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Species Diversity of Sea Snake (Hydrophiidae) Distributed in the Coramantal Coast (East Coast of India)

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Abstract: A detail study of sea snakes (family: Hydrophidae) occurring in the Coramantal coastal region (south east coast of India) has reveled the presence of thirteen species included in five genera. In this study the systematic, ecology, biology and distribution of thirteen species embraced in five genera, which are present in the collections done during 2003 to 2006 are given. The distribution patterns of all the valid species known to occur in the Coramantal coastal region are also included from a detailed study of the literature.

Key words: Sea snakes, biology, taxonomy, ecology, distribution

INTRODUCTION

Sea snakes are closely allied to both the terrestrial cobras and kraits and, to a greater degree, to the Australian elapids. In fact, it should be pointed out that some workers believe that modern sea snakes arose independently at least twice (there are amphibious sea kraits and there are totally marine sea snakes) and that both groups of sea snakes are members of the Elapidae family (Murthy, 1999).

Sea snakes are marine reptiles mainly found in tropical and subtropical waters (Tu, 1988), probably it's the most abundant reptile on earth (Auerbach book). The sea snakes are distinguished from the land snakes by their laterally compressed fin-like tail. Sea snakes coming under family Elapidae with two subfamilies, they are Hydrophiinae and Laticaudinae. Hydrophiinae are the true sea snakes it has tail flattened laterally and the shields on the head large and symmetrical. All have valvular nostrils on top of the snout upwards and can be closed tightly to exclude water (Gow, 1977). The subfamily Laticaudinae is the amphioxus sea snakes considered more primitive (e.g., closer to the original elapid ancestors). Theses sea snakes forage at the sea but return to land to mate (Shetty and Shine, 2002). Laticaudinae has well developed ventrals of one third to more than one-half the breadth of the body compare to Hydrophiidae and it only genus laying eggs on the land.

The sea snake of is represented by 16 genera with about 46 species (Lim and Lee, 1989), 52 species (Tu, 1988), 51 species (Voris, 1972), 50 species (Smith, 1926) and 60 species (Murthy, 1999) distributed in the seas of world. In Indian coast a rich sea snake fauna, with a strong endemic component and greater species diversity (Murthy, 1977). Twenty nine species were recorded from Indian Ocean (Ahemed, 1975) and the coramendal coast have been reported upon by Aiyar (1907), M'kenzie (1820), Wall (1926) and (Murthy, 1986) Sea snakes are abundant in the shallow seas and estuaries (Lim, 1979).

Sea snakes ware collected from coastal areas of Chennai to Nagapattinam (south east coast India, Tamil Nadu, Coramandal coast) (Fig. 1). Systematic position of sea snake found in the Coramental coastal region according to Voris (1977), Cadle and Gorman (1981), Stuebing (1991) and Das (1993) (Fig. 2).

Class : Reptiles
Subclass : Lepidosauria

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Fig. 1: Shows the Coramantal coastal region

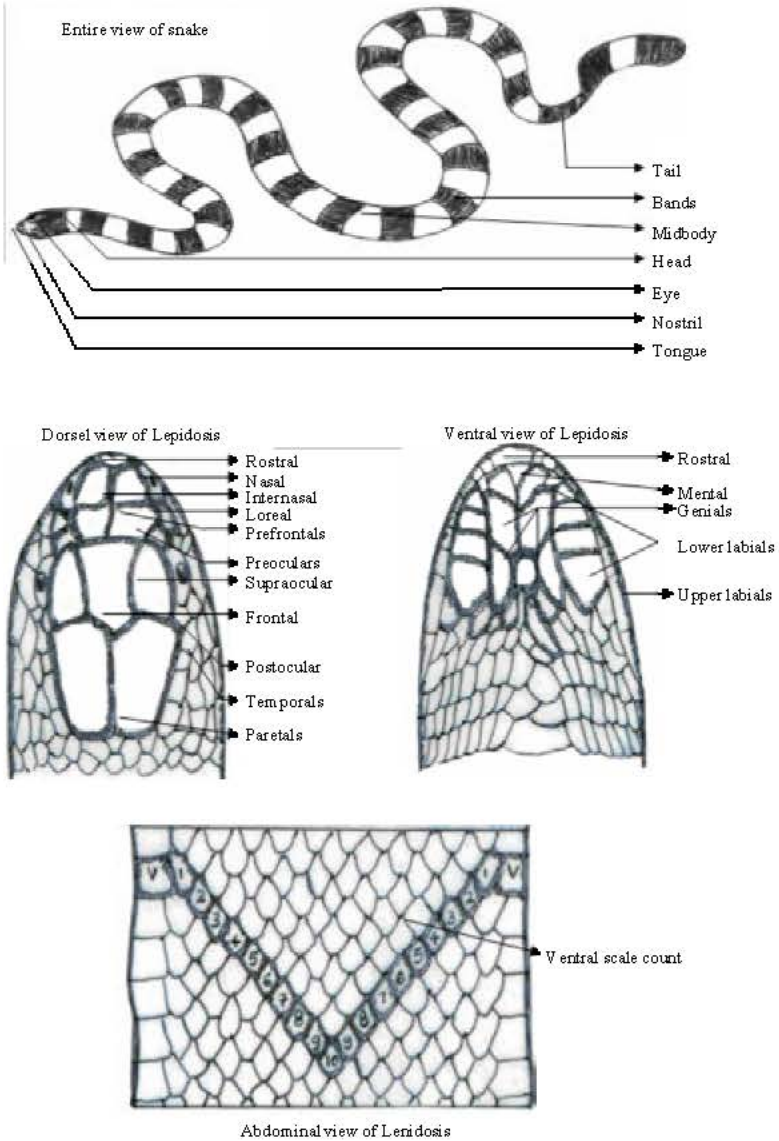

Fig. 2: Schematic diagrams of entire, heads and body Lepidosis in a sea snake

Order : Squamata
Suborder : Serpentes
Family : Elapidae
Subfamily

I. Hydrophiinae
Genus
1 *Enhydrina*
2 *Hydrophis*
3 *Lapemis*
4 *Pelamis*
5 *Praescutata*

Two harmless species,*Acorchordus granulatus* and *Cerberus rhynchops* bears a strong superficial resemblance to some of the sea snakes of Elapidae, particularly in its colour and markings. Also marine, it is distinguished by the peculiar skin and head scalation, in which the scales are minute and granular, irregularly arranged. Although its tail is slightly flattened from side to side, it does not have the paddle-shaped tail form characteristic of the marine elapids. It is dark brown with pale grey cross bands, some of which do not meet over the back. It is coming under non-poisonous snake. Occasionally the nontoxic estuarine snake distributed in the sea, for example *Cerberus rhynchops.*

Sea snakes as a group demonstrate considerable variation in behaviors, size and colour. Many of them are more or less sharply marked with alternate light and dark bands of various colors (usually black or shades of brown, grey or yellow). The bands may completely or partially encircle the body. Large specimens grow up to 3 m, but smaller ones seldom exceed 1.3 m. In most species, the transverse ventral shields found in most land snakes but the Hydrophiinae has small ventrals, not more than one-quarter the breadth of the body or totally without ventral plates (Haile, 1958; Tweedie, 1941)

Sea snakes feed on fish, crabs and prawns. Breeding takes place during different seasons to different species, it also varying place to place. All sea snakes are viviparous except Laticaudinae and the number of their young ranges from 2-17. Sea snakes do not have gills and must come to the surface occasionally for respiration (Tu and Passey, 1972). They can remain submerged for 2 to 8 h and it has been observed below the 800 feet (Herre, 1942). Their have two lungs left lung is lar ger and is almost equal to the length of their body except the tail (Tu and Passey, 1972). The posterior part of the lung is small and it used for swimming and balancing the body. Thus its function is similar to that of the swim bladder of a fish. In general, male snakes are smaller in size compared to females, a common phenomenon among reptiles, which may increase the efficiency of the males in locating their mates for reproduction (Spellerberg, 1982). Ecologists have long been interested in how species differ in their use of resources. Habitat, food and time are three traditional categories of resource dimensions (Pianka, 1978). The habitat dimension is generally most important in resource partitioning of reptiles, with time and food as secondary factors (Tofrt, 1985).

