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Fishery characterisation and standardised CPUE analyses for alfonsino, *Beryx splendens*, (Lowe, 1834) (Berycidae), 1989–90 to 2009–10

New Zealand Fisheries Assessment Report 2013/30

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Contents

EXECUTIVE SUMMARY

MacGibbon, D.J. (2013). Fishery characterisation and standardised CPUE analyses for alfonsino, *Beryx splendens*, (Lowe, 1834) (Berycidae), 1989–90 to 2009–10.
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Alfonsino landings in New Zealand consist almost entirely of one species, *Beryx splendens*: the other species, *B. decadactylus*, is thought to make up less than 1% of landings. Before 1983 alfonsino were virtually unfished. Two main fisheries now exist for alfonsino in New Zealand. The first to develop was the lower east coast North Island fishery, which developed in the mid-1980s. The other is the eastern Chatham Rise fishery, which developed in the mid-1990s. Alfonsino are caught throughout the New Zealand EEZ but only in small quantities outside of the east coast North Island and eastern Chatham Rise fisheries.

The TACC has undergone a number of changes in all QMAs, including decreases in BYX 2. Landings in BYX 2 peaked in the 1995–96 fishing year at 1 868 t. Landings are now lower but often still slightly exceed the current TACC of 1 575 t. Landings from the eastern Chatham Rise (BYX 3) are lower than from the ECNI but are still substantial, often slightly more than 1 000 t per year, i.e., slightly exceeding the 1 010 t TACC. Current TACCs for other QMAs have not been caught.

Most alfonsino is caught in targeted trawls. When caught as bycatch the most common target species are hoki, orange roughy, bluenose, and black cardinalfish. Bottom trawling has taken most of the catch for the 1989–90 to 2009–10 fishing years, followed by midwater trawling on the bottom (i.e., within 5 m of the sea bed) and midwater trawling (more than 5 m above the sea bed). Small amounts are also taken by bottom longline and setnet. They are caught throughout the year but highest catches are made during summer months.

Alfonsino biology is poorly understood in New Zealand and worldwide. Ageing has been validated and otolith zone counts indicate a maximum age of 17 years in New Zealand. Full recruitment into the commercial fishery is thought to occur at around age five. Stock structure is not known but it is possible that New Zealand alfonsino are part of one oceanic eddy population in the south-west Pacific Ocean. No running-ripe female alfonsino have been observed in New Zealand waters.

The annual Chatham Rise middle depth trawl survey is the only research survey that regularly catches and measures alfonsino but it does not produce a good index of abundance. Estimates of abundance show wide inter-annual variation and high coefficients of variation. Standardised CPUE analyses have not been found to be good indicators of alfonsino abundance due to the complex, patchy nature of the fish distribution, and the changing composition of the commercial fleet. Monitoring of the stocks would probably be best achieved through determining the age structure of the catch from the commercial fishing grounds. Recent attempts to collect this information from BYX 3 by the observer programme has had limited success.

Observer coverage of the two main fisheries is patchy and ranges from no sampling to over-sampling depending on year and month. More consistent coverage is needed.

1. INTRODUCTION

Many of New Zealand's middle depth fisheries, other than gemfish, hoki, hake, ling, and southern blue whiting, are not routinely monitored or assessed despite their moderate size and value. Eighteen such species have been selected under the 10 year Research Programme for Deepwater Fisheries (Ministry of Fisheries 2010a). Under the plan, six species are to be assessed each year on a three-year rotating schedule. The '10 year plan' supersedes the five-year rotating schedule described in the Ministry of Fisheries (now Ministry for Primary Industries) medium-term research plan for Middle Depth species (Ministry of Fisheries 2008). The six species selected for characterisation under the 10 year plan in 2011 are pale ghost shark (*Hydrolagus bemisi*), blue mackerel (*Scomber australasicus*), frostfish (*Lepidopus caudatus*), white warehou (*Seriolella caerulea*), sea perch (*Helicolenus percoides*), and alfonsino (*Beryx splendens*). Alfonsino is the subject of this report.

This report summarises the analyses carried out for the Ministry of Fisheries under project DEE201007BYXA, Objectives 1–6: To characterise the New Zealand alfonsino fisheries by analysis of commercial catch and effort data up to 2009–10 including:

- Characterise the fisheries by analysis of commercial catch and effort data up to 2009–10.
- Carry out the standardised CPUE analysis for the major fisheries (Fishstocks) where appropriate.
- Review the indices from CPUE analyses, trawl surveys and Observer logbooks to determine trends.
- Review stock structure using data accessed above and any other relevant biological or fishery information.
- Assess availability and utility of developing a series of age frequency distributions from otoliths.
- To make recommendations on future data requirements and methods for monitoring the stocks.

The report contains sections of text and tables that can be transferred to the Ministry for Primary Industries Plenary Report as appropriate. Tables and figures are provided in four appendices: A, Survey data; B, Observer data; C, Fishery characterisation; and D, Catch-per-unit-effort analyses.

2. FISHERY SUMMARY

2.1 Commercial fisheries

Both species of *Beryx* occur throughout the world's tropical and temperate waters, in depths of between 25 and 1200 m. More than 99 % of 'alfonsino' landed in New Zealand is *B. splendens*, with the remainder being the red bream, *B. decadactylus*. Alfonsino are believed to be mainly associated with undersea structures such as seamounts on the lower east coast of the North Island and the eastern Chatham Rise in depths of between 300 and 500 m (Ministry of Fisheries 2009). Mormede (2009) found no apparent association between the alfonsino fishery and hills in her characterisation of the BYX 3 (see Figure 1) fishery to 2009 with alfonsino targeted tows being between 10 and 50 nautical miles from the nearest known hills. She did concede however that these tows may have occurred in association with smaller features that have not been identified as hills.

Alfonsino was virtually unfished prior to 1983 (Ministry of Fisheries 2009). Development of the fishery in BYX 2 began in 1981 and was focussed on the banks and seamount features on the east coast of the North Island between Gisborne and Cape Palliser. The main grounds in this area were the Palliser Bank, Tuaheni Rise, Ritchie Banks, and Paoanui Ridge. Catches in BYX 3 were historically low until 1994–95 when a target trawl fishery was developed following the discovery of new grounds south-east of the Chatham Islands (Mormede 2009).

The fishery is currently managed as five separate Fishstocks: BYX 1 (FMAs 1 and 9), BYX 2 (FMA 2), BYX 3 (FMAs 3–6), BYX 7 (FMA 7) and BYX 8 (FMA 8) (Figure 1). They are caught in all these areas but mainly within BYX 2/FMA 2, and FMA 4 of BYX 3. Catches outside of these two areas range from low to negligible by comparison, particularly in the Sub-Antarctic. Alfonsino are taken in decreasing order of catch by bottom trawl, midwater trawl on the bottom (defined in this analysis as a midwater trawl used within 5 m of the seabed), and midwater trawl (more than 5 m above the seabed). A smaller amount is taken by bottom longline and negligible amounts by other methods. Most is targeted, with some being taken as bycatch in target fisheries for hoki, orange roughy, bluenose, and black cardinalfish.

Alfonsino has been in the Quota Management System (QMS) since its implementation in 1986 (Table 1, Figure 3). TACCs have changed a number of times for all stocks except BYX 8 and 10. However, all current TACCs have been in place since at least the 2001–02 fishing year. Annual catches have been relatively stable at between 2 600 and 3 000 t since 1994–95 with a peak in 2004–05 at 3 052 t. An administrative stock has been established for the Kermadec area (BYX l0), but apart from landings of less than one tonne in each of 1991–92 and 1992–93 no catch of alfonsino has been recorded from that area.

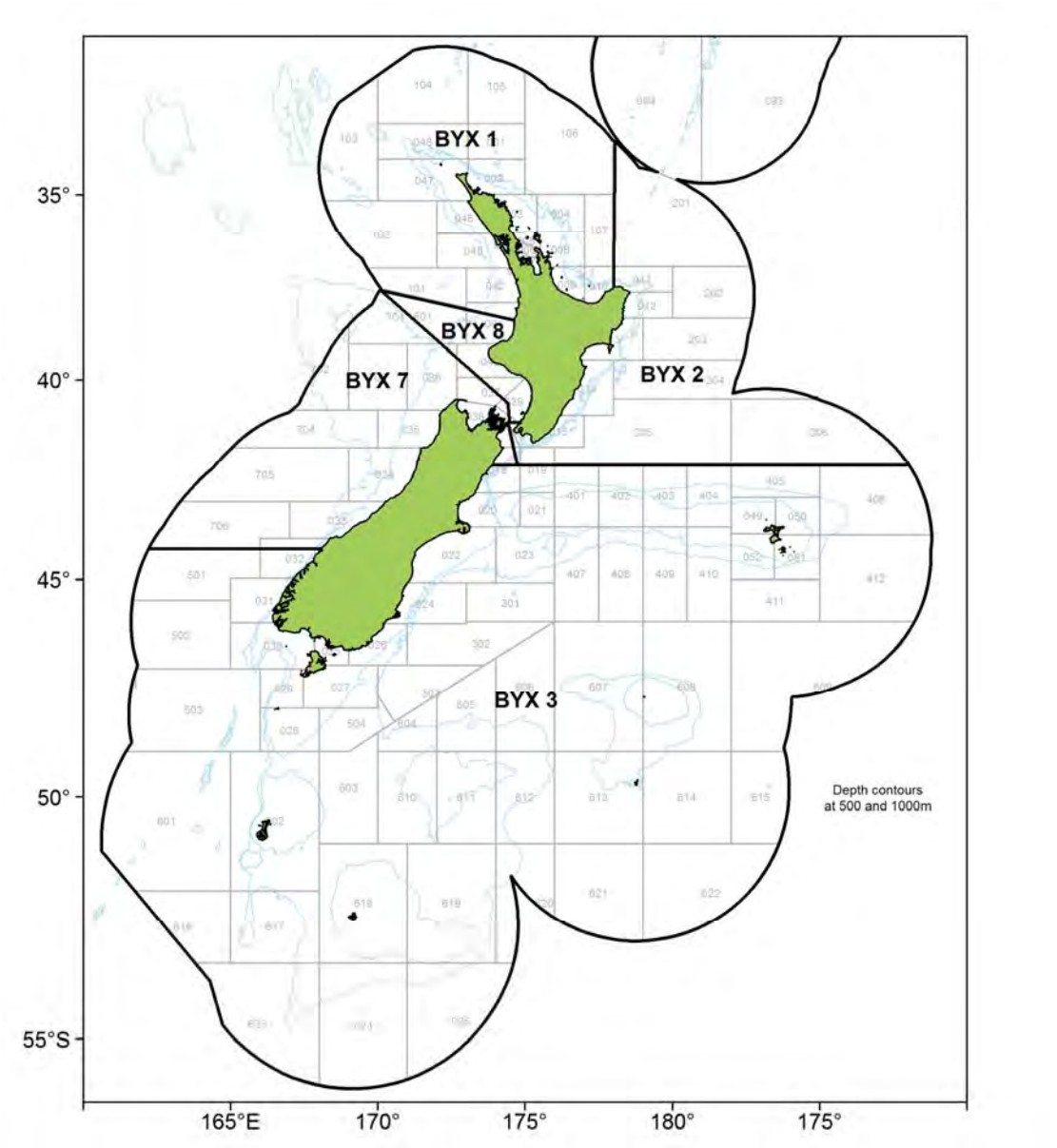

Figure 1: Map showing the administrative fishstock boundaries for all alfonsino stocks.

Table 1: Reported domestic landings (t) of alfonsino by Fishstock from 1985–86 to 2009–10 and actual TACCs (t) from 1986–87 to 209–10. QMS data from 1986–2010.

Fishstock	BYX 1		BYX 2		BYX 3		BYX 7	
FMA (s)	1 & 9		2		3, 4, 5 & 6		7	
	Landings	TACC	Landings	TACC	Landings	TACC	Landings	TACC
1985–86*	11	–	1 454	–	3	–	1	–
1986–87	3	10	1 387	1 510	75	220	4	30
1987–88	8	27	1 252	1 511	101	1 000	2	30
1988–89	6	27	1 588	1 630	64	1 000	4	30
1989–90	24	31	1 496	1 274	147	1 007	21	80
1990–91	17	31	1 459	1 274	202	1 007	26	81
1991–92	7	31	1 368	1 499	264	1 007	2	81
1992–93	6	31	1 649	1 504	113	1 007	12	81
1993–94	7	31	1 688	1 569	275	1 007	31	81
1994–95	11	31	1 670	1 569	482	1 010	59	81
1995–96	11	31	1 868	1 569	961	1 010	66	81
1996–97	39	31	1 854	1 575	983	1 010	77	81
1997–98	14	31	1 652	1 575	1 164	1 010	67	81
1998–99	37	31	1 658	1 575	912	1 010	13	81
1999–00	25	31	1 856	1 575	743	1 010	24	81
2000–01	25	31	1 665	1 575	890	1 010	21	81
2001–02	123	300	1 574	1 575	1 197	1 010	10	81
2002–03	136	300	1 665	1 575	1 118	1 010	7	81
2003–04	219	300	1 468	1 575	884	1 010	11	81
2004–05	300	300	1 669	1 575	1 067	1 010	14	81
2005–06	195	300	1 633	1 575	1 068	1 010	7	81
2006–07	66	300	1 644	1 575	945	1 010	21	81
2007–08	154	300	1 532	1 575	1 030	1 010	32	81
2008–09	172	300	1 589	1 575	895	1 010	18	81
2009–10	190	300	1 600	1 575	1 223	1 010	21	81

Fishstock	BYX 8		BYX 10			
FMA (s)	8		10		Total	
	Landings	TACC	Landings	TACC	Landings	TACC
1985–86*	-	-	0	–	1 469	–
1986–87	-	20	0	10	1 469	1 800
1987–88	-	20	0	10	1 363	2 598
1988–89	0	20	1	10	1 663	2 717
1989–90	0	20	0	10	1 688	2 422
1990–91	-	20	0	10	1 704	2 423
1991–92	0	20	<1	10	1 641‡	2 648
1992–93	0	20	<1	10	1 780‡	2 653
1993–94	0	20	0	10	2 001‡	2 718
1994–95	0	20	0	10	2 222‡	2 721
1995–96	0	20	0	10	2 906‡	2 721
1996–97	0	20	0	10	2 953‡	2 727
1997–98	0	20	0	10	2 897‡	2 727
1998–99	3	20	0	10	2 623‡	2 727
1999–00	0	20	0	10	2 648‡	2 727
2000–01	0	20	0	10	2 601‡	2 727
2001–02	0	20	0	10	2 904‡	2 996
2002–03	2	20	0	10	2 928‡	2 996
2003–04	0	20	0	10	2 582‡	2 996
2004–05	2	20	0	10	3 052‡	2 996
2005–06	0	20	0	10	2 903‡	2 996
2006–07	0	20	0	10	2 676‡	2 996
2007–08	0	20	0	10	2 748‡	2 996
2008–09	0	20	0	10	2 674‡	2 996
2009–10	0	20	0	10	3 034‡	2 996

*FSU data.

‡ Excludes catches taken outside the New Zealand EEZ.

The most recent characterisation of alfonsino was carried out for BYX 3 by Mormede (2009). This was to help in developing a catch sampling programme to monitor the length, sex, age, and catch-at-age structure of the fishery for use in monitoring the stock. Other alfonsino characterisations and CPUE analyses were reported in 2002 (Langley & Walker 2002a, Langley & Walker 2002b). All of these authors found that within BYX 3 the majority of the catch is taken from the eastern end of the Chatham Rise, particularly south-east of the Chatham Islands. Langley & Walker (2002a,b) also found smaller catches taken off the east coast of the South Island, and the northern side of Mernoo Bank and the Chatham Rise. This is consistent with the location of catches found in this study and BYX 3 has been divided into the following areas: east coast South Island, western Chatham Rise, and eastern Chatham Rise (Figure 2). Catches from a fourth area within BYX 3, Sub-Antarctic, are negligible at 33 t in total or 0.07 % for the study period (ranging from 0 to 6 t annually, or 0 to 0.24%). The small catches from this area have been consistent through time and have never been targeted. For this reason the Sub-Antarctic is not considered any further in this study. Alfonsino in BYX 3 has also been the subject of catch sampling programmes in processing sheds in 2002–03, 2003–04, and 2004–05 (Blackwell et al. 2004, Horn et al. 2006, Horn et al. 2004). The west coast of both the North and South Islands (referred to as the West Coast in this study) also have negligible catches of alfonsino and are not considered in detail.

In BYX 1, alfonsino is mainly caught as a target species by bottom trawl within QMA 1. A smaller amount is taken as bycatch by bottom longline in the bluenose target fishery. The TACC has undergone a number of increases and was completely caught in 2005 (300 t) but has never been exceeded.

BYX 2 has historically been the major alfonsino fishery in the New Zealand EEZ. Landings have exceeded the TACC almost every year despite numerous TACC increases. The highest landing was 1 868 t in 1996 (exceeding the TACC at the time by 19%). Landings are usually a little over 1 600 t in most years. Most of the catch is taken as a target trawl species, but with moderate amounts taken in trawl fisheries targeting hoki, bluenose, black cardinalfish, orange roughy and gemfish. Catches are made all year round but decrease during the winter months.

In BYX 3 catches of alfonsino were low in the early 1990s and were mainly bycatch of the hoki fishery. However, the discovery of new grounds in the mid-1990s saw the rapid development of a target alfonsino fishery, most notably south-east of the Chatham Islands in Statistical Area 051. Annual landings are usually close to 1 000 t. The TACC of 1 010 t has been exceeded a number of times. The greatest landing was 1 197 t in 2002, exceeding the 1 010 TACC by 19%. The vast majority of the BYX 3 alfonsino catch now is targeted, followed by bycatch in fisheries for orange roughy, bluenose, hoki and hake. Catches are made all year round but decrease during the winter months. Catches of alfonsino in the Southland and Sub-Antarctic regions of BYX 3 are negligible.

Catches of alfonsino in BYX 7 are small. They are mainly taken by vessels midwater trawling for spawning hoki in Statistical Areas 034 and 035 in winter. There is essentially no targeting of alfonsino in BYX 7. The TACC was increased from 30 t to 80 t in 1989 and then again to 81 t in 1990, even though the TACC has never been caught. Annual landings are usually less than 30 t.

Landings have been reported from BYX 8 in only three years during the study period. No targeting has ever been reported from this area. All catch has been from midwater trawls targeting jack mackerel and bottom longline targeting bluenose.

Catches of alfonsino from BYX 10 (Kermadec Region) are negligible. Apart from 1 t in 1989, and less than 1 t in each of 1992 and 1993, there have been no reported landings of alfonsino from this area.

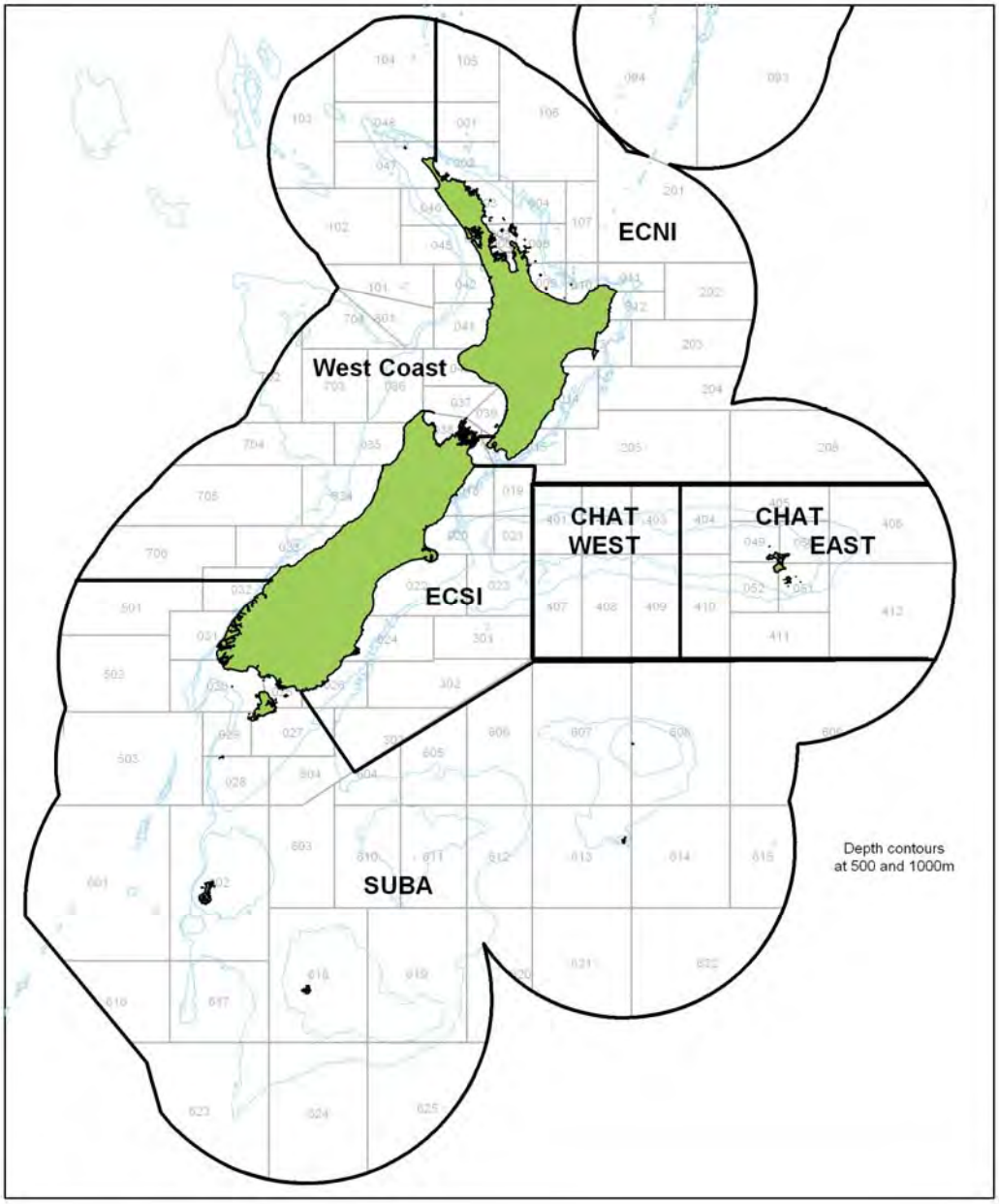

Figure 2: Map showing the areas used in this analysis, including statistical areas, and the 500 m and 1000 m depth contours. ECNI (east coast North Island), ECSI (east coast South Island), CHAT WEST (Western Chatham Rise), CHAT EAST (Eastern Chatham Rise), Southland & SubAntarctic (SUBA), and West Coast.

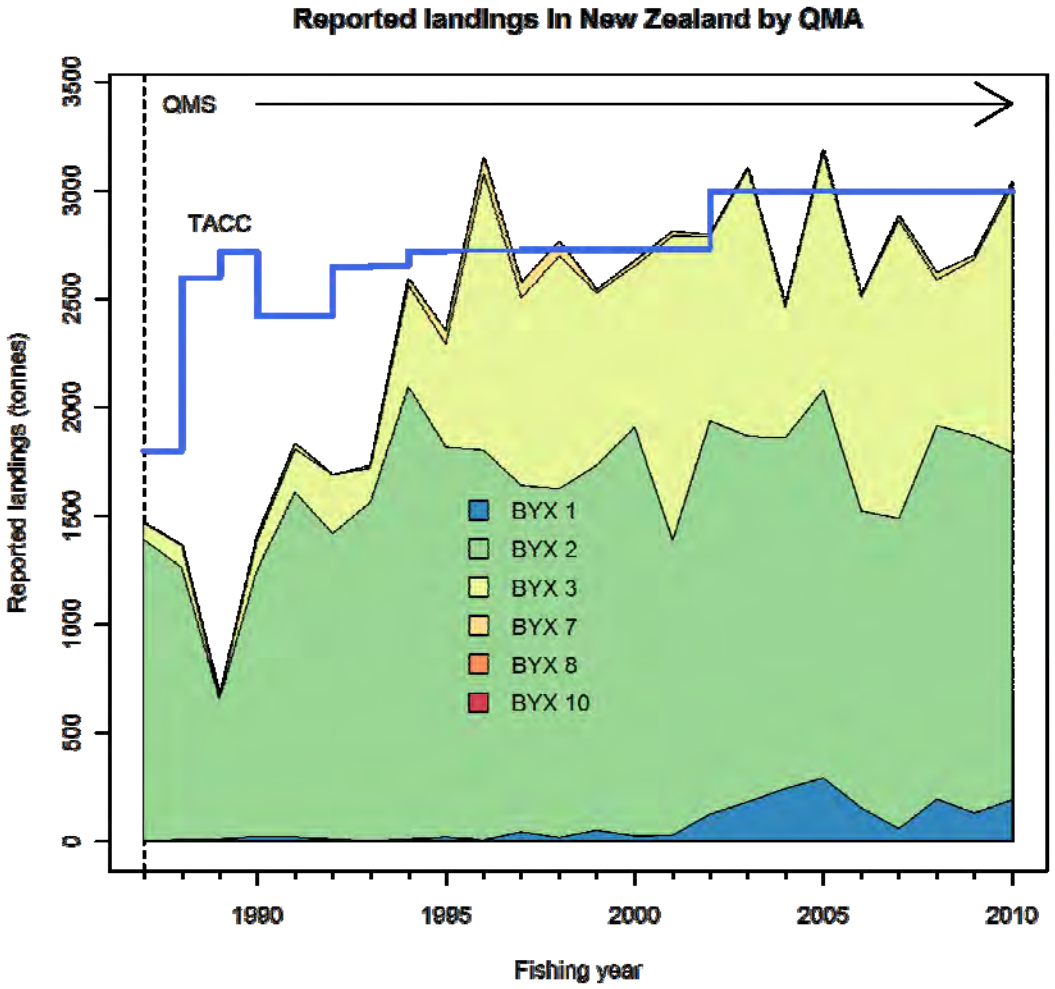

Figure 3: Total reported alfonsino landings by QMA (shaded regions) and TACC (blue line) from fishing years 1986–2010.

2.2 Recreational fisheries

Recreational fishers have occasionally reported catching alfonsino in negligible amounts.

2.3 Maori customary fisheries

Quantitative information on the current level of customary non-commercial take of alfonsino is not available.

2.4 Illegal and misreported catch

Quantitative information on the level of illegal catch of alfonsino is not available.

2.5 Other sources of mortality

There is no quantitative information of non-fishing sources of alfonsino mortality.

2.6 Regulations affecting the fishery

Current and historical limits on catch or effort in alfonsino fisheries are described in Section 2.1. Trawl codend minimum mesh-size regulations that currently apply are 60 mm for Sub-Antarctic (FMA 6) fisheries and FMA 5 south of 48° S; and 100 mm elsewhere. From 1 October 1977, the trawl codend mesh-size change took effect at the boundary between the Snares and Auckland Islands fisheries (the former EEZ area F/E boundary), which was at 48° 30'S. The management area boundary was changed on 1 October 1983 to 49° S (now the FMA5/6 boundary) but the codend mesh size change takes effect at latitude 48° S to allow for targeting of squid around the Snares Islands (Hurst 1988). Given the

negligible amount of alfonsino caught in the Sub-Antarctic area this regulation on codend mesh size is unlikely to have much if any impact on the species.

Protection of bycatch species in multi-species fisheries is mainly through the QMS, with quotas currently set on 628 fish stocks. Catch of protected species such as seabirds and fur seals is monitored through the Ministry for Primary Industries Observer Programme and all trawl vessels have been required to deploy seabird mitigation devices to minimise interactions with trawl warps since April 2006 (Ministry of Fisheries 2009). Bottom longline vessels 7 m or more in length must use streamer lines to deter seabirds when setting lines and no vessel may discharge offal while setting lines. When hauling lines, offal may only be discharged from the opposite side of the vessel from which the line is being hauled.

3. BIOLOGY

3.1 Distribution

Alfonsino are widespread in tropical, subtropical and temperate waters from the Atlantic, Pacific, and Indian Oceans (Busakhin 1982). They have been recorded in depths ranging from 10–1200 m but are most commonly found at 200–800 m, on or close to the seabed, often in association with seamounts and other underwater features (Maul 1981, Vinnichenko 1997a, Vinnichenko 1997b).

In New Zealand, alfonsino have been recorded in research bottom trawls in depths of 109–1150 m. They are most common from about 300–500 m (Anderson et al. 1998). They can be found all around New Zealand waters but occur in greatest numbers along the lower east coast North Island and south-east Chatham Rise. These two areas are essentially where the commercial fisheries for alfonsino in New Zealand are confined.

3.2 Spawning

Alfonsino from Japan, northwest of Hawaii, and in the northeast of the Atlantic are known to spawn from August to October (Masuzawa et al. 1975, Uchida 1986). In the southeast Atlantic, alfonsino spawn from January to March (Alekseev et al. 1986) and from November to February in New Caledonian waters (Lehodey & Grandperrin 1994, Lehodey et al. 1997). In New Zealand waters it has been suggested that alfonsino spawn from July to August (Horn & Massey 1989). This was based on observations of fish caught commercially from the lower east coast North Island that were ripening to spawn. However it is not known when and where spawning of alfonsino occurs in New Zealand waters. No running ripe fish were observed in regular samples taken over a 14-month period off the lower Wairarapa coast (Horn & Massey 1989).

Masuzawa et al. (1975) estimated the fecundity of a 40 cm female alfonsino from Japan to be 300 000–500 000 eggs. The fecundity of New Zealand alfonsino however has not been established because a full size range of ripening fish has not been observed (Horn & Massey 1989). Because of this the size and age at maturity cannot be determined precisely for either sex.

Analysis of observer records (see Section 6.1) found only two individual fish from a single tow on the west coast of the North Island recorded as running ripe. This is quite possibly a mistake. Almost all fish from observer records are recorded as stage 1 or 2 (immature or resting).

3.3 Stocks and spatial distribution

Stock structure is not currently known for New Zealand alfonsino. Horn & Massey (1989) found substantial differences in length frequency distributions between commercially-caught alfonsino from the Palliser bank compared with those from other locations on the east coast North Island. These differences suggest that there may be some age-specific migration occurring.

It has been suggested that alfonsino could comprise widespread populations in large oceanic eddy systems (Alekseev et al. 1986). If New Zealand alfonsino form part of such a system then the east coast North Island may be a vegetative, non-reproductive zone where fish grow and mature before leaving for a possible reproductive zone further east of the mainland (Horn & Massey 1989).

Given the concentration of alfonsino catches in the lower east coast North Island and eastern Chatham Rise with little continuity in catches between the two areas, the current separation of BYX 2 and BYX 3 is probably not unreasonable. The small catches from BYX 1, 7, and 8 are unlikely to be of much consequence and the current management areas are probably adequate.

Scaled population length frequencies from the Chatham Rise time series are patchy and show no obvious year class progression. There are no data currently available to compare the length frequencies of alfonsino from different management areas, and therefore investigate potential stock structures.

Tagging has been unsuccessful for alfonsino (Horn 1989). Being a moderately deepwater fish means that bringing them to the surface is not a viable option due to sudden and usually fatal changes in temperature, light, and particularly, pressure. Horn (1989) evaluated the use of detachable hook tags using drop lines to tag alfonsino without bringing them to the surface. Only a small number of alfonsino tags were returned by commercial fishermen. This was thought to be due to a combination of low numbers being tagged to begin with (the tagging programme essentially targeted bluenose), low recapture rates, the loss of tags (either before or during capture by commercial fishermen), and possibly low rates of observation by fishermen.

3.4 Ageing

Massey & Horn (1990) examined otoliths from commercially caught alfonsino from various alfonsino fishing grounds of the lower east coast of the North Island (BYX 2) from November 1985 to December 1986. They found evidence that one opaque and one hyaline zone (one ‘ring’) were formed annually (as did Lehodey & Grandperrin (1996)). They investigated the validity of zone counts by measuring the position of each ring and comparing it to the position of successive ring groups. They calculated the ‘marginal index’ of each otolith which was defined as the distance from the outer edge of the last hyaline ring to the otolith edge divided by the width of the last complete opaque and hyaline ring. They plotted the mean marginal indices of fish for each month over the study period and found that the index in every fishing ground dropped dramatically from June to December. This drop in mean marginal index meant that for most fish opaque material has started forming in June, and that the hyaline margin is probably laid down from March to May for most fish. Subsequent ageing has also shown the progression of relatively strong year classes between consecutive years of sampling, thus providing further support for the ageing method.

Massey & Horn (1990) observed very few fish younger than three years of age, and believed that full recruitment to the commercial fishery probably occurs at around five years of age.

No age and growth studies have been carried out for BYX 3. Obtaining this information through the use of market sampling or dedicated observers on vessels targeting alfonsino was recommended by Langley & Walker (2002a) in their 2002 characterisation of the BYX 3 fishery. A programme aimed at collecting this data on board vessels targeting alfonsino in BYX 3 was intended under Ministry for Primary Industries project BYX200801. Unfortunately this project was cancelled.

3.5 Growth curves

Von Bertalanffy growth parameters were derived for alfonsino from BYX 2 by Stocker & Blackwell (1991) (Table 2). They found that females attain a larger size than males and are also larger at corresponding ages. Massey & Horn (1990) presented von Bertalanffy parameters separately by sex for three fishing grounds off the lower east coast of the North Island.

Table 2: Von Bertalanffy growth parameters for alfonsino from Stocker & Blackwell (1991).

Region	Sex	L_∞	K	t_0
BYX 2	Female	57.5	0.080	–4.10
	Male	51.1	0.110	–3.56

3.6 Natural mortality (*M*)

Stocker & Blackwell (1991) used the equation $M = \log_e 100/\text{maximum age}$, where maximum age is the age to which 1% of the population survives in an unexploited stock. Using a maximum age of 20 years, they estimated *M* for both sexes as 0.23 for BYX 2. As no ageing has been done for alfonsino from BYX 3 a separate value of *M* cannot be calculated for this QMA.

3.7 Length-weight relationship

Length-weight relationship parameters presented in Table 3 for the Chatham Rise are those reported by O'Driscoll et al. (2011) for all fish from the summer Chatham Rise trawl survey time series from 1992–2010.

Table 3: length-weight parameters for alfonsino.

Weight (grams) = αL^{β} L= fork length in cm.

	Sexes combined	
	α	β
Chatham Rise	0.019	3.049

3.8 Feeding and trophic status

Horn et al. (2010) examined stomach contents from *Beryx splendens* caught on three consecutive summer trawl surveys of the Chatham Rise (2005–2007). They found that alfonsino were moderately selective feeders that fed primarily in the mesopelagic layers. The most common prey items were crustaceans and mesopelagic fishes. By mass, the most important were prawns from the genus *Sergestes*, followed by the myctophid fish *Lampanyctodes hectoris*, and then prawns from the genus *Pasiphaea*.

Smaller crustaceans such as euphasiids and amphipods are most important in the diet of smaller alfonsino (17–26.5 cm fork length). Larger prawn species and mesopelagic fishes were more important for larger alfonsino (27–42 cm fork length). Horn et al. (2010) postulated that they are selective feeders based on the observation that prey items such as squid and salps would be relatively abundant where alfonsino feed on the Chatham Rise, but are rarely taken.

4. CURRENT AND ASSOCIATED RESEARCH PROGRAMMES

The most recent characterisation of alfonsino was carried out by Mormede (2009) for BYX 3 under Ministry of Fisheries project BYX200801, objective 1. This was to establish a representative sampling regime for monitoring the length, sex, age, and catch-at-age composition of commercial catches from BYX 3 under objective 2 of the same project. Annual research trawl surveys in summer by *Tangaroa* on the Chatham Rise have been carried out since 1991 and they collect biological information on alfonsino (see Section 5). The survey is not designed to optimise monitoring of alfonsino, and biomass estimates have fluctuated somewhat and often have very high c.v.s. Alfonsino are occasionally caught on other surveys such as those for orange roughy and oreo species.

5. FISHERY INDEPENDENT OBSERVATIONS

5.1 Research survey biomass indices and length frequencies

There have been no surveys designed specifically to estimate alfonsino abundance. The Chatham Rise *Tangaroa* trawl survey time series, started in 1991, is primarily aimed at surveying hoki, hake and ling, as well as a variety of other middle depth species. The survey area and depth range is appropriate for alfonsino but biomass appears to be poorly estimated. The patchy nature of alfonsino distribution and its association with particular bottom features means that the chances of a randomly allocated trawl station being in an area of high alfonsino concentration is low. Trends in biomass and length frequencies from these surveys are presented in Table 4 and Appendix A (Figures A1–A2).

Biomass estimates for the Chatham Rise time series range from 594 t to 26 027 t (Figure A1). Coefficients of variation fluctuate wildly, ranging from 20 to 91%. Biomass estimates for the Chatham Rise show considerable variation, particularly for the first three years and last six years of the time series. Higher biomass estimates are associated with high c.v.s, particularly in 1994, 2005, and 2008. Males and females contribute roughly equal amounts to the biomass in most years. The Chatham Rise series is probably not suited to the monitoring of alfonsino abundance.

Numbers of alfonsino measured range from 480 to 1 603 per survey. Males contribute slightly more of the total biomass than females for the time series with a mean proportion of 0.51 but this fluctuates from 0.39 to 0.67. Males usually outnumber females with a mean male:female ratio of 1.31 for the time series (range 0.84–2.69). For both sexes, fish range from 16–52 cm fork length (FL) (Figure A2). Virtually all fish of both sexes are 20–35 cm, although females tend to reach slightly larger sizes than males. Length frequencies are usually unimodal and show no obvious trend in mean length over time. Only two individual fish have had otoliths collected from this survey series and therefore it is not possible to develop a catch-at-age history from the time series.

Table 4: Biomass indices (t) and coefficients of variation (c.v.) of alfonsino from *Tangaroa* summer trawl surveys of the Chatham Rise (Assumptions: areal availability, vertical availability and vulnerability = 1).

	Trip code	Date	Biomass (t)	% c.v.
Chatham Rise				
	TAN9106	Dec 91–Feb 92	6 598	51
	TAN9212	Dec 92–Feb 93	7 168	85
	TAN9401	Jan 94	25 853	90
	TAN9501	Jan–Feb 95	1 338	36
	TAN9601	Dec 95–Jan 96	1 807	58
	TAN9701	Jan–Jan 97	4 152	63
	TAN9801	Jan–Jan 98	2 269	52
	TAN9901	Jan–Jan 99	4 216	51

TAN0001	Dec 99–Jan 00	1 216	20
TAN0101	Dec 00–Jan 01	4 867	60
TAN0201	Dec 01–Jan 02	5 570	64
TAN0301	Dec 02–Jan 03	1 151	39
TAN0401	Dec 03–Jan 04	594	31
TAN0501	Dec 04–Jan 05	15 813	79
TAN0601	Dec 05–Jan 06	6 439	86
TAN0701	Dec 06–Jan 07	1 384	57
TAN0801	Dec 07–Jan 08	26 027	91
TAN0901	Dec 08–Jan 09	13 378	82
TAN1001	Jan 10	14 533	65

6. FISHERY DEPENDENT OBSERVATIONS

6.1 Observer data

6.1.1 Length and age sampling

The Ministry of Fisheries Observer Programme has collected alfonsino length, weight, and female gonad stage data from various fisheries since the 1993–94 fishing year. All tables and figures relating to observer data collected from alfonsino fisheries are contained in Appendix B (Tables B1–20, Figures B1–10).

The number of tows that measured alfonsino from 1994 to 2010, in order of largest to smallest, came from the West Coast (235), east coast North Island (166), eastern Chatham Rise (126), western Chatham Rise (26), east coast South Island (23), and Sub-Antarctic (2) (Table B1). The percentage of observed catch by area, averaged across all years, was highest for the Southland/SUBA region (2.2%) and WCSI (1.6%), slightly lower for ECSI/CHAT (1.1%), and lowest for the North Island fishery (0.5%).

The highest number of length frequencies taken however has been from the east coast North Island (7920 fish measured, Table B11) which has traditionally been the dominant commercial fishery for alfonsino. The West Coast has the next largest number of length frequencies with 7 697 individuals measured. However, nearly half of these were from the 2010 fishing year, with more sporadic sampling in other years. An investigation into the fishing locations of these West Coast length frequencies found that nearly all of the observed tows were actually outside the NZ EEZ (this means that they were probably mis-coded as west coast in the Observer database). The eastern Chatham Rise has the next largest number of individuals measured at 5 032.

There was no Observer coverage of alfonsino before the 1994 fishing year, and it has been patchy since. The most consistent coverage has been for the east coast North Island fishery which has always produced the largest catches of alfonsino. The second most important fishery, the eastern Chatham Rise, has experienced the second most consistent coverage. An increase in samples was taken in the 2010 fishing year in response to Ministry for Primary Industries project BYX200801, which seeks to monitor the age and length structure of alfonsino in BYX 3.

There is little seasonality in the level of coverage, although most areas show a decrease in winter months. This could be due to the deployment of observers to vessels fishing for hoki during the spawning season and/or to the possible migration of alfonsino to unknown spawning grounds during winter (see Section 3.2).

The representativeness of observer sampling of alfonsino was evaluated by plotting the proportion of landed catch for each year by area and by month as circles, and overlaying this with the proportion of

the observed catch for those same cells as crosses (Figures B1–B6). If the proportions are the same, the plots align; if over- or under-sampling has occurred, the crosses are either larger or smaller than the circles respectively. Sampling has been sporadic in all areas and is practically non-existent for the east coast South Island, western Chatham Rise, and Sub-Antarctic, although these three areas contribute little to the total alfonsino catch anyway. Observer coverage for the east coast North Island ranges from none to over-sampling (Figure B1). October and November are the most consistently sampled months for this area since 1999. Observer coverage for the eastern Chatham Rise (Figure B4) ranges from no sampling in some months (typically but not exclusively winter, when catches are small) to over-sampling (typically summer and autumn months). The West Coast also has coverage ranging from none to over-sampling (Figure B6).

Observers have taken otoliths from 2 416 alfonsino according to the Centralised Observer Database (COD). Samples of 385 male and 489 female fish have been taken from the lower ECNI region (BYX 2), and 203 males and 294 females from the Chatham Rise. Simulations and power analyses by Mormede (2009) on shed sampling data collected from the BYX 3 fishery found that about 320 female and 220 male samples of alfonsino would be sufficient to have a 95% probability of detecting a change in mean age of one year with a mean weighted c.v. of 30%. At this stage it appears that there are insufficient data to develop a catch-at-age history for the Chatham Rise fishery, but work is underway under Ministry for Primary Industries Project BYX200801 to collect sufficient otoliths from the eastern Chatham Rise fishery. There may be sufficient data from the ECNI fishery. Otolith numbers collected from other areas are also insufficient to develop catch-at-age histories but this is of little concern as these areas do not support significant alfonsino fisheries.

6.1.2 Length frequencies

Scaled length frequencies were determined using the 'Catch at Age' software (Bull 2002). This process scales the length frequency from each catch up to the tow catch, sums over catches in each stratum, scales up to the total stratum catch, and then sums across the strata to yield overall length frequencies. Numbers of alfonsino were estimated from catch weights using the length-weight relationship given in Table 3.

Length frequencies are plotted in Figures B7–B10 for the east coast North Island and eastern Chatham Rise fishing areas. For the other fishery areas there was too little data to calculate scaled length frequencies and/or the contribution of those areas to the total catch is insignificant. While the West Coast had sampled a larger number of individuals for length frequencies the vast majority of fish were actually from outside the New Zealand EEZ. The size of fish caught by commercial vessels is similar for both areas with the majority of fish of both sexes being between 25 and 45 cm (range 19–59 cm). Comparison with length frequencies from the Chatham Rise trawl surveys is difficult because so few alfonsino have been caught by those trawl surveys. However, it appears that, on average, the commercial fishery may catch larger fish (i.e., more fish larger than 35 cm) than the Chatham Rise trawl survey series.

Sampling has been patchy in some years for both areas and there are no clear trends visible in the length frequency plots. No obvious year class progression can be seen in either area, nor do there appear to be any differences in sex ratios between the two main fishing areas.

6.1.3 Female maturity

Observer collected data on female maturity stage has used a 5-stage gonad scale (immature/resting, maturing, ripe, running ripe, spent). The numbers of female alfonsino staged from the study period, by area, are given in Tables B15–B20. The data are patchy for a number of areas, and essentially non-existent for the Sub-Antarctic. The east coast North Island and eastern Chatham Rise have been the most heavily sampled for gonad stages.

The proportions of each gonad stage by month for each year are plotted for all areas in Figure B11. For all areas combined, most gonads at any time of year are stage 1. The next most common stage is 2, although they are considerably less common than stage 1. Stage 3 fish are rarely seen, and only two stage 4 fish have been recorded, and these are quite possibly mistakes, as the location of spawning alfonsino is not known (see Section 3.2). This pattern is also observed in individual areas, i.e., eastern Chatham Rise, West Coast, and East Coast North Island. Data are sparse for the other areas with sampling having never occurred in a number of months. Stage 5 fish have also been observed from June to December for the east coast North Island. This is not at odds with the observation of ripening fish in early winter that then disappear before spawning which led Horn & Massey (1989) to suggest that spawning takes place (in an unknown location) during June and July. Spent females on the west coast are seen in a number of months during all seasons; if the data are correct then there may be no discrete spawning season for West Coast alfonsino. Stage 5 females from the eastern Chatham Rise have been observed in very small numbers in January and March.

6.2 Catch and effort data sources

All plots and tables relating to catch and effort data are contained in Appendix C, Tables C1–C28 and Figures C1–C133. Catch and effort data were requested from the Ministry of Fisheries catch-effort database "warehou" as extract 8208. The data consist of all fishing and landing events associated with a set of fishing trips that reported a positive landing of alfonsino in BYX 1–8 between 1 October 1989 and 30 September 2010. Fishing year is labelled as the most recent year (i.e., the 1998–1999 fishing year is referred to as 1999). The fields from the database tables requested are listed in Table C28.

The estimated catch associated with the fishing events were reported on the general Catch Effort Landing Returns (CELR) and the more detailed Trawl Catch Effort and Processing Return (TCEPR). The green weights associated with landing events were reported on the bottom part of the CELR forms, or where fishing was reported on the TCEPR, on the associated Catch Landing Return (CLR). TCEPR forms record tow-by-tow data and summarise the estimated catch for the top five species (by weight) for individual tows. CELR forms summarise daily catches, which are further stratified by statistical area, method of capture, and target species. Trawl vessels less than 28 m in length can use either CELR or TCEPR forms; trawl vessels over 28 m use TCEPR forms. From 1 October 2007, the Trawl Catch Effort Return (TCER) forms replaced the CELR forms, and they summarise daily estimated catches for up to the top eight species.

Information on total harvest levels is reported in the Plenary document (Ministry of Fisheries 2009), but only at the resolution of Quota Management Area. The CELR forms report catches at the level of individual fishing events, but the fishers are only required to report the top five species in their catch. This has led to concerns (e.g., Phillips 2001) that bycatch species may not be well reported at the fishing event level. The daily processed part of the TCEPR contains information regarding the catch (of all quota species) that was caught and processed that day, and these data are generally believed to provide a more accurate account of low and zero catch observations. However, daily processed catch data suffer from the inability to assign processed catch to a specific day or amount of effort because catch is not always processed on the day it was caught and can be split among days. The daily processed catch was not examined in this study.

The extracted data are groomed and restratified to derive the datasets required for the characterisation and CPUE analyses using a variation of Starr's (2003) data processing method as implemented by Manning et al. (2004), with refinements by Blackwell et al. (2005), and Manning (2007) and further modified for this study. The method allows catch-effort and landings data collected using different form types that record data with different spatial and temporal resolutions to be combined. It also overcomes the main limitation of the CELR and TCEPR reporting systems (frequent non-reporting of species that make up only a minor component of the catch). The procedure was comprehensively described by Manning et al. (2004) and Starr (2007). The major steps are as follows.

Step1: The fishing effort and landings data are first groomed separately. Outlier values in key variables that fail a range check are corrected using median imputation. This involves replacing missing or outlier values with a median value calculated over some subset of the data. Where grooming fails to find a replacement, all fishing and landing events associated with the trip will be excluded.

Step 2: The fishing effort within each valid trip is then restratified by statistical area, method, and target species.

Step 3: The greenweight landings for each fish stock for each trip are then allocated to the effort strata. The greenweight landings are mapped to the effort strata using the relationship between the statistical area for each effort stratum and the statistical areas contained within each fish stock.

Step 4: The greenweight landings are then allocated to the effort strata using the total estimated catch in each effort stratum as a proportion of the total estimated catch for the trip. If estimated catches are not recorded for the trip although a landing was recorded for the trip, then the total fishing effort in each effort stratum as a proportion of the total fishing effort for the trip is used to allocate the greenweight landings.

Step 5: The original intent of the merging process was to allow trip level landings data to be mapped to CELR effort strata. However, many species are captured in fisheries reporting using a combination of form types, and some may use TCEPR forms almost exclusively. The grooming and merging process also allows an evaluation of the amount of catch and effort that is not captured using TCEPR forms at the fishing event level. If significant, the best characterisation dataset is likely to be the merged trip level data. But if the amount of lost catch and effort is predictable, minor, and stable over time and area, the estimated catch at the level of the fishing event provides a much more detailed dataset for characterisation and CPUE analysis.

7. DESCRIPTIVE ANALYSIS OF CATCH

Commercially, alfonsino are most often caught in decreasing order of tonnage by bottom trawl, midwater trawl on the bottom (i.e., within 5 m of the sea bed), and midwater trawl. Small amounts are taken by bottom longline and as bycatch by a variety of other methods such as set netting. Most alfonsino are targeted, but when caught as bycatch they are most often associated with target fisheries for hoki (*Macruronus novaezelandiae*), orange roughy (*Hoplostethus atlanticus*), bluenose (*Hyperoglyphe antarctica*) and black cardinalfish (*Epigonus telescopus*) (Figure C37). Where targeted, alfonsino are mainly caught along the lower east coast of the North Island and the south-east Chatham Rise. Smaller amounts are taken on the upper east coast of the North Island, off Kaikoura, and along the northern edge of the Chatham Rise. They are also caught in other areas (i.e., the Sub-Antarctic, Southland, and the west coasts of the North and South Islands) but in negligible amounts and are not targeted there.

7.1 Summary of catches

All tables and figures relating to catch and effort analyses of alfonsino fisheries are contained in Appendix C (Tables C1–C27, Figures C1–133). Table C27 contains a list of species codes used in the report and their corresponding common and scientific names.

The reported plenary landings, catch-effort landings (un-groomed), and TACCs for BYX 1–8, from 1982–83 to 2009–10, are shown in Table 1 and Figures C1–C3. The ungroomed catch-effort landings in the raw dataset are similar to the reported plenary landings for most years in most QMAs. Aside from the odd discrepancy in some years, ungroomed and plenary reported landings in alfonsino stocks are minimally different after the grooming process (see Figures C4–C6).

The plenary landings have overrun the TACC in a number of QMAs in a number of years in BYX 1–3 where there is active target fishing of alfonsino. The TACC has never been caught in either BYX 7 or BYX 8 where there is no target fishing for alfonsino and landings are very small in comparison to other QMAs.

The landings data provide a verified greenweight landed for a fish stock on a trip basis. However, landings data include all final landing events – where a vessel offloads catch to a Licensed Fish Receiver (LFR), and interim landing events, where catch is transferred or retained, and may therefore appear subsequently as a final landing event (SeaFIC 2007). Starr's procedure separates final and interim landings based on the landing destination code, and only landings with destination codes which indicate a final landing are retained (see Table 2 in Starr (2007)).

Tables C1–C5 summarise the number of landing events for the major destination codes in the dataset for each QMA. The weight, number of records, and disposition of each potential landed state is given in Table C6. For all five QMAs considered in this report, most alfonsino both by greenweight and individual landing events is landed in New Zealand to LFRs (recorded as "L") for both CLR and CELR landing forms. Greenweight landings coded as "L" account for between 92% and 99% of the total.

The retained landings, interim landings, and total landings dropped during data grooming for each QMA are shown in Figures C4–6. The estimated catch and landings removed from the dataset in this process are generally insignificant throughout the time series.

In all QMAs the main processed state for alfonsino is "Green", followed by "Dressed" (includes "Dressed", "Headed and Gutted", and "Trunked"). In some years more fish is landed dressed than green in BYX 3. The next most common processed state is fish meal but in negligible amounts. Some conversion factors for alfonsino have changed since its introduction to the QMS. Most of the catch is landed green, with no conversion factor issue. "Trunked" comes under the "dressed" state code for which there has been a change in conversion factor. Although other processed states contribute to only as small proportion of the catch there have been changes in the conversion factors for some of these states. This means that different amounts of greenweight catch are associated with the same amount of processed catch for some product forms throughout the dataset. Therefore the greenweights were standardised using the most recent conversion factor for those processed states for which there have been changes in conversion factor. This assumes that the changes in conversion factors reflect improving estimates of the actual conversion when processing alfonsino, rather than real changes in processing methodology across the fleet.

The retained landings adjusted for the change of conversion factors were allocated to the effort strata using the relationship between the statistical area for each effort stratum and the statistical areas contained within each fish stock. Difficulties arise with effort strata associated with statistical areas that straddle stock management area boundaries (e.g., statistical areas 018, 019, and 027), as the proportion of catches to be allocated to each QMA cannot be determined. There are two options to address this problem. The first assumes that catches of the straddling statistical area had been taken from a single fish stock if the trip had only reported to that stock, and excludes all the fishing and landing events from that trip if it had reported to multiple fish stocks ("straddle" method). This may not be ideal if trips often straddle fishstock boundaries. The second option allocates statistical areas to alfonsino fish stocks based on the location of the centroid of each area ("centroid" method). The centroid method was used here and resulted in a closer relationship between reported plenary landings, merged landings, and estimated catch in all areas. Details of the retained landings in unmerged and merged datasets and estimated catches in the groomed and merged datasets, by QMA, are given in Table C7. The recovery rates, defined as the groomed and

merged landings as a proportion of the groomed and unmerged landings (after Manning et al. 2004), are plotted in Figures C10–C12.

The reported landings, retained landings in the unmerged and merged datasets, and the estimated catch reported on CELR, TCEPR, or TCER forms is shown for all QMAs in Figures C13–C15. The reporting rate, defined to be the annual estimated catch as a proportion of the retained landings in the groomed and merged dataset, was also calculated (Figures C16–C18). Both the CELR and TCEPR reporting rates fluctuate somewhat in BYX 1. Both form types are reasonable in BYX 2 (usually above 80%) probably as a result of it being an area where alfonsino is actively targeted and hence more attention paid to the quantities caught as opposed to bycatch species. The reporting rate in BYX 3 fluctuates for CELR forms but is particularly good for TCEPR forms, usually close to 1. Again this is quite likely because there is a significant amount of active targeting of alfonsino there. Reporting rates are poor in BYX 7and BNS 8 where very little alfonsino is caught and none targeted.

The proportions of estimated catches and retained landings by form type for each fishstock are shown in Figures C19–C21. For BYX 1 to 3, the majority of landings are on CLR forms and estimated catches on TCEPR forms. There are slightly more landings on CELR and estimated catches on CEL forms in BYX 1 and 2, most likely due to the close proximity of the fishing grounds in those QMAs to shore, allowing smaller vessels to participate in the fisheries there. The offshore nature of the main fishery in BYX 3 means that most of the vessels involved will be larger than 28 m and therefore required to use TCEPR forms and report landings on the associated CLR forms. Most of the catch in BYX 7 is on TCEPR/CLR forms in most years, probably because it is caught by larger vessels targeting hoki and hake during the spawning season. No clear pattern is seen in BYX 8 where very little alfonsino is caught.

In BYX 1, the proportion of trips that report landing alfonsino but record no estimated catch of it has fluctuated throughout the time period for vessels reporting on CELR forms (Table C8). For TCEPR forms this has also fluctuated throughout the time period but declined overall (Table C8, Figure C25). In BYX 2 for the CELR form, there is also a lot of fluctuation in the proportion of trips that land alfonsino but recorded no estimated catch (Table C8). For vessels reporting on TCEPR forms in BYX 2 there is an overall decline in the number of trips landing alfonsino but reporting no estimated catch of it (Table C8, Figure C26). The proportions in BYX 3 are higher, particularly for CELR vessels (Table C8), but also for TCEPR vessels (Table C8, Figure C27). This is a large QMA (FMAs 3-6 combined) with many different target fisheries operating in it. Alfonsino is widespread along FMA 4 within BYX 3 but there are only small areas where targeting is concentrated and large catches made. This probably accounts for the higher proportion of trips reporting no estimated catch when alfonsino was landed when compared to the proportions seen in BYX 1 and 2. In BYX 7 and BYX 8 where there is no targeting of alfonsino and it is only caught in small quantities the majority of trips that land alfonsino do not report it in their estimated catches for both form types (Table C8, Figure C28–C29).

7.2 Fishery summary

Alfonsino catches for the four main fishery areas east coast North Island (ECNI), east coast South Island (ECSI), western Chatham Rise, and Eastern Chatham Rise are given in Table C9. There are two other areas included in this table: Sub-Antarctic, and West Coast (which includes both the North and South Islands). For these two areas, there is no targeting of alfonsino and the catches are so low that their contribution to the total is insignificant. Their low contribution has been consistent through time, so there is little potential there for any developing alfonsino fishery. Consequently, catches in the Sub-Antarctic and on the West Coast were not investigated in any more detail and will not be discussed any further here. Distribution of catch is shown by statistical areas in Figure C30, and by 0.2 degree squares from TCEPR data in Figure C31–C34 and TCER data in Figure C35.

Alfonsino fisheries occur predominantly on ECNI and the south-eastern Chatham Rise. Smaller fisheries occur off Kaikoura and along the northern edge of the western Chatham Rise (Table C9, Figures C31–C35). The greatest landings from 1990 to 2010 by region have consistently come from the ECNI (34 118

t), followed by the eastern Chatham Rise where the fishery developed in the mid-1990s (13 510 t). For the ECNI, statistical areas 015, 014 and 204 contribute the largest proportion of the catch for all years, followed by areas 013. For the eastern Chatham Rise statistical area 051 is the most important, followed by areas 412, 404, and 406.

New Zealand flagged vessels and vessels of unspecified flag state take almost all of the alfonsino catch (Table C10, Figure C36a). Catches by vessels of other nationalities are minor. Most vessels are between 300 and 2100 engine kilowatts, with a strong mode at 900 kilowatts (Figure C36b). Most of the vessels are between 250 and 750 gross tonnes (Figure C36c) and between 25 and 45 metres in overall length (Figure C36d).

Across all regions, most catches are taken between September and April, with small catches from May to August (Figure C37a). Bottom trawling has consistently been the dominant fishing method, followed by midwater trawling on the bottom (i.e., within 5 m of the sea bed), and midwater trawling (Figure C37c). By comparison bottom longlining has been of minor importance but appears to have been increasing since the mid-2000s. All other fishing methods are insignificant. The majority of alfonsino has been caught as a target fishery throughout the study period (Figure C37d). As bycatch, alfonsino is most often caught in the hoki fishery, followed by orange roughy, bluenose and black cardinalfish.

7.2.1 East Coast North Island

Alfonsino from the ECNI fishery are caught throughout the year with a slight drop off in catches during the winter months of May to August (Table C11, Figure C38a). The most important statistical area is 015, followed by 204 and 014 (Table C12, Figure C38b). Area 013 is also important. The majority of the catch is taken in order of decreasing catch by midwater trawling on the bottom, bottom trawling, and midwater trawling (Table C13, Figure C38c). Bottom longlining accounts for only 2% of the catch. Alfonsino is caught mainly as a target fishery (67% of the catch) but is bycatch in a variety of other fisheries (Table C14, Figure C38d). Hoki, black cardinalfish, bluenose, and orange roughy are the most important target fisheries that also catch alfonsino.

Vessels reporting on TCEPR forms fish mainly in statistical areas 014, 015, and 204 (Figure C39), irrespective of which trawl method they use. Vessels reporting on CELR forms fish almost entirely in areas 013 and 014. This may be due to their smaller size making areas like 015 and 204 too far from port to be either safe or economical to fish. The locations of the main ECNI grounds where alfonsino are targeted are shown by Horn & Massey (1989).

TCEPR vessels catching alfonsino are mainly targeting it (Figure C40). Smaller amounts are caught in hoki, black cardinalfish, orange roughy and bluenose fisheries. The black cardinalfish and orange roughy fisheries are entirely by bottom trawl. CELR vessels catching alfonsino are almost exclusively targeting alfonsino by midwater trawl.

Where alfonsino is the target species statistical areas 013–015 and 204 are most important irrespective of fishing method (Figure C41). When hoki is the target species most alfonsino is caught in area 015. The orange roughy target fishery mainly catches alfonsino in areas 015 and 204 by bottom trawl and for gemfish mainly in area 014 and 015 (Figure C42). Other target species catching alfonsino do so in small amounts over most statistical areas (Figures C41–C42). Most targeted alfonsino is caught in the spring to autumn months, although targeting occurs all year round (Figure C43). Small amounts are caught in target fisheries for other species all year round.

The largest proportion of alfonsino caught as target is in statistical areas 204, followed by 015, 014 and 013 (Figure C44). Although most of the total catch comes from area 015 the proportion of that catch reported as target fluctuates markedly between years.

By month the largest proportion of alfonsino caught as target is from September to December (Figure C45). Other months sometimes show targeted alfonsino as being the majority of the catch over the years but there is a lot of variation between years.

The proportion of TCEPR tows that report no alfonsino catch is predictably lowest when alfonsino is the target species and has been less than 0.2 throughout the study period (Figure C46). For the hoki and black cardinalfish target fisheries, the proportion ranges from about 0.2 to 0.6. In the bluenose fishery the proportion is more variable, ranging from 0 to about 0.6. The orange roughy fishery reports the highest proportion of zero alfonsino catches and this has been climbing throughout the study period.

The catch of alfonsino in kg/hour fished is predictably much higher in the target fishery (Figure C47). There appears to be an overall increasing trend over the time period and it is now nearly 5500 kg/hour. The bluenose fishery has the next highest catch rate with a peak of nearly 2500 kg/hour, but the rate has been highly variable over time. Other target species exhibit considerable variation.

Tow duration has been constant throughout the study period for bottom trawl tows targeting alfonsino; nearly all are less than two hours long (Figure C49). Tows targeting orange roughy and black cardinalfish are similarly short in duration and also constant over time. Hoki target tows are longer with most being two to five hours in duration. Other target species catch relatively minor amounts of alfonsino and most show variable tow durations. For midwater trawl and midwater trawl on the bottom, alfonsino and hoki target trawls have similar tow durations as they do for bottom trawling (Figures C50 and C51). Data for other species for midwater and midwater trawl on the bottom are patchy and fairly inconsistent.

Effort depth for alfonsino target tows has been relatively constant through the study period for bottom tows with most being between 300 and 600 m deep (Figure C52). Black cardinalfish targeted tows have also been constant through time at around 600–700 m. Hoki targeted tows have also been fairly consistent, although shallower at 200–600 m. Tows for orange roughy are the deepest at around 800–1100 m and are again fairly consistent through time. Gemfish tows are the shallowest, again fairly constant through time, at around 150–300 m.

For most targeted midwater alfonsino tows, effort depth is slightly shallower than bottom tows at 300–500 m (Figure C53). Hoki targeted tows are also slightly shallower for midwater at 200–500 m for most tows. Other target species using midwater gear and catching alfonsino are patchy and inconsistent and no pattern can be seen.

For midwater trawl on the bottom, alfonsino targeted tows are similar to midwater trawl at 300–500 m (Figure C54) as is hoki at mainly 200–500 m. Though only caught in small quantities, when alfonsino is caught in rubyfish targeted tows with this method, effort depth is fairly consistent through the time period at 200–300 m. The gemfish target fishery is also consistent at around 350–300 m effort depth. Depths for other species targeted using this method are again patchy and inconsistent through time with no obvious pattern.

Fishing effort variables for bottom trawl caught alfonsino for various target species are presented in Figure C55. Effort width for alfonsino, bluenose and cardinalfish are all very similar with most being about 18–20 m. Other target species have slightly wider effort widths of around 20–35 m, with scampi being the widest at around 50–60 m. For effort height bluenose, alfonsino, and cardinalfish are again all very similar to one another at around 5–7 m, quite likely because the same vessels are fishing for all three of those species with the same gear. Effort height is also similar for orange roughy. All target species show similar effort speeds with most being 3–4 knots. Distance towed is very short for bluenose, alfonsino, black cardinalfish and orange roughy tows with most being less than 10 km. Hoki target tows are generally a bit longer at about 5–20 km for most tows. Practically all vessels involved are less than 1000 gross tonnes and under 40 m overall length.

Fishing effort variables for alfonsino caught by midwater trawl for various target species are presented in Figure C56. Effort widths are wider for midwater trawl than for bottom trawl with most being around 40–

70 m. Also, effort height is higher, usually 20–30 m but up to 60 m. Effort speeds are similar to bottom trawl with most tows being between 3 and 4 knots. Distance towed is generally short for most target species (under 10 km), but for hoki can be longer at around 5–20 km. Practically all vessels are again under 1000 gross tonnes in weight and under 40 m in overall length. It is likely that these are the same vessels using midwater trawl gear as use bottom trawl gear.

Fishing effort variables for vessels midwater trawling on the bottom for various target species are presented in Figure C57. The values seen are almost identical to regular midwater trawling. This is most likely because they are the same vessels as those doing regular midwater trawling, using the same gear, but on or very close to the bottom.

There has been little change in the location of catch of trawl-caught alfonsino on the ECNI as recorded on TCEPR forms (Figures C58–61). These plots include all three trawling methods described after finding no difference in the location of alfonsino catches between them. Nearly all of the catch is taken from the lower ECNI between Cape Palliser and Gisborne although some alfonsino are caught around the upper ECNI too. Statistical areas 014, 015, and 204 are consistently the most important areas. If location of effort has changed in this time, it is at a finer scale than at the resolution of 0.2 degrees. Catches of alfonsino on TCER forms are negligible and not plotted.

Figure C62 shows the locations of alfonsino target catches (black squares) with catches of alfonsino caught as bycatch in other target fisheries overlaid (grey squares). There appears to be very little difference in the locations of alfonsino catches between target species, at least not at the resolution of 0.2 degree squares.

7.2.2 Eastern Chatham Rise

The eastern Chatham Rise reports the second largest catches of alfonsino (after the east coast North Island) with 13 510 t (27 %) of the total landings for the study period (Table C9). They are caught all year round but there is a noticeable decline from April to August (Table C15, Figure C63a). Highest catches are in January. Most of the catch comes from Statistical Area 051 (47 %) followed by 404 (22 %), and 412 (13 %) (Table C16, Figure C63b). Bottom trawl has been the most common method with 83 % of the total for the study period, followed by midwater trawl on the bottom (11 %) with the remaining 6 % taken by midwater trawl (Table C17, Figure C63c). Catches from this area were low in the early 1990s and it was almost caught entirely as bycatch in target fisheries for hake, hoki, and orange roughy (Table C18, Figure C63d). In 1996 a target fishery developed suddenly and total catches of alfonsino increased dramatically and the target fishery has accounted for most of the catch in most years since then.

For bottom trawl caught fish from vessels reporting on TCEPR forms most of the catch is taken in Statistical Areas 051, 404 and 412 (Figure C64). Areas 404 and 406 are most important for fish caught by midwater trawl and midwater trawl on the bottom. Trawl vessels reporting on CELR forms and bottom longliners reporting on LCE forms catch negligible amounts of alfonsino.

Most TCEPR vessels that catch alfonsino when targeting other species are using bottom trawl. Midwater and midwater trawl on the bottom are only significant for the alfonsino target fishery (Figure C65).

Alfonsino caught as bycatch in the bluenose fishery are taken mainly from Statistical Areas 051 and 404 (Figure C66). When actively targeted, alfonsino is most often caught in area 051, followed by 404. The hake fishery mainly catches alfonsino in area 404. For the hoki fishery, alfonsino is caught in small amounts in all statistical areas. The orange roughy fishery mainly reports alfonsino bycatch in area 412.

Figure C67 shows the distribution of alfonsino catch by month for various target species over the study period. For fisheries in which alfonsino is bycatch there is no obvious temporal pattern in the catches. For the target fishery, catches clearly drop off in the winter months from May to August.

Figure C68 shows the total alfonsino catch by statistical area for the study period and the proportion of that catch that was reported as targeted. The areas that contribute the greatest amount of total catch also unsurprisingly show large proportions of that catch being targeted (areas 049, 051, 404, and 406). In some years for some statistical areas the total catch appears to be targeted (e.g., area 051 in 2007, area 049 in 2009).

Figure C69 shows the total alfonsino catch by month for the study period and the proportion of that catch that was reported as targeted. It shows again that from the early- to mid-1990s very little alfonsino was targeted (or caught). The sudden expansion of a target fishery in 1996 produced larger catches that were frequently reported as being targeted in summer from December to March, and there can also be a high proportion of targeted fishing from September to November as well.

As shown previously for the east coast North Island, the proportion of tows that contain no alfonsino is generally lowest for the target alfonsino fishery (Figure C70). The target fishery with the next lowest proportion of zero tows is hake although this is variable through time. The highest proportion is again in the orange roughy target fishery, probably because alfonsino are relatively less abundant at orange roughy depths. The next highest is in the hoki fishery. No clear pattern is seen for the bluenose fishery, with several years without data in the first half of the study period.

Unstandardised catch rates (kg/tow) are shown for the main target species in Figure C71. For the alfonsino target fishery catch rates are fairly steady from the late 1990s at around 1500 kg/tow, probably following a learning period as the fishery developed from the mid-1990s. Catch rates were variable in the orange roughy fishery for the first few years of the study period but appeared to decrease in the late-1990s. Catch rates are variable for the bluenose target fishery but very low in the 1990s. Catch rates are variable for both the hoki and hake fisheries though usually under 300 and 200 kg/tow respectively.

Catch rates in kg per hour are presented in Figure C72 for the main target species. They are predictably highest for the alfonsino target fishery, though variable over time. Since the mid-1990s, the catch rate has been 5000–10 000 kg per hour. Throughout the 1990s the catch rate in the orange roughy target fishery fluctuated between about 400 and 1000 kg per hour and then substantially declined to under 250 kg per hour from 2000. The patchiness of the bluenose fishery catches again makes it difficult to make any meaningful interpretation of alfonsino catch in that fishery. Catch rates in the hoki fishery appear to be highly variable through time but the actual range seen is small, between about zero and 200 kg. Apart from a spike in 1998 catch rates for the hake fishery have been consistently low, usually less than 50 kg per hour.

Bottom tow duration for both the alfonsino and orange roughy fisheries are typically very short, usually less than one hour (Figure C73). This is most likely as a result of these typically being ‘feature associated’ fisheries. Tows targeting bluenose and catching alfonsino are similarly short. Tows for hoki are usually longer with most being between three and five hours duration. Most hake tows are between three and twelve hours although most were shorter in the earlier years of the study and an overall increasing trend is seen.

There is little midwater trawling for alfonsino on the eastern Chatham Rise (Figure C74). What little occurs is mainly targeted at alfonsino and hoki with similar tow durations as is seen with bottom trawling. Other target species that report catching alfonsino only appear to do so intermittently. A similar pattern is seen for midwater trawling on the bottom (Figure C75).

Effort depth for targeted bottom trawl caught alfonsino has been very consistent since the fishery became substantial in 1996 with most tows every year being between around 300 to 350 m (Figure C76). When targeting orange roughy most tows are between 700 and 1 000 m. Years for which there is information show that when catching alfonsino the bluenose fishery operates at a similar depth to the alfonsino target fishery with most tows being between 200 and 400 m. The hoki fishery mainly catches alfonsino at depths of 500–600 m. The hake fishery also catches alfonsino in a very tight depth band, mainly between 400 and 500 m. Similar depths are seen for alfonsino and hoki for the midwater and midwater on the

bottom methods (Figures C77–C78). Other target species that report catching alfonsino with these methods only do so intermittently.

Other bottom trawl fishing effort variables for the main target fisheries are given in Figure C79. For bluenose, alfonsino, and orange roughy, effort width is mainly between 18 and 30 m. Hake and hoki have slightly wider effort widths of between 35 and 40 m. Effort height is around 3–6 m for all species except for bluenose which is mainly between 5 and 10 m. Effort speed is usually 3–3.5 knots for bluenose, alfonsino, and orange roughy, and slightly faster for hake and hoki at around 3.5–4.5 knots. Distance towed is short for bluenose, alfonsino, and orange roughy (under 5 km usually), around 10–50 km for hake, and 15–35 for hoki. Most of the vessels targeting alfonsino and bluenose are under 1000 gross tonnes, between 500 and 1500 t for hake, around 1800 to 2500 t for hoki, and around 500–1800 t for orange roughy. Vessels targeting bluenose and alfonsino are typically under 40 m overall length. Hake, hoki, and orange roughy vessels are typically longer than 40 m.

Other fishing effort variables for midwater trawl for the main target fisheries are given in Figure C80. Effort width values are greater than those seen for bottom trawl, mostly between 50 and 80 m. Alfonsino targeted tows have slightly narrower effort width at about 40–50 m. Effort height values are also greater with virtually all being greater than 30 m. Effort speed, distanced towed, gross tonnes, and overall length are similar to those seen for bottom tows, most likely because they are the same vessels as use bottom trawl gear. For midwater trawls used on the bottom, fishing effort variables and characteristics are also similar, again most likely because the data relate to the same vessels.

An initial investigation of the locations of catches of alfonsino for the three different trawling methods (as reported on TCEPR forms) showed no obvious differences and so all are combined to produce Figures C82–C84. Since the development of the fishery in 1996, statistical areas 051 and 404 have consistently been, by far, the most important. Within these statistical areas catches appear to be occurring in much the same locations, at least at the resolution of 0.2 degrees. There are some years in which some locations don't appear to be important within a given statistical area, possibly due to changing fleet (see section 8.4). Alfonsino are caught in all other statistical areas but in small amounts.

Figure C85 shows the locations of alfonsino target catches (black squares) with catches of alfonsino caught as bycatch in other target fisheries overlaid (grey squares). The figure shows that alfonsino are quite widespread over the eastern Chatham Rise but most overlap between the alfonsino and other target fisheries appears to occur with the hoki and orange roughy fisheries. The least overlap occurs with the bluenose and hake fisheries. Unsurprisingly, these latter two fisheries have caught the smallest proportion of the total alfonsino catch for the study period.

7.2.3 Other areas where alfonsino are caught in minor quantities

This study identified four other areas where alfonsino are caught but in small quantities: east coast South Island, western Chatham Rise, Sub-Antarctic, and the West Coast (of both the North and South Islands). For the total study period, catches in these areas comprise just 1500 t (2.9 %), 644 t (1.3%), 33 t (0.1%), and 451 t (0.9%) respectively (Table C9, Figure C37). As such this analysis will not go into detail about these areas but each is briefly summarised below.

Catches from the east coast South Island usually exceeded 100 t per annum from 1990 to 2000. Since then annual catches have dropped, often to less than 10 t. There is no distinct season, although January and February appeared more important than the other months from 1990–2000 when catches were at their highest. Statistical area 018 (off Kaikoura) was the most important area for this period. The catch was taken almost entirely by the three trawl methods described for the ECNI and eastern Chatham Rise fisheries. The small amounts of alfonsino caught from this area for the first ten years were mainly caught in alfonsino targeted tows and hoki targeted tows in around equal proportions. Since 2000 most has been taken in hoki targeted tows.

For the western Chatham Rise catches are even smaller, usually under 30 t and as low as 1 t. Catches have only exceeded 100 t in two years. There is no apparent month in which most of the catch is taken, although less is taken in the winter months. As most is caught as bycatch of the hoki fishery, the drop off (of already negligible catches) during winter is unsurprising as vessels targeting hoki move to the Cook Strait and west coast South Island spawning areas. Most is taken from statistical areas 401–403 by bottom trawl with smaller amounts taken by midwater trawl and midwater trawl on the bottom.

Catches from the Sub-Antarctic are minimal, having never exceeded 6 t in any year and often with no catch reported at all. Alfonsino are rare in this area. Summer Sub-Antarctic trawl surveys of hoki and other middle depth species by *Tangaroa* have never caught alfonsino.

Alfonsino catches on the West Coast are mainly a midwater trawl bycatch of the winter spawning hoki fishery off the South Island. Smaller amounts are taken by bottom trawl as bycatch from the bluenose and orange roughy target fisheries off the west coast of the North Island, with slightly more taken in the summer and autumn months than in winter and spring. A very small amount of the West Coast alfonsino catch has been reported as targeted off both the North and South Islands.

7.2.4 Summary

Alfonsino is caught throughout New Zealand waters but only in significant quantities off the east coast North Island and the eastern Chatham Rise. Catches in these areas tend to be very localised and are generally thought to be feature-associated.

The majority of the catch for the east coast North Island is targeted (67% for the entire study period) with hoki being the next most important target fishery at 17%, followed by bluenose and black cardinalfish (5% each) and orange roughy 3%. Most vessels catching alfonsino in this area are between 20 and 40 m in length. Most of the catch is reported on TCEPR forms but some is also reported on CELR forms.

The fishery for the eastern Chatham Rise did not develop until the mid-1990s but the majority of the catch since then has been reported as targeted (79% for the entire study period). As bycatch it is most often taken in target fisheries for orange roughy (7%), bluenose (6%), hoki (4%), and hake (3%). Nearly all of the catch is taken by larger vessels (larger than 35 m) reporting on TCEPR forms.

In both areas nearly all is caught by bottom trawling, midwater trawling, and midwater trawling on the bottom (within 5 m of the seabed). A very small amount is taken by bottom longline. Catches by other fishing methods are negligible. There is no distinct season but catches decline over winter in both areas.

Catches of alfonsino in other areas are negligible and targeting is rare or non-existent.

8. CPUE ANALYSES

All tables and figures relating to CPUE analyses of alfonsino are contained in Appendix D (Tables D1–9, Figures D1–25).

The recent standardised CPUE analyses for silver warehou (Parker & Fu 2011), arrow squid (Hurst et al. 2012), and ribaldo (MacGibbon & Hurst 2011) considered only TCEPR (tow by tow) data because CELR data were minor. Utilising tow by tow data allows for the trend in catch rates to be modelled using smaller spatial and temporal scales, and also enables additional factors influencing CPUE to be included (such as tow distance or bottom depth). The CPUE analyses that follow also only consider

TCEPR data at a tow-by-tow resolution as most alfonsino are caught in trawls targeting them and recorded on TCEPR forms.

The ECNI region was considered for standardised CPUE analyses because it has long been the dominant alfonsino fishery area with catches usually exceeding 1500 t per annum in the time period examined (1990–2010 fishing years). The Eastern Chatham Rise fishery was also considered for standardised CPUE analyses as the second (and only other) important area for alfonsino. However, very few vessels operate in the eastern Chatham Rise fishery and only three vessels comprise the 'core' vessel data set (defined as those vessels that have at least four years in the fishery and collectively report about 90% of the catch). In the case of the eastern Chatham Rise fishery, catches from the last four years comprise just one core vessel. Due to the commercially sensitive nature of the data, a CPUE analysis containing periods with just one individual vessel cannot be published. For this reason, the CPUE analysis for the eastern Chatham Rise is not discussed further.

Three models were run for the ECNI using different data sets (Table 5).

Table 5: Summary of CPUE analyses for the east coast North Island alfonsino fishery.

Area	Model	Stat areas used	Target species	Method	Months
ECNI	1	013–015, 204	BYX	MWB	Oct-Apr
ECNI	2	013–015, 204	BYX	BT	Oct-Apr
ECNI	3	013–015, 204	BYX	MWB, BT, MW	Oct-Apr

Estimates of relative year effects in each CPUE model were obtained from a stepwise multiple regression method in which the data were modelled using a lognormal generalised linear model following Dunn (2002). A forward stepwise multiple–regression fitting algorithm (Chambers & Hastie 1991) implemented in the R statistical programming language (R Development Core Team 2011) was used to fit all models. The algorithm generates a final regression model iteratively and used the *fishing year* term as the initial or base model in all cases. The reduction in residual deviance relative to the null deviance, R^2, is calculated for each single term added to the base model. The term that results in the greatest reduction in residual deviance is added to the base model if this would result in an improvement in the residual deviance of more than 1%. The algorithm then repeats this process, updating the model, until no new terms can be added. A stopping rule of 1% change in residual deviance was used as this results in a relatively parsimonious model with moderate explanatory power (Parker & Fu 2011). Alternative stopping rules or error structures were not investigated. Note that while R^2 values are reported they do not necessarily assist in helping choose between the various models.

Variables offered to the ECNI Models 1 and 2 were fishing year, vessel key, statistical area, and month. Also offered to the model as 3rd order polynomials were effort width, effort height, effort depth, distance towed, latitude, longitude, and fishing duration. ECNI Model 3 was offered the same variables as Models 1 and 2 but with the addition of fishing method as the dataset used included bottom trawling, midwater trawling, and midwater trawling on the bottom. Models 1 and 2 used just midwater trawling on the bottom and bottom trawling data, respectively. A model using midwater trawl catches on its own was not attempted because there was little catch taken with just this method. The variable *fishing year* was forced to be in the model as the relative year effects calculated from the regression coefficients represent the change in CPUE over time. Year indices were standardised to the mean and were presented in canonical form (Francis 1999).

Vessel effects were incorporated into the CPUE standardisations to allow for possible differences in fishing power between vessels. A set of core vessels was defined based on vessels that had at least four years in the fisheries examined and collectively reported about 90% of the catch.

The dependent variable was the log–transformed estimated catch. Model fits were investigated using standard regression diagnostic plots. For each model, a plot of residuals against fitted values and a plot of residuals against quantiles of the standard normal distribution were produced to check for departures from the regression assumptions of homoscedasticity and normality of errors in log-space (i.e., log-normal errors).

8.1 ECNI Standardised CPUE Model 1

The number of records, proportion of zeros, catch, effort and unstandardised CPUE for the ECNI model are listed in Table D1. Standardised model results are shown in Tables D2–D3 and Figures D1–D8.

A total of 25 unique vessels (range 2–9 vessels each year) using midwater trawls on the bottom caught an estimated 8152 t of alfonsino since 1990, from 2827 tows (Table D1). The percentage of zero tows was low, ranging between 3 and 24%. Nine core vessels (range 2–6 per year) caught an estimated 7200 t of alfonsino, representing 88% of the total catch in the data set. Estimated alfonsino catches for core vessels ranged from 138–572 t annually, totalling 2392 tows with an average of 114 tows per year (Table D1). A number of the core vessels have been present for much of the time period, although none have been present throughout. Catches from the all vessels data set are patchy and show big differences between a number of vessels (Figure D1). Catches are similar between core vessels but most show some variation between years (Figure D2).

The variable 'fishing year' is forced into the model and accounted for just 2.9% of the residual deviance (Table D2). Three other variables were retained. Vessel accounted for the greatest amount of residual deviance explained, increasing the total to 11.3%. Depth and month were also retained, increasing the total residual deviance explained to 13.7 and 15.5%.

CPUE indices are presented in Table D3 and Figure D3. The standardised indices fluctuate throughout the 21 year time period and have wider error bars. The standardised, unstandardised geometric, and arithmetic CPUE indices are often quite different from one another and show no overall pattern. There are no suitable trawl survey indices to compare the indices to.

The effects of the selected variables on the expected catch rates of alfonsino for the model are shown in Figure D4. Catch rates are expected to decrease with increasing depth, with highest catch rates being between around 200 and 600 m in depth. Catch rates by month are similar from October to March, dropping off in April. Catch rates are fairly similar between most vessels but one generally catches more than the others, and another generally catches less.

Figures D5–D7 show that the influence of each retained variable varies greatly through the time period, with all having both positive or negative influence at varying times.

The diagnostics plots for the model are not very satisfactory (Figure D8) with some departure from assumptions of normality and homoscedacity.

8.2 ECNI Standardised CPUE Model 2

The number of records, proportion of zeros, catch, effort and unstandardised CPUE for the ECNI Model 2 are listed in Table D4. Standardised model results are shown in Table D5–D6 and Figures D9–D17. The analysis excludes the 1990 fishing year because the division of the total ECNI data set into the subset analysed resulted in no data for the 1990 fishing year.

A total of 24 unique vessels (range 1–7 vessels each year) using bottom tows caught an estimated 2777 t of alfonsino since 1990, from 3448 tows (Table D4). The percentage of zero tows ranged widely from 3 to 56%. Seven core vessels (range 1–6 per year) caught an estimated 2428 t of alfonsino, representing 87% of the total catch in the data set. Estimated alfonsino catches for core vessels ranged from 2–352 t annually, totalling 1139 tows with an average of 54 tows per year. Catches by year for all vessels vary widely and are patchy (Figure D9). Some vessels in the core data

set have been present for much of the time period but none have been present throughout (Figure D10). The largest catches have been made by one vessel in particular between 2006 and 2010. Prior to this that vessel appeared only in 1997 and 2002 and made only minor catches.

The variable 'fishing year' accounted for just 2.77% of the residual deviance (Table D5). Four other variables were retained. Depth brought the total to 12.73% and was the single most influential variable, followed by vessel, which brought the total to 16.54%. Duration raised the residual deviance explained to 18.25% and month was the last variable retained by the model bringing the total to 19.97%.

CPUE indices are presented in Table D6 and Figure D11. As with ECNI Model 1 the indices vary widely with wide error bars. No apparent pattern is evident although the unstandardised geometric and arithmetic CPUE indices follow the standardised index better than they do in Model 1.

The effects of the selected variables on the expected catch rates of alfonsino for the model are shown in Figure D12. Catch rates are predicted to be highest from about 200–400 m. For month, the highest catch rates are expected from January to March. Shorter tow durations are expected to have higher catches than longer ones, probably because the fishery is generally feature associated. Some vessels show higher expected catches than others. Vessel and depth both show widely fluctuating negative and positive influence on CPUE throughout the time period (Figures D13 and D14 respectively). Duration often had a negative influence until about 2000 after which it is steady and close to one (Figure D15). Month fluctuates widely between positive and negative influence throughout the time period (Figure D16).

The diagnostics plots for the model are satisfactory (Figure D17).

8.3 ECNI Standardised CPUE Model 3

The number of records, proportion of zeros, catch, effort and unstandardised CPUE for the ECNI Model 3 are listed in Table D7. Standardised model results are shown in Table D8–D9 and Figures D18–D25.

A total of 30 unique vessels (range 3–10 vessels each year) using either bottom trawl or midwater trawl on the bottom caught an estimated 13 692 t of alfonsino since 1990, from 5265 tows (Table D7). The percentage of zero tows was fairly small, ranging from 5 to 24%. Nine core vessels (range 2–7 per year) caught an estimated 11 836 t of alfonsino, representing 86% of the total catch in the data set. Estimated alfonsino catches for core vessels ranged from 138–890 t annually, totalling 4353 tows with an average of 207 tows per year. Catches by year for all vessels vary widely and are patchy (Figure D18). A number of vessels in the core data set have been present for much of the time period but none have been present throughout (Figure D19). Two vessels in particular appear to have caught more than the others for the last five years of the period examined.

The variable 'fishing year' accounted for just 2.08% of the residual deviance (Table D8). Three other variables were retained. Vessel was the most influential and brought the total to 9.01%. This was followed by depth, which brought the total to 12.17%. Method was the last variable retained by the model bringing the total to 13.76%.

CPUE indices are presented in Table D9 and Figure D20. As with ECNI Models 1 and 2 the indices vary widely with wide error bars (though less so than Models 1 and 2). No apparent pattern is evident. The unstandardised geometric and arithmetic CPUE indices follow each other fairly closely in a number of years but are often very different to the standardised index.

The effects of the selected variables on the expected catch rates of alfonsino for the model are shown in Figure D21. Catch rates are predicted to be highest from about 200–400 m as they were for Models 1 and 2. There are marked differences in expected catch from the three trawling methods which are highest for midwater trawling on the bottom, followed by mid water trawling then bottom trawling. There are also marked differences between some vessels with some clearly outperforming others. This

could be partly due to factors such as skipper experience but could also be explained by the preference of some vessels to use certain trawling methods over others, which show a difference in expected catch. Vessel and depth both show widely fluctuating negative and positive influence on CPUE throughout the time period (Figures D22 and D23 respectively). The influence of method declined over the period from being positive at the beginning and to being not very influential in the mid-2000s and now has quite a negative influence on CPUE (Figure D24).

The diagnostics plots for the model are satisfactory (Figure D25).

8.4 CPUE summary

Standardised CPUE analyses of alfonsino were attempted for the ECNI and Eastern Chatham Rise fisheries. Three models were attempted for the ECNI with the difference between models being fishing method. The eastern Chatham Rise model cannot be presented due to the commercially sensitive nature of an analysis that for the last four years comprises just one individual vessel. The eastern Chatham Rise model was presented to the Middle Depths Working Group in July 2012 and rejected on the grounds that the model was severely limited by having such a small data set. Further, it was likely to have been hampered by the complex nature of a fishery that is comprised of a number of geographically distinct areas, as well as changes in the composition of the fleet over time. All models used only target alfonsino fishery data. Most alfonsino is caught in targeted fisheries so the exploration of CPUE models in which alfonsino are bycatch of other targets was not appropriate.

Fishing year was forced into every CPUE model, and explained little of the null model deviance for any model in both regions (under 3% in all cases). Vessel and depth were consistent between all three ECNI models and month entered both Models 1 and 2. Method only entered Model 3 for the ECNI; it was not offered to Models 1 and 2 which each focussed on single methods. Standardised CPUE indices for all three ECNI models fluctuated widely with large variation and showed no pattern. None are likely to be good indicators of abundance. Past attempts to carry out standardised CPUE analyses of alfonsino for the ECNI (BYX 2) fishery have also had limited success and had uncertain results (Blackwell 2000, Horn 1988, Horn & Massey 1989, Langley 1995, Langley & Walker 2002b, Stocker & Blackwell 1991) and past CPUE analyses of BYX 2 have been rejected by the Inshore Fishery Assessment Working Group (Langley & Walker 2002b). Problems with developing CPUE indices have arisen from the complexity of the fishery which is comprised of a number of geographically distinct grounds and changes in the fleet over time. This still appears to be a problem today.

9. SUMMARY AND RECOMMENDATIONS

9.1 Commercial and research data

Alfonsino was virtually unfished prior to 1983 when the ECNI target fishery developed. Catches of alfonsino elsewhere were mainly as bycatch of other target fisheries until the mid-1990s when the target fishery on the Eastern Chatham Rise developed, mainly concentrated to the south-east of the Chatham Islands. Both fisheries are of moderate size with landings often more than 1000 t per year, particularly on the ECNI. Alfonsino are caught in other areas of New Zealand's EEZ but in small quantities. Most is caught by bottom trawling, midwater trawling on the bottom, and midwater trawling. A small amount is also caught by bottom longline; other fishing methods catch negligible amounts of alfonsino.

No research surveys have been optimised to survey alfonsino and the only survey that regularly catches them is the Chatham Rise Middle Depth survey conducted in January every year since 1992. However, this time series poorly estimates alfonsino abundance and estimates are highly variable from year to year with high c.v.s. The patchy nature of alfonsino means that the chance of a randomly

selected trawl survey station occurring on an aggregation is low. They are also generally feature-associated and hence not sampled well by this time series which is optimised to survey hoki, hake, and ling on easily trawled ground.

Observer data on reproductive state has found that virtually all fish are immature or resting. No spawning alfonsino have ever been observed in research data and the two running ripe fish recorded by the observer programme may be errors. Otolith data is currently lacking. More samples from BYX 3 were being collected as part of Ministry for Primary Industries project BYX200801. Unfortunately insufficient data was collected each year and the project was abandoned.

Many aspects of alfonsino biology are poorly understood both in New Zealand and worldwide. Ageing by zone counts in otoliths has been validated both in New Zealand (Massey & Horn 1990) and overseas (e.g., Lehodey & Grandperrin 1996). Timing and location of spawning is not known. For the lower east coast of the North Island there have been few fish observed younger than three years. Full recruitment into the commercial fishery is thought to occur at around five years.

The stock structure of alfonsino remains uncertain and this study found no indication of stock boundaries. Alfonsino are found throughout the New Zealand EEZ but are only found in large concentrations on the lower east coast North Island and the eastern Chatham Rise. It has been suggested that alfonsino populations could be associated with large oceanic eddy systems (Alekseev et al. 1986). If New Zealand alfonsino comprise part of such a system then the east coast North Island may be a vegetative, non-reproductive zone where fish grow and mature before leaving for a possible reproductive zone (Horn & Massey 1989). The current QMAs are probably sufficient for management purposes.

9.2 Status of the stocks

The status of the stocks is not known. Chatham Rise middle-depth surveys carried out by *Tangaroa* since 1991 show high inter-annual variability and high c.v.s. No other surveys regularly catch alfonsino. Past standardised CPUE analyses of the ECNI and Eastern Chatham Rise for the target fisheries show no systematic trends and are not thought to be good indices of abundance. The same problems encountered in the past with CPUE analyses were encountered in this study.

It is not known if current TACCs and recent catches are sustainable or whether they are at levels which will allow the stocks to move towards a size that will support the maximum sustainable yield.

There are currently insufficient data with which to develop stock assessment models.

9.3 Observer Programme sampling

Observer coverage from the commercial fishery is patchy. For all areas including the main fishing areas sampling by the observer programme is inconsistent, ranging from no sampling to over-sampling. Ministry for Primary Industries project BYX200801 aims to increase coverage in BYX 3 to investigate the possibility of developing a catch-at-age history of the fishery. Unfortunately there has been difficulty in deploying observers on enough boats to adequately carry out the required sampling regime set out for the programme.

9.4 Future data needs and research requirements

Recognising that neither CPUE nor the Chatham Rise trawl surveys have been found to be suitable indicators of alfonsino abundance, and with the goal of developing a quantitative stock assessment in the future, the data collection needs for alfonsino are as follows:

1. Optimised length and otolith sampling and development of catch-at-age for key fishing areas to enhance knowledge of recruitment and age structure of the fishery. This was an objective under Ministry for Primary Industries project BYX200801. However there was limited success in deploying observers on appropriate vessels to adequately sample BYX 3 and the project has been cancelled.
2. Improved knowledge of stock structure. Further investigation needs to be done on how best to carry out an investigation into alfonsino stock structure in New Zealand (and south-west Pacific) waters.
3. Attempt to carry out CPUE analyses for the two main fisheries at a fine scale geographic resolution such as individual features where alfonsino are targeted.

10. ACKNOWLEDGMENTS

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APPENDIX A: TRAWL SURVEY SUMMARIES

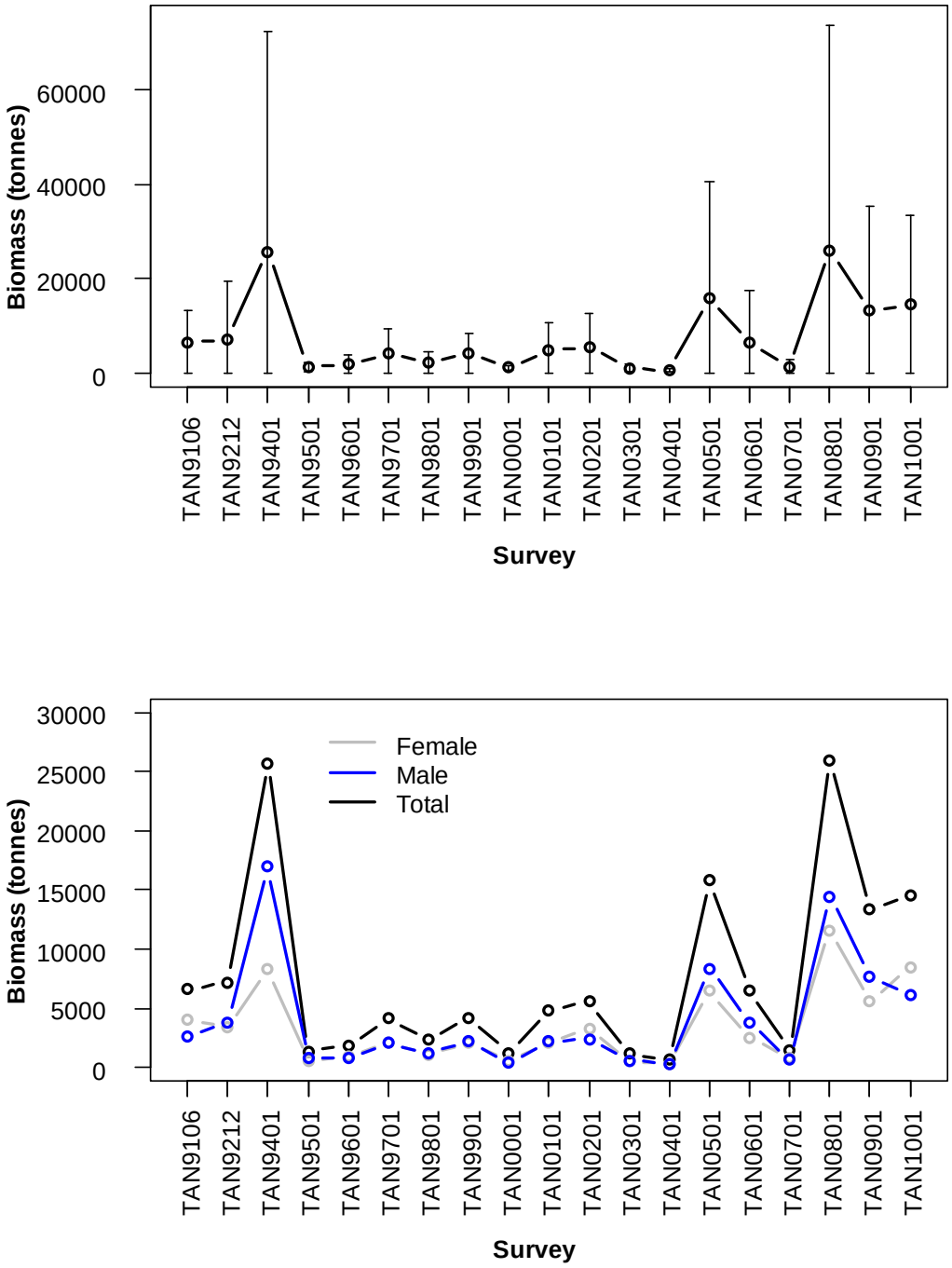


Figure A1: Doorspread biomass estimates of alfonsino from the Chatham Rise, from *Tangaroa* surveys from 1991 to 2010 for all fish (top plot) and by sex (bottom plot).

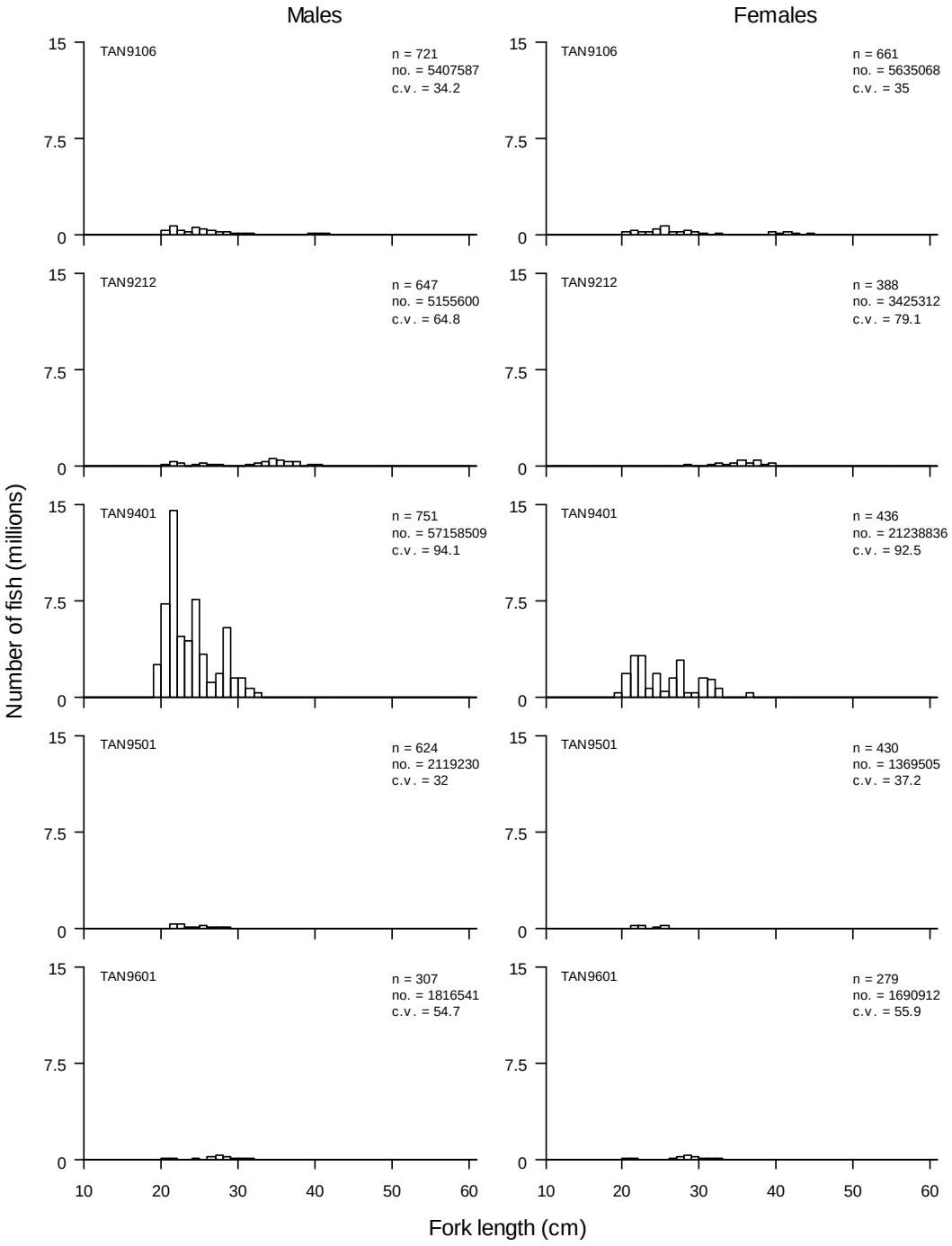


Figure A2: Scaled population length frequencies by sex of alfonsino from the Chatham Rise from *Tangaroa* surveys from 1991 to 1996.

