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SCH 1, 2, 3, 4, 5, 7 and 8 Fishery Characterisation and CPUE Report

New Zealand Fisheries Assessment Report 2016/64

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EXECUTIVE SUMMARY

Starr, P.J.; Kendrick, T.H. (2016). SCH 1, 2, 3, 4, 5, 7 and 8 Fishery Characterisation and CPUE Report.

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The fisheries taking school shark (*Galeorhinus galeus*) around the New Zealand North and South Islands are described from 1989–90 to 2012–13, based on compulsory reported commercial catch and effort data held by the Ministry for Primary Industries (MPI). A number of setnet, bottom trawl and bottom longline fisheries take school shark throughout New Zealand, with the three capture methods accounting for over 95% of the accumulated landings over the 24 year period. A large proportion of the setnet and bottom longline fisheries target school shark, but these fisheries also target other species, depending on the QMA of capture. Other setnet target species of importance are rig, snapper, blue moki and blue warehou. Other bottom longline target species of importance are bluenose, hapuku/bass and ling. Smaller school shark are taken incidentally in mixed target species bottom trawl fisheries off the North and South Islands which are targeted at a wide range of demersal species. Detailed characteristics of the landing data associated with these fisheries, as well as the spatial, temporal, target species and depth distributions relative to the catch of school shark in these fisheries are presented for all SCH QMAs. Annual performance of the SCH QMA catches and some regulatory information are also presented.

Fine scale positional information from catch and effort records are available for setnet from 2006–07 and for bottom trawl and bottom longline from 2007–08. These data were investigated with the intention of defining school shark fisheries showing consistency in capture locations and spatial affinity. In particular, these fishery definitions needed to be consistent among capture methods and to divide fisheries spatially at areas of low or non-existent catches. Finally, the fishery definitions needed to follow existing statistical area boundaries so that data collected prior to the existence of the fine scale positional data could be incorporated into the revised fishery definitions. Given these criteria, four setnet (SN) and five bottom longline fisheries (BLL) were defined, with largely overlapping spatial definitions. The main difficulty was in eastern Cook Strait, where the setnet and bottom longline fishery data behaved differently. In the end, setnet catches from the northern part of the South Island east coast (Kaikoura and Pegasus Bay) were added to the east coast North Island setnet catches, while bottom longline catches from the western end of the Chatham Rise (which lies in SCH 3) were added to the bottom longline catches from rest of the Chatham Rise (SCH 4). Catches from eastern Cook Strait for both bottom longline and setnet were incorporated into the fishery defined for the combined central west coast of the North/South Island.

Commercial Catch Per Unit Effort (CPUE) analyses for the four setnet (SN) and five bottom longline (BLL) fisheries described above were considered as candidates for use as biomass indices to track school shark population trends. These analyses were based on the compulsory reported commercial catch and effort data which are collected by MPI. Seven of these nine fisheries were accepted as being adequate for monitoring school shark. The only fishery rejected outright was the bottom longline fishery associated with the lower part of the South Island east coast, Foveaux Strait and the lower west coast of the South Island, because the amount of available data was small and extremely unbalanced in terms of coverage by vessels and statistical areas. The Chatham Rise bottom longline analysis was considered not completely reliable because of the short time series (the analysis only started in 2003–04) and the relatively small amount of available data. The remaining seven CPUE analyses were considered acceptable for monitoring school shark in the respective fisheries, with adequate supporting diagnostics.

The setnet analyses for the FarNorth, Bay of Plenty region matched the adjacent setnet analysis on the east coasts of the North Island and upper South Island, with both analyses showing an increasing trend. The FarNorth/Bay of Plenty bottom longline analysis matched the setnet analysis in the same region because it also showed an increasing trend. However, the east coast North Island/upper South

Island bottom longline analysis contradicted the setnet analysis in the same region with a strongly declining trend, without an apparent reason for the difference. The setnet analyses for the southern east coast South Island/Foveaux Strait matched the setnet analysis for the central west coast North/Island, with both series showing longterm declining trends of 26–35% over the 24 years of record. However, the associated bottom longline analysis from the central west coast North/Island showed an increasing trend that matched the increasing trends estimated for the SN and BLL FarNorth/Bay of Plenty analyses. It is not known how to reconcile these contradictory trends in such a highly mobile species, other than to hypothesise that the SN and BLL fisheries operate on different parts of the school shark population. Overall, this review concluded that school shark on the north and east coasts of the North Island are doing well, given the increasing CPUE trends, while the fisheries that encompass the entire southern and west coast of the South Island are in decline, given the declining setnet CPUE trends. These observed declines in the two southern setnet fisheries are of concern because these fisheries are known to harvest mature school shark and comprise a significant proportion of the overall school shark catch.

Recent (in 2008–09 and 2011–12) large scale management restrictions applied to the New Zealand setnet fishery for the protection of endemic dolphins have the potential to compromise the capacity of the setnet fishery to reliably monitor school shark because of spatial and temporal disruption in access to fishing locations.

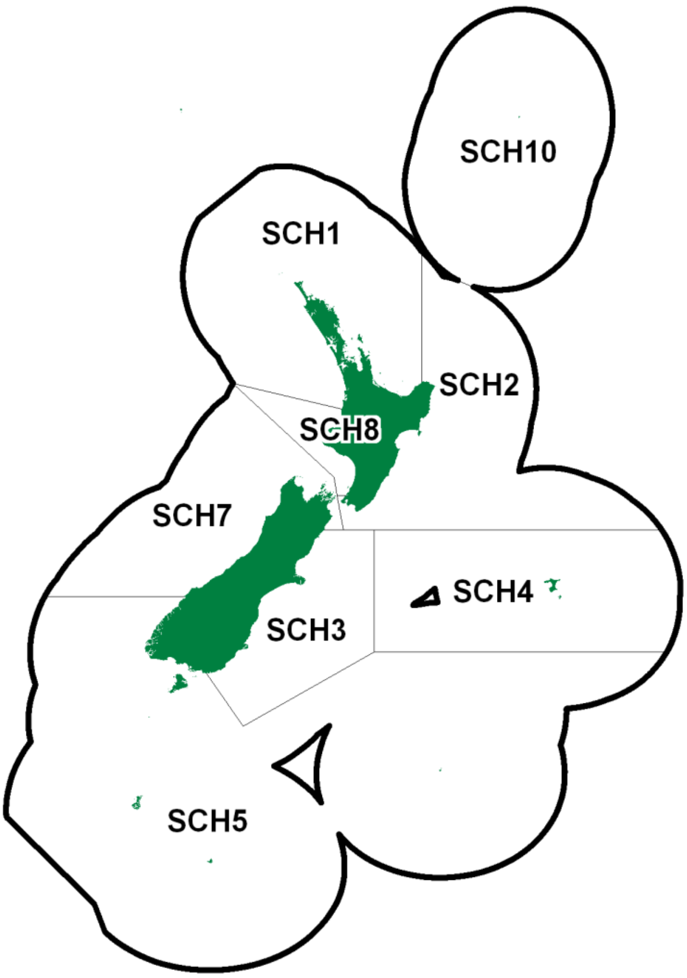


Figure 1: Map of SCH QMAs.

1. INTRODUCTION

This document describes work conducted under Objectives 1 and 2 of the Ministry for Primary Industries (MPI) contract SCH2013/01.

Overall Objective:

1. To characterise all school shark (*Galeorhinus galeus*) fisheries and undertake CPUE analyses in SCH 1, 2, 3, 4, 5, 7 and 8.

Specific Objectives:

1. To characterise the SCH 1, 2, 3, 4, 5, 7 and 8 fisheries.
2. To analyse existing commercial catch and effort data to the end of 2012/13 fishing year and undertake CPUE standardisations for each stock.

This project extends a number of previous projects in a single document/analysis:

Fishstock	Reference	Last fishing year in analysis
SCH 1	Starr & Kendrick (2010a)	2008–09
SCH 2	Starr & Kendrick (2010b)	2008–09
SCH 3	Starr, Kendrick & Bentley (2010)	2008–09
SCH 4	never been done	–
SCH 5	Starr & Kendrick (2011)	2009–10
SCH 7	Starr & Kendrick (2011)	2009–10
SCH 8	Starr & Kendrick (2011)	2009–10

This report documents an update of the SCH CPUE analyses listed above that was commissioned in 2014 by the Ministry for Primary Industries (MPI), summarising fishery and landings characterisations for SCH 1, SCH 2, SCH 3, SCH 4, SCH 5, SCH 7, and SCH 8, as well as presenting nine CPUE standardisations derived from setnet and bottom longline data originating from the above QMAs. The update was reviewed and accepted by the Northern Inshore Fishery Assessment Working Group (NINSWG) in April 2014 and subsequently reviewed in May 2014 at the MPI Stock Assessment Plenary. The results of the 2014 review are summarised in Chapter 79 of the MPI Plenary Stock Assessment Report (Ministry for Primary Industries 2016).

Abbreviations and definitions of terms used in this report are presented in Appendix A. A map showing the school shark MPI QMAs is presented in Figure 1. Appendix B presents the MPI FMAs in the context of the contributing finfish statistical reporting areas.

2. INFORMATION ABOUT THE STOCK/FISHERY

2.1 Catches

When this species was introduced into the QMS on 1 October 1986, SCH TACCs were set lower than the reported landings in the preceding three years with an overall decrease of 42% relative to the 1983–84 to 1985–86 average reported landings (calculated by totalling all annual landings and the 1986–87 TACCs after excluding SCH 4[1]; Table C.1). The relative decreases in the individual QMAs varied (again excluding SCH 4): SCH 1=-39%; SCH 2=-35%; SCH 3=-46%; SCH 5=-25%; SCH 7=-52%; SCH 8=-55% (calculated by comparing the 1986–87 TACC with the 1983–84 to 1985–86 average reported landings in each QMA Table C.1).

The TACC for school shark in SCH 1 was set at 560 t when this Fishstock was first introduced into the QMS in 1986, but increased through the process of quota appeals to around 660 t by the early 1990s, where it has remained (Figure 2; Table C.1). The current TACC is 689 t. Landings have fluctuated around the TACC which has been exceeded by landings 14 times in the 27 years since SCH 1 entered the QMS, including a 10 year period between 1995–96 to 2004–05 when the TACC was exceeded by an average of 13%/year (Figure 2; Table C.1). Landings in 2011–12 and 2012–13 were at or just below the TACC.

The TACC for school shark in SCH 2 was set at 162 t when this Fishstock was first introduced into the QMS in 1986. It rose through the process of quota appeals to just under 200 t by 1989–90 where it has remained (Figure 2; Table C.1). The current TACC is 199 t. Landings have fluctuated around the TACC which has been exceeded by landings 14 times in the 27 years since SCH 2 entered the QMS, averaging around 11% in the years of overage (Figure 2; Table C.1). Landings have been at or just below the TACC since 2010–11 (Table C.1).

The TACC for SCH 3 was set at 270 t when this Fishstock was first introduced into the QMS in 1986. It rose through the process of quota appeals to around 320 t by 1989–90 where it remained to 2003–04 (Figure 2; Table C.1). The TACC for SCH 3 was raised 20% to 387 t in 2004–05 under the provisions of the Adaptive Management Programme (AMP), where it has remained even though the programme was discontinued in 2009. Landings exceeded the TACC in the six years preceding the 2004–05 increase and twice (in 2004–05 and 2009–10) after the increase (Table C.1; Figure 2). Landings have declined in the three years after 2009–10 and equal the previous TACC in 2012–13.

The TACC for SCH 4 was set at 200 t when this Fishstock was first introduced into the QMS in 1986. It rose through the process of quota appeals to 239 t in 1990–91 where it has since remained (Figure 2; Table C.1). Landings in this Fishstock have been consistently below the TACC, which has only been approached with landings greater than 200 t in 1995–96, 2004–05 and 2011–12 (Table C.1; Figure 2). Landings dropped to 127 t in 2012–13.

[1] This QMA was excluded because the fishery was undeveloped (<30 tt annual catch in the 1980s) but was assigned a 200 t TACC.

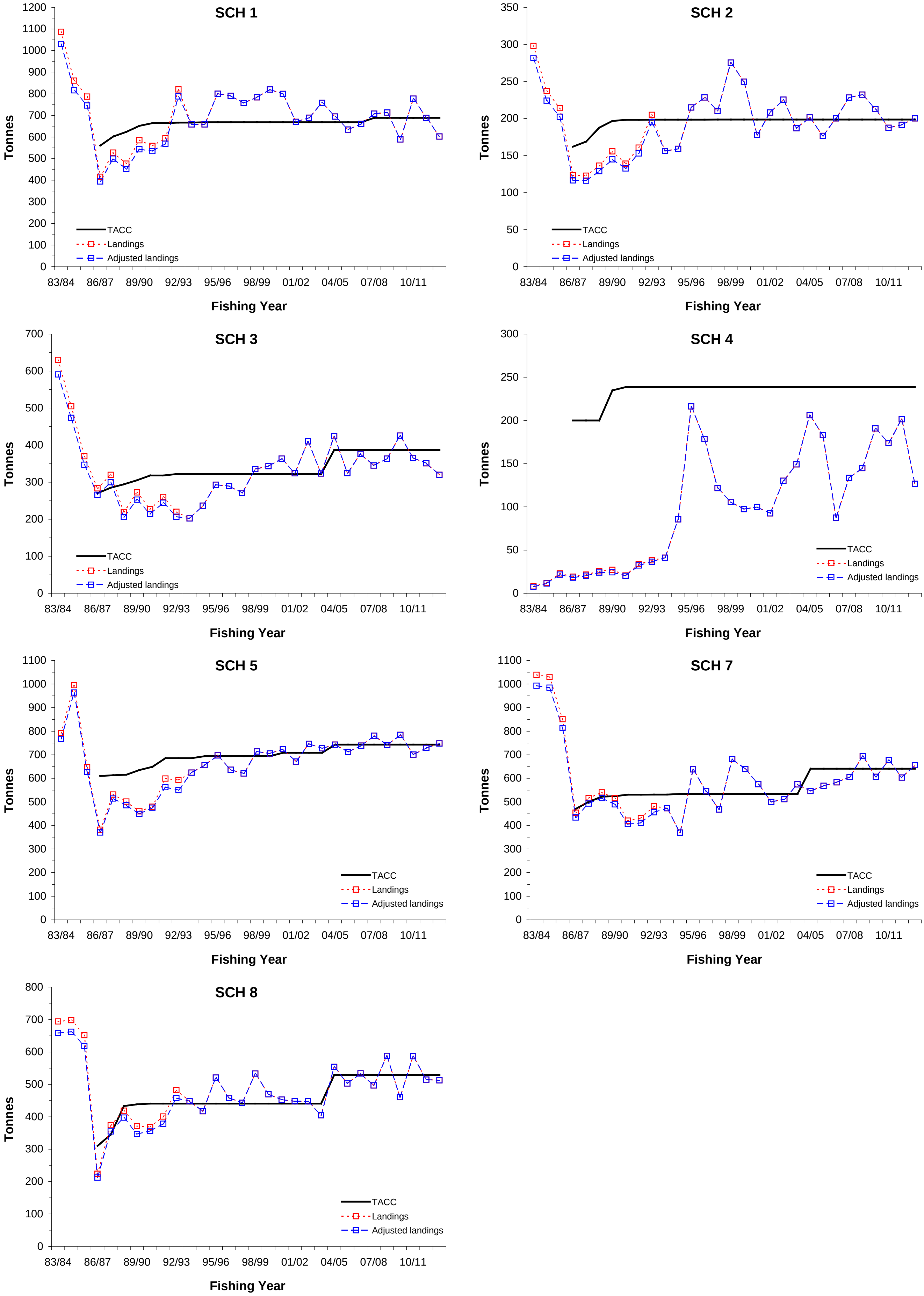


Figure 2: **Plots of SCH 1, SCH 2, SCH 3, SCH 4, SCH 5, SCH 7 and SCH 8 landings and TACCs from 1983–84 to 2012–13 (see Table C.1 for list of landings and TACCs by SCH QMA).**

The TACC for SCH 5 was set at 610 t when this Fishstock was first introduced into the QMS in 1986. It rose through the process of quota appeals to 686 t by 1991–92, followed by two small rises to 708 t in 2000–01 (Figure 2; Table C.1). The TACC for SCH 5 was raised 5% to 743 t in 2004–05 under the provisions of the Adaptive Management Programme (AMP), where it has remained even though the programme was discontinued in 2009. Landings have fluctuated very closely around the TACC which has been exceeded by landings 9 times in the 27 years since SCH 5 entered the QMS, with the average excess in those years at 3% (Table C.1; Figure 2). Landings have been below or at the TACC in the period 2010–11 to 2012–13.

The TACC for SCH 7 was set at 470 t when this Fishstock was first introduced into the QMS in 1986. It rose through the process of quota appeals to 531 t by 1990–91 and 534 t in 1994–95 (Figure 2; Table C.1). The TACC for SCH 7 was raised 20% to 641 t in 2004–05 under the provisions of the Adaptive Management Programme (AMP), where it has remained even though the programme was discontinued in 2009. Landings have fluctuated near to the TACC which has been exceeded by landings 11 times in the 27 years since SCH 7 entered the QMS, with 8 of those occurrences occurring before the 2004–05 increase with an average excess in the 8 years of 11% (Table C.1; Figure 2). Landings have been greater than 600 t/year in the six years from 2007–08 to 2012–13, exceeding the TACC by an average of 5% in three of those years.

The TACC for SCH 8 was set at 310 t when this Fishstock was first introduced into the QMS in 1986. It rose through the process of quota appeals to 441 t by 1990–91 where it remained to 2003–04 (Figure 2; Table C.1). The TACC for SCH 8 was raised 20% to 529 t in 2004–05 under the provisions of the Adaptive Management Programme (AMP), where it has remained even though the programme was discontinued in 2009. Landings have fluctuated near the TACC which has been exceeded by landings 15 times in the 27 years since SCH 8 entered the QMS, with 11 of those occurrences occurring before the 2004–05 increase with an average excess in those 11 years of 7% (Table C.1; Figure 2). Landings have fluctuated around the higher TACC ever since the 2004–05 increase, with landings averaging at 528 t/year and exceeding the TACC by an average of 7% in four of the nine years after the increase.

2.1.1 Recreational catches

Recreational catches in all school shark QMAs (SCH 1, SCH 2, SCH 3, SCH 4, SCH 5, SCH 7 and SCH 8) are poorly estimated. A series of regional and national surveys, which combined phone interviews with randomly selected diarists, have been conducted since the early 1990s (Teirney et al. 1997, Bradford 1998, Boyd & Reilly 2005), but the results from these surveys are not considered to be reliable by most of the Fishery Assessment Working Groups. In particular, the Recreational Technical Working Group (RTWG) concluded that the framework used for the telephone interviews for the 1996 and previous surveys contained a methodological error, resulting in biased eligibility figures. Consequently the harvest estimates derived from these surveys are unreliable. This group also indicated concerns with some of the harvest estimates from the 2000–01 survey. The following summarises that group’s views on the telephone /diary estimates:

> “*The RTWG recommends that the harvest estimates from the diary surveys should be used only with the following qualifications: a) they may be very inaccurate; b) the 1996 and earlier surveys contain a methodological error; and, c) the 2000 and 2001 harvest estimates are implausibly high for many important fisheries*.” (quoted from Chapter 36, Kahawai, Ministry for Primary Industries 2016)

A large scale population-based diary/interview survey was conducted under contract for MPI from 1 October 2011–30 September 2012, with the intention of estimating FMA-specific annual catches for all major finfish and non-finfish species (Heinemann et al. 2015). This survey estimated the coastwide recreational school shark catch to be on the order of 30 500 fish (CV=0.17; Table 1). No estimate of catch weight was provided because there was no associated mean weight estimate. Catches were distributed reasonably evenly across FMAs, except for FMA 5 at the southern end of the South Island and FMA 8 which is quite small. The largest numbers caught were in FMA 7 (equivalent to SCH 7) and combined FMA 1 and FMA 9 (equivalent to SCH 1). The reliability of this survey with respect to school shark is unknown.

Table 1: Summary catch information for school shark from the Large Scale Marine Survey (LSMS: Wynne-Jones et al. 2014). The 'number fishers' and 'number events' categories are the survey sample size.

Summary statistics		Catch by FMA		Catch by Method		Catch by Platform	
Category	**Value**	**FMA**	**Fish**	**Capture method**	**Fish**	**Capture platform**	**Fish**
Number fishers	95	1	5 483	Rod/line	25 242	Trailer boat	13 969
Number events	160	2	2 739	Longline	3 533	Launch	3 186
Catch (numbers)	30 555	3	5 381	Net	1 780	Yacht	0
CV (numbers)	0.17	5	443	Pot	0	Large yacht	317
MeanWgt (kg)[1]	–	7	10 311	Dredge	0	Kayak	131
Catch (t)[1]	–	8	1 892	Hand/shore	0	Shore	12 611
CV (catch)[1]	–	9	4 304	Diving	0	Other	341
				Spear	0		
				Other	0		
		Total	30 553	Total	30 555	Total	30 555

[1] Not provided

2.2 Regulations Affecting the Fishery

There were changes to the factors used to convert processed weight to greenweight in the early 1990s and these have been adjusted to a constant conversion factor when preparing the data for the analyses presented in this report (see Section 2.3.2). An exception to this was the change in conversion factor for the state code "GUT", which shifted from 1.1 to 1.65 between 1990–91 and 1991–92. Interviews with fishers active at that time determined that practices associated with this state code in 1989–90 and 1990–91 were likely to have resulted in an effective conversion factor closer to 1.65. Given this observation, it probably would be ill advised to adjust these early landings upward by 50% (i.e. 1.65/1.1). It appears that fishers took advantage of the low conversion factor of 1.1 by cutting off more of the shark than was originally envisioned by the Ministry of Agriculture and Fisheries (as it was known at that time) when it set the conversion factor. Fishers were taking advantage of an imprecise definition for the state code GUT, which apparently only demanded that "part of the head remain on the trunk". However, by cutting the head in this [perfectly legal] manner, the carcass represented a greater loss from greenweight than the 1.1 conversion factor would suggest. This practice allowed fishers to land more school shark against their quota that would be possible if the conversion factor had been set in keeping with the actual loss in weight from processing.

It has become the practice to treat landings for all SCH QMAs using the GUT state code before 1991–92 (the year that the GUT conversion factor was raised from 1.1 to 1.65) as being equivalent to the landings which followed, making it unnecessary to adjust for the change (see Starr & Kendrick 2011). The remaining changes in conversion factors are minor, resulting in small drops of 3 to 7% compared to the sum of the greenweights declared at the time of landing (see Table C.1).

Beginning in the early 2000s, but culminating on 1 October 2008, a suite of regulations intended to protect Maui's and Hector's dolphins was implemented for all of New Zealand by the Minister of Fisheries. Further regulations were implemented on the west coast of the North Island on 1 October 2012 to further protect the small population of Maui's dolphins. These regulation changes are listed by gear type and location in Appendix D. Many of these new regulations, particularly those which restrict access by setnets in inshore areas, have the capacity to change the effective catchability in the CPUE analyses derived from the fisheries affected by these regulation changes.

2.3 Analysis of SCH 1, SCH 2, SCH 3, SCH 4, SCH 5, SCH 7 and SCH 8 catch and effort data

2.3.1 Methods used for 2014 analysis of MPI catch and effort data

Three data extracts were obtained from the Ministry for Primary Industries (MPI) Warehou database (Ministry of Fisheries 2010). One extract consisted of the complete data (all fishing event information along with all school shark landing information) from every trip which recorded landing school shark in any New Zealand school shark QMA (SCH 1, SCH 2, SCH 3, SCH 4, SCH 5, SCH 7 or SCH 8, starting from 1 October 1989 and extending to 30 September 2013). Two further extracts were obtained: one consisting of all New Zealand trips using the methods BLL (bottom longline) and which targeted BNS, HPB, HAP, BAS, LIN, SCH, SNA, BCO or TRU (see Appendix A for abbreviation definitions); and the second of all New Zealand trips which used the setnet method, without regard to target species. Once these trips were identified, all fishing event data and school shark landing data from the entire trip, regardless of method of capture, were obtained. These data extracts (MPI replog 9302) were received on 07 January 2014. The first data extract was used to characterise and understand the fisheries taking school shark. These characterisations are reported in Sections 2.3.2 and 2.3.3. The remaining two extracts were used to calculate CPUE standardisations for BLL and SN respectively (Section 3).

Data were prepared by linking the effort (“fishing event”) section of each trip to the landing section, based on trip identification numbers supplied in the database. Effort and landing data were groomed to remove “out-of-range” outliers. The method used to groom the landings data is documented in Appendix E; the remaining procedures used to prepare these data are documented in Starr (2007) and below.

The original level of time stratification for a trip is either by tow or day of fishing, depending on the type of form used to report the trip information. The data used in the characterisation section of the report were amalgamated into a common level of stratification known as a “trip stratum” (see table of definitions: Appendix A). Depending on how frequently an operator changed areas, method of capture or target species, a trip could consist of one to several “trip strata”. This amalgamation was required so that these data could be analysed at a common level of stratification across all reporting form types while maintaining the integrity of the QMA of capture. School shark landings by QMA within a trip were allocated to the “trip strata” in proportion to the estimated school shark catches in each “trip stratum”. In situations when trips recorded landings of school shark without any associated estimates of catch in any of the “trip strata” (operators were only required to report the top five species in any fishing event), the school shark landings were allocated proportionally to effort (tows for trawl data, sets for bottom longline data and length of net set for setnet data) in each “trip stratum”. Some inshore statistical areas, particularly those around Cook Strait, are not unique among the school shark QMAs. Trips which fished within an ambiguous statistical area and landed to multiple SCH QMAs were dropped entirely from the characterisation data set.

Data used for CPUE analysis were prepared using the “daily effort stratum” procedure proposed by Langley (2014). As noted above, catch/effort data must be summarised to a common level of stratification in order to construct a time series of CPUE indices that spans the change in reporting forms instituted the late 2000s. Although the “trip-stratum” procedure proposed by Starr (2007) addresses the nominal instructions provided to fishers using the daily-effort CELR forms, Langley (2014) showed that the actual realised stratification in the earlier form types was daily, with the fisher tending to report the “predominant” statistical area of capture and target species rather than explicitly following the instructions. He showed this by noting that the frequency of changes in statistical area of fishing or target species within a day of fishing was much higher for comparable tow-by-tow event-based forms than in the earlier daily forms. Consequently, we have adopted Langley’s (2014) recommendation to use the “daily-effort-stratum” method for preparing data for CPUE analysis. The following steps were used to “rollup” the event-based data (by longline set in the LTCER forms or a setnet set in the NCELR forms) to a “daily-stratum”:

1. discard trips that used more than one method in the trip (except for rock lobster potting, cod potting and fyke nets: these methods are dropped because they are deemed unlikely to capture school shark) or that used more than one form type;
2. sum effort for each day of fishing in the trip;
3. sum estimated catch for each day of fishing in the trip[2];
4. calculate the modal statistical area and target species for each day of fishing, weighted by the number of fishing events: these are the values assigned to the effort and catch for that day of fishing;
5. distribute landings proportionately to each day of the trip based on the species estimated catch or to the daily effort when there is no species estimated catch, without maintaining QMA integrity.

Note that the above procedure was also applied to the original CELR forms to ensure that each of these trips was also reduced to "daily effort strata" if fishers report more than one statistical area or target species in a day of fishing.

Table 2. Comparison of the total adjusted QMR/MHR catch (t), reported by fishing year, with the sum of the corrected landed catch totals (bottom part of the MPI CELR form), the total catch after matching effort with landing data ('Analysis' data set) and the sum of the estimated catches from the Analysis data set, all representing the combined SCH 1, SCH 2, SCH 3, SCH 4, SCH 5, SCH 7 and SCH 8 QMAs. Data source: MPI replog 9302: 1989–90 to 2012–13. Landings and QMR/MHR totals have been adjusted to consistent conversion factors across years.

Fishing Year	QMR/MHR (t)	Total landed catch (t)[1]	% landed/ QMR/MHR	Total Analysis catch (t)	% Analysis /Landed	Total Estimated Catch (t)	% Estimated /Analysis
89/90	2 387	1 878	79	1 702	91	1 386	81
90/91	2 214	1 947	88	1 775	91	1 394	79
91/92	2 479	2 160	87	1 967	91	1 559	79
92/93	2 840	2 549	90	2 269	89	1 730	76
93/94	2 603	2 488	96	2 282	92	1 664	73
94/95	2 582	2 528	98	2 354	93	1 736	74
95/96	3 381	3 332	99	2 827	85	1 783	63
96/97	3 127	3 016	96	2 615	87	1 643	63
97/98	2 892	2 860	99	2 485	87	1 504	61
98/99	3 429	3 335	97	2 966	89	1 821	61
99/00	3 324	3 248	98	2 808	86	1 842	66
00/01	3 193	3 126	98	2 778	89	1 861	67
01/02	2 914	2 938	101	2 616	89	1 831	70
02/03	3 161	3 138	99	2 824	90	2 003	71
03/04	3 124	3 060	98	2 768	90	1 927	70
04/05	3 369	3 300	98	2 925	89	1 966	67
05/06	3 101	2 982	96	2 608	87	1 759	67
06/07	3 180	3 114	98	2 747	88	1 951	71
07/08	3 298	3 203	97	2 726	85	2 111	77
08/09	3 478	3 445	99	2 923	85	2 252	77
09/10	3 269	3 213	98	2 770	86	2 169	78
10/11	3 469	3 434	99	2 854	83	2 222	78
11/12	3 280	3 206	98	2 735	85	2 104	77
12/13	3 165	3 122	99	2 661	85	2 039	77
Total	73 257	70 624	96	61 985	88	44 257	71

[1] includes all SCH 1, SCH 2, SCH 3, SCH 4, SCH 5, SCH 7 and SCH 8 landings in replog 9302 except for 112 trips excluded for being "out of range" (Table E.1).

Catch totals in the fishery characterisation tables have been scaled to the QMR/MHR totals reported in Table C.1 by calculating the ratio of these catches with the total annual landed catch in the analysis dataset and scaling all the landed catch observations (i) within a trip using this ratio:

[2] ideally this would be done for every species reported on the trip on that day with the procedure only taking the top five species captured in the day; however, this level of information was not part of the data request so this step in the preparation routine was omitted;

$$L'_{q,i,y} = L_{q,i,y} \frac{\mathbf{QMR}_{q,y}}{AL_{q,y}} \qquad \text{Eq. 1}$$

where $\mathbf{QMR}_{q,y}$ is the annual QMR/MHR landings in QMA q, $AL_{q,y}$ is the corresponding total annual landings from the analysis data set for QMA q and $L_{q,i,y}$ are the landings for record i in year y associated with QMA q.

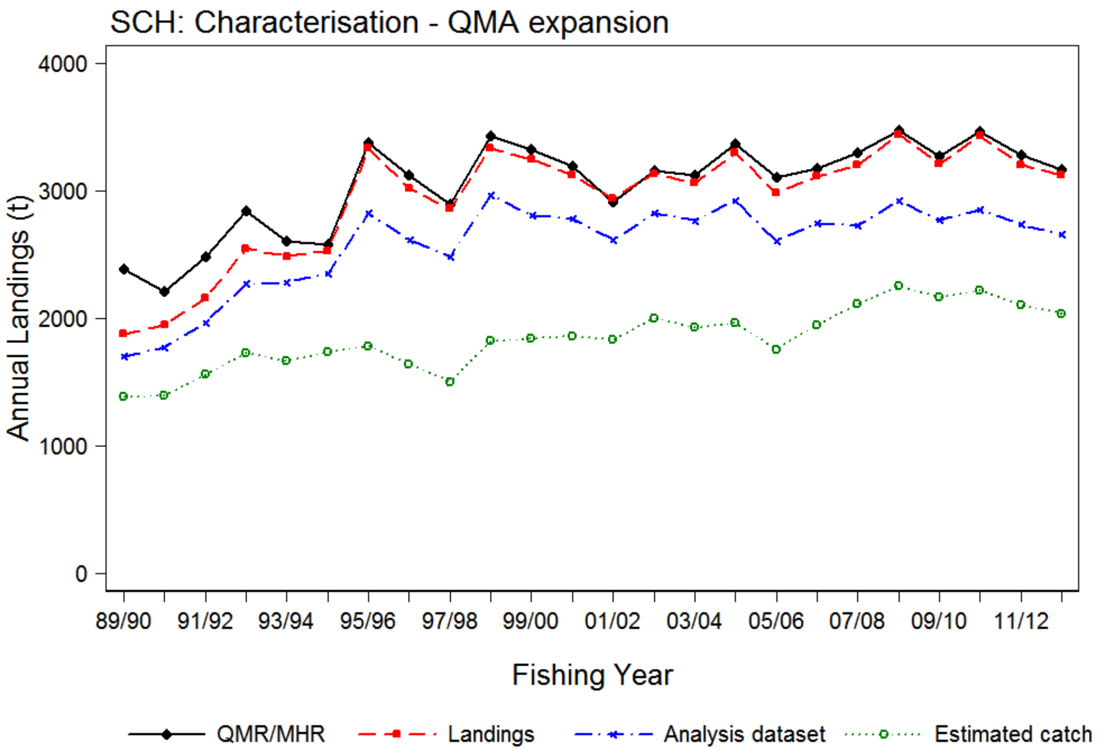
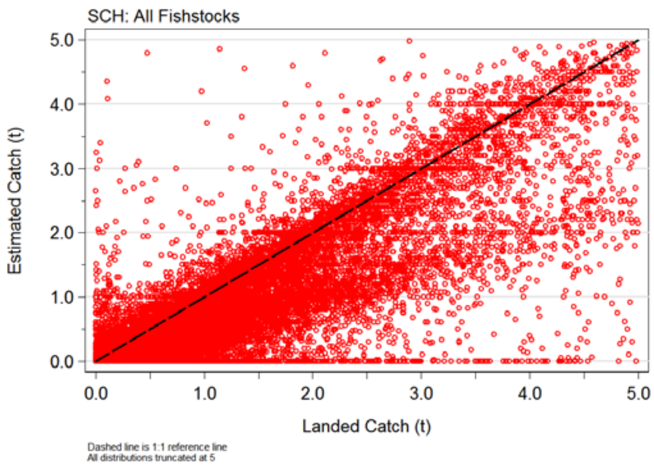


Figure 3: **Plot of the combined SCH 1, SCH 2, SCH 3, SCH 4, SCH 5, SCH 7 and SCH 8 catch dataset for totals presented in Table 2. Note that both the QMR/MHR totals and the landings have been adjusted to consistent conversion factors for all years.**



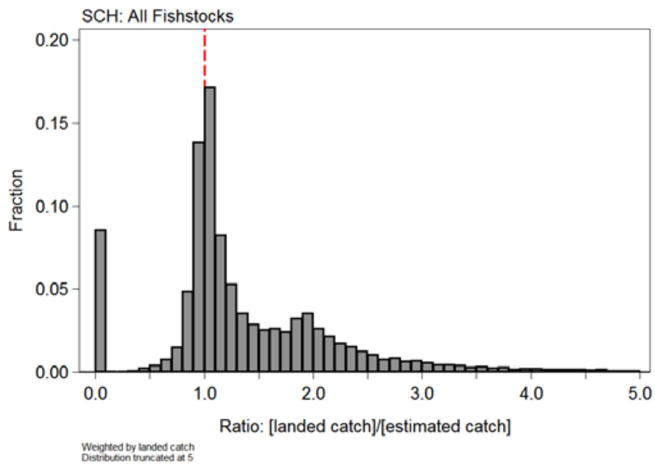


Figure 4: **[left panel]: scatter plot of the sum of landed and estimated school shark catch for each trip in the combined SCH 1, SCH 2, SCH 3, SCH 4, SCH 5, SCH 7 and SCH 8 analysis dataset. [right panel]: distribution (weighted by the landed catch) of the ratio of landed to estimated catch per trip. Trips where the estimated catch=0 have been assigned a ratio=0.**

The annual totals at different stages of the data preparation procedure are presented in Table 2 and Figure 3. Total landings in the data set are similar to the landings in the QMR/MHR system, except for 10 to 21% shortfalls in landings in the first four years of data (1989–90 to 1992–93: see Table 2). Landings by year in the subsequent fishing years vary from –4% to +1% relative to the QMR/MHR annual totals (Table 2). The shortfall between landed and estimated catch by trip varies from -39% to -19% by fishing year and has averaged -26% over the 10 years from 2004–05 to 2011–12 (Table 2), indicating that there has not been any recent change in school shark reporting practices. A scatter plot of the estimated and landed catch by trip shows that relatively few trips overestimate the landing total for the trip (Figure 4 [left panel]). The distribution of the ratios of the landed relative to estimated catch shows a skewed distribution with many ratios greater than 1.0 and with a mode slightly above 1.0 and a lesser mode around 1.9 (Figure 4 [right panel]).

Table 3: Summary statistics pertaining to the reporting of estimated catch from the combined SCH 1, SCH 2, SCH 3, SCH 4, SCH 5, SCH 7 and SCH 8 analysis dataset.

	Trips with landed catch but which report no estimated catch			Statistics (excluding 0s) for the ratio of landed/estimated catch by trip			
Fishing year	**Trips: % relative to total trips**	**Landings: % relative to total landings**	**Landings (t)**	**5% quantile**	**Median**	**Mean**	**95% quantile**
89/90	36	9	213	0.60	1.00	1.51	2.98
90/91	38	11	242	0.64	1.05	1.49	3.02
91/92	41	9	222	0.60	1.04	1.48	2.96
92/93	40	9	267	0.56	1.06	1.59	3.37
93/94	40	8	206	0.60	1.18	1.69	3.60
94/95	43	9	241	0.60	1.20	1.77	3.57
95/96	40	16	548	0.62	1.25	2.45	3.79
96/97	43	16	503	0.61	1.26	1.94	4.01
97/98	42	17	478	0.58	1.30	2.58	3.92
98/99	42	14	485	0.60	1.37	2.13	4.02
99/00	40	11	353	0.60	1.43	2.03	4.29
00/01	38	8	270	0.65	1.44	2.27	4.48
01/02	38	8	244	0.65	1.42	1.99	4.49
02/03	38	8	242	0.65	1.47	2.07	4.69
03/04	37	8	238	0.66	1.49	2.11	4.97
04/05	39	8	274	0.69	1.51	2.10	5.10
05/06	42	9	271	0.68	1.54	2.15	5.03
06/07	37	7	219	0.70	1.50	2.19	4.88
07/08	18	2	79	0.65	1.48	2.07	4.78
08/09	17	2	82	0.60	1.49	2.10	5.30
09/10	19	2	79	0.65	1.55	2.17	5.30
10/11	19	3	90	0.65	1.51	2.23	5.29
11/12	19	3	86	0.65	1.50	2.09	5.13
12/13	20	3	102	0.63	1.52	2.20	5.31
Total	35	8	6 035	0.63	1.36	2.03	4.39

For the entire SCH dataset across all years, 35% of all trips which landed school shark estimated no catch of school shark but reported SCH in the landings (Table 3). This occurs because operators using the CELR form were only required to estimate the catch of the top five species in any single day (compared with eight species by fishing event since the introduction of the NCELR form in 2006–07 and the TCER and LTCER in 2007–08). These landings represented 8% of the total SCH landings over the period, for a total of 6035 tonnes over all years (Table 3). The introduction of the new inshore forms (NCELR, TCER and LTCER), which record fishing activity at the level of a fishing event and report more species, has halved the proportion of trips which estimated nil school shark while landing this species, and has reduced the proportion of SCH landings in this category, with less than 3% of the total SCH landings from 2007–08 to 2011–12 (Table 3).

There is a strong tendency in the SCH dataset to underestimate the landings of school shark, with the 5% to 95% quantiles for the ratio of landed to estimated catch (in the total SCH dataset excluding trips where there was no estimated catch) ranging from 0.63 to 4.39. The median and mean ratios have the landed catch at 36% and 103% higher respectively than the estimated catch (Table 3), with an increasing trend in these statistics over time. This behaviour is thought to be linked with some operators reporting processed weights for school shark rather than greenweight when estimating catches. The mode at 1.9 in the right panel of Figure 4 is evidence that this behaviour is occurring (the conversion factor for DRE and HGU are 1.95 and 1.85 respectively – see discussion in Section 2.3.2 below). This large and consistent shortfall between estimated and landed catches (see Figure 3 and Figure F.1) means that estimated catches must be adjusted to reflect actual landings in the characterisation and CPUE analyses.

Plots equivalent to Figure 3 and Figure 4 and tables equivalent to Table 2 and Table 3 are provided for each SCH QMA in Appendix F, showing the shortfall in landings by QMA in the analysis datasets relative to the QMR/MHR catches and having the following cross-references:

Equivalent	**SCH 1**	**SCH 2**	**SCH 3**	**SCH 4**	**SCH 5**	**SCH 7**	**SCH 8**
Table 2	Table F.1A	Table F.1A	Table F.1B	Table F.1B	Table F.1C	Table F.1C	Table F.1D
Table 3	Table F.2A	Table F.2A	Table F.2B	Table F.2B	Table F.2C	Table F.2C	Table F.2D
Figure 3	Figure F.1A	Figure F.1A	Figure F.1A	Figure F.1A	Figure F.1B	Figure F.1B	Figure F.1B
Figure 4 [left panel]	Figure F.2A	Figure F.2A	Figure F.2A	Figure F.2A	Figure F.2B	Figure F.2B	Figure F.2B
Figure 4 [right panel]	Figure F.3A	Figure F.3A	Figure F.3A	Figure F.3A	Figure F.3B	Figure F.3B	Figure F.3B

Only SCH 8 shows relatively large shortfalls between the actual landings and the landings in the analysis data set, ranging from -43% in 2011–12 to -13% in 1994–95 (see SCH 8 in Figure F.1B). Although the average shortfall was -35% in the 10 years from 2002–03 to 2012–13, it was deemed that the analysis dataset, prepared using the trip-stratum method of Starr (2007), was adequate to use for the descriptive characterisation analyses (presented in Section 2.3.3), given that there is no alternative method that maintains the integrity of the QMA landings.

All of the SCH QMAs show a strong tendency to underestimate landings (Figure F.2), but to differing degrees, with SCH 3, SCH 5 and SCH 8 showing narrower 5 and 95% quantiles and lower median and means for the ratio landed divided by estimated catch compared to those in Table 3 (Table F.2). The values for SCH 1, SCH 2 and SCH 7 have wider quantiles and higher median and mean values, although there is no apparent reason for these regional differences in reporting (Table F.2). All seven of the SCH QMAs show a drop in the percentage of trips which report no school shark in their estimated catch coincident with the introduction of the new event-based forms in 2006–07 and 2007–08 (Table F.2).

2.3.2 Description of landing information for SCH 1, SCH 2, SCH 3, SCH 4, SCH 5, SCH 7 and SCH 8

2.3.2.1 Destination codes in the SCH landing data

Landing data for school shark were provided for every trip which landed SCH 1, SCH 2, SCH 3, SCH 4, SCH 5, SCH 7 or SCH 8 at least once, with one record for every reported SCH landing from the trip. Each of these records contained a reported green weight (in kilograms), a code indicating the processed state of the landing, along with other auxiliary information such as the conversion factor used, the number of containers involved and the average weight of the containers. Every landing record also contained a "destination code" (Table 4), which indicated the category under which the landing occurred. The majority of the landings were made using destination code "L" (landed to a Licensed Fish Receiver; Table 4). However, other codes (e.g., A, C or W; Table 4) also potentially described valid landings and were included in this analysis but these are all minor compared to code "L". A number of other codes (notably T, Q and R; Table 4) were not included because it was felt that these landings would be reported at a later date under the "L" destination category. Two other codes (D and NULL) represented errors which could not be reconciled without making unwarranted assumptions and these were not included in the landing data set.

Some of the destination codes (notably "T", "Q" and "R") represent intermediate holding states that have the potential to invalidate the methods of Starr (2007) and Langley (2014), which assume that the reported landings for a trip have been taken using the effort reported for the trip. However, because these intermediate landing destination codes are dropped (due to the potential for double counting), it is possible that "L" landings reported for a trip may have been taken by another trip where the landings were declared by an intermediate code. This issue cannot be resolved within the current MPI catch reporting system because the integrity of catches among trips cannot be maintained. Consequently, in these situations, the linking method of either Starr (2007) or Langley (2014) may result in biased estimates of CPUE, with landings associated with an incorrect measure of effort. The use of intermediate landings has been common in the rock lobster fishery, where catches have been left in holding pots (destination code "P") beginning in the early 2000s (Starr 2016). Kendrick & Bentley (2012) and Starr & Kendrick (2016) have documented the existence of this problem in the SPO 1 setnet fishery, where an increasing proportion of landings use the intermediate code "Q" because operators in this QMA hold landings in shore-based freezers for a period of time before taking them to a LFR, mostly likely due to economic reasons. For instance, the LFRs may limit the amount of landings permitted in a time period or the operators may wait for a more favourable beach price. Destination codes for all SCH QMAs have been examined, concluding that there is little evidence that this type of behaviour is an important component in any of the SCH QMAs. The sum of the R, T, Q landings has ranged between 1 and 8% of the L landings by QMA over the 23 year period of record with a 3% overall average (Table 4). A plot of the trend of the dropped destination codes R, T, and Q relative to the sum of the annual L landings by SCH QMA is noisy but not alarming, without apparent trends in these intermediate destination codes in any of the SCH QMAs (Figure 5).

Table 4: Total landings (t) over the period 1989–90 to 2012–13 by destination codes in the unedited landing data for SCH 1, SCH 2, SCH 3, SCH 4, SCH 5, SCH 7, SCH 8 and total SCH. The "how used" column indicates which destination codes were included in the characterisation analysis. "–": no landings in the QMA for the indicated destination code.

Destination code	SCH 1	SCH 2	SCH 3	SCH 4	SCH 5	SCH 7	SCH 8	Total	Description	How used
L	16 444.7	4 709.5	7 712.1	2 907.9	16 112.4	13 500.5	11 898.3	73 285.3	Landed in NZ (to LFR)	Keep
C	8.2	58.4	22.5	2.0	2.1	15.9	3.7	112.8	Disposed to Crown	Keep
O	0.2	1.1	1.1	0.4	10.3	26.8	23.5	63.4	Conveyed outside NZ	Keep
A	0.7	4.9	1.5	9.5	8.9	2.2	5.3	33.0	Accidental loss	Keep
E	0.1	0.2	3.1	3.0	12.5	5.7	0.2	24.7	Eaten	Keep
U	16.5	0.1	0.0	0.1	0.1	–	–	16.8	Bait used on board	Keep
F	1.4	0.3	0.4	0.0	1.4	1.5	1.0	6.0	Section 111 Recreational Catch	Keep
W	1.8	1.8	0.5	0.0	–	0.6	0.4	5.1	Sold at wharf	Keep
X	1.8	0.1	–	–	–	0.1	0.0	2.0	QMS returned to sea, except 6A	Keep
S	0.0	0.2	0.0	0.0	–	0.0	–	0.2	Seized by Crown	Keep
H	–	–	0.0	–	–	–	–	0.0	Loss from holding pot	Keep
R	80.3	31.5	74.3	199.8	177.2	273.1	178.6	1 014.7	Retained on board	Drop
T	10.8	12.9	20.2	33.5	53.0	234.4	383.6	748.3	Transferred to another vessel	Drop
Q	137.7	8.1	205.1		20.4	17.9	53.7	442.9	Holding receptacle on land	Drop
NULL	9.5	1.8	10.4	0.9	0.6	6.3	8.6	38.2	Nothing	Drop
D	0.0	0.3	8.8	1.4	2.2	8.2	0.4	21.3	Discarded (non-ITQ)	Drop
B	1.7	0.1	0.0	0.1	0.0	0.1	0.1	2.2	Bait stored for later use	Drop
P	0.0	–	–	–	–	–	–	0.0	Holding receptacle in water	Drop
Σ(R,T,Q)/L	1.4%	1.1%	3.9%	8.0%	1.6%	3.9%	5.2%	3.0%		

Table 5: Total greenweight reported and number of events by state code in the landing file used to process the total SCH characterisation and CPUE data, arranged in descending landed weight (only for destination codes indicated as "Keep" in Table 4). These data summaries have been restricted to SCH 1, SCH 2, SCH 3, SCH 4, SCH 5, SCH 7 and SCH 8 from 1989–90 to 2012–13.

State code	Number Events	Total reported green weight (t)	Description
DRE	173 180	54 443.0	Dressed
HGU	65 659	14 601.9	Headed and gutted
GRE	12 395	1 320.7	Green (or whole)
GUT	2 511	989.7	Gutted
FIN	2 876	540.2	Fins
FIL	760	467.7	Fillets: skin-on
GGO	467	437.2	Gilled and gutted tail-on
SKF	351	299.5	Fillets: skin-off
HGT	1 606	238.7	Headed, gutted, and tailed
Other	24 766	210.6	Other (misc)[1]

[1] includes (in descending order): Fish meal, Shark fins, Missing, Headed, gutted, and finned, Dressed-V cut (stargazer), Flaps, Fillets: skin-on trimmed, Livers, Fillets: skin-on untrimmed, Fillets: skin-off trimmed.

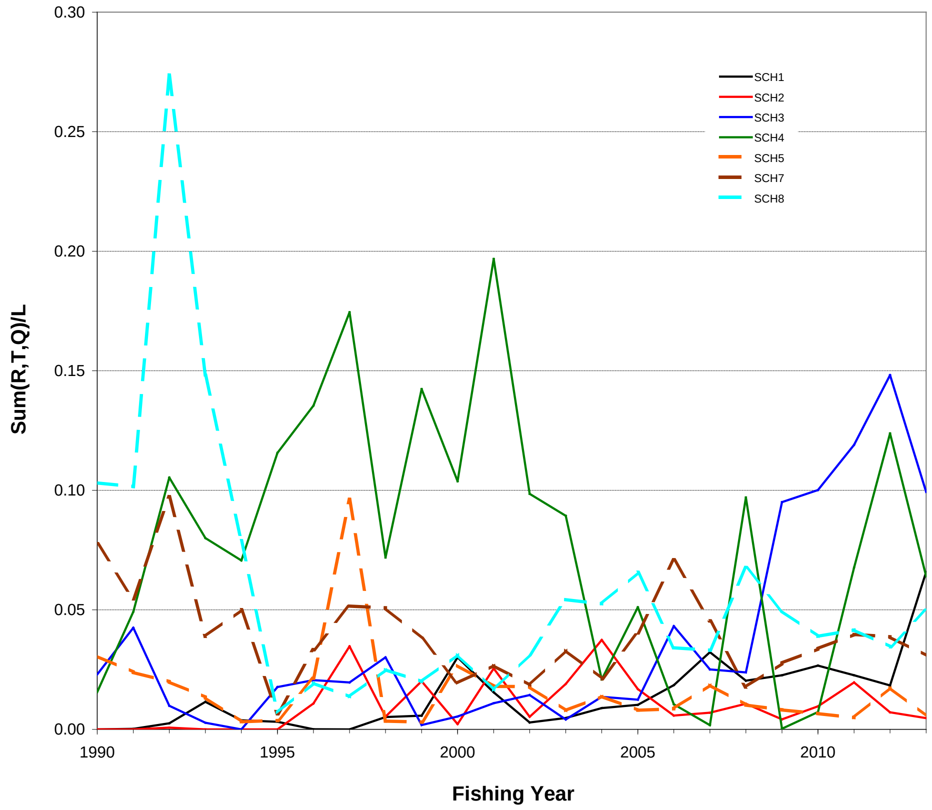


Figure 5: Plot of the sum of destination codes “R”, “T” and “Q” divided by the sum of destination code “L” by fishing year for each SCH QMA and the total of all SCH QMAs. The definition of each destination code is provided in Table 4.

2.3.2.2 State codes in the SCH landing data

Almost all (93%) of the valid landing data for SCH 1, SCH 2, SCH 3, SCH 4, SCH 5, SCH 7 and SCH 8 were reported using state code DRE or HGU with the remaining landings divided between state codes GRE, GUT, FIN and FIL (Table 5). There have been some changes in the conversion factors for the two primary state codes (DRE and HGU) used for processing SCH, with DRE dropping from 2 to 1.95 and HGU from 2 to 1.85 (Table 6). Although these changes are minor, they have been corrected using Eq. 2 to a consistent conversion factor, representing the conversion factors that have been in place from 1993–94 onward. As described in Section 2.2, there was a short period early in the time series when the GUT state code was misused in some of the SCH QMAs. Section 2.2 describes the rationale for ignoring the low conversion factor in place in 1989–90 and 1990–91 (Table 6) and Table 7 shows that this problem was confined mainly to 1990–91 and that the GUT state code has not been in use since that period.

Table 6: Median conversion factor for the six most important state codes reported in (in terms of total landed greenweight) and the total reported greenweight by fishing year in the edited file used to process SCH landing data. These data summaries include all of the NZ EEZ over the period 1989–90 to 2012–13. '–': no observations.

Fishing						Landed State Code	
Year	DRE	HGU	GRE	GUT	FIN	FIL	Other
	Median Conversion Factor						
89/90	2	2	1	1.1 [1]	–	2.7	2
90/91	2	2	1	1.1 [1]	–	2.3	1.1
91/92	2	2	1	1.65	–	2.3	5.6
92/93	2	2	1	1.65	–	2.3	5.6
93/94	1.95	1.85	1	1.65	30	2.15	2.7
94/95	1.95	1.85	1	1.65	30	2.15	2.7
95/96	1.95	1.85	1	1.65	30	2.15	1.85
96/97	1.95	1.85	1	1.65	30	2.15	1
97/98	1.95	1.85	1	1.65	30	2.15	1
98/99	1.95	1.85	1	1.65	30	2.15	1
99/00	1.95	1.85	1	1.65	30	2.15	1
00/01	1.95	1.85	1	1.65	30	2.15	1
01/02	1.95	1.85	1	1.65	30	2.15	2.7
02/03	1.95	1.85	1	1.65	30	2.15	5.6
03/04	1.95	1.85	1	1.65	30	2.15	3.85
04/05	1.95	1.85	1	1.65	30	2.15	2.7
05/06	1.95	1.85	1	1.65	30	2.15	2.7
06/07	1.95	1.85	1	1.65	30	2.15	2.7
07/08	1.95	1.85	1	1.65	30	2.15	4.15
08/09	1.95	1.85	1	1.65	30	2.15	2.7
09/10	1.95	1.85	1	1.65	30	2.15	5.6
10/11	1.95	1.85	1	1.65	30	2.15	5.6
11/12	1.95	1.85	1	1.65	30	2.15	5.6
12/13	1.95	1.85	1	1.65	30	2.15	5.6
	Annual Landed Weight (t)						
89/90	0.0	1 410.5	95.3	51.8	–	26.3	427.9
90/91	698.7	685.4	118.2	524.9	–	13.9	69.8
91/92	662.7	1 393.0	55.2	204.8	–	9.0	2.6
92/93	937.3	1 611.9	95.9	48.5	–	20.3	3.2
93/94	1 137.8	1 198.7	100.9	25.1	3.9	27.7	1.3
94/95	1 681.5	725.1	80.4	28.7	5.6	15.5	2.7
95/96	2 194.5	984.1	79.4	12.5	68.7	55.7	41.9
96/97	2 034.6	824.2	72.6	11.5	87.1	44.3	63.4
97/98	2 144.2	596.6	57.1	9.7	157.7	12.8	57.8
98/99	2 574.7	654.3	31.1	8.8	129.3	7.9	83.4
99/00	2 473.8	589.1	34.9	16.4	15.2	8.8	144.1
00/01	2 352.8	590.7	25.5	16.6	61.4	112.8	44.4
01/02	2 445.5	400.4	56.7	0.2	32.2	19.7	28.4
02/03	2 657.8	369.4	53.1	0.3	33.5	25.4	43.5
03/04	2 658.4	323.7	44.7	3.2	8.6	11.0	32.4
04/05	2 966.4	279.5	28.3	0.7	38.5	25.4	43.8
05/06	2 660.5	281.4	47.0	0.4	28.5	2.1	12.1
06/07	2 832.9	239.1	28.8	0.5	53.4	11.2	22.3
07/08	2 983.7	194.8	35.6	1.1	7.5	6.1	12.7
08/09	3 183.5	211.4	42.3	0.5	2.2	2.5	28.3
09/10	3 016.3	175.4	28.3	5.3	5.7	4.6	25.7
10/11	3 178.8	226.4	40.2	4.9	5.6	0.1	10.2
11/12	2 959.0	238.8	36.0	5.6	9.1	0.0	10.1
12/13	2 866.4	258.5	29.1	7.8	4.9	0.0	14.0
Total	53 302.0	14 462.6	1 316.5	989.7	758.5	463.2	1 225.8

[1] No adjustment made for these early conversion factors. See Section 2.2 for a discussion of the reason.

Table 7: Annual totals for state code "GUT" by SCH QMA and for all SCH QMAs. Fishing years with large amounts of GUT landings are marked in grey.

	School Shark QMA							
Fishing year	SCH 1	SCH 2	SCH 3	SCH 4	SCH 5	SCH 7	SCH 8	Total
89/90	1.11	1.97	1.07	0.03	15.66	21.01	10.99	51.84
90/91	1.33	8.73	6.19	6.28	288.00	132.68	81.75	524.95
91/92	2.72	7.38	2.87	1.81	90.82	93.49	5.67	204.76
92/93	6.92	4.39	0.56	–	2.52	34.11	–	48.50
93/94	3.17	4.85	1.74	–	0.47	14.87	–	25.09
94/95	4.27	3.18	1.29	–	0.05	19.87	0.01	28.67
95/96	1.61	5.91	0.23	–	0.02	4.63	0.17	12.56
96/97	0.98	4.72	0.15	0.68	0.07	4.89	0.01	11.49
97/98	7.56	1.97	0.00	–	–	0.35	0.02	9.89
98/99	5.33	0.01	0.36	–	–	2.39	0.67	8.77
99/00	11.55	4.38	0.06	–	–	0.43	–	16.42
00/01	9.42	3.28	0.04	–	0.07	0.44	3.37	16.60
01/02	0.02	0.05	0.09	–	–	–	–	0.16
02/03	0.07	0.02	0.16	–	0.03	0.02	–	0.29
03/04	0.23	0.08	0.05	–	0.13	2.63	0.19	3.31
04/05	0.37	0.00	0.26	–	0.03	0.13	–	0.79
05/06	0.10	–	0.28	–	–	0.02	–	0.40
06/07	0.08	–	–	–	0.09	0.30	–	0.47
07/08	0.01	0.08	0.42	–	–	0.65	–	1.16
08/09	0.03	0.01	0.17	–	–	0.27	–	0.48
09/10	1.27	0.00	1.24	–	0.07	1.62	1.81	6.01
10/11	0.01	0.00	–	–	0.02	3.34	1.55	4.93
11/12	0.02	0.40	0.02	0.02	0.10	5.02	–	5.56
12/13	0.53	0.04	0.00	–	–	7.27	–	7.85
Total	58.69	51.45	17.23	8.82	398.13	350.42	106.21	990.96

Table 8: Distribution of total landings (t) by school shark Fishstock and by fishing year for all trips that recorded SCH landings, regardless of QMA. Landing records with improbable greenweights have been dropped (see Appendix E).

	School Shark QMA							
Fishing year	SCH 1	SCH 2	SCH 3	SCH 4	SCH 5	SCH 7	SCH 8	Total
89/90	413.5	114.7	216.2	12.1	367.1	453.8	319.9	1 897.2
90/91	498.3	122.2	203.8	18.1	495.3	393.8	309.5	2 041.0
91/92	517.7	130.7	231.9	31.3	585.1	382.0	327.0	2 205.6
92/93	700.2	178.7	199.6	31.5	563.3	459.9	438.2	2 571.5
93/94	645.9	159.8	205.9	41.2	579.7	449.6	410.9	2 492.9
94/95	614.0	153.1	248.9	79.0	631.9	388.9	418.2	2 534.0
95/96	766.6	235.2	298.0	180.0	719.8	637.6	522.9	3 360.1
96/97	744.9	222.8	263.3	212.2	628.0	546.5	433.6	3 051.4
97/98	781.5	195.6	268.8	123.7	627.7	448.6	422.5	2 868.3
98/99	791.7	270.6	323.0	103.6	666.0	663.5	523.6	3 342.1
99/00	800.2	241.8	332.3	104.2	680.9	637.1	455.8	3 252.2
00/01	788.7	175.5	367.7	100.7	682.2	581.5	433.1	3 129.4
01/02	731.6	203.7	325.1	88.5	658.5	493.8	458.5	2 959.6
02/03	694.3	219.5	404.7	122.8	749.2	524.8	437.7	3 153.1
03/04	764.6	182.4	333.6	144.0	694.0	566.4	389.6	3 074.6
04/05	714.0	193.3	418.2	217.4	731.3	535.4	548.2	3 357.8
05/06	632.0	181.8	305.7	174.7	645.9	560.6	506.8	3 007.6
06/07	666.3	190.8	382.3	92.7	705.3	580.9	517.6	3 136.0
07/08	684.4	226.0	329.0	122.2	766.5	614.2	492.3	3 234.5
08/09	711.0	227.4	384.1	146.8	719.1	691.5	588.3	3 468.3
09/10	585.1	207.6	418.3	201.5	781.0	603.5	459.1	3 256.1
10/11	795.1	191.3	361.6	164.0	692.0	678.9	578.6	3 461.5
11/12	693.4	197.2	336.4	193.3	716.4	607.1	505.9	3 249.7
12/13	603.3	203.8	321.0	136.3	748.4	654.0	509.7	3 176.5
Total	16 338.3	4 625.5	7 479.4	2 841.8	15 834.5	13 154.2	11 007.4	71 281.0

Green weight landings $\left(G'_{i,y}\right)$ were adjusted in the CPUE analysis and for some parts of the characterisation analysis for state codes DRE and HGU to a consistent conversion factor using the following equation:

Eq. 2 $$G'_{i,s,y} = G_{i,s,y} \, {}^{cf_{i,s,2012-13}}\!\big/_{cf_{i,s,y}}$$

where

$G_{i,s,y}$ is the reported green weight for record *i* using landed state code *s* in year *y*;

$cf_{i,s,y}$ is the conversion factor for record *i* using landed state code *s* in year *y*;

$cf_{i,s,2000-01}$ is the conversion factor for record *i* using landed state code *s* in year 2012–13

A convention adopted in this analysis was to drop the landings for state codes FIN, FLP (flaps), SHF (shark fins) and ROE when there was more than one landing in a trip (Starr, 2007). The latter three state codes are considered “secondary” and thus should not enter into the calculation of landed greenweight, but these were all dropped to avoid potential double counting.

Total landings available in the data set are primarily from SCH 1, SCH 5, SCH 7, SCH 8, SCH 3, SCH 2 and finally SCH 4 (in descending order of importance) (Table 8). These annual totals have been adjusted upwards to match the QMR/MHR totals (see Table C.1) using Eq. 1.

Table 9: Distribution by form type for landed catch by weight for each fishing year in the combined school shark landings dataset. Also provided are the number of days fishing and the associated distribution of days fishing by form type for the effort data in the combined school shark. See Appendix A for definitions of abbreviations used in this table.

	Landings (%)[1]			Days Fishing (%)[2]						Days Fishing							
	CELR	CLR	NCELR	CELR	TCEPR	TCER	NCELR	LTCER	LCER	CELR	TCEPR	TCER	NCELR	LTCER	LCER	TUN	Total
89/90	93	7	0	81	19	–	–	–	–	17 070	4 090	–	–	–	–	–	21 160
90/91	94	6	0	81	19	–	–	–	–	19 408	4 603	–	–	–	–	–	24 011
91/92	96	4	0	81	19	–	–	–	–	19 745	4 715	–	–	–	–	29	24 489
92/93	94	6	0	83	17	–	–	–	–	23 007	4 647	–	–	–	–	54	27 708
93/94	95	5	0	83	17	–	–	–	–	21 282	4 337	–	–	–	–	98	25 717
94/95	93	7	0	79	19	–	–	–	–	22 058	5 292	–	–	–	–	524	27 874
95/96	84	16	0	73	27	–	–	–	–	21 443	8 054	–	–	–	–	50	29 547
96/97	83	17	0	72	26	–	–	–	–	22 607	8 209	–	–	–	–	429	31 245
97/98	84	16	0	72	27	–	–	–	–	20 510	7 831	–	–	–	–	273	28 614
98/99	86	14	0	72	26	–	–	–	–	23 028	8 426	–	–	–	–	452	31 906
99/00	86	14	0	70	29	–	–	–	–	22 206	9 346	–	–	–	–	324	31 876
00/01	86	14	0	65	35	–	–	–	–	21 419	11 459	–	–	–	–	204	33 082
01/02	84	16	0	61	38	–	–	–	–	18 999	11 867	–	–	–	–	333	31 199
02/03	84	16	0	62	37	–	–	–	–	21 147	12 551	–	–	–	–	459	34 157
03/04	83	17	0	61	35	–	–	–	2	20 288	11 657	–	–	–	600	526	33 071
04/05	80	20	0	62	35	–	–	–	3	21 055	11 829	–	–	–	1 014	285	34 183
05/06	81	19	0	65	32	–	–	–	3	19 974	9 926	–	–	–	825	220	30 945
06/07	35	18	46	53	31	–	12	–	4	16 697	9 773	–	3 665	–	1 116	131	31 382
07/08	7	49	44	9	27	35	12	13	4	2 583	8 074	10 676	3 642	3 783	1 305	201	30 264
08/09	13	47	41	10	26	35	12	13	3	3 090	7 996	10 751	3 732	3 901	1 069	319	30 858
09/10	7	52	41	7	26	38	11	13	3	2 403	8 659	12 571	3 583	4 205	1 004	275	32 700
10/11	7	54	38	8	26	35	11	16	3	2 466	8 559	11 504	3 656	5 073	996	239	32 493
11/12	8	52	40	8	25	37	11	16	2	2 559	7 542	11 353	3 389	4 939	613	244	30 639
12/13	8	51	41	9	25	37	11	16	1	2 761	7 802	11 346	3 239	4 984	378	187	30 697
Total	63	24	13	54	27	9	3	4	1	387 805	197 244	68 201	24 906	26 885	8 920	5 856	719 817

[1] Percentages of landed greenweight
[2] Percentages of number of days fishing

2.3.2.3 Form types used in the SCH landing and effort data

Sixty three percent of the total SCH landings in the NZ EEZ have been reported on CELR forms over the 24 years of record, with the remaining landings split between the CLR and the new NCELR forms (Table 9). The CLR form is used to report the landings from effort on forms other than the CELR and the NCELR (which have both effort and landings sections). The overall proportion of landings reported on the CELR form has dropped to below 10% in every year from 2007–08 (except in 2008–09), having been replaced with a large uptake of the NCELR set net form which has been used for over 40% of the landings since 2006–07. The use of the CELR form by SCH QMA to report SCH landings is plotted in Figure 6, showing that there is a similar trend in each QMA and that the usage of the CELR form in some QMAs (notably SCH 1, SCH 4 and SCH 5) is now nearly non-existant.

There was a corresponding drop in the usage of the CELR form in the effort data, beginning from 2006–07 (calculated as days fishing, Table 9) and an increase in the use of other form types in the effort data set after that year. The NCELR form is used to report setnet effort while the TCER and the LTCER forms report effort for vessels between 6 and 28 m in total length for bottom trawl and bottom longline methods respectively.

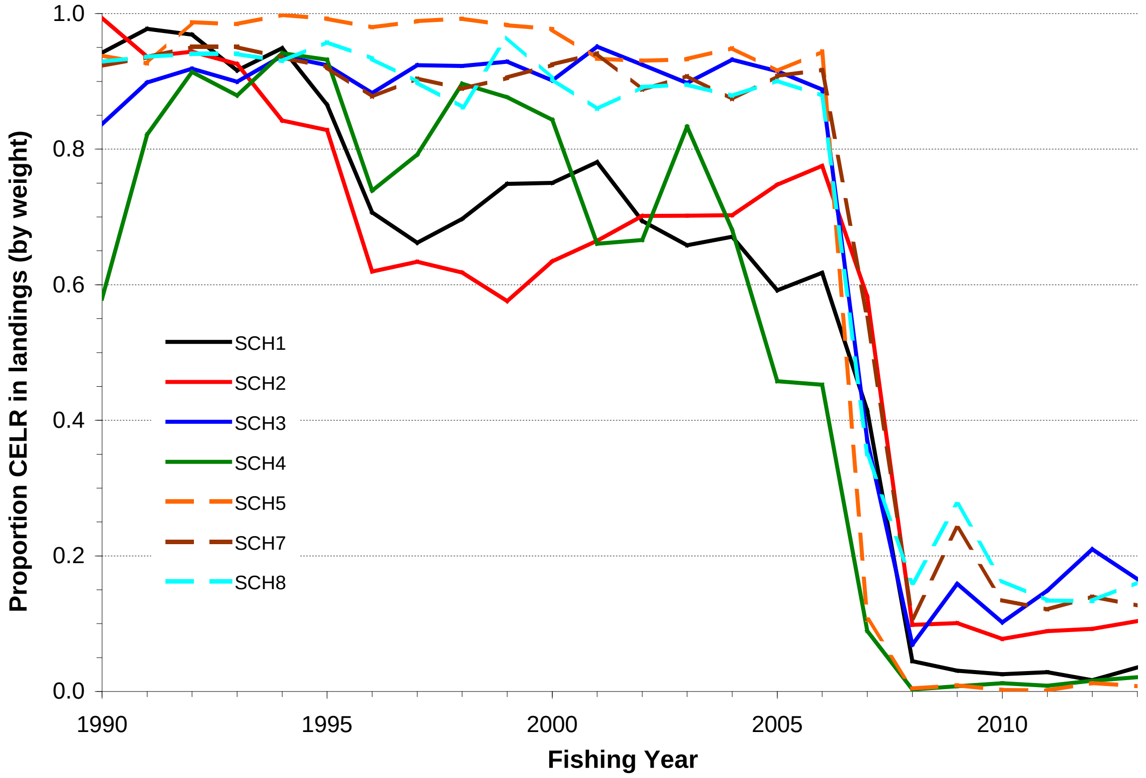


Figure 6: Time series of the proportion of landings (by weight) reported on the CELR form for each QMA in the SCH 1, SCH 2, SCH 3, SCH 4, SCH 5, SCH 7 and SCH 8 dataset.

2.3.3 Description of the SCH 1, SCH 2, SCH 3, SCH 4, SCH 5, SCH 7 and SCH 8 fisheries

2.3.3.1 Introduction

As discussed in Section 2.3.1, landings were matched with effort for every trip while maintaining the integrity of the QMA-specific information. This procedure worked well for all SCH QMAs except for SCH 8, where about 35% of the catch was lost because trips were dropped which fished in shared statistical areas and reported landings from more than one QMA. The relatively high level of loss in

SCH 8 occurs because all of the SCH 8 statistical areas are shared with either SCH 1 or SCH 7, except for the offshore Area 801 (Appendix B). This amount of lost landings was considered acceptable for the purposes of characterising the fishery, but was not accepted for CPUE analyses, where trips were assigned to statistical areas without maintaining the integrity of the QMA information. Consequently the CPUE analyses only approximate the SCH QMA and will contain mixed QMA information from the shared statistical areas. The characterisation information in this section is presented by SCH QMA, except for SCH 1, which has been split into "East" and "West" components that correspond to FMAs 1 and 9 (see Appendix B for the locations of these FMAs):

SCH QMA reported	Statistical Area definition
SCH 1E	SCH 1 (001–010,105–107)
SCH 2	not used: assignment to QMA based on declared landings
SCH 3	not used: assignment to QMA based on declared landings
SCH 4	not used: assignment to QMA based on declared landings
SCH 5	not used: assignment to QMA based on declared landings
SCH 7	not used: assignment to QMA based on declared landings
SCH 8	not used: assignment to QMA based on declared landings
SCH 1W	SCH 1 (041–048, 101–104)

Characterisation information from SCH 1E and SCH 1W in the following sections will be treated as if they come from separate QMAs in recognition that these fisheries are located in management areas that substantially differ from each other, at a level similar to the differences seen between the remaining SCH QMAs.

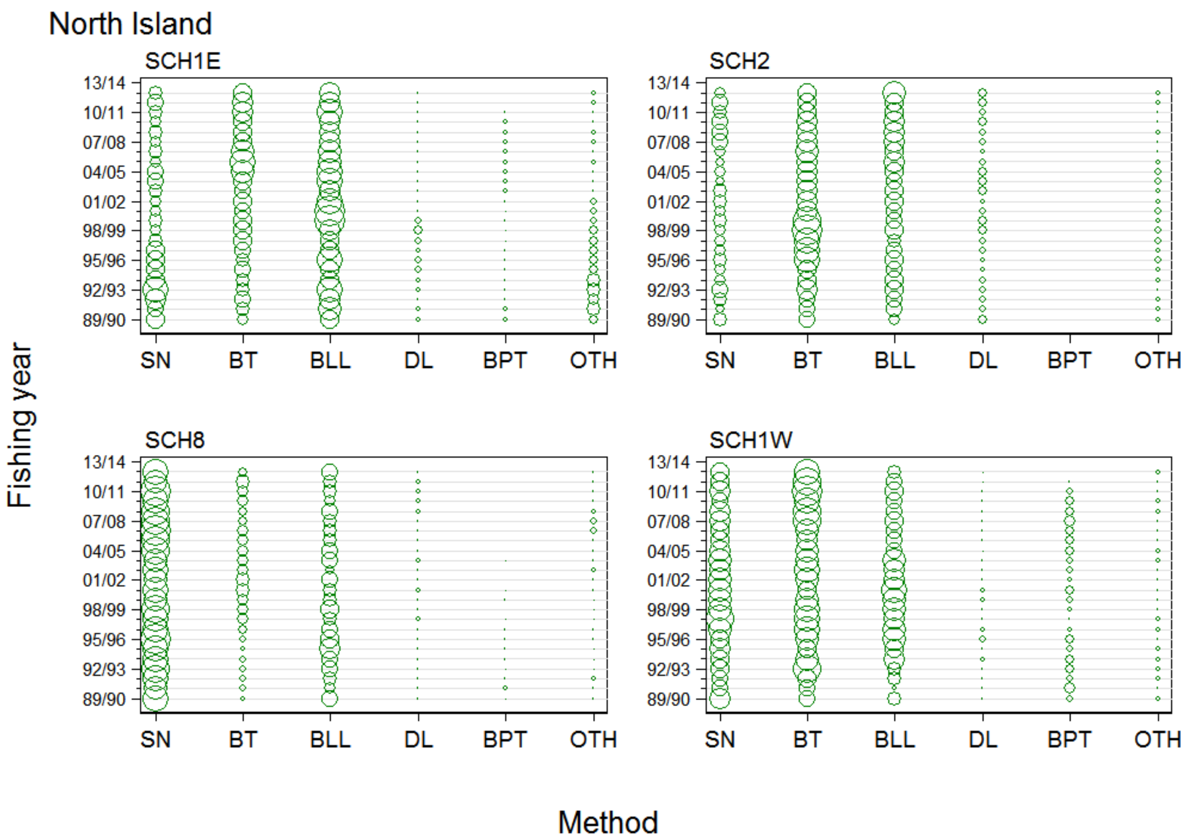


Figure 7A: Distribution of school shark landings in the North Island for the major fishing methods by fishing year by SCH QMA from 1989–90 to 2012–13. Circles are proportional to the catch totals by method and fishing year within each sub-graph: [SCH 1E]: largest circle= 200 t in 00/01 for BLL; [SCH 2]: largest circle= 172 t in 98/99 for BT;[SCH 8]: largest circle= 309 t in 95/96 for SN; [SCH 1W]: largest circle= 289 t in 10/11 for BT. Data for these plots are presented in Table G.1.

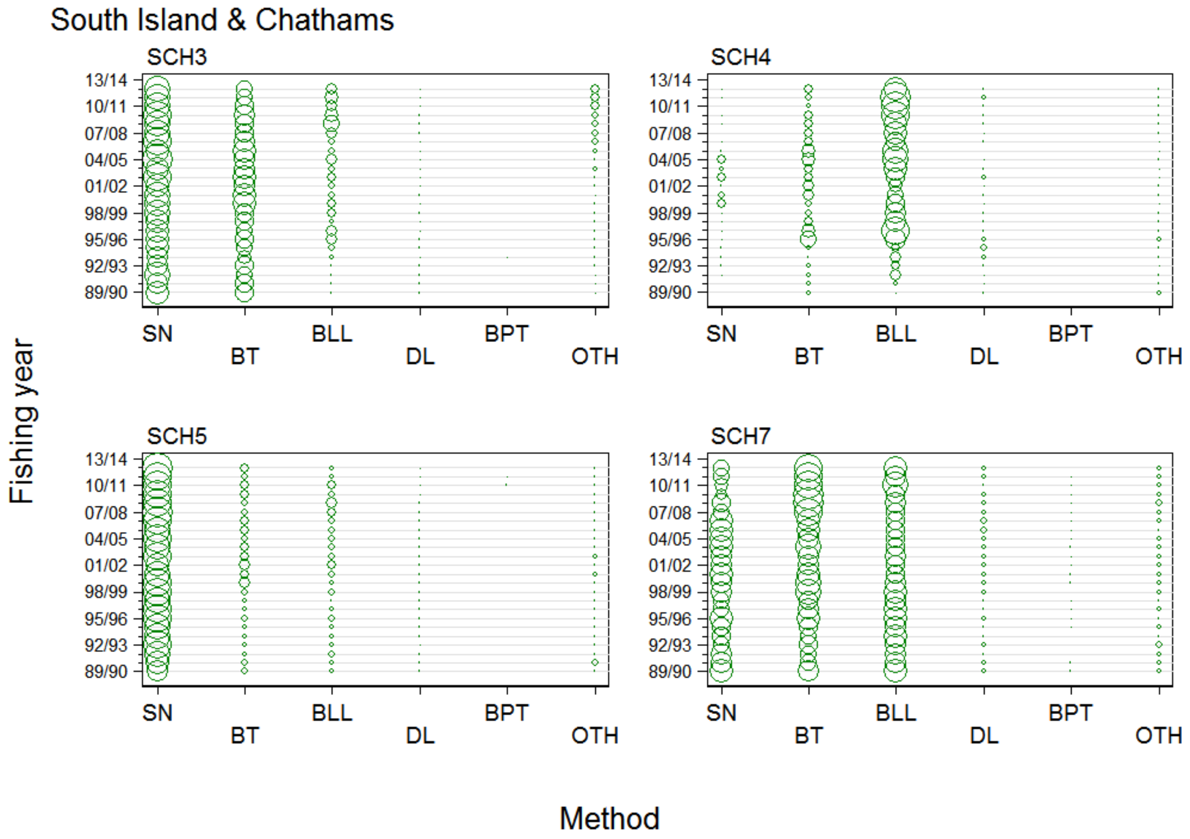


Figure 7B: Distribution of school shark landings in the South Island for the major fishing methods by fishing year by SCH QMA from 1989–90 to 2012–13. Circles are proportional to the catch totals by method and fishing year within each sub-graph: [SCH 3]: largest circle= 264 t in 04/05 for SN; [SCH 4]: largest circle= 217 t in 11/12 for BLL;[SCH 5]: largest circle= 772 t in 07/08 for SN; [SCH 7]: largest circle= 311 t in 09/10 for BT. Data for these plots are presented in Table G.1.

Table 10: Total landings (t) and distribution of landings (%) for school shark for important fishing methods over the SCH QMAs from trips which landed school shark, summed from 1989–90 to 2012–13.

	Method						
Major Area	SN	BT	BLL	DL	BPT	OTH	Total
	Total landings (t)						
SCH 1E	1 407	1 863	2 851	112	54	326	6 613
SCH 2	831	2 187	1 589	275	–	114	4 997
SCH 3	4 486	2 781	635	10	0.08	142	8 054
SCH 4	94	509	2 428	49	–	33	3 112
SCH 5	15 319	1 306	945	79	3.0	181	17 833
SCH 7	3 376	4 719	3 781	177	7.0	173	12 232
SCH 8	5 847	924	1 974	89	15	70	8 920
SCH 1W	3 396	4 579	2 856	62	500	103	11 496
Total	34 756	18 868	17 058	853	579	1 143	73 257
	Distribution of landings (%)						
SCH 1E	1.9	2.5	3.9	0.2	0.1	0.4	9.0
SCH 2	1.1	3.0	2.2	0.4	–	0.2	6.8
SCH 3	6.1	3.8	0.9	0.0	0.0	0.2	11.0
SCH 4	0.1	0.7	3.3	0.1	–	0.0	4.2
SCH 5	20.9	1.8	1.3	0.1	0.0	0.2	24.3
SCH 7	4.6	6.4	5.2	0.2	0.0	0.2	16.7
SCH 8	8.0	1.3	2.7	0.1	0.0	0.1	12.2
SCH 1W	4.6	6.3	3.9	0.1	0.7	0.1	15.7
Total	47.4	25.8	23.3	1.2	0.8	1.6	100.0

2.3.3.2 Distribution of landings and effort by method of capture and QMA

The fisheries for school shark are complex, with the relative importance of the major capture methods differing among the eight QMAs (Figure 7; Table 10; Table G.1). Set net is the most important overall capture method for this species and predominates in SCH 3, SCH 5 and SCH 8 (47% of the total NZ school shark landings; Table 10). Bottom trawl is the overall second most important capture method for school shark and predominates in SCH 2, SCH 7 and SCH 1W (26% of the total NZ school shark landings; Table 10). Bottom longline ranks third in overall importance as a capture method for school shark but it predominates in SCH 1E and SCH 4 (23% of the total NZ school shark landings; Table 10). School shark landings by other methods are minor in most QMAs, with the combined setnet bottom trawl and bottom longline landings accounting for about 95% of overall SCH landings for all QMAs. (Table 10). Two QMAs stand out as having only a single method predominating, with SCH 4 being mainly bottom longline and SCH 5 mainly setnet.

2.3.3.3 Seasonal distribution of landings

The school shark setnet fishery tends to be seasonal in the South Island fisheries of SCH 3, SCH 5 and SCH 7, with the majority of landings taking place in the spring and early summer in these QMAs (Figure 8B; Table G.2). However, the setnet landings in the North Island QMAs appear to be more spread out seasonally, with landings in all four regions extending to May/June in most years. (Figure 8A).

The seasonal distribution of bottom trawl school shark landings is much more uniform across all months in all eight QMA/regions, particularly when compared to the seasonal setnet landings (Figure 9; Table G.3). This uniformity in the seasonality of trawl landings of school shark reflects the timing of the target species of interest to the fishery, rather than having much to do with the availability of school shark. This is because trawl fisheries rarely target school shark (see following Section) while these fisheries target a range of species throughout the year, but tend to capture school shark as an associated bycatch while targeting the more abundant or desirable species. There is some structure in the BT seasonal catch of school shark in SCH 3, SCH 5 and SCH 7, with winter landings of school shark tending to diminish in the 1990s, but this effect appears to have disappeared in recent years (Figure 9). However, the broad seasonal distribution of school shark landings from the trawl fleet demonstrates that school shark are likely to be present year-round in the New Zealand inshore waters.

The seasonal distribution of bottom longline school shark landings is sporadic but covers most months in all eight QMA/regions (Figure 10; Table G.4). The sporadic nature of the seasonal timing can be seen in the size of the “bubbles” in Figure 10, which vary in size without an apparent pattern, indicating what appears to be opportunistic fishing (in some years, fishers go fishing and in other years they do not). This probably reflects the nature of the fishery, with economic considerations and opportunity driving the level of catch. Given this high level of variability, it is difficult to determine if there is an underlying seasonal pattern in this fishery. However, the lack of a pattern and the ubiquity of the fishery leads to the same conclusion as was made for the bottom trawl fishery: school shark are likely to be present year-round in the New Zealand inshore waters.

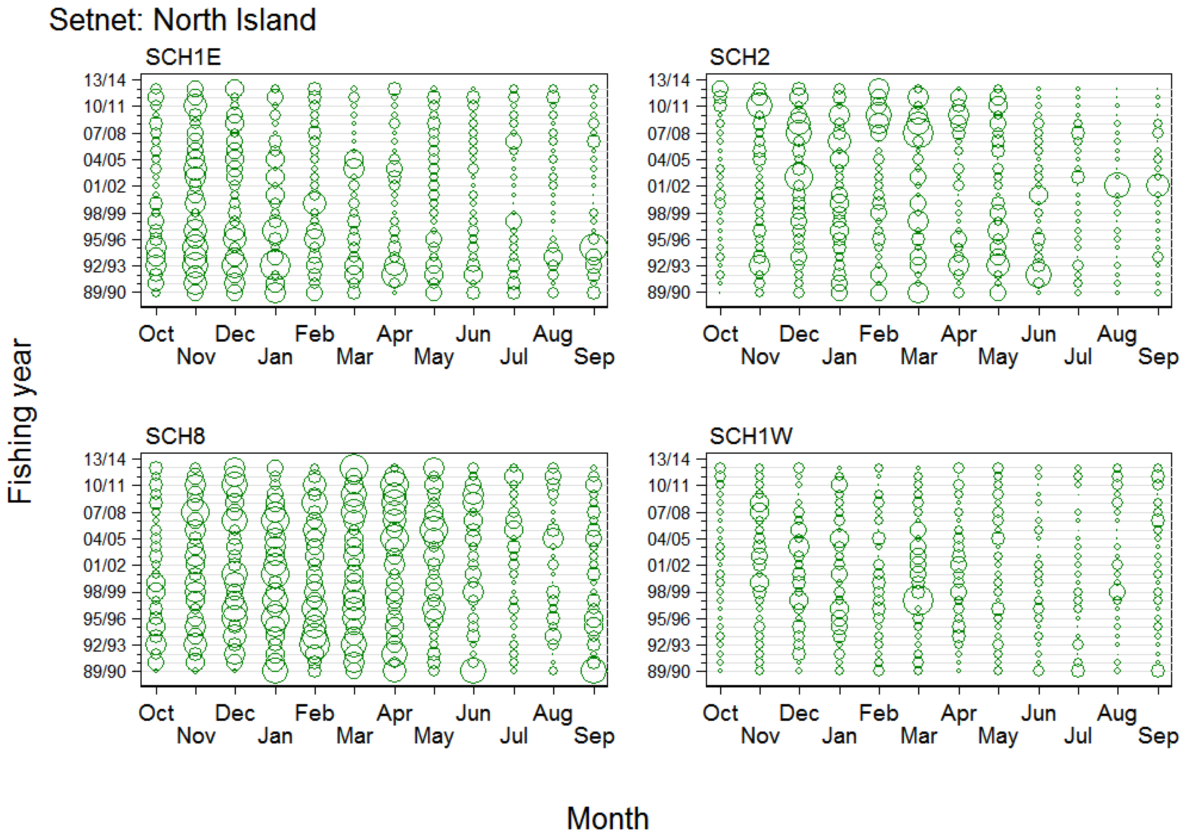


Figure 8A: Distribution of landings by month and fishing year for North Island setnet based on trips which landed school shark. Circle sizes are proportional within each panel: [SCH 1E]: largest circle= 25 t in 92/93 for Jan; [SCH 2]: largest circle= 18 t in 07/08 for Mar; [SCH 8]: largest circle= 63 t in 92/93 for Feb; [SCH 1W]: largest circle= 105 t in 97/98 for Mar. Values for the plotted data are provided in Table G.2.

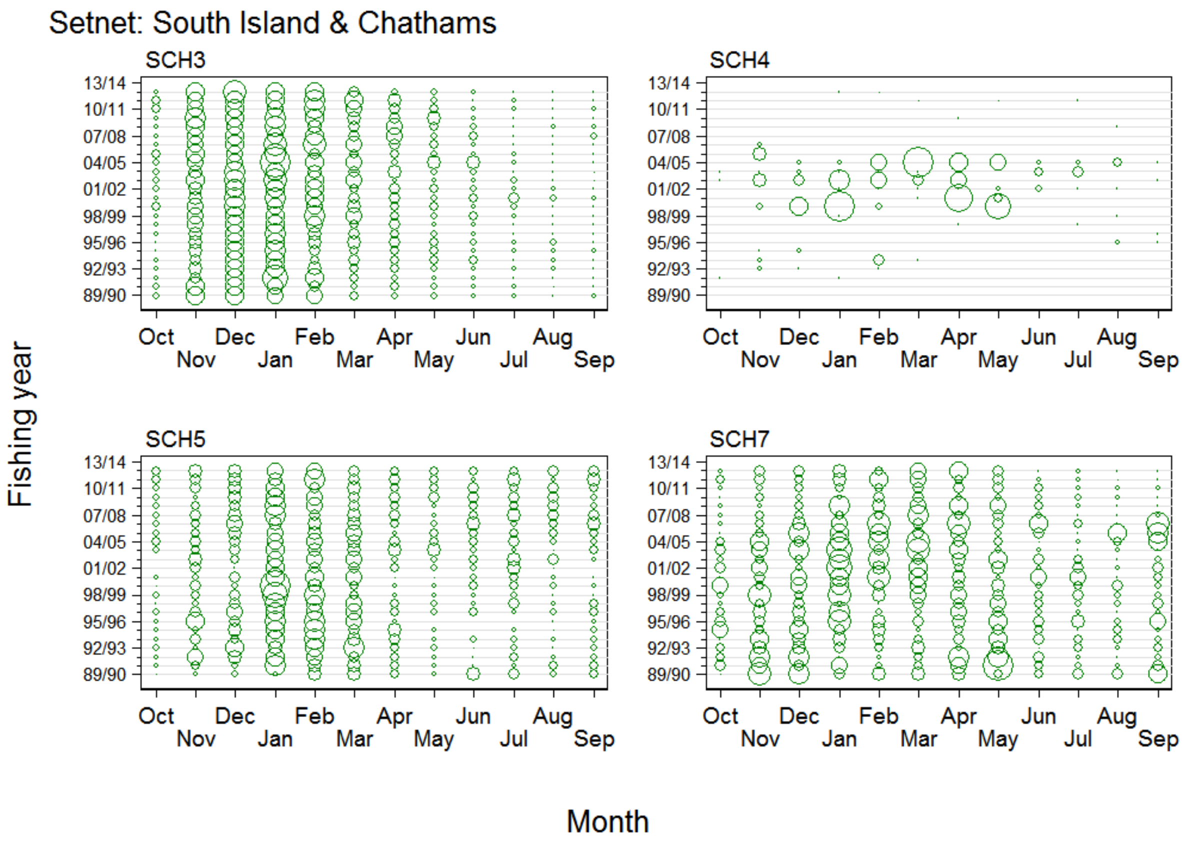


Figure 8B: Distribution of landings by month and fishing year for South Island and Chathams setnet based on trips which landed school shark. Circle sizes are proportional within each panel: [SCH 3]: largest circle= 90 t in 04/05 for Jan; [SCH 4]: largest circle= 12 t in 04/05 for Mar; [SCH 5]: largest circle= 360 t in 99/00 for Jan; [SCH 7]: largest circle= 64 t in 90/91 for May. Values for the plotted data are provided in Table G.2

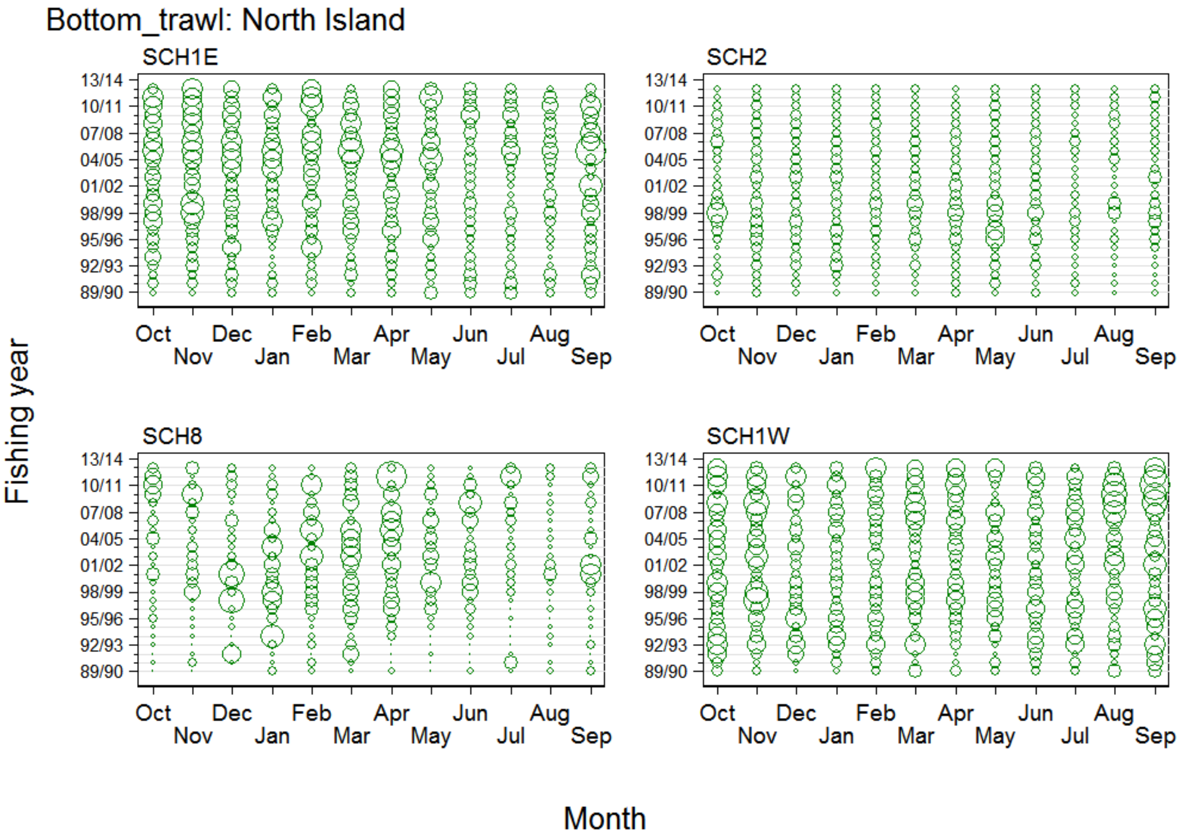


Figure 9A: Distribution of landings by month and fishing year for North Island bottom trawl based on trips which landed school shark. Circle sizes are proportional within each panel: [SCH 1E]: largest circle= 27 t in 05/06 for Sep; [SCH 2]: largest circle= 30 t in 98/99 for Oct; [SCH 8]: largest circle= 22 t in 11/12 for Apr; [SCH 1W]: largest circle= 60 t in 10/11 for Sep. Values for the plotted data are provided in Table G.3.

