

A description of the 1998 Atlantic cod fishery in NAFO Division 3Ps from port sampling and fishery observer records compared to 1997

by

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ABSTRACT

In 1998, the second year following re-opening, the quota for cod in NAFO Subdiv. 3Ps was increased from 10,000 t to 20,000 t. Nearshore, the fishery was prosecuted primarily in Placentia and Fortune Bay by gillnet, longline and trap. Offshore, the fishery took place at four locations; on the bank in shallow water south of Hermitage Channel (gillnet), two locations on the south central portion of St. Pierre Bank (gillnet and otter trawl) and the mouth of Halibut Channel in deep water (gillnet and otter trawl). The best gillnet catches, averaging 17.5 t per 100 nets were taken in Sept.-Oct. on south central St. Pierre Bank in shallow water. From Jul.-Sept., the otter trawl fishery progressed southward from St. Pierre Bank into the Halibut Channel. The best catch rates averaging 7.5 t per hour were attained by otter trawlers in the Halibut Channel in Oct.-Dec. Length and age composition samples were collected from the inshore trap, gillnet and linetrawl fisheries and the offshore otter trawl and gillnet fisheries. The spread and shape of length frequency distributions were similar between samples taken by observers and those taken port-side indicating little or no discarding. There were some differences in length composition of offshore catches of cod taken by France and that taken by Canada but mesh sizes varied between fleets and sample size was small. Overall, Placentia Bay fish were the largest of the inshore catch and 3Psh (Halibut Channel) catch the largest of the offshore. Bimodal length frequencies, modes at 65 and 85 cm were constant in catches taken on shallow portions of St. Pierre Bank (3Psd, f, and g). The proportion of fish in the smaller mode increased from Jul. to Nov. Deep water Halibut Channel and nearshore sets showed a single mode at about 74 cm for both gillnet and otter trawl catches. Length composition of cod taken as bycatch in redfish and hake fisheries (January-April) included modes of smaller fish ranging in length from 30-60 cm not seen in the directed fishery where cod-end mesh size ≤ 105 mm was used.

RÉSUMÉ

En 1998, deuxième année suivant la réouverture de la pêche de la morue, le quota alloué dans la subdivision 3Ps de l'OPANO a été augmenté de 10 000 t à 20 000 t. Le long de la côte, la pêche à l'aide de filets maillants, de palangres et de trappes s'est poursuivie en grande partie dans les baies Placentia et Fortune. En haute mer, elle s'est pratiquée en quatre endroits, soit sur le banc dans les eaux peu profondes du chenal Hermitage (filets maillants), à deux endroits dans le secteur centre-sud du banc Saint-Pierre (filets maillants et chaluts à panneaux) et en eaux profondes à l'entrée du chenal Halibut (filets maillants et chaluts à panneaux). Les meilleurs taux de captures au filet, qui s'élevaient en moyenne à 17,5 t par 100 filets, ont été réalisés au cours des mois de septembre et octobre dans les eaux peu profondes de la partie centre-sud du banc Saint-Pierre. De juillet à septembre, la pêche au chalut a progressé à partir du banc Saint-Pierre vers le sud dans le chenal Halibut. Les plus hauts taux de captures, atteignant en moyenne 7,5 t par heure, sont survenus entre octobre et décembre dans le chenal Halibut. Des échantillons visant à déterminer la structure par taille et par âge ont été recueillis des pêches côtières à la trappe, à la palangre et à au filet maillant de même que des pêches hauturières au chalut à panneaux et au filet maillant. L'étendue et la forme des courbes de fréquences provenant des échantillons des observateurs et ceux prélevés à quai étaient comparables, indiquant peu de rejets. Par contre, des différences dans la structure par taille sont apparues entre les prélèvements effectués en haute mer par la France et le Canada, quoique le maillage différait entre les deux flottilles et la taille des échantillons était réduite. En général, les plus gros poissons prélevés en zone côtière ont été capturés dans la baie Placentia, tandis qu'en haute mer, les plus gros l'ont été dans 3Psh (chenal Halibut). La fréquence des tailles correspond à une courbe bimodale. Deux modes ont été observés à 65 et à 85 cm, lesquels n'ont pas montré de variation entre les prélèvements effectués dans les eaux peu profondes du banc Saint-Pierre (3Psd, f et g). Entre juillet et novembre, une plus forte proportion de poissons avaient une taille correspondant au mode inférieur. Les données provenant de prélèvements effectués au moyen de filets maillants et de palangres en eaux profondes au large et le long des côtes du chenal Halibut ont produit une courbe à un seul mode à 74 cm. La courbe de fréquences de tailles des morues capturées accidentellement entre janvier et avril, par les engins de pêche du sébaste et de la merluche, affiche des modes correspondant à des poissons de petites tailles variant entre 30 et 60 cm. Ce phénomène ne se produit pas en pêche sélective, où le maillage utilisé dans les culs de chalut est de ≤ 105 mm.

Introduction

Cod in NAFO Subdiv. 3Ps, commonly referred to as the 'St Pierre Bank' stock encompasses Hermitage, Fortune and Placentia Bay nearshore. The offshore encompasses Burgeo, St. Pierre and Green Banks and surrounding channels (Fig.1). Shelton *et al.* (1996) noted that over this diverse collection of banks, bays and channels, the distribution of fish does not conform well to management boundaries and the stock is considered to be a complex mixture of sub-components. From this mixture, traditional pre-1993 fisheries employed all of the common fixed and mobile gears and covered the length of the coastline plus several offshore grounds. Between 1959 and 1992 prior to closure of the fishery, total annual catches ranged between 27,221 t (1978) and 86,824 t (1961).

Changes in the status of this stock were first seen in the 1970's but the greatest decline was observed in the early 1990's. The 1992 assessment of this stock (Bishop and Murphy 1992) estimated 3+ biomass at the beginning of 1991 at about 300,000 t, among the highest observed in the time series. However, by the winter of 1992, both the Canadian and French surveys indicated substantial declines in the minimum trawlable biomass. Based mainly on these survey results and a poor fishery, the Fisheries Resource Conservation Council (FRCC) in 1993 recommended that the 3Ps cod fishery be discontinued. Only 15,216 t was taken during the year to the closure in August. From closure until 1997, the only fishing for cod in 3Ps was by a sentinel survey started in 1995 and a food fishery in 1994 and 1996-1998. Preliminary results from the sentinel fishery were reported in Davis and Jarvis (1996, 1998). Kulka *et al.* (1995), Kulka (1997) and Inkpen and Kulka (1998) reported on the food fishery in terms of catch rate and fish sizes taken. Kulka (1998) provided a summary of the newly reopened 1997 commercial fishery.

The fishery

Based in part on the abundance of fish observed along the coast, a limited commercial fishery was re-instituted in 1997 then expanded in 1998. Historically, the fishery was prosecuted offshore primarily by mobile gear and inshore primarily by fixed gear. A quota of 10,000 t in 1997 and 20,000 t in 1998 was divided among the historical participants. As specified in the 1972 Agreement between Canada and France in their Mutual Fishing Relations, 15.6% or 1,560 t in 1997 and 2,340 t in 1998 was allocated to France. The French Conservation Harvesting Plan allocated 468 t in 1997 and 610 t in 1998 to the inshore while the other 1,092 t in 1997 2,510 t in 1998 was fished for France by two Canadian offshore vessels with catches processed in St. Pierre. The remainder of the quota was allocated to Canada: 414 t in 1997 and 2,464 t in 1998 for the mobile gears > 100 ft. (otter trawlers) and 6,338 t in 1997 and 13,037 t in 1998 for the fixed gear sector. Conservation Harvesting Plans (CHP's) were used to define the parameters of the fisheries for various fixed gear sectors. In addition, a total of 1,688 t in 1997 was set aside for by-catch and experimental fisheries. In 1998, 230 t was set aside for sentinel and aboriginal fisheries.

In 1997, three separate seasons, to be fished competitively, were set up for the inshore sector during May-June, August and September through November. Large numbers of fishers (~ 1,200) participating in the fishery led to very brief, intense periods of fishing at the start of each of the three seasons. In an attempt to spread out the effort in 1998, Individual Quotas (IQ's) were assigned to fishers with vessels less than 65 ft based in 3Pc, Placentia Bay. To the west, fishers from 3Psa and b continued to operate under competitive quotas with weekly limits, as in 1997. Cod taken in other directed fisheries was applied against the allocation whether it was competitive or IQ. An allocation was also set aside for fishers based outside of Subdiv. 3Ps in Divisions 3K and 3L.

In 1998, the fishery opened on June 29, later than in 1997 due primarily to the late announcement of the TAC on May 29. This late start had the added benefit of reducing the proportion of spawning fish in the catches. An analysis of maturities from 1997 catches by Kulka and Inkpen (1998) suggested that the majority of spawning would be completed before the June 29 opening date.

Regardless of sector, fixed gear fishers were required to land at a monitored port and to complete logbooks. A portion (10%) were required to carry an at-sea observer on vessels thirty-five (35') and greater. A Small Fish Protocol was in affect to prevent excessive catches of undersized (less than 45 cm) fish. In 1998, the fixed gear allocation was open to fishers with trap, gillnet, linetrawl and handline gears. Fixed gear specifications for vessels less than 65 ft. were:

Gillnets: Minimum mesh size of 5 1/2" with restrictions on the number nets in use per set depending on unit area.

Cod Traps: Minimum mesh size of 3 1/2" throughout the trap, maximum of 2 cod traps per vessel.

Baited Gear: Minimum hook size of 11 circle or 16J, maximum of number of hooks depending on area fished.

For mobile gear, a minimum 155 mm mesh was specified for all parts of the net. A quota of 2,464 t was split among three companies. Fishing commenced in early June.

The purpose of this paper is to describe the spatial and temporal details of the fishing effort and report the sampling results of the second year of the re-instituted fishery with comparison to the previous year.

Methods

Biological monitoring in 1998 comprised the collection of catch lengths and otoliths plus information on catch and effort. The fishery in 1998 was monitored at a level similar to 1997 as outlined in Kulka and Inkpen (1998). Conservation and Protection Branch of the Department of

Fisheries and Oceans carried out a dockside monitoring Program for NAFO Subdiv. 3Ps similar to the previous year. Under this program, 16 traditionally high volume landing sites were subject to full time monitoring of landed weights of cod and an additional 27 sites were subject to part time monitoring. Biological monitoring locations were chosen from these ports to maximize sampling opportunities and geographical coverage. The sampling locations were also adjusted during the fishery based on weather conditions and landing patterns determined through consultation with dockside monitoring personnel. Six port samplers covering the landing sites were teamed with 38 fishery observers to the landing sites and also vessels at sea. Conservation and Protection Branch determined vessels to be targeted and levels of coverage at sea by fishery observers.

Both the inshore and the offshore fixed and mobile gear effort were monitored including bycatch from vessels directing for other species in Subdiv. 3Ps. For the inshore sector, data were collected from three unit areas, 3Psa (west of Pass Island), 3Psb (Fortune Bay including the Connaigre Peninsula), and 3Psc (Placentia Bay). Offshore landings from unit areas 3Psd (northwest St. Pierre Bank), 3Psf (northeast St. Pierre Bank), 3Psg (southwest St. Pierre Bank) and 3Psh (Halibut Channel) were sampled (Fig.1). In addition, Placentia Bay was divided into four quadrants to intensify sampling and sites were assigned to cover each quadrant. Information on lengths was also collected from cod bycaught with other directed species.

During the 1998 Canadian cod fishery in Subdiv. 3Ps, a total of 54,019 fish were measured from the catches of the gillnet, linetrawl and handline and the offshore otter trawl fisheries (Table 1). In addition, two samples from traps plus samples of cod bycatch were taken. From the French quota fished by Canadian vessels, 13,572 fish were measured (Table 2). Gutting at sea prevented maturity determination for landed samples. A total of 6,208 otoliths were collected for ageing purposes.

For all samples, sample and turnout weight was obtained from the dockside monitor or company weigh-master. In rare cases (i.e. retention of fish for personal use at unmonitored sites), the entire catch was measured and the weight estimated using a length weight regression taken from Shelton *et al.* (1996). Each length frequency was extrapolated to the vessel turnout weight prior to summation by area and month.

Observers also collected detailed, geo-referenced information on the catch and effort of the otter trawl and gillnet fisheries in a manner specified in Kulka and Firth (1987). Observers were deployed to cover 100% of the offshore effort under French quota. For Canadian effort, 20% of the otter trawl and 3% of the gillnet activity was covered, with higher coverage levels offshore (3Psd-h). Only 5 longline sets were observed. Table 3a for otter trawl and Table 3b for gillnets specifies the number of sets where catch, effort and fishing position were recorded as used for the spatial analysis. Other narrative information including opinions on the fishery and the stock status were recorded.

Results & Discussion

Spatial analysis of the fishery

The fishery for cod took place at a number of distinct locations within Subdiv. 3Ps in 1998. Records collected by fishery observers show that different gears tended to be fished at different locations, with some overlap (Fig. 2).

Nearshore, gillnet effort was distributed intermittently near the coast from the eastern boundary of 3Ps off St. Brides into Placentia Bay to the northwestern extent of Fortune Bay. This fishery was prosecuted exclusively by the smaller class 1 (0-25 Gross Registered Tonnage or GRT) and 2 (25-50 GRT) vessels. In general, the vessels in these two tonnage classes are less than 65 ft in length. Depths fished ranged from 26 m near land to 150 m in the deep channels in the bays. The average catch rate for observed gillnet sets nearshore was 6,297 kg per 100 nets. However, these rates were variable along the coast (Fig. 3). Longline activity covered by fisheries observers amounted to only six sets thus no catch rate analysis was done for this gear. Longline and gillnet fishing also took place off Burgeo/Ramea.

This pattern of effort distribution was similar to what was observed for the 1997 fishery (Kulka and Inkpen 1998) except that no sets were observed on the western side of Fortune Bay south of the Connaigre Peninsula in 1998. Landing reports indicated that fishing did occur at this location in 1998 but this activity was not covered by fisheries observers.

Offshore, four grounds referenced as Offshore1 through 4 in Fig. 2 were fished in 1998 by gillnetters and otter trawlers. Directed gillnet activity occurred at all four locations each with substantially different catch rates:

- Lat. 46° 20' Long. 57° in 38-97 m in Subdiv. 3Psd and 3Pse, (Offshore1 in Fig. 2 and 3)
Catch rate – 9,979 kg per 100 nets
- Lat. 45° 50', Long. 56° in 25-65 m in Subdiv. 3Psg (Offshore2 in Fig. 2 and 4)
Catch rate – 12,704 kg per 100 nets
- Lat. 45° 30', Long. 55° 45' in 25-65 m in Subdiv. 3Psf (Offshore3 in Fig. 2, 4 and 5)
Catch rate – 17,453 kg per 100 nets
- Lat. 45°, Long. 55° in 140-236 m in Subdiv. 3Psh (Offshore4 in Fig. 2, 4 and 5).
Catch rate – 4,871 kg per 100 nets.

For gillnets, the best catches were taken in Offshore3, the lowest in Offshore4, the opposite of what was observed for otter trawlers. This reversal in catch rates between gears is due to the two gears being fished at different times between areas as shown in a later section.

The gillnet grounds at Offshore1 (Fig. 3) were the most extensive of all the areas fished covering 225 km². As with the nearshore effort, this area was fished almost exclusively by the smaller

class 1 and 2 (0-50 GRT) vessels. The best catches on this ground, 14,945 kg per 100 nets were located in a small area on the southern extent of the ground. In contrast, only a few sets were observed at this Offshore1 location in the previous years fishery in 1997. Offshore2, 3 and 4 (Fig. 4) were fished by the larger class 3 (50-150 GRT) and 4 (150-500 GRT) vessels and covered smaller areas (37, 35 and 150 km² respectively).

Otter trawl fishing activity took place at only two locations, both offshore:

- Lat. 45° 30', Long. 55° 45', in 25-65 m in Subdiv. 3Psf (Offshore3 in Fig. 2, 4 and 5)
Catch rate – 2.44 t per hour
- Lat. 45°, Long. 55° 20', in 140-236 m in Subdiv. 3Psh (Offshore4)
Catch rate – 7.48 t per hour.

Otter trawl catch rates in Offshore4 were very similar to the 7 t per hour observed in 1997 (Kulka and Inkpen 1998). However, the extent of Offshore4 fished in 1998 was substantially larger (22 km² in 1997 vs. 140 km² in 1998). On the other hand, the Offshore3 catch rate was about half of the 4.7 t per hour observed in 1997 but the area fished in 1998 at 215 km² was almost double the 110 km² ground observed for 1997. Whether the areas fished in 1998 were larger because the extent of commercial concentrations were larger or that the grounds were similar in size between years and effort was extended over these similar sized grounds is unclear, except in 3Psd and 3Pse. Unlike 1998, limited effort by two Canadian vessels fishing French quota in 1997 in 3Psd and 3Pse (Offshore1) did not yield catches of sufficient size to for vessels to continue fishing the area. This suggests the presence of dense concentrations of fish in this area in 1998 were not present in 1997 at the time of the fishery.

In 1998, the location of the four offshore fishing grounds were reasonably well matched to where aggregations of cod were observed in both the spring DFO research survey and the fall GEAC industry survey in the same year (Bratney *et al.* 1999).

Time series maps were used to examine change in fishing location over time. For small gillnetters (Fig. 3b) shows that the early June-July effort inshore occurred on the western side of Placentia Bay and Fortune Bay. Most of the fishing in eastern Placentia Bay occurred from September on. On the Offshore1 ground, effort started to the north and moved south. For Offshore2 and 3 (Fig. 4b), most effort occurred late in the season, primarily after late September whereas Offshore4 was fished from August through November. Otter trawl effort commenced in the northern most extent of Offshore3 and progressed southward into Offshore4 (Fig. 5b). The west to east pattern observed for Offshore3 in 1997 (Kulka and Inkpen, 1998) was not duplicated in 1998.

Catch rates for gillnets varied widely over time with no trend (Fig. 6a). This was the case even when the data were broken down by vessel class (Fig. 6b-d). However, for otter trawls, the catch rates were quite similar between July and October averaging about 2.4 t per hour then increasing rapidly in the last two months of the fishery to 6 then 12 t per hour in November and December respectively (Fig. 7). This increase is a result of a change in fishing grounds from Offshore3 on

shallow part of St. Pierre Bank to Offshore4 in the deeper Halibut Channel.

Length Frequencies

Biological samples from the Canadian 3Ps fishery were collected by both fishery observers and port samplers. Samples were obtained from 30 of the 71 NAFO unit area*month combinations in which 3Ps cod were landed (Table 1). In area*month combinations where sampling occurred, coverage (port samples and fishery observers combined) ranged from 0.2 to 42 % of the landings.

Samples were also collected from the French 3Ps fishery. Length frequencies were compiled for a total of 13 area*month combinations fished under France's quota.

- **Source comparisons**

Samples were collected by both observers and port samplers in 10 gear*area*month combinations allowing a comparison of fish size distributions of what was caught (sea samples before culling) vs. what was landed. Length frequencies from the two sources in most cases revealed little variation in either the spread or form of distributions between sources (Fig. 8). Exceptions were the October otter trawl fishery and September gillnet fishery in 3Psf when landed samples (port samplers) contained a higher proportion of small fish although gear dimensions and depths fished were comparable. This analysis showed no evidence of size selective discarding in the 'un-observed' fishery, albeit fishery observers noted non-size specific discarding in some gillnet catches (up to 30% of the set catch) due to damage by sea lice, hagfish etc.

Comparable samples of cod caught under French and Canadian quotas were limited to three gear*area*month combinations, two otter trawl and one gillnet (Fig. 9). Only minor differences in length composition were observed between the otter trawls catches. The French gillnet sample however contained a mode of larger fish not seen in the Canadian sample. In part, this may be attributable to low sample size, only 55 fish from the Canadian sample.

- **Directed fishery**

Since differences between data sources (country or mode of sampling) were minimal, observer and port sampling data (as well as frequencies collected from both Canadian and French allocations) were pooled for evaluation of trends among areas and over time. Similarly, the data were pooled as input into the assessment of this stock (Bratney *et al.* 1999).

Seven unit area*month combinations were sampled for otter trawl (Table 4), 22 for gillnet (Table 5), 8 for line trawl (Table 6) and 5 for handline (Table 7). Catches were compared among areas and gears in Fig. 10 (otter trawl), 11 (nearshore gillnet), 12 (offshore gillnet), 13 (linetrawl), 14 (handline) and 15 (trap). Sampling coverage was not only spatially but also temporally diverse, matching reasonably well the fishing effort in terms of gears, location and timing. However, not all months were sampled for each gear. A presentation of fish size by unit area for each gear can be useful in determining spatial variation in size of fish in the catches and in this regard, there were several notable differences observed.

Perhaps the most significant spatial pattern in fish sizes observed in the 1998 catches was the bimodal length distributions from the shallow (25-97 m) portion of the offshore shelf on St. Pierre Bank. The same pattern was observed for three separate grounds Offshore1 (3Psd and e), Offshore2 (3Psg) and Offshore3 across gears. The shape of the frequencies was the same for both gillnet and otter trawl such that modes were observed at 65 cm and at 85 cm (Fig. 10 and 12). The exception was for gillnets in 3Psf where the 85 cm was observed but only a few fish were recorded around the 65 cm mode. In contrast, 3Psf otter trawl frequencies contained a strong 65 cm component.

An examination of individual frequencies from the shallow areas of Subdiv. 3Ps shows that individual catches contained both modes. This indicates that the two size groups were mixed in the same schools. The smaller 65 cm mode comprised primarily 5-7 year olds while the larger 85 cm mode comprised primarily 8-9 year olds. Survey data for 1998 (Bratney *et al.* 1999) showed that these were the most abundant year classes within Subdiv. 3Ps as a whole. Although survey length samples from the shallow part of St. Pierre Bank were limited in 1998, it was the only area that yielded an 85 cm mode of fish.

In comparison, size composition of catches from the GEAC industry survey in 3Ps in 1998 was also bi-modal, closely resembling what was observed for the St. Pierre Bank commercial catches as shown in this analysis. However, this pattern of bi-modality in the shallow portions of St. Pierre Bank was not apparent in the 1997 commercial catches (Kulka and Inkpen 1998). Size frequencies of fish in otter trawl catches from 3Psf (Offshore3) in 1997, although wide in range of sizes caught (wider than what was observed inshore in 3Psa-c or offshore in 3Psh) were not bi-modal.

This bimodal pattern of sizes observed on St. Pierre Bank in 1998 contrasts with the unimodal distribution observed nearshore, 3Psa, b and c (Fig. 11, 13, 14 and 15) and in deep water catches (140-236 m) from Halibut Channel, Offshore4 (Fig. 10, lower panel) in the same year. Nearshore, there was some variation on the modes among areas (across gear types, 3Psc, Placentia Bay fish were the largest of all the nearshore areas) but particularly among gears. The smallest fish were taken with line gears, the mode at about 55 cm. The smallest fish in the 30-40 cm range were taken with line trawl while the Offshore4 grounds fished by otter trawl and gillnet yielded the largest fish. The modes, at 73-75 cm were nearly the same for both gears in this area. The parameters and shape of the overall frequency for 3Psh (Offshore4) was very similar to what was observed in 1997 (Kulka and Inkpen 1998).

