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ON

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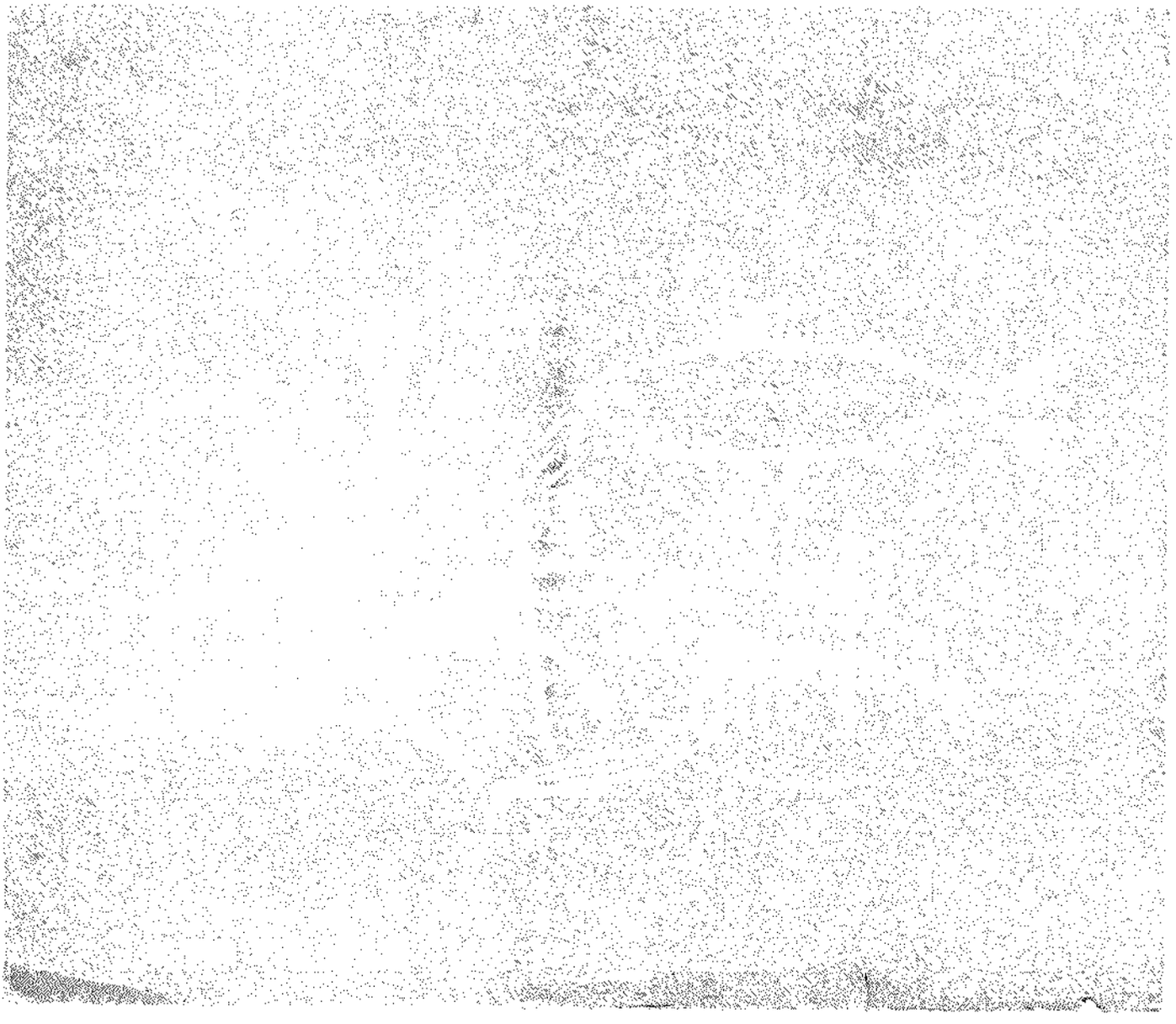

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AN ASSESSMENT ON *NEMIPTERUS* FISHERY OFF ANDHRA-ORISSA COASTS BASED ON EXPLORATORY FISHING*

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ABSTRACT

Exploratory fishing off Andhra and Orissa coasts reveals that *Nemipterus japonicus* forms an important resource in the area. The extent of its distribution and the relative abundance in space and time have been indicated. Based on the results of the exploratory fishing, an assessment of the magnitude of total resources of the species and the potential yield have been made.

INTRODUCTION

OF the twenty species of thread-fin breams belonging to the *gen. Nemipterus* Swainson (*fam. Lutjanidae, subfam. Nemipterinae*) recorded from the Indo-Australian Archipelago (Weber & De Beaufort, 1936), only five species as reported by Day (1878) under *gen. Synagris* (Kein) Gunther, *viz.*, *S. striatus*, *S. tolu* (= *Nemipterus tolu*), *S. bleekeri* (= *N. marginatus*), *S. notatus* (= *N. hexodon*), and *S. japonicus* (= *N. japonicus*), have been known to occur along the Indian coasts. In the trawl catches off the Andhra-Orissa coasts, *N. tolu*, *N. marginatus* and *N. japonicus* do occur; and among them *N. japonicus* is, perhaps, the most common in the fish catches both from the west and east coasts of India (Annual Reports of the Central Marine Fisheries Research Institute, Mandapam Camp). Along the Andhra-Orissa coasts, *N. japonicus* constituted a good fishery during the years 1964–65 to 1967–68, contributing (on an annual basis) sometimes (as in the year 1964–65) as high as 13·8% of the 'All Fish' catches or 23·67% when considered as part of he 'Miscellaneous-Small' fish catches. Yet the extent of distribution and the magnitude of abundance of *N. japonicus* along the Andhra–Orissa coasts are known only since the initiation of extensive exploratory trawling operations for ground fish by the Offshore Fishing Station (Government of India) at Visakhapatnam, employing the fishing trawlers m.t. *Ashok*, m.v. *Champa* and m.v. *Sea Horse*. In the present account an attempt is made to bring together the knowledge gained so far from the trawling operations, on the distribution and abundance of *N. japonicus* along the Andhra-Orissa coasts.

MATERIAL AND METHODS

The log records of the fishing trips maintained by the skippers of the trawlers and made available to the Central Marine Fisheries Research Sub-Station at Waltair, for detailed analyses were the chief source from which data required for the present investigation were drawn. They provided the information concerning the areas of operation, depth range at which fished, duration of each haul (effort), length of warp, directions of wind and currents and such other details of their operations. They were, however, inadequate in the sense that the catch statistics were categorised in respect of only six major groups of fish, *viz.*, the sharks and skates, the rays, the

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cat-fishes, miscellaneous-big ('Other Variety'), miscellaneous-small ('Podimeen'), and the prawns. Since *N. japonicus* along with other 30 and odd fishes, was considered as belonging to the miscellaneous-small group, the log records could serve only a limited purpose, inasmuch as there was no way of knowing the contribution of *N. japonicus* in the catches forming the miscellaneous-small group of fishes. This difficulty was solved by adoption of a system that was meticulously adhered to. The system was briefly as follows. As often as possible but at least twice a week, a scientific worker participated in the fishing voyages and noted haul by haul the percentage composition, by visual estimation, of all the fishes that composed the catches. On those occasions when a fishing voyage could not be undertaken or impracticable due to bad weather or other pressing work, a scientific worker was invariably present at the jetty at the time of unloading of fish, to make record of the catch composition and to note, by enquiry with the skipper, details of the area, depth range, etc., from which the catches were realised. Since the catch of each haul was piled separately into a heap on the deck of the trawlers, the task of identifying each heap and connecting it with a particular haul as entered in the log data was not difficult. This system of making observations, both at the jetty and on board the trawlers, ensured coverage of most fishing trips made by the trawlers. With the data on the percentage composition of the fish catches thus gathered at hand, the extent of contribution of *N. japonicus*, for that matter any other fish composing the catches, in the miscellaneous-small group of fishes knowing its total weight (from the log records), was a routine computational procedure.

Knowing the effort (in hours) from the log records and the computed weight (in kg) of *N. japonicus*, its catch rate, as so many kg per hour, for a month in a square or a latitude zone was arrived at by simply dividing the weight by the effort. The catch rates arrived at in the above manner have been used to study the magnitude of abundance of *N. japonicus* along the Andhra-Orissa coasts during the four years of this study.

