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Pollock (*Pollachius virens*) in NAFO Subdivision 3Ps

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ABSTRACT

An overview of the status of the Northwest Atlantic Fisheries Organization (NAFO) Subdivision (Subdiv.) 3Ps pollock stock is provided. Sources of information included data from commercial landings (1960 to 2013) and data from the Fisheries and Oceans Canada (DFO) research vessel (RV) surveys (1972-2013).

Although pollock in Subdiv. 3Ps have been fished commercially since the early 1960s, since 1991 it has generally been a bycatch fishery. Catches of pollock in the early 1960s declined from 4500 t in 1960 when most of the catch was taken by Spain. Since the extension of jurisdiction in 1977, catches have been mainly taken by Canada and France (St. Pierre). Catches were generally low from 1967-82 being less than 1000 t annually. Catches gradually increased, peaking at 7500 t in 1986 with the entry of the French Metropolitan fleet to the cod fishery. During the cod moratorium (1992-97) bycatches declined to pre-1980s levels and were less than 500 t. Bycatches since the 3Ps cod fishery reopened in 1997 have increased slightly but remain less than 1000 t annually. Reported commercial bycatch of pollock has remained relatively consistent from 1992 to 2013, ranging below 1000 t. Bycatches in recent years (2009-13) were in the range of 500 t.

Estimates from biomass and abundance indices are highly variable over the 1971-83 (Yankee 41.5 Ottertrawl), 1984-95 (Engel 145 Ottertrawl), and 1996-2013 (Campelen Shrimp Trawl) time series. Indices were generally low during the early 1970s and increased from the late 1970s to a time series peak in the mid-1980s. Indices generally stayed low until 2009 but spiked in 2010 and 2012. It is important to note that this assessment attempts to monitor a semi-pelagic species with the use of a bottom trawl and survey trends are therefore unlikely to reflect true stock trends. Hence, the information available is not considered suitable to assess stock level and provide catch options. However, it is clear that pollock have never occurred in Subdiv. 3Ps in large numbers. Their contribution to the groundfish fishery is based on the infrequent occurrence and survival of year-classes in the extreme north of their range.

La goberge (*Pollachius virens*) dans la sous-division 3Ps de l'OPANO

RÉSUMÉ

Le présent document fournit un aperçu de l'état du stock de goberge dans la sous-division 3Ps de l'Organisation des pêches de l'Atlantique Nord-Ouest (OPANO). Les sources de renseignements comprennent des données tirées des débarquements de la pêche commerciale (de 1960 à 2013) et des données tirées des relevés par navire scientifique de Pêches et Océans Canada (de 1972 à 2013).

Bien que la goberge dans la sous-division 3Ps soit pêchée à des fins commerciales depuis le début des années 1960, elle fait généralement l'objet d'une pêche accessoire depuis 1991. Au début des années 1960, les prises de goberge ont chuté; elles étaient de 4 500 t en 1960, alors que l'Espagne était le principal exploitant de cette ressource. Depuis l'élargissement de la zone réglementée en 1977, les prises sont principalement effectuées par le Canada et la France (Saint-Pierre). Les prises étaient généralement faibles de 1967 à 1982, soit moins de 1 000 t par année. Elles ont augmenté graduellement pour atteindre un sommet de 7 500 t en 1986, au moment de l'entrée de la flottille métropolitaine française dans la pêche de la morue. Durant le moratoire sur la morue (de 1992 à 1997), les prises accessoires ont chuté jusqu'aux niveaux observés avant les années 1980, à moins de 500 t. Depuis la réouverture de la pêche de la morue dans la division 3Ps en 1997, les prises accessoires ont légèrement augmenté, mais elles demeurent inférieures à 1 000 t par année. Les prises accessoires commerciales de goberge qui ont été déclarées sont demeurées relativement stables entre 1992 et 2013, soit en deçà de 1 000 t. Au cours des dernières années (de 2009 à 2013), les prises accessoires se situaient autour de 500 t.

Les estimations des indices de la biomasse et de l'abondance varient grandement dans les séries chronologiques de 1971 à 1983 (chalut à panneaux Yankee 41.5), de 1984 à 1995 (chalut à panneaux Engel 145) et de 1996 à 2013 (chalut à crevettes Campelen). Les indices étaient généralement faibles au début des années 1970, et ils ont augmenté à partir de la fin des années 1970 pour atteindre un sommet de la série chronologique au milieu des années 1980. Les indices sont généralement restés faibles jusqu'en 2009, mais ils ont connu un pic en 2010 et 2012. Il est important de noter que la présente évaluation tente de surveiller une espèce semi-pélagique à l'aide d'un chalut de fond et que les tendances dans les relevés ne reflètent donc probablement pas les véritables tendances du stock. Par conséquent, les renseignements disponibles ne sont pas considérés comme convenables pour évaluer le niveau du stock et fournir des possibilités de prises. Toutefois, il est évident que la goberge n'a jamais été observée en grand nombre dans la sous-division 3Ps. Sa contribution à la pêche du poisson de fond est tributaire de la présence occasionnelle et de la survie des classes d'âges à l'extrémité nord de son aire de répartition.

INTRODUCTION

Pollock occur on both sides of the North Atlantic, on the North American side from southern Labrador around Newfoundland into the Gulf of St. Lawrence, and south to Cape Hatteras. Pollock is a member of the cod family (Gadidae), but unlike most gadids they are pelagic in nature spending little time near the bottom. They are voracious eaters and often congregate in large numbers. As pelagic larvae they feed mainly on copepods, but as they settle and move inshore, crustacea, mainly amphipods, are the preferred food. As they increase in size, euphausiids, shrimp and small fish become part of the diet. In the offshore areas, sand lance, herring, silver hake, redfish and lanternfish become more important in the diet (Murphy 2003).

Pollock prefer waters from 0°C to 10°C, however maturation of sex organs and incubation of eggs requires temperatures in the upper range (DFO 2002). Therefore, Newfoundland waters are at the northern end of the pollock range.

This paper provides an assessment of the pollock stock in NAFO Subdiv. 3Ps (Figure 1) by providing analyses and conclusions with respect to data collected within both the commercial fisheries and DFO research vessel (RV) surveys.

THE FISHERY

Although pollock in Subdiv. 3Ps have been fished commercially since the early 1960s, it has generally been a bycatch fishery since 1991 (Table 1, Figure 2). From 2000 to 2013 the primary commercial fishing gears utilized for pollock were gillnet (57.6 %), longline (19.2 %), bottom stern otter trawl (14.3 %), and handline (6.1 %) (Table 2). Danish seine, pots, traps, midwater stern trawl, and Scottish seine were also reported, however they each constituted less than 1 % of gear utilization (Table 2). Commercial landings of pollock declined from 4500 t in 1960 when most of the catch was taken by Spain; through to the mid-1970s when less than 150 t was reported. Since the extension of jurisdiction in 1977, catches have been mainly taken by Canada and France (St. Pierre) (Table 1, Figure 2). Catches were generally low from 1977-82 being less than 1000 t annually. Catches increased, peaking at 7500 t in 1986 with the entry of the French Metropolitan fleet to the cod fishery (Table 1, Figure 2). During the cod moratorium (1992-97) bycatches declined to pre-1980s levels and were less than 500 t. Bycatches since the 3Ps cod fishery reopened in 1997 have increased slightly but remain less than 1000 t annually. Reported commercial bycatch of Pollock has remained relatively consistent from 1992 to 2013, ranging below 1000 t in all years except 2007 when 1132 t was landed. Bycatches in recent years (2009-13) were in the range of 500 t (Table 1, Figure 2).

POLLOCK BY-CATCH CHARACTERISTICS

Pollock bycatch in Subdiv. 3Ps has generally been in the range of < 10 % of the directed species although fisheries for certain species have occasionally exhibited substantially higher bycatch rates (Table 3, Figure 3). The high pollock by-catch percentages in certain years are usually associated with relatively small catches of the directed species.

From 2009-13, pollock by-catch expressed as a percentage of directed species catch ranged from 93.6-210.1 % (mean 122.7 %) for white hake, 0.2-108 % (mean 22.3 %) for redfish, 0.5-39.8 % (mean 9.1 %) for monkfish, 0-8.1 % (mean 2.4 %) for skate, 0.9-3.8 % (mean 2.1 %) for cod 0-5.4 % (mean 1.5 %) and 0-5.4 % (mean 1.5 %) for witch flounder (Table 3, Figure 3).

