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Sentinel Surveys 1995-2002: Catch per Unit Effort in NAFO Divisions 2J3KL.

Pêche Sentinelles 1995-2002 : prises par unité d'effort dans les divisions 2J3KL de l'OPANO.

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Abstract

Sentinel enterprises continued to provide catch rate and biological information on inshore cod resources in 2J3KL for 2002. Data are presented as weekly average catch rates and annual relative length frequencies: number of fish at length divided by amount of gear for each set and averaged by year and gear type, grouped by division. Catch rates in gillnet and on linetrawl were similar to those in 2001, still lower than the best observed catch rates in sentinel by about half. Small mesh gillnet catches increased in 2J in 2002 but did not reach the levels seen in 1997 or 1998.

Résumé

Des entreprises de pêche sentinelle ont continué de fournir des données biologiques et des données de taux de capture sur la morue côtière de 2J3KL en 2002. Les données sont présentées sous forme de taux de capture hebdomadaires et de fréquences de longueurs relatives annuelles : moyenne par année et type d’engin du nombre de poissons par longueur divisé par la quantité d’engins pour chaque mouillage, groupée par division. Les taux de capture au filet maillant et à la ligne traînante étaient semblables à ceux de 2001, soit environ la moitié des plus forts taux de capture observés dans les pêches indicatrices. Les captures faites au filet maillant à petit maillage ont augmenté dans 2J en 2002, mais elles n’ont pas atteint les niveaux observés en 1997 ou en 1998.

INTRODUCTION

Sentinel survey projects were formally announced by the Minister of Fisheries and Oceans in October 1994. The surveys in the DFO Newfoundland Region are an extension of the index fishermen's project from the Northern Cod Science Project with modifications to allow for science activities achievable only under a fishing moratorium. Sentinel data collection has continued during the commercial index fisheries that began in 1998.

The sentinel survey has the following objectives:

1. To develop a catch rate series for use in resource assessments.

2. To incorporate the knowledge of inshore fishers in the resource assessment process.

3. To describe the temporal-spatial distribution of cod in the inshore area over a number of years through, for example, the use of catch rate information, tagging studies, by-catch information and fishers' observations.

4. To gather length frequencies, sex and maturity data and sample ages for use in resource assessment.

5. To establish a long-term physical oceanographic and environmental monitoring program of the inshore areas.

6. To provide a source of biological material for other researchers. For example, tissue for genetic, physiological and toxicological analyses, cod stomachs for food and feeding studies and by-catch information.

Participants

The primary collectors of data in the sentinel survey are inshore fishers. Through consultation with inshore fishers and fisheries organizations, traditional inshore fishing grounds have been identified and mapped.

Fishers from communities within the boundaries of the identified coastal areas and who met eligibility criteria were invited to apply to participate in the survey. Where more than one application was received from an area, the project partner conducted a draw or lottery to select the participant. While there was considerable interest in the project in most areas, there were many sites from which only one application was received and others where additional canvassing was required to enlist participants. Selected participants were required to complete a six-week course designed by the Marine Institute of Memorial University in consultation with DFO. Topics covered included scientific sampling methods and equipment, computer use, resource assessment basics and presentation skills.

In order to minimize inter annual enterprise effects on data collection, participants are expected to remain with the survey over a number of years. It is also expected that most of the sampling activities will continue once commercial fishing operations resume and the sentinel participants will form a core of index fishers.

Sites

Sampling was conducted at 64 sites in NAFO Divisions 2J3KL. The specific location of each site was chosen after consultation between DFO scientists, fishermen, the Fish, Food and Allied Workers Union (FFAW) and the Fogo Island and Petty Harbour Cooperatives (for Fogo Island and Petty Harbour). Site selection was based on the need to survey throughout inshore areas and targeted historical fishing areas and historical gear use patterns.

Sampling Strategy

Sampling was conducted for a minimum of 10 weeks each year from 1999-2002. Many sites were allocated extra time as resources permitted. In 1996 and 1997 the surveys covered a twelve-week period, and in 1998, a minimum of 8 weeks were allocated. In 1995, sampling was conducted over fifteen weeks. The timing of sampling was determined after discussions with fishers but was targeted for seasonally appropriate times based on historical fishing patterns.

The number of trap sites in 2J3KL had been reduced from 35 in 1998 to 12 in 1999, and in 2000, 14 traps were fished. In 2001 and 2002, only a few traps were used, primarily to collect biological data and trap fish to tag. Participants used either baited trawl lines or gillnets for the remaining weeks of the survey. Non-trap sites fished either baited trawls or gillnets for the full survey. While traps are in the water continuously, they were hauled three days per week. Two sites at Petty Harbour fished baited hand lines exclusively. Hook and line, hand line and gillnet crews fished up to three days per week. Fishing days in the week were selected at the discretion of the crew and depend primarily on weather conditions.

When a cod trap was hauled prior to 2000, the crew estimated how much fish by weight had been caught, removed a random sample for biological sampling and released the remaining catch. Meshed and/or dead, floating fish were retained and brought ashore. Fishers were instructed to release as much live fish as possible. For 2000-2002, traps were used primarily as a source of biological data (length frequencies, otolith samples and frozen samples) and as a means to tag fish.

Hook and line crews fished two tubs of baited linetrawl. Each tub consisted of approximately 500 hooks for a total of 1000 hooks per fishing day. Gillnet crews fished a maximum of six fifty fathom 5 ½ inch monofilament gillnets. Nets were rigged 2-3 to a fleet and up to three fleets were fished per fishing day. In addition, selected sites fished one 3-¼ inch monofilament gillnet at least one day per week. All fish caught in gillnets and on hooks were landed and measured. If catches exceeded 500 kg per week, the numbers of nets in a fleet were cut back. However, some consideration was given to bottom topography and net performance when reducing the number of nets in a fleet. Similarly, the number of hooks per tub was reduced if landings exceeded 500 kg per week. Other measures were considered if fish are particularly abundant in an area and catches appear to be excessive even with the minimal amounts of gear possible.

Hand lines were used mostly in conjunction with nets or trawls as a means of determining presence of cod for tagging purposes or when nets were not catching fish. The exception to this was the Petty Harbour area where only hand lines and traps are permitted. In that area, participants used hand lines for the entire survey period. Sites were fished with hand line similar to other gear types, with a control location and experimental locations. The time fished on each ground was recorded, as was number of hooks on each line and number of lines fished. Problems with using these data to calculate a catch rate include drifting off the grounds (which depends on tide conditions, weather conditions and size of the ground), time required to get back on the ground is not accounted for in the time fished, and the effect of fishing more hooks per line is not likely multiplicative to the catch rate. For example, fishing 4 hooks per line does not necessarily mean the catch rate would be 4 times greater than fishing one hook per line if the density of fish on the grounds was equal. Once a fish was hooked, a line is generally pulled up before more than one fish could be caught.

Prior to the start of sampling in 1995, a fixed (control) location on the fishing grounds was established for each site and will remain fixed for the duration of the project. Each fishing day, up to half of the gear was set at the control site. The remainder of the gear (experimental) was set at one or two other locations on the fishing grounds at the discretion of the crew. The location of each fishing set was plotted on a nautical chart. The time of the set and the soak time for the gear were recorded. Other environmental observations were recorded, including wind direction and speed, percent cloud cover, tide conditions, presence of invertebrates (bait) and other fish species in the area, marine mammals, sea birds and any other variables which might have influenced fishing behavior. Selected sites were equipped with a CTD (measuring temperature and salinity at depth). At these locations, casts were conducted in the vicinity of fishing sets each fishing day. CTD locations were fished for subsequent years if possible.

When the gear was retrieved, catches from the control and experimental gear were kept separate and sampled on shore. All fish from gillnet, hand line and linetrawl, and a sample of the catch from traps, were measured for length and sex. Otoliths were sampled on a length-stratified basis and stored in manila envelopes with relevant information recorded on the outside. Every other week, selected sites collected a sample of up to 100 frozen fish. These were transported to St. John’s for detailed biological sampling. All information was recorded on forms similar to those used by the Port Sampling Section and on DFO Research Vessels

Other biological samples were collected as needed.

Data Presentation

The data were summarized for each NAFO division and presented by gear type. The relative length frequency plot depicts the number of fish at length scaled by total amount of gear fished so that changes in length frequency distribution may be compared across years. Lengths, in 1cm intervals, are from both control and experimental gear, and for gillnet and linetrawl represent every fish measured, as the total catch is measured. For hand line and trap data, total number measured are given in the length frequency summary graph. Data are shown as an average of the relative length frequencies for each fisher in the division. The second figure on each summary page gives catch details broken down by year, including number of fish measured (Nmeas), total number of sets (Nhauls) and number of sets in which no fish were caught (Nzero). The CPUE figures (bottom figure on each summary page) give average weekly catch rates, in number of fish per net or 1000 hooks, and are constructed by calculating a daily catch rate for each set and averaging all the CPUEs for all sets (control and experimental) in a given week.

RESULTS

Sixty-four inshore fishing enterprises representing communities from Black Tickle to St. Mary's Bay participated in the 2J3KL Sentinel Survey for 2002. Survey activity covered mostly summer and fall periods in all years, traditional fishing times for the areas involved. A total of 3 051 sets of 5 ½" gillnet and 418 sets of 3 ¼" gillnet resulted in total measurements of roughly 40 500 fish. One hundred seventy-seven sets of linetrawl resulted in 4 014 measurements. Otoliths from 2 821 fish were collected for aging purposes in 2002 and 2 965 cod were tagged.

Figure 1 shows the catches from every nonzero set in 2002 of 5 ½" gillnet and linetrawl. As a comparison, the same plot is given for the 1998 data (Figure 2). Control sites were generally consistent from year to year but shifts in location may have resulted due to weather or tide conditions or competition for sites by commercial activity.

Figure 3 shows overall average CPUE by division from 1995-2002 for the three main gear types used in sentinel activity. 3L, in general, had the highest catch rates in gillnet over the time series. Gillnet (5 ½") catch rates in all divisions declined from 1998. Linetrawl catches were generally higher in 3K until 1998 and catches in 3K and 3L were lower in 2001 and 2002 than in earlier years. 2J shows very low catch rates compared to 3K and 3L in all years. In 2002, though, catches in 5 ½" gillnet were higher than the previous two years and there were some very good catches in small mesh gillnet and the mean CPUE was higher in this gear than in 2001.

Length frequencies, scaled by amount of gear used, are summarized in figure 4. The same data are given in the length frequency plots on the summary sheets that follow (figures 7-37). Seeing them on the same scale and in one place allows easier comparisons between divisions and years. The 5 ½" gillnet frequencies (top plot) show the narrowest range of selectivity (50-80cm). Catch rates in this gear decline from 1998-2002 and 3L has higher catches than the other divisions.

In the small mesh gillnet (middle plot), the frequency has two modes, reflecting two size ranges of fish caught in the gear. Catches of smaller fish, caught by meshing in the net, declined in 3K from 1996-1998 and has remained relatively stable since then. In 3L catches of these smaller fish were lower than in 3K until 2000 when catch rates increased and are still higher than in earlier years. In 2J, this smaller mode decreased from 1997-1999 but in 2002 was similar to the 1998 level once more. The larger modes in the small mesh frequencies are due to larger fish that entangle in the net. The catches of these larger fish in 3 1/4" gear has declined noticeably since 1998 in all divisions, similar to the decline seen in the larger mesh gear.

Linetrawl frequencies (bottom plot) show a wider distribution of fish sizes. In 3K, linetrawl catch rates declined from 1997 through 2000 and then increased slightly in 2001 and 2002. The frequencies in these two years, however, were shifted towards smaller fish. 3L frequencies show the same shift towards smaller fish in 2002. Linetrawl catches in 2J were low in all years and no sampling was done with this gear in 2002.

