Fishery characterisation and standardised CPUE analyses for barracouta, *Thyrsites atun*, (Euphrasen, 1791) (Gempylidae), 1989–90 to 2007–08

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***New Zealand Fisheries Assessment Report 2012/12*. 303p.**

This report is the third in a series of middle depth fishery characterisations for species or stocks for which no robust stock assessment has been developed; the first two being for silver warehou, *Seriolella punctata* (Parker & Fu 2011) and arrow squid, *Nototodarus gouldi* and *N. sloanii* (Hurst et al., submitted). It follows the standardised reporting format used in those reports, with additional information and analyses where appropriate.

Barracouta have been exploited since the late 1960s, with significant landings developing in 1968, the year after Japanese vessels commenced fishing in New Zealand waters. Fishing in inshore waters by foreign vessels was restricted after the introduction of the Exclusive Economic Zone (EEZ) on 1 April 1978, which limited expansion of foreign vessel barracouta catches. Interim management controls introduced under the Deepwater Policy on 1 October 1983 (EEZ annual TAC of 31 000 t) controlled development of the trawl fishery by foreign chartered or larger domestic vessels prior to introduction of the Quota Management System (QMS) on 1 October 1986 (EEZ annual TACC of 31 050 t).

Barracouta are primarily target fished by bottom trawls around mainland New Zealand in Quota Management Areas (QMA) BAR 1 (mainly off the east coast South Island), BAR 5 (Snares shelf), and BAR 7. The barracouta fisheries at the Chatham Islands (BAR 4) and around the Auckland Islands part of BAR 5 are relatively small and sporadic. Fishing takes place over the continental shelf down to about 400 m depth. Catches are usually within quota limits, the largest overcatch being 32% in BAR 7 in 2006–07. Catches have been less than 80% of the quota for extended periods in BAR 1 (from 2000–01), BAR 4 (all but 2 years), BAR 5 (most years up to the quota reduction in 1998–99), and BAR 7 (prior to 2000–01).

Barracouta in an exploited fishery have been aged up to 11 years old, suggesting a maximum age of about 15 years and natural mortality of about 0.3. They mature at about 50–60cm and age 2–3. The main spawning season is in late winter and spring off northern and western coasts and late spring off Southland and the Chatham Islands. There is also evidence of some spawning activity in summer/autumn in a few areas. The main fishing seasons are on spawning grounds in late winter and spring as well as summer/autumn feeding grounds. There are thought to be at least four main stocks, based on known spawning locations and movements (from tagging results). Current management areas are based around these stocks. However, there is the possibility that stock structure within management areas is more complex. For the BAR 7 stock there may be more than one spawning stock (possibly BAR 5) present in the area during the spawning season and, for BAR 5, there may be movement of fish to spawn on the west coast South Island (BAR 7) or mixing of summer/autumn feeding schools between the east coast South Island (BAR 1) and Southland. Trends in CPUE analyses and inferred year class strength (from commercial and research survey length frequencies) support these hypotheses to some extent, but there are enough differences (or insufficient data for BAR 1) to support the retention of current management areas at this stage.

Standardised annual catch per unit effort (CPUE) indices were developed from 1989–90 to 2007–08 for the three main fisheries BAR 1 (east coast South Island), BAR 5 (the Snares) and BAR 7 (west coast South Island). The main models described in detail were for major target species at the trip and tow level and explained 22–50% of the null deviance. Trends in the main models tended to be opposite for the east and west coasts of the South Island (BAR 1 and BAR 7), with the Snares (BAR 5) in between. Some trends in inferred year class strength (from commercial and research survey length frequencies) are consistent with some of the changes in CPUE (for various BAR 5 and BA7 models), suggesting that they may be useful as indices for monitoring stocks. However, this needs to be

properly assessed by incorporating all available data into a stock assessment model (either length-based, or potentially age-based for BAR 5). More information on changes in markets, market prices and fishing practices is also required to interpret trends as barracouta are a relatively low value species and there is some evidence of fishers' ability to avoid them by changing fishing gear or behaviour.

Trends in the main model CPUE indices were not mirrored by the east and west coast trawl surveys. For the east coast South Island surveys, the May–June timing is during a period of spawning migration to or from the area and adult fish appear to be in low abundance in some surveys. However, the survey should provide an index of recruitment. For the west coast South Island surveys in March–April, the indices best matched the trip level November to May (non-spawning season) CPUE index which is different to the main fishery June to October (spawning season) index. Therefore, this survey may not be suitable for monitoring the main fishery, particularly if stock structure is more complex than currently assumed. It does provide indices for adults and recruits that could potentially be useful for monitoring at least part of the BAR 7 fishery if stock structure can be further clarified. The usefulness of the adult index would be increased by collection of otoliths and determination of age frequencies.

Most Observer collected length frequency data and otoliths are from the Snares and are adequate to develop a series of catch-at-age for this fishery. Sampling from the west coasts of the North and South Islands has improved since about 2000 but needs to be optimised to achieve adequate sampling of lengths and otoliths. Sampling from the east coast of the South Island has been somewhat sporadic and ideally should include more inshore vessels to better represent the fishery.

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. This project was designed to ensure that data available for monitoring important middle depth species were routinely summarised and assessed on a five-year rotating schedule as described in the Ministry of Fisheries medium-term research plan for Middle Depth species (Ministry of Fisheries 2008a). The first species to be characterised was silver warehou for Quota Management Areas (QMA) SWA3 and SWA4, in early 2009, under project MID200703 (Parker & Fu 2011). The next two species, arrow squid (Hurst et al., submitted) and barracouta (the subject of this report), were carried out in late 2009 under project MID200801. Both of these fisheries have current management issues that can be informed by up-to-date fishery characterisation.

Previous characterisations of New Zealand barracouta fisheries were carried out from 1936–37 to 1983–84 by Hurst (1988a, b). Specific area analyses were carried out for BAR 1, from 1989–90 to 1999–2000, by Langley & Walker (2002a, b), and for BAR 5, from 1989–90 to 1997–98, by Harley et al. (1999). Stock structure has been reviewed by Hurst (1988a, b), Hurst & Bagley (1989) and Langley & Bentley (2002). Historically, research trawl surveys designed to estimate barracouta abundance (often in conjunction with other species) have been carried out off the east and west coasts of the South Island by *W.J.Scott* and *James Cook* in the 1980s (Fenaughty & Bagley 1981, Hurst & Fenaughty 1985, Hurst & Bagley 1984), around the Chatham Islands by *Akebono Maru #73* in 1984 and 1985 (Hurst & Bagley 1987, 1992), off Southland by *Shinkai Maru* 1981–86 (Kawahara and Tokusa 1981, van den Broek et al. 1984, Uozumi et al. 1987, Hatanaka et al. 1989, Hurst et al. 1990), in November 1986 by *Akebono Maru #3* (Hurst & Bagley 1997a) and 1993–96 by *Tangaroa* (Hurst & Bagley 1997b). Barracouta are also caught on east and west coast South Island *Kaharoa* surveys (Beentjes & Stevenson 2000, 2001, 2008, 2009, Stevenson & Hanchet 2001, Stevenson 2002, 2004, 2006, 2007). Barracouta were also one of the major species caught on some surveys off the west coast North Island in October-December 1986–96 (Morrison et al. 2001).

This report summarises the analyses carried out for the Ministry of Fisheries under project MID200801, Objective 1: To characterise the New Zealand barracouta fisheries by analysis of commercial catch and effort data up to 2007–08 including:

- To carry out CPUE analyses for the major fisheries (Fishstocks) where appropriate.
- To review the indices from CPUE analyses, all relevant research trawl surveys and Observer logbooks to determine any trends in biomass, size frequency distributions or catch rates.
- To review stock structure using data accessed above and any other relevant biological or fishery information.
- To assess the availability and utility of developing a series of age frequency distributions from trawl survey and Observer collected otoliths.
- To make recommendations on future data requirements (including recommendations for annual levels of Observer sampling) and methods for monitoring the stocks.

The report follows the standard format developed for the first report (Parker & Fu, 2011), except where additional information and analyses have been included to meet the specific objectives of this project. The report contains sections of text and tables that can be transferred to the Ministry of Fisheries Plenary report as appropriate. Some topics present in plenary reports were not reported on in this report but the headings are listed in the appropriate place in grey. 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

Barracouta (or snoek) are semipelagic fish found in temperate, continental shelf waters of the Southern Hemisphere. New Zealand has the second largest fishery, the largest being off south and west Africa that peaked at 81 000 t in 1978 (Griffiths 2002). The fishery is presently managed as four separate fish stocks based on Quota Management Areas (QMAs, Figure 1): eastern (BAR 1), Chatham Island (BAR 4) southern (BAR 5) and western (BAR 7). An administrative stock has been established for the Kermadec area (BAR l0), but no catch of barracouta has been recorded from that area.

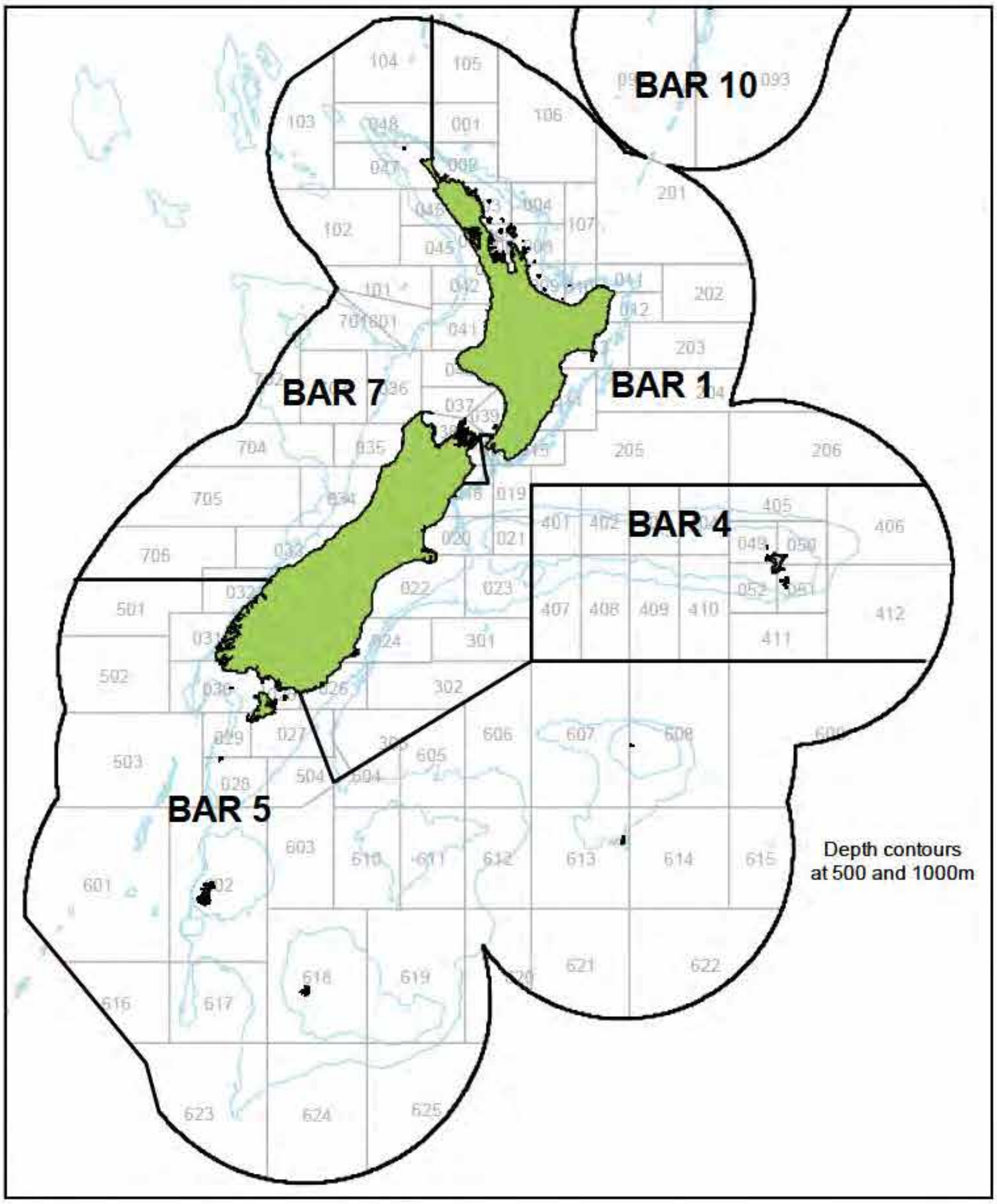


Figure 1: Map showing the administrative fishstock boundaries for barracouta (BAR 1, BAR 4, BAR 5, BAR 7, and BAR 10), including statistical areas, and the 500 m, and 1000 m depth contours.

Previous characterisations of New Zealand barracouta fisheries were carried from 1936–37 to 1983–84 (Hurst 1988a), from 1989–90 to 1999–2000 in BAR 1 (Langley & Walker 2002b), from 1989–90 to 1997–98 in BAR 5, (Harley et al. 1999). Norris (1988, unpub.) documented catch limits from 1978–79 to 1986–87. Administrative Fishstock boundaries were based on hypothesised stock structure from commercial and research data up to the mid 1980s (e.g., Hurst 1988a, Hurst & Bagley 1989, see Section 3.3). However, for the purposes of this report, fishstock areas (excluding BAR 10) are subdivided into eight main fishery areas (Figure 2), in order to allow for sub-area comparisons. Catch or effort restrictions and other management regulations prior to the introduction of the QMS are summarised below, in section 2.6, and by Hurst (1988a).

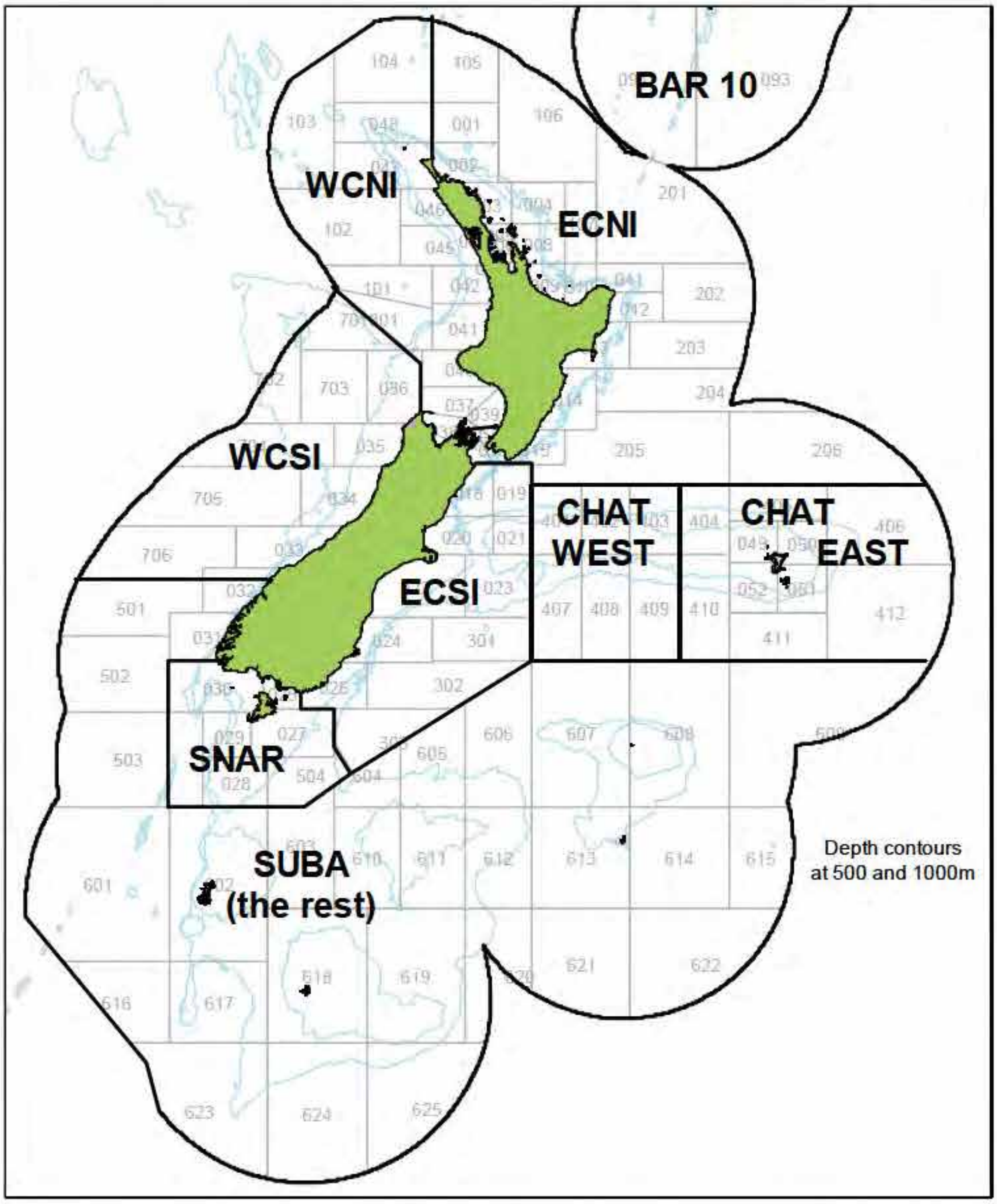


Figure 2: Map showing the areas used in this analysis, including statistical areas, and the 500 m, and 1000 m depth contours. ECNI, east coast North Island; ECSI, east coast South Island; CHAT WEST, western Chatham Rise; CHAT EAST, eastern Chatham Rise; SNAR, Snare/Stewart I. shelf; SUBA (mainly the Auckland Is. shelf); WCSI, west coast South Island; WCNI, west coast North Island.

Table 1: Reported landings (t) by nationality from 1967 to 1987–88 (from Hurst 1988b, Ministry of Fisheries 2009).

Fishing Year [a]	New Zealand Domestic	New Zealand Chartered	Foreign Japan	Foreign Korea	Foreign USSR [b]	Total (FSU)	Total (QMS)
1967	232		2 276		-	2 508	
1968	569		10 744		-	11 313	
1969	643		13 613		-	14 256	
1970	755		16 191		-	16 946	
1971	1 100		14 421		-	15 521	
1972	1 428		17 118		-	18 546	
1973	2 850		9 981		-	12 831	
1974	3 375		18 219		-	21 594	
1975	2 503		10 560		-	13 063	
1976	3 673		10 151		-	13 824	
1977	4 697	0	34 357	8 109	-	47 163	-
1978–79	5 335	58	4 781	2 481	0	12 655	-
1979–80	7 748	6 679	4 339	3 879	47	22 922	-
1980–81	10 058	4 995	4 227	15	60	19 355	-
1981–82	12 055	11 077	2 813	373	0	26 328	-
1982–83	10 814	7 110	1 746	1 888	31	21 589	-
1983–83	7 763	2 961	803	1 115	0	12 642	-
1983–84	12 390	10 226	1 786	4 355	0	28 757	-
1984–85	7 869	10 425	1 430	5 252	0	24 976	-
1985–86	8 427	7 865	1 371	815	0	18 478	-
1986–87	9 829	13 732	1 575	742	0	25 878	27 660[c]
1987–88	9 335	12 077	896	609	0	22 971	26 607[c]

a. fishing years up to 1977 are calendar years, then 1 April–30 March to 1982–83; 1983–83 is a 6 month changeover period; then years are 1 October to 30 September
b. not recorded
c. The discrepancies between QMS and FSU total landings are due to under-reporting to the FSU.

Table 2: Reported landings (t) of barracouta by fishstock from 1983–84 to 2007–08 and TACCs (t) from 1986–87 to 2008–09.

Fish stock	BAR 1		BAR 4		BAR 5		BAR 7		BAR 10			
FMA (s)	1,2, & 3		4		5, & 6		7, 8, & 9		10		Total	
Fishing year	Landings	TACC	Landings	TACC	Landings	TACC	Landings	TACC	Landings	TACC	Landings	TACC
1983–84*	7 805	-	1 743	-	11 291	-	7 222	-	-	-	28 061	31 040‡
1984–85*	5 442	-	1 909	-	12 487	-	4 425	-	-	-	24 263	31 000‡
1985–86*	5 395	-	1 509	-	6 380	-	4 536	-	-	-	17 820	33 116‡
1986–87†	8 877	8 510	3 084	3 010	7 653	9 010	8 046	10 510	-	10	27 660	31 050
1987–88†	9 256	8 837	1 775	3 010	6 457	9 011	9 117	10 603	-	10	26 605	31 471
1988–89†	5 838	9 426	946	3 010	5 323	9 011	8 071	10 702	-	10	20 178	32 159
1989–90†	9 209	9 841	1 349	3 016	5 960	9 281	7 050	10 925	-	10	23 568	33 073
1990–91†	9 401	9 957	1 399	3 016	8 817	9 282	7 138	10 925	-	10	26 755	33 190
1991–92†	6 733	9 957	1 156	3 016	6 897	9 282	7 326	10 925	-	10	22 212	33 190
1992–93†	9 032	9 969	2 251	3 016	7 019	9 282	10 141	10 925	-	10	28 443	33 202
1993–94†	7 299	9 969	606	3 016	3 410	9 282	8 030	10 925	-	10	19 345	33 202
1994–95†	10 023	9 969	331	3 016	2 645	9 282	9 345	10 925	-	10	22 345	33 202
1995–96†	11 252	9 969	2 234	3 016	4 255	9 282	8 593	10 925	-	10	26 334	33 202
1996–97†	11 873	11 000	1 081	3 016	2 839	9 282	10 203	10 925	-	10	25 996	34 233
1997–98†	11 543	11 000	1 966	3 016	6 167	9 282	8 717	10 925	-	10	28 393	34 233
1998–99†	9 229	11 000	459	3 016	7 302	7 470	4 427	10 925	-	10	21 417	32 421
1999–00†	10 032	11 000	1 911	3 016	6 205	7 470	3 288	10 925	-	10	21 436	32 421
2000–01†	7 118	11 000	2 122	3 016	6 101	7 470	6 890	10 925	-	10	22 231	32 421
2001–02†	6 900	11 000	1 160	3 019	5 883	7 470	7 655	11 173	-	10	21 598	32 672
2002–03†	7 595	11 000	573	3 019	7 843	7 470	9 025	11 173	-	10	25 036	32 672
2003–04†	5 949	11 000	477	3 019	6 919	7 470	9 114	11 173	-	10	22 459	32 672
2004–05†	6 085	11 000	98	3 019	8 593	7 470	12 156	11 173	-	10	26 919	32 672
2005–06†	7 030	11 000	687	3 019	9 479	7 470	10 685	11 173	-	10	27 881	32 672
2006–07†	5 351	11 000	3 233	3 019	6 334	7 470	14 698	11 173	-	10	29 617	32 672
2007–08†	5 987	11 000	2 969	3 019	8 561	7 470	10 451	11 173	-	10	27 968	32 672
2008–09†	8 861	11 000	968	3 019	7 659	7 470	8 955	11 173	-	10	26 444	32 672

*FSU data.
†QMS data.
‡Allocation under the Deepwater Policy (from 1 October 1983: 27 650 t, 27 650 t, and 29 766t) and foreign licensed allocations (3 390 t, 3 350 t, and 3 350 t) for 1983–84 to 1985–86). Source: Norris (1988 unpub.).

Commercial fishing for barracouta is recorded from 1936–37 but was less than 1 000 t until the Japanese commenced fishing in 1967. By 1968 the catch was 11 313 t and peaked at 47 163 t in 1977, the year prior to the introduction of the EEZ. Table 1 provides a summary of the early history of the fishery from 1967 up to 1987–88 (for the earlier catch history, see Hurst 1988a). Foreign catch prior to 1978–79 were provided by each nation; note that barracouta were never reported by the U.S.S.R, even though they recorded catch of commonly associated species from known barracouta grounds. The recent catch history from 1983–84, by QMA, is shown in Figure 3 and Table 2 (for a more detailed description of the early history of the fishery prior to 1983, including catch by ports of landing and EEZ areas, see Hurst 1988a,b). Note that the definition of fishing years has changed over time (see Table 1). Since October 1983, fishing years have been 1 October 1 to 30 September 30, and in this report, when fishing years are abbreviated, they are labelled as the most recent year (*e.g.*, 1998–99 becomes 1999).

Three main management measures have influenced barracouta catches: the 200 n. mile EEZ (from 1 April 1978) restricted the amount and location of catch by foreign vessels; the Deepwater Trawl Policy (from 1 October 1983 for barracouta) controlled development of the fishery by foreign chartered or larger domestic vessels (over 43 m length) by setting a total EEZ annual Total Allowable Catch (TAC) of 31 040 t; and lastly, the Quota Management System (QMS) (from 1 October 1986) set an initial Total Allowable Commercial Catch TACC of 31 050 t. This was increased slightly (about 10%) and later reduced to the current level of 32 672 t (Table 2).

Barracouta are primarily caught around mainland New Zealand in QMAs BAR 1, the Snares shelf part of BAR 5, and BAR 7. The barracouta fisheries at the Chatham Islands (BAR 4) and around the Auckland Islands part of BAR 5 are relatively small and sporadic (Table 2, Figure 3). Catches are usually within quota limits, the largest overcatch being 32% in BAR 7 in 2006–07. Catches have been less than 80% of the quota for extended periods in BAR 1 (from 2000–01), BAR 4 (all but two years), BAR 5 (most years up to the quota reduction in 1998–99), and BAR 7 (prior to 2000–01). In the last four years, total catches have been between 80–91% of the TACC.

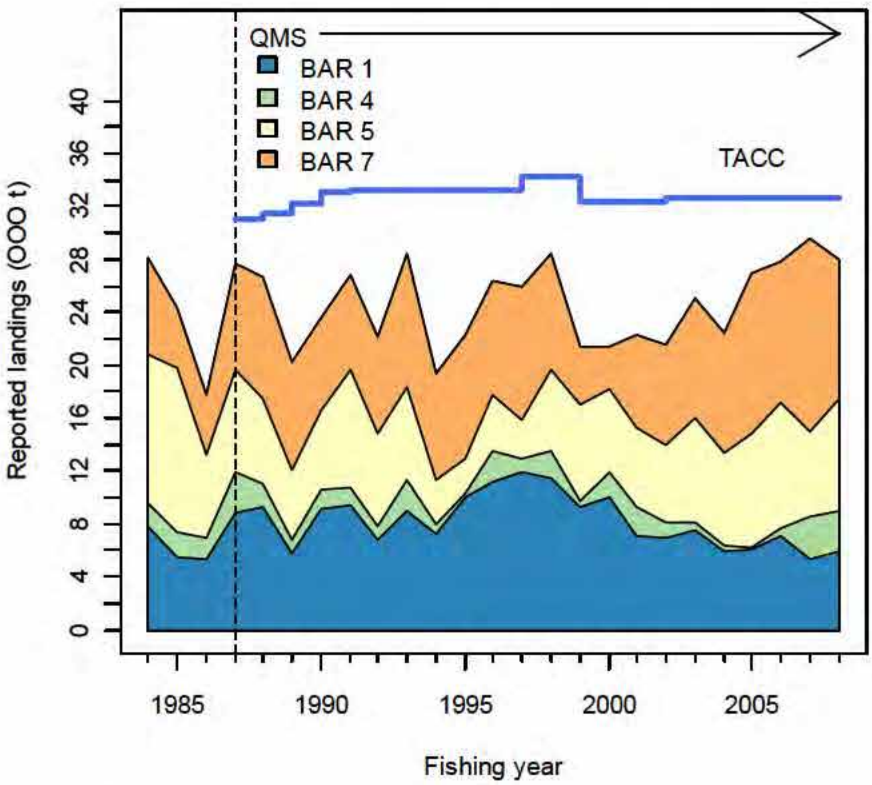


Figure 3: Total reported barracouta landings by QMA (shaded) and TACC from fishing years 1984 to 2008.

2.2 Recreational fisheries

Estimates of recreational catch from the Ministry of Fisheries recreational catch and effort surveys are shown in Table 3 (Ministry of Fisheries 2009).

Table 3: Estimated number and weight of barracouta harvested by recreational fishers by Fishstock and survey*.

Fishstock	Survey	Total Number	Total c.v.	Survey harvest (t)
				1991–92
BAR 1	South	27 000	47%	30–90
BAR 7	South	2 100	44%	–
				1992–93
BAR 1	Central	17 000	22%	25–35
BAR 7	Central	15 600	24%	25–35
				1993–94
BAR 1	North	*		–
BAR 7	North	*		–
				1996
BAR 1	National	68 000	8%	160–190
BAR 7	National	74 000	15%	160–220
				1999–00
BAR 1	National	156 000	35%	182–377
BAR 5	National	2 000	51%	2–7
BAR 7	National	35 000	28%	68–120

*** data not available**

*** Surveys were carried out in different years in the Ministry of Fisheries regions: South in 1991–92, Central in 1992–93, North in 1993–94 (Teirney *et al*. 1997) and nationally in 1996 (Bradford 1998) and 1999/2000 (Boyd & Reilly 2002). The estimated Fishstock harvest is indicative and made by combining estimates from the different years.**

A key component of estimating recreational harvest from diary surveys is determining the proportion of the population that fish. The Recreational Working Group has concluded that the methodological framework used for telephone interviews produced incorrect eligibility figures for the 1996 and previous surveys. Consequently the harvest estimates derived from these surveys are considered to be considerably underestimated and not reliable. However relative comparisons can be made between stocks within these surveys. The Recreational Working Group considered that the 2000 survey using face-to-face interviews better estimated eligibility and that the derived recreational harvest estimates are believed to be more accurate. Fishery Management Area (FMA) 2 catches are nevertheless considered to be over-estimated, probably because of an unrepresentative diarist sample. The 1999–00 Harvest estimates for each Fishstock should be evaluated with reference to the coefficient of variation (Ministry of Fisheries 2009).

2.3 Maori customary fisheries

No quantitative information is available on the current level of customary non-commercial take.

2.4 Illegal and misreported catch

No quantitative information is available on the current level of illegal and misreported catch.

2.5 Other sources of mortality

There may have been considerable amounts of barracouta discarded prior to the introduction of the QMS, either because of restrictions on quota under the deepwater policy, catch restrictions on foreign licensed vessels, low value, or undesirable small size fish. Barracouta may have been under-reported by the U.S.S.R prior to the EEZ in 1978 (Table 1) as the fleet size and area of some activities was similar at times to that of the Japanese (e.g., east coast South Island, Fenaughty & Bagley 1981). Catch under-reporting since the introduction of the QMS is unquantified but may have occurred for reasons of low value, small size or quota limitation. There is also likely to be some mortality associated with escapement from trawl nets.

2.6 Regulations affecting the fishery

Current and historical limits on catch or effort in barracouta fisheries are described in Section 2.1. Codend minimum mesh-size regulations that currently apply to the trawl fisheries are 60 mm for SubAntarctic (FMA 6) fisheries and FMA 5 south of 48°S; and 100 mm elsewhere. From 1 October 1977, the codend mesh-size change took effect at the boundary between the Snares and Auckland Is. fisheries (the old 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 1988a).

Management protection of bycatch species in multi-species fisheries (particularly relevant in trawl fisheries such as barracouta) is mainly through the QMS, with quotas currently set on 628 Fishstocks. Catch of protected species such as seabirds and furseals is monitored through the 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). From 1 October 2008, all commercial fishers have been required to state on their catch effort returns whether they have caught any non-fish or protected fish species, and if so, to give details on the new Non-fish Protected Species Catch Return (NFPSCR).

3 BIOLOGY

3.1 Distribution

Barracouta have been recorded in research bottom trawls in 5–670 m depth, and in more than 20% of tows from 30–350 m depth (Anderson et al. 1998). They are also recorded in midwater trawls and occasionally by tuna longliners (Bagley et al. 2000). Main distribution is around the mainland of New Zealand, shallower areas of the Chatham Rise (Mernoo, Veryan and Reserve Banks, Chatham Islands), and occasionally at the Auckland Islands. Tuna longliners have recorded barracouta in deeper waters to the north-east of the North Island and south-east and west of the South Island, although some early records may have been the black barracouta *Nesiarchus nasutus*. Distribution varies seasonally with extensive spawning migrations (Hurst & Bagley 1989), leading to the definition of 8 key fishery areas described above (Figure 2). Barracouta are targeted or caught as trawl bycatch of associated key target species arrow squid (*Nototodarus* spp.), jack mackerel (*Trachurus spp.*), red cod (*Pseudophycis bachus*), and tarakihi (*Nematodactylus macropterus*), and to a lesser extent, blue warehou (*Seriolella brama*) gemfish (*Rexea solandri*), hoki (*Macruronus novaezelandiae*), and snapper (*Pagrus auratus*) (see Section 7.2 for details by fishery area).

Juvenile barracouta occur in similar depths to mature fish but only occur in more than 20% of tows in 30–150 m depth (Hurst et al. 2000a). Age 0+ and 1+ fish appear to have an even more restricted coastal range and have not been recorded from the Auckland Is. and only rarely from the eastern Chatham Rise. To some extent this may be a reflection of the deeper sampling by research and commercial sampling in these areas (often over 200 m). A summary of research trawl survey data (Hurst et al. 2000a) provided catch rate plots for vessels using the same gear. Surveys by *Kaharoa* found higher catch rates of juveniles in the Hauraki Gulf (in the northern half of the North Island) and in Tasman Bay and Canterbury Bight (around the South Island, except Southland). Surveys by *Tangaroa* off Southland found higher catch rates in shallow coastal waters of Southland and Stewart Island and surveys by *Akebono Maru #73* around the Chatham Islands found higher catch rates in shallow coastal waters on the eastern side of the Islands. *Kaharoa* catch rates were highest in inshore Canterbury Bight when a small mesh (28 mm) codend was used, suggesting that there is probably considerable escapement of juveniles through the *Kaharoa* current standard South Island survey codend (74 mm), the *Tangaroa* middle depth net (60 mm) and commercial codends (100 mm, and 60 mm, see section 2.6), although the slightly shallower depths sampled (10–400 m compared with the usual 30–400 m) may also have been a factor.

Biomass trends and length frequencies for key research survey series since 1990 that cover appropriate depth ranges for barracouta and have sampled lengths are shown in Appendix A. These include *Kaharoa* surveys of the east coast South Island (December-January “summer” and May-June “winter” series) and Tasman Bay/Golden Bay and the west coast of the South Island (March-April) and *Tangaroa* surveys off Southland (Hurst & Bagley 1997b). In terms of distribution, the main conclusion from these data is that biomass off the east coast South Island is consistently greater than off the west coast South Island, by a factor of 4 (winter series, 1992–96), 7 (summer series, 1996–2001) and 9 (winter series, 2007–09). Gear deployed and depth ranges covered were slightly different in the summer series (see above).

The Ministry of Fisheries observer sampling programme has collected length frequencies and otoliths from commercial fisheries mainly in the SNAR, WCNI, WCSI, SUBA, and ECSI areas (Tables B1–B3, Figures B1–B6, see section 6.1). Data for these areas have been summarised by year and show that fisheries in the SNAR and WCNI areas catch proportionately more small fish (1+, less than 45 cm) than other fisheries, mainly due to the depth and target species (barracouta, squid and jack mackerels) and codend mesh size (60 mm south of 48 ºS in the SNAR area).

3.2 Spawning

Sexual maturity is reached at about 50–60 cm fork length (FL) at about 2–3 years of age (Ministry of Fisheries 2009, Hurst et al. 2002b). Mature-sized fish occur all around New Zealand, in shallower waters of the Chatham Rise and at the Auckland Islands in over 10% of tows between 30–350 m depth (Hurst et al. 2002b).

Known spawning areas and seasons from research surveys and observer records were summarised by Hurst (1988a, 1988b) and Hurst et al. (2000a). Spawning grounds were identified as ECNI (August/September), Chatham Is. (December), Southland, particularly around Stewart Is. (October/November), WCSI (July–October), and limited activity on the outer ECSI shelf and at Mernoo (December) and around the Auckland Is. (Jan/February). There was also some evidence of an extended or secondary summer spawning season on the WCNI (January–March) from commercial activity and in Southland (January/February) from research surveys (Hurst & Bagley 1994). Numerous seasonal surveys (to 400 m depth) of the Canterbury Bight in the early to mid 1980s confirmed the lack of major spawning activity in this area.

Observer information is updated here, covering the fishing years 1990–2008 (Section 6.1, Table B6, Figures B7a, b). There were no new data for ECNI. Data for other areas indicated the same general pattern for the main spawning fisheries. Indications of spawning in January at the Auckland Is. are still based on small numbers of fish (29) and the possible extended or secondary spawning season off the WCNI in January–May is based on fewer than 500 fish per month, a few ripe fish in March but mostly spent fish in February and May when samples sizes were under 50. Notable new indications of spawning activity include a stronger indication of some spawning activity off the ECSI and Mernoo in October and indications of some spawning activity in August/September around the Chatham Is. that extends the season from August–December.

Tagging results (Hurst & Bagley 1989) suggest extensive (up to 500 n.mile) northward spawning migrations of barracouta tagged in summer off the east coast South Island (mostly Kaikoura) and recaptured in winter/spring off the east coast North Island and occasionally the west coast North Island. This type of migration is consistent with seasonal patterns in North Island commercial fisheries (Hurst & Bagley 1989) and tagging results from other barracouta fisheries off South Africa (De Jager 1955) and Australia (Blackburn & Gartner 1954). Only one tag return was received from a fish tagged off the north-west coast South Island and it had moved to northern Taranaki Bight, also consistent with a possible spawning migration. No tag returns were received from fish tagged off Stewart Island.

Seasonal research surveys in some areas have also provided indications of changing abundance that reflect spawning activity or movements. From *James Cook* seasonal and *W.J.Scott* continuous surveys of Canterbury Bight in the early 1980s (Hurst & Fenaughty 1985, author's unpublished information), it is known that most adult sized fish are absent from the area in late winter/early spring. The tagging study (described above) did not tag fish from Canterbury Bight although one fish from Dunedin did move to Manukau (WCNI), suggesting that fish from this far south also may move north to spawn. Continuous surveys off the west coast of the South Island by *W.J.Scott* in the early 1980s (Hurst & Fenaughty 1985) suggest increased abundance of barracouta in the winter in one of the two years sampled. Surveys off Southland in various seasons by *Shinkai Maru* and *Akebono Maru #3* found evidence of spawning. In the spring (October/November) survey the biomass of mature sized fish was only 25% of that in the winter, suggesting that some fish may move out of the area to spawn (Hurst & Bagley 1997a). However, the potential difference in vessel catchability of *Shinkai Maru* and *Akebono Maru #3* cannot be discounted. The closest known major spawning ground is the WCSI although some spawning activity has been recorded in deeper waters off Canterbury Bight.

In summary, the main spawning season for barracouta is late-winter/spring (July–October) on the east and west coasts of both of the main islands (except inshore Canterbury Bight), and in late spring (October–December) in deeper water off the ECSI and around Mernoo Bank, off Southland, and around the Chatham Islands. The relative importance of spawning activity recorded in deeper water off ECSI and on Mernoo and at the Auckland Islands in January (Hurst et al. 2000a) is unknown but appears to be relatively minor. There is evidence from tagging and seasonal trends in fisheries of extensive spawning migrations from the ECSI to northern areas, spawning migrations of fish between other areas is also possible. There may also be an extension of some spawning activity into summer/autumn or a secondary peak in activity in some years (e.g., WCNI and SNAR). This is also suggested by the appearance of bimodality in juvenile cohort length frequencies (e.g., Harley et al. 1999). Griffiths (2002) also found the peak spawning period off South Africa to be winter/spring (June–October) and confirmed that barracouta are indeterminate serial spawners.

3.3 Stocks and spatial distribution

Stock structure of barracouta was reviewed by Hurst (1988a) and Hurst & Bagley (1989) based on seasonality of commercial fisheries, research surveys up to 1986, and movements of tagged fish. More recent relevant information comes from a summary of all research and commercial observer data on areas of importance for juveniles (described above in Section 3.1) and spawning (Hurst et al. 2000a).

Langley & Bentley (2002) reviewed barracouta stock structure around the South Island based on published literature, research survey biomass trends, commercial and research survey size frequencies from which they inferred relative year class strengths (YCS), and commercial catch and unstandardised catch rates. They concluded that east coast South Island fish from Canterbury Bight north migrate northwards to the east coast North Island to spawn and that west coast South Island fish are part of one stock with western North Island fish. Both of these conclusions are consistent with previous literature and current management areas. They also found that fish off Southland appear to be less abundant in winter/spring and suggested, on the basis of catch rates and extrapolated year class strengths, that they have stronger affinities with the ECSI than the WCSI stock.

The approach of examining trends in CPUE and YCS between the main fishery areas (ECSI, SNAR, WCSI and WCNI) has been updated here. Series of scaled length frequencies from research trawl surveys up to 2009 (Appendix A, Figures A6–A10) and observer sampling (Appendix B), and fishery characterisations (Appendix C, see also Table 7) and CPUE (Appendix D, Figures 5, 6) up to the fishing year 2007–08, are given in this report and summarised here with respect to stock structure.

Observer length frequency data used for area comparisons are described in Section 6.1. Most observer samples came from the SNAR, WCNI, WCSI, SUBA, and ECSI areas (Table B1). SNAR and WCSI had the most fish measured, the best sampling consistency across months, and were most representative of the catch. Samples from SUBA and WCNI are not used in this analysis because of the large changes in catches and sample sizes during the time series. Trawl survey length frequencies used were the ECSI survey (including both the summer and winter series), the WCSI survey (excluding data from Tasman and Golden Bays because of uncertainty of stock structure), and the Southland series from 1993–96 (described in Section 5.1).

Age groups 0+ up to 4 were identified for modal groups based on length maxima (Table B4) reported by Harley et al. (1999), Hurst et al. (2000b), Langley & Bentley (2002), and those identified here. Strong 4+ modes could also be tracked occasionally but weaker cohorts were generally lost among the general adult mode. Relative YCS was estimated by tracking modal groups across years and classifying them as weak, moderate, strong and strongest based on relative numbers of fish per cohort (Table 4, Figure 4). This is more likely to be accurate from trawl surveys as they better represent the population size structure, sample with codend mesh sizes less than 100m (that better catch the younger age classes), and enable comparison of relative numbers in modal groups between years. However, the frequency of the WCSI trawl survey is less than annual and some observations of a year class are only made once and are uncertain. Numbers at ages 0+ and 1+ did not always correlate well with numbers at ages 2+ and 3+, so more reliance was placed on the older ages. Observer data is collected annually but sample sizes in some years are low and the level of catch has varied between years, which make determination of relative YCS more problematic without using a model. The more uncertain estimates are identified and given less weight in the area comparisons.

Table 4: Inferred relative year class strengths from trawl survey (TS) and observer (Obs) length frequencies. 1, weak; 2, moderate; 3 strong; 4, strongest; shading indicates less certainty in estimation, often due to low sample sizes (obs. data) or survey frequency.

	ECSI			Snares		
	TS		Obs	TS	Obs	TS
	Winter	Summer				
1984				3	3	
1985				3	3	
1986				3	3	
1987				3	3	
1988	1			2	2	
1989	3			3	3	1
1990	3			1	1	2
1991	1			1	1	4
1992	1			1	1	2
1993	1			1	1	2
1994	2			1	1	2
1995	3	3			2	1
1996		3	3		3	2
1997		3	1		3	1
1998		4	4		3	3
1999		3	3		3	4
2000			1		3	3
2001			2		4	1
2002						2
2003	3				3	1
2004	3				2	2
2005	4					1
2006	1					3
2007	4					
2008						

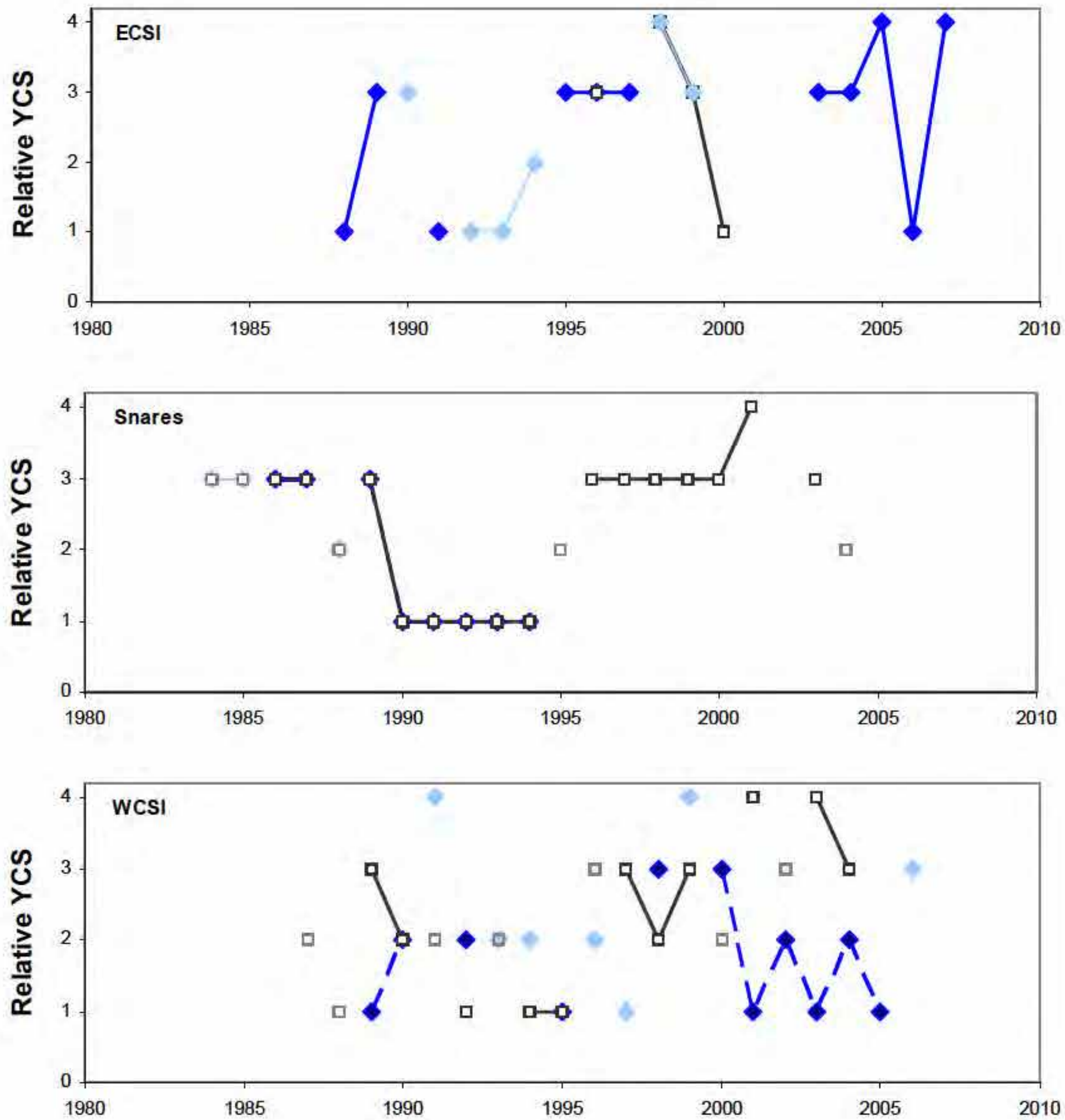


Figure 4: Inferred relative year class strengths (1, weak; 2, moderate; 3 strong; 4, strongest) from trawl survey (blue) and observer (black), see Table 4) length frequencies. Dark symbols and line indicate points with more certainty; lighter shaded symbols indicate points with less certainty.

ECSI trawl survey and observer data matched for three of the four years of overlap (1996–99), although two of these pairs had one point that was uncertain. Using both datasets suggests relatively strong YCS in 1989, 1990, 1996–99, 2003–05, and 2007, the strongest being 1998, 2005 and 2007. Weak YCS occurred in 1988, 1991 (possibly through to 1993), 2000 and 2006 (all single data series only).

For the Snares area, YCS from trawl surveys and observer data match well for the 11 years of overlap to 1994, with interpretation aided by ageing of both survey and observer otoliths (Harley et al. 1999). There appears to have been a period of good recruitment during the mid to late 1980s, followed by poor recruitment from 1990–1994 in both datasets. Observer data only are available since 1995 and suggest relatively strong YCS in 1996–2001 with 2001 being the strongest.

For the WCSI area, there is considerable uncertainty in both sets of rankings for survey and observer data. Of the more certain estimates, five of the eight are within ± 1 point. Strong YCS for the observer winter fishery appear to be 1989, 1997, 1999, 2001, 2003 and 2004, with 2001 and 2003 being the strongest. Trawl survey data agree with 1999 and add 1991, 1998 and 2000 (1991 and 1999 are possibly the strongest). Weak YCS are 1992–1995 in the observer data; trawl surveys agree with 1995 and add 1989, 2001, 2003 (which were all strong in observer data), and 2005. The observer data are mostly taken from the July-Oct spawning fishery and may index a different population to that indexed by the March-April survey, or a mix of populations (see Section 8.2).

Comparing YCS for ECSI, WCSI, and SNAR indicates that 1989, 1996 (probably), 1997–99, and 2003 were strong in all areas (except 1989, 1997 and 2003 for the WCSI survey and 1998 for WCSI observer) and 1992 and 1993 were probably weak in all areas (moderate for the WCSI survey). The ECSI and WCSI also share a probably weak YCS in 1988 and probably a strong year class in 2004; ECSI and SNAR share a weak year class in 1991. ECSI is opposite to WCSI in that 1995 and 2005 (WCSI survey only) were strong and 2000 was weak (also opposite to SNAR). SNAR and WCSI also shared strong year classes in 2000 (WCSI survey only) and 2001 (WCSI observer only) and a weak year class in 1994 (WCSI observer only).

In summary, these observations suggest that there is considerable similarity in patterns of strong and weak year classes for 11 of the 16 years for which there are estimates for all of three main areas, ECSI, WCSI (observer data only), and SNAR. The remaining five years for which at least two areas can be compared do not suggest a stronger affiliation of any one area with any other. ECSI and SNAR each have two unique strong or weak year classes (out of the comparable 16 years), WCSI has one. It is possible that discrepancies between WCSI observer and trawl YCS may reflect different fish composition in the area between the spawning and non-spawning seasons. Unfortunately, length frequencies from the WCNI fishery, which may have strong affiliations with the WCSI non-spawning season fish (if they migrate north to spawn in June–October) and may have helped address the question further, were too difficult to interpret using the methodology applied here.

Interpretation of abundance (CPUE and trawl survey) trends for the three main fishery areas with respect to stock structure is complicated by the uncertainty of CPUE and trawl survey time series indices' ability to monitor abundance (see Sections 8.4–8.6). While there is some level of consistency between trends in indices and suggested patterns of strong and weak year classes, these data are difficult to interpret without the availability of commercial or survey age frequency data and the inclusion of all data into stock assessment models. However, from Figure 8, it appears that the general trend in CPUE indices is for ECSI to show the opposite trend to WCSI, with SNAR intermediate between the two. Comparison of trawl survey and CPUE indices (Figure 9) shows that WCSI survey indices from March/April are more similar to CPUE indices for November–May (non-spawning) rather than the spawning season indices for June–October This lends some support to the suggestion that fish from another area (e.g., SNAR) may be present on the WCSI during the spawning season.

The main conclusion possible at this stage is that while there appear to be many similarities in YCS and possible abundance indices between the three main fishery areas, there are probably enough differences to justify maintaining stock boundaries as they currently are. While significant differences in YCS could have been taken as indicative of stock separation, similarity may just be caused by strong environmental influences on recruitment which could be quite similar in the three main areas, and therefore not informative with respect to stock structure. A more robust technique to estimate YCS, improved information on catch-at-age from the fisheries, and the development of stock assessment models are highly desirable. A method to distinguish Snares barracouta from WCSI and ECSI fish is also desirable (e.g., extension of the previous tagging programme to include southern and western fish, otolith microchemistry, improved monitoring of YCS through optimised length and otoliths sampling). Note that overlap of more than one population of barracouta spatially (but not temporally) has been recorded in Australian waters (Blackburn & Gartner 1954). Griffiths (2002) also raised the possibility of the existence of resident and migratory sub-populations of Benguelan barracouta.

3.3.1 Stock definitions for management:

Data presented here do not contradict the current management boundaries for BAR 1, BAR 4, and BAR 7. However, the relationship between fish in FMA 7 and more northern FMAs (8 and 9) is unclear. It is possible that the fish present off the WCSI in the spring spawning fishery are not the same as those present in the autumn trawl survey, suggesting stock structure in western areas may be more complex than assumed by the management areas. The stock affinities of BAR 5 are still uncertain and there is the possibility of overlap with BAR 1 and BAR 7 but, given the occurrence of some spawning activity off Southland, and differences in CPUE indices and inferred YCS between areas, the retention of a separate area is justified at present.

3.4 Climate and recruitment

Dunn et al. (2009) carried out correlations and association tests between YCS and abundance (trawl survey or CPUE) indices for 56 fish species with 20 climate indices. For barracouta, there were significant relationships of some west coast South Island (2+) and Tasman/Golden Bay (0+) YCS indices (from WCSI trawl surveys) with various Kidson weather patterns and Trenbeth pressure indices, and with the Southern Oscillation Index (SOI) (0+ only). BAR 1 (Langley & Walker 2002a) and BAR 5 (Harley et al. 1999) CPUE indices also showed significant correlations with Kidson or Trenberth indices. Of these, possibly the Tasman/Golden Bay (0+) YCS with Zonal Kidson regime showed the most potential because there were several cycles encompassed within the survey time span, but with only 7 data points, a longer time series is required to determine if there is any relationship. Potential climate relationships were not further investigated here in detail, although it is worth noting that, of the 11 year classes shared between ECSI, SNAR and WCSI (section 3.3), four (1989, 1996, 1999, 2003) of the six high YCS came from La Niña or average SOI conditions and four (1991–94) of the five low YCS came from El Niño conditions.

3.5 Ageing

Age determination of otoliths was validated by Harley et al. (1999). They analysed otoliths from a time series of four research trawl surveys off Southland and found that estimated ages from counting probable annual bands in whole otoliths matched well with distinct length frequency modes for 0+ to 3+ fish, and the progression of a strong year class (1989). Mean length at age data for barracouta from a 1984 survey around the Chatham Islands have also been published (Hurst & Bagley 1987), but the technique was unvalidated.

3.6 Growth curves

Von Bertalanffy parameters were derived for Southland barracouta, for each sex, by Harley et al. 1999 (Table 5).

3.7 Natural mortality

There are no estimates of natural mortality (M) for New Zealand barracouta. The best estimate for M is considered to be 0.3 (Ministry of Fisheries 2009) which implies a maximum age of 15 years old, based on the formula of Sparre et al. (1989):

$$M = log_e(100) / A_{max}$$

where A_{max} is for the maximum age reached by 1% of the population. Harley et al. (1999) found barracouta females up to 11 years old in the relatively heavily fished Southland population, which suggests a slightly higher maximum age is probable and that M is unlikely to be over 0.4 (Table 3).

3.8 Length-weight relationship

Length-weight relationships reported for barracouta from BAR 4 and BAR 5 (Ministry of Fisheries 2009) are given in Table 5.

Table 5: Estimates of biological parameters.

Fishstock	Estimate	Source
1. Natural mortality (*M*)		
All-both sexes	Less than 0.4 *M* = 0.3 considered best estimate for all areas for both sexes	From ageing results presented in Harley et al. (1999)

2. Weight = a(length) (Weight in g, length in cm fork length).

	Females		Males		Sexes combined		
	a	b	a	b	a	b	
BAR 3					0.0091	2.88	Beentjes & Stevenson (2000)
BAR 4	0.0074	2.94	0.0117	2.82			Hurst & Bagley (1992)
BAR 5	0.0075	2.90	0.0075	2.90			Hurst & Bagley (1992)

3. Von Bertalanffy growth parameters

			Both sexes	
	K	t_0	L_∞	Harley et al. (1999)
BAR 5 Males	0.336	-0.35	81.1	
BAR 5 Females	0.259	-0.60	89.3	

3.9 Feeding and trophic status

Feeding records are available from most of the main areas except the west coast of the North Island (Stevens et al. 2011). Of 15 542 barracouta (mainly 30–100 cm fork length) sampled, 48% had stomachs containing food. The highest proportion of empty stomachs (79%) was from the North Island area, possibly related to sampling during the spawning season.

Crustaceans were the most important prey overall, occurring in 77% of stomachs with food. The main crustaceans identified were euphausiids (74%), and *Munida gregaria* (4%). Teleosts comprised 18% overall, with hoki the most commonly identified (4%), mainly from the WCSI, and some myctophids (1%) and sprats (0.6%). Cephalopods, particularly squid, were also important (9%). In total, at least 8 main invertebrate groups in 4 phyla and 24 teleost (including 2 mesopelagic) species were identified.

There were no major differences in diet between smaller (up to 60 cm) and larger fish. However, in northern and western areas (North Island and Challenger), teleosts were more important in the diet (about 50%) than off the east and southern coasts of the South Island and at the Chatham Islands (about 10%). Euphausiids (about 40–60%) and cephalopods (1%) were correspondingly less important in the north and west and more important in the other areas (about 70–90% euphausiid and 6–15% squid). *Munida gregaria* was locally important (up to 9%) off east and southern coasts of the South Island.

These findings are consistent with other records (Thomson 1892, Thomson & Anderton 1921, Phillips 1926, Graham 1938, 1953, Mehl 1969, Hurst 1980, Russell 1983, O'Driscoll 1998) from around New Zealand (i.e., euphausiids and fish were important in all studies; *Munida gregaria*, hoki and sprats are locally important). Other published work did not fill in the gap in knowledge from the west coast of the North Island. These findings are also consistent with studies in south-east Australian waters, where the euphausiid *Nyctiphanes australis* was the main item in the diet from December-July, with teleosts (mainly anchovy, *Engraulis australis*) of secondary importance (Blackburn 1957). They are different to studies from South Africa, where teleosts are more important in the diet than crustaceans (Nepgun 1979, Griffiths 2002), and their importance increases with increasing fish size (Griffiths 2002). Barracouta have been recorded in the diet of New Zealand fur seals, *Arctocephalus forsteri* (Street 1964, Tate 1981, Fea et al. 1999).

4. CURRENT AND ASSOCIATED RESEARCH PROGRAMMES

4.1 Ministry of Fisheries

There are no specific ongoing research programmes on barracouta. Ongoing research trawl surveys in two areas routinely record catches and length frequencies of barracouta in appropriate depths (see Section 5, Appendix A). Barracouta are taken in reasonable quantities on *Kaharoa* trawl surveys off the west and east coasts of the South Island, depth ranges are appropriate to sample barracouta, and these data probably monitor barracouta size frequencies in these areas and months reasonably well. Numbers of barracouta measured range from 2481–7401 on winter surveys of the ECSI and 2998–6472 on autumn surveys of the WCSI. Barracouta squid catches taken by *Tangaroa* on the Chatham Rise and in the Sub-Antarctic surveys are variable, probably because the minimum survey depths are at the deeper edge of the barracouta distribution. Numbers of barracouta measured range from 41–494 on summer surveys of the Chatham Rise.

4.2 FoRST

4.3 Other

5. FISHERY INDEPENDENT OBSERVATIONS

5.1 Research surveys

Biomass indices, length and age frequencies

Bottom trawl surveys in areas and depths appropriate to catch barracouta have been conducted since the early 1980s; some of these were designed to estimate barracouta abundance. Trends in biomass estimates and length frequencies from key surveys are presented in Table 6 and Appendix A (Figures A1–A10) and some of the results of these surveys have been described in Sections 3.1–3.3. This section mainly considers the continuing standardised time series potentially suitable for monitoring barracouta abundance, i.e., *Kaharoa* surveys off the east and west coasts of the South Island. The value of other surveys that could potentially be continued, *Tangaroa* off Southland and *Kaharoa* off the lower east coast of the North Island, is also assessed. Data for the continuing time series of *Tangaroa* surveys for hoki, hake and ling on the Chatham Rise are presented even though much of the barracouta distribution is likely to be inside the 200 m minimum depth limit; data for the Sub-Antarctic series are not presented as the minimum depth limit of 300 m is too deep.

The Southland survey series is the only series listed in Table 6 that was optimised to estimate barracouta (and seven other species) biomass (Figures A5, A10). Surveys were conducted annually from 1993–96 and achieved high levels of precision (c.v.s no more than 20%). Biomass declined during the series in conjunction with relatively poor recruitment after the strong 1989 year class. There was good correlation with observer length frequencies for the fishery for larger (greater than 55 cm) fish (Hurst & Bagley 1997a) and between ages frequencies determined for the survey and observer data using the survey otoliths and age-at-length key (Harley et al. 1999). This survey is appropriate for monitoring the barracouta in BAR 5 at the main time that the fishery operates, although possible stock mixing issues with BAR 7 and BAR 1 would still need to be resolved. The survey was discontinued in 1996 because of the cost of the surveys relative to the value of the fisheries being monitored.

Kaharoa surveys off the west coast South Island (including Tasman and Golden Bays) have been conducted on 1–3 year time scales, but have been biennial since 2003 (Figures A4, A9). Precision is generally good (less than 20% CV). Biomass indices from the west coast part of the survey (Figure A4a) have been relatively flat, averaging about 3000 t plus or minus approximately 1000 t. Length frequencies (Figure A9) include fish about 10–100cm and modal groups can be tracked for at least the first 3 year groups (0+ to 2+), although this is more complicated when survey spacing is 2 or 3 years apart. Estimates from Tasman and Golden Bays are more variable (Figure A4b), reflecting the variability in relative strength of individual juvenile (0+ and 1+) year classes. Both areas suggested strong year classes (based on 0+ fish) in 1991 and 1996. The 1999 year was also strong on the west coast, whereas 1993, 2004 and 2008 were strong in Tasman/Golden Bays. The relationship between fish in these two areas is not known and the relationship with barracouta that spawn off the west coast in winter is unclear (see section 3.3). Barracouta is not one of the target species of the survey and otoliths have not been collected. In conclusion, these surveys are suitable for monitoring biomass of barracouta during the autumn but require otolith collection in order to establish age frequencies. Monitoring of the winter spawning biomass and research to better determine the stock relationship between fish present in different seasons is also required to inform effective fishstock management.

Table 6: Biomass indices (t) and coefficients of variation (c.v.) (Assumptions: areal availability, vertical availability and vulnerability = 1).

Area	Vessel	Trip code	Date	Biomass[1]	%c.v.	Biomass[2]	%c.v.
Southland							
	Tangaroa	TAN9301	Feb-Mar 93	11 587	18		
		TAN9402	Feb-Mar 94	6 151	20		
		TAN9502	Feb-Mar 95	4 539	17		
		TAN9604	Feb-Mar 96	7 693	19		
East coast South Island	*Kaharoa*	KAH9105	May-Jun 91	12 936	29		
		KAH9205	May-Jun 92	11 672	23		
		KAH9306	May-Jun 93	18 197	22		
		KAH9406	May-Jun 94	7 451	32		
		KAH9606	May-Jun 96	16 845	19		
		KAH9618	Dec 96-Jan 97	21 513	34		
		KAH9704	Dec 97-Jan 98	11 843	25		
		KAH9809	Dec 98-Jan 99	21 877	14		
		KAH9917	Dec 99-Jan 00	21 416	14		
		KAH0014	Dec 00-Jan 01	21 808	19		
		KAH0705	May-Jun 07	21 132	17	24 938	19
		KAH0806	May-Jun 08	25 544	16	25 587	16
		KAH0905	May-Jun 09	33 360	16	34 807	16
West coast South Island	*Kaharoa*	KAH9203	Mar-Apr 92	2 478	14	1 403	12
		KAH9404	Mar-Apr 94	5 298	16	2 907	17
		KAH9504	Mar-Apr 95	4 480	13	4 125	13
		KAH9701	Mar-Apr 95	2 993	19	2 530	22
		KAH0004	Mar-Apr 00	1 787	11	1 403	12
		KAH0304	Mar-Apr 03	4 485	20	2 907	17
		KAH0503	Mar-Apr 05	2 763	13	2 263	14
		KAH0704	Mar-Apr 07	2 582	14	2 078	15
		KAH0904	Mar-Apr 09	3 512	17	2 978	18
East coast North Island	*Kaharoa*	KAH9304	Mar-Apr 93	2 673	15		
		KAH9402	Feb-Mar 94	8 433	33		
		KAH9502	Feb-Mar 95	2 103	29		
		KAH9602	Feb-Mar 96	2 495	23		

[1] Biomass from comparable series
[2] Biomass from selected strata: ECSI, new 10-30m depth strata included; WCSI, west coast only (no Tasman/Golden Bay)

Kaharoa surveys off the east coast of the South Island have been carried out in winter (1991–1996, 2007–2009) and summer (1996–2000) (Figures A3, A8), except for a missing year in 1995. The summer series has been discontinued because of concerns of annually fluctuating biomass for many of the top 25 species that may have been caused by changes in catchability (Figure A3b). There were three “extreme” survey years where the survey biomass index doubled or halved (Francis et al. 2001). Winter survey precision is not as good as for the west coast surveys, but is mostly under 30% C.V. Biomass indices for winter surveys show an increasing trend, from an average of about 13 000 t in the early series to about 27 000 t in recent series (Figure A3a). Summer surveys averaged in between the winter series, at about 20 000 t. Length frequencies (Figure A8) include fish about 15–90 cm and modal groups can be tracked for at least the first three year groups (0+ to 2+). Winter surveys are carried out when mature barracouta are likely to be actively migrating out of the area to spawn (see Section 3.2) and adult biomass and modal groups may be under-represented. This may have contributed to the fluctuating biomass in the early series, particularly the low estimates of adult-sized fish in 1994. Timing of the summer surveys may also have been problematic in that not all spawning fish may have returned to the Canterbury Bight by December, e.g., low numbers of adult-sized fish in 2000. Length frequency data from winter surveys suggest strong year classes in 1989, 1990, 1995, 2003 to 2005 and 2007; summer surveys suggest 1995 to 1999 were strong (see Table 4). Barracouta is not one of the target species of the survey and otoliths have not been collected. In conclusion, the winter surveys are suitable for monitoring biomass of immature pre-recruit barracouta. Monitoring of adult-sized fish will be less than optimal due to survey timing and would require otolith collection in order to determine age frequencies. Optimised otolith sampling will be required to identify pre-recruit cohorts accurately.

Kaharoa surveys off the east coast of the North Island (Table 6) were carried annually out in late summer (1993–1996) but have been discontinued. As for the east coast South Island, they exhibited a pattern of annually fluctuating biomass for 22 species, with three “extreme” survey years (Francis et al. 2001). For this reason, further data summaries are not provided here.

Tangaroa surveys for hoki, hake and ling on the Chatham Rise (Figures A1, A2, A6, A7) were assessed. Biomass estimates and length frequencies are highly variable, length frequency sample sizes are often low (especially around the Chatham Islands), most fish are mainly over 50 cm (Chatham West) or 60 cm (Chatham East), and tracking of year classes is not possible. No otoliths are collected. The more targeted Chatham Island surveys in 1984 and 1985 (Figures A2, A7) covered the 50–400 m depth range and found 98% and 86%, respectively, of the biomass inside 200 m (Hurst & Bagley 1987, 1992). This confirms that the current Chatham Rise *Tangaroa* surveys cannot adequately monitor barracouta biomass.

5.2 Other data

A number of trawl surveys during the 1980s provided biomass estimates and length frequencies for barracouta. These provided valuable information for determination of distribution of adults and juveniles, spawning areas and stock structure, as described in Section 3. Otoliths were also collected on all surveys that were optimised for barracouta: *James Cook* east coast South Island 1980–82; west coast South Island 1983; 1984, Bay of Plenty 1984; *Akebono Maru No. 73* Chatham Islands 1984, 1985; *Shinkai Maru,* and *Akebono Maru No. 3* Southland 1986; *Tangaroa* Southland 1993–96. Many of these otoliths were aged using an unvalidated ageing method similar to that described by Harley et al. (1999) for the Southland *Tangaroa* series, but have not been published and are not on the MFish *age* database (the database records 45 otoliths for the Chatham Rise in 1992 and a total of 3014 otoliths for the 1993–96 Southland surveys). The unpublished age data are of limited utility for monitoring barracouta stocks as the series never exceeded three years.

6. FISHERY DEPENDENT OBSERVATIONS

Note that for these sections, unless otherwise stated, fishing years (1 October to 30 September) are labelled as the most recent year (e.g., the fishing year 1998–99 becomes 1999).

6.1 Observer data

6.1.1 Length and age sampling

All tables and figures relating to observer data collected from barracouta fisheries are contained in Appendix B (Tables B1–6, Figures B1–7).

The Ministry of Fisheries Observer Programme has collected barracouta length, weight, female gonad stage, and otoliths from various fisheries since 1985 (Appendix B). The use of observer data to help determine distribution of adults and juveniles, spawning fish and stock structure is described in Section 3.

Most observer samples in the fishing years 1990 to 2008, in order, came from the SNAR (2540), WCNI (639), WCSI (575), SUBA (560), and ECSI (316) areas (Table B1a). The percentage of observed catch by area, averaged across all years, was highest for the SUBA (10%) and SNAR (7%), relatively low WCSI (5%), WCNI (3%), ECSI (3%) and CHATEAST (4.5%) and minimal for CHATWEST (0.2%) and ECNI (less than 0.1%) (Table B1b). The seasons of sampling vary by area: SNAR and SUBA, January–April; WCSI, July–September; ECSI, February–May, with a second peak in July–October; WCNI, October–January with a second peak in Jun–July (Table B2).

The representativeness of observer sampling of barracouta 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 (Figure B1). 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. Sampling best represents catch distributions for SNAR, WCSI, and SUBA (although the Auckland Is. fishery is highly sporadic and usually very small). Sampling in other areas has been highly variable by year and month.

Most samples for ECSI and SNAR measure about 30–50 fish across the full time series but there is considerable variability by months and between years (Table B3). For SNAR, the average of 156 samples per year has resulted in over 3000 fish measured across the 4-month season since 1993 and provides a good time series for monitoring YCS moving through the fishery (see Section 3.3), using the maximum sizes per year class as listed in Table B4. Annual sampling for WCNI has averaged 70 samples since 2000, but number measured are split by spawning and non-spawning seasons, the numbers of fish measured exceed 1000 fish for only 3 of the 9 years. For WCSI (3-month season), the average number of samples has been lower (36) and numbers of fish measured exceed 1000 for 9 of the last 18 years. The average number of samples for the Auckland Is. (3-month season) is similar (35, in years where sampling occurs) but the number of fish measured is mostly under 500 per year. ECSI has a longer 9-month fishing season and, with an average of only 27 samples per year since 1999, numbers of fish measured per season rarely exceed 1000.

Otoliths from commercial catches have been collected from all areas, but the numbers per year are highly variable (Table B5). The best dataset comes from the Southland area where otoliths collected per year have exceeded 500 since 2001 (and often over 800). No other areas approach a time series of otoliths of 500 per annum. No observer collected otoliths have been aged but commercial catch-at-age frequencies were estimated for Southland, from 1991–97, by applying a Southland survey age-length key (Harley et al. 1999).

6.1.2 Length and age frequencies

Scaled length frequencies were determined using the 'catch.at.age' software (Bull 2002) which 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 barracouta were estimated from catch weights using the length-weight relationship for trawl surveys in BAR 4 and BAR 5 (Table 5). No individual fish weight data were collected by observers.

The size of fish caught by commercial vessels varies by area, due to a combination of season, depth of target fishing and cod-end mesh size (Figures B2–B6). The smallest fish (down to about 30 cm fork length) are encountered in the SNAR area, where cod-end mesh of 60 mm is allowed from 48° S and the fishery operates in areas and depths where smaller fish are present. Modal classes at 1+ , 2+ and 3+ were able to be determined. In other areas, the usual minimum sizes and discernable modal groups were: ECSI over 40 cm, ages 2+ and 3+; WCSI (spawning season) over 50 cm, ages 3 and 4; and WCNI over 30 cm, 1+,2+, 3+. SUBA (Auckland Is.) fish were usually over 50 cm, despite the 60 mm mesh allowed, possibly because this is the southern edge of the range and only adults occur there in any numbers. Samples were too few to allow modal groups to be identified and tracked. Inferred relative year class strengths for the key areas are shown in Table 4, Figure 4 and discussed in Section 3.3.

Maximum sizes also vary by area. A low proportion of SNAR fish reached up to 90 cm fork length up until about 1999, but the maxima have been nearer 80 cm since. A similar trend is apparent for ECSI after 2002. WCSI, WCNI, and SUBA fish regularly attain 90 cm fork length, even up to 100 cm in several years for WCSI and WCNI.

Modal groups inferred from observer data are compared among the main fishery areas and with trawl survey data in Section 3.3, with respect to stock structure.

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). Distribution of 0+, 1+, immature, and mature fish from these and survey data combined have been summarised by Hurst et al. (2000b) and are discussed in Sections 3.1 and 3.2.

The number of female barracouta staged from 1990–2008, by area, is given in Table B6. Numbers staged for SNAR are the highest, mostly over 400 per year, up to nearly 8000 in total. Data for other areas rarely exceeds 1000 fish staged per year. Data for the defined fishing areas have been combined across all years to establish general patterns of spawning activity by month (Figure B7a). The location of ripe (stage 3) and running ripe (stage 4) fish is shown for January–June and July–December in Figure B7b).

Across all areas, most spawning activity is recorded from July–November, with most running ripe fish in August–September. Spawning appears to be slightly later in the ECSI, SNAR, and Auckland Is. areas (although note that the Auckland Is. are not sampled from June–December). There is evidence of extended or secondary spawning from February–May in WCNI, although sample sizes in some of these months (February and May in particular) are low. The peak spawning months at the Chatham Islands are still undetermined as sample sizes are low in August (163) when most running ripe fish are reported. Higher numbers in September (1228) suggest this may not be the peak period. The new information these data have contributed to our understanding of spawning locations and times is described in Section 3.2.

6.2 Catch and effort data sources

Catch and effort data were requested from the Ministry of Fisheries catch-effort database “warehou” as extract 7425. The data consist of all fishing and landing events associated with a set of fishing trips that reported a positive landing of barracouta in BAR 1, 4, 5 and 7 for fishing years between 1 October 1989 and 30 September 2008. The fields from the database tables requested are listed in Table C1.

The estimated catch associated with the fishing days or events were reported on the general Catch Effort Landing Returns (CELR) and the more detailed Trawl Catch Effort and Processing Returns (TCEPR). The green weight 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 it summarises tow by tow estimated catches up to the top eight species for all vessel sizes.

Information on total harvest levels are provided via the QMR/MHR system, but only at the resolution of Quota Management Area. The catch-effort and landing returns report catches at the level of individual fishing events, and 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, such as barracouta, 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 may provide a more accurate account of low and zero catch observations. However, daily processed catch data suffers 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 (2007) 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 has been developed for monitoring bycatch species in the AMP, and is 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

Note that for these sections, unless otherwise stated, fishing years (1 October to 30 September) are labelled as the most recent year (e.g., the fishing year 1998–99 becomes 1999).

7.1 Summary of catches

All tables and figures relating to characterisation of barracouta fisheries are contained in Appendix C (Tables C1–16, Figures C1–93). Table C16 contains a list of species codes used.

The reported QMR/MHR landings, catch-effort landings (un-groomed), and TACCs for BAR 1, 4, 5, and 7, from 1984 to 2008, are shown in Figure C1. For all four Fishstocks, the ungroomed catch-effort landings in the raw dataset are similar to the reported MHR landings throughout the time series, except for two years where they are significantly greater, in 1990 in BAR 1 and 1992 in BAR 4 (both single record tonnage errors). The MHR landings have slightly overrun the TACC in six fishing years up to 1998 in BAR 1, two years in BAR 4, five of the last seven years (2003, 2005, 2006, 2008) in BAR 5, and two recent (2005, 2007) years in BAR 7 (Table 2, Figure C1).

The landings data provide a verified green weight 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, 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).

Table C2 summarises the number of landing events for the major destination codes in the dataset. The proportion of landing events recorded under “T” (transferred to another vessel) and “R” (retained on board) destination codes (both defined as interim landing events by Starr 2007) varies by area. “T” events were more commonly recorded in the 1990s, mainly by vessels using CLR forms, comprising 1%, 26%, 15% and 3% of landing events for BAR 1, BAR 4 , BAR 5, and BAR 7 up to 1998. “T” events represented 6%, 1%, 1%, and 1%, by weight for the whole series (Table C3). For “R” events (whole series), the proportions were 1%, 6%, 8% and 2% (9%, 3%, 4%, and 5%). It was unknown how the catches from “T” trips are recorded, as the transferred catches could be landed by foreign vessels to ports outside New Zealand. Other interim landing events (retained as bait, in holding receptacles, or on board) were dropped (after Starr (2007) and Parker & Fu (2011)). The weight, number of records, and disposition of each potential landed state is given in Table C3. Details of the data corrections by imputation and invalid record removal during the grooming process are given in Table C4. The retained landings, interim landings, and total landings dropped during data grooming are shown in Figure C2. The estimated catch and landings removed from the dataset in this process are generally insignificant throughout the four time series, however, the maximum weight of landings dropped was 21% in BAR 4 in 2008.

The main processed state for barracouta is “Dressed” (includes “Dressed”, “Headed and gutted”, and “Trunked”) in the offshore fisheries carried out by larger vessels (BAR 4, BAR 5), “Whole or Green” in the inshore (BAR 1) and a mix of both in BAR 7 (Figure C3). “Dressed”, “Whole or Green” and “Meal” are the next most common states. The conversion factors for barracouta have been static since the full implementation of the QMS (Ministry of Fisheries 2008b), except for a minor change for one year in BAR 1 (Figure C4). When conversion factors change it means that different amounts of greenweight catch are associated with the same amount of processed catch for particular product forms throughout the dataset. Therefore the greenweights were standardised using the most recent conversion factor for each processed state, based on the assumption that the changes in conversion factors reflect improving estimates of the actual conversion when processing barracouta, 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. The usual treatment for a trip fishing in a straddling statistical area is to assume the catches of the straddling statistical area had been taken from a single Fishstock if the trip had only reported to that stock, and to exclude 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. Therefore statistical areas were allocated to BAR fishstocks based on the location of the centroid of each area (“centroid” method). This resulted in a much closer relationship between QMR/MHR landing, merged landings and estimated catch in all areas, particularly in BAR 4 and 5 (Figure C5a), compared to the conventional method (Figure C5b). 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 C5. The recovery rates, defined as the groomed and merged landings as a proportion of the groomed and unmerged landings (after Manning 2004), are plotted in Figure C4.

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 (Figure C6). The TCEPR/CLR reporting rate is close to 90% or above in most years for BAR 1 and BAR 5 and over 80% in most years for BAR 7 and BAR 4, indicating a fairly consistent match between the recorded statistical areas on the TCEPR and the stocks reported on the CLR on a trip basis. CELR/TCER reporting rates were about 80% or above in BAR 1 and BAR 7, fell below 80% in four years in BAR 5, and were highly variable in BAR 4. Most series show minimal change in the level of reporting through time, except for BAR 4 and BAR 5 CELR.

The proportions of estimated catches and retained landings by form type for each fish stock are shown in Figure C7. For BAR 4 and BAR 5 most of estimated catches are recorded on TCEPR (with the landings recorded on the corresponding CLR forms). For BAR 1 about two-thirds are recorded on these forms with the remainder on CELR forms until the introduction of TCER forms in 2008. For BAR 7, the proportion recorded on TCEPR (and CLR) has been increasing over time, from about 70% in the 1990s up to 80% in 2008. In the 2007–08 fishing year all vessels previously on CELR forms appear to have switched to TCER forms.

Trips recording barracouta catch and using CELR forms generally report no estimated barracouta catch more often than trips using TCEPR forms (as found for silver warehou by Parker and Fu (2011)). The percentage of zero estimated catch (when barracouta is landed) on CELR reported trips generally ranges from about 20–40% in all QMAs except BAR 4, where the range is 40–80% (Table C6). On TCEPR recorded trips, the percentage is mostly less than 20% (mostly less than 10% in BAR 5). Trips that recorded no estimated catch have reported a small amount of landings for both CELR and TCEPR forms (Figure C8). Catches are usually less than 0.5 t, although catches greater than this are more common in BAR 5, up to about 2 t.

Though estimated catches tend not to be recorded when catches are small (as vessels only report the top five species caught), overall the estimated catches capture approximately 90% of the harvest reported via the MHR/QMR system for the four Fishstocks (Table C5). There also appears to be a reasonably close match between estimated catch and reported landings at trip level (Figures C9–C12).

7.2 Fishery Summary

Barracouta fisheries occur around mainland New Zealand, on the western Chatham Rise, at the Chatham and Auckland Islands (Figure C13). Highest catches from fishing years 1990–2008, by region (Table C7, Figure 2) and statistical area, have come from the ECSI (areas 018, 020, 022, 024), CHAT EAST (area 050), SNAR (025, 027, 028), WCSI (034, 035), and WCNI (037, 038, 040, 041), with areas 022 (Canterbury Bight) and 028 (Snares Islands) recording the highest totals (Figure C13). Figure C14 shows the relative importance of these areas by fishing year on the finer scale possible from TCEPR forms. The Snares, Canterbury and south Taranaki Bight fisheries have been relatively consistent, whereas the WCSI and Chatham Islands fisheries appear to have been quite variable. These data are mainly from the larger vessels and the value of having the inshore data at this resolution (from TCER forms in 2008) is illustrated in Figure C15.

Across all fisheries, there are two main categories of fishing vessels that take most of the barracouta catch: the smaller inshore New Zealand vessels (less than 40 m length and 500 t) and the larger offshore vessels (over 50 m length and 2000 t), of which the vessels about 100 m and 4000 t have increased their catch significantly to be the dominant group since 2002. These vessels are mostly foreign nationalities, mainly Ukraine, Korea, and to a lesser extent, Vanuatu, all of which have increased their catches over the time period (Figure C16a, Table C8). A high proportion of catch in the early 1990s was taken by vessels of unrecorded nationality. The main difference to earlier (pre-QMS) participation in the fishery (Table 1) is that Japanese vessels are no longer present and that USSR vessels are now from the Ukraine and reporting significantly more barracouta catch.

In this characterisation section, finer scale areas (Figure 2) are used in order to review the hypothesised stock structure (section 3.3) and as a prelude to developing CPUE analyses that might be useful for monitoring the major fisheries. Seven main regions were defined, in part using discontinuities in catches: ECNI, ECSI, CHAT WEST, CHAT EAST, SNAR + SUBA, WCSI, and WCNI. SUBA was combined with SNAR as it is not clear from the level of catch or the length frequency distributions (Section 3.3) that it is a distinct fishery. The Chatham Rise was considered to be potentially distinct from the ECSI and to contain possibly two populations (east and west), based on discontinuities in barracouta depths. Ideally, the CHAT WEST area should be considered in conjunction with the Mernoo part of ECSI; this was not done as it would not match up with FMA boundaries.

Total estimated catch for each region from the groomed and merged dataset are shown in Table C7 (Figure 16f). Traditionally ECSI, SNAR and WCSI were the dominant fisheries, at least to 1984 (Hurst 1988a). Catch by the areas defined has not been reported from 1985–1989, but in the early 1990s, WCSI catches were still higher than WCNI, on average. However, WCNI has recently become a more important fishery as WCSI barracouta catches declined during 1998–2001 and JMA 7 jack mackerel annual catches increased to over 20 000 t from 2002 (Ministry of Fisheries 2009), contributing to barracouta annual catches of 4 000–7 500 t for WCNI for the same period (Figure 16h). Key target species since 1990 are barracouta and squid, jack mackerel since 1998, and red cod intermittently. Over all areas, catch occurs in all months, with more caught in summer/autumn months (December–April), although the most recent pattern is more evenly spread (Figure 16e). Trawl is the dominant method and the amount caught by midwater trawl has been steadily increasing since 1990 (Figure 16g).

7.2.1 East Coast South Island

Barracouta from ECSI are caught throughout the year except for July-September, predominantly in statistical area 022, by bottom trawls targeting barracouta and red cod and reporting predominantly on TCEPR forms (Figures C17, C18a,b, Table C9). Areas 020 and 024, midwater trawling and targeting for squid and jack mackerel, are of secondary importance. Trends in catch distribution are similar throughout the time period, although the amount of barracouta caught by midwater trawling has increased and bycatch from red cod targeting was greater during the late 1990s (when red cod catches were high, Ministry of Fisheries 2009). Main months of catching barracouta as the target and as bycatch of red cod are October-June; bycatch of squid targeting tends to be slightly later, in January-June (Figures C18c, C19). Over time, the proportion of barracouta catch targeted decreased from about two-thirds to about half, from 1994–2001 (when red cod catches increased, Ministry of Fisheries (2009)) and then increased again (Figure C19a). During 1994–2001, the proportion targeted by month decreased most during December–May. Tows reporting the lowest proportion of zero tows with barracouta catch are barracouta (less than 20%) and red cod (mostly 20–50%) (Figure C20).

Catch rates of barracouta in the key target fisheries reflect the above patterns: they are highest for barracouta target, with no major trend (except for a large increase in 2008), and average about 4 t/tow; and variable for red cod and squid target but average about 1 t/tow and 0.5 t/tow, respectively (Figure C21). Tow duration and effort depth are most similar and relatively constant over time for these three target species, about 3–5 hours (Figure C22) and 50–200 m for barracouta and red cod, slightly deeper 100–300 m) for squid (Figure C23). Fishing effort variables for bottom trawls are similar for the three main species (width 20–40 m, height 4–5 m, speed 3–4 knots, distance towed 10–25 km, vessels under 1000 t and 25–40 m), except that squid target tends to be taken with larger vessels that tow faster and for longer (Figure C24). Hoki target vessels are substantially (i.e., outside the 75th percentile range) larger (1000–2500 t) and tarakihi effort width substantially lower than for the three main target species. Fishing effort variables for midwater trawls are also similar for the three key target species (width 80–120 m, height 20–50 m, speed 4–5 knots, distance towed 15–25 km) and vessels are large (greater than 2000 t) (Figure C25). They are most dissimilar for hoki target (height 50–70 m) and spiny dogfish target (height 10–20 m and vessel tonnage 1000–1500 t).

There is little change in the location of barracouta catch within the ECSI area from 2003, as recorded on TCEPR forms, but considerable variability in the location of highest catches, from mid Canterbury Bight in earlier years to deeper waters off Banks Peninsula in 2008 (Figure C26a). Inshore effort from TCER forms (Figure C26b) shows that high catches were taken in shallower waters in 2008 and emphasises the value of having a complete dataset for fisheries that span these depth ranges. The combined distribution of tows for the major target species encountering barracouta within the ECSI region again demonstrates the overlap between barracouta, red cod and squid target fishing (Figure C27). Jack mackerel, hoki, and silver warehou tend to overlap more on the outer shelf and western Chatham Rise (within the area defined), whereas elephantfish, flatfish, red gurnard and tarakihi overlap more in shallower areas and minimally on the western Chatham Rise.

7.2.2 East Coast North Island

Barracouta from ECNI are caught mainly from July–October, predominantly in statistical areas 013 and 014, by bottom trawls targeting barracouta and tarakihi and reporting predominantly on CELR forms (Figures C28, C29a, Table C10). Area 009 was important up to 1999. Catches in all areas are lower in the 2000s compared to the 1990s. A high proportion of barracouta catch was targeted up until 2004; a similar or greater proportion has been caught by tarakihi target. Gemfish and blue warehou target were of secondary importance until the late 1990s. There is a small amount of midwater trawl catch from targetting barracouta and gemfish, and bottom pair trawl catch from snapper target. The main months of catching barracouta as a bycatch of tarakihi and snapper are July–November, and as a bycatch of gemfish is May (Figure C29b). The proportion of barracouta targeted was about or greater than 50% in area 009 in most years; the proportion in the other key areas is less than a third (Figure C30). In the main catching months (July–October), barracouta are about 25–60% targeted (Figure C30). The only tows recording less than 30% zero barracouta catch are barracouta target tows. Tarakihi target tows have recorded 40–90% zero barracouta catch, averaging about 60–70% from 1997 (Figure C31).

Catch rates of barracouta in the key target fisheries also tend to be higher during the 1990s. Overall barracouta have averaged about 1 t/tow; other target species less than 0.5 t/tow (Figure C32). Tow duration and depth are most similar for barracouta and tarakihi target (3–5 hours, 50–150 m); gemfish and blue warehou durations are more variable and the gemfish effort depths are 200–300 m (Figures C33, C34). Snapper, red gurnard, john dory and trevally target depths are all shallower and hoki target depths deeper. Fishing effort variables for bottom trawls are similar for most target species (width 10–30 m, height 3–5 m, speed 3–3.5 knots, distance towed 10–25 km, vessels under 300 t and 30 m), except that gemfish and blue warehou target trawls are higher (5–9 m), hoki and blue warehou target towing speed is faster (over 3.5 knots), and hoki vessels are larger (up to 40 m and 800 t) (Figure C35). Fishing effort variables for midwater trawls for the two key target species, barracouta and gemfish, are similar except that gemfish tows are shorter (Figure C36). For other midwater target species, hoki trawls are higher and tarakihi trawls lower.

The location of barracouta catch within the ECNI area is variable by year from 2003, as recorded on TCEPR forms, and catches by 0.2 degree square are considerably lower than for the ECSI (Figure C37a). Locations of highest annual catch are Cook Strait and the Wairarapa coast. TCER data for 2008 also indicate high catches in Cook Strait and the Hawke Bay region (Figure 37b). The combined distribution of tows for the major target species encountering barracouta within the ECNI region indicates strong overlap between barracouta, tarakihi, gemfish, red gurnard and trevally fishing; partial overlap to the south for blue warehou, to the north for snapper, and deeper for hoki, and poor overlap with red cod, kahawai and ghost shark (Figure C38).

7.2.3 Chatham Rise West

Barracouta from CHAT WEST are caught mainly in April–June, in statistical area 407 (east Veryan Bank), by bottom trawls targeting barracouta and reporting on TCEPR forms (Figures C39, C40a, b, Table C11). There is no clear secondary target species (Figure C40a, b, c). The proportion of barracouta targeted was greater than 75% in area 407, and across most months, up until 1998 (Figure C41) and the tows reporting the lowest proportion (mostly less than 20%) of zero tows with barracouta catch are barracouta target tows (Figure C42).

Catch rates of barracouta in the barracouta target fishery were high, averaging 10 t per tow, up until 1998, but catches have been variable since (Figure C43). Catch rates in other target fisheries are also low and catches sporadic. Tow duration and depth are most similar for barracouta and squid target, but variable (1–7 hours, 150–350 m); hoki target is mostly 400–600 m and silver warehou extends deeper, to 450m (Figures C44, 45). Most fishing effort variables for bottom trawls show considerable overlap (width 30–50 m, height 3–5 m, speed 3.5–4.5 knots, distance towed 10–40 km, vessels 300–1000 t and 50–60 m), except that hoki target vessels are over 2000 t and hoki and squid target vessels are over 60 m (Figure C46). Fishing effort variables for midwater trawls for the three key target species, barracouta, hoki and jack mackerel differ in that hoki trawl height and distance towed are greater, jack mackerel trawl width and speed are greater and hoki and jack mackerel vessels are larger (Figure C47).

The location of barracouta target catch on the western Chatham Rise (as defined) is mainly east of Mernoo Bank (Figure C48) and overlaps most closely with squid, red cod and jack mackerel target and least with hoki target which is deeper and extends much further east (Figure C49).

7.2.4 Chatham Rise East

Barracouta from CHAT EAST are caught mainly in May–June and December–January, in statistical area 049 and 050 (northern Chatham Islands), by bottom trawls targeting barracouta and reporting on TCEPR forms (Figures C50, C51, Table C12). Midwater trawls have sporadically been of secondary importance. The proportion of barracouta targeted approaches 100% in key areas and months (Figure C52) and the tows reporting the lowest proportion (mostly less than 20%) of zero tows with barracouta catch are barracouta target tows (Figure C53).

Catch rates of barracouta in the barracouta target fishery have averaged about 4 t per tow, up until 2006 when they increased and have remained higher, up to 16 t per tow (Figure C54). Tow duration and depth are in a similar range for barracouta and most other species target (2–7 hours, 100–300 m) except for hoki and ling that tend to be deeper and red gurnard that is shallower (Figures C55, 56). The main ranges for barracouta target fishing effort variables for bottom trawls are: width 35–40 m, height 4–4.5 m, speed 3.9–

4.2 knots, distance towed 5–25 km, vessels 300–1000 t and 55–65 m (Figure 57). Species target variables that are most different in terms of width, height, speed, or vessel size are red gurnard, tarakihi, stargazer and spiny dogfish; hoki vessels also tend to be over 1000 t. Fishing effort variables for midwater trawls for the three key target species, barracouta, hoki and jack mackerel, are similar except that hoki trawl height is greater. Silver warehou target vessels appear to use smaller gear but there are few data points (Figure C58).

The location of barracouta target catch on the eastern Chatham Rise from 2003, as recorded on TCEPR forms, is mainly north-east of Chatham Islands with the occasional larger catches to the west (Figure C59) and overlaps most closely with jack mackerel, squid, silver warehou, spiny dogfish and tarakihi; red gurnard is at the shallow edge of the range and hoki and ling extend deeper and further west (Figure C60).

7.2.5 West Coast South Island

Barracouta from WCSI are caught mainly in winter/spring (July–September), predominantly in statistical areas 034 and 035, by bottom and midwater trawls targeting barracouta and jack mackerel and reporting predominantly on TCEPR forms (Figures C61, C62, Table C13). Barracouta catch in June and October, areas 033 and 036, and targeting for hoki (mainly by midwater trawl) are of secondary importance. The catch reported on TCER forms in 2008 was minimal (Figure C62c). Trends in catch distribution are similar throughout the time period, although the amount of barracouta caught declined around 1999 and 2000, and increased in area 036 from jack mackerel midwater target in the last few years. Main months of catching barracouta as the target and as bycatch of jack mackerel are the same (June–October, Figure C62d). For the main areas and months, the proportion of barracouta catch targeted has been mostly over 50%, up to about 75% (Figure C63). Tows reporting the lowest proportion of zero tows with barracouta catch are barracouta target (less than 20%), and jack mackerel and tarakihi (20–70%) (Figure C64).

Catch rates of barracouta in the barracouta target fishery averaged about 3.5 t/tow up to 2004 and have been between 9–20 t/tow since 2005 (Figure C65). Catch rates from other species target tows are highly variable and mostly much lower, the highest being from jack mackerel target where the catch rates averaged about 1.5 t/tow up to 2002 and 3–6 t/tow since then. Tow duration and depth are most similar and relatively constant over time for barracouta and jack mackerel (2–5 hours, 100–250 m depth, Figures C66, C67a, b). Gemfish, hoki and silver warehou target are deeper and other species (blue warehou, red cod, stargazer, and tarakihi,) highly variable and often shallower. Fishing effort variables for barracouta target bottom trawls overlap considerably with other species target (width 35–45 m, height 4–5 m, speed 3.5–4.2 knots, distance towed 15–30 km, vessels 300–1000 t, 40–65 m), except that hoki and jack mackerel target vessels tend to be larger (jack mackerel gear higher), and tarakihi and blue warehou target vessels are smaller, with narrower gear that is towed slower (Figure C68). Fishing effort variables for midwater trawls for the three key target species (barracouta, jack mackerel, and hoki) show considerable overlap (width 60–120 m, height 30–60 m, speed 4–5 knots, distance towed 10–30 km) and vessels are large (over 1000 t and 60 m length) but jack mackerel vessel and gear tend to be at the top end of the range and towed faster (Figure C69).

The location of major barracouta catch within the WCSI area from 2003 has varied by year, as recorded on TCEPR forms, but tends to be in a band from 41–42 °S and just to the south of Hokitika (Figure C70a). Inshore effort from TCER forms in 2008 shows that the higher inshore catches were taken further south (from 42° 30´–44 °S) and in a small area just north of 41 °S (Figure C70b). The combined distribution of tows for the major target species encountering barracouta within the WCSI region shows considerable overlap between barracouta target and most other species target (Figure C71). For the two main other species, hoki overlap in most areas except the inshore and to the north, but extend considerably deeper, and jack mackerel do not extend as far inshore or south.

7.2.6 West Coast North Island

Barracouta catches from WCNI show variation over time with respect to months, areas of capture, and trawl gear (Figure C72, Table C14). Up to 1998, most catch was from December–January, in areas 037 and 038, by bottom trawls; catches were low for the next two years and from 2001 the most catch has been from October–December, in areas 037, 040 and 041, by midwater trawl. Key target species in both periods have been barracouta and jack mackerel, with the latter more important since 2001. A secondary peak in catches in July–August has appeared in the last five years. Most catch is reported on TCEPR forms, except in area 038 where CELR forms dominate (Figure 73a). By area and method, barracouta target catch is mostly by bottom trawl in areas 037 and 038 and midwater trawl in areas 040 and 041, whereas jack mackerel target has been predominantly by midwater trawl since 2001, in areas 037 and 040–042 (Figure 73b). The catch reported on TCER forms in 2008 was minimal (Figure C73c).

The proportion of barracouta catch targeted varies by area and month (Figures C73d, C74). The highest proportions (50–75%) have been from areas 037 and 038 and July–January, up to 1997. Catches from 038 have since declined, whereas catches from 037 have increased recently but the proportion targeted is less than 25%. The recent (since 2003) large catches in areas 040 and 041 are mostly less than 25% targeted, except in July and August when a couple of years were over 50% targeted. Tows reporting the lowest proportion of zero tows with barracouta catch are the two main target species, barracouta (mostly less than 20%) and jack mackerel (mostly less than 40%) (Figure C75).

Average catch rates of barracouta in the barracouta target fishery were about 3 t/tow up to 1998, then dropped to about 1 t/tow until 2003, and then increased to average about 7 t/tow (Figure C76). Catch rates from jack mackerel target have shown a steady increase since 1990, averaging about 1.5 t/tow over the series. Barracouta catch rates from other species target are highly variable and, except for blue warehou and red cod, have much lower averages. Tow duration is similar and relatively constant over time for most species (mainly 3–6 hours) (Figure C77). Tow depth was most similar for barracouta, jack mackerel and tarakihi, about 50–150 m, whereas the other minor species all tended to be shallower than 100 m (Figure C78). Fishing effort variables for barracouta target bottom trawls overlap considerably with other species target (width 15–40 m, height 5–6 m, speed 3.5–4 knots, distance towed 15–25 km, vessel size under 500 t and 40 m length). The key exception is jack mackerel target vessels which are larger, have gear at the higher end of the range or greater, and tow faster (Figure 79). Fishing effort variables for midwater trawls for the two key species target (barracouta and jack mackerel) are similar, and overlap with other species target except for blue warehou vessels which are smaller, use smaller gear and tow slower (Figure C80).

The location of major barracouta catch within the WCNI area from 2003 has varied by year, as recorded on TCEPR forms, but tends to be at North Cape, off Manukau, and in south Taranaki Bight (Figure C81a). Inshore effort from TCER forms in 2008 shows that the higher inshore catches were taken in Golden and Tasman Bays (Figure C81b). The combined distribution of tows for the major target species encountering barracouta within the WCNI region shows considerable overlap between barracouta, jack mackerel, and tarakihi target (Figure C82). Shallower species such as John dory, red gurnard, snapper, and trevally are missing from the middle of south Taranaki Bight, and blue warehou and red cod only overlap to the south.

7.2.7 Snares and Auckland Islands

Barracouta from SNAR and SUBA areas are caught mainly from October-April, predominantly in statistical area 028, by bottom and midwater trawls targeting barracouta and arrow squid, and reporting predominantly on TCEPR forms (Figures C83, C84, Table C15). Areas of secondary importance are 025, 027, and 029 (in BAR 5), where catch is taken predominantly by bottom and midwater barracouta target, and area 602 (Auckland Islands, in BAR 6), where bottom and midwater squid target takes place. Target species of secondary importance are jack mackerel, mainly in area 028 from 1998–2006, and blue warehou, mainly in 025 and 027 since 2003. Main months of fishing by key target species are: barracouta October–April; squid January–May; and jack mackerel December-April (Figure C84d). The proportion of barracouta catch targeted is highest (over 50%) in areas 025, 027 and 029, but under 25% in the main area, 028, except from 2004–2007. Proportion targeted is consistently highest in October-December, but also higher from February-April from 2003–2007 (Figure C85). Tows reporting the lowest proportion of zero tows with barracouta catch are barracouta (mostly less than 30%) and jack mackerel and blue warehou (less than 40% from 1999) (Figure C86).

Catch rates of barracouta are highest for barracouta target, averaging about 5 t/tow up until the last four years when rates averaging about 12 t/tow has been reported (Figure C87). Catch rates from jack mackerel and blue warehou target have also increased during the series, averaging about 6 t/tow since 2003, and 3 t/tow since 2001, respectively. Catch rates of barracouta from squid target are more even and have averaged about 0.8 t/tow. Tow duration for squid, barracouta, blue and silver warehou, and ling has increased over time, from mainly 3–5 hours to up to 7 hours (Figure 88), which will impact on catch rates per tow. Tow depth of barracouta target (100–200 m) is similar to other important species (blue warehou and jack mackerel), but slightly less than for squid (about 200 m) and substantially less than hoki, ling, and silver warehou (Figure C89a). Tow depth during midwater trawling (Figure 89b) is similar for barracouta, squid, jack mackerel and blue warehou (100–200 m). Fishing effort variables for bottom trawls are also similar for these species (width 35–45 m, height 3.5–5 m, speed 4–5 knots, distance towed 15–30 km, vessels 300–1600 t, 55–80 m) (Figure C90). Fishing effort variables for midwater trawls are also similar for the barracouta, squid, and jack mackerel target (width 70–120 m, height 20–50 m, speed 4–5 knots, distance towed 15–30 km, vessels 2000–4500 t, 80–110 m); blue warehou nets tend to be narrower and towed from smaller vessels (Figure C91).

The location of highest barracouta catch within the SNAR area from 2003, as recorded on TCEPR forms, is consistently to the east of Stewart Island and south of the Snares Islands, with the area to the north of the Snares important in some years (Figure C92a). Inshore effort from TCER forms from 2008 also shows the importance of the shallow eastern Stewart Island area (Figure C92b). Catches at the Auckland Islands are sporadic and relatively minor, but occur mainly to the north. The combined distribution of tows for the major target species encountering barracouta within the ECSI region shows the overlap between the four main target species, although squid occur more extensively at the Auckland Islands (Figure C93). Hoki and ling are not as shallow and extend deeper and further south, whereas stargazer target is restricted to shallower water to the east and west of Stewart Island.

7.3 Summary

A summary of the characterisations by fishery area is given in Table 7.

Most of the main barracouta fisheries take place during the spawning season which is during July–October in ECNI, WCSI, and WCNI, and slightly later in October–December (CHAT EAST, SNAR) or during the peak feeding period during October–June (ECSI, CHAT WEST, CHAT EAST, SNAR/SUBA, WCNI). Fishing effort is often localised within each area (e.g., SNAR. ECSI) but can be quite widespread, especially if other target species are important (e.g., WCNI, WCSI). Bottom trawling is the main method used in all fisheries except WCNI, where midwater trawl is the main method. Midwater trawls are also important in CHAT EAST, SNAR/SUBA and WCSI, often in relation to target species such as squid and jack mackerel. In all areas except ECNI, most catch is recorded on TCEPR forms, ranging from about 60% of the catch (ECSI) to over 90% (CHAT WEST and EAST, SNAR). Most catch from ECNI is recorded on CELR forms.

In the main barracouta fisheries (ECSI, SNAR + SUBA, WCSI, WCNI) the proportion of barracouta targeted ranges from 29–58%. CHAT WEST and CHAT EAST have the highest proportion targeted (77 and 88%) but the lowest catches. In SNAR + SUBA (32% target), most catch is taken from the arrow squid target fishery around the Snares Is., where the proportion of zero tows is 50–80%. Most catch around Stewart Island is targeted. On ECNI (26% target), most barracouta is taken from tarakihi target, although higher proportions of barracouta are caught in months of spawning. On WCNI (29% target), most barracouta is taken from jack mackerel target, although higher proportions of barracouta are also caught in months of spawning and off Manukau and North Cape. Other main target species to catch barracouta are red cod (ECSI), arrow squid (SNAR/SUBA) and jack mackerel (WCSI). Target species of secondary importance include gemfish and snapper (ECNI), blue warehou (ECNI, SNAR), jack mackerel (ECSI, SNAR) and hoki (CHAT WEST, WCSI).

The degree of overlap between barracouta target and other species target fishing relates mainly to depth, with species such as hoki, ling, and silver warehou often being deeper, and red gurnard, flatfish, trevally, and elephantfish usually shallower. Species with the most consistent overlap with barracouta between fishery areas are arrow squid, blue warehou, jack mackerel, red cod, and tarakihi. Some of these either extend further south than barracouta (e.g., arrow squid at the Auckland Is.) or are more restricted to the southern part of an area (e.g., blue warehou on ECNI, WCNI and WCSI, red cod on WCNI). Others extend further north (e.g., snapper on ECNI) or are more restricted to the northern part of an area compared to barracouta (e.g., jack mackerel WCSI).

Catches appear to have declined from around 1999–2001 in areas east of the mainland (ECNI and ECSI) and catch rates have been relatively flat for most of the series. Catches also appeared low from other mainland areas (SNAR, WCSI, and WCNI) during 1999–2001, but have shown increases at some stage in the last 4 years.

The effort variables (not summarised in Table 7) for the fisheries vary in relation to how much catch is taken by the relatively small inshore vessels. These take higher proportions of the catch on the ECNI, where vessels are usually under 300 t and 30 m length. They are also important on ECSI and WCNI (under 40 m length). Vessels fishing in all other areas include a greater proportion of larger, more offshore vessels, up to 1000–2500 t and 60–90 m. In these areas, tow durations are often longer (up to 10 hours in more recent years), and gear parameters and towing speeds often greater.

On the basis of this characterisation the ECSI, WCSI, and SNAR (including a combined SUBA option) were chosen as the main fishery areas for development of standardised CPUE indices. A summary of areas, months and target species included is given in Table 8.

Table 7: Summary of features of the main barracouta fisheries. BT, bottom trawl, MW; midwater trawl. Area definitions for CPUE analyses are given in Figure 2; species codes in Table C16; target BAR as a percentage of total catch in Table C13; years are fishing years.

	ECNI	ECSI	CHAT WEST	CHAT EAST	SNAR + SUBA	WCSI	WCNI
FMA	1	3	4 (West)	4 (East)	5 (in part), 6	7	8, 9
General characteristics							
Season	July–Oct	Oct–Jun	Apr–Jun	May–Jun, Dec–Jan	Oct–Apr	July–Sep	Oct–Jan, Jul–Aug
Kay statistical areas	013, 014	022	407	049, 050	028	034, 035	037, 040, 041
Key area description	S. of East Cape	Canterbury Bight	E. Veryan, Mernoo	N.E. Chatham Is.	Snares, E. Stewart I.	C. Farewell to Haast	Tasman Bay to N. Taranaki
Secondary statistical areas	009	020,024			025, 027, 029, 602	033, 036	038 (on CELR)
Trawl type	BT	BT	BT	MW, BT	BT, MW	BT, MW	MW, BT
Form type (~ % catch)	CELR (60%)	TCEPR (60%)	TCEPR (99%)	TCEPR (95%)	TCEPR (99%)	TCEPR (80%)	TCEPR (80%)
Target species							
Key target species	TAR, BAR	BAR, RCO	BAR	BAR	BAR, SQU	BAR, JMA	JMA, BAR
Secondary target species	SKI, SNA, WAR	SQU, JMA			JMA, WAR	HOK, TAR	
Target BAR as a % of total 1990–2008 catch	26% (4–55% main months)	46% (28–68% by year)	77% (0–99% by year)	88% (48–98% by year)	32% (14–57% by year)	58% (35–84% by year)	29% (42–52% by year)
Main trend in target BAR catch	Less from 2000	Less from 2001	Less from 1999	Sporadic	Low 1994–97	Low 1999–2001	Low 1999–2001
Main trend in target BAR catch rates	High 1992, 1994 then relatively flat	Flat, large increase in 2008	Increasing to 1998, then sporadic	Higher from 1999	Relatively flat to 2004, then higher to 2008	Average to 1998, low to 2003, then higher since 2004	Low 1999–2003, higher from 2004
Proportion of zero tows with BAR catch and trend for key species target	BAR most <30%, variable; TAR variable to 1996 then ~60–70%	BAR most <20%, flat; RCO 20–50% incr. since 2000	BAR, most <20% to 2000, highly variable since 2005	BAR, most <20% to 2000, highly variable since 2005	BAR; most <30% lower from 1998; SQU 50–80%; JMA & WAR <40% from 1999	BAR; <20%, variable; JMA & TAR 20–70%, variable	BAR most <20%, max. 2000–2004; JMA most <40%, variable
Overlapping distribution of other species target with BAR target	TAR, SKI,	RCO, SQU	SQU, RCO, JMA	JMA, SQU, SWA, SPD, RCO	JMA, WAR	TAR, RCO	BAR, JMA, TAR
Distribution of other main target species	SNA (nth), WAR (sth)				SQU (sth)	JMA (nth), STA, WAR (sth)	WAR, RCO (sth)

Table 8: Summary of CPUE analyses for major fisheries (see Table D1 for details, Table C16 for species codes). Analyses using all major species were carried out on merged (trip-level) and un-merged (tow-level) data. Separate analyses were carried out individually for species as listed.

Area	Statistical areas used	Major target species	Months
ECSI	018, 019, 020, 021, 022, 023, 024, 026, 301, 302, 303	Major species: BAR, RCO, SQU, JMA	Oct–Sep, Dec–Jun
		Merged BAR, RCO, SQU, JMA	Oct–Sep
		Unmerged: No target species	Oct–Sep
WCSI	033, 034, 035, 036	Major species: BAR, JMA, HOK, TAR, RCO, WAR	Oct–Sep, Jun–Oct, Nov–May
		Merged: BAR, JMA, HOK, TAR	Jun–Oct, Nov–May (BAR only)
		Unmerged: BAR, JMA, HOK	Jun–Oct
		Unmerged: No target species	Jun–Oct
SNAR	025,027, 028, 029,030, 504	Major species: BAR, SQU, HOK, JMA, SWA, LIN , WAR, HAK	Oct–Sep, Oct–May, Oct–Dec
		Unmerged: BAR, SQU	Oct–May
		Unmerged: No target species	Oct–May
SUBA	602	Major species: BAR, SQU, HOK, JMA, SWA, LIN , WAR, HAK	Oct–May

8 CPUE ANALYSES

All tables and figures relating to CPUE analyses of the main barracouta fisheries are contained in Appendix D (Tables D1–4, Figures D1–11). Species codes are in Table C16.

The recent standardised CPUE analyses for silver warehou (Parker & Fu 2011) and arrow squid (Hurst et al., in press) considered only TCEPR (tow by tow) data because there was relatively little CELR data. 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). For the three main barracouta fisheries (as defined in Table 8), most catch was recorded on TCEPR forms, but CELR data were important in ECSI and WCSI (Table 7). For this reason, analyses using both merged and unmerged datasets were carried out for all areas except SUBA.

For each area, each CPUE dataset was further defined to encompass a mixed-species fishery which included both barracouta and other major target species in statistical areas and seasons that recorded the majority of the barracouta catch. To examine the effect of various target species on CPUE, barracouta as a bycatch of major target species was modelled for the target species individually, for major target species combined, and by assuming that there was no target species. This will allow for situations where the recorded target species may have been the main species caught (whether it was targeted or not) which could result in a CPUE series that might not be a fair representation of the trend in the underlying fish stock. A total of 37 models were developed for the three main fishery areas: 9 for ECSI, 15 for WCSI, and 12 for SNAR (including 2 models incorporating SUBA) (Table D1).

The main fishing method for barracouta was trawl, with both bottom and midwater trawl important in WCSI, SNAR, and SUBA. Therefore all trawl data were included, with the exception of twin trawls that cause problems because the key unit of effort (doorspread) is not appropriately quantified on TCEPR forms and, although most twin trawls have now been identified (Hurst 2009), tows since mid-

2007 have not. Therefore twin trawl vessels were excluded from core vessel datasets where necessary (WCSI models 5 and 10).

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 (2000). A forward stepwise multiple-regression fitting algorithm (Chambers & Hastie 1991) implemented in the R statistical programming language (R Development Core Team 2008) 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.

For trip level data, the variables offered to the model were *fish_year, vessel_key, start_stats_area_code, target_species, month, method, and fishing_duration* (as a 3rd order polynomial). For tow level data, variables offered were *fish_year, vessel_key, start_time, start_latitude, start_longitude target_species, month, method, fishing_duration, fishing distance* (as recorded), *distance2* (calculated from duration x speed) *effort depth, effort width, and effort height* (as a 3rd order polynomial). 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).

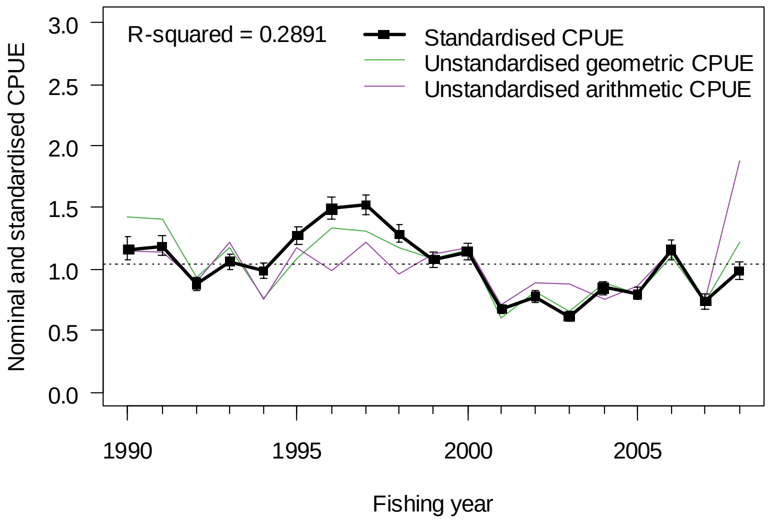
Vessel effects were incorporated into the CPUE standardisations to allow for possible differences in fishing power between vessels. A set of core vessels was defined based on vessels that had at least four consecutive years in the fishery and collectively reported about 90% of the catch. In some cases, such as when limiting the dataset to a particular target species, the number of vessels was limited.

The dependent variable was the log-transformed landed catch per effort stratum for trip level resolution analyses and the log-transformed estimated catch per tow for tow resolution analyses. Only the positive catches were retained, with zeros excluded. A zero refers to an effort stratum without any allocated landings for the merged dataset, or a tow without any estimated catch for the unmerged data. For one tow level model in each area, the percentage of tows with zero barracouta catch was examined for time trends and the effect of excluding those tows was examined by fitting a logistic model to the number of zeros and combining that time series with the log-normal time series following Vignaux (1994). 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 East Coast South Island

The two main models explored for ECSI and described in detail are Model 1a (trip level, major species target, October–September) and Model 2a (tow level, major species target, October–September). The number of records, proportion of zeros, catch, effort and unstandardised CPUE for all 9 models are listed in Table D2. Standardised model results are shown in Tables D3, D4 and Figures D1–D3.

Model 1a (trip level, major species target, October–September) represents 82% of the ECSI catch data (from Tables C7 and D2). There are many vessels with small intermittent catches throughout the fishery history but a good number of consistently higher catching vessels that have been in the fishery for most of the period from 1990–2008 (Figure D1a), resulting in about 20% of the vessels taking 90% of the catch (Figure D1b). The standardised CPUE index follows the geometric mean relatively closely, peaking in 1996, 1997, declining to a low from 2001–2005, and possibly recovering in the last three years (Figure 5, D1c). The R^2 for model 1 was 29% (Table D3), but the large sample sizes for the ECSI result in small confidence intervals for the index. Model 1a uses three explanatory variables available; *vessel_key*, *target_species*, and *month*, with highest catch rates for target species BAR and months Nov–June (Figure D1d). It tends to overestimate low CPUE values (and high values but to a lesser extent) and the standardised residuals were unbalanced (Figure D1e). The index for Model 1b (trip level, major species, December–June) is similar, the R^2 is 28%, and the same explanatory variables, except that *month* was replaced by *stat_area*. (Table D3, 4, Figure D3a).



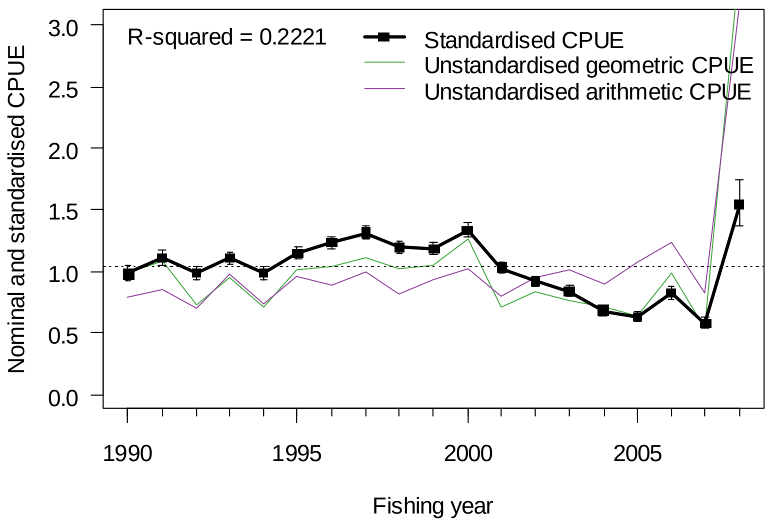


Figure 5: ECSI CPUE Model 1a, trip level (above), and Model 2a, tow level (below), for major species target, October–September.

Model 2a (tow level, major species target, October–September) represents 56% of the ECSI catch data (from Tables C7 and D2). It has fewer but similar key vessels. The CPUE index follows the same general pattern as for Model 1a, but is slightly flatter and the "high" period extended from 1996–2000, followed by a "low" period which only shows signs of recovery in 2008 (Figure D2a–c). The R^2 for model 2a is 22% and explanatory variables selected were *target_species*, *vessel_key*, *effort-depth*, and *time-start*, with highest catch rates for target species BAR, in less than 200 m depth, and between 0500 and 1500 hours (Table D3, Figure D2d). The model fits better than Model 1a at the lower end of the range but still overestimates high CPUE values (Figure D2e). Model 2b is the same as for Model 2a but with no species target. Explanatory variables are the same and the overall trends in the index are similar to Model 1a except that fluctuations are greater; 0.52–1.61 compared with 0.59–1.35 (Table D3, D4).

Model 3 is the logistic model version of Model 2a (tow level, major species target, October–September) that combines the zero (binomial) and lognormal time series (Figure D3c). Trends in the combined model and Model 2a are similar (Table D4). The R^2 was 24%.

For Models 4 to 7 indices (all at trip level), the explanatory variables *vessel* and *month* are included in all analyses, with *stat_area* and *duration* coming into Models 5 and 6 (Table D3). R^2 values range from 15% for the BAR target Model 4 to 53% for the JMA target model. Indices for these models are compared in Figure D3d. The trip level models for major target species, BAR target and RCO target are most similar. The SQU target model is most different at the start of the series and the JMA series is quite different to all other results. The similarity of the major species, BAR and RCO target is to be expected as they are the major target species and have the most similarity in distribution of target effort (Table 7).

Of the nine models for ECSI, most are similar, except for the SQU and JMA target Models (5, 6). They suggest a relatively flattish trend (i.e., values between 0.5 and 1.5) with the highest catch rates between 1995 and 2000 and lower catch rates from 2001 to 2005.

For the ECSI fishery, the models that may have the most potential for monitoring the fishery are the trip and tow level October–September major species target lognormal models. Model 1a incorporates a high proportion of the ECSI (82%) and BAR 1 (69%) catch; Model 2a includes higher resolution data but represents less of the ECSI (56%) and BAR 1 (47%) catch (from Tables C7 and D2). The R^2 values were relatively low (29% and 22%, respectively), as for most of the ECSI models. Trip level October–September major species or BAR target may also be appropriate but will represent only about half of the catch in Models 1a and 2a (from Table C9d). All the models show a general high period for at least four years during 1995–2000, and a lower period from 2001–2003, and a recovery in 2008.

8.2 West Coast South Island

The two main models explored for WCSI and described in detail are Model 1b (trip level, major species target, June–October) and Model 2b (tow level, major species target, June–October). The number of records, proportion of zeros, catch, effort and unstandardised CPUE for the 15 models are listed in Table D2. Standardised model results are shown in Tables D3, D4 and Figures D4–D7.

Model 1b (trip level, major species target, June–October) represents 69% of the WCSI catch data (from Tables C7 and D2). There are a reasonable number of consistently higher catching vessels that have been in the fishery for most of the period from 1990–2008 (Figure D4a), resulting in about 20% of the vessels taking 90% of the catch (Figure D4b). For the spawning season Model 1b (trip level, major species, June–October), the standardised CPUE index is highest in the early 1990s, declines to low values from 1998–2000, and has been average since then except for a low year in 2006 (Figure 6, D4c). The R^2 for Model 1b is 50% (Table D3). Model 1b uses *target_species*, *vessel_key*, and *month* as explanatory variables, and estimates highest catch rates for BAR target and August–September (Table D3, Figure D4d). It tends to overestimate low CPUE values and the standardised residuals were unbalanced (Figure D4e).

Model 2b (tow level, major species target, June–October) represents 54% of the WCSI catch data (from Tables C7 and D2). The spread of higher catching vessels through time is less than for Model 1b, but still with acceptable overlap during the period (Figure D5a). The CPUE index follows the same general pattern as for Model 1a, but was low in the early 1990s (Figure 6, D5c). The R^2 for Model 2b is 31% and explanatory variables selected are *target_species, vessel_key, month, time-start,* *effort-depth*, *latitude* and *distance2* (Table D3, Figure D5d). Catch rates are highest in August–September, depths under 200 m, start time of 0500–1500 hours, and BAR and TAR target (although with significantly more variability for TAR). As for Model 1b, it tends to overestimate low CPUE values and the standardised residuals were unbalanced (Figure D5e).

The non-spawning season Model 1c (trip level, major species, Nov–May) is different to the spawning season Model 1b; there are fewer vessels and the index shows a large peak in 1995, then declines steadily to 2000 and remains low (Figure D6a,c). *Vessel_key* and *month* are the only explanatory variables used by the model and the R^2 is 21% (Table D3). Catch rates are highest in Nov–December. As for Model 1b, it tends to overestimate low CPUE values and the standardised residuals are unbalanced (Figure D6e).

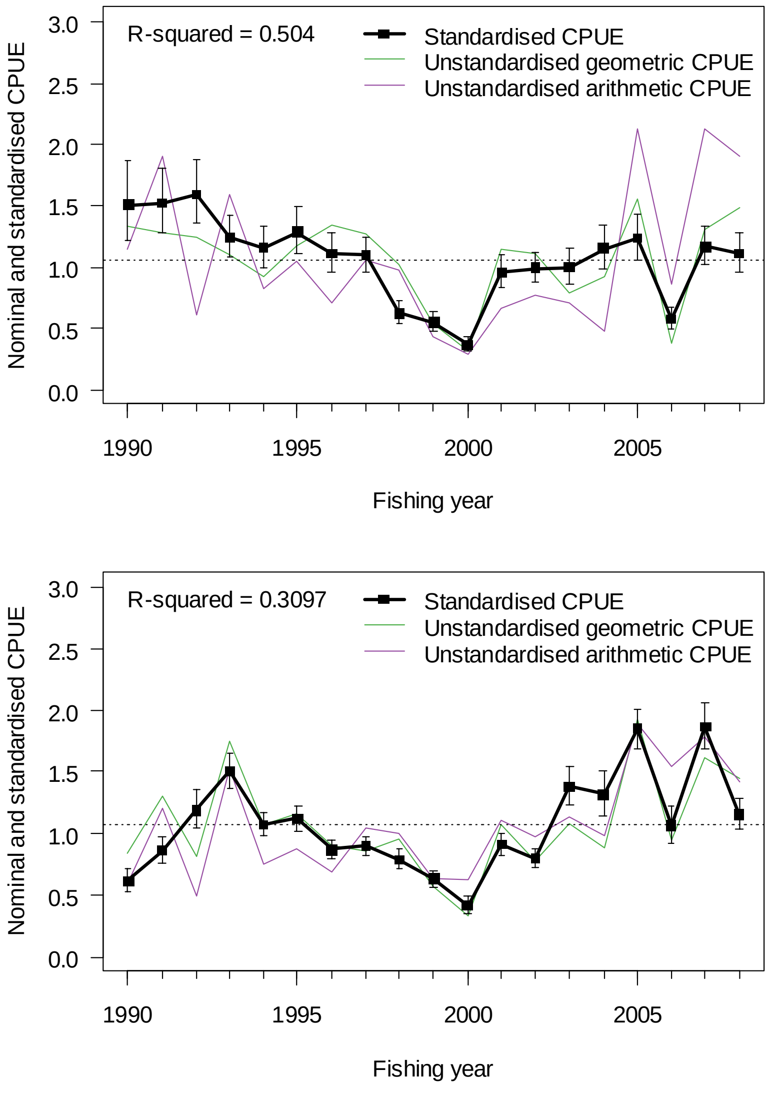


Figure 6: WCSI CPUE Model 1b, trip level (above), and Model 2b, tow level (below), for major species target, June–October.

Trends in all models are illustrated in Figure D7 (Table D4). Models 1a and 1b are most similar, as are Models 2a and 2b. They all show a decline up to 2000 and a subsequent increase. The main differences are some lower indices at the start and a few higher indices at the end of the tow level models. Model 1c (trip level, major species, Nov–May) is different, with low values similar to tow level indices at the start, a high peak in 1995 and higher values through to 1998 not seen in the other models, then lower values at the end.

In individual target species trip level models for the spawning season (Models 3 to 6), the explanatory variable *vessel* is included in all models and *month* in all but one. *Stat_area* only came into the HOK target model (Table D3). R^2 values range from 28% for JMA target to 46% for BAR target. The BAR target model is most similar to the major species target model, showing a general decline to 2000 and then an increase (Figure D7). TAR target shows the recent increase but, prior to 2000, indices are more variable. JMA target shows a large increase after 2000 and HOK target is much higher prior to 2000. Trip level models for all target species (Model 1c) and BAR target (Model 7) for the non-spawning period (November–May) also show similar trends to each other, but a substantially different trend to the spawning season models, peaking in 1995 and declining to average or less than average since 1998.

Indices from individual target species or no target species (i.e., assumes that target species may be mis-specified) tow level models (Models 8–11) used key explanatory variables *vessel*, *depth*, *time-start*, and *month*. R^2 values ranged from 26% for no target to 37% for HOK target. The no species target (Model 11) is most similar to the major species target model; BAR target is also similar except for 1992 being lower and 2006 higher; and JMA target is higher in 1992 and 1993 (Figure D7). In contrast, the hoki target model indices are much higher in 1992; continue to be higher from 1994–2000, and decline at the end of the series rather than increase.

Model 12 is the logistic model version of Model 2b (tow level, major species target, June–October) that combines the zero (binomial) and lognormal time series (Figure D7). The general trend in the combined model is similar to that from Model 2b, but the earlier values are lower and the later values substantially higher. The R^2 was 54%. The uncertainty of what zero values represent in these datasets (i.e., zeros in the estimated catch are not necessarily true zeros) and the relatively large divergence from the lognormal, suggest this model should be treated with caution.

The 12 models described above use subsets of data from different seasons, target species, and data types (i.e., merged includes inshore and offshore vessel data whereas tow-level excludes CELR data). Most catch is taken during the spawning period (July–October) and trip and tow level CPUE series for major species target and BAR target all show about a three-fold decline from 1993 to 2000 and then a recovery to at least the 1993 level by 2005. However, there are major differences in the start and end points of these series; trip level series finish at about the same level, tow level series substantially higher, up to about three times in the combined model (Model 12). The major species and BAR target non-spawning season (November–May) indices are based on low catch and decline to less than average levels in recent years not seen in most other models. It is possible that these November–May models may be indexing different populations of fish if spawning migration into the area has occurred in July–October

For the WCSI fishery, the models that may have the most potential for monitoring the fishery are the trip and tow level June–October major species target models. Model 1b incorporates a high proportion of the WCSI (69%) but a lower proportion of BAR 7 (31%) catch; Model 2b includes higher resolution data but represents less of the WCSI (54%) and BAR 1 (24%) catch (from Tables C7 and D2). R^2 values were 50 and 31%, respectively. Trip and tow level trajectories are quite different, particularly at the start, but both show a general decline to 2000, followed by a recovery to higher levels in recent years.

8.3 Snares shelf / Auckland Islands

The two main models explored for SNAR and described in detail are Model 1b (trip level, major species target, October–May) and Model 2b (tow level, major species target, October–May). The number of records, proportion of zeros, catch, effort and unstandardised CPUE for the 12 models are listed in Table D2. Standardised model results are shown in Tables D3, D4 and Figures D8–D10.

Model 1b (trip level, major species target, October–May) represents 74% of the SNAR+SUBA catch data (from Tables C7 and D2). There are a reasonable number of vessels that have been in the fishery for most of the period from 1990–2008, although some of the higher catching vessels have only been present from the late 1990s (Figure D8a). About 35% of the vessels take 90% of the catch (Figure D8b). For Model 1b (trip level, major species, October–May), the standardised CPUE index is high in the early 1990s, declines to low values from 1995–1997, recovers by 2000, then declines gradually, reaching a low in 2007 and back up to a high in 2008 (Figure 7, D8c). The R^2 for model 1b is 36% and explanatory variables selected are *target_species*, and *vessel_key*, *stat_area*, and *month*, with highest catch rates for BAR and WAR and November (Table D3, Figure D8d). It tends to overestimate low CPUE values and the standardised residuals are unbalanced (Figure D8e).

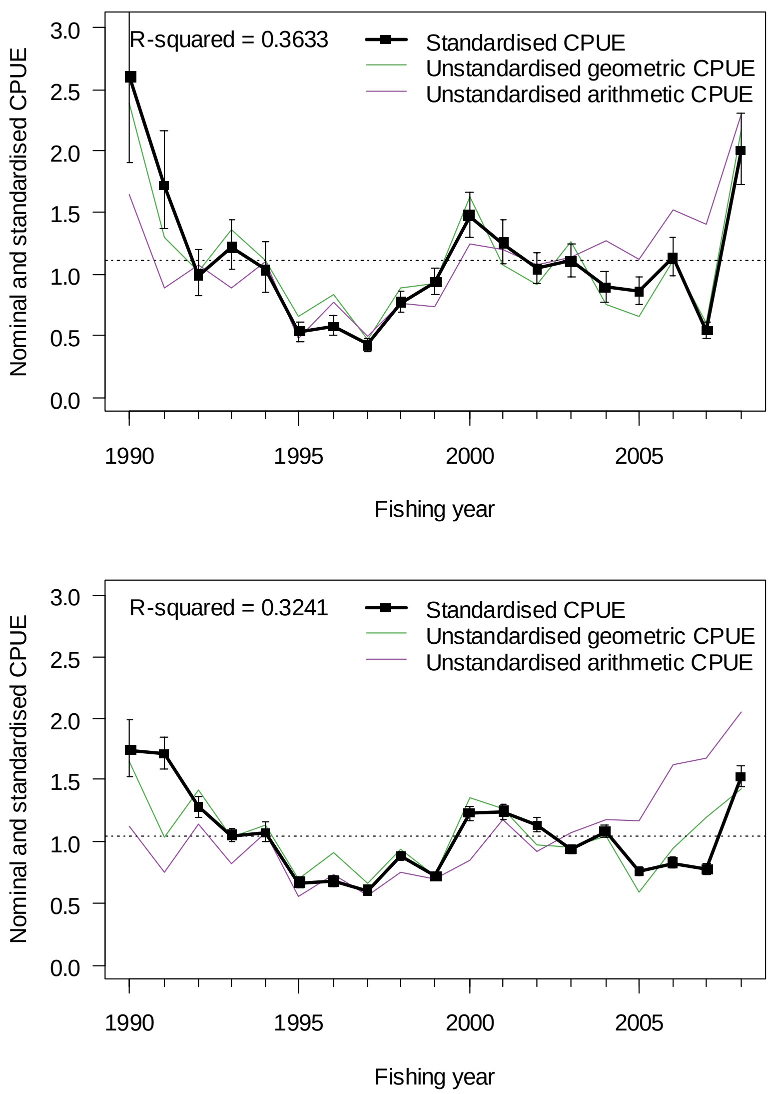


Figure 7: SNAR CPUE Model 1b, trip level (above), and Model 2b, tow level (below), for major species target, October–May.

The Model 2b (tow level, major species target, October–May) represents a similar proportion of the SNAR+SUBA catch to Model 1b (71%) (from Tables C7 and D2). The CPUE index follows the same pattern as for Model 1b (Figure D9c), but the scale of the fluctuations is less extreme, ranging from 0.62–1.76 compared to 0.42–2.59 for Model 1b (Figure 7, D9c). The R^2 for Model 2b is 32%, explanatory variables selected are *target_species*, *vessel_key*, and *month*, and catch rates are highest for BAR and WAR target and in November (Table D3, Figure D9d). As for Model 1b, it tends to overestimate low CPUE values and the standardised residuals are unbalanced (Figure D9e).

Models 1–8 for SNAR CPUE are compared in Figure D10 (Table D4). Choice of season (October–May, October–December, or October–September) makes little difference to trip level major species target models (i.e., Models 1a,b), and inclusion of CELR and TCER data (Model 1c) only makes a slight difference; increasing the indices at the start and reducing them at the end of the series (Figure D10, Table D4). The main three explanatory variables are *target_species*, *month*, and *vessel_key* and the R^2 values range from 27–47% (Table D3).

Tow level major species target models are also similar for October–September and October–May seasons (Models 2a, b) but the October–December only model (Model 2c) resulted in a much more variable index, probably because it represents the spawning season only (Figure D10, Table D4). R^2 values are 32–41% (Table D3). Trip and tow level models for October–May (Models 1b, c, 2b) are all basically similar except for the higher start and end points when all form types are included.

Of the various target species options, SQU target gave the most similar results to major species target; as did no species target, except for the first year which is higher (Figure D10, Tables D3, D4). BAR target diverges quite substantially at the start and end of the series. R^2 values are similar to Model 2b (27, 31%). A model that includes the Auckland Is. (Model 6) gives similar results to Model 2b, but the Auckland Is. only index (Model 7) is different and very variable. R^2 values for these major target species models are 30% and 47%, respectively (Table D3).