The region of trawling operations, undertaken by the fishing trawlers m.t. *Ashok*, m.v. *Champa* and m.v. *Sea Horse*, was a vast area extending from Kakinada (16° 40′ N-84° 40′ E) in the south in Andhra Pradesh to False Point (20° 20′ N-86° 40′ E) in the north in the Orissa State along the coast line and upto the 200 m contour line across the continental shelf. It was roughly 7,200 sq. miles in extent. The entire region was demarcated into small squares each 100 sq. miles in extent, and numbered (Fig. 1 A). The area numbers provided by the skippers in their log records, corresponded with these numbered squares. Owing to operational difficulties it was, however, not possible to conduct exploratory fishing operations systematically in succeeding months in all the squares, with the result that what would have been the most ideal aspect of studying the seasonal fluctuations of *N. japonicus* with respect of each square, could not be achieved. Under these circumstances, the only way out was to demarcate the entire region into broader latitude zones (hereafter referred to as zones only), each zone comprising of a number of small squares and to study the seasonal fluctuations of *N. japonicus* in the respective zones. Ten zones at 30′ intervals, were identified. Each zone comprised of the following squares:

Sl.	*Latitude Zone*	*Squares comprising the zone*
1.	16° 40′	D and 16-82/C5
2.	17° 10′	1 to 9, 9A, A, B and C
3.	17° 40′	10 to 21
4.	18° 10′	22A, 22 to 32 an 32A
5.	18° 40′	33 to 41
6.	19° 10′	42A, 42 to 50A
7.	19° 40′	51A, 51 to 65
8.	20° 10′	66A, 66 to 75
9.	20° 40′	76A, 76 to 93
10.	21° 10′	94 to 104

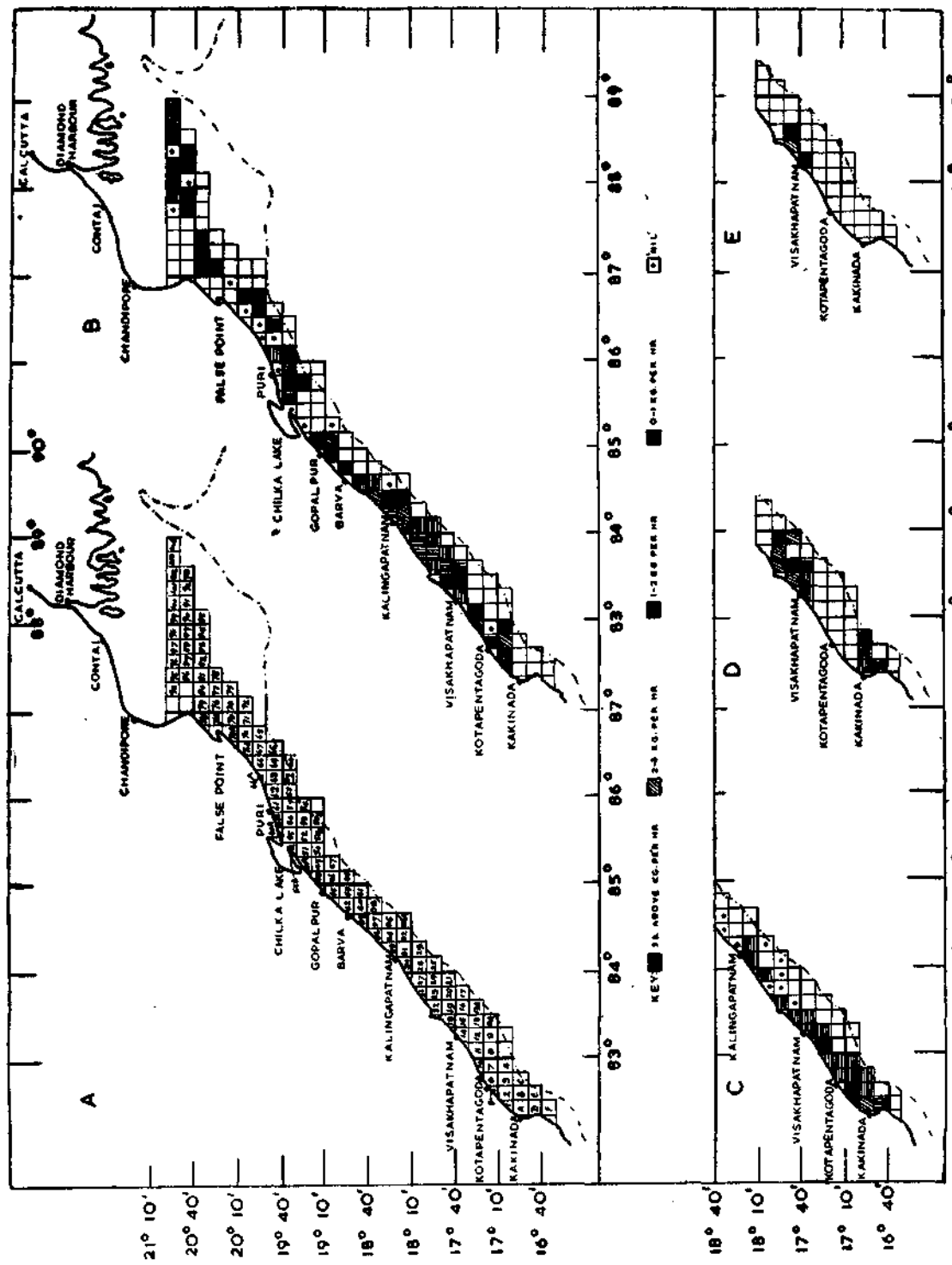

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FIG. 1. General Map of the area included in the exploratory offshore fisheries survey (A); and squares of abundance in terms of catch rates of *N. japonicus* in the catches of m.t. *Ashok* (B: 1964–65; C: 1965–66; D: 1966–67; and E: 1967–68).

TABLE I

Catch statistics of N. japonicus *in the various latitude zones during the years* 1964-65 to 1967-68 *in the catches of m.t.* Ashok

Latitude Zones	Annual Catch (C: in kg), Effort (E: hrs), and Catch Rate (C/E: kg/hr) of *N. japonicus* in the catches of m.t. Ashok in the latitude zones in the years of														
	1964-65			1965-66			1966-67			1967-68			All Years		
	C	E	C/E	C	E	C/E	C	E	C/E	C	E	C/E	C	E	C/E
16° 40′	..	..	..	48·29	25·25	1·91	8·00	3·75	2·13	..	..	..	56·29	29·00	1·94
17° 10′	61·80	33·92	1·82	171·35	74·83	2·29	11·10	12·91	0·86	..	..	..	244·25	121·66	2·01
17° 40′	296·81	232·57	1·28	97·66	202·74	0·48	2741·26	979·59	2·79	1018·70	191·43	5·32	4154·43	1606·33	2·59
28° 10′	249·39	160·69	1·55	44·00	131·08	0·34	34·10	16·25	2·09	..	..	..	327·49	307·99	1·06
18° 40′	162·85	97·29	1·69	0·00	9·50	0·00	..	..	..	..	..	..	162·85	106·79	1·52
19° 10′	177·61	130·75	1·36	..	..	..	..	..	..	..	..	..	177·61	130·75	1·36
19° 40′	210·17	113·83	1·85	..	..	..	..	..	..	..	..	..	210·17	113·83	1·85
20° 10′	79·80	50·25	1·59	..	..	..	..	..	..	..	..	..	79·80	50·25	1·59
20° 40′	60·80	37·00	1·64	..	..	..	..	..	..	..	..	..	60·80	37·00	1·64
51° 10′	61·30	33·50	1·83	..	..	..	..	..	..	..	..	..	61·30	33·50	1·38
All Latitudes	1360·53	889·77	1·53	361·30	443·40	0·81	2794·46	1012·50	2·76	1018·70	191·43	5·32	5534·99	2537·10	28
% Contribution in 'All Fish'	0·89			0·69			2·56			2·77			1·58		
Contribution in Misc. Small	2·14			2·36			6·17			7·18			4·00		

Throughout the period of this study, fishing was by otter-trawls only, *viz.*, 15 m Russian trawl by m.t. *Ashok*, 14 m Russian trawl by m.v. *Champa* and 12 m Russian trawl by m.v. *Sea Horse* (*see* Shariff, 1961; FAO/UN, 1962 for further details about the trawlers and the gear).

Results

(A) *Magnitude of Abundance of* N. japonicus

(i) *In the catches of m.t.* Ashok.—The annual total catches (Table I) of *N. japonicus* ranged from 2794·46 kg (1966–67) to only 361·30 kg (1965–66). In the years 1964–65 and 1967–68, the catches amounted to 1360·53 and 1018·70 kg. respectively. But in terms of catch rate (kg/hr), the year 1967–68 was the most productive year (5·32 kg/hr). The lowest catch rate (0·81 kg/hr) was realised, as in the case of total catches, in the year 1965–66. The catch rates in the years 1964–65 and 1966–67 were 1·53 kg/hr and 2·76 kg/hr respectively. When the percentage contribution of *N. japonicus* in the 'All Fish' catches was considered, a progressively increasing trend, except in the year 1965–66, was apparent (Table I). In the 'Miscellaneous-Small' group, however, it steadily increased through the years from 1964–65 to 1967–68. Far greater numbers of zones were covered in 1964–65 than in 1966–67, and what is important from the point of view of this study was the occurrence of *N. japonicus* in all the zones fished (Table I, Fig. 2). Among the 9 zones fished in 1964–65, the catch rate of *N. japonicus* ranged from 1·28 kg/hr (17° 40′) to 1·85 kg/hr (19° 40′). Fairly high catch rates of 1·83 kg/hr and 1·82 kg/hr, comparable with that recorded in the 19° 40′ zone, were respectively obtained from the northernmost zone of 21° 10′ and the southernmost zone of 17° 10′. In the year 1965–66, unlike in the year 1964–65, *N. japonicus* did not occur in the zone of 18° 40′. Also, the highest catch rate of 1·91 kg/hr was obtained in 16° 40′ zone. In the year 1966–67, the highest catch rate was obtained in the 17°40′ zone (2·79 kg/hr) with comparably high catch rates of 2·13 and 2·09 kg/hr in the zones of 16° 40′ and 18° 10′ respectively. The only