Figures summarizing the data by gear for the entire stock area and also broken out by division follow on pages 15-25. The bottom figure on each page shows the weekly average catch rate. The decline in catch rate from 1995-2002 is most evident in 5 ½” gillnet plot (figure 9). Catch rates in small mesh gillnet (figure 21) were lower in the first part of 2001 and 2002 than in previous years, although there are still good catch rates in the latter part of the year (sites surveyed in 3L during this time bring the average up (figure 30)).

Handline data are not summarized in this document as calculating catch rates for this gear type is difficult. Trying to account for how the gear fishes (hooks drifting off the ground in different tides or weather, for example) and the variability in how fish are caught by this gear (behaviour of fish to the hook) complicates comparisons between years and sites.

Traps were only used as a means of catching fish to tag in 2002 and catch rates were not calculated for this gear.

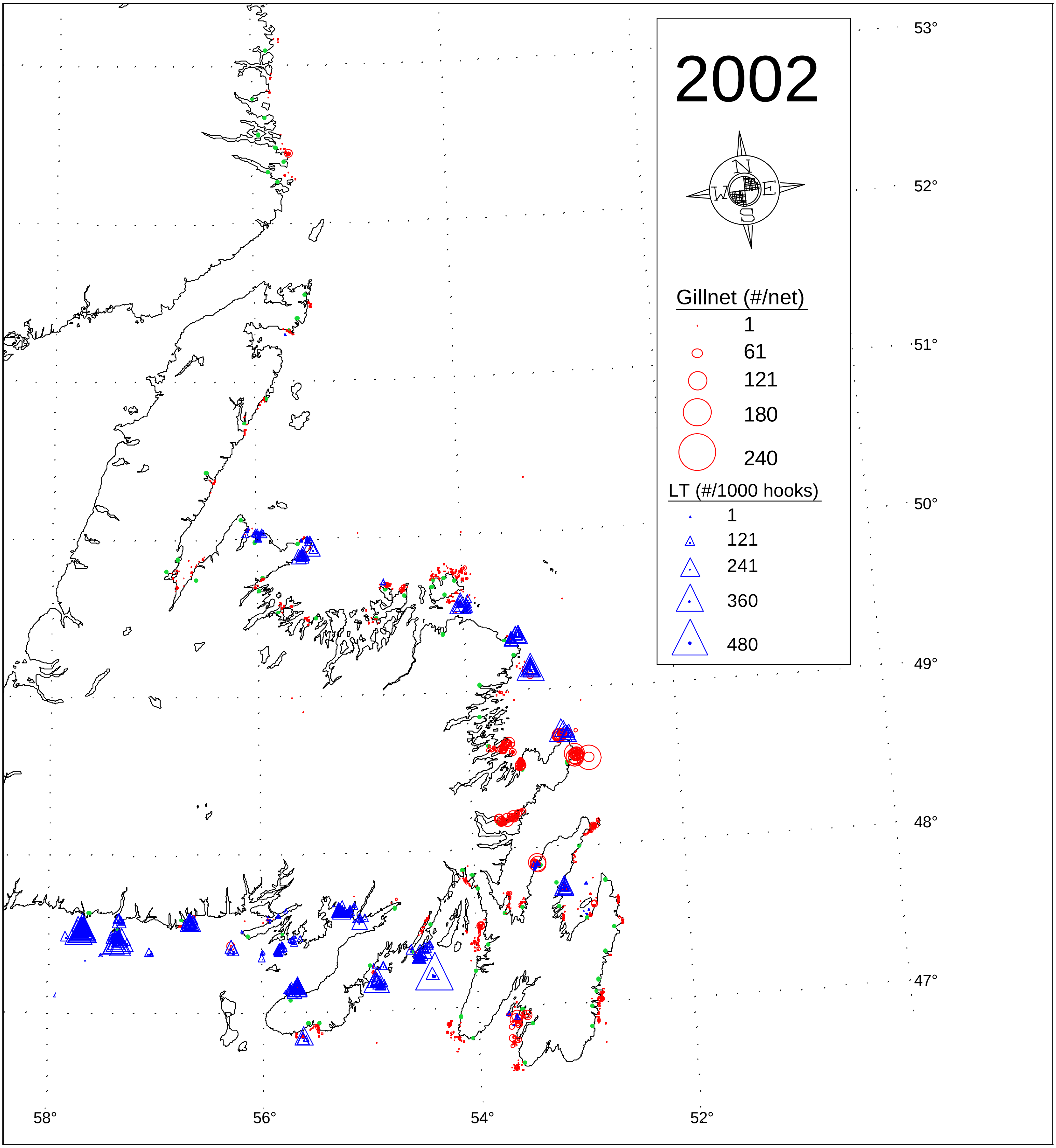


Figure 1. Expanding symbol plot of 2002 Sentinel catch rates for 5 1/2" gillnet (#/net) and linetrawl (#/1000 hooks).

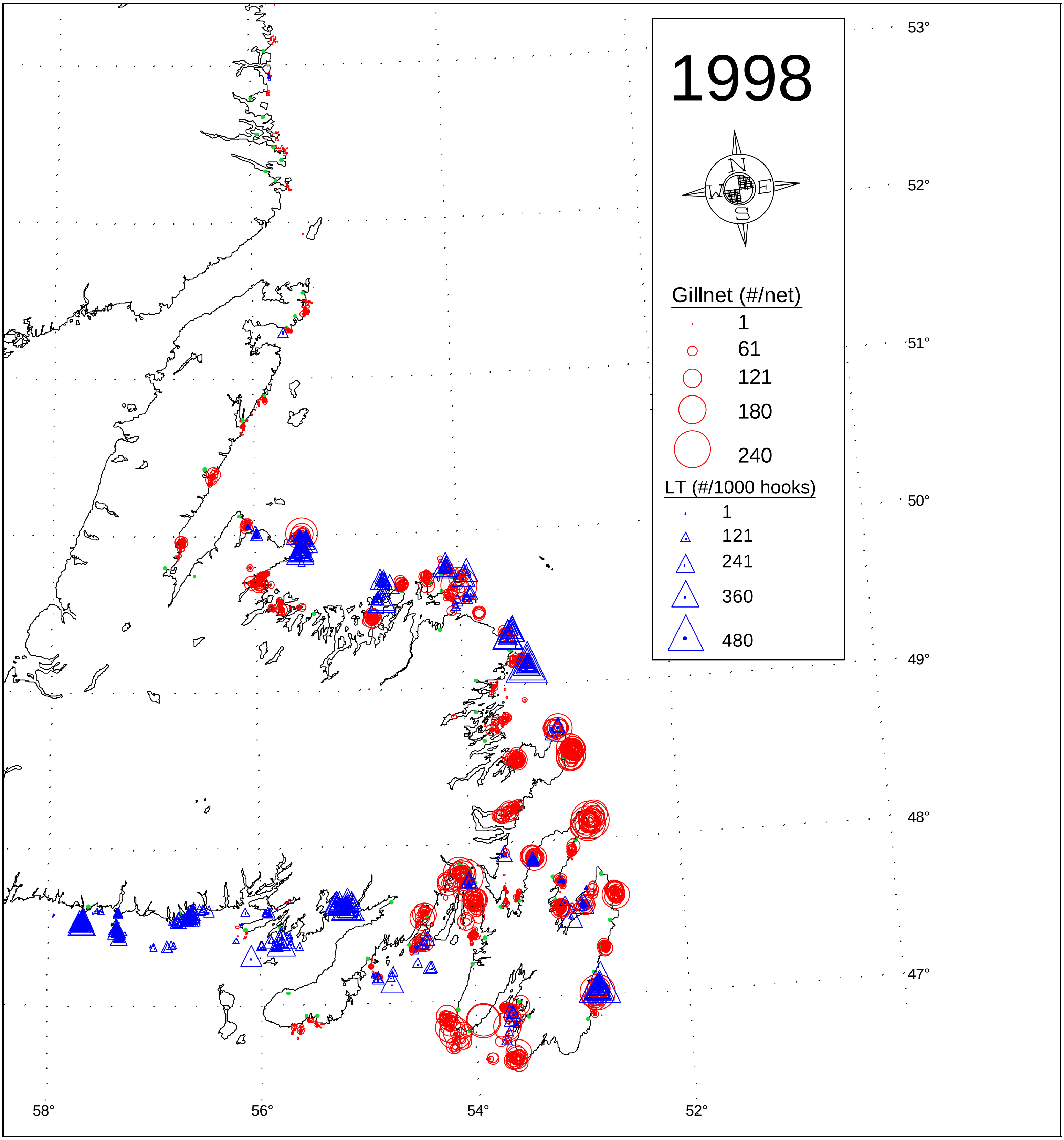
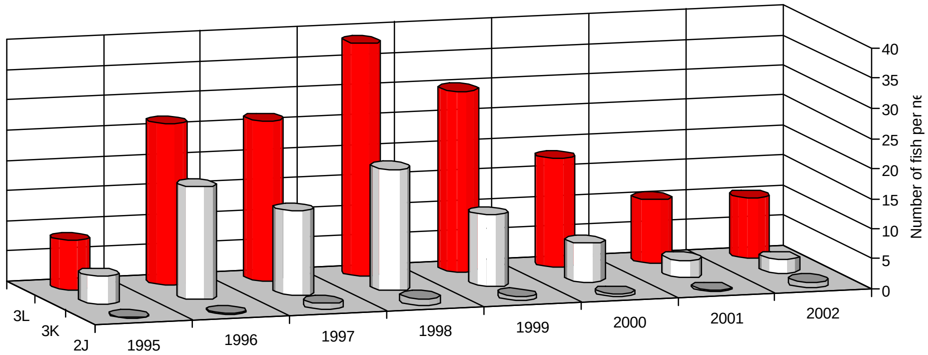
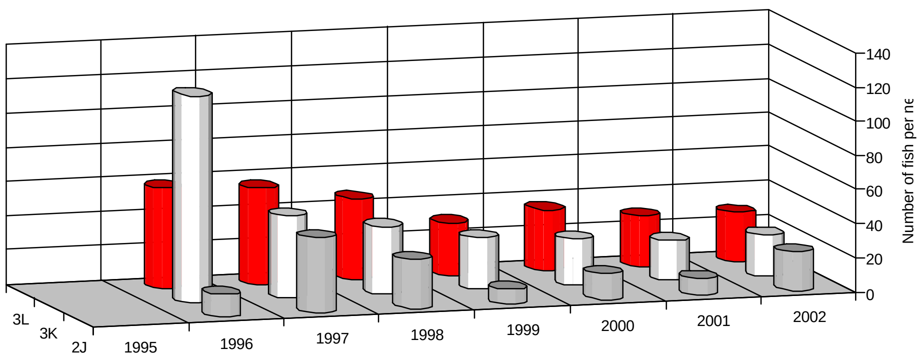


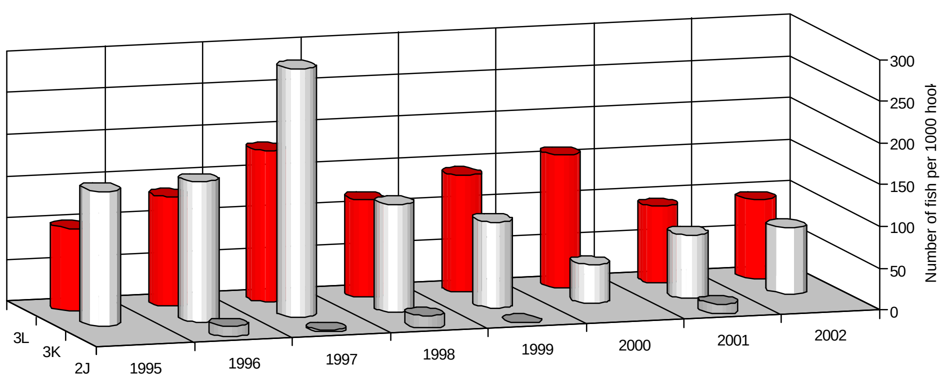
Figure 2. Expanding symbol plot of 1998 Sentinel catch rates for 5 1/2" gillnet (#/net) and linetrawl (#/1000 hooks).



