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IDENTIFICATION OF EGGS AND LARVAE

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History of identification of fish eggs and larvae:

Towards the end of the 19th century Marine Biologists, Holt and Scott (1898) M'Intosh and Masterman (1897), Cunningham (1897) and E hrenbaum (1905-1909) succeeded in describing the eggs and larvae of a large number of marine teleostean fishes in European waters. The Danish scientists, Schmidt (1904-1918) and Petersen (1892-1919) described several postlarval stages of demersal fishes. These efforts were supplemented by Clark (1920), Ford (1920-1931) and Lebour (1919-1927) at Plymouth. The prolific contributions of Japanese workers as well as those from USSR and Germany have not been freely accessible to Indian workers either due to language problems or for other reasons. However the contributions of Mito (1960) Ueyanagi (1959-63), Matsumoto (1958, 1959) Nakamura (1951, 1956) etc. are now well known to specialists working in the field. Likewise, the works of the Russian author Gorbunova (1963-1967) are also fairly well documented in English language.

The results of earlier workers showed that all marine food fishes except the herring and the capelin have pelagic eggs. The sand eels (Ammodytes) too are found to have demersal eggs.

Eggs and larval studies of marine fishes in Indian waters:

Studies on the natural history of marine fishes in India were pioneered by the erstwhile Madras Presidency

Fisheries Department (Hornell, 1910, 1922, Nayudu, 1922, Hornell and Nayudu, 1924). Several contributions to the knowledge of eggs and larvae of different commercial fishes were also made by the above Department in later years (John, 1939, Devanesan and John, 1940, 1941, Devanesan and Varadarajan 1942, Devanesan, 1943, Devanesan and Chacko, 1944, Chidambaram, 1943, Chidambaram and Venkataraman, 1946, Jacob, 1949, Chacko, 1950, 1954, Chacko and Mathew, 1955, Chacko and Gnanamekhalai, 1963).

Maritime Universities like Madras, Bombay and Travancore (erstwhile) also contributed to the studies on fish eggs and larval taxonomy (Aiyar 1935, Jones, 1937, Panikkar and Aiyar 1939, Panikkar and Nair, 1945, Nair, 1952, John. 1951, Vijayaraghavan, 1957, 1959, Kuthalingam, 1957, 1958, 1959, 1960, 1961, Bal and Pradhan, 1945, 1946, 1947, 1951, Menon, 1945 and Gopinath, 1942, 1946, 1950).

Recent studies at the Department of Marine Science, University of Kerala, Cochin have resulted in a number of contributions on the fish eggs and larvae of the southwest coast of India (Balakrishnan, 1959, 1961, 1963, 1969, 1971, Balakrishnan and Devi, 1974, Dileep, 1977, Premalatha, 1977, Sreekumari, 1977). Likewise, Andhra and Annamalai Universities also took up similar studies on the east coast (Ganapathi and Raju, 1961, 1963, Ganapathi and Rao, 1962, Dutt 1966, Rao, 1963, Raju and Ganapathi, 1949, Balasubramanyan, 1973, Balasubramanyan et al. 1969. Venkataramanujam and Ramamurthi 1974, 1977).

With the establishment of the Central Marine Fisheries and the Central Inland Fisheries Research Institute in 1947, studies on eggs and larvae were taken up as a regular programmes resulting in a number of publications (Jones and Menon 1950, 1951, 1952, 1953, Pantalu and Jones, 1951, Jones and Pantalu, 1958, Jones, 1958-1967, Jones and Kumaran, 1963, 1964, Sarojini and Malhotra, 1952, Karamchandani and Motwani, 1952,Balakrishan,

1957, Kuthalingam, 1960. Bapat and Prasad, 1952, Bapat, 1955, Nair, 1948, 1952, 1959, 1961, Nair and Mohamed 1961, Rao, 1964, Subrahmanyam 1964, 1968, Chandra, 1964, James, 1967, Kotwal, 1967, Balakrishnan and Rao, 1971, Bensam, 1968, 1969, 1971, 1973, Gupta, 1972, Achari and Vincent, 1972, Vijayaraghavan, 1973, Girijavallabhan and Gnanamuthu, 1974, Silas and George 1971, Silas, 1974). Eggs, larvae and juveniles of several species like Sardinella longiceps, S. fimbriata, S. gibbosa, Kowala coval, Rastrelliger kanagurta, Scomberomorus spp., Auxis sp., Katsuwonus pelamis, Thunnus albacares, Euthynnus affinis, Xiphias gladius, Caranx kalla, Gempylus serpens, Stolephorus spp., Myripristis murdjan. Holocentrous sp., Dactyloptena orientalis and the eels have been the subject of studies by the above authors. While these efforts have been localised and generally taxonomy oriented they have resulted in a number of contributions on the life-history and spawning of several commercial species.