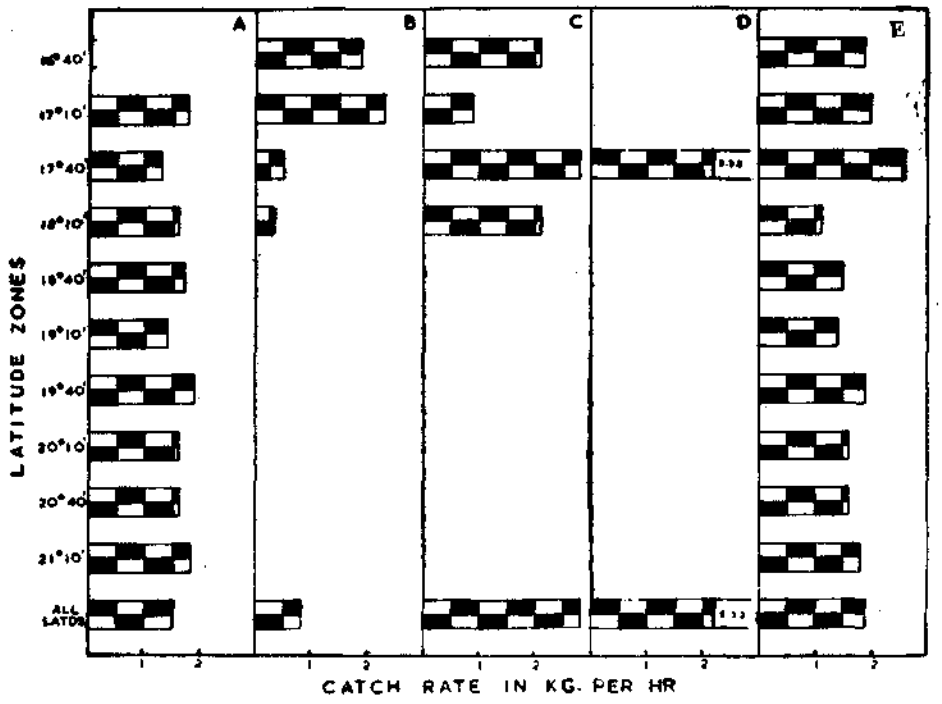

Fig. 2. Histogram to show the annual average catch rates of *N. japonicus* in the various latitude zones in the catches of m.t. *Ashok* (A: 1964–65; B: 1965–66; C: 1966-67; D; 1967–68; E: All years).

TABLE II

Catch statistics of N. japonicus *in the various latitude zones during the years from* 1964–65 *to* 1967–68 *in the catches of m.v. Champa*

Annual Catch (C: in kg), Effort (E: hrs) and Catch Rate (C/E: kg/hr) of *N. japonicus* in the catches of m.v. *Champa*

Years	in the latitude zones of													
	17° 49′			18° 10′			21° 10′			All Latitudes				
	C	E	C/E	C	E	C/E	C	E	C/E	C	E	C/E	% Contribution	
													In 'All Fish'	In Misc.-Small
1964–65	6317·06	474·24	13·32	887·14	62·41	14·21	21·00	12·00	1·75	7225·20	548·65	13·17	13·80	23·67
1965–66	597·68	671·58	0·89	153·40	113·50	1·35	..	..	..	751·08	785·08	0·96	1·24	2·85
1966–67	2228·28	830·59	2·66	61·40	18·50	3·32	..	..	..	2289·68	855·09	2·68	3·16	6·67
1967–68	2948·00	564·74	5·22	..	..	..	..	..	..	2948·00	564·74	5·22	5·65	10·36
All Years	12091·02	2547·15	4·75	1101·94	194·41	5·67	21·00	12·00	1·75	13213·96	2753·56	4·80	5·57	11·04

TABLE III

Catch statistics of N. japonicus *in the various latitude zones during the period from April,* 1964–65 *to June,* 1965 *in the catches of m.v.* Sea Horse

Years	Annual Catch (C: in kg), Effort (E: hrs) and Catch Rate (C/E: kg/hr) of *N. japonicus* in the catches of m.v. *Sea Horse* in the latitude zones of										
	17° 40′			18° 10′			All Latitudes				
	C	E	C/E	C	E	C/E	C	E	C/E	% Contribution	
										In 'All Fish'	In Misc.-Small
1964–65	992·54	555·20	1·79	221·65	44·67	4·96	1214·19	599·87	2·02	3·34	6·56
April to June, 1965	205·30	158·00	1·29	11·80	9·50	1·24	217·10	167·50	1·29	2·43	4·50
July, 1965 onwards	No fishing by m.v. *Sea Horse* condemned as unserviceable										
All Years	1197·84	713·20	1·68	232·45	54·17	4·31	1431·29	767·37	1·87	3·17	6·13

zone (17° 40′), fished in 1967–68, yielded a catch rate of 5·32 kg/hr which incidentally was also the highest catch rate realised in all the years of this study.

(ii) *In the catches of m.v.* Champa.—By far the greatest contribution to the fisheries of *N. japonicus* was obtained through the catches of this vessel, since the four year total catch amounted to 13,213·96 kg (Table II) which was about two and half times that realised in the catches of m.t. *Ashok* (5534·99 kg) during the corresponding period. This high contribution was partly due generally to consistent good catches in all the years except in 1965–66 when only 751·08 kg of *N. japonicus* was realised, and particularly to the extraordinary high catches of 1964–65 amounting to 7225·20 kg. The catches were once again good in the year 1967–68 (2948 kg) and better than those obtained in the year 1966–67 (2289·68 kg). The catch rate as well as the percentage contribution either in the ' All Fish ' catches or in the ' Miscellaneous-Small ' group, showed similar trends with the highest rates in 1964–65 and the lowest in 1965–66. An increase seen in 1966–67 further improved in 1967–68. In the three years 1964–65, 1965–66 and 1966–67 when both the zones (17° 40′ and 18° 10′) were fished, the catch rates of *N. japonicus* were better in the 18° 10′ zone than in 17° 40′ zone. In the one zone (17° 40′) fished in 1967–68, a considerably improved catch rate of 5·22 kg/hr was registered (Fig. 3).

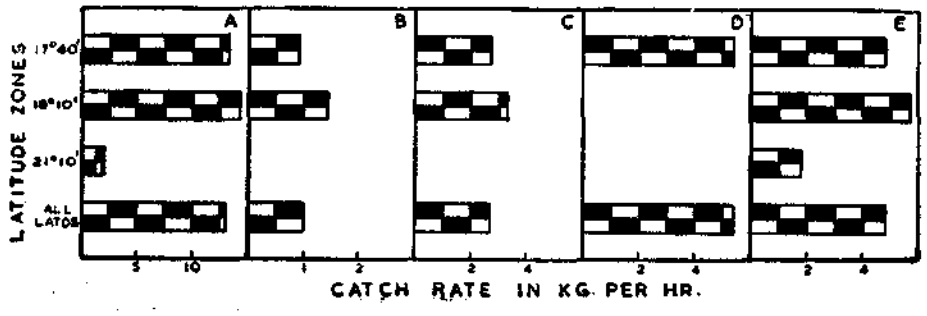

FIG. 3. Histogram to show the annual average catch rates of *N. japonicus* in the various latitude zones in the catches of m.v. *Champa* (A: 1964–65; B; 1965–66; C: 1966–67; D: 1967–68; E: All years).

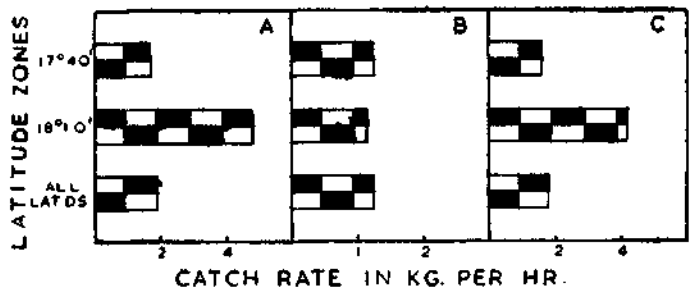

FIG. 4. Histogram to show the annual average catch rates of *N. Japonicus* in the various latitude zones in the catches of m.v. *Sea Horse* (A: 1964–65; B: April 1965 to June 1965; C: April, 1964 to June, 1965).

(iii) *In the catches of m.v.* Sea Horse.—There was fishing by m.v. *Sea Horse* for only 3 months *viz.*, April, May and June, in 1965, the vessel having been condemned as unserviceable thereafter. Although in this year catch rates of 1·29 and 1·24 kg/hr were respectively realised in the two zones fished, *i.e.*, 17° 40′ and 18° 10′ (Table III, Fig. 4), they were strictly not comparable with those obtained in the corresponding zones of 1964–65 when catch rates of 1·79 and 4·96 kg/hr were obtained in the respective zones of 17° 40′ and 18° 10′. since the latter represent catch rates realised over an annual period. However, the catch rate of *N, japonicus* in the catches of m.v. *Sea Horse* in the one year of its fishing was better in the 18° 10′ zone than in the 17° 40′ zone, and resembled a similar situation obtained in the catches of m.v. *Champa*.