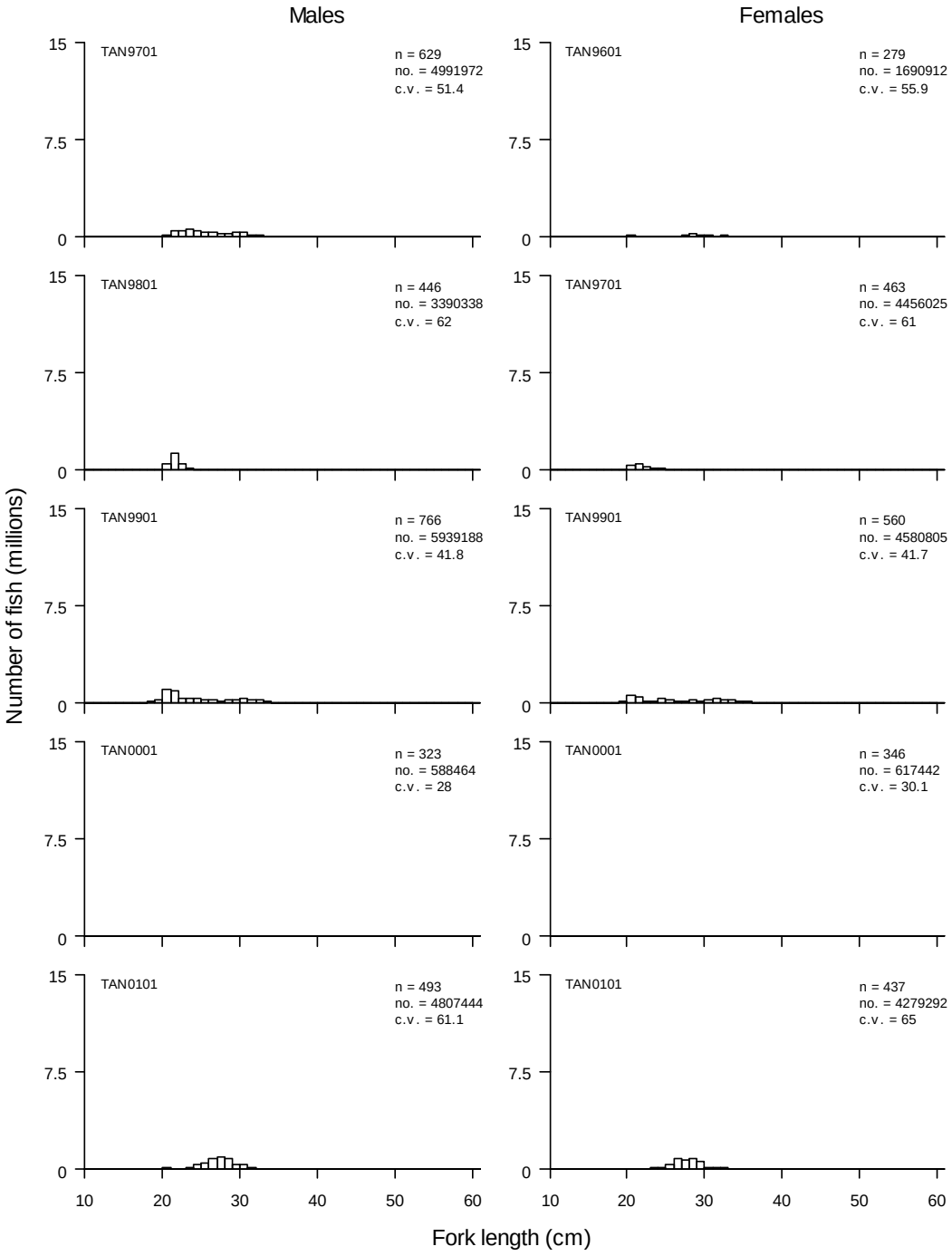


Figure A2 continued: Scaled population length frequencies by sex of alfonsino from the Chatham Rise from *Tangaroa* surveys from 1997 to 2001.

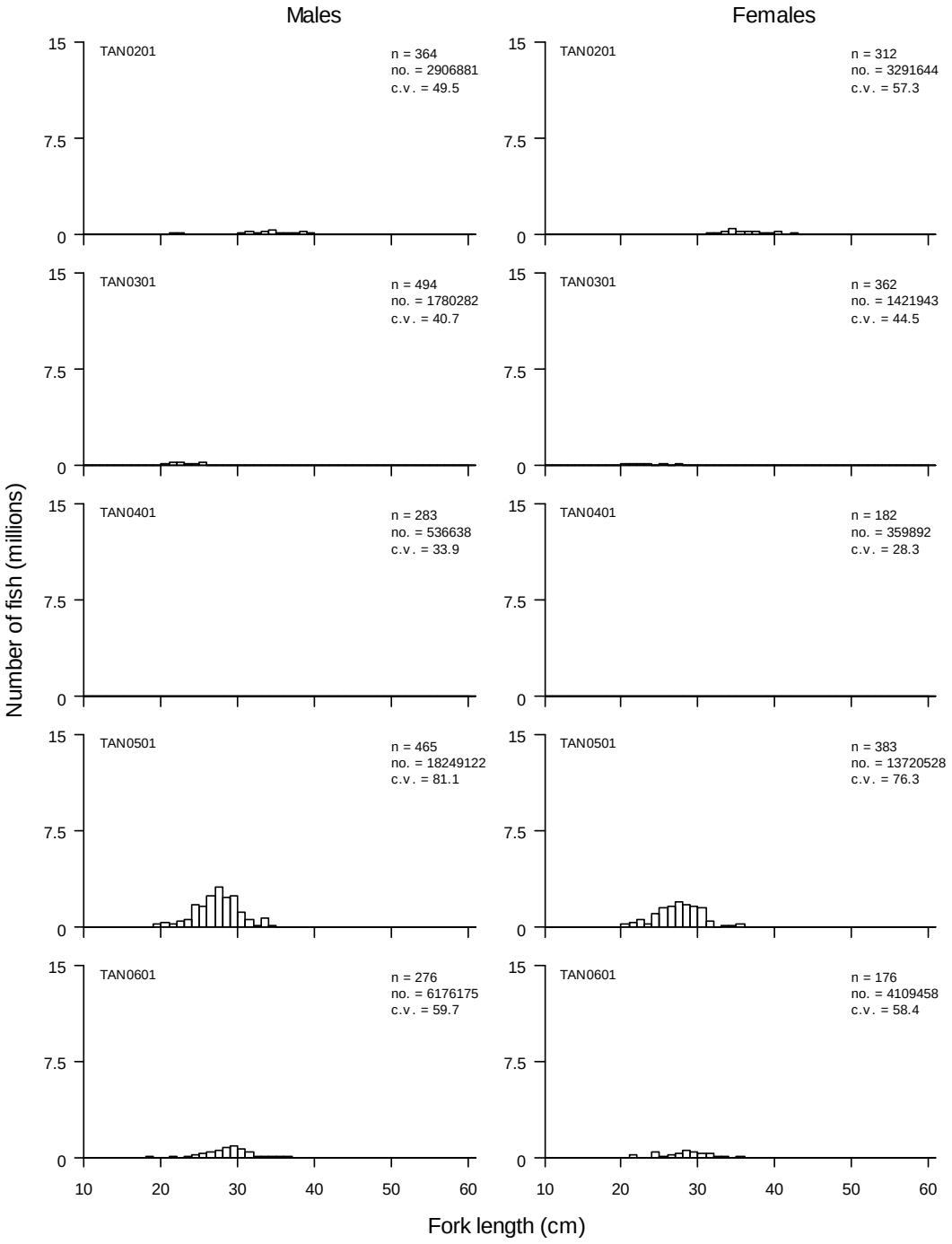


Figure A2 continued: Scaled population length frequencies by sex of alfonsino from the Chatham Rise from *Tangaroa* surveys from 2002 to 2006.

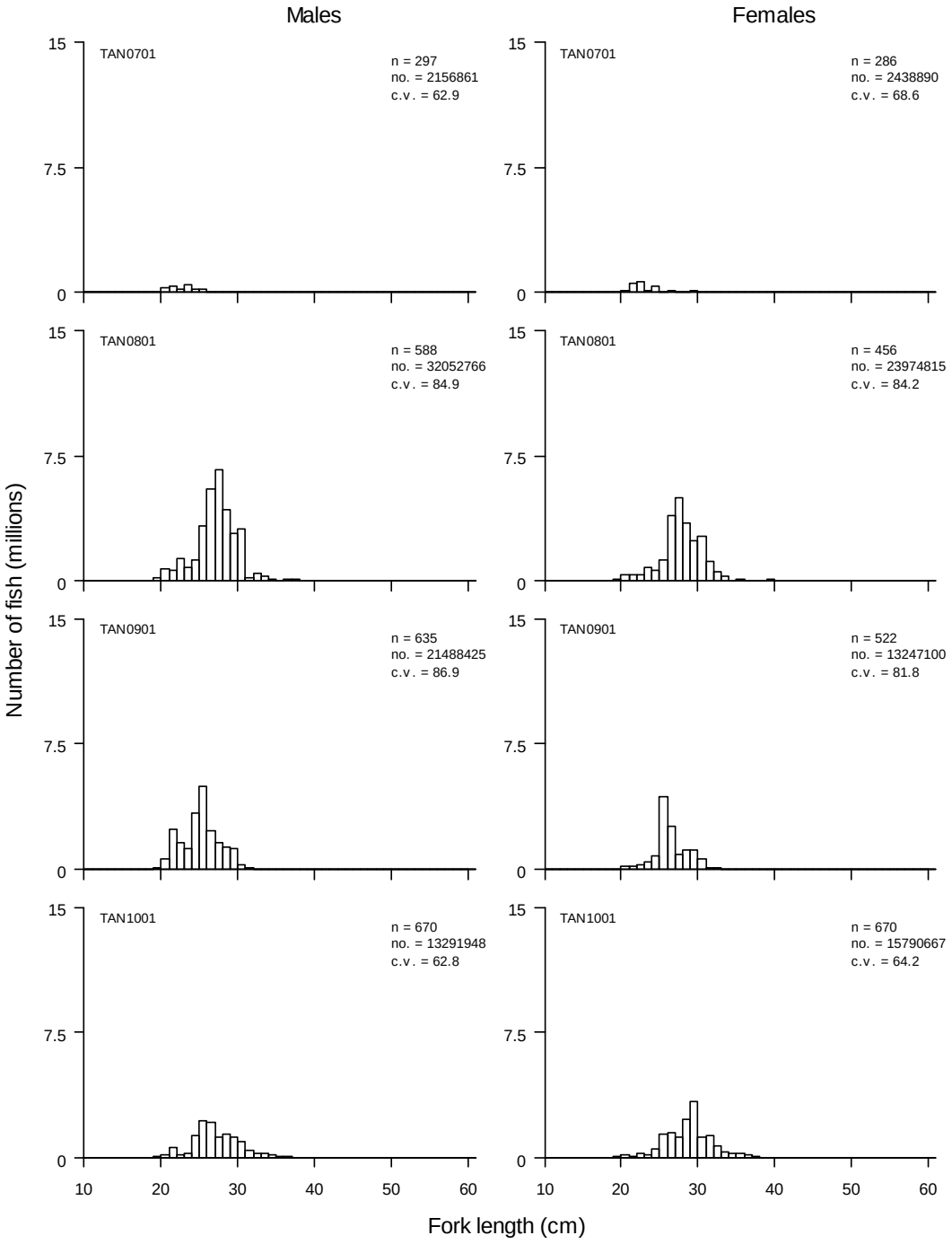


Figure A2 continued: Scaled population length frequencies by sex of alfonsino from the Chatham Rise from *Tangaroa* surveys from 2007 to 2010.

APPENDIX B. OBSERVER DATA

Table B1: Total number of tows by fishing year sampled for alfonsino length from each area overall by the observer programme for the fishing years 1993–94 to 2009–10.

Fishing year	East Chat	West Chat	ECNI	ECSI	SUBA	West Coast	Total
1993–94	-	-	2	-	-	-	2
1994–95	18	1	-	-	-	-	19
1995–96	-	2	-	-	-	1	3
1996–97	2	2	1	-	-	-	5
1997–98	2	-	-	-	-	-	2
1998–99	-	-	15	-	-	5	20
1999–00	-	-	12	1	-	15	28
2000–01	11	-	4	1	-	20	36
2001–02	1	-	1	3	-	1	6
2002–03	31	-	9	5	1	58	104
2003–04	7	-	12	-	1	14	34
2004–05	10	2	14	8	-	3	37
2005–06	5	12	24	4	-	5	50
2006–07	13	5	12	1	-	24	55
2007–08	2	-	15	-	-	14	31
2008–09	2	-	16	-	-	19	37
2009–10	22	2	29	-	-	56	109
Total	126	26	166	23	2	235	578

Table B2: Total number of tows by fishing year sampled for alfonsino length by month for all areas combined by the observer programme for the fishing years 1994–2010.

Fishing year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1993–94	-	-	-	-	-	-	-	2	-	-	-	-	2
1994–95	1	3	13	1	-	-	-	-	-	-	-	1	19
1995–96	2	-	-	-	-	-	-	-	-	-	1	-	3
1996–97	-	-	1	-	1	-	1	2	-	-	-	-	5
1997–98	-	-	2	-	-	-	-	-	-	-	-	-	2
1998–99	-	8	5	-	2	-	-	-	2	3	-	-	20
1999–00	7	6	-	-	2	1	-	6	3	-	3	-	28
2000–01	4	7	2	2	3	1	1	-	-	3	13	-	36
2001–02	1	-	-	1	-	1	-	2	-	-	1	-	6
2002–03	-	-	1	18	27	10	6	7	11	3	17	4	104
2003–04	2	3	-	1	3	2	14	2	1	4	2	-	34
2004–05	5	6	-	1	-	-	-	5	14	1	2	3	37
2005–06	17	6	-	-	-	-	2	3	2	3	17	-	50
2006–07	1	3	10	2	9	3	-	3	3	6	15	-	55
2007–08	3	10	-	-	-	-	-	1	1	5	11	-	31
2008–09	-	16	1	-	-	-	-	2	2	12	4	-	37
2009–10	5	24	7	8	6	11	2	1	1	17	16	11	109
Total	48	92	42	34	53	29	26	36	40	57	102	19	578

Table B3: Total number of tows by fishing year sampled for alfonsino length by month for the eastern Chatham Rise by the observer programme for the fishing years 1995–2010.

Fishing year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1994–95	1	3	13	1	-	-	-	-	-	-	-	-	18
1996–97	-	-	1	-	1	-	-	-	-	-	-	-	2
1997–98	-	-	2	-	-	-	-	-	-	-	-	-	2
2000–01	2	4	-	2	3	-	-	-	-	-	-	-	11
2001–02	-	-	-	-	-	1	-	-	-	-	-	-	1
2002–03	-	-	-	13	11	6	-	1	-	-	-	-	31
2003–04	1	-	-	-	3	-	3	-	-	-	-	-	7
2004–05	-	-	-	1	-	-	-	5	4	-	-	-	10
2005–06	-	-	-	-	-	-	2	1	-	2	-	-	5
2006–07	-	1	-	2	8	2	-	-	-	-	-	-	13
2007–08	-	-	-	-	-	-	-	1	-	-	1	-	2
2008–09	-	-	-	-	-	-	-	2	-	-	-	-	2
2009–10	1	1	7	-	-	11	2	-	-	-	-	-	22
Total	5	9	23	19	26	20	7	10	4	2	1	-	126

Table B4: Total number of tows by fishing year sampled for alfonsino length by month for the western Chatham Rise by the observer programme for the fishing years 1995–2010.

Fishing year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1994–95	-	-	-	-	-	-	-	-	-	-	-	1	1
1995–96	2	-	-	-	-	-	-	-	-	-	-	-	2
1996–97	-	-	-	-	-	-	-	2	-	-	-	-	2
2004–05	-	-	-	-	-	-	-	-	2	-	-	-	2
2005–06	12	-	-	-	-	-	-	-	-	-	-	-	12
2006–07	-	-	-	-	1	1	-	3	-	-	-	-	5
2009–10	1	-	-	-	-	-	-	1	-	-	-	-	2
Total	15	-	-	-	1	1	-	6	2	-	-	1	26

Table B5: Total number of tows by fishing year sampled for alfonsino length by month for the east coast North Island by the observer programme for the fishing years 1994–2010.

Fishing year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1993–94	-	-	-	-	-	-	-	2	-	-	-	-	2
1996–97	-	-	-	-	-	-	1	-	-	-	-	-	1
1998–99	-	8	5	-	2	-	-	-	-	-	-	-	15
1999–00	7	1	-	-	2	-	-	1	-	-	1	-	12
2000–01	-	3	1	-	-	-	-	-	-	-	-	-	4
2001–02	-	-	-	-	-	-	-	-	-	-	1	-	1
2002–03	-	-	-	-	-	-	-	-	5	-	4	-	9
2003–04	-	-	-	-	-	-	11	1	-	-	-	-	12
2004–05	4	6	-	-	-	-	-	-	1	-	-	3	14
2005–06	-	6	-	-	-	-	-	-	2	1	15	-	24
2006–07	-	-	8	-	-	-	-	-	2	1	1	-	12
2007–08	2	10	-	-	-	-	-	-	1	2	-	-	15
2008–09	-	16	-	-	-	-	-	-	-	-	-	-	16
2009–10	3	21	-	3	1	-	-	-	-	1	-	-	29
Total	16	71	14	3	5	-	12	4	11	5	22	3	166

Table B6: Total number of tows by fishing year sampled for alfonsino length by month for the east coast South Island by the observer programme for the fishing years 1999–2007.

Fishing year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1999–00	-	-	-	-	-	-	-	-	1	-	-	-	1
2000–01	-	-	1	-	-	-	-	-	-	-	-	-	1
2001–02	1	-	-	-	-	-	-	2	-	-	-	-	3
2002–03	-	-	1	-	-	-	-	-	-	-	-	4	5
2004–05	-	-	-	-	-	-	-	-	7	1	-	-	8
2005–06	4	-	-	-	-	-	-	-	-	-	-	-	4
2006–07	-	-	-	-	-	-	-	-	1	-	-	-	1
Total	5	-	2	-	-	-	-	2	9	1	-	4	23

Table B7: Total number of tows by fishing year sampled for alfonsino length by month for the Sub-Antarctic by the observer programme for the fishing years 2003–2004.

Fishing year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
2002–03	-	-	-	-	-	1	-	-	-	-	-	-	1
2003–04	-	1	-	-	-	-	-	-	-	-	-	-	1
Total	-	1	-	-	-	1	-	-	-	-	-	-	2

Table B8: Total number of tows by fishing year sampled for alfonsino length by month for the West Coast by the observer programme for the fishing years 1996–2010.

Fishing year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1995–96	-	-	-	-	-	-	-	-	-	-	1	-	1
1998–99	-	-	-	-	-	-	-	-	2	3	-	-	5
1999–00	-	5	-	-	-	1	-	5	2	-	2	-	15
2000–01	2	-	-	-	-	1	1	-	-	3	13	-	20
2001–02	-	-	-	1	-	-	-	-	-	-	-	-	1
2002–03	-	-	-	5	16	3	6	6	6	3	13	-	58
2003–04	1	2	-	1	-	2	-	1	1	4	2	-	14
2004–05	1	-	-	-	-	-	-	-	-	-	2	-	3
2005–06	1	-	-	-	-	-	-	2	-	-	2	-	5
2006–07	1	2	2	-	-	-	-	-	-	5	14	-	24
2007–08	1	-	-	-	-	-	-	-	-	3	10	-	14
2008–09	-	-	1	-	-	-	-	-	2	12	4	-	19
2009–10	-	2	-	5	5	-	-	-	1	16	16	11	56
Total	7	11	3	12	21	7	7	14	14	49	79	11	235

Table B9: Number of alfonsino measured by fishing year and month sampled from the eastern Chatham Rise by the observer programme, for fishing years 1995–2010.

Fishing year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1994–95	77	269	817	100	-	-	-	-	-	-	-	-	1 263
1996–97	-	-	10	-	38	-	-	-	-	-	-	-	48
1997–98	-	-	219	-	-	-	-	-	-	-	-	-	219
2000–01	22	133	-	2	25	-	-	-	-	-	-	-	182
2001–02	-	-	-	-	-	49	-	-	-	-	-	-	49
2002–03	-	-	-	398	294	360	-	10	-	-	-	-	1 062
2003–04	2	-	-	-	11	-	60	-	-	-	-	-	73
2004–05	-	-	-	26	-	-	-	384	7	-	-	-	417
2005–06	-	-	-	-	-	-	105	50	-	3	-	-	158
2006–07	-	85	-	2	40	9	-	-	-	-	-	-	136
2007–08	-	-	-	-	-	-	-	9	-	-	10	-	19
2008–09	-	-	-	-	-	-	-	105	-	-	-	-	105
2009–10	10	5	210	-	-	934	142	-	-	-	-	-	1 301
Total	111	492	1 256	528	408	1 352	307	558	7	3	10	-	5 032

Table B10: Number of alfonsino measured by fishing year and month sampled from the western Chatham Rise by the observer programme, for fishing years 1995–2010.

Fishing year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1994–95	-	-	-	-	-	-	-	-	-	-	-	6	6
1995–96	28	-	-	-	-	-	-	-	-	-	-	-	28
1996–97	-	-	-	-	-	-	-	10	-	-	-	-	10
2004–05	-	-	-	-	-	-	-	-	3	-	-	-	3
2005–06	26	-	-	-	-	-	-	-	-	-	-	-	26
2006–07	-	-	-	-	6	7	-	6	-	-	-	-	19
2009–10	8	-	-	-	-	-	-	20	-	-	-	-	28
Total	62	-	-	-	6	7	-	36	3	-	-	6	120

Table B11: Number of alfonsino measured by fishing year and month sampled from the east coast North Island by the observer programme, for fishing years 1994–2010.

Fishing year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1993–94	-	-	-	-	-	-	-	9	-	-	-	-	9
1996–97	-	-	-	-	-	-	62	-	-	-	-	-	62
1998–99	-	510	51	-	219	-	-	-	-	-	-	-	780
1999–00	636	4	-	-	125	-	-	78	-	-	1	-	844
2000–01	-	97	10	-	-	-	-	-	-	-	-	-	107
2001–02	-	-	-	-	-	-	-	-	-	-	1	-	1
2002–03	-	-	-	-	-	-	-	-	52	-	4	-	56
2003–04	-	-	-	-	-	-	361	30	-	-	-	-	391
2004–05	433	357	-	-	-	-	-	-	5	-	-	13	808
2005–06	-	452	-	-	-	-	-	-	8	50	811	-	1 321
2006–07	-	-	288	-	-	-	-	-	83	11	20	-	402
2007–08	190	555	-	-	-	-	-	-	80	178	-	-	1 003
2008–09	-	953	-	-	-	-	-	-	-	-	-	-	953
2009–10	93	632	-	300	100	-	-	-	-	58	-	-	1 183
Total	1 352	3 560	349	300	444	-	423	117	228	297	837	13	7 920

Table B12: Number of alfonsino measured by fishing year and month sampled from the east coast South Island by the observer programme, for fishing years 2000–2007.

Fishing year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1999–00	-	-	-	-	-	-	-	-	43	-	-	-	43
2000–01	-	-	1	-	-	-	-	-	-	-	-	-	1
2001–02	1	-	-	-	-	-	-	26	-	-	-	-	27
2002–03	-	-	1	-	-	-	-	-	-	-	-	13	14
2004–05	-	-	-	-	-	-	-	-	41	2	-	-	43
2005–06	4	-	-	-	-	-	-	-	-	-	-	-	4
2006–07	-	-	-	-	-	-	-	-	5	-	-	-	5
Total	5	-	2	-	-	-	-	26	89	2	-	13	137

Table B13: Number of alfonsino measured by fishing year and month sampled from Sub-Antarctic by the observer programme, for fishing years 2003–2004.

Fishing year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
2002–03	-	-	-	-	-	5	-	-	-	-	-	-	5
2003–04	-	10	-	-	-	-	-	-	-	-	-	-	10
Total	-	10	-	-	-	5	-	-	-	-	-	-	15

Table B14: Number of alfonsino measured by fishing year and month sampled from West Coast by the observer programme, for fishing years 1996–2010.

Fishing year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1995–96	-	-	-	-	-	-	-	-	-	-	41	-	41
1998–99	-	-	-	-	-	-	-	-	30	8	-	-	38
1999–00	-	5	-	-	-	20	-	40	34	-	20	-	119
2000–01	2	-	-	-	-	34	52	-	-	3	178	-	269
2001–02	-	-	-	1	-	-	-	-	-	-	-	-	1
2002–03	-	-	-	333	1 161	114	164	141	40	14	138	-	2 105
2003–04	80	4	-	106	-	17	-	10	15	8	90	-	330
2004–05	20	-	-	-	-	-	-	-	-	-	10	-	30
2005–06	2	-	-	-	-	-	-	11	-	-	94	-	107
2006–07	31	41	90	-	-	-	-	-	-	62	160	-	384
2007–08	35	-	-	-	-	-	-	-	-	50	191	-	276
2008–09	-	-	3	-	-	-	-	-	113	242	58	-	416
2009–10	-	60	-	480	410	-	-	-	20	672	948	991	3 581
Total	170	110	93	920	1 571	185	216	202	252	1 059	1 928	991	7 697

Table B15: Number of female alfonsino gonads staged by fishing year and month sampled from the eastern Chatham Rise by the observer programme, for fishing years 1995–2010.

Fishing year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1994–95	64	183	382	43	-	-	-	-	-	-	-	-	672
1996–97	-	-	5	-	29	-	-	-	-	-	-	-	34
1997–98	-	-	103	-	-	-	-	-	-	-	-	-	103
2000–01	11	32	-	2	15	-	-	-	-	-	-	-	60
2001–02	-	-	-	-	-	25	-	-	-	-	-	-	25
2002–03	-	-	-	303	204	172	-	9	-	-	-	-	688
2003–04	2	-	-	-	10	-	26	-	-	-	-	-	38
2004–05	-	-	-	20	-	-	-	232	3	-	-	-	255
2005–06	-	-	-	-	-	-	74	40	-	1	-	-	115
2006–07	-	38	-	1	28	6	-	-	-	-	-	-	73
2007–08	-	-	-	-	-	-	-	7	-	-	-	-	7
2008–09	-	-	-	-	-	-	-	53	-	-	-	-	53
2009–10	2	5	118	-	-	484	88	-	-	-	-	-	697
Total	79	258	608	369	286	687	188	341	3	1	-	-	2 820

Table B16: Number of female alfonsino gonads staged by fishing year and month sampled from the western Chatham Rise by the observer programme, for fishing years 1995–2010.

Fishing year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1994–95	-	-	-	-	-	-	-	-	-	-	-	3	3
1995–96	14	-	-	-	-	-	-	-	-	-	-	-	14
1996–97	-	-	-	-	-	-	-	7	-	-	-	-	7
2004–05	-	-	-	-	-	-	-	-	1	-	-	-	1
2005–06	11	-	-	-	-	-	-	-	-	-	-	-	11
2006–07	-	-	-	-	3	5	-	5	-	-	-	-	13
2009–10	4	-	-	-	-	-	-	10	-	-	-	-	14
Total	29	-	-	-	3	5	-	22	1	-	-	3	63

Table B17: Number of female alfonsino gonads staged by fishing year and month sampled from the east coast North Island by the observer programme, for fishing years 1994–2010.

Fishing year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1993–94	-	-	-	-	-	-	-	3	-	-	-	-	3
1996–97	-	-	-	-	-	-	24	-	-	-	-	-	24
1998–99	-	223	24	-	112	-	-	-	-	-	-	-	359
1999–00	378	1	-	-	60	-	-	50	-	-	-	-	489
2000–01	-	46	5	-	-	-	-	-	-	-	-	-	51
2001–02	-	-	-	-	-	-	-	-	-	-	1	-	1
2002–03	-	-	-	-	-	-	-	-	32	-	2	-	34
2003–04	-	-	-	-	-	-	156	10	-	-	-	-	166
2004–05	-	-	-	-	-	-	-	-	3	-	-	8	11
2005–06	-	249	-	-	-	-	-	-	3	30	437	-	719
2006–07	-	-	143	-	-	-	-	-	47	3	3	-	196
2007–08	88	245	-	-	-	-	-	-	60	77	-	-	470
2008–09	-	506	-	-	-	-	-	-	-	-	-	-	506
2009–10	58	335	-	149	54	-	-	-	-	23	-	-	619
Total	524	1 605	172	149	226	-	180	63	145	133	443	8	3 648

Table B18: Number of female alfonsino gonads staged by fishing year and month sampled from the east coast South Island by the observer programme, for fishing years 2000–2007.

Fishing year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1999–00	-	-	-	-	-	-	-	-	16	-	-	-	16
2000–01	-	-	-	-	-	-	-	-	-	-	-	-	-
2001–02	-	-	-	-	-	-	-	8	-	-	-	-	8
2002–03	-	-	1	-	-	-	-	-	-	-	-	6	7
2004–05	-	-	-	-	-	-	-	-	27	-	-	-	27
2005–06	2	-	-	-	-	-	-	-	-	-	-	-	2
2006–07	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	2	-	1	-	-	-	-	8	43	-	-	6	60

Table B19: Number of female alfonsino gonads staged by fishing year and month sampled from the Sub-Antarctic Island by the observer programme, for fishing years 2003–2004.

Fishing year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
2002–03	-	-	-	-	-	4	-	-	-	-	-	-	4
2003–04	-	7	-	-	-	-	-	-	-	-	-	-	7
Total	-	7	-	-	-	4	-	-	-	-	-	-	11

Table B20: Number of female alfonsino gonads staged by fishing year and month sampled from the West Coast by the observer programme, for fishing years 1996–2010.

Fishing year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1995–96	-	-	-	-	-	-	-	-	-	-	-	-	-
1998–99	-	-	-	-	-	-	-	-	19	1	-	-	20
1999–00	-	4	-	-	-	10	-	20	13	-	11	-	58
2000–01	1	-	-	-	-	18	18	-	-	-	48	-	85
2001–02	-	-	-	-	-	-	-	-	-	-	-	-	-
2002–03	-	-	-	163	603	48	78	61	21	3	75	-	1 052
2003–04	53	2	-	53	-	8	-	3	8	6	37	-	170
2004–05	-	-	-	-	-	-	-	-	-	-	4	-	4
2005–06	2	-	-	-	-	-	-	6	-	-	1	-	9
2006–07	10	26	23	-	-	-	-	-	-	16	73	-	148
2007–08	10	-	-	-	-	-	-	-	-	19	68	-	97
2008–09	-	-	3	-	-	-	-	-	55	95	24	-	177
2009–10	-	25	-	224	222	-	-	-	10	273	454	517	1 725
Total	76	57	26	440	825	84	96	90	126	413	795	517	3 545

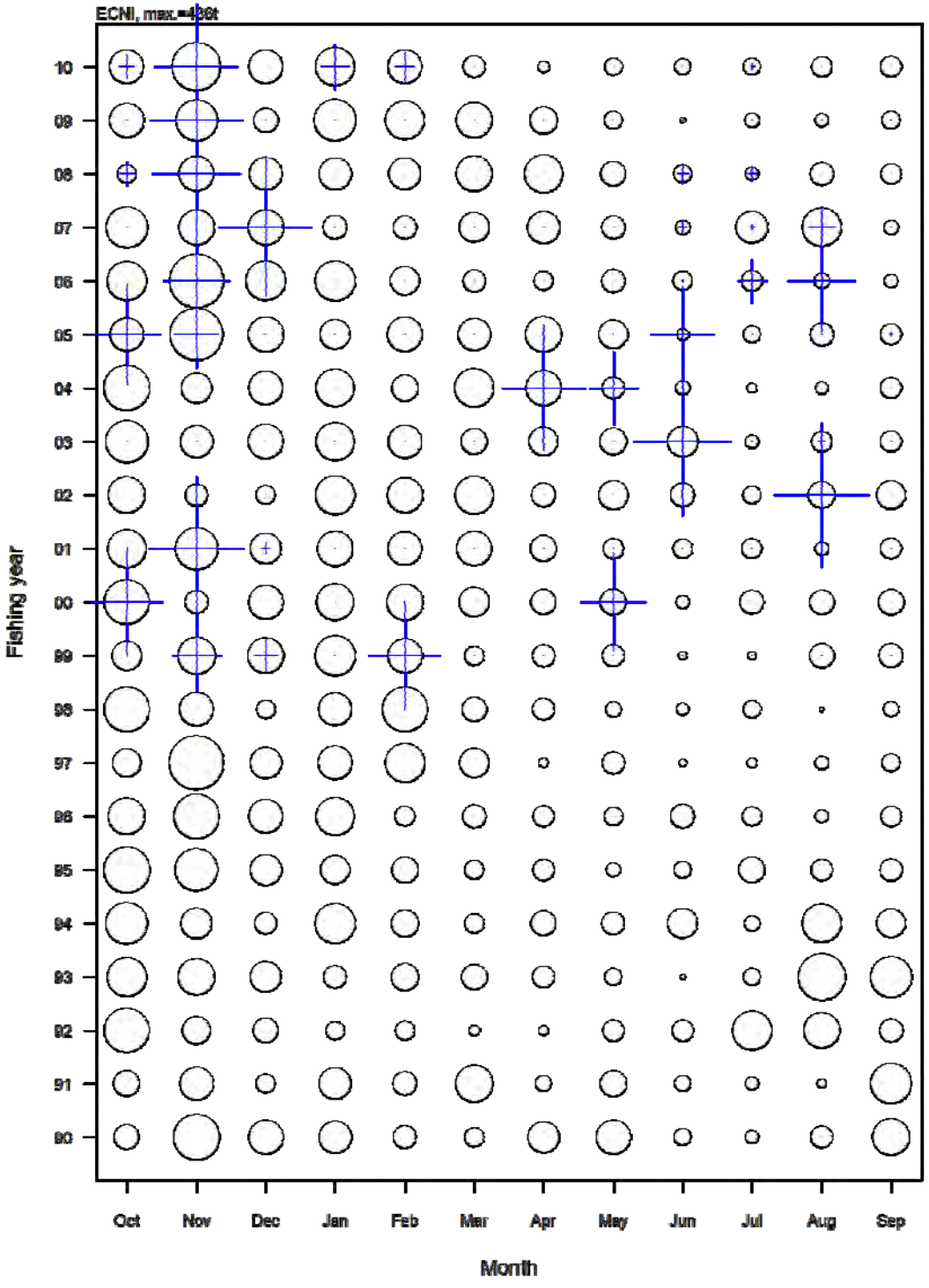
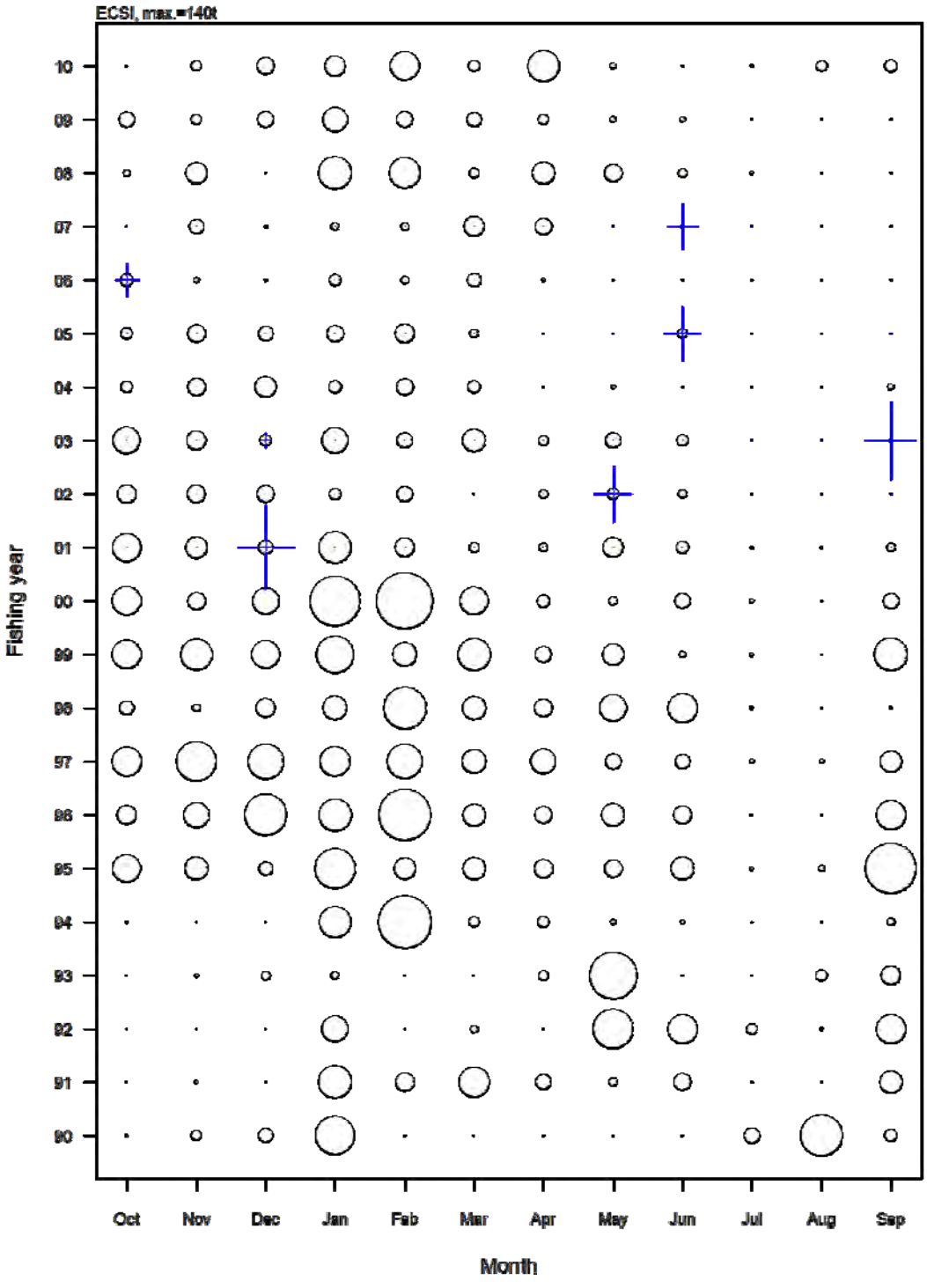


Figure B1: Representativeness of observer sampling of alfonsino catch by fishing year and month (bottom panel) for the east coast North Island for fishing years 1990–2010. Circles show the proportion of alfonsino catch by month within a fishing year; crosses show the proportion of observed alfonsino catch for the same cells. Representation is demonstrated by how closely the cross matches the circle diameter.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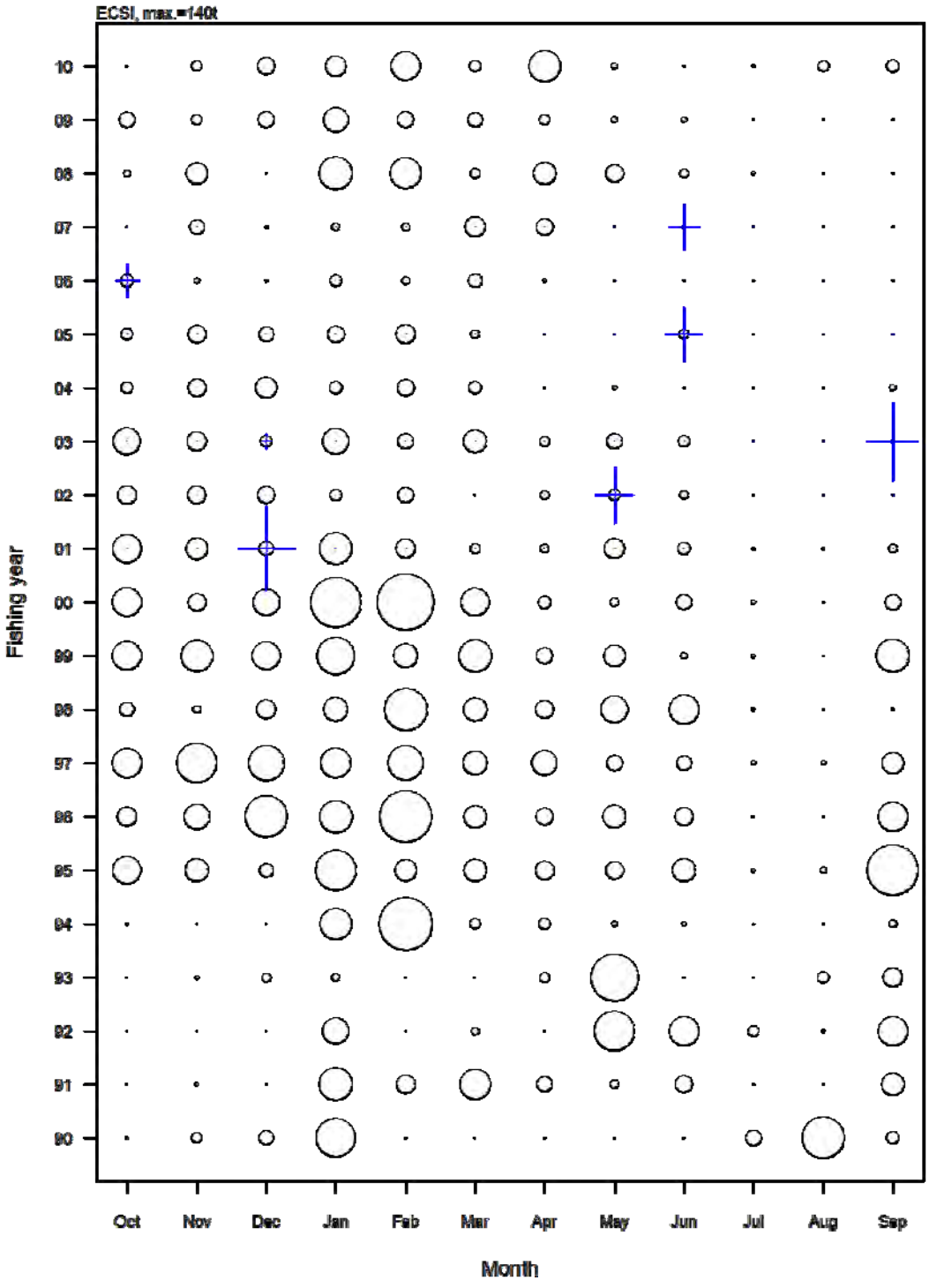


Figure B2: Representativeness of observer sampling of alfonsino catch by fishing year and month (bottom panel) for the east coast South Island for fishing years 1990–2010. Circles show the proportion of alfonsino catch by month within a fishing year; crosses show the proportion of observed alfonsino catch for the same cells. Representation is demonstrated by how closely the cross matches the circle diameter.

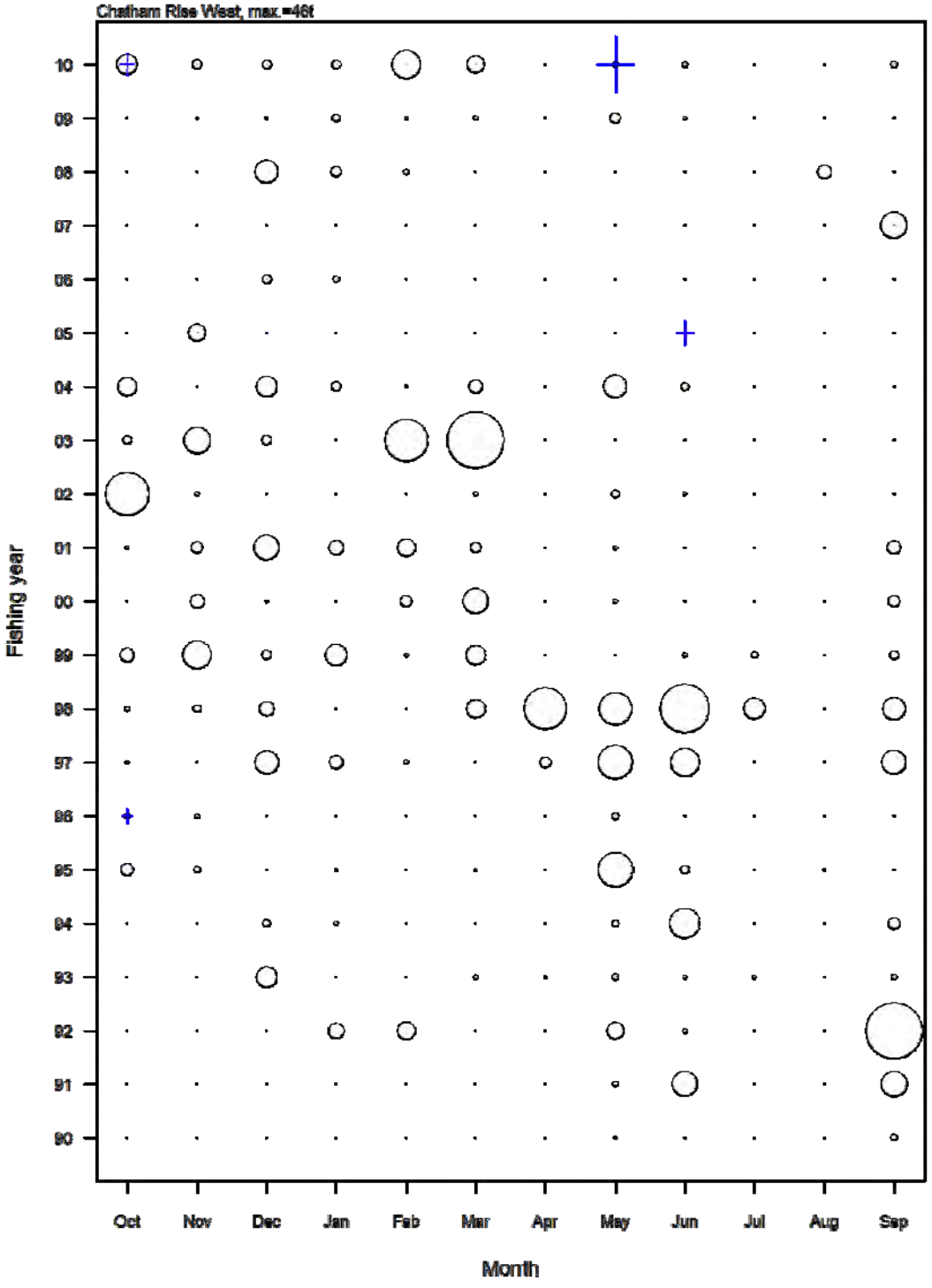


Figure B3: Representativeness of observer sampling of alfonsino catch by fishing year and month (bottom panel) for the western Chatham Rise for fishing years 1990–2010. Circles show the proportion of alfonsino catch by month within a fishing year; crosses show the proportion of observed alfonsino catch for the same cells. Representation is demonstrated by how closely the cross matches the circle diameter.

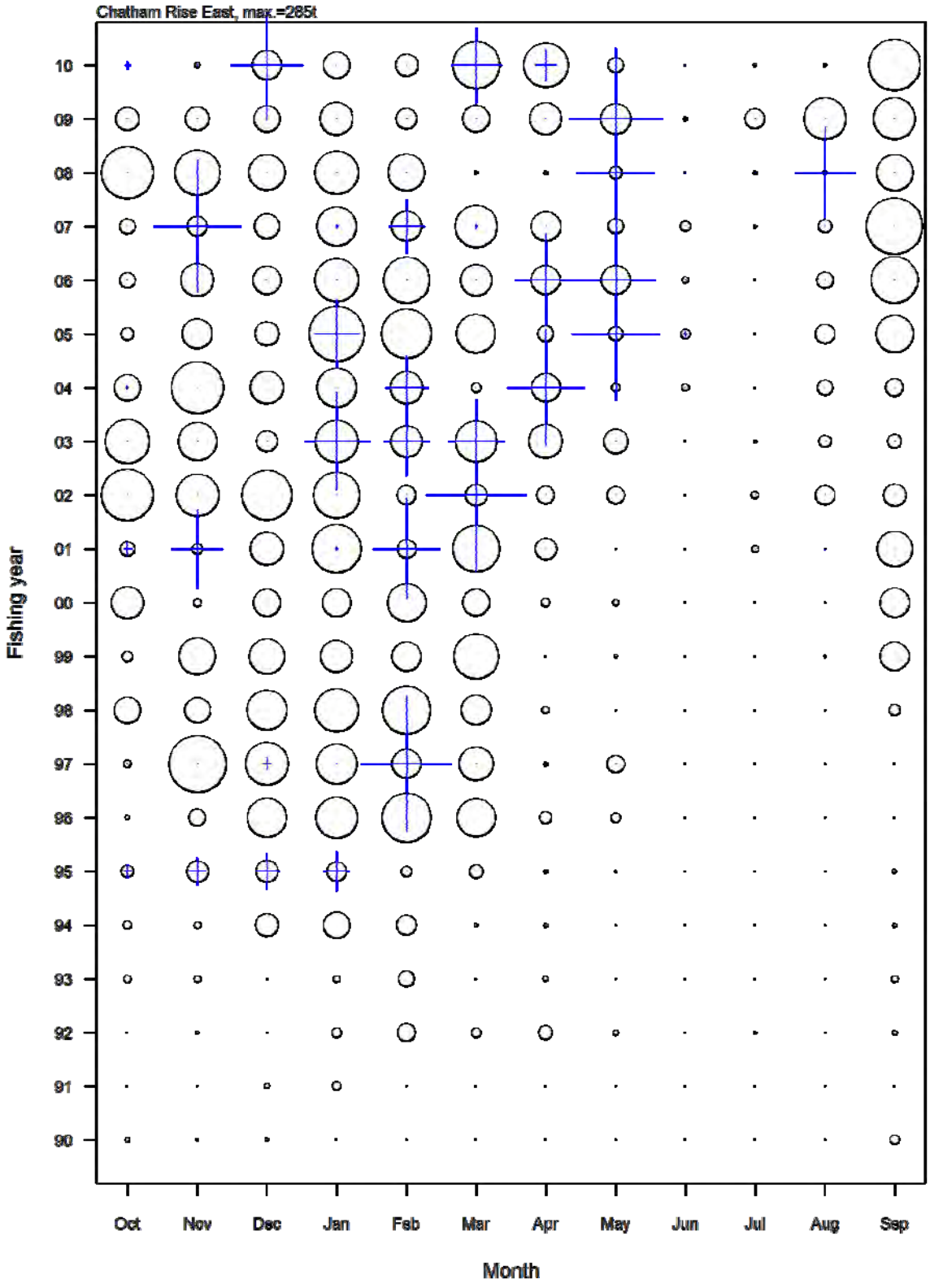


Figure B4: Representativeness of observer sampling of alfonsino catch by fishing year and month (bottom panel) for the eastern Chatham Rise for fishing years 1990–2010. Circles show the proportion of alfonsino catch by month within a fishing year; crosses show the proportion of observed alfonsino catch for the same cells. Representation is demonstrated by how closely the cross matches the circle diameter.

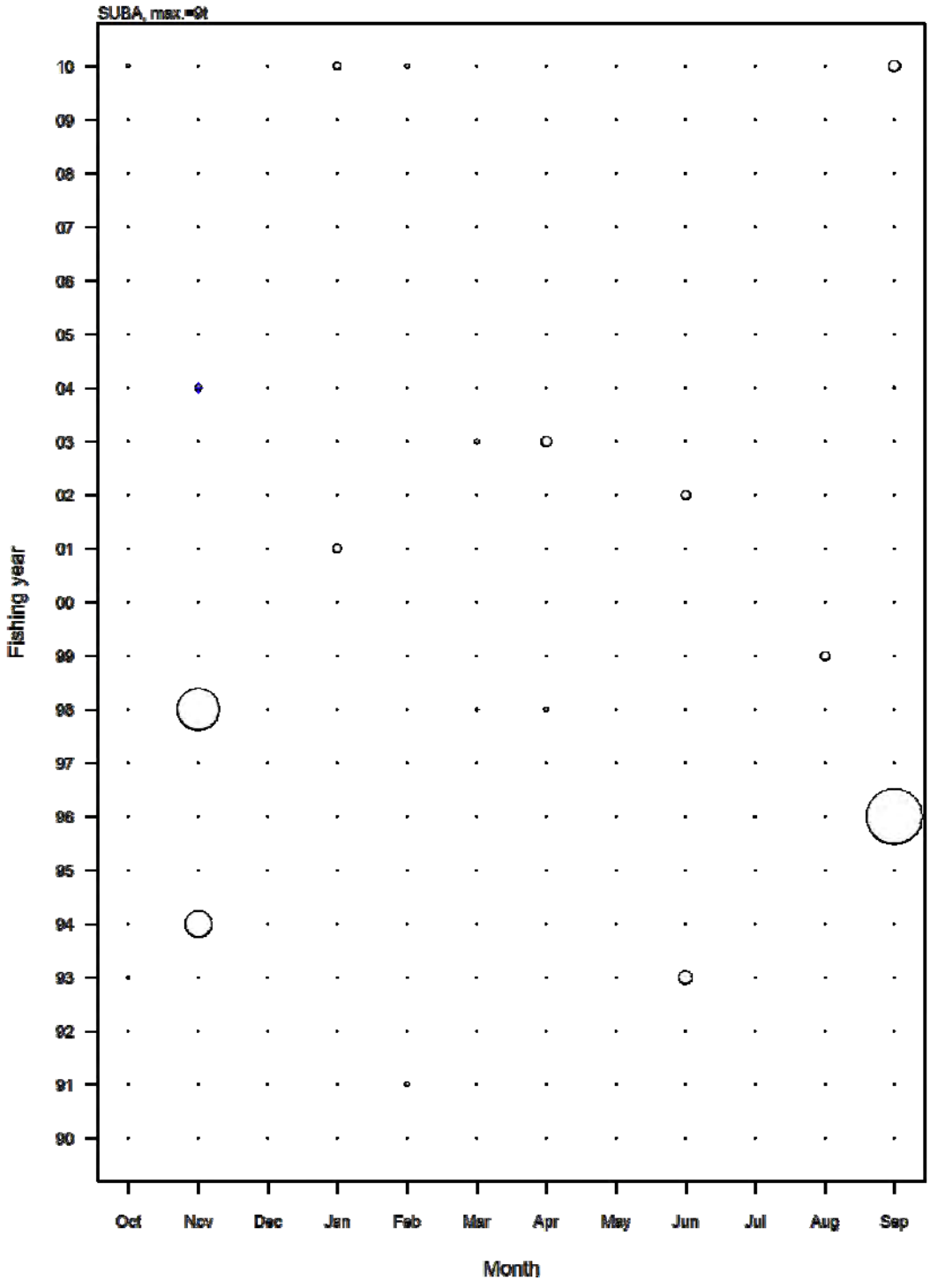


Figure B5: Representativeness of observer sampling of alfonsino catch by fishing year and month (bottom panel) for the Sub-Antarctic for fishing years 1990–2010. Circles show the proportion of alfonsino catch by month within a fishing year; crosses show the proportion of observed alfonsino catch for the same cells. Representation is demonstrated by how closely the cross matches the circle diameter.

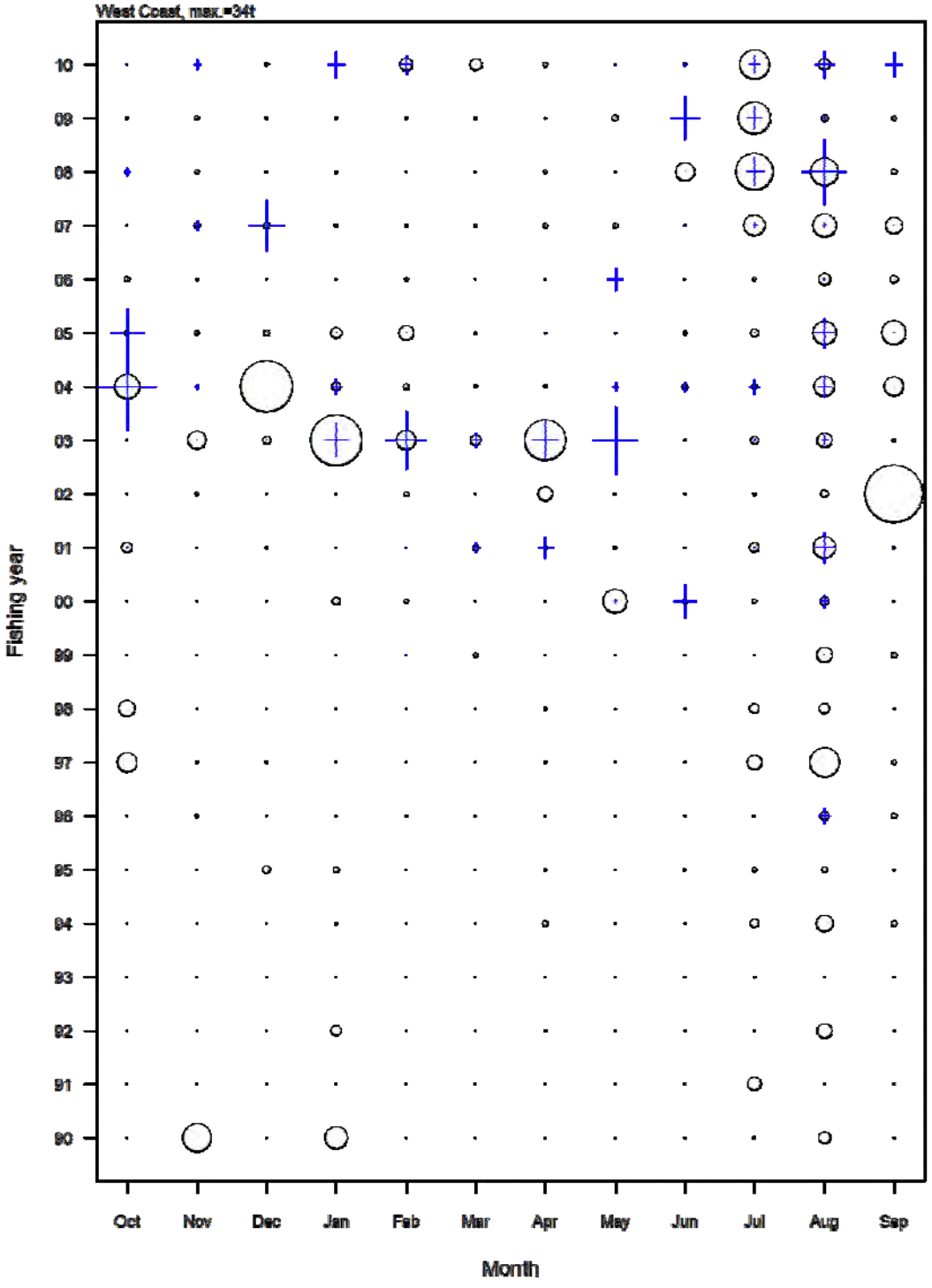


Figure B6: Representativeness of observer sampling of alfonsino catch by fishing year and month (bottom panel) for the West Coast for fishing years 1990–2010. Circles show the proportion of alfonsino catch by month within a fishing year; crosses show the proportion of observed alfonsino catch for the same cells. Representation is demonstrated by how closely the cross matches the circle diameter.

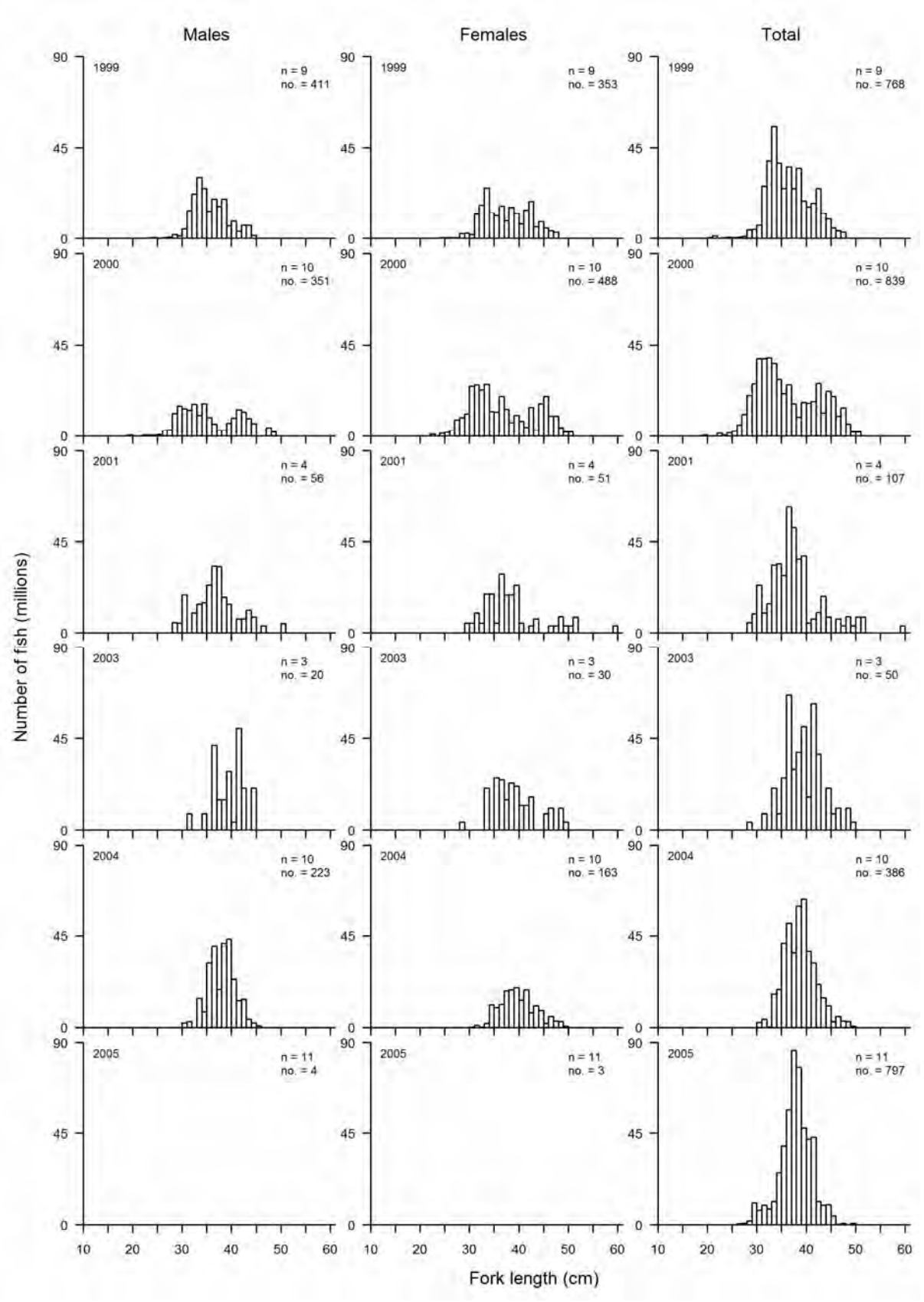


Figure B7: Scaled length frequency of alfonsino taken in commercial catches from the east coast North Island fishery by fishing year sampled by the Observer Programme, for fishing years 1999–2005. n, number of tows sampled; no., number of fish sampled.

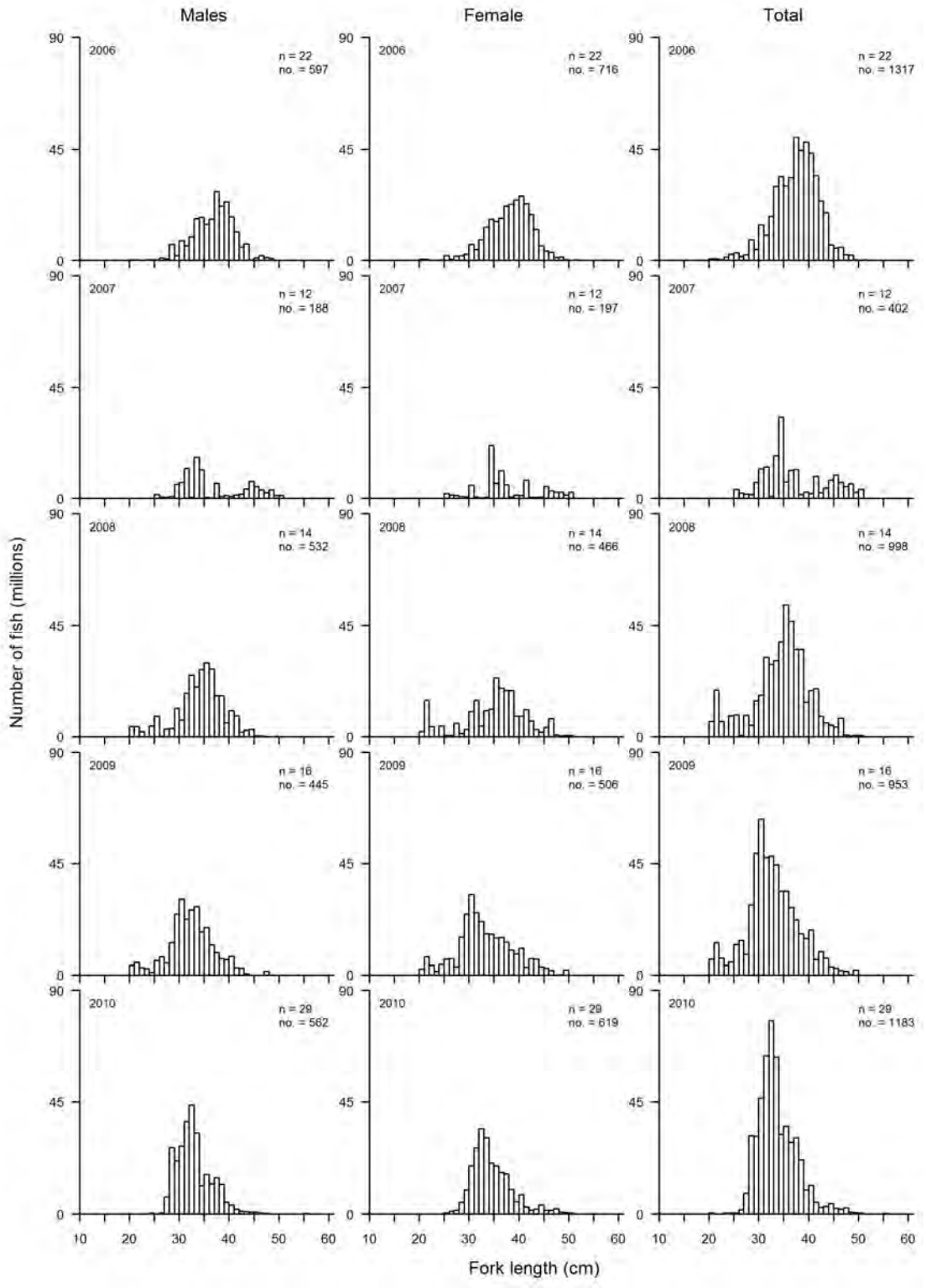


Figure B8: Scaled length frequency of alfonsino taken in commercial catches from the east coast North Island fishery by fishing year sampled by the Observer Programme, for fishing years 2006–2010. n, number of tows sampled; no., number of fish sampled.

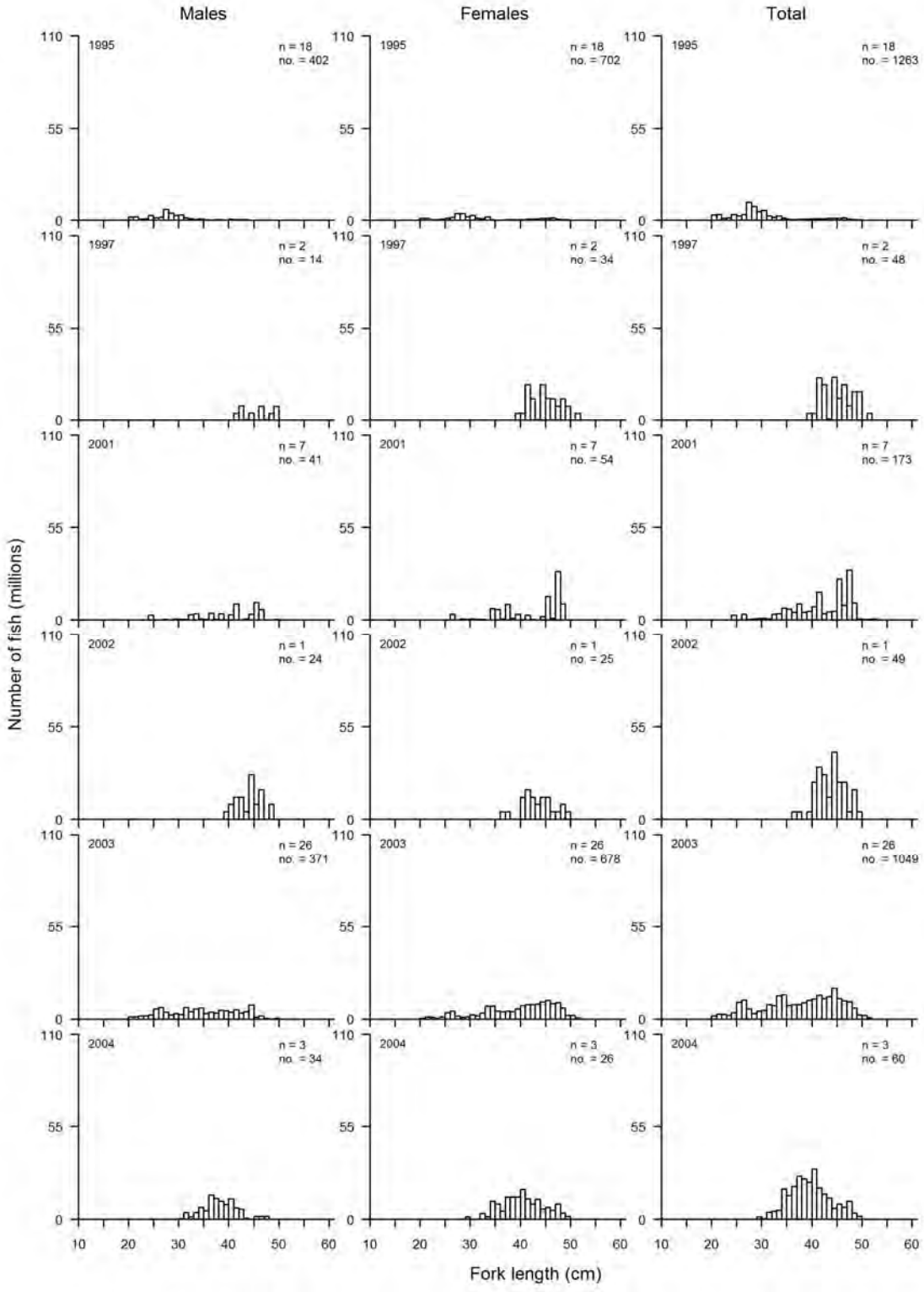


Figure B9: Scaled length frequency of alfonsino taken in commercial catches from the eastern Chatham Rise fishery by fishing year sampled by the Observer Programme, for fishing years 1995–2004. n, number of tows sampled; no., number of fish sampled.

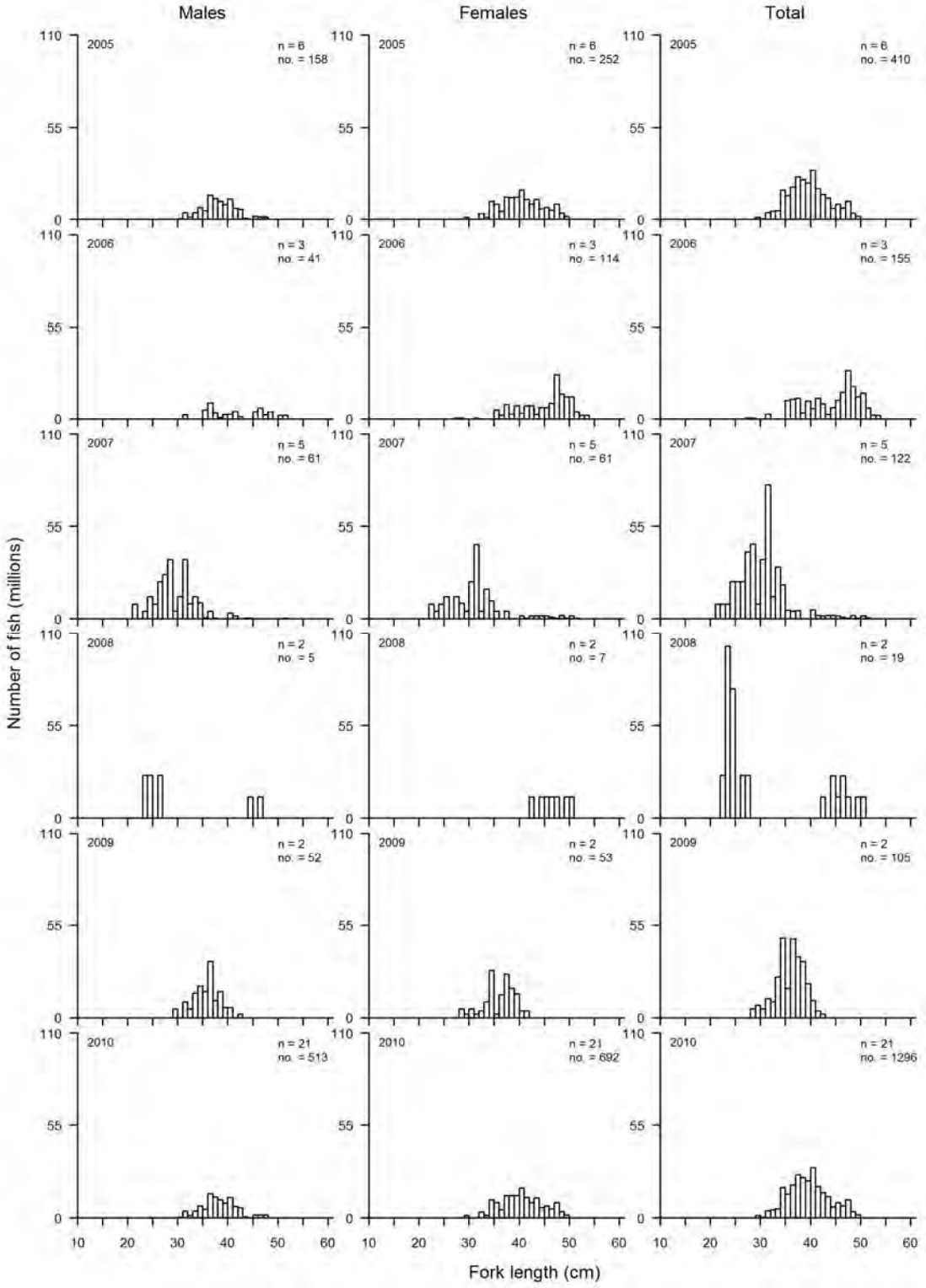


Figure B10: Scaled length frequency of alfonsino taken in commercial catches from the eastern Chatham Rise fishery by fishing year sampled by the Observer Programme, for fishing years 2005–2010. n, number of tows sampled; no., number of fish sampled.

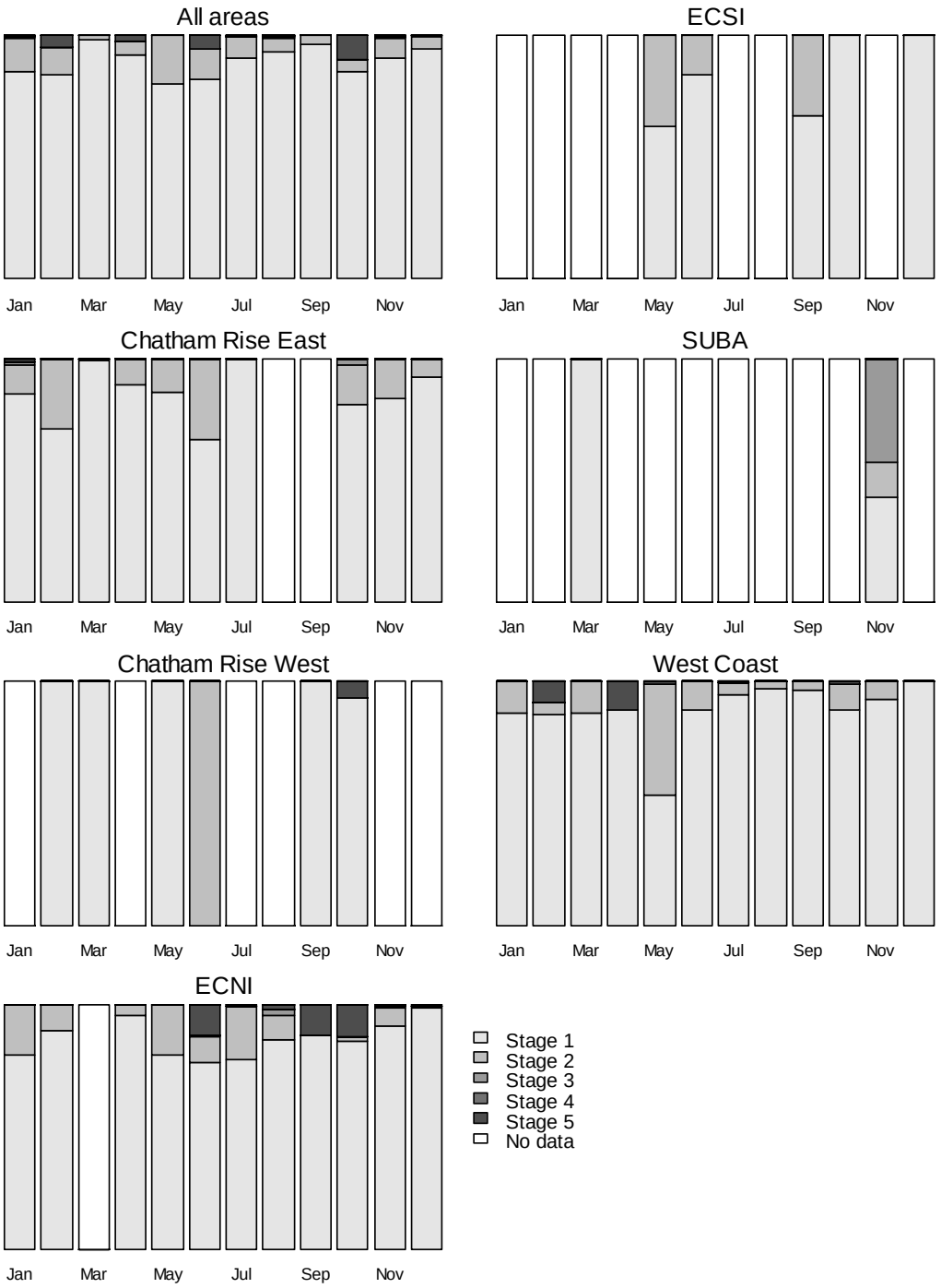


Figure B11: Gonad stages of female alfonsino taken in commercial catches, by month and area, sampled by the Observer Programme, for fishing years 1994–2010. Stages are: 1, resting/immature; 2, maturing; 3, ripe; 4, running ripe; 5, spent. The numbers of observations for each area are given in Table B4.

APPENDIX C: CHARACTERISATION

Table C1: Number of landing events by destination code and form type for BYX 1 from 1990–2010 fishing years. See Table C6 for description of landing codes.

	CLR form						CELR form						
BYX 1	L	R	F	T	B	Other	L	R	F	T	B	Other	Total
1990	7	-	-	-	-	-	107	-	-	-	-	1	115
1991	9	-	-	-	-	-	168	-	-	-	-	-	177
1992	6	-	-	-	-	-	195	-	-	-	-	1	202
1993	4	-	-	-	-	-	178	-	-	-	-	-	182
1994	19	-	-	-	-	-	171	-	-	-	1	1	192
1995	23	-	-	-	-	-	171	-	-	-	3	1	198
1996	37	-	-	-	-	-	147	-	-	-	-	1	185
1997	56	1	-	-	-	-	237	-	-	2	-	2	298
1998	82	-	-	-	-	-	186	-	-	-	2	-	270
1999	75	-	-	-	-	-	168	-	-	-	-	-	243
2000	63	1	-	-	-	-	289	-	-	-	-	1	354
2001	45	-	-	-	-	-	342	-	-	-	-	1	388
2002	90	3	-	-	-	1	354	-	1	-	-	-	449
2003	77	1	-	-	-	1	312	-	-	-	-	-	391
2004	71	-	-	-	-	1	313	-	2	-	-	-	387
2005	53	-	-	-	-	-	314	-	5	-	-	-	372
2006	71	1	-	-	-	-	320	2	6	-	-	-	400
2007	44	1	-	-	-	-	322	1	14	-	-	-	382
2008	323	-	26	-	1	3	26	-	1	-	-	-	380
2009	279	-	18	-	-	1	32	-	-	-	-	-	334
2010	345	-	29	-	-	3	20	-	1	-	-	-	399
Total	1 779	8	73	0	1	10	4 372	3	30	2	6	9	6 298

Table C2: Number of landing events by destination code and form type for BYX 2 from 1990–2010 fishing years. See Table C6 for description of landing codes.

	CLR form						CELR form						
BYX 2	L	R	C	A	H	Other	L	R	C	A	H	Other	Total
1990	72	3	-	-	-	-	159	1	7	-	-	-	242
1991	155	1	-	-	-	-	169	2	14	-	-	-	341
1992	171	3	-	-	-	-	218	-	1	-	-	-	393
1993	228	-	1	-	-	-	146	-	11	2	-	2	390
1994	303	-	-	-	-	-	138	-	1	-	-	-	442
1995	294	2	-	-	-	-	152	-	-	-	-	-	448
1996	323	-	-	-	-	2	149	-	-	-	-	1	475
1997	392	4	-	1	-	1	114	-	-	-	-	1	513
1998	367	4	1	-	-	2	134	-	-	-	-	-	508
1999	373	4	-	1	-	2	124	-	-	-	-	-	504
2000	347	3	-	1	-	2	147	-	-	-	-	-	500
2001	263	2	-	1	-	1	155	8	-	-	-	1	431
2002	239	2	-	-	-	-	125	-	-	2	-	-	368
2003	263	-	-	-	-	1	152	1	-	1	-	7	425
2004	217	2	-	-	-	1	153	-	-	-	-	2	375
2005	221	2	-	1	1	2	159	-	-	-	-	5	391
2006	183	2	-	2	-	5	187	-	-	2	-	12	393
2007	196	3	-	1	-	5	220	-	-	-	-	-	426
2008	458	1	-	1	-	1	6	-	-	-	-	-	479
2009	418	2	-	1	-	13	1	-	-	-	-	-	450
2010	468	7	-	3	-	21	2	-	-	-	-	-	508
Total	5 951	47	2	13	1	59	2 810	12	34	7	0	31	9 002

Table C3: Number of landing events by destination code and form type for BYX 3 from 1990–2010 fishing years. See Table C6 for description of landing codes.

	CLR form						CELR form						
BYX 3	L	R	T	O	A	Other	L	R	T	O	A	Other	Total
1990	18	4	10	-	1	-	127	-	-	-	-	-	160
1991	24	11	12	4	1	2	127	-	-	-	-	-	181
1992	34	10	12	6	1	4	125	-	-	-	-	-	192
1993	40	12	17	1	1	7	163	-	-	-	-	-	241
1994	84	5	8	2	-	2	160	-	-	-	-	-	261
1995	84	6	13	2	-	13	163	-	-	-	-	-	281
1996	112	7	6	2	-	15	144	-	-	-	-	-	286
1997	139	11	4	3	1	9	89	-	-	-	-	-	256
1998	172	12	4	3	-	19	137	-	-	-	-	-	347
1999	183	9	2	-	-	12	164	-	-	-	-	-	370
2000	178	17	-	1	1	31	99	-	-	-	-	-	327
2001	219	17	-	-	2	31	215	-	-	-	-	-	484
2002	203	8	-	-	1	32	109	-	-	-	-	-	353
2003	228	16	-	1	2	40	95	-	-	-	-	2	384
2004	177	17	-	1	-	37	83	-	-	-	-	-	315
2005	165	5	-	-	1	33	58	-	-	-	-	-	262
2006	137	5	-	-	1	25	46	-	-	-	-	-	214
2007	142	4	-	-	3	47	12	-	-	-	-	2	226
2008	169	6	-	-	1	44	22	-	-	-	-	-	259
2009	131	8	-	-	1	51	15	-	-	-	-	-	233
2010	163	6	-	-	6	51	18	-	-	-	-	5	292
Total	2 802	196	88	26	24	505	2 171	0	0	0	0	9	5 924

Table C4: Number of landing events by destination code and form type for BYX 7 from 1990–2010 fishing years. See Table C6 for description of landing codes.

	CLR form						CELR form						
BYX 7	L	R	T	E	D	Other	L	R	T	E	D	Other	Total
1990	5	3	2	-	-	6	2	-	-	-	-	-	18
1991	11	3	1	-	-	4	8	-	-	-	-	2	29
1992	16	2	1	2	3	1	8	-	-	-	-	-	33
1993	11	3	2	4	7	1	11	-	-	-	-	-	39
1994	24	25	6	11	3	1	13	-	-	-	-	-	83
1995	30	1	3	7	4	4	15	-	-	-	-	-	64
1996	21	1	-	4	3	-	20	-	-	-	-	-	49
1997	32	3	3	7	1	2	18	-	-	-	-	-	66
1998	38	-	7	6	1	1	21	-	-	-	-	-	74
1999	36	6	-	8	-	5	6	-	-	-	-	1	62
2000	73	7	-	18	1	4	12	-	-	-	-	-	115
2001	82	8	5	20	1	-	6	-	-	-	-	-	122
2002	49	4	-	15	1	-	11	-	-	-	-	-	80
2003	67	8	-	27	3	3	5	-	-	-	-	-	113
2004	45	-	-	24	3	2	22	-	-	-	-	-	96
2005	43	4	-	28	1	1	9	-	-	-	-	-	86
2006	38	12	-	31	-	1	6	-	-	-	-	-	88
2007	74	6	-	24	-	2	16	1	-	-	-	1	125
2008	91	3	-	24	-	2	1	-	-	-	-	-	121
2009	68	2	-	29	-	2	-	-	-	-	-	-	101
2010	76	1	-	35	-	3	-	-	-	-	-	-	116
Total	930	102	30	324	32	45	210	1	0	0	0	4	1 680

Table C5: Number of landing events by destination code and form type for BYX 8 from 1990–2010 fishing years. See Table C6 for description of landing codes.

	CLR form						CELR form						
BYX 8	L	E	T	R	F	Other	L	E	T	R	F	Other	Total
1990	-	-	2	2	-	-	-	-	-	-	-	-	4
1991	-	-	-	-	-	-	-	-	-	-	-	-	0
1992	-	-	-	-	-	-	-	-	-	-	-	-	0
1993	-	-	-	-	-	-	1	-	-	-	-	-	1
1994	1	1	-	1	-	-	2	-	-	-	-	-	5
1995	-	-	-	-	-	-	7	-	-	-	-	-	7
1996	-	-	-	-	-	-	10	-	-	-	-	-	10
1997	1	-	-	-	-	-	8	-	-	-	-	1	10
1998	-	-	-	-	-	-	7	-	-	-	-	-	7
1999	3	-	-	-	-	-	2	-	-	-	-	-	5
2000	-	-	-	-	-	-	3	-	-	-	-	-	3
2001	-	-	-	-	-	-	2	2	-	-	-	-	4
2002	-	-	-	1	-	-	3	-	-	-	-	-	4
2003	3	2	-	-	-	-	2	-	-	-	3	-	10
2004	7	2	-	-	-	-	6	-	-	-	6	-	21
2005	2	1	-	-	-	-	6	-	-	-	3	-	12
2006	5	1	-	-	-	-	11	-	-	-	1	-	18
2007	1	1	-	-	-	-	13	-	-	-	-	-	15
2008	12	2	-	-	1	-	-	-	-	-	-	-	15
2009	6	-	-	-	-	-	-	-	-	-	-	-	6
2010	5	-	-	-	-	-	-	-	-	-	-	-	5
Total	46	10	2	4	1	0	83	2	0	0	13	1	162

Table C6: Destination codes, total landing weight, number of landings and whether the records were kept or discarded for all alfonsino catch 1990–2010 for BYX 1 to BYX 8.

Destination code	Greenweight (t)	No. records	Description	Action
BYX 1				
L	1 792.567	6 156	Recreational catch	Keep
F	0.428	103	Transferred to another vessel	Keep
T	0.070	2	Eaten	Keep
E	0.038	6	Used as bait	Keep
U	0.026	7	Disposed to the Crown	Keep
C	0.018	1	Discarded	Keep
D	0.018	1	Accidental loss	Keep
A	0.010	2	Retained on board	Drop
R	3.250	11	Missing destination type code	Drop
Null	0.054	2	Stored as bait	Drop
BYX 2				
L	34 332.483	8 796	Landed in New Zealand to a Licensed Fish Receiver	Keep
C	14.171	36	Disposed to the Crown	Keep
A	13.122	20	Accidental loss	Keep
H	5.00	1	Loss from holding pot	Keep
S	1.083	3	Seized by the Crown	Keep
E	0.700	43	Eaten	Keep
D	0.200	3	Discarded	Keep
F	0.098	29	Recreational catch	Keep
U	0.033	1	Used as bait	Keep
W	0.004	2	Sold at wharf	Keep
R	52.871	59	Retained on board	Drop
Null	0.127	2	Missing destination type code	Drop
Q	0.083	6	Holding receptacle on land	Drop
B	0.015	1	Stored as bait	Drop
BYX 3				
L	15 947.287	5 073	Landed in New Zealand to a Licensed Fish Receiver	Keep
T	185.326	88	Transferred to another vessel	Keep
O	137.051	26	Conveyed outside New Zealand	Keep
A	19.446	24	Accidental loss	Keep
C	17.281	6	Disposed to the Crown	Keep
E	11.668	474	Eaten	Keep
D	1.599	10	Discarded	Keep
W	0.282	8	Sold at wharf	Keep
F	0.017	3	Recreational catch	Keep
U	0.003	2	Used as bait	Keep
S	0.002	1	Seized by the Crown	Keep
R	386.189	197	Retained on board	Drop
Q	0.146	8	Holding receptacle on land	Drop
Null	0.020	1	Missing destination type code	Drop
B	0.018	3	Stored as bait	Drop

Destination code	Greenweight (t)	No. records	Description	Action
BYX 7				
L	551.112	1142	Landed in New Zealand to a Licensed Fish Receiver	Keep
T	9.251	30	Transferred to another vessel	Keep
E	8.948	324	Eaten	Keep
D	3.13	32	Discarded	Keep
A	3.127	33	Accidental loss	Keep
O	0.767	8	Conveyed outside New Zealand	Keep
C	0.067	5	Disposed to the Crown	Keep
W	0.002	1	Sold at wharf	Drop
R	21.42	103	Retained on board	Drop
Null	0.013	1	Missing destination type code	Drop
BYX 8				
L	8.279	129	Landed in New Zealand to a Licensed Fish Receiver	Keep
E	0.227	12	Eaten	Keep
T	0.12	2	Transferred to another vessel	Keep
F	0.036	14	Recreational catch	Keep
U	0.001	1	Used as bait	Keep
R	0.104	4	Retained on board	Keep

Table C7: The reported MHR, annual retained landings in the groomed and unmerged dataset, and retained landings in the groomed and merged dataset, and estimated catches in the groomed and merged dataset for BYX 1–8 from 1990–2010, based on the centroid method.

	BYX 1					BYX 2				
				Merged estimated					Merged estimated	
Year	Plenary landings	Un-merged landings	Merged landings	Catch	% Plenary	Plenary landings	Un-merged landings	Merged landings	Catch	% Plenary
1990	20	6	3	2	10	1 229	1 483	1 483	1 485	121
1991	16	18	17	18	113	1 590	1 017	1 013	1 112	70
1992	6	8	8	6	100	1 410	1 537	1 483	1 265	90
1993	5	4	4	3	60	1 557	1 769	1 759	1 541	99
1994	7	8	8	6	86	2 087	1 647	1 569	1 542	74
1995	18	12	12	3	17	1 798	1 564	1 563	1 353	75
1996	5	13	11	10	200	1 796	1 730	1 608	1 305	73
1997	40	37	37	31	78	1 599	1 728	1 608	1 342	84
1998	14	12	12	9	64	1 609	1 468	1 445	1 238	77
1999	47	39	39	31	66	1 684	1 583	1 559	1 264	75
2000	23	29	16	9	39	1 883	1 844	1 789	1 521	81
2001	24	25	24	18	75	1 363	1 652	1 651	1 472	108
2002	124	122	122	96	77	1 813	1 464	1 463	1 368	75
2003	179	125	125	114	64	1 686	1 718	1 718	1 523	90
2004	241	208	208	182	76	1 618	1 454	1 453	1 364	84
2005	291	309	308	269	92	1 788	1 637	1 635	1 454	81
2006	152	202	194	146	96	1 367	1 563	1 563	1 460	107
2007	56	63	62	45	80	1 430	1643	1 643	1 515	106
2008	193	154	154	100	52	1 719	1 508	1 505	1 271	74
2009	128	127	124	103	80	1 740	1 515	1 509	1 305	75
2010	190	139	133	56	29	1 600	1 508	1 508	1 345	84
Totals	1 779	1 660	1 621	1 257	71	34 366	33 032	32 527	29 045	85

	BYX 3					BYX 7				
				Merged estimated					Merged estimated	
Year	Plenary landings	Un-merged landings	Merged landings	Catch	% Plenary	Plenary landings	Un-merged landings	Merged landings	Catch	% Plenary
1990	134	140	140	173	129	21	21	2	1	5
1991	200	182	181	166	83	26	26	7	2	8
1992	270	252	252	230	85	2	2	2	2	100
1993	156	109	85	95	61	12	12	1	0	0
1994	465	327	324	237	51	31	31	7	4	13
1995	474	357	357	351	74	59	60	15	0	0
1996	1 272	912	912	915	72	76	61	57	4	5
1997	864	939	911	1 000	116	69	68	54	3	4
1998	1 073	947	947	951	89	65	76	74	14	22
1999	794	777	777	789	99	13	13	11	2	15
2000	743	736	722	737	99	24	17	15	7	29
2001	1 401	835	835	807	58	20	37	37	7	35
2002	848	1 255	1 237	1 104	130	10	10	6	5	50
2003	1 228	1 109	1 109	1 021	83	7	6	6	2	29
2004	597	870	870	786	132	11	10	10	3	27
2005	1 090	1 061	1 061	953	87	14	12	12	6	43
2006	986	1 154	1 154	1 005	102	7	6	6	2	29
2007	1 373	936	936	878	64	21	22	22	13	62
2008	673	1 032	1 033	978	145	32	33	33	25	78
2009	813	896	896	874	108	18	18	18	11	61

2010	1 223	949	949	931	76	21	21	21	10	48
Totals	16 677	15 775	15 688	14 981	90	559	562	416	123	22

BYX 8

Year	Plenary landings	Un-merged landings	Merged landings	Merged estimated Catch	Merged estimated % Plenary
1990	-	-	-	-	-
1991	-	-	-	-	-
1992	-	-	-	-	-
1993	-	-	-	-	-
1994	-	-	-	-	-
1995	-	-	-	-	-
1996	-	-	-	-	-
1997	-	-	-	-	-
1998	-	-	-	-	-
1999	3	-	-	-	-
2000	-	-	-	-	-
2001	-	-	-	-	-
2002	-	-	-	-	-
2003	2	-	-	-	-
2004	-	2	2	2	-
2005	2	2	2	1	50
2006	-	-	-	-	-
2007	-	-	-	-	-
2008	-	-	-	-	-
2009	-	-	-	-	-
2010	-	-	-	-	
Totals	7	4	4	3	43

Table C8: Total number of trips, number of trips with zero estimated catch and proportion of trips with zero estimated catch, by form type for BYX 1 to BYX 8, 1990–2010 .

	CELR			TCEPR		
BYX 1	Total	Zero	Proportion	Total	Zero	Proportion
1990	107	31	0.29	6	5	0.83
1991	161	41	0.25	5	3	0.60
1992	188	34	0.18	6	5	0.83
1993	165	52	0.32	3	2	0.67
1994	165	45	0.27	10	5	0.50
1995	156	30	0.19	22	18	0.82
1996	144	31	0.22	37	23	0.62
1997	229	31	0.14	51	43	0.84
1998	185	40	0.22	81	64	0.79
1999	167	44	0.26	69	47	0.68
2000	285	65	0.23	63	32	0.51
2001	336	41	0.12	44	34	0.77
2002	352	52	0.15	80	48	0.60
2003	308	53	0.17	69	34	0.49
2004	313	36	0.12	69	40	0.58
2005	311	47	0.15	52	23	0.44
2006	317	62	0.20	61	31	0.51
2007	311	47	0.15	29	9	0.31
2008	25	9	0.36	37	17	0.46
2009	24	1	0.04	20	11	0.55
2010	15	5	0.29	23	8	0.35

	CELR			TCEPR		
BYX 2	Total	Zero	Proportion	Total	Zero	Proportion
1990	147	35	0.24	62	62	0.34
1991	150	29	0.19	109	109	0.45
1992	214	49	0.23	143	143	0.39
1993	157	63	0.40	197	197	0.29
1994	133	45	0.34	262	262	0.24
1995	138	37	0.27	252	252	0.25
1996	141	43	0.30	283	283	0.20
1997	108	26	0.24	329	329	0.16
1998	117	38	0.32	326	326	0.29
1999	122	25	0.20	333	333	0.23
2000	143	24	0.17	301	301	0.17
2001	140	23	0.16	232	232	0.23
2002	123	14	0.11	219	219	0.21
2003	147	35	0.24	215	215	0.21
2004	152	32	0.21	171	171	0.28
2005	153	28	0.18	177	177	0.21
2006	170	24	0.14	144	144	0.18
2007	200	39	0.20	150	25	0.17
2008	4	1	0.25	155	31	0.20
2009	1	0	0.00	153	23	0.15
2010	-	-	-	132	28	0.21

	CELR			TCEPR		
BYX 3	Total	Zero	Proportion	Total	Zero	Proportion
1990	127	85	0.67	23	15	0.65
1991	125	86	0.69	33	12	0.36
1992	122	92	0.75	45	21	0.47
1993	163	137	0.84	49	17	0.35
1994	159	133	0.84	83	34	0.41
1995	160	137	0.86	84	32	0.38
1996	141	117	0.83	101	30	0.32
1997	88	57	0.65	108	36	0.28
1998	133	99	0.74	147	57	0.24
1999	163	108	0.66	152	57	0.38
2000	98	62	0.63	155	64	0.37
2001	214	162	0.76	156	70	0.41
2002	109	78	0.72	168	73	0.42
2003	97	81	0.84	179	63	0.41
2004	83	74	0.89	145	82	0.43
2005	58	48	0.83	141	51	0.58
2006	46	38	0.83	110	61	0.46
2007	11	4	0.36	120	56	0.51
2008	22	7	0.32	112	32	0.50
2009	16	9	0.56	115	66	0.57
2010	18	11	0.61	96	51	0.53

	CELR			TCEPR		
BYX 7	Total	Zero	Proportion	Total	Zero	Proportion
1990	2	1	0.5	13	9	0.69
1991	9	8	0.89	14	8	0.57
1992	8	6	0.75	18	15	0.83
1993	11	8	0.73	20	19	0.95
1994	13	9	0.69	33	13	0.39
1995	14	13	0.93	32	15	0.47
1996	19	12	0.63	24	15	0.62
1997	18	11	0.61	37	21	0.57
1998	20	15	0.75	47	33	0.7
1999	7	7	1	40	32	0.8
2000	12	7	0.58	68	55	0.81
2001	6	5	0.83	81	57	0.7
2002	9	7	0.78	59	49	0.83
2003	5	4	0.8	74	58	0.78
2004	20	14	0.7	50	38	0.76
2005	9	8	0.89	44	30	0.68
2006	6	5	0.83	51	47	0.92
2007	16	8	0.5	61	30	0.49
2008	1	0	0	50	29	0.58
2009	-	-	-	56	40	0.71
2010	-	-	-	61	38	0.62

	CELR			TCEPR		
BYX 8	Total	Zero	Proportion	Total	Zero	Proportion
1990	-	-	-	1	1	1.00
1991	-	-	-	0	0	-
1992	-	-	-	0	0	-
1993	1	0	0.00	0	0	-
1994	2	2	1.00	1	1	1.00
1995	7	2	0.29	0	0	-
1996	10	4	0.40	0	0	-
1997	9	6	0.67	1	1	1.00
1998	6	1	0.17	0	0	-
1999	2	0	0.00	0	0	-
2000	3	2	0.67	0	0	-
2001	4	1	0.25	0	0	-
2002	3	1	0.33	1	1	1.00
2003	5	4	0.80	3	2	0.67
2004	11	6	0.55	6	3	0.50
2005	9	5	0.56	3	3	1.00
2006	12	4	0.33	6	6	1.00
2007	11	2	0.18	1	1	1.00
2008	-	-	-	6	6	1.00
2009	-	-	-	2	2	1.00
2010	-	-	-	2	2	1.00

Table C9: Total alfonsino catch (t) for each region from groomed and merged data for fishing years 1990–2010.