	1995	1996	1997	1998	1999	2000	2001	2002
2J	0	0	1	1	1	0	0	1
3K	5	19	14	20	12	6	3	2
3L	8	27	27	39	30	18	10	10



	1995	1996	1997	1998	1999	2000	2001	2002
2J		13	44	29	9	15	10	23
3K		121	48	39	30	27	24	24
3L		59	56	47	31	36	30	29



	1995	1996	1997	1998	1999	2000	2001	2002
2J		13	2	14	0		12	
3K	162	167	297	129	103	46	76	79
3L	99	131	181	116	140	159	92	94

Fig 3. Catch per unit effort (number of fish per net or 1000 hooks) for gillnet and linetrawl

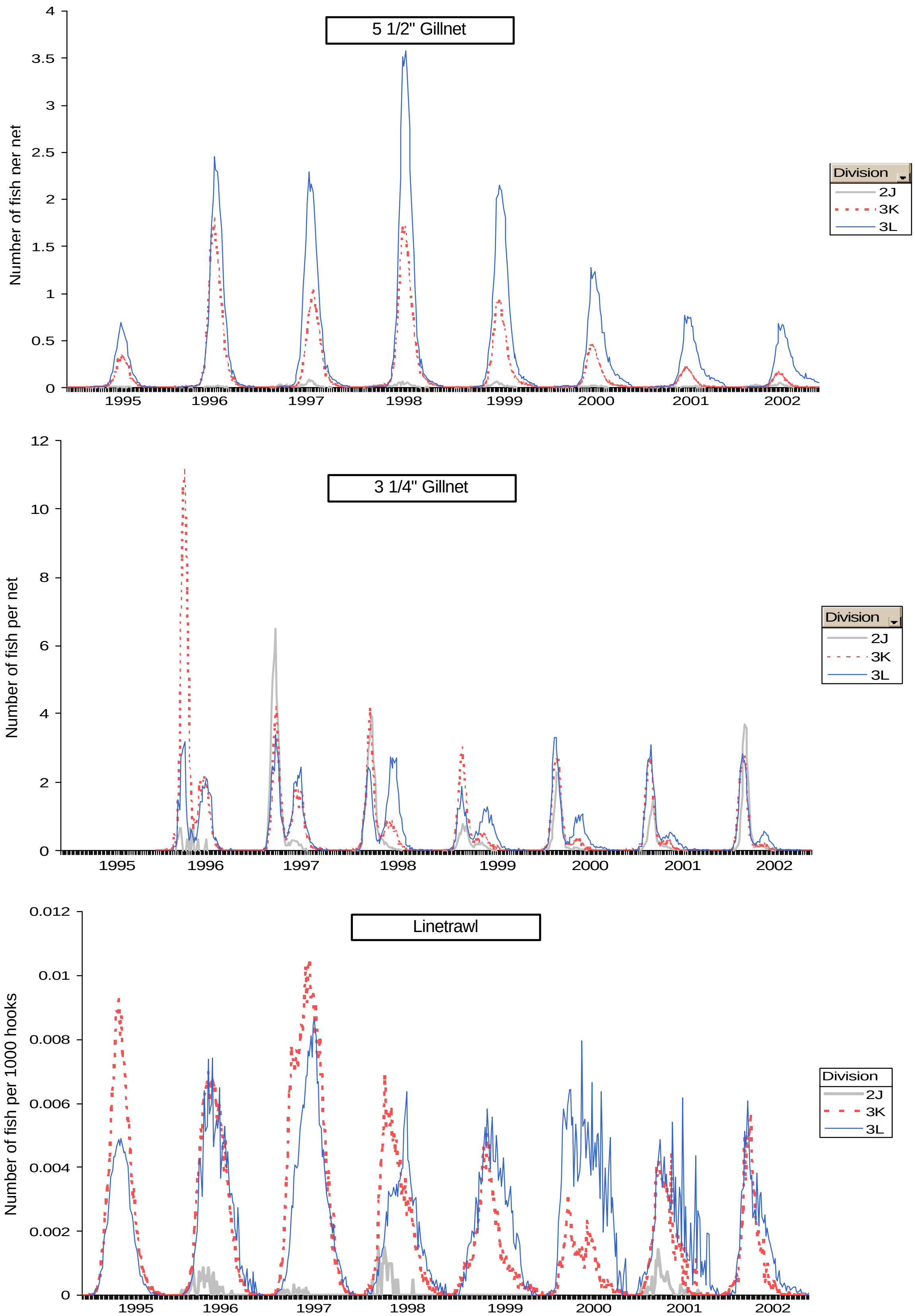


Figure 4. Length frequencies (scaled by amount of gear fished) for gillnet and linetrawl from 1995-2002.
Each frequency ranges from 20cm-90cm.

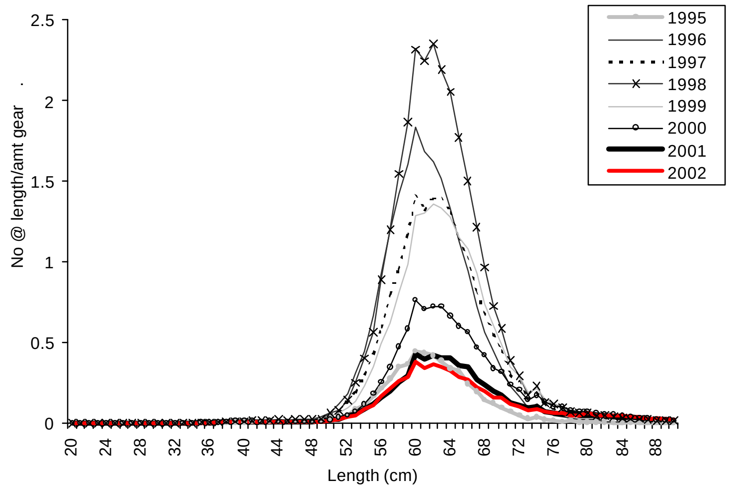
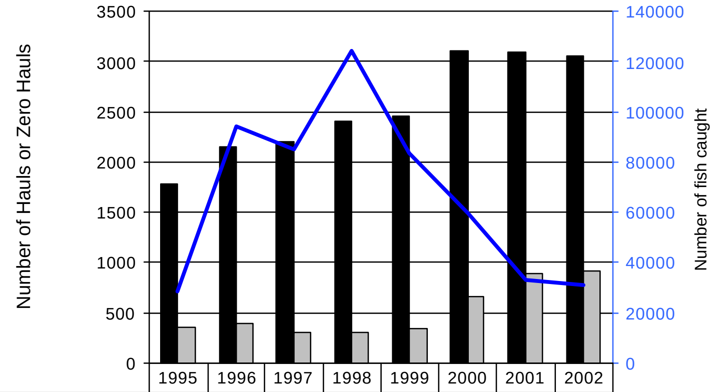


Figure 5. Relative length frequency (number at length / amount of gear) for control and experimental gears, 2J3KL Gillnet 5 1/2 in.



	1995	1996	1997	1998	1999	2000	2001	2002
Sum of Nhauls	1777	2145	2206	2406	2453	3107	3100	3051
Sum of Nzero	359	397	306	3 12434	344	660	886	915
Sum of Nmeas	28799	94095	85188	1E+05	83604	59750	33067	30667

Figure 6. Number of hauls (Nhauls), number of zero catch hauls (Nzero) and total number of fish caught (Nmeas), for control and experimental gears, 2J3KL Gillnet 5 1/2 in.

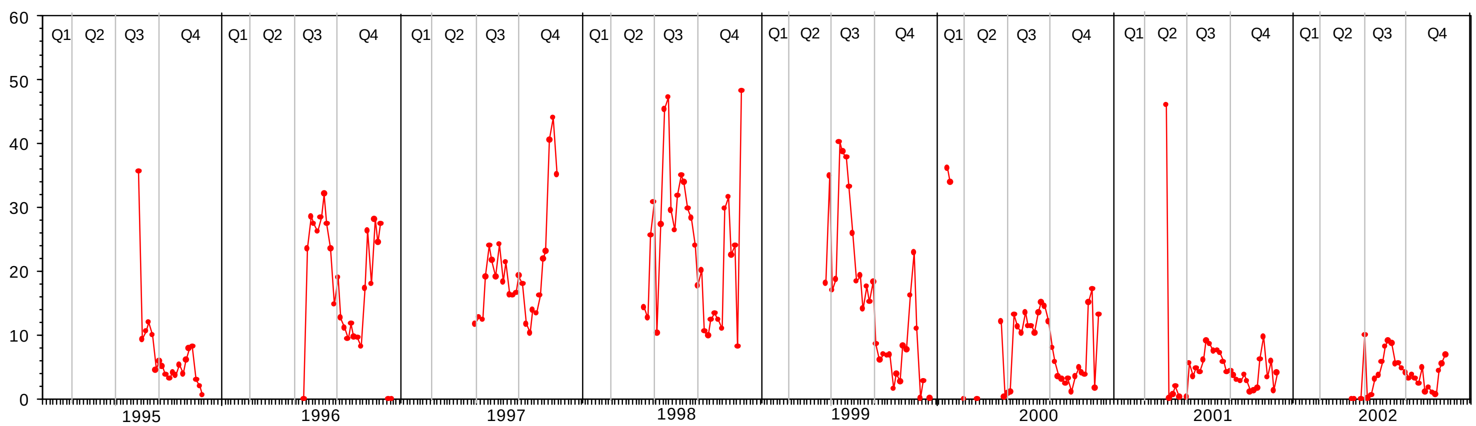


Figure 7. Catch per unit effort (in numbers of fish per net) for all sets (control and experimental) averaged for each week, 2J3KL Gillnet 5 1/2 in.

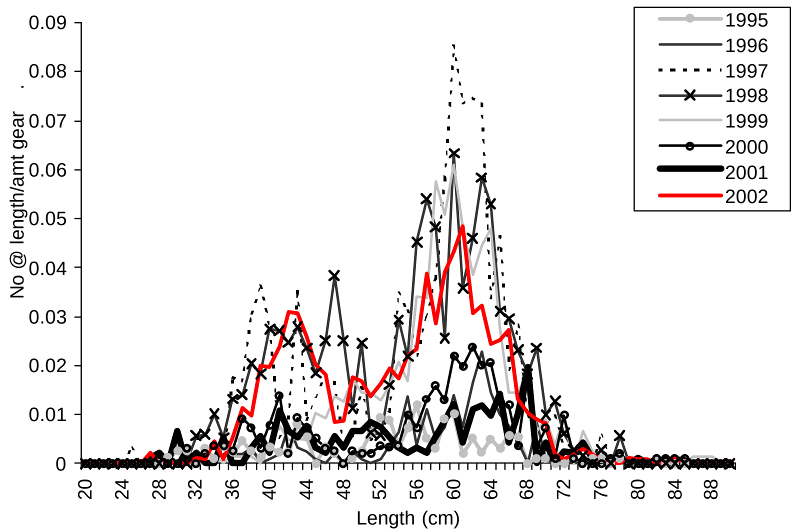
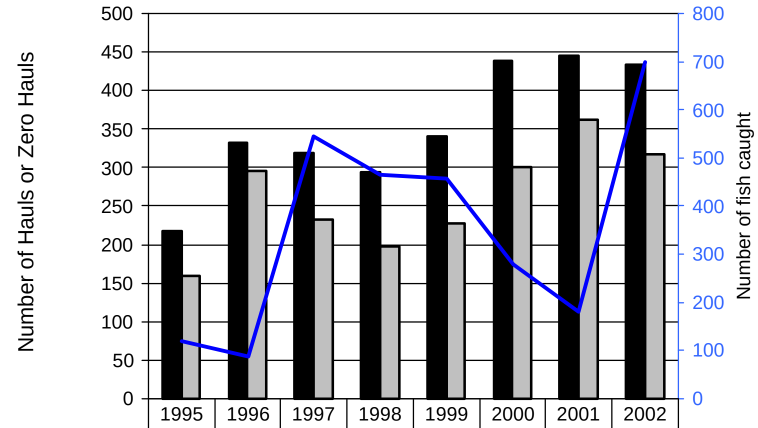


Figure 8. Relative length frequency (number at length / amount of gear) for control and experimental gears, 2JM Gillnet 5 1/2 in.