TABLE IV

Monthly average catch rates of N. japonicus *in the various latitude zones during the years from* 1964–65 *to* 1967–68 *in the catches of m.t.* Ashok

Monthly average catch rate (kg/hr) of *N. japonicus* in the catches of m t. *Ashok* during the years 1964–65 to 1967–68 in the various latitude zones.

	16° 40′	17° 10′	17° 40′	18° 10′	18° 40′	19° 10′	19° 40′	20° 10′	20° 40′	21° 10′	All Latitudes
1964–65											
April	..	..	1·24	1·69	2·83	1·31	2·38	..	..	..	1·86
May	..	..	*(22·17)	4·41	2·60	*(13·50)	..	..	..	..	1·17
June	..	1·36	2·17	0·06	0·46	0·16	2·00	..	..	..	0·96
July	..	..	0·88	..	3·22	0·34	..	..	..	..	1·14
August	..	..	0·61	0·14	..	..	..	..	..	..	0·49
September ..	2·27	1·87	0·18	0·42	1·45	0·17	..	..	..	..	0·96
October	..	..	0·71	2·35	1·52	0·70	2·15	..	..	..	1·51
November ..	..	..	0·99	0·15	*(2·00)	0·05	..	..	..	..	0·29
December ..	..	..	3·65	4·70	..	3·95	7·78	3·02	0·38	..	4·43
January	1·83	2·02	2·89	..	3·50	0·88	1·75	0·62	..	..	1·81
February.. ..	..	..	2·31	0·87	0·05	..	..	0·57	4·50	3·10	1·83
March	..	..	..	0·87	0·48	0·94	0·23	0·06	4·56	1·29	1·68
Annual	1·82	1·28	1·55	1·67	1·36	1·85	1·59	1·64	1·83	1·53	
1965–66											
April ..	4·01	4·20	1·92	0·24	*(8·50)	..	..	..	..	..	2·77
May	..	..	0·78	0·37	*(1·00)	..	..	..	..	..	0·65
June to November	No Fishing										
December ..	..	..	0·26	2·05	..	..	..	..	..	..	0·64
January	..	..	0·39	..	..	..	..	..	..	..	0·39
February.. ..	..	..	0·19	0·44	..	..	..	..	..	..	0·22
March ..	0·54	2·88	1·03	0·16	..	..	..	..	..	..	0·27
Annual ..	1·91	2·29	0·48	0·34	* (9·50)	..	..	..	..	..	0·81
1966–67											
April ..	2·13	0·86	0·29	2·00	..	..	..	..	..	..	0·77
May	..	..	0·17	..	..	..	..	..	..	..	0·17
June	..	..	0·01	..	..	..	..	..	..	..	0·01
July	..	..	0·39	..	..	..	..	..	..	..	0·39
August ..	No Fishing										
September ..	..	..	1·61	..	..	..	..	..	..	..	1·61
October	..	..	2·30	..	..	..	..	..	..	..	2·30
November ..	..	..	4·90	..	..	..	..	..		..	4·90
December ..	..	..	4·85	..	..	..	..	..	..	..	4·85
January	..	..	3·50	..	..	..	..	..	..	..	3·50
February.. ..	..	..	6·20	3·28	..	..	..	..	..	..	0·17
March	..	..	4·50	..	..	..	..	..	..	..	4·50
Annual ..	2·13	0·86	2·79	2·09	..	..	..	..	..	..	2·76
1967–68											
April	..	..	3·60	..	..	..	..	..	..	..	3·60
May	..	..	4·40	..	..	..	..	..	..	..	4·40
June	..	..	*(8·00)	..	..	..	..	..	..	..	..
July	..	..	0·21	..	..	..	..	..	..	..	0·21
August to February	No Fishing										
March	..	..	12·04	..		..	..	..	..	..	12·04
Annual			5·32	..		..	..	..	..	..	5·32

* Fished but without *N. japonicus* in the Catches (Fishing effort in hrs.)

(B) *Seasonal Fluctuations*

(i) *In the catches of m.t.* Ashok.—The monthly average catch rates of *N. japonicus* are set in Table IV and diagrammatically represented in Fig. 5. During the year 1964–65, in the 17° 10′ zone there was a single peak in September (2·27 kg/hr). The 17° 40′ zone was characterised by three peaks of abundance during June (2·17 kg/hr), September (1·87 kg/hr) and December (3·65 kg/hr). A similar trend was noticed in the 18° 10′ zone, but with the difference that the three peaks of abundance were in May (4·41 kg/hr), October (2·35 kg/hr) and December (4·70 kg/hr). Although the succeeding 18° 40′ zone continued to be characterised by three peaks of abundance, the catch rate of October (1·52 kg/hr) was not as high as those realised either in April (2·85 kg/hr) or in July (3·22 kg/hr). The month of April (1·31 kg/hr) continued to be one of the three peak months of abundance in the next zone of 19° 10′ also, with September (1·45 kg/hr) and December (3·95 kg/hr) being the other peak months of abundance. As in the previous two zones, in the 19° 40′ zone also April (2·38 kg/hr) continued to be one peak month of abundance. But unlike the previous zones, this zone was characterised with only two peaks of abundance, the second peak month being December (7·78 kg/hr). Also, in no other zone a catch rate as high as 7·78 kg/hr was realised. In the next three zones, *viz.*, 20° 10′, 20° 40′ and 21° 10′, while the period from December to March was common to the former two zones, in the latter one zone fishing was conducted in February and March only. Furthermore, in all the three zones, there was only one peak month of abundance—December (3·02 kg/hr), March (4·56 kg/hr) and February (3·10 kg/hr) respectively. In the year 1965–66, the catch rate of *N. japonicus* realised in the zone 16° 40′ was better in April (4·01 kg/hr) than that obtained in March (0·54 kg/hr). In the 17° 10′ zone also, a better catch rate was recorded in April (4·20 kg/hr) than that in March (2·88 kg/hr). April (1·92 kg/hr) and March (1·03 kg/hr) continued to be the months of abundance in the 17° 40′ zone. In the 18° 10′ zone, however, there was only one peak of abundance and it was in the month of December (2·05 kg/hr). In the year 1966-67, the zones of 16° 40′ and 17° 10′ were visited only in April and the catch rates realised respectively were 2·13 and 0·86 kg/hr. In the 17° 40′ zone, the two peak months of abundance were November (4·90 kg/hr) and February (6·20 kg/hr). In the two months when fishing was carried out in the 18° 10′ zone, catch rates of 3·28 and 2 kg/hr were realised in the months of Febraury and April respectively. During the year 1967–68, in the one zone of 17° 40′ fished, a peak catch rate of 12·04 kg/hr was obtained in March and a fairly high catch rate of 4·40 kg/hr in May. Incidentally it is of interest that in no other year a catch rate as high as that recorded in March of 1967–68 was obtained. A catch rate of 7·78 kg/hr realised in the month of December of 1964–65 in the zone of 19° 40′ was, perhaps, the nearest comparable figure.

(ii) *In the catches of m.v.* Champa.—While the zone of 17° 40′, in the year 1964–65, was characterised by two peaks of abundance in the months of April (108·12 kg/hr) and March (6·03 kg/hr), the 18° 10′ zone in addition to the two peaks of abundance in April (29·82 kg/hr) and March (2·74 kg/hr), had a third peak of abundance in October (1·26 kg/hr) also (Table V, Fig. 6). During the year 1965–66 also in the 17° 40′ zone there were two peaks in April (3·47 kg/hr) and December (2·84 kg/hr). Similarly the 18° 10′ zone, as in 1964–65, was characterised by two major peaks of abundance in April (2·59 kg/hr) and November (3·39 kg/hr) and a minor peak of abundance in February (1·70 kg/hr). During both the years of 1966–67 and 1967–68, in the 17° 40′ zone a slight departure was noticed in the peaks of abundance in that there was but a single peak of abundance in the month of January (7 kg/hr) in the former year and in May (15·60 kg/hr) in the latter year. Furthermore, the catch rates in the year 1966–67 were generally good during the months from August to February, except in November (0·80 kg/hr), when the catch rates ranged from 1·5 kg/hr (September) to 6·3 kg/hr (February). Also, an improvement seen in the catch rates in the year 1966–67 further improved in the year 1967–68. There was fishing for only three months in the year 1966–67 in the 18° 10′ zone and a peak catch rate of 4·15 kg/hr was realised in the month of August in this zone.

