thunnus alalunga*) , bigeye (*Thunnus obesus*), and skipjack (*Katsuwonus pelamis*). The WCPO supplies close to 50 per cent of the global tuna catch, representing half of the world's canned tuna and one third of the Japanese sashimi market(http://www.worldwildlife.org).In 2009, the highest ever catch of 2.46 million tonnes was recorded in this area (http://www.spc.int/oceanfish/en/tuna-fisheries).

The Western and Central Pacific Fisheries Commission (WCPFC) has been established to manage tuna fisheries in the WCPO and have issued emergent compatible and management measures for compliance by its member countries and other concerned parties like the Philippines and other non-cooperating countries to the Commission .In the effort to contribute and better manage the tuna resources in the country, the Bureau of Fisheries and Aquatic Resources (BFAR) through its multi-purpose vessel the M/V DA-BFAR, has been conducting series of tuna resources surveys in the Pacific Seaboard to promote the management and optimum utilization of tuna resources within the country's Exclusive Economic Zone.

Previous surveys along the Philippine Pacific Seaboard have indicated its importance as spawning ground of tuna and other fishes.Abundant tuna larvae were observed along the northern portions particularly off Batanes, Cagayan, Isabela and Aurora (Bacordo and Ramiscal, 2006).While the major tuna production areas in the Philippines are the Moro Gulf,Celebes Sea, Sulu Sea and the West Philipppine Sea (Vera and Hipolito,2006),exploratory fishing surveys conducted onboard M/V DA-BFARrevealed good tuna fishing grounds alongEastern Samar,Polilio and Isabela.These findings were supported by favorable water parameters such as high chlorophyll *a* and dissolved oxygen(DO) concentrations (Viron,2006), high values of Nautical Area Scattering Coefficient (NASC) on the northern part of the Philippine Sea and along Northern Bicol Shelf (Tanay,2006),pronounced and wider Mixed Layer Depth (MLD) and thermocline layer observed at Eastern Samar (Osorio,2006).In addition, pelagic longline fishing surveywere carried out along Mindanao Pacific Seaboard (Lat. 8° N to 12°N and Long. 126° E to 128°E) in 2009. Said operations confirmed thethe areas from Eastern Samar to Bislig/Mati as a fishing grounds for large tuna especially bigeye tuna (Yleaña et. al,2009).This finding was favorably supported with physico-chemical and biological parameters such as possible upwelling near Bislig (Ampoyos, 2009),high chlorophyll *a*and dissolved oxygen (DO) concentrations (Viron and Fortaliza, 2009) and relatively high densities of ichthyoplankton (Bacordo et. al,2009). However,the 2009 survey was conducted on the season of northeast monsoon, ina different season from the one undertaken in 2006, the season of southwest monsoon.

This study was undertaken to cover the entire stretch of the Pacific Seaboard and Celebes Sea during the southwest monsoon bydetermining the composition, abundance and distribution of larvae oftuna species to helpin better understanding of tuna speciesbiologyin which appropriate management measurescan be formulated and applied,

In particular, the objective of this paper is to determine the composition, abundance and distribution of fish eggs and larvae, concentrating on tuna larvae in the Pacific Seaboard and Celebes Sea.

MATERIALS AND METHODS

Study Site

Fish larvae samples were collected during one of the expeditions of M/V DA-BFAR in May-June 2010 along Philippine Pacific Seaboard and Celebes Sea. The survey areas was located between Latitudes 6º–20.5º N and Longitudes 123º -128º E for Pacific Seaboard, covering 30 sampling stations while stations located at Celebes Sea between Latitudes 5^0-6^0 N and Longitudes 122^0- 125^0 E covering 10 stations. The stations were arbitrarily grouped based on geographical location to facilitate areal depiction (**Figure 1**). Most of the sampling stations were located offshore with depths exceeding 1000 meters.

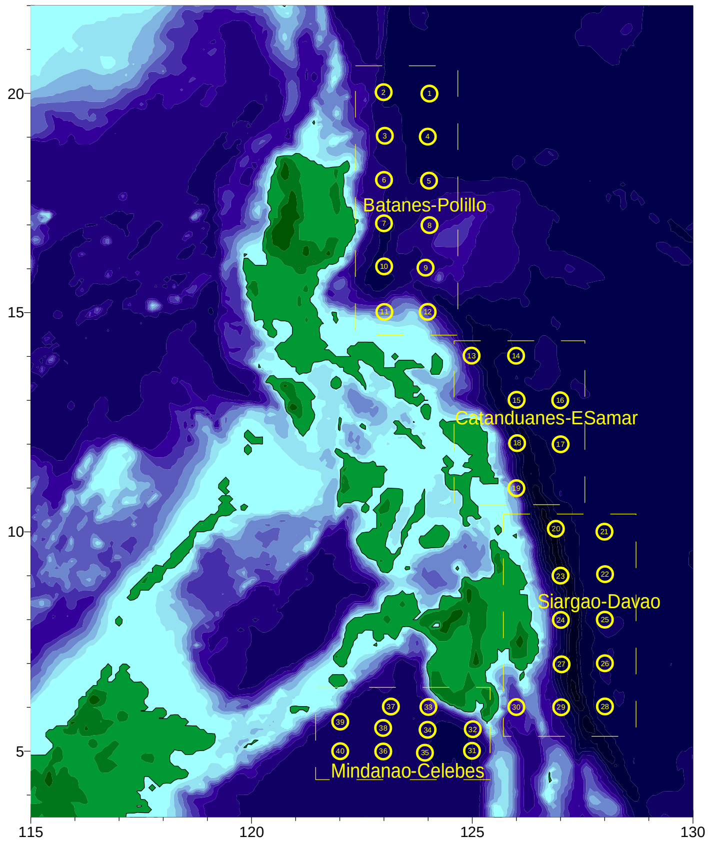


Figure1. Sampling stations and grouping by area

Collection of Samples

Three (3) fish larvae ring netswere used to collectsamplesThe first twonets used hadthe diameter of 50 cm and mesh size of 363 microns, while the third one has a diameter of 70 cm with a mesh size of 500 microns. The first net was used on stations

(1-9), second net on stations (10-19) and the third net to the rest of the stations established. Flowmeters were calibrated accordingly.

