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The Effect of Scallop Fishing on Lobsters in the Western Northumberland Strait

by

G.S. Jamieson[1], M. Etter, and R.A. Chandler[2]

Department of Fisheries and Oceans
Resource Branch
Invertebrates and Marine Plant Division
Halifax, Nova Scotia B3J 2S7

Abstract

Damage to lobsters by commercial scallop dragging in Egmont Bay and off Miminegash, PEI, was minimal with present seasonal scallop fisheries restrictions. During May, when commercial scallop fishing was occurring, lobster abundance was low in areas of profitable scallop exploitation. These areas were generally smooth and most lobsters were able to avoid the gear. Of the lobsters observed to be in the drag path, 12.1 and 2.5% were injured or retained by the drag in the areas studied having no commercial scallop fishing and commercial scallop fishing, respectively. Lobster abundance in July in the areas commercially exploited for scallops in May and June was significantly greater than in May, but whether this was the result of a natural seasonal movement of lobsters or was influenced by the cessation of scallop fishing is unclear.

Résumé

Grâce aux restrictions saisonnières actuellement en vigueur pour la pêche aux pétoncles, les dommages causés au homard par les dragueurs de pétoncles commerciaux dans la baie Egmont et au large de Miminegash (I.-P.-E.) ont été réduits au minimum. En mai, au moment de la pêche commerciale aux pétoncles, le homard était peu abondant dans les zones de bon rendement en pétoncles. Ces zones presentement généralement un substrat régulier où la plupart des homards peuvent éviter la drague. On a constaté que parmi les homards se trouvant sur le parcours de la drague, 12,1 % étaient soit blessés, soit capturés par l'engin dans les zones où le pétoncle n'est pas exploité commercialement, contre seulement 2,5 % dans les zones d'exploitation commerciale. Dans les zones où la pêche aux pétoncles avaient en lieu en mai et juin, l'abondance des homards en juillet était nettement plus élevée qu'en mai. On ignore toutefois si cela résulte d'un mouvement saisonnier naturel des homards ou si l'arrêt de la pêche aux pétoncles y est pour quelque chose.

[1]Present address: Department of Fisheries and Oceans, Resource Services Branch
Pacific Biological Station, Nanaimo, British Columbia V9R 5K6

[2]Biological Station, St. Andrews, New Brunswick EOG 2X0

INTRODUCTION

Scallop (Placopecten magellanicus) and lobster (Homarus americanus) populations are fully exploited in Northumberland Strait (Jamieson et al. 1981b; D. G. Robinson, pers. comm.). Recent, localized declines in abundance of both commercial species has heightened long-held concerns by fishermen as to the direct negative impact of scallop fishing on lobster stocks. This concern became acute in 1980 in the Egmont Bay area, coincident with the discovery and exploitation of new scallop concentrations near West Point, Prince Edward Island. Decreased scallop recruitment in recent years has resulted in a scarcity of scallops in traditionally exploited areas, causing increased exploration for commercially exploitable scallop concentrations. Such exploration, and subsequent exploitation of any newly found scallop concentrations can be expected to continue until significant recruitment reoccurs on traditionally fished scallop grounds.

The magnitude of scallop gear-lobster interaction is dependent on three main factors: the spatial and seasonal distributions of both scallop and lobster, and where overlap occurs, the impact of scallop gear on lobster. While scallops can be found virtually anywhere in the Northumberland Strait (Caddy et al. 1977), they are only found at commercial densities in limited areas. The precise locations of these areas are undocumented, and since they vary with time, they cannot be predicted with any accuracy. However, from commercial log data, Jamieson et al. (1981a, 1981b) provide some indication as to the broad distribution of scallop concentrations in the Northumberland Strait during 1979 and 1980, respectively.

The seasonal abundance and distribution of lobsters is largely unknown but their general distribution commonly overlaps that of scallops (Stasko et al. 1977). The only distribution data available is from commercial lobster landings by port. Individual fishermen frequently fish both scallop and lobster, commonly in the same general area, although the fisheries are usually separated temporally. When the lobster fishing season is open, most fishing effort is generally directed towards this species as it is the most important fishery in the Northumberland Strait.

Scallop drags and Irish moss (Chondrus crispus) drags can damage lobsters (Scarratt 1973, 1975; Pringle et al. 1980). These authors found that exposed lobsters on open ground tended to avoid moving drags, and most gear-induced damage resulted from lobsters in burrows being hit or crushed by rocks disturbed by the drag. Lobsters are often secretive during daylight hours (pers. obs.), the time of day when both scallops and Irish moss are fished in Northumberland Strait, and so may be particularly susceptible to drag damage. The economic impact of drags on lobster injury is related to both scallop density and substrate, making knowledge of the specific, relative microdistributions of each species particularly important when forecasting lobster injury.

This study reports the results of scallop drag/lobster interactions off Miminegash, Prince Edward Island, during August, 1978, and in Egmont Bay during May and July, 1981.

METHODS

A. 1978 STUDY

The effects of three sets of scallop gear on lobsters were independently observed between August 15-30, 1978. The gear used was a two-gang, Gulf rock drag (60-cm buckets); a two-gang Digby rock drag (76-cm buckets); and a 152-cm Gulf sweep chain drag. For experimental purposes, there was a hood of 38-mm stretch mesh over the drags extending to a height of 1 m above the sea bottom, and one of the buckets (half the chain sweep drag) had a similar mesh back cover. The bucket, or portion of the drag, without a back cover had a mesh liner. The study area was in 14 m of water about 1 km from shore (46°52'30"W; 64°14'00"N), and consisted of a sandy bottom interspersed with occasional small rocks. No scallops were present but lobsters were numerous and were observed by divers to be generally in the open. Average carapace length (CL) of 22, diver-collected lobsters was 61.3 (SD=26.8) mm (back of eye socket to posterior carapace margin). Two divers hung onto each drag during tows, and observed the effect of the drag on lobsters. The vessel was the 12.8 m M/V LOUELLA W, operated by Captain E. Wedge and tow velocities over the bottom were estimated to be <5 kt (the divers had problems breathing at high speeds).