Model 8 is the logistic model version of Model 2b (tow level, major species target, October–May) that combines the zero (binomial) and lognormal time series (Figure D10). The general trend in the combined model is similar to that from Model 2b from 2001; prior to this most indices are lower (1992–1998) and the first two years are substantially higher. The R^2 was 23% (Table D3). The uncertainty of what zero values represent in these datasets (i.e., zeros in the estimated catch are not necessarily true zeros) and the relatively large divergence from the lognormal, suggest this model should be treated with caution.

For the SNAR fishery, the model that may have the most potential for monitoring the fishery is the tow level October–May major species target model. This is chosen because it uses higher resolution data, represents 71% of the BAR 5+6 catch (from Tables C7, D2). The R^2 value was the lowest of the October–May options but they were all relatively low (range 22–36%). All October–May major species target models show a general decline to 1997, followed by a recovery, sometimes reaching a modest peak in 2000, a subsequent lesser decline, and an increase in the last year. Most of these models are influenced strongly by SQU target data for which the zero barracouta catch by tow ranges from 50–80% (Figure C86, Table 7). The high proportion of midwater tows may be a problem (barracouta are mostly on the bottom during the day). Gear type does not enter into the model but may be aliased by vessel. It is therefore not clear how suitable a SQU target model might be to model abundance. The tow level October–May BAR target model has a different trajectory, starting lower and ending considerably higher and may be more indicative of barracouta abundance. However, it would also represent only 23% of the BAR 5+6 catch (from Table C15d).

8.4 Area comparisons

Results for major species trip, tow level and BAR target CPUE models (all lognormal) are plotted for each of the three main fishery areas, ECSI, WCSI, and SNAR, in Figure 8. These three model types are shown for completeness, even though only some of them are suggested as potentially more useful for monitoring in Section 8.3 above. Note that there is a lot of similarity between model types within areas (as discussed above), the main differences being trip level WCSI June–October which does not show the increases from 2003 present in the other WCSI June–October models, and tow level SNAR BAR target which is lower at the start and higher at the end relative to the other models.

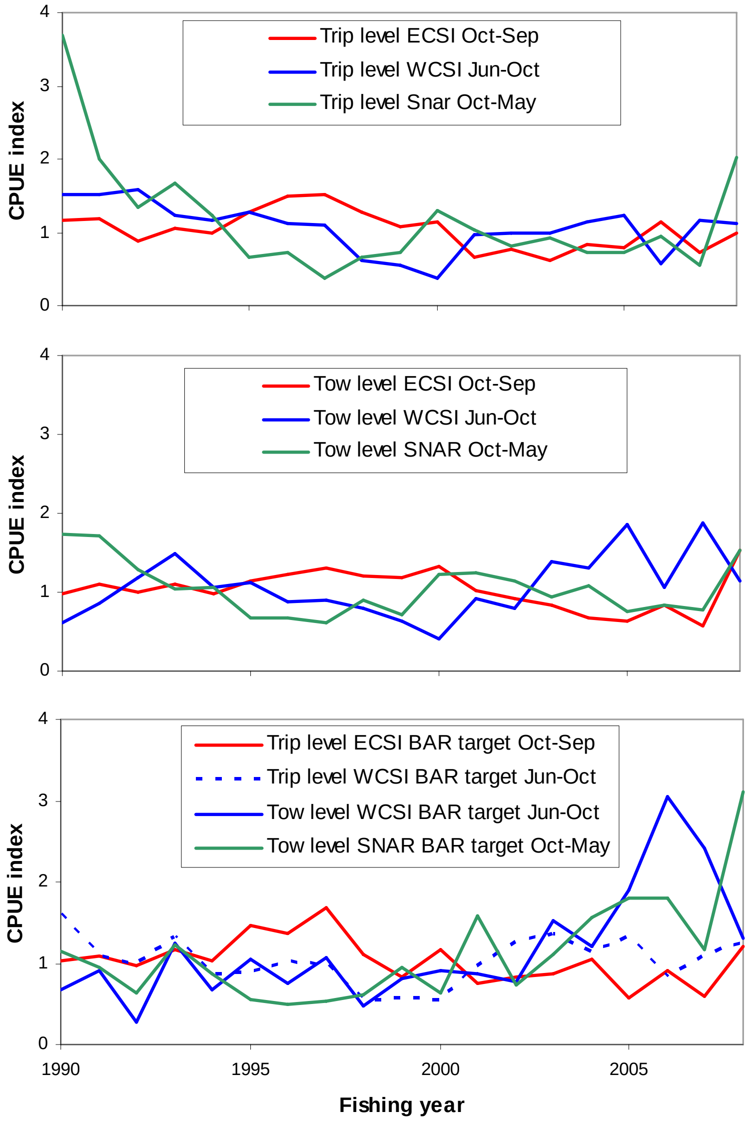


Figure 8: Comparison of trip level major species target (top), tow level major species target (mid), and barracouta (BAR) target (bottom) CPUE indices for the three main fishery areas, ECSI, WCSI and SNAR.

By area, ECSI and WCSI indices appear to show somewhat opposite trends (in both trip and tow level major species target models). ECSI indices are average in the early 1990s, highest between 1995–2000, and subsequently decline to at least 2005; WCSI indices are average or low during the early 1990s, lowest from 1998–2000 and subsequently increase to average or high values from 2003, reaching a peak in tow level major species and BAR target models between 2005–2007.

SNAR indices appear to be a mixture of both ECSI and WCSI trends. They are similar to ECSI models in that the trip and tow level major species target models show a flat or slightly declining trend from 2000. However, SNAR indices differ from ECSI in that they are less than average immediately prior to this (1995–1999) and the two highest years are at the start, in 1990 and 1991. The main similarity of SNAR to WCSI is for the tow level BAR target models (Figure 8, bottom graph) that both show average to low indices up to 2000 and a subsequent increase to the highest levels in the series somewhere between 2006 and 2008. The lack of consistency between the various models for WCSI and SNAR makes interpretation difficult. The potential for variable annual movement of fish between the areas, during the summer/autumn feeding time for ECSI and SNAR, and/or during late winter/spring spawning time for SNAR and WCSI could also explain variable trends in the SNAR indices.

The use of differing trends in CPUE to help determine stock structure for the three main fisheries is discussed in Section 3.3 above.

8.5 CPUE and trawl survey indices

Results for major species trip and tow level lognormal CPUE models are plotted alongside trawl survey indices, for the three main fishery areas, in Figure 9.

The ECSI CPUE indices are average in the early 1990s, highest between 1995–2000, subsequently decline to at least 2005, and show an increase in the last 1–3 years. The two trawl survey series up to 2000 are not inconsistent with this (assuming the surveys are generally comparable with each other). However, the highest trawl survey indices for the series occur from 2007–2009; CPUE was at or near its lowest in 2007 in most models, but the tow-level model does increase up to a maximum in 2008. Note that both the winter (May–June) and summer (December–January) surveys take place at either end of peak fishing season (January–May, Figure C17a) and may encounter variable amounts of spawning fish leaving or returning to the area each year. It is therefore not possible to determine which series might provide the better index of abundance.

The WCSI indices are average or low during the early 1990s, lowest from 1998–2000 and subsequently increase to average or high values from 2003, reaching a peak in the tow level major species target model in 2005 and 2007. The two trawl survey series plotted (WCSI only and the WCSI plus Tasman and Golden Bays, March–April) are consistent with the three CPUE series plotted in tracking a decline from 1995 to 2000. They diverge from the trip level June–October model in being lower than average at the start (compared to higher than average), and from the tow level June–October model in having their highest points in 1994 or 1995 (when CPUE was average) and less than average values in 2005 and 2007, when CPUE was at its highest. The CPUE series that appear to match the trawl survey series the best are the trip level major species target and BAR target (not plotted in Figure 9) November–May. These cover the period when the survey takes place. This may give some support to the suggestion that the stock composition during the spawning season may be different to the non-spawning season, with barracouta from other areas possibly moving into the WCSI to spawn in winter. However, these November–May indices are based on a very small amount of catch. Therefore, it appears that June–October CPUE might provide the most appropriate method to monitor catches on the WCSI, irrespective of stock structure issues. If the timing of the fishery were to change to the non-spawning season then a different index would be required and the WCSI trawl survey may then provide a useful monitoring method.

The SNAR survey series was not inconsistent with CPUE indices over the short four year time period from 1993–96, but only covered a small fraction of the range in variability of the two CPUE series plotted (note that CPUE series are averaged to one over the 1993–96 period so appear exaggerated compared to other plots of the same series).

In summary, for the ECSI and WCSI, there are similarities and inconsistencies between CPUE and trawl survey indices that present unresolved questions about the suitability of either method for stock monitoring. If CPUE indices are to be used, those at tow level for major species target, and BAR target for ECSI and WCSI, are suggested as having the most potential. These series will represent a much higher proportion of the catch into the future as more vessels fill out the recently introduced TCER forms. If trawl survey series are to be used, the WCSI series may only be relevant to the non-spawning part of the fishery, and the ECSI series may be best used as an index of pre-recruits.

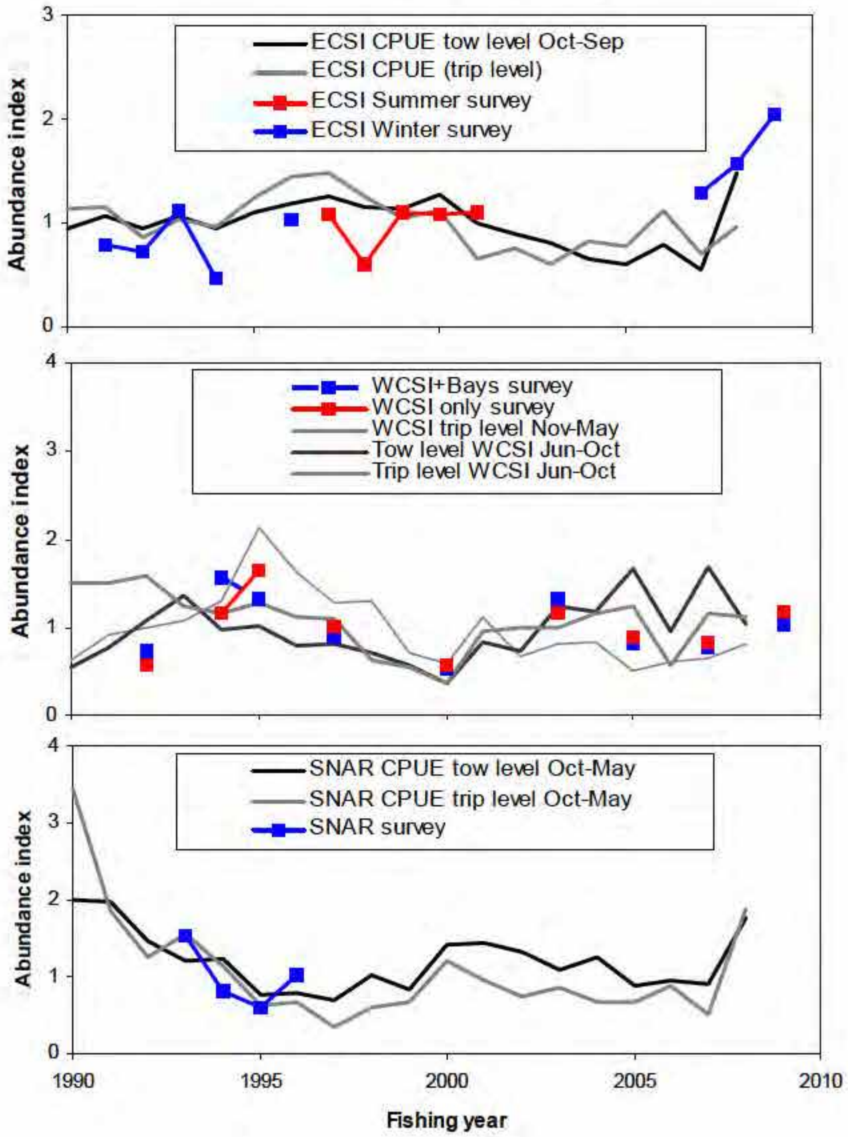


Figure 9: Comparison of selected CPUE indices and trawl survey indices (averaged to 1 for the overlapping period), for the three main fisheries, ECSI, WCSI and SNAR.

8.6 CPUE and inferred YCS

In Section 3.3, possible YCS were inferred for the three main fishery areas based on length frequency data collected from observed commercial catches and trawl surveys. In the absence of a stock assessment model, trends in these YCS are again examined here to determine whether increases or decreases in CPUE or trawl survey indices can be explained by periods of high or low recruitment, assuming that fish will be fully recruited to the fisheries at about age 4 (Figure 10). The main difficulty in attempting this outside of a model is that the impact of fishing levels will be important and cannot easily be factored in using this approach.

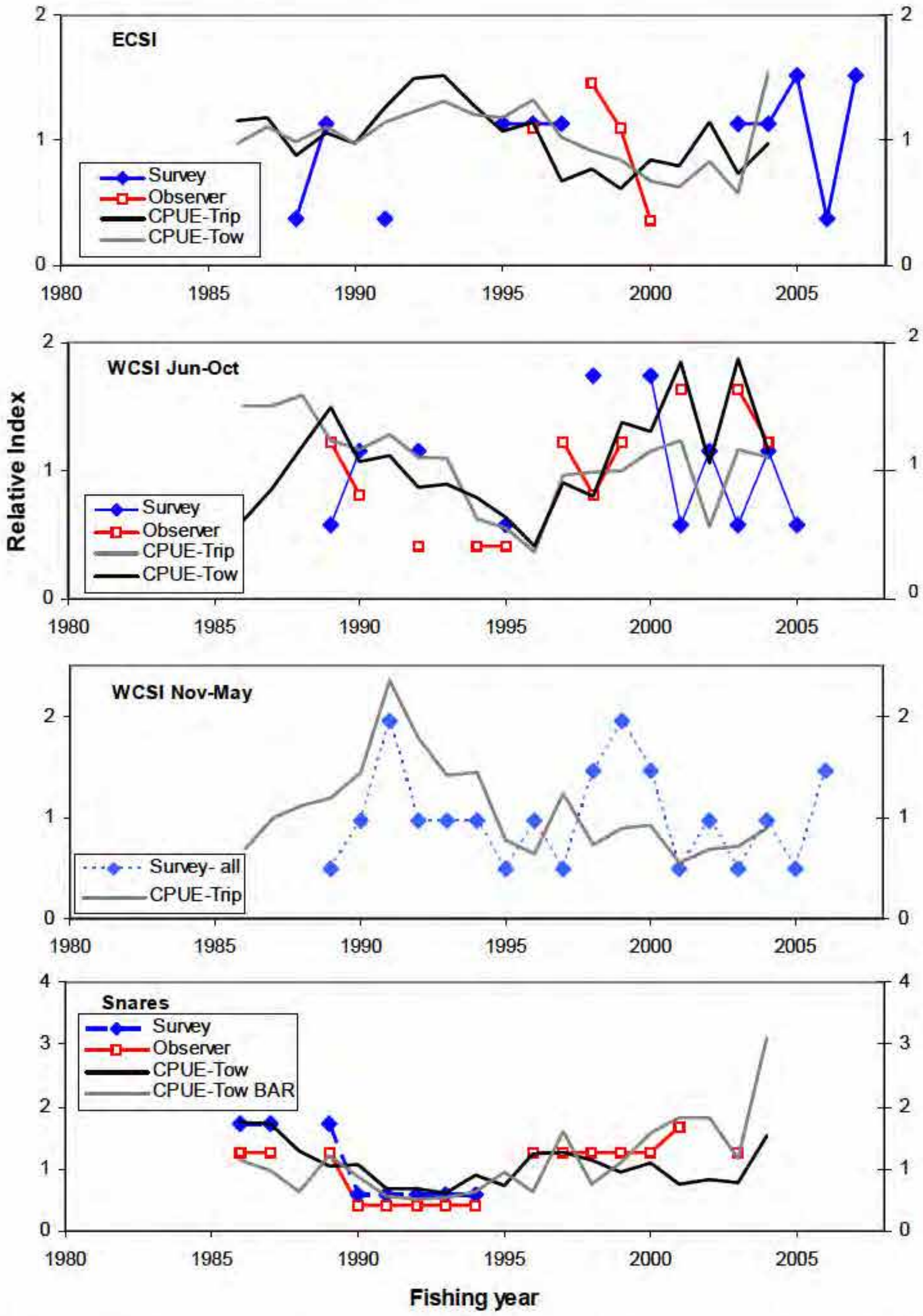


Figure 10: Comparison of selected CPUE indices (assuming a 4-year time lag to allow for full recruitment into the fishery) with YCS inferred from trawl survey or observer length frequencies (averaged to 1), for the three main fisheries, ECSI, WCSI, and SNAR. The less certain YCS estimates have been excluded except for the bottom panel.

For the ECSI, the general trend in CPUE (trip and tow level, major species target) is gradually increasing to a peak somewhere between 1997 and 2000, followed by a decline and lower period somewhere between 2001–2007 and an upturn in 2008 (note Figure 4 lags these by -4 years). At least three strong year classes (1989, 1995, 1996) are consistent with the higher CPUE and levels of catch from 1995–2000. The weak YCS in 2000 (unknown for 2001 and 2002) may have contributed to the subsequent decline, and strong YCS in 2003–5 to the 2008 CPUE increase. The BAR target trip level CPUE (not shown) is similar to that for the major species target and therefore not inconsistent with patterns in YCS. In general, the lack of extended periods of low recruitment (such as seen in the WCSI and Snares) would suggest the CPUE trend might show less variability, which it does. However, quite a few YCS are not able to be determined with any certainty and these tend to have been the weaker looking classes in 1992, 1993 (Figure 4) when CPUE was highest. The May/June trawl survey series suggests a large increase in abundance in recent years (2007–09), which is consistent with at least two recent years of better recruitment (2005, 2007). Unfortunately, assessment of the trawl survey's ability to track abundance is limited by the lack of surveys from 1997–2006.

For the WCSI, the general trend in CPUE (trip and tow level, major species target) is a decline during the mid to late 1990s to a low in 2000, a subsequent increase to average or high values from 2003, peaking between 2005 and 2007. The period of decline appears to be consistent with three weak YCS between 1992 and 1995 and the subsequent increase with at least five strong YCS between 1996 and 2004, of which 2001 and 2003 look the strongest. Trip and tow level CPUE series show similar levels of consistency (or not) with either the observer or trawl survey YCS: the tow level CPUE matches more closely with the later observer YCS and the trip level CPUE with the later survey YCS. The trip level CPUE for November–May (bottom panel, Figure 10) also shows some consistency with survey YCS, but misses the 1998–2000 peak.

For the Snares, the general trend in CPUE (trip and tow level, major species target) is high or average values at the start, a decline during the mid 1990s (1995–99), an increase to higher levels from 2000–2004, a subsequent decline to 2007, and an increase again in 2008. The initial high is consistent with three strong YCS between 1985 and 1989; the low during the mid-1990s with weak YCS from 1990–94, and the next increase with higher YCS from 1999–2000. The decline in major species target CPUE during the 2000s does not appear to be consistent with strong year classes in 2001 and 2003 but catches also increased during this period. However, the sudden upturn in 2008 is consistent with a strong YCS in 2004. The tow level BAR target CPUE also shows some consistency with patterns in YCS and matches the most recent trends better than the major species target model which is dominated by SQU target and has a high proportion of tows with zero barracouta catch. This suggests that the BAR target model may be more appropriate for this area.

8.7 Comparison with previous CPUE analyses

Harley et al. (1999) conducted a standardised analysis of BAR 5 (FMA 5 and 6) for 1990–98 using a log-normal linear model approach (after Vignaux 1992). They restricted their analysis to TCEPR data only as estimated catches represented at least 88% of QMA totals. Their all tows model is similar to SNAR tow-level major target model 6 (Snares and Auckland Is. combined), except that Harley et al. did not include a vessel variable and used statistical area instead of actual position.

The two CPUE series are plotted in Figure 11, averaged to one across the overlapping time period. Both show a relatively steep decline from 1990 to 1995 and similar fluctuations subsequently. Note that the results for our Model 6 are very similar to the Snares only tow-level major target model 2b.

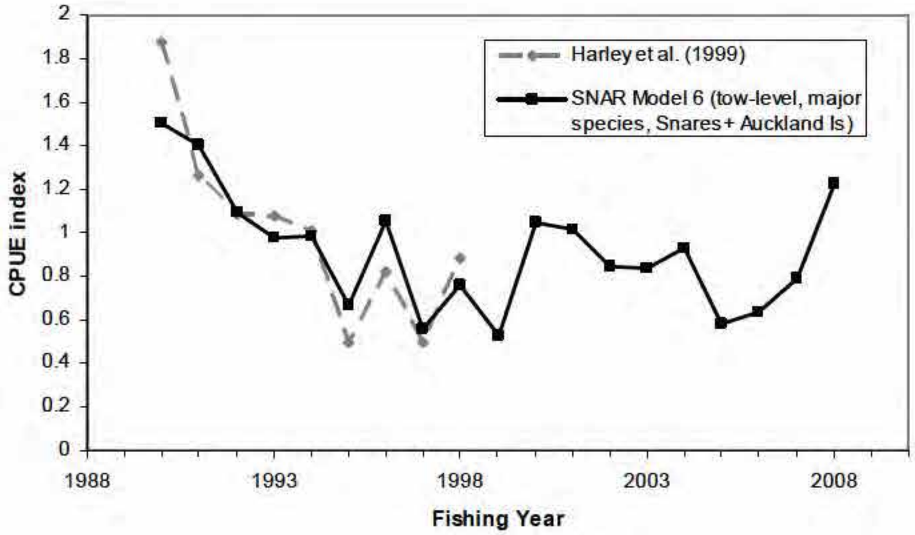


Figure 11: Comparison of Snares CPUE indices from lognormal models reported by Harley et al. (1999) and here (Model 6).

Langley & Walker (2002a) conducted a standardised analysis of the ECSI part of BAR 1 (FMA 3 statistical areas 018, 020, 022 and 024) for 1990–2000 using a log-normal linear model approach (after Vignaux 1992, 1994). They carried out two analyses on merged CELR and TCEPR data: BAR target and RCO target and excluded tows that did not catch barracouta. These models are similar to ECSI trip-level BAR and RCO target models 4 and 7), except that Langley & Walker defined their core vessels slightly differently (minimum of 100 days of fishing) and excluded vessels over 43m length, and we included statistical area 026.

The four CPUE series are plotted in Figure 12, averaged to one across the overlapping time period. The BAR target models both show an increase up to 1997 followed by a decline to 1999 and a slight upturn in 2000. The RCO target models both also show an increase during the mid 1990s, to a peak in 1998 (one year later than for the BAR target model), a decline to 1999 and a slight upturn in 2000. Note that the ECSI trip-level major target model 1a follows an intermediate trajectory through the BAR and RCO target models 4 and 7.

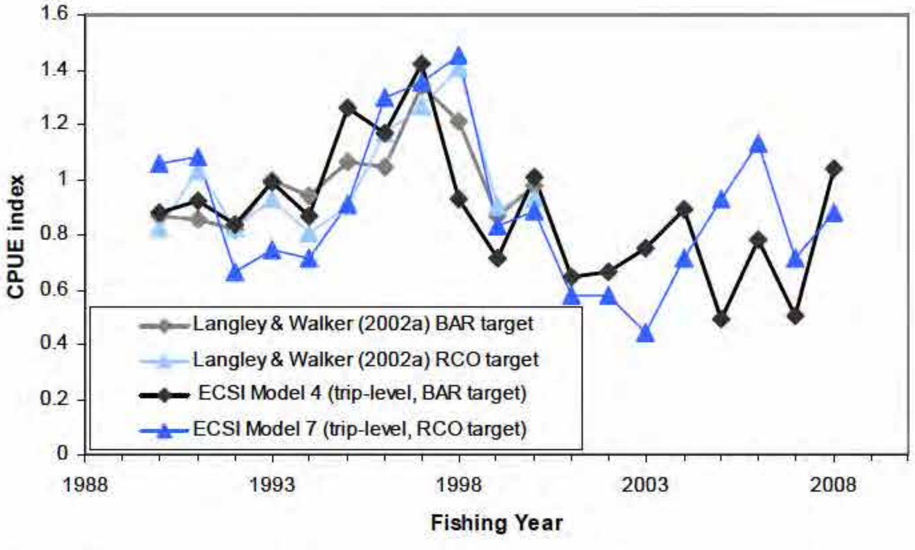


Figure 12: Comparison of ECSI CPUE indices from lognormal models reported by Langley & Walker (2002a) and here (Models 4 and 7).

8.8 Industry feedback on trends in catches and CPUE

Four fishers were consulted about trends in CPUE from the ECSI and WCSI. In both areas, a key factor affecting barracouta catch in the last decade has been less favourable market conditions with the associated low prices paid to fishers. This could affect catch rates in non-target barracouta fishing if fishers were able to avoid catching barracouta. A suggested reduction in targeting for barracouta in the last decade is not evident in the data presented here, except perhaps a slight reduction for the WCSI since the mid 1990s. It appears that there may be some ability to avoid barracouta when market prices are low, either by making gear or deployment changes (reducing headline height, towing slower on smaller inshore vessels), or avoiding fishing in certain areas. However, the ability to avoid barracouta depends on the species being targeted, e.g., they are difficult to avoid when targeting tarakihi. There are few data on gear or gear deployment changes for smaller inshore vessels that would allow these factors to be analysed. On the ECSI, availability of lobster krill (*Munida gregaria*), which is an important food source for barracouta and red cod, has been less in the last decade and this may also be an issue (perhaps a possible reason for barracouta to move to other feeding grounds such as SNAR). On the WCSI it was also suggested that lower fishing pressure in late 1990s may have allowed the stock to increase.

8.9 CPUE summary

After consideration of similarities in the CPUE models (trip v. tow level; major species v. individual target species; binomial v. lognormal), consistency with trawl survey indices and YCS inferred from observer and trawl survey length (and age for the Snares) frequencies, models with the most potential for monitoring the three main barracouta fisheries are:

- ECSI: trip level or tow level major species target, October–September;
- WCSI: trip or tow level major species target, June–October;
- SNAR: tow level major species target (or possibly BAR target), October–May.

BAR target models may also be appropriate for consideration but generally represent a much lower proportion of the catch.

9 PRINCIPLES FOR STOCK ASSESSMENT

9.1 Annual model cycle

9.2 Landings (catch history)

9.3 Exploitation rates

10 ENVIRONMENTAL AND ECOSYSTEM CONSIDERATIONS

10.1 Benthic impact (sea-bed disturbance)

10.2 Incidental catch (fish and invertebrates)

10.3 Incidental catch (seabirds and mammals)

10.4 Community and trophic structure

10.5 Spawning disruption

10.6 Habitats of special significance

10.7 Biodiversity

11 AQUACULTURE AND ENHANCEMENT

12. SUMMARY AND RECOMMENDATIONS

12.1 Biology

Barracouta have been harvested commercially at significant levels (average annual catch 23 500 t) for the last 30 years and were the subject of targeted research programmes from the late 1970s to the mid 1990s. Other research surveys inshore or middle depth species and MFish Observers have also collected barracouta data and this continues up to the present. Data available have provided information on the location of spawning grounds, the timing of main spawning events, the direction of some spawning migrations (BAR 1), size and age at maturity, size and age composition in selected areas and years, the location of juveniles, and diet.

Key biological aspects that are less well known are stock relationships outside of and within BAR 1 and recruitment variability. Although seasonal patterns in commercial fisheries and a tagging study in the mid 1980s established some migration patterns and stock relationships, there are key questions about the relationship of BAR 5 with BAR 1 and BAR 7 that remain unresolved. Nevertheless the current management boundaries are probably appropriate to manage stocks given the current information.

Barracouta are relatively short-lived with maximum observed ages of 12 for females and 10 for males recorded in BAR 5. Monitoring of recruitment variability is required to help with understanding of current trends, and prediction of future trends, in the main fisheries. There have been no dedicated time series of data collection to collect length and age data. Continuing inshore trawl surveys (WCSI, ECSI) are not conducted at the most appropriate times to provide data to manage the main fisheries and sampling by observers has not been best optimised and, except for SNAR, has not provided adequate length and otoliths data to monitor the main fisheries from 1990 (sampling in some areas has improved recently). Length frequencies can be difficult to interpret, as even younger year groups can have bimodal distributions, and ageing of time series of otoliths is therefore required. The longest time series aged (and the only series published) is from BAR 5 (Table B6) and includes four years of trawl survey data and six years of observer data between 1991 and 1997 (Harley et al. 1999). The recruitment pattern exhibited by these data was consistent with a drop in catch and CPUE during the mid 1990s and illustrates their potential value in stock monitoring and assessment.

12.2 Status of the stocks

Estimates of current and reference biomass are not available for any barracouta stocks and therefore 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.

In BAR 1, catches have been below the estimated MCY for eight of the last nine years (increasing to just over the MCY in 2009) and below the TACC for the last eleven years. It is not known if current catch levels, the MCY or the TACC are sustainable. Standardised CPUE indices declined during the 2000s to a low in 2005 but have since shown signs of recovery. There are also some indications of better than average recruitment in 2005 and 2007 that are consistent with a recovery. A trawl survey off the east coast South Island may provide indices of recruitment for this fishery; indices of adult biomass are uncertain due to seasonal migration of some fish out of the area to spawn. A stock assessment model is required to appropriately integrate all these data.

In BAR 4 the catch fluctuates widely and has only reached the level of the TACC three times in the 22 years it has been in place, the most recent occurrences being 2007 and 2008. The landings in the previous four years and in 2009 were below 1000 t. The highly variable nature of this fishery makes standardised CPUE analysis impractical. There is no MCY for this fishery and it is not known if current catch levels, or the TACC are sustainable.

In BAR 5 catch levels in the last five years have averaged 109% of the TACC. There is no MCY for this fishery and it is not known if current catch levels or the TACC are sustainable. Standardised CPUE indices indicate low catch rates during the early 1990s, followed by a recovery to about average levels (major species target model) or higher (BAR target model). Patterns of recruitment from observer data are consistent with the low period in the 1990s and the recovery. A stock assessment model is required to appropriately integrate and assess these data. There is no current trawl survey in the area in appropriate depth ranges but a survey for this species was carried out successfully by *Tangaroa* from 1993–96 and could monitor biomass if reinstated. Potential stock movement between FMA 5 and FMA 7 or FMA 3 is unresolved.

In BAR 7 catch levels in the last five years have averaged 102% of the TACC. There is no MCY for this fishery and it is not known if current catch levels, or the TACC are sustainable. Standardised CPUE indices increased during the 2000s, but have since increased to average or above average values (depending on model). CPUE trends are consistent with indications of poor recruitment in the mid 1990s and better than average recruitment in five years between 1996 and 2004. A trawl survey off the west coast South Island provides biomass indices during the autumn season but it is not clear that it indexes the main winter/spring fishery adequately. A stock assessment model is required to appropriately integrate and assess these data.

Table 9: Summary of yields (t), TACCs (t), and reported landings (t) for Barracouta for the most recent fishing year.

Fishstock		QMA	MCY	2008–09 Actual TACC	2008–09 Reported landings
BAR 1	Auckland (East), Central (East), South–East (Coast)	1, 2, & 3	8050[1]	11 000	8 861
BAR 4	South–East (Chatham)	4	–	3 019	968
BAR 5	Southland, Sub–Antarctic	5 & 6	–	7 470	7 659
BAR 7	Challenger, Central (West), Auckland (West)	7, 8, & 9	–	11 173	8 955
BAR 10	Kermadec	10	–	10	–
Total				32 672	26 444

[1] MCY was estimated using the equation MCY = cY_{AV} (Method 4), where Y_{AV} average estimated catch from 1968-1975 and c = 0.7 (Ministry of Fisheries 2009).

12.3 Observer Programme sampling

Barracouta sampling by observers would benefit from optimisation in key fishery areas. The approach to date has provided good representation of SNAR barracouta catch, with an average of 156 samples per annum (across a four month season) since 1993 and over 3000 fish measured (with about 30–50 fish measured per sample). Representativeness of sampling around the Auckland Is. and off WCSI has been reasonable since 1994, but the number of samples is lower, averaging about 36 samples across a mainly three month season. Numbers of fish measured are mostly less than 500 for the Auckland Is. but exceed 1000 fish 50% of the time for WCSI. Annual sampling for WCNI has improved since 2000, with about 65 samples per annum, but, when split by season, the numbers of fish measured exceed 1000 fish for 50% of the spawning seasons but are mostly under 1000 fish for non-spawning seasons. ECSI sampling does not represent the nine month season well and with an average of only 27 samples per year since 1999, numbers of fish measured per season rarely exceed 1000.

Age sampling would also benefit from optimisation. Sampling in Southland has achieved over 500 otolith pairs since 2001 (mostly over 800) but sampling in other areas has been relatively sporadic and generally fewer than 400 per year have been taken (Table B6).

Optimisation for future observer sampling will depend on whether both length and otolith sampling are also to be optimised and whether a direct age sampling approach or length-at-age keys are to be used. If the direct age sampling approach is to be used, 500 otoliths per area per season would be adequate (i.e., 500 for SNAR and WCSI, 1000 for WCNI). Length sampling in the Snares area is adequate and could possibly be optimised to reduce oversampling in some years. Length sampling in BAR 7 (WCSI and WCNI) could also be usefully optimised to ensure adequate coverage each year (and by season for WCNI). It is not clear whether lack of sampling in inshore waters is a problem. Optimisation of length sampling for ECSI would require considerably more effort to cover the long fishing season and may still not adequately represent length and age composition in more inshore waters, so should probably be lower priority.

12.4 Future data needs and research requirements

Recognising that CPUE will probably not provide a reliable relative abundance indicator for barracouta in isolation, and with the goal of developing a quantitative stock assessment in the future, the data collection needs for barracouta are as follows:

1. Further investigation of stock relationships, focusing on the possible inter-relationship between BAR 5 with BAR 7 and BAR 1.
2. Optimised otolith sampling and development of catch-at-age for BAR 5 and BAR 7, (focusing on the main fisheries areas off WCSI and WCNI, and Southland). Continued collection of data from ECSI may be useful but the longer fishing season and relative importance of smaller un-observed vessels in this fishery makes adequate optimisation problematic.
3. Development of age based stock assessments for BAR 1, BAR 5, BAR 7, incorporating commercial CPUE and catch-at-age and inshore trawl survey biomass indices and potentially length frequencies. Alternatively, length based assessments could be attempted if no catch-at-age data are available.

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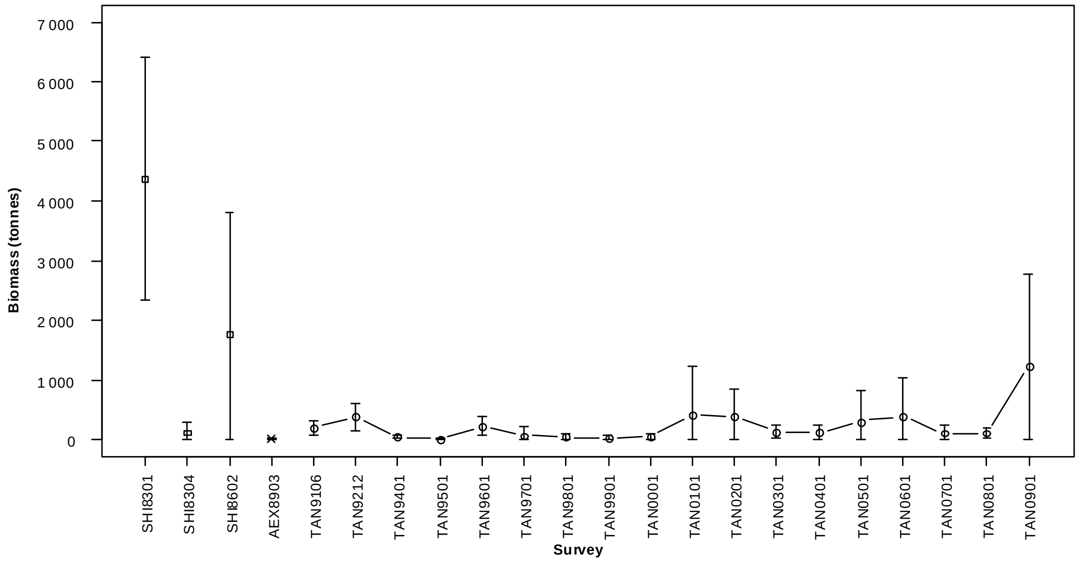
APPENDIX A: TRAWL SURVEY SUMMARIES



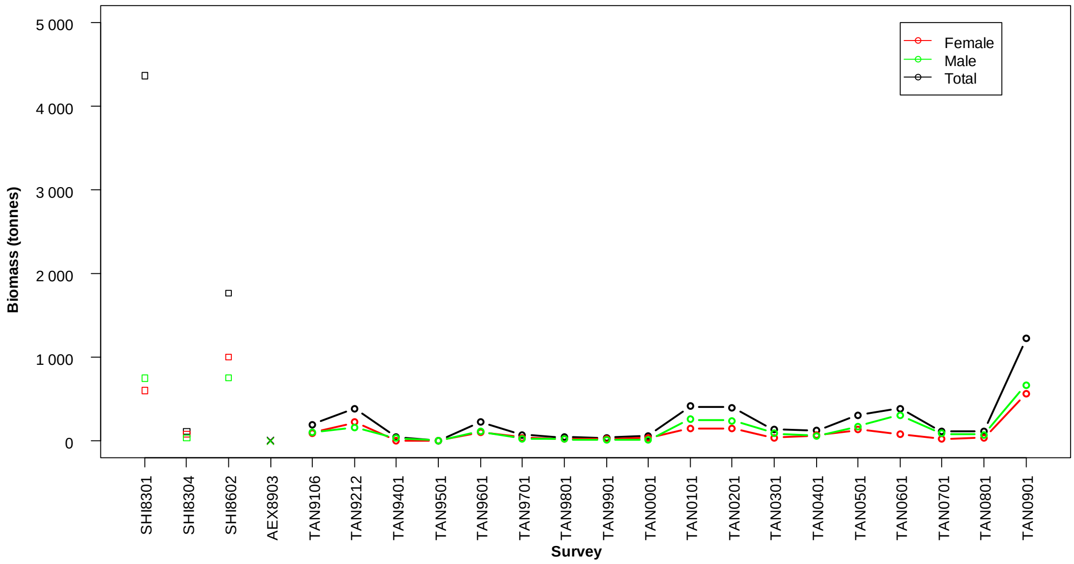
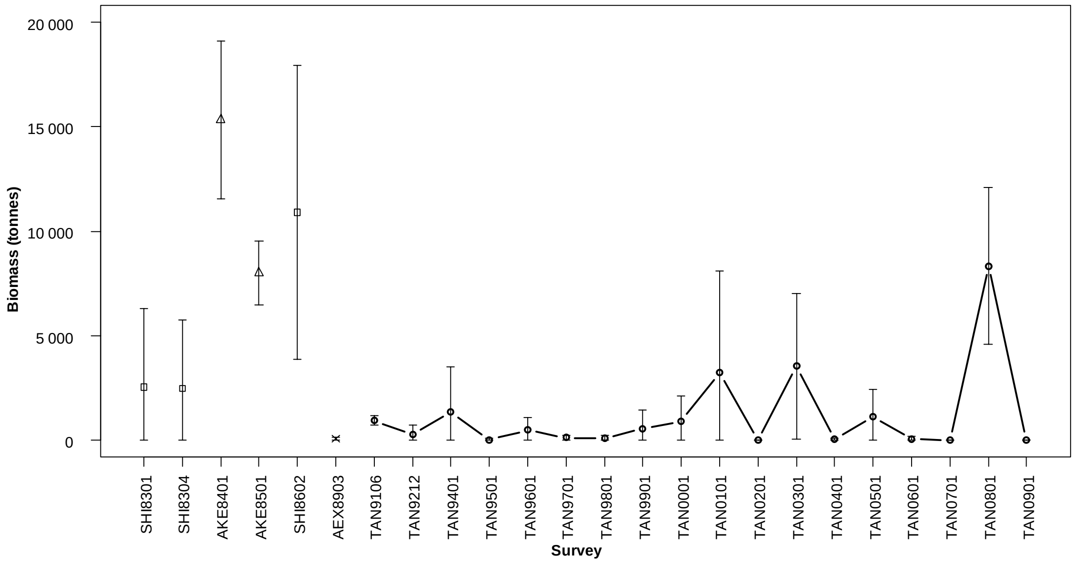


Figure A1. Doorspread biomass estimates, for all barracouta (± C.V., above) and by sex (below), from the Chatham Rise (West), from *Shinkai Maru* (SHI), *Amaltal Explorer* (AEX), and *Tangaroa* surveys between 1983 and 2009.



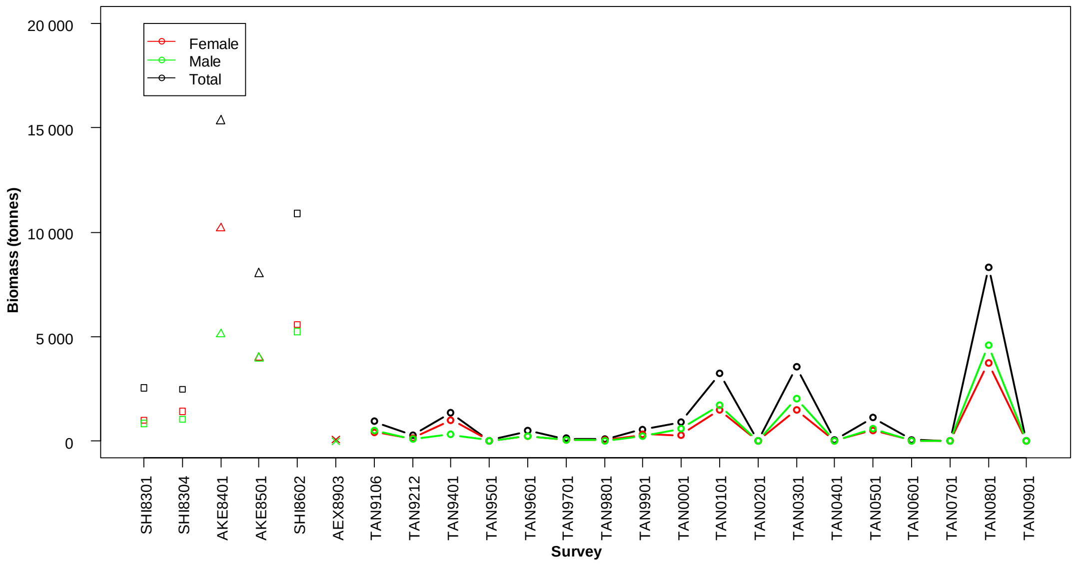
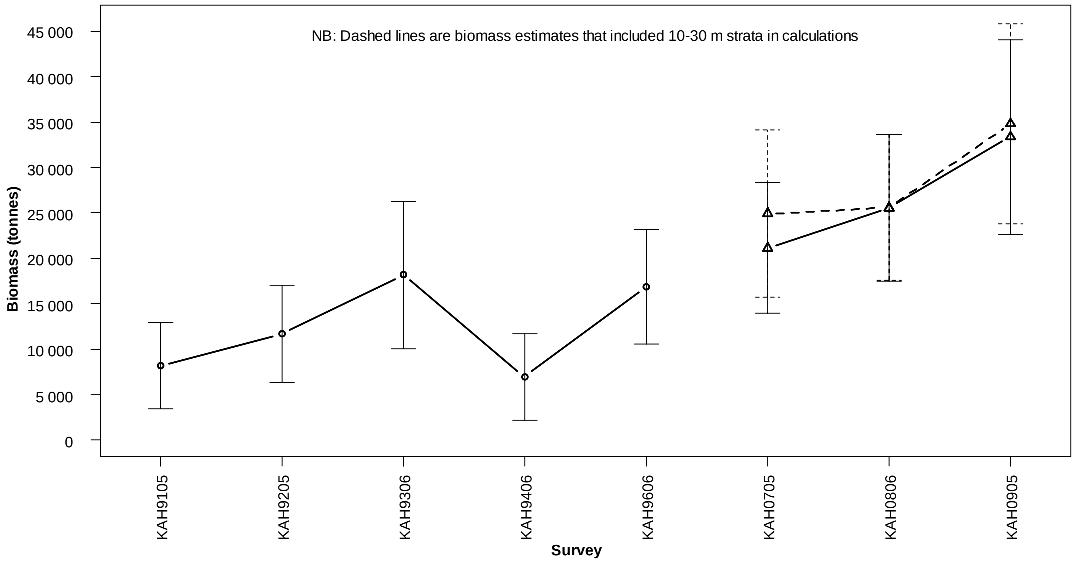


Figure A2. Doorspread biomass estimates, for all barracouta (± C.V., above) and by sex (below), from the Chatham Rise (East), from *Shinkai Maru* (SHI), *Akebono Maru 73* (AKE), *Amaltal Explorer* (AEX), and *Tangaroa* surveys between 1983 and 2009.



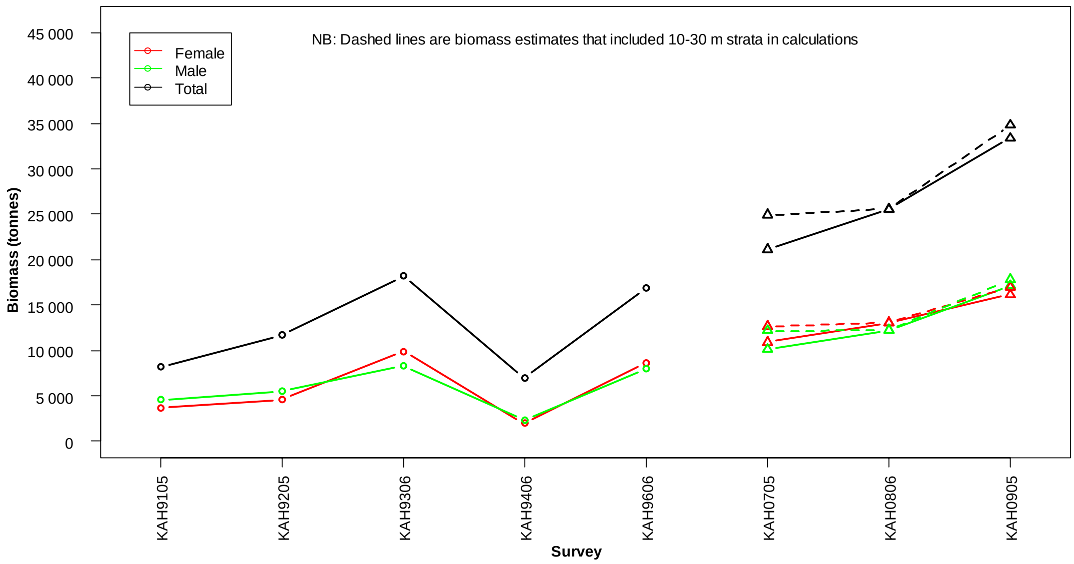


Figure A3a. Doorspread biomass estimates, for all barracouta (± C.V., above) and by sex (below), from the ECSI *Kaharoa* winter surveys between 1991 and 2009.

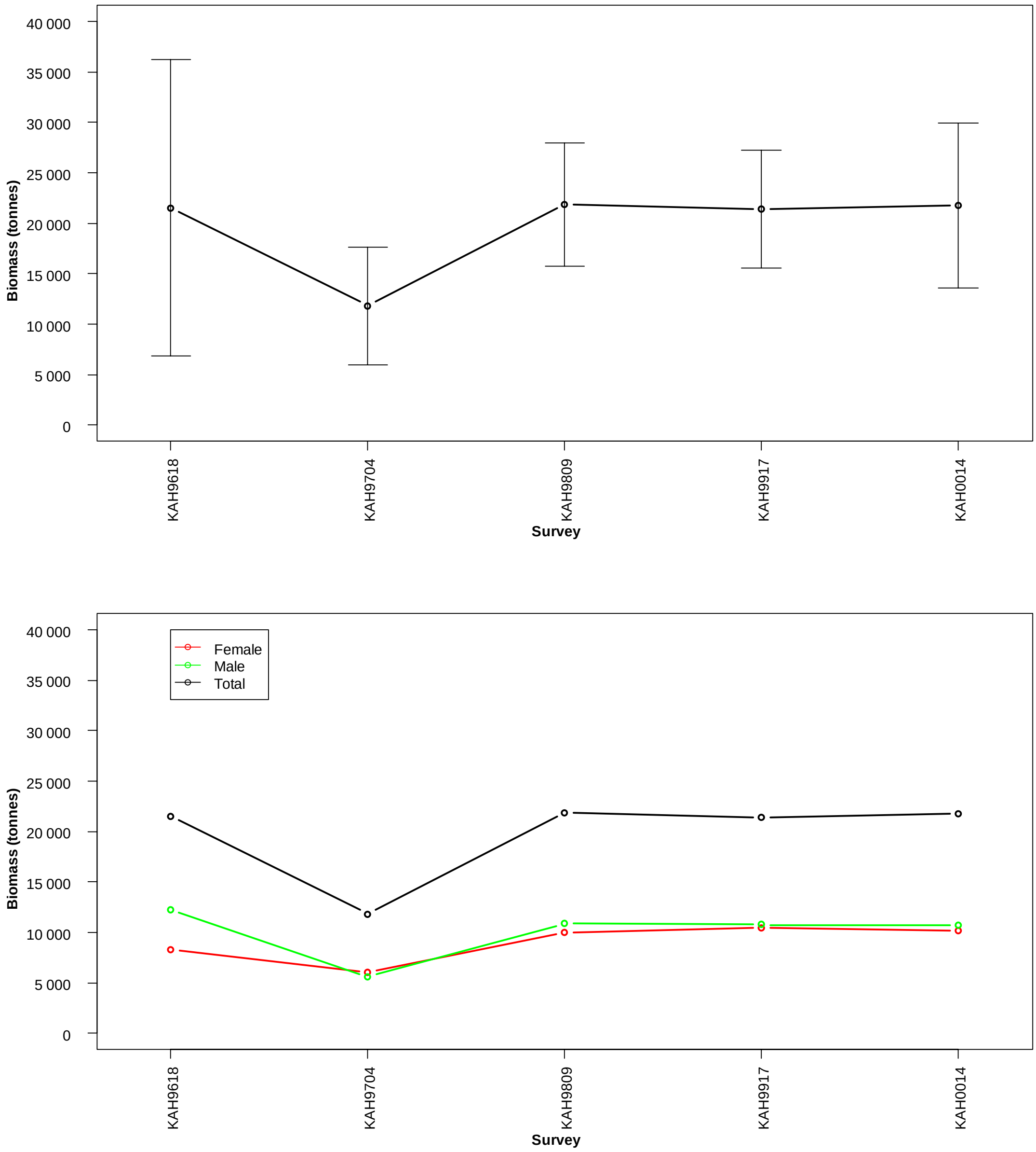
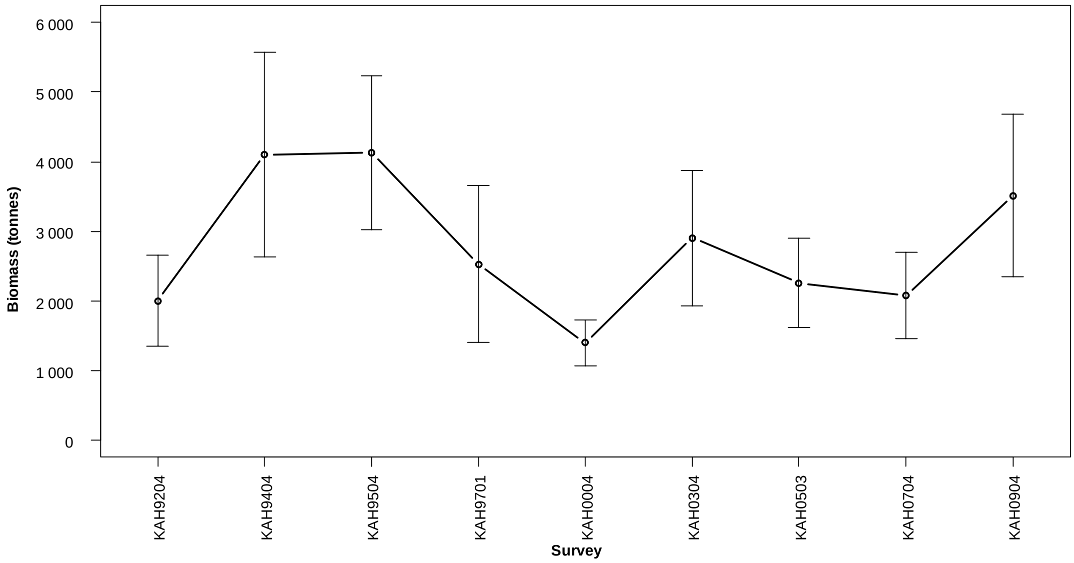


Figure A3b. Doorspread biomass estimates, for all barracouta (± C.V., above) and by sex (below), from ECSI *Kaharoa* summer surveys between 1996 and 2001.



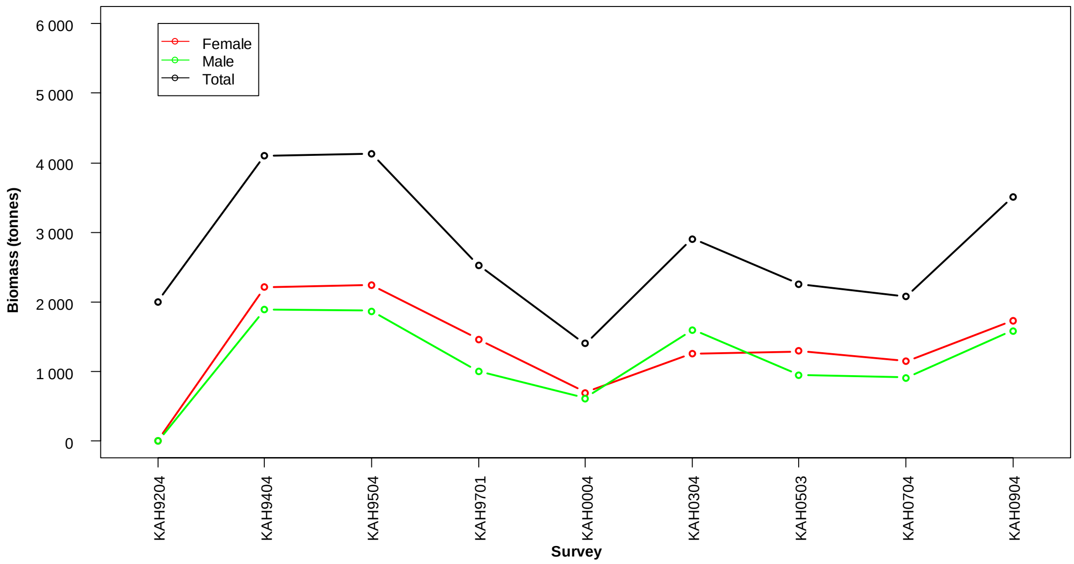


Figure A4a. Doorspread biomass estimates, for all barracouta (± C.V., above) and by sex (below), from WCSI (WCSI only) *Kaharoa* surveys between 1992 and 2009.

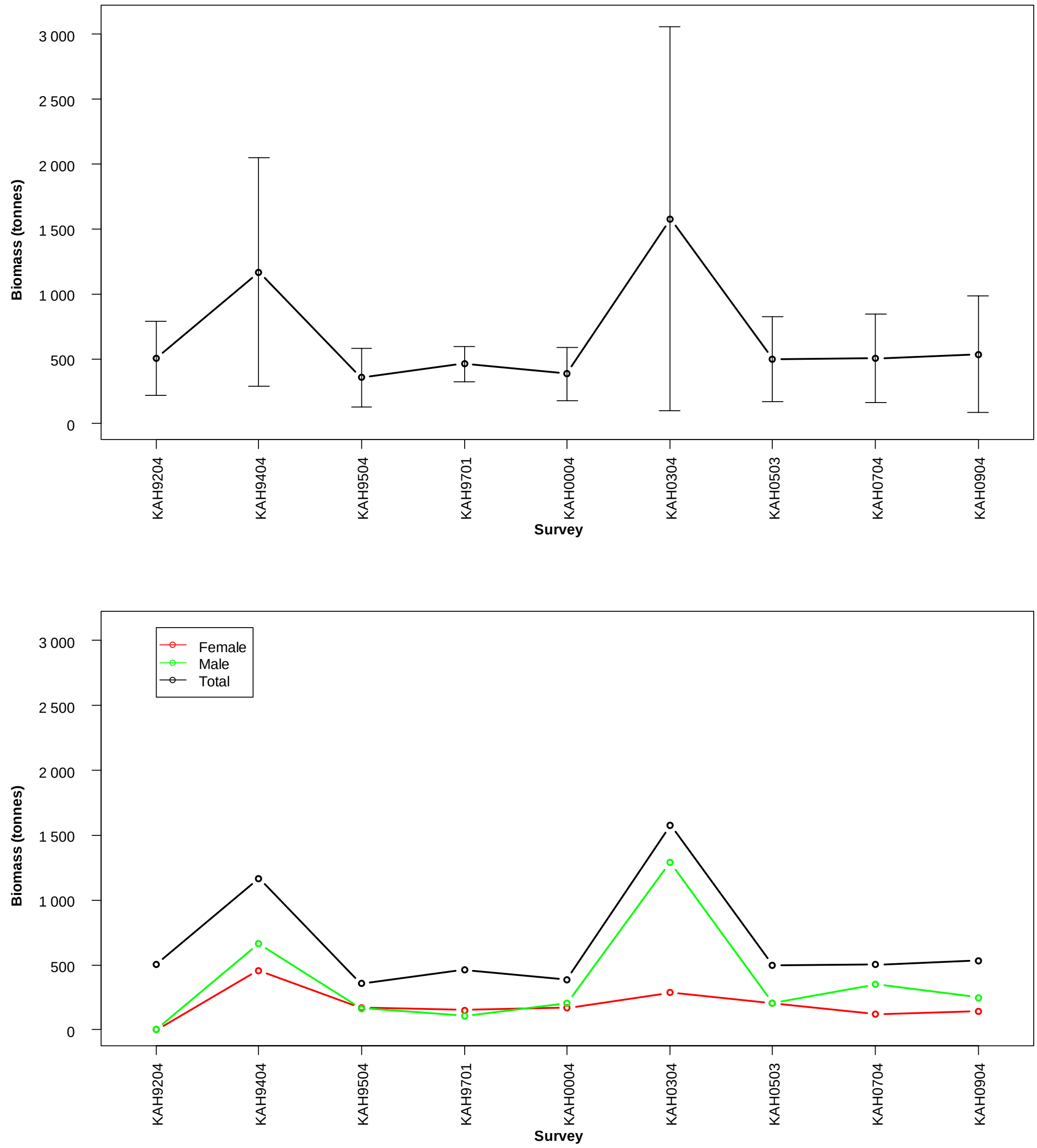
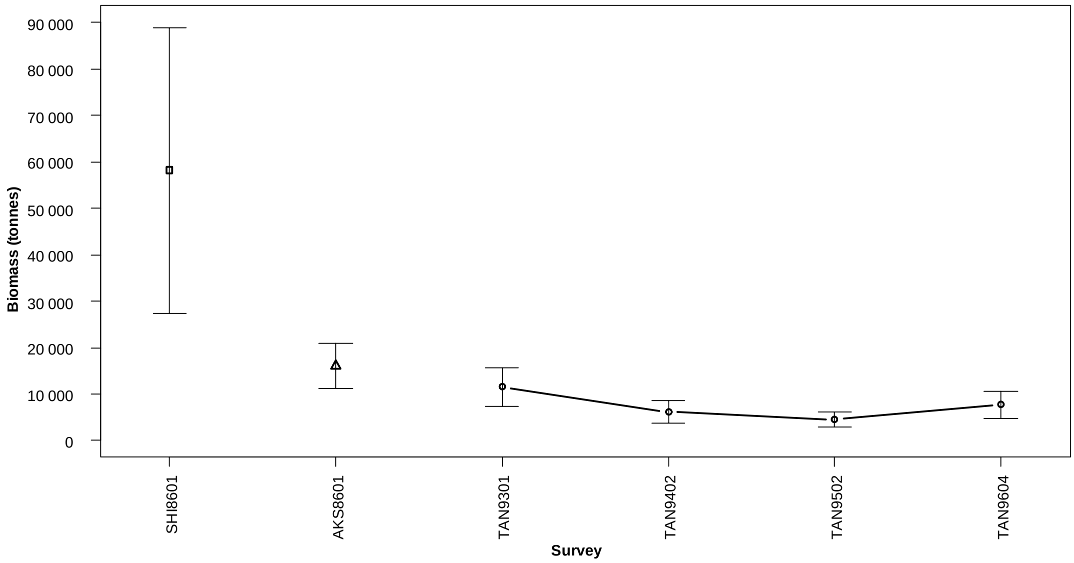


Figure A4b. Doorspread biomass estimates, for all barracouta (± C.V., above) and by sex (below), from WCSI (Tasman Bay, Golden Bay only) *Kaharoa* surveys between 1992 and 2009.



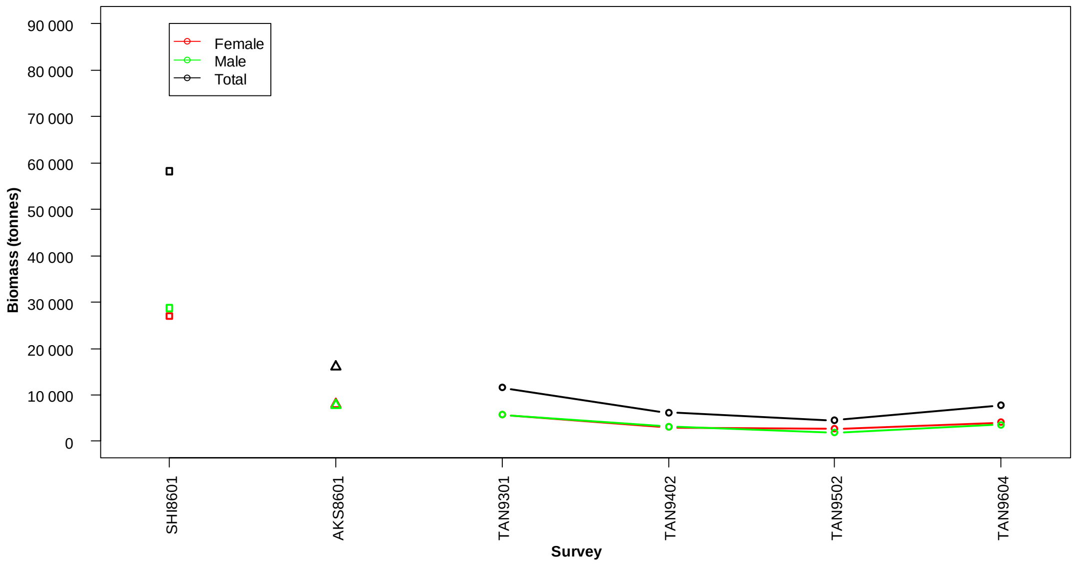


Figure A5. Doorspread biomass estimates, for all barracouta (± C.V., above) and by sex (below), from surveys of Southland by *Shinkai Maru* (SHI) in June 1986, *Akebono Maru 3* (AKS) in November 1986, and *Tangaroa* (TAN) in February–March, 1993–1996.

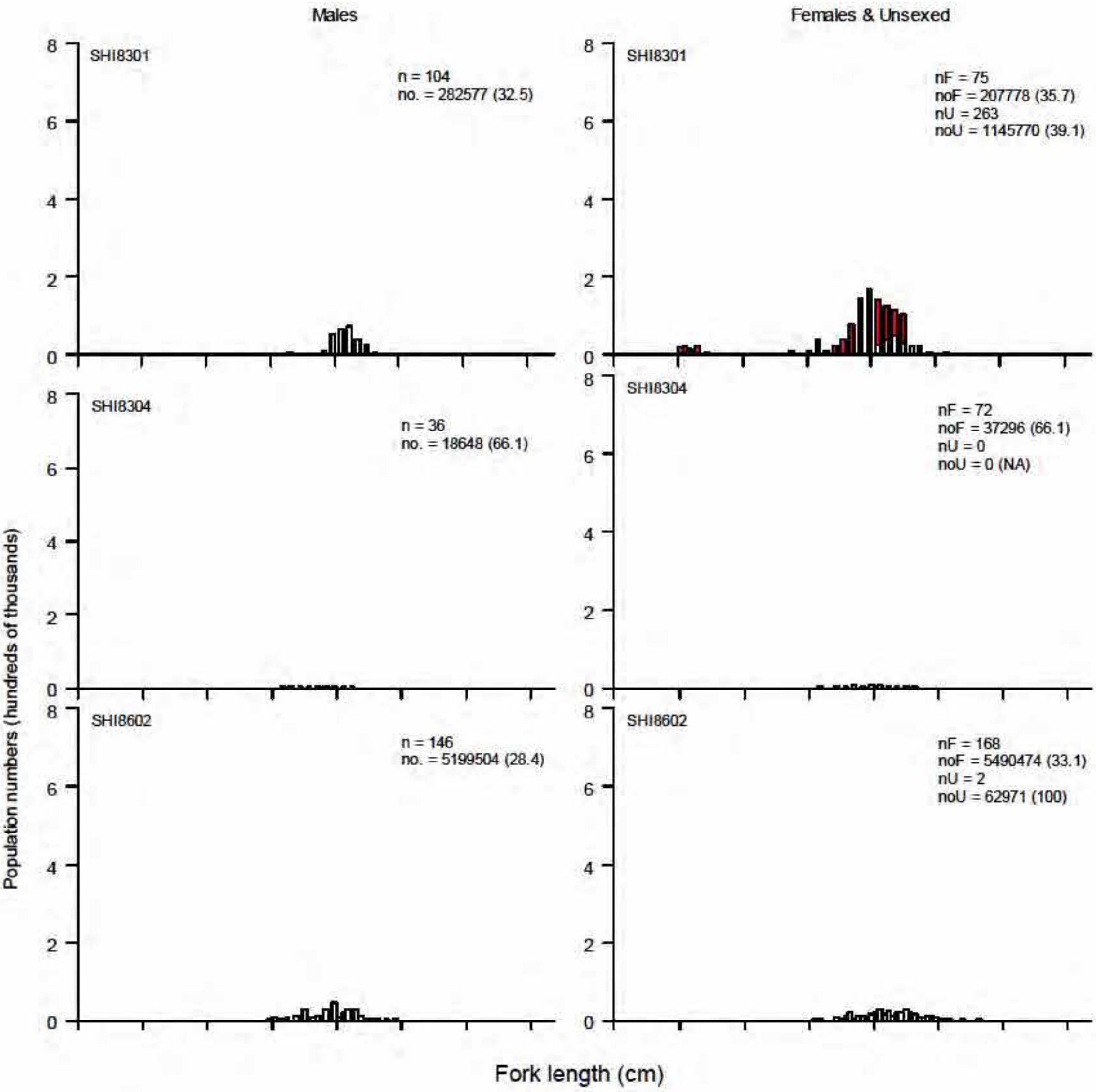


Figure A6a. Length frequencies of barracouta from the Chatham Rise (West), from *Shinkai Maru* (SHI) and *Amaltal Explorer* (AEX) surveys, 1983, 1986 and 1989.

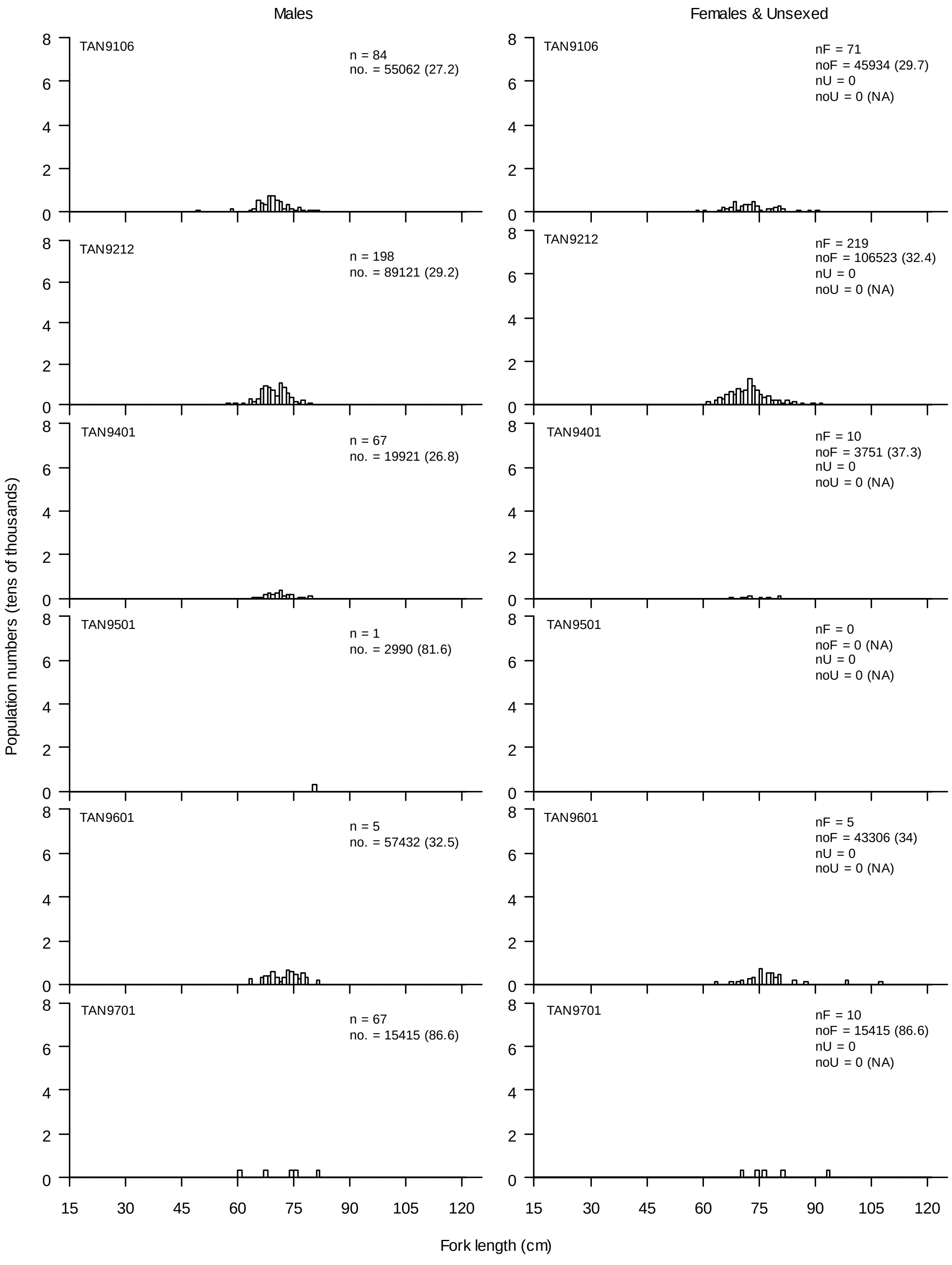


Figure A6b: Length frequencies of barracouta from the Chatham Rise (West), from *Tangaroa* (TAN) surveys, 1991–1997.

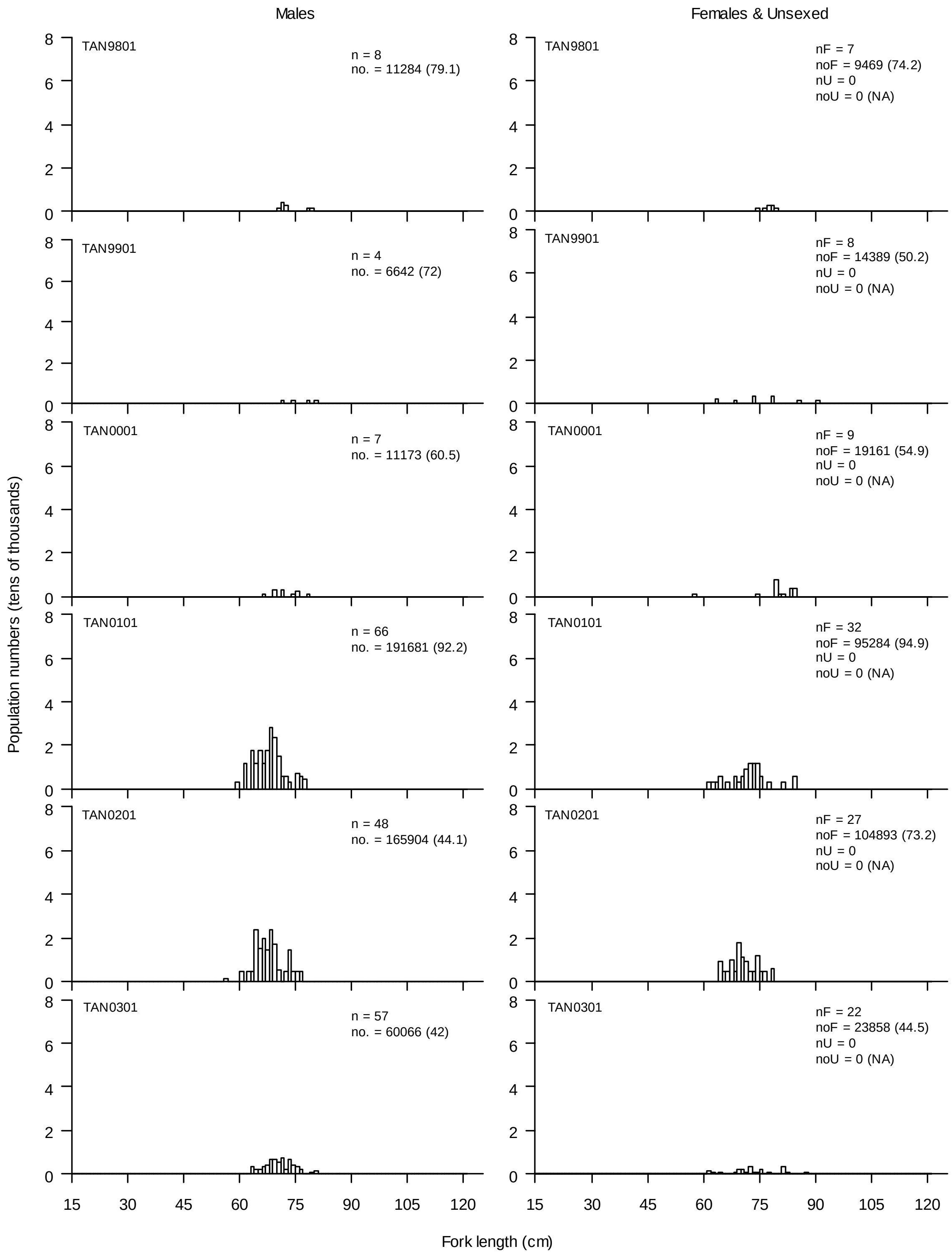


Figure A6b continued: Length frequencies of barracouta from the Chatham Rise (West), from *Tangaroa* (TAN) surveys, 1996–2003.

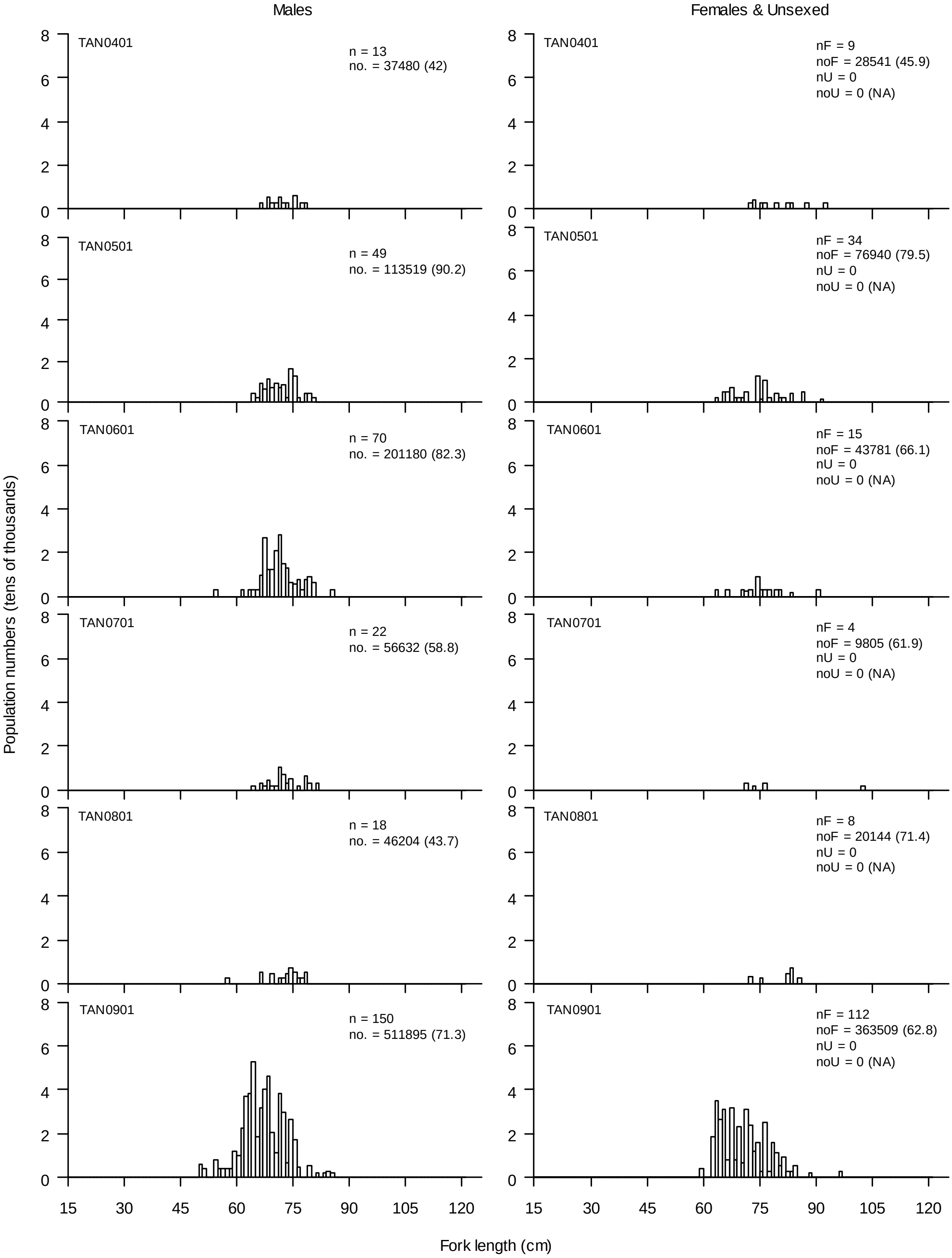


Figure A6b continued: Length frequencies of barracouta from the Chatham Rise (West), from *Tangaroa* (TAN) surveys, 2004–2009, continued.

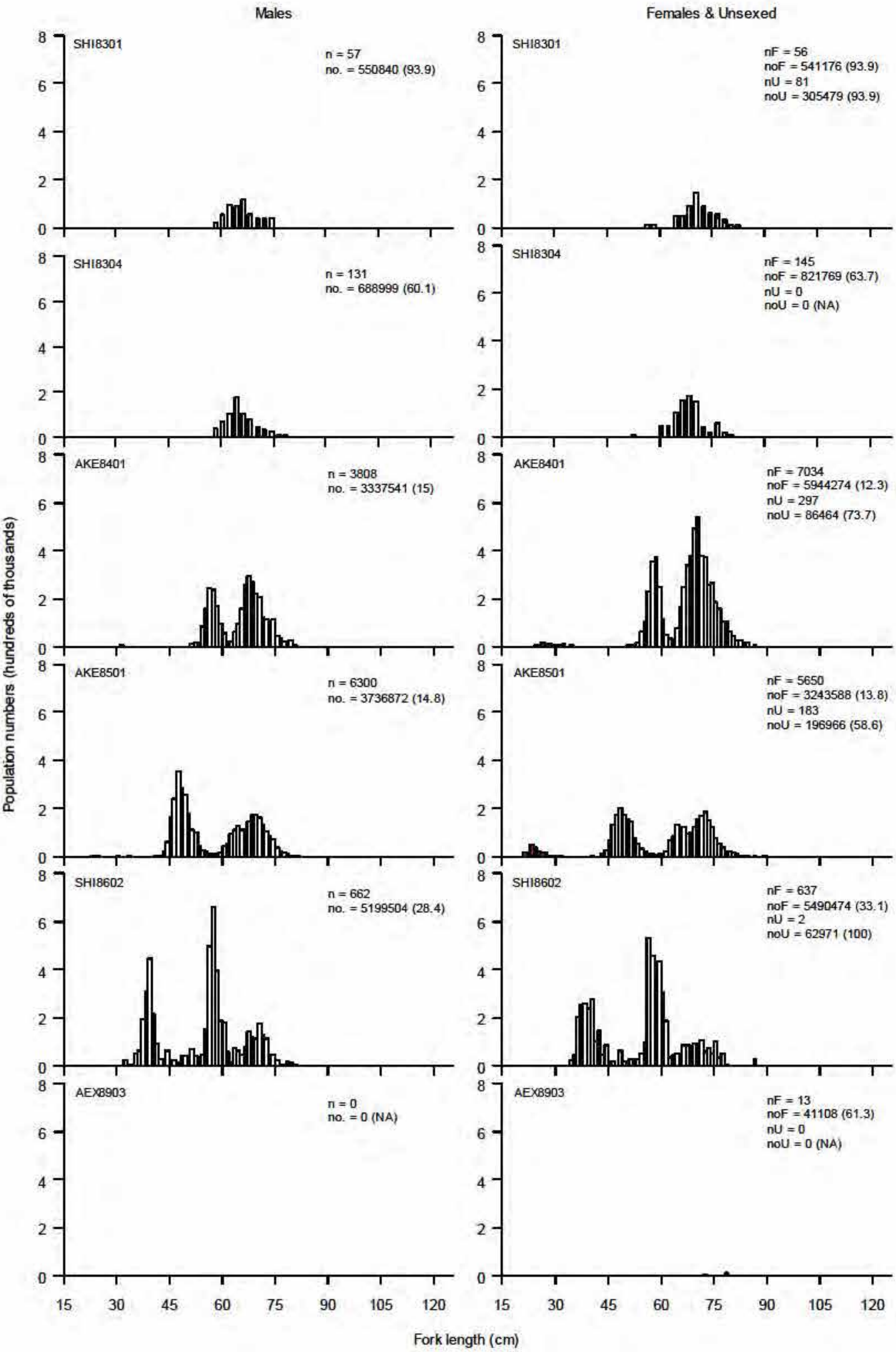


Figure A7a: Length frequencies of barracouta from the Chatham Rise (East), from *Shinkai Maru* (SHI), *Akebono Maru 73* (AKE) and *Amaltal Explorer* (AEX) surveys, 1983–1986 and 1989.

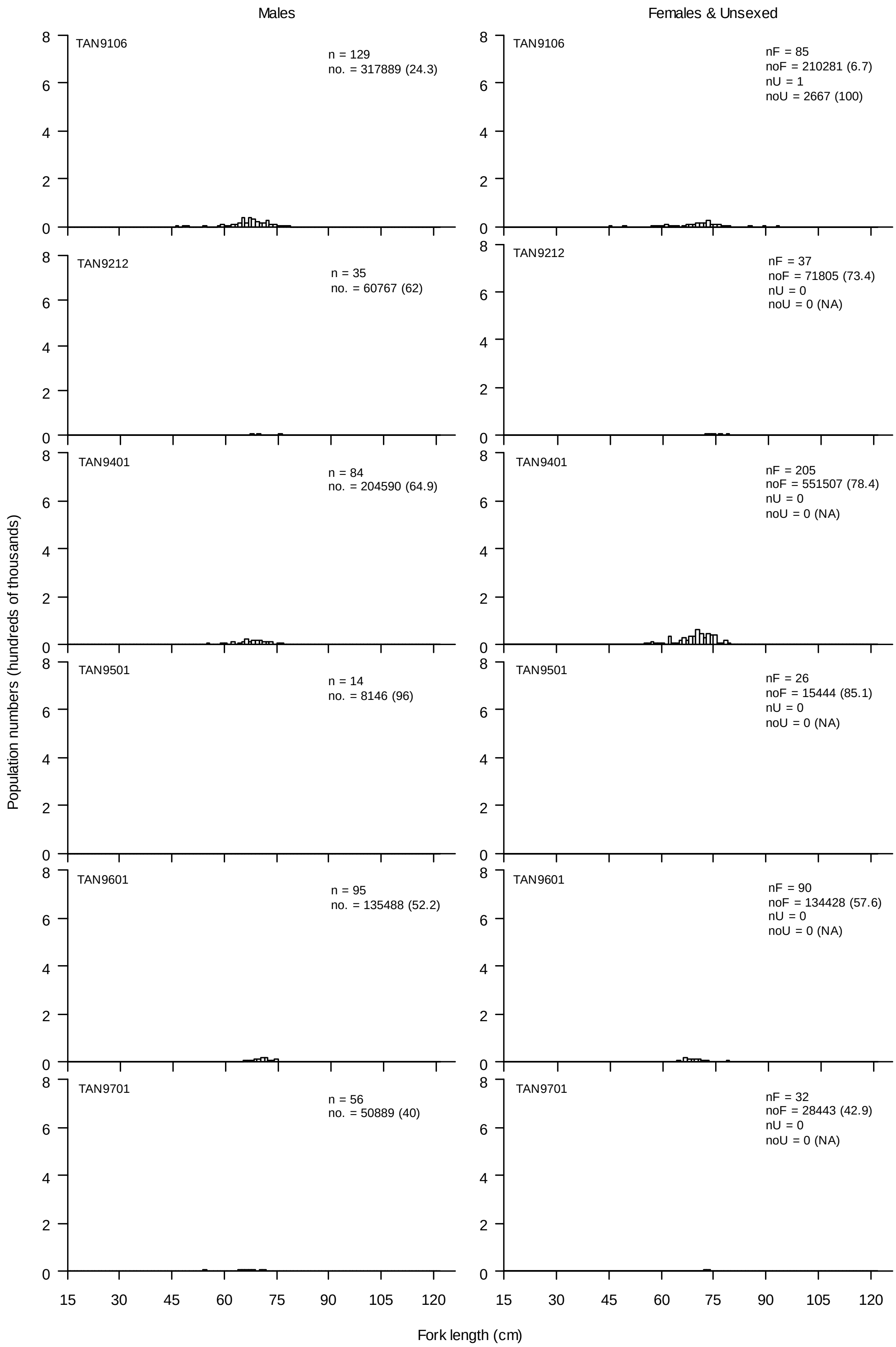


Figure A7b continued: Length frequencies of barracouta from the Chatham Rise (East), from *Tangaroa* (TAN) surveys, 1991–1997.

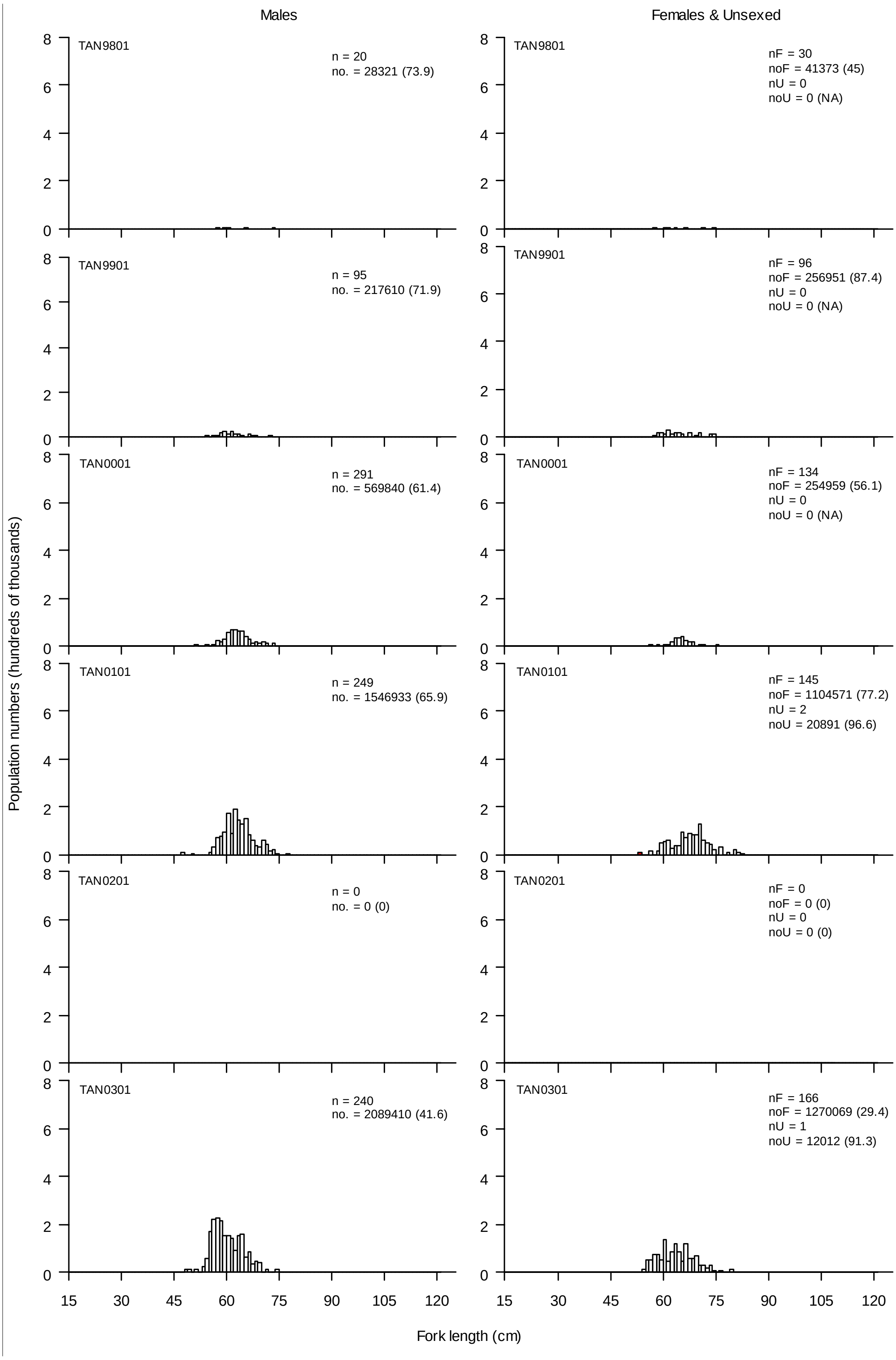


Figure A7b continued: Length frequencies of barracouta from the Chatham Rise (East), from *Tangaroa* (TAN) surveys, 1991–2003.

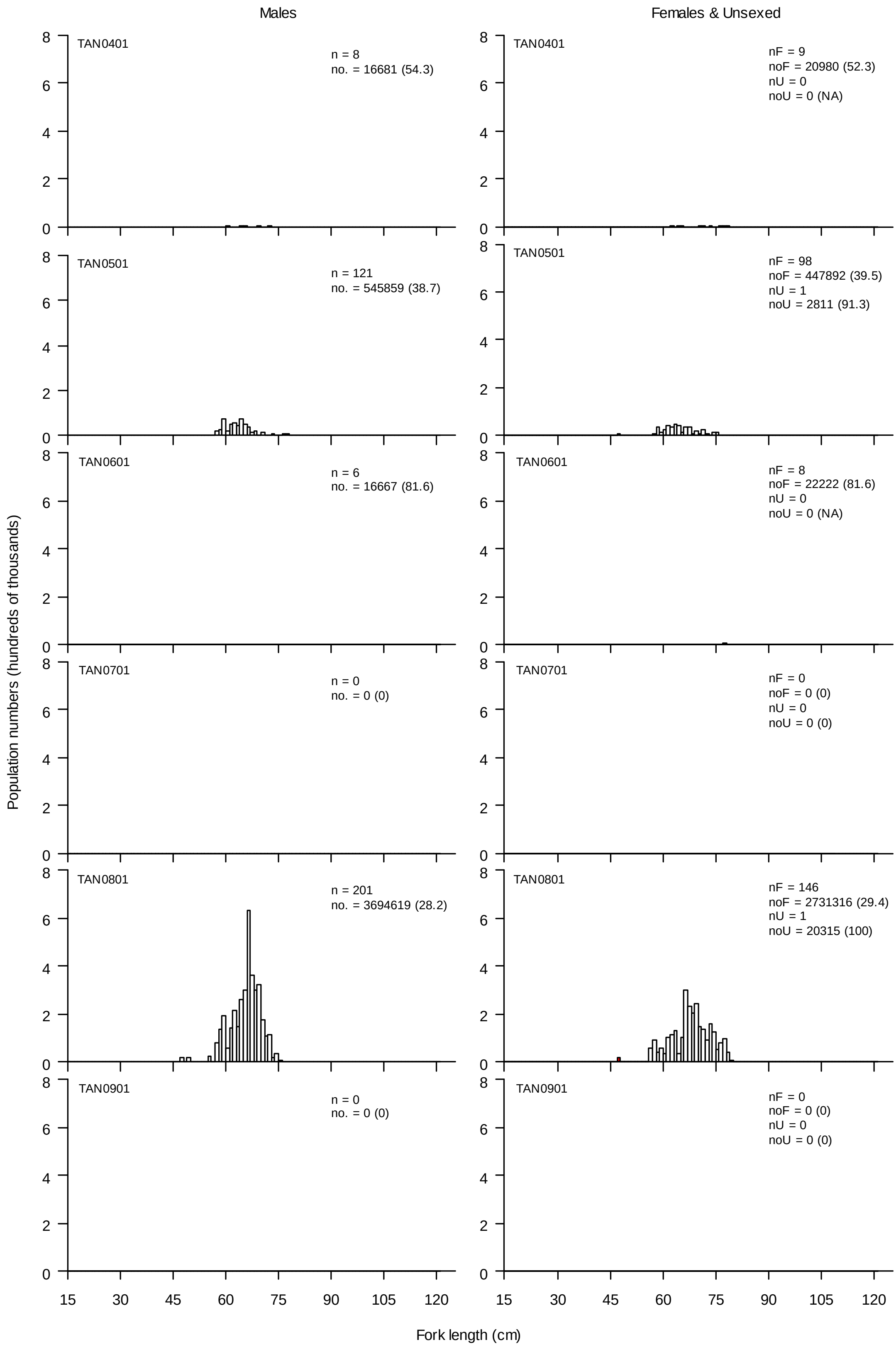


Figure A7b continued: Length frequencies of barracouta from the Chatham Rise (East) *Tangaroa* (TAN) surveys, 2004–2009.

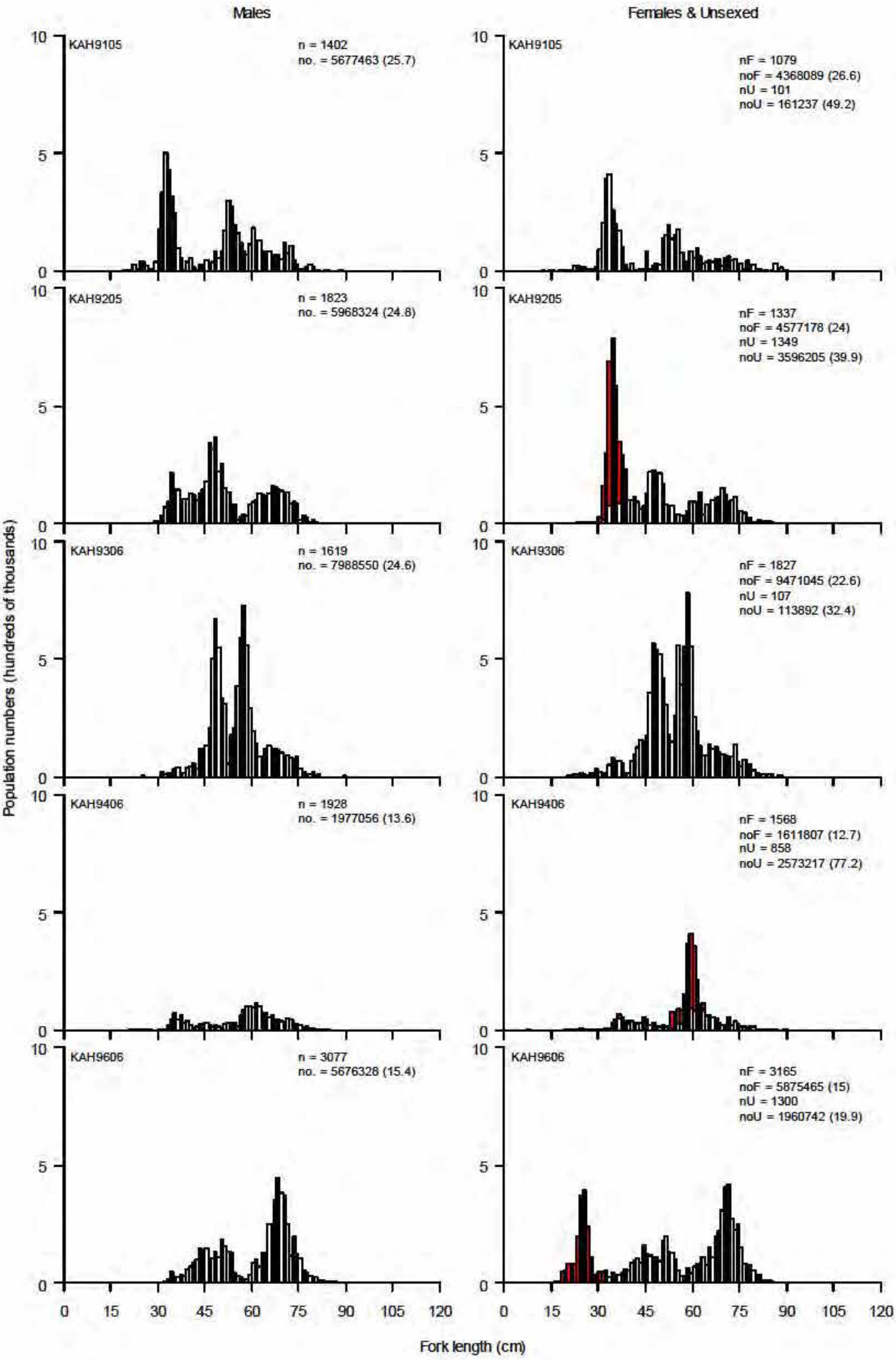


Figure A8a. Length frequencies of barracouta from the ECSI *Kaharoa* (KAH) winter surveys, 1991–1996.

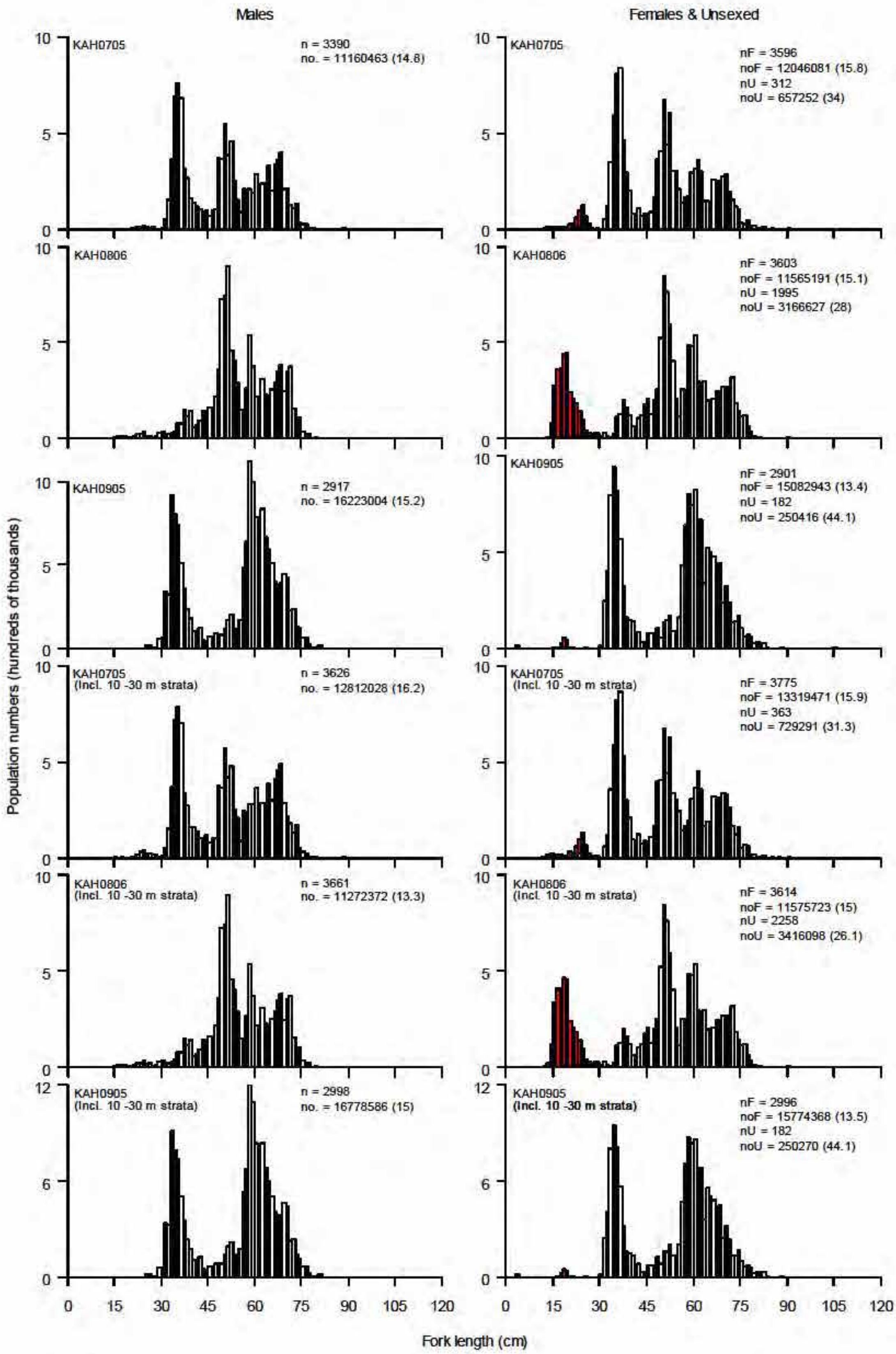


Figure A8b. Length frequencies of barracouta from the ECSI *Kaharoa* (KAH) winter surveys, 2007–2009, including shallower strata from 10–30m depth (bottom two panels).

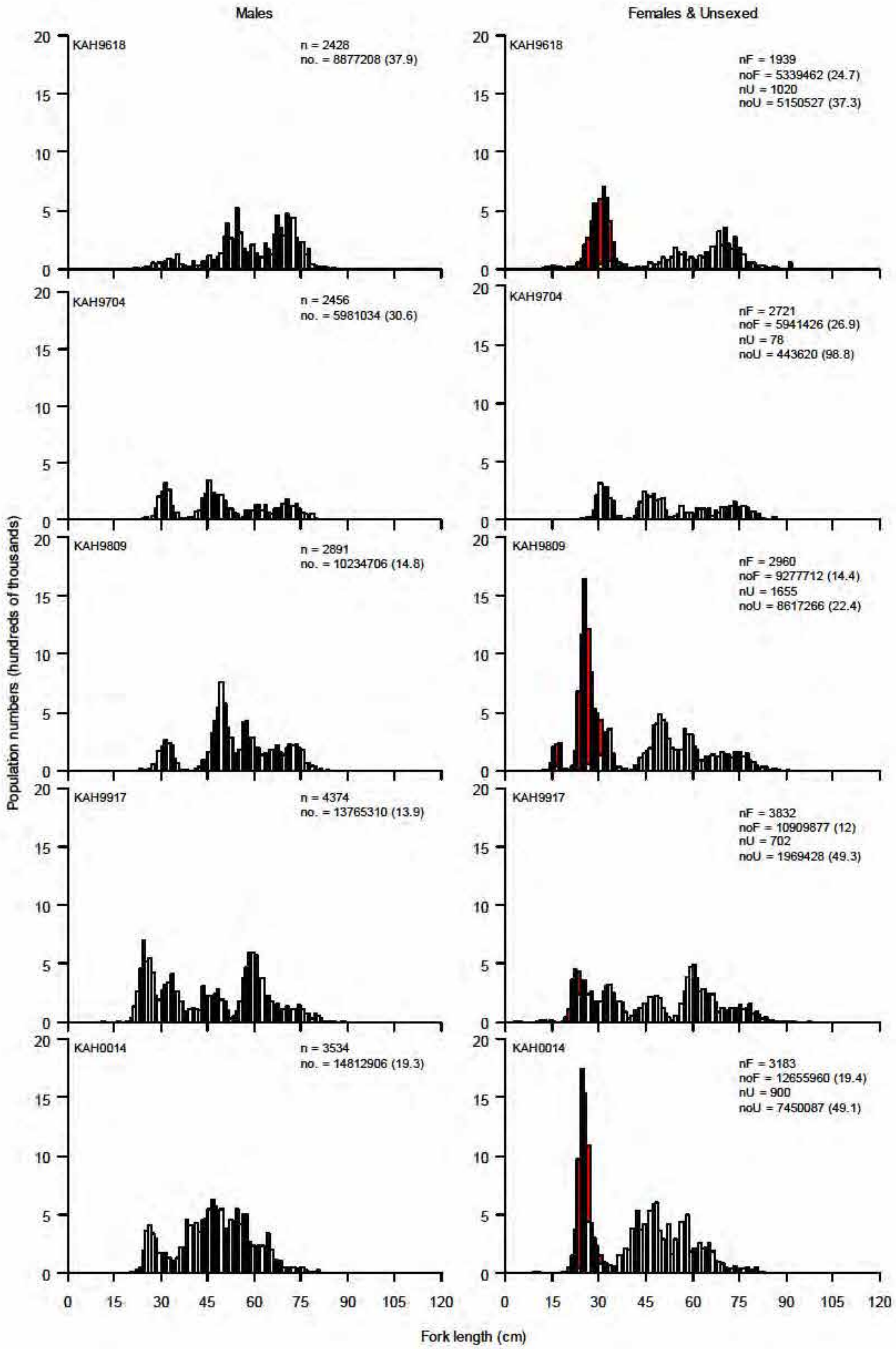


Figure A8c. Length frequencies of barracouta from the ECSI, from *Kaharoa* (KAH) summer surveys, 1996–2001.

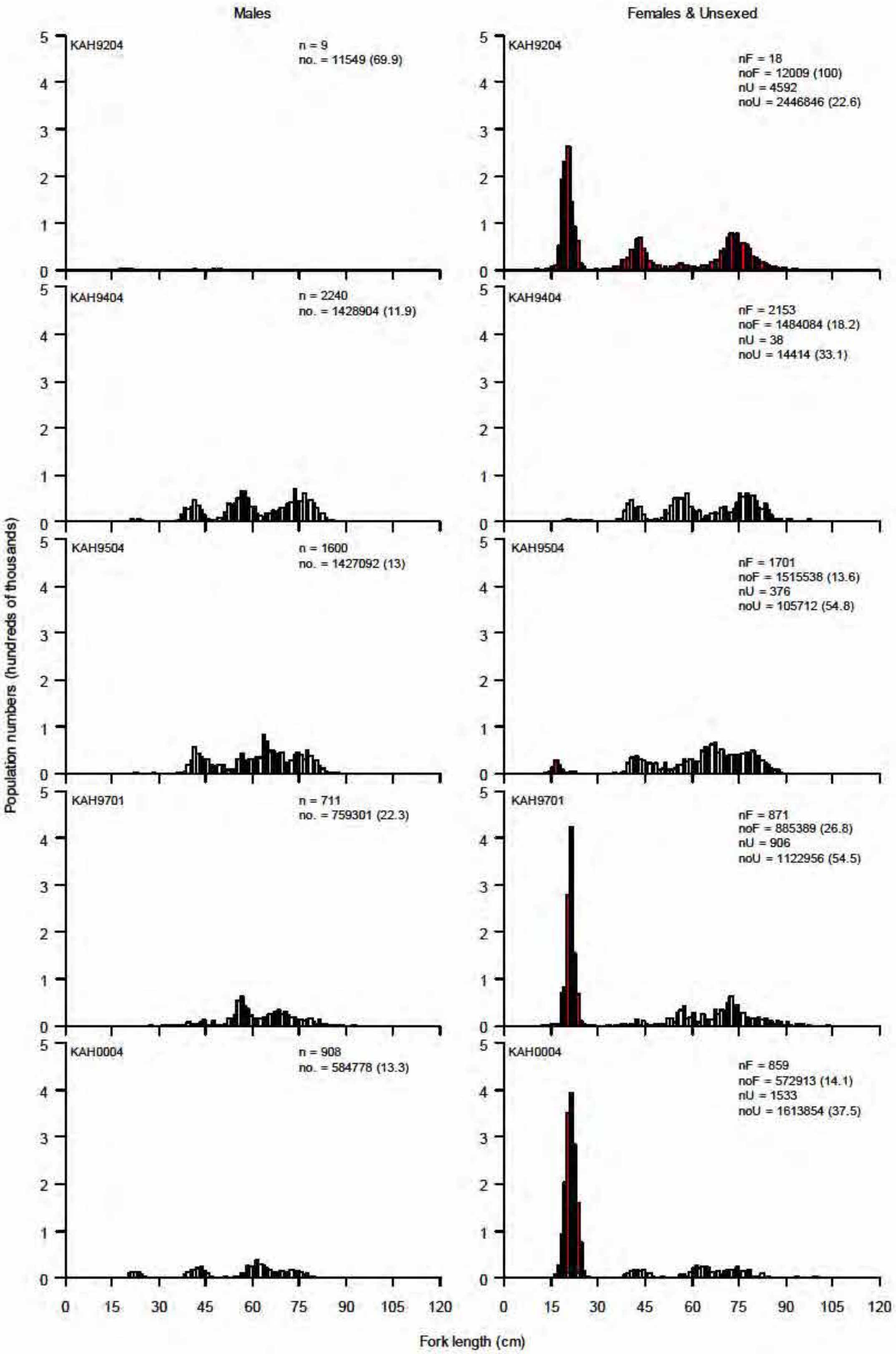


Figure A9a. Length frequencies of barracouta from the WCSI (WCSI only) *Kaharoa* (KAH) surveys, 1992–2000.

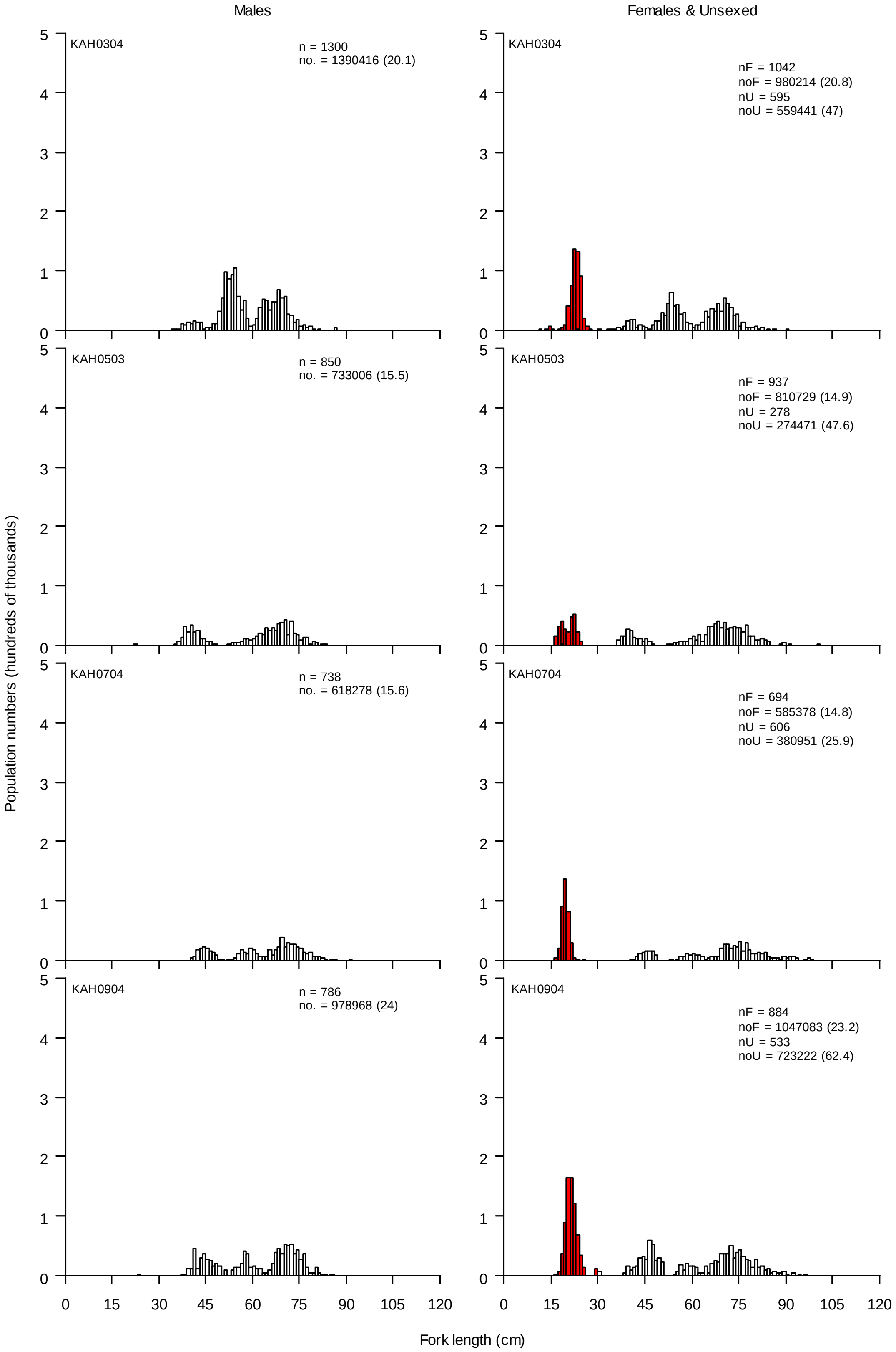


Figure A9a continued: Length frequencies of barracouta from the WCSI (WCSI only) *Kaharoa* (KAH) surveys, 2003–2009.

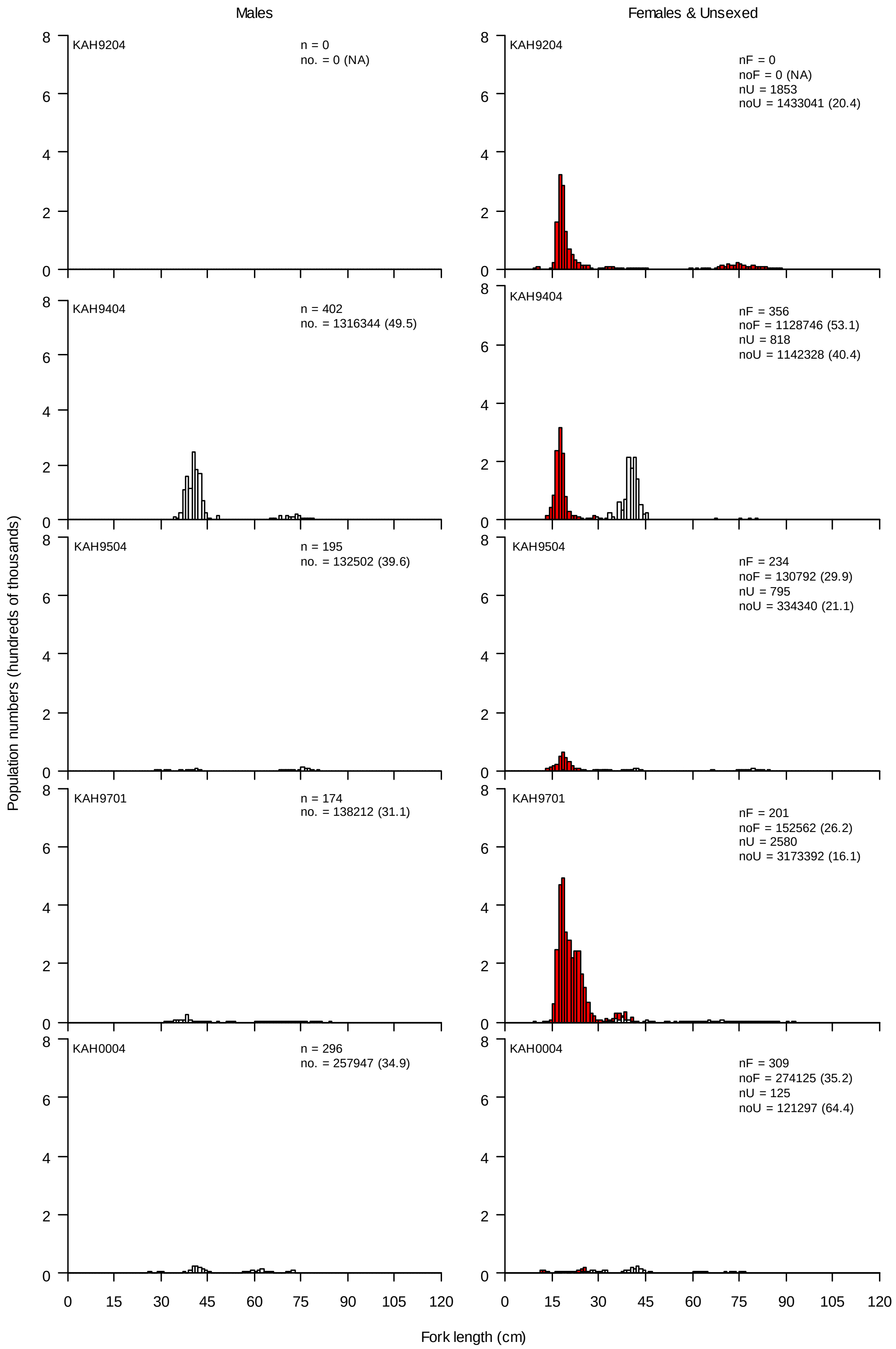


Figure A9b continued: Length frequencies of barracouta from the WCSI (Tasman and Golden Bays) *Kaharoa* (KAH) surveys, 1992–2000.

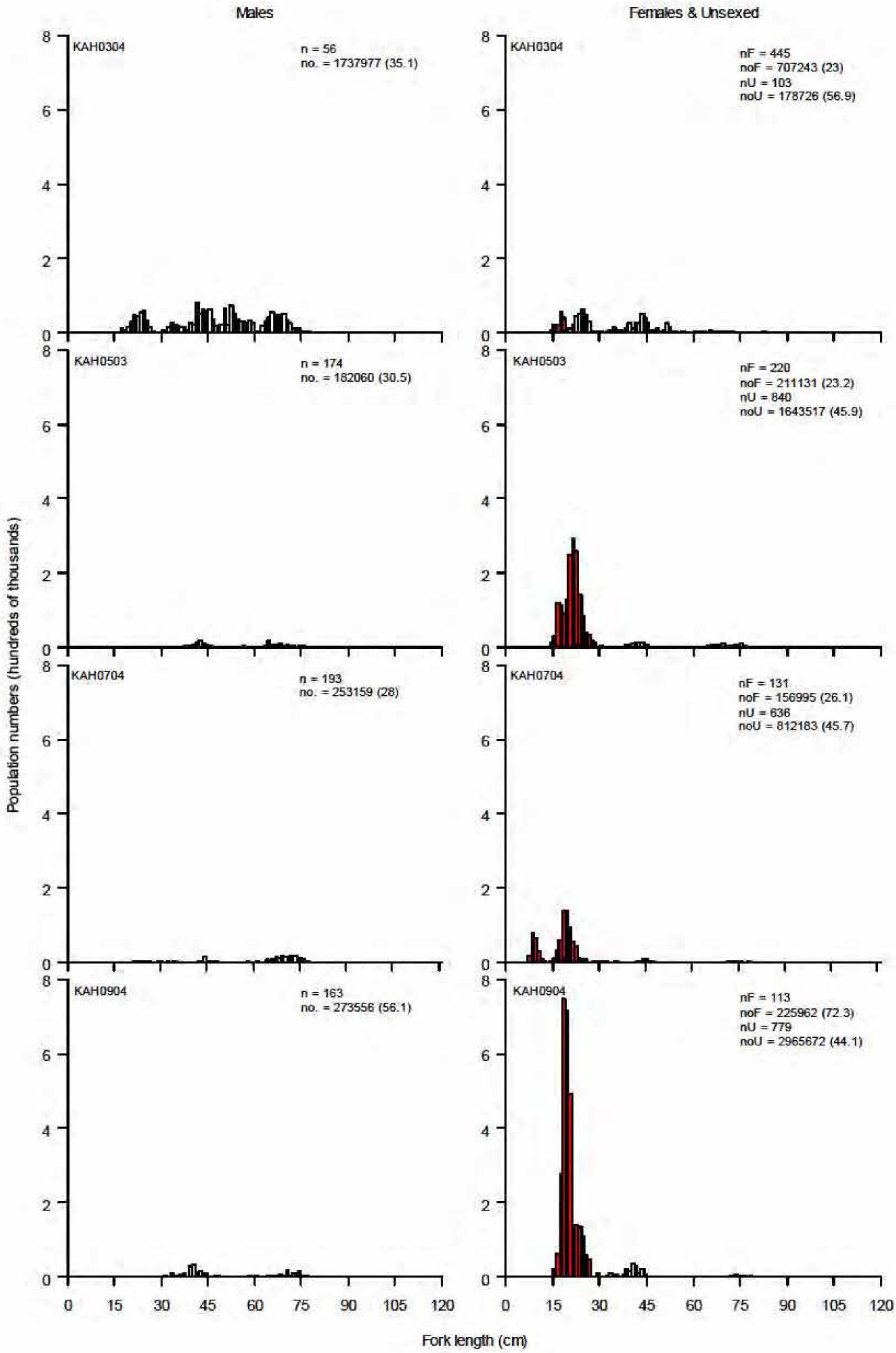


Figure A9b continued: Length frequencies of barracouta from the WCSI (Tasman and Golden Bays) *Kaharoa* (KAH) surveys, 2003–2009.

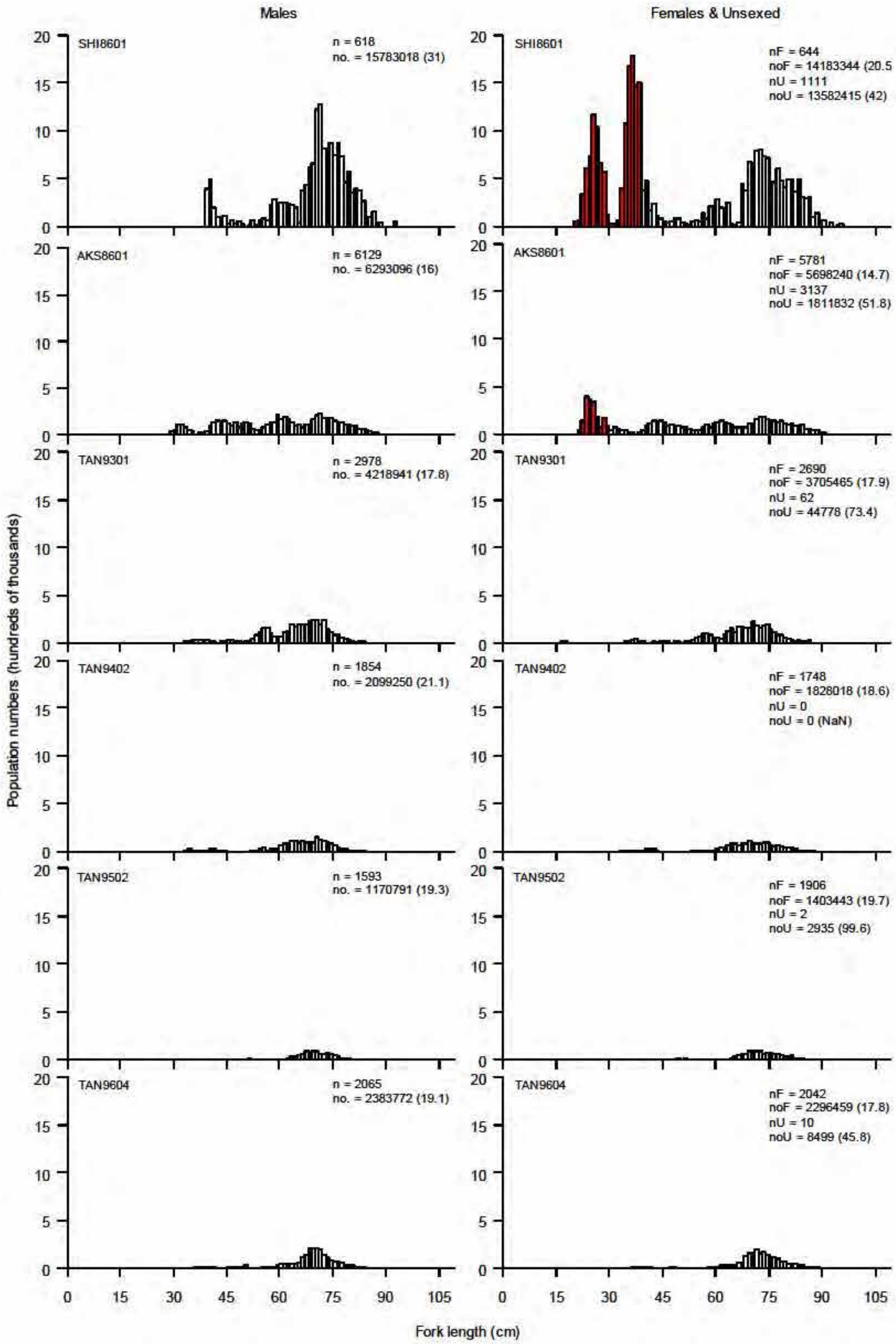


Figure A10a. Length frequencies of barracouta from surveys of Southland by *Shinkai Maru* (SHI) in June 1986, *Akebono Maru 3* (AKS) in November 1986, and *Tangaroa* (TAN) 1993–1996.

APPENDIX B. OBSERVER DATA

Table B1a: Number of trawl tows sampled for length from each barracouta area by the observer programme, for fishing years 1989–90 to 2007–08.

Year	SUBA	SNAR	WCSI	WCNI	ECSI	West Chat	East Chat	ECNI	Total
1989–90	0	1	0	0	0	0	0	0	1
1990–91	1	22	27	0	1	0	17	0	68
1991–92	0	22	1	0	1	0	0	0	24
1992–93	8	93	9	0	14	0	0	0	124
1993–94	62	94	30	12	12	0	0	0	210
1994–95	44	67	12	35	7	0	1	0	166
1995–96	44	26	40	0	5	0	0	0	115
1996–97	18	17	24	1	3	0	0	0	63
1997–98	0	40	3	3	2	0	0	1	49
1998–99	6	108	28	1	19	0	0	1	163
1999–00	53	132	25	20	22	6	4	1	263
2001–01	86	399	86	15	70	0	10	8	674
2001–02	37	227	42	35	31	0	23	0	395
2002–03	21	243	26	104	32	0	1	0	427
2003–04	22	237	18	57	8	0	0	0	342
2004–05	53	292	67	53	18	0	0	9	492
2005–06	91	227	23	104	19	0	0	1	465
2006–07	6	163	66	103	14	0	26	3	381
2007–08	8	130	48	96	38	3	23	4	350
Total	560	2 540	575	639	316	9	105	28	4 772

Table B1b: Percentage of observed barracouta catch from each area, for fishing years 1989–90 to 2007–08.

Year	SUBA	SNAR	WCSI	WCNI	ECSI	West Chat	East Chat	ECNI
1989–90	0.0	0.1	0.0	0.0	0.1	4.3	19.9	0.1
1990–91	0.5	1.8	4.3	0.0	0.7	0.0	1.0	0.0
1991–92	0.0	3.6	0.1	0.0	0.3	0.0	2.0	0.0
1992–93	3.1	10.9	1.6	0.0	0.9	0.0	5.6	0.0
1993–94	3.5	2.5	5.8	0.7	0.2	0.0	24.6	0.0
1994–95	3.6	1.0	0.9	1.3	2.2	0.0	0.5	0.0
1995–96	5.3	1.2	7.6	0.0	1.4	0.0	19.8	0.0
1996–97	2.0	1.7	4.5	0.1	6.5	0.0	11.6	0.0
1997–98	0.0	1.1	0.3	0.3	4.0	0.0	0.0	0.0
1998–99	8.0	6.0	5.5	0.2	3.2	0.0	0.0	0.0
1999–00	8.4	8.7	1.9	2.1	0.5	0.0	0.0	0.0
2001–01	20.3	25.6	7.4	2.5	0.1	0.0	0.0	0.0
2001–02	5.4	15.7	12.9	2.4	3.1	0.0	0.0	0.0
2002–03	8.7	11.5	2.7	7.0	9.3	0.0	0.0	0.0
2003–04	5.3	8.2	2.9	5.6	19.2	0.0	0.0	0.0
2004–05	11.0	6.5	15.3	3.1	0.0	0.0	0.0	0.0
2005–06	20.4	14.7	0.9	15.0	0.0	0.0	0.0	0.0
2006–07	67.8	7.9	10.6	11.3	0.0	0.0	0.0	0.0
2007–08	25.0	12.0	9.1	7.1	0.0	892.6*	0.0	0.0
Average	10.4	7.4	5.0	3.1	2.7	0.2*	4.5	0.0

***** Value exceeds 100% because of a mismatch of relatively small amounts of catch between observer records and total area catch. This value is not included in calculation of the annual average

Table B2: Number of tows by fishing year and month sampled for barracouta length from each area overall by the observer programme, for fishing years 1989–90 to 2007–08.

(a) Snares Shelf

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1989–90	1	-	-	-	-	-	-	-	-	-	-	-
1990–91	0	-	-	-	17	5	-	-	-	-	-	-
1991–92	6	15	-	-	-	1	-	-	-	-	-	-
1992–93	-	-	-	-	30	41	22	-	-	-	-	-
1993–94	-	-	-	-	18	44	32	-	-	-	-	-
1994–95	-	-	-	-	39	28	-	-	-	-	-	-
1995–96	-	-	-	2	19	2	3	-	-	-	-	-
1996–97	-	-	-	-	1	6	9	-	-	-	-	1
1997–98	-	-	-	-	30	9	1	-	-	-	-	-
1998–99	-	-	4	3	60	33	8	-	-	-	-	-
1999–00	-	-	-	7	39	77	8	1	-	-	-	-
2000–01	6	-	-	23	169	124	77	-	-	-	-	-
2001–02	-	-	-	1	103	87	36	-	-	-	-	-
2002–03	5	47	-	49	61	43	32	4	-	-	-	2
2003–04	-	-	-	57	119	34	27	-	-	-	-	-
2004–05	-	-	6	60	139	59	25	2	1	-	-	-
2005–06	-	5	8	45	32	101	32	4	-	-	-	-
2006–07	-	6	-	22	32	62	38	3	-	-	-	-
2007–08	1	-	1	1	61	36	30	-	-	-	-	-
Total	19	73	19	270	969	792	380	14	1	-	-	3

(b) Auckland Islands

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1989–90	-	-	-	-	-	-	-	-	-	-	-	-
1990–91	-	-	-	-	-	1	-	-	-	-	-	-
1991–92	-	-	-	-	-	-	-	-	-	-	-	-
1992–93	-	-	-	-	-	6	2	-	-	-	-	-
1993–94	-	-	-	-	2	53	7	-	-	-	-	-
1994–95	-	-	-	-	0	22	22	-	-	-	-	-
1995–96	-	-	-	-	2	9	30	3	-	-	-	-
1996–97	-	-	-	5	11	2	-	-	-	-	-	-
1997–98	-	-	-	-	-	-	-	-	-	-	-	-
1998–99	-	-	-	-	-	-	6	-	-	-	-	-
1999–00	-	-	-	2	38	13	-	-	-	-	-	-
2000–01	-	-	-	-	77	9	-	-	-	-	-	-
2001–02	-	-	-	-	8	24	5	-	-	-	-	-
2002–03	-	-	-	-	10	2	9	-	-	-	-	-
2003–04	-	-	-	-	7	15	-	-	-	-	-	-
2004–05	-	-	-	-	5	34	14	-	-	-	-	-
2005–06	-	-	-	-	39	39	13	-	-	-	-	-
2006–07	-	-	-	-	4	2	-	-	-	-	-	-
2007–08	-	-	-	-	-	2	6	-	-	-	-	-
Total	-	-	-	7	203	233	114	3	-	-	-	-

Table B2: continued.

(c) ECSI

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1989–90	-	-	1	-	-	-	-	-	-	-	-	-
1990–91	-	-	-	-	-	-	-	-	-		-	-
1991–92	-	-	-	-	-	-	-	-	-	1	-	-
1992–93	-	-	-	-	-	-	9	-	-	5	-	-
1993–94	-	-	-	-	-	-	4	8	-	-	-	-
1994–95	-	-	-	-	-	-	7	-	-	-	-	-
1995–96	-	-	4	-	-	-	-	1	-	-	-	-
1996–97	-	1	-	-	-	-	1	2	-	-	-	-
1997–98	-	2	-	-	-	-	-	-	-	-	-	-
1998–99	-	-	6	1	-	1	11	-	-	-	-	-
1999–00	-	-	-	4	-	12	-	6	-	-	-	-
2000–01	7	-	-	-	39	13	7	3	-	-	-	1
2001–02	9	-	-	-	-	1	19	2	-	-	-	-
2002–03	-	-	-	1	-	1	18	6	-	-	-	6
2003–04	1	-	-	-	1	1	5	-	-	-	-	-
2004–05	-	-	-	-	-	-	-	15	1	-	1	1
2005–06	-	-	-	-	-	6	-	3	-	-	9	1
2006–07	1	-	1	-	-	-	2	-	4	6	-	-
2007–08	-	-	-	-	-	-	-	-	3	10	11	14
Total	18	2	12	6	40	35	83	46	8	22	21	23

(d) WCNI

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1989–90	-	-	-	-	-	-	-	-	-	-	-	-
1990–91	-	-	-	-	-	-	-	-	-	-	-	-
1991–92	-	-	-	-	-	-	-	-	-	-	-	-
1992–93	-	-	-	-	-	-	-	-	-	-	-	-
1993–94	-	-	-	3	4	-	-	3	2	-	-	-
1994–95	-	-	7	16	-	12	-	-	-	-	-	-
1995–96	-	-	-		-	-	-	-	-	-	-	-
1996–97	-	-	-	1	-	-	-	-	-	-	-	-
1997–98	-	1	-	2	-	-	-	-	-	-	-	-
1998–99	-	-	-	-	-	-	-	-	-	-	-	1
1999–00	4	10	-	-	-	-	6	-	-	-	-	-
2000–01	2	2	9	-	-	-	1	-	-	1	-	-
2001–02	35	-	-	-	-	-	-	-	-	-	-	-
2002–03	86	11	-	-	-	-	7	-	-	-	-	-
2003–04	8	-	38	7	-	-	-	-	-	-	2	2
2004–05	-	6	9	-	-	-	4	-	4	30	-	-
2005–06	-	4	56	-	-	-	-	-	18	25	1	-
2006–07	20	-	23	30	-	-	18	-	1	2	5	4
2007–08	24	1	18	3	-	-	-	2	23	23	2	-
Total	179	35	160	62	4	12	36	5	48	81	10	7

Table B2: continued.