Delsman (1922-'38) in his series of publications on the fish eggs and larvae from the Java sea, contributed a wealth of information on the taxonomy of eggs and larvae of a number of species relevant also to the Indian region. A concerted effort to collect marine ichthyoplankton from a wider area, particularly off the west coast of India using ocean going research vessels was made since late fifties by the Central Marine Fisheries Research Institute, in collaboration with the erstwhile Indo-Norwegian Project using the research vessels 'Kalava' and 'Varuna' (Jones 1967). This has led to the collection of several eggs and larval samples from the shelf waters of the SW coast

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For full references cited in page 2 & 3 also refer "An annotated bibliography on the breeding habits and development of fishes of Indian region" Bull.No.3 CMFRI (Jones & Bensam, 1968).

and the Laccadives archipelago. These materials have been used by and large for qualitative studies and also to indicate the spawning grounds, mainly of tunas, (Jones, 1958-1967). Jones and Kumaran (1963, 1964 a) based on Dana Expedition (1928-30) material from the Indian ocean gave an account of the distribution of tuna and billfish larvae in the area. Available information on eggs, larvae and juveniles of Indian scombroid fishes have also been compiled by these authors (Jones and Kumaran, 1964).

Identification of fish eggs:

Identification of fish eggs or larvae will be easier if the parents of the spawn products are already known. However in most cases this is not the case and we have to deal with planktonic material. In such a situation the only way is to apply certain salient sets of characters to a series of different stages of growth and connect them to juvenile stage. Comparison and linking wherever possible with past records of stages of the material will also help in arriving at the identities. M'Intosh and Masterman (1897) Hock and Ehrenbaum (1911), Simpson (1956) gave identifying clues for several fish eggs. Hiemstra (1962) developed a correlation table for identifying pelagic eggs.

A review on the early life histories of Clupeiformes from Indian waters with provisional keys for identifying the eggs and early larvae has been made by Bensam (1971). The important characters generally used in identifying fish eggs are:

1. The shape of the egg.
2. Size (diameter)
3. Nature of egg membrane - smooth, sculptured etc.
4. Extent of perivitelline space.
5. Presence or absence of oil globules.
6. Size of oil globule.
7. Homogenous or segmented yolk.

In later stages of development of the embryo the following characters are useful.

1. Presence or absence of pigmentation on yolk sac or oil globule.
2. Pigmentation pattern of the embryo.
3. Degree of pigmentation of the eyes.

Types of fish eggs and certain examples

Most fish eggs are spherical in shape.

Oval or pear shaped eggs	: Stolephorus, Gobies, Blennies some Pomaentrids, Ammodytes
Demersal eggs	: Herring (Clupea harengus) Jenkinsia, Capelin (Mallotus villosus)
Ornamented/spiny/egg membrane	: Lizard fishes (Saurida, Saurus) Chirocentrus, Macruridae, Apogon
Double egg membrane (outer gelatinous coat)	: Pellona, Ilisha, Hilsa, Sardinella albella, Fistularia, Exocoetus, Vinciguerria lucetia
Filamented egg membrane	: Atherinidae, Hemiramphus, Cypselurus,
Eggs in cluster	: Triacanthus
Spawn mass	: Lophius, cottidae
Wide perivitelline space	: Sardinella spp.
Segmented yolk	: Clupeids, carangids coarse segmented apodes (eels), Vinciguerria lucetia (irregularly segmented).
Stalked nature of yolk in embryo	: Ophichthid eels

No oil globule	: Sardinella sirm, Stolephorus zollingeri; Opisthopterus tardoore, Chanos chanos, Muraenid eels - Most Pleuronectid flat fishes
Many oil globules	: Setipinna, kowala, Anodontostoma, Cynoglossus, Pellona, Chirocentrus, Atherinidae, Siganus, Triglidae
Oil globule of considerable size	: Trichirus (0.65 mm)
Oil globule in yolk at anterior part	: Caranx, Mullidae
Pigmented embryo	: Gadidae, Barracuda, Mullets
Pigment on oil globule	: Caranx, Trichiurus (not conspicuous).

