PROC. N.S. INST. SCI (1989)
Volume 38, Part 2, pp. 43-53

LOBSTER LARVAL ABUNDANCES IN LOBSTER BAY, YARMOUTH CO., NOVA SCOTIA - 1983

D.M. TREMBLAY and G.J. SHARP
Biological Sciences Branch
Scotia-Fundy Region
Halifax Fisheries Research Laboratory
Department of Fisheries and Oceans
P.O. Box 550
Halifax, Nova Scotia B3J 2S7

A program to develop methods of capturing newly settled Stage IV larvae included the need to identify areas with significant planktonic concentrations of Stage IV larvae in Lobster Bay, Yarmouth Co., N.S. During the study, 171 larvae were collected, including 12 at four selected inshore stations studied by Stasko and Gordon (1983) in 1977-1978. Eighty-nine percent of all the larvae were captured within the environs of Whitehead Island. Exploratory towing, despite the wide range of sites, was the least successful category of stations (five larvae in 19 tows). A day-night towing cycle yielded the largest number of larvae at twilight. At Stasko's and Gordon's (1983) inshore stations, Stages I and IV exclusively were captured. Stage IV lobster larvae were rarely captured during our sampling, despite predominance of daytime towing. This survey differed from previous southwestern Nova Scotia surveys by sampling over shallow waters (less than 20 m) and adjacent to land.

Un programme pour développer des méthodes de capture pour les homards du stade IV qui commencent leur vie benthique incluait le besoin d'identifier des zones de haute concentration de larves de homard du stade IV dans Lobster Bay, comté Yarmouth, N.-É. Durant l'étude, 171 larves ont été capturées incluant 12 larves à 4 sites côtiers qui furent étudiées par Stasko et Gordon (1983) en 1977-1978. Quatre-vingt-neuf pourcent de toutes les larves ont été capturées dans les environs de l'Ile Whitehead. La catégorie des stations de trait d'exploration a été la moins fructueuse (cinq larves en 19 traits), malgré une grande variété de sites. Un cycle d'échantillonnage jour-nuit a produit le plus grand nombre de larves au crépuscule. Aux stations côtières de Stasko et Gordon (1983) des stades I et IV exclusivement ont été capturés. Les larves de homard du stade IV ont rarement été capturées malgré la prédominance d'échantillonnage durant le jour. Cette étude diffère des études précédentes au Sud-Ouest de la Nouvelle-Écosse car l'échantillonnage a été fait en eau peu profonde (moins de 20 m) et près des côtes.

Introduction

In 1971, the near-shore (to 92 km) lobster (*Homarus americanus* Milne Edwards) fishery of southwestern Nova Scotia (SWNS) (Fig 1) was expanded to a new offshore zone (>92 km from shore) (Pezzack and Duggan 1983). A lack of understanding of the relationship between offshore lobster stock and inshore stock emphasized the need for research on the early planktonic life stages of the lobster, and sources of recruitment in SWNS (Stasko 1978; Pezzack and Pringle 1986). Although considerable information is available on early developmental stages of *H. americanus* in the laboratory, distributional studies in the field are limited or yield data that are difficult to interpret. Many larval surveys were conducted along the east coast of Canada and the United States (reviews by Stasko 1980; Fair 1980; Fogarty 1983), but few of those were in SWNS. Until the mid 1970's, only 12 larvae were captured offshore of SWNS by neuston net (397 tows) (Stasko 1977). Analysis of the 1976 samples from a Scotian Shelf fish-eggs-and-larvae survey yielded 142 lobster larvae (Stasko 1977). During a 2 years (1977 and 1978) intensive larval survey (1,838 tows) at inshore and offshore stations, 2,325 larvae, including all four stages, were captured primarily in neuston tows (Stasko and Gordon 1983).

A program to develop methods of capturing newly settled Stage IV larvae was initiated in 1982. As a part of this study, the authors attempted to identify areas with

high planktonic concentrations of Stage IV larvae. These sites would then be used to test passive and active collection methods for settled stages. This study incidentally collected other larval stages, and by replication of Stasko's and Gordon's (1983) stations provided comparisons.