B. 1981 STUDY

Dragging was conducted over two time periods, May 14-22 and July 27-31, using the 12.8 m commercial scallop vessel M/V KARLA E., operated by Captain Malcolm Ellis. Gear velocities over the bottom averaged 4.6 kt (SD=1.9) in May and 4.3 kt (SD=1.7) in July. A four-gang Gulf drag with 51-cm buckets was used throughout the study, and operating procedures were the same on both dates. Lead ropes 30 m long were attached to each end of the 2.36 m club stick to define an area behind the drag to be surveyed by divers. Before the drags were dropped, the lines were let out while the vessel was steaming or drifting to establish an unfished control area for survey. In each representative area, when the drags were on the bottom, divers swam along the outside edge of each lead line with a 2-m rod, noting all scallops and lobsters encountered in the 2-m wide unfished "path" (120 m^2). The divers then positioned themselves on the drag and noted the number of lobsters in the drag path during the tow, which covered on average 975 m (SD=221). When the tow terminated, the divers searched the drag path between the lead lines (70.8 m^2) and collected the scallops and lobsters encountered. Scallop (edge of hinge to distal edge of the valves) and lobster sizes (CL) were measured, and location (Loran C readings), bottom type (Fig. 1), water temperature, rock crab abundance, and marine plant presence were noted. Tow distance and speed was calculated from Loran C readings.

Four general areas (Fig. 2) were surveyed in both periods. In areas A and A', both scallops and lobsters were known to exist but scalloping had not occurred for several years (May: 5 tows; July: 3 tows). Areas B and C were reported by fishermen to be prime lobster ground and were areas where scalloping had occurred recently or was in progress (May: 30 tows; July: 25 tows), Bottom water temperatures averaged 8.8 and 18.4°C in May and July respectively.

RESULTS

A. 1978 STUDY

Assuming a uniform lobster density during tows, highest lobster catches over both sand and rock-sand were made by the Gulf sweep-chain drag, with average catches in the lined and unlined portion of the drag of 0.53 and 0.07 lobsters/m-min, respectively (Table 1).

No lobsters were caught by the unlined rock drags, but since they were retained in the back cover on this drag, it is evident that lobsters were entering the drag and were passing through the rings. These lobsters did not show any external evidence of damage. The hoods of all three drag types contained lobsters, indicating that lobsters can escape by swimming over the drag.

B. 1981 STUDY

1) Relative scallop and lobster abundances

Catch results and visual sightings per tow (Table 2) indicate that for each study area, considerable variation exists as to the relative abundance of both scallops (Fig. 3) and lobsters (Fig. 4). Substrate type was quite variable even within a tow, and this appeared to be a major factor in determining scallop and lobster abundance.

Scallop and lobster densities in the two fished areas both varied significantly on occasion (Table 3) from those densities in the unfished area; fished grounds had a greater number of scallops, but fewer lobsters, than did the unfished ground. Between the two fished areas, the only significant ($p=0.02$) difference was in the scallop drag catch in May, but the study area off Red Head (Fig. 2,C) generally yielded both more scallops and lobsters than did the study area off West Point (Fig. 2,B).

On a seasonal basis, there were no significant differences in the densities of either scallop or lobster in the unfished area. In both fished areas, lobster sightings per tow were significantly greater ($p<0.05$) in July than in May, although overall number of sightings averaged less than in the unfished area. Scallop catch decreased significantly ($p<0.01$) in the ground of Red Head between May and July. Although not always significant, the general seasonal trend in stock abundance, as indicated by the control sampling, was for lobster density to increase between May and July in all areas. On fished ground, average scallop density decreased whereas scallop density on the unfished ground increased during this time period.

2) Scallop gear:lobster interaction

No relation appears to exist between season and the percentage of lobsters encountered which became damaged or were retained by the gear (Table 4). For the unfished and fished areas, the weighted incidence of damage was 12.1 and 2.5% of the observed lobsters respectively. In the areas studied, no damaged lobsters were found behind the drag in the surveyed portion of the drag's path, although occasionally lobsters were observed by the divers to retreat into their burrows in front of the moving drag. Whether they subsequently became damaged or trapped is unknown, but the absence of damaged lobsters in the drag path suggests that the frequency of this occurrence is low on scallop ground. This may perhaps be correlated with the general lack of large rocks and boulders on the commercial scallop ground surveyed, although 14 of the 30 locations surveyed had occasional large rocks.

The Northumberland Strait lobster fishery is very intensive, and as a result most lobsters encountered were too small (Table 5) to be retained by the gear (a 7.5-cm (3-in) scallop ring is estimated to retain lobsters of carapace length greater than 90 mm; Krouse (1977) notes that a 2-in escape ring allows 100% escape of 82-mm CL lobsters). Lobsters were frequently observed to enter the drag and pass through the rings apparently unscathed. In 63 tows, 11 lobsters appeared to be affected directly by the scallop gear: four were retained by the drag (in one tow the ring openings were blocked with *Laminaria*), four passed under the drag and may have been injured, and three were struck by the drag sufficiently hard enough to cause claw loss or a cracked carapace. In this latter instance, all the damage caused to lobsters was in one tow (May, tow no. 35) in the area not exploited for scallops; strong currents were present which affected the ability of the lobsters to escape.

