Results from the experimental shrimp trap fishery in 1995

by

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ABSTRACT

The area of greatest potential for development of an inshore shrimp trap fishery in Nova Scotia is between Whitehead and Scaterie Island. Areas along the eastern shore south of Whitehead have little potential for trapping commercial quantities of shrimp because they lack appreciable shrimp concentrations offshore and large areas of mud bottom and relatively deep water nearshore. In Northern Cape Breton the sandier substrate is less than optimum shrimp habitat, and the presence of strong bottom currents and shifting substrate may be an additional factor excluding shrimp. Further operations should be restricted to small exploratory efforts of 10-15 traps per location during the fall-winter period when catches are highest. Catches exhibit a seasonal cycle associated with migrations from and to the inshore in response to changing water temperatures. Interactions with snow crabs on and around traps also affect catches. Current management measures for the experimental trap fishery includes trap limits and limited entry. An accurate biomass estimate for the inshore areas is required before additional management measures can be defined. A decrease in the percentage of berried females was noted from 1995 to 1996. This should continue to be monitored in order to determine if it is due to natural variations or to fishing. A snow crab exclusion device should be developed to improve trap efficiency and for conservation purposes. Trap efficiency is highly dependent on trap entrance design and bait location.

RESUMÉ

La région de la Nouvelle-Écosse située entre l'île Whitehead et l'île Scatarie est celle qui offre le plus grand potentiel pour le développement d'une pêche côtière de la crevette à la trappe. Par contre, les secteurs de la côte est au sud de Whitehead offrent peu de possibilités de capture de quantités commerciales de crevettes à la trappe à cause de l'absence de grands bancs de crevettes en eaux hauturières, et de grandes superficies de fonds de vase et d'eau profonde près des côtes. Dans le cas du secteur nord du Cap-Breton, le substrat sablonneux n'est pas un habitat favorable pour la crevette, les forts courants de fond et le substrat mouvant pouvant être des facteurs contribuant à son absence. Les opérations nouvelles devraient être restreintes à de petites pêches exploratoires de 10 à 15 trappes par site pendant l'automne et l'hiver, lorsque les prises sont plus fortes. Les prises montrent un cycle saisonnier lié aux migrations vers les eaux côtières en réponse au changement de la température de l'eau. Les interactions avec le crabe des neiges près des trappes et sur celles-ci influent aussi sur les prises. Les mesures de gestion de la pêche en vigueur comprennent une limite du nombre de trappes et l'accès limité à la pêche. Une estimation précise de la biomasse des eaux côtières est nécessaire avant de définir de nouvelles mesures de gestion. On a noté, entre 1995 et 1996, une baisse du pourcentage de femelles oeuvées. Cette baisse devrait continuer à être surveillée afin de déterminer si elle est le résultat de variations naturelles ou de la pêche. Un dispositif d'exclusion du crabe des neiges devrait être mis au point de sorte à améliorer le rendement des trappes et à conserver la ressource en crevettes. Le rendement des trappes dépend fortement de la conception de l'entrée de la trappe et de la position de l'appât.

INTRODUCTION

In November, 1994, the Atlantic Fisheries Adjustment Program (AFAP) funded a project to determine the feasibility of trapping northern shrimp *(Pandalus borealis)* in Chedebucto Bay, off Canso, Nova Scotia. This project successfully demonstrated commercial quantities of shrimp in the area (Koeller et al 1995). The fisherman who was issued the experimental license (100 traps) continued to fish on a commercial basis after AFAP funding ceased, encouraging additional exploratory operations. It was particularly desirable to widen the area covered by exploratory trapping in order to determine the extend of the inshore shrimp grounds. The eastern shore trapping project was initiated by members of the Fishermen's and Scientists Research Society (FSRS), and funded mainly by the Nova Scotia Department of Fisheries. The eastern shore was less likely to produce commercial quantities of shrimp because of its greater distance from the offshore shrimp "holes" (Canso, Misaine and Louisbourg) and lack of large areas of fine mud which are found in and near Chedebucto Bay. Consequently, only 17 traps were issued to each of 6 fishermen located along the shore from Canso to Chezzetcooke (Figure 1). At about the same time the North of Smokey Fishermen's Association, funded mainly by Human Resources Development Canada, initiated a larger project (2 vessels, 2 licenses for 100 traps each) to explore areas off northern Cape Breton. One additional license was issued by the Gulf (now Maritimes) Region for 100 traps off western Cape Breton.

The main results of all trapping projects in Nova Scotia to date are summarized in this report. Current management measures and future considerations are also discussed.