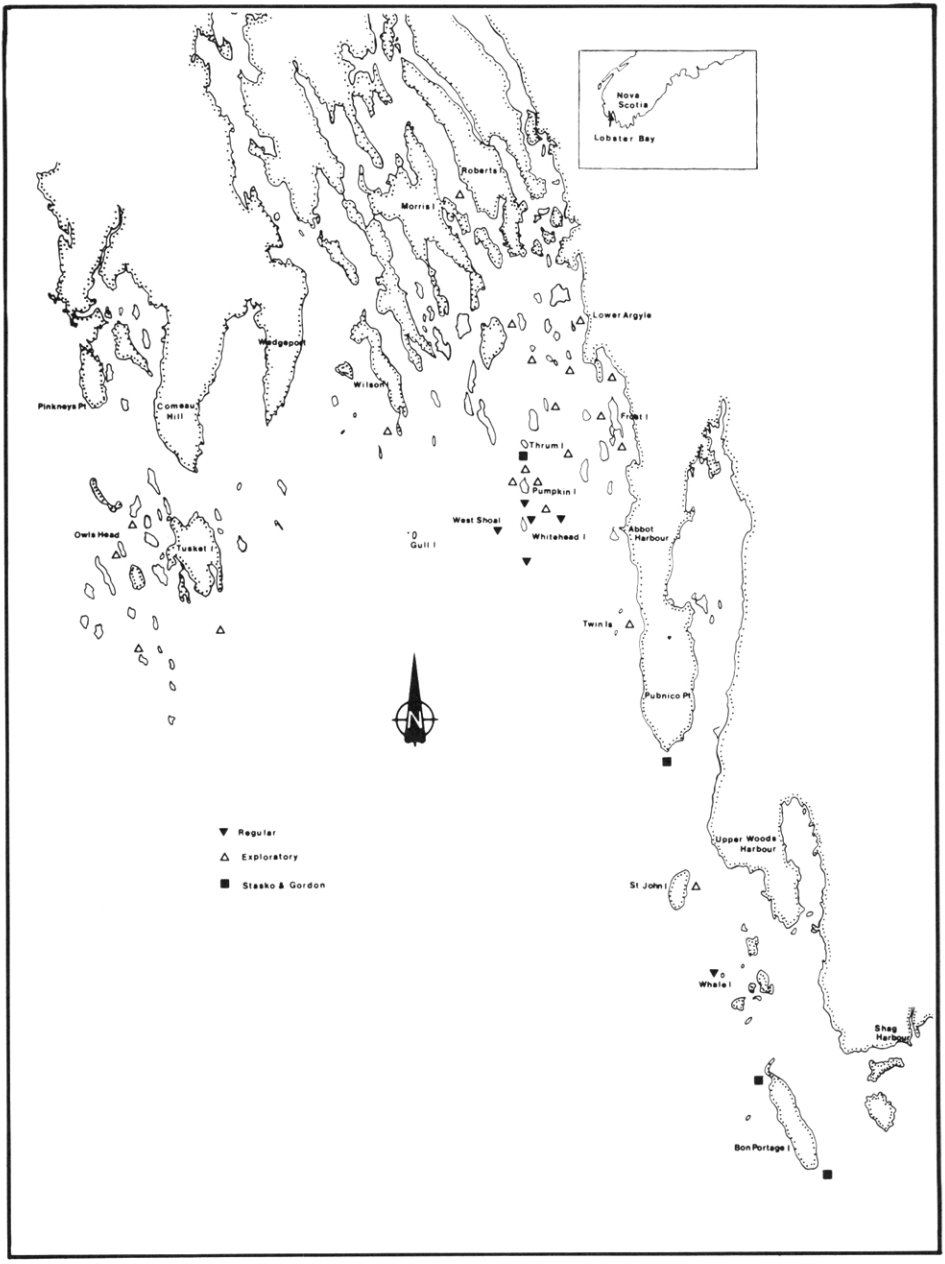

Fig 1 Map of the study area and location of sampling stations in the 1983 *Homarus americanus* larval survey of Lobster Bay, Yarmouth Co., N.S.

Materials and Methods

Lobster larvae were sampled for a period of 10 weeks (July 6 to September 13, 1983) in SWNS. The survey area extended from the Tusket Islands to Bon Portage Island (Fig 1). The majority of the sampling was conducted in Lobster Bay. It is a shallow bay (depth < 20 m) with rocky shallows gently sloping to sand or mud bottom (MacFarlane 1964). The tides are semi-diurnal with a range at spring tides of 4.18 m, creating tidal current flows to 10 km h^{-1} (Anonymous 1982). Islands in the Bay are in a north-to-south direction. Predominant summer winds are from the south to southwest. Intertidal water temperatures ranged between 11.0°C and 16.0°C in July and August 1983 (Dobson and Petrie 1985). Four categories of stations (Table I) were sampled:

1) *Regular stations:* These were located around Whitehead Island and Whale Island. Whale Island was chosen due to knowledge gathered during previous studies and Whitehead Island due to initial success in capturing lobster larvae in that area. These stations were sampled weekly. Tows were generally made during the day, but occasionally at night.