(iii) *In the catches of m.v.*. Sea Horse—The catch rates (Table VI, Fig. 7) of *N. japonicus* in the catches of m.v. *Sea Horse* in the one year of its fishing, *i.e.*, 1964–65, were generally good in the 18° 10′

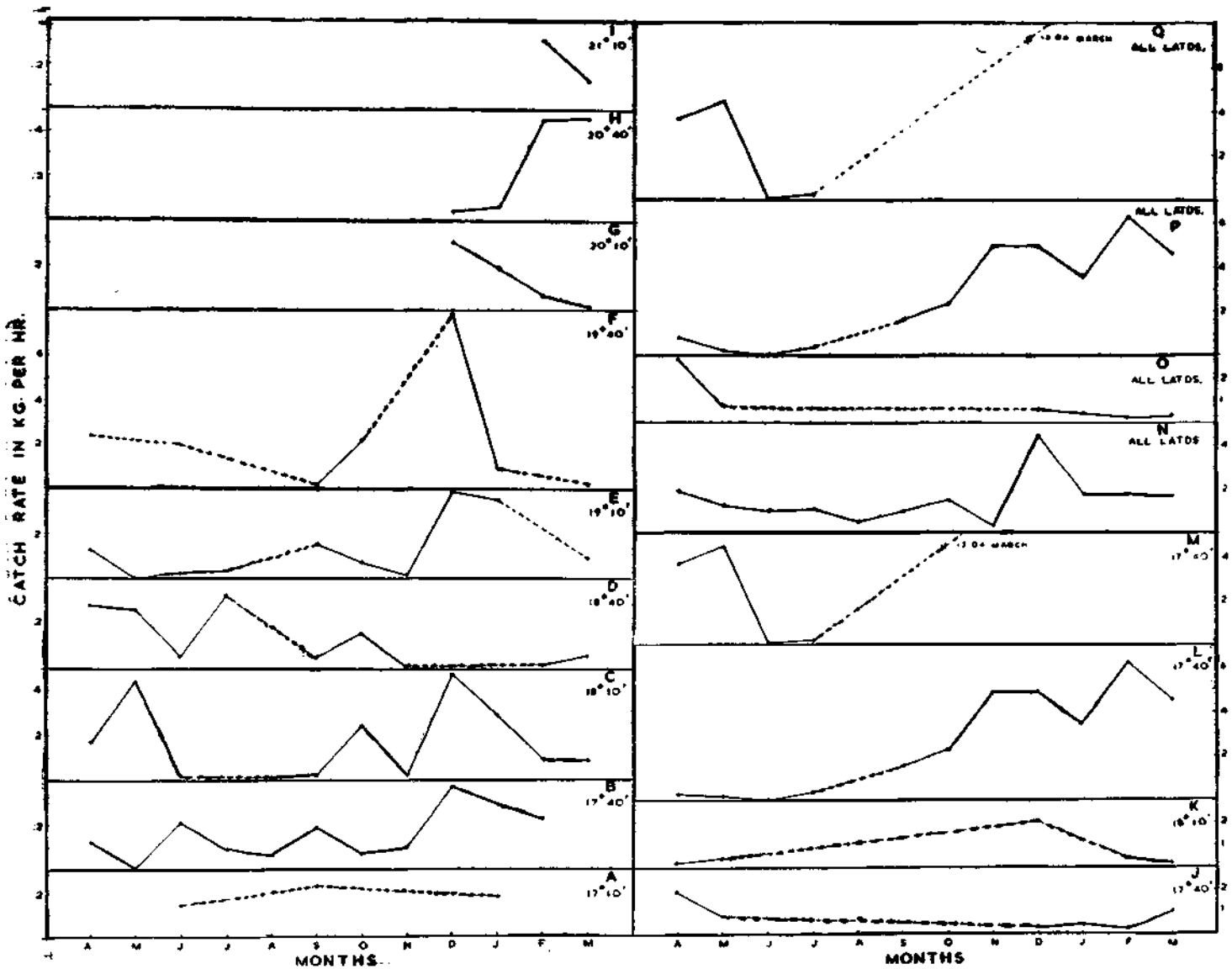

FIG. 5. Seasonal fluctuations of catch rates of *N. japonicus* in the catches of m.t. *Ashok* in the various latitude zones in the year 1964–65 (A to I and N); 1965–66 (J, K and O); 1966–67 (L and P); 1967–68 (M and Q). Broken lines indicate discontinuous data.

TABLE V

Monthly average catch rates of N. japonicus *in the various latitude zones during the years from* 1964-65 *to* 1967-68 *in the catches of m.v.* Champa.

Years	Monthly average catch rate (kg/hr) of *N. japonicus* in the catches of m.v *Champa* during the years 1964-65 to 1967-68 in the various latitude zones			
	17° 40′	18° 10′	21° 10′	All latitudes
1964-65 ..				
April ..	108·12	29·62	..	80·29
May ..	1·43	..	..	1·43
June ..		No fishing		
July ..	0·62	*(2·50)	..	0·59
August ..	0·17	0·82	..	0·26
September ..	0·54	..	..	0·54
October ..	0·53	1·26	..	0·58
November ..		No fishing		
December ..	1·25	*(2·00)	..	1·07
January ..		No fishing		
February ..	0·55	0·73	1·75	0·83
March ..	6·03	2·74	..	5·68
Annual ..	13·32	14·21	1·75	13·17
1965-66 ..				
April ..	3·47	2·59	..	3·20
May ..	0·53	*(6·00)	..	0·49
June ..	0·01	*(11·00)	..	0·01
July ..	0·001	..	..	0·001
August ..	0·16	0·99	..	0·42
September ..	0·14	..	..	0·14
October ..	1·23	*(11·00)	..	1·08
November ..	0·79	3·39	..	1·04
December ..	2·84	0·54	..	1·61
January ..	1·44	0·93	..	1·39
February ..	0·68	1·70	..	0·91
March ..		No fishing		
Annual ..	0·89	1·35	..	0·96
1966-67 ..				
April ..		No fishing		
May ..	*(23·92)	..	..	*
June ..	0·60	..	..	0·60
July ..	0·14	..	..	0·14
August ..	3·42	4·15	..	3·50
September ..	1·50	..	..	1·50
October ..	3·25	2·60	..	3·24
November ..	0·80	..	..	0·80
December ..	3·25	2·20	..	3·46
January ..	7·00	..	..	7·00
February ..	6·30	..	..	6·30
March ..		No fishing		
Annual ..	2·66	3·32	..	2·68
1967-68 ..				
April ..	4·20	..	..	4·20
May ..	15·60	..	..	15·60
June ..	0·14	..	..	0·14
July ..	0·30	..	..	0·30
August ..	0·30	..	..	0·30
September ..	0·28	..	..	0·28
October ..	1·30	..	..	1·30
November ..	1·80	..	..	1·80
December to February ..		No fishing		..
March ..	13·70	..	..	13·70
Annual ..	5·22	..	..	5·22

* Fished but without *N. japonicus* in the catches (Fishing effort in hrs.).

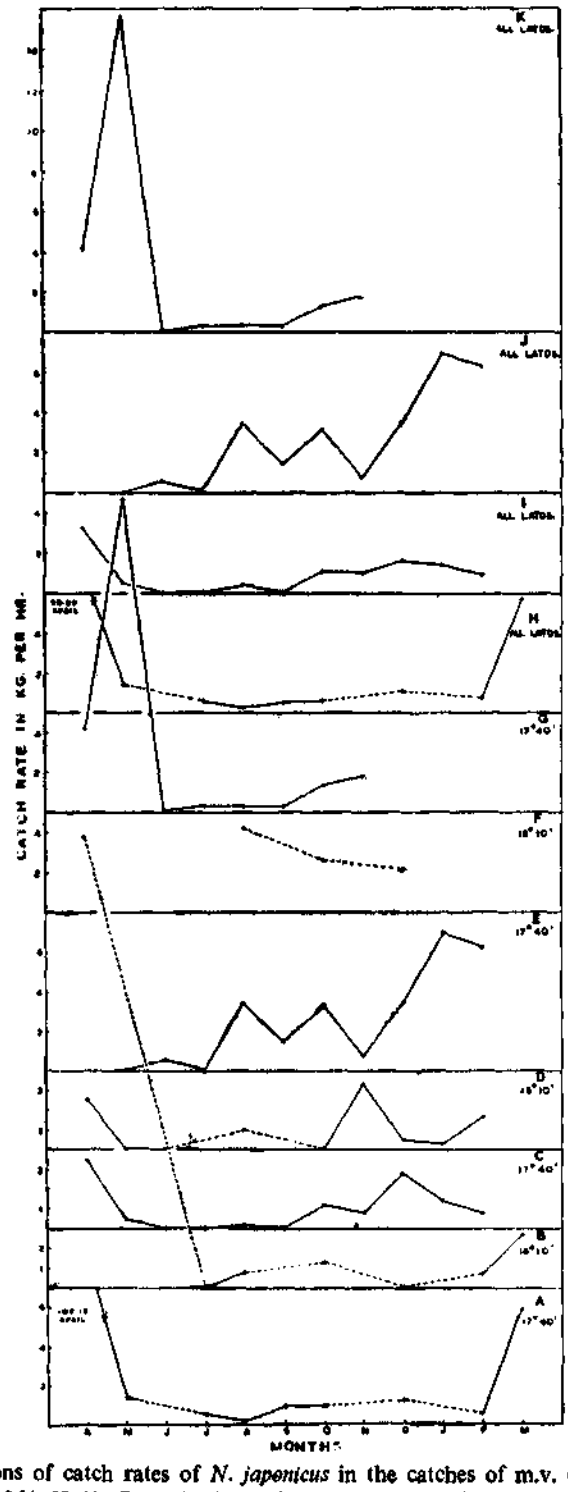

FIG. 6. Seasonal fluctuations of catch rates of *N. japonicus* in the catches of m.v. *Champa* in the various latitude zones in the year 1964–65 (A, B, and H); 1965–66 (C, D and I); 1966-67 (E, F and J). 1967–68 (G and K). Broken lines indicate discontinuous data.

zone similar to the situation obtained in the catches of m.v. *Champa*. Also, in both the zones of 17° 40′ and 18° 10′, as in the case of m.v. *Champa*, there was only one peak of abundance in the month of February (7·46 kg/hr) in the former zone and in January (14·50 kg/hr) in the latter zone.

