CHAPTER 1
GENERAL INTRODUCTION
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1.1 PREAMBLE

Fish forms about half of the total number of vertebrates and provides food for millions as a substantial source of protein. It is rich in vitamins and also contains variable quantities of calcium, phosphorous and nutrients which are important to human health and growth. Also, it serves as a raw material for animal feed. They offer sport for the angler and many species are kept as pets by aquarists. In addition to this, fisheries provide a valuable contribution to economic augmentation in the form of increased chance of employment, industrial income and foreign exchange.

Fishes of the family Nemipteridae of the order Perciformes constitute a good fishery in coastal and neritic regions in the world and naturally have attained considerable attention from fishery biologists. They are widely encountered in the Indo-Pacific region from South Japan to East Africa and the Red Sea (Wongratana 1972; Eggleston, 1972; Hoda, 1976). Dentex (Cuvier and Valenciennes, 1830; Bleeker, 1851; Fowler, 1904) Nemipterus (Swainson, 1839), Synagris (Gunther, 1859; Day, 1878; Fowler, 1938), Anomura, Odontoglyphis and Euthyopteroma (Fowler, 1904) were the various generic names used to describe this particular group of fish. Recently the generic name Nemipterus is accepted by the taxonomists working in this field.
Day (1878) reported five species of Nemipterids from Indian waters under the genus *Synagris* (Klein) Gunther, namely *Synagris striatus*, *S. toly*, *S. bleekeri*, *S. notatus* and *S. japonicus*. Weber and de Beaufort (1935) described twenty species of Nemipterids from Indo-Australian Archipelago. Wongratana (1973) recorded a number of Nemipterids from Indo-Pacific region. Rajagopalan et al. (1975), Murthy (1978) and Sophy and Hameed (1983) recorded *Nemipterus mesoprion* and *Nemipterus delaggae* from Indian waters.

Nemipterids are small or moderately sized, slightly compressed, pink coloured fishes. They are characterised by terminal mouth with canine teeth on the upper jaw. Front of the head scaleless, scales beginning above eye and on cheek. Scales on body ctenoid and easily shed. Dorsal fin single and its first spine prolonged into a filament in certain species. A medium sized auxiliary scale present above each pelvic fin. Caudal fin forked or emarginate and the upper lobe often with a filament.

Nemipterids are commonly called threadfin breams. Japanese threadfin bream (English), Cohana japonaise (French) and Baga japonesa (Spanish) are the vernacular names used to describe Nemipterids. In India the various names to describe Nemipterids are Kilimeen/Puthiyapakora (Malayalam), Thullukendai (Tamil), Sallengunti (Telugu), Madmal (Kannada), Rani (Konkani) and Bammi (Marathi).
The Nemipterids are exploited all along the Indian coasts in varying quantities. The identification of many species were doubtful because of the confusion in nomenclature. Though Rajagopalan et al. (1975) and Murthy (1978) have clarified the confusion to some extent, the identification of Nemipterids still pose many problems. In the current inquiry, detailed studies have been undertaken to establish the systematic position of *Nemipterus* spp. available at Cochin waters.

Detailed information on the biology of fishes is an essential prerequisite for their proper conservation, management and exploitation. An amplified knowledge on the biology is fundamentally essential to plan sound management policies for rational utilization of Nemipterid fishes along the Indian coast. Any information on the biochemical composition of fishes will be of immense use in assessing their nutritive value. The importance of understanding body composition during growth is essential in production studies. Detailed work on Nemipterid fishes has been done in other parts of the world whereas along the Indian coast not much work has been carried out. Hence the present investigation is undertaken on the systematics of Nemipterids available at Cochin and the biology and biochemical aspects of *N. japonicus* and *N. mesoprion*.

1.2 NEMIPTERID FISHERY IN INDIA

India has a coast line of about 7,500 km including the Andaman Nicobar islands with nearly 3000 fishing villages along the coast.
The marine fish caught from the inshore waters by indigenous craft as well as by large mechanized vessels are landed at 1500 fish landing centres.