2) *Night stations:* Thirteen percent of all tows (127) were made during the night; all but two night tows were around Whitehead Island.

Table I Location and depth of towing stations in Lobster Bay, Yarmouth Co., N.S., during 1983.

Station	Latitute (north)	Longitude (west)	Depth range (m)
Bon Portage - north	43°29'02"	65°46'04"	1 to 12
Bon Portage - south	43°27'04"	65°44'04"	1 to 10
St. Ann Point	43°35'02"	65°48'02"	2 to 10
Thrum Is.	43°41'03"	65°52'00"	2 to 13
Whale Is.	43°31'02"	65°47'01"	1 to 10
Whitehead Is. - channel	43°40'03"	65°52'00"	8 to 11
Whitehead Is. - west	43°40'01"	65°52'02"	5 to 10
Whitehead ledge	43°39'08"	65°51'00"	3 to 13
West Shoal	43°40'00"	65°52'07"	4 to 6
1.6 km south - Whitehead Is.	43°38'06"	65°52'01"	16 to 18
Pumpkin Is. - east	43°40'05"	65°51'06"	5 to 11
Pumpkin Is. - west	43°40'08"	65°52'03"	5 to 12
Twin Is.	43°37'09"	65°49'03"	4 to 13
Camp Is. to Black ledge	43°42'06"	65°50'08"	2 to 14
Frost Is. - south	43°41'03"	65°49'08"	2 to 7
Birch Is. - north	43°43'05"	65°51'08"	2 to 6
Black ledge to Little Gooseberry Is.	43°42'01"	65°51'02"	2 to 8
Argyle Sound	43°42'06"	65°49'05"	2 to 6
Robert Is. - west	43°46'03"	65°53'09"	1 to 5
Bond Is. - channel	43°43'07"	65°51'07"	5 to 10
Pumpkin Is. to Big Gooseberry Is.	43°40'09"	65°51'05"	5 to 12
Wilson Is. to Eastern Bar	43°41'02"	65°55'06"	2 to 7
Owl's Head Is.	43°39'02"	66°03'02"	2 to 5
Deep Cove Is.	43°39'09"	66°02'04"	10 to 24
Half Bald Is.	43°37'00"	66°02'05"	5 to 13
Old Woman buoy to 91Y buoy	43°37'05"	65°59'00"	2 to 12
St. John Is. - east	43°32'06"	65°47'06"	1 to 3
Big Gooseberry Is. to Frost Is.	43°42'00"	65°50'00"	5 to 15
Lr. Argyle Shore to Nanny Is.	43°44'00"	65°50'05"	2 to 5
Whitehead Ledge to Pumpkin Is.	43°40'00"	65°51'06"	5 to 13
Pumpkin Is. to Thrum Is.	43°40'09"	65°52'01"	5 to 10

3) *Stasko's and Gordon's stations:* Four inshore stations of the Stasko and Gordon (1983) SWNS surveys were sampled weekly. The stations were: Thrum Island, St. Ann Point, Bon Portage north, and Bon Portage south (Fig 1).

4) *Exploratory stations:* These were used to discover other areas of larval concentration. They were spread throughout the study area but only sampled once or twice (Fig 1).

Harding et al. (1982) and Fair (1980) mentioned possible concentration of larvae by various current phenomena. Thus, whenever possible, tows were made through eddies, slicks, foam lines, and windrows.

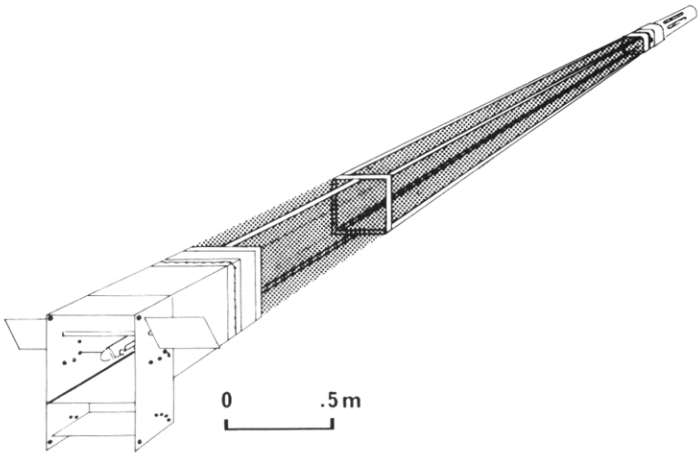

Fig 2 Neuston sampler, as described by Sameoto and Jaroszynski (1969).