The mean percentage of the total annual pollock by-catch (2009-13) for all directed species combined indicates that the majority of the pollock by-catch occurs within the white hake (56.5 %) and cod (38 %) fisheries (Table 3, Figure 4). For the 2009-2013 period 25,144 t of cod

(476 t of pollock by-catch) and 641 t of white hake (730 t of pollock by-catch) were harvested respectively from Subdiv. 3Ps (Table 3).

Directed fisheries in Subdiv. 3Ps which have reported a negligible pollock by-catch include; haddock, halibut, winter flounder, turbot, dogfish, lumpfish, herring, and tuna.

RESEARCH VESSEL SURVEYS

Canada has conducted research vessel (RV) surveys in Subdiv. 3Ps using the stratified random design since 1972 (Figure 5). Surveys were conducted primarily in February to March prior to 1993 but since then have been conducted in April (DFO 2002). Strata were added to the inshore of Placentia Bay in 1994. In 1997, strata were added to the inshore of Fortune Bay and in inshore areas westward of the Subdiv. 3Pn line (Figure 5).

The vessels and survey gear used to conduct the survey have changed over time. The A.T. Cameron conducted surveys from 1972-83 using the Yankee 41.5 ottertrawl. From 1984 to 1995 the Wilfred Templeman or its sister ship the Alfred Needler conducted the survey using the Engel 145 hi-rise ottertrawl. Since 1996 the Wilfred Templeman, Teleost, and Alfred Needler have conducted the survey using the Campelen 1800 shrimp trawl.

The use of the research vessel ottertrawl time series as an indicator of stock status is complicated by various vessel and gear changes over time. Insufficient data was available from comparative fishing experiments to provide data conversion factors for pollock. Therefore the data for each gear needs to be treated as a different dataset and no comparisons made among them.

Due to the semi-pelagic nature of pollock, research vessel (bottom trawl) surveys may not provide representative indices of abundance and biomass.

Recent information on growth rates and age at maturity are not available.

ABUNDANCE AND BIOMASS INDICES

Mean number per tow (abundance) and mean weight per tow (biomass) were used to evaluate stock status. There is no analytical assessment model for this stock. Abundance indices (mean#/tow) for the Yankee time series were generally low during the early 1970s but showed an increasing trend during the late 1970s and early 1980s (Tables 4, 5, and 6; Figure 6). Abundance indices for the Engel time series gradually increased during the 1980s to the highest values of the overall time series in 1987 but then indicated a steep decreasing trend towards the mid 1990s (Tables 4, 5, and 6; Figure 6). Abundance indices for the Campelen time series increased from the mid 1990s to 2001, declined from 2001 to 2008 and exhibited a variable but generally increasing trend from 2009 to 2013 (Tables 4, 5, and 6; Figure 6).

Biomass indices (mean weight/tow) for the Yankee time series were generally low during the early 1970s but showed an increasing trend during the late 1970s and early 1980s (Tables 4, 5, and 6; Figure 7). Biomass indices for the Engel time series gradually increased during the 1980s to the highest values of the overall time series in 1987 but then indicated a steep decreasing trend towards the mid-1990s (Tables 4, 5, and 6; Figure 7). Biomass indices for the Campelen time series increased from the mid 1990s to 1999, declined steeply in 2000, remained relatively low from 2000 to 2008 and exhibited a variable but generally increasing trend from 2009 to 2013 (Tables 4, 5, and 6; Figure 7).

LENGTH FREQUENCIES

Length data was analyzed for the 2003 to 2013 time period. The survey length analysis was hampered by large fluctuations in abundance, sporadic large tows, and variable size distributions. Despite these limitations, tracking of pulses of recruitment indicated a peak at 40 cm in 2003 which was tracked through to approximately 78 cm in 2009 and a peak at 30 cm in 2009 which was tracked through to approximately 58 cm in 2012 (Figure 8).

The lack of aging data precluded a complete catch at age analysis.

DISTRIBUTION

RV surveys for pollock in Subdiv. 3Ps from 1986 to 2013 indicate that mature fish occur predominantly along the slopes of St. Pierre Bank and the slopes of the southern Grand Bank (Figure 9). Since the inclusion of inshore sampling in 1994 pollock have occasionally (2000, 2001, and 2002) been encountered within Fortune Bay and within inshore strata west of Fortune Bay (Figure 9).

One of the questions raised related to pollock in Subdiv. 3Ps is whether the population in the area constitutes a discrete stock or if it is a northward extension of the Scotian Shelf stock (Divisions 4VWX and Subdiv. 5Zc). Survey indices indicate that pollock are present in both the winter and spring portions of the time series. Commercial catches (though sometimes low) have been recorded in all areas in all months. Catch and survey data indicate pollock of all sizes and all stages of maturity, from maturing to spent have been recorded (Neilson et al. 2003, DFO 2005). A comprehensive review of NL and Maritimes commercial fisheries data, tagging studies, and research survey data concluded that the current boundaries are appropriate and 3Ps pollock should continue to be managed as a separate population (Murphy 2003).

ECOSYSTEM

There is a clear warming signal in the 3Ps region; since the early 1990s, bottom temperature during the spring survey has been increasing at an average rate of around 3 % per year. Although trends of the overall fish community in the 1980s and early 1990s are potentially confounded with changes in the RV survey (e.g. timing of survey, sampling effort, gear change), it is evident that the overall fish community declined during the mid-1980s and early 1990s. This decline was also accompanied by a decrease in the average fish size. Overall, the biomass and abundance of the entire fish community has increased since the mid-1990s.

Changes in biomass/abundance (BA) ratio at the fish community level can be explained by changes in community composition, like recent increases in planktivores. Pollock has shown substantial fluctuations over time and although 2010 and 2012 were relatively strong years they were still below the levels encountered in the mid-1980s. During the early 2010s, dominance of cod seems to be increasing among piscivores, but other gadoids (e.g. silver hake) also seem to be increasing within this functional group. Among large benthivores, American plaice biomass levels have shown very few changes since the mid-1990s. This functional group has been dominated by thorny skate and American plaice. The observed warming within Subdiv. 3Ps, together with recent increases of “warmer-water” species like sandlance, silver hake, and pollock suggests that this ecosystem could be undergoing structural changes.

CONCLUSION

Pollock have never occurred in Subdiv. 3Ps in large numbers. Their contribution to the groundfish fishery is based on the infrequent occurrence and survival of year-classes in the extreme north of their range.

Although pollock remains under moratorium, the 3Ps Atlantic cod fishery reopened in 1997. Reported commercial by-catch of pollock has remained relatively consistent from 1992 to 2013, ranging below 1000 t (except for 1132 t in 2007).

From 2009 to 2013 the highest percentage of pollock by-catch was associated with directed fisheries for white hake (123 %), redfish (22 %), and monkfish (2.4 %). However, when the relative scale of each directed fishery is incorporated into the analysis the mean % of the pollock by-catch for all directed species combined indicates that the majority of the pollock by-catch occurs within the white hake (57 %) and cod (38 %) fisheries.

From 2009 to 2013 the primary commercial fishing gears utilized for pollock were gillnet (58 %), longline (19 %), bottom stern otter trawl (14 %), and handline (6 %)

RV surveys for pollock in Subdiv. 3Ps from 1983 to 2013 indicate they are distributed predominantly in the warmer waters along the slopes of the St. Pierre Bank and the slopes of the southern Grand Bank.

Biomass and abundance indices estimates indicate substantial variability over the 1972-2013 time series. In recent years, biomass and abundance spiked in 2010 and 2012 but both were relatively low in all but one or two years in the Campelen time series.

In light of issues identified with respect to gear variability and the use of bottom trawl surveys to survey pollock (a semi-pelagic species) and the lack of recent aging/growth data, the information currently available is not sufficient to quantitatively assess stock level and provide catch recommendations at this time.

The influence of recent increases in surface temperatures in Subdiv. 3Ps may result in increased larval survival for a variety of fish species. Increased temperatures could potentially favour warm water species, such as pollock, potentially leading to changes in community structure.

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APPENDIX I - TABLES

Table 1. NAFO Subdivision 3Ps pollock commercial landings (t) and TACs from 1960 to 2013.