(e) WCSI

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1989–90	-	-	-	-	-	-	-	-	-	-	-	-
1990–91	-	-	-	-	-	-	-	-	-	-	11	16
1991–92	-	-	-	-	-	-	-	-	-	1	-	-
1992–93	-	-	-	-	-	-	-	-	-	-	3	6
1993–94	12	-	-	-	-	-	-	-	-	1	10	7
1994–95	-	-	-	-	-	-	-	-	1	6	4	1
1995–96	-	-	-	-	-	-	-	-	-	-	18	22
1996–97	-	-	-	-	-	-	-	-	2	-	7	15
1997–98	-	-	-	-	-	-	-	-	-	3	-	-
1998–99	-	-	-	-	-	-	-	-	4	10	8	6
1999–00	5	-	-	-	-	-	-	-	-	12	8	-
2000–01	5	-	-	-	-	-	-	-	-	37	30	14
2001–02	0	-	-	-	-	-	-	-	-	10	20	12
2002–03	15	-	-	-	-	-	-	-	-	1	6	4
2003–04	-	-	-	-	-	-	-	-	-	-	17	1
2004–05	-	2	-	-	-	-	-	-	-	12	46	7
2005–06	-	-	-	-	-	-	-	-	1	1	18	3
2006–07	6	-	-	-	1	1	1	-	18	15	23	1
2007–08	-	1	-	-	-	-	-	-	17	10	19	1
Total	43	3	-	-	1	1	1	-	43	119	248	116

Table B3: Number of barracouta measured by fishing year and month sampled from each tow by area by the observer programme, for fishing years 1989–90 to 2007–08, and the average sample size by month (Av SS).

(d) Snares Shelf

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1989–90	102	-	-	-	-	-	-	-	-	-	-	-
1990–91	-	-	-	-	1 662	499	-	-	-	-	-	-
1991–92	529	1 218	-	-	-	150	-	-	-	-	-	-
1992–93	-	-	-	-	782	1 268	1 276	-	-	-	-	-
1993–94	-	-	-	-	581	2 742	1 269	-	-	-	-	-
1994–95	-	-	-	-	617	953	-	-	-	-	-	-
1995–96	-	-	-	97	601	173	268	-	-	-	-	-
1996–97	-	-	-	-	6	55	858	-	-	-	-	50
1997–98	-	-	-	-	991	488	104	-	-	-	-	-
1998–99	-	-	189	14	1 910	2 081	499	-	-	-	-	-
1999–00	-	-	-	219	1 609	5 075	806	20	-	-	-	-
2000–01	613	-	-	1 181	5 412	4 404	3 672	-	-	-	-	-
2001–02	-	-	-	10	4 568	3 782	896	-	-	-	-	-
2002–03	539	3 672	-	491	2 141	835	1 335	27	-	-	-	6
2003–04	-	-	-	863	2 680	1 544	1 636	-	-	-	-	-
2004–05	-	-	257	877	3 447	1 756	1 450	21	47	-	-	-
2005–06	-	24	122	864	1 347	5 696	1 716	23	-	-	-	-
2006–07	-	573	-	206	264	1 717	1 907	147	-	-	-	-
2007–08	20	-	20	20	1 002	515	837	-	-	-	-	-
Total	1 803	5 487	588	4 842	29 620	33 733	18 529	238	47	-	-	19
Av SS	95	75	31	18	31	43	49	17	47	-	-	6

Table B3: continued.

(b) Auckland Islands

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1990–91	-	-	-	-	-	131	-	-	-	-	-	-
1991–92	-	-	-			740			-	-	-	-
1992–93	-	-	-	-	-	222	169	-	-	-	-	-
1993–94	-	-	-	-	46	698	27	-	-	-	-	-
1994–95	-	-	-	-	-	23	179	-	-	-	-	-
1995–96	-	-	-	-	13		296	125	-	-	-	-
1996–97	-	-	-	57	153	-	-	-	-	-	-	-
1997–98	-	-	-			228			-	-	-	-
1998–99	-	-	-	-	-	153	171	-	-	-	-	-
1999–00	-	-	-	40	363	155	-	-	-	-	-	-
2000–01	-	-	-	-	669	71	-	-	-	-	-	-
2001–02	-	-	-	-	72	92	64	-	-	-	-	-
2002–03	-	-	-	-	130	570	145	-	-	-	-	-
2003–04	-	-	-	-	32	359	-	-	-	-	-	-
2004–05	-	-	-	-	32	11	294	-	-	-	-	-
2005–06	-	-	-	-	164	11	151	-	-	-	-	-
2006–07	-	-	-	-	8		-	-	-	-	-	-
2007–08	-	-	-	-	-	131	95	-	-	-	-	-
Total	-	-	-	97	1,682	3,595	1,591	125	-	-	-	-
Av SS	-	-	-	14	8	15	14	42				

(c) ECSI

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1990–91	-	-	77	-	-	-	-	-	-	-	-	-
1991–92	-	-	-	-	-	-	-	-	-	102	-	-
1992–93	-	-	-	-	-	-	44	-	-	453	-	-
1993–94	-	-	-	-	-	-	104	110	-	-	-	-
1994–95	-	-	-	-	-	-	757	-	-	-	-	-
1995–96	-	-	22	-	-	-	-	2	-	-	-	-
1996–97	-	-	-	-	-	-	110	216	-	-	-	-
1997–98	-	22	-	-	-	-	-	-	-	-	-	-
1998–99	-	-	28	1	-	27	1045	-	-	-	-	-
1999–00	-	-	-	172	-	547	-	348	-	-	-	-
2000–01	685	-	-	-	1,956	530	188	305	-	-	-	7
2001–02	929	-	-	-	-	10	402	173	-	-	-	-
2002–03	-	-	-	98	-	118	795	52	-	-	-	234
2003–04	10	-	-	-	8	5	150	-	-	-	-	-
2004–05	-	-	-	-	-	-	-	180	2	-	1	1
2005–06	-	-	-	-	-	315	-	206	-	-	869	90
2006–07	100	-	10	-	-	-	191	-	416	581	-	-
2007–08	-	-	-	-	-	-	-	-	250	819	977	1,300
Total	1,724	22	137	271	1,964	1552	3786	1,592	668	1,955	1,847	1,632
Av SS	96	11	11	45	49	44	46	35	84	89	88	71

Table B3: continued.

(d) WCNI

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1990–91	-	-	-	-	-	-	-	-	-	-	-	-
1991–92	-	-	-	-	-	-	-	-	-	-	-	-
1992–93	-	-	-	-	-	-	-	-	-	-	-	-
1993–94	-	-	-	50	43	-	-	75	100	-	-	-
1994–95	-	-	161	478	-	598	-	-	-	-	-	-
1995–96												117
1996–97	-	-	-	40	-	-	-	-	-	-	-	-
1997–98	-	20	-	50	-	-	-	-	-	-	-	-
1998–99	-	-	-	-	-	-	-	-	-	-	-	-
1999–00	211	143	-	-	-	-	134	-	-	-	-	-
2000–01	40	158	667	-	-	-	6	-	-	19	-	226
2001–02	592	-	-	-	-	-	-	-	-	-	-	-
2002–03	887	120	-	-	-	-	97	-	-	-	-	-
2003–04	420	-	438	453	-	-	-	-	-	-	202	80
2004–05	-	70	100	-	-	-	65	-	39	1.823	-	-
2005–06	-	62	2,099	-	-	-	-	-	283	1.256	22	-
2006–07	1,067	-	395	280	-	-	615	-	20	95	358	-
2007–08	565	1	352	60	-	-	-	3	756	1.170	40	117
Total	3,782	574	4,212	1,411	43	598	917	78	1.198	4.363	622	540
Av SS	21	16	26	23	11	50	25	16	25	54	62	77

(e) WCSI

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1990–91	-	-	-	-	-	-	-	-	-	-	1,036	1,614
1991–92	-	-	-	-	-	-	-	-	-	49	-	-
1992–93	-	-	-	-	-	-	-	-	-	-	119	428
1993–94	300	-	-	-	-	-	-	-	-	30	105	189
1994–95	-	-	-	-	-	-	-	-	60	196	26	41
1995–96	-	-	-	-	-	-	-	-	-	-	735	1,041
1996–97	-	-	-	-	-	-	-	-	55	-	71	942
1997–98	-	-	-	-	-	-	-	-	-	100	-	-
1998–99	-	-	-	-	-	-	-	-	186	265	165	836
1999–00	149	-	-	-	-	-	-	-	-	75	131	-
2000–01	76	-	-	-	-	-	-	-	-	830	376	619
2001–02	-	-	-	-	-	-	-	-	-	742	820	144
2002–03	129	-	-	-	-	-	-	-	-	2	137	387
2003–04	-	-	-	-	-	-	-	-	-	-	735	39
2004–05	-	70	-	-	-	-	-	-	-	471	3051	748
2005–06	-	-	-	-	-	-	-	-	5	20	232	109
2006–07	488	-	-	-	100	20	20	-	1,001	994	723	10
2007–08	-	10	-	-	-	-	-	-	924	487	1186	20
Total	1,142	80	-	-	100	20	20	-	2,231	4,261	9648	7,167
Av SS	27	27	-	-	100	20	20	-	52	36	39	62

Table B4: Maximum length (cm) cut-offs used as a guideline for determination of age classes from barracouta length frequency modes, based on survey and observer LFs for ECSI, SNAR, and WCSI (with reference to Harley et al. 1999, Hurst et al 2000, Langley & Bentley 2002). Ranges given are maxima for both sexes combined (females are slightly larger by age 3).

Age class	Mid-year	End of year	Harley et al. 4–6 months (based on mean + 2.s.d.)	Hurst et al. (up to 3, 6, 9, 12 months)	Langley & Bentley (mostly up to 8 months)
0+	25	32	22	20, 25, 30, 32	25
1+	43	47	47	36, 40, 42, 45	45
2+	53	63	51		55
3+	62	70	68		65

Table B5: Number of barracouta otolith pairs collected by the Observer programme by region from fishing years 1991−92 to 2008–09 and during research (*RV Tangaroa*) surveys[1].

	Scientific observer programme							*Tangaroa* surveys
Fishing Year	CHAT(E)	CHAT(W)	ECSI	SOU	SubA	NNI	WCSI	Southland
1991–92			10	63			1	
1992–93			58	358	46		10	835
1993–94			26	458	190	11	154	704
1994–95	10	1	80	233	118	64	52	847
1995–96				79	112		116	628
1996–97			25	43	1		102	
1997–98			8	248		24	5	
1998–99			55	555	27		142	
1999–00		4	71	442	189	26	152	
2000–01	27		346	1 392	222	62	255	
2001–02	35		106	976	99	358	220	
2002–03	3		171	1 194	85	604	361	
2003–04			31	1 151	65	192	129	
2004–05			67	1 631	235	239	515	
2005–06			138	1 096	336	479	202	
2006–07	110	34	114	857	2	569	561	
2007–08	155	100	305	805	65	429	471	
2008−09		5	76	571	14	205	277	
Total	340	144	1 687	12 152	1 806	3 262	3 725	3 014

1 Additional structures have been collected and aged from research surveys but, as of February 2010, only 45 from the Chatham Rise survey in 1992 were catalogued in the *age* database; numerous otoliths collected on barracouta surveys from 1980–86 are not on the database

2 SOU, Southland, NNI, mainly WCNI but includes some ECNI; SubA, FMA 6

Table B6: Number of female barracouta gonads staged by fishing year and month sampled from each area by the observer programme.

(a) Snares Shelf

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1989–90	0	-	-	-	-	-	-	-	-	-	-	-
1990–91	-	-	-	-	251	234	-	-	-	-	-	-
1991–92	66	260	-	-	-	0	-	-	-	-	-	-
1992–93	-	-	-	-	363	687	656	-	-	-	-	-
1993–94	-	-	-	-	229	1,449	781	-	-	-	-	-
1994–95	-	-	-	-	343	489	-	-	-	-	-	-
1995–96	-	-	-	67	347	104	155	-	-	-	-	-
1996–97	-	-	-	-	5	15	438	-	-	-	-	0
1997–98	-	-	-	-	555	260	44	-	-	-	-	-
1998–99	-	-	93	10	1,241	1,146	252	-	-	-	-	-
1999–00	-	-	-	141	886	2,827	464	13	-	-	-	-
2000–01	228	-	-	602	2,938	2,220	1,721	-	-	-	-	-
2001–02	-	-	-	4	2,480	1,958	435	-	-	-	-	-
2002–03	240	1612	-	294	1,161	414	651	17	-	-	-	4
2003–04	-	-	-	434	1,394	757	826	-	-	-	-	-
2004–05	-	-	114	494	1,643	859	695	13	34	-	-	-
2005–06	-	16	62	454	632	2,722	914	12	-	-	-	-
2006–07	-	129	-	111	170	847	957	62	-	-	-	-
2007–08	15	-	1	4	498	283	398	-	-	-	-	-
Total	549	2017	270	2,615	15,136	17,271	9,387	117	34	-	-	4

(b) Auckland Islands

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1990–91	-	-	-	-	-	14	-	-	-	-	-	-
1991–92	-	-	-						-	-	-	-
1992–93	-	-	-	-	-	69	98	-	-	-	-	-
1993–94	-	-	-	-	21	445	18	-	-	-	-	-
1994–95	-	-	-	-	-	147	132	-	-	-	-	-
1995–96	-	-	-	-	10	292	788	93	-	-	-	-
1996–97	-	-	-	3	10	1	-	-	-	-	-	-
1997–98	-	-	-	-					-	-	-	-
1998–99	-	-	-	-	-	-	101	-	-	-	-	-
1999–00	-	-	-	26	239	166	-	-	-	-	-	-
2000–01	-	-	-	-	959	86	-	-	-	-	-	-
2001–02	-	-	-	-	54	80	32	-	-	-	-	-
2002–03	-	-	-	-	94	51	97	-	-	-	-	-
2003–04	-	-	-	-	23	59	-	-	-	-	-	-
2004–05	-	-	-	-	15	334	190	-	-	-	-	-
2005–06	-	-	-	-	96	164	93	-	-	-	-	-
2006–07	-	-	-	-	3	8	-	-	-	-	-	-
2007–08	-	-	-	-	-	6	52	-	-	-	-	-
Total	-	-	-	29	1,524	1,922	1,601	93	-	-	-	-

Table B6: continued.

(c) ECSI

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1990–91	-	-	51	-	-	-	-	-	-	-	-	-
1991–92	-	-	-	-	-	-	-	-	-	53	-	-
1992–93	-	-	-	-	-	-	16	-	-	219	-	-
1993–94	-	-	-	-	-	-	62	52	-	-	-	-
1994–95	-	-	-	-	-	-	364	-	-	-	-	-
1995–96	-	-	11	-	-	-	-	2	-	-	-	-
1996–97	-	-	-	-	-	-	57	104	-	-	-	-
1997–98	-	12	-	-	-	-	-	-	-	-	-	-
1998–99	-	-	7	0	-	14	513	-	-	-	-	-
1999–00	-	-	-	102	-	279	-	201	-	-	-	-
2000–01	121	-	-	-	1,044	272	115	116	-	-	-	1
2001–02	434	-	-	-	-	7	221	85	-	-	-	-
2002–03	-	-	-	57	-	33	418	38	-	-	-	125
2003–04	7	-	-	-	3	1	80	-	-	-	-	-
2004–05	-	-	-	-	-	-	-	81	1	-	0	1
2005–06	-	-	-	-	-	163	-	109	-	-	493	42
2006–07	50	-	4	-	-	-	84	-	227	242	-	-
2007–08	-	-	-	-	-	-	-	-	94	437	555	705
Total	612	12	73	159	1,047	769	1,930	788	322	951	1,048	874

(d) WCNI

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1990–91	-	-	-	-	-	-	-	-	-	-	-	-
1991–92	-	-	-	-	-	-	-	-	-	-	-	-
1992–93	-	-	-	-	-	-	-	-	-	-	-	-
1993–94	-	-	-	21	24	-	-	38	57	-	-	-
1994–95	-	-	92	188	-	318	-	-	-	-	-	-
1995–96												
1996–97	-	-	-	15	-	-	-	-	-	-	-	-
1997–98	-	15	-	28	-	-	-	-	-	-	-	-
1998–99	-	-	-	-	-	-	-	-	-	-	-	71
1999–00	105	76	-	-	-	-	27	-	-	-	-	-
2000–01	12	52	230	-	-	-	1	-	-	16	-	-
2001–02	300	-	-	-	-	-	-	-	-	-	-	-
2002–03	402	37	-	-	-	-	61	-	-	-	-	-
2003–04	120	-	246	188	-	-	-	-	-	-	105	102
2004–05	-	34	49	-	-	-	36	-	19	920	-	-
2005–06	-	35	979	-	-	-	-	-	123	567	20	-
2006–07	357	-	164	115	-	-	305	-	10	54	247	36
2007–08	232	8	144	38	-	-	-	3	354	630	33	-
Total	1,528	257	1,904	593	24	318	430	41	563	2,187	405	209

Table B6: continued.

(e) WCSI

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1990–91	-	-	-	-	-	-	-	-	-	-	87	-
1991–92	-	-	-	-	-	-	-	-	-	26	-	-
1992–93	-	-	-	-	-	-	-	-	-	-	59	205
1993–94	90	-	-	-	-	-	-	-	-	21	45	84
1994–95	-	-	-	-	-	-	-	-	30	103	11	14
1995–96	-	-	-	-	-	-	-	-	-	-	379	428
1996–97	-	-	-	-	-	-	-	-	36	-	22	358
1997–98	-	-	-	-	-	-	-	-	-	50	-	-
1998–99	-	-	-	-	-	-	-	-	88	154	63	245
1999–00	81	-	-	-	-	-	-	-	-	43	50	-
2000–01	36	-	-	-	-	-	-	-	-	407	207	178
2001–02	-	-	-	-	-	-	-	-	-	252	270	75
2002–03	69	-	-	-	-	-	-	-	-	2	41	124
2003–04	-	-	-	-	-	-	-	-	-	-	293	20
2004–05	-	36	-	-	-	-	-	-	-	222	1,403	207
2005–06	-	-	-	-	-	-	-	-	1	8	99	37
2006–07	207	-	-	-	-	12	16	-	530	449	234	2
2007–08	-	6	-	-	-	-	-	-	468	285	431	8
Total	483	42	-	-	-	12	16	-	1,153	2,022	3,694	1,985

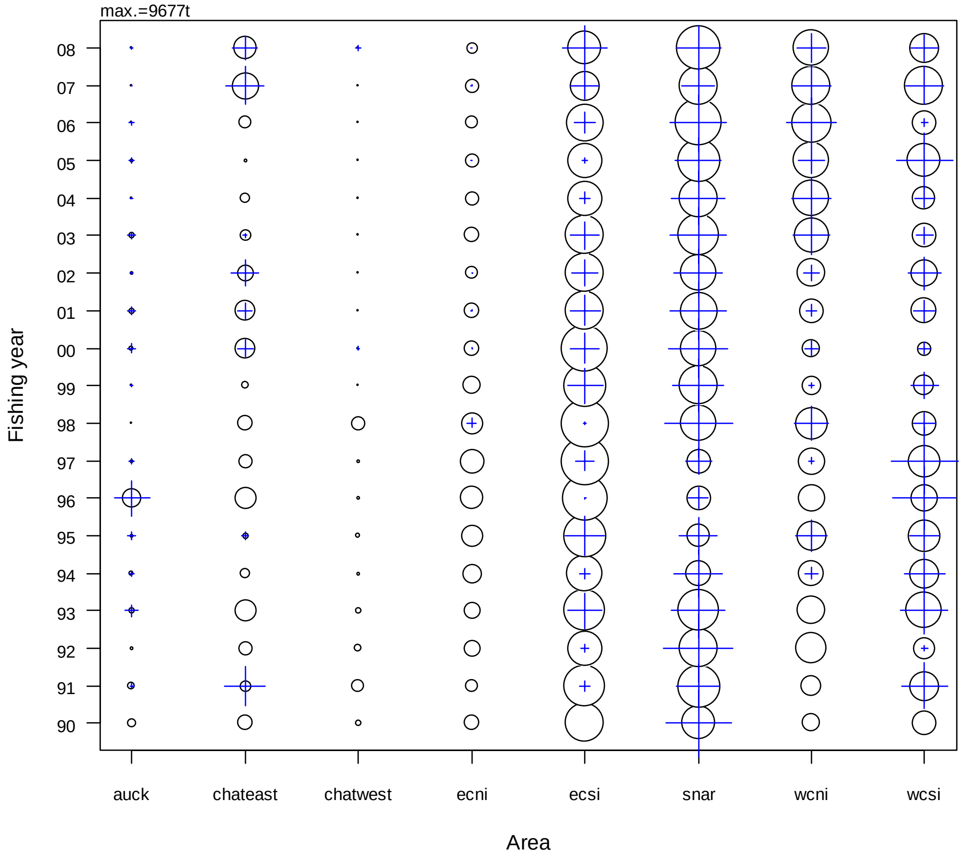
(f) CHAT WEST

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1990–91	-	-	-	-	-	-	-	-	-	-	-	-
1991–92	-	-	-	-	-	-	-	-	-	-	-	-
1992–93	-	-	-	-	-	-	-	-	-	-	-	-
1993–94	-	-	-	-	-	-	-	-	-	-	-	-
1994–95	-	-	-	-	-	-	-	-	-	-	-	-
1995–96	-	-	-	-	-	-	-	-	-	-	-	-
1996–97	-	-	-	-	-	-	-	-	-	-	-	-
1997–98	-	-	-	-	-	-	-	-	-	-	-	-
1998–99	-	-	-	-	-	-	-	-	-	-	-	-
1999–00	-	-	-	-	-	-	-	8	98	-	-	-
2000–01	-	-	-	-	-	-	-	-	-	-	-	-
2001–02	-	-	-	-	-	-	-	-	-	-	-	-
2002–03	-	-	-	-	-	-	-	-	-	-	-	-
2003–04	-	-	-	-	-	-	-	-	-	-	-	-
2004–05	-	-	-	-	-	-	-	-	-	-	-	-
2005–06	-	-	-	-	-	-	-	-	-	-	-	-
2006–07	-	-	-	-	-	-	-	-	-	-	-	-
2007–08	-	-	-	-	-	-	-	-	-	-	-	122
Total	-	-	-	-	-	-	-	8	98	-	-	122

Table B6: continued.

(g) CHAT EAST

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1990–91	-	-	-	67	-	-	-	-	-	-	-	-
1991–92	-	-	-	-	-	-	-	-	-	-	-	-
1992–93	-	-	-	-	-	-	-	-	-	-	-	-
1993–94	-	-	-	-	-	-	-	-	-	-	-	-
1994–95	-	-	-	-	-	-	-	-	-	-	-	-
1995–96	-	-	-	-	-	-	-	-	-	-	-	-
1996–97	-	-	-	-	-	-	-	-	-	-	-	-
1997–98	-	-	-	-	-	-	-	-	-	-	-	-
1998–99	-	-	-	-	-	-	-	-	-	-	-	-
1999–00	-	-	-	-	-	-	-	-	-	-	-	163
2000–01	-	-	-	-	-	-	-	-	-	-	-	596
2001–02	-	-	-	-	-	-	-	399	-	-	-	-
2002–03	10	-	-	-	-	-	-	-	-	-	-	-
2003–04	-	-	-	-	-	-	-	-	-	-	-	-
2004–05	-	-	-	-	-	-	-	-	-	-	-	-
2005–06	-	-	-	-	-	-	-	-	-	-	-	-
2006–07	-	-	-	-	-	-	-	1,157	-	180	-	-
2007–08	-	-	-	-	-	-	-	-	31	162	163	469
Total	10	-	-	67	-	-	-	1,556	31	342	163	1,228



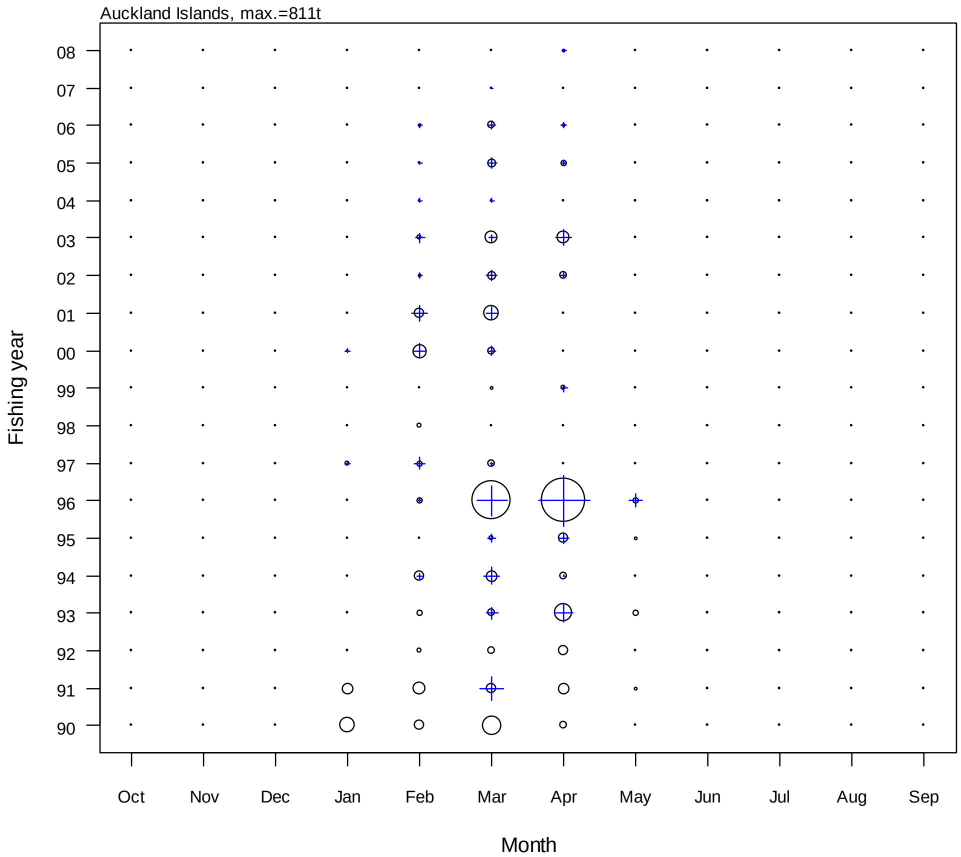
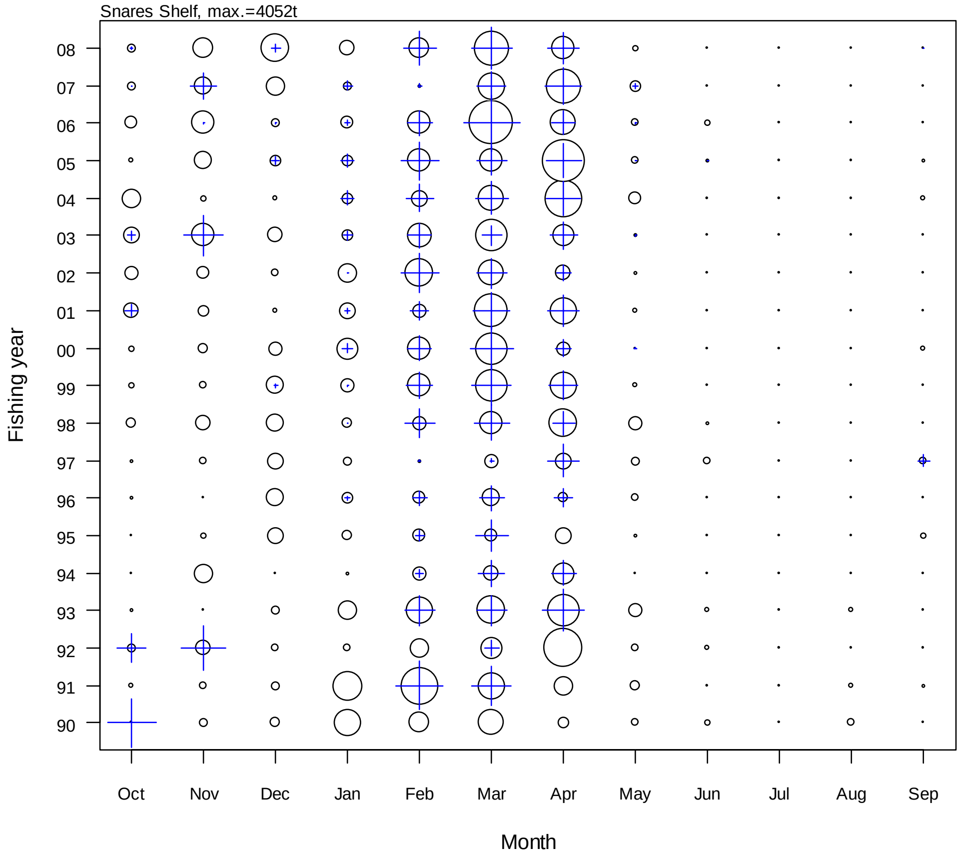


Figure B1: Representativeness of observer sampling of barracouta catch by fishing year and area (top panel) and by fishing year and month (bottom panel) for the Auckland Islands, Snares Shelf, ECSI, WCSI, and WCNI. Circles show the proportion of target catch by month within a year; crosses show the proportion of observed target catch for the same cells. Representation is demonstrated by how closely the cross matches the circle diameter.



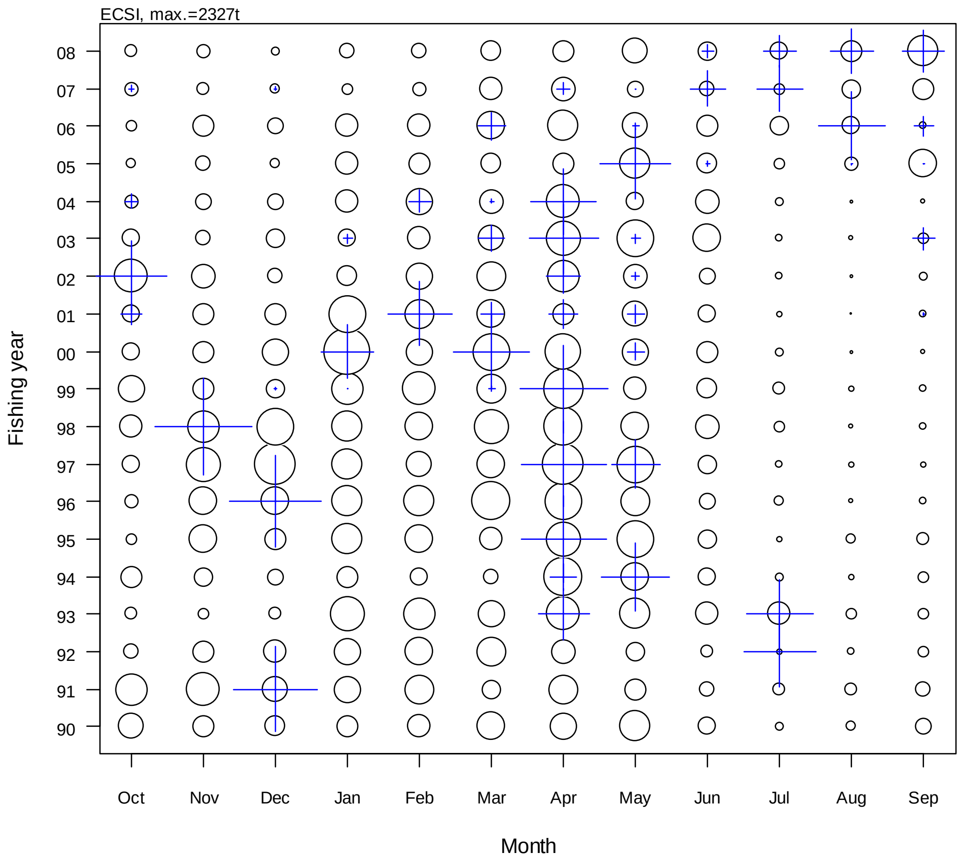
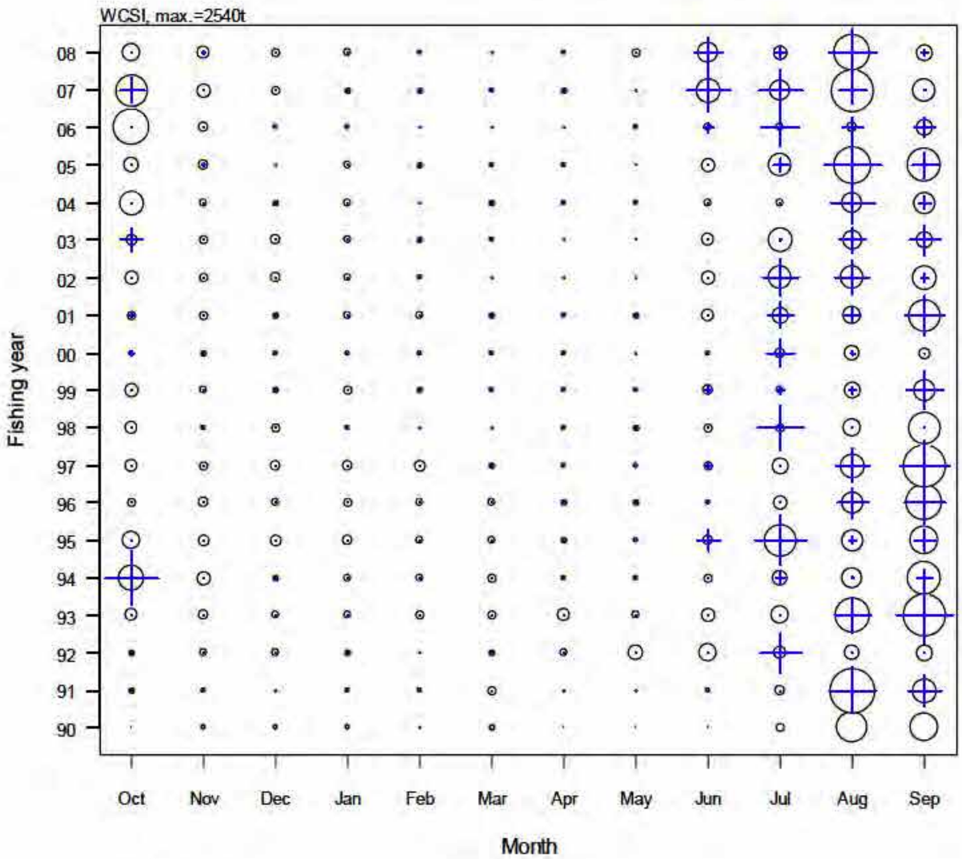


Figure B1: continued.



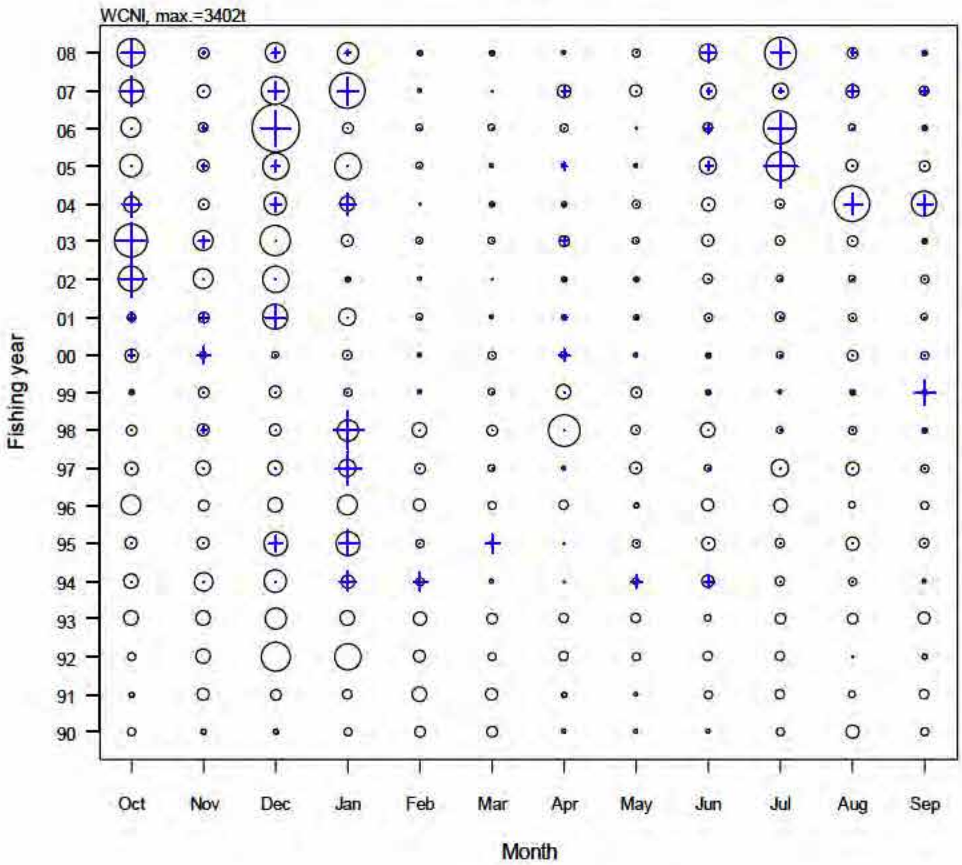


Figure B1: continued.

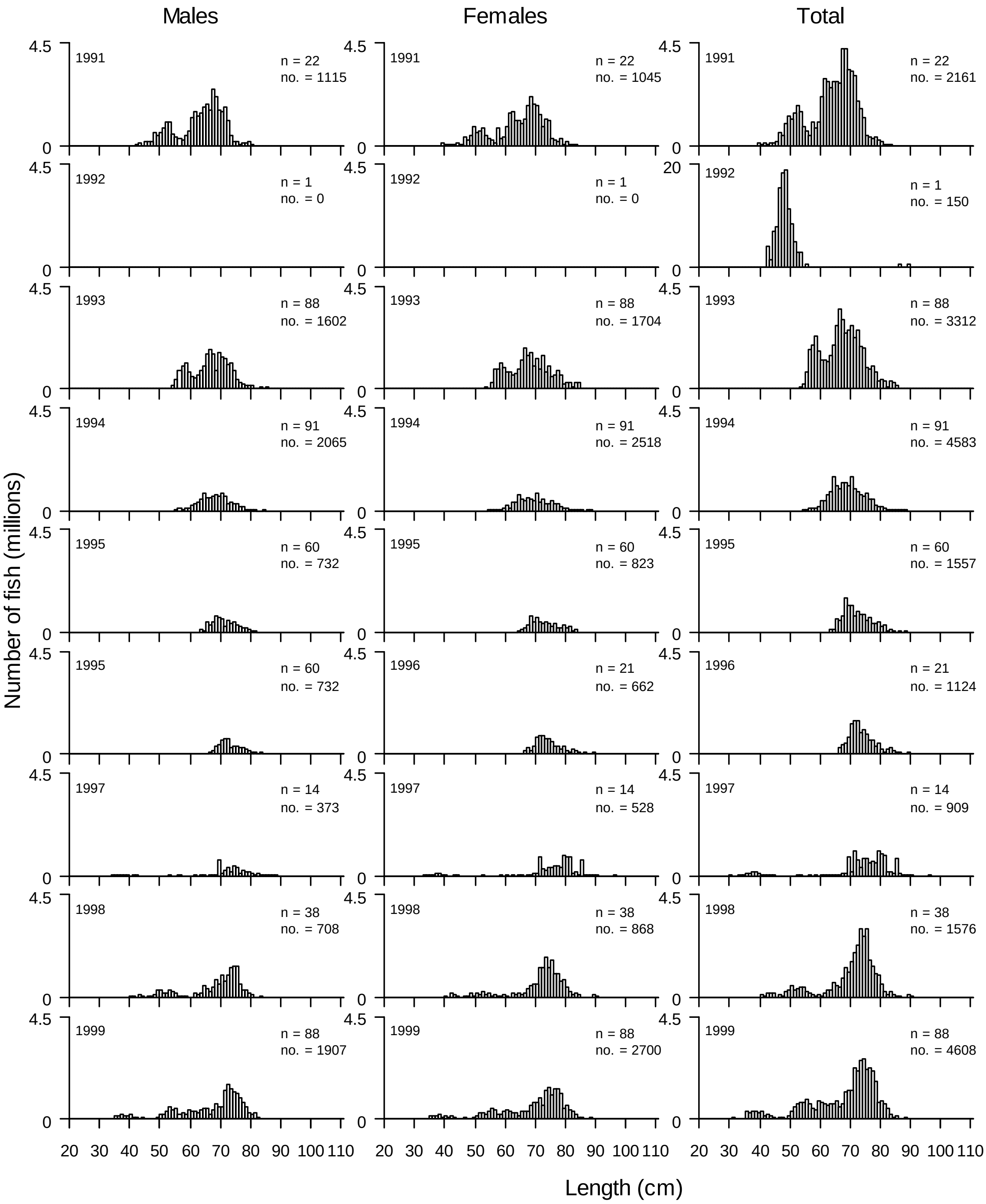


Figure B2: Scaled length frequency of barracouta taken in commercial catches from the SNARES SHELF trawl fishery by fishing year sampled by the Observer Programme. n, number of tows sampled; no., number of fish sampled. Note that the vertical axis changes in some cases to accommodate exceptionally large or small numbers.

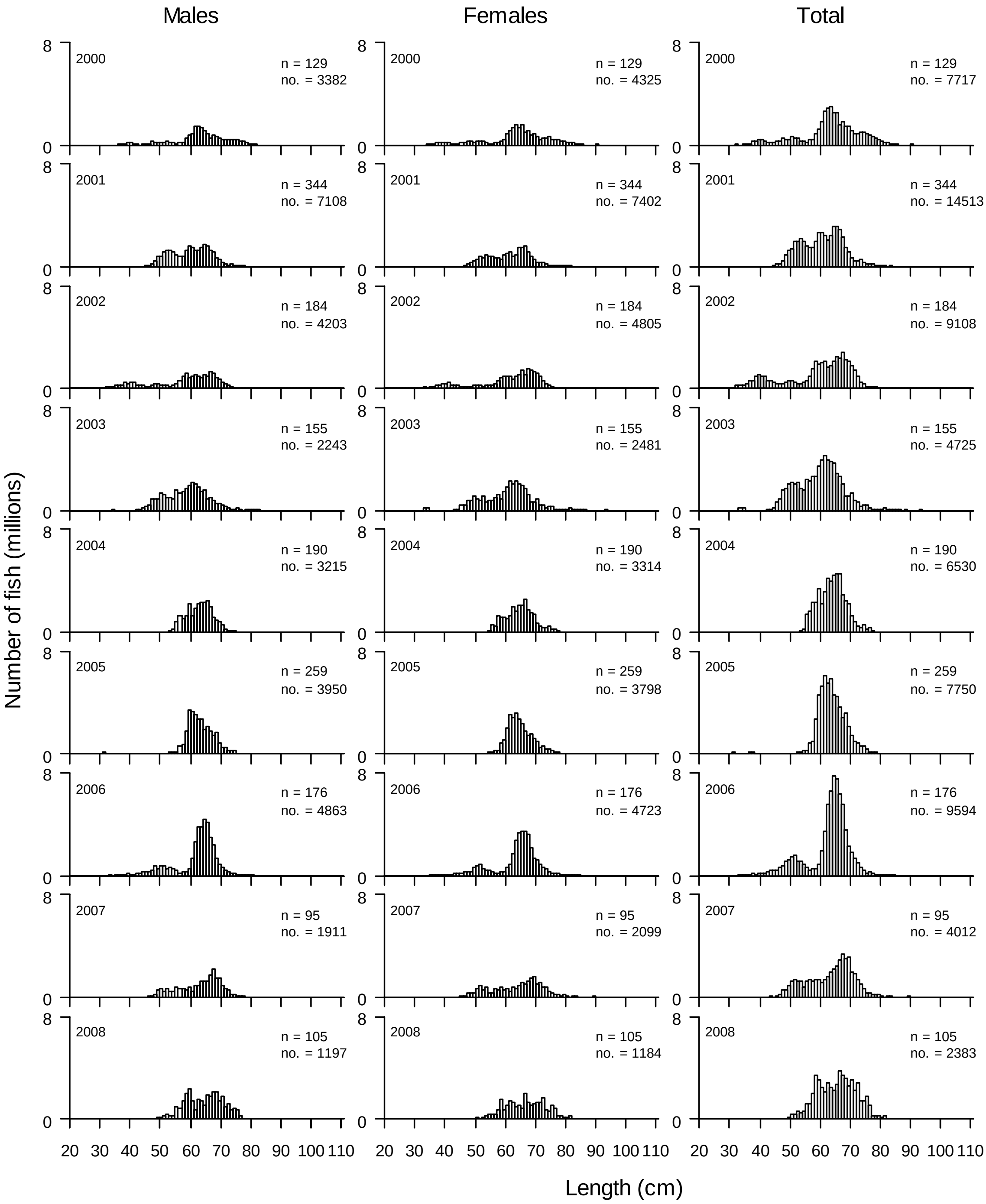


Figure B2: continued.

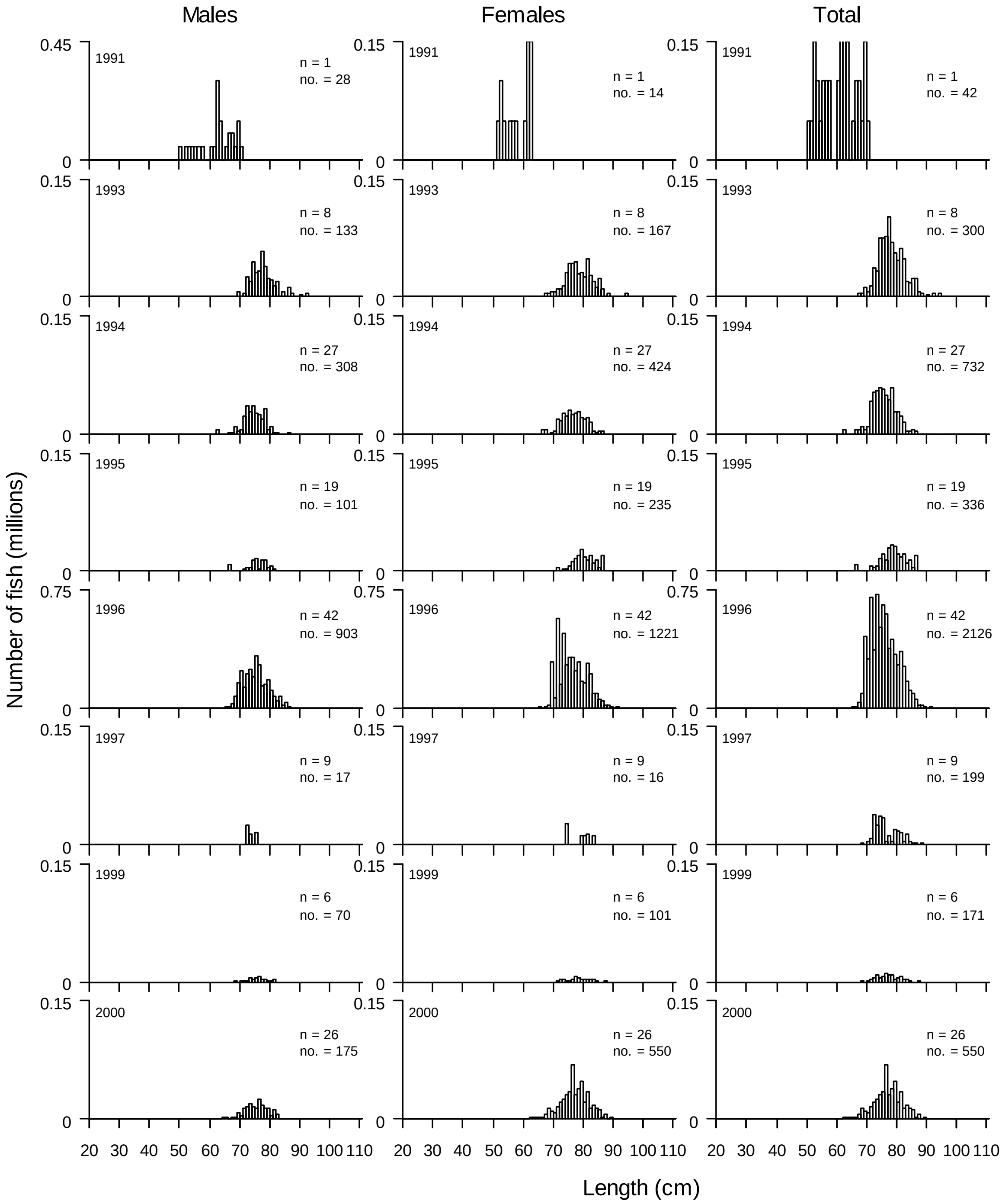


Figure B3: Scaled length frequency of barracouta taken in commercial catches from the AUCKLAND ISLANDS trawl fishery by fishing year sampled by the Observer Programme. n, number of tows sampled; no., number of fish sampled. Note that the vertical axis changes in some cases to accommodate exceptionally large or small numbers.

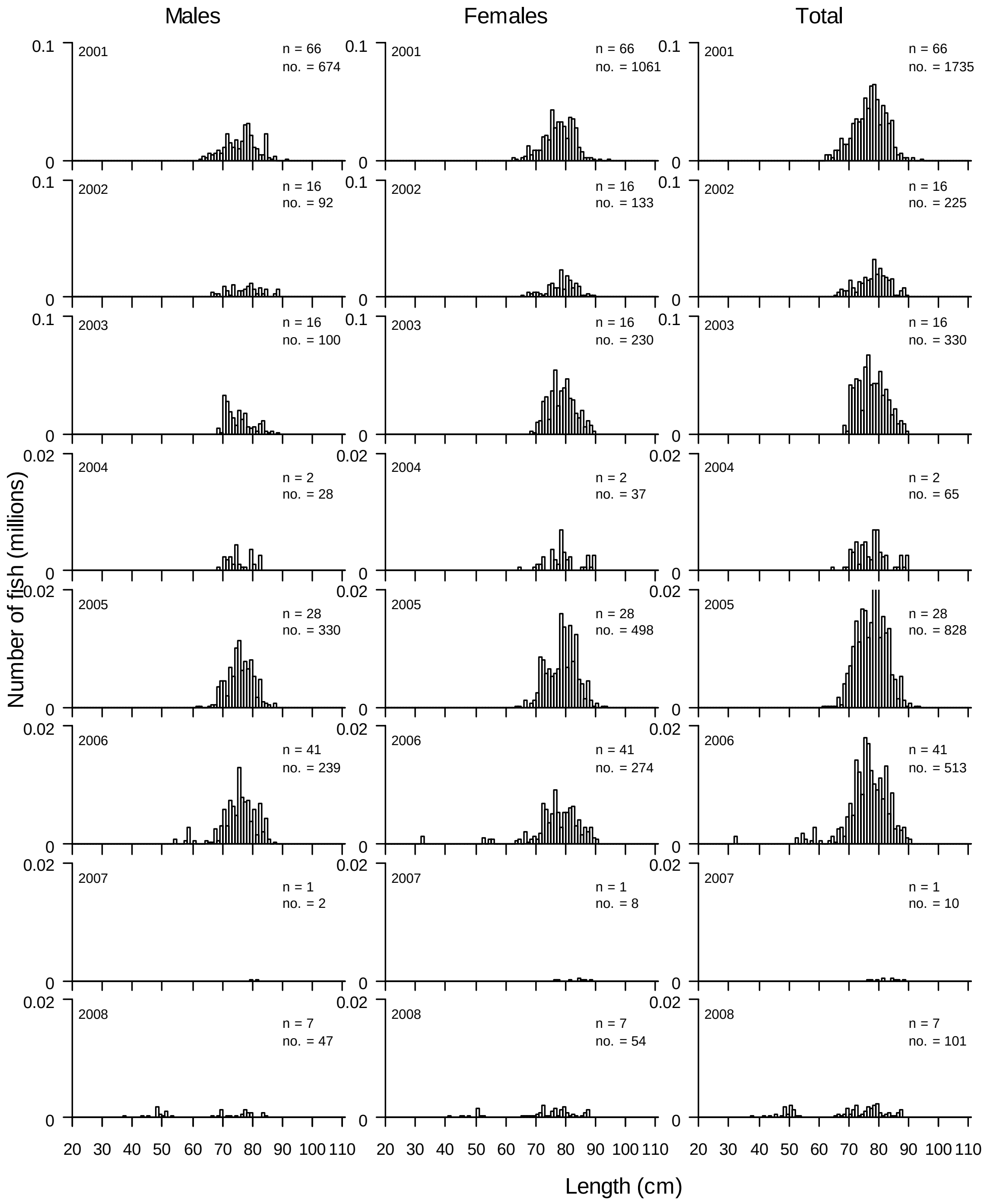


Figure B3: continued.

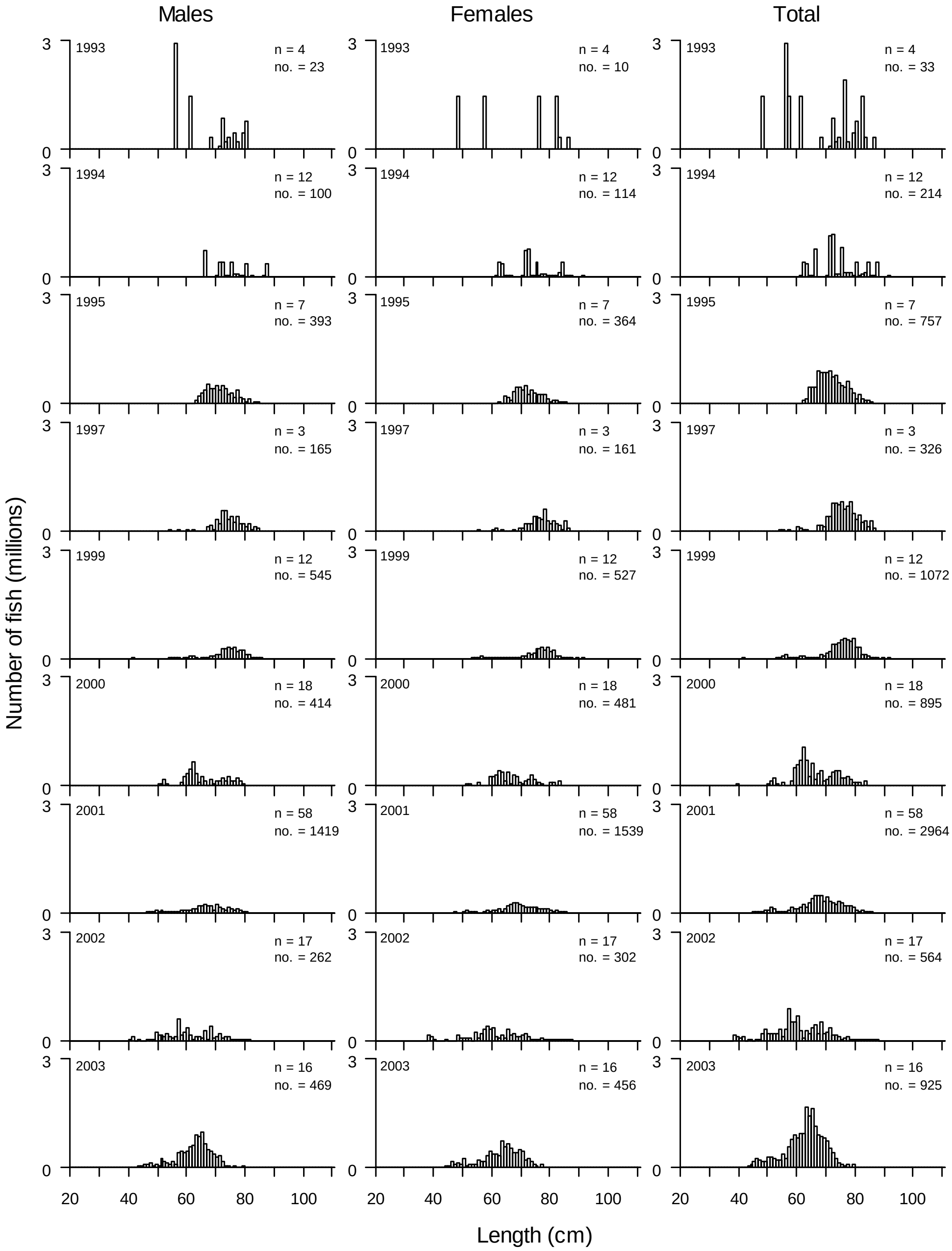


Figure B4: Scaled length frequency of barracouta taken in commercial catches from the ECSI trawl fishery by fishing year sampled by the Observer Programme. n, number of tows sampled; no., number of fish sampled.

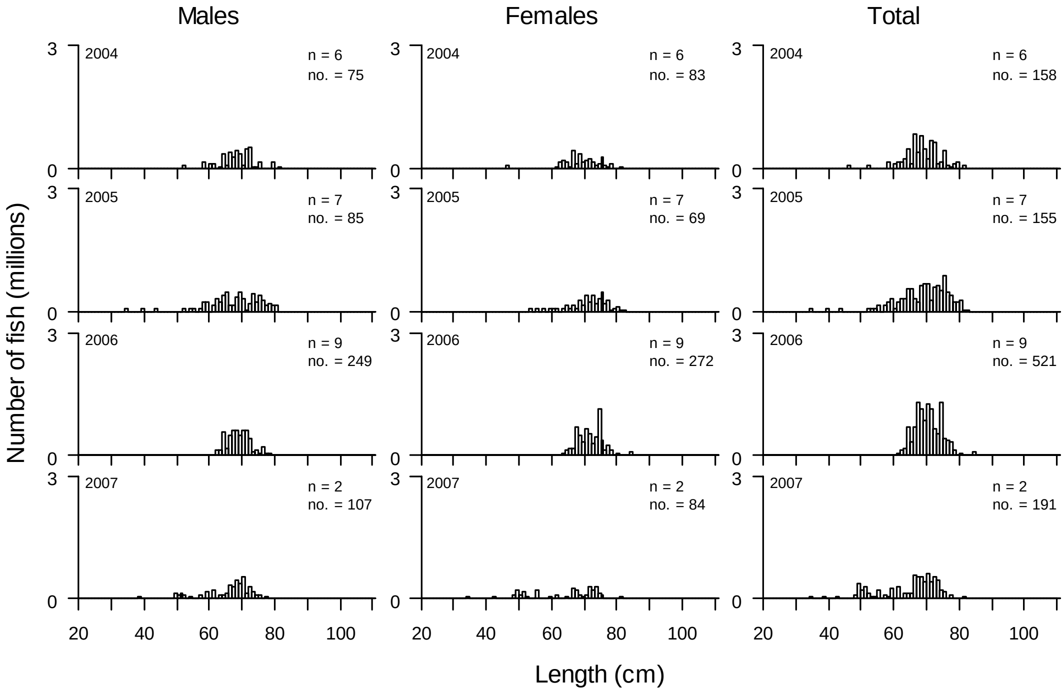


Figure B4: continued

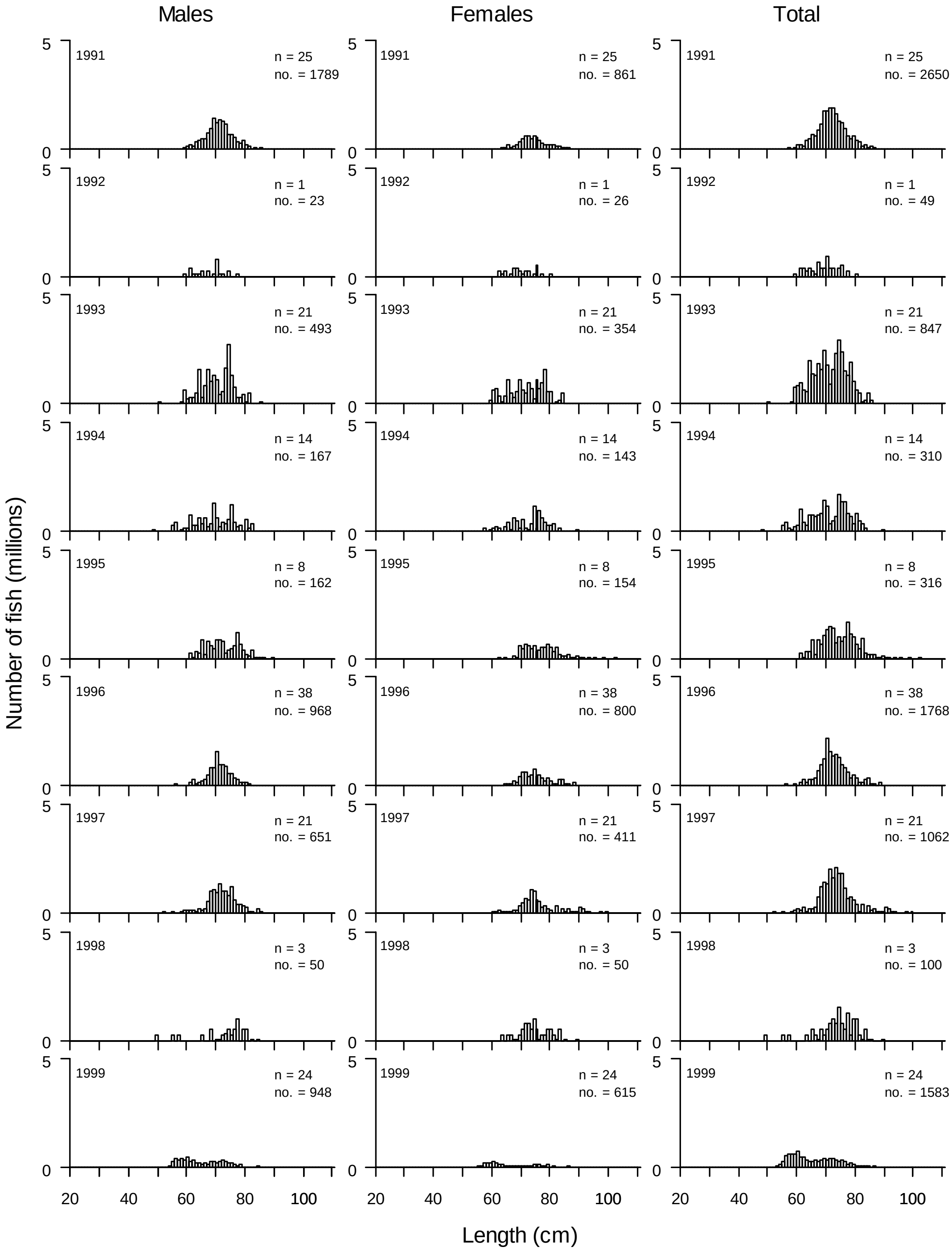


Figure B5: Scaled length frequency of barracouta taken in commercial catches from the WCSI trawl fishery by calendar year sampled by the Observer Programme (note that calendar year is used in this figure because this fishery crosses the September/October fishing year bounday). n, number of tows sampled; no., number of fish sampled.

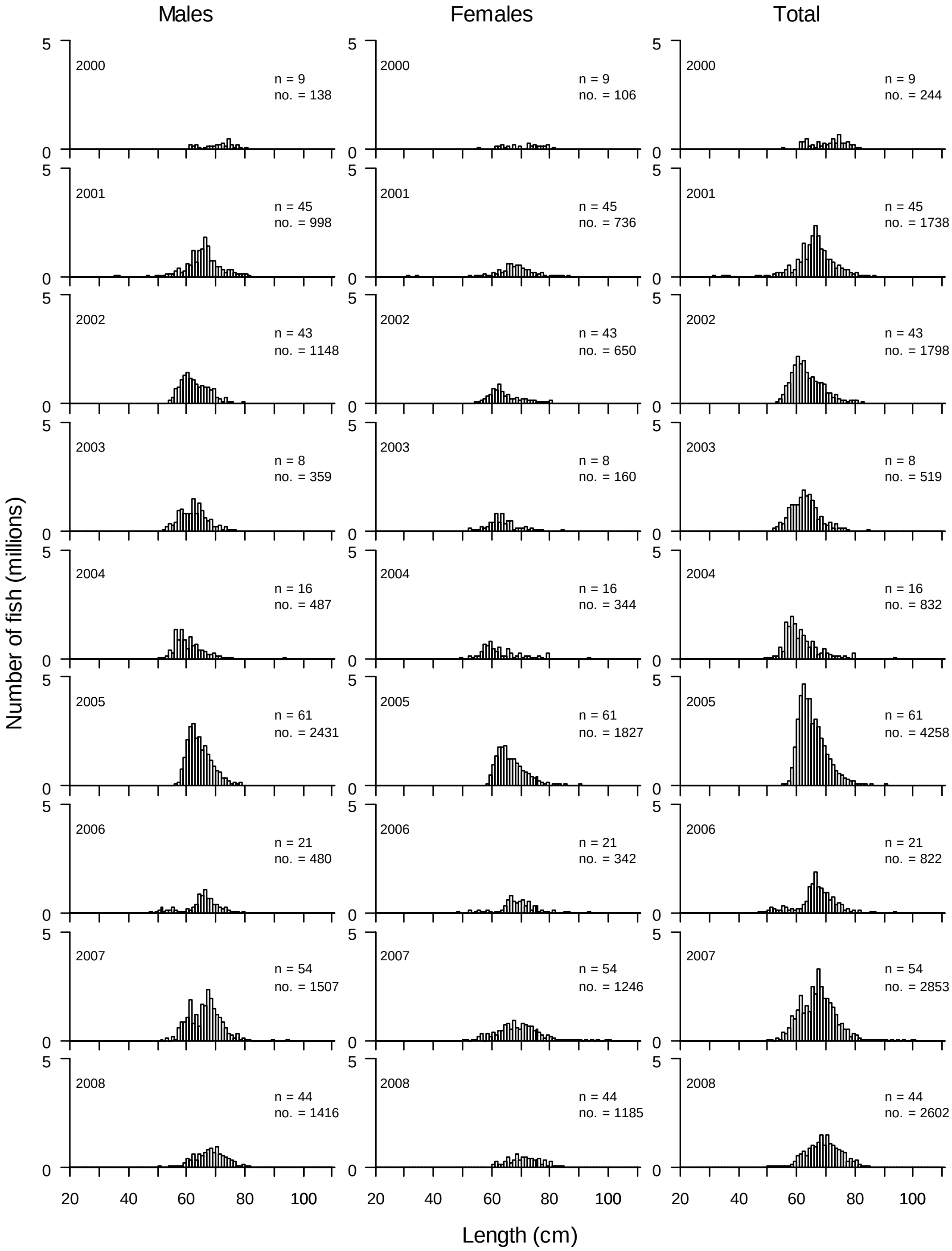


Figure B5: continued.

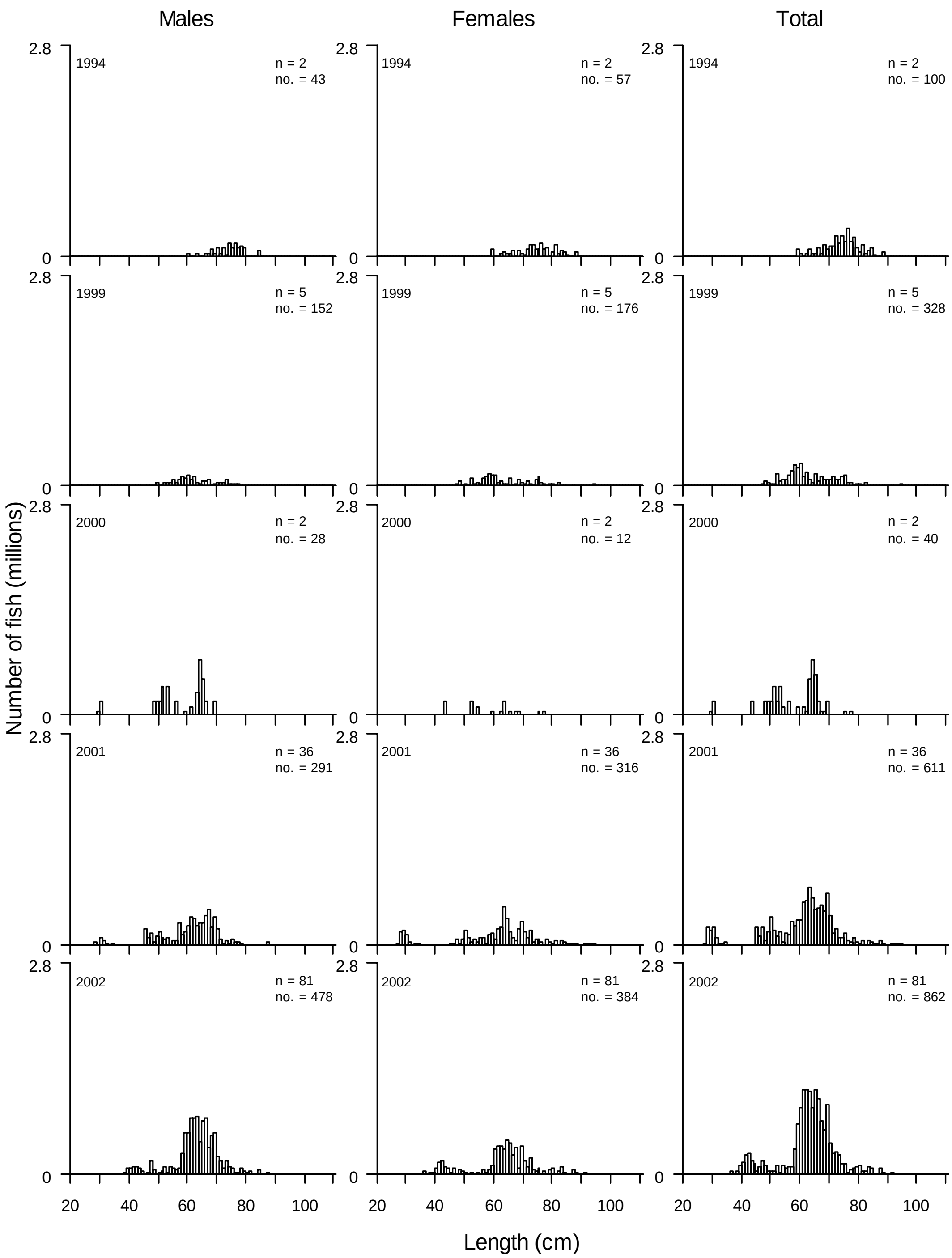


Figure B6a: Scaled length frequency of barracouta taken in commercial catches from the WCNI trawl fishery by calendar year sampled by the Observer Programme, June–October (note that calendar year is required to avoid the Sep./Oct. end of fishing year break). n, number of tows sampled; no., number of fish sampled.

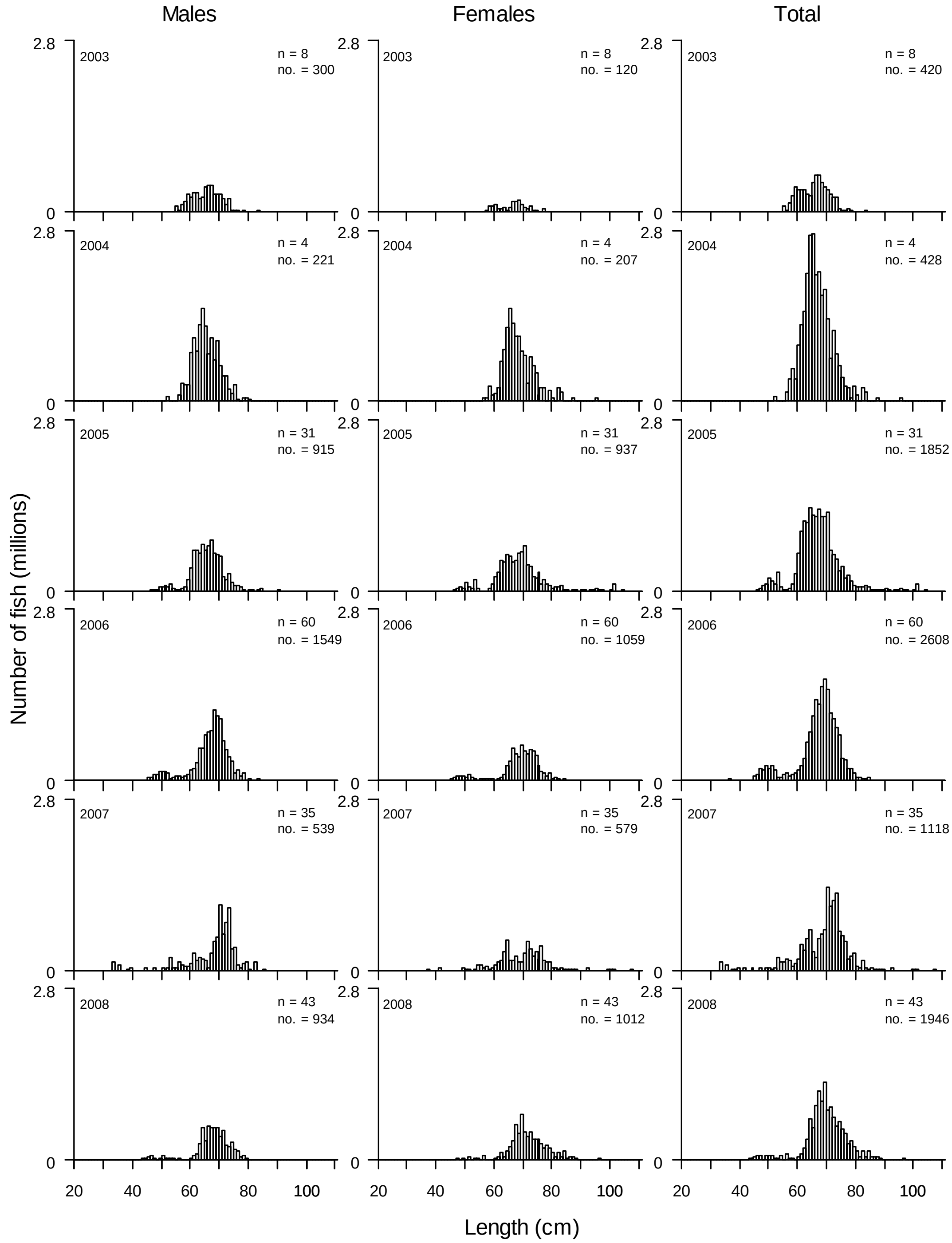


Figure B6a: continued.

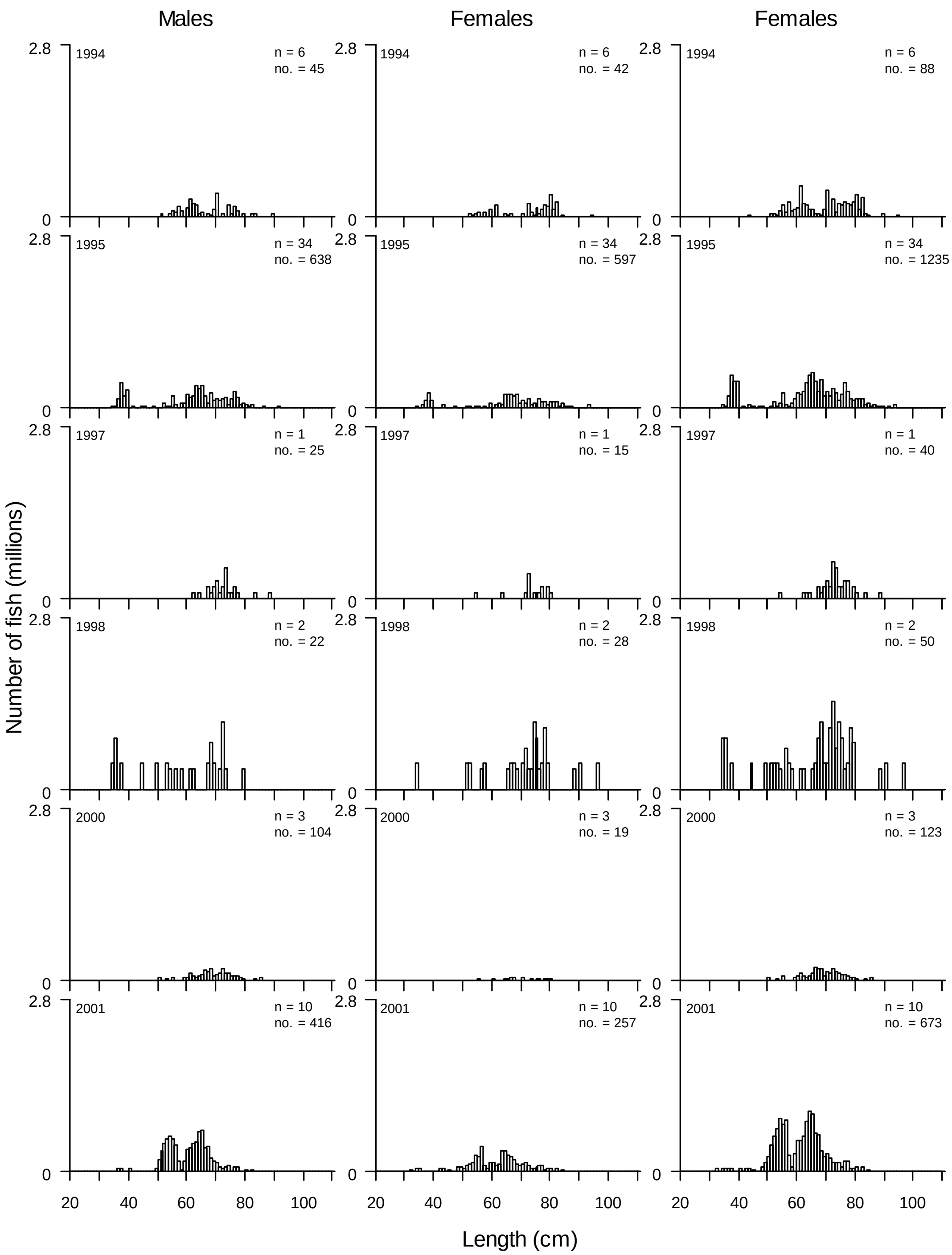


Figure B6b: Scaled length frequency of barracouta taken in commercial catches from the WCNI trawl fishery by fishing year sampled by the Observer Programme, December–April. n, number of tows sampled; no., number of fish sampled.

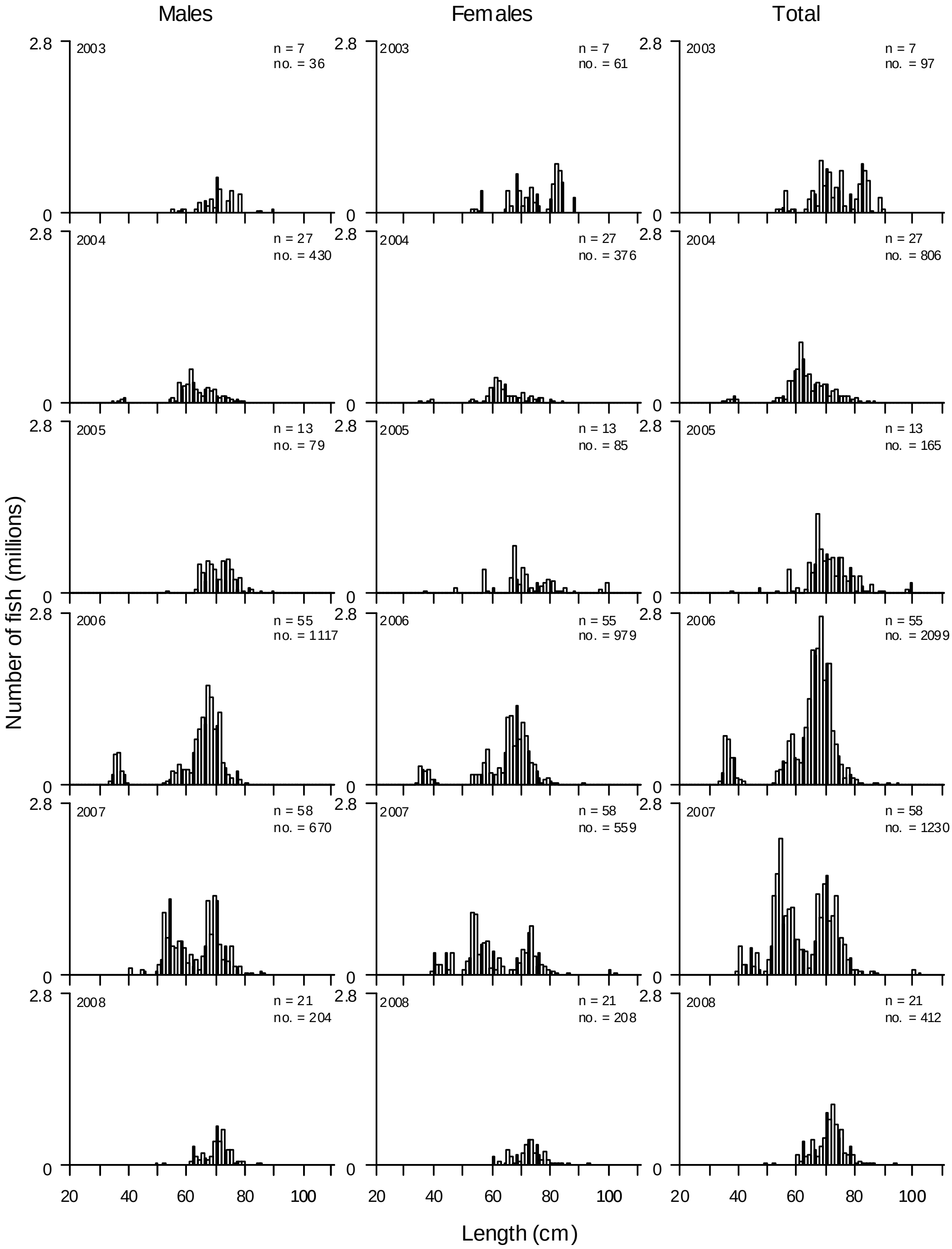


Figure B6b: continued.

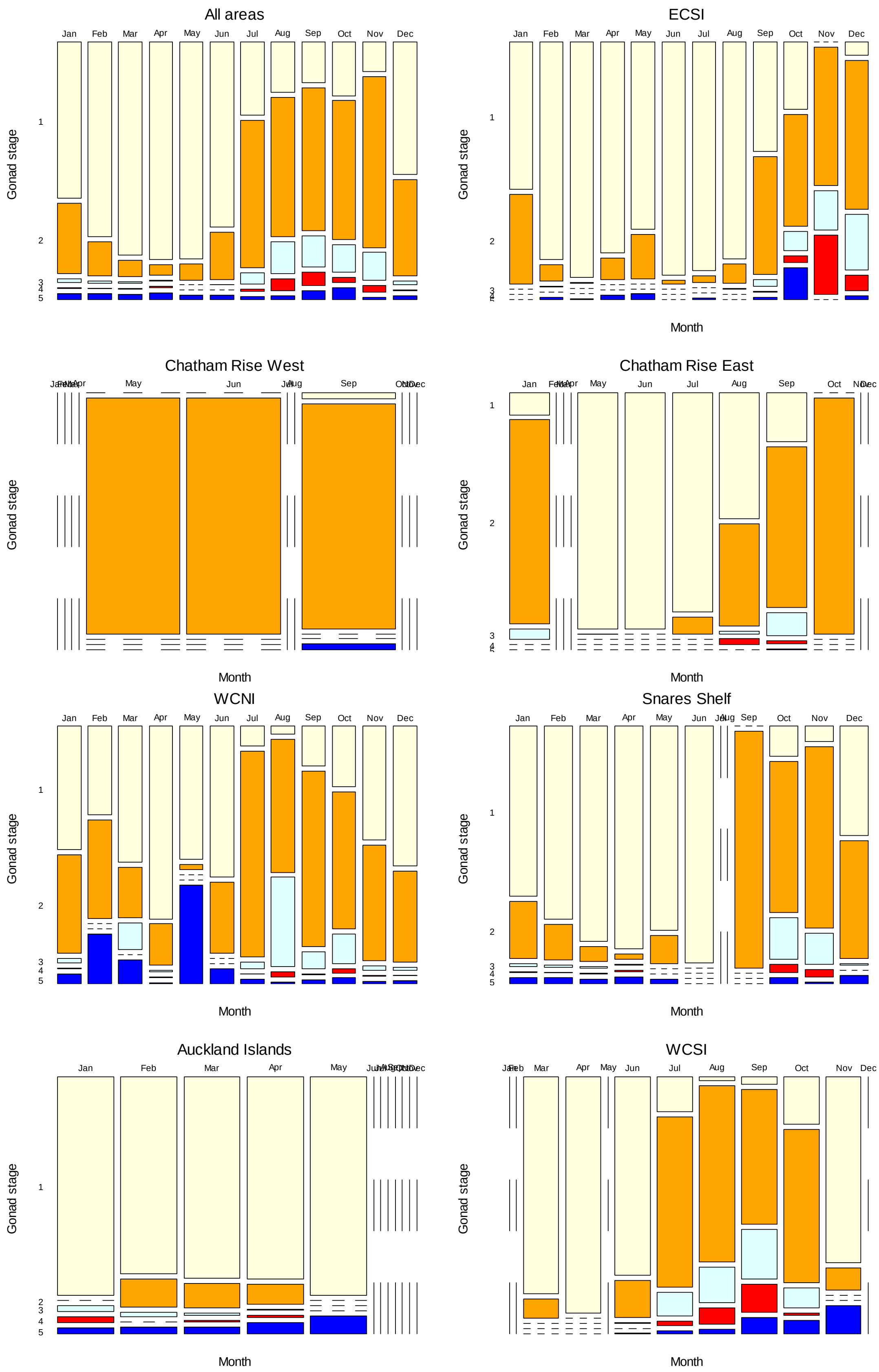


Figure B7a: Gonad stages of female barracouta taken in commercial catches, by month and area, sampled by the Observer Programme. Stages are: 1, resting/immature; 2, maturing; 3, ripe; 4, running ripe; 5, spent. The numbers of observations are given in Table B6.

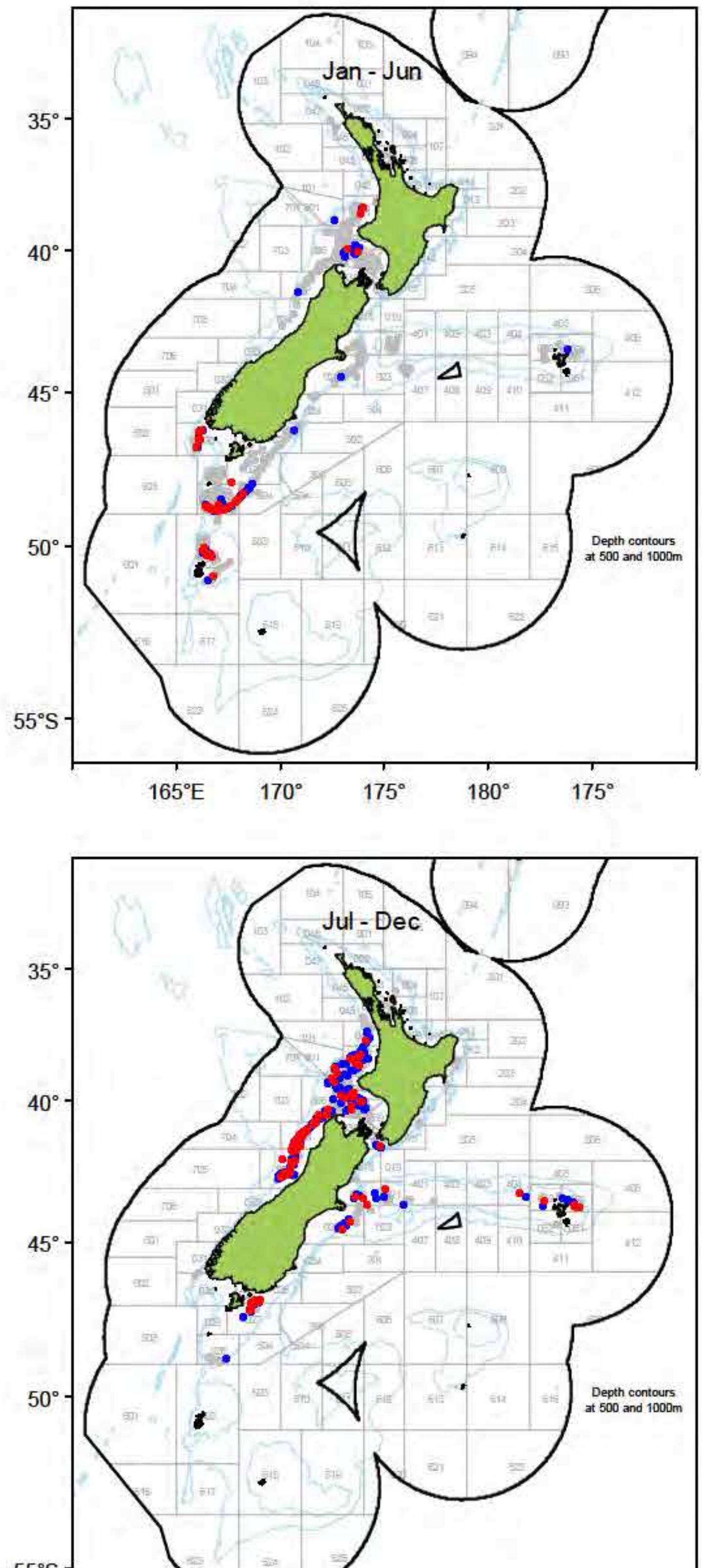


Figure B7b: Location of female barracouta gonad stages 4 (ripe, blue dots) and 5 (running ripe, red dots) taken in commercial catches, January–June (above) and July–December, sampled by the Observer Programme.

APPENDIX C: CHARACTERISATION

Table C1. List of tables and fields requested in the Ministry of Fisheries extract 7425.

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
Form_type
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

Process data table

Event_Key
Version_seqno
DCF_key
Spec_prod_action_type
Processed_datatime
Species_code
State_code
Unit_type
Unit_num
Unit_weight
Conv_factor
Green_weight
Green_weight_type
Processed_weight
Processed_weight_type
Vessel_key
Form_type
Trip_key
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

Table C2: Number of landing events by major destination code and form type for BAR 1, BAR 4, BAR 5, and BAR 7 from 1989–90 to 2007–08. "L" refers to "landed to NZ"; "T" refers to "transferred to another vessel"; "R" refers to "retained on board".

	CLR form			CELR form			
BAR 1	L	T	R	L	T	R	Total
1990	526	39	11	3 189	0	3	3 883
1991	455	58	11	4 169	0	3	4 722
1992	614	47	29	4 611	0	10	5 380
1993	717	72	9	5 354	1	17	6 204
1994	889	42	23	4 868	0	14	5 865
1995	1 000	80	34	5 354	0	21	6 545
1996	1 526	90	19	5 266	3	20	7 028
1997	1 491	35	15	4 872	0	18	6 494
1998	1 512	9	27	4 717	0	33	6 355
1999	1 385	0	18	4 071	3	23	5 548
2000	1 188	0	17	3 627	0	10	4 871
2001	1 113	0	12	2 957	0	7	4 131
2002	1 087	0	11	2 523	0	26	3 668
2003	1 155	0	23	2 444	0	5	3 653
2004	1 120	0	23	2 647	0	15	3 864
2005	956	0	28	2 877	0	17	3 945
2006	891	0	14	2 902	0	6	3 918
2007	864	0	11	2 248	8	4	3 333
2008	2 491	0	41	232	0	5	2 975
Total	20 980	472	376	68 928	15	257	92 382

	CLR form			CELR form			
BAR 4	L	T	R	L	T	R	Total
1990	34	9	3	16	0	0	63
1991	36	30	13	10	0	0	94
1992	27	19	9	13	0	0	71
1993	16	26	9	0	0	0	54
1994	13	12	4	3	0	0	35
1995	27	4	0	18	0	0	52
1996	22	22	1	9	0	0	54
1997	35	12	3	0	0	0	51
1998	47	4	6	3	0	0	63
1999	30	0	3	1	0	0	35
2000	57	0	3	1	0	0	63
2001	70	0	2	0	0	0	72
2002	81	0	1	9	0	0	96
2003	44	0	0	3	0	0	48
2004	26	0	3	1	0	0	31
2005	39	0	0	5	0	0	45
2006	63	0	1	2	0	0	66
2007	53	0	3	4	0	0	66
2008	84	0	5	0	0	0	98
Total	804	138	69	98	0	0	1 157

Table C2: continued.

BAR 5	CLR form L	CLR form T	CLR form R	CELR form L	CELR form T	CELR form R	Total
1990	114	44	32	50	0	0	248
1991	152	57	50	69	0	0	355
1992	157	48	60	47	0	0	320
1993	175	58	39	63	0	0	353
1994	124	37	48	53	0	0	276
1995	124	44	34	45	0	0	260
1996	202	80	32	40	0	0	363
1997	201	39	41	36	0	0	334
1998	236	5	31	20	0	0	302
1999	227	0	30	29	0	0	297
2000	228	0	23	38	0	0	297
2001	226	0	9	73	0	0	330
2002	299	0	5	74	0	0	402
2003	262	0	14	49	0	2	351
2004	326	0	18	51	0	2	445
2005	326	0	32	24	0	0	433
2006	321	0	13	27	0	0	409
2007	300	0	20	41	0	0	405
2008	323	0	14	0	0	0	381
Total	4 323	412	545	829	0	4	6 561

BAR 7	CLR form L	CLR form T	CLR form R	CELR form L	CELR form T	CELR form R	Total
1990	153	63	59	1 775	0	0	2 077
1991	126	59	64	1 947	0	0	2 237
1992	145	97	83	1 833	0	0	2 180
1993	241	107	94	2 463	0	1	2 934
1994	256	58	74	1 906	0	5	2 338
1995	388	84	41	2 206	0	0	2 745
1996	574	69	37	2 182	0	3	2 882
1997	686	44	43	2 393	0	5	3 205
1998	691	9	35	1 804	0	0	2 563
1999	630	3	37	1 665	0	1	2 355
2000	564	2	13	1 581	0	0	2 170
2001	819	5	29	1 406	0	3	2 282
2002	778	0	17	1 377	0	3	2 190
2003	717	0	30	1 265	0	12	2 043
2004	691	0	16	1 336	0	3	2 069
2005	710	0	17	1 344	0	3	2 116
2006	527	1	28	922	0	2	1 500
2007	580	0	27	1 125	0	3	1 822
2008	1 662	0	42	96	0	1	1 903
Total	10 938	601	786	30 626	0	45	43 611

Table C3: Destination codes, total landing weight, number of landings and whether the records were kept or dropped for all barracouta catch 1990–2008 for BAR 1, BAR 4, BAR 5, and BAR 7.

Destination code	Greenweight (t)	No. records	Description	Action
BAR 1				
L	156 993.493	90092	Landed in New Zealand to a Licensed Fish Receiver	Keep
T	7 036.101	487	Transferred to another vessel	Keep
O	157.927	19	Conveyed outside New Zealand	Keep
A	63.769	81	Accidental loss	Keep
C	102.795	129	Disposed to the Crown	Keep
D	5.362	23	Discarded	Keep
E	1.613	82	Eaten	Keep
U	12.839	248	Used as bait	Keep
W	1.189	136	Sold at wharf	Keep
F	0.285	40	Recreational catch	Keep
H	0.300	2	Loss from holding pot	Keep
S	0.186	3	Seized by the Crown	Keep
R	2 917.712	633	Retained on board	Drop
B	9.070	244	Stored as bait	Drop
Null	30.640	62	Missing destination type code	Drop
Q	2.983	101	Holding receptacle on land	Drop
BAR 4				
L	21 973.218	902	Landed in New Zealand to a Licensed Fish Receiver	Keep
T	4 351.220	138	Transferred to another vessel	Keep
O	99.817	5	Conveyed outside New Zealand	Keep
D	22.461	5	Discarded	Keep
A	167.682	7	Accidental loss	Keep
E	0.312	19	Eaten	Keep
S	0.001	1	Seized by the Crown	Keep
U	0.000	1	Used as bait	Keep
R	783.917	69	Retained on board	Drop
B	15.206	10	Stored as bait	Drop
BAR 5				
L	108 485.956	5152	Landed in New Zealand to a Licensed Fish Receiver	Keep
T	10 544.022	412	Transferred to another vessel	Keep
O	1 114.033	46	Conveyed outside New Zealand	Keep
A	105.672	77	Accidental loss	Keep
D	82.796	35	Discarded	Keep
E	26.549	274	Eaten	Keep
U	0.250	1	Used as bait	Keep
S	0.007	2	Seized by the Crown	Keep
R	3 930.015	549	Retained on board	Drop
Null	71.999	3	Missing destination type code	Drop
B	15.467	10	Stored as bait	Drop

Table C3: continued.

Destination code	Greenweight (t)	No. records	Description	Action
BAR 7				
L	142 709.500	41645	Landed in New Zealand to a Licensed Fish Receiver	Keep
T	17 798.205	601	Transferred to another vessel	Keep
O	1 443.133	78	Conveyed outside New Zealand	Keep
D	72.728	49	Discarded	Keep
A	104.596	109	Accidental loss	Keep
U	9.245	55	Used as bait	Keep
C	6.982	13	Disposed to the Crown	Keep
E	1.482	80	Eaten	Keep
S	0.098	5	Seized by the Crown	Keep
W	0.074	2	Sold at wharf	Keep
F	0.015	4	Recreational catch	Keep
R	8 034.889	831	Retained on board	Drop
Null	264.284	26	Missing destination type code	Drop
B	59.587	80	Stored as bait	Drop
Q	0.213	33	Holding receptacle on land	Drop

Table C4: Details of data corrections by imputation and invalid record removal during the grooming process for each QMA.

BAR 1

Imputations made	Records	Before	After	Difference	% kept
Invalid start date	533 010	455	192	263	0.05
Invalid primary method	531 460	696	298	398	0.07
Invalid target species	531 182	500	86	414	0.08
Invalid stat area	531 096	5 699	0	5 699	1.07
Invalid latitude or longitude	531 096	531 096	323	530 773	99.94
Invalid effort depth (TCEPR)	525 883	1325	177	1 148	0.22
Invalid bottom depth (TCEPR)	525 883	3755	1 801	1 954	0.37
Transpose bottom-effort depth	525 883	27 983	0	27 983	5.32
Invalid BT effort number	296 986	2 576	5	2 571	0.87
Invalid BT effort width	296 986	25 337	164	25 173	8.48
Invalid BT effort height	296 986	14 305	34	14 271	4.81
Invalid BT effort speed for TCEPR	296 986	453	0	453	0.15
Invalid BT fishing duration	296 986	3 971	17	3 954	1.33
Invalid MW effort number for TCEPR	67 486	20	0	20	0.03
Invalid MW effort width for TCEPR	67 486	1 865	4	1 861	2.76
Invalid MW effort height for TCEPR	67 486	339	0	339	0.5
Invalid MW effort speed for TCEPR	67 486	340	1	339	0.5
Invalid MW fishing duration for TCEPR	67 486	532	9	523	0.77
Other misc	9 233	3 720	155	3 565	38.61

			Effort			Landings
Records removed	Records	Trips	Catch	Records	Trips	Catch
Original extract	536 860	87 788	231 140	98 869	88 377	170 106
Missing vessel key	536 854	87 784	231 136	98 864	88 373	170 101
Unmatched trip number	536 854	87 784	231 136	98 234	87 784	167 924
Duplicate form number	533 010	87 419	230 557	97 776	87 419	167 387
Invalid start date	531 460	87 292	230 336	97 602	87 292	167 171
Invalid primary method	531 182	87 268	230 331	97 577	87 268	167 157
Invalid target	531 096	87 253	230 330	97 562	87 253	167 155
Invalid stats area	525 883	86 945	226 907	97 113	86 945	165 694
Re-stratify by stat area, trip, target, method	166 451	86 945	226 907	97 113	86 945	165 694
Remove interim landing codes	165 618	86 422	226 548	95 724	86 422	162 759

Table C4: continued.

BAR 4

Imputations made	Records	Before	After	Difference	% kept
Invalid start date	44 543	7	0	7	0.01
Invalid primary method	44 543	19	14	5	0.01
Invalid target species	44 529	8	0	8	0.01
Invalid stat area	44 529	313	0	313	0.70
Invalid latitude or longitude	43 112	500	27	473	1.09
Invalid effort depth (TCPER)	43 482	23	0	23	0.05
Invalid bottom depth (TCEPR)	43 482	202	108	94	0.21
Transpose bottom-effort depth	43 482	2 270	0	2 270	5.22
Invalid BT effort number	33 967	7	0	7	0.02
Invalid BT effort width	33 967	1 015	104	911	2.68
Invalid BT effort height	33 967	1 560	281	1 279	3.76
Invalid BT effort speed for TCPER	33 967	19	0	19	0.05
Invalid BT fishing duration	33 967	185	15	170	0.50
Invalid MW effort number for TCPER	9 145	2	0	2	0.02
Invalid MW effort width for TCPER	9 145	271	60	211	2.30
Invalid MW effort height for TCPER	9 145	15	0	15	0.16
Invalid MW effort speed for TCPER	9 145	15	0	15	0.16
Invalid MW fishing duration for TCPER	9 145	131	2	129	1.41
Other misc	9 145	3	0	3	0.03

	Effort			Landings		
Records removed	Records	Trips	Catch	Records	Trips	Catch
Original extract	44 700	731	47 837	2 572	732	27 848
Missing vessel key	44 700	731	47 837	2 572	732	27 848
Unmatched trip number	44 700	731	47 837	2 570	731	27 848
Duplicate form number	44 543	729	47 689	2 559	729	27 818
Invalid start date	44 543	729	47 689	2 559	729	27 818
Invalid primary method	44 529	728	47 670	2 558	728	27 796
Invalid target	44 529	728	47 670	2 558	728	27 796
Invalid stats area	43 482	708	45 739	2 482	708	26 835
Re-stratify by stat area, trip, target, method	7 140	708	45 739	2 482	708	26 835
Remove interim landing codes	7 106	703	45 689	2 271	703	26 037

Table C4: continued.

BAR 5

Imputations made	Records	Before	After	Difference	% kept
Invalid start date	220 145	49	4	45	0.02
Invalid primary method	219 939	42	0	42	0.02
Invalid target species	219 939	34	0	34	0.02
Invalid stat area	219 939	886	0	886	0.40
Invalid latitude or longitude	213 916	2 106	162	1 944	0.91
Invalid effort depth (TCPER)	217 153	3 113	170	2 943	1.36
Invalid bottom depth (TCEPR)	217 153	3 707	569	3 138	1.45
Transpose bottom-effort depth	217 153	10 633	0	10 633	4.90
Invalid BT effort number	117 998	31	0	31	0.03
Invalid BT effort width	117 998	3 452	56	3 396	2.88
Invalid BT effort height	117 998	8 940	135	8 805	7.46
Invalid BT effort speed for TCEPR	117 998	398	137	261	0.22
Invalid BT fishing duration	117 998	575	9	566	0.48
Invalid MW effort number for TCEPR	96 400	31	0	31	0.03
Invalid MW effort width for TCEPR	96 400	1 664	39	1 625	1.69
Invalid MW effort height for TCEPR	96 400	196	0	196	0.20
Invalid MW effort speed for TCEPR	96 400	142	0	142	0.15
Invalid MW fishing duration for TCEPR	96 400	725	1	724	0.75
Other misc	96 400	2	2	0	0.00

	Effort			Landings		
Records removed	Records	Trips	Catch	Records	Trips	Catch
Original extract	220 230	3 575	159 856	9 954	3 594	125 470
Missing vessel key	220 230	3 575	159 856	9 954	3 594	125 470
Unmatched trip number	220 230	3 575	159 856	9 915	3 575	124 191
Duplicate form number	220 145	3 571	159 740	9 904	3 571	124 073
Invalid start date	219 939	3 568	159 645	9 893	3 568	124 050
Invalid primary method	219 939	3 568	159 645	9 893	3 568	124 050
Invalid target	219 939	3 568	159 645	9 893	3 568	124 050
Invalid stats area	217 153	3 526	157 830	9 756	3 526	122 808
Re-stratify by stat area, trip, target, method	23 487	3 526	157 830	9 756	3 526	122 808
Remove interim landing codes	23 144	3 460	157 189	8 904	3 460	118 881

Table C4: continued.

BAR 7

Imputations made	Records	Before	After	Difference	% kept
Invalid start date	337 277	313	140	173	0.05
Invalid primary method	379 003	474	173	301	0.08
Invalid target species	378 830	344	1	343	0.09
Invalid stat area	378 829	3 047	0	3 047	0.8
Invalid latitude or longitude	258 500	2 521	459	2 062	0.8
Invalid effort depth (TCEPR)	373 922	1 548	175	1 373	0.37
Invalid bottom depth (TCEPR)	373 922	3 149	782	2 367	0.63
Transpose bottom-effort depth	373 922	15 145	0	15 145	4.05
Invalid BT effort number	150 191	868	6	862	0.57
Invalid BT effort width	150 191	9 264	2 862	6 402	4.26
Invalid BT effort height	150 191	11 057	396	10 661	7.1
Invalid BT effort speed for TCEPR	150 191	334	2	332	0.22
Invalid BT fishing duration	150 191	2 459	11	2 448	1.63
Invalid MW effort number for TCEPR	113 578	117	0	117	0.1
Invalid MW effort width for TCEPR	113 578	2 857	4	2 853	2.51
Invalid MW effort height for TCEPR	113 578	388	0	388	0.34
Invalid MW effort speed for TCEPR	113 578	127	0	127	0.11
Invalid MW fishing duration for TCEPR	113 578	1 041	1	1 040	0.92
Other misc	113 578	895	306	589	0.52

			Effort			Landings
Records removed	Records	Trips	Catch	Records	Trips	Catch
Original extract	382 643	39 288	182 532	47 643	39 471	172 471
Missing vessel key	382 643	39 288	182 532	47 642	39 470	172 470
Unmatched trip number	382 643	39 288	182 532	47 417	39 288	171 748
Duplicate form number	380 369	39 095	182 295	47 170	39 095	171 493
Invalid start date	379 003	39 006	182 146	47 034	39 006	171 366
Invalid primary method	378 830	38 985	182 140	47 012	38 985	171 359
Invalid target	378 829	38 984	182 140	47 011	38 984	171 359
Invalid stats area	373 922	38 835	178 988	46 752	38 835	169 041
Re-stratify by stat area, trip, target, method	89 250	38 835	178 988	46 752	38 835	169 041
Remove interim landing codes	88 483	38 594	177 776	45 552	38 594	161 103

Table C5: 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 BAR 1, BAR 4, BAR 5, and BAR 7 from 1989–90 to 2007–08.

	BAR 1					BAR 4				
				Merged estimated					Merged estimated	
Year	MHR	Un-merged landings	Merged landings	Catch	% MHR	MHR	Un-merged landings	Merged landings	Catch	% MHR
1990	9 209	7 135	7 066	6 788	74	1 349	1 006	1 006	1 106	82
1991	9 401	8 074	7 919	7 482	80	1 399	1 368	1 364	1 250	89
1992	6 733	6 461	6 408	5 840	87	1 156	1 109	1 085	1 057	91
1993	9 032	8 981	8 928	8 068	89	2 251	2 167	2 166	2 122	94
1994	7 299	7 107	7 060	6 615	91	606	712	676	680	112
1995	10 023	9 763	9 714	8 769	87	331	324	321	285	86
1996	11 252	10 607	10 376	9 867	88	2234	2 156	2 025	2 080	93
1997	11 873	12 178	12 115	10 954	92	1 081	791	769	860	80
1998	11 543	11 114	11 036	10 657	92	1 966	1 813	1 813	1 784	91
1999	9 229	9 303	9 285	8 562	93	459	438	438	248	54
2000	10 032	9 958	9 926	9 388	94	1 911	1 796	1 779	1 755	92
2001	7 118	7 131	7060	6 724	94	2 122	1 744	1 724	1 715	81
2002	6 900	6 900	6 880	6 569	95	1 160	1 444	1 441	1 388	120
2003	7 595	7 516	7 507	6 902	91	573	583	576	571	100
2004	5 949	5 388	5 366	5 585	94	477	225	225	150	31
2005	6 085	5 594	5 570	5 142	85	98	377	377	361	368
2006	7 030	7 507	7 495	6 918	98	687	683	683	649	94
2007	5 351	3 916	3 903	3 461	65	3 233	2 938	2 894	3 097	96
2008	5 987	5 871	5 846	5 182	87	2 969	2 791	2 016	1 937	65
Totals	157 641	153 247	152 350	142 177	90	26 062	24 124	23 812	23 489	90

Table C5: continued.

	BAR 5					BAR 7				
				Merged estimated					Merged estimated	
Year	MHR	Un-merged landings	Merged landings	Catch	% MHR	MHR	Un-merged landings	Merged landings	Catch	% MHR
1990	5 960	5 189	5 185	5 133	86	7 050	4 668	3 769	3 769	53
1991	8 817	8 289	8 289	7 971	90	7 138	6 720	6 235	6 235	87
1992	6 897	6 524	6 403	6 325	92	7 326	7 429	7 024	7 024	96
1993	7 019	7 391	7 390	7 236	103	10 141	10 072	9 491	9 491	94
1994	3 410	3 233	3 170	2 904	85	8 030	6 673	6 267	6 267	78
1995	2 645	2 536	2 530	2338	88	9 345	10 071	9 613	9 613	103
1996	4 255	4 151	4 147	3 950	93	8 593	7 491	6 748	6 748	79
1997	2 839	2 565	2 564	2307	81	10 203	9 171	8 020	8 020	79
1998	6 167	6 122	5 999	5 499	89	8 717	9 653	8 384	8 384	96
1999	7 302	7 032	7 001	6 292	86	4 427	4 652	4 125	4 125	93
2000	6 205	5 985	5 772	5 614	90	3 288	3 268	2 814	2 814	86
2001	6 101	6 091	6 077	5 910	97	6 890	5 953	5 231	5 231	76
2002	5 883	5 876	5 864	5 364	91	7 655	8 127	7 706	7 706	101
2003	7 843	7 831	7 815	7 223	92	9 025	9 045	8 725	8 725	97
2004	6 919	6 894	6 875	6 508	94	9 114	9 046	8 685	8 685	95
2005	8 593	8 245	8 175	7 689	89	12 156	12 014	11 795	11 795	97
2006	9 479	9 253	9 191	9 041	95	10 685	10 600	10 224	10 224	96
2007	6 334	6 239	6 238	6 094	96	14 698	14 196	13 958	13 958	95
2008	8 561	8 341	8 294	7 840	92	10 451	10 260	10 149	9 144	87
Totals	121 229	118 877	118 069	112 206	93	164 932	161 061	150 912	150 912	91

Table C6: Total number of trips, number of trips with zero estimated catch and proportion of trips with zero estimated catch, by form type for BAR 1, BAR 4, BAR 5, and BAR 7 from 1990 to 2008.

	CELR			TCEPR		
BAR 1	Total	Zero	Proportion	Total	Zero	Proportion
1990	3 167	1 006	0.31	377	16	0.04
1991	4 051	1 349	0.33	380	27	0.07
1992	4 539	1 797	0.39	570	62	0.10
1993	5 212	1 954	0.37	701	86	0.12
1994	4 744	1 785	0.37	819	119	0.14
1995	5 126	1 823	0.35	953	154	0.16
1996	4 901	1 489	0.30	1 336	231	0.17
1997	4 693	1 385	0.29	1 345	252	0.18
1998	4 514	1 267	0.28	1 420	244	0.17
1999	3 941	1 137	0.28	1 228	222	0.18
2000	3 514	1 064	0.30	1 026	240	0.23
2001	2 912	846	0.29	968	221	0.22
2002	2 481	748	0.30	973	233	0.23
2003	2 393	727	0.30	988	231	0.23
2004	2 636	816	0.30	967	193	0.19
2005	2 862	993	0.34	846	150	0.17
2006	2 886	1 013	0.35	745	103	0.13
2007	2 213	746	0.33	685	89	0.12
2008	222	78	0.35	435	78	0.18

	CELR			TCEPR		
BAR 4	Total	Zero	Proportion	Total	Zero	Proportion
1990	16	42	0.76	21	0	0.00
1991	10	140	0.60	39	0	0.00
1992	13	312	0.66	36	1	0.02
1993	0	278	0.50	23	1	0.04
1994	3	228	0.42	16	1	0.06
1995	17	296	0.45	24	3	0.12
1996	9	353	0.46	28	1	0.03
1997	0	303	0.58	25	0	0.00
1998	3	380	0.60	39	2	0.05
1999	1	388	0.61	25	7	0.28
2000	1	243	0.65	32	0	0.00
2001	0	360	0.56	40	4	0.10
2002	9	175	0.58	51	5	0.09
2003	3	212	0.54	35	4	0.11
2004	1	202	0.56	21	0	0.00
2005	5	231	0.63	33	6	0.18
2006	2	206	0.71	36	3	0.08
2007	4	117	0.66	35	6	0.17
2008	0	0	0.00	40	1	0.02

Table C6: continued.

BAR 5	CELR Total	CELR Zero	CELR Proportion	TCEPR Total	TCEPR Zero	TCEPR Proportion
1990	48	11	0.22	103	4	0.03
1991	67	14	0.20	148	5	0.03
1992	45	9	0.20	143	8	0.05
1993	61	22	0.36	149	8	0.05
1994	52	25	0.48	108	9	0.08
1995	45	14	0.31	128	7	0.05
1996	41	14	0.34	180	3	0.01
1997	35	11	0.31	147	8	0.05
1998	20	8	0.40	155	5	0.03
1999	27	13	0.48	125	3	0.02
2000	38	20	0.52	108	11	0.10
2001	69	35	0.50	108	15	0.13
2002	70	27	0.38	133	8	0.06
2003	49	18	0.36	129	10	0.07
2004	52	17	0.32	155	12	0.07
2005	24	3	0.12	166	8	0.04
2006	27	11	0.40	155	11	0.07
2007	41	14	0.34	123	16	0.13
2008	0	0	0.00	108	2	0.01

BAR 7	CELR Total	CELR Zero	CELR Proportion	TCEPR Total	TCEPR Zero	TCEPR Proportion
1990	1 697	620	0.36	156	25	0.16
1991	1 878	652	0.34	153	18	0.11
1992	1 771	639	0.36	194	32	0.16
1993	2 358	848	0.35	254	33	0.12
1994	1 828	709	0.38	233	33	0.14
1995	2 100	690	0.32	369	39	0.10
1996	2 003	588	0.29	512	105	0.20
1997	2 245	589	0.26	603	87	0.14
1998	1 730	516	0.29	599	91	0.15
1999	1 609	377	0.23	509	87	0.17
2000	1 521	396	0.26	470	92	0.19
2001	1 367	381	0.27	640	187	0.29
2002	1 350	369	0.27	572	148	0.25
2003	1 234	308	0.24	488	91	0.18
2004	1 300	245	0.18	473	87	0.18
2005	1 323	286	0.21	480	49	0.10
2006	895	207	0.23	346	36	0.10
2007	1 098	280	0.25	338	46	0.13
2008	83	39	0.46	250	32	0.09

Table C7: Total barracouta catch (t) for each region from groomed and merged data for fishing years 1990 – 2008.

Year	ECNI	ECSI	Chatham West	Chatham East	WCNI	WCSI	SNAR + SUBA	Total
1990	1 053.7	6 011.8	138.7	866.9	1 434.7	2 334.2	5 184.5	17 024.5
1991	715.5	7 203.7	774.5	589.4	2 237.9	3 996.9	8 288.9	23 806.8
1992	1 297.5	5 110.8	248.0	837.0	4 501.2	2 523.1	6 402.9	20 920.4
1993	1 445.6	7 482.0	125.6	2 040.4	3 922.7	5 568.2	7 389.9	27 974.5
1994	1 842.6	5 217.3	154.1	521.5	3 060.9	3 206.2	3 170.1	17 172.7
1995	2 322.0	7 392.0	119.5	201.4	4 304.0	5 309.0	2 530.0	22 178.0
1996	2 152.8	8 223.3	63.7	1 961.4	3 500.5	3 247.3	4 146.7	23 295.9
1997	2 094.4	10 020.9	86.7	682.6	3 732.5	4 287.4	2 564.5	23 469.0
1998	1 828.3	9 207.3	777.5	1 035.5	5 032.5	3 351.6	5 998.6	27 231.4
1999	1 342.3	7 942.4	195.0	242.7	1 962.6	2 162.8	7 000.9	20 848.8
2000	973.7	8 952.6	47.0	1 732.1	1 820.6	993.4	5 772.1	20 291.5
2001	1 023.7	6 036.0	77.0	1 646.7	2 902.7	2 328.7	6 077.1	20 091.8
2002	695.8	6 184.1	7.5	1 433.5	4 008.6	3 697.6	5 864.2	2 1891.3
2003	1 011.0	6 496.1	12.7	563.4	5 815.1	2 909.6	7 814.7	24 622.7
2004	906.7	4 459.2	14.5	210.7	6 101.8	2 582.8	6 875.1	21 150.8
2005	904.3	4 666.2	2.4	374.4	6 502.7	5 292.1	8 174.8	25 916.8
2006	830.8	6 664.6	13.0	669.9	7 525.7	2 698.1	9 190.8	27 592.9
2007	949.1	2 954.2	25.9	2 868.0	7 067.2	6 891.2	6 238.4	26 994.1
2008	675.2	5 171.3	1.7	2 014.3	6 139.9	4 009.5	8 293.7	26 305.6
Total	24 065.1	125 396.0	2 885.1	20 491.7	81 573.8	67 389.7	116 977.8	438 779.2

Table C8: Total barracouta catch by vessel nationality from groomed and merged data for fishing years 1990 – 2008.

Year	Korea	NZ	Japan	Ukraine	Malta	Vanuatu	Poland	Belize	Russian	Unknown	Other	Total
1990	1 287	8 026	19	33	0	0	0	0	28	7 631	0	Total
1991	1 942	7 186	44	583	0	0	0	0	184	13 866	0	17 024
1992	2 659	8 479	14	923	0	759	0	0	4	8 084	0	23 807
1993	6 216	9 590	51	2526	96	378	0	20	0	9 041	57	20 920
1994	3 693	7 136	5	2 318	388	269	126	210	80	2 947	1	27 974
1995	4 788	10 438	8	2 303	113	711	65	882	74	2 737	58	17 173
1996	5 808	11 306	23	2915	79	319	142	1 330	189	1 185	0	22 178
1997	5 035	13 371	12	3021	21	433	49	263	259	957	47	23 296
1998	7 535	12 214	3	3357	52	2 129	19	1 645	180	96	1	23 469
1999	3 815	8 343	23	4 625	69	1 770	3	1 480	706	13	2	27 231
2000	3 416	7 821	59	6 113	96	2 188	8	579	0	9	1	20 849
2001	4 383	6 743	47	5 910	516	2 469	10	0	0	8	5	20 292
2002	3 792	7 487	221	7 529	405	2 457	0	0	0	0	1	20 092
2003	3 963	8 371	218	8 519	529	2 971	0	0	0	0	52	21 891
2004	2 031	7 970	24	7 247	960	2 917	0	0	0	0	2	24 623
2005	3 588	8 272	1	10 024	206	3 770	0	0	0	0	57	21 151
2006	2 751	7 663	459	10 402	315	5 203	0	0	796	0	3	25 917
2007	7 953	5 703	566	8 375	264	2 970	0	0	1 163	0	0	27 593
2008	8 806	5 496	6	8 624	498	2 875	0	0	0	0	0	26 306
Total	83 462	161 614	1 803	95 347	4606	34 589	423	6 410	3 664	46 575	286	438 779

Table C9a: Proportion of barracouta catch (total in tonnes) reported each month from the ECSI area for fishing years 1990–2008.

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1990	0.11	0.12	0.04	0.10	0.10	0.14	0.13	0.16	0.06	0.02	0.01	0.02	6 012
1991	0.11	0.14	0.09	0.10	0.12	0.06	0.14	0.07	0.05	0.02	0.02	0.06	7 204
1992	0.06	0.10	0.09	0.15	0.15	0.18	0.13	0.07	0.02	0.01	0.02	0.01	5 111
1993	0.02	0.02	0.02	0.20	0.14	0.13	0.19	0.11	0.11	0.03	0.02	0.01	7 482
1994	0.09	0.06	0.07	0.10	0.07	0.05	0.31	0.17	0.05	0.02	0.01	0.01	5 217
1995	0.03	0.10	0.08	0.12	0.13	0.06	0.16	0.23	0.05	0.01	0.01	0.02	7 392
1996	0.03	0.10	0.09	0.13	0.13	0.18	0.17	0.10	0.03	0.01	0.00	0.01	8 223
1997	0.04	0.19	0.13	0.10	0.07	0.12	0.18	0.11	0.04	0.01	0.00	0.00	10 021
1998	0.06	0.11	0.14	0.11	0.10	0.15	0.15	0.09	0.06	0.01	0.00	0.00	9 207
1999	0.08	0.06	0.05	0.17	0.17	0.10	0.22	0.06	0.06	0.02	0.01	0.01	7 942
2000	0.04	0.08	0.08	0.24	0.08	0.23	0.13	0.06	0.05	0.01	0.00	0.00	8 953
2001	0.05	0.09	0.18	0.21	0.09	0.14	0.06	0.12	0.05	0.00	0.00	0.00	6 036
2002	0.15	0.10	0.04	0.07	0.15	0.15	0.19	0.09	0.04	0.01	0.00	0.01	6 184
2003	0.04	0.04	0.06	0.06	0.09	0.16	0.18	0.21	0.13	0.01	0.00	0.02	6 496
2004	0.04	0.05	0.05	0.14	0.08	0.17	0.21	0.07	0.14	0.02	0.00	0.02	4 459
2005	0.02	0.04	0.02	0.13	0.12	0.10	0.16	0.18	0.10	0.03	0.04	0.06	4 666
2006	0.02	0.07	0.04	0.07	0.10	0.14	0.16	0.13	0.06	0.06	0.05	0.08	6 665
2007	0.08	0.05	0.03	0.06	0.08	0.22	0.22	0.08	0.09	0.04	0.04	0.01	2 954
2008	0.03	0.04	0.02	0.06	0.06	0.09	0.12	0.15	0.10	0.14	0.06	0.13	5 171
Total	0.06	0.09	0.08	0.13	0.11	0.13	0.17	0.12	0.06	0.02	0.01	0.02	125 396

Table C9b: Proportion of barracouta catch (total in tonnes) reported for each statistical area from the ECSI area for fishing years 1990–2008.

Year	018	019	020	021	022	023	024	026	Other	Total
1990	0.08	0	0.19	0.01	0.70	0.00	0.01	0.01	0	6 012
1991	0.08	0	0.13	0.02	0.60	0.01	0.12	0.03	0	7 204
1992	0.04	0	0.17	0.00	0.53	0.00	0.22	0.02	0	5 111
1993	0.05	0	0.08	0.03	0.64	0.00	0.14	0.07	0	7 482
1994	0.07	0	0.16	0.04	0.64	0.00	0.06	0.02	0	5 217
1995	0.04	0	0.15	0.05	0.65	0.00	0.11	0.01	0	7 392
1996	0.04	0	0.15	0.01	0.68	0.00	0.06	0.04	0	8 223
1997	0.03	0	0.14	0.01	0.74	0.00	0.06	0.02	0	10 021
1998	0.04	0	0.25	0.01	0.62	0.00	0.05	0.04	0	9 207
1999	0.05	0	0.16	0.00	0.66	0.00	0.11	0.02	0	7 942
2000	0.03	0	0.12	0.00	0.76	0.00	0.08	0.01	0	8 953
2001	0.07	0	0.15	0.00	0.64	0.01	0.06	0.08	0	6 036
2002	0.05	0	0.18	0.00	0.63	0.00	0.12	0.01	0	6 184
2003	0.04	0	0.10	0.02	0.77	0.00	0.05	0.02	0	6 496
2004	0.01	0	0.14	0.00	0.51	0.00	0.30	0.04	0	4 459
2005	0.01	0	0.22	0.00	0.70	0.00	0.04	0.02	0	4 666
2006	0.01	0	0.10	0.02	0.76	0.00	0.08	0.02	0	6 665
2007	0.01	0	0.22	0.00	0.62	0.00	0.14	0.00	0	2 954
2008	0.02	0	0.13	0.03	0.63	0.00	0.17	0.02	0	5 171
Total	0.04	0	0.15	0.01	0.66	0.00	0.10	0.03	0	125 396

Table C9c: Proportion of barracouta catch (total in tonnes) reported by gear type from the ECSI area for fishing years 1990–2008.

Year	BT	MW	DS	PS	Total
1990	0.98	0.00	0.00	0.02	6 012
1991	0.98	0.01	0.00	0.01	7 204
1992	0.99	0.00	0.00	0.01	5 111
1993	0.86	0.13	0.00	0.01	7 482
1994	0.59	0.39	0.00	0.02	5 217
1995	0.78	0.21	0.00	0.01	7 392
1996	0.85	0.15	0.00	0.00	8 223
1997	0.84	0.16	0.00	0.00	10 021
1998	0.88	0.11	0.00	0.01	9 207
1999	0.85	0.15	0.00	0.00	7 942
2000	0.76	0.24	0.00	0.01	8 953
2001	0.88	0.11	0.00	0.01	6 036
2002	0.75	0.24	0.00	0.01	6 184
2003	0.77	0.21	0.00	0.02	6 496
2004	0.97	0.03	0.00	0.00	4 459
2005	0.73	0.27	0.00	0.00	4 666
2006	0.70	0.30	0.00	0.00	6 665
2007	0.75	0.24	0.01	0.00	2 954
2008	0.59	0.40	0.00	0.00	5 171
Total	0.82	0.17	0.00	0.01	125 396

Table C9d: Proportion of barracouta catch (total in tonnes) reported by target species from the ECSI area for fishing years 1990–2008.

Year	BAR	FLA	HOK	JMA	RCO	SQU	SWA	TAR	WAR	Other	Total
1990	0.67	0.01	0.01	0.00	0.23	0.02	0.01	0.01	0.01	0.04	6 012
1991	0.68	0.01	0.02	0.02	0.20	0.02	0.00	0.01	0.01	0.04	7 204
1992	0.63	0.01	0.01	0.00	0.24	0.08	0.01	0.01	0.01	0.02	5 111
1993	0.59	0.01	0.01	0.02	0.28	0.04	0.01	0.00	0.00	0.04	7 482
1994	0.28	0.01	0.02	0.04	0.26	0.36	0.01	0.01	0.00	0.02	5 217
1995	0.42	0.00	0.01	0.09	0.31	0.15	0.00	0.00	0.00	0.01	7 392
1996	0.35	0.01	0.01	0.04	0.39	0.16	0.00	0.01	0.00	0.02	8 223
1997	0.35	0.01	0.01	0.06	0.46	0.08	0.01	0.01	0.00	0.01	10 021
1998	0.28	0.02	0.01	0.08	0.47	0.12	0.00	0.00	0.00	0.02	9 207
1999	0.40	0.03	0.01	0.11	0.27	0.16	0.00	0.01	0.01	0.01	7 942
2000	0.38	0.01	0.01	0.10	0.26	0.22	0.00	0.00	0.01	0.01	8 953
2001	0.35	0.02	0.00	0.07	0.19	0.36	0.00	0.00	0.00	0.01	6 036
2002	0.50	0.01	0.00	0.11	0.20	0.16	0.00	0.00	0.00	0.01	6 184
2003	0.53	0.00	0.02	0.13	0.18	0.11	0.00	0.00	0.01	0.02	6 496
2004	0.52	0.01	0.01	0.00	0.29	0.10	0.00	0.01	0.01	0.05	4 459
2005	0.48	0.01	0.01	0.01	0.35	0.06	0.00	0.04	0.02	0.02	4 666
2006	0.38	0.00	0.00	0.15	0.26	0.10	0.00	0.04	0.02	0.04	6 665
2007	0.44	0.00	0.00	0.06	0.21	0.15	0.02	0.07	0.02	0.04	2 954
2008	0.66	0.00	0.00	0.07	0.11	0.05	0.04	0.04	0.01	0.01	5 171
Total	0.46	0.01	0.01	0.06	0.29	0.13	0.01	0.01	0.01	0.01	125 396

Table C10a: Proportion of barracouta catch (total in tonnes) reported each month from the ECNI area for fishing years 1990–2008.

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1990	0.03	0.01	0.01	0.03	0.02	0.01	0.01	0.04	0.06	0.07	0.31	0.39	1 054
1991	0.03	0.05	0.03	0.03	0.24	0.06	0.03	0.03	0.07	0.14	0.12	0.17	716
1992	0.04	0.04	0.05	0.09	0.04	0.03	0.02	0.05	0.08	0.08	0.20	0.28	1 298
1993	0.06	0.07	0.04	0.08	0.07	0.06	0.03	0.07	0.07	0.18	0.16	0.10	1 446
1994	0.06	0.07	0.05	0.09	0.07	0.04	0.05	0.02	0.04	0.12	0.21	0.19	1 843
1995	0.09	0.06	0.05	0.05	0.04	0.03	0.03	0.04	0.06	0.18	0.19	0.17	2 322
1996	0.11	0.10	0.05	0.05	0.03	0.03	0.03	0.03	0.08	0.20	0.13	0.16	2 153
1997	0.16	0.12	0.07	0.05	0.04	0.04	0.03	0.05	0.04	0.12	0.14	0.14	2 094
1998	0.07	0.08	0.04	0.05	0.03	0.05	0.09	0.20	0.04	0.08	0.14	0.12	1 828
1999	0.07	0.07	0.08	0.04	0.03	0.05	0.04	0.08	0.07	0.11	0.16	0.19	1 342
2000	0.07	0.08	0.07	0.10	0.05	0.10	0.04	0.05	0.03	0.08	0.13	0.20	974
2001	0.16	0.08	0.05	0.06	0.04	0.03	0.02	0.03	0.05	0.13	0.23	0.12	1 024
2002	0.10	0.07	0.04	0.06	0.06	0.06	0.04	0.05	0.09	0.17	0.15	0.09	696
2003	0.09	0.04	0.05	0.07	0.05	0.04	0.02	0.03	0.06	0.10	0.27	0.17	1 011
2004	0.10	0.06	0.04	0.09	0.03	0.04	0.07	0.03	0.06	0.07	0.10	0.29	907
2005	0.10	0.05	0.06	0.08	0.05	0.07	0.06	0.06	0.06	0.10	0.21	0.10	904
2006	0.06	0.05	0.08	0.07	0.05	0.07	0.07	0.06	0.05	0.11	0.23	0.10	831
2007	0.11	0.06	0.07	0.05	0.06	0.05	0.05	0.06	0.05	0.18	0.19	0.09	949
2008	0.15	0.08	0.14	0.07	0.05	0.04	0.07	0.04	0.04	0.06	0.16	0.10	675
Total	0.09	0.07	0.06	0.06	0.05	0.04	0.04	0.06	0.06	0.13	0.18	0.17	24 065

Table C10b: Proportion of barracouta catch (total in tonnes) reported for each statistical area from the ECNI area for fishing years 1990–2008.

Year	001	002	003	004	005	006	007	008	009	010	011
1990	0.02	0.11	0.12	0.00	0.03	0.03	0.00	0.04	0.13	0.10	0.01
1991	0.01	0.06	0.29	0.01	0.02	0.01	0.00	0.05	0.16	0.05	0.01
1992	0.00	0.02	0.05	0.00	0.01	0.00	0.01	0.03	0.38	0.03	0.01
1993	0.01	0.03	0.04	0.00	0.01	0.00	0.01	0.05	0.16	0.05	0.01
1994	0.02	0.05	0.04	0.00	0.01	0.00	0.00	0.03	0.15	0.05	0.02
1995	0.01	0.04	0.03	0.00	0.01	0.00	0.00	0.02	0.11	0.06	0.04
1996	0.01	0.04	0.04	0.00	0.03	0.00	0.00	0.02	0.08	0.07	0.04
1997	0.02	0.06	0.03	0.00	0.03	0.00	0.00	0.01	0.11	0.05	0.04
1998	0.02	0.05	0.07	0.00	0.01	0.00	0.00	0.03	0.36	0.04	0.03
1999	0.00	0.03	0.05	0.00	0.01	0.01	0.00	0.05	0.29	0.06	0.06
2000	0.00	0.11	0.07	0.00	0.03	0.00	0.00	0.05	0.12	0.03	0.07
2001	0.00	0.07	0.06	0.00	0.02	0.00	0.00	0.02	0.10	0.12	0.04
2002	0.00	0.02	0.12	0.00	0.02	0.00	0.00	0.03	0.09	0.08	0.03
2003	0.00	0.02	0.04	0.00	0.01	0.00	0.00	0.04	0.10	0.06	0.04
2004	0.00	0.01	0.03	0.00	0.01	0.00	0.00	0.01	0.07	0.08	0.05
2005	0.00	0.08	0.04	0.01	0.01	0.00	0.00	0.04	0.06	0.06	0.05
2006	0.00	0.05	0.06	0.01	0.01	0.01	0.00	0.03	0.07	0.05	0.07
2007	0.00	0.03	0.05	0.01	0.04	0.01	0.00	0.02	0.05	0.04	0.04
2008	0.00	0.03	0.04	0.01	0.04	0.01	0.00	0.04	0.10	0.03	0.04
Total	0.01	0.05	0.06	0.00	0.02	0.01	0.00	0.03	0.15	0.06	0.04

Table C10b: continued.