Sea snakes are highly known for the neurotoxic venom and valuable skin. There are about 29 species have been so for reported from the Indian waters (Ahemed, 1975) and now their exploitation is protected under wild life protection act, 1972 of Indian government. Interest in the sea snakes has grown noticeably in recent years for their most powerful animal toxins (Murthy, 1977) and their role in marine food chain (Voris, 1972).

Species Distributed in the Coramantal Coast

Enhydrina Schistosa (Daudin)
Beaked Sea Snake

Identification characteristics

Lepidosis: (Fig. 3)

- Rostral: Protrudes downwards.
- Frontal: Small
- Supraoculars: Broad and nearly two thirds the area of the Frontal.
- Parietals: The largest shields on the head of the snake and very prominent.
- Prefrontals: The entire system is shaped like the wings of a butterfly.
- Nasals: Triangular and the nostril is situated towards the posterior of the shield.
- Loreals: Absent
- Preoculars: Entire
- Postoculars: Entire
- Temporals: Entire and prominent, often touching the last four pairs of Supralabials.
- Supralabials: Eight pairs of which the last two are minuscule and may be absent. The third and fourth pairs touch the eye while the fifth pair may be divided.
- Mental: Absent
- Infralabials: Five pairs of which the first pair is slender and elongated and replaces the mental shield.
- Sublinguals: May contain one amorphous pair.
- Costals: Take the form of an elongated overlapping hexagon with a small keel in the centre.
- Ventrals: Small and often divided, falling into 230 to 361 rows.

Fig. 3: *Enhydrina schistosa*

Status: Common

Distribution: The species is widespread. It occurs along the east coast of India, Southeast Asia and southern China to northern Australia. In several areas, this species is the sea snake most frequently encountered or caught by human observers

Habitat: It is found in deep sea, where the bottom is sandy or rocky. It is also seen in tidal creeks and other sheltered spots during monsoon The species occurs in swallow open sea, river mouths, estuaries, coastal lagoons and mangrove forests.

Activity: The snakes are actively feeding at night. Juveniles occasionally float on the surface in a ball. The significance of this behavior is unknown.

Diet. In the wild, the snakes eat crustaceans (prawns) and fish. There is relationship between the snout-vent length of the snake and the length of its prey (mainly fish). In other words, in generally, larger snakes eat larger prey

Reproduction: Two males combat were found intertwined off in the mid-dry season. Intertwining is a feature of male combat in terrestrial snakes, suggesting that what was occurring in this instance. Mating may occur in mid-autumn. Females containing yoking follicles occur in the mid-dry season (June-August) and females containing developing embryos occur in the mid-dry season (August) and in the mid-wet season (January).

In the waters off Chennai (Madras) off the southeast coast of India, females can carry large follicles during the monsoon season (November). They can also carry developing young during (November) and just after (December) the monsoon season (Samuel, 1944; Kasturirangan, 1951). And in what were probably waters around India, females were pregnant during December-February (Wall, 1918). In the Straits of Malacca during the northeast monsoon (January), all mature sized females were gravid (Voris and Jayne, 1979), suggesting that during at least some seasons, every adult female reproduces.

Litter size ranges 4-10 (Wall, 1918; Bergman, 1949, 1955; Minton, 1966; Fry *et al*., 2001) with means of 6.8 (n = 5; Fry *et al*., 2001) and 7.0 (n = 12; Bergman, 1955; Bergman, 1949).

In the waters off northern Java, there is a strong positive correlation between the snout-vent length of the females and her clutch size ($r^2 = 0.36$, $p<0.05$, n = 12) (Bergman, 1955). In the Straits of Malacca, there is also a strong positive correlation between these two variables ($r^2 = 0.66$, $p<0.01$, n = 30) (Voris and Jayne, 1979). The data from both regions, therefore, indicate that larger females tend to have a larger number of young, the females' size alone accounting for up to 66 percent of the variation in the number of young in some populations.

In males ($r = 0.41$, $p = 0.047$, n = 23) and in both sexes combined ($r = 0.34$, $p = 0.02$, n = 46) but not in females ($r = 0.30$, $p = 0.15$, n = 23) there is a positive correlation between the number of longitudinal scale rows at midbody and the number of ventral scales (Smith, 1926). If these two scale counts reflect some measure of length and girth, respectively, then length and girth would appear to be correlated in development, as the scales are laid down during development and once formed do not change in number. In the Straits of Malacca, the neonates smallest free-ranging snake measured 210 mm in snout-vent length and the largest oviducal embryo measured 233 mm in snout-vent length (Voris and Jayne, 1979), suggesting that this may be the snout-vent length range of neonates.

In what were probably waters around India, the smallest free-ranging snake measured 317 mm in total length and the largest oviducal embryo measured 279 mm in total length (Wall, 1918). In waters off southern Pakistan, a female contained fully pigmented embryos as large as 327 mm in total length (Minton, 1966). Ontogenetic colour change the contrasting banding pattern of the young becomes more muted (Minton, 1966). Size at sexual maturity in the waters off northern Java, the snout-vent length of the largest female (n = 48) with enlarging follicles was 624 mm and the snout-vent length of the largest female with developing embryos was 685 mm (Bergman, 1955). In the Straits of Malacca, the snout-vent length of the smallest gravid female was about 730 mm (Voris and Jayne, 1979). In

what were probably waters around India, the smallest gravid female had a total length of 965 mm (Wall, 1918). The snout-vent length of the largest specimen from Australian waters was 1024 mm (Fry *et al*., 2001). The snout-vent and total length of the largest male (n = 48) from waters off northern Java was 867 mm and 1008 mm, respectively and for the largest female (n = 48) was 938 mm and 1074 mm, respectively (Bergman, 1955) The snout-vent length of the largest specimen from the Straits of Malacca was 1120 mm (Voris and Jayne, 1979).

Sex ratio of collected specimens at coast of Java over a few years, the total number of males (n = 51) and females (n = 48) was not significantly different (χ^2 = 0.09, p = 0.76; Bergman, 1955 and Bergman, 1956). Similarly, among museum specimens from throughout the species range, the number of males (n = 25) and females (n = 23) was not significantly different (χ^2 = 0.08, p = 0.77) (Smith, 1926). All these data indicate that the sex ratio for the species does not differ from parity.

Sexual dimorphisms of females are probably larger than males. In the Straits of Malacca, a large sampling program found that the snout-vent length of the largest male was 970 mm and the snout-vent length of the largest female was 1120 mm (Voris and Jayne, 1979). Similarly, in the waters off northern Java, the snout-vent length of the largest male (n = 51) was 867 mm and the snout-vent length of the largest female (n = 48) was 938 mm (Bergman, 1955).