Year	Canadian	Foreign	Totals	TAC Can
1960	502	4,019	4,521	na
1961	547	2,117	2,664	na
1962	621	542	1,163	na
1963	455	314	769	na
1964	265	495	760	na
1965	178	423	601	na
1966	233	293	526	na
1967	194	423	617	na
1968	109	336	445	na
1969	64	123	187	na
1970	83	379	462	na
1971	77	199	276	na
1972	154	157	311	na
1973	121	145	266	na
1974	134	84	218	na
1975	100	23	123	na
1976	69	68	137	na
1977	835	4	839	na
1978	430	2	432	na
1979	718	59	777	na
1980	570	94	664	na
1981	246	42	288	na
1982	434	336	770	na
1983	929	181	1,110	na
1984	1,319	497	1,816	na
1985	1,328	956	2,284	na
1986	5,400	2,152	7,552	na
1987	2,311	2,760	5,071	1,500
1988	1,752	2,514	4,266	5,400
1989	2,159	1,145	3,304	5,400
1990	1,581	1,200	2,781	5,400
1991	1,263	341	1,604	5,400
1992	475	82	557	5,400
1993	137	0	137	600
1994	93	0	93	500
1995	290	0	290	100
1996	441	0	441	100

Year	Canadian	Foreign	Totals	TAC Can
1997	594	14	608	na
1998	639	13	652	na
1999	750	5	755	na
2000	826	37	863	na
2001	828	13	841	na
2002	534	135	669	na
2003	391	225	616	na
2004	323	292	615	na
2005	534	16	550	na
2006	793	12	805	na
2007	1,112	20	1,132	na
2008	620	3	623	na
2009	308	8	316	na
2010	391	22	413	na
2011	194	6	200	na
2012	413	8	421	na
2013	162	22	184	na

Table 2. Commercial Fishing Percent Landings by Gear Type for 3Ps Pollock 2000-13 (NL – all Fisheries Combined).

Gear Type	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Mean 2000-13
Gillnet (Fixed)	56.9	57.6	57.4	56.3	55.3	64.8	62.5	53.1	51.8	53.6	58.7	62.6	67.6	46.7	57.6
Longline	22.2	14.6	14.2	15.8	17.8	19.5	16.1	23.8	24.8	22.3	24.0	17.6	21.1	23.3	19.2
Otter Trawl (Stern)	9.7	20.5	15.4	14.2	14.5	7.5	14.1	15.6	14.6	17.0	13.3	15.4	4.2	26.7	14.3
Handline	2.8	6.0	6.2	7.7	9.9	6.3	6.3	6.9	8.8	6.3	4.0	3.3	4.2	0.0	6.1
Danish Seine	1.4	0.7	2.5	2.2	1.3	0.0	0.5	0.0	0.0	0.9	0.0	0.0	0.0	3.3	0.9
Pot	2.8	0.0	3.7	1.1	0.0	1.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8
Trap	0.0	0.0	0.0	2.7	1.3	0.6	0.0	0.6	0.0	0.0	0.0	1.1	2.8	0.0	0.6
Mid Trawl (Stern)	2.8	0.7	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
Scottish Seine	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1

Table 3. Directed fisheries catches (t), pollock bycatch (t), % pollock bycatch for each species, and % of total combined pollock bycatch for each species for NAFO Subdivision 3Ps (2009-13).

Fishery	2009	2010	2011	2012	2013	Mean %
Cod (NL 3Ps catch)	6404.29	6336.623	5238.455	4181.071	2983.308	na
Pollock 3Ps bycatch	108.58	84.46	44.58	158	79.98	na
% bycatch (of total cod catch)	1.7	1.33	0.85	3.78	2.68	2.07
% of total pollock bycatch	36.16	25.89	25.07	49.48	53.34	37.99
Redfish (NL 3Ps catch)	578.62	329.456	271.518	112.937	2.183	na
Pollock 3Ps bycatch	8.67	0.63	1.85	1.37	2.36	na
% bycatch (of total redfish catch)	1.5	0.19	0.68	1.21	108.11	22.34
% of total pollock bycatch	2.89	0.19	1.04	0.43	1.57	1.22
White Hake (NL 3Ps catch)	181.534	212.983	99.605	72.727	73.767	na
Pollock 3Ps bycatch	169.92	222.29	128.91	152.83	56.09	na
% bycatch (of total white hake catch)	93.6	104.37	129.42	210.14	76	122.71
% of total pollock bycatch	56.59	68.15	72.49	47.86	37.41	56.50
Monkfish (NL 3Ps catch)	64.777	30.021	25.431	18.045	0	na
Pollock 3Ps bycatch	0.935	1.253	0.118	7.098	0	na
% bycatch (of total monkfish catch)	1.44	4.17	0.46	39.33	0	9.08
% of total pollock bycatch	0.31	0.38	0.07	2.22	0.00	0.60
Skate (NL 3Ps catch)	419.73	215.645	383.951	277.152	207.844	na
Pollock 3Ps bycatch	3.17	17.4	2.23	0.007	0.005	na
% bycatch (of total skate catch)	0.76	8.07	0.58	0	0	1.88
% of total pollock bycatch	1.06	5.33	1.25	0.00	0.00	1.53
Witch (NL 3Ps catch)	424.331	365.736	152.642	161.185	211.988	na
Pollock 3Ps bycatch	8.99	0.16	0.15	0	11.5	na
% bycatch (of total witch catch)	2.12	0.04	0.1	0	5.42	1.54
% of total pollock bycatch	2.99	0.05	0.08	0.00	7.67	2.16

Table 4. Research vessel abundance (mean #/tow) and biomass (mean kg/tow) indices estimates for Pollock in NAFO Subdivision 3Ps 1972-2013 (inshore and offshore strata combined).

Year	Gear	Abundance Index - Mean#/Tow	Abundance Index - Lower Limit	Abundance Index - Upper Limit	Biomass Index - Mean Wt/Tow	Biomass Index - Lower Limit	Biomass Index - Upper Limit
1972	Yankee	0.08	-0.13	0.28	0.06	-0.07	0.19
1973	Yankee	0.11	-0.05	0.27	0.13	-0.01	0.26
1974	Yankee	0.28	0.09	0.47	0.31	0.02	0.59
1975	Yankee	0.09	-0.06	0.24	0.09	-0.05	0.22
1976	Yankee	0.02	-0.21	0.24	0.02	-0.19	0.22
1977	Yankee	0.25	0.06	0.45	0.59	-0.15	1.34
1978	Yankee	0.17	0.05	0.29	0.27	0.08	0.47
1979	Yankee	0.50	-0.38	1.37	1.03	-0.58	2.63
1980	Yankee	0.59	-4.62	5.80	1.29	-9.62	12.21
1981	Yankee	1.23	-3.55	6.02	3.30	-9.41	16.01
1982	Yankee	0.49	0.18	0.81	1.05	-0.26	2.35
1983	Yankee	0.34	0.13	0.56	0.87	0.17	1.57
1984	Engels	0.42	0.05	0.79	0.68	-0.29	1.65
1985	Engels	2.49	-23.22	28.21	3.16	-27.83	34.16
1986	Engels	1.19	0.55	1.83	2.05	1.17	2.93
1987	Engels	3.06	-3.33	9.45	6.02	-4.32	16.35
1988	Engels	0.95	0.55	1.34	1.75	0.49	3.02
1989	Engels	0.88	0.56	1.20	1.77	1.20	2.33
1990	Engels	0.35	0.15	0.55	0.73	0.32	1.14
1991	Engels	0.15	0.08	0.23	0.27	0.08	0.46
1992	Engels	0.42	-3.86	4.69	1.06	-10.36	12.48
1993	Engels	0.06	na	na	0.13	na	na
1994	Engels	0.08	na	na	0.17	na	na
1995	Engels	0.13	na	na	0.34	na	na
1996	Campelen	0.12	-0.04	0.27	0.14	-0.08	0.36
1997	Campelen	0.05	0.00	0.11	0.08	-0.06	0.22
1998	Campelen	0.02	0.00	0.04	0.02	-0.01	0.05
1999	Campelen	0.81	-0.51	2.12	2.29	-1.53	6.11
2000	Campelen	0.06	-0.01	0.14	0.15	0.00	0.29
2001	Campelen	1.88	-0.79	4.54	0.37	-0.01	0.75
2002	Campelen	0.04	-0.04	0.12	0.12	-0.80	1.05
2003	Campelen	0.52	-0.87	1.91	0.48	-1.28	2.23
2004	Campelen	0.42	-0.17	1.00	1.08	-0.96	3.12
2005	Campelen	0.09	-0.21	0.39	0.14	-0.35	0.64
2006	Campelen	0.29	-2.53	3.12	0.67	-5.13	6.47
2007	Campelen	0.11	0.02	0.21	0.24	0.03	0.45
2008	Campelen	0.07	0.00	0.15	0.15	-0.11	0.42
2009	Campelen	0.24	0.11	0.37	0.54	0.12	0.96
2010	Campelen	1.58	-0.24	3.40	4.20	-0.60	8.99
2011	Campelen	0.12	-0.02	0.26	0.10	-0.26	0.45
2012	Campelen	1.97	-6.17	10.10	4.32	-13.60	22.25
2013	Campelen	0.74	-2.21	3.69	1.69	-0.66	4.04

Table 5. Research vessel abundance (mean #/tow) and biomass (mean kg/tow) indices estimates for pollock in NAFO Subdivision 3Ps 1972-2013 (offshore strata only).