Two neuston samplers (Sameoto and Jaroszynski 1969), each 0.4 m x 0.4 m with Nitex 502 μm mesh nets, were towed for 30 min (Fig 2). The samplers were towed on each side of a 6 m Cape Islander-style boat on 2 m booms (Fig 3). Tow speed was adjusted to allow the sampler frame to break the surface of the water. Each net sampled the top 0.4 m of the water column and filtered an average of 305 m^3 of water during a 30 min tow at *ca.* 2 knots. The amount of water filtered was determined by averaging readings obtained from a General Oceanic Incorporated flowmeter installed on one sampler. Six tows were completed with only one net (i.e. half tows) as a result of damage to the other net; the remaining 124 tows were made with two nets.

The towing stations were close to islands or the mainland (less than 2 km) and over shallow waters (less than 20 m). Stations (Table I) were located by a combination of landmarks, water depth, and radar fixes. To restrict the sampled area, the course was reversed 15 min into the tow or at the limit of a landmark. During each tow, surface temperature, wind speed/direction, and cloud cover were recorded. After the tow, samples from each net were examined separately without visual aids. Large pieces of vegetation were checked for larvae, rinsed, checked again, then discarded. Port and starboard samples were separately preserved in 5% buffered formaldehyde solution. Later, samples were sorted for lobster larvae, representative crustaceans, and fish larvae. Lobsters were inspected using a dissecting microscope and staged according to Herrick (1911). Port and starboard samples for each tow were combined for data analysis, as the towing pattern took the nets through the same body of water usually more than once.

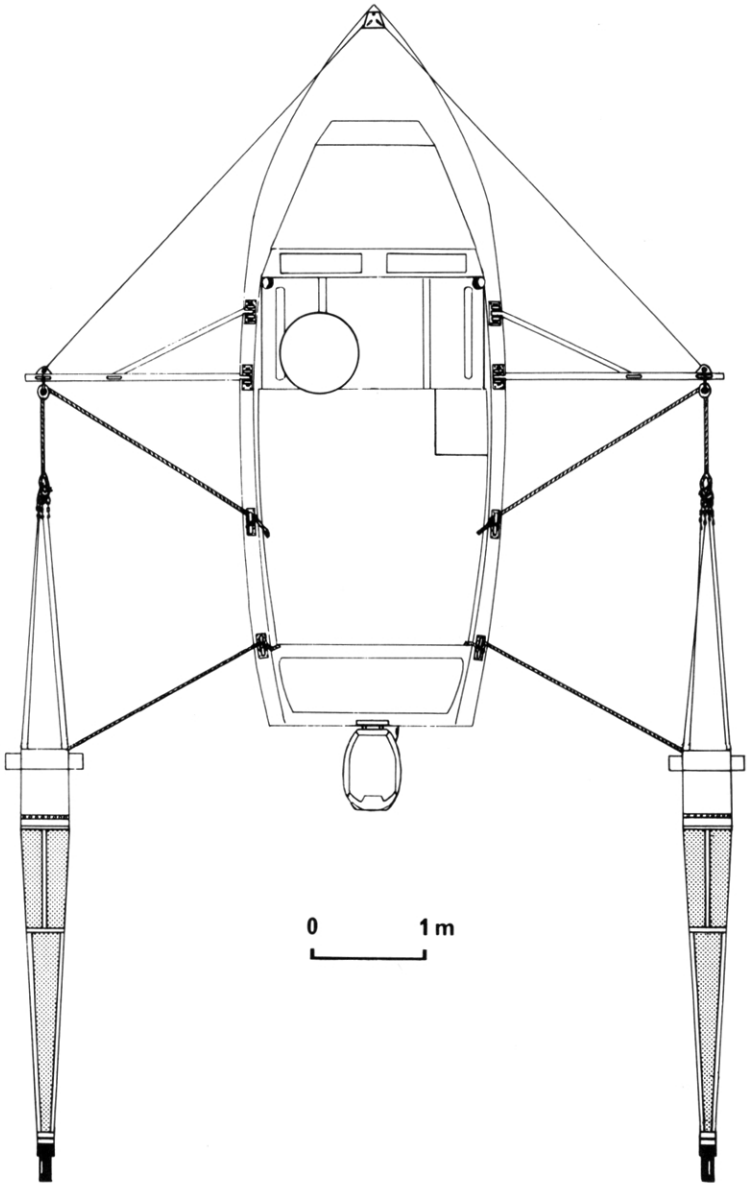

Fig 3 Towing configuration for two neuston samplers from a 6 m outboard-powered vessel.

Results

In 28 sampling days between July 6 and September 13, 1983, 171 larvae were caught, an average of 2.21 larvae 1000 m^{-3} of water filtered. The composition of the catch was as follows.