	1995	1996	1997	1998	1999	2000	2001	2002
Sum of Nhauls	218	333	319	294	341	438	445	433
Sum of Nzero	160	295	233	198	228	300	363	318
Sum of Nmeas	118	87	544	464	456	280	180	698

Figure 9. Number of hauls (Nhauls), number of zero catch hauls (Nzero) and total number of fish caught (Nmeas), for control and experimental gears, 2JM Gillnet 5 1/2 in.

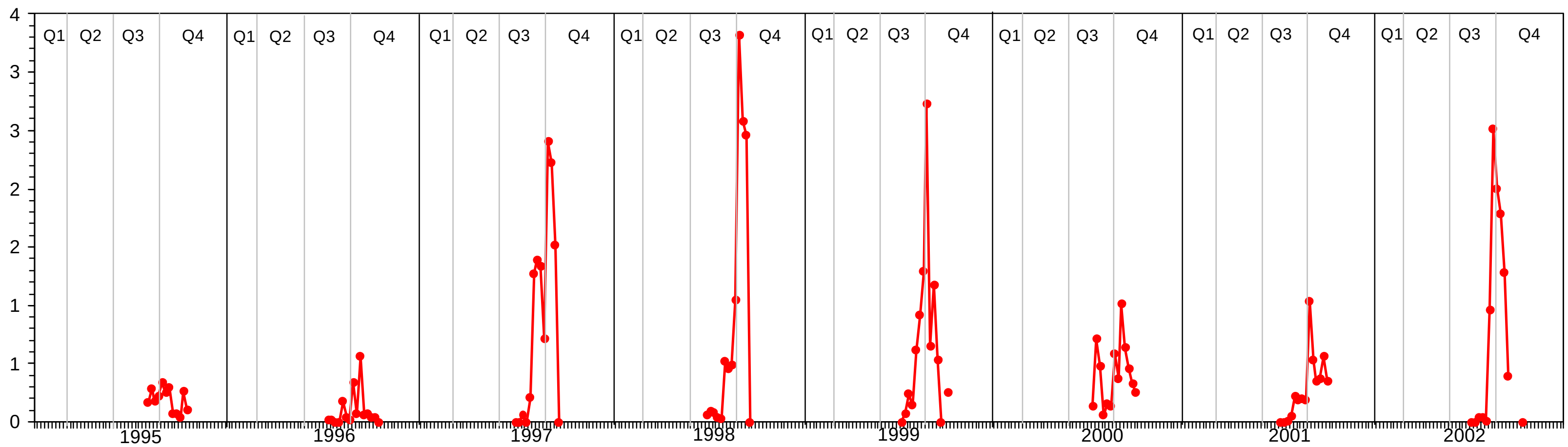


Figure 10. Catch per unit effort (in numbers of fish per net) for all sets (control and experimental) averaged for each week, 2JM Gillnet 5 1/2 in.

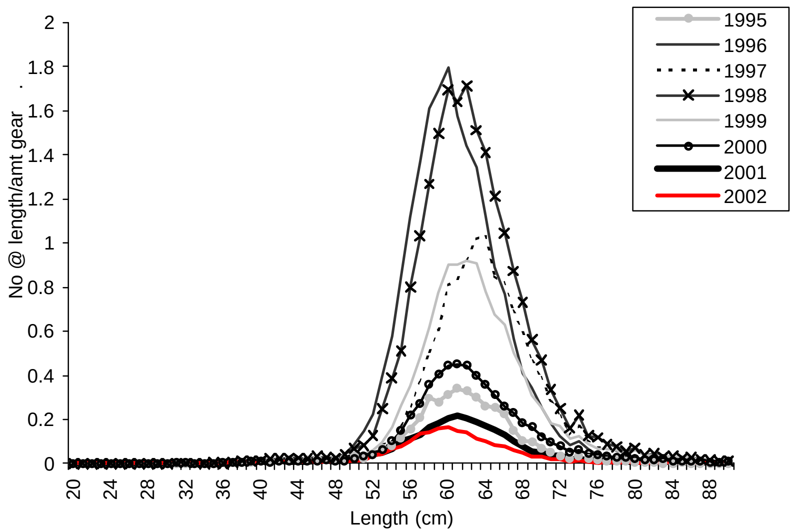
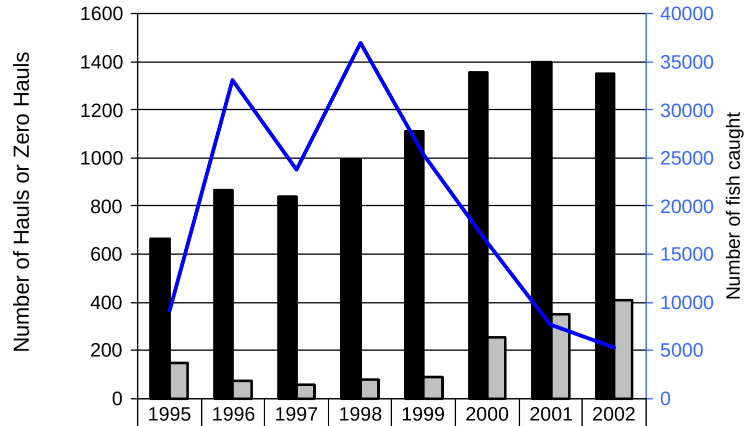


Figure 11. Relative length frequency (number at length / amount of gear) for control and experimental gears, 3K Gillnet 5 1/2 in.



	1995	1996	1997	1998	1999	2000	2001	2002
Sum of Nhauls	663	866	839	994	1112	1353	1400	1351
Sum of Nzero	150	72	55	76	87	253	351	408
Sum of Nmeas	9160	33117	23747	36991	25422	16146	7670	5345

Figure 12. Number of hauls (Nhauls), number of zero catch hauls (Nzero) and total number of fish caught (Nmeas), for control and experimental gears, 3K Gillnet 5 1/2 in.

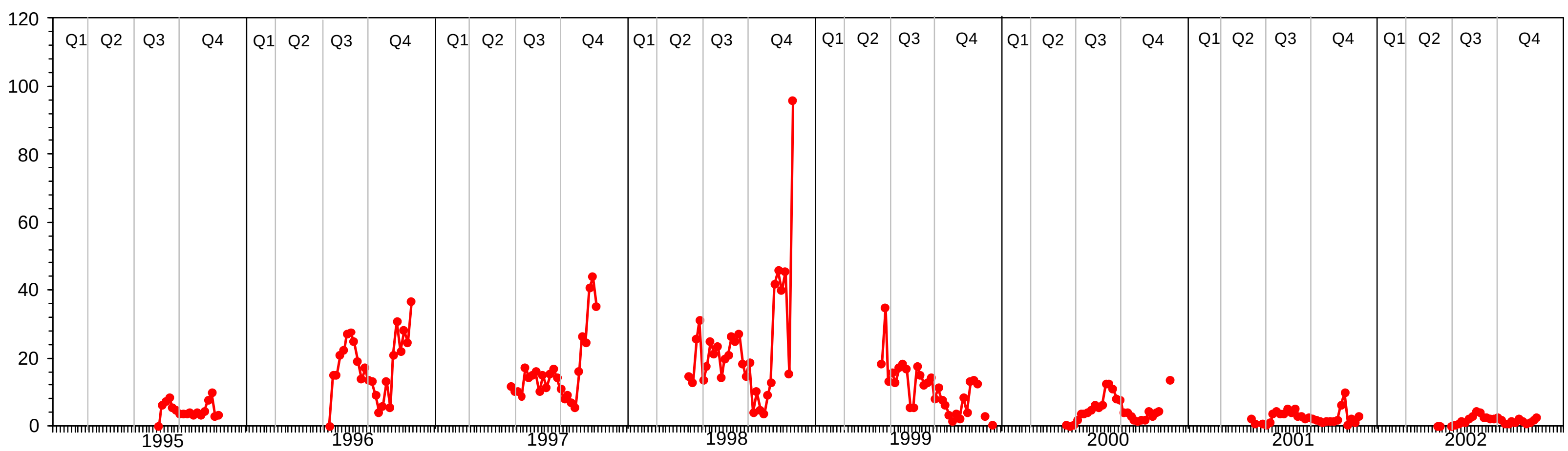


Figure 13. Catch per unit effort (in numbers of fish per net) for all sets (control and experimental) averaged for each week, 3K Gillnet 5 1/2 in.

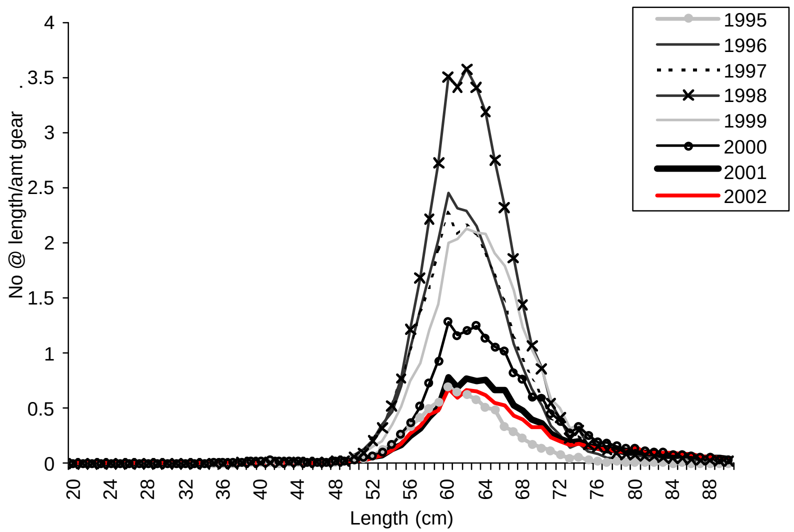
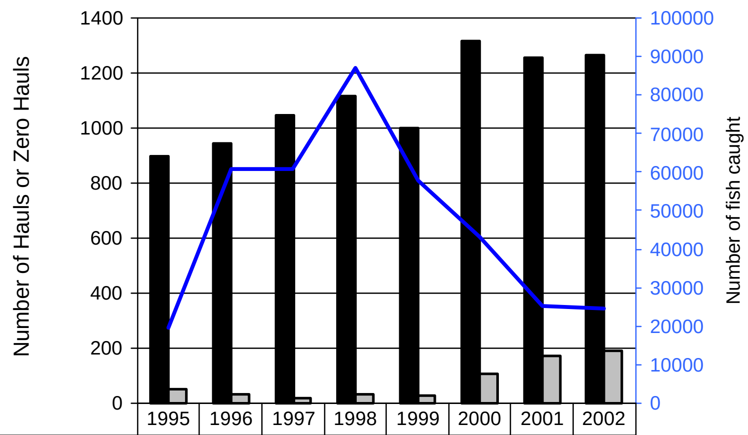


Figure 14. Relative length frequency (number at length / amount of gear) for control and experimental gears, 3L Gillnet 5 1/2 in.