Size of eggs:

Size of eggs are stated as diameter or as length of the longest axis when nonspherical. Most marine fish eggs are 0.5 mm above in diameter.

Range of diameter of egg	Some examples
0.5 - 1.0 mm	: Caranx Cynoglossus Kowala Anodontostoma Vinciguerria Opisthopterus Platycephalus Dorosoma Mackerel

1.0 - 1.5 mm	Saurida
	Sardinella longiceps
	S. fimbriata
	Coilia
	Auxis
	Thrissocles
1.0 - 1.5 mm	Setipinna
	Chanos chanos
	Scomberomorus
1.5 - 2mm	Chirocentrus
	Fistularia
	Sardinella leiogaster
2 mm	Eel, Alosa, Trichiurus

The hatching method for identification of fish larvae

The identity of free planktonic eggs at group, family or generic level may be possible in some cases from published information. Further, development of the fertilised eggs after hatching will throw more light on the egg as well as the larvae due to the closer semblance of the material to the actual adult.

These observations are possible by the hatching and rearing method for the eggs in the laboratory. For successful accomplishment of this process a closed circulating water system is the primary need. It is advisable to have some sort of automatic or semiautomatic circulating system where self filtering and waste eliminating and oxygenating systems are also incorporated.

The physical, chemical and biological parameters of the circulating water system are to be monitored regularly so that all these are kept within the tolerance limit of the organisms reared. The temperature, salinity, pH and live food population introduced if any, bacterial protozoon or furgal contamination etc. are to be monitored systematically in the rearing system.

Apart from hatching eggs already fertilised in nature and collected from the plankton, it may be possible in some cases to artificially fertilise ripe eggs in the laboratory introducing milt from ripe male of the species. If successful fertilisation takes place all such fertilised eggs can be removed to the rearing system for further development.

It is well known that in the development of fish eggs, the yolk serves as a reservoir of food from which the yolk sac larva takes its nutrition. Once development goes beyond this stage and the larva develops the mouth and mobility they are to be fed with appropriate food items preferably unicellular planktonic organisms reared for the purpose or collected from nature. The supply and in take of food of suitable quality and particle size are critical for the survival and growth of the larvae.

All debris and dead organic matter are to be removed from the system as soon as they are found by siphoning them off carefully.

If successful progressive development happen it is required to collect and fix the larvae at suitable intervals of time 6,12,24,48,72 hours etc. and upto as many days till we are able to get juvenile stage or closs to it. Detailed examination of these series of material will enable linking the earliest stage to the latest and the adult.

The series method:

The series method of study of ichthyoplankton for identification is applied partly in the hatching method as well. However the method is more appropriately employed in case of material collected from plankton where their origin is not at all clear. In this case, as it usually happens a collection of ichthyoplankton from a station may contain eggs or larvae or both of a species in various

stages of development or such closely resembling material may be available from different collections. The observer has to sort out and assign the material to a series in sequences of size and development. Since the progressive developmental process is likely to leave a trace of the immediately previous stage and the latest stage may show close semblance to juvenile characteristics especially in meristic and partly morphological features of the adult, the built up series will enable confirmation of the identity of the material. In many cases, study of the series of larval stages may require staining for clarifying osteological features, fin counts etc.

Identification of larvae:

The larval stage includes that stage prior to the acquiring of juvenile characters; the transition stage when juvenile characters are acquired. The juvenile stage is defined as the stage in which all the fin elements are present. In some cases there is the specialised juvenile stage which is found only in a few groups of fishes. The standard larval terminologies used are as follows:

Embryo	- Developmental stages to the moment of hatching
Larva	- Developmental stages well differentiated from the juvenile and intervening between the moments of hatching and transformation; commonly divided into Prolarva and post larva.
Prolarva	Still bearing yolk.
Post larva	Larva following the absorption of yolk applied only when the structure continue to be strikingly unlike that of juvenile.
Alevin	Larva of species in which post larval stages are not recognised i.e. in which the yolk bearing larva transforms directly into

Juvenile Young essentially similar to adult.

When larvae from a specific area is studied, basic information on the endemic and migrant adult species occurring in the area is to be known. It is also important to have clear knowledge of the meristic (countable) characters of the adult fishes.

