DISTRIBUTION OF SEA SNAKES IN THE SOUTH CHINA SEA AND EAST INDIAN OCEAN

by V. P. Shuntov

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The Russian fishing trawler SESKAR cruised the South China Sea from January through March 1964. A. I. Chigirinskiy and Yu. M. Maksimov observed about 70 snakes and collected 75 specimens belonging to 7 species. V. G. Osipov, when cruising the South China Sea and East Indian Ocean in November and December 1963 and January through March 1964 on the fishing trawler ORLIK, observed about 100 sea snakes. These specimens were processed by the Pacific Research Institute of Marine Fishery Management and Oceanography in Vladivostok.

Data of all the counts of sea snakes have been reduced to one denominator--the number of individ-
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uals observed per hour when the speed of the vessel is 10 knots (Figs. 1, 2, 3).

It is known that sea snakes gravitate in their distribution toward shallow coastal areas. The distribution of sea snakes presented in Fig. 1 confirms the above statement. Indeed, most of the samples taken from the open water of the East China sea, in the central part of the South China sea and northeast of the Philippine Islands did not contain any sea snakes at all; whereas the sample taken from the southern belt of the South China Sea, notably in the Gulf ofSiam, as well as between Sumatra and Kalimantan Islands, contained many sea snakes. Out of 45 samples, 38 contained snakes. In 15 samples the number of snakes varied from 1 to 5; in 10 samples from 5 to 10, and in 11 samples from 10 to 25 snakes per hour of trawling with the speed of the vessel being 10 knots (Fig. 2). Because the snakes are expert divers and spend considerable time under water, the listed figures indicate only their relative quantity in these areas. Also in the Gulf of Tonkin, north of the Gulf of Siam, the number of sea snakes was considerable (according to our observations conducted in 1961).

The number of samples taken from the Indian Ocean is, of course, too small for the elucidation of regularities in the distribution of snakes in this vast area. However, the data listed in Fig. 1 show quite clearly that in the open ocean the snakes are seldom seen. Here they usually are observed not farther than 60-70 miles from the coastline. Only on December 7 1963 were four individuals of Pelamis platurus observed in the central sector of the ocean about 800-850 miles from Ceylon land Sumatra.

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As a rule, the snakes are encountered in places with bottom depths less than 90-100 m. The main mass, however, is limited to depths less than 75 m. This is conspicuously confirmed by the character of distribution of sea snakes in areas with shoals of varying sizes. Where the shelf is narrow, the snakes are seldom observed at a distance of several tens of miles from the coast. However, in the Gulf of Tonkin and in the southern South China Sea, where the shelf is very wide, sea snakes occur in large numbers at distances of 70-100 miles off the coast (Figs. 1 and 2).

Especially large numbers of snakes are observed in shallow gulfs. The reason for this is that in places with very indented coastal line, the currents create eddy circulations which help keep mature snakes (which are not good swimmers) in a definite location and prevent the young from being transported beyond the boundaries of the shoals.

The tropical Australian and Asian Seas are most favorable for sea snakes. In addition to many shoals and gulfs, there is an abundance of fish and invertebrates in the seas, on which the sea snakes depend for food. Because of these facts, this region has become a center of abundance of qualitative and quantitative of sea snakes (as to the latter cause, one must also take into consideration historical reasons).

At our disposal were only 75 snakes obtained from several stations in the Gulf of Siam. Therefore, it is impossible to plot distribution schemes for individual species because the absolute number of species cannot be estimated by visual observations. The only exception is Pelamis platurus, which is a unique color and can be readily identified at a greater distance. In the Gulf of Siam area this species was most numerous (Fig. 3), making up 55% of the snakes.

Our observations conducted in 1961 in the Gulf of Tonkin (Shuntov, 1962) demonstrate that in the open sectors of the Gulf, P. platurus was also most numerous of the snakes. Of several tens of samples examined by V. G. Osipov in the Indian Ocean (mainly over great bottom depths at distances exceeding 50-70 miles from the coast) only 10 samples contained snakes, 8 of which consisted of only P.
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platurus. The absence of this species from samples taken in the extreme south of the South China Sea between Sumatra and Kalimantan Islands was unexpected (Fig. 3).