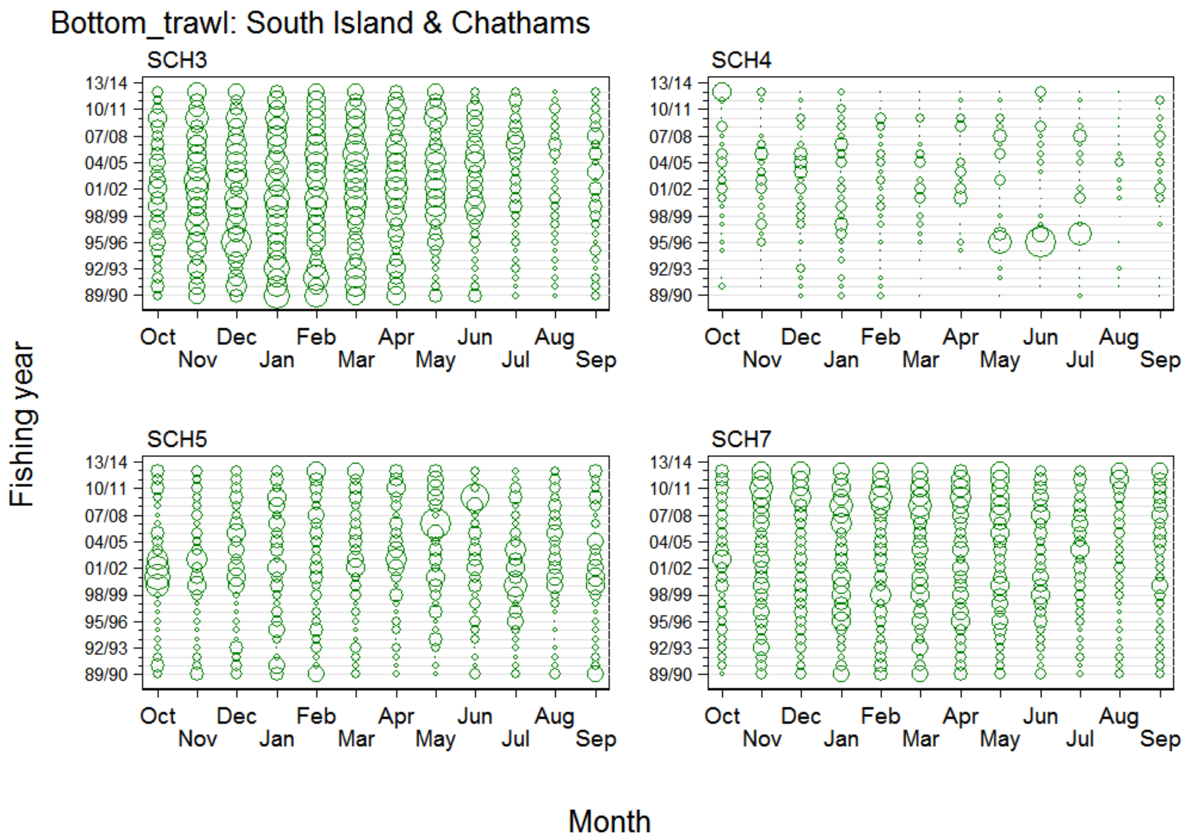


Figure 9B: Distribution of landings by month and fishing year for South Island and Chathams bottom trawl based on trips which landed school shark. Circle sizes are proportional within each panel: [SCH 3]: largest circle= 32 t in 95/96 for Dec; [SCH 4]: largest circle= 33 t in 95/96 for Jun; [SCH 5]: largest circle= 27 t in 06/07 for May; [SCH 7]: largest circle= 52 t in 08/09 for Mar. Values for the plotted data are provided in Table G.3.

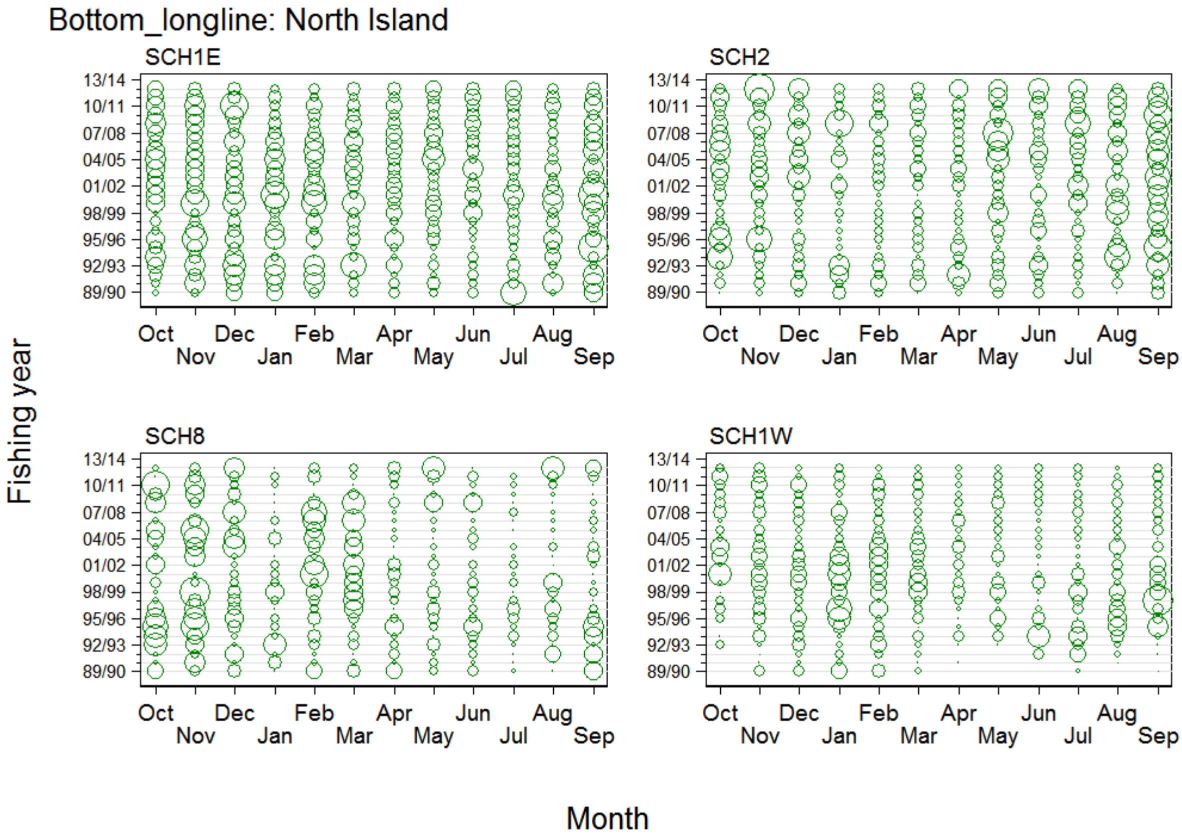


Figure 10A: Distribution of landings by month and fishing year for North Island bottom longline based on trips which landed school shark. Circle sizes are proportional within each panel: [SCH 1E]: largest circle= 35 t in 94/95 for Sep; [SCH 2]: largest circle= 23 t in 12/13 for Nov; [SCH 8]: largest circle= 40 t in 98/99 for Nov; [SCH 1W]: largest circle= 68 t in 97/98 for Sep. Values for the plotted data are provided in Table G.4.

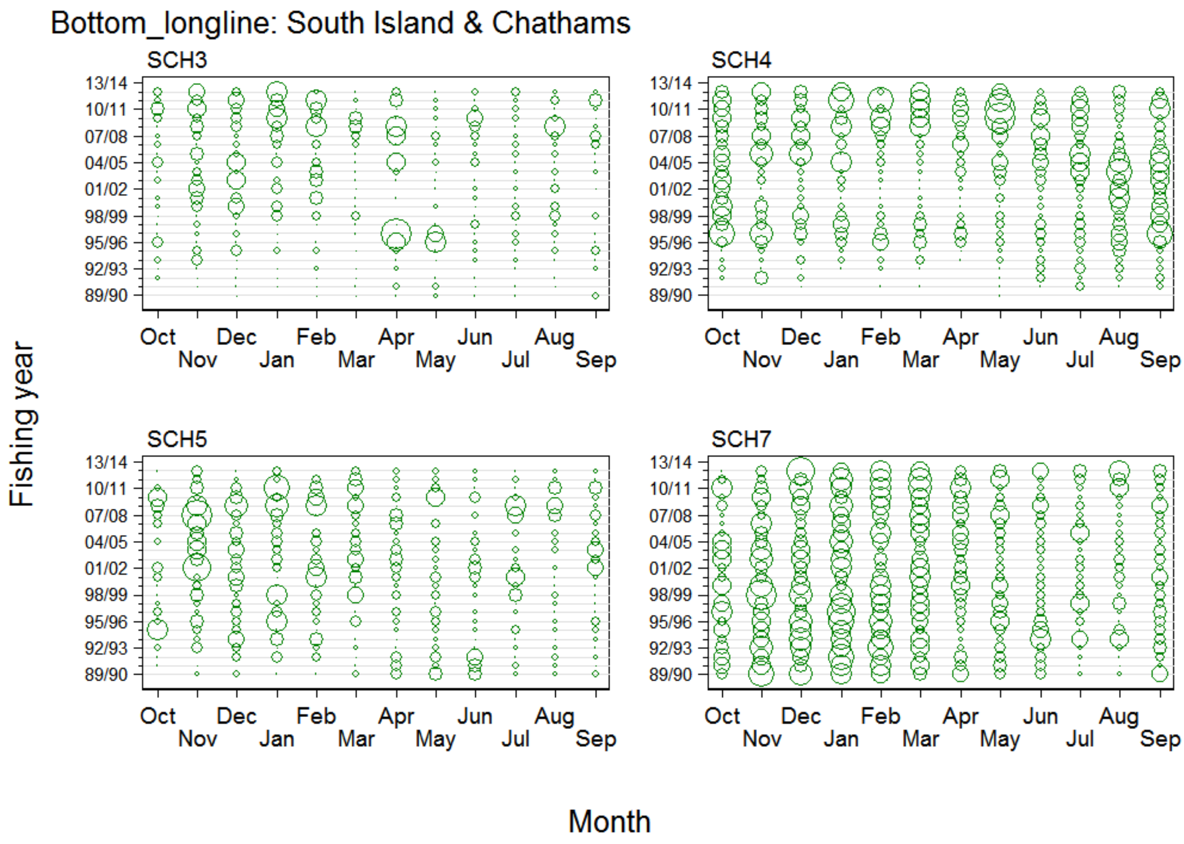


Figure 10B: Distribution of landings by month and fishing year for South Island and Chathams bottom longline based on trips which landed school shark. Circle sizes are proportional within each panel: [SCH 3]: largest circle= 30 t in 96/97 for Apr; [SCH 4]: largest circle= 49 t in 09/10 for May; [SCH 5]: largest circle= 29 t in 07/08 for Nov; [SCH 7]: largest circle= 51 t in 98/99 for Nov. Values for the plotted data are provided in Table G.4.

2.3.3.4 Distribution of landings by declared target species

The setnet fisheries taking school shark are almost exclusively targeted at this species in SCH 1W, SCH 5 and SCH 7, while other species are targeted, but also take school shark, in SCH 1E, SCH 2, SCH 3 and SCH 8 (Table 11). The bycatch of school shark when target fishing for trevally in SCH 1E appears to be greater than when targeting school shark (Figure 11A). Target fishing for rig, snapper and flatfish all capture school shark in the SCH 1E setnet fishery in addition to school shark target fishing. Fishing is less complicated in SCH 2, where the setnet fishery taking school shark also targets blue warehou and blue moki; while in SCH 3 there is considerable targeting of rig. The primary target species in the remaining four setnet fisheries is school shark, coupled with some rig targeting (Table 11).

The range of target species taking school shark while bottom trawl fishing is complex, with each QMA showing different prevalence (Figure 12; Table G.5). What is clear is that SCH is rarely declared a target when using bottom trawl in any of these areas. The SCH 1E bottom trawl fishery taking school shark is primarily targeted at tarakihi, with some targeting of snapper and red gurnard. The SCH 2 trawl fishery is mainly targeted at tarakihi, gemfish, hoki, and gurnard. The SCH 3 fishery is more diverse, targeting red cod, flatfish, barracouta, tarakihi and even elephantfish while capturing school shark as a bycatch. The SCH 7 fishery targets barracouta, tarakihi and flatfish, while the SCH 8 fishery targets tarakihi, gurnard and trevally. Finally, the SCH 1W fishery targets tarakihi, snapper, trevally and red gurnard.

The range of target species which take school shark while bottom longline fishing is simpler than for bottom trawl, with fewer target species fisheries taking school shark as bycatch in each QMA (Figure 13; Table G.5). The SCH 1E bottom longline fishery is the most diverse, taking school shark when targeting snapper, hapuku/bass, school shark and bluenose. The SCH 2 longline fishery is mainly targeted at hapuku/bass, followed by school shark, ling and bluenose. The SCH 3 longline fishery targets hapuku/bass, ling and school shark which are the same target species as in the SCH 5 longline. The SCH 7 longline fishery mainly targets school shark and hapuku/bass, which are the same species targeted by the SCH 8 and SCH 1W longline fisheries. SCH 4, which is an exclusive longline fishery, targets ling, hapuku/bass and bluenose in addition to school shark.

Table 11: Total landings (t) and distribution of landings (%) for school shark by target species and method of capture for each major area (Table G.1) from trips which landed school shark, summed from 1989–90 to 2012–13. '–': no data.

Target	Method of Capture (t)							Method of Capture (%)						
species	SN	BT	BLL	DL	BPT	Other	Total	SN	BT	BLL	DL	BPT	Other	Total
SCH 1E														
SNA	117	277	932	0	32	17	1 376	8.3	14.9	32.7	0.0	59.4	5.4	20.8
SCH	388	12	780	6	–	7	1 193	27.6	0.6	27.4	5.7	–	2.2	18.0
HPB	4	1	782	100	–	275	1 162	0.3	0.1	27.4	89.2	–	84.3	17.6
TAR	47	1 007	64	0	13	5	1 134	3.3	54.0	2.2	0.0	23.1	1.5	17.2
TRE	433	105	0	0	9	0	548	30.8	5.7	0.0	0.0	15.8	0.1	8.3
SPO	236	0	0	–	–	0	236	16.7	0.0	0.0	–	–	0.0	3.6
BNS	1	1	195	6	–	1	203	0.1	0.0	6.8	5.0	–	0.3	3.1
JDO	1	122	0	–	0	2	125	0.1	6.5	0.0	–	0.1	0.6	1.9
SKI	3	102	1	0	0	0	106	0.2	5.5	0.0	0.0	0.2	0.0	1.6
HOK	1	89	–	–	–	0	90	0.1	4.8	–	–	–	0.0	1.4
LIN	–	16	57	0	–	0	74	–	0.9	2.0	0.0	–	0.0	1.1
OTH	178	130	40	0	1	18	367	12.6	7.0	1.4	0.0	1.3	5.5	5.5
Total	1 407	1 863	2 851	112	54	326	6 613	21.3	28.2	43.1	1.7	0.8	4.9	100.0
SCH 2														
TAR	17	1 050	0	0	–	1	1 067	2.0	48.0	0.0	0.0	–	0.6	21.4
SCH	297	2	463	89	–	3	854	35.8	0.1	29.1	32.3	–	2.5	17.1
HPB	8	0	471	170	–	8	658	1.0	0.0	29.7	61.8	–	7.3	13.2
LIN	12	11	368	9	–	7	407	1.5	0.5	23.2	3.4	–	5.8	8.2
HOK	1	280	0	–	–	78	360	0.1	12.8	0.0	–	–	68.5	7.2
SKI	5	310	14	–	–	2	330	0.6	14.2	0.9	–	–	1.5	6.6
BNS	6	1	260	3	–	2	273	0.7	0.1	16.4	1.2	–	2.0	5.5
WAR	226	47	0	0	–	0	273	27.2	2.1	0.0	0.0	–	0.0	5.5
GUR	4	234	1	0	–	1	239	0.4	10.7	0.0	0.0	–	0.9	4.8
MOK	135	6	–	–	–	0	141	16.3	0.3	–	–	–	0.0	2.8
SCI	–	79	–	–	–	–	79	–	3.6	–	–	–	–	1.6
OTH	120	168	11	3	–	12	315	14.4	7.7	0.7	1.2	–	10.9	6.3
Total	831	2 187	1 589	275	–	114	4 997	16.6	43.8	31.8	5.5	–	2.3	100.0
SCH 3														
SCH	1 717	34	130	3	–	2	1 886	38.3	1.2	20.4	32.6	–	1.4	23.4
SPO	1 665	36	0	0	–	21	1 722	37.1	1.3	0.0	0.1	–	14.7	21.4
RCO	12	1 128	0	0	0	39	1 179	0.3	40.5	0.0	0.0	42.1	27.8	14.6
TAR	208	265	0	0	–	27	500	4.6	9.5	0.0	0.0	–	19.2	6.2
FLA	1	415	–	–	–	28	443	0.0	14.9	–	–	–	19.7	5.5
HPB	146	3	263	6	–	1	418	3.3	0.1	41.4	55.0	–	0.4	5.2
BAR	0	413	–	0	–	1	414	0.0	14.9	–	0.0	–	0.8	5.1
LIN	155	12	183	1	–	2	352	3.4	0.4	28.9	5.6	–	1.1	4.4
SPD	297	23	0	–	–	1	321	6.6	0.8	0.0	–	–	0.5	4.0
ELE	131	150	0	–	–	4	285	2.9	5.4	0.0	–	–	2.5	3.5
WAR	45	64	–	–	–	1	110	1.0	2.3	–	–	–	0.6	1.4
OTH	110	239	59	1	0	16	424	2.4	8.6	9.2	6.7	57.9	11.2	5.3
Total	4 486	2 781	635	10	0	142	8 054	55.7	34.5	7.9	0.1	0.2	1.8	100.0

Table 11: (cont.)

Target species	Method of Capture (t)							Method of Capture (%)						
	SN	BT	BLL	DL	BPT	Other	Total	SN	BT	BLL	DL	BPT	Other	Total
SCH 4														
LIN	1	13	1 010	0	–	3	1 027	0.6	2.5	41.6	0.5	–	10.5	33.0
HPB	0	0	640	29	–	9	679	0.2	0.0	26.4	60.3	–	27.4	21.8
SCH	82	1	530	16	–	7	636	87.4	0.1	21.8	32.4	–	21.8	20.4
BNS	4	3	189	0	–	0	195	3.8	0.5	7.8	0.7	–	0.3	6.3
TAR	–	183	0	–	–	0	183	–	36.0	0.0	–	–	0.0	5.9
BAR	–	100	–	–	–	6	106	–	19.6	–	–	–	19.5	3.4
STA	–	65	–	–	–	0	65	–	12.8	–	–	–	0.3	2.1
TRU	1	–	33	1	–	0	34	0.7	–	1.3	2.0	–	0.2	1.1
SWA	–	34	–	–	–	0	34	–	6.7	–	–	–	0.0	1.1
BCO	0	0	25	2	–	5	31	0.0	0.1	1.0	3.2	–	14.0	1.0
HOK	–	30	–	–	–	0	30	–	5.8	–	–	–	0.9	1.0
OTH	7	81	2	0	–	2	91	7.3	15.9	0.1	1.0	–	5.0	2.9
Total	94	509	2 428	49	–	33	3 112	3.0	16.3	78.0	1.6	–	1.0	100.0
SCH 5														
SCH	14 861	8	266	17	–	8	15 160	97.0	0.6	28.2	21.5	–	4.5	85.0
STA	0	595	–	–	0	1	596	0.0	45.6	–	–	0.0	0.3	3.3
SPO	381	7	–	–	–	–	388	2.5	0.5	–	–	–	–	2.2
HPB	2	1	310	52	–	10	376	0.0	0.1	32.8	66.5	–	5.7	2.1
LIN	3	86	259	0	2	1	350	0.0	6.6	27.4	0.2	74.8	0.4	2.0
SQU	–	221	–	–	–	72	293	–	16.9	–	–	–	39.9	1.6
FLA	0	123	–	–	–	0	124	0.0	9.5	–	–	–	0.1	0.7
BNS	1	0	110	9	–	2	122	0.0	0.0	11.6	11.6	–	1.0	0.7
HOK	–	67	–	–	–	5	72	–	5.1	–	–	–	2.7	0.4
OTH	71	197	0	0	1	82	352	0.5	15.1	0.0	0.1	25.2	45.3	2.0
Total	15 319	1 306	945	79	3	181	17 833	85.9	7.3	5.3	0.4	0.0	1.0	100.0
SCH 7														
SCH	2 609	37	2 794	14	–	8	5 462	77.3	0.8	73.9	7.8	–	4.6	44.7
BAR	0	1 366	5	–	1	1	1 372	0.0	29.0	0.1	–	9.4	0.4	11.2
TAR	0	1 288	–	–	1	1	1 290	0.0	27.3	–	–	18.2	0.8	10.5
HPB	44	1	520	162	–	9	736	1.3	0.0	13.7	91.7	–	5.4	6.0
FLA	2	521	0	–	1	28	552	0.1	11.0	0.0	–	9.8	16.4	4.5
SPO	499	4	1	–	0	0	504	14.8	0.1	0.0	–	2.4	0.0	4.1
LIN	72	59	315	0	–	8	455	2.1	1.3	8.3	0.2	–	4.7	3.7
HOK	–	324	–	–	–	62	386	–	6.9	–	–	–	36.0	3.2
RCO	0	287	0	–	0	0	288	0.0	6.1	0.0	–	5.3	0.1	2.4
STA	1	214	–	–	–	0	215	0.0	4.5	–	–	–	0.0	1.8
WAR	5	165	–	–	1	0	171	0.1	3.5	–	–	10.6	0.1	1.4
OTH	144	453	147	0	3	54	801	4.3	9.6	3.9	0.2	44.3	31.3	6.6
Total	3 376	4 719	3 781	177	7	173	12 232	27.6	38.6	30.9	1.4	0.1	1.4	100.0
SCH 8														
SCH	3 209	15	1 586	15	–	2	4 827	54.9	1.7	80.3	17.1	–	2.8	54.1
SPO	2 203	1	0	–	–	1	2 205	37.7	0.1	0.0	–	–	0.8	24.7
TAR	1	319	4	–	1	0	326	0.0	34.5	0.2	–	8.9	0.3	3.7
WAR	309	6	0	–	–	0	315	5.3	0.6	0.0	–	–	0.0	3.5
HPB	4	0	227	73	–	4	309	0.1	0.0	11.5	82.1	–	6.2	3.5
GUR	21	201	18	–	3	35	278	0.4	21.7	0.9	–	22.1	49.9	3.1
TRE	26	167	0	–	4	0	197	0.5	18.1	0.0	–	27.5	0.0	2.2
BNS	7	–	92	1	–	0	100	0.1	–	4.7	0.8	–	0.5	1.1
SNA	9	50	20	0	6	1	87	0.2	5.4	1.0	0.0	41.5	1.0	1.0
OTH	58	164	26	0	0	27	276	1.0	17.8	1.3	0.0	0.0	38.4	3.1
Total	5 847	924	1 974	89	15	70	8 920	65.5	10.4	22.1	1.0	0.2	0.8	100.0
SCH 1W														
SCH	2 184	232	1 751	6	–	18	4 191	64.3	5.1	61.3	9.1	–	17.1	36.5
TAR	2	1 924	10	0	86	1	2 022	0.1	42.0	0.4	0.3	17.1	0.5	17.6
SNA	11	892	131	0	178	6	1 218	0.3	19.5	4.6	0.0	35.7	5.6	10.6
TRE	83	779	1	–	186	0	1 049	2.4	17.0	0.0	–	37.3	0.4	9.1
HPB	1	1	867	48	–	44	961	0.0	0.0	30.3	77.1	–	42.5	8.4
GUR	383	460	6	–	36	26	911	11.3	10.1	0.2	–	7.3	25.1	7.9
SPO	668	0	0	–	–	0	668	19.7	0.0	0.0	–	–	0.0	5.8
BAR	0	149	–	–	10	–	159	0.0	3.3	–	–	1.9	–	1.4
OTH	63	142	91	8	3	9	316	1.8	3.1	3.2	13.5	0.7	8.8	2.7
Total	3 396	4 579	2 856	62	500	103	11 496	29.5	39.8	24.8	0.5	4.3	0.9	100.0

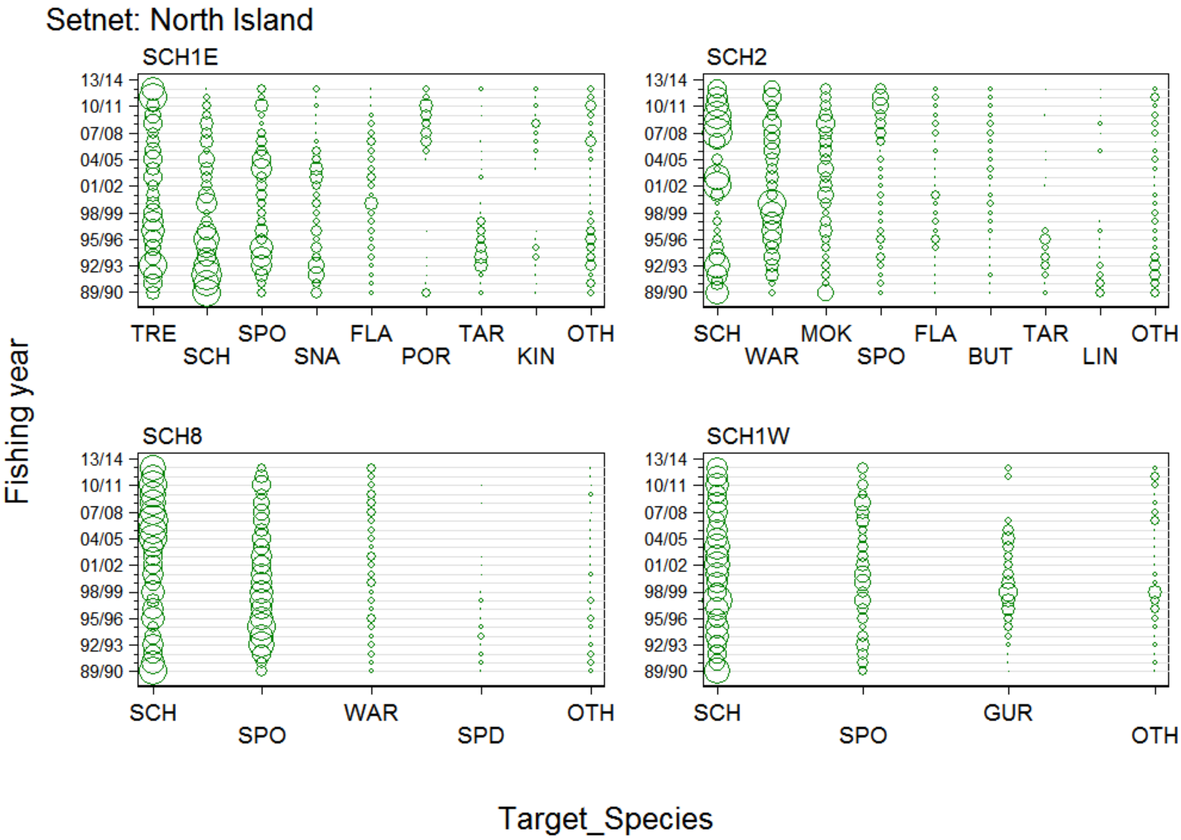


Figure 11A: Distribution of landings by target species (ranked in terms of descending order of total landings) and fishing year for North Island setnet trips which landed school shark. Circle sizes are proportional within each panel: [SCH 1E]: largest circle= 47 t in 91/92 for SCH; [SCH 2]: largest circle= 31 t in 07/08 for SCH;[SCH 8]: largest circle= 221 t in 06/07 for SCH; [SCH 1W]: largest circle= 162 t in 97/98 for SCH. Values for the plotted data are provided in Table G.5.

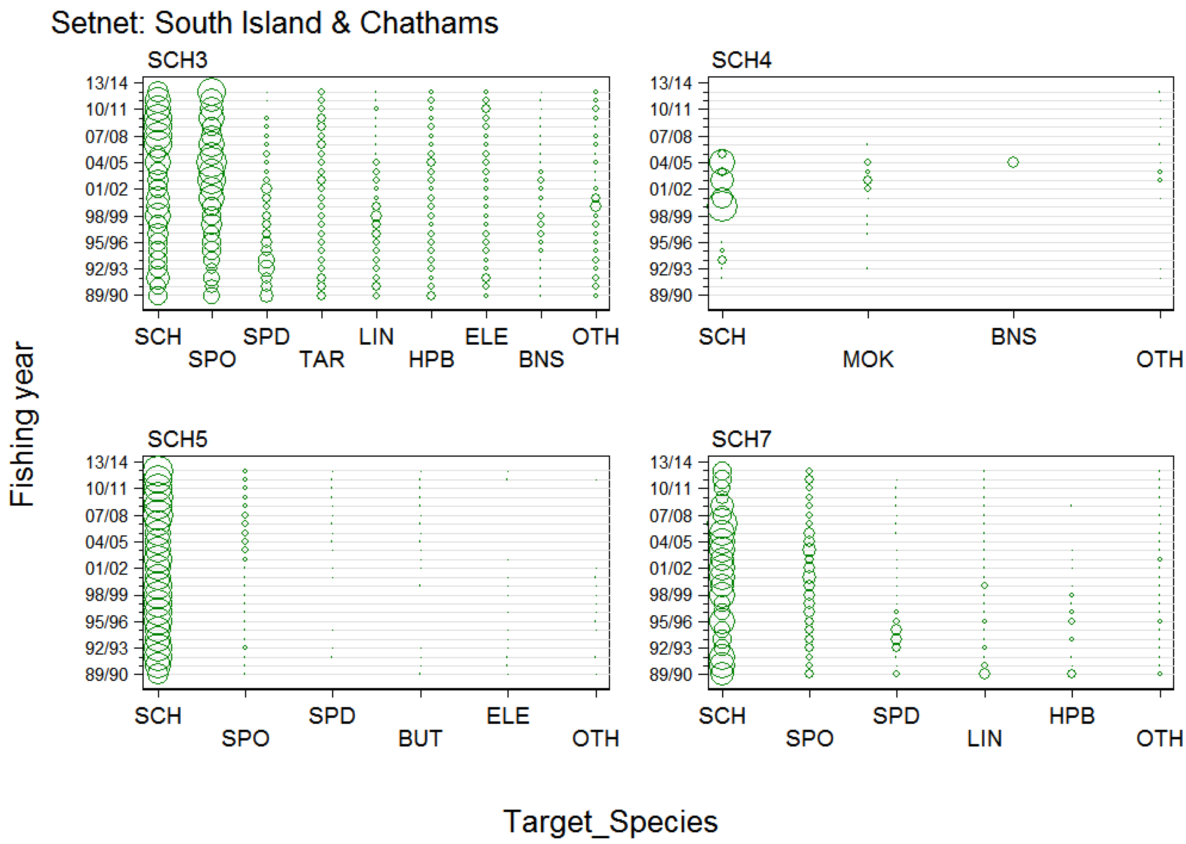


Figure 11B: Distribution of landings by target species (ranked in terms of descending order of total landings) and fishing year for South Island and Chathams setnet trips which landed school shark. Circle sizes are proportional within each panel: [SCH 3]: largest circle= 128 t in 04/05 for SPO; [SCH 4]: largest circle= 26 t in 99/00 for SCH;[SCH 5]: largest circle= 739 t in 07/08 for SCH; [SCH 7]: largest circle= 193 t in 06/07 for SCH. Values for the plotted data are provided in Table G.5.

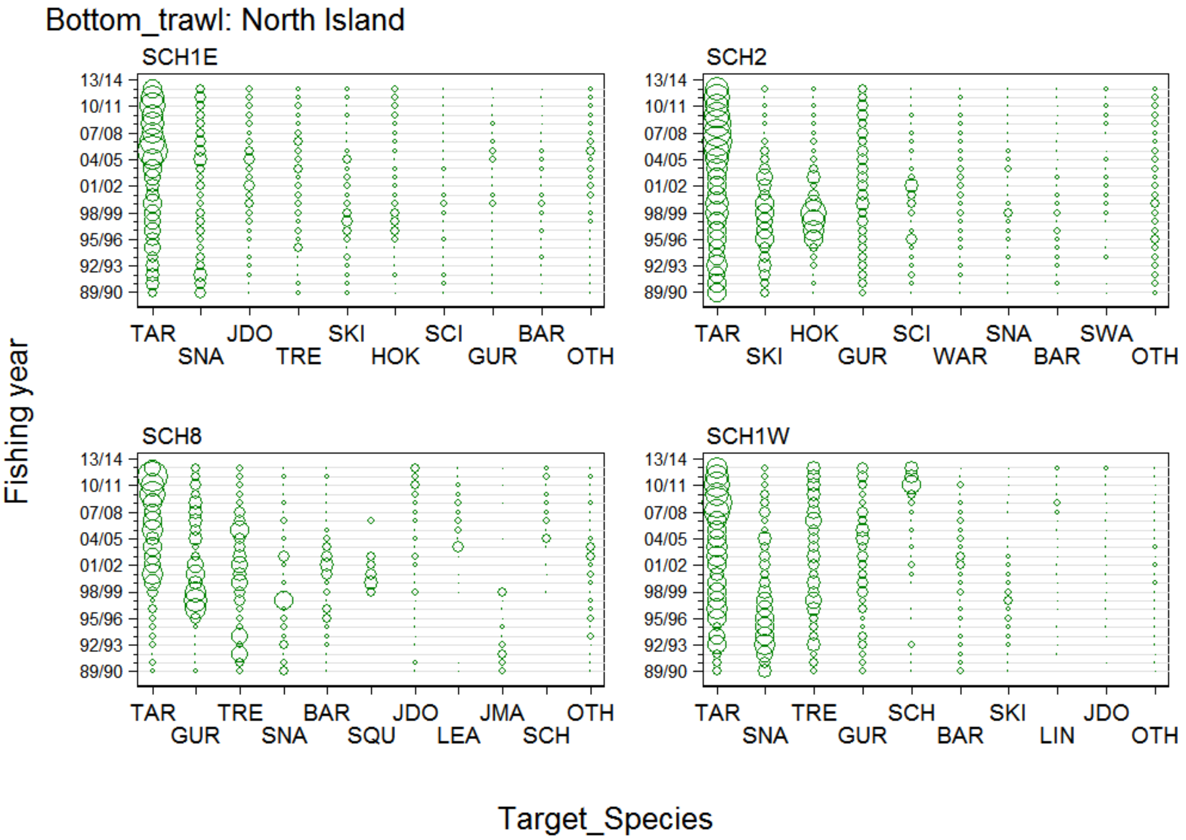


Figure 12A: Distribution of landings by target species (ranked in terms of descending order of total landings) and fishing year for North Island bottom trawl trips which landed school shark. Circle sizes are proportional within each panel: [SCH 1E]: largest circle= 103 t in 05/06 for TAR; [SCH 2]: largest circle= 79 t in 06/07 for TAR; [SCH 8]: largest circle= 45 t in 11/12 for TAR; [SCH 1W]: largest circle= 188 t in 08/09 for TAR. Values for the plotted data are provided in Table G.6.

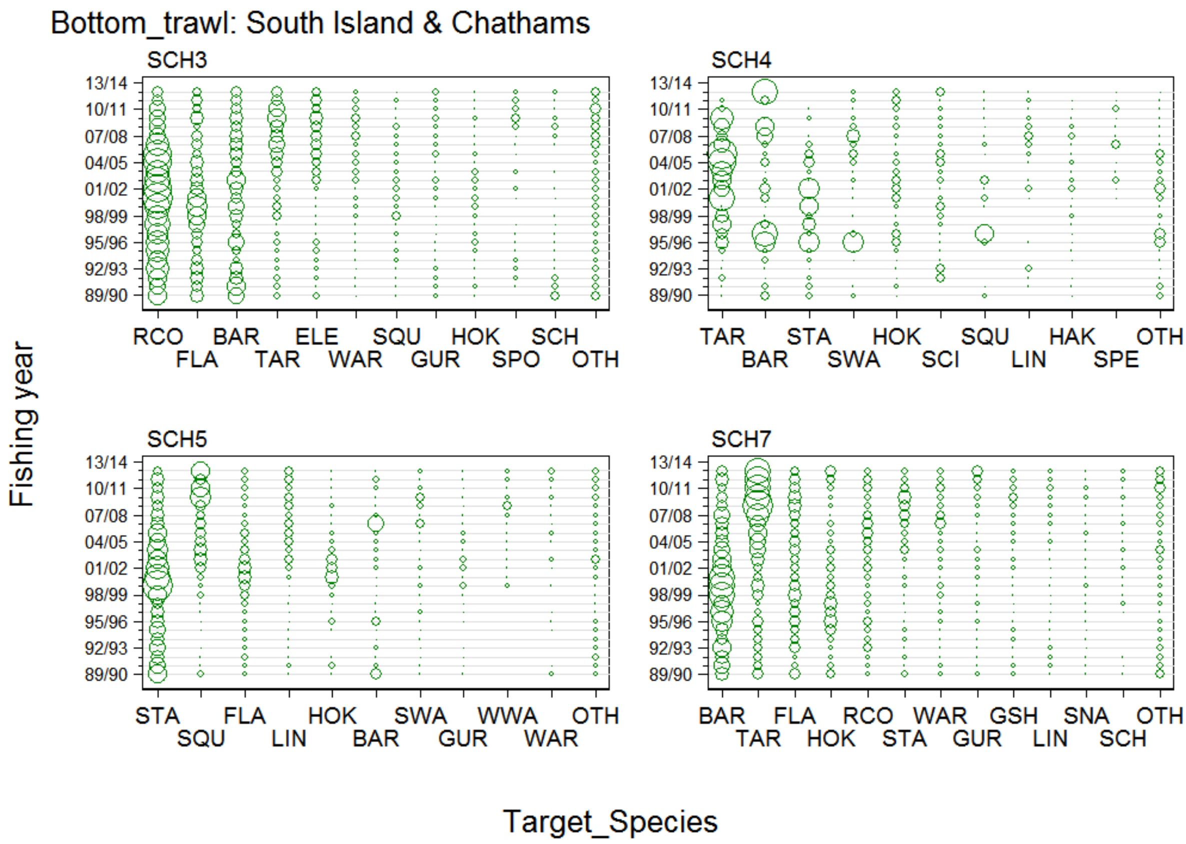


Figure 12B: Distribution of landings by target species (ranked in terms of descending order of total landings) and fishing year for South Island and Chathams bottom trawl trips which landed school shark. Circle sizes are proportional within each panel: [SCH 3]: largest circle= 87 t in 00/01 for RCO; [SCH 4]: largest circle= 28 t in 05/06 for TAR; [SCH 5]: largest circle= 76 t in 99/00 for STA; [SCH 7]: largest circle= 167 t in 08/09 for TAR. Values for the plotted data are provided in Table G.6.

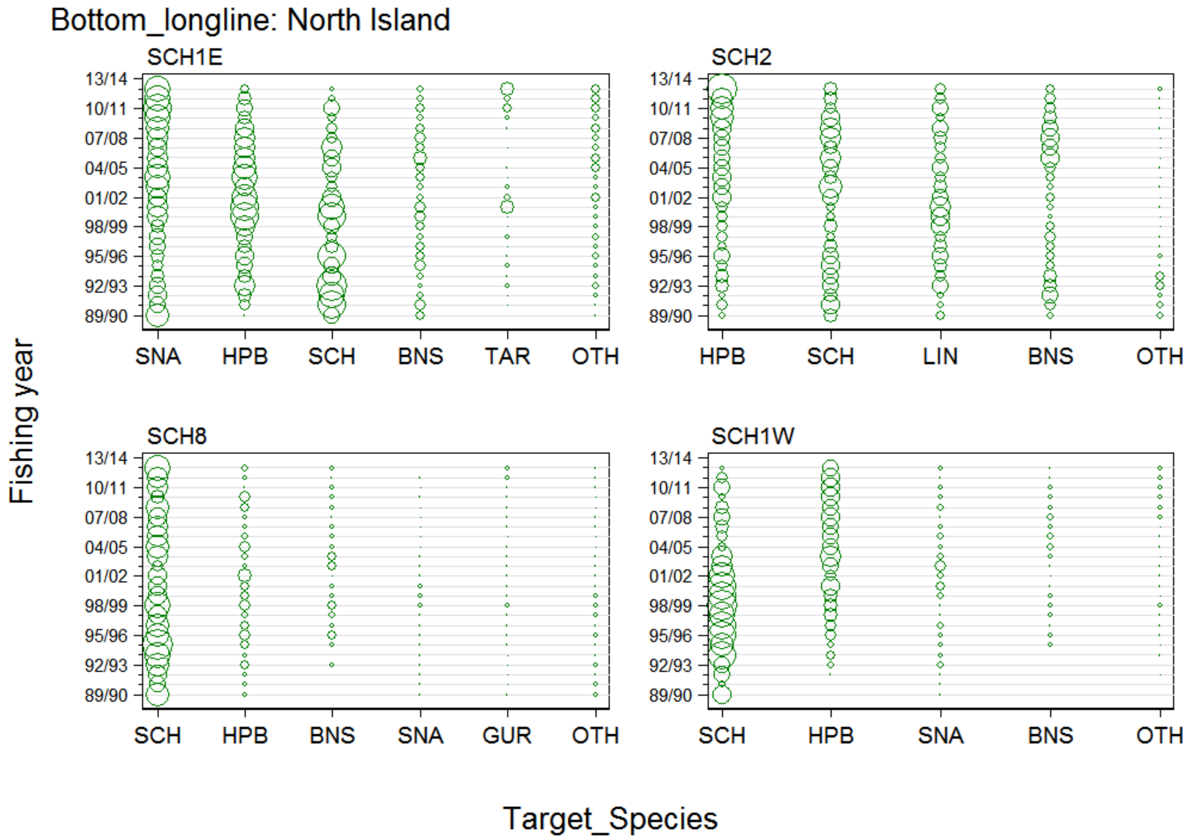


Figure 13A: Distribution of landings by target species (ranked in terms of descending order of total landings) and fishing year for North Island bottom longline trips which landed school shark. Circle sizes are proportional within each panel: [SCH 1E]: largest circle= 81 t in 92/93 for SCH; [SCH 2]: largest circle= 66 t in 12/13 for HPB; [SCH 8]: largest circle= 127 t in 94/95 for SCH; [SCH 1W]: largest circle= 153 t in 98/99 for SCH. Values for the plotted data are provided in Table G.7.

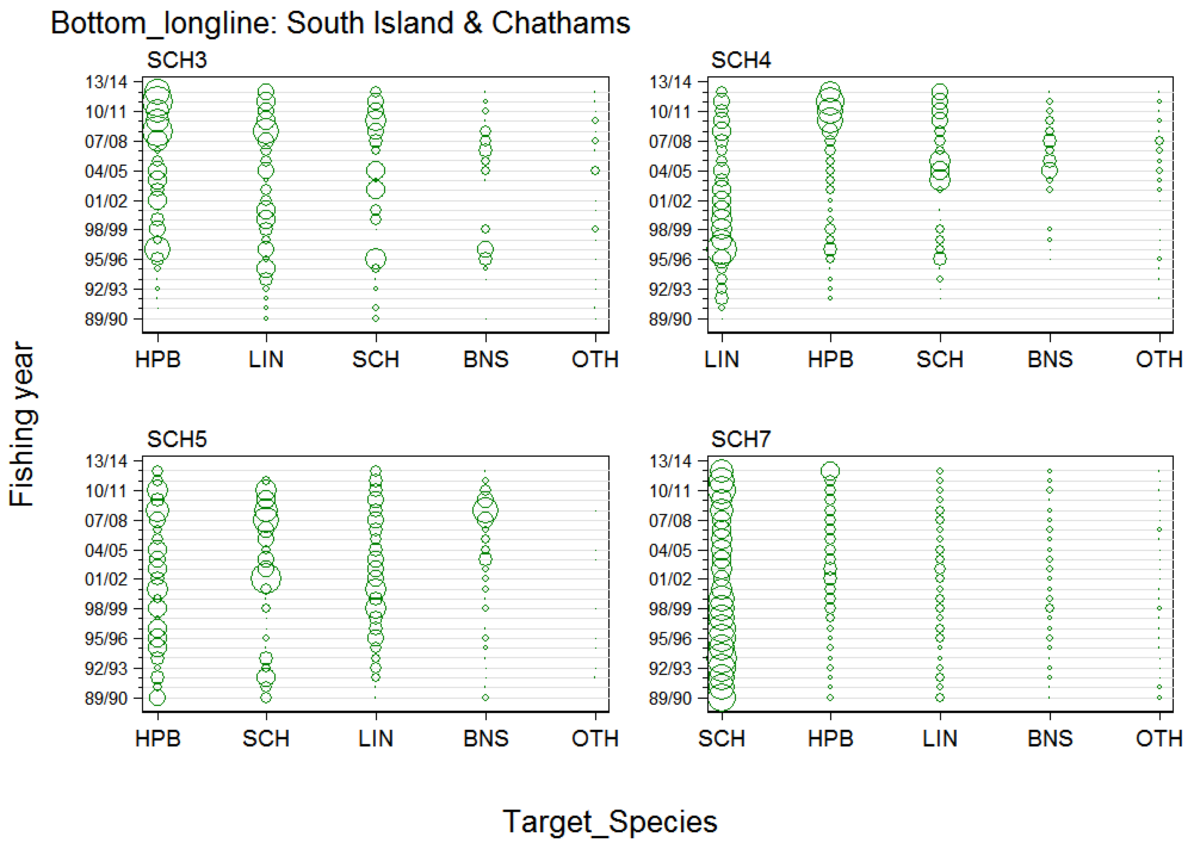


Figure 13B: Distribution of landings by target species (ranked in terms of descending order of total landings) and fishing year for South Island and Chathams bottom longline trips which landed school shark. Circle sizes are proportional within each panel: [SCH 3]: largest circle= 34 t in 11/12 for HPB; [SCH 4]: largest circle= 139 t in 96/97 for LIN; [SCH 5]: largest circle= 46 t in 01/02 for SCH; [SCH 7]: largest circle= 172 t in 93/94 for SCH. Values for the plotted data are provided in Table G.7.

2.3.3.5 Preferred bottom trawl fishing depths for school shark

The setnet forms (NCELR) introduced in 2006–07 do not require fishers to provide depth information (Ministry of Fisheries 2010).

Depth information is available for bottom trawl fishing relevant to school shark (fishing either recording an estimated catch of school shark or declaring school shark as the target species). These data come from the recently introduced (1 October 2007) TCER forms as well as the longstanding TCEPR forms, which are primarily used by the larger offshore vessels and have been in operation since the first year of data in this report (1989–90). However only data from 2007–08 onwards are reported here, so that a complete picture across all vessel types greater than 6 m in overall length can be obtained for the inshore bottom trawl school shark fishery (Table 12).

Similarly, depth information is available for bottom longline fishing relevant to school shark (fishing either recording an estimated catch of school shark or declaring school shark as the target species). These data come either from the more recently introduced (1 October 2007) LTCER forms or the LCER forms which were introduced in 2004 for use with large (over 28 m) longline vessels. Only data from 2007–08 onwards are reported here, so that a complete picture across all vessel types greater than 6 m in overall length can be obtained for the inshore bottom longline school shark fishery (Table 13)

Reported depth observations, summarised over both TCER and TCEPRs, show that bottom trawl catches (or declared targeting) of school shark mainly lie between 30 and 220 m across all QMAs, ranging from a minimum 5th quantile of 14 m in SCH 5 to a maximum 95th quantile of 380 m in

SCH 1E (Table 12). The distribution of tows which caught or targeted school shark varies according to the target fishery in all seven QMAs, with deeper fisheries such as tarakihi, ghost shark and stargazer taking school shark at depths greater than 200 m compared to the shallower depths for successful school shark catches for fisheries like red gurnard, elephantfish and flatfish (Figure 14).

Reported depth observations, summarised over both LCER and TLCERs, show that bottom longline catches (or declared targeting) of school shark mainly lie between 50 and 500 m across all QMAs, ranging from a minimum 5th quantile of around 30 m for the combined east coast North Island QMAs to a maximum 95th quantile of around 500 m for all QMAs (Table 13). The distribution of sets which caught or targeted school shark varies according to the target fishery in all QMAs, with the deeper ling and bluenose fisheries taking school shark at depths greater than 500 m compared to shallower maximum depths of under 300 m for targeted school shark sets (Figure 15).

Table 12: Summary statistics by QMA from distributions from all records (combined TCER and TCEPR formtypes) using the bottom trawl method for effort that targeted or caught school shark by target species category. Data are summarised by QMA from 2007–08 to 2012–13.

		Depth (m)			
Target species category	Number observations	Lower 5% of distribution	Mean of distribution	Median (50%) of distribution	Upper 95% of distribution
SCH 1E					
TAR	2 819	94	177	180	255
SNA	702	28	73	55	140
JDO	436	43	79	80	123
HOK	211	225	385	396	461
TRE	138	25	81	77	143
SKI	94	163	310	335	416
LIN	89	323	415	429	471
Other	140	43	197	141	405
Total	4 629	45	166	151	380
SCH 2					
TAR	7 772	50	112	111	196
GUR	2 151	24	51	47	92
GSH	1 071	61	135	119	267
RCO	563	22	97	98	169
FLA	401	8	29	22	60
WAR	285	60	104	100	146
BAR	225	38	116	120	203
HOK	187	142	309	268	530
STA	151	84	132	137	160
SNA	150	31	58	50	100
SKI	138	134	204	199	300
LIN	104	142	292	255	460
Other	406	21	143	111	365
Total	13 604	30	107	100	208
SCH 3					
TAR	2 408	51	91	89	130
FLA	1 878	12	25	20	54
RCO	1 758	23	62	53	118
ELE	1 015	12	30	22	72
BAR	804	25	72	64	129
WAR	436	37	54	50	96
STA	404	72	120	113	202
GUR	290	20	36	35	56
SPO	221	10	36	26	101
GSH	99	58	108	116	137
SCH	84	16	63	54	128
SPD	82	89	122	125	140
Other	278	36	168	122	400
Total	9 757	15	64	53	131

Table 12: (Cont.)

Target species category	Number observations	Depth (m) Lower 5% of distribution	Mean of distribution	Median (50%) of distribution	Upper 95% of distribution
SCH 4					
TAR	156	92	145	137	212
SCI	53	321	347	346	396
BAR	24	130	207	212	289
BYX	20	236	332	340	433
SWA	13	230	259	257	312
Other	15	24	248	252	760
Total	281	103	213	163	377
SCH 5					
STA	1 574	32	121	126	160
FLA	796	8	34	28	65
SQU	398	140	200	184	307
TAR	188	32	52	47	100
LIN	156	120	365	379	519
BAR	47	40	96	95	170
SWA	40	134	309	323	430
ELE	37	9	29	20	70
SPO	36	10	17	14	35
WAR	32	32	77	80	120
SPD	27	27	48	38	86
Other	53	40	245	84	589
Total	3 384	14	118	110	354
SCH 7					
TAR	9 639	50	133	130	225
FLA	5 856	11	29	27	49
BAR	2 113	32	92	69	195
GUR	2 062	27	49	47	79
RCO	1 448	23	81	60	200
WAR	1 353	40	102	80	197
GSH	1 206	60	131	117	250
STA	1 132	70	143	143	225
SNA	610	12	38	30	90
JDO	576	40	99	102	151
LIN	431	63	290	300	423
LEA	400	28	49	47	75
SCH	296	40	133	140	198
HOK	230	160	407	430	537
TRE	155	19	50	50	77
Other	409	18	191	123	390
Total	27 916	18	99	79	228
SCH 8					
TAR	4 328	65	134	140	195
GUR	1 867	30	50	47	75
JDO	665	40	94	100	148
BAR	555	30	73	65	162
WAR	301	55	69	66	115
TRE	281	21	50	49	75
SNA	213	31	56	50	110
SCH	213	70	134	140	190
FLA	198	16	46	41	75
LEA	169	40	59	63	77
Other	285	48	136	99	388
Total	9 075	35	100	85	185

Table 12: (Cont.)

					Depth (m)
Target species category	Number observations	Lower 5% of distribution	Mean of distribution	Median (50%) of distribution	Upper 95% of distribution
SCH 1W					
GUR	2 279	28	45	43	70
TAR	2 251	90	142	144	196
TRE	1 020	30	59	55	105
SNA	669	34	70	60	120
JDO	256	35	72	55	127
SCH	160	86	159	165	214
Other	167	40	205	132	440
Total	6 802	31	89	68	184
Overall					
SCH 1E	4 629	45	166	151	380
SCH 2	13 604	30	107	100	208
SCH 3	9 757	15	64	53	131
SCH 4	281	103	213	163	377
SCH 5	3 384	14	118	110	354
SCH 7	27 916	18	99	79	228
SCH 8	9 075	35	100	85	185
SCH 1W	6 802	31	89	68	184
Total	75 448	14	120	93	380
Median		31	104	93	218

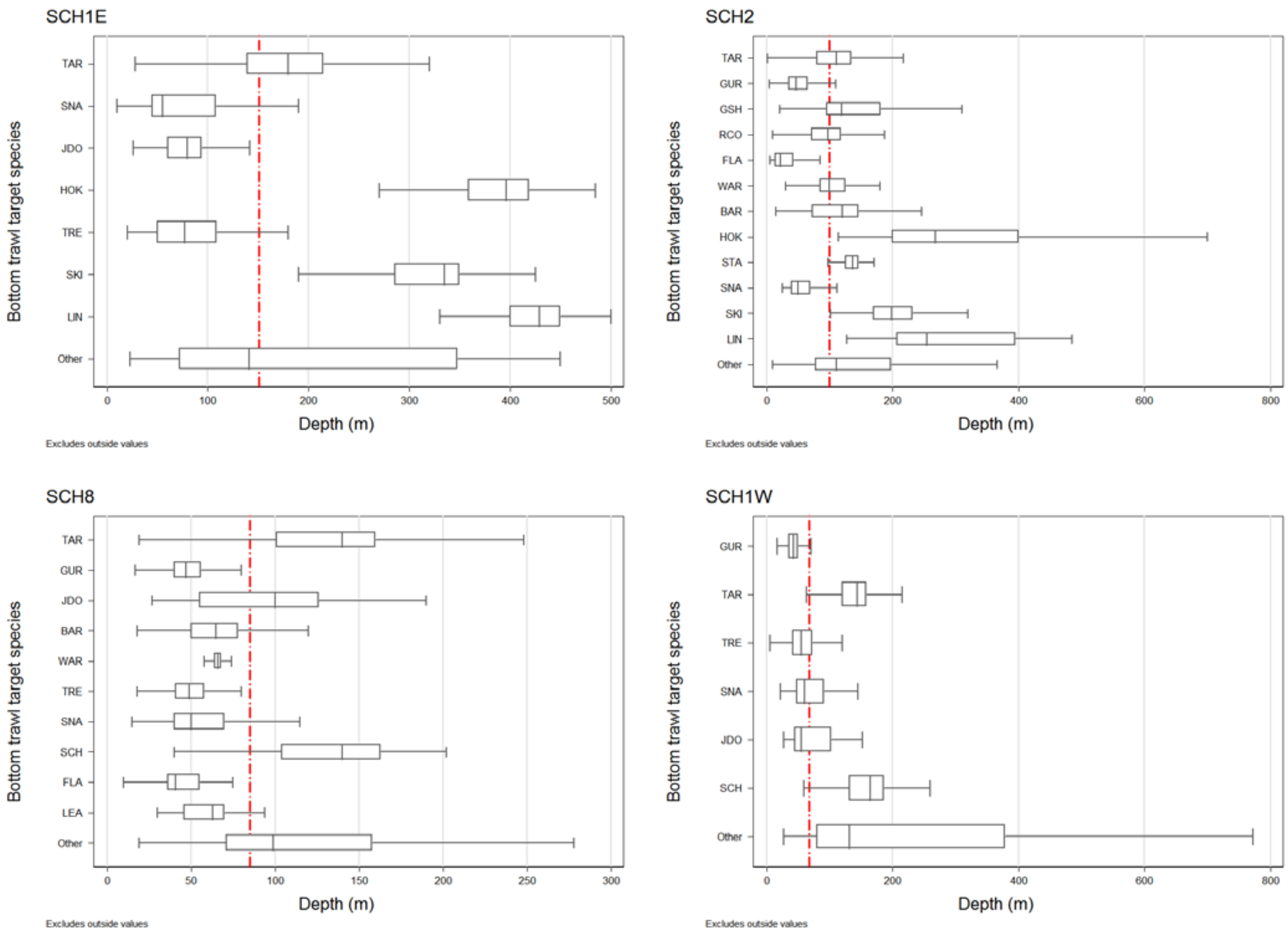


Figure 14A: Box plot distributions by QMA of bottom depth from combined TCER and TCEPR formtypes using the bottom trawl method for effort that targeted or caught school shark in the North Island by target species category for the period 2007–08 to 2012–13. The vertical line in each sub graph indicates the median depth from all tows which caught or targeted school shark in the indicated QMA (see Table 12 for statistics by target species).

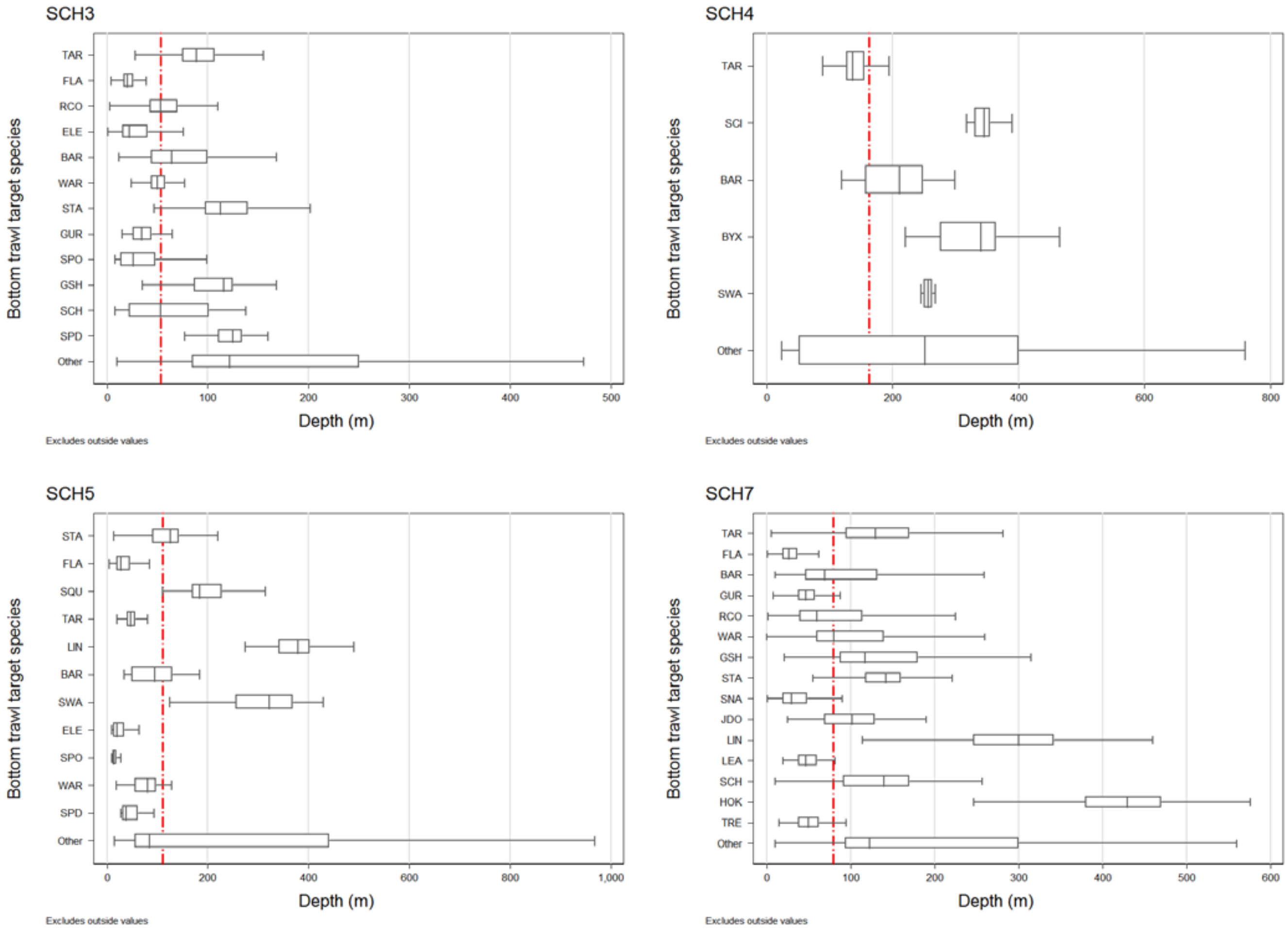


Figure 14B: Box plot distributions by QMA of bottom depth from combined TCER and TCEPR formtypes using the bottom trawl method for effort that targeted or caught school shark in the South Island and Chathams by target species category for the period 2007–08 to 2012–13. Vertical line in each sub graph indicates the median depth from all tows which caught or targeted school shark in the indicated QMA (see Table 12 for statistics by target species).

Table 13: Summary statistics by QMA from distributions from all records (combined LCER and LCTER formtypes) using the bottom longline method for effort that targeted or caught school shark by target species category. Data are summarised by QMA from 2007–08 to 2012–13.

					Depth (m)
Target species	Number	Lower 5% of	Mean of	Median (50%) of	Upper 95% of
SCH 1E & SCH 2					
SNA	5 212	20	61	50	120
HPB	2 234	100	214	200	380
BNS	1 734	227	380	380	520
LIN	1 374	207	395	400	574
SCH	603	48	151	142	270
TAR	177	75	136	128	215
Other	166	33	108	95	265
Total	11 500	28	185	121	480
SCH 4					
LIN	3 493	247	403	408	528
HPB	2 871	77	184	145	352
BNS	841	220	347	348	482
SCH	445	48	138	125	294
TRU	74	120	195	200	307
BCO	57	22	73	61	142
RIB	23	510	556	545	607
Total	7 804	90	297	332	482

Table 13: (cont.)

Target species category	Number	Lower 5% of	Mean of distribution	Median (50%) of	Depth (m) Upper 95% of
SCH 7					
LIN	1 336	160	339	320	550
SCH	1 291	60	158	148	298
HPB	1 159	100	219	200	409
BNS	476	155	327	320	500
GUR	62	31	62	65	85
SNA	52	16	49	26	92
Other	21	14	112	57	360
Total	4 397	65	245	220	500
SCH 8 & SCH 1W					
HPB	2 454	120	245	220	422
SCH	1 579	60	164	164	280
BNS	790	234	402	400	564
GUR	515	35	63	60	85
LIN	203	230	469	475	666
SNA	166	16	63	56	106
Other	138	40	126	130	200
Total	5 845	55	228	200	490
Overall					
SCH 1E & SCH 2	11 500	28	185	121	480
SCH 4	7 804	90	297	332	482
SPO 7	4 397	65	245	220	500
SCH 8 & SCH 1W	5 845	55	228	200	490
Total	29 546	28	239	210	500
Median		55	239	210	490

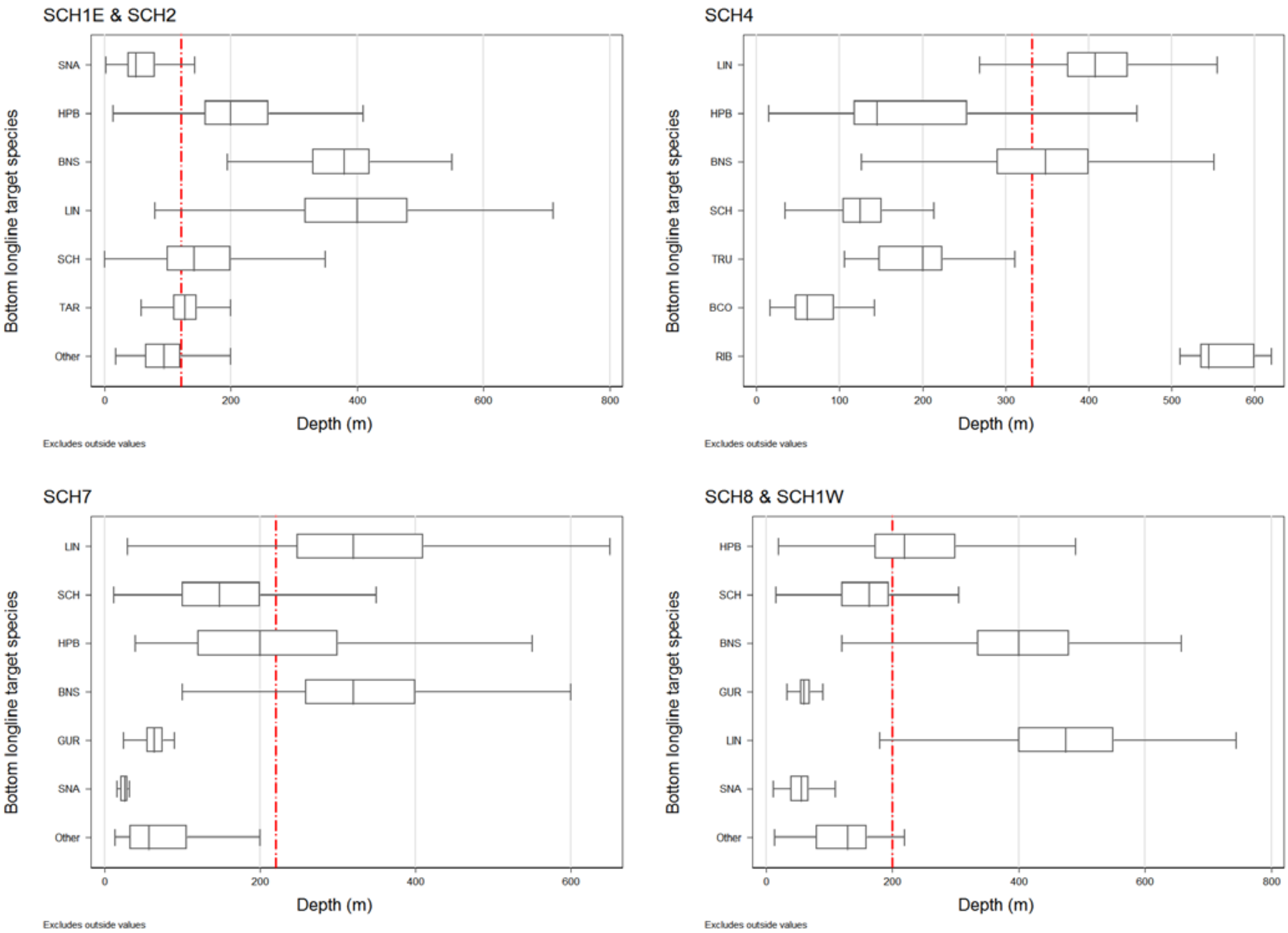


Figure 15: Box plot distributions by QMA of bottom depth from combined LCER and LTCER formtypes using the bottom longline method for effort that targeted or caught school shark by target species category for the period 2007–08 to 2012–13. The vertical line in each sub graph indicates the median depth from all tows which caught or targeted school shark in the indicated QMA or combined QMAs (see Table 13 for statistics by target species).

2.3.3.6 Fine scale distribution of landings for setnet, bottom longline and bottom trawl

Fine scale event-based catch information is available from 1 October 2006 for setnet effort data and from 1 October 2007 for bottom trawl and bottom longline effort data. The method of Starr (2007) can be applied to records at the level of each event, distributing the landings within a trip in proportion to the declared estimated catch for the event. By summing the school shark landings within a trip without regard to QMA, the allocation of landings to events is straightforward and there are no lost trips due to fishing in statistical areas that are valid for multiple QMAs. It is these expanded landings, linked to events with location information, that are plotted in Figure 16, Figure 17 and Figure 18. Because each plotted event represents a single fishing event associated with either a tow, a line set or a net set, the summed grids represent implicit CPUE. Equivalent plots are available which plot explicit CPUE (kg/h, kg/km or kg/hook depending on the method of capture) but they are not provided because the plotted distributions are very similar to figures presented here. All plots are provided gridded into 0.25×0.25° cells, summed over the six or seven years of available data. Only grid cells with at least three reporting vessels are plotted.

Setnet landings show a relatively restricted range of locations where school shark have been taken using the setnet method (Figure 16). The main concentrations of catch locations are at the tip of the North Island, in the North and South Taranaki Bights, in Tasman/Golden Bays, along the southern end of the South Island, off Timaru and the lower Canterbury Bight and Kaikoura (Figure 16). Note that several of the boundary lines for previous SCH CPUE analyses cut right through areas of intense catching, including the division at the Area 041/042 boundary, the split into SCH 1W and SCH 1E at the top of the North Island, and the split between the east and south coasts of the South Island.

A different distribution of catches can be seen when the fine scale bottom longline locations are plotted (Figure 17). The central west coast catches are aligned along a clear contour line situated on the 200–400 m shelf, extending from just below Cape Fairweather to the Manukau Harbour. Catches pick up again at the top of the North Island west coast and extend continuously around to the east side of the North Island to the Coromandel Peninsula (Figure 17). There is a further concentration of catches around East Cape which extends down the east side of the North Island to Mahia Peninsula. Bottom longline catches are strong in the eastern end of Cook Strait, on the western end of the Chatham Rise (Mernoo Bank) and around the Chatham Islands. Bottom longline catches are negligible south of the Chatham Rise and in Foveaux Strait, although the lower half of the west coast South Island (off of Fiordland) also yields concentrations of bottom longline catches. As for the setnet landings, boundaries used previously to identify SCH CPUE analyses cut through areas of continuous catching. For instance, SCH 1W and SCH 1E were split at North Cape and SCH 1W and SCH 8 were split at the Area 041/042 boundary.

Bottom trawl catches of school shark are far less localised, with strong concentrations of catch on northern halves of both sides of the South Island and throughout Cook Strait (Figure 18). High concentrations of bottom trawl catches surround the entire North Island, with hardly any breaks in the distribution (Figure 18). Given that these catches will be made up largely of smaller school shark, an obvious interpretation from the bottom trawl catch distribution is that juvenile school shark are ubiquitous around the North and South Islands and are always available for capture when fishing at suitable depths. Consequently, there is little signal from these distributions to help with defining fisheries for monitoring this species.

Given the distributions provided in Figure 16, Figure 17 and Figure 18, it is possible to redefine fisheries for school shark that minimise dividing existing fisheries and consequently may be in position to better monitor the status of this species in New Zealand. These new definitions should be based on the following considerations:

1. There should be consistent fishery definitions between gear types.
2. Fisheries can be divided into regions using boundaries where existing catch and effort are minimal or even absent.

3. Logical linkages should be made between statistical areas without regard to administrative boundaries that are not relevant to school shark. It is preferable to define these boundaries along existing statistical area boundaries so that the fishery definitions can be projected back in time.
4. All this should be done keeping in mind that school shark are known to migrate over long distances.
5. The fisheries in Cook Strait and at the top of South Island are highly complex with differing catch patterns between gear types:

   SN: mainly caught in Statistical Areas 018 (Kaikoura) and 020 (Pegasus Bay) and Area 038 (Tasman/Golden Bay) (see Figure 19 [left panel]).

   BLL: mainly caught in Statistical Areas 017 (Eastern Cook Strait) and 021 (Mernoo Bank) (see Figure 19 [right panel]).

Revised fishery definitions based on the above fine scale catch distributions (Table 14; Figure 20) were presented to NINSWG in April 2014 and subsequently reviewed and accepted at the MPI Stock Assessment Plenary (Chapter 79 in MPI 2016). The revised fishery definitions in Table 14 form the basis for the CPUE standardisations summarised in Section 3 and presented in detail beginning in Appendix H. The fisheries were selected on the basis of fine scale positional data but use MPI statistical areas in order to apply these definitions to the period before fine scale positional data became available. This approach assumes that the fine scale positional information is representative of the distribution of fishing before the data became available. Given the continuous distribution of setnet and bottom longline catches in Cook Strait presented in Figure 19, it was decided to place all Cook Strait setnet and bottom longline catches, even those from the eastern end of Cook Strait, into the west coast fishery (SCH 7, SCH 8 & lower SCH 1W). Setnet landings from Kaikoura and Pegasus Bay were assigned to the SCH 2 & top of SCH 3 fishery and bottom longline landings from the western end of the Chatham Rise (Areas 019, 020 and 021) were assigned to SCH 4.

Table 14: List of 9 fisheries selected to monitor NZ school shark. Core statistical areas are shown as well as any additional statistical areas needed to complete the fishery definition by capture method. There is no recorded fishing for school shark using setnet on the Chatham Islands (SCH 4).

			Additional statistical areas	
Region	Code	Core Statistical Areas	SN	BLL
Far North & SCH 1E	N1E	043–010	same as core	same as core
SCH 2 & top of SCH 3	23N	011–015	add 018, 020	same as core
Chatham Rise (SCH 4)	ChatRise	049–051, 401–412	NA	add 019, 020, 021
lower SCH 3 & SCH 5	3S5	022–033	same as core	same as core
SCH 7, SCH 8 & lower SCH 1W	781W	034–042,801	add 016, 017	add 016, 017, 018

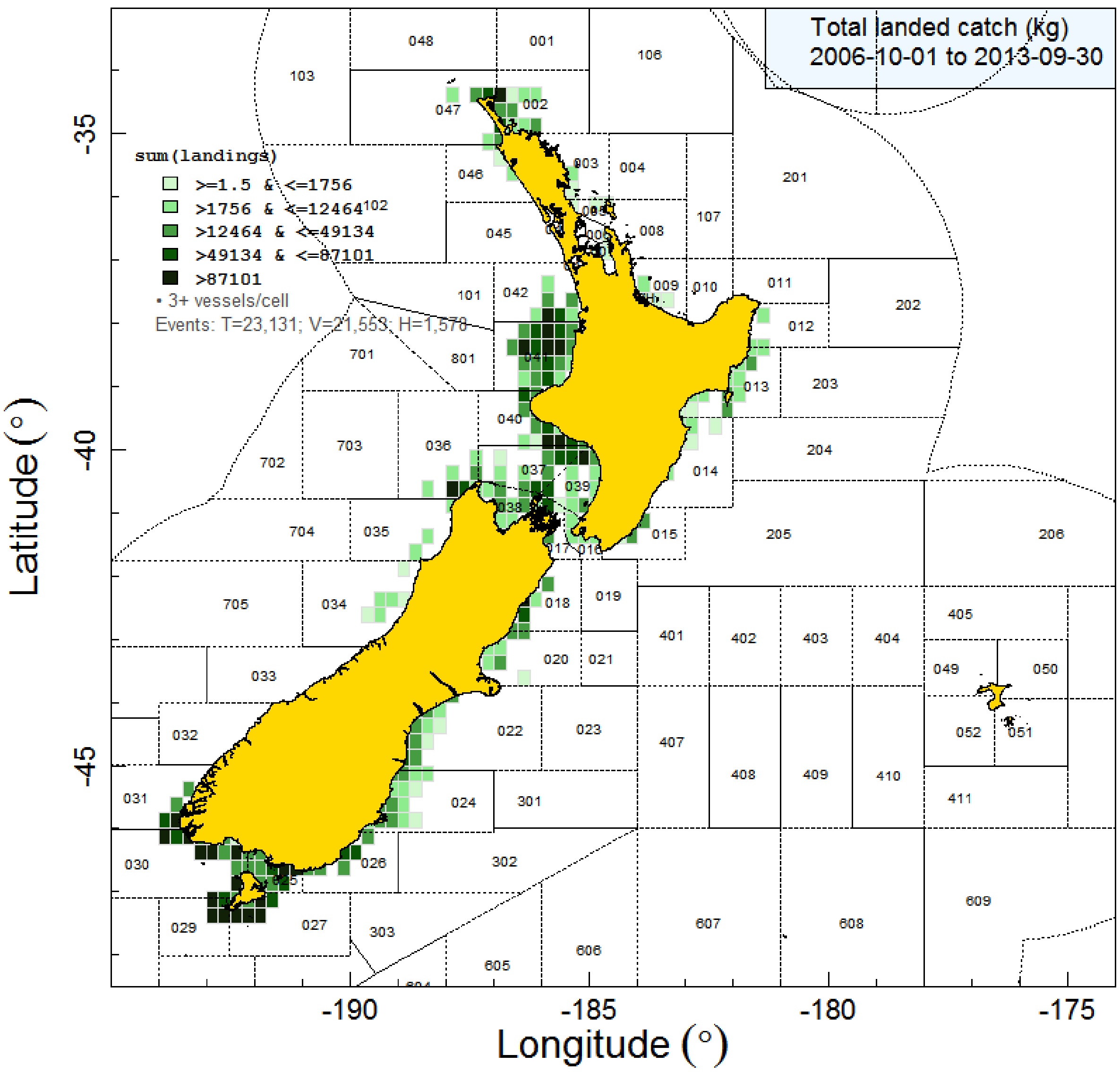


Figure 16. **Total NZ setnet catches (t) for school shark, arranged in 0.25° × 0.25° grids, summed from 2006–07 to 2012–13. Legend colours divide the distribution of total landings into 25%, 50%, 75%, 90% and 95% quantiles. Only grids which have at least three reporting vessels are plotted. Boundaries are shown for the general statistical areas plotted in Appendix B.**

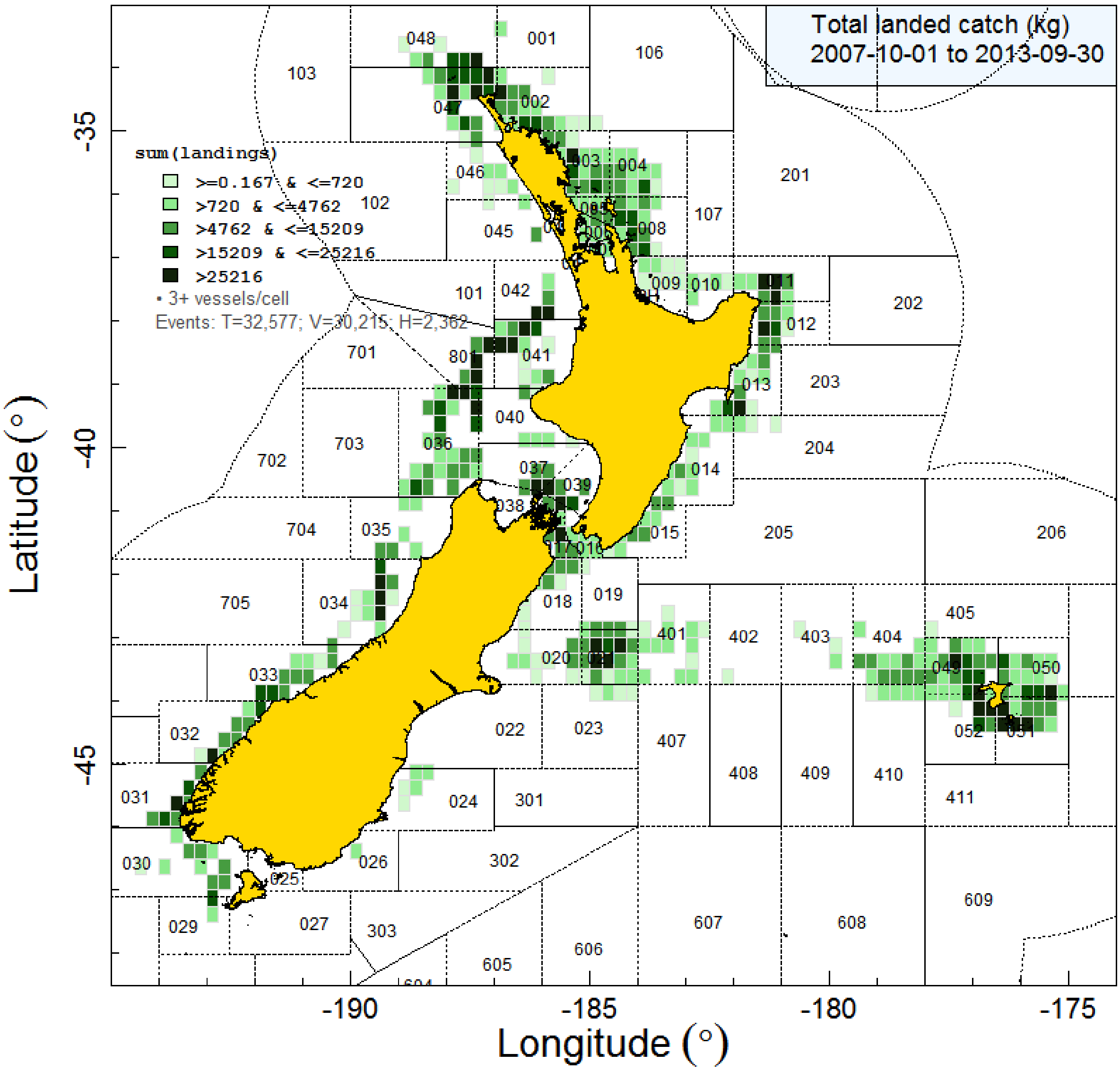


Figure 17: Total NZ bottom longline catches (t) for school shark, arranged in 0.25° × 0.25° grids, summed from 2007–08 to 2012–13. Legend colours divide the distribution of total landings into 25%, 50%, 75%, 90% and 95% quantiles. Only grids which have at least three reporting vessels are plotted. Boundaries are shown for the general statistical areas plotted in Appendix B.

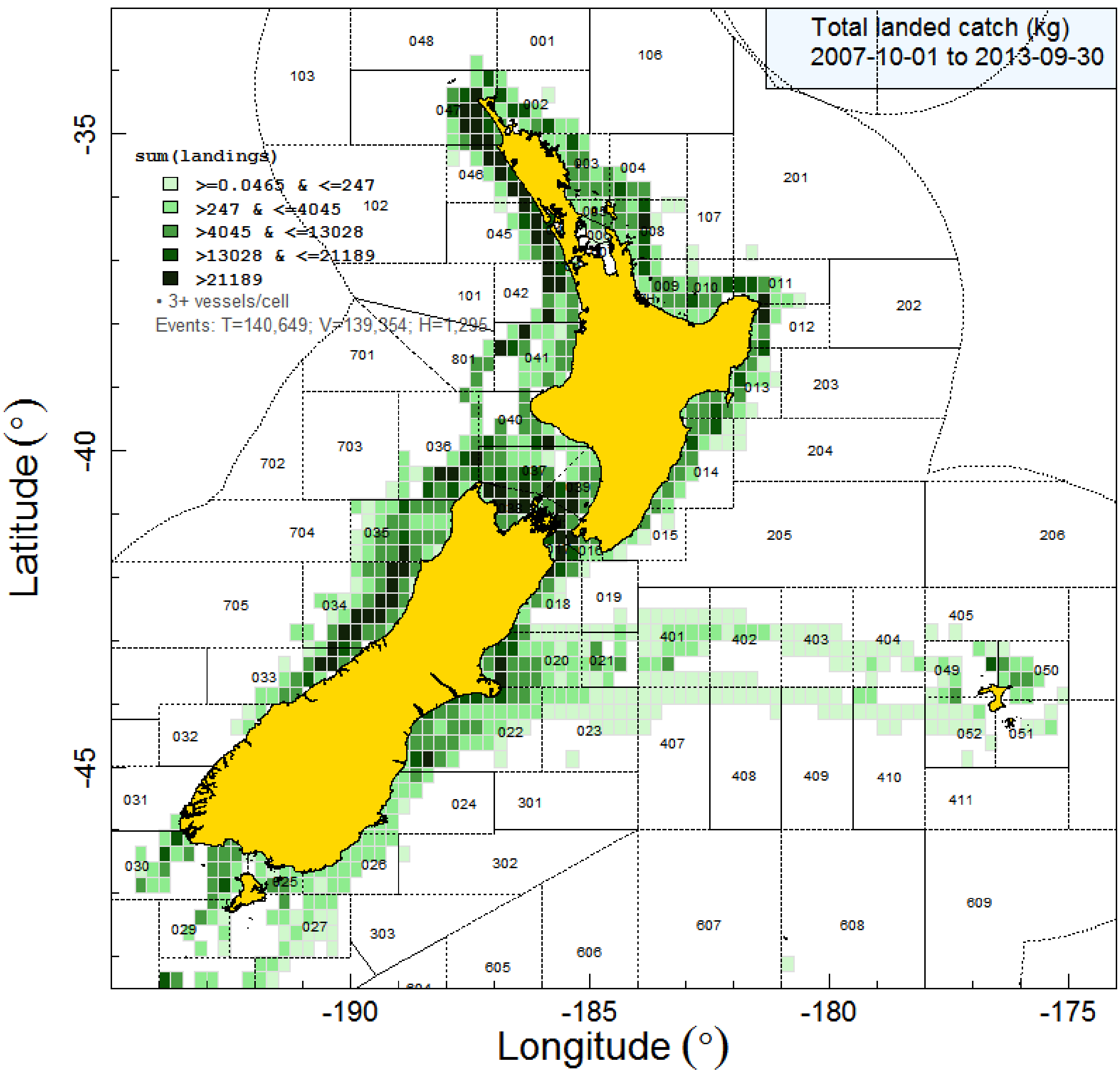


Figure 18: Total NZ bottom trawl catches (t) for school shark, arranged in 0.25° × 0.25° grids, summed from 2007–08 to 2012–13. Legend colours divide the distribution of total landings into 25%, 50%, 75%, 90% and 95% quantiles. Only grids which have at least three reporting vessels are plotted. Boundaries are shown for the general statistical areas plotted in Appendix B.

[Set net] **[Bottom longline]**

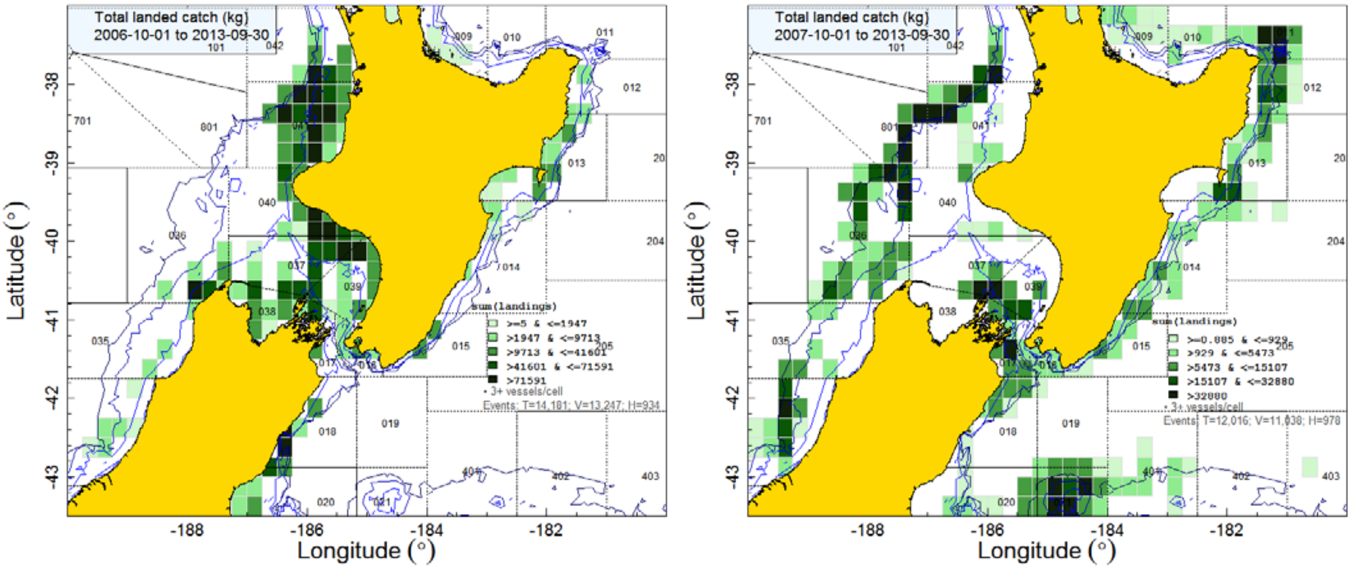


Figure 19: Plots showing more detailed 0.25° × 0.25° grid distributions for set net [left panel] and bottom longline [right panel], summed from 2006–07 (set net) or 2007–08 (bottom longline) to 2012–13. Legend colours divide the distribution of total landings into 25%, 50%, 75%, 90% and 95% quantiles. Only grids which have at least three reporting vessels are plotted. Boundaries are shown for the general statistical areas plotted in Appendix B, showing the 100, 200 and 400 m depth contours.

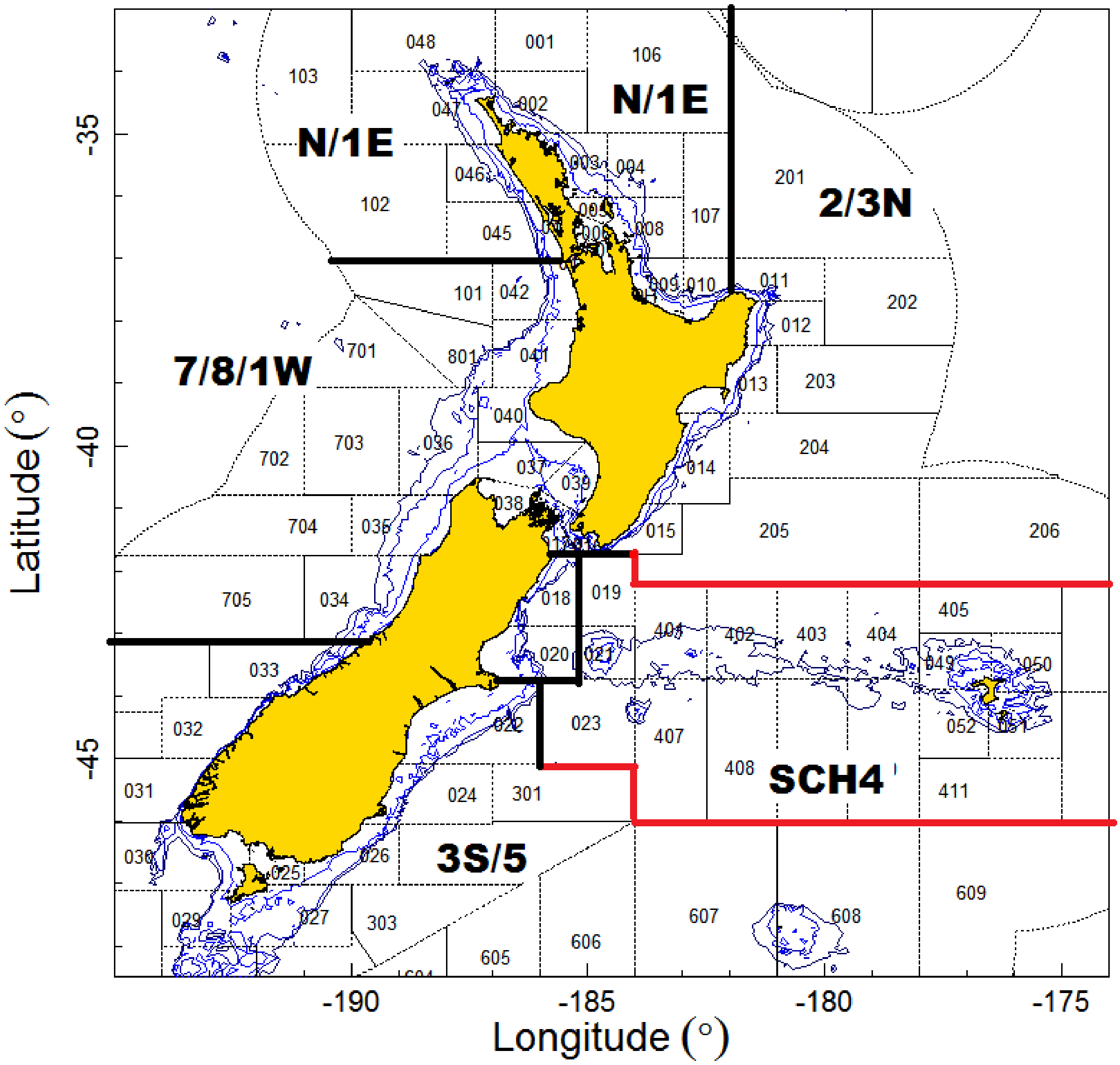


Figure 20: Map showing boundaries for the agreed SCH fisheries using the statistical area definitions in Table 14.

3. STANDARDISED CPUE ANALYSIS

Nine fisheries in five regions encompassing all of New Zealand (Table 14; Figure 20) have been described in Section 2.3.3.6 as the basis for detailed CPUE analysis which will be used to create biomass index series for monitoring school shark abundance. These CPUE analyses are reported in detail, including diagnostics, beginning with Appendix H, which gives an overview and the methodology, followed by each of nine fishery analyses in Appendix I to Appendix Q.

The following sections discuss the standardisation results for each of the nine analyses, followed by a comparison of the trends within a region and then among regions.

3.1 FAR NORTH & SCH 1E

3.1.1 Setnet

There is a high percentage of trips with no school shark landings in this fishery (between 60–70%; Table I.1) but there is no trend in this statistic over time ([lower left panel]; Figure I.2). The mean number of events per day of fishing is unchanged over the series, even from 2006–07 ([lower right panel]; Figure I.2), indicating that the daily-effort data preparation procedure successfully adjusted for the change from a daily to an event-based form type. The lognormal model explained 31% of the deviance (Table I.2), with vessel, target species and month entering the model after fishing year. The standardisation effect in this model is moderate, bringing down some high indices in the mid-2000s, when most of the vessels fishing at the time were those with high CPUE coefficients (Figure I.5; Figure I.7). The model fits the lognormal distribution well (Figure I.6), with the series showing a gradually increasing trend with a sharp upturn in 2011–12 and 2012–13 (Figure I.4). This upturn is seen in the target×year implied residual plots for all five target species categories (Figure I.10). Although area was not accepted into the lognormal model (Table I.2), the area×year implied residual plots are presented (Figure I.11). These plots show that the increasing trend estimated by the model is mirrored in most statistical areas, particularly the two areas on both sides of North Cape (Areas 047 and 002), both of which show the upturn in 2011–12 and 2012–13. This analysis is supported by its diagnostics and can be used for monitoring the SCH population that is vulnerable to this fishery.