Year	012	013	014	015	016	017	Other	Total
1990	0.03	0.11	0.14	0.11	0.01	0.03	0.00	1 054
1991	0.07	0.09	0.05	0.05	0.04	0.02	0.00	716
1992	0.02	0.13	0.17	0.02	0.09	0.02	0.00	1 298
1993	0.02	0.21	0.26	0.05	0.06	0.01	0.00	1 446
1994	0.04	0.16	0.28	0.08	0.07	0.02	0.00	1 843
1995	0.06	0.17	0.27	0.06	0.11	0.01	0.00	2 322
1996	0.05	0.17	0.25	0.09	0.07	0.02	0.00	2 153
1997	0.04	0.16	0.25	0.03	0.16	0.02	0.00	2 094
1998	0.04	0.10	0.15	0.03	0.02	0.01	0.01	1 828
1999	0.06	0.11	0.13	0.06	0.06	0.02	0.00	1 342
2000	0.08	0.22	0.12	0.02	0.05	0.03	0.00	974
2001	0.06	0.24	0.15	0.03	0.05	0.03	0.00	1 024
2002	0.05	0.17	0.21	0.06	0.08	0.03	0.00	696
2003	0.06	0.31	0.17	0.03	0.09	0.03	0.00	1 011
2004	0.08	0.31	0.13	0.04	0.10	0.06	0.00	907
2005	0.07	0.21	0.15	0.07	0.10	0.05	0.00	904
2006	0.09	0.18	0.17	0.10	0.07	0.04	0.00	831
2007	0.06	0.24	0.28	0.05	0.06	0.01	0.00	949
2008	0.04	0.17	0.24	0.09	0.12	0.01	0.00	675
Total	0.05	0.18	0.20	0.06	0.08	0.02	0.00	24 065

Table C10c: Proportion of barracouta catch (total in tonnes) reported by gear type from the ECNI area for fishing years 1990–2008.

Year	BLL	BPT	BT	DS	MW	PS	SN	T	Other	Total
1990	0.00	0.03	0.95	0.00	0.00	0.02	0.00	0.00	0	1 054
1991	0.00	0.04	0.91	0.01	0.00	0.02	0.00	0.00	0	716
1992	0.00	0.02	0.94	0.00	0.01	0.01	0.01	0.00	0	1 298
1993	0.00	0.03	0.92	0.00	0.02	0.02	0.01	0.00	0	1 446
1994	0.00	0.05	0.89	0.00	0.02	0.02	0.00	0.00	0	1 843
1995	0.00	0.02	0.93	0.00	0.02	0.02	0.00	0.00	0	2 322
1996	0.01	0.00	0.94	0.01	0.02	0.01	0.01	0.01	0	2 153
1997	0.01	0.00	0.91	0.01	0.05	0.01	0.00	0.00	0	2 094
1998	0.00	0.00	0.96	0.01	0.01	0.02	0.00	0.00	0	1 828
1999	0.01	0.00	0.96	0.01	0.01	0.02	0.00	0.00	0	1 342
2000	0.01	0.07	0.90	0.01	0.00	0.01	0.00	0.00	0	974
2001	0.01	0.02	0.96	0.00	0.01	0.00	0.00	0.00	0	1 024
2002	0.01	0.01	0.96	0.01	0.01	0.01	0.00	0.00	0	696
2003	0.00	0.05	0.78	0.00	0.16	0.00	0.00	0.00	0	1 011
2004	0.00	0.02	0.81	0.01	0.15	0.01	0.00	0.00	0	907
2005	0.01	0.03	0.93	0.01	0.02	0.00	0.00	0.00	0	904
2006	0.01	0.02	0.96	0.00	0.01	0.01	0.00	0.00	0	831
2007	0.00	0.01	0.94	0.01	0.02	0.02	0.00	0.00	0	949
2008	0.01	0.01	0.96	0.01	0.00	0.01	0.00	0.00	0	675
Total	0.00	0.02	0.92	0.01	0.03	0.01	0.00	0.00	0	24 065

Table C10d: Proportion of barracouta catch (total in tonnes) reported by target species from the ECNI area for fishing years 1990–2008.

Year	BAR	GUR	HOK	JDO	JMA	KAH	RCO	SKI	SNA	SWA	TAR
1990	0.55	0.01	0.00	0.01	0.00	0.02	0.01	0.05	0.18	0.00	0.14
1991	0.44	0.03	0.01	0.03	0.00	0.02	0.01	0.03	0.17	0.00	0.20
1992	0.41	0.05	0.00	0.01	0.00	0.01	0.00	0.13	0.09	0.00	0.19
1993	0.31	0.08	0.01	0.01	0.01	0.01	0.01	0.14	0.08	0.00	0.20
1994	0.29	0.06	0.06	0.01	0.01	0.01	0.00	0.11	0.11	0.01	0.25
1995	0.18	0.07	0.02	0.02	0.01	0.01	0.01	0.14	0.06	0.00	0.32
1996	0.22	0.07	0.05	0.03	0.00	0.02	0.00	0.13	0.09	0.01	0.27
1997	0.31	0.08	0.07	0.04	0.00	0.01	0.00	0.09	0.06	0.01	0.21
1998	0.25	0.05	0.08	0.05	0.01	0.00	0.01	0.13	0.11	0.00	0.22
1999	0.32	0.04	0.03	0.04	0.00	0.01	0.00	0.03	0.12	0.01	0.32
2000	0.20	0.10	0.03	0.04	0.00	0.00	0.00	0.04	0.12	0.01	0.34
2001	0.30	0.16	0.02	0.01	0.00	0.00	0.00	0.01	0.09	0.00	0.26
2002	0.17	0.16	0.01	0.02	0.01	0.00	0.07	0.02	0.08	0.02	0.28
2003	0.33	0.10	0.04	0.01	0.00	0.00	0.01	0.03	0.08	0.01	0.27
2004	0.27	0.09	0.10	0.01	0.00	0.00	0.00	0.02	0.10	0.00	0.33
2005	0.04	0.13	0.06	0.02	0.00	0.00	0.01	0.01	0.10	0.00	0.53
2006	0.06	0.13	0.04	0.02	0.00	0.00	0.00	0.01	0.10	0.00	0.55
2007	0.04	0.13	0.02	0.04	0.00	0.00	0.00	0.00	0.11	0.00	0.57
2008	0.11	0.17	0.01	0.05	0.00	0.00	0.00	0.00	0.06	0.01	0.47
Total	0.26	0.08	0.04	0.02	0.00	0.01	0.01	0.08	0.10	0.00	0.29

Year	TRE	WAR	Other	Total
1990	0.01	0.01	0.01	1 054
1991	0.01	0.03	0.01	716
1992	0.01	0.07	0.02	1 298
1993	0.03	0.07	0.03	1 446
1994	0.02	0.04	0.02	1 843
1995	0.02	0.11	0.03	2 322
1996	0.02	0.08	0.02	2 153
1997	0.02	0.08	0.02	2 094
1998	0.05	0.02	0.01	1 828
1999	0.05	0.02	0.01	1 342
2000	0.06	0.03	0.02	974
2001	0.05	0.07	0.02	1 024
2002	0.04	0.12	0.01	696
2003	0.03	0.08	0.02	1 011
2004	0.03	0.02	0.02	907
2005	0.03	0.05	0.01	904
2006	0.03	0.05	0.01	831
2007	0.03	0.03	0.02	949
2008	0.04	0.06	0.02	675
Total	0.03	0.06	0.02	24 065

Table C11a: Proportion of barracouta catch (total in tonnes) reported each month from the CHAT WEST area for fishing years 1990–2008.

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1990	0.00	0.00	0.00	0.00	0.00	0.49	0.01	0.07	0.01	0.00	0.00	0.42	139
1991	0.38	0.01	0.00	0.05	0.00	0.01	0.00	0.11	0.28	0.07	0.00	0.10	774
1992	0.00	0.00	0.08	0.07	0.00	0.00	0.44	0.09	0.30	0.00	0.02	0.00	248
1993	0.00	0.00	0.00	0.00	0.01	0.00	0.44	0.33	0.00	0.00	0.00	0.22	126
1994	0.00	0.20	0.00	0.08	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.69	154
1995	0.03	0.70	0.03	0.21	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	120
1996	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.97	0.00	0.00	0.00	0.01	64
1997	0.00	0.00	0.27	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.71	87
1998	0.01	0.05	0.06	0.00	0.00	0.00	0.22	0.58	0.08	0.00	0.00	0.00	778
1999	0.00	0.00	0.96	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	195
2000	0.00	0.00	0.10	0.00	0.00	0.01	0.62	0.24	0.00	0.00	0.00	0.02	47
2001	0.00	0.00	0.34	0.08	0.00	0.25	0.22	0.11	0.00	0.00	0.00	0.00	77
2002	0.29	0.07	0.36	0.05	0.00	0.00	0.16	0.06	0.00	0.00	0.00	0.00	7
2003	0.02	0.21	0.26	0.29	0.01	0.00	0.00	0.21	0.00	0.00	0.00	0.00	13
2004	0.02	0.02	0.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15
2005	0.00	0.67	0.00	0.00	0.00	0.00	0.00	0.02	0.31	0.00	0.00	0.00	2
2006	0.19	0.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13
2007	0.00	0.00	0.18	0.03	0.00	0.01	0.01	0.77	0.00	0.00	0.00	0.00	26
2008	0.00	0.01	0.02	0.01	0.00	0.00	0.01	0.82	0.00	0.00	0.12	0.01	2
Total	0.11	0.06	0.12	0.04	0.00	0.03	0.13	0.25	0.12	0.02	0.00	0.12	2 885

Table C11b: Proportion of barracouta catch (total in tonnes) reported for each statistical area from the CHAT WEST area for fishing years 1990–2008.

Year	401	402	403	407	408	409	Other	Total
1990	0.01	0.00	0.00	0.99	0.00	0.00	0.00	139
1991	0.11	0.00	0.00	0.89	0.00	0.00	0.00	774
1992	0.15	0.00	0.00	0.85	0.00	0.00	0.00	248
1993	0.01	0.00	0.00	0.99	0.00	0.00	0.00	126
1994	0.05	0.00	0.00	0.95	0.00	0.00	0.00	154
1995	0.02	0.04	0.00	0.93	0.01	0.00	0.00	120
1996	0.02	0.00	0.00	0.98	0.00	0.00	0.00	64
1997	0.00	0.00	0.00	1.00	0.00	0.00	0.00	87
1998	0.02	0.00	0.00	0.98	0.00	0.00	0.00	778
1999	0.00	0.00	0.00	0.04	0.96	0.00	0.00	195
2000	0.48	0.01	0.00	0.40	0.11	0.00	0.00	47
2001	0.00	0.00	0.00	1.00	0.00	0.00	0.00	77
2002	0.56	0.08	0.01	0.32	0.04	0.00	0.00	7
2003	0.82	0.12	0.05	0.00	0.00	0.00	0.00	13
2004	0.27	0.39	0.33	0.02	0.00	0.00	0.00	15
2005	0.78	0.15	0.03	0.00	0.02	0.01	0.00	2
2006	1.00	0.00	0.00	0.00	0.00	0.00	0.00	13
2007	0.92	0.04	0.00	0.04	0.00	0.00	0.00	26
2008	0.34	0.63	0.01	0.01	0.00	0.00	0.00	2
Total	0.08	0.01	0.00	0.84	0.07	0.00	0.00	2 885

Table C11c: Proportion of barracouta catch (total in tonnes) reported by gear type from the CHAT WEST area for fishing years 1990–2008.

Year	BT	MW	Total
1990	1.00	0.00	139
1991	1.00	0.00	774
1992	0.98	0.02	248
1993	1.00	0.00	126
1994	1.00	0.00	154
1995	0.90	0.10	120
1996	0.05	0.95	64
1997	0.47	0.53	87
1998	1.00	0.00	778
1999	1.00	0.00	195
2000	0.66	0.34	47
2001	0.90	0.10	77
2002	0.71	0.29	7
2003	1.00	0.00	13
2004	1.00	0.00	15
2005	1.00	0.00	2
2006	1.00	0.00	13
2007	1.00	0.00	26
2008	1.00	0.00	2
Total	0.95	0.05	2 885

Table C11d: Proportion of barracouta catch (total in tonnes) reported by target species from the CHAT WEST area for fishing years 1990–2008.

Year	BAR	HOK	JMA	RCO	SPD	SPE	SQU	SSO	SWA	Other	Total
1990	0.98	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	139
1991	0.84	0.09	0.00	0.02	0.03	0.00	0.00	0.00	0.02	0.00	774
1992	0.83	0.03	0.00	0.00	0.00	0.00	0.02	0.00	0.11	0.01	248
1993	0.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	126
1994	0.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	154
1995	0.86	0.09	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.04	120
1996	0.57	0.07	0.34	0.00	0.00	0.00	0.03	0.00	0.00	0.00	64
1997	0.99	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	87
1998	0.89	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	778
1999	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.96	0.00	0.00	195
2000	0.57	0.37	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.01	47
2001	0.00	0.10	0.00	0.00	0.00	0.00	0.89	0.00	0.00	0.00	77
2002	0.00	0.31	0.00	0.00	0.00	0.09	0.00	0.00	0.01	0.58	7
2003	0.00	0.02	0.42	0.00	0.00	0.53	0.02	0.00	0.00	0.00	13
2004	0.00	0.92	0.02	0.00	0.00	0.00	0.06	0.00	0.00	0.00	15
2005	0.00	0.29	0.00	0.00	0.00	0.24	0.46	0.00	0.00	0.01	2
2006	0.60	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.27	13
2007	0.77	0.01	0.00	0.00	0.00	0.12	0.04	0.00	0.00	0.05	26
2008	0.00	0.03	0.00	0.00	0.00	0.76	0.01	0.00	0.20	0.01	2
Total	0.77	0.05	0.01	0.01	0.01	0.00	0.06	0.06	0.02	0.01	2 885

Table C12a: Proportion of barracouta catch (total in tonnes) reported each month from the CHAT EAST area for fishing years 1990–2008.

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1990	0.00	0.00	0.00	0.08	0.04	0.13	0.16	0.15	0.41	0.01	0.00	0.00	867
1991	0.00	0.05	0.01	0.33	0.00	0.00	0.00	0.39	0.19	0.01	0.00	0.00	589
1992	0.00	0.00	0.83	0.05	0.00	0.00	0.02	0.00	0.09	0.00	0.00	0.01	837
1993	0.00	0.00	0.27	0.05	0.00	0.00	0.00	0.48	0.20	0.00	0.00	0.00	2 040
1994	0.00	0.11	0.07	0.30	0.00	0.01	0.00	0.05	0.27	0.00	0.00	0.19	521
1995	0.01	0.05	0.00	0.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	201
1996	0.00	0.01	0.12	0.16	0.00	0.00	0.00	0.42	0.29	0.00	0.00	0.00	1 961
1997	0.00	0.00	0.13	0.00	0.00	0.00	0.07	0.38	0.41	0.00	0.00	0.00	683
1998	0.00	0.01	0.11	0.02	0.00	0.00	0.00	0.40	0.46	0.00	0.00	0.00	1 036
1999	0.01	0.00	0.06	0.00	0.00	0.01	0.89	0.01	0.00	0.00	0.00	0.00	243
2000	0.00	0.00	0.56	0.39	0.00	0.01	0.01	0.02	0.02	0.00	0.00	0.01	1 732
2001	0.00	0.00	0.73	0.01	0.02	0.02	0.08	0.00	0.00	0.00	0.00	0.13	1 647
2002	0.09	0.02	0.01	0.00	0.01	0.02	0.23	0.36	0.00	0.04	0.00	0.23	1 434
2003	0.02	0.12	0.09	0.04	0.00	0.07	0.36	0.21	0.05	0.00	0.01	0.03	563
2004	0.34	0.19	0.32	0.00	0.01	0.00	0.00	0.00	0.10	0.00	0.00	0.03	211
2005	0.03	0.01	0.01	0.00	0.04	0.05	0.00	0.00	0.00	0.05	0.01	0.80	374
2006	0.07	0.05	0.02	0.08	0.01	0.02	0.00	0.02	0.66	0.00	0.00	0.07	670
2007	0.00	0.00	0.00	0.01	0.01	0.00	0.01	0.94	0.00	0.00	0.00	0.04	2 868
2008	0.04	0.03	0.01	0.00	0.00	0.00	0.00	0.64	0.19	0.02	0.01	0.06	2 014
Total	0.02	0.02	0.20	0.09	0.01	0.01	0.06	0.37	0.16	0.01	0.00	0.06	20 492

Table C12b: Proportion of barracouta catch (total in tonnes) reported for each statistical area from the CHAT EAST area for fishing years 1990–2008.

Year	049	050	051	052	404	405	406	410	412	Total
1990	0.50	0.45	0.00	0.04	0.01	0.00	0	0	0	867
1991	0.44	0.54	0.00	0.01	0.00	0.00	0	0	0	589
1992	0.89	0.08	0.00	0.02	0.00	0.00	0	0	0	837
1993	0.28	0.65	0.00	0.06	0.01	0.00	0	0	0	2 040
1994	0.35	0.55	0.00	0.10	0.00	0.00	0	0	0	521
1995	0.91	0.05	0.00	0.03	0.00	0.00	0	0	0	201
1996	0.32	0.63	0.00	0.05	0.00	0.00	0	0	0	1 961
1997	0.11	0.86	0.00	0.02	0.01	0.00	0	0	0	683
1998	0.17	0.72	0.00	0.11	0.00	0.00	0	0	0	1 036
1999	0.93	0.06	0.00	0.01	0.00	0.00	0	0	0	243
2000	0.95	0.02	0.00	0.02	0.00	0.00	0	0	0	1 732
2001	0.75	0.17	0.01	0.07	0.00	0.00	0	0	0	1 647
2002	0.73	0.24	0.00	0.02	0.00	0.00	0	0	0	1 434
2003	0.57	0.21	0.00	0.21	0.01	0.00	0	0	0	563
2004	0.56	0.25	0.05	0.13	0.00	0.00	0	0	0	211
2005	0.16	0.81	0.00	0.03	0.00	0.00	0	0	0	374
2006	0.23	0.66	0.01	0.10	0.01	0.00	0	0	0	670
2007	0.13	0.83	0.00	0.00	0.03	0.00	0	0	0	2 868
2008	0.20	0.77	0.00	0.02	0.00	0.01	0	0	0	2 014
Total	0.43	0.51	0.00	0.04	0.01	0.00	0	0	0	20 492

Table C12c: Proportion of barracouta catch (total in tonnes) reported by gear type from the CHAT EAST area for fishing years 1990–2008.

Year	BT	MW	Total
1990	1.00	0.00	867
1991	1.00	0.00	589
1992	0.19	0.81	837
1993	0.71	0.29	2 040
1994	0.84	0.16	521
1995	0.99	0.01	201
1996	0.77	0.23	1 961
1997	0.92	0.08	683
1998	0.94	0.06	1 036
1999	0.19	0.81	243
2000	0.07	0.93	1 732
2001	0.27	0.73	1 647
2002	0.41	0.59	1 434
2003	0.39	0.61	563
2004	0.55	0.45	211
2005	0.97	0.03	374
2006	0.92	0.08	670
2007	1.00	0.00	2 868
2008	0.93	0.07	2 014
Total	0.69	0.31	20 492

Table C12d: Proportion of barracouta catch (total in tonnes) reported by target species from the CHAT EAST area for fishing years 1990–2008.

Year	BAR	GUR	HOK	JMA	LIN	RCO	SPD	SQU	STA	SWA	TAR	Total
1990	0.98	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	867
1991	0.97	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	589
1992	0.93	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.02	0.00	0.02	837
1993	0.93	0.00	0.00	0.04	0.00	0.01	0.00	0.01	0.00	0.00	0.00	2 040
1994	0.78	0.00	0.00	0.15	0.00	0.00	0.00	0.06	0.01	0.00	0.00	521
1995	0.97	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	201
1996	0.93	0.00	0.00	0.02	0.00	0.00	0.00	0.03	0.00	0.02	0.00	1 961
1997	0.90	0.00	0.02	0.06	0.00	0.00	0.00	0.01	0.00	0.00	0.00	683
1998	0.79	0.00	0.00	0.12	0.00	0.00	0.00	0.05	0.03	0.00	0.00	1 036
1999	0.89	0.00	0.01	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.01	243
2000	0.90	0.00	0.00	0.05	0.00	0.00	0.00	0.03	0.01	0.00	0.01	1 732
2001	0.85	0.01	0.00	0.01	0.00	0.00	0.00	0.02	0.00	0.00	0.10	1 647
2002	0.79	0.01	0.00	0.05	0.01	0.00	0.00	0.00	0.12	0.00	0.02	1 434
2003	0.67	0.01	0.00	0.10	0.02	0.00	0.00	0.01	0.00	0.01	0.16	563
2004	0.48	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.36	211
2005	0.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.00	0.17	374
2006	0.62	0.01	0.00	0.05	0.01	0.00	0.04	0.01	0.01	0.02	0.23	670
2007	0.95	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.02	2 868
2008	0.95	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.01	2 014
Total	0.88	0.00	0.00	0.03	0.01	0.00	0.00	0.02	0.02	0.00	0.03	20 492

Table C13a: Proportion of barracouta catch (total in tonnes) reported each month from the WCSI area for fishing years 1990–2008.

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1990	0.00	0.01	0.01	0.01	0.01	0.02	0.00	0.00	0.01	0.15	0.46	0.31	2 334
1991	0.03	0.01	0.00	0.01	0.01	0.02	0.01	0.01	0.01	0.05	0.66	0.18	3 997
1992	0.02	0.03	0.04	0.01	0.00	0.03	0.07	0.15	0.14	0.08	0.21	0.21	2 523
1993	0.03	0.02	0.02	0.02	0.03	0.02	0.07	0.02	0.08	0.06	0.34	0.30	5 568
1994	0.22	0.08	0.02	0.02	0.03	0.03	0.01	0.02	0.03	0.10	0.26	0.17	3 206
1995	0.08	0.04	0.04	0.03	0.02	0.02	0.01	0.01	0.09	0.28	0.24	0.16	5 309
1996	0.04	0.04	0.03	0.04	0.03	0.02	0.02	0.02	0.05	0.07	0.33	0.32	3 247
1997	0.06	0.03	0.03	0.04	0.03	0.01	0.01	0.01	0.05	0.07	0.29	0.35	4 287
1998	0.07	0.01	0.02	0.01	0.01	0.01	0.01	0.02	0.04	0.07	0.27	0.47	3 352
1999	0.10	0.04	0.02	0.05	0.03	0.01	0.01	0.03	0.07	0.07	0.22	0.34	2 163
2000	0.04	0.06	0.04	0.04	0.03	0.05	0.04	0.02	0.06	0.13	0.27	0.22	993
2001	0.04	0.06	0.02	0.03	0.02	0.02	0.02	0.07	0.09	0.16	0.24	0.22	2 329
2002	0.07	0.04	0.04	0.02	0.01	0.00	0.00	0.00	0.08	0.23	0.13	0.36	3 698
2003	0.07	0.04	0.06	0.03	0.03	0.01	0.01	0.00	0.14	0.27	0.17	0.17	2 910
2004	0.27	0.04	0.03	0.04	0.01	0.02	0.01	0.02	0.03	0.08	0.21	0.24	2 583
2005	0.06	0.02	0.00	0.01	0.01	0.01	0.01	0.01	0.05	0.18	0.35	0.28	5 292
2006	0.64	0.05	0.01	0.02	0.01	0.01	0.01	0.02	0.03	0.05	0.06	0.08	2 698
2007	0.21	0.02	0.02	0.01	0.01	0.01	0.01	0.00	0.16	0.06	0.37	0.12	6 891
2008	0.11	0.06	0.02	0.02	0.01	0.00	0.01	0.03	0.17	0.08	0.34	0.09	4010
Total	0.11	0.04	0.02	0.02	0.02	0.02	0.02	0.02	0.08	0.12	0.30	0.24	67 390

Table C13b: Proportion of barracouta catch (total in tonnes) reported for each statistical area from the WCSI area for fishing years 1990–2008.

Year	033	034	035	036	701	702	703	704	705	706	801	Total
1990	0.16	0.55	0.25	0.03	0	0	0	0	0	0	0.01	2 334
1991	0.14	0.65	0.17	0.03	0	0	0	0	0	0	0.01	3 997
1992	0.17	0.27	0.30	0.25	0	0	0	0	0	0	0.01	2 523
1993	0.09	0.34	0.46	0.09	0	0	0	0	0	0	0.00	5 568
1994	0.11	0.23	0.54	0.12	0	0	0	0	0	0	0.00	3 206
1995	0.06	0.25	0.62	0.06	0	0	0	0	0	0	0.00	5 309
1996	0.07	0.47	0.37	0.08	0	0	0	0	0	0	0.00	3 247
1997	0.07	0.52	0.36	0.05	0	0	0	0	0	0	0.00	4 287
1998	0.05	0.54	0.36	0.05	0	0	0	0	0	0	0.00	3 352
1999	0.07	0.62	0.25	0.06	0	0	0	0	0	0	0.00	2 163
2000	0.12	0.71	0.06	0.11	0	0	0	0	0	0	0.00	993
2001	0.09	0.66	0.12	0.13	0	0	0	0	0	0	0.00	2 329
2002	0.02	0.59	0.28	0.11	0	0	0	0	0	0	0.00	3 698
2003	0.10	0.54	0.23	0.12	0	0	0	0	0	0	0.01	2 910
2004	0.11	0.50	0.13	0.08	0	0	0	0	0	0	0.17	2 583
2005	0.06	0.45	0.31	0.12	0	0	0	0	0	0	0.06	5 292
2006	0.08	0.15	0.10	0.66	0	0	0	0	0	0	0.01	2 698
2007	0.04	0.13	0.53	0.28	0	0	0	0	0	0	0.02	6 891
2008	0.10	0.20	0.40	0.25	0	0	0	0	0	0	0.06	4 010
Total	0.08	0.40	0.35	0.14	0	0	0	0	0	0	0.02	67 390

Table C13c: Proportion of barracouta catch (total in tonnes) reported by gear type from the WCSI area for fishing years 1990–2008.

Year	BT	MW	BPT	Total
1990	0.89	0.11	0.00	2 334
1991	0.90	0.09	0.01	3 997
1992	0.73	0.27	0.00	2 523
1993	0.83	0.17	0.00	5 568
1994	0.77	0.23	0.00	3 206
1995	0.64	0.36	0.00	5 309
1996	0.53	0.47	0.00	3 247
1997	0.34	0.66	0.00	4 287
1998	0.26	0.74	0.00	3 352
1999	0.40	0.60	0.00	2 163
2000	0.72	0.28	0.00	993
2001	0.51	0.49	0.00	2 329
2002	0.53	0.47	0.00	3 698
2003	0.45	0.55	0.00	2 910
2004	0.48	0.51	0.00	2 583
2005	0.47	0.53	0.00	5 292
2006	0.34	0.66	0.00	2 698
2007	0.36	0.64	0.00	6 891
2008	0.49	0.51	0.00	4 010
Total	0.55	0.45	0.00	67 390

Table C13d: Proportion of barracouta catch (total in tonnes) reported by target species from the WCSI area for fishing years 1990–2008.

Year	BAR	FLA	FRO	GUR	HAK	HOK	JMA	RCO	SKI	STA	TAR
1990	0.68	0.00	0.00	0.00	0.00	0.12	0.12	0.00	0.03	0.01	0.01
1991	0.84	0.00	0.00	0.00	0.00	0.04	0.07	0.01	0.00	0.00	0.02
1992	0.44	0.00	0.00	0.00	0.00	0.08	0.36	0.05	0.00	0.01	0.04
1993	0.73	0.00	0.00	0.00	0.00	0.08	0.12	0.03	0.00	0.00	0.01
1994	0.59	0.00	0.00	0.00	0.00	0.18	0.11	0.02	0.02	0.00	0.04
1995	0.62	0.00	0.00	0.00	0.00	0.15	0.14	0.03	0.00	0.01	0.03
1996	0.60	0.02	0.00	0.00	0.00	0.15	0.16	0.01	0.00	0.00	0.03
1997	0.68	0.00	0.00	0.00	0.00	0.09	0.21	0.00	0.00	0.00	0.01
1998	0.53	0.00	0.00	0.00	0.00	0.07	0.36	0.01	0.00	0.00	0.01
1999	0.56	0.03	0.01	0.00	0.00	0.07	0.31	0.01	0.00	0.00	0.01
2000	0.72	0.04	0.01	0.01	0.00	0.01	0.17	0.00	0.00	0.00	0.03
2001	0.55	0.01	0.01	0.00	0.00	0.07	0.32	0.01	0.00	0.00	0.01
2002	0.58	0.01	0.01	0.01	0.00	0.06	0.28	0.01	0.00	0.00	0.01
2003	0.35	0.01	0.01	0.00	0.00	0.10	0.46	0.02	0.00	0.00	0.02
2004	0.54	0.01	0.00	0.00	0.00	0.16	0.19	0.02	0.00	0.01	0.04
2005	0.65	0.01	0.00	0.00	0.00	0.13	0.12	0.02	0.00	0.01	0.04
2006	0.37	0.02	0.00	0.00	0.00	0.03	0.37	0.04	0.00	0.01	0.10
2007	0.44	0.01	0.00	0.00	0.02	0.02	0.36	0.01	0.00	0.01	0.03
2008	0.48	0.01	0.00	0.00	0.00	0.00	0.28	0.03	0.00	0.01	0.07
Total	0.58	0.01	0.00	0.00	0.00	0.09	0.23	0.02	0.00	0.00	0.03

Table C13d: continued.

Year	TRE	WAR	Other	Total
1990	0.00	0.00	0.00	2 334
1991	0.00	0.00	0.00	3 997
1992	0.00	0.00	0.01	2 523
1993	0.00	0.00	0.00	5 568
1994	0.01	0.00	0.00	3 206
1995	0.00	0.01	0.00	5 309
1996	0.01	0.01	0.00	3 247
1997	0.00	0.00	0.00	4 287
1998	0.00	0.00	0.00	3 352
1999	0.00	0.01	0.00	2 163
2000	0.00	0.00	0.00	993
2001	0.00	0.00	0.00	2 329
2002	0.00	0.02	0.00	3 698
2003	0.00	0.02	0.01	2 910
2004	0.00	0.02	0.00	2 583
2005	0.00	0.02	0.00	5 292
2006	0.00	0.03	0.02	2 698
2007	0.00	0.02	0.01	6 891
2008	0.00	0.05	0.02	4 010
Total	0.00	0.01	0.01	67 390

Table C14a: Proportion of barracouta catch (total in tonnes) reported each month from the WCNI area for fishing years 1990–2008.

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1990	0.05	0.05	0.05	0.08	0.15	0.14	0.06	0.03	0.04	0.08	0.16	0.13	1 435
1991	0.04	0.12	0.10	0.10	0.17	0.12	0.05	0.02	0.05	0.08	0.07	0.08	2 238
1992	0.04	0.15	0.30	0.24	0.05	0.02	0.04	0.03	0.04	0.03	0.02	0.04	4 501
1993	0.12	0.13	0.19	0.11	0.11	0.06	0.03	0.05	0.03	0.05	0.05	0.07	3 923
1994	0.13	0.17	0.26	0.08	0.07	0.01	0.01	0.05	0.08	0.06	0.05	0.01	3 061
1995	0.06	0.08	0.30	0.18	0.03	0.03	0.01	0.07	0.05	0.04	0.09	0.06	4 304
1996	0.20	0.07	0.13	0.15	0.10	0.01	0.05	0.02	0.10	0.08	0.03	0.05	3 501
1997	0.10	0.14	0.13	0.12	0.07	0.02	0.05	0.07	0.05	0.13	0.09	0.04	3 732
1998	0.06	0.07	0.06	0.22	0.05	0.01	0.34	0.03	0.08	0.02	0.03	0.02	5 033
1999	0.07	0.17	0.12	0.06	0.03	0.07	0.23	0.10	0.03	0.02	0.03	0.06	1 963
2000	0.18	0.07	0.13	0.06	0.05	0.07	0.06	0.04	0.06	0.07	0.13	0.09	1 821
2001	0.05	0.17	0.38	0.06	0.04	0.03	0.05	0.03	0.04	0.06	0.05	0.04	2 903
2002	0.27	0.33	0.16	0.02	0.01	0.01	0.02	0.03	0.05	0.03	0.03	0.04	4 009
2003	0.33	0.21	0.17	0.02	0.02	0.03	0.06	0.01	0.07	0.02	0.04	0.02	5 815
2004	0.08	0.04	0.18	0.03	0.01	0.02	0.02	0.03	0.06	0.01	0.48	0.02	6 102
2005	0.13	0.08	0.25	0.08	0.02	0.01	0.01	0.02	0.08	0.22	0.05	0.06	6 503
2006	0.08	0.07	0.45	0.02	0.02	0.02	0.02	0.00	0.03	0.25	0.01	0.02	7 526
2007	0.14	0.11	0.35	0.08	0.01	0.01	0.06	0.05	0.09	0.04	0.04	0.01	7 067
2008	0.12	0.07	0.20	0.05	0.01	0.01	0.01	0.02	0.10	0.26	0.03	0.11	6 140
Total	0.13	0.12	0.23	0.09	0.04	0.03	0.06	0.03	0.06	0.10	0.08	0.04	81 574

Table C14b: Proportion of barracouta catch (total in tonnes) reported for each statistical area from the WCNI area for fishing years 1990–2008.

Year	037	038	039	040	041	042	045	046	047	Other	Total
1990	0.31	0.24	0.10	0.12	0.12	0.03	0.03	0.01	0.04	0	1 435
1991	0.29	0.42	0.04	0.13	0.02	0.01	0.03	0.00	0.05	0	2 238
1992	0.30	0.38	0.02	0.12	0.15	0.01	0.01	0.00	0.01	0	4 501
1993	0.39	0.26	0.02	0.11	0.10	0.04	0.02	0.00	0.05	0	3 923
1994	0.44	0.20	0.05	0.07	0.07	0.04	0.05	0.02	0.05	0	3 061
1995	0.27	0.34	0.08	0.09	0.05	0.08	0.05	0.01	0.04	0	4 304
1996	0.41	0.33	0.05	0.06	0.02	0.03	0.04	0.02	0.05	0	3 501
1997	0.34	0.24	0.04	0.08	0.04	0.02	0.03	0.01	0.20	0	3 732
1998	0.37	0.12	0.21	0.18	0.04	0.02	0.03	0.01	0.03	0	5 033
1999	0.26	0.26	0.22	0.08	0.05	0.03	0.04	0.03	0.04	0	1 963
2000	0.28	0.15	0.04	0.13	0.06	0.12	0.09	0.04	0.09	0	1 821
2001	0.29	0.13	0.06	0.32	0.05	0.04	0.04	0.03	0.05	0	2 903
2002	0.45	0.13	0.03	0.26	0.04	0.03	0.03	0.01	0.01	0	4 009
2003	0.29	0.10	0.02	0.47	0.06	0.03	0.02	0.01	0.02	0	5 815
2004	0.14	0.09	0.03	0.11	0.51	0.08	0.02	0.01	0.01	0	6 102
2005	0.17	0.14	0.04	0.27	0.16	0.16	0.04	0.01	0.02	0	6 503
2006	0.40	0.03	0.01	0.20	0.20	0.12	0.01	0.01	0.01	0	7 526
2007	0.40	0.07	0.02	0.26	0.15	0.04	0.02	0.00	0.03	0	7 067
2008	0.27	0.08	0.01	0.15	0.35	0.08	0.03	0.01	0.01	0	6 140
Total	0.32	0.17	0.05	0.19	0.15	0.06	0.03	0.01	0.03	0	81 574

Table C14c: Proportion of barracouta catch (total in tonnes) reported by gear type from the WCNI area for fishing years 1990–2008.

Year	BPT	BT	MW	PS	Total
1990	0.04	0.92	0.03	0.00	1 435
1991	0.04	0.92	0.04	0.00	2 238
1992	0.01	0.96	0.03	0.00	4 501
1993	0.01	0.95	0.02	0.01	3 923
1994	0.05	0.88	0.07	0.00	3 061
1995	0.02	0.86	0.12	0.00	4 304
1996	0.03	0.93	0.03	0.00	3 501
1997	0.01	0.88	0.10	0.00	3 732
1998	0.00	0.86	0.13	0.00	5 033
1999	0.01	0.77	0.21	0.00	1 963
2000	0.11	0.65	0.25	0.00	1 821
2001	0.05	0.46	0.49	0.00	2 903
2002	0.00	0.40	0.60	0.00	4 009
2003	0.00	0.26	0.73	0.00	5 815
2004	0.01	0.23	0.77	0.00	6 102
2005	0.04	0.34	0.63	0.00	6 503
2006	0.01	0.12	0.87	0.00	7 526
2007	0.00	0.22	0.78	0.00	7 067
2008	0.01	0.21	0.78	0.00	6 140
Total	0.02	0.53	0.45	0.00	81 574

Table C14d: Proportion of barracouta catch (total in tonnes) reported by target species from the WCNI area for fishing years 1990–2008.

Year	BAR	FLA	GUR	HOK	JDO	JMA	RCO	SFL	SNA	TAR	TRE
1990	0.42	0.04	0.01	0.01	0.01	0.39	0.00	0.00	0.07	0.01	0.03
1991	0.52	0.02	0.00	0.00	0.00	0.33	0.00	0.00	0.04	0.02	0.04
1992	0.47	0.01	0.01	0.01	0.00	0.41	0.00	0.00	0.02	0.00	0.03
1993	0.44	0.04	0.01	0.00	0.00	0.37	0.01	0.01	0.04	0.02	0.03
1994	0.44	0.03	0.01	0.00	0.00	0.33	0.02	0.00	0.09	0.03	0.03
1995	0.46	0.04	0.03	0.00	0.00	0.27	0.04	0.00	0.06	0.02	0.04
1996	0.45	0.04	0.03	0.00	0.00	0.32	0.04	0.00	0.06	0.01	0.02
1997	0.51	0.06	0.06	0.01	0.00	0.18	0.05	0.01	0.06	0.04	0.02
1998	0.14	0.04	0.03	0.00	0.00	0.67	0.01	0.01	0.04	0.01	0.05
1999	0.19	0.07	0.05	0.00	0.00	0.47	0.03	0.00	0.06	0.04	0.05
2000	0.34	0.04	0.04	0.00	0.00	0.25	0.00	0.00	0.10	0.05	0.16
2001	0.20	0.03	0.03	0.00	0.00	0.52	0.00	0.00	0.04	0.05	0.09
2002	0.21	0.03	0.02	0.00	0.00	0.66	0.00	0.00	0.02	0.02	0.03
2003	0.12	0.03	0.02	0.00	0.00	0.74	0.00	0.00	0.02	0.02	0.04
2004	0.47	0.03	0.02	0.00	0.00	0.41	0.00	0.00	0.02	0.01	0.03
2005	0.24	0.04	0.03	0.00	0.00	0.53	0.00	0.00	0.08	0.02	0.03
2006	0.13	0.01	0.02	0.00	0.00	0.78	0.00	0.00	0.01	0.01	0.04
2007	0.16	0.03	0.01	0.00	0.00	0.73	0.01	0.00	0.01	0.01	0.02
2008	0.19	0.01	0.01	0.00	0.00	0.69	0.01	0.00	0.02	0.02	0.03
Total	0.29	0.03	0.02	0.00	0.00	0.53	0.01	0.00	0.04	0.02	0.04

Year	WAR	Other	Total
1990	0.00	0.01	1 435
1991	0.02	0.01	2 238
1992	0.02	0.00	4 501
1993	0.02	0.01	3 923
1994	0.01	0.01	3 061
1995	0.01	0.01	4 304
1996	0.01	0.01	3 501
1997	0.01	0.01	3 732
1998	0.01	0.00	5 033
1999	0.03	0.01	1 963
2000	0.01	0.01	1 821
2001	0.02	0.01	2 903
2002	0.00	0.00	4 009
2003	0.01	0.01	5 815
2004	0.00	0.01	6 102
2005	0.02	0.00	6 503
2006	0.01	0.00	7 526
2007	0.02	0.01	7 067
2008	0.02	0.00	6 140
Total	0.01	0.01	81 574

Table C15a: Proportion of barracouta catch (total in tonnes) reported each month from the SNAR and SUBA area for fishing years 1990–2008.

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1990	0.00	0.04	0.12	0.34	0.10	0.27	0.04	0.03	0.02	0.00	0.03	0.00	5 185
1991	0.02	0.02	0.13	0.30	0.24	0.22	0.04	0.02	0.00	0.00	0.01	0.00	8 289
1992	0.07	0.06	0.02	0.03	0.28	0.34	0.14	0.05	0.01	0.00	0.00	0.01	6 403
1993	0.00	0.00	0.05	0.08	0.43	0.24	0.16	0.01	0.01	0.00	0.01	0.00	7 390
1994	0.00	0.30	0.00	0.01	0.22	0.16	0.30	0.00	0.00	0.00	0.00	0.00	3 170
1995	0.00	0.06	0.25	0.09	0.15	0.28	0.13	0.02	0.00	0.00	0.00	0.01	2 530
1996	0.01	0.01	0.18	0.06	0.15	0.30	0.22	0.05	0.00	0.00	0.00	0.02	4 147
1997	0.02	0.07	0.24	0.07	0.04	0.28	0.16	0.07	0.05	0.00	0.00	0.01	2 564
1998	0.04	0.08	0.15	0.05	0.08	0.29	0.23	0.07	0.00	0.00	0.00	0.00	5 999
1999	0.01	0.02	0.19	0.12	0.13	0.42	0.10	0.00	0.00	0.00	0.00	0.00	7 001
2000	0.01	0.08	0.06	0.29	0.27	0.27	0.01	0.00	0.00	0.00	0.00	0.00	5 772
2001	0.05	0.04	0.03	0.16	0.10	0.47	0.13	0.01	0.00	0.00	0.00	0.02	6 077
2002	0.12	0.03	0.05	0.20	0.41	0.10	0.08	0.01	0.00	0.00	0.00	0.00	5 864
2003	0.16	0.12	0.04	0.15	0.15	0.27	0.09	0.00	0.00	0.00	0.00	0.00	7 815
2004	0.14	0.01	0.01	0.10	0.06	0.42	0.24	0.01	0.00	0.00	0.00	0.01	6 875
2005	0.01	0.10	0.04	0.12	0.10	0.29	0.32	0.01	0.00	0.00	0.00	0.00	8 175
2006	0.07	0.11	0.03	0.10	0.31	0.20	0.15	0.01	0.01	0.00	0.00	0.00	9 191
2007	0.03	0.15	0.10	0.02	0.04	0.45	0.18	0.03	0.00	0.00	0.00	0.00	6 238
2008	0.06	0.08	0.21	0.14	0.15	0.25	0.10	0.01	0.00	0.00	0.00	0.00	8 294
Total	0.05	0.07	0.09	0.14	0.19	0.29	0.14	0.02	0.00	0.00	0.00	0.00	116 978

Table C15b: Proportion of barracouta catch (total in tonnes) reported for each statistical area from the SNAR and SUBA area for fishing years 1990–2008.

Year	025	027	028	029	030	031	503	504	602	613	Total
1990	0.03	0.07	0.62	0.17	0.01	0.00	0.00	0.03	0.07	0.00	5 185
1991	0.02	0.05	0.84	0.01	0.00	0.00	0.00	0.04	0.03	0.00	8 289
1992	0.10	0.05	0.68	0.09	0.01	0.00	0.00	0.04	0.02	0.00	6 403
1993	0.11	0.06	0.72	0.04	0.01	0.00	0.00	0.02	0.03	0.00	7 390
1994	0.17	0.15	0.59	0.00	0.01	0.00	0.00	0.03	0.05	0.00	3 170
1995	0.14	0.16	0.52	0.03	0.02	0.00	0.00	0.08	0.05	0.00	2 530
1996	0.13	0.17	0.24	0.00	0.02	0.00	0.00	0.07	0.35	0.02	4 147
1997	0.14	0.24	0.50	0.02	0.03	0.00	0.00	0.05	0.02	0.00	2 564
1998	0.13	0.28	0.54	0.00	0.00	0.00	0.00	0.05	0.00	0.00	5 999
1999	0.09	0.12	0.72	0.00	0.00	0.00	0.00	0.06	0.00	0.00	7 001
2000	0.03	0.10	0.70	0.05	0.00	0.00	0.00	0.09	0.02	0.00	5 772
2001	0.04	0.14	0.76	0.00	0.00	0.00	0.00	0.03	0.03	0.00	6 077
2002	0.05	0.14	0.69	0.05	0.01	0.00	0.00	0.05	0.01	0.00	5 864
2003	0.13	0.19	0.39	0.24	0.01	0.00	0.00	0.01	0.02	0.00	7 815
2004	0.07	0.09	0.81	0.02	0.01	0.00	0.00	0.01	0.00	0.00	6 875
2005	0.09	0.05	0.80	0.03	0.02	0.00	0.00	0.01	0.01	0.00	8 175
2006	0.10	0.09	0.67	0.09	0.01	0.00	0.00	0.02	0.01	0.00	9 191
2007	0.13	0.17	0.49	0.20	0.01	0.00	0.00	0.00	0.00	0.00	6 238
2008	0.16	0.20	0.56	0.05	0.00	0.00	0.00	0.03	0.00	0.00	8 294
Total	0.09	0.13	0.64	0.06	0.01	0.00	0.00	0.03	0.03	0.00	11 6978

Table C15c: Proportion of barracouta catch (total in tonnes) reported by gear type from the SNAR and SUBA area for fishing years 1990–2008.

Year	BT	MW	Total
1990	0.67	0.33	5 185
1991	0.33	0.67	8 289
1992	0.36	0.64	6 403
1993	0.25	0.75	7 390
1994	0.46	0.54	3 170
1995	0.43	0.57	2 530
1996	0.34	0.66	4 147
1997	0.28	0.72	2 564
1998	0.38	0.62	5 999
1999	0.13	0.87	7 001
2000	0.19	0.81	5 772
2001	0.19	0.81	6 077
2002	0.20	0.80	5 864
2003	0.24	0.76	7 815
2004	0.13	0.87	6 875
2005	0.25	0.75	8 175
2006	0.23	0.77	9 191
2007	0.39	0.61	6 238
2008	0.40	0.60	8 294
Total	0.29	0.71	116 978

Table C15d: Proportion of barracouta catch (total in tonnes) reported by target species from the SNAR and SUBA area for fishing years 1990–2008.

Year	BAR	FLA	GUR	HOK	JMA	LIN	SQU	SQX	STA	SWA
1990	0.54	0.00	0.00	0.00	0.02	0.01	0.40	0.00	0.01	0.02
1991	0.14	0.00	0.00	0.00	0.00	0.00	0.85	0.00	0.00	0.00
1992	0.26	0.00	0.00	0.00	0.02	0.00	0.70	0.00	0.01	0.00
1993	0.24	0.00	0.00	0.00	0.01	0.00	0.73	0.00	0.01	0.00
1994	0.39	0.00	0.00	0.00	0.02	0.00	0.57	0.00	0.01	0.01
1995	0.36	0.00	0.00	0.01	0.03	0.00	0.56	0.00	0.01	0.00
1996	0.27	0.00	0.00	0.02	0.07	0.00	0.62	0.00	0.00	0.00
1997	0.38	0.00	0.00	0.00	0.11	0.00	0.47	0.00	0.01	0.00
1998	0.33	0.00	0.00	0.00	0.34	0.00	0.29	0.00	0.00	0.00
1999	0.21	0.00	0.00	0.00	0.38	0.00	0.40	0.00	0.00	0.00
2000	0.16	0.00	0.00	0.00	0.30	0.00	0.53	0.00	0.00	0.01
2001	0.16	0.00	0.00	0.00	0.11	0.00	0.71	0.00	0.00	0.00
2002	0.17	0.01	0.00	0.00	0.22	0.00	0.57	0.00	0.00	0.00
2003	0.39	0.00	0.00	0.00	0.15	0.00	0.41	0.00	0.00	0.00
2004	0.30	0.00	0.00	0.00	0.03	0.00	0.65	0.00	0.00	0.00
2005	0.39	0.00	0.00	0.00	0.03	0.00	0.54	0.00	0.00	0.00
2006	0.47	0.00	0.01	0.00	0.06	0.00	0.38	0.01	0.00	0.00
2007	0.57	0.00	0.00	0.00	0.01	0.00	0.28	0.00	0.00	0.00
2008	0.45	0.00	0.00	0.00	0.01	0.00	0.50	0.00	0.00	0.00
Total	0.32	0.00	0.00	0.00	0.10	0.00	0.54	0.00	0.00	0.00

Table C15d: continued.

Year	WAR	Total
1990	0.00	5 185
1991	0.00	8 289
1992	0.00	6 403
1993	0.00	7 390
1994	0.00	3 170
1995	0.03	2 530
1996	0.01	4 147
1997	0.01	2 564
1998	0.02	5 999
1999	0.00	7 001
2000	0.00	5 772
2001	0.02	6 077
2002	0.02	5 864
2003	0.04	7 815
2004	0.02	6 875
2005	0.04	8 175
2006	0.08	9 191
2007	0.13	6 238
2008	0.03	8 294
Total	0.03	116 978

Table C16: Species codes used in the report.

Code	Common name	Scientific name
BAR	Barracouta	*Thyrsites atun*
ELE	Elephant fish	*Callorhinchus milii*
EMA	Blue mackerel	*Scomber australasicus*
FLA	Flatfish	*Rhombosolea leporina, R. plebeia, R. plebeia, R. plebeia, Peltotretis flavilatus, Peltorhamphus novaezeelandiae, Colistium guntheri, C. nudipinnis*
FRO	Frostfish	*Lepidopus caudatus*
GUR	Red gurnard	*Chelidonichthyes kumu*
HAK	Hake	*Merluccius australis*
HOK	Hoki	*Macruronus novaezelandiae*
JDO	John dory	*Zues faber*
JMA	Jack mackerels	*Trachurus declivis, T. novaezelandiae, T. symmetricus murphyi*
KAH	Kahawai	*Arripis trutta, A. xylabion*
LIN	Ling	*Genypterus blacodes*
RCO	Red cod	*Pseudophycis bachus*
SFL	Sand flounder	*Rhombosolea plebeia*
SKI	Genfish	*Rexea solandri*
SNA	Snapper	*Pagrus auratus*
SPD	Spiny dogfish	*Squalus acanthias*
SPE	Sea perch	*Helicolenus percoides*
SQU	Arrow squid	*Nototodarus gouldi, N. sloanni*
SQX	Squid	Unidentified squid
SSO	Smooth oreo	*Pseudocyttus maculatus*
STA	Stargazers	*Kathestoma giganteum*
SWA	Silver warehou	*Seriolella punctata*
TAR	Tarakihi	*Nemadactylus macropterus*
TRE	Trevally	*Pseudocaranx dentex*
WAR	Blue warehou	*Seriolella brama*

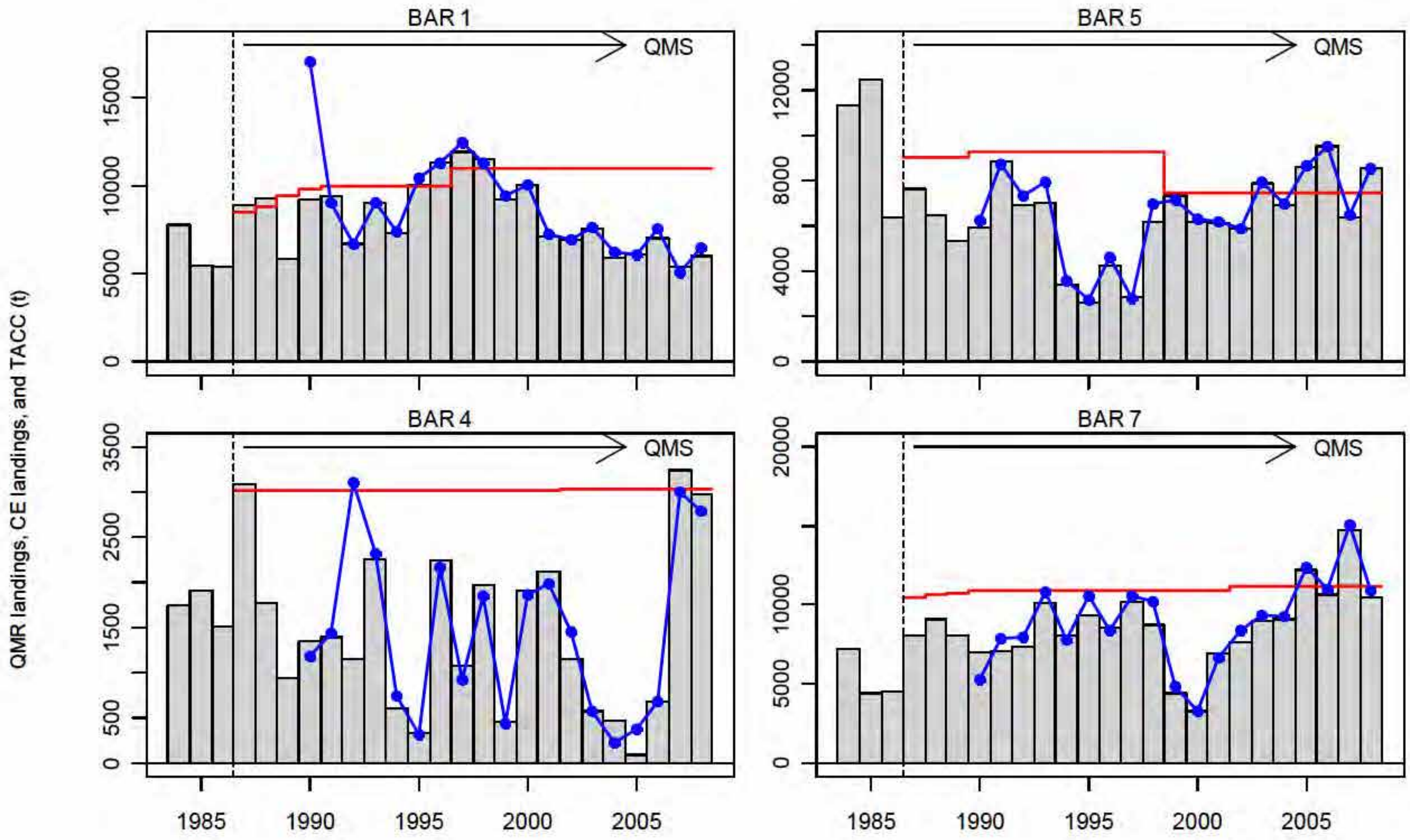


Figure C1: The QMR/MHR barracouta landings (gray bars), un-groomed catch effort landings (dotted blue line), and TACC (red line) for BAR 1, 4, 5, and 7 from the 1983–84 to 2007–08 fishing year.

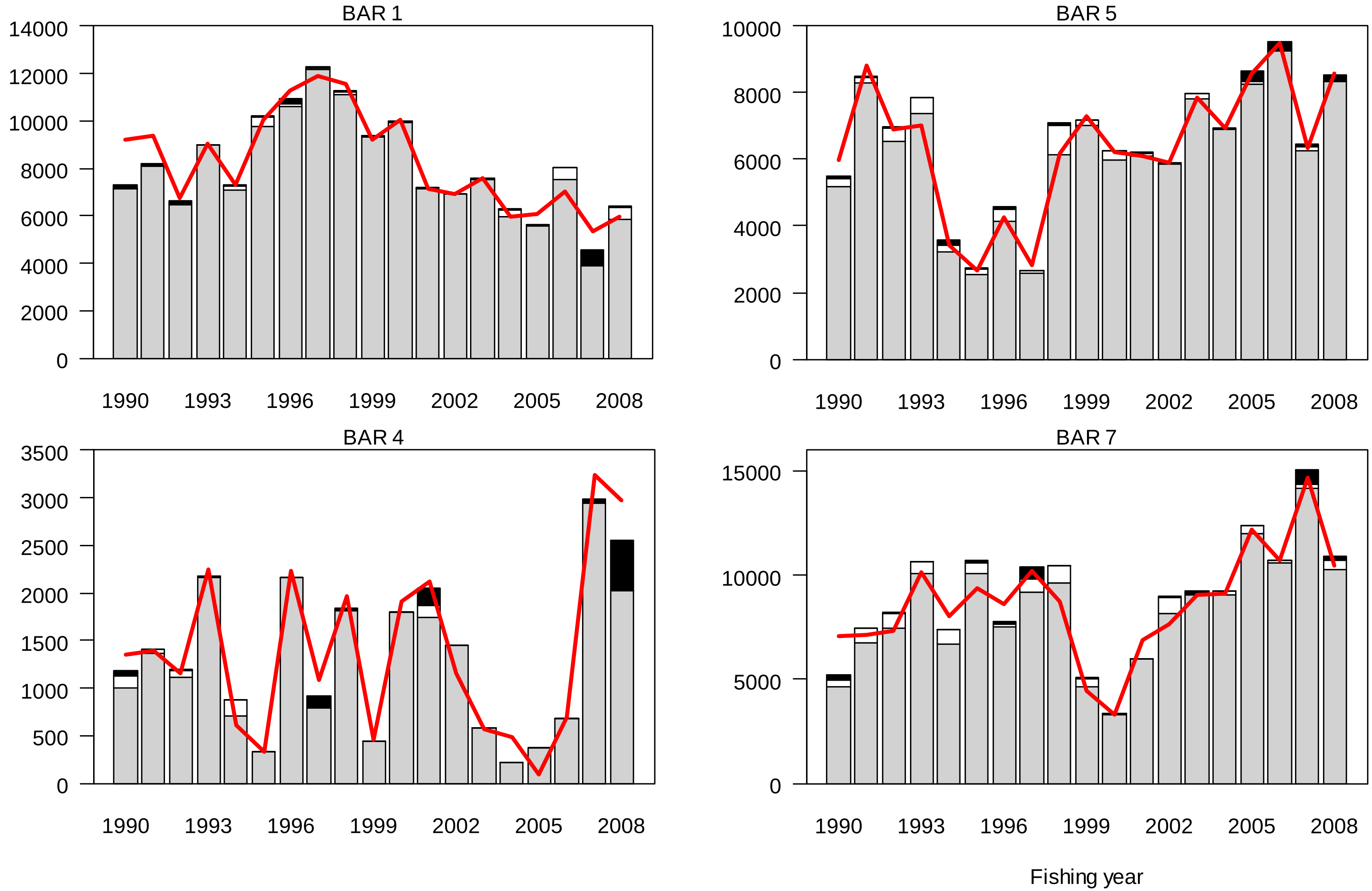


Figure C2:The retained barracouta landings (gray bars), interim landings (white bars), and landings dropped during data grooming (black bars), and MHR landings (red line) for BAR 1, 4, 5, and 7 from the 1989–90 to 2007–08 fishing year.

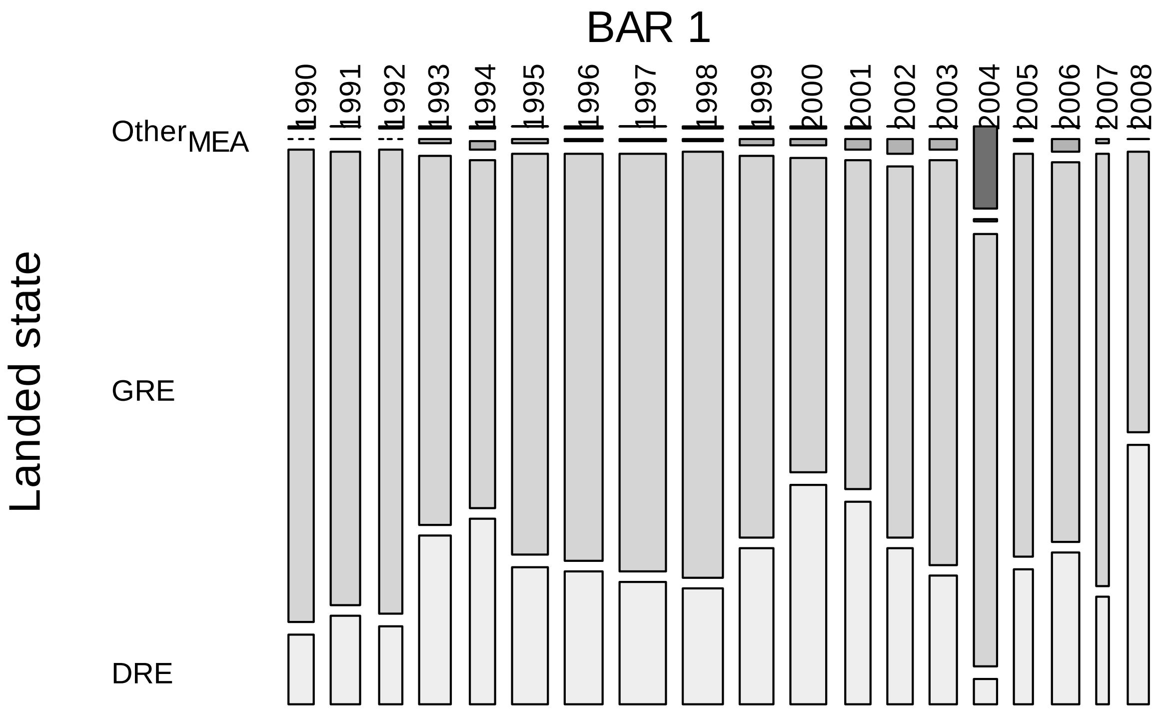
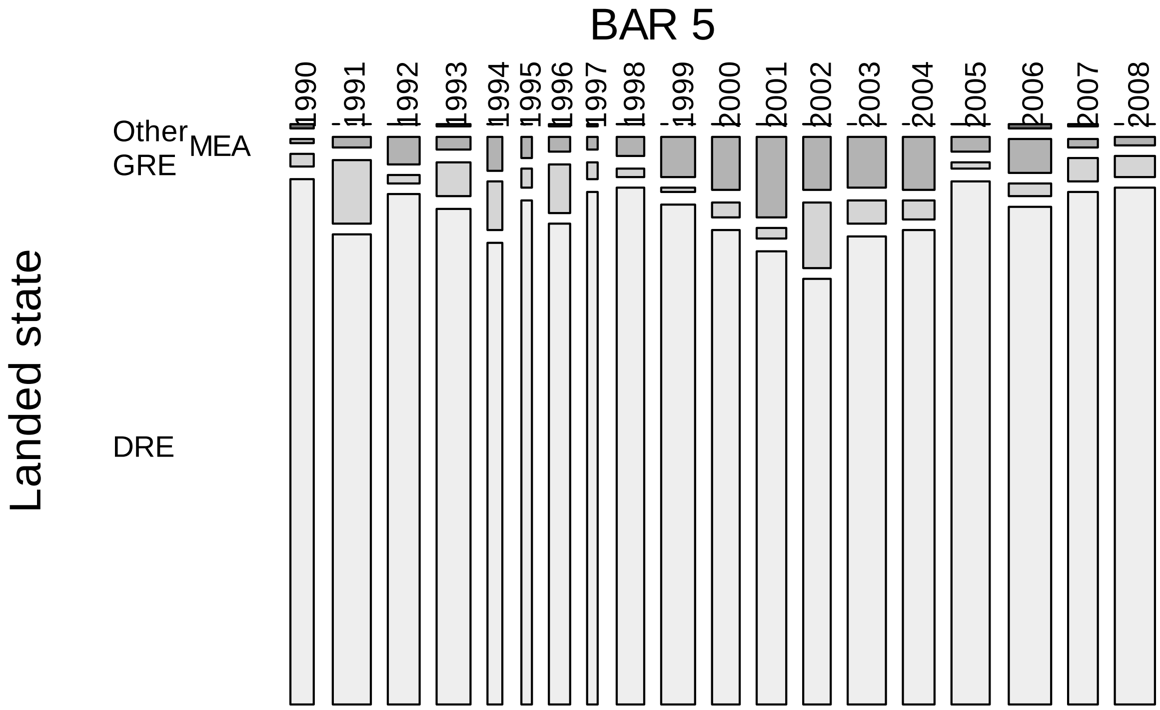


Figure C3: The proportion of retained barracouta landings (greenweight) by processed state for BAR 1, 4, 5, and 7 from the 1989–90 to 2007–08 fishing year in the groomed and unmerged dataset. "DRE" includes "Dressed", "Headed, gutted, and tailed", "Headed and gutted", and "trunked"; "GRE" refers to "Whole or Green"; "MEA" refers to "Mealed".



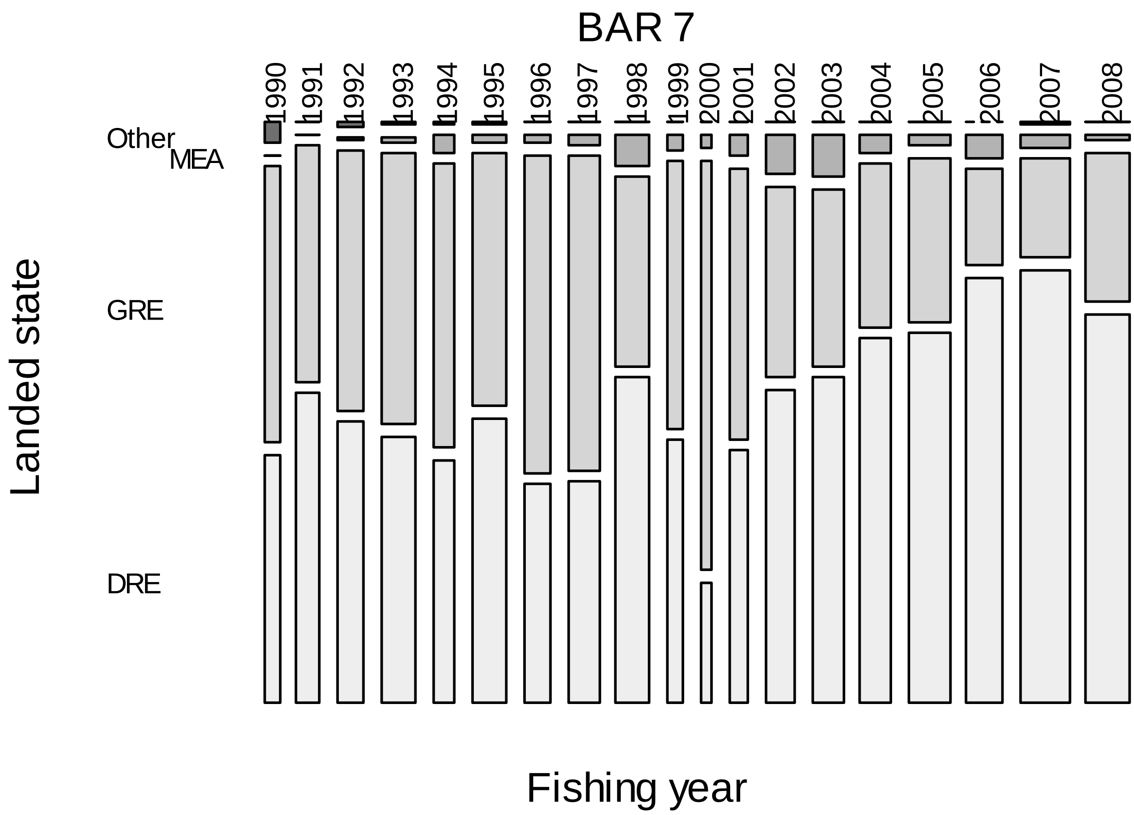


Figure C3: continued. The proportion of retained barracouta landings (greenweight) by processed state for BAR 1, 4, 5, and 7 from the 1989–90 to 2007–08 fishing year in the groomed and unmerged dataset. “DRE” includes “Dressed”, “Headed, gutted, and tailed”, “Headed and gutted”, and “trunked”; “GRE” refers to “Whole or Green”.

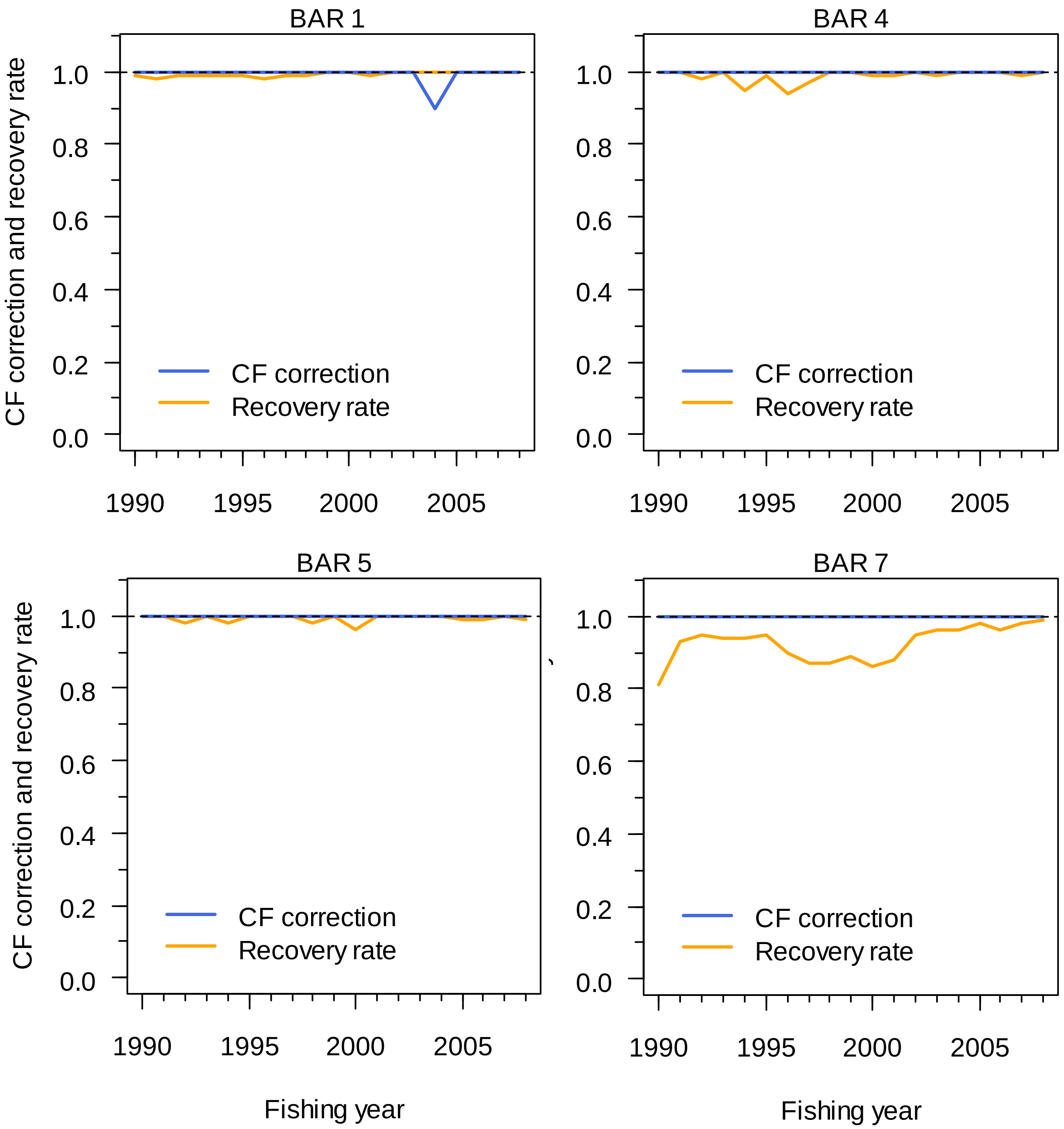


Figure C4a: Conversion factor (CF) corrections (defined as the ratio of annual green weight of barracouta recalculated using the most recent correction factors for each processed state to the reported green weight) and the recovery rate (defined as the ratio of annual landings in the groomed and merged dataset to those in the groomed and unmerged dataset using the centroid method), for BAR 1, 4, 5, and 7 from the 1989–90 to 2007–08 fishing year.

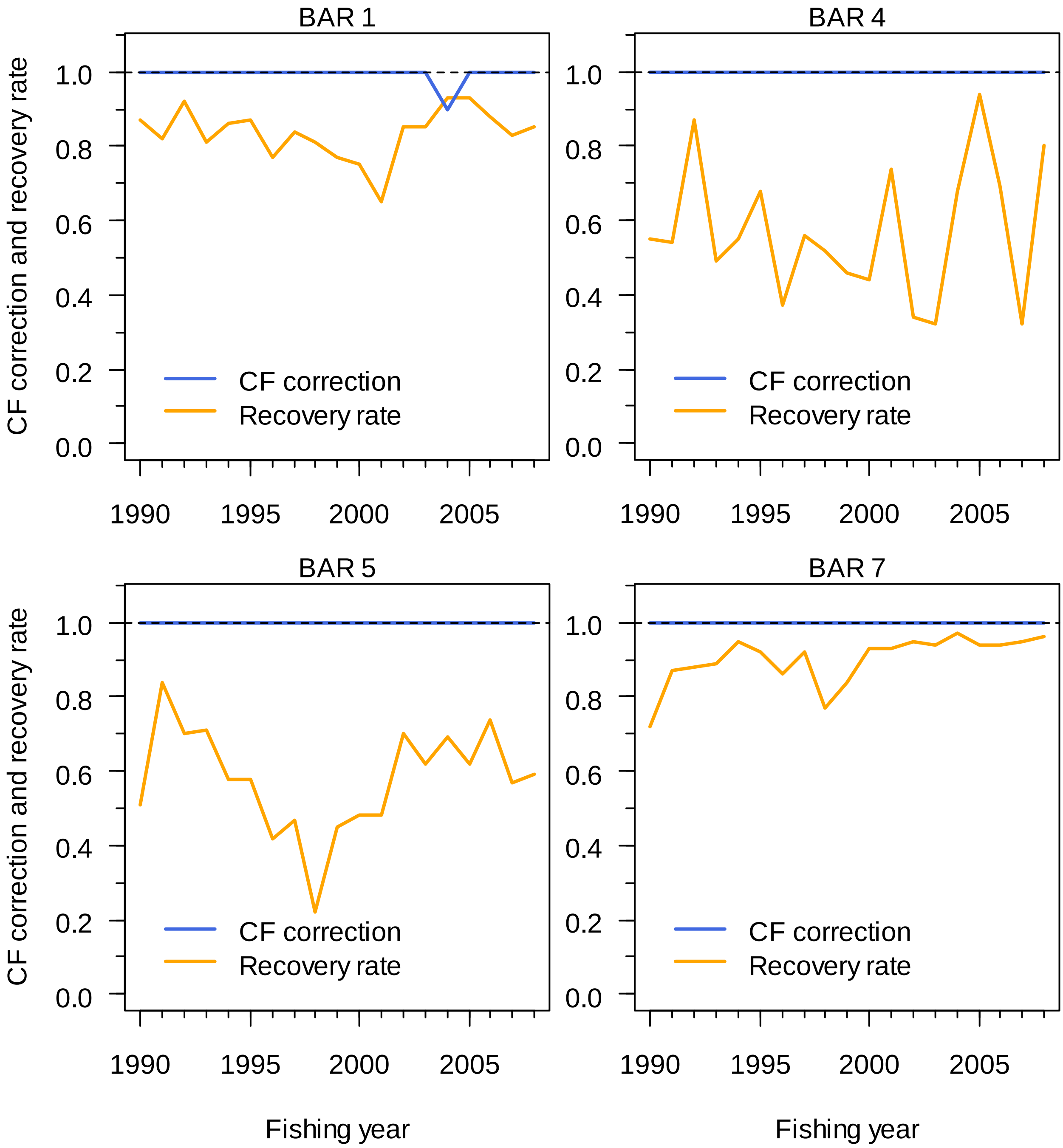


Figure C4b: Conversion factor (CF) corrections (defined as the ratio of annual green weight of barracouta recalculated using the most recent correction factors for each processed state to the reported green weight) and the recovery rate (defined as the ratio of annual landings in the groomed and merged dataset to those in the groomed and unmerged dataset using the straddle method), for BAR 1, 4, 5, and 7 from the 1989–90 to 2007–08 fishing year.

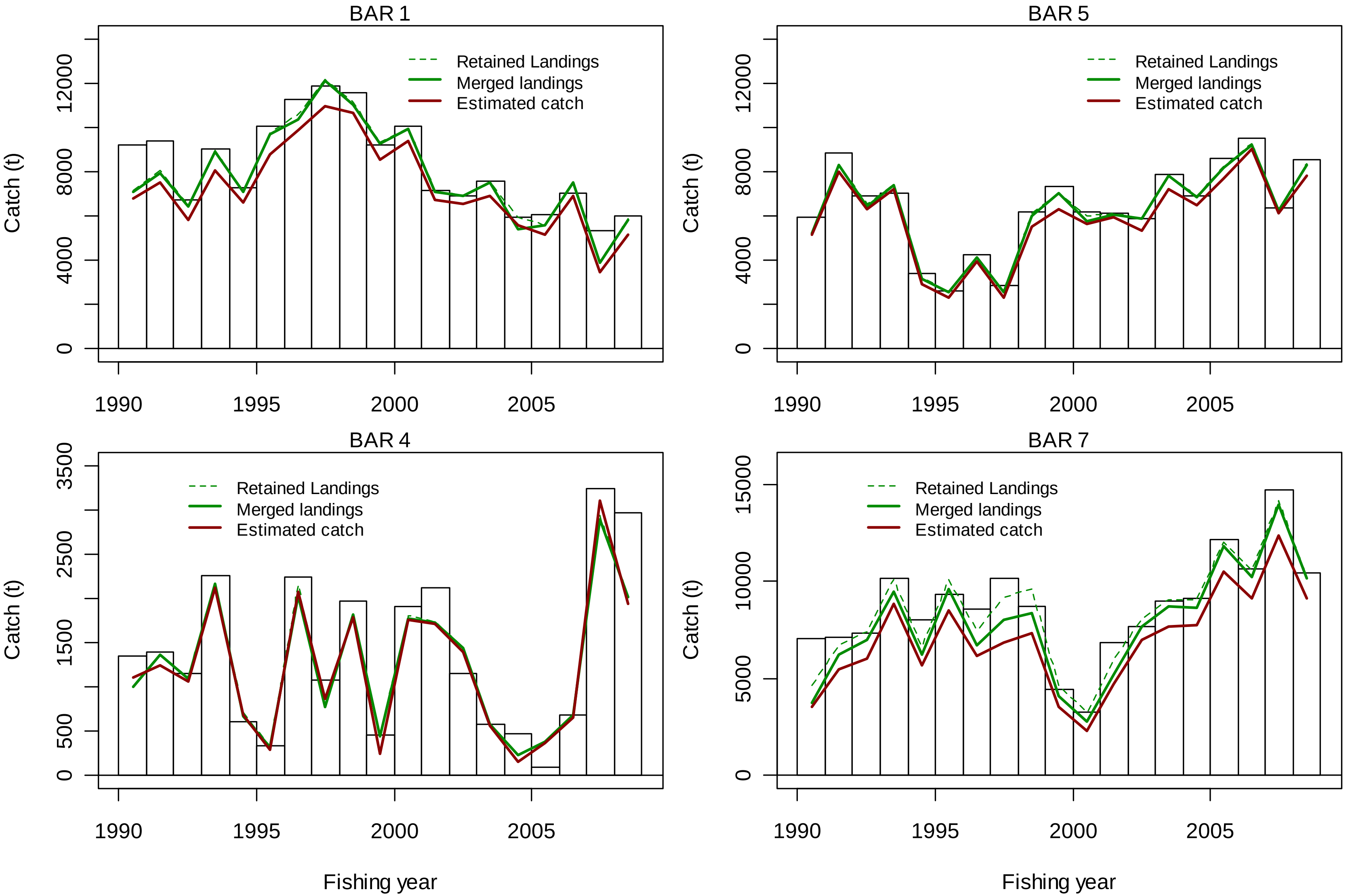


Figure C5a: The QMR/MHR landings (white bars), retained landings in the groomed and unmerged dataset (green dashed line), retained landings in groomed and merged dataset (green solid line), and estimated catch in the groomed and merged dataset (red solid line), using the centroid method, for BAR 1, 4, 5, and 7 from the 1989–90 to 2007–08 fishing year.

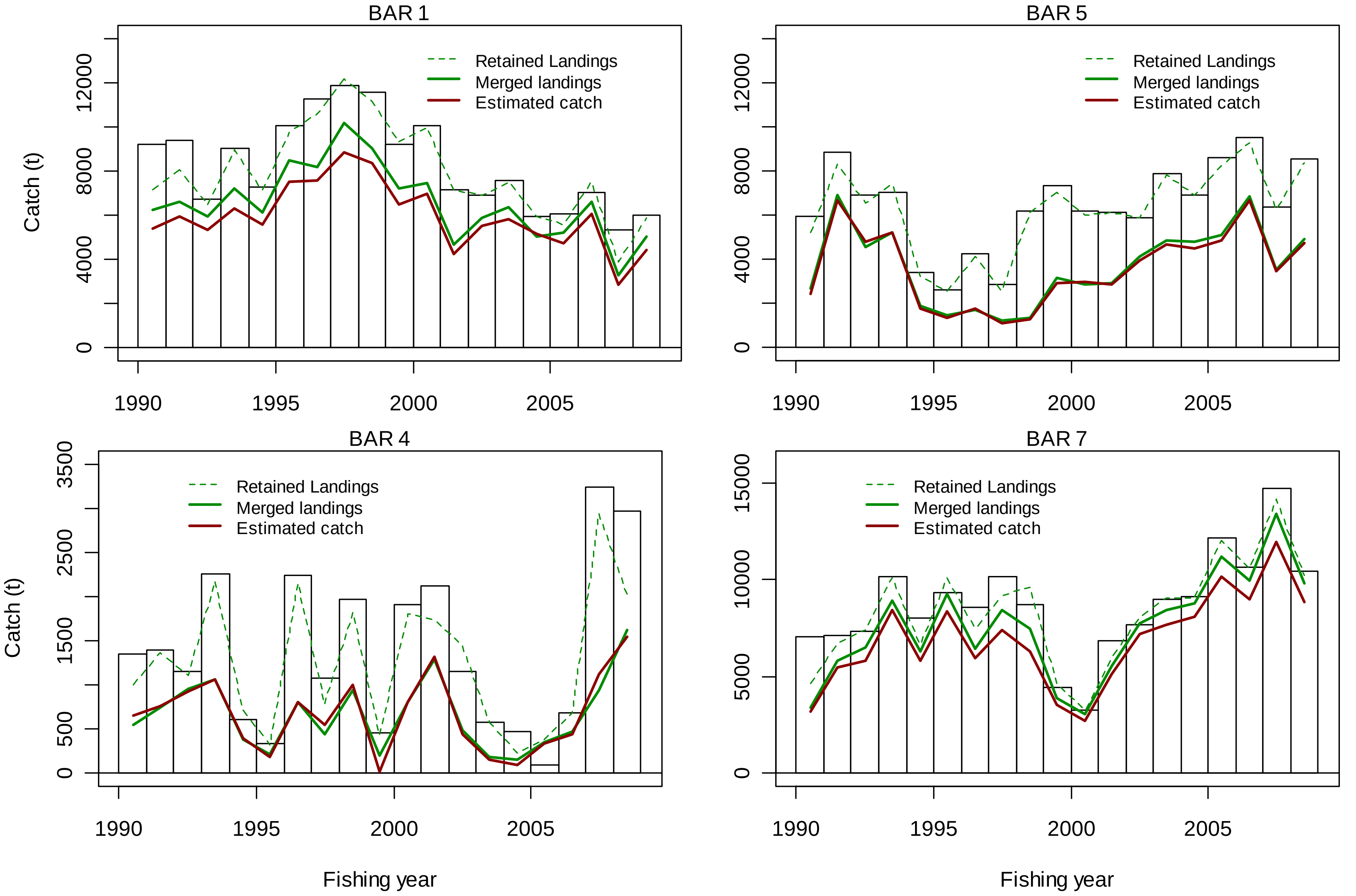


Figure C5b: The QMR/MHR landings (white bars), retained landings in the groomed and unmerged dataset (green dashed line), retained landings in groomed and merged dataset (green solid line), and estimated catch in the groomed and merged dataset (red solid line), using the straddle method, for BAR 1, 4, 5, and 7 from the 1989–90 to 2007–08 fishing year.

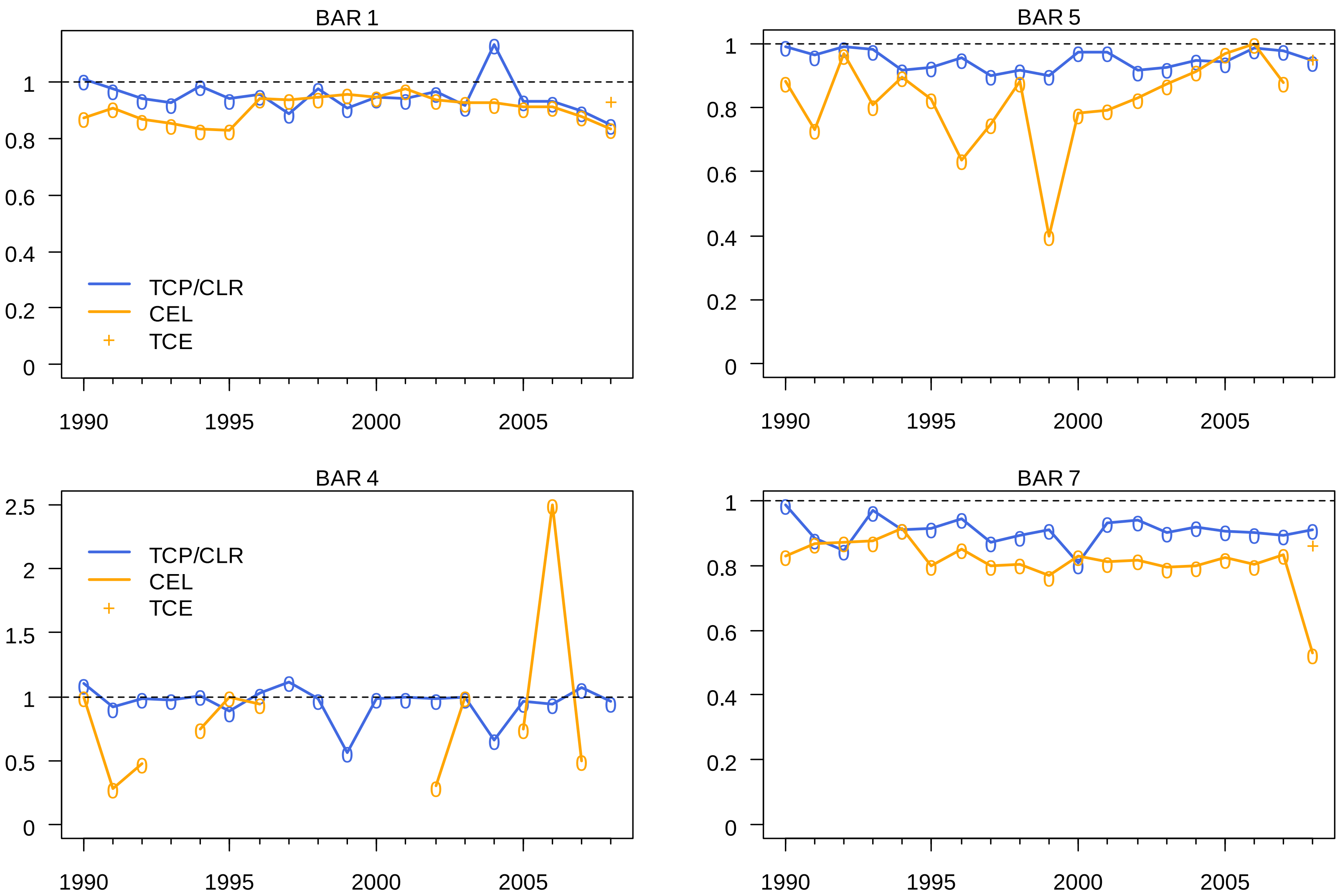


Figure C6: The ratio of estimated barracouta catch to retained landings in the groomed and merged dataset, for BAR 1, 4, 5, and 7 from the 1989–90 to 2007–08 fishing year.

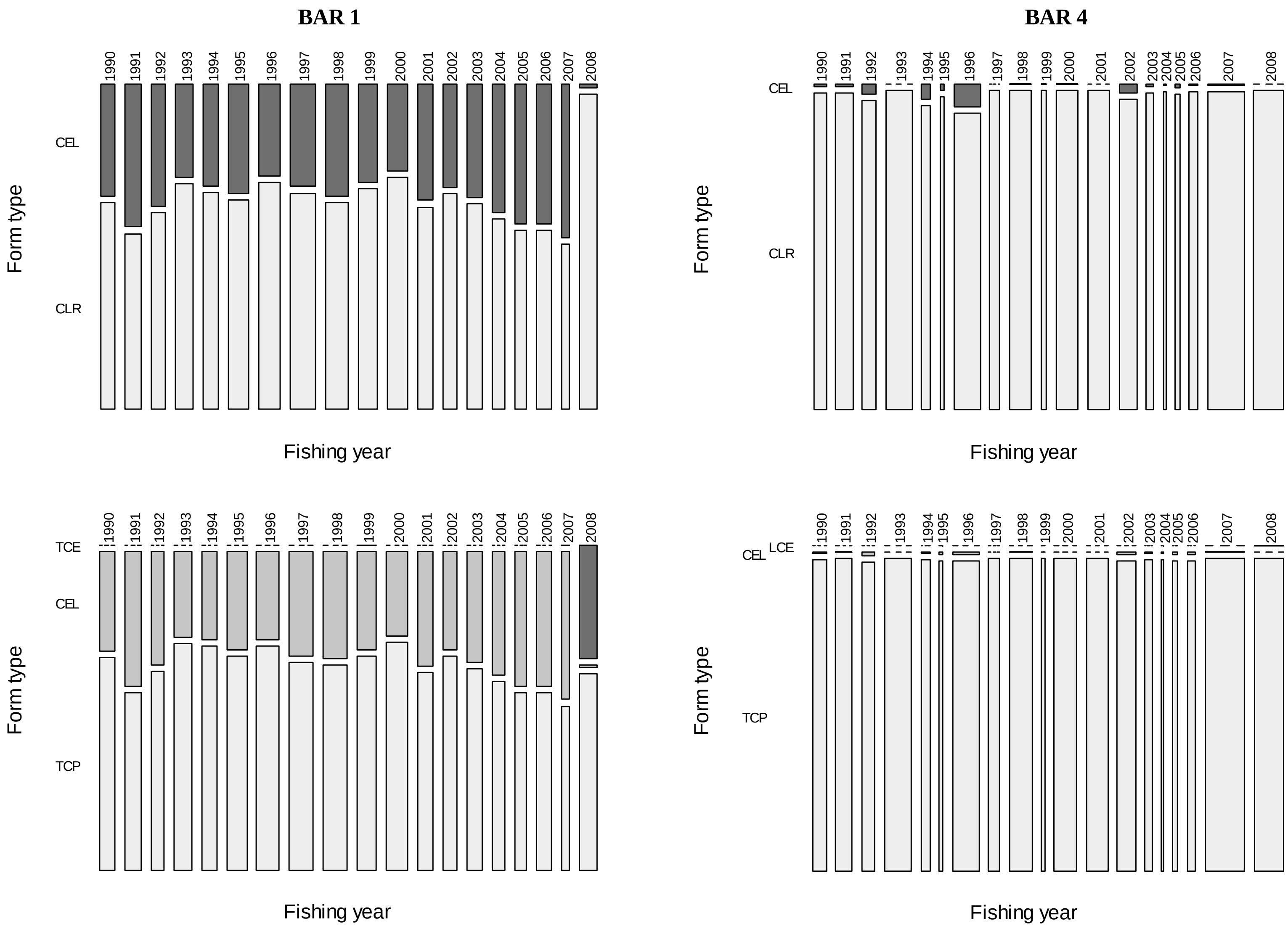


Figure C7a: Proportion of barracouta landings by form type (top panels) in the groomed and unmerged dataset, and proportion of estimated catches by form type (bottom panels) in the groomed and merged dataset, for BAR 1 and 4, from 1989–90 to 2007–08 fishing year. The width of the bar is proportional to the annual catches (only comparable within each panel).

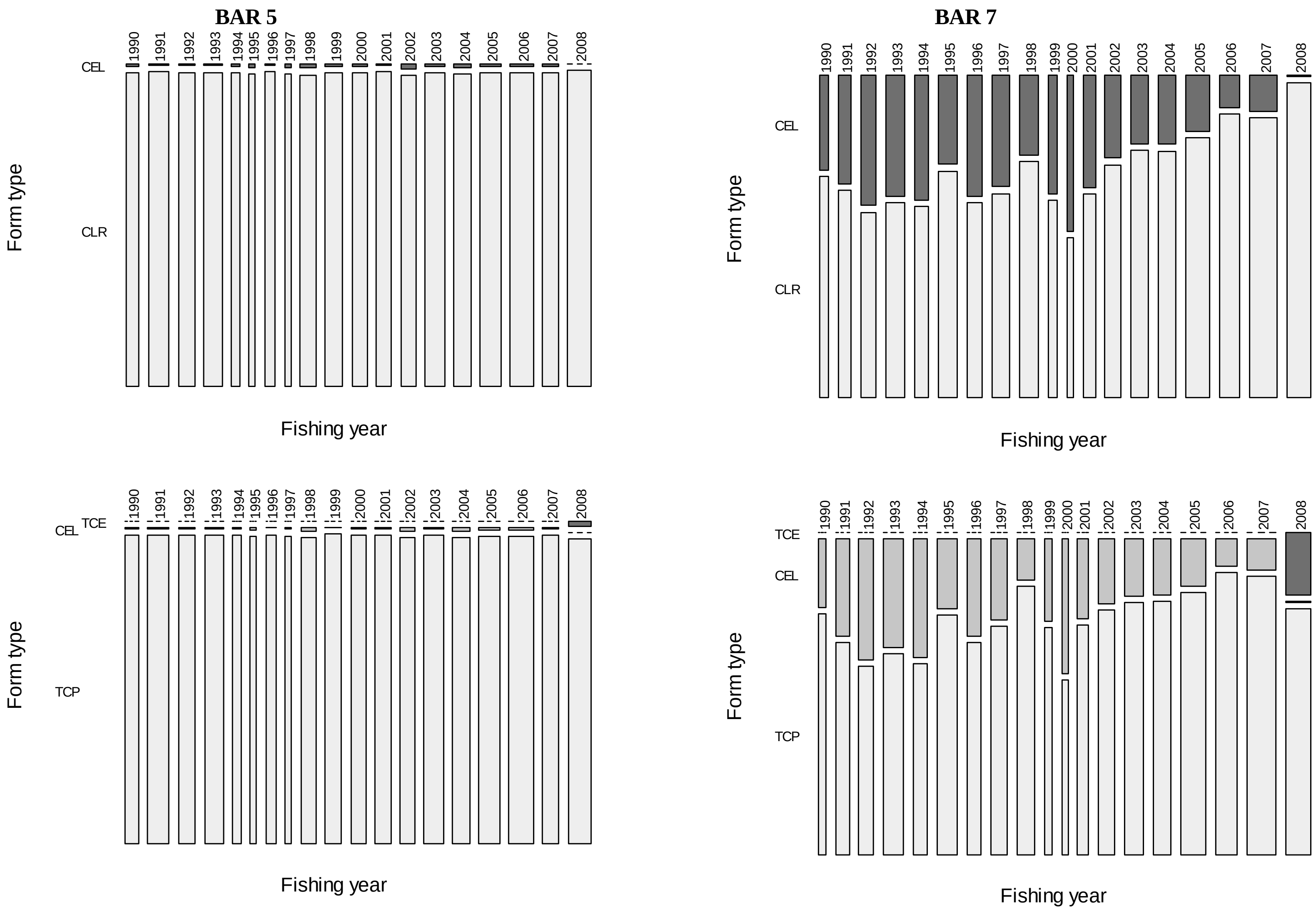


Figure C7b: Proportion of barracouta landings by form type (top panels) in the groomed and unmerged dataset, and proportion of estimated catches by form type (bottom panels) in the groomed and merged dataset, for BAR 5 and 7, from 1989–90 to 2007–08 fishing year. The width of the bar is proportional to the annual catches (only comparable within each panel.

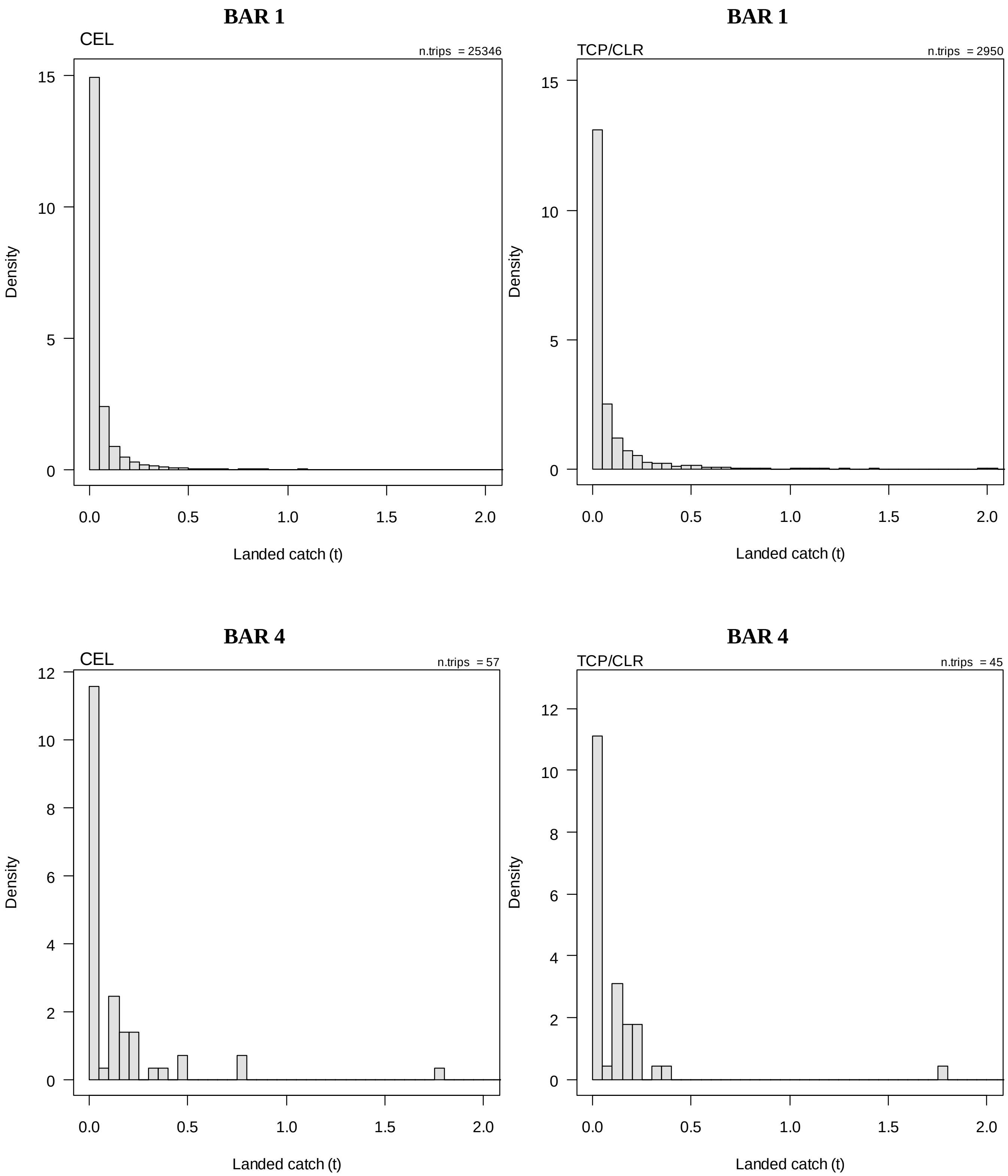


Figure C8: The distribution of reported barracouta landing weights for trips that recorded no estimated catch of barracouta by form type for BAR 1, 4, 5, and 7 from the 1989–90 to 2007–08 fishing year.

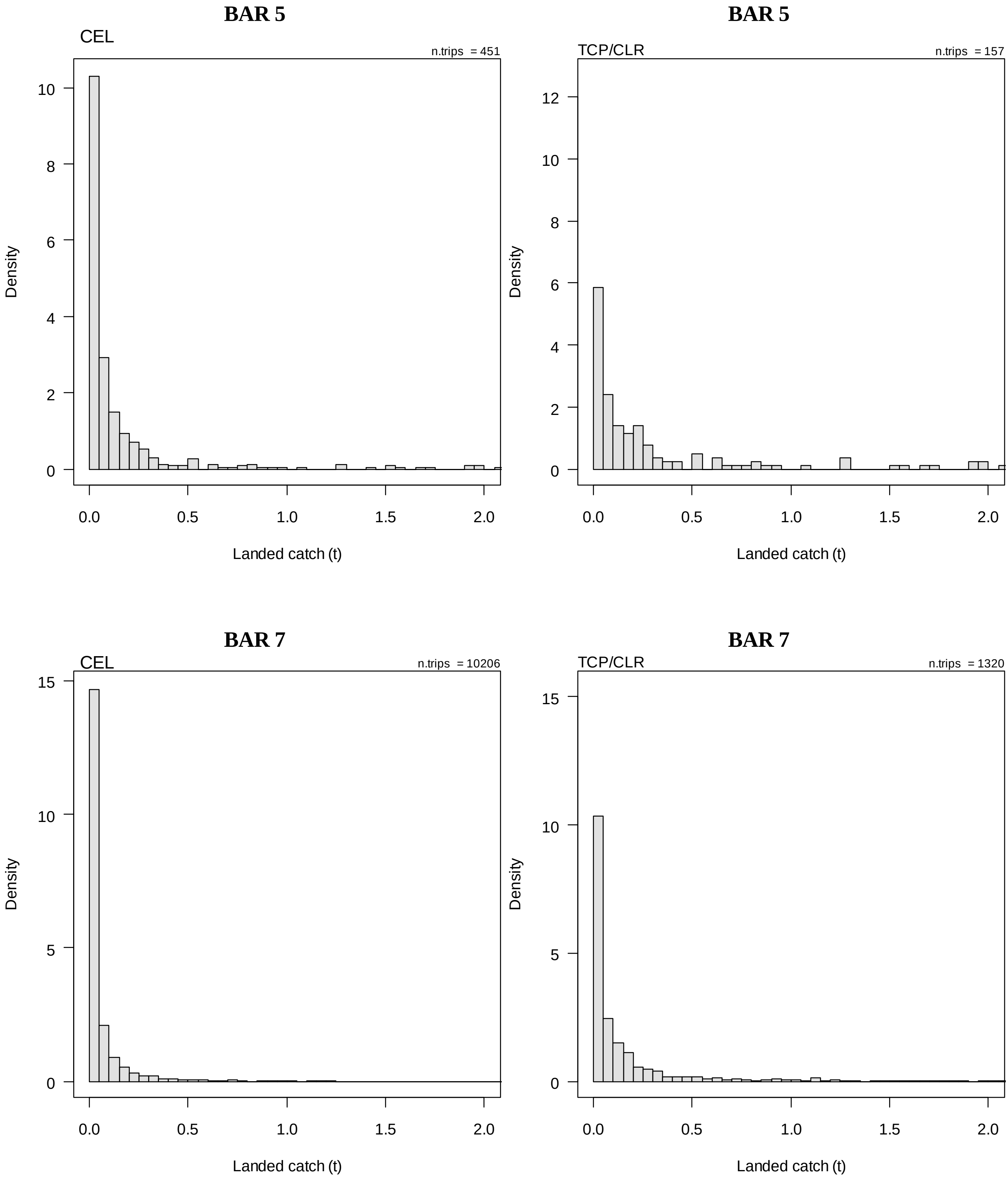


Figure C8: continued.

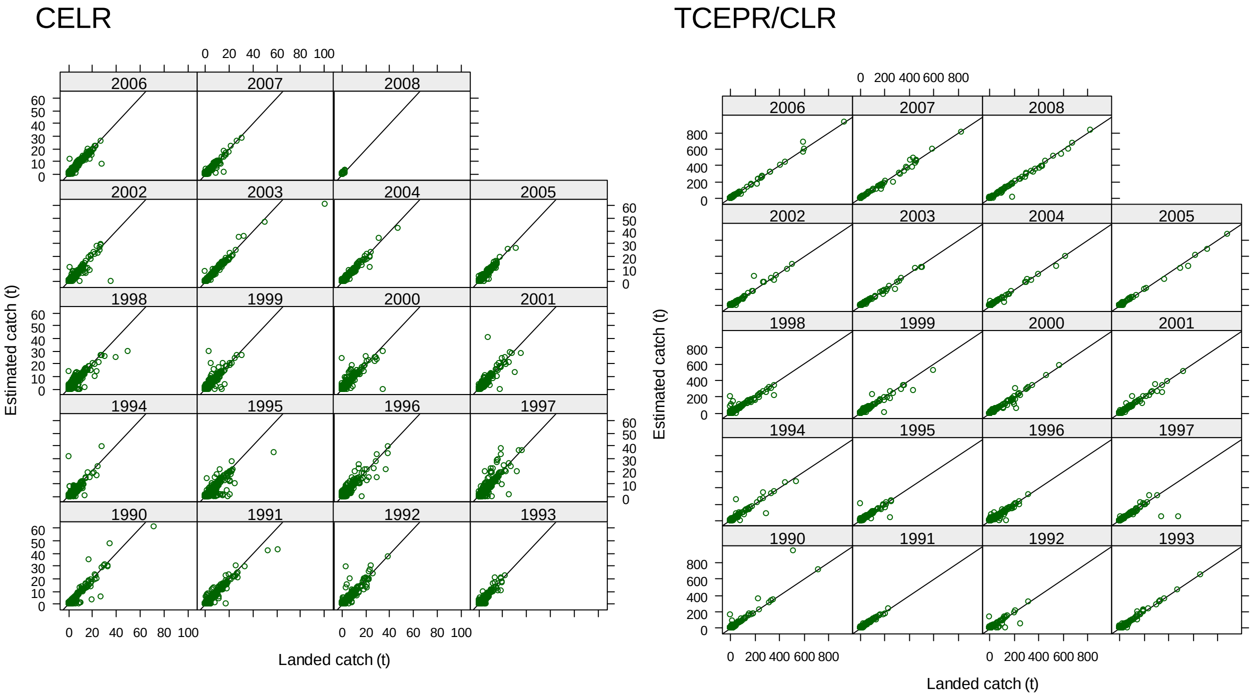


Figure C9: Estimated barracouta catches vs. reported landings on a trip basis in the groomed and merged dataset, for BAR 1 from the 1989–90 to 2007–08 fishing year.

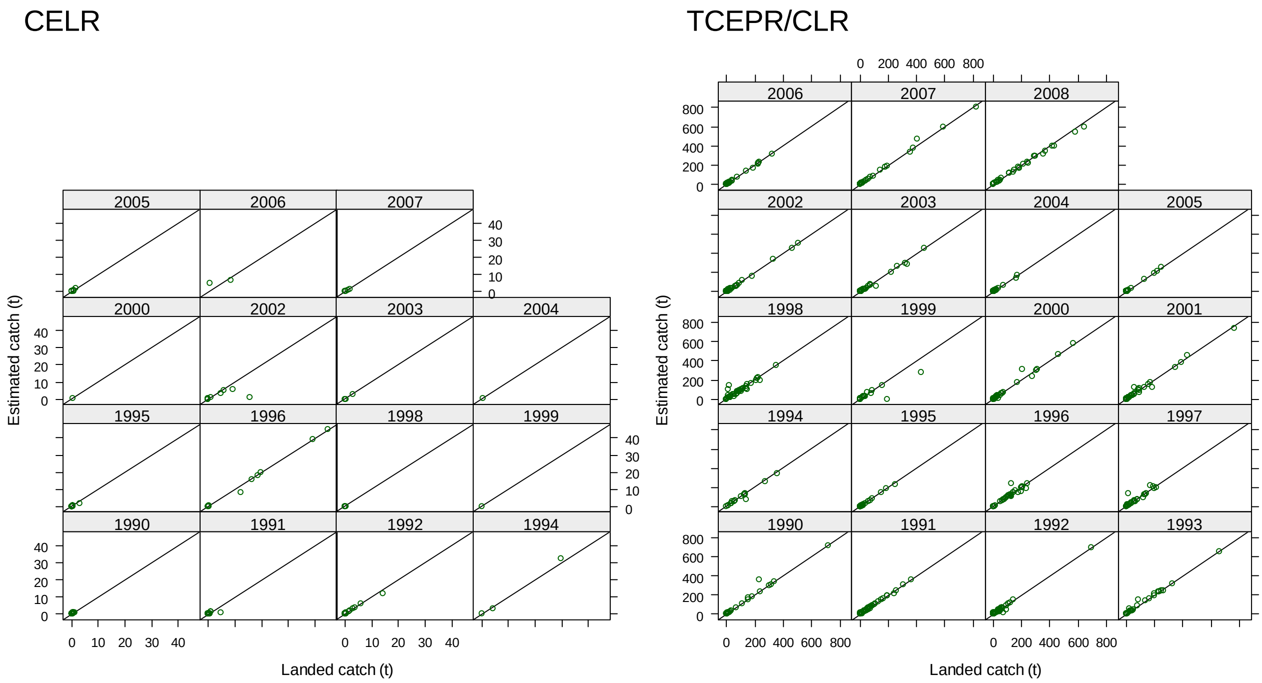


Figure C10: Estimated barracouta catches vs. reported landings on a trip basis in the groomed and merged dataset, for BAR 4 from the 1989–90 to 2007–08 fishing year.

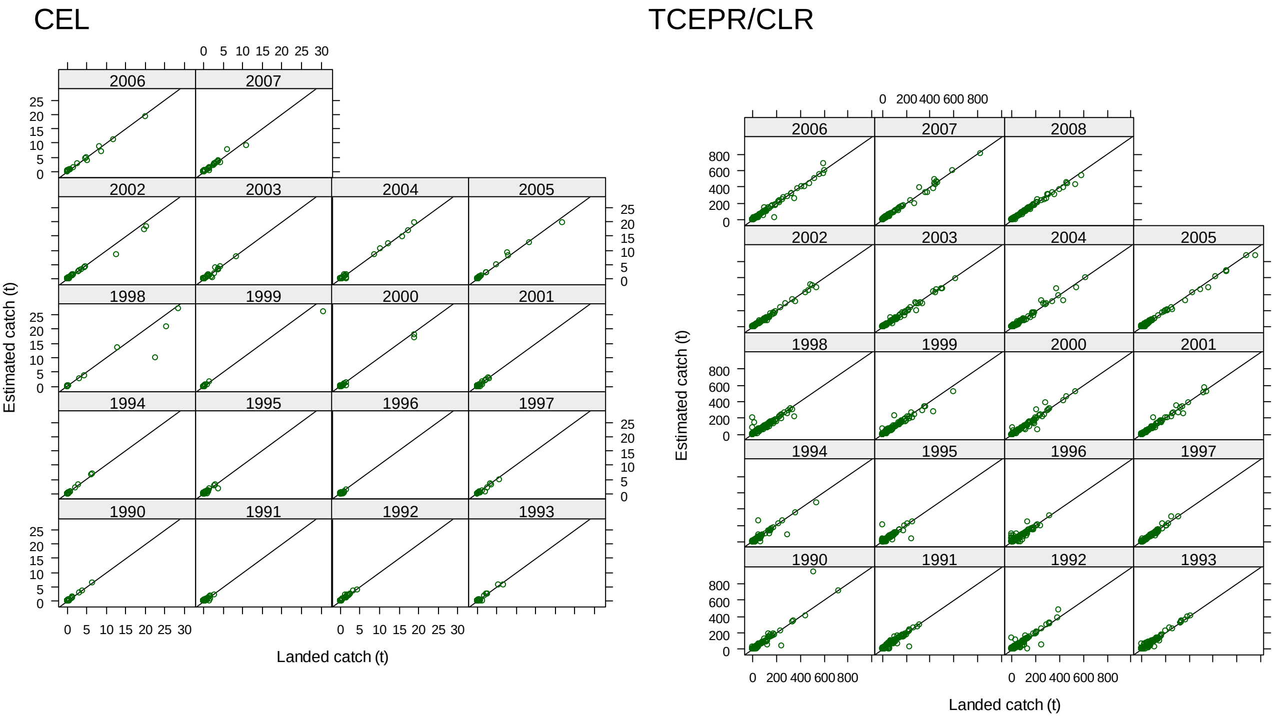


Figure C11: Estimated barracouta catches vs. reported landings on a trip basis in the groomed and merged dataset, for BAR 5 from the 1989–90 to 2007–08 fishing year.

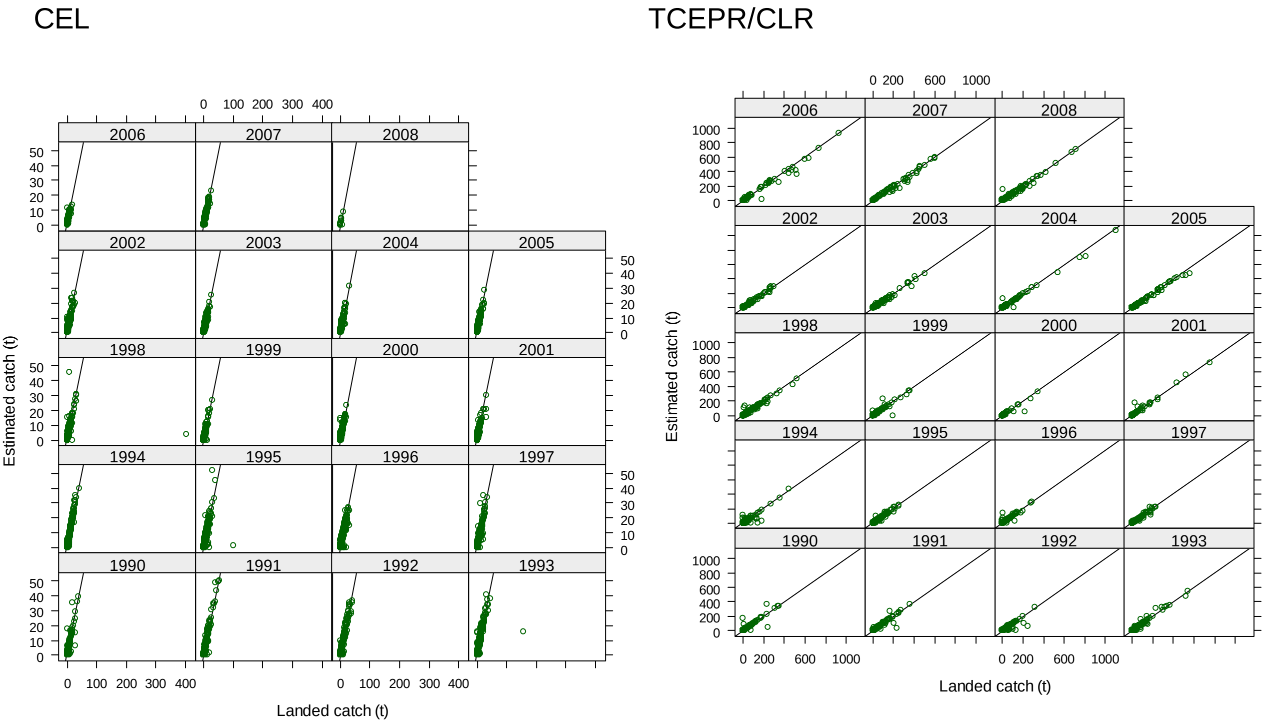


Figure C12: Estimated barracouta catches vs. reported landings on a trip basis in the groomed and merged dataset, for BAR 7 from the 1989–90 to 2007–08 fishing year.

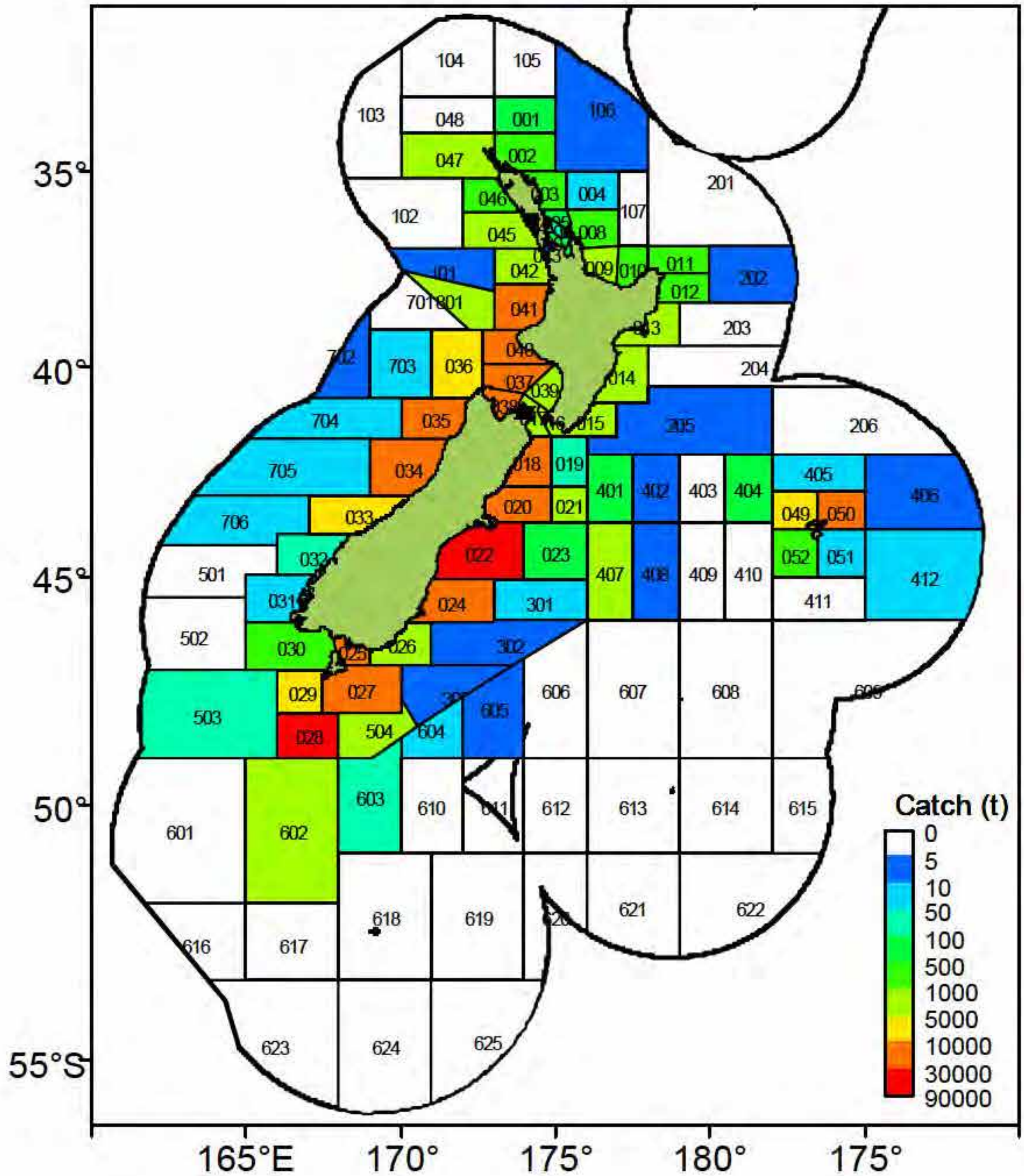


Figure C13: Annual commercial catch (in tonnes) of barracouta, from all records, by statistical area and fishing year (1 October to 30 September) 1989–90 to 2007–08.

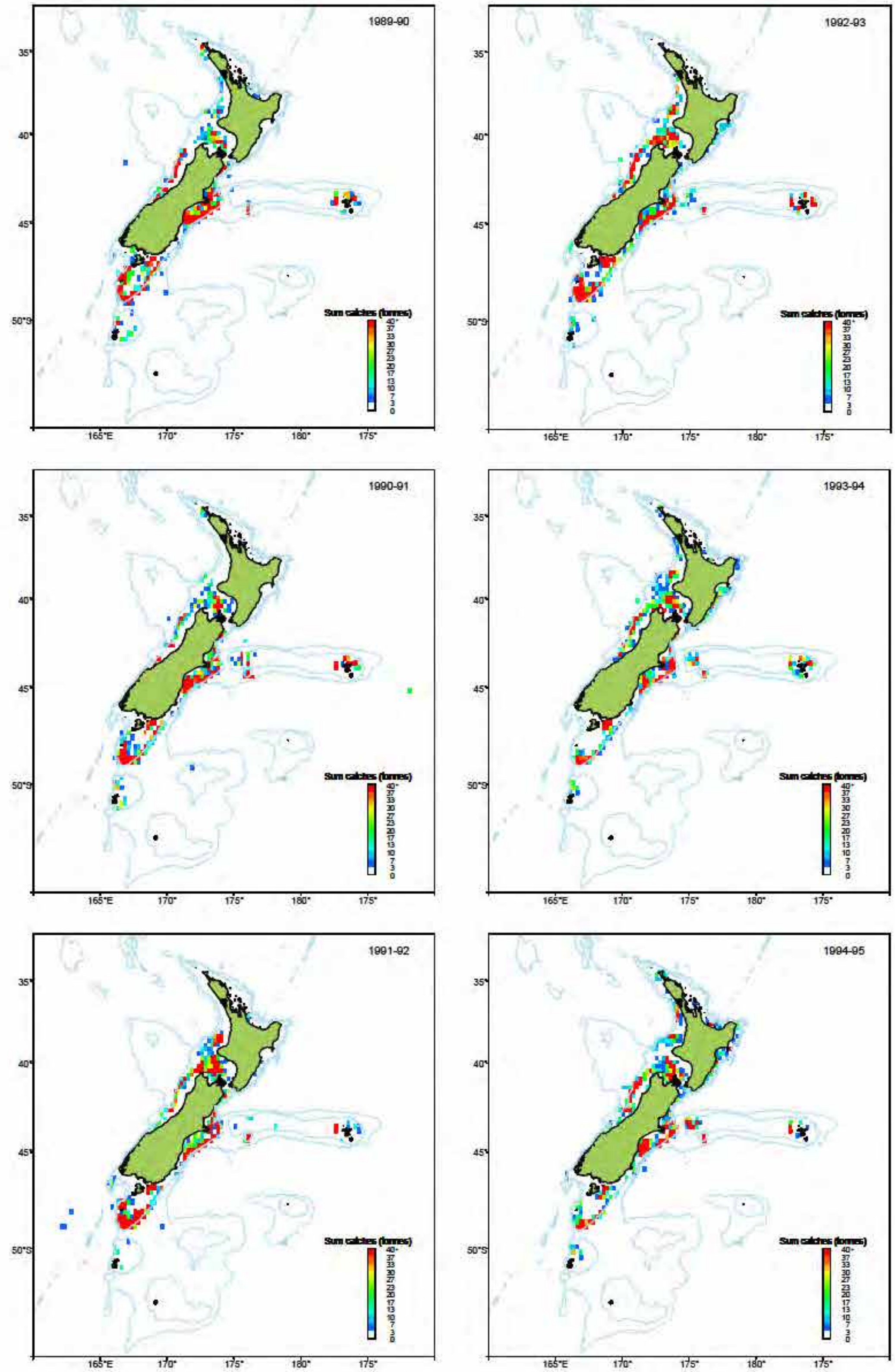


Figure C14: Annual commercial catch (in tonnes) of barracouta from TCEPR records by fishing year (1 October to 30 September) 1989–90 to 2007–08.

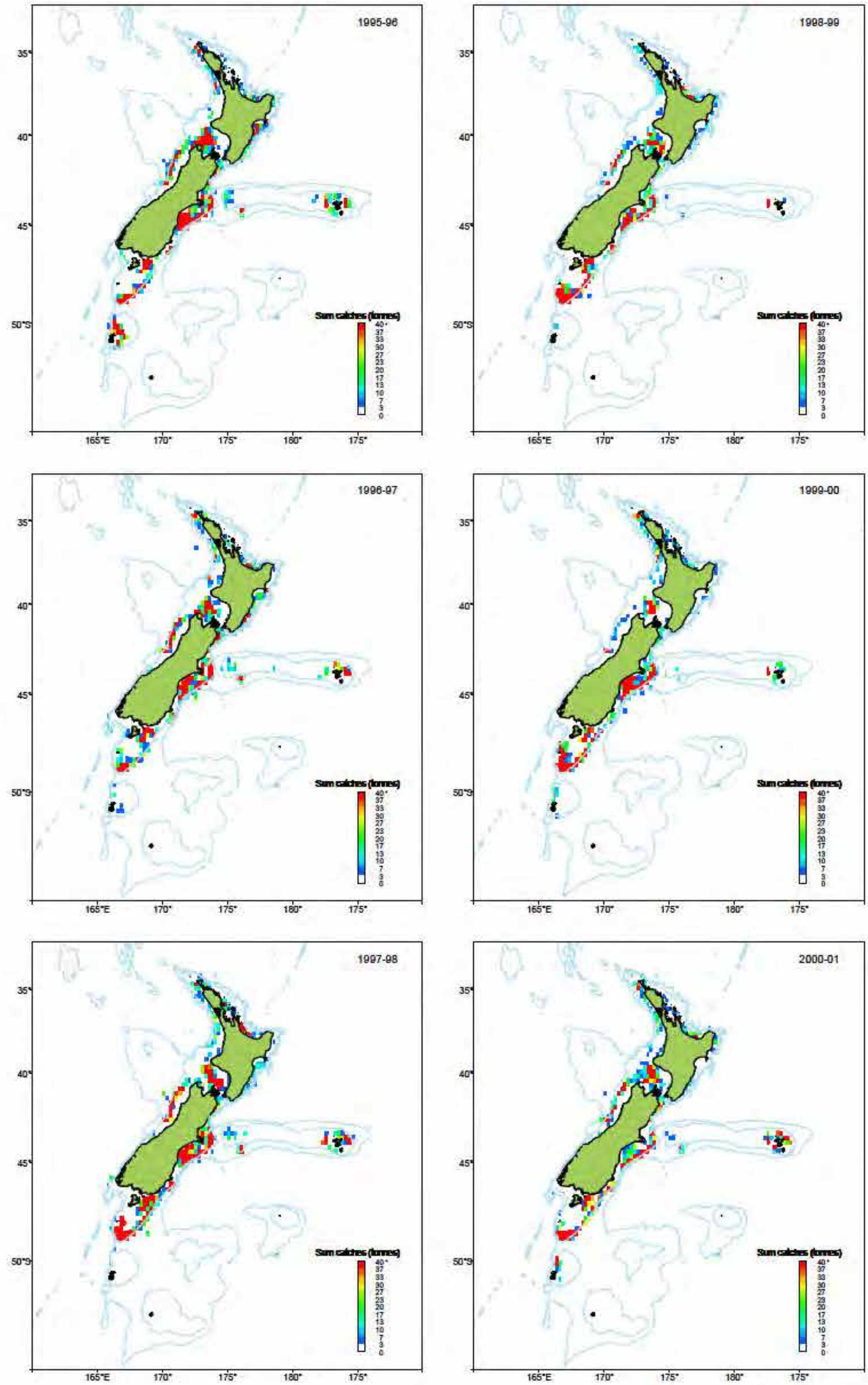


Figure C14: continued.

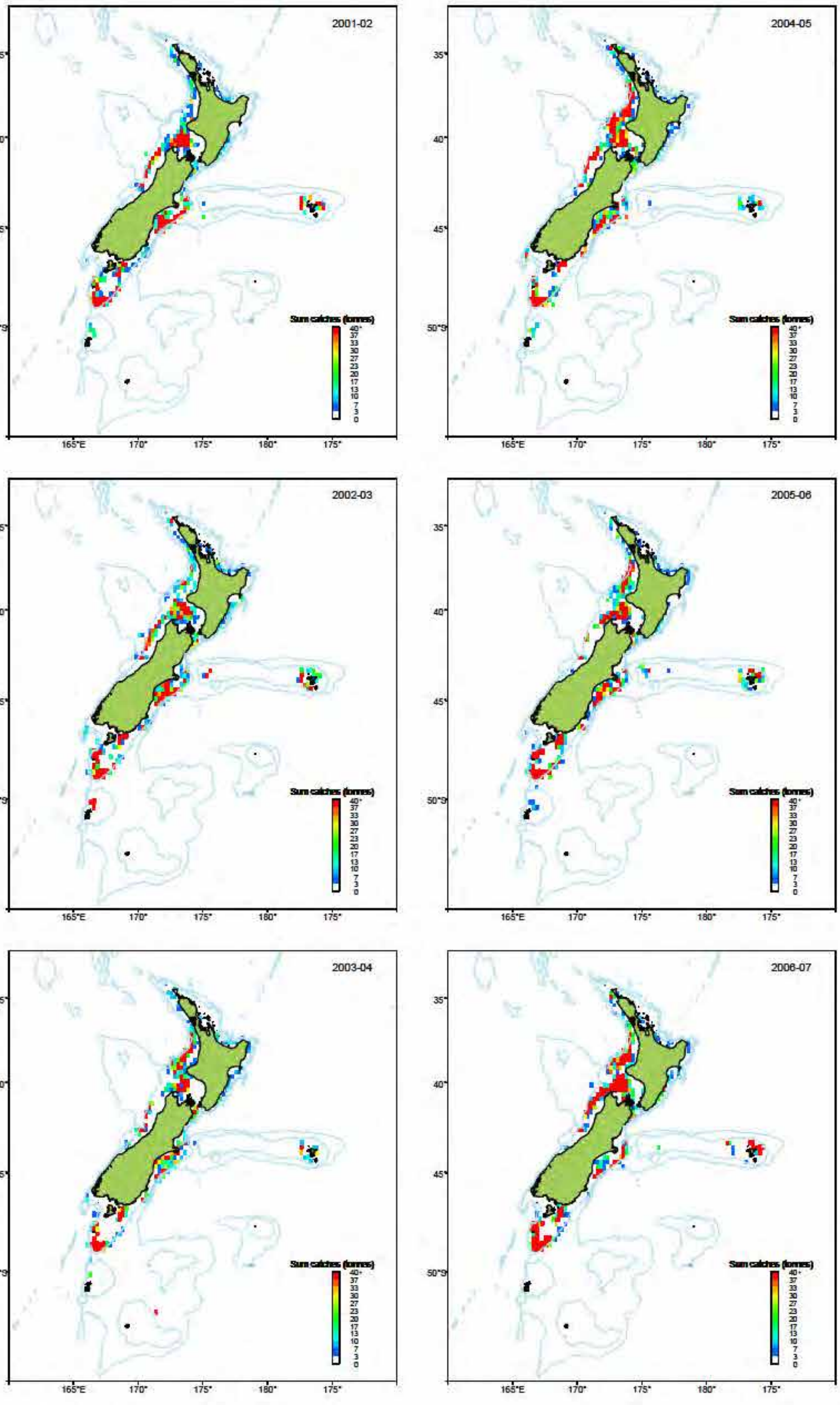


Figure C14: continued.

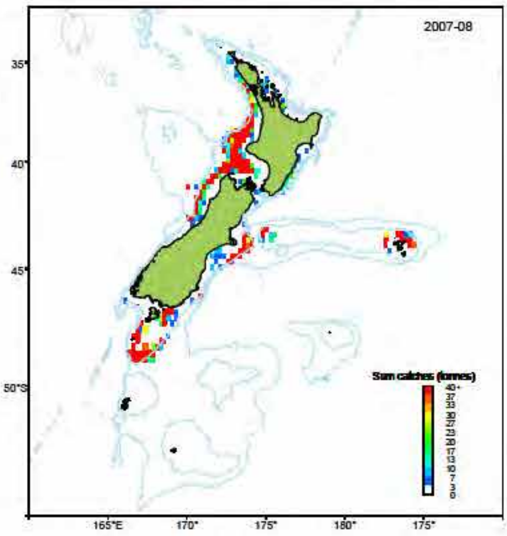


Figure C14: continued.

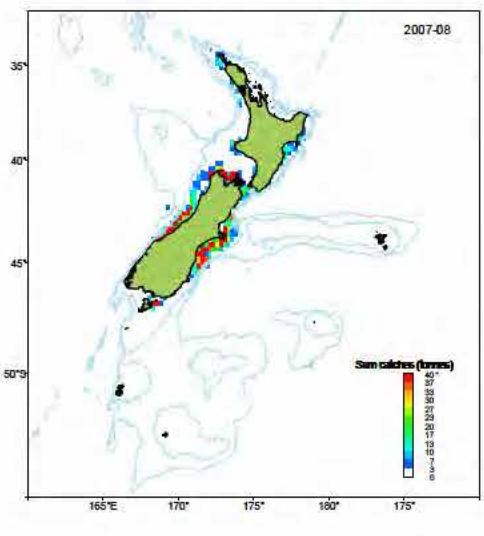


Figure C15: Annual commercial catch (in tonnes) of barracouta from TCER records for the 2007–08 fishing year.