In the Gulf of Tonkin, P. platurus inhabits waters where the salinity exceeds 32‰. Therefore, the quantity of these snakes sharply decreases in the NW part of the gulf where the water is diluted by rivers. Off Hainan Island, however, where the water is quite saline, P. platurus is found in the littoral water (Shuntov, 1962). In the Gulf of Siam the species is more widely distributed than in the Gulf of Tonkin. The possible reason for such a distribution is the river discharges at the tip of the gulf. However, it has not yet been established how the dilution affects the distribution of P. platurus because no observations have been conducted north of 12°N.

Other species of snakes were less often observed in the given areas; out of 75 snakes caught in the Gulf of Siam, P. platurus made up 53, Astrotia stokessii (Gray) 8, Lapemis hardwickii Gray 4, Hydrophis spiralis Shaw 3, Praescutata viperina (Schmidt) 3, Hydrophis fasciata Guenther 2, Microcephalophis cantoris Schm. 2 individuals.

In the southern South China Sea and in the Gulf of Siam, several observations were conducted in various seasons. This enables us to conclude roughly about the migrations of snakes. Yu. M. Maksimov observed concentrations of snakes in the eastern part of the Gulf of Siam and in the southern part of the sea between Sumatra and Kalimantan Islands at the beginning of Feburary 1964. V. G. Osipov had observed such concentrations by the end of 1963 in the same areas. Snake concentrations in these areas were considerable at the end of March 1964 (see Figures 2 and 3). In the Gulf of Siam area one could observe migration toward the gulf. In a num-

ber of species, the migration to more concealed areas could be associated with the birth of young. This is, in a way, confirmed by the snakes that were caught during 17-20 March 1964 at three stations in the Gulf of Siam.

It is seen from the table that the females with embryos were observed only in the upper part of the Gulf. The listed data show that P. platurus reproduced during the observation period. Four young P. platurus were observed at two stations; the length of their bodies equaling that of the embryos. Undoubtedly, they were born in March. A part of the snake population would probably reproduce during April.
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It should be noted that the reproduction of sea snakes has been little investigated. For the majority of species, we do not even know the time of reproduction. According to M. Smith (1926), most of the snakes that inhabit the Gulf of Siam bear young in March and April. The data listed in the table confirms that the P. platurus reproduces at this time. On the basis of data at our disposal it is seen that Hydrophis spiralis also reproduces in the spring. We dissected three females of this species, which were caught on 17 and 18 March 1964 at the first and second stations. One of them (150 cm.) contained 8 embryos, the other (135 cm.) 5 embryos, 28-30 cm. long. Microcephalophis cantoris evidently reproduced by the end of summer. A female caught at station 2 on 18 March 1964 was 98 cm. long and had three embryos 2-3 cm. long. The reproduction of Astrotia stokessii occurs evidently in the winter. This is confirmed by samples caught on 18 March 1964: six young snakes were 37, 38, 41, 40, 40 cm. long.

Laemis hardwickii and Hydrophis fasciatus evidently reproduce in the winter or autumn. Females of these species were observed in August and September of 1961 in the Gulf of Tonkin; they contained large embryos (10-15 cm. long).

All of the sampled snakes were molting. Evidently, the molting, in contrast to reproduction, occurs at the same time in all the species. P. platurus that were observed during summer in the Gulf of Tonkin had a contrasting color with a brilliant yellow hue. P. platurus, which were caught in March 1964 in the Gulf of Siam, had a rather monotonous color with a pink hue. A new yellow skin could be observed through the epidermis by the beginning of summer.

The stomachs of the individuals that were caught in the Gulf of Siam contained only fish (mainly young sturgeons). Some individuals contained 5-7 small sturgeons, 2-6 cm. long. The main food of the snakes inhabiting the Gulf of Siam consisted of sturgeons--evidently, because these are the most numerous fishes in the area.

TABLE

DATA ON THE DISSECTION OF FEMALE P. PLATURUS
CAUGHT DURING 17 - 20 MARCH 1964

No. of Stations	Coordinates	Number	Mean Length	No. of Newly-Born and Their Length in CM	No. of Females With Embryos and The Length of Embryos in CM
1	9°07' N. 102°52' E.	10	35.0	2 (23.5; 20.0)	--
2	11°21' N. 102°31' E.	12	42.0	--	2 (18.0; 18.5; 17.0; 16.0; 16.0; 8.5)
33	12°00' N. 101°08' E.	12	40.0	2 (20.0; 24.5)	2 (20.0; 22.0)

