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Effort allocation of the Dutch beam trawl fleet in response to a temporarily closed area in the North Sea

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Abstract

The spawning stock of North Sea cod is at a historic low level and immediate management measures are needed to improve this situation. As a first step, the European Commission in 2001 closed a large area in the North Sea between February 15 and April 30 to all cod related fishing fleets in order to protect the spawning population. The closed area comprised important fishing grounds of the beam trawl fleet fishing for flatfish. In this paper the response of the Dutch fleet (components 225-300hp and >300hp) is analysed using data from EU-logbooks and from position recordings from the Vessel Monitoring System. No change was observed in the fleet of small beam trawlers. The fleet of large vessels displaced its activity to fishing grounds in the North Sea outside the closed areas, and to fishing grounds outside the North Sea. In the North Sea, beam trawling concentrated along the borders of closed areas and the Plaice Box. In the first week after the closure the number of trips in the open area doubled. Coinciding with this increase, the catch rate, expressed as revenue per hp-day, decreased. After the area was re-opened, the catch rate was exceptionally high but decreased to the normal level in the 2nd - 3rd week. The change in catch rate in relation to the change in fishing effort indicated that competitive interactions (in particular interference interactions) occurred among vessels. The implication of the observed fleet response is discussed against the background of the objective of the management measure to protect cod and the broader objective of the Common Fisheries Policy of ecosystem management. It is concluded that it is unlikely that cod has benefited from the area closure. Furthermore, the closure may have had a negative impact on the rate of discarding of demersal species and a negative impact on vulnerable components of the ecosystem (e.g. skates, long lived benthic species) due to an increase in trawling activities in certain areas.

Introduction

The objectives of the Common Fisheries Policy of the European Union (Council Regulation No. 3760/92) are to: protect and conserve available and accessible living marine aquatic resources, and to provide for rational and responsible exploitation on a sustainable basis, in appropriate economic and social conditions for sector, taking account of its implications for marine ecosystem and in particular taking account of the needs of both producers and consumers. Instruments to achieve these objectives comprise of output control measures through annual total allowable catch (TAC) for commercially exploited species; input control through Multiannual Guidance Programs; and technical management measures such as mesh size and closed areas/seasons.

Despite this, due to heavy overexploitation, North Sea cod *Gadus morhua* L. is in such a poor state that immediate measures are needed to prevent the stock for collapse. As a first step in the development of a cod recovery plan, the European Commission decided to close fishing for all cod related fisheries in part of the spawning areas from 15 February to 30 May 2001. The closed area comprised offshore fishing grounds outside the 12-nm limit and outside the plaice box (Figure 1 and 2).

One of the fisheries affected by the closed area is the beam trawl fishery. This fishery targets at flatfish species sole *Solea solea* (L.), plaice *Pleuronectes platessa* L., dab *Limanda limanda* L., turbot *Pseta maxima* and brill *Scophthalmus rhombus* L. and catches cod and roundfish such as cod as a bycatch (Rijnsdorp *et al*., 2000). The beam trawl fleet comprise of two components: a fleet of Eurocutters (engine power <=300 hp) that is allowed to fish inside the 12-nm limit from the coast, and the fleet of large beamers with an engine power about 2000hp (Daan, 1997; Rijnsdorp *et al*., 2000). The Dutch beam trawl fleet is managed by restrictive individual transferable quota (ITQ's) and by a restricted number of fishing days (Daan, 1997; Poos et al., 2001). The fishing grounds of the beam trawl fleets are located in the southern and south-eastern North Sea. The fleet of Euro-cutters was not directly affected by the area closure because this fleet was allowed to fish within the 12-nm zone bordering the closed areas. However, this fleet may have benefited from the reduced exploitation rate of sole by the fleet of large vessels in the offshore areas, as this target species migrates in spring into the inshore areas to spawn. The fleet of large vessels may have experienced a reduced catch rate due to the increase in vessel density on the limited fishing grounds accessible outside the closed areas due to competitive interactions among vessels (Rijnsdorp *et al*, 2000a, 2000b). This may have resulted in a wider dispersion in the remaining area. Also, it may be expected that vessels has increased exploration to search for profitable fishing grounds in the accessible area. Finally, skippers may have decided to reduce their fishing effort during the closed period and postpone part of their fishing to later in the year or moved to fishing grounds outside the North Sea.

In this paper, we analyse the response of the fleet of large and small beam trawl vessels and discuss the implications for fisheries management and ecosystem management. We will:

1. study how both fleets re-allocated their fishing effort during the closed period ;
2. study how these changes coincided with changes in catch rate;
3. study how both fleets behaved in the weeks after re-opening of the closed areas.

Material & Methods

The analysis is based on the EU-logbook data of individual vessels available from the VIRIS data base. This data base comprise data on landings (kg) by commercial fish species, fishing effort (days at sea), ICES rectangle fished, engine power of the vessel and fishing gear. Only beam trawl vessels were analysed (TBB with engine power between 225 and 300hp), excluding shrimpers. Data for the year in which the closed area was imposed were only available until mid June. The patterns in effort allocation and catch rates during the area closure (15 February – 30 April 2001) and the period following the closure (1 May – 15 June 2001) were compared to the average patterns between 1997-2000.

Effort distribution was expressed as the number of days at sea per ICES rectangle. The catch rate was analysed for sole, plaice and cod and corrected for the difference in fishing power between vessels due to the engine power by dividing the landings per ICES rectangle per trip by the number of horsepower days. The latter is calculated as the days at sea times the horse power of the vessel and devided by 2000 to standardise to a 2000 hp vessel. In addition to analysis of the total number of days at sea, the number of fishing trips was calculated.

The distribution of the beam trawl fleet was quantified by calculating an index that is analogue to the index for niche breadth (Krebs, 1989): $B = (1- 1/ \Sigma\ p_i^2)/(n-1)$, where p_i is the proportion of effort allocated in ICES rectangle i, and n is the total number of ICES rectangle fished. The breadth of the distribution that takes a value between 0 (highly concentrated effort distribution) to 1 (widely dispersed distribution) was calculated for the 4 study areas (Figure 1) and three time periods (January 1 – February 14; February 15 – April 30; May 1 – June 15).

A detailed comparison of the spatial pattern in beam trawling was made by comparing the micro-distribution data obtained from a sample of beam trawl vessels during the period in the years 1993-2000 (Rijnsdorp *et al*., 1998) and the Vessel Monitoring System (VMS) data available for 15 February – 30 April 2001 in 2001. At the moment of writing this draft the VMS data for 2001 were not yet available. In the final paper this data will be included.