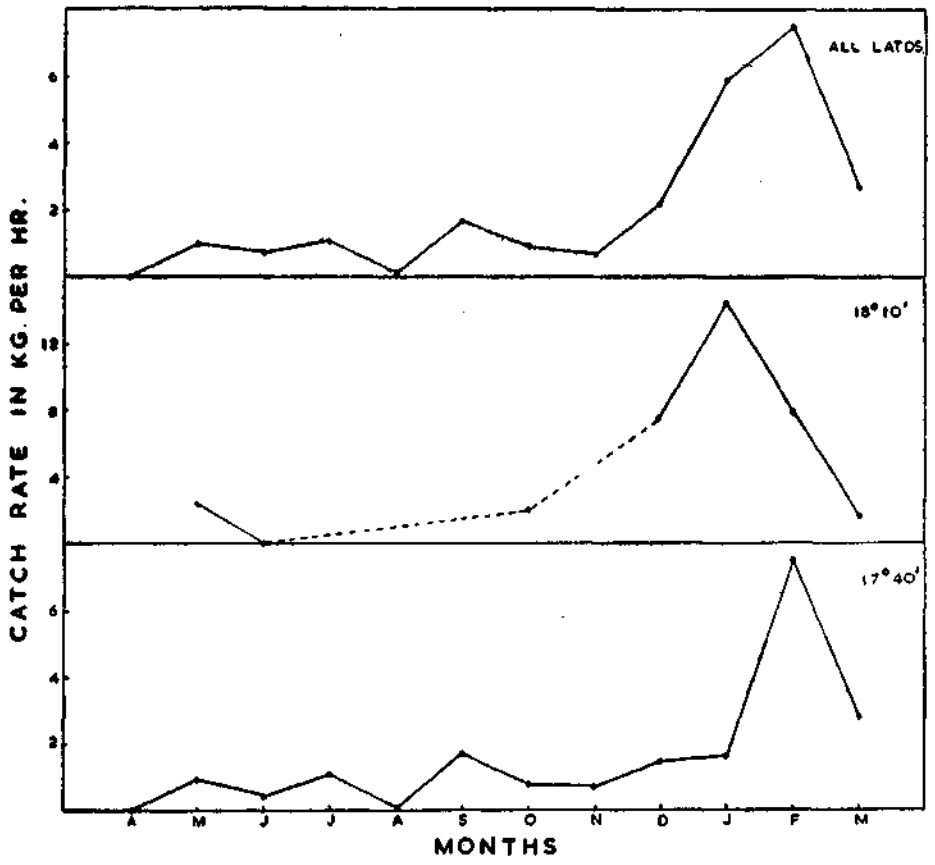

FIG. 7. Seasonal fluctuations of catch rates of *N. japonicus* in the catches of m.v. Sea Horse in the various latitude zones in the year 1964–65. Broken lines indicate discontinuous

(C) *Squares of Abundance*

In the last two sections, it was seen that the annual average catch rates varied not only from one zone to another within a year but also between years (Section A). Furthermore, the peak months of abundance, as indicated by the monthly average, catch rate, also similarly differed (Section B). The question then arose whether these features were a consequence of localisation of populations of *N. japonicus* to a particular square(s) and if so, what was the magnitude of abundance, in terms of annual average catch rate of *N. japonicus* in such square(s) of localisation. In Tables VII and VIII and Figs. 1 (B–E) and (A–F), are presented the results of analyses carried out with the above object in view. In the following Tables A, B and C are shown the zonewise distribution of the number of squares that yielded various grades of catch rates. It was, thus, seen (Tables A–C, Fig. 8 A–F), that the southern zones upto the 18° 40′ zone, as also the northern zones

TABLE VI

Monthly average catch rate (kg/hr) of N. japonicus *in the catches of m.v.* Sea Horse *during the years* 1964–65 *to* 1967–68 *in the various latitude zones*

a Zones 1964–65	17° 40′	18° 10′	All Latitudes
April	*(5·91)	..	..
May	0·98	..	0·98
June	0·52	2·50	0·70
July	1·07	*(1·50)	1·05
August	0·09	..	0·09
September	1·72	..	1·72
October	0·78	2·07	0·89
November	0·69	..	0·69
December	1·48	7·54	2·21
January	1·60	14·50	5·90
February	7·46	7·77	7·54
March	2·83	1·81	2·73
Annual	1·79	4·96	2·02
1965–66			
April	1·37	1·24	1·36
May	1·38	..	1·38
June	*(1·38)	..	*
July to March	No Fishing, the vessel having been condemned as unserviceabl		
Annual	1.29	1.24	1.29

* Fished but without *N. japonicus* in the catches (Fishing effort in hrs)

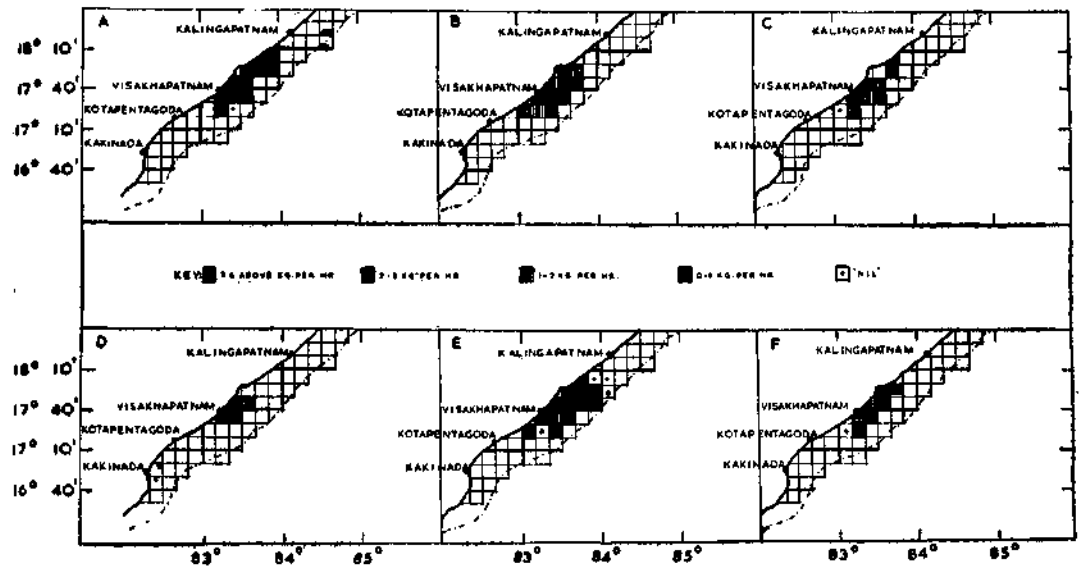

FIG. 8. Squares of abundance in terms of catch rates of *N. japonicus* in the catches of m.v. *Champa* (A: 1964–65; B: 1965–66; C: 1966–67; D: 1967–68) and m.v. *Sea Horse* (E: 1964–65; F: April, 1965 to June, 1966).

TABLE VII

Squares of abundance in terms of catch rates of N. japonicus *in the catches of m.t.* Ashok *during the years from* 1964–65 *to* 1967–68

Annual average catch rate (c.r.) of *N. japonicus* in the catches of m.t. *Ashok* during the years 1964-65 to 1967-68 (April to March)

Year	Square	c.r. (kg/hr)	Rank	Month(s) of high c.r. (in the order of abundance)
1964–65	92	10·50	1	March (10·50)
	102	6·25	2	,, (6·25)
	89	6·25		,, (6·25)
	91	4·50	3	February (4·50)
	58	4·22	4	December (13·70)
	34	3·70	5	April (5·40)
	99	3·51	6	March (3·51)
	11	3·39	7	September (4·14)
	67	3·38	8	December (5·90)
	53	3·10	9	June (3·10)
	48	3·04	10	December (7·90)
	3	2·89	11	September (3·56)
	46	2·83	12	March (27·00)
	10	2·44	13	January (4·40)
	57	2·30	14	December (7·90) and October (3·06)
	30	2·24	15	May (5·24)
	103	2·25	16	February (2·25)
	31	2·15	17	,, (4·00)
	36	2·03	18	July (4·75); October (3·95) and April (2·42)
	23	1·99	19	December (10·90) and January (5·00)
	2	1·95	20	June (2·80)
	6	1·91	21	January (1·91)
	26	1·90	22	October (3·84); December (2·70) and April (2·11)
	33	1·80	23	May (1·80)
	70	1·78	24	January (3·50)
	4	1·75	25	,, (2·30)
	104	1·70	26	March (1·70)
	19	1·66	27	December (4·70); January (4·50) and October (3·67),
	27	1·45	28	December (2·50) and October (1·83)
	55	1·23	29	April (2·38)
	64	1·23		March (1·23)
	15	1·21	30	January (4·30) and November (2·27)
	68	1·20	31	February (1·20)
	18	1·16	32	April (4·68) and January (3·30)
	16	1·12	33	January (2·80)
	1	1·01	34	June (1·01)
	37	1·00	35	May (6·40)
	32	0·94	36	April (1·21)
	45A	0·88	37	,, (1·30)
	26A	0·86	38	,, (0·86)
	39	0·80	39	March (0·80)
	56	0·80		September (0·80)
	76	0·80		January (0·80)
	100	0·75	40	February (0·75)
	14	0·56	41	July (1·27)
	81	0·54	42	January (0·54)
	80	0·50	43	,, (0·50)
	88	0·50		March (0·50)
	22	0·42	44	February (1·40) and January (1·20)
	45	0·38	45	September (2·00) and April (1·30)
	79	0·38		December (0·38)
	24	0·32	46	March (0·35)
	20	0·29	47	January (0·30)
	42	0·24	48	March (1·50)
	28	0·23	49	April (0·52)
	25	0·08	50	March (0·08)
	62	0·06	51	,, (0·06)
	98	0·06		,, (0·06)