At each station, samples were collected three times, namely 1) horizontal surface tow, 25m horizontal to and bounce cast up to 150m (oblique tow). Surface and 25m horizontal tows lasted for 15 minutes and obliqueback tow was done up to 150m depth.Samplings were done while the vessel was moving ahead at approximately 2.5-3.5 knots depending on the current. Samples taken from the larvae net were sieved and placed in labeled 500 ml polyethylene plastic bottles and preserved with 250 ml of 95 % ethanol solution.

Sorting of Samples

During sorting, samples from polyethylene plastic bottle were sieved and washed in running tap water until the odor of preserving solution was minimized. Samples were then scooped using stainless spoon or spatula and placed in a labeled petri dish with the use ofstereo microscope. Fish eggs and fish larvae were sorted and picked using tiny tipped forceps.The number of eggs and larvae according to depth and station were recorded in a log sheet. Samples were then placed in labeled vials and preserved with 70 % ethyl alcohol.

Identification of Samples

Fish larvae samples were analyzed and identified with the aid of stereo microscope. Fish larvae were identified according to Family and species whenever possible. Samples were identified by station and placed in separate glass vial, labeled and preserved with 70% ethyl alcohol.

The total number of larvae and number of each larva identified and the volume of water in all sampling proceduresin every station were computedand converted to itsconcentration (numbers per 1000 m^3 volume) using the formula:

$$\mathbf{T = 1000\ t/V}$$

Where

T is the number of larvae or eggs in the sample per 1000 m^3 seawater volume (number/1000 m^3 seawater volume)

t is number of fish larvae or eggs

V is seawater volume flow through larvae nets (m^3)

Where

$$\mathbf{V = n \times N_1 \times a} \quad \textit{or} \quad \mathbf{a \times n/N}$$

n is the number of revolutions of flow meter during the tow

a is the area of the mouth of the net in square meter = πr^2

N is the calibration factor in number of revolutions of the flow meter per 1 meter (rev/1 m)

N_1 is the calibration factor in meters per revolution for a given flow meter (m/1 rev)

Where **N** or **N_1** derived from calibrated flow meter before and after each sampling trip.

The protocol used in the collection and analysis of samples were based on the FAO "Standard Techniques for Pelagic Fish Eggs and Larva Surveys" by Smith, P.E and S. Richardson , 1977.

RESULTS AND DISCUSSIONS

Fish eggs density and distribution

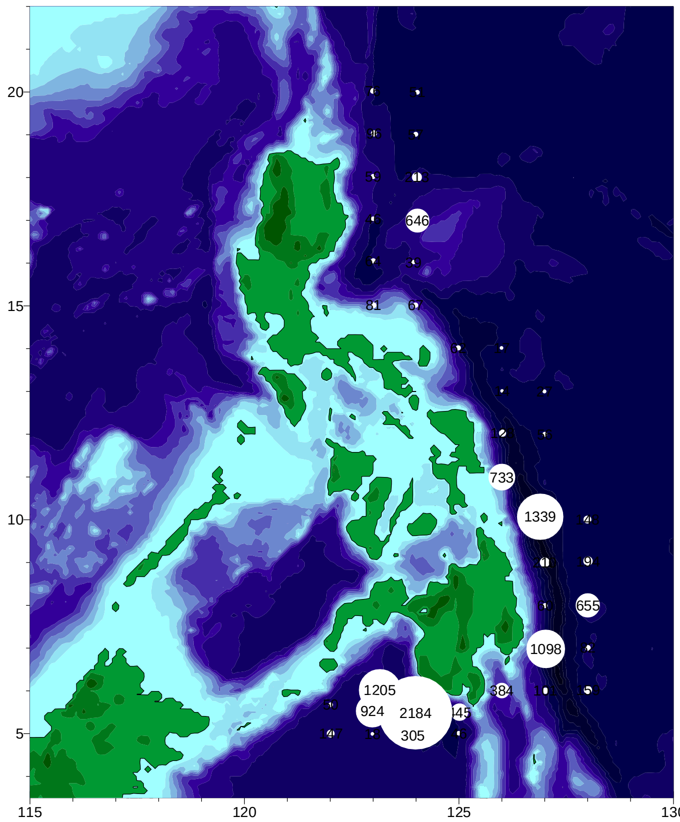


Figure2. Fish egg density (eggs/1000 m³of seawater) and distribution

Fish egg density and distribution is shown in Fig 2. Overall average density was about 360 eggs/1000 m³ of seawater, with higher densities exceeding 1000 eggs/1000 m³seawater observed in stations along the vicinity/edge of Benham Rise, Siargao-Davao and in the central portion of Mindanao Sea (Celebes Sea). Higher average densities for fish eggs were observed in Mindanao-Celebes Sea and Siargao-Davao in terms of regional distribution (Table 1).

Table 1. Average fish egg density by area

Area	Ave. density (# eggs/1000 m³ of seawater)
Batanes_Polillo	125
Catanduanes_Eastern Samar	148
Siargao_Davao	403
Mindanao_Celebes	541
Total	309

Comparative analysis of the distribution of fish eggs in relation to the results of the observed temperature and chlorophyll *a*concentrations of the sampling areas (Ampoyos, 2010 and Viron and Fortaliza, 2010) indicated the relevance of warm water temperatures with the fluctuation of chlorophyll *a*concentrations and occurrence and distribution of fish eggs. Fish eggs were at peaks on areas subjected to warm water temperatures from surface to a depth of atleast100m.

