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CATCHES OF LARVAL LOBSTERS IN BUZZARDS BAY AND VINEYARD SOUND, MASSACHUSETTS IN SPRING AND SUMMER 1980

by

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INTRODUCTION

Monitoring larval lobster abundance through a neuston survey in Buzzards Bay has been done annually by the Northeast Fisheries Center since 1976 when a joint study of the distribution and abundance of the planktonic stages of Homarus americanus was begun in cooperation with the Massachusetts Division of Marine Fisheries.

The 1980 sampling program was similar in general purpose and methods to those conducted in previous years, with six Buzzards Bay stations being sampled (Figure 1). A description of this is given by Lux, Kelly, and Wheeler (1980). The scope of the investigation was enlarged in 1980 to include the waters of Vineyard Sound so that larval abundance there might be compared with findings in Buzzards Bay. Past observations by Herrick (1896) indicated that larvae were not abundant in the sound. To further investigate this matter two transects in Vineyard Sound, consisting of three 20-minute tows each, were laid out as shown in Figure 1.

Sampling in Buzzards Bay was begun on April 17 and terminated on August 25. The first series of tows in Vineyard Sound was made on June 17 and the last on July 25.

Buzzards Bay is a relatively shallow body of water ranging in depth from 5 m at the Cape Cod Canal end to about 30 meters near its mouth off Cuttyhunk Island (Figure 1). Sediments consist largely of sand and silt, although there is rock ledge along the northwest shore and numerous areas of rocky bottom. Water temperatures in excess of 25°C are not uncommon in mid-summer in some localities. Tidal currents are mostly weak, except for the Hog Island Channel section which is influenced by the strong currents of the Cape Cod Canal. The bay lies entirely within Massachusetts territorial waters and is closed by state law to fishing with trawls or

nets. There is, however, a substantial trap fishery for lobsters.

Vineyard Sound is about 20 miles in length and varies from three to ten miles in width (Figure 1). It is bounded on the south by the island of Martha's Vineyard and on the north by the Cape Cod mainland and the Elizabeth Island chain. Water flows northeast on the flood tide and southwest during the ebb, and current velocities may reach 4 knots in some places. A large volume of water from Buzzards Bay enters Vineyard Sound, primarily during the flood tide, through channels between the several Elizabeth Islands where currents sometimes exceed 4 knots. There is, likewise, a reverse flow of water from the sound to the bay, the bulk of which occurs on the ebb. In addition, there is some exchange of water between bay and sound around the western end of Cuttyhunk, the last island in the Elizabeth chain. The sound is deeper than the bay with an approximate average depth of 20 m and the bottom is predominantly rock and gravel although there are extensive sand shoals like those at Hedge Fence and Middle Ground. There is comparatively little silt because of the scouring action of the tidal currents. The summer temperature in the main body of the sound seldom exceeds 23°C although higher readings are to be found in embayments, such as Menemsha Bight and Tarpaulin Cove. The use of otter trawls in Vineyard Sound is prohibited from late spring to early fall by Massachusetts state law. Lobster fishing there is largely confined to the shallower waters close to land where tidal currents are comparatively weaker. This fishery is less intensive than in Buzzards Bay.

METHODS

There is considerable evidence that plantonic lobster larvae are positively phototactic and are found at or near the water surface in the

daytime (Smith, 1873; Herrick, 1896; Templeman, 1936; Templeman and Tibbo, 1945; Sherman and Lewis, 1967). For this reason a neuston net (1 x 2 m mouth, 9 m length) with a mesh size of 0.97 mm, bar measure, was used for sampling. This net retained all sizes of lobster larvae and many smaller animals as well. Towing was done from a diesel powered research vessel 12 m in length, and the net was fished with the mouth one-half to two-thirds submerged. The point of towing was the end of a boom extending 2.5 m outboard amidships over the starboard rail, which, for the most part, kept the net out of the wake. Standard towing position of the net was about 20 m astern, and the towing speed was 6.0 km/hr (3.25 knots). This speed was determined initially with an electronic log and subsequently was translated into terms of engine revolutions per minute.