MATERIALS AND METHODS

The methods used in the Canso project are given in Koeller et al (1995). Methods used in the eastern shore and Cape Breton projects were essentially the same i.e. all used Maine style shrimp traps built to the same specifications by the same supplier. Bait used was usually salt herring or mackerel, located just inside the top entrance. Fishermen were encouraged to cover as wide an area and depth range as possible within the limits of their vessels and weather conditions, but to restrict operations to mud bottom. Bait was changed every time traps were hauled. Soak times varied considerable, and tended to be longer along the eastern shore where traps were tended on an opportunity basis, ancillary to other activities. All fishermen were provided with logs to record relevant information, including date, time, number of traps hauled, exact location, number and weight of shrimp and bycatch species caught.

RESULTS

The locations of all trap hauls reported to date are given in Figure 1, and summary statistics are given in Table 1. Chedebucto Bay was well covered during the experimental fishery, and obtained a catch rate of nearly 4 pounds per trap haul of *Pandalus borealis* during the winter of 1994/95. Average catch rates improved in the fall of 1995 due to gear modifications, with catches often exceeding 10 lb. per trap haul during the fall/winter of 1995/96 (Figure 2). There is a clear seasonal cycle in catches due to several factors. The initial rapid increase at the beginning of the fishery was due to a change in bait location, from well inside the trap to just inside the entrance. A rapid decrease in catches beginning in late March is coincident to a decrease in water temperatures below -1°C, which is approaching lethal limits. A large increase in the bycatch of small snow crabs began at the end of April, when shrimp catches had already decreased to low levels. Snow crabs persisted on the grounds throughout May-July when shrimp catches were negligible. Shrimp catches began to increase again toward the end of July. At this time strings were fitted with "collars" of plastic lawn edging in an attempt to exclude crabs from the traps and increase shrimp catch. This appeared to have been partially successful in that the only string not fitted with collars (String #5, Figure 2) maintained a slightly lower shrimp catch rate during August-September. However, snow and toad crab bycatch persisted at levels at least as high as during the spring decrease in shrimp catch, indicating that factors other than crab/shrimp interactions were primarily influencing changes in catch rates. Trawl sets in the area during the period of low or nil trap catches (Koeller et al 1995) indicated that relatively low numbers of the large female shrimp which dominate trap catches were present

on the inshore grounds. At the beginning of November, 1995 catches increased dramatically when trap entrances were modified. The importance of this change in nearly doubling catch rates was clear when entrances to traps in String #5 were changed back to the original configuration (Figure 2). Catches then increased steadily throughout the winter in both gear configurations, suggesting immigration of large animals back into the area. Snow crab bycatch decreased during the early winter when shrimp catches were increasing. The inverse relationship between snow crab and shrimp catches is significant (Koeller et al 1995). Submersible observations (Koeller, unpublished video recordings) show that this is due to direct interaction of crabs and shrimp in the immediate vicinity and at the entrances of traps. Shrimp approaching traps are dispersed by crab activity around the traps and are prevented from entering the trap by large crabs blocking the entrance. By the end of March, 1996, shrimp catches had once again declined to low levels (M. Newell, personal communication, data not available at time of writing), indicating that this is an annual event.

The percentage of ovigerous females from trap catches and from the offshore trawl fishery is given in Figure 3. The notably lower percentage of egg bearing females inshore could be due to emigration, but it may also be due to the trap fishery, which targets the larger animals. It is unlikely that the lower percentage during the winter of 1994/95 was due to fishing, since this had only just started. However, after a year's fishing, the percentage in the fall/winter of 1995/96 was even lower. This change may be part of the natural variation in the inshore, whose population composition appears to undergo large swings due to immigration/emigration, but this aspect should continue to be monitored to determine the difference between fishing and natural effects.

Coverage in Northern Cape Breton was good, with almost 3000 trap hauls in 600 locations (Figure 1, Table 1). However, only 6 northern shrimp and 613 (6 lbs) striped shrimp *(Pandalus montagui)* were caught during the 3 month fishing period. Coverage off west Cape Breton was also relatively good, but here were no northern shrimp caught. Despite relatively wide coverage along the eastern shore only the traps set off Whitehead caught shrimp in commercial quantities, with catch rates about 30% below those obtained in Canso during the same period (2.13 vs. 3.3 pounds per trap haul). Only one shrimp was caught of Jeddore, Chezzetcooke, Tangier and Mitchell Bay in over 600 trap hauls. Although catches were also negligible off Sherbrooke, approximately mid way between Whitehead and Jeddore, 26 shrimp were caught here in only 145 trap hauls.