Results

Fleet of large beam trawlers (>300hp)

Following the closure of the fisheries in the areas 'Closed South' and 'Closed North' on February 15th 2001, the beam trawl effort was mainly redistributed to the area 'Open North' (Figure 3). The number of fishing trips in this area increased from a level of around 100 in weeks 1 to 6 to 140 trips in week 8. In the following weeks, the number of trips gradually decreased to a pre-closure level around week 14. The dip in fishing effort in week 7 (2000) in the two northern areas is related to the 'bidweek' during which a part of the Dutch fleet stays in the harbour for religious reasons (bidweek). No apparent change in fishing effort is apparent in area 'Open South'. This may be due to the rough grounds in this area for which specialised beam trawls (chain mats) are required. After the closure was lifted, the beam trawl fleet moved into the previously closed area, the number of fishing trips in the areas 'Closed South' and 'Closed North' was higher than in any of the weeks prior to the closure, whereas the number of trips in the area 'Open North' was lower than in the weeks before the closure. In the area 'Open South' no increase in the number of trips is apparent after the closure, or decrease after the closure was lifted. In 2001 a number of vessels has fished in areas outside the North Sea. The pattern in 200 was clearly different from that in 1999 and 2000 and coincided with the cod closure between week 8 and 17. In 1999 and 2000, fewer trips were made outside the study area and generally somewhat later in spring (Figure 4).

The catch rates in relation to the closure of the fisheries and the re-distribution of the fishing effort is shown in Figure 5. The catch rate was expressed as the revenue per hp-day standardised for a 2000 hp vessel to combine the various species caught in the mixed bag, In order to compare the trends observed in 2001 with the general seasonal pattern, the revenue per hp-day was standardised to the mean revenue in the weeks 1-7 and 18-23 by year and compared to the patterns observed in 1999 and 2000. All four areas showed a general decline in revenue per hp-day from winter to spring. In January and early February, the revenue varied around a level of about 1.2 and decreased to a level of about 0.8 between April and June. A closer look to the results for 2001 revealed changes in revenue that contrasted to the general seasonal pattern observed in 1999 and 2000 and that coincided with the closure and re-opening of the fisheries in the two closed areas. In week 8, the first week of the closure, revenue dropped by about 40% in area 'Open North' and by 20% in 'Open South' as compared to the revenue in the week just before the closure. In the subsequent weeks, the revenue in 'Open North' slightly decreased to a minimum in week 13 and thereafter slightly increased to about 0.8 in week 17, the last week of the closure. In 'Open South', the revenue showed a similar pattern reaching a minimum of 0.6 in week 14 and increasing to a level of 0.8 at the end of the closed period. At the end of the closed period, the revenue in both open areas was at the same level as observed in 1999 and 2000. The sudden drop in revenue in 'Open North' coincided with an almost doubling of the number of trips from 77 in week 7 to 141 in week 8. In 'Open South' the number of trips decreased from 19 in week 7 to 10 in week 8.

After the closure was lifted in week 18, the revenue showed an increase in area 'Open North' but not in 'Open South'. The coinciding number of trips showed a 30% decrease from 84 in week 17 to 58 in week 18. In 'Open South', the number of trips increased from 13 to 16 in week 17 and 18, respectively. In the previously closed areas, the revenue showed a distinct peak of 1.2 in the first week after the fishery was re-opened. The revenue decreased sharply in the second week and reached a level typical for the season in the second or third week after the fishery was re-opened. The changes in revenue and number of trips as observed in 2001 are summarised in Figure 6.

Figure 7 shows the distribution of fishing effort of the large fleet of beam trawl vessels in the time period of the cod closure and the period immediately following the closure. During the cod closure period in 2001, beam trawling occurred in roughly the same area as in the preceding years. The number of days at sea in individual rectangles during the period of the cod closure revealed small differences. Fishing effort was concentrated along the borders of the Plaice Box (rectangles 35F3, 36F4, 36F5, 37F5 and 37F6) and in the western grounds (35F1, 35F2, 36F1 and 36F2). No change occurred in 34F1, 34F2 and in the area Open_South. Also the index of the breadth of distribution did not indicate a change in distribution (Table 1).

The micro-distribution of the Dutch beam trawl fleet of large and small vessels, based on position recordings of a sample of the fleet over the period 1993-2000, shows the patchy distribution of beam trawling (Figure 8). This patchy distribution implies that a test of the hypothesis that the expected increase

in dispersion of the fishing activities due to competitive interactions and exploratory behaviour of the fleet may occur on a small spatial scale. In the final version, this analysis will be included.

Fleet of small beam trawlers (225-300hp)

The trends in the number of fishing trips of the fleet of small vessels (225-300 hp), that was not directly affected by the area closure, varies around an increasing seasonal trend, but do not indicate particular features related to the area closure (Figure 9). None of the vessels of this fleet left the North Sea in 2001.

Revenue of small vessels (Figure 10) show a variable pattern around a seasonal increase between winter and spring. This pattern contrasts to the seasonal decrease in revenue of larger vessels (Figure 5). No change in revenue in 2001 in relation to the closure of the fisheries between week 8 and 17 is apparent. During the first weeks after the fisheries of large vessels in area 'Closed South' was closed, revenue stayed on a low level typical for the winter period and only started to increase in week 11 to reach a peak in week 15. The increase in 2001 was similar to that in 1999 and 2000 although it occurred about 2 weeks later than in 1999 and 4 weeks later than in 2000. The spatial distribution of fishing days in the period of closure and the period immediately following the closure did not reveal any change (Figure 11).

Discussion

Competition among fishing vessels

The analysis of the available logbook data revealed a clear response of the beam trawl fleet of large vessels to the temporarily area closure in 2001. No response of the fleet of small vessels was apparent. After the fishery was displaced, the number of trips in 'Open North' increased to a level 40% above the upper level observed previously and was concentrated along the borders of the area 'Closed South' and the Plaice Box. After the establishment of the Plaice Box, effort of large beamers heavily concentrated along the borders of this area (Rijnsdorp *et al*., 1998; Pastoors *et al*., 2000). The high level of effort lasted only during the first two weeks after the closure and gradually decreased thereafter. Coinciding with this increase in effort, the revenue per hp-day decreased by about 40%, and decreased even further during the subsequent weeks. This low revenue, that was clearly below the level characteristic for the time period, led to an increase in the number of fishing trips in areas outside of the North Sea. Also, the total number of trips during the period of closure appeared to have decreased. This decrease is related to the national cod recovery plan that was agreed between the fishing industry and the government (Staatscourant 1 mei 2001, nr 83 / p. 18). This plan comprised of the use of more selective fishing gear (large meshed panel in upper net, lowering of the head rope) in combination with a vessel lay-up of 3 weeks.

Because the 2001 data are still preliminary, the number of fishing trips may underestimate the real effort in the study period, because some of the logbooks may not have been entered in the data base. This effect is likely to increase towards the end of the study period. It is unlikely that this will affect the analysis of the revenue per hp-day or the analysis of the spatial distribution of effort.

The observation that the catch rate decreased as the number of fishing trips increased is likely to be related to interference competition between beam trawlers (Rijnsdorp *et al*., 2000a). The increase in vessel density was larger in 'Open North', the area in which the decrease in catch rate was also largest. The steep decrease in catch rate after the re-opening of the fishery in the two areas may be due to a combined effect of the interference among vessels and the fishing-up of local concentrations. In contrast to the expectation, no change in the catch rate of small trawlers was observed during the closed period. This suggests that the harvest of fish, in particular sole, outside the 12-nm zone by the large vessels, does not affect the fishing opportunities for the fleet of small vessels within this zone.