Relative scallop abundance at size appeared similar in May and July in each of the two areas commercially fished for scallops (Fig. 5); all scallop age classes appeared to be exploited about equally.

DISCUSSION

The results of this study are to a large extent site specific, and perhaps time specific as well in that the density of both scallops and lobsters appears to vary seasonally. Nevertheless, the results do provide an indication of the significance of scallop gear damage on lobster stocks in Egmont Bay, as well as allowing estimation of the incidence of scallop gear damage in other locations of similar substrate type.

Published records of lobster densities are scarce. Scarratt (1968) observed a density of 41.7 lobsters/1000 m^2 on an artificial reef and a density of 34.5 lobsters/1000 m^2 on good natural lobster ground in Kouchibouguac Bay, New Brunswick. Scarratt (1973) found densities ranging from 7-109 lobsters/1000 m^2 on Irish moss beds off Prince and Queen counties, Prince Edward Island. In contrast, the maximum lobster densities observed in this study off Prince County, Prince Edward Island, were 16.7 and 5.6 lobsters/1000 m^2 in the unfished and fished areas respectively. Lobster densities were lower during May than July, and since Scarratt's (1973) observations also commenced in May, this difference in relative lobster density may be even greater.

Lobster density on scallop ground is probably influenced by scallop fishing activity. In the unfished area, there was no significant difference in lobster abundance between the May and July observations, whereas there were significant differences in relative seasonal lobster abundance in both fished areas. In western Northumberland Strait, scallop fishing occurs primarily between late April and late June, with a minor amount of fishing between mid-October and winter freeze-up (Jamieson et al. 1981b). There is limited scallop fishing during July. If lobsters were displaced by scallop dragging during May and June, normal seasonal lobster densities could perhaps be re-established by late July. Whether the greater density of lobsters in the study areas in July is due to a normal seasonal migration onto these grounds or the absence of scallop fishing is unclear, although data (A. Campbell, unpublished) suggest that lobster immigration could be occurring from the deeper water areas of the Strait.

Fishing has two effects on apparent scallop abundance, both of which reduce scallop density per unit area: individuals are removed through capture by the fishing gear, and escape behaviour through swimming causes the scallops to scatter over a larger area (Jamieson and Chandler 1980). Being poikilotherms, the metabolic rate of both lobsters and scallops is increased by a rise in ambient water temperature. In lobster fishing, gear is stationary, and increased lobster activity generally results in a higher fishing mortality. Scallop fishing, in contrast, involves mobile gear, and an increase in water temperature facilitates scallop escape (lobster escape also appears to be enhanced), thus reducing fishing mortality. This is in part the rationale for a scallop closure from mid-July to mid-October in Lobster District 8.

July scallop densities may also have been affected by the increase in water temperature (maximum value was 19.4°C on July 29) to a level near their upper tolerance threshold (20-23.5°C: Dickie 1958). High water temperatures may cause direct mortality (Dickie and Medcof 1963), and anecdotal reports from fishermen suggest that high, but non-lethal, water temperatures result in gradual scallop catch declines. This latter suggestion, if true, could be due to reduced gear effectiveness, but when water temperatures decrease in the fall, CPUE, in a previously high CPUE area, often remains low, suggesting that the scallops have moved elsewhere. Dispersal might result from the scattering stimulated by fishing or from natural scallop movement arising from their efforts to locate a more optimal temperature environment, although Caddy (1968) suggests that large scallops may move infrequently.

High summer water temperature and ice scouring in the winter have tended to make shallow water areas in the Northumberland Strait an unsuitable environment for long-term scallop survival. As a result, traditionally exploited commercial scallop ground has largely been located in the deeper waters of the Strait. Since scallop fishermen generally exploit any scallop concentration they find, the relative lack of expended effort in shallow water (Jamieson et al. 1981a, 1981b) suggests that scallop concentrations in such waters are few.

With the present seasonal fisheries restriction, the impact of scallop gear on lobsters appears to be minimized: lobsters are in low abundance on scallop ground at the time of greatest scallop fishing activity.

Commercial concentrations of scallops and lobsters also appear to be largely separated spatially (Fig. 3, 4). What then is the likely economic impact in Egmont Bay of scallop fishing on lobsters, and how does this compare to the value of the exploited scallop resource?

In 1980, there was no reported commercial scallop fishing off Red Head, but 1,509.4 kg of adductor muscle, as reported by log records, was fished from scallop log areas 77 and 78 combined (Jamieson et al. 1981b). Average CPUE was about 2.4 kg/hr-m, indicating that 629 hr-m of effort was expended. In this study, a total of 8.2 hr-m of effort was expended in May on the fished grounds (average tow duration was 6.9 min) and 22 lobsters were observed in the drag path. Drag velocities over the bottom in both commercial fishing operations and in this study are assumed to be similar. If 2.6% of the lobsters observed are adversely affected, with 50% of these lobsters killed, then the total number of lobsters estimated to be destroyed by commercial scallop fishing in 1980 was 22 lobsters. If each weighed 0.5 kg and with a value of $6.60/kg, then the total dollar loss would be about $73. In comparison, at $8.27/kg in May, 1980 (Jamieson et al. 1981b), the scallop landings from these two log areas had an estimated value of $12,483.

If lobster abundance was as high as that in the unfished area, i.e. 3.03 lobsters/1000 m^2, then 139 lobsters, with a value of $460, would have been destroyed. In both instances, this loss is negligible in comparison to the values of both the lobster and scallop fisheries.

