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Report on the Scotian Shelf Fishery for Jonah Crab,
Cancer borealis, during 1983

by

Robert W. Elner and David A. Robichaud
Invertebrates and Marine Plants Division
Fisheries Research Branch
Department of Fisheries and Oceans
Biological Station
St. Andrews, New Brunswick E0G 2X0

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Abstract

Background information is presented on the development of a directed fishery for jonah crab, Cancer borealis, on the Scotian Shelf during 1983. Before the fishery closed due to processing problems, 90.3 metric tons (MT) of jonah crab were landed by 10 permit holders through the period May-August. Port and at-sea sampling of commercial catches indicate that the mean size for landed males remained relatively constant and well above the minimum size limit of 130 mm carapace width. Female crabs were, on average, smaller than the males and comprised only 5%, by numbers, of landings sampled. Catch and effort statistics compiled from sales slips and fishermen's logbooks show catch rates tended to increase for the three major fishing grounds through the season. Based on available background information, the present minimum size limit and stock characteristics appear adequate to buffer the reproductive potential of the resource against fishing pressure. Indicators suggest that the resource could absorb a conservative increase in fishing effort.

Résumé

L'article qui suit porte sur l'expansion d'une pêcherie réglementée de crabes tourteaux-boréaux (Cancer borealis) sur la côte de la Nouvelle-Ecosse en 1983. Avant la fermeture de la pêcherie en raison de problèmes de transformation, 90,3 tonnes métriques de crabe avaient été débarquées par dix détenteurs de permis, entre mai et août. L'échantillonnage des prises commerciales au port et en mer indiquait que la taille moyenne des mâles débarqués était relativement constante et bien supérieure à la limite minimale de 130 mm de largeur de carapace. Les femelles étaient en général plus petites que les mâles et ne représentaient, en nombre, que cinq pour cent des débarquements. D'après les statistiques sur les prises et l'effort de pêche, établies à partir des bordereaux de vente et des journaux de bord des pêcheurs, le taux de capture a connu une hausse continue dans les trois principaux lieux de pêche durant la saison. À la lumière des données réunies, il semble que la limite de taille établie et les caractéristiques des stocks préservent bien le potentiel reproducteur du crabe tourteau et qu'on puisse autoriser une augmentation modérée de l'effort de pêche.

Introduction

The jonah crab, Cancer borealis, commonly occurs between Nova Scotia and the Bermudas, from the intertidal zone to a depth of approximately 800 m (Rathbun 1930; Squires 1966). Since at least the mid-1960's, the jonah crab resource in Canadian waters has been subject to sporadic low-level exploitation as a by-catch to the trap fishery for American lobster, Homarus americanus (Caddy et al. 1974). The principal barriers to further development of a commercial jonah crab fishery have been the poor economic returns on the marketed product (due mainly to the high cost of meat extraction) and enforcement difficulties (jonah crab and lobster distributions overlap and, therefore, fishermen in a directed jonah crab fishery may damage or poach the lobster by-catch in their traps). With the collapse of Alaskan crab stocks in 1982 and the subsequent increase in world market demand and price for crab, the economics of a directed jonah crab fishery have become more viable. Consequently, in October 1982, the Department of Fisheries and Oceans started to actively foster industry interest in developing a directed fishery for jonah crab on the Scotian Shelf. On January 17, 1983, the Scotian Shelf Crab Advisory Committee was formed as "a focal point for federal-provincial, processor- fishermen consultations on matters relating to resource allocation, harvesting and processing, including:

- a) annual management plan;
- b) the setting of Total Allowable Catches and Quotas as necessary;
- c) and other regulatory measures such as licensing seasons, size and gear restrictions."*

Backed by only scanty survey data on the distribution and relative abundance of jonah crab, and equally limited biological and marketing information, the Committee was faced with a formidable array of biological, economic and social decisions to be made regarding the prospective fishery. Notwithstanding such difficulties, the Committee made the following recommendations for jonah crab on March 4, 1983:

1. that the area of directed fishing be restricted to:
 - a. 12 or more miles off the coast;
 - b. north and east of a line which commences 12 miles off at 65°33' west longitude, proceeds true south to 43° north latitude, then true east to 64°30' west longitude, then true south to the "200 mile" limit (Fig. 1);
2. that a minimum size limit of 130 mm (5 1/8 in.) carapace width be adhered to;
3. that crabs be landed in live, whole condition;
4. that, subject to ongoing review, no restrictions be imposed during 1983 regarding quotas, gear, sex (including berried females) or season;

*Verbatim from Scotian Shelf Advisory Committee terms of reference.

5. that log records as supplied by Fisheries Research Branch be faithfully kept; and observers carried upon request;
6. that there be no special development funding, but that industry seek its own most cost-efficient level;
7. that any crab caught as a by-catch in an otherwise directed fishery may be landed and sold, subject to recommendation number two (2);
8. that the directed fishery be conducted through the issuance of exploratory permits for 1983.