Tail length relative to total length in adults is probably greater in males than in females. For example, in Pakistan tail length as a proportion of total length ranged 11.2-13.7% in males (n = 15) but only 10.2-11.6% in females (Minton, 1966). Relative tail length is usually larger in males than in females in snakes. Heart rate the heart rate in unborn young has been reported as 26 beats per minute (Wall, 1918), but the temperature was unspecified.

Venom. The venom of this species has been extensively studied for nearly two centuries. The earliest studies were conducted by Dr. Patric Russell and Australian scientists successfully developed a functioual antivenin for this species which was first tested during the early 1960's. This snake produces neurotoxic venom which causes paralysis and ultimately death by suppressing the respiratory system within a few hours. The antivenin developed for this species along with that of the Australian Tiger Snake (Notechis scutatus) are used as a standard for nearly all hydrophiidae snakebites.

Due to the fact that this snake is widely distributed, relatively common and has a dangerous bite, its venom has been widely studied (Tu *et al*., 1971; Gawade and Bhide, 1977, 1978; Geh and Toh, 1978; Gawade and Gaitonde, 1980, 1982a-b).

The venom does appear to have some effect on individuals of the same species. A snake with a snout-vent length of 843 mm bit another snake with a snout-vent length of 583 mm and a result, the swimming speed of the latter was slowed markedly (Bergman, 1955). Danger to humans, although the snakes are recorded as being not inclined to bite and recorded fatalities are rare (Wall, 1918), the bite can kill humans (Manouri *et al*., 2005).

Hydrophis ornatus (Gray)

Cochin banded sea snake

Identification characteristics:

Lepidosis*:* (Fig. 4)

- Rostral: Protrudes downwards. A notch in the rostral scale facilities protrusion of the tongue when the mouth closed.
- Frontal: hexagoual shape like benzene ring. Larger than Supraocular.
- Supraoculars: Narrow and nearly two thirds smaller than partials.
- Parietals: The largest shields on the head of the snake and very prominent.

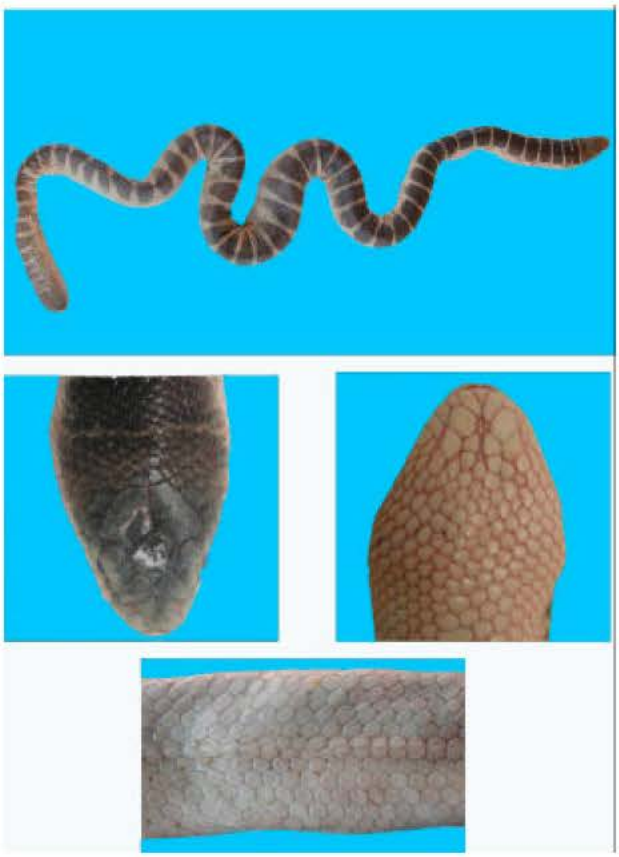

Fig. 4: *Hydrophis ornatus*

- Prefrontals: elongated the width is short.
- Nasals: Prominent, the nostril is situated towards the right posterior of the shield.
- Loreals: Absent
- Preoculars: One preocular
- Postoculars: One pair Postoculars, lower one having connection with forth upper labials.
- Temporals: Two anterior temporals and it prominent. Posterior temporals smaller compared the anterior temporals.
- Supralabials: 6-7 pair upper labials, forth pair bordered the eye. First pair box shaped.
- Mental: Triangular shape.
- Infralabials: Five pairs from the first pair the size the scale are reduced.
- Sublinguals: May contain two amorphous pair.
- Ventrals: Ventrals distinct throughout, in ♂ 209-260, in ♀36-312, anteriorly ventrals about twice as large as adjacent scales, narrowing posteriorly.

Coloration: Head elongated and slightly depressed. Body anterior cylindrical, posteriorly compressed and heavy; the body dorsally grayish or light olive to almost white with broad dark bars or rhomboidal spots separated by narrow interspaces; below yellow or whitish.
Status: Rare.
Distribution: Rarely in India, broadly throughout the coastal area of Australia (Gow 1989; Mirtschin and Davis, 1992; Heatwhole, 1999), although it has been recorded in Tasmania, New Guinea, as well

as Arabian and Persian Gulf, Indonesia, China and Taiwan.
Habitats: It inhabits waters greater than 30 m in depth, although it has been found on corals reefs and moderately turbid inshore water and estuaries (O'Shea, 1996; Ineich and Laboute, 2002).
Size: Total length of adult snake ♂950 mm, ♀860 mm.
Activity: Active at night and day (Ineich and Laboute 2002).
Diet: In the wild, the species eats fish (Rasmussen, 1989; Fry *et al*., 2001).
Reproduction: Gravid females have been found in the middle of the dry season (10 March-11 April) this is supported by Rasmussen (1989) in Thailand waters. Litter size ranges 1-17, with a recorded mean of 6.0 (n = 37) for Australian waters (Fry *et al*., 2001) and a calculated mean of 2.9 (n = 7) for Thailand waters. Size at sexual maturity was reported the snout-vent length of the smallest gravid female was c. 800 mm (n = 37) (Fry *et al*., 2001) and c. 800 mm also from Thailand waters (Rasmussen, 1989).
Venom: It is nuerotoxic, potent toxin to kill the human beings.

Hydrophis Cyanocinctus (Daudin)
Annulated Sea Snake

Identification
Lepidosis: (Fig. 5)

- Rostral: Small protruding downward
- Frontal: cone shaped, sharp end towards parietals.