These conclusions are in agreement with the observations of Scarratt (1973) in his assessment of the impact of Irish moss raking on lobster populations. On smooth beds, lobsters are low in abundance and mortality is negligible.

ACKNOWLEDGMENT

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REFERENCES

Caddy, J. F. 1968. Underwater observations on scallop (Placopecten magellanicus) behaviour and drag efficiency. J. Fish. Res. Bd. Can. 25: 2123-2141.

Caddy, J. F., T. Amaratunga, M. J. Dadswell, T. Edelstein, L. E. Linkletter, B. R. McMullin, A. B. Stasko, and H. W. van DePoll. 1977. 1975 Northumberland Strait project, Part I. Benthic fauna, flora, demersal fish and sedimentary data. Fish. Mar. Serv. MS Rep. 1431: 46 p.

Dickie, L. M. 1958. Effects of high temperature on survival of the giant scallop. J. Fish. Res. Bd. Can. 15: 1189-1211.

Dickie, L. M., and J. C. Medcof. 1963. Causes of mass mortalities of scallops (Placopecten magellanius) in the southwestern Gulf of St. Lawrence. J. Fish. Res. Bd. Can. 20(2): 451-482.

Jamieson, G. S., and R. A. Chandler. 1980. The potential for research and fishery performance data isopleths in population assessment of offshore, sedentary, contagiously distributed species. CAFSAC Res. Doc. 80/77: 32 p.

Jamieson, G. S., N. B. Witherspoon, and M. J. Lundy. 1981a. Assessment of Northumberland Strait scallop stocks - 1979. Can. Tech. Rep. Fish. Aquat. Sci. 1013: 9 p.

Jamieson, G. S., N. B. Witherspoon, and M. J. Lundy. 1981b. Assessment of Northumberland Strait scallop stocks. 1980. Can. Tech. Rep. Fish. Aquat. Sci. 1017: 11 p.

Krouse, J. S. 1977. Facts behind the lobster escape vent law. Maine Dept. Fish., Lobster Info. Leaflet No. 9.

Pringle, J. D., and D. J. Jones. 1980. The interaction of lobster, scallop and Irish moss fisheries off Borden, Prince Edward Island. Can. Tech. Rep. Fish. Aquat. Sci. 973: 6 p.

Scarratt, D. J. 1968. An artificial reef for lobsters (Homarus americanus). J. Fish. Res. Bd. Can. 25(12): 2683-2690.

Scarratt, D. J. 1973. The effects of raking Irish moss (Chondrus crispus) on lobsters in Prince Edward Island. Helgolander wiss. Meeresunters. 24: 415-429.

Scarratt, D. J. 1975. Observations on lobsters and scallops near Pictou, N.S. Fish. Mar. Serv. Tech. Rep. 532: 6 p.

Stasko, A. B., T. Amaratunga, and J. F. Caddy. 1977. 1975 Northumberland Strait project, Part II. Commercial shellfish data. Fish. Mar. Serv. MS Rep. 1432: 29 p.

Table 1. Average lobster catches per minute per meter of drag width in the hoods and linings of the scallop gear studied. Each drag type was hauled over both sand and sand-rock substrates off Miminegash, Prince Edward Island. L = lined gear; UL = unlined gear; H = hood; B = back cover.

Drag type	No. tows	Lobster catch			
		L	UL	H	B
Gulf sweep chain	5	0.53	0.07	0.15	0.31
Gulf rock drag	5	0.11	0.00	0.06	0.11
Digby rock drag	6	0.02	0.00	0.07	0.04

Table 2. Substrate type, catches and lobster sightings per tow (average length: 975 m) in the three areas surveyed during 1981 in Egmont Bay, Northumberland Strait. M=mud; L=<u>Laminaria</u>; r=small rocks; R=large rocks; I=Irish moss; S=sand; SS=sandstone shelves; x=tow repeated in July. Sighted: visible to the divers but not in the path of the drag.

					Lobster			
Tow no.			Scallops in drag		In drag path		Sighted	
May	July	Substrate	May	July	May	July	May	July
UNEXPLOITED GROUND								
32		M,L	0		0			
10	X	M,R	0	0	0	2		
23	X	r,R	2	0	15	10		
24		r,R,I	6	1	9	20	2	
35		SS	0		4			
EXPLOITED GROUND								
<u>Off West Point</u>								
1	X	r,L	7	1	0	4		1
2		r,L	20		0			
3		r,R,L	8		2		1	
4		r,L	16		2		1	
12	X	r,R	-	39	-	0	-	1
13	X	r,R	13	31	4	7	5	
14	X	r	5	46	0	4		1
15	X	r,5	46	22	0	2	1	3
16	X	r,S	4	23	0	0		1
33	X	R,L	0	1	1	2		
34		r,R,S,L	9		1			
<u>Off Red Head</u>								
5	X	r	31	27	0	0		
6	X	r	84	49	1	15	2	
7	X	r,S	56	13	0	2		2
8	X	r,R	58	10	3	8	3	
9	X	r,M	33	9	0	1		
11	X	r,R	45	26	0	5		
17	X	r,R	35	13	1	1	1	
18	X	r	62	23	5	1		
19	X	r,S	71	40	1	3		
20	X	r,S	11	2	5	10		
21	X	r,R,L	8	10	1	5		
22	X	r,R,L	1	2	2	4		
25		r,R,L	2		0			
26	X	r,R	18	1	2	4		

Table 2. (cont'd)

Tow no.			Scallops in drag		Lobster			
					In drag path		Sighted	
May	July	Substrate	May	July	May	July	May	July
27	X	r	57	24	2	6	1	
28	X	r,R	8	1	4	6		
29	X	r	46	17	1	3		
30	X	r	40	10	7	4	1	
31	X	r	48	43	0	3		

Table 3. Average scallop and lobster abundance per 1000 m^2 in each study area before the drag was towed (control), in a towed drag, and in the drag path behind the drag. Of the total number of lobsters sighted during the tows in each location, the percentage of lobsters observed to be physically damaged by the drag and/or retained by the drag is indicated. Values with asterisks are significantly different from the corresponding value in the non-fished location. * = $p<0.05$; ** = $p<0.01$.