A consequence of interference competition among vessels is that vessels will spread out over a wider fishing area. The analysis of the spatial distribution at a scale of ICES rectangles during the period of the closure, however, did not provide support for this expectation. However, no detailed data were yet available on the micro-distribution of the fleet within the ICES rectangles.

Fisheries and ecosystem management

Whether the management measure to protect spawning cod by closing part of the spawning grounds for all cod related fisheries will have contributed to the protection of the North Sea cod stock is difficult to assess without detailed insight in the distribution of both undersized and adults/spawning cod. However, there are several reasons to believe that it is unlikely that the measure will have contributed to the protection of

(spawning) cod. Moreover, there are reasons for concern that the measure may have been counter effective both for cod as well as for other commercially exploited species and the benthic ecosystem.

Based on the known distribution of cod spawning areas, it is unlikely that the closed area has reduced the mortality of spawning fish. Daan (1978) reviewed the data on the distribution of pelagic cod eggs. Important centres of egg production occurred in the Southern Bight, the inner German Bight, around the Dogger Bank and off Flamborough. Egg production in the northern North Sea was indicated by concentrations of spawning fish. which overlapped with area 'Closed South'. The distribution of cod spawning in the southeastern North Sea was corroborated by egg surveys carried out in the second half of the 1980s (Heessen & Rijnsdorp, 1989; van der Land et al., 1990). The known spawning areas only partly overlapped with the closed areas. The spawning areas in the German Bight, around the Dogger Bank and in the western North Sea (off Flamborough and off Scotland) were not, or only to a small extend, included in the closed area. Because the overall fishing effort was not reduced, and heavy demersal trawling occurs in the the part of the North Sea that remained accessible during the cod closure (Jennings et al., 1999), the establishment of closed areas has only reduced fishing in part of the spawning grounds. Because we have seen that effort was displaced from the closed area to the fishing grounds outside the closed areas, fishing intensity on the other spawning grounds has likely increased.

Also the timing of the closure was not particularly well chosen. The closed area was imposed for week 8 to 17, whereas Daan (1981) showed from plankton surveys in 5 years that the peak spawning in the Southern Bight ranged between week 4 and 7. Although spawning may be somewhat later in the year in more northern grounds, the area closure has protected only the second part of the spawning season of the local populations.

The area closure may have resulted in a change in discard mortality if the fishing effort was displaced to areas with a different proportion of undersized cod. Without detailed information on the distribution of undersized fish, it cannot be assessed whether the discarding has increased or decreased. The same argument applies, of course to other commercially exploited fish species such as haddock and plaice.

Finally, the displacement of effort, illustrated by the relative increase in beam trawl effort in some of the ICES rectangles in the western North Sea, may have had a negative impact on the benthic ecosystem. It is known that bottom trawling, and in particular beam trawling, has a negative impact on long lived components of the benthic ecosystem, such as *Arctica islandica* (Witbaard & Klein, 1994). Also species with low reproductive rates, such as rays that are among the fish species most vulnerable for trawling (Brander, 1984; Walker & Heessen, 1996; ICES, 1997; Walker & Hislop, 1998) may have suffered from additional mortality because these populations are restricted to the western North Sea which was accessible during the cod closure. When the detailed data on the distribution of the beam trawl fleet become available from the Vessel Monitoring System this aspect can be evaluated.

The objectives of the Common Fisheries Policy (CFP) include sustainable exploitation of commercial species and the protection of the ecosystem. From the above considerations it is evident that the actual management measures of the European Commission do not comply with these objectives. The cod closure is rather poorly designed, did not consider side effects on the level of discarding in demersal stocks, and did not consider the wider ecosystem implications. For management to be successful, an overall reduction in fishing mortality in necessary. Only in combination with a restriction in fishing effort, area closures can be expected to protect spawning populations. Without the accompanying reduction in fishing effort, area closures will generally result in a displacement of fishing effort with the possibility of serious negative consequences.

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Table 1. Breadth in the distribution (Ba) of the Dutch beam trawl fleet (days at sea by ICES rectangle) in three periods in 2001 representing the cod closure period (15 February – 30 April) and the period immediately preceeding and following the cod closure.

	1996	1997	1998	1999	2000	2001
Period: 1 January - 14 February 2001						
Closed_north	0.27	0.38	0.46	0.23	0.49	0.38
Closed_south	0.43	0.65	0.75	0.49	0.45	0.44
Open_north	0.26	0.53	0.44	0.46	0.49	0.44
Open-south	0.45	0.53	0.30	0.46	0.20	0.40
Period: 15 February - 30 April						
Closed_north	0.15	0.34	0.39	0.30	0.23	0.26
Closed_south	0.58	0.44	0.54	0.48	0.54	0.58
Open_north	0.43	0.44	0.41	0.48	0.31	0.46
Open-south	0.35	0.35	0.33	0.25	0.17	0.34
Period: 1 May - 15 June 2001						
Closed_north	0.19	0.35	0.41	0.54	0.30	0.34
Closed_south	0.54	0.41	0.59	0.55	0.57	0.62
Open_north	0.47	0.30	0.33	0.40	0.26	0.37
Open-south	0.36	0.26	0.39	0.25	0.09	0.15

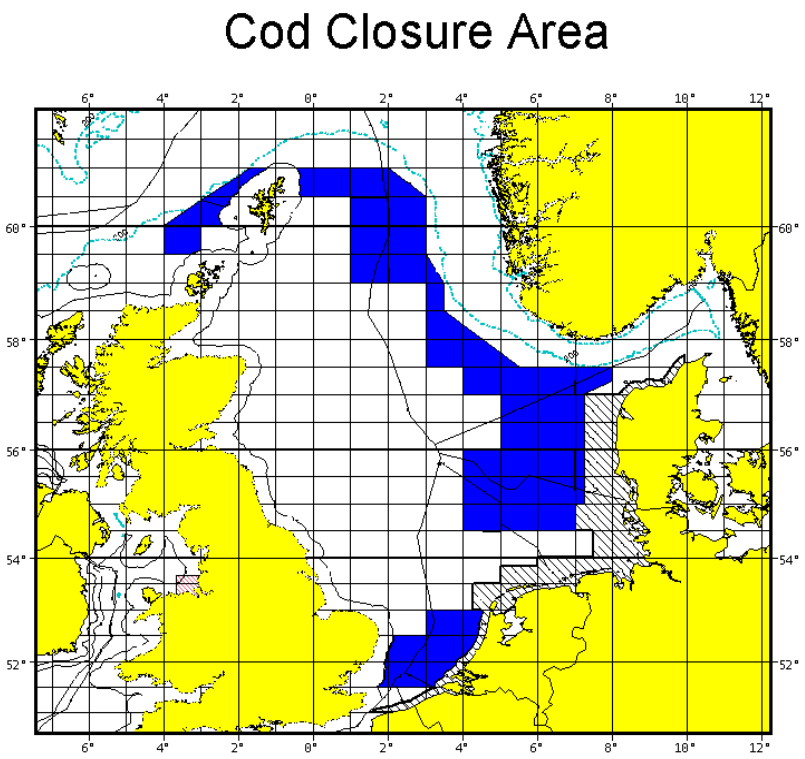


Figure 1. Area closed to fishing in the period between 15 February and 30 April 2001 to protect spawning cod.