In the matter of permit applications, it was recommended:

9. that eligibility be based on the principle of "one enterprise equals one application." In practice, where one individual owns/controls, say, six vessels registered under two companies, one "enterprise," and thus one application, was seen to apply. It may be noted that the absence of such a provision in the offshore lobster fishery has been a constant source of contention with many in private industry;
10. that eligibility be limited to those in possession of a registered fishing vessel of 35 or more feet in length carrying at least one limited fishing license. (Note: The size restriction was seen to be prudent in the interests of safety, especially in view of the "12 mile offshore" restriction.)

The Director General duly approved the Committee's recommendations and 32 jonah crab permits were released in May 1983. Ultimately, only 10 of the permit holders actively fished for jonah crab. The fishery operated from May to August, 1983 when it effectively closed down due to the closure of the principal buyer (UMF, East Port Hebert, Queens County, N.S.). It should be stressed that processing and marketing economics were the cause of the close-down and not a lack of resource.

The purpose of this paper is to document and review the biological information provided to the Scotian Shelf Crab Advisory Committee, as well as to assess the 1983 jonah crab fishery.

Methods

Logbooks were supplied to all jonah crab permit holders (Fig. 2), together with instructions on correct usage (Appendix I). The logbooks are as previously used in the trap fishery for snow crab, *Chionoecetes opilio*, around Cape Breton Island and are designed to provide detailed catch and effort data for each fishing trip. Data from sales slips provided supplementary landings statistics.

Port sampling was carried out on an opportunistic basis throughout the fishing season to assess the size-frequency distribution, shell hardness and sex ratio of the commercial landings (Fig. 3). A single at-sea sample from a commercial vessel was obtained on June 2. Jonah crab size was determined by measuring the carapace width (CW) across the widest part of the carapace, from tip to tip of the most distal marginal teeth.

The 1983 fishery for jonah crab is assessed on the basis of the logbooks, sales slips and port sampling information.

Results

Commercial catch sampling

Catch CW-frequency distributions for male and female jonah crabs caught in May, June, July and August 1983 are shown in Fig. 4.

The port samples are partitioned according to the major fishing grounds of origin where possible. As the size-frequency characteristics of the sea sample closely resemble those of the port samples, they have been considered together in the following evaluations:

Mean carapace width for the male jonah crabs remained within narrow limits (144.1-148.8 mm CW) throughout the sampling period; there appeared no meaningful differences in mean CW between the grounds of origin. The CW-frequency distributions for the males were all unimodal with a combined range from 114-182 mm CW; 96% (n=2761) of the 2872 males sampled were at or above the 130.0 mm CW size limit.

Overall, female jonah crabs comprised only 5% (n=150) of the total number of jonah crabs sampled (n=3022) producing a male:female sex ratio of 20.2:1.0. The mean carapace widths (124.0-134.8 mm) and size ranges (110-142 mm) of females sampled were considerably less than those for males and only 27% (n=40) of the female jonah crabs sampled were above the 130-mm CW size limit.

No ovigerous females or soft-shell crabs were detected in the commercial catches sampled, although the processing plant reported an occasional incidence of up to ~10% soft-shelled crabs.

Logbooks

Logbooks were received from nine of the 10 permit holders who participated in the 1983 fishery for jonah crab. The various locations at which jonah crabs were trapped, as identified from the logbooks, are shown in Fig. 5. Three major fishing grounds are apparent: Emerald Basin, LaHave Basin and the edge of the Scotian Shelf. Fishing depths ranged from:

110-229 m - Emerald Basin
146-220 m - LaHave Basin
130-275 m - Scotian Shelf edge.

Traps were baited with fresh cusk, mackerel or herring and left to soak between 1 and 14 d before hauling. Fishermen experimented with various trap designs and determined that conical crab traps and rectangular snow crab traps were ineffective for fishing jonah crab. Gear used included modified inshore lobster traps, unmodified offshore lobster traps, modified offshore lobster traps and crab traps. Overall, the logbooks show a total of 1610 traps in the fleet (range: 50-320 traps/vessel) and record a total of 13,753 trap hauls for the 1983 season.

Weekly landings statistics for each of the three major fishing areas are presented in Fig. 6 and Table 1. Logbooks gave total landings as 90.3 MT (Emerald Basin: 21.7 MT, LaHave Basin: 43.3 MT, Scotian Shelf edge: 18.8 MT) as compared to the 68.1 MT recorded through statistics compiled from sales slips. At an approximate price to the fishermen of \$0.40/lb (\$0.88/kg), the total landings (from sales slips) have an estimated value of \$79,478.