Larval stage	Number
I	159 (93%)
II	4 (2%)
III	1 (1%)
IV	7 (4%)
A	Total: 171

Regular stations At Whale Island, one Stage I was captured in 13 tows. However, around Whitehead Island larvae were consistently captured. Forty-nine percent of the towing took place around Whitehead Island, and yielded 89% of all the larvae captured. Although larvae were difficult to locate in Lobster Bay on this survey, on the first sampling day (July 6, 1983) at Whitehead Island, four Stage I larvae were caught in a tow with one net. The most successful sampling day was July 20 at stations around Whitehead Island; 51% of all larvae were caught (20.61 larvae 1000 m^{-3}) (Table II). During the sampling period, seven of the tows around Whitehead Island were made in surface phenomena. They yielded ten larvae (2.34 larvae 1000 m^{-3}).

Night stations All successful night towing (19:00-07:00 h) was around Whitehead Island; two exploratory night tows yielded no larvae. Night towing at Whitehead Island captured 2.84 larvae 1000 m^{-3}, while day towing captured 4.38 larvae 1000 m^{-3}, approximately 1.5 times more. But night tows were not as frequent as day tows. If we compare results on a weekly basis, night towing was successful (Table III). The majority of the night tows took place August 25-26, 1983, during continuous day-night towing around Whitehead Island. The six "day" tows yielded one Stage I larvae (0.27 larvae 1000 m^{-3}), while the "night" tows yielded 22 larvae (3.28 larvae 1000 m^{-3}) (Fig 4). Of these, two day and one night tow were made in surface phenomena and yielded one and three Stage I larvae, respectively. The largest number of larvae (11) were captured at twilight (Fig 4). It was also during this period that the only Stage III larva was captured (Fig 4). Two of the four Stage II and four of the seven Stage IV larvae found in the surveys were captured in night tows.

Exploratory stations Five Stage I larvae occurred in 19 tows (0.43 larvae 1000 m^{-3}) (Table II). This was the least successful category of stations, despite the range of sites selected, from intertidal at high tide to 24 m of water, over mud, rock, and sand

Table II Absolute numbers of larvae captured, by week and by station categories, in Lobster Bay, Yarmouth Co., N.S., during 1983.

Date (1983)	Regular stations - day					Regulation stations - night				
		Larval Stage					Larval Stage			
	# tows	I	II	III	IV	# tows	I	II	III	IV
July 4-8	0.5	4	0	0	0					
July 11-15	4	9	0	0	0					
July 18-22	7	88	1	0	0					
July 25-29	4	3	0	0	0	1	0	0	0	0
Aug. 1-5										
Aug. 8-12	11	12	0	0	0					
Aug. 15-19	4	3	0	0	0					
Aug. 22-26	7	1	0	0	2	10	16	2	0	4
Aug. 29-Sept. 2	2	1	0	0	0	2	3	0	0	0
Sept. 5-9	4	2	1	0	0	2	0	0	1	0
Sept. 12-16	4	1	0	0	0					
Total:	47.5	124	2	0	2	15	19	2	1	4

Table III Weekly comparisons of 1983 day and night towing at Whitehead Island, Yarmouth Co., N.S. (number of larvae 1000 m^{-3} of water filtered).

Date	Day towing	Night towing
July 25-29	1.23	0
Aug. 22-26	0.70	3.61
Aug. 29-Sept. 2	0.82	2.46
Sept. 5-9	1.23	0.82

substrates. Tows in surface phenomena occurred in 3.5 of 19 exploratory tows yielding two Stage I larvae.

Stasko's and Gordon's stations Replication of Stasko's and Gordon's four inshore stations (Stations 206, 207, 301, 303) found 12 larvae in 30.5 tows (0.64 larvae 1000 m^{-3}) (Table IV). Stasko and Gordon (1983) caught an average of 0.80 larvae 1000 m^{-3} and 2.35 larvae 1000 m^{-3} in 1977 and 1978, respectively.

Results were not exactly comparable because Stasko and Gordon sampled a shallower part of the water column (i.e. 0.15 m versus 0.4 m), at higher speed (i.e. 4 knots versus 2 knots). The tows also covered a larger area than did the tows in this survey, as in this survey the course was reversed half way in the tow. All 3 years, the catch consisted of Stages I and IV larvae exclusively. However, Stage I larvae was dominant in our survey versus Stage IV larvae in Stasko's 1977—1978 surveys. The percent composition of the catch was as follows:

Stage	1977	1978	1983
I	11%	29%	92%
II	0%	0%	0%
III	0%	0%	0%
IV	89%	71%	8%

Seven of the 30.5 tows were made in surface phenomena, yielding four Stage I larvae.

