Chapter 4

Discussion

Species Composition

Occurrence of fish larvae of 38 Families around the Chang Islands in 1987 was not different from the occurrence in other regions in the Gulf of Thailand, the Andaman Sea and the South China Sea. The Families Gobiidae, Engraulidae, Bregmacerotidae, Leiognathidae, Nemipteridae, Clupeidae and Callionymidae were also the dominant groups in this area, agreeable to the reports of Chamchang (1986), Chantarasakul (1988), Chayakul and Uttapong (1983 a, b), Chayakul and Vatanachai (1980), Janekarn (1988), Janekarn and Boonruang (1986), Predalumpaburt et al. (1988), Termvidchakorn (1987), Tangkaseranee (1980, 1982, 1983, 1984), Vatanachai (1972, 1975, 1978, 1979 a, b). In all studies the Family Gobiidae succeeded the first dominance. Larvae of the economic groups such as the Engraulidae, Nemipteridae and the Clupeidae were so abundant as the adults caught by the trawlers and purse seins as well as the Leiognathidae (Tubtimsaeng, personal communication).

Tangkaseranee (1981) had reported on fish larvae of 50 Families of the Chang Islands. She had found, that the larvae of Families Gobiidae, Callionymidae, Bregmacerotidae, Leiognathidae, Carangidae, Cynoglossidae and Scombridae were dominant, respectively. Composition of the major groups was similar to this study, but some economic Families such as the Carangidae, Cynoglossidae and Scombridae were found to be relatively less abundant in the present study. However, it was difficult to consider that the fisheries resources became less productive because the methods and schedule of samplings as well as the stations were different. Tangkaseranee (1981) used a larval net of 0.55 mm mesh and 120 cm in mouth part diameter whereas the net of 0.33 mm mesh and 45 cm in mouth part diameter was used in this study. Moreover, the trawling method, trawling period and speed of the boat were also altered.

Identification

Larval fishes could be distinguished from each other by many categories as proposed by Vatanachai (1972). The main criteria were the body shape, spination, pigmentation, myomere count and other specialization. Most of the diagnostic features used as the criteria of differentiation in this study were mainly reliable on the works of Leis and Rennis (1983) and Vatanachai (1972).

According to Vatanachai (1972), larvae of elongated and slender bodies evident in this study included the Families Clupeidae, Engraulidae, Synodontidae, Belonidae, Syngnathidae, Fistulariidae and Blenniidae.

The Clupeidae and Engraulidae could be separated by the position of anal opening. The anus of the clupeids located beyond the dorsal fin bases while that of the engraulids located in the overlapping position of dorsal and anal fins.

The Synodontidae could be easily distinguished by the pigment patches on the ventral edge of the body. The Saurida undosquamis and the Trachinocephalus myops were also identified by the pattern of 4 and 7 pairs, respectively (Jones et al., 1978; Okigama, 1974; Ozawa, 1986; Vatanachai, 1975).

The belonid, syngnathid, fistutariid and blenniid are simply differentiated by the characters of mouth. The belonid developed a beak-mouth. The syngnathid and fistulariid developed tubular mouth. In contrast, the blenniid never developed special mouth. Among the tubular mouth, the fistulariid had a long filament on the tail and similar shape of dorsal and anal fin, whereas the dorsal fin of the syngnathid was larger (Leis and Rennis, 1983).

The leptocephalus was very distinctive in the extremely compressed body which was also elongated and transparent. The flatfishes were also extremely thin, but had short and coiled guts and deeper bodies.

The flatfish larvae of the Bothidae, Soleidae and Cynoglossidae were similar in shape, but different in the head profile. The bothid and cynoglossid had steeply sloped head but the sole slightly. The Cynoglossidae usually had more protruding gut and a large mouth. Larvae of Pseudorhombus and Psettina of the Bothidae were clearly different in dorsal ray formation that more numbers were developed in the Pseudorhombus, whereas the Psettina developed only the single ray. The Cynoglossus larvae had 2 dorsal spines and more sloped head than the Bothidae.

The pegasid larvae were clearly unique because of the dermal sac covering on the head and anterior body. The syngnathids also developed bony structure on the body but the pegasids had depressed head and trunk.

The exocoetid larvae had well-developed fins even in smallest size. The far-back developed pelvic fins were also distinctive. Pectoral fins were developed on dorsal body as the Bregmacerotidae but they should never be confused because the pectoral fins of the Bregmaceros spp were paddle-like. Moreover, their bodies were different; the exococtids were rounded but the Bregmaceros laterally compressed.

The Sphyraena spp. were also elongate bodied, but rounded head with pointed snout could distinguish them from the others. The long straight gut was distinct too. The Trichiuridae also had a pointed snout, but its elongated dorsal spines were distinctive as well as its strongly compressed body. Pointed snout was also present in the platycephalids but deeper body and large pectoral fins characterize the flatheads. The barracudas were one of the 24 myomere larvae as well as the Carangidae, Gobiidae, Mullidae, Theraponidae, Leiognathidae, Lutjanidae, Epinephelidae, Apogonidae and Sciaenidae (Vatanachai, 1972). However, the body shape of the Sphyraenidae was still differentiative. Some elongated gobies also had uncoiled gut but the prominent gas bladder was distinctive. The barracudas were heavily pigmented but the gobies rarely.