Fish larvae density and distribution

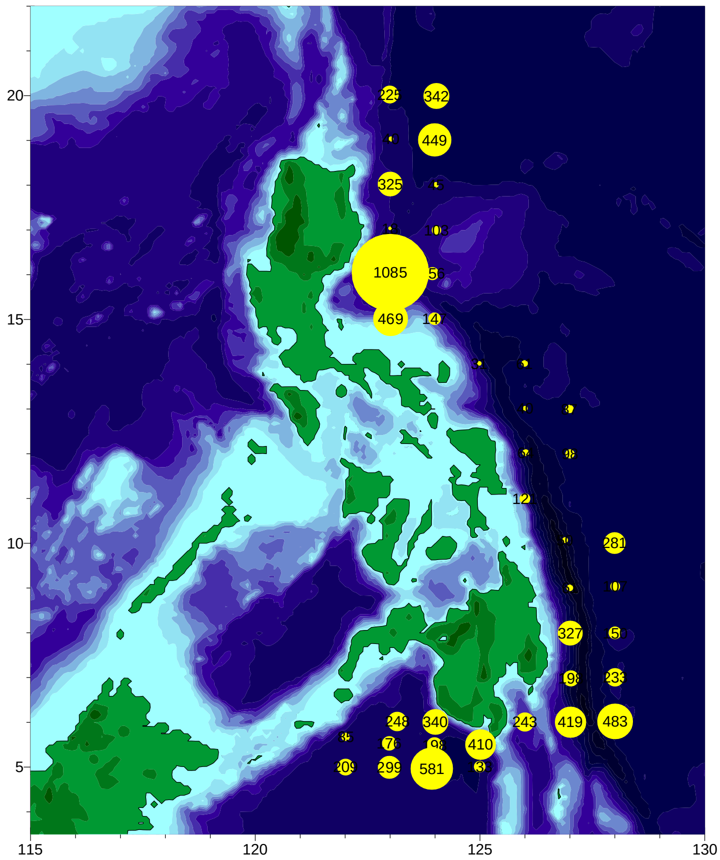


Figure 3. Fish larvae density (larvae/1000 m³of seawater) and distribution

The average fish larvae density for the entire survey area was 325 larvae/1000^m3 of sea water.Fish larvae were noted to accumulate in the vicinities of cold water mass which is divergent on the observed distribution of fish eggs.Mean fish larvae density (568 larvae/1000^m3 seawater) along Batanes-Polillo Island was significantly higher when compared to other areas. Lesser density (126 larvae/1000^m3 seawater) was observed along Catanduanes-Eastern Samar (Fig. 3, Table 2).

Highest fish larvae density (>2000 larvae/1000^m3 seawater) was observed in a station east of Isabela (Fig. 3) and correspondingly withhigh chlorophyll *a* concentration(Viron and Fortaliza, 2010).This finding might be influenced by the transport of water masses in the region where the North Equatorial Current (NEC)bifurcates into two branches at around 13°N (Catanduanes_Eastern Samar). The northward branch forms the Kuroshio Current (KC) while the southern branch flows east of Mindanao as Mindanao Current (MC) (Bingham and Lukas, 1995).These currents are assumed to contribute to the transport and aggregation of the fish larvae in the area.

Table2. Average fish larvae density by area

Area	Ave. density (# larvae/1000 m^3 of seawater)
Batanes_Polillo	284
Catanduanes_Eastern Samar	71
Siargao_Davao	232
Mindanao_Celebes	268
Total	228

Fish larvae composition

A total of 2460 fish larvae were collected from all sampling depths and stations. Identified fish larvae belong to 87 families excluding some unidentified fish larvae. (Appendix 4).The dominant groups were lanternfish (Family *Myctopidae,* 30.9%), bristlemouth/anglemouth fish (*Gonostomatidae*, 11.7%), tunas and mackerels (*Scombridae,* 8.8%), escolar/snake mackerels (*Gempylidae*, 5.3%), wrasses (*Labridae,* 4.3%) and scad/trevally (*Carangidae,* 3.7%), about 1.3% of the samples were unidentified (Fig. 5).