	1995	1996	1997	1998	1999	2000	2001	2002
Sum of Nhauls	896	946	1048	1118	1000	1316	1255	1267
Sum of Nzero	49	30	18	33	29	107	172	189
Sum of Nmeas	19521	60891	60897	86892	57726	43324	25217	24624

Figure 15. Number of hauls (Nhauls), number of zero catch hauls (Nzero) and total number of fish caught (Nmeas), for control and experimental gears, 3L Gillnet 5 1/2 in.

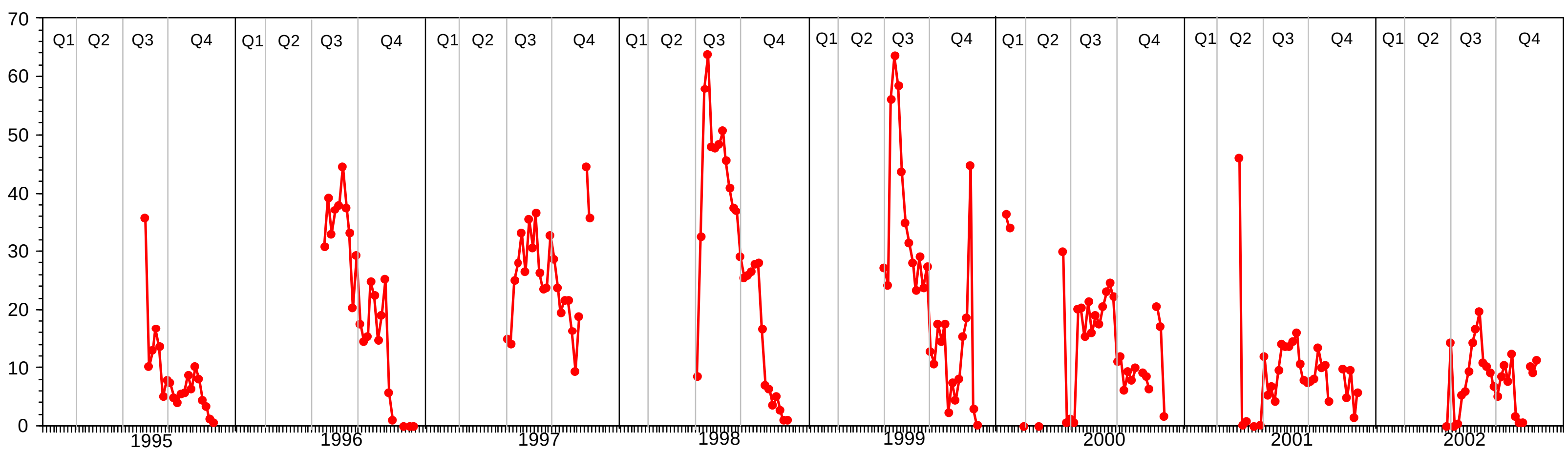


Figure 16. Catch per unit effort (in numbers of fish per net) for all sets (control and experimental) averaged for each week, 3L Gillnet 5 1/2 in.

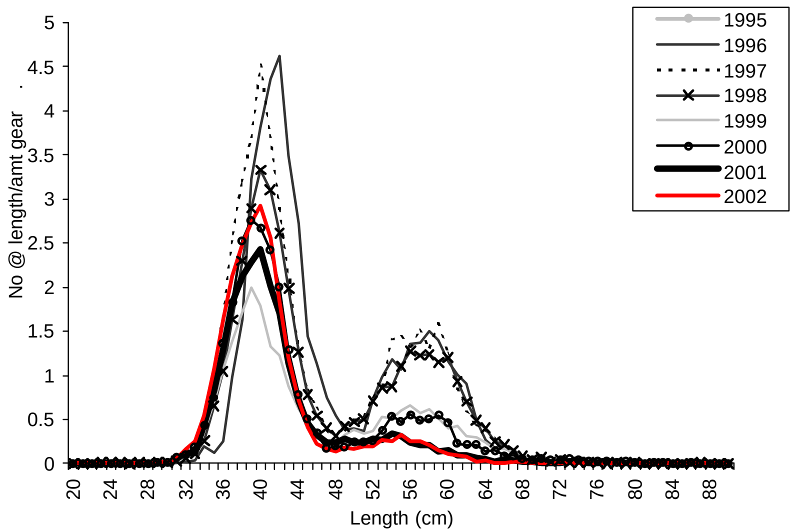
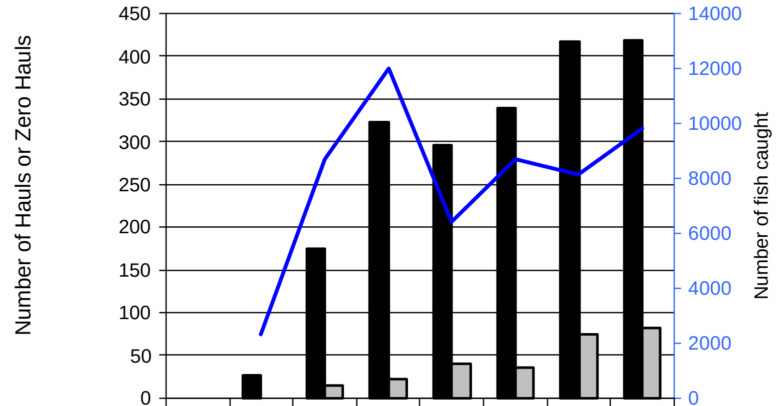


Figure 17. Relative length frequency (number at length / amount of gear) for control and experimental gears, 2J3KL Gillnet 3 1/4 in.



	1995	1996	1997	1998	1999	2000	2001	2002
Sum of Nhauls		27	175	323	296	340	417	418
Sum of Nzero		0	15	22	40	36	74	82
Sum of Nmeas		2336	8678	11997	6409	8715	8120	9798

Figure 18. Number of hauls (Nhauls), number of zero catch hauls (Nzero) and total number of fish caught (Nmeas), for control and experimental gears, 2J3KL Gillnet 3 1/4 in.

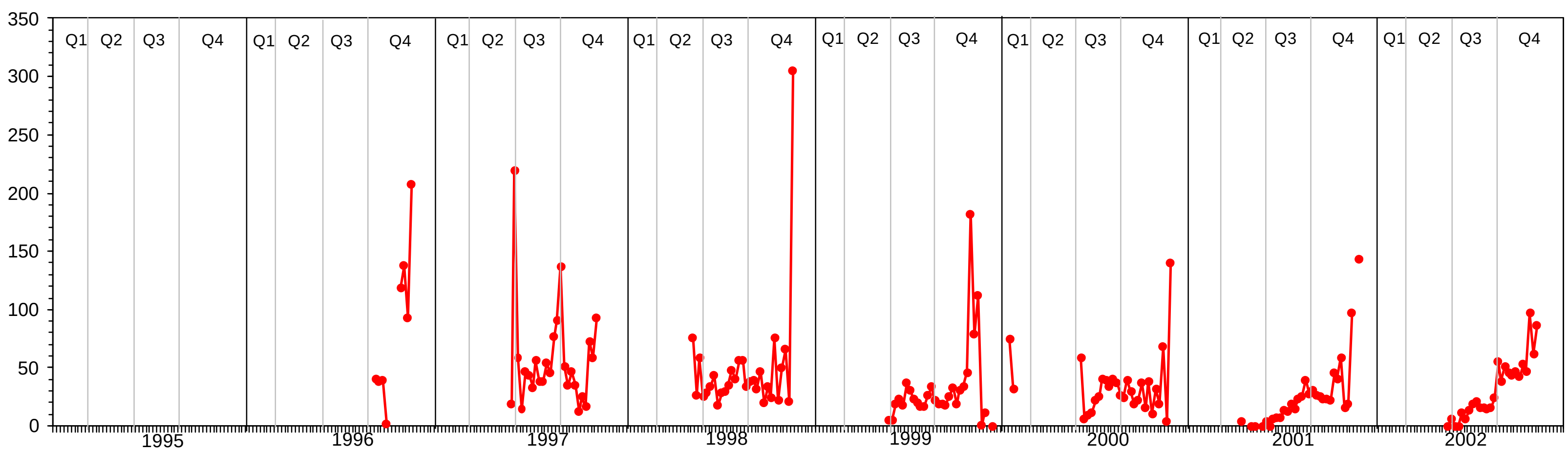


Figure 19. Catch per unit effort (in numbers of fish per net) for all sets (control and experimental) averaged for each week, 2J3KL Gillnet 3 1/4 in.

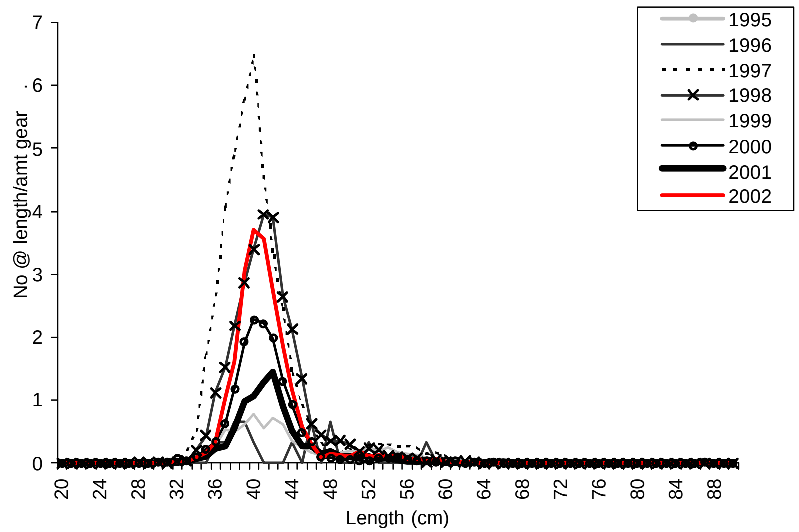
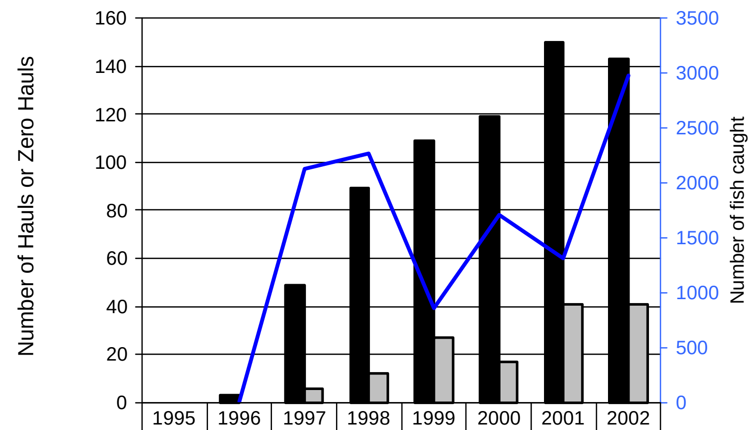


Figure 20. Relative length frequency (number at length / amount of gear) for control and experimental gears, 2JM Gillnet 3 1/4 in.



	1995	1996	1997	1998	1999	2000	2001	2002
Sum of Nhauls		3	49	89	109	119	150	143
Sum of Nzero		0	6	12	27	17	41	41
Sum of Nmeas		14	2131	2265	854	1707	1309	2975

Figure 21. Number of hauls (Nhauls), number of zero catch hauls (Nzero) and total number of fish caught (Nmeas), for control and experimental gears, 2JM Gillnet 3 1/4 in.