The other 24 myomer larvae were moderate or fusiform bodied. The Carangidae, Leiognathidae and some Apogonidae developed a bony crest on the nape. But the leiognathid had steeply sloped and short head. The apogonid had rounded snout. The Carangid also had a large head but more elongated than the leiognathid. The deep body with 3 anal spines was very distinetive in the Carangidae. The Priacanthidae also developed a serrated cranial crest but more elongate; however, the elongate preopercular spines with serrations were very distinct in the Priacanthidae too. The monacanthids also developed dorsal spine on the nape, but deep head and compressed body distinguished them.

The Lutjanidae and Epinephelidae developed elongate serrated dorsal and pelvic spines as well as the Siganidae. But the Siganus spp. usually developed serrated ridges on the head and even on the snout, that was distinctive. The elongated spine in the Epinephelidae was longer than the body length but shorter in the Lutjanidae. The serrations on other head spines were present only in the Epinephelidae (Leis and Rennis, 1983).

The *Therapon* larva was simply recognized by the present of a pointed spine on the operculum. The *Mene maculata* was more easier diagnosed by its so deep body that expressed by the triangular shape of the ventral body.

The Nemipteridae and Mullidae were quite difficult to identify; however, pigment spots on the ventral margin of the tail were more frequently developed in nemipterids than the mullids. Gas bladder was prominent in nemipterids but inconspicuous or absent in the mullids. In general, the Mullidae developed melanophores on lateral surface of the tail and 3 pigment spots on the brain were quite distinctive (Leis and Rennis, 1983). The *Upeneus* was also recognized by this character. The *Rastrelliger* larvae were similar shape and pigmentation to the nemipterid but the myomere count of 30-31 characterized the *Rastrelliger*. The nemipterids; however, had rather tapering bodies than the *Rastrelliger* (Author's comment).

The Sciaenidae had short deep and robust head with posttemporal spines in every species, that were quite unique characteristics of the Sciaenidae (Fahay, 1983).

The Sillaginidae was elongated, slender and compressed bodied, that might be confused with the *Sphyraena* spp. but myomere number of the *Sillago* spp. more than 24. Pigment spots rowing along the entire ventral body also distinguished the Sillaginidae.

The Scorpaenidae was easily recognized by the broadened pectoral fins as well as the Platycephalidae. But the scorpaenid larvae usually developed a lot of head spines. However, the elongated snout and flattened head could define the platycephalids, as well (Leis and Rennis, 1983).

The labrid larvae obtained from this study were moderate and slender bodies with a pointed snout that expressed the triangular shape of the head. There were no spines on the head and rarely pigment on the body that became the differentiative features.

The Callionymidae was ovoid bodied; rounded head but laterally compressed trunk, similar to the shape of the Tetraodontidae in top view, but the tetraodontids also had rounded trunk in cross-section. In larger size, the callionymid head became slightly depressed but still globular in the Tetraodontidae. However, larvae of the two Families were never confused because the tetraodontids developed a dermal sac as just newly hatched and the inflation also evident in the larvae (Leis and Rennis, 1983).

The Champsodon sp. was very easy to be identified because the elongated tentacle on the opeculum was very unique character.

Abundance and Distribution

Occurrence of the fish larvae was mainly abandant in the inner area between the Chang Islands and the continent, especially in the NE-moonsoon . The more abundance in the inner area agreed to Vatanachai (1973), Miller et al., (1979) and Chamchang (1986). That might be the result of high nutrition according to Suwanrumpha (1978), who found that the nearshored waters contained more planktons than the offshored waters.

The larvae of more than 100 samples of 12 Families could be splitted into 3 groups in relation to the areas; the inner, the outer and general. Larvae of the Clupeidae and Scombridae (<u>Rastrelliger</u> spp.) belonged to the outer zone abundance, but the larvae of Carangidae, Leiognathidae, Apogonidae, Sciaenidae, Gobiidae and Callionymidae belonged to the inner zone abundance. Whereas the Engraulidae, Bregmacerotidae, Bothidae and Nemipteridae were the general or common groups in both outer and inner regions. Concerning to mode of living, it was noticeable, that the pelagic fishes might probably prefer living in the open sea, whereas the bottom associated in the nearshore. Tangkaseranee (1984) stated the relationship of the pelagic fish larvae and the depth, that the larvae were more abundant in the depth of 20-50 m, where was far off the shore. The evidence of pelagic fish larvae was found to be coincident to this concept. However, the inner groups still became lesser abundance in the SW-monsoon.

Most of the larvae, agreeable with Chantarasakul (1988) were more abundant in the NE-monsoon in February and the first intermonsoon period in April, as the Western Coast (Vatanachai, 1973; Tangkaseranee, 1982; Chayakul and Uttapong 1983 a,b; Chamchang, 1986). However, the larvae of Engraulidae, Sciaenidae and Apogonidae still stayed concentrated in the SW-monsoon (> 25.00 %). Nevertheless, the abundance of apogonid fishes was constant in all seasons. Larvae of all Families were distinctively low abundance in the SW-monsoon especially in August, but the lowest abundance in the Western Coast was in February (Chamchang, 1986), when it rained heavily as the effect of the monsoons. On the other hand, the same peak of larval fishes in both coasts was in April, the summer time, when high salinity, high oxygen and rising temperature.