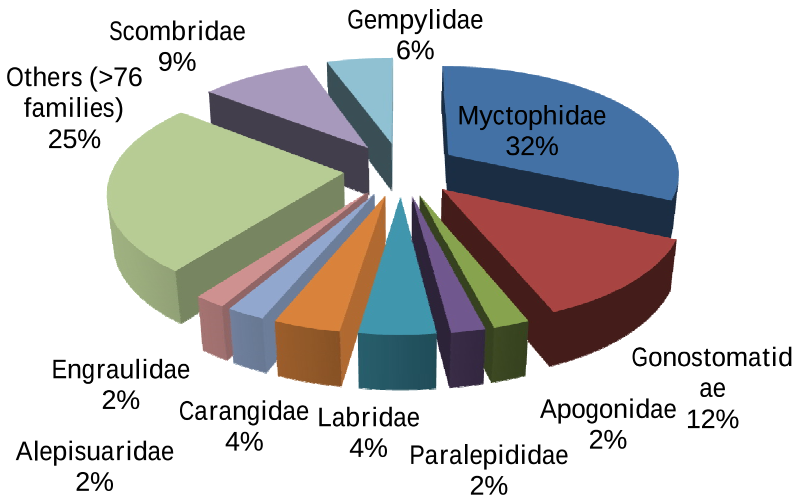


Figure5. Relative composition of fish larvae

Tuna and other Scombrid larvae densityand distribution

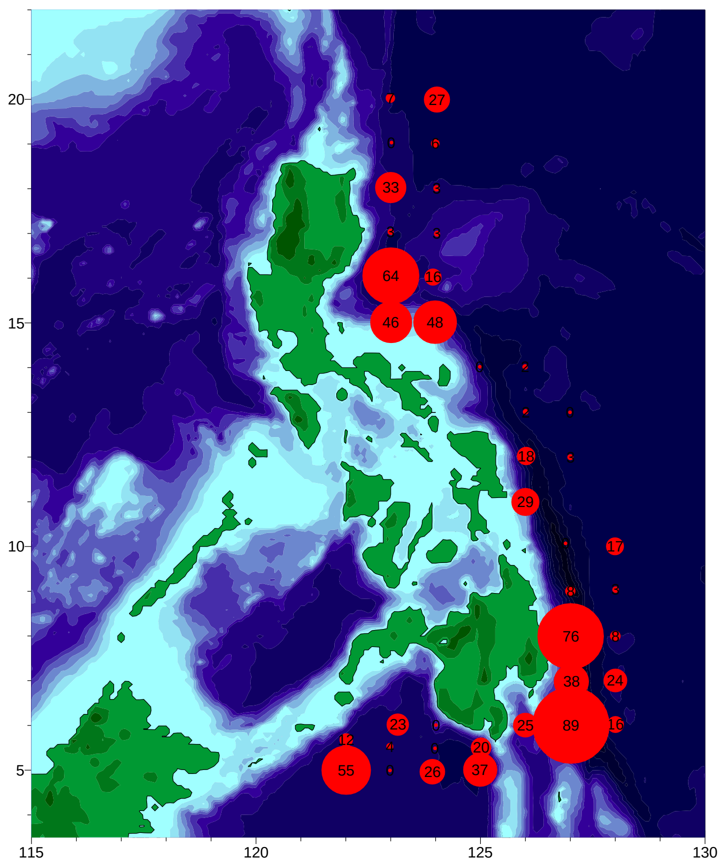


Figure4. Tuna and other scombrid larvae density (larvae/1000 m³of seawater) and distribution

The overall tuna and other scombrid larvae density was computed at 26.66 larvae/1000^m³seawater. Highest density was observed along stations off Isabela, Aurora/Polillo, Surigao and Davao. Mean density was highest in Batanes-Polillo area (44 larvae/1000^m³seawater)compared to the rest of the area (Fig. 4 and Table 3).

Table3. Average density of tuna and other scombrid larvae by area

Area	Ave. density (# larvae/1000 m^3 of seawater)
Batanes_Polillo	21
Catanduanes_Eastern Samar	8
Siargao_Davao	28
Mindanao_Celebes	18
Total	20

Scombrid larvae composition and distribution by area

All in all there were eleven species of tuna and other scombrid larvae identified namely: *Acanthocybium solandri*, *Allothunnus spp.*, *Auxis spp.*, *Euthynnus spp.*, *Gymnosarda unicolor*, *Katsuwonus pelamis*, *Rastrelliger spp.*, *Sarda orientalis*, *Scomber spp.*, *Thunnus albacares* and *Thunnus obesus.*Among the species, yellowfin tuna (39%), skipjack (21%), bigeye (15%) and mackerels (14%) were most dominant (Figure 6).

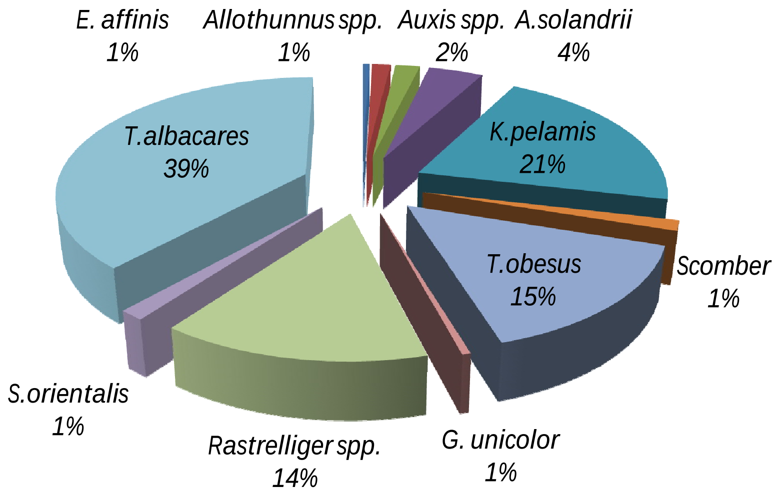
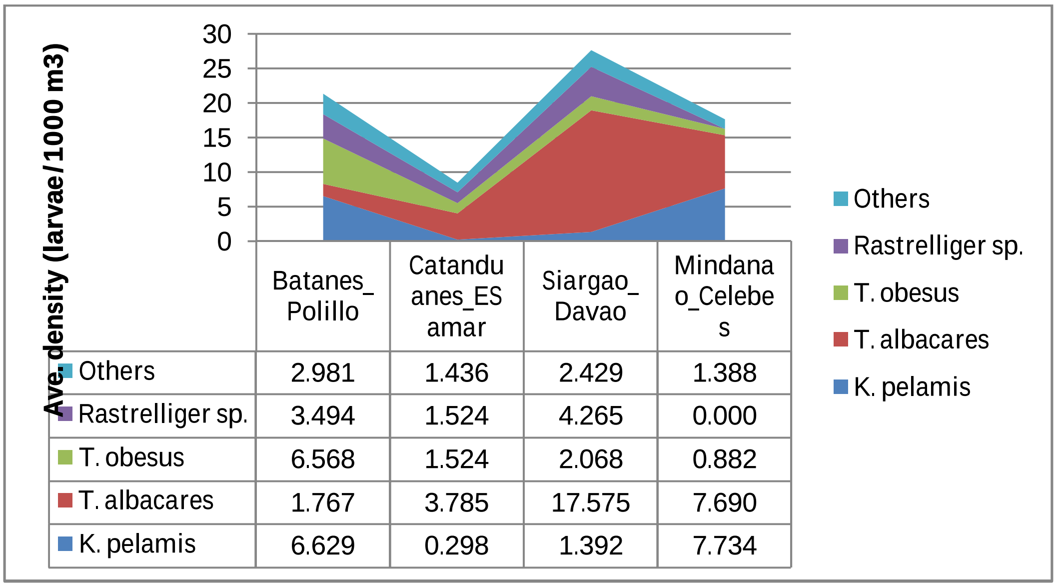


Figure6. Relative percentage composition of tuna and other scombrid larvae

In terms of abundance and distribution, average density of yellowfin was highest in Siargao-Davao (17.5 larvae/1000 m^3seawater) while bigeyeand skipjack were higher larvae along Batanes-Polillo Islandat 13.139 larvae/1000 m^3seawater and (13.262 larvae/1000 m^3seawater) densities respectively.However, relatively high densities of yellowfin larvae and skipjack (~7.7 larvae/1000 m^3seawater) a were also noted at Mindanao-Celebes Sea (Figure 7).