		Control				Drag				Drag path				%
Location	Month	n	Scallop	n	Lobster	n	Scallop caught	n	Lobsters observed	n	Scallop	n	Lobster	lobsters injured
Non-fished area	May	4	6.25	4	2.08	5	0.87	4	3.03	2	0.0	2	0.00	11
	July	2	12.50	2	16.67	3	0.15	3	4.62	3	4.71	3	4.71	13
West Point	May	4	56.23	4	0.00	12	7.59*	11	0.48	8	24.70*	8	1.76	10
	July	3	22.21	3	2.78*	7	10.10	7	1.48*	5	127.08	5	5.65	11
Red Head	May	9	99.03**	9	0.93	19	16.38**	19	0.87	12	68.25**	12	1.18	0
	July	9	58.31	9	5.55	18	8.34**	18	1.98*	10	52.24	10	1.41	5

n=number of tows.

Table 4. Frequency of lobster injury during dragging by month and location.

	Month	Non-fished area	Fished areas	
			West Point	Red Head
No. lobsters observed in drag path	May	28	10	35
	July	32	19	82
No. lobsters injured	May	3	1	0
	July	4	1	2
% injured	May	11	10	0
	July	13	5	2

Table 5. Average sizes (mm CL) of lobsters caught by both the drag or divers before towing (control), during the tow, and in the drag path behind the drag in both May and July. Of the 19 lobsters measured, only 3 exceeded 90 mm carapace length.

	Control			Tow			Drag path		
	n	Average	Range	n	Average	Range	n	Average	Range
May 1981	1	66	-	4	85	57-134	0		
July 1981	10	71	36-134	1	73	-	3	64	45-88

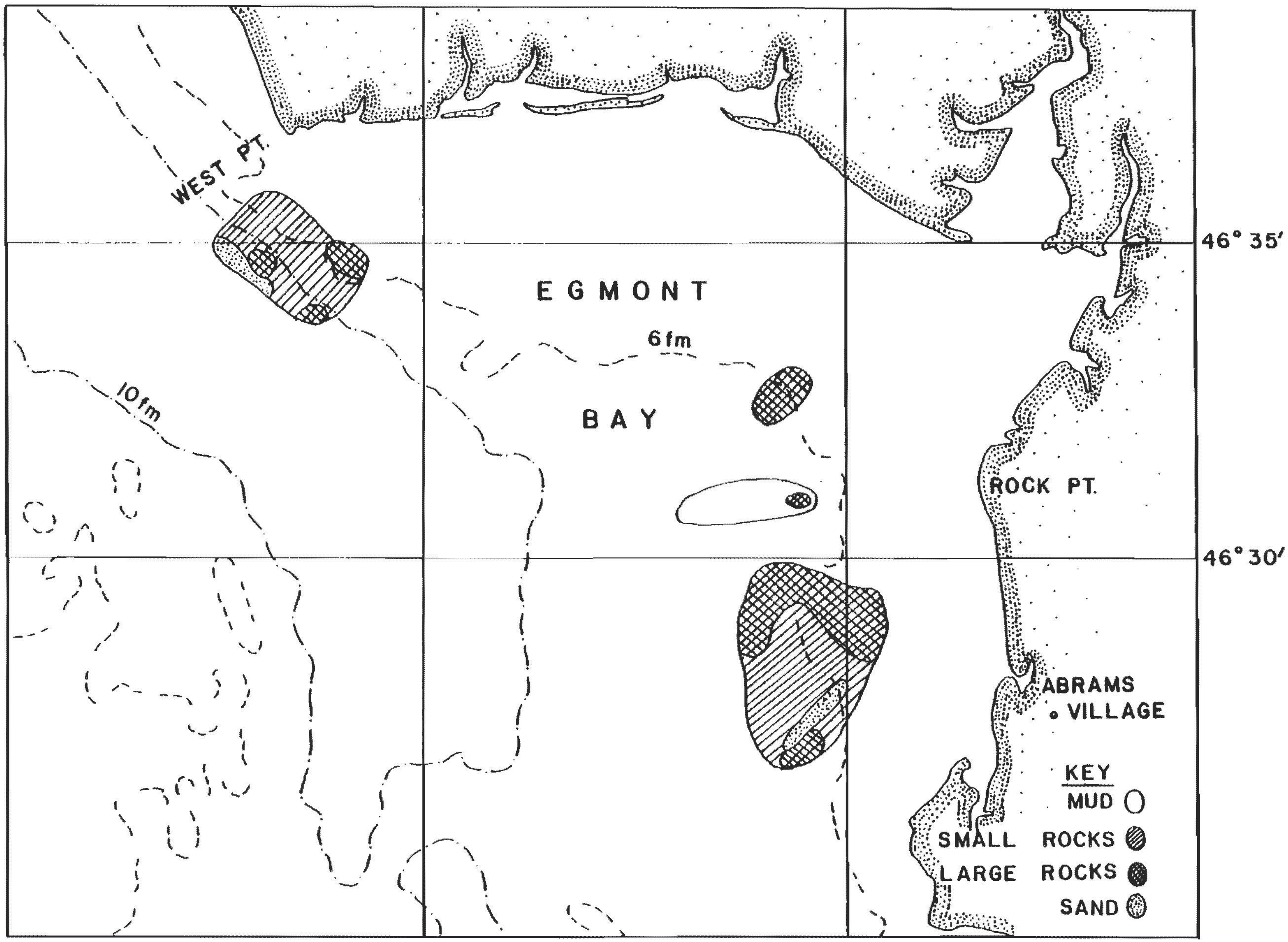

Fig. 1. General substrate type as observed by divers in the areas surveyed in Egmont Bay, Northumberland Strait.