The total estimated catch of marine fishery resources during the year 1983-84 along the coasts of India was 1.83 million tonnes as compared to 1.47 million tonnes in 1982-83, showing an increase of 12%, but in 1984-85 the exploited resources was only 1.56 million tonnes, showing a reduction of 7%. The marine fish production for the past 15 years (1971-1986) shows fluctuations; the minimum landing was reported in 1972 (0.98 million tonnes) and maximum in 1984 (1.631 million tonnes) (Anon, 1986).

The present exploitation is confined to the contiguous zones, where the exploited varieties are mainly sardine, mackerel, tuna, catfish, elasmobranchs, wide variety of sciaenids, leiognathids, clupeiods, prawns and deep-sea shrimps. Nemipterids form one of the major demersal fishery resources of India and are exploited by small commercial trawlers along both east and west coasts and it forms about 2% of the total marine landings. The average annual landings of Nemipterids are more in west coast than in east coast. Kerala state accounts for the maximum catch (35%) of Nemipterids followed by Maharashtra (21%), Gujarat (5%) and other maritime states. The present fishing grounds data have revealed that threadfin breams are more abundant in the depth range of 75-125 m and the catch of these fishes contribute to about 75% of the total catch from this depth range (Anon, 1986).
In Andhra Pradesh, an estimated landings of 1,700 tonnes of Nemipterids were accounted annually. At Waltair, these fishes formed about 14% of the total trawl landings while they constituted only about 6% at Kakinada. The peak period in this region was December - March. Along the coast of Tamil Nadu an annual average of 740 tonnes of Nemipterids were landed which formed about 15% of the total trawl landings and June - September was the peak period. Along the Maharashtra coast an estimated annual average of 3,000 tonnes of threadfin breams were landed and the catches were heavy during February - May. Along the Gujarat coast an estimated annual average of 2,700 tonnes of these fishes were landed and there were two peaks, one in March and the other in October (Anon, 1986).

Information regarding the eggs and larvae of Nemipter the Indian coast is scanty. Five to six species contribute to the fishery along the east coast whereas only two to three contribute to the fishery along the west coast. *N. japonica* is the most dominant species along both the coasts, followed by *N. marinus*. These two species together contribute 70-100% of the landings at different trawl landing centres of Kerala.

### 1.3 Nemipterid Fishery in Cochin

At Cochin an estimated annual average of about 9,800 Nemipterids are landed. In this region the trawlers operating in relatively deeper waters and very heavy landings of threadfin breams are obtained during July - September. The catch
of these months accounts for over 80% of Nemipterids. The total Nemipterids landed by the mechanized boats at Cochin Fisheries Harbour during 1983-84 were about 1,030 tonnes and at Integrated Fisheries Project were 6,355 tonnes and during 1984-85 the total landings from Cochin Fisheries Harbour were 5,348 tonnes and from Integrated Fisheries Project were 5,350 tonnes. An increased yield of threadfin breams can be obtained from the relatively deeper waters beyond the present trawling grounds, by employing the maximum effort during monsoon months (Anon, 1986).

1.3.1 Craft and Gear employed

Prior to the introduction of mechanized fishing in our country, traditional fishing methods were in vogue and many types of fishing craft and gear were employed. Among the craft the main types are the dug out and plank built canoes. These craft employ all types of indigenous fishing gear developed by the fishermen such as long lines, gill nets, boat seines, shore seines, etc. which are designed to suit the local fishing conditions and to exploit the resources. The various indigenous fishing gear are not capable of catching Nemipterids, as their zone of action is limited only to a few meters in depth and a short distance from the shore. The type of gear that could have landed them are the shore seines and some of the boat seines particularly 'iraguvala', the two-boat seines, operated along the east coast. But being non-mechanized, they could not extend
their range of operation. This clearly indicates that *Nemipterus* species were incidental catches in many of the fishing gear, like shore and boat seines, when these fishes approach the shore. This situation has changed with the introduction of demersal trawling from small mechanized boats. These boats could easily reach depths far beyond that of the traditional craft but limited up to 60 meters depth.

Several attempts have been made for the introduction of trawling in India. Although it was initiated in 1902 this method was taken up on a commercial scale only in the latter half of the fifties in Cochin (Kuriyan, 1965) and subsequently spread to other parts.