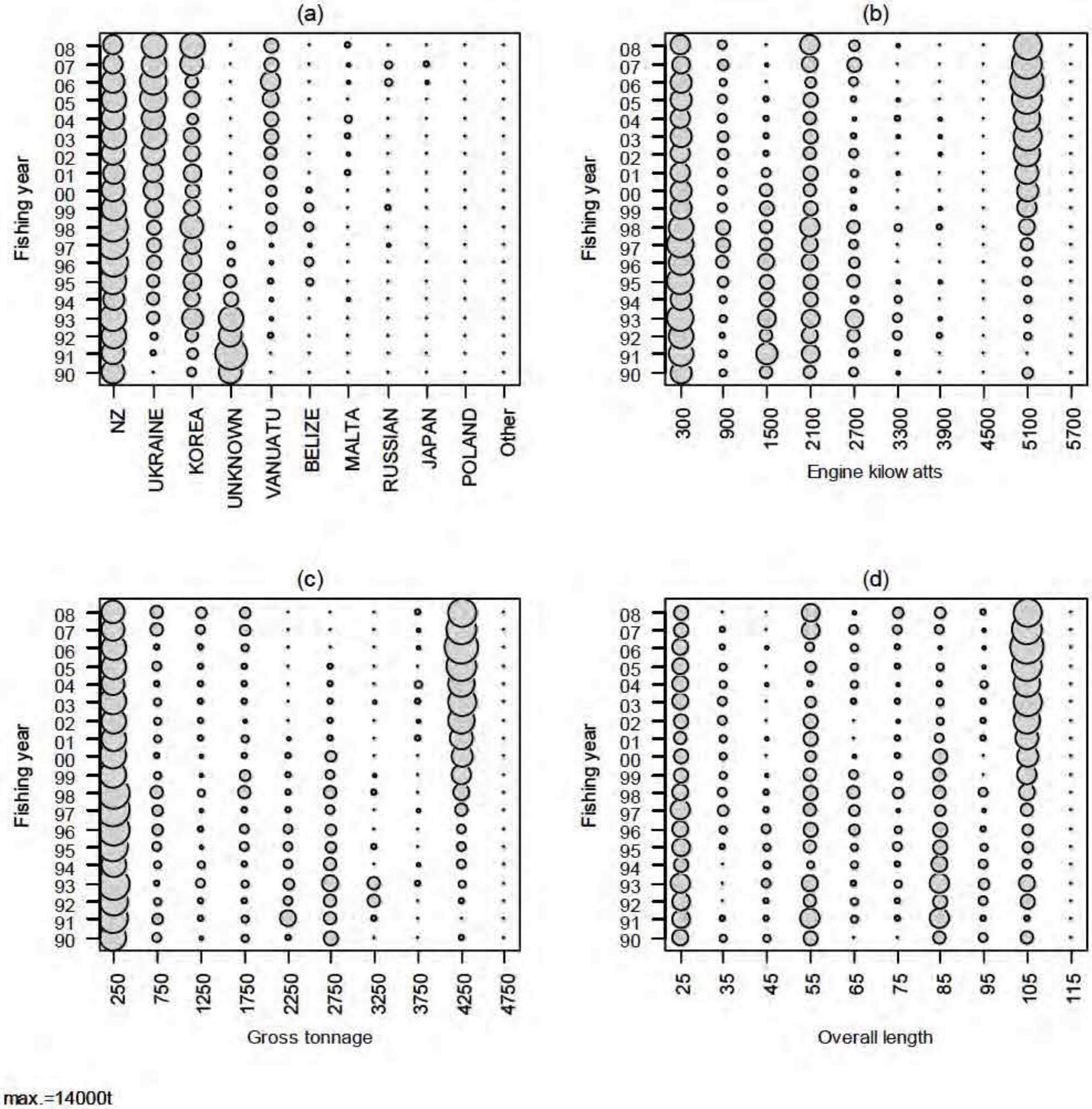


Figure C16: Distribution of annual commercial catch of barracouta by nationality, vessel power, gross tonnage, and length (m) for all merged data. Circle size is proportional to catch; maximum circle size is indicated in lower left hand corner.

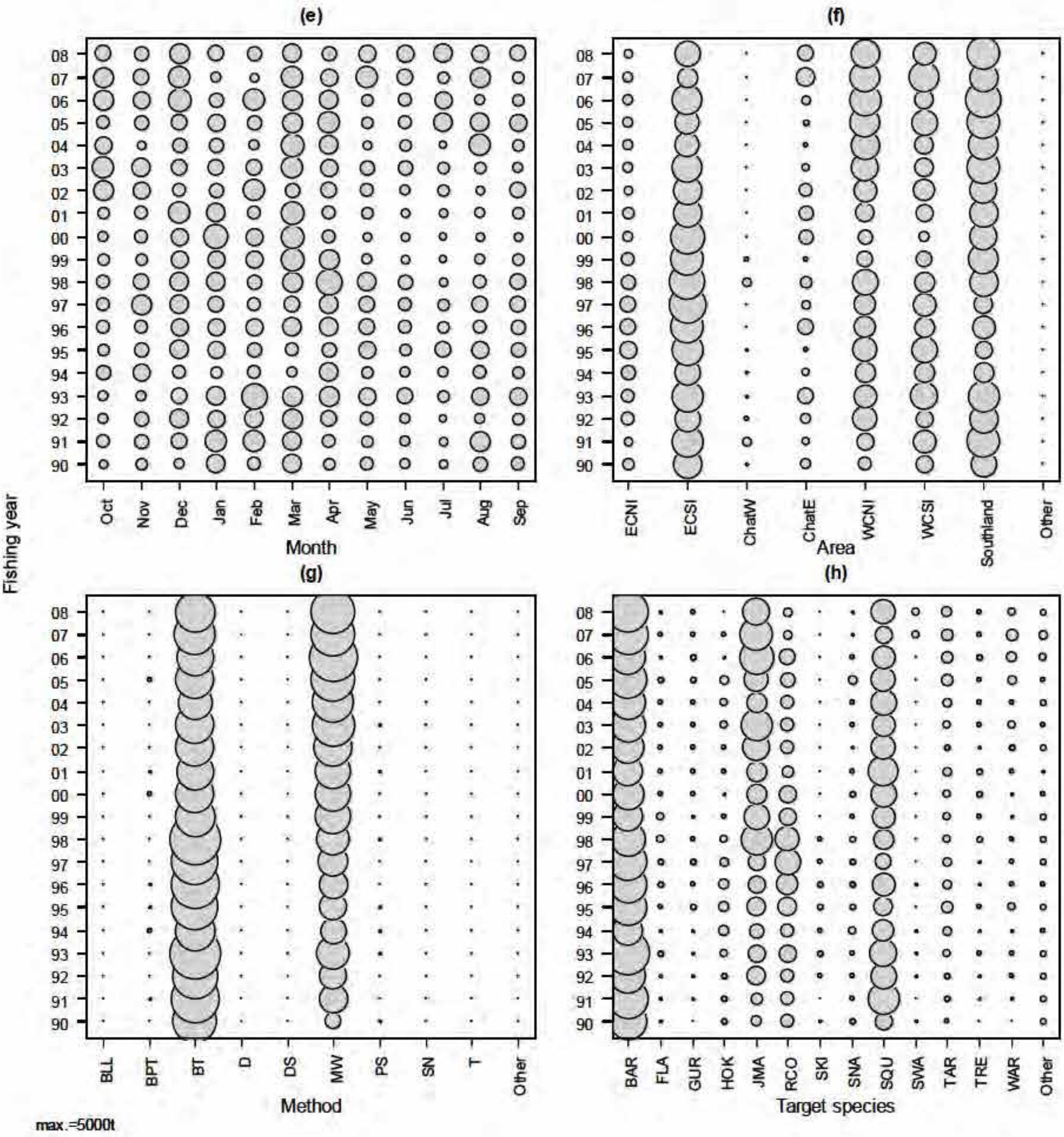


Figure C16: continued.

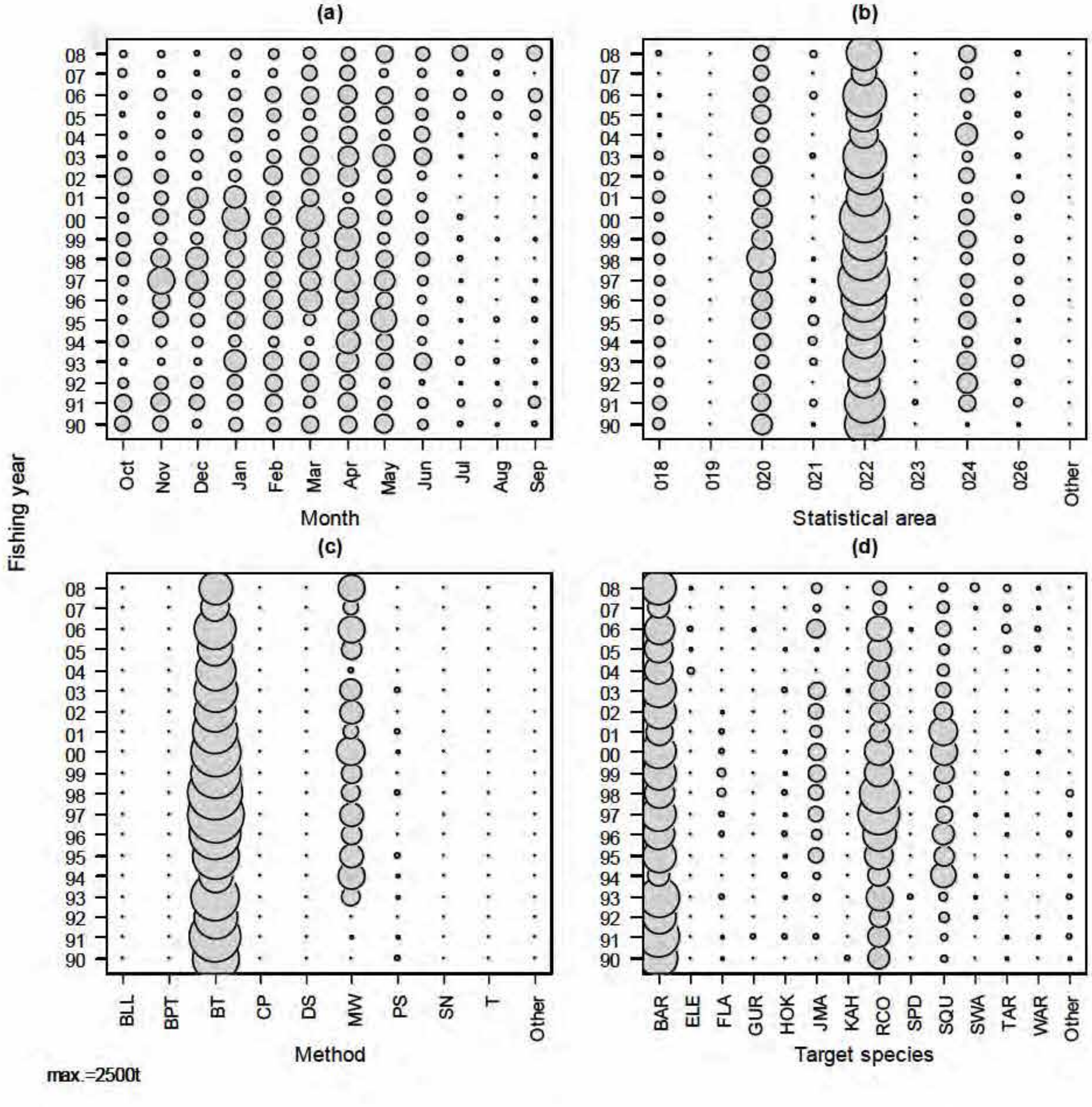


Figure C17: Distribution of barracouta commercial catch in the ECSI region for the 1990–2008 fishing years in relation to a) month, b) statistical area, c) fishing method, and d) target species. Circle size is proportional to catch; maximum circle size is indicated in lower left hand corner.

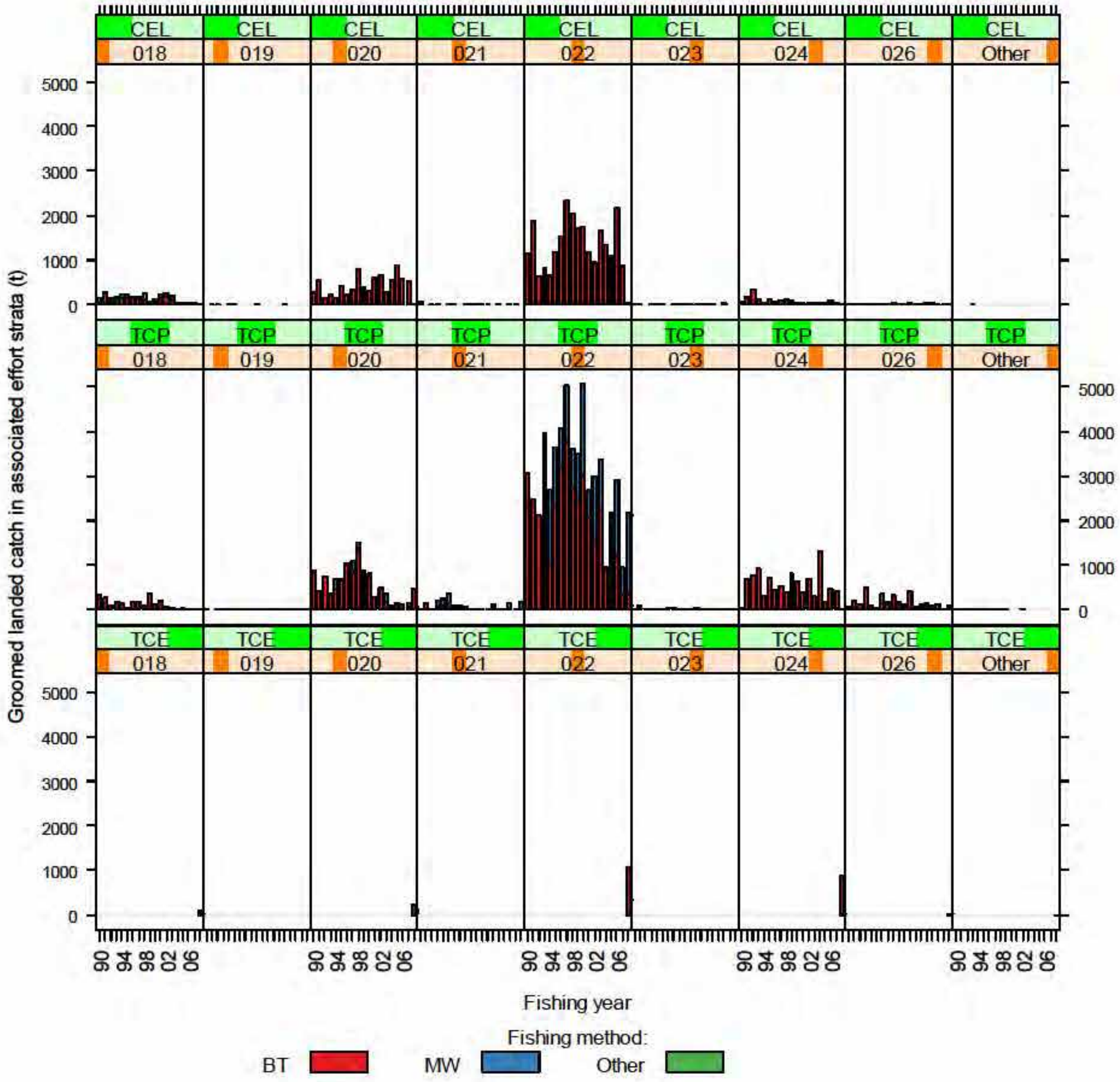
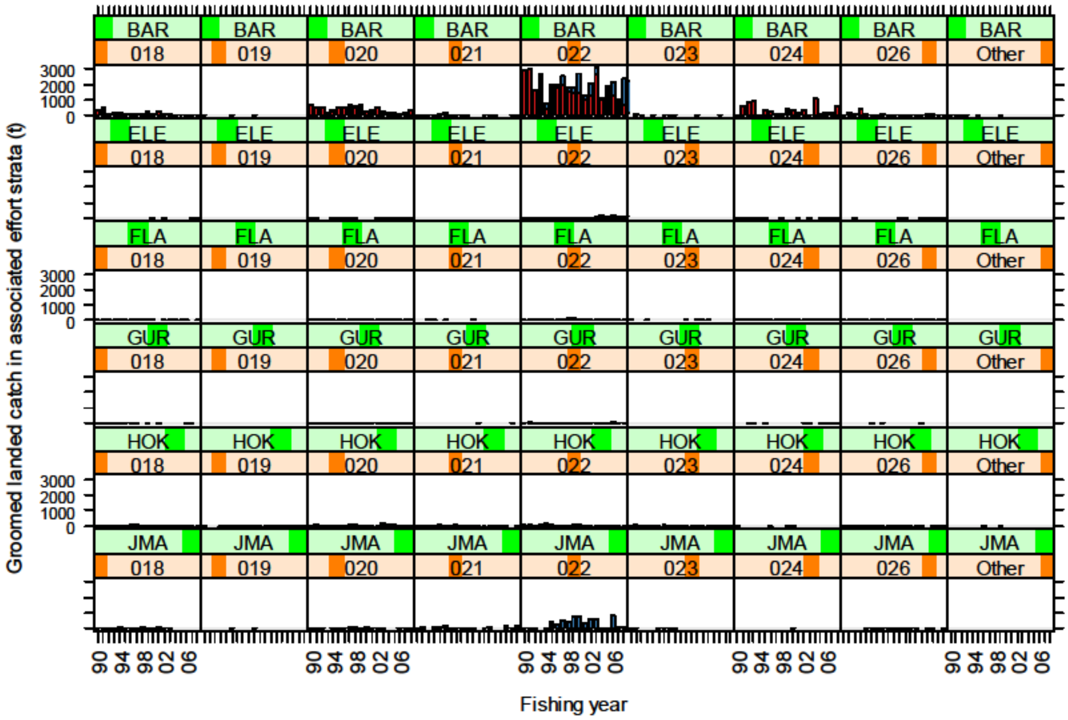
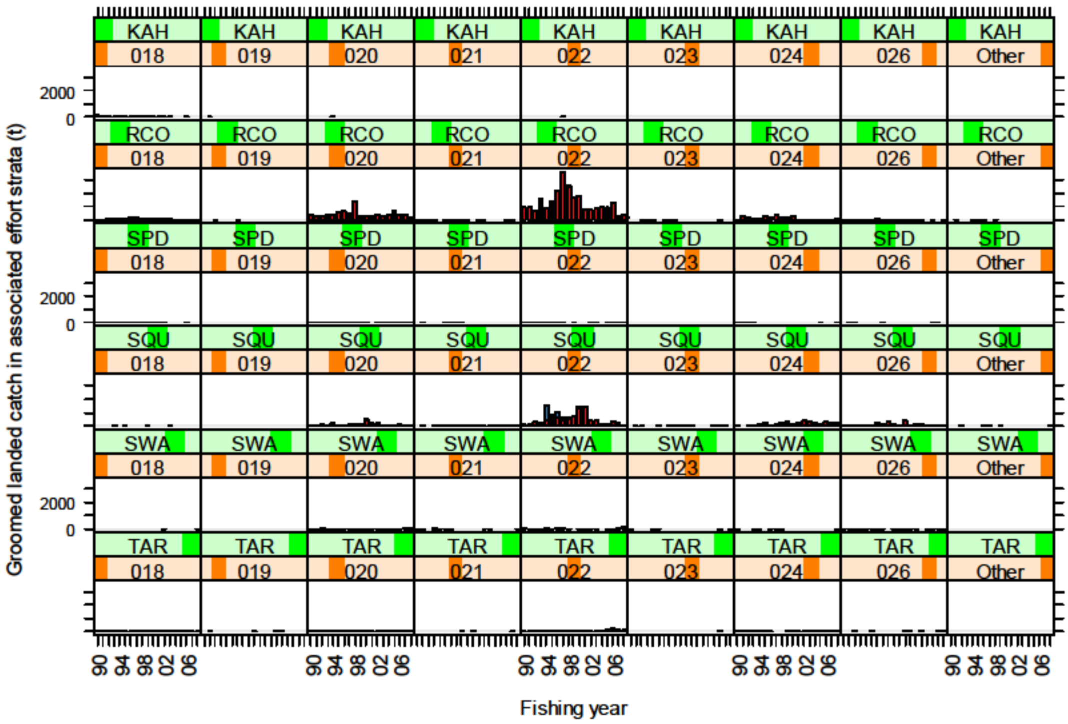


Figure C18a: Distribution of barracouta catch in the ECSI region in relation to form type (CEL, CELR; TCP, TCEPR; TCE, TCER) and statistical area for fishing years 1990–2008 taken by bottom (BT) and midwater (MW) trawl and other gear.





Fishing method:
BT MW Other

Figure C18b: Distribution of barracouta catch in the ECSI region in relation to target species and statistical area by fishing method for fishing years 1990–2008 taken by bottom (BT) and midwater (MW) trawl and other gear.

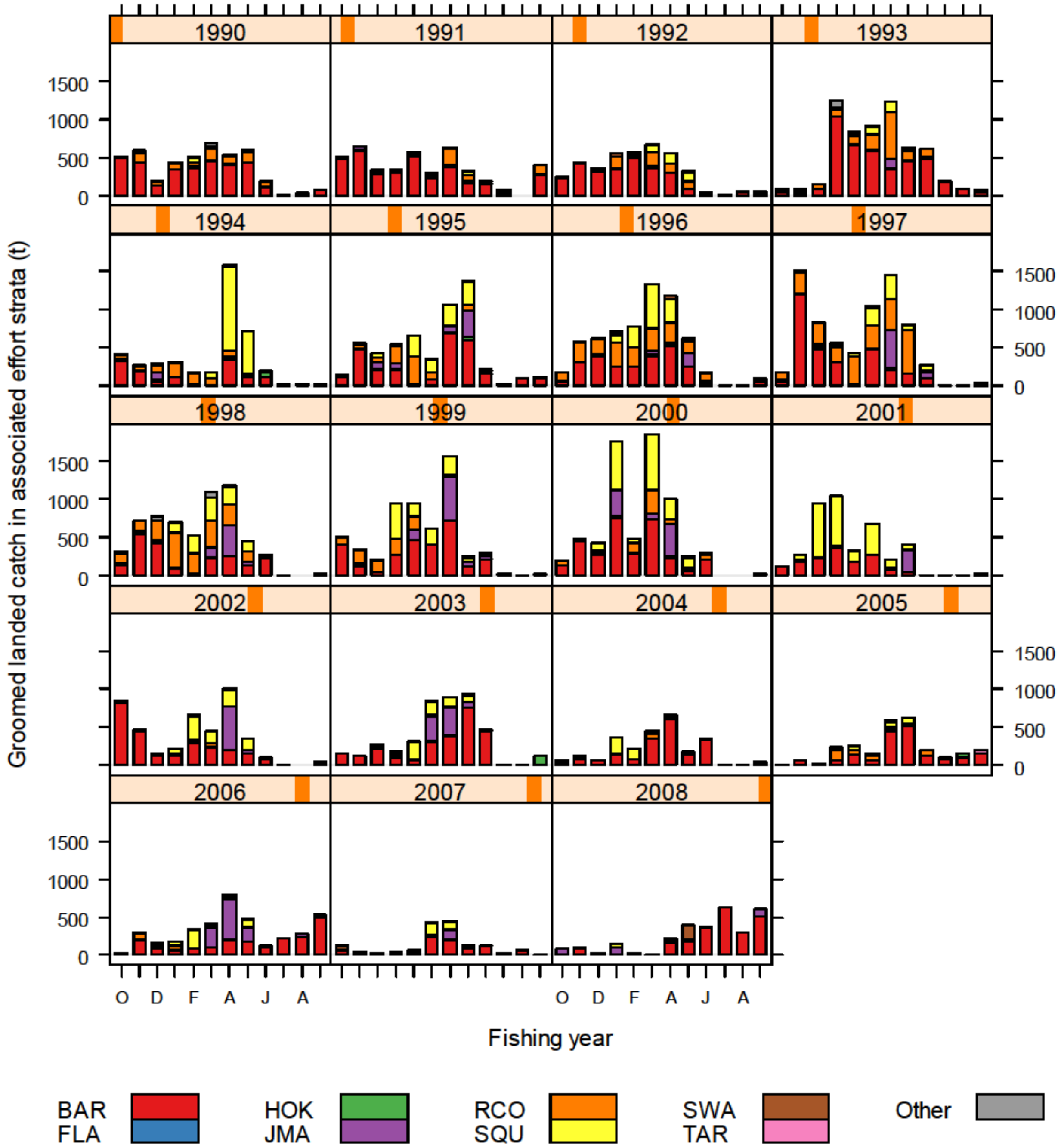


Figure C18c: Distribution of barracouta catch taken by bottom and midwater trawl in the ECSI region in relation to target species and month by fishing method for fishing years 1990–2008.

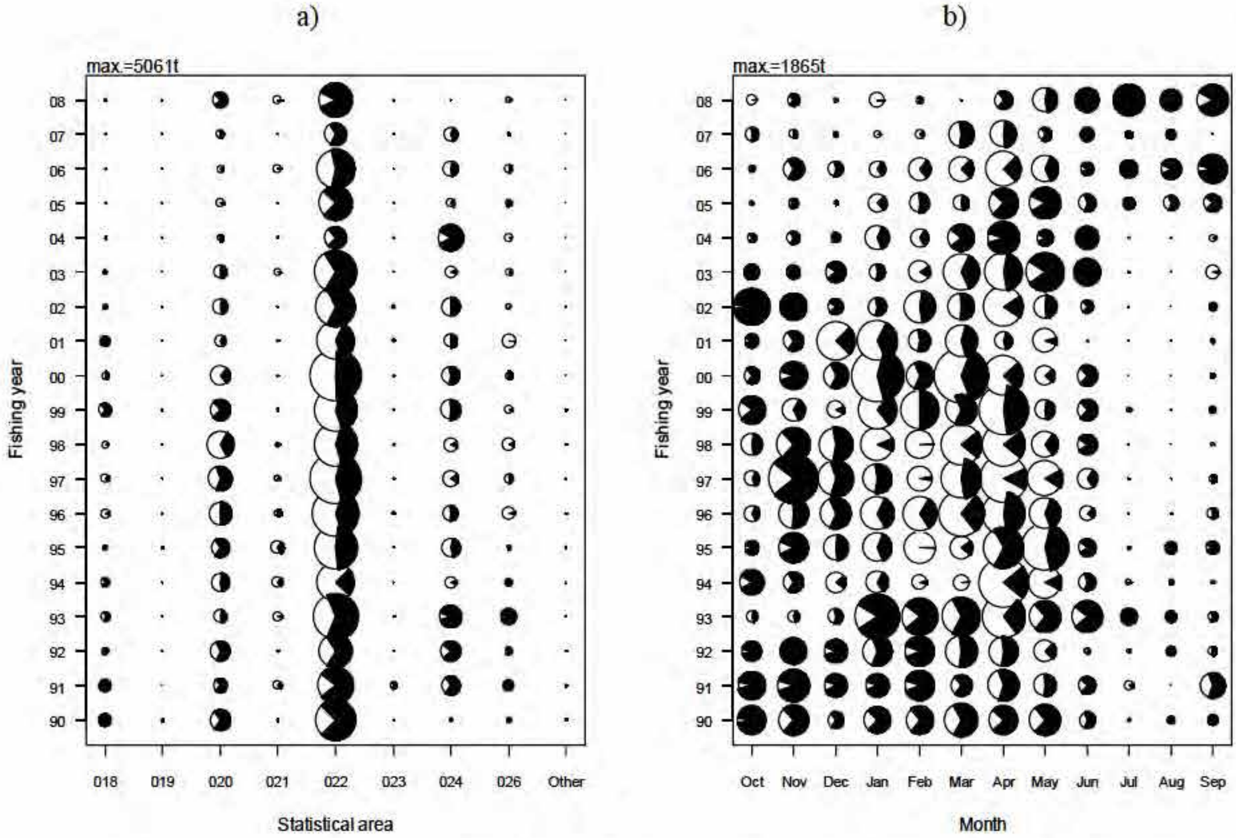


Figure C19: Distribution of barracouta catch taken by midwater and bottom trawl gear by fishing year with circle size proportional to the total catch and black portion of the pie indicating proportion of the catch as targeted barracouta by a) statistical area and b) month for the ECSI region.

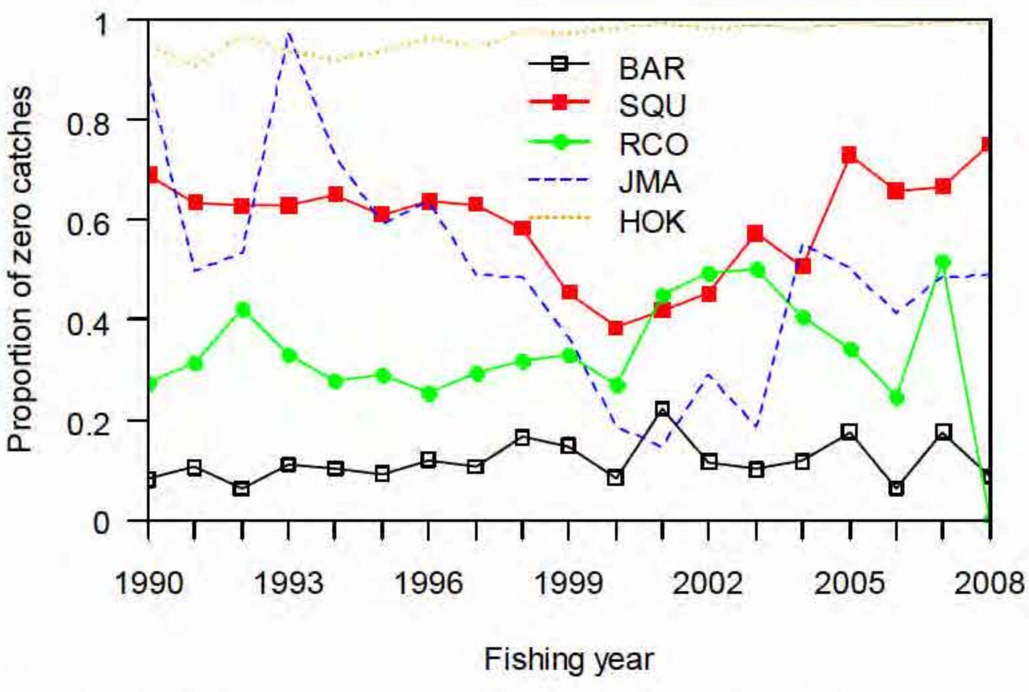


Figure C20: Proportion of TCEPR tows with zero reported barracouta catch for major target species for the ECSI region taken by midwater and bottom trawl gear.

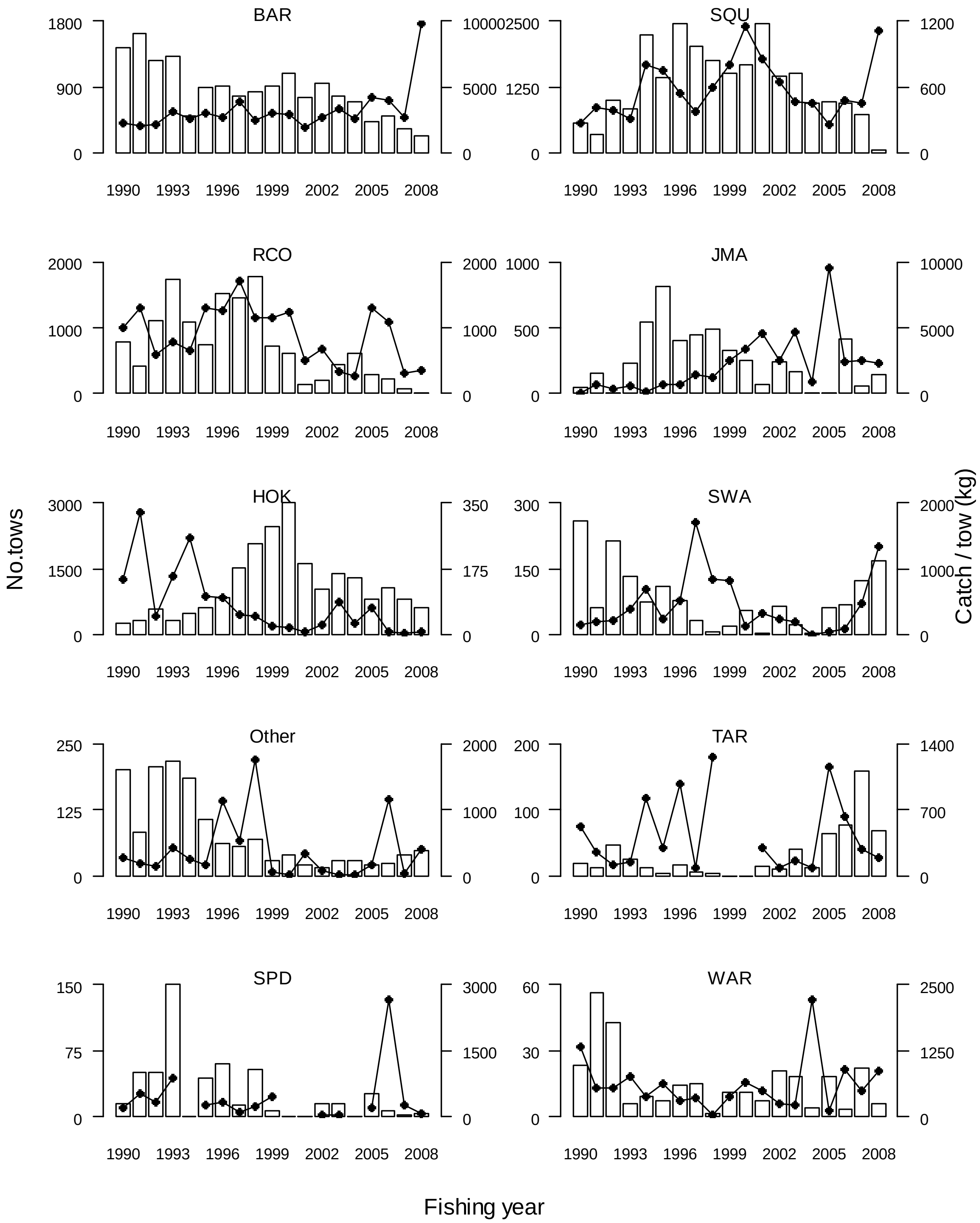


Figure C21: The number of tows (bars) that caught barracouta in the ECSI region taken by midwater and bottom trawl gear and the annual catch rate (lines) of barracouta by major target species.

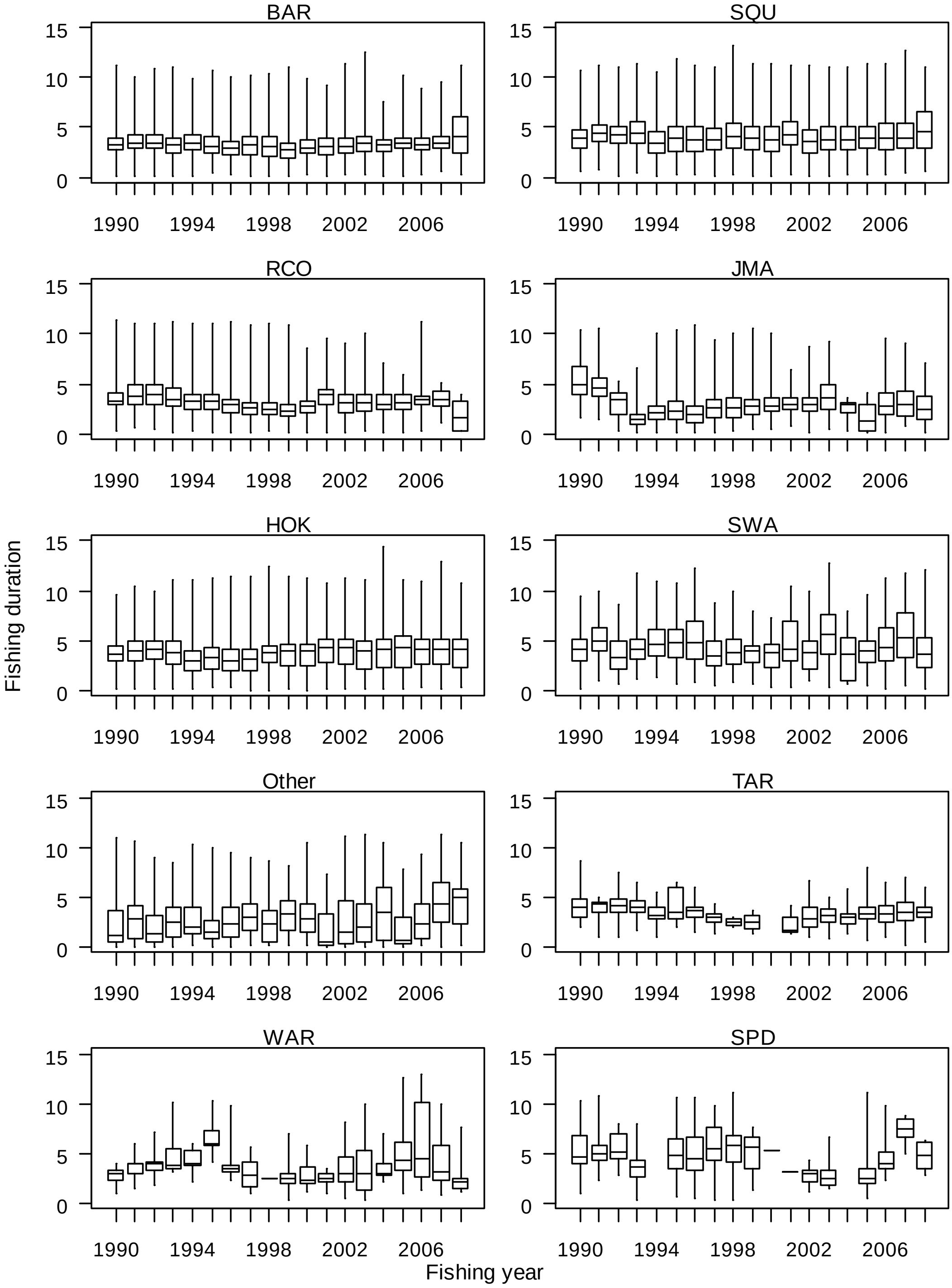


Figure C22: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) of midwater and bottom trawl tow durations (hours) reported for major target species catching barracouta in the ECSI region.

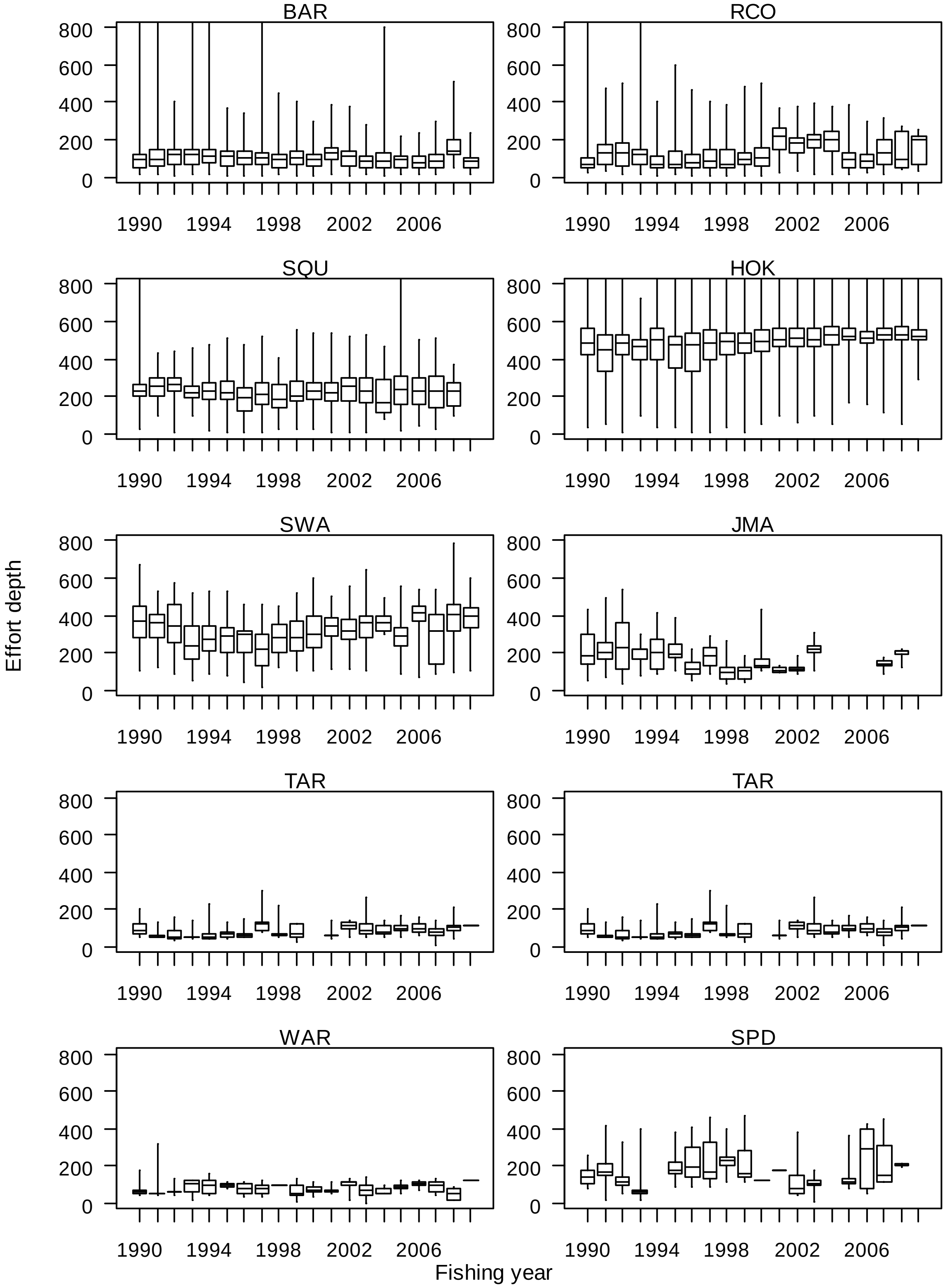


Figure C23a: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) of depths (m) fished by bottom trawl tows for major target species catching barracouta in the ECSI region.

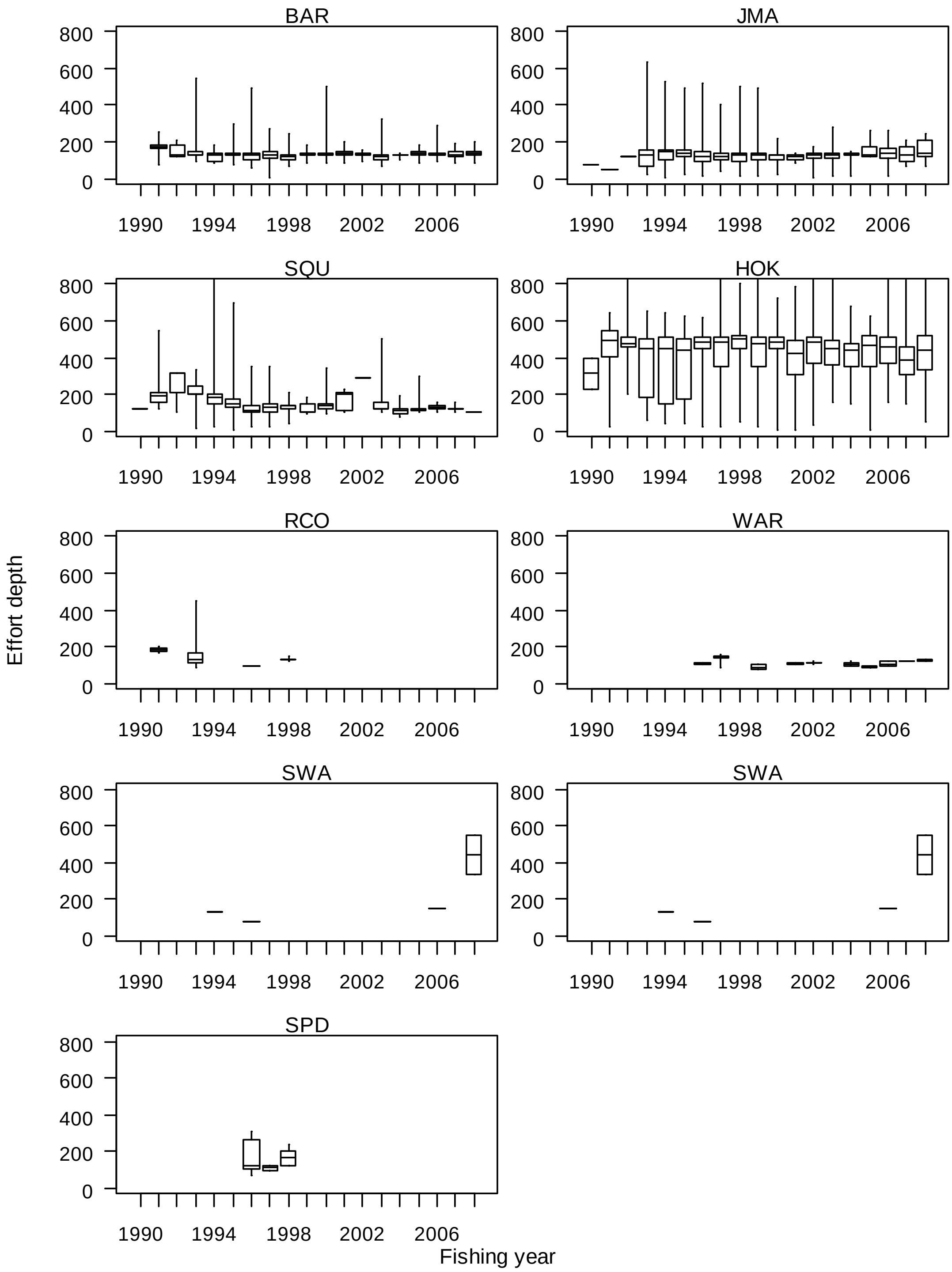


Figure C23b: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) of depths (m) fished by midwater tows for major target species catching barracouta in the ECSI region.

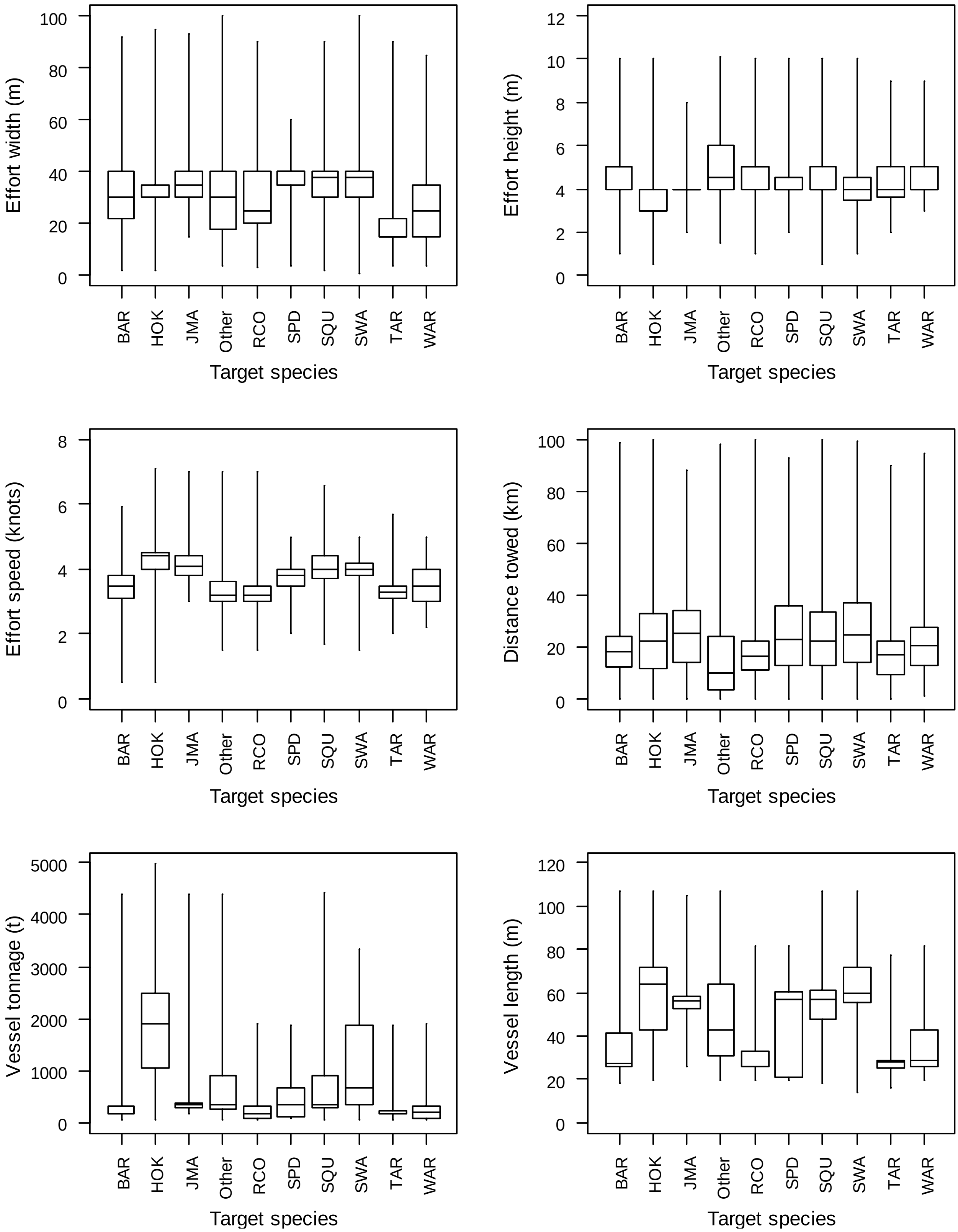


Figure C24: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) of fishing effort variables and vessel characteristics for bottom trawl tows for major target species catching barracouta in the ECSI region.

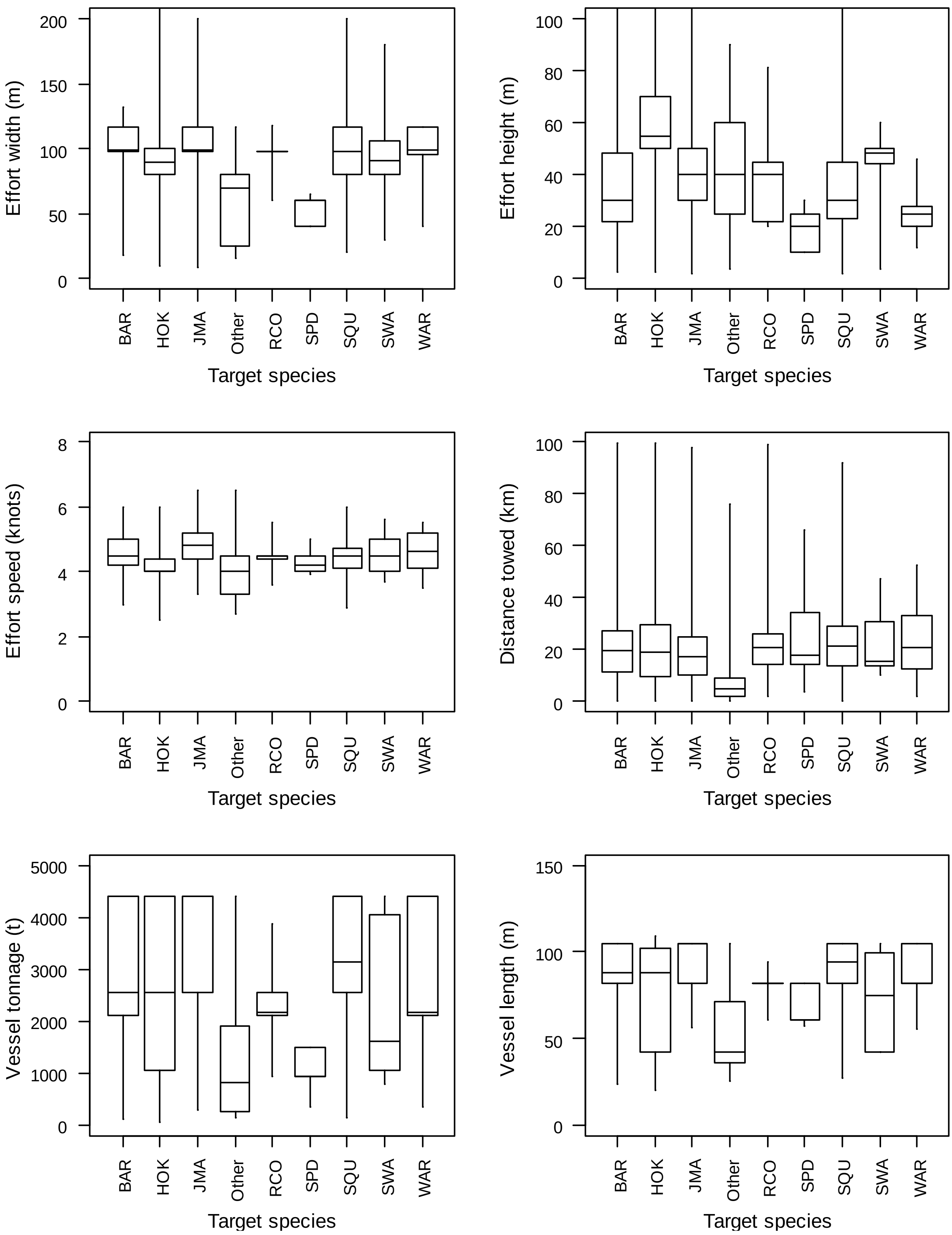


Figure C25: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) of fishing effort variables and vessel characteristics for midwater trawl tows for major target species catching barracouta in the ECSI region.

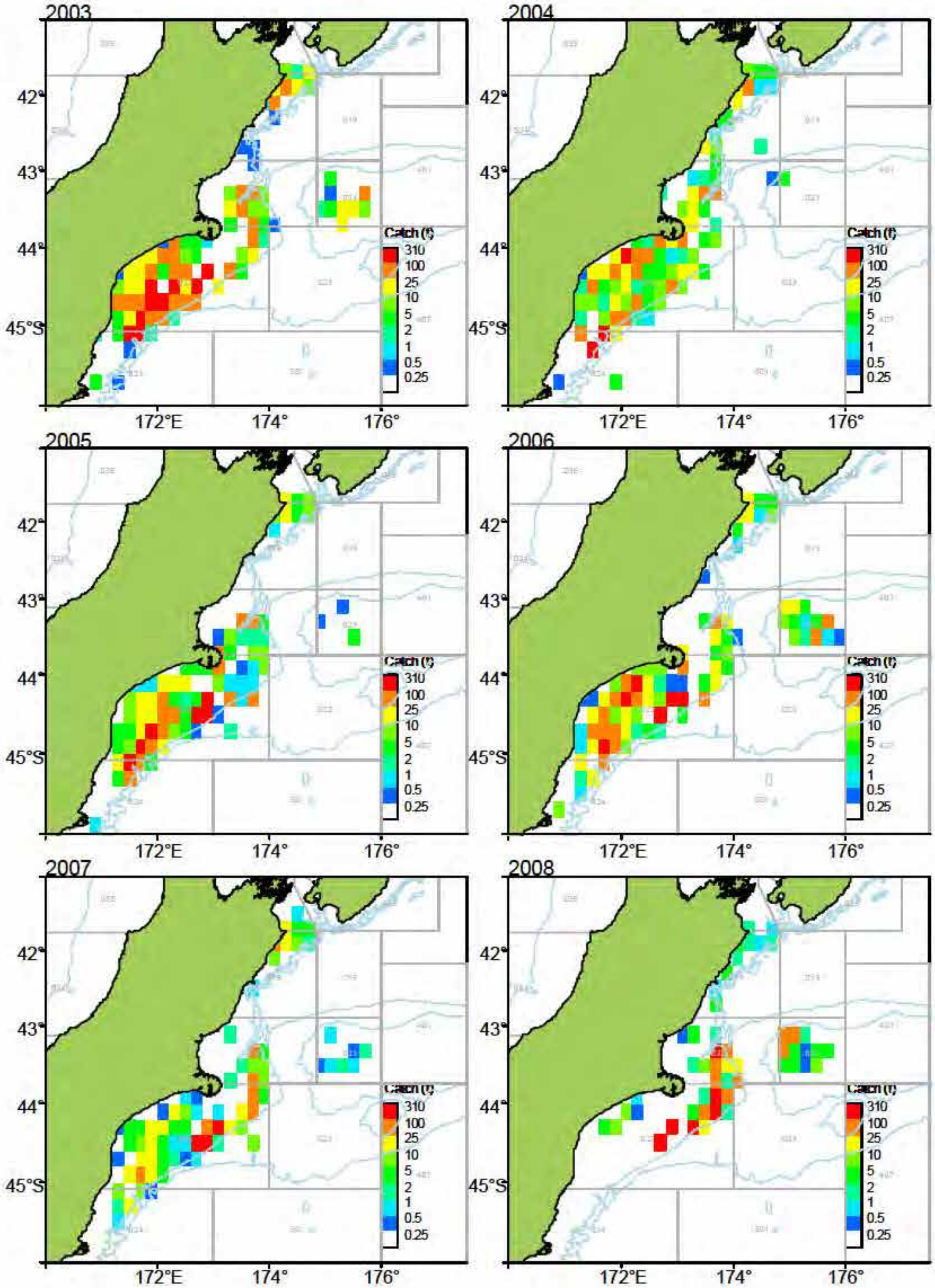


Figure C26a: Distribution of barracouta catch in the ECSI region aggregated into 0.2 degree spatial blocks for fishing years 2003–2008 reported on TCEPR forms and using midwater and bottom trawl gear.

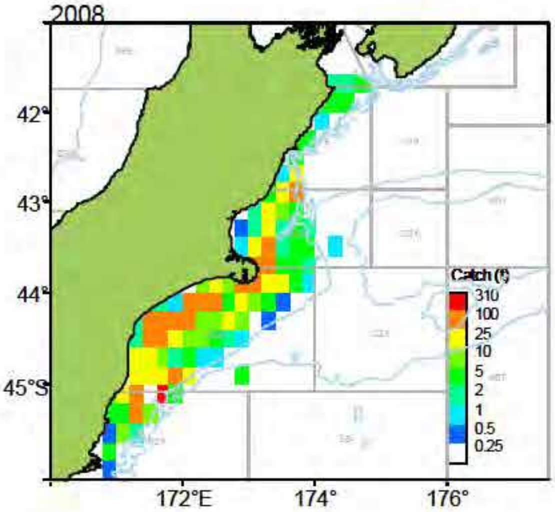


Figure C26b: Distribution of barracouta catch in the ECSI region aggregated into 0.2 degree spatial blocks for the fishing year 2008 reported on TCER forms and using midwater and bottom trawl gear.

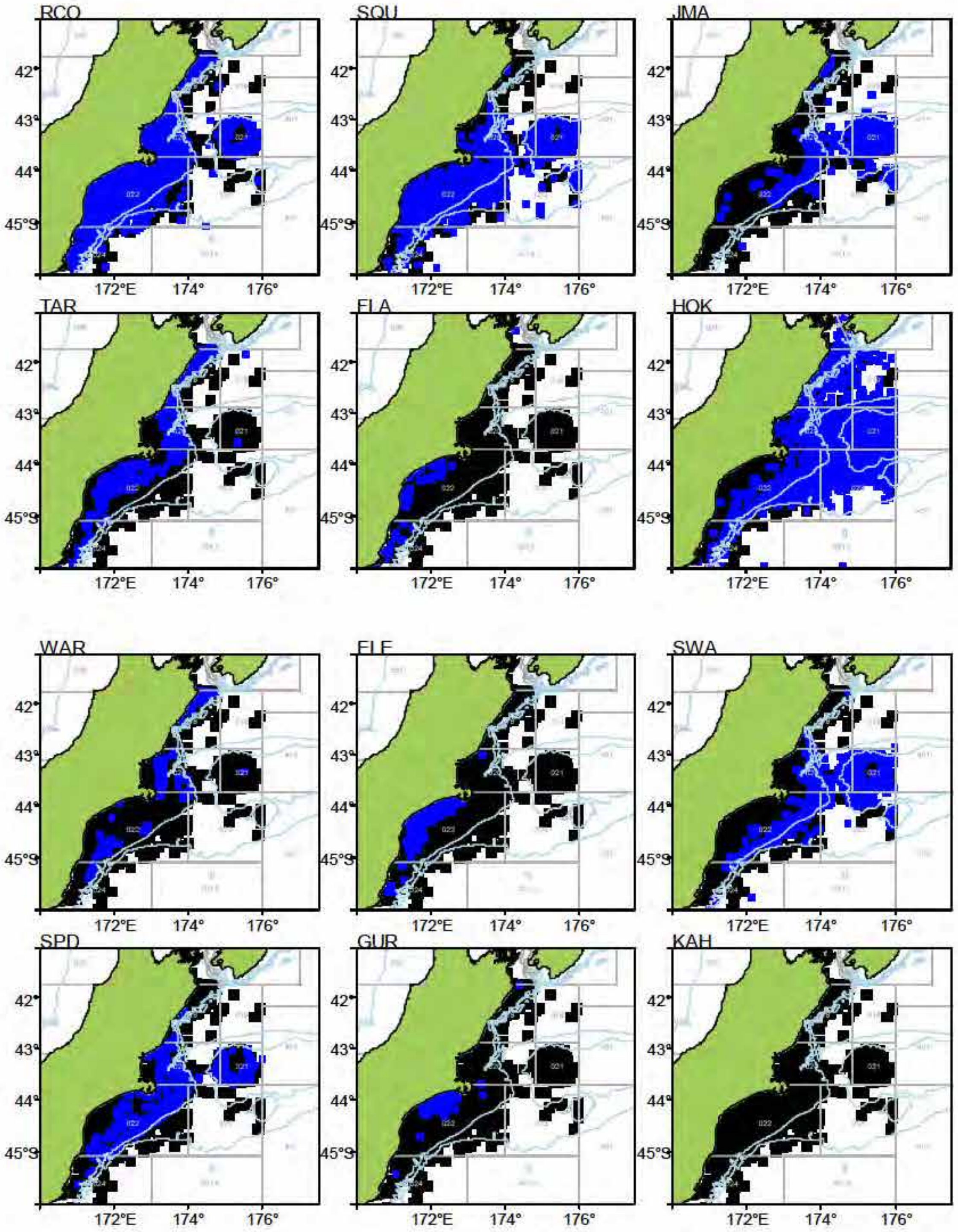


Figure C27: Comparison of the distribution of bottom and midwater trawls in the ECSI region by target species for the main target species (blue cells) overlaid on the distribution of barracouta target effort distribution (black cells), for all years combined.

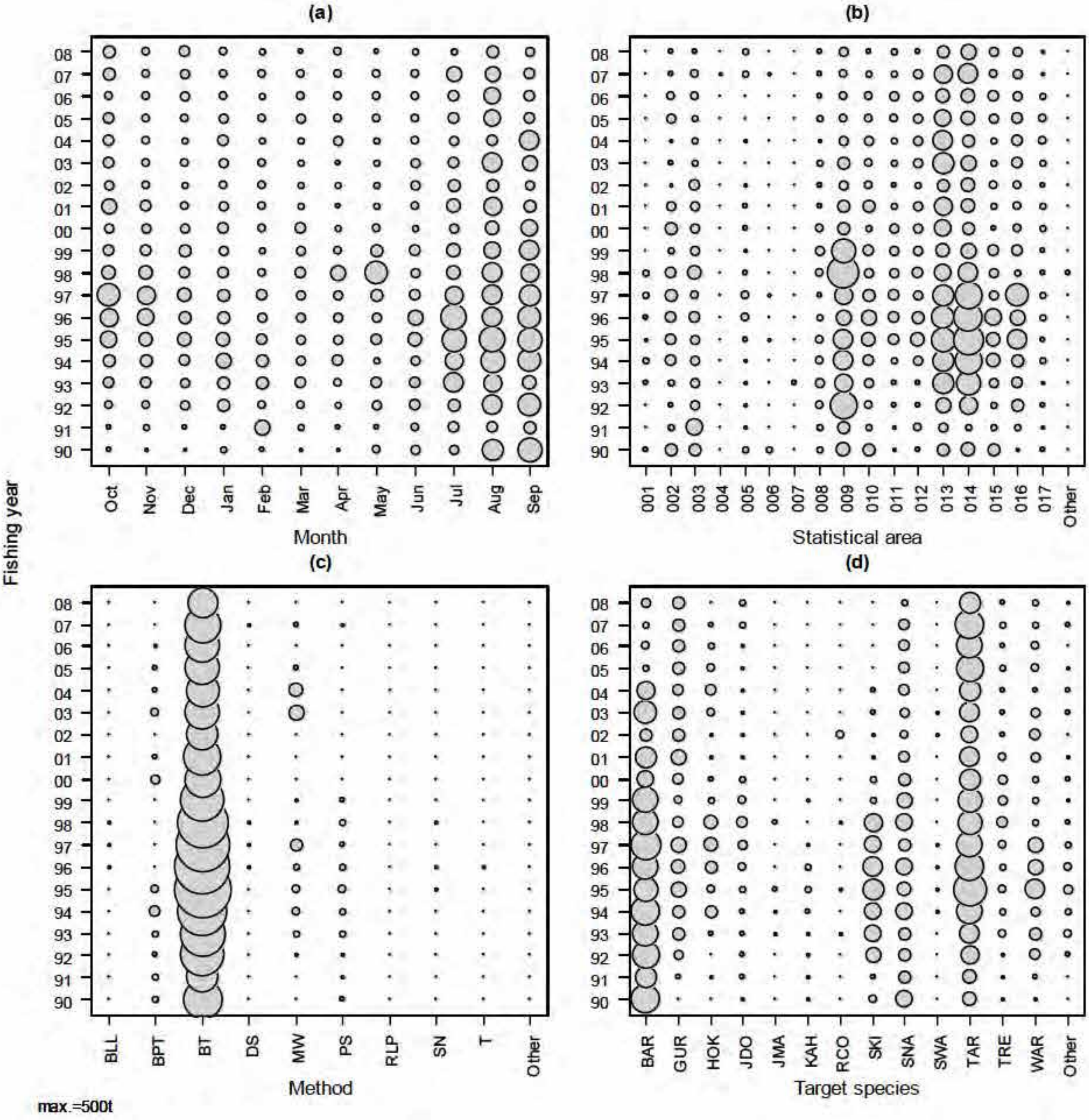


Figure C28: Distribution of barracouta catch in the ECNI region for the 1990–2008 fishing years in relation to a) month, b) statistical area, c) fishing method, and d) target species. Circle size is proportional to catch; maximum circle size is indicated in lower left hand corner.

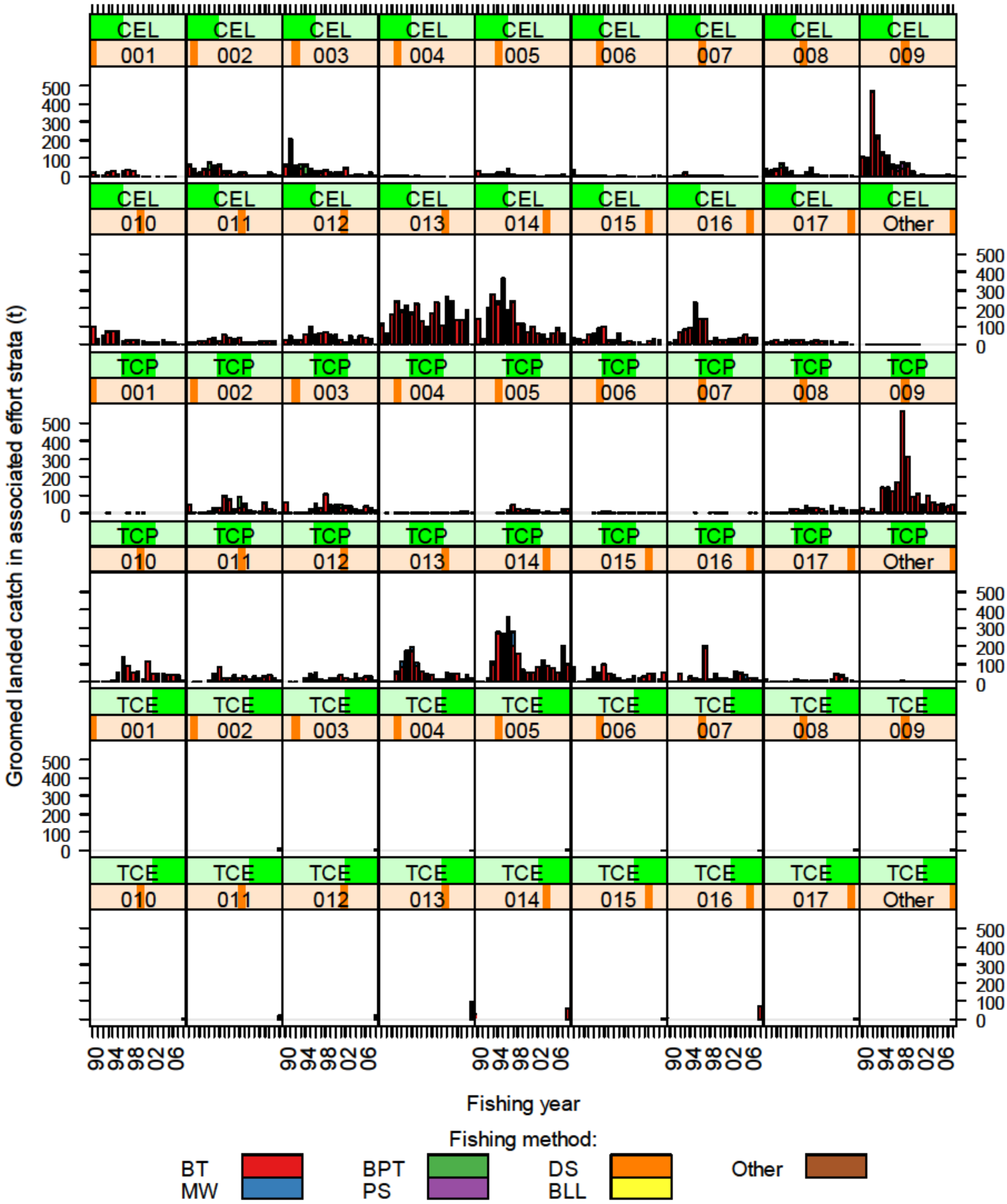


Figure C29a: Distribution of barracouta catch in the ECNI region in relation to form type (CEL, CELR; TCP, TCEPR; TCE, TCER) and statistical area by fishing method (bottom (BT), midwater (MW) and bottom pair trawl (BPT); purse (PS) and Danish (DS) seine; bottom long-line (BLL)) for fishing years 1990–2008.

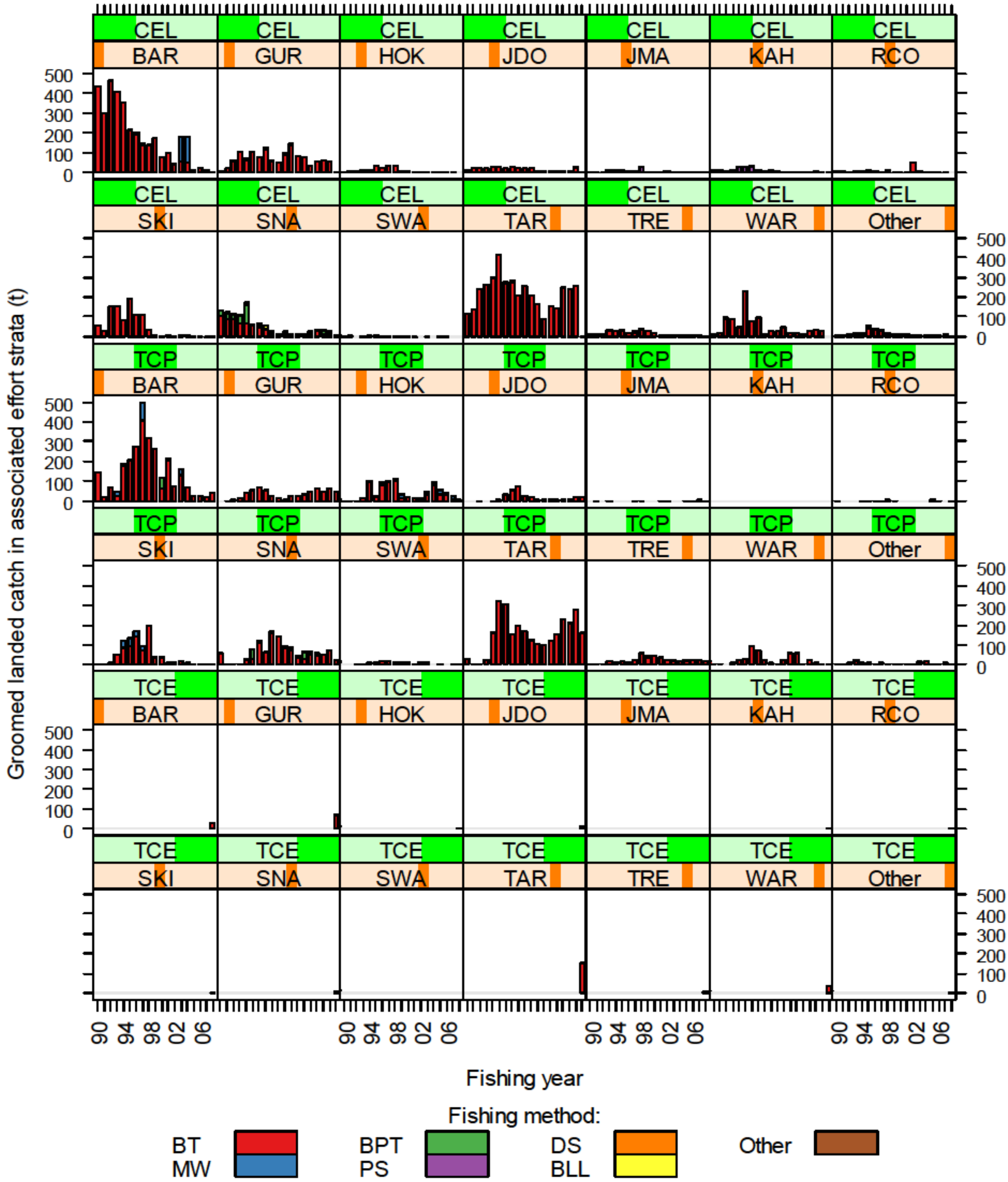


Figure C29b: Distribution of barracouta catch in the ECNI region in relation to form type (CEL, CELR; TCP, TCEPR; TCE, TCER) and target species by fishing method (bottom (BT), midwater (MW) and bottom pair trawl (BPT); purse (PS) and Danish (DS) seine; bottom long-line (BLL)) for fishing years 1990–2008.

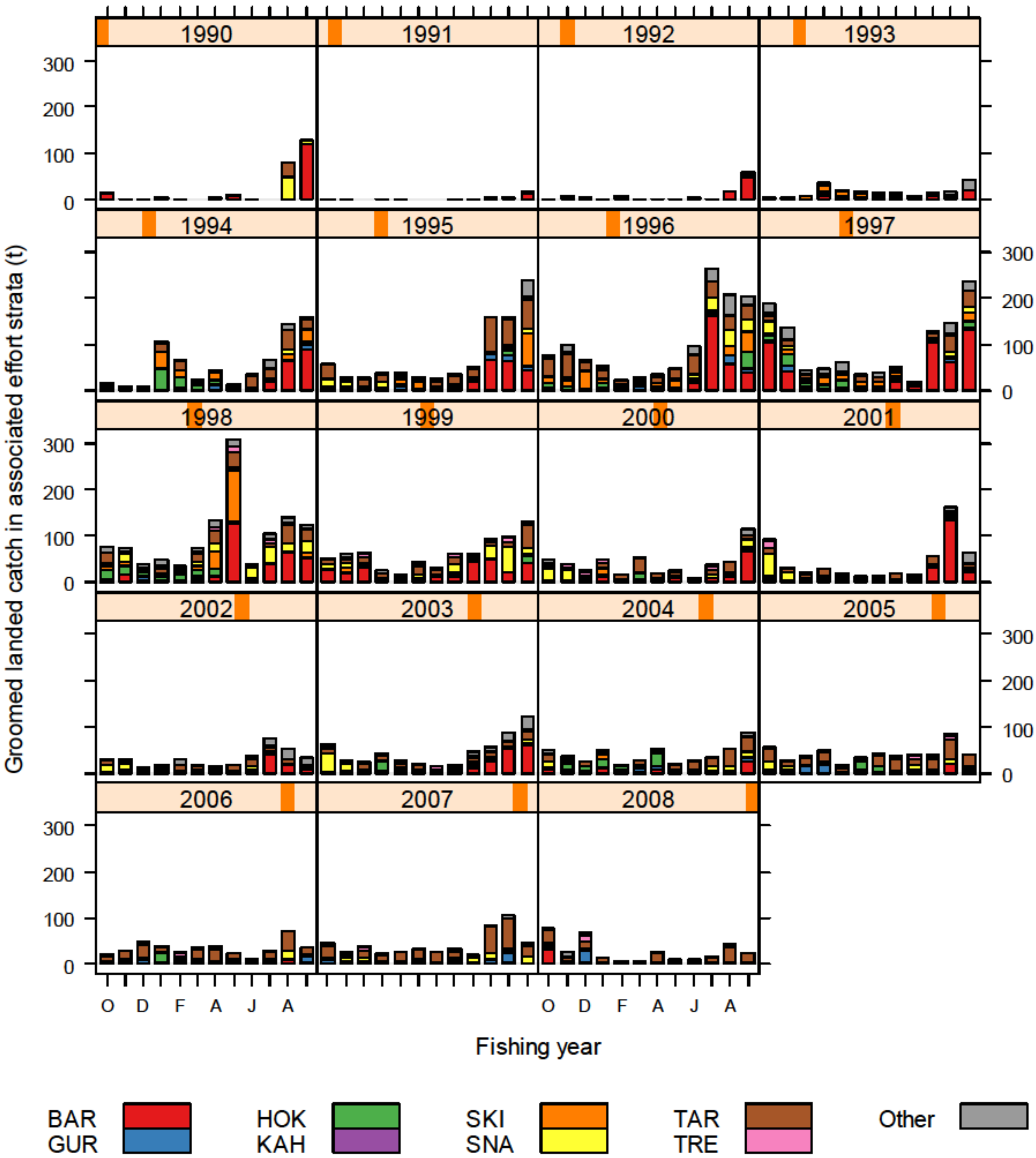


Figure C29c: Distribution of barracouta catch in the ECNI region in relation to target species by month for fishing years 1990–2008 taken by midwater and bottom trawl gear.

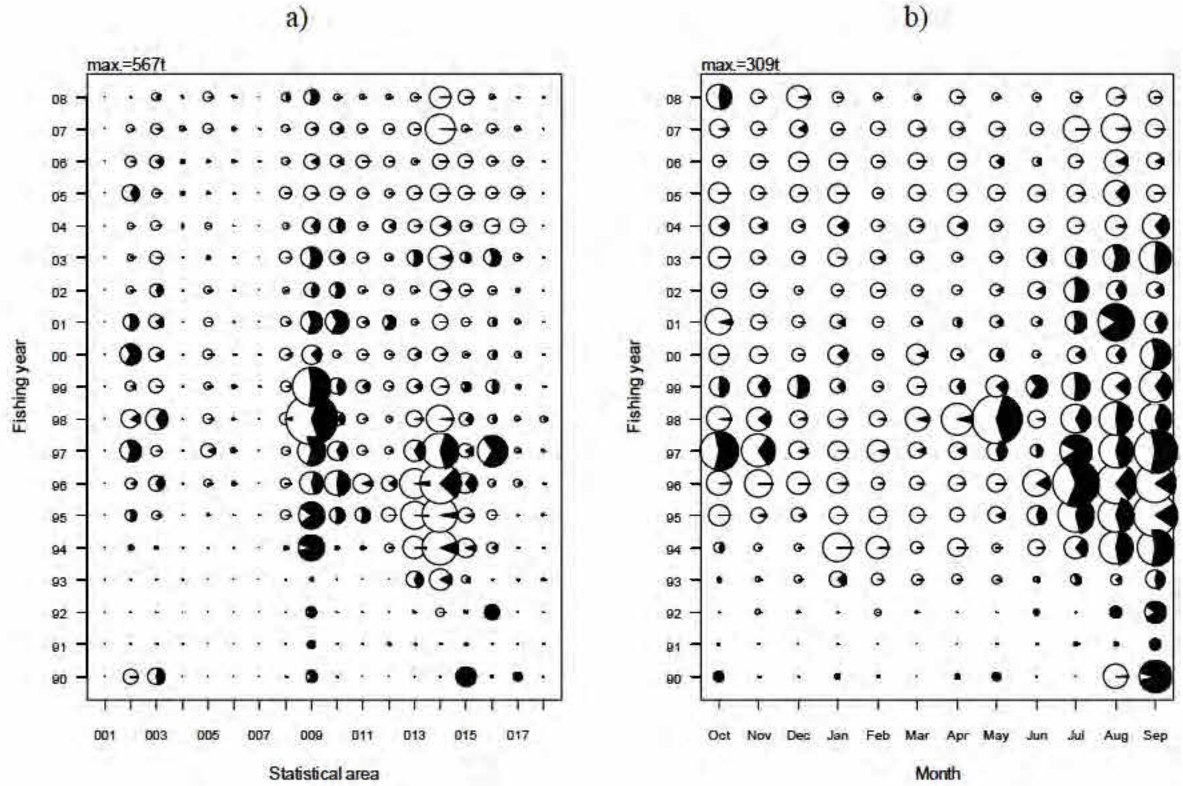


Figure C30: Distribution of barracouta catch taken by midwater and bottom trawl gear by fishing year with circle size proportional to the total catch and black portion of the pie indicating proportion of the catch as targeted barracouta by a) statistical area and b) month for the ECNI region.

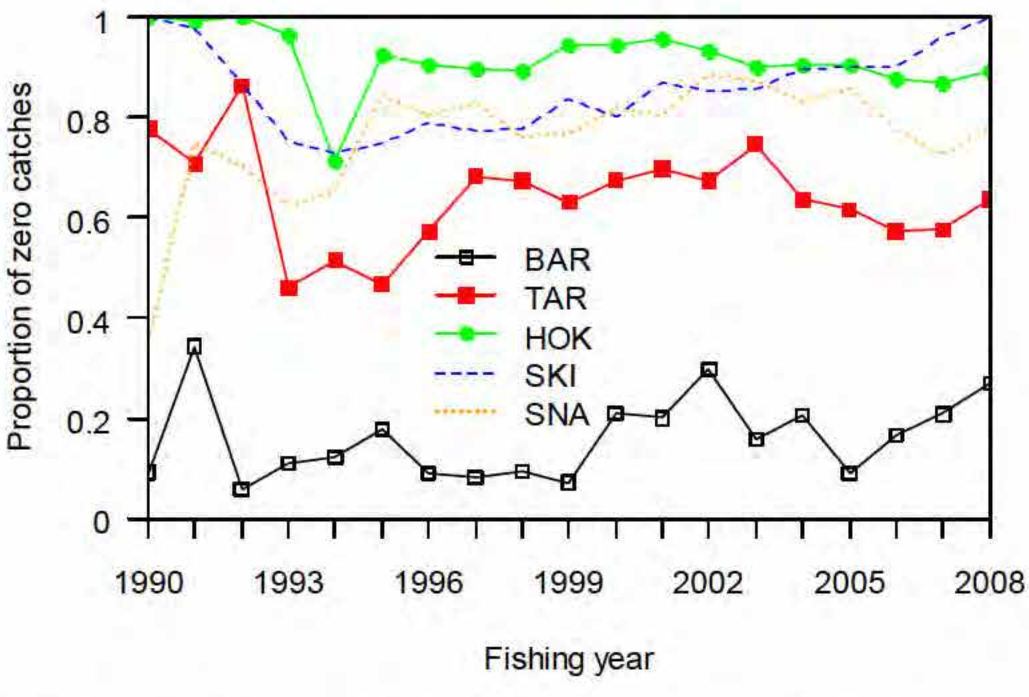


Figure C31: Proportion of TCEPR tows with zero reported barracouta catch for major target species for the ECNI region taken by midwater and bottom trawl gear.

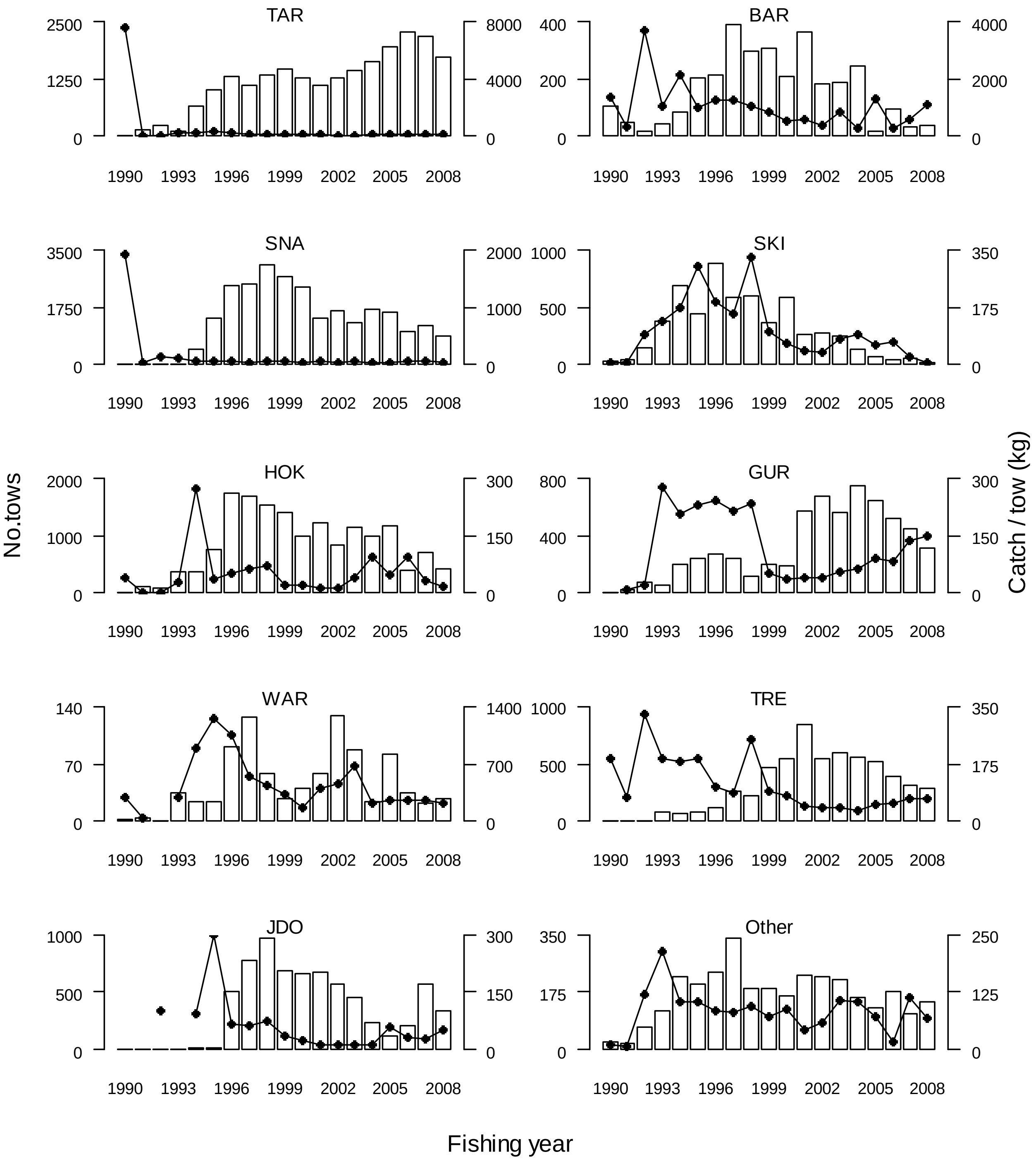


Figure C32: The number of tows (bars) that caught barracouta in the ECNI region taken by midwater and bottom trawl gear and the annual catch rate (lines) of barracouta by target species.

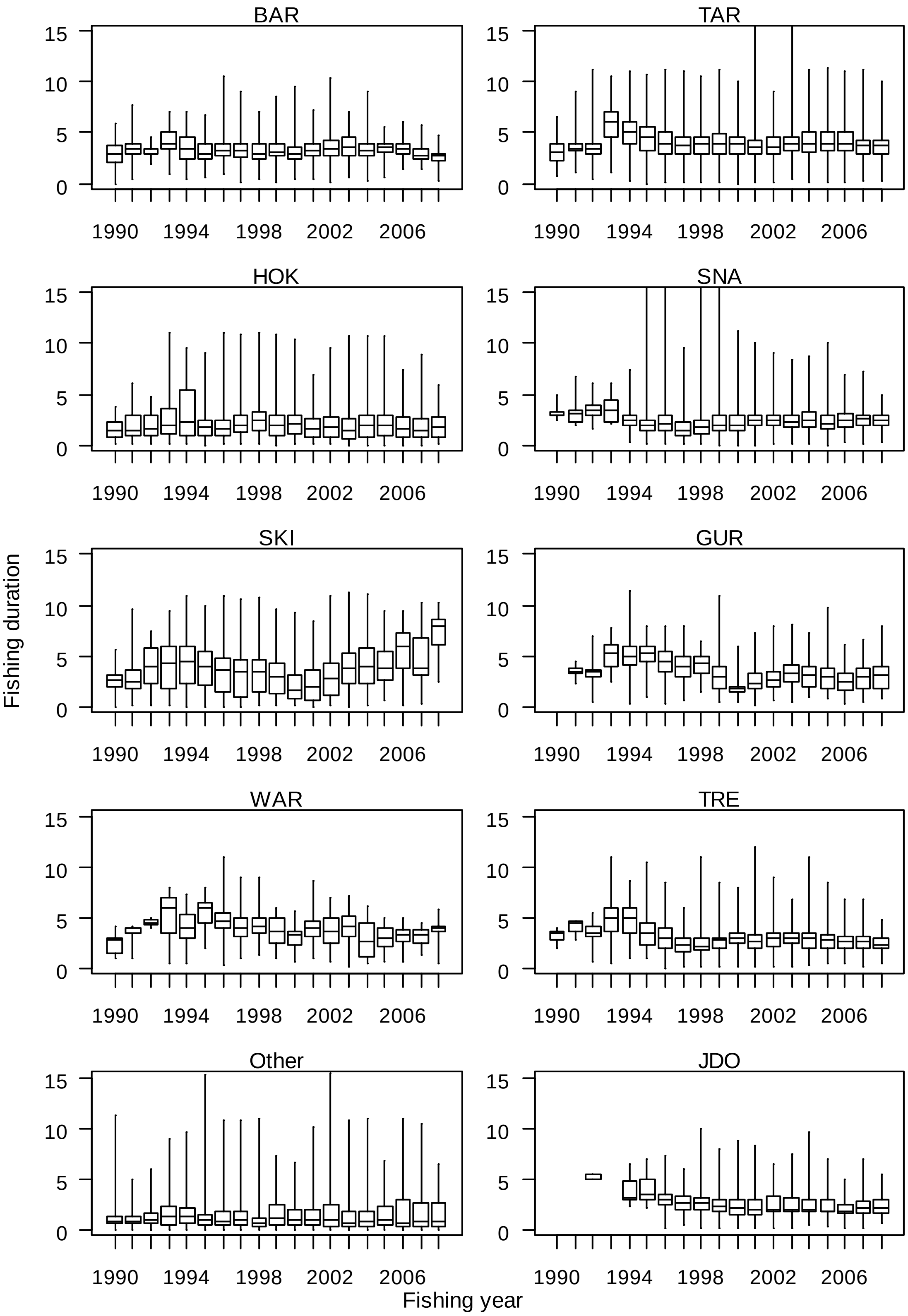


Figure C33: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) of midwater and bottom trawl tow durations (hours) reported for major target species catching barracouta in the ECNI region.

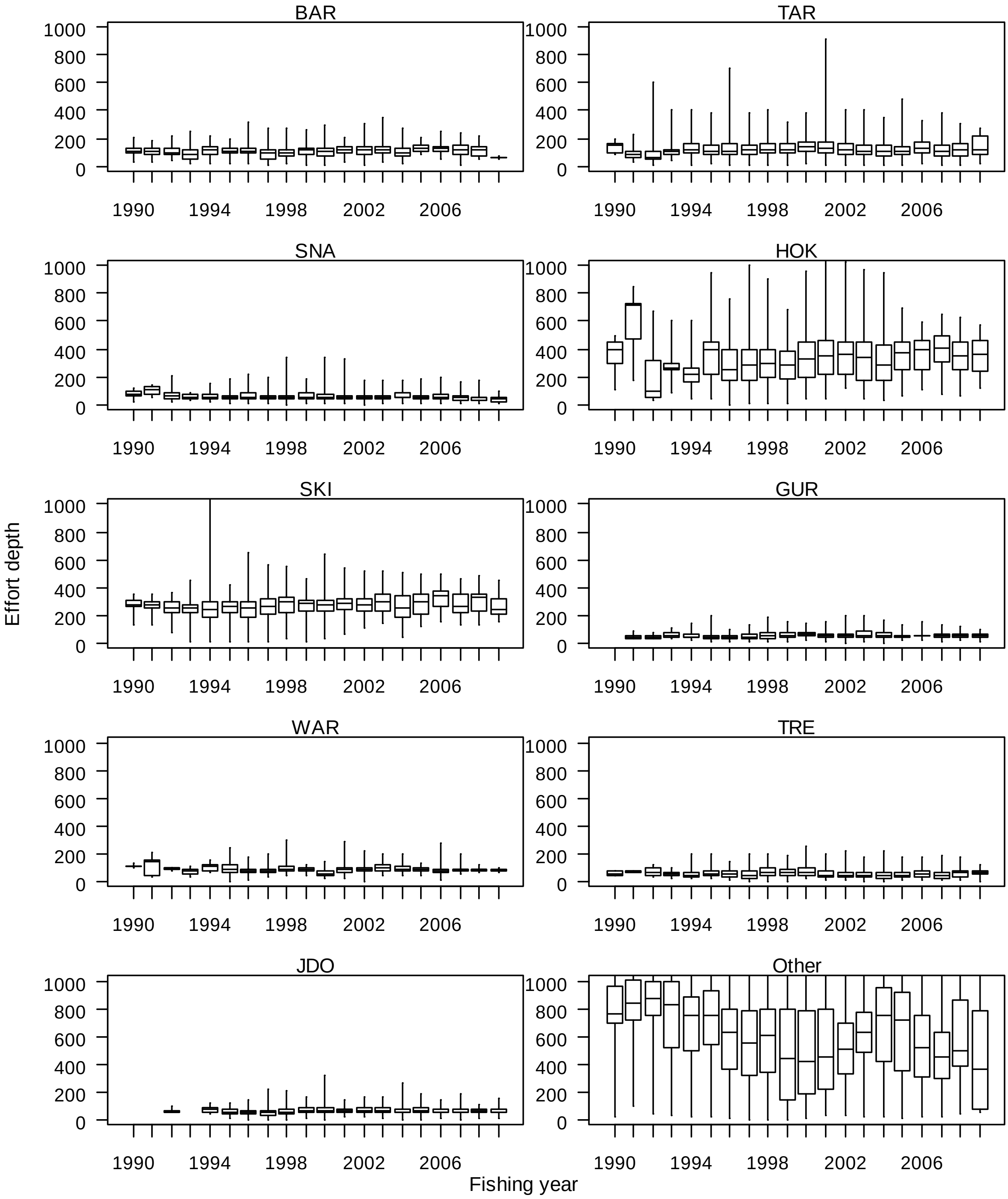


Figure C34a: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) of depths (m) fished by bottom trawl tows for major target species catching barracouta in the ECNI region.

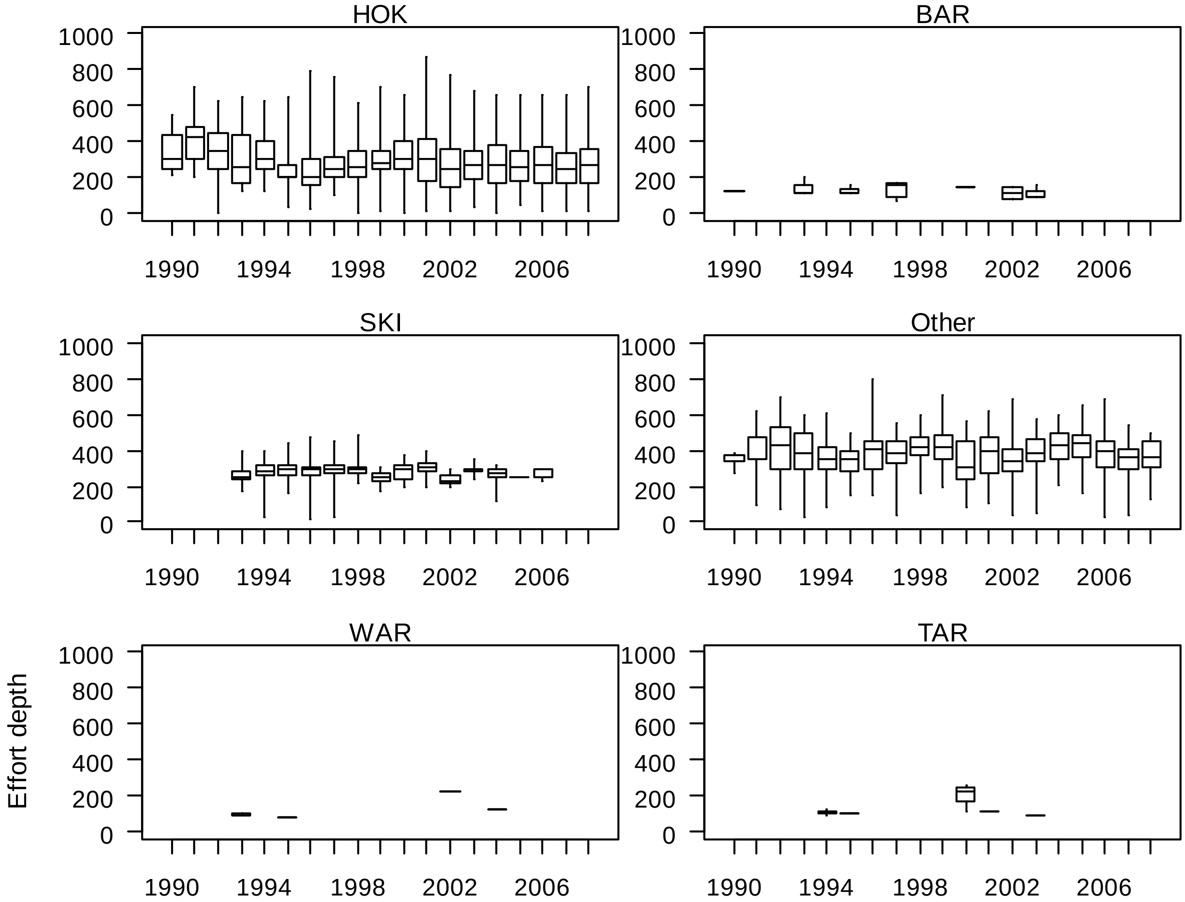


Figure C34b: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) of depths (m) fished by midwater tows for major target species catching barracouta in the ECNI region.

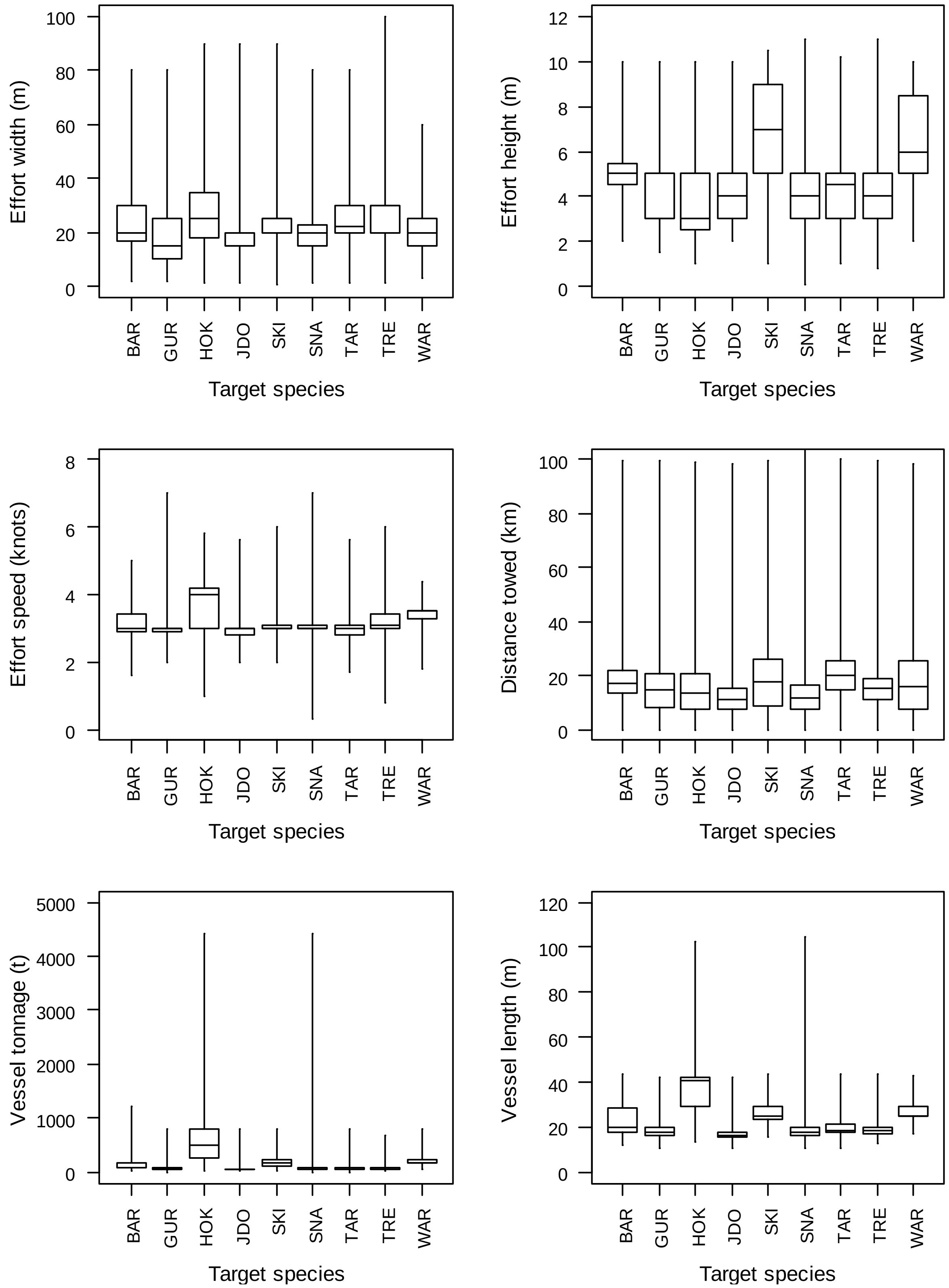


Figure C35: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) of fishing effort variables and vessel characteristics for bottom trawl tows for major target species catching barracouta in the ECNI region.

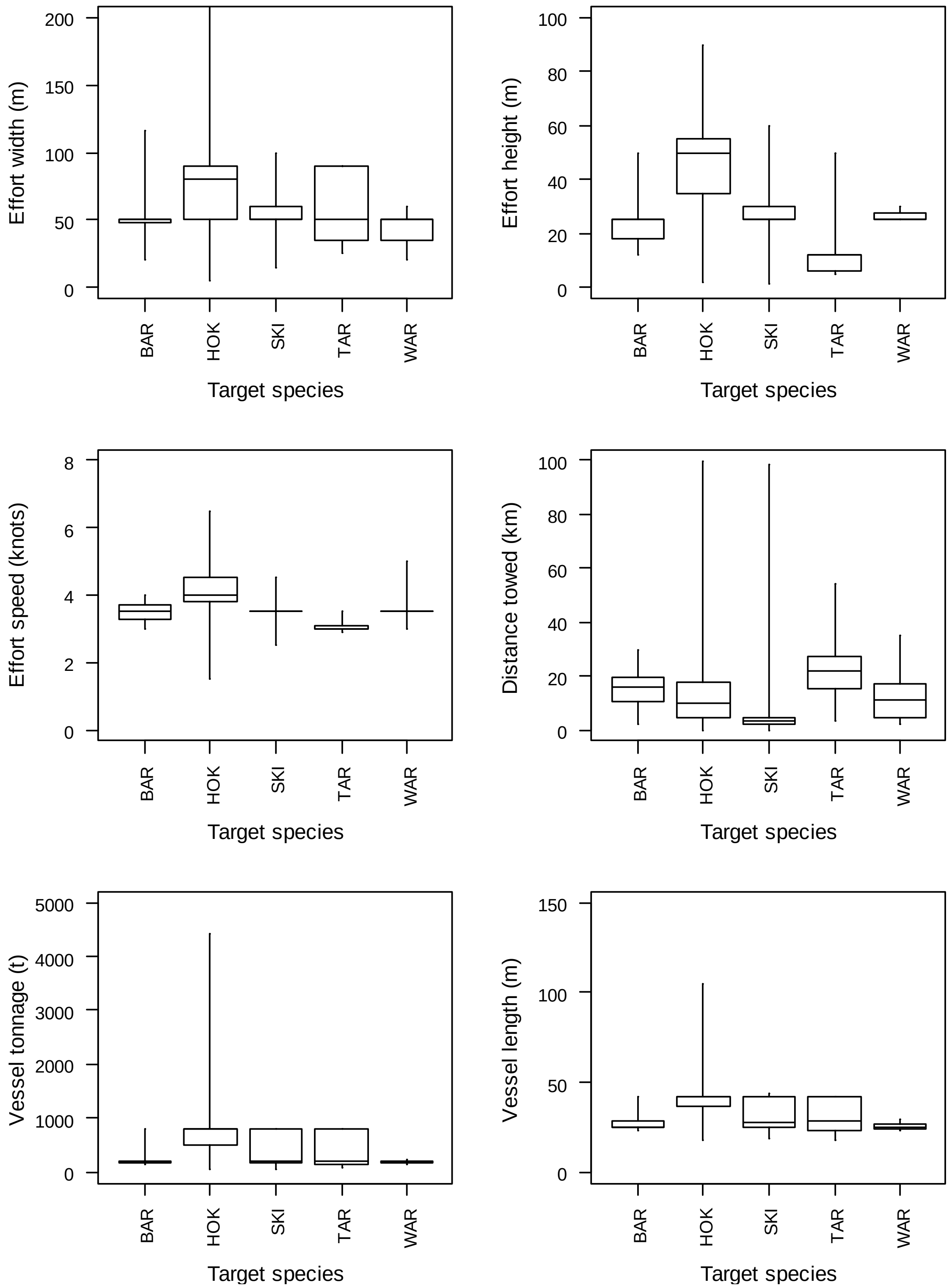


Figure C36: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) of fishing effort variables and vessel characteristics for midwater trawl tows for major target species catching barracouta in the ECNI region.

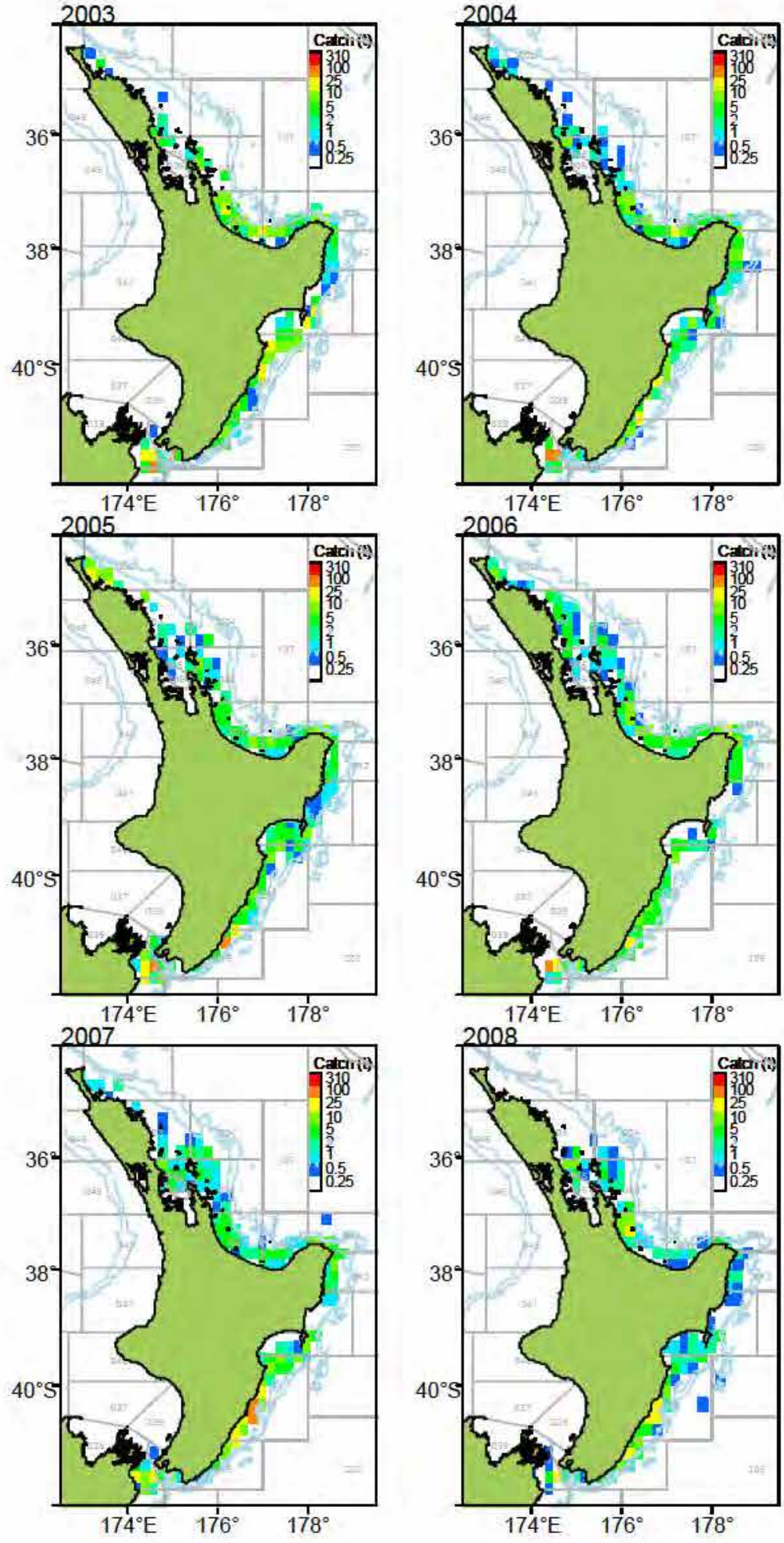


Figure C37a: Distribution of barracouta catch within the ECNI region aggregated into 0.2 degree spatial blocks for fishing years 2003–2008 reported on TCEPR forms and using midwater and bottom trawl gear.

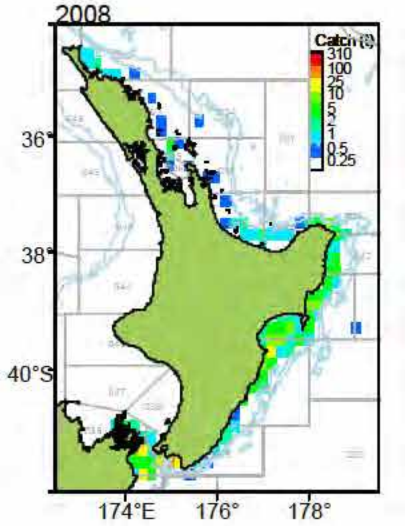


Figure C37b: Distribution of barracouta catch within the ECNI region aggregated into 0.2 degree spatial blocks for the fishing year 2008 reported on TCER forms and using midwater and bottom trawl gear.

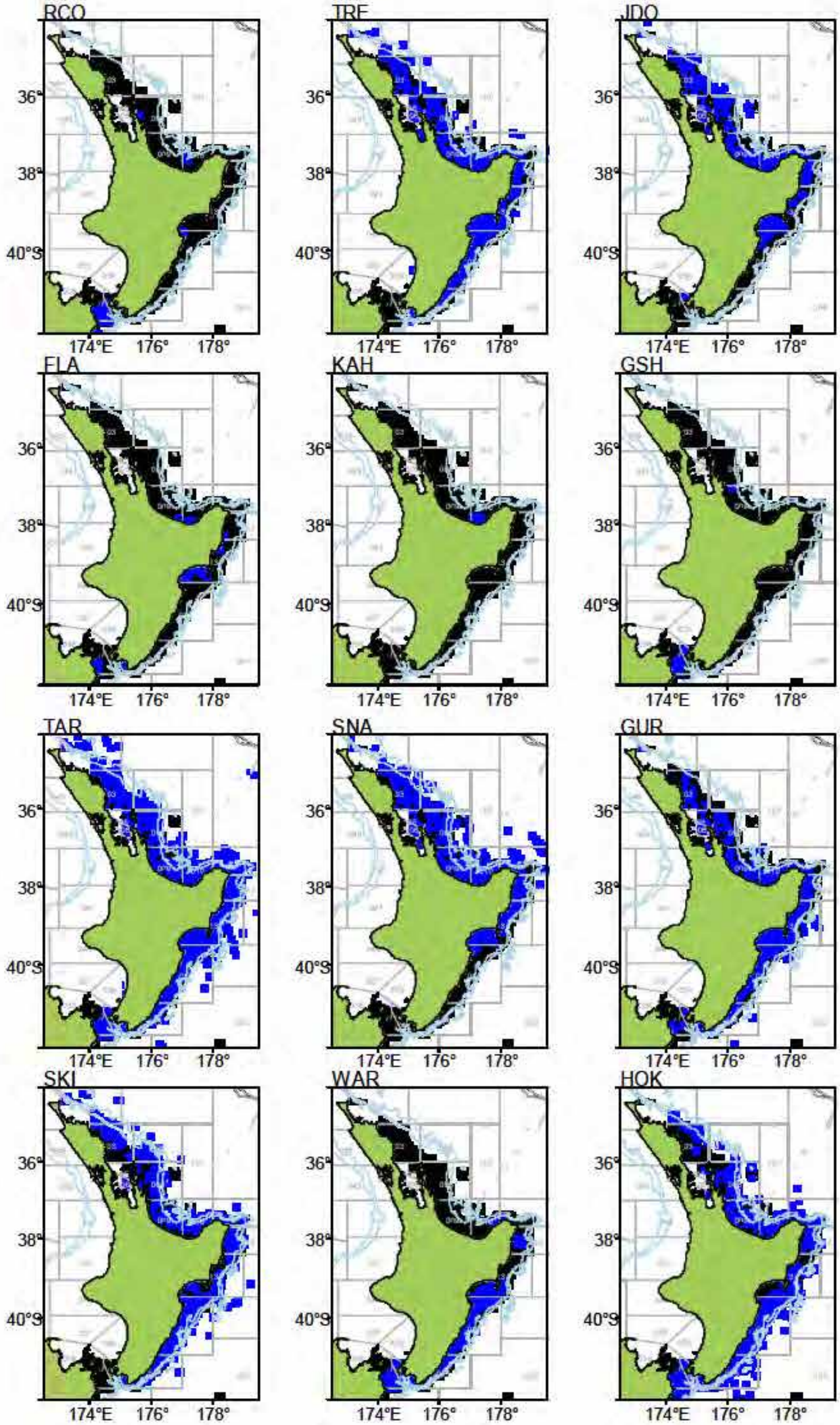


Figure C38: Comparison of the distribution of bottom and midwater trawls in the ECNI region by target species for the main target species (blue cells) overlaid on the distribution of barracouta target effort distribution (black cells), for all years combined.

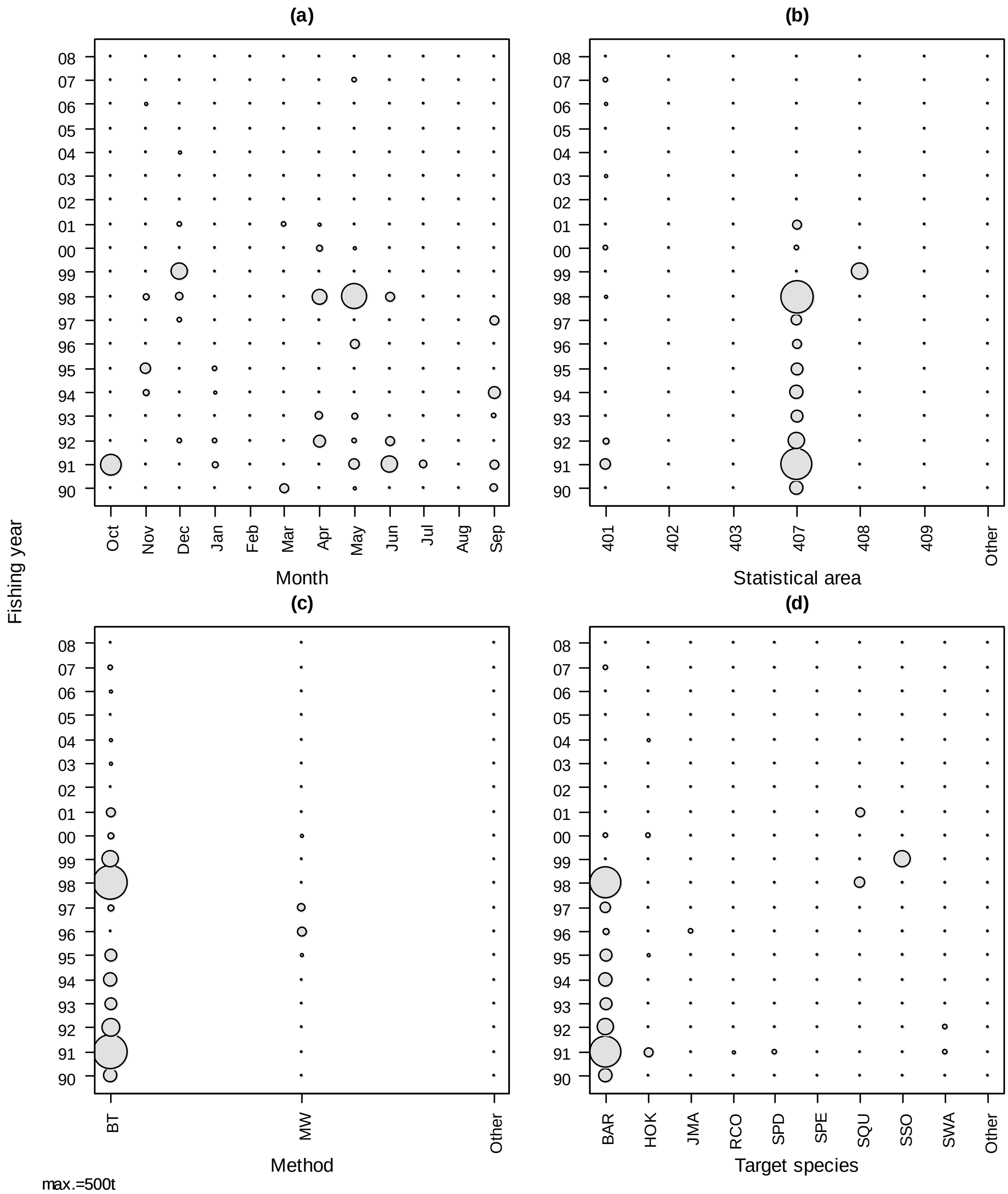


Figure C39: Distribution of barracouta catch in the WEST CHATHAM RISE region for the 1990–2008 fishing years in relation to a) month, b) statistical area, c) fishing method, and d) target species. Circle size is proportional to catch; maximum circle size is indicated in lower left hand corner.

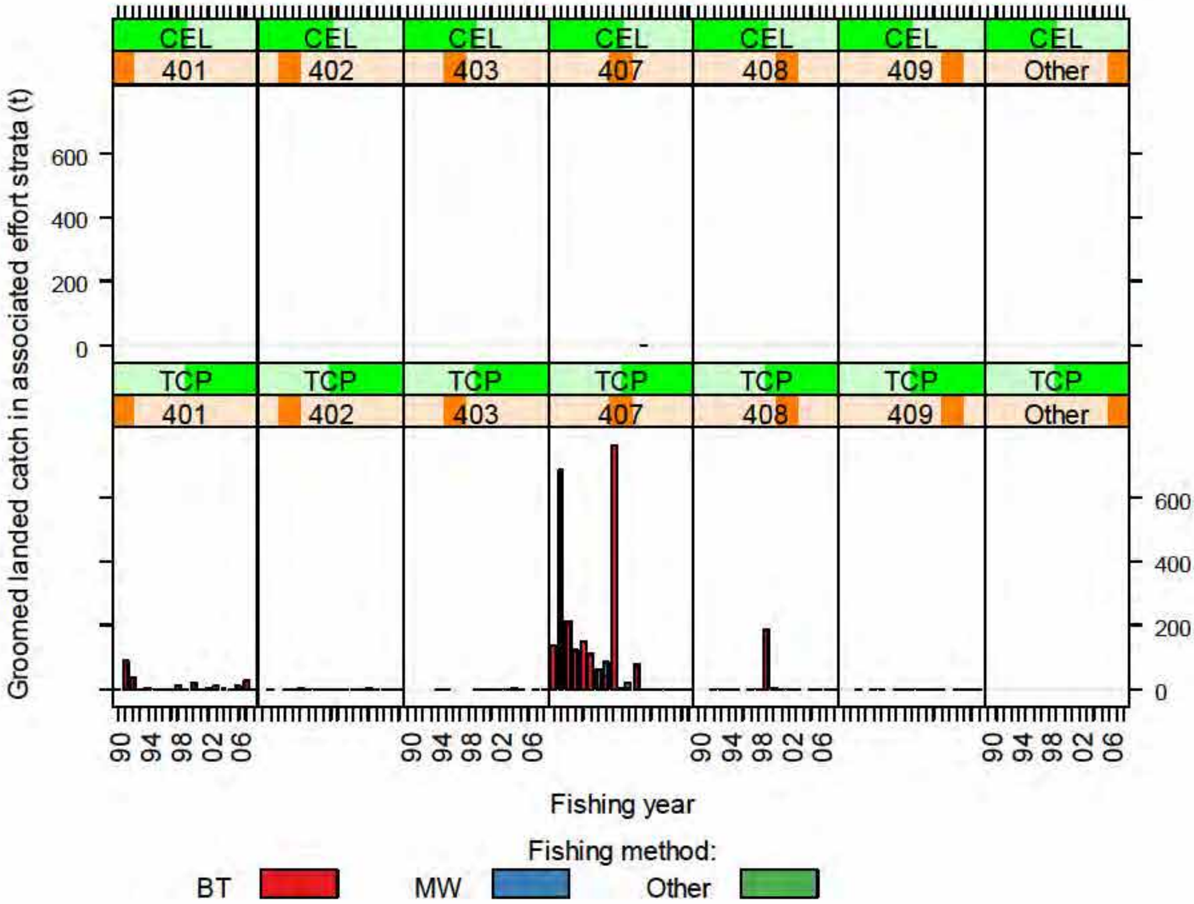


Figure C40a: Distribution of barracouta catch in the WEST CHATHAM RISE region in relation to form type (CEL, CELR; TCP, TCEPR) and statistical area by fishing method (bottom trawl (BT), midwater trawl (MW)) for fishing years 1990–2008.

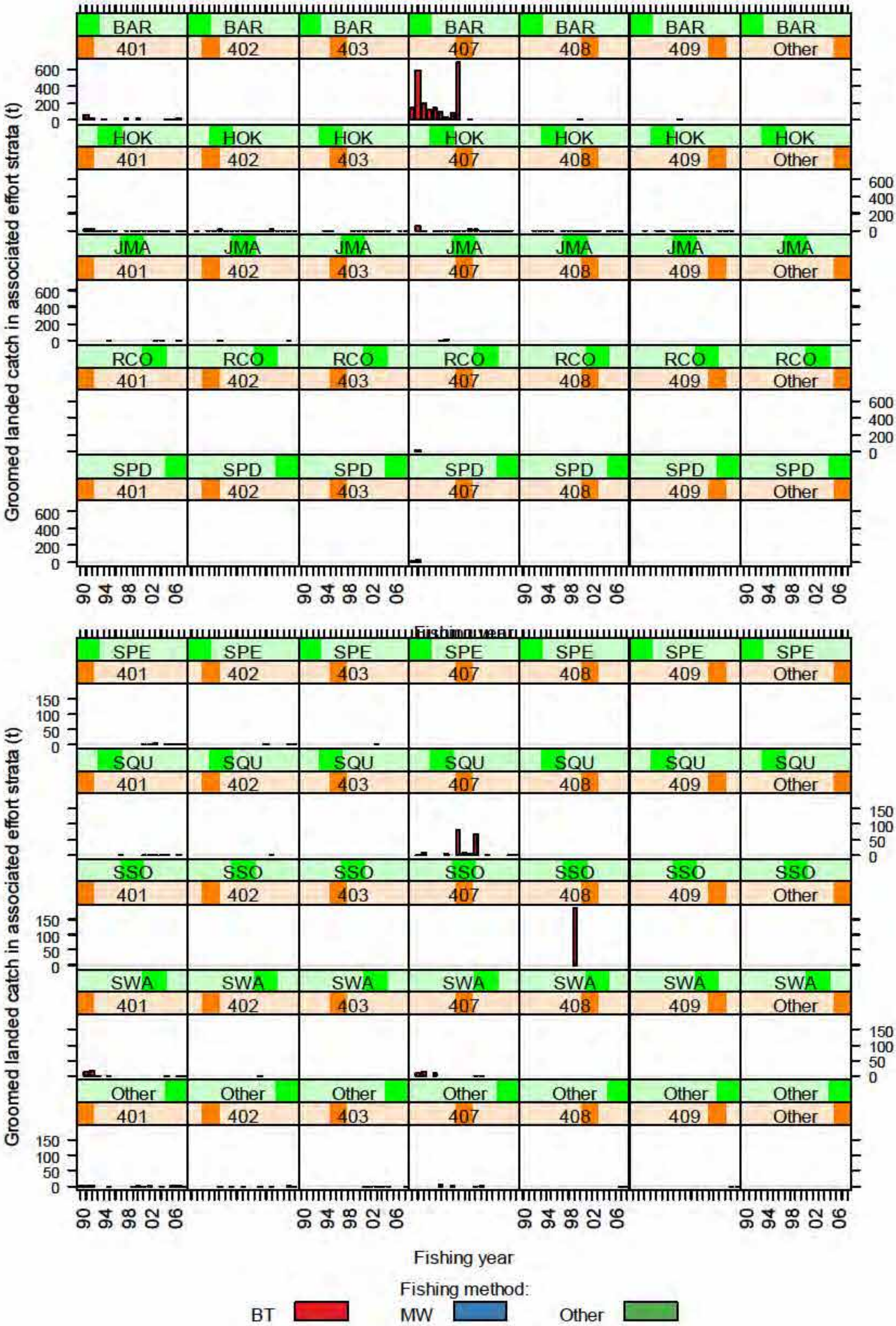


Figure C40b: Distribution of barracouta catch in the WEST CHATHAM RISE region in relation to target species and fishing method (bottom (BT), midwater (MW)) for fishing years 1990–2008.

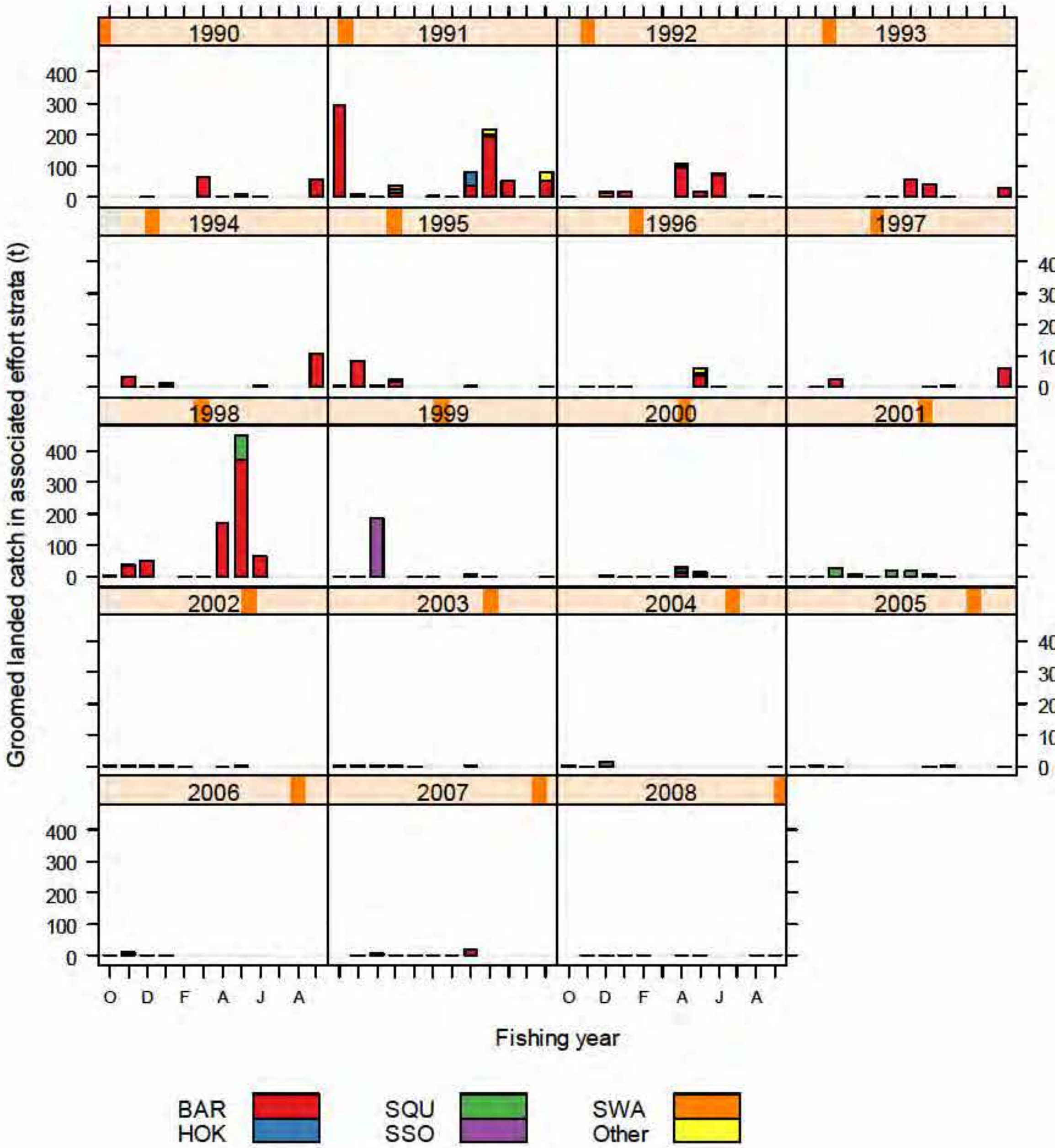


Figure C40c: Distribution of barracouta catch taken by bottom and midwater trawl in the WEST CHATHAM RISE region in relation to target species by month for fishing years 1990–2008.

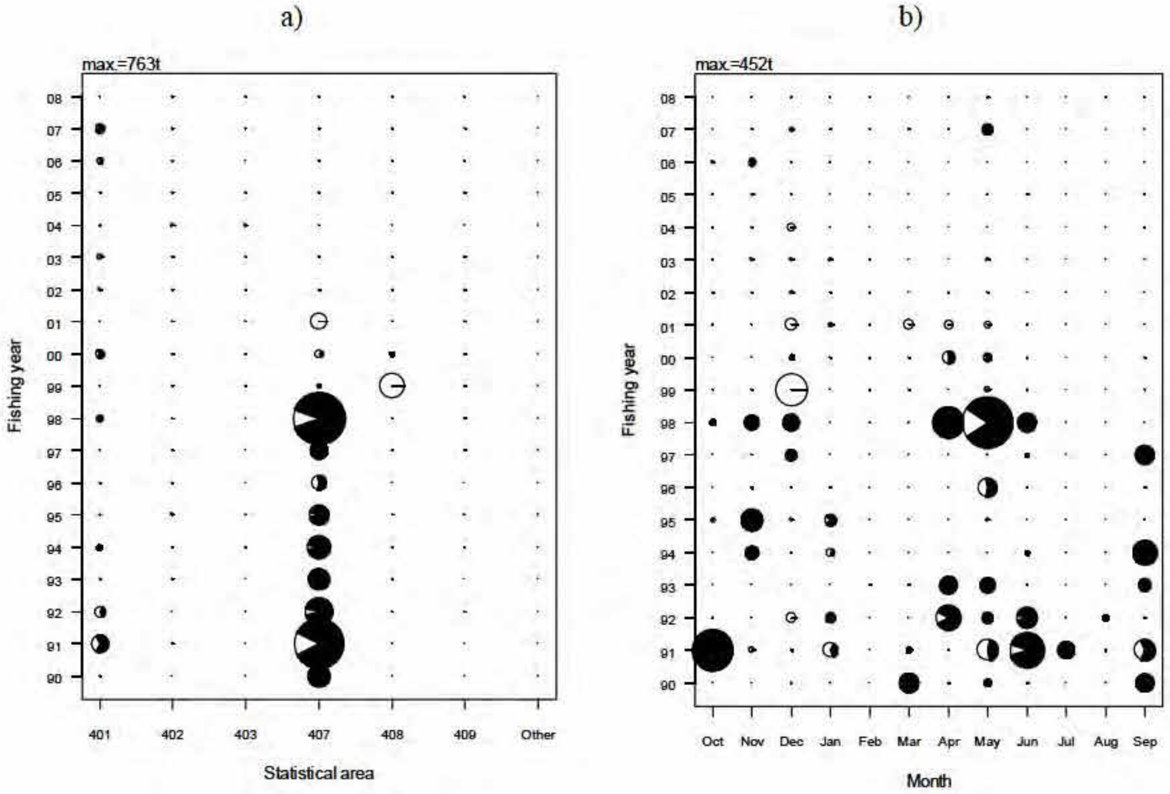


Figure C41: Distribution of barracouta catch taken by midwater and bottom trawl gear by fishing year with circle size proportional to the total catch and black portion of the pie indicating proportion of the catch as targeted barracouta by a) statistical area and b) month for the WEST CHATHAM RISE region.

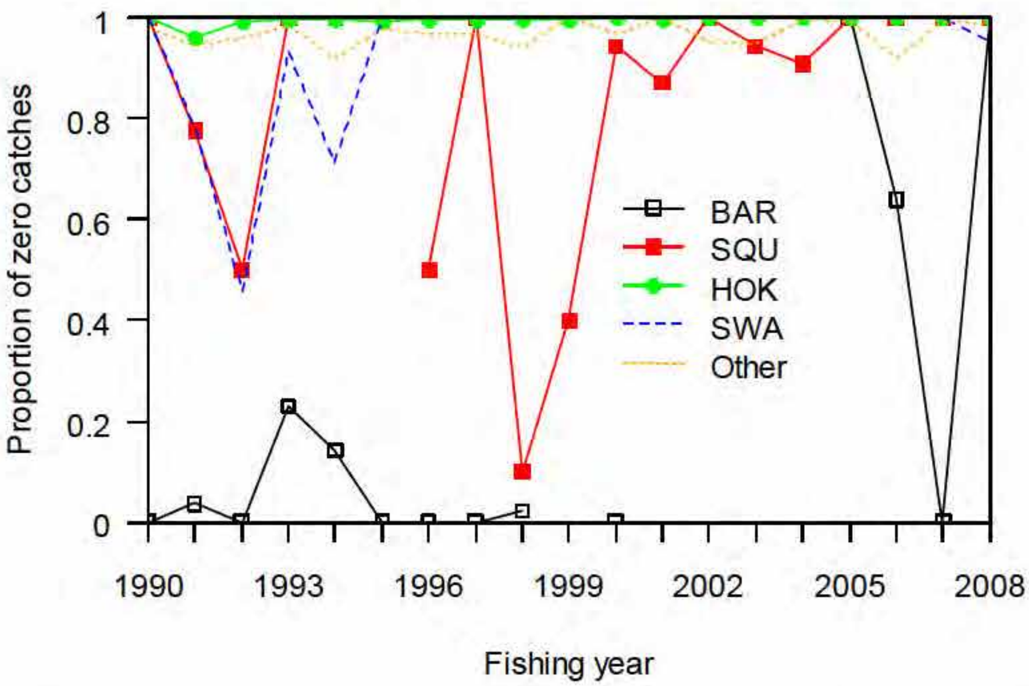


Figure C42: Proportion of TCEPR tows with zero reported barracouta catch for major target species for the WEST CHATHAM RISE region taken by midwater and bottom trawl gear.