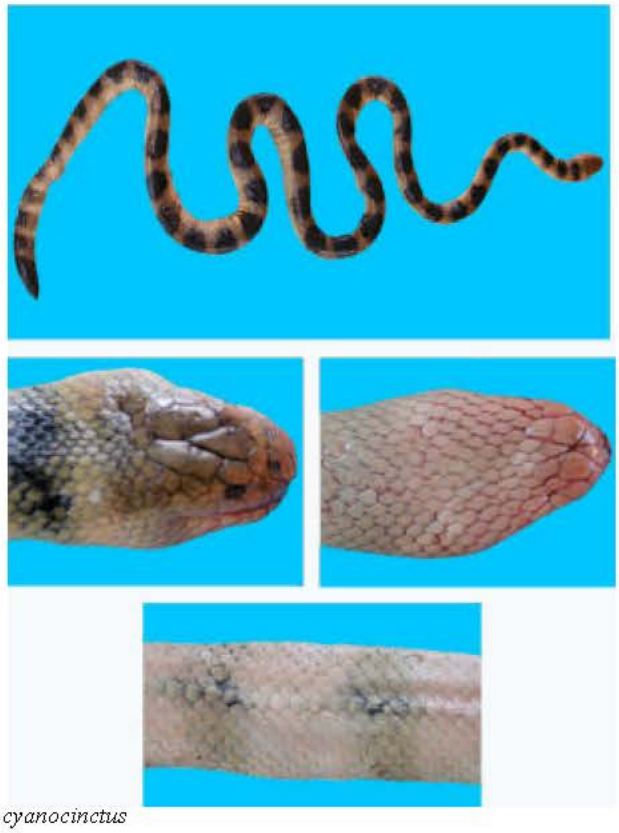

Fig. 5: *Hydrophis cyanocinctus*

- Supraoculars: Relatively big compare with Prefrontals.
- Prefrontals: highly compressed between the Nasals and Frontal.
- Parietals: Prominent and having groove on the top the scale.
- Nasals: Entire with the nostril situated at the outer rear frontals edge.
- Preoculars: small
- Postoculars: Large compare to Preocular.
- Temporals: upper temporals larger and lower smaller.
- Supralabials: The number of scales on the upper labial varies from 7-8 in numbers.
- Mental: Triangle two ends are upwards.
- Infralabials: The number of scales on the lower labial varies from 9-10 in numbers. Metal and first two pair lowers labials from a flower like structure.
- Sublinguals: First pair even shapes and second pair irregular shape.
- Ventrals: ventrals 290-390

Coloration: Head is black with horse-shoe shape marked on crown. The ground colour is dirty white, pale greenish or yellow. The tail is darker in colour as compare to the rest of the body. The colour of the chin and throat is dark gray. The body is covered with sooty cross bands, which varies from 41-70 in numbers. The bands on mid dorsum are wider than the sides of the body. Similar bands are present on the tail, which vary from 6-9 in numbers.
Status: Common
Habitat: This snake inhabits shallow muddy water. mangrove swamps are their preferred habitats of this species.
Distribution: They are found in the Persian Gulf, Idzu sea, Pakistan, Srilanka and Indonesia. Some species can also be witnessed in Burmese coasts. In India, This species is found in all the coastal areas.
Size: Its length varies from 870-1885 mm.
Activity: During monsoon season these snakes can be seen 12-20 miles from Kalpakkam offshore. These snakes they can crawl and lift their heads on the ground. They are aggressive by nature and do not like to be touched or handled and on doing so, attack and bite actively.
Diet: They feed on fishes, crabs, prawns and other crustacean species.
Reproduction: Mating takes place during the month of January to February and a female gives birth to 3-7 young ones in the months of April-June
Venom: They are deadly venomous snakes. Their venom is nuerotoxic in nature.
LD50 value of this species 0.35 mg kg^{-1} was observed.
Hydrophis Spiralis (Shaw)

Yellow sea snake

Identification characteristics
Lepidosis: (Fig. 6)

- Rostral: Pointed tips, Protrudes downwards.
- Frontal: Small
- Supraoculars: small compared to Frontal.
- Parietals: The largest shields on the head of the snake and very prominent.
- Prefrontals: broad, one third of frontal between two parietals.
- Nasals: Triangular and the nostril is situated towards the anterior of the shield.
- Loreals: Absent
- Preoculars: one scale and small

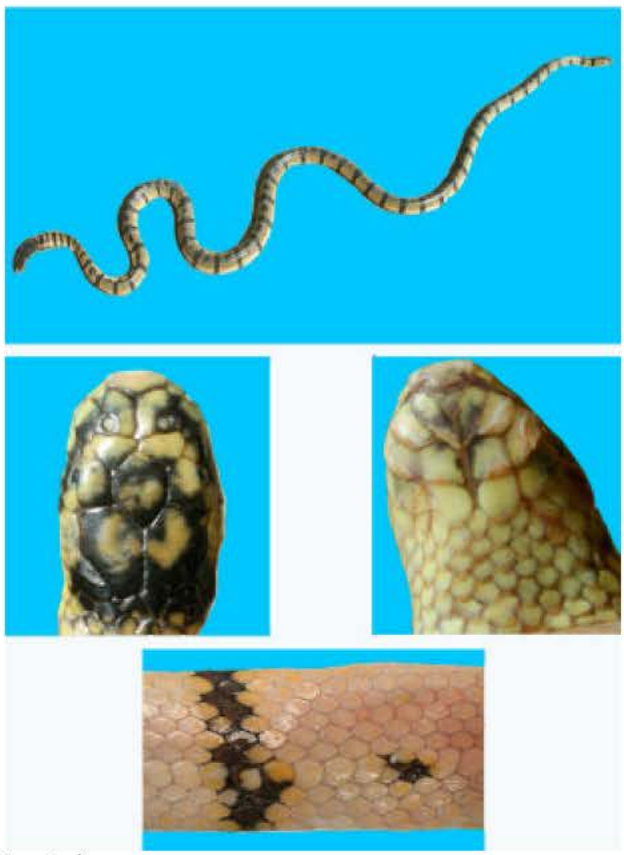

Fig. 6: *Hydrophis spiralis*

- Postoculars: one large compared to Preocular.
- Temporals: 1 anterior temporal prominent, often touching the last upper labials.
- Upper labials: The number of scales on the upper labial varies from 6-8. The 2nd scale touches the prefrontal while 3rd, 4th and 5th or only two of them touch the eye. 6-8 upper labials.
- Mental: upward triangle shape.
- Lower labials: The scales on lower labial are 4 in number and touch the chin shield.
- Sublinguals: 25-31 scale rows around neck
- Costals: scale row around the mid body 33-38.
- Ventrals: Ventrals 295-362, distinct throughout, about twice as broad as adjacent body scales. Small and often divided, falling into 230 to 361 rows.

Coloration: The head is large, broad and yellow in colour but in young snakes it is blackish with yellow markings. The dorsal surface is golden yellow to yellow green in colour. The colour of the ventral surface is pinkish and the scales are with black margin. 41-46 narrow black bands encircle body, the bands usually less than one-third the width of the lighter interspaces. A black patch is present near the tip of the tail. These annuli are wide at the vertebral region but narrow on flanks and on ventral side.
Status: less common
Distribution: This specie occurs is found in the Persian Gulf, Oman, United Arab Emirates, Iran, Pakistan, Sri Lanka, Indonesia, Malaysia, Philippines, China, New Guinea. In India this specie is found in the east and west coastal.

Habitat: Warm shallow over a reef, deep waters and tidal rivers. It prepares only sea grass and sandy bottom.
Size: Total length ♂1620 mm, ♀830 mm; tail length ♂140 mm, ♀120 mm.
Activity: The yellow sea snake is perhaps an exception to the generally docile nature of sea snakes and is reputably aggressive. It is large and dangerous, the bite potentially fatal.
Diet: They feed on fishes, crabs, prawns and other crustacean species.
Reproduction: Mating Season of this snake April-May and the A female gives birth to 4-5 young ones at a time in the months of July and August.
Venom: Their venom is nuerotoxic in nature. LD 50 dose of their venom 315 mg kg^{-1}.

Hydrophis Gracilis (Shaw)

Common small headed sea snake

Identification Characteristics:
Lepidosis: (Fig. 7)

- Rostral: Long touches nasals.
- Frontal: Frontal and Supraocular are equal size.
- Supraoculars: Shapes differ from frontal.
- Parietals: Large, cone shape and very prominent.
- Prefrontals: Prefrontal in contact with third upper labial and nasal.