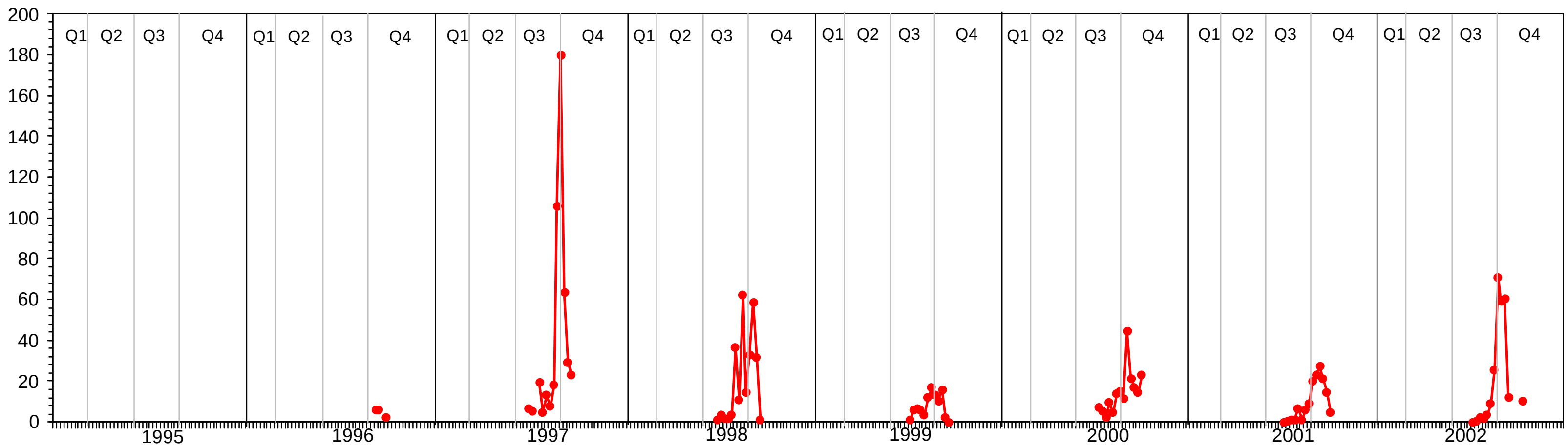


Figure 22. Catch per unit effort (in numbers of fish per net) for all sets (control and experimental) averaged for each week, 2JM Gillnet 3 1/4 in.

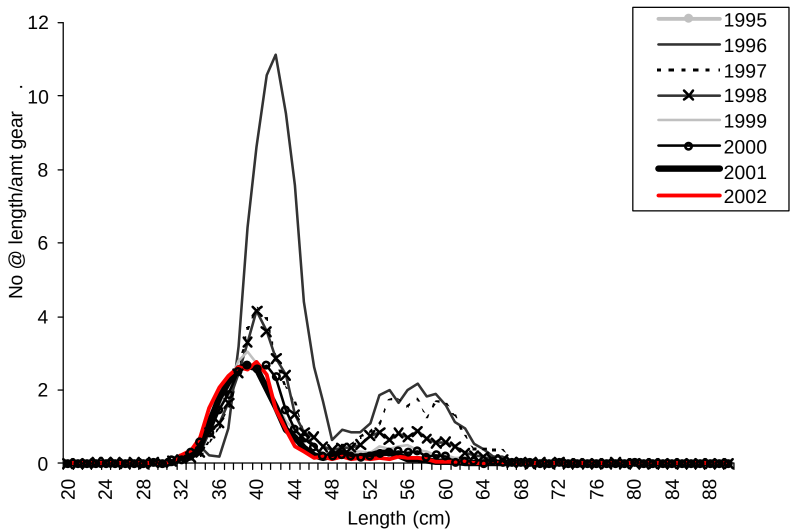
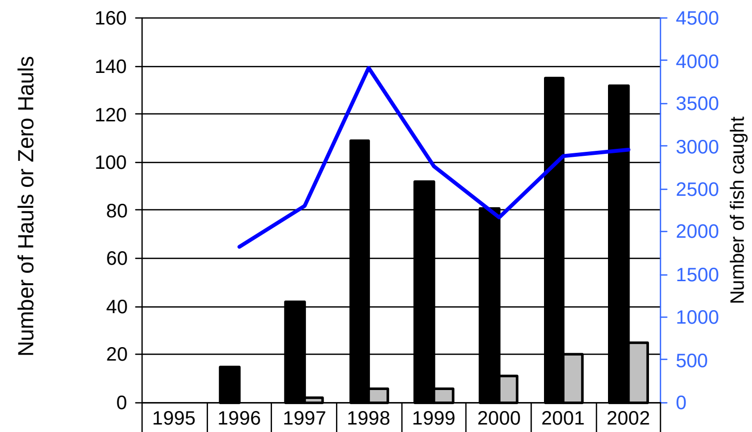


Figure 23. Relative length frequency (number at length / amount of gear) for control and experimental gears, 3K Gillnet 3 1/4 in.



	1995	1996	1997	1998	1999	2000	2001	2002
Sum of Nhauls		15	42	109	92	81	135	132
Sum of Nzero		0	2	6	6	11	20	25
Sum of Nmeas		1822	2299	3917	2762	2165	2880	2966

Figure 24. Number of hauls (Nhauls), number of zero catch hauls (Nzero) and total number of fish caught (Nmeas), for control and experimental gears, 3K Gillnet 3 1/4 in.

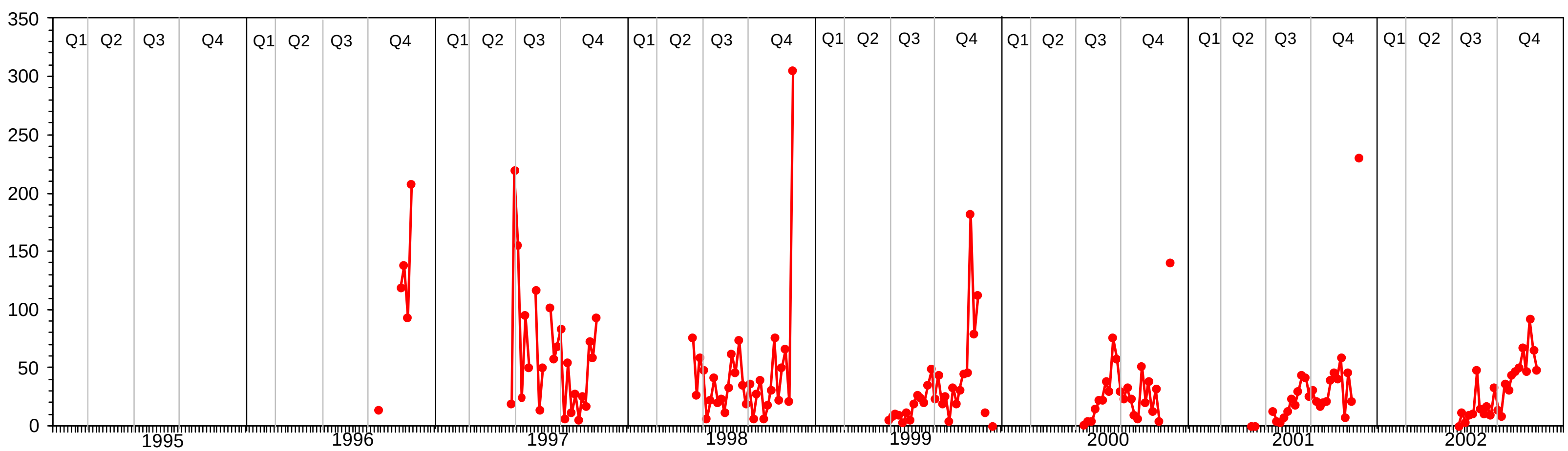


Figure 25. Catch per unit effort (in numbers of fish per net) for all sets (control and experimental) averaged for each week, 3K Gillnet 3 1/4 in.

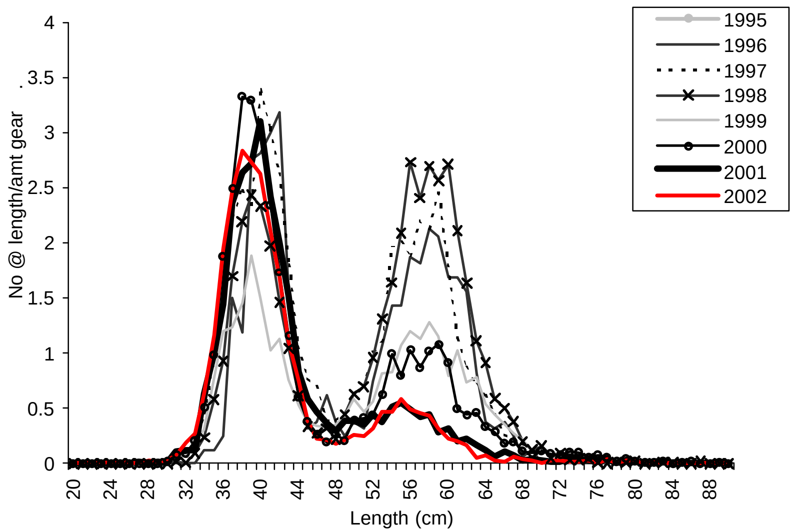
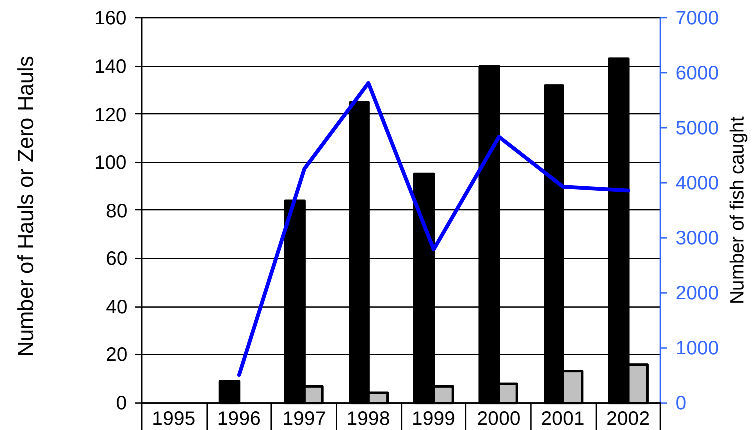


Figure 26. Relative length frequency (number at length / amount of gear) for control and experimental gears, 3L Gillnet 3 1/4 in.



	1995	1996	1997	1998	1999	2000	2001	2002
Sum of Nhauls		9	84	125	95	140	132	143
Sum of Nzero		0	7	4	7	8	13	16
Sum of Nmeas		500	4248	5815	2793	4843	3931	3857

Figure 27. Number of hauls (Nhauls), number of zero catch hauls (Nzero) and total number of fish caught (Nmeas), for control and experimental gears, 3L Gillnet 3 1/4 in.