Besides these, medium and large trawlers capable of reaching depths beyond the scope of the small trawlers are also used for this fishing. The size of the trawl employed by the vessels depend on the horse power of the engine fitted in the trawler (Miyamoto, 1958). Satyanarayana et al. (1962) suggested the size of gear suitable for the small class of vessels. Subsequently many modifications and improvements were made in the design and construction of trawlers used by these vessels by Central Institute of Fisheries Technology. Recently the Bay of Bengal Programme has introduced two-seam bottom trawl (Pajot et al. 1982) which is getting accepted by the operators of small mechanized vessels in the country. When trawling gained momentum, the catch of Nemipterids increased many fold. During the
initial period, when trawling was mainly aimed at shrimps, Nemipterid fishes were considered as trash fishes and often thrown over board. When the Catch Per Unit Effort of prawn decreased these fishes were brought to shore and presently command a very high price in many parts of the country.

1.3.2 Check list of Nemipterid fishes of Cochin coast

Nemipterus, Scolopsis and Parascolopsis were included in the family Nemipteridae by Fischer and Bianchi (1984) from Western Indian Ocean. Of these, only Nemipterus could be collected from Cochin waters.

The various representatives of Nemipterids identified from Cochin waters are listed below:

<table>
<thead>
<tr>
<th>Family</th>
<th>Nemipteridae</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genus</td>
<td>Nemipterus, Swainson, 1839.</td>
</tr>
<tr>
<td>Species</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1) N. japonicus (Bloch, 1795)</td>
</tr>
<tr>
<td></td>
<td>(2) N. mesoprion (Bleeker, 1853)</td>
</tr>
<tr>
<td></td>
<td>(3) N. tolu (Valenciennes, 1830)</td>
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<tr>
<td></td>
<td>(4) N. delagoae (Smith, 1949)</td>
</tr>
</tbody>
</table>

1.3.3 Seasonal abundance and size groups

Nemipterus japonicus (Bloch): This species constitutes a good fishery (about 2% of the total catch) throughout the year with a peak occurrence from July to October; and the size ranges are between 100 to 285 mm (Total length). Peak fishery coincides with monsoon. The fish with maturing and mature gonads are found during this season.
Nemipterus mesoprion (Bleeker): This species also forms a good fishery along Cochin coast. Though represented throughout the year, peak landings are observed from August to October along with *N. japonicus*. The fish with mature gonads are observed abundantly during this period. The size ranges recorded during this period are 80 to 195 mm (T.L.).

Nemipterus tolu (Valenciennes): This species does not form a fishery along Cochin waters, however they are found along with the other Nemipterids during February - May. The minimum size recorded for these fishes are 53 mm (T.L.) and maximum 187 mm (T.L.). The maturing fishes are obtained at that period.

Nemipterus delaggae (Smith): This species are rarely seen along with other Nemipterids in Cochin, but its occurrence appears to be seasonal, being limited to February, March and April. The minimum size ranges recorded for these species are 90 mm (T.L.) and maximum 150 mm (T.L.)

1.4 REVIEW OF PREVIOUS RESEARCH WORK

The genus *Nemipterus* was first erected by Swainson (1839) on *Dentex* (Cuvier and Valenciennes, 1830). *Anomura, Odontoglyphis, Euthyopteroidea* (Fowler, 1904) are the other generic names used to describe these group of fishes before Swainson. Gunther (1859) established the genus *Synagris* for *Nemipterus* and later it was synonimized with *Nemipterus* by Weber and de Beaufort (1936).
Day (1878) reported five species of Nemipterids from Indian waters under the genus *Synagris* (Gunther, 1859). Weber and de Beaufort (op. cit) included twenty species of *Nemipterus* from the Indo-Australian Archipelago. Earlier studies on the taxonomy of Nemipterids were of Smith (1949) from South African waters, Munro (1955) from Ceylon and New Guinea, Fischer and Whitehead (1974) from Eastern Indian Ocean and Western Central Pacific, Wongratana (1973) from Thailand waters, Senta and Tan (1975) from Andaman waters and Weber and Jothi (1977) from Malaysian waters.

The recent taxonomical reports on this group of fishes from Indian waters are those of Rajagopalan et al. (1975), Murthy (1978), Indra (1981) and Sophy and Hameed (1983).