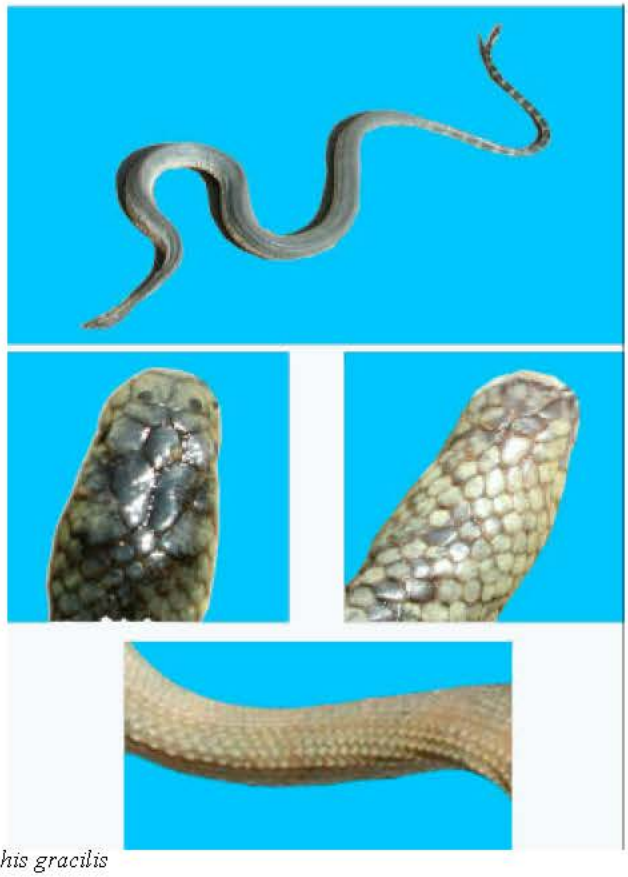

Fig. 7: *Hydrophis gracilis*

- Nasals: Inter nasal absent, large size compared to Prefrontals.
- Loreals: Absent
- Preoculars: One and small size
- Postoculars: One large compared to Preocular.
- Temporals: Entire and prominent, one temporal broad.
- Supralabials: Five pairs all are equal size. The second pairs touch the eye.
- Mental: Exact triangle shape.
- Infralabials: Six pairs of which the second and six pare smaller. Sixth pair is narrow and elongated.
- Genials: May contain two pair. First pair is small compared to second pair.
- Ventrals: Small and often divided falling into 220-287 rows. Ventrals divided by a longitudinal fissure.

Coloration:Bands are 40-60 posteriorly, with age the markings disappear. Adult is usually grayish above, paler in the ventral side.
Status: Rare
Distribution: Common in the coramendal and Malabar coast of southern Indian. Coastal waters from the Persian Gulf Sri Lanka, Thailand, Malaysia, Vietnam, China, Taiwan, Indonesia, Australia, Melanesia. Provides information on the geographic variation in scale counts for this species. The values included in the diagnosis above apply only to those populations inhabiting the coastal waters of India and along the east coast of Myanmar.

Hydrophis Stricticollis (Gunther)

Identification:

To make identification the following factors should be taken into account
Lepidosis: (Fig. 8)

- Rostral: Touches four shields.
- Frontal: Has a blunt anterior and sharp posterior with near straight sides.
- Supraoculars: Relatively short but broad.
- Prefrontals: Broad but highly compressed between the Nasals and Frontal-Supraocular system. The line of contact between both individual shields is very short.
- Parietals: Highly prominent being and each individual shield is around three and a half the size of the Frontal and nearly three times longer.
- Nasals: Entire with the nostril situated at the outer rear edge.
- Preoculars: Entire
- Postoculars: Entire
- Temporals: Divided and the lower pair fuses with the sixth pair of Supralabials.
- Supralabials: Seven pairs of which the second is the largest and the first the smallest. The third and fourth pairs touch the eye while the sixth pair is fused with the lower Temporals.
- Mental: Takes the form of an equilateral triangle.
- Infralabials: Four pairs. The first pair is extremely elongate with a long line of contact. The last pair is the largest and broadest.
- Sublinguals: Posterior pair larger than the Anterior pair and partially divided by smaller scales.
- Costals: Take the form of a near perfect hexagon with a median keel. 19 to 23 rows of Costals two head lengths after the head

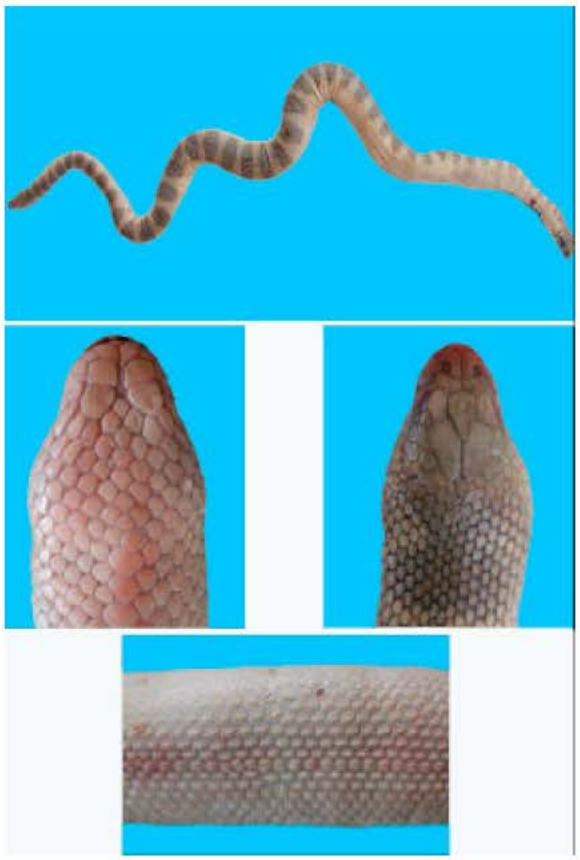

Fig. 8: *Hydrophis stricticollis*

Coloration: Young black with 35-55 bright yellow or whitish dorsal bars, Posteriorly becoming complete bands that encircle body, head with curved yellow marking extending from snout to either side of parietal scales; adults markings become indistinct and older individuals almost uniform grayish above, yellowish below.

Distribution: This snake is most common along the coasts of Bay of Bengal, Bangladesh, Burma and northern India. It is rare along the southern Indian and Sri Lanka coasts.

Habitat: This species is reported to occur mainly in brackish waters and also in Deep Ocean. Historical records indicate that it can be found at the mouths of rivers.

Activity: active in the night hours. A powerful swimmer capable of raising its head and a good part of its fore body clear out of water. It is a relatively peaceful but inquisitive creature that frequents in brackish water.

Diet: Feeds exclusively on fish

Reproduction: Little is known about its reproductive cycle apart from the fact that it is viviparous and that the brood size may vary from 5 to 10. The young measure around 350 mm at birth and mature when around 70 cm long. The maximum length attained by this specie is under 120 cm. Adults usually tend to be around 1 m long.

Venom: Little studies and testing have been conducted on this snake due to the paucity of specimens. However the poison of this snake does appear to be capable of killing a human being with a few hours. Bites from this snake should best be treated with *Enhydrina schistosa* antivenin.