Table II (Cont.) Absolute numbers of larvae captured, by week and by station categories, in Lobster Bay, Yarmouth Co., N.S., during 1983.

Date (1983)	Exploratory stations					Stasko and Gordon stations				
		Larval Stage					Larval Stage			
	# tows	I	II	III	IV	# tows	I	II	III	IV
July 4-8	1	0	0	0	0	0.5	0	0	0	0
July 11-15	2.5	1	0	0	0	4	0	0	0	0
July 18-22	4	3	0	0	0	4	4	0	0	0
July 25-29	2.5	0	0	0	0	2	3	0	0	0
Aug. 1-5										
Aug. 8-12	4	0	0	0	0	4	3	0	0	0
Aug. 15-19	3	1	0	0	0	4	0	0	0	1
Aug. 22-26	2	0	0	0	0	2	1	0	0	0
Aug. 29-Sept. 2							3	0	0	0	0
Sept. 5-9							3	0	0	0	0
Sept. 12-16							4	0	0	0	0
Total:	19	5	0	0	0	30.5	11	0	0	1

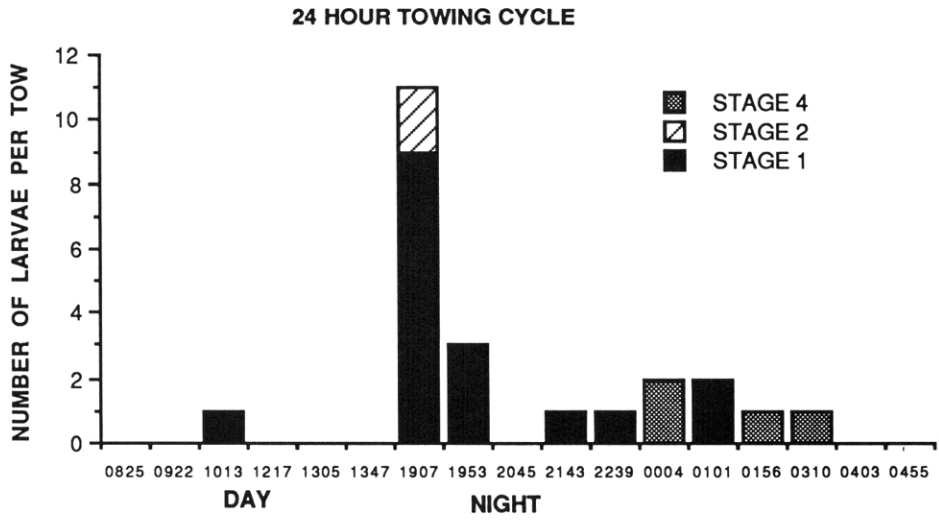

Fig 4 Results of the day-night towing cycle, August 25-26, 1983, absolute numbers caught per tow (two nets).

Discussion

The patchiness of spatial and temporal captures in this survey was not atypical for lobster larval surveys. Frequently one station or one day will yield a large proportion of the total captures in an extensive survey. For example, in Buzzard Bay, Massachusetts, 746 lobster larvae (266.2 larvae 1000 m^{-3}) were collected in one tow, representing 18% of the total catch for that year (Collings et al. 1983). Lux et al. (1983) captured 6,746 larvae in five tows in 1 day (450 larvae 1000 m^{-3}), representing 65% of their total 1979 catch. Part of the problem is a poor understanding of vertical distribution of all larval stages and the influence of behaviour relative to physical phenomena (Harding et al. 1987). Stage IV larvae were found to be equally abundant in Canadian offshore waters both day and night (Harding et al. 1987). Most of our towing was done in the daytime, yet we found few Stage IV larvae. The four stations established by Stasko and Gordon (1983) produced a predominance of Stage IV larvae in 1977 and 1978 but

Table IV Number of lobster larvae 1000 m^{-3} of water filtered in neuston gear at Stasko's and Gordon's stations.

	Station 206 - Bon Portage north					Station 207 - Bon Portage south				
	Larval stage					Larval stage				
Year	I	II	III	IV	Total #	I	II	III	IV	Total #
1977	0	0	0	0.47	1	0.37	0	0	1.49	5
1978	0	0	0	4.15	20	1.68	0	0	0.56	12
1983	0.47	0	0	0	2	0.61	0	0	0	3

Note 1977 and 1978 neuston nets sampled the top 0.15 m of the water column, and filtered 535 m^3 of water during a 30 min tow at 4 knots.

1983 neuston nets sampled the top 0.4 m of the water column, and filtered 610 m^3 of water during a 30 min tow at *ca.* 2 knots.

