A NOTE ON MORTALITY RATES AND YIELD PER RECRUIT IN *NEMIPTERUS JAPONICUS* (BLOCH)

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ABSTRACT

Both the yield per recruit in weight (Y_W/R) and in numbers (Y_N/R) in *Nemipterus japonicus* (Bloch) increase with increased fishing mortality i.e., with increased fishing mortality, yield increases to an asymptote. Since the rate of exploitation works to about 3% only, it seems reasonable to remark that the stocks of *N. japonicus* are very much underexploited.

For formulating operable fishery management policies, a knowledge of the different mortality rates viz., total (Z), fishing (F) and natural (M) besides growth characteristics, is of prime importance. Based on knowledge already gained on a few aspects of the biology of *Nemipterus japonicus* (Krishnamoorthi 1971) and its abundance and distribution (Krishnamoorthi 1973), the present note deals with the mortality rates and the yield curve derived from them.

All the catches of *N. japonicus* during the years from 1964-65 to 1966-67, were obtained mainly through the exploratory trawling operations of the Govt. of India trawlers M.T. *Ashok*, M.V. *Champa* and M.V. *Sea Horse*. Also,

as major fishing time was expended in one latitude zone i.e., 17°-18°, off Visakhapatnam, by all the vessels, the data presented here relate to material collected mostly from this zone. The extent of this zone is 7,838 sq. km.

The formula (Ssentongo & Larkin, 1973):

$$\hat{Z} = K \left(\frac{n}{n+1}\right) \left(\frac{1}{\bar{y} - y_c}\right) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 1$$

where $\bar{y}$ is the annual average of y values calculated for each month (Table 1),

TABLE 1. *The sample number* (n) *mean length* (l) *and* 'y' *values during the different months of the years* 1964-65; 1965-66 *and* 1966-67.

	1964-65			1965-66			1966-67		
AUG	100	196.90	1.0373	87	172.01	0.8301	220	176.45	0.8639
SEP	257	196.67	1.0354	49	155.82	0.7152	288	164.10	0.7744
OCT	403	199.97	1.0660	38	163.95	0.7711	244	178.16	0.8773
NOV	179	171.76	0.8280	145	172.10	0.8308	243	175.62	0.8576
DEC	567	183.25	0.9183	136	164.14	0.7726	458	182.95	0.9158
JAN	148	188.85	0.9655	215	155.19	0.7109	223	187.60	0.9548
FEB	406	190.12	0.9763	115	159.17	0.7379	232	187.33	0.9524
MAR	542	191.38	0.9875	147	196.16	1.0303	228	190.92	0.9835
APR	406	190.79	0.9822	130	170.54	0.8190	183	173.09	0.8382
MAY	138	192.17	0.9945	68	187.79	0.9563	111	176.80	0.8668
JUN	—	—	—	125	169.96	0.8147	—	—	—
JUL	—	—	—	33	187.73	0.9558	—	—	—
TOTAL	3146		9.7910	1288		9.9447	2430		8.8847

was utilised for the calculation of the total mortality (Z) since recruitment in *N. japonicus* is discrete. The l_c values for the years 1964-65, 1965-66 and 1966-67 respectively were 35 mm, 75 mm and 95 mm.

TABLE 2. *Fishing effort expended by the three exploratory trawlers during the various years.*

Year	Fishing Effort (Hrs) in 17°-18° zone		
	Ashok (15m trawl)	Champa (14m trawl)	Sea Horse (12m trawl)
1964-65	289.07	522.99	589.71
1965-66	285.74	785.08	167.50
1966-67	995.84	855.09	—

TABLE 3.