Hydrophls Caerulescens **(Shaw)**

Many toothed sea snake

Identification Characteristics

Lepidosis: (Fig. 9)

- **Rostral: It is small size but protrudes downwards with sharp end.**
- **Frontal: Large hexagonal shape. Blind at pre frontal side sharp end at parietal side.**
- **Supraoculars: hexagonal shape, curve in the eye side.**
- **Parietals: both are even size and rectangular shape touch the lower end to form a triangle.**
- **Prefrontals: it is long ending between the preocular and nasal scales Contact with pre and Supraocular scales. Prefrontal usually in contact with second upper labial.**
- **Nasals: It occupies large area less space for rostral. Blind triangular shape towards the rostral. Nasals in contact with one another. Nasal hole touches the end line of prefrontal, in that area nasal scale is having bent.**
- **Loreals: Absent**
- **Preoculars: Small, triangular shape and it touch with third upper labials.**
- **Postoculars: Two pair in both side upper scales larger compares to lower.**
- **Temporals: In this species one side upper temporal 2 and other side 3scales.**
- **Supralabials: 7-8 pair upper labials 4 scale bordering eye.**

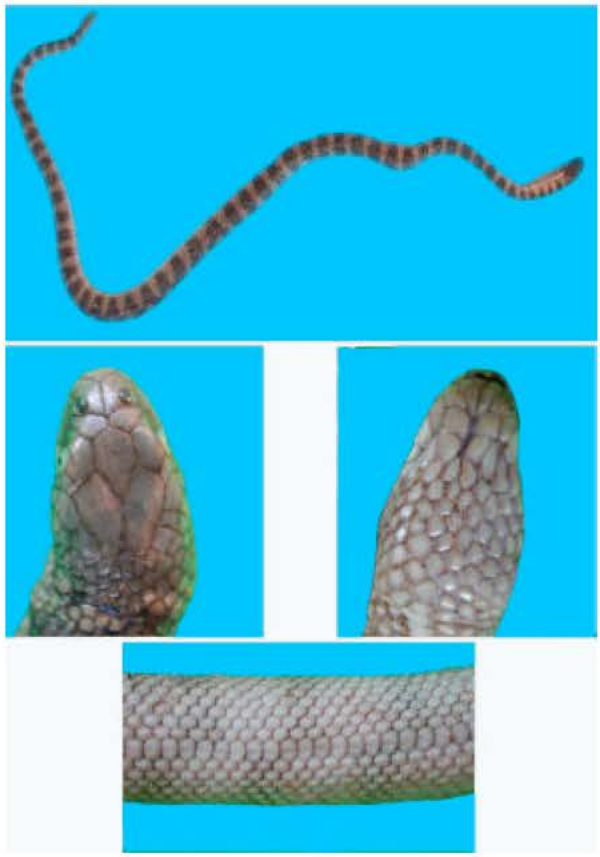

Fig. 9: *Hydrophis caerulescens*

- Mental: very small triangular shape.
- Infralabials: Five pairs of which the second and third pair bigger.
- Sublinguals: Unevenly arranged.
- Ventrals: Scale rows at midbody 38-54, Ventrals 253-334.

Coloration: Head small; anterior part of body is slender; body gray dorsally, yellow ventrally; 35 to 58 deep gray with black bands, Total length of my specimen 705-1210 mm. Broad irregular band occasionally present; adults often lack any pattern and are uniform olive to dark gray; head pale olive to gray.
Status: common
Distribution: East and west coasts of India (vicinity of Bombay and Karwar in the west and from Madras to the mouth of the Ganges on the east coast) east through Straits of Malacca to the Gulf of Siam to southeastern China and western Indonesia. Myanmar coastal waters, especially abundant in the Mergui Archipelago and also found in Karachi coast.
Habitat: It inhabits shallow seas and muddy creeks with mangrove swam.
Reproduction:
Venom: Neurotoxin

Hydrophis fasciatus (Schneider)
Banded sea snake

Identification haracteristics:
Lepidosis: (Fig.10)

- Rostral: Prominent protrudes downwards.
- Frontal: Hexagonal shape like benzene ring.
- Supraoculars: Prominent, same size as Frontal..
- Parietals: The long shields on the head of the snake and very prominent.
- Prefrontals: elongated the width is short.
- Nasals: Prominent, the nostril is situated towards the right posterior of the shield.
- Loreals: Absent
- Preoculars: One preocular
- Postoculars: One pair Postoculars, lower one having connection with forth upper labials.
- Temporals: Two large anterior temporals and it prominent. Posterior temporals smaller compared the anterior temporals
- Neck scale: Usually 18-23 rows around the neck
- Midbody scale: 35-45 around midbody increase in number of rows from neck to midbody.
- Supralabials: 6-8 pair upper labials, forth pair ended bordered of the eye. First pair small compared to next three pairs.
- Mental: Round shape and light colour.
- Infralabials: Five pairs from the first pair the size the scale are reduced second third and fourth pair are large size.
- Sublinguals: Contain two amorphous pair.
- Ventrals: ventral scales 323-452 average 366 or less.

Coloration: Black with bright yellow or whitish dorsal bars, dorsal and ventral side of head portion fully black in colour. Complete bands are without encircle body, this band dark in dorsal side and going down going to be light colour, head with curved black marking extending from snout to either side of parietal scales.

Fig. 10: *Hydrophis fasciatus*

Distribution: In the Bay of Bengal are most probably *H. fasciatus*, with which *H. atriceps* has long been associated. Myanmar (Toriba, 1993), but according to Smith, (1943), *H. atriceps* occurs from the Gulf of Siam eastward and is not known to the west. David and Ineich (1999) do not include Myanmar in its recorded range.
Habitat: This species is reported to occur mainly in brackish waters and also in shallow seas. It mainly found at the mouths of rivers.
Activity: Active in the night hours. A powerful swimmer capable of raising its head and a good part of its fore body clear out of water
Diet: Feeds exclusively on fish
Reproduction: Reproductive behavior happens in the surface of the water, it is viviparous and that the brood size may vary from 4 to 8.
Venom: Little studies and testing have been conducted on this snake due to the paucity of specimens. However the poison of this snake does appear to be capable of killing a human being with a few hours. Bites from this snake should best be treated with *Enhydrina schistosa* antivenin.

Lapemis curtus (Shaw) (Short Sea Snake)

Identification characteristics
Lepidosis*:* (Fig. 11)

