CHANGES IN ABUNDANCE OF THE MARINE WORM, GLYCERA DIBRANCHIATA, ASSOCIATED WITH SEAWATER TEMPERATURE FLUCTUATIONS

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Two species of marine annelids (worms) used as bait for salt-water sport fishing support fourth most valuable fishery in Maine with a 1963 landed value of $1.2 million.

The bloodworm, Glycera dibranchiata, has highest landed unit value of any Maine ma- resource. To the more than 900 licensees 963, bloodworms had a value of $2.40 und. The sandworm, Neanthes virens, also -dug from intertidal growing areas during tide, with a landed value of about $1.10 a id, has the second highest unit value.

Table 1 - Maine Production of Bloodworms, 1946-1963

Year	Number of Worms In Millions
1963	32.2
1962	25.7
1961	26.1
1960	24.2
1959	18.8
1958	13.6
1957	10.5
1956	7.5
1955	8.9
1954	10.6
1953	11.2
1952	9.2
1951	9.5
1950	13.7
1949	17.7
1948	25.0
1947	7.2
1946	2.6

Fig. 1 - Digging bloodworms in intertidal area, Cod Cove, Wiscasset, Maine.

Although worms are bought by dealers by undred, for statistical purposes such pur- es are converted to pounds using a factor for bloodworms and 40 for sandworms. nt sampling has indicated that the average pound contains more than 50 sandworms or than 100 bloodworms. Market acceptance of smaller sizes accounts for the increase lue per pound.

By reason of negligible winter markets and frozen or ice-covered intertidal areas, the ry is limited to the March-November period. During the harvesting season, high demand rages an intensive fishery; in the case of bloodworms, probably the most intensive fish- n Maine. Only since 1946 have landings of the two species been separated. Production e bloodworm fishery by calendar years is listed in table 1.

Reasons for fluctuations in production suggested by the industry as well as by scientific stigators have ranged nearly as widely as landings themselves.

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Restrictive legislation had rapidly increased from 1937 with the early beginnings of the fishery, only to culminate in complete repeal of all regulations by 1955. Regulations had curtailed the free-roving activities of commercial diggers, but it was three years after the effective date of repeal before there was any appreciable increase in landings.

Fig. 2 - Close-up of fisherman digging bloodworms.

Increases in fishing effort are suggested by the growth in the number of licenses issued from 449 in 1948 (the first year of issue) to 921 in 1963, but the inconsistency of any relationship between increased number of fishermen and landings precludes effort, in terms of number of fishermen, as the causative factor.

Table 2 - Maine Bloodworm Production and Number of Fishermen Harvesting Them

Year	Number of Fishermen	Number of Worms In Millions
1963	921	32.2
1962	775	25.7
1961	729	26.1
1960	643	24.2
1959	784	18.8
1958	628	13.6
1957	640	10.5
1956	530	7.5
1955	551	8.9
1954	625	10.6
1953	522	11.2
1952	435	9.2
1951	324	9.5
1950	389	13.7
1949	498	17.7
1948	449	25.0

Cyclic changes in the environment (Dow 1951, Dow and Wallace 1955), gradual changes in soil composition (Klawe and Dickie 1957), expansion of area fished (Dow and Wallace 1955), and changes in tidal exposure because of bridge and highway construction (Ganaros 1951) are other factors which have exercised relatively minor or local influence.

Dow and Wallace (1955) concluded that year-to-year fluctuations in production were indicative of short-term natural fluctuations in abundance. Klawe and Dickie (1957) conclude that bloodworm catches in Nova Scotia consist largely of three-year olds. Growing area conditions in Nova Scotia and Maine appear to be similar and observations made in Maine (Dow and Wallace 1955) agree with those of Canadian biologists.

Recent studies of Maine production and seawater temperatures as measured at Boothbay Harbor by the U. S. Fish and Wildlife Service suggest that abundance is determined primarily by seawater temperature during the spawning year. Data presented in table 3 indicate an optimum annual temperature range of 47.0° to 49.0° F. during the year of spawning. Both higher and lower seawater temperatures are associated with substantial declines in worm landings.

Table 3 - Annual Sea Water Temperature and the Bloodworm Production Three Years Later

Year and Temp. in Declining Order		Number of Worms and Year Landed	
	°F.	In Millions	
1953	51.9	7.5	1956
1951	51.5	10.6	1954
1954	50.2	10.5	1957
1955	50.1	13.6	1958
1949	50.1	9.2	1952
1952	50.0	8.9	1955
1950	49.6	11.2	1953
1957	49.0	24.2	1960
1947	48.5	13.7	1950
1956	48.5	18.8	1959
1960	47.8	32.2	1963
1958	47.3	26.1	1961
1946	47.2	17.7	1949
1945	47.0	25.0	1948
1959	47.0	25.7	1962
1948	46.7	9.5	1951
1944	46.5	7.2	1947
1943	45.3	2.6	1946

These data are the only data which can be consistently used to account for fluctuations in abundance as indicated by commercial production. Deviations from high production levels between 47.0° and 49.0° F. which occurred in 1949 and 1950--although still higher than any other year outside the optimum range--can be accounted for by a brief

causeway construction project in those two rs which drastically reduced tidal expo- e in one major producing area. Estimates e independently by both the industry and Maine Department of Sea and Shore Fish- s of annual production losses resulting n this construction ranged from 25 to 30 ent.

How seawater temperature influences the dance of bloodworms is not understood. y be a direct relationship in terms of l and juvenile survival, or it may be in- t through its influence on the amount of gical activity in the growing area. Klawe Dickie (1957) observed that bloodworms rently do not occupy sediments which are fficiently stable to support burrows. conditions are frequently associated with ased organic activity during periods of temperature. Conversely, during extremely cold winters greater ice overburden may te unfavorable sediment compaction in intertidal areas.

Fig. 3 - Packing bloodworms for shipment to dealers in bait for sport fishermen.

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