Year	ECNI	ECSI	Western Chatham Rise	Eastern Chatham Rise	SubAntarctic	West Coast	Total
1990	1 486	133	<1	4	3	2	1 628
1991	1 033	145	19	17	1	3	1 217
1992	1 491	115	59	76	1	2	1 744
1993	1 763	28	17	40	0	1	1 849
1994	1 577	64	20	237	3	7	1 908
1995	1 577	141	27	188	1	13	1 947
1996	1 662	155	6	747	5	14	2 589
1997	1 664	125	58	727	1	36	2 610
1998	1 517	68	115	758	6	15	2 479
1999	1 598	102	46	626	3	11	2 385
2000	1 806	164	18	539	1	14	2 541
2001	1 675	81	27	726	1	38	2 548
2002	1 544	27	34	1 175	2	48	2 829
2003	1 787	57	105	946	2	62	2 959
2004	1 613	8	28	833	1	60	2 544
2005	1 935	16	4	1 040	0	23	3 019
2006	1 756	1	3	1 150	0	6	2 916
2007	1 703	4	11	920	0	24	2 662
2008	1 658	8	17	1 007	0	33	2 724
2009	1 632	4	5	886	0	19	2 547
2010	1 641	54	27	867	1	20	2 611
Total	34 118	1 500	644	13 510	33	451	50 258

Table C10: Total alfonsino catch by vessel nationality from groomed and merged data for fishing years 1990–2010.

Year	NZ	UNKNOWN	KOREA	UKRAINE	PANAMA	VANUATU	JAPAN	POLAND	Total
1990	447	1 181	-	-	-	-	-	-	1 628
1991	670	547	1	-	-	-	-	-	1 218
1992	1 047	697	1	-	-	-	-	-	1 745
1993	879	970	-	-	-	-	-	-	1 849
1994	646	1 255	7	1	-	-	-	-	1 909
1995	780	1 147	20	1	-	-	-	-	1 948
1996	886	1 700	-	-	-	-	1	-	2 587
1997	1 023	1 572	2	10	-	2	-	2	2 611
1998	1 111	1 356	-	-	9	-	1	-	2 477
1999	1 536	836	12	-	1	-	-	-	2 385
2000	1 513	1 025	-	-	-	2	-	-	2 540
2001	1 518	1 013	10	1	6	1	-	-	2 549
2002	1 698	1 119	11	-	0	-	-	-	2 828
2003	1 747	1 184	8	1	20	-	-	-	2 960
2004	1 540	995	3	1	5	-	-	-	2 544
2005	2 009	1 000	9	-	1	-	-	-	3 019
2006	2 006	908	2	-	-	-	-	-	2 916
2007	1 876	753	30	3	-	-	-	-	2 662
2008	1 808	866	29	12	-	8	-	-	2 723
2009	1 743	783	11	8	-	2	-	-	2 547
2010	1 750	848	7	5	-	-	-	-	2 610
Total	28 234	28 233	163	163	43	42	15	2	50 255

Table C11: Proportion of alfonsino catch reported each month from the ECNI area for fishing years 1990–2010.

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1990	0.07	0.27	0.06	0.12	0.04	0.03	0.07	0.08	0.04	0.02	0.04	0.16	1 486
1991	0.08	0.15	0.05	0.14	0.11	0.07	0.03	0.11	0.04	0.02	0.01	0.18	1 033
1992	0.22	0.10	0.04	0.03	0.04	0.01	0.01	0.10	0.05	0.14	0.12	0.13	1 491
1993	0.14	0.17	0.08	0.04	0.06	0.05	0.05	0.05	-	0.03	0.20	0.13	1 763
1994	0.16	0.08	0.04	0.17	0.06	0.05	0.06	0.04	0.08	0.02	0.14	0.08	1 577
1995	0.24	0.16	0.09	0.11	0.08	0.03	0.05	0.03	0.03	0.06	0.09	0.05	1 577
1996	0.15	0.20	0.12	0.18	0.06	0.06	0.05	0.04	0.05	0.03	0.02	0.03	1 662
1997	0.11	0.28	0.09	0.11	0.18	0.08	0.02	0.05	0.01	0.01	0.02	0.03	1 664
1998	0.21	0.12	0.04	0.14	0.25	0.06	0.06	0.05	0.02	0.03	-	0.02	1 517
1999	0.10	0.16	0.13	0.16	0.13	0.06	0.07	0.05	0.01	0.01	0.06	0.06	1 598
2000	0.20	0.06	0.09	0.15	0.13	0.08	0.06	0.05	0.01	0.05	0.05	0.06	1 806
2001	0.15	0.17	0.09	0.14	0.12	0.09	0.06	0.05	0.03	0.04	0.02	0.04	1 675
2002	0.14	0.06	0.04	0.15	0.13	0.14	0.07	0.07	0.05	0.02	0.08	0.04	1 544
2003	0.18	0.08	0.11	0.12	0.10	0.05	0.08	0.08	0.08	0.01	0.03	0.08	1 787
2004	0.20	0.09	0.11	0.14	0.07	0.14	0.13	0.05	0.02	0.01	0.02	0.04	1 613
2005	0.11	0.22	0.10	0.08	0.10	0.08	0.11	0.08	0.02	0.03	0.04	0.04	1 935
2006	0.15	0.27	0.11	0.15	0.08	0.06	0.03	0.06	0.02	0.04	0.02	0.02	1 756
2007	0.15	0.12	0.11	0.05	0.05	0.09	0.10	0.05	0.01	0.10	0.14	0.02	1 703
2008	0.04	0.12	0.10	0.14	0.11	0.13	0.14	0.06	0.03	0.02	0.07	0.05	1 658
2009	0.12	0.17	0.07	0.19	0.16	0.11	0.09	0.01	-	0.02	0.02	0.03	1 632
2010	0.11	0.23	0.12	0.14	0.13	0.07	0.03	0.03	0.02	0.04	0.04	0.04	1 641
Total	0.14	0.16	0.09	0.13	0.10	0.07	0.07	0.06	0.03	0.04	0.06	0.06	34 118

Table C12: Proportion of alfonsino catch reported for each statistical area from the ECNI area for fishing years 1990–2010.

Year	010	012	013	014	015	016	106	204	Other	Total
1990	-	-	0.03	0.42	0.22	-	-	0.32	-	1 486
1991	0.01	-	0.11	0.17	0.13	-	-	0.56	0.01	1 033
1992	-	-	0.18	0.09	0.26	0.02	-	0.45	-	1 491
1993	-	-	0.06	0.15	0.41	0.02	-	0.36	-	1 763
1994	-	0.02	0.12	0.23	0.29	0.02	-	0.27	0.05	1 577
1995	-	0.11	0.05	0.21	0.28	-	-	0.29	0.04	1 577
1996	-	0.04	0.10	0.29	0.26	0.09	-	0.14	0.08	1 662
1997	-	0.03	0.12	0.42	0.23	0.07	0.02	0.09	0.02	1 664
1998	-	0.03	0.09	0.45	0.21	0.07	-	0.10	0.06	1 517
1999	0.01	0.05	0.27	0.16	0.27	0.08	0.01	0.13	0.02	1 598
2000	-	0.03	0.13	0.26	0.32	0.09	-	0.13	0.02	1 806
2001	-	0.07	0.14	0.29	0.34	0.05	-	0.09	0.02	1 675
2002	0.03	0.09	0.17	0.17	0.35	0.02	-	0.15	0.02	1 544
2003	0.03	0.01	0.14	0.14	0.35	0.02	-	0.29	0.02	1 787
2004	0.02	-	0.18	0.14	0.43	0.02	0.07	0.13	0.01	1 613
2005	0.04	0.01	0.12	0.19	0.36	0.01	0.11	0.15	0.01	1 935
2006	0.02	0.01	0.14	0.10	0.35	0.01	0.08	0.25	0.04	1 756
2007	0.01	-	0.11	0.12	0.44	0.01	0.01	0.26	0.02	1 703
2008	0.04	0.05	0.08	0.11	0.38	0.06	0.02	0.23	0.04	1 658
2009	0.04	0.05	0.06	0.11	0.42	0.02	0.03	0.24	0.03	1 632
2010	0.03	0.02	0.03	0.14	0.41	0.01	0.04	0.29	0.04	1 641
Total	0.02	0.03	0.12	0.21	0.32	0.03	0.02	0.23	0.03	34 118

Table C13: Proportion of alfonsino catch reported by gear type from the ECNI area for fishing years 1990–2010.

	BLL	BT	MW	MWB	Total
1990	-	0.09	0.63	0.28	1 486
1991	0.01	0.18	0.28	0.54	1 033
1992	0.01	0.09	0.27	0.63	1 491
1993	-	0.11	0.17	0.71	1 763
1994	-	0.22	0.16	0.62	1 577
1995	0.01	0.34	0.12	0.53	1 577
1996	-	0.43	0.06	0.51	1 662
1997	-	0.50	0.07	0.42	1 664
1998	-	0.35	0.25	0.39	1 517
1999	0.01	0.25	0.42	0.32	1 598
2000	0.01	0.29	0.37	0.33	1 806
2001	0.02	0.25	0.42	0.31	1 675
2002	0.01	0.20	0.47	0.32	1 544
2003	0.01	0.31	0.22	0.45	1 787
2004	0.02	0.21	0.33	0.44	1 613
2005	0.01	0.33	0.30	0.36	1 935
2006	0.03	0.39	0.17	0.41	1 756
2007	0.04	0.45	0.16	0.36	1 703
2008	0.07	0.35	0.18	0.40	1 658
2009	0.08	0.37	0.20	0.34	1 632
2010	0.05	0.45	0.19	0.30	1 641
Total	0.02	0.30	0.26	0.42	34 118

Table C14: Proportion of alfonsino catch reported by target species from the ECNI area for fishing years 1990–2010. Refer to Table C27 for species codes.

Year	BNS	BYX	CDL	HOK	LIN	ORH	RBY	SCI	SKI	WAR	Other	Total
1990	0.14	0.81	0.01	-	-	0.01	-	-	0.02	-	-	1 486
1991	0.18	0.69	0.04	0.05	-	0.03	-	-	-	-	0.01	1 033
1992	0.05	0.81	0.01	0.08	-	0.04	0.01	-	-	-	0.01	1 491
1993	0.06	0.80	0.02	0.06	-	0.03	0.01	-	-	-	-	1 763
1994	0.01	0.77	0.05	0.03	0.01	0.13	-	-	0.02	-	-	1 577
1995	0.02	0.71	0.08	0.05	-	0.10	-	-	0.03	-	-	1 577
1996	0.01	0.55	0.09	0.22	-	0.05	-	-	0.07	-	0.02	1 662
1997	0.03	0.49	0.05	0.34	-	0.02	-	-	0.05	-	0.01	1 664
1998	0.02	0.53	0.05	0.31	-	0.02	-	-	0.03	0.03	-	1 517
1999	0.01	0.56	0.08	0.28	-	0.05	-	0.01	0.01	-	-	1 598
2000	0.02	0.57	0.06	0.27	-	0.04	0.02	-	0.01	-	-	1 806
2001	0.04	0.61	0.06	0.27	-	0.01	-	-	0.01	-	-	1 675
2002	0.04	0.66	0.06	0.22	-	-	-	0.01	-	-	-	1 544
2003	0.08	0.57	0.08	0.25	-	0.01	-	-	-	-	-	1 787
2004	0.06	0.67	0.03	0.22	-	0.01	-	-	-	-	-	1 613
2005	0.05	0.77	0.04	0.13	-	-	0.01	-	-	-	-	1 935
2006	0.05	0.73	0.06	0.14	-	-	0.01	-	-	-	-	1 756
2007	0.05	0.71	0.07	0.15	-	0.01	0.01	-	-	-	-	1 703
2008	0.10	0.64	0.06	0.15	0.01	-	0.04	-	-	-	-	1 658
2009	0.09	0.65	0.05	0.18	-	-	0.01	-	-	-	-	1 632
2010	0.07	0.79	0.06	0.03	-	0.03	0.01	-	-	-	-	1 641
Total	0.05	0.67	0.05	0.17	<0.01	0.03	0.01	<0.01	0.01	<0.01	<0.01	34 118

Table C15: Proportion of alfonsino catch reported each month from the Eastern Chatham Rise area for fishing years 1990–2010.

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1990	0.48	0.18	0.28	-	-	0.06	-	-	-	-	-	-	4
1991	-	-	0.17	0.56	-	-	-	-	-	-	-	0.27	17
1992	-	0.01	0.01	0.13	0.53	-	0.27	0.04	-	0.01	-	-	76
1993	0.07	0.08	0.01	0.12	0.54	-	0.06	-	-	-	-	0.12	40
1994	0.01	0.13	0.14	0.25	0.15	-	-	-	-	-	-	0.30	237
1995	0.13	0.27	0.16	0.22	0.01	0.12	0.01	-	-	-	-	0.07	188
1996	0.01	0.04	0.21	0.28	0.27	0.16	0.02	0.01	-	-	-	-	747
1997	0.01	0.33	0.18	0.19	0.10	0.14	-	0.04	-	-	-	-	727
1998	0.08	0.09	0.18	0.27	0.25	0.12	-	-	-	-	-	-	758
1999	0.03	0.20	0.22	0.14	0.13	0.25	-	-	-	-	-	0.03	626
2000	0.10	0.01	0.12	0.16	0.25	0.12	-	0.01	-	-	-	0.23	539
2001	0.03	0.02	0.15	0.32	0.01	0.32	0.01	-	-	-	-	0.14	726
2002	0.22	0.16	0.21	0.17	0.03	0.03	0.03	0.03	-	-	0.02	0.09	1 175
2003	0.19	0.13	0.04	0.20	0.08	0.18	0.10	0.06	-	-	0.02	0.01	946
2004	0.08	0.33	0.12	0.19	0.10	0.01	0.10	-	0.01	-	0.04	0.01	833
2005	0.01	0.11	0.04	0.29	0.21	0.14	0.02	0.02	0.01	-	0.04	0.12	1 040
2006	0.02	0.17	0.06	0.18	0.15	0.07	0.07	0.06	-	-	0.04	0.18	1 150
2007	0.02	0.09	0.08	0.09	0.10	0.17	0.08	0.02	0.01	-	0.06	0.26	920
2008	0.24	0.19	0.16	0.13	0.13	-	-	0.02	-	-	-	0.13	1 007
2009	0.06	0.06	0.08	0.11	0.04	0.08	0.10	0.09	-	0.05	0.14	0.18	886
2010	-	-	0.10	0.08	0.05	0.26	0.21	0.03	-	-	-	0.27	867
Total	0.08	0.13	0.13	0.19	0.12	0.13	0.05	0.03	<0.01	<0.01	0.03	0.12	13 510

Table C16: Proportion of alfonsino catch reported for each statistical area from the Eastern Chatham Rise area for fishing years 1990–2010.

Year	049	050	051	052	404	406	410	412	Total
1990	-	-	0.06	-	0.92	-	0.01	-	4
1991	0.55	-	-	-	0.45	-	-	-	17
1992	-	0.02	-	-	0.09	-	-	0.89	76
1993	-	-	0.54	-	0.35	-	-	0.11	40
1994	-	-	0.24	0.01	0.07	-	-	0.66	237
1995	0.05	0.07	0.02	-	0.28	-	-	0.57	188
1996	-	-	0.57	-	0.01	0.14	0.01	0.26	747
1997	0.01	0.01	0.61	-	0.02	0.15	-	0.20	727
1998	0.02	-	0.30	-	0.09	0.26	-	0.34	758
1999	-	0.15	0.32	-	0.05	0.13	-	0.34	626
2000	-	-	0.52	-	0.14	0.21	-	0.13	539
2001	0.01	-	0.61	0.01	0.16	0.06	-	0.15	726
2002	0.05	0.02	0.40	-	0.41	0.02	-	0.10	1 175
2003	0.04	0.11	0.66	-	0.16	-	-	0.03	946
2004	0.01	-	0.84	-	0.10	0.03	-	0.02	833
2005	0.32	-	0.42	-	0.18	0.03	-	0.06	1 040
2006	0.20	-	0.28	-	0.28	0.09	-	0.15	1 150
2007	0.09	-	0.49	-	0.40	-	0.01	0.01	920
2008	0.01	-	0.36	-	0.45	0.15	-	0.02	1 007
2009	0.17	-	0.54	-	0.25	0.04	-	-	886
2010	0.05	-	0.52	-	0.42	-	-	-	867
Total	0.07	0.02	0.47	<0.01	0.22	0.08	<0.01	0.13	13 510

Table C17: Proportion of alfonsino catch reported by gear type from the Eastern Chatham Rise area for fishing years 1990–2010.

Year	BT	MW	MWB	Total
1990	1.00	-	-	4
1991	1.00	-	-	17
1992	1.00	-	-	76
1993	0.85	0.03	0.12	40
1994	0.98	-	0.02	237
1995	0.93	0.06	0.01	188
1996	0.78	0.10	0.12	747
1997	0.95	0.04	-	727
1998	0.97	0.02	0.01	758
1999	0.96	-	0.03	626
2000	0.99	-	0.01	539
2001	0.98	0.02	-	726
2002	0.99	-	0.01	1 175
2003	0.97	-	0.03	946
2004	0.99	0.01	-	833
2005	0.92	0.04	0.04	1 040
2006	0.75	0.11	0.13	1 150
2007	0.64	0.12	0.24	920
2008	0.43	0.12	0.45	1 007
2009	0.62	0.11	0.26	886
2010	0.52	0.16	0.32	867
Total	0.83	0.06	0.11	13 510

Table C18: Proportion of alfonsino catch reported by target species from the Eastern Chatham Rise area for fishing years 1990–2010. Refer to Table C27 for species codes.

Year	BNS	BYX	HAK	HOK	ORH	Other	Total
1990	-	-	0.92	0.01	0.01	0.07	4
1991	-	-	0.17	0.28	-	0.55	17
1992	-	-	0.02	0.09	0.89	-	76
1993	-	-	0.35	0.54	0.11	-	40
1994	-	0.05	0.06	0.02	0.86	-	237
1995	-	0.18	0.17	0.22	0.43	-	188
1996	-	0.84	0.01	-	0.14	0.01	747
1997	-	0.82	0.01	0.10	0.06	-	727
1998	-	0.66	0.07	0.06	0.21	-	758
1999	-	0.82	0.04	-	0.13	-	626
2000	-	0.96	-	0.01	0.03	-	539
2001	0.07	0.80	0.01	0.08	0.03	0.02	726
2002	0.28	0.51	0.12	0.03	0.02	0.05	1 175
2003	0.09	0.72	0.02	0.11	0.02	0.02	946
2004	0.15	0.78	0.01	0.04	0.03	-	833
2005	0.11	0.84	0.01	0.03	0.01	0.01	1 040
2006	0.07	0.84	-	-	0.09	0.01	1 150
2007	-	0.95	0.02	-	0.01	0.03	920
2008	0.01	0.93	0.01	-	0.01	0.04	1 007
2009	0.01	0.94	-	0.02	-	0.03	886
2010	-	0.97	-	-	-	0.02	867
Total	0.06	0.79	0.03	0.04	0.07	0.02	13 510

Table C19: Proportion of alfonsino catch reported each month from the ECSI area for fishing years 1990–2010.

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1990	-	0.03	0.07	0.41	-	-	-	-	-	0.08	0.36	0.04	133
1991	-	-	-	0.34	0.17	0.18	0.06	0.01	0.07	-	-	0.15	145
1992	-	-	-	0.25	-	0.04	-	0.03	0.28	0.04	0.01	0.35	115
1993	-	0.01	0.01	0.10	0.02	0.01	0.03	0.17	0.01	0.01	0.18	0.46	28
1994	0.01	-	0.05	0.30	0.35	0.07	0.02	0.04	0.02	0.01	-	0.13	64
1995	0.04	0.05	0.01	0.19	0.02	0.12	-	-	-	0.01	-	0.55	141
1996	0.05	0.01	0.07	0.18	0.33	0.01	0.01	0.07	0.07	-	-	0.22	155
1997	0.23	0.25	0.21	0.03	0.03	0.07	0.07	0.06	0.02	-	-	0.02	125
1998	-	0.01	0.11	0.01	0.14	0.14	0.01	0.34	0.12	-	-	0.13	68
1999	0.01	0.02	0.08	0.34	0.01	0.02	-	0.03	0.01	0.01	-	0.49	102
2000	-	0.01	0.03	0.05	0.65	0.14	0.01	0.02	0.07	-	-	0.01	164
2001	0.38	0.08	0.09	0.03	0.07	0.03	0.09	0.17	0.01	-	-	0.04	81
2002	0.01	0.32	0.34	0.15	0.01	0.01	0.04	0.10	0.01	-	-	0.01	27
2003	0.05	0.02	-	0.39	0.42	0.01	0.02	0.05	0.02	-	-	0.02	57
2004	0.64	0.02	0.05	0.02	0.07	0.01	0.01	0.08	0.03	0.01	0.01	0.05	8
2005	0.03	0.32	0.03	-	0.02	0.02	0.02	0.01	0.52	-	-	0.03	16
2006	0.17	0.06	0.01	0.01	0.03	0.02	0.18	0.28	0.07	0.14	0.02	0.01	1
2007	0.02	0.21	0.02	-	0.06	0.12	0.09	0.05	0.31	0.04	0.04	0.03	4
2008	0.12	0.02	-	-	0.08	0.02	0.02	0.56	0.06	0.12	0.01	0.01	8
2009	0.18	0.09	0.07	0.21	0.02	0.25	0.01	0.01	0.13	0.03	-	0.02	4
2010	-	-	0.13	0.25	0.09	-	0.25	-	0.01	-	0.20	0.05	54
Total	0.06	0.05	0.06	0.20	0.17	0.07	0.03	0.06	0.06	0.01	0.04	0.18	1 500

Table C20: Proportion of alfonsino catch reported for each statistical area from the ECSI area for fishing years 1990–2010.

Year	018	019	020	021	Other	Total
1990	0.60	0.37	0.01	0.01	0.01	133
1991	0.84	0.01	0.07	0.07	0.01	145
1992	0.71	-	0.04	0.04	0.22	115
1993	0.44	-	0.07	0.47	0.02	28
1994	0.76	-	0.01	0.01	0.22	64
1995	0.41	0.24	0.02	0.32	0.01	141
1996	0.59	-	0.04	0.35	0.01	155
1997	0.54	0.02	0.24	0.04	0.16	125
1998	0.28	-	0.47	0.20	0.04	68
1999	0.07	0.33	0.03	0.50	0.08	102
2000	0.11	-	0.32	0.52	0.04	164
2001	0.36	0.02	0.13	0.47	0.01	81
2002	0.39	-	0.37	0.19	0.05	27
2003	0.08	-	0.13	0.77	0.02	57
2004	0.14	-	0.14	0.66	0.06	8
2005	0.05	0.01	0.06	0.86	0.02	16
2006	0.27	0.02	0.36	0.13	0.23	1
2007	0.45	0.22	0.16	0.07	0.10	4
2008	0.16	-	0.05	0.77	0.02	8
2009	0.37	-	0.19	0.04	0.40	4
2010	0.41	-	0.01	0.54	0.04	54
Total	0.45	0.08	0.12	0.28	0.06	1 500

Table C21: Proportion of alfonsino catch reported by gear type from the ECSI area for fishing years 1990–2010.

Year	BT	MW	MWB	Other	Total
1990	0.12	0.73	0.14	0.01	133
1991	0.22	0.77	0.01	0.01	145
1992	0.30	0.44	0.25	0.01	115
1993	0.79	-	0.13	0.07	28
1994	0.89	0.03	0.04	0.04	64
1995	0.45	0.31	0.22	0.02	141
1996	0.61	0.01	0.37	0.01	155
1997	0.96	0.02	0.01	-	125
1998	0.64	0.02	0.32	0.02	68
1999	0.61	0.01	0.35	0.02	102
2000	0.59	0.23	0.18	0.01	164
2001	0.43	0.38	0.16	0.03	81
2002	0.77	0.01	0.16	0.06	27
2003	0.94	-	0.04	0.01	57
2004	0.87	0.03	0.05	0.05	8
2005	0.93	0.01	0.04	0.02	16
2006	0.76	0.01	0.03	0.20	1
2007	0.78	0.15	0.02	0.05	4
2008	0.33	0.01	0.62	0.04	8
2009	0.91	-	0.03	0.06	4
2010	0.17	0.74	0.09	0.01	54
Total	0.53	0.28	0.17	0.02	1 500

Table C22: Proportion of alfonsino catch reported by target species from the ECSI area for fishing years 1990–2010. Refer to Table C27 for species codes.

Year	BNS	BYX	CDL	HOK	ORH	Other	Total
1990	-	0.97	-	-	-	0.03	133
1991	-	0.68	0.17	0.10	-	0.04	145
1992	-	0.48	-	0.50	-	0.02	115
1993	0.01	0.03	-	0.34	-	0.62	28
1994	0.01	-	-	0.68	0.19	0.11	64
1995	0.02	0.53	-	0.13	0.30	0.02	141
1996	0.01	0.33	-	0.66	-	-	155
1997	-	0.26	-	0.69	0.01	0.03	125
1998	0.01	0.17	-	0.78	0.02	0.02	68
1999	0.01	0.87	-	0.11	-	0.02	102
2000	-	0.30	-	0.63	-	0.07	164
2001	0.02	0.36	-	0.59	-	0.03	81
2002	0.03	-	-	0.88	-	0.09	27
2003	-	0.34	-	0.64	-	0.02	57
2004	0.02	-	-	0.93	-	0.04	8
2005	0.01	-	-	0.97	-	0.02	16
2006	0.01	-	-	0.67	-	0.31	1
2007	0.03	-	-	0.90	-	0.07	4
2008	0.08	0.46	-	0.39	-	0.07	8
2009	0.04	0.23	-	0.55	-	0.18	4
2010	0.23	0.29	-	0.47	-	0.01	54
Total	0.02	0.44	0.02	0.44	0.04	0.05	1 500

Table C23: Proportion of alfonsino catch reported each month from the Western Chatham Rise area for fishing years 1990–2010.

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1990	0.22	0.02	0.03	-	-	-	-	0.72	-	-	-	0.01	<1
1991	-	-	-	-	-	-	0.01	-	0.42	-	-	0.56	19
1992	-	-	-	0.11	-	-	-	0.06	0.02	-	-	0.80	59
1993	0.02	-	0.42	-	-	0.03	0.01	0.02	0.14	-	0.35	-	17
1994	-	0.03	0.03	0.01	-	0.01	-	0.36	0.43	-	-	0.12	20
1995	0.14	0.03	-	-	-	-	0.04	0.66	0.02	-	-	0.10	27
1996	0.19	-	-	0.01	-	-	0.13	0.22	0.18	-	-	0.26	6
1997	0.02	0.01	0.18	0.02	0.15	-	0.05	0.54	0.01	-	-	0.02	58
1998	-	0.05	-	-	0.19	0.01	0.20	0.31	0.13	-	-	0.10	115
1999	0.14	0.22	0.04	0.24	0.01	0.19	-	-	0.01	0.01	-	0.13	46
2000	0.11	0.13	0.01	-	0.17	0.36	-	0.01	0.01	-	-	0.19	18
2001	0.02	0.10	0.67	-	0.08	0.09	0.02	0.01	-	-	-	0.02	27
2002	0.80	0.05	0.03	-	-	0.01	-	0.04	-	-	-	0.06	34
2003	0.04	0.11	0.02	-	0.55	0.28	-	-	-	-	-	-	105
2004	0.01	0.02	0.22	0.05	0.02	0.07	0.29	-	0.14	-	-	0.18	28
2005	0.03	0.88	0.02	-	0.01	0.01	0.01	0.01	0.01	-	-	0.01	4
2006	0.06	0.36	0.23	0.24	-	0.01	-	0.03	0.03	0.04	-	-	3
2007	-	-	-	0.01	-	0.02	0.01	0.02	0.01	-	-	0.93	11
2008	-	0.27	0.51	-	0.02	-	-	-	0.01	0.02	0.17	-	17
2009	0.06	-	0.09	0.28	0.03	0.06	-	0.30	0.12	-	-	0.05	5
2010	0.25	0.06	0.05	0.29	0.08	0.16	-	0.07	-	-	-	0.03	27
Total	0.08	0.08	0.09	0.05	0.15	0.09	0.06	0.16	0.07	<0.01	0.01	0.16	644

Table C24: Proportion of alfonsino catch reported for each statistical area from Western Chatham Rise area for fishing years 1990–2010.

Year	401	402	403	407	408	409	Total
1990	0.77	0.12	0.08	0.01	0.02	-	0
1991	0.87	0.12	-	-	0.01	-	19
1992	0.89	0.11	-	-	-	-	59
1993	0.46	0.50	0.04	-	-	-	17
1994	0.10	0.75	0.08	0.05	0.01	0.01	20
1995	0.65	0.27	0.05	0.02	0.01	-	27
1996	0.47	0.47	0.01	0.02	0.02	-	6
1997	0.93	0.06	-	-	-	-	58
1998	0.99	0.01	-	-	-	-	115
1999	0.63	0.30	0.04	0.02	-	-	46
2000	0.38	0.53	0.06	0.01	0.01	-	18
2001	0.15	0.42	0.42	0.01	0.01	-	27
2002	0.95	0.03	0.01	-	-	-	34
2003	0.04	0.85	0.11	-	-	-	105
2004	0.29	0.40	0.30	-	-	0.02	28
2005	0.14	0.81	0.03	-	0.01	0.01	4
2006	0.65	0.08	-	0.01	0.25	-	3
2007	0.02	0.95	0.01	-	0.01	0.01	11
2008	0.21	0.78	0.01	-	-	-	17
2009	0.16	0.78	0.03	0.01	0.01	0.01	5
2010	0.40	0.52	0.06	-	-	-	27
Total	0.57	0.35	0.06	0.01	<0.01	<0.01	644

Table C25: Proportion of alfonsino catch reported by gear type from the Western Chatham Rise area for fishing years 1990–2010.

Year	BT	MW	MWB	Other	Total
1990	-	-	-	-	-
1991	0.98	-	0.02	-	19
1992	1.00	-	-	-	59
1993	0.99	-	0.01	-	17
1994	0.64	-	0.36	-	20
1995	0.91	0.01	0.08	-	27
1996	0.67	0.04	0.28	-	6
1997	0.56	0.01	0.43	-	58
1998	0.65	0.10	0.25	-	115
1999	0.73	0.01	0.27	-	46
2000	0.87	-	0.13	-	18
2001	0.97	-	0.03	-	27
2002	0.98	-	0.02	-	34
2003	1.00	-	-	-	105
2004	0.92	-	0.07	-	28
2005	0.21	0.77	0.01	0.01	4
2006	1.00	-	-	-	3
2007	0.07	-	0.93	-	11
2008	0.98	-	-	0.02	17
2009	1.00	-	-	-	5
2010	0.77	0.23	-	-	27
Total	0.82	0.04	0.14	-	644

Table C26: Proportion of alfonsino catch reported by target species from the Western Chatham Rise area for fishing years 1990–2010. Refer to Table C27 for species codes.

Year	BYX	HOK	LIN	ORH	Other	Total
1990	-	0.92	-	0.07	0.01	0
1991	-	0.55	0.42	-	0.03	19
1992	-	0.93	-	-	0.07	59
1993	-	0.93	-	-	0.07	17
1994	0.08	0.79	-	-	0.12	20
1995	0.01	0.99	-	-	0.01	27
1996	-	0.98	-	-	0.02	6
1997	-	0.85	-	0.14	0.01	58
1998	-	0.96	-	-	0.04	115
1999	-	0.94	0.05	-	0.01	46
2000	0.09	0.78	-	-	0.12	18
2001	-	0.99	-	-	0.01	27
2002	0.50	0.30	0.15	-	0.05	34
2003	-	1.00	-	-	-	105
2004	-	0.57	-	0.30	0.14	28
2005	0.77	0.16	-	0.02	0.05	4
2006	-	0.72	-	-	0.28	3
2007	0.93	0.05	-	-	0.02	11
2008	-	0.19	0.27	-	0.54	17
2009	-	0.81	0.01	-	0.18	5
2010	0.23	0.71	0.05	-	0.01	27
Total	0.06	0.83	0.03	0.03	0.05	644

Table C27: Species codes used in the report.

Code	Common name	Scientific name
BNS	Bluenose	*Hyperoglyphe antarctica*
BYX	Alfonsino	*Beryx splendens, B. decadactylus*
CDL	Black cardinalfish	*Epigonus telescopus*
HAK	Hake	*Merluccius australis*
HOK	Hoki	*Macruronus novaezelandiae*
LIN	Ling	*Genypterus blacodes*
ORH	Orange roughy	*Hoplostethus atlanticus*
RBY	Rubyfish	*Plagiogeneion rubiginosus*
SCI	Scampi	*Metanephrops challengeri*
SKI	Gemfish	*Rexea solandri*
WAR	Blue warehou	*Seriolella brama*

Table C28. List of tables and fields requested in the Ministry of Fisheries extract 8208 for alfonsino.

Fishing_events table

Event_Key
Version_seqno
DCF_key
Start_datetime
End_datetime
Primary_method
Target_species
Fishing_duration
Catch_weight
Effort_depth
Effort_height
Effort_num
Effort_num_2
Effort_seqno
Effort_total_num
Effort_width
Effort_speed
Total_net_length
Total_hook_num
Set_end_datetime
Haul_start_datetime
Start_latitude (full accuracy)
Start_longitude (full accuracy)
End_latitude (full accuracy)
End_longitude (full accuracy)
Pair_trawl_yn
Bottom_depth
Column_a
Column_b
Column_c
Column_d
Display_fishyear
Start_stats_area_code
Vessel_key
Form_type
Trip
Literal_yn
Interp_yn
Resrch_yn

Landing_events table

Event_Key
Version_seqno
DCF_key
Landing_datetime
Landing_name
Species_code
Species_name
Fishstock_code (ALL fish stocks)
State_code
Destination_type
Unit_type
Unit_num
Unit_weight
Conv_factor
Green_weight
Green_weight_type
Processed_weight
Processed_weight_type
Form_type
Trip_key
Trip_start_datetime
Trip_end_datetime
Vessel_key
Literal_yn
Interp_yn
Resrch_yn

Estimated subcatch table

Event_Key
Version_seqno
DCF_key
Species_code (ALL species for each fishing event)
Catch_weight
Literal_yn
Interp_yn
Resrch_yn

Vessel_history table

Vessel_key
Flag_nationality_code
Built_year
Engine_kilowatts
Gross_tonnes
Overall_length_metres
History_start_datetime
History_end_datetime

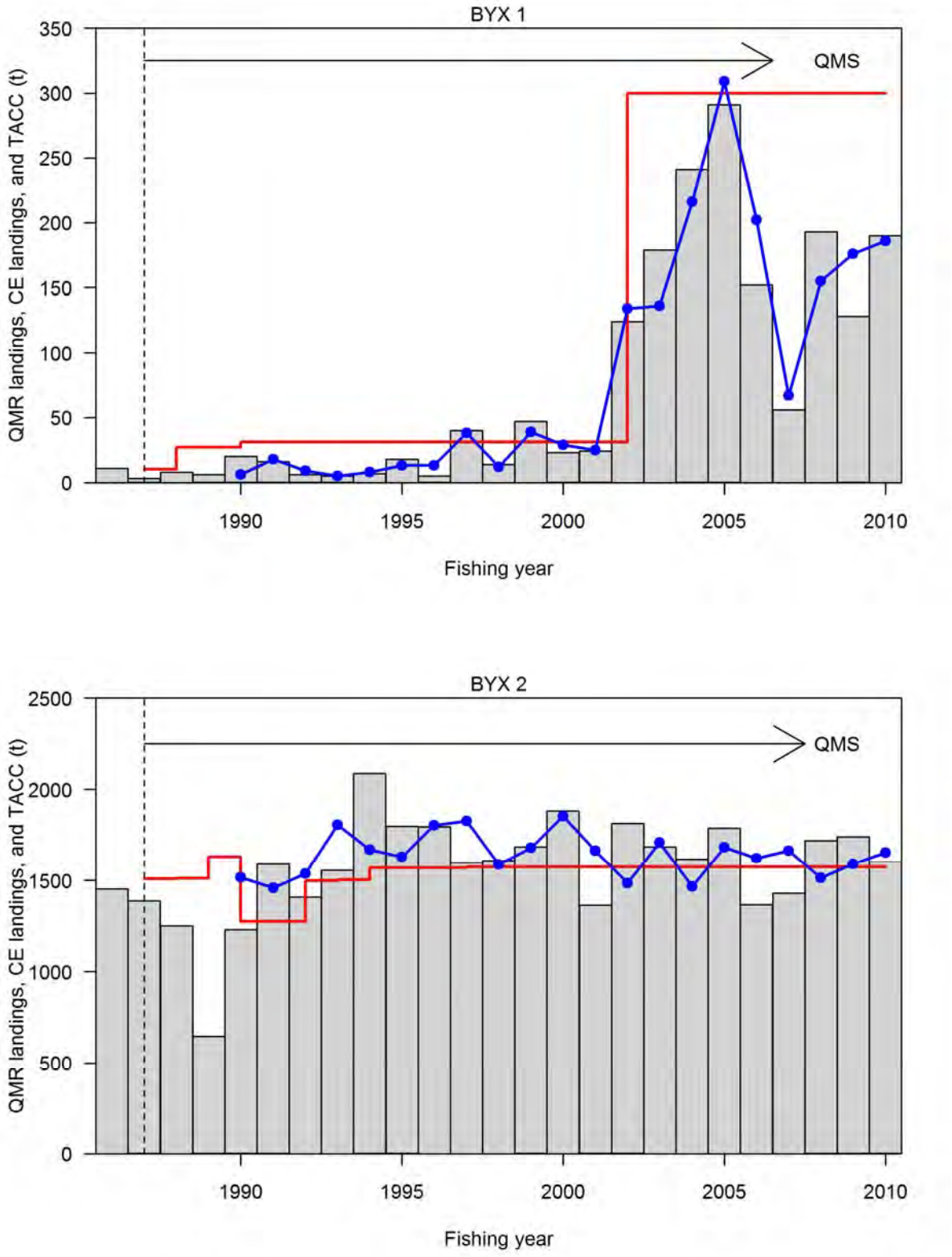


Figure C1: Reported plenary landings (grey bars), un-groomed catch effort landings (blue line) and TACC (red line) for BYX 1 and BYX 2 for the fishing years 1983–2010.

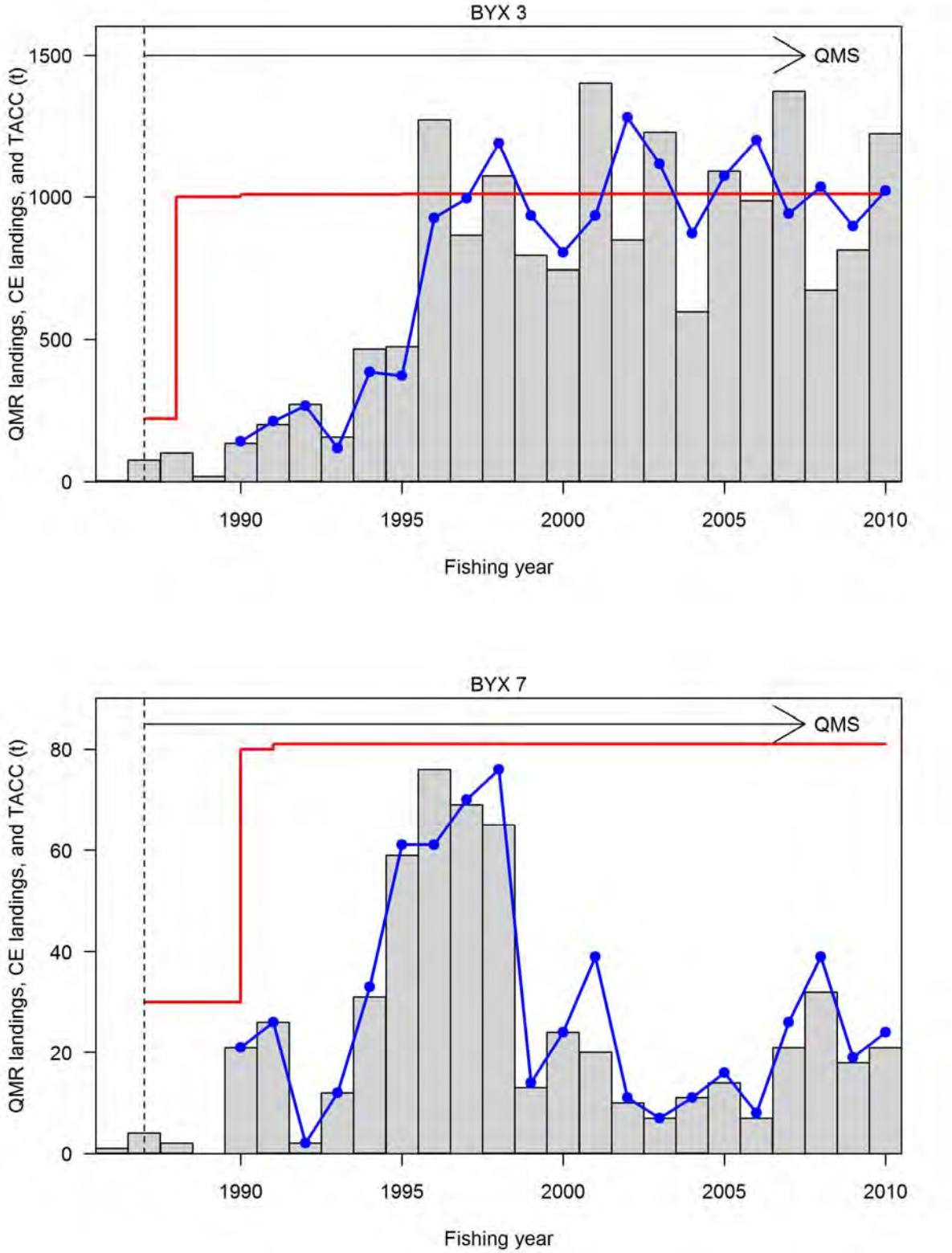


Figure C2: Reported plenary landings (grey bars), un-groomed catch effort landings (blue line) and TACC (red line) for BYX 3 and BYX 7 for the fishing years 1983–2010.

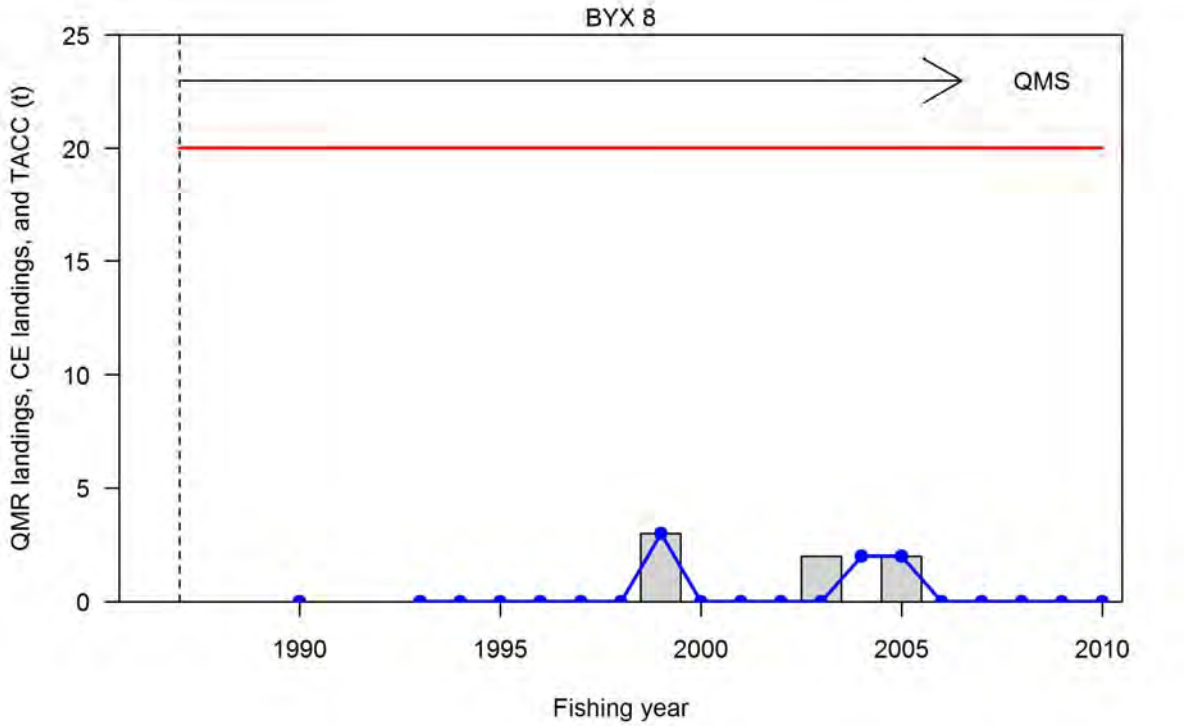


Figure C3: Reported plenary landings (grey bars), un-groomed catch effort landings (blue line) and TACC (red line) for BYX 8 for the fishing years 1983–2010.

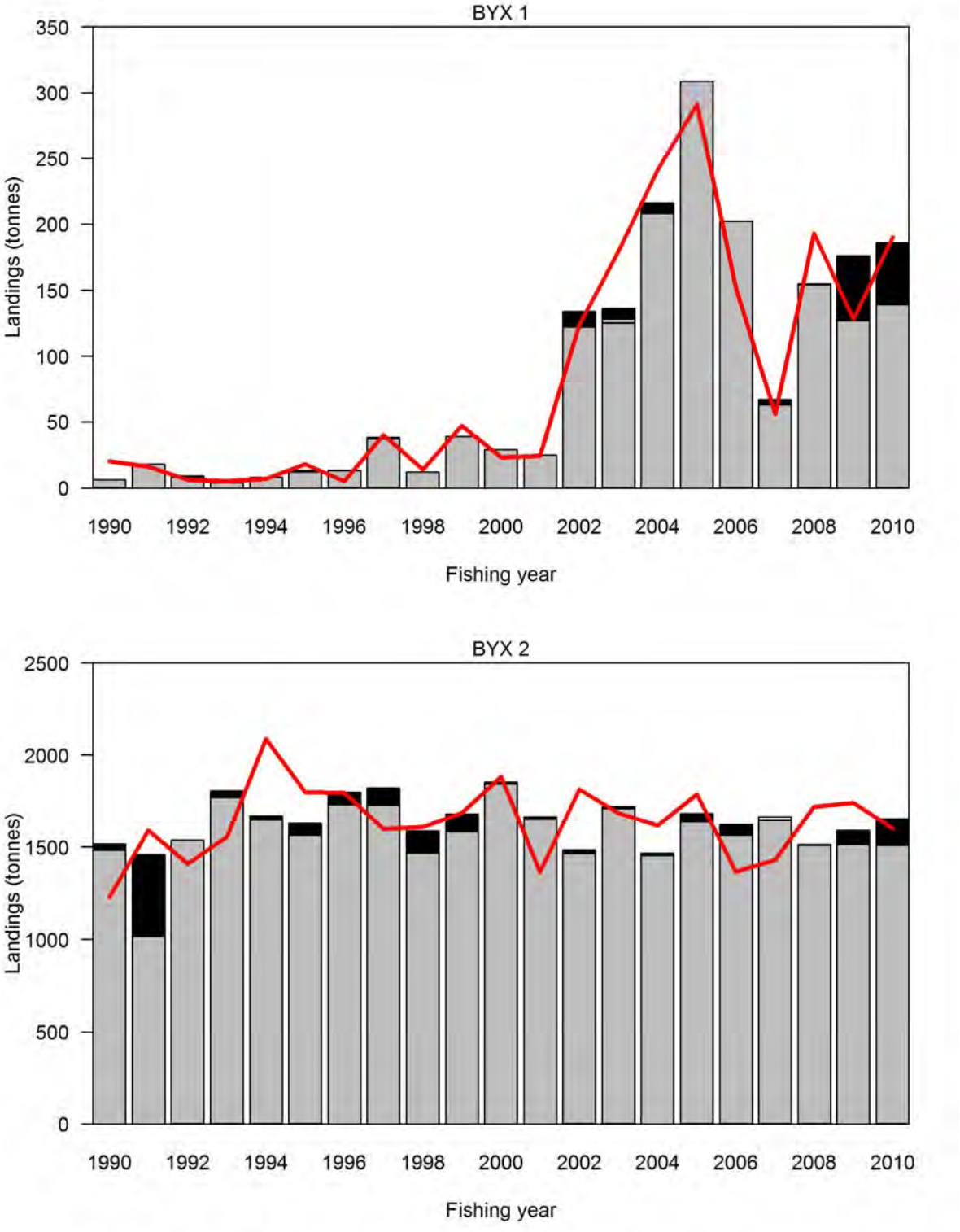


Figure C4: The retained landings (grey bars), interim landings (white bars), landings dropped during the grooming process (black bars), and reported plenary landings (red line) for BYX 1 and BYX 2 for the fishing years 1990–2010.

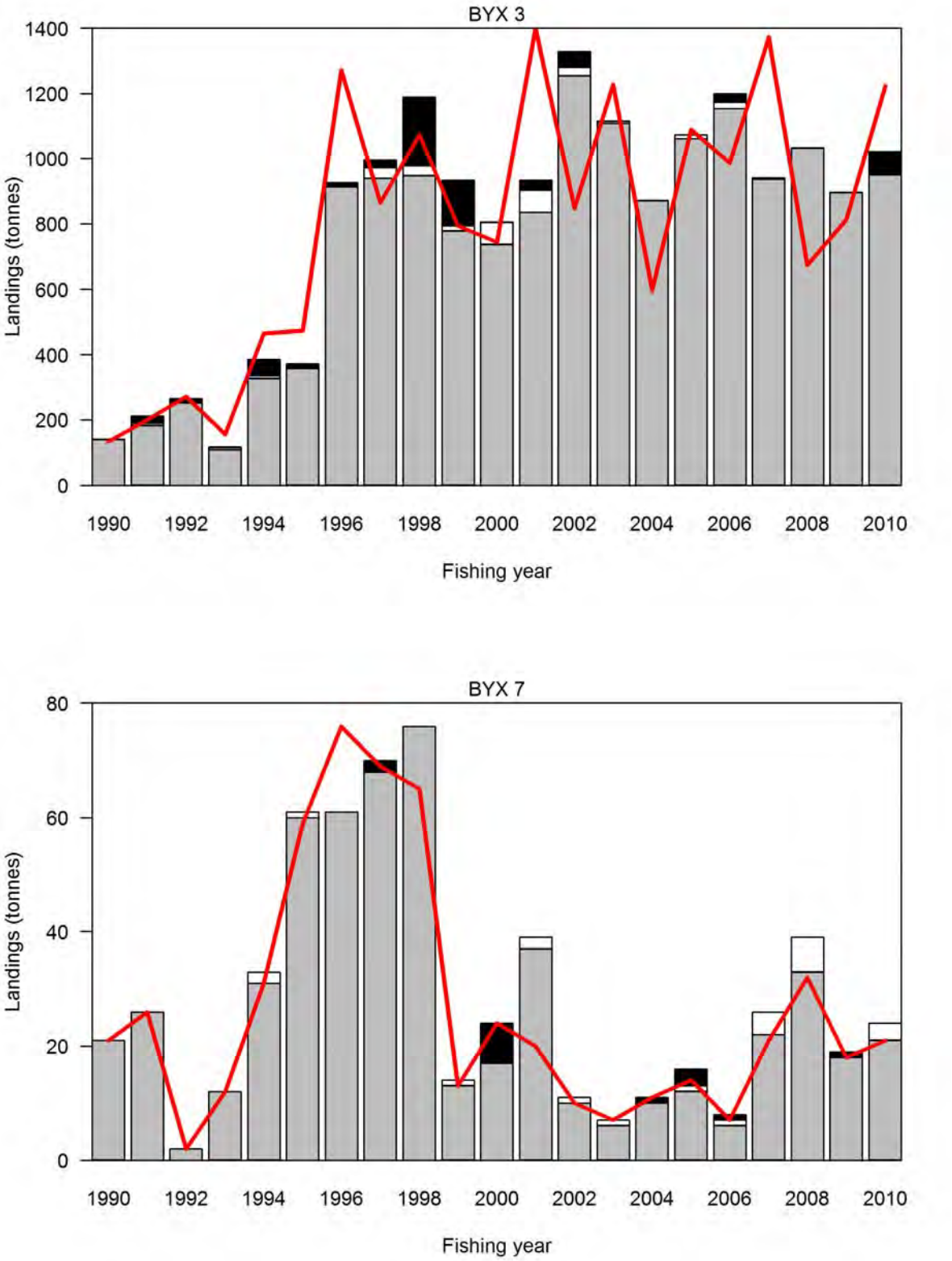


Figure C5: The retained landings (grey bars), interim landings (white bars), landings dropped during the grooming process (black bars), and reported plenary landings (red line) for BYX 3 and BYX 7 for the fishing years 1990–2010.

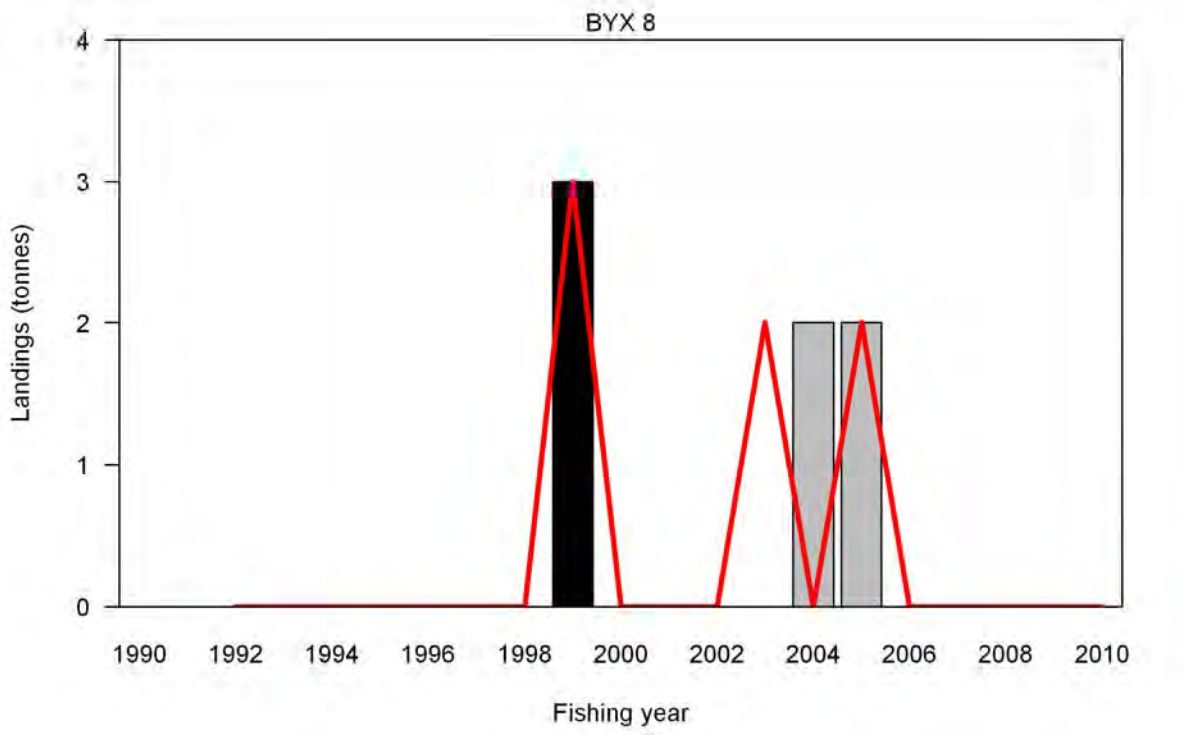


Figure C6: The retained landings (grey bars), interim landings (white bars), landings dropped during the grooming process (black bars), and reported plenary landings (red line) for BYX 8 for the fishing years 1990–2010.

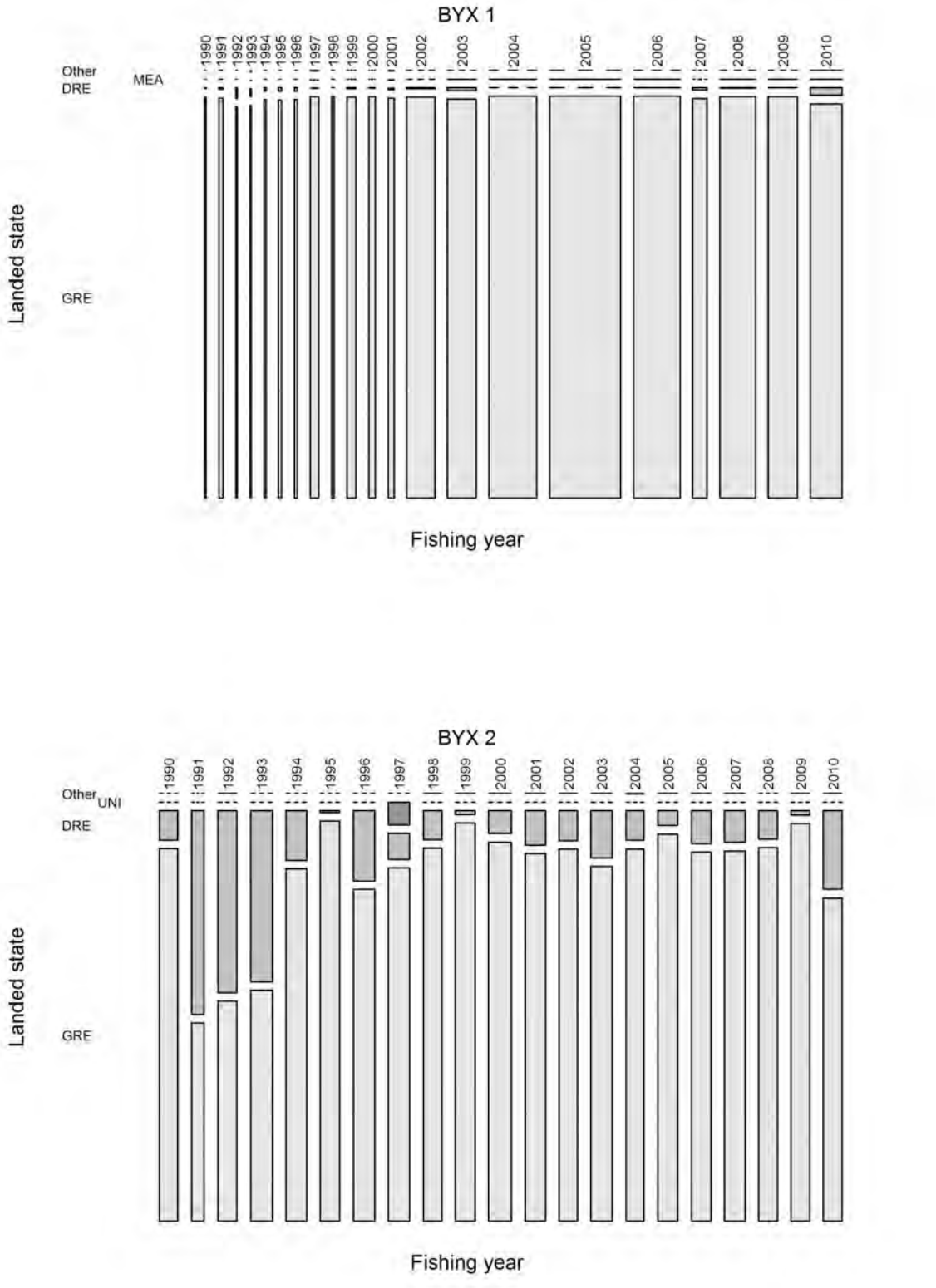


Figure C7: The proportion of retained landings (greenweight) by processed state for BYX 1 and BYX 2 for the 1990–2010 fishing year in the groomed and unmerged dataset. Width of bars for each year is proportional to the total catch of the study period.

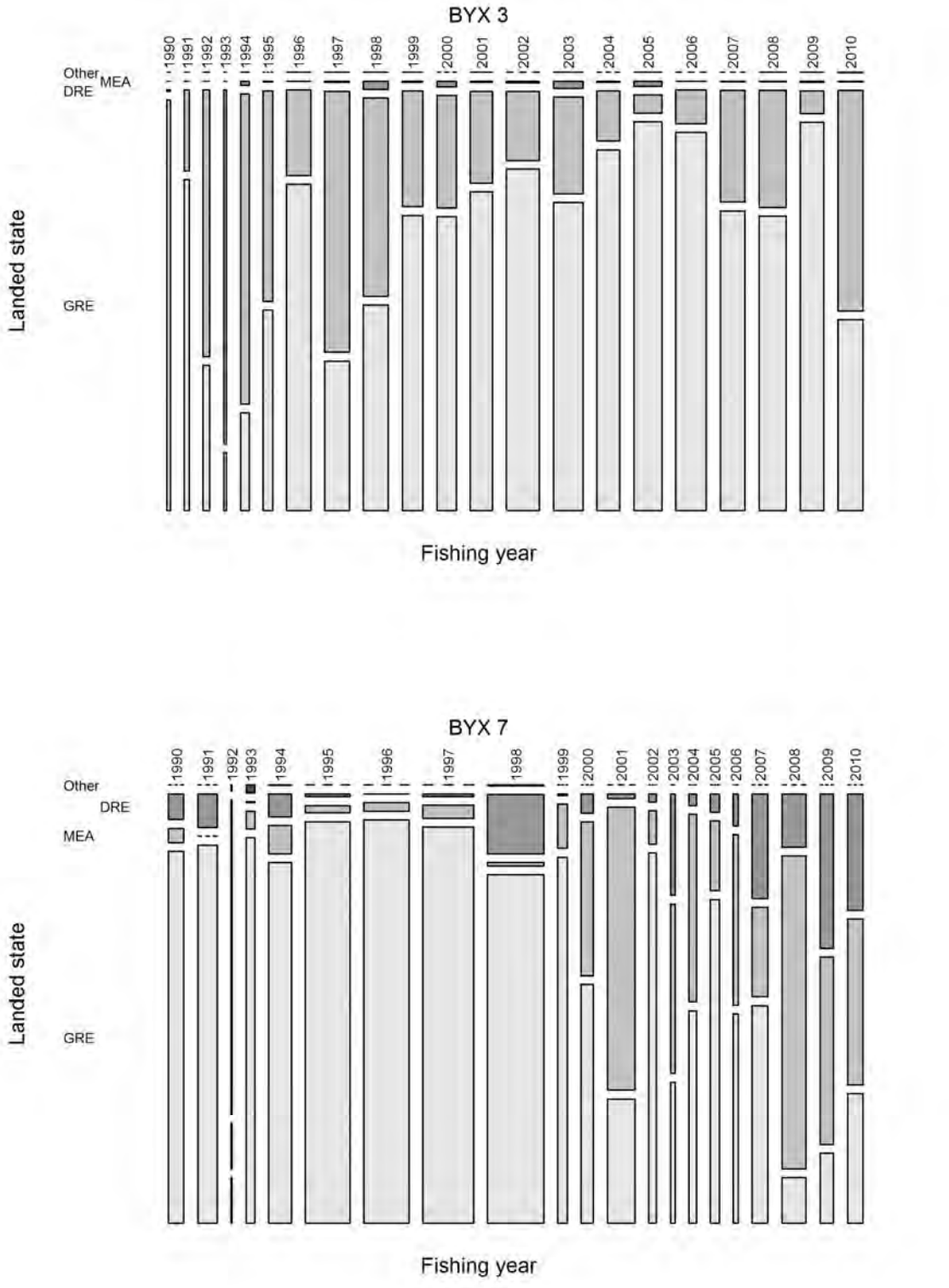


Figure C8: The proportion of retained landings (greenweight) by processed state for BYX 3 and BYX 7 for the fishing years 1990–2010 in the groomed and unmerged dataset. Width of bars for each year is proportional to the total catch of the study period.

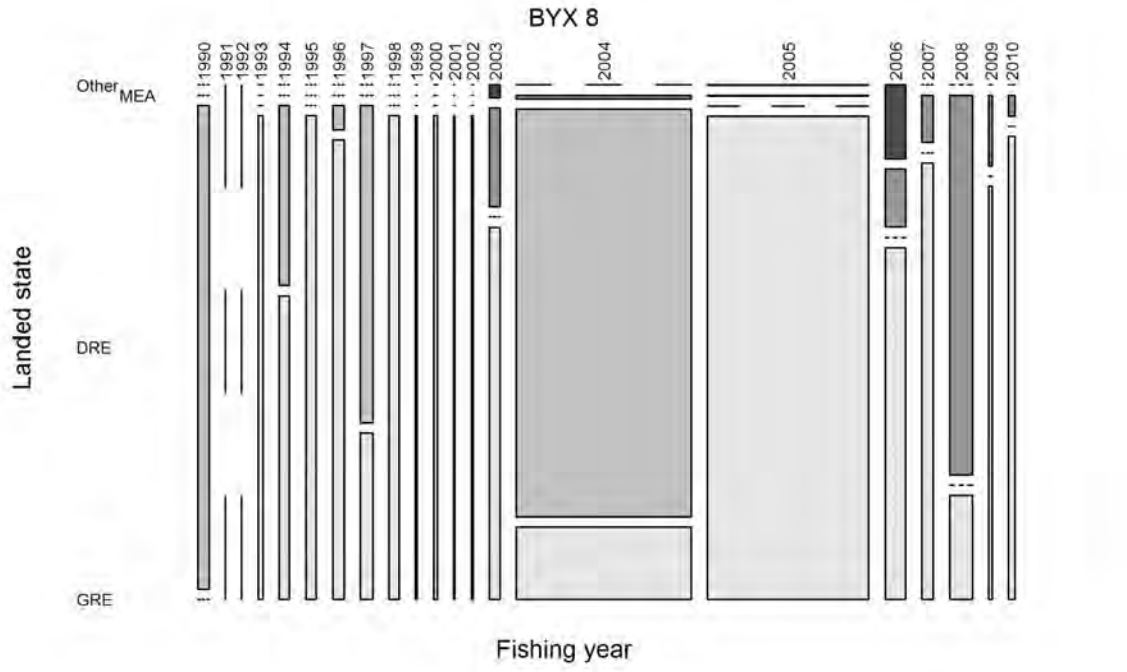


Figure C9: The proportion of retained landings (greenweight) by processed state for BYX 8 for the 1990–2010 fishing years in the groomed and unmerged dataset. Width of bars for each year is proportional to the total catch of the study period.

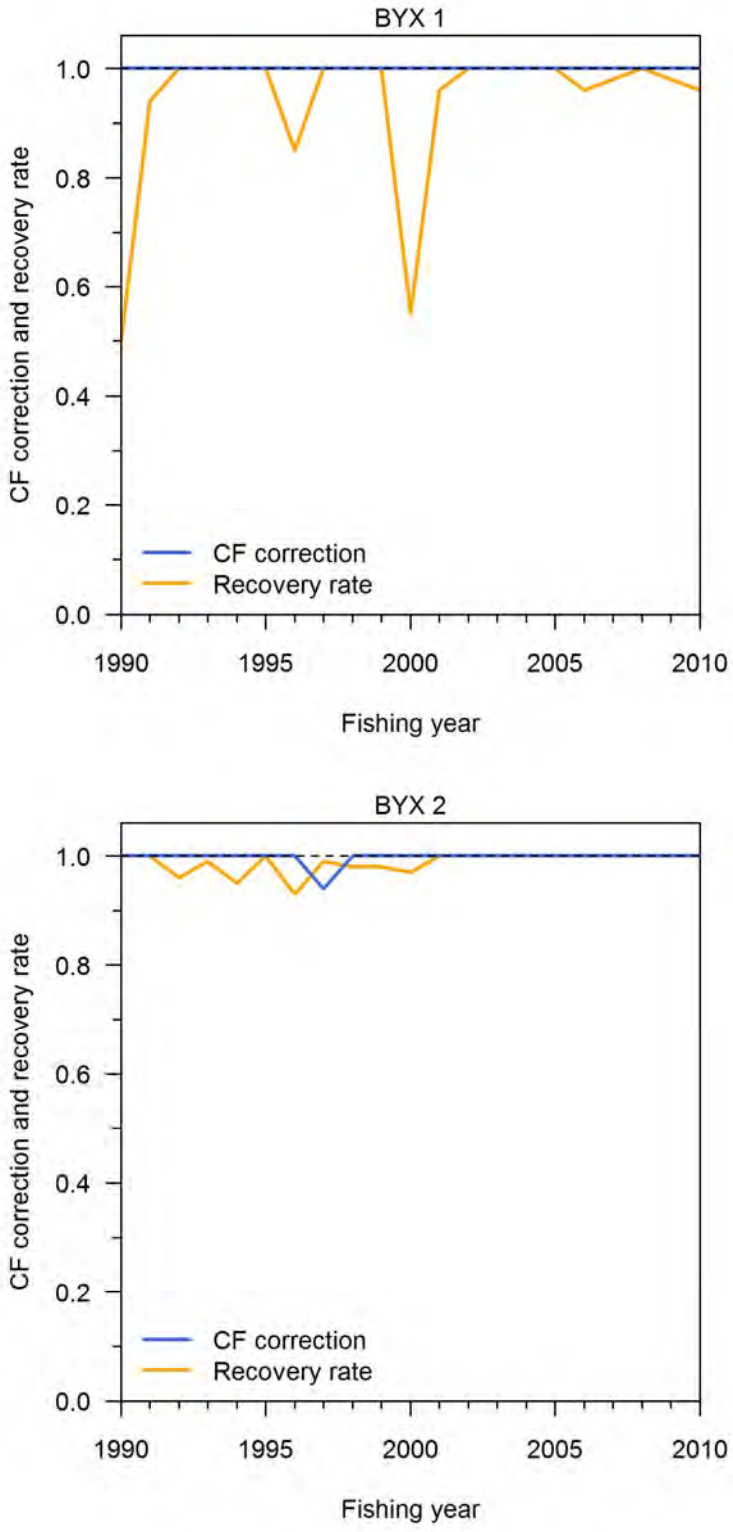


Figure C10: Conversion factor (CF) corrections, defined as the ratio of annual green weight recalculated using the most recent correction factors for each processed state to the reported green weight, and the recovery rate, defined as the ratio of annual landings in the groomed and merged dataset to those in the groomed and unmerged dataset, for BYX 1 and BYX 2 for the fishing years 1990–2010.

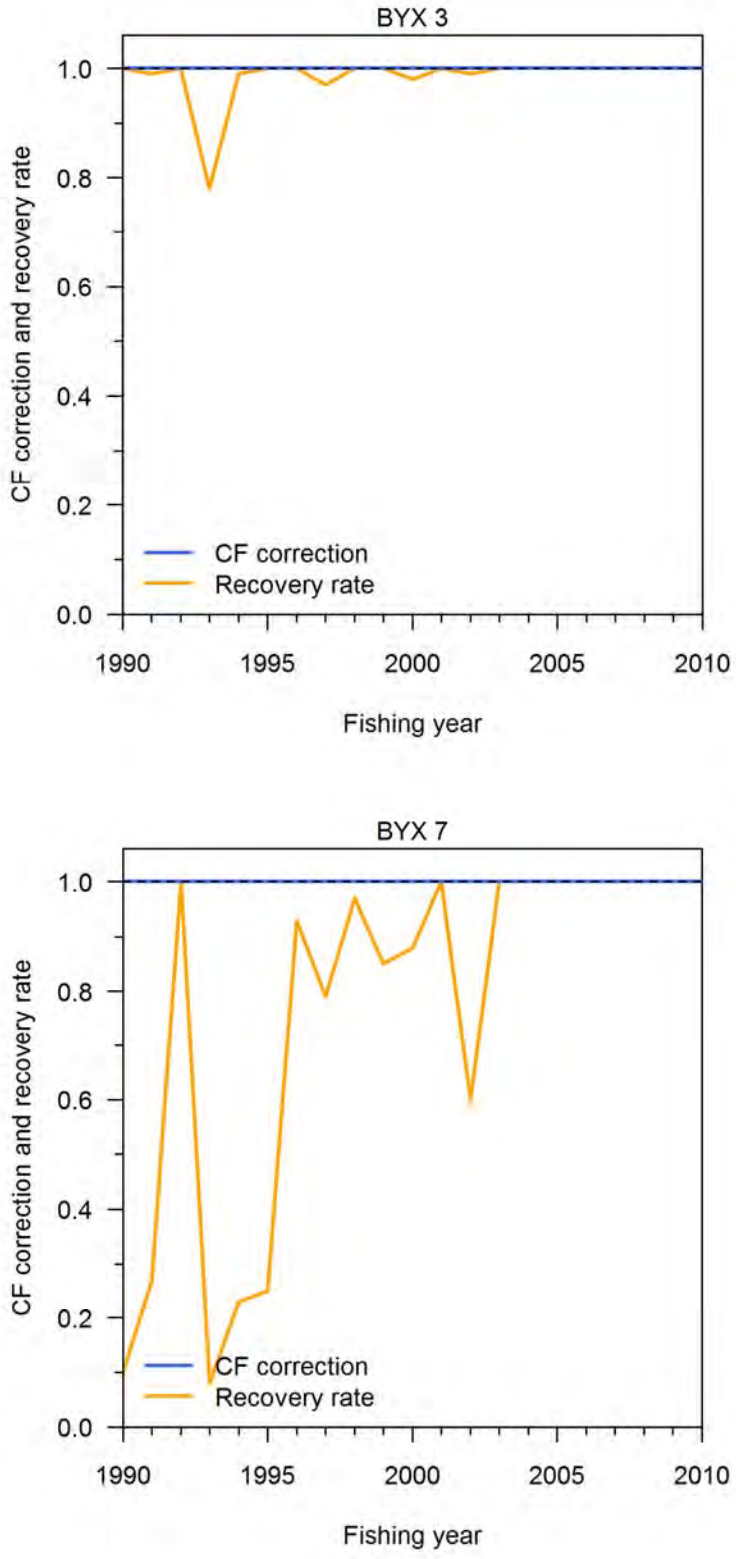


Figure C11: Conversion factor (CF) corrections, defined as the ratio of annual green weight recalculated using the most recent correction factors for each processed state to the reported green weight, and the recovery rate, defined as the ratio of annual landings in the groomed and merged dataset to those in the groomed and unmerged dataset, for BYX 3 and BYX 7 for the fishing years 1990–2010.

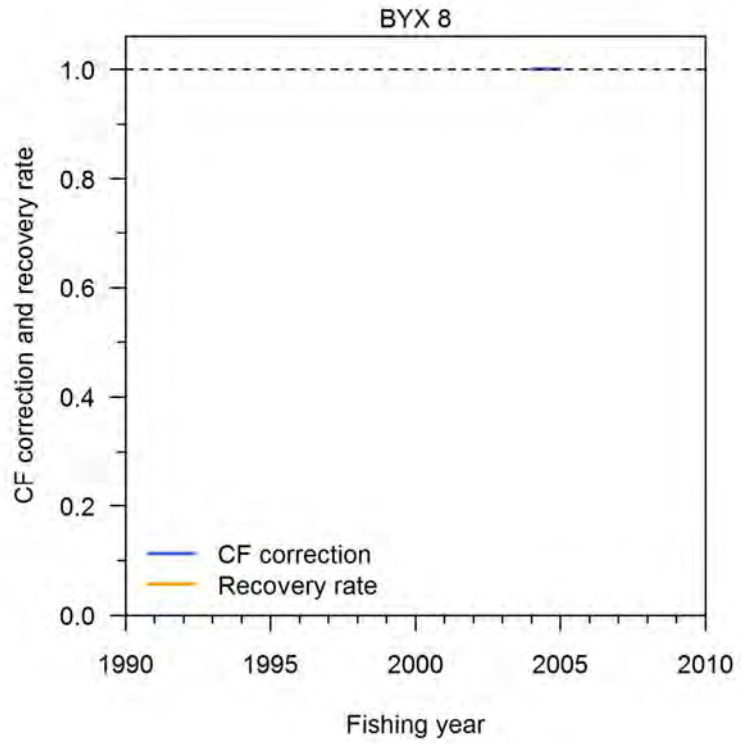


Figure C12: Conversion factor (CF) corrections defined as the ratio of annual green weight recalculated using the most recent correction factors for each processed state to the reported green weight, and the recovery rate, defined as the ratio of annual landings in the groomed and merged dataset to those in the groomed and unmerged dataset, for BYX 8 for the fishing years 1990–2010.

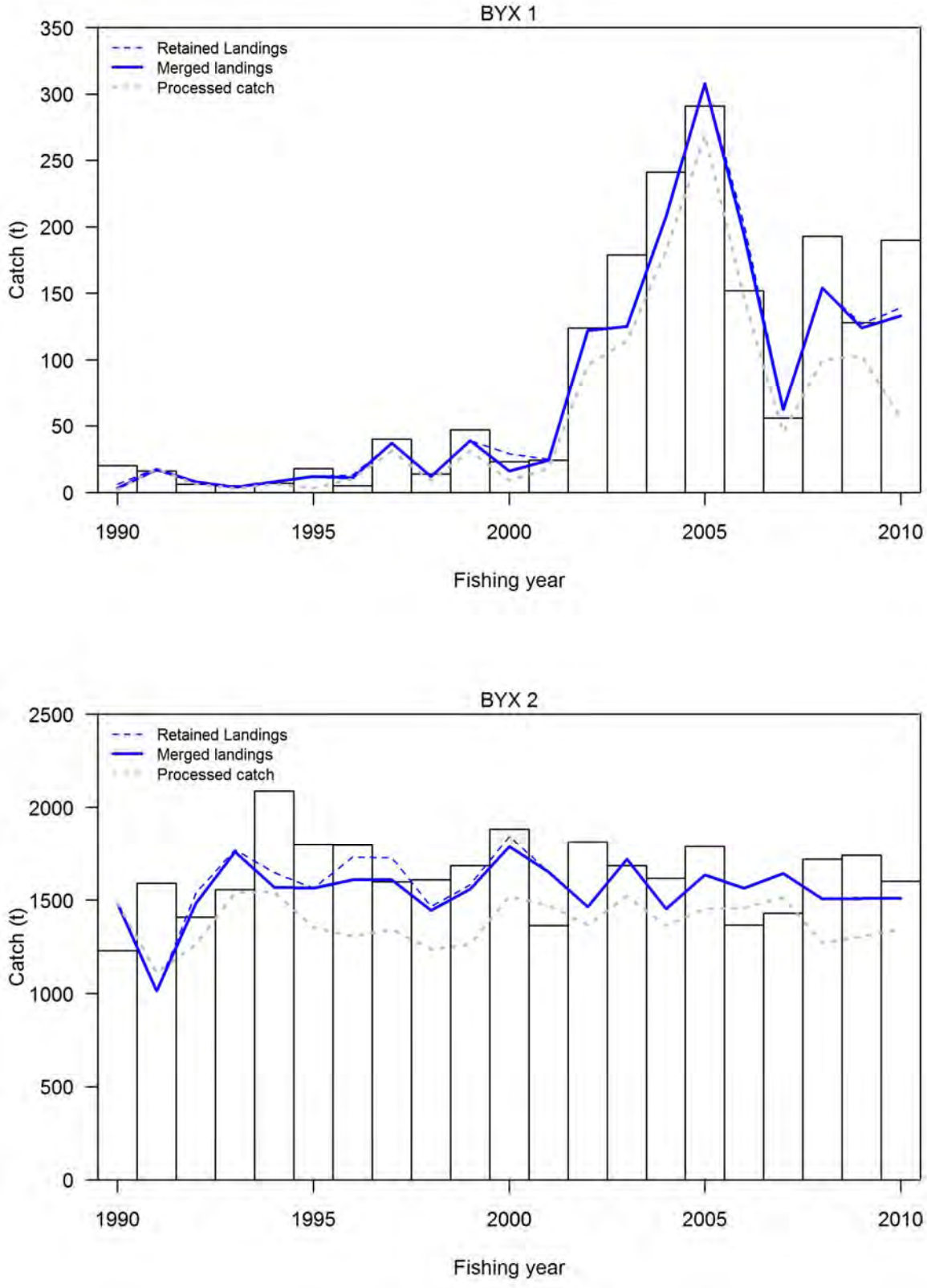


Figure C13: The reported plenary landings (white bars), retained landings in the groomed and unmerged dataset (green dashed line), retained landings in groomed and merged dataset (green solid line), and estimated catch in the groomed and merged dataset (red solid line), using the centroid method, for BYX 1 and BYX 2 for the fishing years 1990–2010.

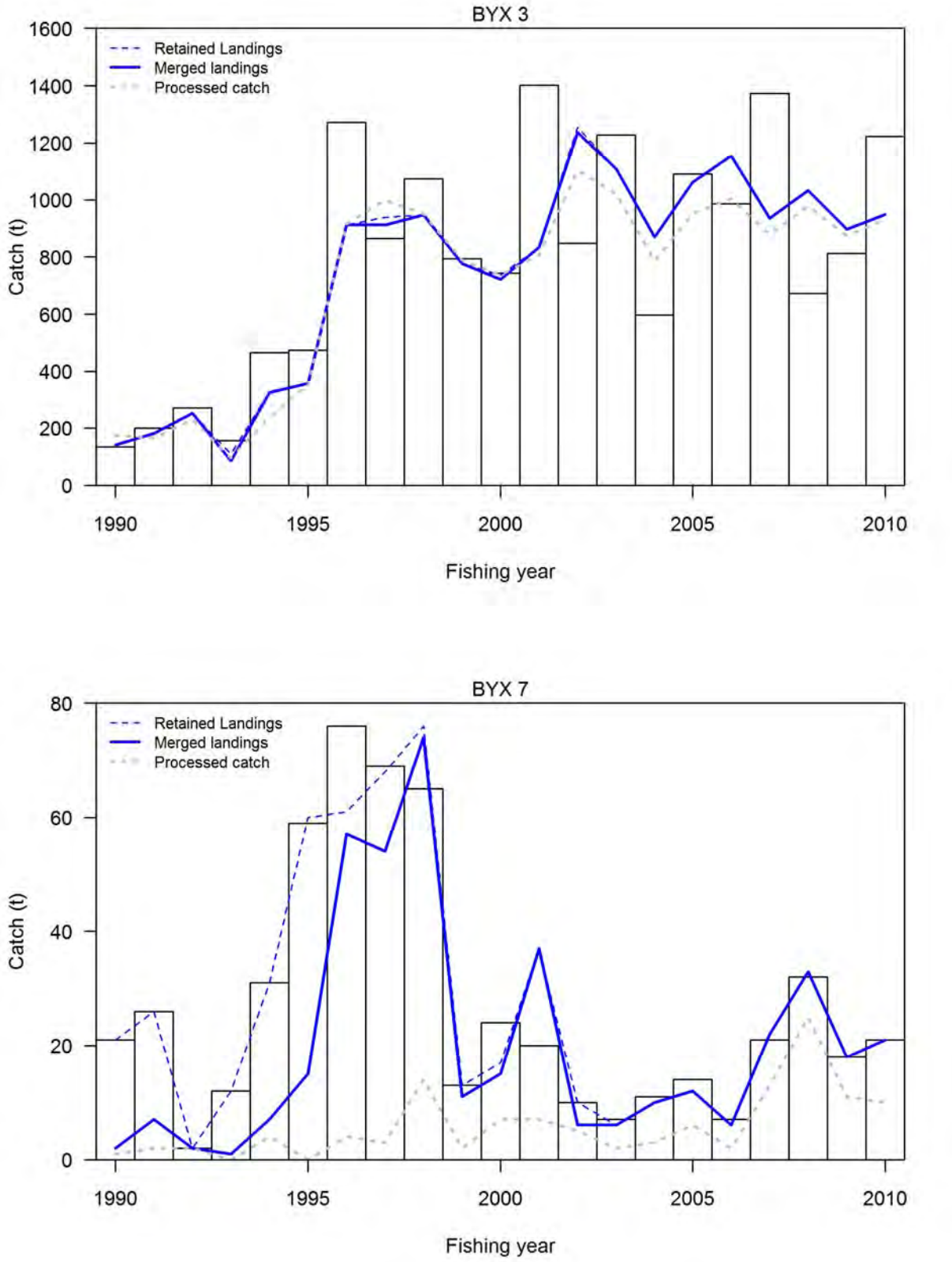


Figure C14: The reported plenary landings (white bars), retained landings in the groomed and unmerged dataset (green dashed line), retained landings in groomed and merged dataset (green solid line), and estimated catch in the groomed and merged dataset (red solid line), using the centroid method, for BYX 3 and BYX 7 for the fishing years 1990–2010.

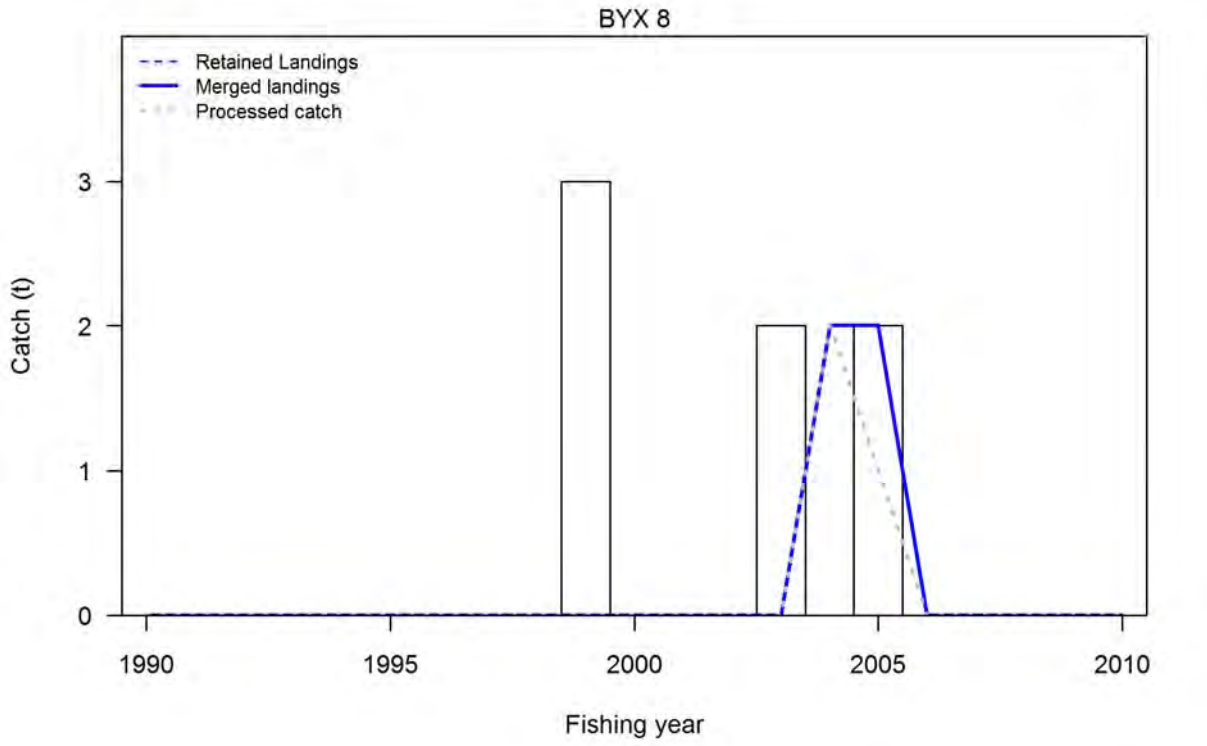


Figure C15: The reported plenary landings (white bars), retained landings in the groomed and unmerged dataset (green dashed line), retained landings in groomed and merged dataset (green solid line), and estimated catch in the groomed and merged dataset (red solid line), using the centroid method, for BYX 8 for the fishing years 1990–2010.

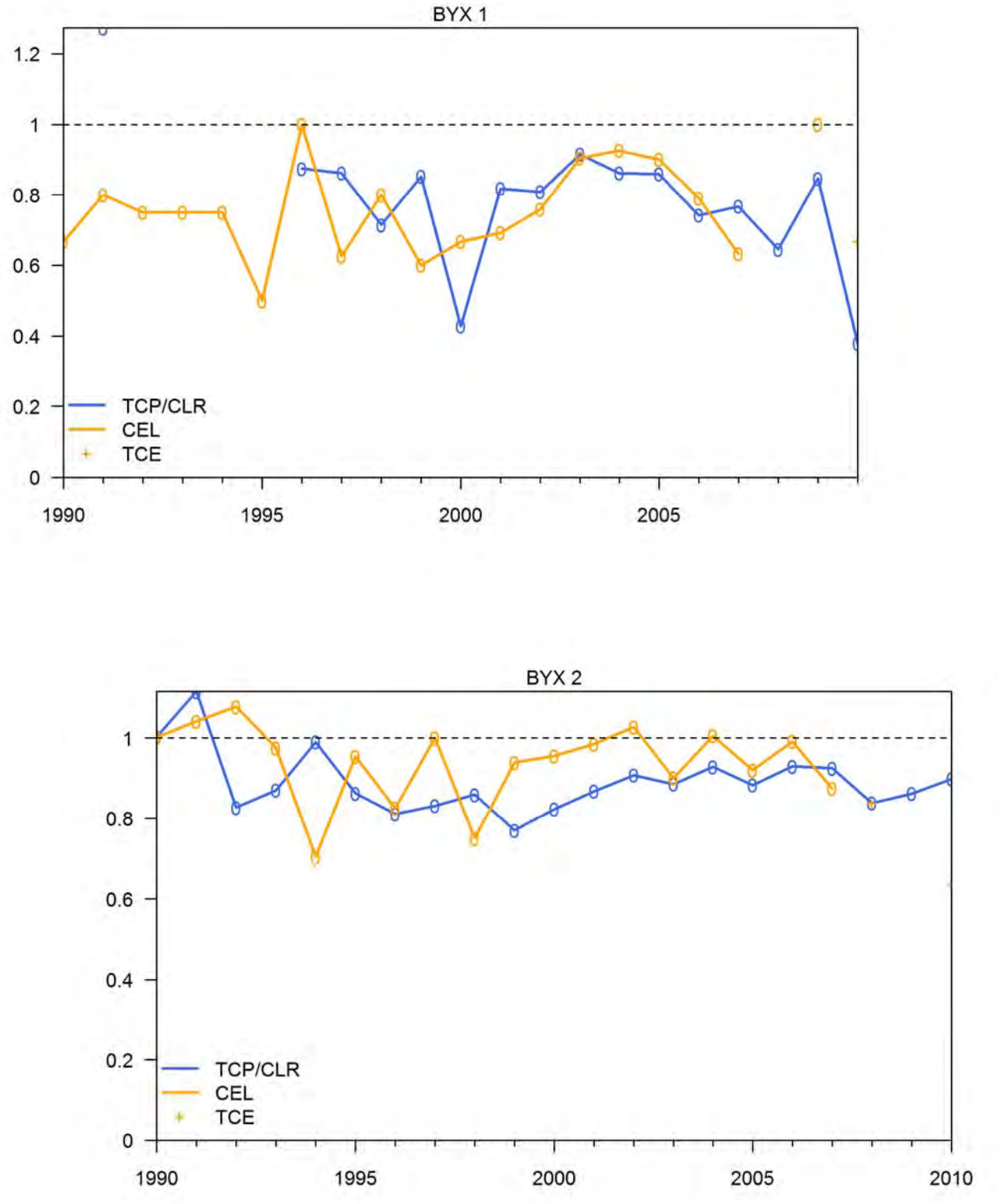


Figure C16: The reporting rate of estimated catch by form type, defined as the ratio of estimated catch as a proportion of retained landings in the groomed and merged dataset, for BYX 1 and BYX 2 for the fishing years 1990–2010.

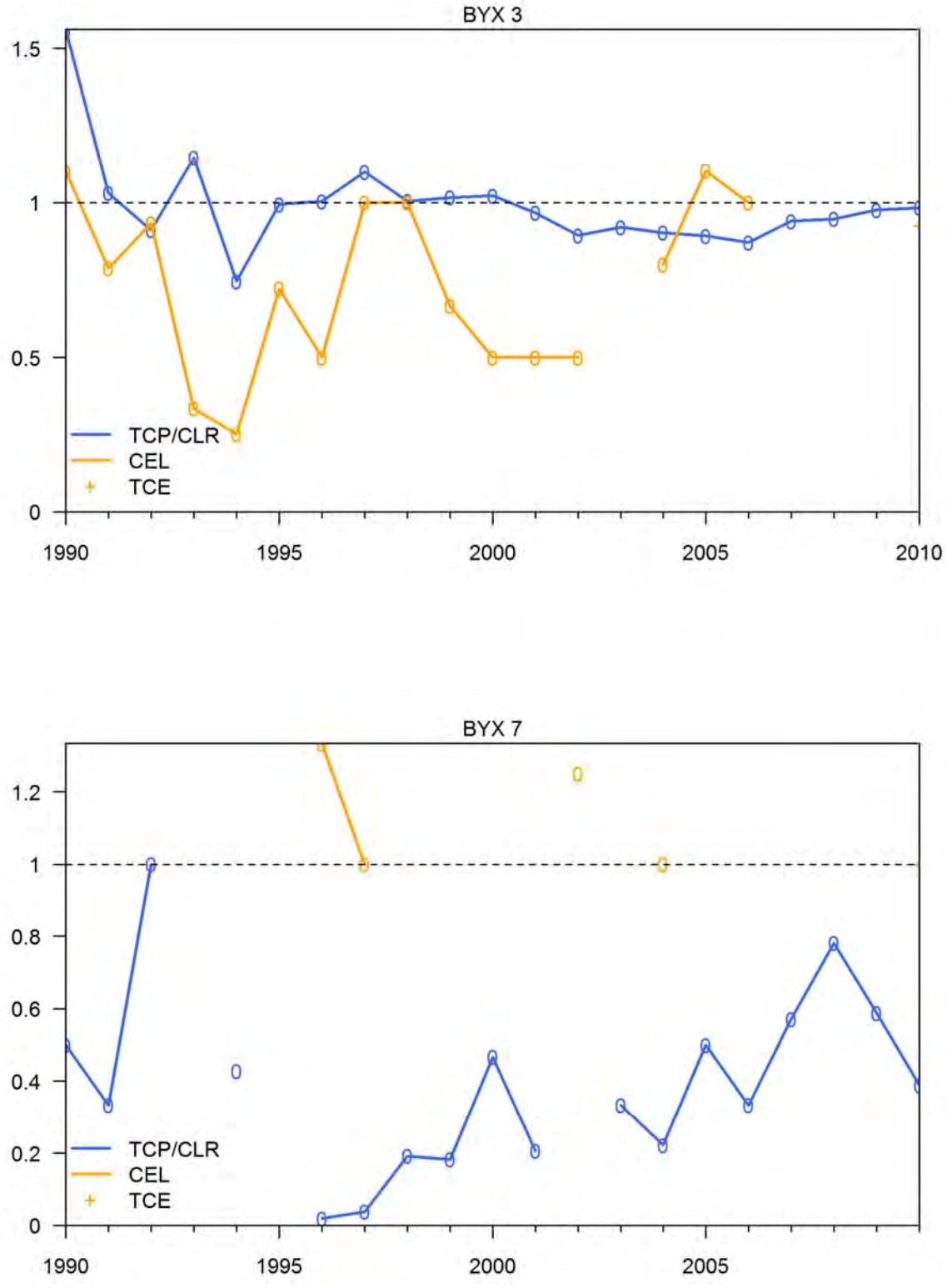


Figure C17: The reporting rate of estimated catch by form type, defined as the ratio of estimated catch as a proportion of retained landings in the groomed and merged dataset, for BYX 3 and BYX 7 for the fishing years 1990–2010.

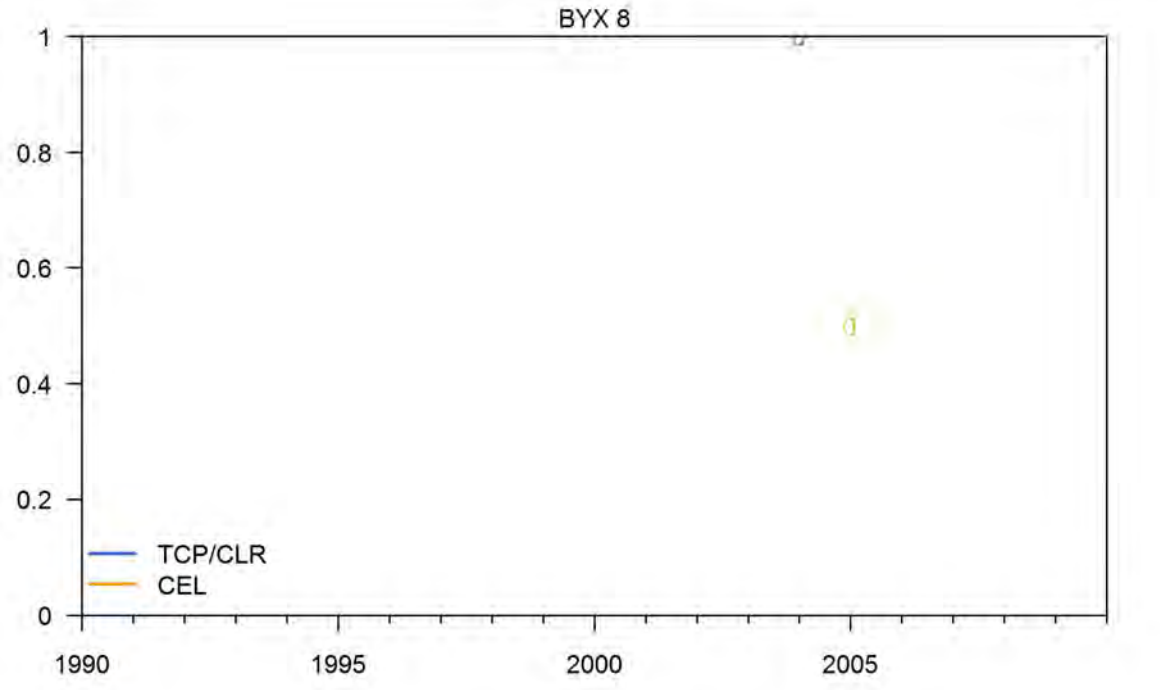


Figure C18: The reporting rate of estimated catch by form type, defined as the ratio of estimated catch as a proportion of retained landings in the groomed and merged dataset, for BYX 8 for the fishing years 1990–2010.

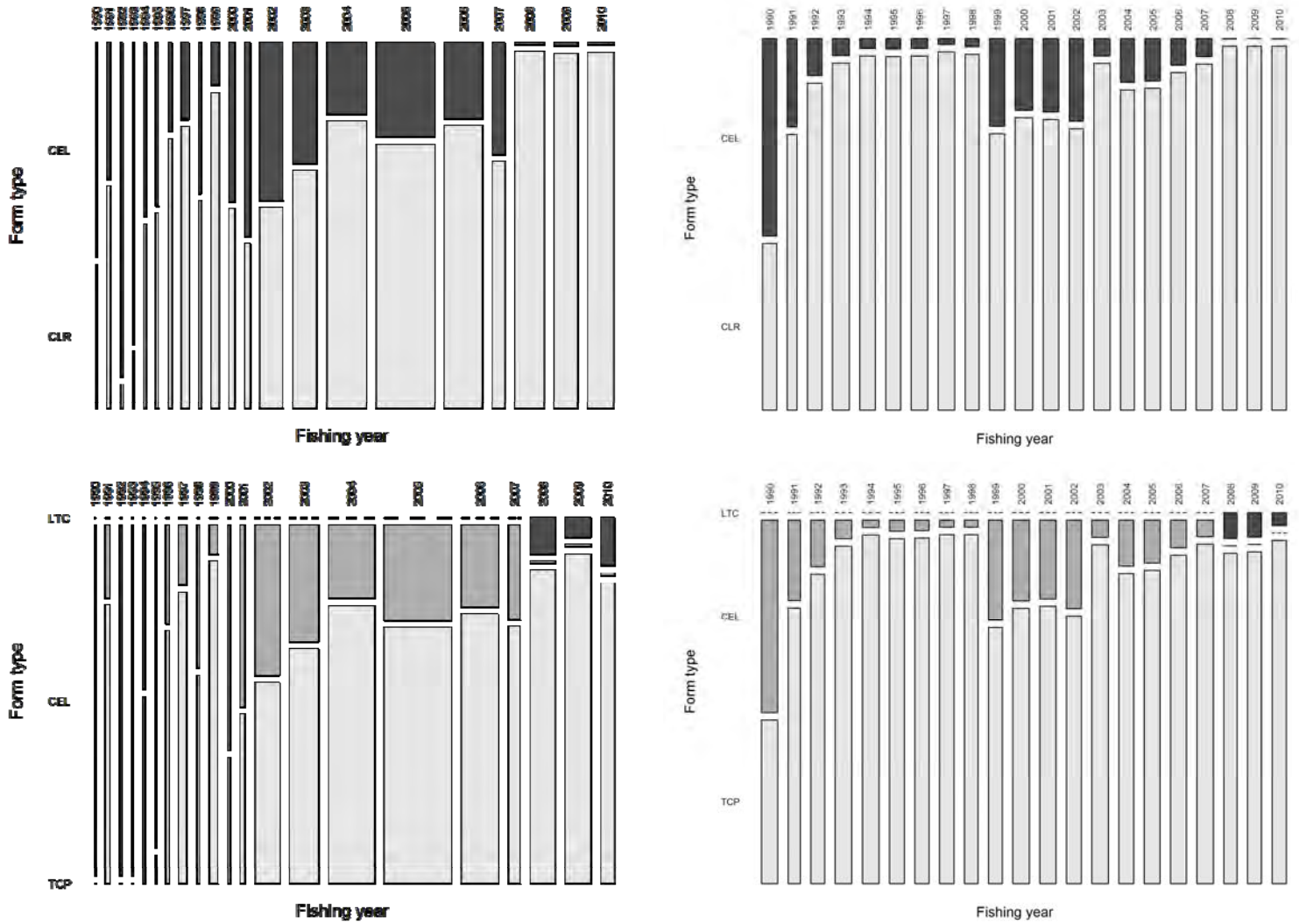


Figure C19: Proportion of landings by form type (top panels) in the groomed and unmerged dataset, and proportion of estimated catches by form type (bottom panels) in the groomed and merged dataset, for BYX 1 (left panels) and BYX 2 (right panels), for the fishing years 1990–2010. The width of the bar is proportional to the annual catches (only comparable within each panel).

