

Status of the Northwestern Atlantic Butterfish Stock:

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## Introduction

Recent assessments of the northwestern Atlantic butterfish, Peprilus triacanthus, stock (Murawski and Waring 1978; Murawski 1978) have indicated that during the period 1968-1976 fishing mortality rates increased, while mean weights of individuals in the catch and average age at capture generally declined. However, no consistent trends in total stock size were evident. Maximum equilibrium yield was determined to be 21,635 MT under the assumption of constant annual recruitment. However, this figure presupposed a mesh size of 82 mm would be consistently used throughout the industry. Present regulations allow 60 mm mesh nets to be used for bottom trawls and 45 mm for pelagic gear; furthermore, recruitment of butterfish is not constant. Based on the analysis presented by Murawski and Waring (1978) the maximum long term average yield (MAY) under present gear selection and recruitment conditions is probably about 16,000 MT. With the enactment of the FCMA the total catch of butterfish from this stock declined 73% from 15,837 MT in 1976 to 4,293 MT in 1977. This paper presents updated survey and commercial catch information for the stock, and the implications of this additional information are discussed. Only a brief explanation of the method of analysis is presented here, for a more complete description of the methods and data sources, the reader is referred to Murawski and Waring (1978).

## Survey Abundance Indices

The relative abundance of butterfish has been calculated on an annual basis as the catch in numbers and weight per tow from offshore (>27 m) bottom trawl surveys conducted by the National Marine Fisheries Service. Catches from the Middle Atlantic and Southern New England strata during the autumn have been the largest and most consistent, thus the most relevant abundance indices are stratified random catches per tow for these cruises and strata (Figure 1; Table 1). The linear catch per tow index (in numbers) from the autumn 1977 survey (94.69) declined 40.9% from the previous year, and was 19.5% below the 10 year average of 117.70. However, linear weight per tow increased 2.4% to 6.87 kg/tow, implying that, although numbers per tow declined, their average weight increased. Autumn mean weights per fish were 72.6 g, highest since 1968, and a 73.3% increase over the autumn 1976 mean (41.86 g; Figure 2). The re-transformed weight per tow index decreased 21.9% to 3.24 kg/tow in 1977 (Table 1; Figure 3).

The autumn linear catch per tow index in numbers was partitioned into age classes using the fourth quarter age/length key of Kawahara (1977). The autumn estimate of age 0+ relative abundance (Table 2) was 40.11 fish/tow, 68.5% below the 1976 estimate, and 53.2% below the 10 year average of 85.66. Thus the 1977 year class appears to be relatively weak when autumn abundance indices are compared with other year classes. In contrast, the 1976 year class was 48.8% greater than the 10 year average, and third highest in the time series.

Spring linear catch per tow estimates have been used to assess total mortality of various year classes by regressing  $\log_e$  catch/tow on coded age (Murawski and Waring 1978). Table 3 incorporates the data for the 1978 spring survey. The decline in the value of Z for the 1976 year class may be attributed to the sharp decline in total catch following the implementation of the FCMA in March 1977 but should be interpreted with caution due to the limited amount of data. The spring catch per tow indices in numbers have, however, been relatively poor in 1976 and 1977 despite the presence of a relatively strong 1976 year class in the autumn of that year. Interestingly, a similar phenomenon has occurred with abundance indices of long-finned squid (Loligo pealei; Resource Assessment Division 1978), but the cause of such fluctuations is as yet not apparent.

#### Commercial Catch Data

The U.S. commercial harvest of butterfish declined 5.3% from 1976 to 1977, and established a five year low of 1,447 MT (Table 4). Nominal distant water fleet (dwf) catches, however, declined 71.2% in 1977. The total landings in 1977 of 4,293 MT were smallest since 1963 (the first year of reported landings by the dwf's), and 52.1% below the 15 year average nominal catch of 8,969 MT. If catches are adjusted to include discards of countries not reporting butterfish (Murawski and Waring 1978), the total catch in 1977 was only 37.1% of the estimated 15 year average of 11,630 MT (Table 4).

Total distant water fleet catches in 1978 as of 9 September 1978 were only 595.1 MT, or 16.7% of the total allocation of 3,649 MT (Table 5). Traditionally dwf's take much of their catch of butterfish in the late autumn, thus although

landings to date indicate 16.3% of the allocation was taken in the first 8 months of the year, total dwf landings may approximate the allocation.