At least four major characters are to be taken into account for identification of fish larvae. They are:

1. Morphometrics: Measurements of body parts over a size range of specimens from larva to early juvenile stage. Changes in body proportions such as in body depth, head size, gut length, shape of viscera; fin positions including size at end of yolk sac stage and size at transformation stages.
2. Meristics: Countable structures such as myotomes or vertebrae, number of fin rays etc.
3. Pigment patterns and their changes during early stages. Melanophores are somewhat variable on larvae of the same size; may be expanded or contracted at the time of preservation and can be destroyed by exposure to light or through improper preservation.
4. Specialised larval characters such as spines on opercular bones or head; shape of eyes (subcircular, stalked etc); elongated dorsal/ventral rays or spines, extended snout etc.

The very shape of the larvae itself broadly distinguishes the major groups from each other for eg. the elongate clupeids from the broad and laterally compressed scombroids, carangids and several perches. As examples it may be instructive to look at in detail the larvae of some of the important commercial fishes and their identification.

1. Family Clupeidae

The clupeids and engraulids of this family constitute a large fishery resource in our country as elsewhere in the world.

Two typical genera among them are the Sardinella and Stolephorus.

Both clupeids and engraulids have elongate, rod shaped larvae with long guts. The gut length of most clupeid, is greater than 80% of their notochord length (NL), while that of engraulids it is less than 75% NL. Engraulid larvae have slightly greater body depth than clupeids and they are less laterally compressed than clupeids. Median fin development begins at less than 6 mm NL in engraulids, but does not begin until 7 mm NL in the clupeids.

Engraulid larvae have pigment on the ventral midline posterior to the anus, at sizes less than 6 mm NL, but no clupeids develop pigment until much larger sizes. Engraulids have fewer melanophores in the foregut series at any given size, than do clupeid larvae of the same size. No other larvae are likely to be confused with the above two groups except perhaps certain gonostomatids like Vinciguerria sp. However the subcircular eyes, pigmentation pattern and development of photophores in later larvae enable distinguishing them from the clupeids and engraulids. The early larvae of clupeids generally show typical crossed muscle fibres on the body.

Identifying clupeid genera:

Meristics are the most useful characters in distinguishing the genera, especially the myotomes which closely tally with the vertebral counts of the adults. As examples we can cite (Sardinella (45-47) Stolephorus (39-32), Mackerel (31), Tunas (39-42) etc.

Morphometrics are not very reliable to distinguish genera, except during the transforming stages, when measurement such as predorsal, prepelvic and preanal length may be useful in some cases.

Pigmentation associated with the caudal area in larvae less than about 8 mm NL may distinguish some genera if used along with myotome counts. Staining of smaller specimens before ossification is complete, may make it easier to count myotomes and the developing fin rays.

The Family scombridae:

The family includes the mackerel, tunas, frigate mackerel, bonitos, seer fishes bill fishes etc. About two dozen species of the family are recorded from Indian waters.

The salient features of the scombroid larvae is their short truncated shape, large head and presence of strong opercular spines (tunas) and pterotic spines (bill fishes; exception mackerel).

Mackerel larva.

The salient diagnostic characters of mackerel larvae can be summarised as follows:

- Characteristics short bodied larva with about 31 myotomes
- Anus placed well forward
- Larval fin-fold begins at the occiput
- Lack pre-opercular spines (unlike the larvae of tunas)
- A post vent row of melanophores along the ventral margin of the body, reaching upto the urostyle.

Tuna larvae:

Matsumoto (1958) has illustrated a typical tuna larva and has given its general features. Tuna larvae are characterised by a large head, with opercular spines,

a triangular visceral mass located well forward in the body, the pre-anal distance being less than half of total body length in specimens upto about 9 mm, myotome number between 38-42, pigmentation (melanophores/chromatophores) rather sparse, most of it concentrated over abdominal sac, over the brain and in the caudal region, larvae about 10 mm (S.L) lose most of the pigment characters.

The main characters relied upon for the identification of tuna larvae are some fairly consistent black pigmentation such as those over the forebrain, tip of jaws and posterior half of the trunk. Meristic characters such as numbers of the myotomes, vertical fin rays and morphometrics of the head and eye and sizes at which structures differentiate are also found useful.