Effort statistics for the three areas are given in Tables 1 and 2. Mean CPUE values (based on logbooks) were 6.0 kg/trap haul (range 3.0-10.3 kg/trap haul), 6.5 kg/trap haul (range 4.1-13.0 kg/trap haul) and 7.1 kg/trap haul (range 2.0-15.1 kg/trap haul) for Emerald Basin, LaHave Basin and the Scotian Shelf edge, respectively. Weekly trends in mean CPUE for the three areas are shown in Fig. 7 and Table 1. Although mean CPUE in each area fluctuated through the season, likely a result of the 'naive' fishermen exploring the fishing grounds, the general trend is for mean CPUE to increase slightly through the season.

Discussion

From the outset, it should be remembered that we are considering an exploratory fishery on a virgin resource. The area defined for the directed fishery has not been subject to any extensive resource surveys for jonah crab and one of the major criteria for its definition was that its boundaries were to be outside recognized lobster fishing grounds. Fishermen were required to seek out and explore new fishing grounds and, at the same time, experiment with various trap types and fishing strategies on an unfamiliar target species. Notwithstanding such difficulties, fishermen sustained a mean catch rate of 6.6 kg/trap haul over the season. Overall, the catch rates attained in the 1983 fishery appeared as high or higher than those attained by McElman and Elner (unpublished report) in trap surveys for jonah crab off southern Nova Scotia and the edge of the Scotian Shelf in 1980 and 1981. Over the short term, given that the 1983 level of fishing effort is at least maintained, catch rates and landings can be expected to increase as fishermen become more adept at exploiting the resource. In the medium term, the accumulated virgin biomass will become depleted and the fishery will rely increasingly on annual recruitment and growth over the 130-mm CW size limit. However, as we have no information on either the available biomass of jonah crab within the fishing area or the production characteristics of jonah crab, meaningful medium- to long-term prognoses for the fishery are impossible.

Given the 130-mm CW minimum size regulation and, despite the lack of restrictions on landing females, exploitation should have little impact on overall egg production. As well as representing the smallest size of crab that industry determined was economical to process, the minimum size was chosen to be well above the 90-100 mm CW size of male maturity and the 85 mm CW size of female maturity given for jonah crab by Carpenter (1978). Supporting evidence for jonah crab size at maturity comes from observations on copulation between a female of 106 mm CW and two males of 121 and 130 mm CW (Elner et al. 1983). In addition, ovigerous jonah crab females as small as 65 mm CW have been recorded on the Scotian Shelf (J.F. McElman,

unpublished data). Thus, males should be able to mate and females express eggs well before becoming vulnerable to exploitation. Given also that females do not commonly attain sizes above 150 mm CW and form only a small proportion of the landings, they will be subject to less fishing pressure than males and the reproductive potential of the stock will be further protected.

In summary, we are witnessing the development of a directed fishery on a resource of unknown magnitude and resilience to sustained fishing pressure. Overall, the relative abundance (in terms of CPUE) of jonah crab tended to increase while the mean size of landed male crabs remained constant over the 1983 fishing season. Both these latter factors suggest that the 1983 fishery did little to impact the resource and that there is scope for fishing effort to increase in 1984. While prudence dictates a cautious approach towards allowing additional vessels into the fishery, industry enterprise should not be unduly restricted as it is only from data collected from a directed fishery that the necessary biological knowledge needed to optimize exploitation will be generated. Certainly the reproductive integrity of the resource appears sufficiently buffered against fishing pressure to allow for stock recovery should exploitation rates become too high.

Acknowledgments

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Table 1. Catch and effort statistics from logbook data for the directed jonah crab fishery in 1983. (Note: although separate statistics are given for each of the three major fishing grounds, the statistics for the total are not an amalgam because the origin of some landings was not disclosed in the logbooks.)

Date	LaHave Basin				Emerald Basin				Scotian Shelf edge				Total			
	No. traps	kg landed	CPUE	ΣC	No. traps	kg landed	CPUE	ΣC	No. traps	kg landed	CPUE	ΣC	No. traps	kg landed	CPUE	ΣC
23/04	225	2935	13.0	0	-	-	-	-	-	-	-	-	245	3253	13.3	0
01/05	320	1315	4.1	2935	180	590	3.3	0	-	-	-	-	500	1905	3.8	3253
08/05	310	1315	4.2	4250	-	-	-	590	-	-	-	-	310	1315	4.2	5158
15/05	1030	7716	7.5	5565	180	544	3.0	590	-	-	-	-	1210	8261	6.8	6473
22/05	280	2132	7.6	13281	60	437	7.3	1134	-	-	-	-	340	2569	7.6	14734
29/05	145	1333	9.2	15413	128	1315	10.3	1571	-	-	-	-	273	2648	9.7	17303
05/06	990	5197	5.3	16746	820	5895	7.2	2886	120	245	2.0	0	1950	11338	5.8	19951
12/06	1235	6712	5.4	21943	770	5034	6.5	8781	520	2409	4.6	245	2575	14166	5.5	31289
19/06	480	2358	4.9	28655	730	3832	5.3	13815	60	907	15.1	2654	1270	7098	5.6	45455
26/06	640	3447	5.4	31013	380	2268	6.0	17647	340	1361	4.0	3561	1740	8826	5.1	52553
03/07	320	3084	9.6	34460	400	1814	4.5	19915	-	-	-	-	935	6557	7.0	61379
10/07	-	-	-	37544	-	-	-	-	-	-	-	-	50	1026	20.5	67936
17/07	-	-	-	37544	-	-	-	-	-	-	-	-	-	-	-	68962
24/07	-	-	-	37544	-	-	-	-	-	-	-	-	50	1283	25.7	68962
31/07	160	1905	11.9	37544	-	-	-	-	645	5328	8.3	4922	885	7749	8.8	70245
07/08	480	3820	8.0	39449	-	-	-	-	940	8503	9.1	10250	1420	12323	8.7	77994
Total	6615	43269	6.5	43269	3648	21729	6.0	21729	2625	18753	7.1	18753	13753	90317	6.6	90317