Domestic landings through July 1978 (1,025.2 MT) indicate a slight increase in the annual catch if projected forward for the year, but total catches in 1978 will probably not exceed 5,000 MT.

#### Future Condition of the Resource

Recruitment of butterfish appears to vary independently of total stock size, therefore,  $F_{0.1}$  was applied to average recruitment in order to estimate MAY (16,000 MT) under the assumption that future recruitment will fluctuate within the range of values observed in recent years. A more refined management strategy will only be possible if recruitment can be monitored on a real-time basis, and used almost immediately in the formulation of regulations since a significant portion of the recruits enter the fishery in their first year of life (Murawski and Waring 1978).

The most recent survey data available (Autumn 1977, Spring 1978) indicate that butterfish abundance is still within the range of values used earlier to calculate MAY and the total mortality rate of the population has been drastically reduced. With the sharp decline in total catch in 1977 and early 1978, a greater proportion of larger fish are available to spawn than would normally be the case with intensive fishing pressure. Even though an implicit stock-recruitment relation has not been demonstrated for this stock, the probability of a good 1978 year-class is no doubt enhanced. Early indication from the joint US-USSR juvenile hake survey, and observations aboard U.S. commercial vessels

from Rhode Island suggest that the 1978 year class may be strong relative to other years. These observations combined with the low projected catch for 1978 lead us to conclude the present status of the population is good relative to past years.

The information presented in this document does not indicate any biological basis for altering the proposed butterfish optimum yield ( ) of 16,000 MT.

## References

- Kawahara, S. 1967. Age and growth of butterfish, Poronotus triacanthus (Peck) in ICNAF Subarea 5 and Statistical Area 6. ICNAF Res. Doc. 77/VI/27: 13 p.
- Murawski, S.A. 1978. Consideration of the maximum sustainable yield from the northwestern Atlantic butterfish stock. NMFS, Woods Hole Lab. Ref. 78-30: 8 p.
- Murawski, S.A., and G.T. Waring. 1978. An assessment of the butterfish, Peprilus triacanthus (Peck), off the northwestern Atlantic coast. NMFS, Woods Hole Lab. Ref. 77-29: 33 p.
- Resource Assessment Division. 1978. Summary of stock assessments August - 1978. NMFS Woods Hole Lab. Ref. 78-40: 26 p.

Table 1. Autumn USA survey butterfish catch per tow, Strata 1-12, 61-76, 1968-1977.

Year	Catch per tow in Numbers			Catch per tow in Weight (kg)		
	linear	log <sub>e</sub>	re-transformed	linear	log <sub>e</sub>	re-transformed
1968	121.09	1.99	47.28	10.44	0.66	2.91
1969	76.93	2.16	57.25	5.32	0.66	2.72
1970	48.29	1.13	10.74	3.07	0.34	1.06
1971	242.17	2.19	112.00	5.45	0.58	2.29
1972	86.67	1.36	20.11	3.21	0.36	1.16
1973	178.03	2.35	124.08	8.39	0.75	3.70
1974	116.32	1.95	77.52	5.12	0.66	2.66
1975	52.47	1.69	36.19	2.94	0.58	1.80
1976	160.31	2.32	156.60	6.71	0.86	4.15
1977	94.69	1.99	69.33	6.87	0.70	3.24



Table 2. Estimates of relative juvenile (age 0+) abundance from NMFS autumn offshore bottom trawl surveys, and total 0+ stock size for year classes 1968-1977.

Year Class	Autumn Catch Per Tow Index ( $\bar{x}$ N/tow Age0+)	Estimate of 0+ Population Size from VPA ( $\times 10^6$ )
1968	46.19	1684.2
1969	44.61	823.3
1970	30.06	847.5
1971	231.58	1215.3
1972	79.59	1976.8
1973	135.02	1168.8
1974	92.02	1024.0
1975	29.95	368.1
1976	127.50	-
1977	40.11	-

Table 3. Calculation of total instantaneous mortality (Z) utilizing number per tow by age for NMFS spring surveys, 1968-1978.