3.1.2 Bottom longline

There was a decreasing trend in the percentage of trips with zero SCH landings in this fishery (from 80% to just over 60%; [lower left panel] Figure J.2). The mean number of events per day of fishing jumped from 1.0 to nearly 1.3 from 2007–08 ([lower right panel]; Figure J.2), indicating that the daily-effort data preparation procedure did not completely adjust for the change from a daily to an event-based form type. The lognormal model explained 44% of the deviance (Table J.2), with vessel, target species and area entering the model after fishing year. There is a standardisation effect in the mid-2000s, which brings down a peak around 2008, when vessels with high CPUE coefficients predominated in the data, leading to the model adjusting those CPUE values downward (Figure J.5; Figure J.7). The model fits the lognormal distribution well (Figure J.6), with the lognormal series showing an increasing trend from a nadir in the early 1990s to the end of the series (Figure J.4). This upturn is very strong in the SNA panel of the target×year implied residual plots (Figure J.10), which accounts for about 70% of the positive catch observations in this model. The BNS, HPB, SCH and LIN panels also match the upturn, but more weakly, reflecting the smaller amount of data in these categories. The implied residual plots for area×year also match the increasing trend in most statistical areas, including those areas on the west coast of the North Island (e.g., 046, 047 048; Figure J.11). The combined series shows a very strong increasing trend once the similarly increasing binomial series is added to the lognormal series (Figure J.12). This analysis is supported by its diagnostics and can be used for monitoring the SCH population that is vulnerable to this fishery.

3.2 SCH 2 & TOP OF SCH 3

3.2.1 Setnet

The percentage of trips which landed no SCH began near 60% at the start of the series in the early 1990s, dropped to nearly 20% in the late 2000s and then rose to above 40% by the end of the series ([lower left panel]; Figure K.2). The mean number of events per day of fishing jumped from 1.0 to greater than 2.0 from 2006–07 ([lower right panel]; Figure K.2; Table K.1), indicating that the daily-effort data preparation procedure did not properly adjust for the change from a daily to an event-based form type. The lognormal model explained 40% of the deviance (Table K.2), with vessel, month, target species and net length entering the model after fishing year (it is interesting to note that this is the only model among the nine that accepted an effort variable). The standardisation effect is similar to that seen in the two FarNorth/SCH 1E analyses, with the high unstandardised indices in the mid-

2000s dropping after the effect of vessels with high coefficients are removed (Figure K.5; Figure K.7). The model fits the lognormal distribution reasonably well (Figure K.6), with the series showing a gradually increasing trend (Figure K.4). This upturn is seen in the primary SCH and SPO categories in the target×year implied residual plots, but the WAR and MOK target species categories, with fewer observations, are flat (Figure K.11). Although area was not accepted into the lognormal model (Table K.2), the area×year implied residual plots are presented (Figure K.12). These plots show that the increasing trend estimated by the model is mirrored in the statistical areas, although the correlations are higher in the two South Island statistical areas and weaker for the North Island statistical areas. This analysis is supported by its diagnostics and can be used for monitoring the SCH population that is vulnerable to this fishery.

3.2.2 Bottom longline

The percentage of trips which did not land any SCH in this fishery was constant at around 40% until the early 2000s, when it dropped to about 20% ([lower left panel] Figure L.2). The mean number of events per day of fishing jumped from 1.0 to greater than 2.0 from 2007–08 ([lower right panel]; Figure L.2), indicating that the daily-effort data preparation procedure did not properly adjust for the change from a daily to an event-based form type. The lognormal model explained 32% of the deviance (Table L.2), with target species, vessel and area entering the model after fishing year. There is not much standardisation effect in this model, with a downward trend well established in the unstandardised series, and which changed little as the explanatory variables were added (Figure L.5). The model fits the lognormal distribution well (Figure L.6). The declining trend is apparent in three of the four target×year implied residual plots, with the exception of SCH which has relatively few observations (Figure L.10). The residual plots for area×year also show declining trends in all five statistical areas (Figure L.11). In spite of the drop in the proportion zero trips noted above, the binomial series showed a declining trend after standardisation and, when combined with the lognormal, resulted in a strongly declining trend in the combined series (Figure L.12). The declining trend in this series is troubling, given the corresponding increasing trend in the SN series from the same region. However, the strong corroboration of the annual trends in the area and target species implied residual plots, combined with the weak standardisation effect of the model, indicate that this is a robust analysis that needs to be considered an indicator of the SCH population available to this fishery.

3.3 LOWER SCH 3 & SCH 5:

3.3.1 Setnet

The percentage of trips which landed no SCH declined from near 30% at the beginning of the series to about 20% by the end of the series ([lower left panel]; Figure M.2). The mean number of events per day of fishing was slightly above 1.0 over the early part of the series, and did not increase from 2006–07 ([lower right panel]; Figure M.2), indicating that the daily-effort data preparation procedure adjusted for the change from a daily to an event-based form type. The lognormal model explained 62% of the deviance (Table M.2), with vessel, target species, month and area entering the model after fishing year. The standardisation effect changed an increasing trend in the second half of the series into a decreasing trend that continued a decline in the first part of the series (Figure M.5). This shift occurred when the vessel explanatory variable was added, with the model explaining the increasing CPUE in the second half of the series being caused by a preponderance of vessels with high CPUE coefficients (Figure M.7). The model fits the lognormal distribution reasonably well (Figure M.6) and the lognormal series shows a gradually decreasing trend (Figure M.4). The decreasing trend is corroborated by each target species category in the target×year implied residual plots (Figure M.11) and by the statistical areas with the most observations (e.g., 022, 024, 025 and 030) in the area×year implied residual plots (Figure M.12). This series is well determined with acceptable diagnostics, making it suitable for monitoring the SCH population available to this fishery.

3.3.2 Bottom longline

The percentage of trips which landed no SCH began at 40% in the 1990s but fell to below 20% by the end of the series ([lower left panel] Figure N.2). The mean number of events per day of fishing jumped from around 1.0 to greater than 2.0 starting in 2007–08 ([lower left panel]; Figure N.2; Table N.1), indicating that the daily-effort data preparation procedure did not properly adjust for the change from a daily to an event-based form type. The lognormal model explained 45% of the deviance (Table N.2), with target species, vessel, month and area entering the model after fishing year. The standardisation effect is relatively small in this model, except in the early to mid-2000s when the initial unstandardised CPUE is pulled down because there was an increase in SCH target fishing which ended by the end of the series (Figure N.5; Figure N.7). The model fits the lognormal distribution well (Figure N.6) but the lognormal series shows considerable year-to-year variation and no overall trend. Each panel in the target×year implied residual plots (Figure N.11) matches the model year trend, except for SCH which has fewer observations, as do the panels in the area×year implied residual plots, except for Area 030 which also has few observations (Figure N.12). The combined series is very close to the lognormal series, showing the same pattern of strong inter-annual variation and no overall trend (Figure L.12). This is a highly unbalanced analysis with the fewest number of records among the nine analyses (except for the Chatham Rise BLL series which has only 10 years of data). Figure N.10 shows that the only statistical areas where there has been continuous fishing are Statistical Areas 032 and 033 (lower west coast South Island off Fiordland), with the remaining statistical areas only contributing sporadically and the east coast South Island statistical areas entering the model in the 2000s. These observations, along with the considerable interannual variability, lead to the conclusion that this series is not a reliable indicator for monitoring the SCH population available to this fishery.

3.4 CHATHAM RISE (SCH 4):

3.4.1 Bottom longline

Unlike the other eight series which all started with the 1989–90 fishing year, this analysis was started with the 2003–04 fishing year because of the unbalanced vessel distribution (Figure O.1) and the relatively small amount of available catch and corresponding effort observations in the years preceding 2003–04 (Figure O.2). The percentage of trips which did not land any SCH in this fishery was relatively constant and low, with most years below 20% ([lower left panel] Figure O.4). The mean number of events per day of fishing is much higher in this fishery than in the other four bottom longline fisheries, ranging from 2.7 to 4.5, even before the form type change (Table O.1). There is no evidence of a strong increase in the mean number of events per record in response to the form type change in 2007–08 ([lower right panel] Figure O.4). The lognormal model explained 38% of the deviance (Table O.2), with target species, vessel, area and month entering the model after fishing year. There is not much standardisation effect in this model, with the model changing the index values for only 2003–04 and 2008–09 when the target and vessel explanatory variables were added to the model (Figure O.7; Figure O.9; Figure O.10). The model fits the lognormal distribution reasonably well (Figure O.8) and there is no apparent trend over the 10 years of the lognormal series (Figure O.6). The target×year implied residual plots (Figure O.13) and the area×year implied residual plots(Figure O.14) generally match the overall model annual trend. Of interest are the residual plots for Areas 020 and 021 from the western Chatham Rise, which match the overall model annual trend equally well as the statistical areas in the centre of the Chatham Rise, giving some justification for including these statistical areas from SCH 3 into this model. The binomial series matches the lognormal series, but with even less variation, leading to a combined series which looks much like the lognormal series and which shows no overall trend (Figure O.15). It is difficult to determine if this series is reliably monitoring SCH on the Chatham Rise because of the relatively small amount of data combined with the large area of the region.

3.5 SCH 7, SCH 8 & LOWER SCH 1W:

3.5.1 Setnet

The percentage of trips which landed no SCH was near or above 40% for the first half of the series and then dropped to below 20% in the second half of the series ([lower left panel]; Figure P.2). The mean number of events per day of fishing was slightly above 1.0 over the early part of the series, but rose to just above 1.1 from 2006–07 ([lower right panel]; Figure P.2; Table P.1), indicating that the daily-effort data preparation procedure acceptably adjusted the change from a daily to an event-based form type. The lognormal model explained 49% of the deviance (Table P.2), with target species, vessel, area and entering the model after fishing year. The standardisation effect is quite strong, changing an increasing trend from the early 1990s into a decreasing trend by lifting the early years and dropping the later years (Figure P.5). This happened in two steps, with the first occurring when the target species explanatory variable was added to the model, adjusting the CPUE upwards (Figure P.7) because of a gradual shift away from targeting SPO (which has a lower CPUE coefficient) in favour of targeting SCH (with a higher CPUE coefficient). The second step occurred when the vessel explanatory variable was added, with the model attributing the increasing CPUE in the second half of the series to the presence of vessels with high CPUE coefficients (Figure P.8). The model fits the lognormal distribution reasonably well (Figure P.6) and the lognormal series showed a gradually decreasing trend (Figure P.4). The corroboration of the overall model annual indices in the target×year implied residual plots is mixed, with the two primary target species (SCH and SPO) corresponding well to the estimated annual trend while the other minor species appear to have too few observations to be well estimated (Figure P.11). The corroboration of the model annual time series in the area×year implied residual plots is even more mixed, with fairly weak correlations with the annual time series for most of the South Island statistical areas and Area 017 in the eastern Cook Strait, while the correlations are stronger for the west coast North Island statistical areas and Area 038 (Figure P.12). This series is supported by its diagnostics and appears to be suitable as an indicator of abundance for the population of SCH vulnerable to this fishery.

3.5.2 Bottom longline

The percentage of trips which landed no SCH was between 30–40% until the mid-2000s and then dropped to below 20% at the end of the series [lower left panel] Figure Q.2). The mean number of events per day of fishing jumped from around 1.0 to about 1.5 starting in 2007–08 ([lower right panel]; Figure Q.2; Table Q.1), indicating that the daily-effort data preparation procedure did not completely adjust for the change from a daily to an event-based form type. The lognormal model explained 53% of the deviance (Table Q.2), with target species, vessel and area entering the model after fishing year. The standardisation effect is moderate, with the model bringing down the early part of the series because of substantial targeting of SCH in the early 1990s (which have a high CPUE coefficient; Figure Q.5; Figure Q.7). There is a slight raising of the latter part of the series when the vessel explanatory variable is added when, unlike in some other fisheries in this analysis, vessels with lower CPUE coefficients predominate (Figure Q.8). The model fits the lognormal distribution reasonably well, although there is some divergence at the lower tail of the fitted distribution (Figure Q.6). The lognormal series shows an overall increasing trend from the beginning of the series, but there is an intermediate peak in the early 2000s from which the CPUE dropped to nadir in the mid-2000s (Figure Q.4). This intermediate peak is visible in four of the five target species categories in the target×year implied residual plots, with the exception being BNS which has a completely different trend (Figure Q.10). Unlike for the associated SN analysis, the residual plots for the area×year implied residuals show a reasonable correlation between the model annual time trend and the eastern Cook Strait statistical areas (Figure Q.11). However, the correlations with the west coast North and South Island statistical areas are more mixed, with some showing reasonable correlations and others less so, but there does not seem to be an overall pattern in how the statistical areas match the overall annual model trend. The binomial series has very little signal, so the combined series closely resembles the lognormal series (Figure Q.12). As for the corresponding SN series, this series is supported by its diagnostics and appears to be suitable as an indicator of abundance for the population of SCH vulnerable to this fishery.

3.6 Summary:

3.6.1 FarNorth/SCH 1E

The SN and BLL series for the FarNorth/SCH 1E region are in general agreement, with each showing an increasing trend (Figure 21). The agreement is good for the two lognormal series, but the combined BLL series has an exaggerated increase relative to the other two series.

3.6.2 SCH 2/top of SCH 3

The SN and BLL series for the SCH 2/top of SCH 3 region show differing trends, with the SN series increasing while the BLL series is decreasing (Figure 22). Both series seem well determined, with the supporting diagnostics supporting each observed trend (see discussion in Section 3.2 above). Part of the reason for the difference may lie in the inclusion of statistical areas 018 and 020 in the setnet analysis but which are not present in the BLL analysis, with both South Island areas showing strong increasing trends (see lower two panels in Figure K.12). However, that cannot be the entire explanation, because the east coast North Island statistical areas also show some increase in the SN analysis while the same statistical areas are decreasing for the BLL analysis (see Figure L.11). Consequently the reason for the differing trends between the two fisheries is unknown.

3.6.3 Lower SCH 3/SCH 5

There is a long and gradual declining trend in the setnet series for this region, dropping 35% when the average index for 1989–90 to 1993–94 is compared to the 2008–09 to 2012–13 average index (Figure 23). The setnet fishery is known to target large mature fish, but there is no nearby spawning or nursery ground (Francis 2010; MPI 2016). The bottom longline series, which shows no trend, is considered to be an unreliable abundance indicator for SCH (see Section 3.5.2 above).

3.6.4 Chatham Rise

There is only one CPUE bottom longline series available to track SCH in this region, as there is no existing setnet fishery for the species. This series shows no trend over the ten year period of available data (Figure 24) and it is not known if this series is a reliable indicator of SCH abundance.

3.6.5 SCH 7/SCH 8/lower SCH 1W

As seen for the lower SCH 3/SCH 5 region, there is a long and gradual declining trend in the setnet series for this region, dropping 26% when the average index for 1989–90 to 1993–94 is compared to the 2008–09 to 2012–13 average index (Figure 25). Unlike for the lower SCH 3/SCH 5 region, the bottom longline series has credibility as an indicator of SCH abundance, with an analysis showing reasonable diagnostics. As for the SCH 2/top of SCH 3 region, the two series in this region have conflicting trends, although the situation is reversed, with the BLL series showing an increasing trend while the SN series is declining. The reasons for the differing trends between the two fisheries are unknown.

3.6.6 Setnet comparison by region

The setnet series for the adjacent FarNorth/SCH 1E and the SCH 2/top SCH 3 compare well, with good agreement between the increasing trends among the two series (Figure 26). There is also good agreement between the adjacent lower SCH 3/SCH 5 and SCH 7/SCH 8/lower SCH 1W setnet series (Figure 27). However, the two pairs of series do not compare well, given that the former series is increasing while the latter series is decreasing.

3.6.7 Bottom longline comparison by region

Similar comparisons are possible for the bottom longline series, with the increasing trend in the west coast region SCH 7/SCH 8/SCH 1W matching reasonably well with the increasing trend estimated for the FarNorth/SCH 1E fishery (Figure 28). Moving around the North Island, the declining trend in the SCH 2/top SCH 3 does not match the trendless series estimated from the lower SCH 3/SCH 5 bottom longline data (Figure 29). The Chatham Rise bottom longline series also shows no trend, which is consistent with the bottom longline series from SCH 3/SCH 5.

3.6.8 Summary

Given that it is known that school shark is a highly mobile species, these contradictory trends in Region SCH 2/top SCH 3 and Region SCH 7/SCH 8/SCH 1W are difficult to interpret. Overall, the North and East Coast regions seem to be doing well, given the increasing trends in CPUE. The Southern and West Coast regions appear to have been in a long-term gradual decline, which may show some signs of flattening out. The decline in these fisheries is of concern because these setnet fisheries are known to have a high proportion of mature fish in the catch. It is possible that the lack of similarity between the bottom longline and setnet CPUE series within North Island east coast and the North/South Island west coast may be caused by these fisheries operating at different depths and in different areas (compare the catch distributions in Figure 16 and Figure 17). This may point to the fisheries operating on different components of the school shark population.

Recent (in 2008–09 and 2011–12) large scale management restrictions applied to the New Zealand setnet fishery for the protection of endemic dolphins (see Section 2.2 above and Appendix D below) have the potential to compromise the capacity of the setnet fishery to reliably monitor school shark because of spatial and temporal disruption in access to fishing locations. This problem is likely to become more acute in future years.

When reviewing the results of this project in 2014, the Plenary identified the following analyses for inclusion in future school shark CPUE studies.

1. A single New Zealand-wide CPUE index should be developed by weighting each index by the landings from each set of statistical areas.
2. Other available data from trawl surveys, observer records and bottom trawl CPUE indices should be analysed for comparison with the setnet and longline indices.
3. Length and age data should be examined to determine which components of the population are fished by each gear type.

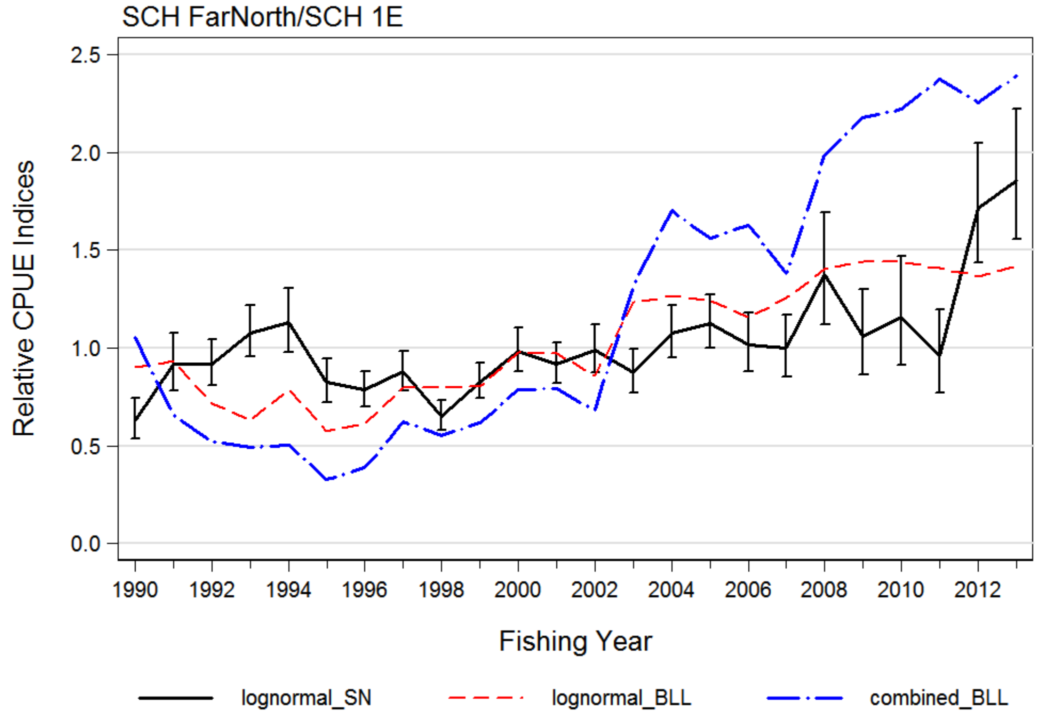


Figure 21: Comparison of standardised CPUE for Region FarNorth/1E in three series based on two fisheries: a) setnet lognormal; b) bottom longline lognormal; c) bottom longline combined.

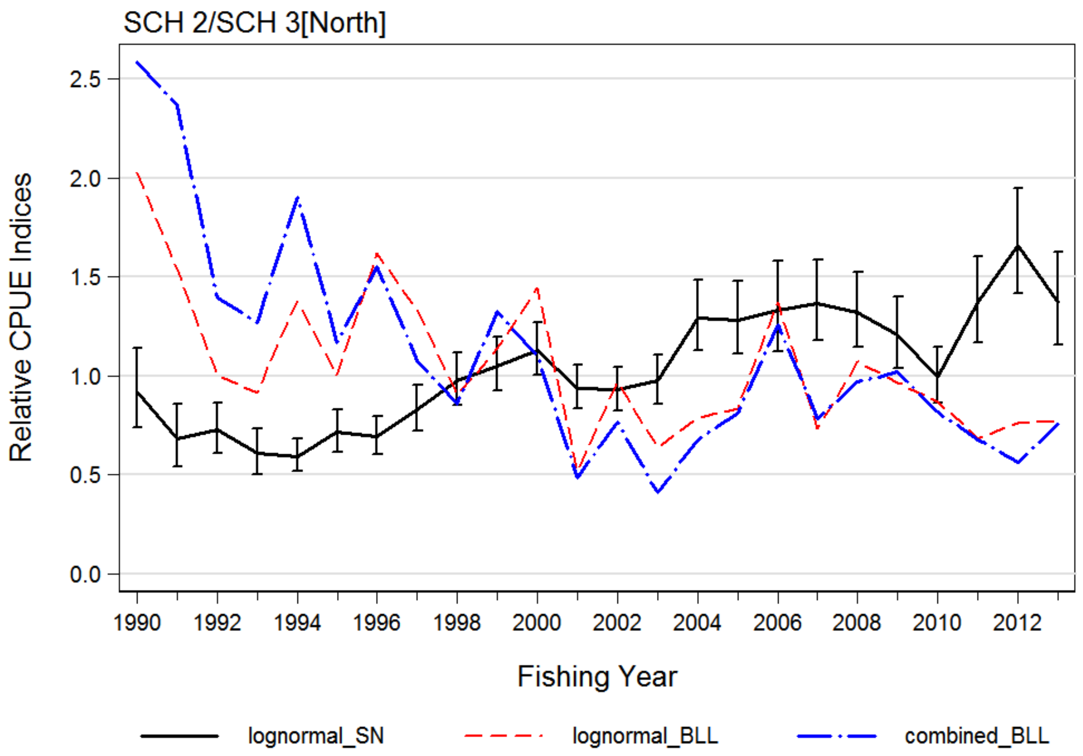


Figure 22: Comparison of standardised CPUE for Region SCH 2 & top of SCH 3 in three series based on two fisheries: a) setnet lognormal; b) bottom longline lognormal; c) bottom longline combined.

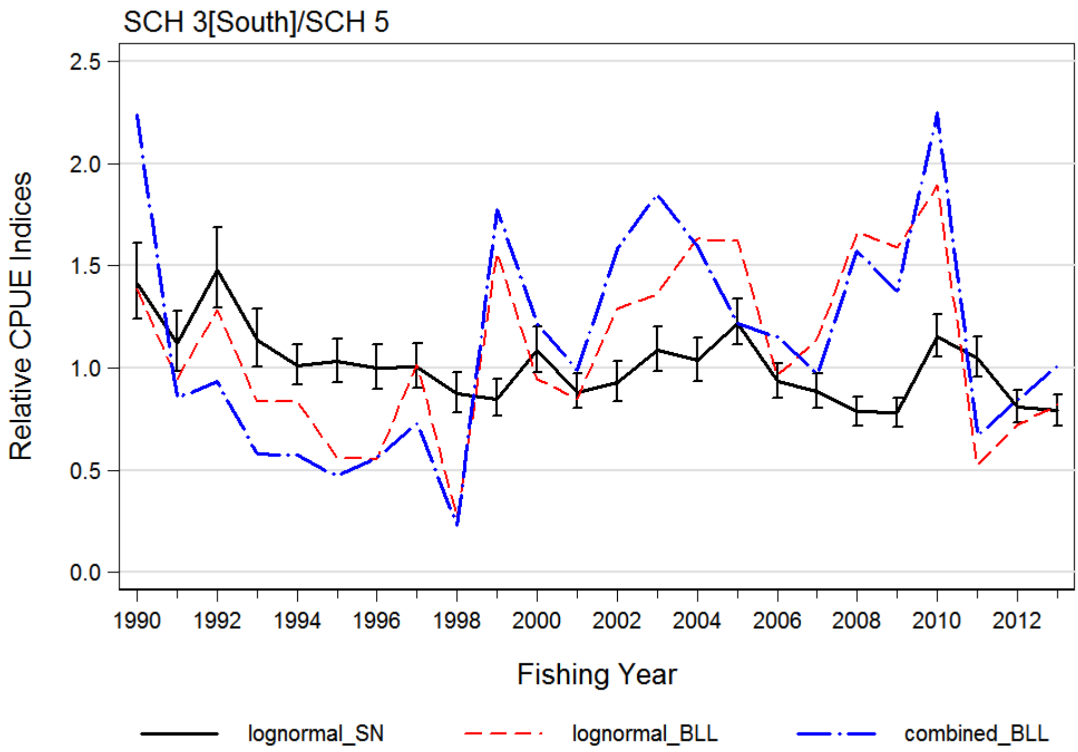


Figure 23: Comparison of standardised CPUE for Region lower SCH 3 & SCH 5 in three series based on two fisheries: a) setnet lognormal; b) bottom longline lognormal; c) bottom longline combined.

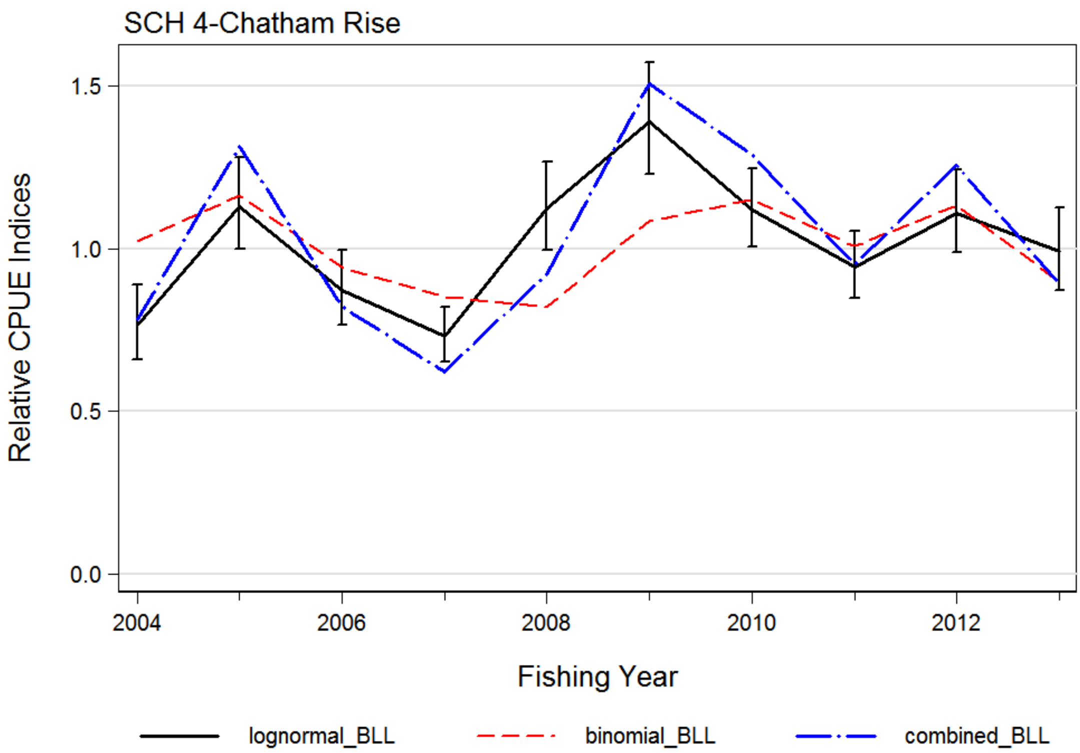


Figure 24: Comparison of standardised CPUE for Region Chatham Rise (SCH 4) in three series based on a single fishery: a) bottom longline lognormal; b) bottom longline binomial; c) bottom longline combined.

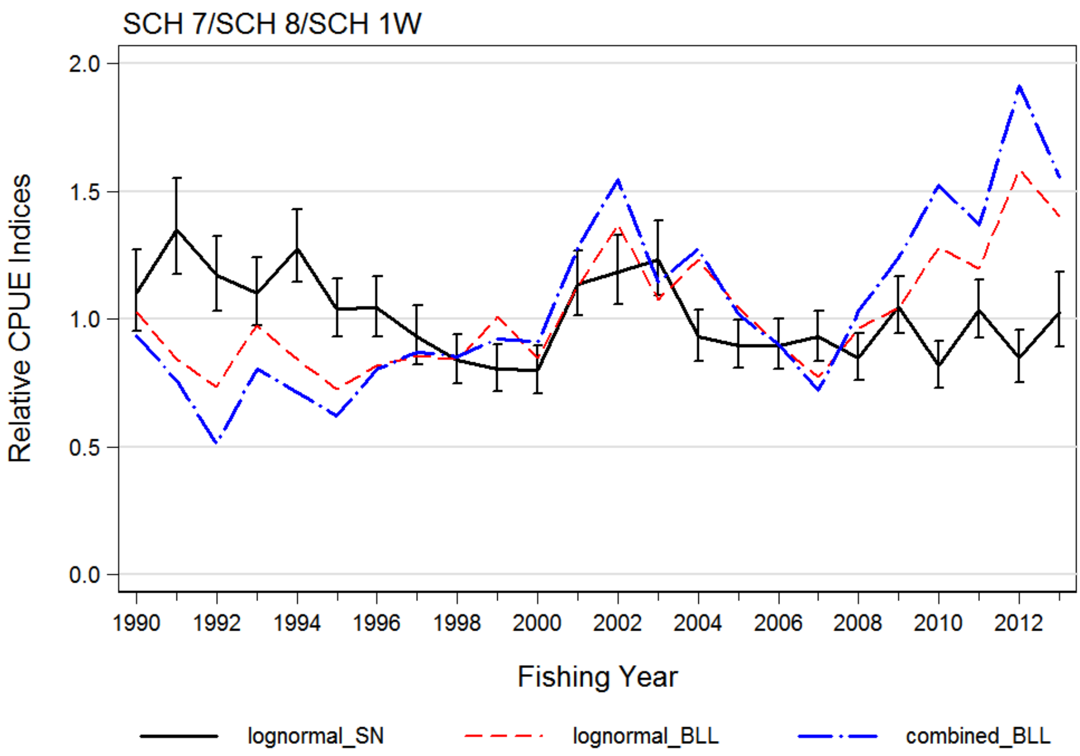


Figure 25: Comparison of standardised CPUE for Region SCH 7, SCH 8 & lower SCH 1W in three series based on two fisheries: a) setnet lognormal; b) bottom longline lognormal; c) bottom longline combined.

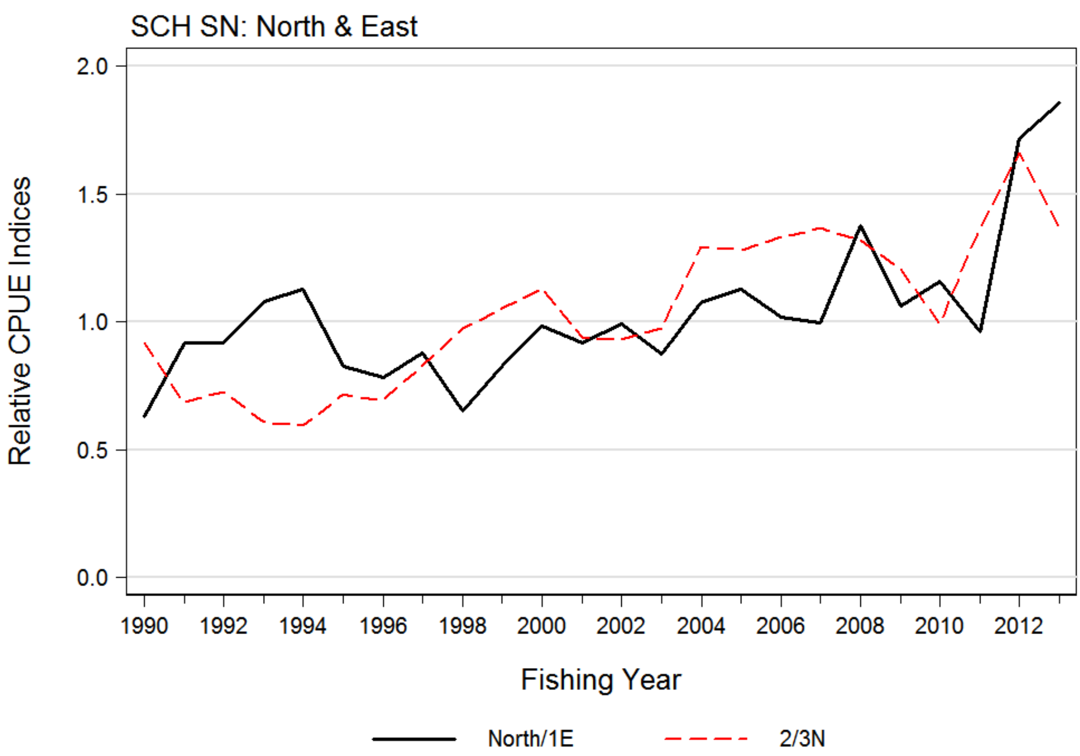


Figure 26: Comparison of standardised setnet CPUE for two North Island regions: a) FarNorth & SCH 1E; b) SCH 2 & top of SCH 3.

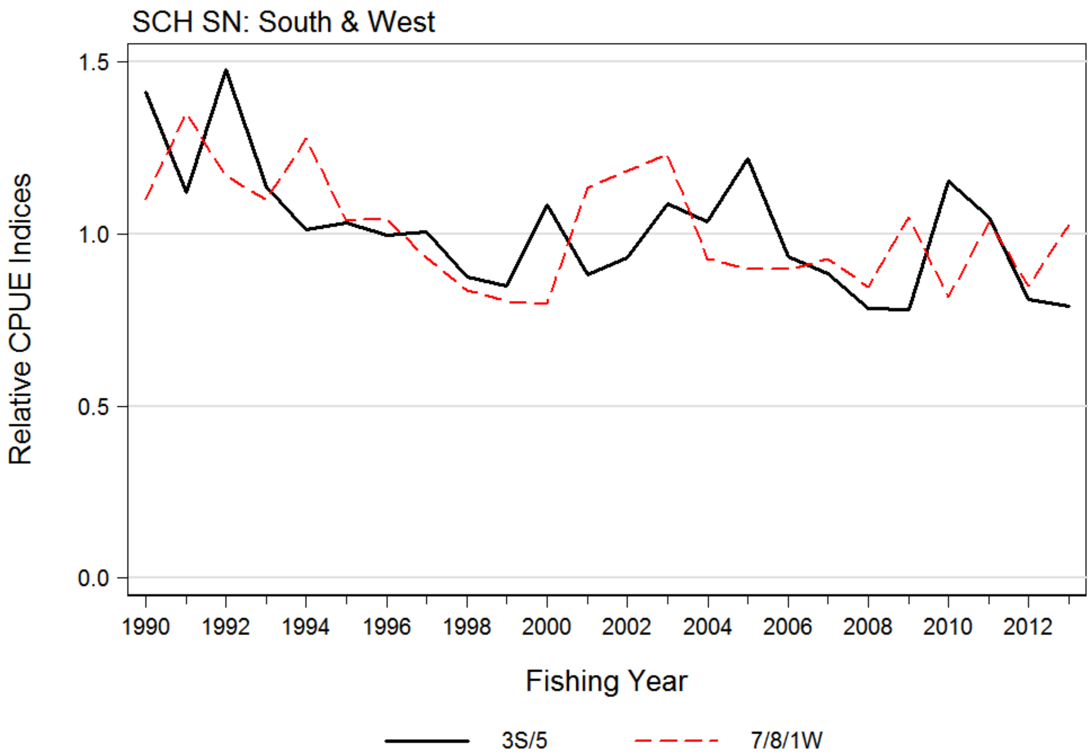


Figure 27: Comparison of standardised setnet CPUE for two South Island regions: a) lower SCH 3 & SCH 5; b) SCH 7, SCH 8 & lower SCH 1W.

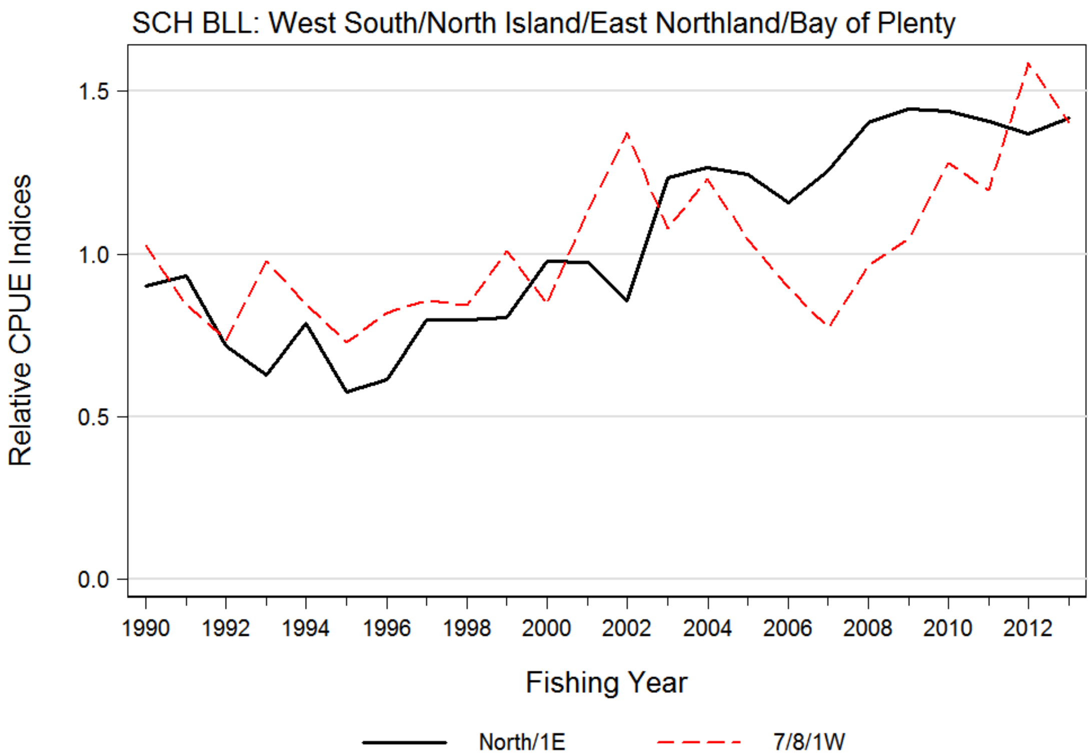


Figure 28: Comparison of standardised lognormal bottom longline CPUE for two west coast North and South Island regions: a) FarNorth & SCH 1E; b) SCH 7, SCH 8 & lower SCH 1W.

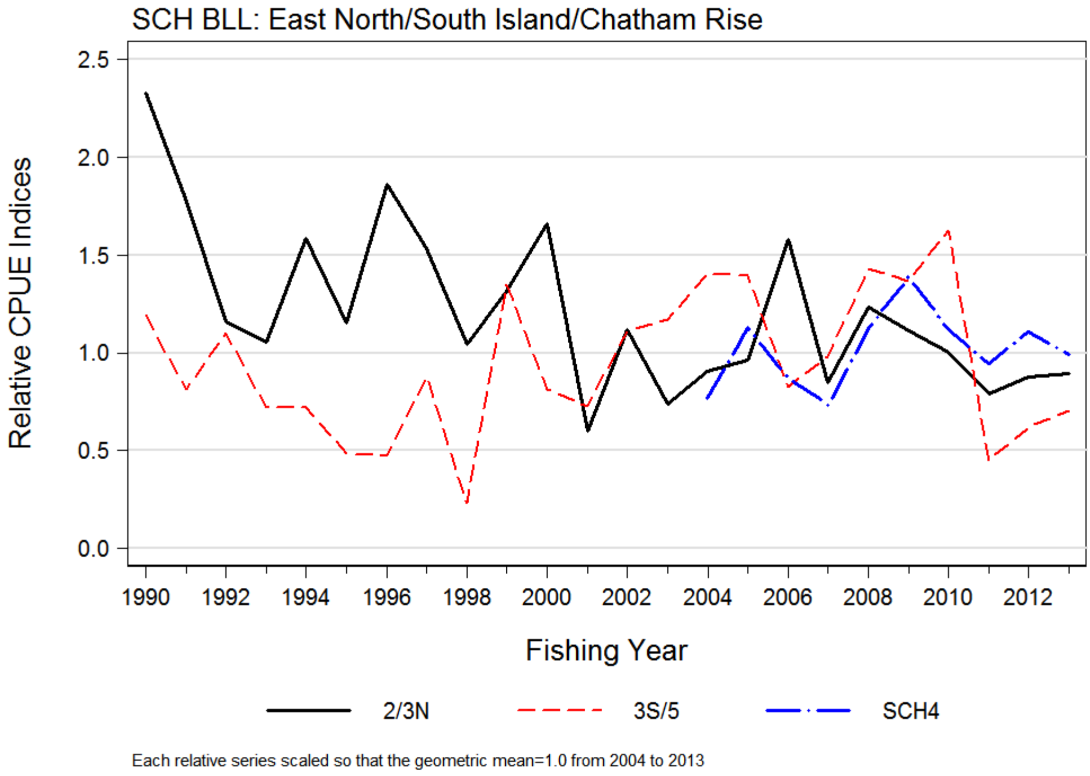


Figure 29: Comparison of standardised lognormal bottom longline CPUE for three east coast North and South Island regions: a) SCH 2 & top of SCH 3; b) lower SCH 3 & SCH 5; c) Chatham Rise (SCH 4).

4. ACKNOWLEDGEMENTS

This work was funded by MPI Research Project SCH2013/01. We thank the MPI Information and Data Management team for providing the catch/effort data in a timely manner. Members of the Northern Inshore Working Group and the MPI Stock Assessment Plenary provided important input and advice through several iterations of the analyses contained in this report.

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Appendix A. GLOSSARY OF ABBREVIATIONS, CODES, AND DEFINITIONS OF TERMS

Table A.1: Table of abbreviations and definitions of terms

Term/Abbreviation	Definition
AIC	Akaike Information Criterion: used to select between different models (lower is better)
AMP	Adaptive Management Programme
analysis dataset	data set available after completion of grooming procedure (Starr 2007)
arithmetic CPUE	Sum of catch/sum of effort, usually summed over a year within the stratum of interest (Eq. H.1)
CDI plot	Coefficient-distribution-influence plot (see Figure I.7 for an example) (Bentley et al. 2011)
CELR	Catch/Effort Landing Return (Ministry of Fisheries 2010): active since July 1989 for all vessels less than 28 m. Fishing events are reported on a daily basis on this form
CLR	Catch Landing Return (Ministry of Fisheries 2010): active since July 1989 for all vessels not using the CELR or NCELR forms to report landings
CPUE	Catch Per Unit Effort
daily-effort-stratum	summarisation within a trip by day of fishing with the modal statistical area of occupancy and modal declared target species assigned to the day of fishing; only trips which used a single capture method are used
destination code	code indicating how each landing was directed after leaving vessel (see Table 4)
EEZ	Exclusive Economic Zone: marine waters under control of New Zealand
estimated catch	an estimate made by the operator of the vessel of the weight of school shark captured, which is then recorded as part of the "fishing event". Only the top 5 species are required for any fishing event in the CELR and TCEPR data (expanded to 8 for the TCER form type)
fishing event	a "fishing event" is a record of activity in trip. It is a day of fishing within a single statistical area, using one method of capture and one declared target species (CELR data) or a unit of fishing effort (usually a tow or a line set) for fishing methods using other reporting forms
fishing year	1 October – 30 September for school shark
FMA	MPI Fishery Management Areas: 10 legal areas used by MPI to define large scale stock management units; QMAs consist of one or more of these regions
landing event	weight of school shark off-loaded from a vessel at the end of a trip. Every landing has an associated destination code and there can be multiple landing events with the same or different destination codes for a trip
LCER	Lining Catch Effort Return (Ministry of Fisheries 2010): active since October 2003 for lining vessels larger than 28 m and reports set-by-set fishing events
LFR	Licensed Fish Receiver: processors legally allowed to receive commercially caught species
LTCER	Lining Trip Catch Effort Return (Ministry of Fisheries 2010): active since October 2007 for lining vessels between 6 and 28 m and reports individual set-by-set fishing events
MHR	Monthly Harvest Return: monthly returns used after 1 October 2001. Replaced QMRs but have same definition and utility
MPI	New Zealand Ministry for Primary Industries
NCELR	Netting Catch Effort Landing Return (Ministry of Fisheries 2010): active since October 2006 for inshore vessels using setnet gear between 6 and 28 m and reports individual fishing events
QMA	Quota Management Area: legally defined unit area used for school shark management (Figure 1)
QMR	Quota Management Report: monthly harvest reports submitted by commercial fishers to MPI. Considered to be best estimates of commercial harvest. In use from 1986 to 2001.
QMS	Quota Management System: name of the management system used in New Zealand to control commercial and non-commercial catches
replog	data extract identifier issued by MPI data unit
residual implied coefficient plots	plots which mimic interaction effects between the year coefficients and a categorical variable by adding the mean of the categorical variable residuals in each fishing year to the year coefficient, creating a plot of the "year effect" for each value of the categorical variable (see Figure I.10 for an example)
rollup	a term describing the average number of records per "trip-stratum"
RTWG	MPI Recreational Technical Working Group
SINSWG	Southern Inshore Fisheries Assessment Working Group: MPI Working Group overseeing the work presented in this report

Term/Abbreviation	Definition
standardised CPUE	procedure used to remove the effects of explanatory variables such as vessel, statistical area and month of capture from a data set of catch/effort data for a species; annual abundance is usually modelled as an explanatory variable representing the year of capture and, after removing the effects of the other explanatory variables, the resulting year coefficients are considered to represent the relative change in species abundance (Eq. H.3)
statistical area	sub-areas (Appendix B) within an FMA which are identified in catch/effort returns. The boundaries for these statistical areas do not always coincide with the QMA/FMA boundaries, leading to ambiguity in the assignment of effort to a QMA.
TACC	Total Allowable Commercial Catch: catch limit set by the Minister of Fisheries for a QMA that applies to commercial fishing
TCEPR	Trawl Catch Effort Processing Return (Ministry of Fisheries 2010): active since July 1989 for deepwater vessels larger than 28 m and reports tow-by-tow fishing events
TCER	Trawl Catch Effort Return (Ministry of Fisheries 2010): active since October 2007 for inshore vessels between 6 and 28 m and reports tow-by-tow fishing events
trip	a unit of fishing activity by a vessel consisting of “fishing events” and “landing events”, which are activities assigned to the trip. MPI generates a unique database code to identify each trip, using the trip start and end dates and the vessel code (Ministry of Fisheries 2010)
trip-stratum	summarisation within a trip by fishing method used, the statistical area of occupancy and the declared target species
unstandardised CPUE	geometric mean of all individual CPUE observations, usually summarised over a year within the stratum of interest (Eq. H.2)

Table A.2: Code definitions used in the body of the main report and in Appendix G.

Code	Definition	Code	Description
BLL	Bottom longlining	BAR	Barracouta
BPT	Bottom trawl—pair	BNS	Bluenose
BS	Beach seine/drag nets	BUT	Butterfish
BT	Bottom trawl—single	ELE	Elephant Fish
CP	Cod potting	FLA	Flatfish (mixed species)
DL	Drop/dahn lines	GMU	Grey mullet
DS	Danish seining—single	GSH	Ghost shark
HL	Handlining	GUR	Red gurnard
MW	Midwater trawl—single	HOK	Hoki
RLP	Rock lobster potting	HPB	Hapuku and Bass
SLL	Surface longlining	JDO	John Dory
SN	Set netting (includes gill nets)	JMA	Jack mackerel
T	Trolling	KAH	Kahawai
TL	Trot lines	KIN	Kingfish
		LEA	Leatherjacket
SCH 1E	the part of SCH 1 in FMA 1	LIN	Ling
SCH 1W	the part of SCH 1 in FMA 9	MOK	Moki
		POR	Porae
		RCO	Red cod
		SCH	School shark
		SCI	Scampi
		SKI	Gemfish
		SNA	Snapper
		SPD	Spiny dogfish
		SPE	Sea perch
		SQU	Arrow squid
		STA	Giant stargazer
		SWA	Silver warehou
		TAR	Tarakihi
		TRE	Trevally
		WAR	Blue warehou

Appendix B. MAP OF MPI STATISTICAL AND MANAGEMENT AREAS

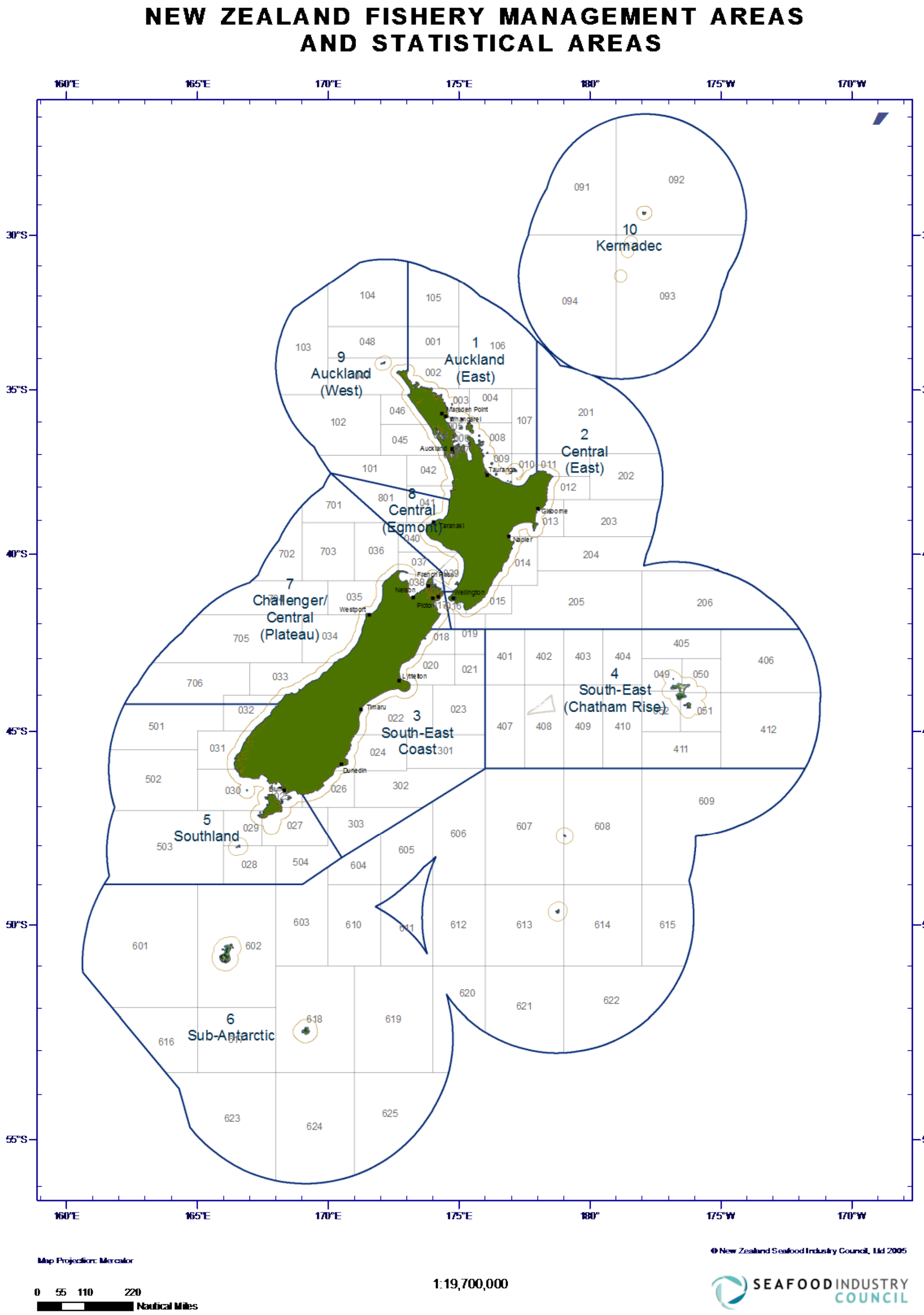

Figure B.1: Map of Ministry for Primary Industries statistical areas and Fishery Management Area (FMA) boundaries, showing locations where FMA boundaries are not contiguous with the statistical area boundaries.

Appendix C. QMR/MHR LANDINGS AND TACC BY QMA

Table C.1: Reported landings (t) and TACC (t) of school shark in SCH 1, SCH 2, SCH 3, SCH 4, SCH 5, SCH 7 and SCH 8 from 1983–84 to 2012–13 (Data sources: FSU [1983–84 to 1985–86]; QMR [1986–87 to 2000–01]; MHR [2001–02 to 2012–13). $\tilde{SL}_{q,y}$ is the sum of landings for QMA *q* in year *y* adjusted for changes in conversion factor (Eq. 2) and $SL_{q,y}$ is the sum of the same landings for QMA *q* in year *y* without adjustment. '–': TACC not set from 1983–84 to 1985–86

Fishing	FSU/QMR/MHR$_{q,y}$								$R_{q,y} = \tilde{SL}_{q,y} / SL_{q,y}$						
Year	SCH 1	SCH 2	SCH 3	SCH 4	SCH 5	SCH 7	SCH 8	Total	SCH 1	SCH 2	SCH 3	SCH 4	SCH 5	SCH 7	SCH 8
1983–84	1087.0	298.0	630.0	8.0	792.0	1039.0	694.0	4548.0	0.948[1]	0.945[1]	0.938[1]	0.942[1]	0.969[1]	0.956[1]	0.948[1]
1984–85	861.0	237.0	505.0	12.0	995.0	1030.0	698.0	4338.0	0.948[1]	0.945[1]	0.938[1]	0.942[1]	0.969[1]	0.956[1]	0.948[1]
1985–86	787.0	214.0	370.0	23.0	647.0	851.0	652.0	3544.0	0.948[1]	0.945[1]	0.938[1]	0.942[1]	0.969[1]	0.956[1]	0.948[1]
1986–87	416.0	123.2	283.5	19.2	382.2	454.2	224.0	1902.3	0.948[1]	0.945[1]	0.938[1]	0.942[1]	0.969[1]	0.956[1]	0.948[1]
1987–88	527.7	122.7	319.8	21.7	530.9	515.9	374.0	2412.7	0.948[1]	0.945[1]	0.938[1]	0.942[1]	0.969[1]	0.956[1]	0.948[1]
1988–89	476.7	136.4	219.6	25.5	501.3	540.2	418.9	2318.5	0.948[1]	0.945[1]	0.938[1]	0.942[1]	0.969[1]	0.956[1]	0.948[1]
1989–90	584.7	155.7	272.4	27.2	459.9	515.8	371.2	2386.9	0.929	0.931	0.928	0.894	0.976	0.949	0.934
1990–91	558.9	139.0	226.8	20.6	479.8	420.4	368.6	2214.0	0.957	0.954	0.945	0.979	0.991	0.965	0.967
1991–92	594.2	160.6	260.2	33.8	598.9	431.0	400.6	2479.3	0.957	0.952	0.941	0.953	0.939	0.953	0.945
1992–93	820.1	204.9	220.0	38.1	593.0	481.9	482.3	2840.3	0.960	0.951	0.940	0.956	0.928	0.947	0.949
1993–94	658.3	156.1	202.1	41.2	624.1	473.2	448.1	2603.1	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1994–95	658.5	159.1	236.6	85.6	655.9	369.6	417.0	2582.2	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1995–96	800.5	214.9	293.1	216.3	697.3	638.1	520.9	3381.1	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1996–97	790.6	228.5	289.4	178.4	636.2	545.1	458.3	3126.5	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1997–98	757.1	210.2	271.2	121.7	620.7	467.9	443.2	2892.0	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1998–99	783.8	275.3	335.3	105.7	713.9	681.7	533.2	3429.0	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1999–00	819.7	249.6	343.3	97.4	705.5	639.2	469.3	3324.1	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2000–01	799.4	177.8	363.5	99.8	724.2	575.5	452.9	3193.1	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2001–02	670.1	208.0	324.0	92.6	671.0	500.0	447.7	2913.5	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2002–03	689.3	225.4	410.4	130.2	746.5	511.7	447.5	3161.1	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2003–04	758.3	186.8	323.5	149.2	727.2	574.2	404.5	3123.8	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2004–05	694.8	201.4	423.9	206.0	742.8	546.0	553.6	3368.5	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2005–06	634.3	176.5	324.7	182.9	711.7	568.4	502.6	3101.1	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2006–07	660.7	200.2	376.2	87.6	738.5	583.0	533.6	3179.8	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2007–08	707.8	228.1	345.1	133.5	781.0	605.7	496.8	3298.0	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2008–09	713.3	232.2	363.6	144.9	741.5	694.2	588.0	3477.7	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2009–10	589.0	212.7	425.5	190.8	784.1	606.1	460.4	3268.7	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2010–11	777.3	187.5	365.7	173.8	700.6	677.2	586.6	3468.8	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2011–12	688.7	191.4	351.1	201.4	729.0	603.2	514.7	3279.5	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2012–13	602.1	200.2	319.9	126.6	747.6	655.6	512.5	3164.6	1.000	1.000	1.000	1.000	1.000	1.000	1.000

[1] average: 1989–90 to 1991–92

Table C.1: (cont.)

Fishing Year	$\tilde{\text{FSU}}/\text{QMR}/\text{MHR}_{q,y} = \text{FSU}/\text{QMR}/\text{MHR}_{q,y} * R_{q,y}$								$\text{TACC}_{q,y}$							
	SCH 1	SCH 2	SCH 3	SCH 4	SCH 5	SCH 7	SCH 8	Total	SCH 1	SCH 2	SCH 3	SCH 4	SCH 5	SCH 7	SCH 8	Total
1983–84	1030.1	281.7	590.7	7.5	767.2	992.9	658.3	4328.6	–	–	–	–	–	–	–	–
1984–85	816.0	224.1	473.5	11.3	963.9	984.3	662.0	4135.1	–	–	–	–	–	–	–	–
1985–86	745.8	202.3	346.9	21.7	626.8	813.3	618.4	3375.2	–	–	–	–	–	–	–	–
1986–87	394.2	116.5	265.8	18.1	370.2	434.1	212.4	1811.4	560.1	161.9	270.3	200.0	610.0	470.2	310.0	2582.5
1987–88	500.1	116.0	299.8	20.4	514.3	493.0	354.7	2298.5	602.1	168.9	285.0	200.0	613.1	500.3	344.9	2714.3
1988–89	451.7	128.9	205.9	24.0	485.7	516.3	397.3	2209.8	623.9	187.7	294.3	200.0	615.3	522.2	433.0	2876.4
1989–90	543.1	144.9	252.7	24.3	448.8	489.5	346.7	2250.0	651.7	196.7	305.3	234.8	635.1	524.4	438.3	2986.3
1990–91	534.7	132.6	214.2	20.2	475.6	405.5	356.3	2139.3	664.1	198.2	318.0	238.5	648.8	530.6	440.6	3038.8
1991–92	568.9	152.8	244.7	32.2	562.5	410.9	378.5	2350.5	664.2	198.2	318.0	238.5	685.5	530.6	440.6	3075.6
1992–93	787.6	194.9	206.8	36.5	550.2	456.1	457.6	2689.7	666.8	198.5	321.9	238.5	685.5	531.0	440.6	3082.8
1993–94	658.3	156.1	202.1	41.2	624.1	473.2	448.1	2603.1	666.8	198.5	321.9	238.5	685.5	531.0	440.6	3082.8
1994–95	658.5	159.1	236.6	85.6	655.9	369.6	417.0	2582.2	668.3	198.5	321.9	238.5	693.9	533.7	440.6	3095.4
1995–96	800.5	214.9	293.1	216.3	697.1	637.9	520.8	3380.5	668.3	198.5	321.9	238.5	693.9	533.7	440.6	3095.4
1996–97	790.6	228.5	289.4	178.4	636.2	545.0	458.3	3126.5	668.3	198.5	321.9	238.5	693.9	533.7	440.6	3095.4
1997–98	757.1	210.2	271.2	121.7	620.7	467.9	443.2	2892.0	668.3	198.6	321.9	238.5	693.9	533.7	440.6	3095.5
1998–99	783.8	275.3	335.3	105.7	713.9	681.7	533.2	3429.0	668.3	198.6	321.9	238.5	693.9	533.7	440.6	3095.5
1999–00	819.7	249.6	343.3	97.4	705.5	639.2	469.3	3324.1	668.3	198.6	321.9	238.5	693.9	533.7	440.6	3095.5
2000–01	799.4	177.8	363.5	99.8	724.2	575.5	452.9	3193.1	668.3	198.6	321.9	238.5	708.4	533.7	440.6	3110.0
2001–02	670.1	208.0	324.0	92.6	671.0	500.0	447.7	2913.5	668.5	198.6	321.9	238.5	708.4	533.7	440.6	3110.2
2002–03	689.3	225.4	410.4	130.2	746.5	511.7	447.5	3161.1	668.5	198.6	321.9	238.5	708.4	533.7	440.6	3110.2
2003–04	758.3	186.8	323.5	149.2	727.2	574.2	404.5	3123.8	668.5	198.6	321.9	238.5	708.4	533.7	440.6	3110.2
2004–05	694.8	201.4	423.9	206.0	742.8	546.0	553.6	3368.5	668.5	198.6	387.0	238.5	743.0	641.0	529.0	3405.6
2005–06	634.3	176.5	324.7	182.9	711.7	568.4	502.6	3101.1	668.5	198.6	387.0	238.5	743.0	641.0	529.0	3405.6
2006–07	660.7	200.2	376.2	87.6	738.5	583.0	533.6	3179.8	668.5	198.6	387.0	238.5	743.0	641.0	529.0	3405.6
2007–08	707.8	228.1	345.1	133.5	781.0	605.7	496.8	3298.0	689.0	198.6	387.0	238.5	743.0	641.0	529.0	3426.1
2008–09	713.3	232.2	363.6	144.9	741.5	694.2	588.0	3477.7	689.0	198.6	387.0	238.5	743.0	641.0	529.0	3426.1
2009–10	589.0	212.7	425.5	190.8	784.1	606.1	460.4	3268.7	689.0	198.6	387.0	238.5	743.0	641.0	529.0	3426.1
2010–11	777.3	187.5	365.7	173.8	700.6	677.2	586.6	3468.8	689.0	198.6	387.0	238.5	743.0	641.0	529.0	3426.1
2011–12	688.7	191.4	351.1	201.4	729.0	603.2	514.7	3279.5	689.0	198.6	387.0	238.5	743.0	641.0	529.0	3426.1
2012–13	602.1	200.2	319.9	126.6	747.6	655.6	512.5	3164.6	689.0	198.6	387.0	238.5	743.0	641.0	529.0	3426.1

Appendix D. NEW ZEALAND SET NET AND TRAWL REGULATION SUMMARY

Area	Commercial measures	Date from
West Coast North Island	• All set nets were prohibited to 4 NM offshore – Maunganui Bluff and Pariokariwa Point, including Manukau entrance	October 2003
	• Set net restrictions extended to 7 NM offshore between Maunganui Bluff and Pariokariwa Point (including the entrances to the Kaipara, Manukau (extended further into harbour) and Raglan Harbours and the entrance to the Waikato River)	October 2008
	• restrictions commercial and recreational set netting to 2 NM offshore from Pariokariwa Point to Hawera; MPI observer on any commercial set net vessel operating between 2 and 7 NM	April 2012
	• bottom trawl prohibited to 2 NM offshore between Maunganui Bluff and Pariokariwa Point; no bottom trawl to 4 NM between Manukau Hbr and Waikato River; no bottom trawl in harbours	October 2008
West Coast South Island	• voluntary closure for setnets: both sides of Farewell Spit	October 2006
	• Commercial set netting is prohibited offshore to 2 NM between 1 December and 28 February between Cape Farewell and Awarua Point	October 2008
East Coast South Island	• Banks Peninsula (Sumner Head in the north to the Rakaia River in the south): commercial set netting prohibited out to 4 NM. from the coast and recreational set netting was subject to seasonal restrictions	October 1988
	• surface set netting banned along the east coast of the South Island from the Clarence River to Slope Point; seasonal closure (January to April) to set netting within a 1 NM circle of the mouths of the Waiau, Hurunui, Waimakariri, Rakaia, Ashburton, Rangitata, Orari, Opihi, Waitaki and Clutha Rivers	October 1989
	• SouthEast Code of Practice: closed 4 NM from shore from southern end of the Banks Peninsula Marine Mammal Sanctuary to the Waitaki River for October–January; avoid fishing all year inside the 40 m depth contour from the Clarence River to the Waitaki River; trawlers and set netters to stay outside 1 NM between the southern end of the Banks Peninsula Marine Mammal Sanctuary to the Waitaki River throughout the fishing year	2000
	• all set netting largely prohibited within 4 NM of the coast on the ECSI from Cape Jackson (Marlborough Sounds) to Slope Point (Catlins – Kaikoura Canyon exception to 1 NM)	October 2008
	• ·trawling banned to 2 NM between Cape Jackson in Marlborough Sounds and Slope Point (Catlins) (flatfish headlines allowed inside of 2 NM)	October 2008
South Coast South Island	• voluntary year-round closure to setnets of Porpoise Bay (outer part of Waikawa Harbour)	October 2004
	• all set netting prohibited within 4 NM of the coast from Slope Point (Catlins) to SandHill Point (east of Fiordland) including whole of TeWaewae Bay	October 2008
	• all trawling prohibited within 2 NM of the coast from Slope Point (Catlins) to SandHill Point (east of Fiordland)	October 2008

Appendix E. METHOD USED TO EXCLUDE "OUT-OF-RANGE" LANDINGS

E.1 INTRODUCTION

The method previously used to identify "implausibly large" landings used arithmetic CPUE, with the presumption that trips with extremely large arithmetic CPUE values existed because the contributing landings were implausibly large. This method had two major problems: one was that the arithmetic CPUE for mixed-method trips could not be easily calculated and the other was that there was a lot of subjectivity in the process (how does one identify an "implausibly large" arithmetic CPUE?). Dropping "implausibly large" landings is necessary because there are large landings which are due to data errors (possibly at the data entry step), with landings from single trips occasionally exceeding 100–300 t for some species (there is a single landing of 800 t for SCH 8). These errors can result in substantial deviations from the accepted QMR/MHR catches and affect the credibility of the characterisation and CPUE analyses. The previous method transferred the problem of identifying "implausibly large" landings to identifying unreasonably large CPUE values. A further problem with the procedure was that the CPUE method was difficult to automate, requiring intermediate evaluations.

E.2 METHODS

The method used for this procedure is less subjective and can be automated, evaluating trips with very large landings based on internal evidence within the trip that potentially corroborate the landings. The method proceeds in two steps:

Step 1 Trips with large landings above a specified threshold were selected using the empirical distribution of trip landing totals from all trips in the data set (for instance, all trips in the largest 1% quantile in terms of total trip landings);

Step 2 Internal evidence substantiating the landings within each trip was derived from summing the estimated catch for the species in question, as well as summing the "calculated green weight" (=*number_bins*avg_weight_bin*conversion_factor*) (Eq. E.1). The ratio of each these totals was taken with the declared green weight for the trip, with the minimum of the two ratios taken as the "best" validation (Eq. E.2). High values for this ratio (for instance, a value of 9 for this ratio implies that the declared green weight is 9 times larger than the "best" secondary total) are taken as evidence that the declared greenweight landing for the trip was not corroborated using the other available data, making the trip a candidate for dropping.

A two-way grid search was implemented for this procedure across a range of empirical quantiles (Step 1) and test ratio values (Step 2). The reason for stepping down through the quantiles was to minimise the number of trips removed by starting with trips that returned the largest catches. Similarly, the search starting with the most extreme $rat_{t,s}$ values and stepped down from there. For each pair of values, the "fit" (SSq^z; Eq. E.3) of the annual sum of the landings was evaluated against the QMR/MHR totals, using a least-squares criterion. The pair of quantile and $rat_{t,s}$ values which gave the lowest SSq^z was used to select the set of candidate trips to drop because the resulting landings totals would be the closest overall to the QMR/MHR total catch.

The grid search was done independently for each SCH QMA because different ranges of quantile thresholds needed to be explored within each QMA in order to find a minimum.

E.3 EQUATIONS

For every trip, there exist three estimates of total greenweight catch for species *s*:

Eq. E.1
$$G_{t,s}^{d} = \sum_{i=1}^{n_t} gwt_{t,s,i}$$
$$G_{t,s}^{c} = \sum_{i=1}^{n_t} CF_s * W_{t,i} * B_{t,i}$$
$$G_{t,s}^{e} = \sum_{j=1}^{m_t} est_{t,s,j}$$

where $G_{t,s}^{d}$ = sum of declared greenweight (*gwt*) for trip *t* over all n_t landing records;

$G_{t,s}^{c}$ = sum of calculated greenweight for trip *t* over all n_t landing records, using conversion factor CF_s, weight of bin $W_{t,i}$ and number of bins $B_{t,i}$;

$G_{t,s}^{e}$ = sum of estimated catch (*est*) for trip *t* over all m_t effort records.

Assuming that $G_{t,s}^{d}$ is the best available estimate of the total landings of species *s* for trip *t*, calculate the following ratios:

Eq. E.2
$$r1_{t,s} = G_{t,s}^{d} \big/ G_{t,s}^{c}$$
$$r2_{t,s} = G_{t,s}^{d} \big/ G_{t,s}^{e}$$
$$rat_{t,s} = \min(r1_{t,s}, r2_{t,s})$$

where $G_{t,s}^{d}$, $G_{t,s}^{c}$ and $G_{t,s}^{e}$ are defined in Eq. E.1, and ignoring $r1_{t,s}$ or $r2_{t,s}$ if missing when calculating $rat_{t,s}$.

The ratio $rat_{t,s}$ can be considered the "best available information" to corroborate the landings declared in the total $G_{t,s}^{d}$, with ratios exceeding a threshold value (e.g. $rat_{t,s} > 9.0$) considered to be uncorroborated. This criterion can be applied to a set of trips selected using a quantile of the empirical distribution of total trip greenweights. The set of trips to drop was selected on the basis of the pair of criteria (quantile and ratio threshold) which gave the lowest SSq^z (Eq. E.3) relative to the annual QMR/MHR totals:

Eq. E.3
$$gg_y^z = \sum_{1}^{p_y^z} L_y^z$$
$$Ssq^z = \sum_{y=89/90}^{y=12/13} \left(gg_y^z - MHR_y \right)^2$$

where p_y^z is the number landing records in year *y* for iteration *z* (i.e.: a combination of a ratio threshold criterion with an empirical quantile cut-off criterion);

L_y^z is a landing record included in year *y* for iteration *z*.

MHR_y is the corresponding MHR/QMR landing total for SCH in the QMA in year *y*.

E.4 RESULTS

A total of 112 trips were dropped across the seven QMAs, representing over 1300 t of greenweight landings (Table E.1; Table E.2). The number of trips to drop was selected from the minimum found in each QMA, although it is not clear that the search was exhaustive in all QMAs.

In the case of SCH 1, the best ‘fit’ to the QMR/MHR annual totals was obtained without dropping any landings (Table E.3, Figure E.1), consequently none were dropped (Table E.1). Twenty-five trips were dropped from the SCH 2 landings data, representing just over 100 t (Table E.1). The 98th quantile threshold for investigating trips for out-of-range landings in SCH 2 was 1.2 t (Table E.4), indicating that school shark in SCH 2 are not landed in vary large amounts. SCH 3 resembled SCH 2, in that 27 trips representing 155 t were dropped (Table E.1). Landings by trip are also about the same in SCH 3 as in SCH 2, with the 99th quantile threshold set at 1.4 t (Table E.4).

There is a strange anomaly in the SCH 4 landings data, with the annual landing totals for 1995–96 and 1996–97 apparently reversed relative to the QMR totals (Table E.5, Figure E.1). The SCH 4 QMR total for 1995–96 is 216 t while the landings sum to 180 t. In the following fishing year, the landings sum to 219 t while the QMR total is 178 t. As a consequence of this, the “fit” to the QMR/MHR data is rather poor (Table E.5). Only 10 trips were dropped in SCH 4, representing 30 t of landings (Table E.1).

Eight trips representing 57 t of landings were dropped from the SCH 5 data set (Table E.1). Landings by trip are considerably larger in SCH 5 than in the other SCH QMAs, with the 92th quantile threshold at 4.5 t (Table E.4). SCH 7 dropped the largest number of trips (41), which represented just under 200 t of landings (Table E.1). Only one trip was dropped from SCH 8, but it accounted for over 800 t of landing (Table E.1).

Tables comparing the annual QMR/MHR reported catches by SCH QMA with the equivalent summed landings by fishing year, before and after edits, are presented in Table E.5 and plotted in Figure E.1. Table E.6 presents the sum of dropped landings (in tonnes) for each quantile/ratio threshold investigated by QMA. Table E.7 shows the difference between the QMR/MHR total relative to the landings total for each quantile/ratio pair investigated by QMA.

Table E.1. Statistics associated with the selected minimum in each QMA. $MHR_y =$ QMR/MHR landings in year *y*; $gg_y^0 =$ unedited landings in year *y*; $gg_y =$ edited landings at selected minimum in year *y*; $rat_{t,s}$ as defined in Eq. E.2.

Fishstock	Quantile	$rat_{t,s}$	Number trips dropped	Total trips in data set	Sum landings dropped (t)	$\sum_{y=89/90}^{y=12/13} MHR_y$	$\sum_{y=89/90}^{y=12/13} gg_y^0$	$\sum_{y=89/90}^{y=12/13} gg_y$	$\sum_{y=89/90}^{y=12/13} \left(gg_y - MHR_y\right)$
SCH 1	99.99	10	0	73 026	0	16 812	16 475	16 475	-336
SCH 2	98	4	25	37 191	108.0	4 782	4 776	4 668	-114
SCH 3	99	4	27	78 423	154.6	7 668	7 741	7 586	-81
SCH 4	86	2	10	5 260	30.0	2 885	2 923	2 893	7
SCH 5	92	2	8	20 319	57.2	16 331	16 148	16 091	-241
SCH 7	92	4	41	45 735	187.2	13 365	13 553	13 366	1.6
SCH 8	99	4	1	24 617	808.1	11 414	11 932	11 124	-290
Total			112	242 793[1]	1 345	73 257	73 548	72 203	

[1] This is the total number of trips in the landings data. The sum of the above QMA-specific trip totals is 284 571, indicating that there are about 40 000 trips landing to multiple QMAs.

Table E.2. Number of trips dropped over a two parameter search: A) a threshold quantile cut-off which selected the set of large landings over which to search and B) the ratio $\left(rat_{t,s}\right)$ (Eq. E.2) which sets the maximum criterion for accepting a landing. The quantile/ratio pair with the lowest Ssq^2 (Eq. E.3) is coloured blue for each SCH QMA. –: quantile/ratio pair not investigated.

					$\left(rat_{t,s}\right)$
	2	4	6	8	10
SCH 1					
90	205	76	68	59	48
92	159	66	60	54	44
94	116	56	53	48	38
96	73	40	37	34	27
97	–	–	–	–	–
98	41	27	24	23	19
99	30	24	21	20	16
99.99	3	2	1	1	0
SCH 3					
86	–	–	–	–	–
88	–	–	–	–	–
90	–	–	–	–	–
92	–	–	–	–	–
94	–	–	–	–	–
96	89	65	60	54	46
97	69	53	50	46	40
98	51	41	40	37	32
99	33	27	27	26	21
99.9	11	10	10	9	7
99.99	3	3	3	2	1
SCH 5					
90	12	8	8	6	2
92	8	5	5	4	2
94	4	3	3	2	1
97	1	1	1	1	0
98	1	1	1	1	0
SCH 8					
93	19	6	4	4	4
94	17	5	3	3	3
95	15	5	3	3	3
96	13	4	2	2	2
97	8	2	2	2	2
98	6	2	2	2	2
99	3	1	1	1	1

			$\left(rat_{t,s}\right)$
	2	4	6
SCH 2			
90	–	–	–
92	–	–	–
94	–	–	–
96	48	32	28
97	42	29	26
98	33	25	23
99	22	16	15
99.99	–	–	–
SCH 4			
86	10	5	–
88	9	5	–
90	5	4	4
92	3	3	3
94	3	3	3
96	2	2	2
97	–	–	–
98	–	–	–
99	–	–	–
99.9	–	–	–
99.99	–	–	–
SCH 7			
90	121	45	35
92	112	41	31
94	91	37	28
97	62	28	22
98	47	23	18

Table E.3. "Fit" (Ssq^2: Eq. E.3) over the two parameter search defined in Table E.2. The quantile/ratio pair with the lowest Ssq^2 is coloured blue for each SCH QMA.

					$(rat_{t,s})$				$(rat_{t,s})$
	2	4	6	8	10		2	4	6
SCH 1						SCH 2			
90	67 260	56 823	54 233	53 339	49 755		–	–	–
92	65 807	56 518	53 964	53 096	49 624		–	–	–
94	63 925	56 282	53 758	52 966	49 603		–	–	–
96	61 683	55 589	53 129	52 367	49 385		3 499	3 092	3 093
97	–	–	–	–	–		3 464	3 087	3 100
98	57 431	53 948	51 665	51 370	48 916		3 349	3 056	3 087
99	57 032	53 930	51 672	51 376	48 946		3 350	3 089	3 073
99.99	46 732	46 237	44 707	44 707	43 514		–	–	–
SCH 3						SCH 4			
86	–	–	–	–	–		4,248	4,339	–
88	–	–	–	–	–		4,293	4,339	–
90	–	–	–	–	–		4,382	4,461	4,461
92	–	–	–	–	–		4,467	4,467	4,467
94	–	–	–	–	–		4,467	4,467	4,467
96	5 550	5 118	5 113	5 699	6 687		4,489	4,489	4,489
97	5 421	5 087	5 089	5 686	6 731		–	–	–
98	5 281	5 036	5 037	5 677	6 757		–	–	–
99	5 069	4 939	4 939	5 573	6 659		–	–	–
99.9	5 308	5 347	5 347	5 982	7 034		–	–	–
99.99	6 618	6 618	6 618	7 252	8 206		–	–	–
SCH 5						SCH 7			
90	23 119	23 358	23 358	23 794	22 480		9 148	6 749	7 374
92	22 474	22 722	22 722	22 967	22 480		8 958	6 743	7 380
94	22 869	22 620	22 620	22 865	22 476		8 517	6 768	7 413
97	22 891	22 891	22 891	22 891	22 502		7 795	6 966	7 471
98	22 891	22 891	22 891	22 891	22 502		7 242	7 148	7 796
SCH 8									
93	12 253	10 776	10 237	10 237	10 237				
94	12 267	10 816	10 277	10 277	10 277				
95	12 339	10 816	10 277	10 277	10 277				
96	12 191	10 679	10 140	10 140	10 140				
97	11 042	10 140	10 140	10 140	10 140				
98	10 653	10 140	10 140	10 140	10 140				
99	9 994	9 826	9 826	9 826	9 826				

Table E.4. Trip threshold (t) associated with each quantile searched: every trip above the indicated threshold tonnage was evaluated for corroboration of declared greenweight catch. Thresholds used to determine the minimum in each Fishstock are indicated in aqua.

							Fishstock
Quantile	SCH 1	SCH 2	SCH 3	SCH 4	SCH 5	SCH 7	SCH 8
86	–	–	–	1.2	–	–	–
88	–	–	–	1.4	–	–	–
90	0.6	–	–	1.8	3.4	0.8	–
92	0.8	–	–	2.2	4.5	1.0	–
93	–	–	–	–	–	–	2.2
94	1.0	–	–	2.9	6.0	1.4	2.6
95	–	–	–	–	–	–	3.1
96	1.4	0.6	0.5	4.0	–	–	3.8
97	–	0.8	0.6	–	9.7	2.4	4.6
98	2.3	1.0	0.8	–	11.5	3.2	5.9
99	3.5	1.7	1.4	–	–	–	8.1
99.9	–	–	4.8	–	–	–	–
99.99	16.9	–	13.5	–	–	–	–

Table E.5. Annual statistics associated with the selected minima in SCH 1, SCH 2, SCH 3 and SCH 4. MHR_y = QMR/MHR landings in year *y*; gg_y^0 = unedited landings in year *y*; gg_y = edited landings at selected minimum in year *y*. The final two columns are the annual result of applying Eq. E.3 to the unedited landings and to the selected QMA "minimum" defined in Table E.1. –: no landing edits for SCH 1.

Fishing year	MHR_y	gg_y^0	gg_y	$\left(gg_y^0 - MHR_y\right)$	$\left(gg_y - MHR_y\right)$	MHR_y	gg_y^0	gg_y	$\left(gg_y^0 - MHR_y\right)$	$\left(gg_y - MHR_y\right)$
	SCH 1					SCH 2				
89/90	584.7	445.0	–	19 524.8	–	155.7	123.2	123.2	1 052.9	1 052.9
90/91	558.9	520.2	–	1 495.5	–	139.0	128.1	128.1	119.5	119.5
91/92	594.2	540.6	–	2 872.0	–	160.6	137.3	137.3	542.8	542.8
92/93	820.1	729.1	–	8 293.0	–	204.9	187.9	187.9	288.7	288.7
93/94	658.3	646.3	–	143.2	–	156.1	165.9	159.8	96.1	13.4
94/95	658.5	614.8	–	1 912.4	–	159.1	155.9	153.2	9.7	34.6
95/96	800.5	771.0	–	868.3	–	214.9	251.8	234.8	1 360.5	397.6
96/97	790.6	748.0	–	1 817.5	–	228.5	235.1	228.0	44.4	0.2
97/98	757.1	783.2	–	679.1	–	210.2	197.8	196.1	153.9	197.8
98/99	783.8	793.9	–	101.2	–	275.3	273.5	270.8	3.3	20.5
99/00	819.7	802.4	–	299.8	–	249.6	252.1	244.9	6.0	22.6
00/01	799.4	795.2	–	17.4	–	177.8	176.4	176.4	1.9	1.9
01/02	670.1	733.1	–	3 976.4	–	208.0	207.4	204.3	0.4	14.1
02/03	689.3	694.9	–	31.8	–	225.4	219.7	219.7	33.5	33.5
03/04	758.3	765.6	–	53.2	–	186.8	198.4	183.2	133.8	12.9
04/05	694.8	715.7	–	437.5	–	201.4	201.3	193.4	0.0	64.0
05/06	634.3	632.1	–	5.2	–	176.5	182.0	182.0	30.1	30.1
06/07	660.7	666.9	–	38.2	–	200.2	190.8	190.8	87.3	87.3
07/08	707.8	684.0	–	565.5	–	228.1	227.1	226.0	1.0	4.5
08/09	713.3	711.2	–	4.4	–	232.2	243.3	227.7	124.7	19.6
09/10	589.0	587.2	–	3.2	–	212.7	224.7	207.6	145.5	25.6
10/11	777.3	795.7	–	336.8	–	187.5	195.0	191.7	57.0	17.8
11/12	688.7	693.9	–	27.2	–	191.4	197.8	197.8	40.9	40.9
12/13	602.1	605.4	–	10.4	–	200.2	203.8	203.8	13.2	13.2
Total	16 811.5	16 475.4	–	43 514.0	–	4 782.0	4 776.4	4 668.5	4 347.3	3 056.1
	SCH 3					SCH 4				
89/90	272.4	232.4	232.4	1 602.9	1 602.9	27.2	13.5	13.5	186.8	186.8
90/91	226.8	215.7	215.7	121.7	121.7	20.6	18.6	18.6	4.3	4.3
91/92	260.2	261.9	246.5	3.0	186.4	33.8	32.8	32.8	1.0	1.0
92/93	220.0	212.4	212.4	57.9	57.9	38.1	32.9	32.9	27.4	27.4
93/94	202.1	221.4	206.1	372.2	15.9	41.2	41.2	41.2	0.0	0.0
94/95	236.6	278.6	249.9	1 767.6	177.2	85.6	79.0	79.0	43.3	43.3
95/96	293.1	320.3	301.4	736.2	68.9	216.3	180.2	180.2	1 303.1	1 303.1
96/97	289.4	269.6	263.2	392.7	687.1	178.4	218.8	217.3	1 632.2	1 510.5
97/98	271.2	283.8	281.1	159.3	97.8	121.7	142.7	135.9	440.3	200.5
98/99	335.3	356.0	346.5	429.9	126.7	105.7	116.6	106.6	117.2	0.7
99/00	343.3	346.7	332.5	11.5	118.3	97.4	104.2	104.2	45.6	45.6
00/01	363.5	375.8	374.1	149.9	112.3	99.8	104.6	100.9	23.4	1.3
01/02	324.0	326.2	324.7	4.9	0.4	92.6	89.4	89.4	10.0	10.0
02/03	410.4	412.4	404.8	4.0	31.5	130.2	125.5	125.5	21.6	21.6
03/04	323.5	335.8	335.8	151.8	151.8	149.2	144.0	144.0	27.4	27.4
04/05	423.9	432.2	419.0	69.9	24.0	206.0	226.1	222.8	406.0	282.2
05/06	324.7	305.2	305.2	377.3	377.3	182.9	192.1	190.4	84.0	57.2
06/07	376.2	402.2	382.5	674.3	39.6	87.6	92.7	92.7	26.6	26.6
07/08	345.1	329.2	329.2	252.1	252.1	133.5	125.3	122.2	68.4	127.8
08/09	363.6	384.2	384.2	423.6	423.6	144.9	147.5	147.5	6.9	6.9
09/10	425.5	418.6	418.6	47.7	47.7	190.8	201.9	201.9	122.9	122.9
10/11	365.7	362.3	362.3	11.8	11.8	173.8	164.1	164.1	94.9	94.9
11/12	351.1	337.0	337.0	199.1	199.1	201.4	193.5	193.5	63.5	63.5
12/13	319.9	321.0	321.0	1.3	1.3	126.6	135.7	135.7	82.3	82.3
Total	7 667.6	7 741.1	7 586.2	8 022.5	4 933.1	2 885.5	2 922.8	2 892.8	4 839.0	4 247.6

Table E.5. (cont.) Annual statistics associated with the selected minima in SCH 5, SCH 7 and SCH 8. MHR_y **= QMR/MHR landings in year *y*;** $gg_y^0 =$ **unedited landings in year *y*;** $gg_y =$ **edited landings at selected minimum in year *y*. The final two columns are the annual result of applying Eq. E.3 to the unedited landings and to the selected QMA "minimum" defined in Table E.1.**

	SCH 5					SCH 7					SCH 8				
Fishing year	MHR_y	gg_y^0	gg_y	$\left(gg_y^0 - MHR_y\right)$	$\left(gg_y - MHR_y\right)$	MHR_y	gg_y^0	gg_y	$\left(gg_y^0 - MHR_y\right)$	$\left(gg_y - MHR_y\right)$	MHR_y	gg_y^0	gg_y	$\left(gg_y^0 - MHR_y\right)$	$\left(gg_y - MHR_y\right)$
89/90	459.9	376.2	376.2	7 016.4	7 016.4	515.8	480.1	478.2	1 271.9	1 413.8	371.2	342.6	342.6	820.4	820.4
90/91	479.8	499.6	499.6	392.9	392.9	420.4	411.1	408.1	85.2	150.1	368.6	320.9	320.9	2 275.3	2 275.3
91/92	598.9	623.0	623.0	580.8	580.8	431.0	408.5	400.7	505.7	918.3	400.6	346.1	346.1	2 970.1	2 970.1
92/93	593.0	607.1	607.1	198.3	198.3	481.9	485.8	485.8	15.8	15.8	482.3	461.9	461.9	418.0	418.0
93/94	624.1	579.8	579.8	1 965.2	1 965.2	473.2	454.8	450.2	338.0	526.1	448.1	411.9	411.9	1 312.0	1 312.0
94/95	655.9	640.4	633.8	240.4	489.8	369.6	404.1	390.3	1 195.4	430.8	417.0	418.3	418.3	1.8	1.8
95/96	697.3	723.9	723.9	703.9	703.9	638.1	677.9	670.9	1 584.1	1 078.0	520.9	526.5	526.5	31.2	31.2
96/97	636.2	626.9	626.9	85.6	85.6	545.1	624.4	574.3	6 282.4	853.3	458.3	446.1	446.1	149.7	149.7
97/98	620.7	647.9	647.9	742.7	742.7	467.9	496.3	481.1	805.1	173.9	443.2	423.9	423.9	373.8	373.8
98/99	713.9	763.4	758.8	2 450.1	2 019.0	681.7	669.2	666.7	156.5	225.2	533.2	1 332.8	524.8	639 422.9	71.2
99/00	705.5	681.1	681.1	597.9	597.9	639.2	639.0	638.0	0.0	1.6	469.3	456.6	456.6	161.1	161.1
00/01	724.2	730.0	721.6	32.6	7.0	575.5	594.3	583.9	353.8	70.8	452.9	434.5	434.5	338.0	338.0
01/02	671.0	659.7	659.7	129.6	129.6	500.0	498.7	495.6	1.7	19.7	447.7	460.7	460.7	168.7	168.7
02/03	746.5	764.4	749.6	320.4	9.8	511.7	541.9	535.7	908.8	573.7	447.5	447.1	447.1	0.2	0.2
03/04	727.2	694.0	694.0	1 101.6	1 101.6	574.2	573.9	567.8	0.1	40.4	404.5	390.1	390.1	209.0	209.0
04/05	742.8	736.9	731.3	34.5	132.4	546.0	551.4	538.8	28.9	52.3	553.6	548.3	548.3	28.2	28.2
05/06	711.7	645.9	645.9	4 328.3	4 328.3	568.4	568.6	560.7	0.0	60.2	502.6	511.9	511.9	87.1	87.1
06/07	738.5	706.4	706.4	1 027.7	1 027.7	583.0	598.2	583.3	232.5	0.1	533.6	518.1	518.1	240.4	240.4
07/08	781.0	766.6	766.6	208.3	208.3	605.7	619.8	616.1	201.0	110.0	496.8	492.3	492.3	20.0	20.0
08/09	741.5	731.0	719.1	110.7	499.7	694.2	694.7	692.7	0.2	2.4	588.0	588.3	588.3	0.1	0.1
09/10	784.1	786.5	781.1	5.4	9.2	606.1	604.5	604.5	2.6	2.6	460.4	459.2	459.2	1.6	1.6
10/11	700.6	692.3	692.3	69.3	69.3	677.2	686.7	679.6	89.6	5.7	586.6	578.6	578.6	63.5	63.5
11/12	729.0	716.4	716.4	158.1	158.1	603.2	613.6	607.5	107.7	17.9	514.7	505.9	505.9	76.9	76.9
12/13	747.6	748.4	748.4	0.7	0.7	655.6	655.7	655.7	0.0	0.0	512.5	509.6	509.6	8.2	8.2
Total	16 331.1	16 147.7	16 090.6	22 501.6	22 474.4	13 364.7	13 553.4	13 366.3	14 167.3	6 742.8	11 414.3	11 932.3	11 124.2	649 178.1	9 826.4

Table E.6. Total landings (t) dropped over the two parameter search defined in Table E.2. The quantile/ratio pair with the lowest Ssq^2 (Eq. E.3) is coloured aqua for each SCH QMA.

					$(rat_{t,s})$
	2	4	6	8	10
SCH 1					
90	516.8	327.7	295.6	281.7	187.6
92	486.2	321.0	290.3	278.3	184.9
94	449.8	312.7	284.5	273.3	179.8
96	400.7	294.3	266.1	257.2	167.0
97	–	–	–	–	–
98	342.0	269.5	241.3	236.4	152.6
99	311.1	261.5	233.3	228.4	144.6
99.99	107.3	88.8	69.3	69.3	0.0
SCH 3					
86	–	–	–	–	–
88	–	–	–	–	–
90	–	–	–	–	–
92	–	–	–	–	–
94	–	–	–	–	–
96	212.7	183.2	180.0	156.6	130.6
97	202.8	177.2	175.0	152.5	127.6
98	190.7	169.1	168.3	146.4	122.0
99	172.2	154.6	154.6	135.0	110.6
99.9	116.8	109.9	109.9	90.3	70.8
99.99	48.6	48.6	48.6	28.9	15.4
SCH 5					
90	72.8	52.2	52.2	39.1	13.7
92	57.2	40.4	40.4	31.2	13.7
94	36.0	29.4	29.4	20.2	8.4
97	11.8	11.8	11.8	11.8	0.0
98	11.8	11.8	11.8	11.8	0.0
SCH 8					
93	909.3	829.7	820.9	820.9	820.9
94	904.3	827.2	818.4	818.4	818.4
95	898.9	827.2	818.4	818.4	818.4
96	891.9	823.8	815.0	815.0	815.0
97	870.6	815.0	815.0	815.0	815.0
98	859.7	815.0	815.0	815.0	815.0
99	837.0	808.1	808.1	808.1	808.1

			$(rat_{t,s})$
	2	4	6
SCH 2			
90	–	–	–
92	–	–	–
94	–	–	–
96	138.4	113.7	103.7
97	134.2	111.6	102.3
98	126.2	108.0	99.6
99	111.1	95.5	88.3
99.99	–	–	–
SCH 4			
86	30.0	22.0	–
88	28.7	22.0	–
90	22.5	20.5	20.5
92	18.7	18.7	18.7
94	18.7	18.7	18.7
96	15.0	15.0	15.0
97	–	–	–
98	–	–	–
99	–	–	–
99.9	–	–	–
99.99	–	–	–
SCH 7			
90	428.0	190.9	157.0
92	419.8	187.2	153.3
94	394.8	182.6	149.8
97	342.4	165.5	137.9
98	300.7	150.8	126.2

Table E.7. Differences between the edited total landings and the sum of the QMR/MHR landings $\left(\sum_{y=89/90}^{y=11/12}\left(gg_y - MHR_y\right)\right)$ over the two parameter search defined in Table E.2. The quantile/ratio pair with the lowest Ssq^2 is coloured blue for each SCH QMA. Selected pairings (Table E.1) which differed from the actual minimum are marked in grey.