Figure 4 gives the location of the Canso and Whitehead trap catches in greater detail. Traps off Whitehead were set 5-10 miles from shore in depths between 52 and 114 fathoms (average 79), relatively close to the northwestern edge of the Whitehead hole fished commercially by trawlers. Note that traps set northeast of the Whitehead shrimp concentration were made in June and July, at a time when catches off Canso had dropped to near zero (Figure 2). Crab bycatch in the area northeast of Whitehead, although lower than off Canso, was still significant, so the absence of shrimp in trap catches is not necessarily due to the absence of shrimp on the grounds. However, the absence of shrimp in this area during groundfish surveys conducted in spring, summer and fall between 1971 and 1995 (Koeller 1996a) does suggest that there is a break in shrimp distribution between Chedebucto Bay and the Whitehead hole.

Small snow crabs dominated the bycatch in areas where shrimp were caught (i.e. Canso and Whitehead), with toad crab as the second most important crustacean (Table 1). With the exception of Sherbrooke, snow crab bycatch was negligible in the other areas, where other crab species, particularly rock crab, were more important. Hagfish and whelks were also common here. The different bycatch composition in areas where shrimp were not found suggests the presence of a species assemblage and habitat type not favoured by shrimp. Snow crab catches in shrimp traps can be substantial (Figure 2).

Table 2 gives the distribution of approved experimental licenses by Lobster Fishing Areas (LFA's), which were used for convenience. Licenses are concentrated in the areas most likely to produce commercial quantities of shrimp (LFA's 29, 30 and 31A) while still allowing for exploratory fishing in peripheral areas. Current conservation measures include limited entry, trap limits of 100 traps, and no retention of bycatch. Fishing must occur shoreward of a line (Figure 3) defined to eliminate gear conflict with the

shrimp trawler fleet, which historically has fished almost exclusively seaward of this line (Koeller 1996b), while allowing trappers access to most of the "Noodles". Depending on the results of the 1996 trap fishery and ongoing research, including a biomass estimate of the inshore area, additional management measures may be imposed, including Total Allowable Catches (TAC's) and seasonal closures. With annual catch rates currently averaging about 7 pounds per trap haul the 8 licenses in the best area could catch as much as 460 m. tons (based on a 180d fishing season). If an inshore biomass estimate indicates that the inshore biomass cannot sustain such levels then a TAC limit may be appropriate. Alternatively, seasonal closures may be imposed which could have the added benefit of protecting reproductive potential by allowing ovigerous females to remain in the water until after they have released their eggs in the spring.

Preliminary biomass estimates for the inshore range between 205 m. tons for areas deeper than 100 fathoms, to 6780 m. tons for areas of LaHavre mud (Koeller 1996b). It should be noted, however, that existing hydrographic charts and surficial geology maps provide only course information in this area. More accurate information on bathymetry, surficial geology and shrimp distribution relative to these parameters is needed to provide an accurate biomass estimate.

DISCUSSION

The decreasing catches of shrimp in inshore traps along the eastern shore from Canso to Chezzetcooke are probably a function of distance from the main concentrations from which the animals originate. Large animals, particularly ovigerous females, tend to migrate into shallower, colder water in the fall (Shumway et al 1985). In areas where concentrations are relatively close to shore, such as off Whitehead and the "Noodles", the tendency to move shallower will also bring them nearer to shore. The absence of any major concentration of shrimp along the eastern shore southwest of Whitehead makes it unlikely that commercial quantities of animals will move inshore and become available to trappers. The absence of large inshore areas of shrimp habitat (fine mud) such as is found in the Chedebucto Bay area supports this conclusion. Minor offshore concentrations off southwest Nova Scotia (Koeller 1996a) are probably too far offshore to produce significant inshore movement. Similarly, lack of shrimp concentrations off Cape Breton makes it unlikely that inshore trapping will be successful in this area. However, reports of large shrimp catches in the Laurentian Channel by redfish trawlers in 1995 indicate that shrimp are present in the deeper water of the channel, but trapping here would pose special challenges. Lack of inshore concentrations in this area may be due to the less than optimum bottom substrate which contains more sand than the fine muds off Chedebucto Bay, and the strong bottom currents and sediment movements, which could make it difficult for shrimp to establish themselves for longer periods. Significant concentrations near the mouth of the Bay of Fundy (Koeller 1996a) are worth further investigation.