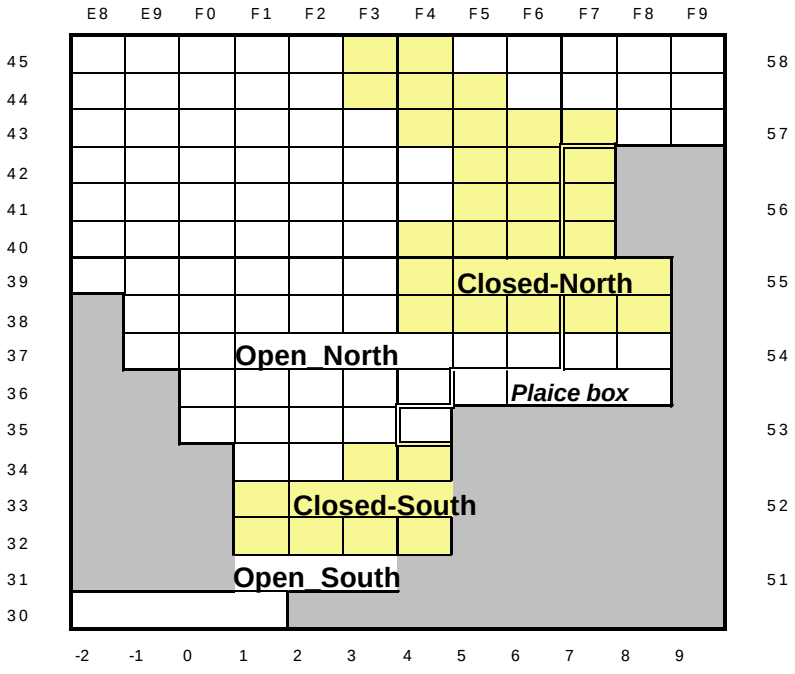


Figure 2. Area codes used in the analysis of the catch and effort statistics of the Dutch beam trawl fleet for the period 1996 – 2001. Areas closed for trawling are lightly shaded. The plaice box is indicated by a dubble line.

Figure 3. Number of fishing trips of large vessels by week in four areas in 1999, 2000 and 2001. The bar indicates the period of the area closure.

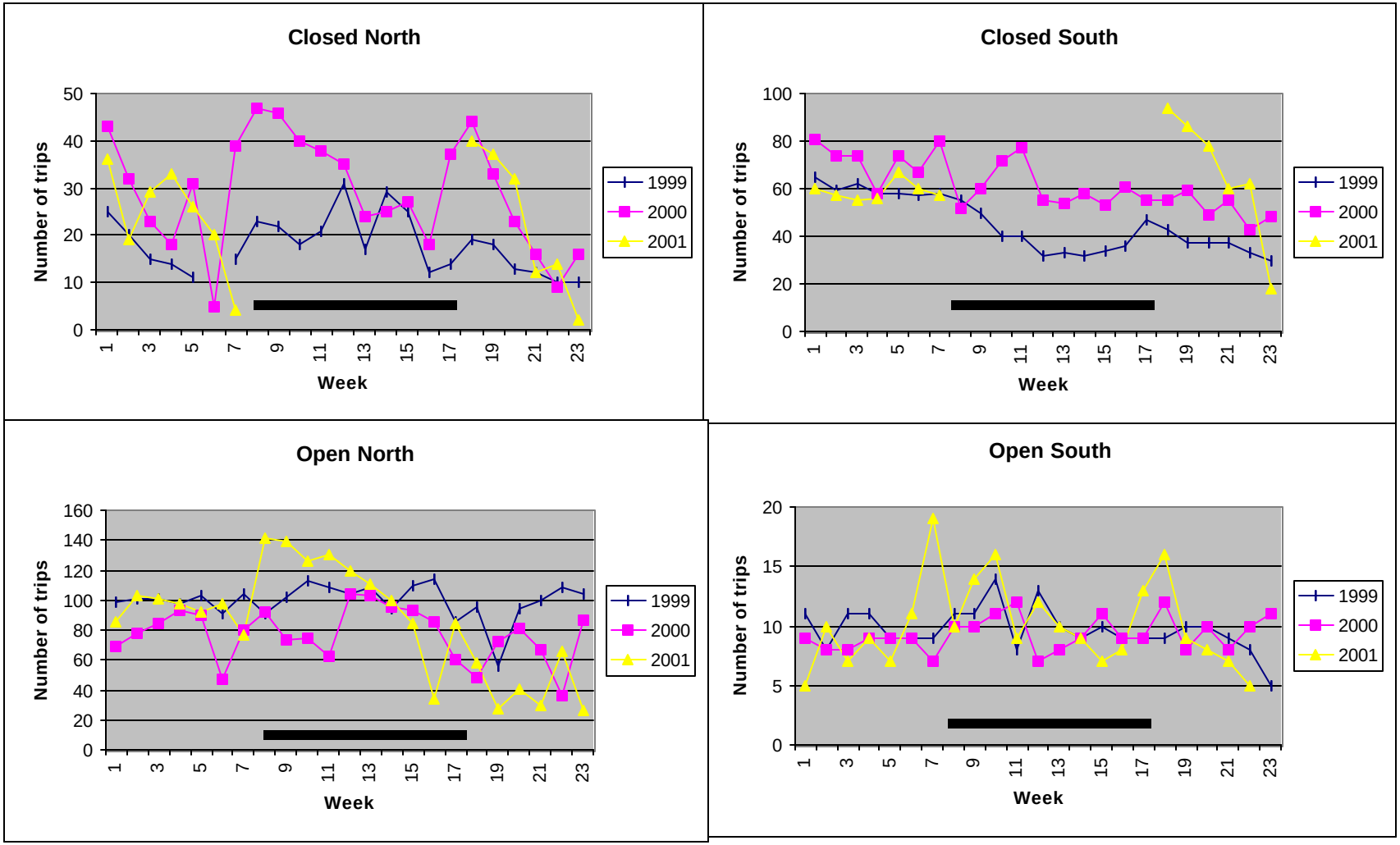


Figure 4. Number of fishing trips of large vessels to grounds outside the North Sea