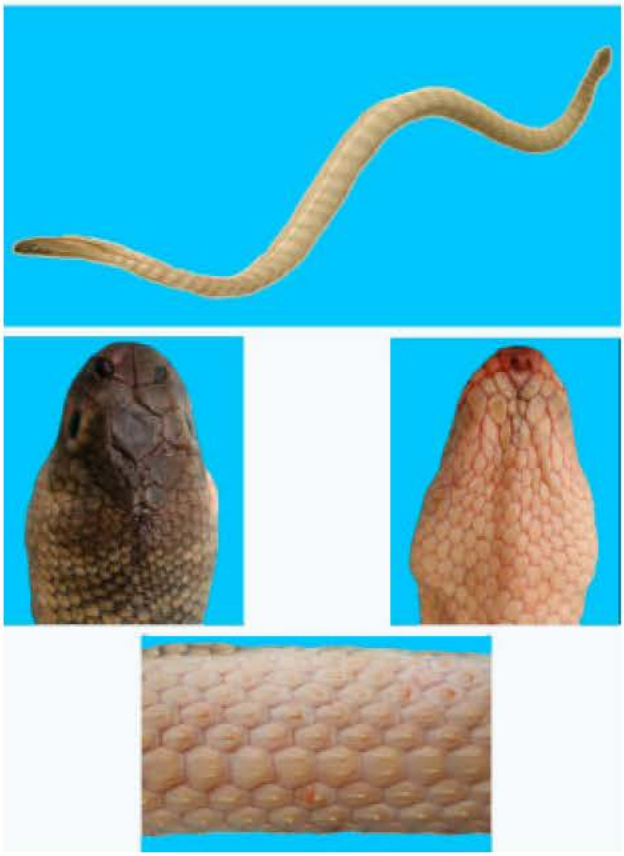

Fig. 11: *Lapemis curtus*

- Rostral: Dorsal view it is small size but protrudes downwards large part.
- Frontal: large hexagonal shape.
- Supraoculars: Half round shape.
- Parietals: The only sea snake with parietal shield on head broken up into small pieces. Both scale not in even shape.
- Prefrontals: Contact with pre and Supraocular scales. Smaller than nasals. Prefrontal usually in contact with second upper labial.
- Nasals: it occupies large area less space for rostral. Triangular shape towards the rostral. Nasals in contact with one another.
- Loreals: Absent
- Preoculars: One Preocular touch with third upper labials.
- Postoculars: 1 or 2 Postoculars
- Temporals: 2, rarely 3, anterior temporals.
- Supralabials: 7-8 upper labials 3-4 bordering eye.
- Mental: heart shape.
- Infralabials: Four pairs of which the third and forth pair bigger.
- Sublinguals: very small size Genials.
- Ventrals: Small and often divided, falling into 230 to 361 rows.

Coloration: Greenish or yellow-olive above, whitish below, 35-50 olive to dark gray dorsal bands, tapering to a point laterally, occasionally encircling body, a narrow dark ventral stripe or broad irregular band occasionally present; adults often lack any pattern and are uniform olive to dark gray; head pale olive to black, yellow markings on snout present or not.

Status: Most common snake

Distribution: The species occurs from the Persian Gulf east through India, Southeast Asia, the Philippines, Karachi, New Guinea and northern Australia (Gritis and Voris, 1990) to New Caledonia (Rasmussen and Andersen, 2000).

Habitat: It inhabits the rocky coast and visits the surface to take fresh air. The species occurs in open seas.

Size: The snout-vent length of the largest measured specimen from Australian waters was 1260 mm for a male (Fry *et al*., 2001). However, the snout-vent length of the largest measured specimen from waters off northern Java was only 697 mm for a female (n = 463) (Bergman, 1949). In addition, the total length of the largest measured specimen from waters off southeast Asia was only 851 mm (Wall, 1926). Therefore, it looks as if, the snakes attain larger size in Australian waters than elsewhere.

Activity: The species occasionally floats on the surface in a ball. The significance of this behavior is unknown. During voluntary diving, the snakes use aerobic, that is, oxygen based metabolism and build up no lactic acid debt indicative of anaerobic metabolism.

Diet: In the wild, the species eats squid (Fry *et al*., 2001) and fish (Smith, 1943; Bergman, 1949; Fry *et al*., 2001). In captivity, some researchers have found it difficult to get the snakes to eat fish (Bergman, 1949).

Reproduction: In Australian waters, one study found females with developing young in the mid-wet season (January-March) but not in the late wet season (April), mid-dry (August) or late dry (October-December) season (Fry *et al*., 2001). These two sets of observations appear to be slightly discordant with regard to stated or implied events in the mid-to late dry season. In Indonesian waters, females with freshly ovulated eggs in the oviduct were found in the middle of the dry season (June, August) and females with more advanced embryos were found in the beginning of the wet season (December-January) (Bergman, 1949). In Indian waters, females with embryos occur at the beginning of the wet season (21 June-2 July) (Wall, 1926).

Litter size in northern Australian waters, litter size ranges 1-10 with recorded means of 4.3 (n = 106) (Fry *et al*., 2001). In snakes from northern Australian waters, there was a significant positive correlation between litter size and female snout-vent length ($r^2 = 0.38$, $P < 0.001$, $n = 106$) (Fry *et al*., 2001). However, in snakes from southeastern Indian waters, there was no correlations between these two variables ($r^2 = 0.15$, $P = 0.21$, $n = 12$). In Indonesian waters, litter size had a mean of 1.9 (Bergman, 1949 and 1943).

Off southeast India, the smallest free ranging specimen had a total length of 330.2 mm and the largest embryo had a total length of 355.6 mm (Wall, 1926), hence this represents the minimum size range for neonates in this area. The length of the largest measured embryos relative to their mother's length suggests that the young are relatively large when born. For example, large embryos in females from the southeast coast of India ranged up to at least 47.3 percent of their mother's length (Wall, 1926).

The smallest gravid female from waters off northern Java had a snout-vent length of 449 mm (Bergman, 1949).

Venom: LD 50 value of this snake 0.62 mg kg^{-1} in mouse. Although it is difficult to get the snakes to bite, when they do bite one another, they seem to suffer no ill-effects (Bergman, 1949). A mouse bitten by a snake forced onto the mouse by a researched died without showing any overt signs of stress such as frantic movement or difficult breathing (Bergman, 1949).

Lapemis hardwickii **(Smith)**

Identification characteristics

- **Lepidosis*:* (Fig. 12)**
- **Rostral: Dorsal view width of the scale less and it long but protrudes downwards large part.**
- **Frontal: Smaller than nasals but other snake frontal larger than nasals.**
- **Supraoculars: Hexagonal shape.**
- **Parietals: The only sea snake with parietal shield on head broken only in the centre part of two parietal, but in the *L. curtus* most the area of parietal broken up into small pieces. Both scale even shape.**
- **Prefrontals: Prefrontal usually in contact with second upper labial.**
- **Nasals: Nasals in contact with one another**
- **Preoculars:; Small one Preocular touch with third upper labials.**
- **Postoculars: 1-2 postoculars.**
- **Temporals: 2, rarely 3, anterior temporals.**
- **Supralabials: 7-8 upper labials 3-4 bordering eye.**
- **Mental: Triangular shape.**
- **Infralabials: Four pairs of which the second and third pair bigger.**
- **Sublinguals: very small size Genials with irregular arrangement.**

Fig. 12: *Lapemis hardwickii*

- Ventrals: Ventrals small, usnally distinct anteriorly, not so posteriorly, in 114-186, in 141-230; head shields entire, parietals occasionally divided

Coloration: Body short, stout, neck region not less than half as thick at midbody; head large; Greenish or yellow-olive above, whitish below, 35-50 olive to dark gray dorsal bars, tapering to a point laterally, occasionally encircling body, a narrow dark ventral stripe or broad irregular band occasionally present; adults often lack any pattern and are uniform olive to dark gray; head pale olive to black, yellow markings on snout present or not.
Status: Common
Distribution: Inhabits coastal waters from the Persian Gulf to the shores of western India and *L. hardwickii* ranges from the coastal waters of Sri Lanka and eastern India east to New Guinea and Australia and north to the coast of China, Malaysia, Philippines and Japan.
Habitat: This species is found to inhabit coral reefs; it also occurs in estuaries and tidal zone regions with sandy or muddy bottoms. It is usually found at depths of 6 to 15 m, but it has been encountered in deeper waters (O'Shea 1996).
Size: Total length 860 mm, tail length 85 mm.
Activity: Known to be active during both day and night
Reproduction: Unknown.
Venom: Neurotoxin.
Remarks: Gritis and Voris (1990) do not recognize *L. hardwickii* as a distinct species, placing it in the synonymy of *L. curtis*. McCarthy (1993) recognizes it as a subspecies of *L. curtis*, allowing that the nominate form. Smith (1926 and 1943) argues that *L. curtis* ranges from the Persian Gulf to the west coast of India as far as Sri Lanka but that it is unknown along the east coast of India.