Except when significant net clogging occurred, the tows were of 30 minutes duration in Buzzards Bay and 20 minutes in Vineyard Sound. The estimated volume of water filtered at 6 km/hr was 1,000 m^3 per 10 minutes, assuming that the net sampled a surface layer of water 0.5 m deep. Thus a standard tow in Buzzards Bay filtered 3,000 m^3 of water and in Vineyard Sound, 2,000 m^3. Because of irregularities in net depth, the extent of clogging, and the amount of wind and wave action there was some variation in the amount of water filtered, and the estimated volumes filtered must be considered approximate. In contrast to earlier experiences there were few net clogging problems in 1980.

At the end of each tow the catch was washed from the codend into one or more plastic buckets. Eelgrass and other floating weeds taken with the catch were rinsed free of organisms and discarded. The catch was then sieved and preserved in jars in 2% solution of formaldehyde. The

net was washed with a hose after each tow to clear blocked meshes. If it was badly fouled it was dragged, inside out, in the wake of the vessel at cruising speed for 5 or 10 minutes which effectually cleaned it.

Weather permitting, all stations in Buzzards Bay were sampled once each week from late May to the end of August with some preliminary sampling in April and early May (Table 1). With the exception of two complete transects on June 17 and 20, the Vineyard Sound sampling also was scheduled at weekly intervals although the total time span of coverage was shorter than in Buzzards Bay.

The surface water temperature was recorded to the nearest 0.1°C at the beginning of each tow, using a mercury thermometer, and weather observations, including wind direction and velocity, cloud cover, and sea state were noted on each tow log.

RESULTS

Buzzards Bay.

The total 1980 catch of lobster larvae in Buzzards Bay was 5,541, an average of 34.8 larvae of all stages per 1,000 m^3 of water strained. This is second only to the 1979 season when 10,303 larvae were collected, an average density of 43.7 per 1,000 m^3 (Tables 1 and 12). The first larvae, all stage I, were taken on May 27 at station 6; stages II and III appeared in the June 4-6 series of tows, and the following week (June 10-11) all four stages were represented (Tables 2-7).

Peaks of larval abundance came during the last two weeks of June and accounted for 76% of the entire season's catch (Figure 2). There was a sharp decline in abundance in early July, and the last larva was collected on August 4. Most hatching had apparently come to an end by mid-July, the last stage I being taken on the 14th. Numerically, fourth stage larvae

ranked highest in the 1980 catch (32.5%) with third stage a close second (29.5%). First and second stages were 16.5% and 21.5% of the total, respectively (Table 1).

The data show a considerable difference in the numbers of larvae collected at the six stations (Table 2-7). As an example, 2,299larvae (41.5% of the total taken in 1980) were caught at station 3, while only 428 larvae (7.7% of the total) came from station 5. These variations in distribution by station were noted in previous surveys (Lux, et al, 1980), although the factors causing them are unknown. With the exception of 1978, station 3 has been the largest producer of larvae, and all the lower bay stations (1, 2, and 3) have generally shown higher larval abundance than stations 4, 5, and 6 (Table 12). Fair (1980) indicated that in Buzzards Bay "significant numbers of female lobsters reach sexual maturity at or below the minimum legal size." This may account, in part, for high larval abundance, since more lobsters may spawn in this area before they are harvested as legal lobsters.

Vineyard Sound.

The Vineyard Sound sampling program began in mid-June, which was the time of peak larval abundance in Buzzards Bay. Lobster larvae were at all times during the sampling period lower in abundance than in Buzzards Bay, and this is clearly shown in Figure 2. Stage IV larvae outnumbered all of the earlier stages combined by more than two to one (Table 8). The largest catches were made on July 2 and 10 (Tables 9-11). The highest concentration of all stages combined was 9.2 per 1,000 m^3 on July 2 and was composed almost exclusively of stage IV's.

A large proportion (39.1%) of the entire season's catch of larvae was obtained at station 1 in Vineyard Sound, with station 5 in second place with 27.7% of the total (Tables 9-11). It is possible that the relatively large numbers of larvae taken at station 1 came, at least in part, from Buzzards Bay since the station is situated close to the south-east end of Woods Hole passage, through which a large volume of bay water flows into the sound during each tidal cycle. With respect to the other five stations, it appears possible that some of the larvae may also have come from Buzzards Bay; however, no conclusions are justified on the basis of the present data. While the peak of early stage larvae may have been missed in Vineyard Sound because of the late initiation of sampling, this does not seem likely. Since water temperatures are slightly lower in the the sound one might expect later hatching there than in the bay.