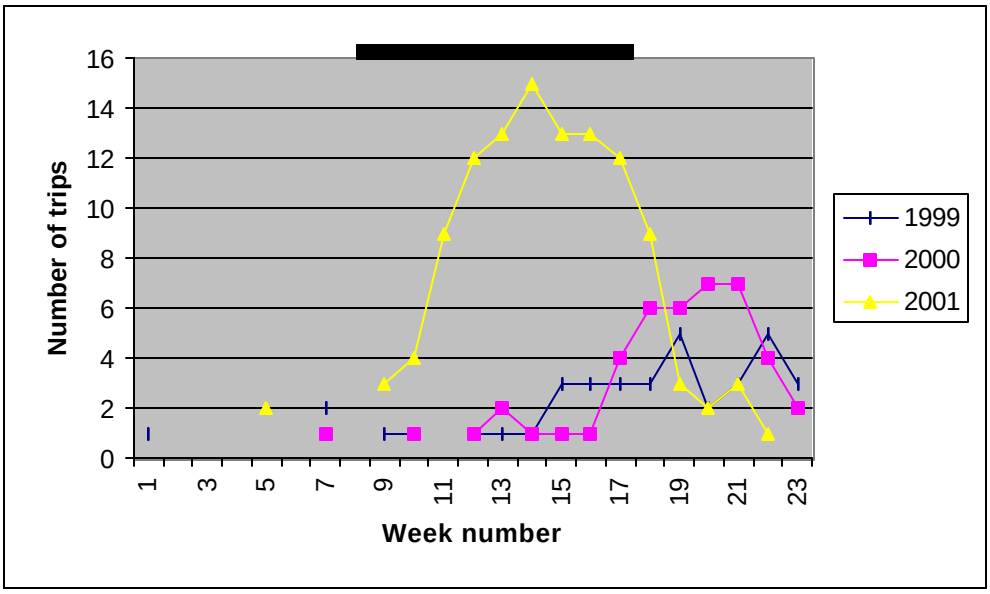


Figure 5. Standardised revenue by week in four areas in 1999, 2000 and 2001. Bar indicates the time period of the closure in 2001.

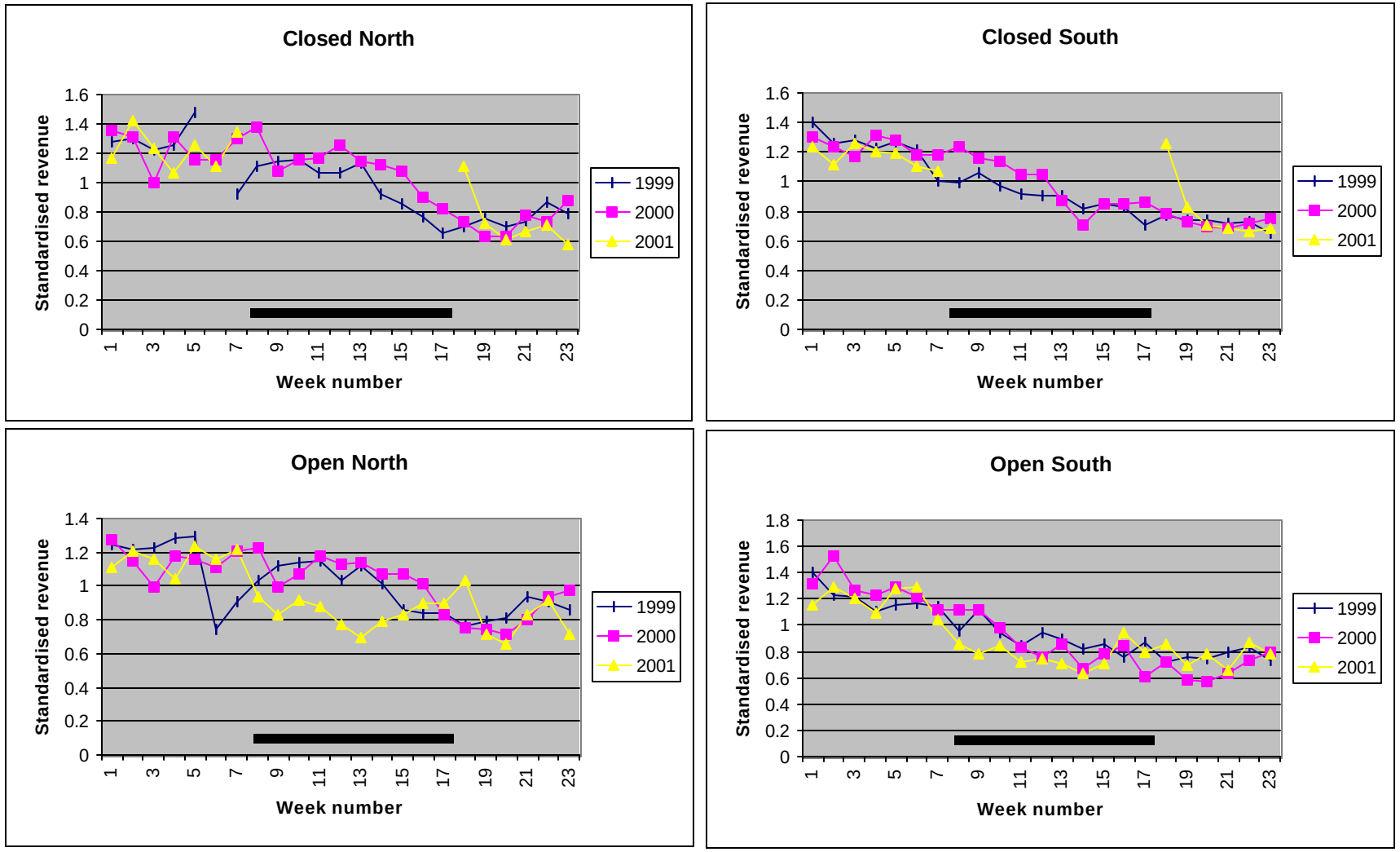


Figure 6. Standardised revenue and the number of trips by week in four areas in 2001 and the reference revenue .
Reference revenue is the 3pnt running mean revenue in 1999 - 2000. Bar indicates the time period of the closure in 2001.