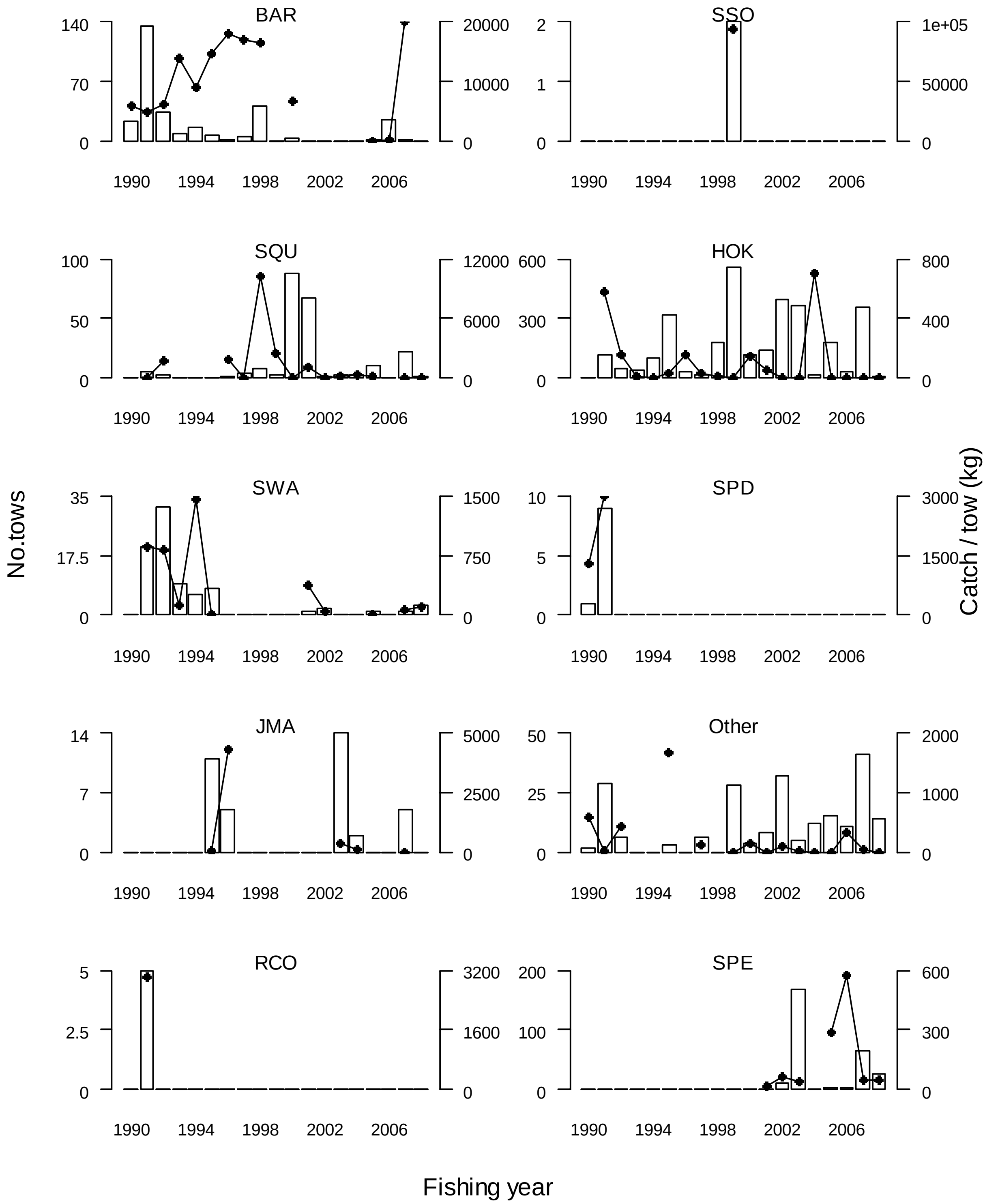


Figure C43: The number of tows (bars) that caught barracouta in the WEST CHATHAM RISE region by midwater and bottom trawl gear and annual catch rate (lines) of barracouta by major target species.

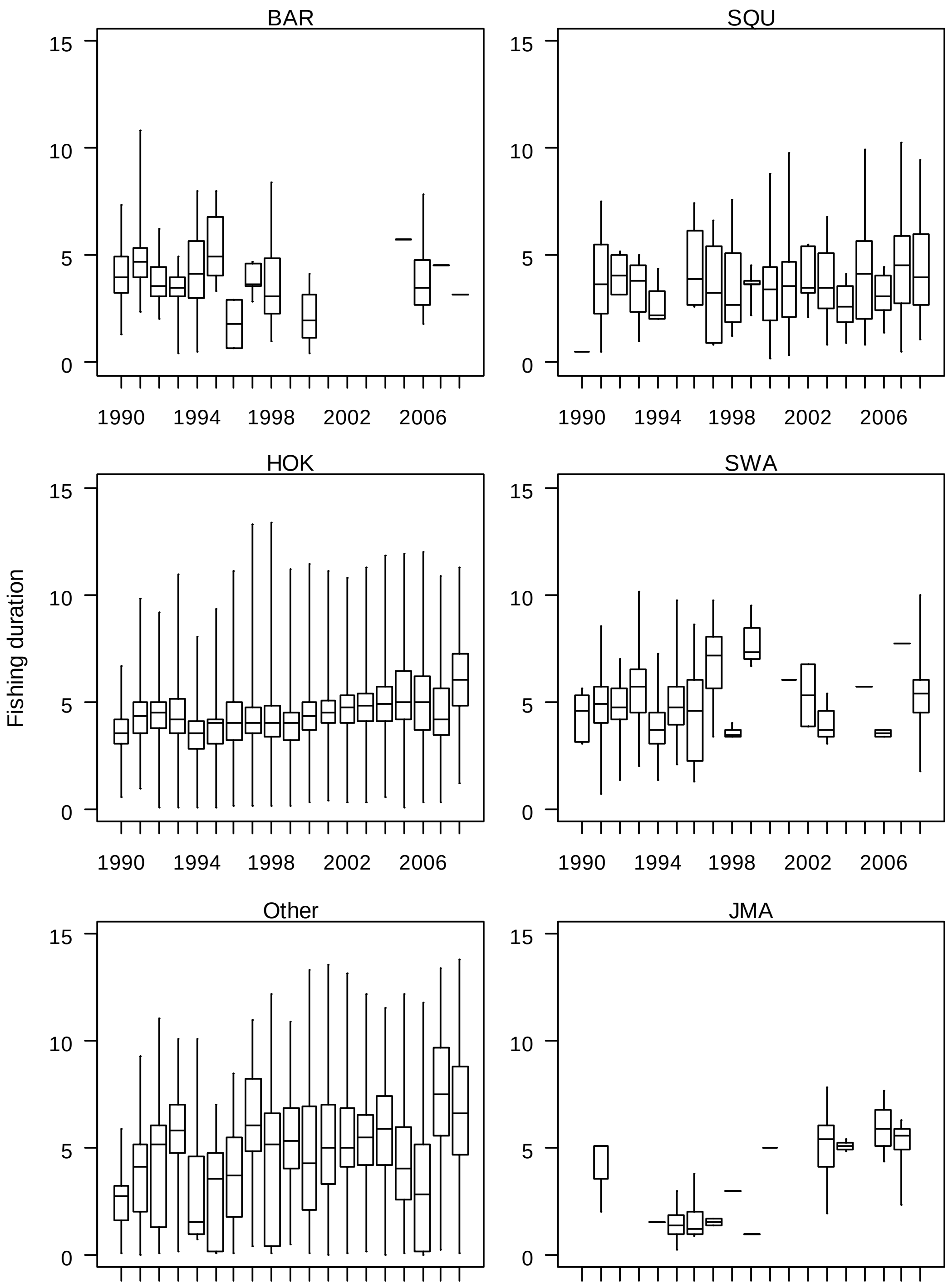


Figure C44: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) of midwater and bottom trawl tow durations (hours) reported for major target species catching barracouta in the WEST CHATHAM RISE region.

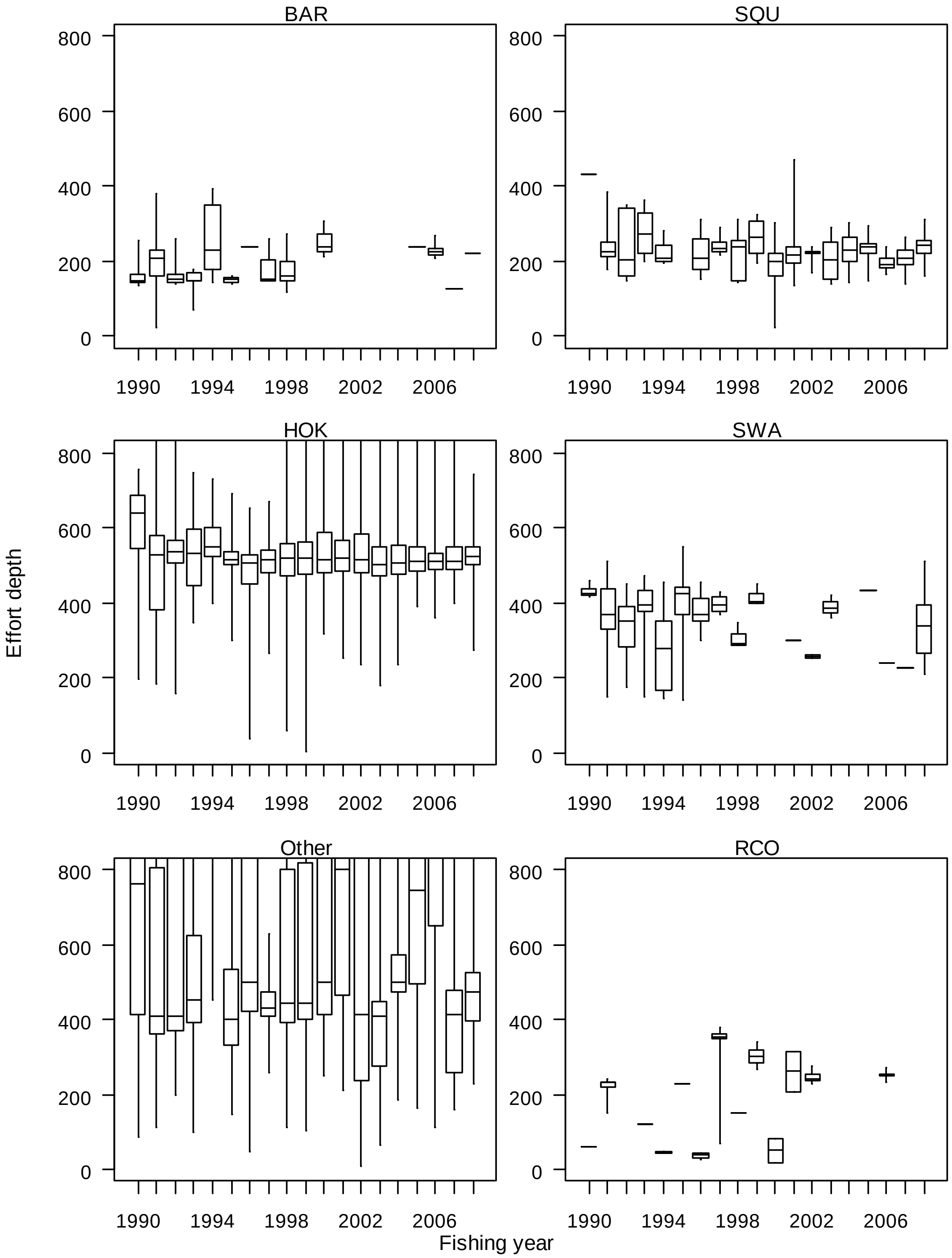


Figure C45a: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) of depths (m) fished by bottom trawl tows for major target species catching barracouta in the WEST CHATHAM RISE region.

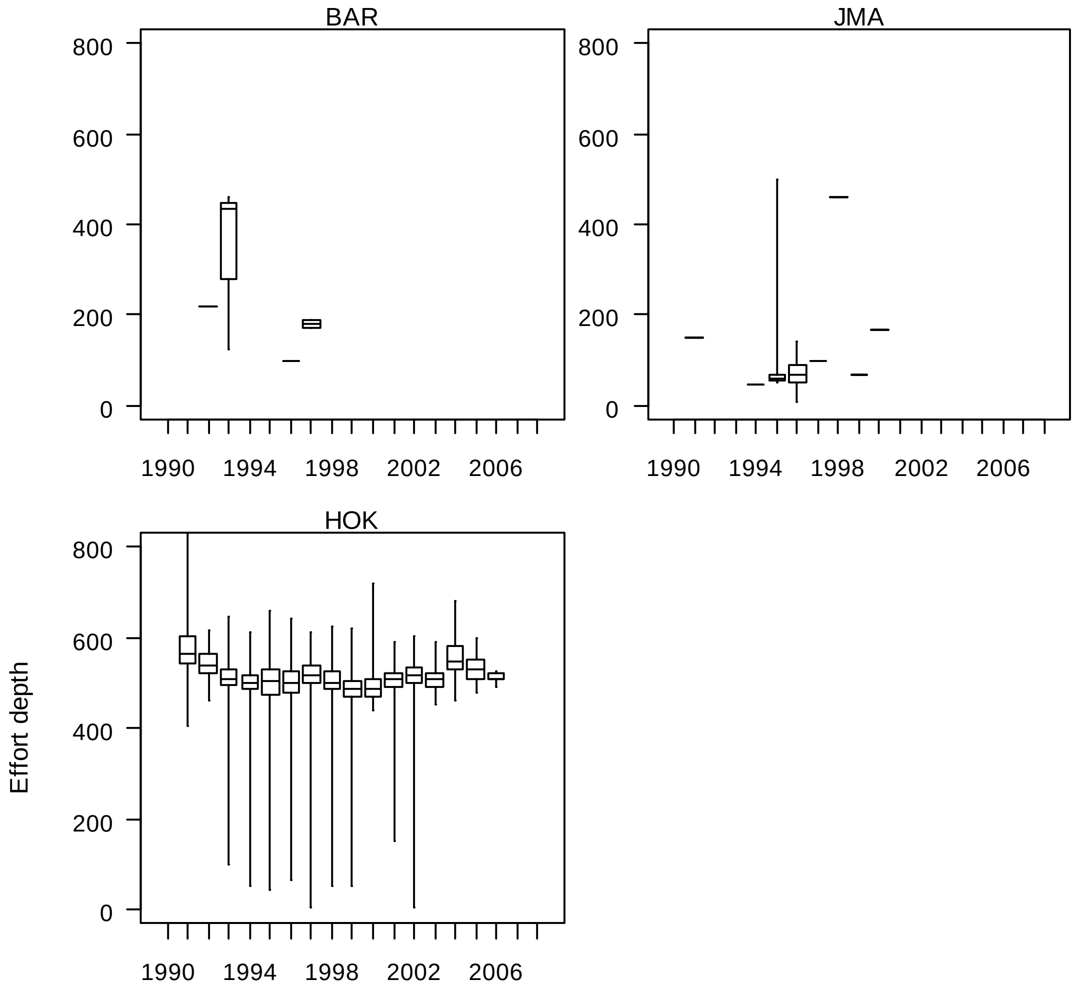


Figure C45b: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) of depths (m) fished by midwater tows for major target species catching barracouta in the WEST CHATHAM RISE region.

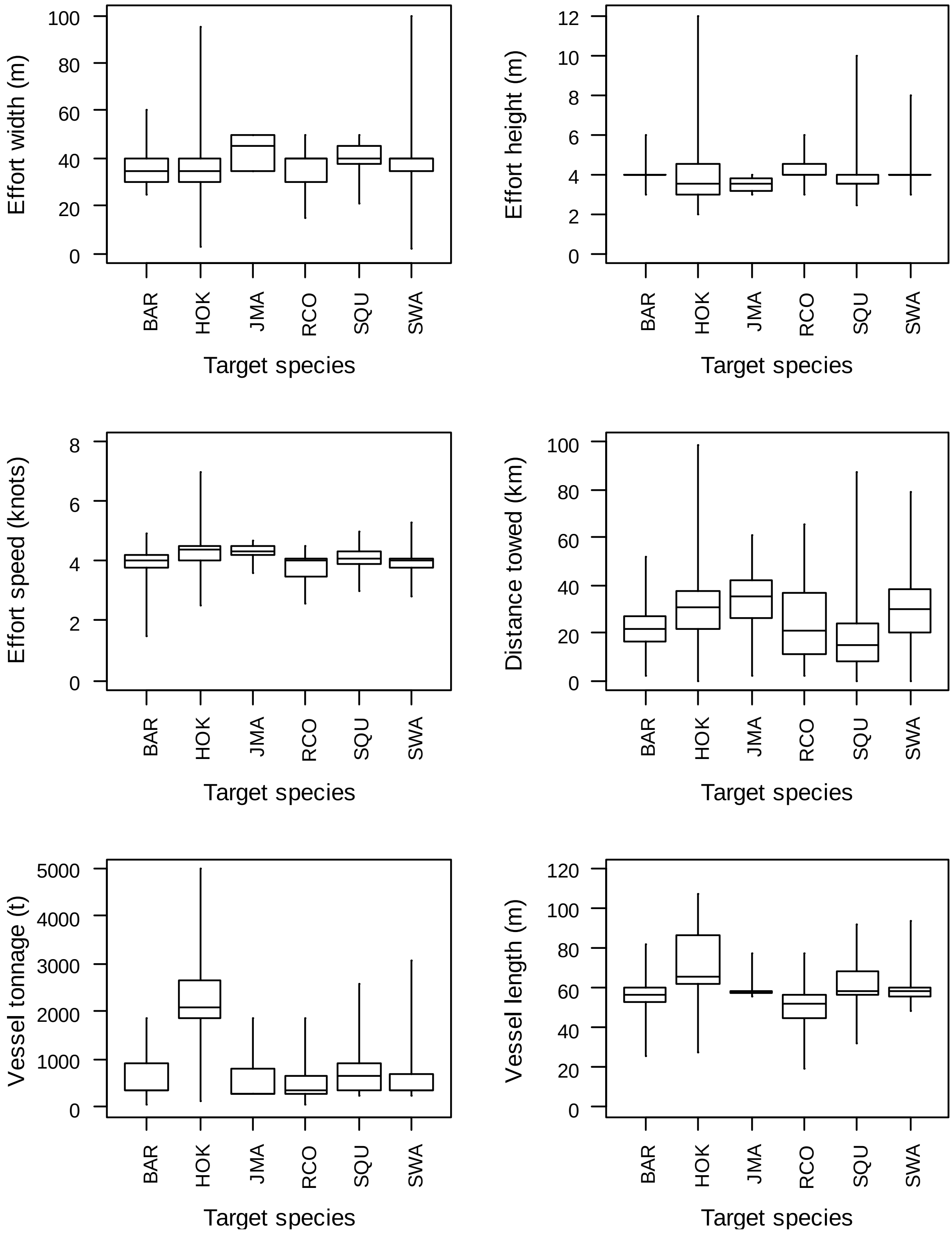


Figure C46: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) of fishing effort variables and vessel characteristics for bottom trawl tows for major target species catching barracouta in the WEST CHATHAM RISE region.

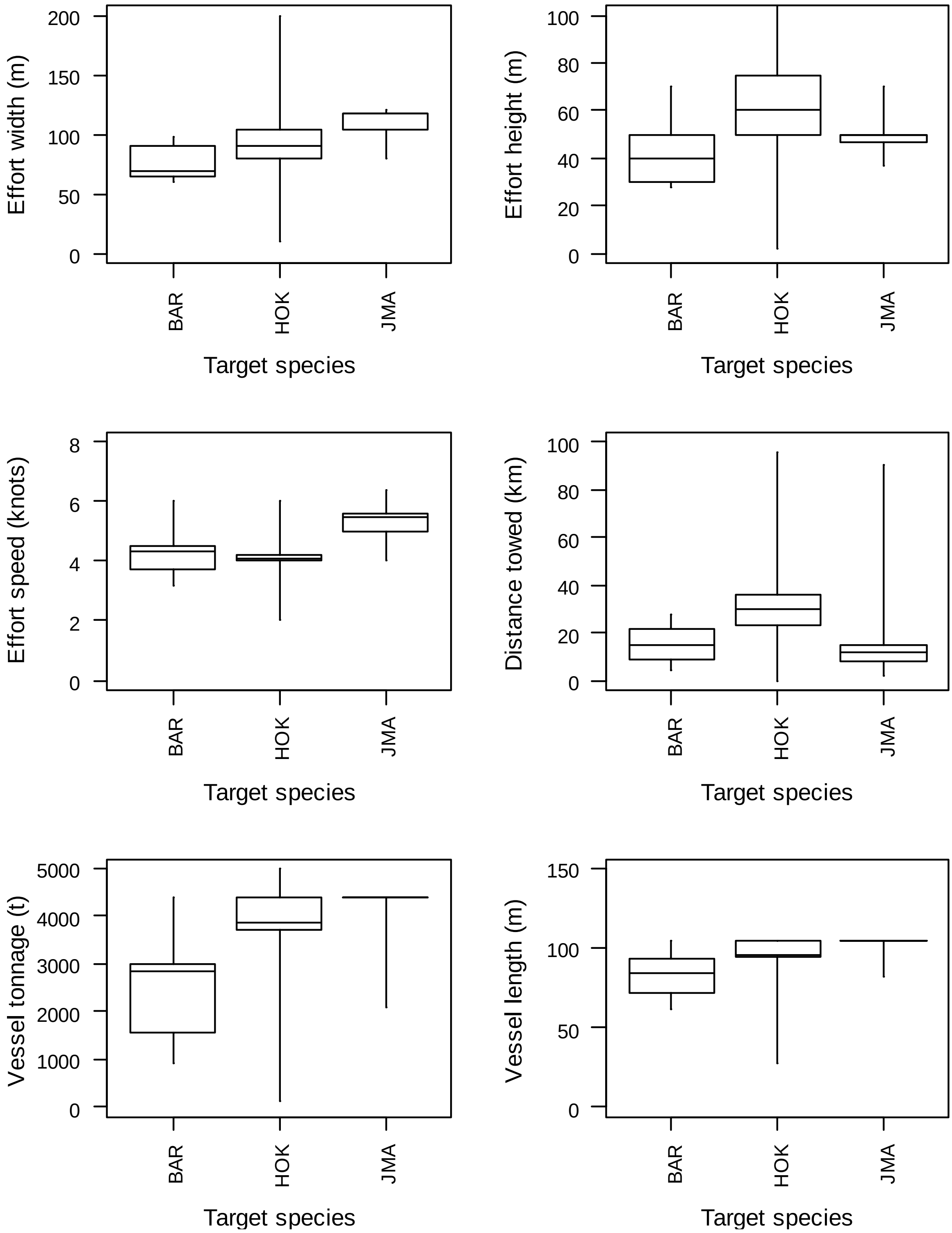


Figure C47: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) of fishing effort variables and vessel characteristics for midwater trawl tows for major target species catching barracouta in the WEST CHATHAM RISE region.

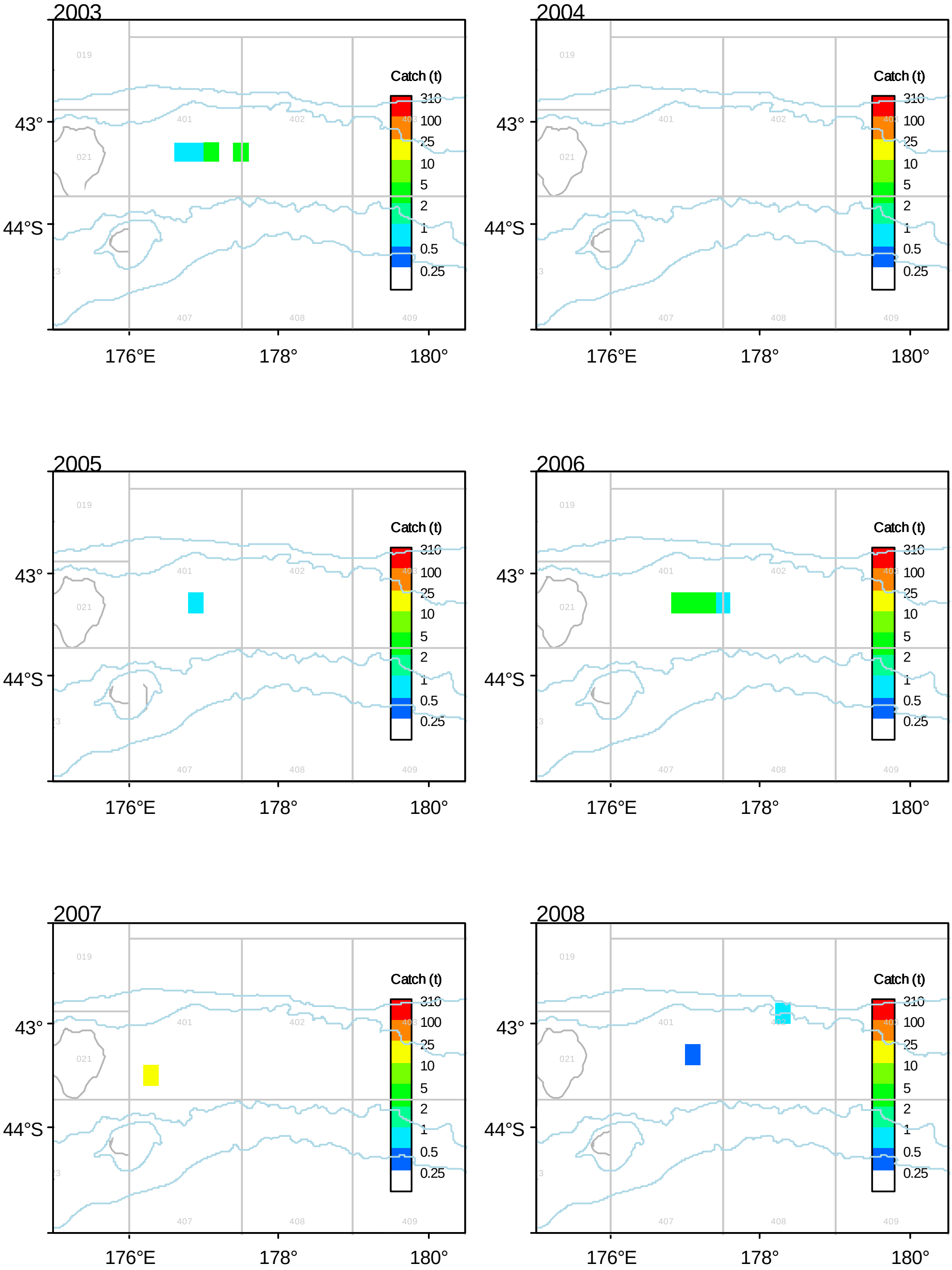


Figure C48: Distribution of barracouta catch within the WEST CHATHAM RISE region aggregated into 0.2 degree spatial blocks for the fishing years 2003–08 reported on TCEPR and using midwater and bottom trawl gear.

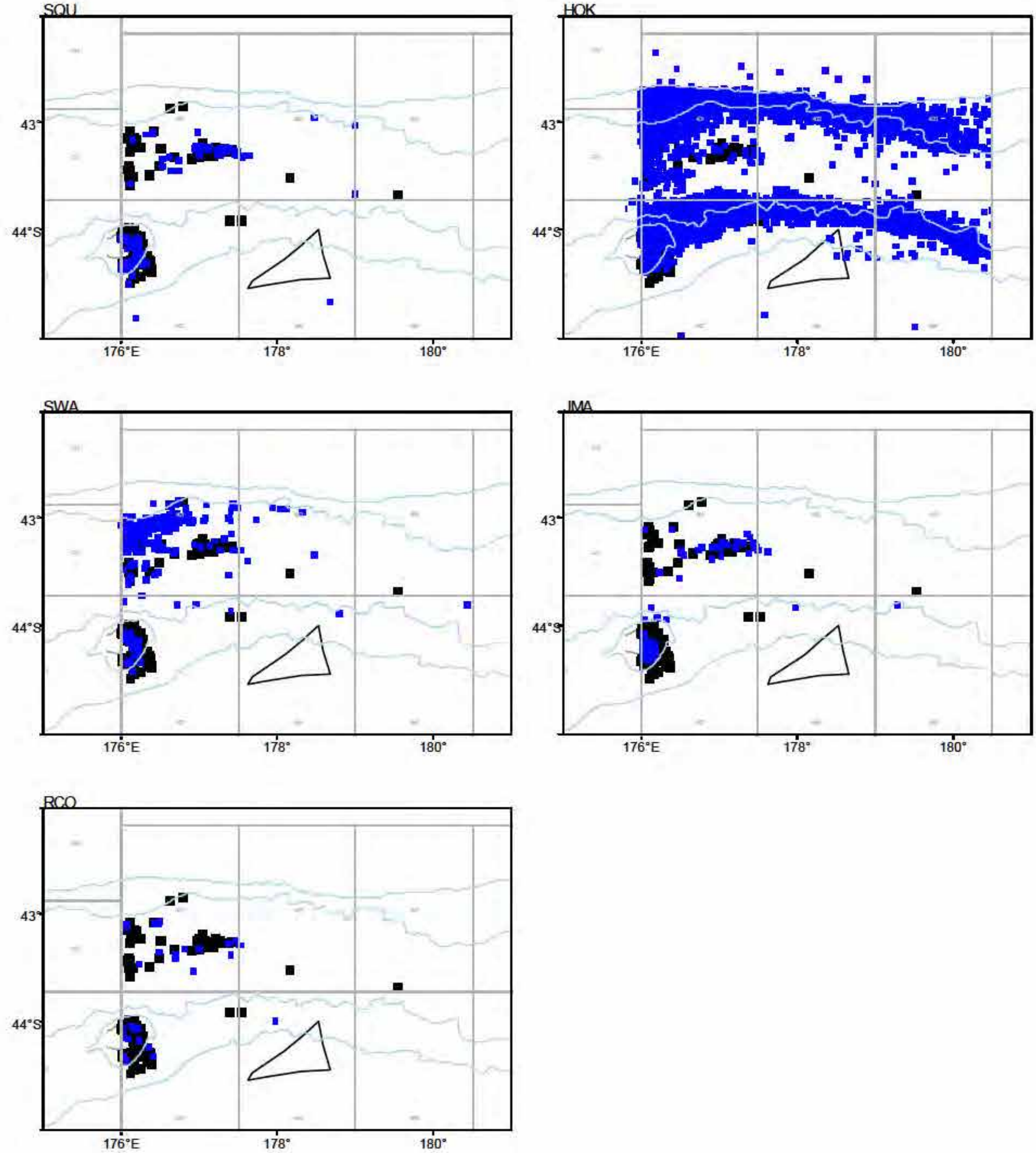


Figure C49: Comparison of the distribution of bottom and midwater trawls in the WEST CHATHAM RISE region by target species for the main target species (blue cells) overlaid on the distribution of barracouta target effort distribution (black cells), for all years combined.

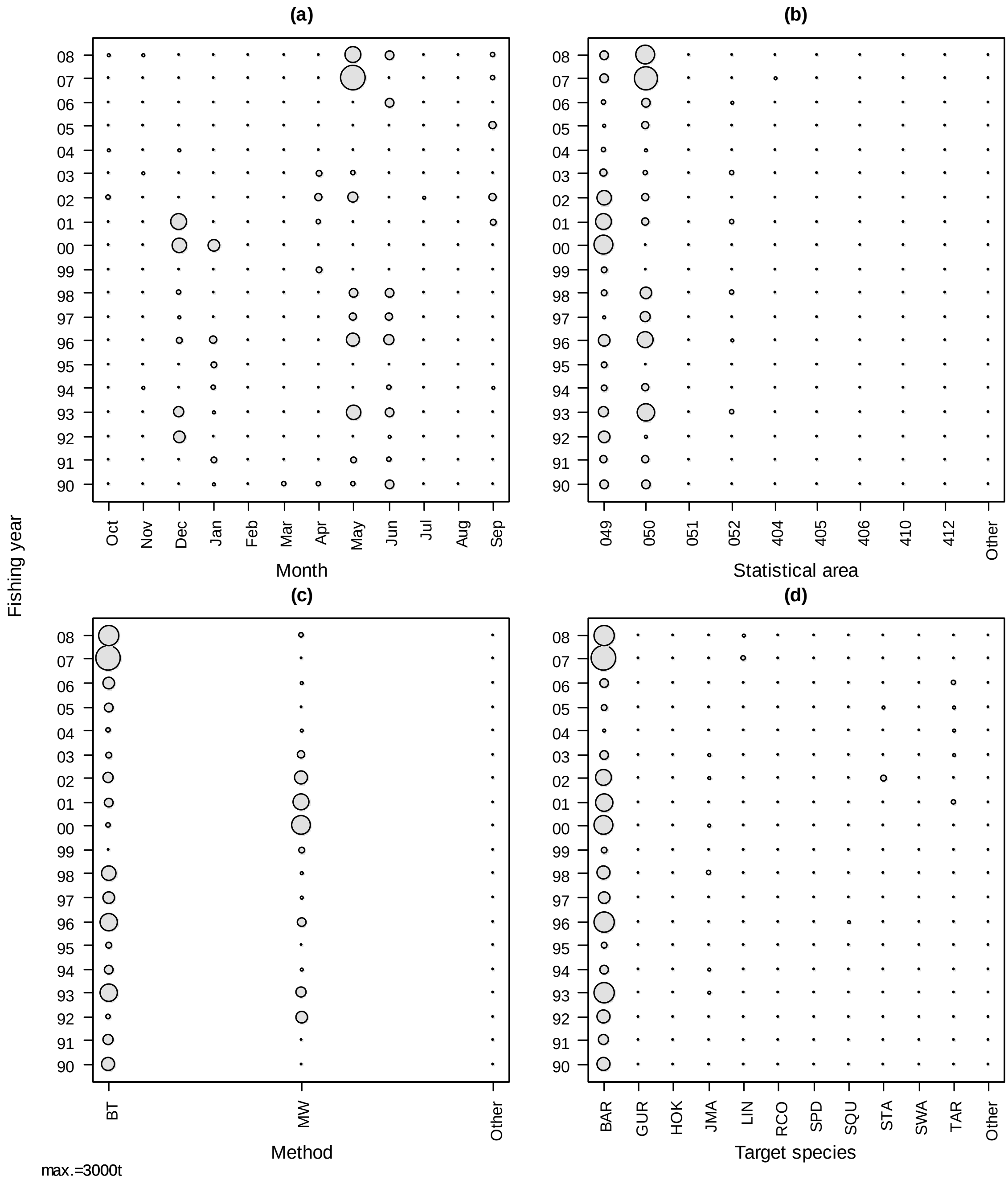


Figure C50: Distribution of barracouta catch in the EAST CHATHAM RISE region for the 1990–2008 fishing years in relation to a) month, b) statistical area, c) fishing method, and d) target species. Circle size is proportional to catch; maximum circle size is indicated in lower left hand corner.

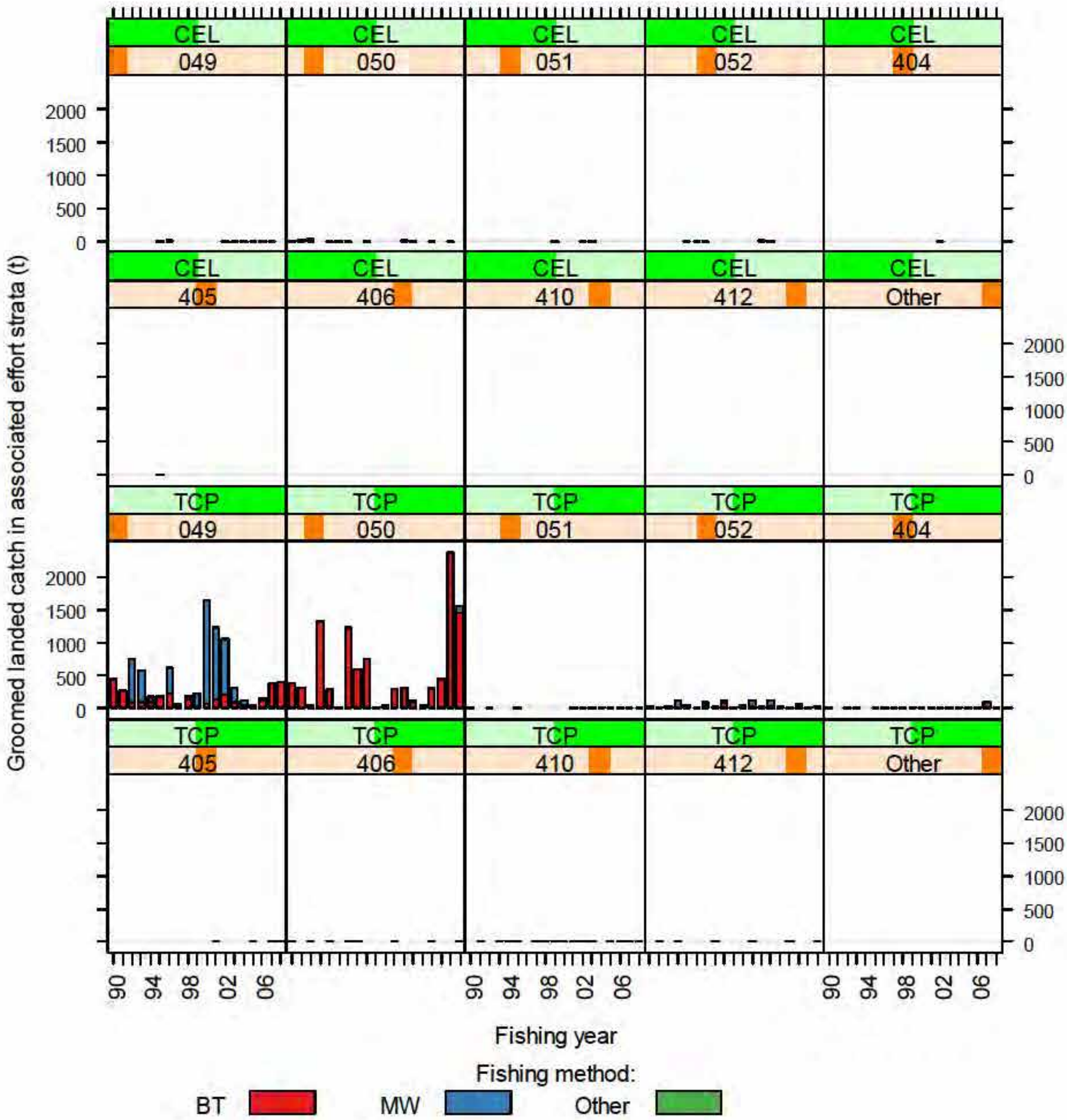


Figure C51a: Distribution of barracouta catch in the EAST CHATHAM RISE region in relation to form type (CEL, CELR; TCP, TCEPR) and statistical area by fishing method (bottom (BT), midwater (MW) trawl) for fishing years 1990–2008.

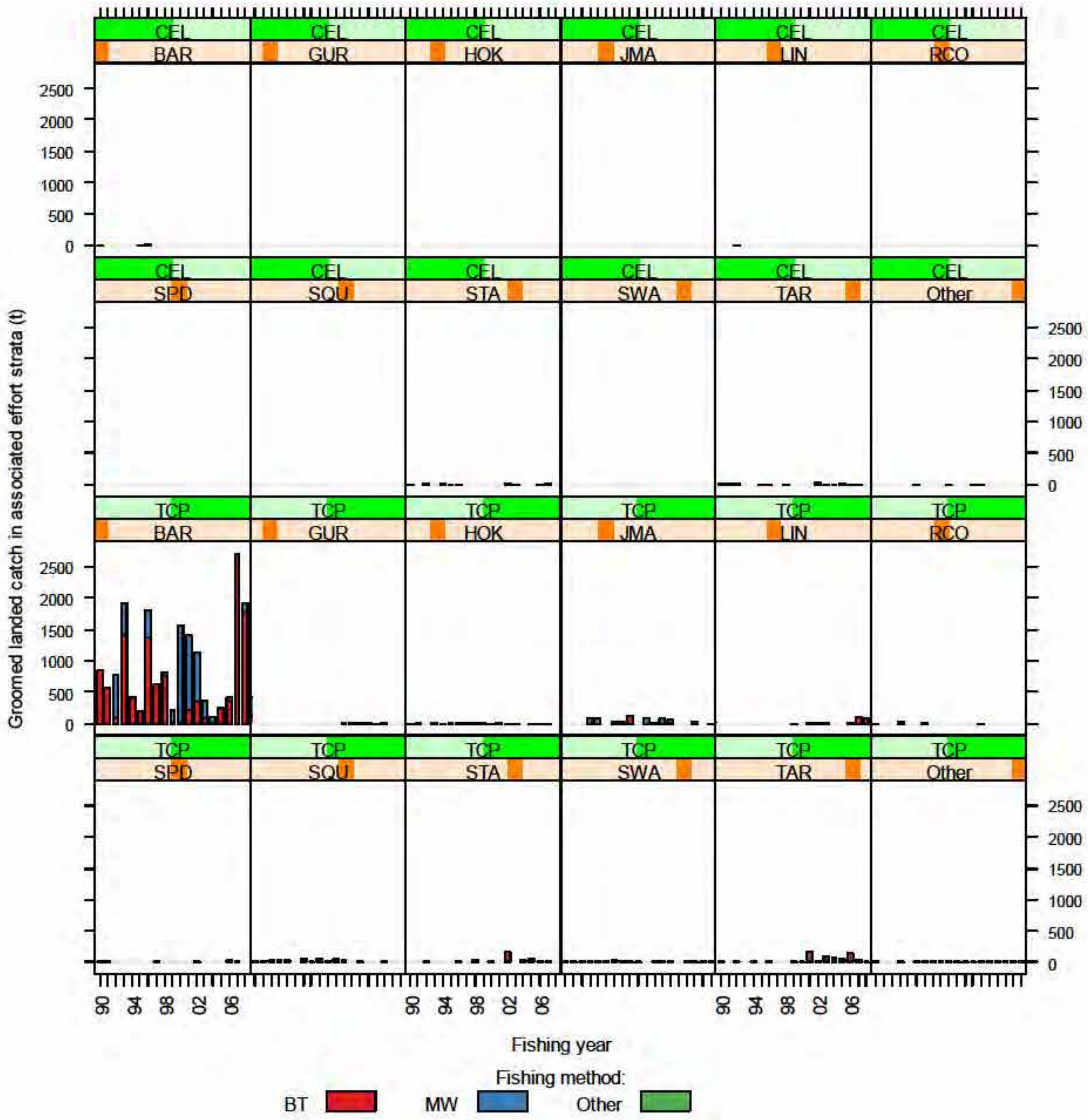


Figure C51b: Distribution of barracouta catch in the EAST CHATHAM RISE region in relation to form type (CEL, CELR; TCP, TCEPR) and target species by fishing method (bottom (BT), midwater (MW) trawl) for fishing years 1990–2008.

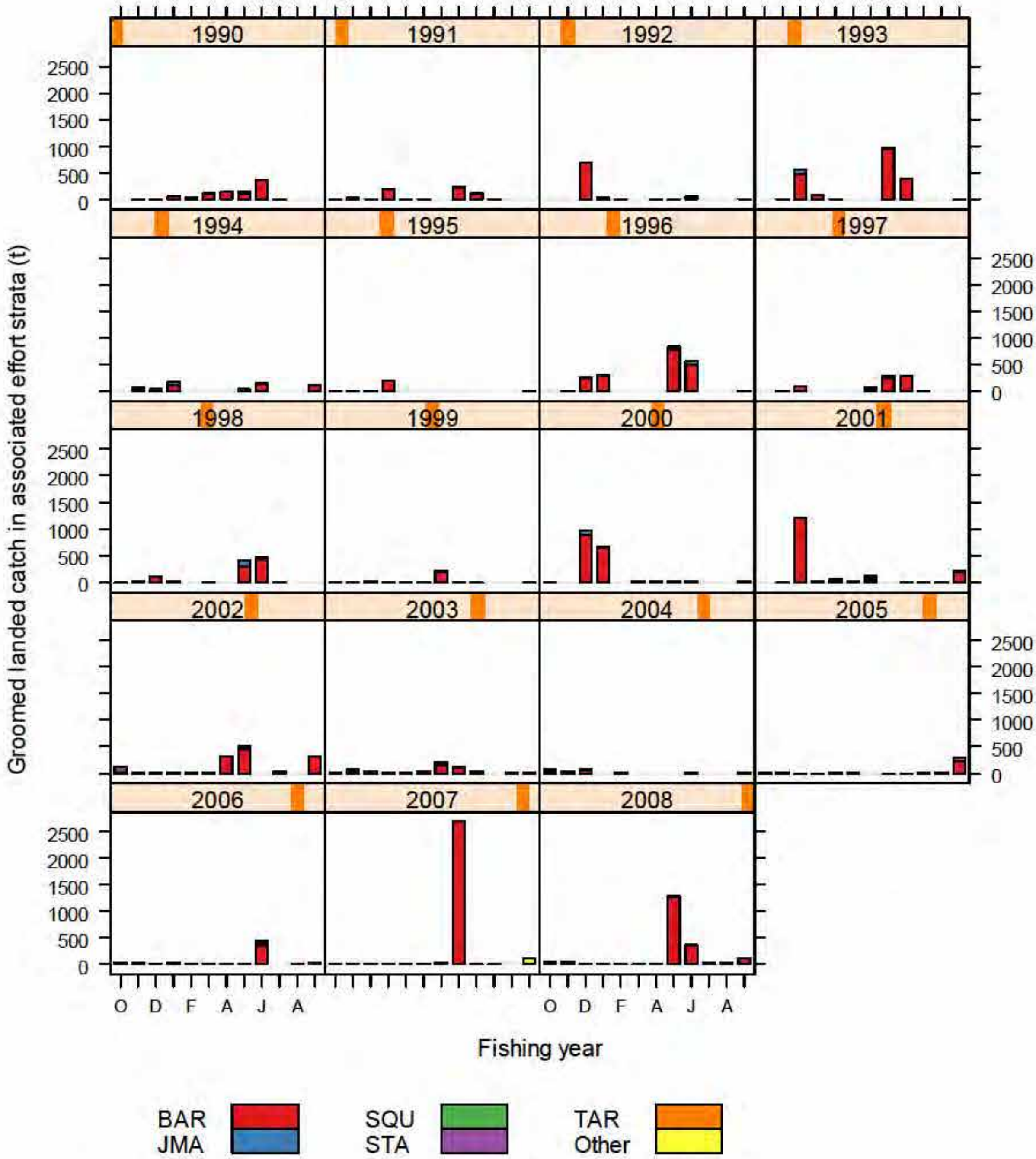


Figure C51c: Distribution of barracouta catch taken by bottom and midwater trawl in the EAST CHATHAM RISE region in relation to target species by month for fishing years 1990–2008.

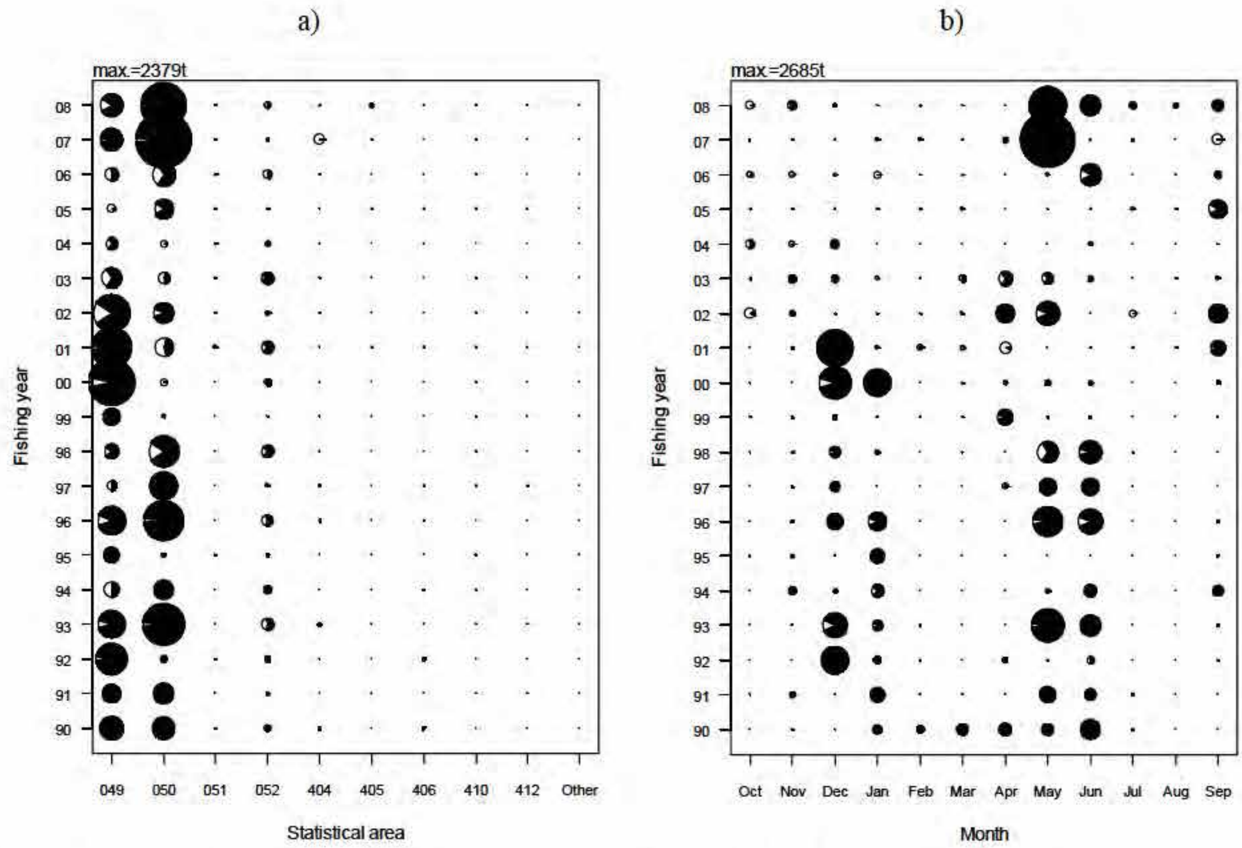


Figure C52: Distribution of barracouta catch taken by midwater and bottom trawl gear by fishing year with circle size proportional to the total catch and black portion of the pie indicating proportion of the catch as targeted barracouta by a) statistical area and b) month for the EAST CHATHAM RISE region.

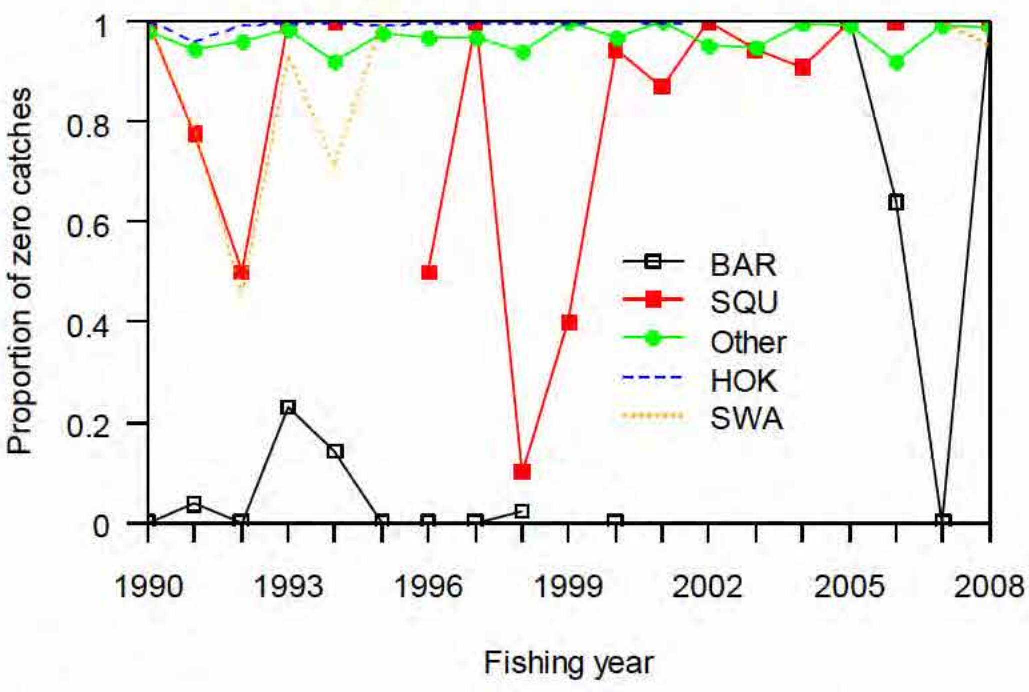


Figure C53: Proportion of TCEPR tows with zero reported barracouta catch for major target species for the EAST CHATHAM RISE region taken by midwater and bottom trawl gear.

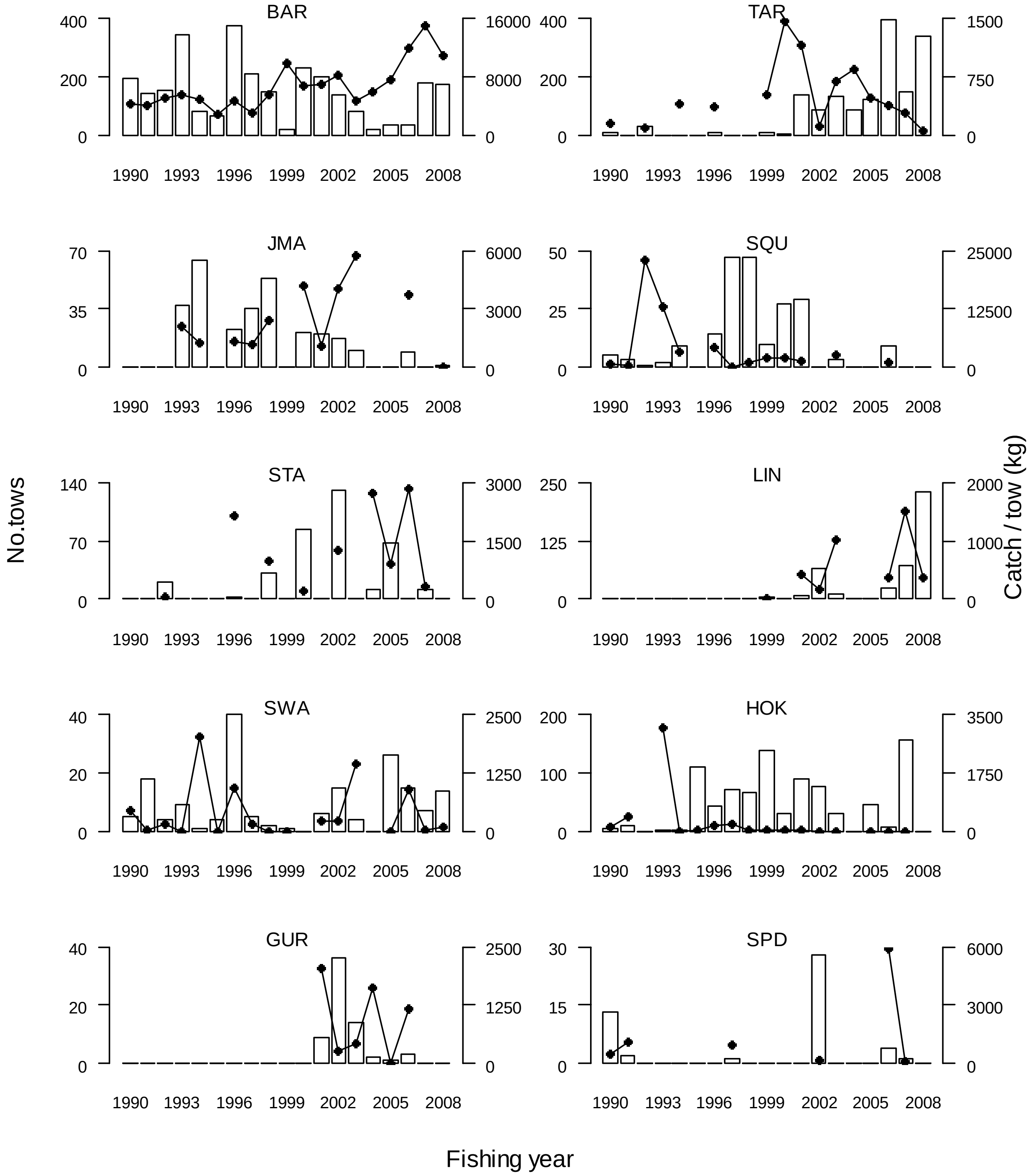


Figure C54: The number of tows (bars) that caught barracouta in the EAST CHATHAM RISE region taken by midwater and bottom trawl gear and the annual catch rate (lines) of barracouta by major target species.

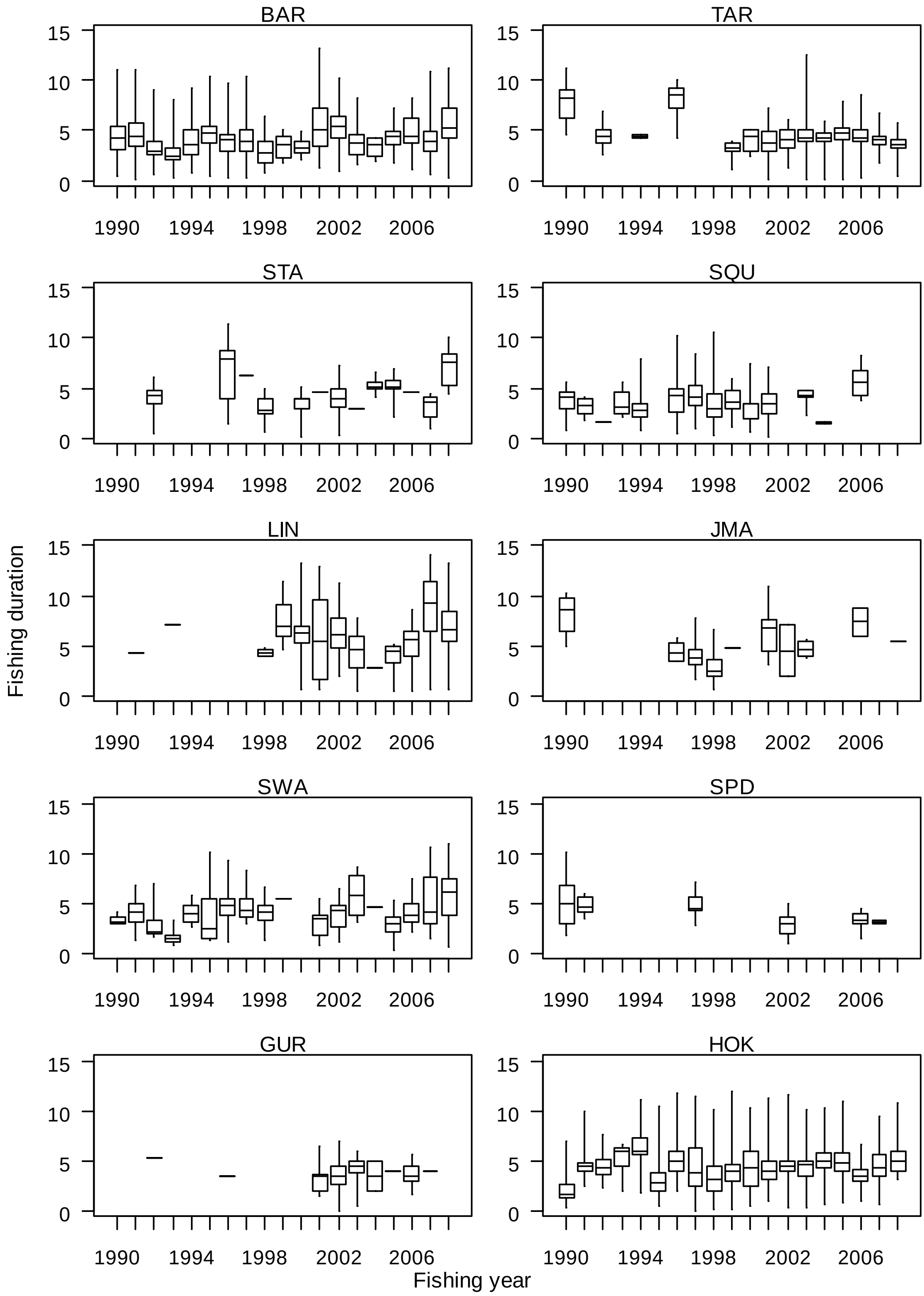


Figure C55: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) of midwater and bottom trawl tow durations (hours) reported for major target species catching barracouta in the EAST CHATHAM RISE region.

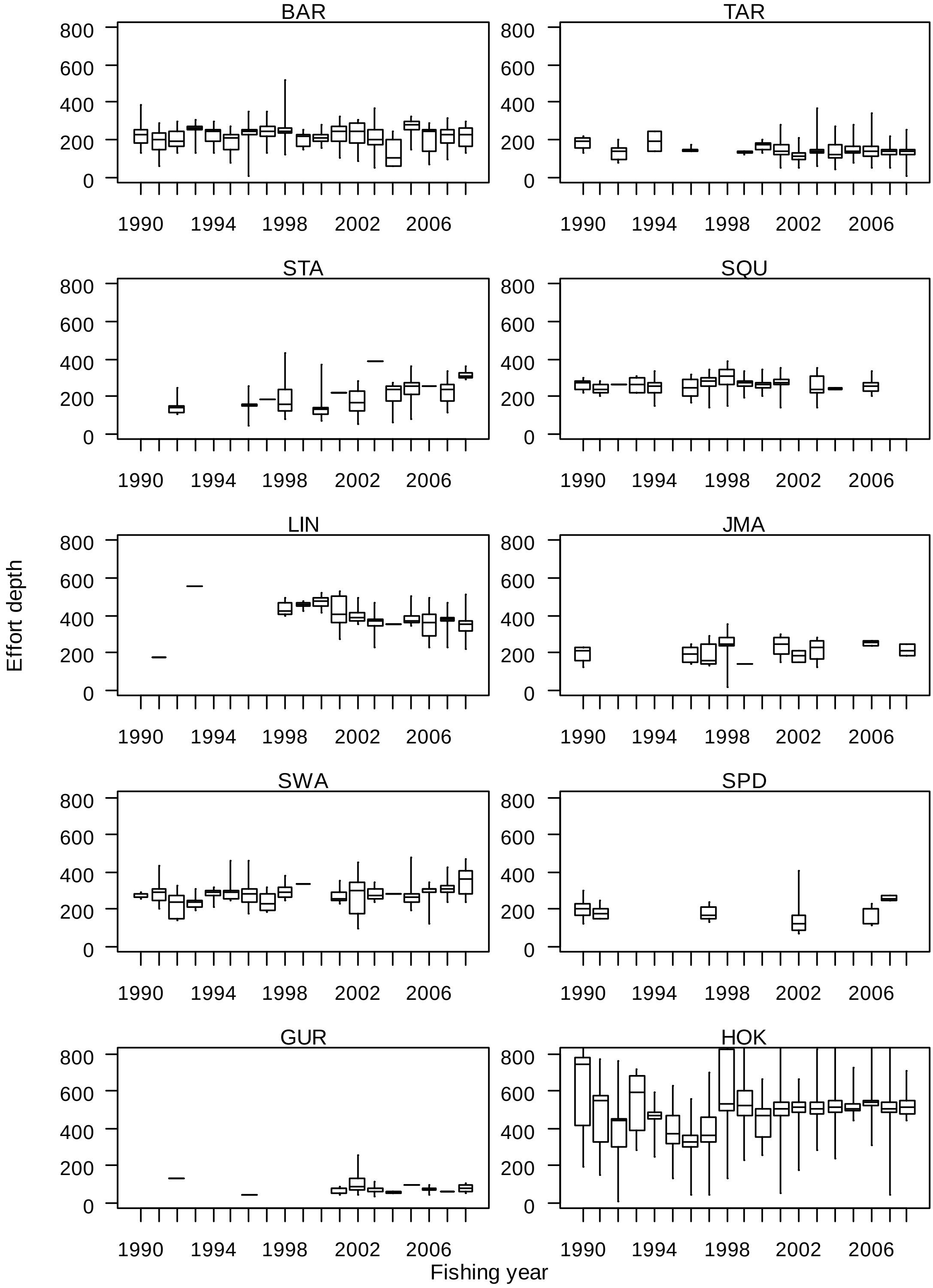


Figure C56a: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) of depths (m) fished by bottom trawl tows for major target species catching barracouta in the EAST CHATHAM RISE region.

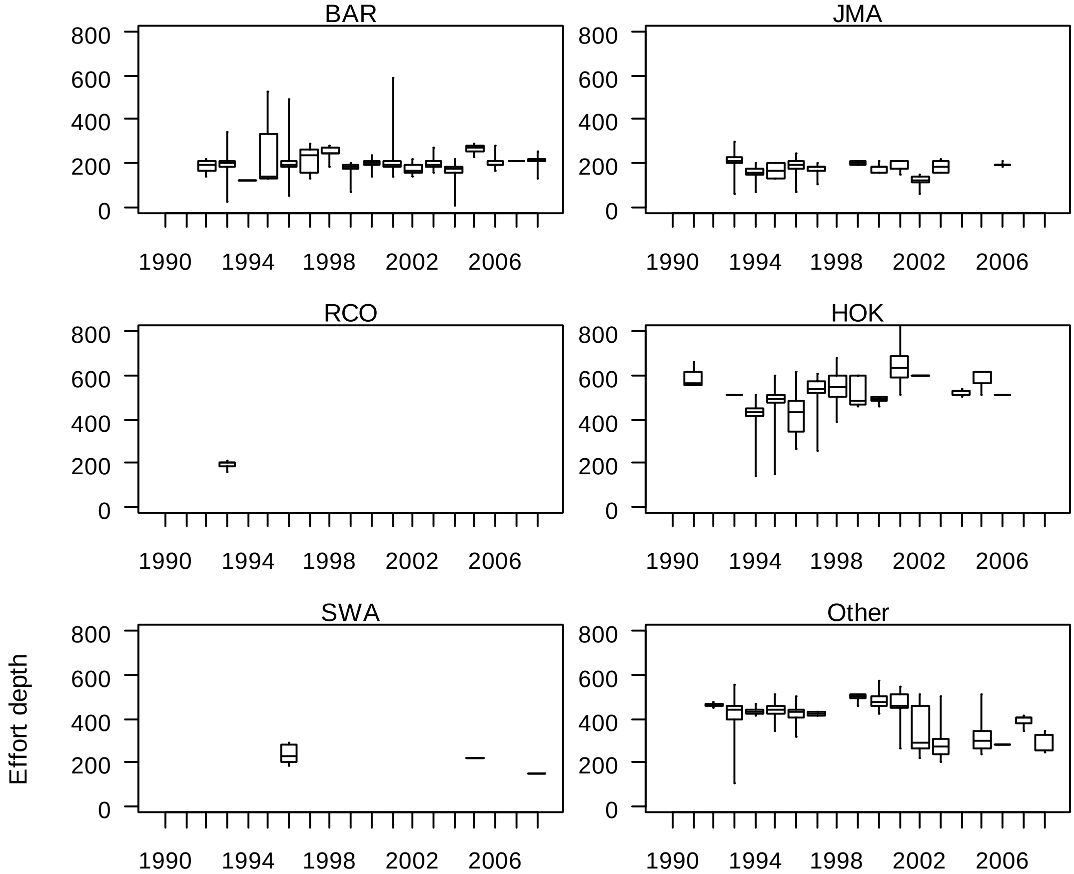


Figure C56b: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) of depths (m) fished by midwater tows for major target species catching barracouta in the EAST CHATHAM RISE region.

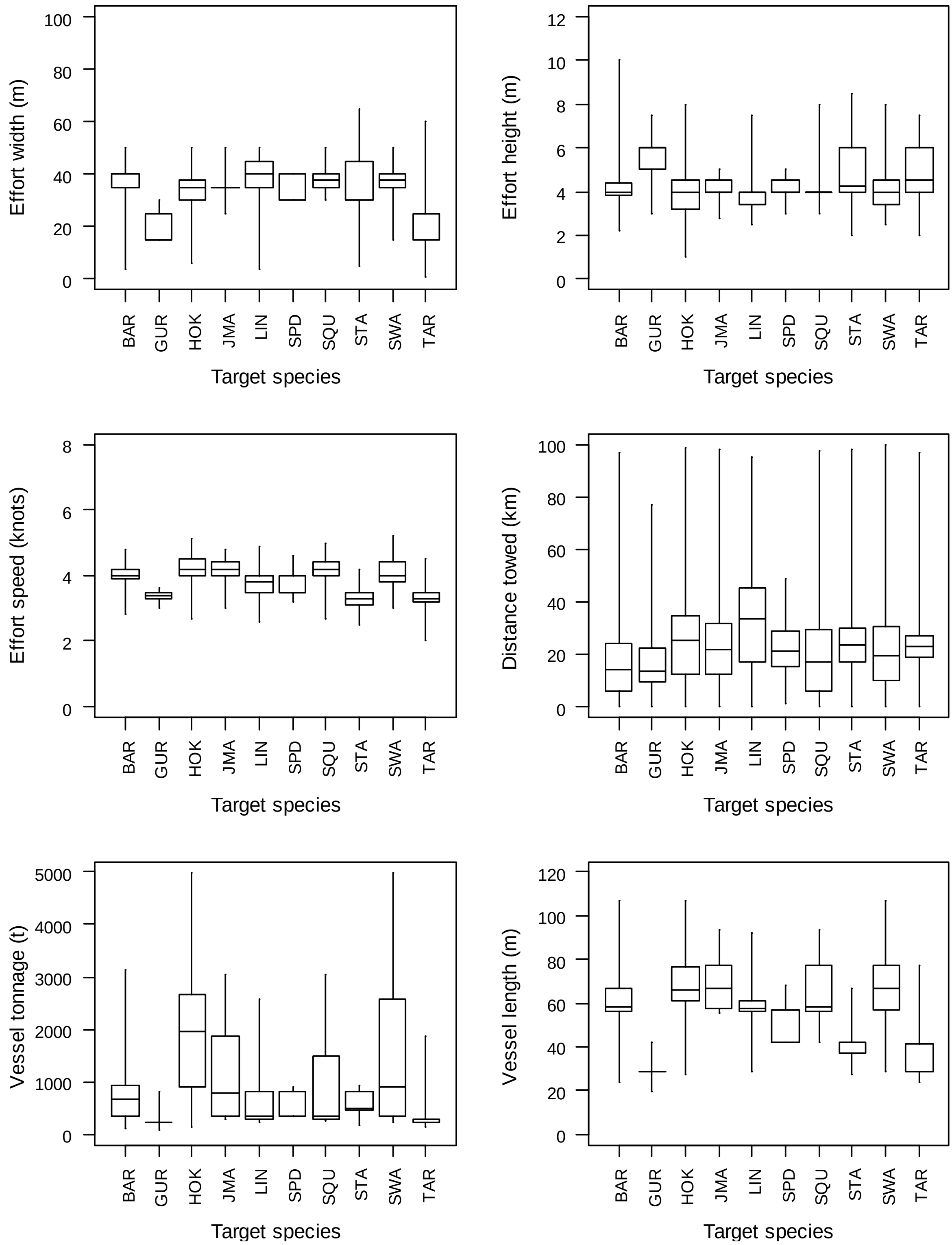


Figure C57: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) of fishing effort variables and vessel characteristics for bottom trawl tows for major target species catching barracouta in the EAST CHATHAM RISE region.

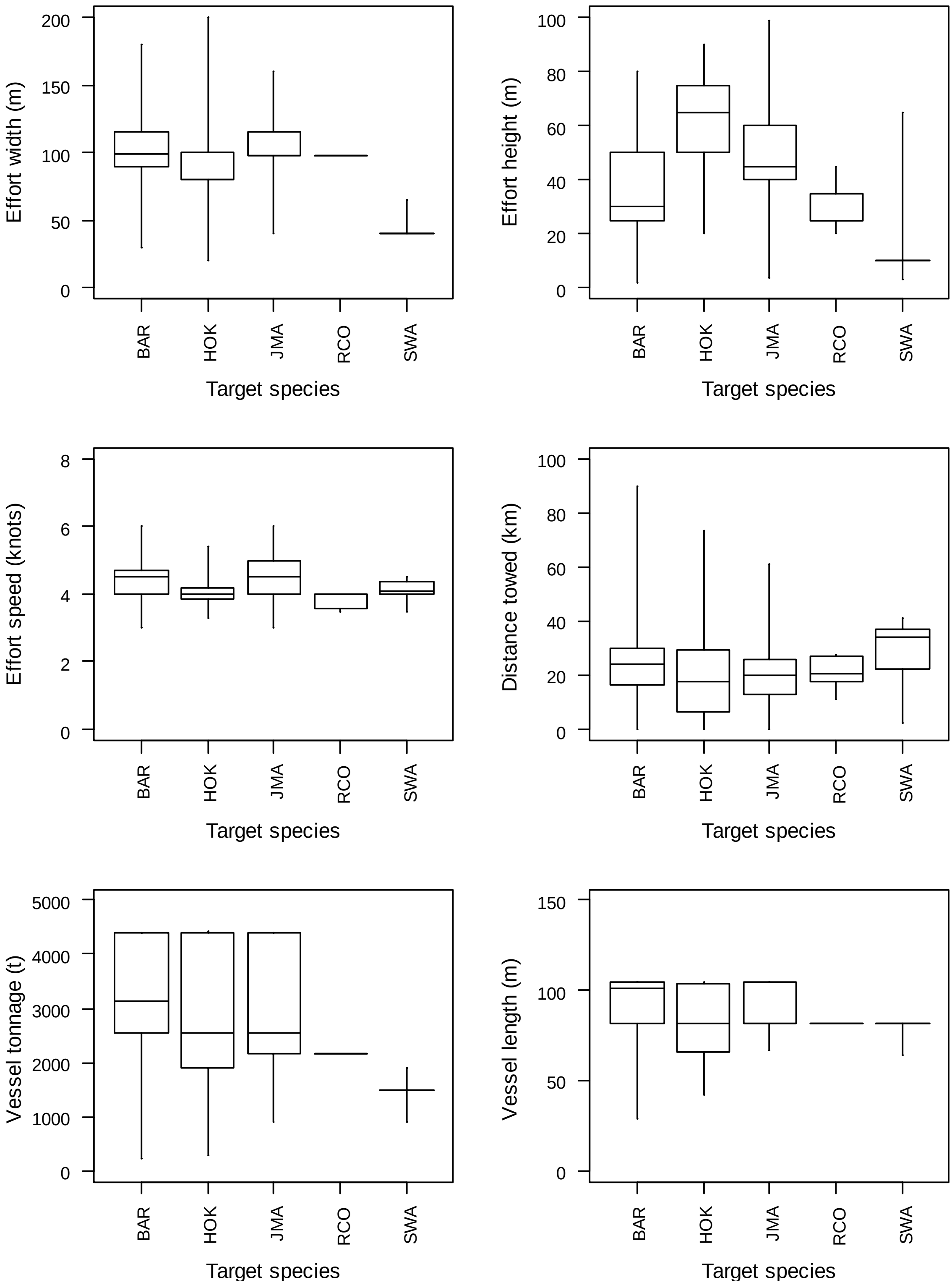


Figure C58: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) of fishing effort variables and vessel characteristics for midwater trawl tows for major target species catching barracouta in the EAST CHATHAM RISE region.

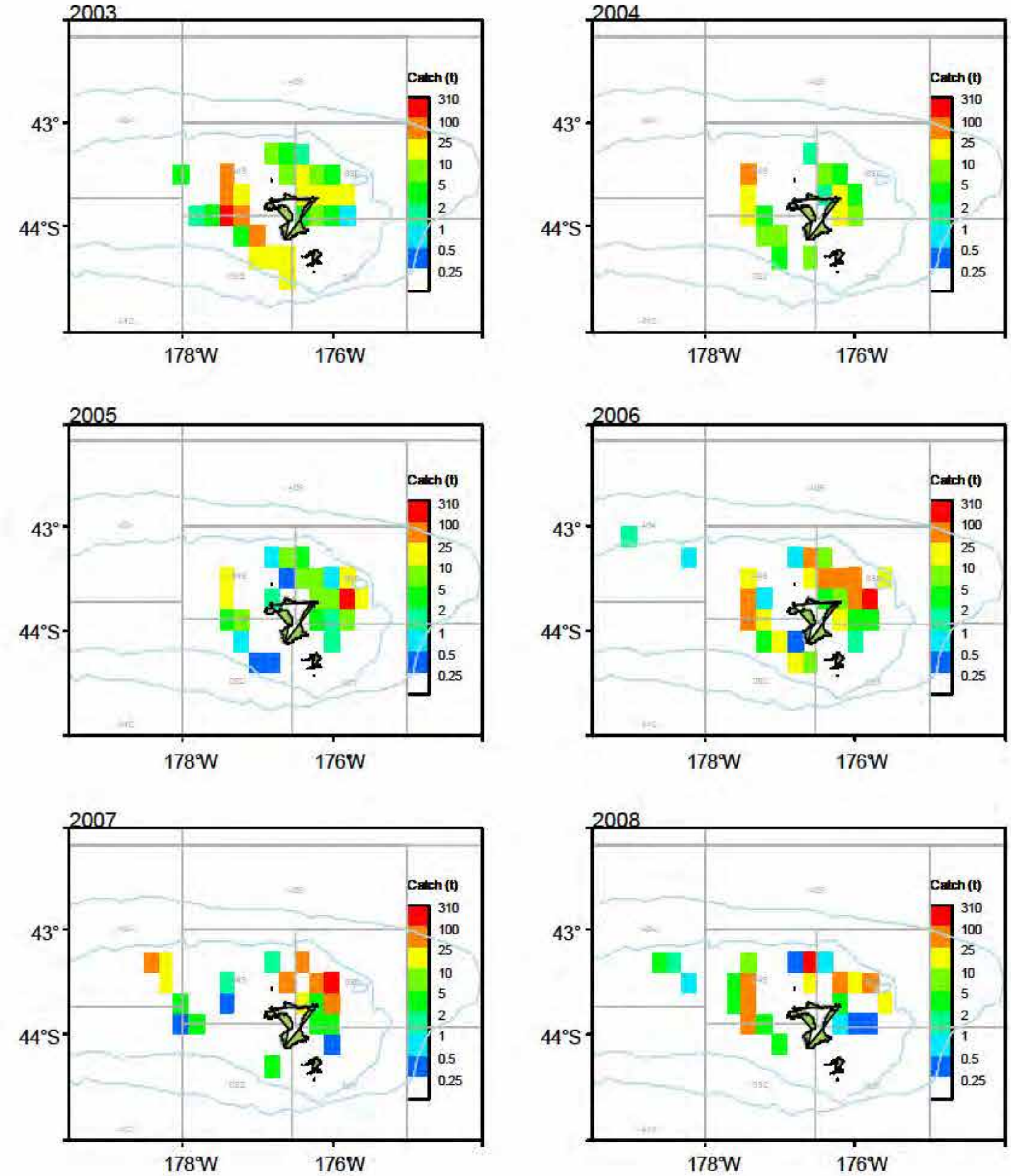


Figure C59: Distribution of barracouta catch within the EAST CHATHAM RISE region aggregated into 0.2 degree spatial blocks for fishing years 2003–2008 reported on TCEPR forms and using midwater and bottom trawl gear.

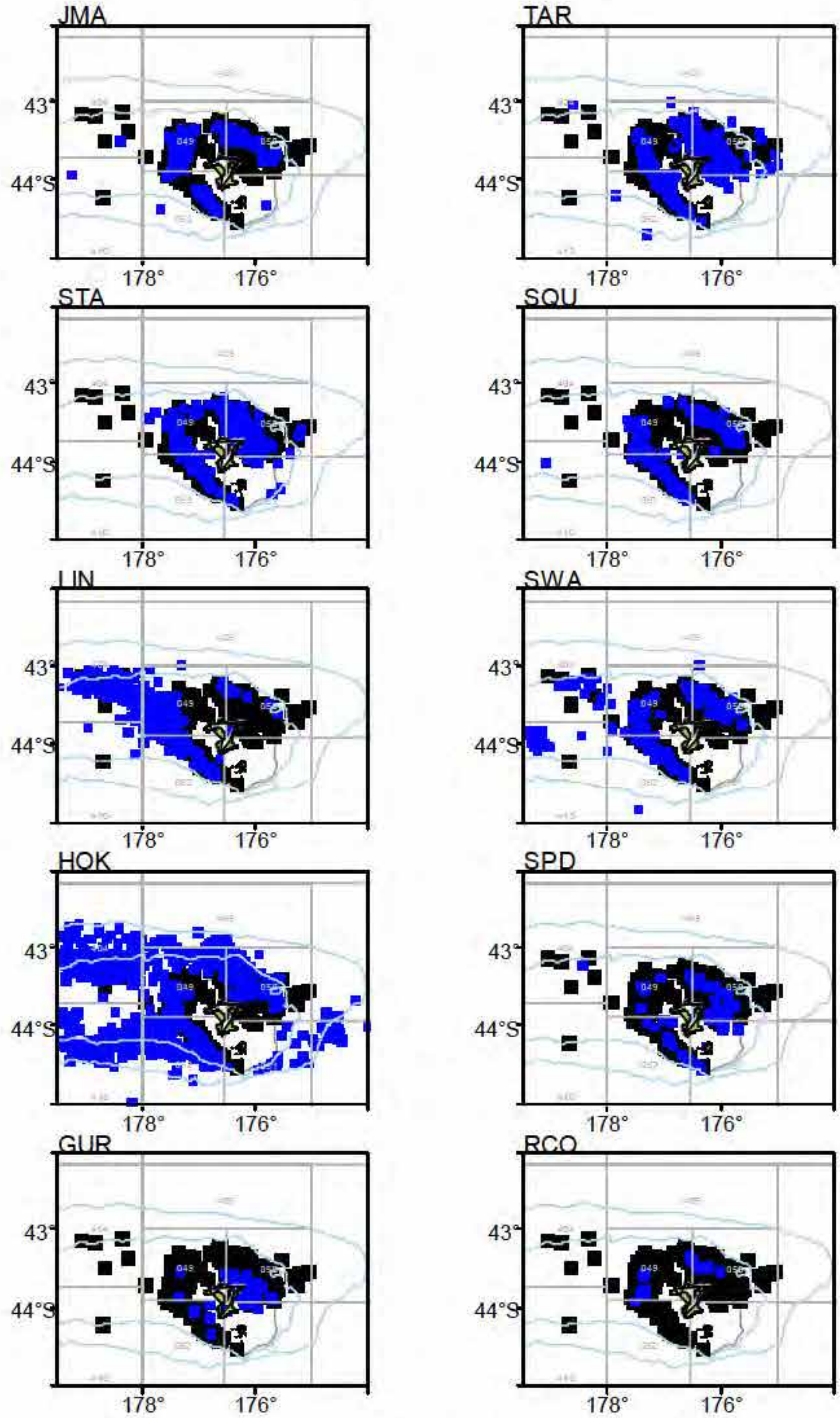


Figure C60: Comparison of the distribution of bottom and midwater trawls in the EAST CHATHAM RISE region by target species for the main target species (blue cells) overlaid on the distribution of barracouta target effort distribution (black cells), for all years combined.

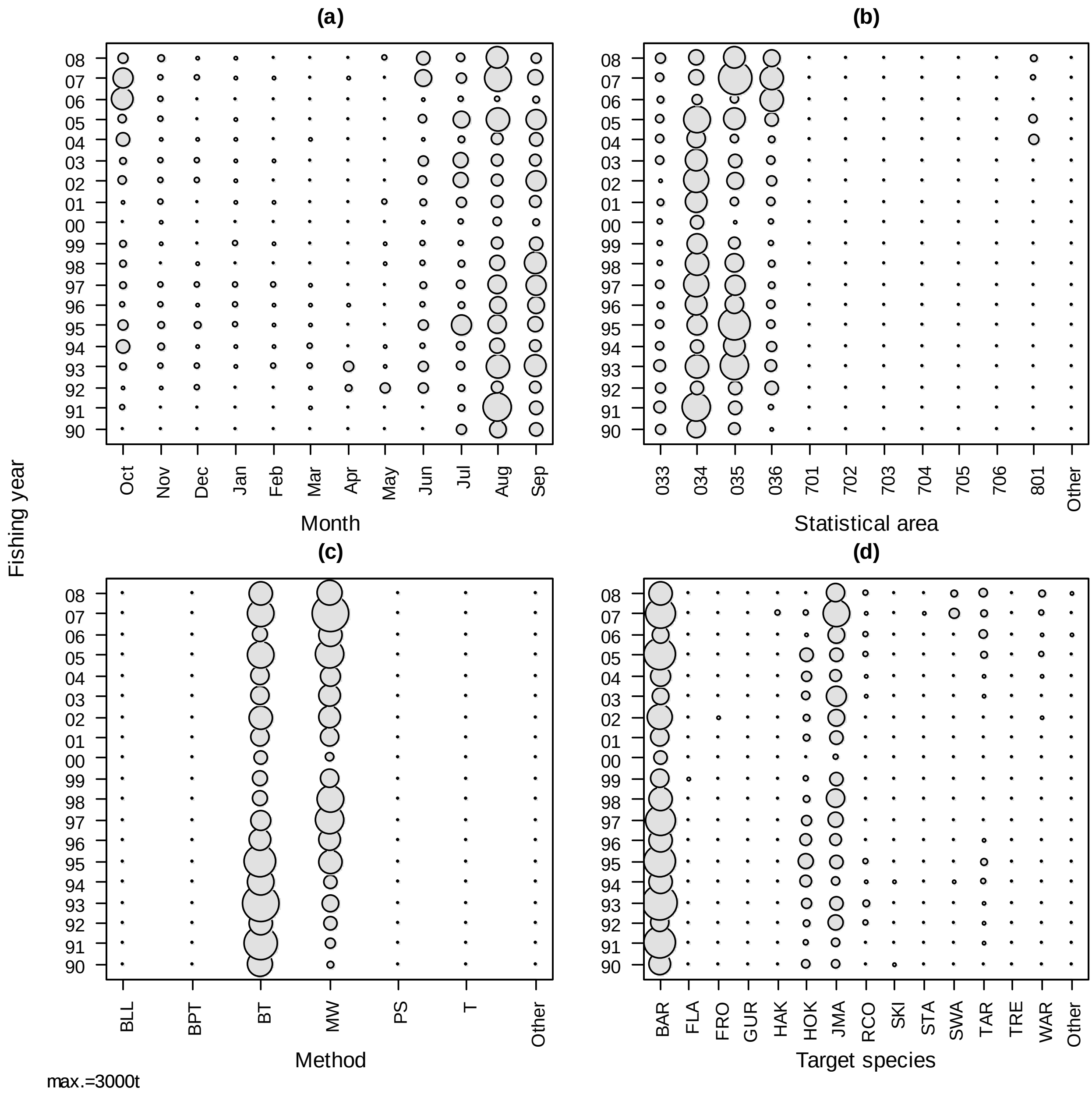


Figure C61: Distribution of barracouta catch in the WCSI region for the 1990–2008 fishing years in relation to a) month, b) statistical area, c) fishing method, and d) target species. Circle size is proportional to catch; maximum circle size is indicated in lower left hand corner.

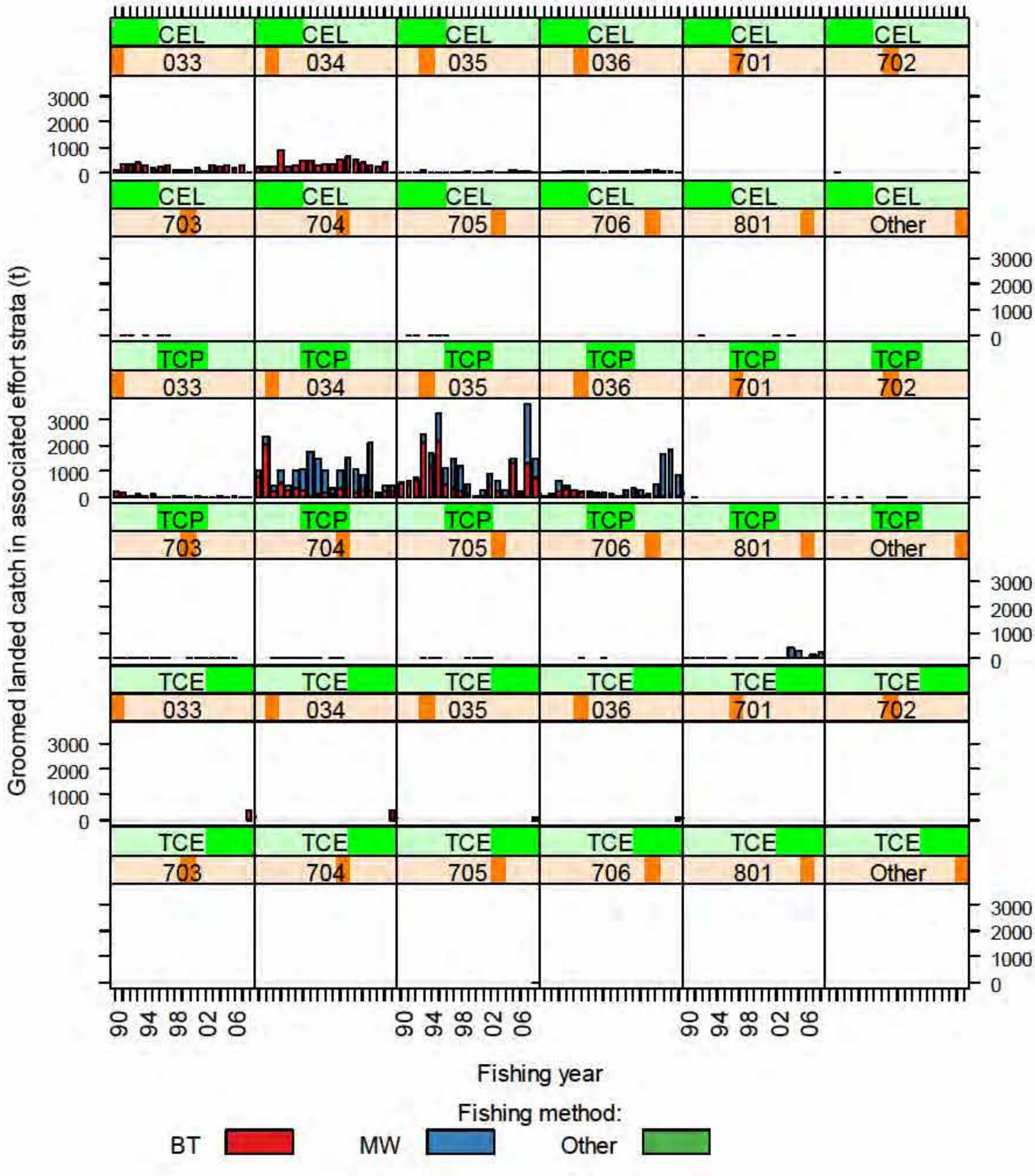


Figure C62a: Distribution of barracouta catch in the WCSI region in relation to form type (CEL, CELR; TCP, TCEPR; TCE, TCER) and statistical area by fishing method (bottom (BT), midwater (MW) trawl) for fishing years 1990–2008.

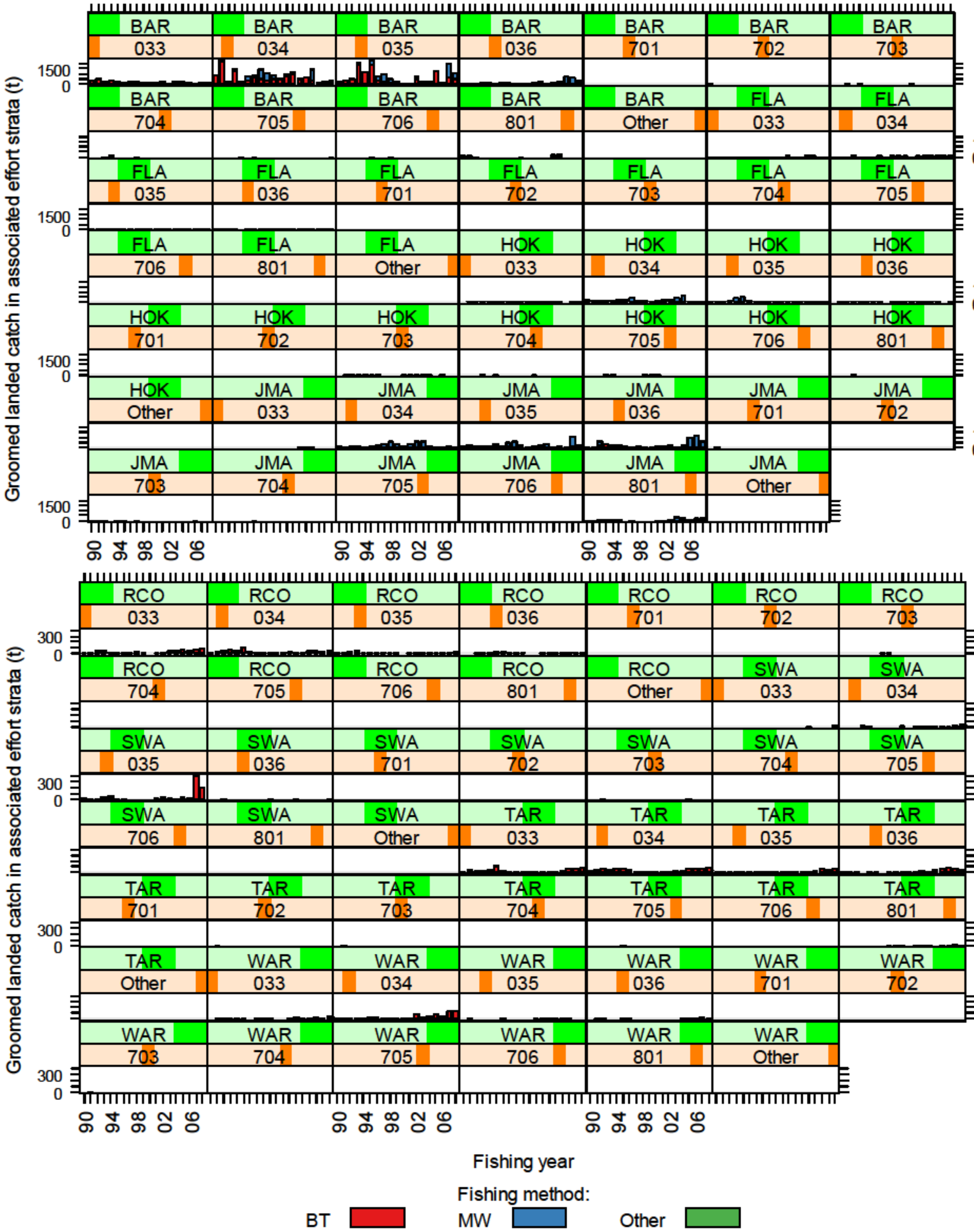


Figure C62b: Distribution of barracouta catch in the WCSI region in relation to major target species and statistical area by fishing method (bottom (BT), midwater (MW) trawl) for fishing years 1990–2008.

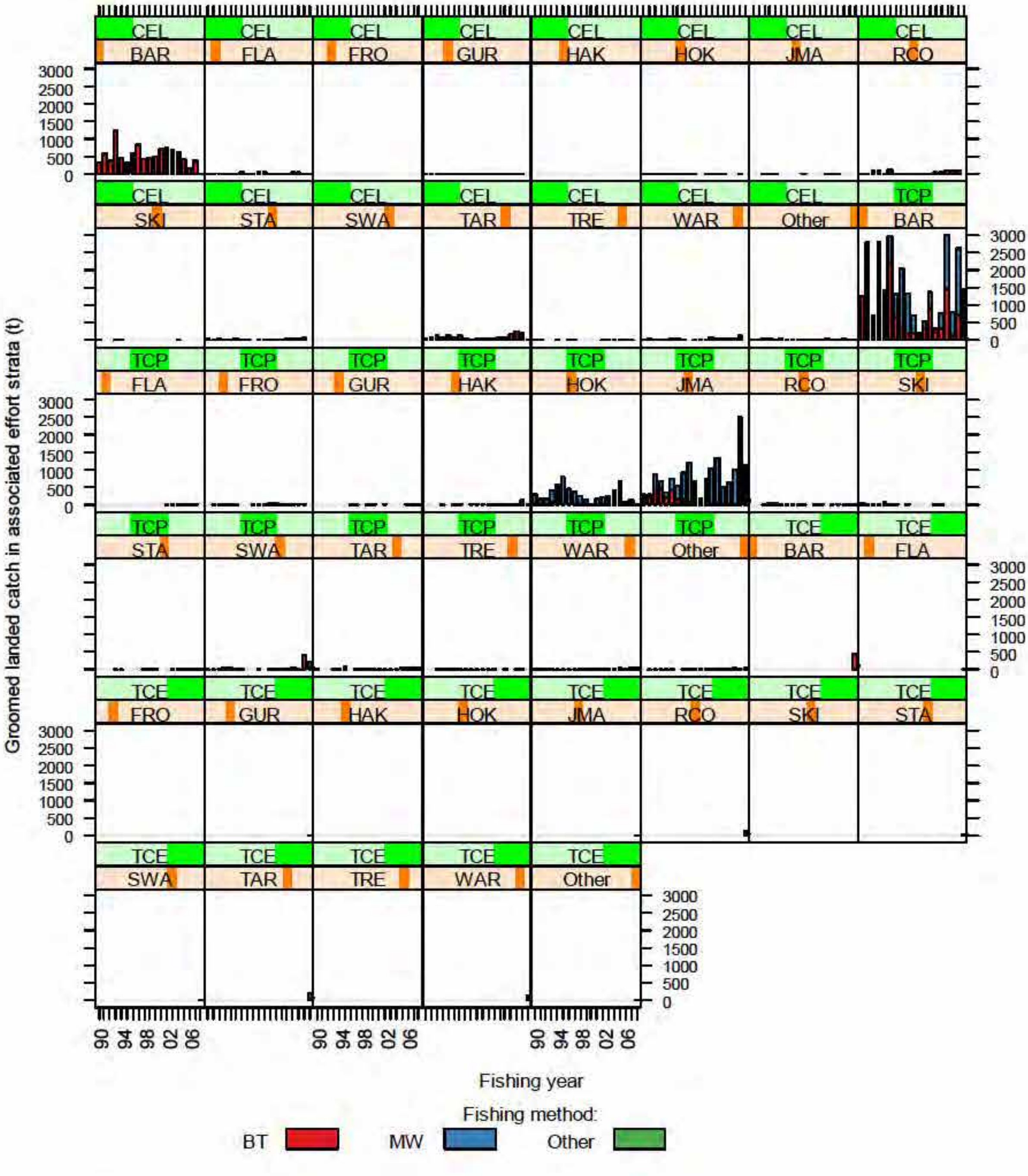


Figure C62c: Distribution of barracouta catch in the WCSI region in relation to form type (CEL, CELR; TCP, TCEPR; TCE, TCER) and target species by fishing method (bottom (BT), midwater (MW) trawl) for fishing years 1990–2008.

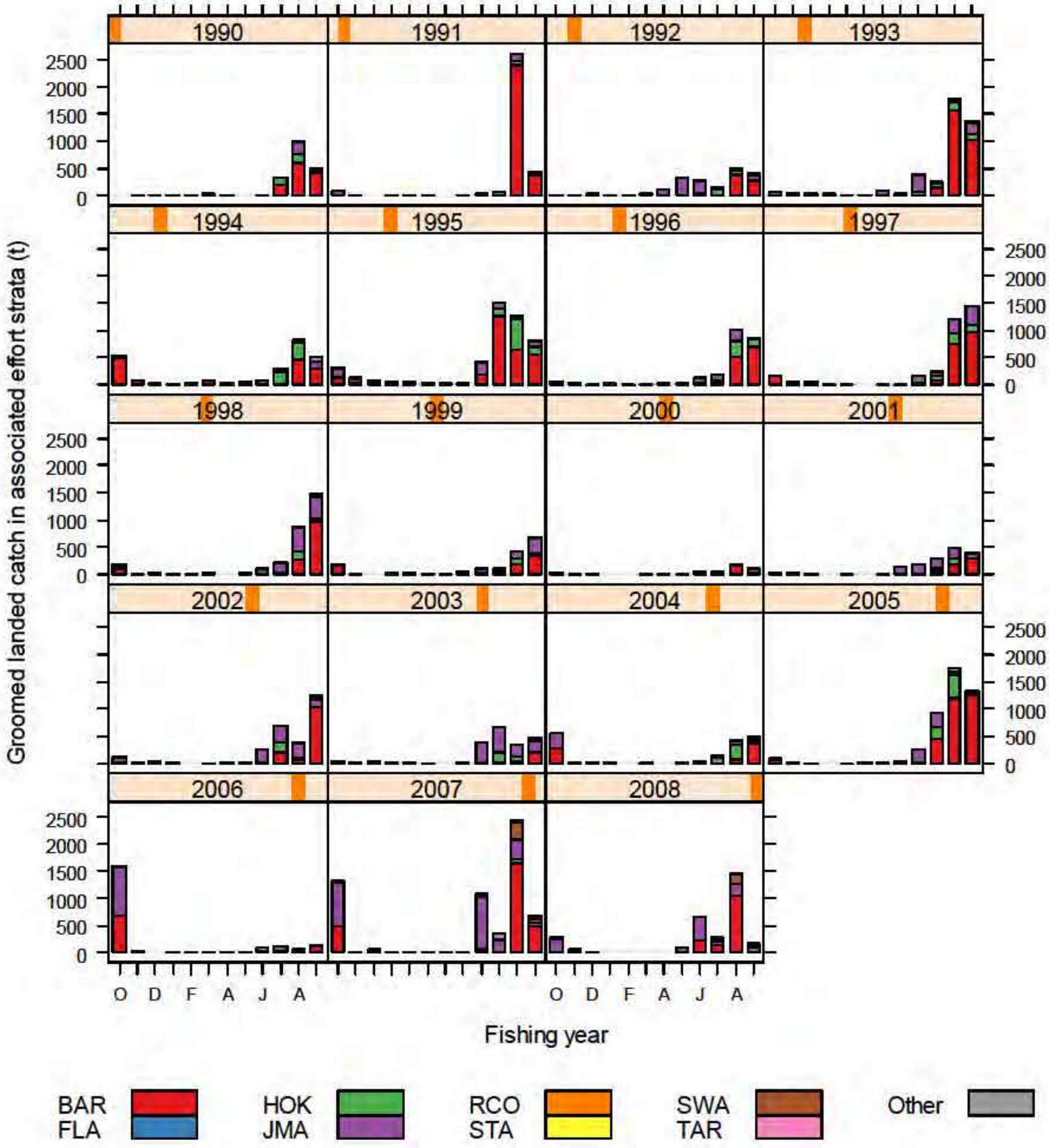


Figure C62d: Distribution of barracouta catch taken by midwater and bottom trawl gear in the WCSI region in relation to target species by month for fishing years 1990–2008.

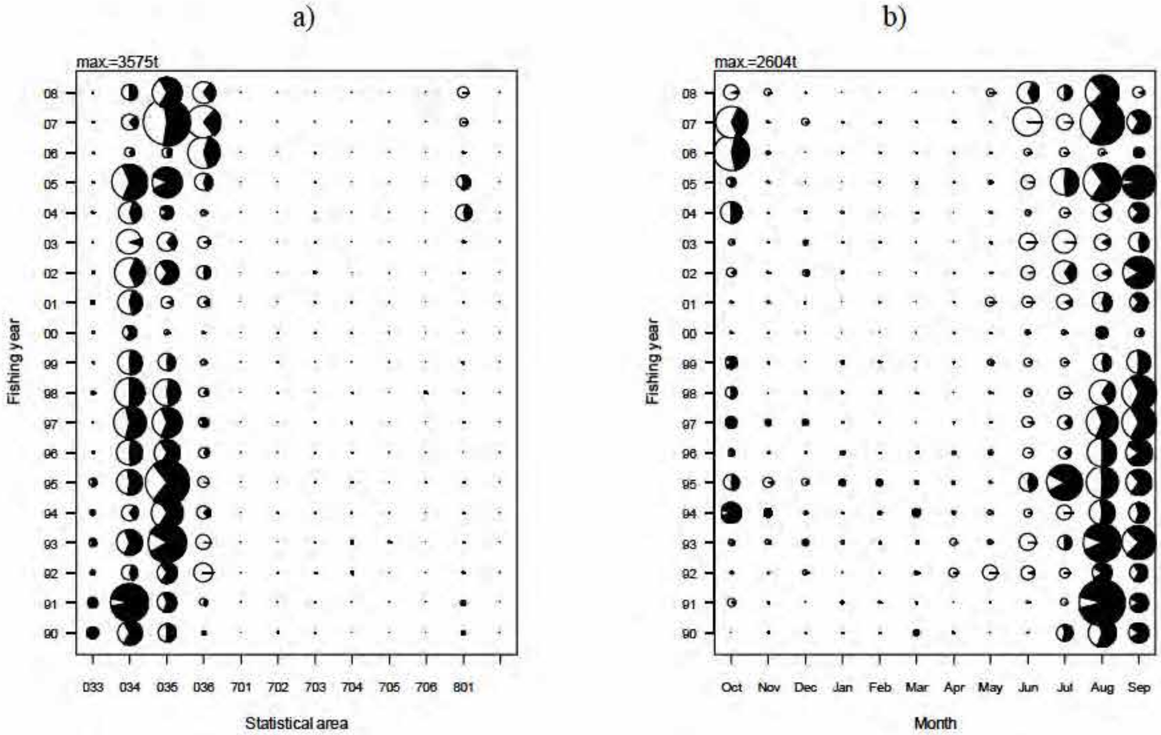


Figure C63: Distribution of barracouta catch taken by midwater and bottom trawl gear by fishing year with circle size proportional to the total catch and black portion of the pie indicating proportion of the catch as targeted barracouta by a) statistical area and b) month for the WCSI region.

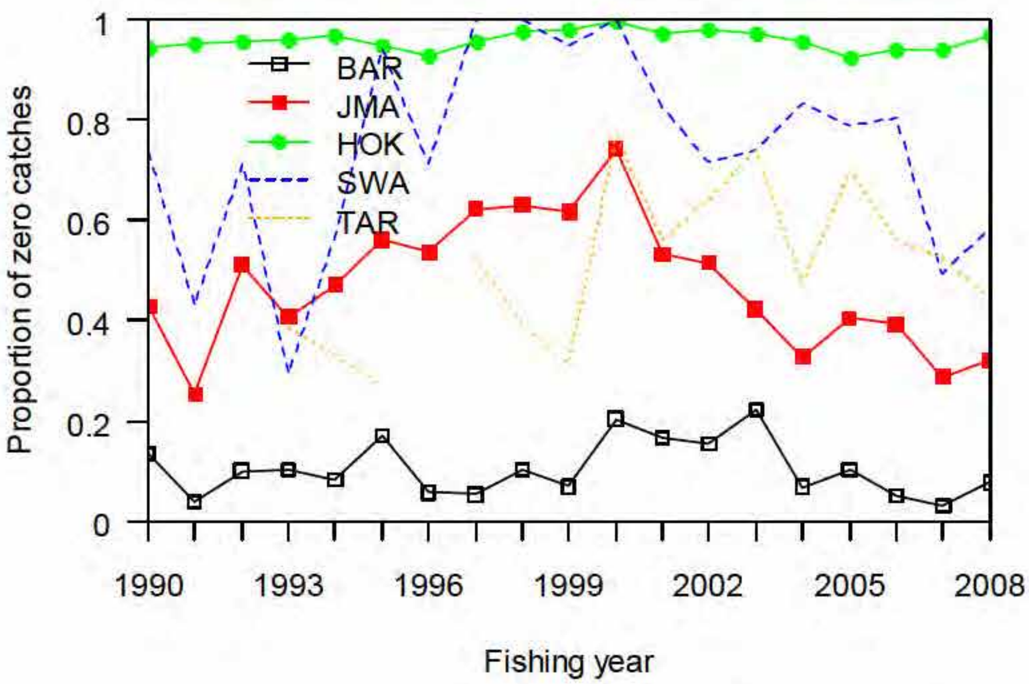


Figure C64: Proportion of tows with zero reported barracouta catch for major target species for the WCSI region taken by midwater and bottom trawl gear.

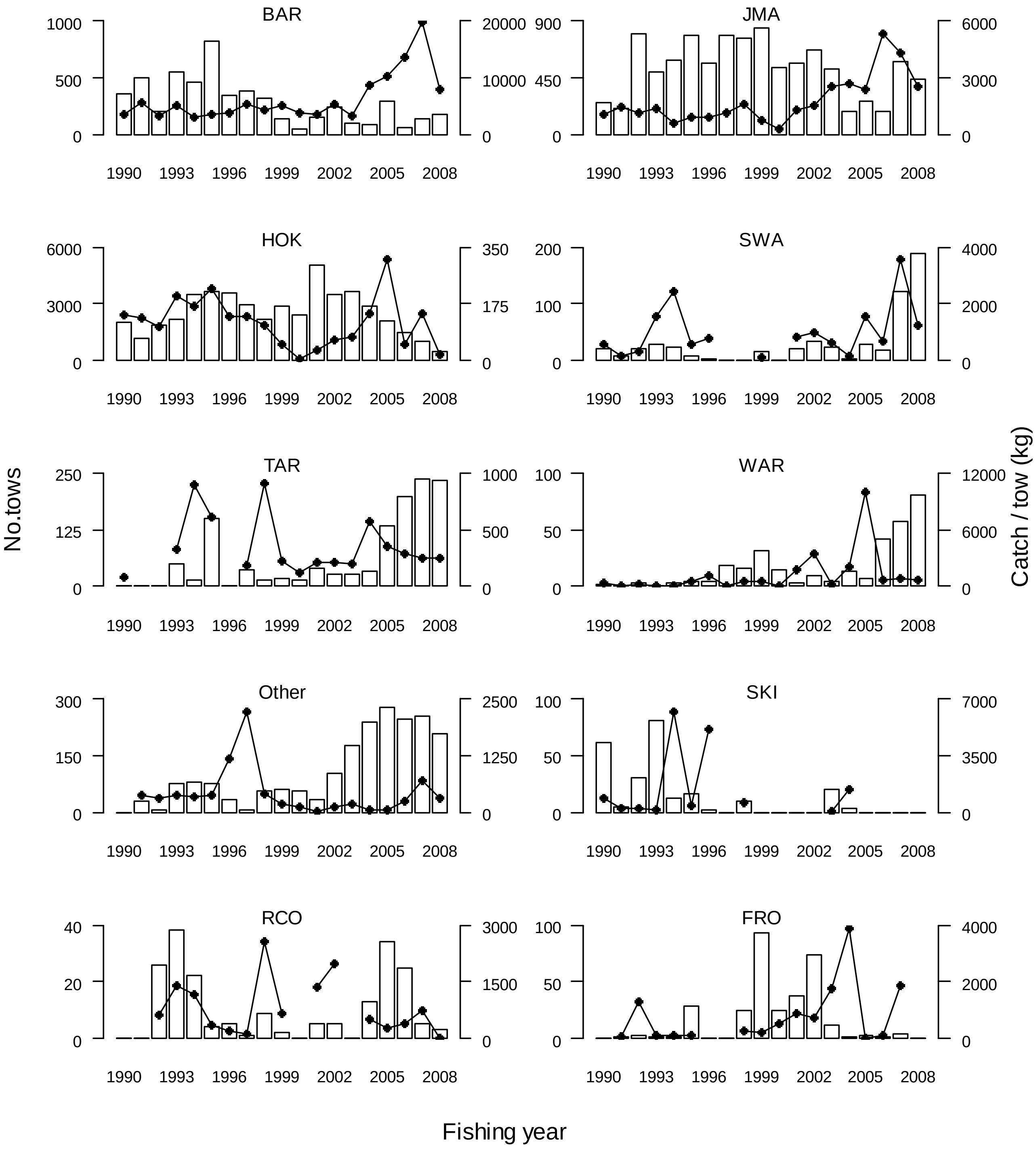


Figure C65: The number of tows (bars) that caught barracouta in the WCSI region taken by midwater and bottom trawl gear and the annual catch rate (lines) of barracouta by major target species.

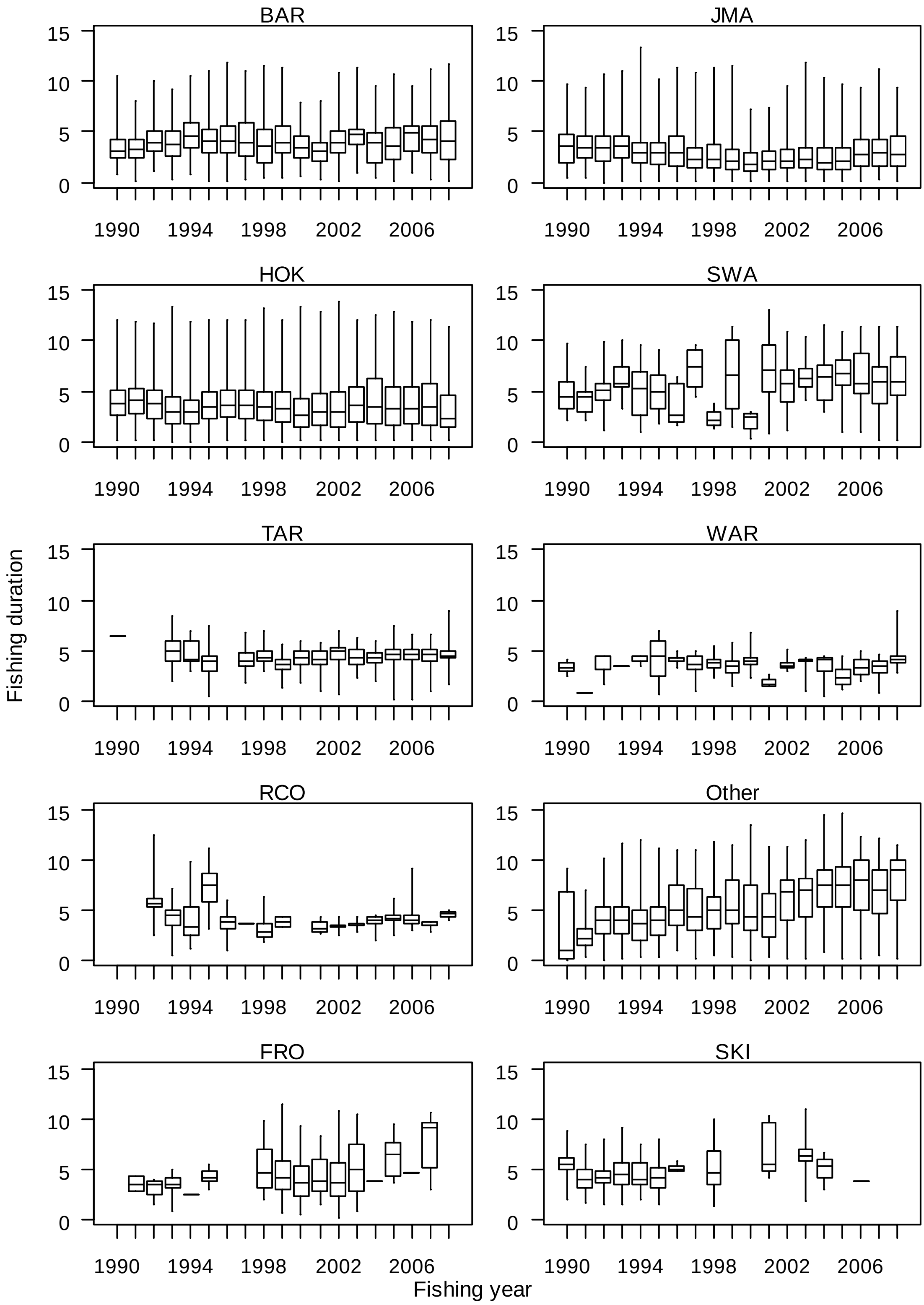


Figure C66: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) of midwater and bottom trawl tow durations (hours) reported for major target species catching barracouta in the WCSI region.

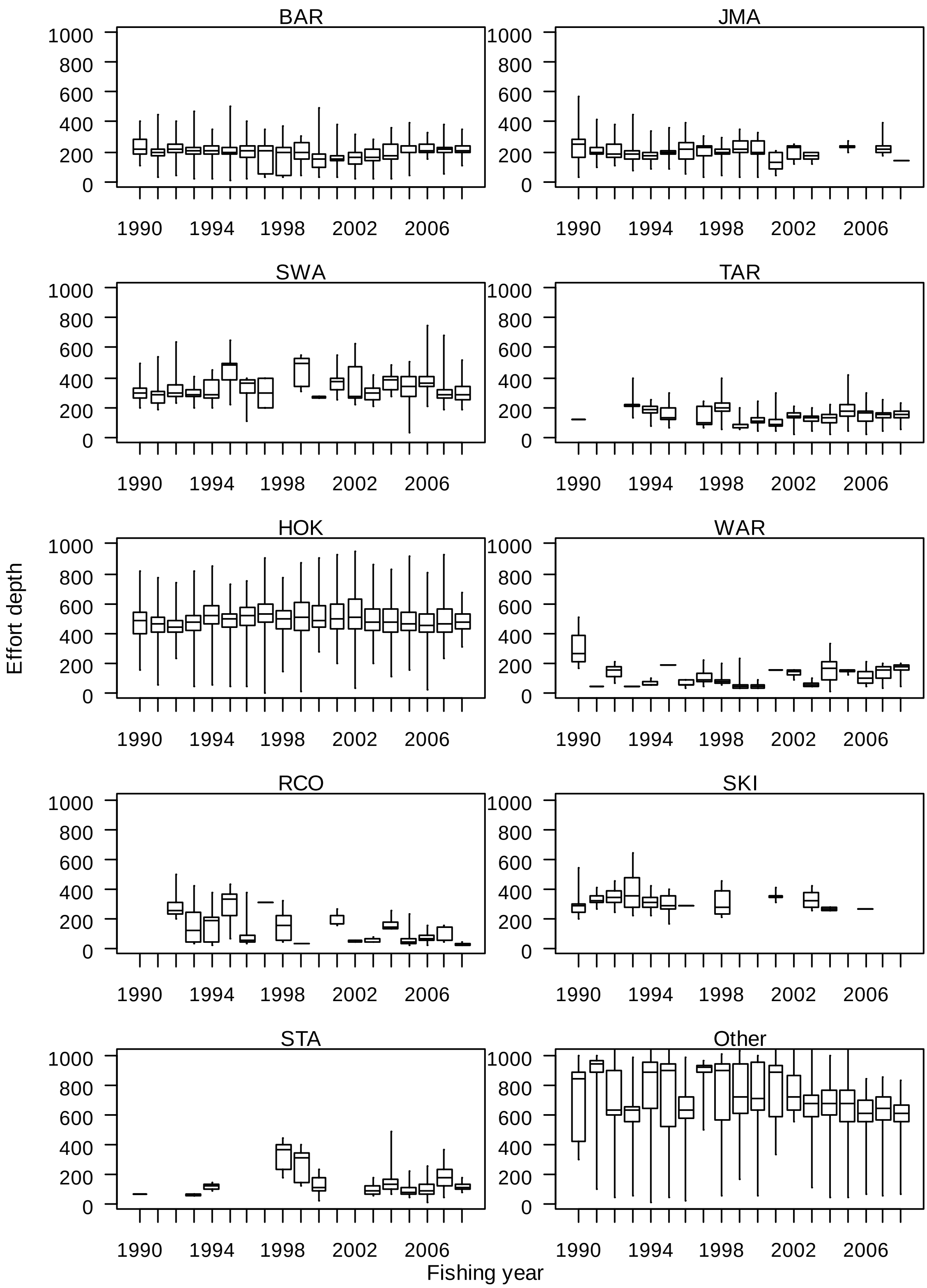


Figure C67a: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) of depths (m) fished by bottom trawl tows for major target species catching barracouta in the WCSI region.

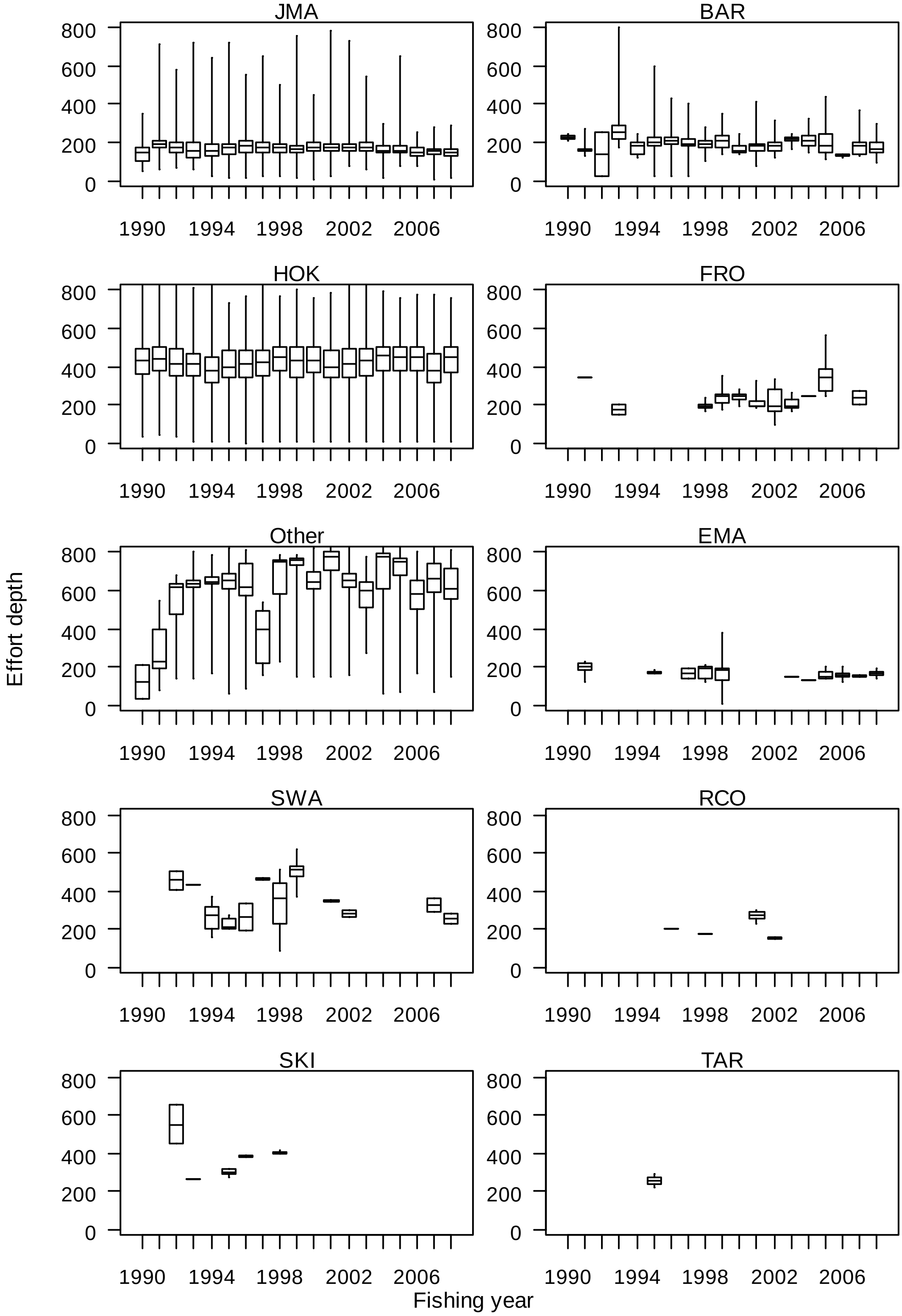


Figure C67b: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) of depths (m) fished by midwater tows for major target species catching barracouta in the WCSI region.

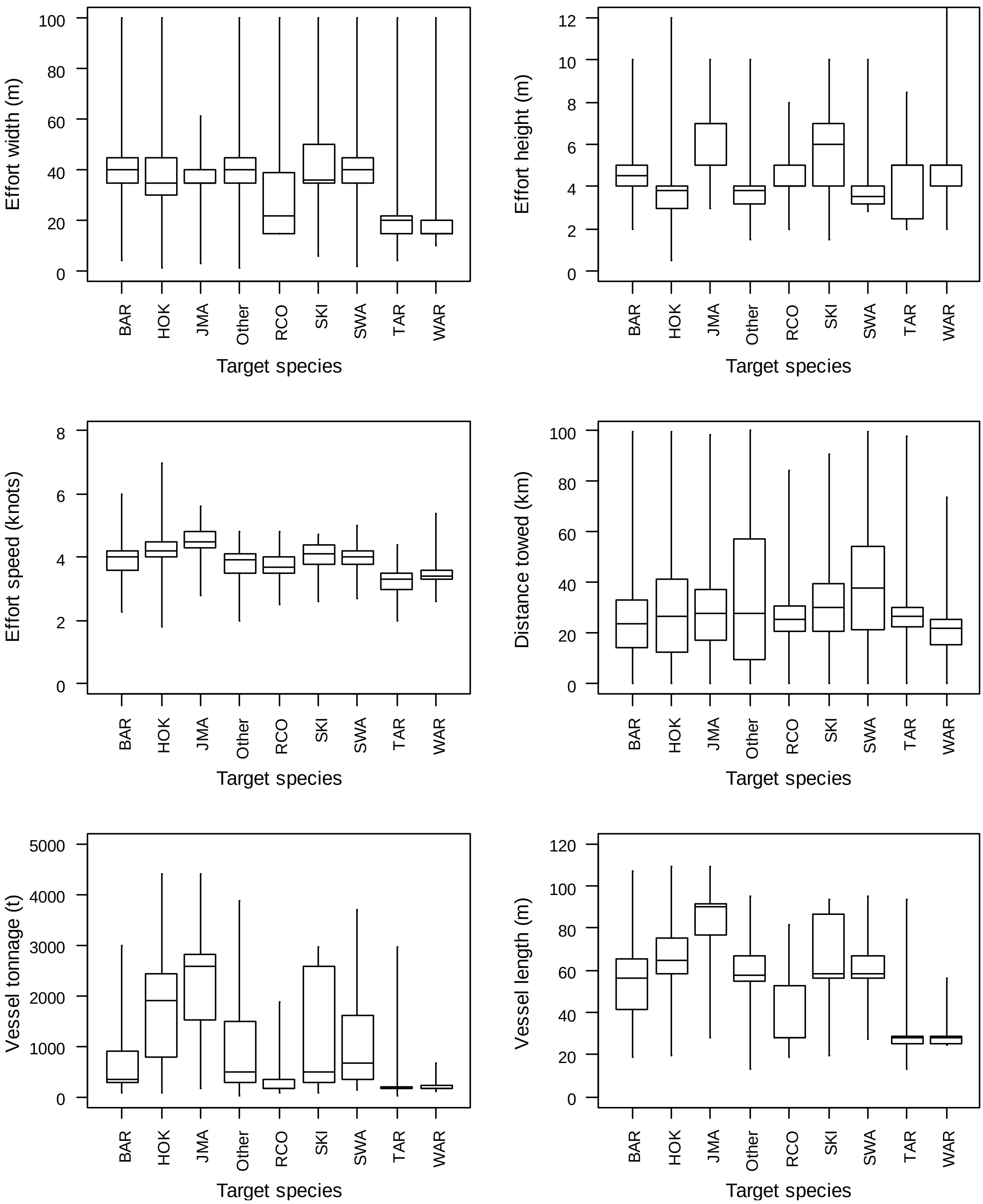


Figure C68: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) of fishing effort variables and vessel characteristics for bottom trawl tows for major target species catching barracouta in the WCSI region.

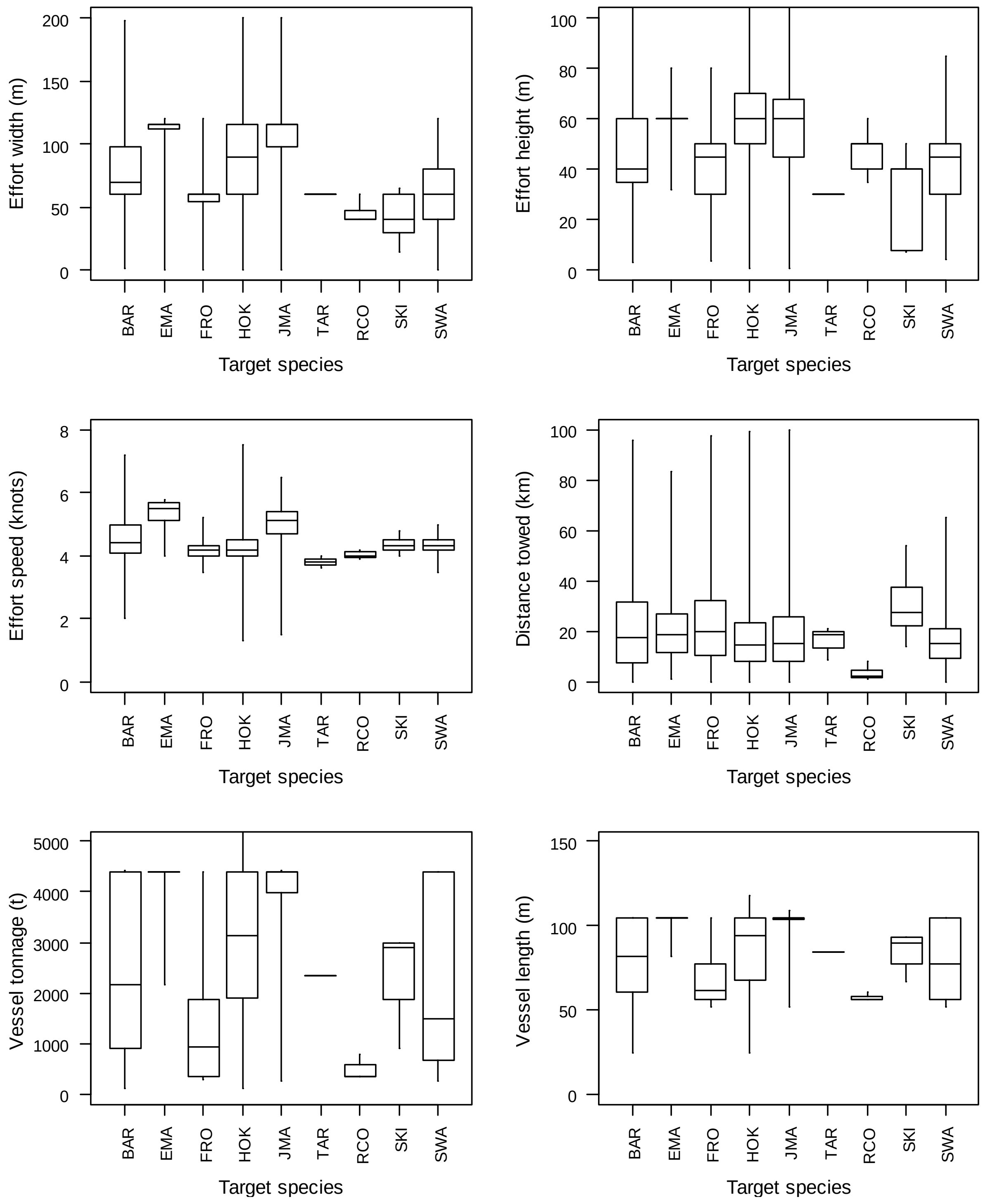


Figure C69: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) of fishing effort variables and vessel characteristics for midwater trawl tows for major target species catching barracouta in the WCSI region.