Stage I larvae in 1983. Harding et al. (1987) caught Stage I larvae in offshore waters, mostly between 15 to 30 m during the day and usually above 10 m at night.

The predominance of Stage I larvae in our survey cannot be explained by diel towing procedure, as towing was done mainly during the day. However, in the 24-hour tow series 16 Stage I larvae were caught in ten night tows, and only one in six day tows. The 14 inshore stations of Stasko and Gordon (1983) between Cape Sable Island and Pinkneys Point in 1977 yielded 85% Stage I larvae, and the converse in 1978, 28% Stage I. Diel migration cannot explain these differences, as daylight towing was used in both years for inshore stations. These data suggest annually cyclic and spatial factors are more predominant in the near shore than in the offshore environment. A survey of eight stations *ca.* 8 km apart in Cape Cod Bay found greater than 20 Stage IV larvae 1000 m^{-3} in seven stations and only 2.6 Stage IV larvae 1000 m^{-3} in the eighth station (Matthiessen and Scherer 1983). Similarly, abundance of all stages in shallow waters can fluctuate dramatically between years; in Buzzard Bay mean larval density ranged from 8.6-15.9 1000 m^{-3} in a 3 years series (1976-1978) (Collings et al. 1983). Spatially adjunct water bodies had an extreme mean range, from 1.3 to 15.8 larvae 1000 m^{-3} within 1 year (Collings et al. 1983).

The limited area covered by this survey's towing technique enabled the identification of areas of concentration on the scale of 0.5 km. As a result Whitehead Island was selected as a station early in the survey and produced consistent results. Positive results occurred in 54% of tows at Whitehead Island versus 23% at Stasko's and Gordon's stations and 8% at Whale Island. Larvae were collected from Whitehead Island every week of the survey. The consistency of capture in this area may be due to several factors relating to source of larvae and physical factors.

Lobster Bay is an area of high lobster abundance; all the shoals and foreshores yield large catches. In 1983, inshore lobster landings were 1536 metric tons (the Department of Fisheries and Oceans' Statistical District 33). Egg-bearing females are present in the Bay during summer months (D.E. Graham[1]).

The shallows of Whitehead Island contain a part of this high lobster abundance. High-speed tidal currents, 2-4 km h^{-1}, pass around Whitehead Island; and the position of land mass and shoals may carry or concentrate larvae from near and distant sources more frequently through this area than at other stations.

However, it is not possible to distinguish larval sources. Stage IV larvae appeared 4 weeks after Stage I larvae in near-shore waters of Lobster Bay. The period of time

[1]D.E. Graham, Biological Sciences Branch, Department of Fisheries and Oceans, St. Andrews, N.B. E0G 2X0.

Table IV (Cont.) Number of lobster larvae 1000 m^{-3} of water filtered in neuston gear at Stasko's and Gordon's stations.

	Station 301 - St. Ann Point					Station 303 - Thrum Island				
	Larval stage					Larval stage				
Year	I	II	III	IV	Total #	I	II	III	IV	Total #
1977	0	0	0	0.31	1	0	0	0	0.62	2
1978	0.37	0	0	1.12	8	0.56	0	0	1.12	9
1983	1.01	0	0	0	4	0.36	0	0	0.18	3

Note 1977 and 1978 neuston nets sampled the top 0.15 m of the water column, and filtered 535 m^3 of water during a 30 min tow at 4 knots.

1983 neuston nets sampled the top 0.4 m of the water column, and filtered 610 m^3 of water during a 30 min tow at *ca.* 2 knots.

between the appearance of Stage I and Stage IV larvae was approximately 2-3 weeks in 1977 and 1978 (Stasko and Gordon 1983). A minimum of 3 weeks is required at 14.5°C to reach Stage IV (MacKenzie 1985). A local source of larvae is possible for our study but less likely in the Stasko and Gordon survey due to the lack of degree days.

It is not justified to create any theories concerning diel and vertical distribution patterns from our limited data base. However, it is clear that the shallow near-shore environment with extreme tidal mixing must be examined directly, and assumptions derived from offshore larval studies cannot be easily applied.

Acknowledgements

We thank K. Stokesbury and T. Helm for field assistance; U. Earanky and L. Boston for sample analysis; J.D. Pringle and G.C. Harding for helpful manuscript review; G. Jeffery for graphics; and S.P. LeBlanc for technical assistance.

References

Anonymous. 1982. Canadian tide and current tables. Vol. 1, 1983. Dept. Fish. and Oceans-Can. Hydrogr. Serv.