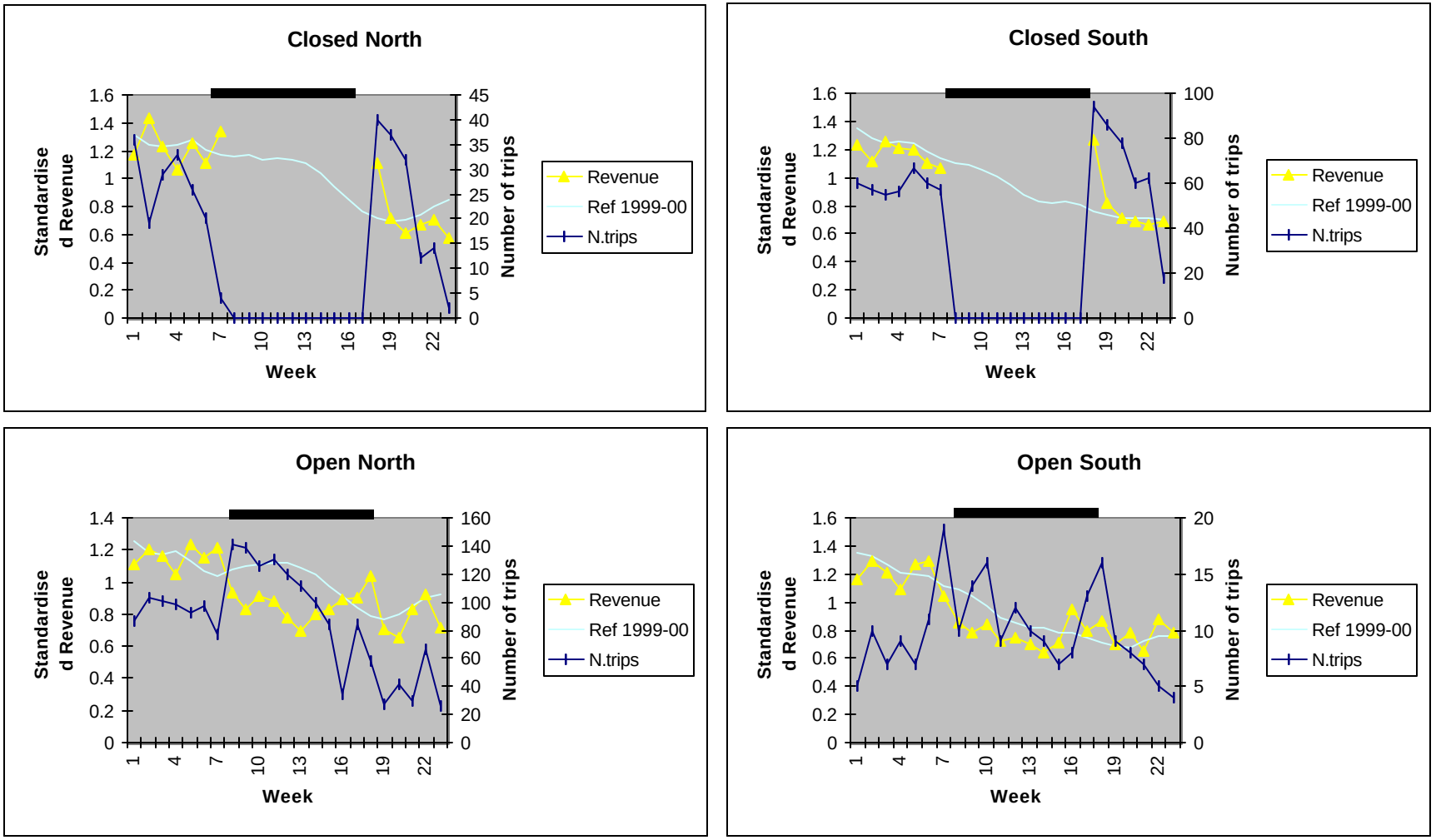


Figure 7. Average number of beam trawl days in two periods in 1997-2000 (upper panels) and 2001 (lower panels) of the fleet of large vessels. The cod closure areas between 15 February -30 April 2001 are shaded. The plaice box is indicated by the double line.

Variable Average number of days at sea
Fleet: Beam trawl >300hp
Period 15 February - 30 April
Years 1997-2000

	E8	E9	F0	F1	F2	F3	F4	F5	F6	F7	F8	F9	
45	0	0	0	0	0	1	0	1	0	0	0	0	58
44	0	0	0	0	2	1	5	6	2	6	0	0	
43	0	0	0	0	1	9	5	11	4	4	0	0	57
42	0	0	0	0	0	4	3	5	6	0			
41	0	0	0	0	0	2	7	7	14	0			56
40	0	0	2	1	10	12	53	19	30	5			
39	0	0	5	14	35	72	66	51	108	9	0		55
38		4	38	29	76	94	132	164	184	4	0		
37		0	186	209	219	219	279	172	433	203	0		54
36			21	74	185	267	264	83	33	8	0		
35			0	46	288	376	144	2					53
34				5	235	392	194						
33				1	219	692	43						52
32				8	432	382	2						
31				78	291	8							51
30	0	0	0	0									
	-2	-1	0	1	2	3	4	5	6	7	8	9	

Variable Average number of days at sea
Fleet: Beam trawl >300hp
Period 1 May - 15 June
Years 1997-2000

	E8	E9	F0	F1	F2	F3	F4	F5	F6	F7	F8	F9	
45	0	0	0	0	0	1	5	7	0	0	0	0	58
44	0	0	0	0	8	8	10	0	0	3	0	0	
43	0	0	0	0	3	25	13	8	16	12	0	0	57
42	0	0	0	1	0	5	12	6	13	1			
41	0	0	0	0	5	2	15	5	16	2			56
40	0	0	0	6	11	43	100	21	23	10			
39	0	0	1	7	43	94	57	13	75	18	0		55
38		0	1	14	59	79	67	6	47	9	1		
37		0	25	61	53	57	84	43	281	287	0		54
36			2	49	50	65	167	48	15	10	0		
35			0	8	166	191	115	2					53
34				2	165	151	127						
33				1	64	373	36						52
32				5	206	225	0						
31				28	158	2							51
30	0	0	0	0									
	-2	-1	0	1	2	3	4	5	6	7	8	9	

Variable Average number of days at sea
Fleet: Beam trawl >300hp
Period 15 February - 30 April
Years 2001

	E8	E9	F0	F1	F2	F3	F4	F5	F6	F7	F8	F9	
45	0	0	0	0	0	0	0	0	0	0	0	0	58
44	0	0	0	0	0	0	0	0	0	0	0	0	
43	0	0	0	0	0	0	0	0	0	0	0	0	57
42	0	0	0	0	0	0	0	0	0	0			
41	0	0	0	0	0	0	7	0	0	0			56
40	0	0	0	0	0	7	0	0	0	0			
39	0	0	0	3	17	76	0	0	0	0	0		55
38		4	28	3	57	23	1	4	1	0	0		
37		0	117	182	253	143	158	208	613	171	0		54
36			21	112	289	198	298	224	17	2	0		
35			0	102	343	441	135	31					53
34				7	224	7	0						
33				0	1	4	0						52
32				0	11	2	0						
31				57	332	0							51
30	0	0	0	0									
	-2	-1	0	1	2	3	4	5	6	7	8	9	

Variable Average number of days at sea
Fleet: Beam trawl >300hp
Period 1 May - 15 June
Years 2001

	E8	E9	F0	F1	F2	F3	F4	F5	F6	F7	F8	F9	
45	0	0	0	0	0	0	0	0	0	0	0	0	58
44	0	0	0	0	0	0	4	2	0	0	0	0	
43	0	0	0	0	0	0	2	7	1	12	0	0	57
42	0	0	0	0	0	0	0	0	4	0			
41	0	0	0	0	0	0	0	8	39	2			56
40	0	0	0	0	0	6	62	32	35	13			
39	0	0	0	3	4	3	34	20	130	109	0		55
38		0	0	0	0	0	0	0	35	15	0		
37		0	5	12	4	0	3	5	116	57	0		54
36			0	9	15	17	100	56	14	3	0		
35			0	16	55	69	74	0					53
34				0	62	197	177						
33				0	33	342	49						52
32				4	234	222	0						
31				4	59	4							51
30	0	0	0	0									
	-2	-1	0	1	2	3	4	5	6	7	8	9	

Figure 8. Micro-distribution of beam trawl vessels (225-330hp and >300hp) between February 15 and April 30 in the years 1993-2000.