Changes in length composition over time were identified in monthly plots of catch length frequency distribution (Fig. 16-28). Not all month*area*gear combinations were fished and not all combinations fished were covered. Where time series were available, length frequency distributions of catches were observed to vary over time for all the gears sampled, but trends over time were not necessarily consistent among gears. Nearshore in 3Psa, size of fish from gillnets was significantly larger in November compared to earlier months while line trawl sizes were fairly consistent over time except for an increase in the proportion of smaller fish (30-40 cm) in September and November (Figs. 16 and 17). In 3Psb, although sample sizes were small, in

several instances, catch samples taken between June and November indicate a moderate increase over time in the proportion of large fish from gillnets. Size for other gears was more consistent (Fig. 18-20). In 3Psc, fish sizes remained fairly consistent over time for gillnet (Fig. 21) and line trawl (Fig. 22) except for a truncation (38-45 cm) in the September frequency. Sample size for handline was small (Fig. 23).

Across months, gillnet length frequency distributions were consistently bimodal in unit areas 3Psd and g (Fig. 24 and 26) with some variation in relative mode sizes. In 3Psf, there were two modes in September (mainly the larger mode) but one in December. Caution should be used in interpreting this observation given the small sample size. Otter trawl catches were consistently bimodal in 3Psf (Fig. 27) and unimodal in 3Psh (Fig. 28).

- **Bycatch**

A limited number of samples were available for cod taken as by catch in other fisheries (mostly directed for redfish). These cod were caught in either midwater or bottom trawls with cod end mesh sizes as small as 90 mm. Length frequency distributions of these incidentally caught fish comprised a wider range of sizes starting at less than 30 cm depending on gear (primarily mesh size) configuration (Fig. 29). Small fish were taken mainly in 3Psd and 3Psg with small mesh bottom and midwater gear.

Length composition of cod taken as bycatch in redfish and hake fisheries (January-April) included modes of smaller fish ranging in length from 30-60 cm not seen in the directed fishery where cod-end mesh size ≤ 105 mm was used. Larger fish were also taken in these small meshed gears suggesting a wide range of sizes available to the gear.

Discussion

Shelton *et al.* (1996) noted that fish in 3Ps do not conform well to management boundaries and that the stock is considered to be a complex mixture of sub-components. Bratney *et al.* (1999) also indicated that stock structure and migration patterns of 3Ps cod are complex and not fully understood. This suggests that the commercial effort location, comprising the four offshore grounds plus effort along much of the coast could be differentially targeting various components of the population of cod in Subdiv. 3Ps.

For example, on the western side of 3Ps, Bratney *et al.* (1999) noted an influx of fish onto Burgeo Bank and Hermitage Channel from the Gulf of St. Lawrence during the winter. Offshore fishing grounds observed for the 1998 offshore fishery were all located south of Burgeo Bank and Heritage Channel where the "Gulf fish" are thought to occur in the spring. The inshore effort on Burgeo Bank occurred primarily after June, thus the later occurring fishery both inshore and offshore likely took little or none of the migratory "Gulf fish".

On the eastern side of 3Ps, Bratney *et al.* (1999) also noted mixing of fish from Div. 3L, particularly at the mouth of St. Mary's Bay (Quadrant 1). Here, significant amounts of fish were taken off St. Brides during the last half of the year in 1997 and 1998 which likely comprised

some portion of fish migrating between Subdiv. 3Ps and Div. 3L. Fig. 30, gillnet catches from the southern portion of Placentia Bay indicates a component of larger fish in Quadrant 1 not elsewhere in 3Ps. Similarly, in the 1997 (Inkpen and Kulka 1998) and 1998 (Inkpen and Kulka 1999) food fisheries where hook and line gear were used the fish from this St. Brides ground were significantly larger than other from coastal catches to the west. The handline frequencies from the 1999 commercial fishery also contained a mode of larger fish in quadrant 1, 3Psc not seen in other areas (Fig. 31). Trap fish from the 1997 commercial fishery off St. Brides also contained a component of larger fish not observed elsewhere inshore in 3Ps (Kulka and Inkpen 1998). Thus this pattern was consistent across gears and years sampled. The size composition of these St. Bride's fish was similar to those caught on the Grand Banks in 3NO (no sampling of trap catches was done at this location in 1998 to compare to 1997). This suggested that some portion of the fish taken off St. Brides in the fishery could be migrate between Div. 3L and Subdiv. 3Ps.

Across all fishing grounds, what proportions of the various stock components being fished is unclear given the uncertainty about stock structure within 3Ps. What we do know from the analysis of geo-referenced commercial records presented in this is where the fishing mortality in terms of time and location is occurring.

Conclusions

The size and age structure of cod caught during the 1998 fishery in Subdiv. 3Ps, with few exceptions was monitored adequately across gears, areas and time periods in terms of fish size in the catch and ageing materials. Limited geo-referenced catch data allowed a spatial analysis of the fishery. These data plus the pooled length frequency information were incorporated into the assessment of the stock as a description of the fishery and to estimate removals at age from the commercial catches (Bratney *et al.* 1999). These data were also of use in defining effort location with respect to the distribution of the fish.

As noted by Shelton *et al.* (1996), the 3Ps management unit contains a diverse collection of banks, bays and channels where the distribution of fish does not conform well to management boundaries and the stock is considered to be a complex mixture of sub-components. Consistent with this description of the stock, the fishery is also complex in terms of spatial and temporal trends. Offshore, the 1998 fishery was prosecuted over a greater area than in 1997 although it should be noted that Canada did not fish its quota in 1997 and less effort was expended in that year. In 1998, there were four fishing grounds compared to two in 1997. It is not clear if this was a result of commercial concentrations of cod being more widespread in 1998 or whether it was strictly due to an expansion of effort location onto grounds previously available but not fished. The exception is the northern part of St. Pierre Bank where concentrations of fish were observed in 1998 but not 1997 during the fishery. As well, size of fish was observed to vary among areas, those from the shallow portion of Subdiv. 3Ps being bimodal, those nearshore and those offshore along the shelf edge having a single mode. This bimodality was not observed anywhere in 1997.

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Table 1. Landings and biological sampling coverage of the Canadian cod fishery in NAFO Subdivision 3Ps in 1998, by month and unit area. Includes samples collected by both port samplers and fishery observers.

3Ps Unit Area	Month	¹ Landings (kg)	² Landed weight sampled (kg)	³ Percent of landings sampled (by weight)	No. samples taken	No. cod measured
a	January	182		0.0	0	0
	February	89		0.0	0	0
	April ¹	6,594	383	5.8	4	135
	May	3,907		0.0	0	0
	June	17,952		0.0	0	0
	July	256,310	2,084	0.8	10	832
	August	49,845		0.0	0	0
	September	651,027	7,364	1.1	20	2,079
	October	2,605		0.0	0	0
	November	594,379	15,748	2.6	22	5,308
	December	6,780		0.0	0	0
	b	April	64,098		0.0	0
May		10,731		0.0	0	0
June		64,709	1,329	2.1	1	182
July		1,082,727	22,718	2.1	32	5,373
August		39,400	3,106	7.9	4	1,040
September		706,307	2,766	0.4	10	1,515
October		1,628		0.0	0	0
November		707,792	9,834	1.4	11	2,134
c	January	10,810		0.0	0	0
	February	1,934		0.0	0	0
	March	8,300		0.0	0	0
	April	795		0.0	0	0
	May	9,379		0.0	0	0
	June	26,315		0.0	0	0
	July	2,204,193	44,051	2.0	46	9,025
	August	462,541	936	0.2	11	331
	September	1,014,118	7,051	0.7	11	2,246
	October	1,631,066	30,198	1.9	44	7,736
	November	1,303,839	20,730	1.6	18	3,325
	December	100,435		0.0	0	0
d	February	17,228	68	0.4	1	12
	April	4,814		0.0	0	0
	May	2,111		0.0	0	0
	July	220,091	22,153	10.1	3	506
	August	21,304	6,500	30.5	3	623
	September	465,602	26,037	5.6	8	608
	October	2,405		0.0	0	0
	November	199,622	64,965	32.5	5	1,176
December	19,305		0.0	0	0	

3Ps Unit Area	Month	¹ Landings (kg)	² Landed weight sampled (kg)	³ Percent of landings sampled (by weight)	No. samples taken	No. cod measured
e	March	26		0.0	0	0
	July	18		0.0	0	0
	August	32		0.0	0	0
	September	73,953		0.0	0	0
	October	11,025		0.0	0	0
	November	71,800		0.0	0	0
	December	562		0.0	0	0
f	September	180,321	34,374	19.1	4	1,107
	October	433,661	135,558	31.3	5	742
	November	117,136		0.0	0	
	December	103,586	26,352	25.4	1	226
g	March	1,997	156	7.8	3	134
	April	3,906		0.0	0	0
	May	18,645		0.0	0	0
	September	34,468		0.0	0	0
	October	45,321		0.0	0	0
	November	67,124	27,952	41.6	2	589
	December	22,080		0.0	0	0
h	March	52,532	5,844	11.1	5	271
	April	155,864	2,081	1.3	10	252
	May	49,043		0.0	0	0
	June	1,566		0.0	0	0
	July	4,899		0.0	0	0
	August	36,269		0.0	0	0
	September	347,752	1,0599	3.0	7	1,067
	October	391,288	15,4953	39.6	15	2,347
	November	897,341	91,2927	101.7	11	2,871
	December	301,206	3,7251	12.4	1	227
All	All	15,416,691	1,636,068	404	328	54,019

¹ Landings before June were from bycatch with other fisheries or the Sentinel fishery.

² Landed catch sampled is not the weight of samples. Rather, it is total weight of landings from which samples were taken.

³ Percent of landings sampled is landed catch sampled (col. 4) divided by Landings (col. 3).

Table 2 Total catch and biological sampling coverage for Atlantic cod caught by directed fishing in 3Ps under France's quota in 1998.

NAFO Unit Area	Month	¹ Landed weight sampled (kg)	No. length frequency samples	Total no. fish measured
c	June	328	1	126
f	July	5,166	9	1,620
f	September	5,791	7	1,291
f	October	9,365	12	2,143
f	November	392	1	86
e	September	575	1	182
d	August	4,357	11	1,224
d	September	8,272	10	1,680
d	October	834	2	211
g	September	742	1	162
h	October	6,443	7	1,470
h	November	8,158	8	1,846
h	December	7,290	6	1,531
Total		57,714	76	13,572

¹ Landed catch sampled is not the weight of samples. Rather, it is total weight of landings from which samples were taken.

Table 3a. Number of otter trawl or mid-water trawl sets where fishery observers recorded catch rate data for Atlantic cod caught in 3Ps during 1998. Country fishing is indicated as C - (Canada), F - (France) or C/F - (both).

Unit	Mode	Data	Jan	Feb	Mar	Apr	May	July	Aug	Sept	Oct	Nov	Dec	Total
3Psa	Directed	No. sets with CPUE Country(s) fishing									1			1
	Bycatch	No. sets with CPUE Country(s) fishing					2	5	8	9		10		34
3Psf	Directed	No. sets with CPUE Country(s) fishing						C	C	C	C		C	
								77	42	132	129	5		385
								F	F	C/F	C/F	F		
3Psd	Directed	No. sets with CPUE Country(s) fishing									6			6
	Bycatch	No. sets with CPUE Country(s) fishing	39	24		1	12			5		3	1	85
			F	C/F		C	C			C		C	C	
3Psg	Directed	No. sets with CPUE Country(s) fishing										3		3
	Bycatch	No. sets with CPUE Country(s) fishing		25	44	15								87
				F	C/F	C							F	
3Psh	Directed	No. sets with CPUE Country(s) fishing							2		66	75	38	181
	Bycatch	No. sets with CPUE Country(s) fishing				37	31		F		C/F	C/F	C/F	68
						C/F	C							
Total sets with CPUE			39	49	81	47	14	84	50	146	202	96	42	850

Table 3b. Number of gillnet sets where fishery observers recorded catch rate data for Atlantic cod caught in 3Ps during 1998. Country fishing is indicated as C - (Canada), F - (France) or C/F - (both).

Unit Area	Mode	Data	Jun	Jul	Aug	Sept	Oct	Nov	Total
3Psa	directed	No. sets with CPUE		3		1			4
		Country(s) fishing		C		C			
3Psb	directed	No. sets with CPUE	2	27					29
		Country(s) fishing	C	C					
3Psc	directed	No. sets with CPUE	9	31	9		65	26	140
		Country(s) fishing	C/F	C	C		C	C	
3Psf	directed	No. sets with CPUE				8		5	13
		Country(s) fishing				C		C	
3Pse	directed	No. sets with CPUE	5	5	5	1	4		20
		Country(s) fishing	F	F	F	F	F		
3Psd	directed	No. sets with CPUE	4	78	50	40	10	3	185
		Country(s) fishing	F	C/F	C/F	C/F	F	C	
3Psg	directed	No. sets with CPUE				1		17	18
		Country(s) fishing				F		C	
3Psh	directed	No. sets with CPUE			22	97		11	130
		Country(s) fishing			C	C		C	
	bycatch	No. sets with CPUE			20	33		2	55
		Country(s) fishing			C	C		C	
Total sets with CPUE			20	144	106	181	79	64	594

Table 4 - Summary length frequency data by area and month for otter trawl samples from the 1998 3Ps directed cod fishery. Data includes port sampling and observer program samples for Canadian and French vessels.

Unit	Month	Depth (m)	Mesh (mm)	Turnout Weight (kg)	Sample Weight (kg)	No. Meas.	Mean Length (cm)	St. Dev.	Modal		Max. Length (cm)
									Length (cm)	Length (cm)	
3Psf	July	40-47	134	31,600	5,166	1,620	75	12.31	81	46	119
	Sept.	44-46	135-142	90,659	7,884	1,778	75	11.41	63	46	110
	Oct.	43-54	139-156	217,204	12,803	2,880	74	10.55	64	48	125
	Nov.	44	139	3,265	392	86	73	6.28	70	53	97
	Total			342,728	26,245	6,364	74	11.21	64	46	125
3Psh	Oct.	47-229	139-156	225,932	17,335	3,817	75	8.15	77	46	110
	Nov.	104-309	135-155	1,055,251	19,517	4,717	74	8.77	73	43	123
	Dec.	154-198	155	138,051	8,256	1,758	76	9.82	81	49	115
	Total			1,419,234	45,108	10,292	74	8.87	73	43	123
Grand Total			2,196,779	74475	17401	74	9.66	73	43	125	

Table 5 - Summary length frequency data by area and month for gillnet samples from the 1998 3Ps directed cod fishery. Data includes port sampling and observer program samples for Canadian and French vessels.

Unit	Month	Depth (m)	Mesh Size (mm)	Turnout Weight (kg)	Sample Weight (kg)	No. Meas.	Mean Length (cm)	St. Dev.	Modal Length (cm)	Min. Length (cm)	Max. Length (cm)
3Psa	July	137-229	140-152	1,422	1,422	503	66	9.69	64	45	111
	Sept.	64-210	140-152	2,308	2,103	778	63	2.21	60	35	117
	Nov.	142-229	140-152	3,680	3,090	987	69	6.63	64	42	108
	Total			7,410	6,615	2,268	66	6.20	64	35	117
3Psb	June	175	140	1,329	334	182	59	10.01	57	50	86
	July	55-199	140-203	22,718	12,593	5,373	63	8.09	59	34	115
	Nov.	73-160	140-165	985	985	312	68	9.60	67	36	105
	Total			25,032	13,912	5,867	63	8.12	57	34	115
3Psc	June	35	140	545	328	126	65	16.01	63	54	86
	July		140-203	38,186	21,490	7,771	66	6.60	62	31	113
	August	36-64	146-178	936	936	331	67	8.80	65	32	99
	Sept.	35-73	140-152	1,490	1,490	545	65	8.24	63	46	106
	Oct.	47-119	140-203	15,357	6,642	2,037	70	7.24	69	40	116
	Nov.	30-73	140-175	20,730	9,859	3,325	67	4.56	66	45	96
	Total			77,244	40,745	14,135	67	7.17	64	31	116
3Psd	July	49-50	140-165	22,153	2,658	506	81	9.01	90	50	131
	August	42-46	140-170	15,127	6,853	1,702	77	10.27	90	37	106
	Sept.	39-49	140-178	44,802	12,218	2,288	77	11.87	89	45	108
	Oct.	44-46	140	2,985	834	211	76	8.29	66	54	103
	Nov.	42-50	140-165	64,965	5,290	1,176	75	11.47	64	45	108
	Total			150,032	27,853	5,883	77	11.99	64	37	131
3Pse	Sept.	59	145	782	575	182	69	18.65	65	52	96
3Psf	Sept.	48	140-152	7,374	3,163	620	82	4.23	80	52	115
	Dec.	45	203	26,352	1,583	226	83	4.42	81	56	105
	Total			33,726	4,746	846	83	5.80	81	52	115
3Psg	Sept.	47	145	2,905	742	162	78	10.58	86	41	116
	Nov.	49-52	152-165	27,952	2,737	589	76	9.16	67	49	105
	Total			30,857	3,479	751	76	9.22	67	41	116
3Psh	Sept.	51-155	150	10,599	4,272	1,067	75	2.30	73	50	109
Grand Total				335,682	102,197	30,999	72	11.58	64	31	131

Table 6 - Summary length frequency data by area and month for linetrawl samples from the 1998 3Ps directed cod fishery. All data from port sampling samples.

Unit	Month	Depth (m)	Turnout Weight (kg)	Sample Weight (kg)	No. Meas.	Mean Length (cm)	St. Dev.	Modal Length (cm)	Min. Length (cm)	Max. Length (cm)
3Psa	July	119-150	662	592	329	57	9.07	56	38	97
	Sept.	26-124	5,056	3,092	1,301	52	6.14	52	30	90
	Nov.	73-247	11,269	6,624	4,112	54	8.47	54	31	118
	Total		16,987	10,308	5,742	54	8.54	54	30	118
3Psb	August	123-155	3,106	1,873	1,040	56	4.66	51	36	113
	Sept.	46-155	2,465	2,465	1,329	55	11.78	54	32	130
	Nov.	67-127	8,656	3,219	1,716	56	8.13	54	33	102
	Total		14,227	7,557	4,085	56	8.87	51	32	130
3Psc	Sept.	24-70	5,339	3,515	1,568	60	5.16	55	45	106
	Oct.	37-82	14,620	11,511	5,595	58	8.79	52	36	115
	Total		19,959	15,026	7,163	59	9.09	54	36	115
Grand Total			51,173	32,890	16,990	56	9.73	54	30	130

Table 7 - Summary length frequency data by area and month for handline samples from the 1998 3Ps directed cod fishery. All data from port sampling samples.

Unit	Month	Depth (m)	Turnout Weight (kg)	Sample Weight (kg)	Sample Size	Mean Length (cm)	St. Dev.	Modal Length (cm)	Min. Length (cm)	Max. Length (cm)
3Psb	Sept.	29-64	301	301	186	55	7.65	57	39	91
	Nov.	35	193	193	106	57	7.23	57	40	84
	Total		494	494	292	56	7.54	57	39	91
3Psc	July	32-41	1,352	664	264	65	10.46	61	45	92
	Sept.	87	222	222	133	55	6.20	54	43	74
	Oct.	37	221	221	104	58	6.87	61	45	75
	Total		1,795	1,107	501	62	6.56	56	43	92
Grand Total			2289	1601	793	61	2.32	56	39	92

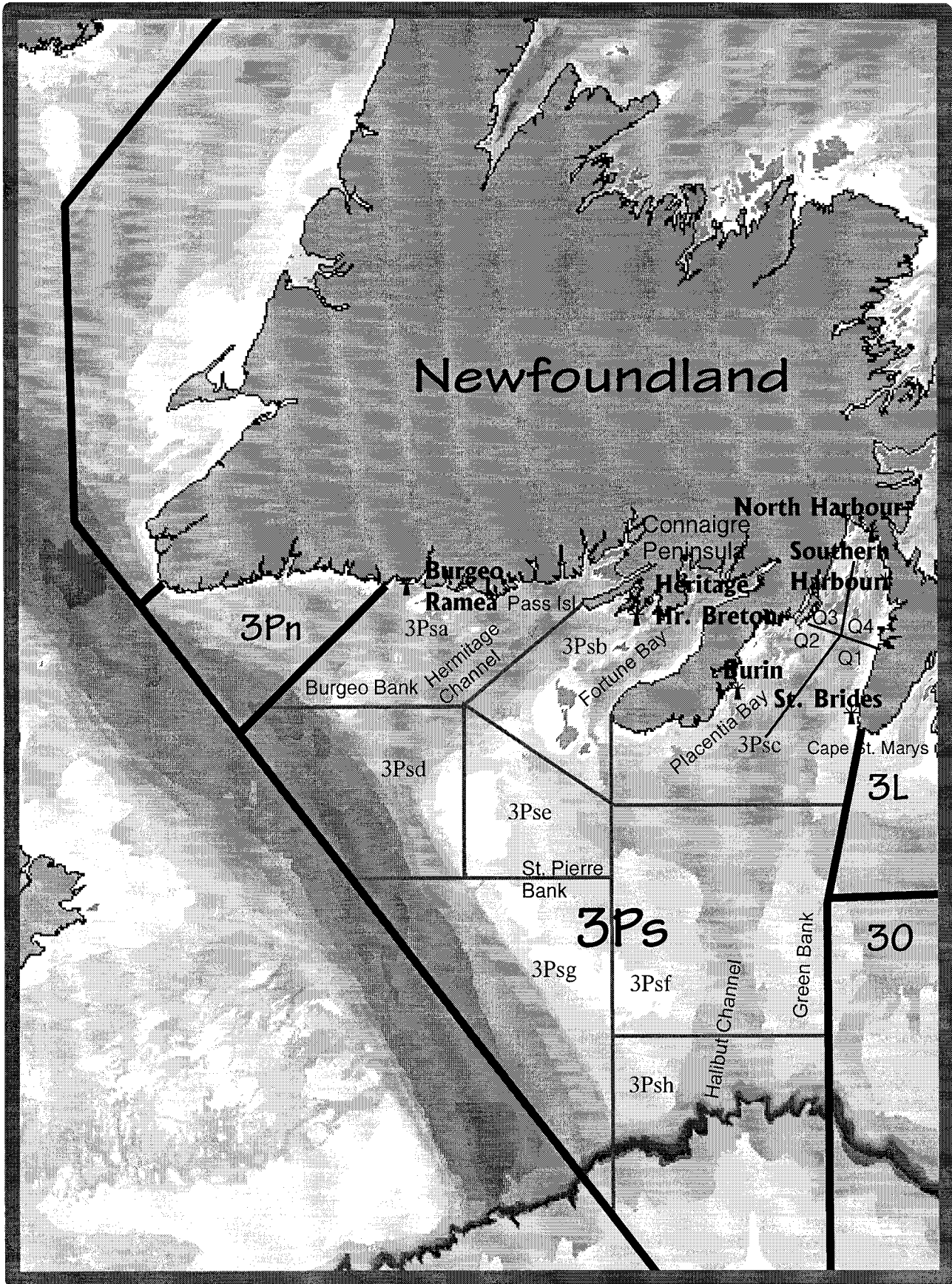


Figure 1 - NAFO Subdivision 3Ps showing the unit areas, location, banks and channels. White areas are 0-50 m depth and light to dark grey shades are 50 m intervals to 450 m then 100 m intervals from 500 to 1000 m then 2000 and 3000 m.