	Batanes_ Polillo	Catanduanes_ESamar	Siargao_ Davao	Mindanao_Celebes
Others	2.981	1.436	2.429	1.388
Rastrelliger sp.	3.494	1.524	4.265	0.000
T. obesus	6.568	1.524	2.068	0.882
T. albacares	1.767	3.785	17.575	7.690
K. pelamis	6.629	0.298	1.392	7.734

Figure7.Average density of Scombrid larvae by area

Developmental life stages of tuna and other Scombrid larvae

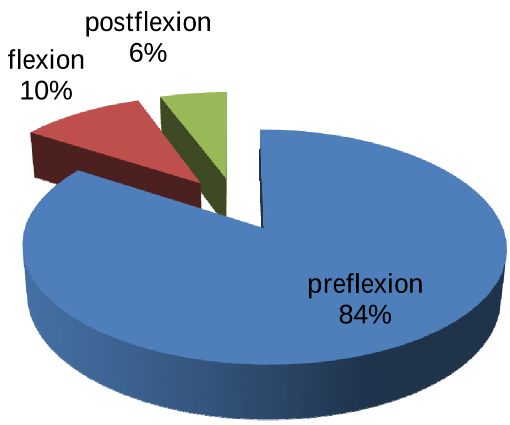


Figure8. Relative composition of the developmental stages of tuna and tuna-like larvae

The relative proportion ofthe three developmental life stages of tuna and other scombrid larvae are depicted in Figures8 and 9.The majority of samples were under preflexion stage with minor portion on flexion and post-flexion stages.It is said that because of the high indeterminate fecundity and batch spawning mode of tunas, they appear to represent a life history pattern characterized by high annual production of larvae and high rates of pre-recruit mortality (Inter-American Tropical Tuna Commission, 2001).The observed low incidence of fish larvae at flexion and post-flexion stages could suggests this high mortality rate taking place as the larvae went through different developmental stages.In fact,estimates of total instantaneous mortality for tuna are among the highestrecorded for marine fish larvae,often exceeding 0.4 day-1 (Davis *et al.,* 1991, Lang *et al.*,1994, and IATTC, 2001).Aside from other factors, cannibalism is believed to be the main cause for their high mortalityas they are preyed upon by zooplankton foragers, such as larger larvae and early juveniles of pelagic fishes (http//: www.fao.org).

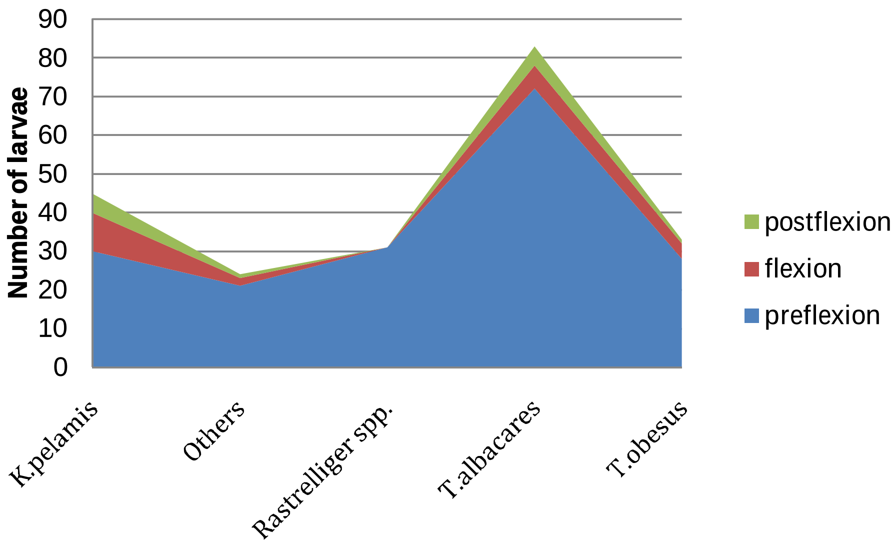


Figure2. Developmental life stages of major tuna species

Further, comparative analysis of the developmental stages of scombrid larvae by area (Figure 10) shows greatest concentration of yellowfin tuna larvae on preflexion stage at Siargao-Davao, followed by Mindanao-Celebes, Catanduanes-Eastern Samar and less extent along Batanes-Polilio area. Bigeye larvae, although found present in all sampling areas, tends tohave greater pre-flexion and flexion stage occurrences along Batanes-Polilio Island.This is also comparable with the distribution of skipjack larvae which might be linked to their biological preferences or mode of spawning.

Typically, bigeye tuna spawned in areas of great biological productivity: near the borders of localized eddies and local seamounts, frontal regions of the equatorial current and the northern branch of the southerly trade current (Rudomiotkina 1983) with larvae frequently found on temperature above 28°C and very rarely below 24°C (Ambrose 1996, Richards, 2006, ICCAT, 2010).Larvae of bullet or frigate tunas (*Auxis spp.*) and skipjack tuna on the other hand, have been collected at sea at temperatures near 22°C (Richards and Simmons, 1971; Boehlert and Mundy, 1994, http://www.freelibrary.com/fishery bulletin, 2007) whilenear-daily spawning of yellowfin tuna was observed to be largely dependent on the occurrence of surface water temperature equal to or greater than 24°C (Schaefer, 1998).