Some observations on the biology of various Nemipterids were made from different parts of the world, nevertheless the available information is rather meagre and scanty. Except for *N. japonicus*, a detailed investigation on the biology of Nemipterids has not been attempted from Indian waters despite their contribution to commercial fishery. This lacuna is perhaps due to the fact that the identification of many species based on morphology is often difficult.

(Kuthalingam, 1865; George et al. 1988; Krishnamoorthi, 1971; Eggleston, 1972; Vinci, 1982; Murthy, 1983 and 1984; Krishnaveni, 1986), N. delagoae (Madan Mohan and Velayudhan, 1983) and N. peronii (Sainsburg and Whitelaw, 1985) are available from different waters. Except the work of George et al. (1988) there is no report on the food and feeding of these group of fishes from Kerala coast.

Age and growth studies on Nemipterids are limited. Available information on age and growth are those of N. virgatus (Eggleston, 1970-1972), N. bathybus (Eggleston, 1972), N. hexadon (Isarankura, 1968), N. japonicus (Eggleston, 1972; Murthy, 1984; Krishnamoorthi, 1971; Manikayala Rao and Srinivasa Rao, 1986; Krishnaveni, 1986), N. mesoprion (Murthy, 1981) and N. peronii (Sainsburg and Whitelaw, 1985). All the authors except Manikayala Rao and Srinivasa Rao (1986) adopted length frequency method but were not successful in their study with hard parts. There is no report on age and growth study of this group of fishes from Kerala coast.

Length - weight relationship in N. japonicus from Cochin coast has been studied by Vinci and Nair (1974). This was studied in N. mesoprion from Andhra-Orissa coast by Murthy (1981) and from Madras coast by Vivekanandan and James (1988).

Studies on the breeding biology of Nemipterus species are scarce from the west coast of India. The detailed study on breeding biology of N. japonicus are by Krishnamoorthi (1971) and Krishnaveni (1986) from the east coast of India. The available literature on
some aspects of maturation and spawning are those on *N. virgatus* (Li Kwan-Ming, 1954; Eggleston, 1972), *N. bathybus* (Eggleston, 1972), *N. peronii* (Sainsburg and Whitelaw, 1985) and *N. mesopriion* (Weber and Jothi, 1977; Murthy, 1981). Practically no information is available on the eggs and larvae of this group of fishes.

The Nemipterid fishery of Andhra - Orissa coast have been described by Krishnamoorthi (1971). Senta and Tan (1975) have reported the fishery comprising the size composition of this group of fishes from South China and Andaman Seas. Information is also available on the population identification on *N. japonicus* by Krishnaveni (1986) from Indian coast and on *N. marginatus* by Pauly and Martosubroto (1980) from Western Kalimantan, South Sea. Krishnaveni (1986) has also reported the proximate composition of *N. japonicus* based on material collected from Portonovo waters.

1.5 RESEARCH APPROACH

The available literature reveals that biological and biochemical studies on *Nemipterus* spp. are scarce and poorly known. In some cases, their validity is doubtful because of the prevailing confusion in taxonomy. In the present investigation attempts are made to inquire about the biological and biochemical aspects of *N. japonicus* and *N. mesopriion*, which contribute to a fishery of considerable importance in Kerala coast.
The results are presented in eight sections.

The first section is a general introduction including a review of previous work on this genus. It also contains an account of the distribution of _Nemipterus_ spp. and their fishery along the Indian coast in general during the period of investigation, with notes on their landings.

The second section deals with the systematics of the Nemipterid fishes along Cochin coast.

The third section deals with the qualitative and quantitative analyses of the food items, feeding behaviour and feeding intensity in relation to season, size, sex and stages of maturity.

The fourth section incorporates the findings on the age and growth rates of _N. japonicus_ and _N. mesoptrion_. The growth parameters are represented using Von Bertalanffy's equation.

In the fifth section length-weight relationship of the two species are dealt with.

The sixth section embodies the results on the breeding biology of the two species covering details on the spawning season, spawning frequency, size and age at first maturity, seasonal variation in relative condition factor, sex ratio and fecundity.
The seventh section includes the results of the present study on the proximate composition of muscle, liver and gonads of *N. japonicus* and *N. mesoprión* based on the maturity stages and length groups.

Synthetic resume followed by reference is given at the end.