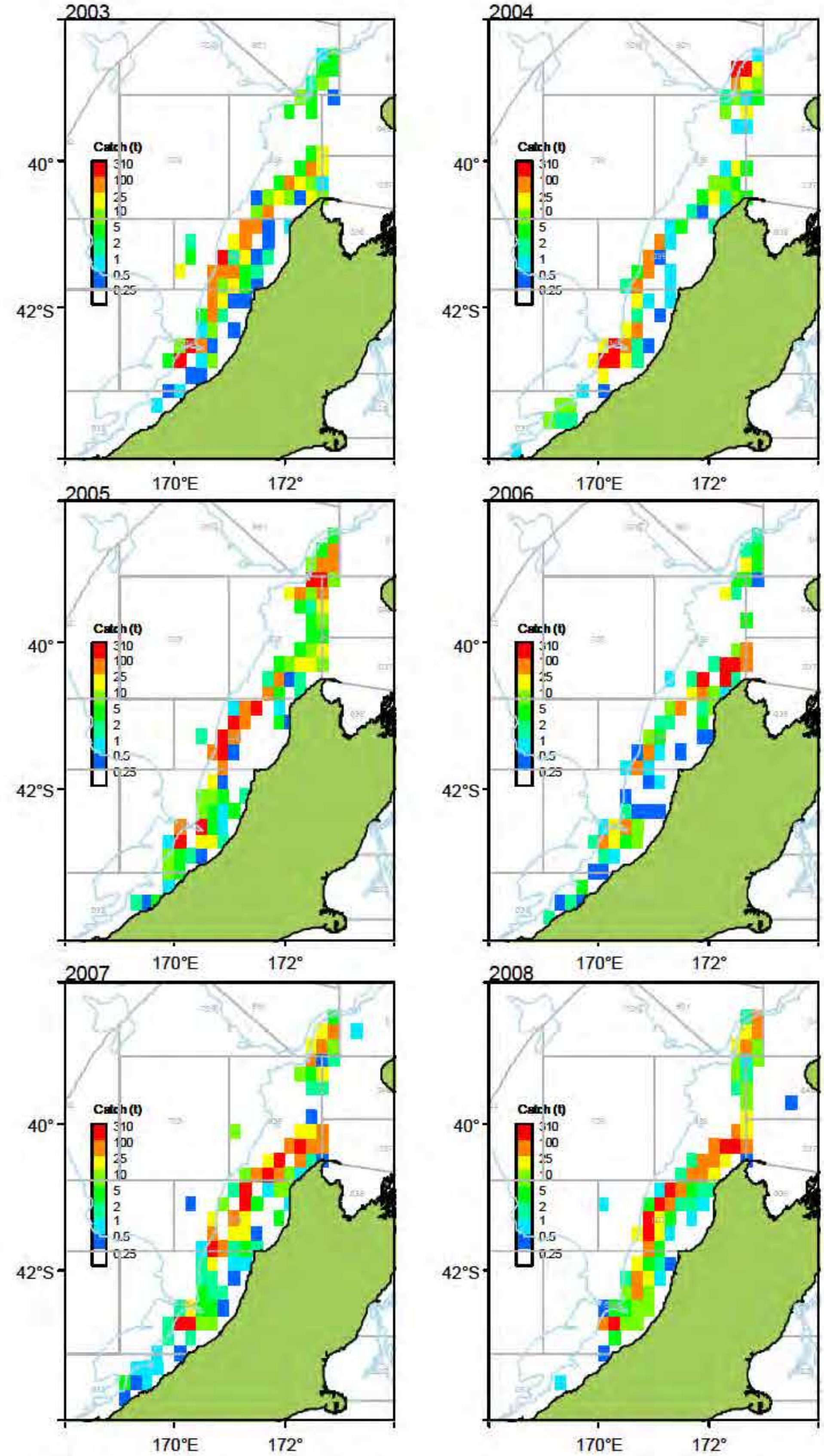


Figure C70a: Distribution of barracouta catch within the WCSI region aggregated into 0.2 degree spatial blocks for fishing years 2003–2008 reported on TCEPR forms and using midwater and bottom trawl gear.

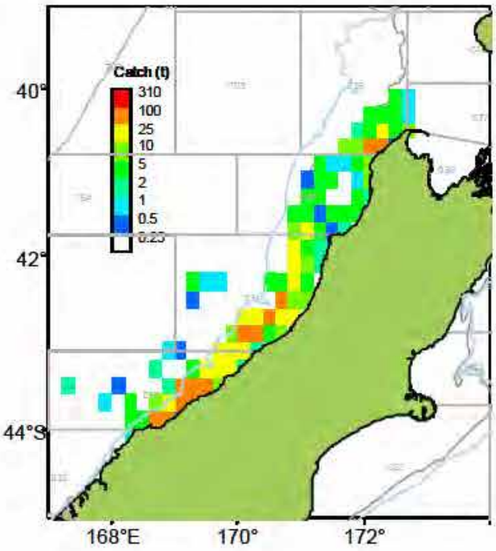


Figure 70b: Distribution of barracouta catch within the WCSI region aggregated into 0.2 degree spatial blocks for the fishing year 2008 reported on TCER forms and using midwater and bottom trawl gear.

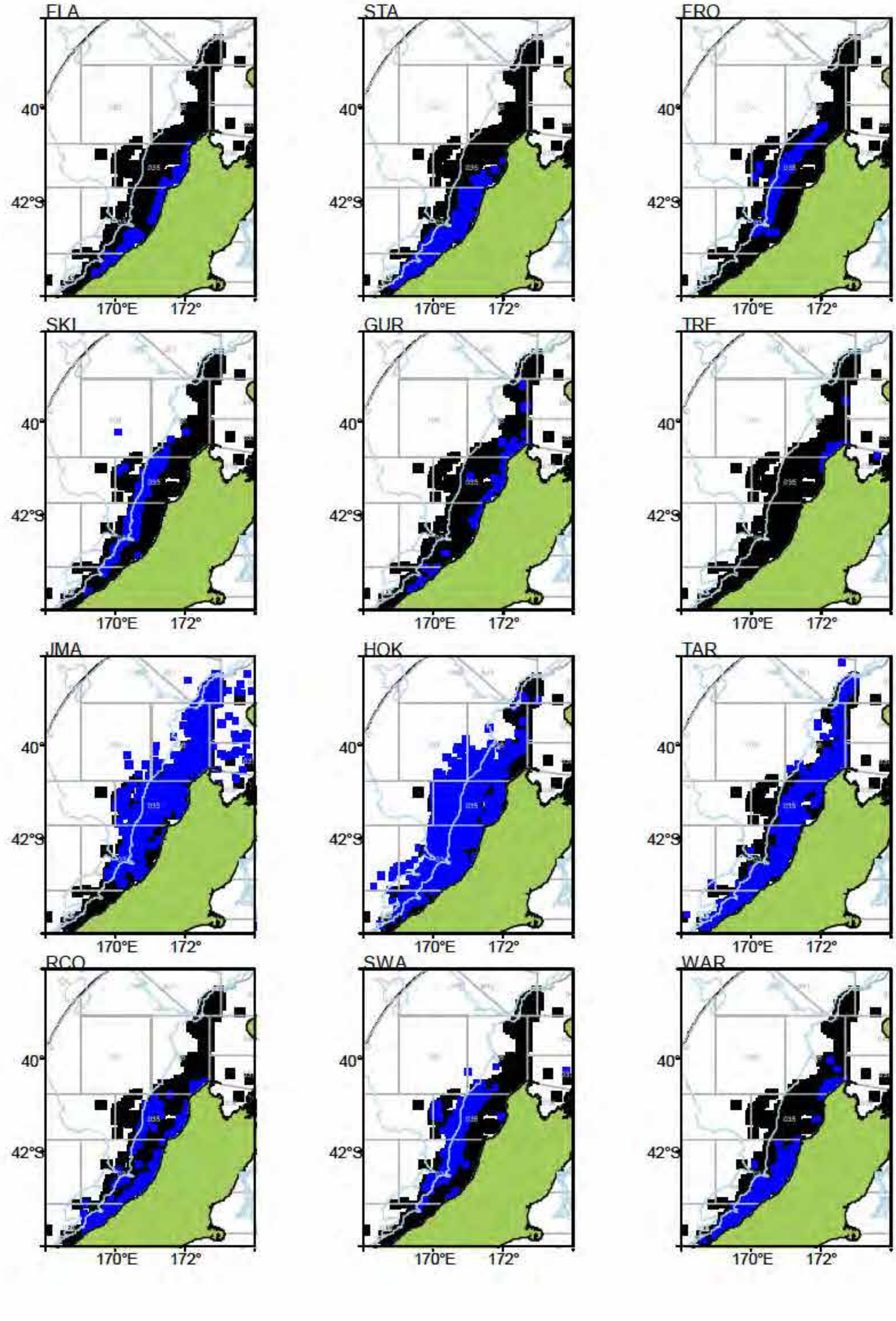


Figure C71: Comparison of the distribution of bottom and midwater trawls in the WCSI region by target species for the main target species (blue cells) overlaid on the distribution of barracouta target effort distribution (black cells), for all years combined.

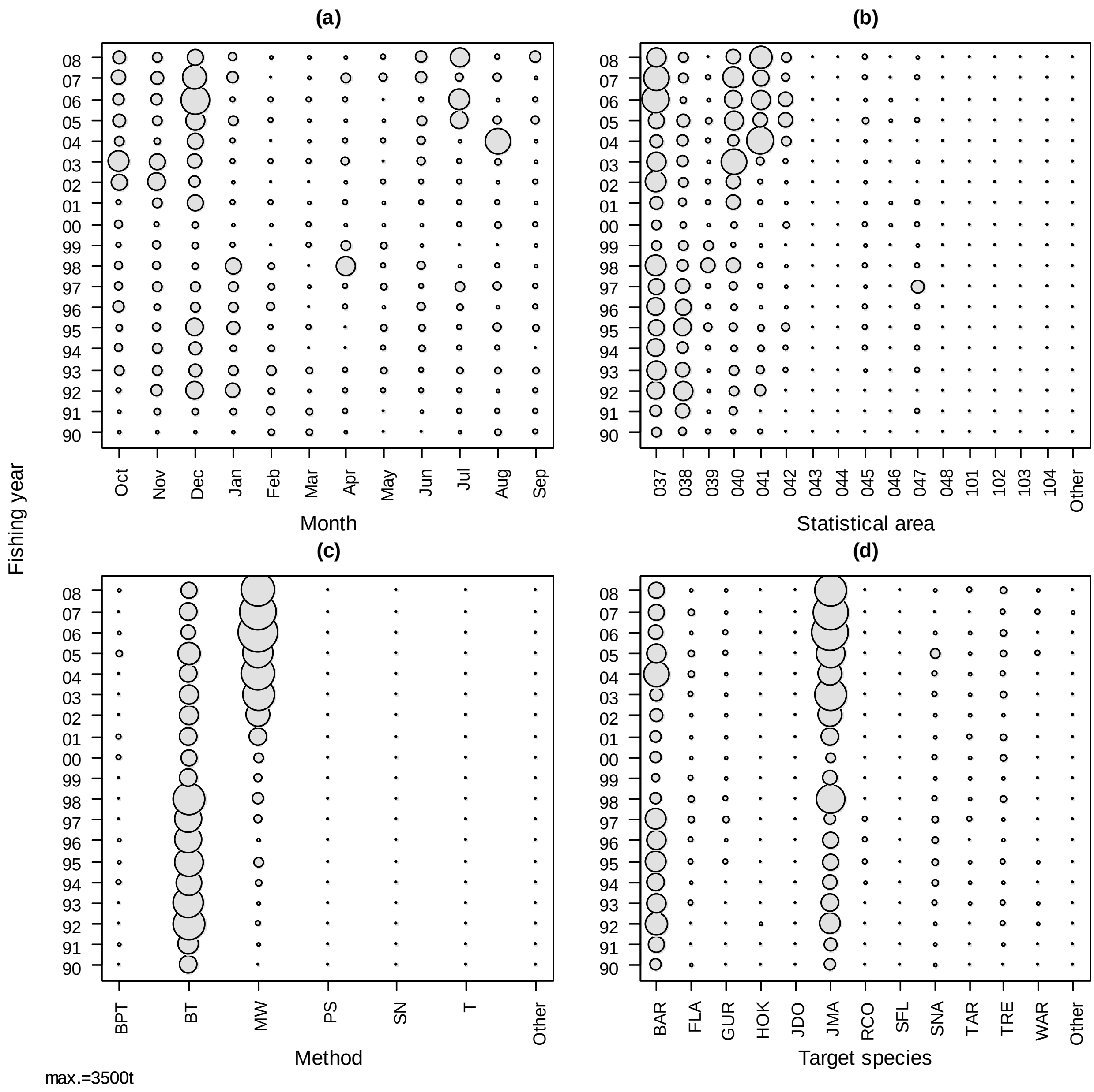


Figure C72: Distribution of barracouta catch in the WCNI region for the 1990–2008 fishing years in relation to a) month, b) statistical area, c) fishing method, and d) target species. Circle size is proportional to catch; maximum circle size is indicated in lower left hand corner.

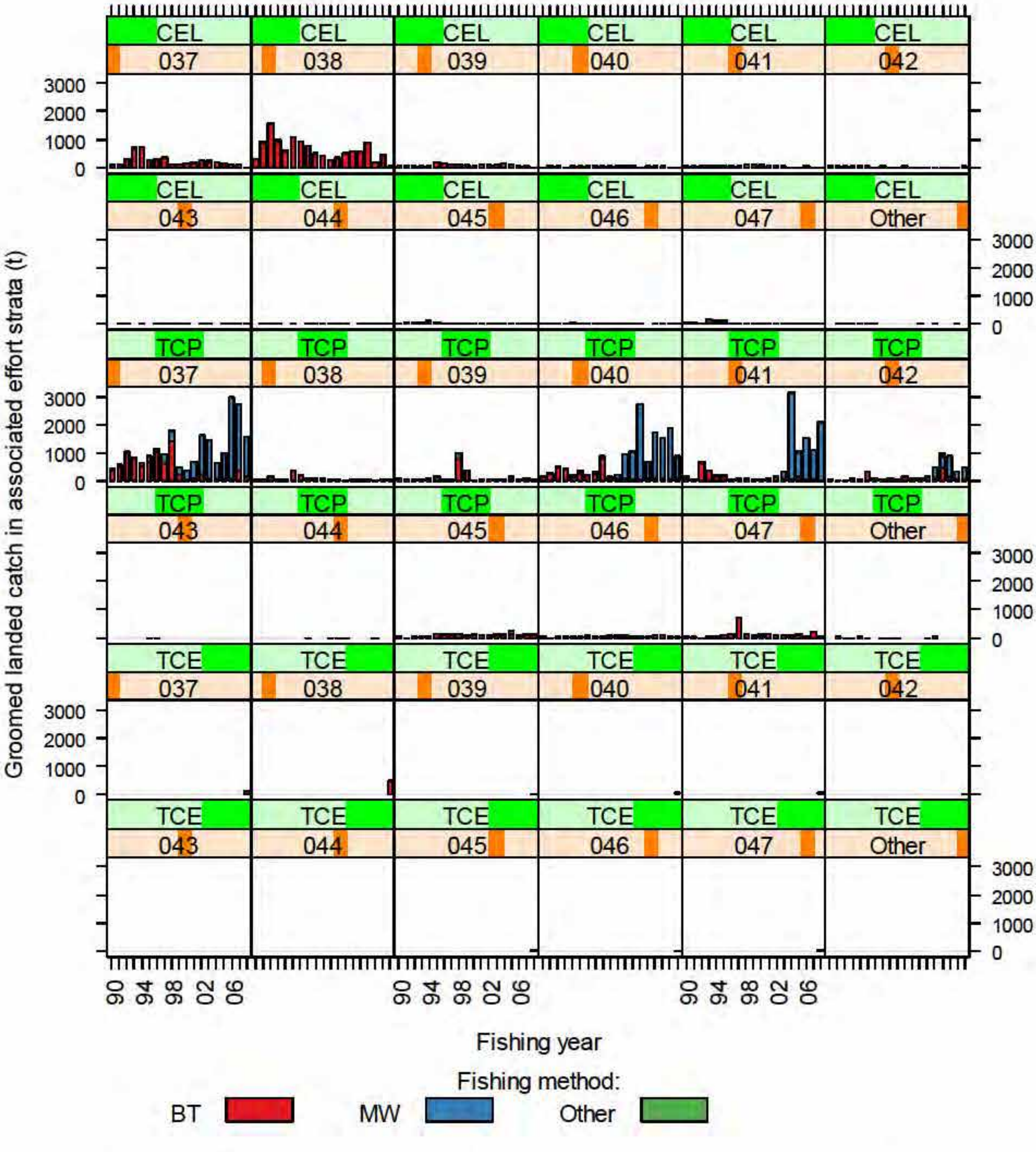


Figure C73a: Distribution of barracouta catch in the WCNI region in relation to form type (CEL, CELR; TCP, TCEPR; TCE, TCER) and statistical area by fishing method (bottom (BT), midwater (MW) trawl) for fishing years 1990–2008.

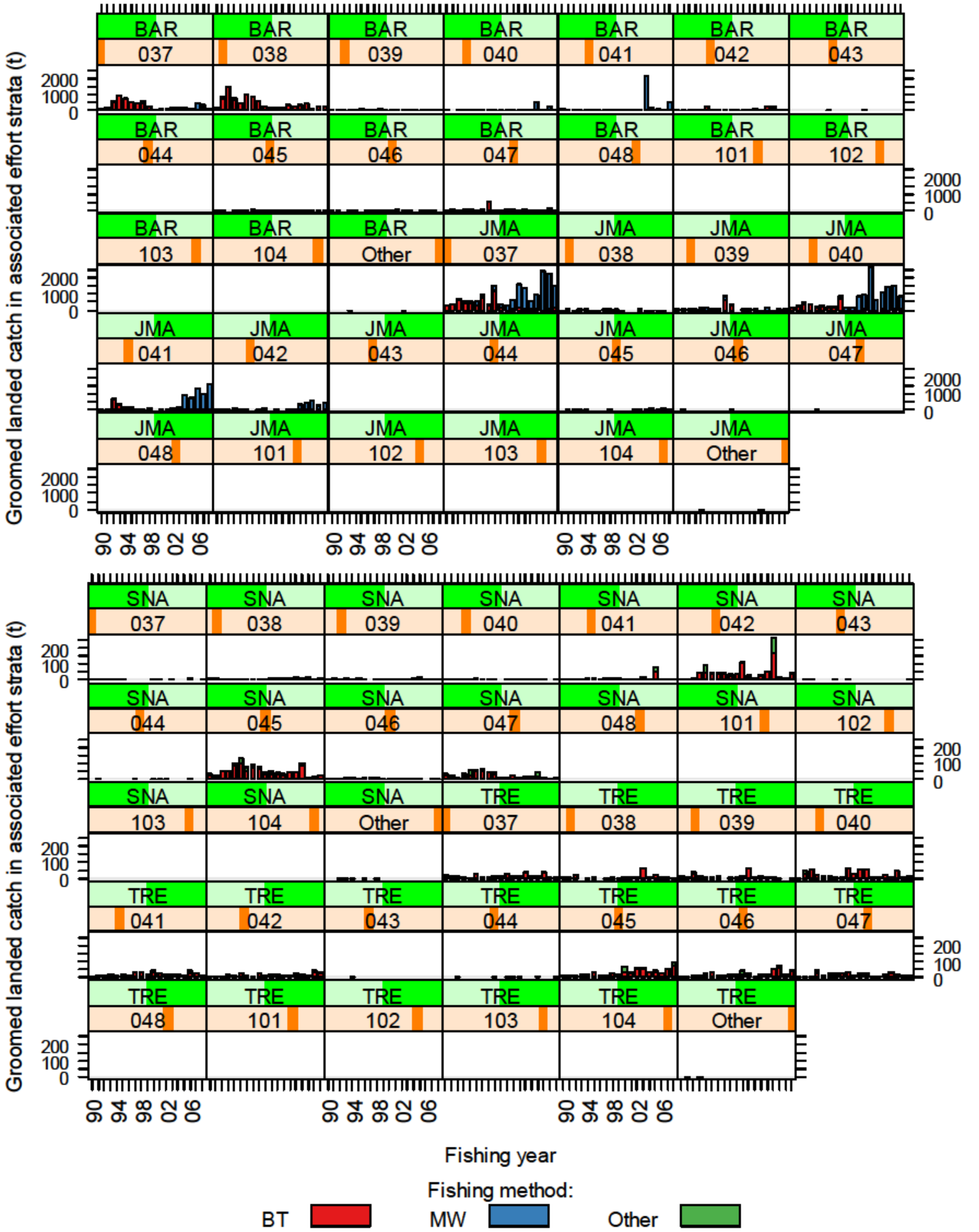


Figure C73b: Distribution of barracouta catch in the WCNI region in relation to target species and statistical area by fishing method (bottom (BT), midwater (MW) trawl) for fishing years 1990–2008.

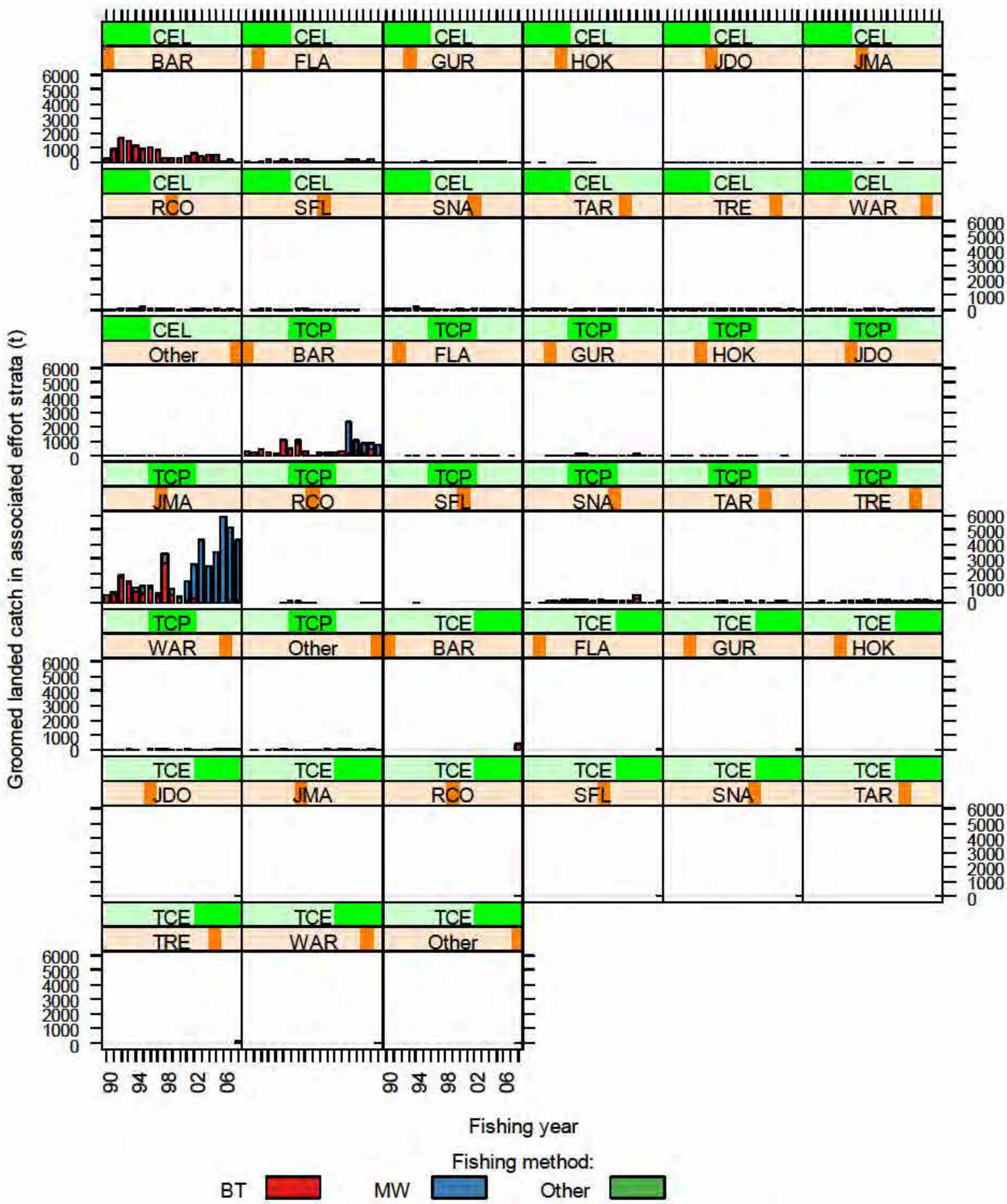


Figure C73c: Distribution of barracouta catch in the WCNI region in relation to form type (CEL, CELR; TCP, TCEPR; TCE, TCER) and target species by fishing method (bottom (BT), midwater (MW) trawl) for fishing years 1990–2008.

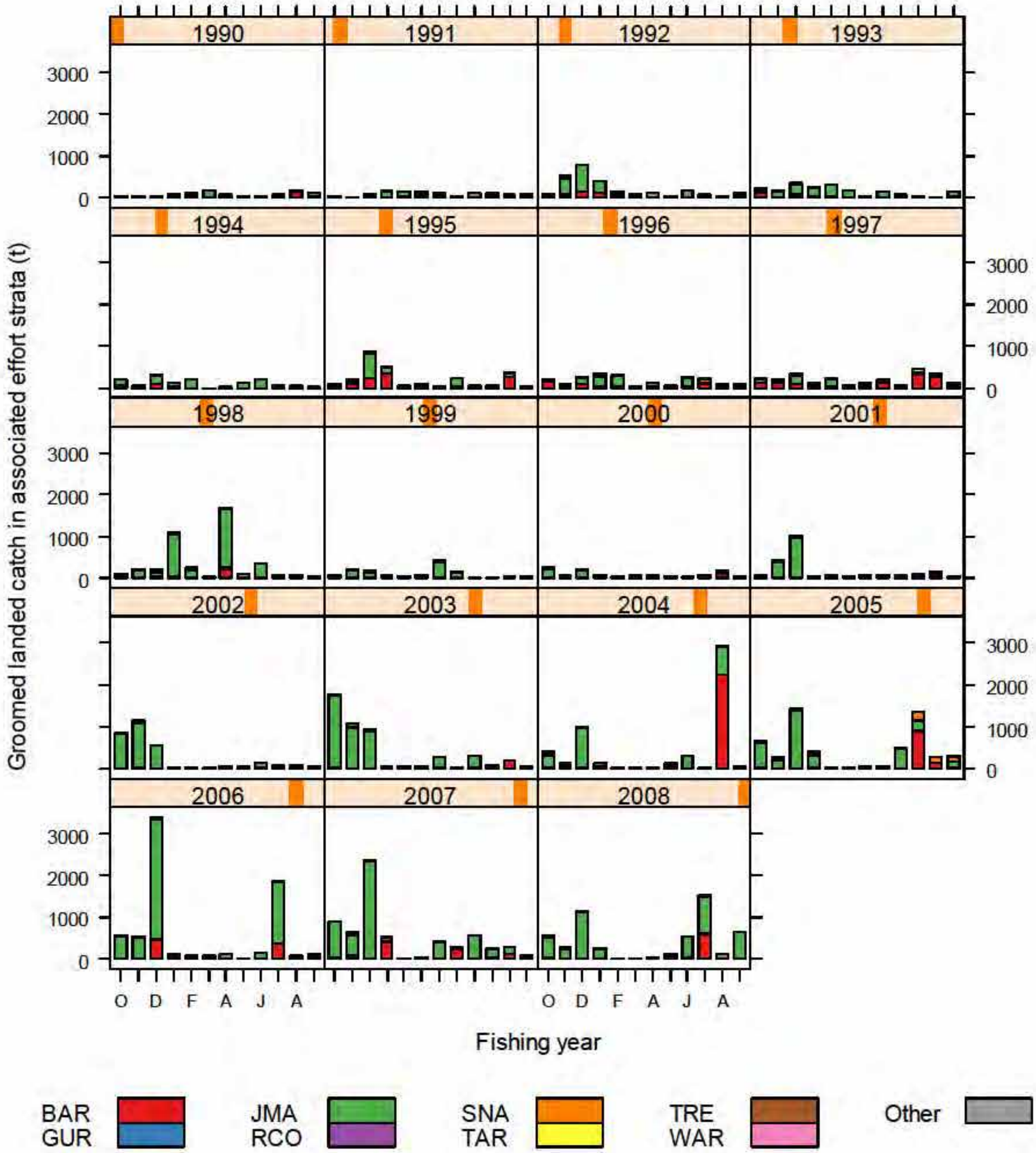


Figure C73d: Distribution of barracouta catch taken by bottom and midwater trawl in the WCNI region in relation to target species and month for fishing years 1990–2008.

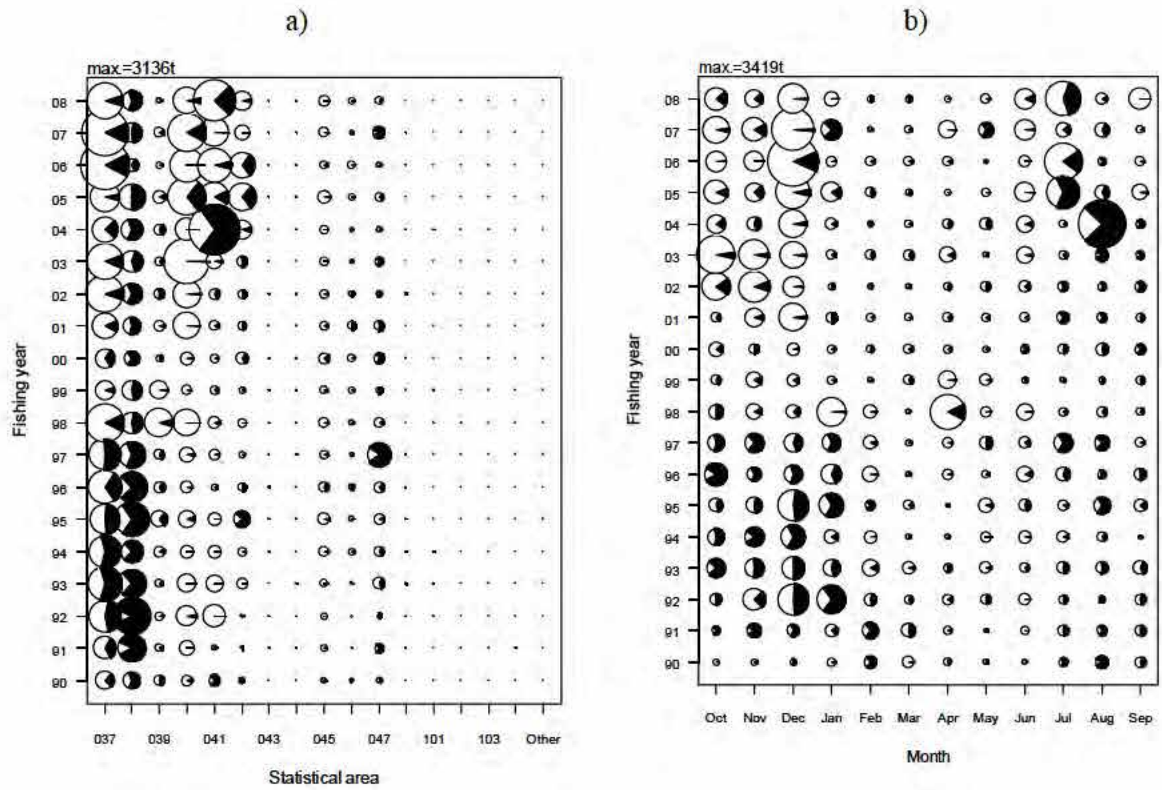


Figure C74: Distribution of barracouta catch taken by midwater and bottom trawl gear by fishing year with circle size proportional to the total catch and black portion of the pie indicating proportion of the catch as targeted barracouta by a) statistical area and b) month for the WCNI region.

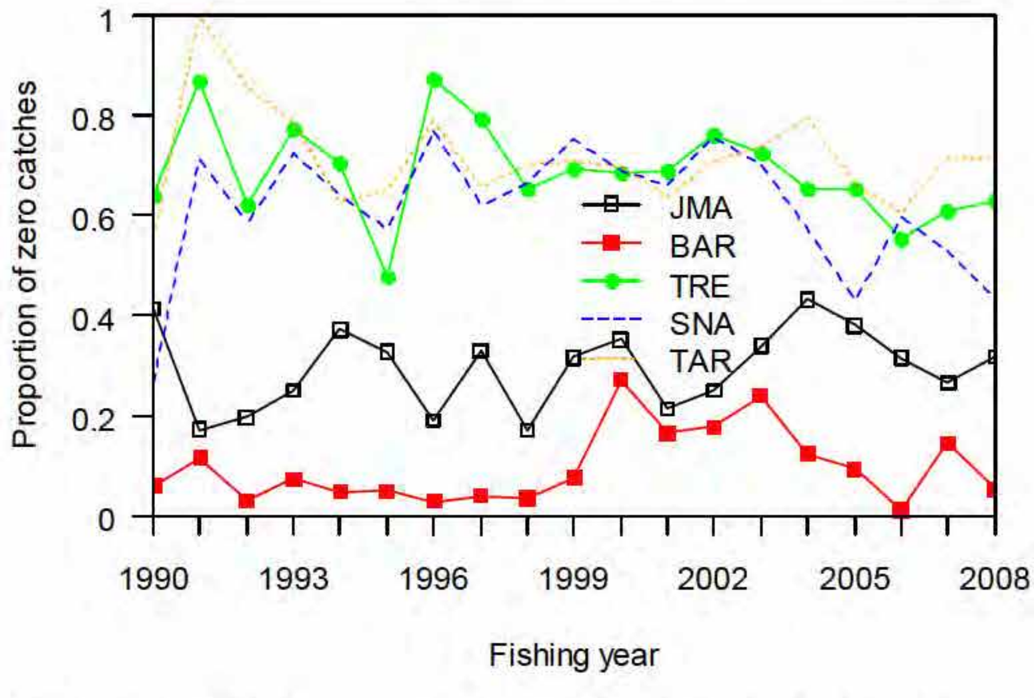


Figure C75: Proportion of TCEPR tows with zero reported barracouta catch for major target species for the WCNI region taken by midwater and bottom trawl gear.

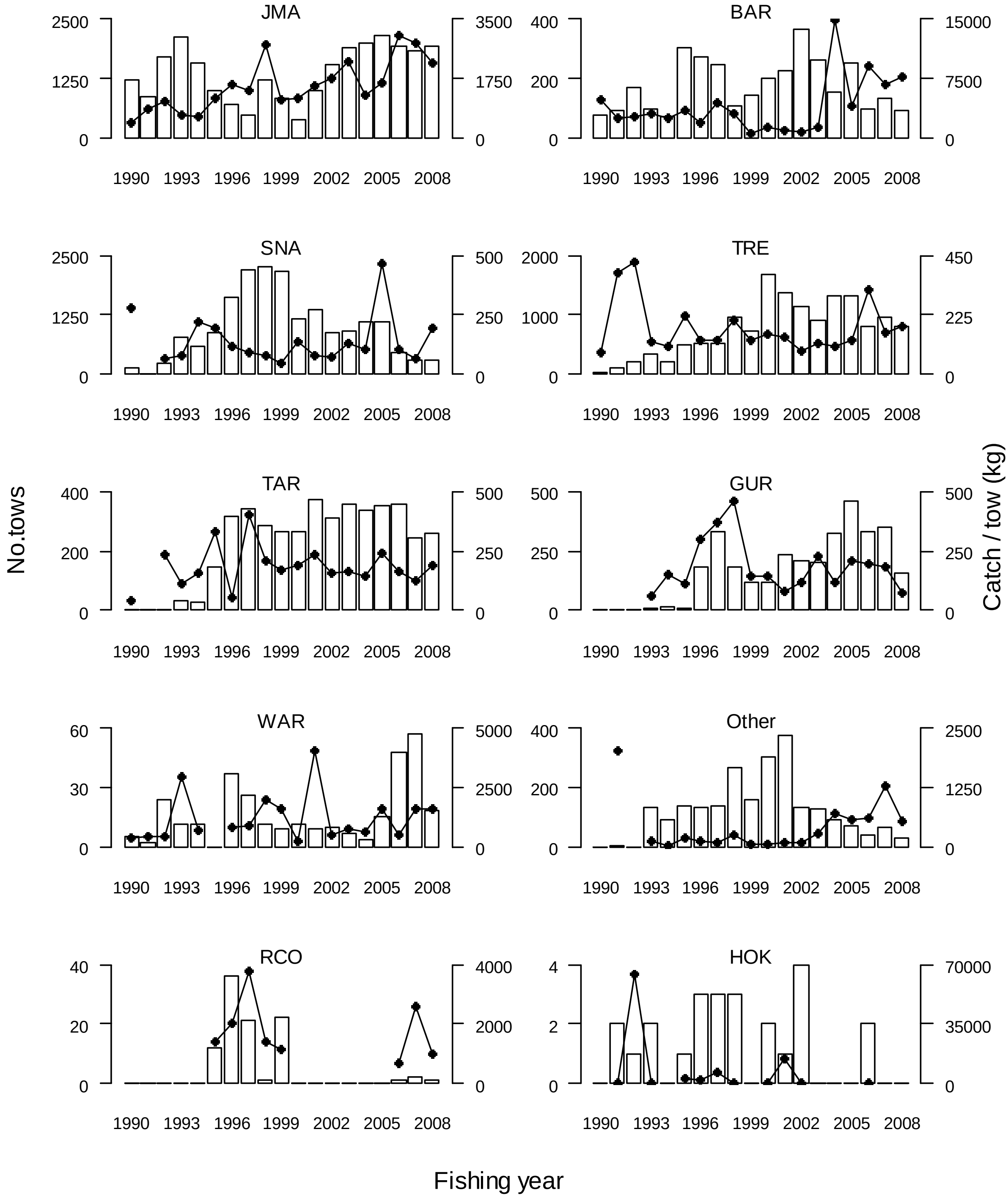


Figure C76: The number of tows (bars) that caught barracouta in the WCNI region taken by midwater and bottom trawl gear and the annual catch rate (lines) of barracouta by major target species.

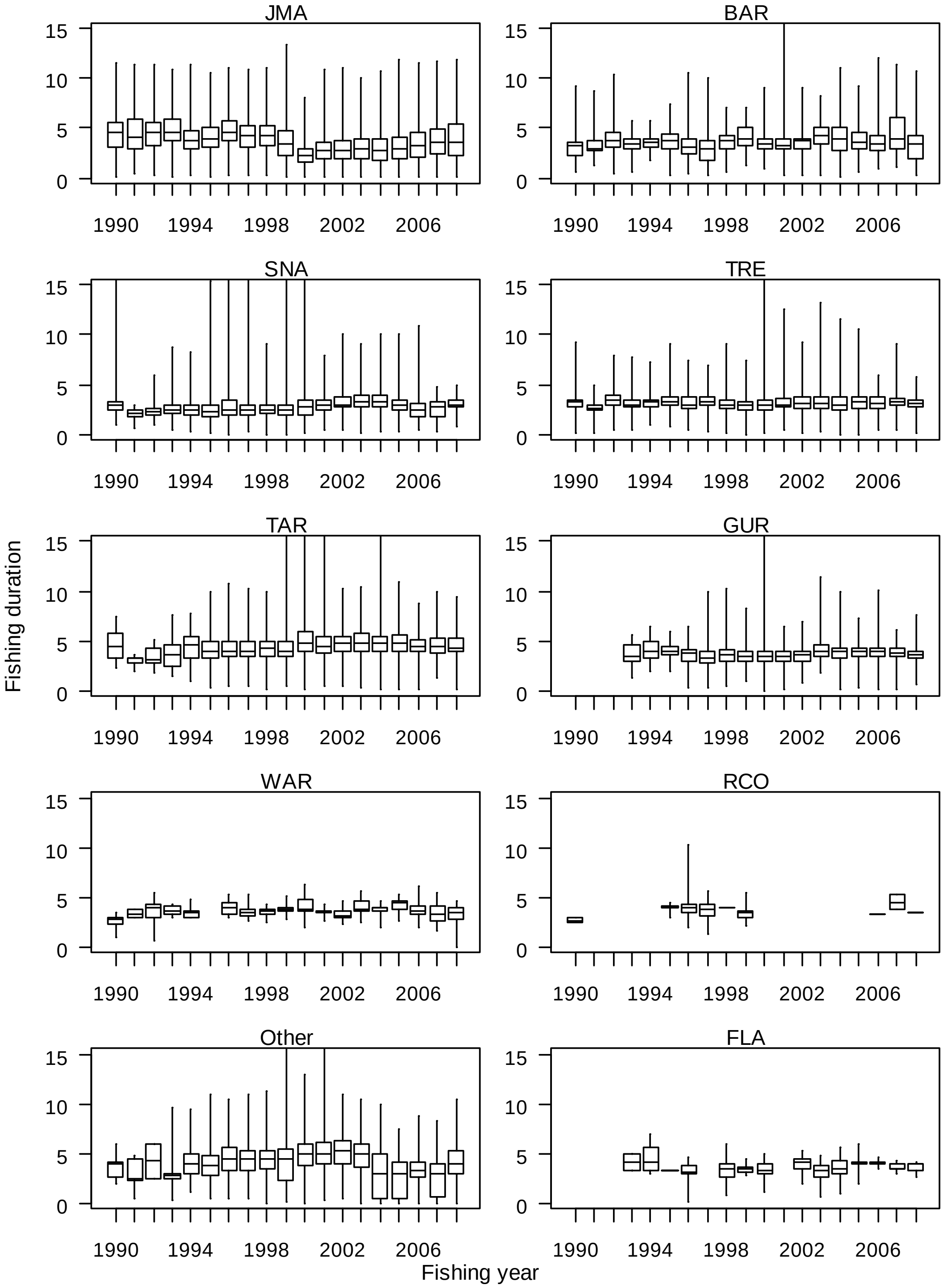


Figure C77: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) of midwater and bottom trawl tow durations (hours) reported for major target species catching barracouta in the WCNI region.

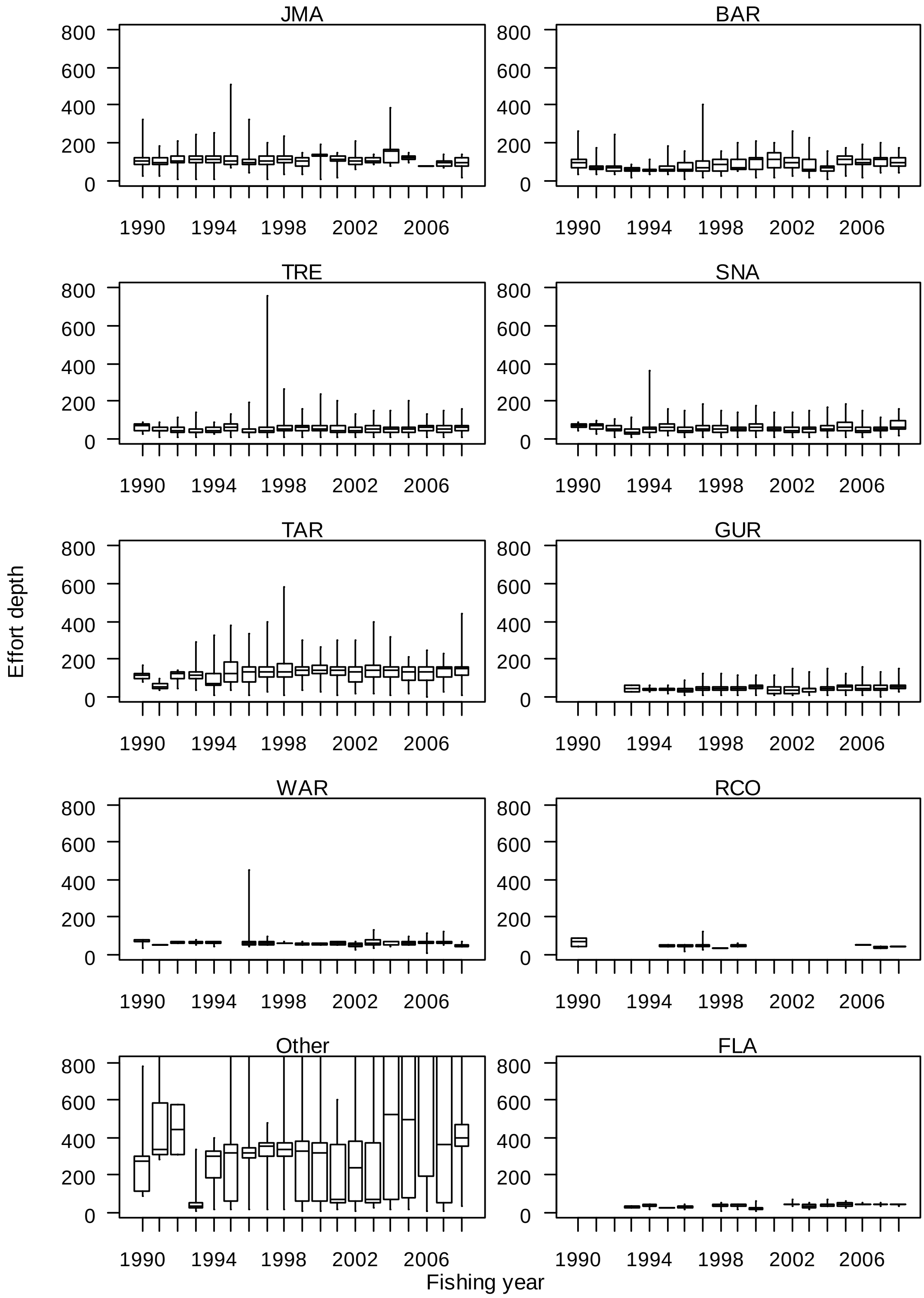


Figure C78a: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) of depths (m) fished by bottom trawl tows for major target species catching barracouta in the WCNI region.

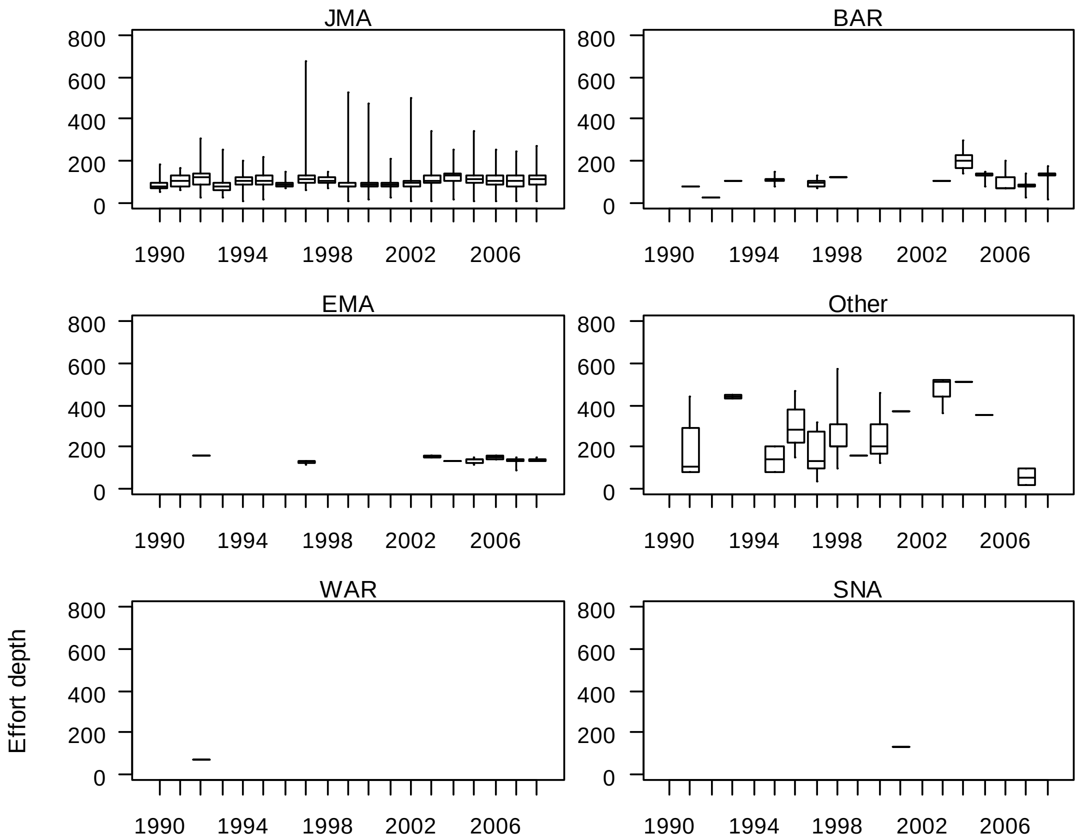


Figure C78b: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) of depths (m) fished by midwater tows for major target species catching barracouta in the WCNI region.

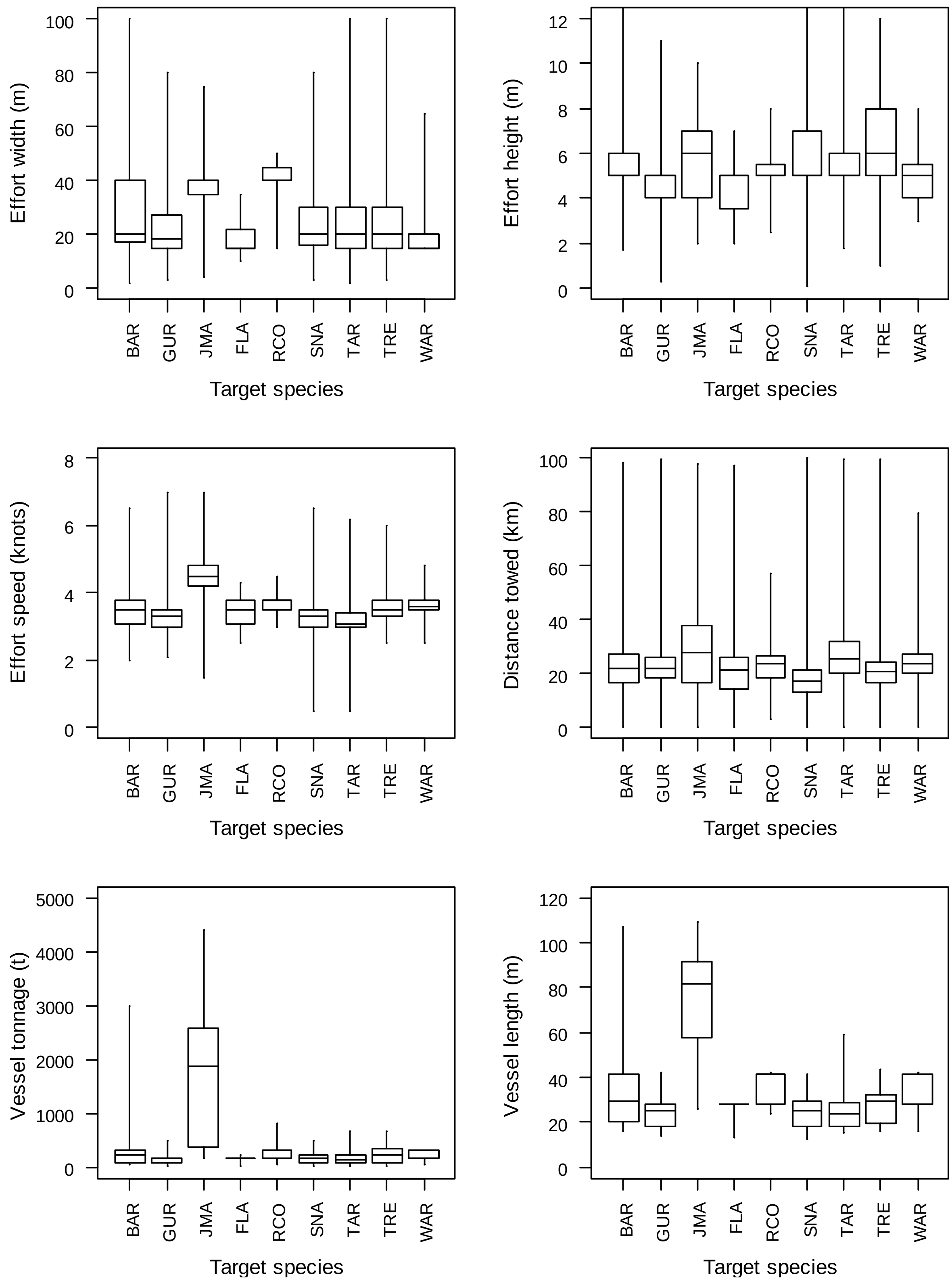


Figure C79: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) of fishing effort variables and vessel characteristics for bottom trawl tows for major target species catching barracouta in the WCNI region.

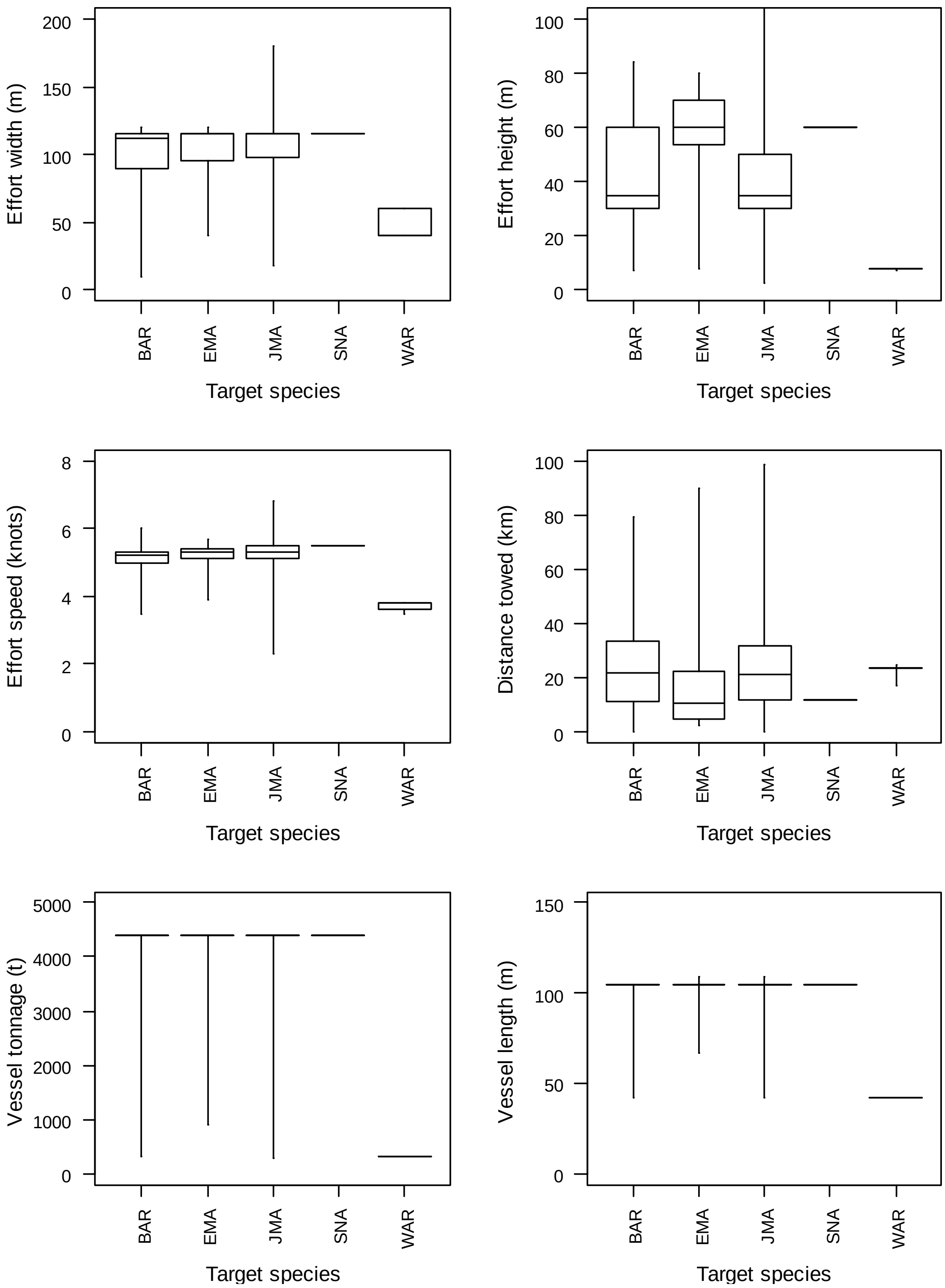


Figure C80: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) of fishing effort variables and vessel characteristics for midwater trawl tows for major target species catching barracouta in the WCNI region.

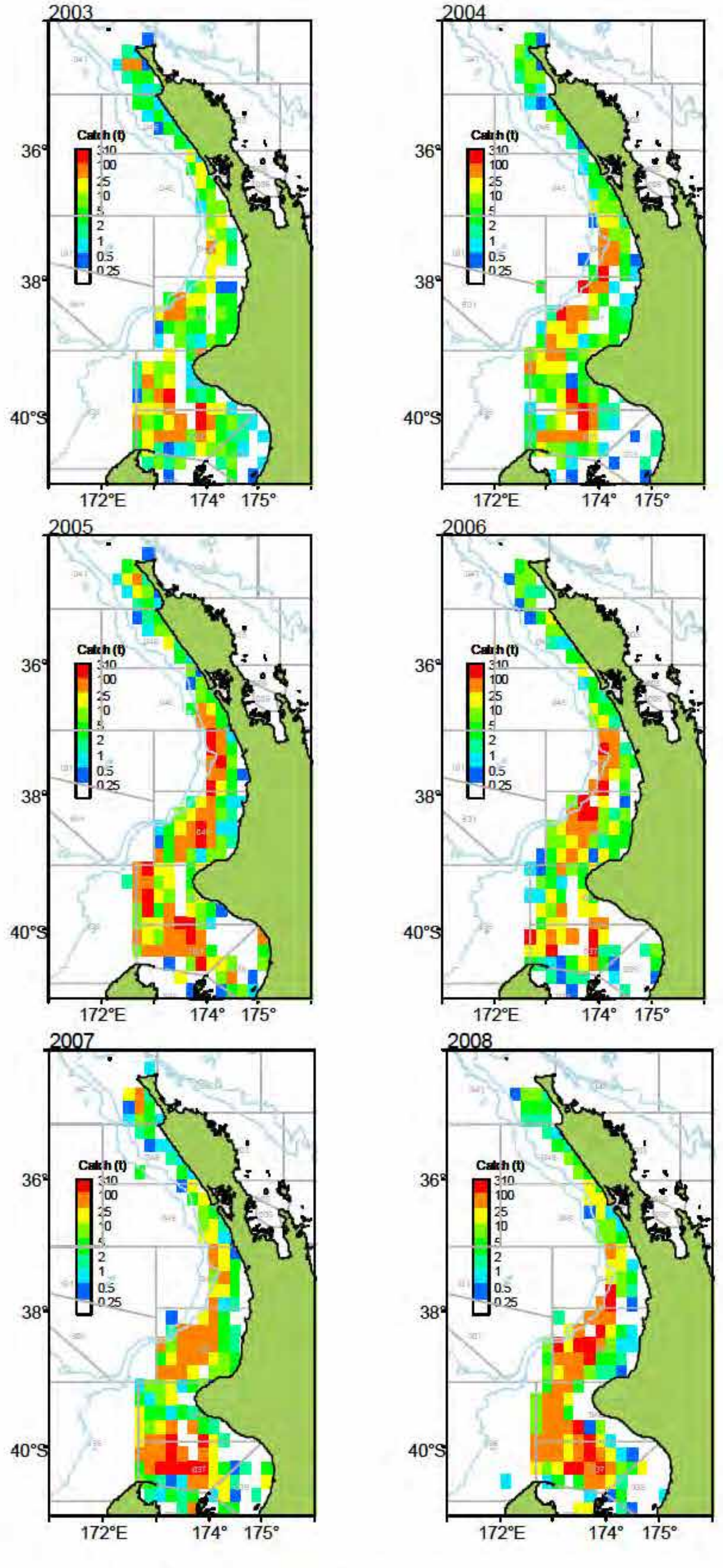


Figure C81a: Distribution of barracouta catch within the WCNI region aggregated into 0.2 degree spatial blocks for fishing years 2003–2008 reported on TCEPR forms and using midwater and bottom trawl gear.

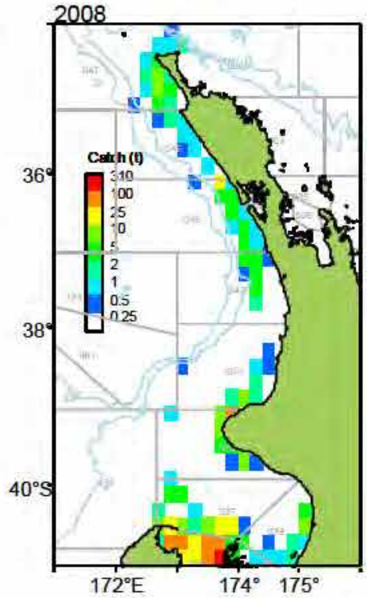


Figure C81b: Distribution of barracouta catch within the WCNI region aggregated into 0.2 degree spatial blocks for the fishing year 2008 reported on TCER forms and using midwater and bottom trawl gear.

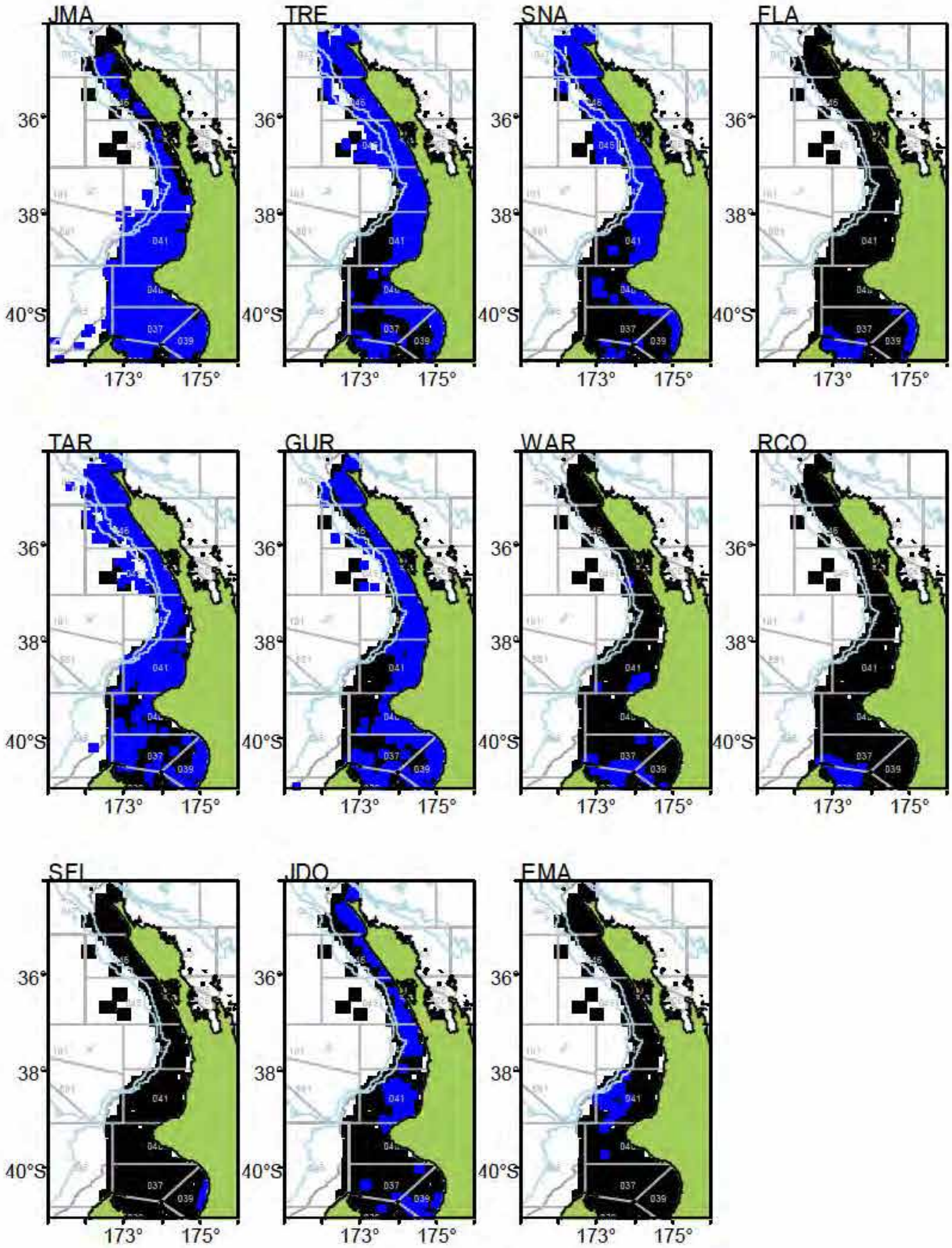


Figure C82: Comparison of the distribution of bottom and midwater trawls in the WCNI region by target species for the main target species (blue cells) overlaid on the distribution of barracouta target effort distribution (black cells), for all years combined.

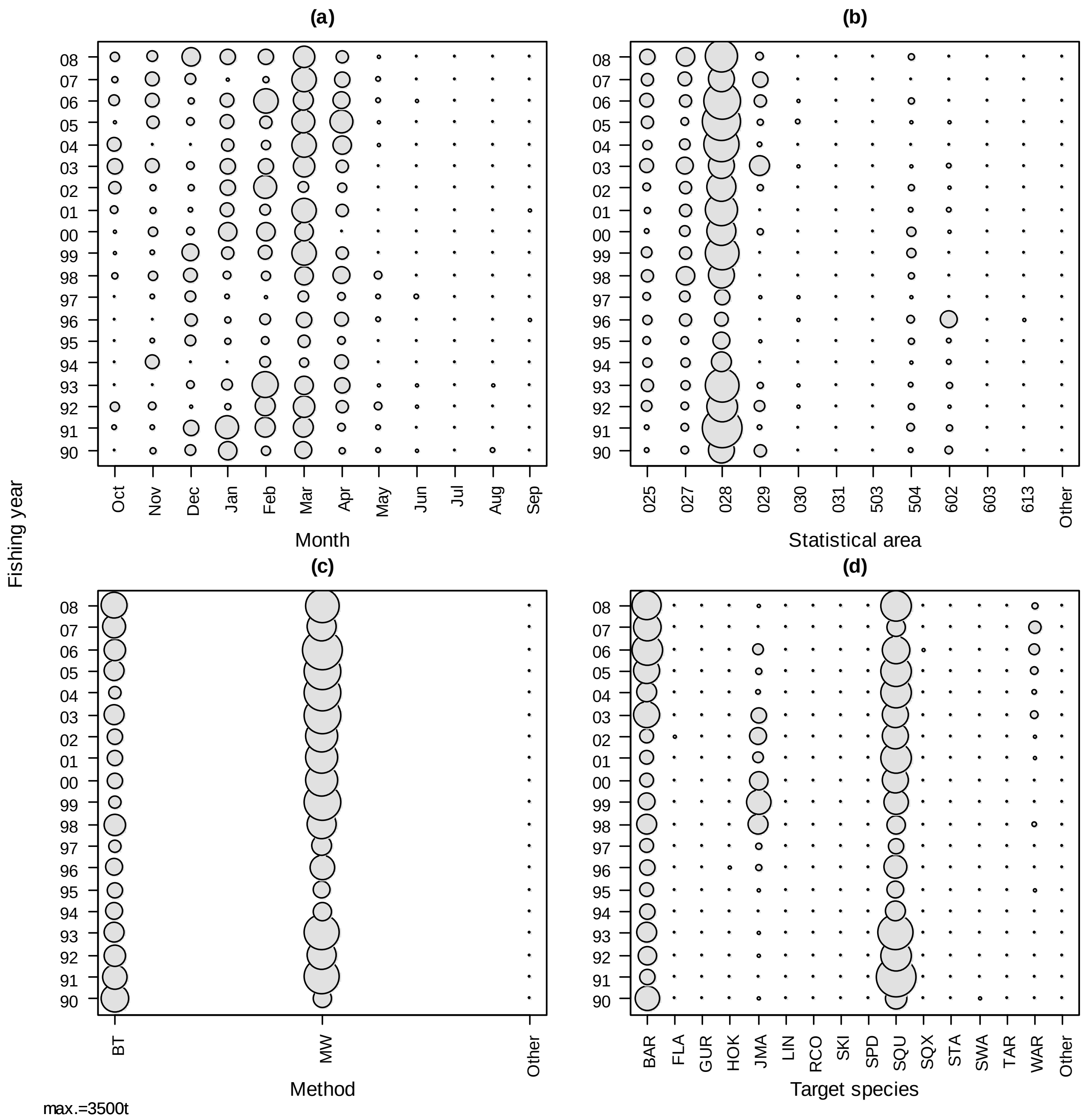


Figure C83: Distribution of barracouta catch in the SNARES SHELF AND SUB ANTARCTIC region for the 1990–2008 fishing years in relation to a) month, b) statistical area, c) fishing method, and d) target species. Circle size is proportional to catch; maximum circle size is indicated in lower left hand corner.

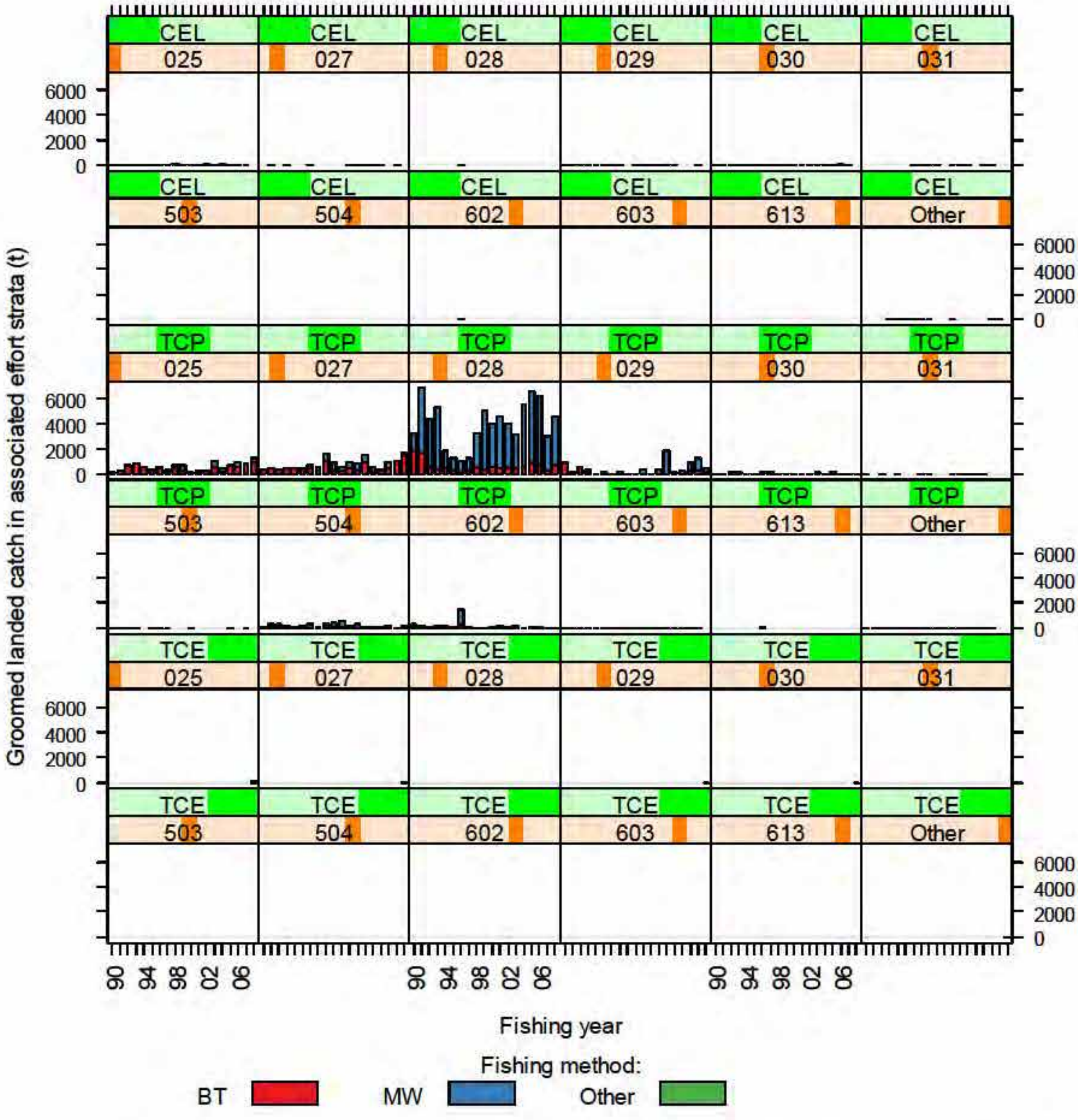


Figure C84a: Distribution of barracouta catch in the SNARES SHELF AND SUB ANTARCTIC region in relation to form type (CEL, CELR; TCP, TCEPR; TCE, TCER) and statistical area by fishing method (bottom (BT), midwater (MW) trawl) for fishing years 1990–2008.

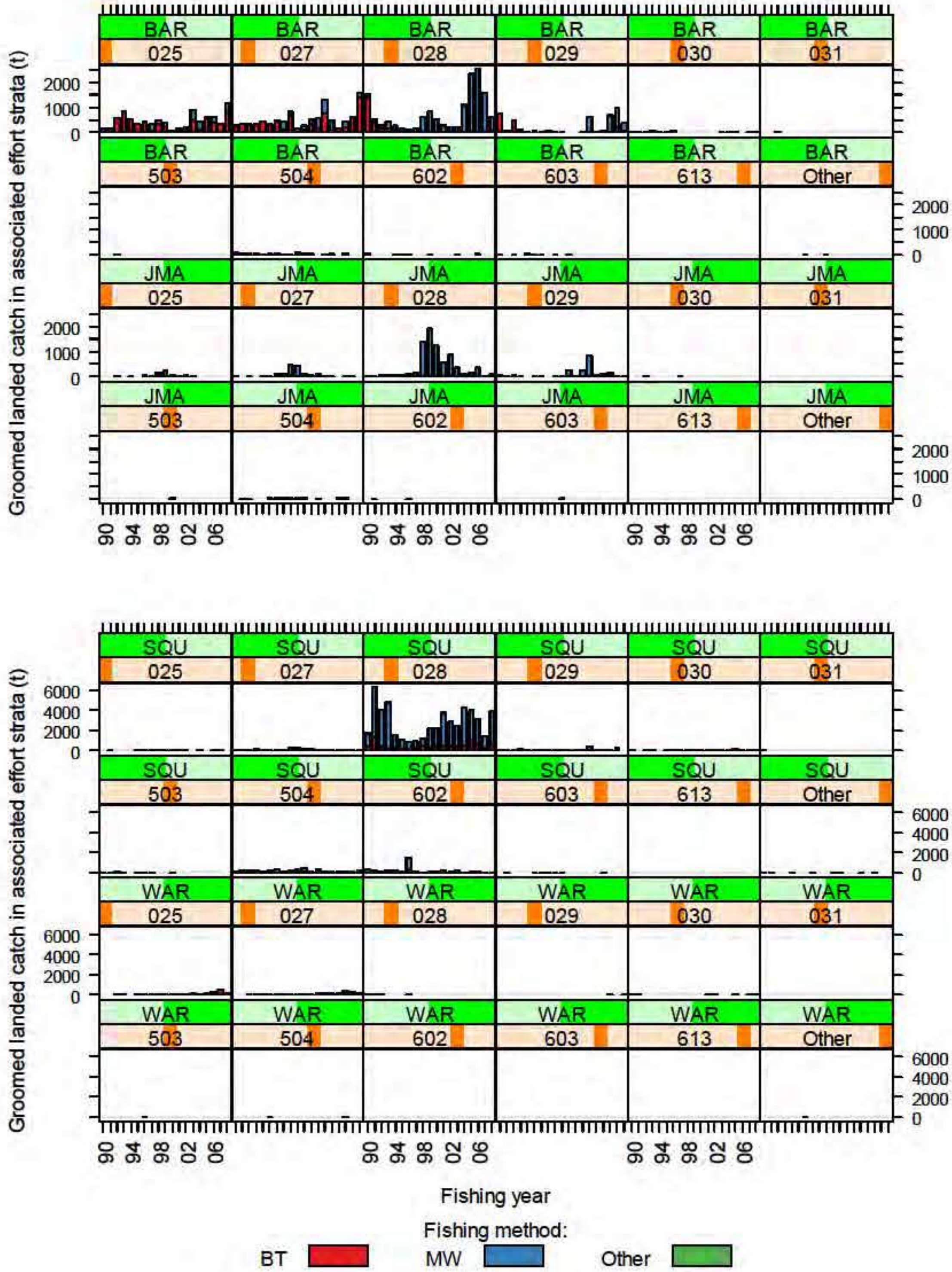


Figure C84b: Distribution of barracouta catch in the SNARES SHELF AND SUB ANTARCTIC region in relation to statistical area and major target species by fishing method (bottom (BT), midwater (MW) trawl) for fishing years 1990–2008.

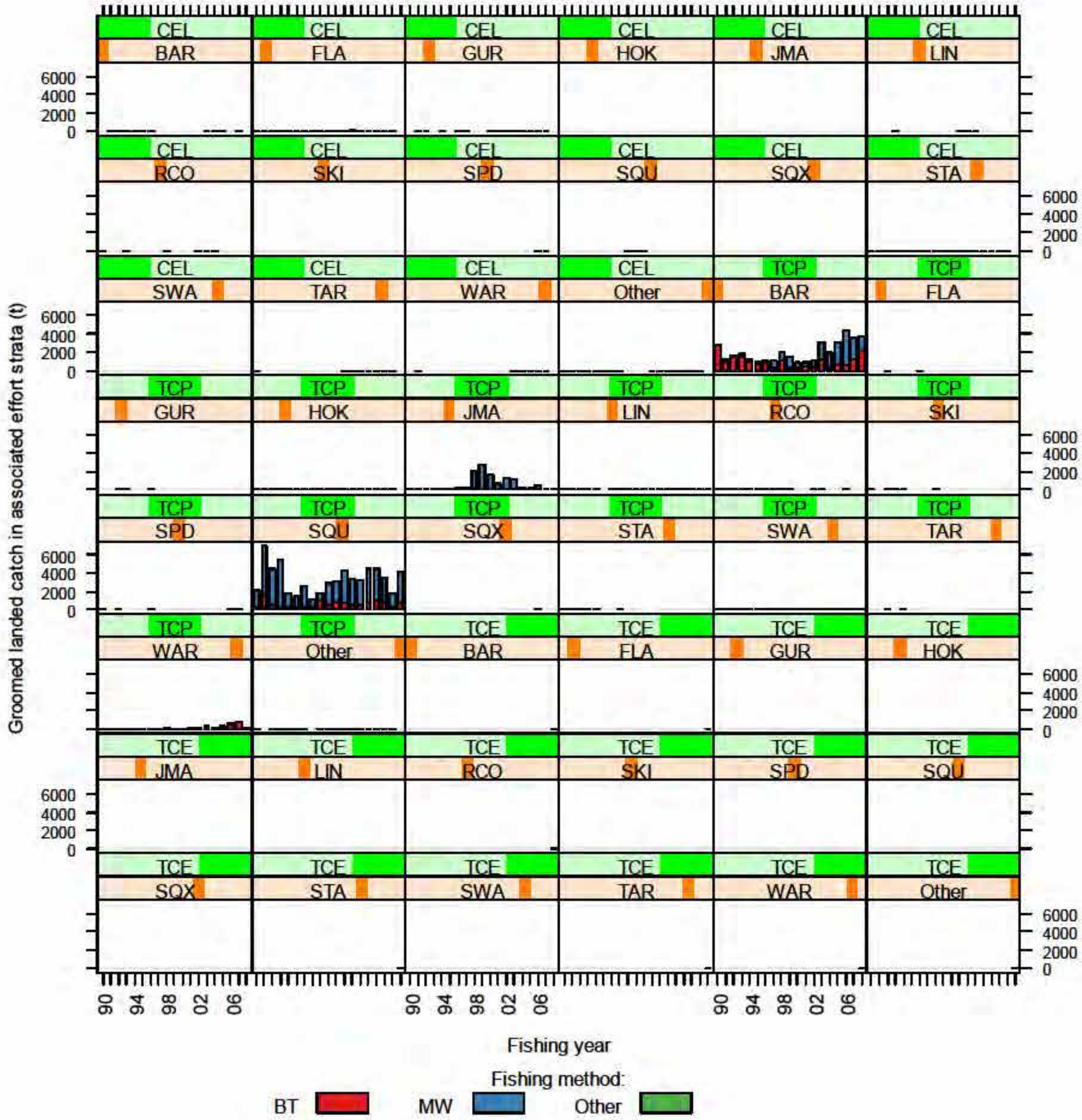


Figure C84c: Distribution of barracouta catch in the SNARES SHELF AND SUB ANTARCTIC region in relation to form type (CEL, CELR; TCP, TCEPR; TCE, TCER) and target species by fishing method (bottom (BT), midwater (MW) trawl) for fishing years 1990–2008.

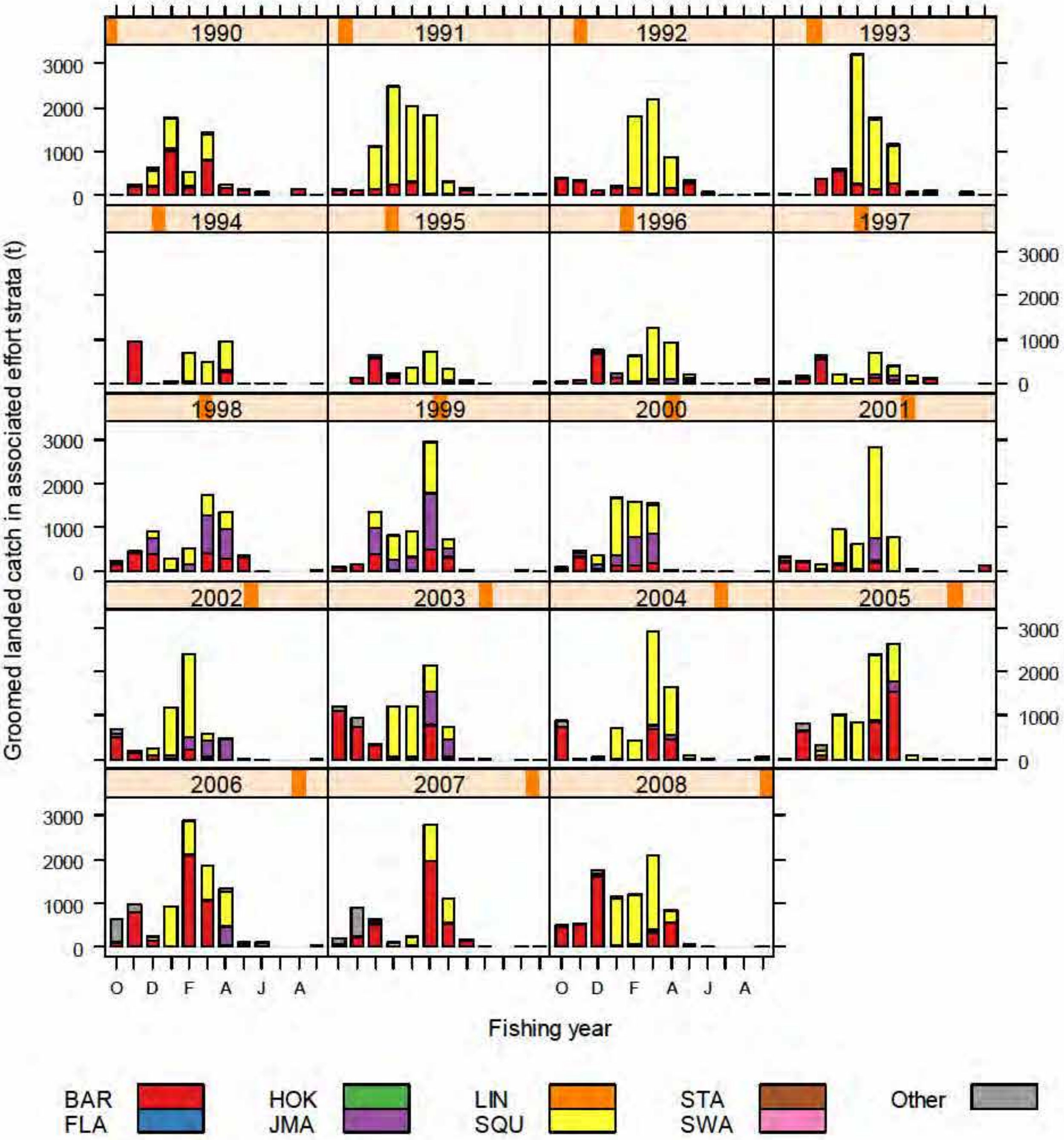


Figure C84d: Distribution of barracouta catch taken by bottom and midwater trawl in the SNARES SHELF AND SUB ANTARCTIC region in relation to target species and month for fishing years 1990–2008.

a) b)

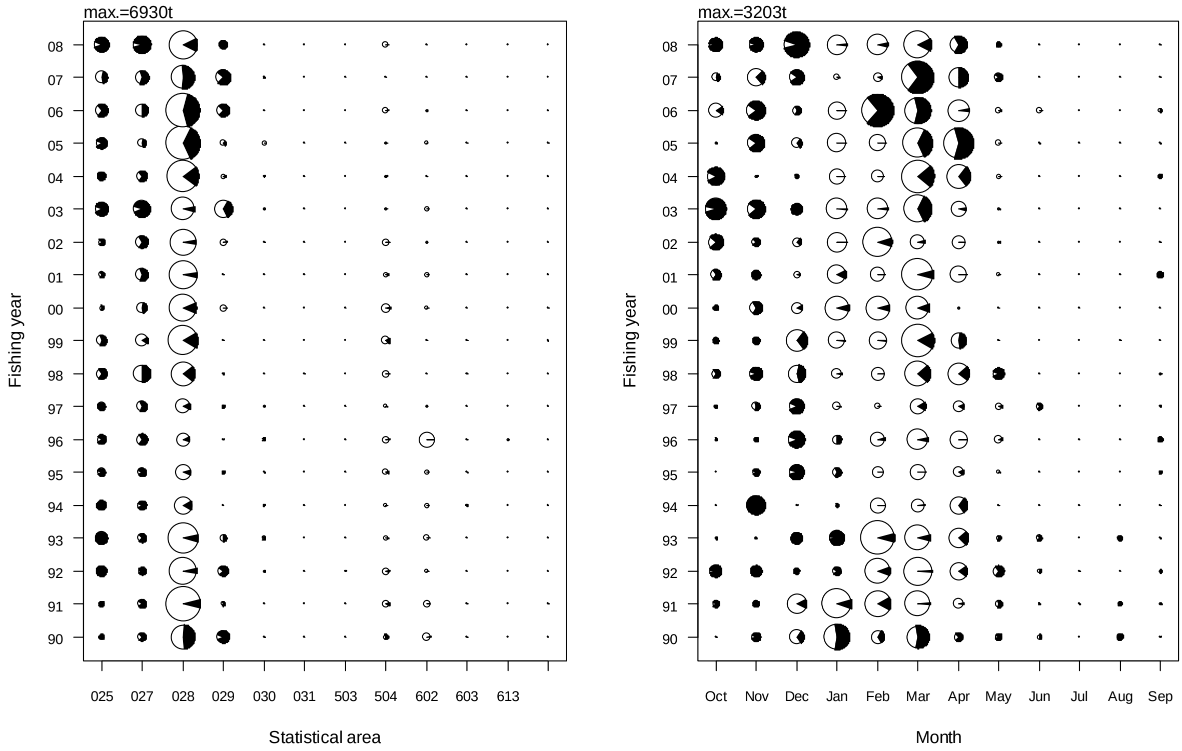


Figure C85: Distribution of barracouta catch taken by midwater and bottom trawl gear by fishing year with circle size proportional to the total catch and black portion of the pie indicating proportion of the catch as targeted barracouta by a) statistical area and b) month for the SNARES SHELF AND SUB ANTARCTIC region.

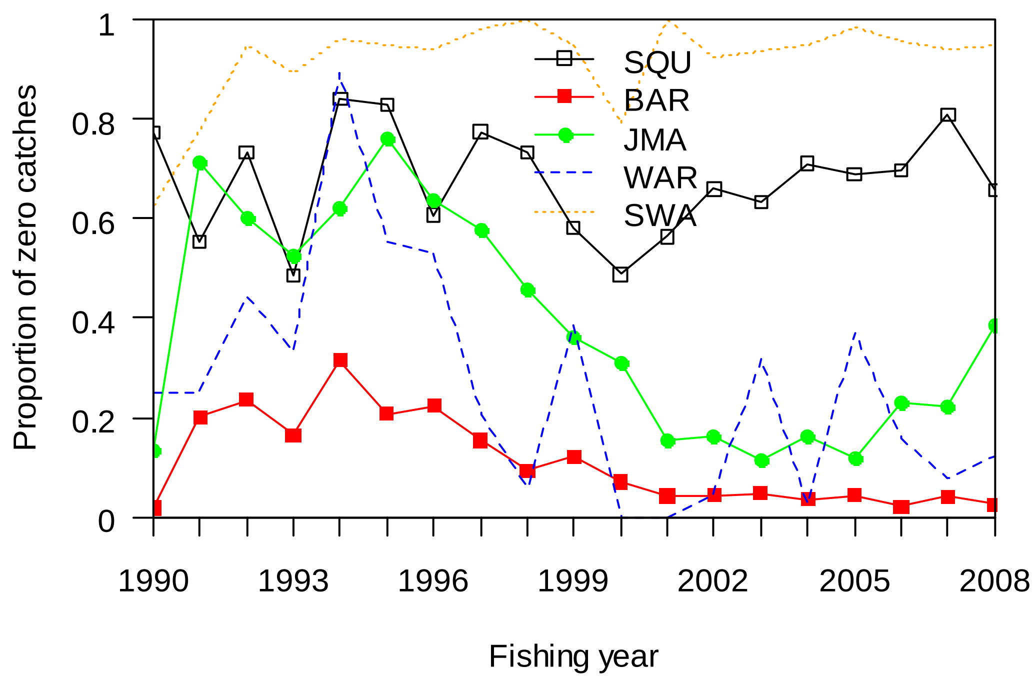


Figure C86: Proportion of TCEPR tows with zero reported barracouta catch for major target species for the SNARES SHELF AND SUB ANTARCTIC region taken by midwater and bottom trawl gear.

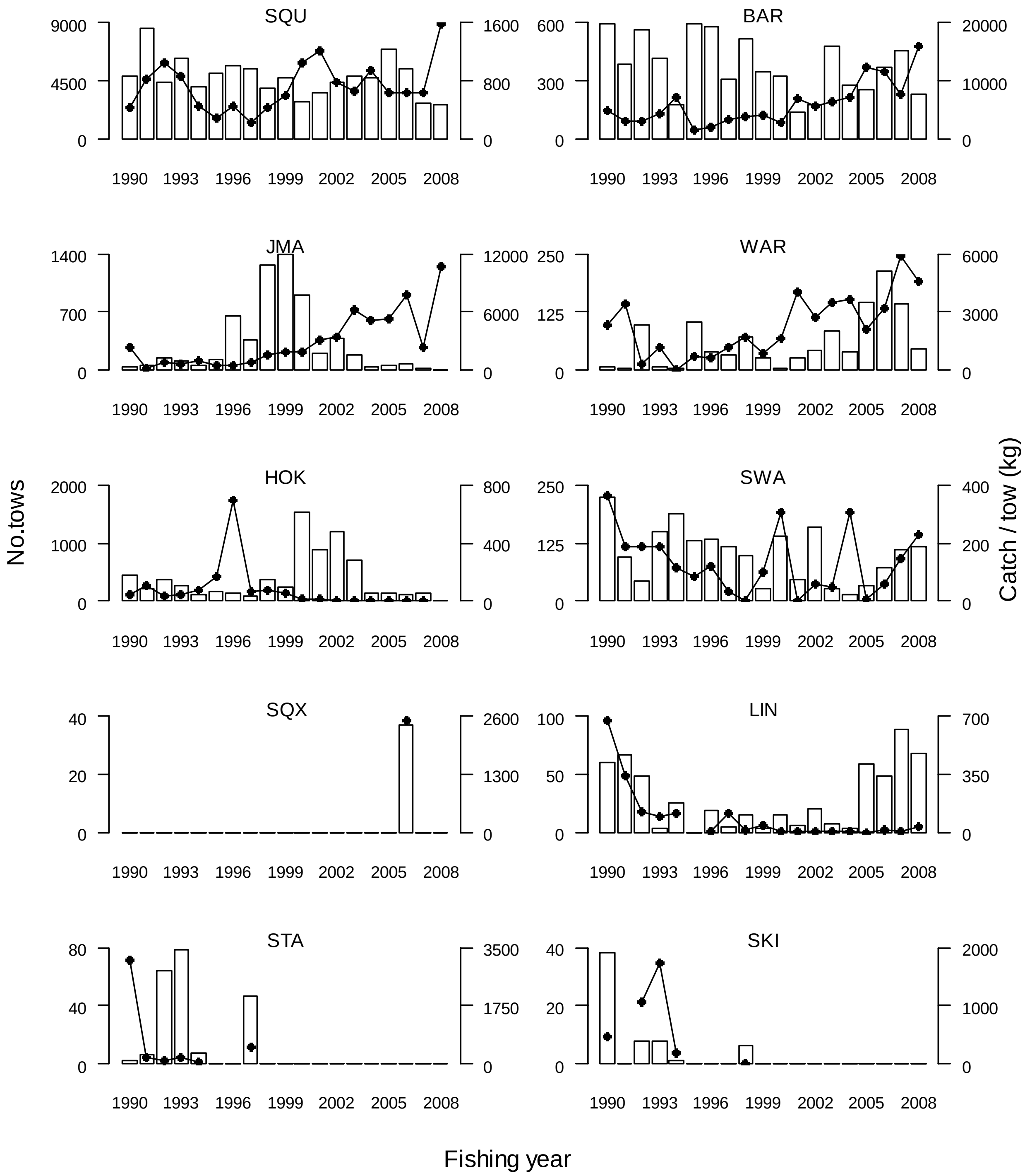


Figure C87: The number of tows (bars) that caught barracouta in the SNARES SHELF AND SUB ANTARCTIC region taken by midwater and bottom trawl gear and the annual catch rate (lines) of barracouta by major target species.

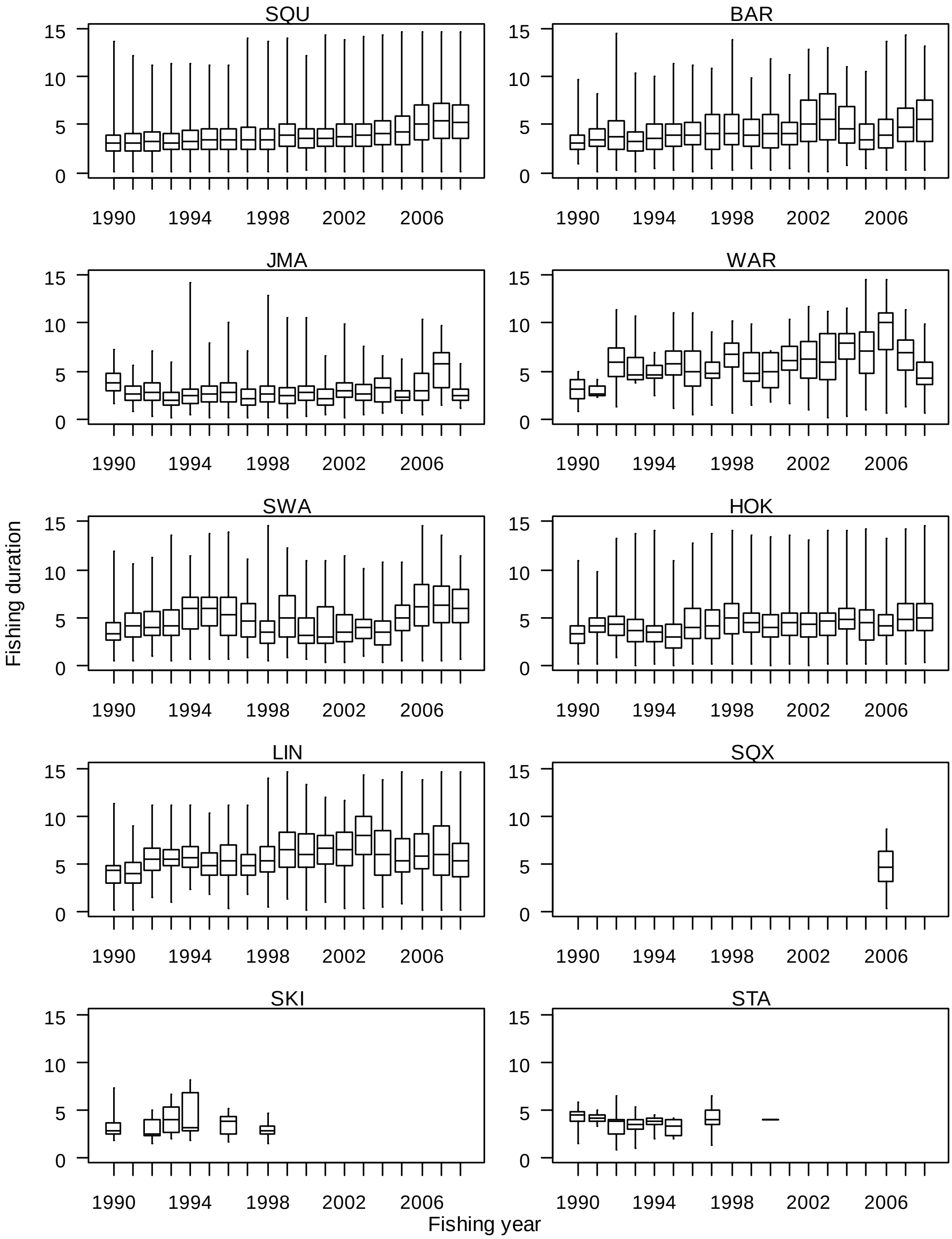


Figure C88: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) of midwater and bottom trawl tow durations (hours) reported for major target species catching barracouta in the SNARES SHELF AND SUB ANTARCTIC region.

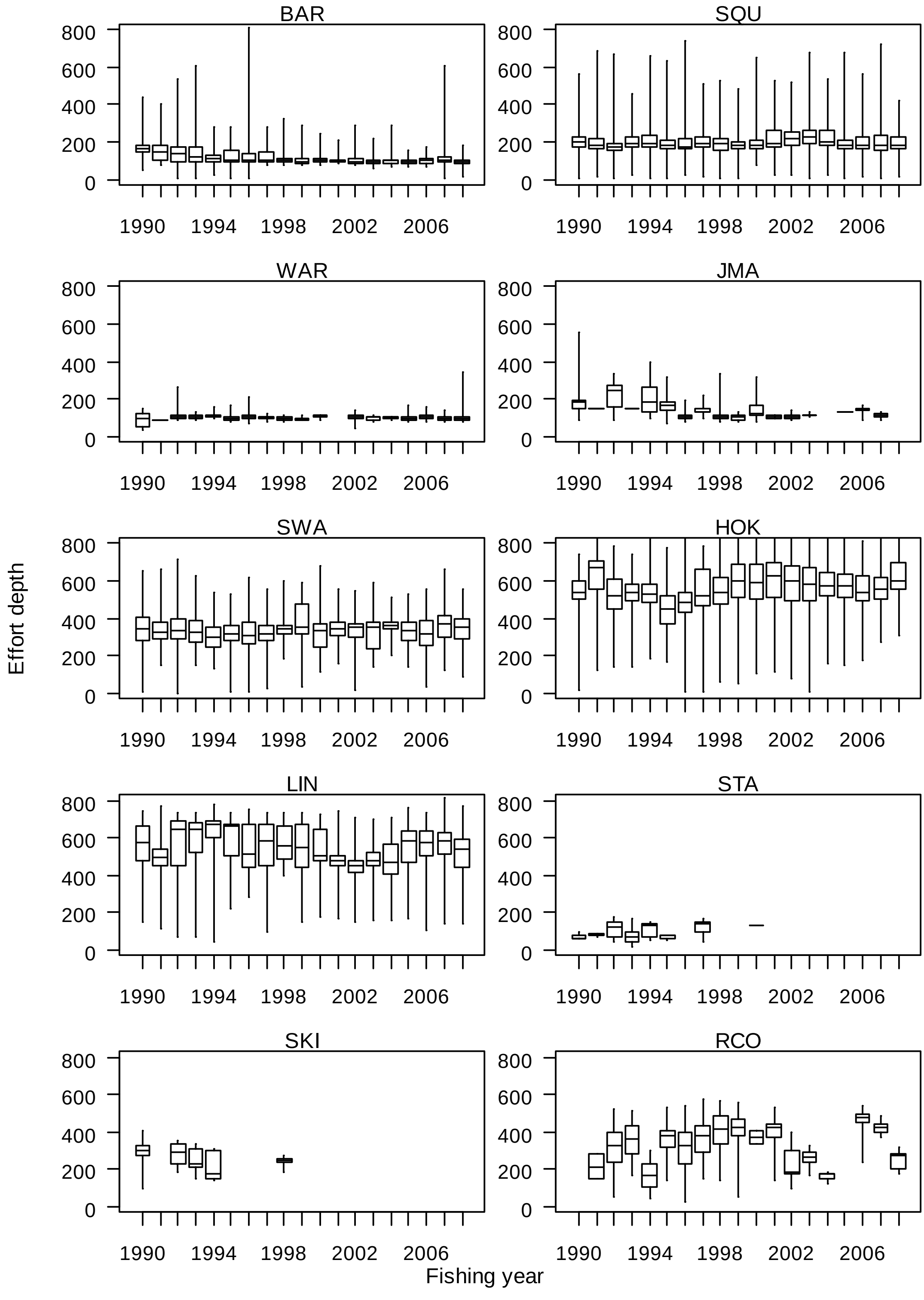


Figure C89a: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) of depths (m) fished by bottom trawl tows for major target species catching barracouta in the SNARES SHELF AND SUB ANTARCTIC region.

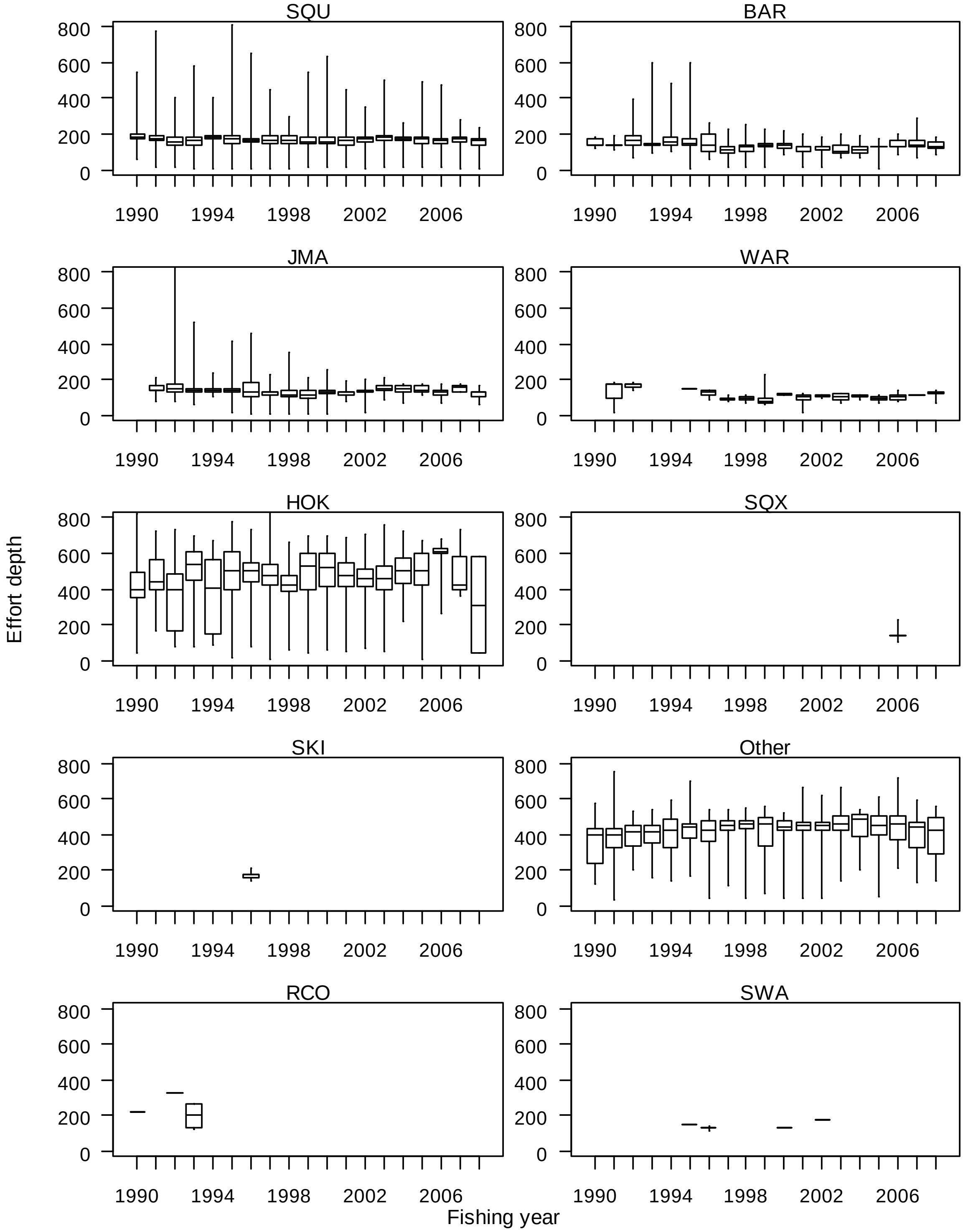


Figure C89b: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) of depths (m) fished by midwater tows for major target species catching barracouta in the SNARES SHELF AND SUB ANTARCTIC region.

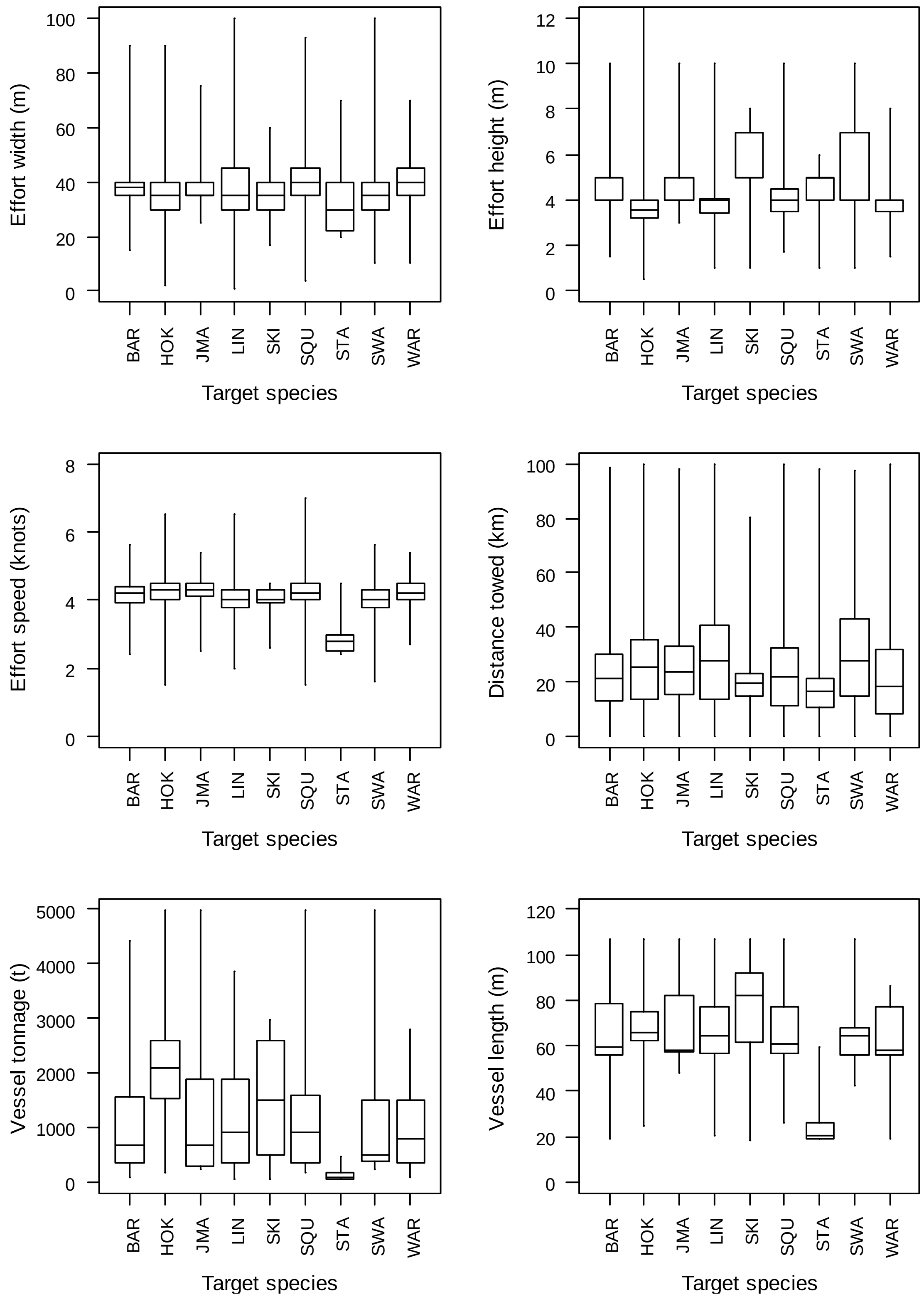


Figure C90: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) of fishing effort variables and vessel characteristics for bottom trawl tows for major target species catching barracouta in the SNARES SHELF AND SUB ANTARCTIC region.

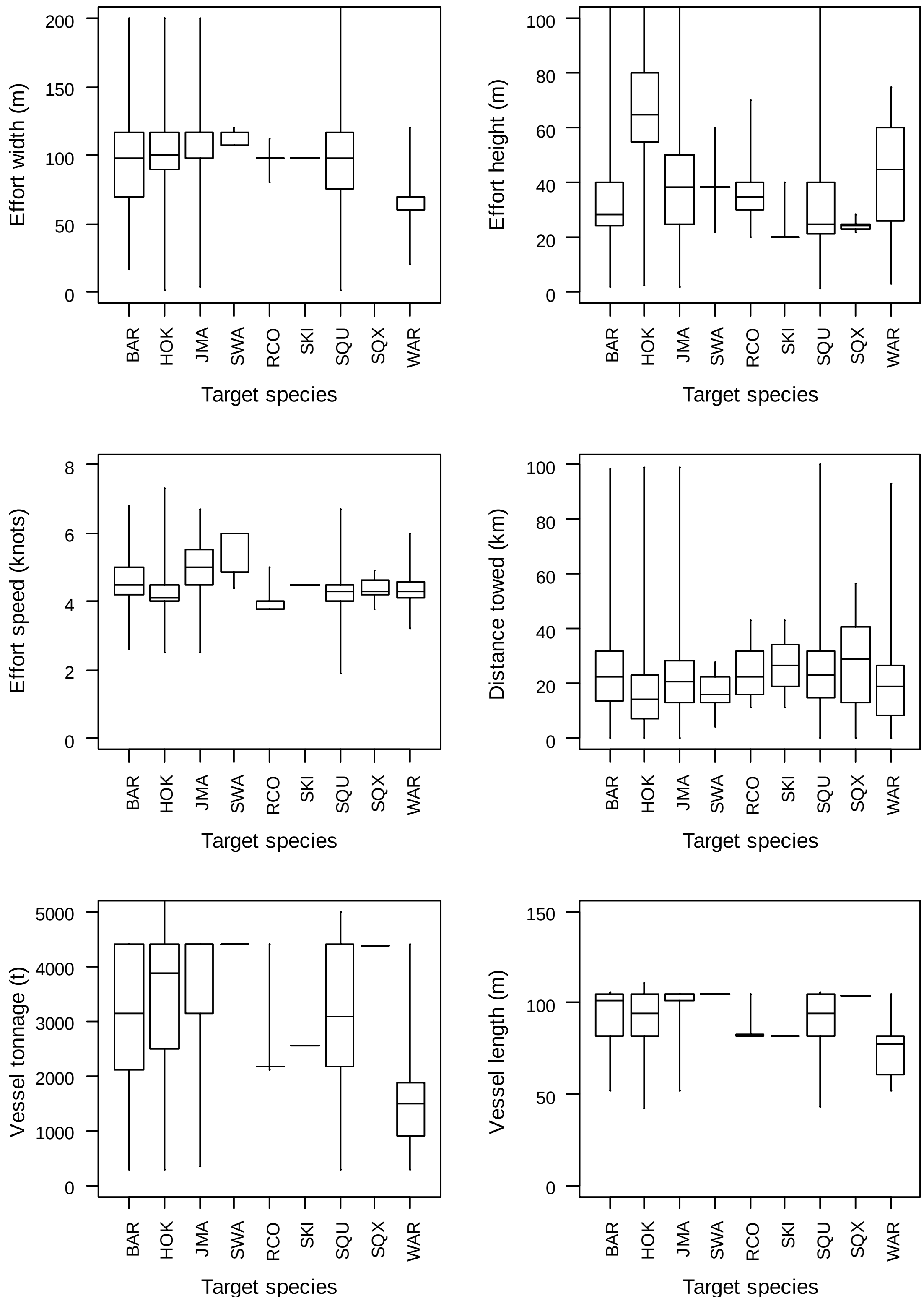


Figure C91: Annual median (horizontal line), inter-quartile ranges (box), and range (vertical lines) of fishing effort variables and vessel characteristics for midwater trawl tows for major target species catching barracouta in the SNARES SHELF AND SUB ANTARCTIC region.

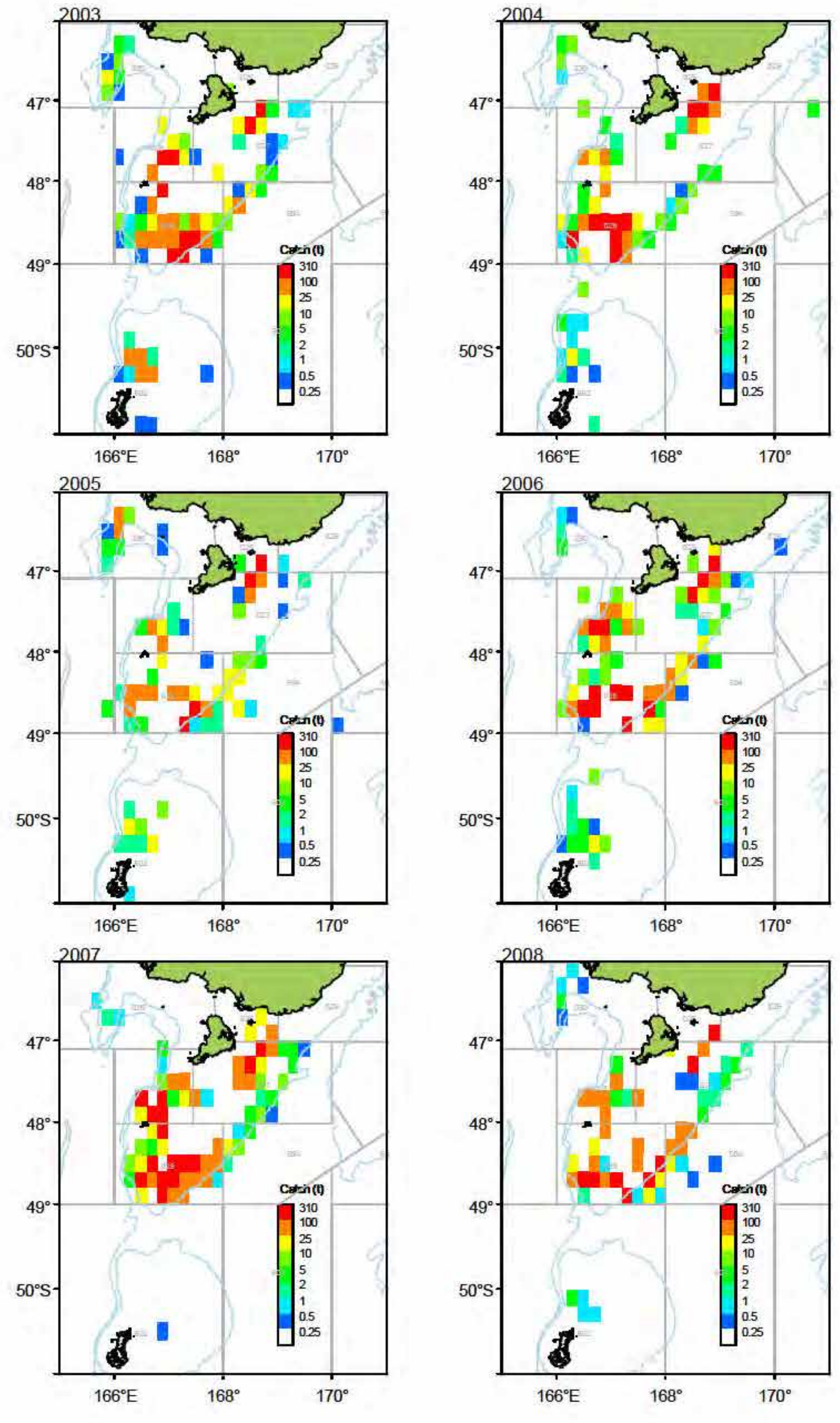


Figure C92a: Distribution of barracouta catch within the SNARES SHELF AND SUB ANTARCTIC region aggregated into 0.2 degree spatial blocks for fishing years 2003–2008 reported on TCEPR forms and using midwater and bottom trawl gear.

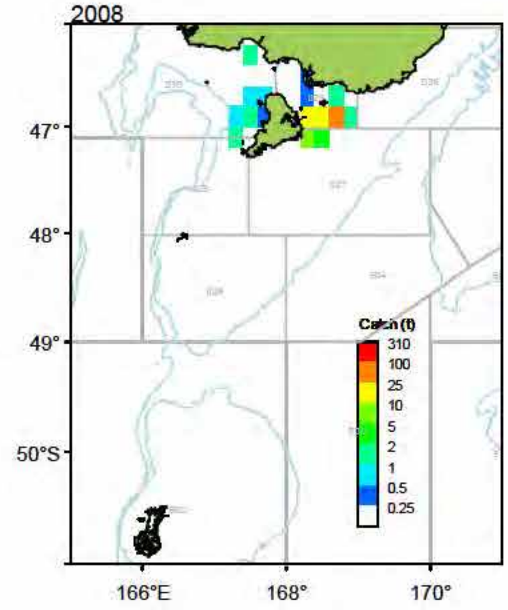


Figure C92b: Distribution of barracouta catch within the SNARES SHELF AND SUB ANTARCTIC region aggregated into 0.2 degree spatial blocks for the fishing year 2008 reported on TCER forms and using midwater and bottom trawl gear.

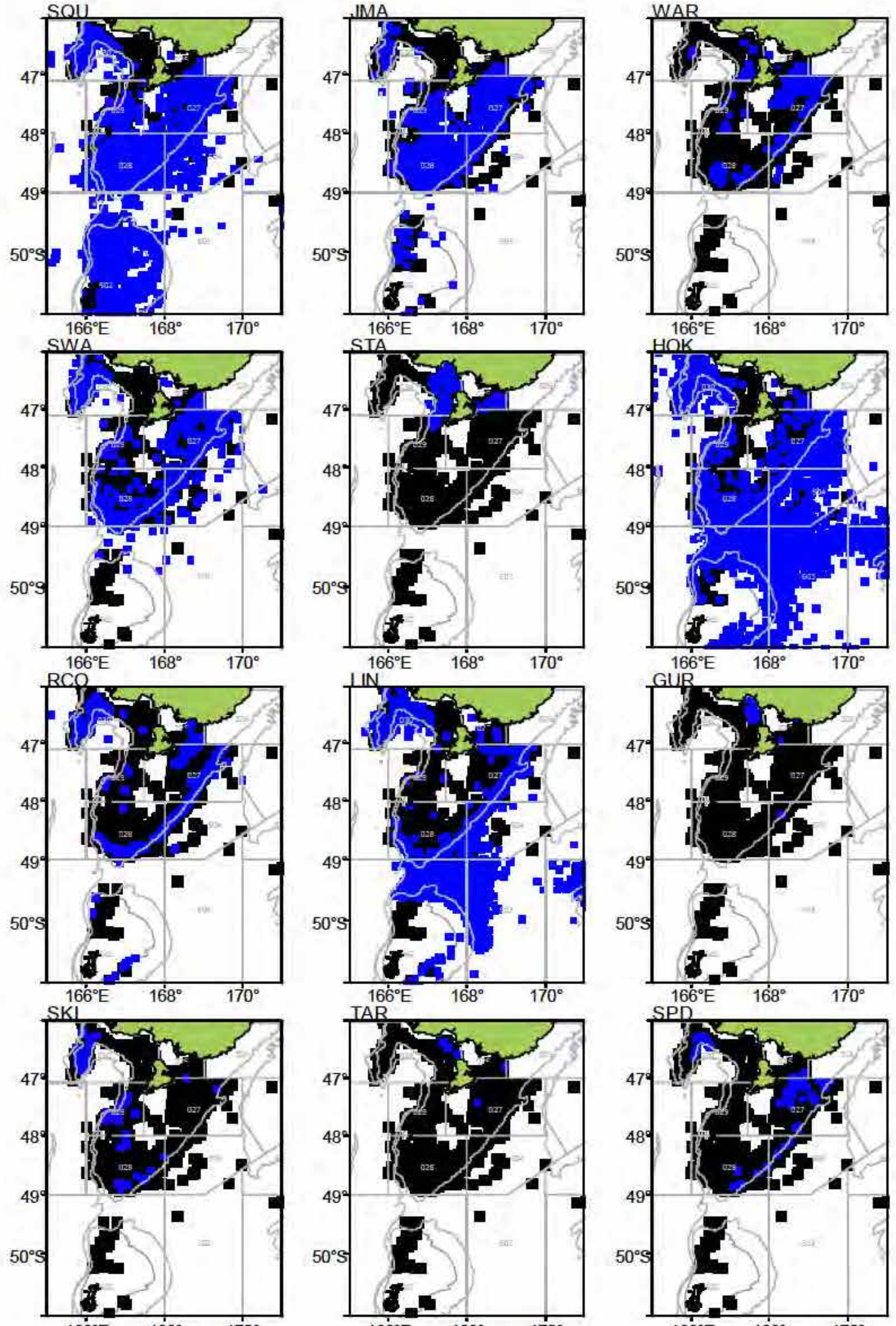


Figure C93: Comparison of the distribution of bottom and midwater trawls in the SNARES SHELF AND SUB ANTARCTIC region by target species for the main target species (blue cells) overlaid on the distribution of barracouta target effort distribution (black cells), for all years combined.

APPENDIX D: CATCH-PER-UNIT-EFFORT ANALYSES

Note: All models are bottom and midwater trawls only; twin trawl vessels were excluded from the WCSI core vessel dataset Models 5 and 10 and not present in other datasets. Species codes are listed in Table C16.

Table D1: Description of CPUE model datasets used for barracouta CPUE analyses.

Model	Area	Months	Form	Target species	Logistic	Merged (trip-level dataset)	Unmerged (tow-level dataset)
1a	ECSI	Oct–Sep	TCEPR, TCER, CELR	Major		Y	
1b	ECSI	Dec–Jun	TCEPR, TCER, CELR	Major		Y	
2a	ECSI	Oct–Sep	TCEPR	Major			Y
2b	ECSI	Oct–Sep	TCEPR	No target			Y
3	ECSI	Oct–Sep	TCEPR	Major	Y		Y
4	ECSI	Oct–Sep	TCEPR, TCER, CELR	BAR		Y	
5	ECSI	Oct–Sep	TCEPR, TCER, CELR	JMA		Y	
6	ECSI	Oct–Sep	TCEPR, TCER, CELR	SQU		Y	
7	ECSI	Oct–Sep	TCEPR, TCER, CELR	RCO		Y	
1a	WCSI	Oct–Sep	TCEPR, TCER, CELR	Major		Y	
1b	WCSI	Jun–Oct	TCEPR, TCER, CELR	Major		Y	
1c	WCSI	Nov–May	TCEPR, TCER, CELR	Major		Y	
2a	WCSI	Oct–Sep	TCEPR	Major			Y
2b	WCSI	Jun–Oct	TCEPR	Major			Y
3	WCSI	Jun–Oct	TCEPR, TCER, CELR	BAR		Y	
4	WCSI	Jun–Oct	TCEPR, TCER, CELR	JMA		Y	
5	WCSI	Jun–Oct	TCEPR, TCER, CELR	HOK		Y	
6	WCSI	Jun–Oct	TCEPR, TCER, CELR	TAR		Y	
7	WCSI	Nov–May	TCEPR, TCER, CELR	BAR		Y	
8	WCSI	Jun–Oct	TCEPR	BAR			Y
9	WCSI	Jun–Oct	TCEPR	JMA			Y
10	WCSI	Jun–Oct	TCEPR	HOK			Y
11	WCSI	Jun–Oct	TCEPR	No target			Y
12	WCSI	Jun–Oct	TCEPR	Major	Y		Y
1a	SNAR	Oct–Sep	TCEPR	Major		Y	
1b	SNAR	Oct–May	TCEPR	Major		Y	
1c	SNAR	Oct–May	TCEPR, TCER, CELR	Major		Y	
2a	SNAR	Oct–Sep	TCEPR	Major			Y
2b	SNAR	Oct–May	TCEPR	Major			Y
2c	SNAR	Oct–Dec	TCEPR	Major			Y
3	SNAR	Oct–May	TCEPR	BAR			Y
4	SNAR	Oct–May	TCEPR	SQU			Y
5	SNAR	Oct–May	TCEPR	No target			Y
6	SNAR/AUCK	Oct–May	TCEPR	Major			Y
7	AUCK	Oct–May	TCEPR	Major			Y
8	SNAR	Oct–May	TCEPR	Major	Y		Y

Table D2: Barracouta CPUE datasets for all vessels and for core vessels for each year (1990–2008) for Model 1 (stratified dataset) and Model 2 (tow-level dataset) for each CPUE area (ECSI, and Snares Shelf, and WCSI). CPUE is unstandardised catch per non-zero tow.

ECSI Model 1a

	All vessels					Core vessels				
Year	No records	Zeros	Catch	Effort	CPUE	No records	Zeros	Catch	Effort	CPUE
1990	1 767	0.05	5 540.7	1 678	3.30	709	0.05	3 275.8	672	4.87
1991	1970	0.05	6 634.4	1 880	3.53	863	0.05	4 144.1	820	5.05
1992	2 177	0.06	4 823.0	2 048	2.35	1 108	0.07	3 819.0	1 028	3.71
1993	2 380	0.06	6 927.4	2 237	3.10	1 236	0.09	5 897.3	1 121	5.26
1994	2 097	0.05	4 753.6	2 000	2.38	1 095	0.06	3 970.8	1 032	3.85
1995	2 591	0.06	7 069.1	2 437	2.90	1 219	0.10	6 219.8	1 102	5.64
1996	2 494	0.07	7 720.8	2 323	3.32	1 315	0.09	6 789.4	1 192	5.70
1997	2 530	0.05	9 603.2	2 397	4.01	1 493	0.07	8 277.7	1 382	5.99
1998	2 711	0.05	8 550.5	2 575	3.32	1 669	0.06	7 307.5	1 563	4.68
1999	2000	0.06	7 461.0	1 876	3.98	1 474	0.08	7 200.5	1 360	5.29
2000	1 747	0.05	8 620.5	1 661	5.19	1 326	0.06	8 315.7	1 250	6.65
2001	1 754	0.06	5 757.9	1 641	3.51	1 346	0.07	5 551.6	1 249	4.44
2002	1 489	0.08	5 957.3	1 365	4.36	1 194	0.09	5 663.0	1 088	5.20
2003	1 619	0.12	6 116.5	1 427	4.29	1 352	0.12	5 894.3	1 193	4.94
2004	1 373	0.08	4 102.9	1 266	3.24	1 150	0.08	3 994.2	1 053	3.79
2005	1 284	0.12	4 190.6	1 130	3.71	1 021	0.12	3 936.5	896	4.39
2006	1 248	0.08	5 977.0	1 146	5.22	984	0.08	5 578.7	907	6.15
2007	949	0.10	2 507.0	857	2.93	761	0.10	2 280.1	682	3.34
2008	989	0.09	4 556.8	896	5.09	793	0.08	4 403.0	726	6.06

ECSI Model 2a

	All vessels					Core vessels				
Year	No records	Zeros	Catch	Effort	CPUE	No records	Zeros	Catch	Effort	CPUE
1990	3 042	0.29	4 285.3	2 167	1.98	1 609	0.22	2 216.8	1 254	1.77
1991	2 843	0.25	4 275.7	2 137	2.00	1 639	0.20	2 519.7	1 309	1.92
1992	3 928	0.37	3 609.1	2 475	1.46	2 666	0.37	2 665.8	1 678	1.59
1993	4 742	0.39	5 481.8	2 898	1.89	3 662	0.40	4 846.2	2 197	2.21
1994	4 828	0.51	3 971.2	2 349	1.69	3 953	0.47	3 472.1	2 090	1.66
1995	4 415	0.43	5 261.6	2 504	2.10	3 705	0.39	4 914.5	2 269	2.17
1996	6 076	0.45	6 127.7	3 360	1.82	4 520	0.44	5 057.2	2 533	2.00
1997	5 192	0.43	6 250.1	2 969	2.11	3 954	0.41	5 277.3	2 343	2.25
1998	5 521	0.41	5 936.7	3 246	1.83	4 625	0.39	5 223.0	2 826	1.85
1999	3 886	0.34	5306.2	2 548	2.08	3 523	0.34	4 959.2	2 342	2.12
2000	3 905	0.26	6 482.0	2 878	2.25	3 588	0.26	6 163.9	2 671	2.31
2001	3 747	0.37	3 835.6	2 356	1.63	3 137	0.34	3 698.9	2 059	1.80
2002	3 133	0.33	4 310.4	2 093	2.06	2 762	0.31	4 087.7	1 912	2.14
2003	3 326	0.42	4 043.0	1 918	2.11	2 686	0.39	3 722.4	1 627	2.29
2004	2 505	0.36	2 995.9	1 601	1.87	2 176	0.35	2 888.9	1 414	2.04
2005	2 051	0.54	2 347.9	936	2.51	1 713	0.51	2 044.9	847	2.41
2006	2 303	0.44	3 462.0	1 299	2.67	1 778	0.37	3 112.4	1 122	2.77
2007	1 402	0.52	1 307.2	671	1.95	1 130	0.46	1 129.5	610	1.85
2008	502	0.34	2 154.3	330	6.53	418	0.33	2025.9	282	7.18

Table D2: continued.

WCSI Model 1**b**

	All vessels					Core vessels				
Year	No records	Zeros	Catch	Effort	CPUE	No records	Zeros	Catch	Effort	CPUE
1990	262	0.26	2 023.5	194	10.43	112	0.31	1 245.6	77	16.18
1991	366	0.24	3 621.9	277	13.08	185	0.27	2 153.3	135	15.95
1992	418	0.30	1 600.9	292	5.48	252	0.38	1 297.5	156	8.32
1993	492	0.27	4 458.0	359	12.42	334	0.30	3 906.4	234	16.69
1994	440	0.34	2 419.3	289	8.37	305	0.40	2 113.2	184	11.48
1995	610	0.40	4 430.7	366	12.11	407	0.42	3 977.3	235	16.92
1996	475	0.37	2 551.3	300	8.50	332	0.39	2 116.9	203	10.43
1997	583	0.34	3 551.7	383	9.27	379	0.35	2 737.4	247	11.08
1998	464	0.37	3 017.4	294	10.26	335	0.40	2 746.0	202	13.59
1999	474	0.34	1 688.7	315	5.36	331	0.39	1 564.1	203	7.70
2000	396	0.25	671.2	297	2.26	238	0.33	591.5	160	3.70
2001	518	0.23	1 705.3	401	4.25	298	0.25	1 632.6	223	7.32
2002	529	0.24	3 171.2	404	7.85	350	0.30	2 979.7	245	12.16
2003	510	0.28	2 322.1	365	6.36	285	0.30	2 105.8	199	10.58
2004	475	0.28	1 669.2	342	4.88	245	0.30	1 374.8	172	7.99
2005	500	0.32	4 513.4	341	13.24	289	0.36	4 004.6	184	21.76
2006	394	0.28	2 233.0	284	7.86	224	0.29	2 008.7	158	12.71
2007	538	0.29	6 083.3	380	16.01	340	0.29	4 976.1	241	20.65
2008	496	0.24	3 112.4	377	8.26	344	0.26	2 719.5	253	10.75

WCSI Model 2b

	All vessels					Core vessels				
Year	No records	Zeros	Catch	Effort	CPUE	No records	Zeros	Catch	Effort	CPUE
1990	3 291	0.81	1 995.1	614	3.25	757	0.70	514.1	226	2.27
1991	2 725	0.74	3 020.8	716	4.22	988	0.64	1 637.7	351	4.67
1992	3 603	0.82	1 068.2	655	1.63	1 276	0.76	587.7	310	1.90
1993	4367	0.80	4 340.1	872	4.98	2 153	0.69	3 925.9	667	5.89
1994	7 130	0.86	2 545.5	1008	2.53	3 140	0.78	2 046.9	706	2.90
1995	7 013	0.85	3 093.6	1017	3.04	3 790	0.81	2 495.8	739	3.38
1996	5 889	0.84	2 406.0	947	2.54	3 099	0.79	1 746.0	649	2.69
1997	6 909	0.87	3 373.8	908	3.72	4 005	0.83	2 734.5	678	4.03
1998	5 371	0.90	1 970.4	545	3.62	3 337	0.86	1 796.1	463	3.88
1999	5 613	0.91	983.9	493	2.00	3 278	0.89	898.0	366	2.45
2000	4 710	0.96	374.8	200	1.87	2 350	0.94	337.1	140	2.41
2001	6 628	0.90	2 058.1	637	3.23	3 361	0.86	2 001.7	470	4.26
2002	5 371	0.89	2 000.8	571	3.50	3 216	0.84	1 973.4	529	3.73
2003	5 434	0.92	1 634.7	437	3.74	2 800	0.88	1 518.9	347	4.38
2004	4 041	0.93	1 006.1	290	3.47	2 635	0.91	901.1	236	3.82
2005	3 629	0.79	5 182.5	780	6.64	2 298	0.71	4 882.5	672	7.27
2006	2 709	0.86	1 521.9	390	3.90	1 514	0.86	1 298.1	219	5.93
2007	2 568	0.72	3 602.3	712	5.06	1 454	0.71	2 951.8	427	6.91
2008	1 928	0.70	2 228.0	575	3.87	1 358	0.73	2 022.5	369	5.48

Table D2: continued.

WCSI Model 1c

	All vessels					Core vessels				
Year	No records	Zeros	Catch	Effort	CPUE	No records	Zeros	Catch	Effort	CPUE
1990	106	0.12	139.9	93	1.50	50	0.08	72.9	46	1.58
1991	152	0.09	263.8	138	1.91	90	0.08	219.5	83	2.64
1992	259	0.12	812.7	227	3.58	135	0.11	360.0	120	3.00
1993	389	0.11	978.5	345	2.84	247	0.11	719.9	220	3.27
1994	225	0.10	632.9	202	3.13	171	0.09	572.6	155	3.69
1995	210	0.14	764.4	181	4.22	140	0.13	524.1	122	4.30
1996	220	0.18	577.2	181	3.19	186	0.18	546.6	153	3.57
1997	241	0.10	691.1	216	3.20	171	0.08	609.9	157	3.88
1998	129	0.22	274.9	101	2.72	106	0.16	270.1	89	3.03
1999	262	0.11	378.4	233	1.62	186	0.08	311.9	172	1.81
2000	239	0.07	252.7	222	1.14	183	0.08	223.0	169	1.32
2001	251	0.14	553.5	217	2.55	188	0.10	464.4	169	2.75
2002	194	0.17	401.0	161	2.49	170	0.17	347.3	141	2.46
2003	298	0.25	463.4	224	2.07	236	0.27	434.8	173	2.51
2004	253	0.17	384.0	211	1.82	222	0.17	362.6	184	1.97
2005	328	0.26	340.6	244	1.40	266	0.27	245.1	195	1.26
2006	261	0.25	296.8	197	1.51	223	0.24	281.2	170	1.65
2007	299	0.22	369.5	234	1.58	263	0.23	352.3	203	1.74
2008	394	0.20	533.0	316	1.69	328	0.20	424.4	262	1.62

Table D2: continued.