					$(rat_{t,s})$
	2	4	6	8	10
SCH 1					
90	- 853	- 664	- 632	- 618	- 524
92	- 822	- 657	- 627	- 615	- 521
94	- 786	- 649	- 621	- 610	- 516
96	- 737	- 631	- 602	- 593	- 503
97	–	–	–	–	–
98	- 678	- 606	- 578	- 573	- 489
99	- 647	- 598	- 570	- 565	- 481
99.99	- 444	- 425	- 406	- 406	- 336
SCH 3					
86	–	–	–	–	–
88	–	–	–	–	–
90	–	–	–	–	–
92	–	–	–	–	–
94	–	–	–	–	–
96	- 139	- 110	- 106	- 83	- 57
97	- 129	- 104	- 102	- 79	- 54
98	- 117	- 96	- 95	- 73	- 48
99	- 99	- 81	- 81	- 61	- 37
99.9	- 43	- 36	- 36	- 17	3
99.99	25	25	25	45	58
SCH 5					
90	-256	-236	-236	-223	-197
92	-241	-224	-224	-215	-197
94	-219	-213	-213	-204	-192
97	-195	-195	-195	-195	-183
98	-195	-195	-195	-195	-183
SCH 8					
93	- 391	- 312	- 303	- 303	- 303
94	- 386	- 309	- 300	- 300	- 300
95	- 381	- 309	- 300	- 300	- 300
96	- 374	- 306	- 297	- 297	- 297
97	- 353	- 297	- 297	- 297	- 297
98	- 342	- 297	- 297	- 297	- 297
99	- 319	- 290	- 290	- 290	- 290

			$(rat_{t,s})$
	2	4	6
SCH 2			
90	–	–	–
92	–	–	–
94	–	–	–
96	- 144	- 119	- 109
97	- 140	- 117	- 108
98	- 132	- 114	- 105
99	- 117	- 101	- 94
99.99	–	–	–
SCH 4			
86	7	15	
88	9	15	
90	15	17	17
92	19	19	19
94	19	19	19
96	22	22	22
97	–	–	–
98	–	–	–
99	–	–	–
99.9	–	–	–
99.99	–	–	–
SCH 7			
90	-239	-2	32
92	-231	2	35
94	-206	6	39
97	-154	23	51
98	-112	38	63

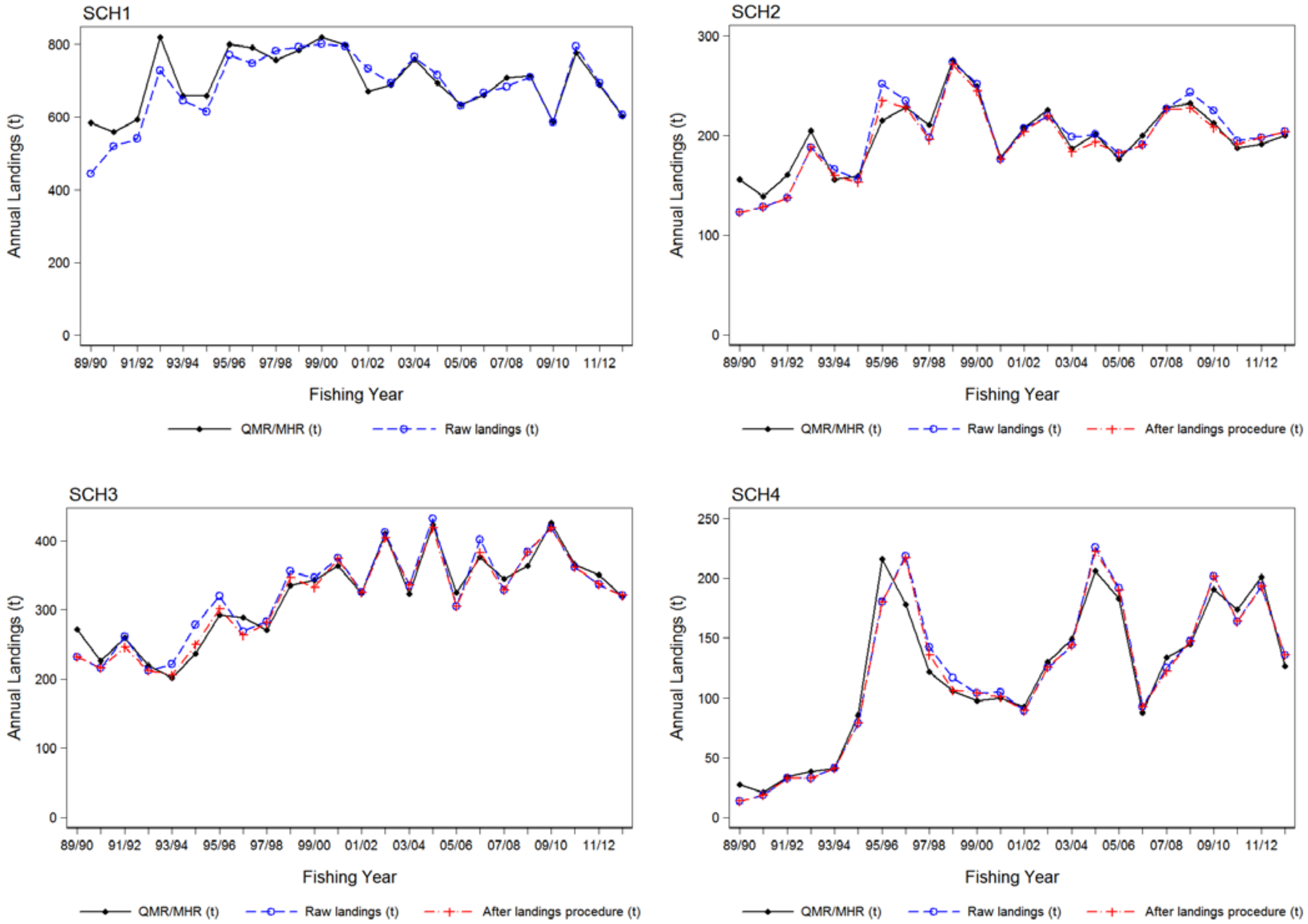

Figure E.1: Comparison of QMR/MHR annual total landings for SCH 1, SCH 2, SCH 3 and SCH 4 with two extracts: A: unedited or "raw" landings; and B: total landings after dropping the trips identified at the selected QMA "minimum" quantile/ratio pairing defined in Table E.1. Note that SCH 1 did not identify any landings to drop.

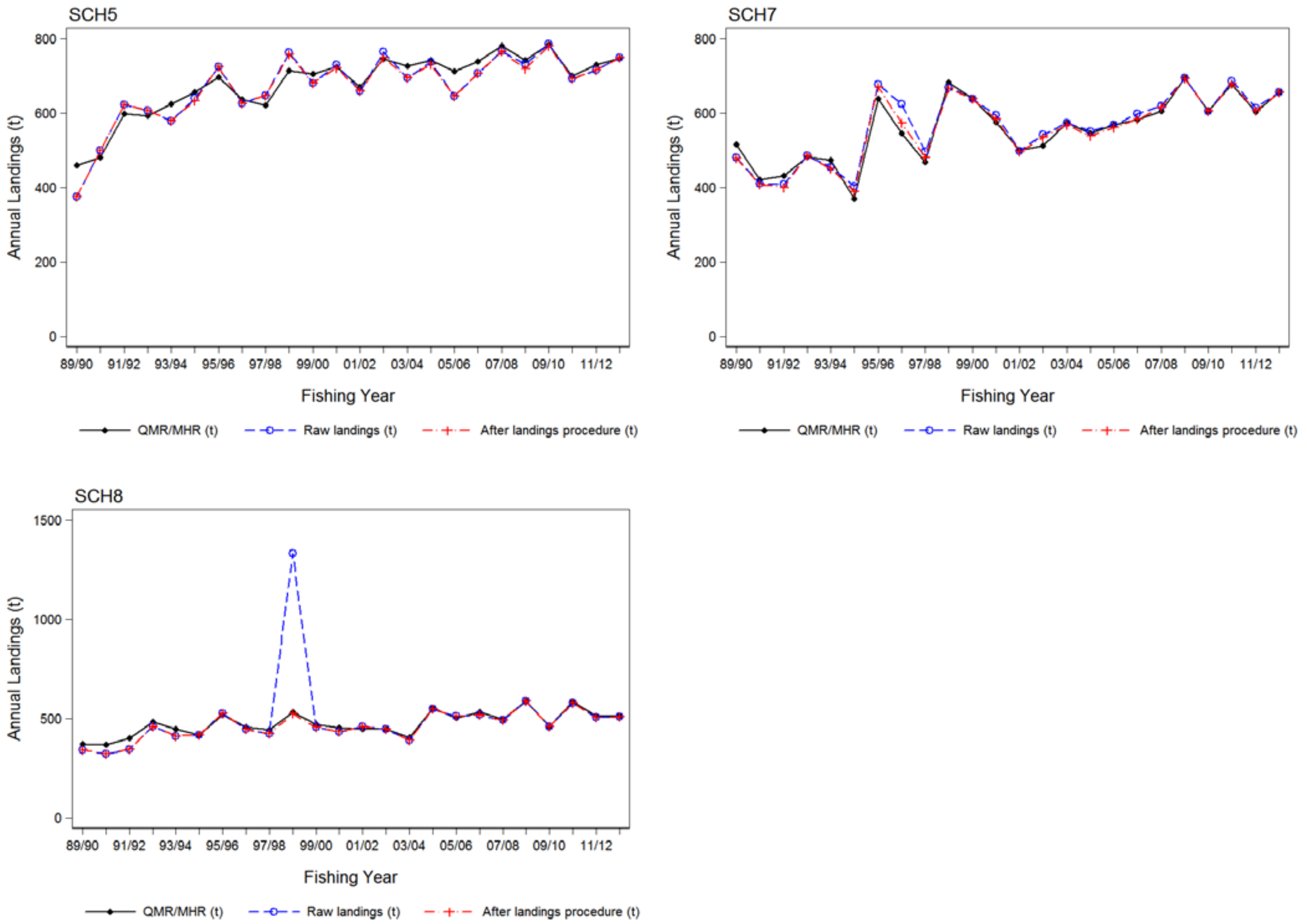

Figure E.1: (cont.) **Comparison of QMR/MHR annual total landings for SCH 5, SCH 7 and SCH 8 with two extracts: A: unedited or "raw" landings; and B: total landings after dropping the trips identified at the selected QMA "minimum" quantile/ratio pairing defined in Table E.1.**

Appendix F. DATA PREPARATION INFORMATION BY QMA

Table F.1A. Comparison of the total adjusted QMR/MHR catch (t) for SCH 1 and SCH 2, reported by fishing year, with the sum of the corrected landed catch totals (bottom part of the MPI CELR form), the total catch after matching effort with landing data ('Analysis' data set) and the sum of the estimated catches from the Analysis data set. Data source: MPI replog 9302: 1989–90 to 2012–13. Landings and QMR/MHR totals have been adjusted to consistent conversion factors across years.

	SCH 1							SCH 2						
Fishing Year	QMR/ MHR (t)	Total landed catch (t)	% landed/ QMR/ MHR	Total Analysis catch (t)	% Analysis /Landed	Total Estimated Catch (t)	% Estimated /Analysis	QMR/ MHR (t)	Total landed catch (t)[1]	% landed/ QMR/ MHR	Total Analysis catch (t)	% Analysis /Landed	Total Estimated Catch (t)	% Estimated /Analysis
89/90	585	413	71	409	99	311	76	156	114	73	94	83	64	68
90/91	559	411	73	406	99	283	70	139	121	87	118	98	78	66
91/92	594	475	80	467	98	348	74	161	131	81	126	97	84	67
92/93	820	678	83	669	99	461	69	205	178	87	172	97	115	67
93/94	658	645	98	642	100	412	64	156	160	102	150	94	93	62
94/95	658	612	93	608	99	444	73	159	153	96	136	89	86	63
95/96	800	748	93	695	93	413	59	215	234	109	202	86	122	60
96/97	791	718	91	688	96	397	58	228	219	96	181	83	106	59
97/98	757	780	103	748	96	387	52	210	195	93	177	91	94	53
98/99	784	788	101	733	93	390	53	275	269	98	248	92	138	56
99/00	820	800	98	778	97	416	53	250	242	97	210	87	121	58
00/01	799	788	99	757	96	470	62	178	175	98	165	94	91	55
01/02	670	731	109	692	95	470	68	208	198	95	187	94	109	58
02/03	689	693	100	669	97	442	66	225	218	97	204	94	121	59
03/04	758	762	100	736	97	491	67	187	181	97	163	90	82	50
04/05	695	706	102	679	96	400	59	201	192	95	180	94	88	49
05/06	634	629	99	610	97	356	58	176	181	103	174	96	93	53
06/07	661	657	99	597	91	378	63	200	191	95	180	94	93	52
07/08	708	672	95	650	97	446	69	228	222	97	210	95	147	70
08/09	713	703	98	669	95	452	68	232	227	98	219	97	149	68
09/10	589	578	98	544	94	362	66	213	207	97	197	95	127	65
10/11	777	787	101	720	91	517	72	187	189	101	171	91	110	64
11/12	689	681	99	623	91	407	65	191	196	102	175	89	119	68
12/13	602	591	98	543	92	360	66	200	200	100	187	93	115	62
Total	16 812	16 044	95	15 332	96	9 816	64	4 782	4 592	96	4 229	92	2 546	60

[1] includes all SCH 2 landings in replog 9302 except for 25 trips excluded for being "out of range" (see Table E.1).

Table F.1B: Caption as for Table F.1A, showing annual totals for SCH 3 and SCH 4.

	SCH 3							SCH 4						
Fishing Year	QMR/ MHR (t)	Total landed catch (t)[2]	% landed/ QMR/ MHR	Total Analysis catch (t)	% Analysis /Landed	Total Estimated Catch (t)	% Estimated /Analysis	QMR/ MHR (t)	Total landed catch (t)[3]	% landed/ QMR/ MHR	Total Analysis catch (t)	% Analysis /Landed	Total Estimated Catch (t)	% Estimated /Analysis
89/90	272	209	77	195	93	128	66	27	12	44	9	71	7	85
90/91	227	201	89	193	96	138	72	21	18	88	11	60	7	65
91/92	260	231	89	225	97	157	70	34	31	92	30	96	18	61
92/93	220	199	91	194	97	127	65	38	31	82	25	78	13	54
93/94	202	206	102	192	94	122	63	41	41	100	39	95	21	53
94/95	237	246	104	231	94	155	67	86	79	92	37	47	21	56
95/96	293	298	102	267	90	181	68	216	174	80	154	88	105	69
96/97	289	263	91	247	94	158	64	178	212	119	195	92	122	63
97/98	271	268	99	246	92	148	60	122	120	99	109	91	76	69
98/99	335	321	96	296	92	203	69	106	104	98	101	97	76	75
99/00	343	331	96	312	94	188	60	97	104	107	101	97	75	74
00/01	364	367	101	342	93	215	63	100	101	101	94	93	59	63
01/02	324	316	98	300	95	207	69	93	88	95	87	98	54	62
02/03	410	405	99	371	92	257	69	130	123	94	117	95	98	83
03/04	323	333	103	287	86	192	67	149	144	96	130	90	113	87
04/05	424	412	97	391	95	274	70	206	204	99	203	99	118	58
05/06	325	300	92	276	92	169	61	183	175	96	163	93	94	58
06/07	376	381	101	347	91	242	70	88	93	106	92	99	56	62
07/08	345	328	95	296	90	216	73	134	122	92	122	100	74	60
08/09	364	380	105	319	84	233	73	145	147	101	144	98	106	73
09/10	426	413	97	369	89	258	70	191	202	106	197	98	153	78
10/11	366	352	96	323	92	220	68	174	164	94	163	99	138	85
11/12	351	328	93	311	95	205	66	201	193	96	193	100	157	82
12/13	320	316	99	289	91	192	66	127	136	107	130	96	110	84
Total	7668	7405	97	6819	92	4587	67	2 885	2 818	98	2 645	94	1 871	71

[2] includes all SCH 3 landings in replog 9302 except for 27 trips excluded for being “out of range” (see Table E.1).
[3] includes all SCH 4 landings in replog 9302 except for 10 trips excluded for being “out of range” (see Table E.1).

Table F.1C: Caption as for Table F.1, showing annual totals for SCH 5 and SCH 7.

Fishing Year	SCH 5 QMR/ MHR (t)	SCH 5 Total landed catch (t)[4]	SCH 5 % landed/ QMR/ MHR	SCH 5 Total Analysis catch (t)	SCH 5 % Analysis /Landed	SCH 5 Total Estimated Catch (t)	SCH 5 % Estimated /Analysis	SCH 7 QMR/ MHR (t)	SCH 7 Total landed catch (t)[5]	SCH 7 % landed/ QMR/ MHR	SCH 7 Total Analysis catch (t)	SCH 7 % Analysis /Landed	SCH 7 Total Estimated Catch (t)	SCH 7 % Estimated /Analysis
89/90	460	366	80	348	95	350	101	516	454	88	399	88	295	74
90/91	480	494	103	484	98	441	91	420	393	94	352	90	261	74
91/92	599	584	97	551	94	506	92	431	381	88	326	86	226	70
92/93	593	563	95	559	99	495	89	482	460	95	340	74	243	72
93/94	624	576	92	574	100	480	84	473	450	95	373	83	276	74
94/95	656	632	96	625	99	493	79	370	389	105	354	91	232	66
95/96	697	719	103	653	91	369	56	638	637	100	480	75	314	65
96/97	636	627	99	595	95	383	64	545	543	100	383	71	242	63
97/98	621	627	101	576	92	385	67	468	449	96	336	75	225	67
98/99	714	666	93	657	99	451	69	682	663	97	539	81	284	53
99/00	706	680	96	650	96	561	86	639	636	100	486	76	284	58
00/01	724	681	94	635	93	573	90	576	581	101	459	79	224	49
01/02	671	658	98	634	96	561	89	500	492	98	408	83	209	51
02/03	746	748	100	725	97	652	90	512	522	102	449	86	220	49
03/04	727	690	95	677	98	605	89	574	565	98	489	87	233	48
04/05	743	730	98	668	91	616	92	546	519	95	423	81	201	48
05/06	712	646	91	623	96	576	93	568	547	96	431	79	222	52
06/07	738	705	95	661	94	606	92	583	573	98	490	85	280	57
07/08	781	759	97	733	97	700	96	606	610	101	398	65	275	69
08/09	741	719	97	694	97	640	92	694	686	99	525	77	373	71
09/10	784	781	100	749	96	692	92	606	580	96	427	74	306	72
10/11	701	690	99	646	94	583	90	677	675	100	477	71	347	73
11/12	729	706	97	674	96	615	91	603	600	99	475	79	360	76
12/13	748	745	100	706	95	633	90	656	626	95	505	81	353	70
Total	16 331	15 790	97	15 096	96	12 968	86	13365	13032	98	10323	79	6484	63

[4] includes all SCH 5 landings in replog 9302 except for 8 trips excluded for being “out of range” (see Table E.1).

[5] includes all SCH 7 landings in replog 9302 except for 41 trips excluded for being “out of range” (see Table E.1).

Table F.1D Caption as for Table F.1A, showing annual totals for SCH 8.

Fishing Year	QMR/MHR (t)	Total landed catch (t)[6]	% landed/ QMR/MHR	Total Analysis catch (t)	% Analysis /Landed	Total Estimated Catch (t)	% Estimated /Analysis
89/90	371	311	84	249	80	229	92
90/91	369	310	84	210	68	186	88
91/92	401	327	82	242	74	219	90
92/93	482	438	91	309	71	275	89
93/94	448	411	92	311	76	262	84
94/95	417	418	100	363	87	305	84
95/96	521	523	100	376	72	278	74
96/97	458	433	94	326	75	234	72
97/98	443	422	95	293	69	188	64
98/99	533	523	98	393	75	278	71
99/00	469	455	97	270	59	197	73
00/01	453	433	96	325	75	227	70
01/02	448	455	102	309	68	221	72
02/03	448	430	96	288	67	214	74
03/04	405	385	95	286	74	210	74
04/05	554	537	97	381	71	268	70
05/06	503	503	100	332	66	248	75
06/07	534	516	97	381	74	296	78
07/08	497	490	99	318	65	254	80
08/09	588	584	99	352	60	298	85
09/10	460	453	98	287	63	272	95
10/11	587	576	98	354	62	307	87
11/12	515	503	98	284	57	240	85
12/13	512	507	99	301	59	276	92
Total	11 414	10 943	96	7 541	69	5 984	79

[6] includes all SCH 8 landings in replog 9302 except for 1 trip excluded for being “out of range” (Table E.1).

Table F.2A. Summary statistics pertaining to the reporting of estimated catch from the SCH 1 and SCH 2 analysis datasets.

	SCH 1							SCH 2						
	Trips with landed catch but which report no estimated catch			Statistics (excluding 0s) for the ratio of landed/estimated catch by trip				Trips with landed catch but which report no estimated catch			Statistics (excluding 0s) for the ratio of landed/estimated catch by trip			
Fishing year	Trips: % relative to total trips	Landings: % relative to total landings	Landings (t)	5% quantile	Median	Mean	95% quantile	Trips: % relative to total trips	Landings: % relative to total landings	Landings (t)	5% quantile	Median	Mean	95% quantile
89/90	31	11	63	0.62	0.98	1.49	2.60	42	18	29	0.74	1.00	1.40	3.24
90/91	34	12	69	0.64	1.04	1.53	3.17	42	18	26	0.74	1.00	1.59	3.49
91/92	33	9	56	0.59	1.07	1.49	3.10	47	24	38	0.60	1.00	1.51	3.56
92/93	30	7	61	0.59	1.07	1.59	3.41	42	17	36	0.62	1.02	1.88	5.55
93/94	32	10	63	0.60	1.25	1.73	3.70	42	17	26	0.70	1.13	1.81	4.72
94/95	30	8	54	0.60	1.20	1.68	3.53	47	21	33	0.66	1.20	1.83	4.26
95/96	30	7	59	0.66	1.25	2.95	3.66	47	23	49	0.71	1.34	1.85	4.63
96/97	32	12	99	0.66	1.40	2.21	3.91	46	16	36	0.66	1.61	2.06	5.00
97/98	35	12	91	0.60	1.49	1.89	4.10	41	16	33	0.68	1.51	2.01	5.04
98/99	35	10	78	0.75	1.69	2.91	4.42	43	11	31	0.73	1.46	1.97	4.33
99/00	31	12	99	0.72	1.76	2.57	5.03	42	13	32	0.67	1.56	2.25	5.26
00/01	25	6	50	0.73	1.66	2.83	4.64	43	16	28	0.72	1.74	2.43	6.43
01/02	28	8	50	0.78	1.64	2.17	4.68	42	12	26	0.67	1.76	2.33	6.42
02/03	24	6	42	0.78	1.74	2.37	5.00	40	10	24	0.73	1.77	2.52	6.50
03/04	25	7	51	0.68	1.70	2.35	4.87	41	12	23	0.72	1.77	2.54	6.71
04/05	30	11	75	0.69	1.80	2.37	5.67	45	14	28	0.80	1.83	2.57	7.18
05/06	30	9	54	0.73	1.83	2.35	5.40	50	16	28	0.63	1.86	2.83	6.83
06/07	28	7	45	0.76	1.76	2.36	5.19	46	12	25	0.73	1.90	2.52	6.57
07/08	19	4	31	0.67	1.67	2.27	5.27	21	5	10	0.66	1.80	2.57	6.30
08/09	16	3	22	0.73	1.71	2.27	5.67	14	3	6	0.68	1.75	2.37	6.00
09/10	18	3	16	0.71	1.71	2.31	5.43	19	5	10	0.66	1.91	2.47	6.45
10/11	18	3	21	0.68	1.60	2.41	5.40	18	5	10	0.57	1.65	2.45	6.65
11/12	17	3	18	0.67	1.51	2.08	4.80	17	4	8	0.65	1.61	2.35	5.85
12/13	18	4	26	0.74	1.52	2.33	5.30	18	3	6	0.59	1.67	2.36	6.32
Total	28	8	1 293	0.68	1.50	2.19	4.50	37	12	601	0.67	1.55	2.21	5.75

Table F.2B. Summary statistics pertaining to the reporting of estimated catch from the SCH 3 and SCH 4 analysis datasets.

	SCH 3							SCH 4						
	Trips with landed catch but which report no estimated catch			Statistics (excluding 0s) for the ratio of landed/estimated catch by trip				Trips with landed catch but which report no estimated catch			Statistics (excluding 0s) for the ratio of landed/estimated catch by trip			
Fishing year	Trips: % relative to total trips	Landings: % relative to total landings	Landings (t)	5% quantile	Median	Mean	95% quantile	Trips: % relative to total trips	Landings: % relative to total landings	Landings (t)	5% quantile	Median	Mean	95% quantile
89/90	45	18	49	0.49	1.11	1.55	3.52	4	3	1	0.80	0.98	1.28	2.08
90/91	46	19	44	0.60	1.07	1.42	2.82	40	20	4	0.45	1.02	1.89	5.23
91/92	51	16	41	0.53	1.05	1.44	2.70	22	4	1	0.59	1.12	1.40	3.39
92/93	48	23	50	0.49	1.06	1.47	2.82	13	10	4	0.72	1.11	1.47	3.47
93/94	48	20	41	0.53	1.10	1.49	2.73	22	7	3	0.50	1.12	3.10	5.68
94/95	54	23	55	0.50	1.10	1.42	2.75	20	7	6	0.48	1.73	1.69	2.63
95/96	48	21	61	0.49	1.11	1.45	2.92	14	3	6	0.68	1.67	1.66	2.76
96/97	52	24	70	0.50	1.05	1.40	2.67	18	3	5	0.87	1.80	2.80	5.15
97/98	52	27	72	0.46	1.16	1.43	2.83	21	5	6	0.60	1.22	1.95	3.63
98/99	51	20	66	0.43	1.14	1.41	2.79	16	3	4	0.77	1.18	1.59	3.61
99/00	50	24	82	0.43	1.20	1.46	2.80	18	3	3	0.90	1.84	2.11	4.70
00/01	49	21	77	0.54	1.24	1.76	3.00	26	6	6	0.86	1.79	2.96	3.86
01/02	47	19	62	0.51	1.20	1.52	3.17	25	11	10	0.74	1.40	2.58	5.25
02/03	48	19	78	0.53	1.20	1.50	3.21	21	6	8	0.52	1.13	1.64	3.28
03/04	48	21	68	0.55	1.20	1.54	3.19	25	3	4	0.79	1.26	1.81	4.52
04/05	45	15	65	0.67	1.23	1.58	3.25	21	4	8	0.82	1.45	2.27	8.25
05/06	49	23	73	0.64	1.23	1.59	3.20	27	4	8	0.80	1.92	2.66	11.00
06/07	40	15	57	0.63	1.30	1.60	3.26	30	9	8	0.69	1.74	1.95	4.02
07/08	15	3	12	0.59	1.31	1.72	3.56	28	4	6	0.80	1.62	2.20	5.27
08/09	21	5	17	0.47	1.24	1.69	3.80	24	3	5	0.74	1.47	2.06	4.75
09/10	20	4	18	0.57	1.39	1.91	4.33	19	2	4	0.61	1.22	1.60	3.20
10/11	22	5	19	0.59	1.45	2.13	5.25	30	3	5	0.70	1.43	1.74	3.68
11/12	24	5	18	0.53	1.50	2.07	5.30	23	3	7	0.40	1.12	1.57	4.21
12/13	26	7	21	0.47	1.45	2.03	5.23	21	6	7	0.61	1.15	2.04	6.58
Total	43	16	1 214	0.52	1.20	1.62	3.38	21	4	128	0.63	1.37	2.02	4.15

Table F.2C. Summary statistics pertaining to the reporting of estimated catch from the SCH 5 and SCH 7 analysis datasets.

	SCH 5							SCH 7						
	Trips with landed catch but which report no estimated catch			Statistics (excluding 0s) for the ratio of landed/estimated catch by trip				Trips with landed catch but which report no estimated catch			Statistics (excluding 0s) for the ratio of landed/estimated catch by trip			
Fishing year	**Trips: % relative to total trips**	**Landings: % relative to total landings**	**Landings (t)**	**5% quantile**	**Median**	**Mean**	**95% quantile**	**Trips: % relative to total trips**	**Landings: % relative to total landings**	**Landings (t)**	**5% quantile**	**Median**	**Mean**	**95% quantile**
89/90	24	3	12	0.59	0.99	1.28	2.55	45	10	51	0.60	1.05	1.78	3.45
90/91	26	7	33	0.67	1.01	1.26	2.59	46	11	48	0.59	1.09	1.57	3.64
91/92	30	3	19	0.66	1.02	1.47	3.33	48	11	48	0.73	1.10	1.68	3.46
92/93	31	5	29	0.72	1.01	1.45	3.07	59	16	79	0.62	1.17	1.85	5.13
93/94	27	1	6	0.76	1.11	1.55	2.88	52	10	50	0.60	1.31	1.95	5.07
94/95	25	3	18	0.60	1.14	3.17	2.99	58	15	55	0.65	1.60	2.22	6.63
95/96	37	35	247	0.64	1.07	1.52	3.20	49	11	70	0.68	1.69	3.94	6.07
96/97	38	30	190	0.73	1.09	1.51	3.30	55	13	73	0.59	1.70	2.20	5.72
97/98	40	30	189	0.62	1.03	1.61	3.02	50	10	47	0.58	1.68	4.51	5.04
98/99	35	28	198	0.68	1.10	1.63	3.71	47	10	70	0.72	1.85	2.58	5.73
99/00	30	5	37	0.72	1.10	1.54	3.27	44	10	64	0.63	1.67	2.16	4.91
00/01	31	3	25	0.63	1.10	1.49	3.27	46	13	73	0.74	1.74	2.55	6.70
01/02	34	3	22	0.60	1.13	1.65	3.40	46	12	61	0.67	1.70	2.37	5.19
02/03	34	2	15	0.68	1.13	1.64	3.51	49	11	58	0.75	1.82	2.53	6.00
03/04	26	2	12	0.67	1.18	1.70	4.73	47	12	67	0.75	1.84	2.38	5.85
04/05	36	2	18	0.68	1.13	1.61	3.96	50	11	60	0.72	1.95	2.70	6.03
05/06	33	2	18	0.71	1.15	1.80	5.59	49	10	59	0.70	1.91	2.65	7.28
06/07	33	2	16	0.74	1.19	1.61	3.81	48	10	57	0.70	1.85	3.51	7.64
07/08	21	1	6	0.70	1.16	1.50	3.17	20	2	13	0.76	1.72	2.30	5.34
08/09	22	2	14	0.53	1.15	1.67	3.94	19	2	14	0.67	1.66	2.53	7.09
09/10	23	2	14	0.60	1.26	1.93	5.47	21	2	14	0.68	1.79	2.59	6.20
10/11	25	2	13	0.69	1.30	2.05	5.01	18	3	18	0.76	1.60	2.38	5.62
11/12	25	1	10	0.76	1.22	1.92	5.27	20	3	17	0.77	1.67	2.28	5.72
12/13	28	2	14	0.70	1.21	1.85	4.60	19	4	23	0.78	1.81	2.51	6.01
Total	30	7	1 174	0.67	1.13	1.69	3.75	42	9	1 189	0.70	1.65	2.50	5.71

Table F.2D. Summary statistics pertaining to the reporting of estimated catch from the SCH 8 analysis dataset.

Fishing year	Trips with landed catch but which report no estimated catch			Statistics (excluding 0s) for the ratio of landed/estimated catch by trip			
	Trips: % relative to total trips	Landings: % relative to total landings	Landings (t)	5% quantile	Median	Mean	95% quantile
89/90	14	4	15	0.71	1.03	1.40	2.78
90/91	17	5	20	0.74	1.10	1.44	2.59
91/92	18	5	20	0.67	1.02	1.33	2.24
92/93	19	1	7	0.69	1.01	1.37	2.36
93/94	23	3	12	0.70	1.20	1.53	2.50
94/95	25	5	19	0.74	1.20	1.56	2.80
95/96	27	5	24	0.74	1.24	3.06	2.83
96/97	29	4	18	0.75	1.13	1.79	3.02
97/98	25	5	22	0.68	1.18	7.69	3.77
98/99	27	5	25	0.67	1.13	1.80	3.20
99/00	29	7	33	0.60	1.18	1.63	3.74
00/01	21	2	10	0.68	1.25	1.63	3.50
01/02	23	3	14	0.72	1.36	1.75	3.46
02/03	25	5	22	0.59	1.25	1.76	3.55
03/04	25	4	15	0.73	1.26	1.94	4.20
04/05	29	3	17	0.65	1.20	1.48	2.99
05/06	29	6	29	0.75	1.23	1.63	3.80
06/07	22	1	7	0.72	1.16	1.42	2.93
07/08	10	1	3	0.66	1.17	1.68	4.05
08/09	10	0	2	0.60	1.23	1.91	3.51
09/10	12	1	3	0.65	1.19	1.63	3.50
10/11	13	1	3	0.75	1.23	1.63	3.40
11/12	16	1	6	0.72	1.27	1.65	3.77
12/13	14	1	4	0.73	1.24	1.58	3.48
Total	21	3	351	0.70	1.17	1.93	3.12

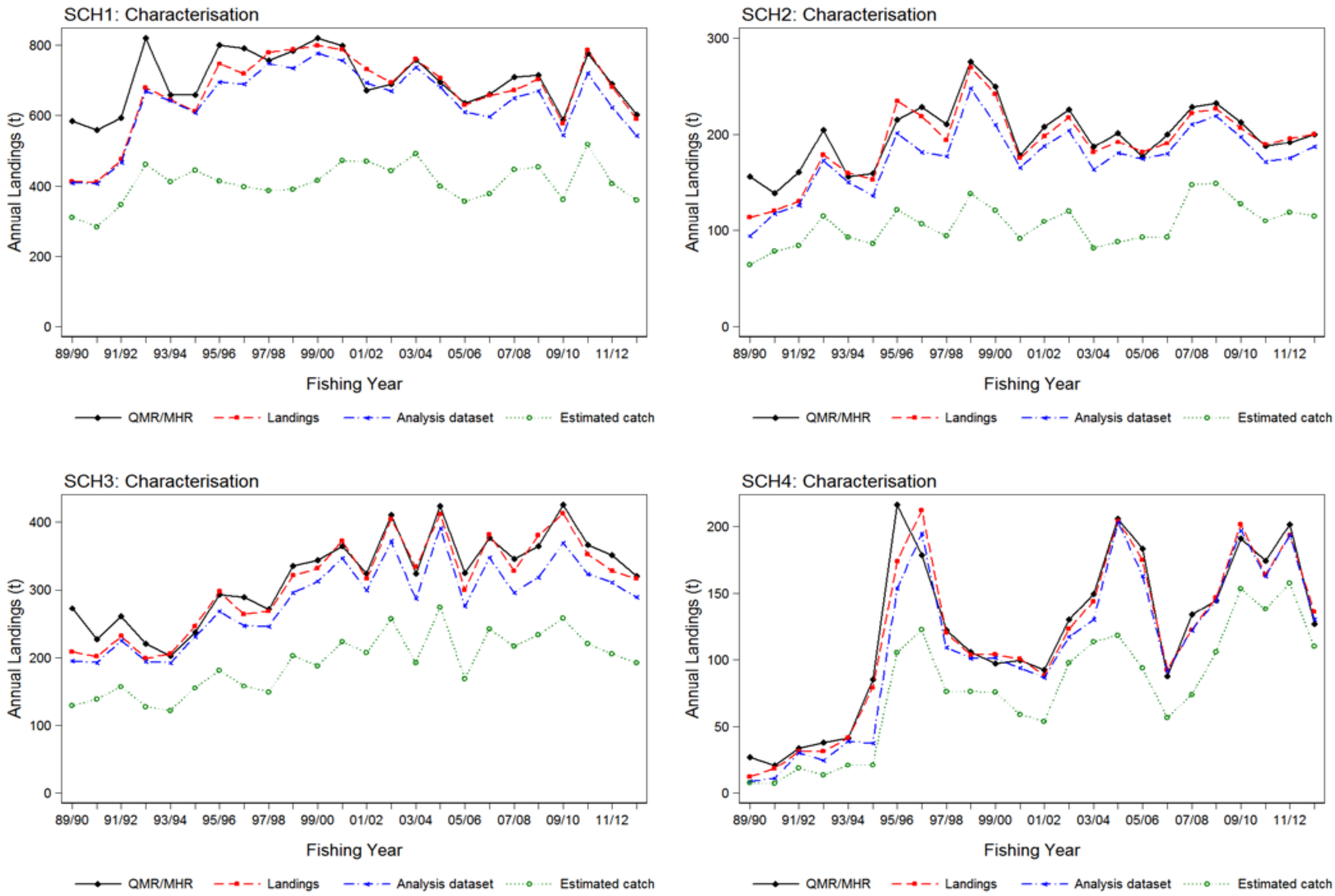

Figure F.1A: Plots of the SCH 1, SCH 2, SCH 3 and SCH 4 catch datasets using annual totals presented in Table F.1. Note that both the QMR/MHR totals and the landings have been adjusted to consistent conversion factors in all subplots.

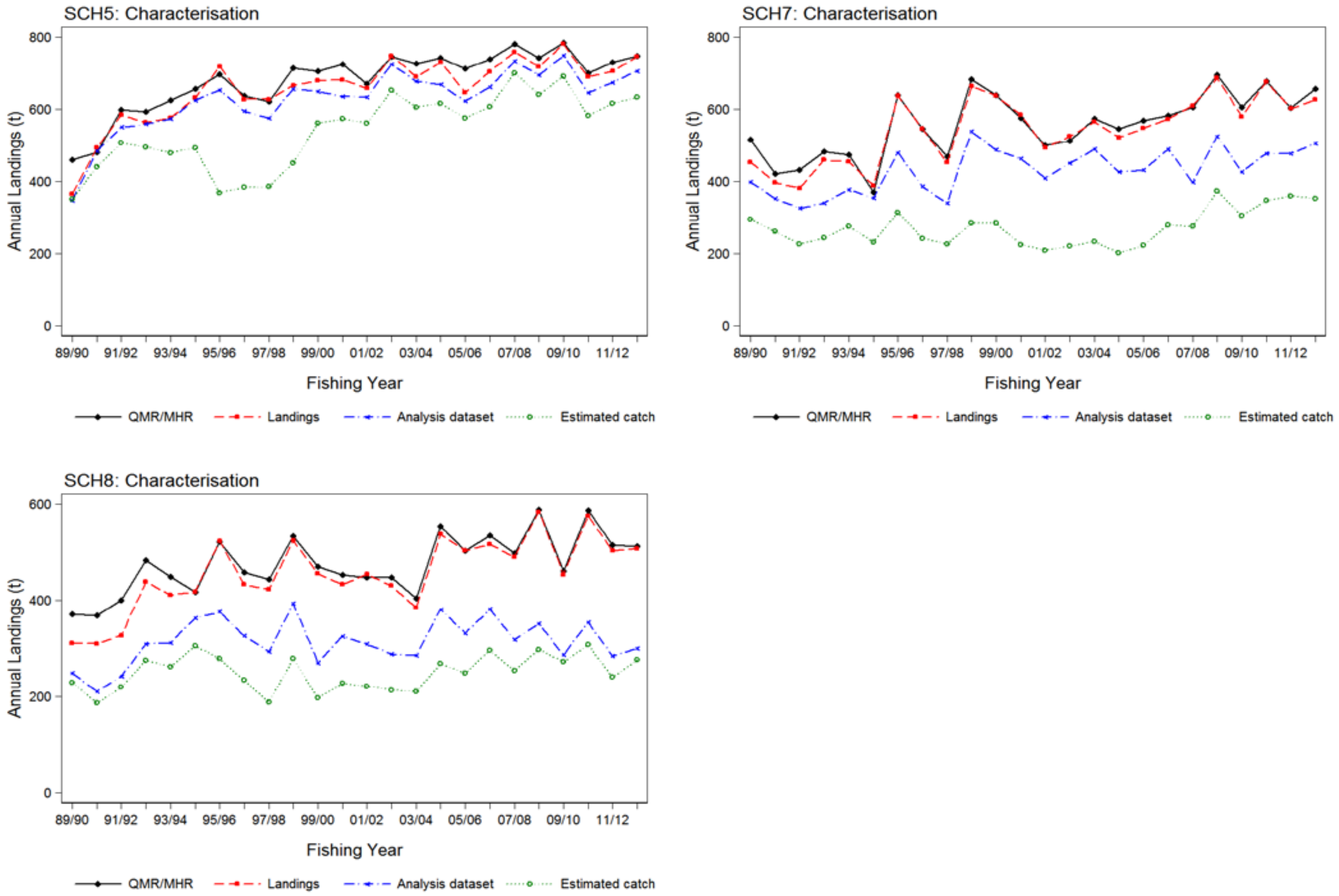

Figure F.1B: Plots of the SCH 5, SCH 7 and SCH 8 catch datasets using annual totals presented in Table F.1. Note that both the QMR/MHR totals and the landings have been adjusted to consistent conversion factors in all subplots.

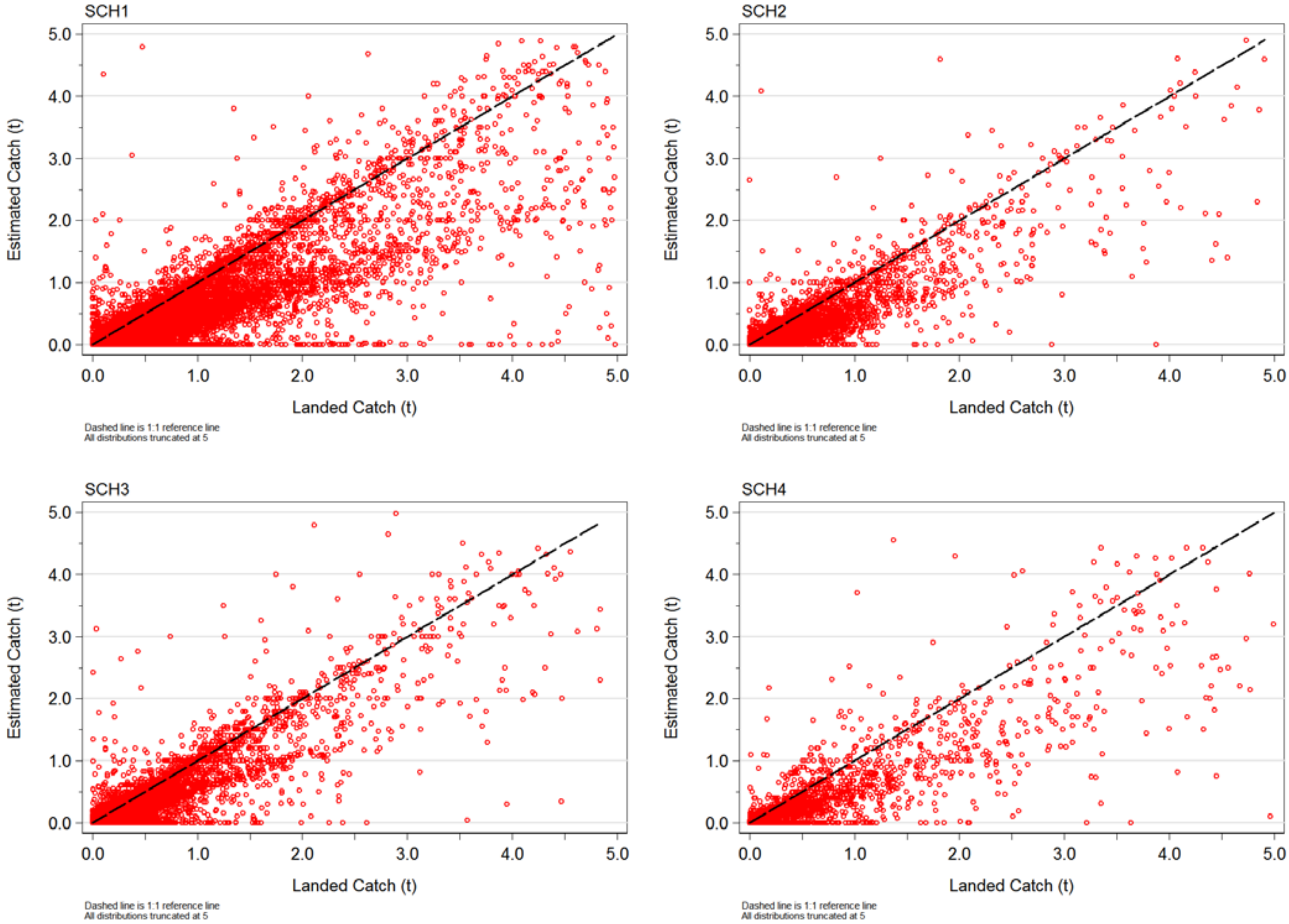

Figure F.2A: Scatter plots of the sum of landed and estimated school shark catch for every trip in each of the SCH 1, SCH 2, SCH 3 and SCH 4 analysis datasets.

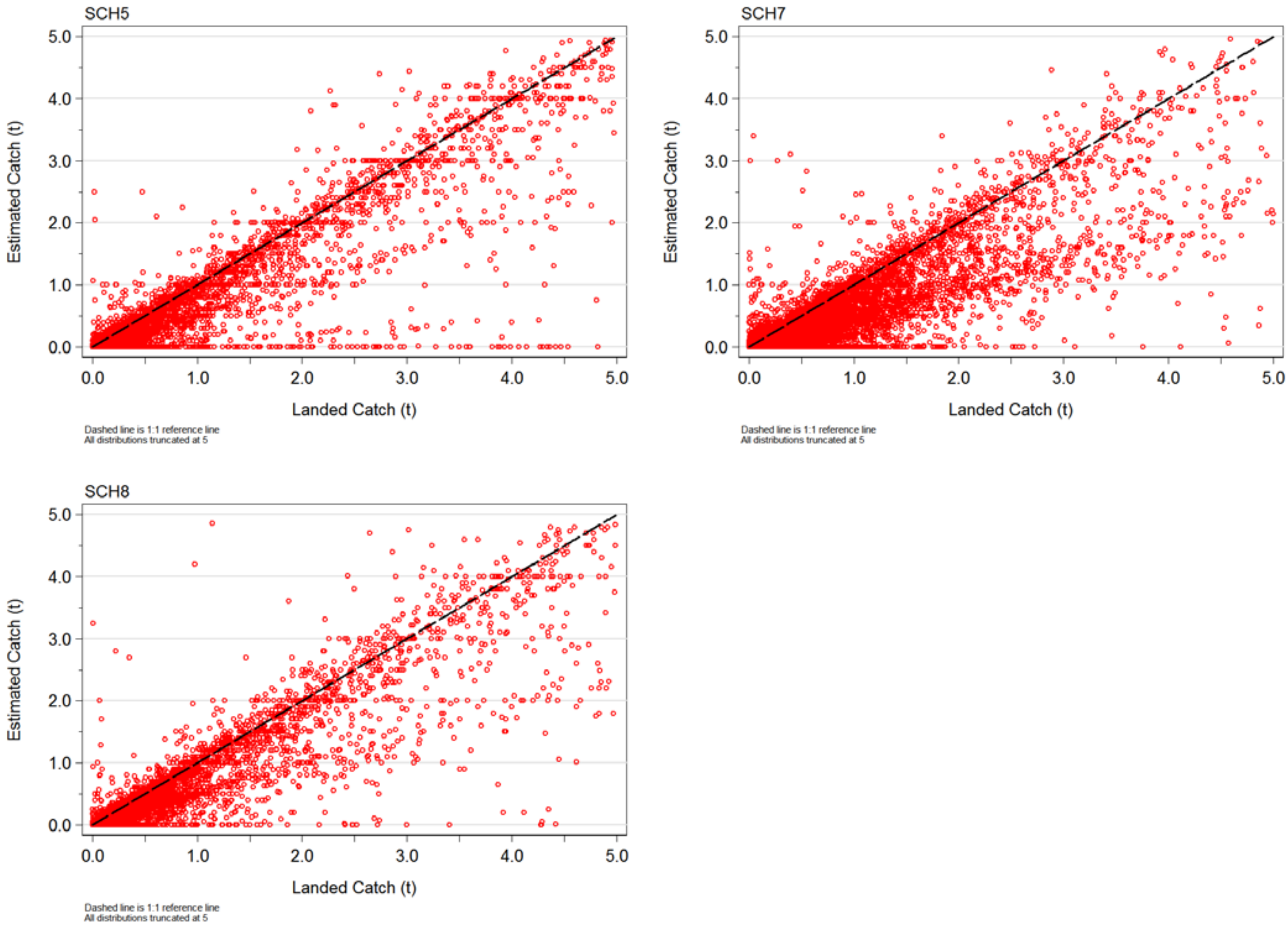

Figure F.2B: Scatter plots of the sum of landed and estimated school shark catch for every trip in each of the SCH 5, SCH 7 and SCH 8 analysis datasets.

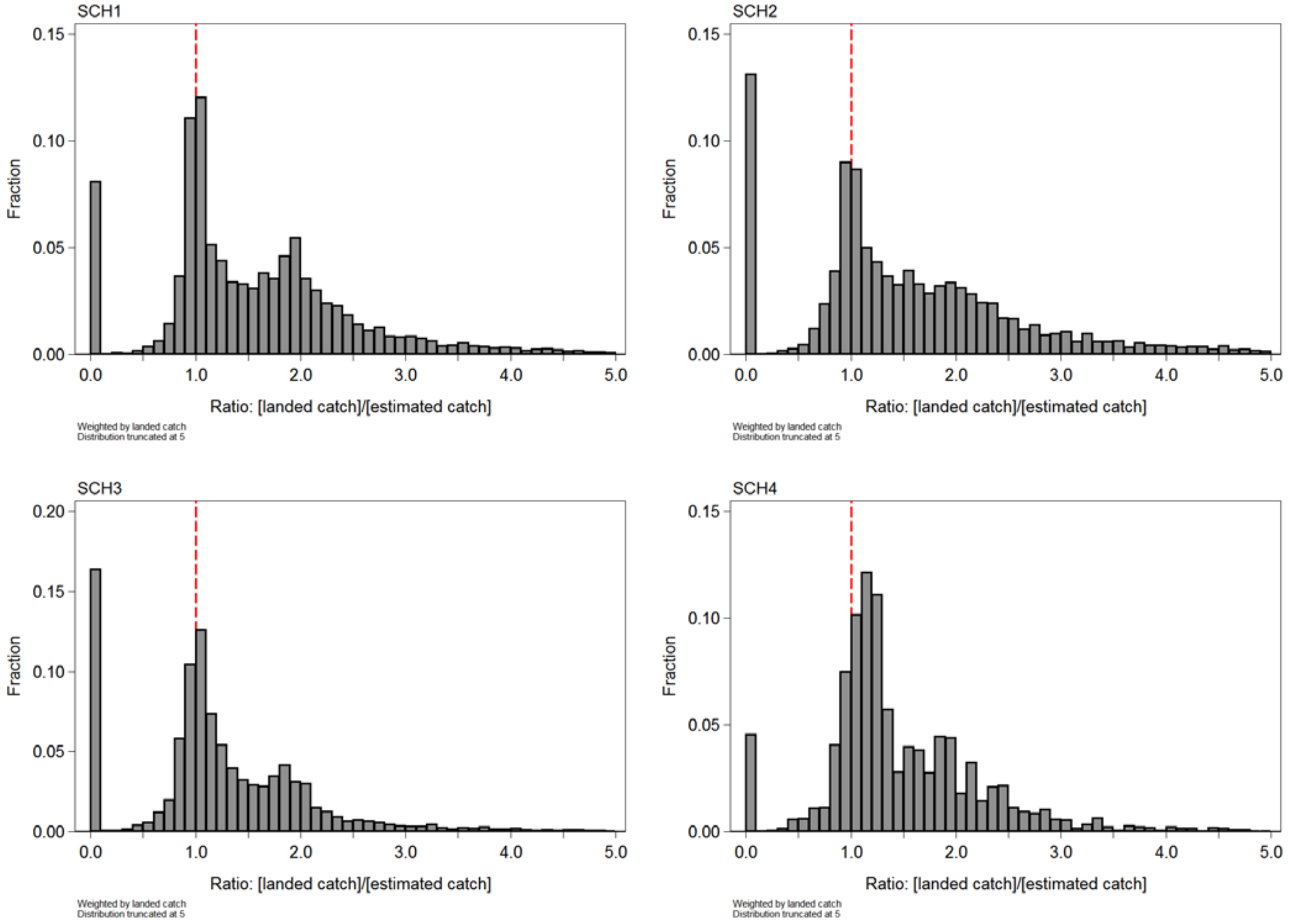

Figure F.3A: Distribution (weighted by the landed catch) of the ratio of landed to estimated catch per trip in each of the SCH 1, SCH 2, SCH 3 and SCH 4 analysis datasets. Trips where the estimated catch=0 have been assigned a ratio=0.

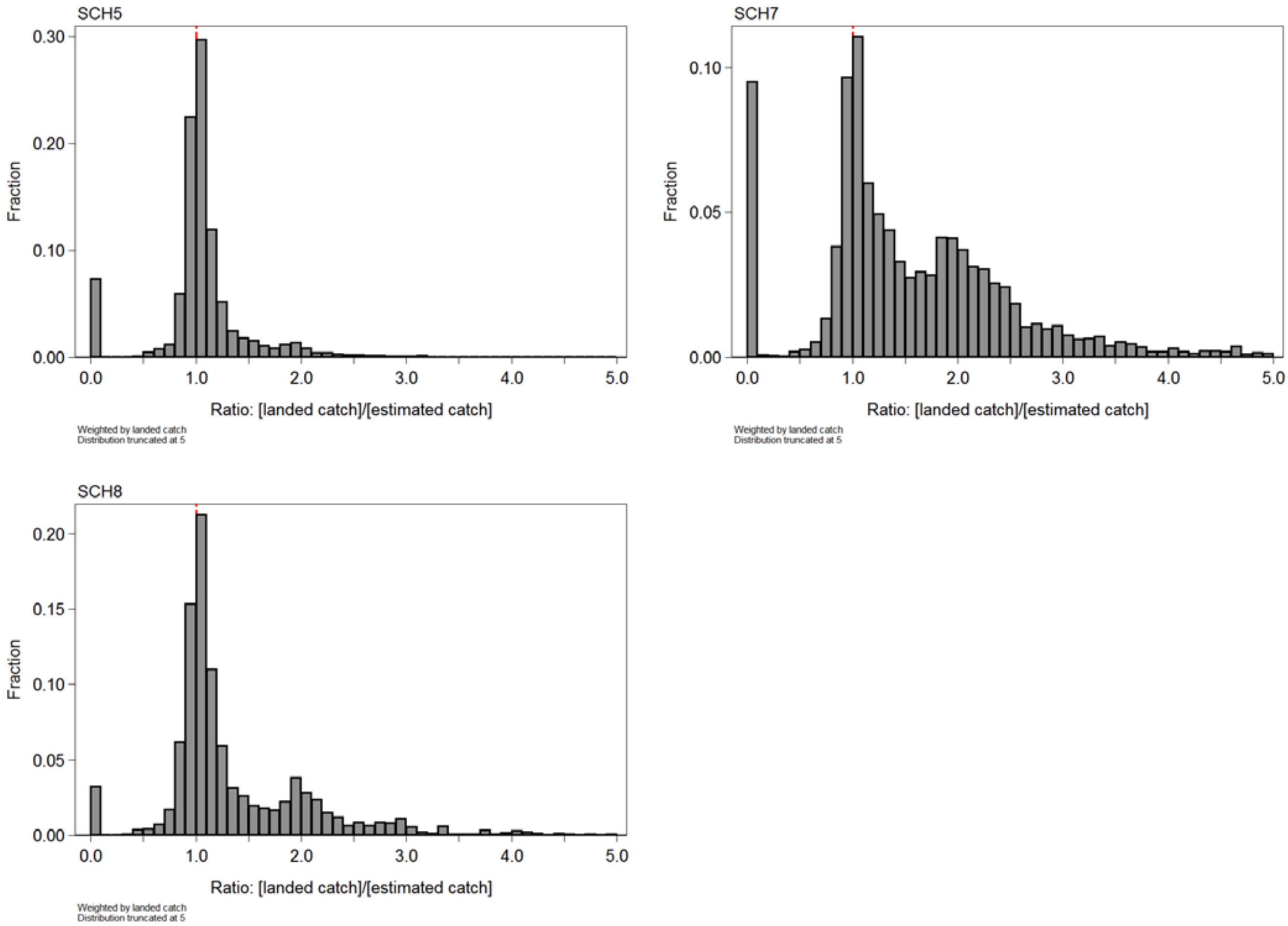

Figure F.3B: Distribution (weighted by the landed catch) of the ratio of landed to estimated catch per trip in each of the SCH 5, SCH 7 and SCH 8 analysis datasets. Trips where the estimated catch=0 have been assigned a ratio=0.

Appendix G. DATA SUMMARIES BY QMA: SCH 1, SCH 2, SCH 3, SCH 4, SCH 5, SCH 7 AND SCH 8

Table G.1A: Distribution of landings (%) by method of capture and fishing year for SCH 1E and SCH 2 based on trips which landed school shark. The final column gives the annual total landings in each QMA. These values are plotted in Figure 7; '–': no data.

Fishing	Distribution (t)							Distribution (%)						
year	SN	BT	BLL	DL	BPT	Other	Total	SN	BT	BLL	DL	BPT	Other	Total
SCH 1E														
89/90	76.1	37.1	88.7	5.7	5.6	23.5	236.7	32.1	15.7	37.5	2.4	2.4	9.9	3.6
90/91	68.9	50.1	123.6	5.6	3.0	40.9	292.0	23.6	17.1	42.3	1.9	1.0	14.0	4.4
91/92	91.5	58.6	107.7	1.3	1.6	32.5	293.2	31.2	20.0	36.7	0.4	0.6	11.1	4.4
92/93	137.5	42.1	150.2	4.8	0.6	39.4	374.6	36.7	11.2	40.1	1.3	0.2	10.5	5.7
93/94	82.3	40.0	76.9	3.8	2.2	38.2	243.4	33.8	16.5	31.6	1.6	0.9	15.7	3.7
94/95	89.1	52.9	79.7	11.9	1.3	17.7	252.6	35.3	20.9	31.6	4.7	0.5	7.0	3.8
95/96	75.6	50.5	141.8	8.6	1.1	18.5	296.0	25.5	17.1	47.9	2.9	0.4	6.2	4.5
96/97	72.9	68.9	75.0	7.6	1.2	16.3	242.0	30.1	28.5	31.0	3.1	0.5	6.8	3.7
97/98	48.4	79.5	78.3	9.7	0.0	21.5	237.5	20.4	33.5	33.0	4.1	0.0	9.0	3.6
98/99	28.7	84.1	92.2	19.0	0.3	19.8	244.1	11.8	34.5	37.8	7.8	0.1	8.1	3.7
99/00	50.6	89.9	197.5	14.2	1.5	9.9	363.6	13.9	24.7	54.3	3.9	0.4	2.7	5.5
00/01	36.7	58.3	199.6	2.6	0.3	9.1	306.6	12.0	19.0	65.1	0.9	0.1	3.0	4.6
01/02	31.2	73.3	138.5	2.5	0.6	8.6	254.7	12.2	28.8	54.4	1.0	0.2	3.4	3.9
02/03	49.4	56.1	104.0	2.3	3.9	1.1	216.9	22.8	25.9	47.9	1.1	1.8	0.5	3.3
03/04	59.7	82.9	140.2	1.8	4.4	1.1	290.3	20.6	28.6	48.3	0.6	1.5	0.4	4.4
04/05	59.3	115.4	137.7	0.4	5.8	2.2	320.8	18.5	36.0	42.9	0.1	1.8	0.7	4.9
05/06	37.2	155.8	130.6	0.9	3.1	3.1	330.7	11.3	47.1	39.5	0.3	0.9	0.9	5.0
06/07	50.8	113.9	132.4	2.5	4.7	1.3	305.6	16.6	37.3	43.3	0.8	1.5	0.4	4.6
07/08	33.6	82.6	110.8	1.6	5.6	4.5	238.6	14.1	34.6	46.4	0.7	2.3	1.9	3.6
08/09	44.0	86.8	107.7	1.3	4.0	5.8	249.6	17.6	34.8	43.1	0.5	1.6	2.3	3.8
09/10	34.2	89.4	97.3	0.8	2.9	2.0	226.6	15.1	39.4	42.9	0.3	1.3	0.9	3.4
10/11	46.3	111.9	141.8	1.8	0.6	2.2	304.5	15.2	36.8	46.6	0.6	0.2	0.7	4.6
11/12	55.9	107.9	102.4	0.4	–	4.0	270.5	20.7	39.9	37.9	0.1	–	1.5	4.1
12/13	47.0	75.2	96.1	0.5	–	3.4	222.2	21.1	33.8	43.2	0.2	–	1.5	3.4
Total	1 407.0	1 863.4	2 850.7	111.5	54.2	326.4	6 613.2	21.3	28.2	43.1	1.7	0.8	4.9	100.0
SCH 2														
89/90	36.6	46.6	31.3	14.2	–	3.3	132.0	27.7	35.3	23.7	10.8	–	2.5	2.6
90/91	18.7	57.3	51.7	13.1	–	6.3	147.1	12.7	39.0	35.1	8.9	–	4.3	2.9
91/92	34.7	56.6	49.1	13.0	–	6.1	159.4	21.8	35.5	30.8	8.1	–	3.8	3.2
92/93	48.1	83.1	75.4	7.1	–	2.2	216.0	22.3	38.5	34.9	3.3	–	1.0	4.3
93/94	31.4	64.4	62.6	8.4	–	4.4	171.2	18.3	37.6	36.6	4.9	–	2.5	3.4
94/95	22.9	61.2	53.7	5.9	–	5.7	149.4	15.3	41.0	35.9	4.0	–	3.8	3.0
95/96	33.3	126.5	68.2	5.3	–	7.8	241.1	13.8	52.5	28.3	2.2	–	3.2	4.8
96/97	31.4	125.0	45.8	11.4	–	3.0	216.7	14.5	57.7	21.1	5.3	–	1.4	4.3
97/98	25.3	128.6	34.7	9.5	–	8.1	206.2	12.3	62.4	16.8	4.6	–	3.9	4.1
98/99	27.8	172.4	60.6	18.6	–	6.8	286.2	9.7	60.2	21.2	6.5	–	2.4	5.7
99/00	37.0	143.7	48.3	14.5	–	5.4	248.8	14.9	57.7	19.4	5.8	–	2.2	5.0
00/01	27.1	93.1	53.4	8.0	–	8.5	190.0	14.2	49.0	28.1	4.2	–	4.5	3.8
01/02	39.5	90.1	70.0	4.0	–	5.2	208.8	18.9	43.2	33.5	1.9	–	2.5	4.2
02/03	36.8	96.9	74.1	14.2	–	6.2	228.3	16.1	42.5	32.5	6.2	–	2.7	4.6
03/04	20.7	83.0	56.3	16.1	–	8.3	184.4	11.2	45.0	30.5	8.7	–	4.5	3.7
04/05	22.7	86.0	76.7	14.5	–	7.6	207.4	10.9	41.4	37.0	7.0	–	3.7	4.2
05/06	20.3	87.6	89.3	6.9	–	3.1	207.2	9.8	42.3	43.1	3.3	–	1.5	4.1
06/07	29.5	105.6	67.1	4.0	–	1.8	208.1	14.2	50.7	32.3	1.9	–	0.9	4.2
07/08	57.6	89.4	92.5	13.0	–	1.8	254.4	22.7	35.1	36.4	5.1	–	0.7	5.1
08/09	59.5	90.3	96.7	11.8	–	2.6	260.9	22.8	34.6	37.1	4.5	–	1.0	5.2
09/10	49.7	84.0	81.5	15.4	–	2.0	232.6	21.4	36.1	35.0	6.6	–	0.9	4.7
10/11	40.2	77.6	76.7	12.3	–	1.4	208.3	19.3	37.3	36.8	5.9	–	0.7	4.2
11/12	48.6	72.6	71.9	14.1	–	2.9	210.1	23.1	34.6	34.2	6.7	–	1.4	4.2
12/13	31.7	65.7	101.0	20.0	–	3.8	222.2	14.3	29.5	45.5	9.0	–	1.7	4.4
Total	831.1	2 187.1	1 588.6	275.4	–	114.3	4 996.6	16.6	43.8	31.8	5.5	–	2.3	100.0

Table G.1B: Distribution of landings (%) by method of capture and fishing year for SCH 3 and SCH 4 based on trips which landed school shark. The final column gives the annual total landings in each QMA. These values are plotted in Figure 7; '–': no data.

Fishing	Distribution (t)							Distribution (%)						
year	SN	BT	BLL	DL	BPT	Other	Total	SN	BT	BLL	DL	BPT	Other	Total
SCH 3														
89/90	158.8	111.0	2.8	0.4	–	0.4	273.4	58.1	40.6	1.0	0.2	–	0.1	3.4
90/91	144.2	92.3	3.2	0.5	–	0.3	240.4	60.0	38.4	1.3	0.2	–	0.1	3.0
91/92	189.6	91.3	1.2	1.4	–	0.3	283.8	66.8	32.2	0.4	0.5	–	0.1	3.5
92/93	136.6	101.5	3.4	0.8	–	0.7	243.0	56.2	41.8	1.4	0.3	–	0.3	3.0
93/94	145.3	65.9	7.6	0.3	0.1	0.4	219.5	66.2	30.0	3.5	0.1	0.0	0.2	2.7
94/95	150.6	84.3	16.9	0.5	–	0.8	253.1	59.5	33.3	6.7	0.2	–	0.3	3.1
95/96	164.6	118.4	34.9	0.4	–	1.6	319.9	51.5	37.0	10.9	0.1	–	0.5	4.0
96/97	165.3	83.9	44.9	0.2	–	0.9	295.2	56.0	28.4	15.2	0.1	–	0.3	3.7
97/98	164.6	113.1	6.1	0.1	–	1.8	285.8	57.6	39.6	2.1	0.0	–	0.6	3.5
98/99	200.8	115.7	22.9	1.6	–	0.7	341.7	58.8	33.8	6.7	0.5	–	0.2	4.2
99/00	188.5	154.6	25.7	0.1	–	0.9	369.8	51.0	41.8	6.9	0.0	–	0.2	4.6
00/01	217.2	155.5	18.9	1.1	–	0.2	392.9	55.3	39.6	4.8	0.3	–	0.1	4.9
01/02	179.6	136.2	17.3	0.0	–	0.4	333.6	53.8	40.8	5.2	0.0	–	0.1	4.1
02/03	221.2	165.0	27.8	0.4	–	1.2	415.6	53.2	39.7	6.7	0.1	–	0.3	5.2
03/04	177.9	125.8	16.2	0.1	–	4.1	324.1	54.9	38.8	5.0	0.0	–	1.3	4.0
04/05	263.7	141.6	42.1	0.3	–	2.9	450.5	58.5	31.4	9.3	0.1	–	0.6	5.6
05/06	157.9	150.5	14.8	0.1	–	4.8	328.1	48.1	45.9	4.5	0.0	–	1.5	4.1
06/07	234.5	134.9	19.5	0.0	–	13.1	402.0	58.3	33.6	4.8	0.0	–	3.3	5.0
07/08	190.5	109.4	41.5	0.4	–	16.1	358.0	53.2	30.6	11.6	0.1	–	4.5	4.4
08/09	185.0	107.4	73.0	0.5	–	13.2	379.0	48.8	28.3	19.3	0.1	–	3.5	4.7
09/10	227.2	144.8	51.3	0.6	–	11.4	435.3	52.2	33.3	11.8	0.1	–	2.6	5.4
10/11	212.0	115.7	43.4	0.1	–	21.6	392.8	54.0	29.5	11.0	0.0	–	5.5	4.9
11/12	209.2	80.9	59.1	0.1	–	23.7	372.9	56.1	21.7	15.8	0.0	–	6.3	4.6
12/13	201.5	81.3	40.4	0.2	–	20.5	343.9	58.6	23.6	11.7	0.1	–	6.0	4.3
Total	4 486.4	2 780.9	634.7	10.2	0.1	142.0	8 054.2	55.7	34.5	7.9	0.1	0.0	1.8	100.0
SCH 4														
89/90	–	5.8	0.1	2.5	–	3.6	12.1	–	48.3	1.1	20.9	–	29.7	0.4
90/91	–	5.4	7.4	0.0	–	0.9	13.7	–	39.3	54.1	0.3	–	6.4	0.4
91/92	0.1	4.9	30.5	0.0	–	2.4	38.0	0.4	12.9	80.3	0.1	–	6.4	1.2
92/93	0.5	5.1	24.0	1.0	–	0.2	30.8	1.6	16.6	77.8	3.3	–	0.6	1.0
93/94	2.2	2.5	35.5	3.6	–	0.6	44.5	5.0	5.7	79.8	8.1	–	1.3	1.4
94/95	0.4	3.7	23.6	11.2	–	2.2	41.0	0.9	8.9	57.5	27.2	–	5.4	1.3
95/96	0.3	61.7	108.8	8.0	–	4.8	183.7	0.2	33.6	59.2	4.4	–	2.6	5.9
96/97	0.2	44.7	183.9	2.0	–	1.8	232.6	0.1	19.2	79.1	0.8	–	0.8	7.5
97/98	0.2	22.3	98.7	2.9	–	3.0	127.1	0.2	17.5	77.7	2.3	–	2.3	4.1
98/99	0.1	11.6	103.4	0.7	–	1.0	116.8	0.1	9.9	88.6	0.6	–	0.9	3.8
99/00	26.0	16.1	77.5	0.1	–	0.2	120.0	21.7	13.4	64.6	0.1	–	0.2	3.9
00/01	11.9	29.4	63.5	0.4	–	2.7	108.0	11.0	27.3	58.9	0.4	–	2.5	3.5
01/02	1.6	38.1	56.2	0.3	–	0.6	96.8	1.6	39.4	58.1	0.3	–	0.6	3.1
02/03	18.6	23.7	84.8	3.7	–	0.3	131.1	14.2	18.1	64.7	2.8	–	0.2	4.2
03/04	3.3	19.2	123.3	0.6	–	0.1	146.6	2.3	13.1	84.1	0.4	–	0.1	4.7
04/05	25.9	41.8	165.5	0.3	–	0.4	233.9	11.1	17.9	70.8	0.1	–	0.2	7.5
05/06	2.4	42.4	148.8	–	–	0.0	193.7	1.2	21.9	76.8	–	–	0.0	6.2
06/07	0.2	19.1	86.1	0.4	–	0.2	106.0	0.2	18.0	81.2	0.4	–	0.2	3.4
07/08	–	24.5	122.6	0.1	–	0.3	147.6	–	16.6	83.1	0.1	–	0.2	4.7
08/09	0.0	26.5	143.1	1.2	–	1.0	171.8	0.0	15.4	83.3	0.7	–	0.6	5.5
09/10	0.0	21.5	207.2	2.2	–	1.7	232.5	0.0	9.2	89.1	1.0	–	0.7	7.5
10/11	–	5.6	190.1	1.1	–	0.9	197.7	–	2.8	96.2	0.5	–	0.5	6.4
11/12	0.0	8.5	216.7	3.3	–	3.0	231.5	0.0	3.7	93.6	1.4	–	1.3	7.4
12/13	0.0	24.5	126.7	3.1	–	0.5	154.8	0.0	15.8	81.8	2.0	–	0.3	5.0
Total	94.0	508.6	2 428.1	48.8	–	32.5	3 112.1	3.0	16.3	78.0	1.6	–	1.0	100.0

Table G.1C: Distribution of landings (%) by method of capture and fishing year for SCH 5 and SCH 7 based on trips which landed school shark. The final column gives the annual total landings in each QMA. These values are plotted in Figure 7; '–': no data.

Fishing	Distribution (t)							Distribution (%)						
year	SN	BT	BLL	DL	BPT	Other	Total	SN	BT	BLL	DL	BPT	Other	Total
SCH 5														
89/90	402.4	52.2	25.5	3.8	–	3.8	487.7	82.5	10.7	5.2	0.8	–	0.8	2.7
90/91	517.2	33.7	13.6	2.7	–	37.2	604.4	85.6	5.6	2.3	0.4	–	6.1	3.4
91/92	631.7	22.4	31.4	1.4	–	7.0	693.9	91.0	3.2	4.5	0.2	–	1.0	3.9
92/93	651.9	27.7	14.7	1.0	–	4.8	700.1	93.1	4.0	2.1	0.1	–	0.7	3.9
93/94	592.4	21.9	26.8	7.8	–	5.5	654.4	90.5	3.3	4.1	1.2	–	0.8	3.7
94/95	615.3	27.6	26.4	7.6	–	9.0	685.8	89.7	4.0	3.8	1.1	–	1.3	3.8
95/96	704.2	30.0	39.7	4.3	–	3.1	781.3	90.1	3.8	5.1	0.6	–	0.4	4.4
96/97	648.5	26.0	27.1	4.0	–	5.5	711.0	91.2	3.7	3.8	0.6	–	0.8	4.0
97/98	634.3	17.9	10.8	2.8	–	4.1	670.0	94.7	2.7	1.6	0.4	–	0.6	3.8
98/99	653.8	47.8	50.1	1.9	–	5.7	759.3	86.1	6.3	6.6	0.3	–	0.7	4.3
99/00	645.2	100.6	14.3	2.8	–	6.3	769.1	83.9	13.1	1.9	0.4	–	0.8	4.3
00/01	561.6	94.0	54.1	4.6	–	15.6	729.9	76.9	12.9	7.4	0.6	–	2.1	4.1
01/02	517.4	102.8	74.9	4.4	–	6.4	705.9	73.3	14.6	10.6	0.6	–	0.9	4.0
02/03	658.5	91.1	45.6	5.1	–	11.8	812.2	81.1	11.2	5.6	0.6	–	1.5	4.6
03/04	631.9	68.5	47.9	6.1	–	10.1	764.5	82.7	9.0	6.3	0.8	–	1.3	4.3
04/05	663.0	55.9	40.2	5.4	–	4.7	769.2	86.2	7.3	5.2	0.7	–	0.6	4.3
05/06	629.4	66.2	32.4	5.3	–	6.9	740.1	85.0	8.9	4.4	0.7	–	0.9	4.2
06/07	651.1	72.1	31.9	1.2	–	8.4	764.8	85.1	9.4	4.2	0.2	–	1.1	4.3
07/08	771.6	37.0	74.6	1.2	–	1.8	886.3	87.1	4.2	8.4	0.1	–	0.2	5.0
08/09	665.4	50.5	101.1	3.3	–	5.6	826.0	80.6	6.1	12.2	0.4	–	0.7	4.6
09/10	740.8	82.1	57.0	0.5	–	3.4	883.8	83.8	9.3	6.4	0.1	–	0.4	5.0
10/11	651.1	61.5	67.0	0.4	3.0	2.0	785.0	82.9	7.8	8.5	0.0	0.4	0.3	4.4
11/12	725.1	52.6	22.3	1.0	0.0	7.3	808.4	89.7	6.5	2.8	0.1	0.0	0.9	4.5
12/13	755.1	63.5	15.6	0.2	–	5.0	839.5	89.9	7.6	1.9	0.0	–	0.6	4.7
Total	15 319.1	1 305.6	945.1	78.8	3.0	181.0	17 832.6	85.9	7.3	5.3	0.4	0.0	1.0	100.0
SCH 7														
89/90	201.4	153.1	187.8	5.4	0.9	11.0	559.6	36.0	27.4	33.6	1.0	0.2	2.0	4.6
90/91	172.2	108.0	142.3	5.2	1.1	10.8	439.6	39.2	24.6	32.4	1.2	0.2	2.5	3.6
91/92	165.5	94.1	140.5	4.1	–	6.4	410.6	40.3	22.9	34.2	1.0	–	1.6	3.4
92/93	97.4	135.5	172.3	8.4	–	12.4	426.0	22.9	31.8	40.4	2.0	–	2.9	3.5
93/94	136.4	97.5	185.9	2.5	–	3.5	425.8	32.0	22.9	43.7	0.6	–	0.8	3.5
94/95	109.4	123.9	146.3	2.7	0.0	5.6	387.9	28.2	31.9	37.7	0.7	0.0	1.4	3.2
95/96	185.5	187.1	191.4	6.0	0.1	4.0	574.0	32.3	32.6	33.3	1.0	0.0	0.7	4.7
96/97	106.0	168.3	176.9	2.1	0.0	4.6	458.0	23.2	36.7	38.6	0.5	0.0	1.0	3.7
97/98	85.5	129.8	167.6	4.2	0.0	3.6	390.8	21.9	33.2	42.9	1.1	0.0	0.9	3.2
98/99	172.6	239.4	189.7	11.7	–	9.3	622.8	27.7	38.4	30.5	1.9	–	1.5	5.1
99/00	149.5	232.2	171.9	8.0	2.5	11.0	575.2	26.0	40.4	29.9	1.4	0.4	1.9	4.7
00/01	182.1	200.1	131.4	9.1	0.7	4.4	527.9	34.5	37.9	24.9	1.7	0.1	0.8	4.3
01/02	165.5	160.5	116.3	6.7	0.1	5.2	454.3	36.4	35.3	25.6	1.5	0.0	1.1	3.7
02/03	159.5	174.8	151.0	11.6	0.4	5.6	502.9	31.7	34.8	30.0	2.3	0.1	1.1	4.1
03/04	189.1	217.4	128.5	9.8	0.7	6.2	551.5	34.3	39.4	23.3	1.8	0.1	1.1	4.5
04/05	179.7	164.5	130.1	6.5	0.2	5.6	486.5	36.9	33.8	26.7	1.3	0.0	1.1	4.0
05/06	177.8	180.2	137.4	12.9	0.0	4.3	512.6	34.7	35.1	26.8	2.5	0.0	0.8	4.2
06/07	209.9	213.1	121.3	14.9	0.0	7.5	566.8	37.0	37.6	21.4	2.6	0.0	1.3	4.6
07/08	84.2	264.4	119.3	8.2	0.1	5.2	481.3	17.5	54.9	24.8	1.7	0.0	1.1	3.9
08/09	127.2	306.1	162.5	10.9	0.1	18.0	624.9	20.4	49.0	26.0	1.8	0.0	2.9	5.1
09/10	48.4	311.0	126.9	8.7	0.0	8.8	503.8	9.6	61.7	25.2	1.7	0.0	1.8	4.1
10/11	69.7	288.8	213.8	2.3	0.0	4.9	579.5	12.0	49.8	36.9	0.4	0.0	0.8	4.7
11/12	98.5	288.4	172.4	4.5	0.0	5.3	569.1	17.3	50.7	30.3	0.8	0.0	0.9	4.7
12/13	102.6	280.7	197.0	10.8	–	9.8	600.8	17.1	46.7	32.8	1.8	–	1.6	4.9
Total	3 375.6	4 718.9	3 780.7	177.0	7.0	173.0	12 232.3	27.6	38.6	30.9	1.4	0.1	1.4	100.0

Table G.1D: Distribution of landings (%) by method of capture and fishing year for SCH 8 and SCH 1W based on trips which landed school shark. The final column gives the annual total landings in each QMA. These values are plotted in Figure 7; '–': no data.

Fishing	Distribution (t)							Distribution (%)						
year	SN	BT	BLL	DL	BPT	Other	Total	SN	BT	BLL	DL	BPT	Other	Total
SCH 8														
89/90	251.3	10.8	81.7	3.0	0.4	1.3	348.6	72.1	3.1	23.4	0.9	0.1	0.4	3.9
90/91	198.7	12.8	42.8	1.4	5.9	0.9	262.5	75.7	4.9	16.3	0.5	2.3	0.3	2.9
91/92	212.7	19.2	62.8	1.5	2.1	7.5	305.7	69.6	6.3	20.5	0.5	0.7	2.4	3.4
92/93	271.4	13.0	99.8	2.5	0.2	0.3	387.3	70.1	3.4	25.8	0.6	0.1	0.1	4.3
93/94	234.9	22.1	94.8	2.4	0.9	0.1	355.2	66.1	6.2	26.7	0.7	0.2	0.0	4.0
94/95	239.5	11.2	144.2	1.2	2.1	0.1	398.4	60.1	2.8	36.2	0.3	0.5	0.0	4.5
95/96	309.5	20.7	114.3	3.5	0.9	0.6	449.5	68.8	4.6	25.4	0.8	0.2	0.1	5.0
96/97	252.4	34.5	98.1	2.9	0.7	1.4	390.0	64.7	8.8	25.2	0.7	0.2	0.4	4.4
97/98	220.2	50.9	63.7	6.2	0.2	0.0	341.3	64.5	14.9	18.7	1.8	0.0	0.0	3.8
98/99	274.7	53.1	123.5	3.3	–	0.0	454.5	60.4	11.7	27.2	0.7	–	0.0	5.1
99/00	199.7	52.7	64.2	2.0	1.3	0.1	320.0	62.4	16.5	20.1	0.6	0.4	0.0	3.6
00/01	232.0	66.6	67.4	7.3	0.1	0.6	373.9	62.0	17.8	18.0	2.0	0.0	0.1	4.2
01/02	196.0	60.8	82.2	2.9	–	1.9	343.8	57.0	17.7	23.9	0.8	–	0.6	3.9
02/03	223.7	52.5	37.8	3.1	–	5.2	322.2	69.4	16.3	11.7	1.0	–	1.6	3.6
03/04	183.0	43.2	86.9	6.4	0.1	2.7	322.2	56.8	13.4	27.0	2.0	0.0	0.8	3.6
04/05	287.3	40.1	105.8	2.5	–	2.9	438.6	65.5	9.2	24.1	0.6	–	0.7	4.9
05/06	258.2	56.7	75.5	2.8	–	1.7	394.8	65.4	14.4	19.1	0.7	–	0.4	4.4
06/07	303.1	43.8	76.2	2.6	–	15.7	441.3	68.7	9.9	17.3	0.6	–	3.6	4.9
07/08	271.5	36.4	60.6	4.1	–	12.0	384.6	70.6	9.5	15.8	1.1	–	3.1	4.3
08/09	270.4	39.2	96.2	4.5	–	8.5	418.8	64.6	9.4	23.0	1.1	–	2.0	4.7
09/10	234.9	46.5	45.9	7.2	–	3.7	338.2	69.5	13.7	13.6	2.1	–	1.1	3.8
10/11	304.7	46.7	71.2	7.0	–	1.2	430.8	70.7	10.8	16.5	1.6	–	0.3	4.8
11/12	202.2	60.3	71.3	5.3	–	1.4	340.5	59.4	17.7	20.9	1.5	–	0.4	3.8
12/13	215.0	30.7	107.3	3.9	–	0.5	357.4	60.2	8.6	30.0	1.1	–	0.1	4.0
Total	5 847.1	924.4	1 974.4	89.2	14.7	70.3	8 920.2	65.5	10.4	22.1	1.0	0.2	0.8	100.0
SCH 1W														
89/90	142.9	94.8	67.7	0.9	21.3	9.2	336.8	42.4	28.1	20.1	0.3	6.3	2.7	2.9
90/91	81.7	84.8	7.4	0.8	37.6	1.9	214.2	38.1	39.6	3.5	0.4	17.5	0.9	1.9
91/92	96.0	115.8	54.9	0.6	21.3	6.2	294.9	32.6	39.3	18.6	0.2	7.2	2.1	2.6
92/93	108.1	248.1	66.8	2.1	29.8	7.7	462.6	23.4	53.6	14.4	0.5	6.4	1.7	4.0
93/94	128.1	167.2	153.6	6.3	28.7	5.1	489.0	26.2	34.2	31.4	1.3	5.9	1.0	4.3
94/95	135.3	128.3	119.5	3.2	20.0	7.6	414.0	32.7	31.0	28.9	0.8	4.8	1.8	3.6
95/96	122.4	185.3	180.5	16.1	27.3	4.1	535.6	22.9	34.6	33.7	3.0	5.1	0.8	4.7
96/97	181.9	209.8	173.5	5.7	5.6	4.6	581.1	31.3	36.1	29.9	1.0	1.0	0.8	5.1
97/98	251.9	220.2	151.8	1.2	1.4	6.9	633.4	39.8	34.8	24.0	0.2	0.2	1.1	5.5
98/99	191.6	202.5	194.3	3.7	7.5	4.0	603.7	31.7	33.5	32.2	0.6	1.2	0.7	5.3
99/00	172.2	176.8	184.0	5.8	16.4	2.3	557.5	30.9	31.7	33.0	1.0	2.9	0.4	4.8
00/01	175.7	123.1	221.9	6.8	35.2	1.2	564.0	31.1	21.8	39.4	1.2	6.2	0.2	4.9
01/02	174.6	184.5	147.0	1.1	6.1	2.4	515.7	33.9	35.8	28.5	0.2	1.2	0.5	4.5
02/03	148.2	212.8	155.9	1.0	11.8	2.4	532.0	27.9	40.0	29.3	0.2	2.2	0.4	4.6
03/04	178.6	177.3	165.2	2.0	11.2	5.9	540.2	33.1	32.8	30.6	0.4	2.1	1.1	4.7
04/05	148.9	194.0	78.5	0.1	35.2	4.8	461.6	32.3	42.0	17.0	0.0	7.6	1.0	4.0
05/06	124.3	160.8	77.8	0.6	27.3	3.2	394.0	31.5	40.8	19.7	0.1	6.9	0.8	3.4
06/07	106.7	162.9	82.7	1.0	30.6	1.3	385.2	27.7	42.3	21.5	0.3	7.9	0.3	3.4
07/08	135.6	256.7	106.1	0.4	44.9	3.6	547.4	24.8	46.9	19.4	0.1	8.2	0.7	4.8
08/09	138.5	277.6	97.5	1.0	26.5	5.5	546.7	25.3	50.8	17.8	0.2	4.8	1.0	4.8
09/10	81.9	209.1	85.0	0.6	34.6	4.5	415.7	19.7	50.3	20.4	0.1	8.3	1.1	3.6
10/11	131.8	288.6	128.0	0.5	18.7	2.6	570.3	23.1	50.6	22.4	0.1	3.3	0.5	5.0
11/12	114.7	267.5	91.8	0.2	0.9	1.4	476.6	24.1	56.1	19.3	0.0	0.2	0.3	4.1
12/13	124.0	230.5	64.2	0.4	–	4.8	423.9	29.3	54.4	15.1	0.1	–	1.1	3.7
Total	3 395.5	4 579.0	2 855.9	62.0	500.0	103.3	11 495.8	29.5	39.8	24.8	0.5	4.3	0.9	100.0

Table G.2A: Distribution of landings (%) by month and fishing year for setnet for SCH 1E & SCH 2 based on trips which landed school shark. The final column gives the annual total landings for setnet in each QMA. These values are plotted in Figure 8; '–': no data.

Fishing												Month	
year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
SCH 1E													
89/90	3.4	9.9	10.3	17.7	10.1	8.4	1.2	9.3	8.1	8.0	5.5	8.1	76
90/91	9.9	22.8	17.1	13.0	6.5	6.0	6.2	4.7	2.1	8.6	1.3	1.6	69
91/92	6.4	10.2	7.8	3.1	5.6	12.1	19.5	10.0	10.7	3.3	5.0	6.3	91
92/93	8.3	14.7	13.9	18.4	6.4	7.2	9.6	5.1	4.2	4.1	3.2	4.9	137
93/94	13.4	17.9	12.6	10.4	6.0	4.2	4.8	3.2	3.5	2.7	12.4	8.7	82
94/95	14.6	22.0	4.4	2.3	4.8	4.3	6.8	4.3	5.1	2.8	4.8	23.9	89
95/96	7.4	14.1	22.4	8.2	16.2	6.8	2.7	8.9	3.6	2.7	1.9	5.0	76
96/97	8.3	20.6	17.5	24.2	10.7	3.9	5.2	1.7	5.3	1.7	0.3	0.6	73
97/98	14.8	17.9	8.0	12.8	4.1	10.5	4.1	3.3	6.1	14.0	1.7	2.7	48
98/99	10.9	10.2	22.9	6.9	11.2	7.6	3.2	7.5	4.8	3.3	2.7	8.7	29
99/00	9.7	25.3	7.9	8.2	29.1	6.9	2.8	4.6	3.6	0.3	1.3	0.4	51
00/01	4.2	21.8	7.6	25.1	9.0	4.6	5.1	11.7	7.9	1.3	1.2	0.5	37
01/02	3.9	20.6	12.0	4.2	7.2	13.3	15.1	11.2	1.3	2.4	7.2	1.7	31
02/03	3.8	24.1	15.8	22.1	3.9	2.0	12.9	4.8	0.9	2.7	6.1	0.8	49
03/04	6.1	24.7	14.4	1.4	2.7	20.8	13.4	5.9	5.9	1.3	1.5	2.1	60
04/05	4.5	15.9	17.5	16.5	4.1	17.3	6.7	6.0	2.2	1.5	4.8	3.1	59
05/06	9.0	20.5	21.5	9.0	5.6	2.6	2.4	11.3	6.9	6.8	2.5	1.8	37
06/07	6.0	14.4	14.2	10.3	7.8	1.2	3.6	8.7	5.2	13.6	5.3	9.7	51
07/08	12.5	23.3	8.4	1.5	15.6	1.8	1.8	10.7	8.6	4.5	7.4	3.9	34
08/09	15.0	10.4	21.4	4.0	5.5	1.3	8.2	11.7	6.3	7.2	1.6	7.3	44
09/10	3.0	17.3	20.8	12.2	8.6	4.6	5.5	6.9	5.1	6.4	6.4	3.2	34
10/11	7.0	36.6	6.5	3.9	8.0	4.1	3.6	9.5	10.3	3.7	3.3	3.6	46
11/12	12.0	12.2	3.5	14.0	8.5	8.5	2.1	9.0	9.7	8.3	10.7	1.5	56
12/13	7.1	17.0	20.6	6.5	11.4	3.0	12.3	3.9	1.9	6.0	5.9	4.5	47
Mean	8.5	18.0	13.3	11.2	8.3	7.1	7.0	6.8	5.4	4.7	4.3	5.4	1 407
SCH 2													0
89/90	0.1	5.4	8.9	14.3	13.1	26.7	7.6	15.1	1.4	3.5	0.9	3.0	37
90/91	3.3	17.1	7.9	27.7	1.8	3.7	1.7	6.3	12.9	10.4	3.7	3.4	19
91/92	6.0	4.2	5.5	10.7	16.6	2.8	7.6	4.2	37.0	3.3	0.9	1.1	35
92/93	0.7	17.6	6.2	5.8	2.3	12.2	17.9	22.0	7.1	4.9	2.6	0.8	48
93/94	6.5	11.2	15.8	5.0	3.5	17.3	8.7	17.5	5.5	0.6	0.6	7.9	31
94/95	5.4	9.0	14.2	15.4	7.9	3.3	7.7	21.5	7.7	4.4	1.9	1.6	23
95/96	1.2	6.6	8.7	10.8	14.3	13.9	18.2	8.9	11.3	2.5	2.3	1.3	33
96/97	2.0	11.2	13.3	23.0	5.2	3.5	2.4	29.0	3.5	3.5	2.3	1.0	31
97/98	3.7	6.1	23.7	13.9	4.1	32.3	2.5	7.8	2.4	1.1	0.9	1.5	25
98/99	2.1	6.7	12.5	14.1	18.8	4.3	3.7	20.5	8.1	4.4	2.9	1.9	28
99/00	9.0	8.2	12.7	21.0	10.9	16.8	2.9	11.1	1.2	0.8	2.0	3.2	37
00/01	9.4	6.0	14.0	20.9	10.8	2.0	0.2	1.6	27.3	2.5	1.6	3.5	27
01/02	2.5	4.4	5.8	4.9	4.8	3.4	6.4	3.8	2.5	0.6	31.8	28.9	39
02/03	2.1	3.5	41.9	5.1	5.8	14.2	0.7	5.2	4.7	12.8	1.3	2.5	37
03/04	8.0	4.6	17.1	10.8	4.6	5.9	14.9	12.1	10.6	6.3	1.1	3.9	21
04/05	2.0	19.0	6.8	30.2	13.2	12.3	0.5	0.9	1.5	1.9	1.9	9.8	23
05/06	2.9	18.9	18.8	6.2	6.2	1.9	8.3	16.7	7.8	4.4	2.9	4.8	20
06/07	3.3	9.9	9.8	34.9	0.7	8.3	3.8	13.6	5.5	5.4	4.0	0.8	30
07/08	1.7	3.5	22.2	6.0	9.9	31.3	7.1	4.2	3.0	6.0	0.5	4.6	58
08/09	2.5	7.8	20.7	5.3	15.7	17.7	10.4	8.6	4.7	2.5	1.2	3.1	60
09/10	1.4	4.2	10.0	16.4	27.3	15.9	16.8	4.5	2.2	0.9	0.1	0.3	50
10/11	9.9	34.2	3.9	1.9	12.4	4.8	8.6	17.6	2.6	1.2	1.4	1.6	40
11/12	9.3	11.0	13.5	7.0	11.8	20.8	11.1	11.7	1.4	1.1	0.2	1.0	49
12/13	19.5	13.2	13.8	7.5	30.9	5.0	1.5	5.2	1.2	1.1	0.6	0.6	32
Mean	4.6	9.8	13.8	12.0	11.2	13.1	7.9	11.0	6.5	3.4	2.9	3.8	831

Table G.2B: Distribution of landings (%) by month and fishing year for setnet for SCH 3 and SCH 4 based on trips which landed school shark. The final column gives the annual total landings for setnet in each QMA. These values are plotted in Figure 8; '–': no data.