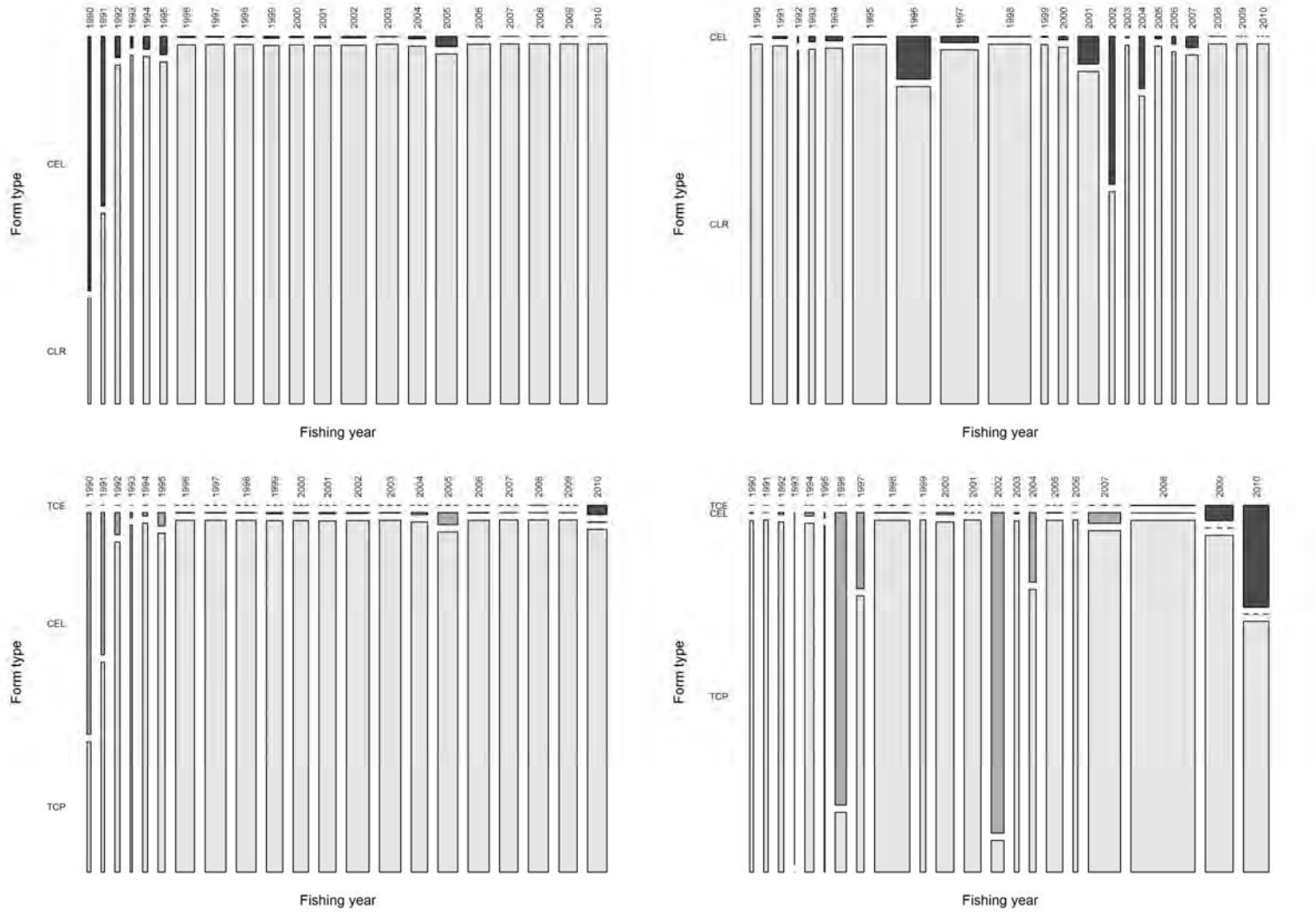


Figure C20: Proportion of landings by form type (top panels) in the groomed and unmerged dataset, and proportion of estimated catches by form type (bottom panels) in the groomed and merged dataset, for BYX 3 (left panels) and BYX 7 (right panels), for the fishing years 1990–2010. The width of the bar is proportional to the annual catches (only comparable within each panel).

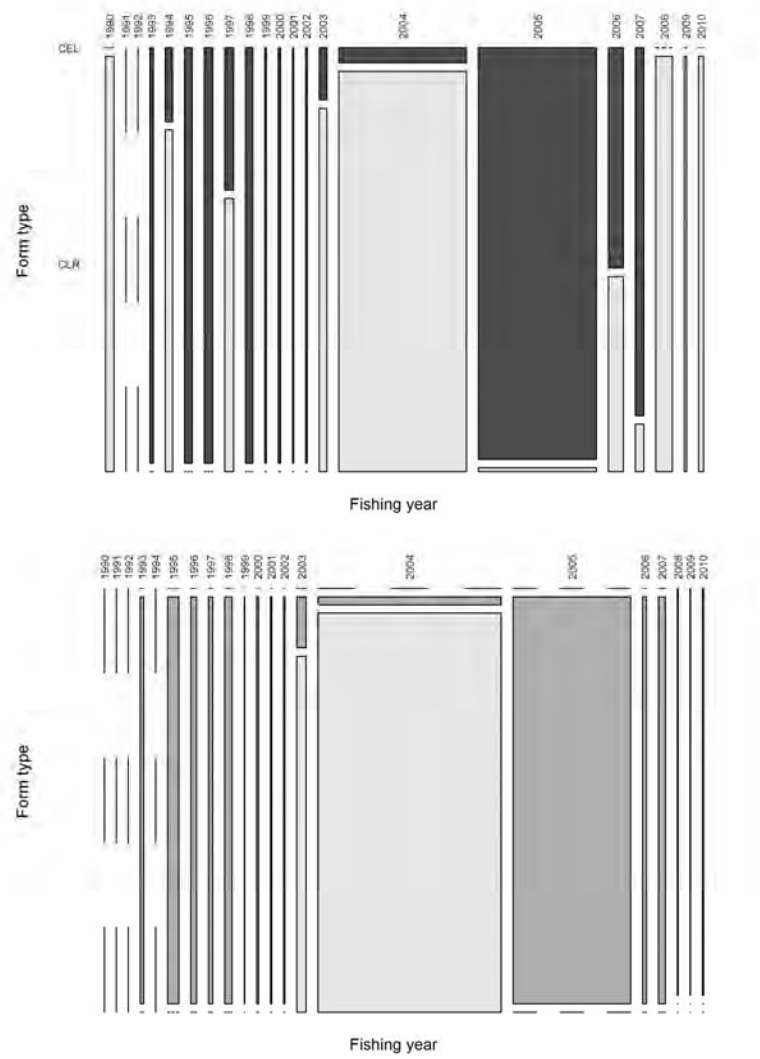
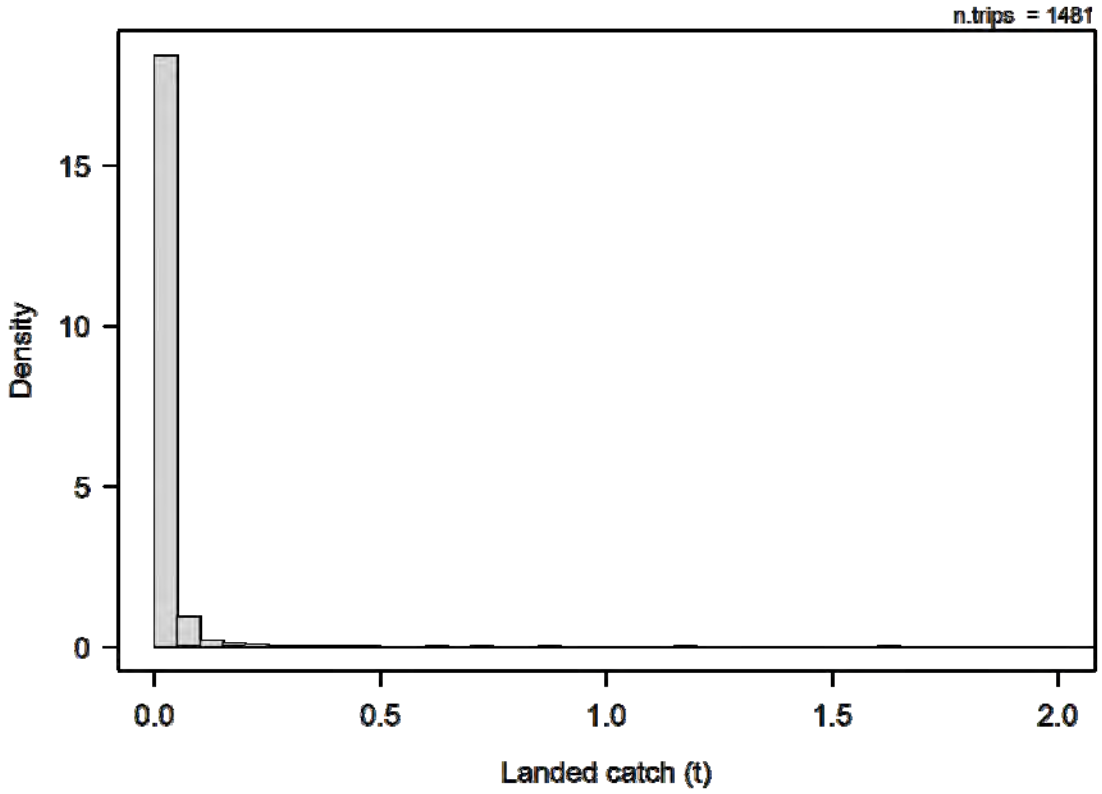


Figure C21: Proportion of landings by form type (top panels) in the groomed and unmerged dataset, and proportion of estimated catches by form type (bottom panels) in the groomed and merged dataset, for BYX 8 for the fishing years 1990–2010. The width of the bar is proportional to the annual catches (only comparable within each panel).

BYX 1



BYX 2

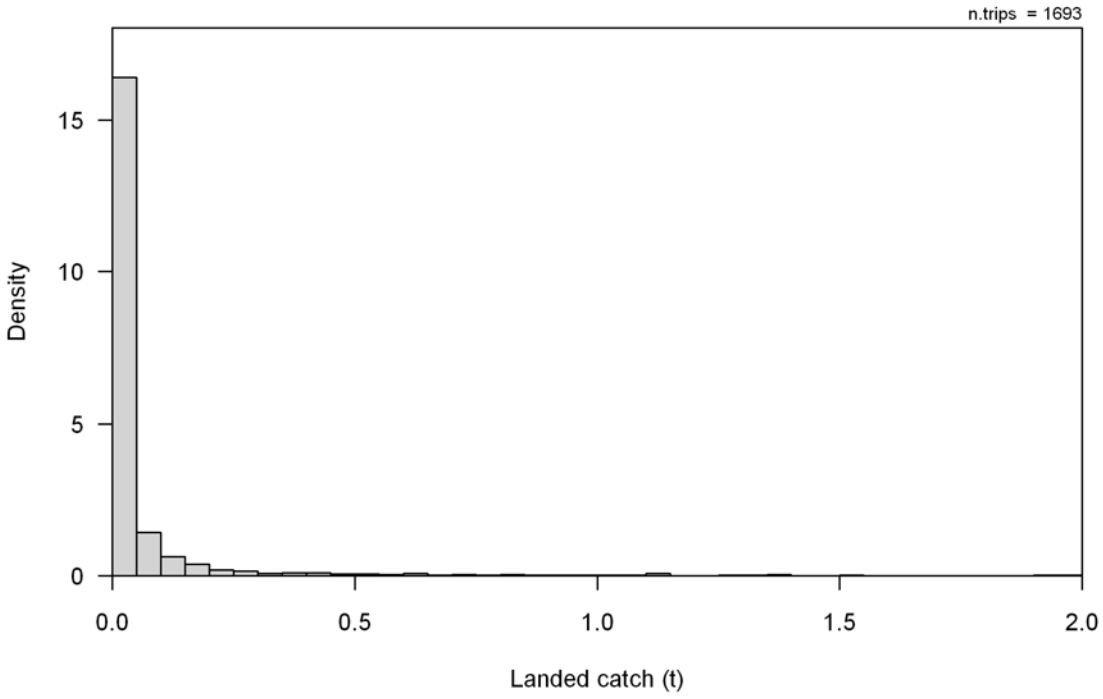
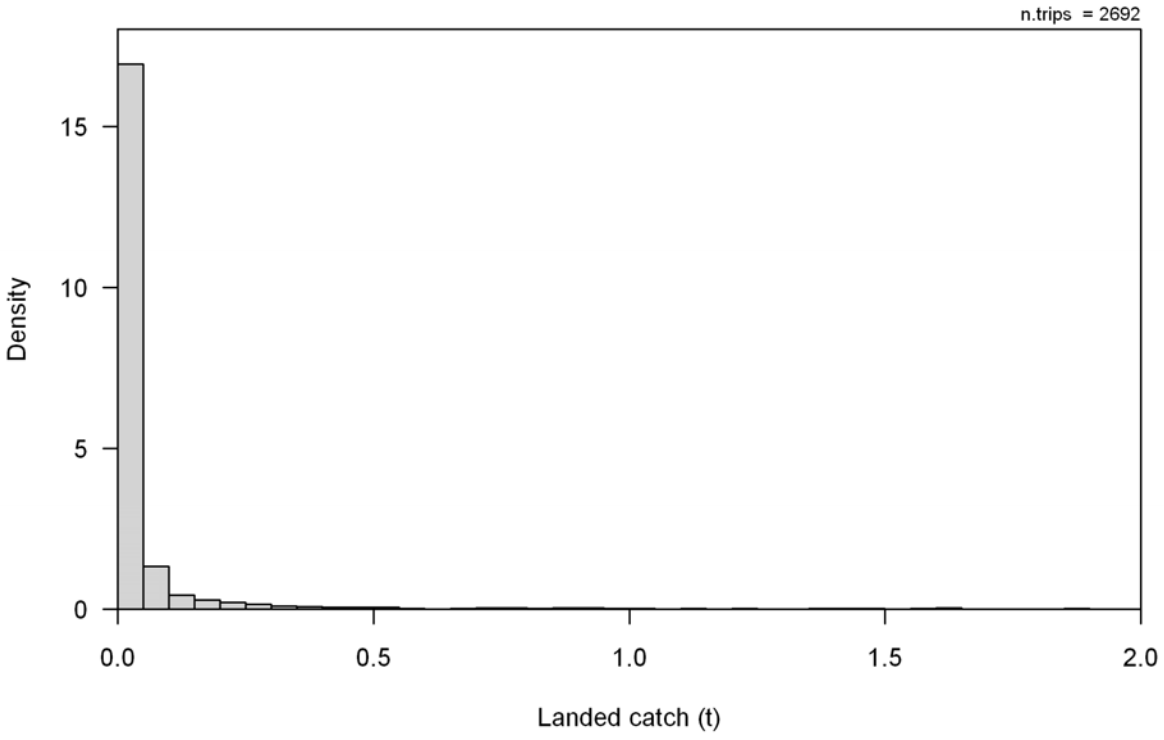


Figure C22: The distribution of reported landing weights for trips that recorded no estimated catch of alfonsino for BYX 1 and BYX 2 for the fishing years 1990–2010.

BYX 3



BYX 7

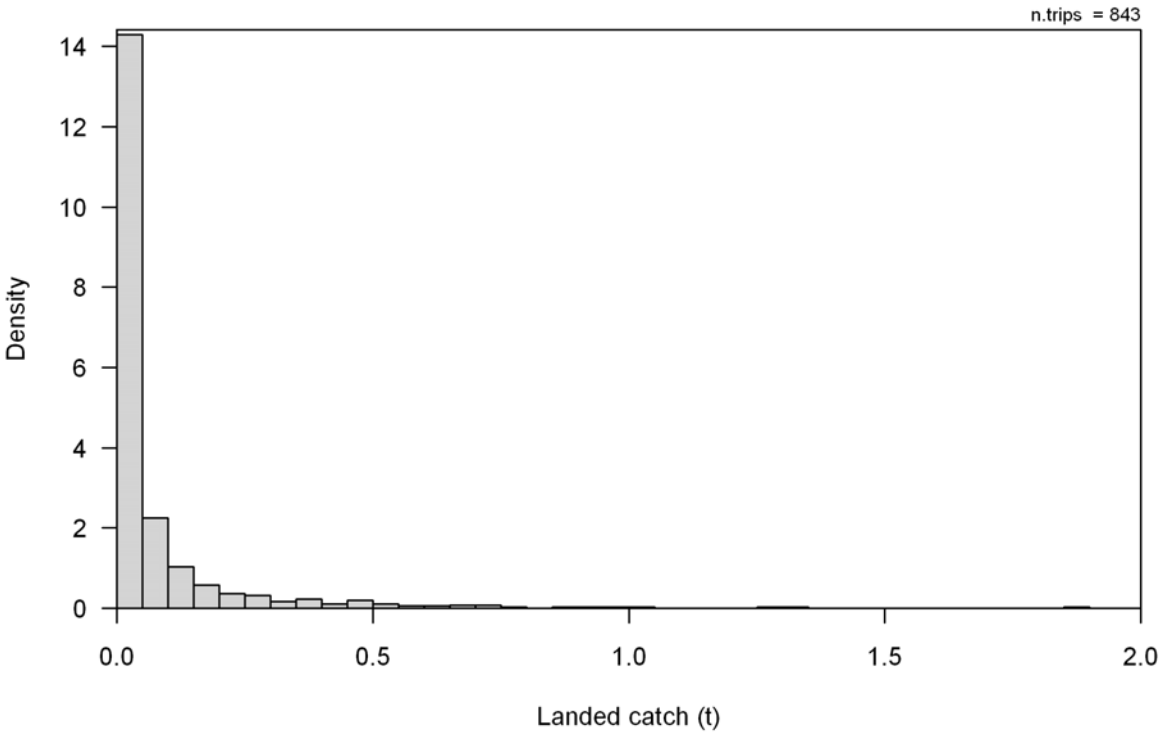


Figure C23: The distribution of reported landing weights for trips that recorded no estimated catch of alfonsino for BYX 3 and BYX 7 for the fishing years 1990–2010.

BYX 8

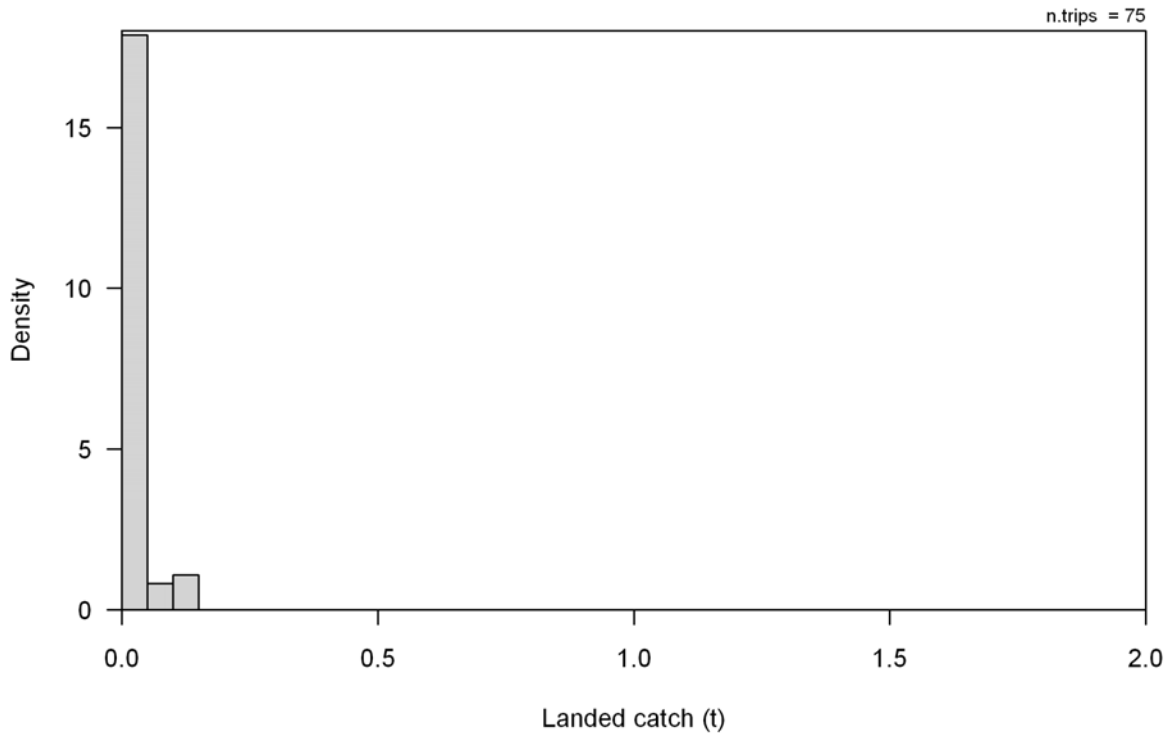


Figure C24: The distribution of reported landing weights for trips that recorded no estimated catch of alfonsino for BYX 8 for the fishing years 1990–2010.

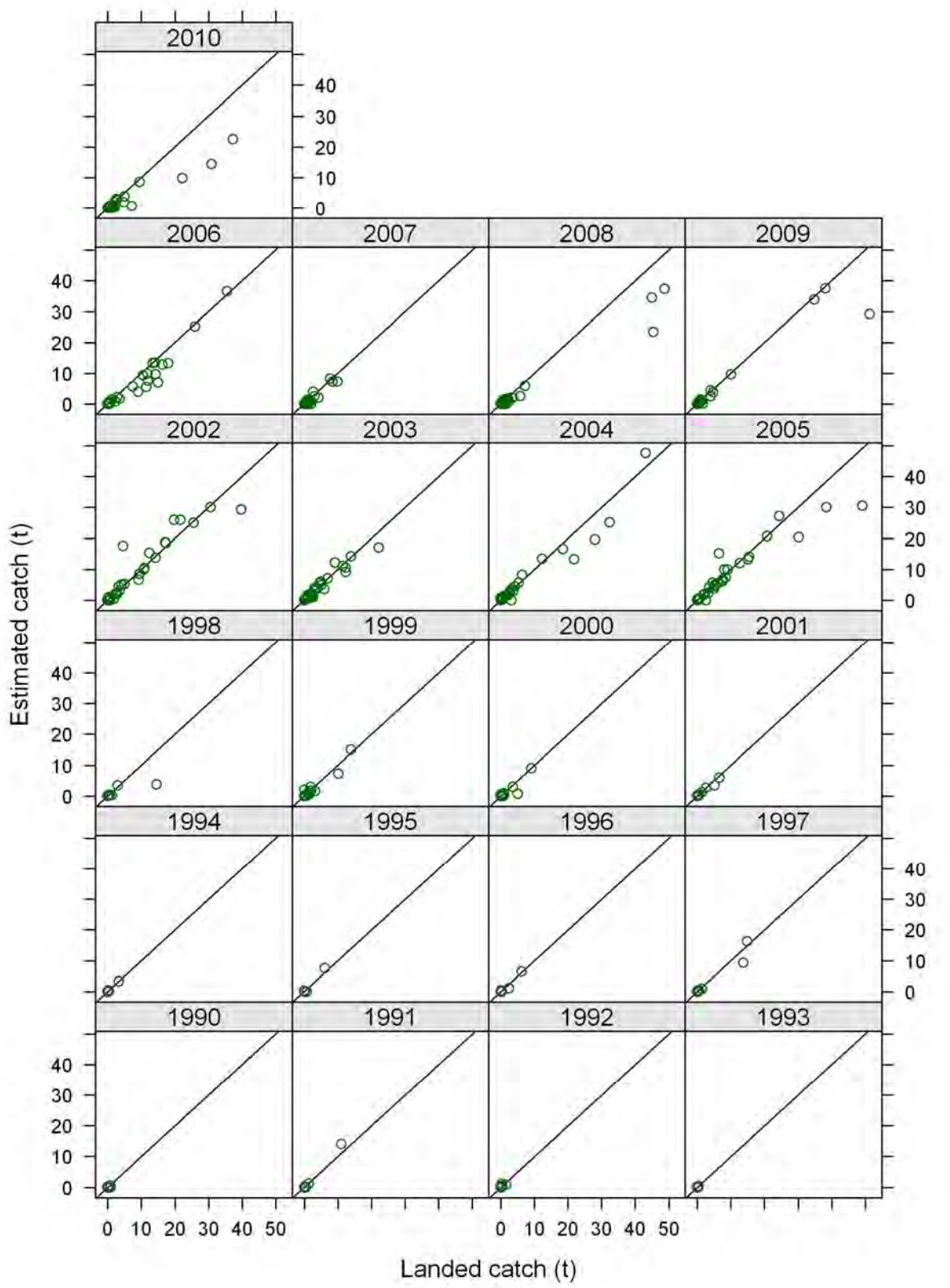


Figure C25: Estimated catches versus reported landings on a trip basis in the groomed and merged dataset, for BYX 1 for the fishing years 1990–2010.

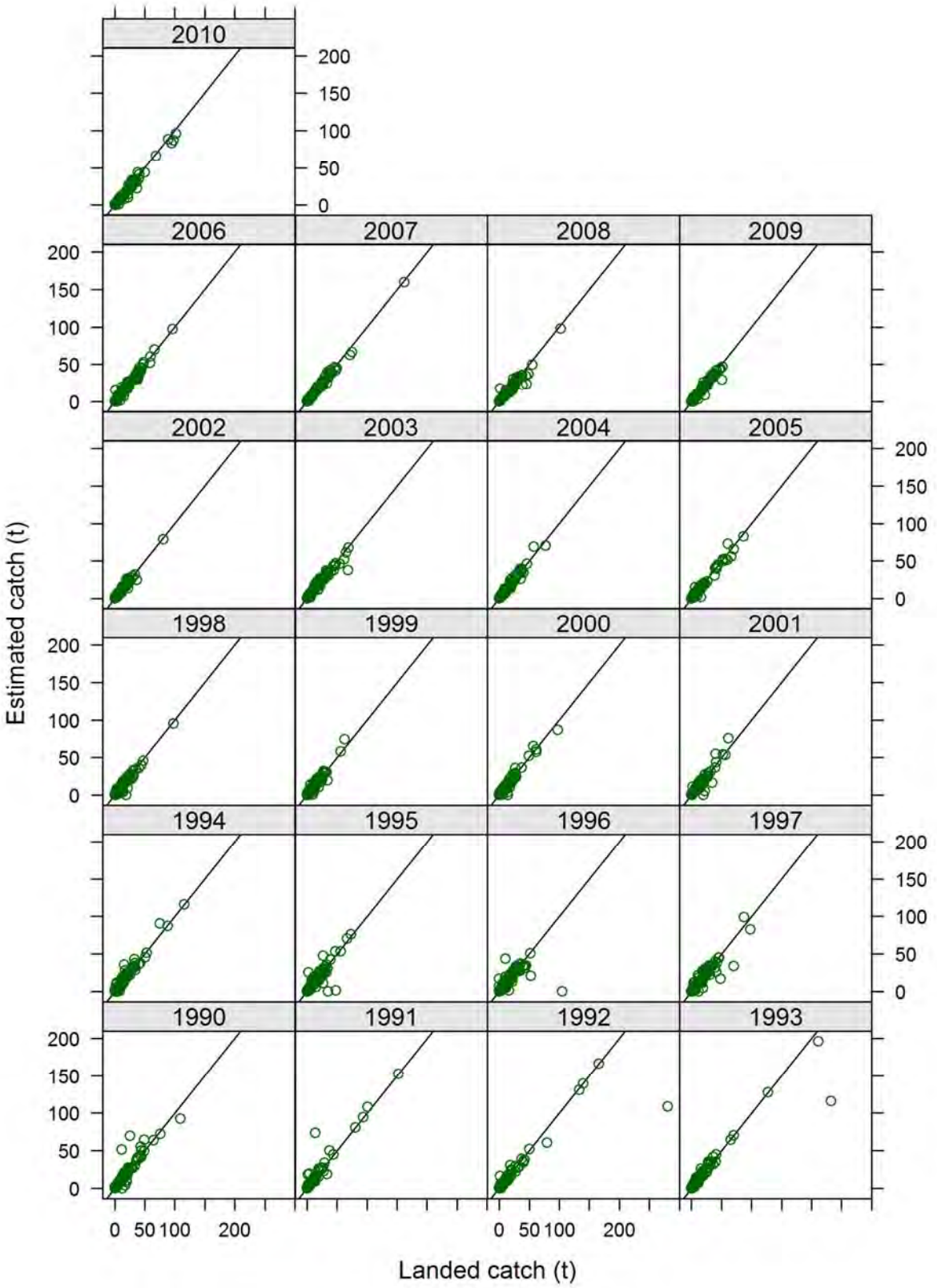


Figure C26: Estimated catches versus reported landings on a trip basis in the groomed and merged dataset, for BYX 2 for the fishing years 1990–2010.

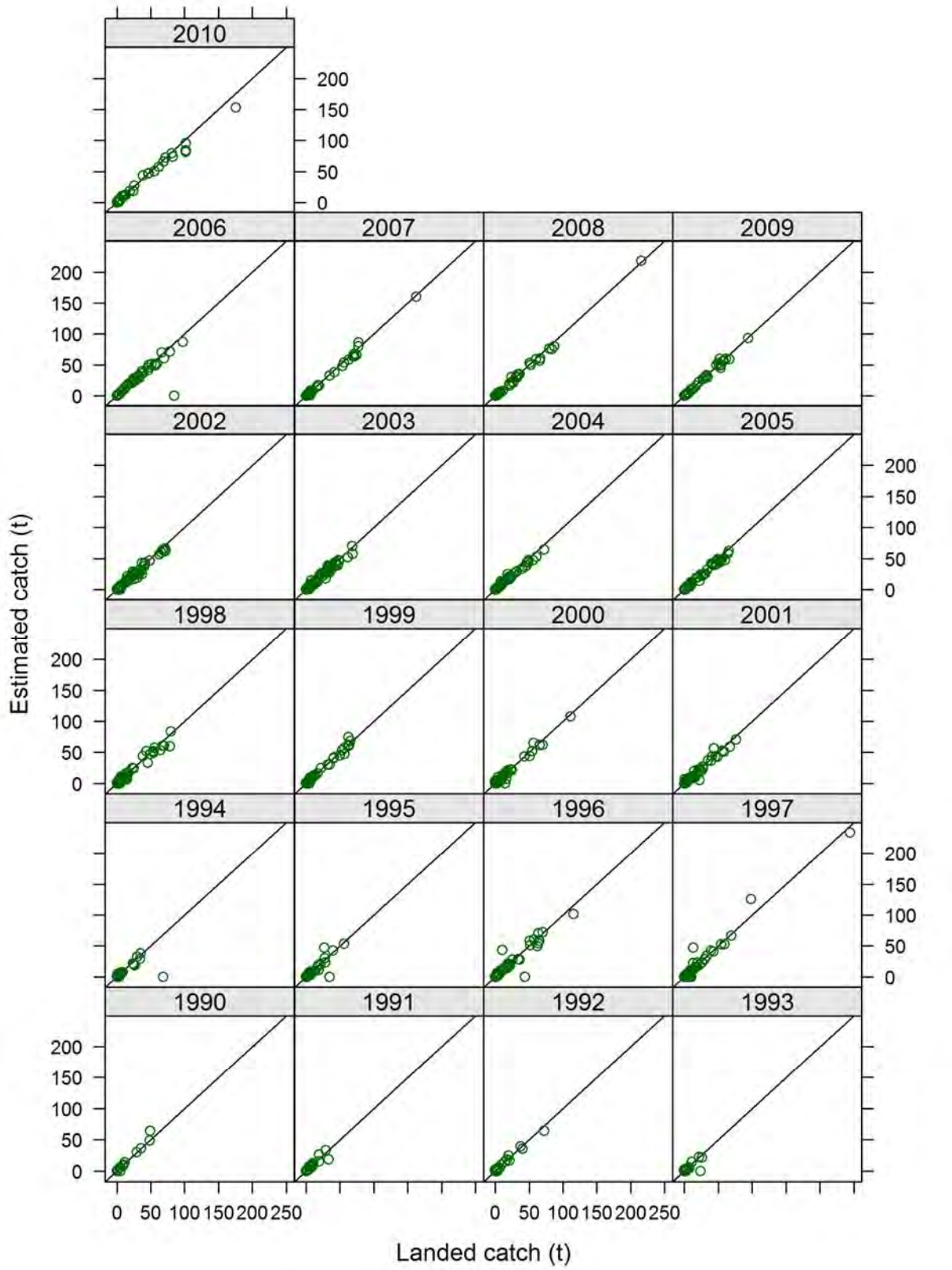


Figure C27: Estimated catches versus reported landings on a trip basis in the groomed and merged dataset, for BYX 3 for the fishing years 1990–2010.

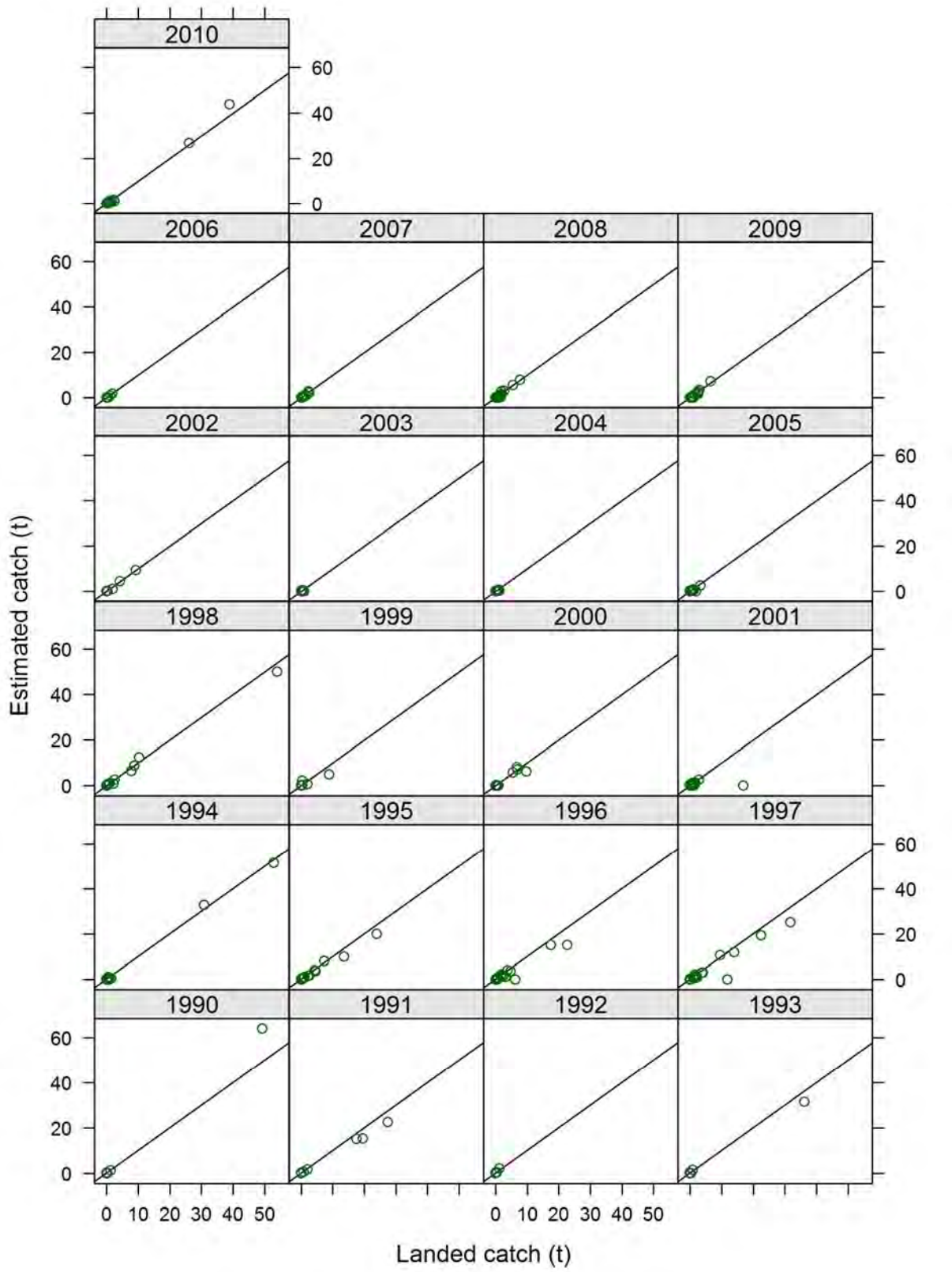


Figure C28: Estimated catches versus reported landings on a trip basis in the groomed and merged dataset, for BYX 7 for the fishing years 1990–2010.

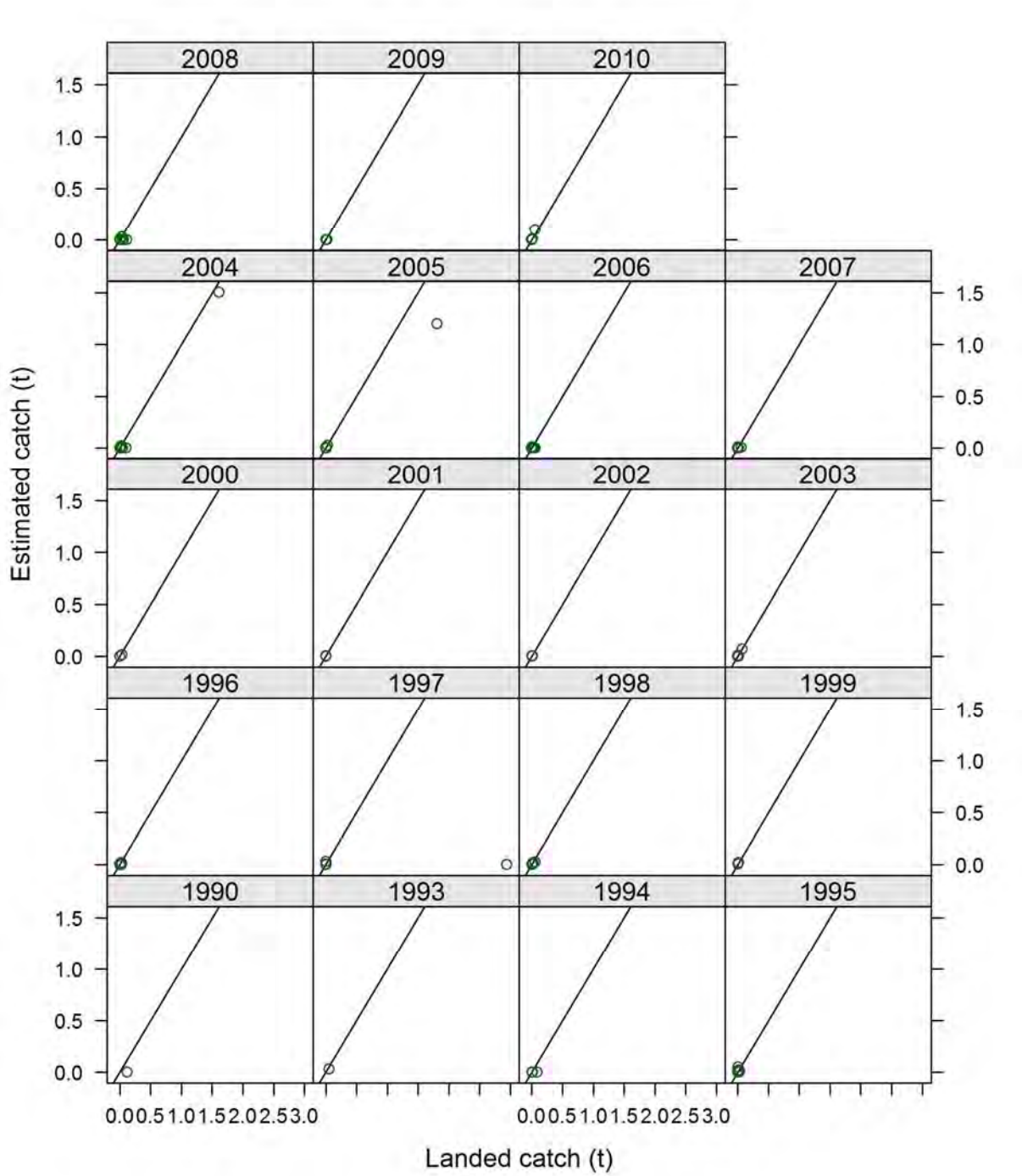


Figure C29: Estimated catches versus reported landings on a trip basis in the groomed and merged dataset, for BYX 8 for the fishing years 1990–2010.

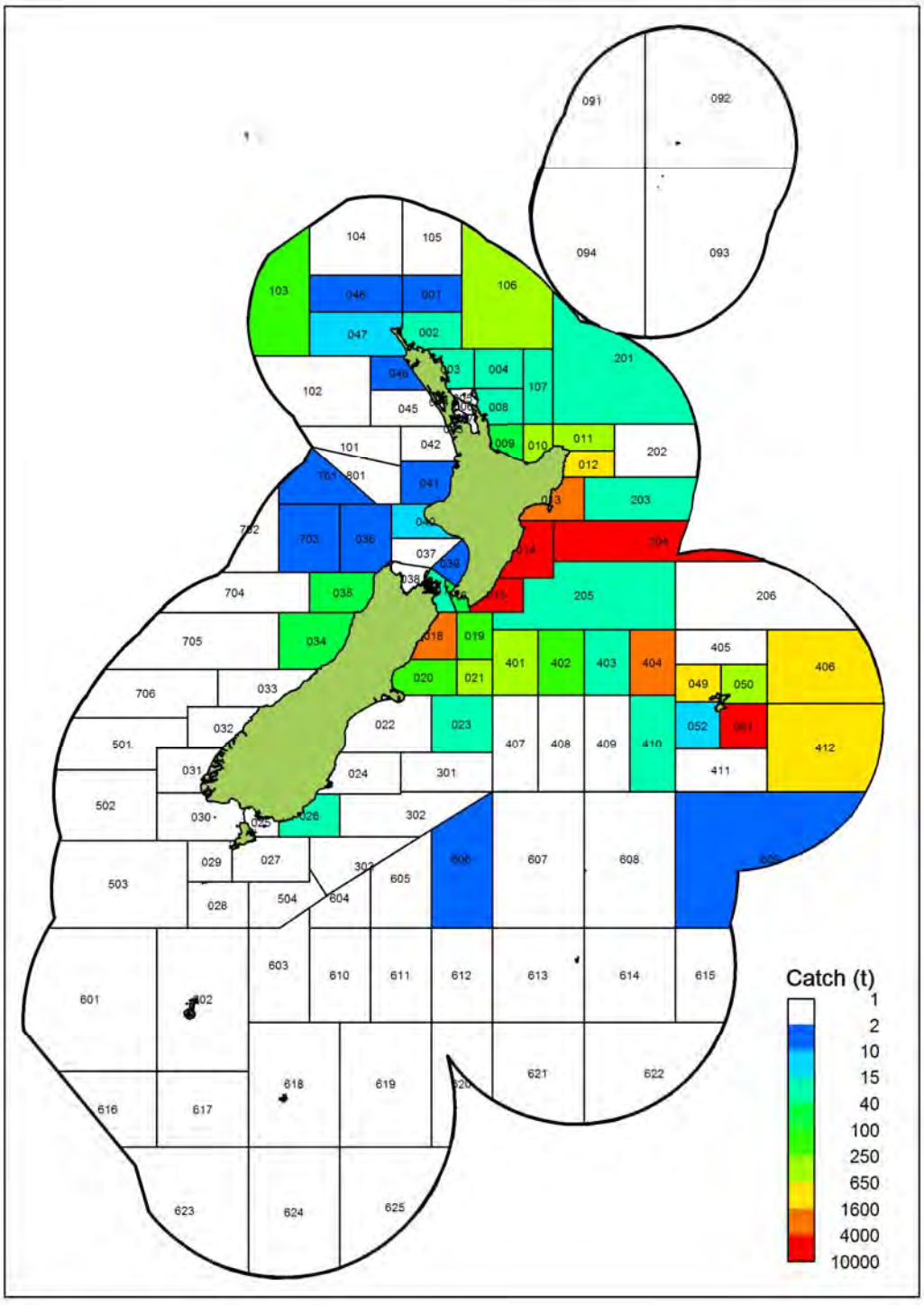


Figure C30: Annual catch (in tonnes) of all commercial alfonsino catches, from all records, by statistical area (1 October to 30 September) 1990–2010.

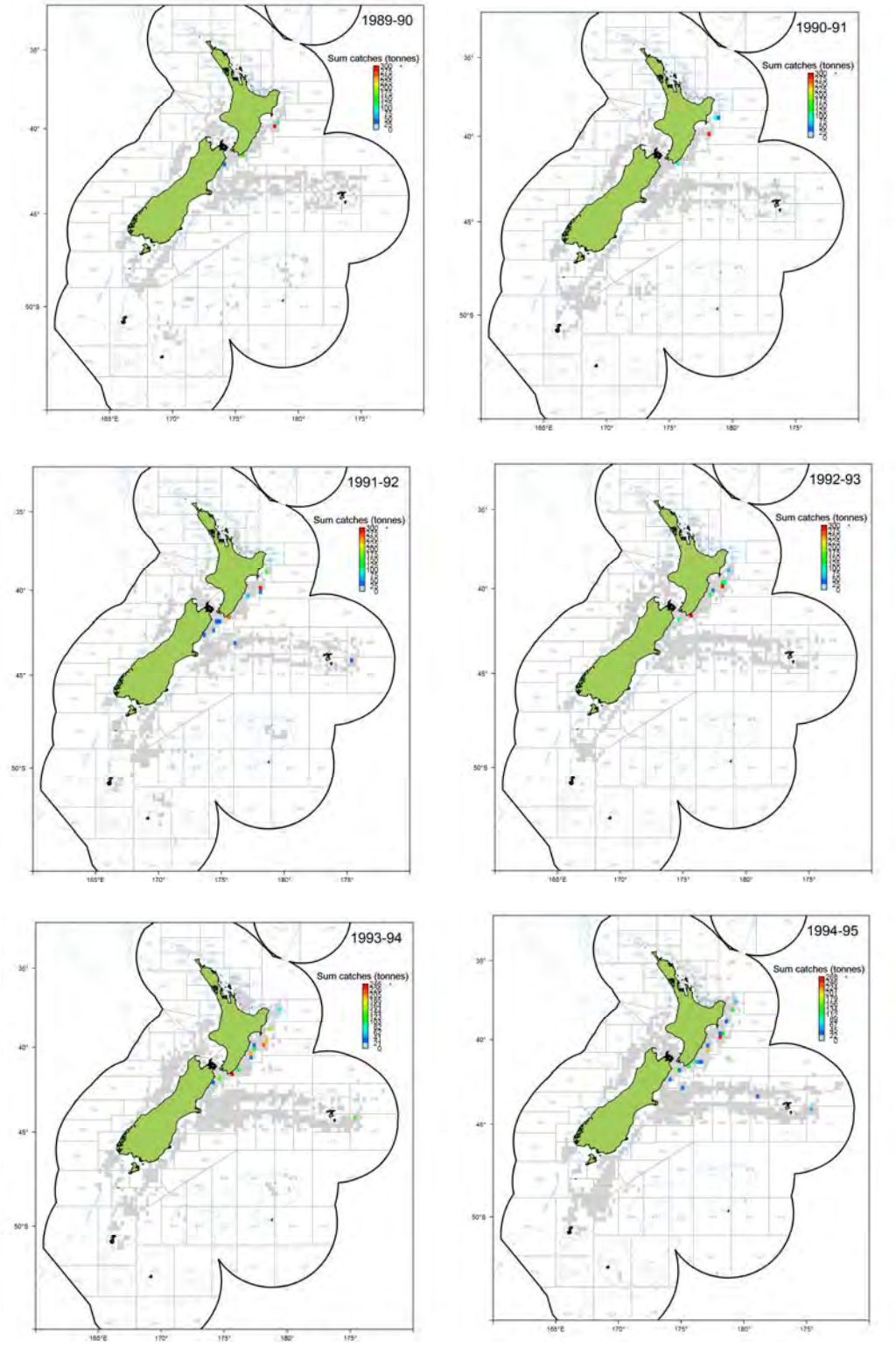


Figure C31: Annual catch of all commercial alfonsino catches from TCEPR records by fishing year (1 October to 30 September) 1990–1995.

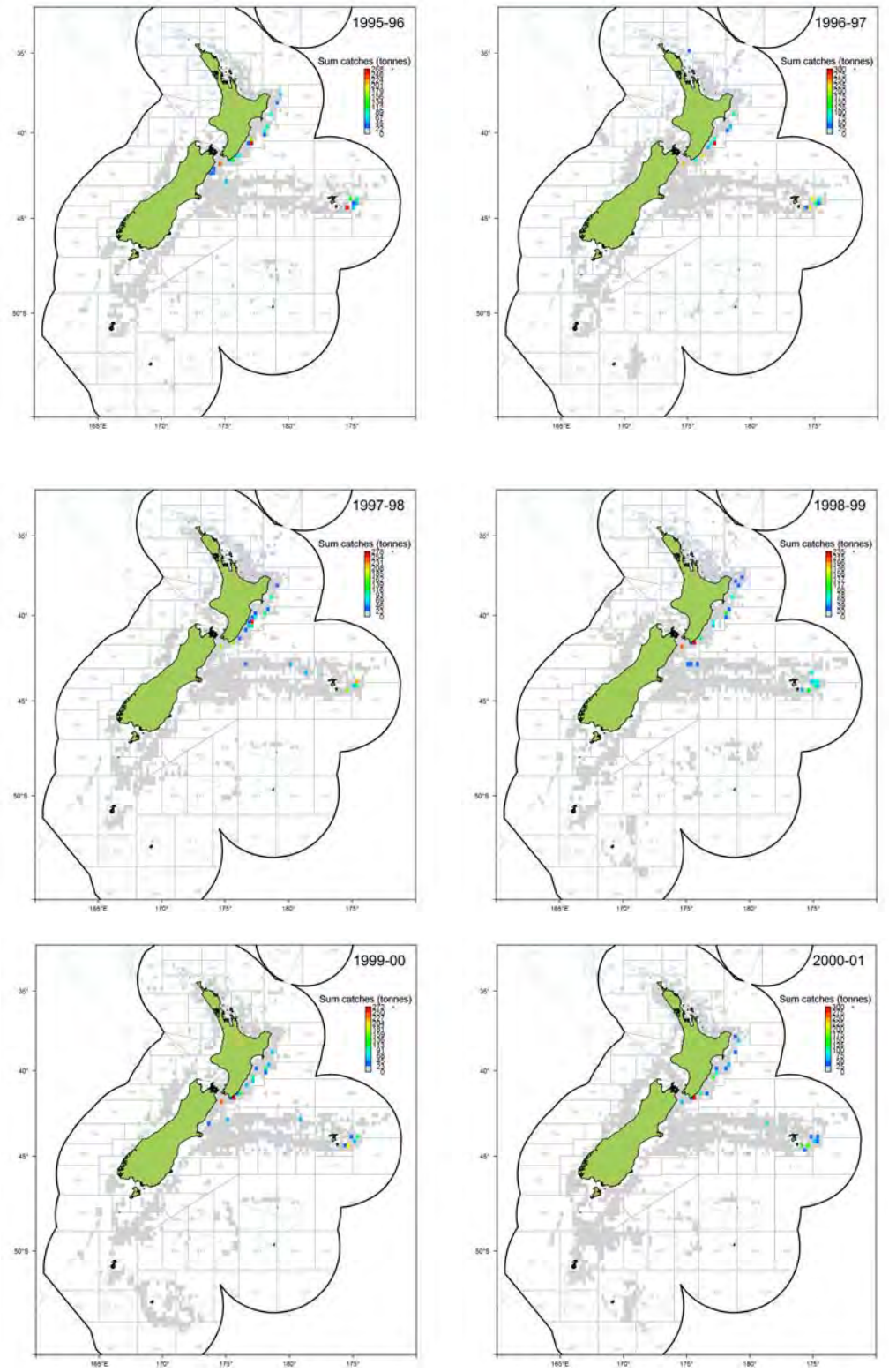


Figure C32: Annual catch of all commercial alfonsino catches from TCEPR records by fishing year (1 October to 30 September) 1996–2001.

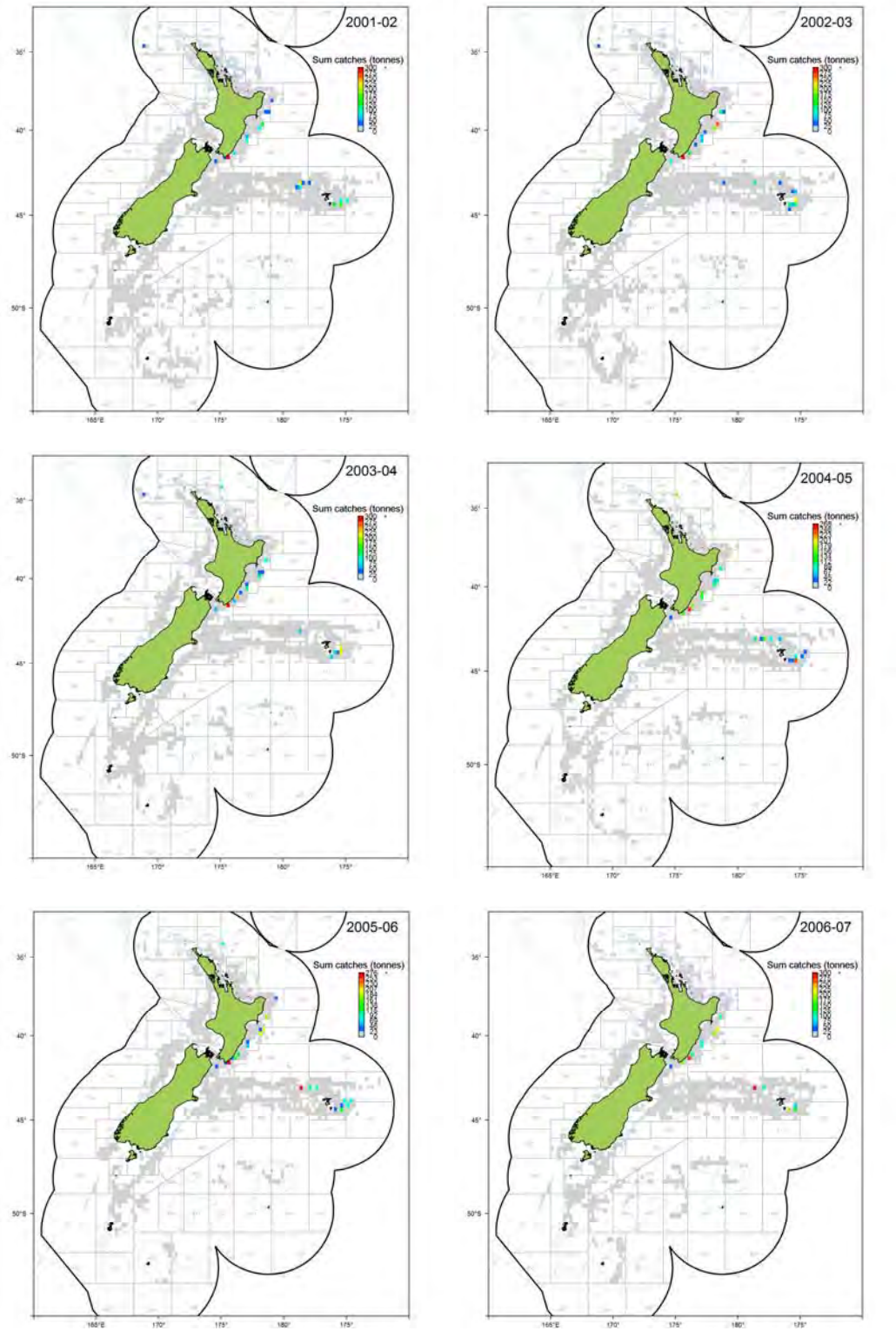


Figure C33: Annual catch of all commercial alfonsino catches from TCEPR records by fishing year (1 October to 30 September) 2002–2007.

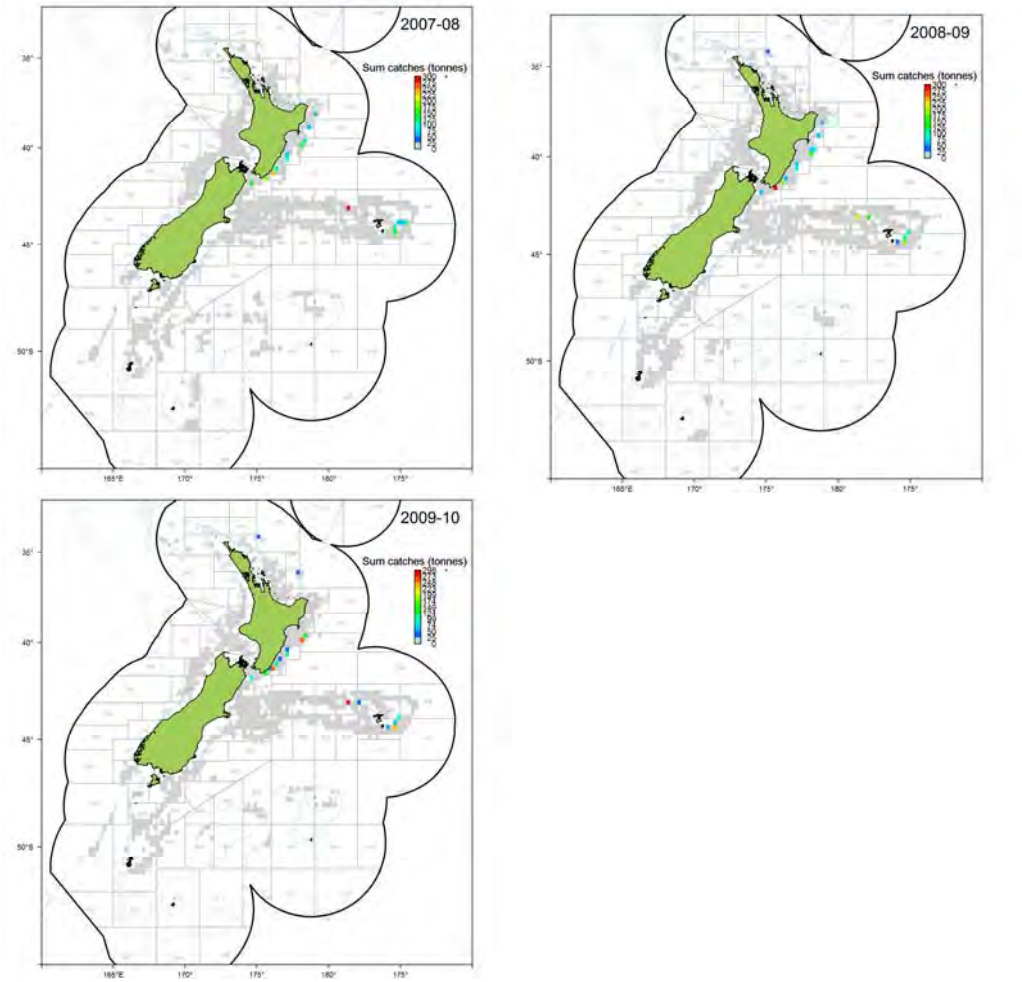


Figure C34: Annual catch of all commercial alfonsino catches from TCEPR records by fishing year (1 October to 30 September) 2008–2010.

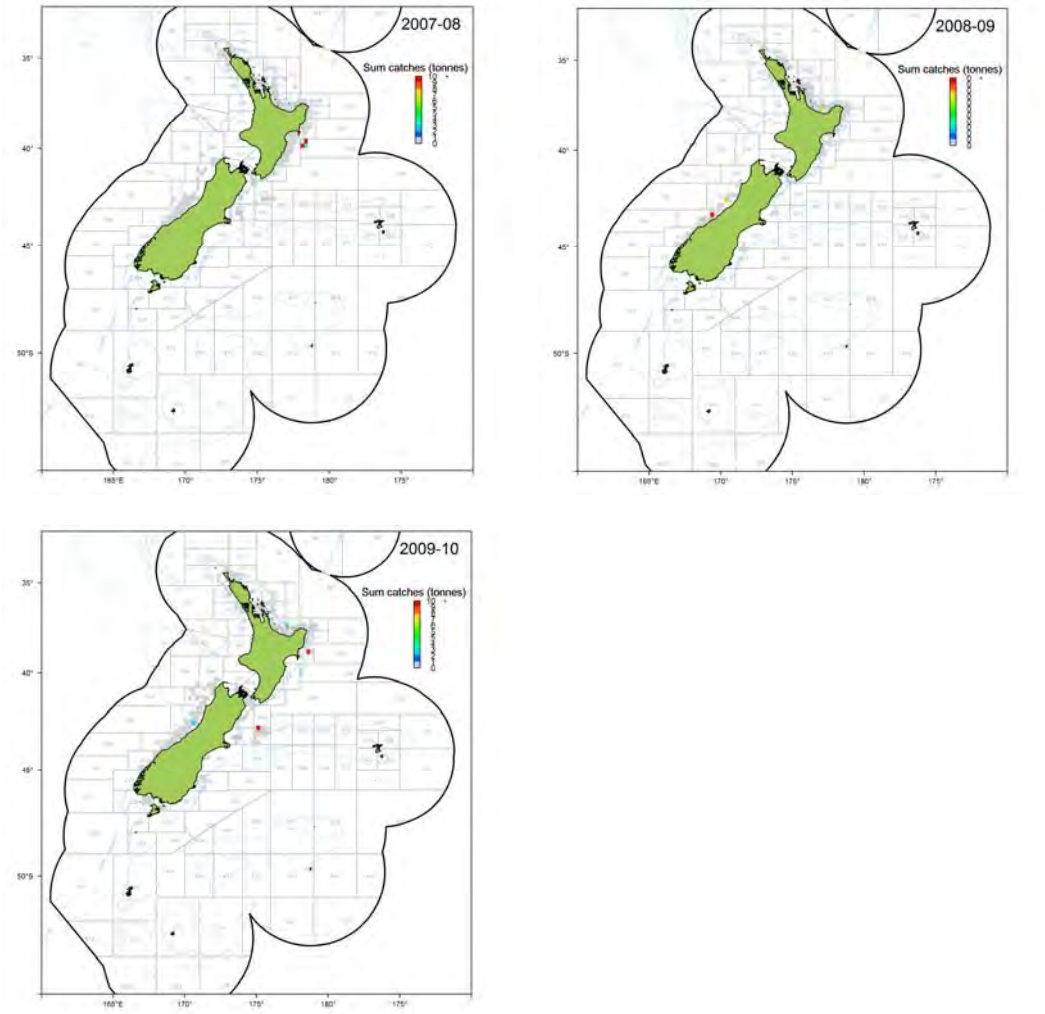


Figure C35: Annual catch of all commercial alfonsino catches from TCER records for the fishing years 2008–2010.

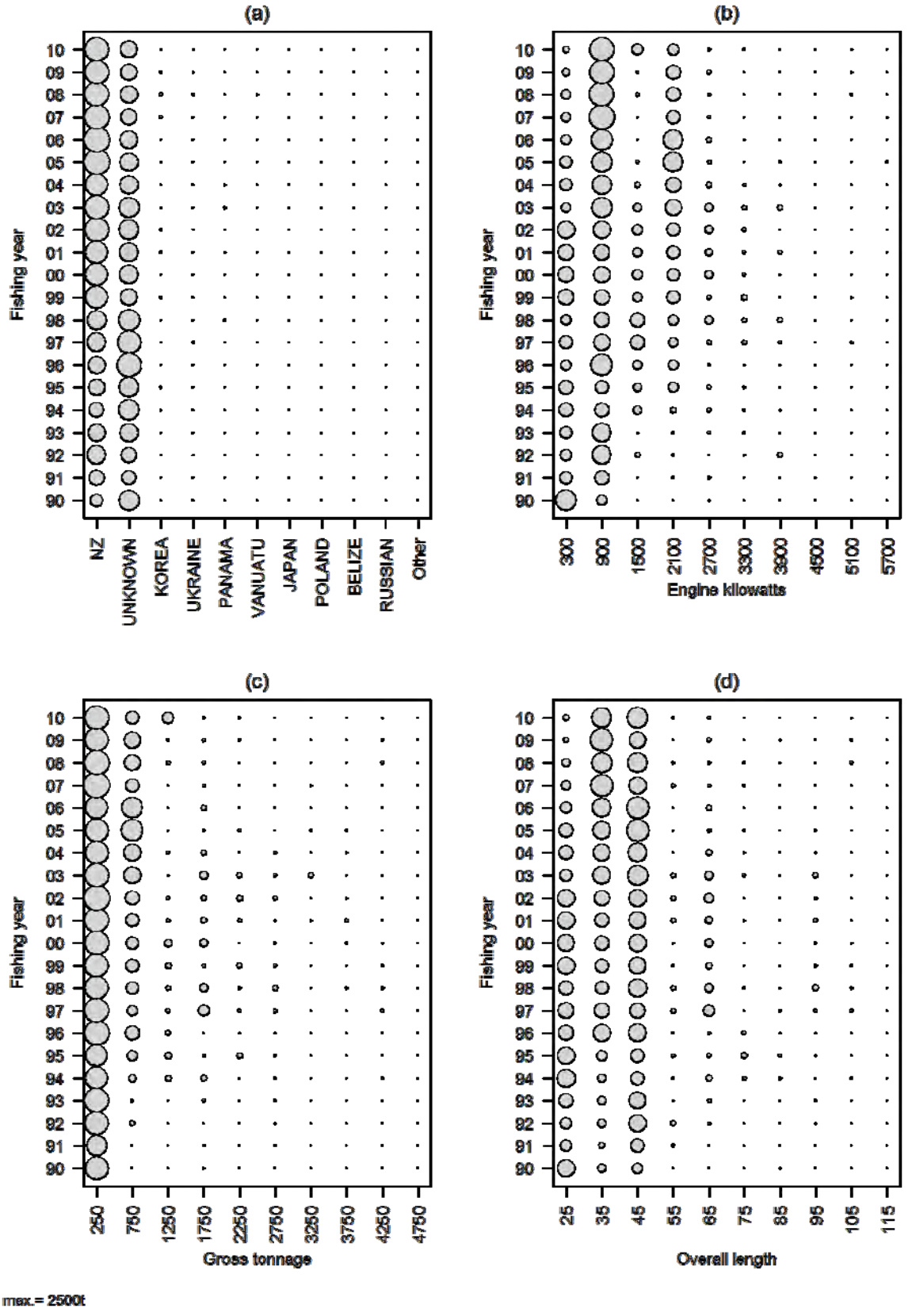


Figure C36: Distribution of annual catch by nationality, vessel power, gross tonnage, and length (m) for all merged data for the fishing years 1990–2010. Circle size is proportional to catch; maximum circle size is indicated in lower left hand corner.

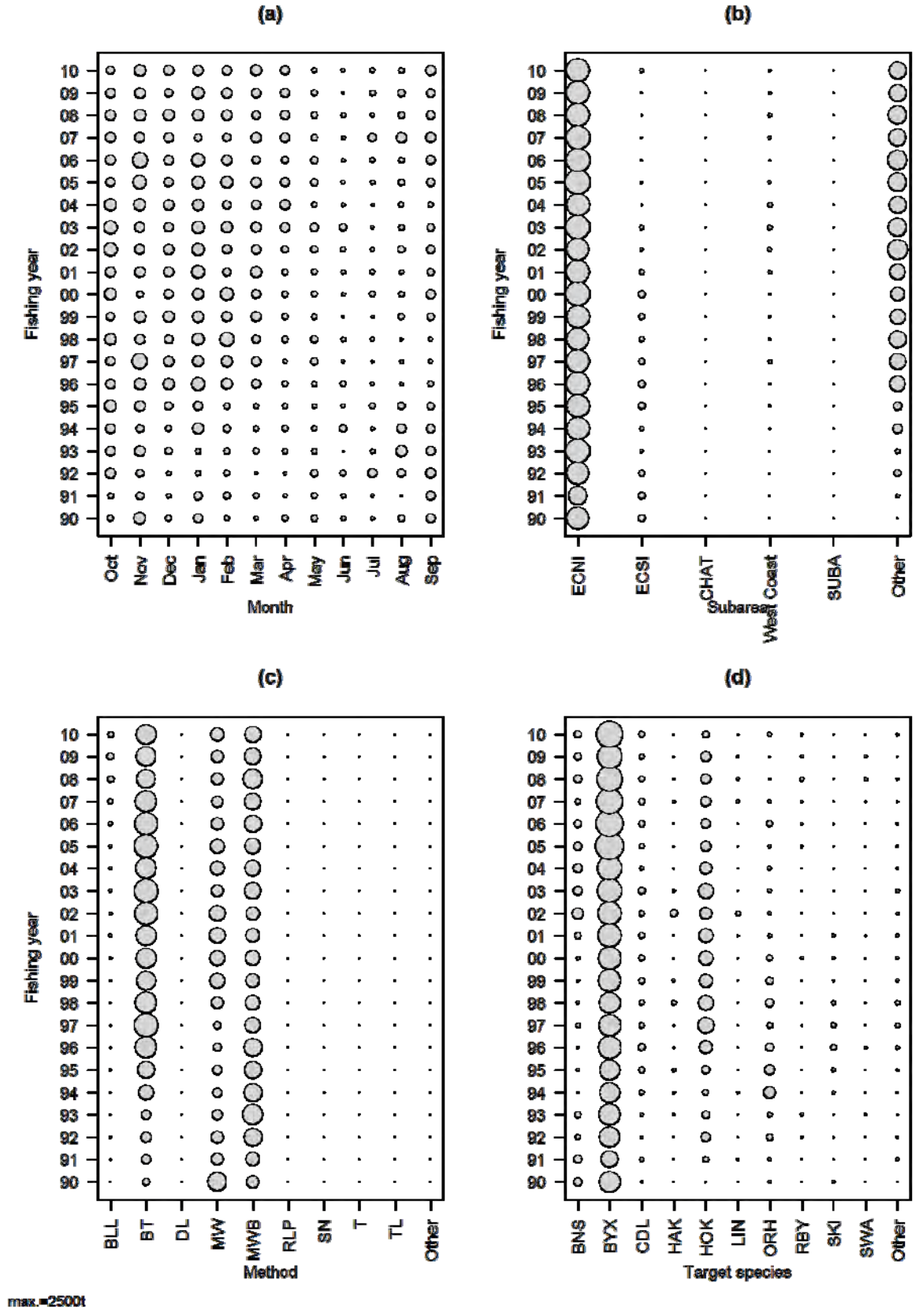


Figure C37: Distribution of annual catch by month, area, method, and target species for all merged data for the fishing years 1990–2010. Circle size is proportional to catch; maximum circle size is indicated in lower left hand corner. Refer to Table C27 for species codes.

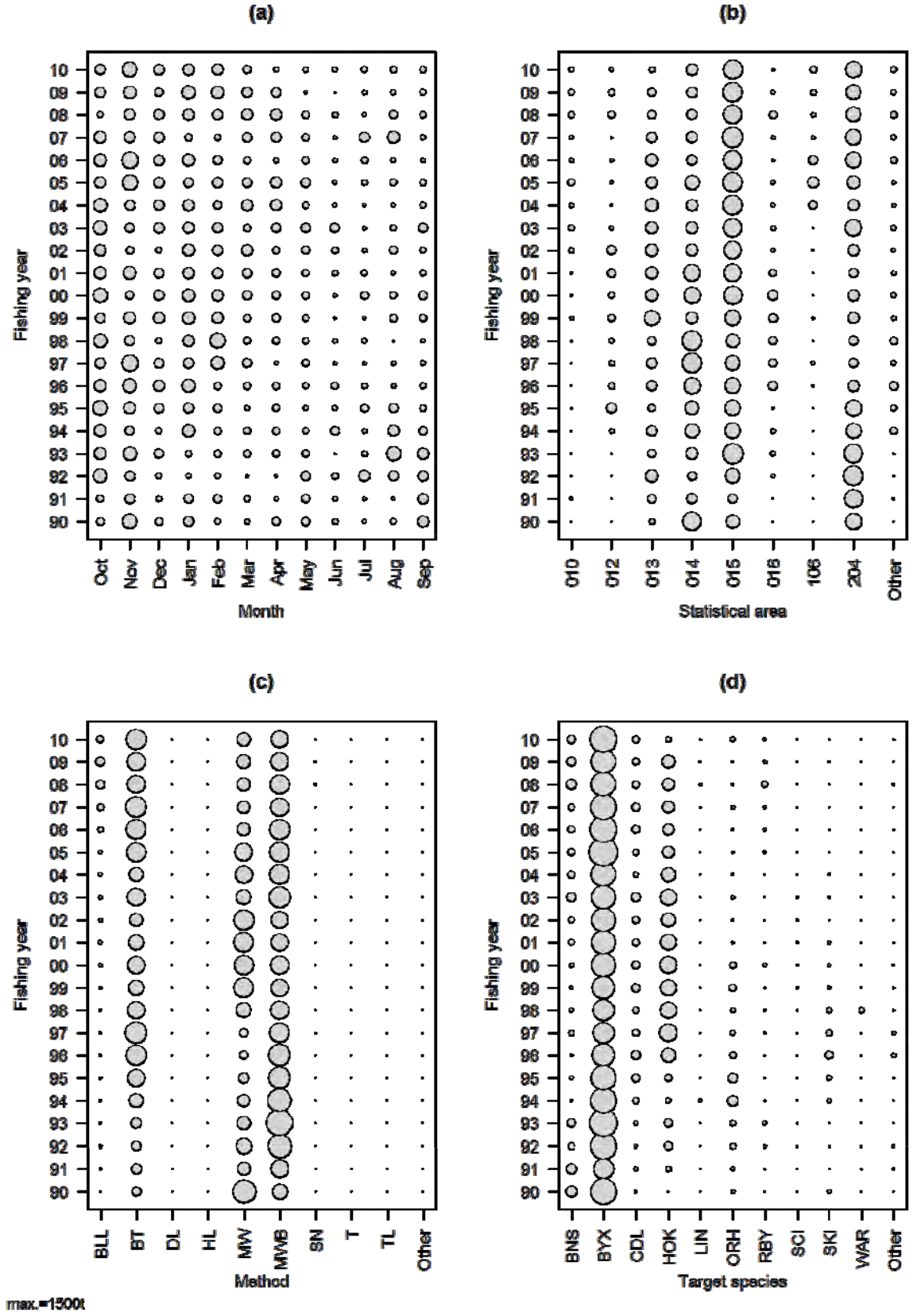


Figure C38: Distribution of alfonsino catch in the ECNI region (circle size is proportional to catch) for fishing years 1990–2010 in relation to a) month, b) statistical area, c) fishing method, and d) target species. Circle size is proportional to catch; maximum circle size is indicated in lower left hand corner. Refer to Table C27 for species codes.

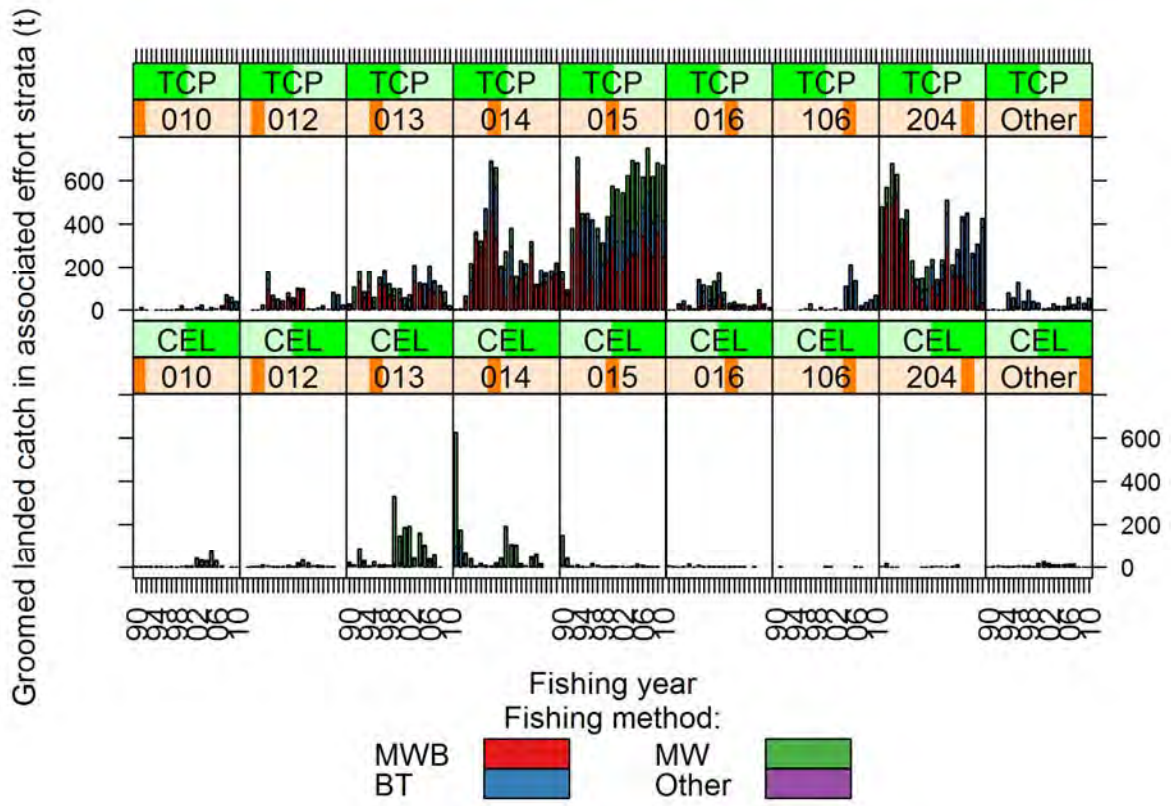


Figure C39: Distribution of alfonsino catch in the ECNI region in relation to form type and statistical area for fishing years 1990–2010 by fishing method.

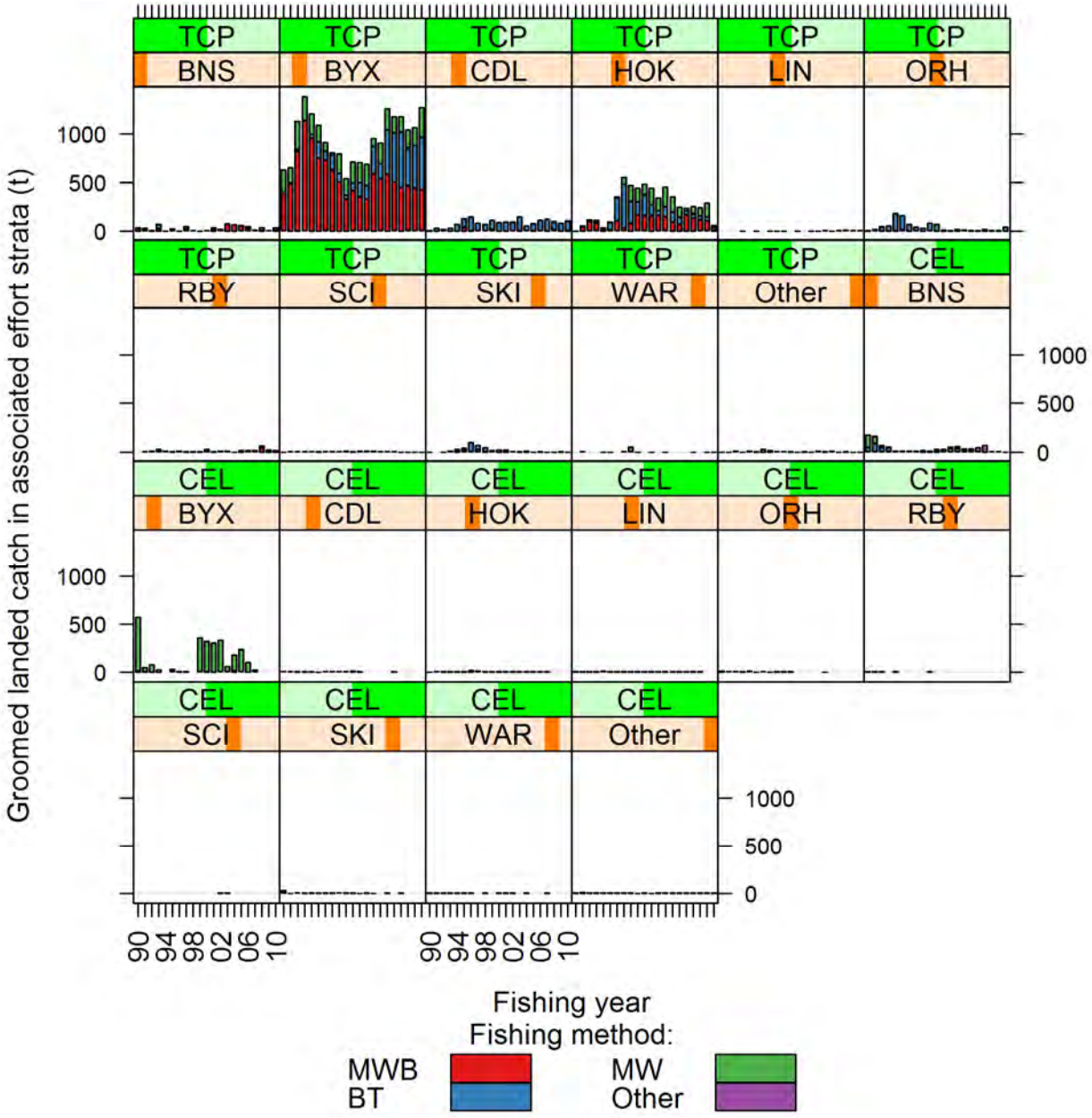


Figure C40: Distribution of alfonsino catch in the ECNI region in relation to form type and target species for fishing years 1990–2010 by fishing method. Refer to Table C27 for species codes.

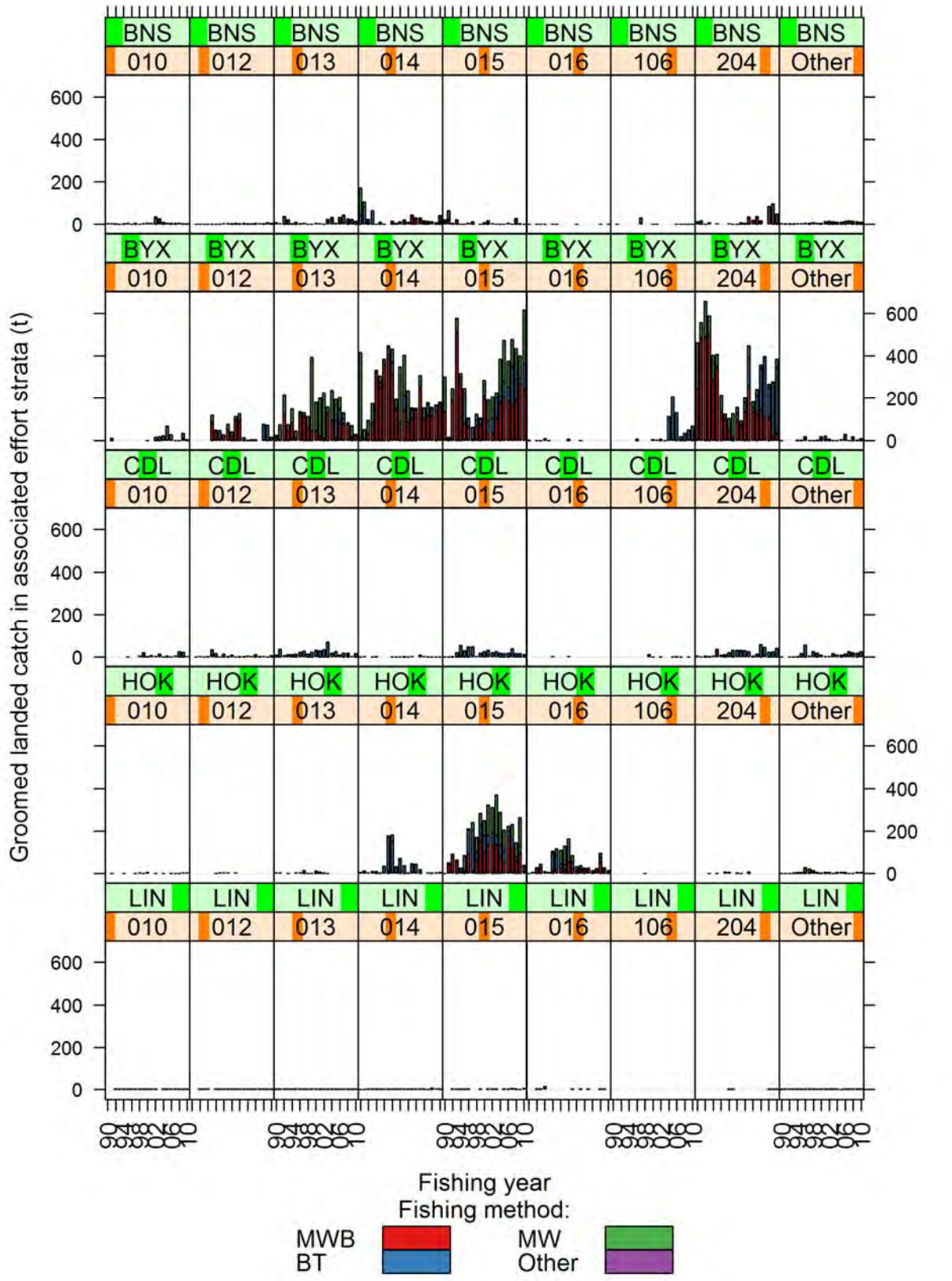


Figure C41: Distribution of alfonsino catch in the ECNI region in relation to target species and statistical area for fishing years 1990–2010 by fishing method. Refer to Table C27 for species codes.

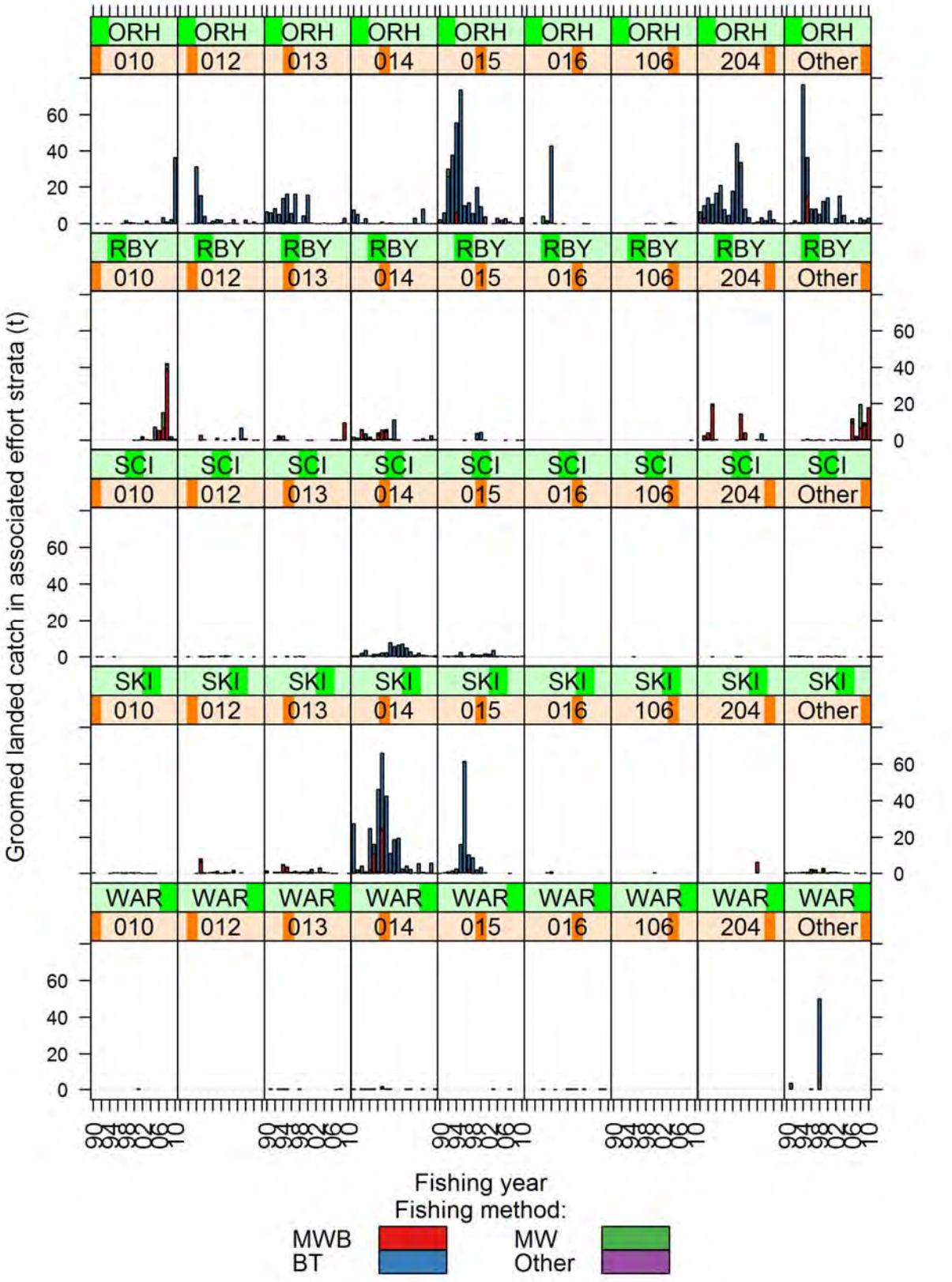


Figure C42: Distribution of alfonsino catch in the ECNI region in relation to target species and statistical area for fishing years 1990–2010 by fishing method. Refer to Table C27 for species codes.

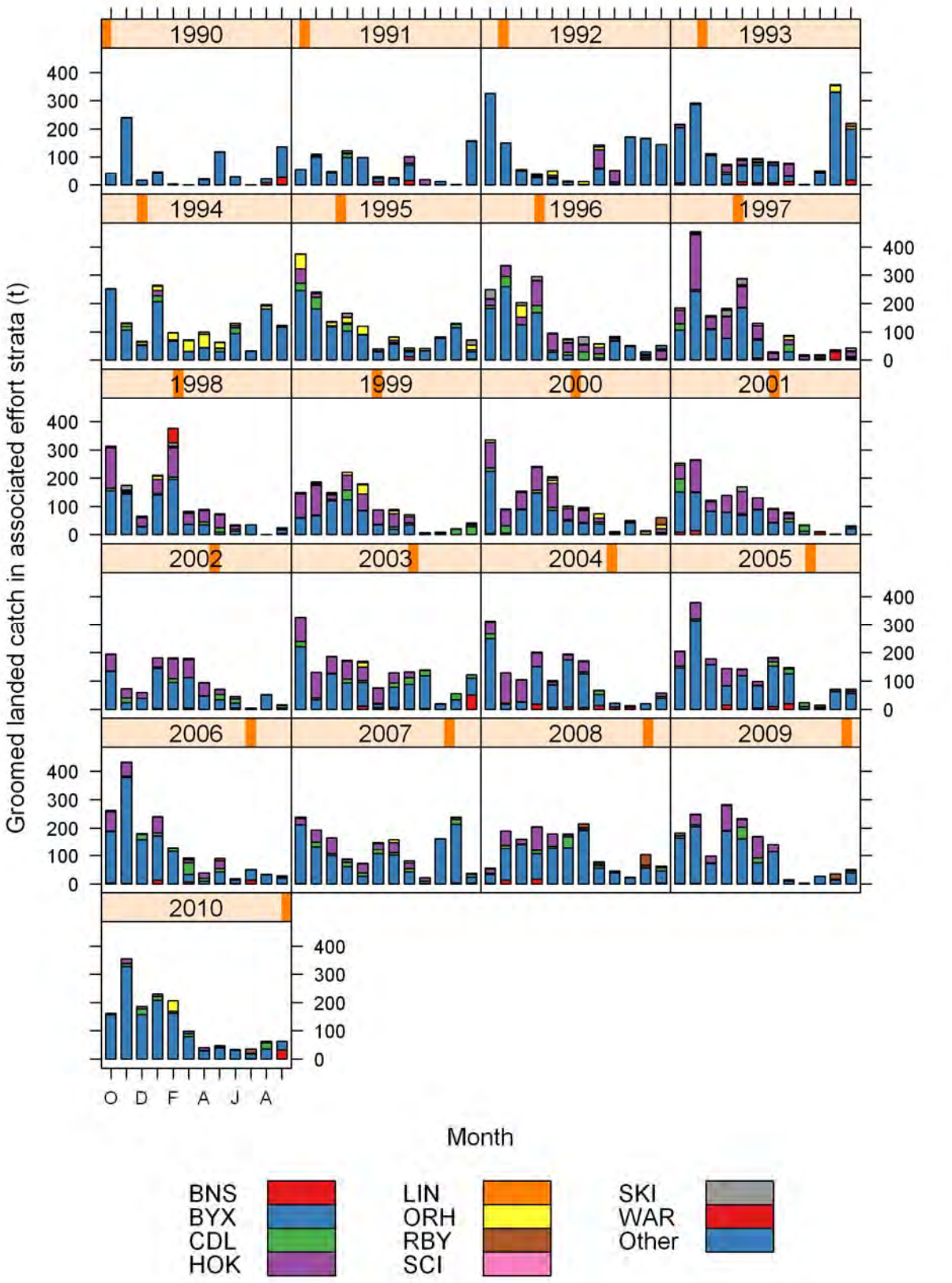


Figure C43: Distribution of alfonsino catch in the ECNI region taken by bottom trawl fishing methods by fishing month for fishing years 1990–2010 by target species. Refer to Table C27 for species codes.

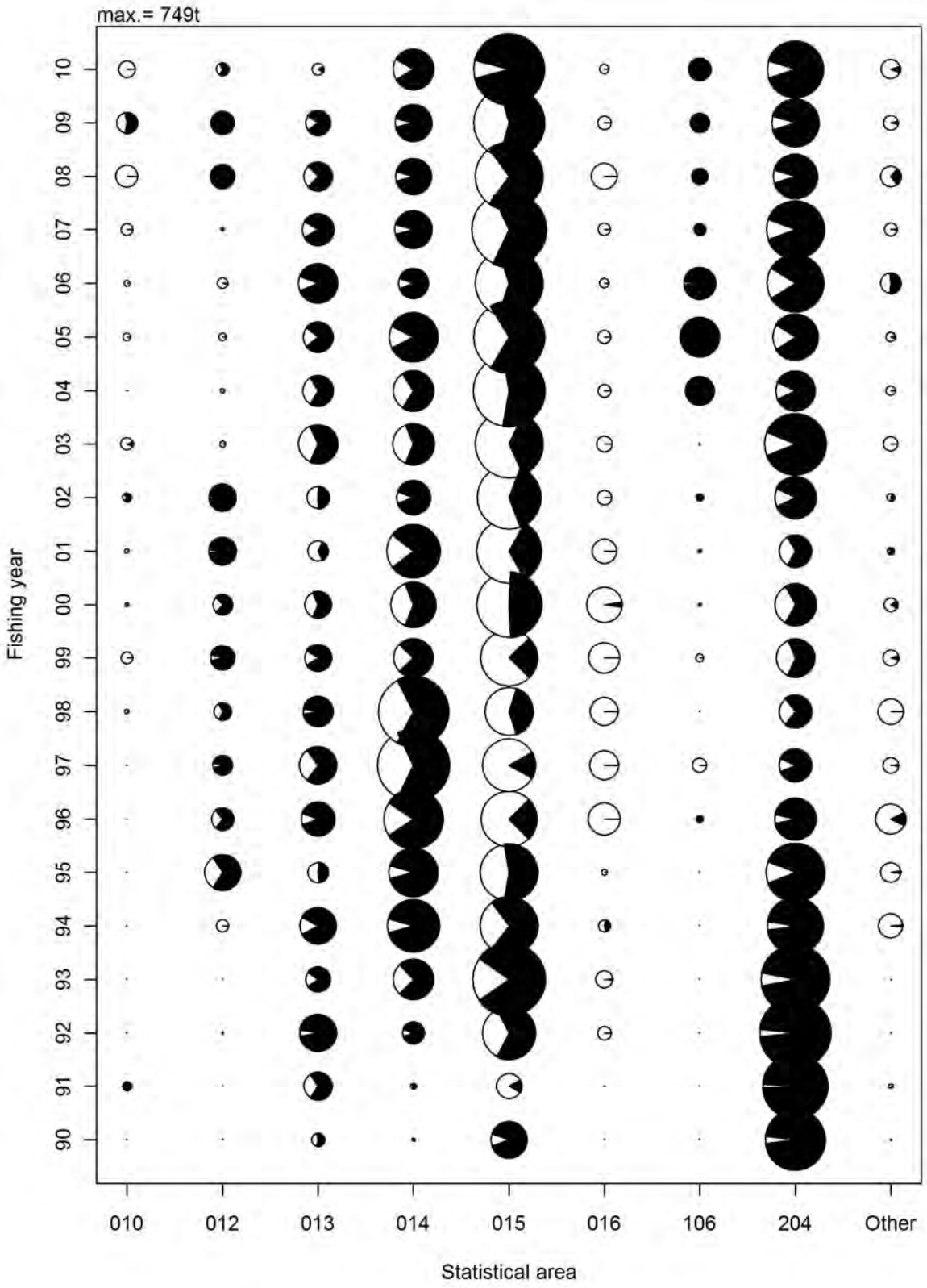


Figure C44: Distribution of alfonsino catch by fishing year with circle size proportional to the total catch and black portion of the pie indicating proportion of the catch as targeted alfonsino by statistical area for TCEPR tows in the ECNI region.

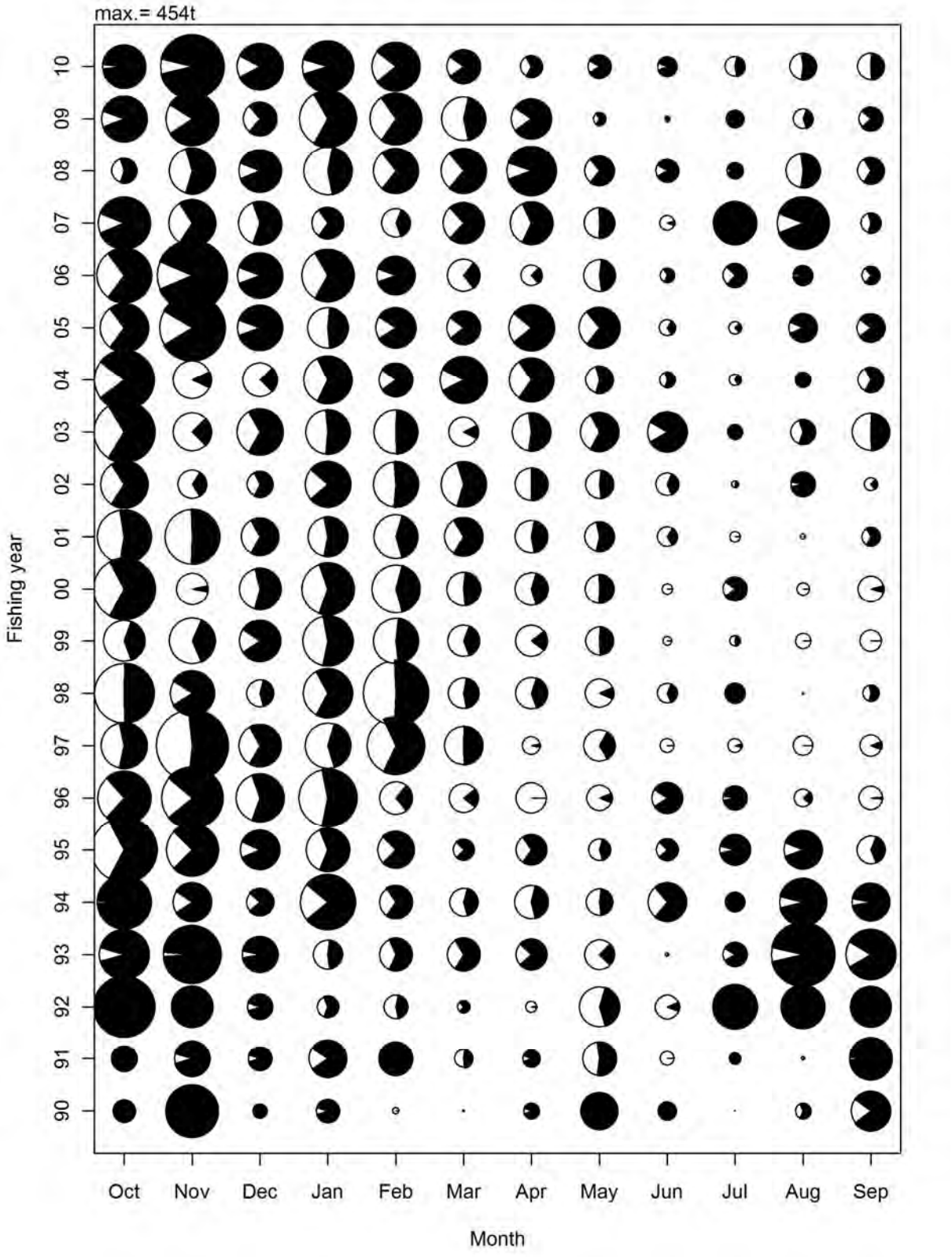


Figure C45: Distribution of alfonsino catch by fishing year with circle size proportional to the total catch and black portion of the pie indicating proportion of the catch as targeted alfonsino by month for TCEPR tows in the ECNI region.