TABLE VII—*Contd.*

Areas with 'nil' catch rate: 7, 35, 47, 48A, 51A, 55B, 60A, 61, 63, 66A, 66, 70A, 73, 90, 97 and 101 (Effort: 2, 2·50, 0·75, 2, 3, 4, 2·25, 2, 6, 2, 2, 6·50, 8, 1, 6 and 3 hrs. respectively)

Year	Square	c.r. (kg/hr)	Rank	Month(s) of high c.r. (in the order of abundance)
1965–66	2	11·44	1	April (11·44)
	1	6·20	2	,, (6·20)
	11	3·00	3	,, (3·00)
	A	2·64	4	,, (5·13)
	D	1·91	5	,, (4·01)
	22	0·85	6	December (2·10)
	15	0·74	7	May (0·74)
	18	0·60	8	,, (0·89)
	30	0·60		,, (0·77)
	10	0·58	9	April (0·75)
	28	0·53	10	March (0·53)
	12	0·48	11	,, (1·04)
	6	0·45	12	April (1·00)
	7	0·34	13	March (0·34)
	31	0·31	14	May (0·43)
	14	0·26	15	January (0·42) and December (0·30)
	27	0·22	16	March (0·29)
	3	0·15	17	,, (0·18)
	C	0·14	18	,, (0·22)
	B	0·08	19	April (0·30)
	4	0·07	20	,, (0·14)

Areas with 'nil' catch rate: 19, 23, 24, 25, 26, 29, 33, 36 and 37 (Effort: 3·75, 4·50, 4·75, 10·75, 17·83, 6·08, 1, 4·50 and 4·50 hrs. respectively)

1966–67	19	6·02	1	February (8·50) and November (6·80)
	18	2·99	2	December (5·40) and February (5·30)
	22	2·50	3	April (2·50)
	23	2·31	4	,, (2·31)
	21	2·22	5	,, (2·22)
	D	2·13	6	,, (2·13)
	16	1·68	7	February (3·20)
	24	1·33	8	April (1·50)
	C	1·08	9	,, (1·08)
	15	0·90	10	December (5·40)
	B	0·71	11	April (0·71)
	14	0·23	12	March (1·40)
	A	0·02	13	April (0·02)
1967–68	14	8·92	1	March (14·90) and May (7·40)
	19	3·76	2	May (4·20) and April (3·80)
	18	2·55	3	March (4·60); May (3·90) and April (3·20)

of 20° 40′ and 21° 10′, appeared to yield richer catch rates. Though comparable catch rates in a few squares in zones lying between the limits of the three previously mentioned zones, were obtained, as in the year 1964–65, the number of squares that yielded better catch rates being fewer, these zones could only be considered poor in comparison, with regard to the fisheries of *N. japonicus*. As most fishing by m.v. *Champa* and m.v. *Sea Horse* during the four years by the former vessel and one year by the latter, was confined only to two zones, *viz*, 17° 40′ and 18° 10′, the catch rates of *N. japonicus* realised in the various squares comprising these zones (Table VIII, Fig. 8 A–F) are helpful only in confirming the earlier conclusion that *N. japonicus* is abundant in the southern zones. In the absence of any appreciable fishing by these vessels in the northern latitude zones, it is difficult to visualise to what extent the catch rates would have compared, had they fished, with those obtained by m.t. *Ashok* in the northern zones. Also, it is of interest to note that most of the productive squares are located away from the shore and could, perhaps, be taken to indicate that

TABLE VIII

Squares of abundance in terms of catch rates of N. japonicus *in the catches of m.v.* Champa *during the years from* 1964–65 *to* 1967–68 *and m.v.* Sea Horse *during the period from April,* 1964 *to June,* 1965

Annual average catch rate (c.r.) of *N. japonicus* during the years 1964–65 to 1967–68 (April to March) in the catches of

	m. v. *Champa*				m. v. *Sea Horse*				
Year	Square	c.r. (kg/hr)	Rank	Month(s) of high c.r. (in the order of abundance)	Year	Square	c.r. (kg/hr)	Rank	Month(s) of high c.r. (in the order of abundance)
1964–65	26	64·25	1	April (76·60)	1964–65	18A	20·00	1	February (20·00)
	23	50·80	2	,, (150·00)		20	7·64	2	,, (8·27)
	14	18·09	3	,, (129·70)		22	6·01	3	January (14·50) and February (13·20)
	15	17·70	4	,, (290·40) and March (8·81)		21	5·88	4	March (5·88)
	27	14·80	5	,, (17·10)		26	5·62	5	March (5·62)
	18	13·91	6	,, (116·90) and March (10·02)		23	5·18	6	February (9·44)
	19	8·57	7	,, (41·30) and May (2·13)		11	2·65	7	March (2·65)
	16	3·01	8	March (4·00)		18	2·46	8	February (11·10)
	22	2·72	9	,, (5·30) and April (4·10)		24	2·00	9	March (2·00)
	28	2·50	10	April (3·10)		19	1·93	10	February (6·40)
	100	1·89	11	February (1·89)		14A	1·53	11	,, (1·53)
	99	1·05	12	,, (1·05)		16	1·40	12	November (1·96)
	12	0·72	13	,, (0·72)		15	1·01	13	February (3·00)
	22 A	0·40	14	March (0·40)		14	0·90	14	,, (2·80)
	13	'nil'		Effort : 6·50 hrs.		13	0·61	15	March (0·70)
1965–66	23	1·90	1	April (2·96)	Areas with 'nil' catch rate: 12, 25, 27 and 28 (Effort: 1·50, 2·75, 0·57 and 0·83 hrs. respectively)				
	18	1·68	2	,, (9·70)					
	12	1·36	3	October (2·10) and April (1·11)					
	22	1·13	4	November (3·40) and April (1·85)	1965–66	19	11·58	1	May (11·58)
	11	0·99	5	,, (2·40) and February (2·00)		22	5·20	2	April (5·20)
	15	0·79	6	December (2·30) and January (1·75)		12	2·50	3	,, (2·50)
	14	0·67	7	,, (3·30) and January (1·83)		15	2·07	4	,, (2·47)
	16	0·35	8	April (2·40)		18	1·18	5	,, (1·26)
	13	0·28	9	May (0·67)		18A	0·60	6	,, (0·90)
	19	0·24	10	February (2·40)		14	0·53	7	,, (1·23)
1966–67	23	4·53	1	August (4·53)		23	0·50	8	,, (0·50)
	18	3·86	2	January (8·70) and February (6·70)	Areas with 'nil' catch rate: 11 and 14A (Effort: 1 and 17·25 hrs. respectively)				
	22	3·08	3	August (3·98)					
	14	1·80	4	February (5·90) and August (4·66)					
	12	1·53	5	,, (1·90)					
	15	1·48	6	December (3·20)					
	19	1·09	7	October (1·90)					
	16	0·84	8	September (0·90)					
	11	'nil'		Effort: 2 hrs.					
1967–68	14	7·94	1	May (30·60) and March (19·70)					
	19	2·93	2	March (5·90)					
	18	2·92	3	May (8·10) and March (6·40)					
	15	0·88	4	November (1·70)					

N. japonicus may generally prefer deep-water habitats; and helps to confirm the observation of Hida and Pereyra (1966) who reported, based on results of bottom trawling in Indian seas by R/V *Anton Bruun* in 1963, that the thread-fin breams provided the highest catch rates and dominated the catches in the 74–183 m depth ranges.