Fishing												Month	
year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
SCH 3													
89/90	3.0	20.5	25.2	17.9	16.9	6.3	3.4	3.3	1.3	1.0	0.1	1.1	159
90/91	4.5	23.9	22.2	19.0	10.3	4.6	7.6	4.3	2.0	1.1	0.1	0.4	144
91/92	1.5	8.0	21.1	38.5	19.6	5.7	2.3	1.3	1.3	0.4	0.2	0.1	190
92/93	1.3	12.7	24.3	25.1	15.4	7.2	5.1	3.7	2.0	1.1	1.4	0.6	137
93/94	1.5	9.9	23.4	26.3	7.4	8.6	6.4	7.6	7.1	0.7	0.9	0.2	145
94/95	0.5	12.4	24.6	29.1	9.3	5.2	7.4	5.0	2.2	0.9	1.0	2.3	151
95/96	0.6	11.5	21.9	21.4	11.0	13.7	7.5	5.4	2.1	1.3	2.8	0.7	165
96/97	1.2	14.1	22.4	29.9	12.1	8.9	5.6	3.3	1.1	0.7	0.6	0.2	165
97/98	1.0	14.8	24.5	21.0	18.7	6.8	9.6	1.4	1.3	0.3	0.2	0.4	165
98/99	1.0	13.9	19.6	16.9	20.2	14.1	5.1	3.0	3.8	1.5	0.6	0.3	201
99/00	3.8	16.4	24.7	12.9	16.0	11.4	5.3	4.0	1.3	3.6	0.5	0.1	188
00/01	1.1	8.9	21.8	20.6	17.3	7.5	6.0	2.1	5.1	6.3	2.5	0.7	217
01/02	2.9	12.1	19.4	20.7	20.6	4.2	9.1	6.0	2.5	1.3	0.9	0.2	180
02/03	2.8	15.5	21.0	25.2	16.7	12.3	1.2	1.3	0.7	2.9	0.3	0.1	221
03/04	3.1	12.9	26.8	20.4	11.8	7.3	12.3	2.2	2.4	0.6	0.3	0.0	178
04/05	1.4	10.9	9.8	34.1	13.6	10.8	2.4	8.6	7.3	0.6	0.5	0.1	264
05/06	6.5	21.7	16.5	29.8	7.2	6.9	4.8	3.5	2.0	0.9	0.3	0.1	158
06/07	0.8	10.9	15.9	25.7	25.9	10.8	5.4	2.9	0.9	0.4	0.1	0.3	235
07/08	0.8	15.0	17.4	16.1	18.4	8.1	14.3	3.0	4.1	0.4	0.2	2.3	191
08/09	1.7	17.4	13.8	22.0	11.4	8.5	15.7	4.8	2.2	0.3	0.8	1.4	185
09/10	1.2	19.0	16.7	20.8	15.3	9.2	6.6	9.7	0.8	0.4	0.2	0.1	227
10/11	5.1	14.5	17.2	13.7	22.2	13.9	6.6	3.5	0.9	0.8	0.4	1.4	212
11/12	4.1	12.7	15.5	15.9	20.7	18.0	8.9	2.2	0.5	0.7	0.5	0.2	209
12/13	1.6	19.2	26.7	18.6	17.0	8.0	3.4	2.8	1.7	0.4	0.4	0.3	202
Mean	2.2	14.4	20.1	22.6	16.0	9.4	6.6	4.0	2.4	1.2	0.6	0.5	4 486
SCH 4													0
89/90	–	–	–	–	–	–	–	–	–	–	–	–	0.0
90/91	–	–	–	–	–	–	–	–	–	–	–	–	0.0
91/92	79.2	–	–	20.8	–	–	–	–	–	–	–	–	0.1
92/93	–	53.1	23.5	–	23.5	–	–	–	–	–	–	–	0.5
93/94	–	8.9	–	–	86.2	5.0	–	–	–	–	–	–	2.2
94/95	–	14.2	85.8	–	–	–	–	–	–	–	–	–	0.4
95/96	–	–	–	–	–	–	–	–	–	–	92.1	7.9	0.3
96/97	–	–	–	–	–	–	–	–	–	–	–	100.0	0.2
97/98	–	–	–	–	–	–	57.4	–	–	42.6	–	–	0.2
98/99	–	–	–	43.3	–	–	–	–	–	–	56.7	–	0.1
99/00	–	3.2	18.0	43.4	3.1	–	–	32.3	–	–	–	–	26.0
00/01	–	–	–	–	–	0.2	88.6	11.2	–	–	–	–	11.9
01/02	–	–	–	3.2	9.7	6.5	6.3	24.5	36.9	6.4	6.4	–	1.6
02/03	0.7	14.2	10.8	29.7	18.0	9.4	16.4	–	–	–	–	0.6	18.6
03/04	0.9	3.6	6.9	1.9	1.6	2.9	0.5	–	37.1	44.7	–	–	3.3
04/05	–	–	1.1	0.8	12.7	44.7	19.4	13.8	1.3	0.7	5.3	0.3	25.9
05/06	–	100.0	–	–	–	–	–	–	–	–	–	–	2.4
06/07	–	100.0	–	–	–	–	–	–	–	–	–	–	0.2
07/08	–	–	–	–	–	–	–	–	–	–	–	–	0.0
08/09	–	–	–	–	–	–	–	–	–	–	100.0	–	0.0
09/10	–	–	–	–	–	–	100.0	–	–	–	–	–	0.0
10/11	–	–	–	–	–	–	–	–	–	–	–	–	0.0
11/12	–	–	–	–	–	0.0	–	34.8	–	65.2	–	–	0.0
12/13	–	–	–	100.0	0.0	–	–	–	–	–	–	–	0.0
Mean	0.3	7.1	8.2	18.4	10.3	14.5	20.0	14.6	2.3	2.0	2.0	0.4	94.0

Table G.2C: Distribution of landings (%) by month and fishing year for setnet for SCH 5 and SCH 7 based on trips which landed school shark. The final column gives the annual total landings for setnet in each QMA. These values are plotted in Figure 8; '–': no data.

Fishing												Month	
year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
SCH 5													
89/90	0.0	2.8	4.4	1.4	19.1	18.5	7.0	1.7	20.0	11.4	3.9	9.9	402
90/91	1.8	5.7	2.8	32.5	16.4	15.6	7.1	1.6	0.7	1.1	6.1	8.7	517
91/92	0.9	19.9	14.1	23.1	15.5	7.8	5.8	1.7	0.5	6.1	1.6	3.0	632
92/93	2.9	1.9	20.5	11.0	23.3	25.5	5.6	2.4	0.0	2.9	0.7	3.4	652
93/94	1.4	8.2	7.2	22.9	28.0	11.8	7.9	1.9	4.1	3.0	0.9	2.5	592
94/95	0.9	4.0	13.0	23.8	28.0	10.4	12.4	2.0	–	0.9	0.0	4.4	615
95/96	1.7	18.6	9.0	27.7	25.5	14.6	1.3	–	–	–	0.4	1.1	704
96/97	2.5	7.1	15.9	19.8	15.5	15.4	5.6	3.3	4.4	1.1	2.9	6.5	648
97/98	0.1	3.0	7.3	27.4	17.2	19.3	4.5	3.8	1.3	9.2	1.5	5.4	634
98/99	3.2	4.9	8.6	42.1	28.7	5.7	1.7	0.9	1.5	2.6	0.1	0.1	654
99/00	0.0	7.8	2.8	55.8	11.7	4.7	0.8	1.7	4.5	5.3	2.7	2.1	645
00/01	1.3	4.6	12.0	27.0	25.0	18.6	0.0	0.1	3.7	5.2	2.2	0.4	562
01/02	–	11.8	0.4	31.1	12.5	12.4	8.4	4.5	4.3	14.5	0.0	–	517
02/03	–	10.8	6.0	18.4	17.0	18.5	2.8	2.5	4.5	10.9	7.3	1.2	659
03/04	2.5	6.2	9.3	20.6	13.1	12.3	14.1	12.0	2.6	1.5	0.0	5.8	632
04/05	4.9	8.3	9.8	14.9	15.3	10.2	9.5	5.3	6.6	8.2	4.1	2.6	663
05/06	4.1	7.2	12.0	16.8	14.9	16.3	1.0	6.1	4.7	5.7	4.5	6.7	629
06/07	3.4	4.9	14.7	12.1	13.2	11.1	6.1	2.8	11.8	4.1	4.3	11.5	651
07/08	3.4	6.5	9.2	24.8	8.7	11.0	7.5	1.2	3.6	9.0	8.1	7.1	772
08/09	2.6	5.5	7.0	25.7	16.1	10.0	5.7	1.0	6.2	6.0	10.1	4.1	665
09/10	2.7	1.7	10.5	20.4	16.0	7.7	8.1	7.6	8.4	8.3	7.0	1.9	741
10/11	3.8	8.6	10.7	19.7	8.8	10.5	4.8	5.3	7.2	6.3	9.0	5.2	651
11/12	4.4	7.6	10.5	9.5	25.9	8.6	7.4	4.2	1.4	9.5	0.9	10.1	725
12/13	4.0	12.5	10.9	16.5	14.2	7.6	3.8	4.5	4.3	4.1	8.9	8.7	755
Mean	2.3	7.6	9.7	22.8	17.8	12.4	5.8	3.3	4.2	5.6	3.8	4.7	15 319
SCH 7													0
89/90	0.0	21.6	17.6	5.6	8.4	8.3	7.5	3.5	3.6	5.6	4.1	14.2	201
90/91	5.5	10.0	6.2	11.6	2.6	3.2	10.8	37.3	3.3	2.8	0.8	5.8	172
91/92	4.3	21.4	19.5	0.5	0.6	4.0	19.0	19.9	7.0	0.9	0.2	2.6	166
92/93	7.6	14.2	14.5	11.3	5.3	16.9	3.7	12.4	0.1	6.8	1.7	5.5	97
93/94	0.2	18.8	10.8	9.2	8.1	5.4	6.2	20.8	8.2	5.8	4.4	1.9	136
94/95	19.4	7.1	22.9	11.0	11.2	0.9	4.7	9.1	7.3	0.5	4.7	1.1	109
95/96	5.7	5.3	6.2	23.1	7.5	5.5	7.9	14.8	5.0	7.4	1.6	9.9	185
96/97	6.1	11.6	12.1	28.8	3.4	3.8	17.0	11.1	3.7	0.9	0.1	1.3	106
97/98	1.5	7.2	14.1	2.2	0.6	11.4	12.2	23.1	7.7	4.3	4.6	11.3	85
98/99	1.6	21.8	4.1	23.4	9.1	10.7	9.8	5.0	4.3	5.9	1.5	2.8	173
99/00	12.7	5.3	14.5	19.1	6.2	13.4	5.5	8.8	3.0	4.1	5.5	1.9	150
00/01	0.3	5.9	11.0	12.9	21.0	14.5	9.2	0.8	10.9	10.6	0.2	2.9	182
01/02	7.1	11.9	2.3	27.1	8.9	16.5	4.9	8.2	0.8	5.8	1.2	5.3	165
02/03	2.5	4.5	4.8	22.6	18.3	6.0	10.5	17.9	5.7	4.7	0.3	2.2	160
03/04	4.5	10.1	16.2	25.0	5.4	20.5	14.5	1.6	1.1	0.1	0.6	0.3	189
04/05	2.9	13.6	5.8	14.7	16.4	21.4	5.2	3.1	0.0	1.3	2.9	12.8	180
05/06	0.3	3.2	17.1	12.8	13.1	6.3	10.2	2.2	4.8	0.1	13.3	16.6	178
06/07	0.6	3.4	6.3	8.9	18.9	4.0	18.9	5.0	12.9	3.4	0.1	17.8	210
07/08	1.4	8.1	8.8	7.0	7.9	40.7	7.4	11.3	4.0	0.4	0.5	2.6	84
08/09	1.3	1.9	4.2	23.5	11.1	16.9	19.4	14.1	6.1	0.8	0.6	0.1	127
09/10	0.9	12.9	6.9	4.3	21.4	20.5	7.4	6.9	7.1	7.4	3.7	0.5	48
10/11	1.4	5.8	8.9	9.4	9.8	15.3	16.3	16.1	8.7	1.7	3.2	3.4	70
11/12	5.5	9.5	6.3	13.7	23.1	21.4	5.9	10.5	2.4	1.5	0.0	0.1	98
12/13	2.2	11.1	8.3	13.0	7.8	20.9	23.2	10.8	0.6	1.2	0.8	0.1	103
Mean	3.8	10.4	10.4	14.9	10.3	11.7	10.7	10.8	5.0	3.6	2.4	6.0	3 376

Table G.2D: Distribution of landings (%) by month and fishing year for setnet for SCH 8 and SCH 1W based on trips which landed school shark. The final column gives the annual total landings for setnet in each QMA. These values are plotted in Figure 8; '–': no data.

Fishing												Month	
Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
SCH 8													
89/90	0.7	1.8	0.5	20.5	6.3	7.3	14.5	3.8	20.3	1.6	2.1	20.6	251
90/91	11.0	14.1	8.6	12.5	7.8	16.1	5.3	6.2	5.9	3.4	1.0	8.1	199
91/92	4.4	7.7	16.4	13.3	11.1	10.5	23.4	6.8	1.7	2.8	0.4	1.4	213
92/93	10.7	14.5	5.4	4.8	23.2	19.0	7.4	2.0	1.2	2.5	3.4	5.8	271
93/94	5.8	9.2	17.7	10.3	19.4	9.7	7.5	2.7	5.6	0.6	7.4	4.2	235
94/95	9.5	11.9	5.7	14.5	17.2	7.8	11.2	3.9	3.5	1.3	2.5	11.1	239
95/96	5.3	7.0	16.3	18.5	8.9	12.2	6.3	7.8	2.7	1.3	5.2	8.5	309
96/97	6.3	3.8	17.4	7.4	17.4	15.9	5.4	15.8	0.8	3.6	2.8	3.4	252
97/98	2.4	10.6	10.6	20.9	8.2	13.8	9.8	6.6	4.7	2.4	3.6	6.4	220
98/99	9.8	10.6	7.2	8.7	10.5	15.4	9.2	8.6	12.6	0.7	5.0	1.7	275
99/00	12.1	15.5	14.3	7.3	10.5	13.6	10.3	8.7	4.7	0.8	0.3	1.9	200
00/01	2.5	5.7	21.6	23.9	7.3	10.1	4.8	4.8	8.9	3.1	0.7	6.7	232
01/02	2.7	12.4	6.5	21.7	7.2	7.1	17.6	6.6	4.2	5.7	5.0	3.5	196
02/03	7.0	14.8	6.5	10.4	12.2	15.9	8.1	15.1	3.8	2.6	0.6	3.0	224
03/04	4.7	10.4	10.5	17.3	11.8	12.2	12.1	4.5	4.3	6.6	1.5	4.0	183
04/05	3.0	5.1	4.5	10.9	8.5	8.1	20.6	12.0	7.6	1.2	12.2	6.4	287
05/06	3.4	11.5	4.6	7.4	15.3	3.4	8.4	20.7	6.0	8.7	5.9	4.7	258
06/07	1.2	7.1	14.7	18.3	6.2	10.4	12.6	11.3	8.7	6.3	0.6	2.6	303
07/08	1.9	19.6	8.0	11.4	4.6	18.8	15.1	8.3	2.0	4.3	0.6	5.5	272
08/09	6.1	7.2	10.2	10.0	18.3	11.6	16.5	3.6	12.1	1.1	1.4	1.9	270
09/10	3.7	7.8	8.7	9.4	6.9	21.1	15.5	5.4	12.2	2.9	3.7	2.8	235
10/11	4.2	9.8	17.0	2.8	12.9	8.0	18.2	8.4	5.9	2.1	4.0	6.8	305
11/12	3.5	9.1	16.2	4.6	6.6	10.6	14.1	4.4	2.6	13.6	10.2	4.5	202
12/13	7.7	4.3	15.5	10.1	3.3	27.9	2.9	14.5	4.0	3.7	4.6	1.5	215
Mean	5.3	9.5	11.0	12.2	11.0	12.6	11.6	8.1	6.2	3.3	3.6	5.4	5 847
SCH 1W													
89/90	2.1	6.1	5.2	8.8	9.9	6.6	1.9	6.2	12.9	17.1	5.6	17.6	143
90/91	9.7	14.7	3.7	5.8	10.5	17.9	3.9	7.0	2.0	13.6	7.4	3.8	82
91/92	5.8	12.1	23.6	14.4	7.4	12.2	5.3	11.1	5.9	0.3	0.0	1.8	96
92/93	7.1	10.2	14.6	7.2	10.6	5.5	10.7	13.0	2.7	12.5	3.3	2.6	108
93/94	8.1	7.2	15.3	19.9	9.2	5.4	15.6	4.3	7.3	2.5	1.4	3.6	128
94/95	3.6	12.0	18.0	23.7	3.7	7.0	15.0	4.0	1.8	0.7	4.2	6.3	135
95/96	1.5	4.1	4.4	29.1	15.1	12.6	7.8	8.1	7.3	2.0	2.9	5.0	122
96/97	1.8	3.2	7.7	20.8	15.1	4.0	10.8	15.2	10.7	6.4	2.2	2.1	182
97/98	2.8	4.4	17.6	3.5	5.7	41.8	5.3	1.3	5.2	4.8	4.4	3.3	252
98/99	2.9	14.0	6.7	7.4	7.6	12.5	15.4	5.0	1.3	4.4	18.2	4.7	192
99/00	5.8	21.8	12.9	3.5	13.1	15.1	8.9	5.8	6.2	1.0	3.5	2.3	172
00/01	5.3	4.5	12.3	17.7	9.0	17.0	11.0	4.1	5.5	3.7	2.9	6.9	176
01/02	2.2	15.0	7.6	9.6	8.6	17.8	16.2	3.4	5.6	2.9	8.3	2.8	175
02/03	6.8	20.7	11.4	6.1	0.8	18.8	14.1	8.0	1.8	4.5	2.5	4.5	148
03/04	6.5	12.5	29.1	7.7	4.5	18.9	10.4	1.9	0.7	3.1	2.8	2.0	179
04/05	1.2	9.5	5.6	27.5	18.1	4.0	10.2	15.0	2.7	2.1	0.7	3.3	149
05/06	5.4	7.6	27.6	1.7	0.4	28.2	9.0	4.7	7.9	0.1	0.7	6.8	124
06/07	1.7	9.0	9.8	16.7	12.3	3.2	3.6	13.4	4.9	1.8	3.8	19.9	107
07/08	5.5	30.1	11.5	6.1	4.8	7.7	7.8	10.7	0.9	5.0	3.5	6.5	136
08/09	4.2	34.2	5.0	6.3	9.7	12.3	2.5	5.7	3.5–		10.0	6.6	139
09/10	5.7	10.0	0.7	13.9	12.3	10.1	13.5	23.9	1.8	0.1	6.3	1.7	82
10/11	8.9	8.9	4.8	22.3	0.8	6.7	12.0	6.9	0.9	6.0	11.4	10.4	132
11/12	14.0	10.2	3.5	7.0	3.3	10.7	0.7	8.1	4.4	8.1	12.2	17.7	115
12/13	11.5	6.9	11.3	2.6	10.8	2.8	14.3	12.8	3.5	4.5	8.2	10.8	124
Mean	5.1	11.9	11.7	11.8	8.4	13.7	9.6	7.6	4.6	4.4	5.4	6.1	3 396

Table G.3A: Distribution of landings (%) by month and fishing year for bottom trawl for SCH 1E and SCH 2 based on trips which landed school shark. The final column gives the annual total landings by QMA for bottom trawl. These values are plotted in Figure 9; '–': no data.

Fishing Year												Month	
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
SCH 1E													
89/90	2.9	3.3	5.9	7.1	4.6	8.3	6.3	14.2	11.2	16.3	8.7	11.2	37
90/91	7.3	7.3	9.2	7.8	7.3	4.0	5.5	3.6	13.6	13.3	9.1	12.1	50
91/92	4.0	5.2	11.0	5.8	7.2	9.2	7.3	6.2	10.8	4.3	10.7	18.2	59
92/93	8.5	13.9	6.8	3.5	7.4	9.3	9.1	9.4	9.2	9.6	4.4	9.1	42
93/94	21.3	9.5	6.2	1.5	8.3	6.8	15.6	5.6	9.8	3.8	2.4	9.3	40
94/95	6.9	8.8	21.1	3.2	24.9	3.1	4.8	3.6	2.3	5.4	3.2	12.7	53
95/96	11.1	12.5	5.7	6.3	9.1	9.6	6.0	15.7	4.8	6.7	4.2	8.3	51
96/97	6.4	7.5	9.1	7.6	8.8	12.2	17.5	6.3	6.9	5.8	2.1	9.8	69
97/98	13.0	10.1	6.8	16.3	8.9	10.3	7.7	9.3	4.6	3.8	5.9	3.3	80
98/99	10.2	19.6	6.3	6.4	4.9	7.0	4.3	7.9	5.4	6.8	7.8	13.3	84
99/00	13.5	18.1	8.7	4.6	10.8	10.0	7.5	5.2	6.7	2.1	3.3	9.4	90
00/01	10.0	8.5	9.5	9.2	7.6	8.2	14.4	6.2	4.2	2.8	10.2	9.0	58
01/02	8.4	11.9	8.9	9.2	5.3	6.8	6.6	10.1	6.0	2.1	2.8	22.0	73
02/03	15.2	15.4	8.3	8.7	13.0	7.1	5.4	6.1	7.1	5.6	5.7	2.6	56
03/04	7.3	7.5	14.0	16.2	9.6	7.4	10.9	7.8	6.1	3.7	5.2	4.4	83
04/05	6.6	10.1	10.8	9.9	4.6	8.9	12.8	15.6	5.0	5.7	5.9	4.1	115
05/06	8.0	9.0	6.4	9.0	6.7	12.0	10.3	5.5	3.0	7.5	5.2	17.5	156
06/07	8.7	12.1	11.4	7.6	11.0	11.7	6.5	9.4	2.9	4.8	4.6	9.3	114
07/08	8.5	10.6	7.1	6.3	12.7	6.7	7.4	5.9	6.6	6.7	5.9	15.5	83
08/09	12.3	16.2	9.2	6.5	3.6	16.8	7.4	6.0	5.6	2.8	7.4	6.1	87
09/10	9.7	11.8	10.7	8.4	5.0	6.1	10.0	4.6	11.4	9.1	4.7	8.4	89
10/11	8.9	12.6	7.6	3.8	16.1	6.4	8.2	5.4	6.4	5.0	8.4	11.2	112
11/12	11.9	10.1	5.1	9.0	12.6	6.5	8.6	15.6	5.9	5.6	4.9	4.2	108
12/13	5.7	17.6	12.4	5.1	14.4	3.8	12.2	9.1	6.9	6.6	1.6	4.7	75
Mean	9.3	11.5	9.0	7.8	9.3	8.6	8.9	8.1	6.3	5.8	5.5	9.9	1 863
SCH 2													
89/90	4.7	11.1	9.1	9.0	10.1	7.2	11.3	8.1	10.5	6.7	3.7	8.5	47
90/91	7.5	8.3	12.0	6.4	5.5	5.6	8.7	19.0	4.4	8.5	6.3	7.7	57
91/92	14.2	10.4	6.3	8.6	7.2	8.2	13.4	11.8	5.8	8.0	2.4	3.7	57
92/93	4.9	9.8	9.9	14.4	6.1	12.9	7.9	11.8	11.6	4.4	2.3	4.1	83
93/94	7.2	10.0	14.7	13.4	7.5	6.6	9.9	10.8	7.6	4.3	4.7	3.3	64
94/95	2.9	12.9	8.6	10.7	5.5	9.5	12.0	12.6	6.6	5.1	5.2	8.4	61
95/96	5.9	9.6	6.8	7.4	4.9	10.1	9.2	17.2	10.1	4.5	5.8	8.5	127
96/97	6.8	11.4	8.1	10.3	8.4	5.7	8.0	21.6	7.1	4.0	2.8	5.9	125
97/98	10.7	11.0	9.9	5.8	7.9	9.0	12.4	12.1	4.1	6.4	1.7	9.0	129
98/99	17.3	6.5	4.5	2.8	5.5	9.4	12.3	9.6	10.2	5.4	7.4	9.2	172
99/00	8.1	8.7	8.0	6.6	10.4	11.4	10.3	11.7	6.1	3.0	8.2	7.5	144
00/01	11.1	5.8	8.4	10.0	8.8	9.9	10.4	8.1	9.8	7.4	3.9	6.4	93
01/02	5.8	8.6	8.1	5.7	7.4	12.5	14.5	11.9	11.5	4.3	4.4	5.2	90
02/03	3.0	12.2	13.6	12.5	7.4	8.7	5.0	8.3	7.9	4.6	2.2	14.6	97
03/04	4.3	8.6	12.9	9.8	8.1	9.3	11.1	12.2	10.1	4.9	2.9	5.8	83
04/05	6.3	11.0	11.2	12.1	6.5	8.8	8.3	8.0	8.1	5.0	9.8	4.8	86
05/06	7.1	9.6	8.0	8.9	12.2	10.8	5.8	9.7	8.2	5.8	5.6	8.3	88
06/07	11.2	7.1	7.3	8.6	6.6	8.8	10.3	10.9	8.7	9.3	4.9	6.2	106
07/08	6.8	11.7	10.8	7.6	6.0	7.1	11.8	8.3	12.0	7.3	3.6	6.9	89
08/09	9.3	10.0	9.4	7.8	10.4	8.1	8.5	7.9	7.5	4.8	8.8	7.5	90
09/10	10.0	8.7	12.7	8.4	5.9	5.8	7.7	11.4	8.4	3.8	10.3	6.9	84
10/11	8.5	13.2	6.2	6.2	8.1	6.5	7.3	11.0	7.7	6.4	9.1	9.8	78
11/12	5.6	8.5	9.5	8.0	6.9	6.3	6.1	9.4	10.1	8.2	8.3	13.0	73
12/13	6.6	8.3	10.3	9.5	10.5	8.5	7.0	8.2	9.0	8.0	6.7	7.3	66
Mean	8.2	9.5	9.1	8.4	7.6	8.8	9.7	11.5	8.5	5.6	5.5	7.6	2 187

Table G.3B: Distribution of landings (%) by month and fishing year for bottom trawl for SCH 3 and SCH 4 based on trips which landed school shark. The final column gives the annual total landings by QMA for bottom trawl. These values are plotted in Figure 9; '–': no data.

Fishing Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep (Month)	Total
SCH 3													
89/90	3.6	9.7	7.2	21.1	19.1	11.2	10.4	6.9	5.6	1.3	0.5	3.3	111
90/91	7.0	10.3	17.1	19.4	9.2	15.7	10.3	3.1	2.6	1.1	1.5	2.7	92
91/92	4.9	7.1	11.2	13.8	25.4	17.9	9.1	2.2	1.8	1.4	1.7	3.5	91
92/93	3.5	12.2	8.1	25.8	13.0	14.3	13.3	2.2	1.7	3.8	1.1	0.8	102
93/94	4.3	6.9	16.3	21.4	12.4	12.2	11.3	4.1	2.9	2.5	2.1	3.7	66
94/95	9.0	16.6	21.9	15.5	4.9	12.0	4.4	5.9	2.3	0.7	1.0	5.9	84
95/96	7.9	13.0	26.9	11.5	10.2	7.2	5.3	8.4	5.0	2.6	1.1	0.8	118
96/97	5.3	12.5	12.4	18.6	15.2	8.5	10.2	7.6	3.3	1.9	1.7	2.8	84
97/98	8.1	18.5	14.9	14.5	10.5	9.4	6.9	5.3	5.0	1.6	2.2	3.1	113
98/99	6.8	10.3	7.7	12.7	8.4	10.4	12.9	13.4	8.2	2.7	2.8	3.8	116
99/00	8.4	9.2	9.6	13.0	11.4	11.5	6.0	10.4	9.6	4.3	2.2	4.4	155
00/01	5.4	10.1	12.4	15.7	11.6	11.7	10.2	8.9	5.8	2.8	2.9	2.6	155
01/02	9.5	14.7	5.7	8.1	6.9	11.4	13.8	11.3	8.2	3.8	1.0	5.8	136
02/03	6.2	14.1	12.9	12.3	10.6	12.3	10.7	10.4	5.4	3.2	1.2	0.6	165
03/04	6.4	9.9	11.8	7.4	10.0	15.5	13.8	7.7	6.6	2.3	1.2	7.4	126
04/05	6.1	12.1	10.4	14.6	11.4	10.4	8.3	10.3	10.3	4.1	0.8	1.2	142
05/06	5.4	8.5	10.5	5.8	12.7	15.7	11.0	10.6	8.8	4.2	2.8	4.1	151
06/07	5.1	8.3	11.1	9.6	10.7	13.1	12.1	5.0	6.7	9.7	6.2	2.5	135
07/08	3.8	15.9	9.0	13.4	10.7	8.5	6.3	5.0	7.0	9.5	2.9	8.0	109
08/09	6.5	6.9	8.3	11.9	11.4	15.3	8.7	5.8	9.8	6.9	3.0	5.5	107
09/10	8.0	12.6	12.0	12.9	9.1	8.2	7.4	13.4	7.5	3.8	1.6	3.5	145
10/11	5.1	9.1	6.7	8.7	10.2	14.4	15.2	12.8	7.9	3.2	3.8	2.9	116
11/12	3.9	7.7	7.4	14.7	15.5	9.5	12.8	9.0	4.8	10.1	2.6	1.9	81
12/13	7.1	15.3	10.8	9.4	13.3	11.6	9.4	10.4	4.2	3.5	1.3	3.7	81
Mean	6.2	11.3	11.6	13.3	11.6	12.0	10.0	8.3	6.3	3.9	2.1	3.5	2 781
SCH 4													
89/90	–	–	14.7	23.5	41.6	1.0	–	5.3	–	12.8	–	1.0	5.8
90/91	36.3	6.5	18.3	15.9	13.6	–	–	–	1.2	4.4	1.0	2.9	5.4
91/92	6.0	5.6	21.4	31.5	13.4	0.5	–	10.5	6.2	1.8	1.6	1.4	4.9
92/93	–	0.1	53.1	–	4.1	–	2.9	9.3	5.2	2.3	22.9	–	5.1
93/94	–	3.1	4.1	71.1	2.7	14.3	–	1.2	3.5	–	–	–	2.5
94/95	13.0	4.4	11.8	32.7	4.7	0.4	22.6	4.7	1.0	4.7	–	–	3.7
95/96	0.8	4.1	1.4	1.6	2.0	1.1	3.7	32.2	52.7	0.2	0.2	–	61.7
96/97	0.1	2.7	0.6	12.0	0.6	2.6	0.4	14.6	22.5	43.9	–	–	44.7
97/98	2.6	23.8	16.6	30.2	6.0	7.3	0.9	1.3	4.0	4.6	–	2.7	22.3
98/99	7.0	15.8	30.0	11.3	8.0	13.4	–	7.3	6.3	0.5	0.0	0.4	11.6
99/00	3.2	10.8	18.5	37.7	21.3	1.9	1.7	2.0	1.4	0.2	–	1.2	16.1
00/01	9.7	2.0	2.4	8.3	4.3	19.0	27.0	1.4	0.1	14.1	2.6	9.0	29.4
01/02	15.9	14.0	15.0	6.9	2.5	12.3	12.7	0.6	0.4	5.8	1.8	12.1	38.1
02/03	12.1	20.7	7.6	8.8	10.6	7.3	2.9	21.7	1.0	0.3	2.7	4.4	23.7
03/04	11.2	14.4	38.5	1.8	2.5	–	23.8	0.4	3.0	1.3	–	3.2	19.2
04/05	14.2	4.3	19.6	13.0	6.8	12.7	6.3	0.3	3.5	3.7	6.2	9.4	41.8
05/06	10.0	15.3	19.3	9.3	8.7	8.6	1.1	13.4	5.5	4.9	1.7	2.4	42.4
06/07	3.0	13.5	10.9	32.5	2.5	5.9	2.0	3.6	12.5	3.9	2.0	7.9	19.1
07/08	4.6	2.4	0.2	9.2	3.9	1.7	0.8	25.1	2.5	29.6	1.0	19.0	24.5
08/09	17.4	0.3	5.4	9.7	11.9	0.2	16.6	6.7	21.1	8.0	0.4	2.3	26.5
09/10	0.4	0.6	11.8	8.0	19.9	16.1	12.9	19.0	1.0	0.5	0.3	9.6	21.5
10/11	1.4	2.4	5.3	60.5	5.1	7.0	8.0	0.5	2.0	3.3	0.7	3.9	5.6
11/12	19.9	5.8	9.8	1.8	0.5	2.6	7.9	8.0	6.1	5.9	0.1	31.5	8.5
12/13	57.3	11.4	0.9	7.0	1.3	1.3	0.4	1.1	17.9	0.4	1.0	–	24.5
Mean	10.1	8.3	11.2	12.2	6.4	6.4	6.7	10.8	12.6	8.6	1.6	5.2	508.6

Table G.3C: Distribution of landings (%) by month and fishing year for bottom trawl for SCH 5 and SCH 7 based on trips which landed school shark. The final column gives the annual total landings by QMA for bottom trawl. These values are plotted in Figure 9; '–': no data.

Fishing												Month	
Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
SCH 5													
89/90	4.0	12.7	6.6	11.6	15.8	4.8	3.8	1.4	9.1	6.1	8.4	15.6	52
90/91	17.9	9.8	11.1	24.1	5.0	5.3	2.7	5.2	2.0	4.1	5.6	7.1	34
91/92	9.7	12.2	13.8	6.8	8.9	14.8	6.9	1.5	5.2	1.9	5.2	13.2	22
92/93	5.7	7.2	19.7	0.9	15.3	17.7	8.1	9.8	1.1	3.9	3.5	7.3	28
93/94	4.9	4.5	3.4	10.1	13.9	4.3	0.8	29.9	10.7	8.7	1.3	7.6	22
94/95	3.7	3.0	5.7	26.7	19.3	2.2	8.3	3.9	9.5	9.2	2.1	6.4	28
95/96	5.7	5.1	4.8	12.2	9.4	6.7	7.5	2.3	13.3	27.7	0.7	4.5	30
96/97	1.8	4.1	3.2	16.2	11.8	8.7	3.4	20.7	3.8	21.2	2.9	2.2	26
97/98	7.1	3.5	2.7	9.0	2.6	4.6	7.1	7.4	19.3	8.0	18.5	10.3	18
98/99	4.0	9.9	2.7	6.8	10.3	9.6	12.4	8.6	2.7	15.7	6.8	10.6	48
99/00	18.4	10.8	7.7	6.3	2.8	3.6	0.9	6.6	6.5	17.1	9.3	10.2	101
00/01	19.7	5.7	12.8	4.9	5.8	3.4	4.1	12.3	5.2	7.2	7.7	11.3	94
01/02	16.9	4.8	7.2	11.5	5.8	11.0	7.4	2.7	7.0	11.2	6.5	8.1	103
02/03	16.7	14.8	5.0	1.7	4.3	8.2	16.5	7.5	6.1	6.3	7.1	5.8	91
03/04	7.0	5.3	11.4	7.8	3.6	6.3	11.3	7.7	8.2	20.8	5.1	5.5	68
04/05	6.3	5.5	7.7	11.1	9.1	11.8	10.0	5.4	4.3	6.8	6.7	15.3	56
05/06	8.4	7.1	14.6	7.3	8.5	8.0	7.5	11.3	10.4	5.2	11.3	0.4	66
06/07	1.7	1.7	9.4	10.6	5.1	5.3	9.1	37.5	3.3	2.4	9.3	4.7	72
07/08	2.7	12.9	8.9	6.5	23.1	12.7	4.1	4.7	4.7	7.8	9.4	2.5	37
08/09	3.9	5.2	6.4	16.1	5.2	4.7	7.3	11.4	16.2	3.2	13.0	7.5	50
09/10	3.2	2.9	7.1	12.0	5.3	8.3	4.9	10.1	28.7	7.6	3.7	6.4	82
10/11	8.3	6.7	7.1	4.2	10.4	8.5	19.5	13.3	5.5	6.3	5.6	4.5	62
11/12	9.0	5.9	9.3	10.5	12.8	7.2	10.2	15.1	2.8	3.4	7.4	6.4	53
12/13	8.1	7.5	7.4	5.7	15.7	14.3	10.8	9.3	3.9	2.6	3.9	10.7	64
Mean	9.5	7.2	8.3	9.1	8.4	7.8	8.0	10.2	8.0	8.9	7.0	7.7	1 306
SCH 7													
89/90	1.1	6.7	8.4	13.4	11.8	15.4	10.7	8.6	8.7	3.5	5.3	6.4	153
90/91	7.5	10.0	6.7	13.4	13.9	13.2	10.7	7.7	3.2	2.2	4.5	7.0	108
91/92	10.4	14.0	5.4	5.2	10.7	4.9	13.7	8.5	3.5	7.7	7.7	8.2	94
92/93	4.7	18.9	8.9	5.9	12.8	15.5	9.5	6.7	5.6	4.3	2.2	5.0	136
93/94	9.4	14.6	11.3	6.6	7.8	7.7	10.2	11.0	9.1	4.3	2.2	5.9	97
94/95	8.4	8.0	11.5	11.2	6.7	9.7	11.2	14.4	7.7	1.6	4.4	5.3	124
95/96	3.5	7.8	6.3	14.5	7.3	14.4	14.6	14.1	9.7	3.7	1.2	2.8	187
96/97	6.0	12.5	11.2	16.5	9.9	8.8	12.2	7.2	8.6	3.6	1.1	2.3	168
97/98	6.2	10.8	10.1	12.1	6.3	4.6	8.7	15.9	13.9	5.4	1.6	4.6	130
98/99	2.3	6.8	7.9	13.0	14.8	11.9	10.5	7.1	11.7	4.7	3.9	5.4	239
99/00	7.6	11.2	8.7	10.0	5.1	9.0	8.4	12.9	8.6	5.1	3.3	10.2	232
00/01	7.2	9.3	6.4	13.6	8.9	11.0	8.5	9.2	12.9	5.9	2.6	4.4	200
01/02	8.5	12.3	7.6	7.8	5.6	7.7	12.7	7.4	7.1	10.2	7.0	6.0	161
02/03	17.3	14.1	10.7	9.2	9.0	8.7	4.5	6.2	7.3	3.6	4.3	5.2	175
03/04	9.4	9.1	6.3	7.3	9.2	10.4	11.0	8.5	6.3	12.5	3.4	6.5	217
04/05	7.9	9.9	7.0	7.7	9.4	9.0	12.0	11.5	5.0	6.9	2.6	11.1	164
05/06	6.0	6.9	7.9	7.6	5.5	8.1	7.4	15.4	9.3	9.5	5.9	10.4	180
06/07	5.6	11.8	5.2	18.0	7.2	7.4	7.1	8.8	5.3	11.9	6.1	5.6	213
07/08	5.4	8.5	7.3	7.8	5.9	10.8	9.9	13.2	11.3	5.8	4.1	10.0	264
08/09	3.9	8.2	6.3	15.8	11.2	16.9	8.7	9.1	6.3	5.0	3.1	5.6	306
09/10	3.6	8.8	12.3	6.7	15.7	10.8	13.2	9.5	6.7	4.1	3.6	5.1	311
10/11	5.5	15.7	9.2	9.7	10.4	9.6	9.6	8.2	5.8	3.1	6.5	6.8	289
11/12	7.0	10.7	7.6	6.7	9.1	8.8	10.9	9.5	6.9	5.6	10.4	6.7	288
12/13	6.1	11.8	9.8	7.6	9.5	9.0	7.0	12.1	4.8	3.9	9.6	9.0	281
Mean	6.3	10.5	8.3	10.3	9.5	10.4	10.0	10.1	7.7	5.6	4.7	6.6	4 719

Table G.3D: Distribution of landings (%) by month and fishing year for bottom trawl for SCH 8 and SCH 1W based on trips which landed school shark. The final column gives the annual total landings by QMA for bottom trawl. These values are plotted in Figure 9; '–': no data.

Fishing											Month		
Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
SCH 8													
89/90	2.1	0.5	–	20.6	12.9	5.6	8.3	2.4	11.4	6.6	8.1	21.4	11
90/91	5.3	14.0	3.0	5.4	15.8	10.0	2.0	2.0	1.6	32.2	3.3	5.3	13
91/92	1.0	2.3	46.3	2.5	0.4	39.4	1.2	2.1	1.5	2.6	–	0.8	19
92/93	2.6	1.4	5.4	17.7	19.6	29.4	1.3	1.8	2.1	0.5	2.7	15.4	13
93/94	1.5	2.0	0.8	62.1	4.6	3.8	12.5	1.0	4.6	0.4	5.9	1.0	22
94/95	6.9	2.9	12.3	0.7	2.9	12.9	33.4	9.5	11.3	0.3	3.2	3.7	11
95/96	13.2	3.8	2.9	19.6	5.9	20.5	10.9	7.5	7.4	3.9	0.3	4.0	21
96/97	3.0	2.3	3.8	8.5	15.4	17.2	19.4	13.5	9.5	0.2	4.2	2.9	35
97/98	2.2	1.2	30.1	18.4	11.2	11.2	14.3	7.6	2.5	0.8	0.3	0.2	51
98/99	0.9	11.0	4.9	22.3	10.8	14.0	9.3	5.5	11.3	3.3	1.7	5.0	53
99/00	1.8	5.4	10.3	8.4	8.7	12.7	6.5	20.1	11.2	4.5	2.8	7.5	53
00/01	7.1	7.0	26.8	8.0	7.9	4.2	7.2	0.4	4.2	2.8	6.6	17.8	67
01/02	0.6	5.6	5.3	11.0	8.9	10.8	13.5	8.6	6.8	4.6	5.2	19.1	61
02/03	4.7	6.0	4.4	5.3	26.0	23.1	4.2	11.1	9.3	3.1	2.0	0.8	52
03/04	1.8	6.8	3.5	25.6	4.2	18.7	18.8	6.6	7.4	4.8	0.7	1.0	43
04/05	14.2	1.3	4.5	6.3	8.5	19.4	14.6	10.7	3.7	1.0	3.0	12.7	40
05/06	1.6	3.1	1.6	10.9	24.8	20.8	26.1	3.4	1.9	2.2	0.7	2.9	57
06/07	7.8	3.4	10.9	3.5	8.8	6.2	19.8	14.0	15.7	6.7	1.4	1.8	44
07/08	2.1	12.7	1.6	6.8	18.8	1.1	30.6	5.2	10.8	4.8	3.3	2.1	36
08/09	6.8	7.0	1.1	1.0	7.5	15.4	2.5	1.8	33.6	13.1	2.6	7.7	39
09/10	14.3	26.4	3.7	7.3	2.3	11.0	13.6	11.7	4.5	1.2	1.8	2.1	46
10/11	17.3	4.8	7.5	6.8	23.7	9.1	4.4	5.4	10.8	5.8	1.4	3.0	47
11/12	10.9	0.5	4.8	2.4	2.0	7.2	36.1	2.3	1.5	17.2	4.1	10.9	60
12/13	12.4	17.6	6.4	3.1	4.7	12.3	7.5	4.8	1.8	10.6	7.1	11.7	31
Mean	6.0	6.4	8.7	10.8	11.0	13.1	14.1	7.1	7.8	5.2	2.9	6.8	924
SCH 1W													
89/90	9.5	6.3	1.0	3.9	5.8	13.3	8.5	7.1	7.0	6.8	14.9	15.9	95
90/91	10.6	3.1	3.0	9.1	9.1	4.5	3.3	9.8	10.8	12.7	4.3	19.8	85
91/92	19.9	9.3	14.9	5.8	9.5	3.7	1.2	0.9	10.3	3.6	4.8	16.1	116
92/93	12.4	9.8	9.7	7.3	9.8	11.2	4.1	1.6	7.1	10.2	5.3	11.6	248
93/94	12.9	7.8	7.4	13.6	6.4	6.1	6.0	7.2	11.8	10.8	6.7	3.2	167
94/95	14.3	7.5	5.3	9.9	10.0	3.3	10.0	3.7	7.4	5.4	8.6	14.7	128
95/96	7.9	9.3	15.2	9.6	8.5	6.5	6.6	9.3	7.0	6.2	2.2	11.7	185
96/97	7.4	5.9	6.5	6.5	4.3	6.2	6.5	7.9	12.7	11.2	5.3	19.5	210
97/98	6.3	20.5	6.6	3.3	6.9	11.1	10.7	8.5	3.9	7.3	7.7	7.1	220
98/99	10.8	18.4	5.7	4.6	7.1	10.6	8.0	6.1	8.5	3.2	9.7	7.1	202
99/00	17.2	8.0	7.3	6.6	6.5	13.9	11.3	7.7	6.8	4.6	5.2	4.8	177
00/01	7.8	6.5	4.5	11.3	3.8	11.3	9.0	6.4	11.5	8.1	8.8	11.0	123
01/02	8.4	9.0	5.6	5.4	4.7	2.9	5.4	6.1	3.9	13.2	16.0	19.4	184
02/03	10.1	17.5	5.1	3.9	8.5	3.6	6.1	10.9	9.1	9.3	10.7	5.3	213
03/04	11.0	10.7	9.5	6.4	4.2	6.9	8.9	7.3	6.0	4.8	7.4	16.9	177
04/05	9.5	11.3	3.2	2.4	6.7	5.2	7.6	10.7	6.6	15.9	10.4	10.5	194
05/06	14.4	8.4	7.7	10.6	7.9	9.8	8.4	3.0	7.5	8.2	6.9	7.2	161
06/07	8.4	7.1	5.3	9.6	6.9	12.9	13.2	7.0	3.2	11.1	10.0	5.3	163
07/08	7.2	10.6	1.7	6.8	6.7	12.6	5.3	8.5	7.5	10.0	13.9	9.2	257
08/09	11.8	15.6	6.3	5.2	4.1	10.4	5.9	1.9	4.8	6.0	12.4	15.7	278
09/10	2.9	6.9	8.6	3.0	9.1	9.1	9.9	2.0	2.9	5.6	21.8	18.1	209
10/11	8.4	8.4	2.0	8.2	5.2	9.2	10.9	2.4	5.5	5.4	13.6	20.7	289
11/12	10.9	11.2	11.6	3.7	5.8	7.5	6.9	4.9	8.0	6.4	8.3	14.8	268
12/13	11.1	6.3	4.0	6.7	11.8	8.7	11.4	11.5	6.0	2.2	6.2	14.1	230
Mean	10.2	10.4	6.6	6.5	7.0	8.5	7.8	6.2	7.1	7.7	9.5	12.5	4 579

Table G.4A: Distribution of landings (%) by month and fishing year for bottom longline for SCH 1E and SCH 2 based on trips which landed school shark. The final column gives the annual total landings by QMA for bottom trawl. These values are plotted in Figure 10; '–': no data.

Fishing												Month	
Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
SCH 1E													
89/90	2.9	4.9	11.3	10.8	6.0	4.3	5.8	3.4	5.2	27.8	1.8	15.9	89
90/91	3.4	15.4	9.2	8.7	13.0	4.4	5.2	6.8	2.6	4.8	13.0	13.3	124
91/92	7.2	7.2	17.9	17.4	16.7	2.5	2.0	1.8	5.3	4.7	2.4	14.9	108
92/93	7.7	11.2	15.9	12.3	12.0	16.6	7.1	4.0	2.4	6.0	2.1	2.8	150
93/94	24.5	8.9	19.5	3.5	0.4	4.5	2.4	1.9	7.3	3.0	15.4	8.5	77
94/95	10.5	13.9	7.2	0.4	1.4	2.1	3.6	1.9	1.4	4.0	9.8	43.8	80
95/96	9.0	19.5	9.1	12.5	6.9	4.9	9.7	4.9	1.4	4.0	9.8	8.4	142
96/97	5.5	16.6	11.2	19.5	4.1	7.9	3.1	9.2	5.1	8.7	2.6	6.4	75
97/98	6.5	8.0	9.4	7.1	14.9	8.9	4.4	5.9	5.4	11.4	9.7	8.6	78
98/99	1.4	4.6	3.6	5.5	3.6	5.6	12.0	13.2	13.9	7.0	6.3	23.5	92
99/00	6.7	16.4	12.1	9.2	14.0	10.1	4.5	4.7	2.2	3.8	9.8	6.5	197
00/01	6.9	7.6	6.4	15.0	11.2	2.2	6.0	4.3	5.4	9.3	8.4	17.2	200
01/02	10.6	6.7	8.8	9.5	13.9	5.5	8.1	4.3	5.5	5.5	6.4	15.2	139
02/03	11.7	13.5	12.8	11.8	8.3	9.3	8.3	5.8	4.2	3.7	4.2	6.6	104
03/04	8.8	9.7	8.6	8.3	6.4	9.7	4.9	5.9	12.8	6.1	7.5	11.4	140
04/05	13.4	8.9	8.7	11.9	9.6	8.7	6.5	14.5	3.1	6.3	3.8	4.4	138
05/06	11.8	8.9	4.5	7.8	12.3	6.7	7.3	9.8	6.7	5.7	4.4	14.1	131
06/07	6.3	7.8	13.6	10.6	11.7	10.9	7.7	6.7	5.6	6.1	3.1	10.0	132
07/08	9.0	11.0	5.4	6.6	7.4	4.2	9.2	13.8	7.9	7.9	5.2	12.3	111
08/09	15.4	12.4	7.4	7.3	4.1	8.9	6.3	7.4	9.1	5.2	2.9	13.5	108
09/10	11.5	13.4	14.2	4.8	8.5	7.1	5.5	4.7	7.9	9.2	6.7	6.6	97
10/11	10.8	12.3	22.8	3.7	7.2	5.6	6.6	5.4	5.4	4.6	6.6	9.0	142
11/12	10.9	11.9	8.4	7.0	4.2	4.3	5.4	8.2	10.5	9.3	8.7	11.3	102
12/13	12.1	8.7	7.5	4.0	5.1	9.0	9.1	10.9	8.6	12.4	4.8	8.0	96
Mean	9.2	10.9	10.6	9.3	9.1	7.0	6.4	6.6	5.8	7.0	6.5	11.7	2 851
SCH 2													
89/90	0.9	4.0	5.9	19.6	6.8	0.3	4.6	14.0	10.3	13.9	0.5	19.3	31
90/91	5.8	8.1	13.2	3.4	13.3	12.2	9.1	11.9	4.6	1.6	7.2	9.6	52
91/92	3.5	4.2	4.5	21.2	4.5	7.1	26.9	6.7	6.6	4.6	1.3	8.7	49
92/93	2.5	3.7	7.5	14.8	7.0	6.9	3.9	7.9	12.7	4.6	7.6	20.8	75
93/94	26.7	8.4	4.7	2.3	3.5	0.9	6.0	7.7	4.8	3.6	26.5	4.9	63
94/95	7.3	5.2	5.4	2.4	1.5	7.0	11.9	1.5	1.2	3.0	17.0	36.4	54
95/96	22.3	27.1	7.2	1.2	4.2	6.0	5.3	3.0	1.0	2.5	6.1	14.2	68
96/97	18.9	6.4	1.7	3.8	4.0	7.9	3.4	12.4	14.4	12.7	3.2	11.2	46
97/98	6.5	10.2	2.8	2.1	5.8	6.8	5.6	1.4	16.4	2.8	8.4	31.3	35
98/99	4.1	6.3	4.3	4.4	3.9	5.6	3.2	19.1	3.7	2.3	22.7	20.3	61
99/00	2.0	3.7	3.0	0.7	2.9	3.1	3.6	10.6	2.9	21.6	32.1	13.7	48
00/01	9.7	12.4	11.3	3.4	0.9	0.3	1.3	5.8	14.8	7.8	10.4	21.8	53
01/02	4.5	4.8	2.9	10.1	5.5	5.7	8.3	4.3	1.0	16.9	20.3	15.6	70
02/03	8.9	12.7	20.7	2.2	7.9	2.6	5.7	6.6	1.6	4.2	1.5	25.3	74
03/04	18.6	12.7	6.1	0.5	6.6	11.7	11.2	3.6	7.7	3.2	7.6	10.5	56
04/05	4.1	10.1	13.4	8.8	7.6	3.1	2.4	17.5	8.3	6.0	4.7	14.0	77
05/06	12.1	5.5	5.0	4.3	3.7	3.6	4.0	13.7	9.7	6.9	13.9	17.6	89
06/07	19.0	6.5	4.4	1.6	4.6	4.6	6.4	17.5	5.9	10.0	5.9	13.5	67
07/08	6.7	5.3	15.6	1.0	1.0	7.6	3.5	24.8	3.6	4.5	9.5	16.9	93
08/09	7.8	14.4	3.5	21.0	10.1	1.7	4.0	2.8	6.2	18.7	2.8	6.9	97
09/10	4.5	3.6	13.8	5.4	2.5	6.2	6.6	9.3	3.5	9.7	8.6	26.3	81
10/11	7.4	7.9	5.4	2.6	7.7	9.4	5.8	4.3	12.4	10.2	13.5	13.3	77
11/12	14.6	11.6	4.5	5.9	5.5	4.0	0.6	13.0	6.7	6.5	11.8	15.2	72
12/13	4.1	23.1	12.8	3.6	3.6	5.9	9.4	9.8	11.5	8.7	3.1	4.5	101
Mean	9.2	9.6	8.0	6.1	5.2	5.4	6.1	9.9	6.9	7.9	10.0	15.8	1 589

Table G.4B: Distribution of landings (%) by month and fishing year for bottom longline for SCH 3 and SCH 4 based on trips which landed school shark. The final column gives the annual total landings by QMA for bottom trawl. These values are plotted in Figure 10; '–': no data.

Fishing												Month	
Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
SCH 3													
89/90	–	–	1.2	–	0.6	1.4	8.2	16.6	4.2	5.2	–	62.6	3
90/91	–	1.1	13.4	0.9	0.0	5.8	38.2	37.4	0.4	2.6	0.0	–	3
91/92	37.0	0.0	21.8	1.6	0.0	0.0	–	7.3	24.4	–	8.0	–	1
92/93	0.3	2.0	0.5	0.1	32.7	1.0	31.3	–	–	4.4	–	27.7	3
93/94	23.3	53.6	0.0	–	–	–	2.4	0.0	9.0	7.1	0.9	3.6	8
94/95	–	15.9	25.2	7.8	10.2	0.0	7.3	2.5	2.9	1.4	10.1	16.7	17
95/96	12.1	0.9	1.1	0.0	1.0	–	30.6	43.6	3.2	5.8	1.0	0.6	35
96/97	0.2	1.3	4.2	0.1	–	0.6	67.9	18.0	0.6	3.4	3.1	0.5	45
97/98	1.8	27.9	2.9	0.0	0.0	6.7	0.7	6.5	41.5	0.0	12.1	–	6
98/99	0.0	0.7	7.9	24.9	12.3	12.0	–	–	0.7	12.9	21.9	6.7	23
99/00	2.4	17.6	37.4	20.0	–	0.4	–	4.3	0.1	7.7	10.0	–	26
00/01	2.9	30.5	29.8	–	31.9	0.3	0.7	–	2.8	1.0	–	–	19
01/02	–	47.4	–	27.3	–	0.0	–	0.6	2.6	4.1	17.8	0.1	17
02/03	7.7	18.5	45.6	5.2	20.9	0.5	0.3	0.4	0.5	0.0	0.4	–	28
03/04	0.9	20.0	4.3	–	40.5	0.3	14.1	0.0	–	3.0	14.0	2.8	16
04/05	13.1	1.7	32.0	9.3	5.7	0.2	25.5	3.0	7.3	0.4	1.0	0.9	42
05/06	0.8	41.8	14.6	0.9	2.3	0.6	–	2.8	6.9	14.1	14.2	1.0	15
06/07	6.7	1.4	8.6	15.0	19.4	11.2	1.0	3.4	4.2	9.6	4.2	15.3	19
07/08	1.0	6.6	2.7	15.9	–	8.0	32.8	6.6	5.9	1.2	8.1	11.2	42
08/09	0.2	10.1	6.0	6.8	20.2	9.0	20.0	0.0	6.1	0.4	20.0	1.2	73
09/10	6.9	5.3	9.1	28.8	8.8	13.8	0.3	1.8	19.1	3.3	2.7	0.1	51
10/11	16.0	25.3	10.8	19.3	15.9	0.1	0.0	2.2	3.9	3.5	0.4	2.6	43
11/12	3.0	8.2	17.9	12.6	23.4	1.7	10.3	2.0	0.4	1.6	5.5	13.5	59
12/13	9.5	21.8	6.3	36.3	2.4	1.0	9.5	0.5	3.1	6.1	2.3	1.3	40
Mean	5.3	12.8	13.1	13.0	11.3	3.9	15.3	5.6	5.0	3.6	7.0	4.3	635
SCH 4													
89/90	–	–	–	–	–	–	–	100.0	–	–	–	–	0.1
90/91	–	–	0.3	–	1.6	1.6	–	2.5	2.2	51.4	2.2	38.2	7.4
91/92	4.9	34.7	11.9	–	–	–	–	2.1	18.2	3.9	10.8	13.4	30.5
92/93	13.7	2.3	0.1	0.8	7.9	0.5	–	0.9	19.7	27.2	17.4	9.5	24.0
93/94	4.4	3.6	12.6	10.6	8.3	14.4	0.2	8.4	12.7	7.4	7.2	10.1	35.5
94/95	0.9	9.7	–	3.3	0.5	0.4	0.2	4.2	6.9	13.1	47.0	13.8	23.6
95/96	7.4	10.6	2.2	7.4	14.1	10.7	7.9	5.1	3.6	6.7	15.3	9.0	108.8
96/97	21.0	15.8	5.1	5.2	5.4	2.3	5.4	1.7	4.2	4.4	9.3	20.3	183.9
97/98	12.0	6.4	7.3	14.4	2.2	10.2	3.9	4.2	7.9	8.0	10.2	13.3	98.7
98/99	20.5	8.1	14.8	6.4	5.4	5.0	2.6	5.1	0.8	5.2	6.6	19.4	103.4
99/00	33.1	14.1	4.0	3.2	1.0	1.7	0.2	0.4	4.1	2.3	17.7	18.1	77.5
00/01	15.7	1.6	4.2	1.1	0.8	1.5	1.1	7.6	2.1	5.0	41.1	18.3	63.5
01/02	24.8	1.0	5.2	3.7	0.4	0.2	1.3	0.2	4.3	7.1	34.8	17.1	56.2
02/03	24.9	4.8	1.6	5.3	2.1	0.2	0.9	7.5	9.3	7.5	14.0	21.9	84.8
03/04	8.7	2.2	2.3	0.8	1.5	1.5	6.2	8.2	7.5	14.6	29.0	17.5	123.3
04/05	9.6	4.3	2.9	16.3	2.4	1.9	3.3	8.3	10.1	11.0	16.2	13.7	165.5
05/06	9.5	19.0	20.8	0.1	2.0	2.4	1.9	1.8	6.4	16.3	7.7	11.9	148.8
06/07	10.0	8.0	7.4	9.6	6.8	5.1	15.7	2.2	12.1	5.2	8.3	9.6	86.1
07/08	8.1	18.1	16.3	2.6	5.6	1.4	3.6	12.0	14.9	7.2	3.9	6.4	122.6
08/09	8.5	3.8	5.6	16.8	14.8	16.5	5.7	9.6	2.2	9.3	1.1	6.1	143.1
09/10	9.3	5.3	9.3	5.2	11.5	9.7	6.3	23.9	8.8	7.2	2.0	1.5	207.2
10/11	7.3	5.3	3.2	1.9	2.8	9.5	8.2	25.9	6.4	11.1	4.6	13.7	190.1
11/12	9.7	4.2	4.5	16.2	18.0	10.5	5.1	13.0	3.5	6.1	2.9	6.3	216.7
12/13	9.3	15.4	7.5	15.8	2.8	14.5	4.0	10.6	2.7	5.0	7.6	4.6	126.7
Mean	12.1	8.6	7.0	7.7	6.4	6.4	4.7	9.6	6.6	8.4	10.7	11.8	2 428.1

Table G.4C: Distribution of landings (%) by month and fishing year for bottom longline for SCH 5 and SCH 7 based on trips which landed school shark. The final column gives the annual total landings by QMA for bottom trawl. These values are plotted in Figure 10; '–': no data.

Fishing Year	Month												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
SCH 5													
89/90	–	1.8	5.8	0.3	0.6	6.3	16.0	23.7	29.5	3.9	3.9	8.2	25
90/91	0.5	0.2	–	–	–	0.6	28.5	12.9	42.6	11.5	3.1	0.2	14
91/92	0.3	–	10.5	15.7	7.0	0.0	12.2	17.2	30.1	1.1	4.5	1.4	31
92/93	8.5	36.5	20.3	0.0	8.8	3.3	2.3	9.7	0.5	5.1	4.3	0.8	15
93/94	–	7.8	37.3	20.2	28.0	1.1	0.1	1.8	0.0	0.8	0.1	2.8	27
94/95	51.9	9.7	9.7	0.8	0.0	–	4.2	4.4	2.4	10.2	2.1	4.6	26
95/96	4.7	17.2	7.0	33.1	5.1	11.8	4.4	8.8	1.2	–	1.1	5.6	40
96/97	11.8	3.5	19.1	19.6	12.3	0.5	8.6	17.5	1.7	3.9	1.1	0.4	27
97/98	6.4	13.2	33.4	20.2	17.3	–	–	1.0	–	0.2	4.9	3.5	11
98/99	0.5	14.9	1.7	27.5	8.2	15.9	7.0	5.0	1.6	14.5	3.1	0.3	50
99/00	1.5	15.5	43.4	0.4	1.9	0.6	5.9	10.8	4.9	13.9	0.6	0.6	14
00/01	4.6	3.7	14.6	0.0	24.2	11.0	5.6	8.6	7.1	19.0	0.4	1.1	54
01/02	6.4	36.3	6.7	3.3	11.3	3.4	5.5	1.3	8.2	3.7	1.2	12.6	75
02/03	–	15.7	8.6	9.7	11.1	19.7	16.5	2.7	8.5	1.2	–	6.3	46
03/04	–	23.5	17.0	6.4	4.4	10.9	9.8	2.8	1.3	3.0	3.0	17.9	48
04/05	4.0	27.5	6.4	11.1	9.3	13.4	3.3	7.5	7.5	–	3.3	6.6	40
05/06	–	22.1	20.9	15.8	8.9	10.5	1.6	–	3.4	5.7	6.3	5.0	32
06/07	9.0	40.3	6.2	8.7	–	6.5	18.1	8.7	–	–	–	2.4	32
07/08	3.6	38.6	6.8	8.1	0.4	4.3	8.4	–	1.9	13.2	7.5	7.2	75
08/09	5.9	12.9	18.3	17.5	14.5	7.6	0.0	–	–	13.4	9.0	0.9	101
09/10	21.8	3.5	10.4	5.7	15.4	3.2	4.4	21.1	7.7	3.0	0.1	3.7	57
10/11	3.3	11.0	7.4	30.2	11.3	12.3	1.0	4.7	0.2	0.2	9.1	9.2	67
11/12	–	15.4	2.4	9.7	11.8	30.4	5.4	8.1	4.2	8.6	3.7	0.2	22
12/13	0.9	24.6	1.5	18.9	–	17.3	9.4	13.9	6.7	0.8	2.9	3.2	16
Mean	6.0	17.6	11.7	12.7	9.8	8.4	6.4	6.5	5.5	6.5	3.7	5.2	945
SCH 7													
89/90	3.8	20.4	15.8	14.5	11.8	5.8	9.2	4.1	5.0	0.8	0.4	8.4	188
90/91	12.1	12.6	8.7	18.9	16.3	13.3	4.5	6.9	5.1	0.4	0.0	1.3	142
91/92	11.7	11.6	11.9	27.2	10.5	4.8	7.4	5.2	5.8	0.9	0.1	2.9	140
92/93	6.1	17.5	13.4	11.7	20.6	11.3	1.2	4.9	3.5	0.9	1.4	7.6	172
93/94	2.9	7.4	15.4	12.9	12.1	9.7	0.6	1.6	13.2	8.5	10.8	4.9	186
94/95	10.6	11.6	18.0	12.9	13.8	4.2	2.5	5.5	10.1	0.1	6.0	4.6	146
95/96	2.2	11.5	15.4	19.2	16.0	8.4	3.2	11.2	5.3	2.5	0.3	4.6	191
96/97	15.1	8.1	6.1	27.8	8.9	11.8	4.5	6.6	3.5	1.2	0.7	5.7	177
97/98	8.4	5.9	5.7	15.3	11.8	12.8	5.1	9.2	2.5	12.4	7.7	3.1	168
98/99	0.2	26.6	15.3	15.9	14.3	8.6	6.0	2.8	3.3	2.5	0.7	3.6	190
99/00	12.4	17.1	12.2	5.3	13.6	9.9	12.1	8.0	2.7	2.8	1.6	2.3	172
00/01	3.0	6.5	9.3	7.7	13.4	20.3	9.3	3.4	4.8	2.5	7.1	12.8	131
01/02	3.8	9.7	8.7	22.6	7.3	19.5	10.5	4.3	1.9	5.1	3.9	2.6	116
02/03	13.2	21.1	12.9	16.2	7.6	9.4	2.8	1.3	1.7	3.4	4.3	5.8	151
03/04	17.0	18.7	15.4	13.0	2.5	6.3	8.6	4.4	3.7	1.3	2.2	6.8	128
04/05	16.8	10.1	7.4	22.3	13.0	6.5	10.6	3.0	4.3	2.0	3.1	0.8	130
05/06	2.7	7.1	6.7	11.9	19.8	13.1	10.3	5.2	2.1	15.0	1.4	4.8	137
06/07	0.6	23.5	7.8	17.6	6.2	16.6	3.3	6.9	7.8	3.4	2.2	4.1	121
07/08	0.7	4.6	7.0	12.6	11.6	23.6	11.2	16.5	4.2	2.6	1.5	3.8	119
08/09	4.2	4.8	12.5	19.0	11.3	10.6	8.3	4.6	9.6	3.3	2.4	9.3	162
09/10	2.2	17.8	13.0	10.4	19.2	16.8	8.1	4.0	3.2	1.1	2.0	2.4	127
10/11	12.4	6.2	14.9	11.8	12.9	15.2	11.3	1.3	1.1	1.4	9.5	2.0	214
11/12	2.4	3.1	6.8	18.1	14.6	18.3	6.7	11.5	1.2	4.9	7.5	4.9	172
12/13	0.2	4.6	21.4	8.1	12.2	10.7	4.4	5.2	7.6	6.6	13.4	5.6	197
Mean	6.8	11.9	12.1	15.4	12.7	11.7	6.6	5.6	4.7	3.6	4.0	4.8	3 781

Table G.4D: Distribution of landings (%) by month and fishing year for bottom longline for SCH 8 and SCH 1W based on trips which landed school shark. The final column gives the annual total landings by QMA for bottom trawl. These values are plotted in Figure 10; '–': no data.

Fishing Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Month Sep	Total
SCH 8													
89/90	13.3	6.3	10.7	0.5	13.9	10.0	13.2	4.6	7.1	1.0	0.1	19.4	82
90/91	3.1	45.8	2.1	24.0	5.7	5.5	1.9	8.6	2.1	0.9	0.1	0.2	43
91/92	1.1	7.4	27.6	1.7	1.4	0.3	10.1	1.5	7.7	0.2	17.9	23.2	63
92/93	25.1	16.1	0.9	26.3	6.3	5.3	3.6	10.1	3.9	1.4	0.2	0.8	100
93/94	28.4	13.1	1.9	2.3	10.8	5.6	1.8	0.3	7.6	5.9	5.6	16.6	95
94/95	21.6	24.6	6.9	2.6	0.3	0.4	11.3	2.6	11.2	1.6	3.5	13.4	144
95/96	19.2	21.1	12.8	3.6	7.1	6.3	3.4	5.2	3.8	5.1	5.5	6.9	114
96/97	11.7	20.2	10.1	0.4	3.9	16.5	0.4	8.2	3.4	8.8	12.7	3.7	98
97/98	4.6	12.8	16.0	5.1	7.9	31.6	6.8	4.2	1.7	7.8	0.9	0.6	64
98/99	0.5	32.1	7.9	12.2	9.3	13.8	4.3	6.5	4.4	0.4	5.1	3.5	123
99/00	8.0	5.3	5.1	5.9	6.1	21.9	5.8	3.0	8.6	5.5	23.5	1.4	64
00/01	0.1	1.7	4.7	5.4	52.4	18.4	11.4	1.1	3.6	1.0	0.0	0.2	67
01/02	18.9	0.1	2.0	4.3	25.1	22.0	10.9	6.5	4.2	3.7	0.0	2.2	82
02/03	5.6	53.4	6.0	1.0	5.3	3.6	0.6	1.6	–	1.6	0.6	20.8	38
03/04	3.0	19.7	26.1	0.5	11.6	20.5	0.3	3.0	2.8	2.3	3.8	6.6	87
04/05	9.9	22.6	18.9	7.1	18.8	13.0	2.3	0.2	7.0	–	0.0	0.2	106
05/06	21.2	43.5	7.6	0.4	16.7	0.5	0.8	1.5	3.0	0.6	1.7	2.4	76
06/07	2.1	11.4	4.1	6.2	34.5	29.7	1.1	2.1	1.0	0.1	1.7	6.1	76
07/08	0.2	–	38.1	0.6	47.8	0.6	1.6	0.6	0.4	6.3	2.1	1.8	61
08/09	19.2	7.0	0.8	0.2	9.2	23.4	6.2	14.7	16.5	0.1	0.1	2.5	96
09/10	16.8	35.7	16.8	0.8	0.6	16.2	0.9	4.9	1.4	2.2	2.9	0.8	46
10/11	46.6	25.6	5.8	3.2	0.1	0.5	6.6	0.1	3.0	2.6	5.8	0.1	71
11/12	0.4	13.6	7.9	7.0	14.3	3.7	8.7	13.4	8.1	3.0	10.3	9.6	71
12/13	1.4	5.2	20.7	0.4	6.7	3.4	8.1	22.1	0.3	–	21.5	10.1	107
Mean	12.6	17.7	10.6	5.0	12.5	11.1	5.3	5.6	5.2	2.5	5.4	6.4	1 974
SCH 1W													
89/90	–	14.6	17.2	34.7	25.1	5.3	–	–	–	3.1	–	0.1	68
90/91	–	5.6	19.5	59.0	–	6.1	8.8	–	–	–	1.0	–	7
91/92	–	0.0	7.4	11.2	12.9	7.5	–	–	17.2	34.1	8.3	1.5	55
92/93	9.2	1.9	20.7	6.4	32.3	6.0	0.7	0.7	0.1	15.2	6.0	0.7	67
93/94	0.6	8.5	7.5	0.8	6.2	6.9	6.9	7.5	25.2	19.3	8.7	1.9	154
94/95	–	1.0	9.6	11.3	7.9	0.1	1.4	2.4	4.1	10.9	24.2	27.1	119
95/96	4.8	7.9	10.6	25.6	2.0	6.9	0.3	10.5	7.8	0.4	16.3	7.1	180
96/97	6.6	8.8	2.4	30.4	17.5	4.3	1.1	0.8	2.4	6.0	12.7	7.2	174
97/98	3.9	4.1	5.1	8.4	1.1	5.5	5.6	2.2	0.2	7.0	11.7	45.1	152
98/99	0.0	7.8	3.7	11.6	10.3	13.7	7.3	9.7	1.3	14.5	9.4	10.7	194
99/00	1.3	11.2	12.4	10.4	12.5	15.0	5.5	7.7	8.2	1.9	1.8	12.0	184
00/01	17.6	8.3	9.1	19.6	10.8	8.2	1.3	1.0	2.2	6.5	5.6	9.8	222
01/02	1.4	7.1	10.4	21.8	19.7	8.5	6.7	1.8	0.5	1.1	7.1	13.9	147
02/03	12.7	14.9	9.8	17.9	19.4	8.7	2.4	9.3	0.7	1.3	2.4	0.4	156
03/04	16.2	9.0	5.2	7.1	16.2	11.1	9.1	3.1	1.8	1.1	12.8	7.3	165
04/05	5.8	10.4	6.6	9.2	19.8	22.4	5.8	3.9	5.4	5.4	4.6	0.8	79
05/06	7.5	16.2	5.0	6.1	7.6	10.2	3.6	8.2	3.6	8.4	9.1	14.6	78
06/07	2.8	2.9	11.1	12.0	13.4	5.9	20.8	9.2	2.2	3.6	9.0	7.0	83
07/08	12.7	13.8	10.3	19.8	6.1	6.7	3.2	3.0	3.0	9.0	3.9	8.6	106
08/09	11.9	12.9	9.4	2.0	6.1	3.1	5.6	16.1	6.3	8.4	10.2	8.0	98
09/10	10.4	10.0	8.0	6.1	15.8	12.7	3.8	6.9	7.2	7.1	4.2	7.7	85
10/11	7.9	17.9	15.5	6.9	11.2	10.0	3.8	4.5	6.0	2.0	7.8	6.6	128
11/12	20.1	17.6	4.6	10.5	3.7	7.8	2.9	6.8	4.2	7.1	4.8	9.7	92
12/13	12.5	15.3	7.0	11.1	5.2	6.0	6.6	4.5	8.7	11.9	2.1	9.0	64
Mean	7.2	9.5	8.7	13.9	11.6	8.5	4.5	5.3	4.9	7.0	8.4	10.2	2 856

Table G.5A: Distribution of landings (%) by fishing year and by target species for setnet for SCH 1E and SCH 2 (see Appendix A for definitions of codes in the table) based on trips which landed school shark. The final column for each QMA gives the annual total setnet landings (t) in each QMA. These values are plotted in Figure 11; '–': no data.

Fishing										SCH 1E										SCH 2
	TRE	SCH	SPO	SNA	FLA	POR	TAR	KIN	OTH	Total	SCH	WAR	MOK	SPO	FLA	BUT	TAR	LIN	OTH	Total
89/90	13.2	57.1	6.8	11.1	1.0	6.6	1.0	0.4	2.7	76.1	49.7	5.1	24.3	2.3	0.2	1.0	2.5	7.0	7.9	37
90/91	23.9	53.3	6.5	8.4	1.4	0.1	0.4	0.1	5.9	68.9	33.9	11.6	6.5	6.9	0.4	1.7	1.2	17.2	20.7	19
91/92	18.0	51.3	10.5	16.2	1.1	0.0	1.2	0.2	1.5	91.5	48.1	16.9	8.8	2.2	0.3	1.3	3.6	4.4	14.4	35
92/93	31.5	27.1	16.5	10.6	1.2	0.0	6.6	0.4	6.1	137.5	51.7	16.1	7.5	2.9	0.5	0.5	6.4	4.6	9.9	48
93/94	17.9	23.2	27.8	6.8	2.2	0.0	13.9	2.7	5.4	82.3	30.4	32.5	5.6	9.0	1.0	1.1	9.3	0.8	10.3	31
94/95	16.9	23.7	32.6	9.4	2.8	–	7.8	2.7	4.1	89.1	31.6	26.6	10.9	5.0	9.9	1.6	8.8	0.5	5.1	23
95/96	26.7	42.8	9.1	4.5	1.4	–	5.4	0.5	9.6	75.6	11.1	40.3	10.7	9.3	10.6	0.8	14.6	0.3	2.2	33
96/97	36.8	22.9	15.7	8.8	3.4	0.0	6.1	0.0	6.2	72.9	4.7	53.2	23.3	4.6	2.0	2.6	3.9	2.1	3.5	31
97/98	45.7	15.4	10.5	6.7	4.7	–	10.0	–	6.9	48.4	14.9	47.9	18.4	3.4	6.2	2.3	–	1.3	5.5	25
98/99	57.8	8.6	12.7	7.4	8.3	–	1.4	–	3.8	28.7	2.6	72.9	7.9	3.1	2.1	4.2	–	–	7.2	28
99/00	18.3	46.8	8.5	7.6	17.9	–	0.5	–	0.6	50.6	1.2	76.4	11.7	2.8	1.6	4.4	–	–	1.9	37
00/01	33.7	38.0	17.8	5.7	3.2	–	–	–	1.6	36.7	24.8	20.7	34.0	5.7	8.7	4.2	–	–	1.9	27
01/02	27.5	23.8	23.6	17.9	6.6	–	–	–	0.8	31.2	66.2	13.3	16.1	2.3	0.7	0.7	0.2	–	0.4	39
02/03	37.9	16.5	16.8	17.9	8.4	–	1.4	–	1.2	49.4	60.4	17.9	15.0	2.1	0.8	3.0	0.0	–	0.8	37
03/04	20.5	14.8	42.3	16.7	5.2	–	0.0	0.1	0.3	59.7	9.5	25.6	45.7	5.2	2.0	8.4	–	–	3.4	21
04/05	30.4	26.7	29.6	6.4	3.7	0.9	0.0	0.5	1.7	59.3	25.3	32.3	23.9	8.7	1.8	2.1	0.1	–	5.8	23
05/06	40.5	8.5	16.7	12.8	5.5	9.4	0.0	3.5	3.0	37.2	–	52.1	36.4	0.3	2.3	3.2	0.0	2.2	3.6	20
06/07	20.6	19.8	15.1	2.9	11.1	12.5	1.2	2.3	14.4	50.8	31.0	28.0	24.7	12.1	1.4	2.8	–	–	0.0	30
07/08	21.9	24.2	17.3	0.5	5.6	22.6	–	5.1	2.9	33.6	53.3	16.7	13.4	6.9	3.9	2.5	–	0.0	3.3	58
08/09	43.2	25.0	3.9	1.0	4.4	11.1	–	8.8	2.5	44.0	43.5	18.7	19.7	8.2	2.7	2.5	–	1.3	3.6	60
09/10	45.4	13.8	7.5	1.4	2.2	23.3	0.0	0.7	5.8	34.2	58.7	9.6	15.7	10.0	1.7	1.3	0.3	0.0	2.6	50
10/11	21.2	12.3	26.0	1.5	1.4	22.5	0.0	1.8	13.4	46.3	46.5	13.6	11.3	22.6	1.4	2.3	–	–	2.3	40
11/12	78.6	5.4	6.0	0.7	0.5	5.1	–	0.2	3.5	55.9	33.9	26.2	11.2	17.3	2.8	1.4	–	0.0	7.2	49
12/13	66.6	1.3	12.5	3.9	0.8	5.0	3.7	1.9	4.3	47.0	36.4	27.2	13.4	14.7	1.6	3.2	0.1	0.1	3.3	32
Mean	30.8	27.6	16.7	8.3	3.7	3.7	3.3	1.2	4.7	1 407.0[1]	35.8	27.2	16.3	7.4	2.6	2.3	2.0	1.5	5.0	831[1]

[1] total landings for all years

Table G.5B: Distribution of landings (%) by fishing year and by target species for setnet for SCH 3 and SCH 4 (see Appendix A for definitions of codes in the table) based on trips which landed school shark. The final column for each QMA gives the annual total setnet landings (t) in each QMA. These values are plotted in Figure 11; '–': no data.

Fishing									SCH 3					SCH 4
year	SCH	SPO	SPD	TAR	LIN	HPB	ELE	BNS	OTH	Total	SCH	MOK	BNS	OTH	Total
89/90	28.5	27.4	17.5	7.7	4.6	8.2	3.0	0.7	2.6	158.8	–	–	–	–	0.0
90/91	29.1	19.4	14.8	10.3	10.3	5.2	5.4	0.2	5.2	144.2	–	–	–	–	0.0
91/92	45.7	21.2	11.8	6.2	3.8	1.0	5.2	0.3	4.9	189.6	79.1	–	–	20.9	0.1
92/93	33.1	15.8	31.1	4.3	5.4	4.4	3.1	0.5	2.3	136.6	52.3	45.7	–	2.0	0.5
93/94	32.2	24.6	24.4	3.4	3.5	4.8	2.3	0.8	4.0	145.3	100.0	–	–	–	2.2
94/95	30.7	36.7	11.9	3.5	4.4	4.0	5.1	1.4	2.4	150.6	100.0	–	–	–	0.4
95/96	30.3	32.8	12.9	4.3	5.7	3.7	5.3	2.7	2.4	164.6	100.0	–	–	–	0.3
96/97	37.0	26.5	9.1	5.2	7.8	4.8	3.7	3.0	2.8	165.3	–	100.0	–	–	0.2
97/98	28.6	41.0	6.1	4.2	6.0	2.4	2.8	4.5	4.4	164.6	–	100.0	–	–	0.2
98/99	45.0	24.2	6.9	2.8	11.1	4.3	1.4	2.8	1.5	200.8	–	100.0	–	–	0.1
99/00	42.9	28.8	3.3	3.5	6.8	4.0	1.3	0.7	8.7	188.5	100.0	–	–	–	26.0
00/01	34.0	44.9	4.5	2.3	2.2	4.0	1.0	1.6	5.3	217.2	99.8	–	–	0.2	11.9
01/02	32.0	44.6	10.1	3.6	2.7	1.6	1.0	2.3	2.0	179.6	–	100.0	–	–	1.6
02/03	28.2	53.3	4.3	4.7	2.3	2.8	0.9	3.0	0.5	221.2	84.7	11.5	–	3.8	18.6
03/04	27.0	53.0	2.3	5.0	4.1	3.1	2.9	2.1	0.6	177.9	64.7	16.4	–	18.8	3.3
04/05	37.3	48.5	1.1	3.0	2.1	3.7	2.4	0.2	1.7	263.7	79.9	6.4	13.7	–	25.9
05/06	28.1	50.8	4.8	5.0	0.7	5.5	4.0	0.3	0.9	157.9	100.0	–	–	–	2.4
06/07	45.2	43.9	1.3	4.6	0.4	1.8	1.5	0.5	0.8	234.5	–	55.2	–	44.8	0.2
07/08	56.2	30.3	1.2	5.1	0.8	2.1	1.8	0.3	2.3	190.5	–	–	–	–	0.0
08/09	57.5	26.3	1.1	7.8	0.9	2.7	2.9	0.1	0.6	185.0	–	–	–	100.0	0.0
09/10	47.9	38.7	1.7	4.9	0.7	0.9	3.6	0.1	1.4	227.2	–	–	–	100.0	0.0
10/11	45.6	36.9	–	4.2	1.3	1.9	5.9	0.0	4.2	212.0	–	–	–	–	0.0
11/12	49.1	38.7	0.0	3.8	0.6	2.8	3.8	0.2	1.1	209.2	–	–	–	100.0	0.0
12/13	31.5	58.5	0.1	4.1	0.3	2.0	2.1	0.0	1.3	201.5	–	–	–	100.0	0.0
Mean	38.3	37.1	6.6	4.6	3.4	3.3	2.9	1.1	2.6	4 486.4[1]	87.4	7.2	3.8	1.7	94.0[1]

[1] total landings for all years

Table G.5C: Distribution of landings (%) by fishing year and by target species for setnet for SCH 5 and SCH 7 (see Appendix A for definitions of codes in the table) based on trips which landed school shark. The final column for each QMA gives the annual total setnet landings (t) in each QMA. These values are plotted in Figure 11; '–': no data.

Fishing							SCH 5							SCH 7
year	SCH	SPO	SPD	BUT	ELE	OTH	Total	SCH	SPO	SPD	LIN	HPB	OTH	Total
89/90	98.8	0.5	–	0.4	0.0	0.3	402.4	62.9	7.4	5.5	12.2	8.4	3.6	201.4
90/91	99.0	0.5	–	0.1	0.4	–	517.2	86.8	7.3	0.0	5.2	–	0.6	172.2
91/92	98.7	0.5	0.2	0.0	0.3	0.3	631.7	90.2	6.3	0.7	1.6	0.7	0.4	165.5
92/93	97.9	1.9	0.0	0.0	0.1	–	651.9	55.3	16.7	23.5	3.3	–	1.3	97.4
93/94	99.2	0.7	–	–	0.1	–	592.4	52.8	15.9	25.7	1.7	3.1	0.7	136.4
94/95	98.7	1.1	0.1	–	0.1	0.0	615.3	58.7	13.9	25.6	1.2	–	0.7	109.4
95/96	97.9	1.5	–	–	–	0.6	704.2	76.4	8.6	5.3	3.1	4.9	1.8	185.5
96/97	99.2	0.6	–	–	0.2	0.1	648.5	60.7	28.2	3.2	0.6	5.0	2.2	106.0
97/98	99.4	0.5	–	–	–	0.1	634.3	62.6	32.7	0.2	2.6	0.8	1.0	85.5
98/99	99.0	0.9	–	–	0.0	0.2	653.8	78.5	15.9	0.0	1.2	3.5	0.8	172.6
99/00	99.2	0.4	–	0.2	0.1	0.1	645.2	73.7	19.7	0.0	5.9	0.1	0.5	149.5
00/01	98.9	0.7	0.0	–	0.0	0.3	561.6	76.4	22.3	0.1	0.3	–	1.0	182.1
01/02	99.3	0.6	0.0	0.1	–	0.0	517.4	83.4	15.2	0.1	1.0	0.0	0.3	165.5
02/03	97.8	2.1	–	0.1	0.0	–	658.5	82.8	14.4	0.2	0.5	0.1	2.0	159.5
03/04	93.1	6.7	0.2	0.1	–	–	631.9	78.3	21.0	0.1	0.4	0.0	0.2	189.1
04/05	91.2	8.4	0.2	0.2	–	–	663.0	79.9	18.8	–	0.2	–	1.1	179.7
05/06	92.3	7.6	0.1	0.1	–	–	629.4	81.4	17.6	0.2	0.2	–	0.4	177.8
06/07	91.8	7.0	0.6	0.6	–	–	651.1	92.0	7.0	0.3	0.7	–	0.1	209.9
07/08	95.8	4.0	0.1	0.1	–	–	771.6	89.5	9.3	–	0.6	–	0.6	84.2
08/09	98.0	1.7	0.0	0.2	–	–	665.4	90.1	8.0	1.0	0.5	0.2	0.2	127.2
09/10	97.1	2.1	0.6	0.2	–	–	740.8	75.5	18.6	1.7	1.8	–	2.4	48.4
10/11	95.5	3.5	0.4	0.7	–	–	651.1	82.7	14.2	0.6	0.5	–	2.0	69.7
11/12	95.4	1.9	1.2	0.2	1.3	0.0	725.1	79.9	18.9	0.0	0.3	–	0.9	98.5
12/13	97.4	2.4	0.0	0.1	0.0	–	755.1	84.0	12.9	–	0.8	–	2.3	102.6
Mean	97.0	2.5	0.2	0.1	0.1	0.1	15 319.1[1]	77.3	14.8	3.4	2.1	1.3	1.1	3 375.6[1]

[1] total landings for all years

Table G.5D: Distribution of landings (%) by fishing year and by target species for setnet for SCH 8 and SCH 1W (see Appendix A for definitions of codes in the table) based on trips which landed school shark. The final column for each QMA gives the annual total setnet landings (t) in each QMA. These values are plotted in Figure 11; '–': no data.

Fishing	SCH 8						SCH 1W				
year	SCH	SPO	WAR	SPD	OTH	Total	SCH	SPO	GUR	OTH	Total
89/90	81.3	13.2	2.5	0.9	2.1	251.3	89.9	8.8	0.0	–	142.9
90/91	71.4	18.1	2.1	2.7	5.7	198.7	66.2	27.7	1.0	–	81.7
91/92	40.8	45.3	5.7	2.3	5.9	212.7	71.0	27.1	1.0	–	96.0
92/93	36.9	56.4	4.3	0.3	2.0	271.4	64.3	29.1	3.3	–	108.1
93/94	27.9	63.3	3.5	4.0	1.2	234.9	73.6	20.2	5.1	–	128.1
94/95	14.1	79.0	4.0	1.4	1.5	239.5	77.3	8.6	11.0	–	135.3
95/96	44.9	44.0	5.8	0.8	4.4	309.5	56.3	20.5	16.6	–	122.4
96/97	47.3	49.0	2.1	0.4	1.1	252.4	56.2	16.3	17.8	–	181.9
97/98	26.0	61.5	5.3	2.7	4.5	220.2	64.4	17.9	12.4	–	251.9
98/99	51.0	46.5	1.5	0.2	0.8	274.7	32.6	11.6	36.9	–	191.6
99/00	34.2	55.3	9.1	–	1.4	199.7	50.2	28.1	18.7	–	172.2
00/01	48.8	44.4	4.9	0.0	1.8	232.0	54.7	28.7	15.0	–	175.7
01/02	44.4	47.0	8.2	0.0	0.3	196.0	68.8	22.9	7.7	–	174.6
02/03	43.9	47.7	7.9	0.1	0.5	223.7	69.0	20.2	9.7	–	148.2
03/04	55.1	40.3	4.0	–	0.6	183.0	71.4	13.8	14.5	–	178.6
04/05	64.9	29.8	5.1	–	0.2	287.3	60.2	11.8	27.3	–	148.9
05/06	77.9	18.0	3.9	–	0.2	258.2	66.8	13.0	19.5	–	124.3
06/07	72.9	22.2	4.6	–	0.3	303.1	49.3	32.4	6.0	–	106.7
07/08	64.2	28.3	7.5	–	0.1	271.5	67.3	–	–	–	135.6
08/09	63.4	27.9	8.1	0.0	0.6	270.4	62.9	–	–	–	138.5
09/10	72.8	17.4	8.4	–	1.3	234.9	80.0	–	–	–	81.9
10/11	68.4	27.1	4.4	–	0.1	304.7	75.5	–	–	–	131.8
11/12	69.9	21.7	7.3	–	1.0	202.2	72.1	10.8	6.3	–	114.7
12/13	82.8	8.3	8.5	–	0.4	215.0	68.7	20.0	8.7	–	124.0
Mean	54.9	37.7	5.3	0.6	1.5	5 847.1[1]	64.3	19.7	11.3	–	3 395.5[1]

[1] total landings for all years

Table G.6A: Distribution of landings (%) by fishing year and by target species for bottom trawl for SCH 1E and SCH 2 (see Appendix A for definitions of codes in the table) based on trips which landed school shark. The final column for each QMA gives the annual total bottom trawl landings (t) in each QMA. These values are plotted in Figure 12; '–': no data.

Fishing											SCH 1E										SCH 2
year	TAR	SNA	JDO	TRE	SKI	HOK	SCI	GUR	BAR	OTH	Total	TAR	SKI	HOK	GUR	SCI	WAR	SNA	BAR	SWA	OTH	Total
89/90	31.2	46.8	2.6	4.5	7.2	0.0	3.6	0.5	0.9	2.8	37	63.5	16.2	1.5	8.8	1.3	0.8	1.3	0.2	0.1	6.4	47
90/91	49.9	34.2	0.7	4.2	3.9	0.0	3.6	0.8	0.3	2.4	50	48.3	14.7	3.1	16.9	3.3	0.9	0.7	3.5	0.0	8.5	57
91/92	36.8	40.5	3.2	1.1	6.2	3.5	5.8	0.9	0.4	1.7	59	47.1	21.0	1.0	13.3	5.9	3.1	0.5	1.8	–	6.5	57
92/93	49.2	22.0	7.1	0.7	9.1	3.3	3.3	1.6	2.6	1.1	42	48.6	21.7	3.8	11.3	1.7	2.9	0.5	3.3	–	6.2	83
93/94	46.8	21.9	3.9	3.6	10.5	0.6	1.5	0.9	7.4	2.9	40	42.1	21.5	8.9	10.3	2.7	1.6	2.5	2.6	2.6	5.2	64
94/95	54.2	13.4	1.6	22.7	1.8	2.6	2.2	0.4	0.7	0.4	53	40.8	20.8	10.2	10.7	1.8	3.0	0.9	2.0	0.6	9.2	61
95/96	45.6	14.3	2.9	3.6	12.5	11.2	3.9	2.1	2.6	1.3	51	25.7	25.7	23.9	5.8	9.5	1.6	1.1	1.4	0.0	5.3	127
96/97	41.6	13.9	3.9	7.1	11.7	15.0	1.1	1.0	3.1	1.5	69	28.0	21.1	33.5	5.0	2.2	1.1	0.9	3.9	–	4.4	125
97/98	44.0	11.8	6.2	2.0	16.4	13.2	1.0	1.0	1.5	3.0	80	27.0	19.8	35.9	8.1	0.9	1.9	1.1	0.7	0.3	4.3	129
98/99	41.7	14.0	6.1	7.7	12.2	9.4	2.4	1.1	2.1	3.2	84	28.4	16.2	33.0	5.4	2.8	2.2	5.2	1.8	1.8	3.3	172
99/00	44.8	7.8	9.5	6.2	8.0	7.8	5.0	5.7	4.4	0.8	90	34.8	21.1	16.2	12.1	4.9	1.5	1.5	1.2	1.5	5.2	144
00/01	39.0	12.7	7.3	12.1	4.7	3.1	6.2	4.1	2.5	8.1	58	38.0	14.6	14.8	12.1	8.0	4.6	0.9	1.5	1.9	3.7	93
01/02	35.4	14.9	19.3	7.9	7.0	3.7	1.4	1.2	2.0	7.3	73	32.6	19.4	4.5	12.8	17.3	3.5	1.0	0.7	3.1	5.1	90
02/03	51.0	12.3	10.9	6.4	7.2	3.3	2.2	2.1	0.9	3.7	56	34.0	21.7	17.3	12.2	5.0	3.3	0.9	1.2	1.6	2.8	97
03/04	47.0	11.3	9.3	9.8	4.7	3.5	2.8	1.3	4.2	6.1	83	47.9	12.8	9.9	13.6	3.0	4.1	3.9	0.6	0.5	3.7	83
04/05	48.1	17.1	11.3	5.9	7.3	0.6	1.1	5.8	1.5	1.3	115	61.0	8.7	4.3	12.6	1.1	2.6	1.7	0.0	3.1	4.9	86
05/06	65.9	11.1	6.4	2.6	2.2	1.2	0.3	3.7	1.2	5.4	156	65.9	7.4	1.3	14.6	2.8	2.1	1.3	0.1	0.0	4.3	88
06/07	62.7	12.6	4.5	7.5	1.3	3.3	0.9	1.4	0.3	5.5	114	74.8	5.2	4.3	8.9	1.3	1.2	1.0	0.6	–	2.6	106
07/08	68.3	11.9	4.3	5.3	1.2	2.3	1.0	0.7	0.3	4.8	83	78.3	0.5	1.9	11.7	1.5	1.8	0.8	0.0	0.5	3.0	89
08/09	73.1	9.0	4.9	4.0	1.4	2.0	0.4	2.0	0.0	3.1	87	72.3	2.9	2.9	10.0	1.0	2.4	1.0	0.9	3.1	3.4	90
09/10	64.6	8.9	7.5	3.9	2.9	6.6	0.9	1.3	0.1	3.2	89	67.6	2.1	2.9	16.2	1.9	1.7	0.5	0.0	1.8	5.4	84
10/11	73.4	9.7	3.6	4.7	0.9	3.7	0.7	0.3	0.0	3.0	112	69.3	3.5	2.6	13.2	1.2	1.3	1.0	0.1	2.4	5.4	78
11/12	64.4	15.4	5.3	3.3	2.5	5.2	1.0	0.1	0.5	2.3	108	75.6	0.6	1.3	11.8	0.5	1.6	0.8	1.3	1.5	5.0	73
12/13	58.1	13.1	8.2	3.7	3.0	10.1	1.3	0.4	0.0	2.1	75	68.3	7.1	2.8	12.8	0.6	0.7	1.0	1.5	2.2	2.7	66
Mean	54.0	14.9	6.5	5.7	5.5	4.8	1.9	1.9	1.5	3.4	1 863[1]	48.0	14.2	12.8	10.7	3.6	2.1	1.5	1.3	1.2	4.6	2 187[1]

[1] total landings for all years

Table G.6B: Distribution of landings (%) by fishing year and by target species for bottom trawl for SCH 3 and SCH 4 (see Appendix A for definitions of codes in the table) based on trips which landed school shark. The final column for each QMA gives the annual total bottom trawl landings (t) in each QMA. These values are plotted in Figure 12; '–': no data.