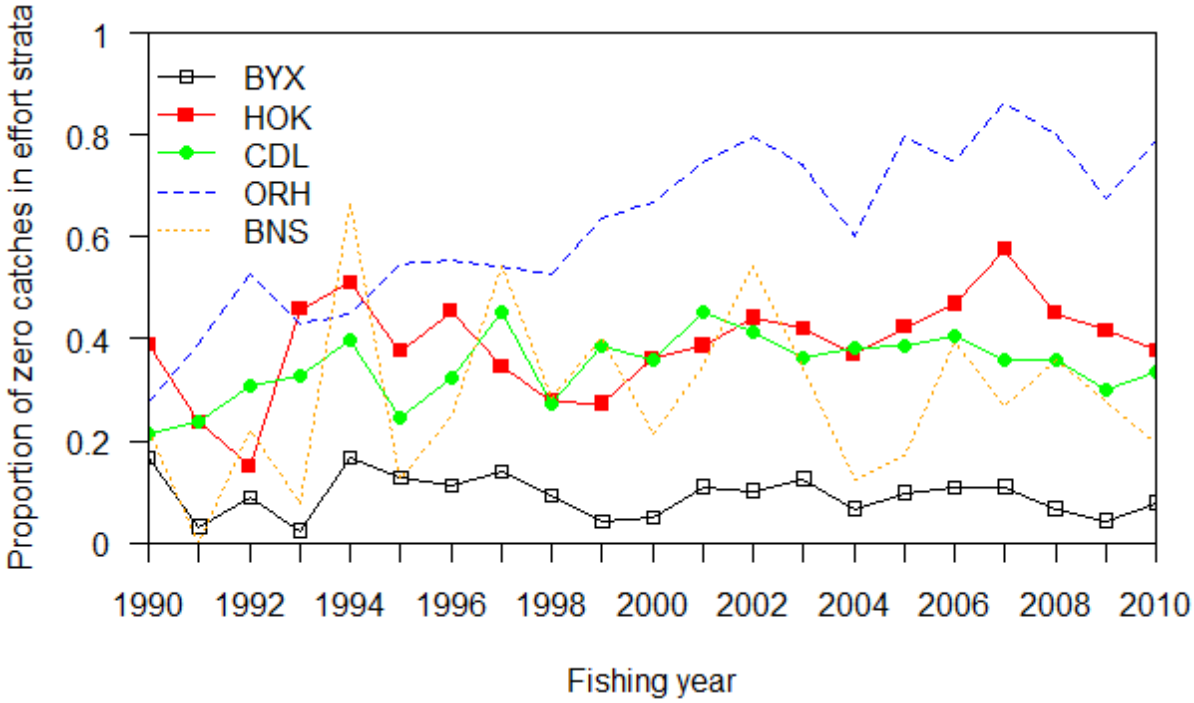


Figure C46: Proportion of TCEPR tows with zero reported alfonsino catch by major target species for the ECNI region. Refer to Table C27 for species codes.

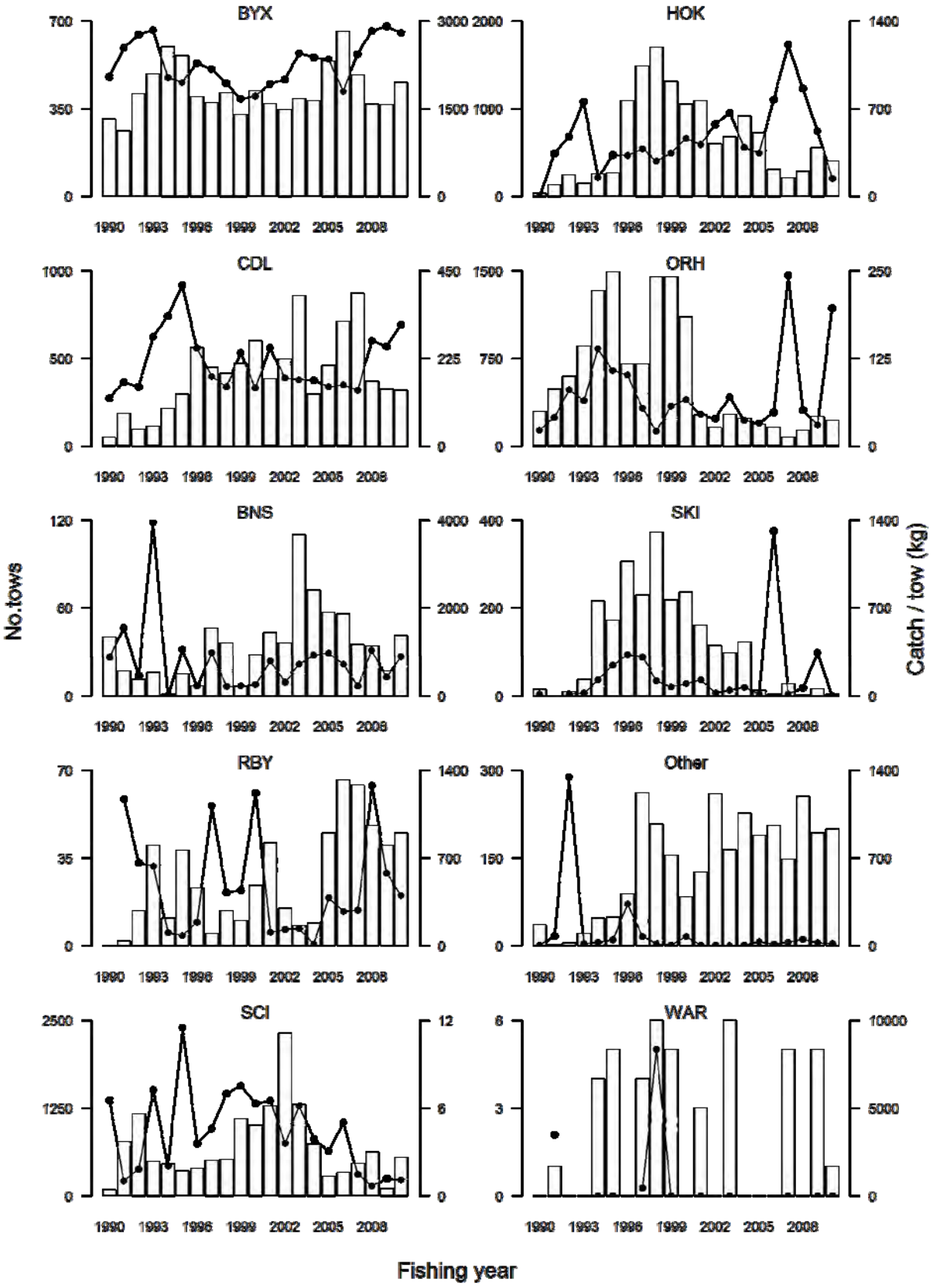


Figure C47: Annual catch rate of alfonsino in kilograms alfonsino (catch/tow) and the number of TCEPR tows in the ECNI region for various target species. Refer to Table C27 for species codes.

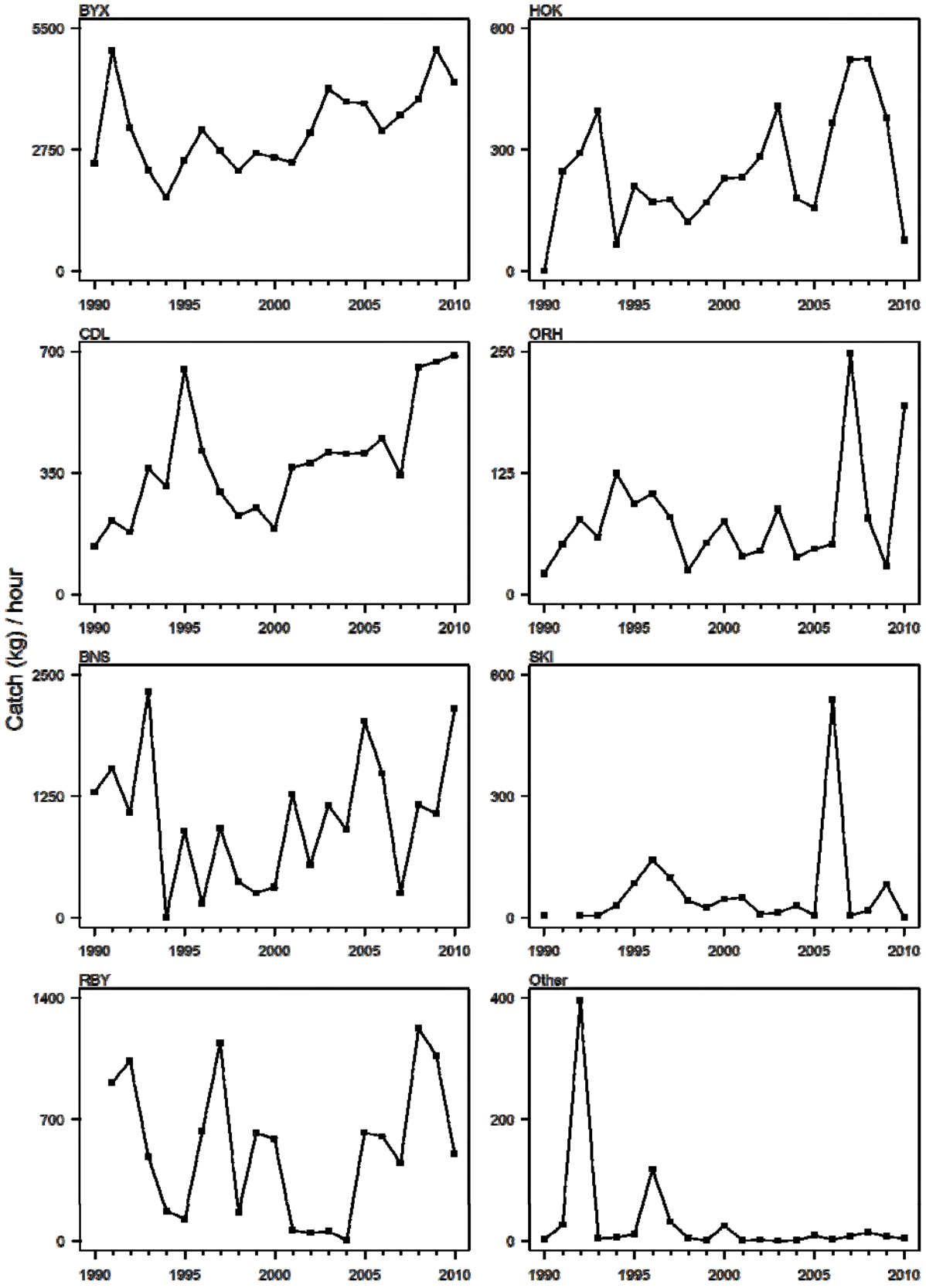


Figure C48: Catch rate (kg per hour) by fishing year for various target species for TCEPR tows in the ECNI region.

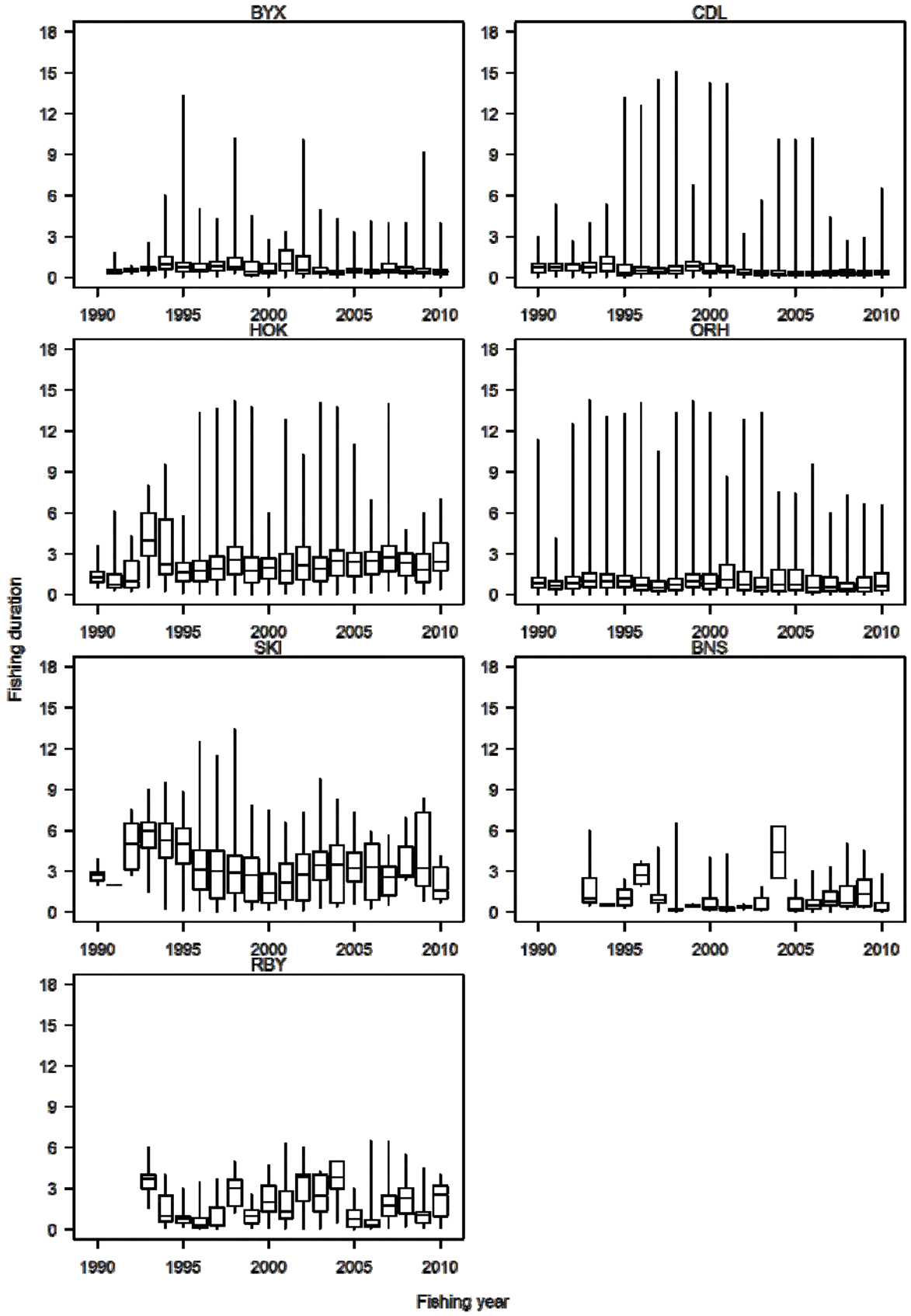


Figure C49: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) for tow durations (hours) reported in various target species fisheries capturing alfonsino in the ECNI region in TCEPR bottom trawl tows in the fishing years 1990–2010. Refer to Table C27 for species codes.

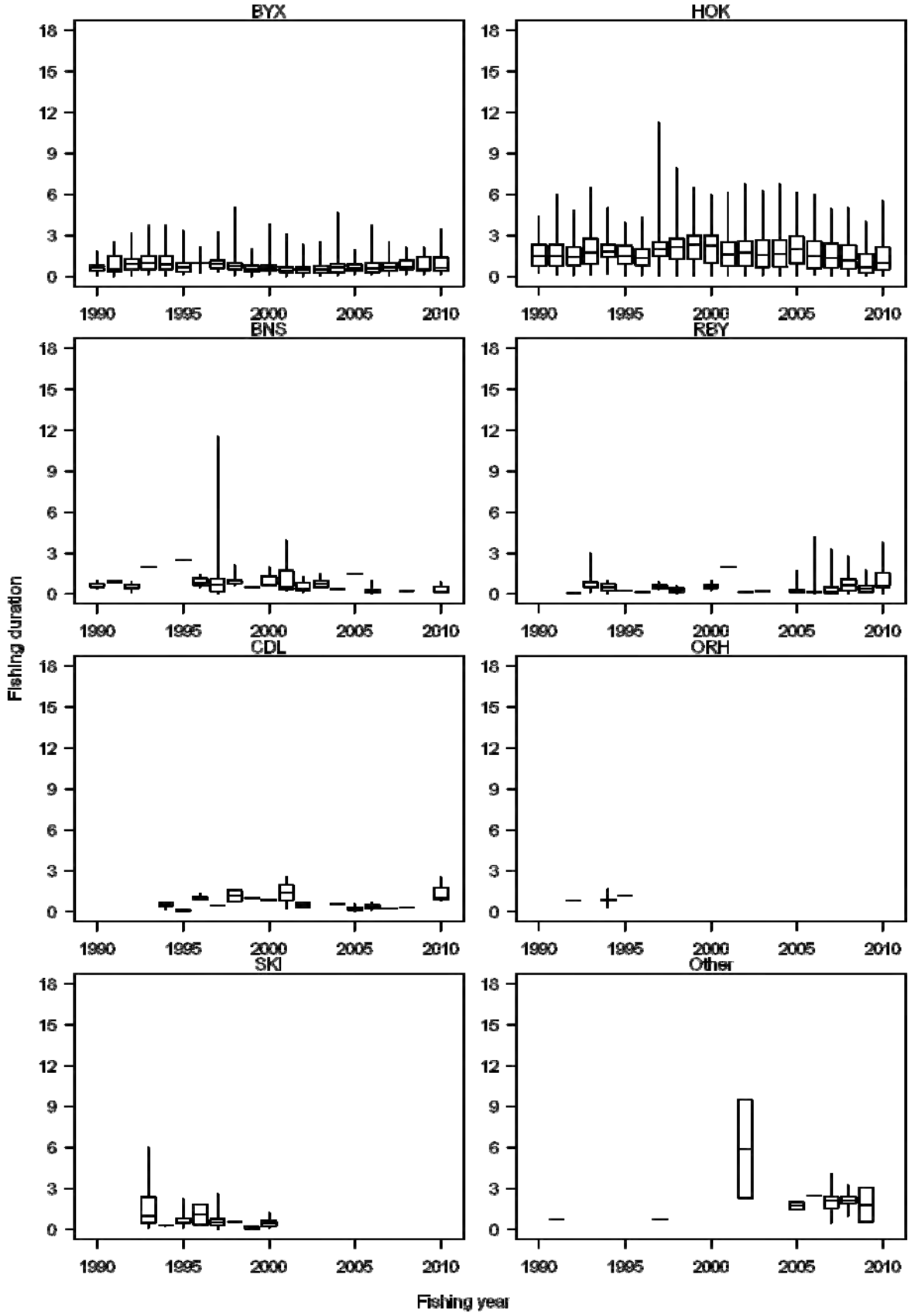


Figure C50: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) for tow durations (hours) reported for various target species fisheries capturing alfonsino in the ECNI region using TCEPR midwater trawl tows in the fishing years 1990–2010. Refer to Table C27 for species codes.

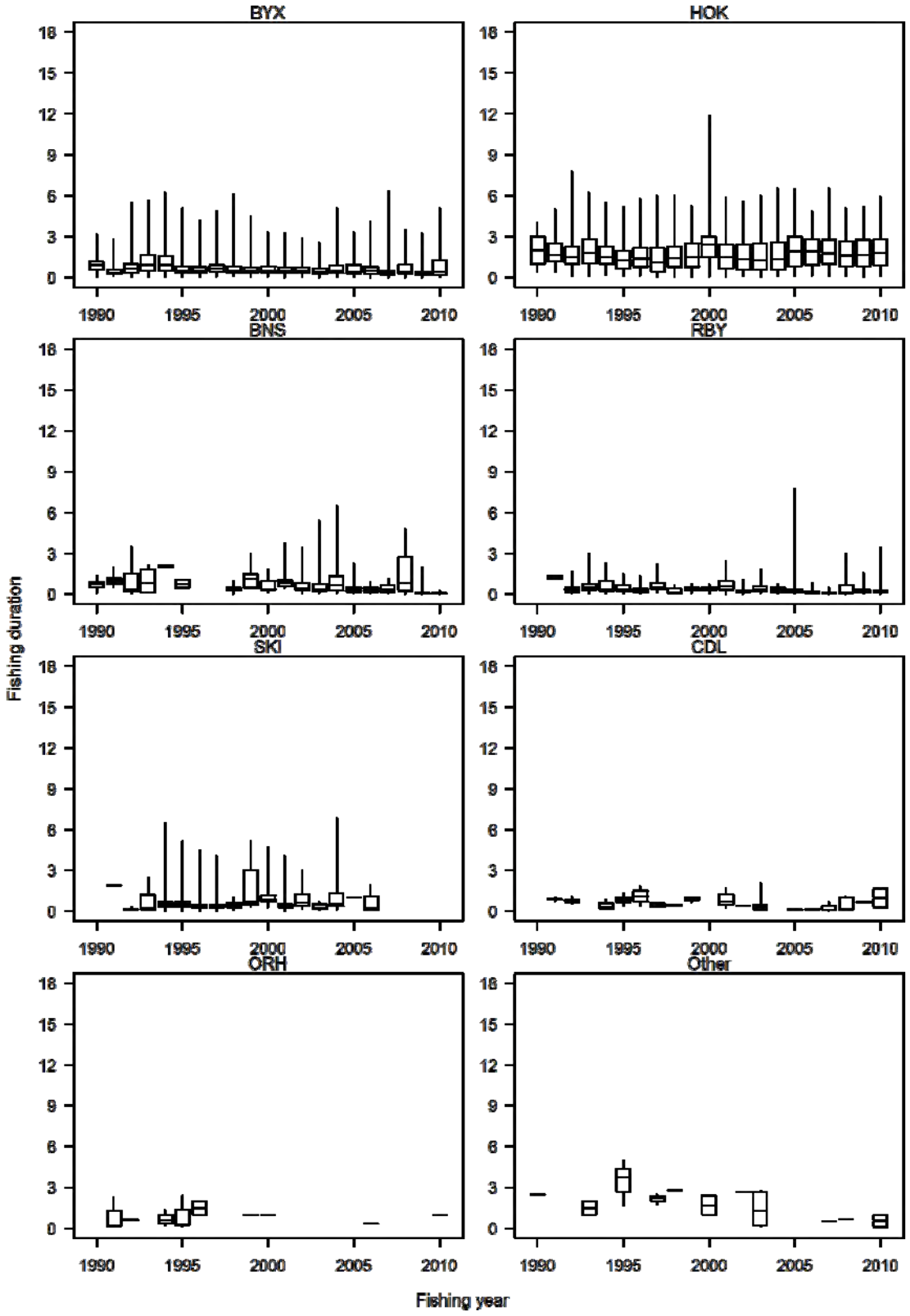


Figure C51: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) for tow durations (hours) reported for various target species fisheries capturing alfonsino in the ECNI region using TCEPR midwater trawl tows on the bottom in the fishing years 1990–2010. Refer to Table C27 for species codes.

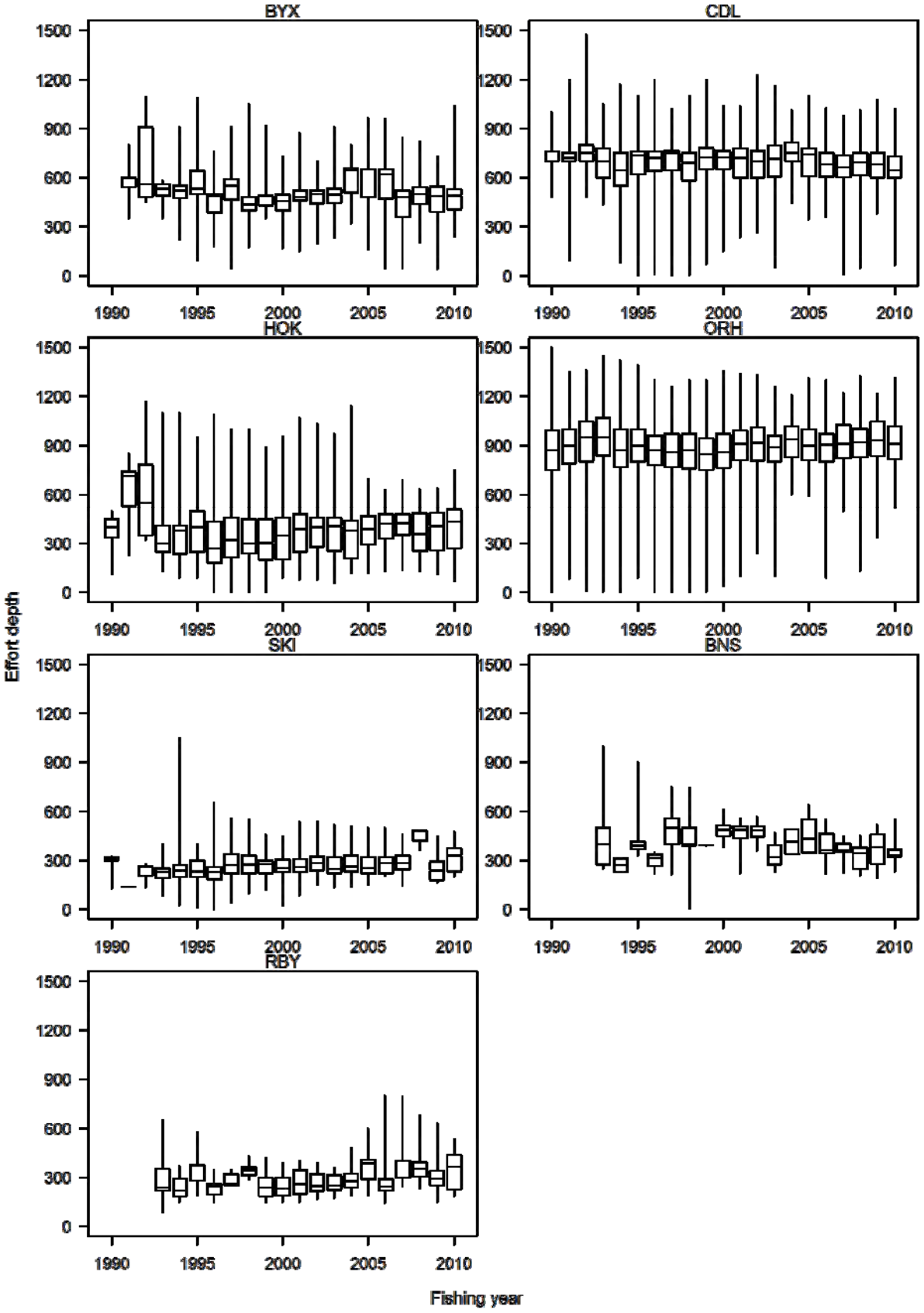


Figure C52: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) for depths (m) fished for various target species fisheries capturing alfonsino in the ECNI region using bottom tows in the fishing years 1990–2010. Refer to Table C27 for species codes.

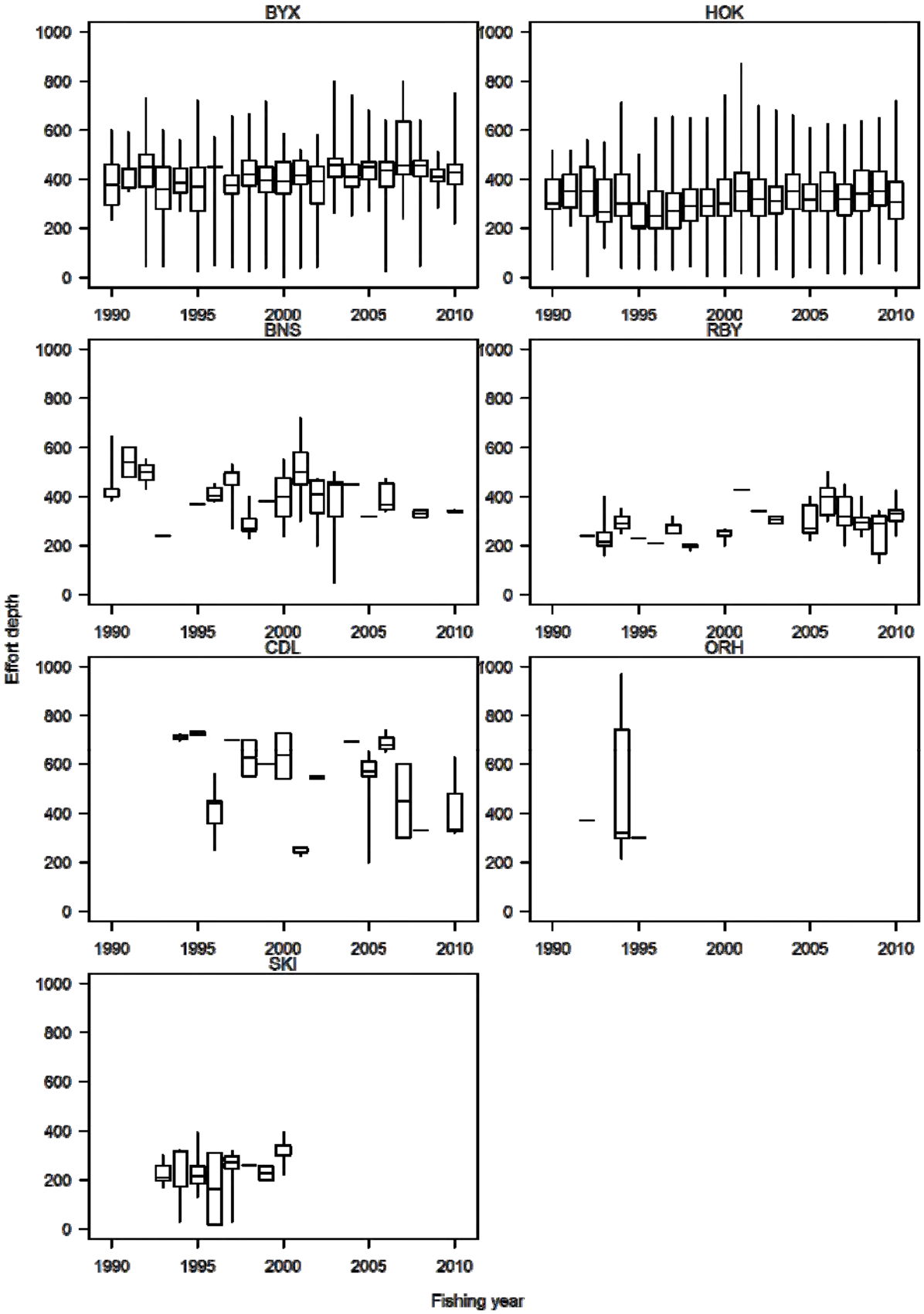


Figure C53: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) for depths (m) fished for various target species fisheries capturing alfonsino in the ECNI region using midwater tows in the fishing years 1990–2010. Refer to Table C27 for species codes.

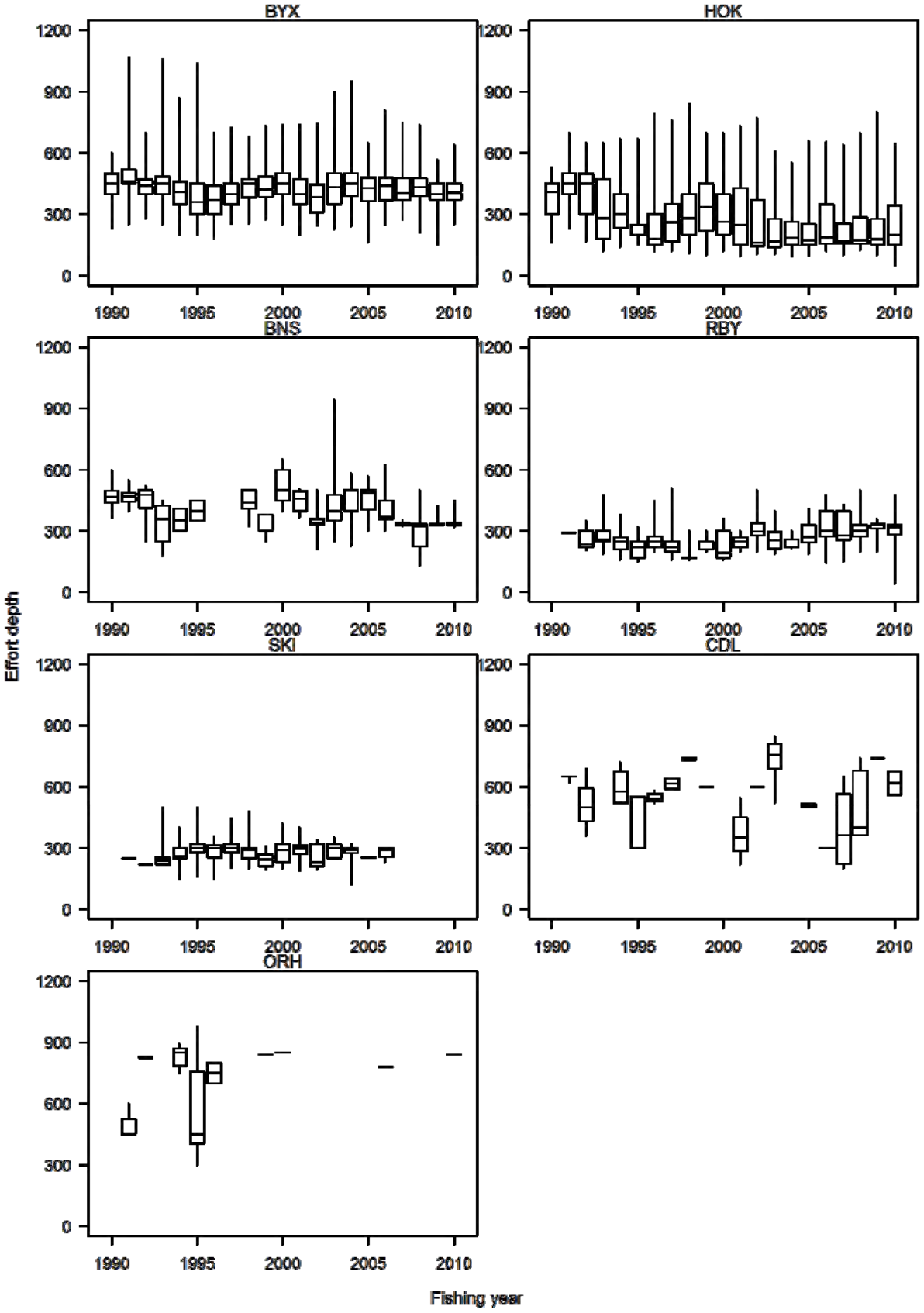


Figure C54: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) for depths (m) fished for various target species fisheries capturing alfonsino in the ECNI region using midwater tows on the bottom in the fishing years 1990–2010. Refer to Table C27 for species codes.

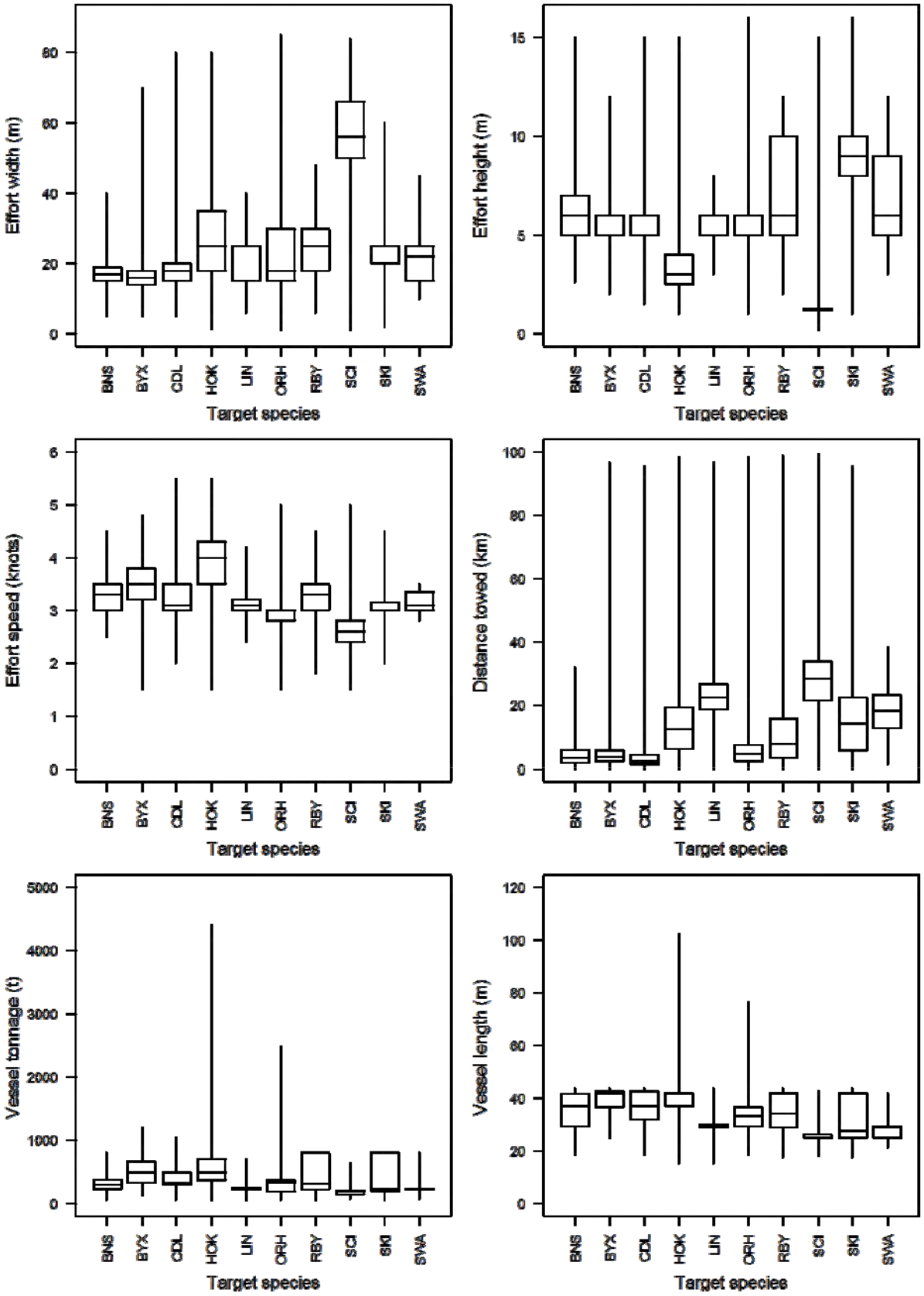


Figure C55: Distribution of fishing effort variables and vessel characteristics for the ECNI area for major target species fisheries catching alfonsino using bottom trawl gear in the fishing years 1990–2010. Refer to Table C27 for species codes.

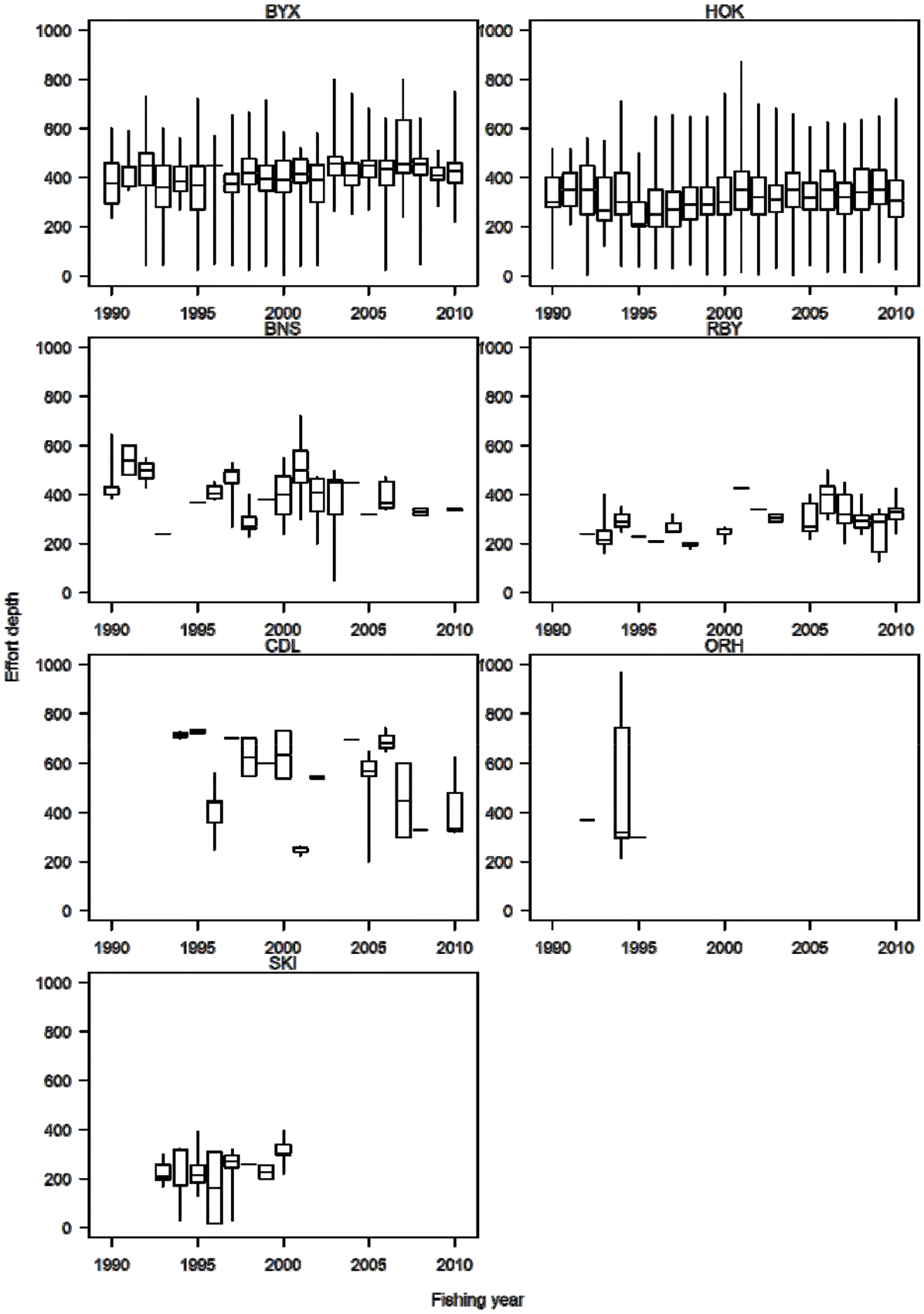


Figure C56: Distribution of fishing effort variables and vessel characteristics for the ECNI area for major target species fisheries catching alfonsino using midwater trawl gear in the fishing years 1990–2010. Refer to Table C27 for species codes.

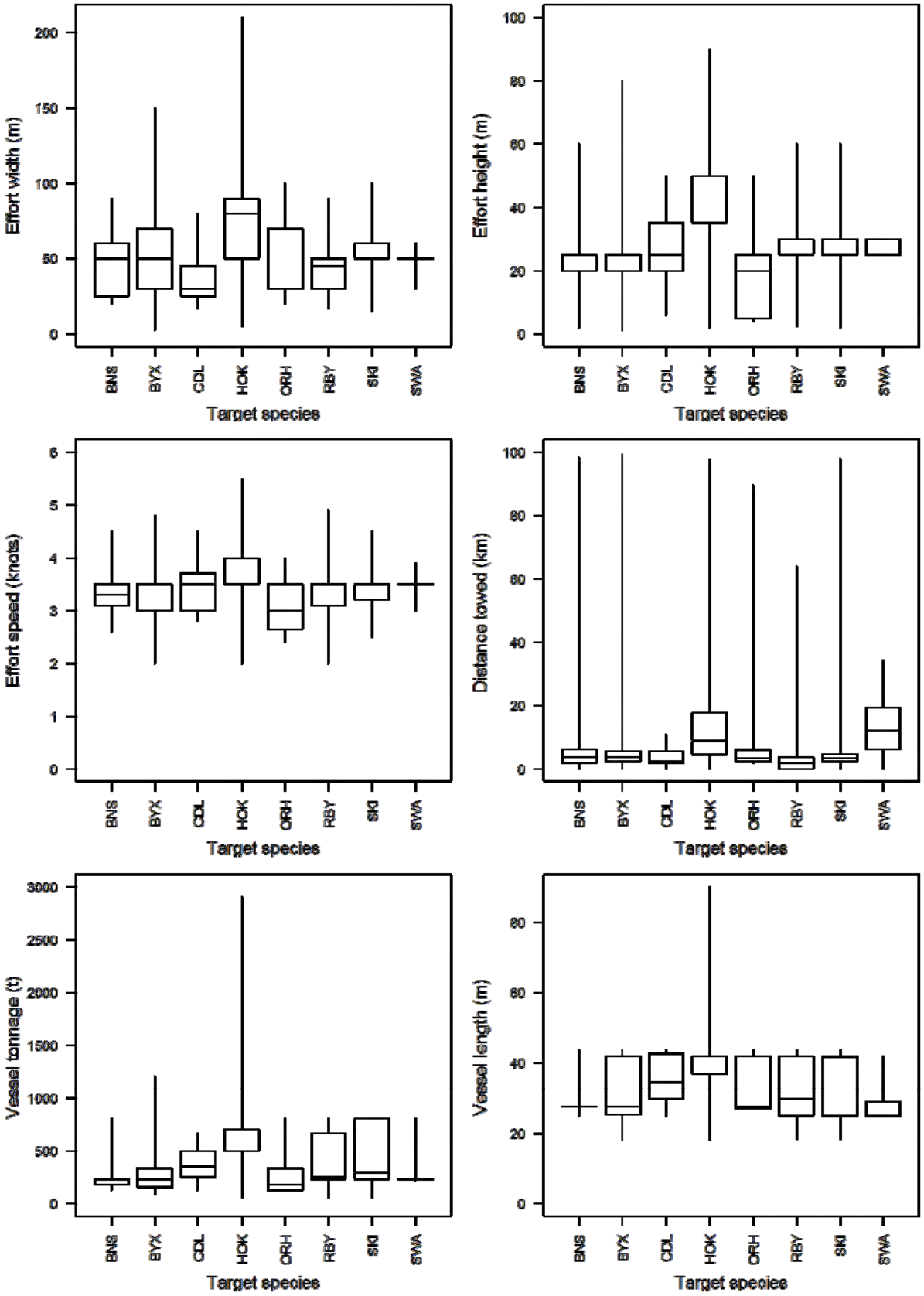


Figure C57: Distribution of fishing effort variables and vessel characteristics for the ECNI area for major target species fisheries catching alfonsino using midwater trawl gear fishing on the bottom in the fishing years 1990–2010. Refer to Table C27 for species codes.

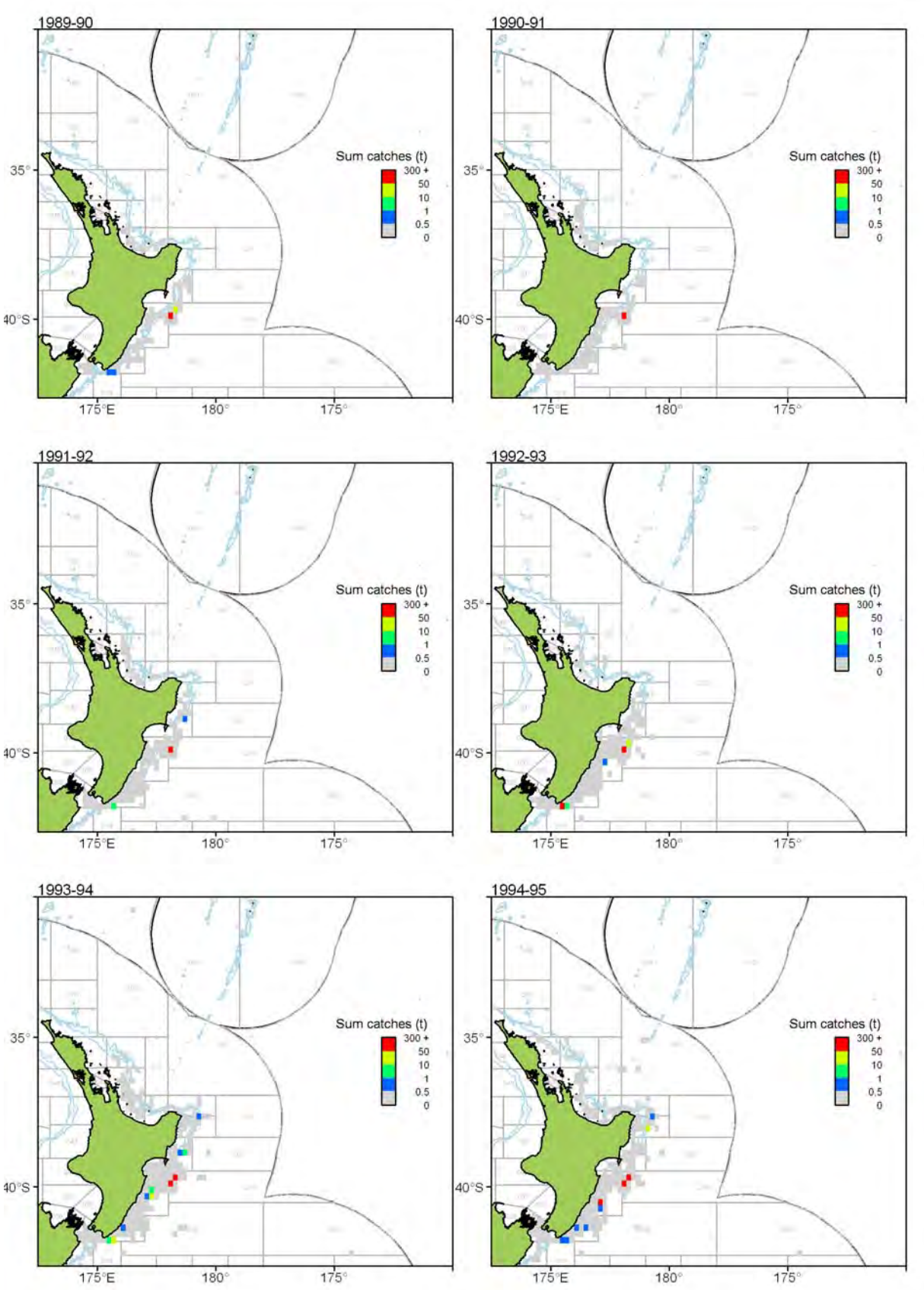


Figure C58: Distribution of alfonsino catch within the ECNI region aggregated into 0.2 degree spatial blocks for fishing years 1990–1995 reported on the TCEPR form taken by all trawl gear.

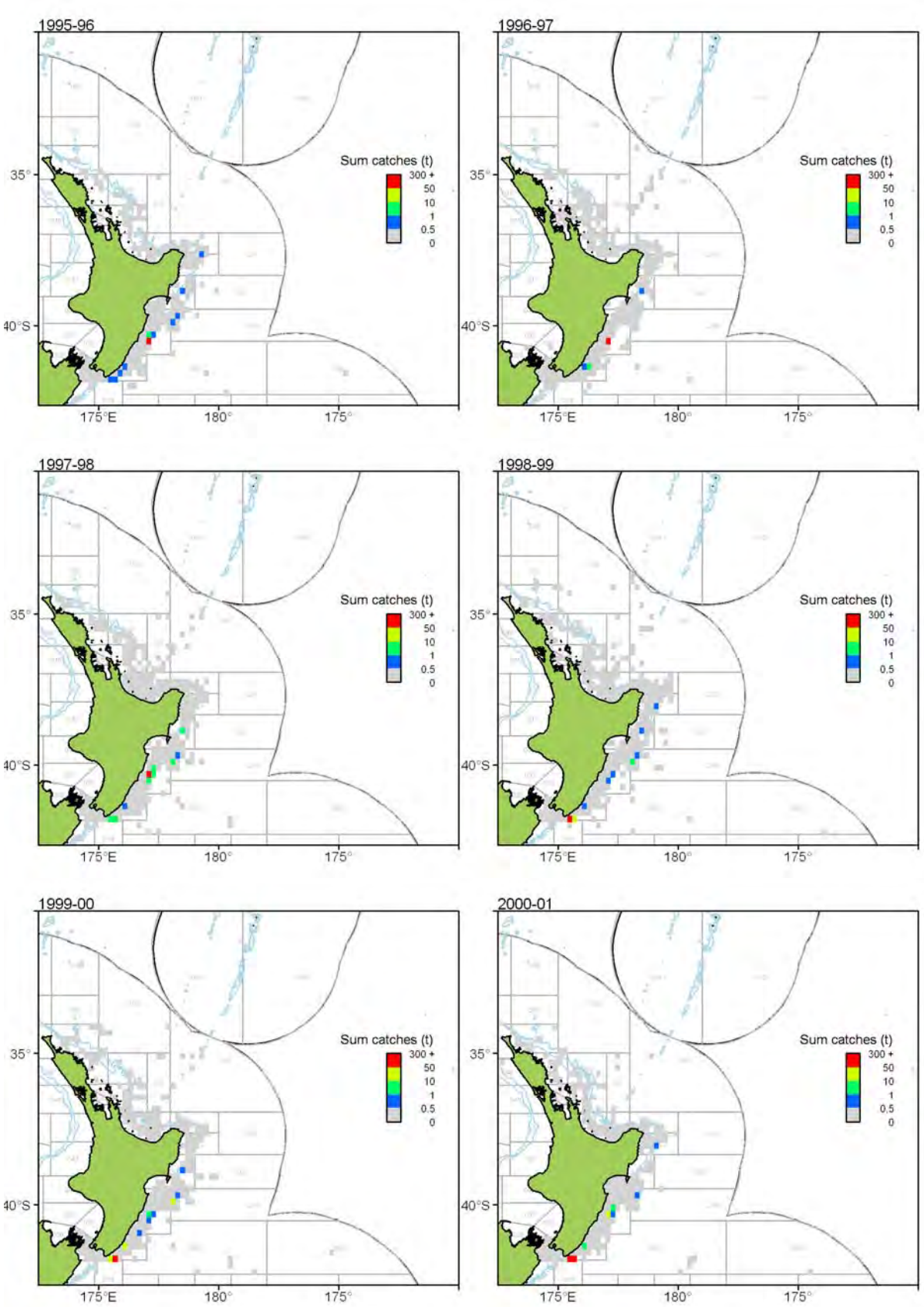


Figure C59: Distribution of alfonsino catch within the ECNI region aggregated into 0.2 degree spatial blocks for fishing years 1996–2001 reported on the TCEPR form taken by all trawl gear.

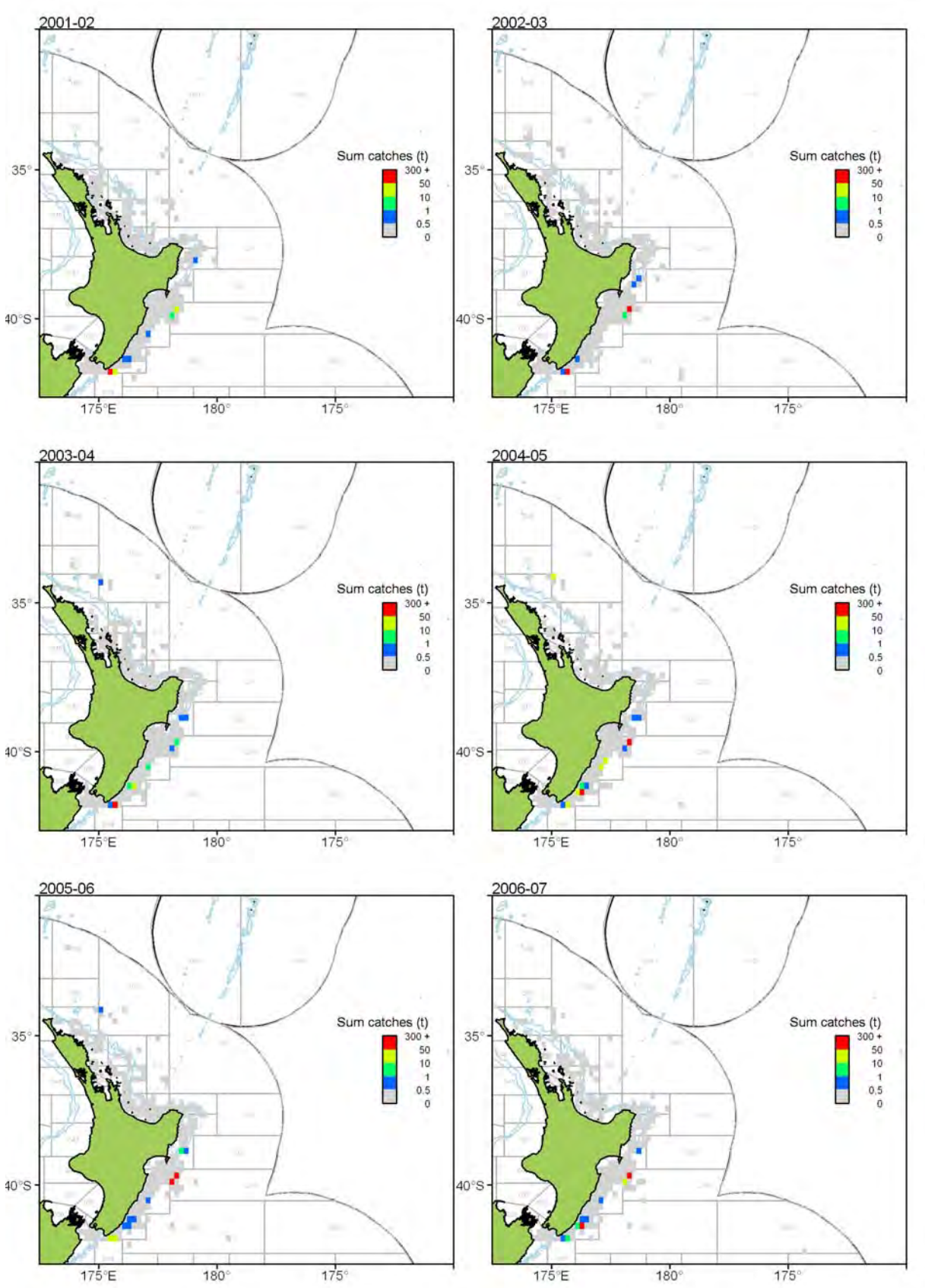


Figure C60: Distribution of alfonsino catch within the ECNI region aggregated into 0.2 degree spatial blocks for fishing years 2002–2007 reported on the TCEPR form taken by all trawl gear.

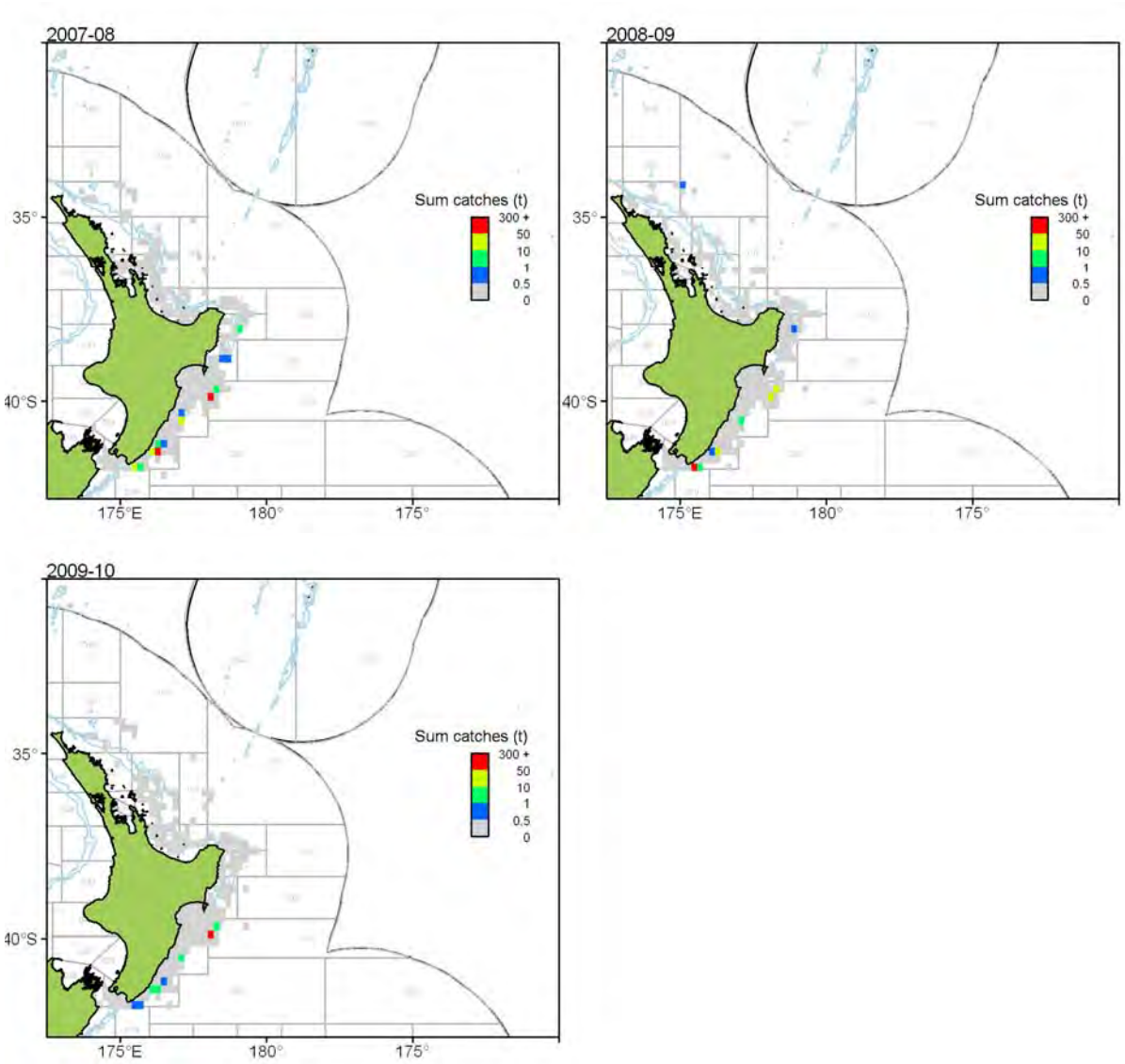


Figure C61: Distribution of alfonsino catch within the ECNI region aggregated into 0.2 degree spatial blocks for fishing years 2008–2010 reported on the TCEPR form taken by all trawl gear.

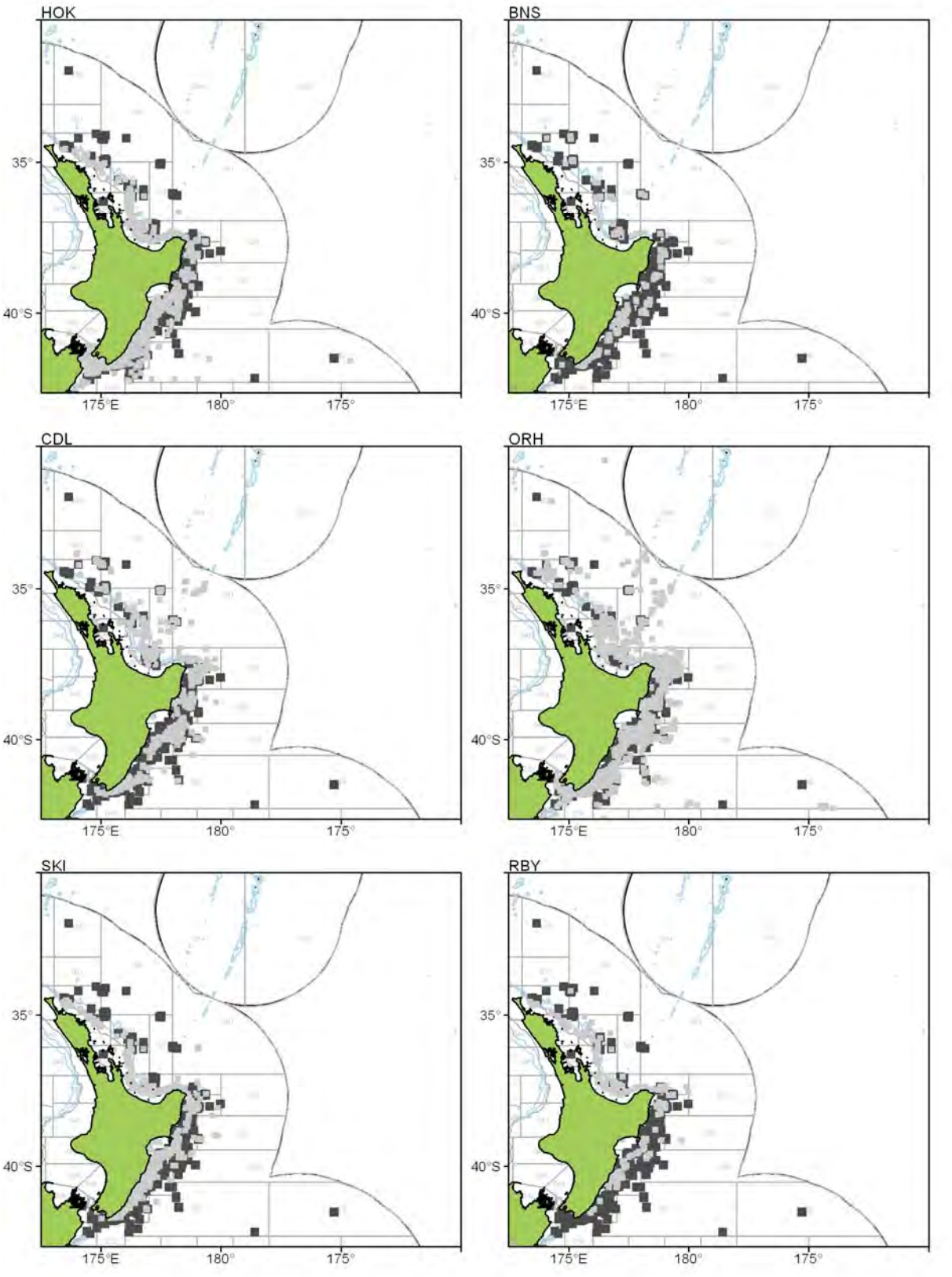


Figure C62: ECNI statistical areas and bathymetry showing the distribution of all TCEPR trawls that caught alfonsino by main target species (grey cells) compared to the distribution of alfonsino targeted trawls (black cells) in the fishing years 1990–2010. Locations are aggregated into 0.2 degree spatial squares.

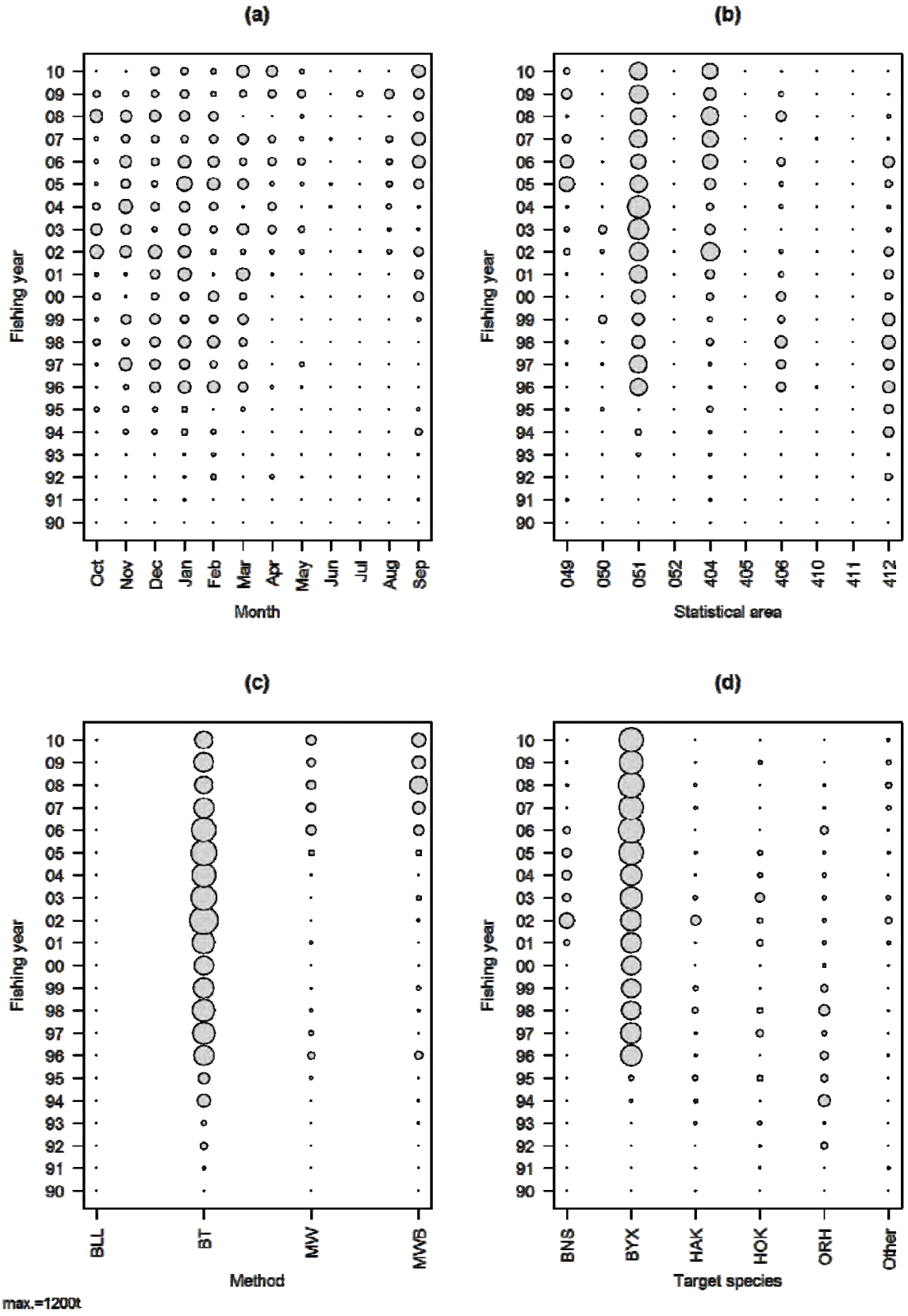


Figure C63: Distribution of alfonsino catch in the Eastern Chatham Rise region (circle size is proportional to catch) for fishing years 1990–2010 in relation to a) month, b) statistical area, c) fishing method, and d) target species. Circle size is proportional to catch; maximum circle size is indicated in lower left hand corner. Refer to Table C27 for species codes.

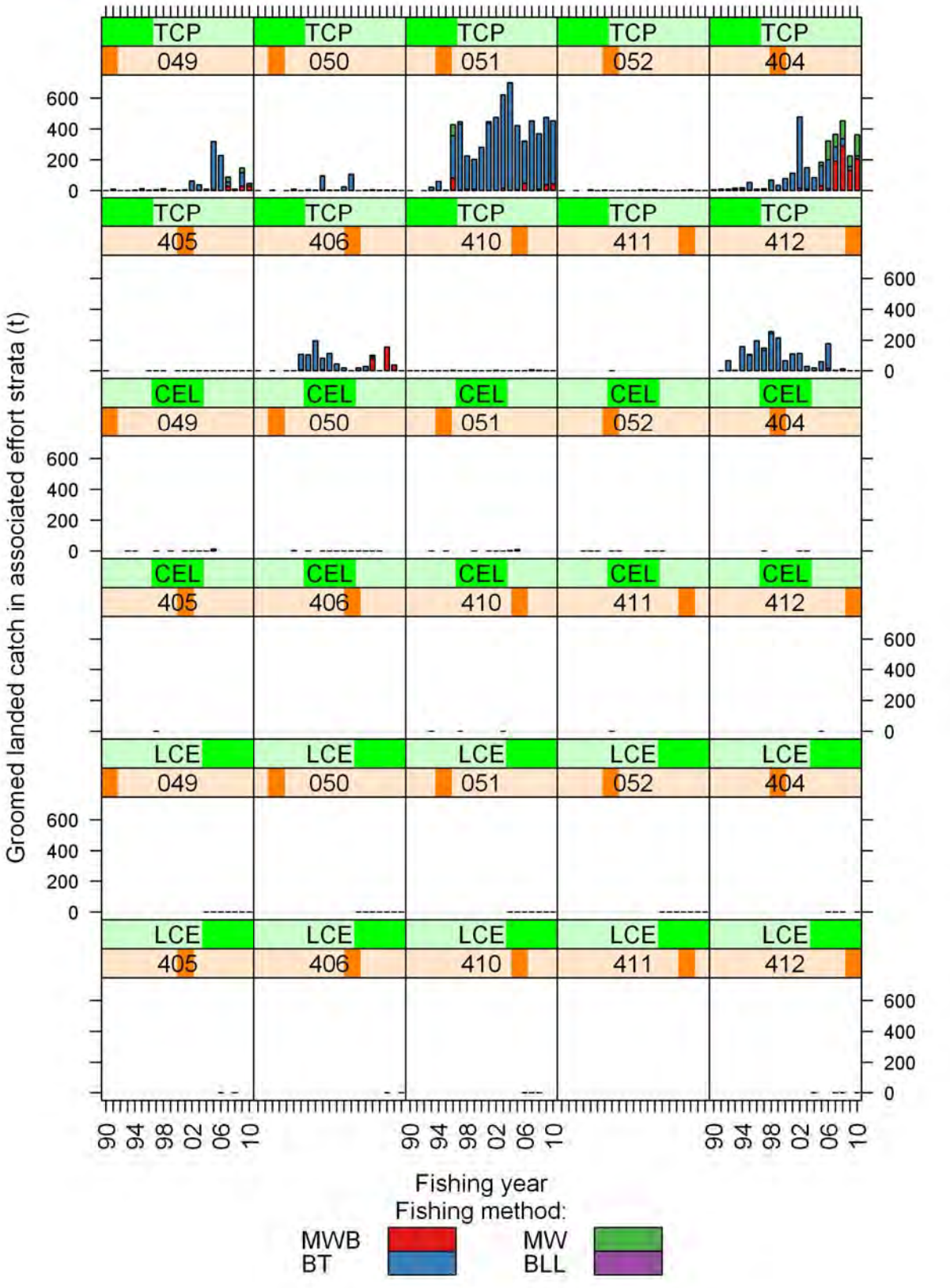


Figure C64: Distribution of alfonsino catch in the Eastern Chatham Rise region in relation to form type and statistical area for fishing years 1990–2010 by fishing method.

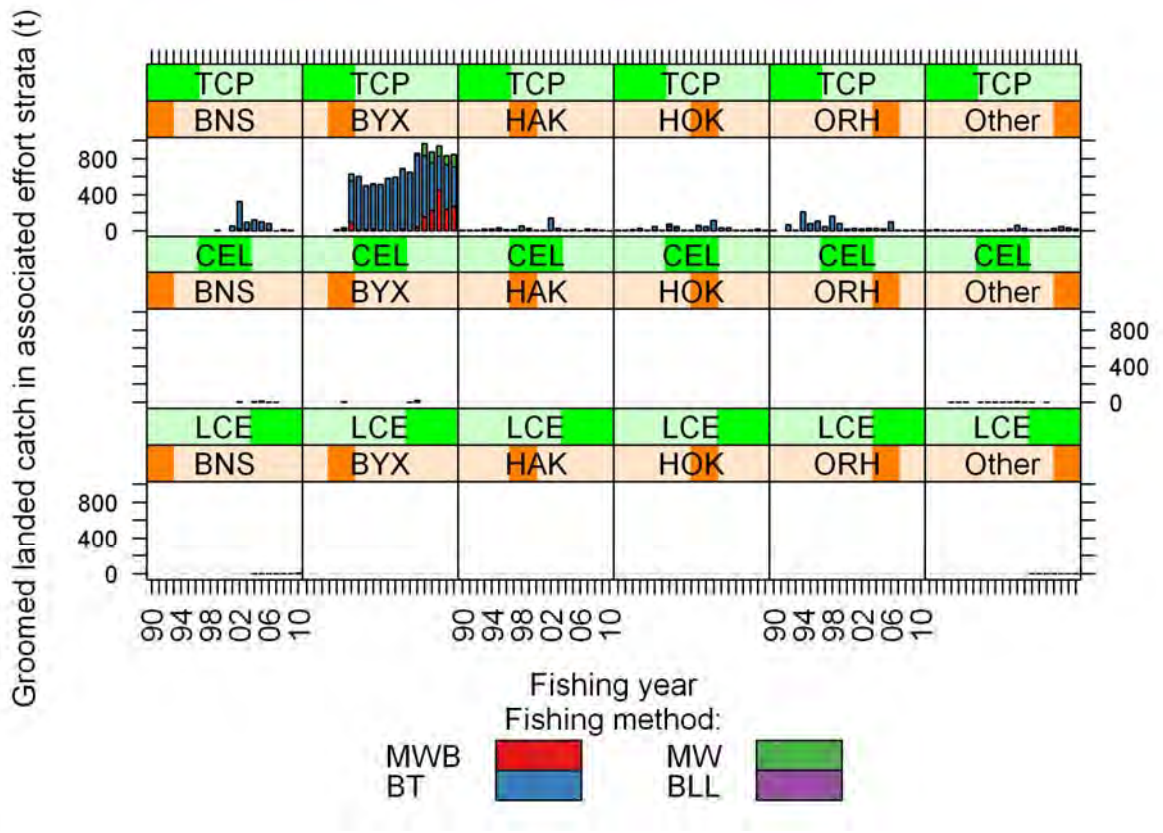


Figure C65: Distribution of alfonsino catch in the Eastern Chatham Rise region in relation to form type and target species for fishing years 1990–2010 by fishing method. Refer to Table C27 for species codes.

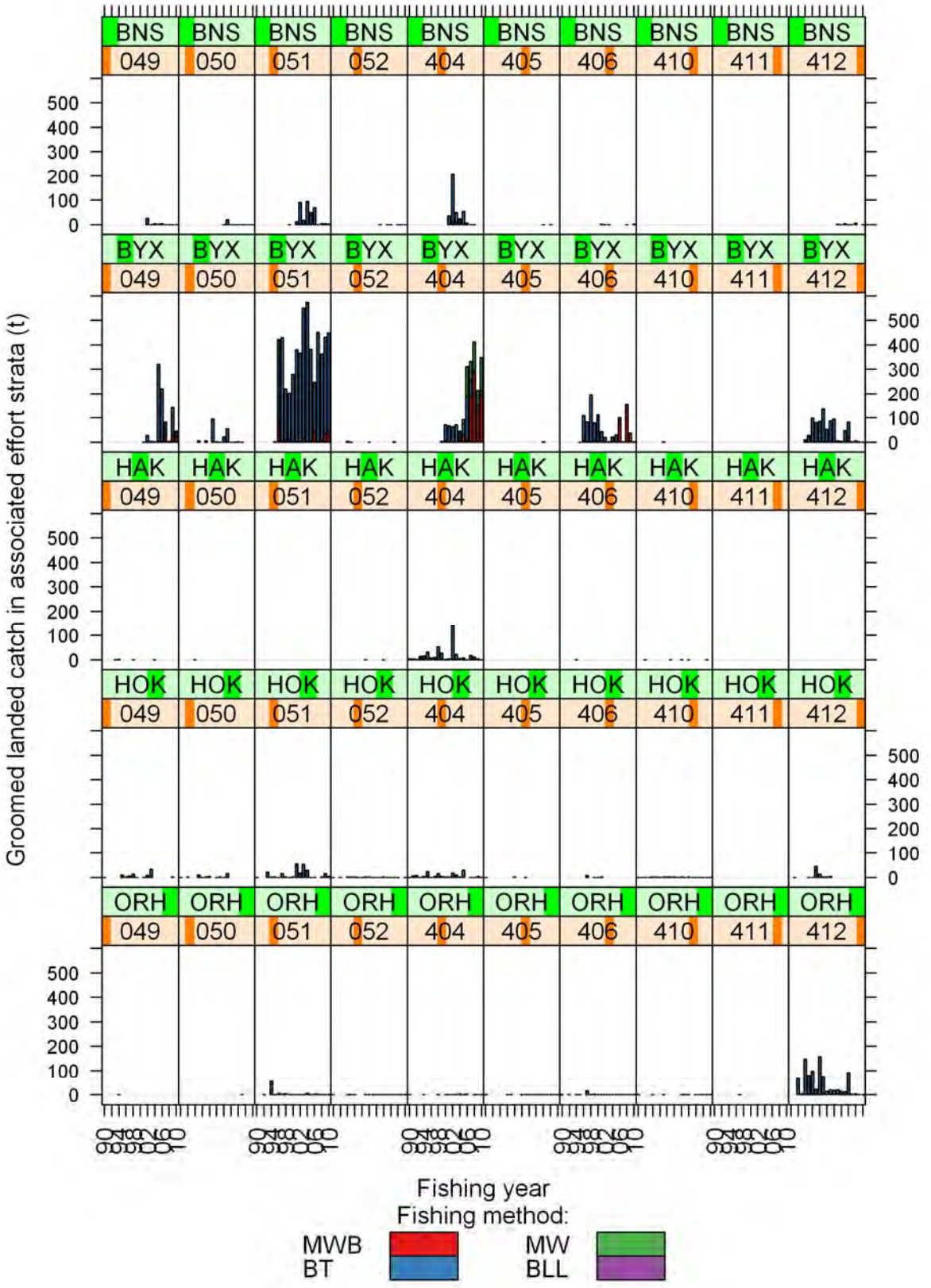


Figure C66: Distribution of alfonsino catch in the Eastern Chatham Rise region in relation to target species and statistical area by fishing method for fishing years 1990–2010. Refer to Table C27 for species codes.

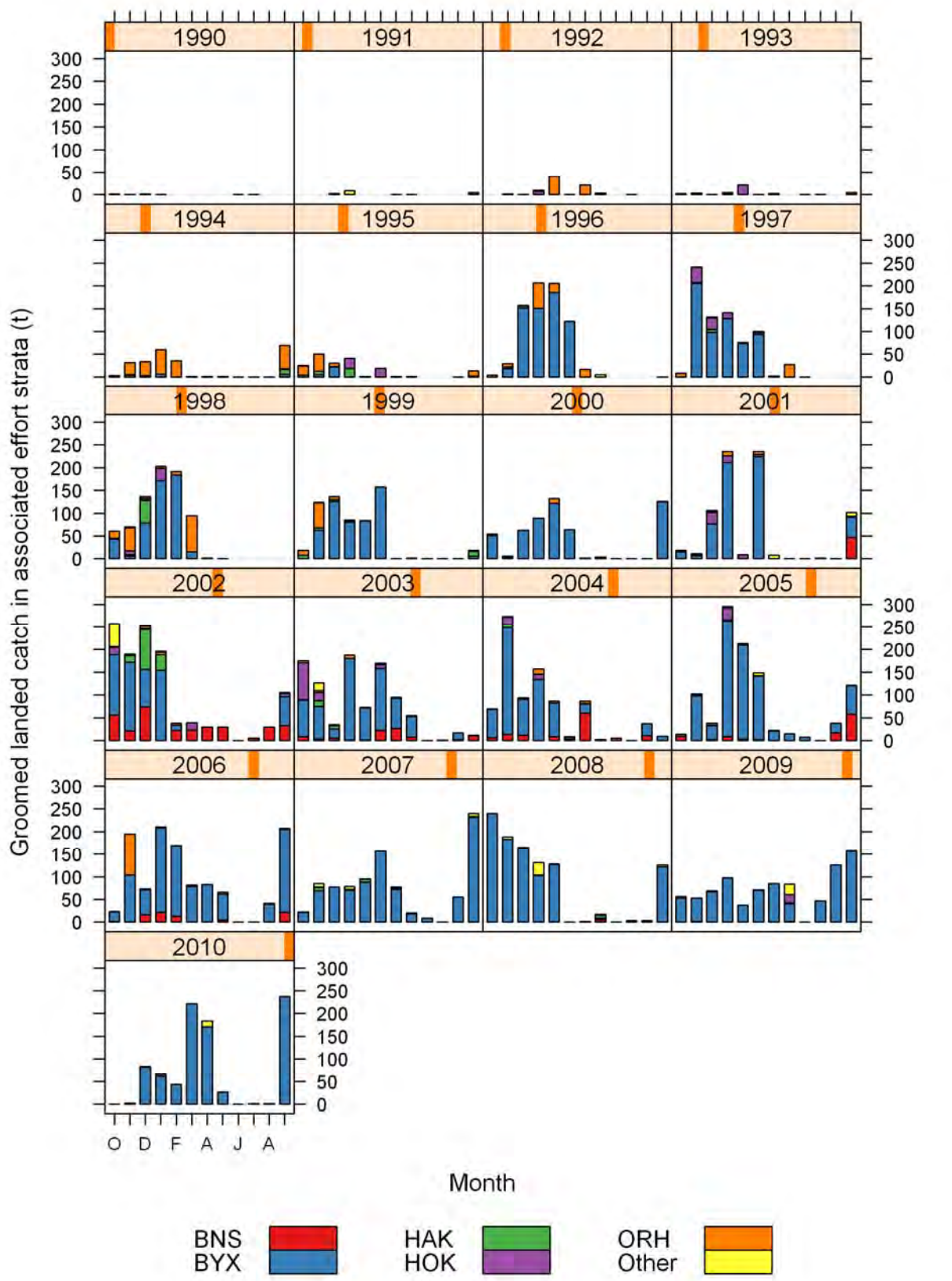


Figure C67: Distribution of alfonsino catch in the Eastern Chatham Rise region taken by bottom trawl fishing methods by fishing month for fishing years 1990–2010 by target species. Refer to Table C27 for species codes.

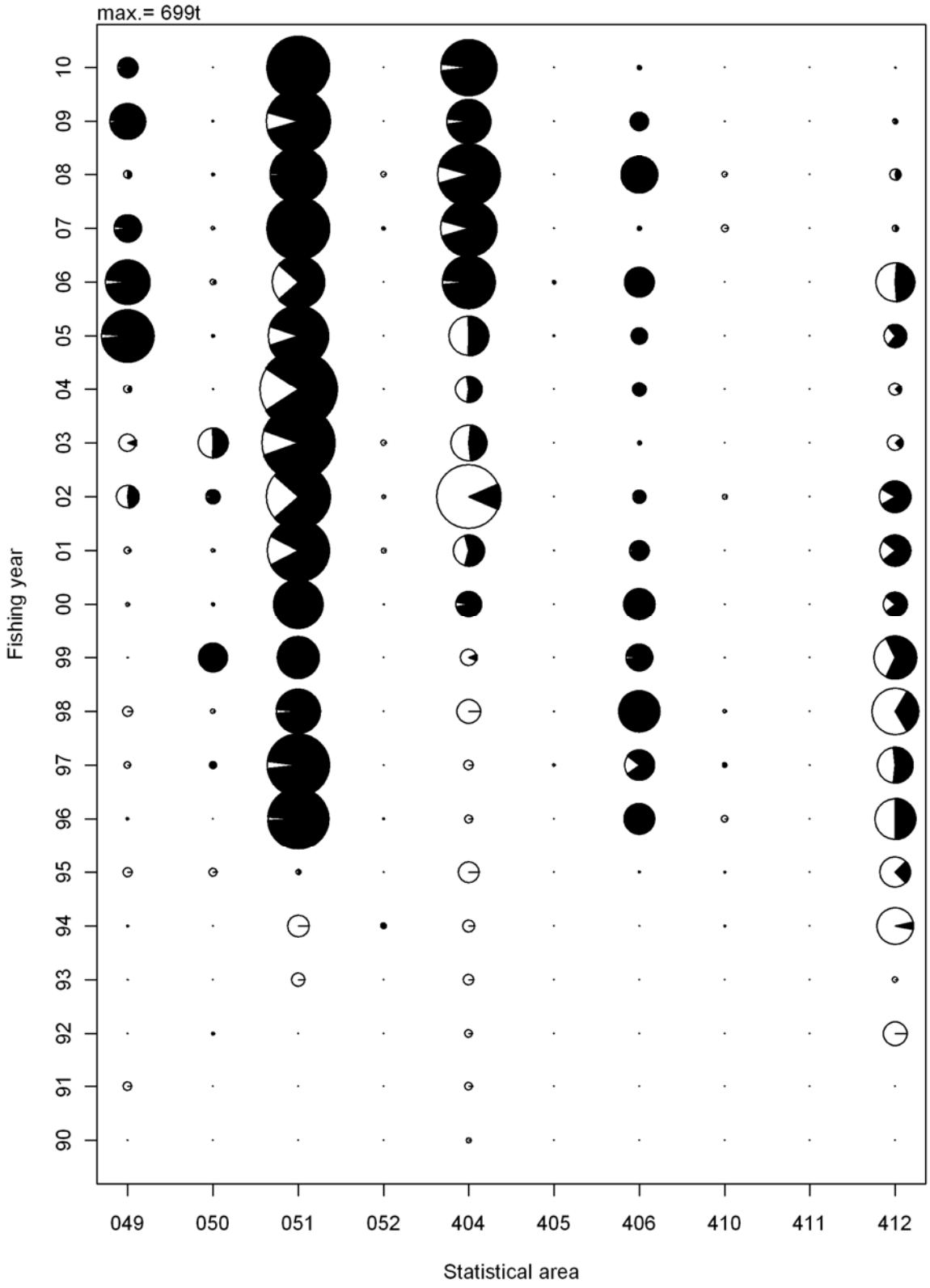


Figure C68: Distribution of alfonsino catch by fishing year with circle size proportional to the total catch and black portion of the pie indicating proportion of the catch as targeted alfonsino by statistical area for TCEPR tows in the Eastern Chatham Rise region.

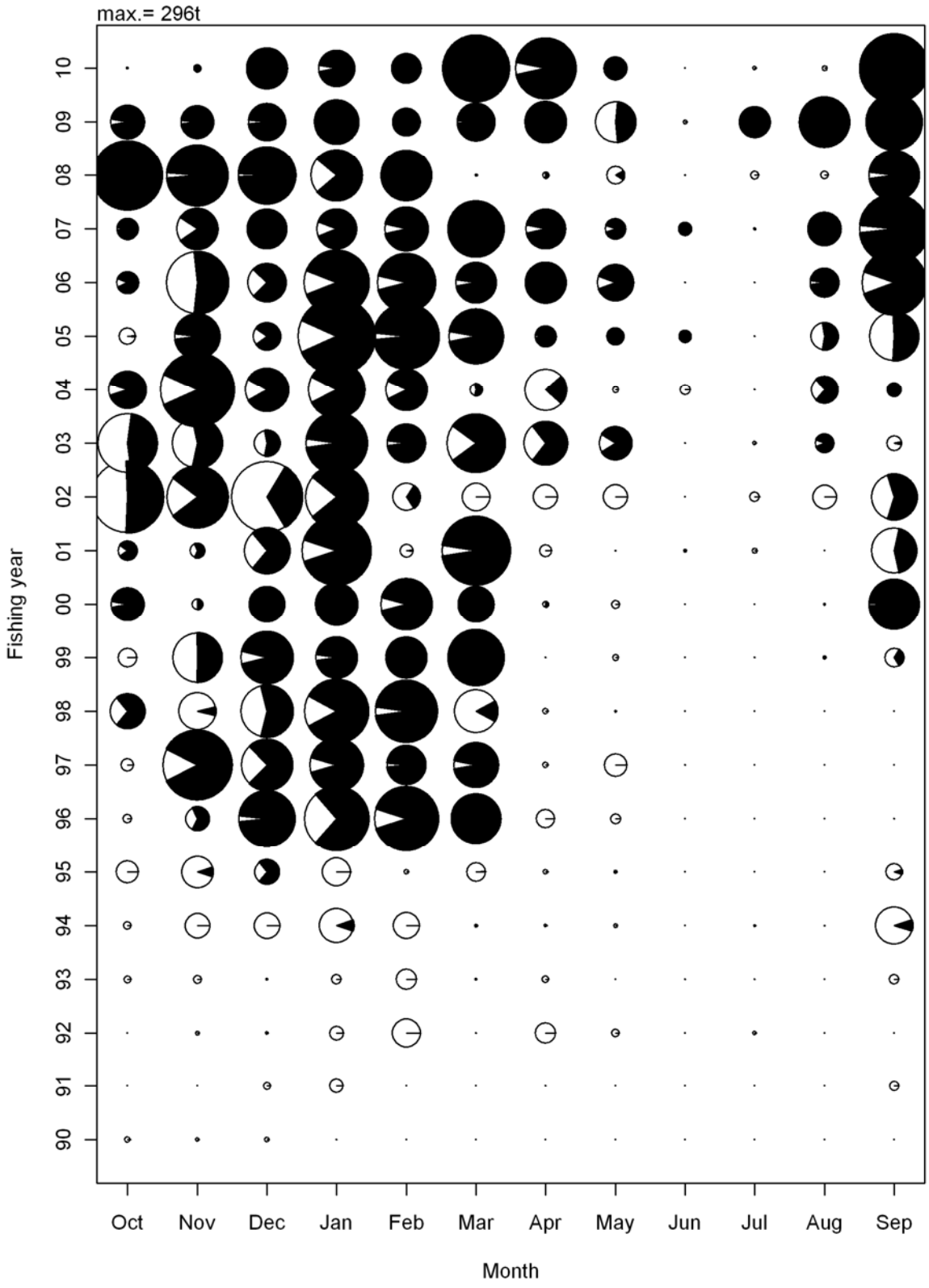


Figure C69: Distribution of alfonsino catch by fishing year with circle size proportional to the total catch and black portion of the pie indicating proportion of the catch as targeted alfonsino by month for TCEPR tows in the Eastern Chatham Rise region.

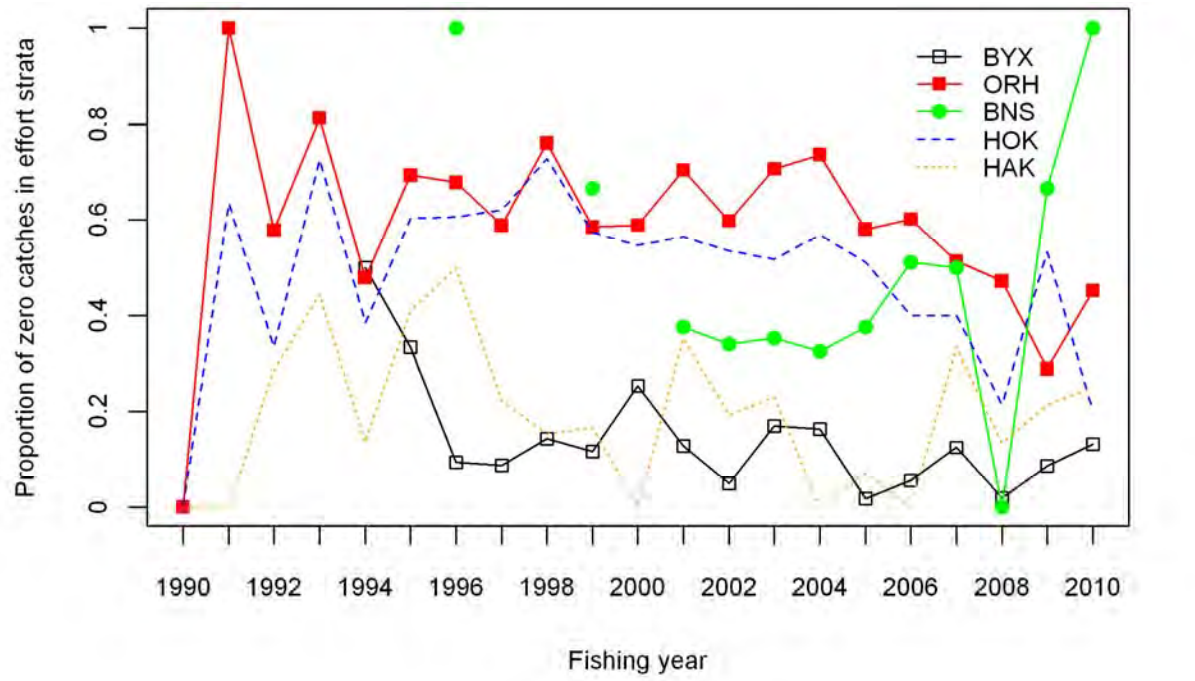


Figure C70: Proportion of TCEPR tows with zero reported alfonsino catch by major target species for the Eastern Chatham Rise region. Refer to Table C27 for species codes.

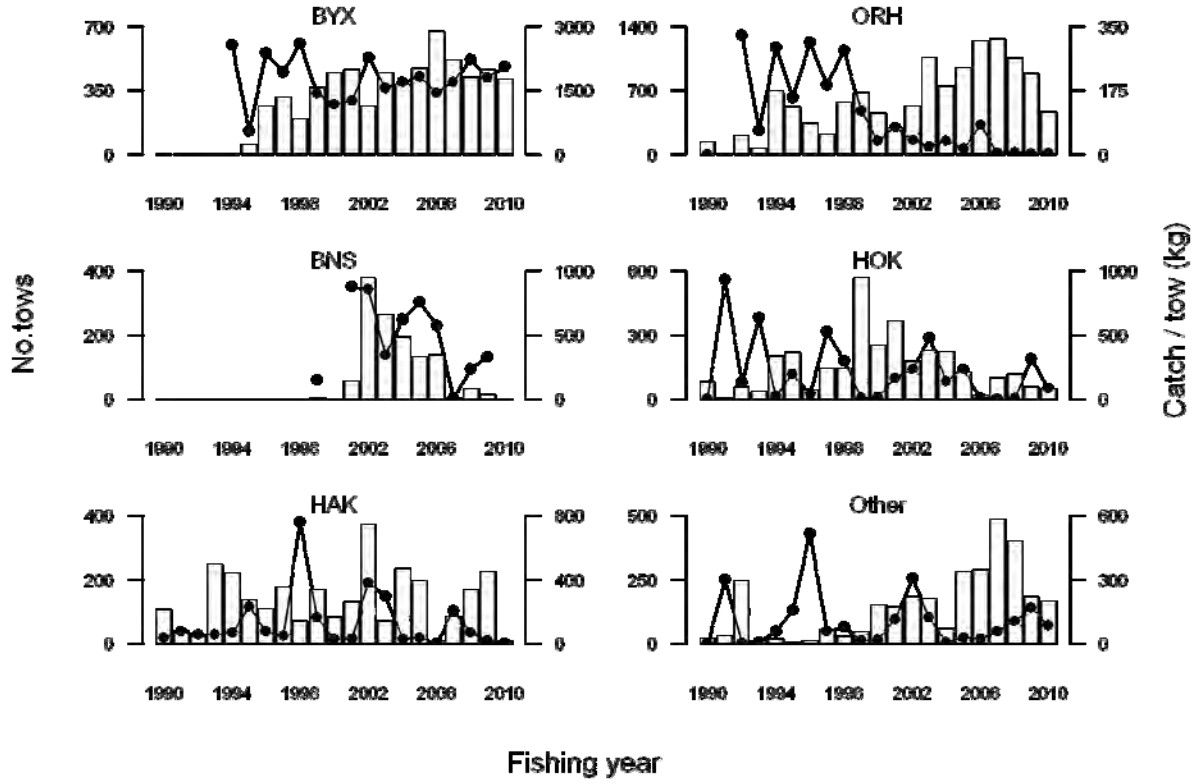


Figure C71: Annual catch rate of alfonsino in kilograms alfonsino (catch/tow) and the number of TCEPR tows in the Eastern Chatham Rise region for various target species. Refer to Table C27 for species codes.

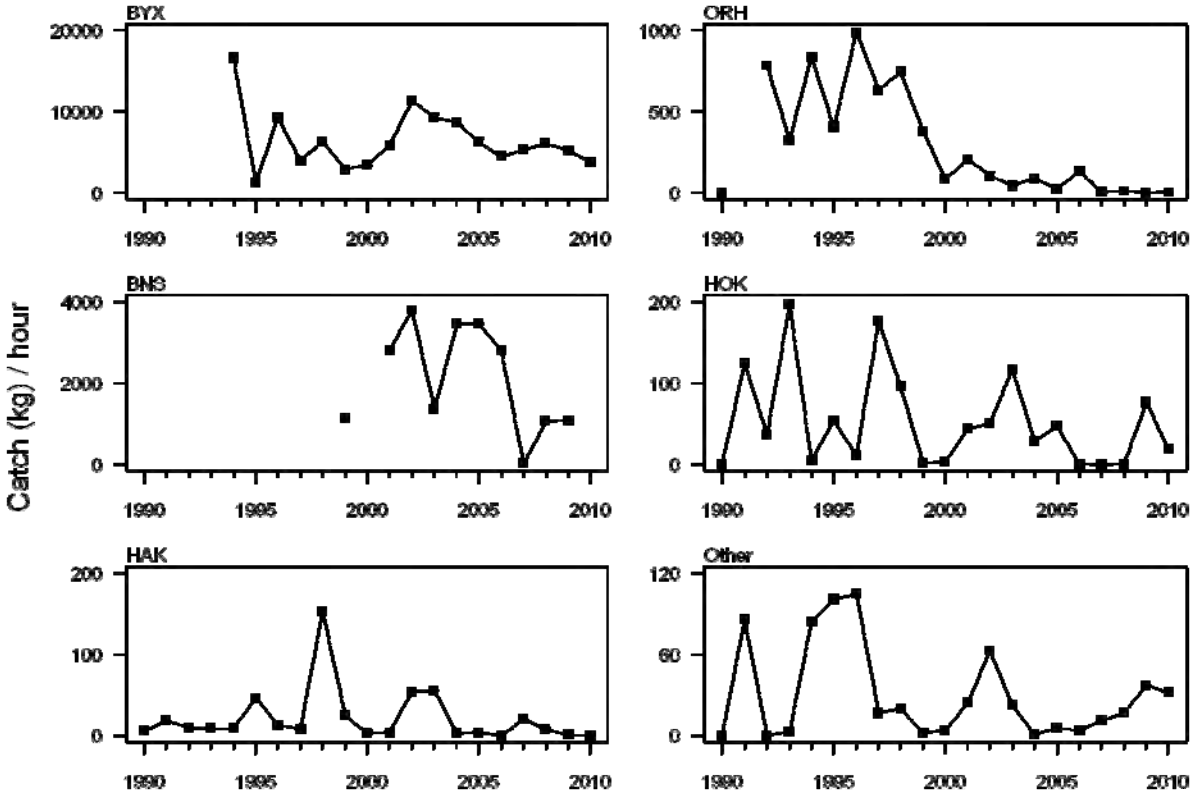


Figure C72: Catch rate (kg per hour) by fishing year for various target species for TCEPR tows in the Eastern Chatham Rise region.