Year	y	y_c	Z	F	M
1964-65	0.9791	0.1218	0.3663	0.0113	0.3550
1965-66	0.8287	0.2822	0.5743	0.0105	0.5638
1966-67	0.8885	0.3732	0.6093	0.0168	0.5925
Total			1.5499	0.0386	1.5113
Mean			0.5166	0.0129	0.5037

The following formula (Gulland 1965) gave the fishing mortality: F = F = a'|A, where a' is the sum of areas covered by all the vessels of the whole fleet and A is the total area inhabited by the stock. Here the area 7,838 sq. km is taken to be the area inhabited by the stocks of *N. japonicus*. The areas (in sq. km) covered by the fleet during the different years were as follows:

	Ashok	Champa	S. Horse	All	F
1964-65	22.1139	33.9002	32.7643	88.7784	0.0113
1965-66	21.8591	50.8889	9.3063	82.0543	0.0105
1966-67	76.1817	55.4269	—	131.6086	0.0168
				Average:	0.0129

Also given in the statement are the F values obtained by the above method. Details of the size of the net, area swept etc., are given in an earlier paper (Krishnamoorthi 1973). The fishing effort in hours are given in Table 2.

After estimating the total mortality and the fishing mortality, the natural mortality was calculated as M = Z — F. These values for the various years are given in Table 3 along with those for y and y_c. It was observed that F being negligible, M was practically equal to Z.

The average value of Z was, therefore, considered for fitting the yield curve based on the yield per recruit in weight (Yw/R) and in numbers (Y_N|R) at different F values (Fig. 1). Earlier studies had indicated that K, L_∞ and t_o took the values of 0.3141, 305 cm and -1.1079 respectively

(Krishnamoorthi 1971). They had also shown that the fishable life span of *N. japonicus* was about 3 years. The following are the other parameters:

$W_{\infty} = 253\,g$; $t_{p'} = t_p = 1$ year; $\lambda = 2$ years: $M = Z = 0.5166$;

$t_{\lambda} = 3$ years; $t_{p'} - t_o = 2.1079$ or 2.11 years.

The yield in weight per recruit was calculated from the formula (Baverton, 1954):

$$Y_W/R = F W_{\infty} e^{-M(t_{p'}+t_o)} \sum_{n=0}^{3} \frac{\sim n\, e^{-nk(t_p - t_o)}}{F + M + nk} \left(1 - e^{-(F+M+nk)\lambda}\right) \quad \ldots\ldots\ldots\ldots\ldots\ldots 2$$

and the yield in numbers per recruit was from the formula (Baverton 1954):

$$Y_N/R = \frac{F}{F + M}\left(1 - e^{-(F+M)\lambda}\right) \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

It is clear from the figure that both $Y_W|R$ and $Y_N|R$ increase with increased fishing mortality i.e., with increased fishing mortality, yield increases to an asymptote. Such a pattern has been reported for herring of the North Sea (Cushing & Bridger, 1966).

Earlier studies have indicated (Krishnamoorthi 1971) that the *Nemipterus* fishery is supported by the two-year-olds which attain an average size of 210 mm with an average weight of about 120 g. The present results have shown that at the lowest rate (0.05) of fishing mortality which is the closest to the current rate, the yield per recruit is just 3.3 g. The rate of

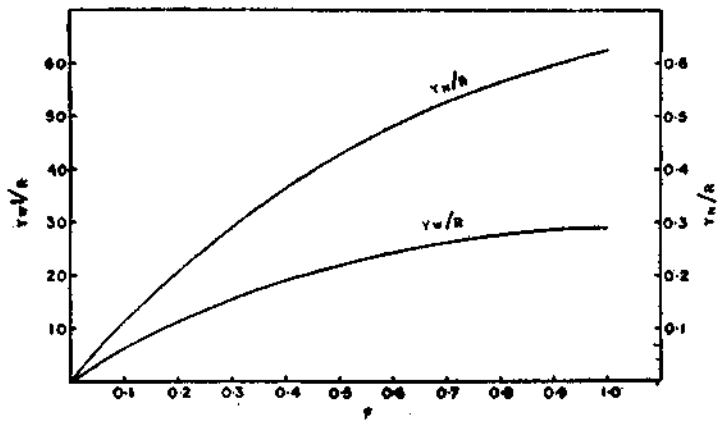

FIG. 1. Yield per recruit in weight ($Y_W|R$) and in numbers (Y_N/R) at different levels of fishing mortality (F) in *Nemipterus japonicus* (Bloch).