Fishing													SCH 3												SCH 4
year	RCO	FLA	BAR	TAR	ELE	WAR	SQU	GUR	HOK	SPO	SCH	OTH	Total	TAR	BAR	STA	SWA	HOK	SCI	SQU	LIN	HAK	SPE	OTH	Total
89/90	31.7	17.0	22.1	5.9	4.1	0.1	1.0	1.7	0.4	–	8.4	7.3	111	2.3	38.3	18.8	12.6	0.0	–	8.5	–	0.0	–	19.5	5.8
90/91	28.1	16.4	34.6	4.4	0.9	1.1	0.4	1.6	1.8	0.4	3.9	6.5	92	5.9	37.1	21.7	1.6	7.5	–	0.1	2.0	3.0	–	21.0	5.4
91/92	37.2	18.5	20.1	6.3	3.1	0.4	0.2	2.0	0.3	2.6	5.0	4.5	91	23.0	0.2	19.8	–	0.4	47.0	–	3.0	0.6	–	6.0	4.9
92/93	51.5	17.6	16.4	1.5	2.7	0.0	0.2	1.2	0.3	1.7	0.5	6.5	102	4.1	2.3	0.0	–	2.3	68.5	–	22.9	–	–	0.0	5.1
93/94	58.4	18.1	6.6	4.9	2.9	0.4	2.4	0.5	1.1	2.6	0.2	1.9	66	1.4	57.0	29.9	0.0	0.9	6.1	–	–	0.1	–	4.6	2.5
94/95	64.2	9.0	7.9	2.5	4.8	0.2	1.8	0.4	1.8	0.9	0.4	6.2	84	31.4	11.2	15.6	0.2	27.1	7.6	–	–	2.1	–	4.8	3.7
95/96	49.7	12.5	20.1	3.1	4.5	0.6	1.0	0.9	4.5	0.3	1.0	1.8	118	11.3	25.2	24.6	24.6	5.7	0.6	1.9	0.2	0.0	–	5.9	62
96/97	58.0	16.6	11.6	3.1	1.2	0.9	2.3	0.1	2.7	0.2	1.4	1.8	84	11.7	44.3	2.1	3.8	5.1	0.8	23.3	–	0.0	–	8.9	45
97/98	61.7	24.0	7.0	0.7	0.1	0.4	0.7	0.1	0.8	0.1	0.0	4.3	113	46.8	13.0	30.4	–	4.1	4.1	–	–	0.6	–	1.0	22
98/99	35.3	28.4	15.7	6.4	0.2	1.4	6.1	0.1	1.6	–	0.4	4.4	116	55.8	0.5	11.6	0.4	2.8	16.9	–	–	4.9	–	7.0	12
99/00	43.5	27.9	15.1	4.9	0.4	1.0	1.5	0.2	2.2	–	–	3.3	155	1.8	0.2	72.7	–	5.5	15.8	1.0	–	1.1	–	1.9	16
00/01	55.7	19.6	9.9	3.1	0.6	1.0	3.3	1.1	2.4	0.0	0.0	3.3	155	67.7	11.5	0.0	0.2	7.8	2.0	6.3	0.0	0.0	0.0	4.4	29
01/02	54.5	12.1	15.1	4.5	0.9	0.6	3.8	1.0	1.3	2.1	0.1	3.9	136	24.8	9.7	35.0	0.7	6.2	1.0	0.3	4.3	5.5	0.0	12.6	38
02/03	40.2	13.6	22.6	3.7	4.5	3.2	2.4	3.5	2.4	–	–	3.9	165	49.2	3.3	0.7	1.9	13.1	5.1	10.4	1.2	3.8	5.7	5.5	24
03/04	46.3	10.8	12.9	9.4	7.9	2.7	1.3	0.3	3.8	1.0	0.1	3.4	126	81.1	0.0	4.5	1.1	6.7	2.2	–	–	1.4	0.3	2.6	19
04/05	50.9	15.5	10.0	9.0	6.6	3.9	1.5	0.7	0.7	–	–	1.2	142	64.1	6.1	11.5	2.8	4.1	6.1	–	0.6	1.7	0.0	3.1	42
05/06	47.8	5.9	13.5	12.9	8.0	2.5	2.0	2.9	1.1	0.0	–	3.5	151	65.7	2.3	6.8	5.7	1.3	7.8	0.0	2.2	0.2	–	8.0	42
06/07	36.3	10.7	13.0	17.5	8.9	1.6	1.3	2.4	0.4	0.6	0.7	6.5	135	38.8	7.5	10.0	7.8	1.3	3.8	5.0	7.7	1.6	14.7	1.9	19
07/08	21.5	11.8	15.5	18.7	11.0	6.3	1.7	2.7	0.7	0.0	1.3	8.9	109	15.3	36.6	0.7	24.8	2.7	3.7	0.5	10.1	4.7	0.5	0.4	24
08/09	22.1	5.7	12.9	21.1	11.1	5.3	3.2	1.9	1.1	5.3	3.3	6.8	107	33.0	40.1	–	5.5	6.2	1.8	0.1	8.0	3.6	0.2	1.5	27
09/10	18.4	11.8	13.4	21.8	12.0	5.4	0.3	2.6	1.0	5.3	2.2	5.7	145	80.6	1.8	2.0	3.6	4.3	2.0	0.4	4.0	0.3	0.1	0.9	21
10/11	22.6	7.5	11.3	25.3	8.2	5.6	0.8	1.7	1.0	3.2	0.6	12.1	116	28.4	–	2.7	5.4	23.9	7.9	1.9	3.5	0.2	22.9	3.1	5.6
11/12	13.7	14.2	14.6	19.4	14.6	6.4	1.7	2.5	0.6	4.4	0.5	7.3	81	7.5	30.3	–	12.6	30.2	4.1	1.1	9.7	0.2	0.3	4.0	8.5
12/13	15.7	12.9	13.6	19.1	12.1	2.9	0.1	6.4	1.0	3.3	2.6	10.4	81	–	79.7	–	3.2	6.2	9.5	0.8	0.3	–	0.0	0.2	25
Mean	40.5	14.9	14.9	9.5	5.4	2.3	1.8	1.6	1.5	1.3	1.2	5.1	2 781[1]	36.0	19.6	12.8	6.7	5.8	5.2	3.6	2.5	1.5	1.1	5.1	509[1]

[1] total landings for all years

Table G.6C: Distribution of landings (%) by fishing year and by target species for bottom trawl for SCH 5 and SCH 7 (see Appendix A for definitions of codes in the table) based on trips which landed school shark. The final column for each QMA gives the annual total bottom trawl landings (t) in each QMA. These values are plotted in Figure 12; '–': no data.

Fishing												SCH 5														SCH 7
year	STA	SQU	FLA	LIN	HOK	BAR	SWA	GUR	WWA	WAR	OTH	Total	BAR	TAR	FLA	HOK	RCO	STA	WAR	GUR	GSH	LIN	SNA	SCH	OTH	Total
89/90	55.2	6.3	3.7	1.9	0.7	20.2	0.8	1.0	–	5.2	4.9	52	28.6	17.8	15.8	10.4	3.5	4.3	2.9	2.0	1.8	0.5	1.4	0.7	10.5	153
90/91	62.4	0.7	7.3	4.1	10.1	6.1	0.8	0.3	–	0.3	7.9	34	45.0	12.1	11.0	8.8	2.8	1.2	3.8	2.1	2.2	2.3	1.3	0.2	7.2	108
91/92	64.4	0.6	15.2	1.2	1.8	2.4	0.1	0.4	–	–	13.9	22	46.5	18.4	3.4	2.5	6.3	4.8	1.7	1.1	0.7	2.8	0.3	1.9	9.4	94
92/93	75.5	0.0	7.6	1.6	–	6.6	0.3	0.0	–	–	8.3	28	43.7	10.4	20.9	2.4	10.2	0.4	1.5	0.8	1.0	2.6	0.2	–	5.9	136
93/94	85.4	–	5.2	1.2	–	0.0	1.9	–	–	–	6.3	22	31.8	20.3	14.5	12.3	8.2	3.0	1.9	1.1	2.8	0.7	0.3	–	3.1	97
94/95	81.1	0.2	6.4	0.8	1.7	0.0	0.1	–	–	0.1	9.6	28	31.8	11.5	15.5	22.0	8.4	2.3	1.8	1.5	2.0	0.9	0.1	–	2.2	124
95/96	47.7	0.0	6.8	0.1	13.8	22.2	0.7	0.3	–	0.7	7.6	30	40.8	15.0	12.3	17.0	7.3	0.7	1.9	1.3	0.2	0.2	0.5	–	2.6	187
96/97	74.7	3.2	9.0	0.1	0.9	3.0	6.5	0.1	–	0.0	2.4	26	58.5	5.4	15.1	13.7	3.2	0.1	2.0	0.8	0.0	0.0	0.3	0.0	0.7	168
97/98	70.3	2.2	22.7	1.2	0.2	0.9	0.0	0.0	–	–	2.5	18	36.9	4.6	14.7	24.7	6.7	1.1	1.5	2.9	0.2	0.2	0.4	2.2	3.9	130
98/99	71.3	8.1	12.7	0.0	5.1	0.0	0.6	0.8	–	–	1.4	48	55.8	10.6	14.4	8.2	4.4	0.3	2.8	0.4	0.4	0.0	0.4	0.7	1.6	239
99/00	75.5	2.5	10.0	0.1	3.5	0.0	1.2	5.6	1.1	0.2	0.3	101	54.9	14.3	9.4	9.1	1.1	2.6	3.2	0.9	1.0	0.6	1.2	0.3	1.4	232
00/01	58.3	4.7	16.2	1.6	16.8	0.0	0.3	0.5	0.4	–	1.3	94	62.1	9.3	9.1	4.5	5.7	1.3	1.1	2.7	0.8	0.1	0.4	0.8	2.1	200
01/02	46.7	12.0	17.0	2.9	11.4	1.6	1.2	4.5	0.3	0.0	2.3	103	41.0	10.5	10.5	11.1	12.9	0.6	2.9	2.9	1.5	0.0	0.3	1.7	4.0	161
02/03	30.3	17.6	11.2	7.8	13.2	1.8	0.1	6.3	0.5	1.3	9.9	91	38.6	20.0	9.9	6.1	6.0	2.0	3.3	2.6	3.0	0.2	0.9	0.5	6.9	175
03/04	51.3	23.6	9.3	4.7	4.5	2.4	0.1	0.4	0.7	–	2.9	68	26.1	22.6	11.5	6.4	7.3	8.1	4.2	3.1	0.8	0.6	0.6	1.2	7.6	217
04/05	36.1	19.6	7.8	16.3	4.9	2.7	0.3	4.5	1.8	1.3	4.9	56	26.3	33.3	14.3	1.8	9.5	4.3	2.5	1.3	2.1	1.5	0.7	0.5	2.0	164
05/06	44.6	16.9	8.8	13.8	1.8	2.0	0.5	2.3	0.6	4.3	4.2	66	19.8	36.2	10.0	4.7	13.3	4.0	3.2	0.7	1.7	1.2	1.3	0.5	3.3	180
06/07	21.2	17.2	7.5	9.8	1.4	28.8	9.3	0.9	0.7	0.1	3.0	72	18.5	25.6	9.3	3.5	11.3	8.2	11.5	0.2	2.5	2.3	0.6	1.8	4.6	213
07/08	39.8	22.2	4.1	13.6	1.9	3.8	2.1	0.3	6.4	2.9	3.0	37	19.7	37.0	10.1	0.9	6.9	9.1	5.5	1.9	1.6	2.1	0.8	0.6	3.9	264
08/09	25.9	19.9	4.7	16.5	2.6	1.0	11.1	0.1	12.4	1.1	4.7	50	9.9	54.6	10.5	0.8	2.7	9.7	3.1	0.9	2.9	1.8	0.5	0.4	2.1	306
09/10	22.9	42.4	5.7	8.2	1.3	1.2	9.3	0.3	1.5	1.5	5.7	82	8.2	44.1	11.6	1.1	3.9	11.2	3.3	3.0	5.0	1.7	1.8	1.3	3.7	311
10/11	19.4	50.4	6.5	9.0	0.9	2.6	3.6	0.1	1.2	0.3	5.9	62	6.7	43.5	7.4	3.2	5.3	7.2	4.7	3.9	4.3	3.3	2.1	0.7	7.7	289
11/12	28.5	25.3	9.6	12.9	0.5	5.8	1.6	0.2	2.3	4.7	8.6	53	11.7	45.4	8.1	4.6	5.1	4.1	3.8	6.4	2.7	1.5	0.7	1.4	4.4	288
12/13	13.7	45.3	5.7	14.8	0.9	1.2	2.3	0.2	3.6	6.2	6.0	64	8.2	45.4	6.4	8.9	3.2	3.0	3.8	10.9	2.2	1.2	0.8	1.0	5.2	281
Mean	45.6	16.9	9.5	6.6	5.1	4.6	2.5	1.8	1.4	1.3	4.7	1 306[1]	29.0	27.3	11.0	6.9	6.1	4.5	3.5	2.6	2.0	1.3	0.8	0.8	4.3	4 719[1]

[1] total landings for all years

Table G.6D: Distribution of landings (%) by fishing year and by target species for bottom trawl for SCH 8 and SCH 1W (see Appendix A for definitions of codes in the table) based on trips which landed school shark. The final column for each QMA gives the annual total bottom trawl landings (t) in each QMA. These values are plotted in Figure 12; '–': no data.

Fishing	SCH 8											
year	TAR	GUR	TRE	SNA	BAR	SQU	JDO	LEA	JMA	SCH	OTH	Total
89/90	8.6	7.2	20.8	35.2	2.1	–	1.5	0.2	21.8	–	2.7	11
90/91	19.2	1.7	30.4	17.3	1.4	–	6.8	0.2	22.4	–	0.6	13
91/92	1.2	2.3	72.3	2.4	3.1	–	–	–	18.0	–	0.7	19
92/93	16.9	2.4	22.5	28.9	8.0	–	2.1	–	19.2	–	0.0	13
93/94	9.2	2.3	62.9	4.2	7.8	–	0.0	–	2.0	–	11.6	22
94/95	20.1	9.2	25.2	23.4	11.7	–	0.7	–	6.0	–	3.7	11
95/96	10.3	33.6	11.4	12.9	19.5	–	1.2	–	0.1	–	11.2	21
96/97	14.8	59.9	5.7	4.3	11.4	–	0.5	–	0.3	–	3.1	35
97/98	1.7	50.3	13.1	32.8	0.2	–	0.0	–	0.0	–	1.9	51
98/99	11.7	44.0	16.0	0.8	3.4	8.3	3.9	0.0	10.6	0.2	1.2	53
99/00	26.7	17.1	29.4	1.4	3.0	18.8	0.6	0.0	–	–	3.0	53
00/01	35.4	27.8	14.5	0.5	9.4	9.2	0.1	0.0	–	0.0	3.2	67
01/02	25.1	22.3	22.0	1.3	17.2	7.9	1.6	–	–	0.2	2.3	61
02/03	28.5	10.5	17.2	11.4	11.4	7.1	5.4	0.0	–	–	8.4	52
03/04	36.9	8.0	17.8	0.8	9.4	–	0.4	16.6	–	0.2	10.0	43
04/05	29.0	26.1	15.4	2.1	5.9	–	2.6	1.0	0.1	13.6	4.2	40
05/06	42.8	13.7	35.9	0.4	2.4	–	0.9	3.3	–	0.1	0.5	57
06/07	41.0	22.0	14.6	4.5	1.0	4.2	1.5	5.2	–	5.5	0.4	44
07/08	39.2	27.9	17.7	0.9	0.3	–	4.3	4.8	–	3.3	1.7	36
08/09	46.3	28.3	7.4	2.6	0.6	–	3.5	5.0	0.0	2.7	3.5	39
09/10	73.1	8.1	6.1	1.1	0.5	–	6.8	1.5	–	2.1	0.8	46
10/11	64.2	17.4	5.0	1.0	0.2	–	7.4	3.4	0.0	0.7	0.7	47
11/12	75.1	7.6	3.2	2.5	2.5	–	3.6	1.0	–	3.3	1.2	60
12/13	51.1	16.4	10.3	0.8	1.6	–	12.1	1.1	0.0	5.1	1.3	31
Mean	34.5	21.7	18.1	5.4	5.4	3.3	2.8	2.0	2.0	1.7	3.1	924[1]

Fishing	SCH 1W										
year	TAR	SNA	TRE	GUR	SCH	BAR	SKI	LIN	JDO	OTH	Total
89/90	22.0	44.9	12.9	8.9	2.6	7.8	0.8	–	–	0.2	95
90/91	27.9	32.6	22.8	9.2	1.1	4.9	0.5	–	0.0	1.0	85
91/92	19.4	52.1	10.9	9.6	1.7	3.6	1.9	0.8	–	0.1	116
92/93	31.9	38.8	14.5	8.1	3.0	1.4	1.5	0.1	–	0.8	248
93/94	34.9	40.3	9.8	9.0	–	3.1	2.6	0.0	0.0	0.3	167
94/95	17.4	51.8	18.3	4.7	–	1.9	4.1	0.6	0.5	0.8	128
95/96	42.3	37.5	8.9	2.9	0.4	2.3	4.8	–	0.1	0.7	185
96/97	40.5	25.9	17.1	9.1	0.4	2.3	3.3	0.1	1.1	0.3	210
97/98	32.3	28.5	25.8	4.7	–	1.1	6.6	0.0	0.6	0.5	220
98/99	38.4	21.8	16.1	11.8	–	5.3	5.3	0.0	0.1	1.2	202
99/00	38.7	17.8	20.7	14.9	1.2	2.9	1.8	0.1	0.0	1.9	177
00/01	33.0	18.7	16.4	19.3	2.4	4.7	2.2	0.3	1.0	2.0	123
01/02	36.8	16.4	14.8	11.5	6.8	9.0	1.6	0.2	0.1	2.7	184
02/03	40.8	12.4	20.5	13.7	1.1	9.7	1.3	0.0	0.5	0.1	213
03/04	55.3	12.7	14.7	10.5	1.6	2.0	0.6	0.1	0.2	2.4	177
04/05	38.5	24.3	12.5	18.8	0.3	4.7	0.4	0.1	0.3	0.2	194
05/06	46.3	5.7	15.9	22.0	4.3	3.9	–	0.4	0.0	1.4	161
06/07	45.2	4.9	33.4	9.9	1.4	4.5	–	0.1	0.3	0.3	163
07/08	52.6	10.3	18.5	13.3	1.6	1.7	0.5	1.2	0.0	0.3	257
08/09	67.5	7.8	11.0	2.7	4.7	2.5	0.3	3.2	0.0	0.2	278
09/10	53.3	10.0	23.1	4.1	7.3	1.0	0.1	0.2	0.9	0.1	209
10/11	46.5	4.8	16.4	5.1	22.9	3.5	0.0	0.2	0.7	0.0	289
11/12	47.7	3.0	18.3	11.7	17.7	0.8	0.0	0.2	0.3	0.3	268
12/13	45.2	5.2	15.9	13.1	17.0	0.1	0.1	2.0	1.2	0.1	230
Mean	42.0	19.5	17.0	10.1	5.1	3.3	1.6	0.5	0.4	0.7	4 579[1]

[1] total landings for all years

Table G.7A: Distribution of landings (%) by fishing year and by target species for bottom longline for SCH 1E and SCH 2 (see Appendix A for definitions of codes in the table) based on trips which landed school shark. The final column for each QMA gives the annual total bottom longline landings (t) in each QMA. These values are plotted in Figure 13; '–': no data.

Fishing							SCH 1E						SCH 2
year	SNA	HPB	SCH	BNS	TAR	OTH	Total	HPB	SCH	LIN	BNS	OTH	Total
89/90	61.0	1.1	26.2	11.1	–	0.7	89	9.8	53.1	18.7	9.2	9.3	31
90/91	22.9	10.1	57.7	8.9	0.0	0.5	124	18.8	46.3	6.7	22.8	5.4	52
91/92	28.3	14.9	52.0	3.6	0.1	1.1	108	9.2	32.6	10.1	43.2	4.8	49
92/93	15.7	24.8	54.0	1.7	1.6	2.1	150	19.3	25.7	27.3	17.7	10.1	75
93/94	23.5	24.1	43.9	6.2	0.5	1.8	77	21.3	33.0	14.9	22.6	8.3	63
94/95	18.0	29.5	33.9	14.4	1.7	2.5	80	16.0	44.4	26.5	11.8	1.2	54
95/96	13.5	23.7	53.8	4.8	0.2	4.1	142	29.0	28.3	33.4	7.8	1.5	68
96/97	37.7	27.7	21.9	10.5	0.0	2.2	75	17.7	29.8	35.8	16.1	0.5	46
97/98	28.9	36.1	18.4	7.4	1.7	7.4	78	24.3	22.7	26.7	25.5	0.8	35
98/99	21.4	41.7	24.9	10.6	0.1	1.3	92	14.2	28.0	44.4	13.4	0.0	61
99/00	19.9	34.9	39.1	5.3	0.0	0.8	197	20.5	15.0	60.2	4.3	0.0	48
00/01	20.9	33.9	28.6	5.4	10.1	1.1	200	18.9	15.4	58.5	6.2	0.9	53
01/02	21.1	42.8	26.2	2.4	2.9	4.5	139	35.6	29.6	26.2	8.5	0.1	70
02/03	50.9	29.3	10.9	5.5	1.2	2.3	104	24.2	54.2	17.1	3.6	0.9	74
03/04	40.3	41.5	9.8	7.0	0.1	1.3	140	45.3	22.4	21.7	10.6	0.0	56
04/05	27.4	33.3	25.3	6.6	0.5	6.9	138	29.7	27.0	29.0	14.2	0.2	77
05/06	30.6	30.6	20.4	12.2	–	6.2	131	21.7	38.6	13.5	26.1	0.1	89
06/07	25.7	34.2	30.8	6.3	0.0	3.0	132	27.7	22.3	16.8	33.1	0.0	67
07/08	38.5	33.2	10.5	13.6	–	4.2	111	24.8	33.2	16.3	25.8	0.0	93
08/09	47.1	27.6	9.6	7.6	0.4	7.8	108	25.7	30.9	21.4	21.6	0.4	97
09/10	60.0	21.5	6.4	4.9	2.6	4.6	97	45.8	30.4	7.7	16.1	0.0	81
10/11	50.2	16.6	16.2	6.7	5.9	4.5	142	48.5	11.6	25.7	14.1	0.1	77
11/12	59.6	16.5	5.3	5.9	3.5	9.1	102	49.4	19.9	17.0	13.5	0.2	72
12/13	60.2	9.1	2.9	4.1	17.1	6.6	96	65.1	16.9	10.8	6.1	1.1	101
Mean	32.7	27.4	27.4	6.8	2.2	3.5	2 851[1]	29.7	29.1	23.2	16.4	1.6	1 589[1]

[1] total landings for all years

Table G.7B: Distribution of landings (%) by fishing year and by target species for bottom longline for SCH 3 and SCH 4 (see Appendix A for definitions of codes in the table) based on trips which landed school shark. The final column for each QMA gives the annual total bottom longline landings (t) in each QMA. These values are plotted in Figure 13; '–': no data.

Fishing						SCH 3						SCH 4
year	HPB	LIN	SCH	BNS	OTH	Total	LIN	HPB	SCH	BNS	OTH	Total
89/90	–	26.6	71.3	1.2	0.8	3	100.0	–	–	–	–	0.1
90/91	0.3	38.4	57.9	–	3.4	3	100.0	–	–	–	–	7.4
91/92	18.9	81.1	–	–	–	1	88.0	10.6	0.5	–	0.9	30
92/93	31.4	43.0	25.1	–	0.5	3	81.6	18.3	0.1	–	–	24
93/94	2.1	93.8	3.5	0.5	0.2	8	60.2	14.4	22.2	–	3.3	36
94/95	8.4	72.4	16.3	2.8	–	17	89.4	4.8	4.8	–	1.0	24
95/96	23.3	6.4	48.5	21.8	0.0	35	51.4	12.8	32.7	0.0	3.1	109
96/97	55.1	21.7	–	23.1	–	45	75.6	15.1	9.3	0.0	0.1	184
97/98	54.7	44.5	–	–	0.8	6	64.3	14.7	17.8	3.2	0.1	99
98/99	46.4	34.7	0.0	12.3	6.6	23	66.9	18.1	11.9	3.0	0.0	103
99/00	26.5	52.3	21.2	–	–	26	92.6	7.4	0.0	–	–	78
00/01	0.0	68.0	31.9	–	0.0	19	92.3	5.9	1.8	–	–	64
01/02	72.5	27.5	–	–	0.0	17	96.1	3.9	–	–	0.0	56
02/03	28.9	22.2	48.9	–	–	28	63.1	19.0	6.9	6.4	4.6	85
03/04	82.3	7.6	7.6	2.5	–	16	28.7	9.8	54.0	5.3	2.2	123
04/05	35.9	22.1	29.1	6.2	6.7	42	25.9	9.6	34.4	24.0	6.1	166
05/06	37.8	37.1	–	25.1	–	15	15.6	9.1	49.0	24.1	2.3	149
06/07	12.5	23.9	20.3	42.8	0.5	19	27.4	25.8	17.5	20.4	8.8	86
07/08	36.6	26.2	19.9	12.8	4.5	42	26.1	20.8	18.3	21.9	13.0	123
08/09	45.3	32.2	15.8	6.7	0.0	73	40.6	29.9	17.4	10.9	1.1	143
09/10	38.6	25.4	32.7	0.5	2.8	51	23.1	46.1	22.7	6.8	1.3	207
10/11	51.2	21.5	21.5	5.7	0.1	43	14.4	56.3	23.1	5.4	0.9	190
11/12	56.8	21.6	19.7	1.8	0.1	59	17.5	57.6	18.9	4.6	1.4	217
12/13	62.2	23.7	12.2	0.9	1.1	40	15.5	51.1	32.0	0.5	1.0	127
Mean	41.4	28.9	20.4	8.0	1.3	635	41.6	26.4	21.8	7.8	2.4	2 428

[1] total landings for all years

Table G.7C: Distribution of landings (%) by fishing year and by target species for bottom longline for SCH 3 and SCH 4 (see Appendix A for definitions of codes in the table) based on trips which landed school shark. The final column for each QMA gives the annual total bottom longline landings (t) in each QMA. These values are plotted in Figure 13; '–': no data.

Fishing						SCH 5						SCH 7
year	HPB	SCH	LIN	BNS	OTH	Total	SCH	HPB	LIN	BNS	OTH	Total
89/90	61.6	26.7	1.3	10.4	–	25	84.6	4.3	9.6	0.1	1.4	187.8
90/91	42.1	50.2	4.4	3.3	–	14	90.0	2.6	4.8	0.7	1.8	142.3
91/92	29.1	52.9	17.5	0.0	0.5	31	84.3	3.4	10.5	1.8	0.0	140
92/93	22.7	31.6	45.7	0.0	0.0	15	84.6	7.5	6.3	1.5	0.1	172
93/94	40.6	41.4	16.8	1.2	–	27	92.5	3.5	3.1	0.9	0.0	186
94/95	70.6	0.5	24.7	4.2	0.0	26	88.0	4.8	4.1	2.6	0.4	146
95/96	51.6	4.6	36.4	7.3	0.1	40	85.9	2.3	7.5	3.8	0.4	191
96/97	60.6	0.0	39.0	0.4	–	27	81.0	6.1	9.2	2.8	1.0	177
97/98	9.9	0.0	90.1	–	–	11	82.5	8.3	5.7	2.6	0.9	168
98/99	39.3	7.1	47.7	5.9	0.0	50	69.3	12.1	9.1	6.9	2.6	190
99/00	25.7	3.6	69.2	1.5	–	14	72.0	13.6	9.0	5.0	0.4	172
00/01	38.4	11.7	46.0	3.9	–	54	70.2	17.8	8.8	2.7	0.4	131
01/02	14.2	61.6	21.1	3.1	–	75	49.6	32.3	13.9	4.2	0.0	116
02/03	36.7	27.6	29.4	6.3	–	46	55.9	23.7	15.6	4.8	0.0	151
03/04	27.2	26.0	28.3	18.4	0.0	48	59.5	22.3	11.6	6.4	0.0	128
04/05	49.7	10.7	29.6	10.0	0.0	40	64.9	18.9	11.3	4.9	0.0	130
05/06	23.9	39.1	20.8	16.1	–	32	69.8	20.3	7.2	2.5	0.2	137
06/07	13.9	43.5	35.6	7.1	–	32	59.8	18.1	8.9	9.3	4.0	121
07/08	21.1	43.4	18.7	16.9	–	75	60.8	20.0	13.8	5.4	0.0	119
08/09	27.8	28.4	11.0	32.8	0.0	101	71.1	14.6	12.6	1.6	0.0	162
09/10	17.2	31.0	25.3	26.4	–	57	65.6	23.5	8.9	1.9	0.2	127
10/11	37.8	33.3	17.1	11.8	–	67	77.7	13.2	4.6	3.8	0.7	214
11/12	27.3	20.8	40.6	11.3	–	22	73.8	16.3	6.7	3.1	0.0	172
12/13	46.1	–	52.3	1.5	–	16	56.9	34.3	4.4	3.2	1.1	197
Mean	32.8	28.2	27.4	11.6	0.0	945[1]	73.9	13.7	8.3	3.3	0.7	3 781[1]

[1] total landings for all years

Table G.7D: Distribution of landings (%) by fishing year and by target species for bottom longline for SCH 8 and SCH 1W (see Appendix A for definitions of codes in the table) based on trips which landed school shark. The final column for each QMA gives the annual total bottom longline landings (t) in each QMA. These values are plotted in Figure 13; '–': no data.

Fishing						SCH 8						SCH 1W
year	SCH	HPB	BNS	SNA	GUR	OTH	Total	SCH	HPB	SNA	BNS	OTH	Total
89/90	92.2	2.5	–	1.1	0.5	3.7	82	99.0	–	1.0	–	–	68
90/91	86.9	4.7	–	2.1	0.1	6.1	43	88.3	–	11.7	–	–	7
91/92	88.5	7.5	–	2.3	0.2	1.6	63	95.2	1.5	3.1	–	0.2	55
92/93	82.4	11.0	2.5	0.8	0.1	3.2	100	74.5	10.9	14.5	–	–	67
93/94	92.6	5.1	–	0.7	0.2	1.4	95	89.3	7.8	1.9	–	1.0	154
94/95	88.0	7.2	2.9	0.7	0.8	0.5	144	85.3	9.4	2.2	3.1	0.0	119
95/96	71.5	14.2	12.1	0.3	0.2	1.6	114	82.3	14.6	1.2	1.2	0.7	180
96/97	80.1	12.6	3.9	0.8	0.8	1.8	98	81.5	12.9	4.4	0.9	0.4	174
97/98	75.2	9.2	9.9	0.9	1.2	3.6	64	73.0	22.0	0.8	3.3	0.9	152
98/99	70.7	13.6	8.1	2.1	2.1	3.4	123	78.7	16.9	0.7	1.8	1.9	194
99/00	70.0	17.9	3.2	4.2	1.3	3.4	64	76.2	19.0	3.6	1.2	0.0	184
00/01	69.3	16.2	6.0	6.0	1.3	1.2	67	66.8	24.5	8.1	0.2	0.5	222
01/02	60.6	37.1	0.0	1.2	0.6	0.6	82	75.3	18.6	5.1	0.1	0.9	147
02/03	57.2	11.5	25.9	2.6	0.9	1.8	38	51.1	32.2	14.8	1.2	0.7	156
03/04	78.2	8.9	11.8	0.3	0.6	0.3	87	48.0	43.9	5.8	2.3	0.0	165
04/05	76.6	20.7	2.2	0.1	0.3	0.1	106	17.3	63.1	2.8	14.3	2.5	79
05/06	90.1	6.9	2.6	0.2	0.1	0.1	76	28.5	52.0	8.8	9.4	1.4	78
06/07	89.2	5.5	2.9	0.1	1.1	1.2	76	37.9	55.6	2.9	3.5	0.1	83
07/08	89.1	4.6	2.8	0.2	2.1	1.2	61	38.8	51.7	1.3	5.7	2.4	106
08/09	85.0	10.8	3.5	0.2	0.4	0.1	96	35.2	48.8	6.7	5.6	3.7	98
09/10	53.8	35.7	9.0	0.4	0.7	0.3	46	12.2	72.7	4.8	6.5	3.8	85
10/11	89.4	2.2	5.9	0.2	1.2	1.1	71	36.5	51.0	4.0	4.5	4.0	128
11/12	87.6	5.8	0.9	0.7	4.1	0.8	71	23.4	69.0	2.2	2.3	3.0	92
12/13	84.4	8.6	4.2	–	1.7	1.1	107	6.0	80.9	6.6	2.7	3.9	64
Mean	80.3	11.5	4.7	1.0	0.9	1.6	1 974[1]	61.3	30.3	4.6	2.5	1.2	2 856[1]

[1] total landings for all years

Appendix H. NORTH/SOUTH ISLAND SCHOOL SHARK CPUE ANALYSES

H.1 GENERAL OVERVIEW

Nine detailed CPUE analyses and their accompanying diagnostics are described in the following appendices:

Analysis	Setnet	Bottom longline
Far North & SCH 1E	Appendix I	Appendix J
SCH 2 & top of SCH 3	Appendix K	Appendix L
lower SCH 3 & SCH 5	Appendix M	Appendix N
Chatham Rise (SCH 4)	no data	Appendix O
SCH 7, SCH 8 & lower SCH 1W	Appendix P	Appendix Q

These appendices correspond to the analyses presented in Section 3 of the main report. Each appendix contains the definition for the modelled fishery, detailed tables and figures providing statistics and diagnostics, and a final table giving the estimated indices with the standard error.

H.2 METHODS

H.2.1 DATA PREPARATION

The identification of candidate trips for these analyses and the methods used to prepare them are described in Section 2.3.1 in the main report. Landings were allocated to effort at the “daily effort stratum” resolution procedure described on page 9.

Those groups of events that satisfied the criteria of target species, method of capture and statistical areas that defined each fishery were selected from available fishing trips. Any effort strata that were matched to a landing of school shark were termed “successful”, and may include relevant but unsuccessful effort given that a "daily-effort stratum" represents amalgamated catch and effort. Consequently, the analysis of catch rates in successful strata also incorporates some zero catch information.

The potential explanatory variables available from each trip in these data sets, include the number of hooks set and number of sets (for bottom longline) or the length of net and the duration of fishing (for setnet), fishing year, statistical area, target species, month of landing, and a unique vessel identifier. The dependent variable will be log(catch) where catch will be the scaled daily landings. Data might not represent an entire fishing trip; just those portions of it that qualified. Trips were not dropped because they targeted more than one species or fished in more than one statistical area.

Datasets were further restricted to core fleets of vessels, defined by their activity in the fishery, thus selecting only the most active vessels without dropping too much of the available catch and effort data.

H.2.2 ANALYTICAL METHODS FOR STANDARDISATION

Arithmetic CPUE $\left(\hat{A}_y\right)$ in year y was calculated as the mean of catch divided by effort for each observation in the year:

Eq. H.1
$$\hat{A}_y = \frac{\sum_{i=1}^{N_y} C_{i,y} / E_{i,y}}{N_y}$$

where $C_{i,y}$ is the [*catch*] and $E_{i,y} = L_{i,y}$ ([*net_length*]–for setnet) or $E_{i,y} = H_{i,y}$ ([*hooks*]–for bottom longline) in record *i* in year *y*, and N_y is the number of records in year *y*.

Unstandardised CPUE $\left(\hat{U}_y\right)$ in year *y* is the geometric mean of the ratio of catch to effort for each record *i* in year *y*:

Eq. H.2 $$\hat{U}_y = \exp\left[\frac{\sum_{i=1}^{N_y} \ln\left(C_{i,y} \big/ E_{i,y} \right)}{N_y}\right]$$

where C_i, $E_{i,y}$ and N_y are as defined for Eq. H.1. Unstandardised CPUE assumes a log-normal distribution, but does not take into account changes in the fishery. This index is the same as the "year index" calculated by the standardisation procedure, when not using additional explanatory variables and using the same definition for $E_{i,y}$. Presenting the arithmetic and unstandardised CPUE indices in this report provides measures of how much the standardisation procedure has modified the series from these two sets of indices.

A standardised abundance index (Eq. H.3) was calculated from a generalised linear model (GLM) (Quinn & Deriso 1999) using a range of explanatory variables including [*year*], [*month*], [*vessel*] and other available factors:

Eq. H.3 $$\ln(I_i) = B + Y_{y_i} + \alpha_{a_i} + \beta_{b_i} + ... + f\left(\chi_i\right) + f\left(\delta_i\right) .... + \varepsilon_i$$

where $I_i = C_i$ for the i^{th} record, Y_{y_i} is the year coefficient for the year corresponding to the i^{th} record, α_{a_i} and β_{b_i} are the coefficients for factorial variables *a* and *b* corresponding to the i^{th} record, and $f\left(\chi_i\right)$ and $f\left(\delta_i\right)$ are polynomial functions (to the 3rd order) of the continuous variables χ_i and δ_i corresponding to the i^{th} record, *B* is the intercept and ε_i is an error term. The actual number of factorial and continuous explanatory variables in each model depends on the model selection criteria. Fishing year was always forced as the first variable, and month (of landing), statistical area, target species, and a unique vessel identifier were also offered as categorical variables. Net length $\left(\ln\left(L\right)_i\right)$ and fishing duration $\left(\ln\left(D_i\right)\right)$ were offered to the setnet models as continuous third order polynomial variables. Number of sets $\left(\ln\left(S\right)_i\right)$ and fishing duration $\left(\ln\left(H_i\right)\right)$ were offered to the bottom longline models as continuous third order polynomial variables.

A diagnostic procedure was applied to the successful (positive) catch records by fitting alternative regressions based on five statistical distributional assumptions (lognormal, log-logistic, inverse Gaussian, gamma and Weibull) and which predicted catch based on a reduced dataset of six explanatory variables (year, month, area, vessel, target species and $\left(\ln\left(L_i\right)\right)$ or $\left(\ln\left(H_i\right)\right)$, depending on the fishery capture method. The distribution which resulted in the model with the lowest negative log-likelihood was noted and the result of this diagnostic is presented for all nine CPUE analyses.

However, it was decided to use the lognormal distribution for all nine CPUE analyses. This was done for consistency among the analyses, including with past analyses, because there was concern that there would be differences among analyses that reflected the different distributional assumptions rather than differences in CPUE. This was not a problem for five of the nine analyses (four BLL, one SN), which selected the lognormal as the "best" distribution. Three of the remaining analyses (two SN, one BLL) selected the log-logistic distribution, which gives results that are always very similar to the lognormal results. The only distributional outlier was the setnet analysis for SCH 7, SCH 8, lower SCH 1W, which selected the Weibull as the "best" distribution. However, this analysis was forced to lognormal for consistency with the remaining eight analyses.

For the positive catch records, log(catch) was regressed against the full set of explanatory variables in a stepwise procedure, selecting variables one at a time until the improvement in the model R^2 was less than 0.01. The order of the variables in the selection process was based on the variable with the lowest AIC, so that the degrees of freedom were minimised.

Canonical coefficients and standard errors were calculated for each categorical variable (Francis 1999). Standardised analyses typically set one of the coefficients to 1.0 without an error term and estimate the remaining coefficients and the associated error relative to the fixed coefficient. This is required because of parameter confounding. The Francis (1999) procedure rescales all coefficients so that the geometric mean of the coefficients is equal to 1.0 and calculates a standard error for each coefficient, including the fixed coefficient.

The procedure described by Eq. H.3 is necessarily confined to the positive catch observations in the data set because the logarithm of zero is undefined. Observations with zero catch were modelled by fitting a linear regression model based on a binomial distribution and using the presence/absence of school shark as the dependent variable (where 1 is substituted for $\ln(I_i)$ in Eq. H.3 if it is a successful catch record and 0 if it is not successful), using the same data set. Explanatory factors were estimated in the model in the same manner as described for Eq. H.3. Such a model provides an alternative series of standardised coefficients of relative annual changes that is analogous to the equivalent series estimated from the positive catch regression.

A combined model, which integrates the lognormal and binomial annual abundance coefficients, was estimated using the delta distribution, which allows zero and positive observations (Vignaux 1994):

Eq. H.4 $$^{C}Y_y = \frac{^{L}Y_y}{\left(1 - P_0\left[1 - \frac{1}{^{B}Y_y}\right]\right)}$$

where $^{C}Y_y$ = combined index for year *y*

$^{L}Y_y$ = lognormal index for year *i*

$^{B}Y_y$ = binomial index for year *i*

P_0 = proportion zero for base year *0*

Confidence bounds, while straightforward to calculate for the binomial and lognormal models, were not calculated for the combined model because a bootstrap procedure (recommended by Francis 2001) has not yet been implemented in the available software.

It was decided to only perform the positive catch standardisation on the setnet data, on the assumption that the setnet fisheries have a large component of school shark targeting and that the proportion of zero records would be relatively constant in the analysis. Positive catch and presence/absence standardisations were done for all the bottom longline analyses, with the resulting series combined into a single series using the delta-lognormal method (Eq. H.4).

Appendix I. DIAGNOSTICS AND SUPPORTING ANALYSES FOR FAR NORTH & SCH 1E SETNET [SN-N1E(MIX)] CPUE STANDARDISATION

I.1 INTRODUCTION

The basis for the selection of this region for monitoring school shark with this capture method is provided in Section 2.3.3.6 and summarised in Table 14.

I.2 FISHERY DEFINITION

SN-N1E(MIX): The fishery is defined from setnet fishing events which fished in Statistical Areas 045, 046, 047, 048, 002, 002, 004, 005, 006, 007, 008, 009, 010 declaring target species SNA, TRE, SPO, SCH, SPD, GUR.

I.3 CORE VESSEL SELECTION

The criteria used to define the core fleet were those vessels that had fished for at least 5 trips in each of at least 5 years using trips with at least 1 kg of catch. These criteria resulted in a core fleet size of 40 vessels which took 73% of the catch (Figure I.1).

I.4 DATA SUMMARY

Table I.1: Number of number of core vessels, trips, daily effort strata, number of events that have been “rolled up” into daily effort strata, calculated number of events per daily-effort stratum, sum of the length of net set, sum of duration fished, sum of landed SCH (t), proportion of trips with catch and proportion of daily-effort strata with catch by fishing year for core vessels (based on a minimum of 5 trips per year in at least 5 years) in the SN-N1E(MIX) fishery.

Fishing year	Vessels	Trips	Daily effort strata	Events	Events per stratum	Length of net set (km)	Duration (h)	Catch (t)	Trips with catch (%)	Strata with catch (%)
1990	11	621	721	812	1.126	1 258.9	9 822	42.31	38.16	39.11
1991	15	761	902	944	1.047	1 568.4	10 723	37.61	29.17	29.93
1992	21	1 179	1 391	1 487	1.069	2 506.0	17 638	59.49	31.81	32.06
1993	22	1 315	1 559	1 699	1.090	2 919.1	20 846	79.02	31.10	30.92
1994	22	947	1 074	1 143	1.064	2 113.4	13 890	49.00	32.00	30.91
1995	22	1 100	1 247	1 451	1.164	2 215.9	18 032	32.43	31.55	30.55
1996	29	1 329	1 501	1 666	1.110	2 791.4	20 978	59.11	39.28	37.51
1997	28	1 422	1 688	1 720	1.019	2 932.2	21 222	57.81	33.54	31.16
1998	27	1 384	1 646	1 704	1.035	2 818.6	20 456	40.42	31.21	30.07
1999	24	1 493	1 726	1 781	1.032	3 079.0	21 243	91.73	33.36	32.50
2000	21	1 426	1 655	1 682	1.016	3 224.2	19 994	77.22	34.01	31.96
2001	21	1 337	1 472	1 486	1.010	2 745.2	17 901	80.32	37.62	36.96
2002	24	1 129	1 284	1 307	1.018	2 414.6	15 018	71.38	31.27	30.92
2003	23	1 126	1 297	1 318	1.016	2 490.7	16 807	62.59	30.28	29.14
2004	22	946	1 047	1 067	1.019	1 992.8	12 307	61.68	38.69	38.11
2005	23	843	943	950	1.007	1 891.8	11 015	78.38	46.14	45.28
2006	17	726	853	865	1.014	1 780.9	10 812	46.33	35.81	35.05
2007	16	600	717	803	1.120	1 439.2	11 188	57.14	34.00	37.80
2008	14	481	542	583	1.076	1 074.1	7 294	34.73	23.49	26.01
2009	12	397	535	599	1.120	1 035.8	7 840	43.76	26.20	32.52
2010	12	404	493	532	1.079	951.6	6 273	25.57	19.55	22.72
2011	14	362	434	463	1.067	705.9	5 600	33.09	26.80	27.88
2012	15	514	637	671	1.053	1 000.8	8 479	63.38	30.54	35.01
2013	14	602	721	767	1.064	1 178.3	10 374	74.43	27.57	29.26

I.5 CORE VESSEL SELECTION

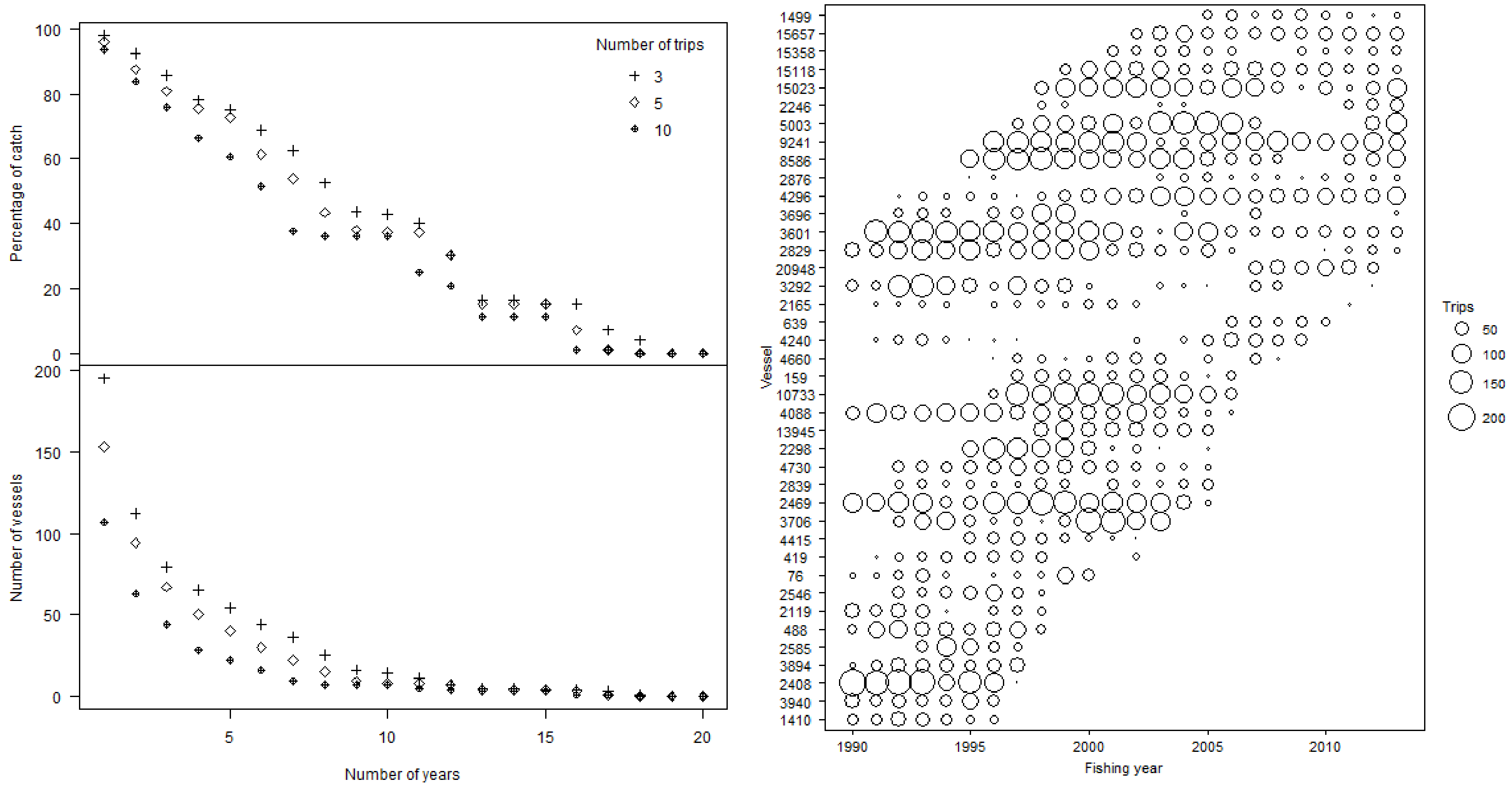

Figure I.1: [left panel] total landed SCH and number of vessels plotted against the number of years used to define core vessels participating in the SN-N1E(MIX) dataset. The number of qualifying years (minimum number of trips per year) for each series is indicated in the legend. [right panel]: bubble plot showing the number of daily-effort strata for selected core vessels (based on at least 5 trips in 5 or more fishing years) by fishing year.

I.6 EXPLORATORY DATA PLOTS FOR CORE VESSEL DATA SET

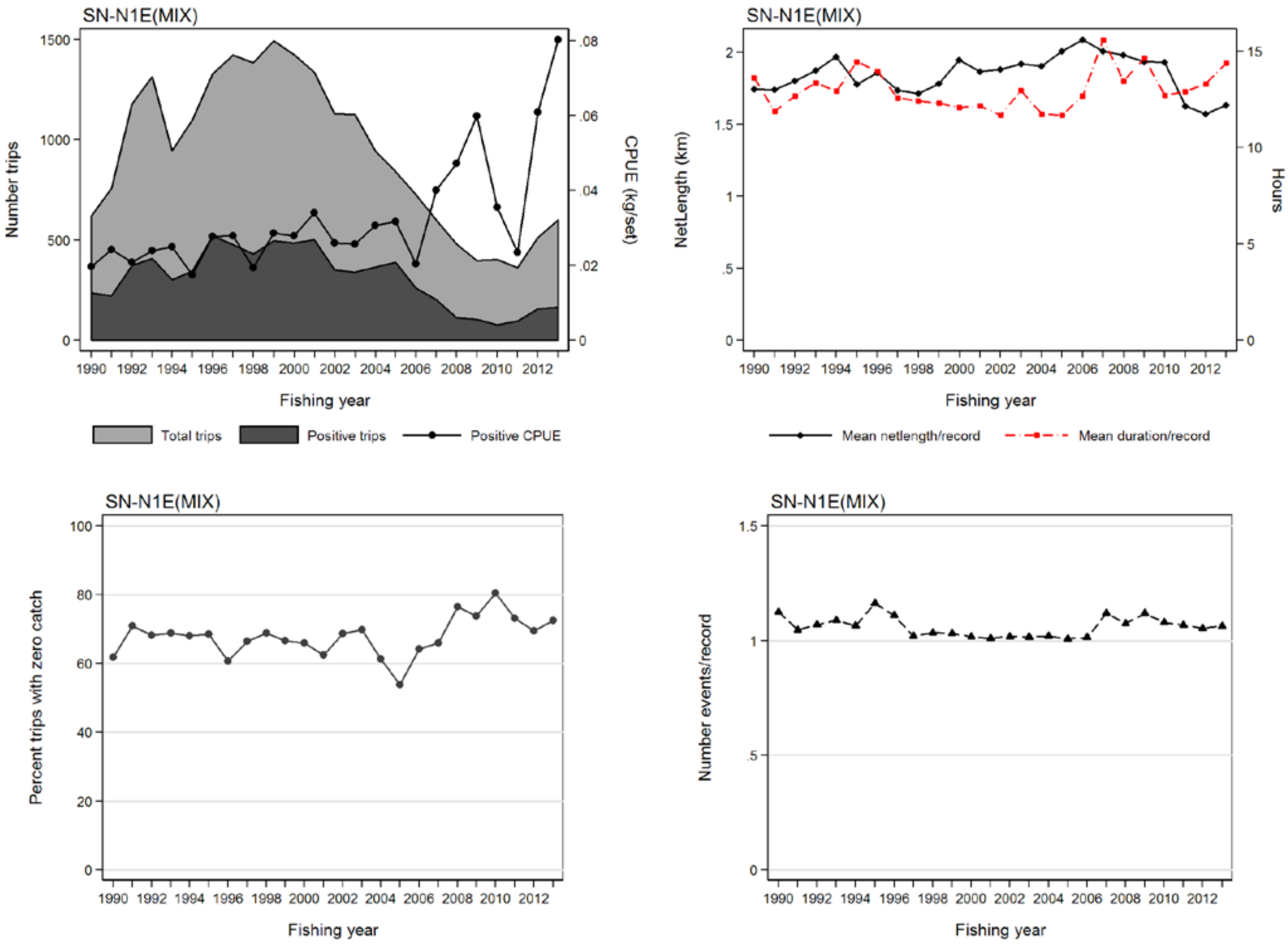

Figure I.2: Core vessel summary plots by fishing year for model SN-N1E(MIX): [upper left panel]: total trips (light grey) and trips with school shark catch (dark grey) overlaid with median annual arithmetic CPUE (kg/set) for all trips *i* with positive catch: $A_y = \text{median}\left(C_{y,i}/E_{y,i}\right)$; [upper right panel]: mean number of sets and mean duration per daily-effort stratum record; [lower left panel]: proportion of trips with no catch of school shark; [lower right panel]: mean number of events per daily-effort stratum record.

I.7 SELECTION OF DISTRIBUTION FOR POSITIVE CATCH RECORDS

The best distribution was lognormal.

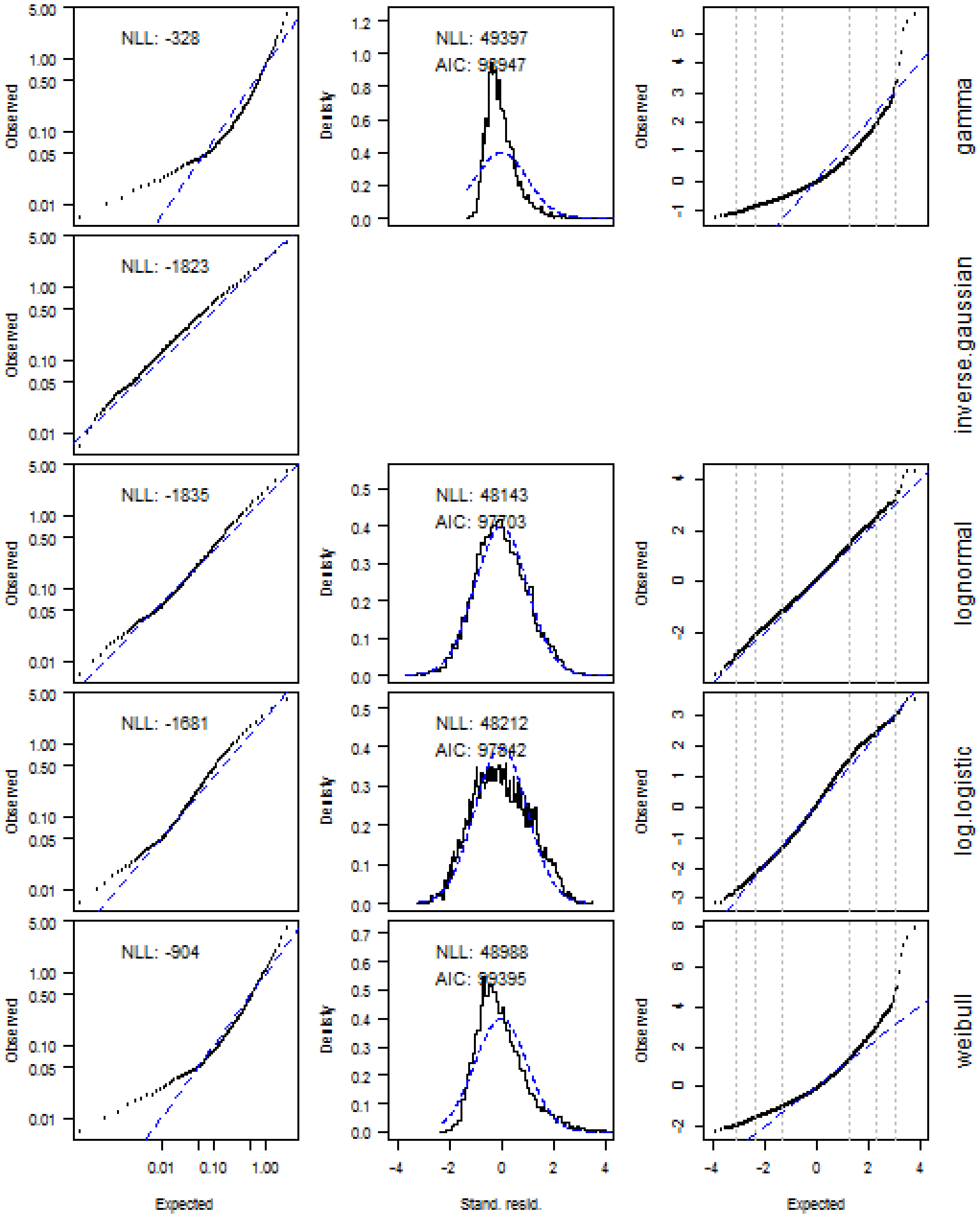

Figure I.3: Diagnostics for alternative distributional assumptions for catch in the school shark SN-NIE(MIX) model. Left: quantile-quantile plot of observed catches (centred (by mean) and scaled (by standard deviation) in log space) versus maximum likelihood fit of distribution (missing panel indicates that the fit failed to converge); Middle: standardised residuals from a generalised linear model fitted using the formula catch ~ fyear + month +area+ vessel + log(sets) and the distribution (missing panel indicates that the model failed to converge); Right: quantile-quantile plot of model standardised residuals against standard normal (vertical lines represent 0.1%, 1% and 10% percentiles). NLL = negative log-likelihood; AIC = Akaike information criterion.

I.8 MODEL SELECTION TABLE

Three explanatory variables entered the model after fishing year (Table I.2), with area and duration fishing non-significant. A plot of the model is provided in Figure I.4 and the CPUE indices are listed in Table I.3.

Table I.2: Order of acceptance of variables into the lognormal model of successful catches in the SN-N1E(MIX) fishery model for core vessels based on the vessel selection criteria of at least 5 trips in 5 or more fishing years), with the amount of explained deviance and R^2 for each variable. Variables accepted into the model are marked with an *, and the final R^2 of the selected model is in bold. Fishing year was forced as the first variable.

Variable	DF	Neg. Log likelihood	AIC	R^2	Model use
fishing year	24	-15 146	30 342	3.98	*
vessel	63	-14 233	28 595	22.96	*
target species	68	-13 866	27 871	29.53	*
month	79	-13 770	27 701	**31.15**	*
area	91	-13 711	27 607	32.13	
poly(log(duration), 3)	94	-13 699	27 587	32.35	

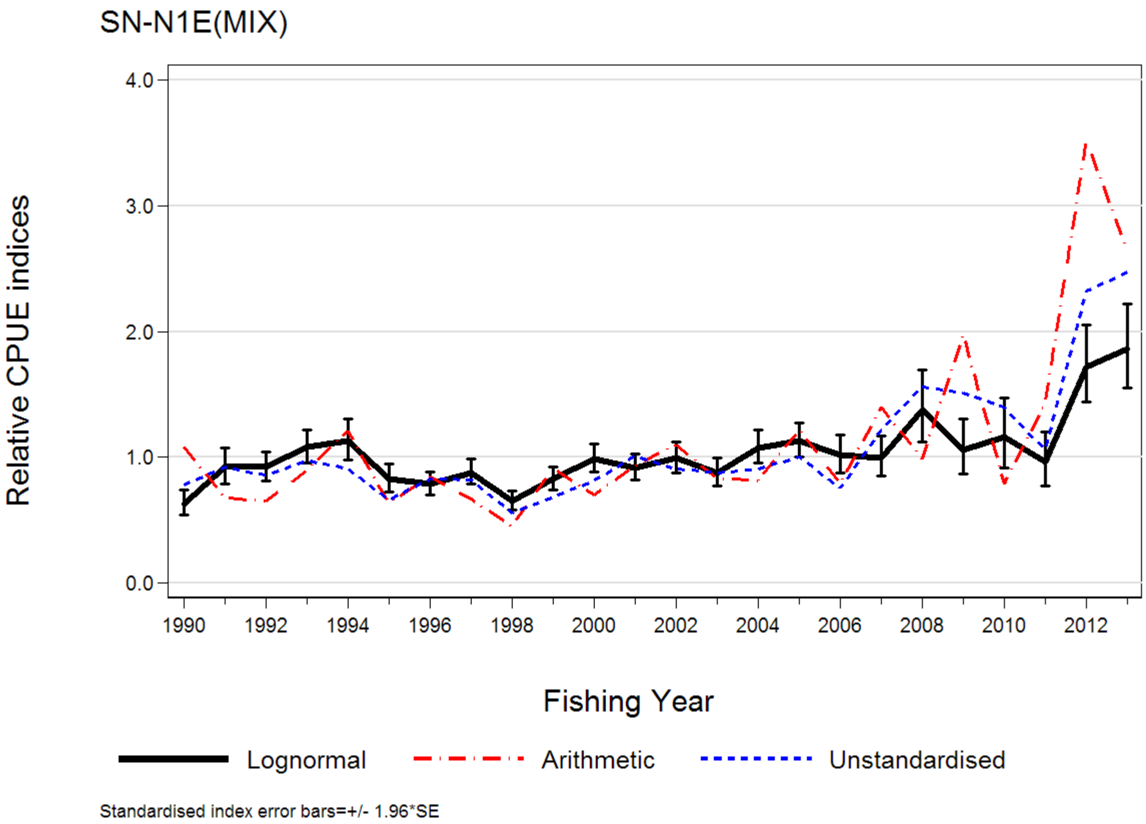

Figure I.4: Relative CPUE indices for school shark using the lognormal non-zero model based on the SN-N1E(MIX) fishery definition. Also shown are two unstandardised series from the same data: a) Arithmetic (Eq. H.1) and b) Unstandardised (Eq. H.2).

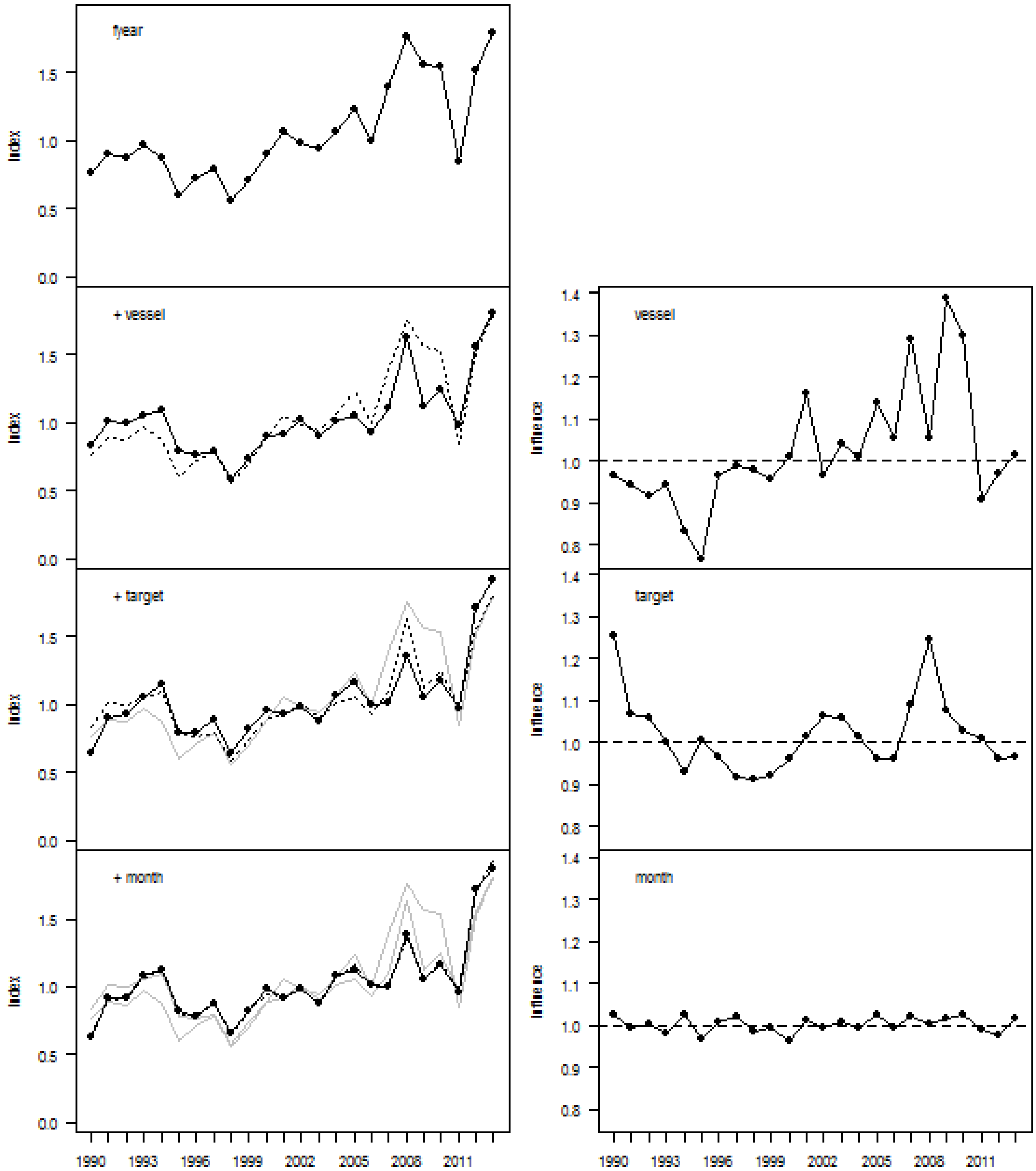

Figure I.5: [left column]: annual indices from the lognormal model of SN-N1E(MIX) at each step in the variable selection process; [right column]: aggregate influence associated with each step in the variable selection procedure.

I.9 RESIDUAL AND DIAGNOSTIC PLOTS

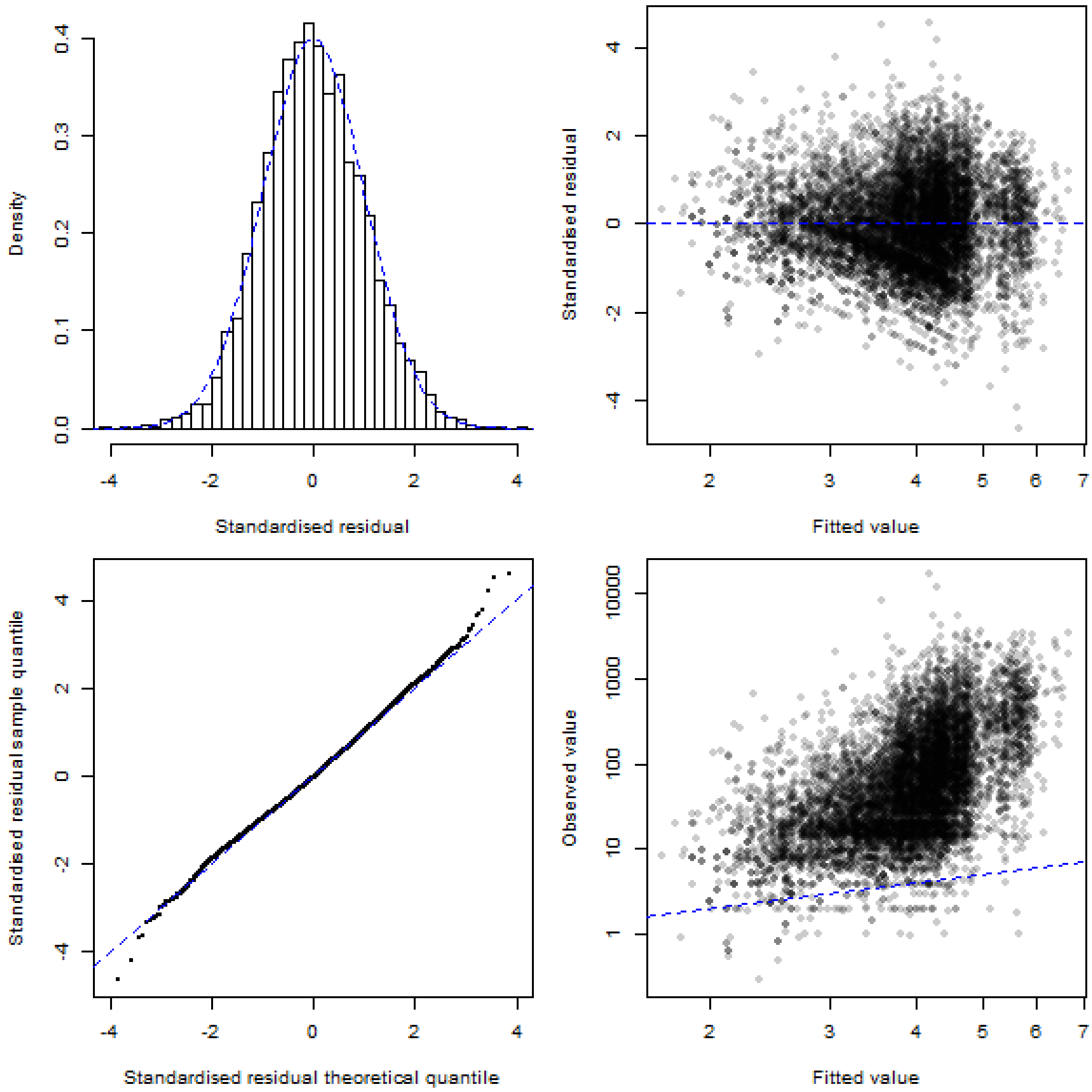

Figure I.6: Plots of the fit of the lognormal standardised CPUE model of successful catches of school shark in the SN-N1E(MIX) fishery. [Upper left] histogram of the standardised residuals compared to a lognormal distribution (SDSR: standard deviation of standardised residuals. MASR: median of absolute standardised residuals); [Upper right] Q-Q plot of the standardised residuals; [Lower left] Standardised residuals plotted against the predicted model catch per trip; [Lower right] Observed catch per record plotted against the predicted catch per record.

I.10 MODEL COEFFICIENTS

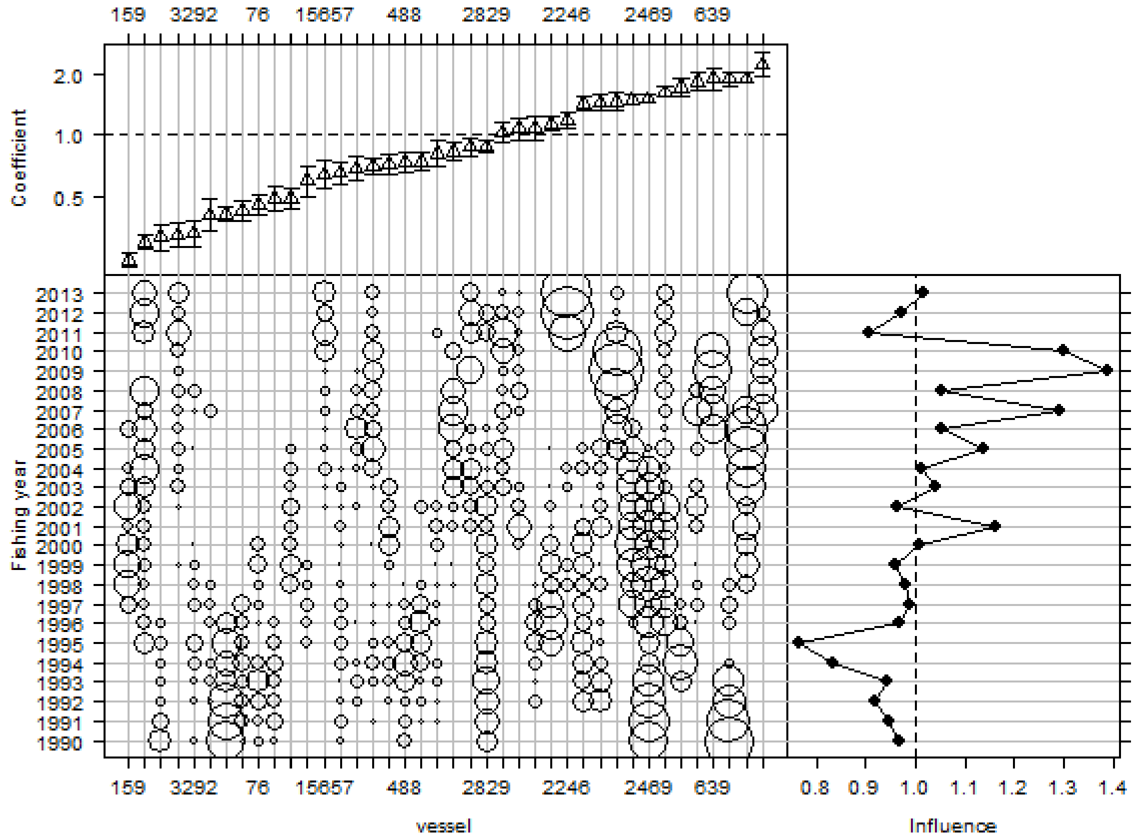

Figure I.7: Effect of vessel in the lognormal model for the school shark SN-N1E(MIX) fishery. Top: effect by level of variable (left-axis: log space additive; right-axis: natural space multiplicative). Bottom-left: distribution of variable by fishing year. Bottom-right: cumulative effect of variable by fishing year (bottom-axis: log space additive; top-axis: natural space multiplicative).

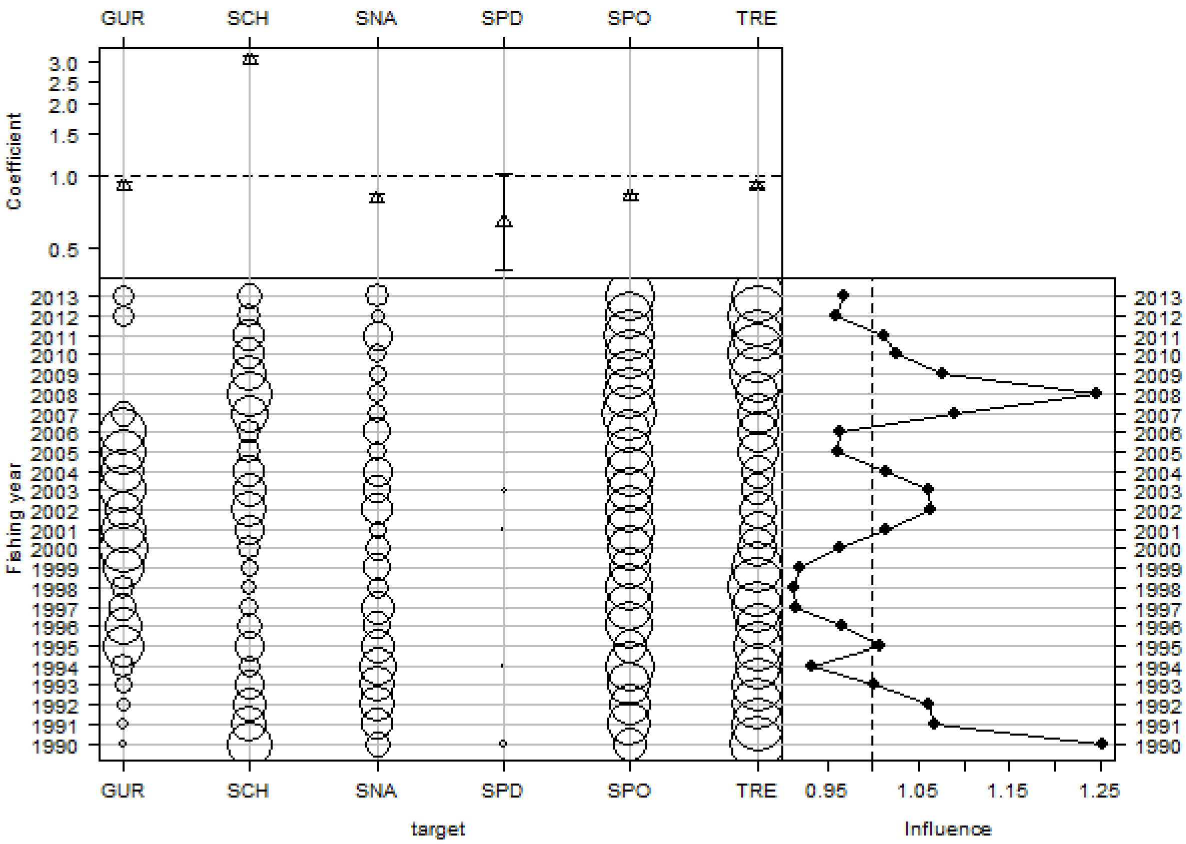

Figure I.8: **Effect of target species in the lognormal model for the school shark SN-N1E(MIX) fishery. Top: effect by level of variable (left-axis: log space additive; right-axis: natural space multiplicative). Bottom-left: distribution of variable by fishing year. Bottom-right: cumulative effect of variable by fishing year (bottom-axis: log space additive; top-axis: natural space multiplicative).**

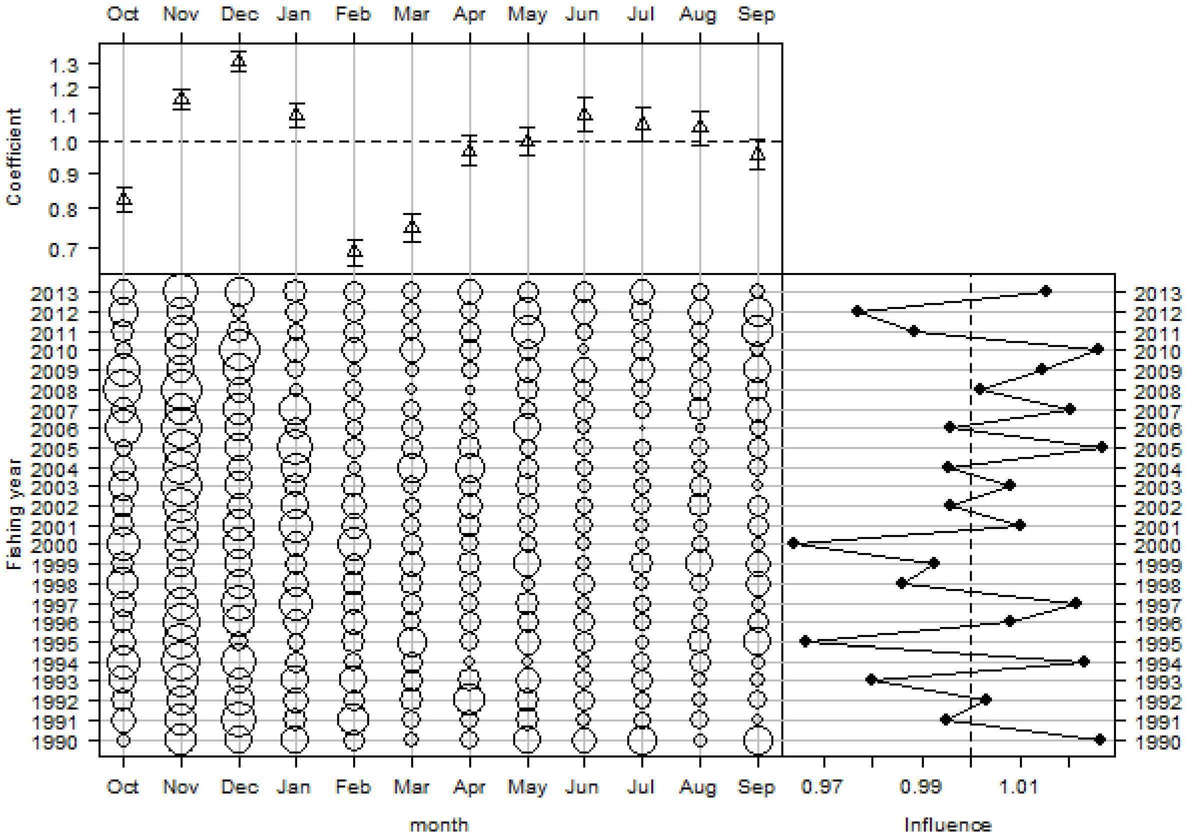

Figure I.9: Effect of month in the lognormal model for the school shark SN-N1E(MIX) fishery. Top: effect by level of variable (left-axis: log space additive; right-axis: natural space multiplicative). Bottom-left: distribution of variable by fishing year. Bottom-right: cumulative effect of variable by fishing year (bottom-axis: log space additive; top-axis: natural space multiplicative).

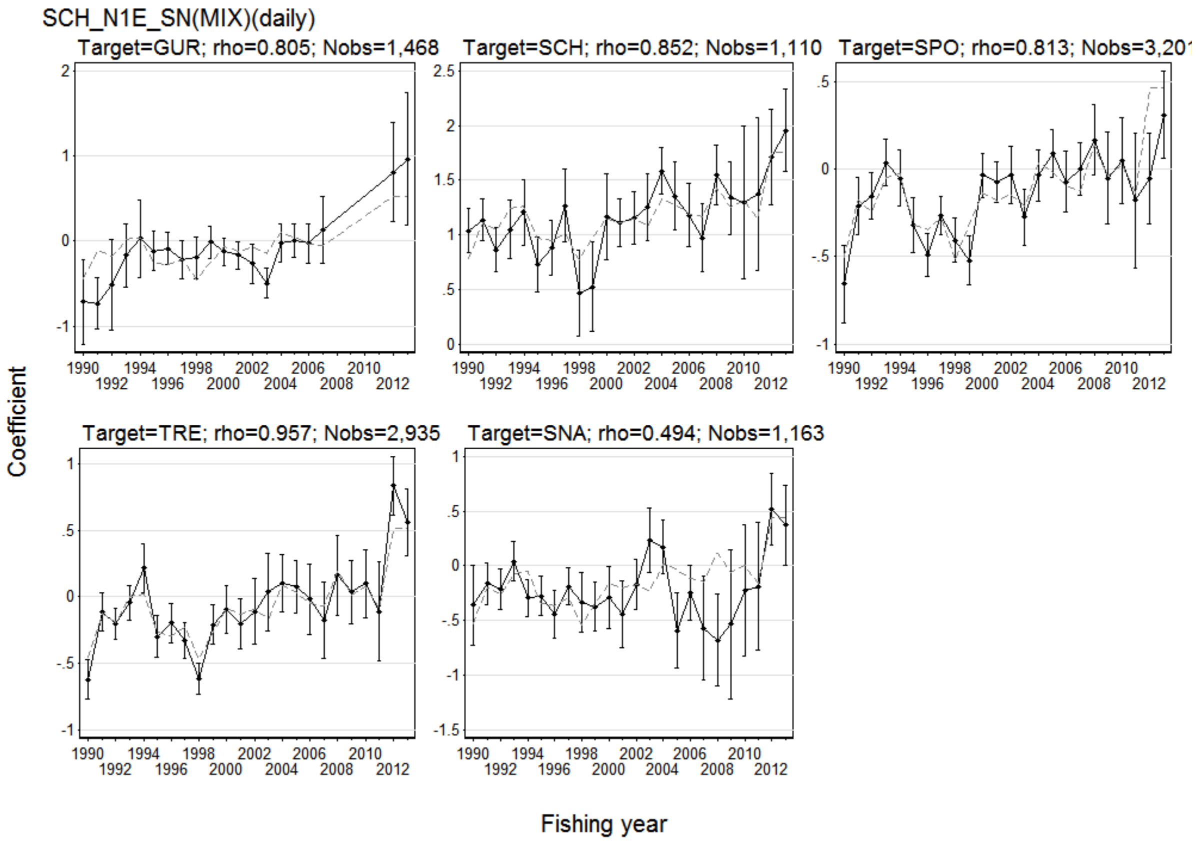

Figure I.10: Residual implied coefficients for target×fishing year interaction (not offered) in the school shark SN-N1E(MIX) lognormal model. Implied coefficients (black points) are calculated as the normalised fishing year coefficient (grey line) plus the mean of the standardised residuals in each fishing year and area. These values approximate the coefficients obtained when an area × year interaction term is fitted, particularly for those area × year combinations which have a substantial proportion of the records. The error bars indicate one standard error of the standardised residuals. The information at the top of each panel identifies the plotted category, provides the correlation coefficient (*rho*) between the category year index and the overall model index, and the number of records supporting the category.

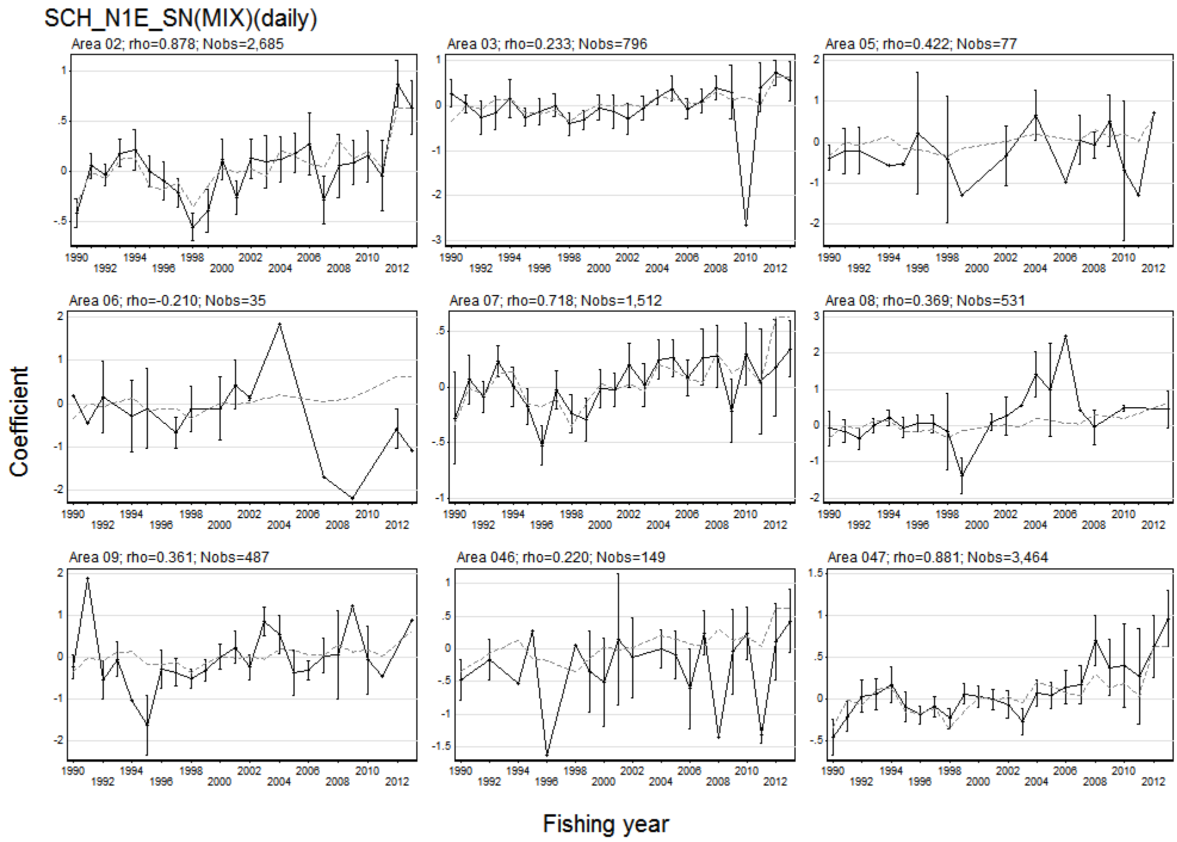

Figure I.11: Residual implied coefficients for area×fishing year interaction (not offered) in the school shark SN-N1E(MIX) lognormal model. Implied coefficients (black points) are calculated as the normalised fishing year coefficient (grey line) plus the mean of the standardised residuals in each fishing year and area. These values approximate the coefficients obtained when an area × year interaction term is fitted, particularly for those area × year combinations which have a substantial proportion of the records. The error bars indicate one standard error of the standardised residuals. The information at the top of each panel identifies the plotted category, provides the correlation coefficient (*rho*) between the category year index and the overall model index, and the number of records supporting the category.

I.11 CPUE INDICES

Table I.3: Arithmetic indices for the total and core data sets, geometric and lognormal standardised indices and associated standard error for the core data set by fishing year for the school shark SN-N1E(MIX) analysis.

Fishing	All vessels				Core vessels
year	Arithmetic	Arithmetic	Geometric	Standardised	SE
1990	1.069	1.078	0.781	0.631	0.0826
1991	0.356	0.682	0.919	0.918	0.0811
1992	0.440	0.648	0.856	0.918	0.0652
1993	0.693	0.894	0.973	1.079	0.0621
1994	0.744	1.211	0.909	1.129	0.0737
1995	0.750	0.634	0.660	0.826	0.0683
1996	0.872	0.845	0.827	0.785	0.0577
1997	0.949	0.664	0.821	0.878	0.0581
1998	0.879	0.452	0.556	0.651	0.0583
1999	1.195	0.912	0.682	0.827	0.0556
2000	0.872	0.701	0.813	0.984	0.0575
2001	1.067	0.930	1.010	0.918	0.0564
2002	1.189	1.097	0.905	0.992	0.0634
2003	0.986	0.833	0.877	0.875	0.0643
2004	1.036	0.813	0.904	1.076	0.0630
2005	1.423	1.218	1.002	1.128	0.0620
2006	0.922	0.791	0.753	1.017	0.0750
2007	1.284	1.398	1.214	0.998	0.0809
2008	0.863	0.983	1.561	1.378	0.1059
2009	1.662	1.972	1.511	1.061	0.1043
2010	0.667	0.788	1.397	1.159	0.1212
2011	1.132	1.430	1.061	0.962	0.1126
2012	3.666	3.518	2.321	1.718	0.0905
2013	2.346	2.638	2.473	1.859	0.0913

Appendix J. DIAGNOSTICS AND SUPPORTING ANALYSES FOR FAR NORTH & SCH 1E BOTTOM LONGLINE [BLL-N1E(MIX)] CPUE STANDARDISATION

J.1 INTRODUCTION

The basis for the selection of this region for monitoring school shark with this capture method is provided in Section 2.3.3.6 and summarised in Table 14.

J.2 FISHERY DEFINITION

BLL-N1E(MIX): The fishery is defined from setnet fishing events which fished in Statistical Areas 045, 046, 047, 048, 002, 002, 004, 005, 006, 007, 008, 009, 010, 105, 106, 107 declaring target species SNA, HPB, BNS, SCH, LIN.

J.3 CORE VESSEL SELECTION

The criteria used to define the core fleet were those vessels that had fished for at least 5 trips in each of at least 5 years using trips with at least 1 kg of catch. These criteria resulted in a core fleet size of 84 vessels which took 70% of the catch (Figure J.1).

J.4 DATA SUMMARY

Table J.1: Number of number of core vessels, trips, daily effort strata, number of events that have been "rolled up" into daily effort strata, calculated number of events per daily-effort stratum, number of sets, sum of hooks (in '000s), sum of landed SCH (t), proportion of trips with catch and proportion of daily-effort strata with catch by fishing year for core vessels (based on a minimum of 5 trips per year in at least 5 years) in the BLL-N1E(MIX) fishery.

Fishing year	Vessels	Trips	Daily effort strata	Events	Events per stratum	Number of sets	Number hooks ('000s)	Catch (t)	Trips with catch (%)	Strata with catch (%)
1990	34	1 596	2 645	2 710	1.025	3 856	3 933	12.70	19.99	16.75
1991	42	2 169	3 423	3 502	1.023	5 120	5 538	13.66	11.94	10.55
1992	51	2 827	4 565	4 615	1.011	7 625	7 915	21.44	12.13	11.26
1993	54	3 000	4 945	5 037	1.019	8 515	9 556	27.05	13.83	12.98
1994	53	3 114	5 179	5 264	1.016	8 515	9 314	45.44	11.62	10.81
1995	56	3 382	5 716	5 819	1.018	9 607	10 314	28.06	10.29	9.31
1996	53	3 100	5 186	5 247	1.012	8 543	9 066	37.94	11.90	10.26
1997	55	3 325	5 411	5 487	1.014	8 713	8 634	45.75	14.29	11.64
1998	55	3 186	4 942	5 039	1.020	7 998	8 274	28.90	12.24	10.83
1999	53	3 564	5 537	5 579	1.008	8 860	9 319	61.70	13.27	11.76
2000	61	3 762	6 076	6 132	1.009	9 039	10 352	73.15	15.79	13.30
2001	64	3 996	6 637	6 699	1.009	10 236	12 152	82.51	16.79	13.76
2002	62	3 672	6 044	6 103	1.010	9 368	11 227	54.26	15.41	13.53
2003	58	3 437	5 603	5 667	1.011	8 147	10 269	68.00	20.28	17.31
2004	61	3 317	5 730	5 800	1.012	7 993	11 254	118.06	26.44	22.13
2005	54	2 787	5 165	5 195	1.006	7 219	10 155	97.09	22.39	19.46
2006	52	2 731	4 588	4 623	1.008	6 222	9 480	87.16	22.41	21.40
2007	50	2 949	4 568	4 591	1.005	6 115	9 183	90.66	19.23	19.05
2008	50	2 619	4 354	5 342	1.227	5 435	8 450	97.84	25.85	23.66
2009	48	2 791	4 669	5 840	1.251	5 936	8 826	107.43	27.12	25.12
2010	47	2 881	4 907	6 277	1.279	6 292	10 523	98.49	29.19	25.84
2011	42	2 680	4 805	6 243	1.299	6 243	10 483	125.21	31.53	29.05
2012	34	2 350	4 032	5 208	1.292	5 208	9 426	84.06	33.28	29.91
2013	32	2 156	3 564	4 549	1.276	4 549	8 422	78.27	32.84	29.15

J.5 CORE VESSEL SELECTION

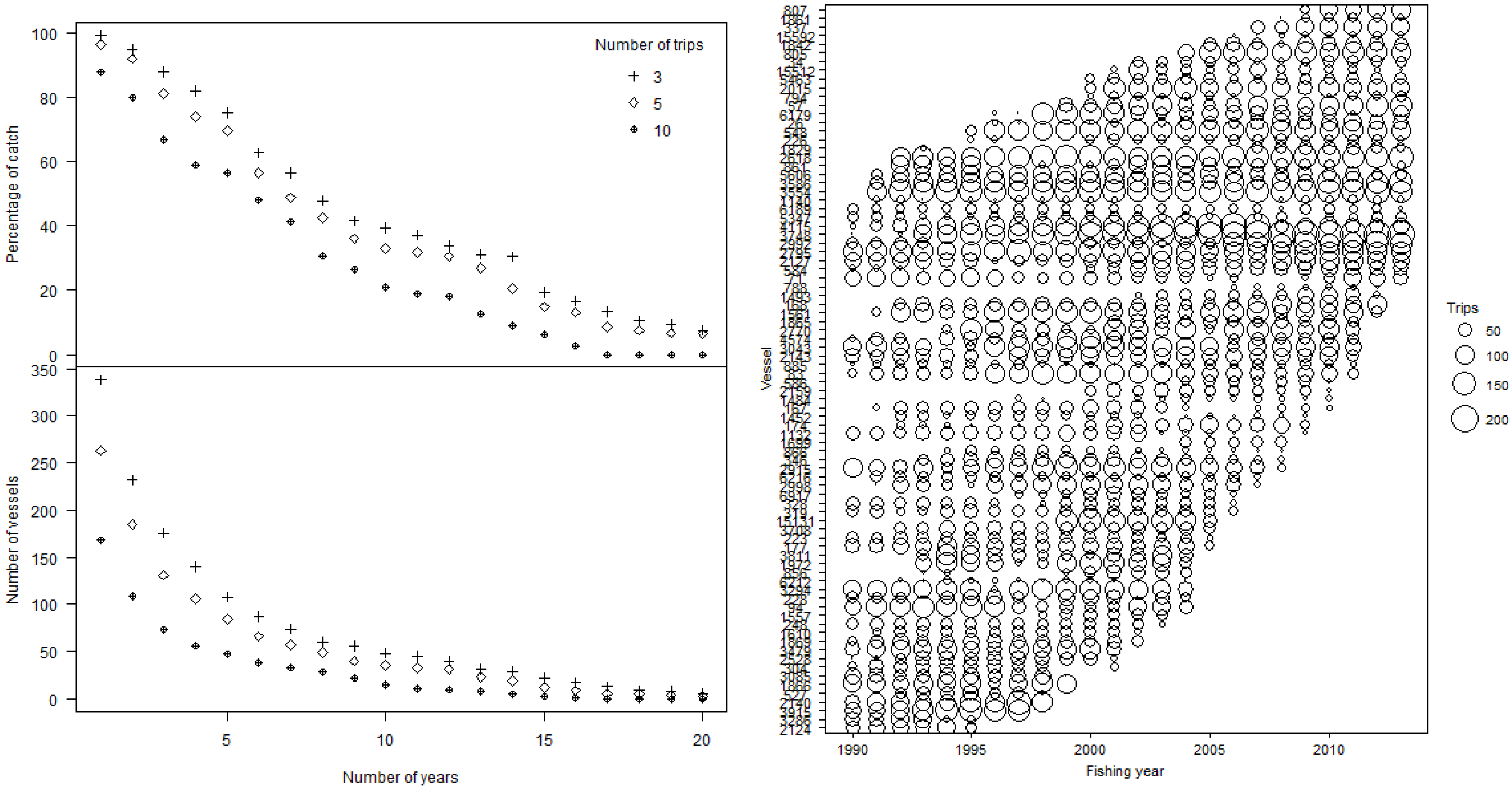

Figure J.1: [left panel] total landed SCH and number of vessels plotted against the number of years used to define core vessels participating in the BLL-N1E(MIX) dataset. The number of qualifying years (minimum number of trips per year) for each series is indicated in the legend. [right panel]: bubble plot showing the number of daily-effort strata for selected core vessels (based on at least 5 trips in 5 or more fishing years) by fishing year.