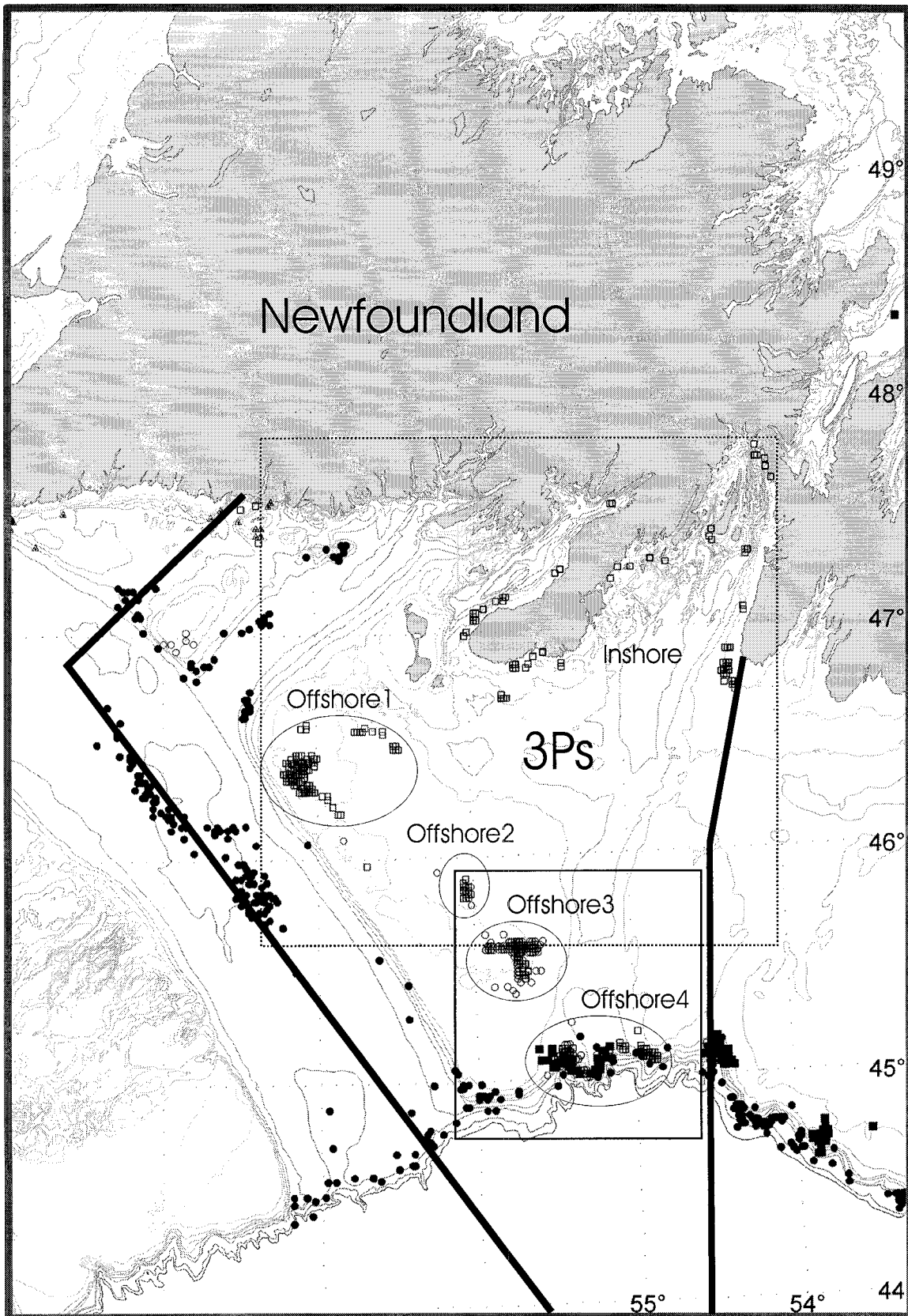


Figure 2 - Observed fishing locations with cod in NAFO Division 3Ps and surrounding areas in 1998. Closed circles show bycatch otter trawl sets and open circles show directed cod trawl sets. Closed squares show bycatch gillnet sets and open squares show vessel directed gillnet sets. Open triangles show longline sets. Solid box denotes areas blown up in Fig. 5 (class 5 ottertrawl) and 4 (class 3-4 gillnet). Dashed box denotes area blown up in Fig. 3 (class 1-2 gillnet)

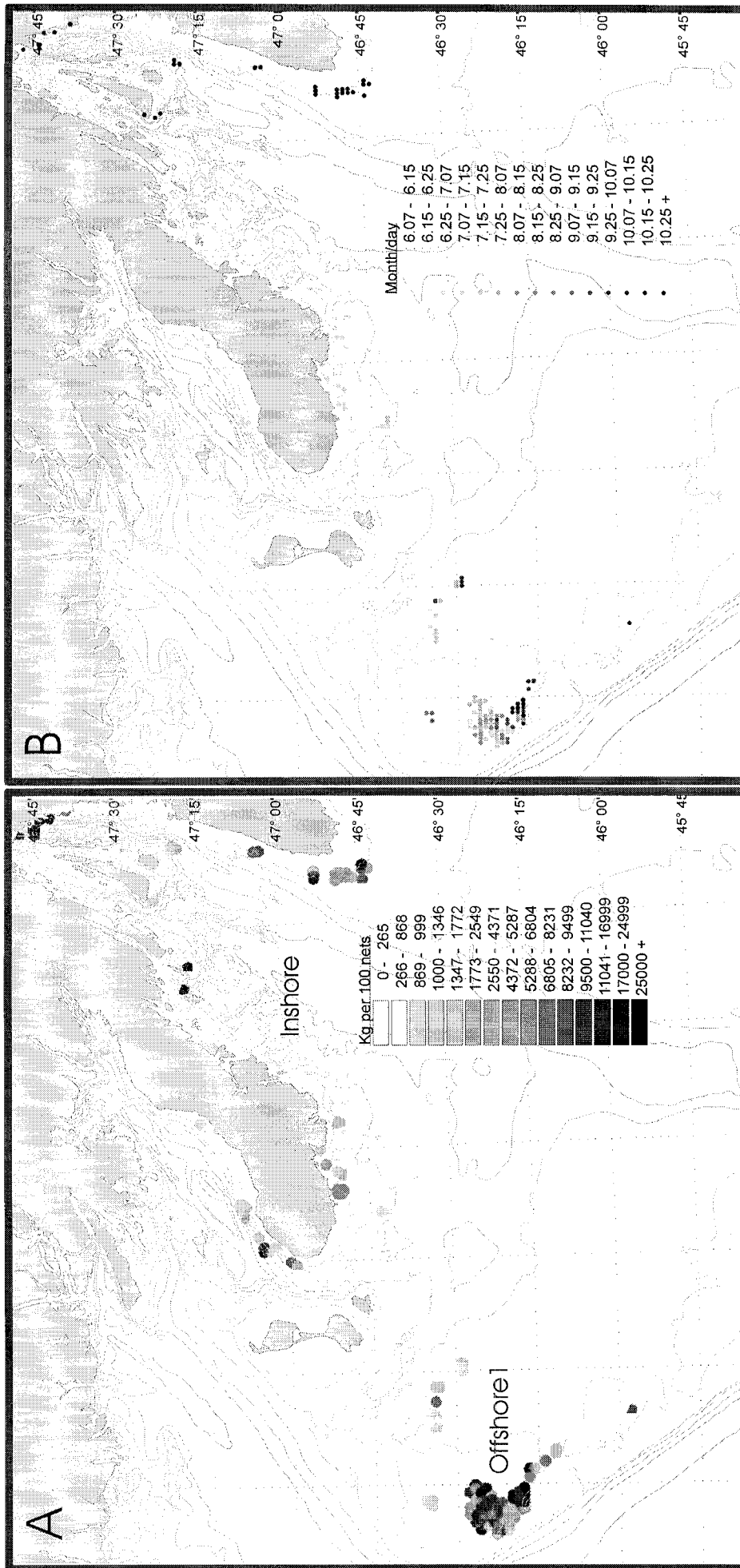


Figure 3 - Observed small boat (class 1-2) gillnet fishery in NAFO Subdivision 3Ps in 1998. Panel A shows catch rate of cod. Panel B shows set locations over time. Fig. 2, dashed box delineates the area within Subdiv. 3Ps shown on this figure.

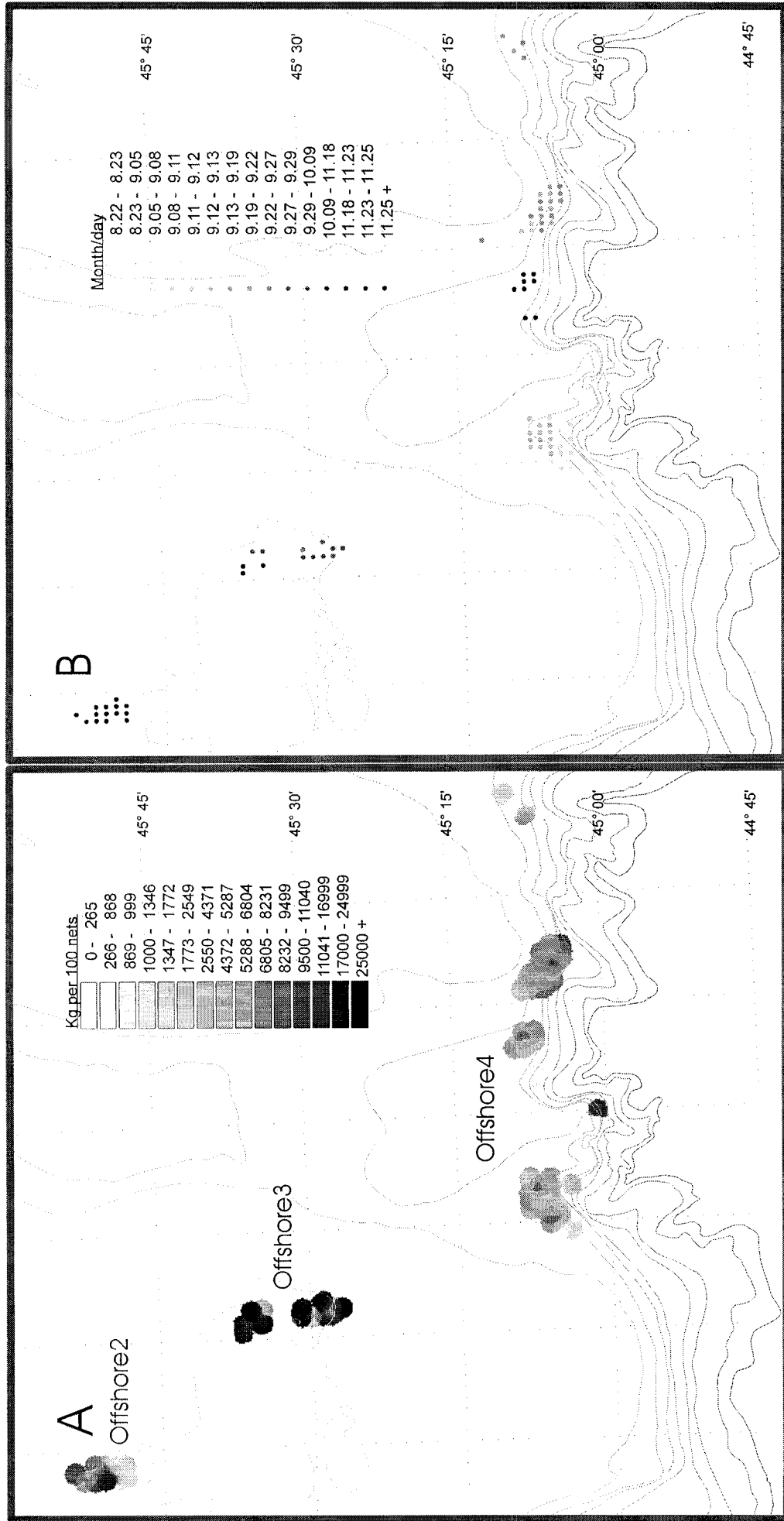


Figure 4 - Observed large boat (class 3-4) gillnet fishery in NAFO Subdivision 3Ps in 1998. Panel A shows catch rate of cod. Panel B shows set locations over time. Fig. 2, solid box delineates the area within Subdiv. 3Ps shown on this figure.

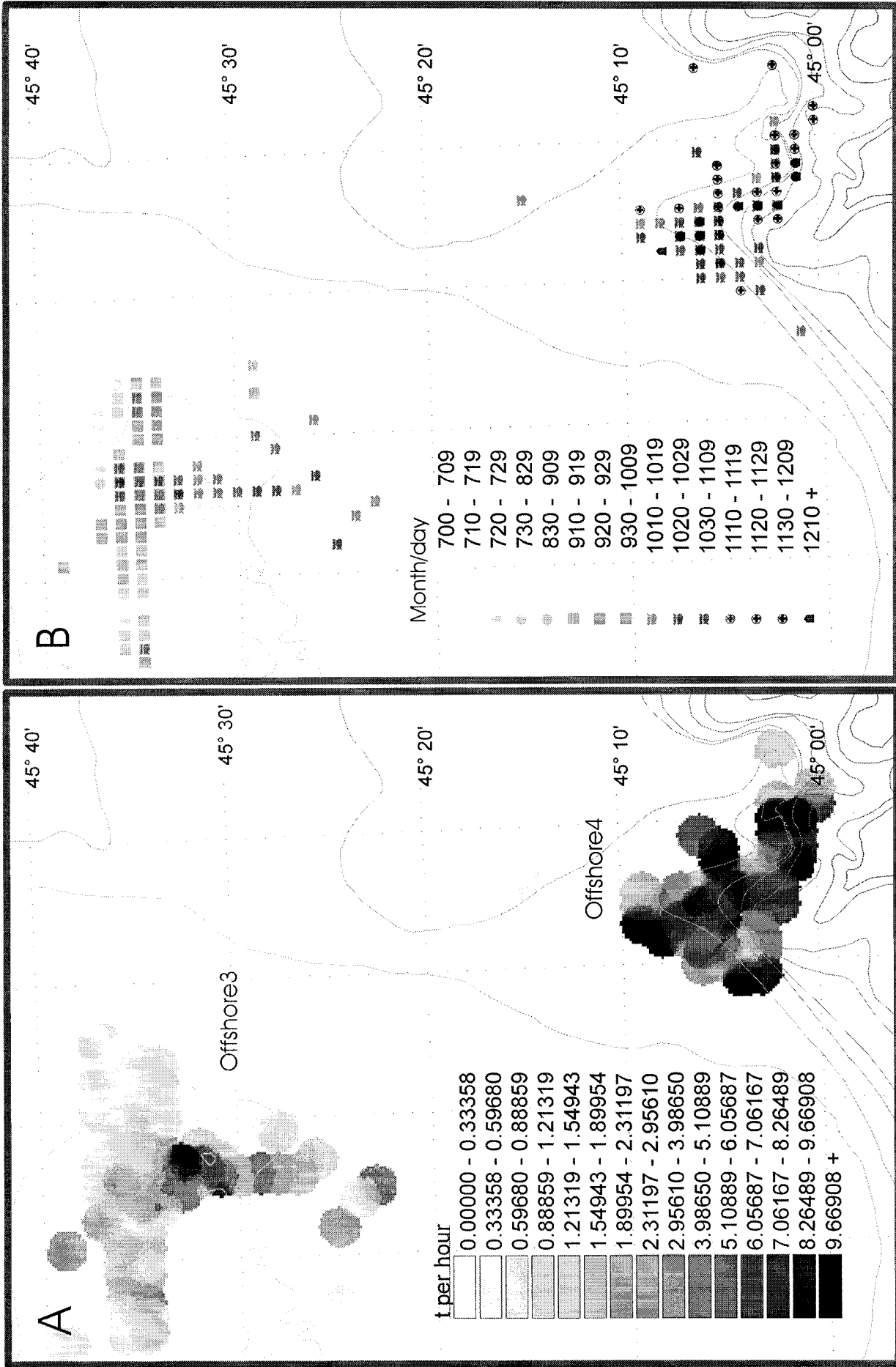


Figure 5 - Observed otter trawl fishery in NAFO Subdivision 3Ps in 1998. Panel A shows catch rate of cod. Panel B shows set locations over time. Fig. 2, solid box delineates the area within Subdiv. 3Ps shown on this figure.

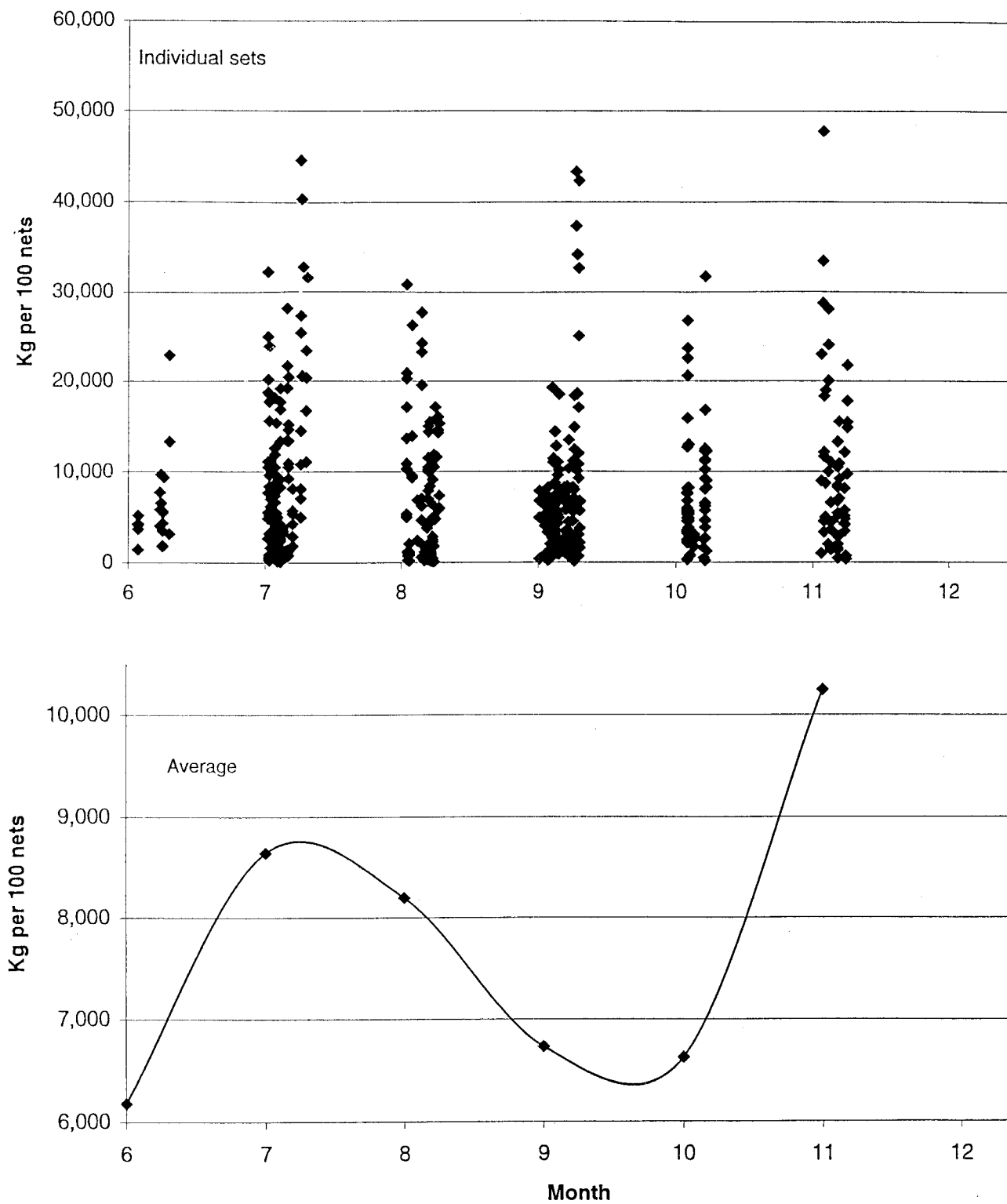


Figure 6a - Catch rates for gillnet fisheries in 3Ps for all vessel classes. Lower panel shows avg. catch rates. For Figs. 6 and 7 upper, set points spread horizontally over a period up to 31 days. A space separates months.