A key for identification of larval tunas based on Chromatophores distribution is given below: **

I. Chromatophores present on trunk

1. Chromatophores present over fore-brain

1.1 A distinct chromatophore mid-ventrally in the caudal region - no chromatophore at the symphysis of the pectoral girdle - Katsuwonus pelamis

1.2 A series of chromatophores along ventral margin on the trunk, from base of anal fin to caudal region - chromatophore at symphysis of the petoral girdle. Series of chromatophores along mandible - Euthynnus affinis

2. No chromatophores over fore-brain

2.1 Three short series of chromatophores on the mid-dorsal, mid-lateral and mid-ventral lines of the caudal region - chromatophore at the symphysis of the pectoral girdle - Auxis sp.

** Adapted from Yabe, Yabuta, Ueyanagi, 1963; Matsumota, 1958, 1962 - referable to adults recorded from Indian waters.

2.2 1-3 chromatophores along the dorsal margin on the trunk, initial one being anterior to origin of second dorsal. 1-5 chromatophores along ventral margin of the trunk - Thunnus tonggol.

2.3 No chromatophore along the dorsal margin on the trunk. 1-5 chromatophores along ventral margin of the trunk - Thunnus obesus

II. No chromatophores on trunk

1. No chromatophores over forebrain, presence of chromatophores at tip of lower jaw - Thunnus albacares

Bill fish larvae:

Indian bill fishes include the sword fish (Xiphias gladius), the sail fish (Istiophorus gladius) the marlins (Tetrapturus audax and Makaira spp.) and the spear fish (Tetrapturus angustirostris). Young stages with prolonged beaks are found in the bill fishes and wahoo. In the wahoo larva there is neither a spiny supraorbital ridge as in sword fish nor the long pterotic and preopercular spines as in the sailfish.

Family carangidae:

The major genera involved in the commercial fishery in India are the Horse mackerel (Megalaspis spp.), scads (Decapterus spp.), and a variety of small and large species.

Among the carangid larvae two different types are distinguished on the basis of morphology. The elongate and the deep bodied.

Among the meristic characters the vertebral formula (consequently the myotomoes in the larvae) is quite stable (10 + 14) in numbers except in few species like Nucrates ductor or Seriola sp.

Armature of the head is another important character distinguishing the larvae of some of the genera from each other -

Shape and number of spines, the biggest one being of particular interest when serrated or denticulated (Elegatis); suborbital crest - whether single and short (Decapterus, Caranx) double and long (Nucrates), long and serrated (Trachynotus). The sagital crest - its presence or absence; shape low or high and the position of its denticulations appear to be quite useful for distinguishing some genera and species.

Other larvae looking like Carangid larvae are Leiognathidae, Lactarius, Theraponidae, Apogonidae, and Ambassidae. All have 24 myotomes, Leiognathids have both Occipital crest and opercular spines as in carangids. But in Leiognathids the supraoccipital and preopercular spines are serrated with a curved spine on supraoccipital. More over anal spines are long and strong and not separate from the rest of the fin as in carangids. Dorsal spines are more than VIII and the soft rays are less than 18, anal spines are III and rays 14-15 at the maximum. In the case of Lactarius, the proportion of the anal fin counts are higher than that of dorsal fin, whereas carangids in general have more dorsal fin rays than anal rays.

In some post larvae like those of Therapon the opercle is provided with about 6 spines, of which the dorsal one is the strongest and the longest. In carangids the long and strong spine on preopercle is at the corner i.e. between the horizontal and vertical edges. The early stages of theraponids also differ from that of carangids in their pigmentation pattern. Apogonids and Ambassids are easily identified by their transparent and less pigmented nature of the body.

The leptocephali

The Leptocephali larvae are deeply compressed, with well developed larval teeth, eyes and nasal organs. The

myomeres are superficial. The interior of the larvae is filled with noncellular nucoid substance. The common sizes met with are 50-100 mm TL, the largest known larvae is 1800 mm TL.

The larvae reportedly do not eat solid food but may utilise dissolved organic substances or bacteria. The function of the teeth is yet unknown.

Different types of Leptocephali

1. Elopiformes:

has large forked caudal fin except in very small larvae. Myomeres less than 100, has ventral fin. Dorsal and anal fin have short bases.

2. Anguilliformes:

Small rounded caudal fin. Myomeres almost always more than 100. Ventral fins are absent. Dorsal and anal fin have long base and are confluent with caudal.

3. Notacanthiformes:

Caudal fin absent, instead they have a long single filament. Several hundreds of myomeres present has very small ventral fin. Dorsal fin short on anterior part of the body. Anal fin present.