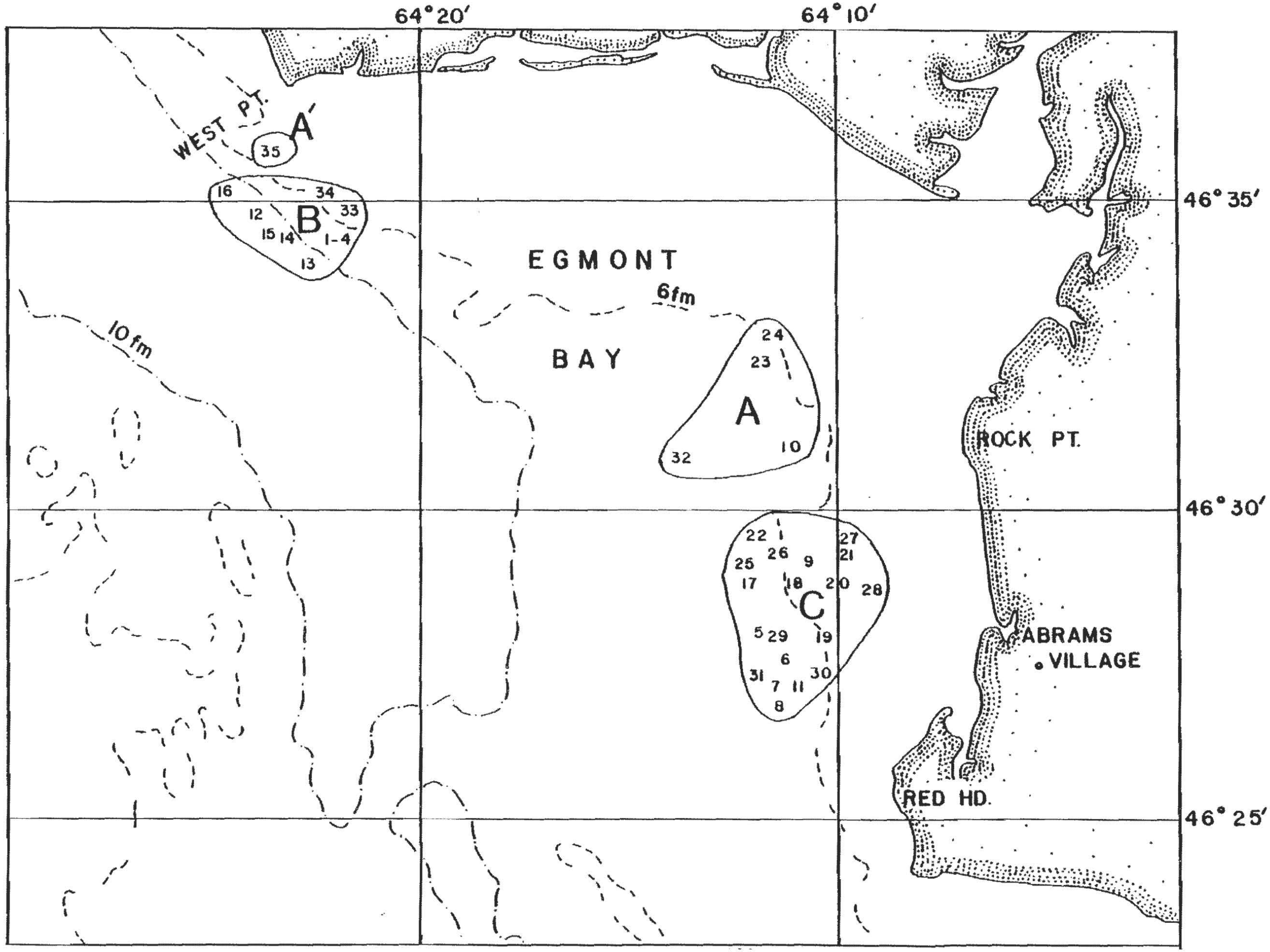

Fig. 2. Locations and station numbers of stations sampled in Egmont Bay, Northumberland Strait. A,A': areas unexploited by the commercial scallop fishery; B, C: areas exploited.