The general character of Vineyard Sound neuston catches was different from those in Buzzards Bay in the scarcity of crab larvae and ctenophores. In fact, there tended to be a considerably lower level of all animal life in the sound tows, and samples from the two bodies of water could be distinguished from each other by casual inspection. It appears possible that the turbulent currents and rapid flushing rate of the sound may have hindered the formation of extensive small animal concentrations there. The flushing rate may also have influenced the abundance of larval lobsters in Vineyard Sound, although this may be primarily a function of greater numbers of ovigerous lobsters in Buzzards Bay.

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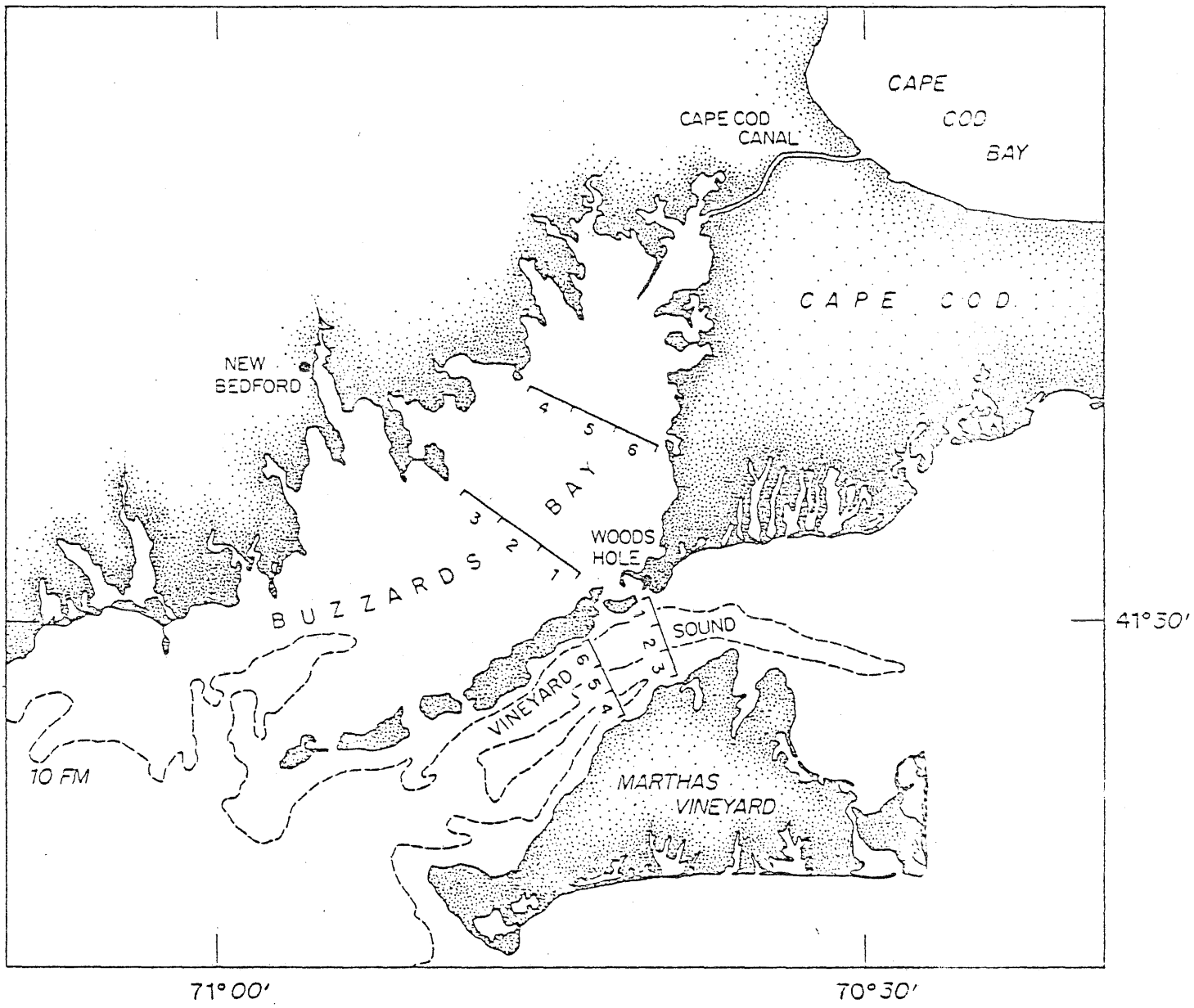

Figure 1.--Chart showing the locations of the six Buzzards Bay and Vineyard Sound neuston stations sampled in 1980.