Seasonal cycles in the shrimp catch in Chedebucto Bay appear to be due mainly to migrations of larger animals in response to changing water temperatures. In spring, larger animals move out of the bay quickly to avoid very cold, near lethal temperatures. In the fall and winter catches increase more gradually as large animals move inshore into cooler water. Catches are also influenced by crab/shrimp interactions on and around the traps, with large crab catches correlated to lower shrimp catches during some periods. The efficiency of traps is strongly related to the design of the entrance and location of the bait.

With the potential catch of new licenses as high as 460 m. tons annually it is essential that the inshore biomass estimate, which currently ranges between 205 and 6780 m. tons, is refined. An accurate estimate will require more detailed information on shrimp distribution by depth and bottom type as well as updated information on bathymetry and surficial geology.

CONCLUSIONS

1. The area of greatest potential for development of an inshore shrimp trap fishery is between Whitehead and Scaterie Island because a) this coastline is closest to the large offshore commercial fishing holes, from which the inshore animals probably originate, b) the area has relatively large patches of the fine

mud with high organic content favored by shrimp c) the area has a relatively large number of deeper holes (e.g. Chedebucto Bay and the Noodles) also favored by shrimp.

2. Areas along the eastern shore south of Whitehead have little potential for trapping commercial quantities of shrimp because they lack appreciable shrimp concentration offshore and large areas of mud bottom and relatively deep water nearshore. In Northern Cape Breton the sandier substrate is less than optimum shrimp habitat, and the presence of strong bottom currents and shifting substrate may be an additional factor excluding shrimp.

3. Seasonal cycles in the inshore trap catch are mainly due to migrations in response to changing water temperatures.

4. Exploratory operations are still worth pursuing in some areas, particularly in the Bay of Fundy. However, they should be restricted to small exploratory efforts such as was conducted on the eastern shore e.g. 10-15 traps per location during the fall-winter period.

5. Current management measures for the experimental trap fishery includes trap limits and limited entry. An accurate biomass estimate for the inshore areas is required before additional management measures can be defined.

6. The percentage of ovigerous females and bycatch should continue to be monitored.

7. A crab exclusion device should be developed and trap efficiency, particularly with regard to bait and entrance design, should be investigated.

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Table 1. Summary statistics from all trap projects to February 16, 1996.

Location	traps	dates fished	# trips	# strings (locations)	# traps hauled	CPTH (lbs)	bycatch (in order of importance)
W. Cape Breton	40	4 Oct-28 Nov 95	5	48	384	0.0	toad crab, rock crab, striped shrimp
N. Cape Bret. (east)	100	21 Aug-1 Dec 95	44	292	1371	0.0	hagfish, whelks, toad crabs, brittle stars, striped shrimp
N. Cape Bret. (Gulf)	100	22 Aug-1 Dec 95	44	292	1511	0.0	toad crab, hagfish, stone crab, snow crab, striped shrimp
Chedebucto Bay	100	21 Nov 94-20 Jan 96	216	1730	17119	**4.0**	snow crab, toad crab, striped shrimp
Whitehead	17	8 Aug-4 Oct 95	20	59	295	**2.1**	snow crab,whelk, toad crab
Sherbrooke	17	18 Aug-25 Sep 95	11	27	145	0.0	snow crab,toad crab
Mitchell Bay	17	6 Dec 94-21 Feb 95	14	14	238	0.0	no bycatch information
Tangier	17	15 Jul-16 Aug	5	10	80	0.0	hagfish, rock crab
Jeddore	17	17 Jul-20 Oct 95	20	32	264	0.0	rock crab, whelk, hagfish
Chezzetcooke	17	21 Jul-15 Sep 95	6	6	39	0.0	rock crab, hagfish, whelks, toad crab
total			385	2510	21446		

Table 2. Distribution of experimental shrimp trapping licences for 1996. Licences in the area most likely to produce commercial quantities of shrimp are outlined.

LFA	Area	existing	new	total
26	western Cape Breton	2	0	2
27	Sydney Bight	2	3	5
29	north shore of Chedebucto Bay		3	3
30	southeastern Cape Breton		1	1
31A	south shore of Chedebucto Bay to Whitehead	1	4	4
31B/32	eastern shore of Nova Scotia		1	1
33	south shore of Nova Scotia		1	1
34	southwestern Nova Scotia		1	1
	total			18

