A CURRENT ASSESSMENT OF NORTHERN SHRIMP IN THE GULF OF MAINE

by

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The Scientific Committee met on September 3, 1975, in Gloucester, Massachusetts, to review current data on the Northern shrimp fishery (Rinaldo, unpublished, Table 1) and to formulate some form of recommendation for a 1976 closed season. Fishing mortality rates appear to have remained high in 1974 as indicated by research vessel survey catch per tow declines (F = 1.96 and 1.51, weighted by numbers caught at age over ages 2-4, and unweighted, respectively. M = 0.24). Also, 1975 catches (prior to the July 5-Sept. 27 closed season) to date indicate that the total 1975 catch will approximate 12.5 million pounds. This figure is substantially above the desired maximum catch of 9 million pounds recommended by the Scientific Committee from the results of an earlier assessment (Anthony, unpublished) to maintain the already depleted 1975 level of stock size. Accordingly, stock size continued to decline in 1975 (Table 1). Commercial catch/effort data (Rinaldo, unpublished, Table 2) indicate that stock size might reach a level of 9 million pounds in 1976. The obvious conclusion is that far more stringent controls on catch or effort will be necessary if stock size is to be increased or even stabilized.

Table 3 provides a series of options for control based on an estimated initial stock size of 10 million pounds, obtained by averaging estimated 1976 stock sizes from the regressions in Table 2 (11.2 and 9.5 x 10^6 pounds from highliners and the remainder of the fleet, respectively). Recruitment estimates from Table 1 (obtained by subtracting survivors from year n from calculated stock size in year n + 1) indicate a sharp decline in recruitment in recent years. It is reasonable, therefore, to assume that this trend will continue and that recruitment in 1976 would fall in the range indicated.

Table 3 indicates that if we do allow for progressively lower recruitment (*i.e.* adopt the 6-8 x 10^6 figures), a sharp curtailment of fishing will be necessary if further declines are to be prevented. Thus, we may stabilize stock size only be reducing 1976 catch to 4.4-6.8 x 10^6 pounds (F_1, Table 3), while to permit even modest recoveries (10% and 25%, F_2 and F_3, Table 3) ranges of from 3.2-5.5 and from 1.5-3.8 x 10^6 lbs, respectively, will be required. It should also be noted that to allow recovery to the already depleted 1975 figure, fishing would have to virtually cease (F_4, Table 3). It would appear, then, that in 1976 a catch in the range of 5-6 x 10^6 lbs is the absolute maximum that should be allowed. Such a level should at least prevent a further decline in stock size and at best would allow some degree of recovery. A catch of 5 x 10^6 lbs would therefore appear to be a reasonable target level for 1976 if catch restrictions are to be imposed.

The length of the 1976 closed season necessary to achieve this objective will obviously depend upon the time of year in which it is imposed, as the amount landed varies considerably on a monthly basis. If the assumption is made that unrestricted fishing in 1976 would take 10 x 10^6 lbs, which is

reasonable considering recent fishing mortality rates, it can be seen that 5 million lbs could be taken by mid-March (on the average, 60 percent of all annual landings have been taken in the first three months of the year between 1970 and 1974, Table 4). Accordingly, it would appear that a brief open season in winter would be most effective if management by seasonal closure is to be continued. It should be stressed, however, that some form of quota system, which would close the fishery when the quota is reached, would be more effective.

Table 1. Catch (C), stock size (Wo), and recruitment (R) and related parameters used in northern shrimp stock assessment. F estimates from August research cruises, weighted and unweighted.

Year	F	μ	S	C[1]	Wo[1]	R[1]
a Weighted F						
1968	0.72	0.461	0.379	14.6	31.7	
1969	0.76	0.479	0.364	28.2	58.9	46.9
1970	0.72	0.461	0.379	23.5	51.0	29.6
1971	1.96	0.789	0.110	24.6	31.2	11.9
1972	1.73	0.753	0.138	24.5	32.5	29.1
1973	0.89	0.531	0.320	20.8	39.2	34.7
1974	1.96	0.821	0.111	17.6	21.4	9.0
1975	1.88[2]	0.778	0.119	(12.5)	16.0	13.6
b Unweighted F						
1968	0.44	0.318	0.502	14.6	45.9	
1969	0.90	0.535	0.317	28.2	52.7	29.6
1970	0.65	0.428	0.407	23.5	54.9	38.2
1971	1.96	0.789	0.109	24.6	31.2	8.9
1972	1.43	0.693	0.186	24.5	35.4	32.0
1973	0.98	0.564	0.292	20.8	36.9	30.3
1974	1.51	0.708	0.174	17.6	24.9	14.1
1975	1.63[2]	0.734	0.153	(12.5)	17.0	12.7

[1] Lbs $\times 10^6$

[2] Arithmetic mean, 1971-1974 figures, 3 highest years. The 1973 value was not used as it appeared to be inconsistent with the remaining data.

Table 2. Catch per unit of effort from highliners (a) and from the remainder of the fleet (b) and calculated regressions and stock sizes projected from 1972 estimate of stock size.

	a			b		
Year	Observed	Calculated[1]	Estimated Stock Size[2]	Observed	Calculated[3]	Estimated Stock Size[2]
1969	1105	868		-		
1970	440	667		-		
1971	535	513		-		
1972	463	394	32.0	288	283	32.0
1973	298	303	24.6	202	209	23.6
1974	228	233	18.9	164	155	17.5
1975	-	179	14.5	111	114	12.9
1976	-	138	11.2	-	84	9.5

[1] $\ln(y) = 24.923 - 0.26314x$
[2] Lbs x 10^6
[3] $\ln(y) = 27.463 - 0.3030x$

Table 3. F values and corresponding catch levels (in parentheses) needed in 1976 to maintain the 1976 stock level or to increase stock size as indicated, assuming an initial stock size of 10 x 10^6 lbs in 1976 and various levels of recruitment.

R (10^6 lbs)	F_1	F_2	F_3	F_4
10	- (10.0)	2.05 (8.0)	1.14 (6.1)	0.44 (3.1)
8	1.36 (6.8)	0.95 (5.5)	0.55 (3.8)	0.11 (0.9)
6	0.67 (4.4)	0.44 (3.2)	0.18 (1.5)	- -
4	0.26 (2.0)	0.11 (0.9)	- -	- -

[1] F_1 will maintain stock size at the 1976 level; F_2, F_3, and F_4 will permit increases of 10%, 25%, and 50%, respectively.

Table 4. Mean monthly landings of northern shrimp (lbs. x 10^6 for Maine and Massachusetts, and average percentages of total catch landed by month, computed using 1970-1974 data.

Month	MASS.	MAINE	Percent of Total Annual Landings
January	3.0	10.0	11.8
February	4.5	17.6	20.0
March	4.0	27.7	28.8
April	3.1	7.5	9.6
May	4.0	1.4	4.9
June	4.8	1.5	5.8
July	4.4	1.4	5.2
August	2.6	0.8	3.0
September	2.8	0.6	3.0
October	1.5	0.8	2.1
November	0.6	1.1	1.5
December	1.1	3.5	4.2
			99.9