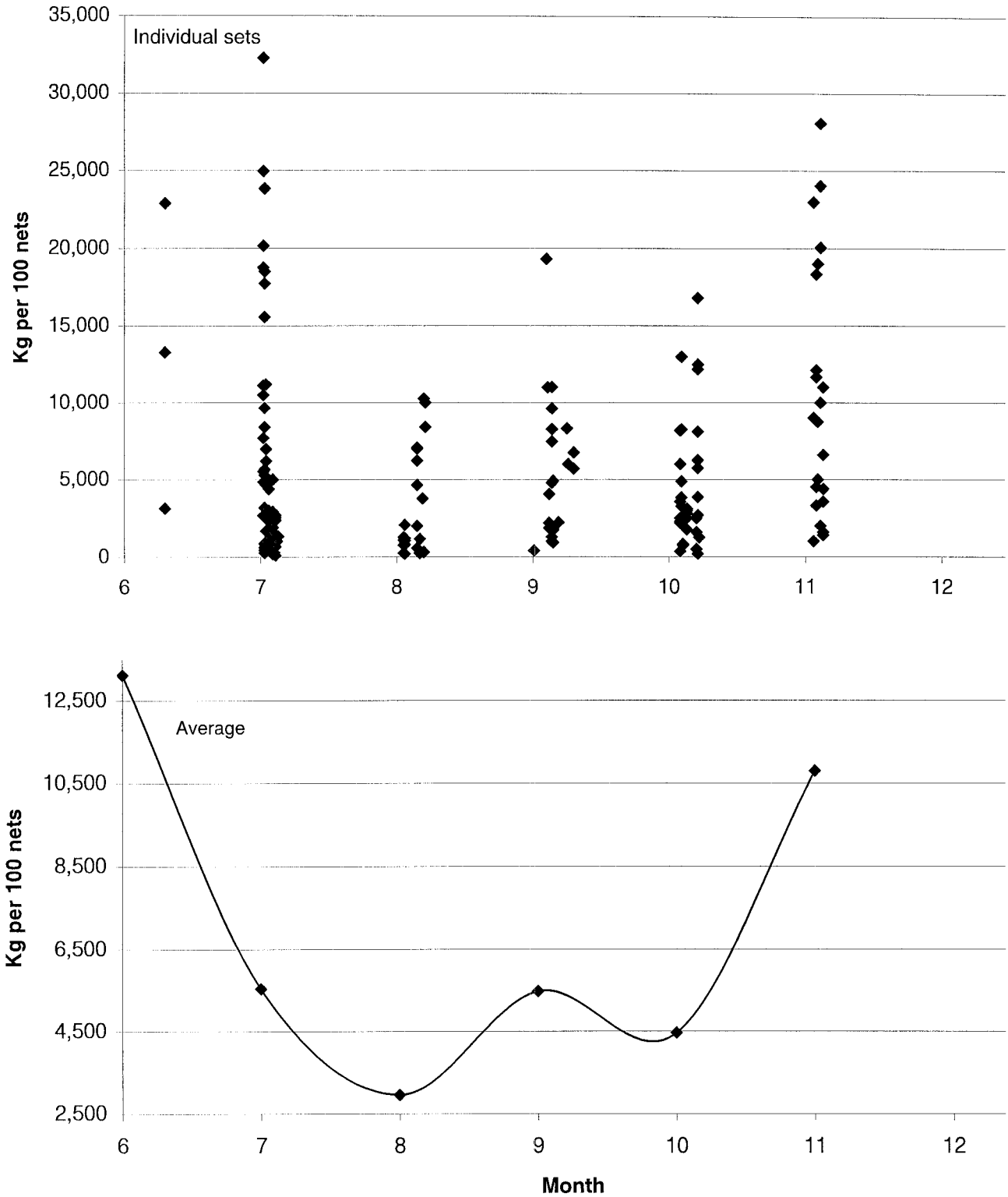


Figure 6b - Catch rates for gillnet fisheries in 3Ps for vessel class 1. Lower panel shows avg. catch rates. For Upper panel set points spread horizontally over a period up to 31 days. A space separates months.

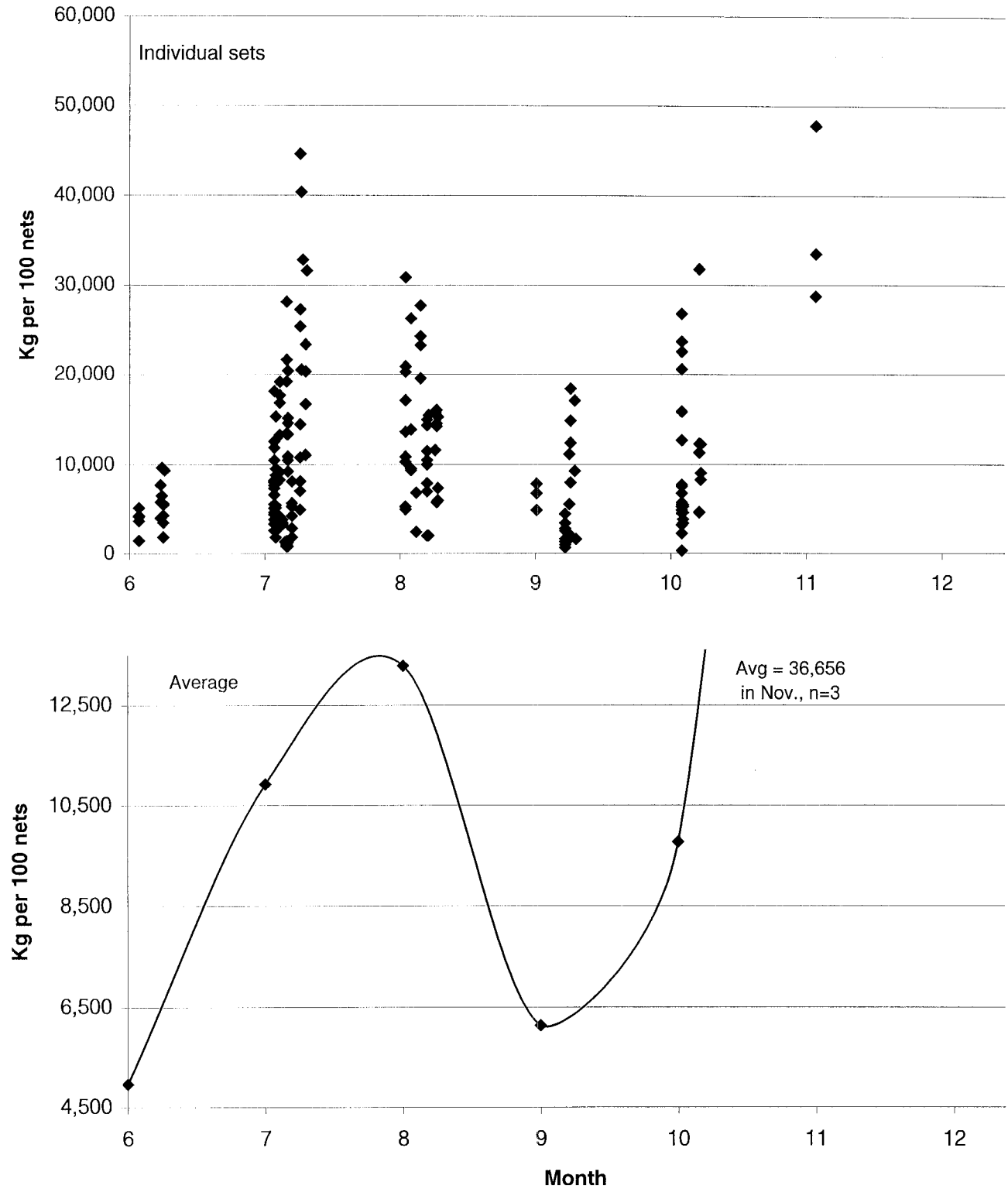


Figure 6c - Catch rates for gillnet fisheries in 3Ps for vessel class 2. Lower panel shows avg. catch rates. For Upper panel set points spread horizontally over a period up to 31 days. A space separates months.

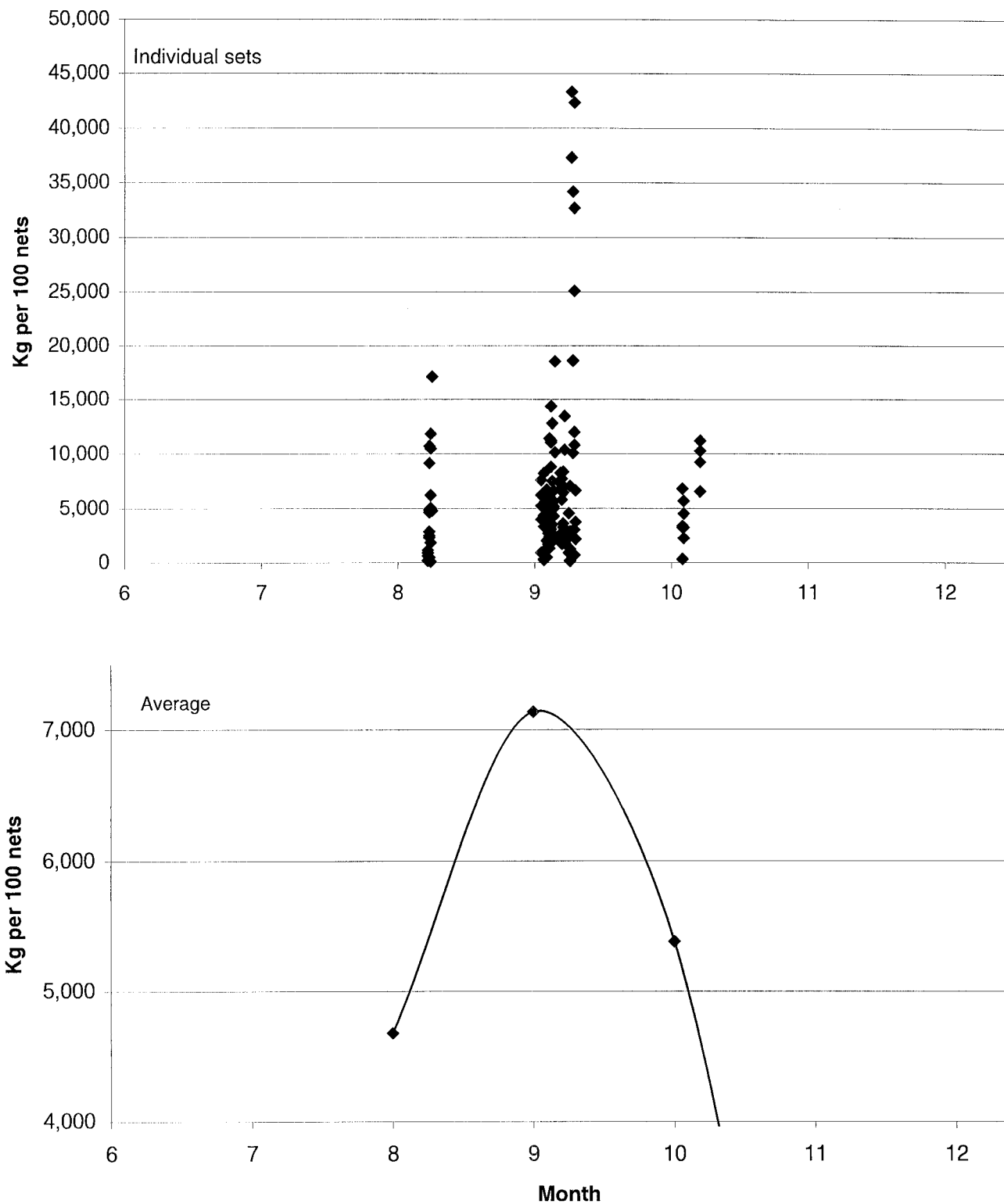


Figure 6d - Catch rates for gillnet fisheries in 3Ps for vessel class 3. Lower panel shows avg. catch rates. For Upper panel set points spread horizontally over a period up to 31 days. A space separates months.

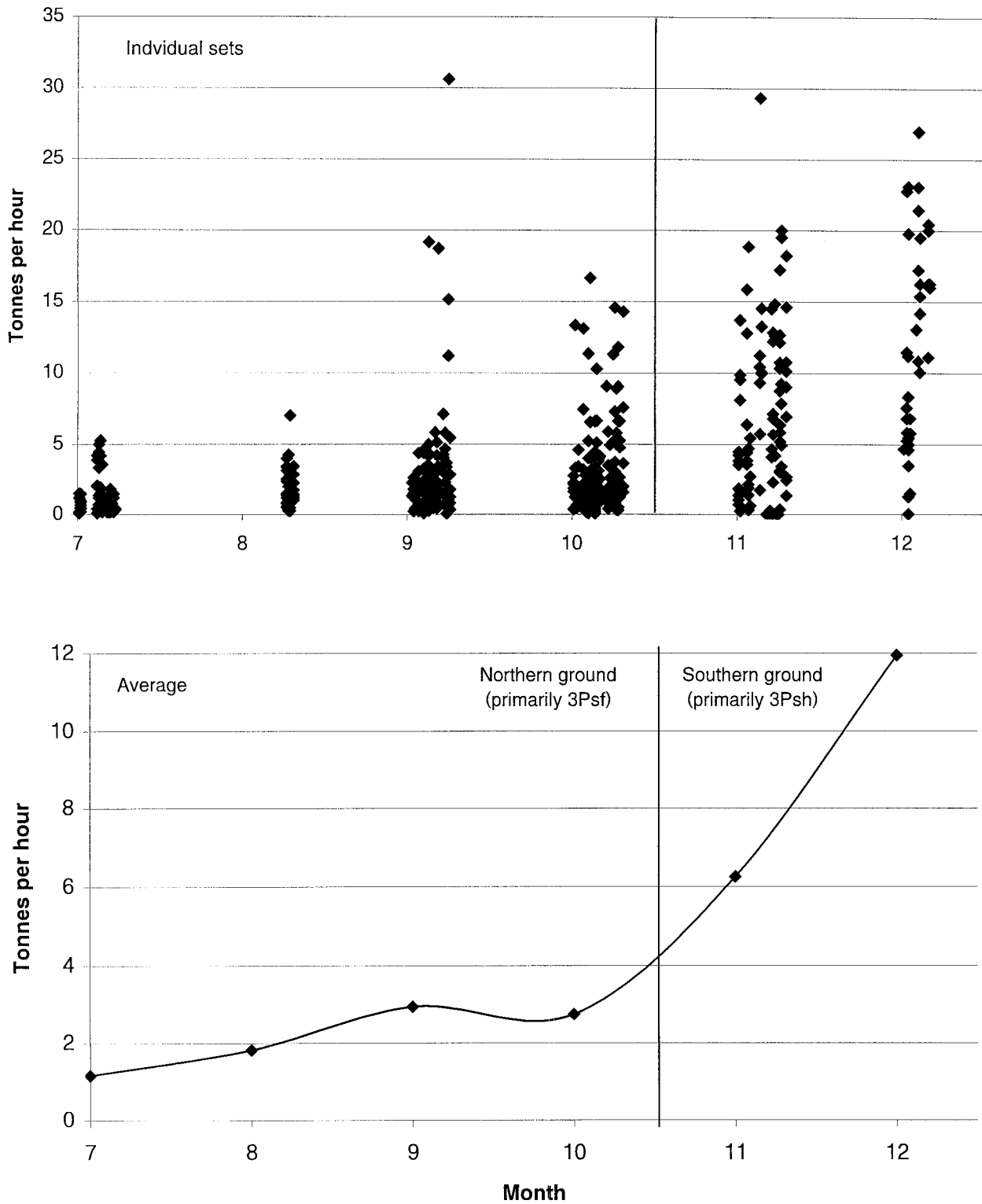
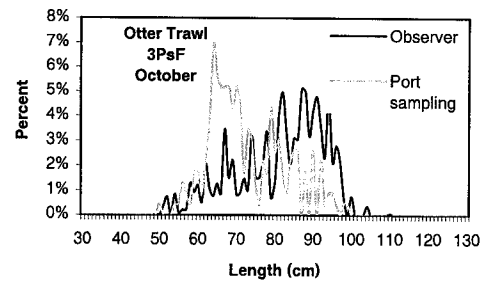
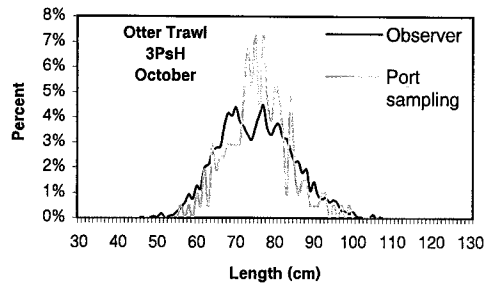


Figure 7 - Catch rates for the otter trawl fishery for cod in 3Ps over time. Upper panel shows scatter of individual catch rates. Lower panel shows average monthly catch rates.

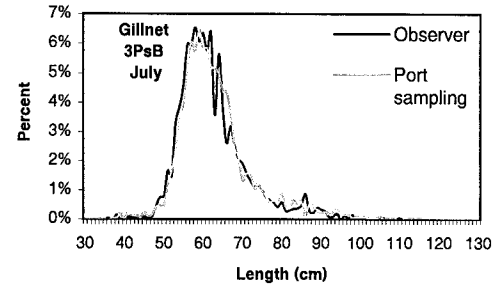
Observer	Port sampling
Otter trawl	
NAFO unit	F F
Month	October October
No. trips observed	1 1
Number sets sampled	3 1
Cod end mesh size (mm)	156 155
Depths fished (m)	43-45 54
Number sampled	506 231
Mean length (cm)	81.4 72.6



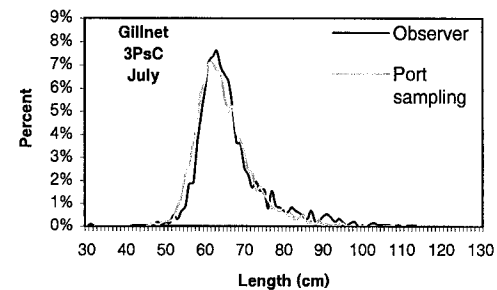
Observer	Port sampling
Otter trawl	
NAFO unit	H H
Month	October October
No. trips observed	1 1
Number sets sampled	14 1
Cod end mesh size (mm)	155-156 155
Depths fished (m)	47-229 187
Number sampled	2139 208
Mean length (cm)	75.2 75.7



Observer	Port sampling
Gillnet	
NAFO unit	B B
Month	July July
No. trips observed	3 17
Number sets sampled	15 17
Mesh size (mm)	130-159 140-152
Depths fished (m)	55-168 82-199
Number sampled	1777 3596
Mean length (cm)	62.5 63.2



Observer	Port sampling
Gillnet	
NAFO unit	C C
Month	July July
No. trips observed	3 25
Number sets sampled	17 25
Mesh size (mm)	140-203 140-165
Depths fished (m)	40-69 20-91
Number sampled	2041 5730
Mean length (cm)	66.4 64.7



Observer	Port sampling
Gillnet	
NAFO unit	C C
Month	August August
No. trips observed	1 2
Number sets sampled	9 2
Mesh size (mm)	146-178 unknown
Depths fished (m)	46-60 64
Number sampled	152 179
Mean length (cm)	65.5 67.8

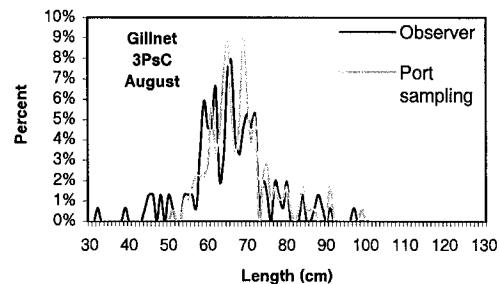
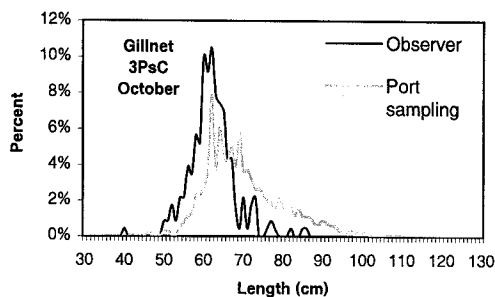
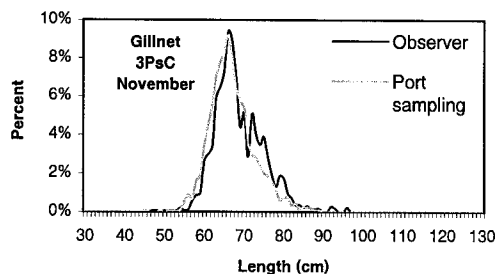


Figure 8 - Length frequency distribution of samples collected from landed catch by port samplers and at sea by fishery observers, during the 1998 Canadian directed cod fishery.

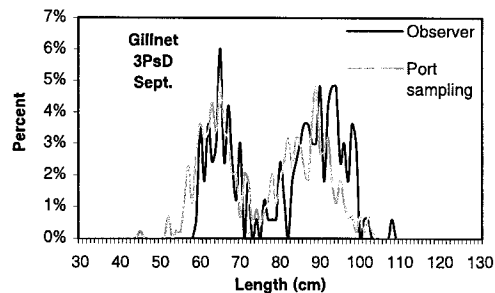
Gillnet	Observer	Port sampling
NAFO unit	C	C
Month	October	October
No. trips observed	1	14
Number sets sampled	9	14
Mesh size (mm)	140	140-203
Depths fished (m)	57-119	47-82
Number sampled	229	1808
Mean length (cm)	62.2	70.1



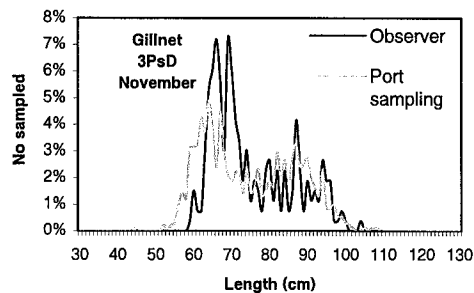
Gillnet	Observer	Port sampling
NAFO unit	C	C
Month	November	November
No. trips observed	1	10
Number sets sampled	8	10
Mesh size (mm)	140-175	140-152
Depths fished (m)	30-47	46-73
Number sampled	945	2380
Mean length (cm)	68.7	67



Gillnet	Observer	Port sampling
NAFO unit	D	D
Month	September	September
No. trips observed	1	2
Number sets sampled	3	2
Mesh size (mm)	140	unknown
Depths fished (m)	40-48	44-46
Number sampled	166	442
Mean length (cm)	81.1	76



Gillnet	Observer	Port sampling
NAFO unit	D	D
Month	November	November
No. trips observed	1	4
Number sets sampled	1	4
Mesh size (mm)	140	140
Depths fished (m)	49	42-50
Number sampled	1225	912
Mean length (cm)	75.3	74.9



Gillnet	Observer	Port sampling
NAFO unit	F	F
Month	September	September
No. trips observed	1	1
Number sets sampled	1	1
Mesh size (mm)	150	unknown
Depths fished (m)	48	48
Number sampled	305	315
Mean length (cm)	82.1	74.7

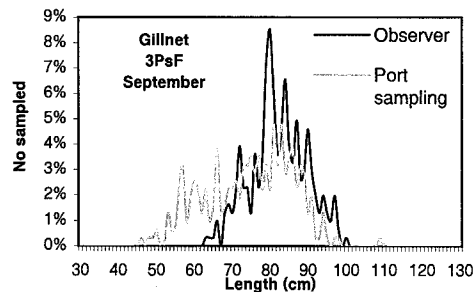
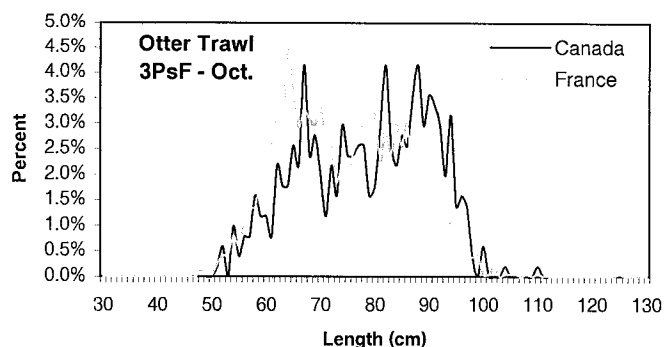
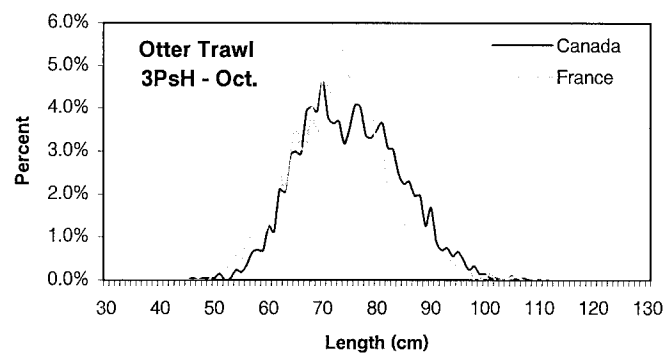


Figure 8 (continued)

Otter trawl	Canada	France
NAFO unit	F	F
Month	October	October
No. trips observed	1	2
Number sets sampled	3	12
Cod end mesh size (mm)	156	139-155
Depths fished (m)	43-45	44-51
Number sampled	506	2143
Mean length (cm)	81.4	74.4



Otter trawl	Canada	France
NAFO unit	H	H
Month	October	October
No. trips observed	2	2
Number sets sampled	14	7
Cod end mesh size (mm)	155-156	139-155
Depths fished (m)	47-229	161-211
Number sampled	2139	1470
Mean length (cm)	75.2	73.3



Gillnets	Canada	France
NAFO unit	D	D
Month	September	September
No. trips observed	1	2
Number sets sampled	3	10
Gillnet mesh size (mm)	140	140-145
Depths fished (m)	43-45	44-51
Number sampled	166	1680
Mean length (cm)	74.2	80.6

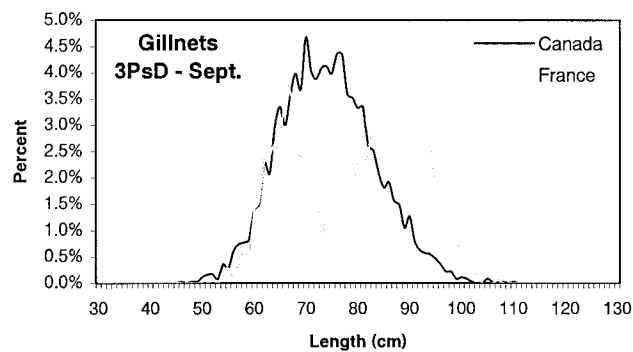


Figure 9 - Comparison of catch composition and gear specifications for French and Canadian vessels fishing Atlantic cod in NAFO Division 3Ps, 1998, as reported by fishery observers.