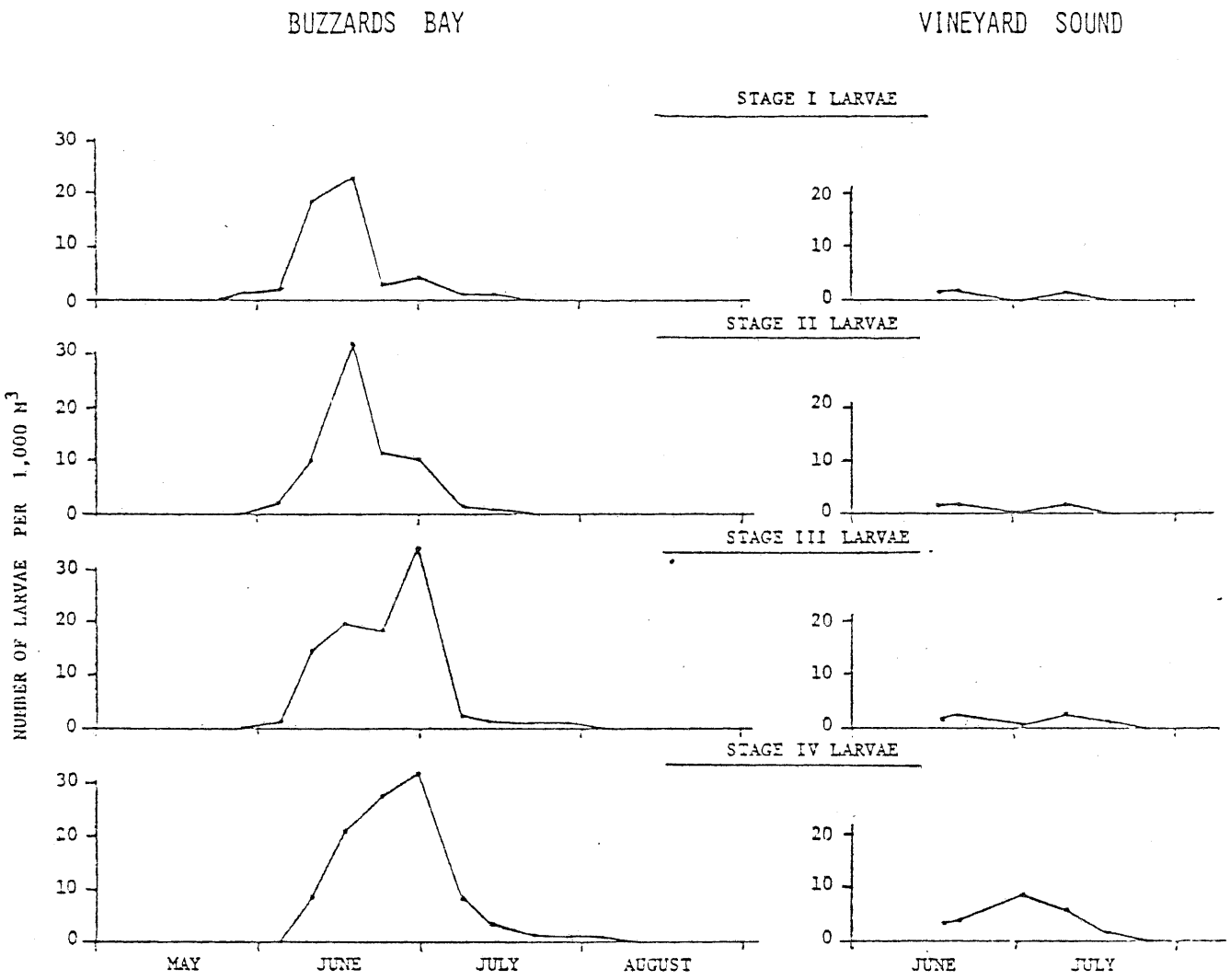

Figure 2.--Abundance of stage I-IV lobster larvae in Buzzards Bay and Vineyard Sound in 1980, in terms of estimated numbers per 1,000 m^3 of water filtered.