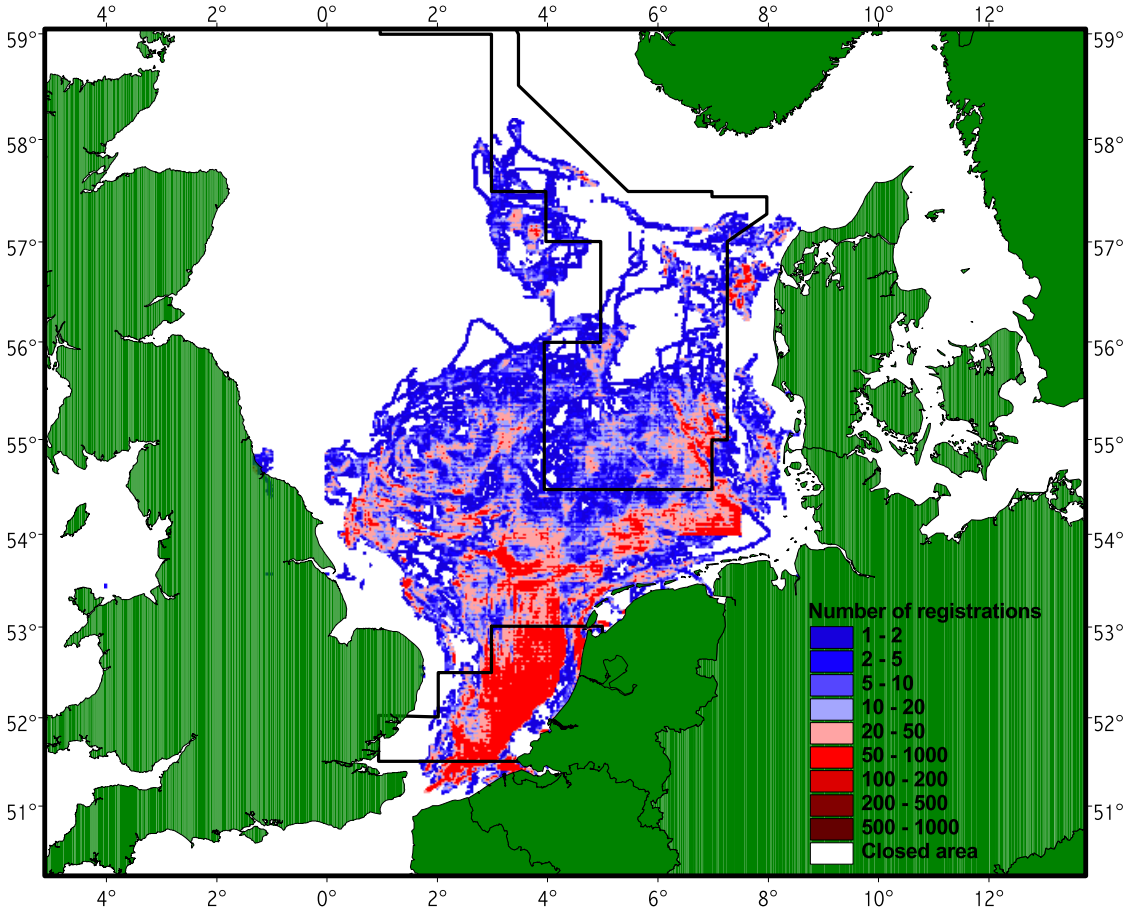


Figure 9. Number of fishing trips per week of the fleet of small beam trawl vessels (225-300hp) in the four study areas in 1999, 2000 and 2001.

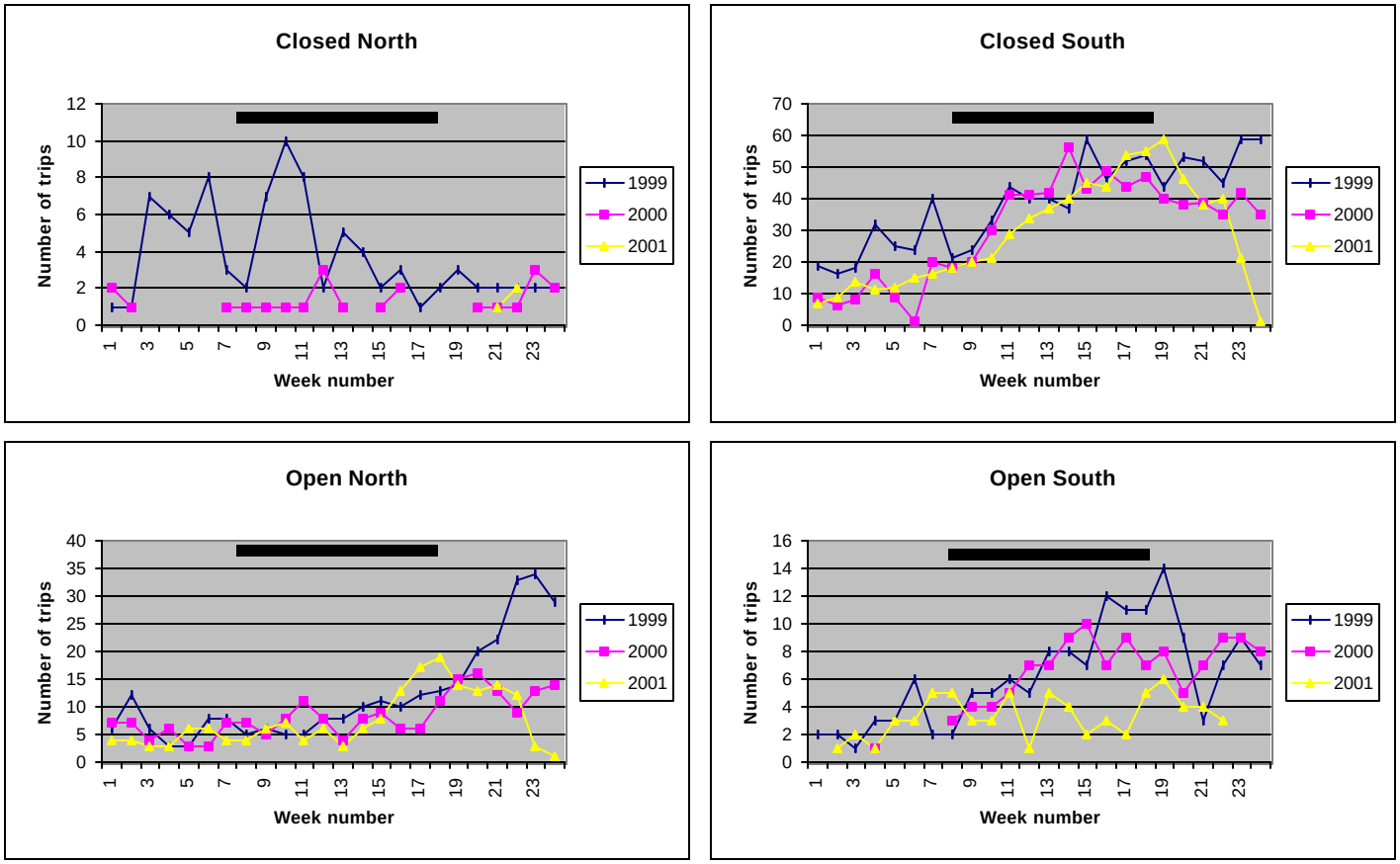


Figure 10. Standardised revenue by week of the fleet of small beam trawl vessels (225-300hp) in the four study areas in 1999, 2000 and 2001.