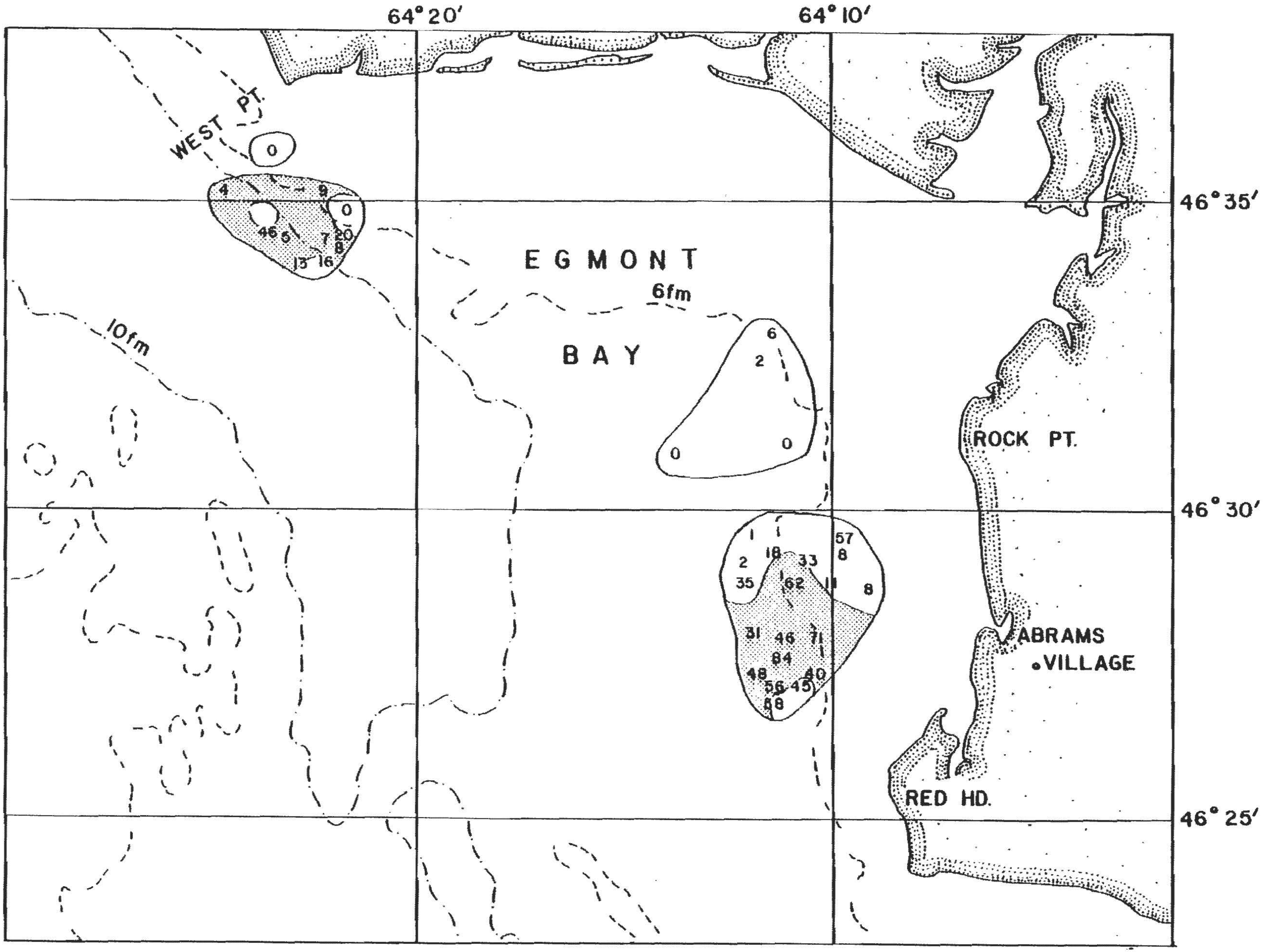

Fig. 3. Number of scallops fished by the gear in May in each tow in Egmont Bay, Northumberland Strait. Stippled area: substrate of small rocks or sand.