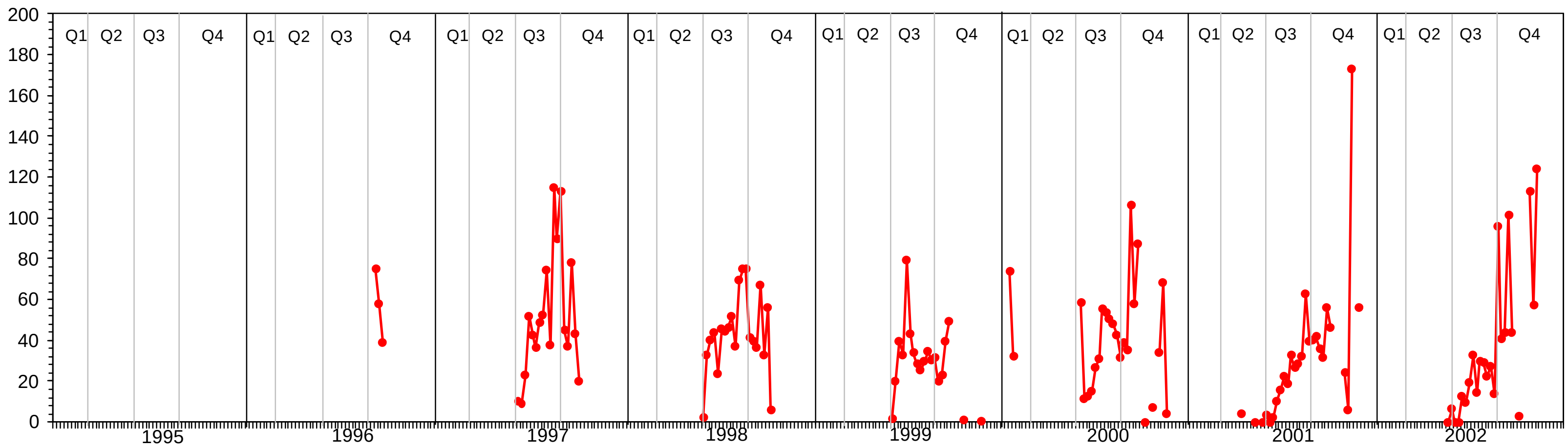


Figure 28. Catch per unit effort (in numbers of fish per net) for all sets (control and experimental) averaged for each week, 3L Gillnet 3 1/4 in.

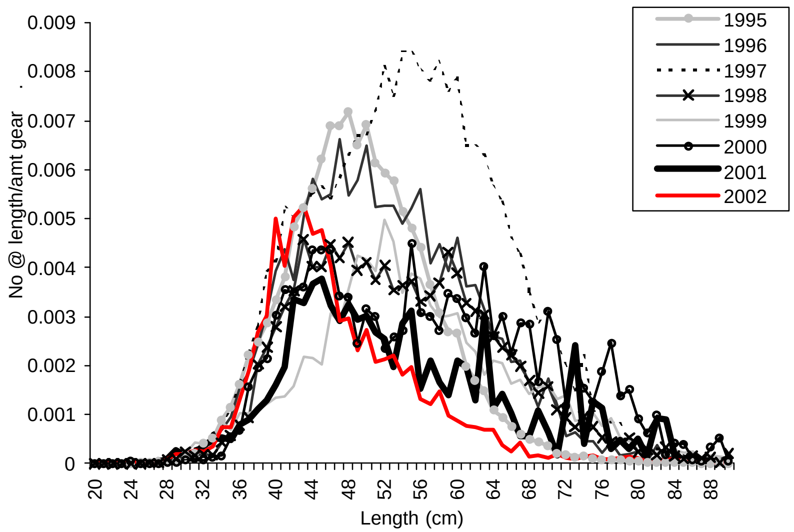
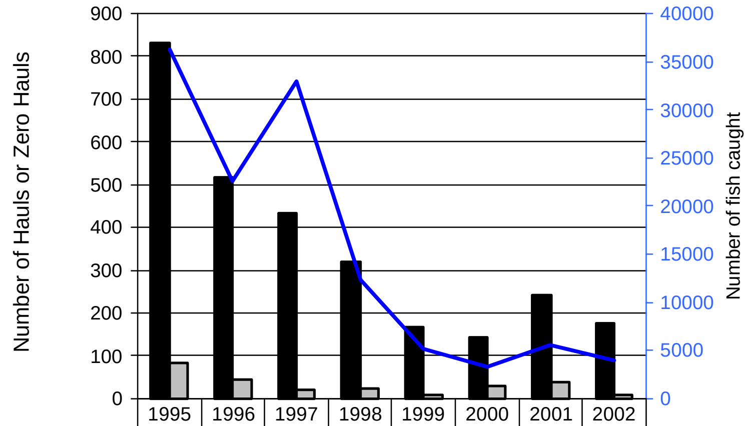


Figure 29. Relative length frequency (number at length / amount of gear) for control and experimental gears, 2J3KL Linetrawl .



	1995	1996	1997	1998	1999	2000	2001	2002
Sum of Nhauls	830	517	433	321	166	143	240	177
Sum of Nzero	82	43	21	23	9	30	37	9
Sum of Nmeas	36343	22533	33023	12350	5166	3239	5525	4014

Figure 30. Number of hauls (Nhauls), number of zero catch hauls (Nzero) and total number of fish caught (Nmeas), for control and experimental gears, 2J3KL Linetrawl .

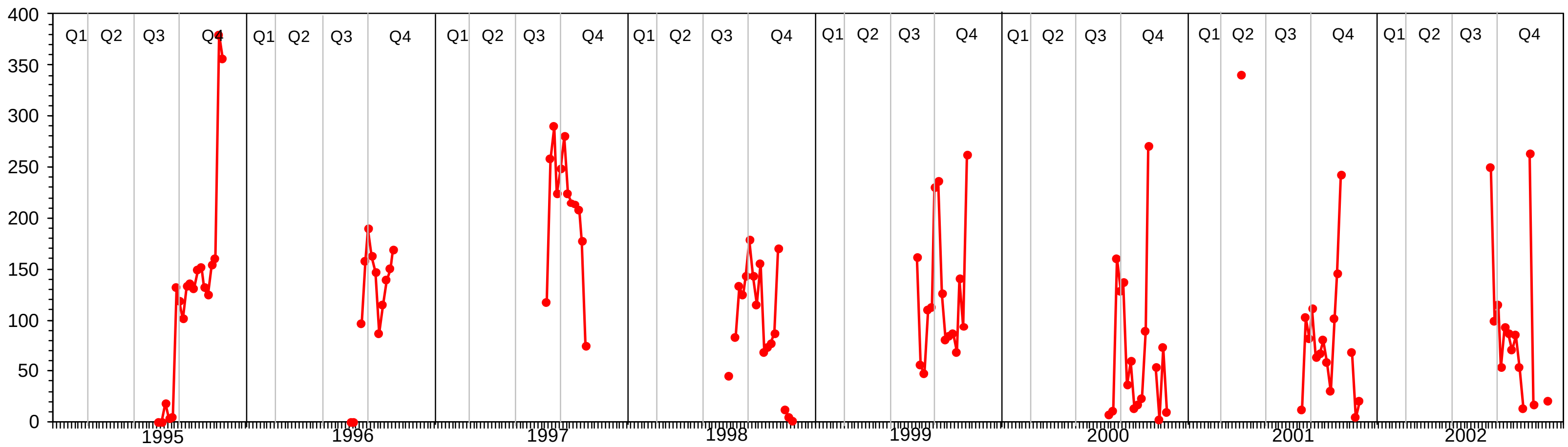


Figure 31. Catch per unit effort (in numbers of fish per 1000 hooks) for all sets (control and experimental) averaged for each week, 2J3KL Linetrawl .

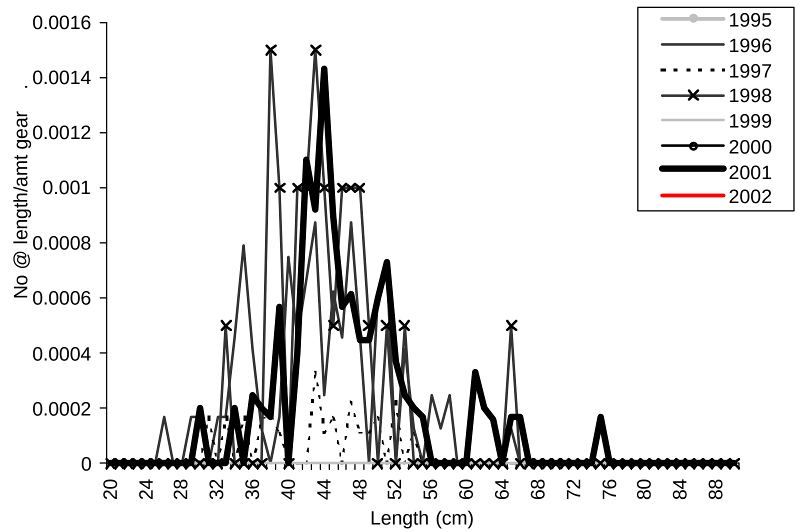
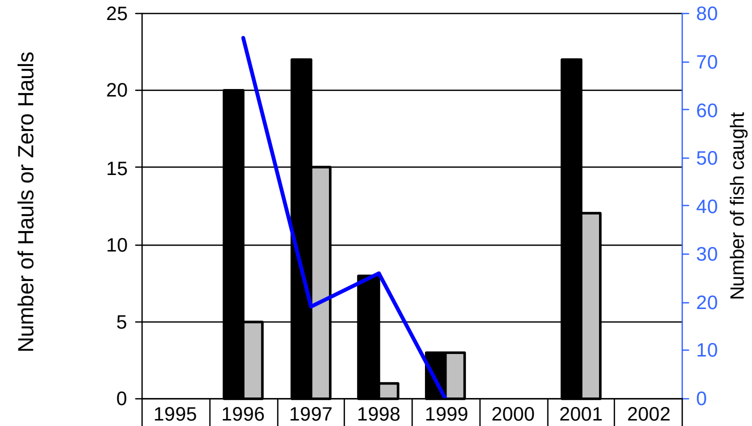


Figure 32. Relative length frequency (number at length / amount of gear) for control and experimental gears, 2JM Linetrawl .



	1995	1996	1997	1998	1999	2000	2001	2002
Sum of Nhauls		20	22	8	3		22	
Sum of Nzero		5	15	1	3		12	
Sum of Nmeas		75	19	26	0		59	

Figure 33. Number of hauls (Nhauls), number of zero catch hauls (Nzero) and total number of fish caught (Nmeas), for control and experimental gears, 2JM Linetrawl .

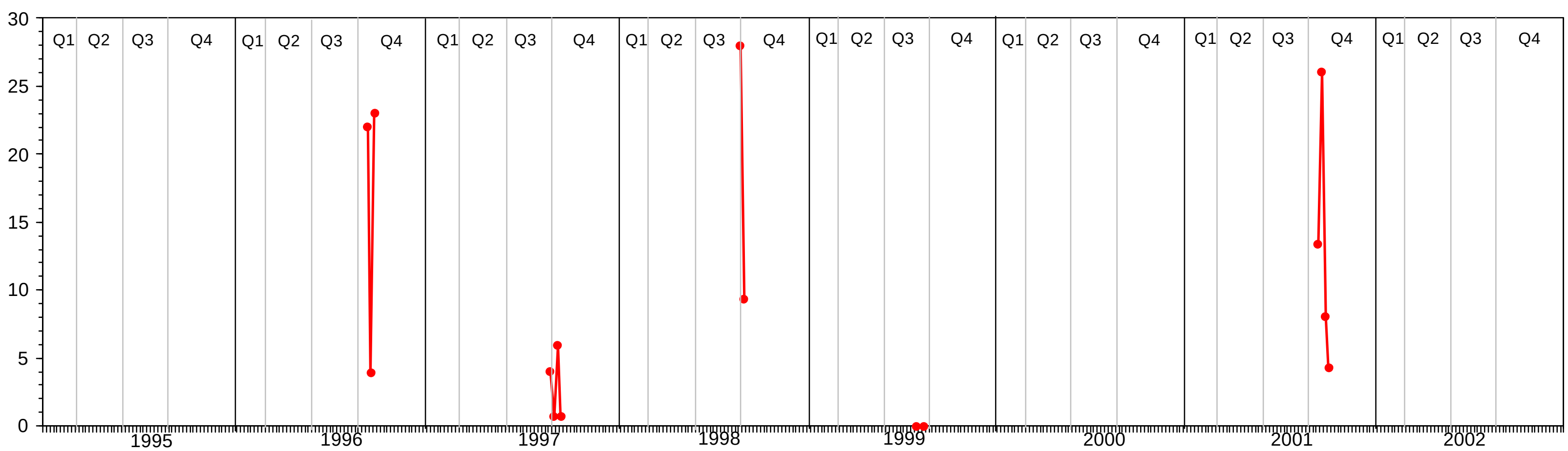


Figure 34. Catch per unit effort (in numbers of fish per 1000 hooks) for all sets (control and experimental) averaged for each week, 2JM Linetrawl .