/From 1889/

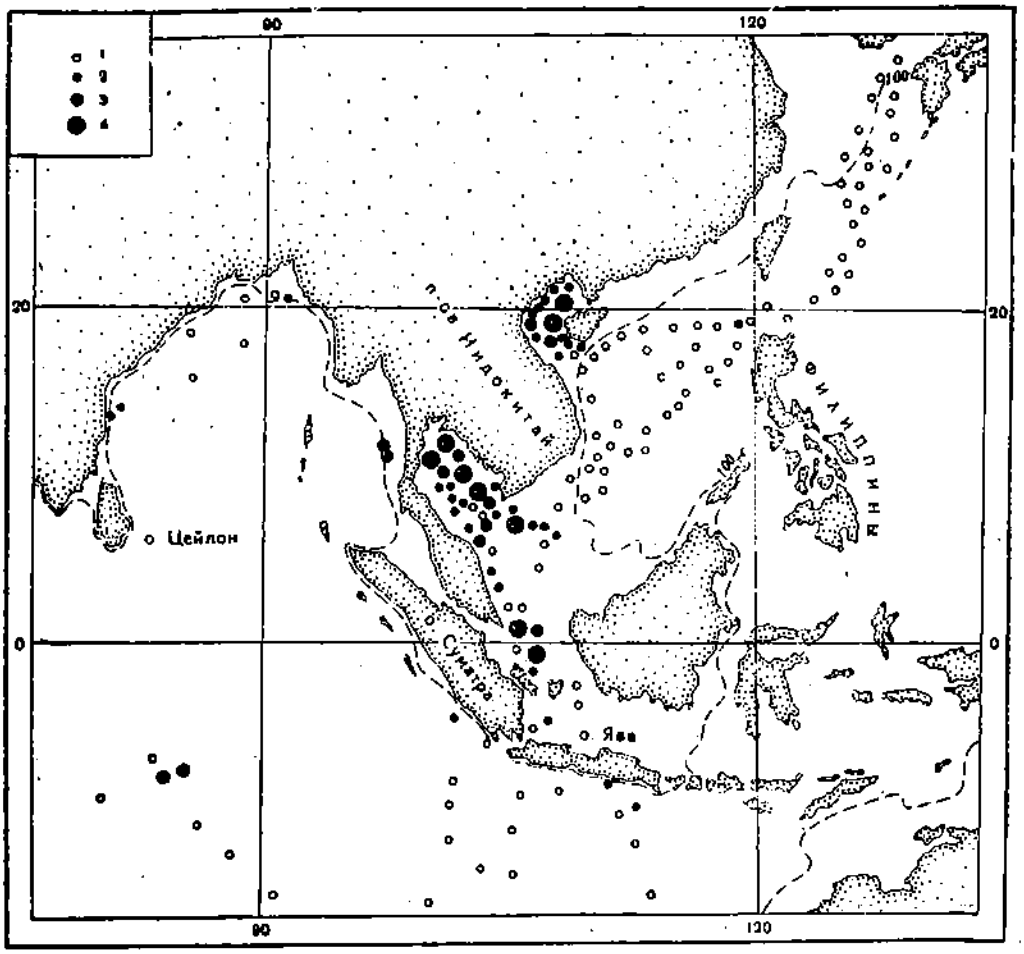

FIG. 1. Distribution of Sea Snakes in the South China Sea and East Indian Ocean From November 1963 through March 1964 (For the Gulf of Tonkin, the data pertain to 1961).

1 - Snakes have not been noticed; 2 - 1 to 5 snakes;
3 - 5 to 10 snakes; 4 - 10 to 25 snakes per 1 hour with the speed of vessel being 10 knots.