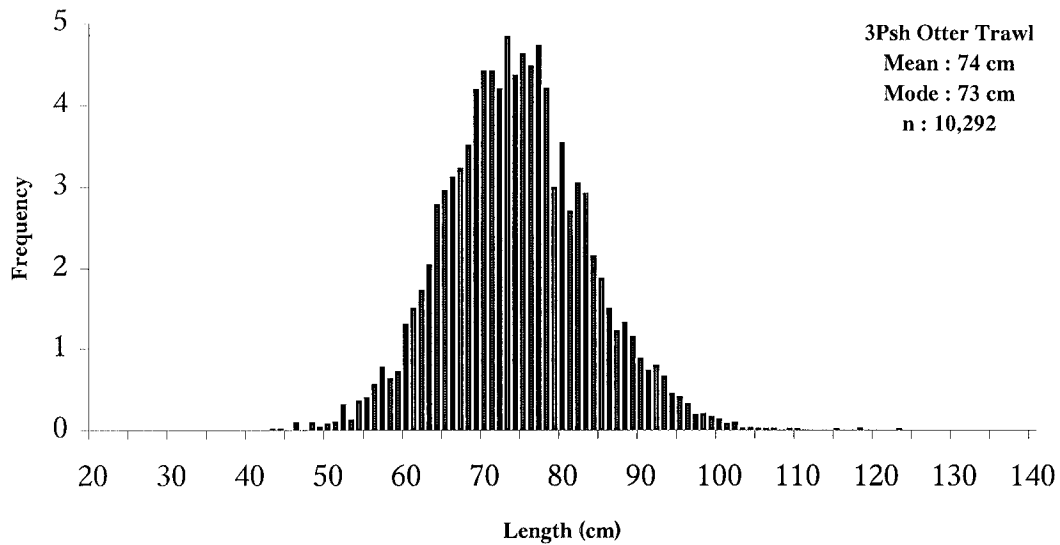
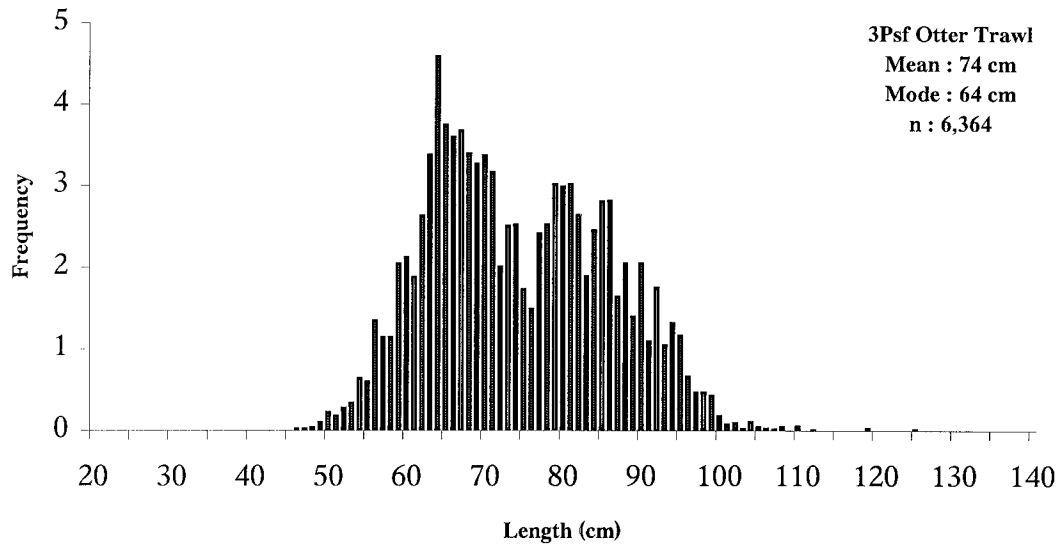


Figure 10 - Pooled otter trawl length frequency distributions by NAFO unit area for the 1998 3Ps directed cod fishery from samples obtained by port samplers and observers, on both Canadian and French vessels. Individual frequencies were extrapolated to either the total landed weight (port samples) or set catch weight (observers).

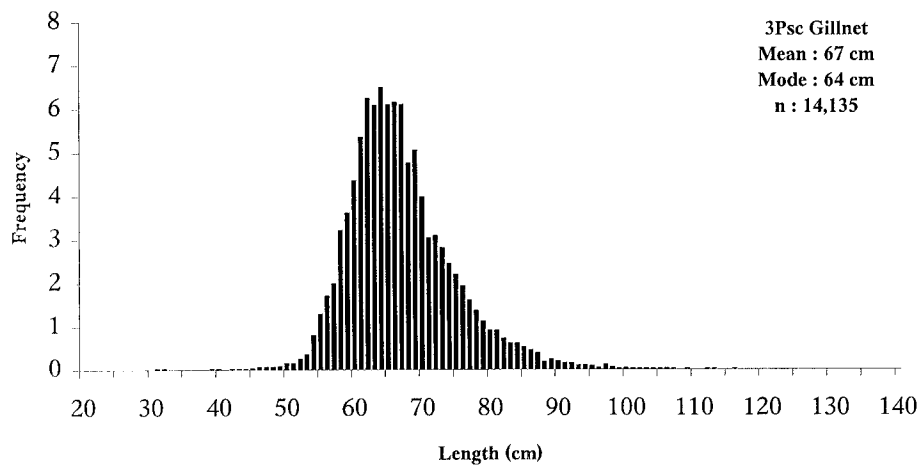
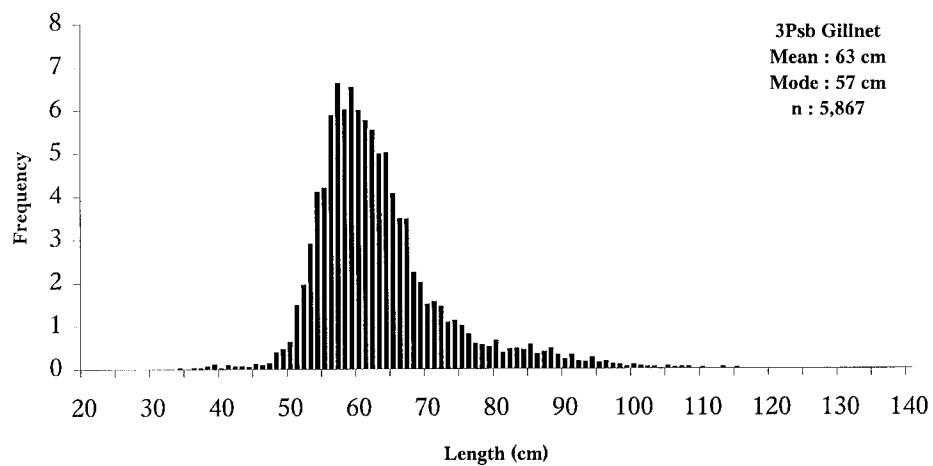
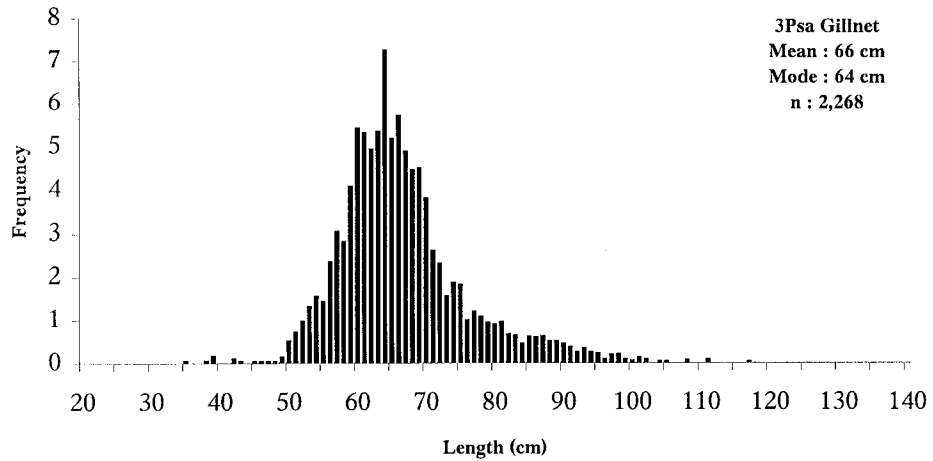


Figure 11 - Pooled gillnet length frequency distributions by NAFO unit area for the 1998 3Ps nearshore directed cod fishery obtained by port samplers and observers, on both Canadian and French vessels. Individual frequencies were extrapolated to either the total landed weight (port samples) or set catch weight (observers).

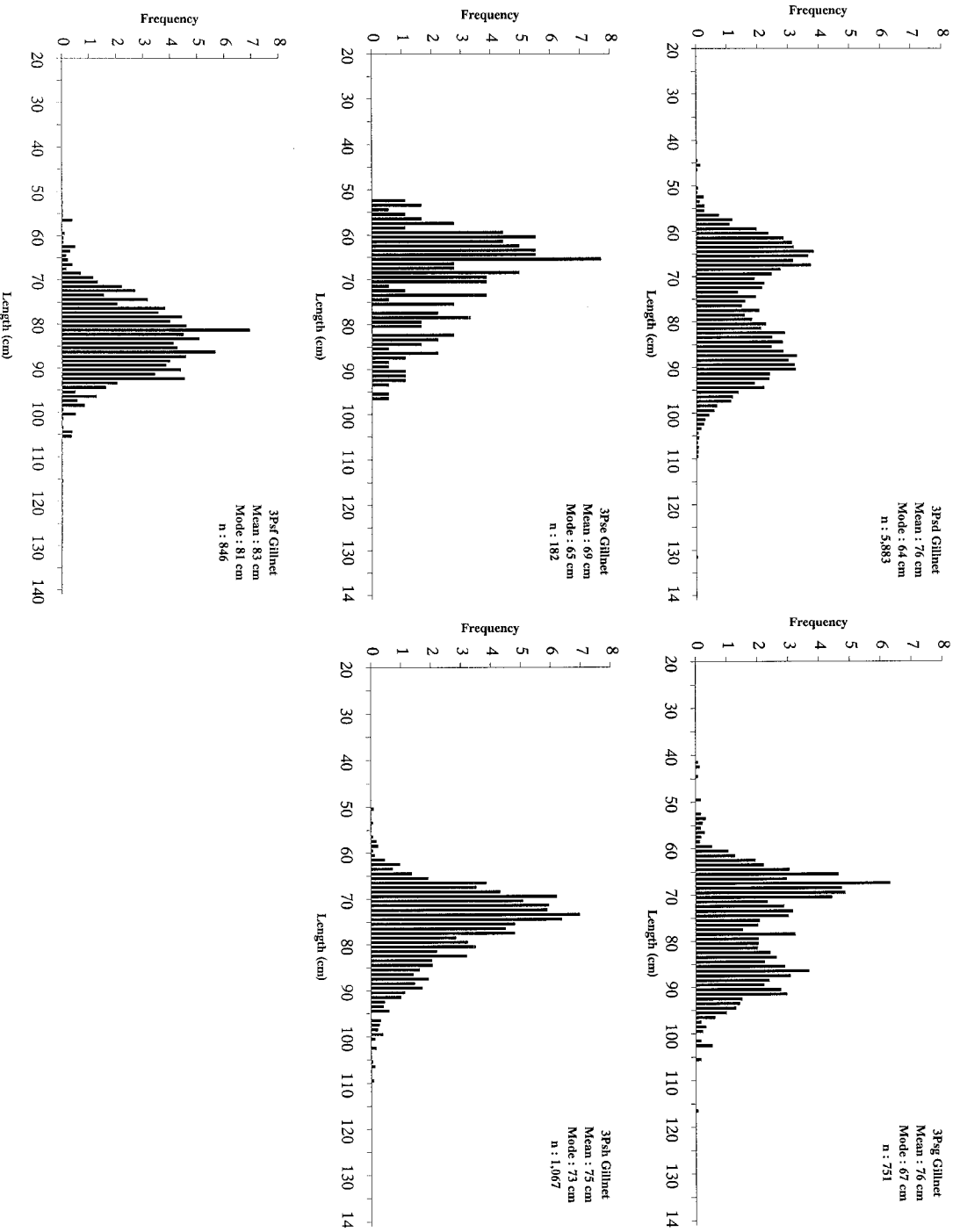


Figure 12 - Pooled gillnet length frequency distributions by NAFO unit area for the 1998 3Ps directed cod fishery offshore obtained by port samplers and observers, on both Canadian and French vessels. Individual frequencies were extrapolated to either the total landed weight (port samples) or set catch weight (observers).

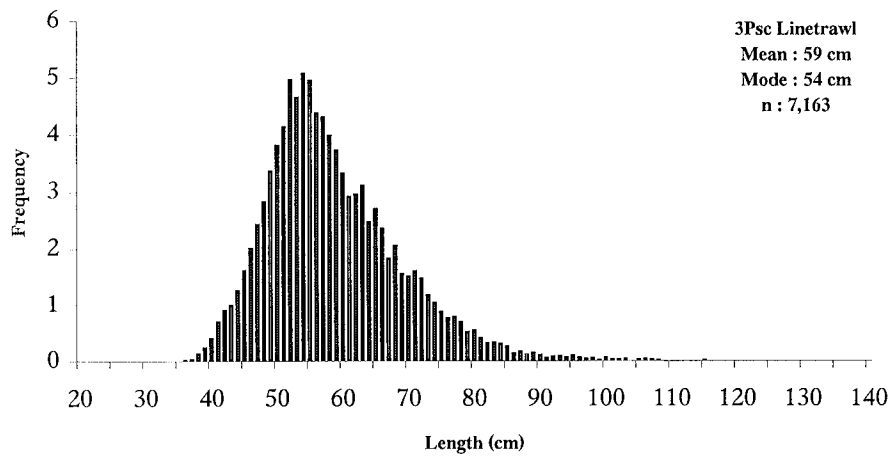
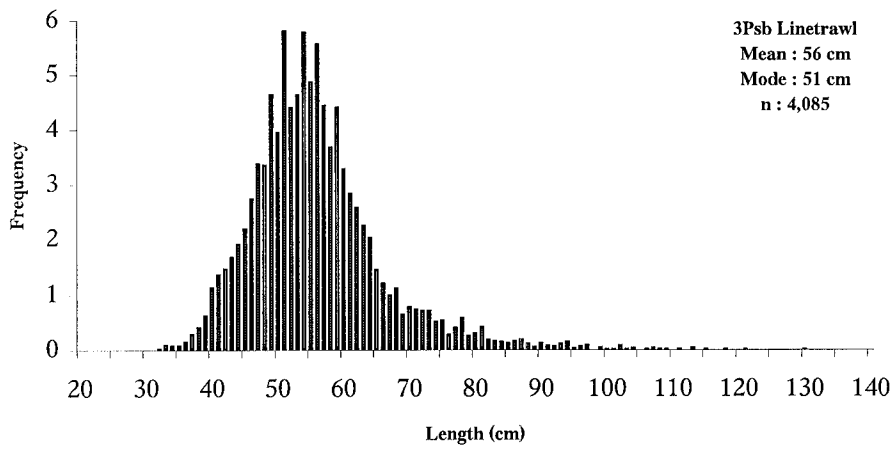
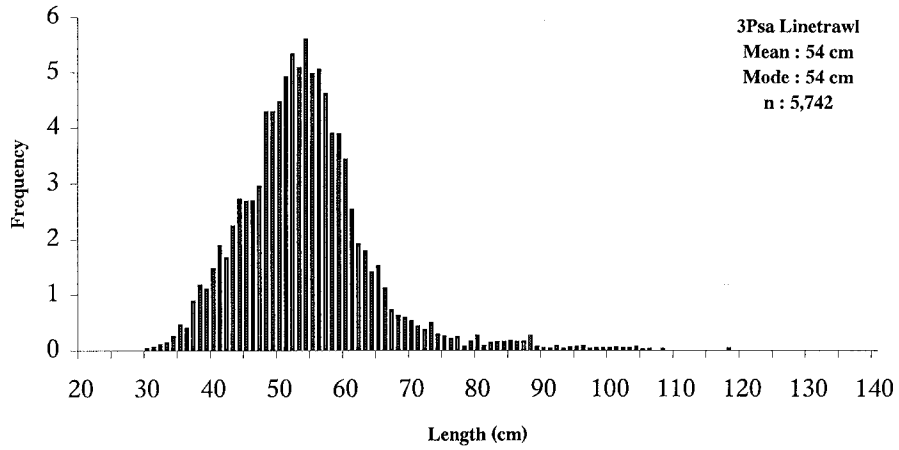


Figure 13 - Pooled linetrawl length frequency distributions by NAFO unit area for the 1998 3Ps directed cod fishery from data obtained by port samplers only. Individual frequencies were extrapolated to the total landed weight.

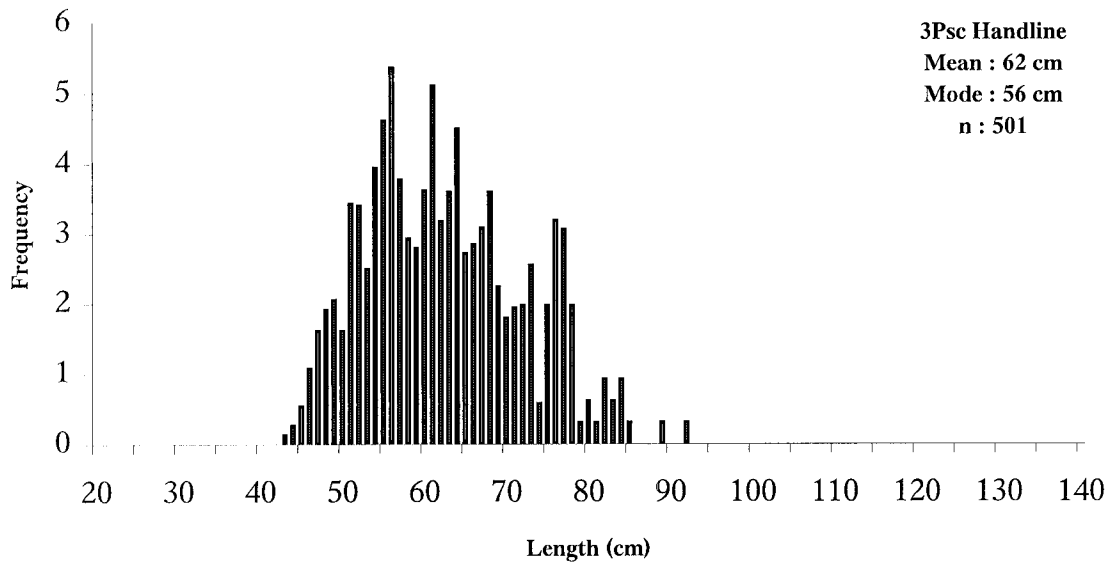
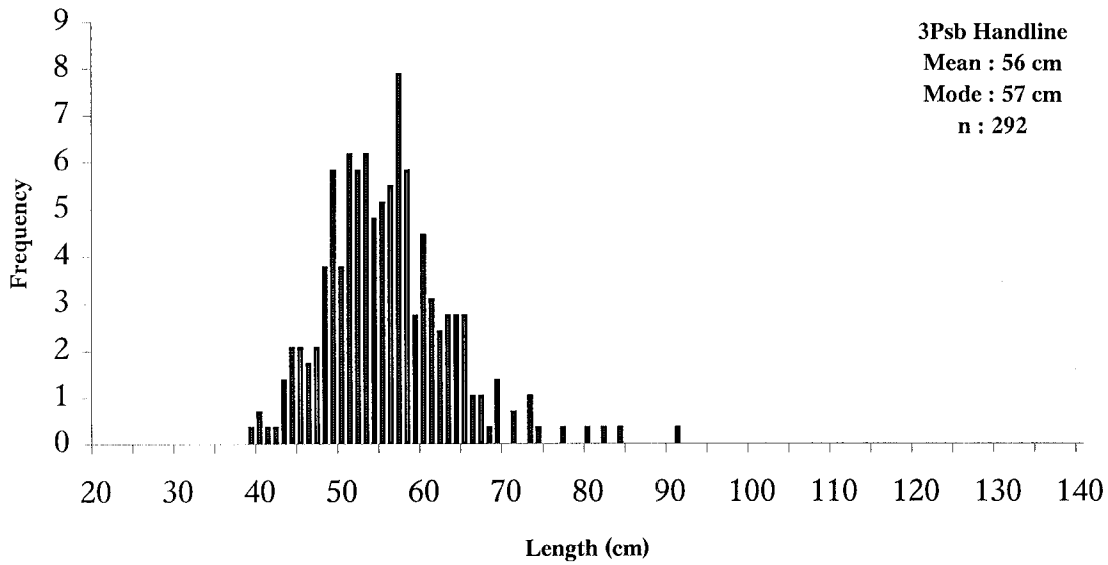


Figure 14 - Pooled handline length frequency distributions by NAFO unit area for the 1998 3Ps directed cod fishery from samples obtained by port samplers and observers, on both Canadian and French vessels. Individual frequencies were extrapolated to either the total landed weight (port samples) or set catch weight (observers).