Year	Gear	Abundance Index - Mean#/Tow	Abundance Index - Lower Limit	Abundance Index - Upper Limit	Biomass Index - Mean Wt/Tow	Biomass Index - Lower Limit	Biomass Index - Upper Limit
1972	Yankee	0.08	-0.13	0.28	0.06	-0.07	0.19
1973	Yankee	0.11	-0.05	0.27	0.13	-0.01	0.26
1974	Yankee	0.28	0.09	0.47	0.31	0.02	0.59
1975	Yankee	0.09	-0.06	0.24	0.09	-0.05	0.22
1976	Yankee	0.02	-0.21	0.24	0.02	-0.19	0.22
1977	Yankee	0.25	0.06	0.45	0.59	-0.15	1.34
1978	Yankee	0.17	0.05	0.29	0.27	0.08	0.47
1979	Yankee	0.50	-0.38	1.37	1.03	-0.58	2.63
1980	Yankee	0.59	-4.62	5.80	1.29	-9.62	12.21
1981	Yankee	1.23	-3.55	6.02	3.30	-9.41	16.01
1982	Yankee	0.49	0.18	0.81	1.05	-0.26	2.35
1983	Yankee	0.34	0.13	0.56	0.87	0.17	1.57
1984	Engels	0.42	0.05	0.79	0.68	-0.29	1.65
1985	Engels	2.49	-23.22	28.21	3.16	-27.83	34.16
1986	Engels	1.19	0.55	1.83	2.05	1.17	2.93
1987	Engels	3.06	-3.33	9.45	6.02	-4.32	16.35
1988	Engels	0.95	0.55	1.34	1.75	0.49	3.02
1989	Engels	0.88	0.56	1.20	1.77	1.20	2.33
1990	Engels	0.35	0.15	0.55	0.73	0.32	1.14
1991	Engels	0.15	0.08	0.23	0.27	0.08	0.46
1992	Engels	0.42	-3.86	4.69	1.06	-10.36	12.48
1993	Engels	0.06	na	na	0.13	na	na
1994	Engels	0.08	na	na	0.17	na	na
1995	Engels	0.13	na	na	0.34	na	na
1996	Campelen	0.12	-0.04	0.27	0.14	-0.08	0.36
1997	Campelen	0.05	0.00	0.11	0.08	-0.06	0.22
1998	Campelen	0.02	0.00	0.04	0.02	-0.01	0.05
1999	Campelen	0.81	-0.51	2.12	2.29	-1.53	6.11
2000	Campelen	0.06	-0.01	0.14	0.15	0.00	0.29
2001	Campelen	1.88	-0.79	4.54	0.37	-0.01	0.75
2002	Campelen	0.04	-0.04	0.12	0.12	-0.80	1.05
2003	Campelen	0.52	-0.87	1.91	0.48	-1.28	2.23
2004	Campelen	0.42	-0.17	1.00	1.08	-0.96	3.12
2005	Campelen	0.09	-0.21	0.39	0.14	-0.35	0.64
2006	Campelen	0.29	-2.53	3.12	0.67	-5.13	6.47
2007	Campelen	0.11	0.02	0.21	0.24	0.03	0.45
2008	Campelen	0.07	0.00	0.15	0.15	-0.11	0.42
2009	Campelen	0.24	0.11	0.37	0.54	0.12	0.96
2010	Campelen	1.58	-0.24	3.40	4.20	-0.60	8.99
2011	Campelen	0.12	-0.02	0.26	0.10	-0.26	0.45
2012	Campelen	1.97	-6.17	10.10	4.32	-13.60	22.25
2013	Campelen	0.74	-2.21	3.69	1.69	-0.66	4.04

Table 6. Research vessel abundance (mean #/tow) and biomass (mean kg/tow) indices estimates for Pollock in NAFO Subdivision 3Ps 1996-2013 (inshore strata only).

Year	Gear	Abundance Index - Mean#/Tow	Abundance Index - Lower Limit	Abundance Index - Upper Limit	Biomass Index - Mean Wt/Tow	Biomass Index - Lower Limit	Biomass Index - Upper Limit
1996	Campelen	0.00	na	na	0.00	na	na
1997	Campelen	0.06	-0.68	0.80	0.05	-0.63	0.74
1998	Campelen	0.06	-0.13	0.25	0.01	-0.02	0.03
1999	Campelen	0.53	-0.13	1.18	0.99	-1.10	3.08
2000	Campelen	0.21	-0.69	1.12	0.35	-1.66	2.36
2001	Campelen	2.23	2.08	6.56	0.30	-1.55	2.14
2002	Campelen	5.04	-39.90	50.08	1.13	-9.11	11.38
2003	Campelen	0.00	na	na	0.00	na	na
2004	Campelen	0.00	na	na	0.00	na	na
2005	Campelen	0.00	na	na	0.00	na	na
2006	Campelen	0.10	-0.21	0.40	0.22	-0.47	0.92
2007	Campelen	0.03	-0.32	0.37	0.01	-0.03	0.04
2008	Campelen	0.00	na	na	0.00	na	na
2009	Campelen	0.00	na	na	0.00	na	na
2010	Campelen	0.28	0.14	0.42	0.05	-0.25	0.36
2011	Campelen	0.09	-0.28	0.46	0.02	0.02	0.02
2012	Campelen	0.34	-0.78	1.47	0.18	-0.75	1.11
2013	Campelen	0.10	-0.35	0.55	0.02	-0.14	0.18

APPENDIX II - FIGURES

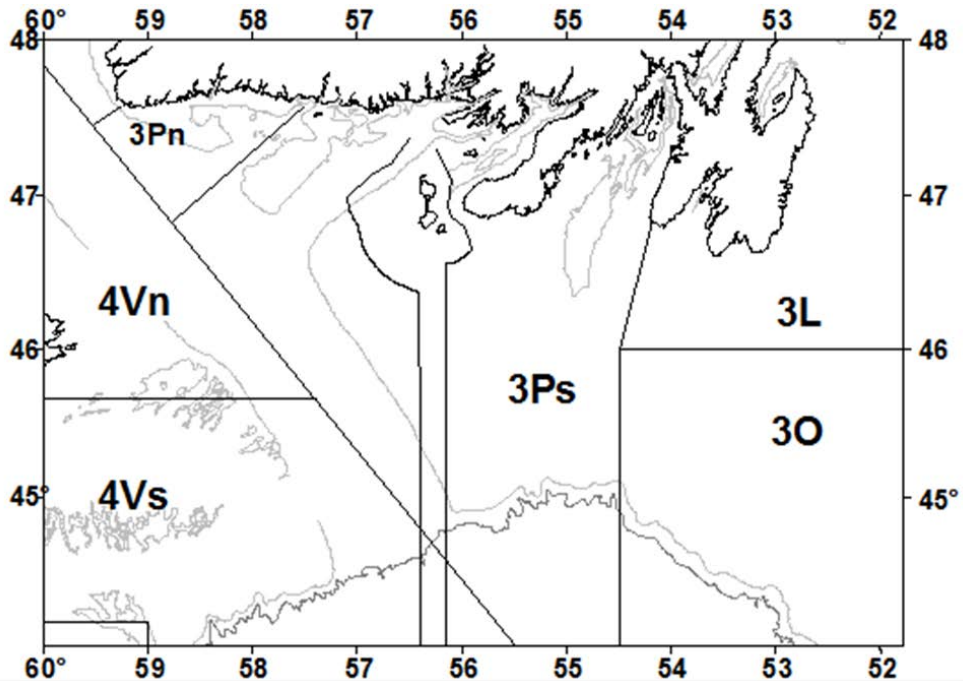


Figure 1. NAFO Subdivision 3Ps.