Collings, W.S., Cooper-Sheehan, C., Hughes, S.C., and **Buckley, J.L.,** 1983. The spatio-temporal distribution of American lobsters, *Homarus americanus,* larvae in the Cape Cod Canal and approaches, p. 35-40. *In* M.J. Fogarty (ed.) Distribution and abundance of American lobster, *Homarus americanus,* larvae: New England investigations during 1974-1979. NOAA Tech. Rep. NMFS SSRF-775:64 p.

Dobson, D. and **Petrie, B.,** 1985. Long-term temperature monitoring program 1984, Scotia-Fundy, Gulf Regions. Can. Data Rep. Hydrogr. Ocean Sci. 35:vii + 691 p.

Fair, J.J., Jr. 1980. U.S. surveys of lobster larvae. *Can. Tech. Rep. Fish. Aquat. Sci.* 932:153-155.

Fogarty, M.J. 1983. Distribution and relative abundance of American lobster, *Homarus americanus,* larvae: A review, p. 3-8. *In* M.J. Fogarty (ed.) Distribution and relative abundance of American lobster, *Homarus americanus,* larvae: New England investigations during 1974-1979. NOAA Tech. Rep. NMFS SSRF-775:64 p.

Harding, G.C., Vass, W.P., and **Drinkwater, K.F.** 1982. Aspects of larval American lobster (*Homarus americanus*) ecology in St. Georges Bay, Nova Scotia. *Can. J. Fish. Aquat. Sci.* 39:1117-1129.

Harding, G.C., Pringle, J.D., Vass, W.P., Pearre Jr., S. and **Smith, S.J.** 1987. Vertical distribution and daily movements of larval lobsters *Homarus americanus* over Browns Bank, Nova Scotia. *Mar. Ecol. Prog. Ser.* 41:29-41.

Herrick, F.H. 1911. Natural history of the American lobster. *Bull. U.S. Bureau Fish.* 29:149-408.

Lux, F.E., Kelly, G.F., Wheeler, C.L., 1983. Distribution and abundance of larval lobsters (*Homarus americanus*) in Buzzards Bay, Massachusetts, during 1976-1979, p. 29-33. *In* M.J. Fogarty (ed.) Distribution and relative abundance of American lobster, *Homarus americanus,* larvae: New England investigation during 1974-1979. NOAA Tech. Rep. NMFS SSRF-775:64 p.

MacFarlane, C.I. 1964. A comparison of two marine drumlin regions in Nova Scotia, p. 240-247. *In* A.D. De Verville and J. Feldmann (ed.) Proceedings of the Fourth International Seaweed Symposium.

MacKenzie, B. 1985. Temperature considerations of larval lobster (*Homarus americanus* Milne Edwards) ecology in waters off southwestern Nova Scotia. M.Sc. Thesis, Dal. Univ.: 106 p.

Matthiessen, G.C. and **Scherer, M.D.,** 1983. Observations on the seasonal occurrence, abundance and distribution of larval lobsters (*Homarus americanus*) in Cape Cod Bay, p. 41-46. *In* M.J. Fogarty (ed.) Distribution and relative abundance of American lobster, *Homarus americanus,* larvae: New England investigations during 1974-1979. NOAA Tech. Rep. NMFS SSRF-775:64 p.

Pezzack, D.S. and **Duggan, D.R.,** 1983. The Canadian offshore lobster (*Homarus americanus*) fishery - 1971-1982. Int. Coun. Explor. Sea C.M. 1983/K:34.

Pezzack, D.S. and **Pringle, J.D.** 1986. Gulf of Maine area lobster management areas, and suggestions on stock structure. Can. Atl. Fish. Sci. Adv. Comm. Res. Doc. 86/65.

Sameoto, D.D. and **Jaroszynski, L.O.,** 1969. Otter surface sampler: A new neuston net. *J. Fish. Res. Board Can.* 26:2240-2244.

Stasko, A.B. 1977. Lobster larvae on the Scotian Shelf. Can. Atl. Fish. Sci. Adv. Comm. Res. Doc. 77/31.

Stasko, A.B. 1978. Inshore-offshore SW Nova Scotia lobster stock interaction: A hypothesis. Can. Atl. Fish. Sci. Adv. Comm. Res. Doc. 78/37.

Stasko, A.B. 1980. Lobster larval surveys in Canada. Can. Tech. Rep. Fish. Aquat. Sci. 932:157-169.

Stasko, A.B., and **Gordon, D.J.,** 1983. Distribution and relative abundance of lobster larvae off southwestern Nova Scotia, 1977-1978. Can. Tech. Rep. Fish. Aquat. Sci. 1175:iii + 23 p.

(Received 10 December 1987)