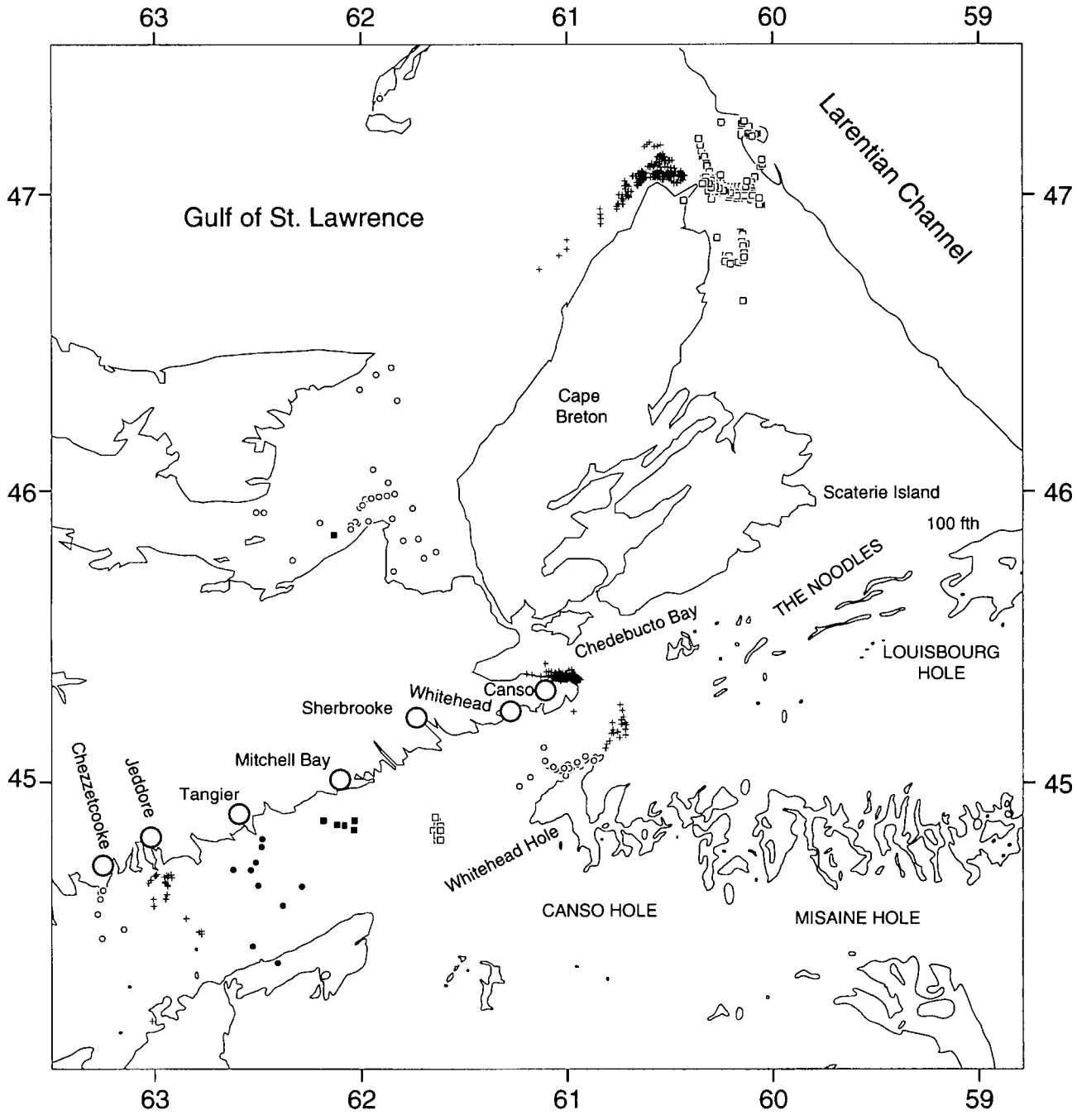

Figure 1. Locations of trap strings and place names used in the text.