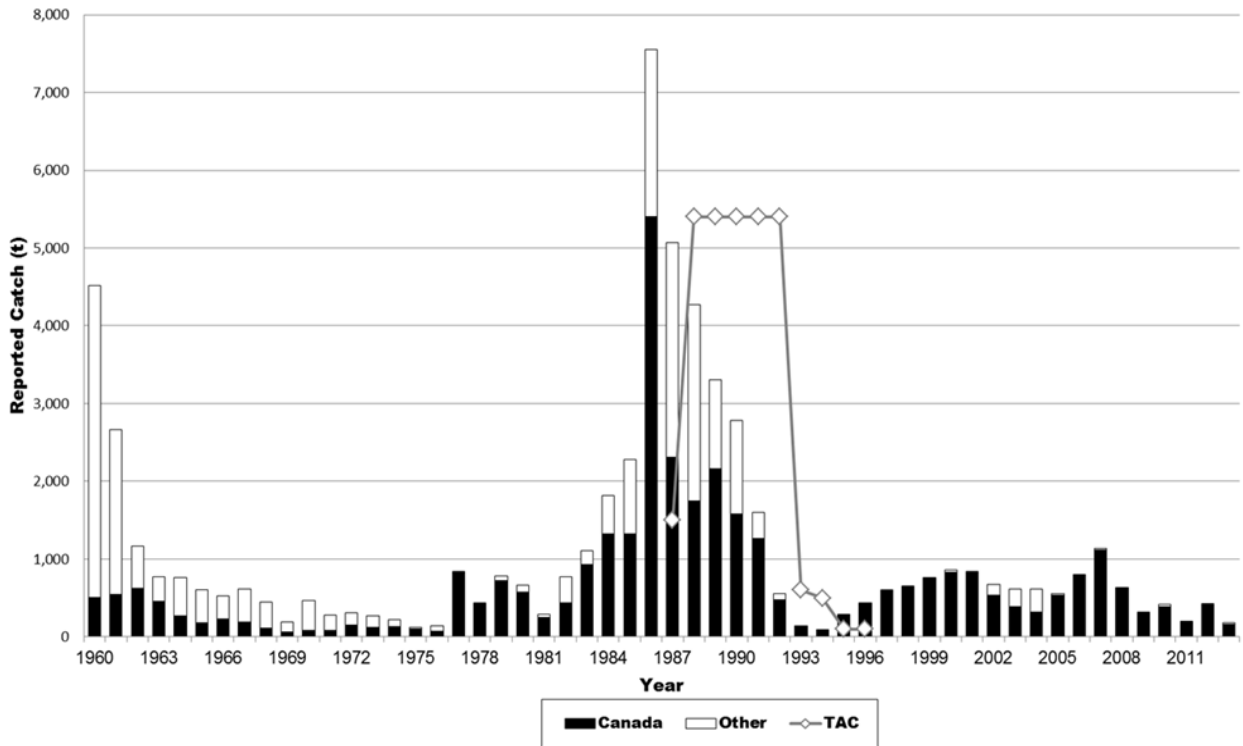


Figure 2. NAFO Subdivision 3Ps pollock commercial landings (t) and TACs from 1960 to 2013.

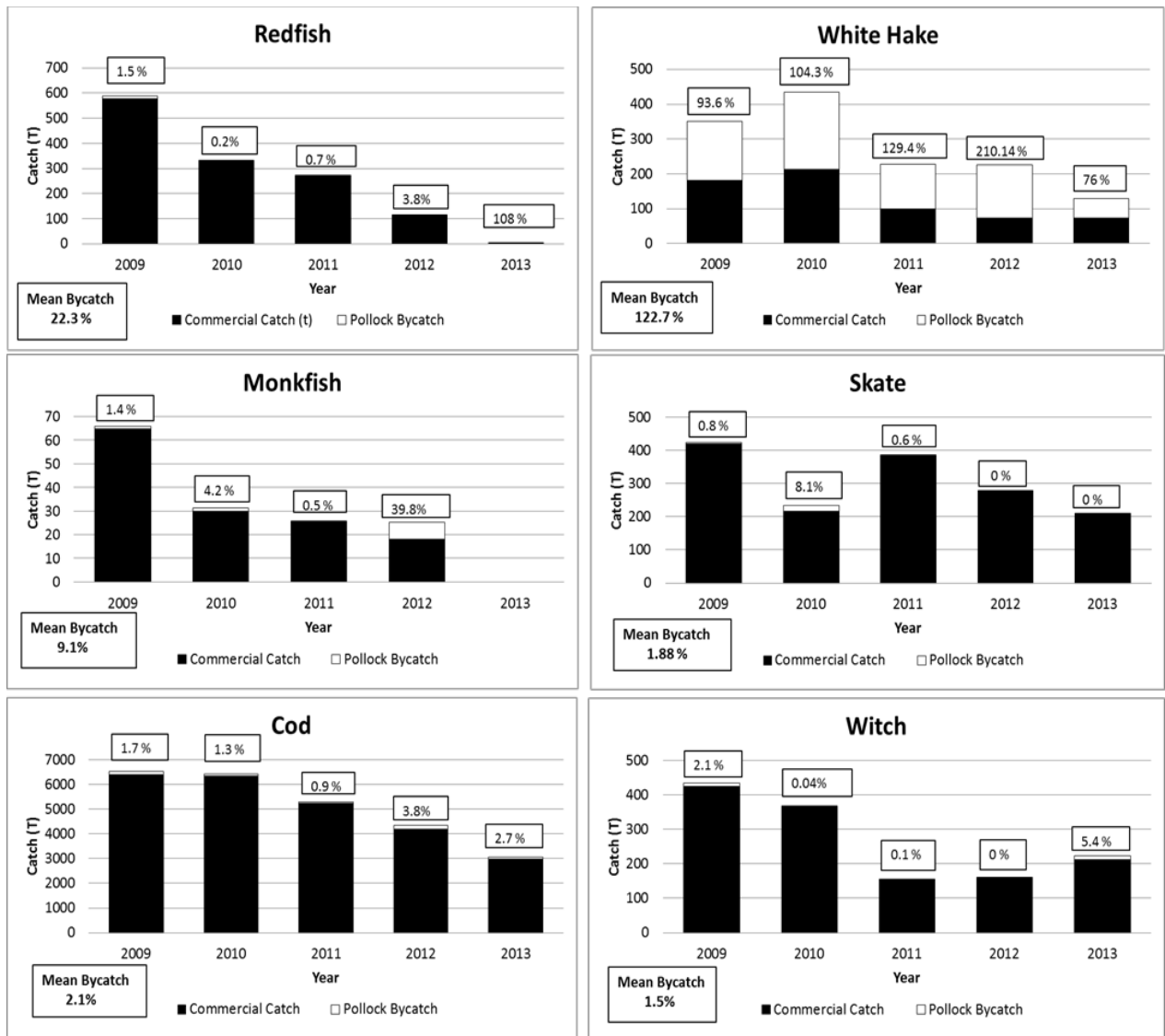


Figure 3. Pollock bycatch (t) as a percentage of NL directed commercial fisheries in NAFO Subdivision 3Ps (2009-13).

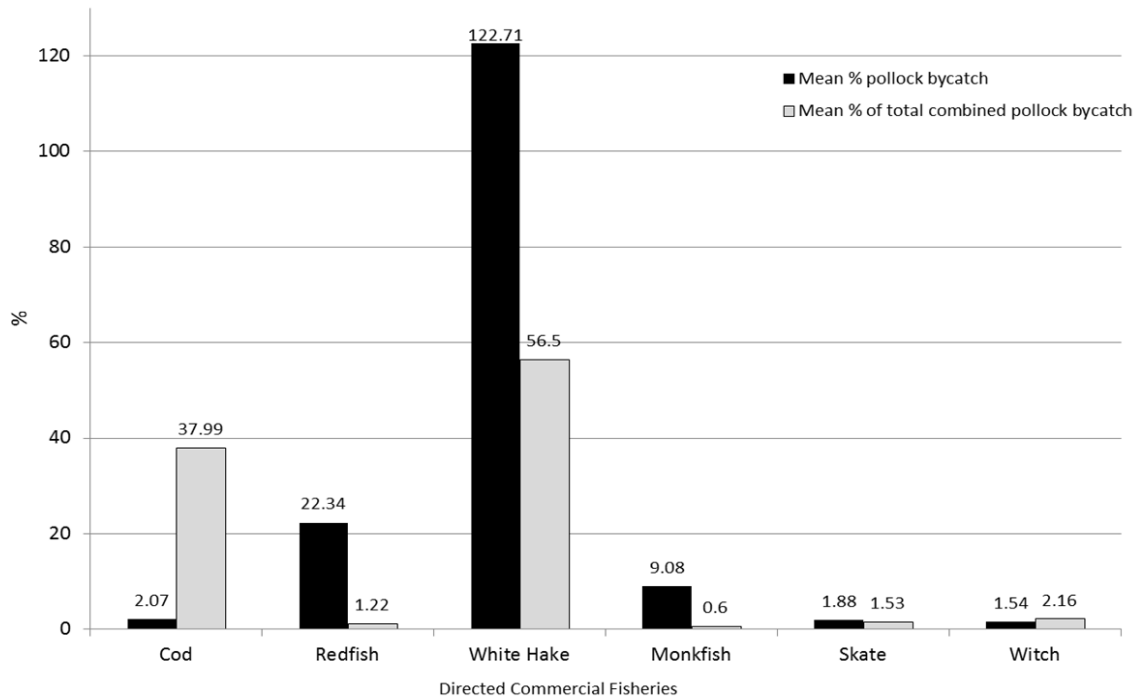


Figure 4. Mean % of pollock bycatch and mean % of total combined pollock bycatch for directed fisheries in NAFO Subdivision 3Ps from 2009-13.