Praescutata Viperina (Schmidt).
Viperine sea snake

Identification Characteristics

- Lepidosis: (Fig. 13)
- Rostral: Small and Prominent it protrudes downwards.
- Frontal: Hexagonal but unevenly present.
- Supraoculars: Prominent, same size as Frontal.
- Parietals: Barrel shape, bigger scales compare to others.
- Prefrontals: Both are different shape, one scale larger than other.
- Nasals: Nostrils superior shields in contact with one another.
- Loreals: Absent
- Preoculars: Larger and extended between supraocular and prefrontal.
- Postoculars: One pair Postoculars, lower one having connection with forth upper labials and it's smaller than preoculars.
- Temporals: usually prominent one anterior temporal. Posterior temporals smaller compared the anterior temporals.
- Neck scale: Usnally 27-34 rows on the neck.
- Midbody scale: 37-50 around midbody increase in number of rows from neck to midbody.
- Supralabials: Only 4 to 5 pair scales, firest scale larger than other scales and third scale bordering eye.
- Mental: Triangular shape.
- Infralabials: Five pairs from the first pair the size the scale are reduced second third and fourth pair are large size.

Fig. 13: *Praescutata viperina*

- Sublinguals: Contain two nebulous pair and first pair small than second.
- Ventrals: scales numbers between 227-276.

Coloration: Body color, more or less bicolored, gray above, white below, the 2 usually clearly demarked on the sides, often with 25-35 dark rhomboidal spots, rarely with dark bands. Scales hexagonal, juxtaposed, in, at Midbody; narrowing posterior to about twice the width of the adjacent scales, or slightly less; Total length male 925 mm, female 820 mm; tail length male 100 mm, female 80 mm.
Distribution: Distributed elsewhere particularly south Asia and Myanmar coastal waters abundant.
Habitat: it is found in the shallow sea and brackish water and it mainly found in the rocky bottom environment.
Activity: Nocturnal very active.
Diet: Feeds exclusively on fish
Reproduction: not known
Venom: Neurotoxin

Pelamis Platurus (Linnaeus)

Pelagic, black and yellow, yellow bellied sea snake

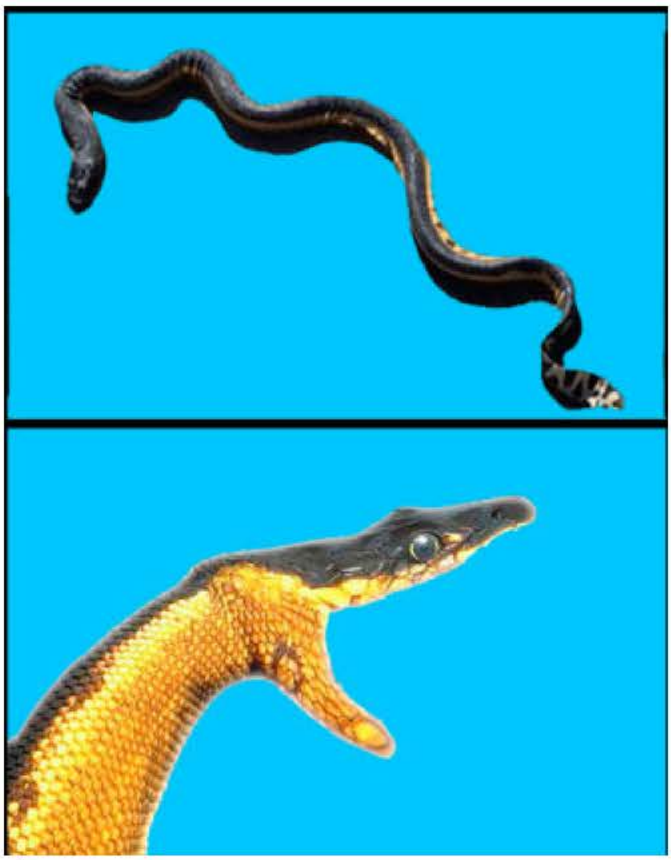

Fig. 14: *Pelamis platurus*

Identification Characteristics

Lepidosis: (Fig. 14) Prefrontals: prefrontal in contact with second upper labial Nasals: nasal shields in contact with one another Loreals: Absent Preoculars: 1-2 Postoculars: 2-3 Temporals: 2-3 small anterior temporal Infralabials: 7-8 upper labials, 4-5 below eye but separated from border by sub ocular Ventrals: ventral scales, 264-406, very small and, if distinct, divided by a longitudinal groove, but usually indistinguishable from adjacent body scales

Coloration: color variable but most often distinctly bicolored, black above, yellow or brown below, the dorsal and ventral colors sharply demarcated from one another ventrally there may be a series of black spots or bars on the yellow or brown background, or the yellow may extend dorsally so that there is only a narrow middorsal black stripe, or a series of black crossbars noticed.

Status: Common

Distribution: Indian and Pacific oceans around eastern Africa, Madagascar, Arabia and India. Coastal line of southeastern Asia, Indonesia, Japan, Australia, New Zealand and Pacific Islands. Extending to the western coast of the Americas from Equador and the Galapagos Islands north to Baja California and the Gulf of California coasts. As represent by resident populations, the species is widespread in the tropical parts of the Pacific and Indian Oceans between the 18-20°C isotherms (Dunson, 1975; Graham *et al*., 1987).

Habitat: They are usually found within a few kilometers of the coast and prefer shallow inshore waters. Normally these snakes live in waters with temperatures between 11.7 and 36 degrees Celsius. The species is the most pelagic of the sea snakes, occurring in the open ocean well away from coasts

and reefs. It is probably the only reptile that never voluntarily touches a These snakes are restricted to tropical and subtropical waters.

Size: 535 mm to 880 mm

Activity: The snakes swim by lateral undulation of the body. They can swim both forward and backward. They are capable of bursts of speed of up to 1 m sec^{-1} when diving, fleeing and feeding. In the wild, the snakes have not been observed to swim against a current. When swimming rapidly, the snakes sometimes carry the head out of water. The snakes can not move effectively on land. In fact, their laterally compressed bodies mean that they can not hold themselves upright; instead, they roll over on their sides (Kropach, 1975).

Diet: Diet. In the wild, the snakes eat only fish (Klawe, 1964; Kropach, 1975). Foraging behavior and prey capture. Small fish are often attracted to inanimate objects such as debris floating on the surface. In the wild the snakes also often lie motionless on the surface and fish are attracted to them (Kropach, 1975).

Reproduction: In the bay of bengal, females with small developing embryos have been found in late winter and females with near-term embryos have been found in early spring and mid-autumn. Gestation from observations in captivity, gestation has been inferred to last at least five months. Litter size ranges 2-6 (Wall, 1926; Kropach, 1975).

Venom: Nuerotoxic, LC 50 value of venom.

CONCLUSIONS

The sea snakes are distributed in the trophical region of the Indian and Pacific Oceans. Of the twelve species of the family Hydrophidae known from the Coramantal coastal region, all eccepting one species cocur in the shallow water near the coast some time extending up to rivers. *Pelamis platurus* has a wider range of distribution in the coastal and oceanic regions.

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