Table 1. .--Larval lobster catches in numbers by stage, total numbers, and estimated total numbers per 1,000 m^3 of water filtered for all Buzzards Bay neuston stations combined, by sampling dates, in 1980 .

Date	Number of tows	Numbers of larvae of each stage				Total number	Number per 1,000 m^3
		I	II	III	IV		
April 17 - 18	5	-	-	-	-	None	- -
" 30	6	-	-	-	-	"	- -
May 5	6	-	-	-	-	"	- -
" 20	2	-	-	-	-	"	- -
" 23	3	-	-	-	-	"	- -
" 27	6	5	-	-	-	5	0.3
June 4 - 6	6	38	34	31	-	103	5.7
" 10 - 11	6	338	182	255	159	934	51.9
" 16 - 17	6	408	572	358	372	1,710	95.0
" 23	6	50	207	327	499	1,083	60.2
" 30	6	66	174	609	561	1,410	78.3
July 7 - 9	6	10	17	39	146	212	11.8
" 14	6	1	5	9	50	65	3.8
" 21	6	-	2	5	9	16	0.9
" 28	6	-	-	1	1	2	0.1
Aug. 4	5	-	-	-	1	1	0.1
" 11	4	-	-	-	-	None	- -
" 18	3	-	-		-	"	- -
" 25	5	-	-	-	-	"	- -
Season totals	99	916	1,193	1,634	1,798	5,541	34.8 *
% by stage		16.5	21.5	29.5	32.5	100	

* Includes only dates when larvae were caught.

Table 2. .--Surface water temperature and larval lobster catches in numbers by stage, total numbers, and estimated total numbers per 1,000 m^3 of water filtered at Buzzards Bay neuston stations, by sampling date, in 1980.

Station No. 1.

Date	Surface °C	Numbers of larvae of each stage				Total number	Number per 1,000 m^3
		I	II	III	IV		
April 17	8.1						
" 30	8.7						
May 5	10.7						
" 20	13.7						
" 27	15.0						
June 4	16.4	1	1	2	-	4	1.3
" 10	16.1	37	28	68	24	157	52.3
" 16	18.6	5	11	28	69	113	37.7
" 23	17.8	2	4	21	17	44	14.7
" 30	20.1	58	62	98	51	269	89.7
July 7	21.4	2	2	3	64	71	23.7
" 14	20.8	-	2	1	4	7	2.3
" 21	23.2						
" 28	23.1						
Aug. 4	24.5						
" 11	24.3						
" 18	23.0						
" 25	22.1						
Totals		105	110	221	229	665	31.7

Table 3 .--Surface water temperature and larval lobster catches in numbers by stage, total numbers, and estimated total numbers per 1,000 m^3 of water filtered at Buzzards Bay neuston stations, by sampling date, in 1980.

Station No. 2

Date	Surface °C	Numbers of larvae of each stage				Total number	Number per 1,000 m^3
		I	II	III	IV		
April 17	8.2						
" 30	9.2						
May 5	11.2						
" 20	13.6						
" 27	15.3						
June 4	16.7			2		2	0.67
" 11	16.0	14	14	29	8	65	21.7
" 16	18.1	60	115	168	110	453	151.0
" 23	17.9	—	2	7	18	27	9.0
" 30	20.3	—	6	17	65	88	29.3
July 7	20.9	—	—	1	27	28	9.3
" 14	21.5	—	1	—	7	8	2.7
" 21	22.9						
" 28	23.5						
Aug. 4	24.5						
" 18	22.3						
" 25	22.4						
Totals		74	138	224	235	671	

Table 4 .--Surface water temperature and larval lobster catches in numbers by stage, total numbers, and estimated total numbers per 1,000 m^3 of water filtered at Buzzards Bay neuston stations, by sampling date, in 1980.

Station No. 3.