Table 2. Catch and effort statistics from logbook and sales slip data for each of the ten participating permit holders in the directed fishery for jonah crab, 1983. Note: LH = LaHave Basin; EM = Emerald Basin; SL = Scotian Shelf edge; UG = unspecified grounds.

Boats number	No. of trips	No. of traps hailed	Landings (kg) from logbooks	Mean CPUE (kg/trap haul) over the season	Landings (kg) from sales slips	Fishing grounds
1) 2	3	120	612	5.1	-	LH, SL
2) 12	13	2125	13929	6.6	7782	LH, SL
3) 17	14	4260	25107	5.9	19910	LH
4) 22	13	2335	15339	6.6	9291	EM, LH
5) 23	6	300	3168	10.6	-	EM, UG
6) 26	16	2365	15532	6.6	8305	EM, SL
7) 28	2	700	6618	9.5	7059	SL
8) 29	3	700	3561	5.1	-	SL
9) 31	6	848	6451	7.6	9006	EM
10) 30	-	-	-	-	6781	UG
Total	76	13753	90317	6.6	68134	

Fig. 1. The area defined for the directed jonah crab fishery in 1983;
fishing was restricted to at least 12 miles off the coast then N
and E of the boundary line (—•—•—•) up to the 200 mile limit
(-----).