Year Class	Stratified Number per tow at Age				Regression coefficients for $\log_e$ No./Tow vs. coded Age <sup>1</sup>		
	0+	1+	2+	3+	$r^2$	a	b(= -Z)
1968	11.66	2.96	1.30	0.01 <sup>2</sup>	0.980	3.462	-1.097
1969	10.04	2.36	1.24	0.31	0.981	3.322	-1.108
1970	26.36	4.22	8.00	0.33	0.768	4.546	-1.250
1971	313.31	40.17	3.78 <sup>2</sup>	0.17 <sup>2</sup>	1.000	7.801	-2.054
1972	44.09	9.05	1.89	0.18	0.989	5.745	-1.807
1973	22.12	6.88	1.82	0.18	0.972	4.918	-1.576
1974	162.24	5.12	1.04	0.03 <sup>2</sup>	0.957	7.304	-2.524
1975	36.40	4.39	0.37	--	0.998	5.949	-2.294
1976	4.21	1.93	--	--	1.000	2.217	-0.780
1977	4.25						

<sup>1</sup>Coded Ages  $A_j = 1, 2, 3, \dots, n$  for Ages 0+, 1+, 2+....N+

<sup>2</sup>Not included in regression

Table 4. Nominal landings (MT, ICNAF SA 4-6) by country, and adjusted total catches<sup>a</sup>, 1963-1977.

Year	USA	Japan	USSR	Poland	Bulgaria	GDR	Romania	Others	Nominal Total	Adjusted Catch
1963	4513		2285						6798	6798
1964	2461		748						3209	3209
1965	3340		749						4089	4089
1966	2615		3865						6480	6480
1967	2452	146	2170						4768	4768
1968	1804	3526	1911						7241	7241
1969	2438	3930	11107		36				17511	17816
1970	1869	8624	404		26				10897	14319
1971	1570	5771	486		114				7853	10483
1972	819	3675	1848		114	34			6490	13040
1973	1557	12172	2334	2804	239	196	152		19454	33236
1974	2528	5457	1372	3508					12865	17993
1975	2088	3624	789	3754	298	1		612 <sup>b</sup>	11166	14852
1976	1528	7884	420	1518	4	3	62		11419	15837
1977	1447	1750	419	280			16	381 <sup>c</sup>	4293	4293

<sup>a</sup>Adjusted to account for discards of countries not reporting butterflyfish catches from the Loligo fishery.

<sup>b</sup>Ireland

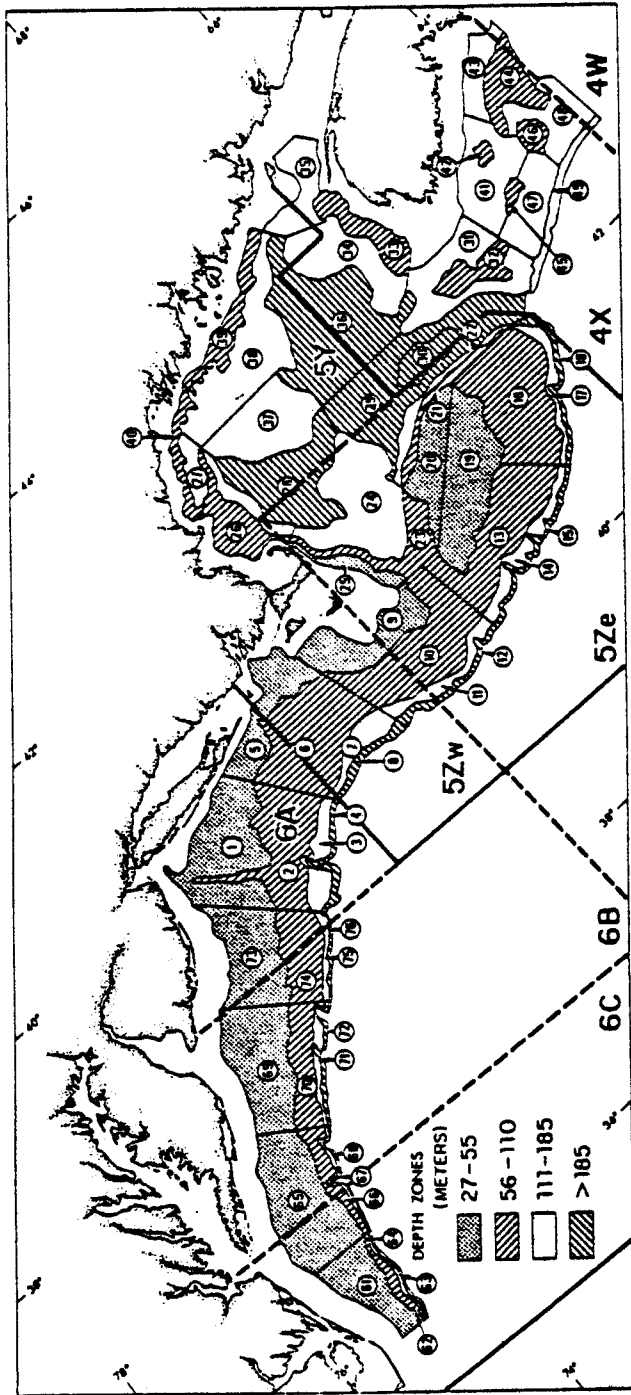
<sup>c</sup>Spain = 105, Italy = 60, Cuba = 111, Canada = 105.