Date	Surface °C	Numbers of larvae of each stage				Total number	Number per 1,000 m^3
		I	II	III	IV		
April 17	8.1						
" 30	9.9						
May 5	11.4						
" 23	13.9						
" 27	15.9						
June 4	17.2	11	16	23	—	50	16.7
" 11	16.1	261	120	111	94	586	179.7
" 16	18.0	333	443	152	66	994	331.3
" 23	19.1	5	7	4	68	84	28.0
" 30	20.1	3	73	320	158	554	184.7
July 9	20.2	4	1	1	7	13	4.3
" 14	21.5	--	1	—	12	13	4.3
" 21	22.7	--	1	1	2	4	1.3
" 28	23.5	—	--	1	--	1	0.33
Aug. 4	24.0						
" 11	23.7						
" 18	22.1						
" 25	22.1						
Totals		617	662	613	407	2,299	

Table 5 .--Surface water temperature and larval lobster catches in numbers by stage, total numbers, and estimated total numbers per 1,000 m^3 of water filtered at Buzzards Bay neuston stations, by sampling date, in 1980.

Station No. 4.

Date	Surface °C	Numbers of larvae of each stage				Total number	Number per 1,000 m^3
		I	II	III	IV		
April 18	8.6						
" 30	10.6						
May 5	11.5						
" 23	15.1						
" 27	16.2						
June 6	17.9	2	4	1	—	7	2.3
" 11	16.7	23	5	13	16	57	19.0
" 17	18.3	2	3	6	71	82	27.3
" 23	20.1	1	--	12	177	190	63.3
" 30	21.3	2	17	48	66	133	44.3
July 9	21.5	--	--	1	21	22	7.3
" 14	22.7	1	--	2	14	17	5.7
" 21	22.7	--	1	3	2	6	2.0
" 28	24.7	--	--	--	1	1	0.3
Aug. 4	25.2	--	--	--	1	1	0.3
" 11	25.1	--	--	--	--	---	--
" 25	22.7	--	--	--	--	---	--
Totals		31	30	86	369	516	

Table 6 .--Surface water temperature and larval lobster catches in numbers by stage, total numbers, and estimated total numbers per 1,000 m^3 of water filtered at Buzzards Bay neuston stations, by sampling date, in 1980 .

Station No. 5.

Date	Surface °C	Numbers of larvae of each stage				Total number	Number per 1,000 m^3
		I	II	III	IV		
April 18	8.6						
" 30	10.5						
May 5	12.0						
" 23	14.8						
" 27	16.1						
June 6	17.8	11	6	2	--	19	6.3
" 11	16.8	--	3	16	7	26	8.7
" 17	18.3	1	--	2	29	32	10.7
" 23	19.8	--	1	13	111	125	41.7
" 30	20.7	--	1	55	118	174	58.0
July 9	21.8	2	7	11	10	30	10.0
" 14	22.5	--	1	5	11	17	5.7
" 21	24.0	--	--	1	4	5	1.7
" 28	24.0	--	--	--	--	--	--
Aug. 4	25.1						
" 11	22.3						
" 25	22.9						
Totals		14	19	105	290	428	

Table 7. .--Surface water temperature and larval lobster catches in numbers by stage, total numbers, and estimated total numbers per 1,000 m^3 of water filtered at Buzzards Bay neuston stations, by sampling date, in 1980 .

Station No. 6.

Date	Surface °C	Numbers of larvae of each stage				Total number	Number per 1,000 m^3
		I	II	III	IV		
April 18	8.9						
" 30	10.4						
May 27	15.8	5	--	--	--	5	1.7
June 6	18.1	13	7	1	--	21	7.0
" 11	16.7	3	12	18	10	43	14.3
" 17	18.4	7	--	2	27	36	12.0
" 23	20.3	42	193	270	108	613	204.3
" 30	20.7	3	15	71	103	192	64.0
July 9	21.5	2	7	22	17	48	16.0
" 14	22.7	--	--	1	2	3	1.5*
" 21	24.0	--	--	--	1	1	0.3
Aug. 25	22.9	--	--	--	--	---	---
Totals		75	234	385	268	962	

* 20 minute tow

* 20 minute tow

Table 8. -- Larval lobster catches in numbers by stage, total numbers and estimated total numbers per 1,000m^3 of water filtered for all Vineyard Sound neuston stations combined, by sampling dates, 1960.