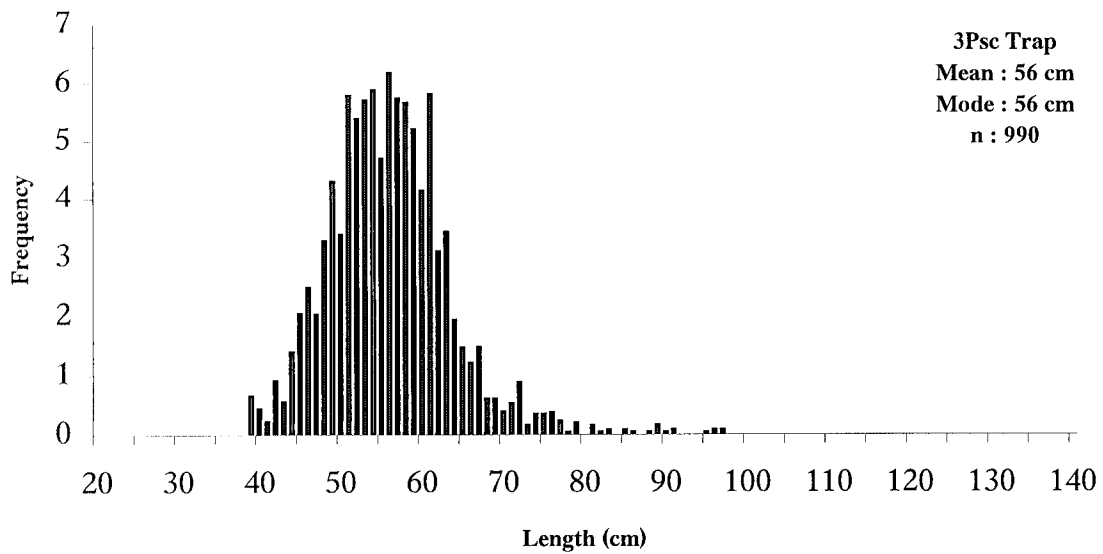


Figure 15 - Pooled trap length frequency distribution by month from NAFO unit area 3Psc during the 1998 directed cod fishery from data obtained by port samplers. Individual frequencies were extrapolated to the total landed weight.

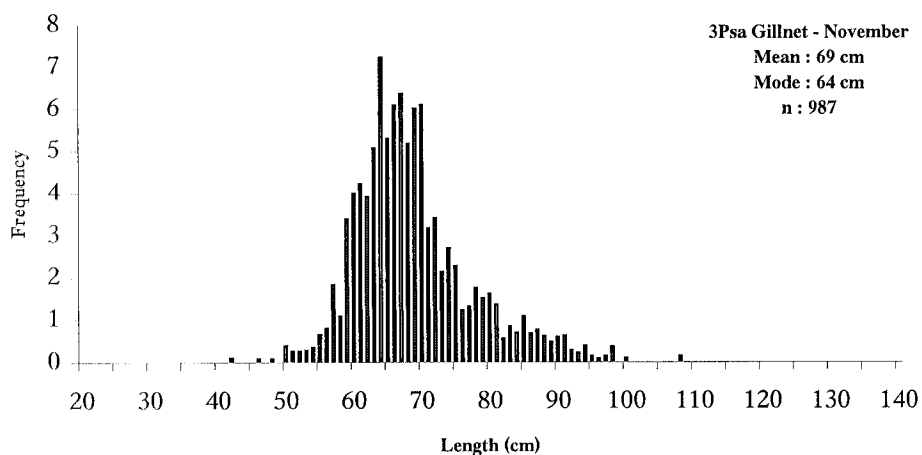
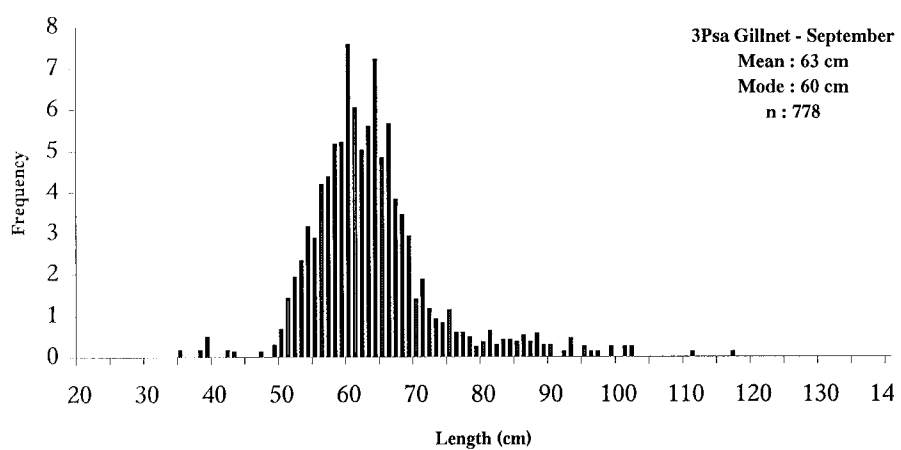
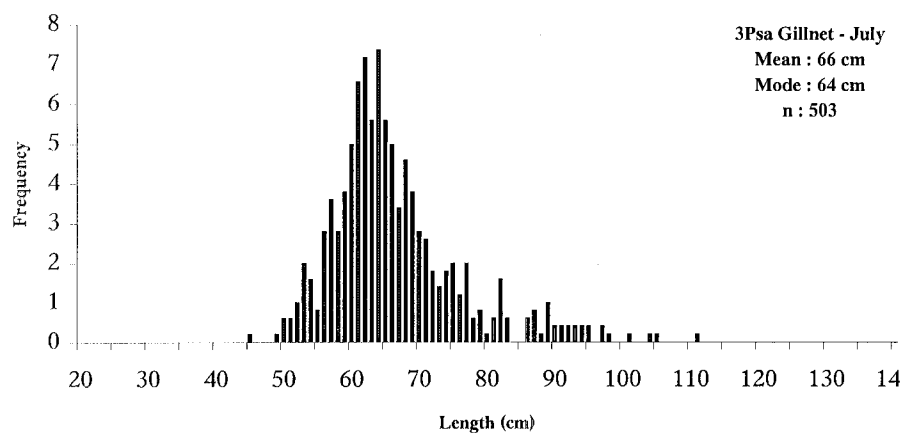


Figure 16 - Pooled gillnet length frequency distributions by month for NAFO unit area 3Psa during the 1998 directed cod fishery from data obtained by port samplers and observers, on both Canadian and French vessels. Individual frequencies were extrapolated to either the total landed weight (port samples) or set catch weight (observers).

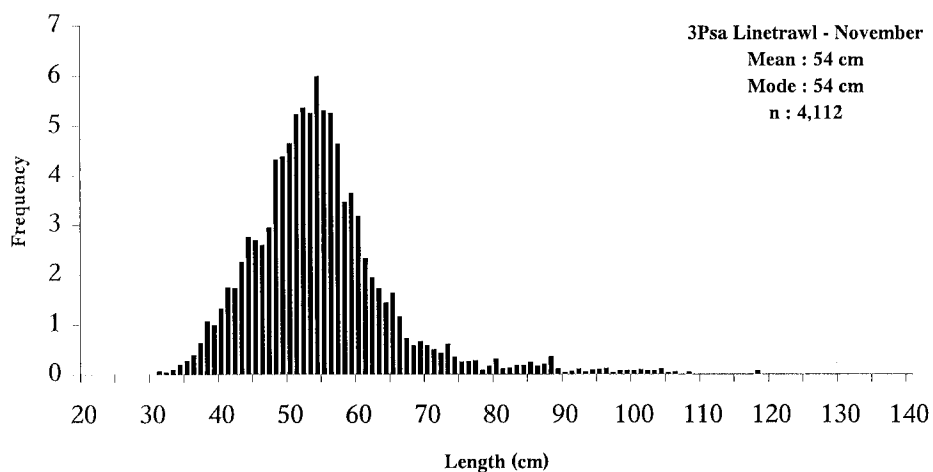
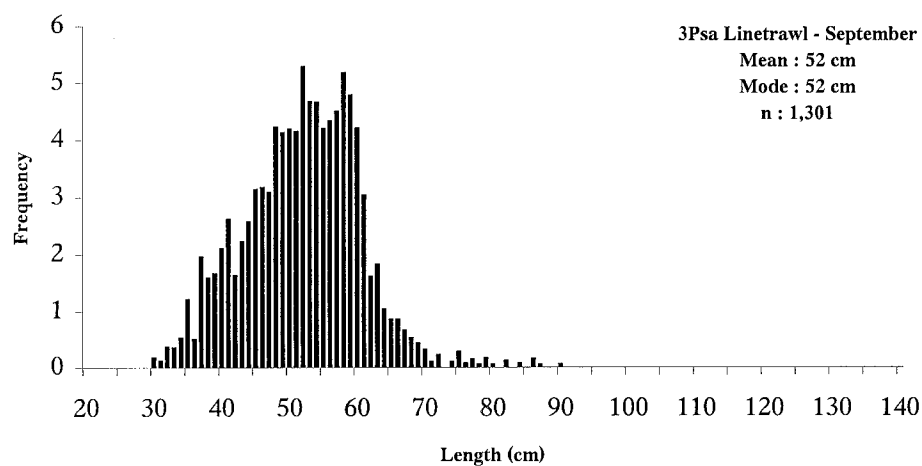
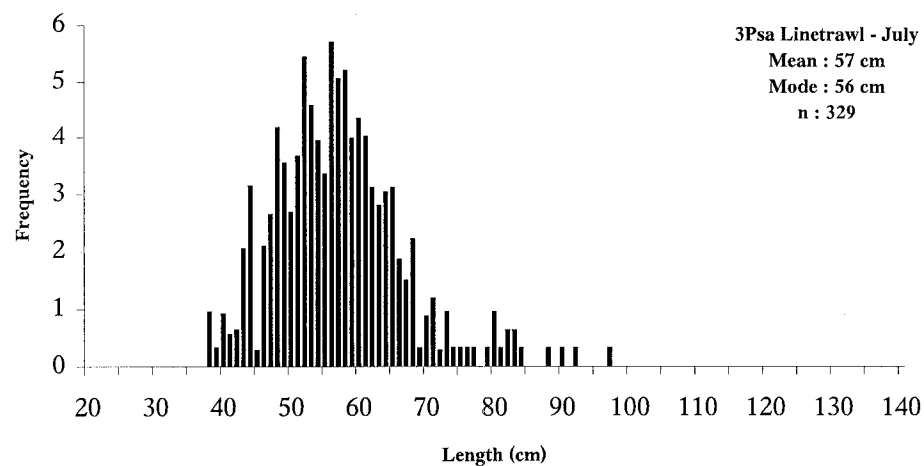


Figure 17 - Pooled linetrawl length frequency distributions by month for NAFO unit area 3Psa during the 1998 directed cod fishery. Contains samples obtained by port samplers only. Individual frequencies were extrapolated to the total landed weight.

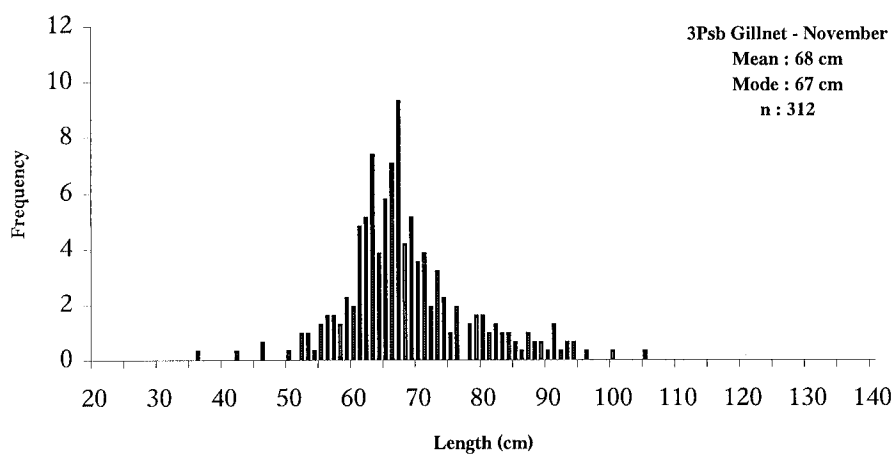
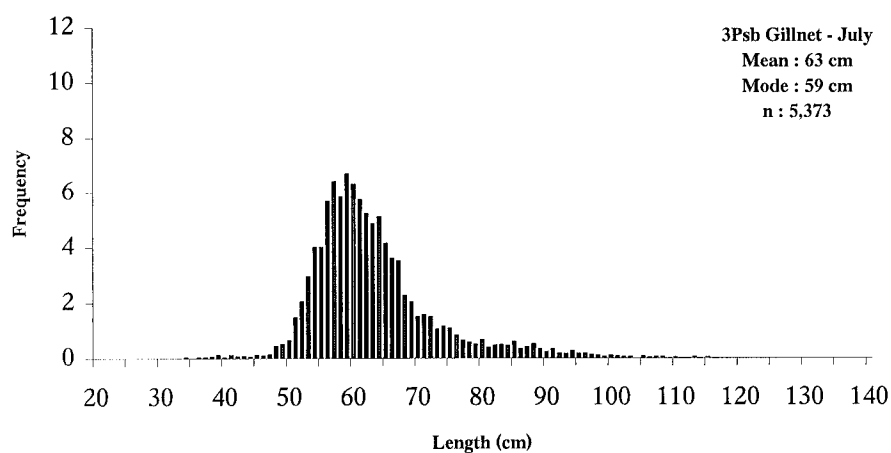
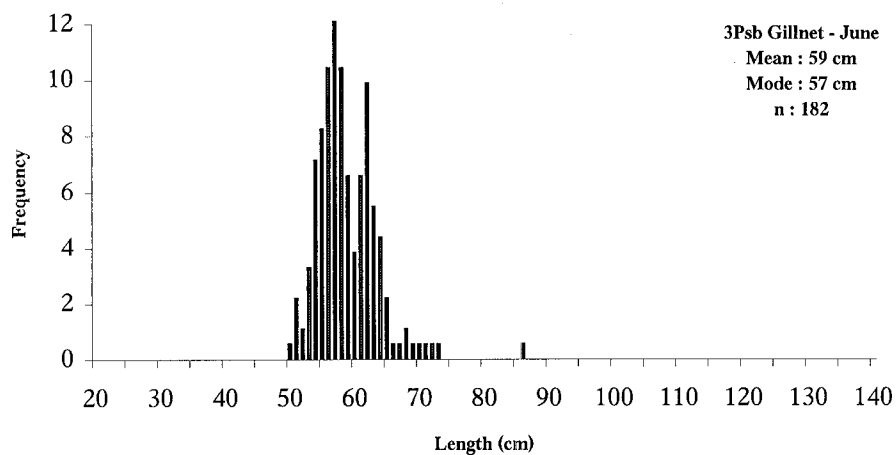


Figure 18 - Pooled gillnet length frequency distributions by month for NAFO unit area 3Psb during the 1998 directed cod fishery from data obtained by port samplers and observers, on both Canadian and French vessels. Individual frequencies were extrapolated to either the total landed weight (port samples) or set catch weight (observers).

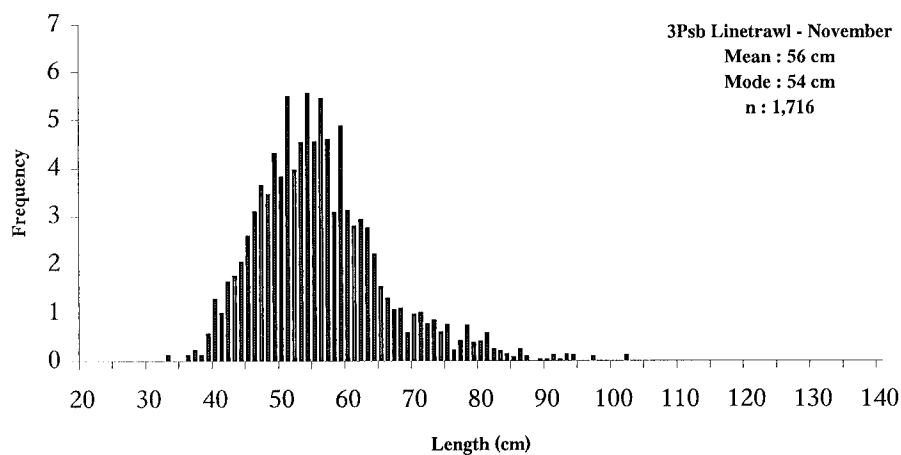
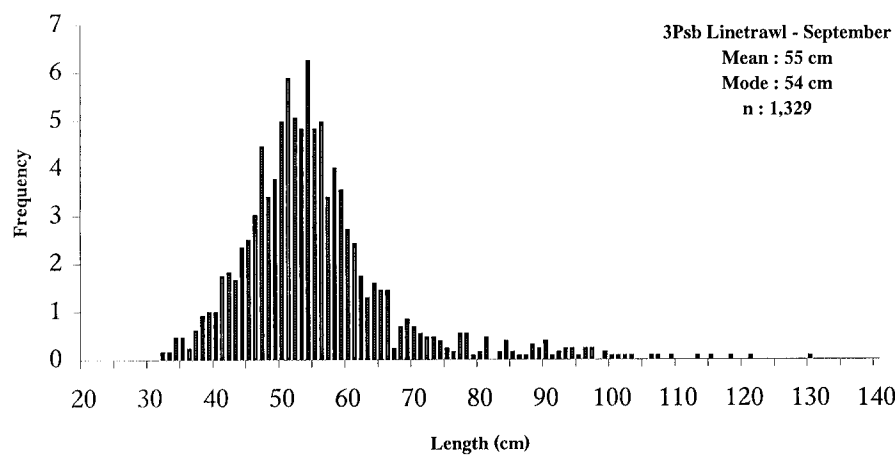
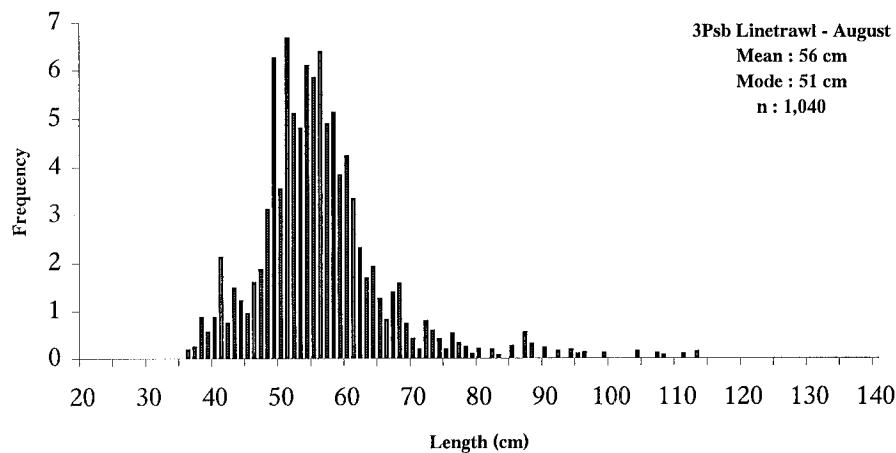


Figure 19 - Pooled linetrawl length frequency distributions by month for NAFO unit area 3Psb during the 1998 directed cod fishery from samples obtained by port samplers only. Individual frequencies were extrapolated to the total landed weight.

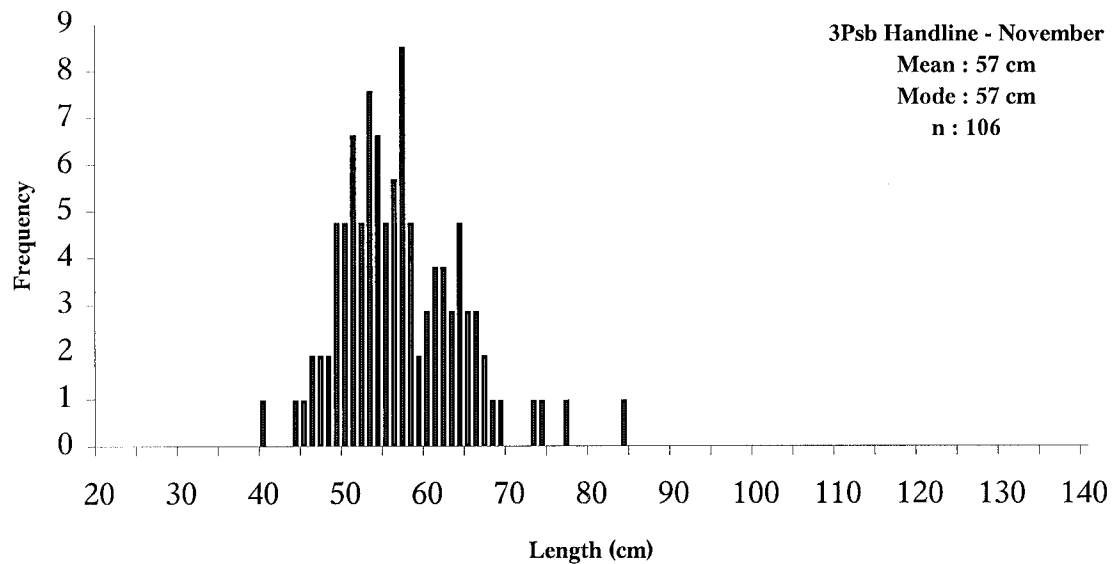
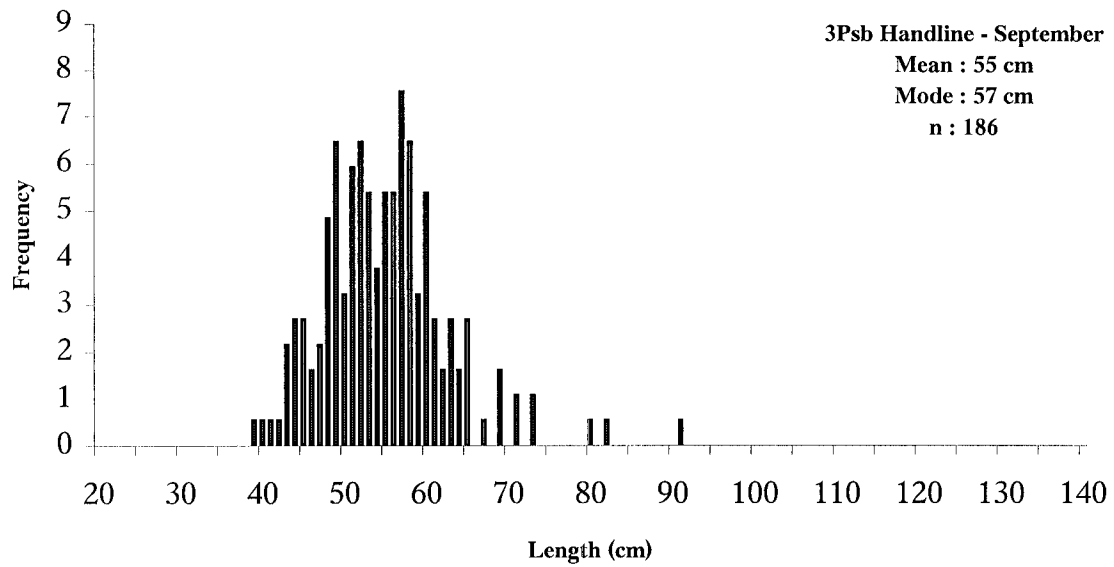


Figure 20 - Pooled handline length frequency distributions by month for NAFO unit area 3Psb during the 1998 directed cod fishery from samples obtained by port samplers only. Individual frequencies were extrapolated to the total landed weight.