Snares Shelf
Model 1b

	All vessels					Core vessels				
Year	No records	Zeros	Catch	Effort	CPUE	No records	Zeros	Catch	Effort	CPUE
1990	182	0.09	4 431.6	166	26.70	51	0.08	1 053.9	47	22.42
1991	312	0.12	7 845.2	275	28.53	100	0.08	2 168.2	92	23.57
1992	296	0.19	6 111.7	239	25.57	152	0.15	2 663.4	129	20.65
1993	322	0.19	6 843.6	262	26.12	187	0.20	3 133.2	150	20.89
1994	206	0.30	2 940.6	144	20.42	153	0.32	2 167.6	104	20.84
1995	364	0.24	2 294.1	277	8.28	246	0.26	1 700.8	182	9.35
1996	434	0.28	2 462.0	314	7.84	290	0.28	1 955.4	209	9.36
1997	416	0.25	2 315.4	313	7.40	333	0.26	1 958.2	245	7.99
1998	571	0.23	5 885.4	437	13.47	489	0.23	5 147.6	378	13.62
1999	466	0.17	6 936.8	388	17.88	408	0.18	5 999.5	335	17.91
2000	341	0.10	5 525.5	306	18.06	315	0.10	5 242.8	285	18.40
2001	276	0.23	5 754.9	213	27.02	268	0.23	5 740.6	207	27.73
2002	404	0.21	5 699.9	318	17.92	381	0.21	5 618.7	301	18.67
2003	393	0.23	7 589.6	304	24.97	370	0.22	7 433.8	289	25.72
2004	338	0.24	6 723.6	258	26.06	306	0.25	6 542.6	230	28.45
2005	421	0.26	7 995.8	312	25.63	361	0.26	7 646.8	267	28.64
2006	413	0.27	8 827.8	303	29.13	334	0.27	7 610.7	245	31.06
2007	369	0.24	6 164.3	281	21.94	312	0.22	5 304.2	243	21.83
2008	268	0.15	8 159.1	227	35.94	242	0.16	7 911.1	204	38.78

Snares Shelf
Model 2b

	All vessels					Core vessels				
Year	No records	Zeros	Catch	Effort	CPUE	No records	Zeros	Catch	Effort	CPUE
1990	2 959	0.48	4 582.2	1 529	3.00	865	0.46	1 385.2	465	2.98
1991	7 556	0.43	7 632.9	4 293	1.78	1 807	0.40	2 150.9	1 085	1.98
1992	5 021	0.61	6 079.3	1 967	3.09	2 259	0.58	2 899.7	947	3.06
1993	7 658	0.51	6 977.0	3 777	1.85	3 249	0.58	2 985.4	1 369	2.18
1994	2 838	0.66	2 752.8	979	2.81	1 982	0.63	2 089.4	729	2.87
1995	5 889	0.70	2 222.0	1 784	1.25	3 550	0.70	1 597.9	1 078	1.48
1996	4 316	0.63	2 379.3	1 590	1.50	2 724	0.65	1 837.5	947	1.94
1997	4 850	0.67	2 098.5	1 599	1.31	3 673	0.67	1 827.1	1 229	1.49
1998	6 796	0.61	5 313.5	2 673	1.99	5 656	0.59	4 652.4	2 330	2.00
1999	7 602	0.56	6 250.8	3 321	1.88	6 428	0.56	5 362.8	2 859	1.88
2000	4 669	0.48	5 463.7	2 444	2.24	3 995	0.42	5 200.3	2 308	2.25
2001	4 773	0.62	5 579.4	1 817	3.07	4 477	0.61	5 558.9	1 760	3.16
2002	5 119	0.58	5 178.0	2 147	2.41	4 578	0.55	5 090.9	2 061	2.47
2003	5 500	0.54	7 041.4	2 537	2.78	5 034	0.52	6 862.2	2 409	2.85
2004	4 441	0.51	6 373.7	2 163	2.95	3 943	0.50	6 207.3	1965	3.16
2005	6 362	0.57	7 478.9	2 761	2.71	4 918	0.53	7 136.3	2 295	3.11
2006	5 180	0.58	8 461.5	2 165	3.91	3 910	0.56	7 463.5	1 722	4.33
2007	4 178	0.68	5 983.4	1 345	4.45	3 252	0.64	5 268.1	1 181	4.46
2008	3 131	0.54	7 610.5	1 447	5.26	2 663	0.49	7 353.4	1 345	5.47

Table D3: Variables retained in order of decreasing explanatory value by each barracouta CPUE model for each area and the corresponding total R^2 value (see table 13 for description of the datasets).

ECSI Model	Dataset	Variable	R^2
1a	Oct–Sep	Fishing year	2.09
	Merged	Vessel	17.12
	Major target spp.	Target species	26.19
		Month	28.91
1b	Dec–Jun	Fishing year	1.95
	Merged	Target species	17.38
	Major target spp.	Vessel	27.10
		Stat area	28.17
2a	Oct–Sep	Fishing year	2.33
	TCEPR	Target species	11.23
	Major target spp.	Vessel	18.01
		Effort depth	20.72
		Time start	22.21
2b	Oct–Sep	Fishing year	2.33
	TCEPR	Vessel	9.57
	No target	Effort Depth	16.37
		Time start	17.89
3	Oct–Sep	Fish year	1.65
	TCEPR	Target species	13.92
	Major target spp.	Effort depth	18.06
	Binomial	Longitude	20.82
		Time start	22.74
		Vessel	23.79
4	Oct–Sep	Fish year	2.56
	Merged	Vessel	10.47
	BAR target	Month	15.19
5	Oct–Sep	Fish year	17.03
	Merged	Stat area	43.27
	JMA target	Month	48.38
		Vessel	51.52
		Duration	52.93
6	Oct–Sep	Fish year	5.25
	Merged	Month	13.28
	SQU target	Vessel	21.05
		Stat area	27.91
		Duration	29.20
7	Oct–Sep	Fish year	3.83
	Merged	Vessel	28.47
	RCO target	Month	32.23

Table D3: continued.

WCSI Model	Dataset	Variable	R^2
1a	Oct–Sep Merged Major target spp.	Fishing year Target species Vessel Month	2.87 29.61 42.39 47.27
1b	Jun–Oct Merged Major target spp.	Fishing year Target species Vessel Month	3.02 36.13 46.88 50.40
1c	Nov–May Merged Major target spp.	Fishing year Vessel Month	7.72 18.08 21.42
2a	Oct–Sep TCEPR Major target spp.	Fishing year Target species Vessel Month Start time Effort depth Latitude	3.52 16.81 24.35 26.47 28.45 30.16 31.36
2b	Jun–Oct TCEPR Major target spp.	Fishing year Target species Vessel Start time Month Effort depth Latitude Distance 2	4.13 18.58 22.17 24.26 26.42 28.40 29.95 30.97
3	Jun–Oct Merged BAR target	Fishing year Vessel Month	8.93 41.78 46.24
4	Jun–Oct Merged JMA target	Fishing year Vessel Month	17.46 25.02 28.33
5	Jun–Oct Merged HOK target	Fishing year Vessel Month Stat area	20.90 32.03 37.07 39.64
6	Jun–Oct Merged TAR target	Fishing year Vessel	16.73 29.61
7	Nov–May Merged BAR target	Fishing year Vessel Month	13.67 25.33 29.30

WCSI Model	Dataset	Variable	R^2
8	Jun–Oct TCEPR BAR target	Fishing year Start time Vessel Month Effort depth	11.09 17.28 23.04 25.53 27.00
9	Jun–Oct TCEPR JMA target	Fishing year Latitude Time start Vessel Month Effort height Distance2	11.49 17.63 21.60 24.86 27.40 29.16 30.61
10	Jun–Oct TCEPR HOK target	Fishing year Vessel Effort depth	16.86 33.92 37.38
11	Jun–Oct TCEPR No target assumed	Fishing year Vessel Effort depth Month Time start Latitude	4.13 12.18 16.67 20.80 24.12 26.34
12	Jun–Oct TCEPR Major target spp. Binomial	Fishing year Target species Month Effort depth Vessel	3.69 47.31 50.38 52.76 54.21

Table D3: continued.

Snares Shelf Model	Dataset	Variable	R^2
1a	Oct–Sep	Fishing year	3.17
	Merged TCEPR	Target species	21.87
	Major target spp.	Vessel	30.62
		Stat area	34.02
		Month	36.24
1b	Oct–May	Fishing year	3.10
	Merged TCEPR	Target species	21.74
	Major target spp.	Vessel	30.84
		Stat area	34.17
		Month	36.33
1c	Oct–May	Fishing year	3.10
	Merged	Stat area	15.23
	Major target spp.	Vessel	23.58
		Month	28.61
		Method	29.67
2a	Oct–Sep	Fishing year	2.54
	TCEPR	Target species	15.98
	Major target spp.	Vessel	27.51
		Month	31.69
2b	Oct–May	Fishing year	2.44
	TCEPR	Target species	16.58
	Major target spp.	Vessel	28.29
		Month	32.41
2c	Oct–Dec	Fishing year	16.07
	TCEPR	Target species	33.54
	Major target spp.	Month	36.76
		Effort depth	39.15
		Vessel	40.57
3	Oct–May	Fishing year	19.21
	TCEPR	Month	24.25
	BAR target	Vessel	27.44
		Distance 2	28.74
		Fishing distance	30.14
		Start time	31.20
4	Oct–May	Fishing year	5.34
	TCEPR	Vessel	22.73
	SQU target	Month	27.08
5	Oct–May	Fishing year	2.44
	TCEPR	Vessel	15.30
	No target	Month	25.01
		Effort depth	27.57

Mixed area Model	Dataset	Variable	R^2
6	Oct–May	Fishing year	2.61
	Snares + Auck	Vessel	15.57
	TCEPR	Month	23.73
	Major target spp.	Latitude	28.28
		Effort depth	29.82
7	Oct–May	Fishing year	30.26
	Auck.	Vessel	44.14
	TCEPR	Latitude	46.56
	Major target spp.		
8	Oct–May	Fishing year	1.48
	Snares	Target species	16.45
	TCEPR	Effort depth	19.66
	Major target spp.	Vessel key	21.72
	Binomial	Month	22.75

Table D4: Barracouta CPUE estimated values and CVs by year and area for all models.

ECSI	1a		1b		2a		2b		3	
Year	CPUE	CV	CPUE	CV	CPUE	CV	CPUE	CV	CPUE	CV
1990	1.16	0.04	1.09	0.05	0.98	0.03	1.08	0.03	0.97	-
1991	1.18	0.04	0.99	0.04	1.11	0.03	1.37	0.03	1.16	-
1992	0.88	0.03	0.94	0.04	0.99	0.03	1.15	0.03	0.96	-
1993	1.06	0.03	1.13	0.03	1.11	0.02	1.28	0.02	1.01	-
1994	0.98	0.03	1.00	0.03	0.98	0.02	0.91	0.02	0.90	-
1995	1.27	0.03	1.26	0.03	1.15	0.02	1.13	0.02	1.14	-
1996	1.49	0.03	1.48	0.03	1.23	0.02	1.14	0.02	1.14	-
1997	1.52	0.03	1.45	0.03	1.31	0.02	1.24	0.02	1.25	-
1998	1.28	0.03	1.29	0.03	1.20	0.02	1.06	0.02	1.14	-
1999	1.07	0.03	1.05	0.03	1.18	0.02	1.10	0.02	1.22	-
2000	1.14	0.03	1.19	0.03	1.33	0.02	1.32	0.02	1.49	-
2001	0.67	0.03	0.68	0.03	1.03	0.02	0.94	0.02	1.14	-
2002	0.77	0.03	0.85	0.04	0.92	0.02	0.90	0.02	1.00	-
2003	0.62	0.03	0.65	0.03	0.84	0.03	0.83	0.03	0.86	-
2004	0.84	0.03	0.88	0.04	0.68	0.03	0.67	0.03	0.68	-
2005	0.80	0.03	0.80	0.04	0.63	0.03	0.57	0.03	0.53	-
2006	1.15	0.03	1.09	0.04	0.83	0.03	0.73	0.03	0.85	-
2007	0.73	0.04	0.70	0.05	0.58	0.04	0.51	0.04	0.53	-
2008	0.98	0.04	0.96	0.04	1.54	0.06	2.06	0.06	1.63	-

ECSI	4		5		6		7	
Year	CPUE	CV	CPUE	CV	CPUE	CV	CPUE	CV
1990	1.03	0.07	-	-	1.10	0.19	1.25	0.05
1991	1.08	0.06	-	-	3.03	0.25	1.28	0.04
1992	0.98	0.06	-	-	1.46	0.16	0.78	0.03
1993	1.16	0.05	0.36	0.56	0.84	0.15	0.88	0.03
1994	1.02	0.08	1.03	0.35	1.55	0.09	0.84	0.03
1995	1.47	0.06	0.97	0.27	1.43	0.09	1.09	0.03
1996	1.37	0.07	0.48	0.28	1.18	0.09	1.53	0.03
1997	1.68	0.08	0.58	0.28	1.21	0.08	1.61	0.03
1998	1.11	0.07	1.19	0.20	0.86	0.07	1.72	0.03
1999	0.84	0.06	1.14	0.28	1.18	0.07	0.99	0.03
2000	1.17	0.07	0.81	0.22	1.83	0.08	1.05	0.03
2001	0.76	0.07	1.35	0.33	0.80	0.06	0.69	0.04
2002	0.83	0.07	1.06	0.27	1.08	0.07	0.68	0.04
2003	0.88	0.06	2.37	0.24	0.62	0.07	0.52	0.04
2004	1.04	0.07	0.63	0.79	0.99	0.08	0.85	0.04
2005	0.58	0.08	1.37	0.54	0.31	0.08	1.10	0.04
2006	0.91	0.08	1.69	0.25	0.77	0.08	1.35	0.04
2007	0.59	0.08	1.09	0.34	0.48	0.09	0.85	0.05
2008	1.20	0.08	1.68	0.27	0.69	0.10	0.85	0.06

Table D4: continued.

WCSI	1a		1b		1c		2a		2b	
Year	CPUE	CV	CPUE	CV	CPUE	CV	CPUE	CV	CPUE	CV
1990	1.46	0.09	1.51	0.11	0.69	0.15	0.68	0.07	0.61	0.08
1991	1.40	0.07	1.51	0.09	1.00	0.11	0.95	0.06	0.86	0.06
1992	1.42	0.06	1.59	0.08	1.11	0.09	1.18	0.05	1.19	0.07
1993	1.38	0.05	1.24	0.07	1.19	0.07	1.46	0.04	1.50	0.05
1994	1.24	0.05	1.16	0.07	1.44	0.08	1.06	0.04	1.07	0.05
1995	1.37	0.05	1.28	0.07	2.35	0.09	1.03	0.03	1.12	0.04
1996	1.27	0.05	1.11	0.07	1.79	0.08	1.04	0.04	0.87	0.04
1997	1.11	0.05	1.09	0.07	1.42	0.08	0.91	0.04	0.90	0.04
1998	0.83	0.06	0.62	0.08	1.44	0.10	0.70	0.04	0.79	0.05
1999	0.63	0.05	0.55	0.07	0.78	0.08	0.84	0.05	0.63	0.05
2000	0.38	0.06	0.37	0.08	0.64	0.08	0.31	0.07	0.41	0.08
2001	0.81	0.05	0.96	0.07	1.23	0.08	0.77	0.05	0.91	0.05
2002	0.89	0.05	0.99	0.06	0.73	0.09	0.91	0.04	0.80	0.05
2003	0.89	0.05	1.00	0.07	0.89	0.08	0.96	0.05	1.38	0.06
2004	1.01	0.05	1.15	0.08	0.92	0.08	1.40	0.06	1.31	0.07
2005	0.89	0.05	1.23	0.08	0.55	0.07	1.47	0.04	1.85	0.04
2006	0.69	0.05	0.57	0.08	0.68	0.08	1.35	0.06	1.06	0.07
2007	1.07	0.05	1.16	0.07	0.72	0.07	2.02	0.05	1.87	0.05
2008	1.20	0.05	1.11	0.07	0.90	0.07	1.25	0.05	1.15	0.06

WCSI	3		4		5		6		7	
Year	CPUE	CV	CPUE	CV	CPUE	CV	CPUE	CV	CPUE	CV
1990	1.60	0.18	0.30	0.46	5.07	0.33	0.45	0.88	1.14	0.26
1991	1.11	0.14	0.31	0.42	4.04	0.29	1.47	0.29	1.15	0.15
1992	1.00	0.13	1.68	0.32	2.72	0.25	1.50	0.42	1.33	0.14
1993	1.33	0.10	0.64	0.26	3.19	0.19	0.33	0.34	1.38	0.10
1994	0.87	0.14	0.34	0.22	5.41	0.16	0.79	0.24	1.26	0.11
1995	0.89	0.12	0.12	0.29	3.37	0.15	2.38	0.33	1.92	0.13
1996	1.03	0.09	0.55	0.28	1.14	0.16	0.78	0.37	1.58	0.11
1997	0.99	0.09	1.01	0.16	2.28	0.15	1.16	0.39	1.10	0.09
1998	0.56	0.11	1.15	0.18	1.08	0.21	0.70	0.45	1.07	0.11
1999	0.57	0.10	0.63	0.19	0.40	0.15	0.46	0.43	0.58	0.09
2000	0.56	0.10	0.61	0.20	0.17	0.19	0.63	0.36	0.53	0.09
2001	0.98	0.10	2.84	0.17	0.24	0.15	1.51	0.43	0.92	0.09
2002	1.26	0.10	1.60	0.16	0.14	0.16	0.83	0.25	0.64	0.10
2003	1.37	0.12	4.33	0.17	0.54	0.16	0.80	0.27	1.01	0.10
2004	1.14	0.11	2.28	0.21	0.89	0.19	1.70	0.23	1.10	0.10
2005	1.33	0.14	3.38	0.23	1.44	0.21	1.44	0.17	0.62	0.12
2006	0.83	0.15	1.19	0.22	0.26	0.20	1.44	0.17	0.51	0.13
2007	1.10	0.11	2.46	0.17	2.26	0.23	1.85	0.22	1.07	0.14
2008	1.27	0.12	2.26	0.19	0.12	0.30	1.37	0.19	1.32	0.12

Table D4: continued.

WCSI	8		9		10		11		12	
Year	CPUE	CV	CPUE	CV	CPUE	CV	CPUE	CV	CPUE	CV
1990	0.68	0.12	0.72	0.19	0.48	0.49	0.83	0.07	0.24	-
1991	0.91	0.08	0.58	0.16	0.50	0.24	0.97	0.06	0.98	-
1992	0.27	0.12	3.15	0.13	6.92	0.33	1.36	0.07	0.81	-
1993	1.25	0.06	2.54	0.12	1.69	0.17	1.81	0.05	1.06	-
1994	0.68	0.07	1.47	0.11	3.29	0.11	1.16	0.05	0.56	-
1995	1.04	0.07	0.60	0.10	2.94	0.09	1.17	0.04	1.10	-
1996	0.76	0.06	0.59	0.11	1.89	0.09	0.89	0.04	0.97	-
1997	1.07	0.08	0.82	0.07	1.55	0.11	0.77	0.04	0.59	-
1998	0.47	0.11	1.07	0.08	1.97	0.17	0.70	0.05	0.34	-
1999	0.82	0.12	0.46	0.08	1.52	0.15	0.54	0.05	0.29	-
2000	0.91	0.23	0.35	0.10	1.21	0.26	0.34	0.08	0.13	-
2001	0.88	0.09	1.00	0.07	0.45	0.12	0.81	0.05	0.74	-
2002	0.78	0.09	0.65	0.07	1.26	0.15	0.71	0.05	0.69	-
2003	1.53	0.19	1.66	0.08	0.88	0.11	1.17	0.06	1.52	-
2004	1.21	0.14	0.83	0.12	1.39	0.12	1.23	0.07	1.64	-
2005	1.91	0.09	2.24	0.09	1.07	0.10	2.07	0.04	3.29	-
2006	3.04	0.16	0.99	0.11	0.39	0.13	1.11	0.07	1.34	-
2007	2.41	0.12	1.96	0.07	0.22	0.18	1.72	0.05	2.48	-
2008	1.31	0.10	1.08	0.09	0.05	0.20	1.29	0.05	1.49	-

Snares Shelf	1a		1b		1c		2a		2b	
Year	CPUE	CV	CPUE	CV	CPUE	CV	CPUE	CV	CPUE	CV
1990	2.42	0.15	2.60	0.16	3.70	0.16	1.76	0.06	1.74	0.06
1991	1.78	0.11	1.72	0.12	1.99	0.12	1.75	0.03	1.71	0.04
1992	0.88	0.09	0.99	0.09	1.34	0.09	1.23	0.03	1.28	0.03
1993	1.39	0.08	1.22	0.08	1.67	0.08	1.05	0.03	1.05	0.03
1994	1.03	0.10	1.03	0.10	1.22	0.10	1.07	0.04	1.07	0.04
1995	0.51	0.07	0.53	0.08	0.67	0.07	0.63	0.03	0.67	0.03
1996	0.59	0.07	0.57	0.07	0.73	0.07	0.69	0.03	0.68	0.03
1997	0.46	0.06	0.42	0.07	0.38	0.07	0.62	0.03	0.61	0.03
1998	0.78	0.06	0.77	0.06	0.65	0.05	0.91	0.02	0.89	0.02
1999	0.93	0.06	0.93	0.06	0.73	0.06	0.72	0.02	0.72	0.02
2000	1.45	0.06	1.47	0.06	1.29	0.06	1.23	0.02	1.23	0.02
2001	1.26	0.07	1.25	0.07	1.03	0.07	1.25	0.02	1.25	0.02
2002	1.01	0.06	1.04	0.06	0.81	0.06	1.12	0.02	1.14	0.02
2003	1.08	0.06	1.10	0.06	0.93	0.06	0.93	0.02	0.94	0.02
2004	0.89	0.07	0.89	0.07	0.73	0.07	1.08	0.02	1.08	0.02
2005	0.84	0.06	0.85	0.06	0.72	0.06	0.76	0.02	0.76	0.02
2006	1.18	0.06	1.13	0.07	0.94	0.07	0.85	0.03	0.83	0.03
2007	0.55	0.07	0.54	0.07	0.55	0.07	0.79	0.03	0.78	0.03
2008	1.93	0.07	2.00	0.07	2.02	0.07	1.53	0.03	1.53	0.03

Table D4: continued.

Snares Shelf	2c		3		4		5		6	
Year	CPUE	CV	CPUE	CV	CPUE	CV	CPUE	CV	CPUE	CV
1990	3.73	0.37	1.14	0.13	2.33	0.10	3.02	0.06	1.72	0.05
1991	2.12	0.19	0.96	0.13	1.71	0.04	1.57	0.04	1.59	0.04
1992	0.74	0.10	0.63	0.08	1.94	0.04	1.24	0.03	1.24	0.03
1993	0.82	0.21	1.22	0.07	1.15	0.03	1.06	0.03	1.11	0.03
1994	1.98	0.12	0.87	0.10	1.17	0.04	1.09	0.04	1.12	0.03
1995	0.57	0.07	0.55	0.06	0.60	0.04	0.73	0.03	0.77	0.03
1996	0.45	0.08	0.50	0.06	0.77	0.05	0.77	0.03	1.20	0.03
1997	0.56	0.07	0.54	0.08	0.67	0.04	0.60	0.03	0.64	0.03
1998	0.64	0.06	0.62	0.06	1.04	0.03	0.84	0.02	0.86	0.02
1999	0.75	0.07	0.95	0.08	0.72	0.03	0.60	0.02	0.60	0.02
2000	0.50	0.08	0.64	0.07	1.71	0.03	1.13	0.02	1.19	0.02
2001	1.09	0.09	1.59	0.09	1.12	0.03	1.03	0.02	1.15	0.02
2002	1.14	0.08	0.74	0.08	1.15	0.03	1.02	0.02	0.96	0.02
2003	0.94	0.06	1.10	0.05	0.77	0.03	0.97	0.02	0.95	0.02
2004	1.69	0.08	1.57	0.07	0.92	0.03	1.05	0.02	1.06	0.02
2005	0.58	0.08	1.81	0.07	0.70	0.03	0.67	0.02	0.66	0.02
2006	0.77	0.07	1.81	0.07	0.66	0.03	0.83	0.03	0.72	0.02
2007	1.03	0.07	1.17	0.06	0.48	0.04	0.91	0.03	0.90	0.03
2008	3.30	0.09	3.10	0.07	1.19	0.03	1.40	0.03	1.35	0.03

Snares Shelf	7		8	
Year	CPUE	CV	CPUE	CV
1990	0.42	0.14	3.10	-
1991	2.84	0.24	2.14	-
1992	5.08	0.28	0.85	-
1993	2.79	0.19	0.84	-
1994	1.22	0.11	0.76	-
1995	3.28	0.21	0.30	-
1996	3.08	0.05	0.40	-
1997	0.69	0.08	0.39	-
1998	0.86	0.21	0.70	-
1999	0.45	0.15	0.65	-
2000	3.19	0.10	1.91	-
2001	2.21	0.09	1.09	-
2002	0.82	0.10	1.25	-
2003	1.21	0.08	0.99	-
2004	0.57	0.15	1.12	-
2005	0.68	0.11	0.73	-
2006	0.33	0.09	0.73	-
2007	0.06	0.29	0.45	-
2008	0.33	0.20	1.57	-

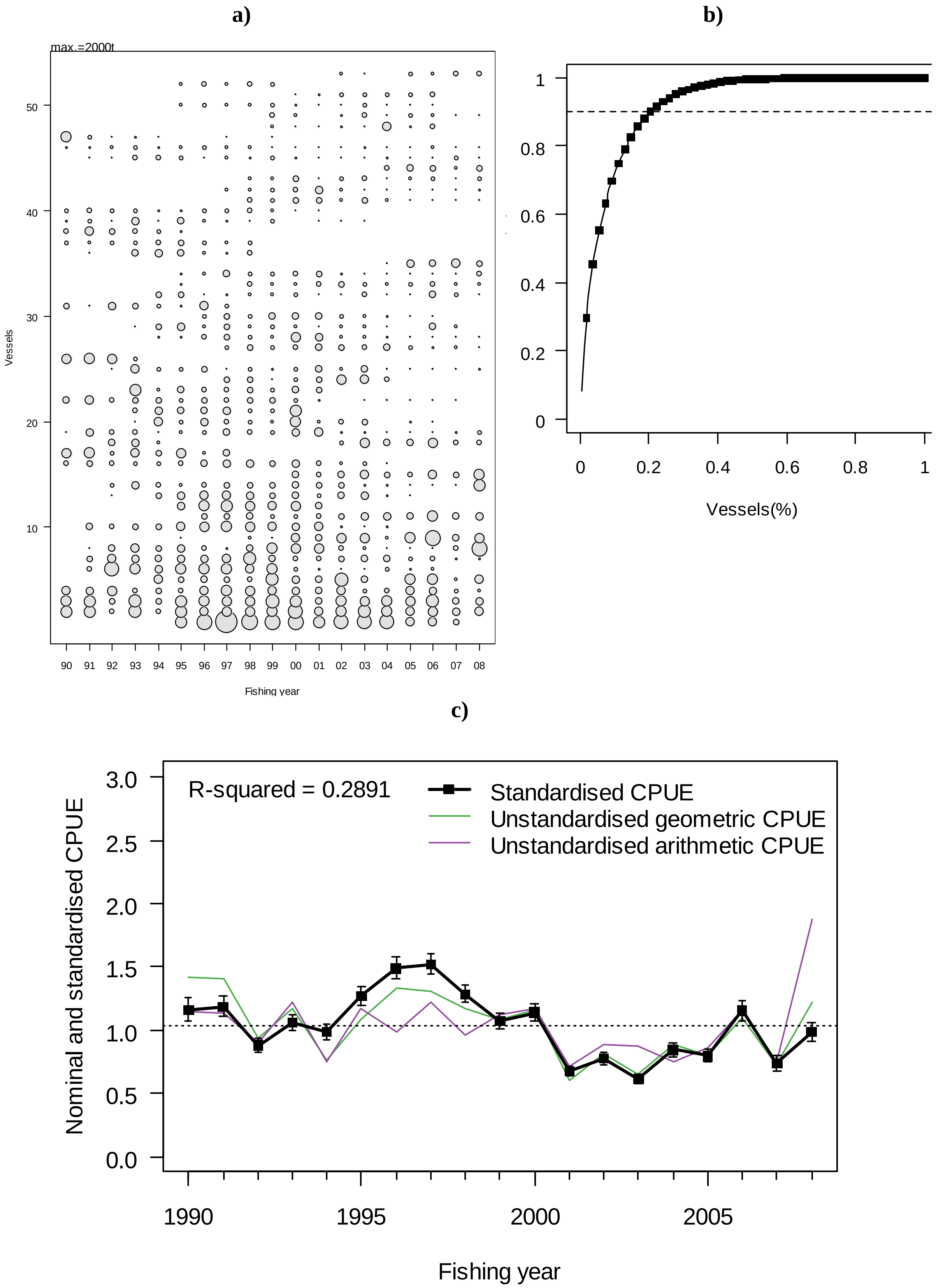


Figure D1: ECSI CPUE Model 1a (trip-level, major species, Oct–Sep dataset): a) scaled annual catch by vessel. b) Cumulative proportion of barracouta catch ranked by vessel. c) arithmetic, geometric and standardised CPUE indices for barracouta 1990–2008.

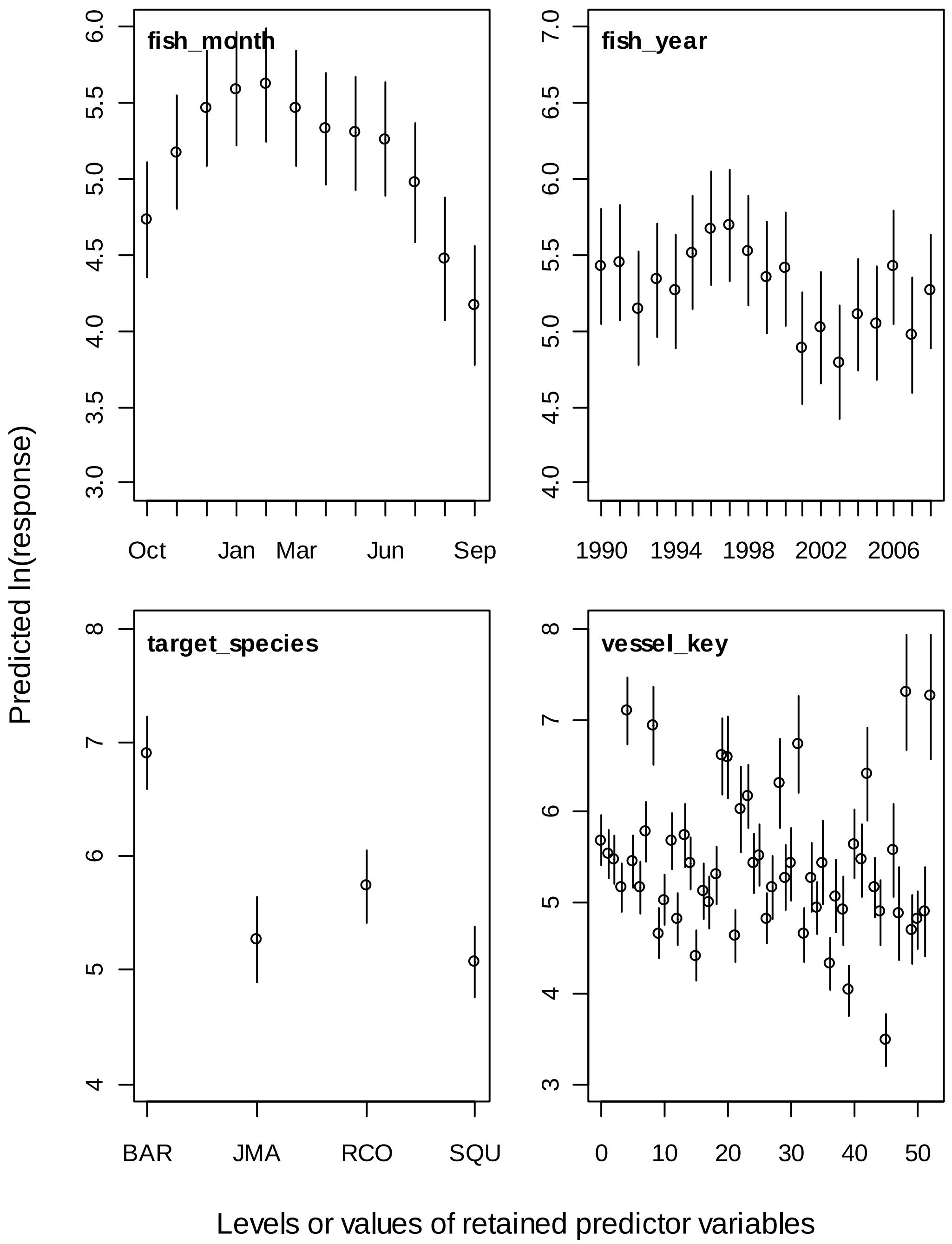


Figure D1 continued: d) ECSI CPUE model 1a (trip-level, major species, Oct–Sep dataset). Predictor variables retained in the GLM analysis and their distributions by factor levels.

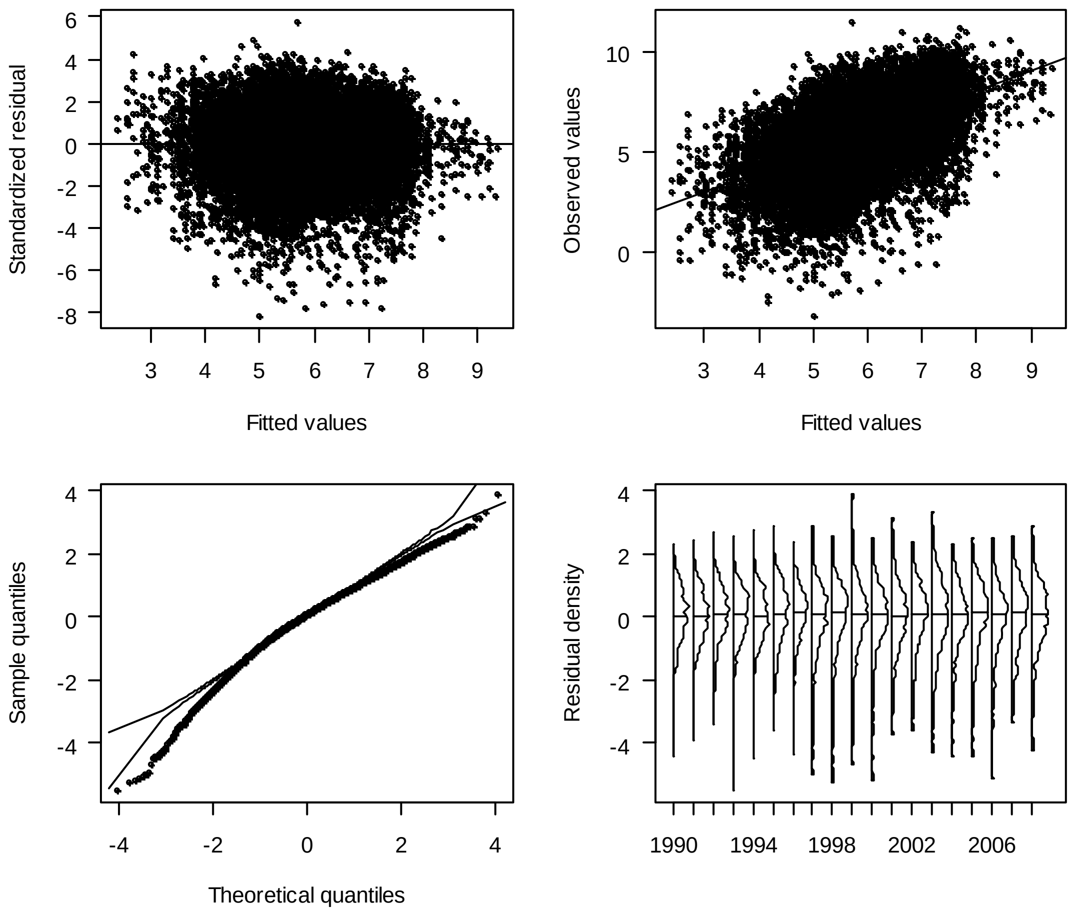
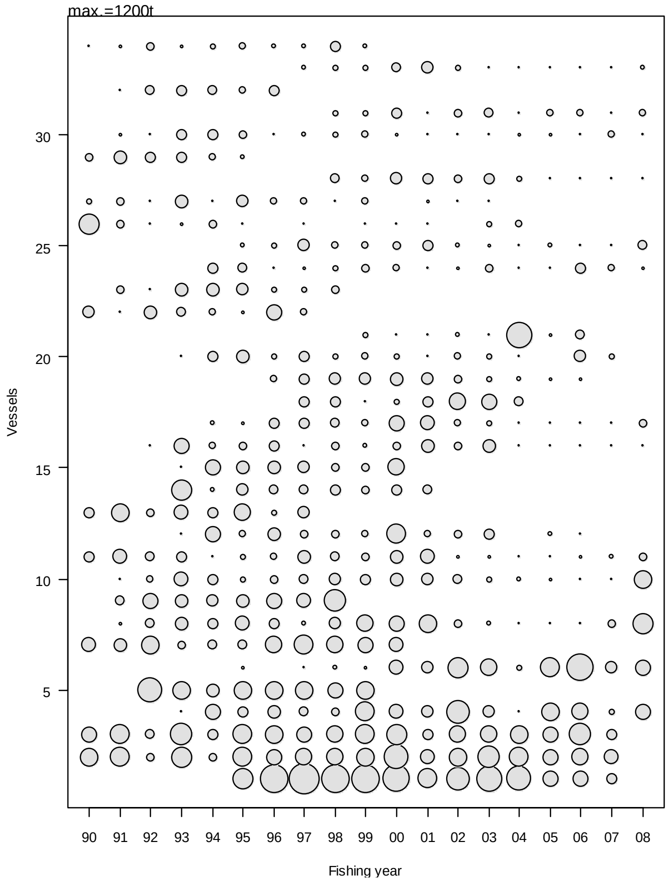
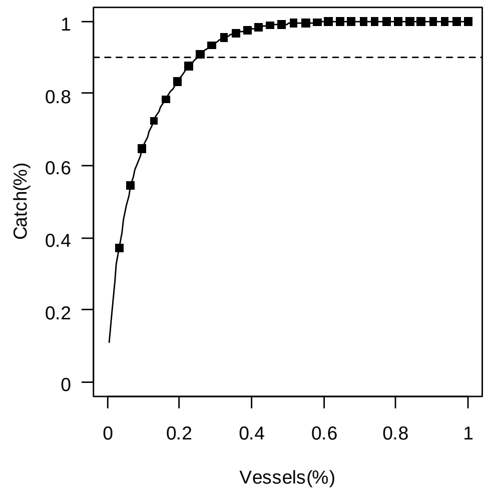


Figure D1 continued: e) ECSI CPUE model 1a (trip-level, major species, Oct–Sep dataset). Residual diagnostic plots describing the fit of the GLM CPUE model

a)



b)



c)

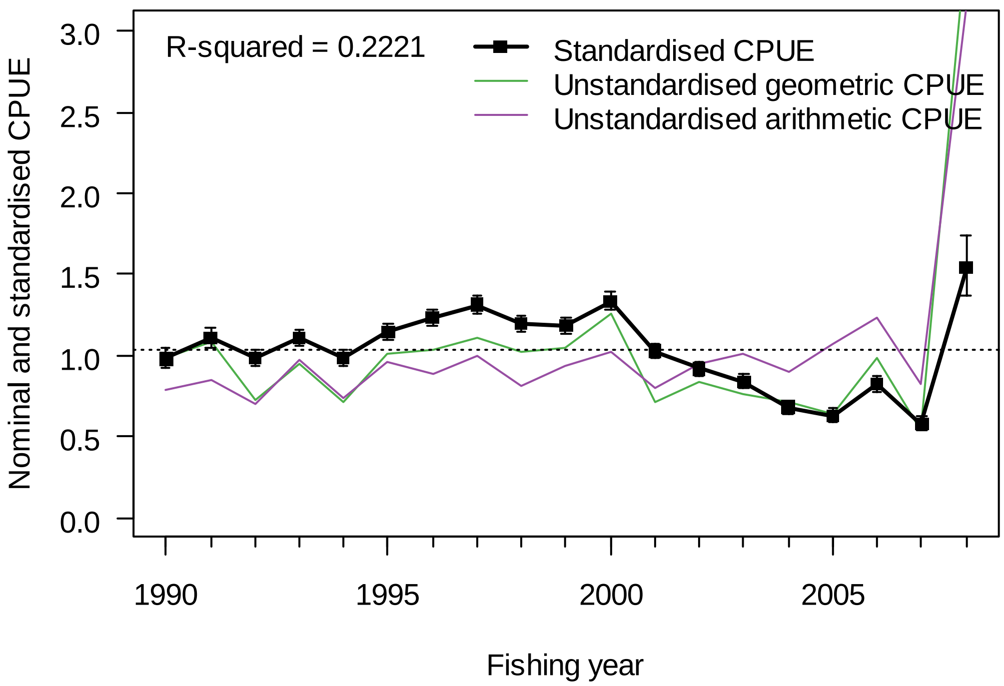


Figure D2: ECSI CPUE Model 2a (tow-level, major species, Oct–Sep dataset): a) scaled annual catch by vessel. b) Cumulative proportion of barracouta catch ranked by vessel. c) arithmetic, geometric and standardised CPUE indices for barracouta 1990–2008.

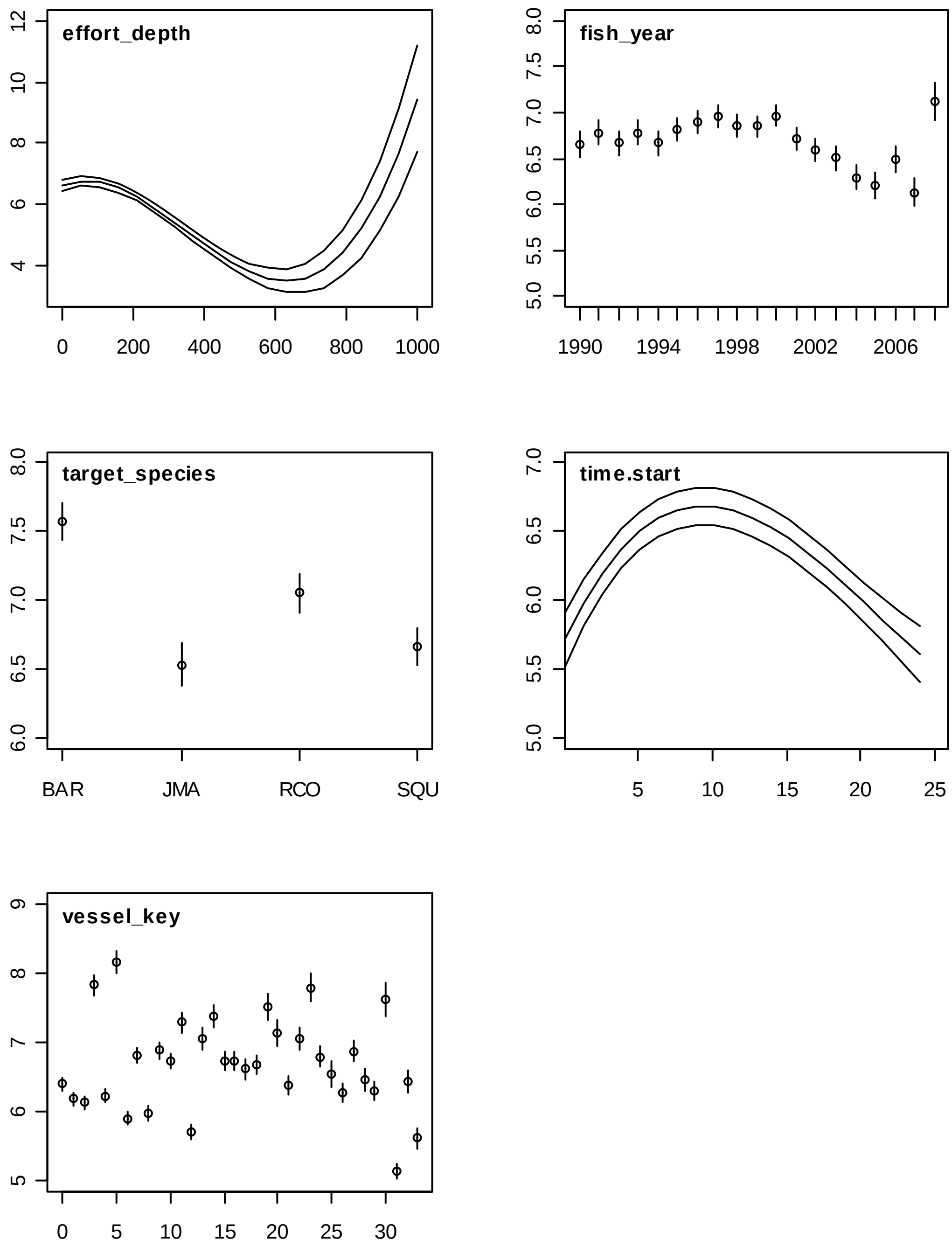


Figure D2 continued: d) ECSI CPUE model 2a (tow-level, major species, Oct–Sep dataset). Predictor variables retained in the GLM analysis and their distributions by factor levels.

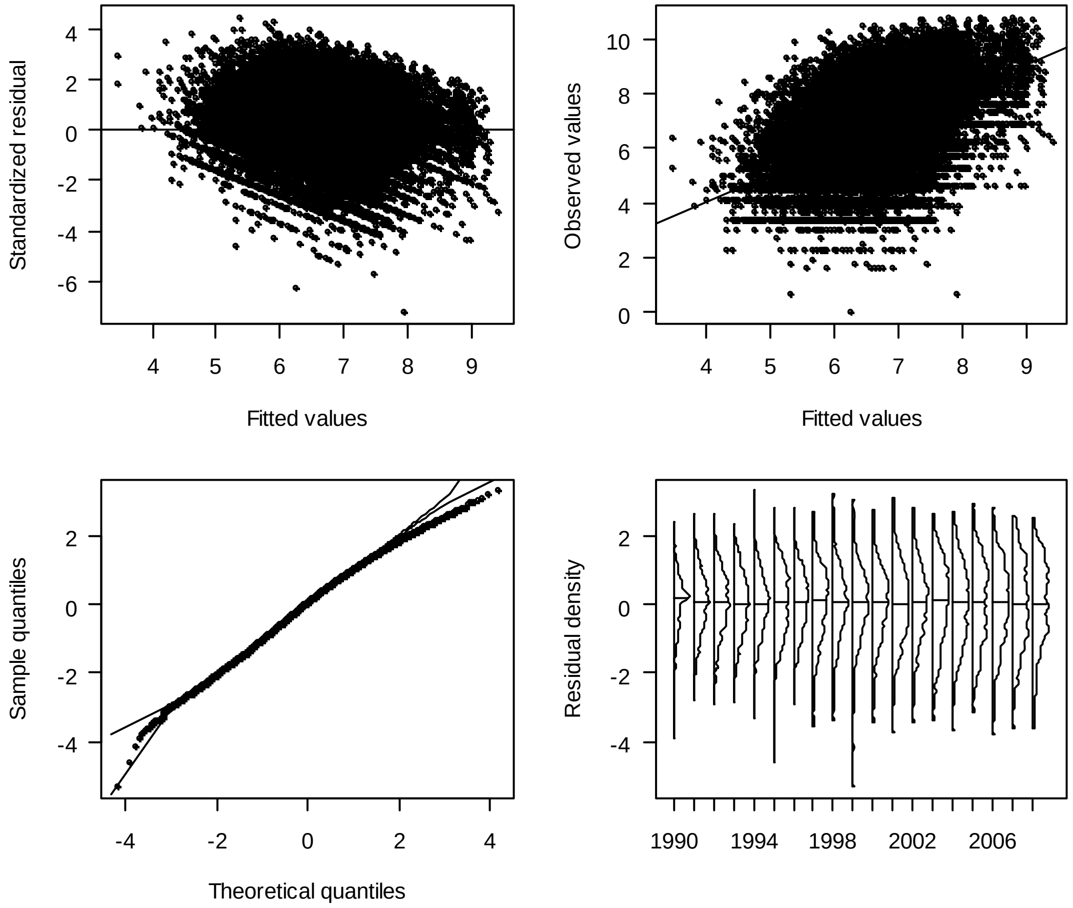


Figure D2 continued: e) ECSI CPUE Model 2a (tow-level, major species, Oct–Sep dataset). Residual diagnostic plots describing the fit of the GLM CPUE model.

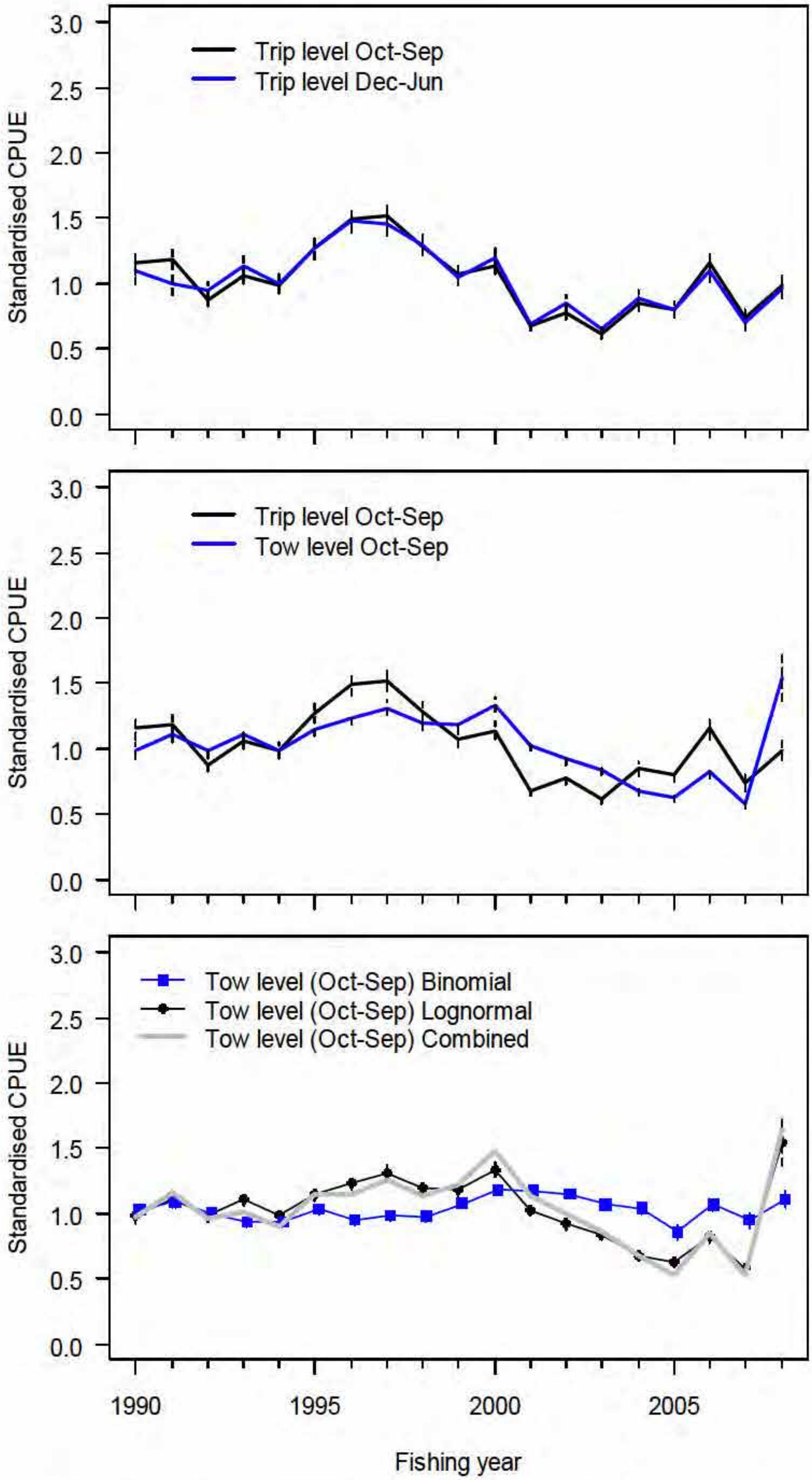


Figure D3: Overlay of canonical barracouta CPUE indices, standardised from Models 1 to 7 for the ECSI: top Models 1a and 1b; middle, Models 1a and 2a; bottom Model 3.

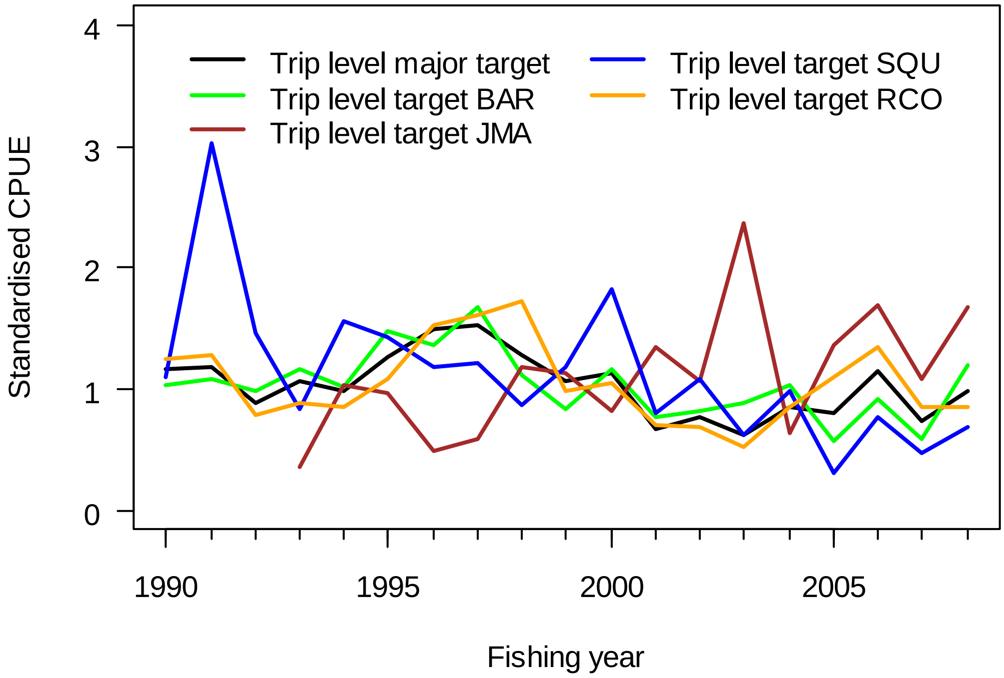
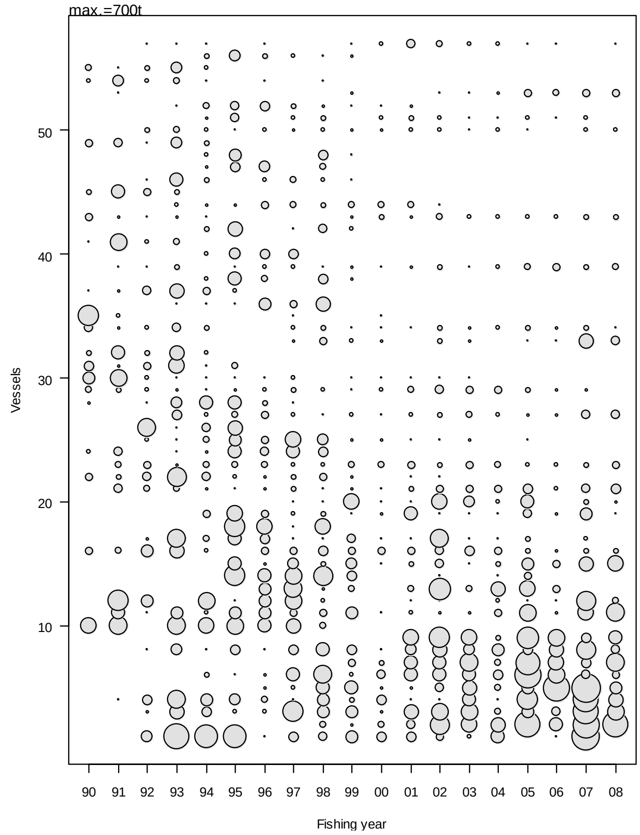
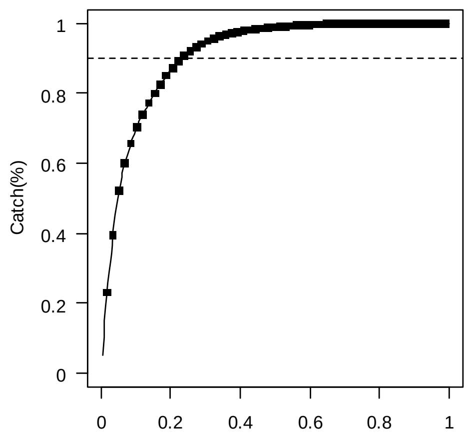


Figure D3 continued: Overlay of canonical barracouta CPUE indices, standardised from Models 1 to 7 for the ECSI: Models 1a, 4–7.

a)



b)



c)

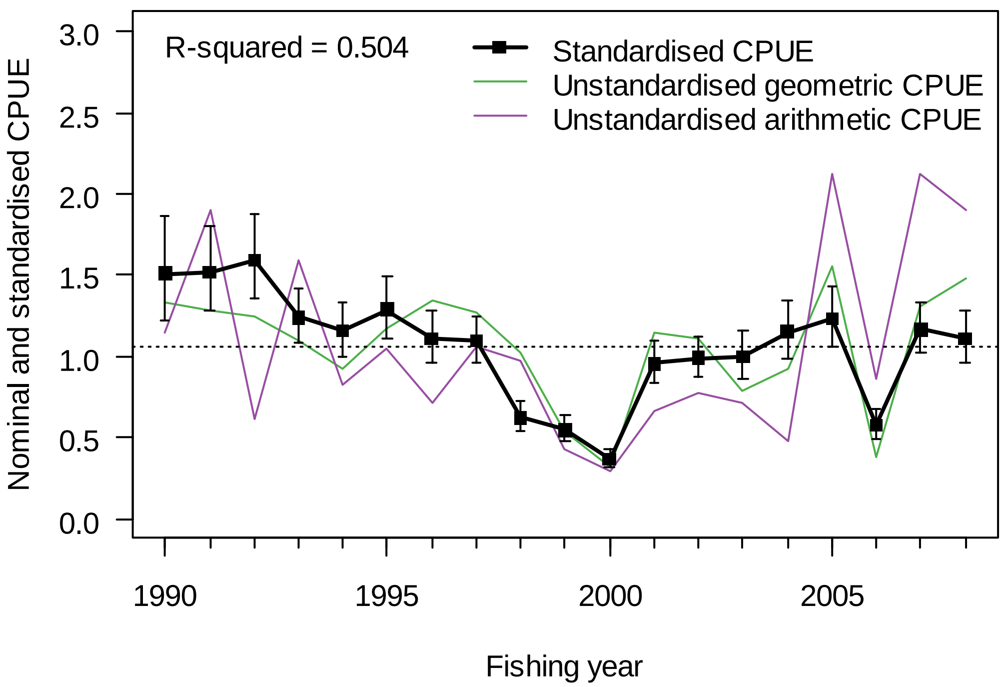


Figure D4: WCSI CPUE Model 1b (trip-level, major species, Jun–Oct dataset): a) scaled annual catch by vessel. b) Cumulative proportion of barracouta catch ranked by vessel. c) arithmetic, geometric and standardised CPUE indices for barracouta 1990–2008.

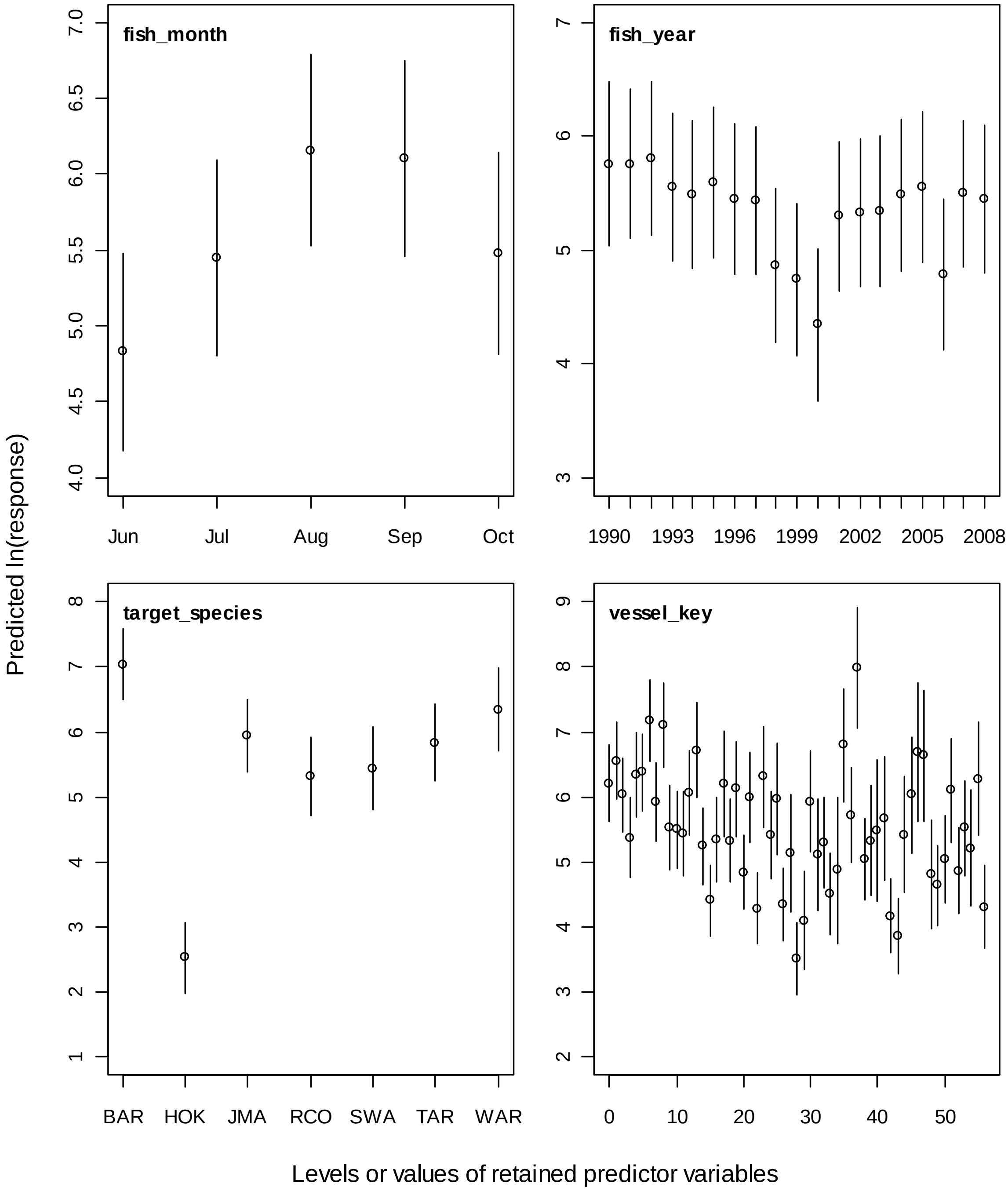


Figure D4 continued: d) WCSI CPUE model 1b (trip-level, major species, Jun–Oct dataset). Predictor variables retained in the GLM analysis and their distributions by factor levels.

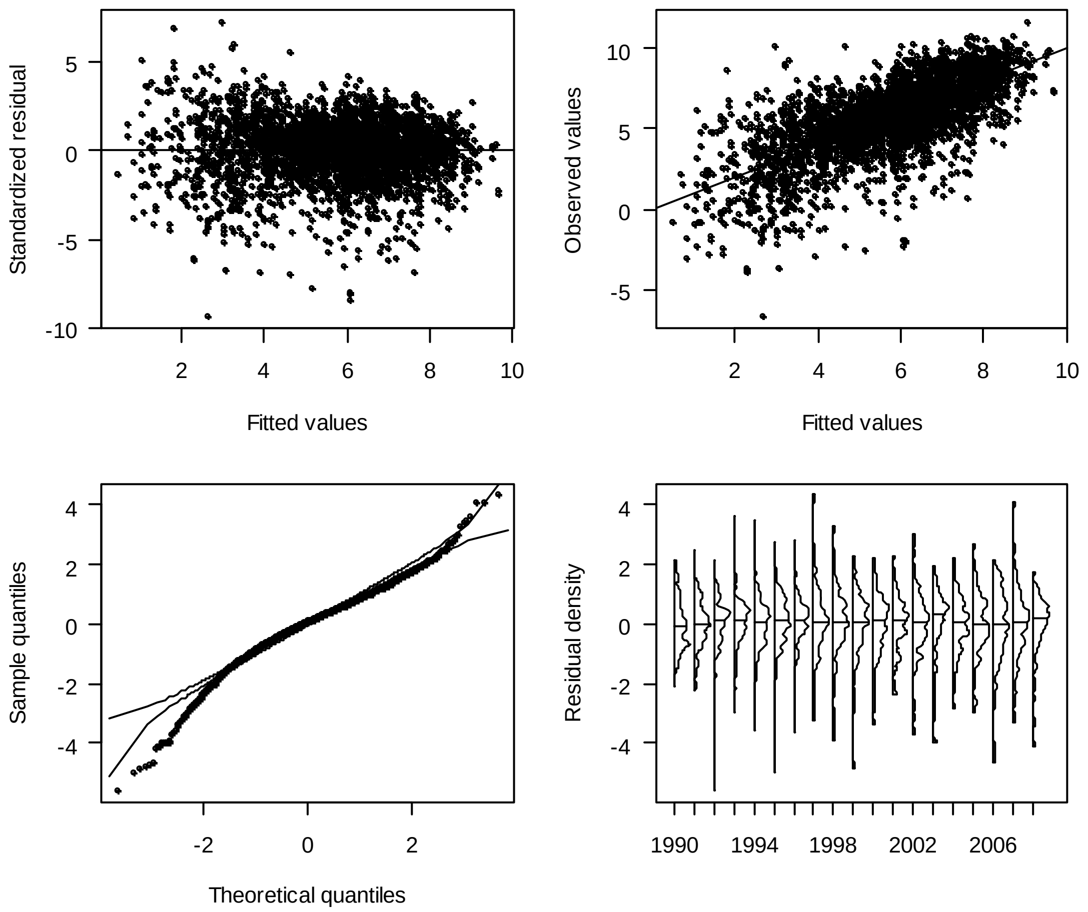
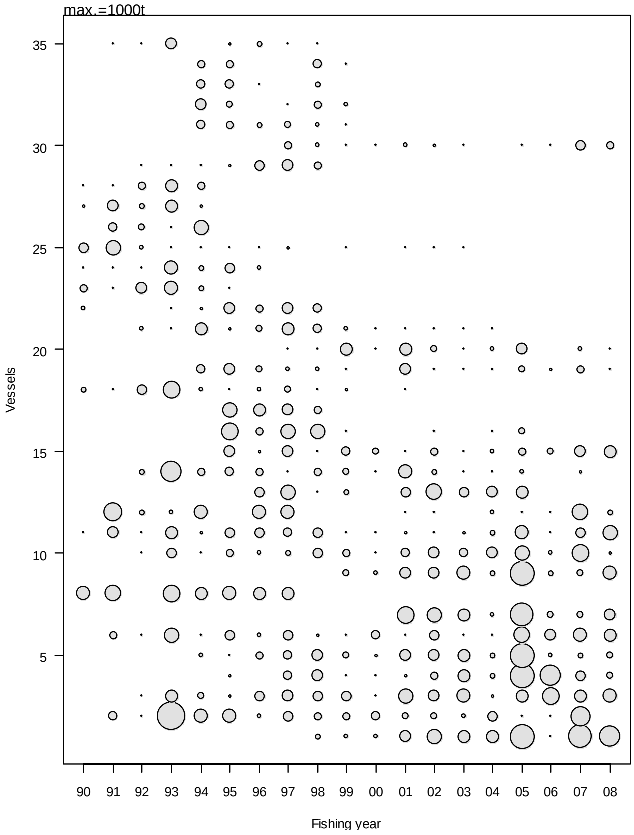
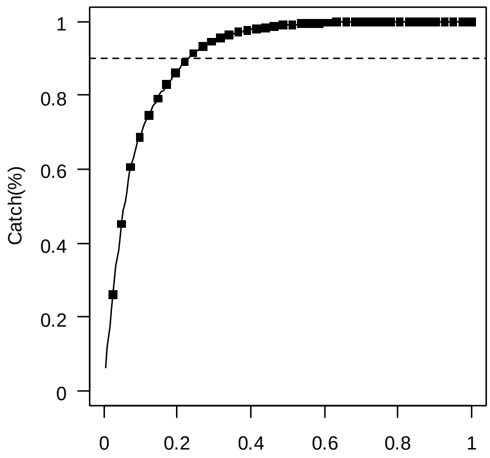


Figure D4 continued: e) WCSI CPUE model 1b (trip-level, major species, Jun–Oct dataset). Residual diagnostic plots describing the fit of the GLM CPUE model.

a)



b)



c)

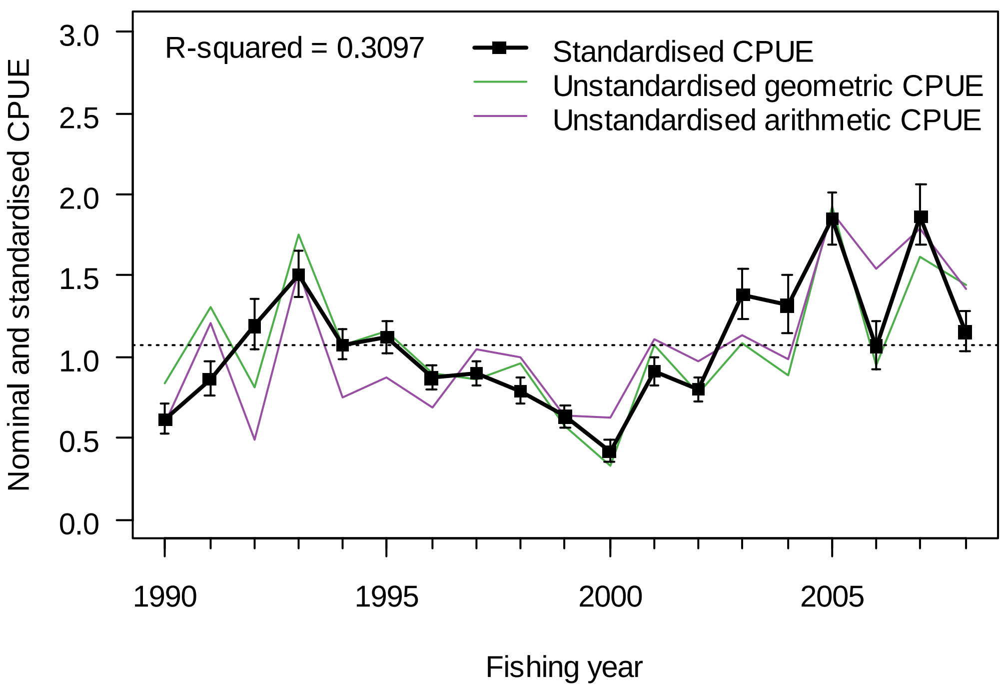


Figure D5: WCSI CPUE Model 2b (tow-level, major species, Jun–Oct dataset): a) scaled annual catch by vessel. b) Cumulative proportion of barracouta catch ranked by vessel. c) arithmetic, geometric and standardised CPUE indices for barracouta 1990–2008.

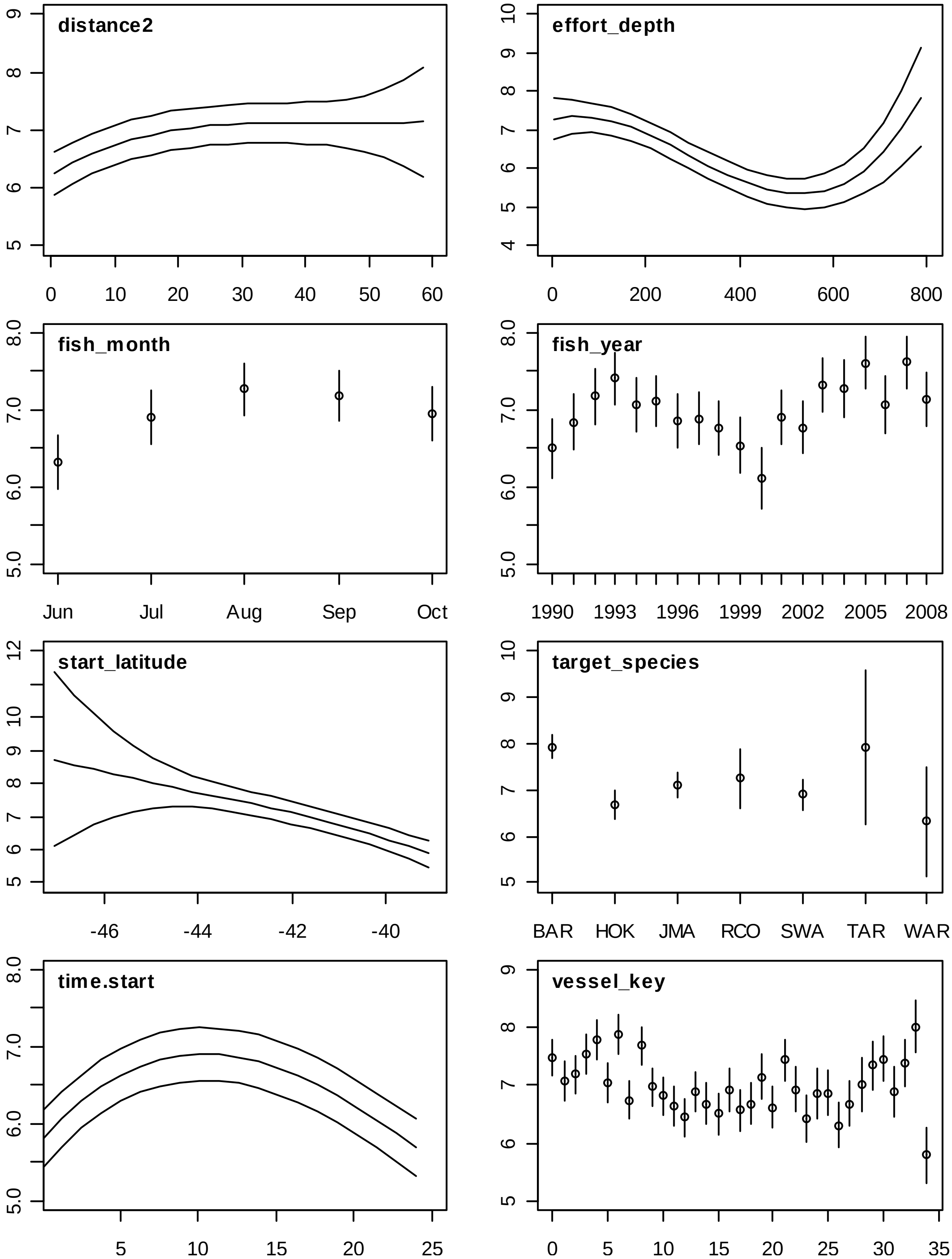


Figure D5 continued: d) WCSI CPUE model 2b (tow-level, major species, Jun–Oct dataset). Predictor variables retained in the GLM analysis and their distributions by factor levels.

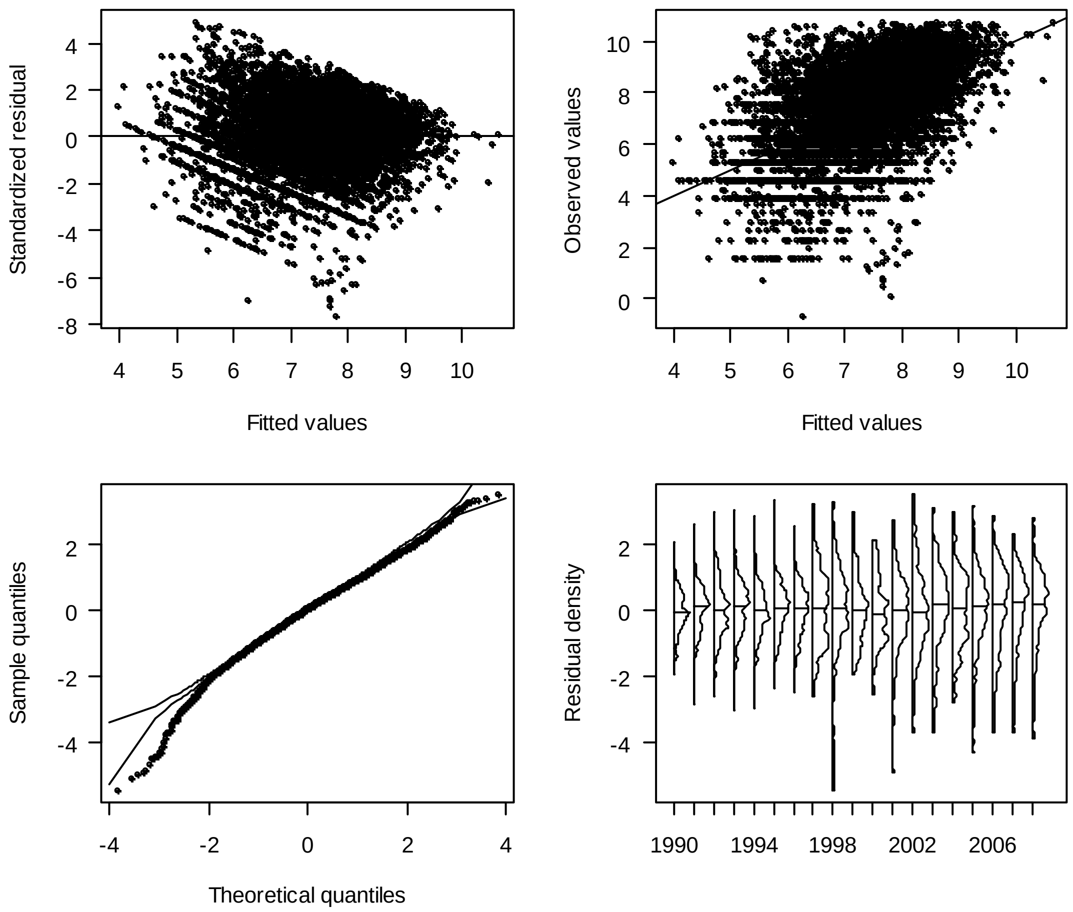
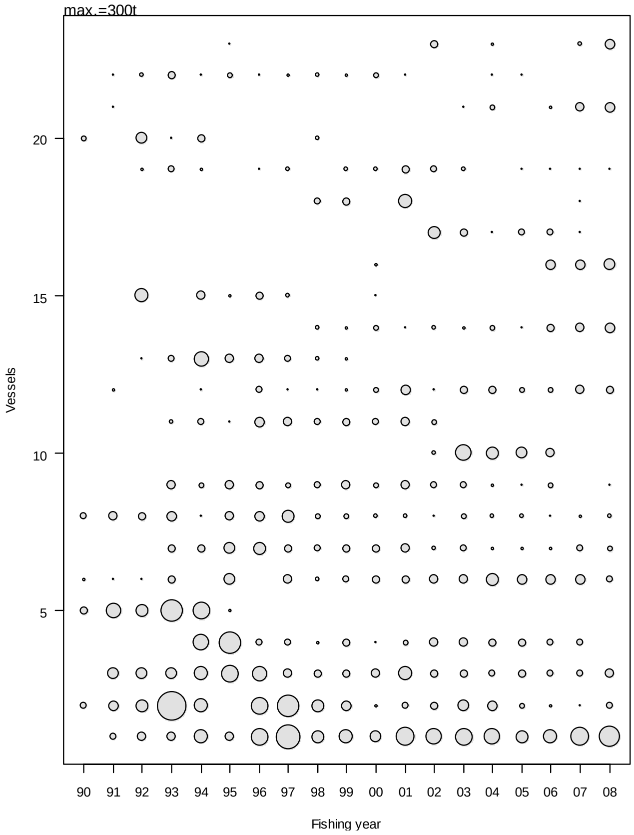
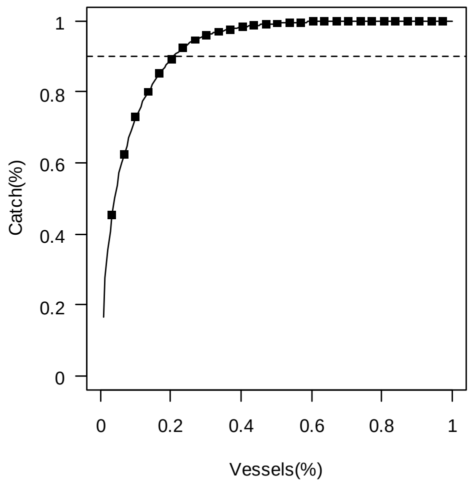


Figure D5 continued: e) WCSI CPUE model 2b (tow-level, major species, Jun–Oct dataset). Residual diagnostic plots describing the fit of the GLM CPUE model.

a)



b)



c)

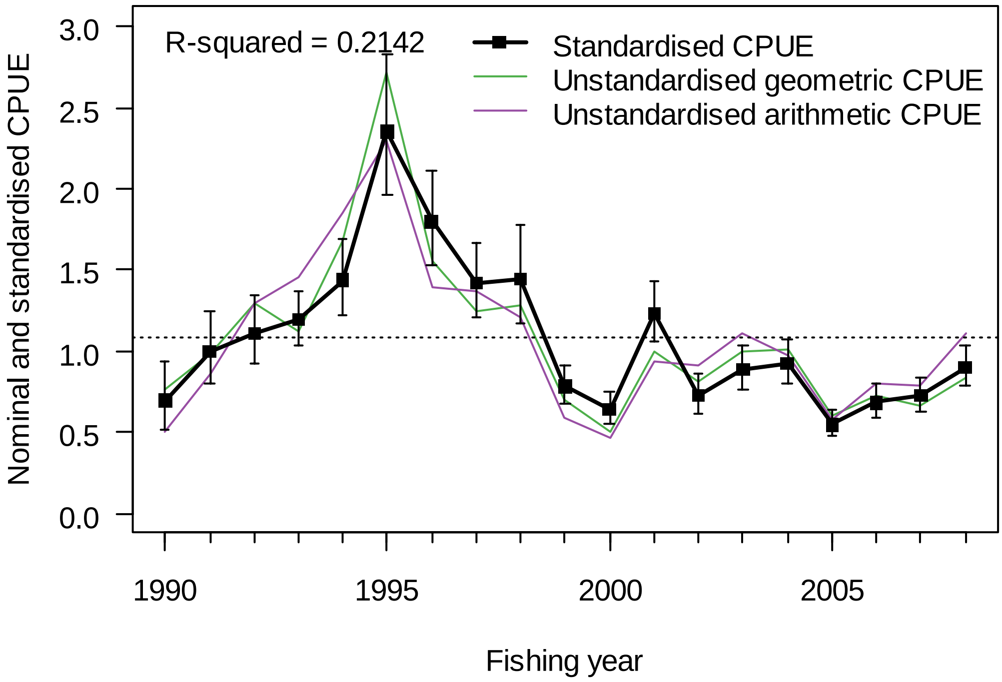


Figure D6: WCSI CPUE Model 1c (trip-level, major species, Nov–May dataset): a) scaled annual catch by vessel. b) Cumulative proportion of barracouta catch ranked by vessel. c) arithmetic, geometric and standardised CPUE indices for barracouta 1990–2008.

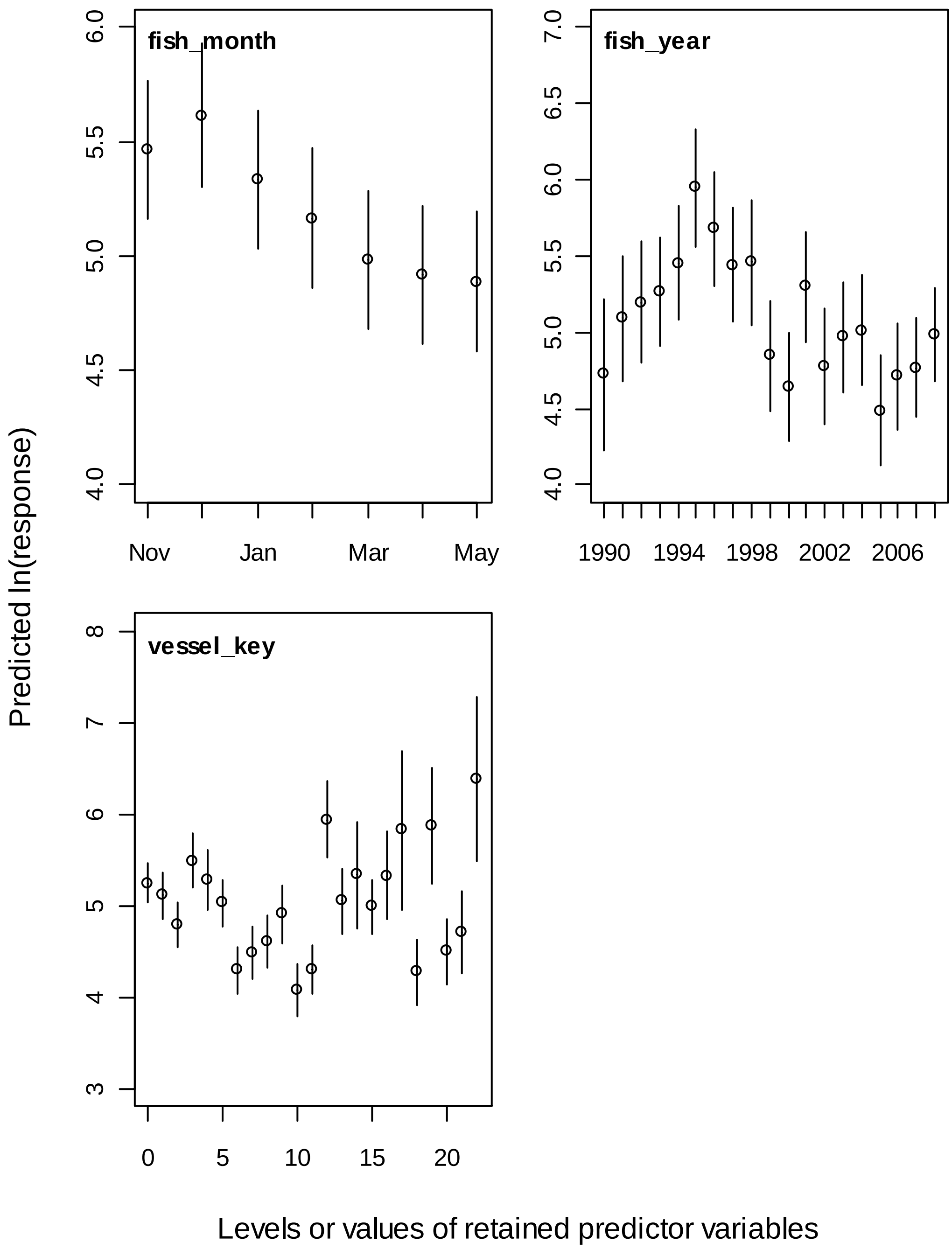


Figure D6 continued: d) WCSI CPUE Model 1c (trip-level, major species, Nov–May dataset). Predictor variables retained in the GLM analysis and their distributions by factor levels.

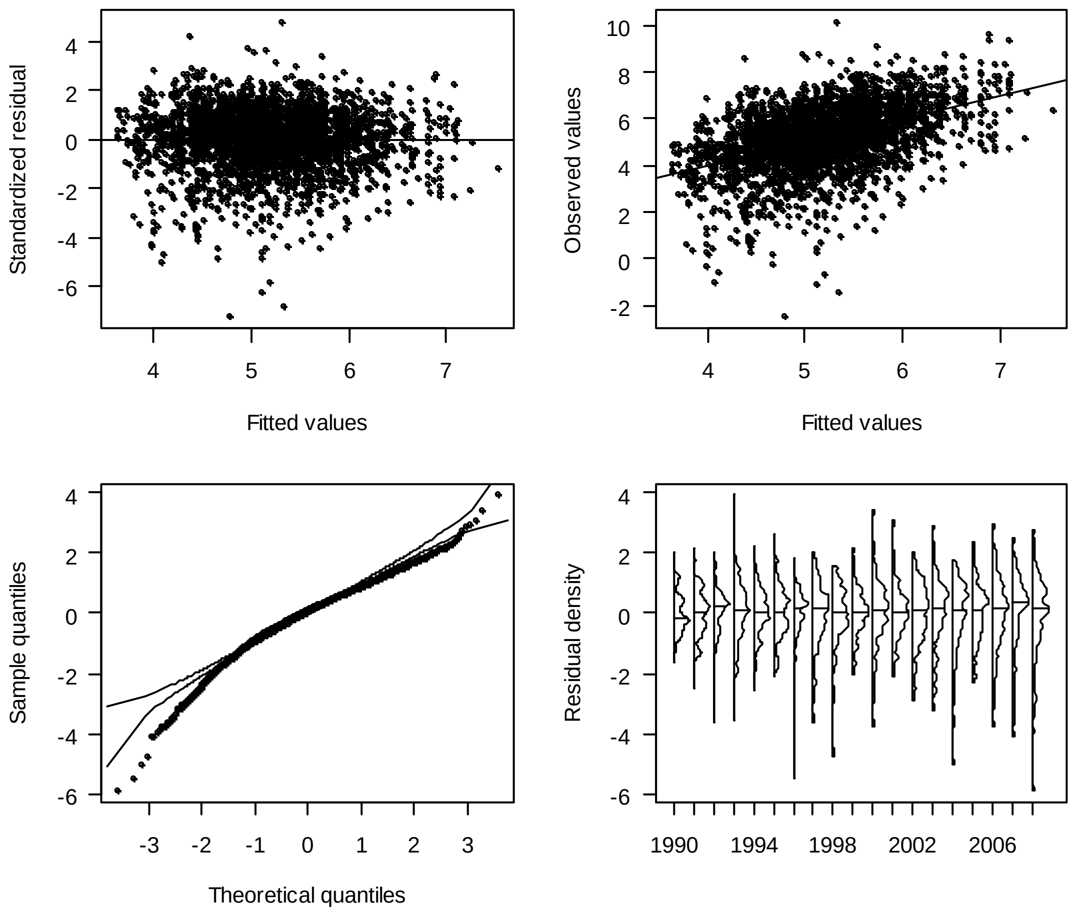


Figure D6: e) WCSI CPUE Model 1c (trip-level, major species, Nov–May dataset). Residual diagnostic plots describing the fit of the GLM CPUE model.

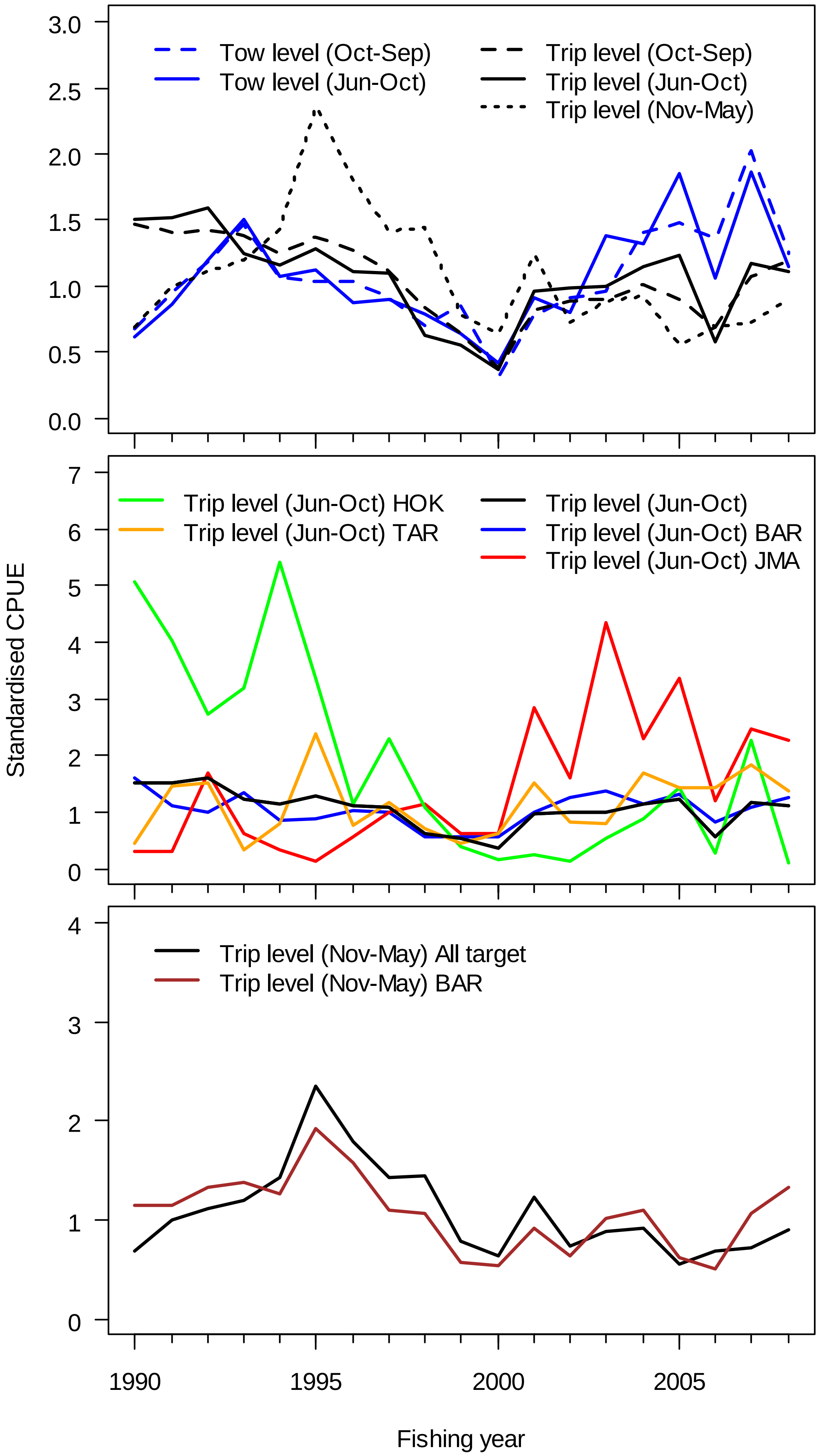


Figure D7: Overlay of canonical barracouta CPUE indices, standardised for WCSI models: Top, Models 1a,b,c (black), 2a, 2b (blue); Middle, Models 1b, 3–6; Bottom, Model 1c, 7, 8.

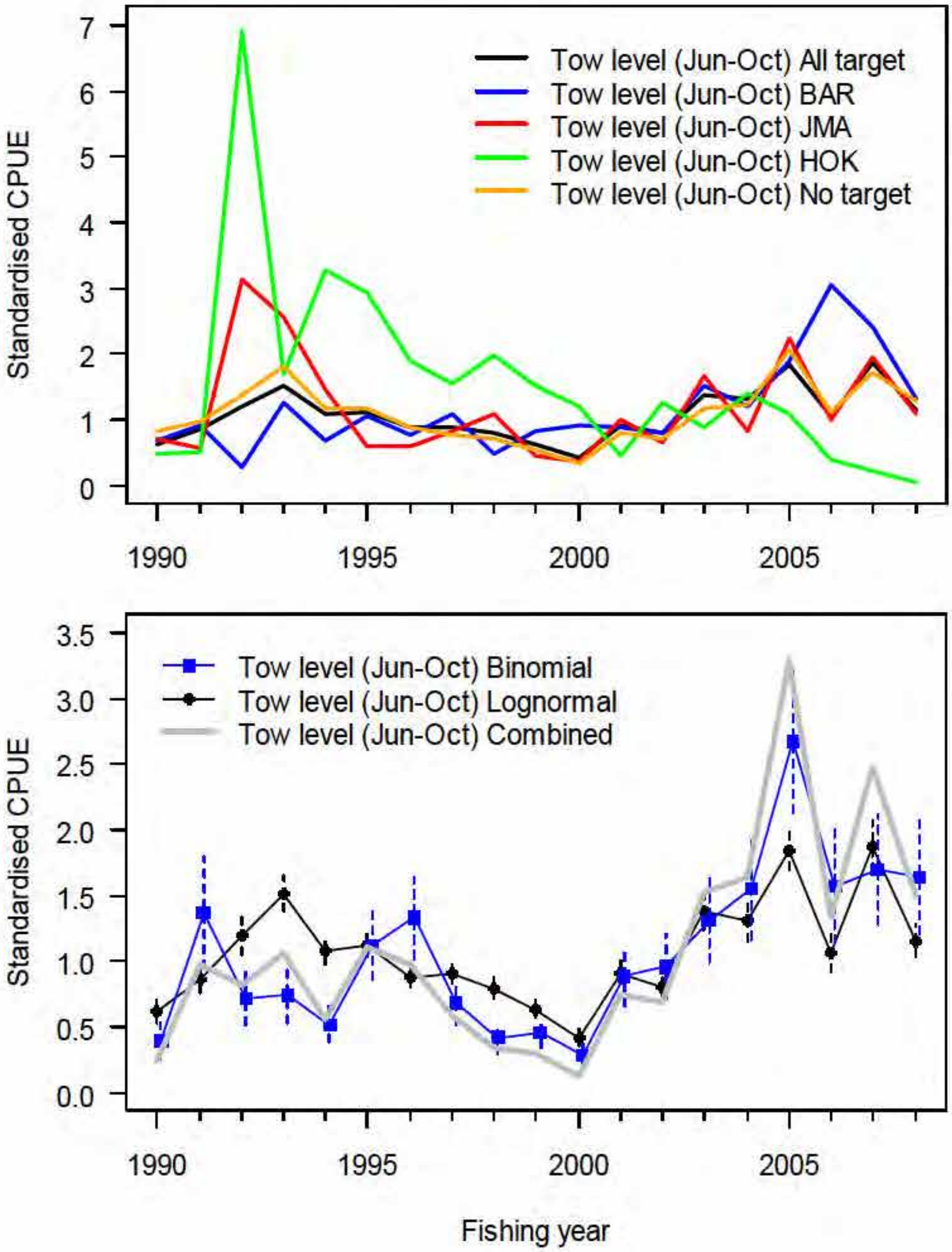
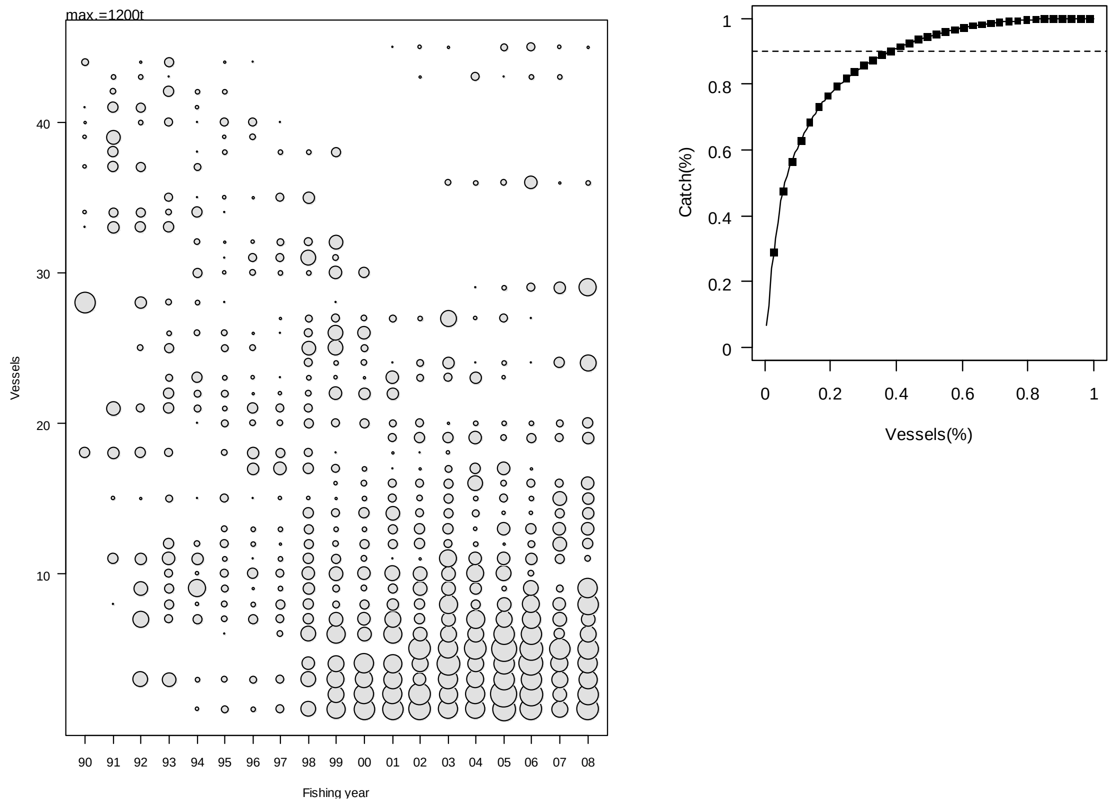


Figure D7: continued: Top, Models 2b, 8–11a,b,c (blue), 2a,b; Middle, Models 2b, 8–11; Bottom, Logistic model (Model 12)

a)

b)



c)

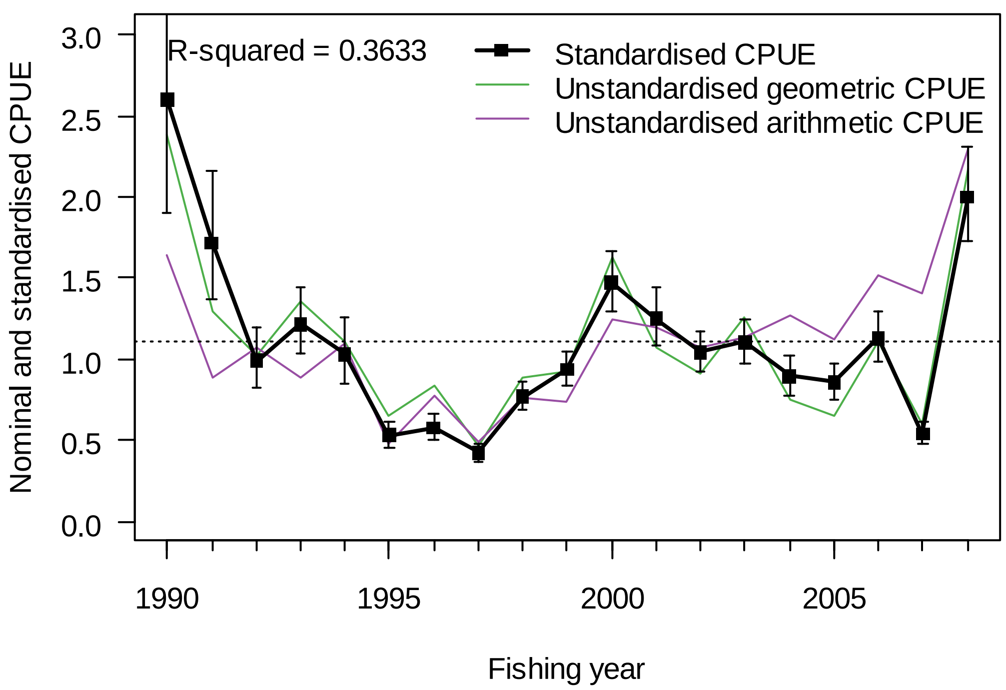


Figure D8: Snares Shelf CPUE Model 1b (trip-level, major species target, Oct–May dataset): a) scaled annual catch by vessel. b) Cumulative proportion of barracouta catch ranked by vessel. c) arithmetic, geometric and standardised CPUE indices for barracouta 1990–2008.

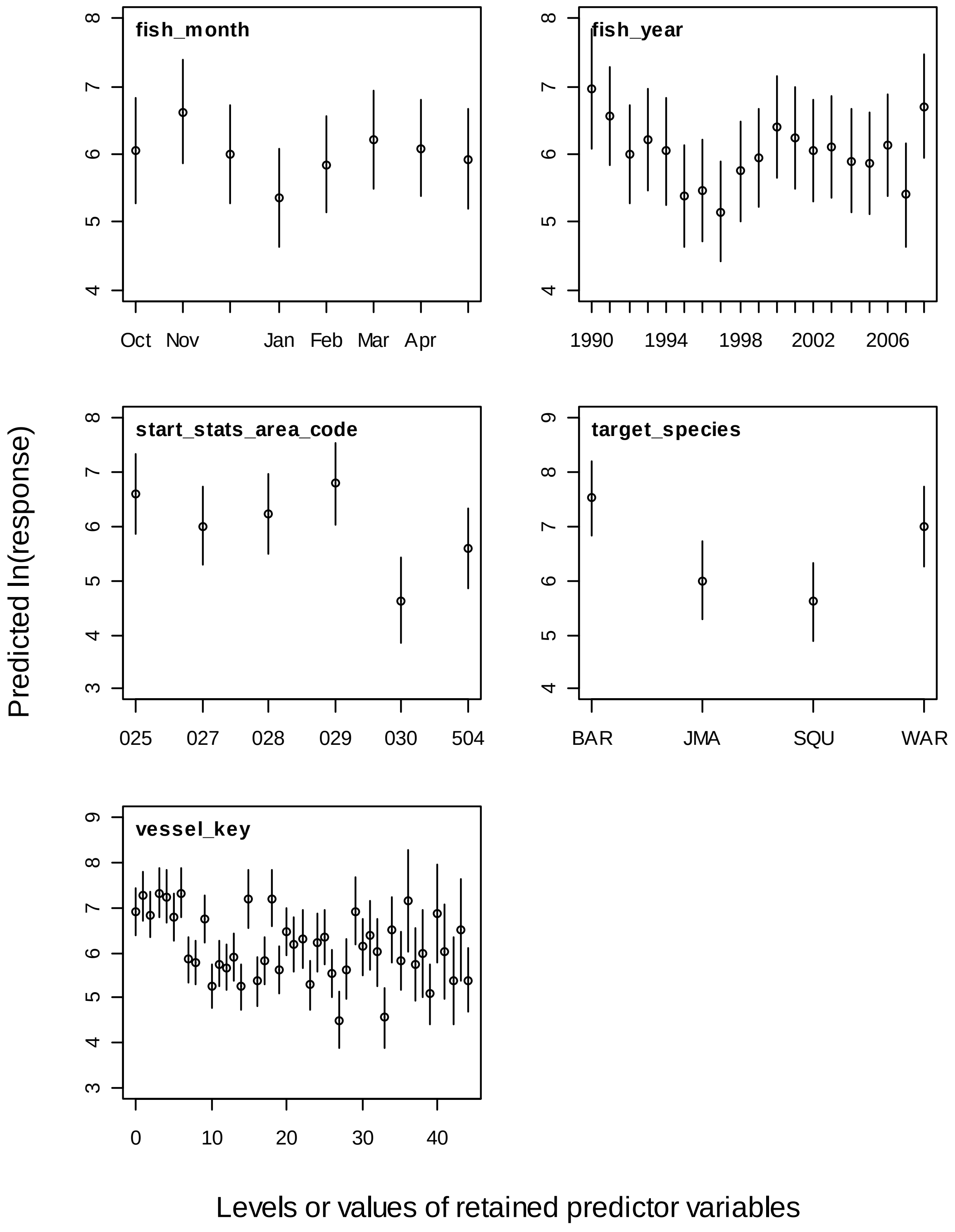


Figure D8 continued: d) SNAR CPUE Model 1b (trip-level, major species target, Oct–May dataset). Predictor variables retained in the GLM analysis and their distributions by factor levels.

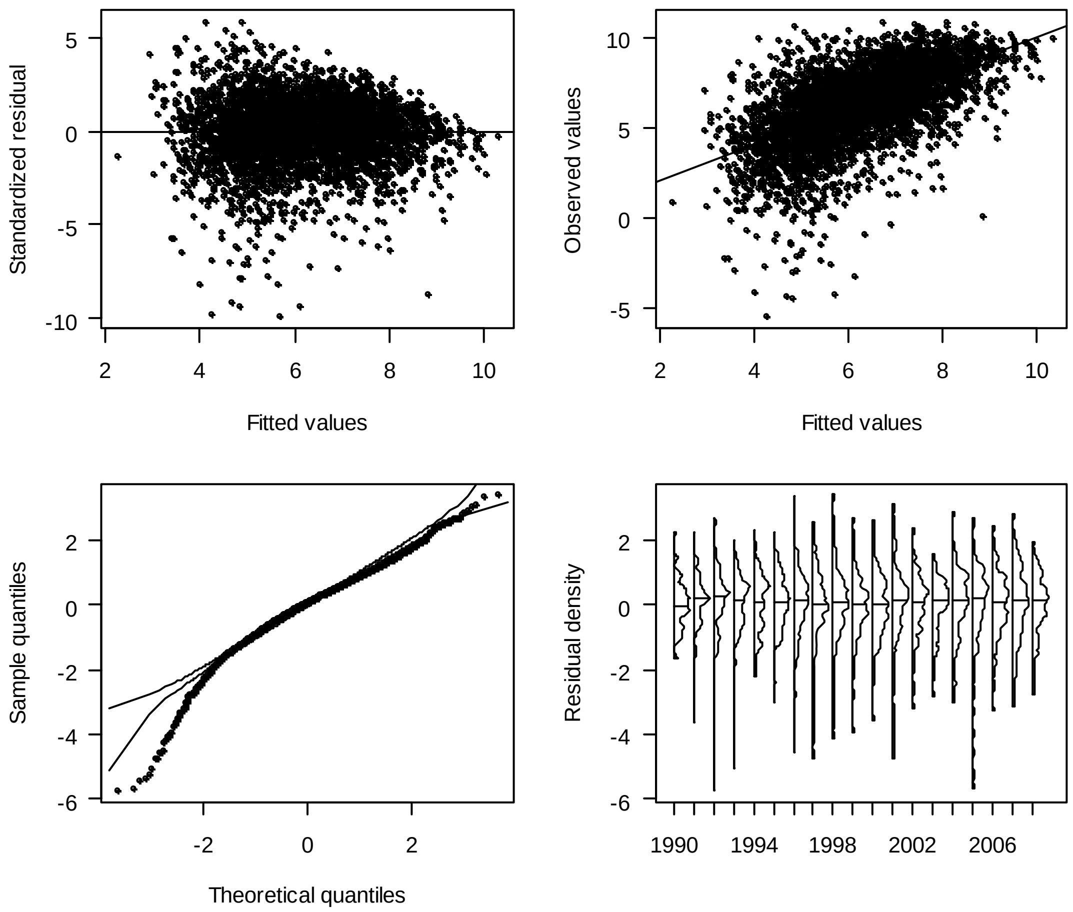
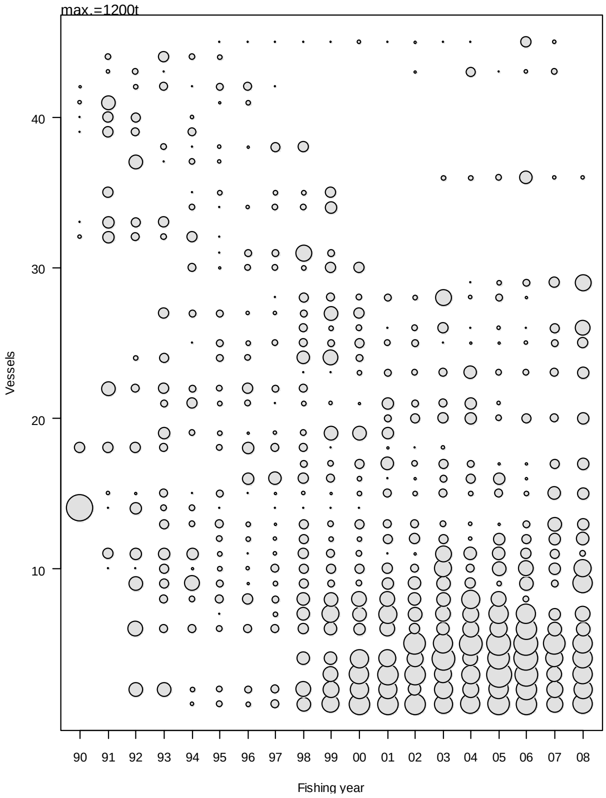
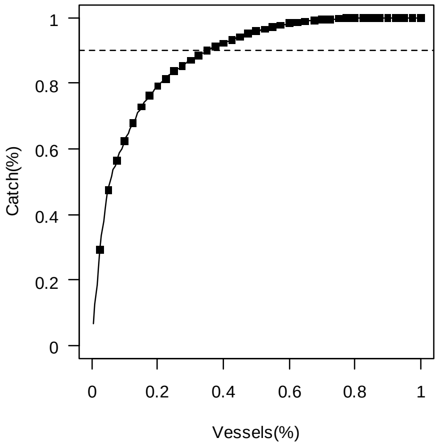


Figure D8 continued: e) SNAR CPUE Model 1b (trip-level, major species target, Oct–May dataset). Residual diagnostic plots describing the fit of the GLM CPUE model.

a)



b)



c)

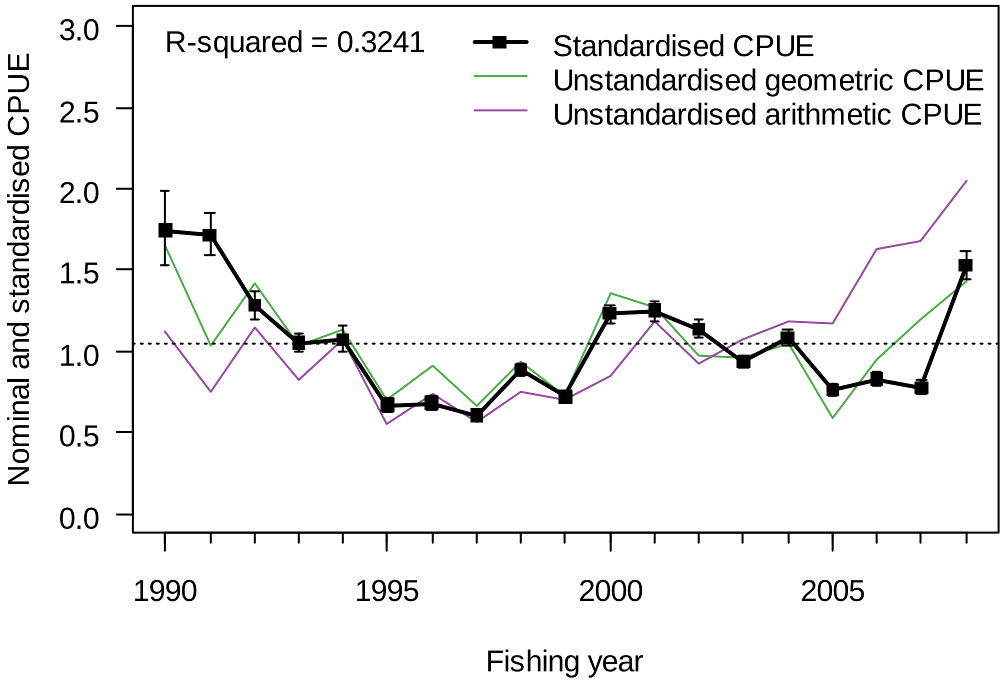


Figure D9: SNAR CPUE Model 2b (tow-level, major species target, Oct–May dataset): a) scaled annual catch by vessel. b) Cumulative proportion of barracouta catch ranked by vessel. c) arithmetic, geometric and standardised CPUE indices for barracouta 1990–2008.

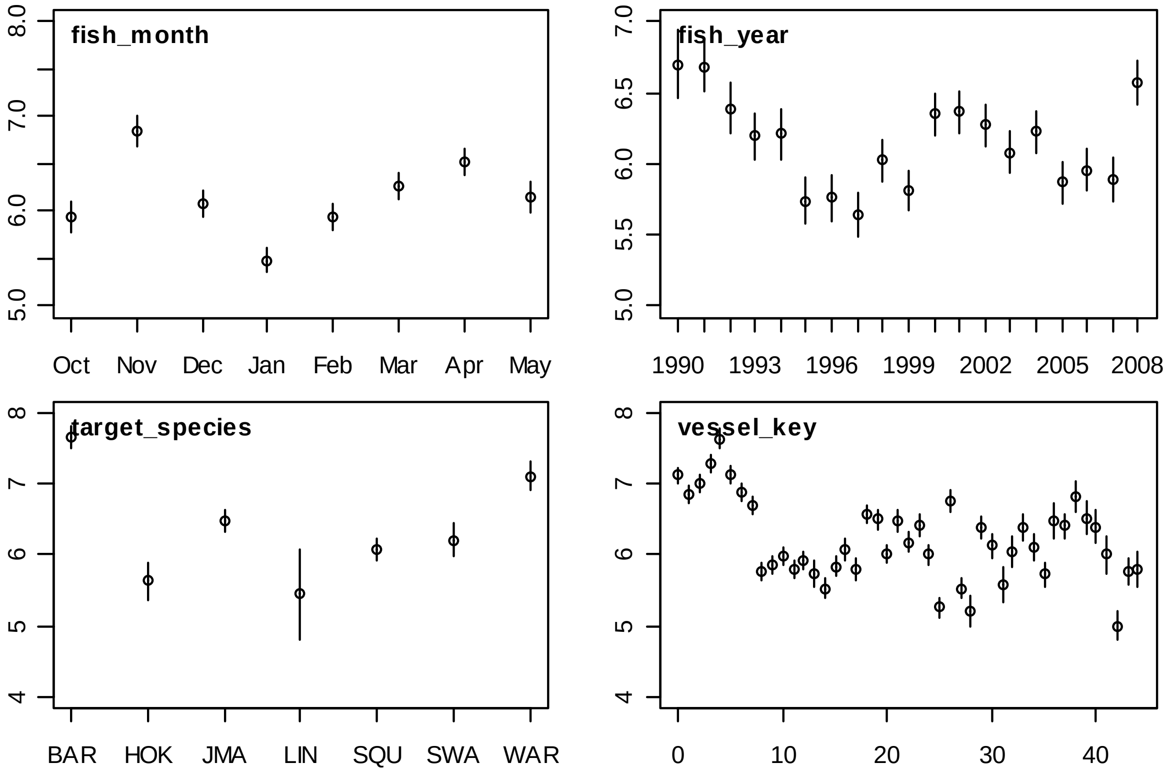


Figure D9 continued: d) SNAR CPUE Model 2b (tow-level, major species target, Oct–May dataset). Predictor variables retained in the GLM analysis and their distributions by factor levels.

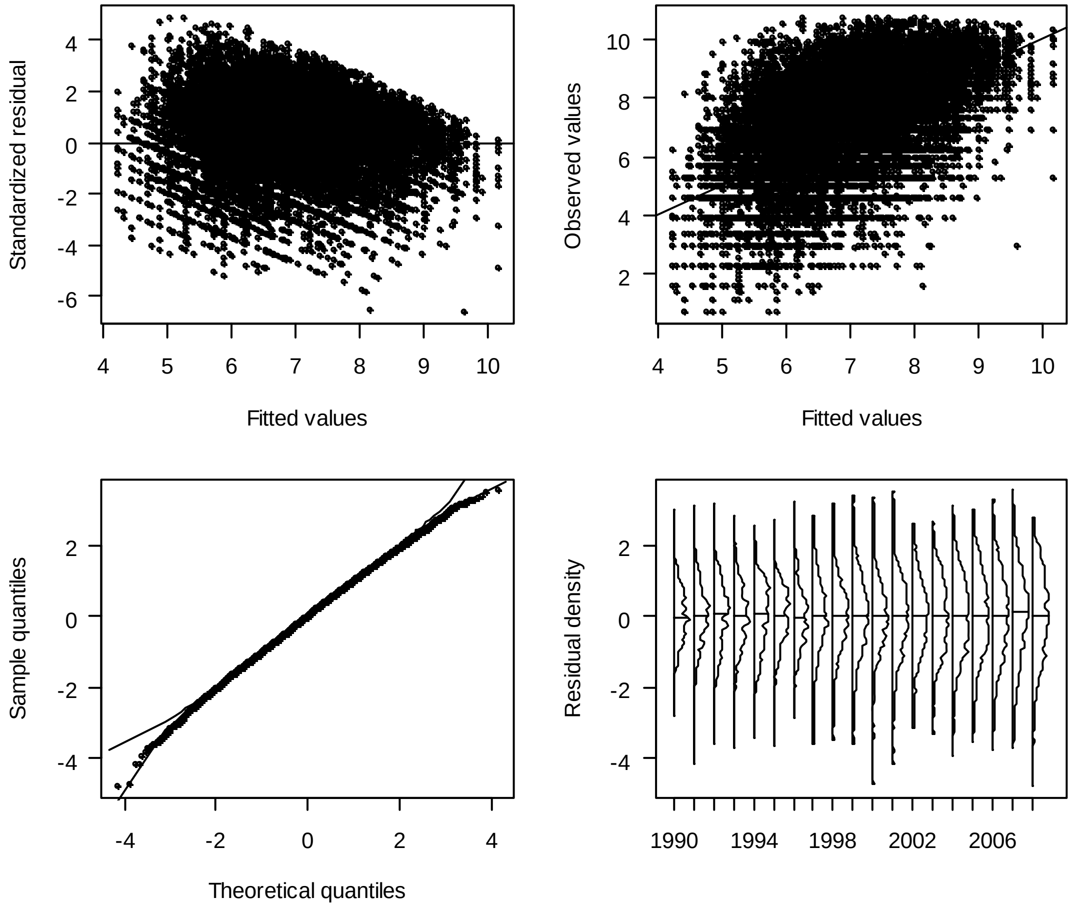


Figure D9 continued: e) SNAR CPUE Model 2b (tow-level, major species target, Oct–May dataset). Residual diagnostic plots describing the fit of the GLM CPUE model.

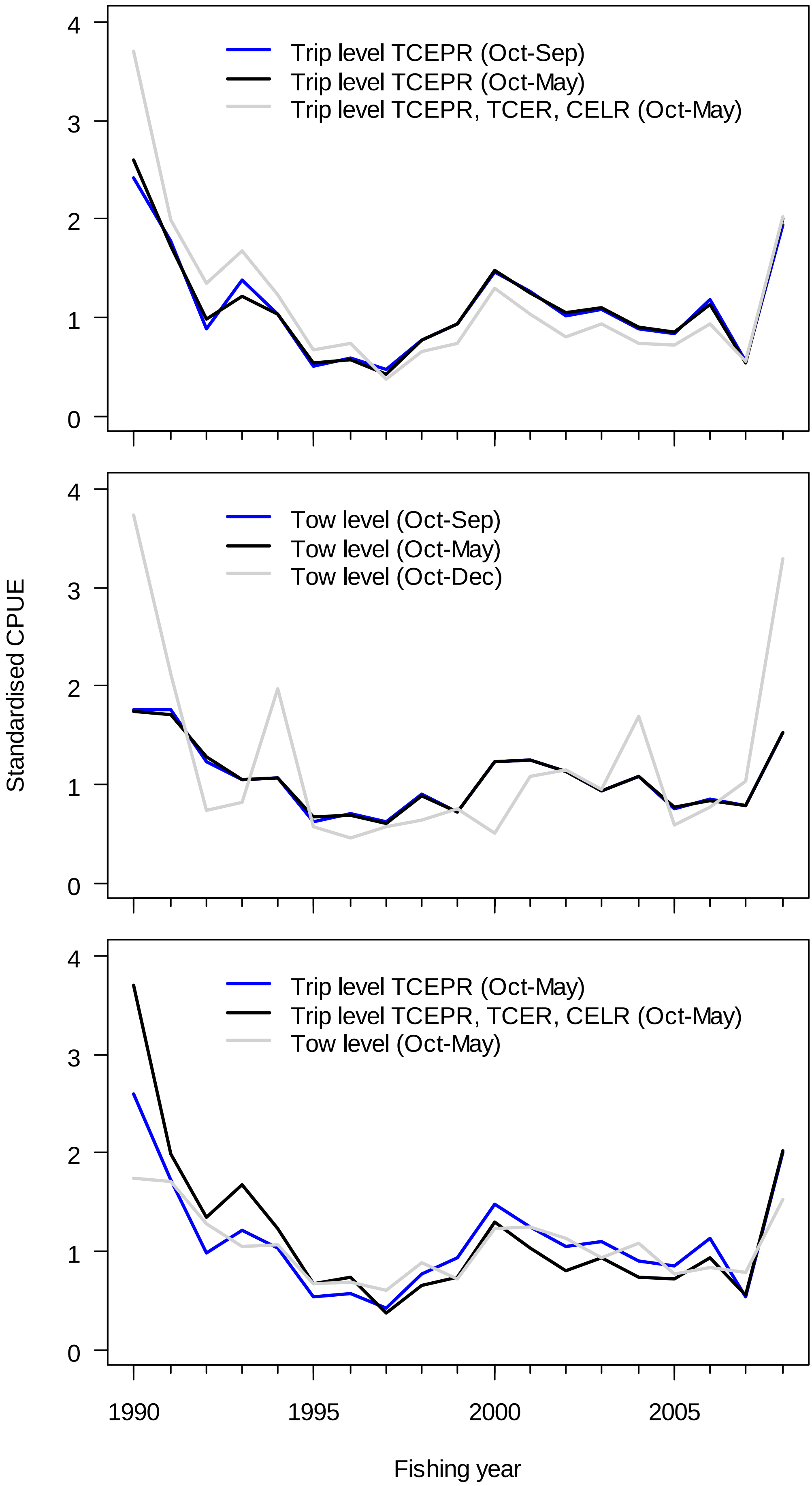


Figure D10: Overlay of canonical CPUE indices, standardised for SNAR major species target models: Top, trip-level (1a,b,c); middle, tow-level (2a,b,c); bottom, trip and tow-level comparison (1b,c, 2b).

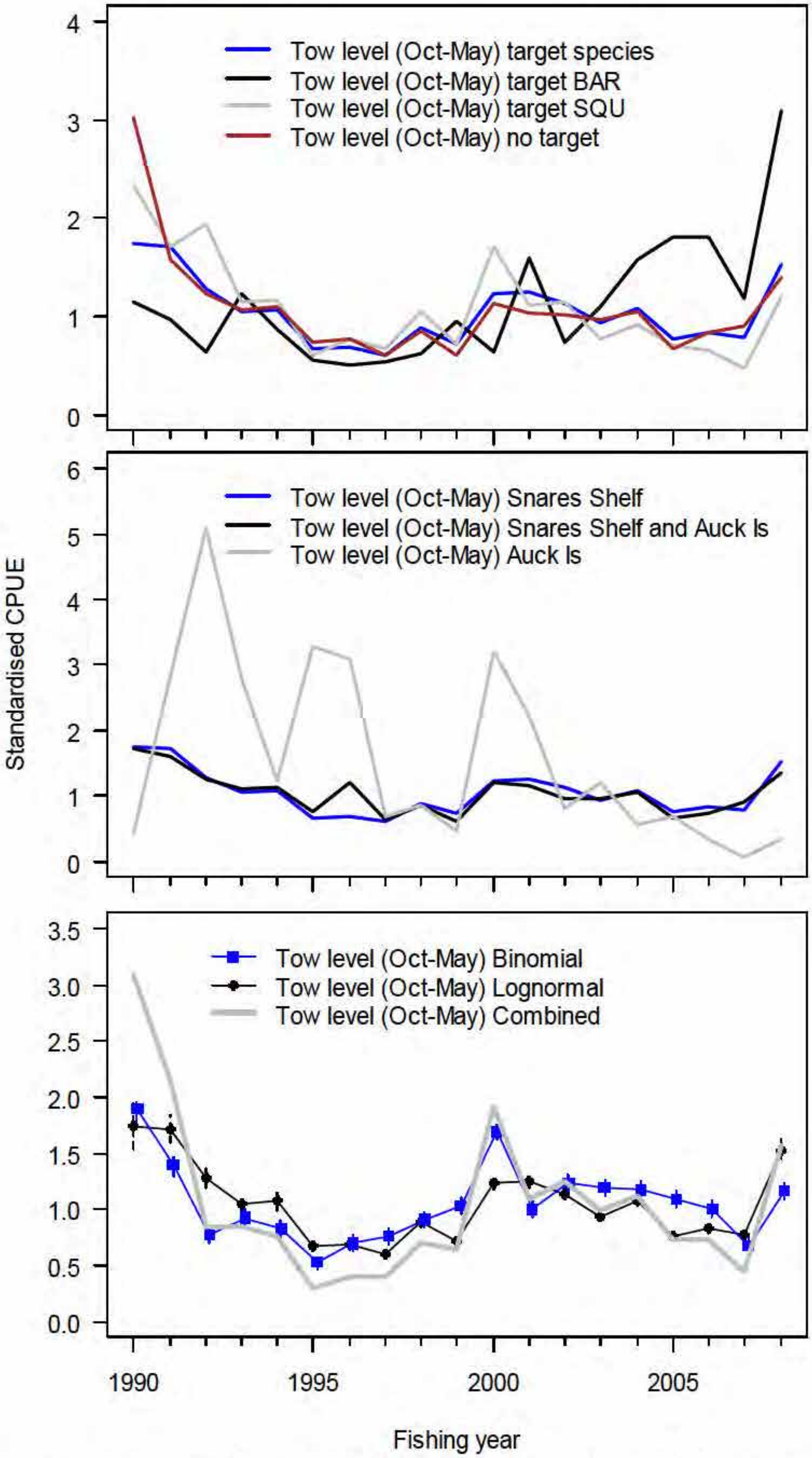


Figure D10 continued: Overlay of canonical barracouta CPUE indices, standardised for SNAR tow-level models: Top, target species comparisons (2b, 3, 4, 5); middle, area comparisons (2a,b,c); bottom, Logistic model (8).

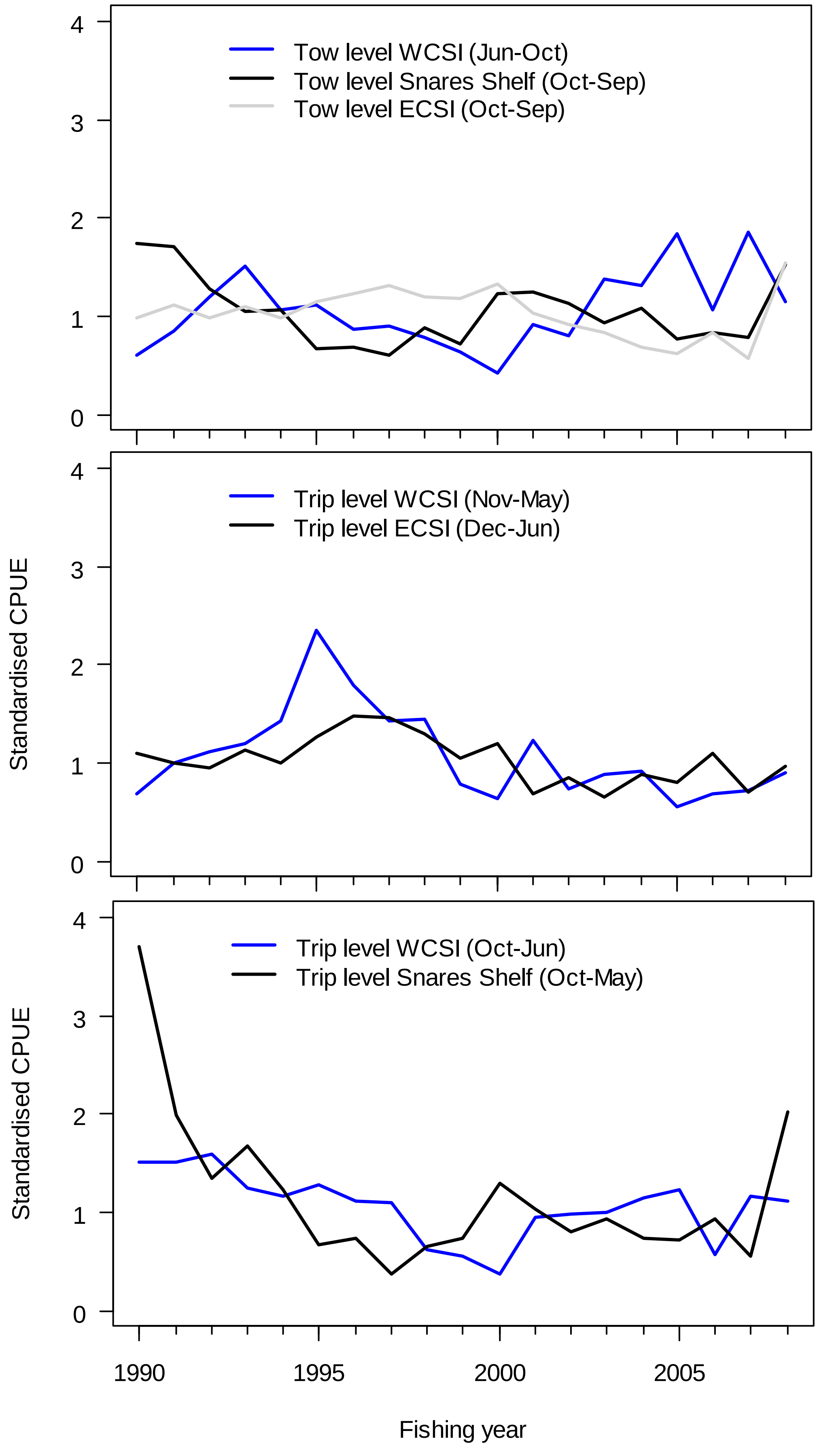


Figure D11: Overlay of barracouta CPUE trends for the three areas.