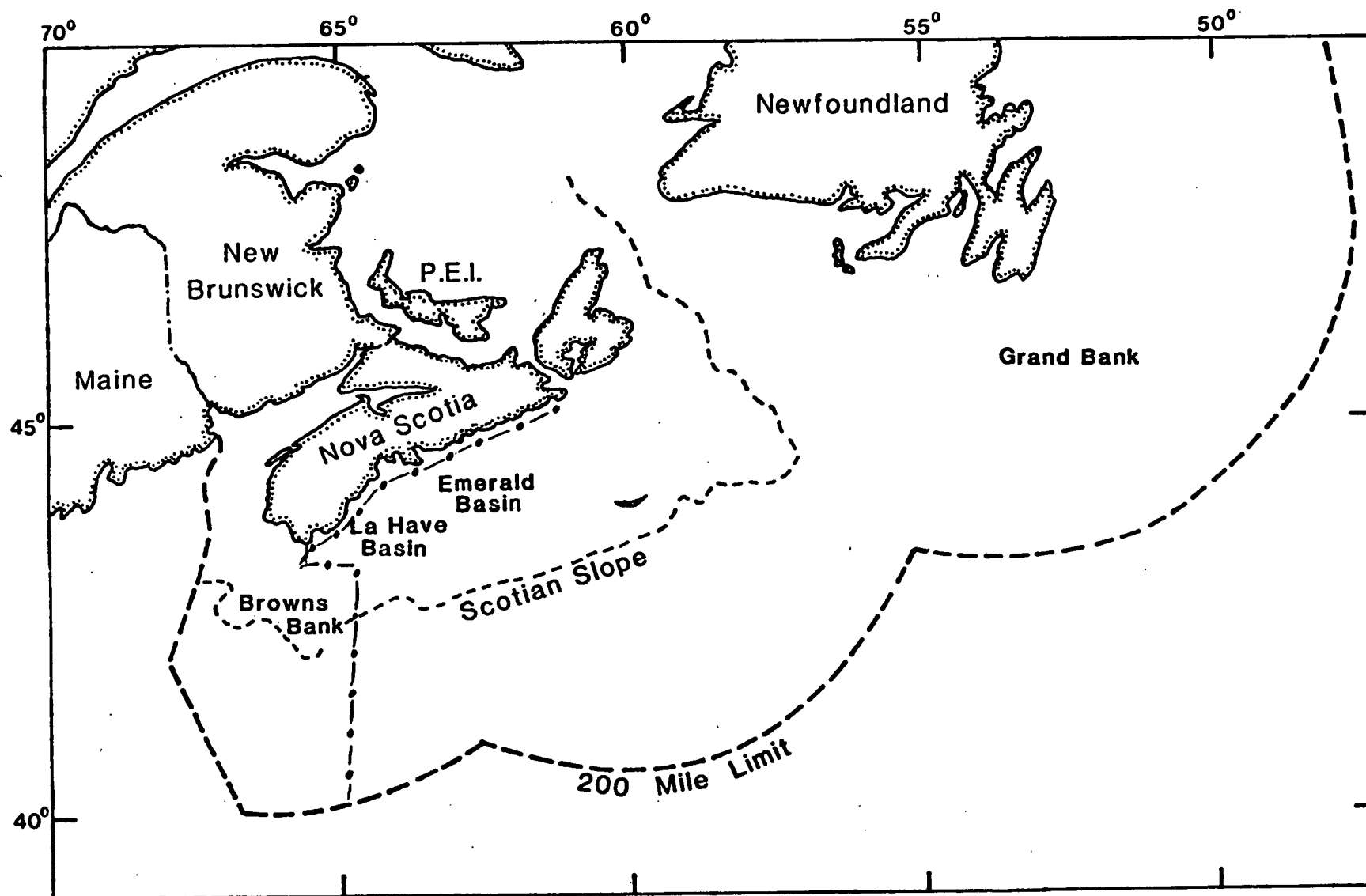


Fig. 4. Carapace width frequency distributions for male and female jonah crabs sampled from commercial landings during the 1983 fishing season.

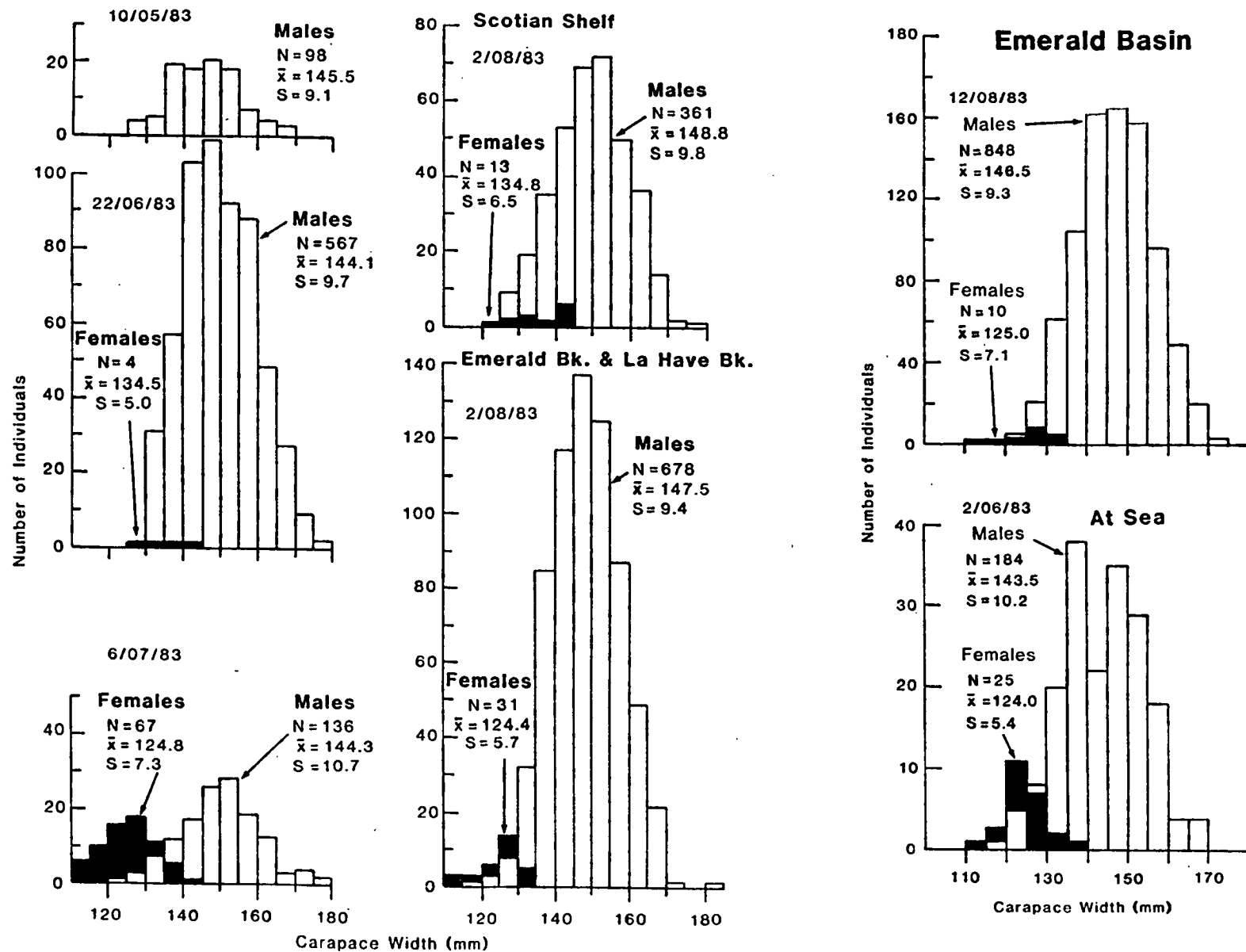


Figure 5. Known trap locations in the directed fishery for jonah crab on the Scotian Shelf, 1983, as determined from fishermen's logbooks. Mean CPUE and range are shown for each of the three major fishing grounds: Emerald Basin, LaHave Basin and Scotian Shelf edge.