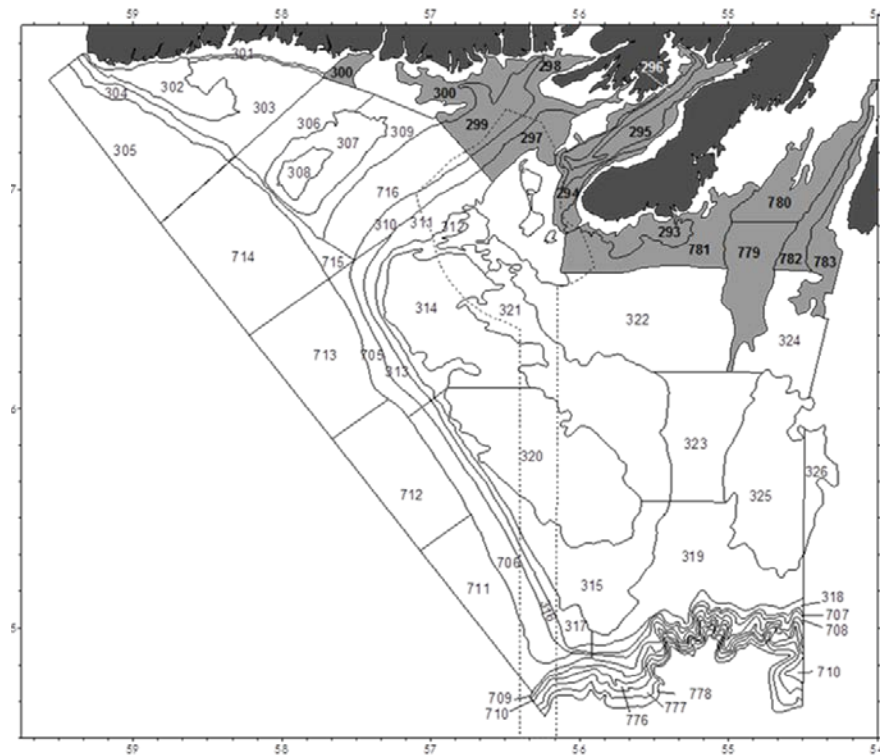


Figure 5. Map delineating the original 1972-1994 survey area (white outline), 1994 Placentia Bay extension (grey) and 1997 Fortune Bay extension (grey) within NAFO Subdivision 3Ps.

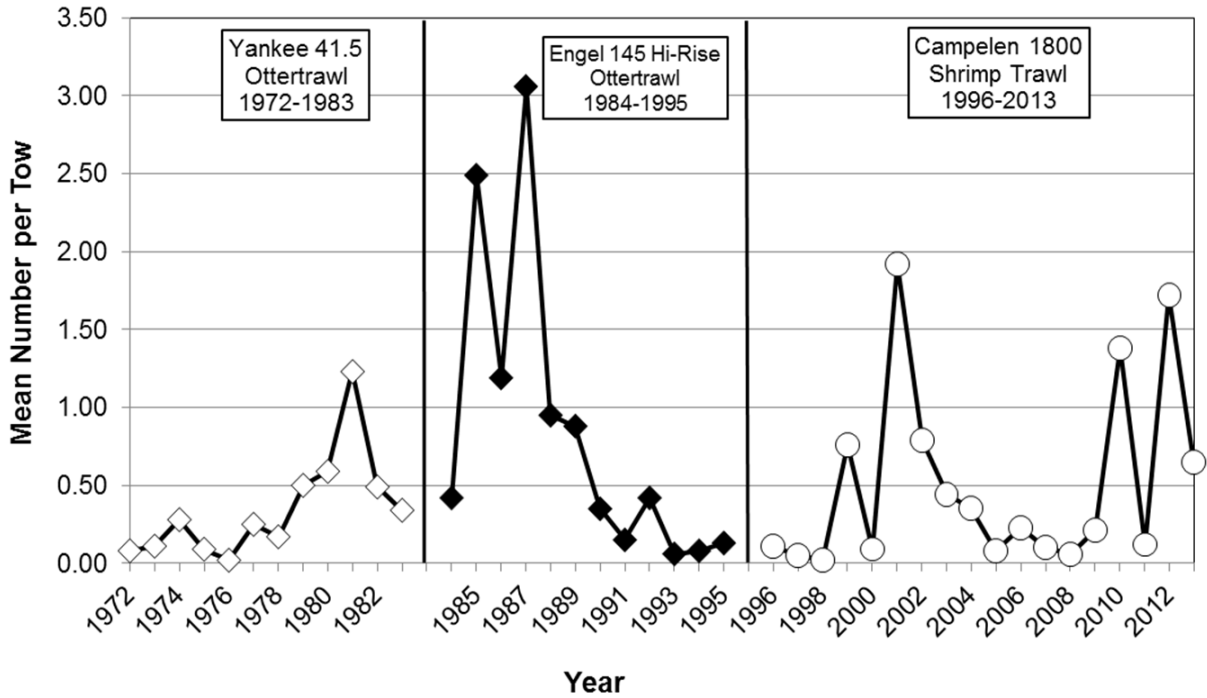


Figure 6. Research vessel survey abundance (mean #/tow) indices for Pollock in NAFO Subdivision 3Ps (1972-2013). Note that conversion factors are not available for the three datasets and hence only trends, not absolute values, can be compared. Vertical lines between each dataset emphasize this point.

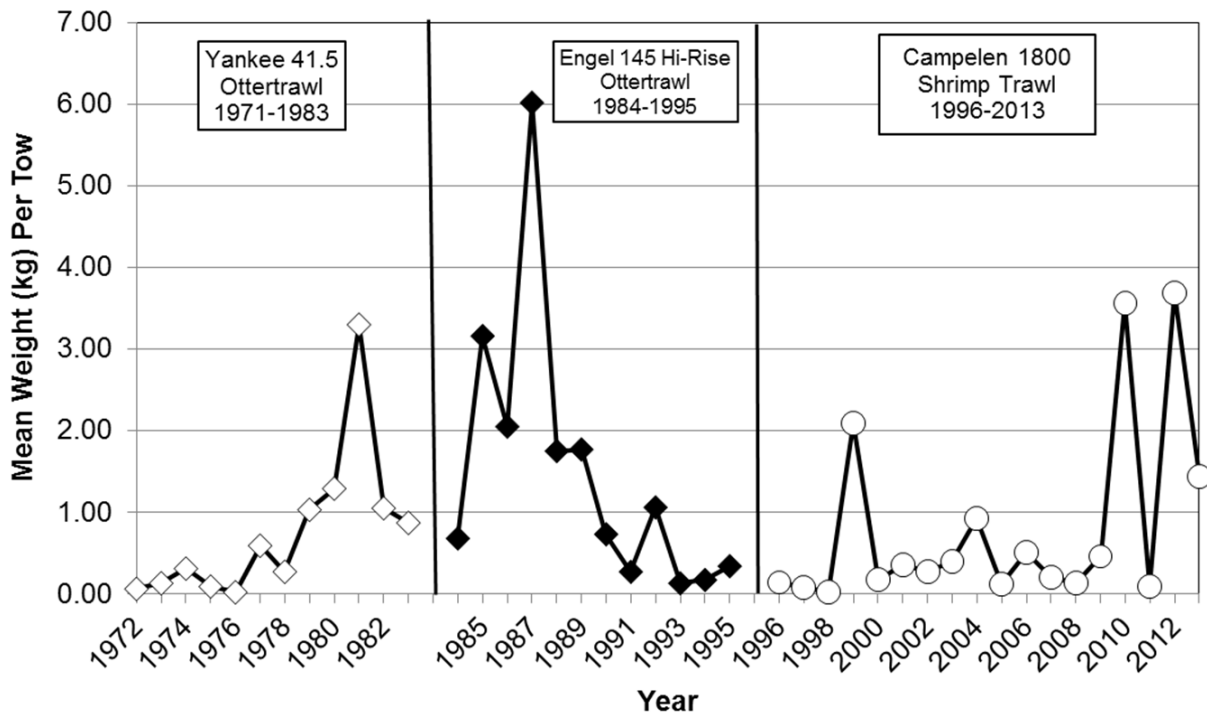


Figure 7. Research vessel survey biomass (mean kg/tow) indices for Pollock in NAFO Subdivision 3Ps (1972-2013). Note that conversion factors are not available for the three datasets and hence only trends, not absolute values, can be compared. Vertical lines between each dataset emphasize this point.