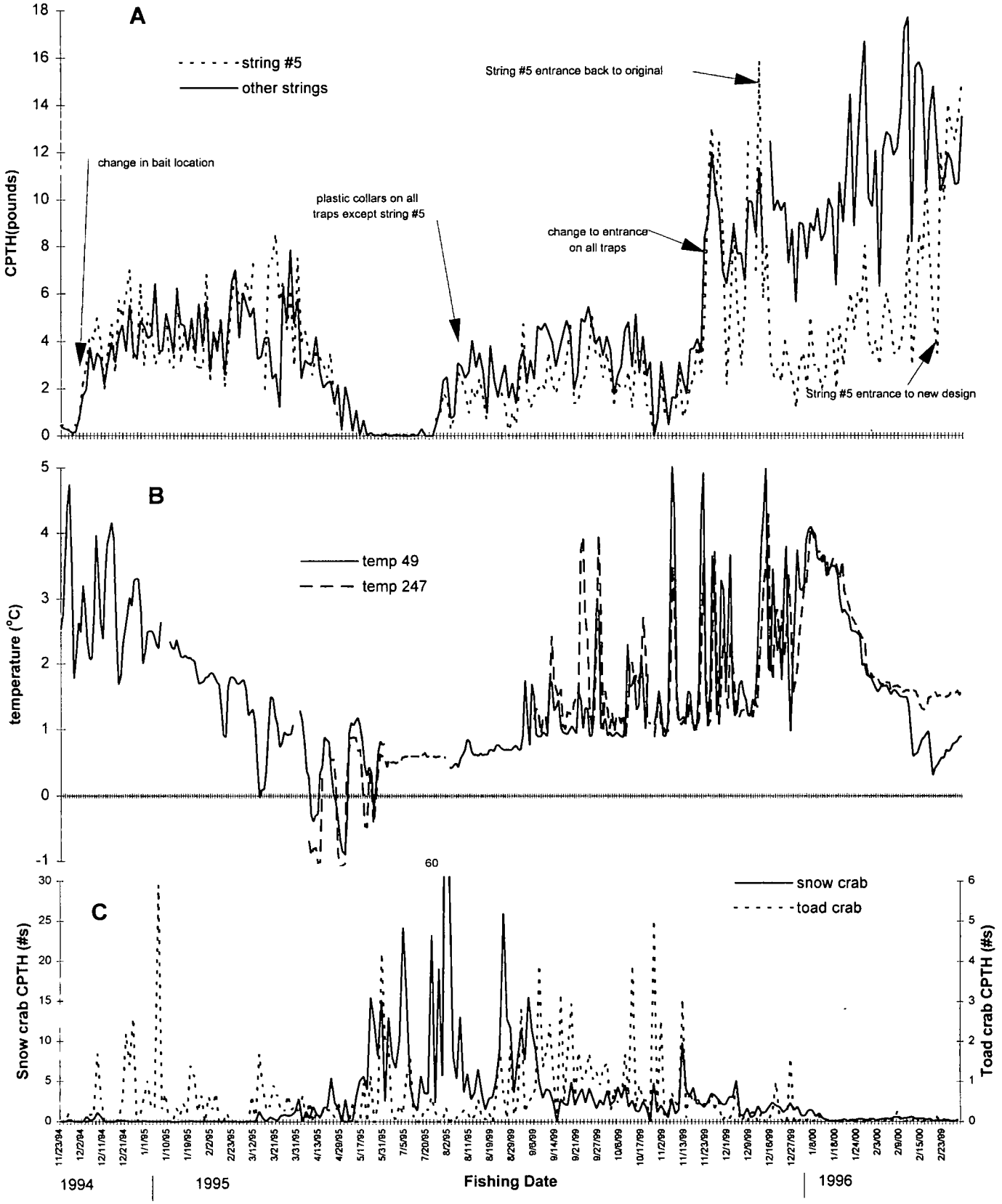

Figure 2. A - shrimp catch/trap haul off Canso. B - bottom temperatures (100m) in Chedebucto Bay from 2 continuous recorders. C - snow crab/toad crab bycatch.