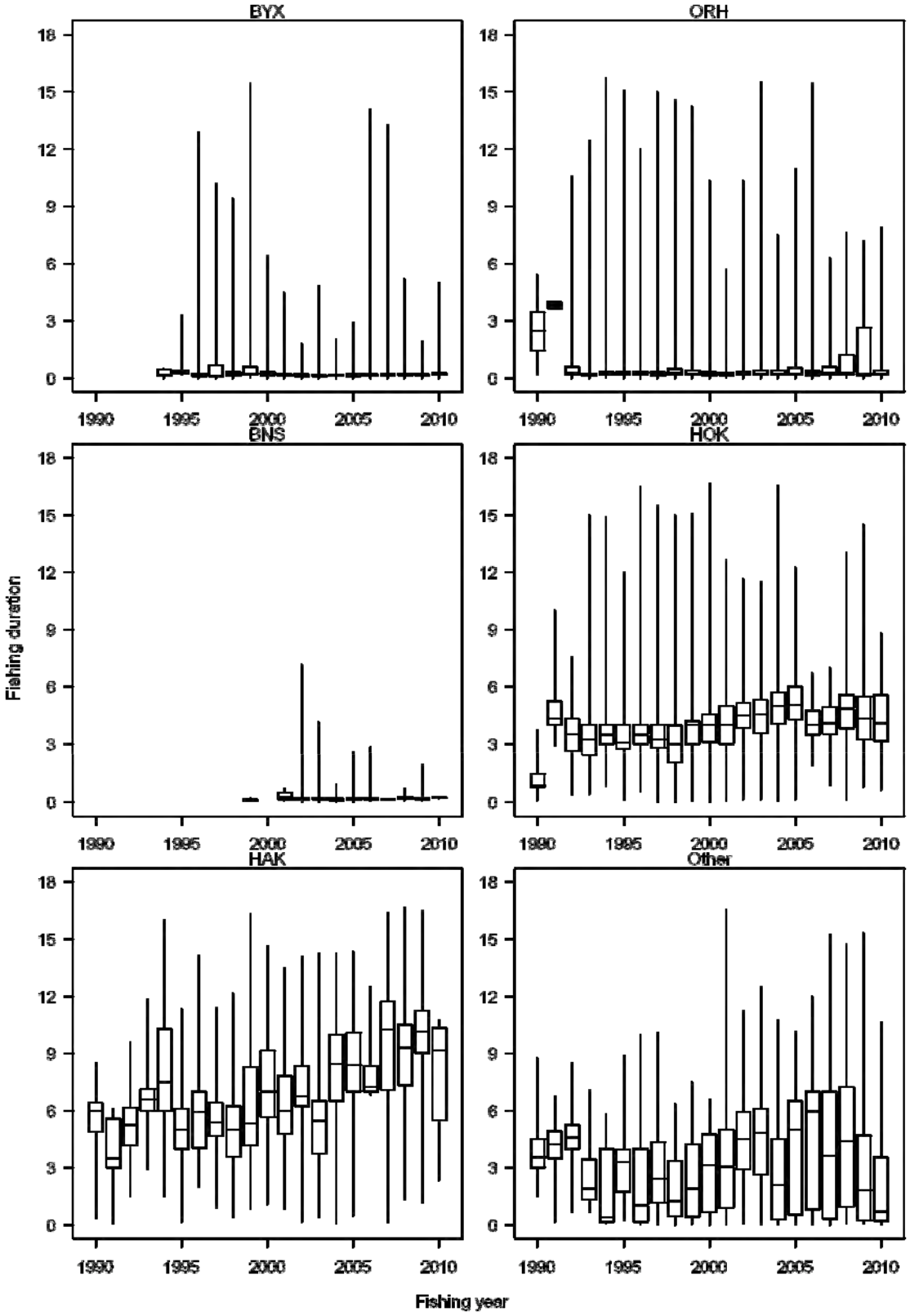


Figure C73: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) for tow durations (hours) reported for various target species fisheries capturing alfonsino in Eastern Chatham Rise region using TCEPR bottom trawl tows in the fishing years 1990–2010. Refer to Table C27 for species codes.

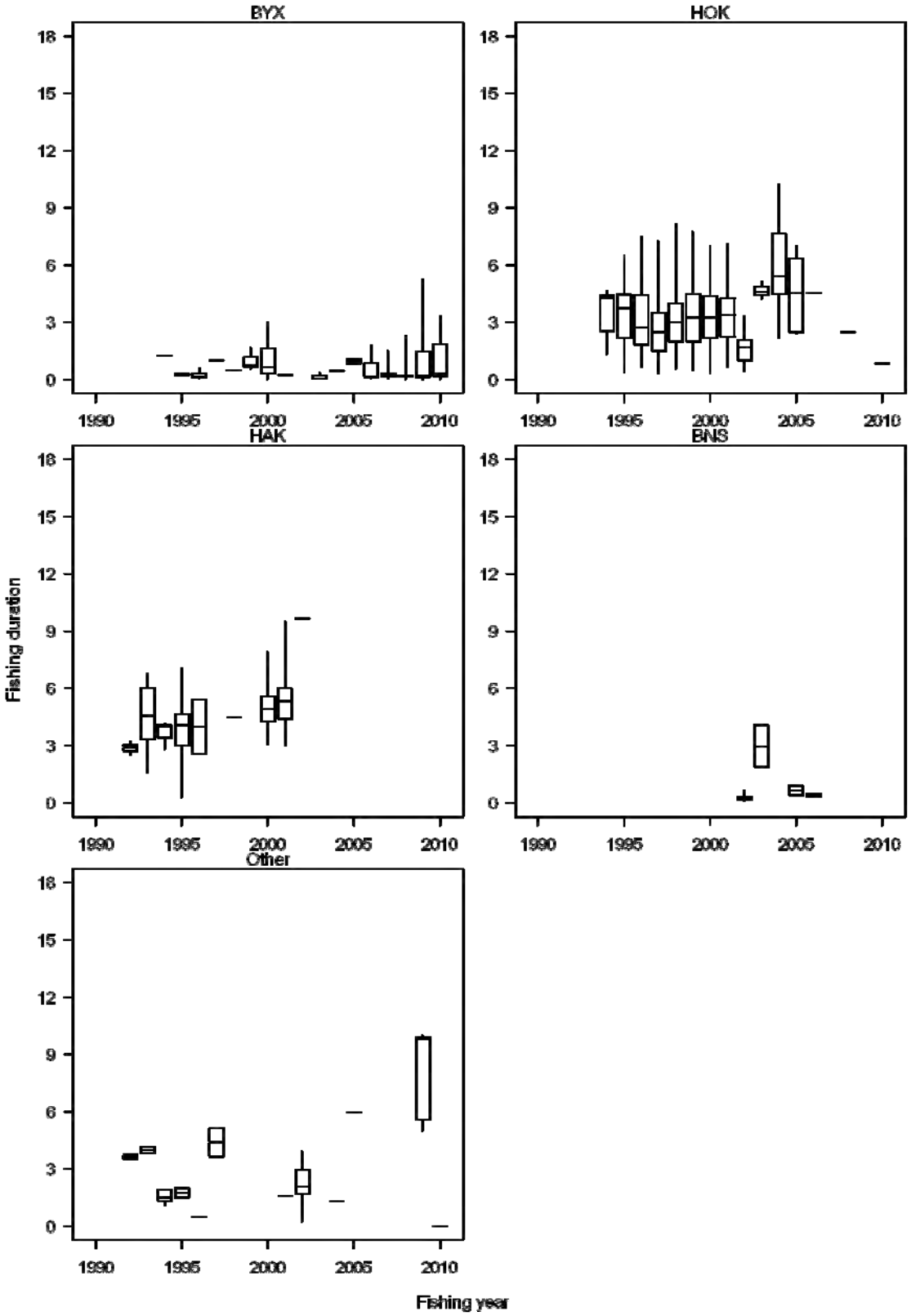


Figure C74: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) for tow durations (hours) reported for various target species fisheries capturing alfonsino in Eastern Chatham Rise region using TCEPR midwater trawl tows in the fishing years 1990–2010. Refer to Table C27 for species

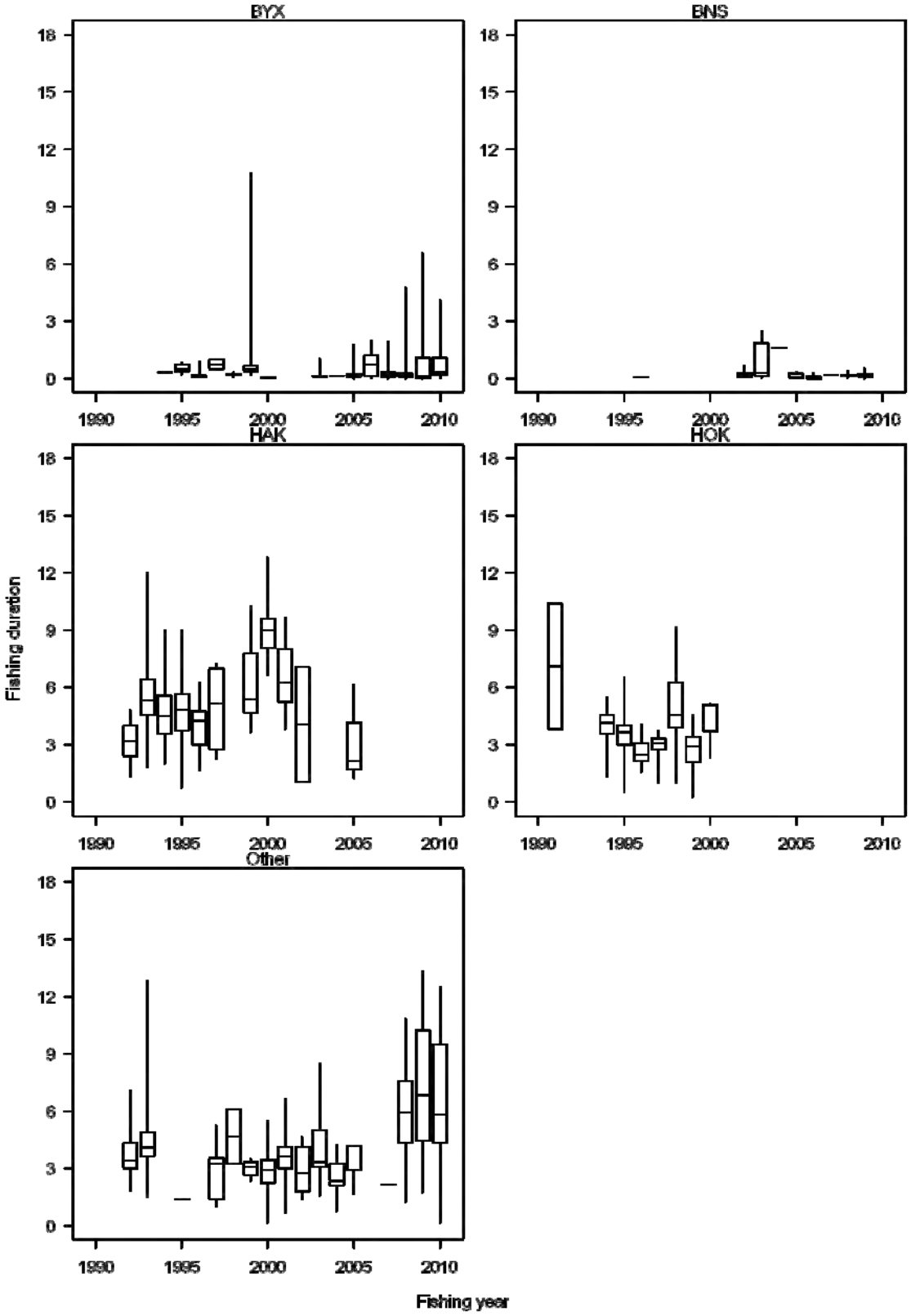


Figure C75: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) for tow durations (hours) reported for various target species fisheries capturing alfonsino in Eastern Chatham Rise region using TCEPR midwater trawl tows on the bottom in the fishing years 1990–2010. Refer to Table C27 for species codes.

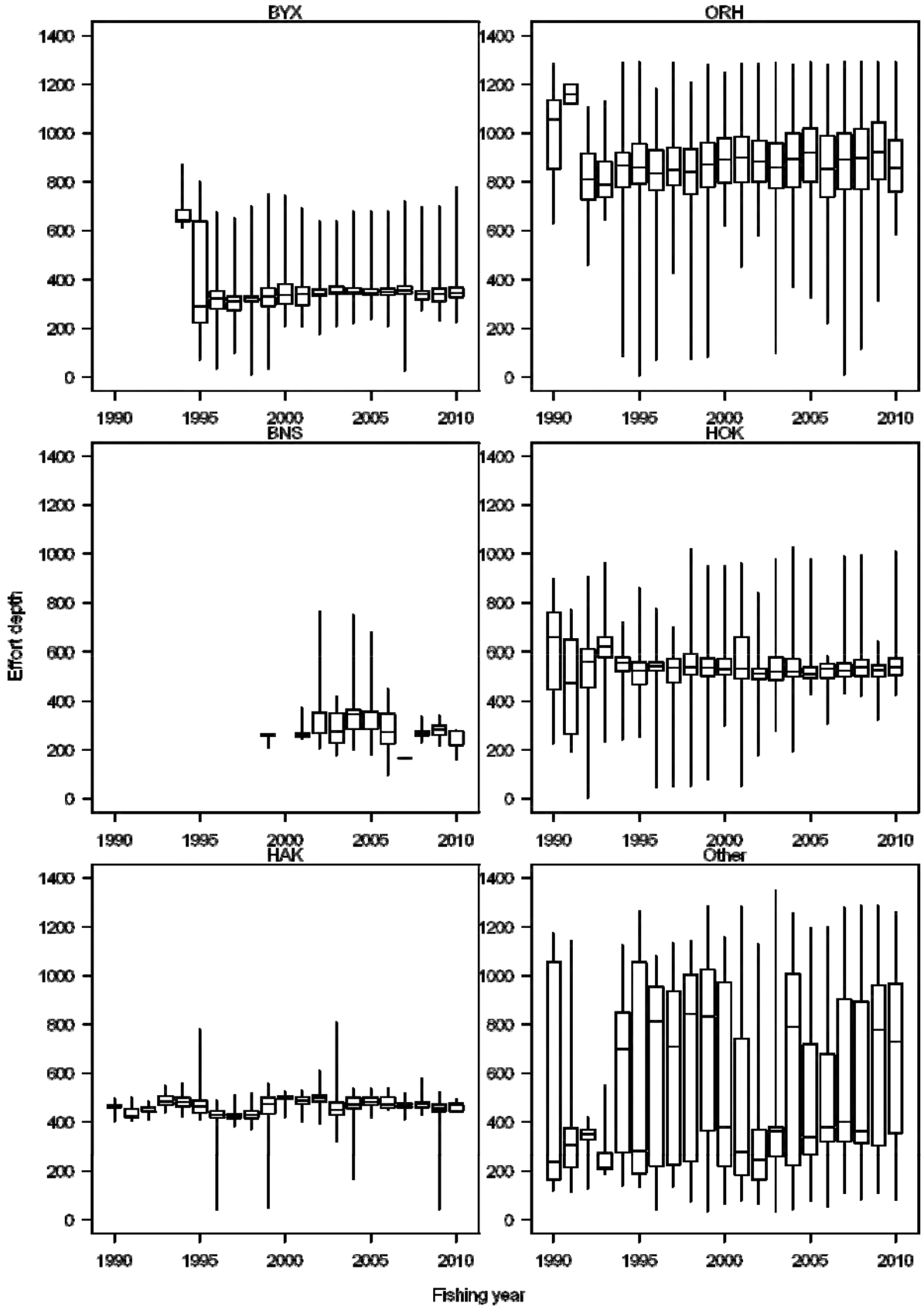


Figure C76: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) for depths (m) fished for various target species fisheries capturing alfonsino in the Eastern Chatham Rise region using bottom tows in the fishing years 1990–2010. Refer to Table C27 for species codes.

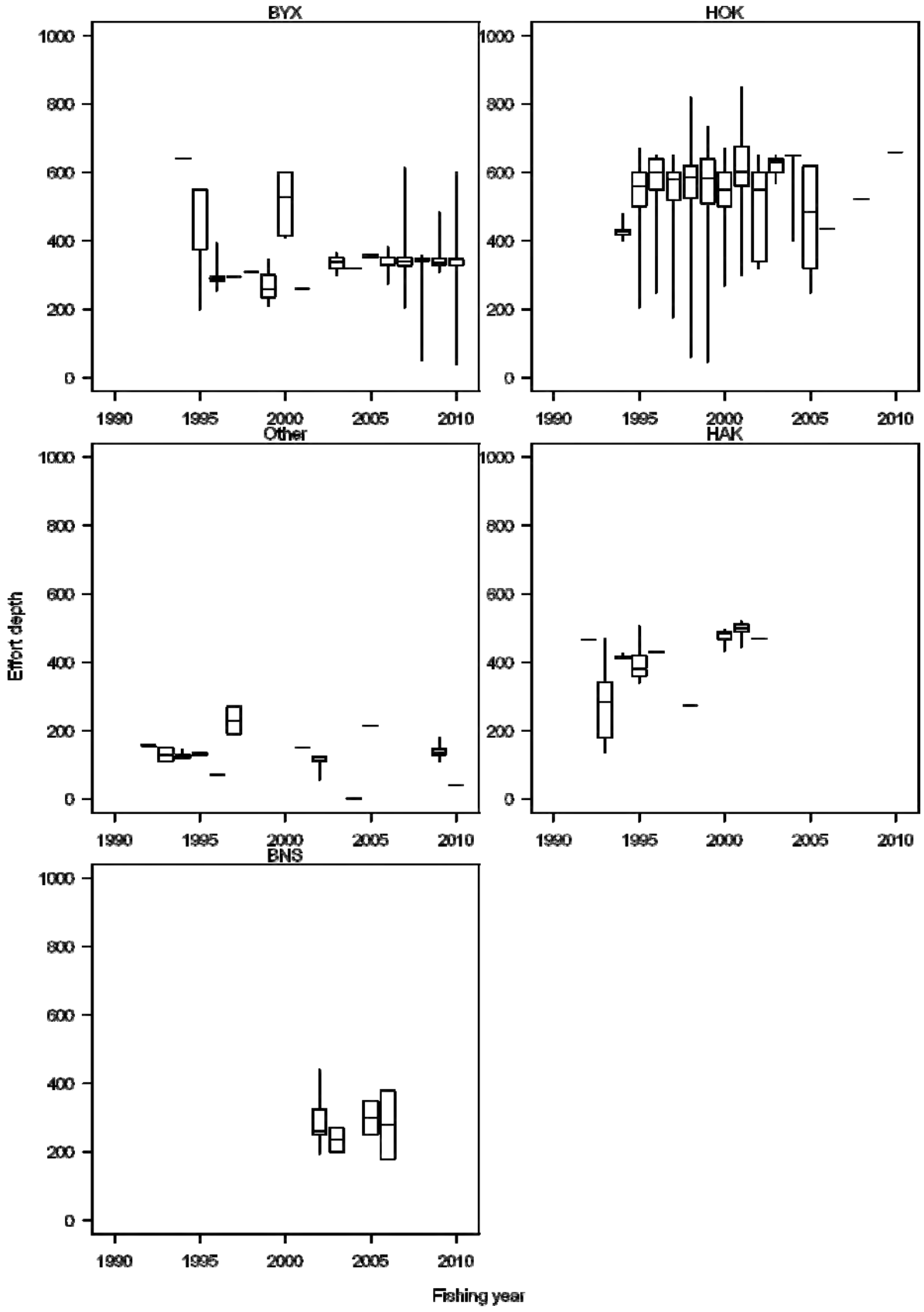


Figure C77: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) for depths (m) fished for various target species fisheries capturing alfonsino in the Eastern Chatham Rise region using midwater tows in the fishing years 1990–2010. Refer to Table C27 for species codes.

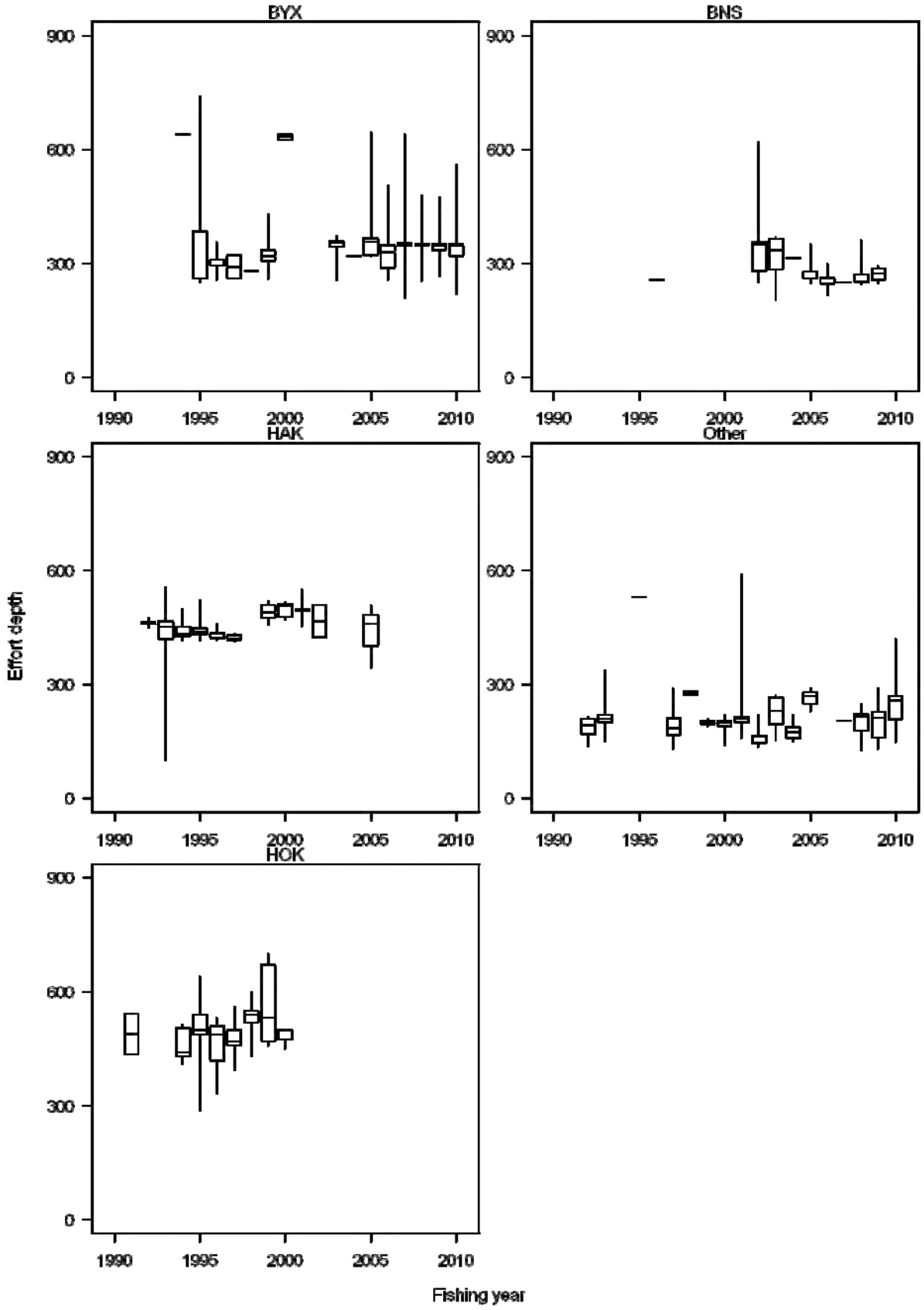


Figure C78: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) for depths (m) fished for various target species fisheries capturing alfonsino in the Eastern Chatham Rise region using midwater tows on the bottom in the fishing years 1990–2010. Refer to Table C27 for species codes.

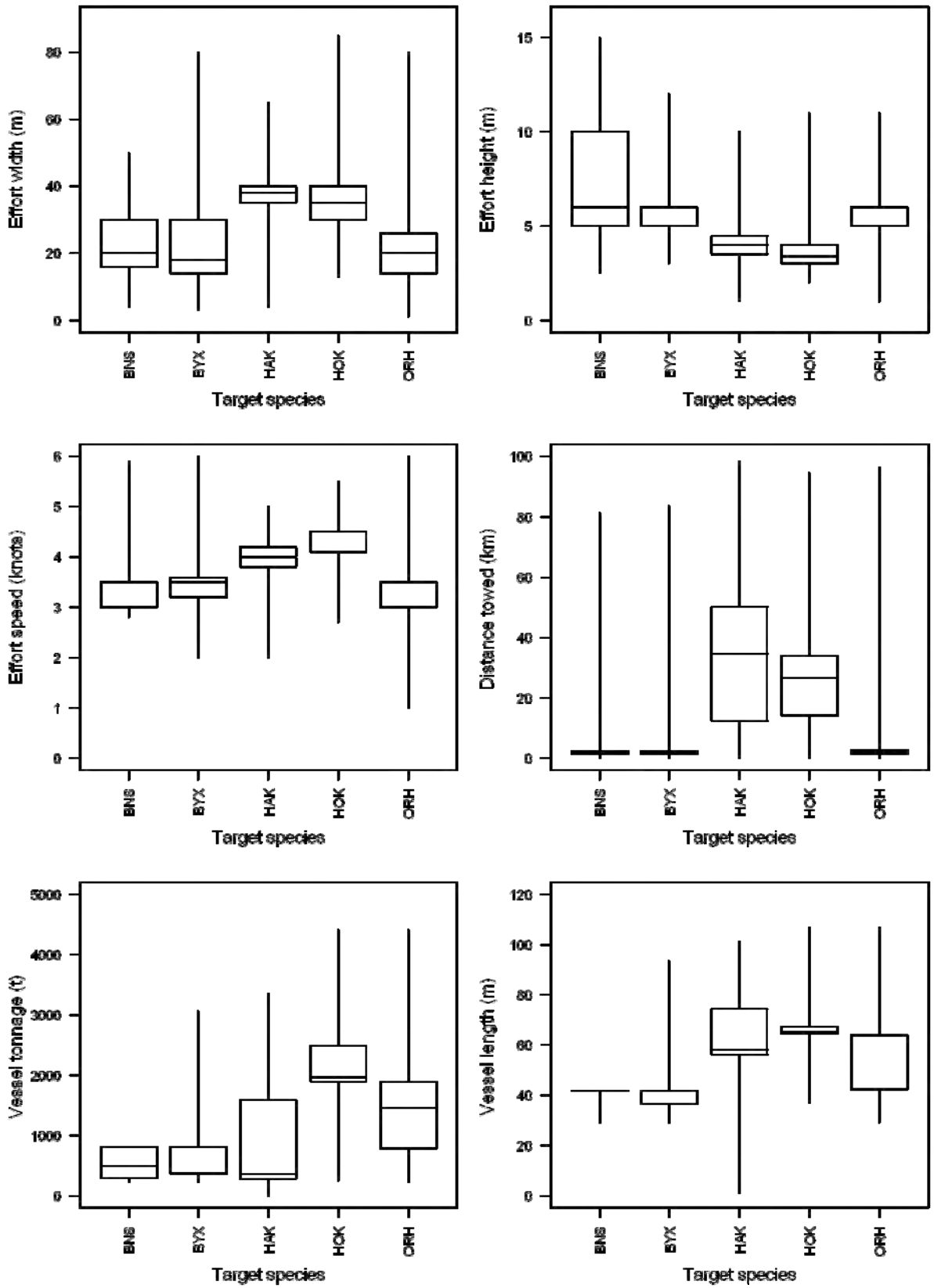


Figure C79: Distribution of fishing effort variables and vessel characteristics for the Eastern Chatham Rise area for major target species fisheries catching alfonsino using bottom trawl gear in the fishing years 1990–2010. Refer to Table C27 for species codes.

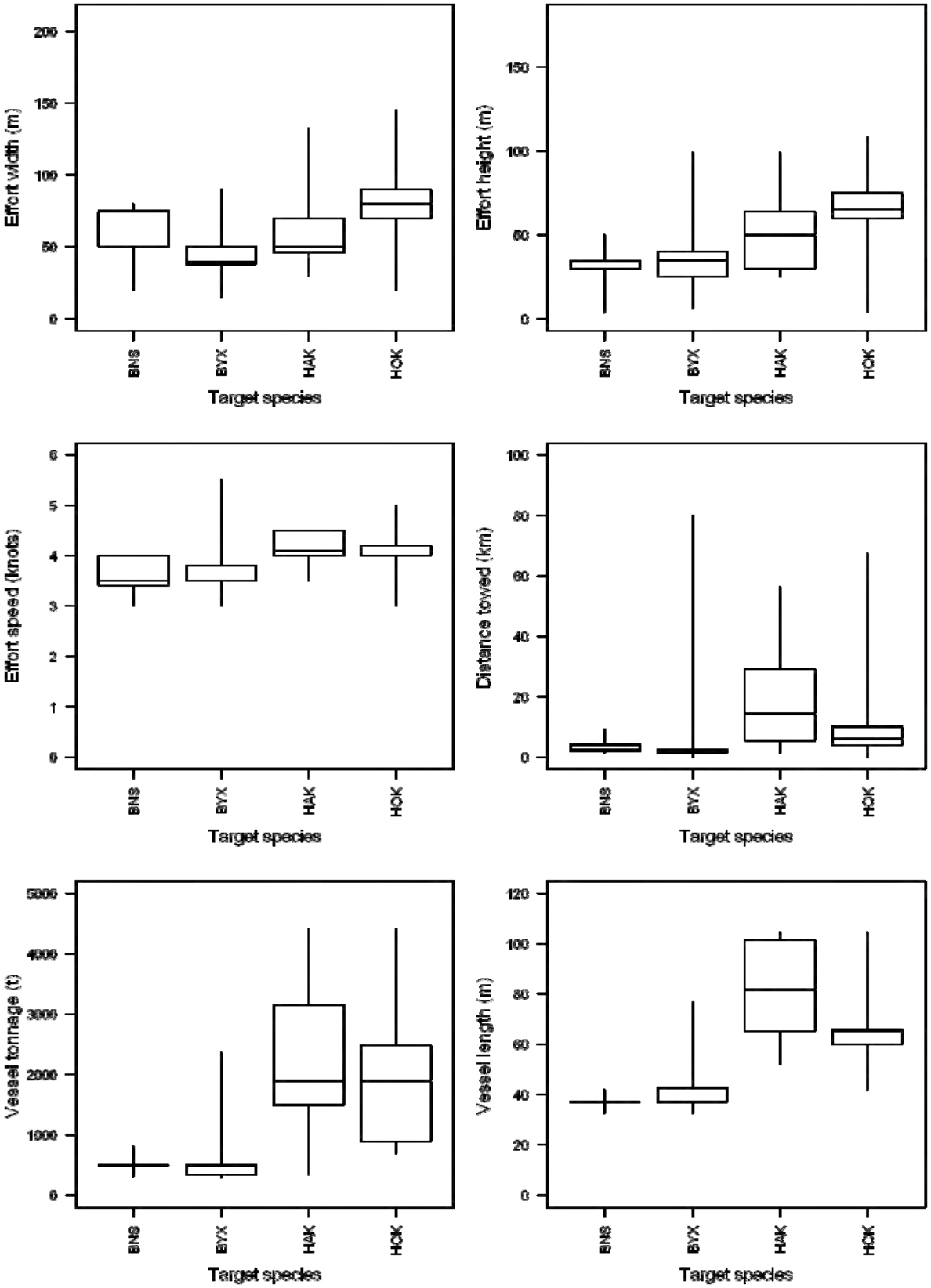


Figure C80: Distribution of fishing effort variables and vessel characteristics for the Eastern Chatham Rise area for major target species fisheries catching alfonsino using midwater trawl gear in the fishing years 1990–2010. Refer to Table C27 for species codes.

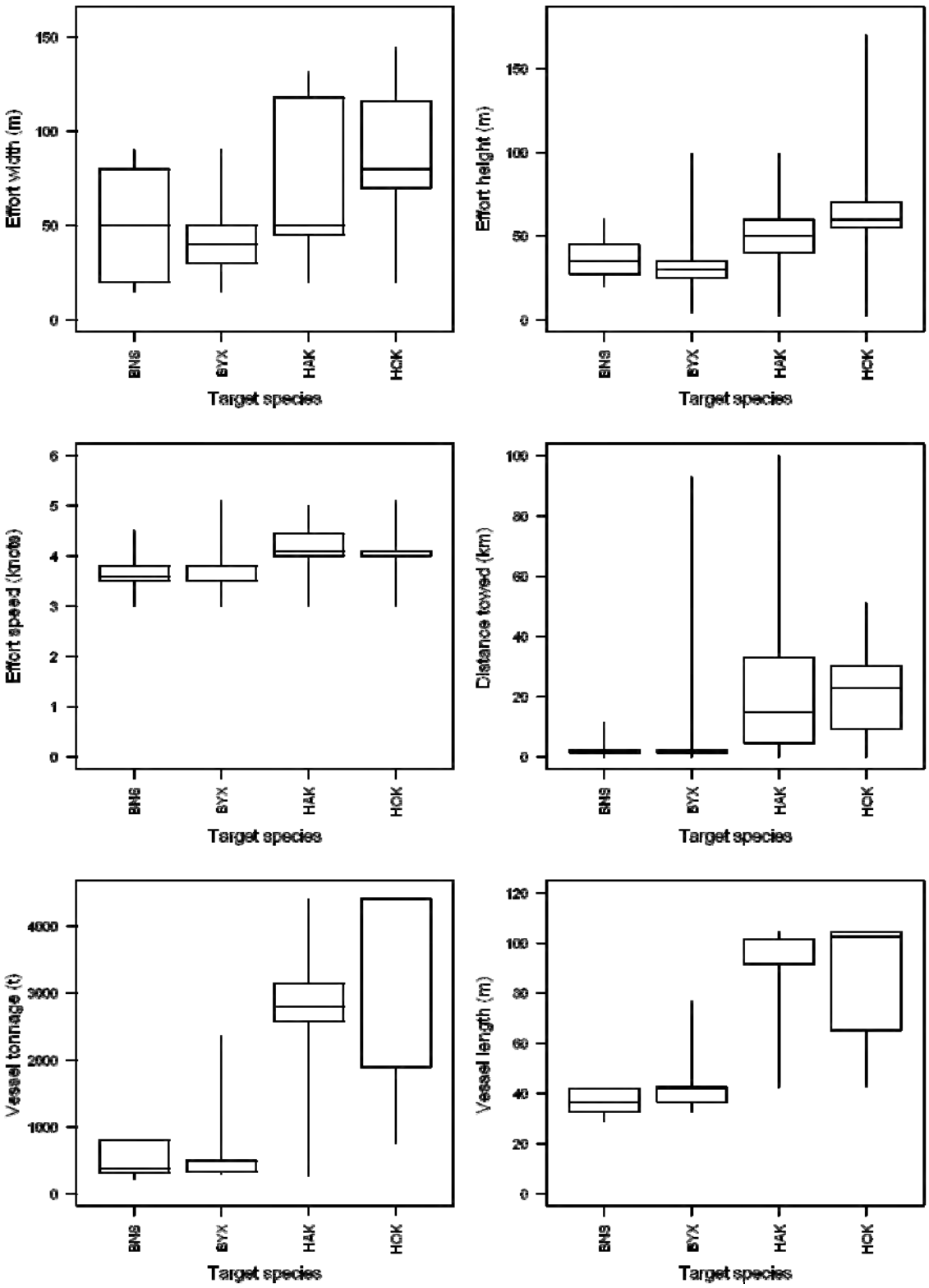


Figure C81: Distribution of fishing effort variables and vessel characteristics for the Eastern Chatham Rise area for major target species fisheries catching alfonsino using midwater trawl gear fishing on the bottom in the fishing years 1990–2010. Refer to Table C27 for species codes.

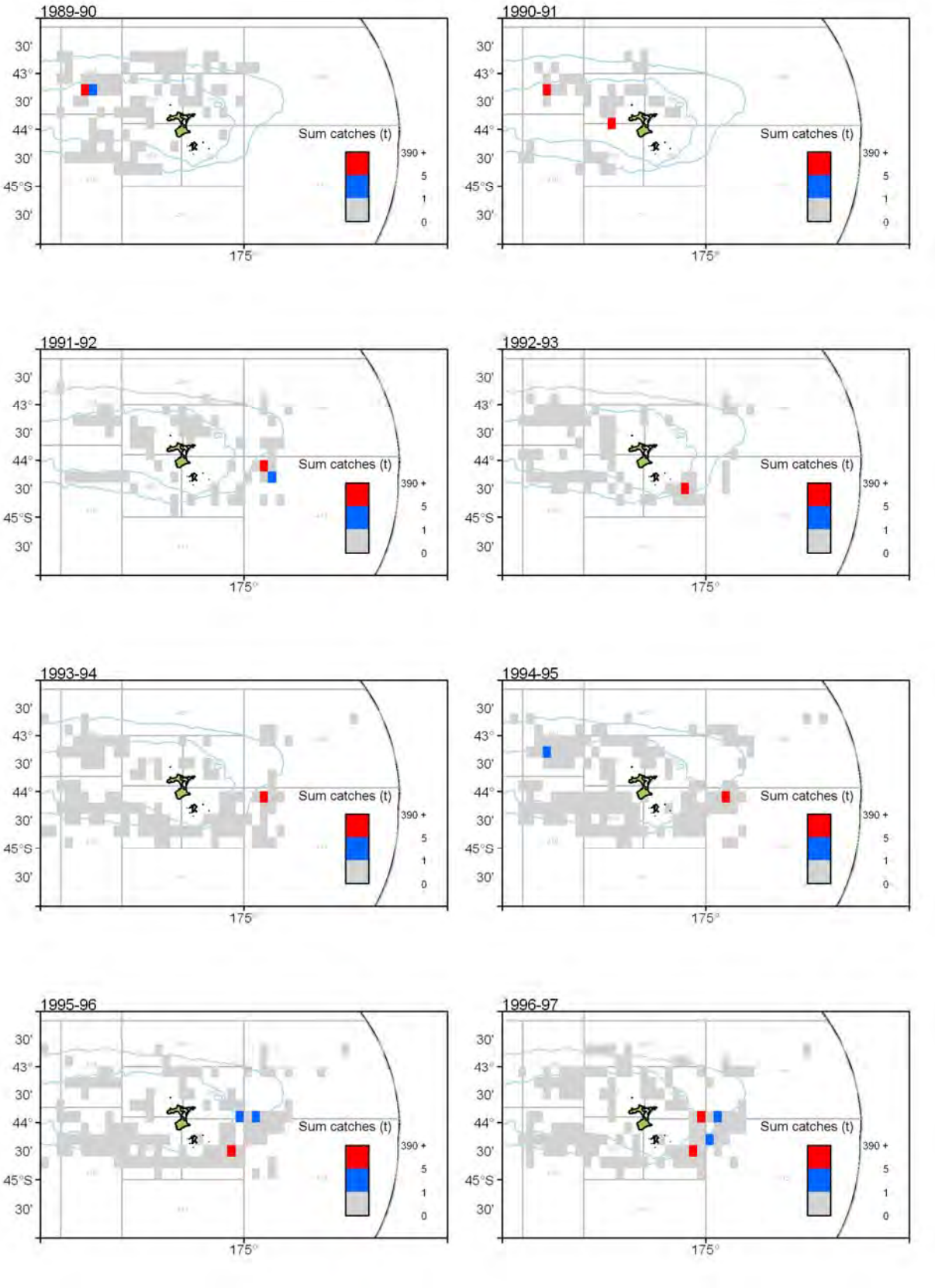


Figure C82: Distribution of alfonsino catch within the Eastern Chatham Rise region aggregated into 0.2 degree spatial blocks for fishing years 1990–1997 for the TCEPR form taken by all trawl gear.

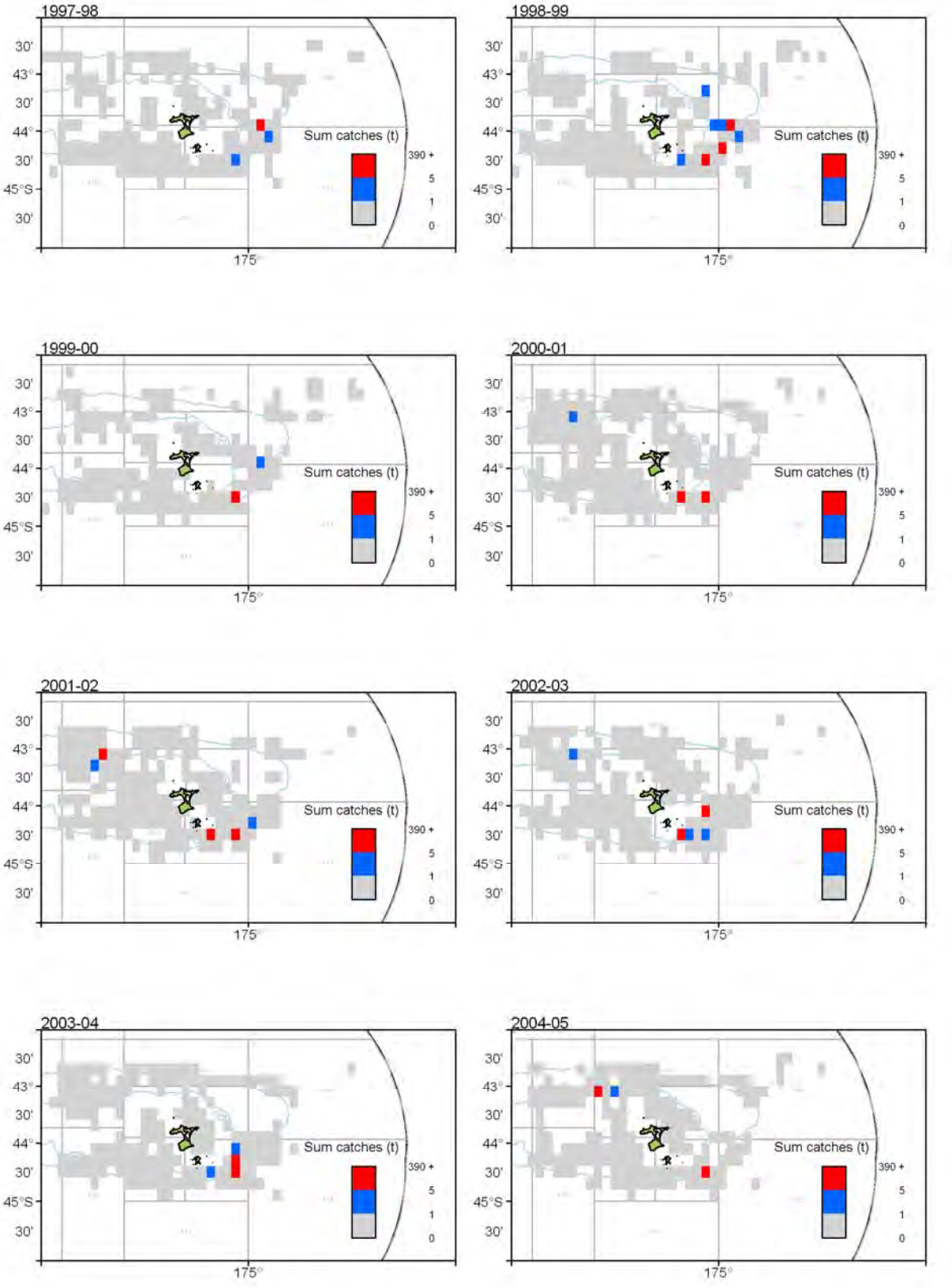


Figure C83: Distribution of alfonsino catch within the Eastern Chatham Rise region aggregated into 0.2 degree spatial blocks for fishing years 1998–2005 for the TCEPR form taken by all trawl gear.

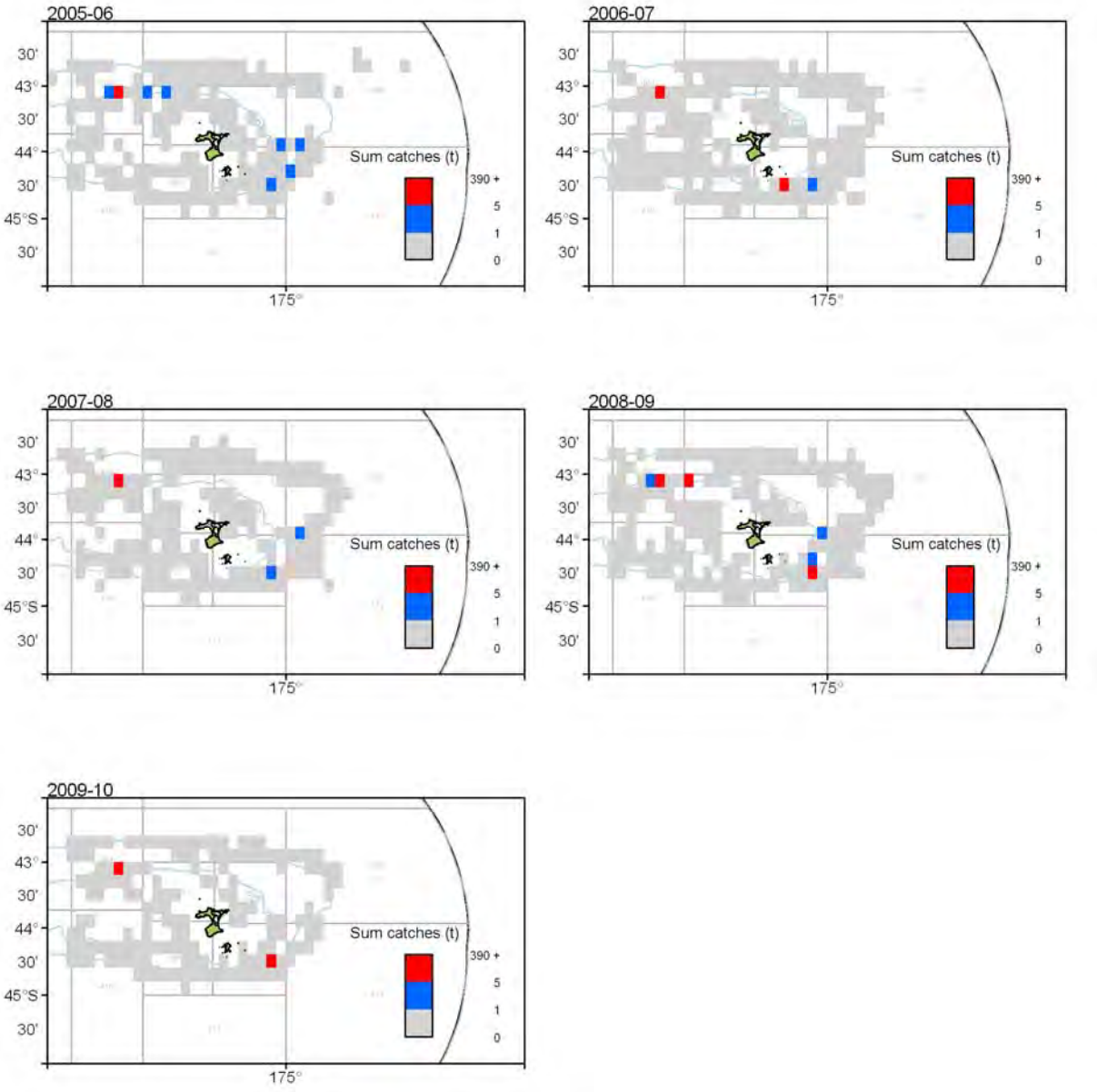


Figure C84: Distribution of alfonsino catch within the Eastern Chatham Rise region aggregated into 0.2 degree spatial blocks for fishing years 2006–2010 for the TCEPR form taken by all trawl gear.

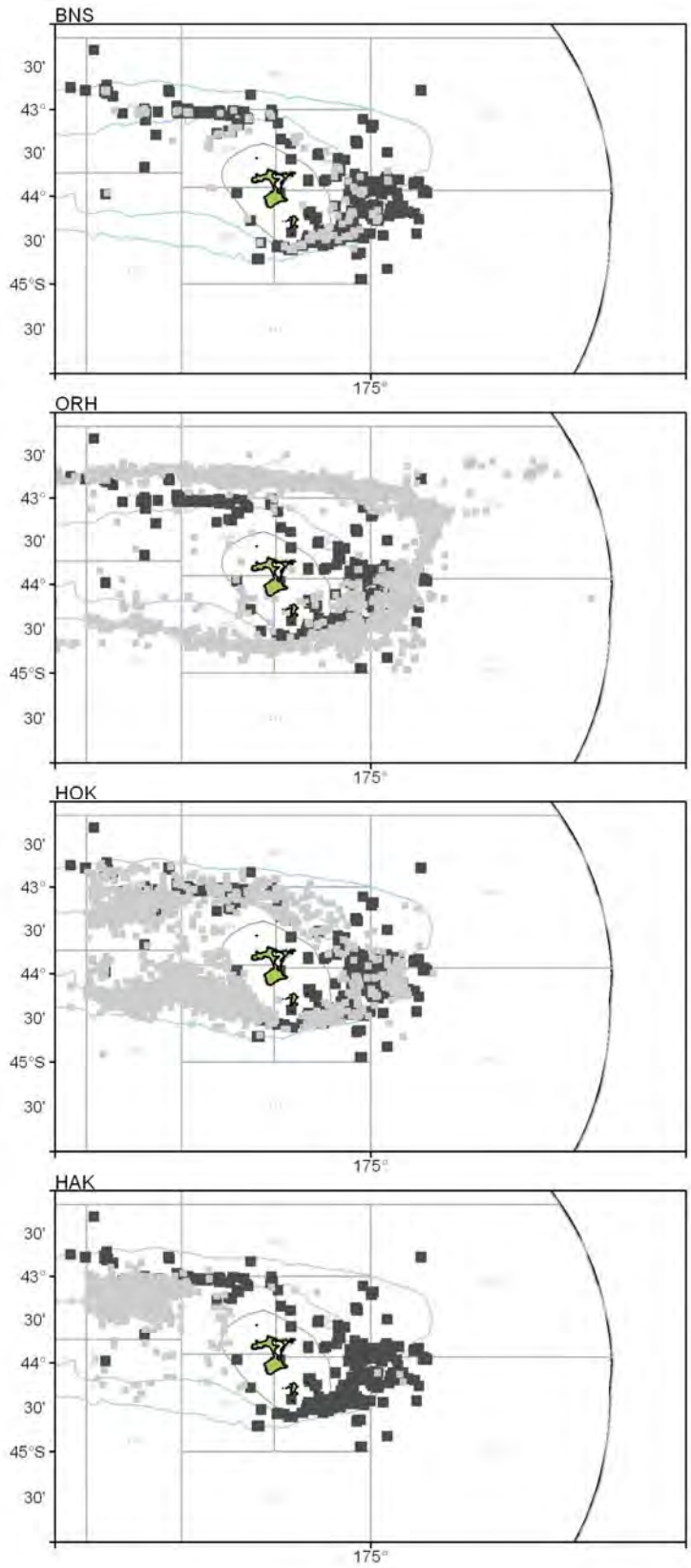


Figure C85: Eastern Chatham Rise statistical areas and bathymetry showing the distribution of all TCEPR trawls that caught alfonsino by main target species (grey cells) compared to the distribution of alfonsino targeted trawls (black cells) in the fishing years 1990–2010. Locations are aggregated into 0.2 degree spatial squares.

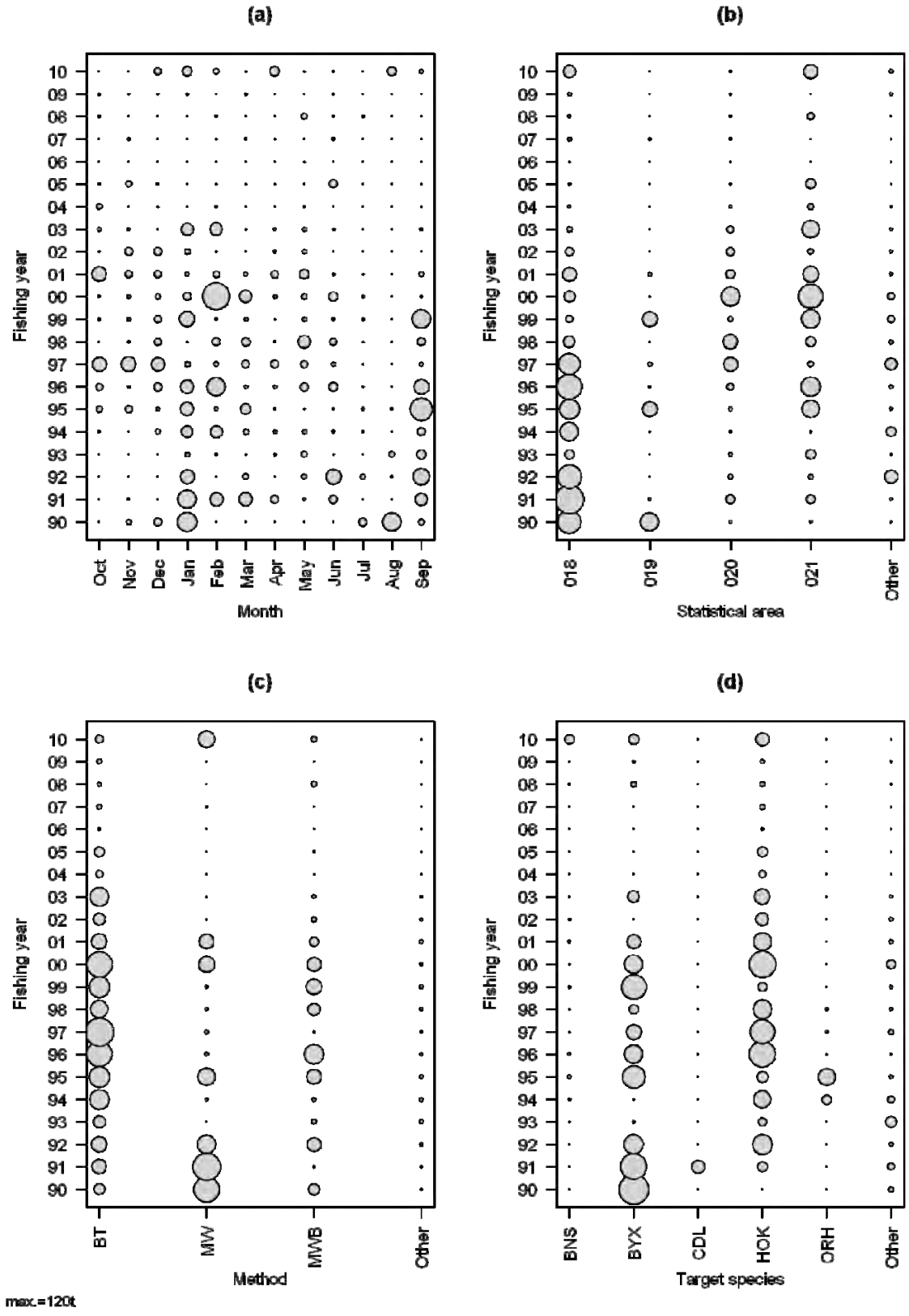


Figure C86: Distribution of alfonsino catch in the ECSI region (circle size is proportional to catch) for fishing years 1990–2010 in relation to a) month, b) statistical area, c) fishing method, and d) target species. Circle size is proportional to catch; maximum circle size is indicated in lower left hand corner. Refer to Table C27 for species codes.

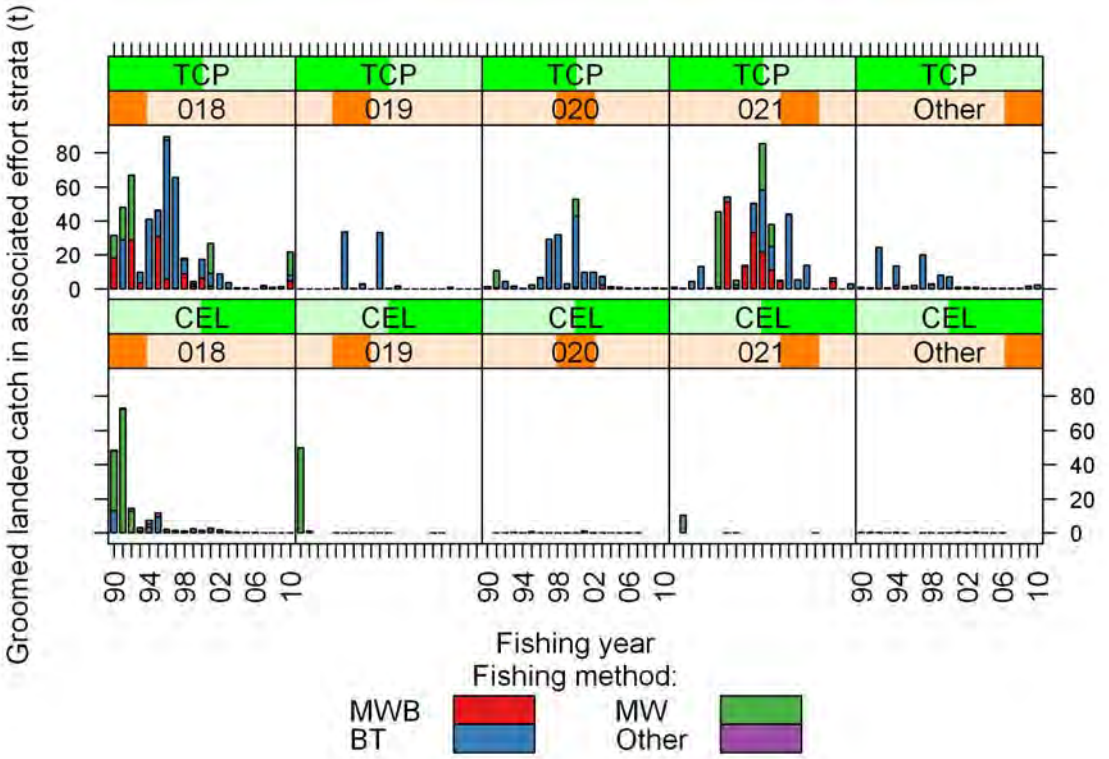


Figure C87: Distribution of alfonsino catch in the ECSI region in relation to form type and statistical area for fishing years 1990–2010 by fishing method.

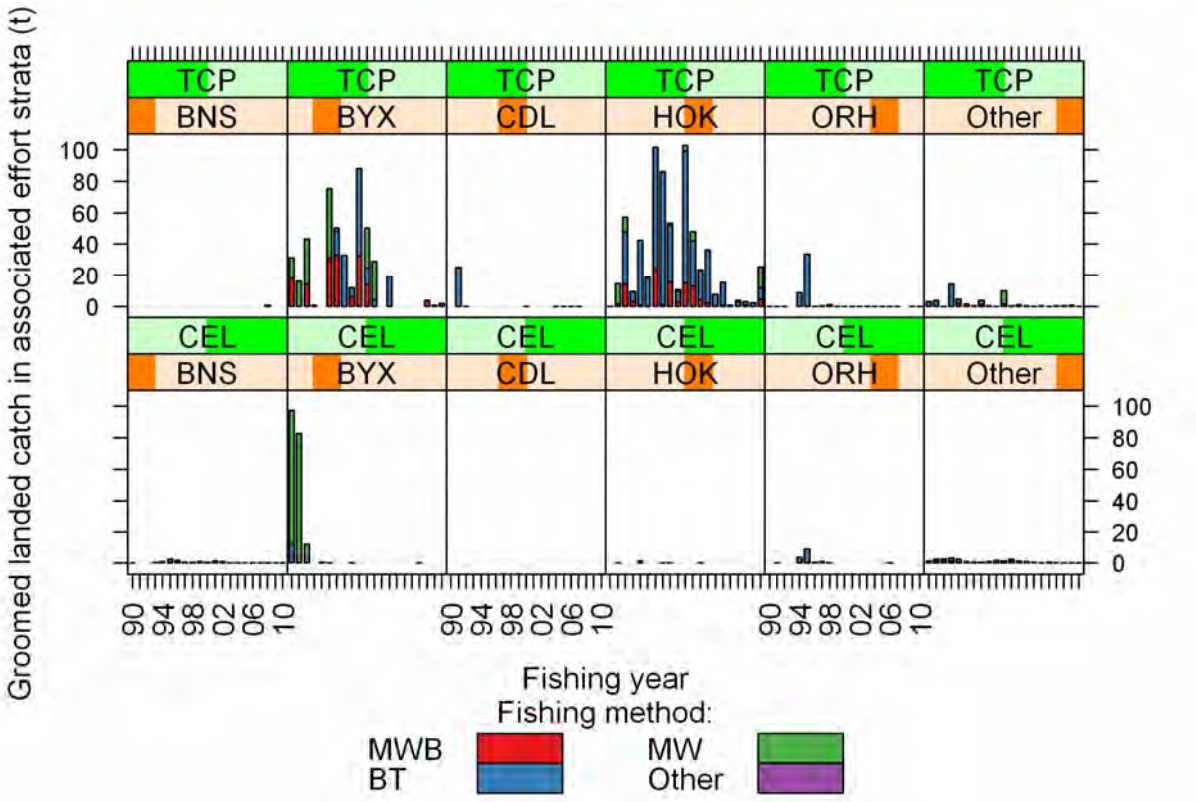


Figure C88: Distribution of alfonsino catch in the ECSI region in relation to form type and target species for fishing years 1990–2010 by fishing method. Refer to Table C27 for species codes.

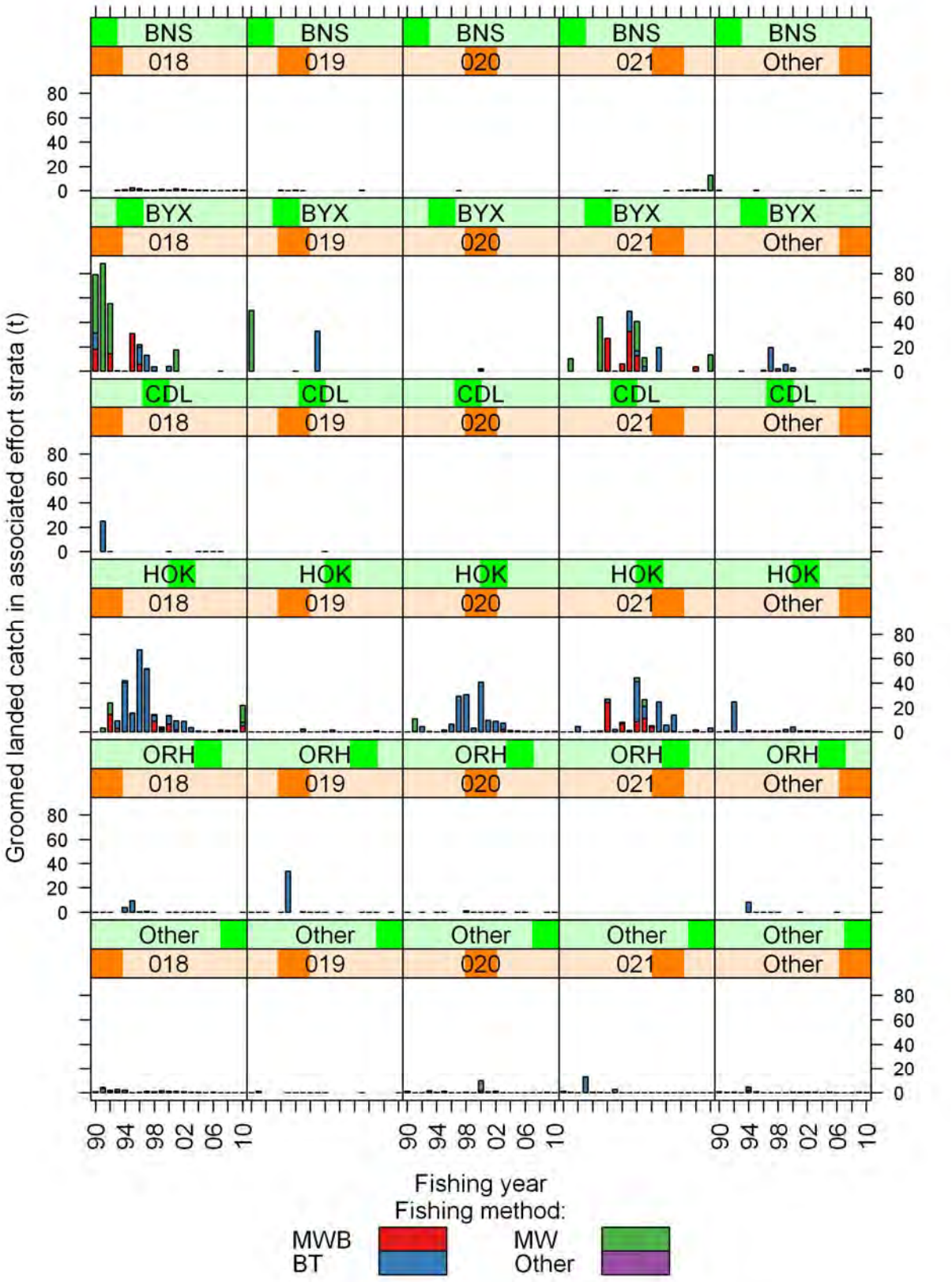


Figure C89: Distribution of alfonsino catch in the ECSI region in relation to target species and statistical area for fishing years 1990–2010 by fishing method. Refer to Table C27 for species codes.

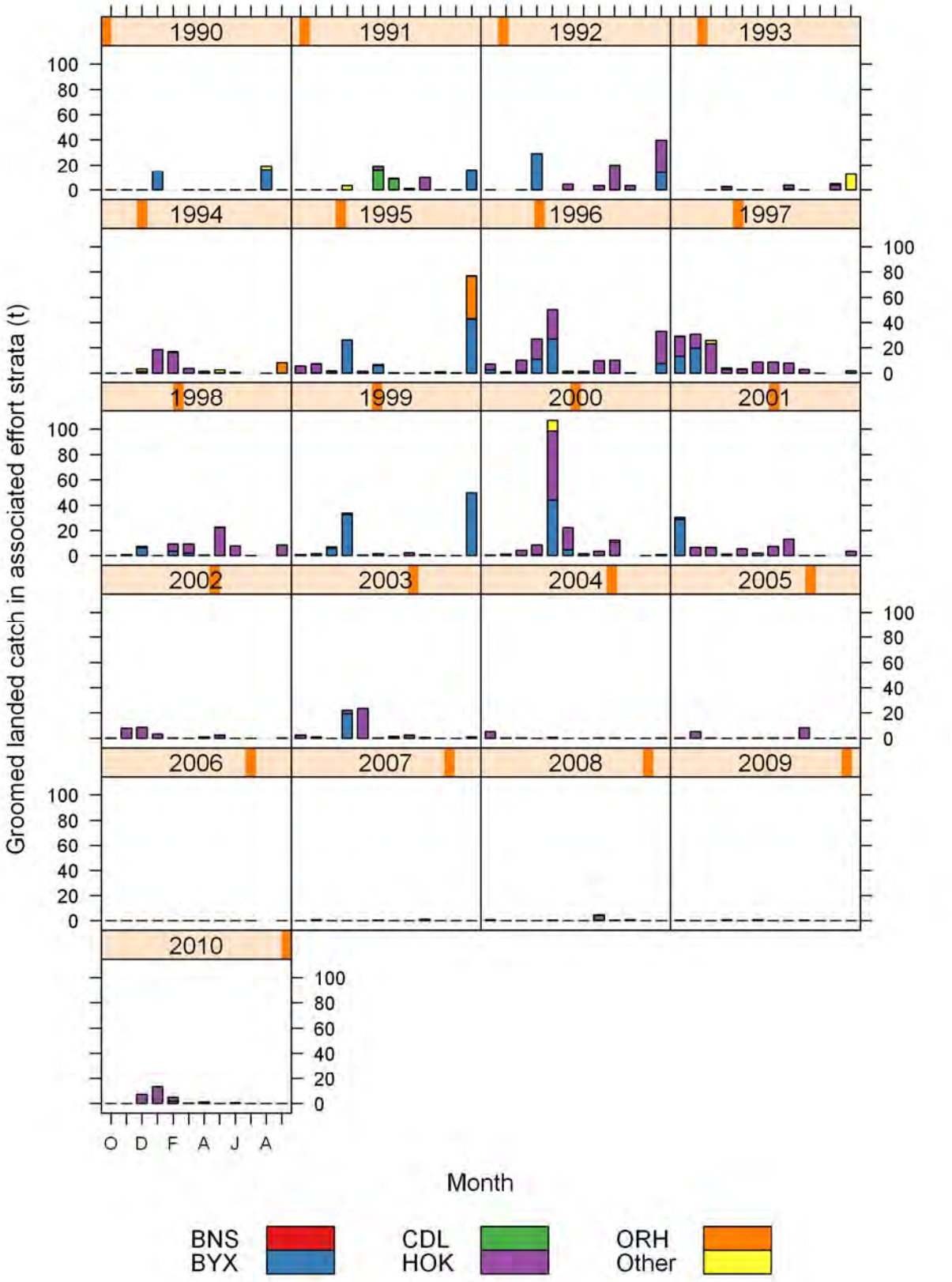


Figure C90: Distribution of alfonsino catch in the ECSI region taken by bottom trawl fishing methods by fishing month for fishing years 1990–2010 by target species. Refer to Table C27 for species codes.

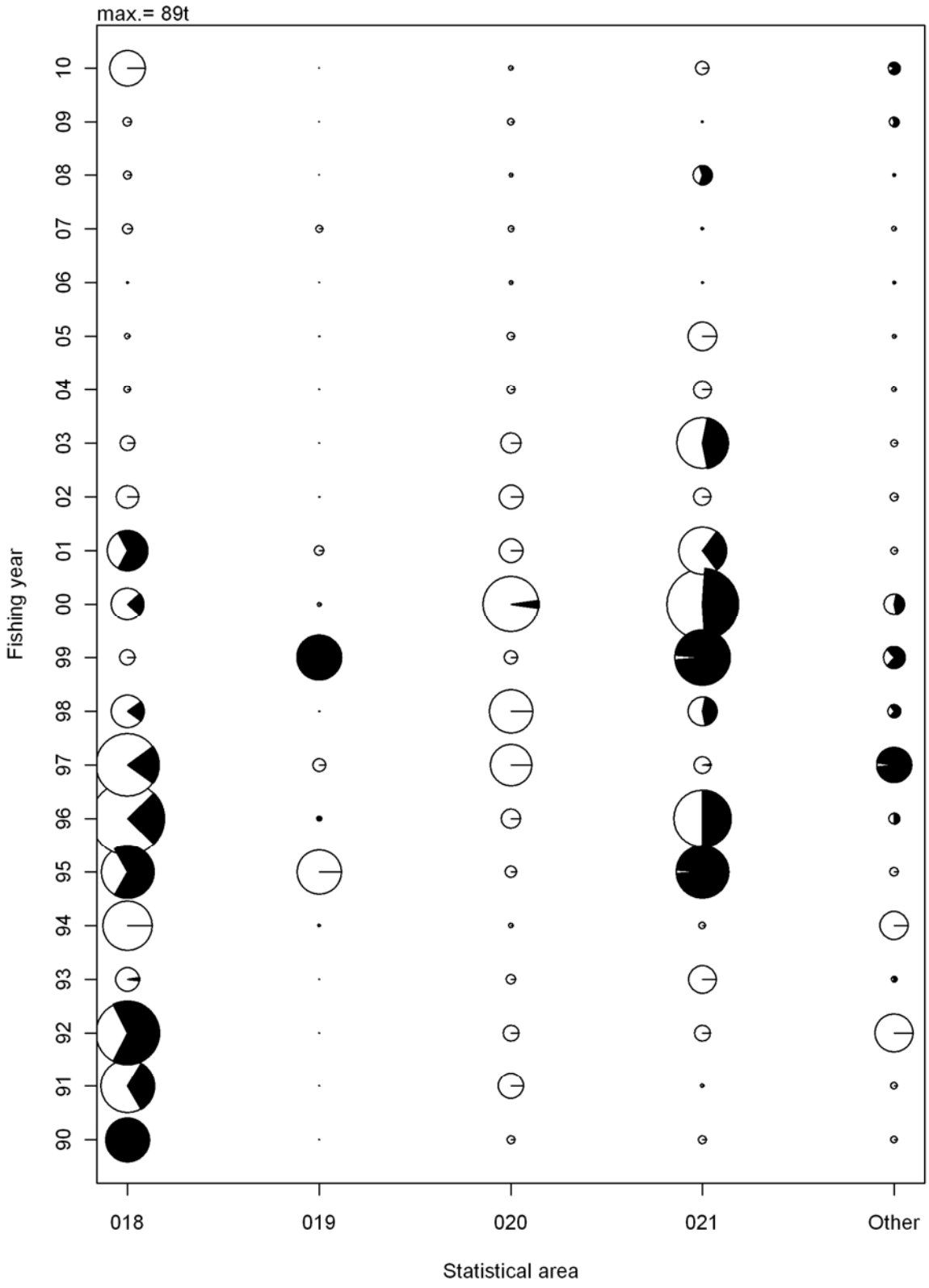


Figure C91: Distribution of alfonsino catch by fishing year with circle size proportional to the total catch and black portion of the pie indicating proportion of the catch as targeted alfonsino by statistical area for TCEPR tows in the ECSI region.

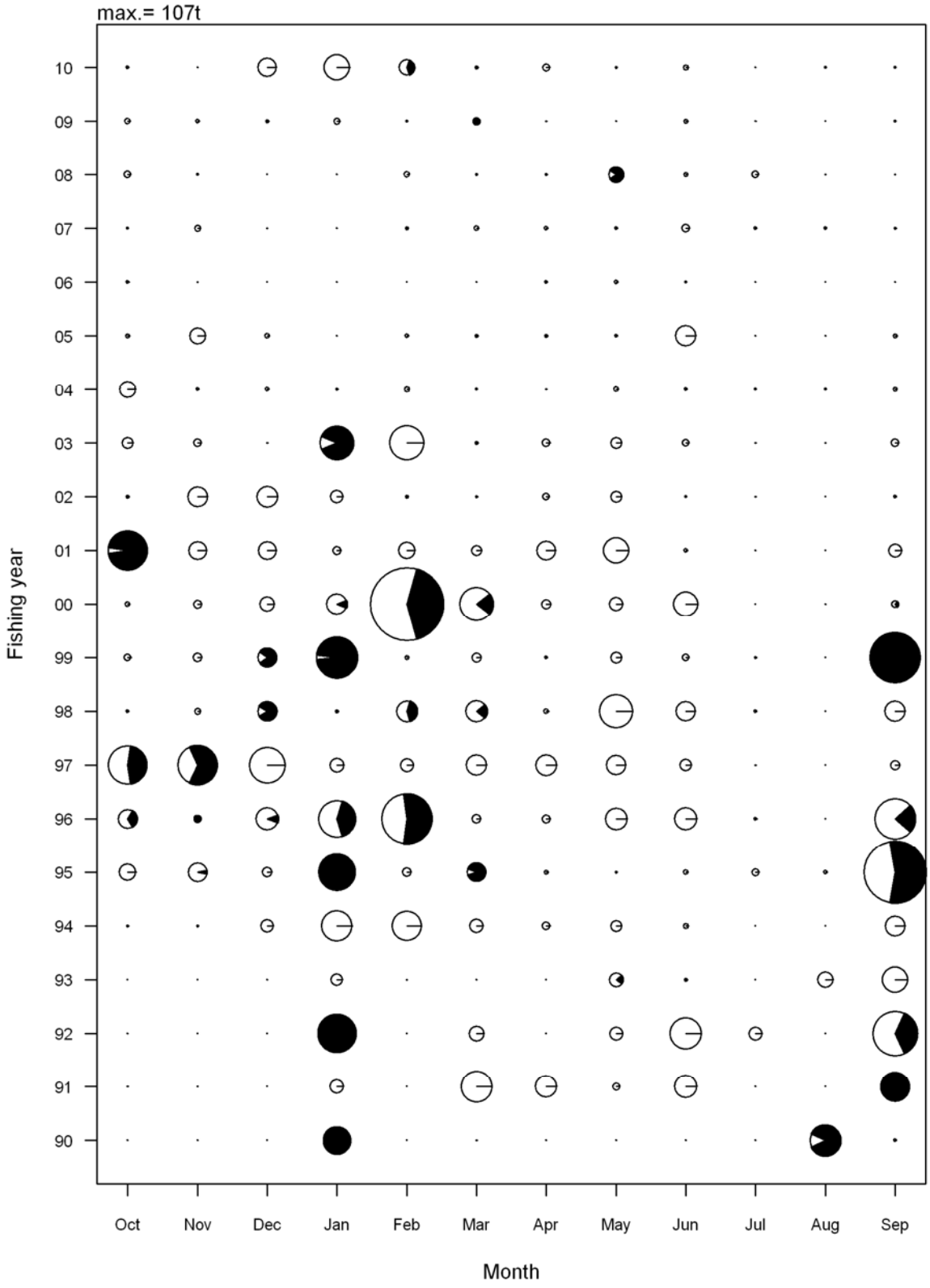


Figure C92: Distribution of alfonsino catch by fishing year with circle size proportional to the total catch and black portion of the pie indicating proportion of the catch as targeted alfonsino by month for TCEPR tows in the ECSI region.

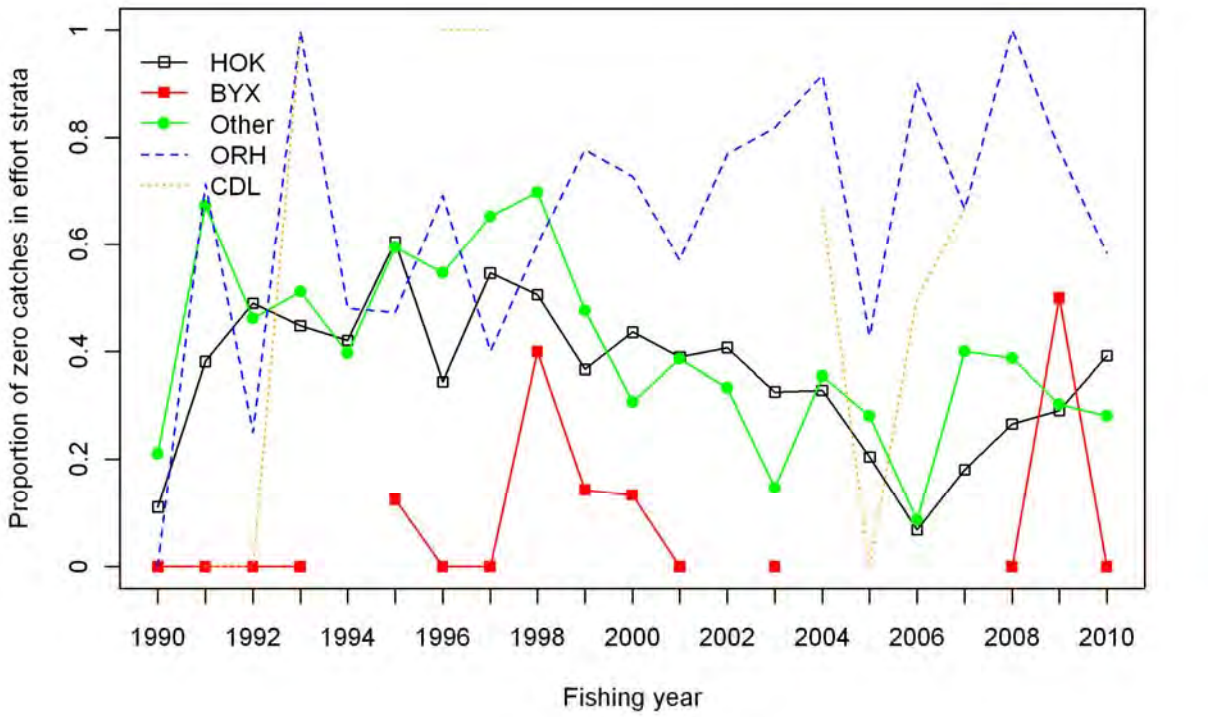


Figure C93: Proportion of TCEPR tows with zero reported alfonsino catch by major target species for the ECSI region. Refer to Table C27 for species codes.

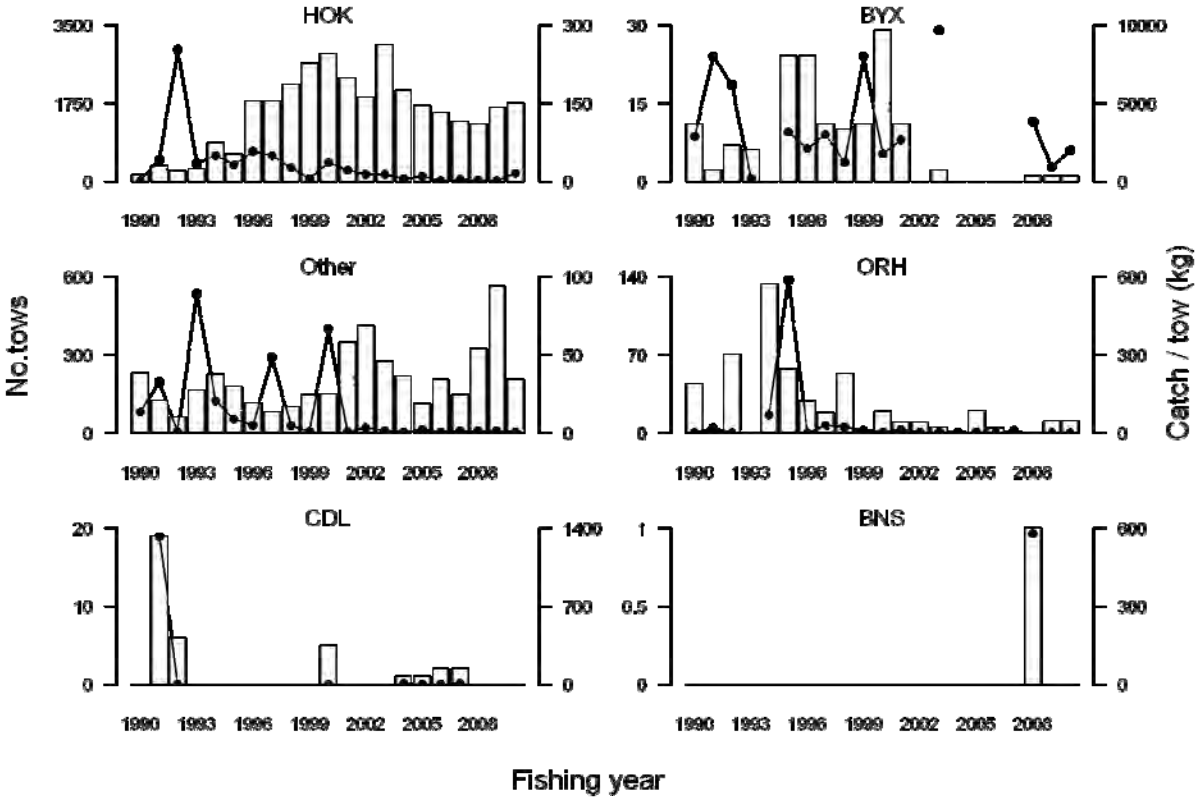


Figure C94: Annual catch rate of alfonsino tows in kilograms alfonsino (catch/tow) and the number of TCEPR tows in the ECSI region for various target species. Refer to Table C27 for species codes.

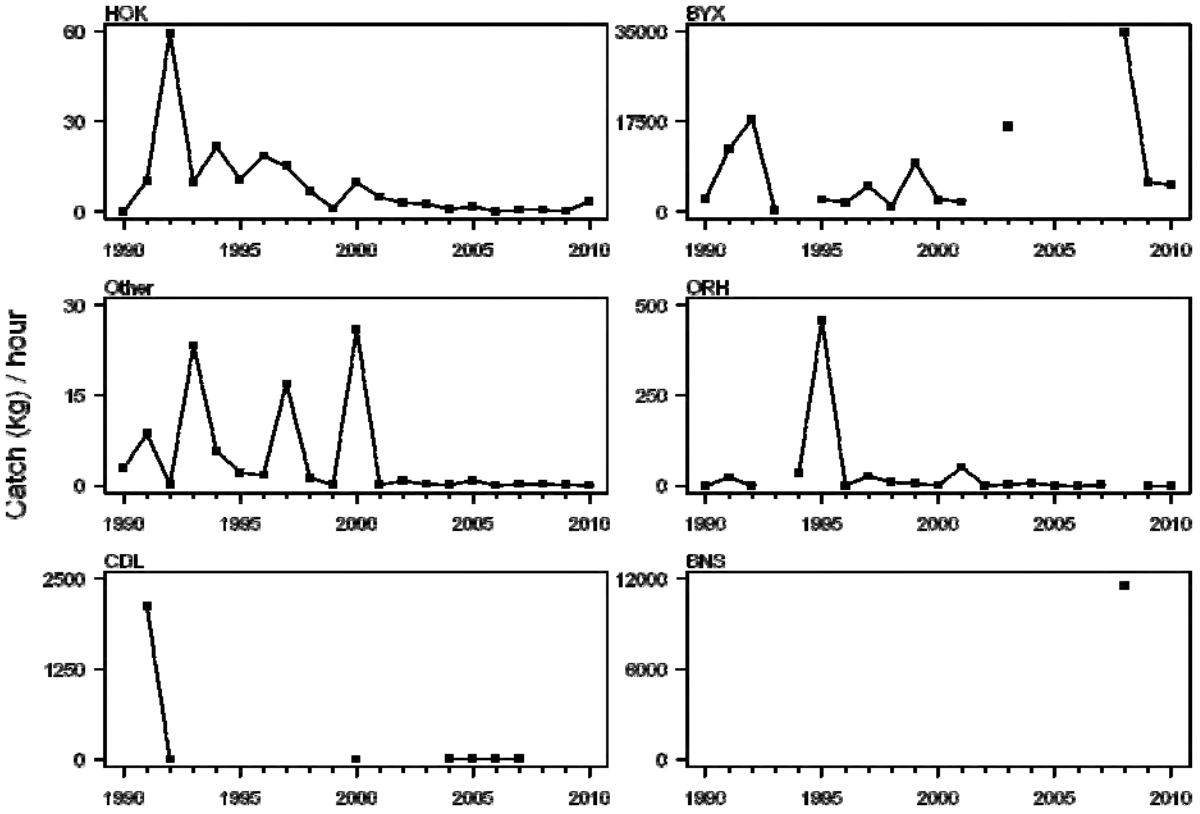


Figure C95: Catch rate (kg per hour) by fishing year for various target species by fishing year for TCEPR tows in the ECSI region.

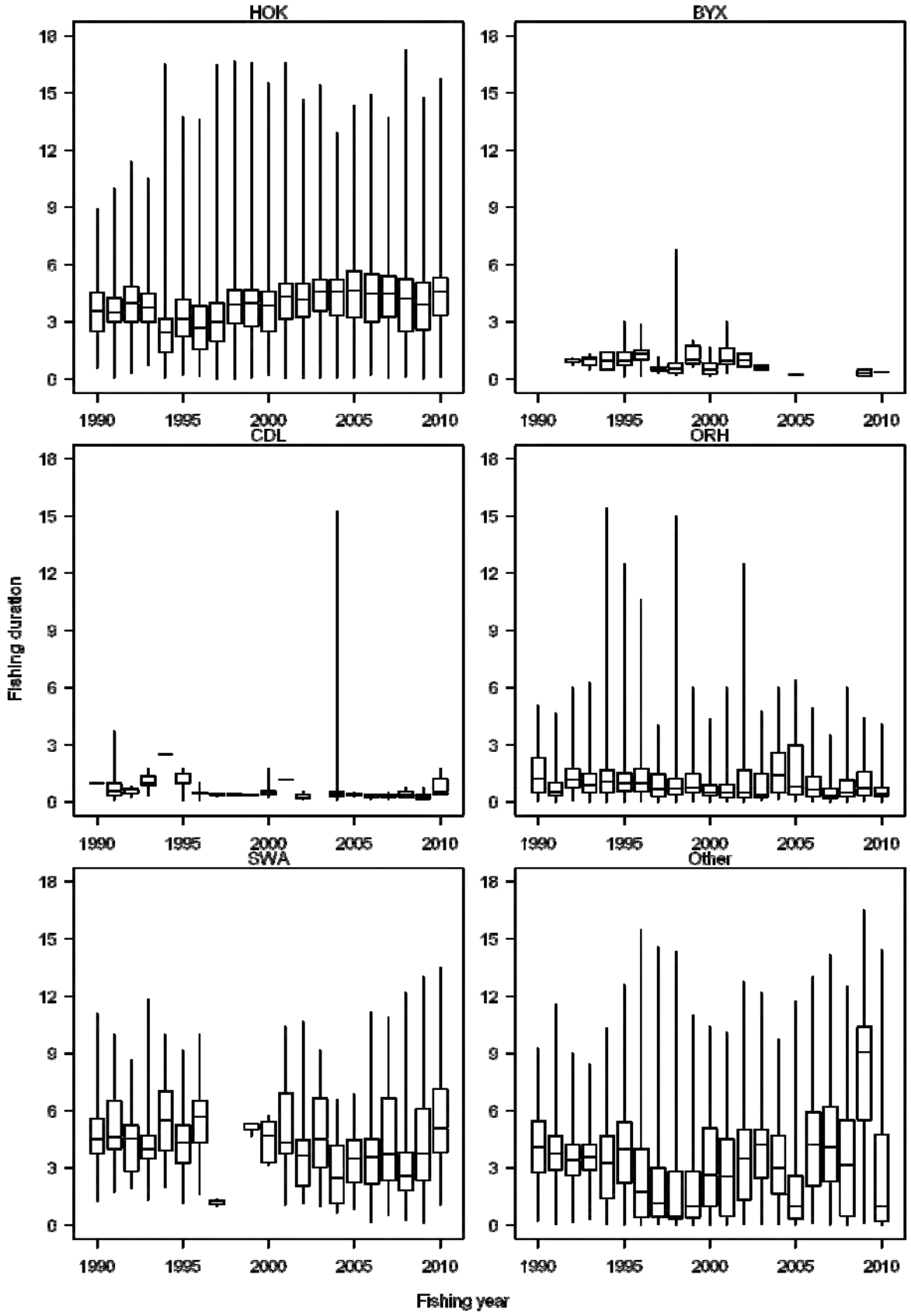


Figure C96: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) for tow durations (hours) reported for various target species fisheries capturing alfonsino in the ECSI region using TCEPR bottom trawl tows in the fishing years 1990–2010. Refer to Table C27 for species codes.

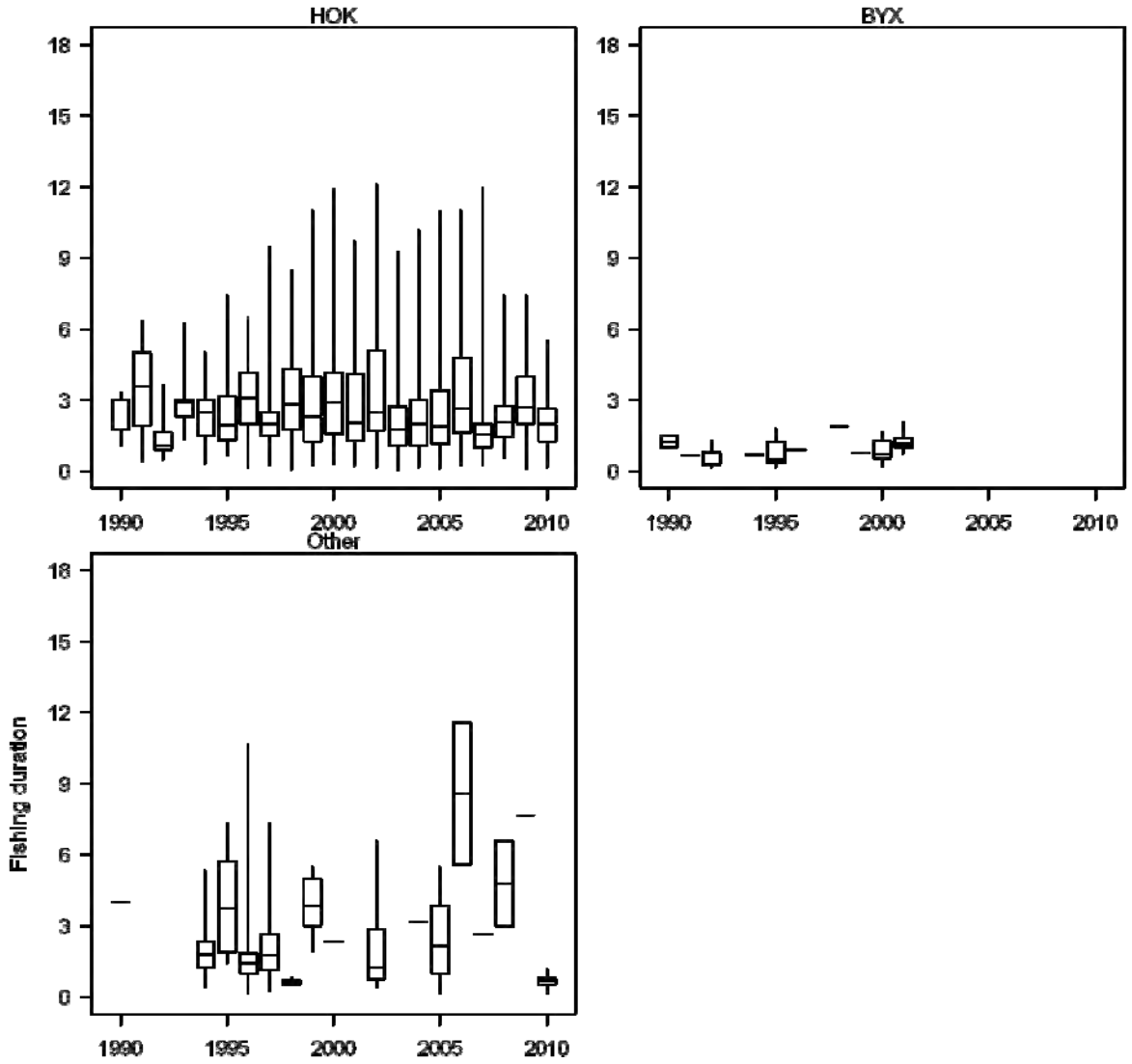


Figure C97: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) for tow durations (hours) reported for various target species fisheries capturing alfonsino in the ECSI region using TCEPR midwater trawl tows in the fishing years 1990–2010. Refer to Table C27 for species codes.

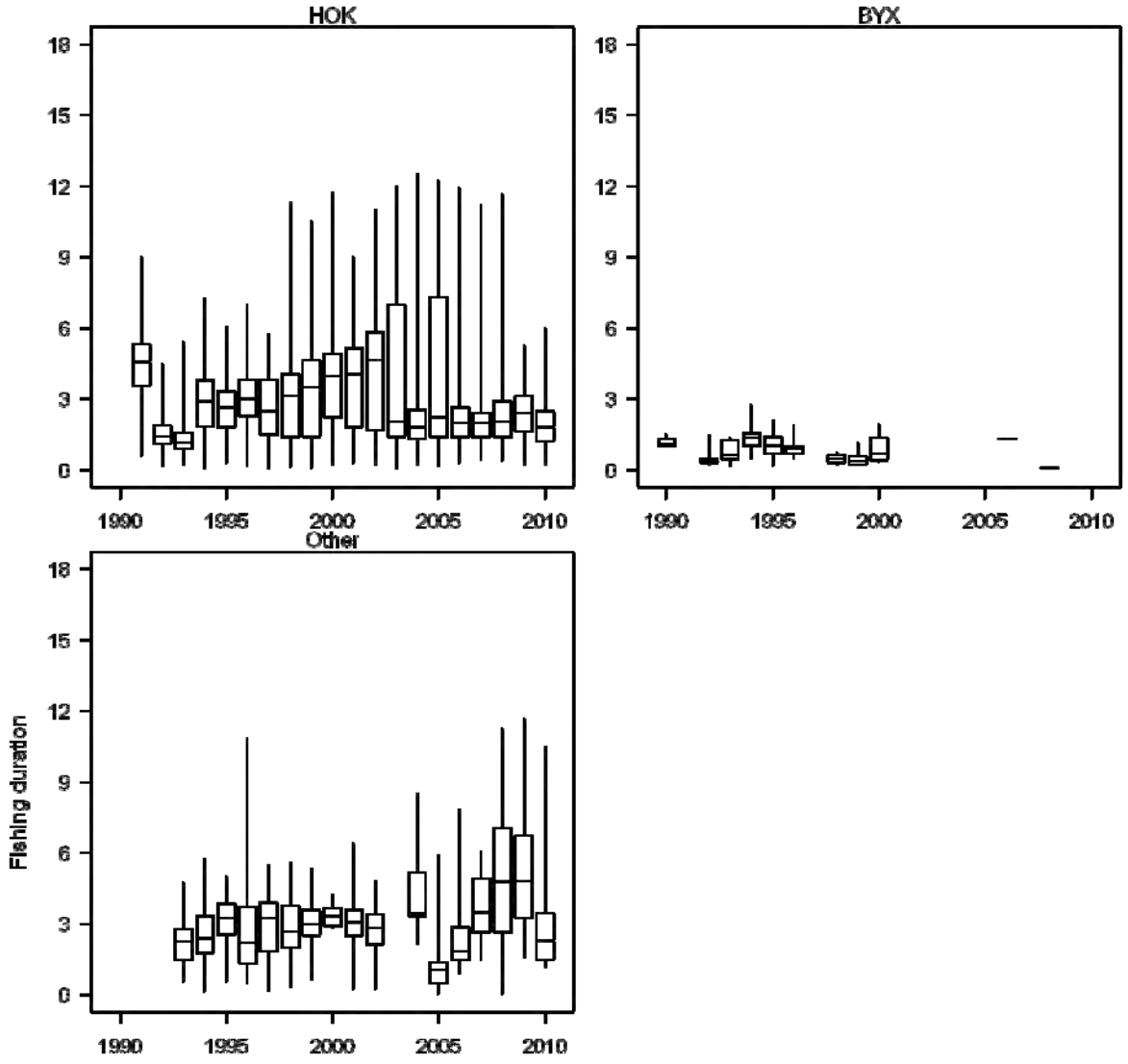


Figure C98: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) for tow durations (hours) reported for various target species fisheries capturing alfonsino in the ECSI region using TCEPR midwater trawl tows on the bottom in the fishing years 1990–2010. Refer to Table C27 for species codes.

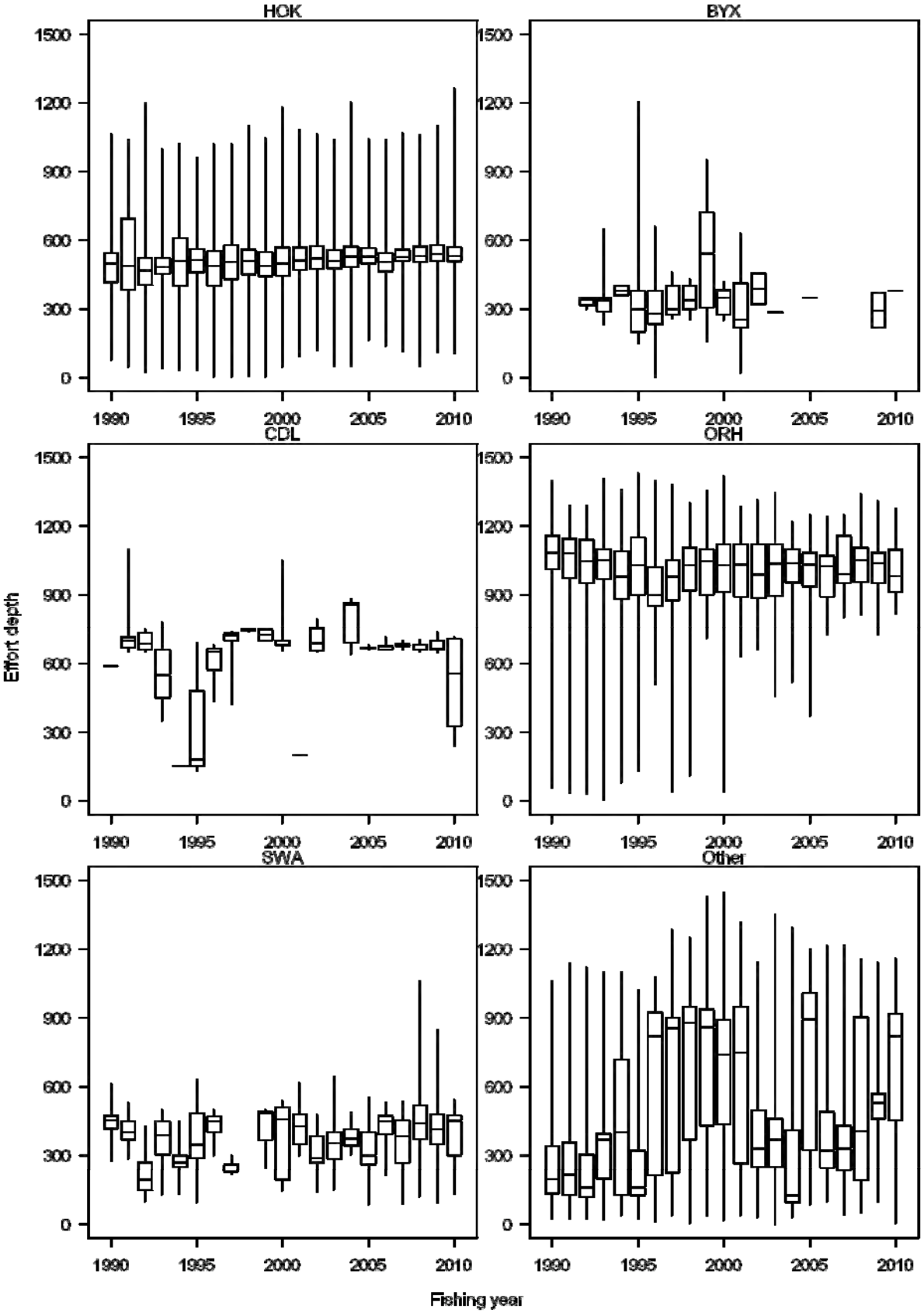


Figure C99: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) for depths (m) fished for various target species fisheries capturing alfonsino in the ECSI region using bottom tows in the fishing years 1990–2010. Refer to Table C27 for species codes.