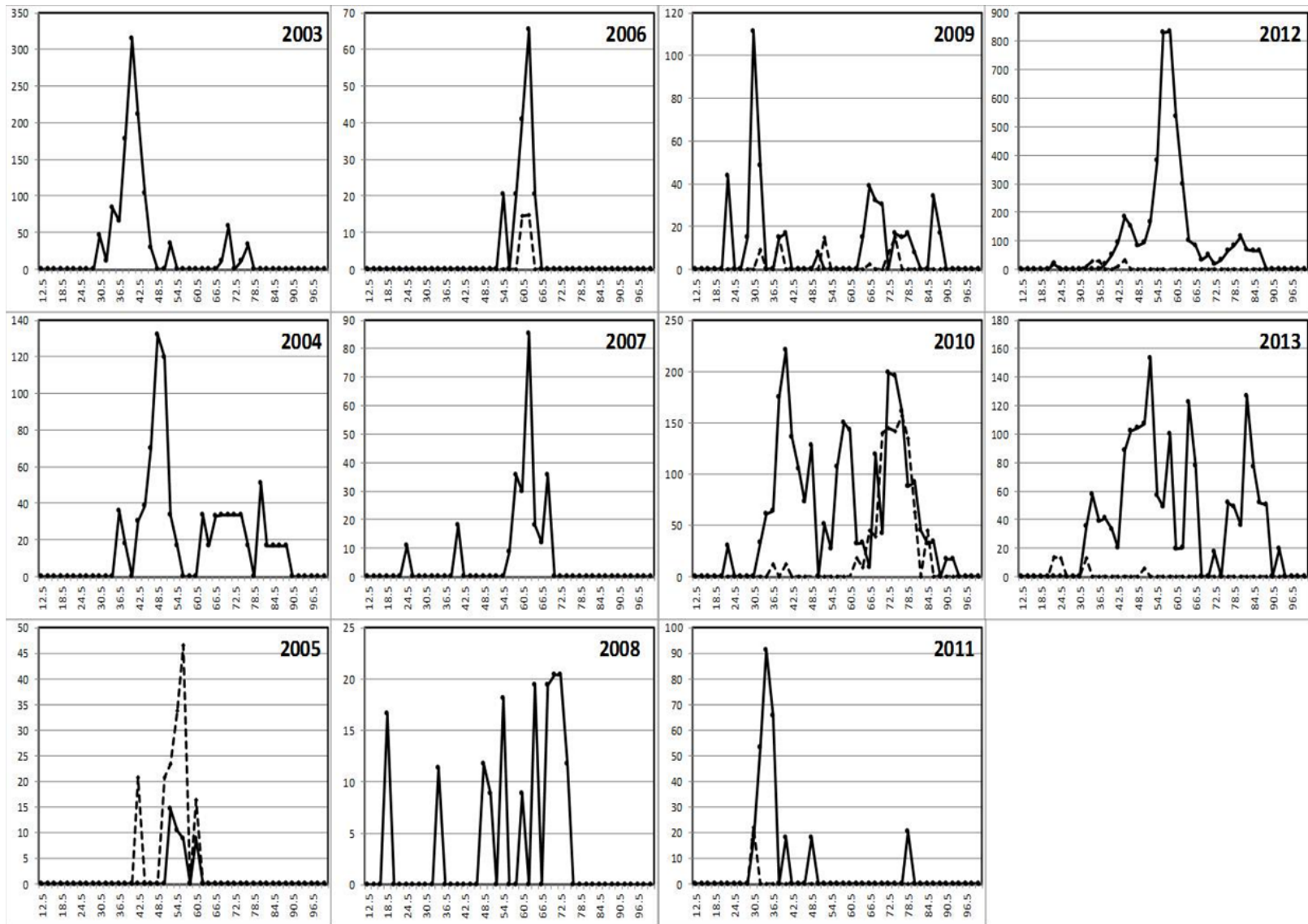


Figure 8. Length frequency (2 cm) distributions for pollock from research vessel surveys in NAFO Subdivision 3Ps (2003-13). Solid line = offshore strata, dashed line = inshore strata.

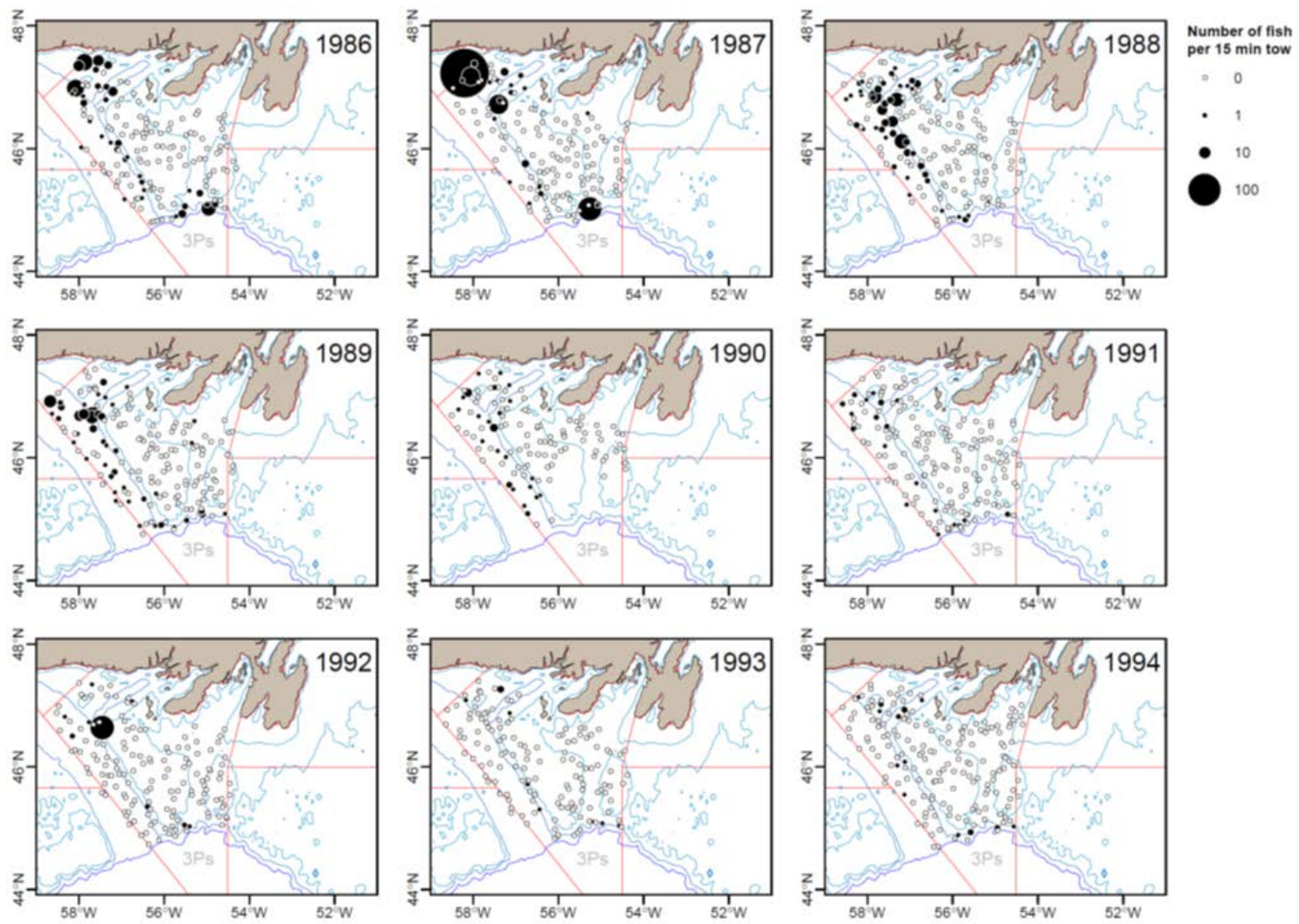


Figure 9a. Number of pollock per tow from research vessel surveys in NAFO Subdivision 3Ps for 1986-1994. Plots for 1986-1995 are based on unconverted Engel Hi-Rise Ottertrawl data.