The favorablywarm surface water distribution towards the coast (up to 300m depth) along the northernmost and southernmost stations at Siargao-Davao unaffected bythe dispersion of a cold water mass originating off Surigao (Ampoyos, 2010) may explain the high incidence of yellowfin larvae at preflexion stage in the area and their least incidence along Batanes-Polilio Island.Batanes-Polilio Island revealed erratic water temperature characteristics(warm water distribution at stations off Polilio Island from surface to 100m depth and gradually decreasing temperature from surface to deeper column at stations moving northward off coast (Ampoyos, 2010)which might have intervened with the abundance of yellowfin tuna larvae in this region for they are shown to be sensitive to low water temperatures (Schaefer 1998, 2001; Margulies et al., in press).Nevertheless, the abundance of bigeye and skipjack larvae not only on preflexion stage but also on progressive developmental stages could standtheir tolerance to temperature flux and habit of thriving on areas with great biological productivity.

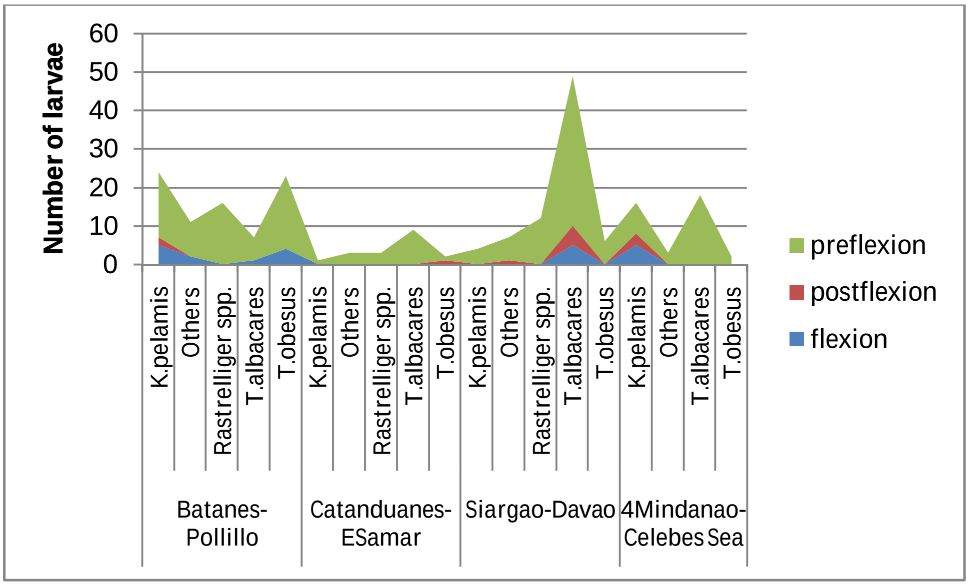


Figure3. Developmental life stages of *Scombrid* species by area

CONCLUSION

Based on the above results, isbe stipulated that the density and distribution of fish eggs and fish larvae in the Pacific Seaboard and Celebes Sea is highly dependent on the hydrological characteristics of the area.The physical properties of water such as temperature,depth and currents that brought about water masses are the driving factors for their occurrence and aggregation.Fish eggs were found to abound in areas subjected to warm water distribution from surface to a depth of atleast 100m while fish larvae generally congregate in the vicinities of cold water mass.

Highest average fish egg density noted along Mindanao-Celebes Sea and Siargao-Davao coincides well with the warm surface water temperature of these areas during sampling that might have triggered the spawning of most marine fishes collected while the high average concentration of fish larvae and scombrid larvae along Batanes-Polilio Island is attributed to the favourable characteristics of this area such as highest chlorophyll *a* and dissolved oxygen (DO) concentrations and suspected upwelling off Batanes indicative of high biological productivity.

As per geographical areas ofdistribution of tuna larvae, Siargao-Davao and Mindanao-Celebes proved to be the major spawning grounds for yellowfin tuna, Batanes-Polilio Island for bigeye and skipjack and Mindanao-Celebes Sea for skipjack tuna.

The abundance of these valuable tuna species (yellowfin tuna, skipjack and bigeye tuna) during sampling couldconfirm the spawning season for these species and the notion thatthe Philippine's Exclusive Economic Zoneis the spawningand nursery ground of these highly migratory stocks.

RECOMMENDATION

1. A comparative study for another season (northeast monsoon) shallbe undertaken to determine the seasonalityand the effects of different seasons in the abundance and distribution of fish eggs and fish larvae, specifically on Scombrid larvae.
2. Intensive management and conservation measures should be formulated through a Fisheries Administrative Order (FAO) for subsequent implementation along Batanes-Polilio Island considering its importance as spawning/nursery ground forvarious marine fishes particularly bigeye tuna.
3. Fishery resource and conservation management measurethrough formulation of FAO for yellowfin tuna along Siargao-Davao isrecommended.
4. There is also a need to expandsurvey in other areas particularly non-traditional tuna fishing grounds.

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http//: www.fao.org

Appendix 1. Operational data, surface tow

Appendix 2. Operational data, 25 horizontal tow

Appendix 3. Operational data, Oblique Tow (150m)

Appendix 4. List of identified fish larvae by family

Family	Count	%
Myctophidae	759	30.9
Gonostomatidae	288	11.7
Scombridae	216	8.8
Gempylidae	130	5.3
Labridae	105	4.3
Carangidae	92	3.7
Alepisuaridae	53	2.2
Apogonidae	50	2.0