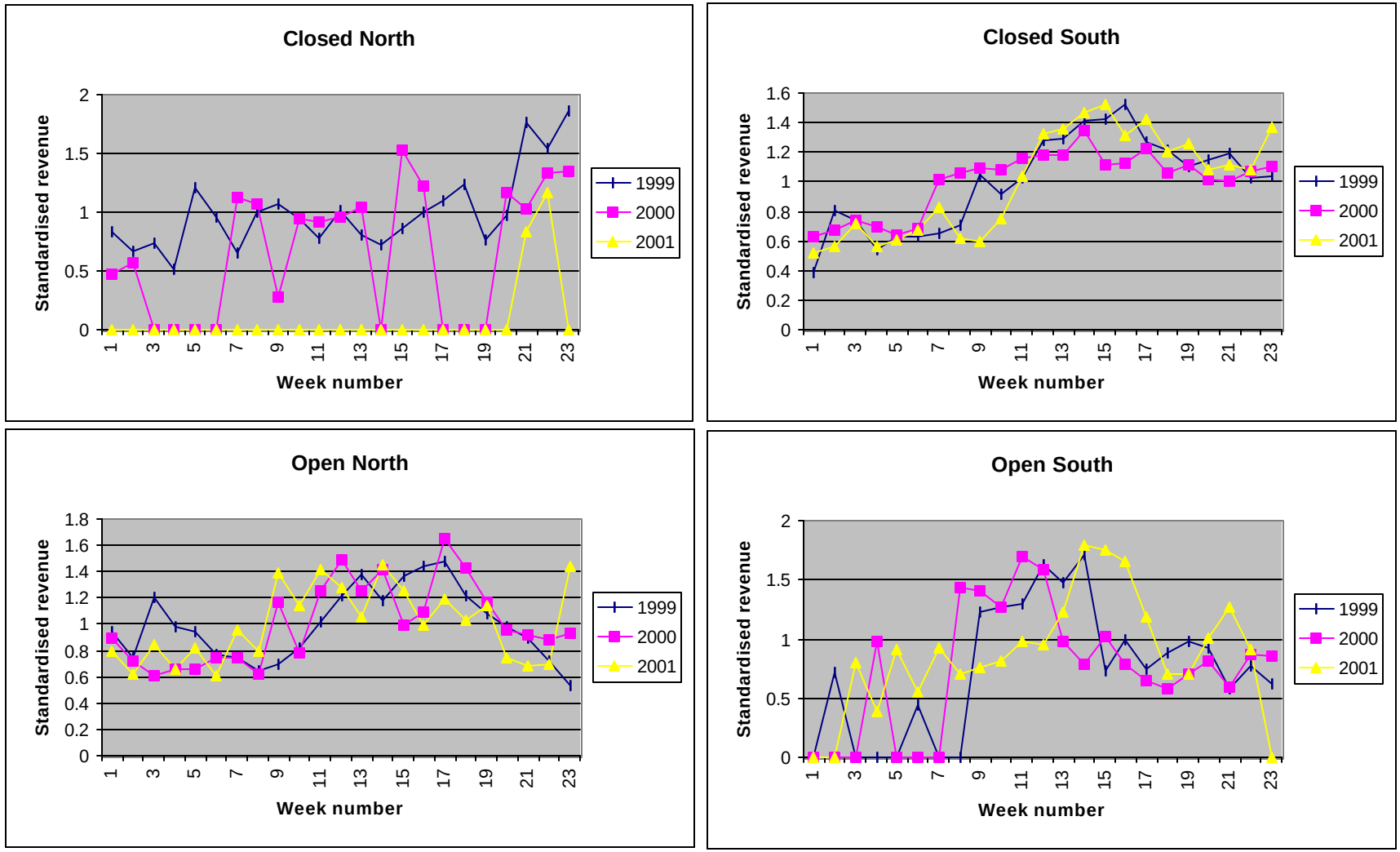
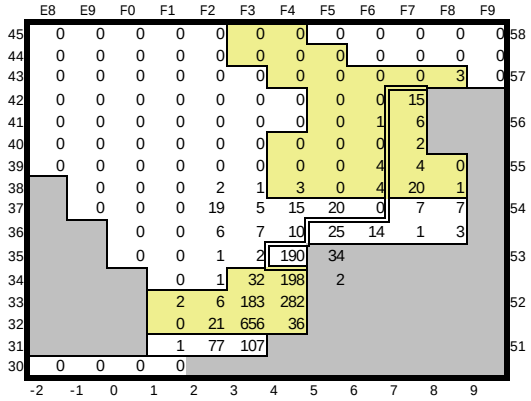
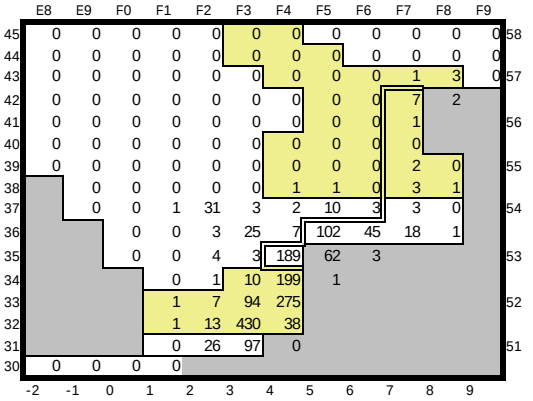


Figure 11 Average number of beam trawl days in two periods in 1997-2000 (upper panels) and 2001 (lower panels) of the fleet of small vessels.
The cod closure areas between 15 February -30 April 2001 are shaded. The plaice box is indicated by the double line.

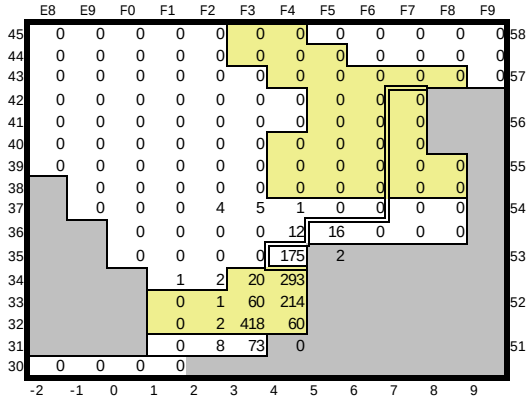
Variable Average number of days at sea
Fleet: Beam trawl 225-300hp
Period 15 February - 30 April
Years 1997-2000



Variable Average number of days at sea
Fleet: Beam trawl 225-300hp
Period 1 May - 15 June
Years 1997-2000



Variable Average number of days at sea
Fleet: Beam trawl 225-300hp
Period 15 February - 30 April
Years 2001



Variable Average number of days at sea
Fleet: Beam trawl 225-300hp
Period 1 May - 15 June
Years 2001