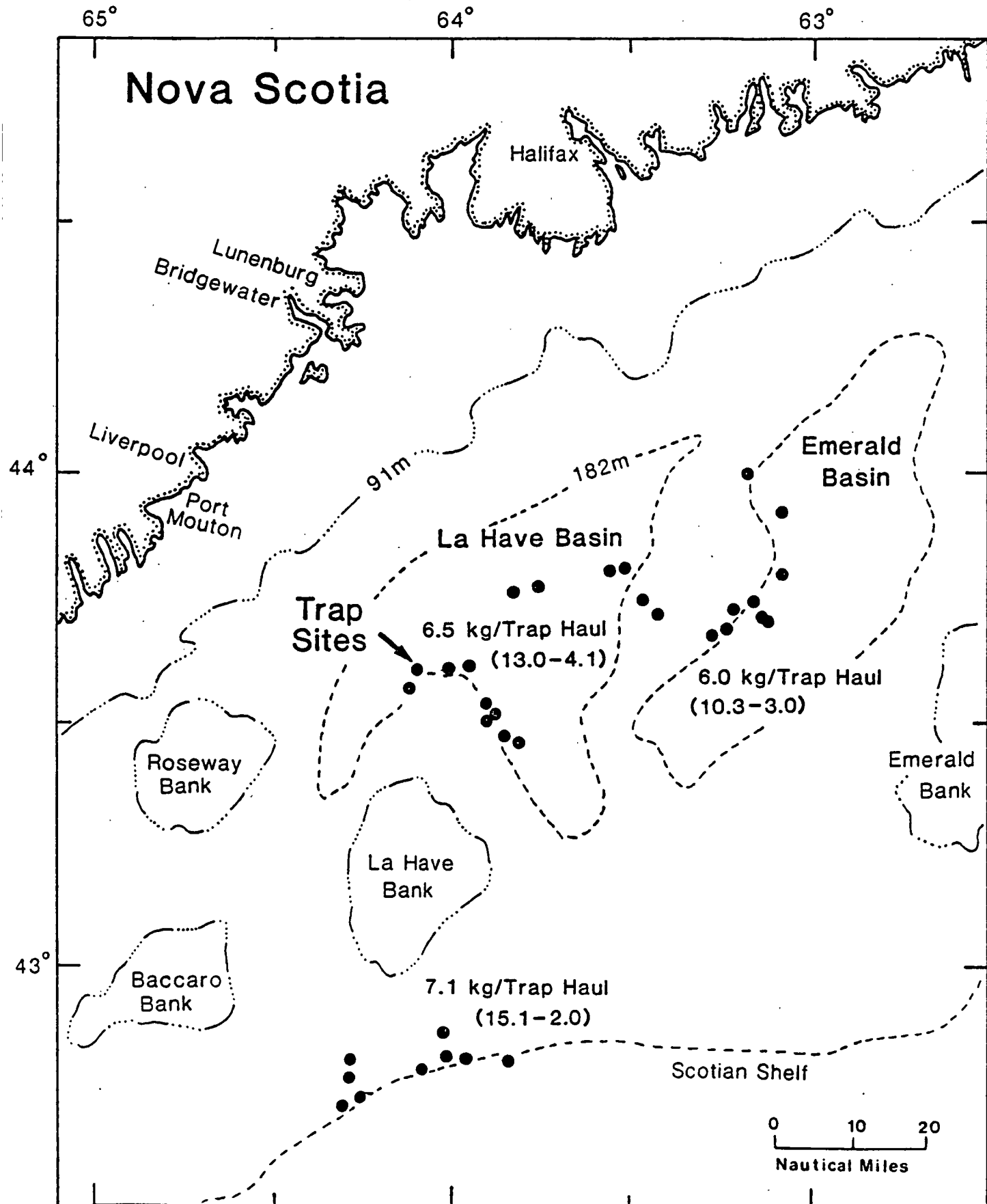


Figure 6. Total cumulative landings of jonah crab by weekly period for the directed fishery in 1983; data from fishermen's logbooks. Separate relationships are shown for each of the three major fishing grounds. (Note: the sum of landings from the three grounds do not equal the total landings as the origin of some landings were not disclosed in the logbooks).