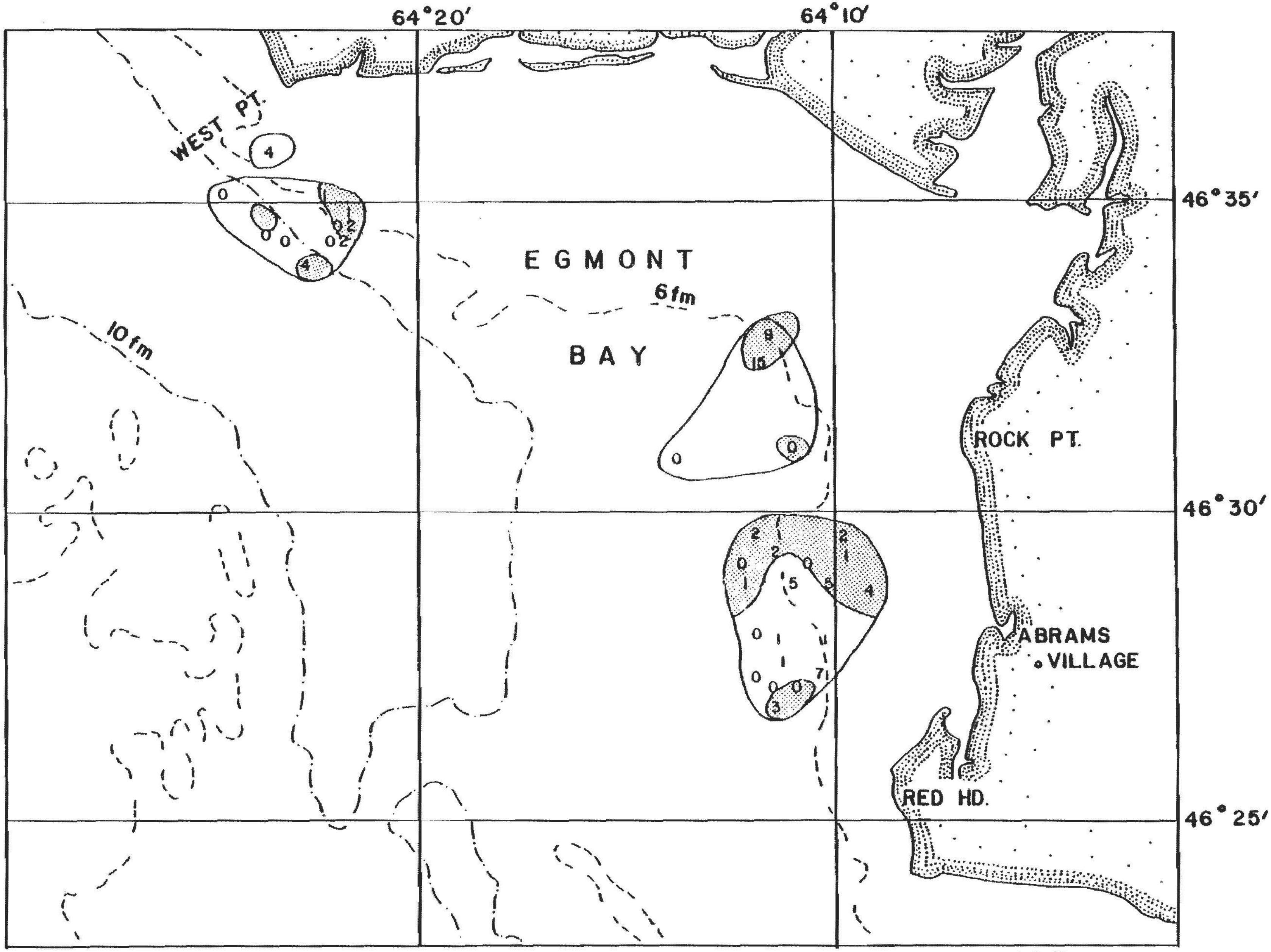

Fig. 4. Number of lobsters observed by divers in May during each tow in Egmont Bay, Northumberland Strait. Stippled area: large rocks.

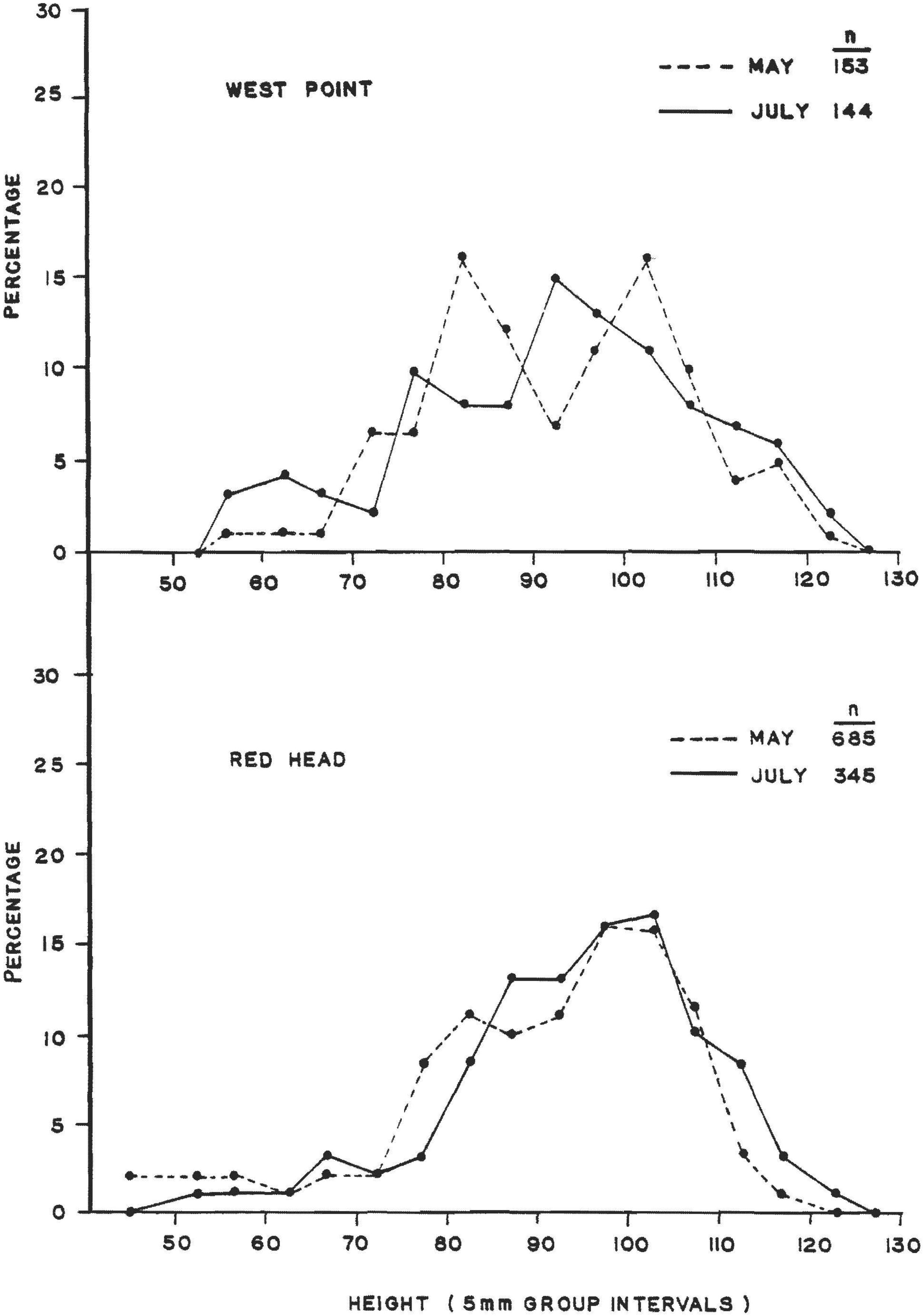

Fig. 5. Relative abundance of scallop size classes in each of the commercially fished areas in both May and July. (West Point cf. Fig. 1,B; Red Head cf. Fig. 1,C.)