Paralepididae	47	1.9
Engraulidae	44	1.8
Lutjanidae	38	1.5
Phosichtyidae	37	1.5
Unidentified	33	1.3
Bathylaginae	30	1.2
Microdesmidae	30	1.2
Serranidae	29	1.2
Holocentridae	26	1.1
Scaridae	26	1.1
Acanthuridae	24	1.0
Bregmacerotidae	23	0.9
Platycephalidae	22	0.9
Coryphaenidae	20	0.8
Schindleriidae	18	0.7
Monacanthidae	17	0.7
Sphyraenidae	17	0.7
Trichuiridae	16	0.7
Scorphaenidae	15	0.6
Clupeidae	14	0.6
Hemiramphidae	13	0.5
Lethrinidae	13	0.5
Creediidae	12	0.5
Istiophoridae	12	0.5
Nomeidae	12	0.5
Sillaginidae	11	0.4
Bramidae	10	0.4
Chlorophthamidae	10	0.4
Melanostomiidae	10	0.4
Blenniidae	9	0.4
Exocoetidae	9	0.4
Mullidae	9	0.4
Nemipteridae	9	0.4
Synodontidae	9	0.4
Congridae	6	0.2
Gobiidae	5	0.2
Trichonotidae	5	0.2
Antennariidae	4	0.2
Bothidae	4	0.2
Callionymidae	4	0.2
Chanidae	4	0.2
Ogcocephalidae	4	0.2
Percopidae	4	0.2
Balistidae	3	0.1

Echeinidae	3	0.1
Pomacentridae	3	0.1
Xiphiidae	3	0.1
Caproidae	2	0.1
Diodontidae	2	0.1
Gobiesocidae	2	0.1
Leiognathidae	2	0.1
Menidae	2	0.1
Priacanthidae	2	0.1
Rachycentridae	2	0.1
Tetraodontidae	2	0.1
Acropomtidae	1	0.0
Atheniridae	1	0.0
Belonidae	1	0.0
Chaetodontidae	1	0.0
Cirrhitidae	1	0.0
Citharidae	1	0.0
Dactylopteydae	1	0.0
Eleotrididae	1	0.0
Gadidae	1	0.0
Haemulidae	1	0.0
Idiacanthidae	1	0.0
Ipnopidae	1	0.0
Lobotidae	1	0.0
Malacanthidae	1	0.0
Molidae	1	0.0
Mugilidae	1	0.0
Muraenidae	1	0.0
Ophichthidae	1	0.0
Ophidiidae	1	0.0
Ostraciidae	1	0.0
Percophidae	1	0.0
Pomacanthidae	1	0.0
Stomiidae	1	0.0
Toxotidae	1	0.0
Tripterygiidae	1	0.0
Grand Total	2460	100.0

Appendix 5. Tuna and Other Scombrid Larvae by developmental stages

Area	Stn.#	Depth	Family	Species	Stages	Count
Batanes-Polilio	1	surf	Scombridae	*T.obesus*	flexion	1
Batanes-Polilio	1	surf	Scombridae	*T.obesus*	preflexion	1
Batanes-Polilio	1	surf	Scombridae	*T.albacares*	preflexion	1
Batanes-Polilio	1	25m	Scombridae	*T.albacares*	preflexion	1
Batanes-Polilio	1	25m	Scombridae	*T.obesus*	preflexion	3
Batanes-Polilio	1	150m	Scombridae	*A.solandrii*	preflexion	1
Batanes-Polilio	2	surf	Scombridae	*Rastrelliger spp.*	preflexion	3
Batanes-Polilio	4	surf	Scombridae	*T.obesus*	preflexion	1
Batanes-Polilio	4	surf	Scombridae	*Scomber*	preflexion	1
Batanes-Polilio	5	surf	Scombridae	*A.solandrii*	preflexion	1
Batanes-Polilio	6	surf	Scombridae	*T.obesus*	flexion	1
Batanes-Polilio	6	surf	Scombridae	*Auxis spp.*	flexion	1
Batanes-Polilio	6	25m	Scombridae	*K.pelamis*	preflexion	4
Batanes-Polilio	6	25m	Scombridae	*Auxis spp.*	preflexion	1
Batanes-Polilio	6	150m	Scombridae	*T.obesus*	preflexion	1
Batanes-Polilio	6	150m	Scombridae	*T.albacares*	flexion	1
Batanes-Polilio	7	25m	Scombridae	*T.obesus*	preflexion	1
Batanes-Polilio	8	surf	Scombridae	*Rastrelliger spp.*	preflexion	1
Batanes-Polilio	9	surf	Scombridae	*K.pelamis*	preflexion	1
Batanes-Polilio	9	surf	Scombridae	*K.pelamis*	postflexion	1
Batanes-Polilio	9	surf	Scombridae	*K.pelamis*	flexion	1
Batanes-Polilio	9	25m	Scombridae	*K.pelamis*	flexion	2
Batanes-Polilio	10	surf	Scombridae	*S.orientalis*	preflexion	1
Batanes-Polilio	10	25m	Scombridae	*K.pelamis*	preflexion	5
Batanes-Polilio	10	25m	Scombridae	*K.pelamis*	postflexion	1
Batanes-Polilio	10	25m	Scombridae	*T.obesus*	flexion	1
Batanes-Polilio	10	25m	Scombridae	*T.obesus*	preflexion	3
Batanes-Polilio	10	150m	Scombridae	*T.obesus*	preflexion	3
Batanes-Polilio	10	150m	Scombridae	*T.obesus*	flexion	1
Batanes-Polilio	10	150m	Scombridae	*Auxis spp.*	preflexion	1
Batanes-Polilio	11	surf	Scombridae	*T.albacares*	preflexion	1
Batanes-Polilio	11	surf	Scombridae	*T.obesus*	preflexion	4
Batanes-Polilio	11	surf	Scombridae	*K.pelamis*	flexion	2
Batanes-Polilio	11	surf	Scombridae	*K.pelamis*	preflexion	2
Batanes-Polilio	11	surf	Scombridae	*Allothunnus spp.*	preflexion	1
Batanes-Polilio	11	25m	Scombridae	*K.pelamis*	preflexion	3
Batanes-Polilio	11	150m	Scombridae	*T.obesus*	preflexion	2
Batanes-Polilio	11	150m	Scombridae	*K.pelamis*	preflexion	2