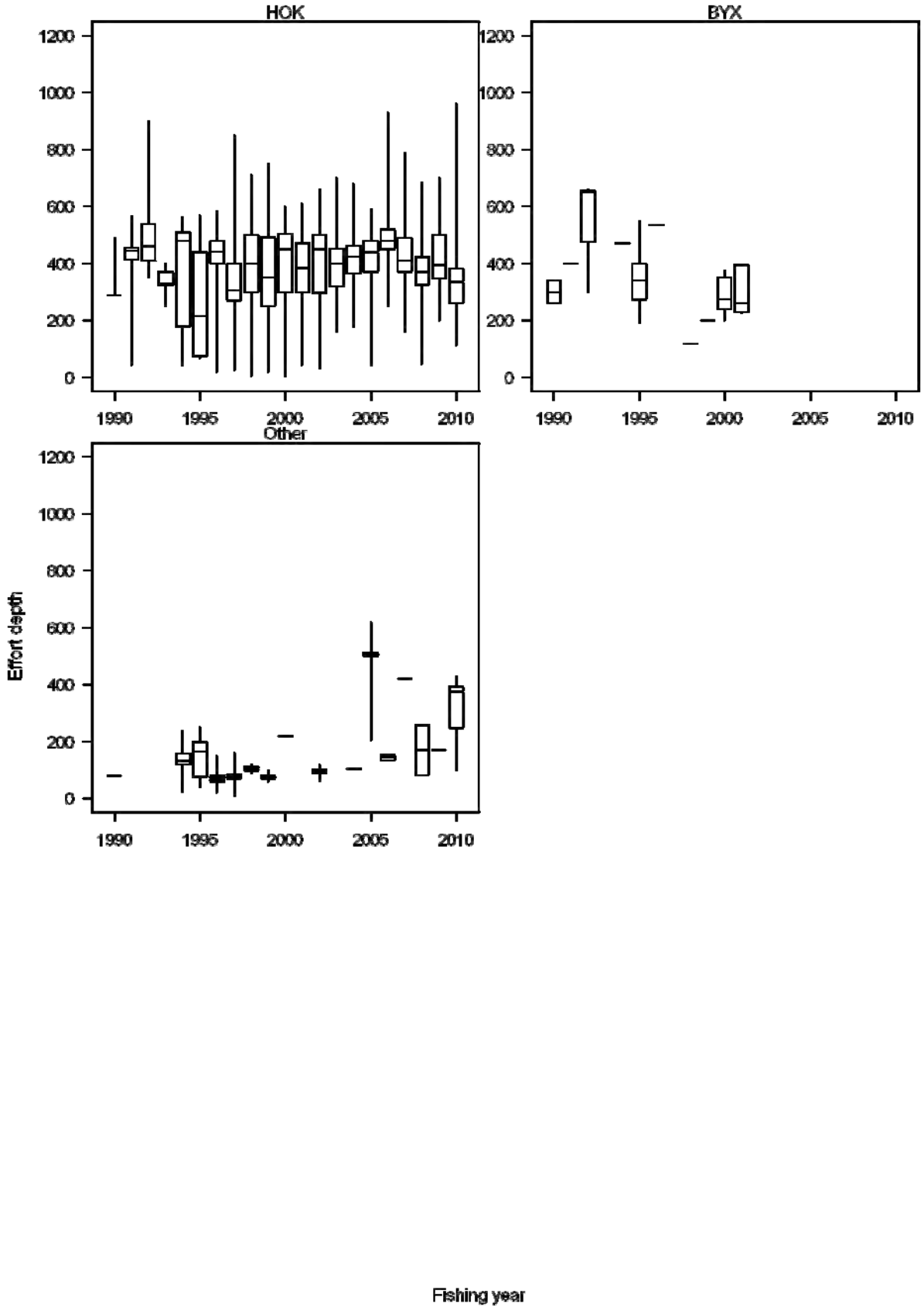


Figure C100: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) for depths (m) fished for various target species fisheries capturing alfonsino in the ECSI region using midwater tows in the fishing years 1990–2010. Refer to Table C27 for species codes.

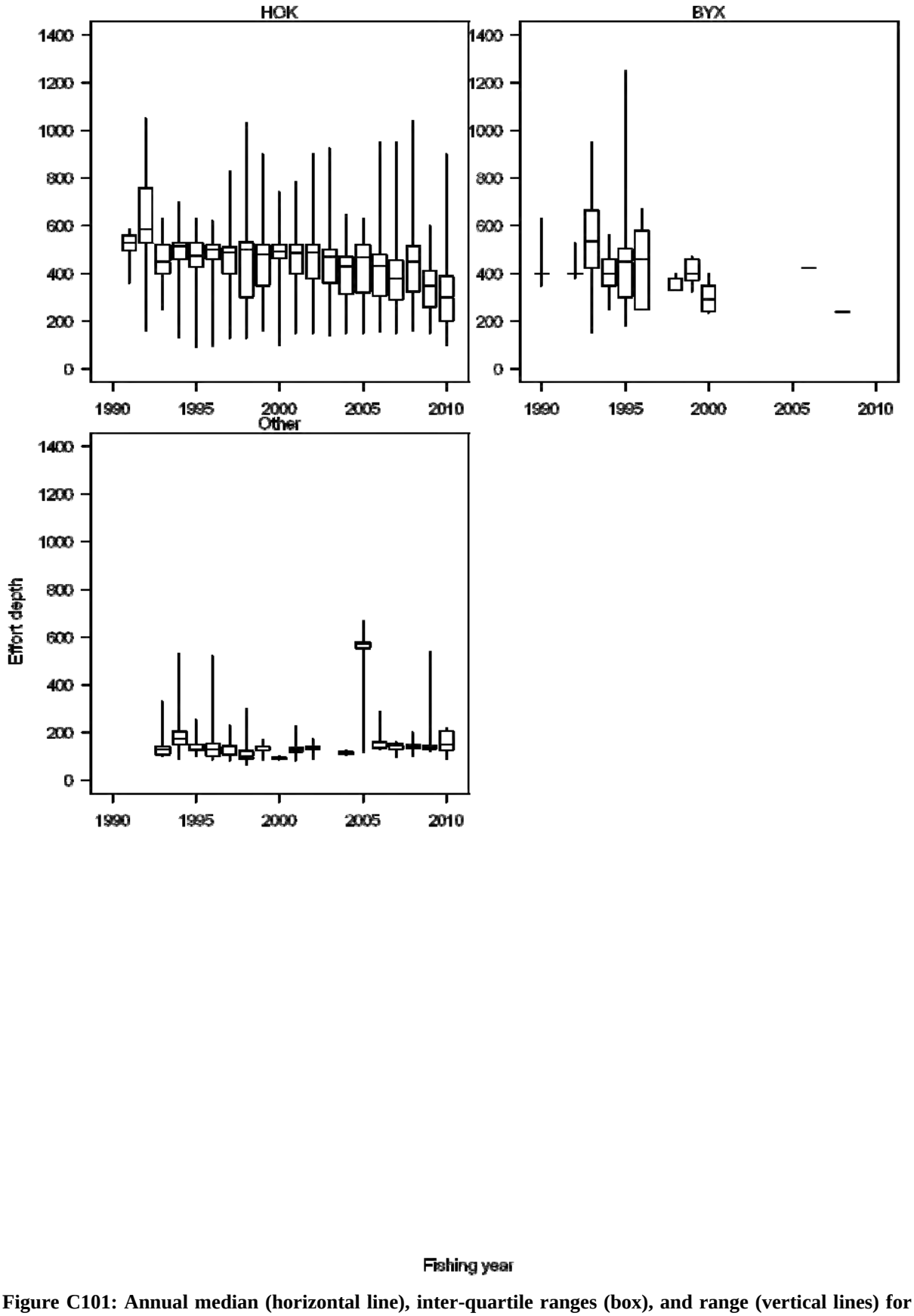


Figure C101: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) for depths (m) fished for various target species fisheries capturing alfonsino in the ECSI region using midwater tows on the bottom in the fishing years 1990–2010. Refer to Table C27 for species codes.

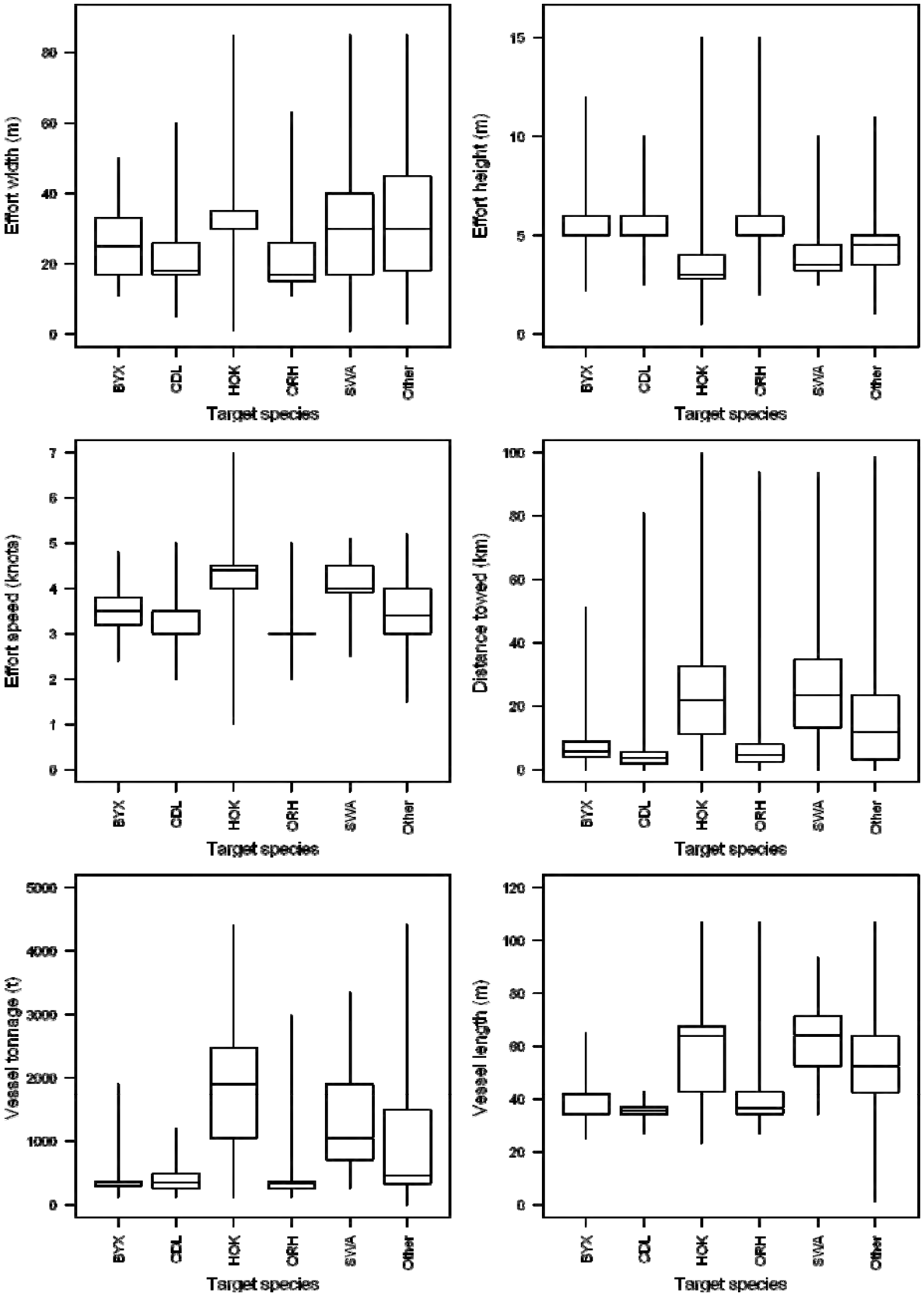


Figure C102: Distribution of fishing effort variables and vessel characteristics for the ECSI area for major target species fisheries catching alfonsino taken using bottom trawl gear in the fishing years 1990–2010. Refer to Table C27 for species codes.

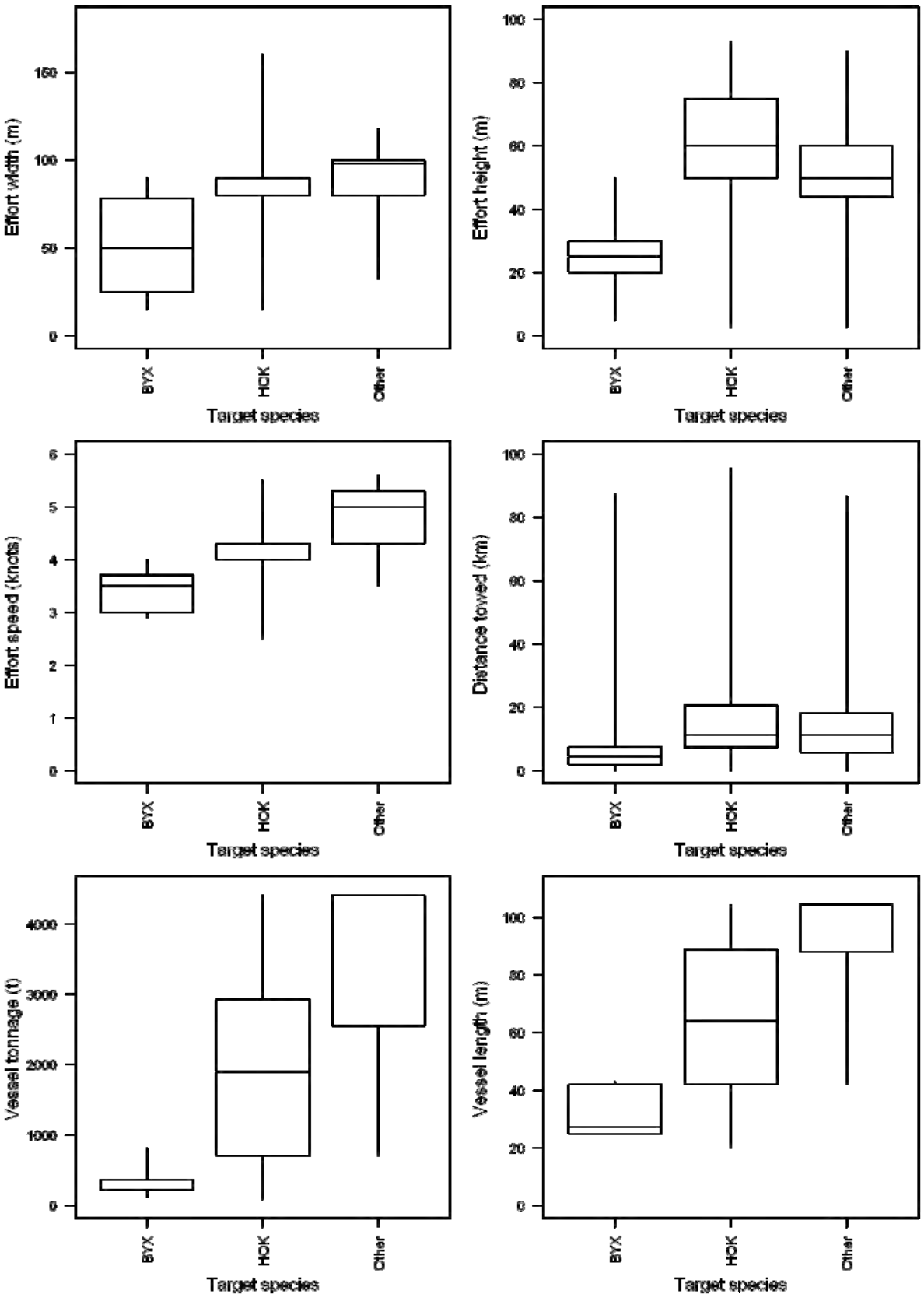


Figure C103: Distribution of fishing effort variables and vessel characteristics for the ECSI area for major target species fisheries catching alfonsino using midwater trawl gear in the fishing years 1990–2010. Refer to Table C27 for species codes.

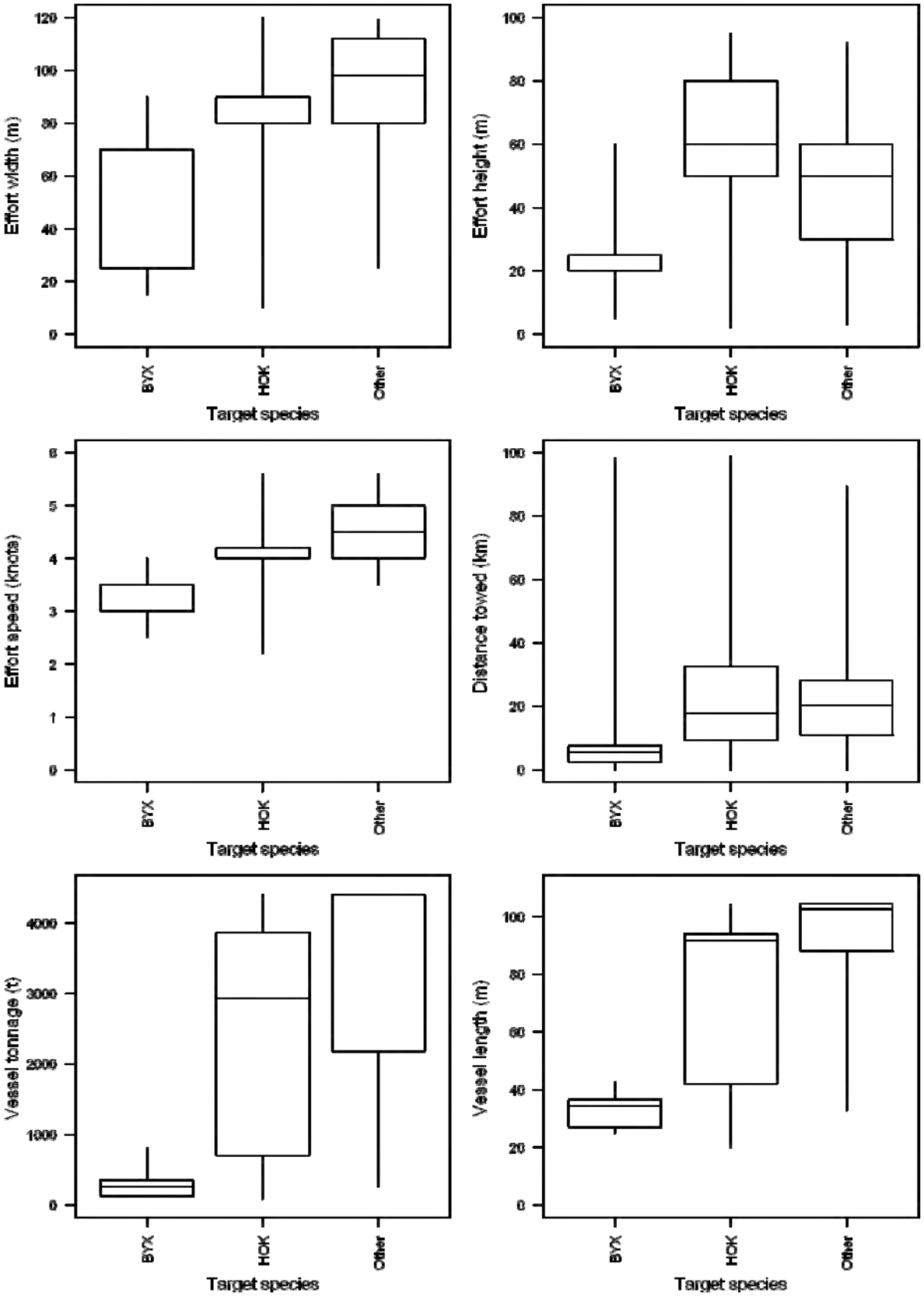


Figure C104: Distribution of fishing effort variables and vessel characteristics for the ECSI area for major target species fisheries catching alfonsino using midwater trawl gear fishing on the bottom in the fishing years 1990–2010. Refer to Table C27 for species codes.

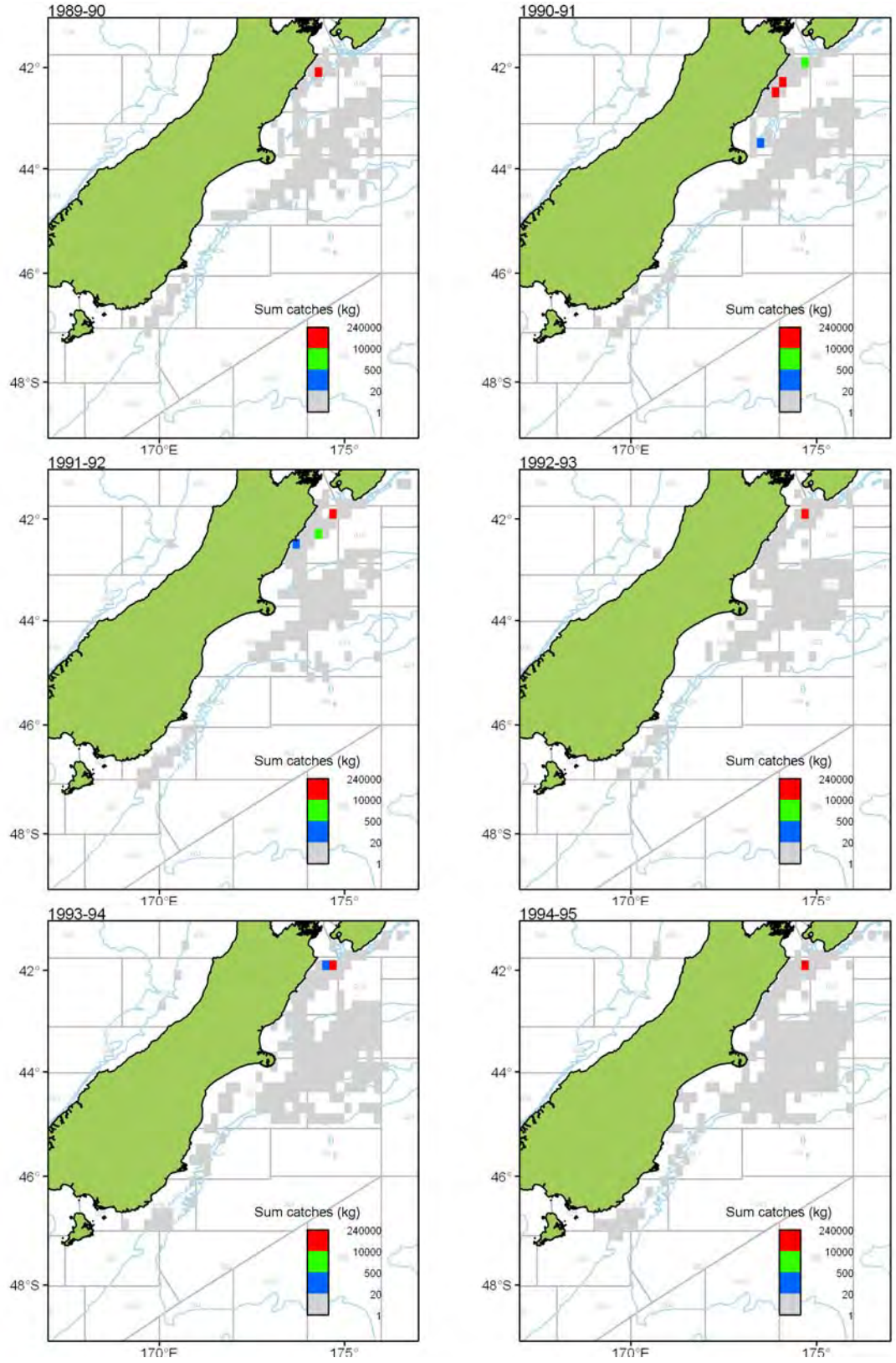


Figure C105: Distribution of alfonsino catch within the ECSI region aggregated into 0.2 degree spatial blocks for fishing years 1990–1995 for the TCEPR form taken by all trawl gear.

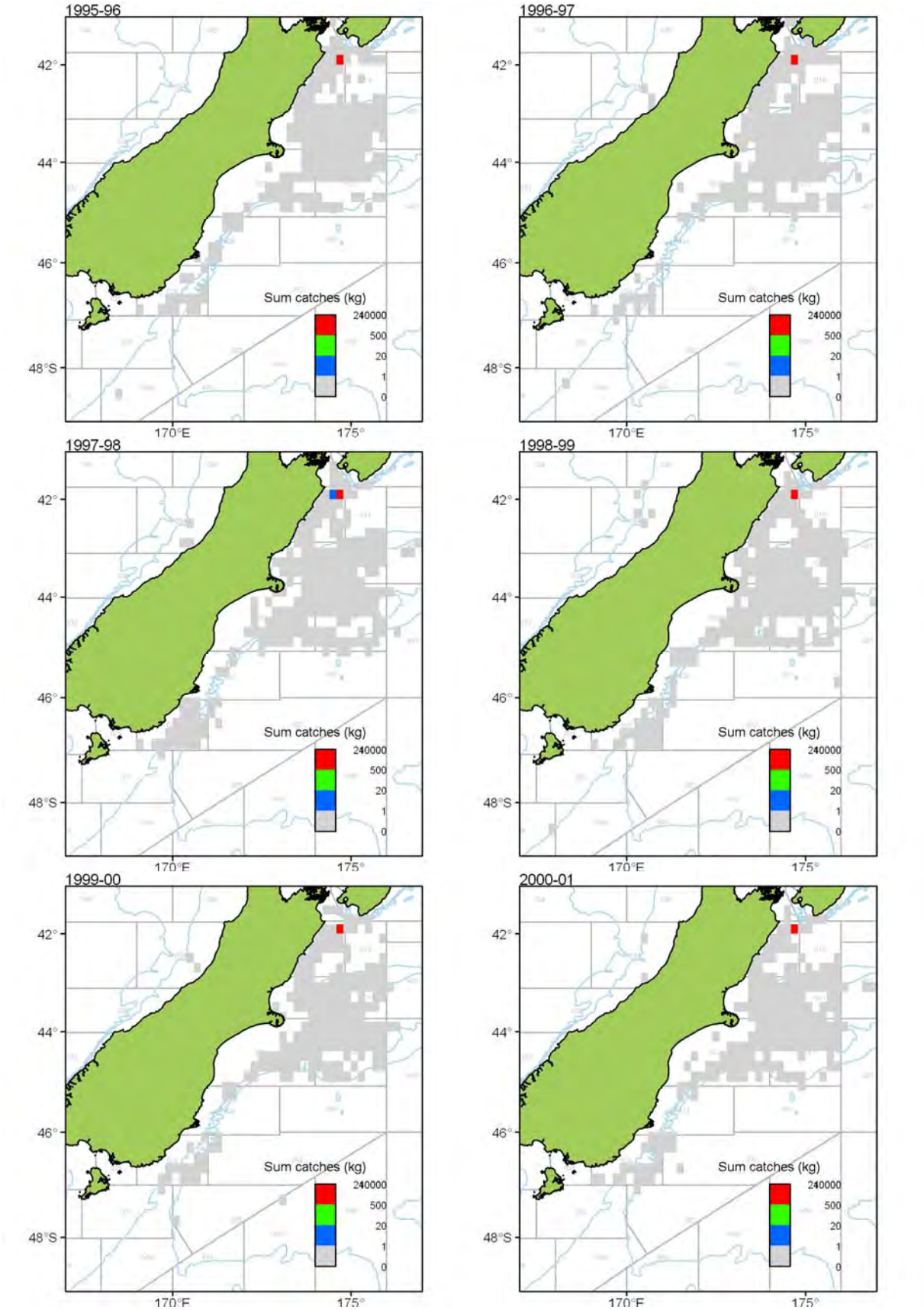


Figure C106: Distribution of alfonsino catch within the ECSI region aggregated into 0.2 degree spatial blocks for fishing years 1996–2001 for the TCEPR form taken by all trawl gear.

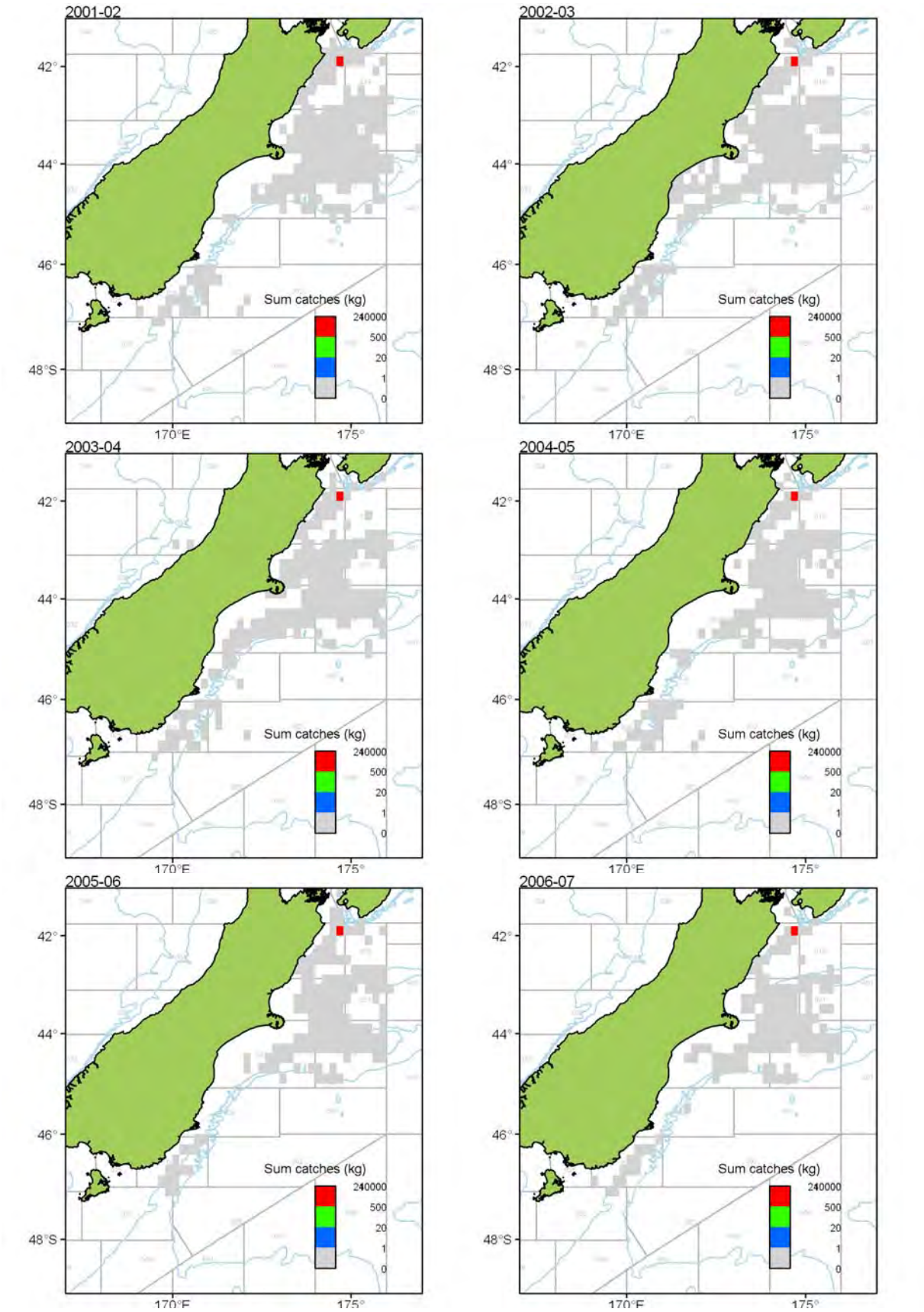


Figure C107: Distribution of alfonsino catch within the ECSI region aggregated into 0.2 degree spatial blocks for fishing years 2002–2007 for the TCEPR form taken by all trawl gear.

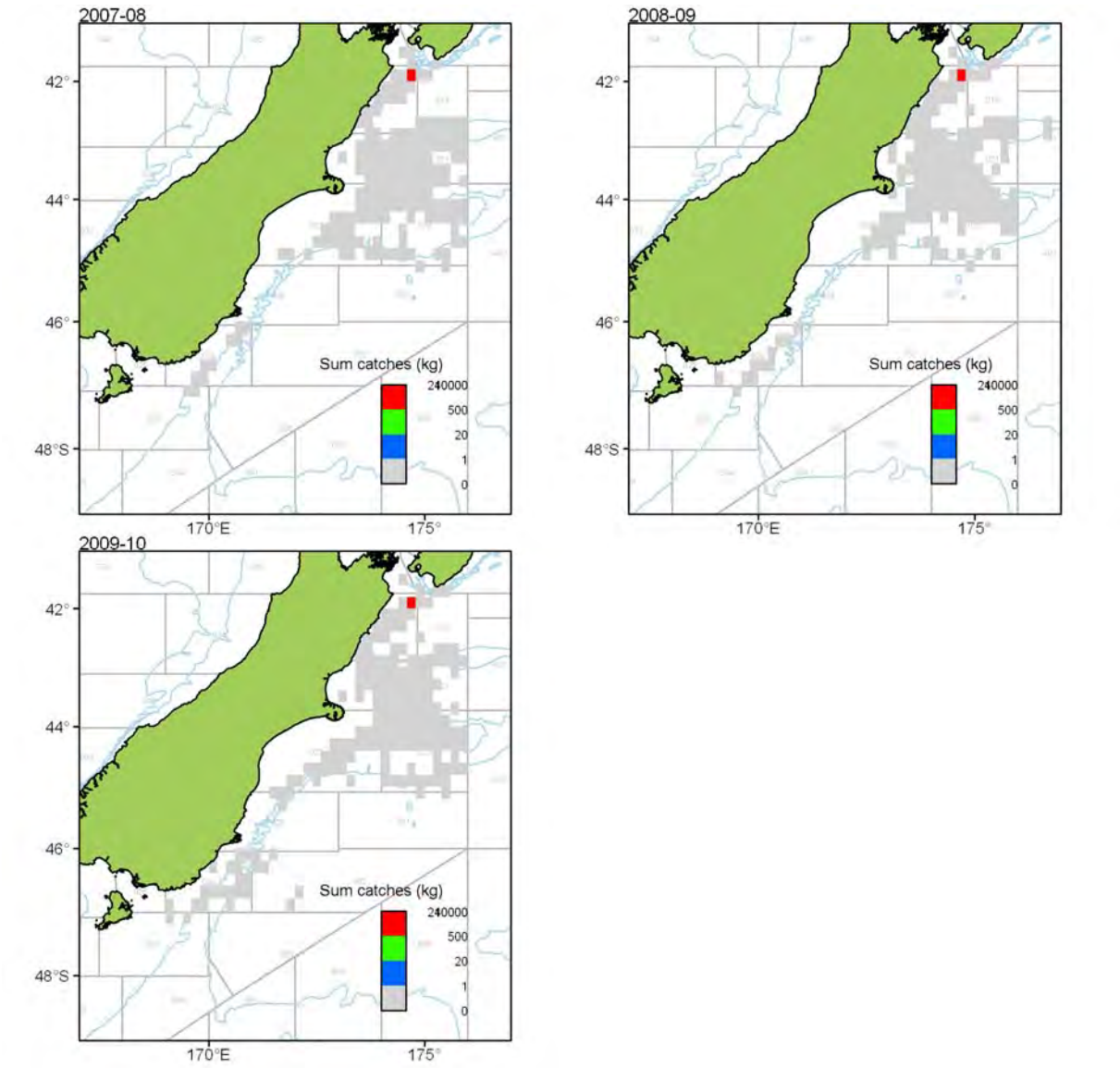


Figure C108: Distribution of alfonsino catch within the ECSI region aggregated into 0.2 degree spatial blocks for fishing years 2008–2010 for the TCEPR form taken by all trawl gear.

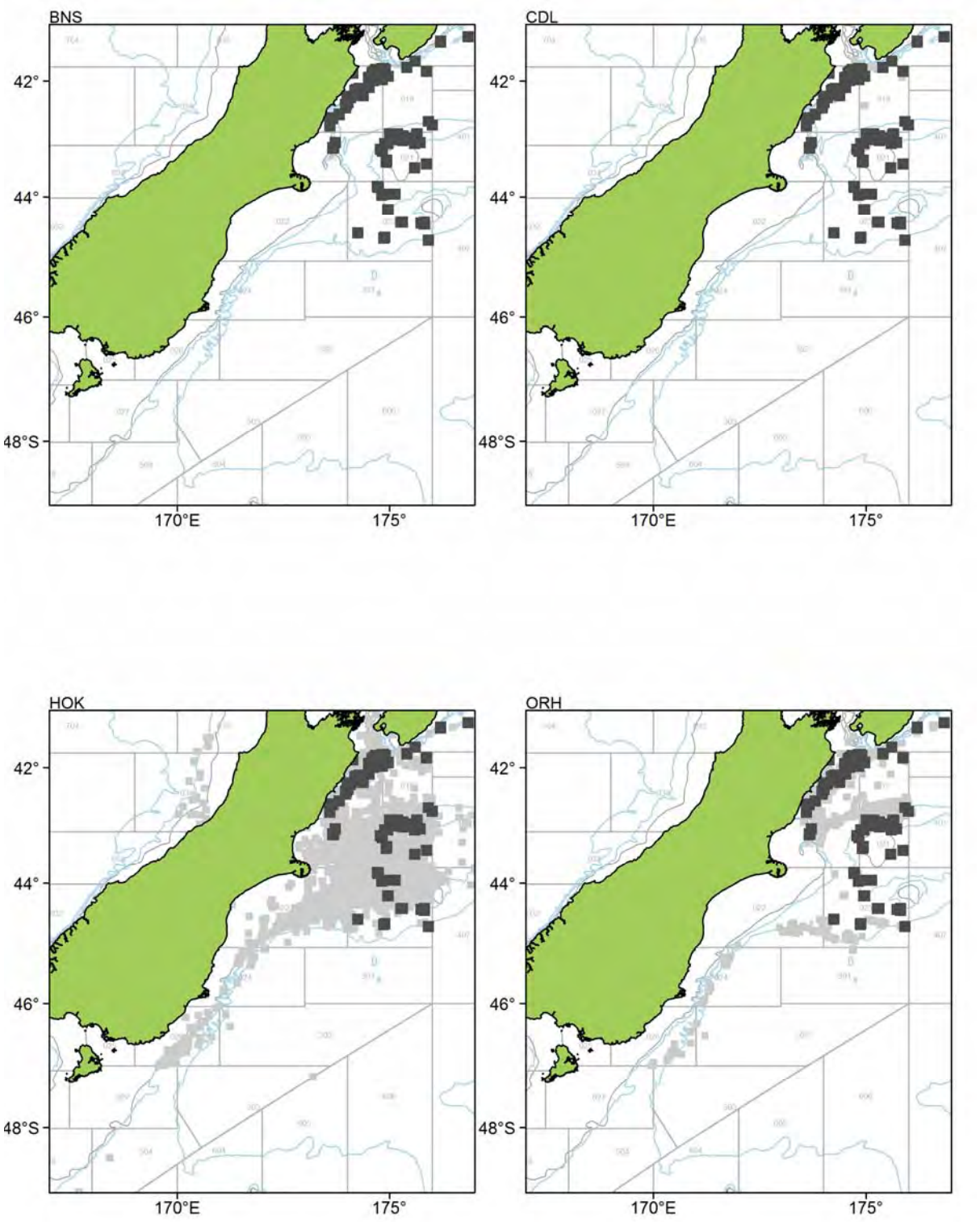


Figure C109: ECSI statistical areas and bathymetry showing the distribution of all TCEPR trawls that caught alfonsino by main target species (grey cells) compared to the distribution of alfonsino targeted trawls (black cells) in the fishing years 1990–2010. Locations are aggregated into 0.2 degree spatial squares.

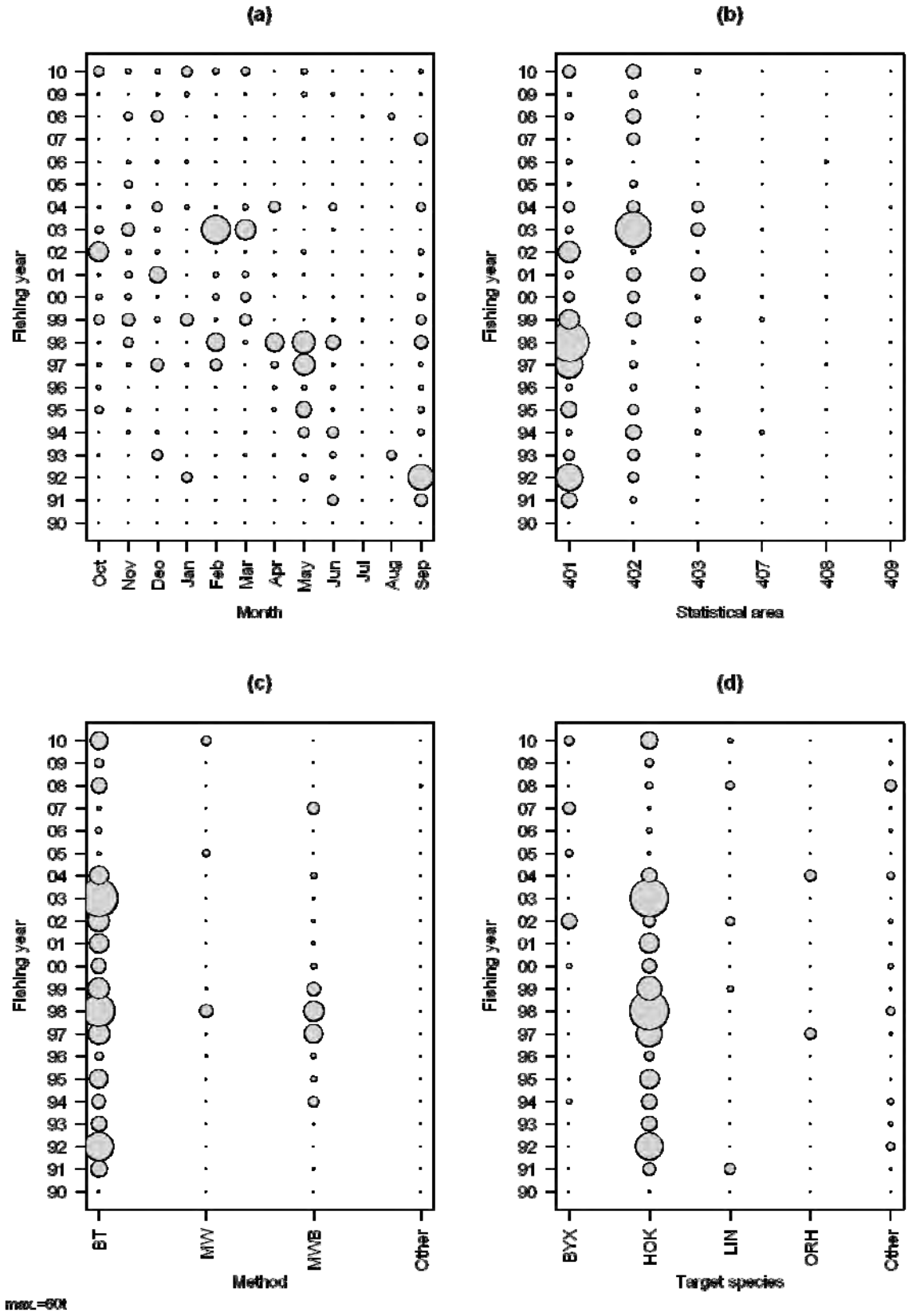


Figure C110: Distribution of alfonsino catch in the Western Chatham Rise region (circle size is proportional to catch) for fishing years 1990–2010 in relation to a) month, b) statistical area, c) fishing method, and d) target species. Circle size is proportional to catch; maximum circle size is indicated in lower left hand corner.

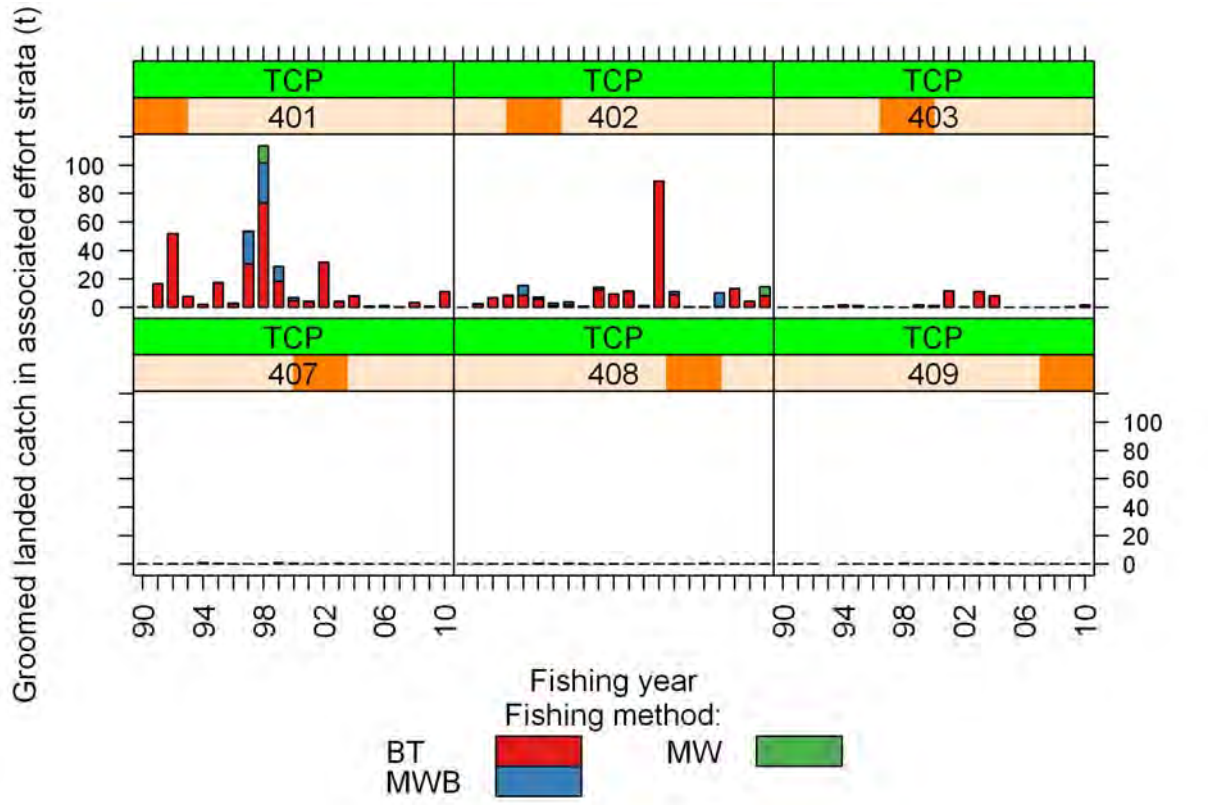


Figure C111: Distribution of alfonsino catch in the Western Chatham Rise region in relation to form type and statistical area for fishing years 1990–2010 by fishing method.

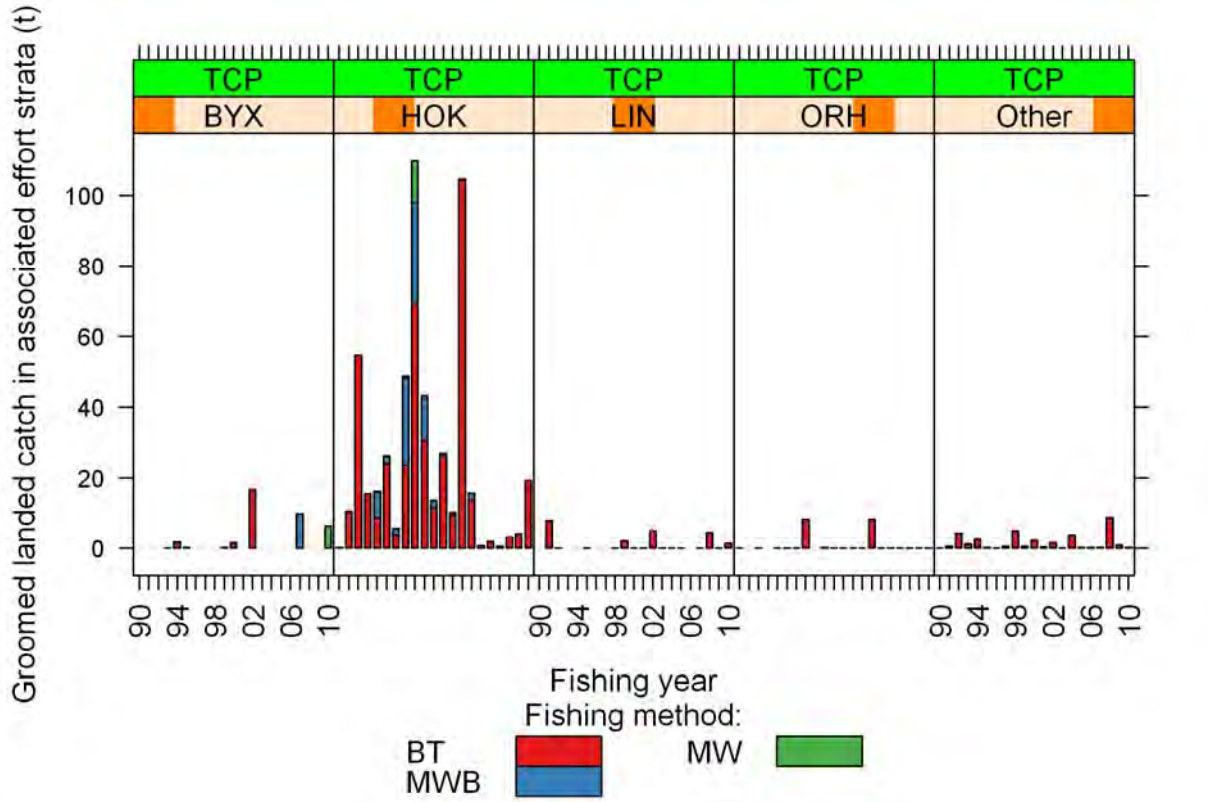


Figure C112: Distribution of alfonsino catch in the Western Chatham Rise region in relation to form type and target species for fishing years 1990–2010 by fishing method. Refer to Table C27 for species codes.

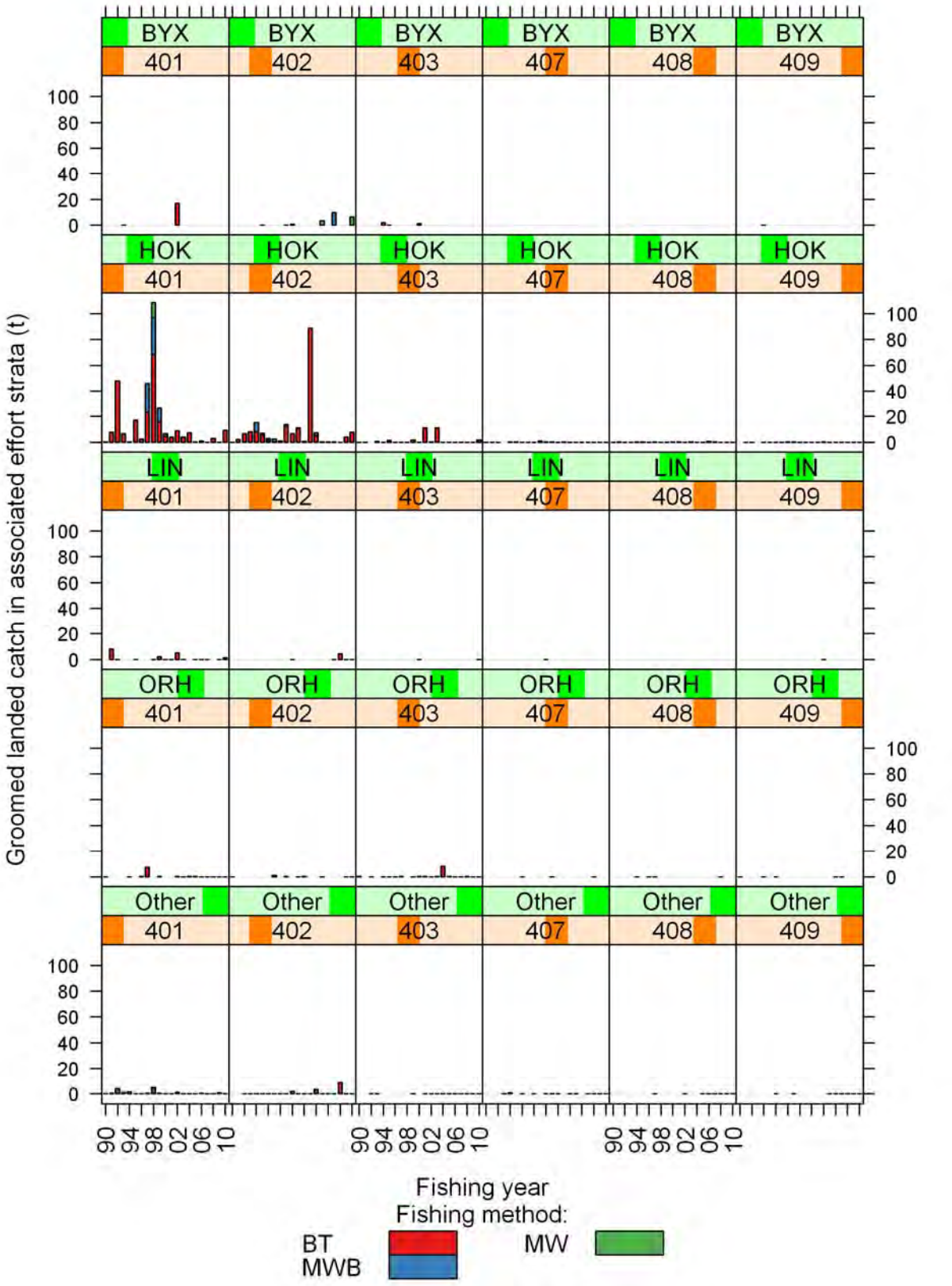


Figure C113: Distribution of alfonsino catch in the Western Chatham Rise region in relation to target species and statistical area for fishing years 1990–2010 by fishing method. Refer to Table C27 for species codes.

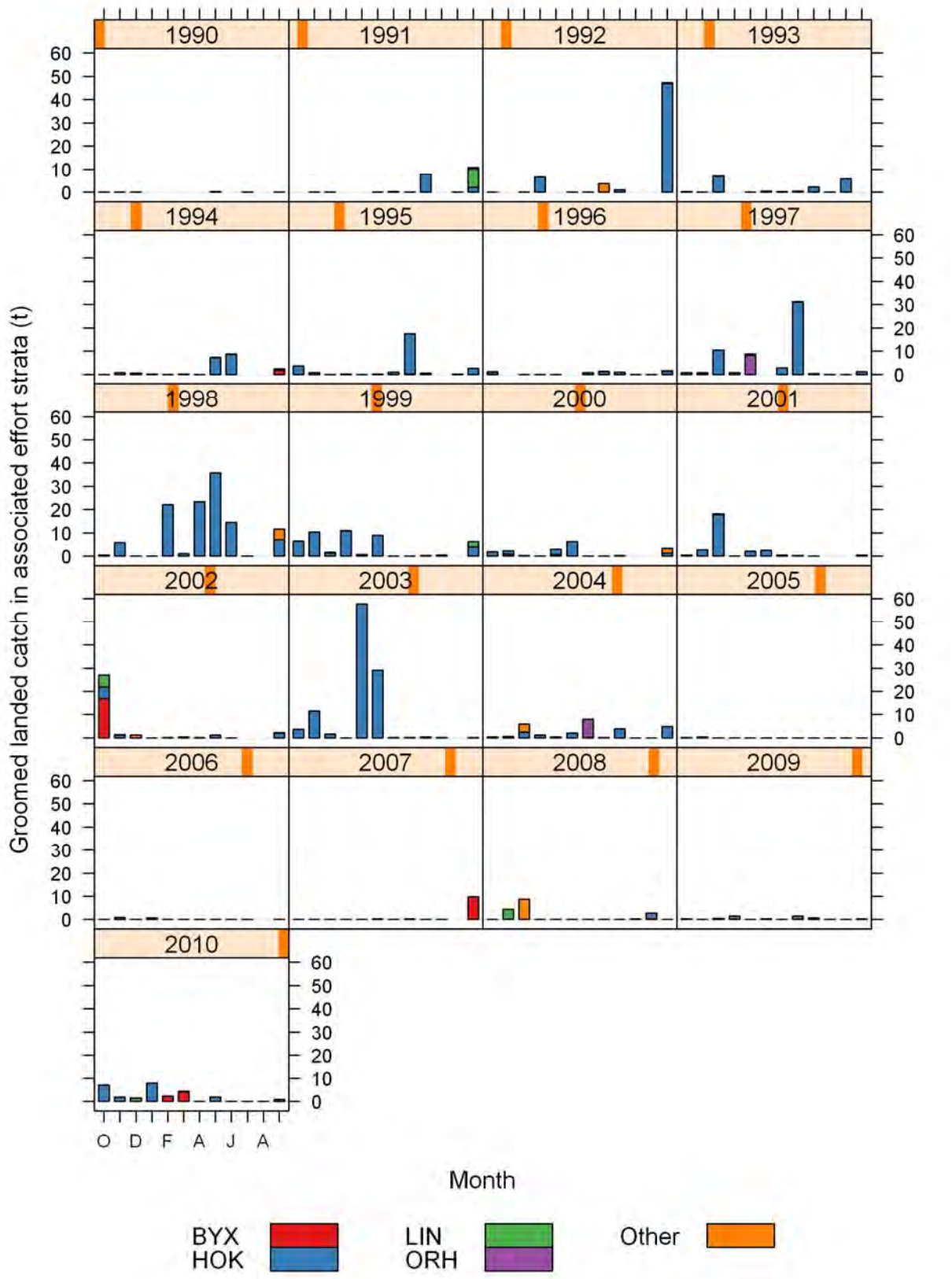


Figure C114: Distribution of alfonsino catch in the Western Chatham Rise region taken by bottom trawl fishing methods by fishing month for fishing years 1990–2010 by target species. Refer to Table C27 for species codes.

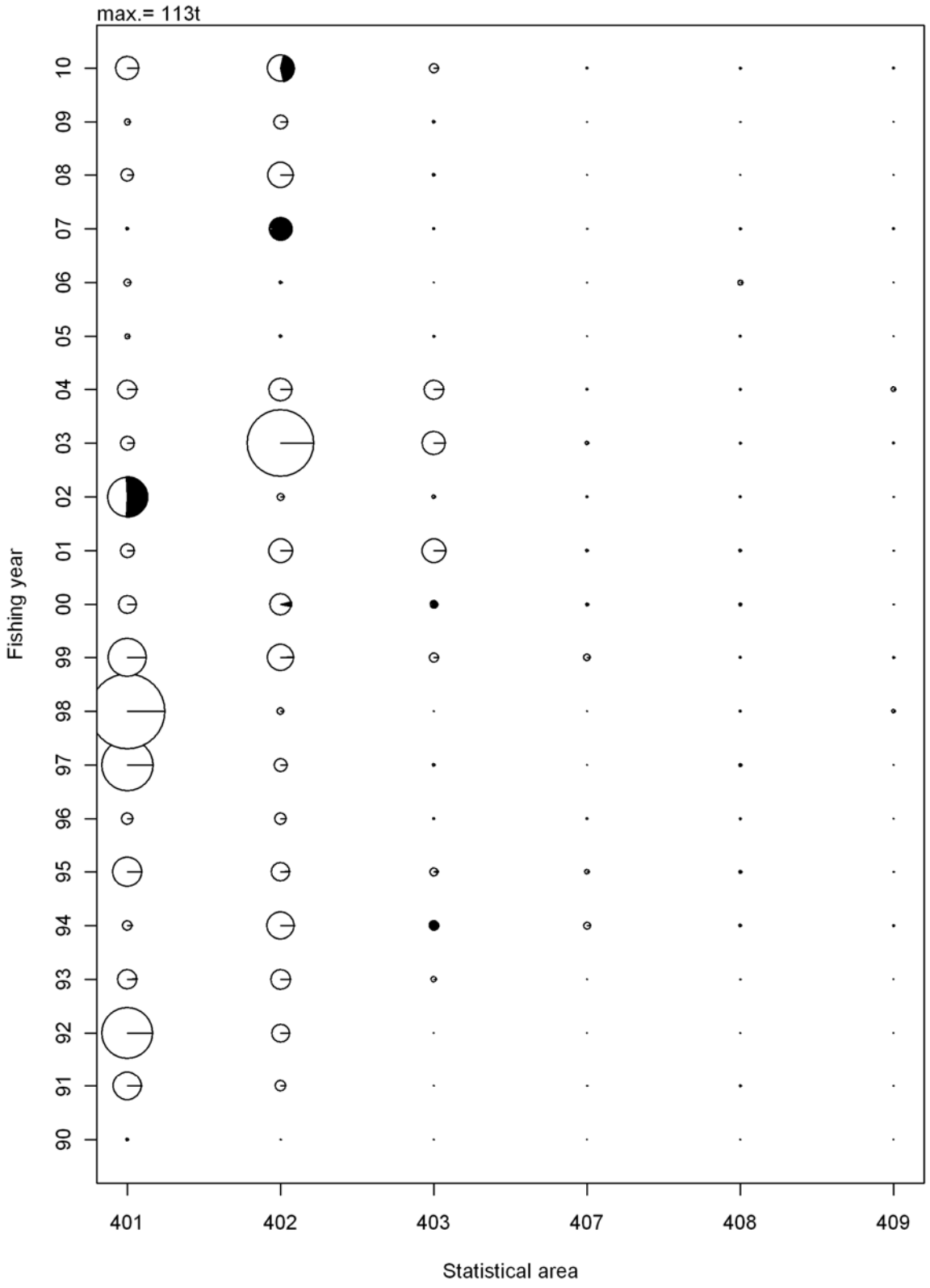


Figure C115: Distribution of alfonsino catch by fishing year with circle size proportional to the total catch and black portion of the pie indicating proportion of the catch as targeted alfonsino by statistical area for TCEPR tows in the Western Chatham Rise region.

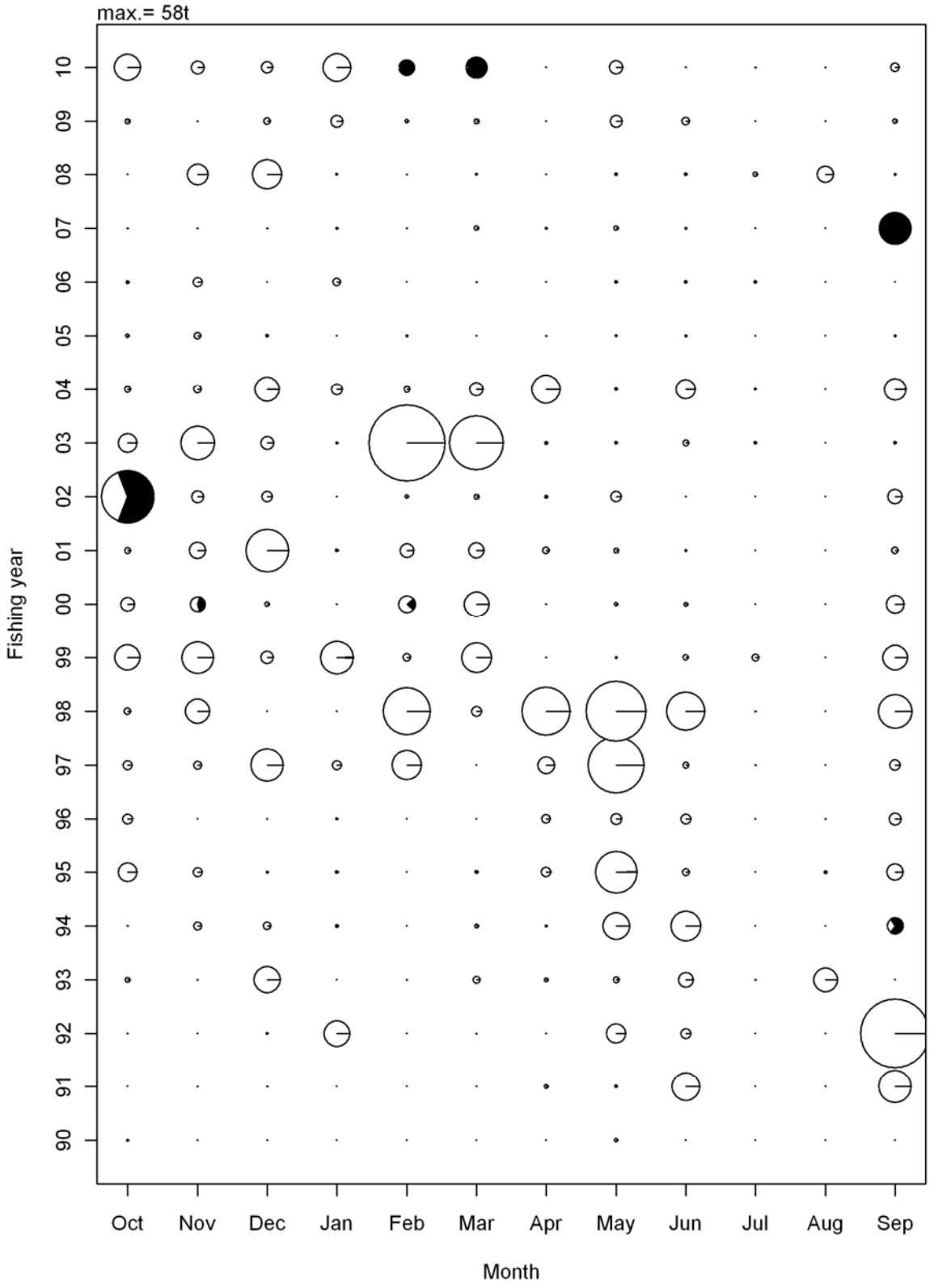


Figure C116: Distribution of alfonsino catch by fishing year with circle size proportional to the total catch and black portion of the pie indicating proportion of the catch as targeted alfonsino by month for TCEPR tows in the Western Chatham Rise region.

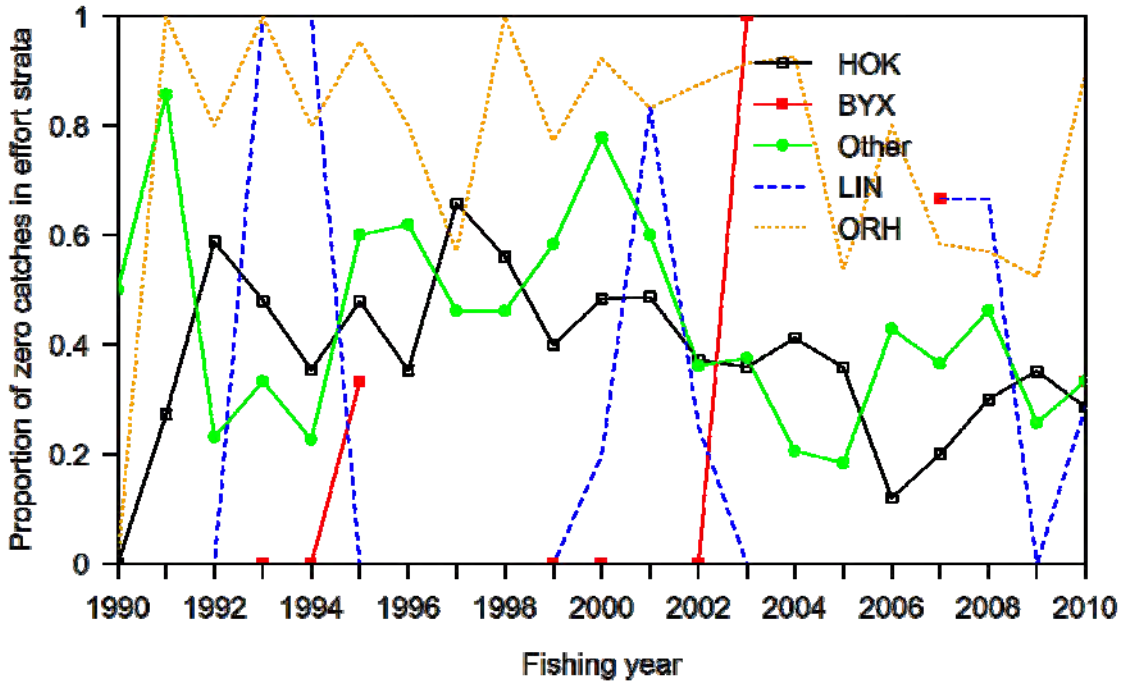


Figure C117: Proportion of TCEPR tows with zero reported alfonsino catch by major target species for the Western Chatham Rise region. Refer to Table C27 for species codes.

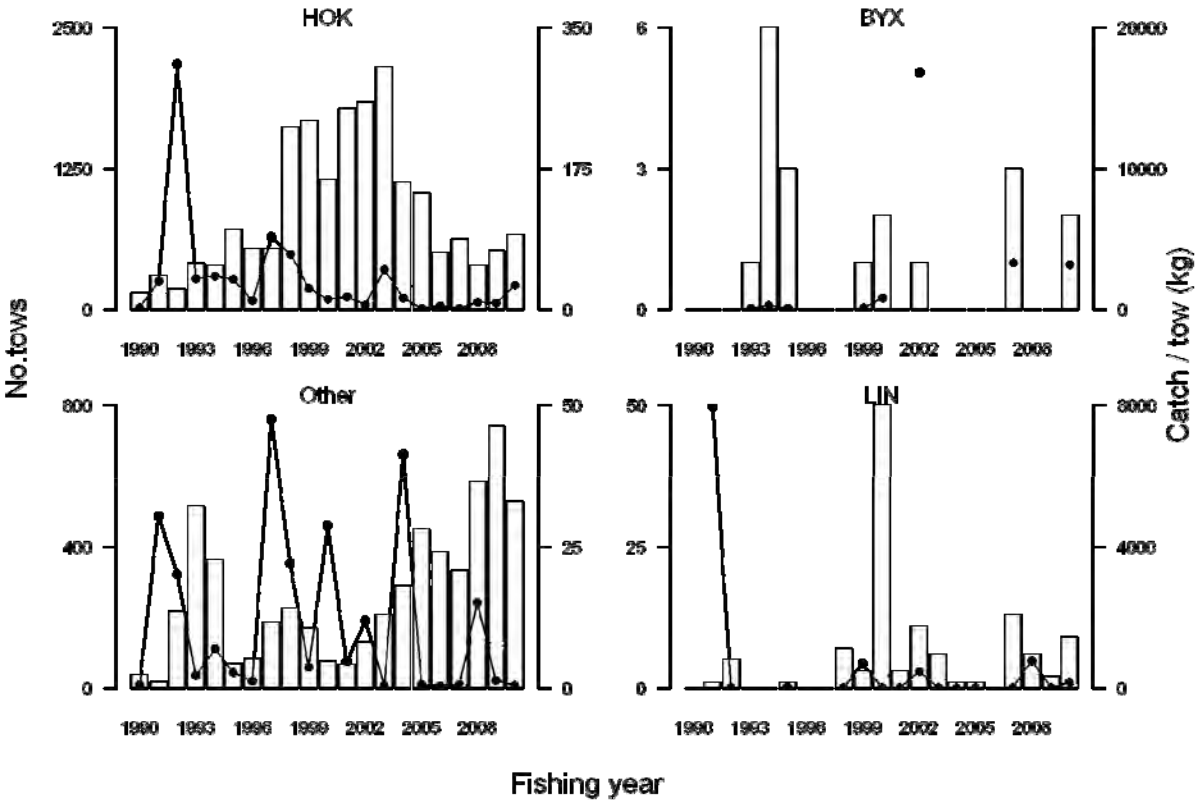


Figure C118: Annual catch rate of alfonsino in kilograms alfonsino (catch/tow) and the number of TCEPR tows in the Western Chatham Rise region for various target species. Refer to Table C27 for species codes.

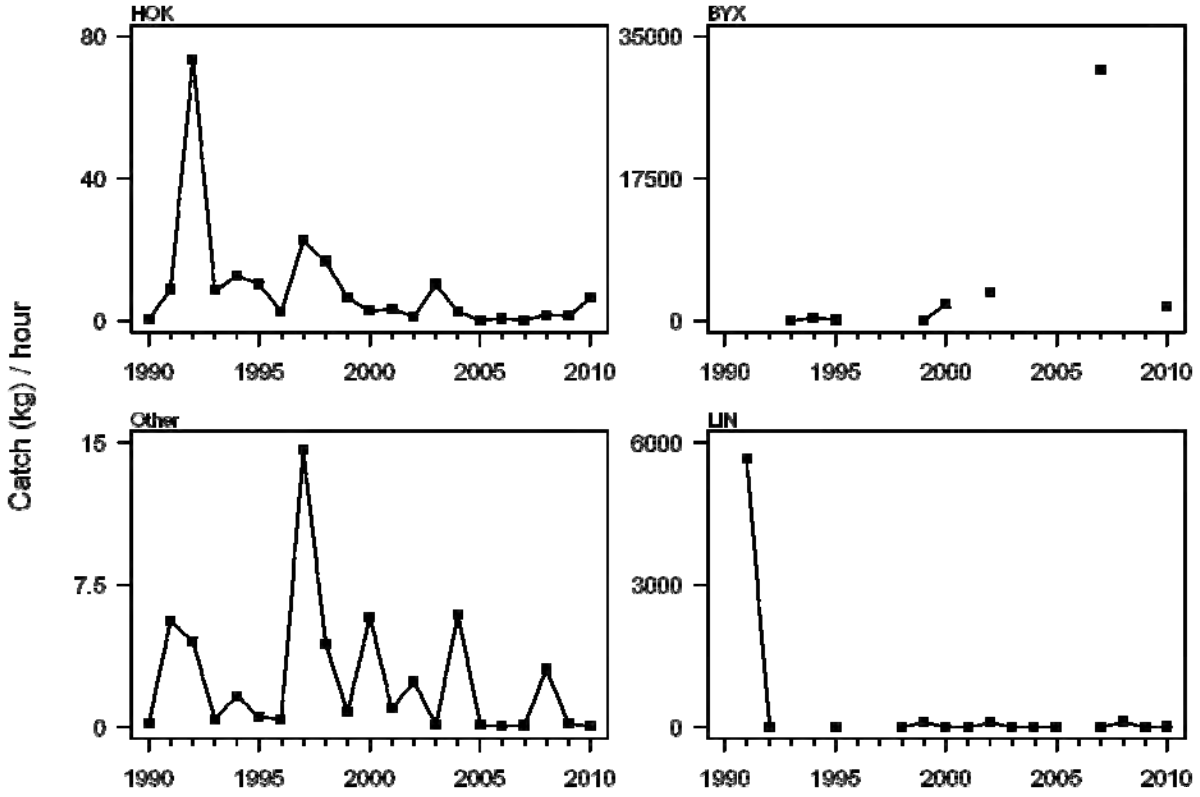


Figure C119: Catch rate (kg per hour) by fishing year for various target species for TCEPR tows in the Western Chatham Rise region.

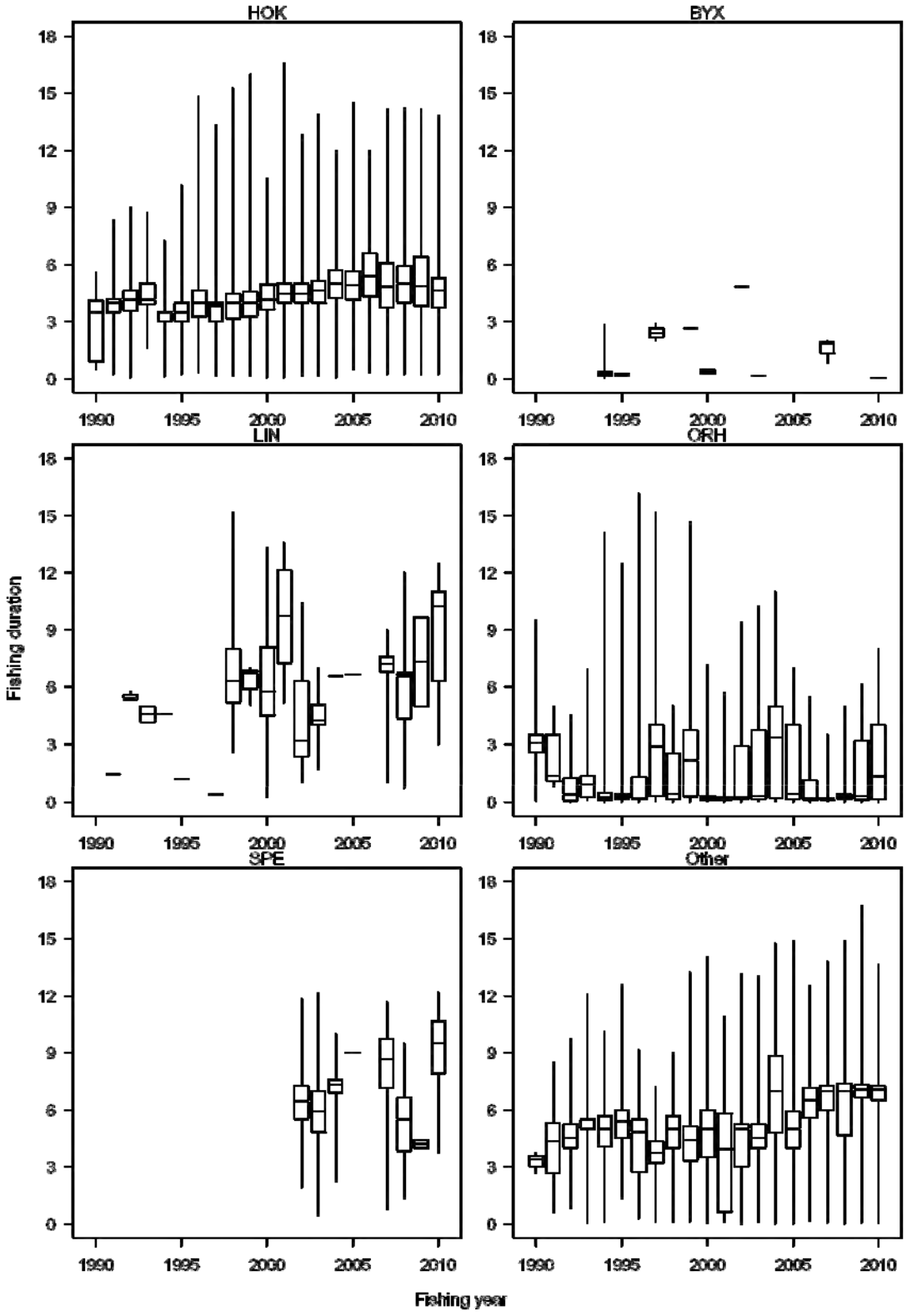


Figure C120: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) for tow durations (hours) reported for various target species fisheries capturing alfonsino in the Western Chatham Rise region using TCEPR bottom trawl tows in the fishing years 1990–2010. Refer to Table C27 for species codes.

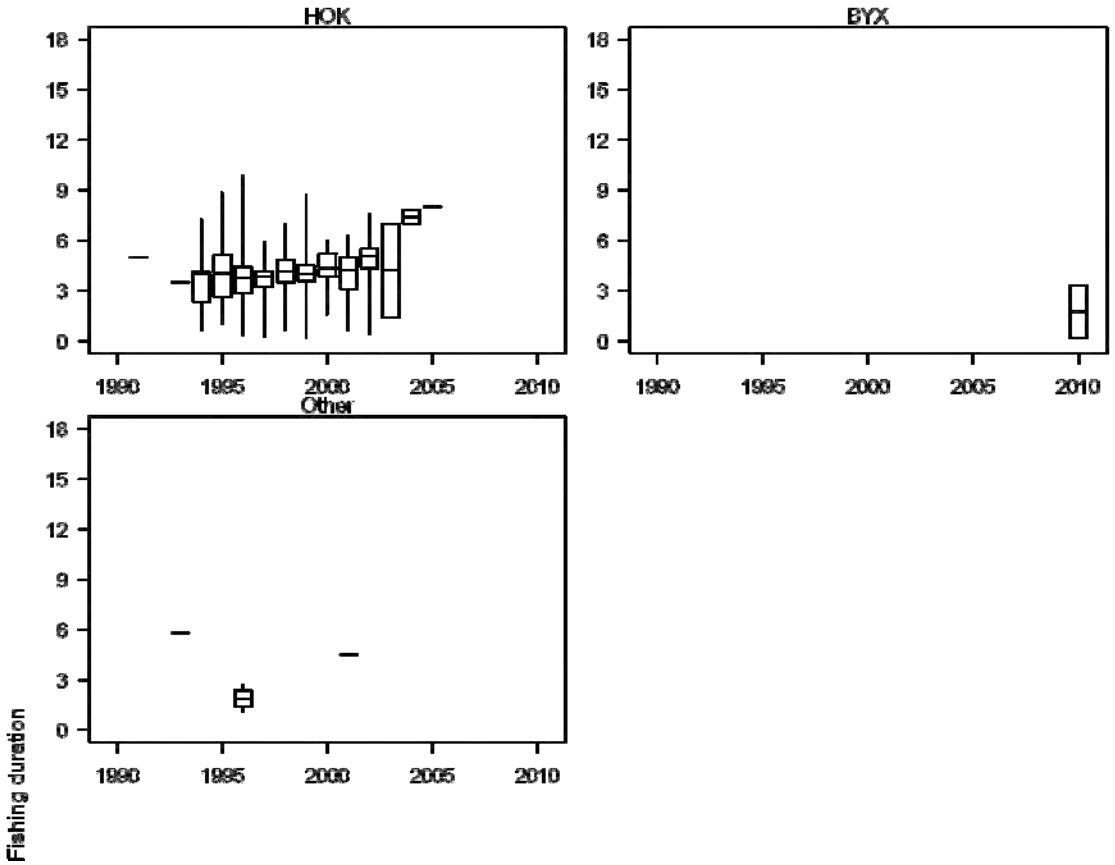


Figure C121: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) for tow durations (hours) reported for various target species fisheries capturing alfonsino in the Western Chatham Rise region using TCEPR midwater trawl tows in the fishing years 1990–2010. Refer to Table C27 for species codes.

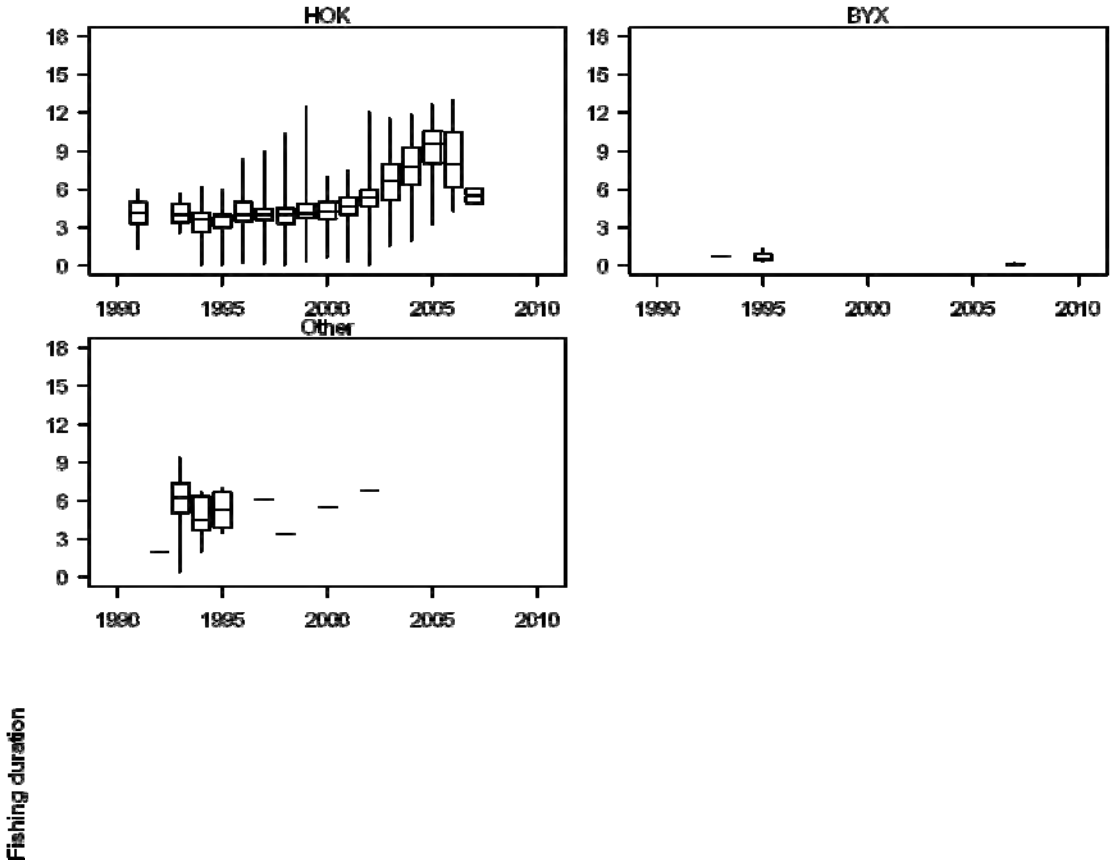


Figure C122: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) for tow durations (hours) reported for various target species fisheries capturing alfonsino in the Western Chatham Rise region using TCEPR midwater trawl on the bottom tows in the 1990–2010 fishing years. Refer to Table C27 for species codes.

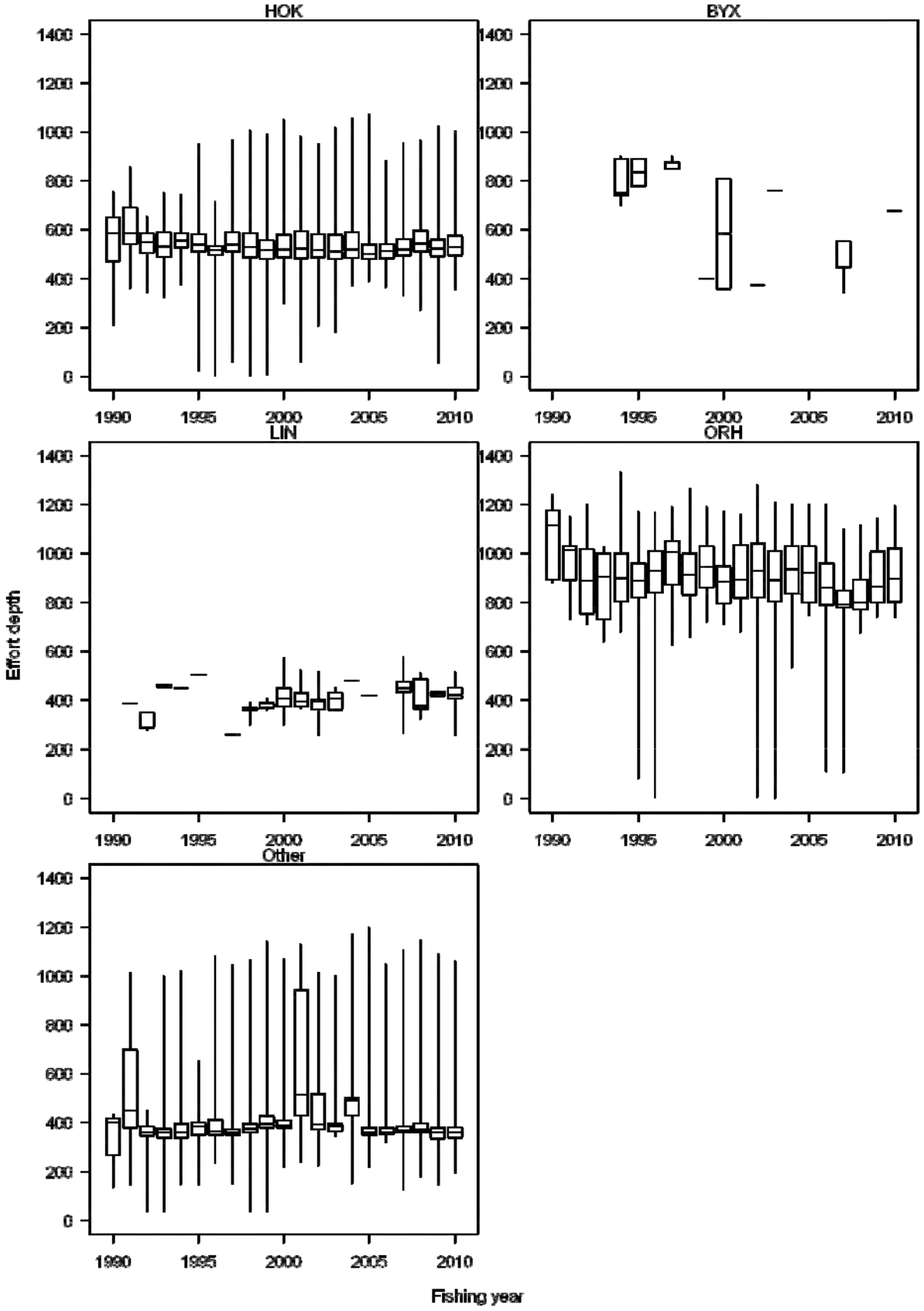


Figure C123: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) for depths (m) fished for various target species fisheries capturing alfonsino in the Western Chatham Rise region using bottom tows in the fishing years 1990–2010. Refer to Table C27 for species codes.

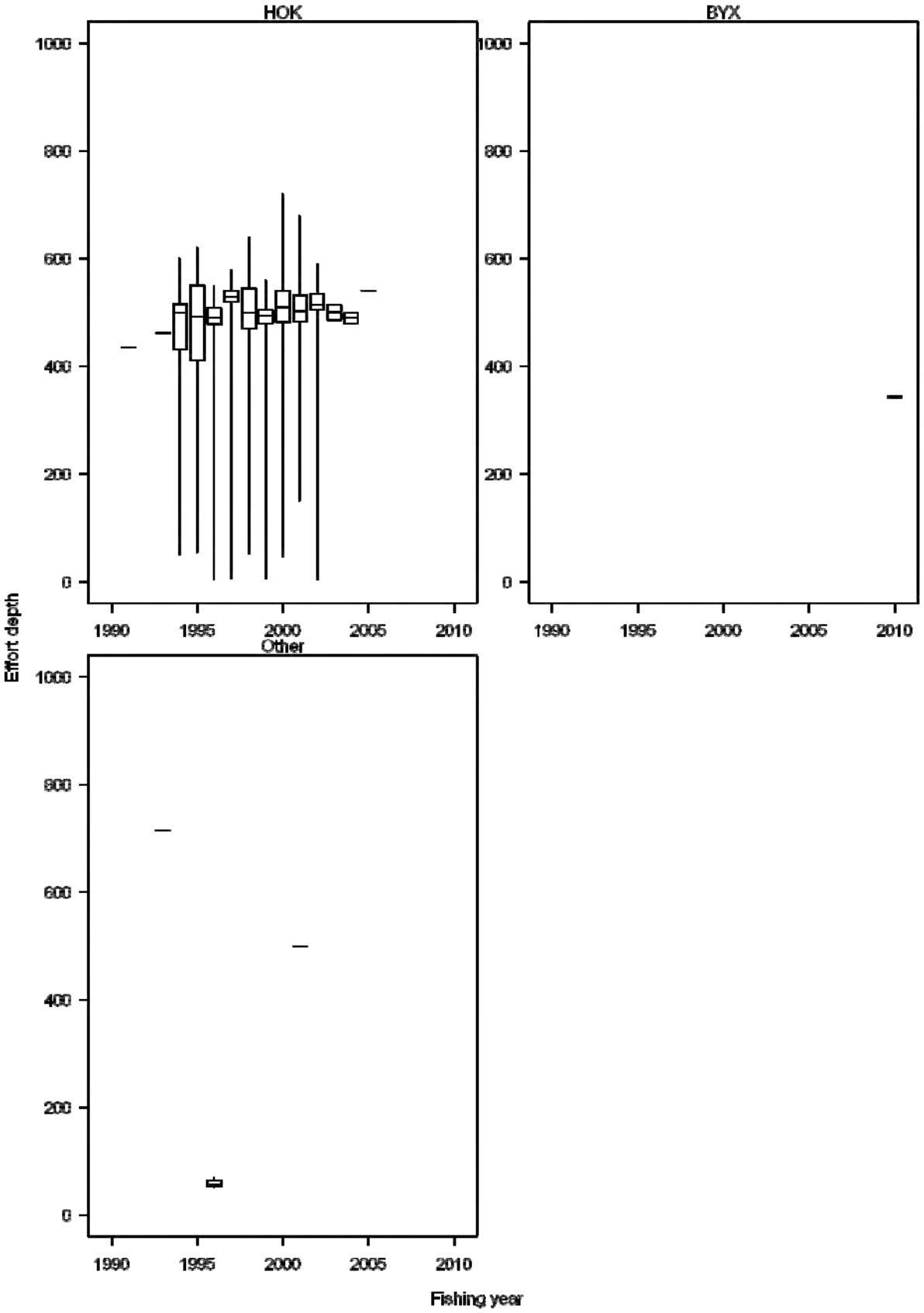


Figure C124: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) for depths (m) fished for various target species fisheries capturing alfonsino in the Western Chatham Rise region using midwater tows in the fishing years 1990–2010. Refer to Table C27 for species codes.

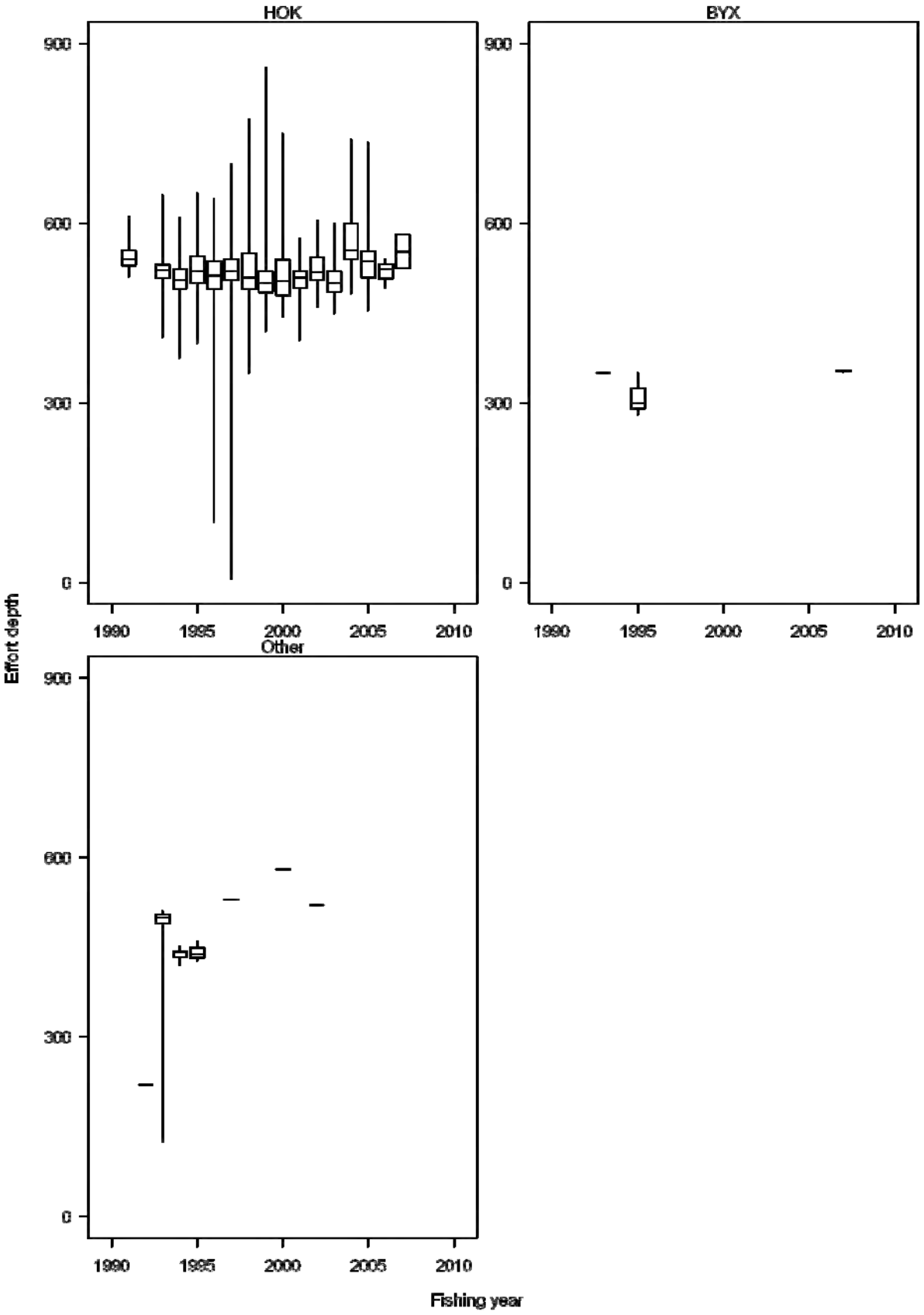


Figure C125: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) for depths (m) fished for various target species fisheries capturing alfonsino in the Western Chatham Rise region using midwater tows on the bottom in the fishing years 1990–2010. Refer to Table C27 for species codes.

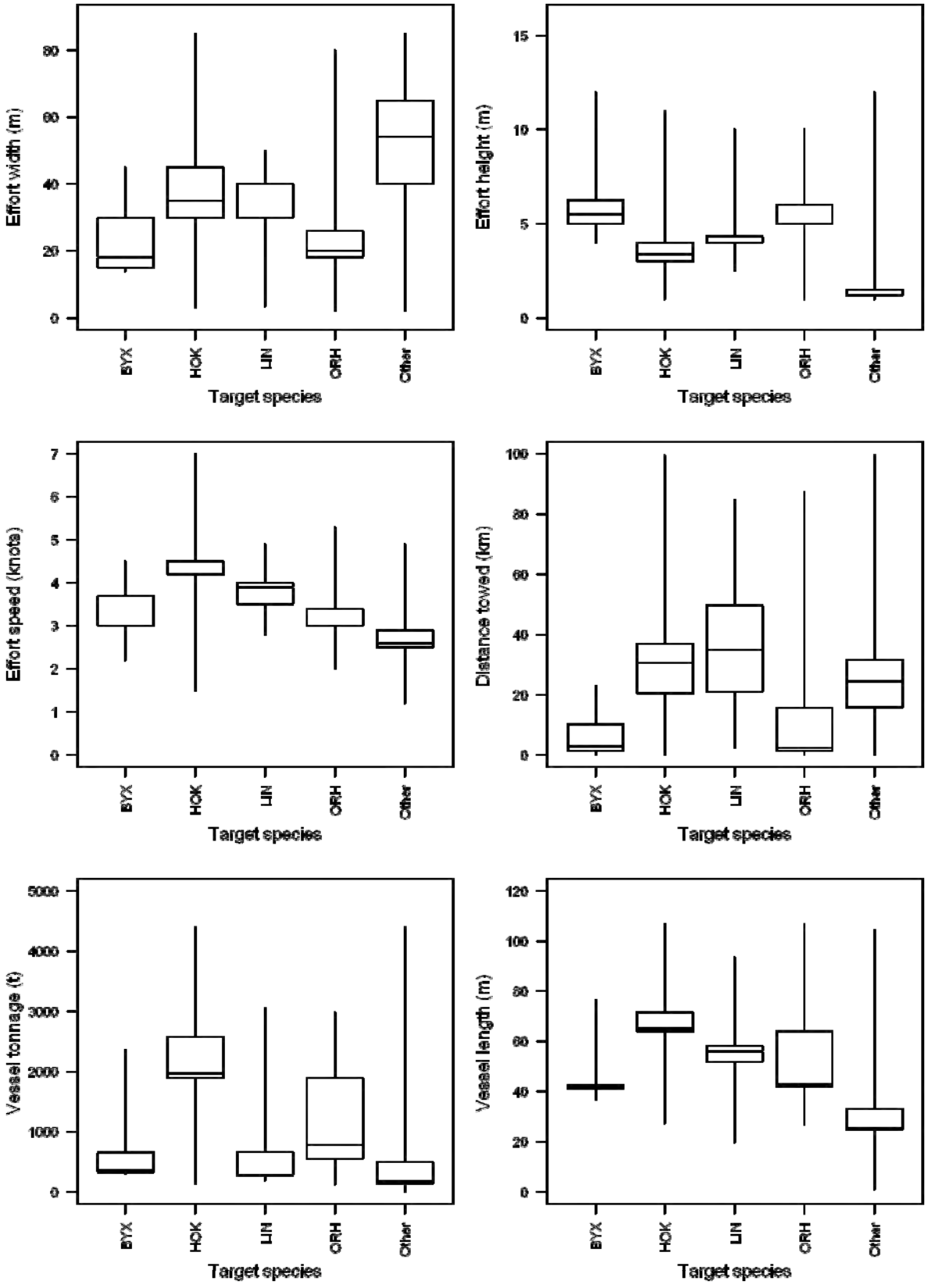


Figure C126: Distribution of fishing effort variables and vessel characteristics for the Western Chatham Rise area for major target species fisheries catching alfonsino using bottom trawl gear in the fishing years 1990–2010. Refer to Table C27 for species codes.