Family Myctophidae and Gonostomatidae:

The larvae of lantern fishes and light fishes are relatively very abundant in the Indian seas, and those of the gonostomatids (eg. Vinciguerria) can be confused with clupeoid larvae by the inexperienced observers. The elongate larvae with subcircular or stalked eyes differentiate them clearly from the clupeids.

The formation of photophores, especially the second branchiostegal photophore and the sequence of formation can be used to distinguish some genera -

The pigments, size of pectorals, presence of preopercular spines and development of snout are other important larval characters of myctophids. Useful meristic characters include vertebral, branchiostegal, dorsal, anal and ventral fin count. The gonostomid like Vinciguerria the light organs are formed at the same time and the pattern of photophores also differ.

Salient diagnostic features applicable to different groups of fish larvae

Short oval body	Monacanthidae, Balistidae, Antennaridae
Short depressed body	Platycephalidae, Pagasidae, Dactylopteridae
Crest on nape	Holocentridae, Carangidae, Leiognathidae, Coryphaenidae, Scorpaenidae, Platycephalidae.
Barbel on lower jaw	Exocoetidae
Elongated tentacle on operculam	Champsodontidae.
Bony ridge over eyes	Carangidae, Stromateidae, Holocentridae, Histiophoridae, Scorpaenidae.
Protruded snout	Holocentridae, Histiophoridae, Pegasidae, Exocoetidae, Hemiramphidae
Pelvic fins abdominal	Isospondyli, Iniomi, Scomberosox. They are soft rayed fishes lacking spines in the dorsal, anal and pelvic fin.
Single short dorsal fin	Gonostomatidae, Clupeidae, Engraulidae, Dussumieridae.

Single long dorsal fin	: Bregmacerotidae, Serranidae, Carangidae, Coryphaenidae, Leiognathidae, Histiophoridae, Stromateidae, Bothidae, Pleuronectidae, Soleidae, Cynoglossidae.
Two dorsal fins	Mugilidae, Apogonidae, Mullidae Gobiidae,
Pectorals enlarged	Exocoetidae, Stromateidae, Callyonymidae, Platycephalidae, Champsodontidae
Ventral fins absent	Angulliformes, Syngnathidae, Tetradontidae.
Elongated fin rays on dorsal	Bothidae, Soleidae, Cynoglossidae, Bregmacerotidae.
No spines on operculam	Labridae, Gobiidae, Trachypteridae Spines on operculam - Scombridae, Carrangidae.
Elongated spines on the dorsal and ventrals	Serranidae, Ballistidae, Acanthuridae
Alimentary canal	
Long straight alimentary canal	Many Gonostomatidae, Clupeidae, Synodontids.
	Bulged or sac like - Cynoglossidae, Soleidae.
Short and coiled	Majority of Perciformes.
Anal opening	At middle of body - Apogonidae, Carangidae, Thunnidae, Scombridae, Gobiidae, Scorpaenidae, Pleuronectidae, Bothidae.
Behind middle of body	Apodes, Hemirahampidae, Exocoetidae, Fistularidae, Mugilidae, Sphyraenidae, Coryphaenidae.

Far backwards	Stomiatoids, Clupeides, Synodontids.
Far forwards	Bregmacerotidae, Atherinidae, Blennidae, Trypauchenidae.
Pigmentation	
Dense	Exocoetidae, Hemirhamphidae, Holocentridae, Mugilidae, Coryphaenidae, Histiophoridae
Partial	Atherinidae, Bregmacerotidae, Mullidae, Apogonidae, Stromateidae, Theraponidae, Platycephalidae
Blotches, spots	Engraulidae, clupeidae, Synodontidae, Carangidae, Apogonidae, Serranidae, Leiognathidae, Thunnidae, Scromberomoridae, Pleuronectidae, Cynoglossidae.
Myctomes/Vertebrae	
Less than 24	Calliyonomidae, Balistidae, Monacanthidae, Diodontidae, Tetradontidae, Molidae.
30-40	Gonostomidae, Engraulidae, Myctophidae, Coryphaenidae, Labridae, Scombridae, Thunnidae, Sillaginidae.
41-50	Clupeidae, Engraulidae,Chirocentridae, Myctophidae, Scomberomoridae, Bregmacerotidae
51-80	Elopidae, Albulidae, Megalopidae, Chirocentridae, Beloniformes, Syngnathidae.
100-200	Anguilliformes, Trichiuridae Gempylidae.
Eye stalks	Asteronesthidae, Bathylagidae, Myctophidae, Idiacanthus

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