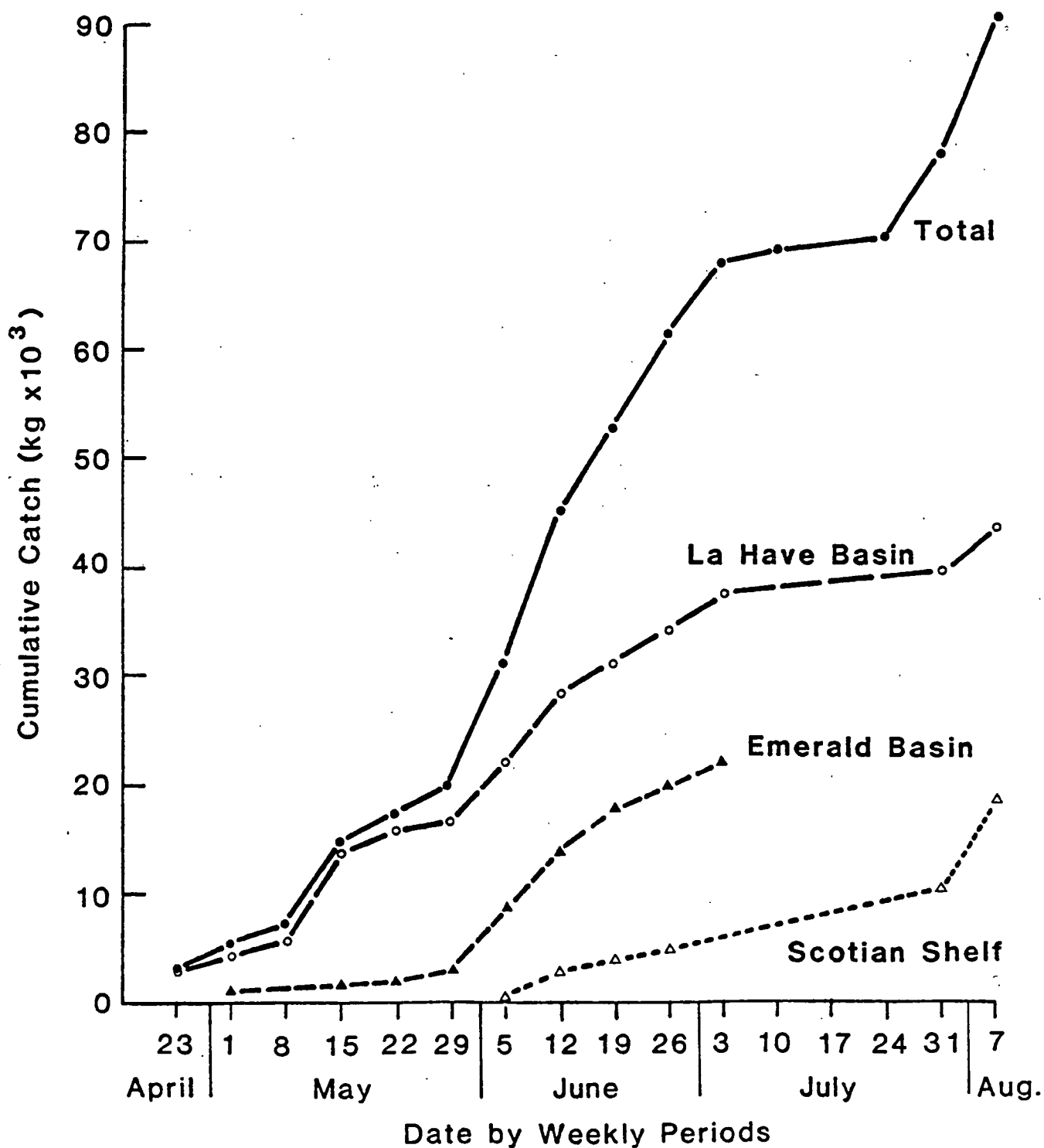
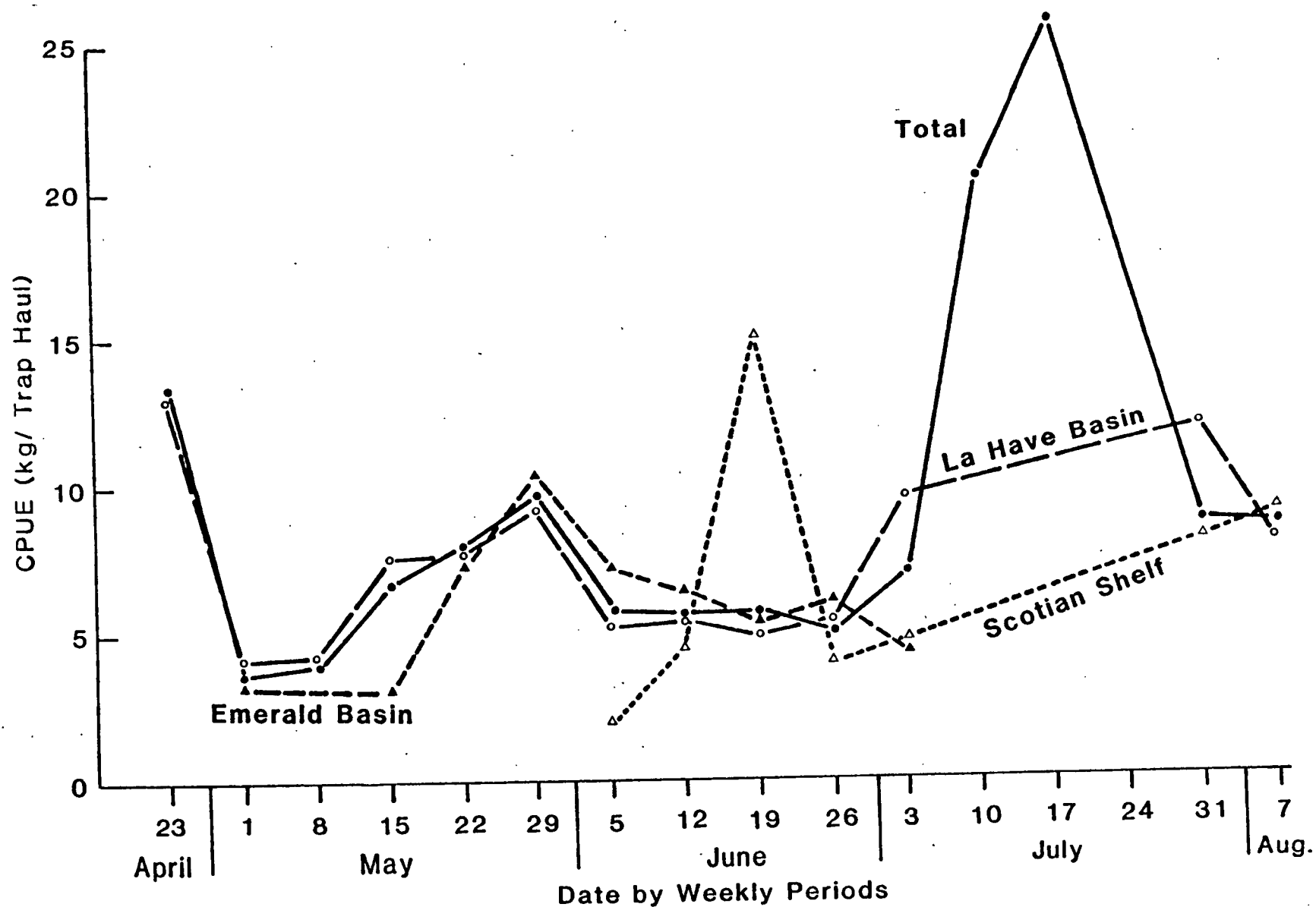