Batanes-Polilio	12	surf	Scombridae	*A.solandrii*	preflexion	1
Batanes-Polilio	12	surf	Scombridae	*Allothunnus spp.*	preflexion	1
Batanes-Polilio	12	surf	Scombridae	*Rastrelliger spp.*	preflexion	1
Batanes-Polilio	12	25m	Scombridae	*A.solandrii*	flexion	1
Batanes-Polilio	12	150m	Scombridae	*T.albacares*	preflexion	3
Batanes-Polilio	12	150m	Scombridae	*Rastrelliger spp.*	preflexion	11
Total						**81**
Catanduanes-E.Samar	14	25m	Scombridae	*K.pelamis*	preflexion	1
Catanduanes-E.Samar	15	25m	Scombridae	*T.obesus*	preflexion	1
Catanduanes-E.Samar	17	25m	Scombridae	*T.obesus*	postflexion	1
Catanduanes-E.Samar	18	surf	Scombridae	*A.solandrii*	preflexion	1
Catanduanes-E.Samar	18	surf	Scombridae	*Rastrelliger spp.*	preflexion	3
Catanduanes-E.Samar	18	150m	Scombridae	*A.solandrii*	preflexion	1
Catanduanes-E.Samar	19	surf	Scombridae	*A.solandrii*	preflexion	1
Catanduanes-E.Samar	19	surf	Scombridae	*T.albacares*	preflexion	9
Total						**18**
Siargao-Davao	21	surf	Scombridae	*T.albacares*	preflexion	1
Siargao-Davao	21	25m	Scombridae	*K.pelamis*	preflexion	2
Siargao-Davao	21	25m	Scombridae	*T.obesus*	preflexion	1
Siargao-Davao	21	150m	Scombridae	*T.albacares*	preflexion	1
Siargao-Davao	22	150m	Scombridae	*Euthynnus affinis*	postflexion	1
Siargao-Davao	23	surf	Scombridae	*T.albacares*	preflexion	2
Siargao-Davao	24	surf	Scombridae	*T.albacares*	preflexion	1
Siargao-Davao	24	surf	Scombridae	*T.albacares*	flexion	1
Siargao-Davao	24	25m	Scombridae	*T.albacares*	preflexion	6
Siargao-Davao	24	25m	Scombridae	*Rastrelliger spp.*	preflexion	11
Siargao-Davao	25	surf	Scombridae	*Scomber*	preflexion	2
Siargao-Davao	26	surf	Scombridae	*T.albacares*	flexion	1
Siargao-Davao	26	surf	Scombridae	*Rastrelliger spp.*	preflexion	1
Siargao-Davao	26	25m	Scombridae	*T.albacares*	postflexion	3
Siargao-Davao	26	25m	Scombridae	*T.albacares*	preflexion	2
Siargao-Davao	26	150m	Scombridae	*T.obesus*	preflexion	1
Siargao-Davao	27	surf	Scombridae	*T.obesus*	preflexion	1
Siargao-Davao	27	surf	Scombridae	*T.albacares*	preflexion	2
Siargao-Davao	27	surf	Scombridae	*T.albacares*	flexion	2
Siargao-Davao	27	25m	Scombridae	*K.pelamis*	preflexion	2
Siargao-Davao	27	25m	Scombridae	*T.obesus*	preflexion	2
Siargao-Davao	28	25m	Scombridae	*T.albacares*	flexion	1
Siargao-Davao	28	25m	Scombridae	*T.albacares*	preflexion	2
Siargao-Davao	29	surf	Scombridae	*T.albacares*	preflexion	6
Siargao-Davao	29	25m	Scombridae	*T.albacares*	postflexion	2
Siargao-Davao	29	25m	Scombridae	*T.albacares*	preflexion	13

Siargao-Davao	29	150m	Scombridae	*Auxis spp.*	preflexion	1
Siargao-Davao	30	surf	Scombridae	*A.solandrii*	preflexion	2
Siargao-Davao	30	surf	Scombridae	*T.albacares*	preflexion	3
Siargao-Davao	30	surf	Scombridae	*T.obesus*	preflexion	1
Siargao-Davao	30	150m	Scombridae	*S.orientalis*	preflexion	1
Total						**78**
Celebes Sea	31	surf	Scombridae	*T.albacares*	preflexion	1
Celebes Sea	31	25m	Scombridae	*T.albacares*	preflexion	7
Celebes Sea	32	surf	Scombridae	*K.pelamis*	preflexion	1
Celebes Sea	32	150m	Scombridae	*T.obesus*	preflexion	1
Celebes Sea	32	150m	Scombridae	*Gymnosarda unicolor*	preflexion	1
Celebes Sea	32	150m	Scombridae	*S.orientalis*	preflexion	1
Celebes Sea	35	surf	Scombridae	*T.albacares*	preflexion	2
Celebes Sea	35	25m	Scombridae	*K.pelamis*	postflexion	3
Celebes Sea	35	25m	Scombridae	*T.albacares*	preflexion	2
Celebes Sea	37	25m	Scombridae	*Allothunnus spp.*	preflexion	1
Celebes Sea	37	25m	Scombridae	*K.pelamis*	preflexion	4
Celebes Sea	37	25m	Scombridae	*T.obesus*	preflexion	1
Celebes Sea	38	surf	Scombridae	*T.albacares*	preflexion	1
Celebes Sea	39	surf	Scombridae	*T.albacares*	preflexion	2
Celebes Sea	39	surf	Scombridae	*K.pelamis*	preflexion	1
Celebes Sea	39	25m	Scombridae	*T.albacares*	preflexion	1
Celebes Sea	40	25m	Scombridae	*T.albacares*	preflexion	2
Celebes Sea	40	25m	Scombridae	*K.pelamis*	preflexion	2
Celebes Sea	40	25m	Scombridae	*K.pelamis*	flexion	5
Total						**39**