Table 5. Total reported landings (MT) of butterfish from US waters as of 9 September 1978, 1978 allocations, and US landings through June 1978.

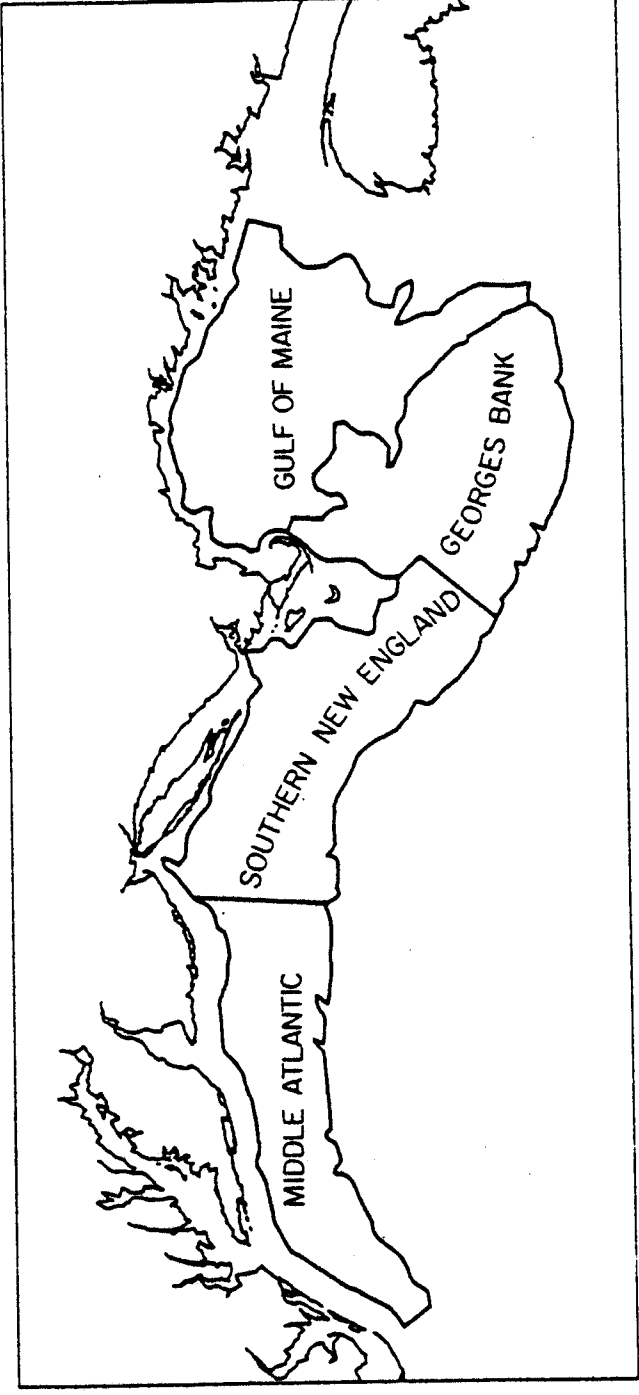
Country	Catch to Date	1978 Allocation	Percent taken
Bulgaria	0.0	6	0.0
France	0.0	2	0.0
FRG	0.0	3	0.0
GDR	0.0	185	0.0
Italy	306.0	345	88.7
Japan	216.1	622	34.7
Mexico	13.0	1263	1.0
Poland	0.0	67	0.0
Romania	0.0	3	0.0
Spain	46.0	1053	4.4
USSR	14.0	100	14.0
$\Sigma$	595.1	3649	16.3
USA (through June 1978)	<u>869.9</u> $\Sigma$ 1465.0	-	-

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- Figure 3. Retransformed catch per tow (kg) from the Southern New England and Middle Atlantic areas during autumn USA research vessel surveys 1968-1977.



A



B