Date	Number of tows	Numbers of larvae of each stage				Total number	Number per 1,000 m^3
		I	II	III	IV		
June 17	6	12	8	13	42	75	6.5
" 20	6	9	12	28	46	95	7.9
July 2	5	--	--	4	88	92	9.2
" 10	5	1	3	24	57	85	8.5
" 18	3	--	--	1	10	11	1.4
" 25	5	--	--	--	--	--	---
Totals	30	22	23	70	243	358	5.8 *
%		6.1	6.4	19.6	67.9	100	

* Includes only dates when larvae were caught.

Table 9. --Surface water temperature and larval lobster catches in numbers by stage, total numbers and estimated total numbers per 1,000m^3 of water filtered at Vineyard Sound neuston stations, by sampling date in 1960.

Date	Surface °C	Numbers of larvae of each stage				Total number	Number per 1,000m^3
		I	II	III	IV		
			STATION	NO. 1			
June 17	17.0	2	--	5	12	19	9.5
" 20	17.3	2	2	9	16	29	14.5
July 2	20.0	--	--	--	47	47	23.5
" 10	20.5	--	1	9	26	36	18.0
" 18	21.5	--	--	--	9	9	3.6
" 25	22.0	--	--	--	--	---	
Totals		4	3	23	110	140	
			STATION	NO. 2			
June 17	16.8	--	--	--	--	---	
" 20	17.1	--	--	3	3	6	3.0
July 2	19.2	--	--	1	12	13	6.5
" 10	---	--	--	4	9	13	6.5
" 18	21.3	--	--	1	1	2	0.8
" 25	21.3	--	--	--	--	---	--
Totals		--	--	9	25	34	

Table 10. ---Surface water temperature and larval lobster catches in numbers by stage, total numbers and estimated total numbers per 1,000m^3 of water filtered at Vineyard Sound neuston stations, by sampling date in 1960

Date	Surface °C	Numbers of larvae of each stage				Total number	Number per 1,000m^3
		I	II	III	IV		
			STATION	NO. 3			
June 17	16.0	2	--	--	--	2	1.0
" 20	16.8	2	2	2	1	7	3.5
July 2	18.7	--	--	1	1	2	1.0
" 10	19.5	--	--	1	1	2	1.0
" 18	20.3	--	--	--	--	---	---
" 25	20.5	--	--	--	--	---	---
Totals		4	2	4	3	13	
			STATION	NO. 4			
June 17	16.0	8	7	3	--	18	9.0
" 20	16.5	5	5	5	4	19	9.5
July 2	18.7	--	--	1	2	3	1.5
" 10	19.3	--	--	1	2	3	1.5
" 25	20.7	--	--	--	--	---	--
Totals		13	12	10	8	43	

Table 11 .--Surface water temperature and larval lobster catches in numbers by stage, total numbers and estimated total numbers per 1,000m^3 of water filtered at Vineyard Sound neuston stations, by sampling date in 1960

Date	Surface °C	Numbers of larvae of each stage				Total number	Number per 1,000m^3
		I	II	III	IV		
			STATION	NO. 5			
June 17	16.0	--	1	2	29	32	16.0
" 20	16.8	--	--	2	7	9	4.5
July 2	18.7	--	--	1	26	27	13.5
" 10	19.5	1	2	9	19	31	15.5
" 25	20.6	--	--	--	--	---	---
Totals		1	3	14	81	99	
			STATION	NO. 6			
June 17	16.4	--	--	3	1	4	2.7
" 20	17.5	--	3	7	15	25	12.5
Totals		--	3	10	16	29	

Table 12.--Mean numbers of lobster larvae, of all stages, caught per 1,000 m^3 of water filtered in Buzzards Bay for each station in 1977-80. (Dates when no larvae were caught were not included in computing means.)

Year	Station 1	Station 2	Station 3	Station 4	Station 5	Station 6	Mean annual density
1977	13.8	12.0	30.7	7.1	9.5	9.2	17.7
1978	7.2	5.6	9.8	10.9	9.3	14.3	9.1
1979	57.3	63.8	91.9	28.0	24.1	22.3	43.7
1980	20.2	20.3	69.7	15.6	13.0	30.1	34.8
Average	24.6	25.4	50.5	15.4	14.0	19.0	26.3