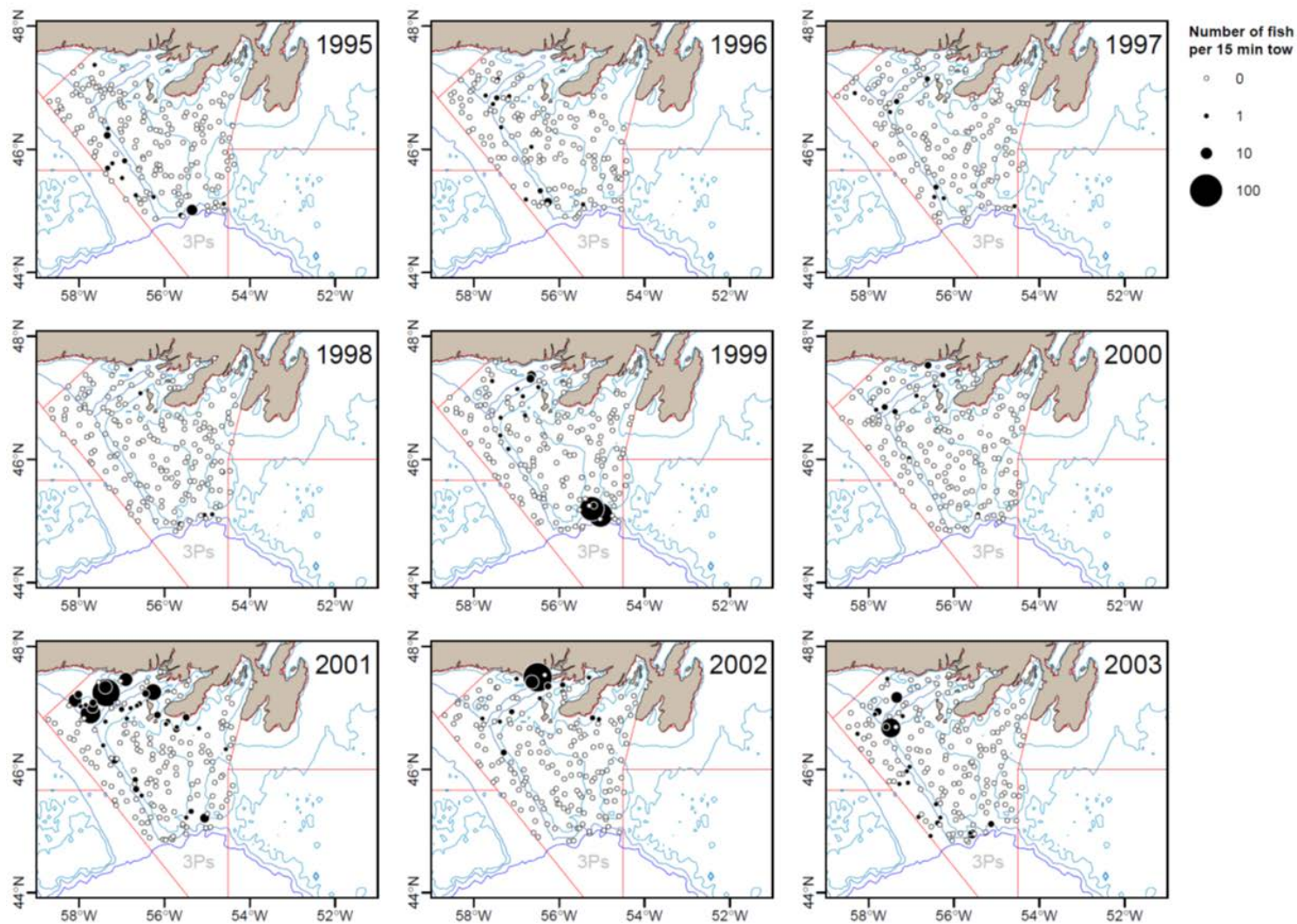


Figure 9b. Number of pollock per tow from research vessel surveys in NAFO Subdivision 3Ps for 1995-2003. Plots for 1986-1995 are based on unconverted Engel Hi-Rise Ottertrawl data. Plots for 1996-2013 are based on Campelen trawl data.

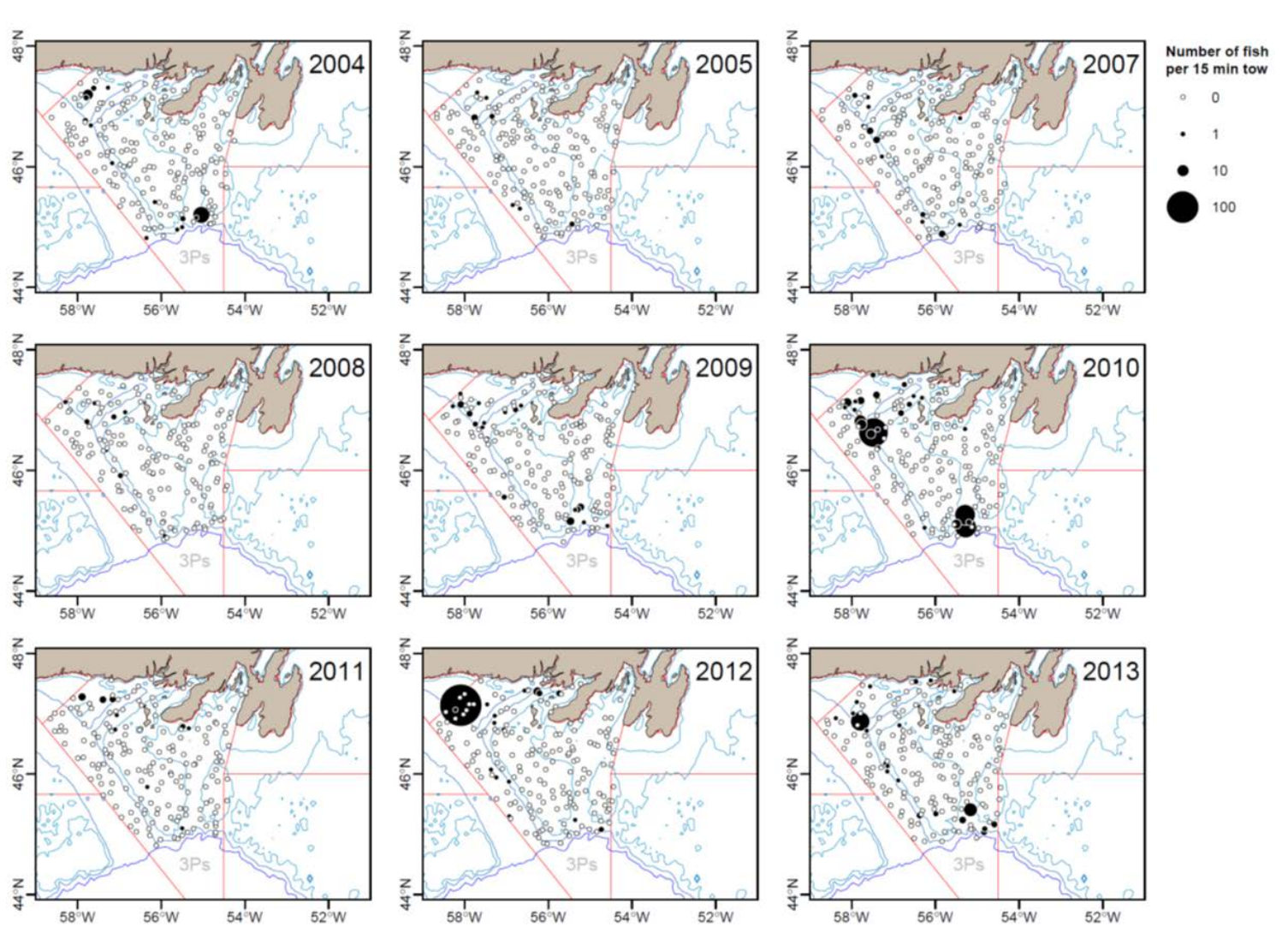


Figure 9c. Number of pollock per tow from research vessel surveys in NAFO Subdivision 3Ps for 2004-13. Plots for 1996-2013 are based on Campelen trawl data.