/from 1884/

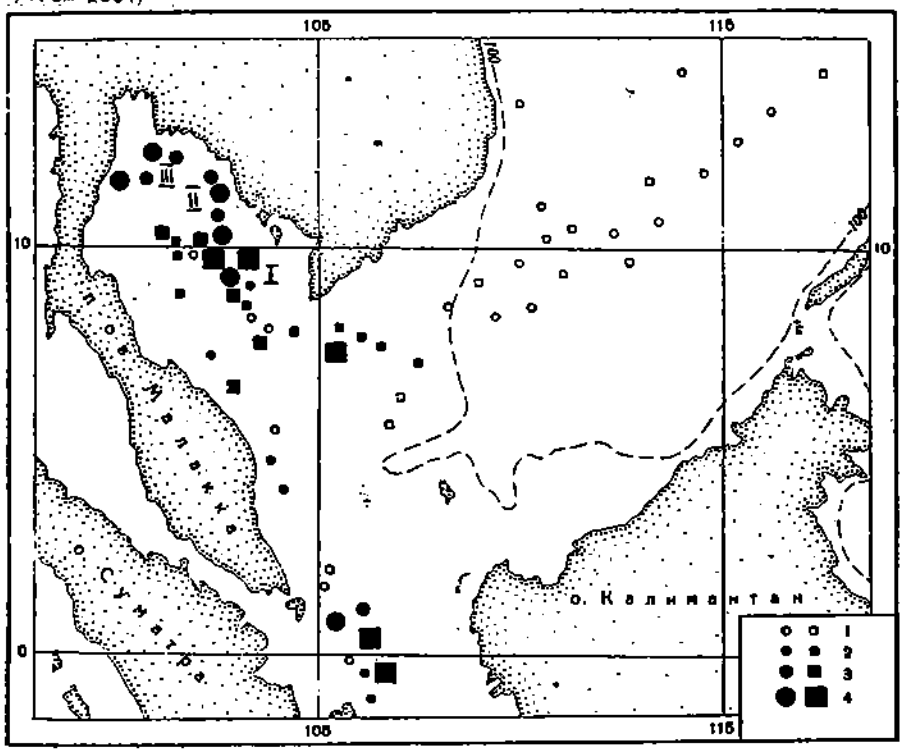

FIG. 2. Distribution of Sea Snakes in the South China Sea during February and March 1964.

1 - no snakes seen; 2 - from 1 to 5 snakes; 3 - from 5 to 10 snakes; 4 - from 10 to 25 snakes per 1 hour with the speed of vessel 10 knots. Squares denote February, Circles March; the Roman numbers (I - III) show the locations of light stations.

/from 1885/

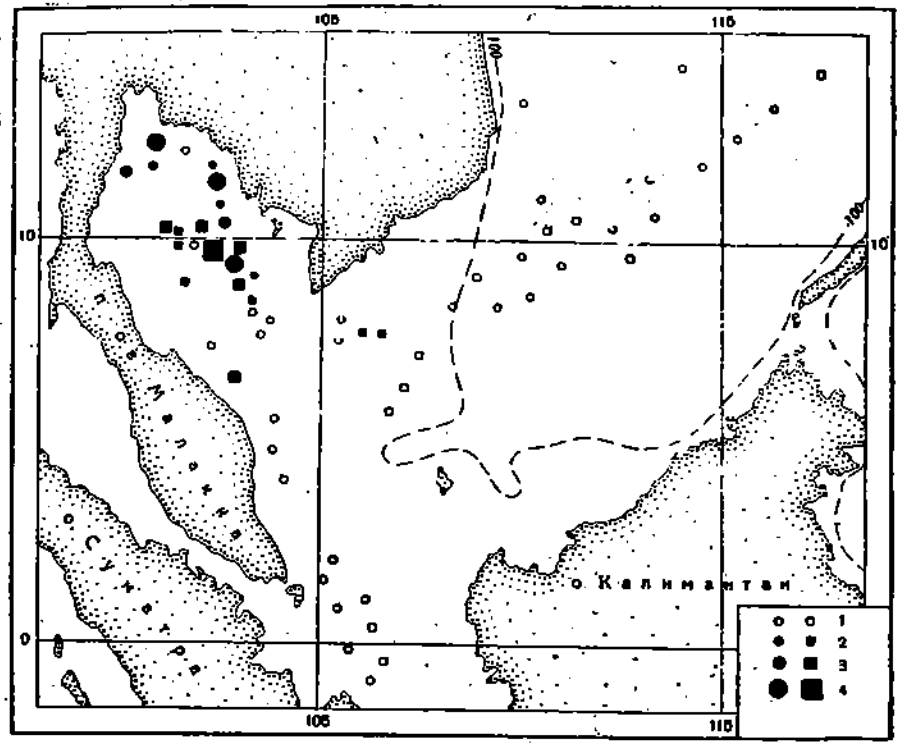

FIG. 3. Distribution of P. platurus in the South China Sea in February and March 1964.

1 - no snakes; 2 - 1 to 5 snakes; 3 - 5 t0 10 snakes; 4 - 10 to 25 snakes per hour with the speed of vessel being 10 knots.