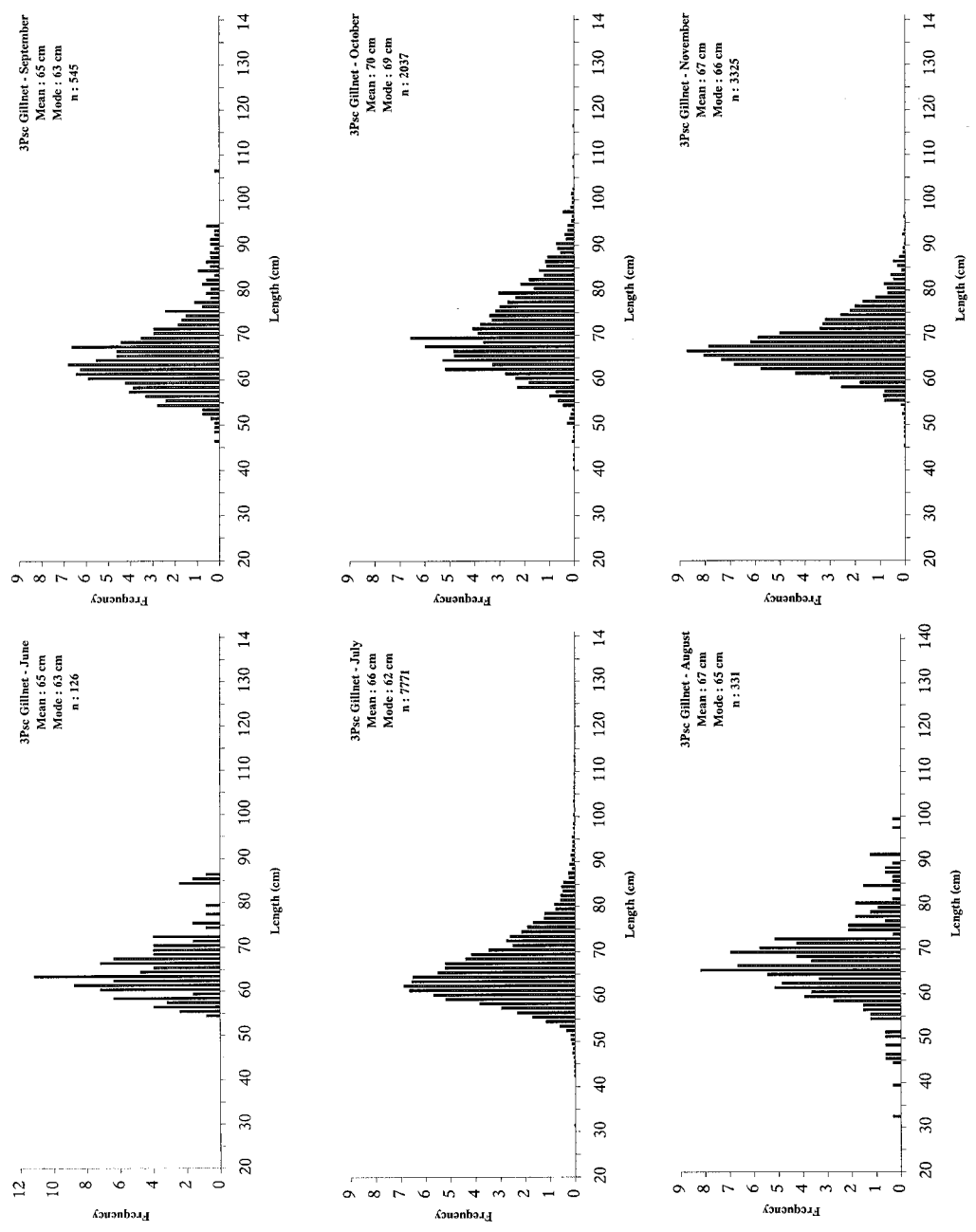


Figure 21 - Pooled gillnet length frequency distributions by month for NAFO unit area 3Psc during the 1998 directed cod fishery obtained by port samplers and observers, on both Canadian and French vessels. Individual frequencies were extrapolated to either the total landed weight (port samples) or set catch weight (observers).

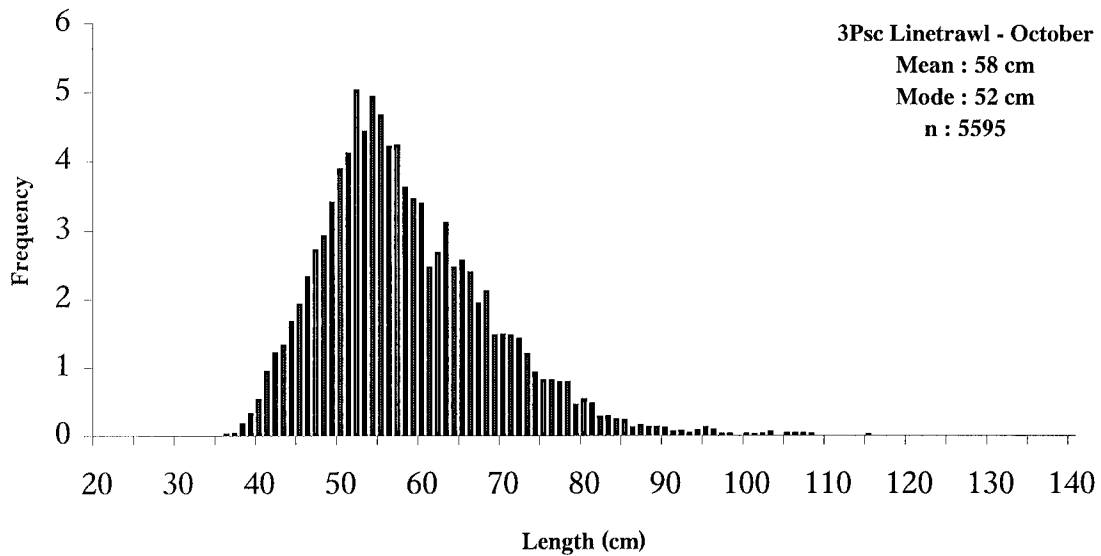
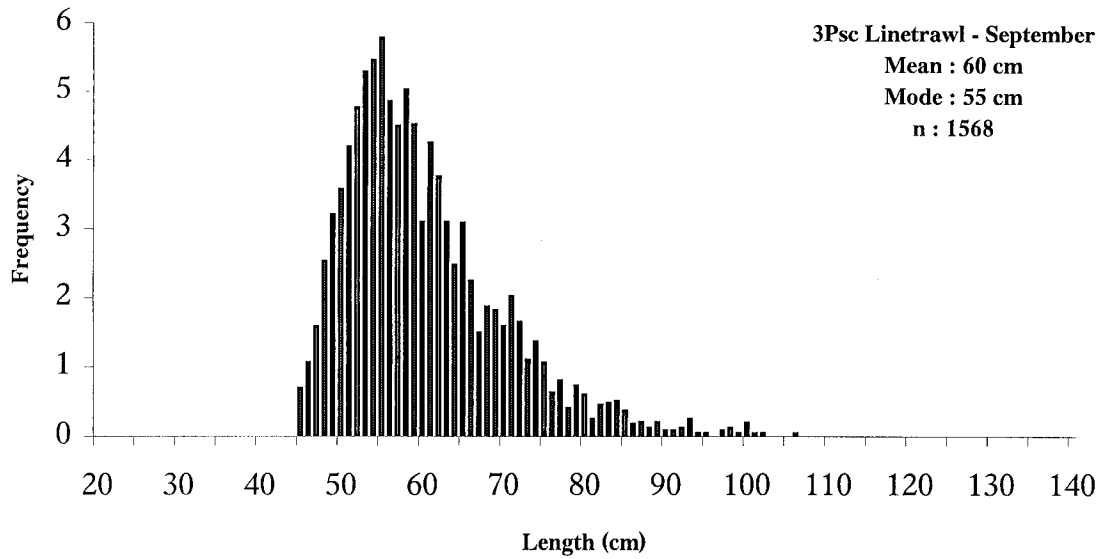


Figure 22 - Pooled linetrawl length frequency distributions by month for NAFO unit area 3Psc during the 1998 directed cod fishery from samples obtained by port samplers only. Individual frequencies were extrapolated to the total landed weight.

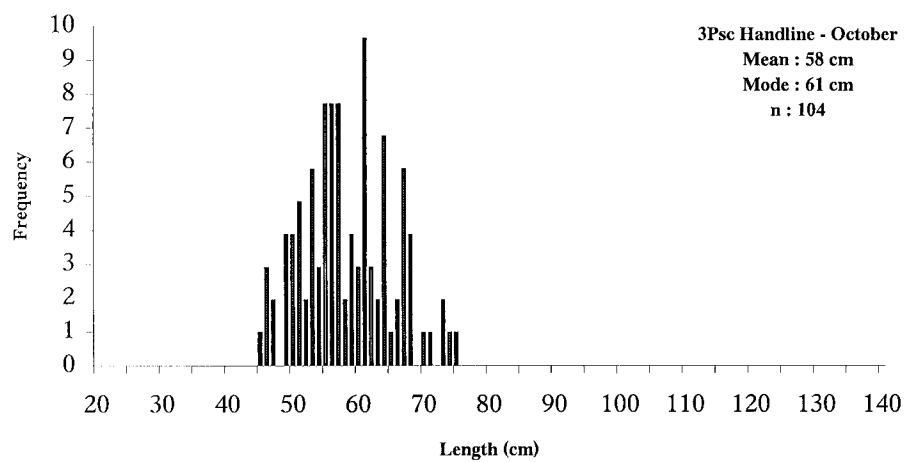
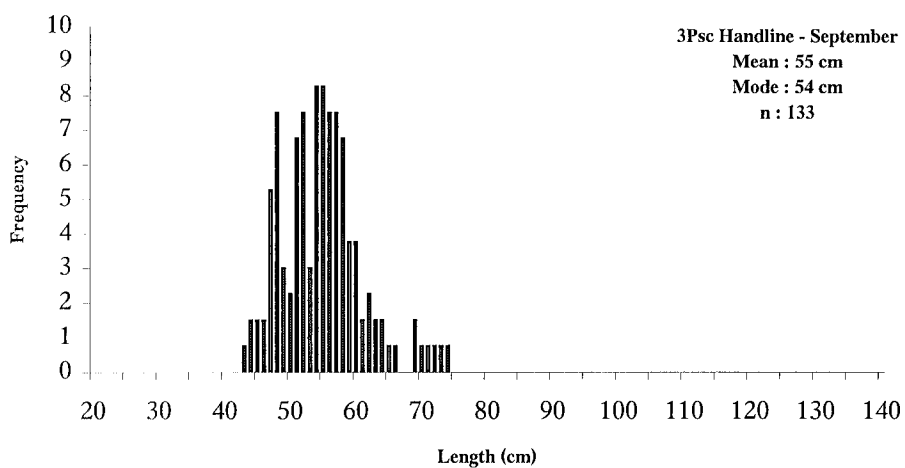
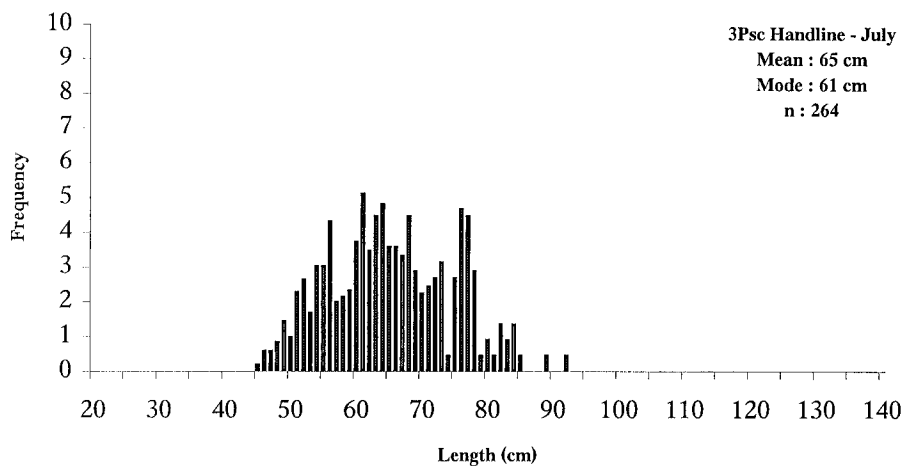


Figure 23 - Pooled handline length frequency distributions by month for NAFO unit area 3Psc during the 1998 directed cod fishery from data obtained by port samplers only. Individual frequencies were extrapolated to the total landed weight.

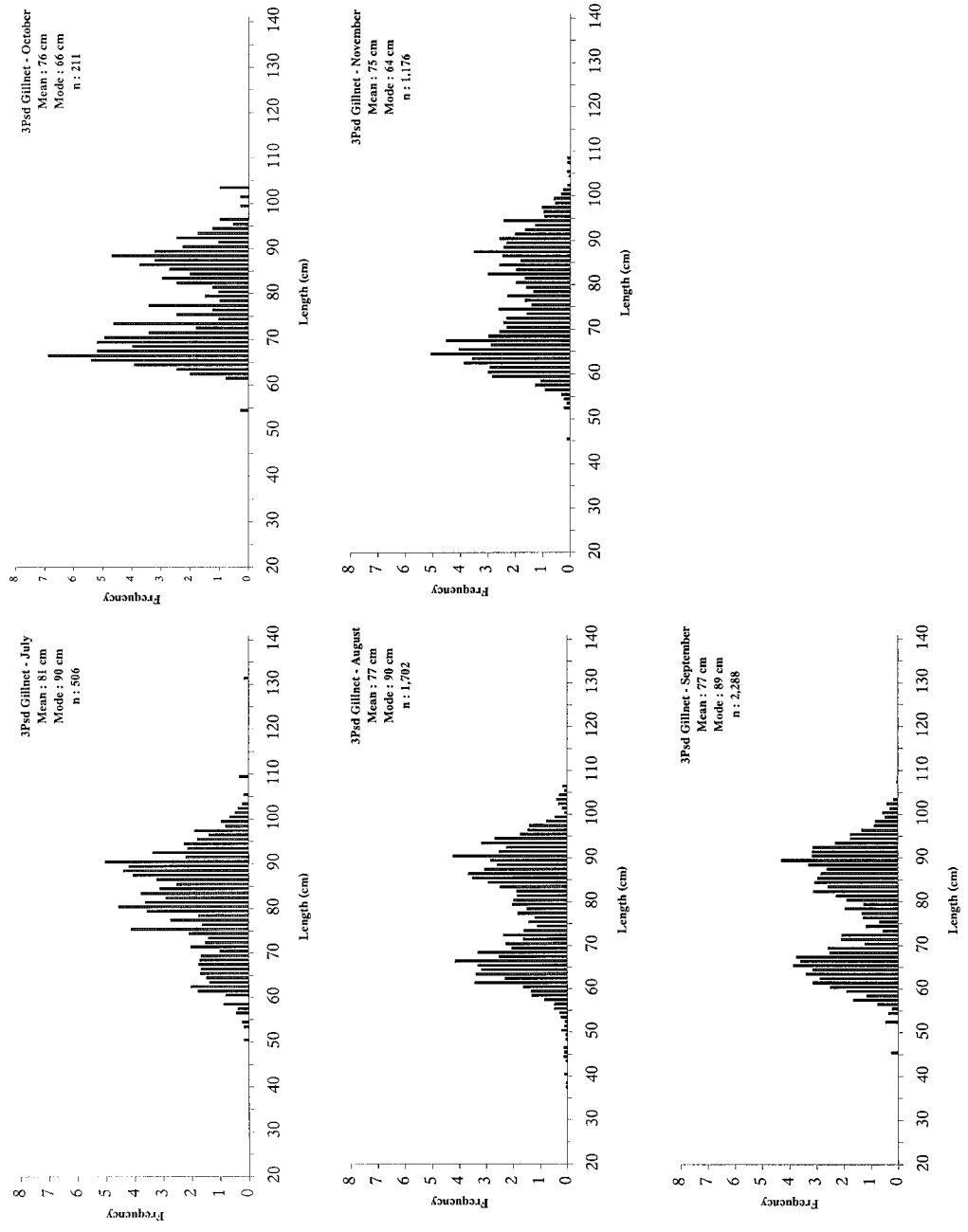


Figure 24 - Pooled gillnet length frequency distributions by month for NAFO unit area 3Psd during the 1998 directed cod fishery obtained by port samplers and observers, on both Canadian and French vessels. Individual frequencies were extrapolated to either the total landed weight (port samples) or set catch weight (observers).

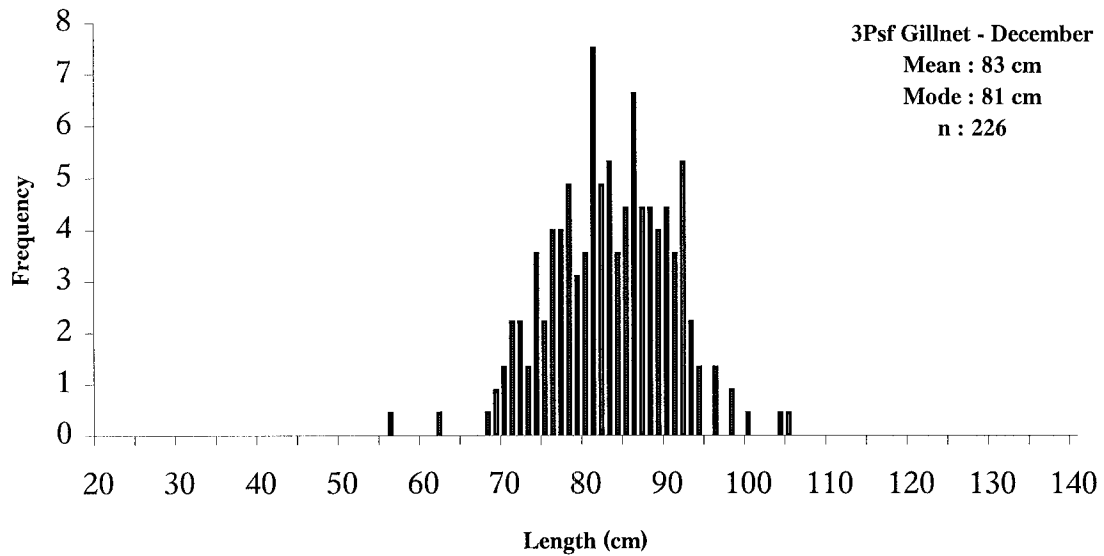
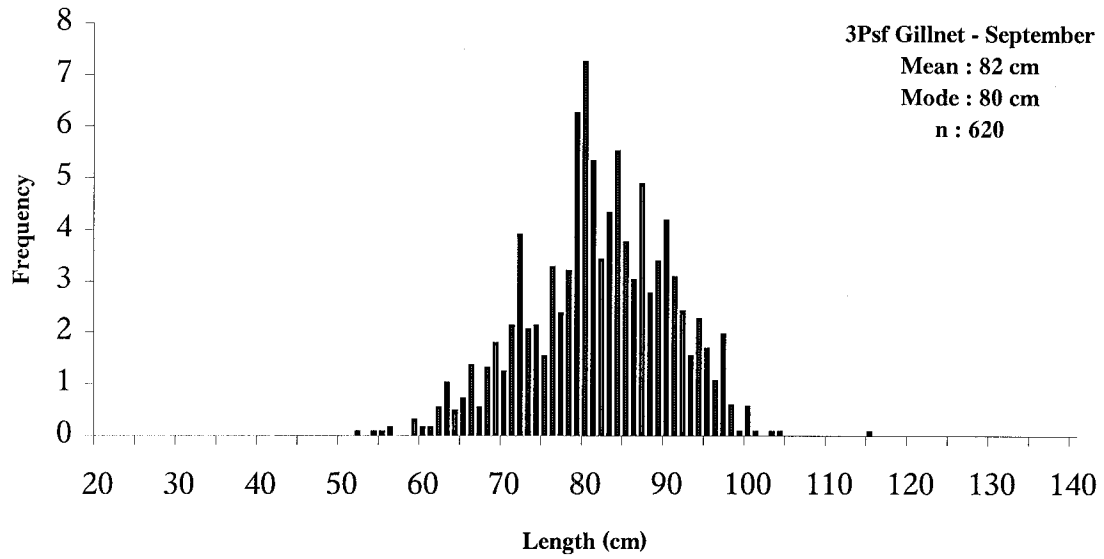


Figure 25 - Pooled gillnet length frequency distributions by month for NAFO unit area 3Psf during the 1998 directed cod fishery obtained by port samplers and observers, on both Canadian and French vessels. Individual frequencies were extrapolated to either the total landed weight (port samples) or set catch weight (observers).