J.6 EXPLORATORY DATA PLOTS FOR CORE VESSEL DATA SET

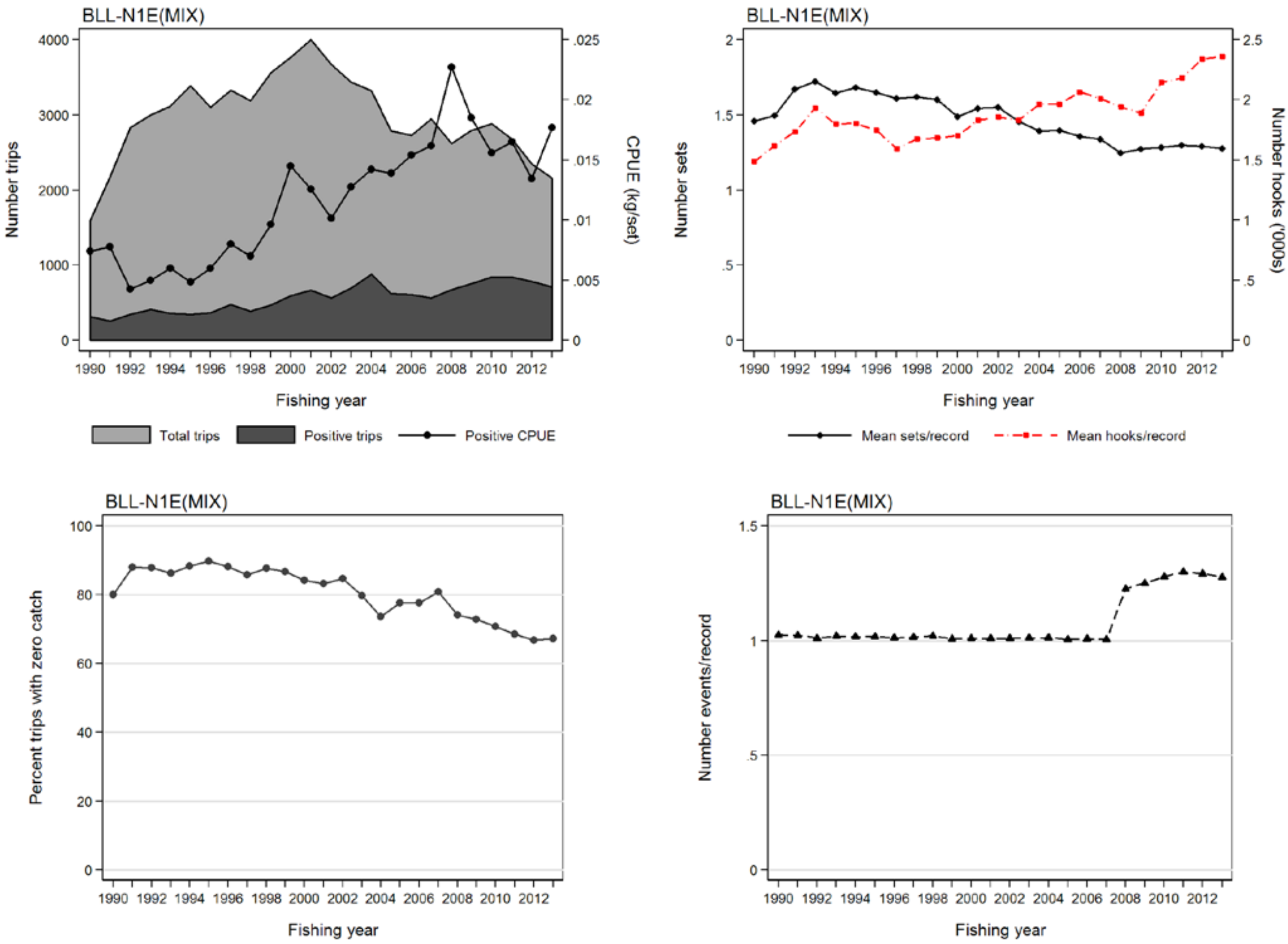

Figure J.2: Core vessel summary plots by fishing year for model BLL-N1E(MIX): [upper left panel]: total trips (light grey) and trips with school shark catch (dark grey) overlaid with median annual arithmetic CPUE (kg/set) for all trips *i* with positive catch: $A_y = \text{median}\left(C_{y,i}/E_{y,i}\right)$; [upper right panel]: mean number of sets and mean number of hooks per daily-effort stratum record; [lower left panel]: proportion of trips with no catch of school shark; [lower right panel]: mean number of events per daily-effort stratum record.

J.7 SELECTION OF DISTRIBUTION FOR POSITIVE CATCH RECORDS

The best distribution was log-logistic.
Distribution was forced to lognormal.

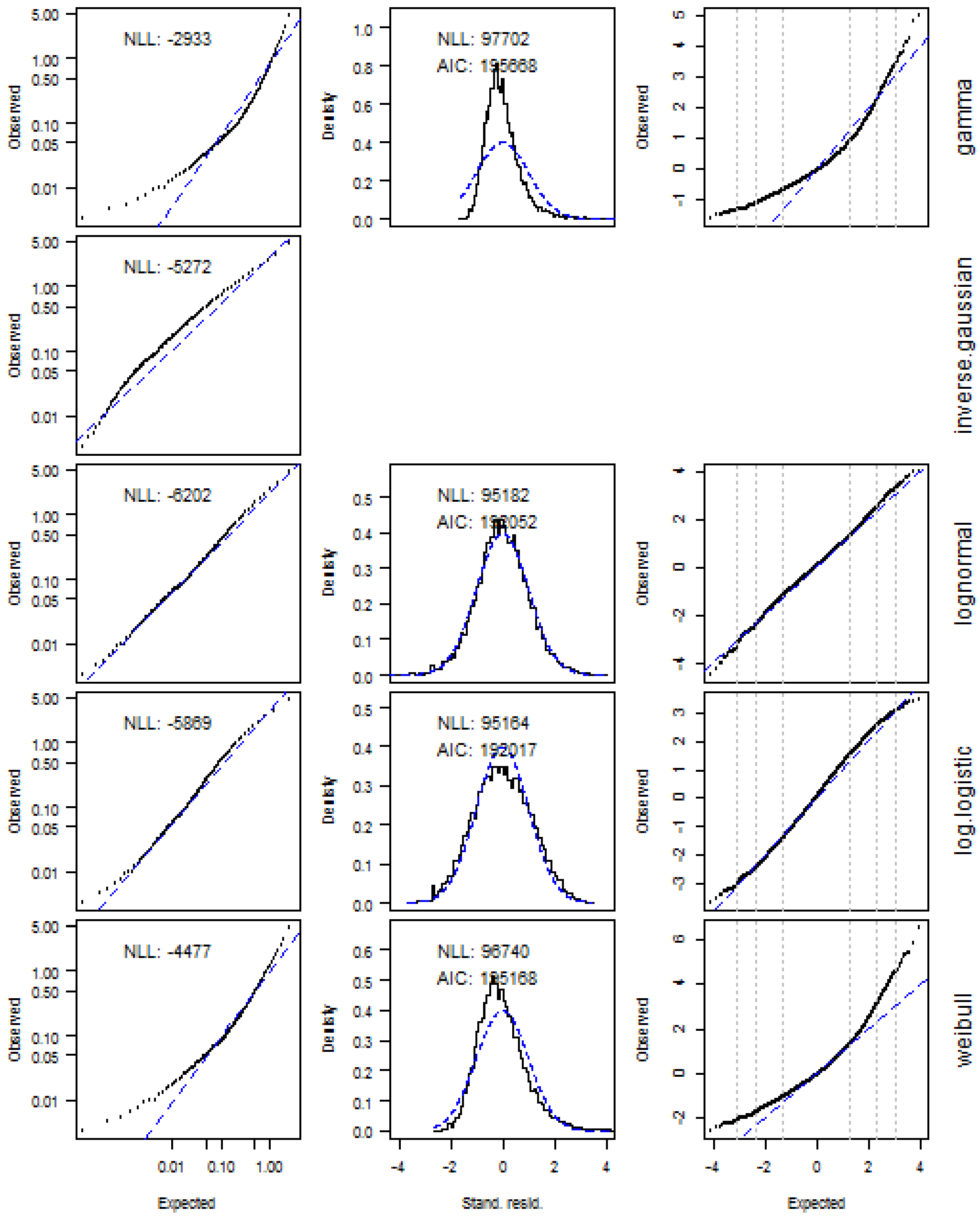

Figure J.3: Diagnostics for alternative distributional assumptions for catch in the school shark BLL-N1E(MIX) model. Left: quantile-quantile plot of observed catches (centred (by mean) and scaled (by standard deviation) in log space) versus maximum likelihood fit of distribution (missing panel indicates that the fit failed to converge); Middle: standardised residuals from a generalised linear model fitted using the formula catch ~ fyear + month +area+ vessel + log(sets) and the distribution (missing panel indicates that the model failed to converge); Right: quantile-quantile plot of model standardised residuals against standard normal (vertical lines represent 0.1%, 1% and 10% percentiles). NLL = negative log-likelihood; AIC = Akaike information criterion.

J.8 Positive catch model selection table

Three explanatory variables entered the model after fishing year (Table J.2), with number of hooks, month and form type non-significant. A plot of the model is provided in Figure J.4 and the CPUE indices are listed in Table J.4.

Table J.2: Order of acceptance of variables into the lognormal model of successful catches of in the BLL-N1E(MIX) fishery model for core vessels based on the vessel selection criteria of at least 5 trips in 5 or more fishing years), with the amount of explained deviance and R^2 for each variable. Variables accepted into the model are marked with an *, and the final R^2 of the selected model is in bold. Fishing year was forced as the first variable.

Variable	DF	Neg. Log likelihood	AIC	R^2	Model use
fishing year	24	-38 618	77 286	6.60	*
vessel	107	-35 068	70 353	34.95	*
target species	111	-33 944	68 111	42.04	*
area	124	-33 547	67 344	**44.36**	*
poly(log(hooks), 3)	127	-33 443	67 143	44.95	
month	138	-33 385	67 047	45.28	
form	140	-33 371	67 024	45.36	

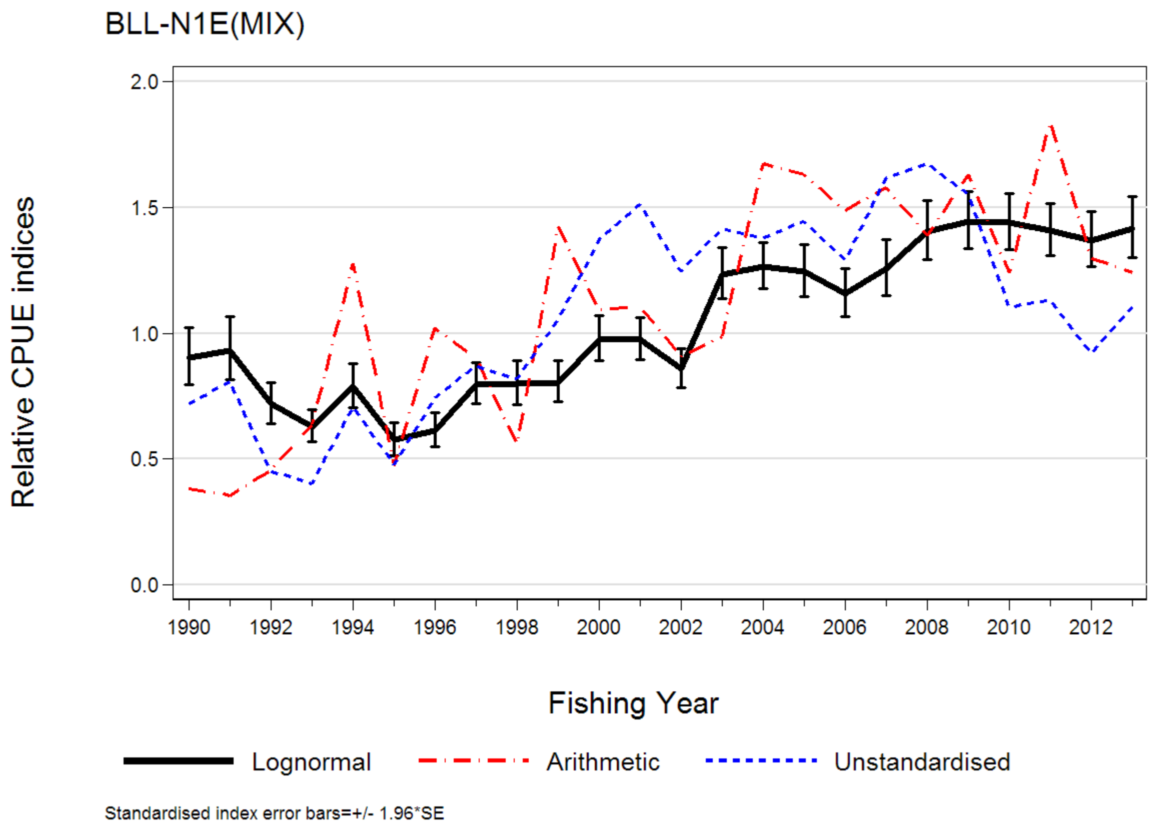

Figure J.4: Relative CPUE indices for school shark using the lognormal non-zero model based on the BLL-N1E(MIX) fishery definition. Also shown are two unstandardised series from the same data: a) Arithmetic (Eq. H.1) and b) Unstandardised (Eq. H.2).

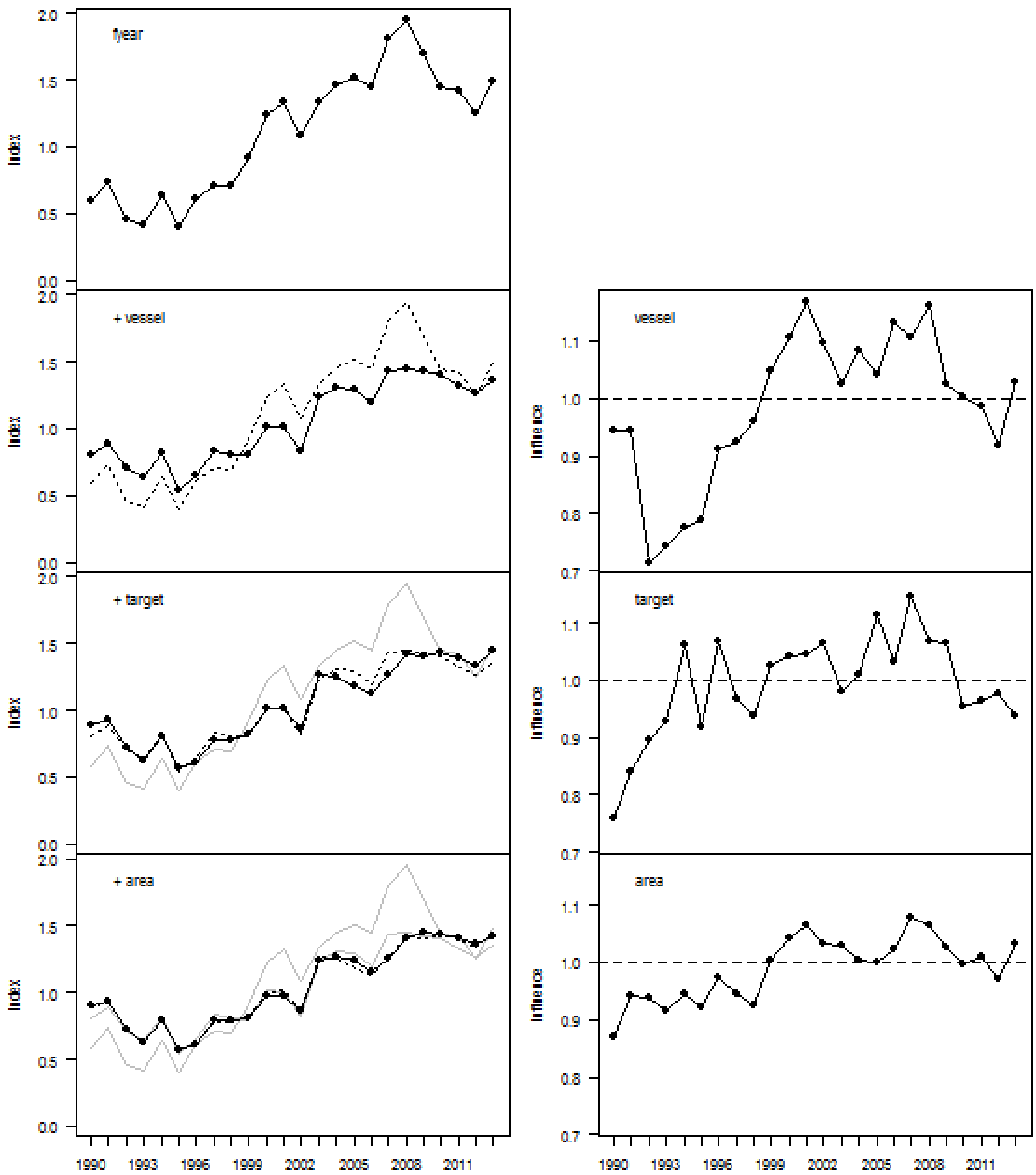

Figure J.5: [left column]: annual indices from the lognormal model of BLL-N1E(MIX) at each step in the variable selection process; [right column]: aggregate influence associated with each step in the variable selection procedure.

J.9 RESIDUAL AND DIAGNOSTIC PLOTS

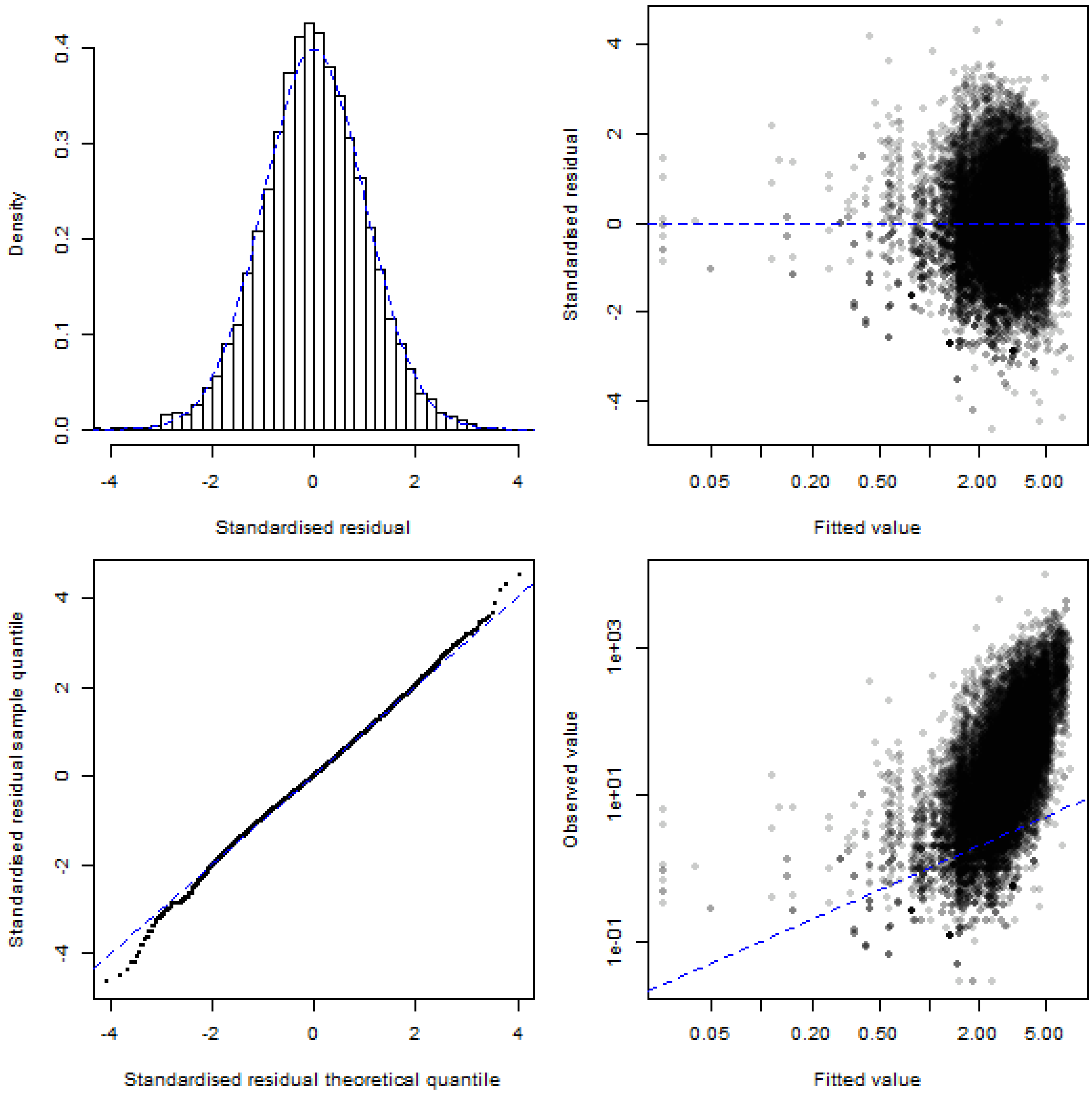

Figure J.6: Plots of the fit of the lognormal standardised CPUE model to successful catches of school shark in the BLL-N1E(MIX) fishery. [Upper left] histogram of the standardised residuals compared to a lognormal distribution (SDSR: standard deviation of standardised residuals. MASR: median of absolute standardised residuals); [Upper right] Q-Q plot of the standardised residuals; [Lower left] Standardised residuals plotted against the predicted model catch per trip; [Lower right] Observed catch per record plotted against the predicted catch per record.

J.10 MODEL COEFFICIENTS

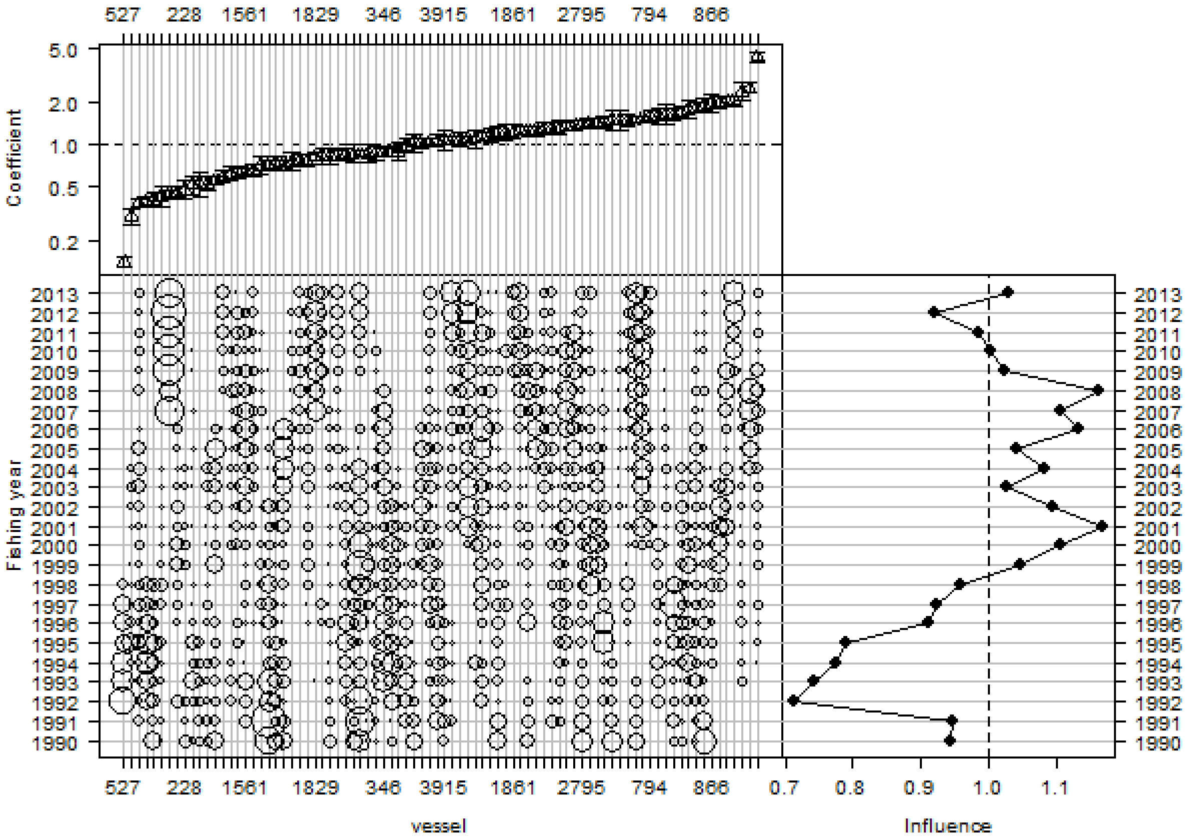

Figure J.7: Effect of vessel in the lognormal model for the school shark BLL-N1E(MIX) fishery. Top: effect by level of variable (left-axis: log space additive; right-axis: natural space multiplicative). Bottom-left: distribution of variable by fishing year. Bottom-right: cumulative effect of variable by fishing year (bottom-axis: log space additive; top-axis: natural space multiplicative).

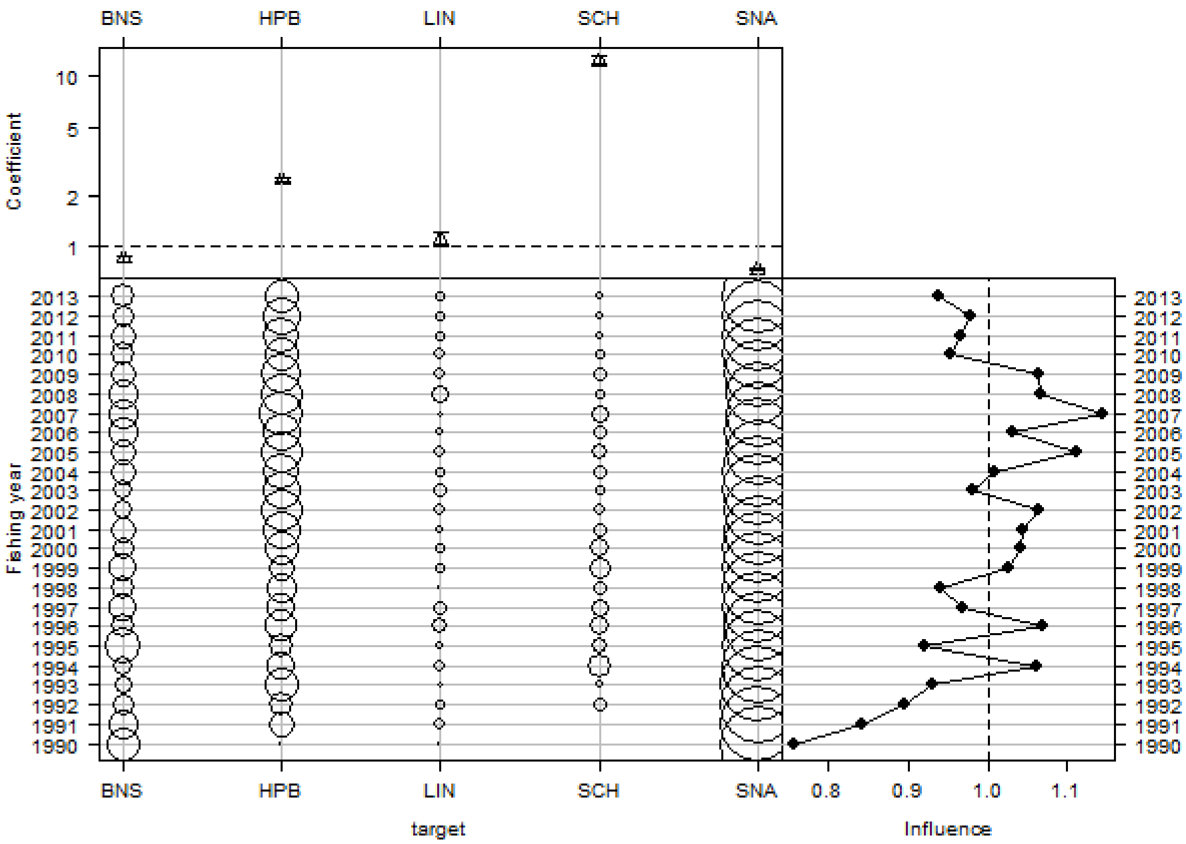

Figure J.8: Effect of target species in the lognormal model for the school shark BLL-N1E(MIX) fishery. Top: effect by level of variable (left-axis: log space additive; right-axis: natural space multiplicative). Bottom-left: distribution of variable by fishing year. Bottom-right: cumulative effect of variable by fishing year (bottom-axis: log space additive; top-axis: natural space multiplicative).

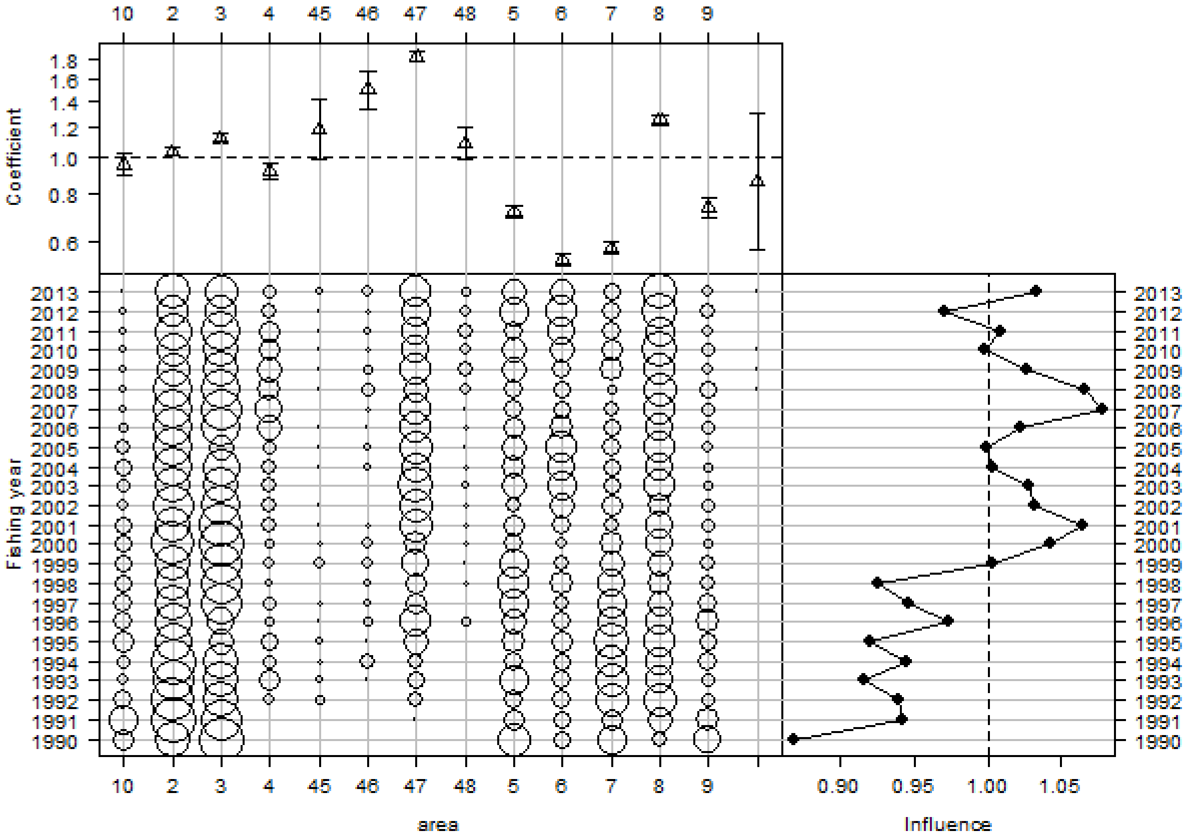

Figure J.9: Effect of area in the lognormal model for the school shark BLL-N1E(MIX) fishery. Top: effect by level of variable (left-axis: log space additive; right-axis: natural space multiplicative). Bottom-left: distribution of variable by fishing year. Bottom-right: cumulative effect of variable by fishing year (bottom-axis: log space additive; top-axis: natural space multiplicative).

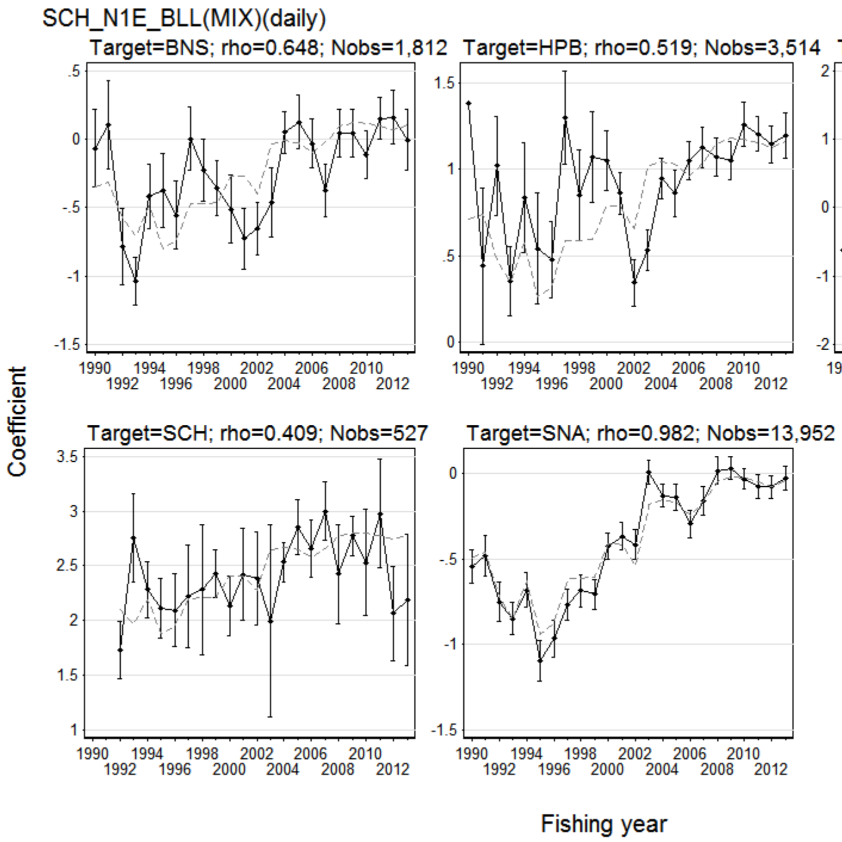

Figure J.10: Residual implied coefficients for target×fishing year interaction (not offered) in the school shark BLL-N1E(MIX) lognormal model. Implied coefficients (black points) are calculated as the normalised fishing year coefficient (grey line) plus the mean of the standardised residuals in each fishing year and area. These values approximate the coefficients obtained when an area × year interaction term is fitted, particularly for those area × year combinations which have a substantial proportion of the records. The error bars indicate one standard error of the standardised residuals. The information at the top of each panel identifies the plotted category, provides the correlation coefficient (*rho*) between the category year index and the overall model index, and the number of records supporting the category.

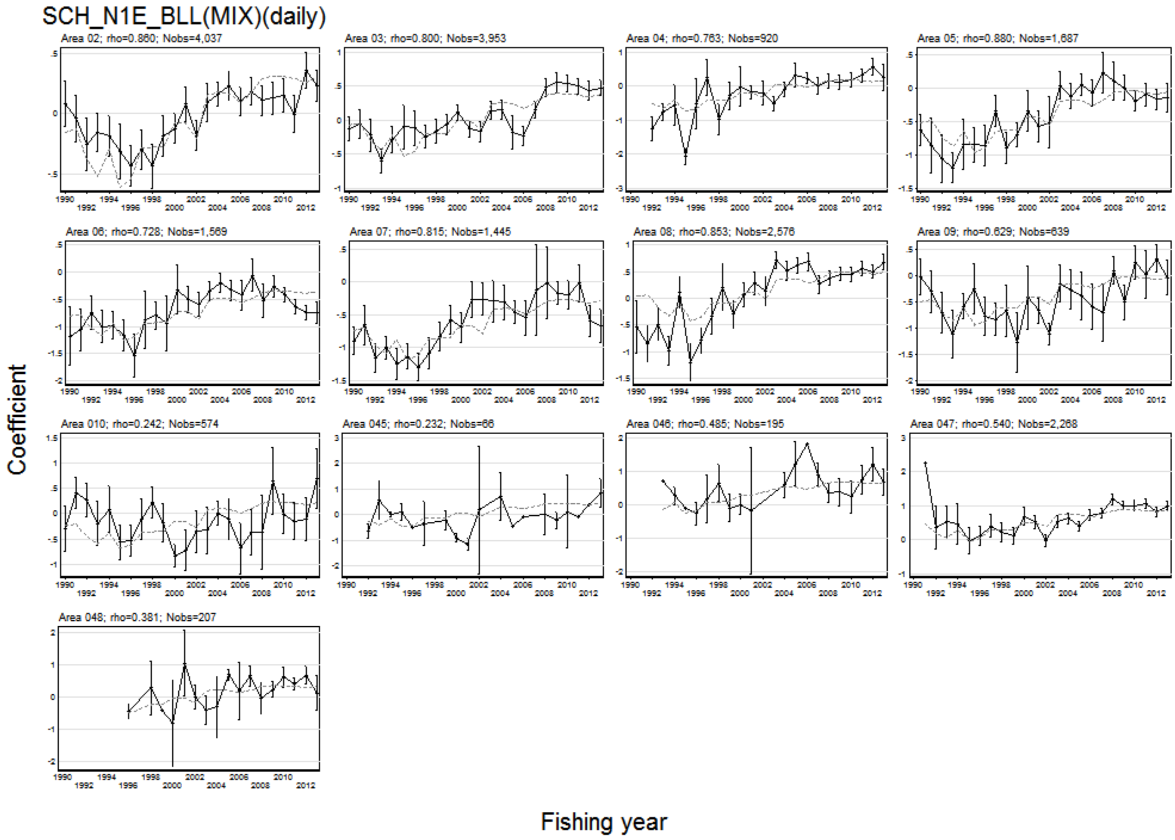

Figure J.11: Residual implied coefficients for area×fishing year interaction (not offered) in the school shark BLL-N1E(MIX) lognormal model. Implied coefficients (black points) are calculated as the normalised fishing year coefficient (grey line) plus the mean of the standardised residuals in each fishing year and area. These values approximate the coefficients obtained when an area × year interaction term is fitted, particularly for those area × year combinations which have a substantial proportion of the records. The error bars indicate one standard error of the standardised residuals. The information at the top of each panel identifies the plotted category, provides the correlation coefficient (*rho*) between the category year index and the overall model index, and the number of records supporting the category.

J.11 LOGISTIC (BINOMIAL) MODEL SELECTION TABLE

Three explanatory variables entered the model after fishing year (Table J.3), with number of hooks, month and form type non-significant. A plot of the binomial model and the combined delta-lognormal model is provided in Figure J.12 and the CPUE indices are listed in Table J.4.

Table J.3: Order of acceptance of variables into the binomial (logistic) model of successful catches in the BLL-N1E(MIX) fishery model for core vessels based on the vessel selection criteria of at least 5 trips in 5 or more fishing years), with the amount of explained deviance and R^2 for each variable. Variables accepted into the model are marked with an *, and the final R^2 of the selected model is in bold. Fishing year was forced as the first variable.

Variable	DF	Neg. Log likelihood	AIC	R^2	Model use
fishing year	24	-52 291	106 300	4.72	*
vessel	107	-47 096	94 407	18.37	*
target species	111	-45 419	91 059	22.53	*
area	124	-45 023	90 295	**23.49**	*
poly(log(hooks), 3)	127	-44 882	90 019	23.83	
month	138	-44 787	89 850	24.06	
form	140	-44 749	89 777	24.15	

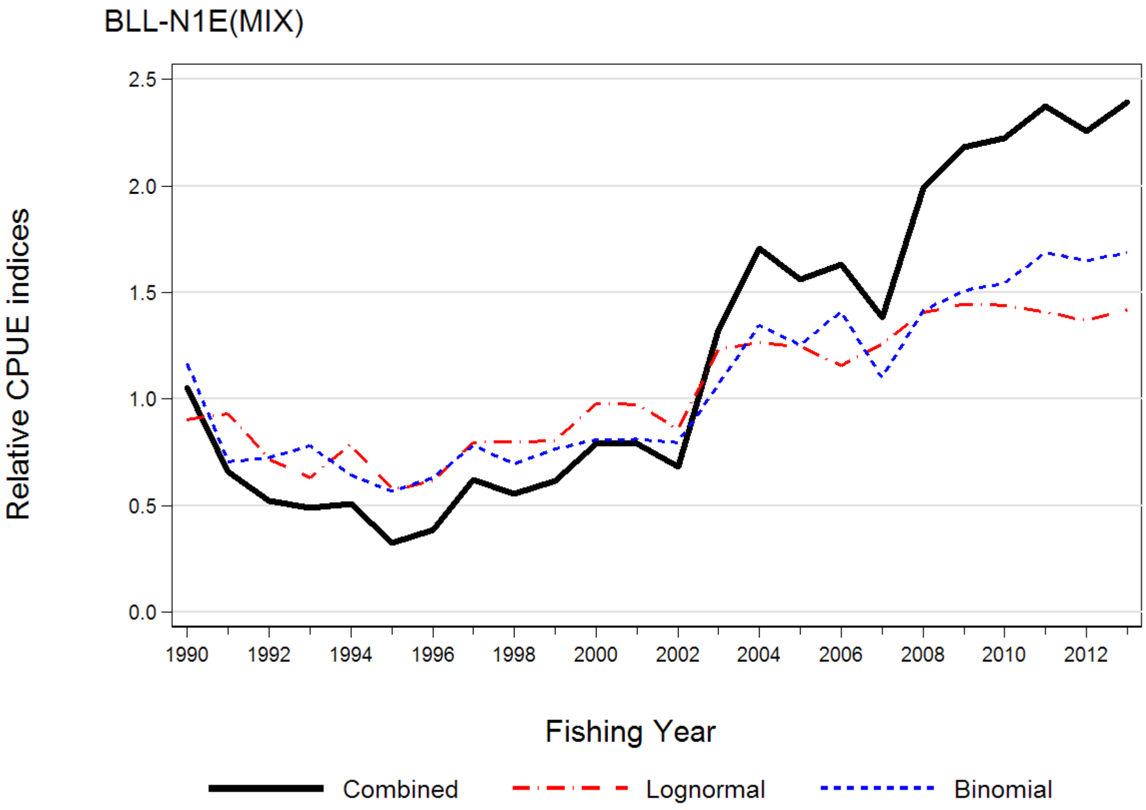

Figure J.12: Relative CPUE indices for school shark using the lognormal non-zero model based on the BLL-N1E(MIX) fishery definition, the binomial standardised model using the logistic distribution and a regression based on presence/absence of SCH, and the combined model using the delta-lognormal procedure suggested by Vignaux (1994).

J.12 CPUE INDICES

Table J.4: Arithmetic indices for the total and core data sets, geometric and lognormal standardised indices and associated standard error (SE) for the core data set by fishing year for the school shark BLL-N1E(MIX) analysis. All series (except SE) standardised to geometric mean=1.0.

Fishing	All vessels	Core vessels					
year	Arithmetic	Arithmetic	Geometric	Standardised	SE	Binomial	Combined
1990	0.420	0.382	0.718	0.903	0.0637	1.166	1.052
1991	0.342	0.355	0.809	0.932	0.0682	0.704	0.656
1992	0.299	0.453	0.451	0.719	0.0575	0.725	0.521
1993	0.508	0.634	0.403	0.629	0.0525	0.780	0.490
1994	0.550	1.279	0.707	0.787	0.0561	0.642	0.506
1995	0.419	0.473	0.476	0.575	0.0573	0.567	0.326
1996	1.325	1.021	0.743	0.614	0.0563	0.630	0.387
1997	0.772	0.901	0.870	0.796	0.0525	0.782	0.622
1998	1.271	0.558	0.818	0.799	0.0557	0.695	0.555
1999	1.124	1.424	1.054	0.805	0.0513	0.766	0.616
2000	0.892	1.094	1.373	0.977	0.0462	0.808	0.789
2001	1.373	1.105	1.513	0.975	0.0432	0.811	0.791
2002	1.532	0.907	1.247	0.858	0.0454	0.795	0.681
2003	1.360	0.986	1.416	1.234	0.0423	1.071	1.322
2004	1.854	1.674	1.379	1.266	0.0374	1.347	1.705
2005	1.404	1.631	1.446	1.245	0.0423	1.253	1.561
2006	1.440	1.488	1.292	1.157	0.0424	1.410	1.631
2007	1.777	1.580	1.618	1.257	0.0454	1.100	1.383
2008	1.431	1.389	1.675	1.406	0.0426	1.415	1.989
2009	1.587	1.630	1.553	1.445	0.0404	1.510	2.182
2010	1.138	1.241	1.104	1.440	0.0392	1.544	2.223
2011	1.698	1.840	1.132	1.408	0.0378	1.687	2.374
2012	1.466	1.299	0.921	1.369	0.0409	1.650	2.259
2013	1.246	1.243	1.106	1.418	0.0433	1.687	2.391

Appendix K. DIAGNOSTICS AND SUPPORTING ANALYSES FOR SCH 2 & TOP OF SCH 3 SETNET [SN-23N(MIX)] CPUE STANDARDISATION

K.1 INTRODUCTION

The basis for the selection of this region for monitoring school shark with this capture method is provided in Section 2.3.3.6 and summarised in Table 14.

K.2 FISHERY DEFINITION

SN-23N(MIX): The fishery is defined from setnet fishing events which fished in Statistical Areas 011, 012, 013, 014, 015, 018, 019, 020, 021 declaring target species SCH, SPO, WAR, MOK.

K.3 CORE VESSEL SELECTION

The criteria used to define the core fleet were those vessels that had fished for at least 5 trips in each of at least 4 years using trips with at least 1 kg of catch. These criteria resulted in a core fleet size of 33 vessels which took 80% of the catch (Figure K.1).

K.4 DATA SUMMARY

Table K.1: Number of number of core vessels, trips, daily effort strata, number of events that have been "rolled up" into daily effort strata, calculated number of events per daily-effort stratum, total length (km) of net set, sum of duration fished, sum of landed SCH (t), proportion of trips with catch and proportion of daily-effort strata with catch by fishing year for core vessels (based on a minimum of 5 trips per year in at least 4 years) in the SN-23N(MIX) fishery.

Fishing year	Vessels	Trips	Daily effort strata	Events	Events per stratum	Length of net set (km)	Duration (h)	Catch (t)	Trips with catch (%)	Strata with catch (%)
1990	11	226	243	361	1.486	364.9	6 726	17.46	45.13	44.03
1991	10	277	305	368	1.207	394.2	7 027	7.16	31.41	32.13
1992	11	388	420	521	1.240	584.2	10 535	17.62	44.33	43.57
1993	12	468	490	566	1.155	687.7	12 138	15.02	29.70	29.59
1994	16	673	739	895	1.211	1 138.2	18 597	25.53	44.13	43.17
1995	17	583	661	746	1.129	950.5	13 598	25.32	40.48	39.94
1996	16	624	720	828	1.150	1 064.5	13 613	31.45	47.28	47.78
1997	17	641	717	839	1.170	1 051.3	13 950	40.77	48.52	47.84
1998	15	690	757	887	1.172	1 031.7	14 171	47.11	44.64	45.97
1999	16	746	867	995	1.148	1 152.8	15 440	58.93	46.65	47.29
2000	17	800	899	1 036	1.152	1 443.8	17 105	73.86	60.63	60.40
2001	17	831	898	1 061	1.182	1 581.8	20 895	64.45	59.81	58.69
2002	21	707	742	855	1.152	1 207.2	16 123	59.53	56.72	56.60
2003	20	529	567	659	1.162	1 052.3	12 471	70.83	64.65	64.20
2004	16	389	433	512	1.182	764.1	9 025	65.08	75.32	71.59
2005	15	409	441	489	1.109	790.3	9 748	68.59	67.24	64.40
2006	13	277	381	440	1.155	659.7	8 297	50.96	61.01	54.86
2007	12	348	456	728	1.596	821.5	15 346	51.07	74.14	68.64
2008	13	351	456	861	1.888	725.1	21 974	58.31	80.63	79.39
2009	12	457	524	782	1.492	841.6	19 824	45.80	66.96	63.74
2010	13	498	621	1 113	1.792	903.8	28 530	58.95	59.24	59.42
2011	11	453	508	1 040	2.047	883.2	27 628	41.79	52.76	53.15
2012	11	390	456	1 030	2.259	807.9	24 081	63.98	53.85	54.17
2013	11	314	359	689	1.919	577.9	16 127	44.25	57.96	58.50

K.5 CORE VESSEL SELECTION

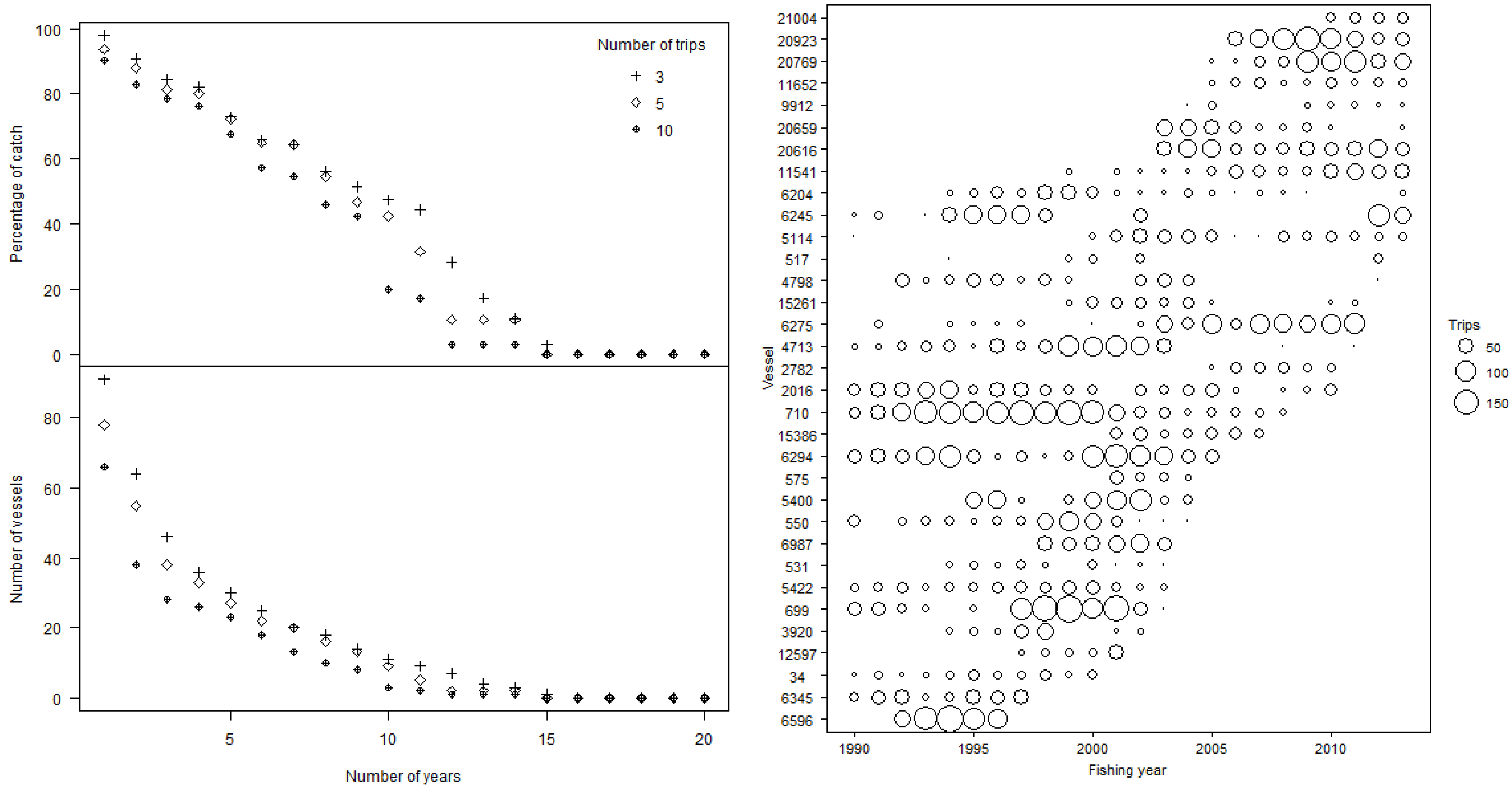

Figure K.1: [left panel] total landed SCH and number of vessels plotted against the number of years used to define core vessels participating in the SN-23N(MIX) dataset. The number of qualifying years (minimum number of trips per year) for each series is indicated in the legend. [right panel]: bubble plot showing the number of daily-effort strata for selected core vessels (based on at least 5 trips in 4 or more fishing years) by fishing year.

K.6 EXPLORATORY DATA PLOTS FOR CORE VESSEL DATA SET

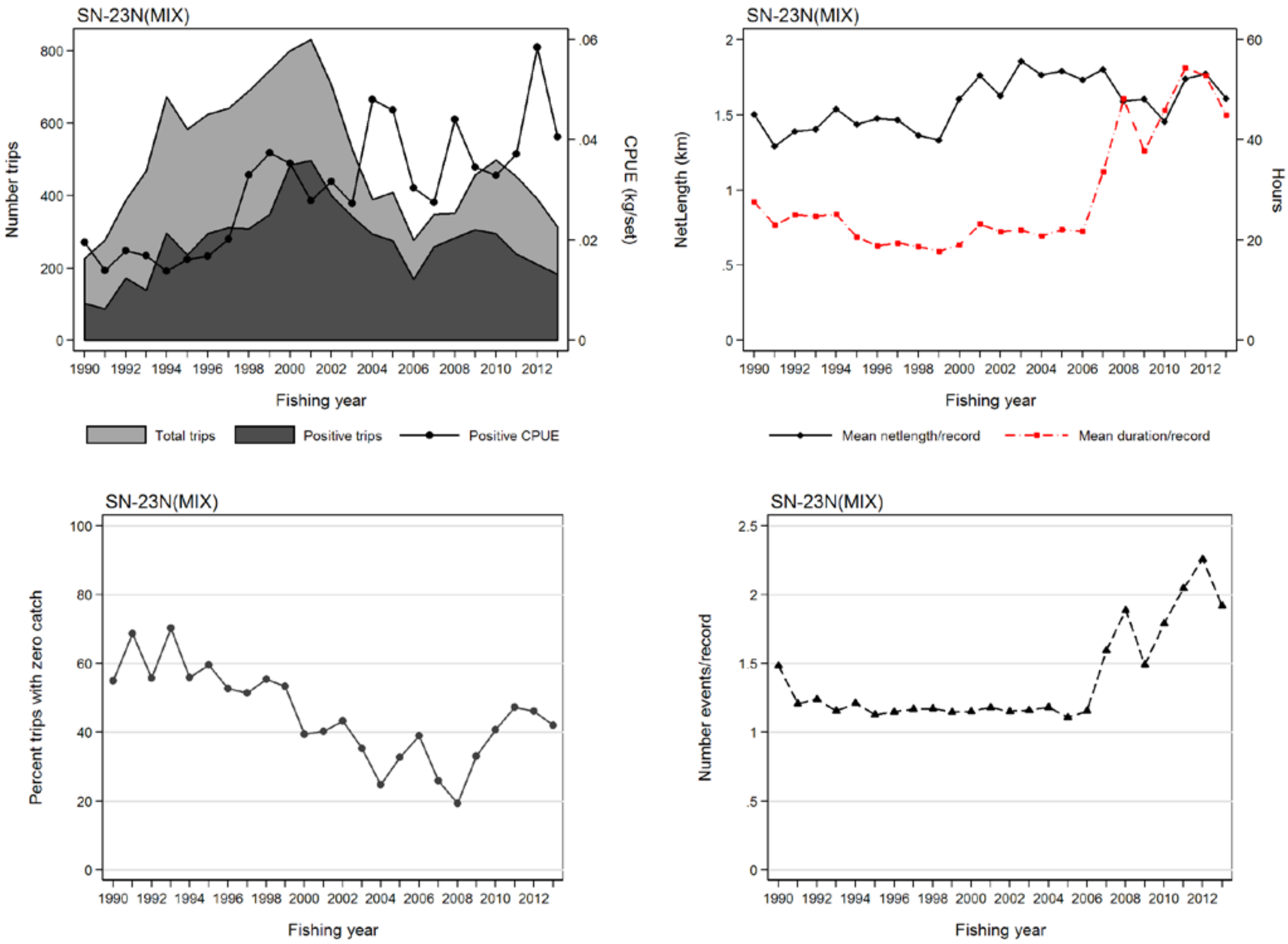

Figure K.2: Core vessel summary plots by fishing year for model SN-23N(MIX): [upper left panel]: total trips (light grey) and trips with school shark catch (dark grey) overlaid with median annual arithmetic CPUE (kg/set) for all trips *i* with positive catch: $A_y = \text{median}\left(C_{y,i}/E_{y,i}\right)$; [upper right panel]: mean net length (km) and mean duration per daily-effort stratum record; [lower left panel]: proportion of trips with no catch of school shark; [lower right panel]: mean number of events per daily-effort stratum record.

K.7 SELECTION OF DISTRIBUTION FOR POSITIVE CATCH RECORDS

The best distribution was log.logistic.
The distribution was forced to lognormal.

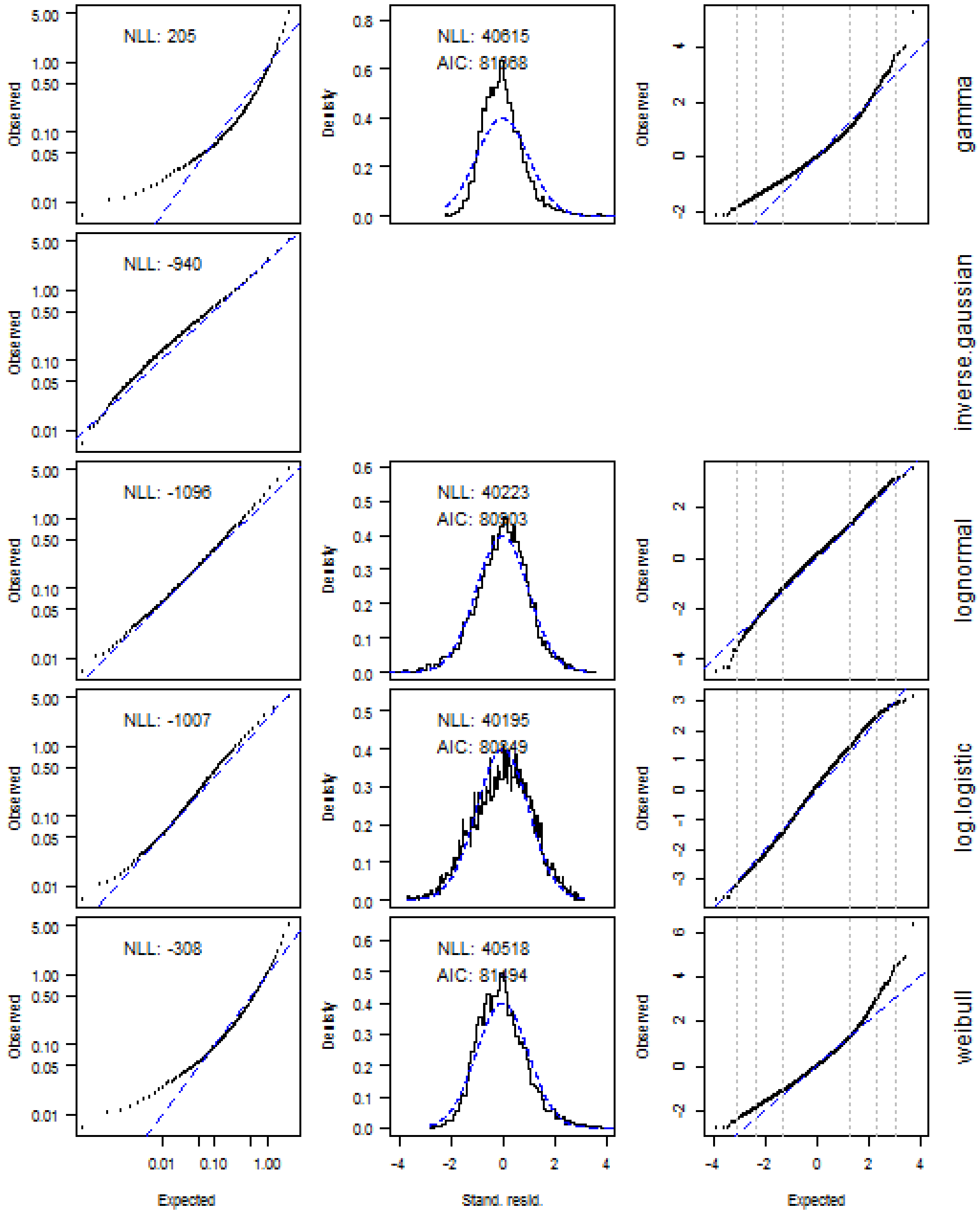

Figure K.3: Diagnostics for alternative distributional assumptions for catch in the school shark SN-NIE(MIX) model. Left: quantile-quantile plot of observed catches (centred (by mean) and scaled (by standard deviation) in log space) versus maximum likelihood fit of distribution (missing panel indicates that the fit failed to converge); Middle: standardised residuals from a generalised linear model fitted using the formula catch ~ fyear + month +area+ vessel + log(sets) and the distribution (missing panel indicates that the model failed to converge); Right: quantile-quantile plot of model standardised residuals against standard normal (vertical lines represent 0.1%, 1% and 10% percentiles). NLL = negative log-likelihood; AIC = Akaike information criterion.

K.8 MODEL SELECTION TABLE

Four explanatory variables entered the model after fishing year (Table K.2), with area and hours fishing non-significant. A plot of the model is provided in Figure K.4 and the CPUE indices are listed in Table K.3.

Table K.2: Order of acceptance of variables into the lognormal model of successful catches in the SN-23N(MIX) fishery model for core vessels based on the vessel selection criteria of at least 5 trips in 4 or more fishing years), with the amount of explained deviance and R^2 for each variable. Variables accepted into the model are marked with an *, and the final R^2 of the selected model is in bold. Fishing year was forced as the first variable.

Variable	DF	Neg. Log likelihood	AIC	R^2	Model use
fishing year	24	-12 840	25 730	5.88	*
vessel	56	-11 823	23 760	29.41	*
month	67	-11 500	23 136	35.61	*
target species	70	-11 336	22 814	38.56	*
poly(log(netlength), 3)	73	-11 241	22 631	**40.21**	*
area	79	-11 184	22 528	41.18	
poly(log(duration), 3)	82	-11 166	22 497	41.49	

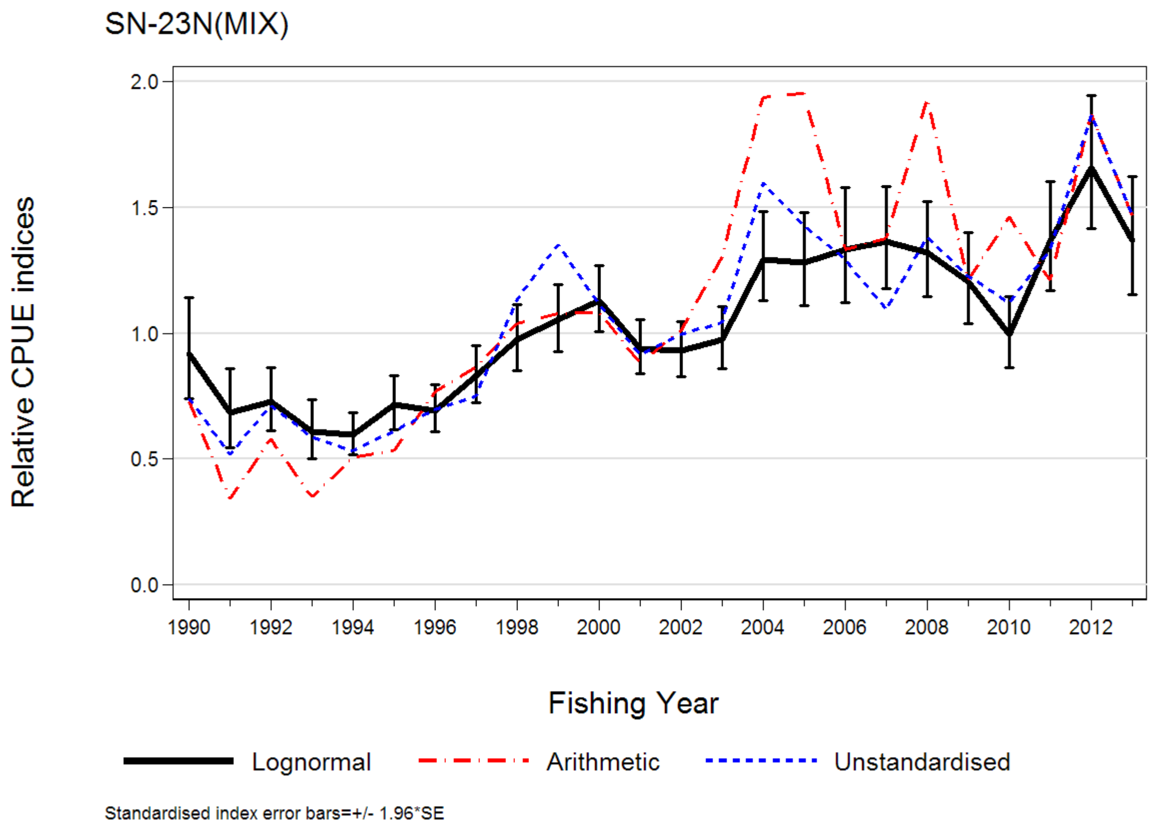

Figure K.4: Relative CPUE indices for school shark using the lognormal non-zero model based on the SN-23N(MIX) fishery definition. Also shown are two unstandardised series from the same data: a) Arithmetic (Eq. H.1) and b) Unstandardised (Eq. H.2).

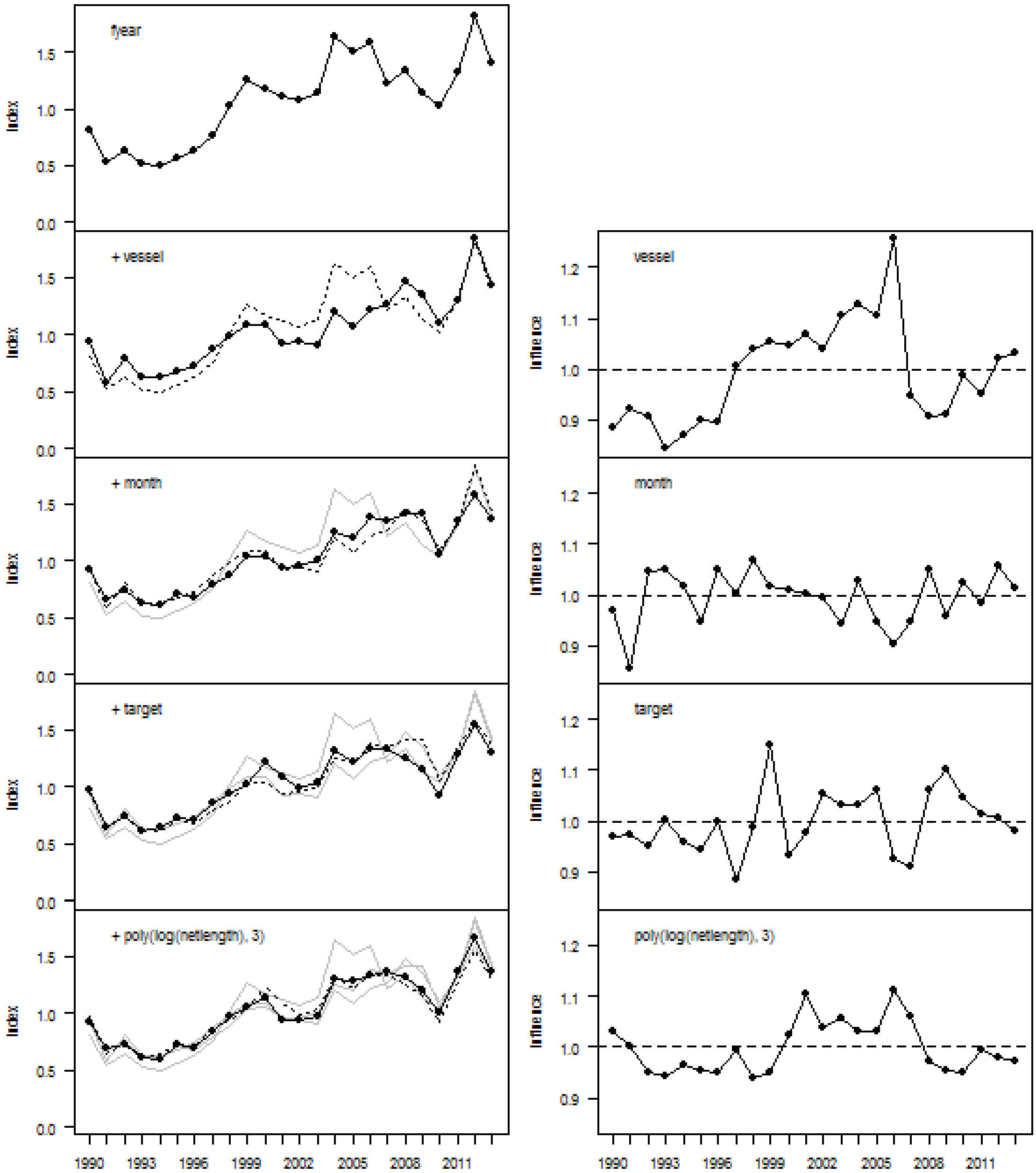

Figure K.5: [left column]: annual indices from the lognormal model of SN-23N(MIX) at each step in the variable selection process; [right column]: aggregate influence associated with each step in the variable selection procedure.

K.9 RESIDUAL AND DIAGNOSTIC PLOTS

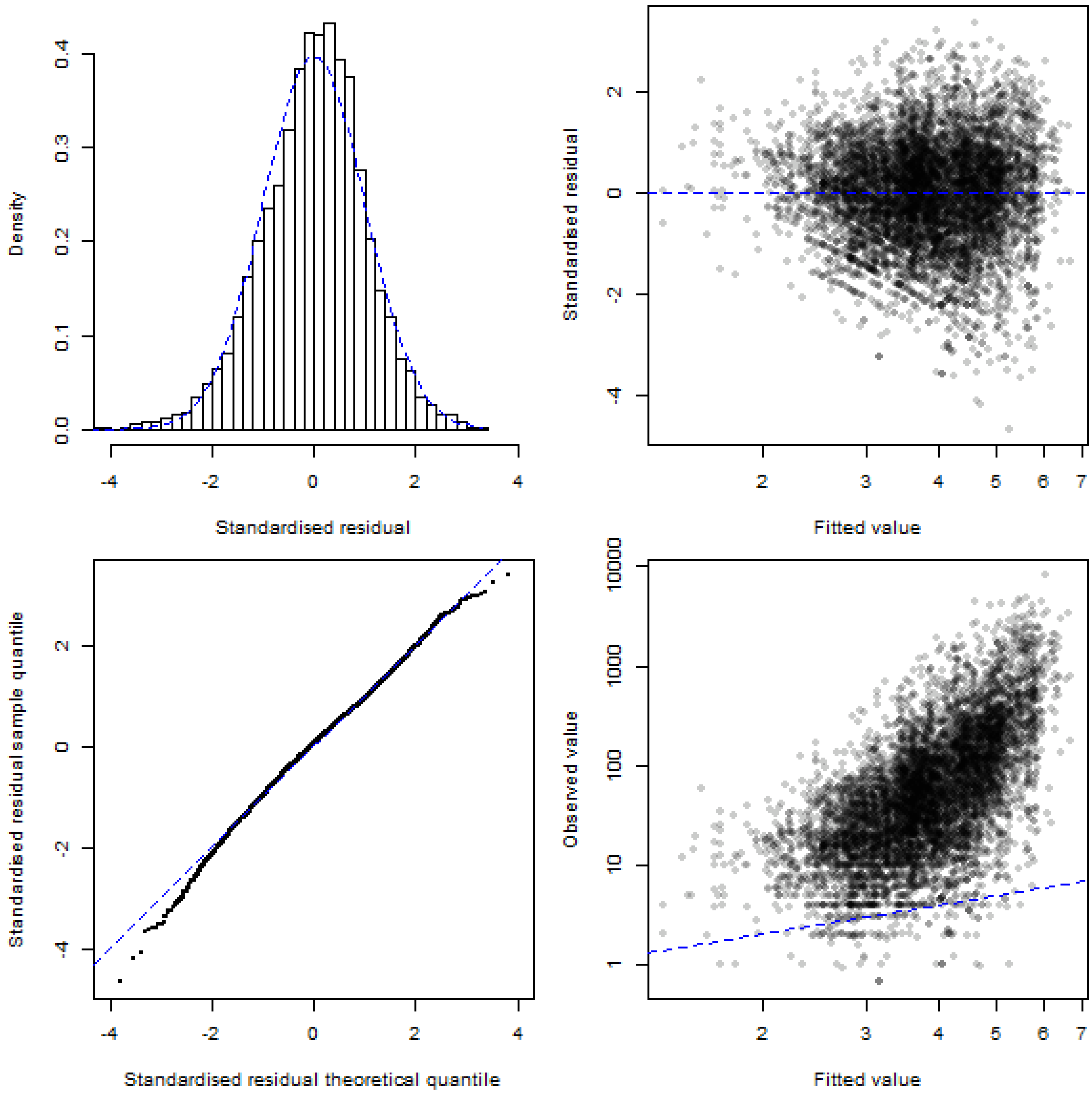

Figure K.6: Plots of the fit of the lognormal standardised CPUE model to successful catches of school shark in the SN-23N(MIX) fishery. [Upper left] histogram of the standardised residuals compared to a lognormal distribution (SDSR: standard deviation of standardised residuals. MASR: median of absolute standardised residuals); [Upper right] Q-Q plot of the standardised residuals; [Lower left] Standardised residuals plotted against the predicted model catch per trip; [Lower right] Observed catch per record plotted against the predicted catch per record.

K.10 MODEL COEFFICIENTS

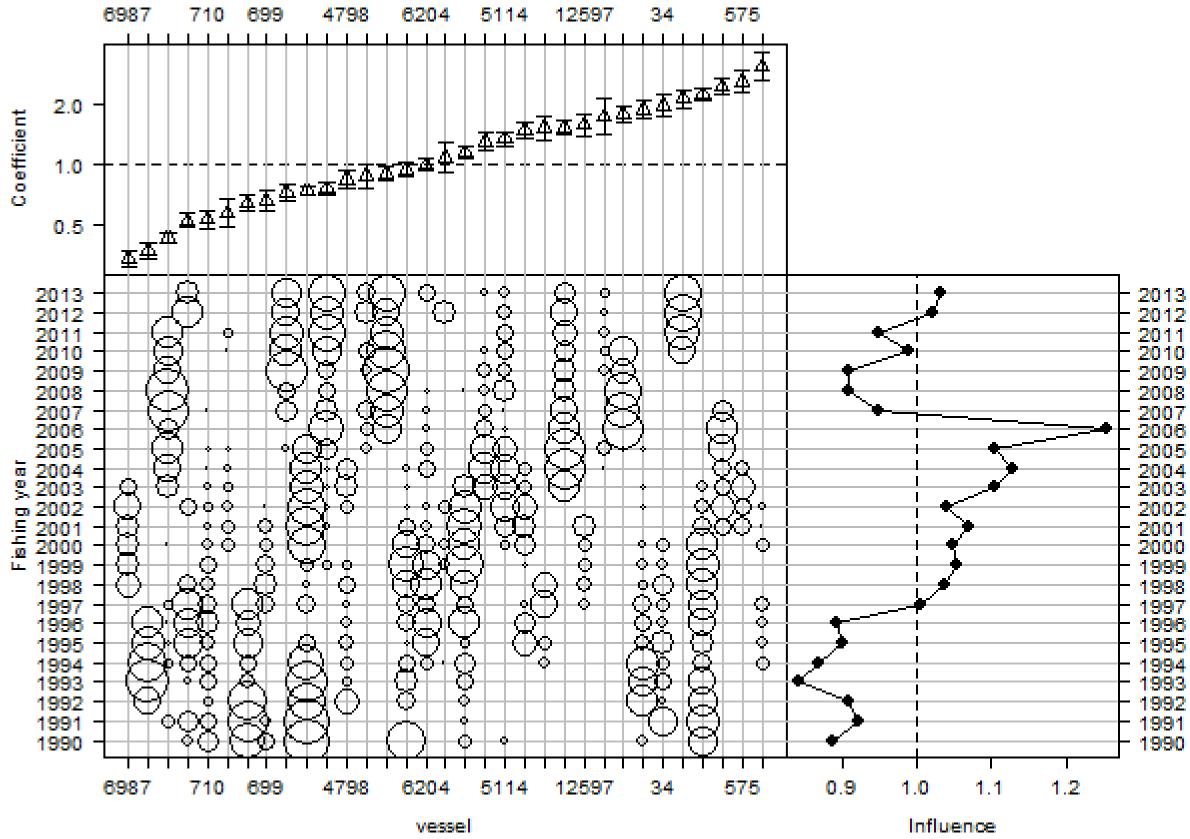

Figure K.7: Effect of vessel in the lognormal model for the school shark SN-23N(MIX) fishery. Top: effect by level of variable (left-axis: log space additive; right-axis: natural space multiplicative). Bottom-left: distribution of variable by fishing year. Bottom-right: cumulative effect of variable by fishing year (bottom-axis: log space additive; top-axis: natural space multiplicative).

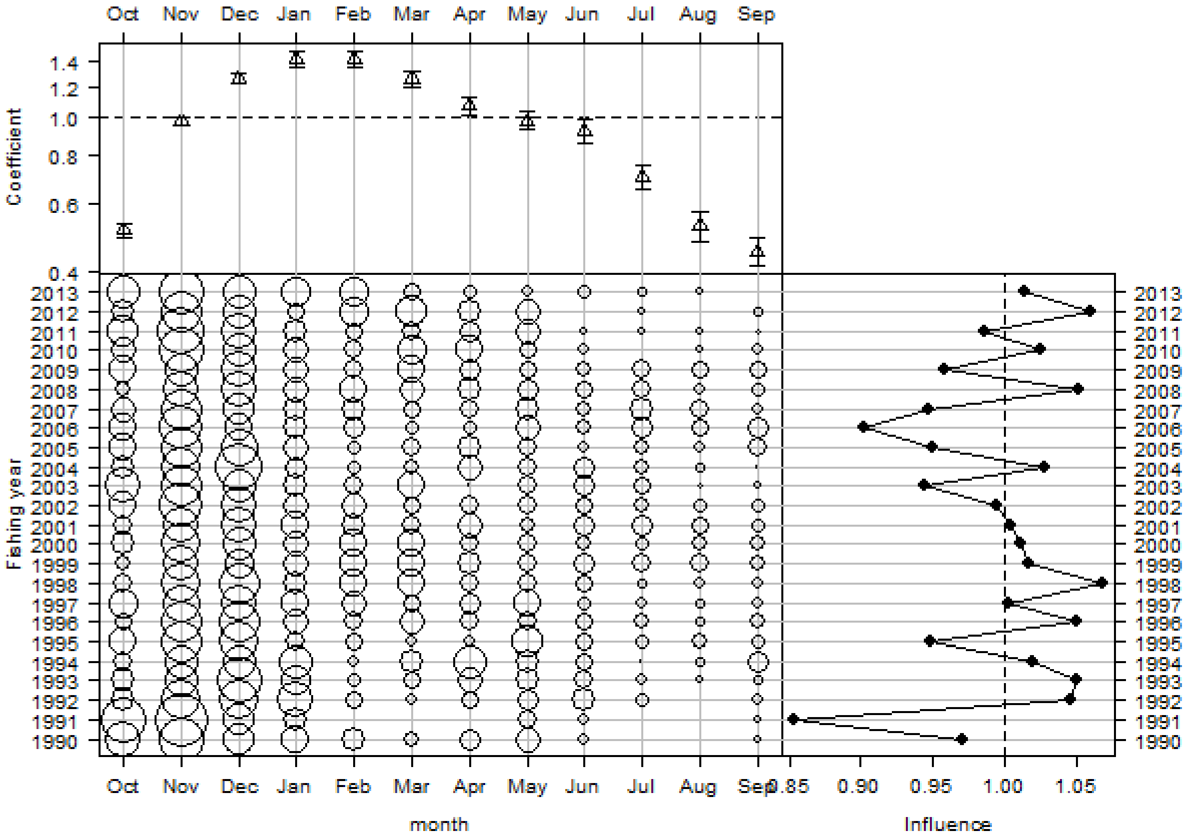

Figure K.8: Effect of month in the lognormal model for the school shark SN-23N(MIX) fishery. Top: effect by level of variable (left-axis: log space additive; right-axis: natural space multiplicative). Bottom-left: distribution of variable by fishing year. Bottom-right: cumulative effect of variable by fishing year (bottom-axis: log space additive; top-axis: natural space multiplicative).

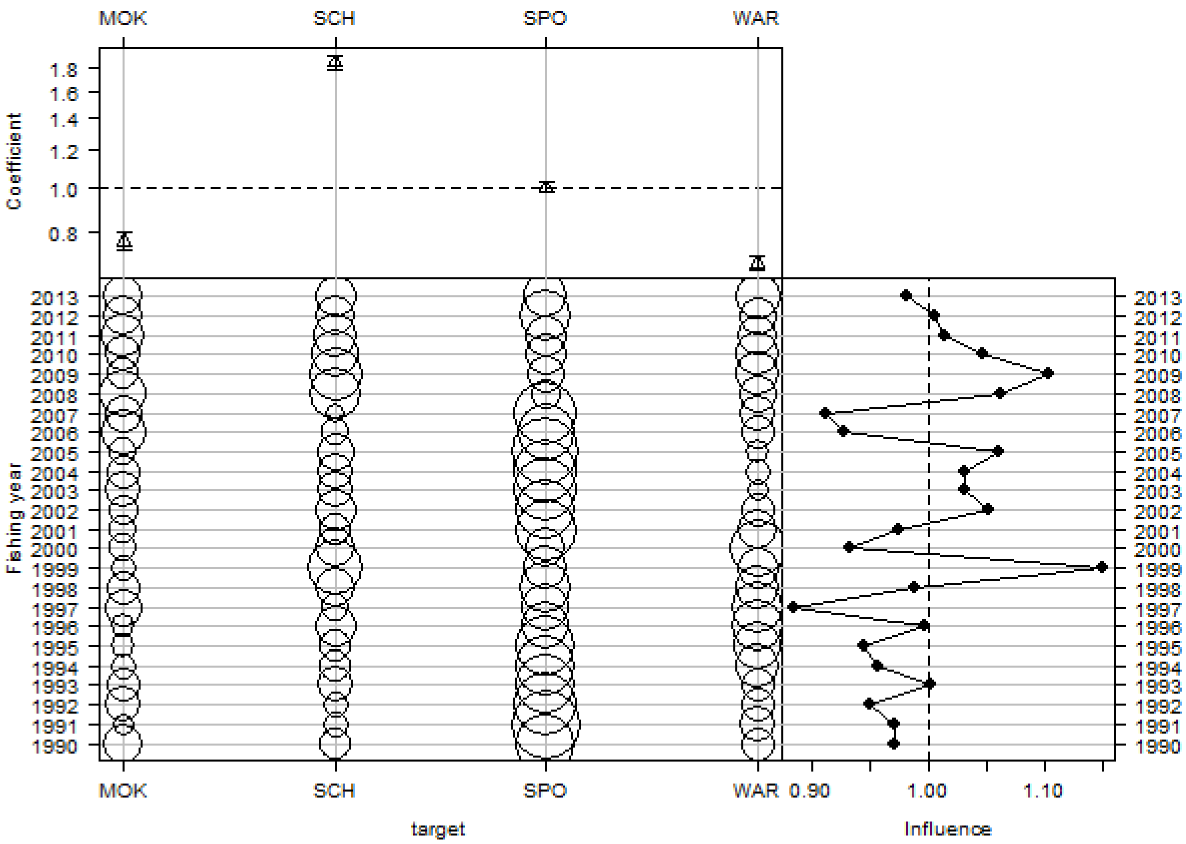

Figure K.9: Effect of target species in the lognormal model for the school shark SN-23N(MIX) fishery. Top: effect by level of variable (left-axis: log space additive; right-axis: natural space multiplicative). Bottom-left: distribution of variable by fishing year. Bottom-right: cumulative effect of variable by fishing year (bottom-axis: log space additive; top-axis: natural space multiplicative).

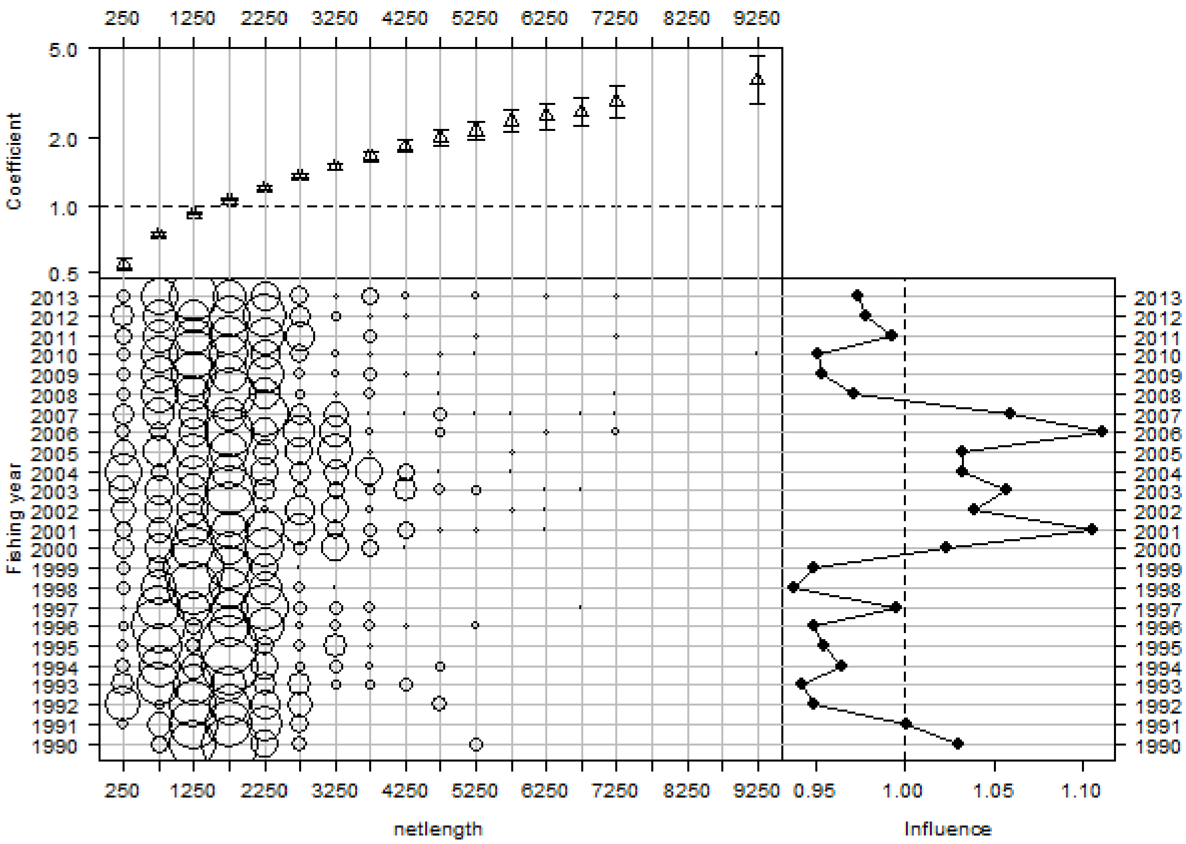

Figure K.10: Effect of net length in the lognormal model for the school shark SN-23N(MIX) fishery. Top: effect by level of variable (left-axis: log space additive; right-axis: natural space multiplicative). Bottom-left: distribution of variable by fishing year. Bottom-right: cumulative effect of variable by fishing year (bottom-axis: log space additive; top-axis: natural space multiplicative).

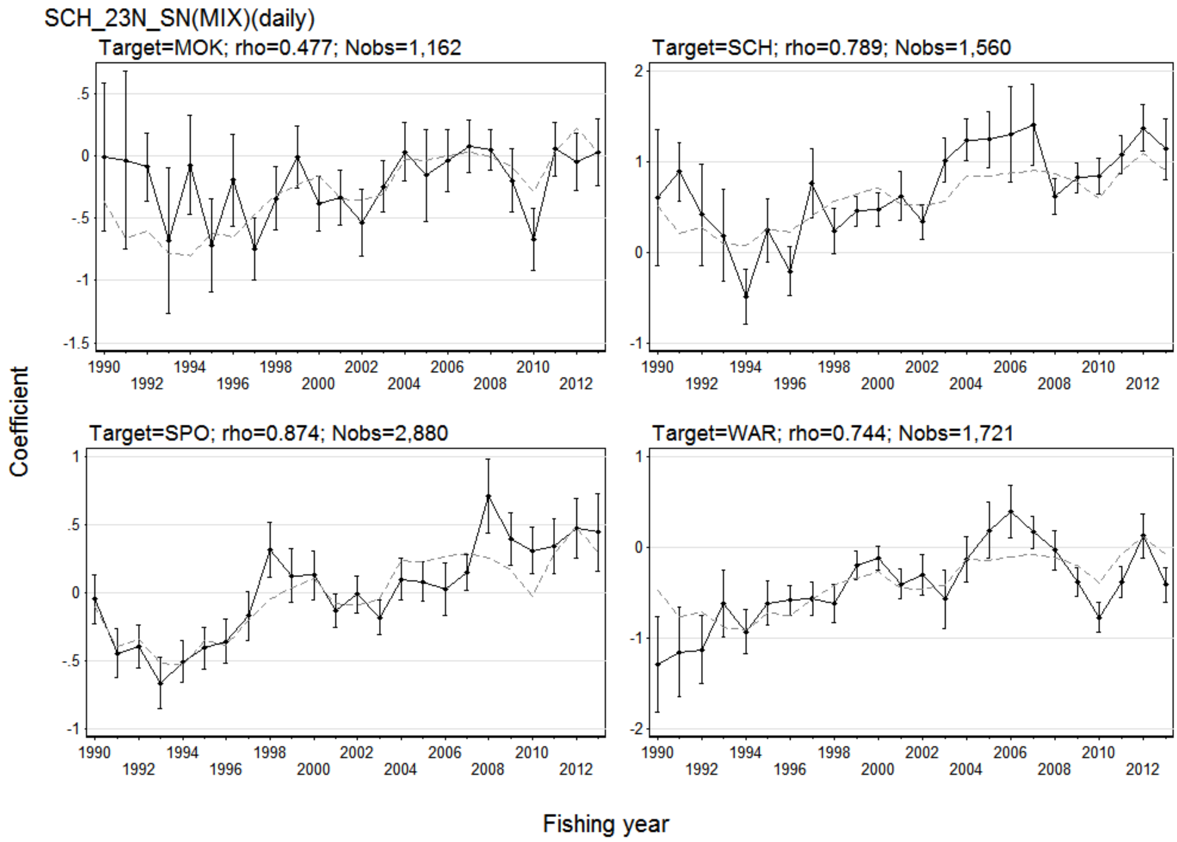

Figure K.11: Residual implied coefficients for target×fishing year interaction (not offered) in the school shark SN-23N(MIX) lognormal model. Implied coefficients (black points) are calculated as the normalised fishing year coefficient (grey line) plus the mean of the standardised residuals in each fishing year and area. These values approximate the coefficients obtained when an area × year interaction term is fitted, particularly for those area × year combinations which have a substantial proportion of the records. The error bars indicate one standard error of the standardised residuals. The information at the top of each panel identifies the plotted category, provides the correlation coefficient (*rho*) between the category year index and the overall model index, and the number of records supporting the category.