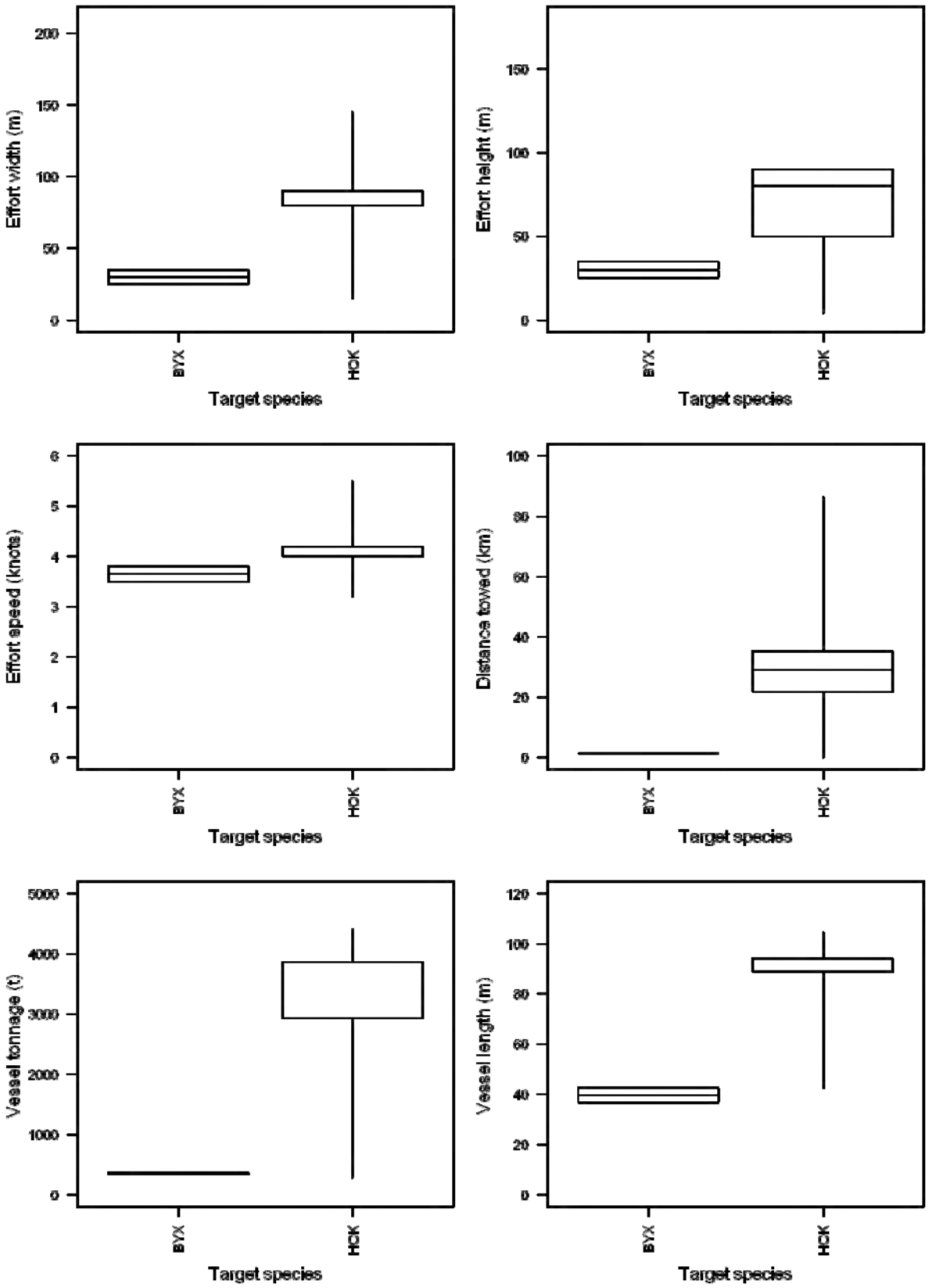


Figure C127: Distribution of fishing effort variables and vessel characteristics for the Western Chatham Rise area for major target species fisheries catching alfonsino using midwater trawl gear in the fishing years 1990–2010. Refer to Table C27 for species codes.

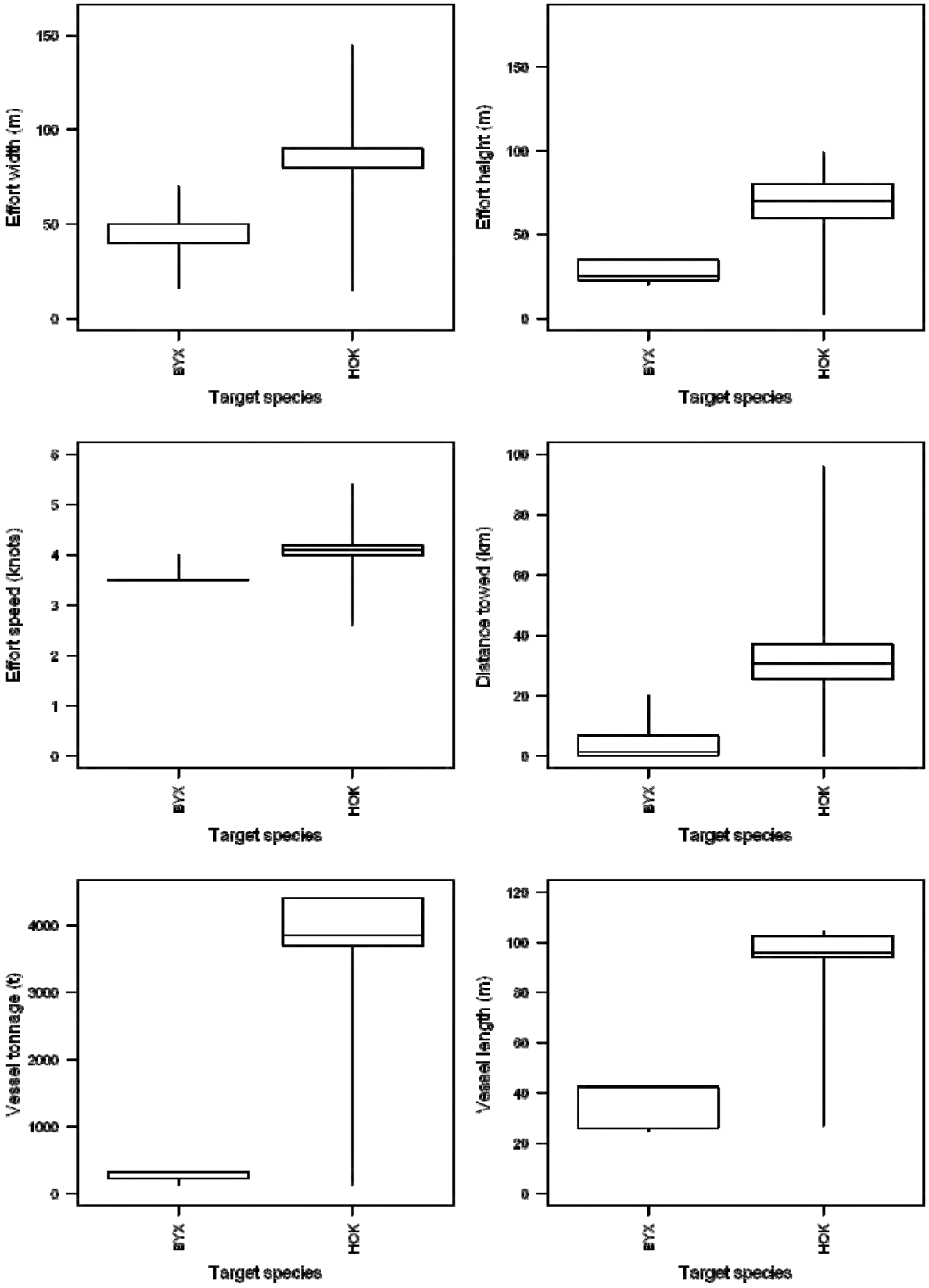


Figure C128: Distribution of fishing effort variables and vessel characteristics for the Western Chatham Rise area for major target species fisheries catching alfonsino using midwater trawl gear fishing on the bottom in the fishing years 1990–2010. Refer to Table C27 for species codes.

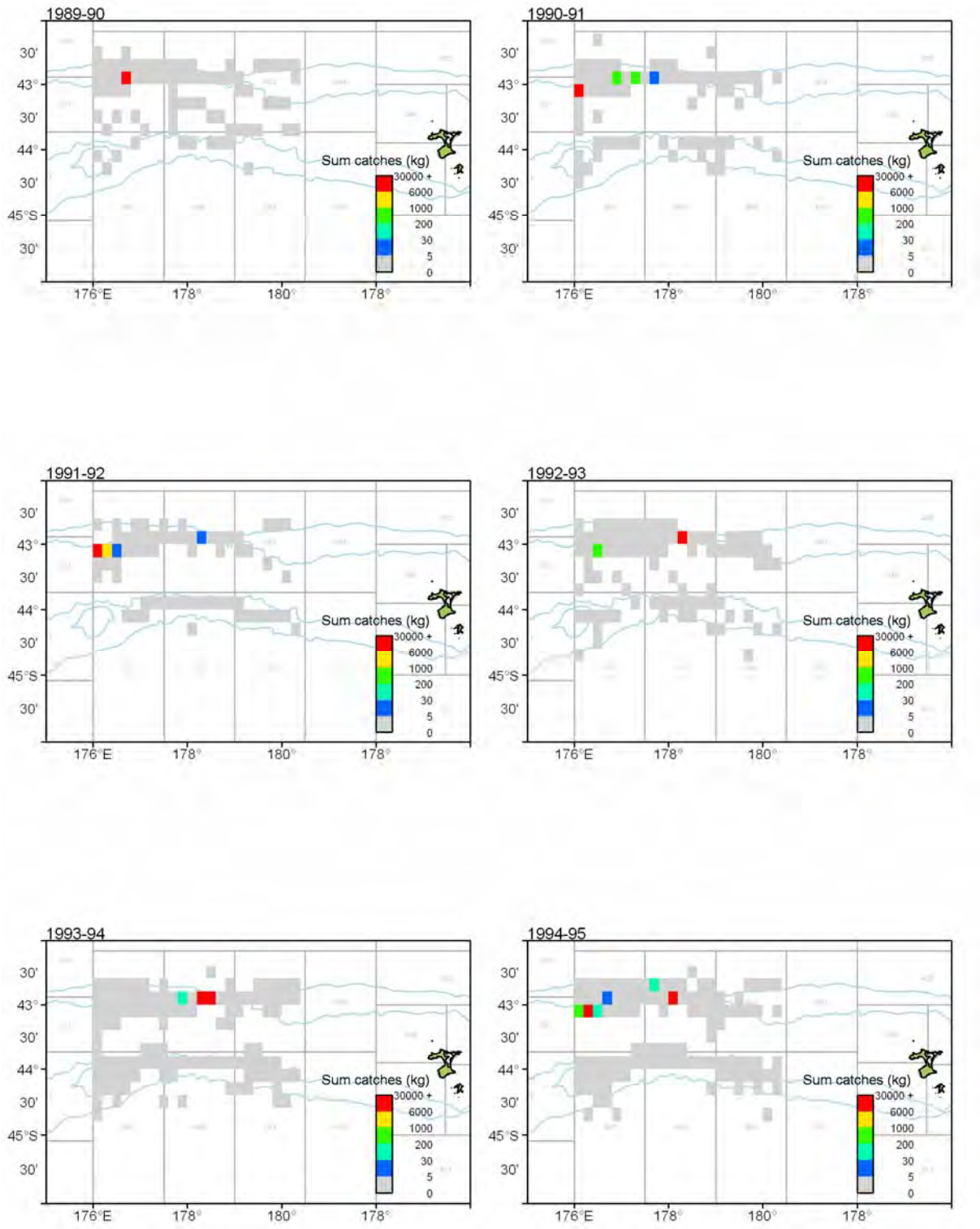


Figure C129: Distribution of alfonsino catch within the Western Chatham Rise region aggregated into 0.2 degree spatial blocks for fishing years 1990–1995 for the TCEPR form taken by all trawl gear.

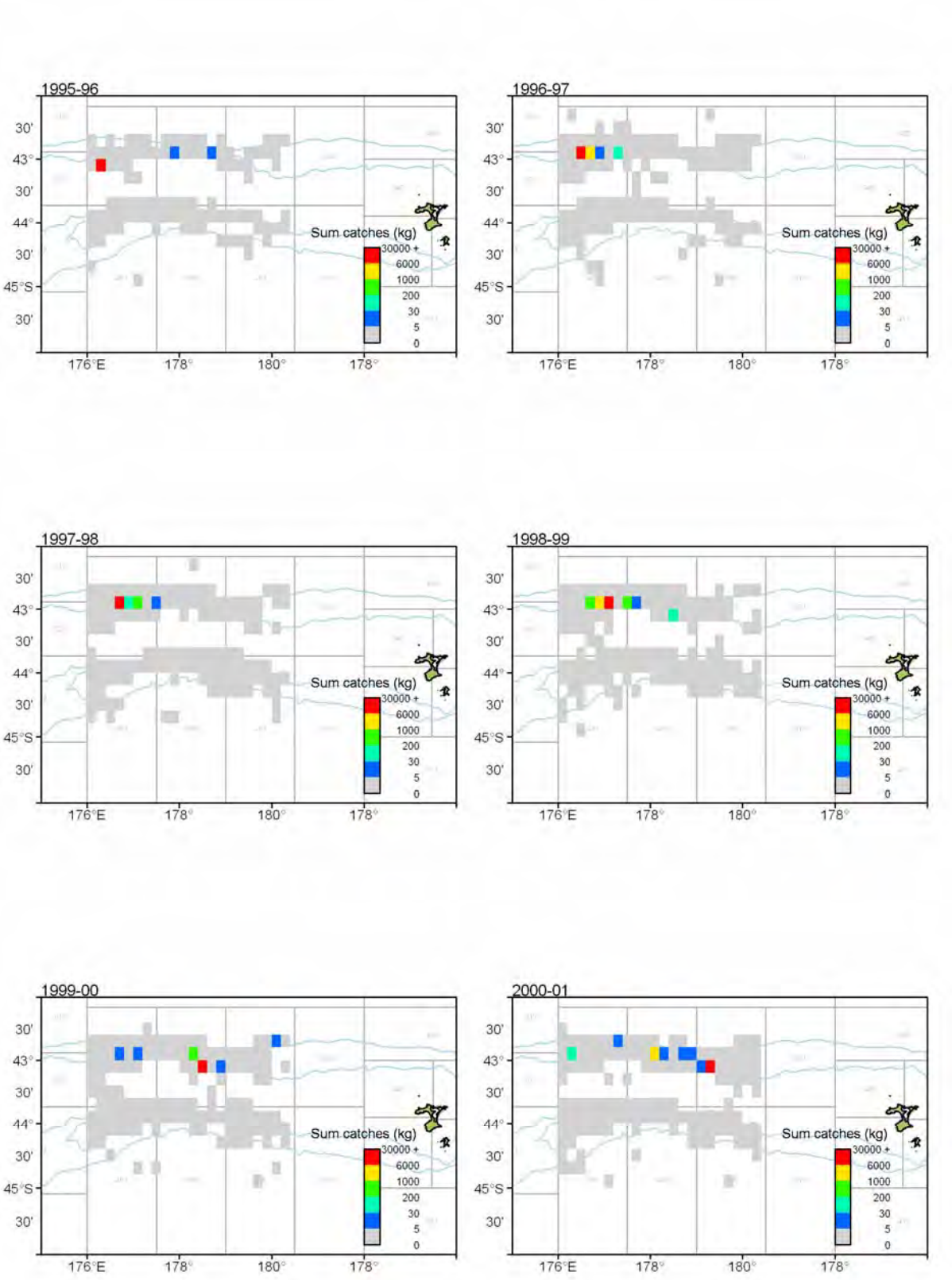


Figure C130: Distribution of alfonsino catch within the Western Chatham Rise region aggregated into 0.2 degree spatial blocks for fishing years 1996–2001 for the TCEPR form taken by all trawl gear.

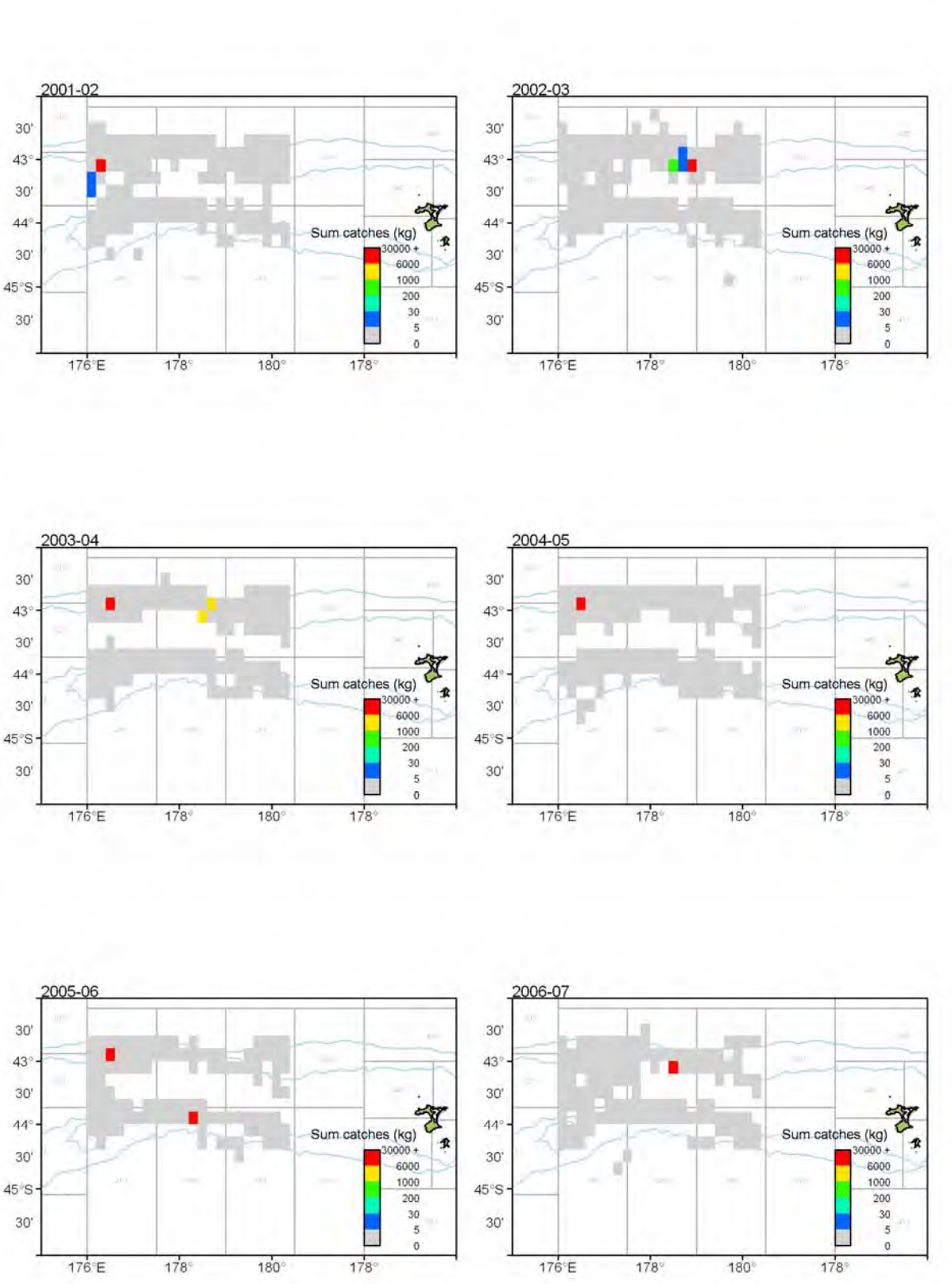


Figure C131: Distribution of alfonsino catch within the Western Chatham Rise region aggregated into 0.2 degree spatial blocks for fishing years 2002–2007 for the TCEPR form taken by all trawl gear.

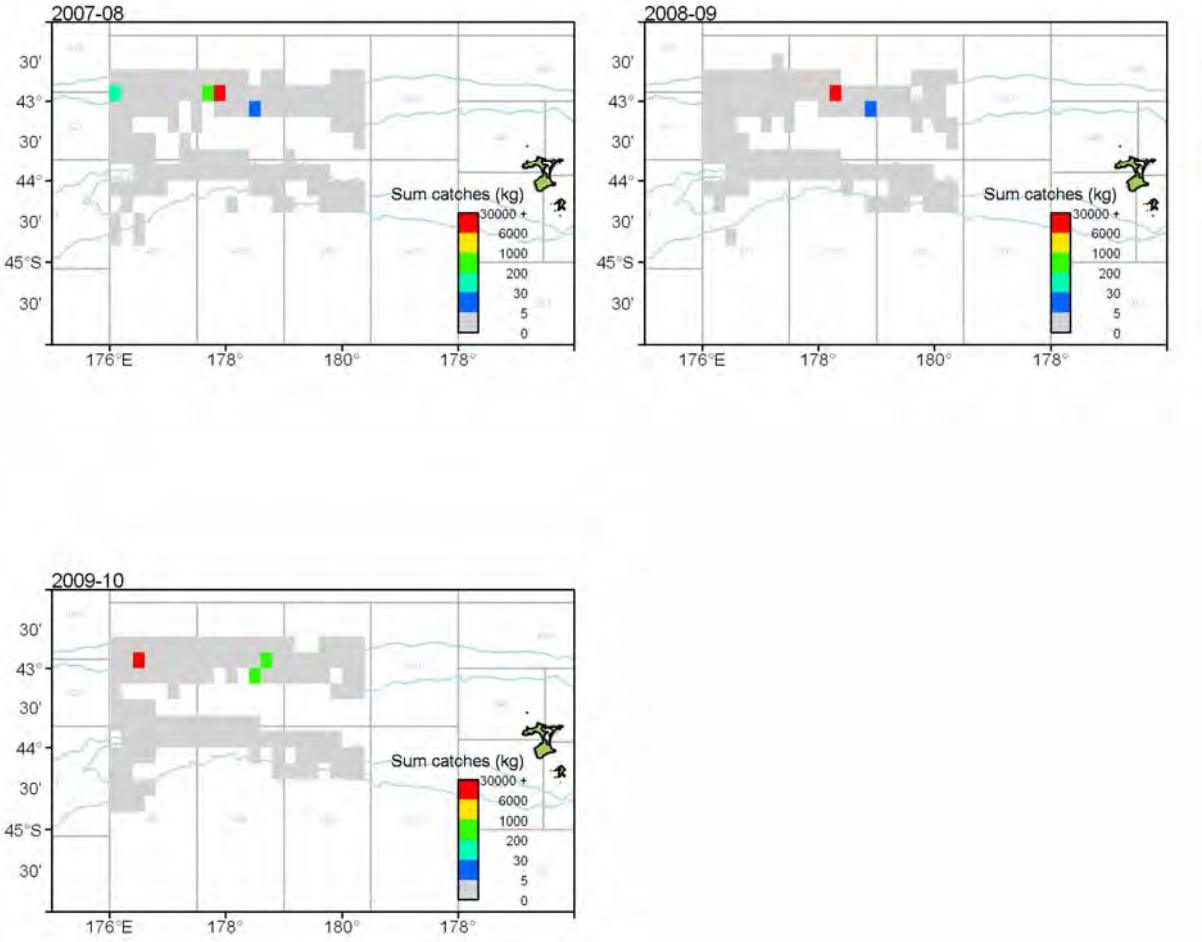


Figure C132: Distribution of alfonsino catch within the Western Chatham Rise region aggregated into 0.2 degree spatial blocks for fishing years 2008–2010 for the TCEPR form taken by all trawl gear.

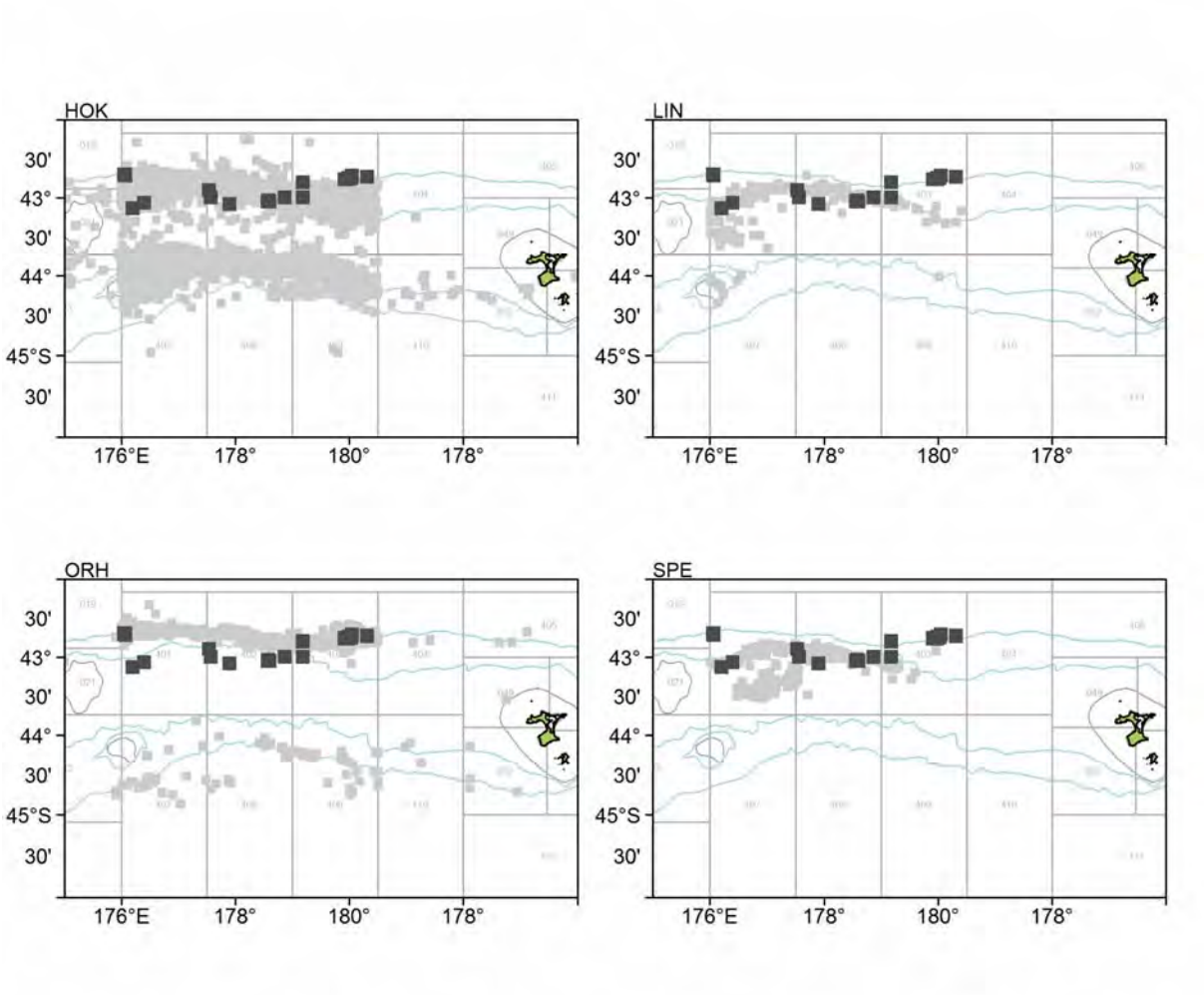


Figure C133: Western Chatham Rise statistical areas and bathymetry showing the distribution of all TCEPR trawls that caught alfonsino by main target species (grey cells) compared to the distribution of alfonsino targeted trawls (black cells) in the fishing years 1990–2010. Locations are aggregated into 0.2 degree spatial squares.

APPENDIX D: CATCH-PER-UNIT-EFFORT ANALYSES

Table D1: CPUE datasets for all vessels and for core vessels for each year (1990–2010) for ECNI Model 1. CPUE is unstandardised catch per non-zero tow.

	All vessels				Core vessels			
Year	Zeros	Catch	Effort	CPUE	Zeros	Catch	Effort	CPUE
1990	0.24	221	52	4.25	0.28	138	36	3.82
1991	0.05	481	170	2.83	0.05	481	170	2.83
1992	0.22	386	167	2.31	0.21	374	157	2.38
1993	0.05	550	236	2.33	0.06	450	174	2.58
1994	0.12	633	284	2.23	0.08	494	206	2.40
1995	0.18	503	156	3.22	0.12	483	148	3.26
1996	0.08	501	173	2.90	0.05	486	159	3.06
1997	0.06	572	234	2.44	0.06	572	234	2.44
1998	0.13	455	204	2.23	0.09	394	162	2.43
1999	0.05	247	126	1.96	0.06	219	113	1.94
2000	0.11	333	131	2.54	0.09	307	102	3.01
2001	0.12	209	79	2.64	0.10	204	77	2.65
2002	0.12	210	85	2.47	0.11	195	79	2.47
2003	0.09	292	97	3.01	0.09	273	90	3.03
2004	0.06	472	116	4.07	0.01	364	78	4.66
2005	0.07	478	107	4.47	0.08	453	98	4.62
2006	0.06	455	120	3.79	0.07	399	90	4.43
2007	0.12	187	35	5.33	0.14	173	30	5.76
2008	0.04	295	78	3.78	0.01	283	74	3.83
2009	0.07	317	80	3.97	0.04	309	67	4.60
2010	0.03	355	97	3.66	0.02	149	48	3.10
Total		8 152	2 827			7 200	2 392	

Table D2: Variables retained in order of decreasing explanatory value for ECNI Model 1 and the corresponding total R^2 value.

Variable	R^2
Fishing year	2.88
Vessel	11.28
Depth	13.74
Month	15.48

Table D3: ECNI Model 1 CPUE estimated values, upper and lower confidence intervals and c.v.s by year.

Year	CPUE	Lower CI	Upper CI	c.v.
1990	1.08	0.76	1.54	0.18
1991	1.38	1.13	1.69	0.10
1992	0.86	0.71	1.04	0.10
1993	1.00	0.84	1.20	0.09
1994	0.83	0.71	0.97	0.08
1995	0.86	0.72	1.03	0.09
1996	0.96	0.80	1.14	0.09
1997	1.21	1.04	1.42	0.08
1998	1.10	0.93	1.31	0.09
1999	1.03	0.85	1.26	0.10
2000	1.27	1.03	1.57	0.11
2001	1.03	0.81	1.30	0.12
2002	1.32	1.04	1.68	0.12
2003	0.61	0.49	0.77	0.11
2004	1.12	0.89	1.43	0.12
2005	0.90	0.72	1.11	0.11
2006	0.95	0.77	1.18	0.11
2007	1.18	0.80	1.73	0.20
2008	0.97	0.74	1.27	0.14
2009	0.94	0.68	1.31	0.16
2010	0.75	0.50	1.12	0.20

Table D4: CPUE datasets for all vessels and for core vessels for each year (1990–2010) for ECNI Model 2. CPUE is unstandardised catch per non-zero tow.

	All vessels				Core vessels			
Year	Zeros	Catch	Effort	CPUE	Zeros	Catch	Effort	CPUE
1990	-	-	-	-	-	-	-	-
1991	0.23	10	10	0.96	0.23	10	10	0.96
1992	0.56	5	4	1.15	0.62	4	3	1.43
1993	0.40	2	3	0.73	0.25	2	3	0.73
1994	0.37	17	26	0.64	0.33	4	10	0.38
1995	0.34	91	77	1.18	0.20	17	8	2.08
1996	0.21	78	42	1.87	0.00	12	3	4.00
1997	0.37	116	61	1.91	0.33	62	30	2.06
1998	0.23	80	50	1.59	0.22	80	47	1.69
1999	0.26	37	25	1.46	0.23	34	23	1.47
2000	0.10	77	61	1.26	0.11	71	49	1.45
2001	0.17	120	69	1.73	0.19	97	46	2.10
2002	0.15	102	39	2.62	0.17	101	34	2.96
2003	0.16	266	125	2.13	0.16	266	122	2.18
2004	0.24	48	37	1.28	0.18	34	28	1.22
2005	0.16	204	80	2.55	0.14	193	74	2.61
2006	0.16	283	164	1.73	0.16	280	152	1.84
2007	0.12	378	200	1.89	0.09	352	177	1.99
2008	0.09	203	86	2.36	0.07	203	86	2.36
2009	0.03	303	126	2.40	0.03	281	116	2.42
2010	0.07	357	143	2.50	0.02	325	118	2.75
Total		2 777	1 428			2 428	1 139	

Table D5: Variables retained in order of decreasing explanatory value for ECNI Model 2 and the corresponding total R^2 value.

Variable	R^2
Fishing year	2.77
Depth	12.73
Vessel	16.54
Duration	18.25
Month	19.97

Table D6: ECNI Model 2 CPUE estimated values, upper and lower confidence intervals and c.v.s by year.

Year	CPUE	Lower CI	Upper CI	c.v.
1990	-	-	-	-
1991	1.31	0.69	2.48	0.33
1992	1.86	0.61	5.66	0.60
1993	0.73	0.24	2.22	0.60
1994	0.52	0.28	0.98	0.32
1995	1.17	0.58	2.34	0.36
1996	0.52	0.17	1.61	0.61
1997	1.34	0.91	1.97	0.19
1998	1.14	0.79	1.64	0.18
1999	2.00	1.27	3.14	0.23
2000	0.95	0.68	1.32	0.17
2001	1.26	0.91	1.74	0.16
2002	2.19	1.51	3.18	0.19
2003	0.80	0.64	1.01	0.11
2004	0.46	0.31	0.68	0.20
2005	1.05	0.79	1.40	0.14
2006	0.78	0.61	1.00	0.12
2007	0.68	0.55	0.84	0.11
2008	0.89	0.68	1.17	0.14
2009	1.00	0.76	1.32	0.14
2010	1.23	0.93	1.61	0.14

Table D7: CPUE datasets for all vessels and for core vessels for each year (1990–2010) for ECNI Model 3. CPUE is unstandardised catch per non-zero tow.

	All vessels				Core vessels			
Year	Zeros	Catch	Effort	CPUE	Zeros	Catch	Effort	CPUE
1990	0.24	335	81	4.13	0.29	138	37	3.72
1991	0.06	522	185	2.82	0.06	522	185	2.82
1992	0.19	529	221	2.39	0.19	516	205	2.52
1993	0.06	688	295	2.33	0.07	553	218	2.54
1994	0.16	745	360	2.07	0.09	556	250	2.22
1995	0.22	677	279	2.43	0.20	595	239	2.49
1996	0.12	640	259	2.47	0.06	558	193	2.89
1997	0.15	723	305	2.37	0.11	669	275	2.43
1998	0.16	692	316	2.19	0.13	595	241	2.47
1999	0.12	411	229	1.80	0.11	369	208	1.77
2000	0.13	579	291	1.99	0.14	554	250	2.22
2001	0.15	508	222	2.29	0.14	495	197	2.51
2002	0.17	450	198	2.27	0.18	415	178	2.33
2003	0.14	626	257	2.44	0.12	572	220	2.60
2004	0.11	718	204	3.52	0.08	654	185	3.54
2005	0.14	873	252	3.46	0.13	862	246	3.50
2006	0.14	905	315	2.87	0.14	890	309	2.88
2007	0.12	699	255	2.74	0.10	659	225	2.93
2008	0.07	664	197	3.37	0.05	637	185	3.44
2009	0.05	742	232	3.20	0.05	599	165	3.63
2010	0.06	966	312	3.09	0.03	428	142	3.02
Total		13 692	5 265			11 836	4 353	

Table D8: Variables retained in order of decreasing explanatory value for ECNI Model 3 and the corresponding total R^2 value.

Variable	R^2
Fishing year	2.08
Vessel	9.01
Depth	12.17
Method	13.76

Table D9: ECNI Model 3 CPUE estimated values, upper and lower confidence intervals and c.v.s by year.

Year	CPUE	Lower CI	Upper CI	c.v.
1990	0.86	0.62	1.19	0.17
1991	1.32	1.13	1.56	0.08
1992	0.92	0.79	1.07	0.07
1993	0.88	0.76	1.02	0.07
1994	0.73	0.64	0.83	0.07
1995	0.82	0.71	0.94	0.07
1996	0.94	0.81	1.09	0.08
1997	1.29	1.13	1.47	0.06
1998	1.12	0.98	1.28	0.07
1999	1.17	1.01	1.36	0.07
2000	1.13	0.98	1.29	0.07
2001	1.37	1.19	1.59	0.07
2002	1.22	1.04	1.43	0.08
2003	0.69	0.60	0.80	0.07
2004	0.90	0.77	1.04	0.07
2005	0.76	0.66	0.87	0.07
2006	0.90	0.79	1.02	0.06
2007	0.87	0.75	1.01	0.07
2008	0.96	0.81	1.13	0.08
2009	1.06	0.89	1.27	0.09
2010	1.62	1.33	1.96	0.10

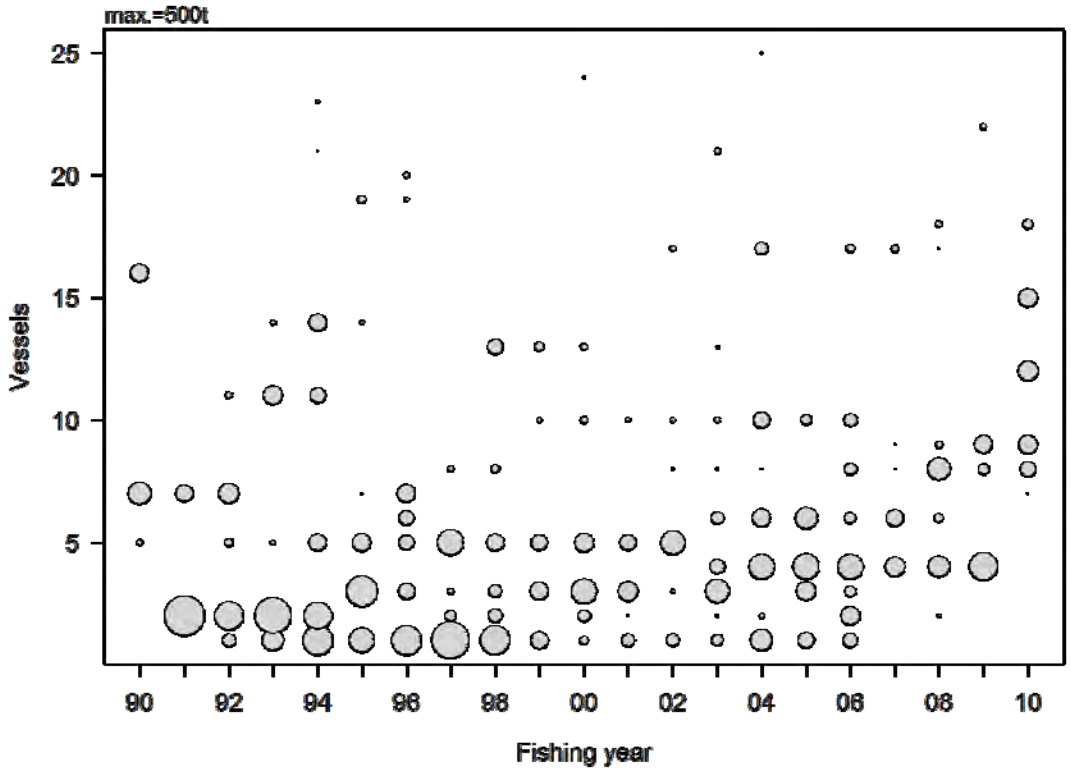


Figure D1: ECNI Model 1 scaled annual catch for all vessels for fishing years 1990–2010.

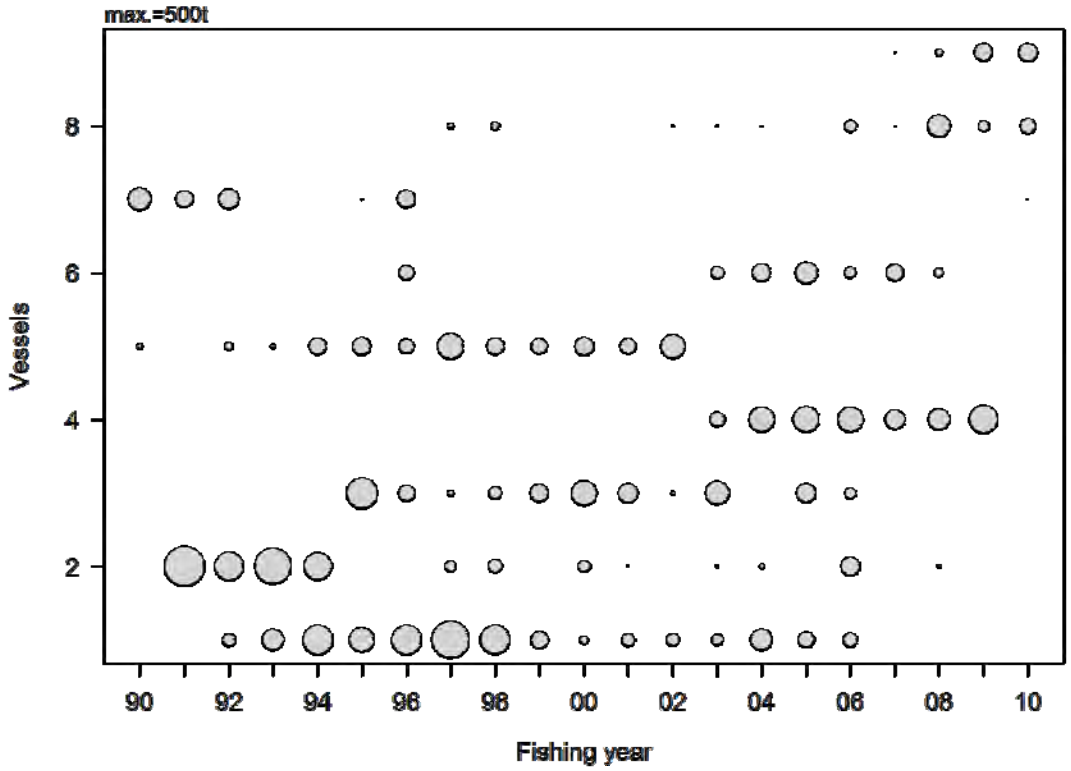


Figure D2: ECNI Model 1 scaled annual catch for core vessels for fishing years 1990–2010.

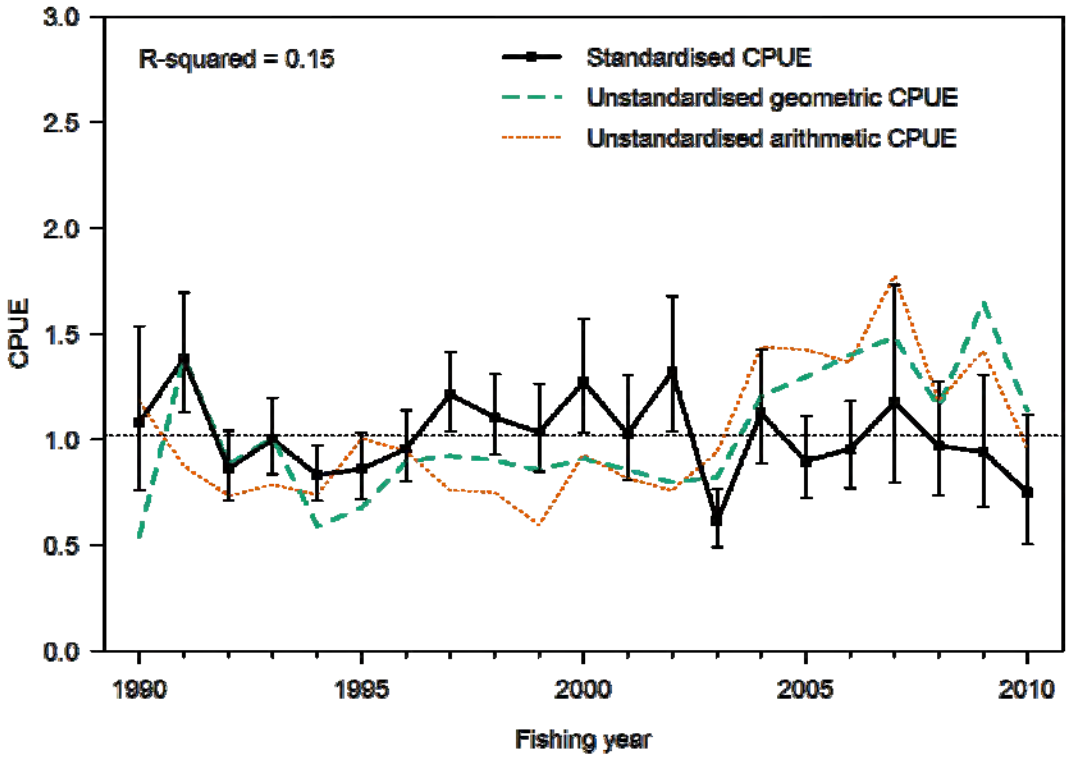


Figure D3: ECNI Model 1standardised, geometric, and arithmetic CPUE for fishing years 1990–2010.

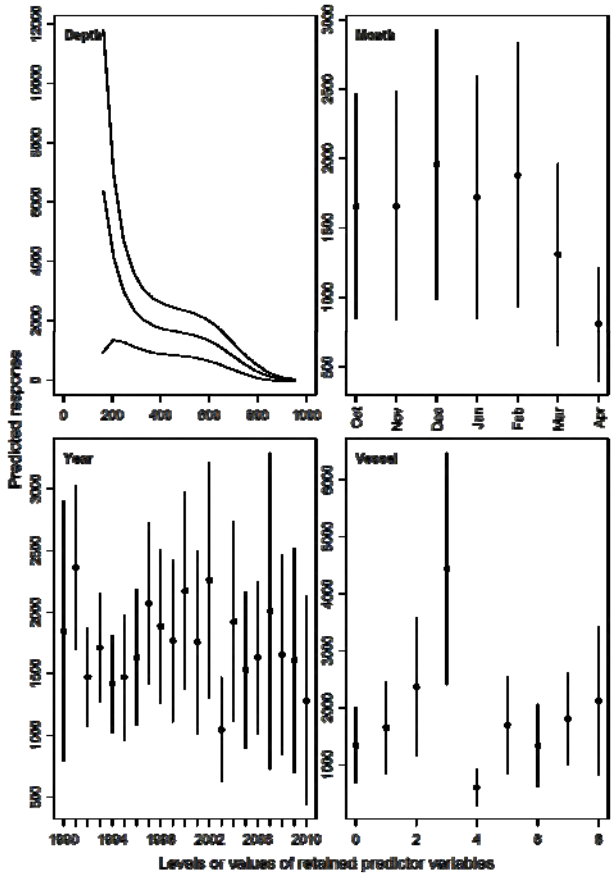


Figure D4: ECNI Model 1 CPUE predictor variables retained in the GLM analysis and their distributions by factor levels for fishing years 1990–2010.

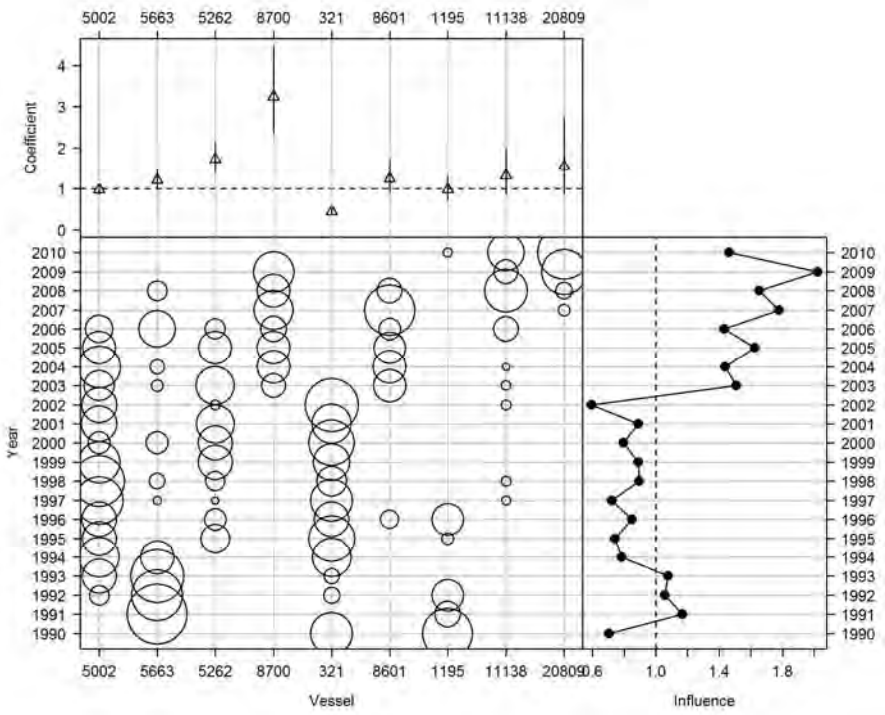


Figure D5: Effect and influence of vessel for the ECNI CPUE Model 1. Top: relative effect by level of variable. Bottom left: relative distribution of variable (vessel) by fishing year. Bottom right: influence of variable (vessel) on unstandardised CPUE by fishing year.

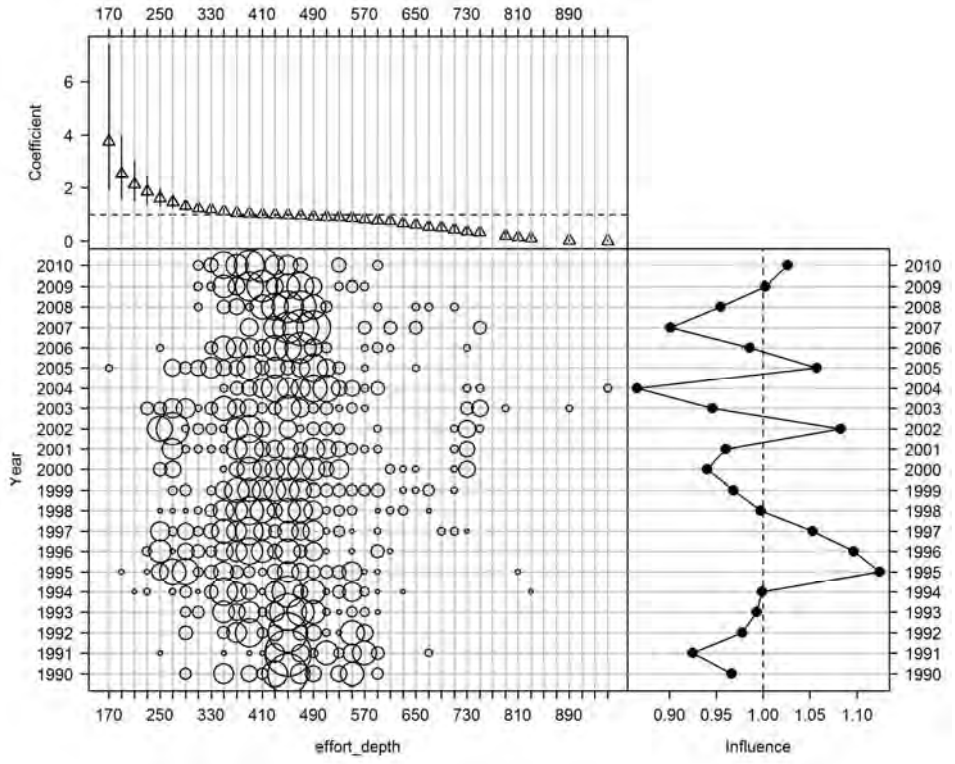


Figure D6: Effect and influence of effort depth for the ECNI CPUE Model 1. Top: relative effect by level of variable. Bottom left: relative distribution of variable (effort depth) by fishing year. Bottom right: influence of variable (effort depth) on unstandardised CPUE by fishing year.

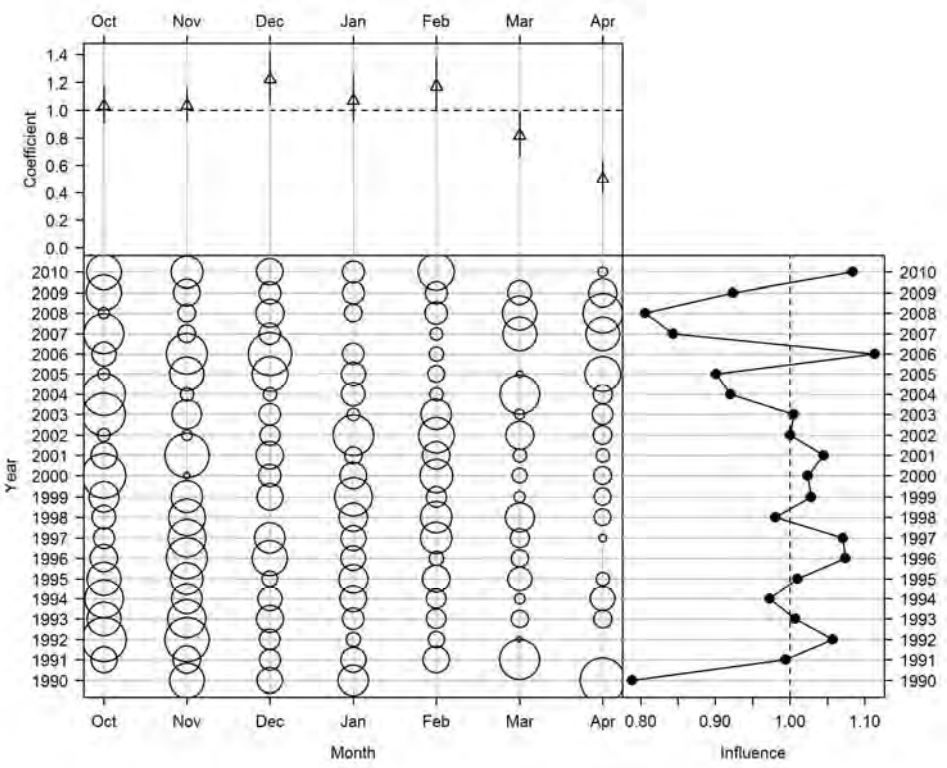


Figure D7: Effect and influence of month for the ECNI CPUE Model 1. Top: relative effect by level of variable. Bottom left: relative distribution of variable (month) by fishing year. Bottom right: influence of variable (month) on unstandardised CPUE by fishing year.

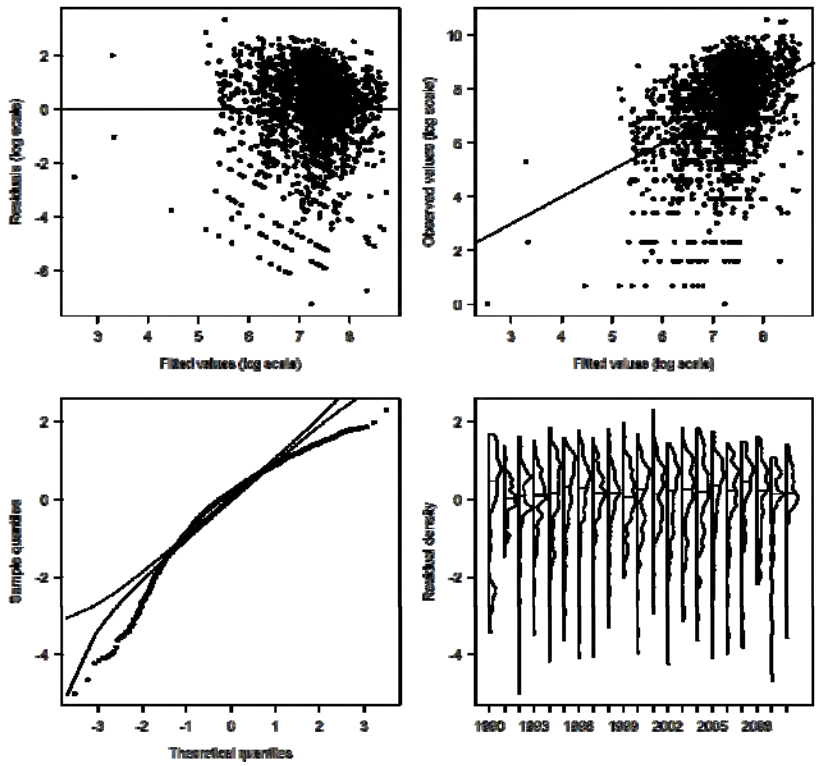


Figure D8: ECNI Model 1 CPUE residual diagnostic plots describing the fit of the GLM CPUE model.

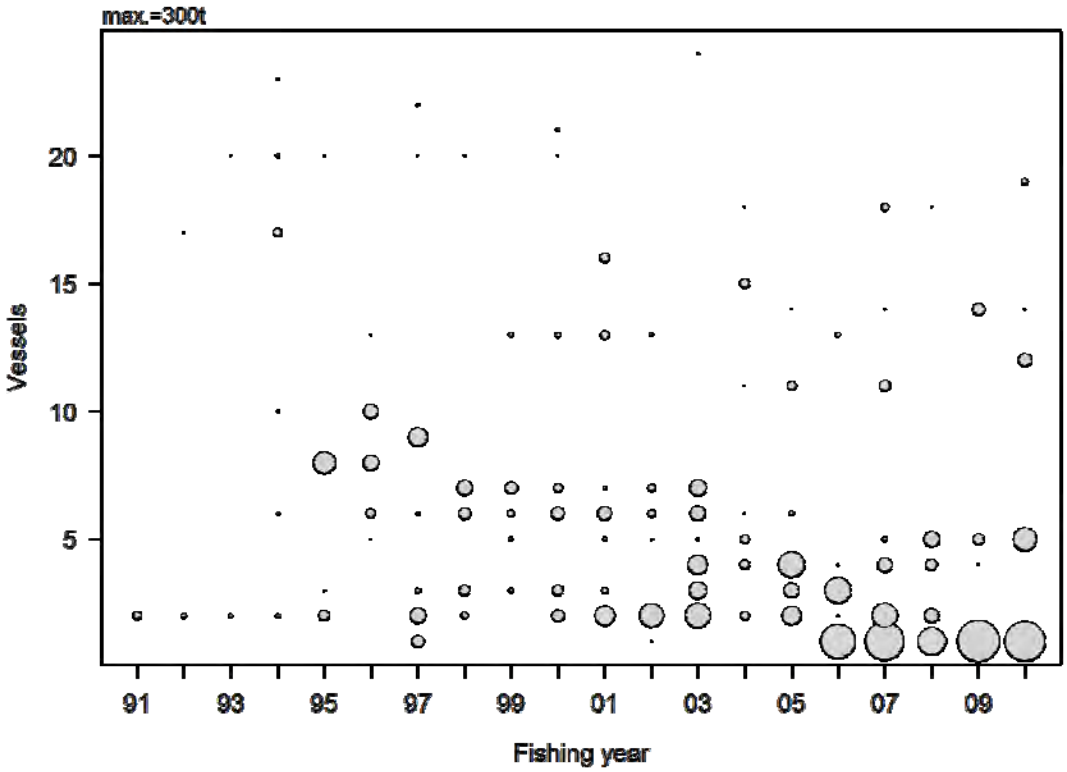


Figure D9: ECNI Model 2 scaled annual catch for all vessels for fishing years 1990–2010.

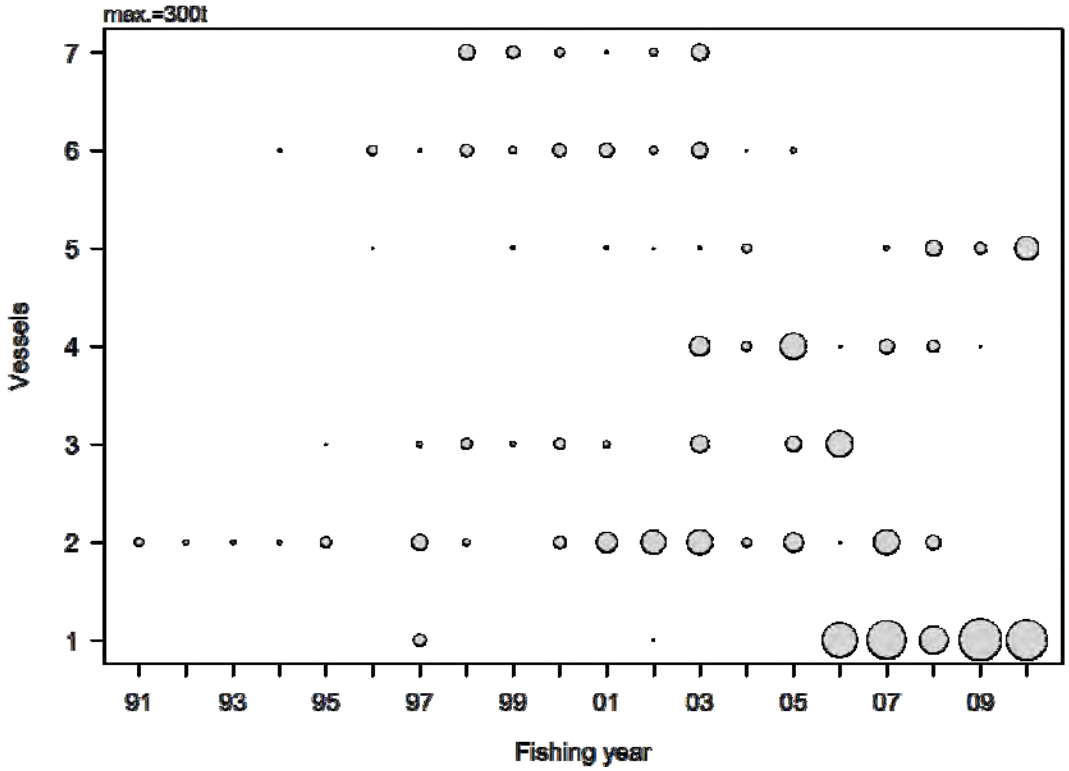


Figure D10: ECNI Model 2 scaled annual catch for core vessels for fishing years 1990–2010.

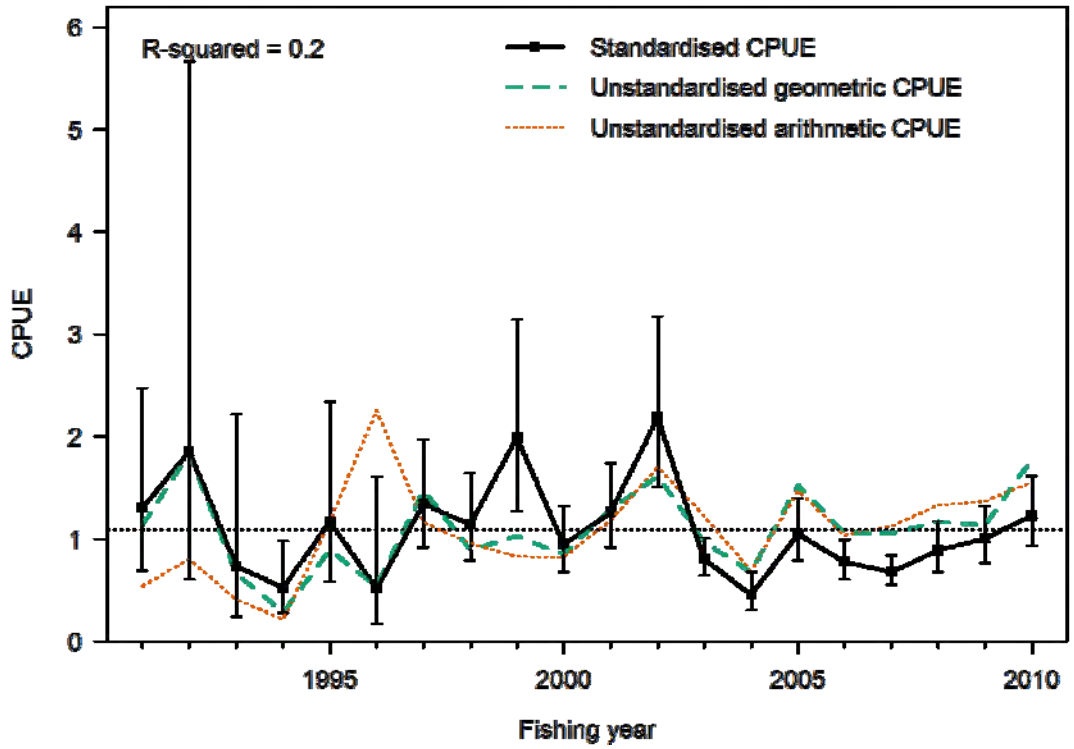


Figure D11: ECNI Model 2standardised, geometric, and arithmetic CPUE for fishing years 1990–2010.

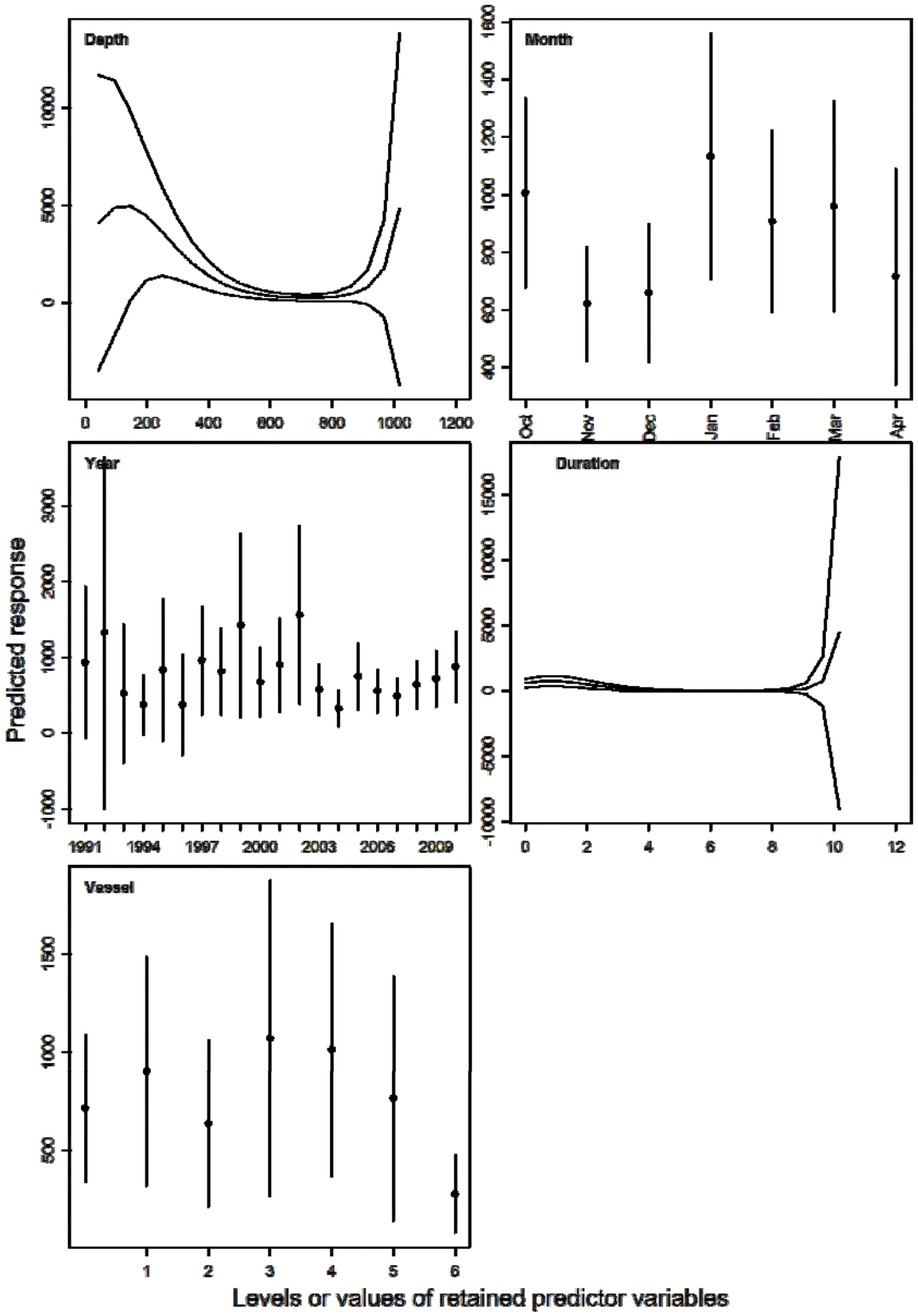


Figure D12: ECNI Model 2 CPUE predictor variables retained in the GLM analysis and their distributions by factor levels for fishing years 1990–2010.

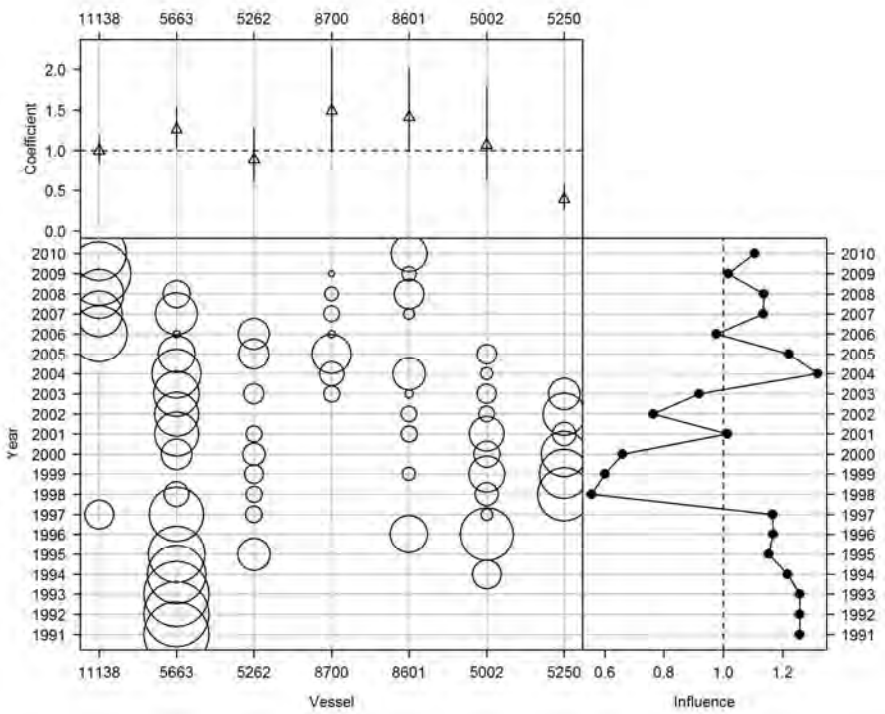


Figure D13: Effect and influence of vessel for the ECNI CPUE model 2. Top: relative effect by level of variable. Bottom left: relative distribution of variable (vessel) by fishing year. Bottom right: influence of variable (vessel) on unstandardised CPUE by fishing year.

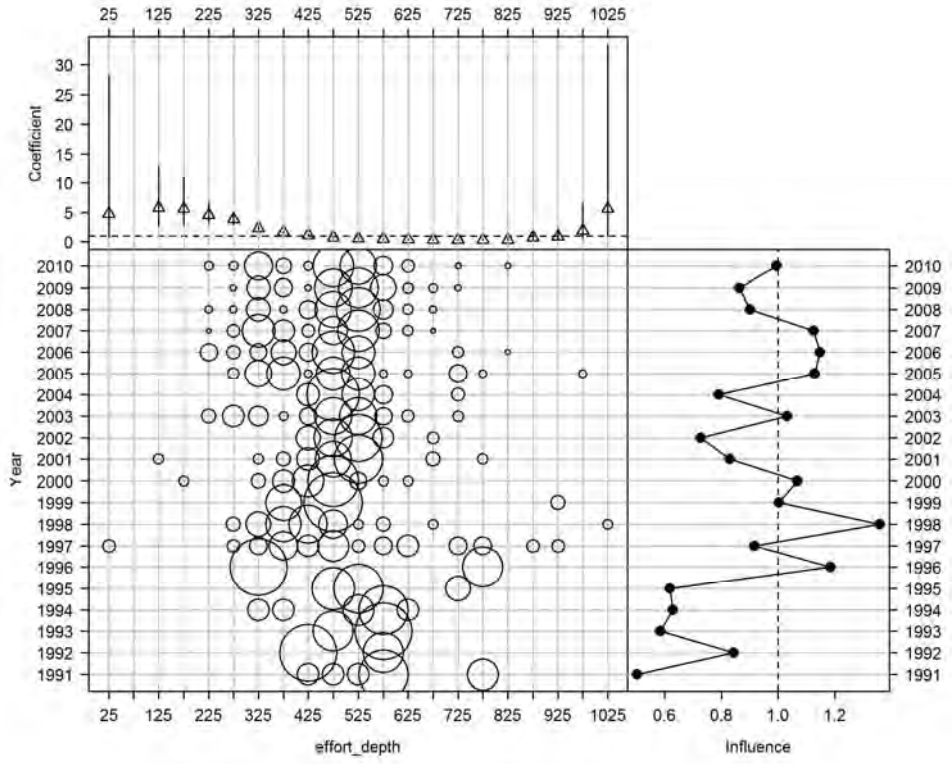


Figure D14: Effect and influence of effort depth for the ECNI CPUE model 2. Top: relative effect by level of variable. Bottom left: relative distribution of variable (effort depth) by fishing year. Bottom right: influence of variable (effort depth) on unstandardised CPUE by fishing year

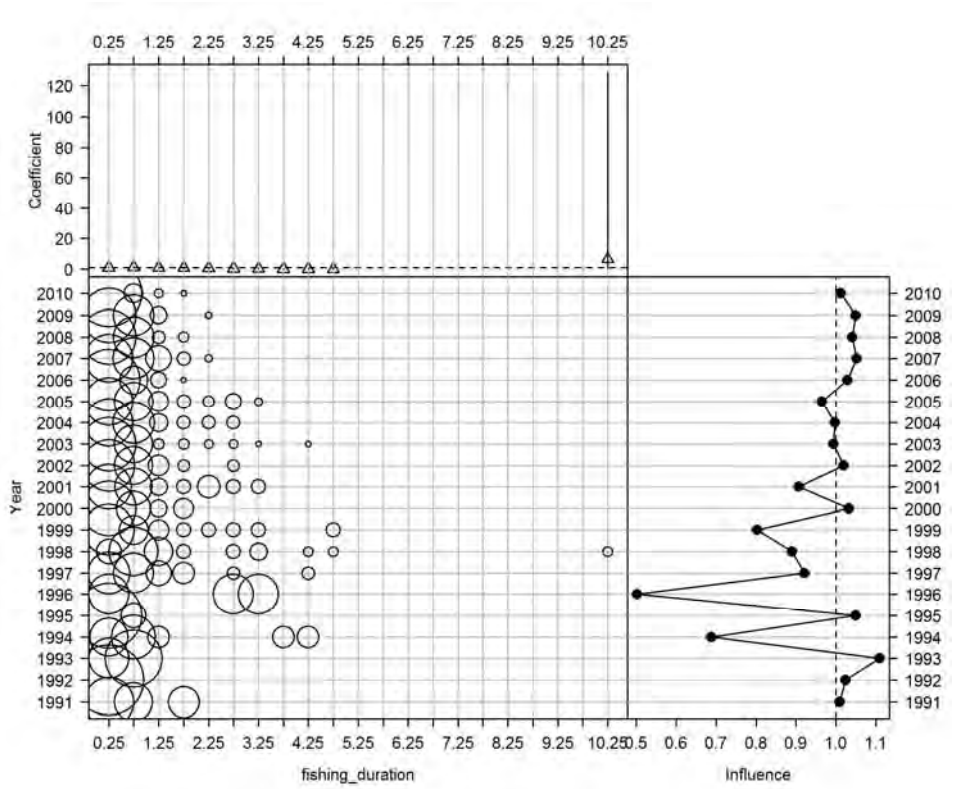


Figure D15: Effect and influence of fishing duration for the ECNI CPUE model 2. Top: relative effect by level of variable. Bottom left: relative distribution of variable (tow duration) by fishing year. Bottom right: influence of variable (tow duration) on unstandardised CPUE by fishing year.

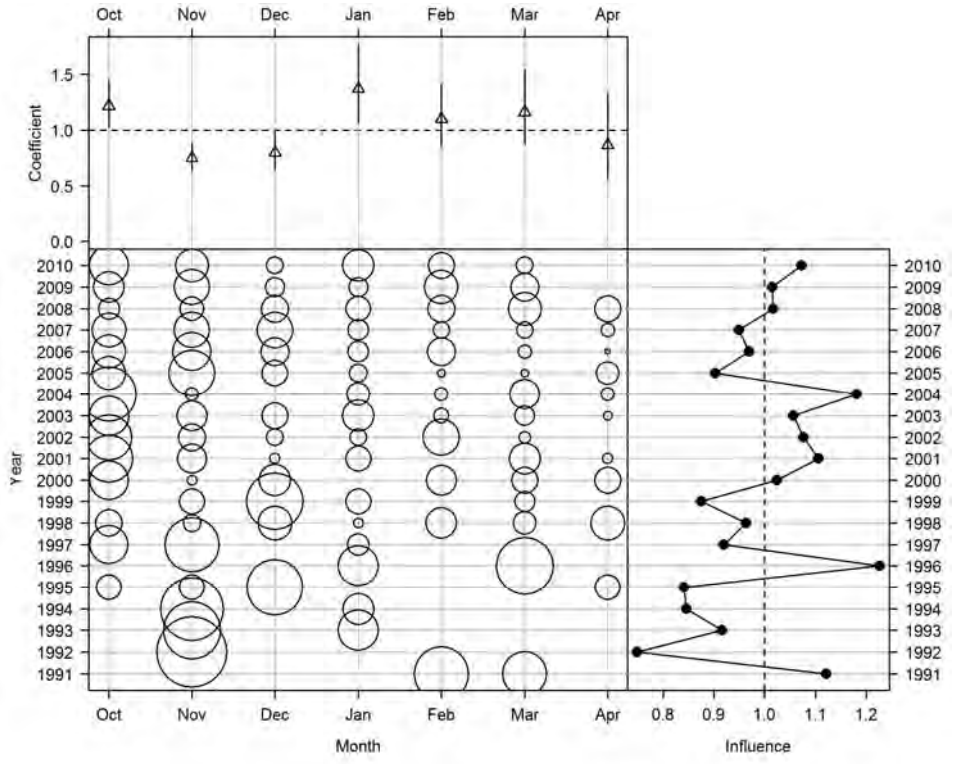


Figure D16: Effect and influence of month for the ECNI CPUE model 2. Top: relative effect by level of variable. Bottom left: relative distribution of variable (month) by fishing year. Bottom right: influence of variable (month) on unstandardised CPUE by fishing year.

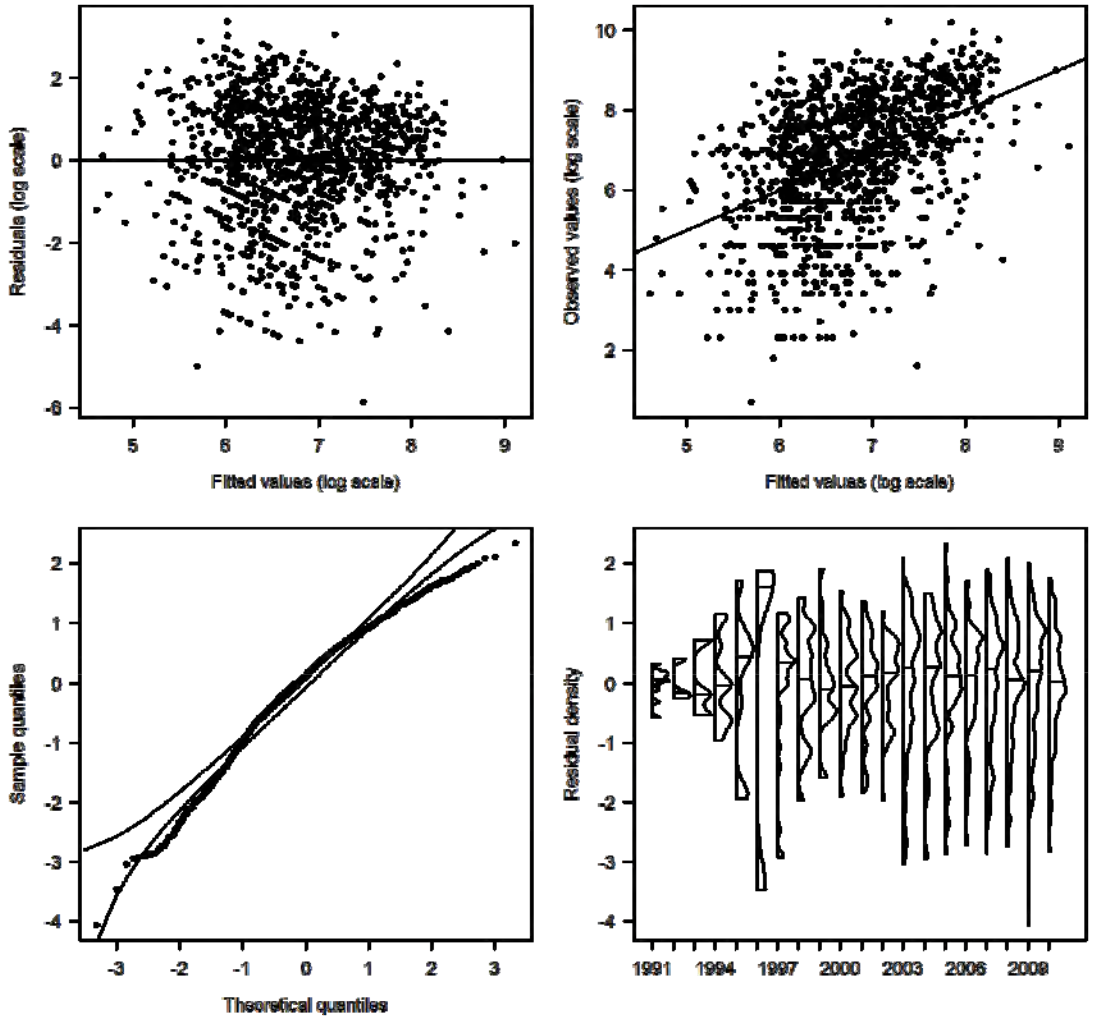


Figure D17: ECNI Model 2 CPUE residual diagnostic plots describing the fit of the GLM CPUE model.

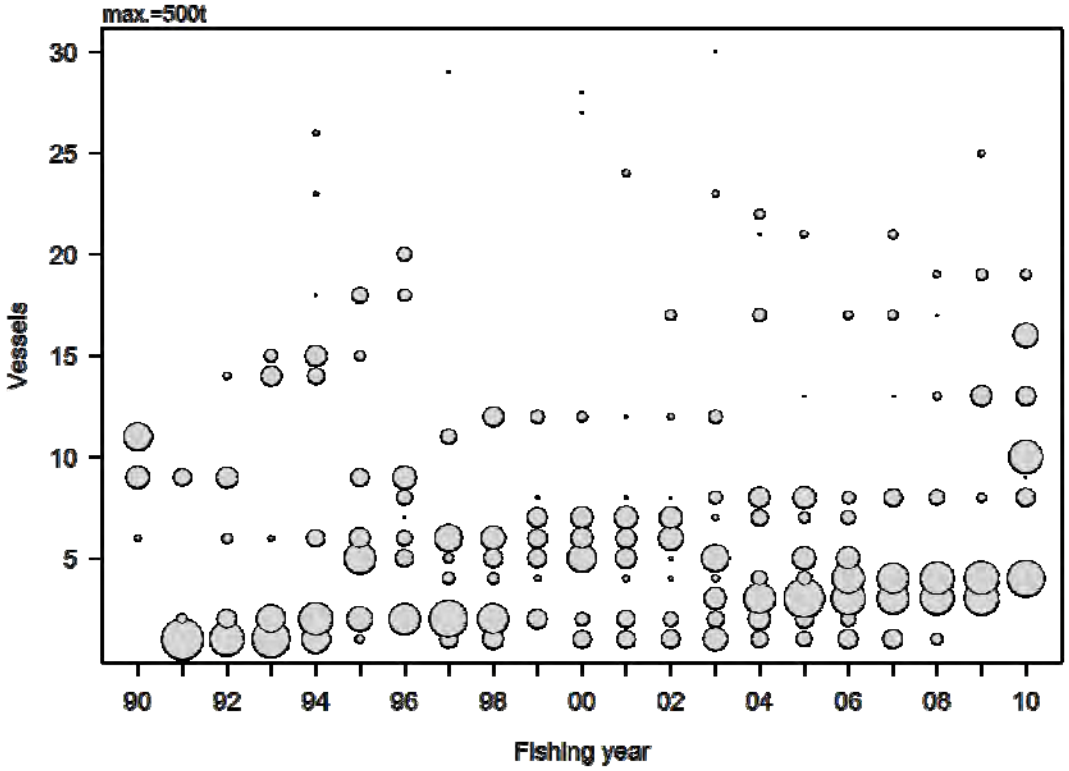


Figure D18: ECNI Model 3 scaled annual catch for all vessels for fishing years 1990–2010.

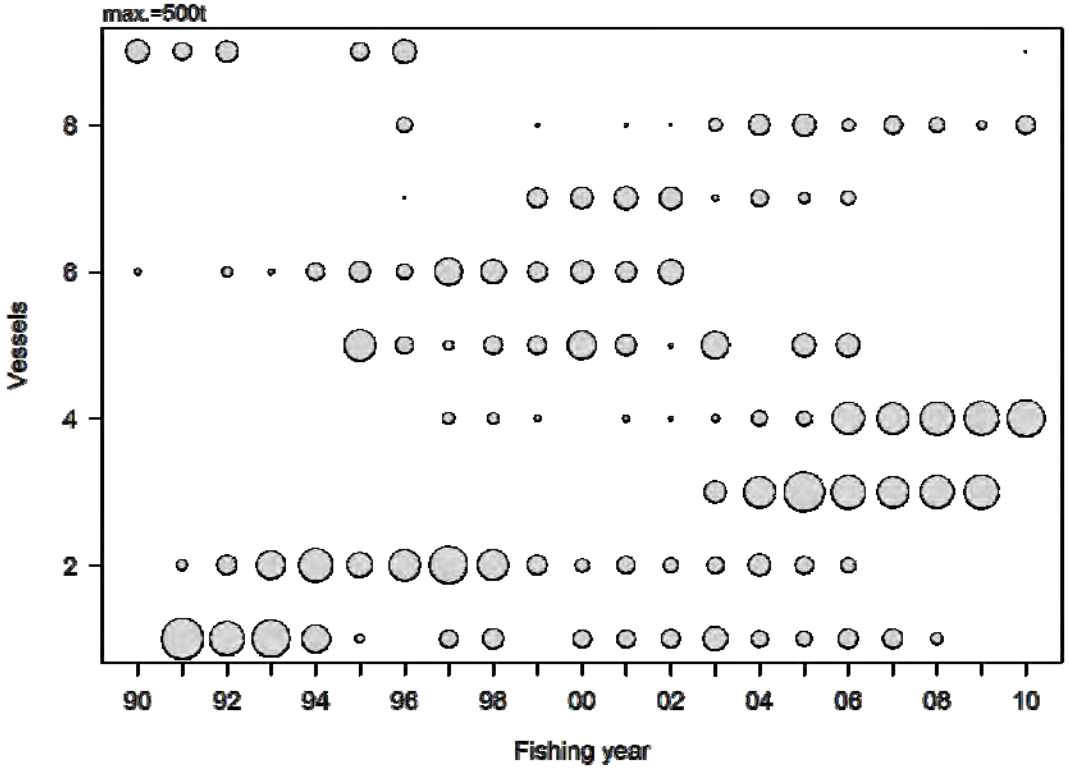


Figure D19: ECNI Model 3 scaled annual catch for core vessels for fishing years 1990–2010.

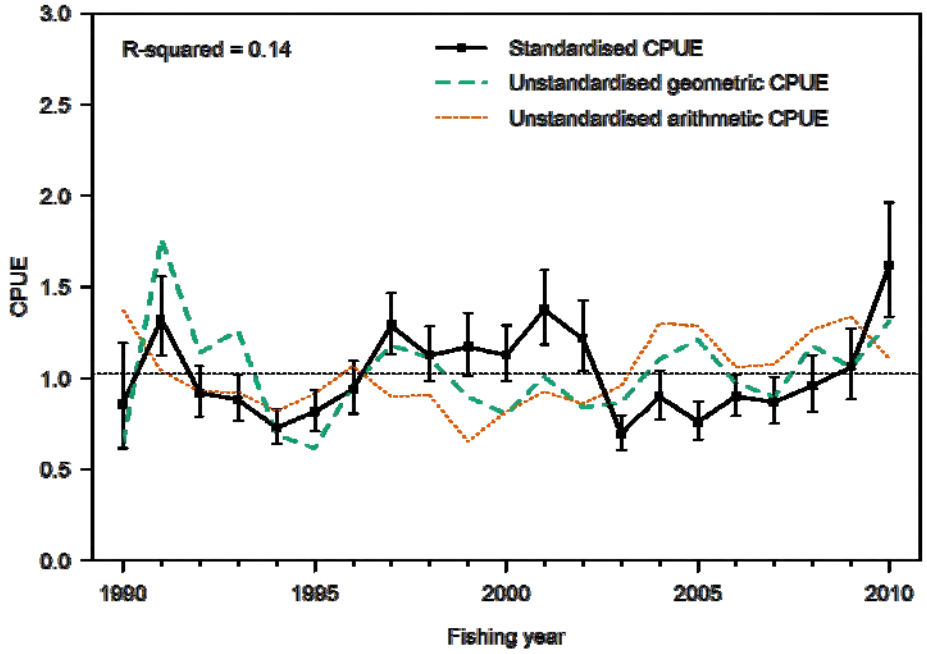


Figure D20: ECNI Model 3 standardised, geometric, and arithmetic CPUE for fishing years 1990–2010.

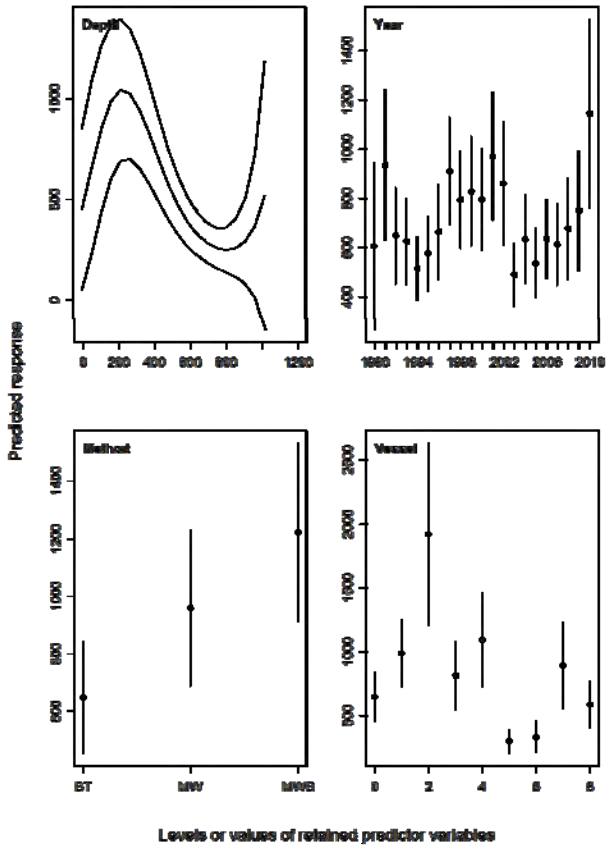


Figure D21: ECNI Model 3 CPUE predictor variables retained in the GLM analysis and their distributions by factor levels for fishing years 1990–2010.

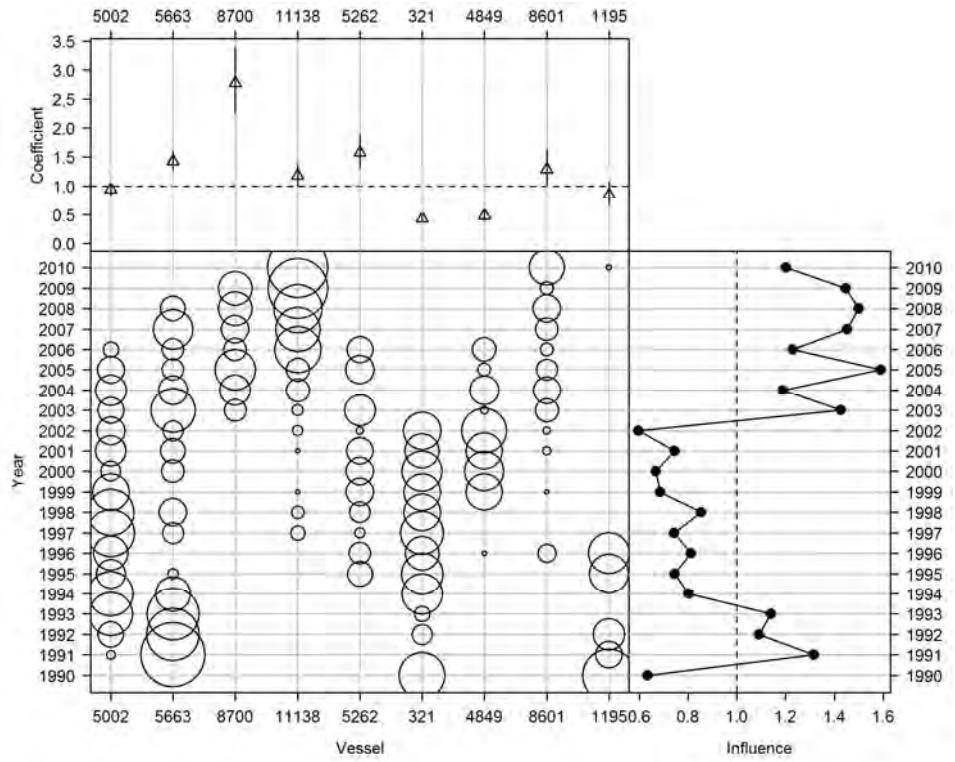


Figure D22: Effect and influence of vessel for the ECNI CPUE Model 3. Top: relative effect by level of variable. Bottom left: relative distribution of variable (vessel) by fishing year. Bottom right: influence of variable (vessel) on unstandardised CPUE by fishing year.

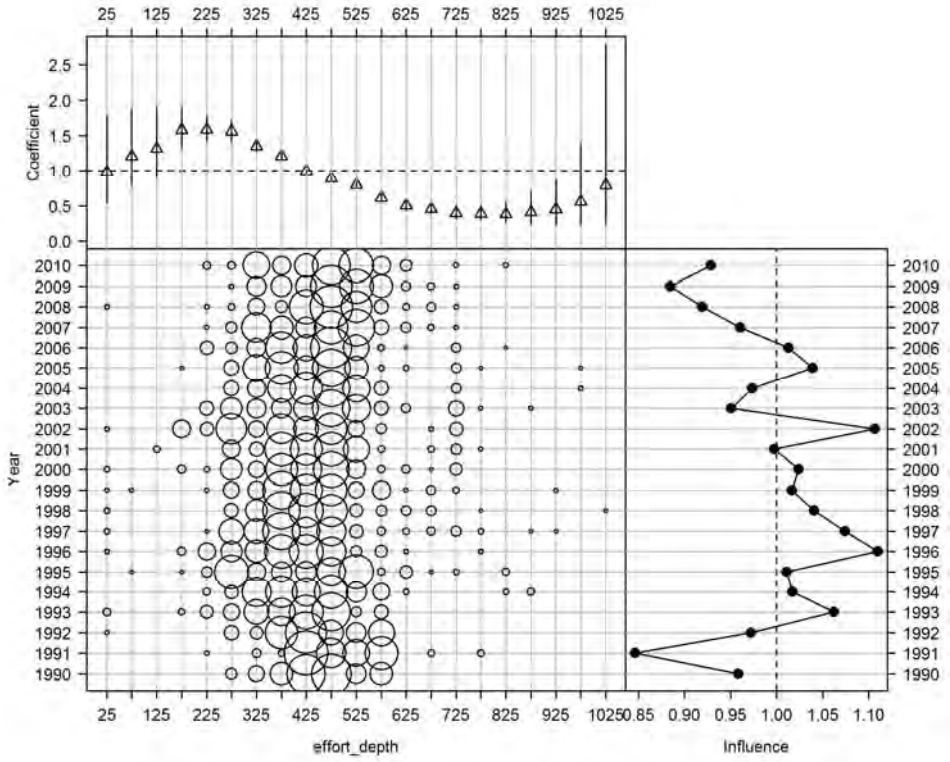


Figure D23: Effect and influence of effort depth for the ECNI CPUE Model 3. Top: relative effect by level of variable. Bottom left: relative distribution of variable (effort depth) by fishing year. Bottom right: influence of variable (effort depth) on unstandardised CPUE by fishing year.

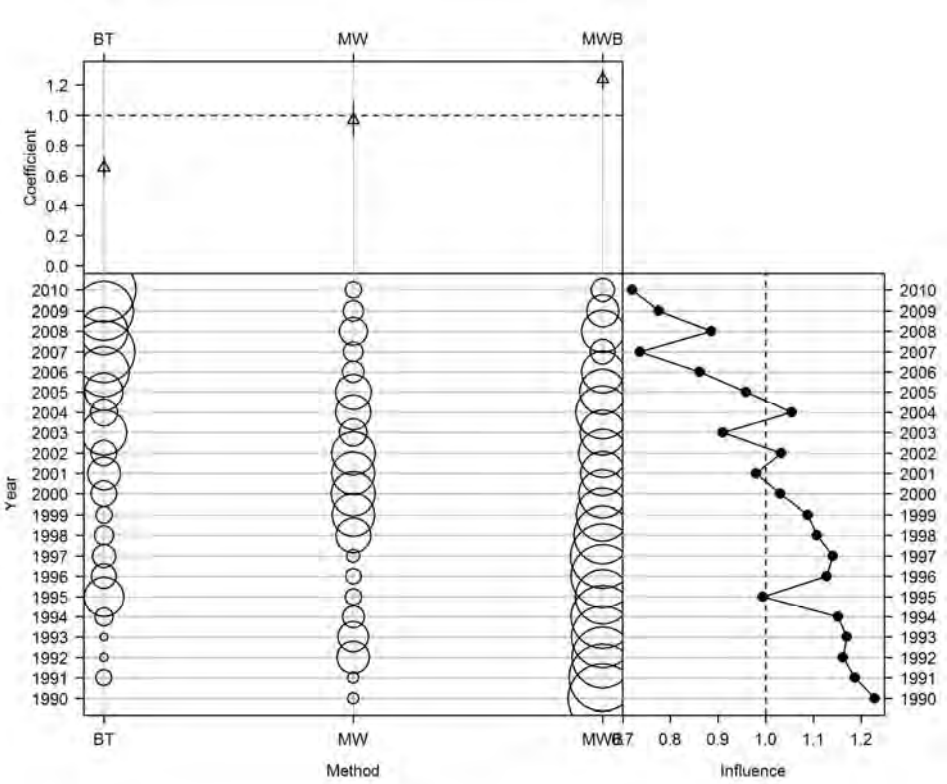


Figure D24: Effect and influence of fishing method for the ECNI CPUE Model 3. Top: relative effect by level of variable. Bottom left: relative distribution of variable (method) by fishing year. Bottom right: influence of variable (method) on unstandardised CPUE by fishing year.

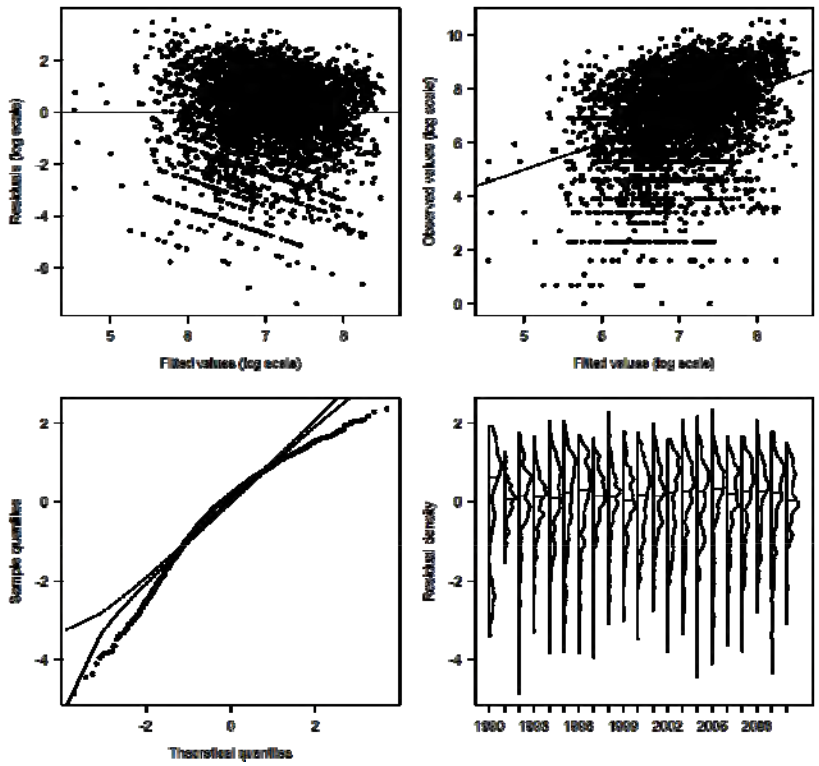


Figure D25: ECNI Model 3 CPUE residual diagnostic plots describing the fit of the GLM CPUE model.