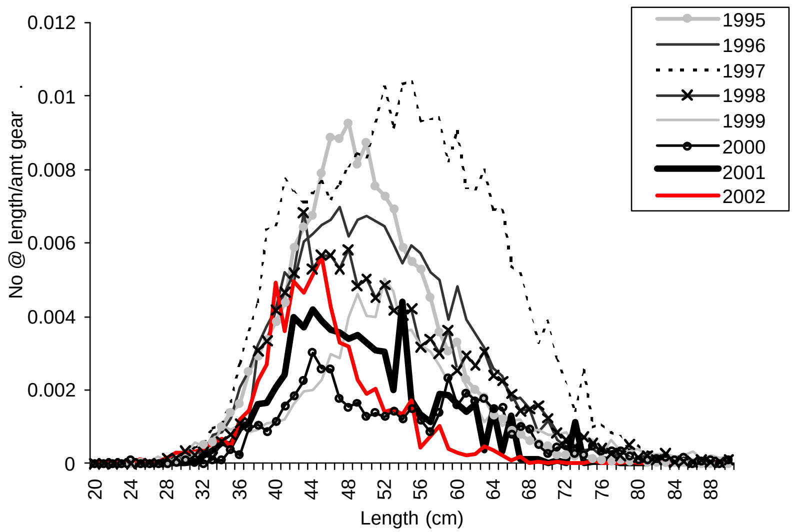
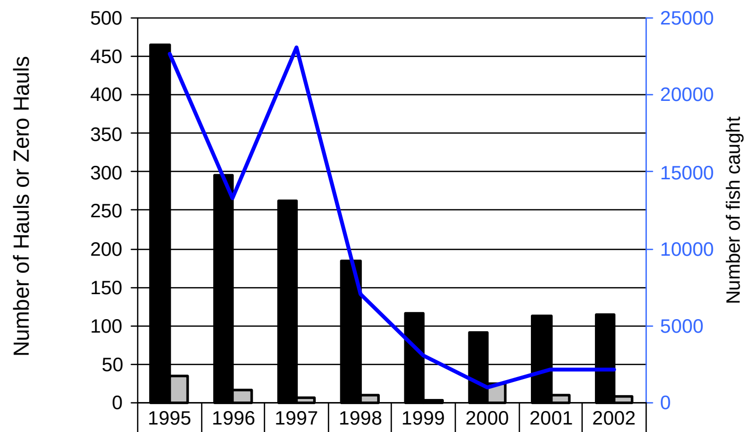


Figure 35. Relative length frequency (number at length / amount of gear) for control and experimental gears, 3K Linetrawl .



	1995	1996	1997	1998	1999	2000	2001	2002
Sum of Nhauls	465	296	262	184	116	91	112	115
Sum of Nzero	34	16	6	9	3	24	10	8
Sum of Nmeas	22681	13305	23066	7017	3094	967	2135	2126

Figure 36. Number of hauls (Nhauls), number of zero catch hauls (Nzero) and total number of fish caught (Nmeas), for control and experimental gears, 3K Linetrawl .

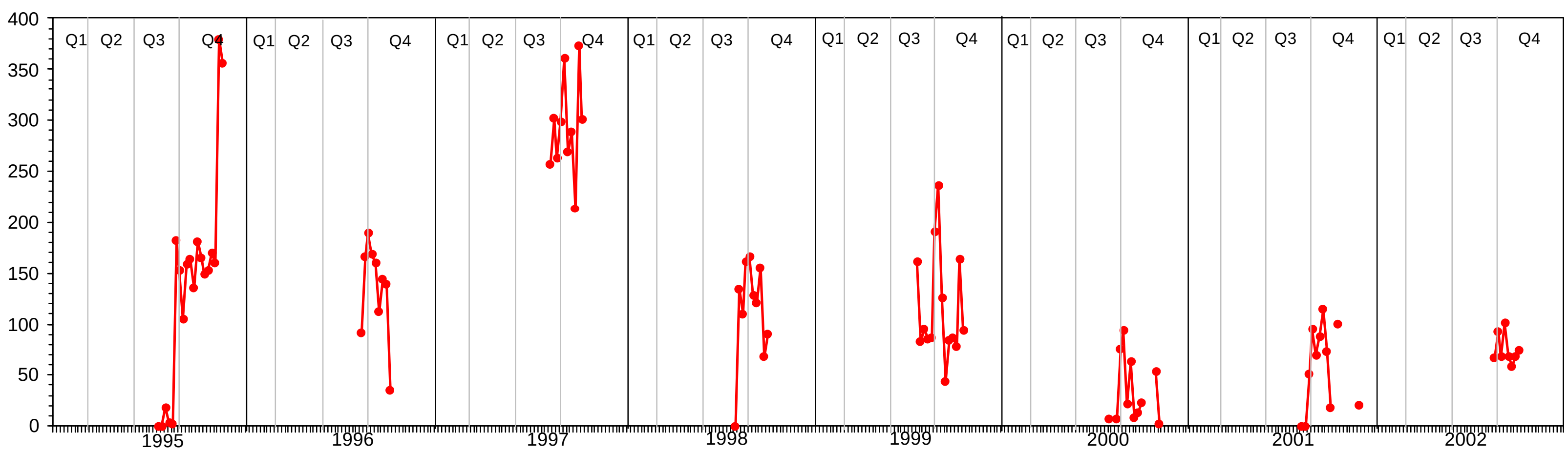


Figure 37. Catch per unit effort (in numbers of fish per 1000 hooks) for all sets (control and experimental) averaged for each week, 3K Linetrawl .

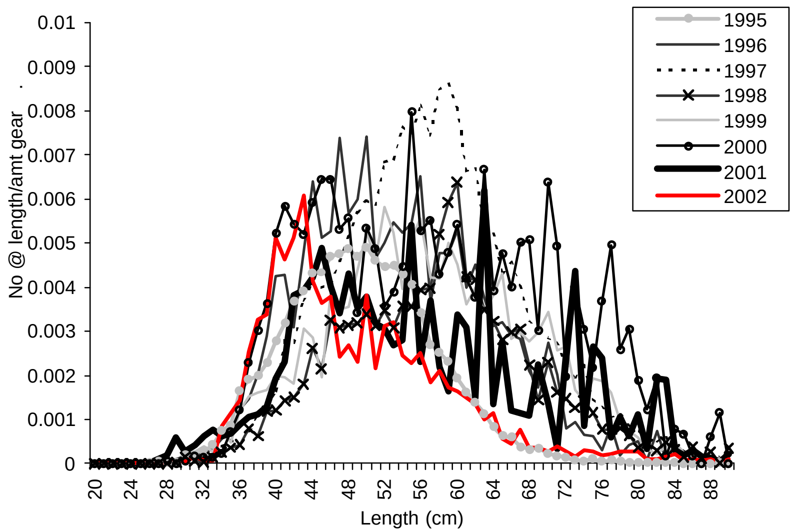
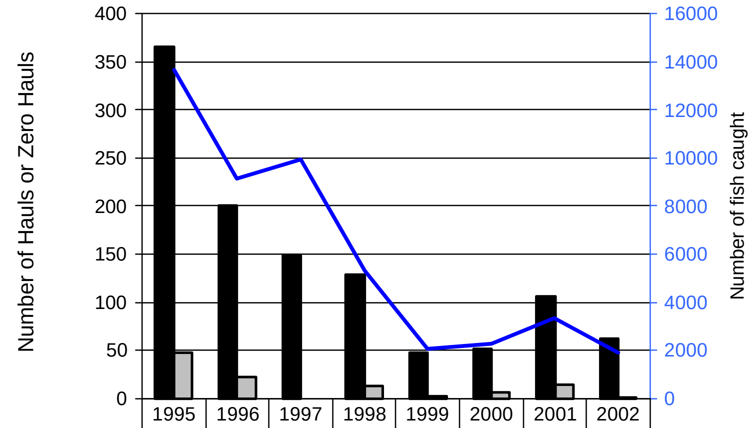


Figure 38. Relative length frequency (number at length / amount of gear) for control and experimental gears, 3L Linetrawl .



	1995	1996	1997	1998	1999	2000	2001	2002
Sum of Nhauls	365	201	149	129	47	52	106	62
Sum of Nzero	48	22	0	13	3	6	15	1
Sum of Nmeas	13662	9153	9938	5307	2072	2272	3331	1888

Figure 39. Number of hauls (Nhauls), number of zero catch hauls (Nzero) and total number of fish caught (Nmeas), for control and experimental gears, 3L Linetrawl .

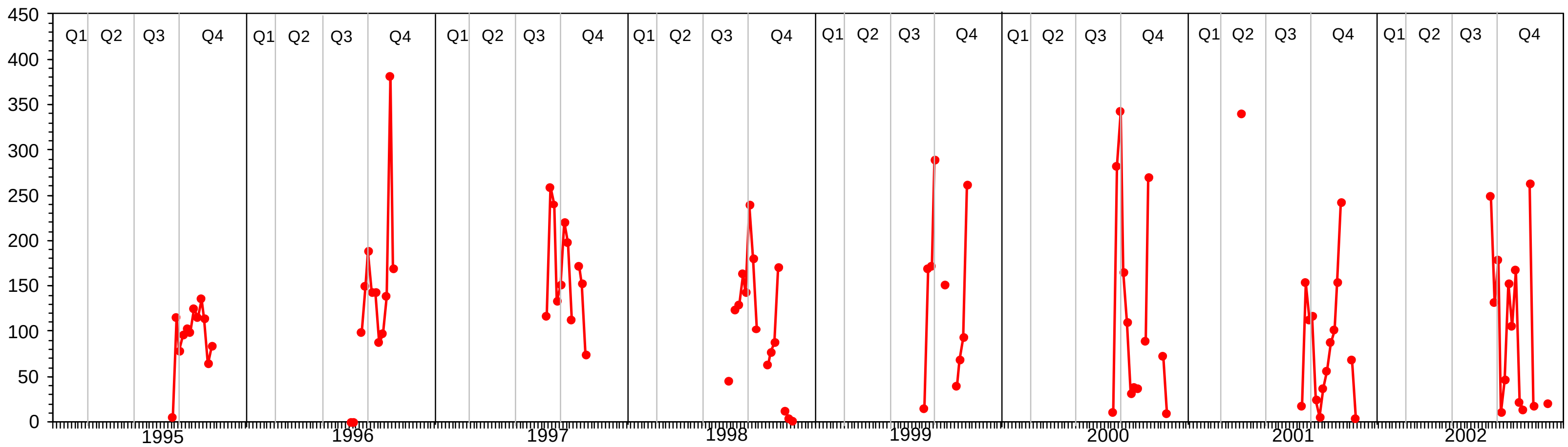


Figure 40. Catch per unit effort (in numbers of fish per 1000 hooks) for all sets (control and experimental) averaged for each week, 3L Linetrawl .