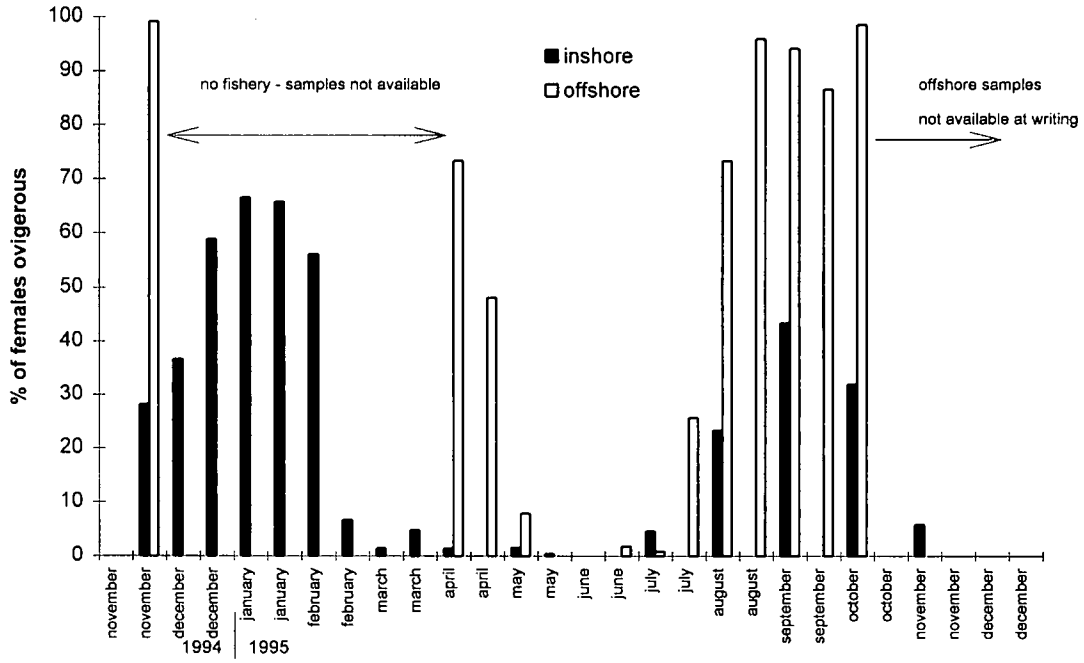

Figure 3. Percent of females that were carrying eggs (ovigerous) in samples collected from inshore traps (Chedebucto Bay) and offshore trawls in 1994/95.

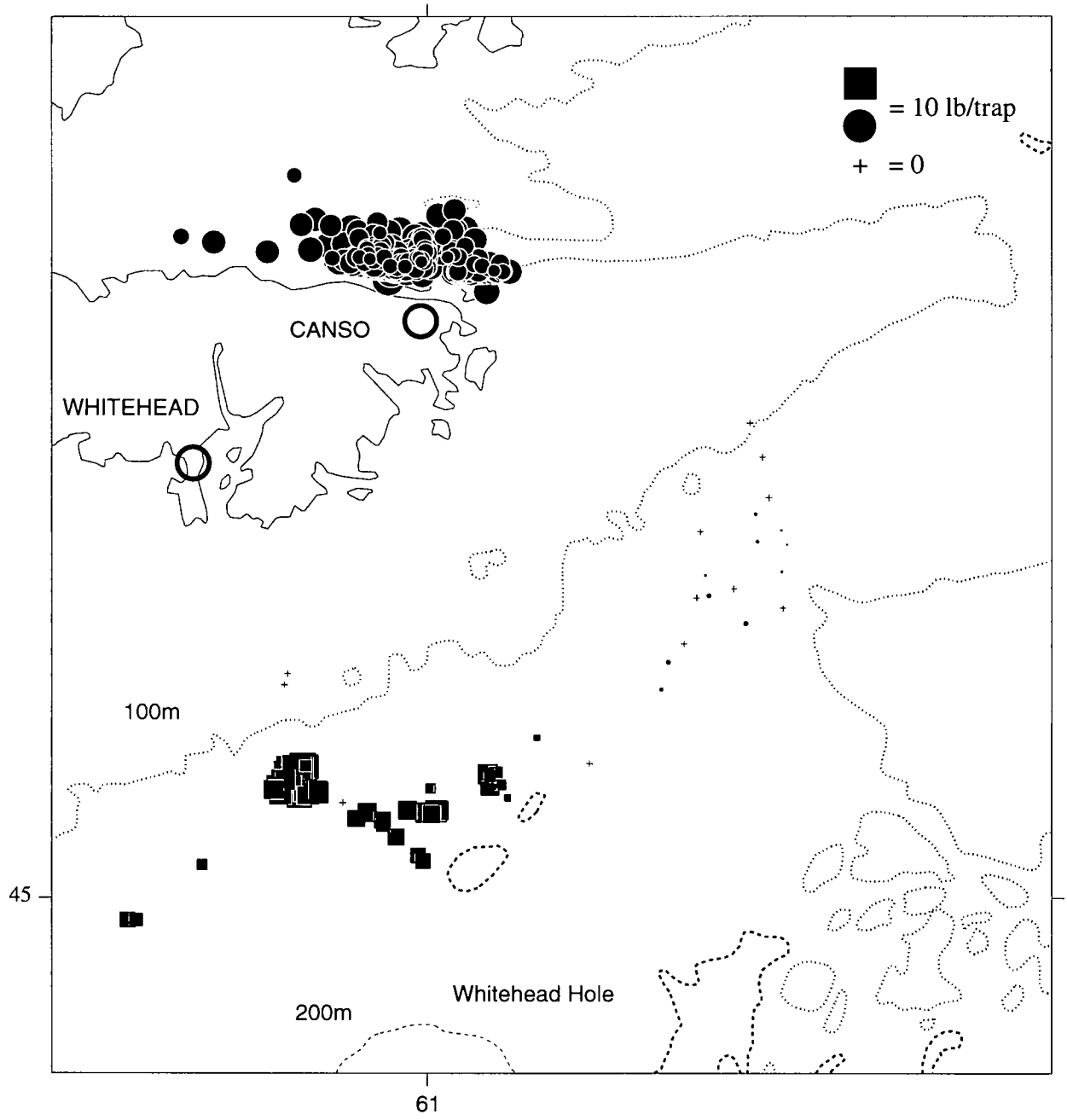

Figure 4. Detailed map of Canso and Whitehead trap locations and catches, August-September 1995. Each dot represents the average catch per trap from a string of traps. Symbol sizes are proportional to the catch per trap.