Figure 7. Mean CPUE (kg/trap haul) by weekly period for the directed jonah crab fishery in 1983; data from fishermen's logbooks. Separate relationships are shown for the three major grounds. (Note: the relationship for the total fishery is not merely an amalgam of the three grounds as the origin of some landings were not disclosed in the logbooks).



Appendix I

Dear :

SUBJECT: JONAH CRAB LOGBOOKS

We understand you are the recipient of a permit to fish jonah crabs (Cancer borealis) and by now you should have received a crab logbook. Proper completion of your logbook is a condition of permit and provides information essential to the sound management of your fishery. The information you give assists in estimating the abundance and distribution of jonah crabs and enables optimal management of the resource.

In order to help you complete your logbook we present the following:

At the top of each logbook page you are required to provide:

- a) the year
- b) the vessel's name and C.F.V. number
- c) the type and size of traps you are using including the mesh and fishing head size, and also the number of traps per string
- d) the captain's name
- e) the number of crew including the captain

After completion of the above, indicate in column:

- 1 - TRIP NO: The number of the fishing trip, i.e. the first trip in which you hauled traps would be trip #1 and your second trip #2, etc.....
- 2 - DATE: The date of the fishing trip
- 3 - POSITION: Position in terms of Lat. and Long., Loran, Decca or the distance and direction from nearest landmark
- 4 - DEPTH: Should be the average or maximum and minimum depth you set traps
- 5 - TIME GEAR SET: Number of days the traps were set from the last time you hauled
- 6 - NUMBER OF TRAPS: The number of traps actually hauled during the fishing trip
- 7 - ESTIMATED CATCH: The estimated weight of jonah crab caught over the fishing trip
- 8 - DATE CRAB SOLD: The date crabs were sold
- 9 - BUYER: The name of the buyer
- 10 - TOTAL CRABS SOLD: The actual weight in pounds of jonah crabs sold

11 - REMARKS: Your observations such as:
traps lost, shifting gear, the presence of soft-shell
crabs, females with eggs, by-catch etc.....

On completion of each logbook page the yellow duplicate should be removed and delivered to your local Fisheries Officer for forwarding on to me at the above address. The white original provides a valuable record for your own use.

.....