TABLE A

1964–65

Latitude Zone	Number of squares with catch rates (kg/hr)					Total
	3 & above	2 to 3	1 to 2	0 to 1	'nil'	
17°10′	..	1	4	..	1	6
17°40′	1	1	4	2	..	8
18°10′	..	2	3	6	..	11
18°40′	1	1	1	2	1	6
19°10′	1	1	..	3	2	7
19°40′	2	1	2	2	5	12
20°10′	1	..	2	..	4	7
20°40′	3	..	..	5	1	9
21°10′	2	1	1	2	2	8
TOTAL	11	8	17	22	16	74

TABLE B

1965–66

Latitude Zone	Number of squares with catch rates (kg/hr)					Total
	3 & above	2 to 3	1 to 2	0 to 1	'nil'	
16°40′	..	..	1	..	..	1
17°10′	2	1	..	6	..	9
17°40′	1	..	..	5	1	7
18°10′	..	..	..	5	5	10
18°40′	..	..	..	..	3	3
TOTAL	3	1	1	16	9	30

(D) *Resources of* N. japonicus—*An estimate*

For this study the annual average catch rates realised in the various zones at 1° intervals lying between the 16° latitude zone in the south and the 21° latitude zone in the north, were considered. Such catch rates yielded by the various vessels during the different years and in respect of the five latitude zones thus demarcated, are given in Table IX. Also given in the table are the extent of the

area swept (in sq. km/hr) by the various boat-net combinations and the total area that was considered in respect of each latitude zone. Knowing the area swept, the area considered and the catch rate, an estimate of the extent of the resources of *N. japonicus* was computed by the 'swept area method' (Gulland, 1965) and the results are presented in Table X. It may be said that in the region so far explored, *i.e.*, between 16° and 21° latitudes, on an average, a minimum of 216 m. tons and to a maximum of 588 m. tons of *N. japonicus* could be expected.

TABLE C

1966–67

Latitude Zone	Number of squares with catch rates (kg/hr)					Total
	3 & above	2 to 3	1 to 2	0 to 1	'nil'	
16°40′	..	1	..	..	..	1
17°10′	..	..	1	2	..	3
17°40′	1	2	1	2	..	6
18°40′	..	2	1	..	..	3
TOTAL	1	5	3	4	..	13

TABLE IX

Catch rates (kg/hr) of N. japonicus *during the Years* 1964–65 *to* 1967–68 *and the area swept*

Latitude Zone	Number of Squares	Area considered (in Sq. Km.)	*Ashok*				*Sea Horse*				*Champa*			
			1964-65	1965-66	1966-67	1967-68	1964-65	1965-66	1966-67	1967-68	1964-65	1965-66	1966-67	1967-68
16–17	3	980	..	1·55	1·15	..	..	..	..	..	..	..	..	..
17–18	24	7838	1·39	0·85	2·79	5·32	2·04	1·29	..	..	13·14	0·96	2·68	5·22
18–19	19	6205	1·56	0·24	..	..	3·53	..	..	..	2·42	..	..	..
19–20	27	8818	1·76	..	..	..	..	..	..	..	..	..	..	..
20–21	43	14044	1·49	..	..	..	..	..	..	..	1·75	..	..	..
Area Swept (Sq. Km/hr)				0·07650				0·05556				0·06482		

TABLE X

Estimated resources (in m. tonnes) of N. japonicus *in the various latitude zones (A: Ashok*: S.H. : *Sea Horse*; C: *Champa* ; Ave.: Average.)

Latitude Zone	1964-65				1965-66				1966-67				1967-68			
	A	S.H.	C	Ave.	A	S.H.	C	Ave.	A	S.H.	C	Ave.	A	S.H.	C	Ave
16-17	..	..	..	..	20	..	..	20	15	..	..	15	..	..	..	..
17–18	142	288	1589*	215	87	182	116	128	286	..	324	305	545	..	631	588
18–19	127	394	232	251	19	..	..	19	..	..	..	..	..	..	..	..
19–20	203	..	..	203	..	..	..	..	..	..	..	..	..	..	..	..
20–21	274	..	379	327	..	..	..	..	..	..	..	..	..	..	..	..

(* not considered in striking the avearge).

Discussion and Conclusions

N. japonicus has a wide distribution along the Andhra-Orissa coasts occurring from Kakinada in the south to False Point in the north. Even so, studies on the magnitude of its abundance seem to suggest a certain degree of localisation. The catch rates of *N. japonicus* obtained either from the catches of m.t. *Ashok* or m.v. *Champa* or m.v. *Sea Horse*, all point to the fact that the southern zones upto the limit of 18° 40′, may support a good fishery for *N. japonicus*. Furthermore, the catch rates obtained by m.t. *Ashok* clearly indicate that the northern zones of 20° 40′ and 21° 10′ also have some productive grounds for *N. japonicus*. Although a few squares in the intermediate zones yielded catch rates comparable with those obtained in the two previously mentioned zones, they could not be classified as productive since majority of the squares forming the zones yielded poor catch rates. What is (are) the factor(s) responsible for this localisation, is difficult to answer with the available data. Nevertheless, it could be that the river systems—the Godavary at Kakinada in the south and the Mahanadi in the north—are exerting, with their large discharge of nutrient waters, a certain amount of influence to bring about this localisation. While such a situation appears plausible in regard to the two northern zones of 20° 40′ and 21° 10′ because of their closeness to the Mahanadi river system, it remains to be explored whether or not the influence of the Godavari river system extends upto the 18° 40′ zone which marks the southern limit of localisation.

In the four years of this study, the catch rates were generally high during 1964–65, poorest in 1965–66 and considerably good during 1966–67 with further improvement in 1967–68. The reason for the sharp decline in the catch rates in 1965-66 needs to be explained. The year 1965–66 was marked with considerable climatic set-back of a general failure in the seasonal rains leading to conditions of drought all over the Indian peninsula. Perhaps, the failure of the fisheries of *N. japonicus* was a reflection of this ' drought ' in seas around India. The second peak of abundance realised in the year 1967–68 was four years after the first peak in 1964–65. Till August of 1968–69, unpublished data (compiled and computed at the C.M.F.R. Sub-Station, Waltair) on catch statistics show that the fisheries of *N. japonicus* has been a failure. In view of the above fact, there is, thus, reason to believe that there may be a four year periodicity for the fisheries of *N. japonicus* in the area investigated.

During all the years of this study, irrespective of the zone investigated, the peak months of abundance of *N. japonicus*, were generally from January to April and on a few occasions the months of October to December and May and June were also marked with good catch rates. The months of January to April are characterised by profound changes in the Bay waters. This is the period when the northerly current system (Sewell, 1929) brings in not only enriched oceanic waters of the bottom Antartic Drift (Sewell, 1932), but helps stabilisation of the hydrological conditions (Ganapati and Subba Rao, 1958). Also, during this period upwelling has been reported (*see* La Fond, 1957 for further references; Banse, 1960), although the geographical extent of the upwelled area along the coast as well as the distance from the shore, is not definitely delineated (La Fond, 1955). More recently, based on observations from April, 1964 to December, 1966, on temperature, salinity, dissolved oxygen, phosphate and silicate content of surface waters off Waltair upto the depths of 55 meters off the shore, Mojumder (1967) came to a similar conclusion. It is also known, that during the southerly current system from July to December, the Bay waters are nearly esturarine (Sewell, 1929) but not without a certain degree of enrichment of the nutrients washed down, perhaps, by the large rivers of the north (Ganapati and Subba Rao, 1958). To what extent these hydrological changes are influencing the fisheries of *N. japonicus* is worth examining, though on the strength of the available observations on the peak months of abundance of *N. japonicus* and the reported month(s)/period(s) of extensive hydrological changes and/or upwelling, there appears to be a kind of coincidence too close to be casual. Whether it is real, the present investigations are not adequate enough to provide an answer. Since *N. japonicus* subsists mainly on bottom living forms the *Squilla*, the carid prawns, the crabs, the polychaetes, the bivalves, the gastropods and the ophiuroids (observations on the food and feeding habits of *N. japonicus* are being published elsewhere), it primarily calls for a study of the effect(s) of the hydrological changes on these bottom communities,

before any attempt is made to draw parallels between them (hydrological changes) and the fluctuations in the fisheries of *N. japonicus*. In this context, it may not be inappropriate here to recall the observation that upwelling only indirectly exerted a governing influence on the distribution of demersal fishes, the catches of *S. japonicus* (= *N. japonicus*) in particular, off the west-coast of India (Banse, 1959).

Summary

1. *N. japonicus* has a wide range of distribution along the Andhra–Orissa coasts. The latitude zones upto 18° 40′ in the south and the 20° 40′ and 21° 10′ zones in the north, appear to be comparatively more productive. A few of the squares in the intermediate zones also yielded comparable catch rates, but the number of such squares being few, these zones could only be considered poor.

2. One possible factor influencing the productiveness of the southern and northern zones could, perhaps, be their closeness to the great river systems, the Godavari in the south and the Mahanadi in the north, which empty nutrient rich waters into the Bay.

3. Among the four years of this study, the years 1964–65 and 1967–68 were comparatively more productive, but the year 1965–66 was the poorest. The decline in the fisheries of *N. japonicus* during the year 1965–66 is perhaps a reflection of the large-scale drought that hit the peninsular India that year. Also, there is reason to believe that there may be a four-year periodicity in the fisheries of *N. japonicus*.

4. During all the years of this study, irrespective of the zone investigated, the peak months of abundance of *N. japonicus* were generally from January to April and on a few occasions the months of October to December and May and June, were also marked with good catch rates.

5. On the strength of the available observations on the peak months of abundance of *N. japonicus* and the reported period(s) of hydrological changes and/or upwelling, there appears to be a kind of coincidence too close to be casual.

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