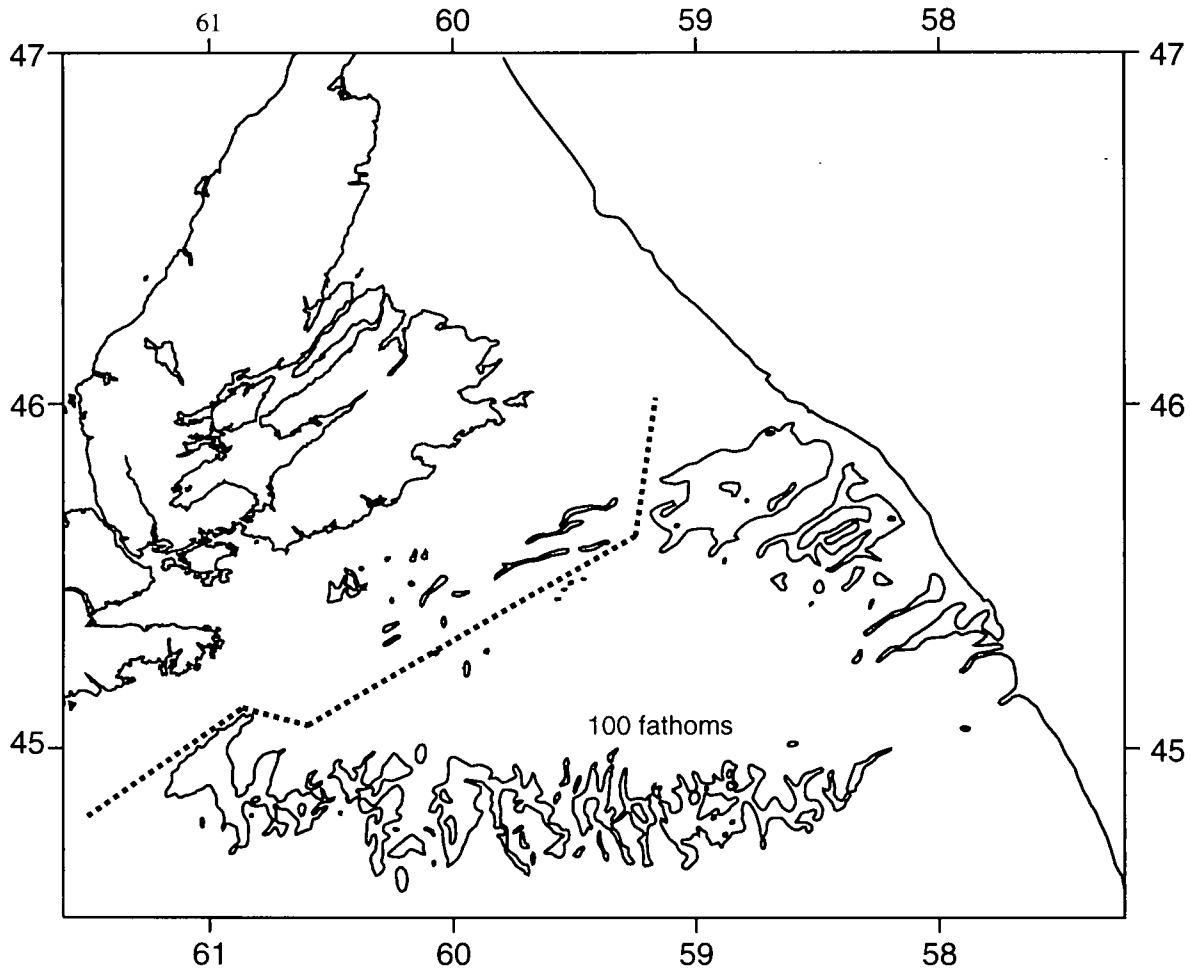

Figure 5. Scotian Shelf shrimp fishing grounds, including the proposed inshore "trap line".