The abundance and distritution of fish larvae in both space and time approaches could be implied to the spawning or nursing grounds and seasons of some economic fishes. The Clupeidae and the Scombridae (Rastrelliger spp.) might spawn mainly in the outer regions in the NE-monsoon to the early SW-monsoon during November to April. Chayakul and Vatanachai (1980) reported the spawning grounds of the Rastrelliger, that was off 50 miles of Rayong Coast, that might be the same occurrence as the outer zone of the Chang Islands. The Carangidae and Sciaenidae, on the other hand, could have the spawning grounds in the inner regions with the peaks during NE-monsoon to the early SW-monsoon. The Sciaenidae could extend spawning in the SW-monsoon period, too. The general occurrence group of the Engraulidae and Bothidae could have the same spawning period as the others. The Engraulidae could also have the spawning peaks during the SW-monsoon. The Sciaenidae as well as the Engraulidae seemed to be more tolerate than the others.

Larvae of the Family Gobiidae were distinctly high abundant and distributed around the Chang Islands as well as the other regions in the Gulf of Thailand. Fritzsche (1978) summarized that the Gobiidae was the largest group of fishes, including more than 700 species in the world. They were widely distributed in both tropical and temperate waters in fresh water and sea water. They were also success in temporarily living on the muddy flat or aerial surrounding too. These physiological properties resulted in the high diversity of the gobiid fishes. And the euryhaline adaptation might be the cause of the occurrence of the gobiid larvae in this study and in the entire Gulf of Thailand.

It was found that the inner stations were plentiful of fish larvae especially the stations 1, 15 and 16. The stations 9 and 10 of the outer zone were also abundant too. Therefore, the inner zone and some outer stations could be considered the nursing grounds of fish larvae. However, only some studied stations located within the 3 km off shore line, where were protected by the state proclamation of non-fishing areas of the Thai waters. The Eastern Coast still has never been programmed for non-fishing season and period as practising in the Western Coast. Although some light-luring gears were prohibited fishing around the Chang Islands in order to protect the young fishes, it might be not enough to conserve the fisheries resources. The inner area should be closed during the NE-monsoon period or at least during February to April when most of fishes were spawning.

Environmental Association

Larval fishes were abundant around the Chang Islands during the NE-monsoon when the salinity was more than 31.0 ppt., slightly high oxygen (7.40-7.54 mg/l) and lower temperature (28.86-29.64°C). On the other hand, during the SW-monsoon, the salinity and oxygen trends were dropped, while the temperature rather high in general. The response of lower density and distribution of the inner group could demonstrate the influences of the environmental factors such as the salinity quite well.

Generally, the nearshored waters were more fertile than the offshored by the influences of the runoff water. But the high precipitation could also cause dilution the salinity. Turbidity and sedimentation might be the factors of transparency and photosynthesis. The water drainage itself probably exported the larvae from the inner region too. By coincidental interactions, the environment would become unsuitable for the fish larvae, that corresponsed by the decrease in abundance and distribution of the nearshore group during the SW-monsoon. The larvae of the Family Bregmacerotidae in the inner zone could show the relationship to the temperature, salinity and dissolved oxygen, they were probably the more sensitive group than the others. Whereas the larvae of the Family Gobiidae expressed no relationship to those factors, they might be the most tolerant.

Fish larvae of the outer zone, on the other hand, expressed no relationship to the temperature, salinity and dissolved oxygen. However, they also attained the peaks during the NE-monsoon period. From NAGA Expedition, Robinson (1963) reported on the evidence of upwelling along the Eastern coast between the Chang Islands and Samit Point during the NE-monsoon. The upwelling brought about the nutrients to the waters, that might coincidentally result in the peaks of the larvae in the outer zone. .Occurrence of high nutrition in the inner zone by water discharge and in the outer zone by upwelling might be the main factor of abundance and distribution of fish larvae, that was highly concentrated and widely distributed during the NE-monsoon period.

Feature of the larval occurrence, therefore, could not be explained by some certain factors. However, the total biological interactions were still far from being understood. The salinity alone might be not the only factor affecting the larval fishes of the Chang Islands. But the other coincidental factors including nutrients, water current and biological interactions themselves still never have been studied, otherwise the environmental association must be more perfectly identified.

The Chang Islands were also an important spawning grounds of economic fishes such as the engraulids, clupeids, nemipterids and Rastrelliger spp. They should be protected as the Western coast by the proclamation of non-fishing period during the NE-monsoon. The increase of industrial factories, fish piers, fish mills, fish farms as well as the expansion of the residential areas and the promotion of tourism can cause pollution to seawater and fisheries resources. The waste controls must be urgently managed, so as to the environmental studies, in order to prevent the resources from being poisoned.