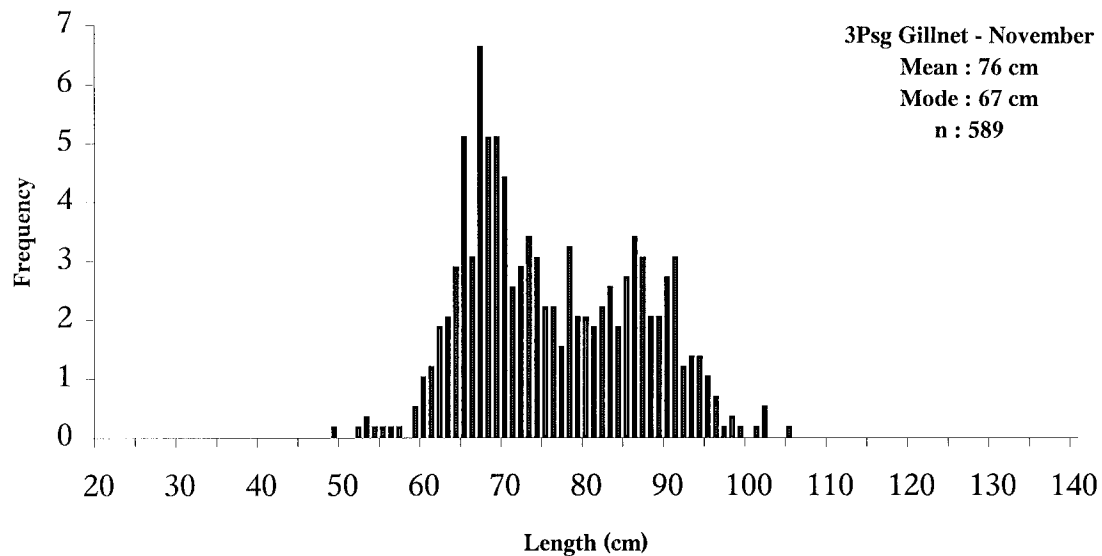
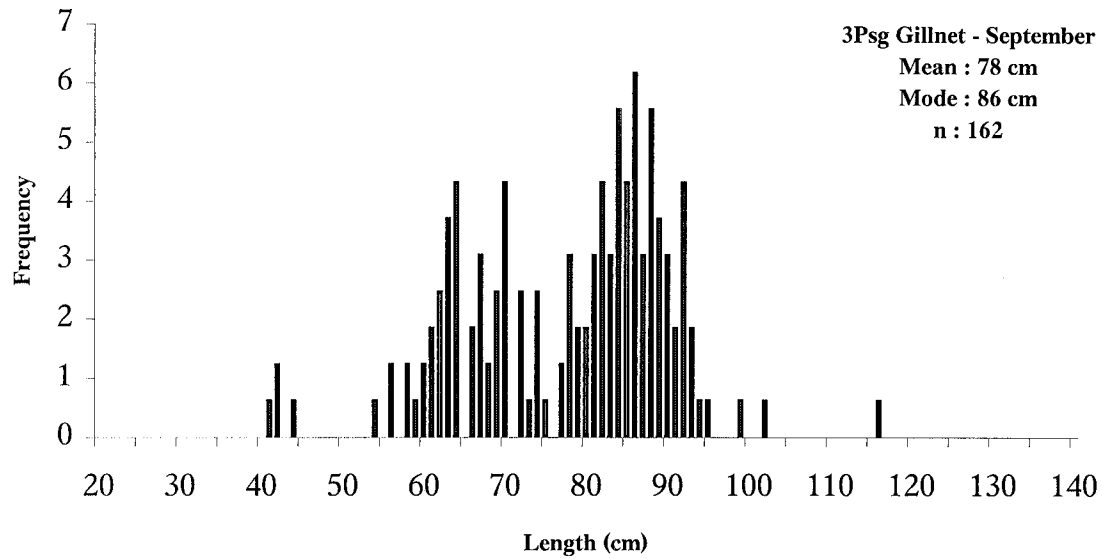


Figure 26 - Pooled gillnet length frequency distributions by month for NAFO unit area 3Psg during the 1998 directed cod fishery from data obtained by port samplers and observers, on both Canadian and French vessels. Individual frequencies were extrapolated to either the total landed weight (port samples) or set catch weight (observers).

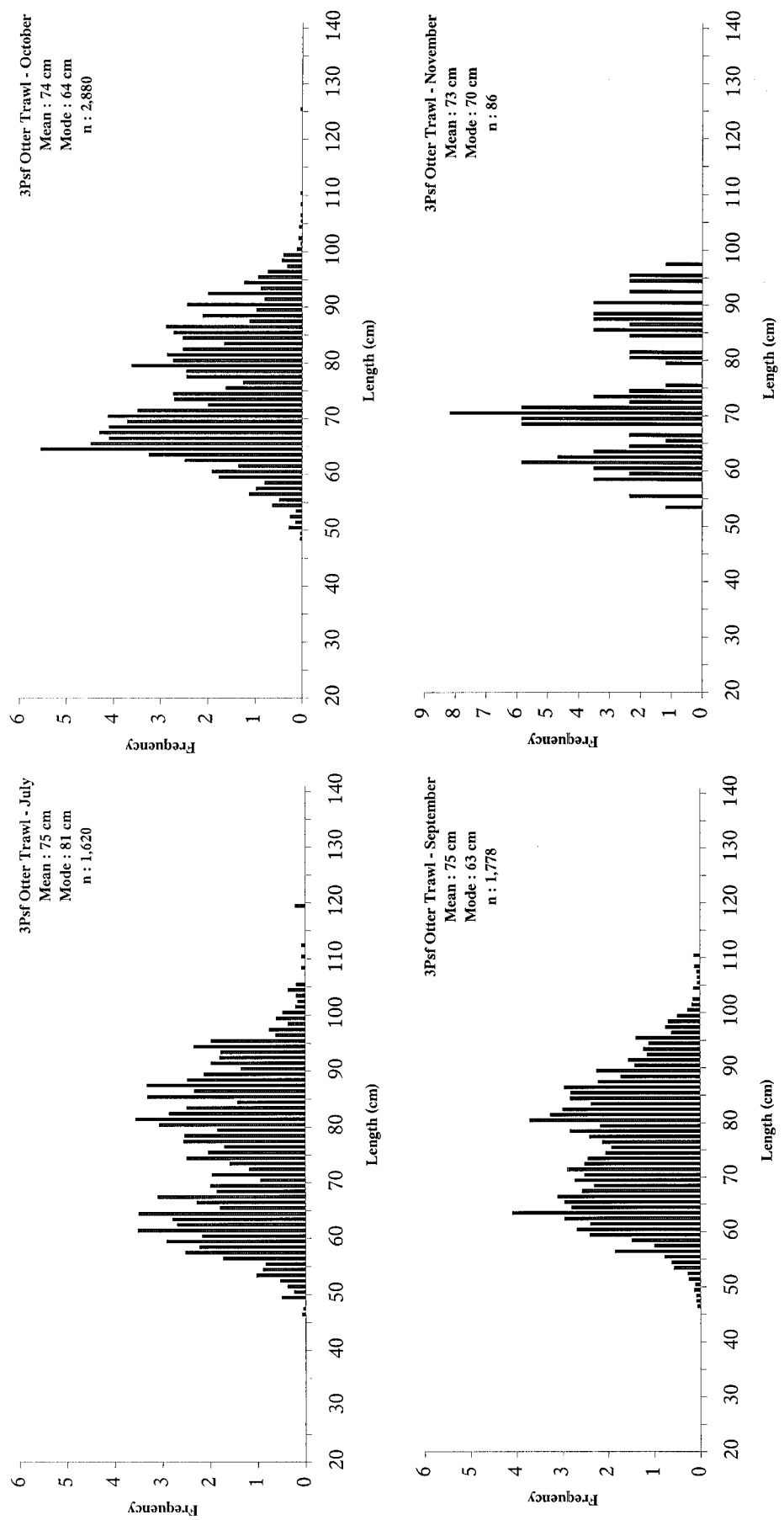


Figure 27 - Pooled otter trawl length frequency distributions by month for NAFO unit area 3Psf during the 1998 directed cod fishery from data obtained by port samplers and observers, on both Canadian and French vessels. Individual frequencies were extrapolated to either the total landed weight (port samples) or set catch weight (observers).

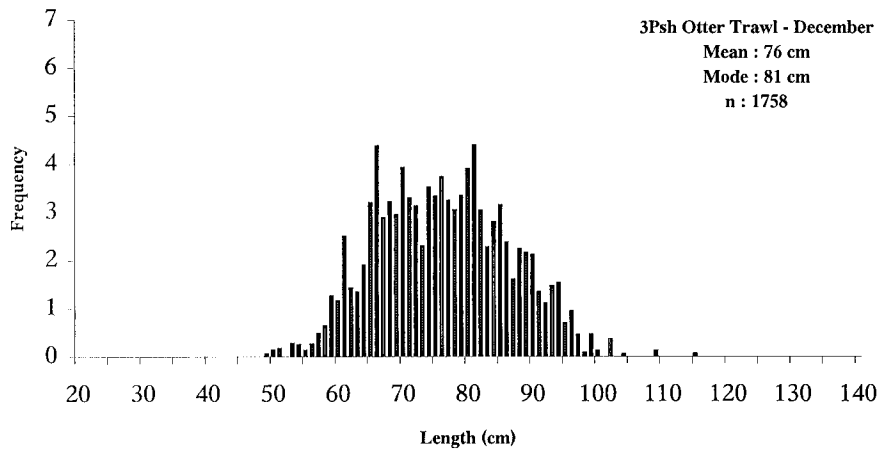
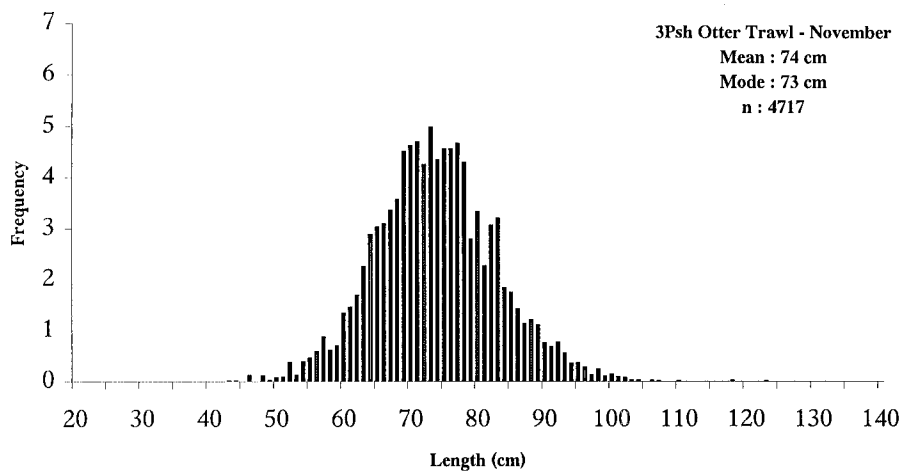
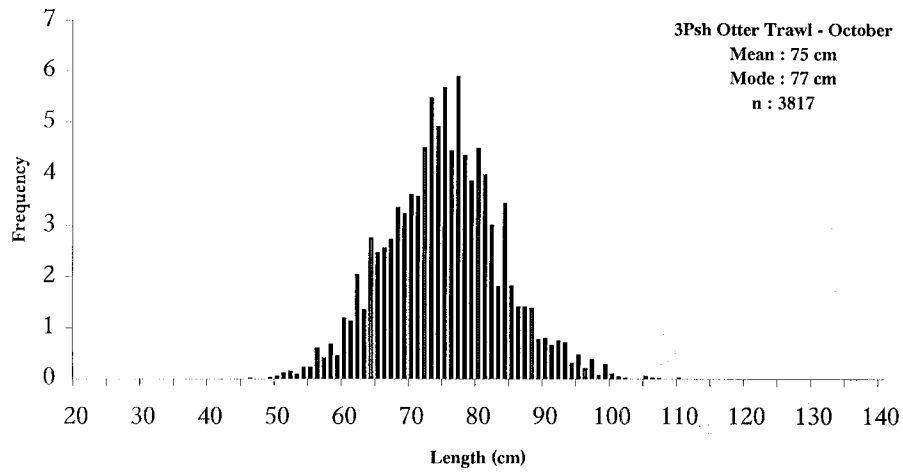


Figure 28 - Pooled otter trawl length frequency distributions by month for NAFO unit area 3Psh during the 1998 directed cod fishery from data obtained by port samplers and observers, on both Canadian and French vessels. Individual frequencies were extrapolated to either the total landed weight (port samples) or set catch weight (observers).

NAFO Unit	A	A
Month	April	
Gear	Gillnet	
Directed species		
Mesh (mm)	140	
Depth (m)	165-183	
No. sampled	135	
Mean length (cm)	67.4	

NAFO Unit	D	D
Month	January	February
Gear	Otter trawl	Otter trawl
Directed species	Redfish	Redfish
Mesh (mm)	90	90
Depth (m)	436-487	458-478
No. sampled	101	63
Mean length (cm)	64.2	66.3

NAFO Unit	D	
Month	January	
Gear	Midwater trawl	
Directed species	Redfish	Redfish
Mesh (mm)	105	
Depth (m)	472	
No. sampled	12	
Mean length (cm)	81	

NAFO Unit	G	G
Month	February	March
Gear	Otter trawl	Otter trawl
Directed species	Redfish	Redfish
Mesh (mm)	90	90
Depth (m)	403-468	454-472
No. sampled	23	171
Mean length (cm)	64.3	59.8

NAFO Unit	G	G
Month	March	
Gear	Midwater trawl	
Directed species	Redfish	
Mesh (mm)	105	
Depth (m)	461-468	
No. sampled	134	
Mean length (cm)	48.2	

NAFO Unit	H	H
Month	March	April
Gear	Otter trawl	Otter trawl
Directed species	Red./Hake	Red./Hake
Mesh (mm)	145&155	145&300
Depth (m)	228-741	202-586
No. sampled	505	252
Mean length (cm)	72.8	75.9

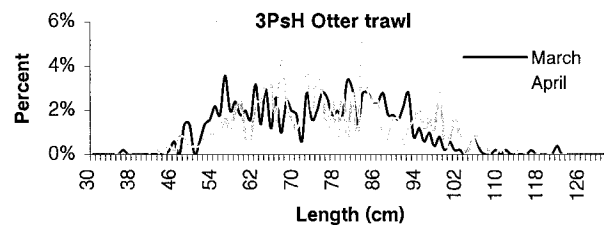
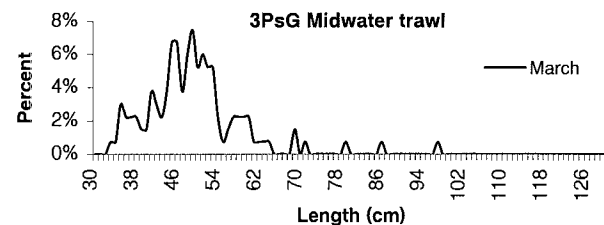
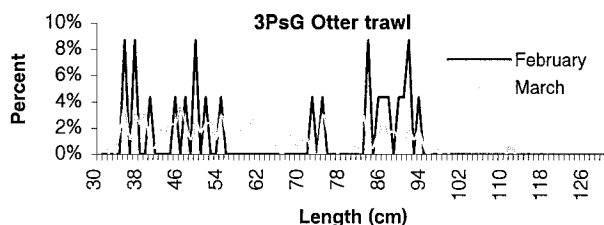
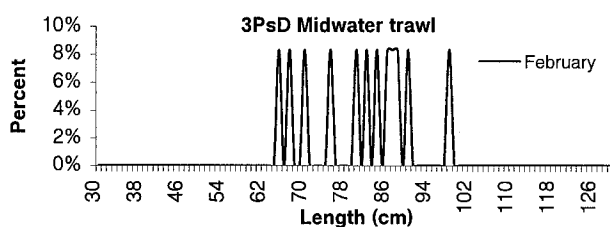
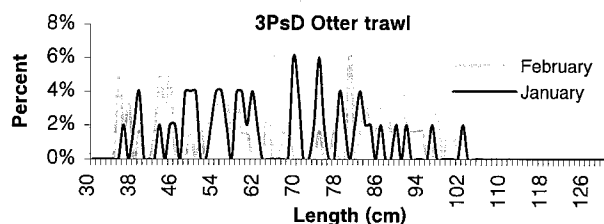
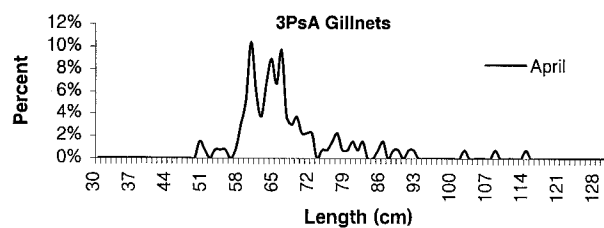


Figure 29 - Length frequencies of cod taken as bycatch in various 3Ps fisheries in 1998.

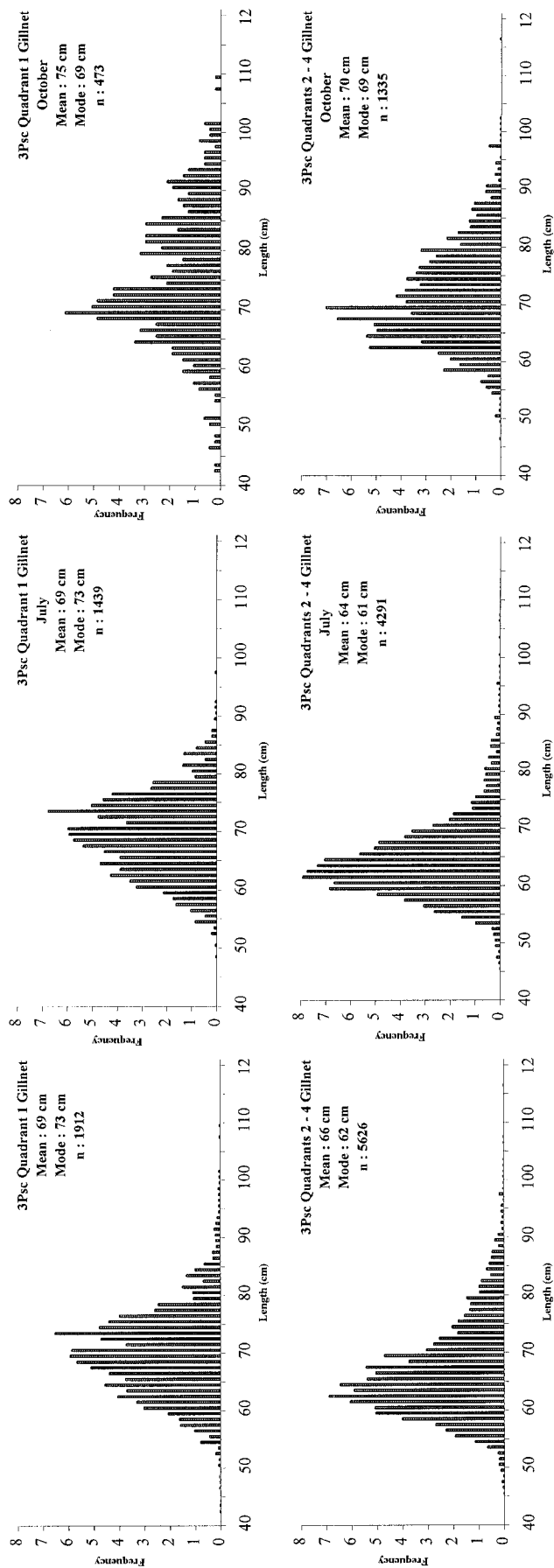


Figure 30 - Length frequency distribution comparison for gillnet samples for quadrant 1 and quadrants 2-4 combined. Includes only samples for July and October to allow direct temporal and spatial comparison.

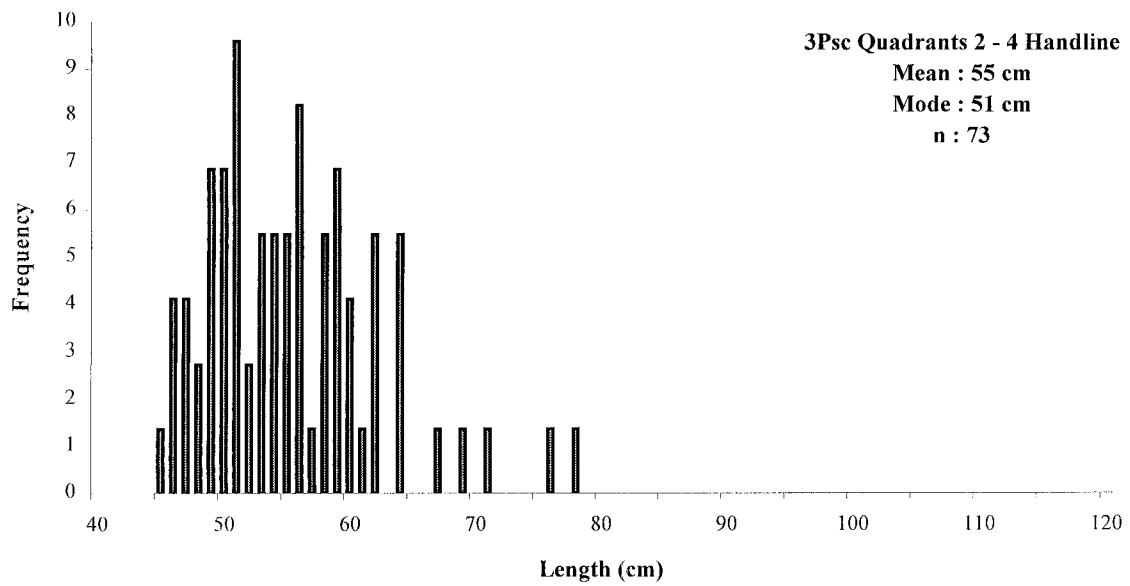
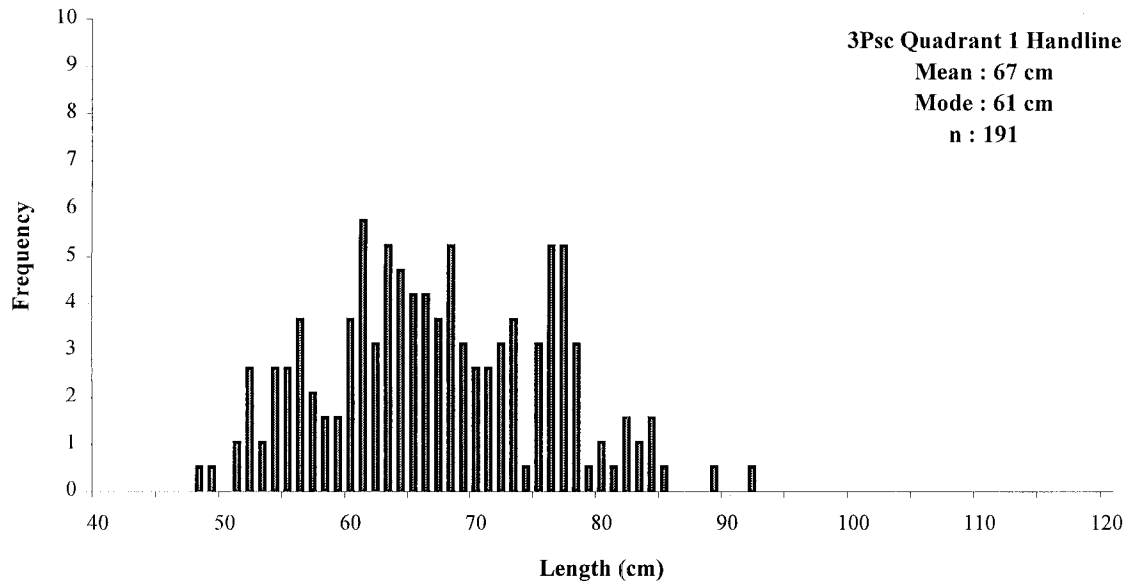


Figure 31 - Length frequency distribution comparison for handline samples from quadrant 1 and quadrants 2 - 4 combined. All samples obtained from July landings.