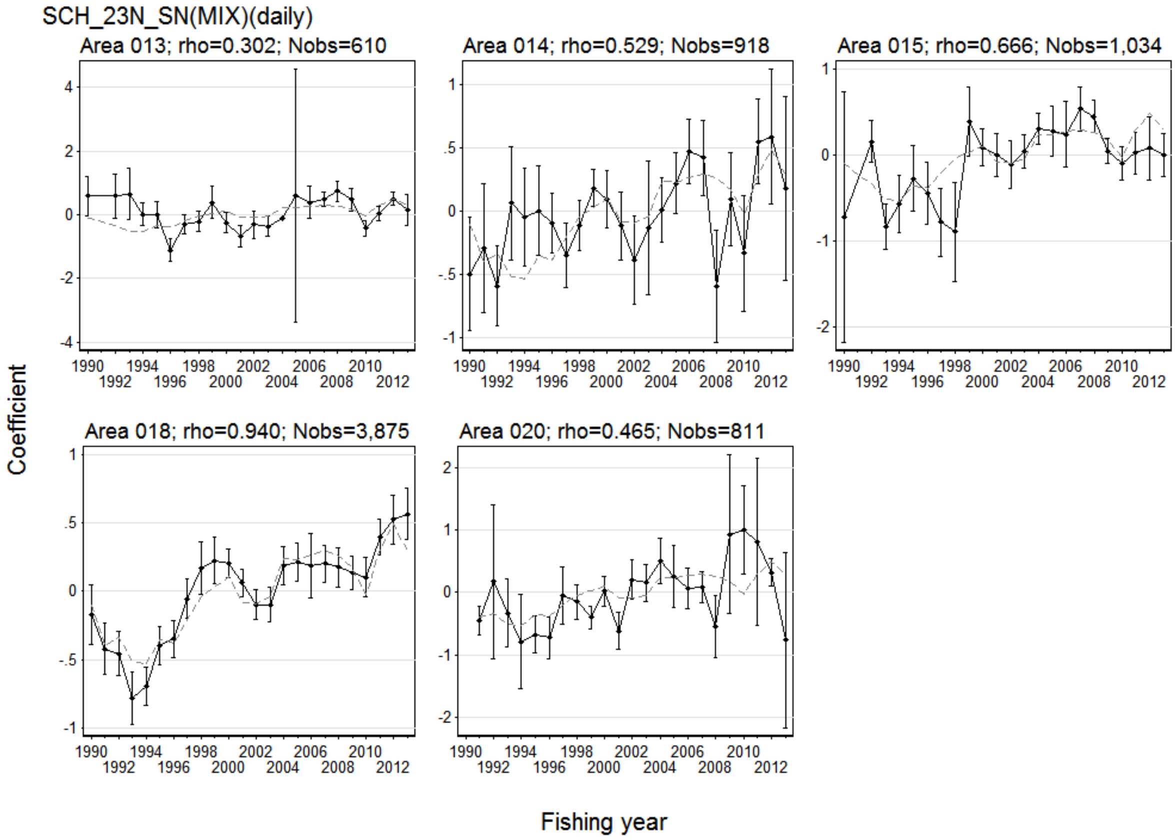

Figure K.12: Residual implied coefficients for area×fishing year interaction (not offered) in the school shark SN-23N(MIX) lognormal model. Implied coefficients (black points) are calculated as the normalised fishing year coefficient (grey line) plus the mean of the standardised residuals in each fishing year and area. These values approximate the coefficients obtained when an area × year interaction term is fitted, particularly for those area × year combinations which have a substantial proportion of the records. The error bars indicate one standard error of the standardised residuals. The information at the top of each panel identifies the plotted category, provides the correlation coefficient (*rho*) between the category year index and the overall model index, and the number of records supporting the category. Categories with fewer than 10 observations were not plotted.

K.11 CPUE INDICES

Table K.3: Arithmetic indices for the total and core data sets, geometric and lognormal standardised indices and associated standard error for the core data set by fishing year for the school shark SN-23N(MIX) analysis.

Fishing	All vessels				Core vessels
year	Arithmetic	Arithmetic	Geometric	Standardised	SE
1990	0.494	0.728	0.741	0.920	0.1108
1991	0.329	0.340	0.519	0.684	0.1158
1992	0.427	0.580	0.712	0.727	0.0887
1993	0.872	0.349	0.586	0.607	0.0980
1994	0.817	0.505	0.532	0.596	0.0718
1995	0.661	0.533	0.611	0.715	0.0763
1996	1.085	0.766	0.697	0.694	0.0685
1997	0.710	0.864	0.751	0.830	0.0693
1998	0.845	1.038	1.134	0.974	0.0691
1999	0.970	1.078	1.352	1.053	0.0648
2000	0.984	1.083	1.115	1.130	0.0588
2001	0.840	0.882	0.915	0.940	0.0588
2002	0.981	1.012	0.996	0.929	0.0604
2003	1.011	1.306	1.043	0.975	0.0639
2004	1.561	1.939	1.599	1.294	0.0696
2005	1.656	1.955	1.428	1.281	0.0730
2006	1.150	1.334	1.294	1.332	0.0870
2007	2.793	1.377	1.094	1.367	0.0756
2008	1.656	1.933	1.383	1.321	0.0733
2009	1.497	1.211	1.227	1.206	0.0764
2010	1.343	1.463	1.122	0.995	0.0726
2011	1.033	1.210	1.333	1.369	0.0805
2012	1.494	1.869	1.870	1.660	0.0809
2013	1.385	1.470	1.471	1.369	0.0867

Appendix L. DIAGNOSTICS AND SUPPORTING ANALYSES FOR SCH 2 & TOP OF SCH 3 BOTTOM LONGLINE [BLL-23N(MIX)] CPUE STANDARDISATION

L.1 INTRODUCTION

The basis for the selection of this region for monitoring school shark with this capture method is provided in Section 2.3.3.6 and summarised in Table 14.

L.2 FISHERY DEFINITION

BLL-23N(MIX): The fishery is defined from bottom longline fishing events which fished in Statistical Areas 011, 012, 013, 014, 015 declaring target species SNA, HPB, BNS, SCH, LIN.

L.3 CORE VESSEL SELECTION

The criteria used to define the core fleet were those vessels that had fished for at least 3 trips in each of at least 4 years using trips with at least 1 kg of catch. These criteria resulted in a core fleet size of 31 vessels which took 80% of the catch (Figure L.1).

L.4 DATA SUMMARY

Table L.1: Number of number of core vessels, trips, daily effort strata, number of events that have been "rolled up" into daily effort strata, calculated number of events per daily-effort stratum, number of sets, number of hooks (in '000s), sum of landed SCH (t), proportion of trips with catch and proportion of daily-effort strata with catch by fishing year for core vessels (based on a minimum of 3 trips per year in at least 4 years) in the BLL-23N(MIX) fishery.

Fishing year	Vessels	Trips	Daily effort strata	Events	Events per stratum	Number of sets	Number hooks ('000s)	Catch (t)	Trips with catch (%)	Strata with catch (%)
1990	5	56	126	126	1.000	131	122.9	3.65	42.86	26.98
1991	8	170	282	283	1.004	304	310.2	11.00	60.00	43.62
1992	13	267	472	475	1.006	781	635.4	18.06	58.80	42.16
1993	13	253	544	545	1.002	961	936.7	15.93	59.29	42.46
1994	12	230	439	441	1.005	805	844.3	22.44	63.91	43.51
1995	16	227	426	434	1.019	704	746.0	15.07	50.22	38.50
1996	14	156	314	317	1.010	546	649.9	19.32	48.08	36.31
1997	10	103	236	236	1.000	322	428.1	12.86	51.46	33.90
1998	10	116	266	266	1.000	440	442.9	14.06	50.86	35.71
1999	10	116	305	306	1.003	660	474.0	16.08	62.93	40.00
2000	13	162	404	404	1.000	721	1 023.0	25.79	61.73	33.91
2001	12	138	378	378	1.000	712	869.1	19.23	60.87	39.95
2002	14	115	363	363	1.000	662	734.7	14.97	60.87	33.61
2003	13	147	460	466	1.013	926	946.0	18.29	50.34	30.22
2004	16	171	562	565	1.005	1 248	1 332.2	15.28	65.50	38.08
2005	12	163	633	640	1.011	1 413	1 653.1	25.73	77.91	44.23
2006	17	169	692	753	1.088	1 480	2 163.0	32.40	71.60	38.87
2007	13	214	901	1 005	1.115	2 041	3 600.5	22.65	74.30	41.95
2008	13	199	795	1 493	1.878	1 512	3 305.6	30.29	64.82	38.62
2009	12	166	707	1 341	1.897	1 341	2 912.4	22.78	77.11	46.39
2010	14	168	757	1 718	2.269	1 718	3 251.0	28.60	77.38	44.12
2011	14	159	715	1 606	2.246	1 606	2 855.8	27.52	86.16	48.81
2012	13	143	643	1 255	1.952	1 255	2 424.5	23.54	70.63	36.70
2013	11	105	384	591	1.539	591	1 065.1	26.95	76.19	48.70

L.5 CORE VESSEL SELECTION

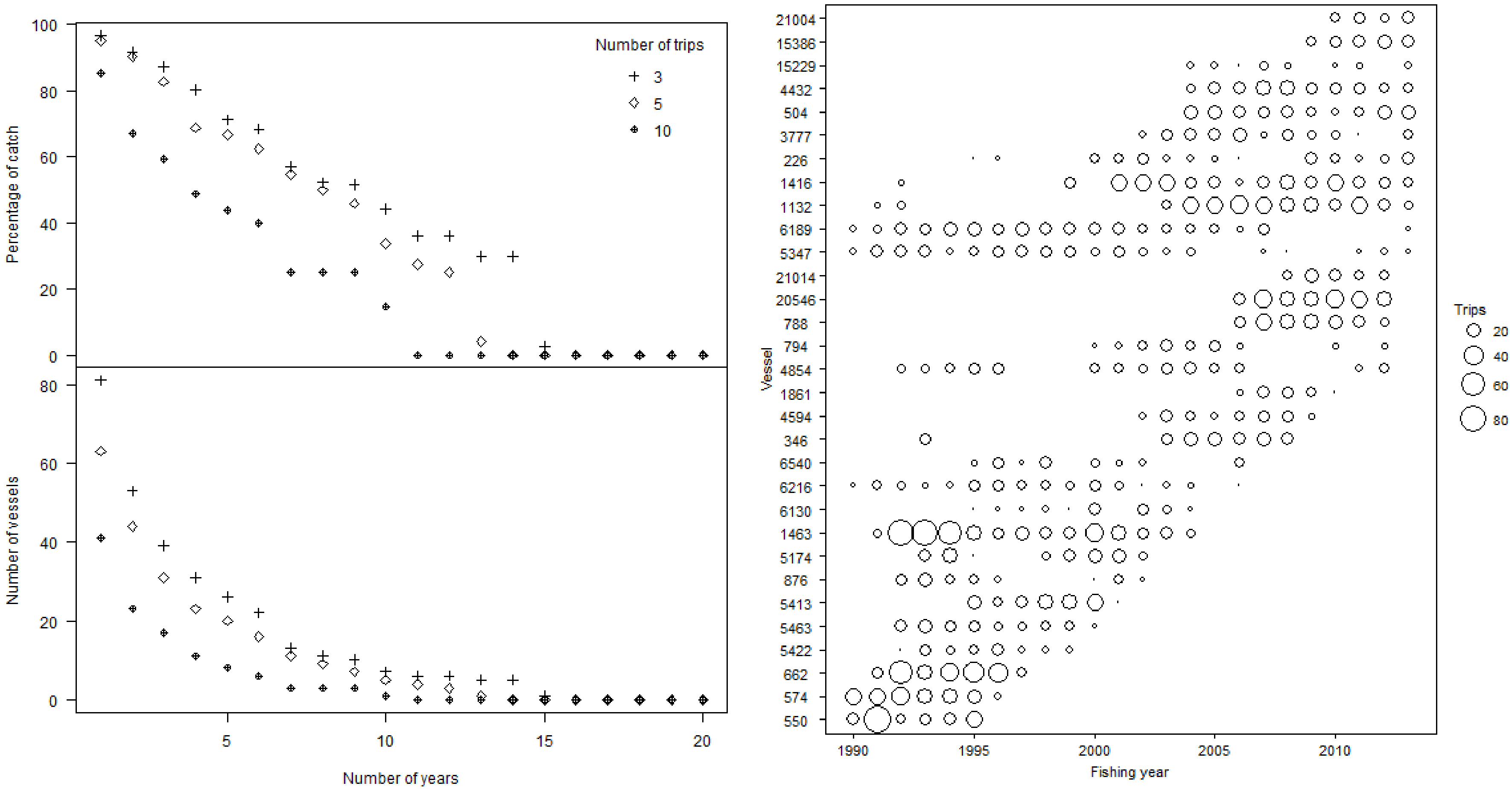

Figure L.1: [left panel] total landed SCH and number of vessels plotted against the number of years used to define core vessels participating in the BLL-23N(MIX) dataset. The number of qualifying years (minimum number of trips per year) for each series is indicated in the legend. [right panel]: bubble plot showing the number of daily-effort strata for selected core vessels (based on at least 3 trips in 4 or more fishing years) by fishing year.

L.6 EXPLORATORY DATA PLOTS FOR CORE VESSEL DATA SET

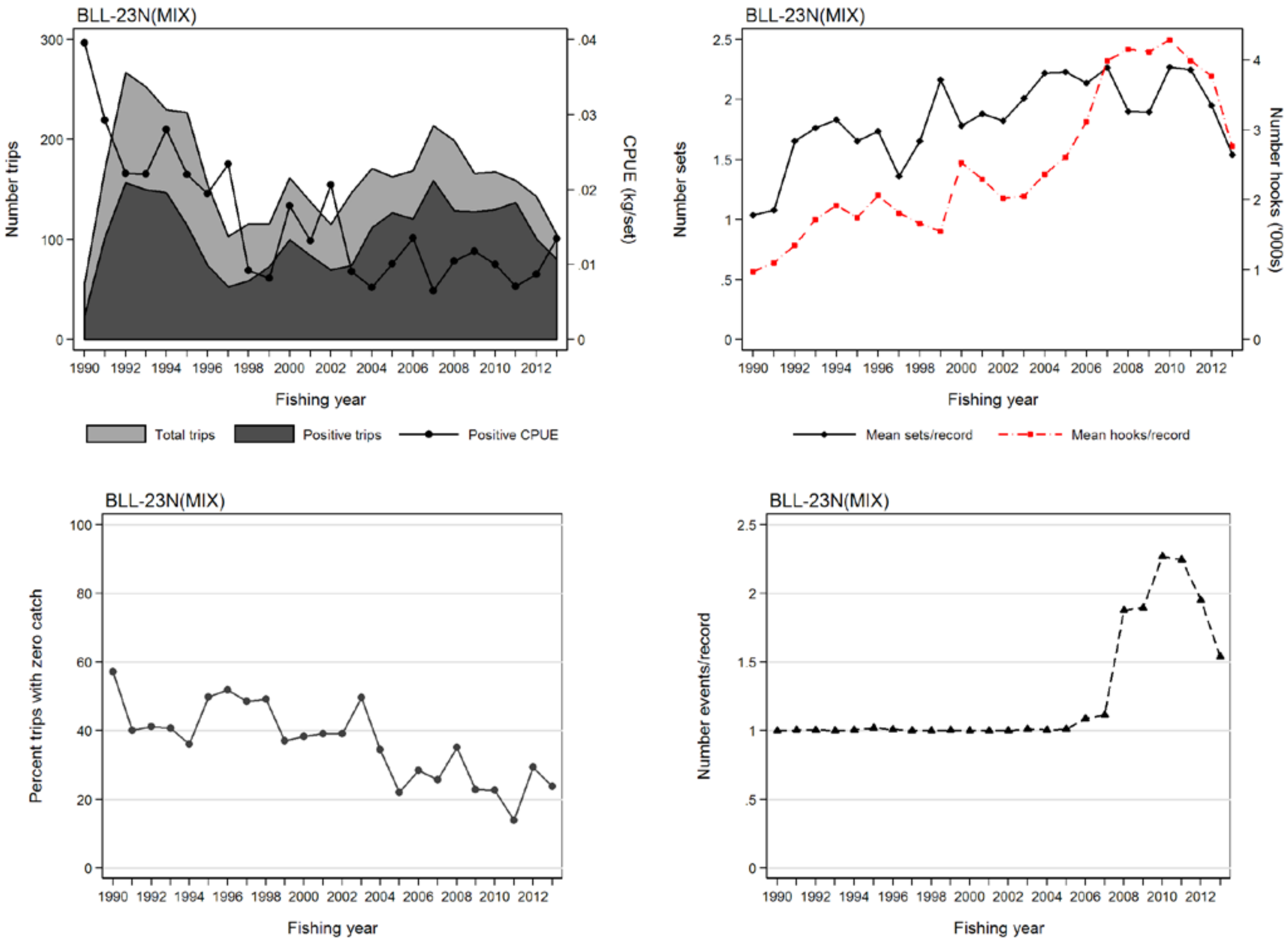

Figure L.2: Core vessel summary plots by fishing year for model BLL-23N(MIX): [upper left panel]: total trips (light grey) and trips with school shark catch (dark grey) overlaid with median annual arithmetic CPUE (kg/set) for all trips *i* with positive catch: $A_y = \text{median}\left(C_{y,i}/E_{y,i}\right)$ **; [upper right panel]: mean number of sets and mean number of hooks per daily-effort stratum record; [lower left panel]: proportion of trips with no catch of school shark; [lower right panel]: mean number of events per daily-effort stratum record.**

L.7 SELECTION OF DISTRIBUTION FOR POSITIVE CATCH RECORDS

The best distribution was lognormal.

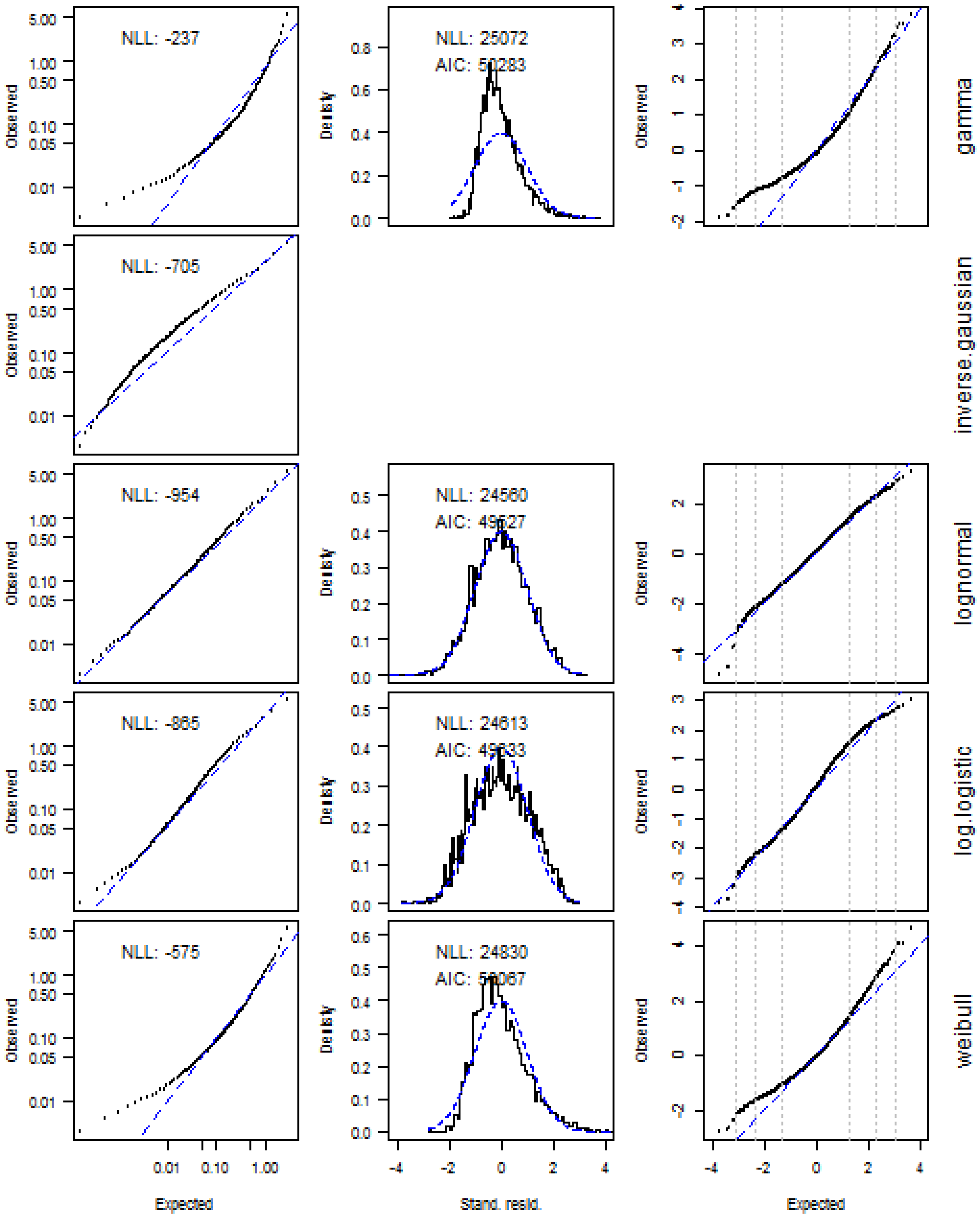

Figure L.3: Diagnostics for alternative distributional assumptions for catch in the school shark BLL-23N(MIX) model. Left: quantile-quantile plot of observed catches (centred (by mean) and scaled (by standard deviation) in log space) versus maximum likelihood fit of distribution (missing panel indicates that the fit failed to converge); Middle: standardised residuals from a generalised linear model fitted using the formula catch ~ fyear + month +area+ vessel + log(sets) and the distribution (missing panel indicates that the model failed to converge); Right: quantile-quantile plot of model standardised residuals against standard normal (vertical lines represent 0.1%, 1% and 10% percentiles). NLL = negative log-likelihood; AIC = Akaike information criterion.

L.8 POSITIVE CATCH MODEL SELECTION TABLE

Three explanatory variables entered the model after fishing year (Table L.2), with number of hooks, month and form type non-significant. A plot of the model is provided in Figure L.4 and the CPUE indices are listed in Table L.4.

Table L.2: Order of acceptance of variables into the lognormal model of successful catches in the BLL-23N(MIX) fishery model for core vessels based on the vessel selection criteria of at least 3 trips in 4 or more fishing years, with the amount of explained deviance and R^2 for each variable. Variables accepted into the model are marked with an *, and the final R^2 of the selected model is in bold. Fishing year was forced as the first variable.

Variable	DF	Neg. Log likelihood	AIC	R^2	Model use
fishing year	24	-9 137	18 324	2.74	*
target	28	-8 688	17 435	19.74	*
vessel	58	-8 438	16 993	27.95	*
area	62	-8 298	16 723	**32.15**	*
month	73	-8 264	16 677	33.13	
poly(log(hooks), 3)	76	-8 252	16 659	33.48	

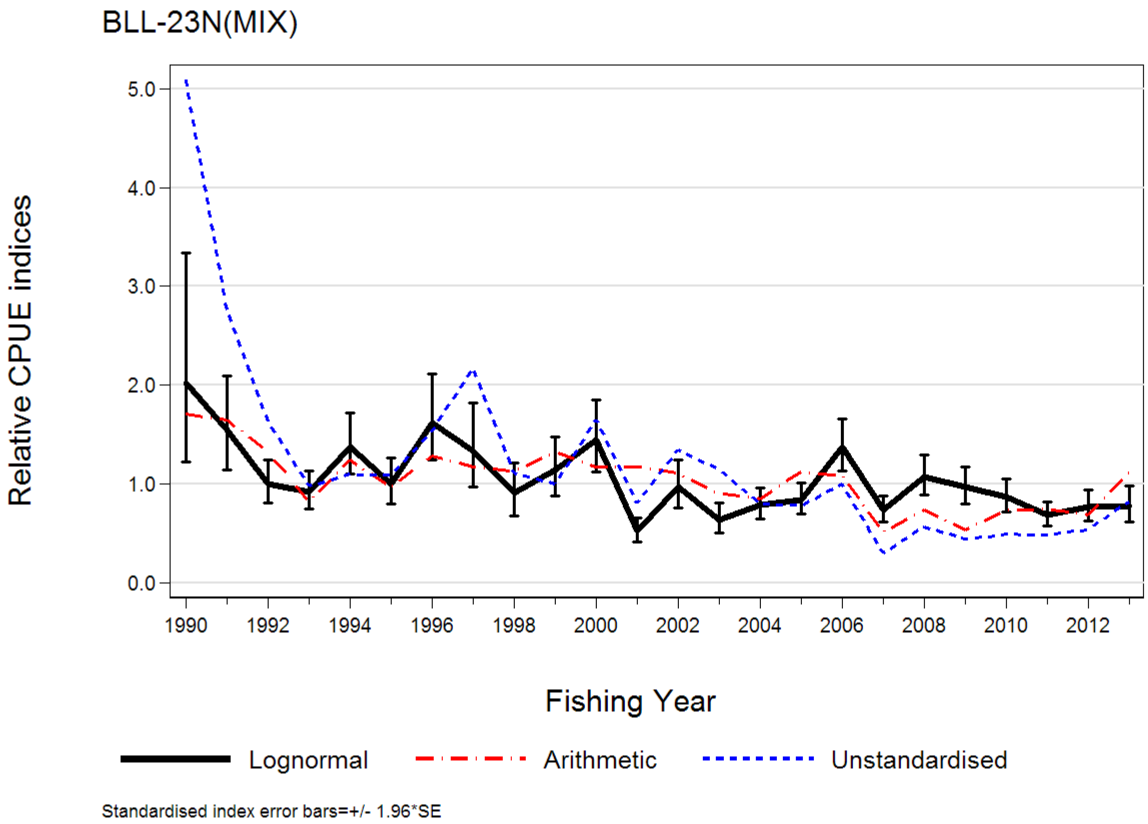

Figure L.4: Relative CPUE indices for school shark using the lognormal non-zero model based on the BLL-23N(MIX) fishery definition. Also shown are two unstandardised series from the same data: a) Arithmetic (Eq. H.1) and b) Unstandardised (Eq. H.2).

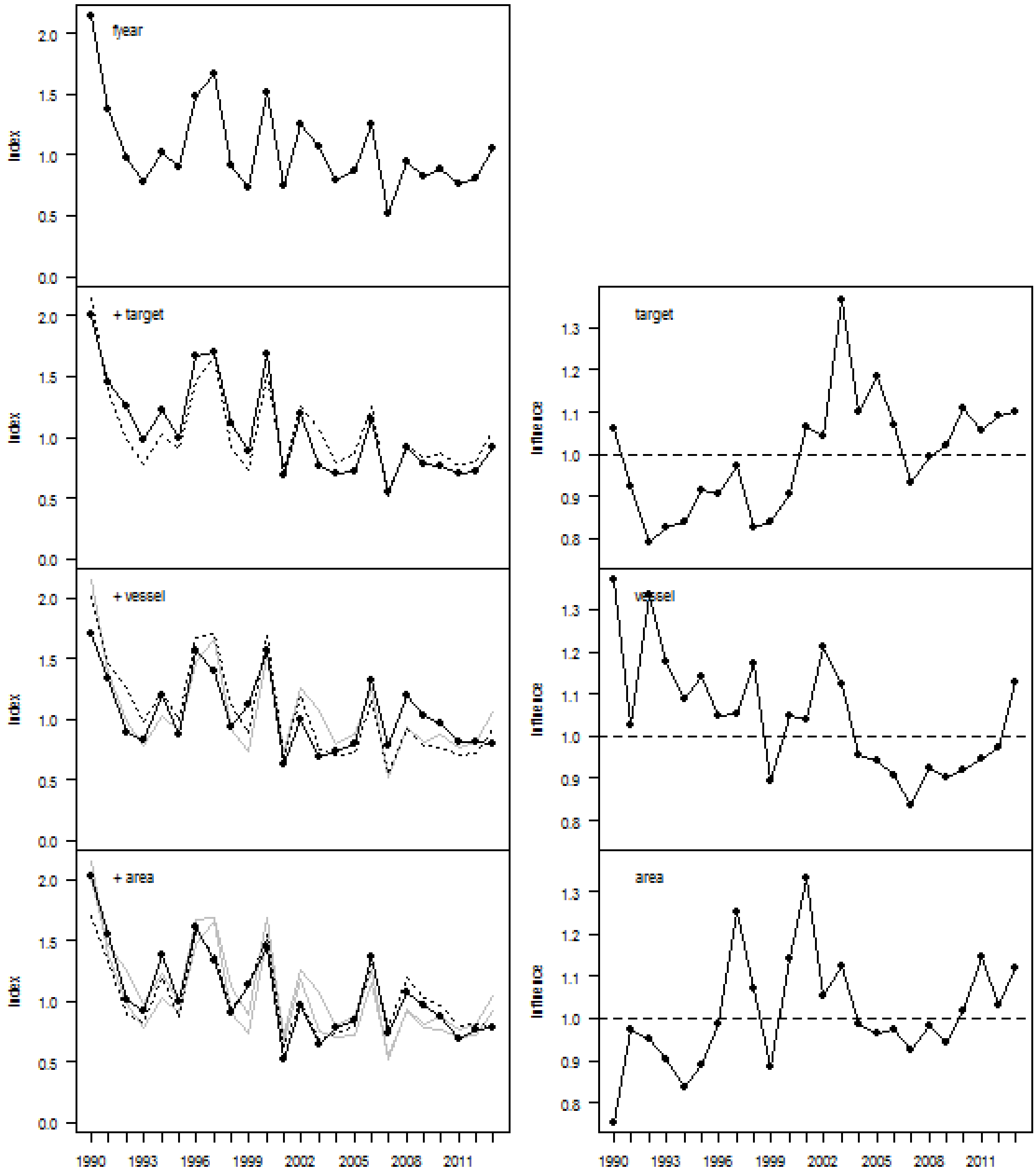

Figure L.5: [left column]: annual indices from the lognormal model of BLL-23N(MIX) at each step in the variable selection process; [right column]: aggregate influence associated with each step in the variable selection procedure.

L.9 RESIDUAL AND DIAGNOSTIC PLOTS

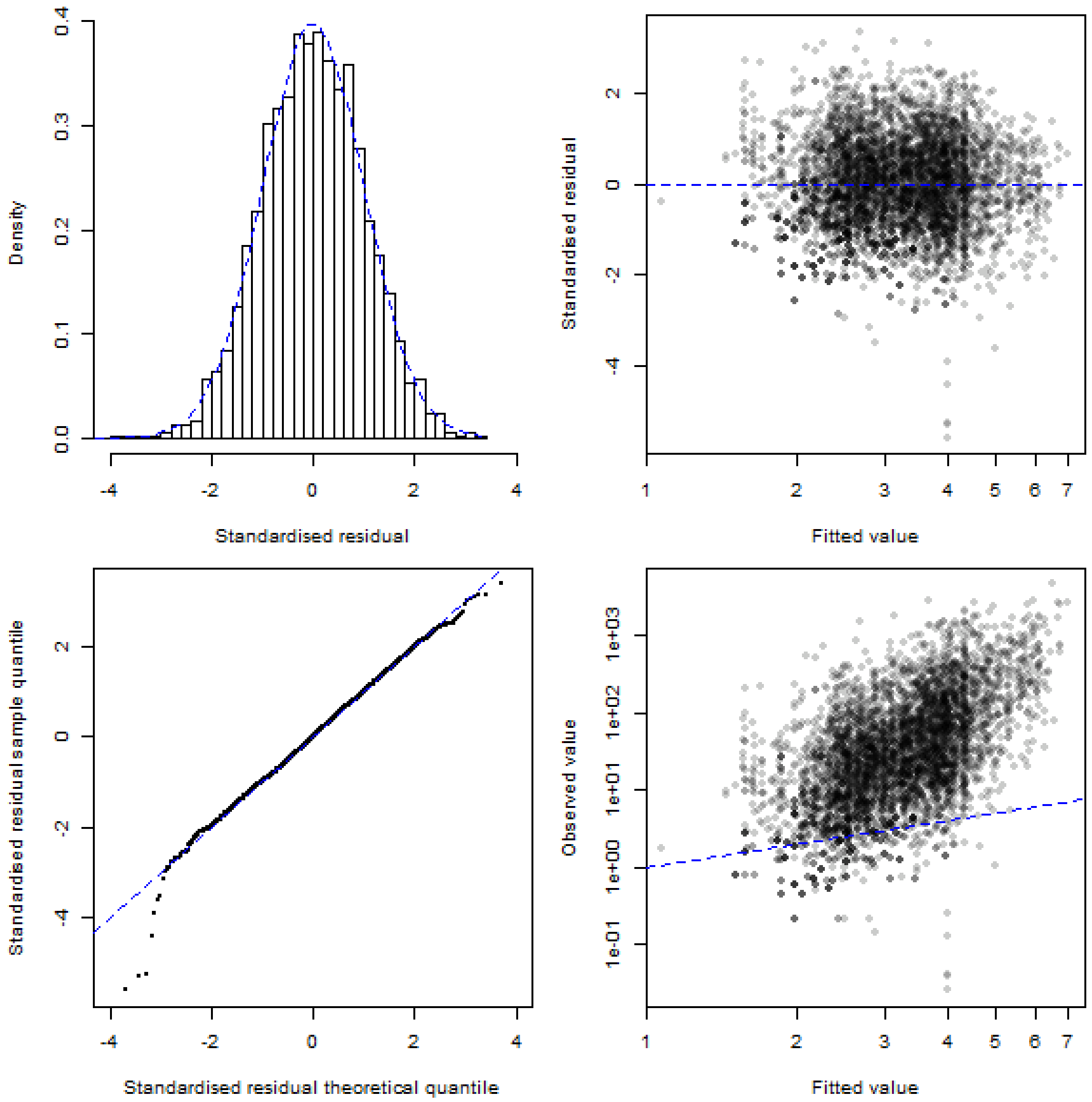

Figure L.6: Plots of the fit of the lognormal standardised CPUE model to successful catches of school shark in the BLL-23N(MIX) fishery. [Upper left] histogram of the standardised residuals compared to a lognormal distribution (SDSR: standard deviation of standardised residuals. MASR: median of absolute standardised residuals); [Upper right] Q-Q plot of the standardised residuals; [Lower left] Standardised residuals plotted against the predicted model catch per trip; [Lower right] Observed catch per record plotted against the predicted catch per record.

L.10 MODEL COEFFICIENTS

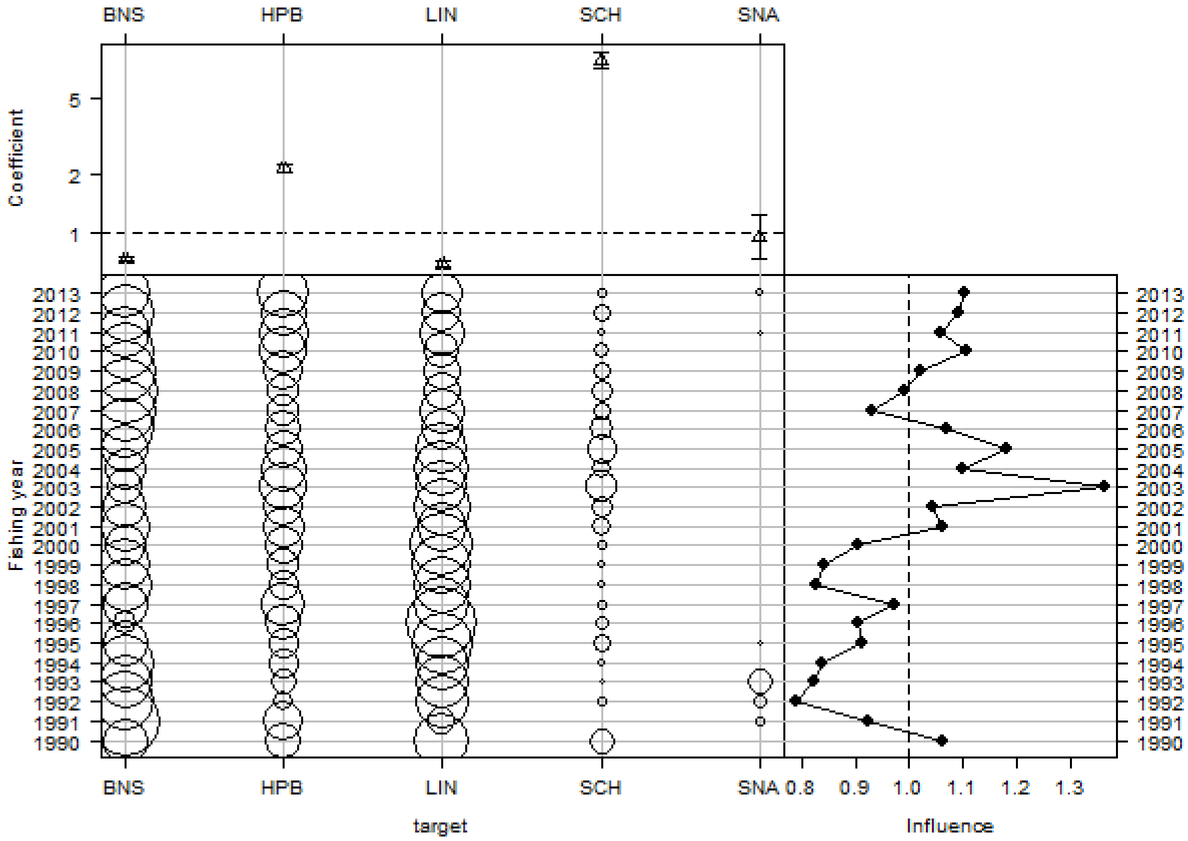

Figure L.7: Effect of target species in the lognormal model for the school shark BLL-23N(MIX) fishery. Top: effect by level of variable (left-axis: log space additive; right-axis: natural space multiplicative). Bottom-left: distribution of variable by fishing year. Bottom-right: cumulative effect of variable by fishing year (bottom-axis: log space additive; top-axis: natural space multiplicative).

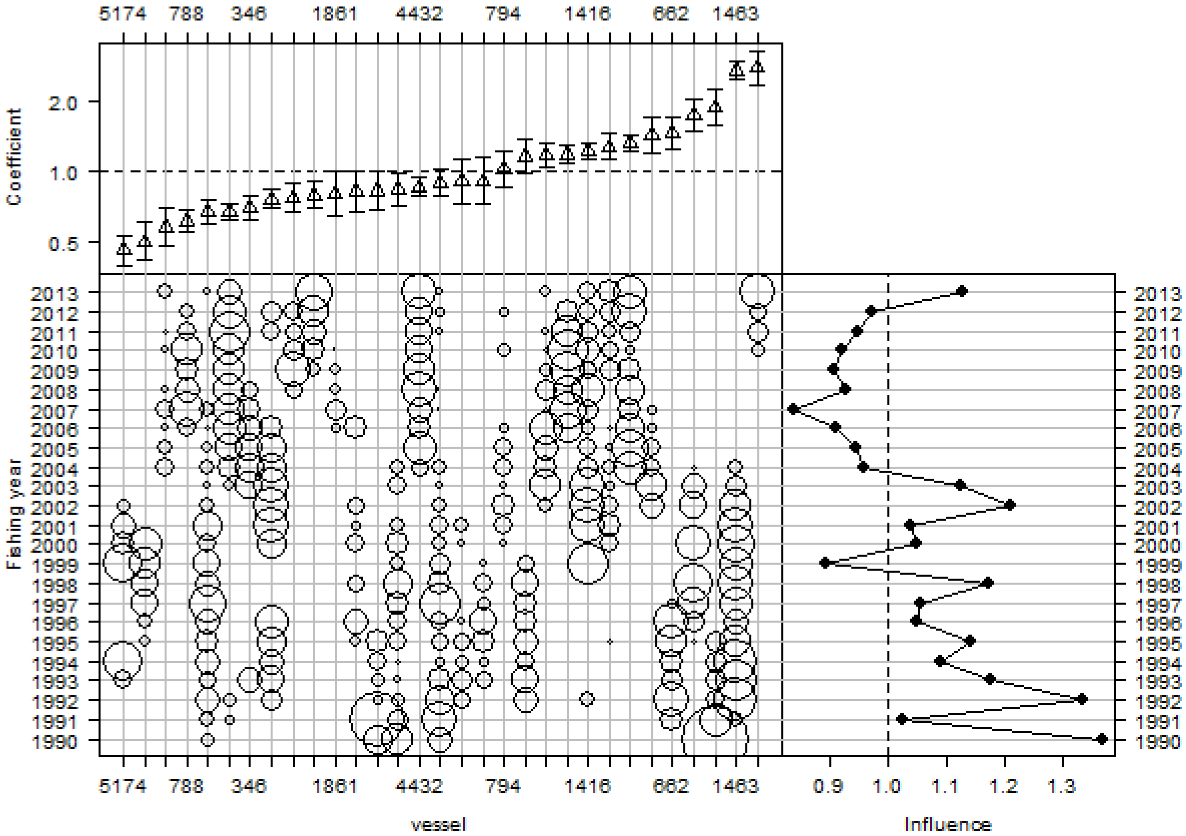

Figure L.8: Effect of vessel in the lognormal model for the school shark BLL-23N(MIX) fishery. Top: effect by level of variable (left-axis: log space additive; right-axis: natural space multiplicative). Bottom-left: distribution of variable by fishing year. Bottom-right: cumulative effect of variable by fishing year (bottom-axis: log space additive; top-axis: natural space multiplicative).

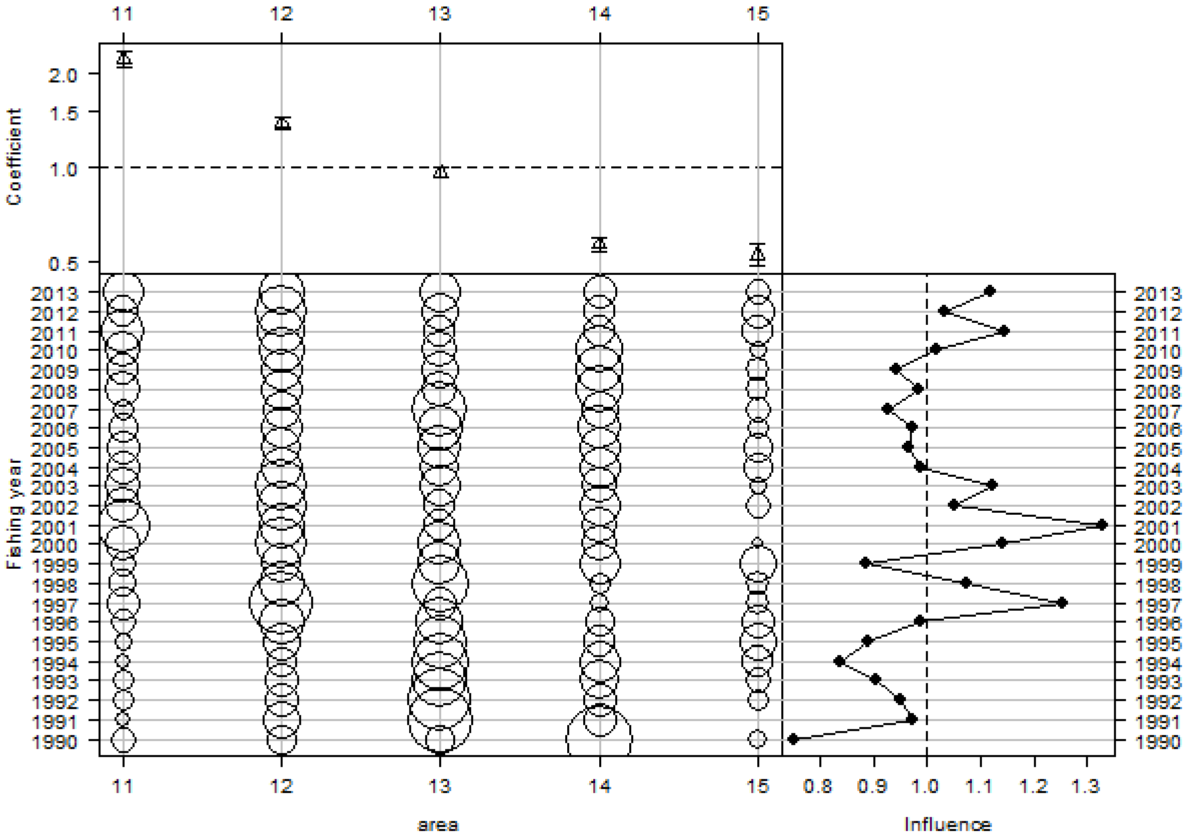

Figure L.9: Effect of area in the lognormal model for the school shark BLL-23N(MIX) fishery. Top: effect by level of variable (left-axis: log space additive; right-axis: natural space multiplicative). Bottom-left: distribution of variable by fishing year. Bottom-right: cumulative effect of variable by fishing year (bottom-axis: log space additive; top-axis: natural space multiplicative).

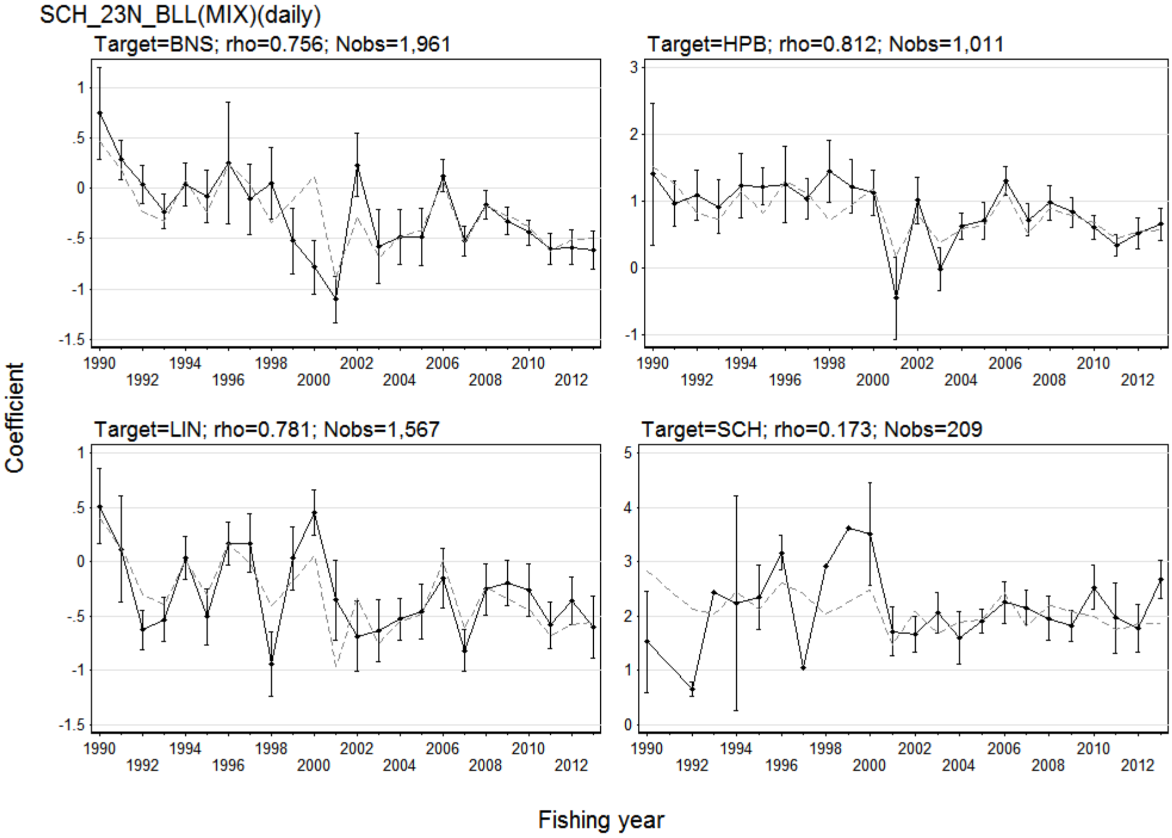

Figure L.10: Residual implied coefficients for target×fishing year interaction (not offered) in the school shark BLL-23N(MIX) lognormal model. Implied coefficients (black points) are calculated as the normalised fishing year coefficient (grey line) plus the mean of the standardised residuals in each fishing year and area. These values approximate the coefficients obtained when an area × year interaction term is fitted, particularly for those area × year combinations which have a substantial proportion of the records. The error bars indicate one standard error of the standardised residuals. The information at the top of each panel identifies the plotted category, provides the correlation coefficient (*rho*) between the category year index and the overall model index, and the number of records supporting the category.

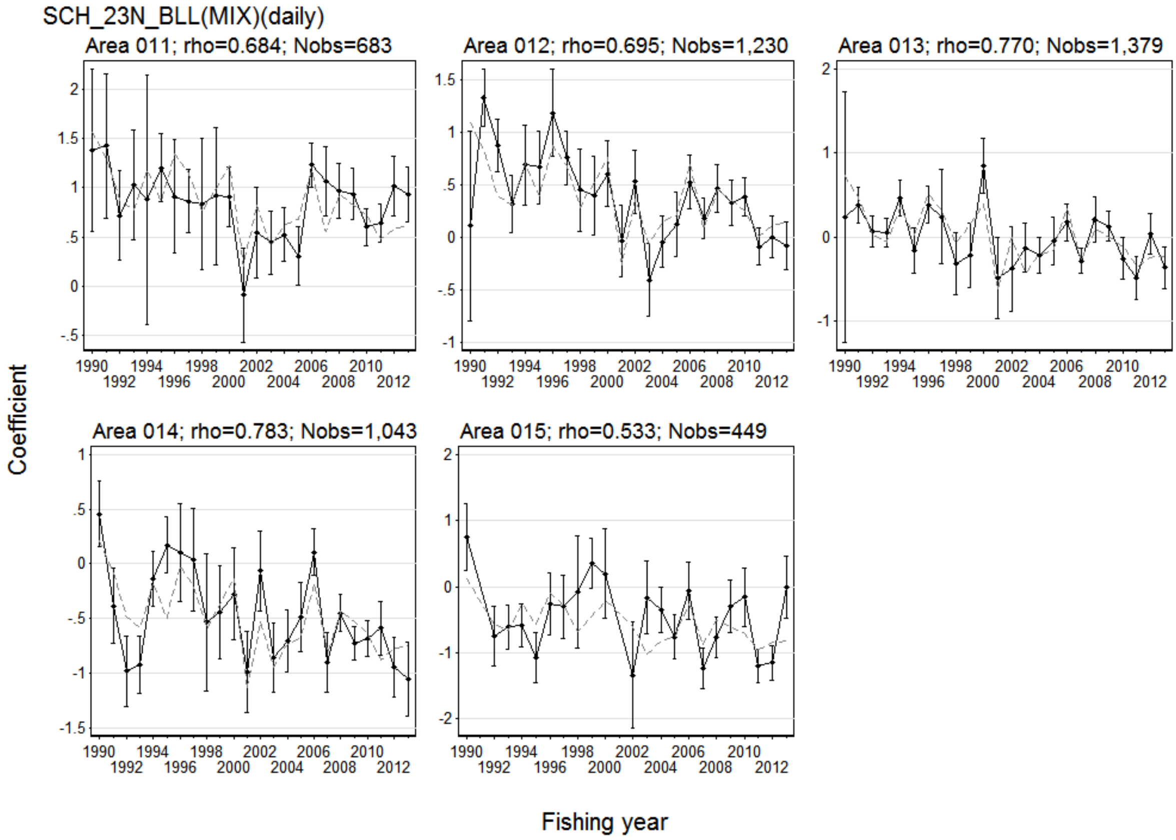

Figure L.11: Residual implied coefficients for area×fishing year interaction (not offered) in the school shark BLL-23N(MIX) lognormal model. Implied coefficients (black points) are calculated as the normalised fishing year coefficient (grey line) plus the mean of the standardised residuals in each fishing year and area. These values approximate the coefficients obtained when an area × year interaction term is fitted, particularly for those area × year combinations which have a substantial proportion of the records. The error bars indicate one standard error of the standardised residuals. The information at the top of each panel identifies the plotted category, provides the correlation coefficient (*rho*) between the category year index and the overall model index, and the number of records supporting the category.

L.11 LOGISTIC (BINOMIAL) MODEL SELECTION TABLE

Four explanatory variables entered the model after fishing year (Table L.3), with number of hooks, and form type non-significant. A plot of the binomial model and the combined delta-lognormal model is provided in Figure L.12 and the CPUE indices are listed in Table L.4.

Table L.3: Order of acceptance of variables into the binomial (logistic) model of successful catches in the BLL-23N(MIX) fishery model for core vessels based on the vessel selection criteria of at least 3 trips in 4 or more fishing years, with the amount of explained deviance and R^2 for each variable. Variables accepted into the model are marked with an *, and the final R^2 of the selected model is in bold. Fishing year was forced as the first variable.

Variable	DF	Neg. Log likelihood	AIC	R^2	Model use
fishing year	24	-7 911	15 869	1.32	*
target	28	-7 400	14 856	12.40	*
vessel	58	-7 149	14 413	17.52	*
month	69	-7 083	14 303	18.82	*
area	73	-7 031	14 208	**19.84**	*
poly(log(hooks), 3)	76	-7 015	14 182	20.15	
form	79	-7 010	14 178	20.25	

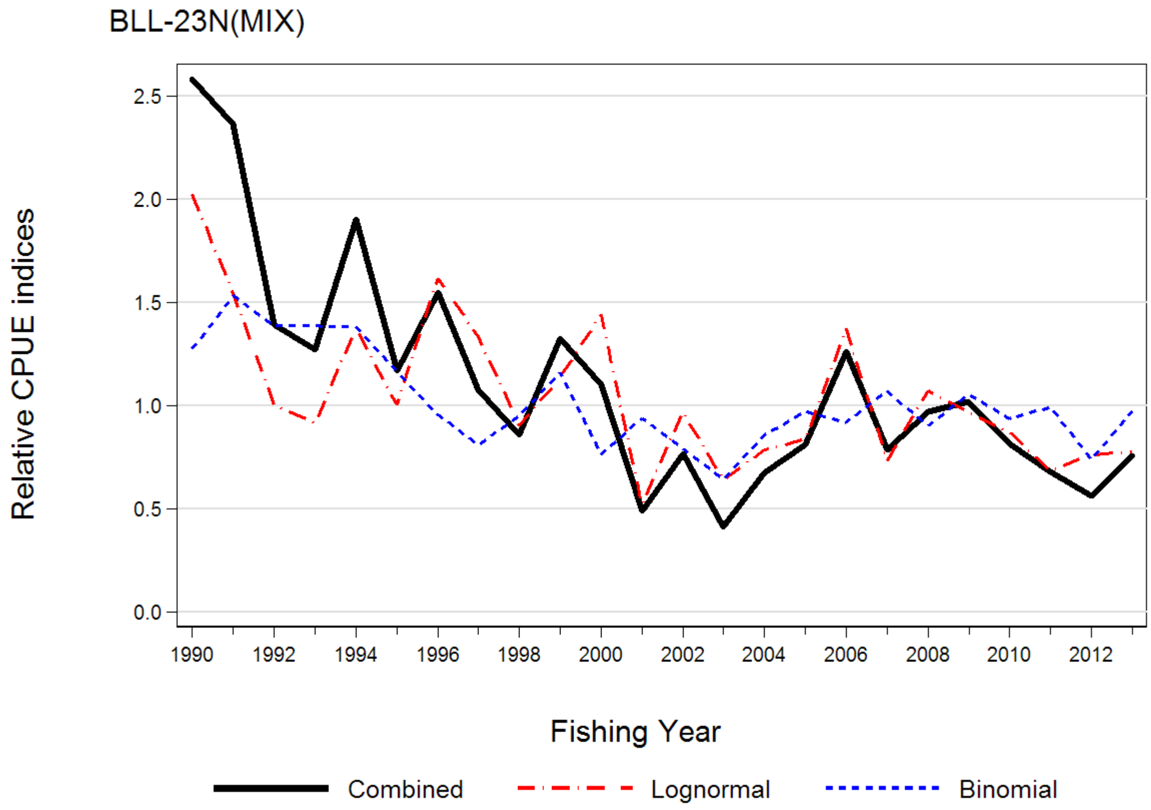

Figure L.12: Relative CPUE indices for school shark using the lognormal non-zero model based on the BLL-23N(MIX) fishery definition, the binomial standardised model using the logistic distribution and a regression based on presence/absence of SCH, and the combined model using the delta-lognormal procedure suggested by Vignaux (1994).

L.12 CPUE INDICES

Table L.4: Arithmetic indices for the total and core data sets, geometric and lognormal standardised indices and associated standard error (SE) for the core data set by fishing year for the school shark BLL-23N(MIX) analysis. All series (except SE) standardised to geometric mean=1.0.

Fishing	All vessels						Core vessels
year	Arithmetic	Arithmetic	Geometric	Standardised	SE	Binomial	Combined
1990	1.725	1.707	5.086	2.024	0.2554	0.516	2.582
1991	1.639	1.650	2.761	1.543	0.1548	0.621	2.366
1992	1.208	1.328	1.636	1.005	0.1101	0.561	1.395
1993	1.183	0.819	0.977	0.916	0.1060	0.561	1.271
1994	1.103	1.241	1.098	1.377	0.1130	0.560	1.905
1995	1.184	0.966	1.088	1.004	0.1177	0.472	1.171
1996	1.177	1.284	1.535	1.618	0.1360	0.388	1.551
1997	1.342	1.177	2.173	1.333	0.1599	0.328	1.080
1998	1.440	1.129	1.110	0.905	0.1499	0.385	0.861
1999	1.384	1.320	1.001	1.139	0.1320	0.471	1.324
2000	1.248	1.174	1.651	1.442	0.1265	0.309	1.102
2001	1.234	1.177	0.804	0.520	0.1151	0.380	0.488
2002	1.047	1.106	1.345	0.969	0.1268	0.321	0.769
2003	0.780	0.899	1.147	0.640	0.1219	0.260	0.411
2004	0.835	0.854	0.800	0.787	0.1006	0.348	0.676
2005	0.958	1.122	0.782	0.837	0.0953	0.393	0.813
2006	1.046	1.085	0.997	1.373	0.0971	0.372	1.260
2007	0.557	0.512	0.299	0.734	0.0916	0.434	0.787
2008	0.665	0.735	0.568	1.072	0.0956	0.366	0.969
2009	0.578	0.537	0.441	0.967	0.0973	0.427	1.020
2010	0.636	0.732	0.491	0.870	0.0960	0.380	0.816
2011	0.596	0.746	0.483	0.685	0.0929	0.402	0.680
2012	0.888	0.689	0.538	0.763	0.1036	0.299	0.563
2013	0.793	1.116	0.823	0.777	0.1182	0.394	0.757

Appendix M. DIAGNOSTICS AND SUPPORTING ANALYSES FOR LOWER SCH 3 & SCH 5 SETNET [SN-3S5(MIX)] CPUE STANDARDISATION

M.1 INTRODUCTION

The basis for the selection of this region for monitoring school shark with this capture method is provided in Section 2.3.3.6 and summarised in Table 14.

M.2 FISHERY DEFINITION

SN-3S5(MIX): The fishery is defined from setnet fishing events which fished in Statistical Areas 022, 023, 024, 025, 026, 027, 028, 029, 030, 031, 032, 033 declaring target species SCH, SPO, SPD, ELE.

M.3 CORE VESSEL SELECTION

The criteria used to define the core fleet were those vessels that had fished for at least 5 trips in each of at least 5 years using trips with at least 1 kg of catch. These criteria resulted in a core fleet size of 40 vessels which took 89% of the catch (Figure M.1).

M.4 DATA SUMMARY

Table M.1: Number of number of core vessels, trips, daily effort strata, number of events that have been "rolled up" into daily effort strata, calculated number of events per daily-effort stratum, total length (km) of net set, sum of duration fished, sum of landed SCH (t), proportion of trips with catch and proportion of daily-effort strata with catch by fishing year for core vessels (based on a minimum of 5 trips per year in at least 5 years) in the SN-3S5(MIX) fishery.

Fishing year	Vessels	Trips	Daily effort strata	Events	Events per stratum	Length of net set (km)	Duration (h)	Catch (t)	Trips with catch (%)	Strata with catch (%)
1990	17	352	481	498	1.035	1 111.4	5 243	261.0	76.42	80.46
1991	16	402	544	570	1.048	1 153.3	6 468	339.1	65.17	69.49
1992	16	468	574	579	1.009	1 237.4	5 680	428.7	63.46	67.07
1993	17	475	595	610	1.025	1 163.8	6 950	424.7	73.89	75.29
1994	22	821	951	970	1.020	1 744.2	11 897	540.6	77.71	78.55
1995	23	778	875	900	1.029	1 529.9	10 471	452.3	78.66	79.89
1996	24	620	726	751	1.034	1 412.9	9 430	448.1	80.16	82.23
1997	23	564	693	714	1.030	1 387.8	7 794	364.2	81.56	83.26
1998	23	544	638	655	1.027	1 243.4	8 059	406.0	81.99	84.01
1999	22	610	731	758	1.037	1 403.3	9 599	408.3	81.97	84.13
2000	23	624	741	787	1.062	1 370.5	8 169	491.1	81.41	82.05
2001	24	756	877	932	1.063	1 553.7	9 207	534.9	82.01	81.98
2002	19	604	707	759	1.074	1 294.4	7 870	500.2	83.11	84.02
2003	18	777	903	970	1.074	1 740.0	11 153	576.3	72.59	75.30
2004	18	754	887	942	1.062	1 672.7	10 921	586.1	70.16	72.83
2005	18	751	923	988	1.070	1 888.5	10 004	663.5	84.02	85.70
2006	18	982	1 158	1 197	1.034	2 132.6	12 519	570.6	71.69	73.06
2007	18	851	1 068	1 135	1.063	1 780.1	11 929	659.9	72.62	74.63
2008	17	871	1 167	1 250	1.071	2 313.7	12 839	725.7	77.04	77.04
2009	19	811	1 063	1 122	1.056	2 084.1	12 305	680.8	79.78	82.13
2010	17	794	1 036	1 120	1.081	2 093.1	12 879	771.9	84.63	84.85
2011	17	752	1 011	1 107	1.095	2 146.9	13 053	679.8	80.72	81.40
2012	16	669	898	943	1.050	2 041.7	11 322	693.6	84.01	85.08
2013	16	693	972	1 074	1.105	2 290.3	12 377	723.2	79.22	82.30

M.5 CORE VESSEL SELECTION

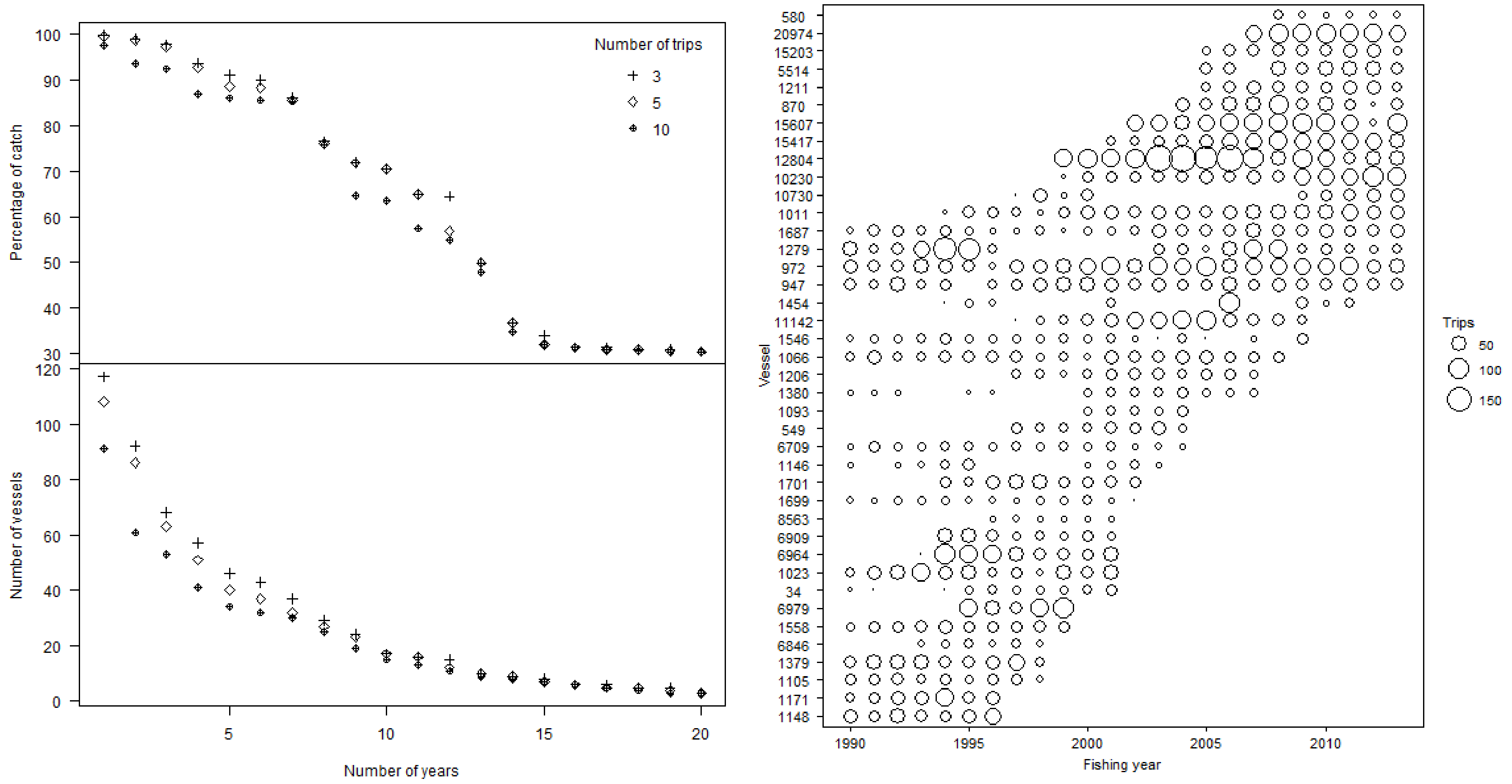

Figure M.1: [left panel] total landed SCH and number of vessels plotted against the number of years used to define core vessels participating in the SN-3S5(MIX) dataset. The number of qualifying years (minimum number of trips per year) for each series is indicated in the legend. [right panel]: bubble plot showing the number of daily-effort strata for selected core vessels (based on at least 5 trips in 5 or more fishing years) by fishing year.

M.6 EXPLORATORY DATA PLOTS FOR CORE VESSEL DATA SET

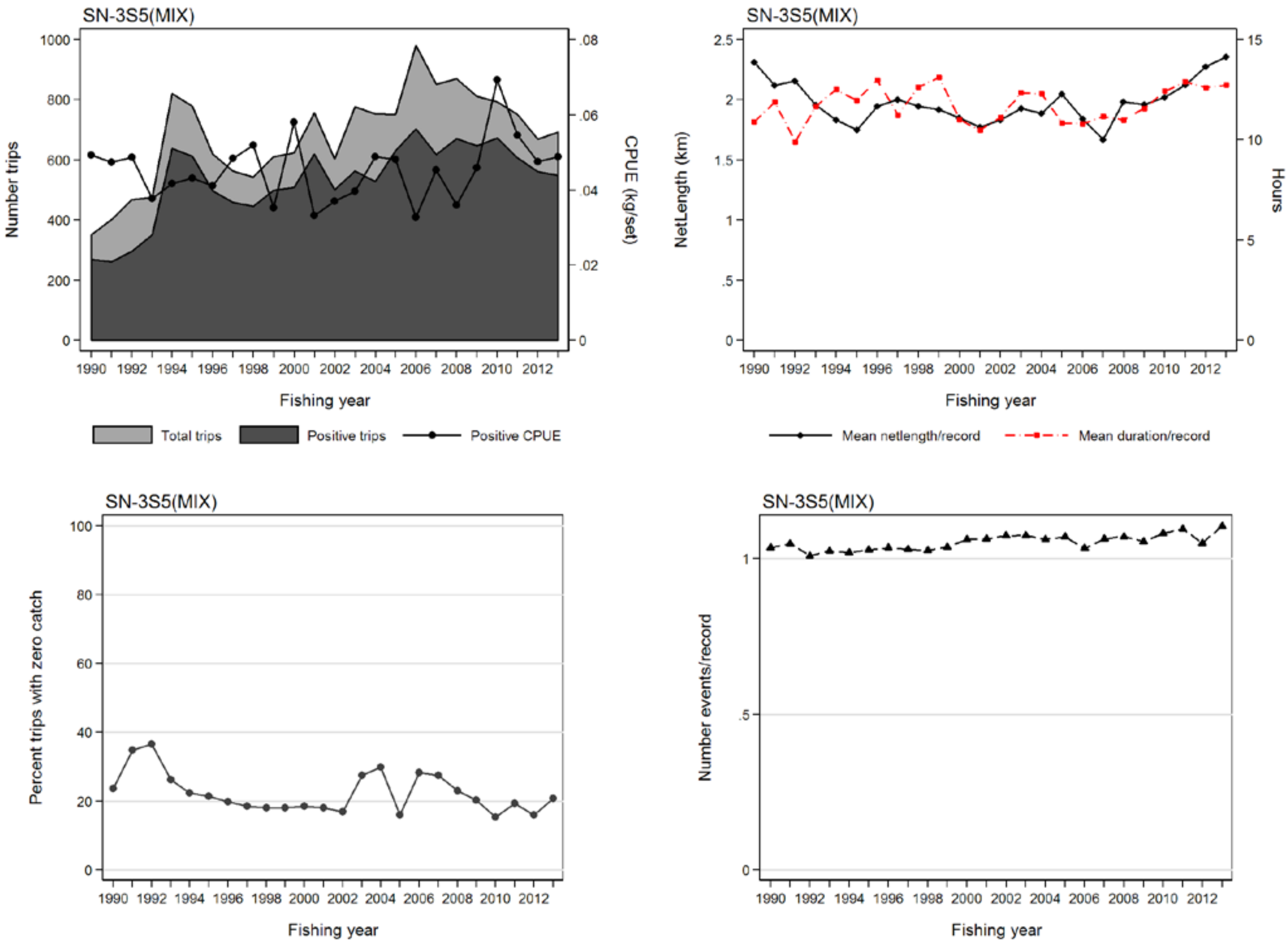

Figure M.2: Core vessel summary plots by fishing year for model SN-3S5(MIX): [upper left panel]: total trips (light grey) and trips with school shark catch (dark grey) overlaid with median annual arithmetic CPUE (kg/set) for all trips *i* with positive catch: $A_y = \text{median}\left(C_{y,i}/E_{y,i}\right)$**; [upper right panel]: mean net length (km) and mean duration per daily-effort stratum record; [lower left panel]: proportion of trips with no catch of school shark; [lower right panel]: mean number of events per daily-effort stratum record.**

M.7 SELECTION OF DISTRIBUTION FOR POSITIVE CATCH RECORDS

The best distribution was log.logistic.
The distribution was forced to lognormal.

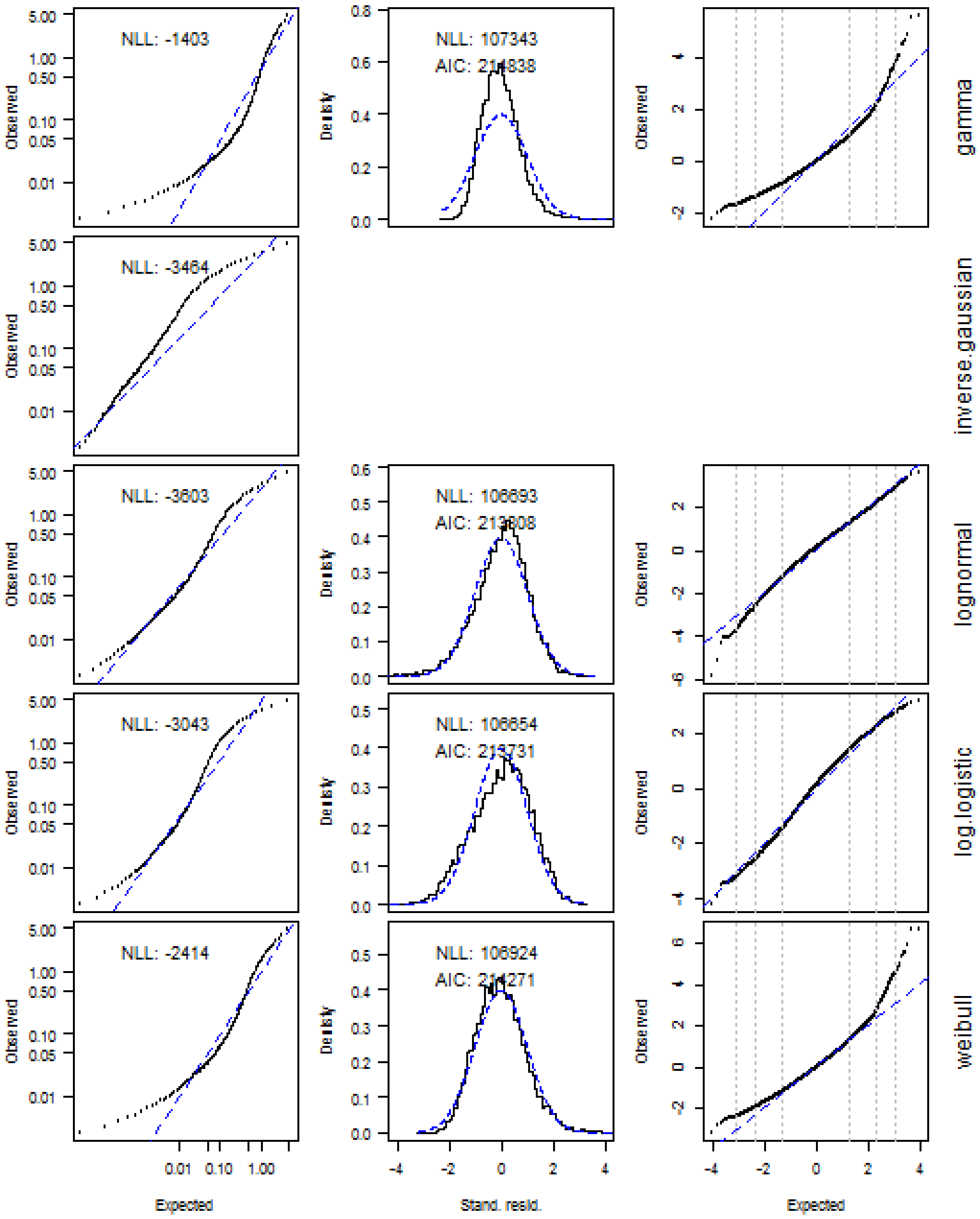

Figure M.3: Diagnostics for alternative distributional assumptions for catch in the school shark SN-3S5(MIX) model. Left: quantile-quantile plot of observed catches (centred (by mean) and scaled (by standard deviation) in log space) versus maximum likelihood fit of distribution (missing panel indicates that the fit failed to converge); Middle: standardised residuals from a generalised linear model fitted using the formula catch ~ fyear + month +area+ vessel + log(sets) and the distribution (missing panel indicates that the model failed to converge); Right: quantile-quantile plot of model standardised residuals against standard normal (vertical lines represent 0.1%, 1% and 10% percentiles). NLL = negative log-likelihood; AIC = Akaike information criterion.

M.8 MODEL SELECTION TABLE

Four explanatory variables entered the model after fishing year (Table M.2), with neither effort variable (net length and hours fishing) significant. A plot of the model is provided in Figure M.4 and the CPUE indices are listed in Table M.3.

Table M.2: Order of acceptance of variables into the lognormal model of successful catches in the SN-3S5(MIX) fishery model for core vessels based on the vessel selection criteria of at least 5 trips in 5 or more fishing years), with the amount of explained deviance and R^2 for each variable. Variables accepted into the model are marked with an *, and the final R^2 of the selected model is in bold. Fishing year was forced as the first variable.

Variable	DF	Neg. Log likelihood	AIC	R^2	Model use
fishing year	24	-34 361	68 771	1.16	*
vessel	63	-27 952	56 032	56.21	*
target	66	-27 309	54 751	59.68	*
month	77	-27 066	54 289	60.92	*
area	87	-26 754	53 684	**62.46**	*
poly(log(netlength), 3)	90	-26 631	53 445	63.05	
poly(log(duration), 3)	93	-26 556	53 300	63.41	

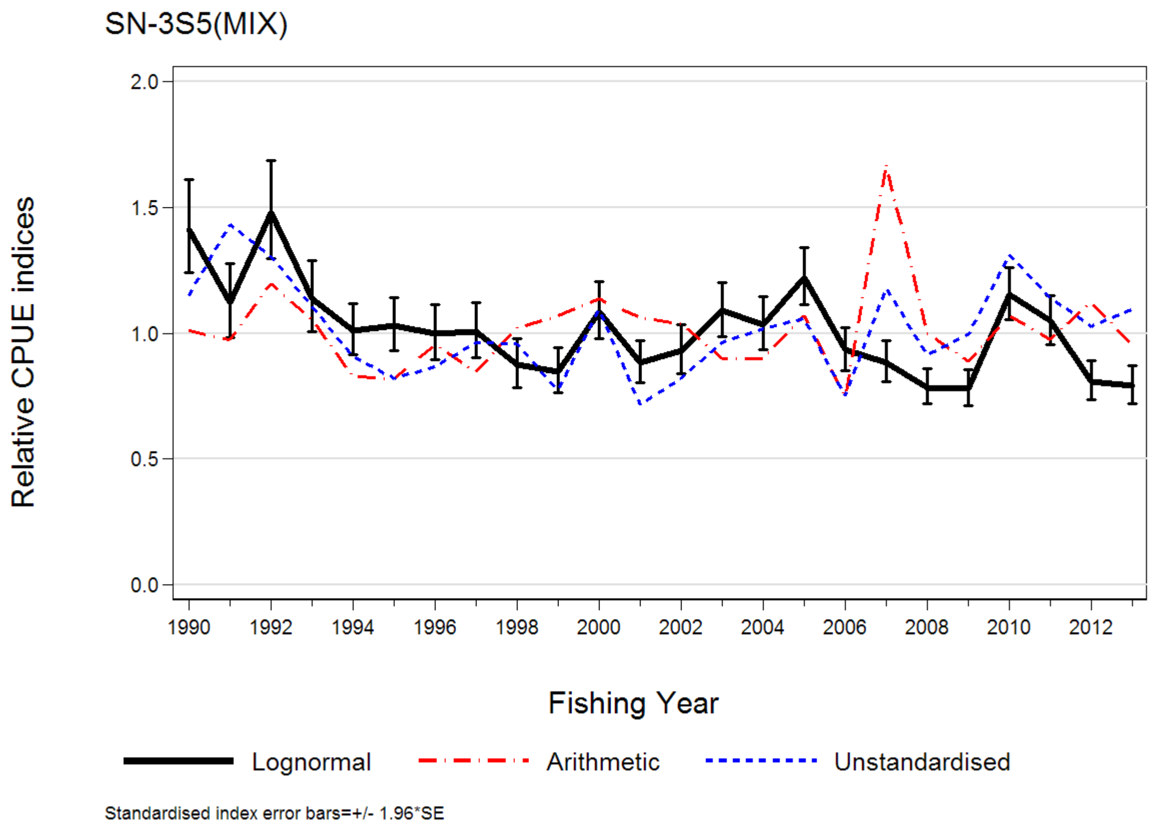

Figure M.4: Relative CPUE indices for school shark using the lognormal non-zero model based on the SN-3S5(MIX) fishery definition. Also shown are two unstandardised series from the same data: a) Arithmetic (Eq. H.1) and b) Unstandardised (Eq. H.2).

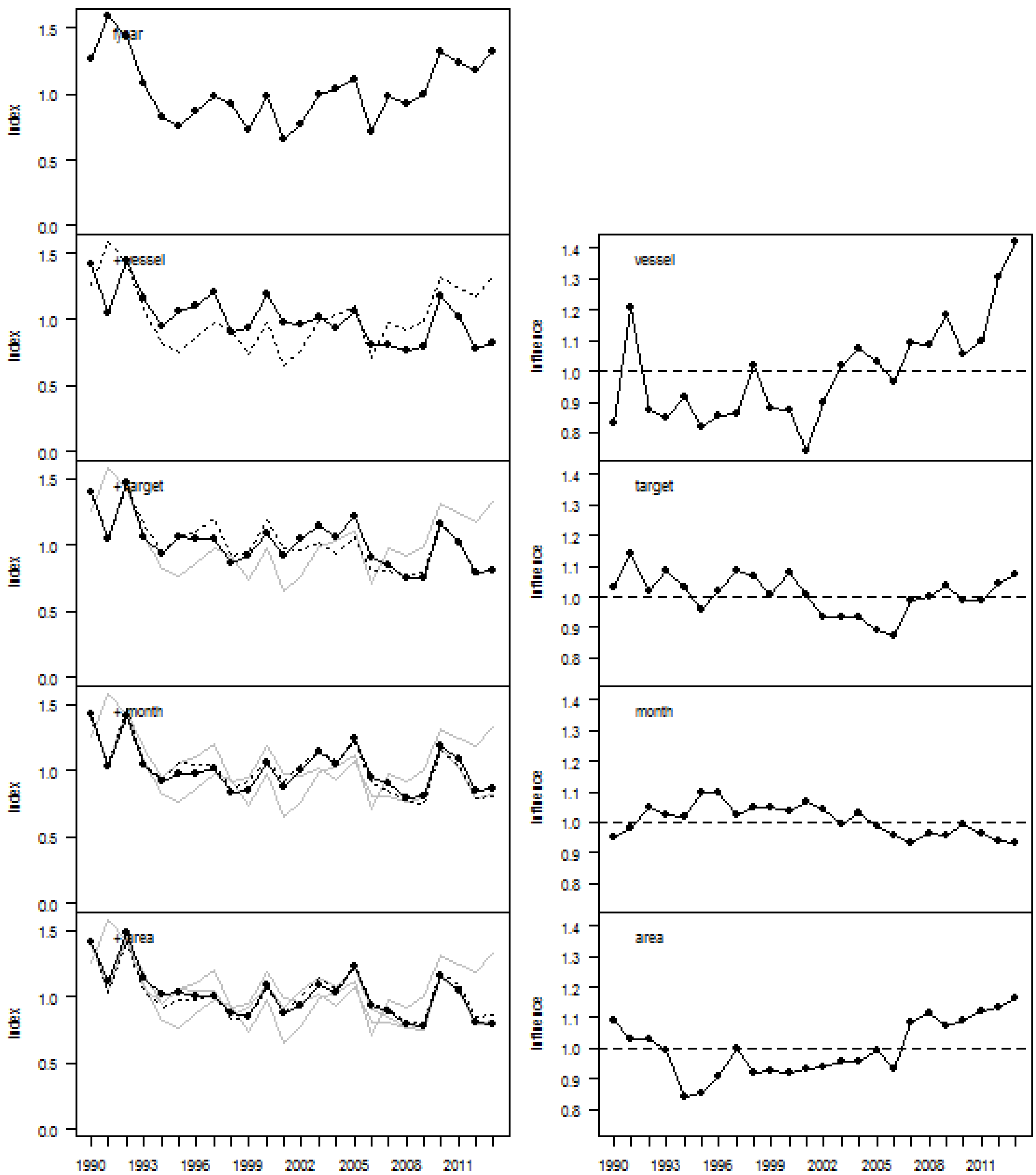

Figure M.5: [left column]: annual indices from the lognormal model of SN-3S5(MIX) at each step in the variable selection process; [right column]: aggregate influence associated with each step in the variable selection procedure.

M.9 RESIDUAL AND DIAGNOSTIC PLOTS

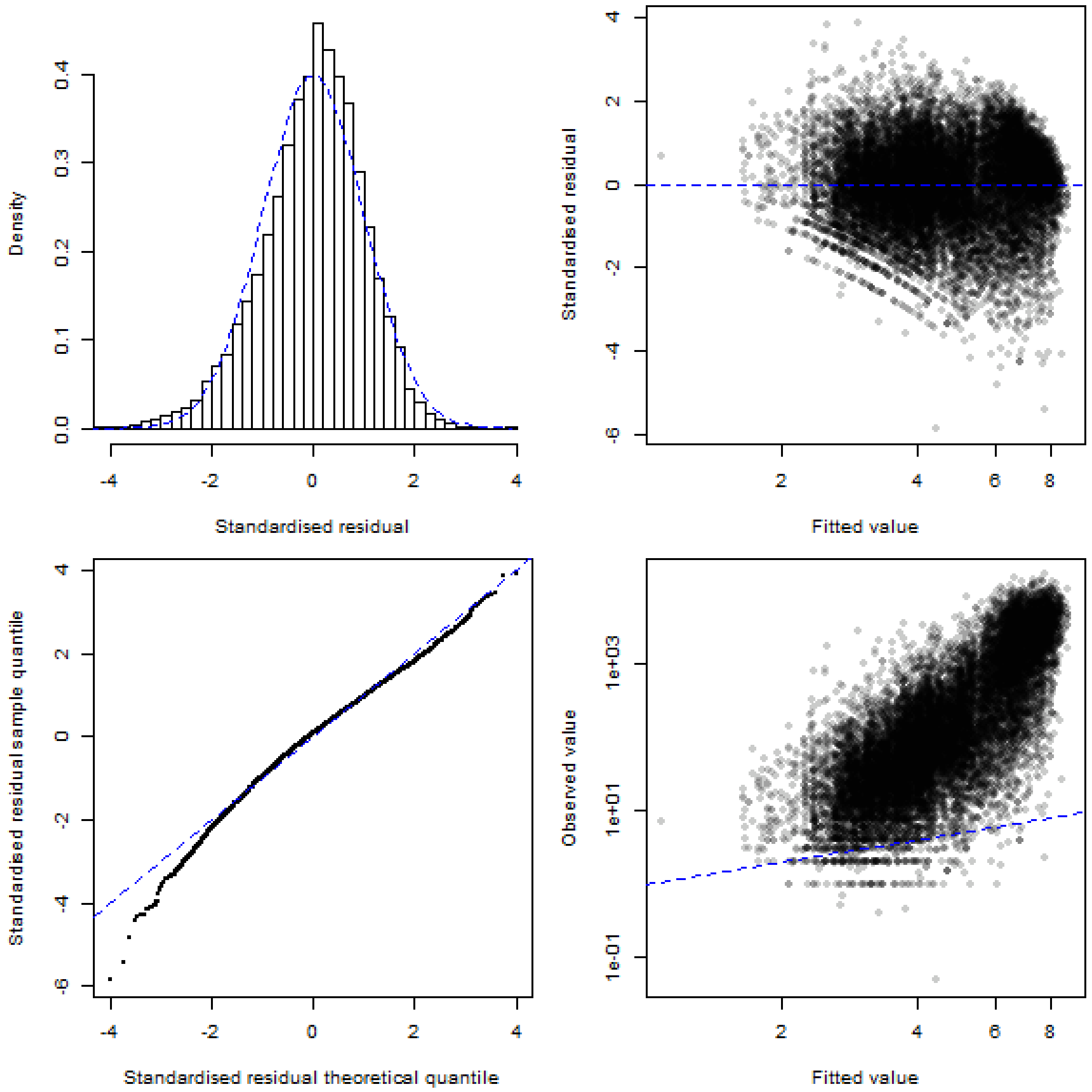

Figure M.6: Plots of the fit of the lognormal standardised CPUE model to successful catches of school shark in the SN-3S5(MIX) fishery. [Upper left] histogram of the standardised residuals compared to a lognormal distribution (SDSR: standard deviation of standardised residuals. MASR: median of absolute standardised residuals); [Upper right] Q-Q plot of the standardised residuals; [Lower left] Standardised residuals plotted against the predicted model catch per trip; [Lower right] Observed catch per record plotted against the predicted catch per record.

M.10 MODEL COEFFICIENTS

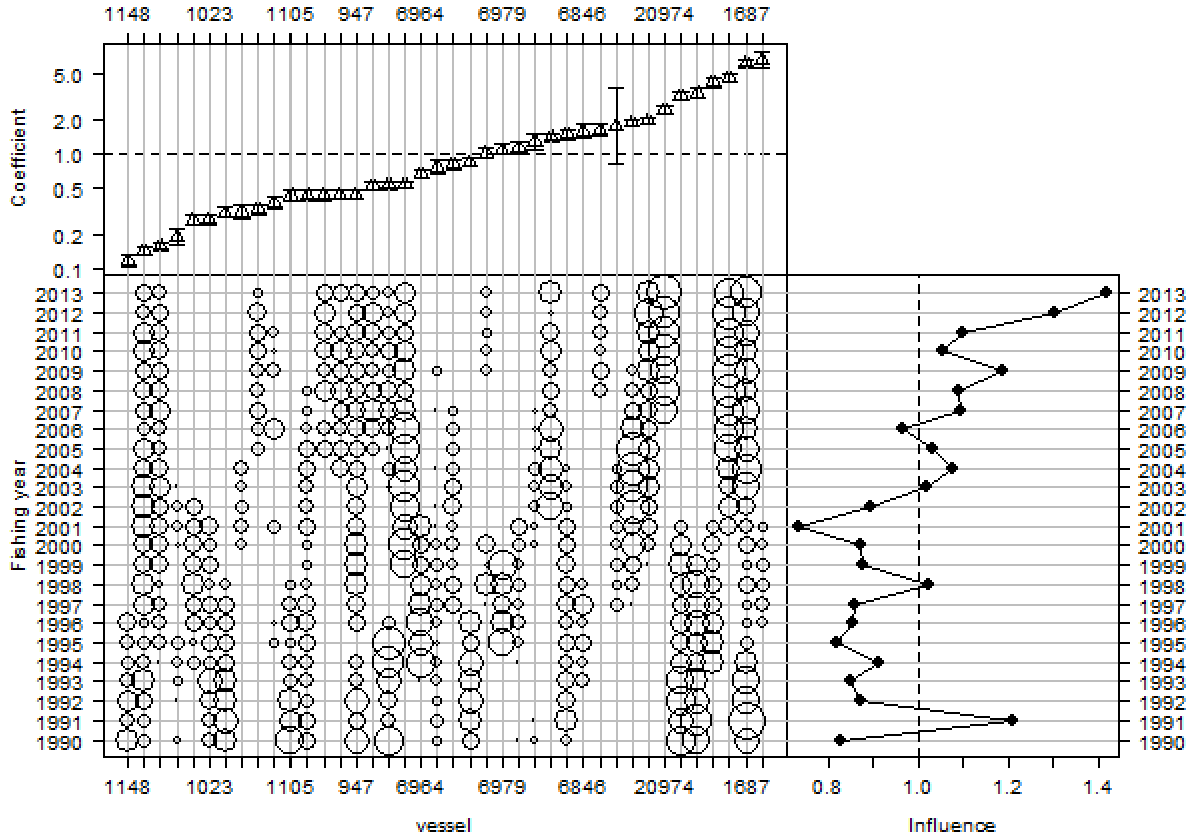

Figure M.7: Effect of vessel in the lognormal model for the school shark SN-3S5(MIX) fishery. Top: effect by level of variable (left-axis: log space additive; right-axis: natural space multiplicative). Bottom-left: distribution of variable by fishing year. Bottom-right: cumulative effect of variable by fishing year (bottom-axis: log space additive; top-axis: natural space multiplicative).

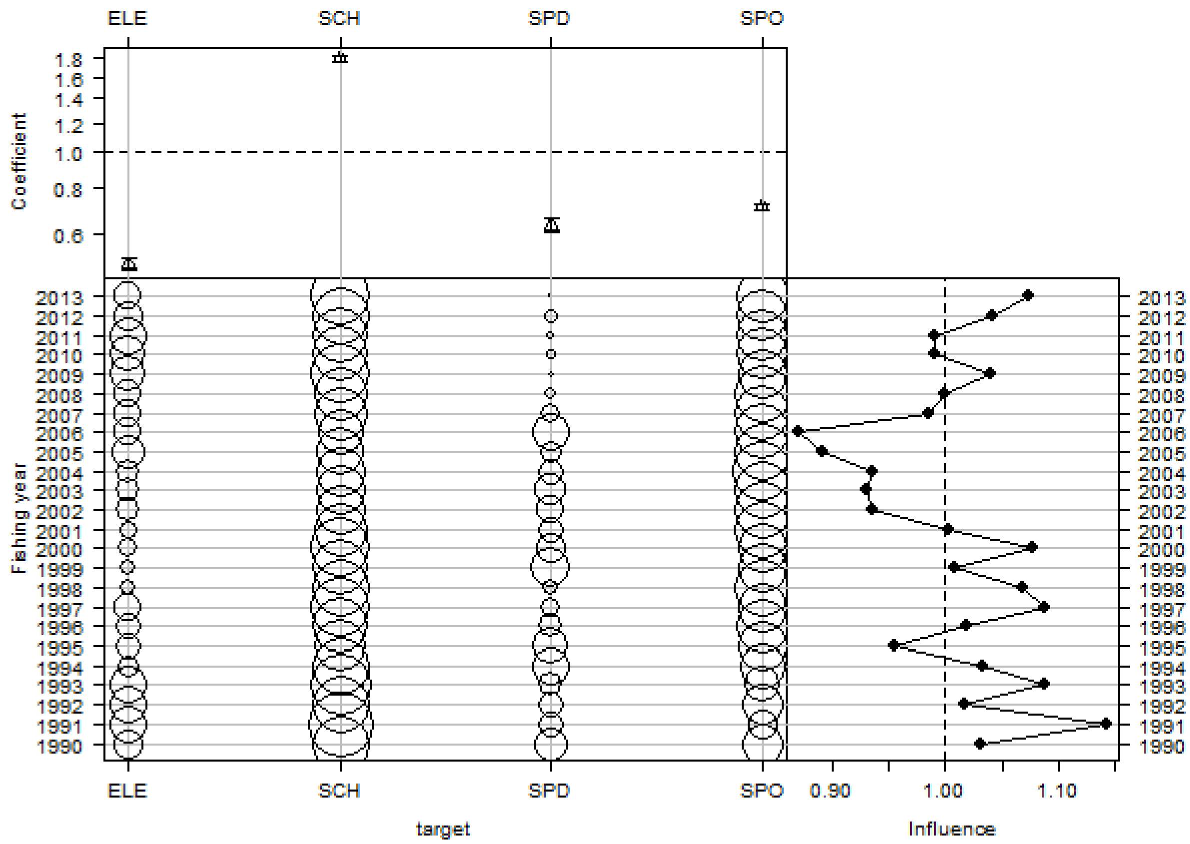

Figure M.8: Effect of target species in the lognormal model for the school shark SN-3S5(MIX) fishery. Top: effect by level of variable (left-axis: log space additive; right-axis: natural space multiplicative). Bottom-left: distribution of variable by fishing year. Bottom-right: cumulative effect of variable by fishing year (bottom-axis: log space additive; top-axis: natural space multiplicative).

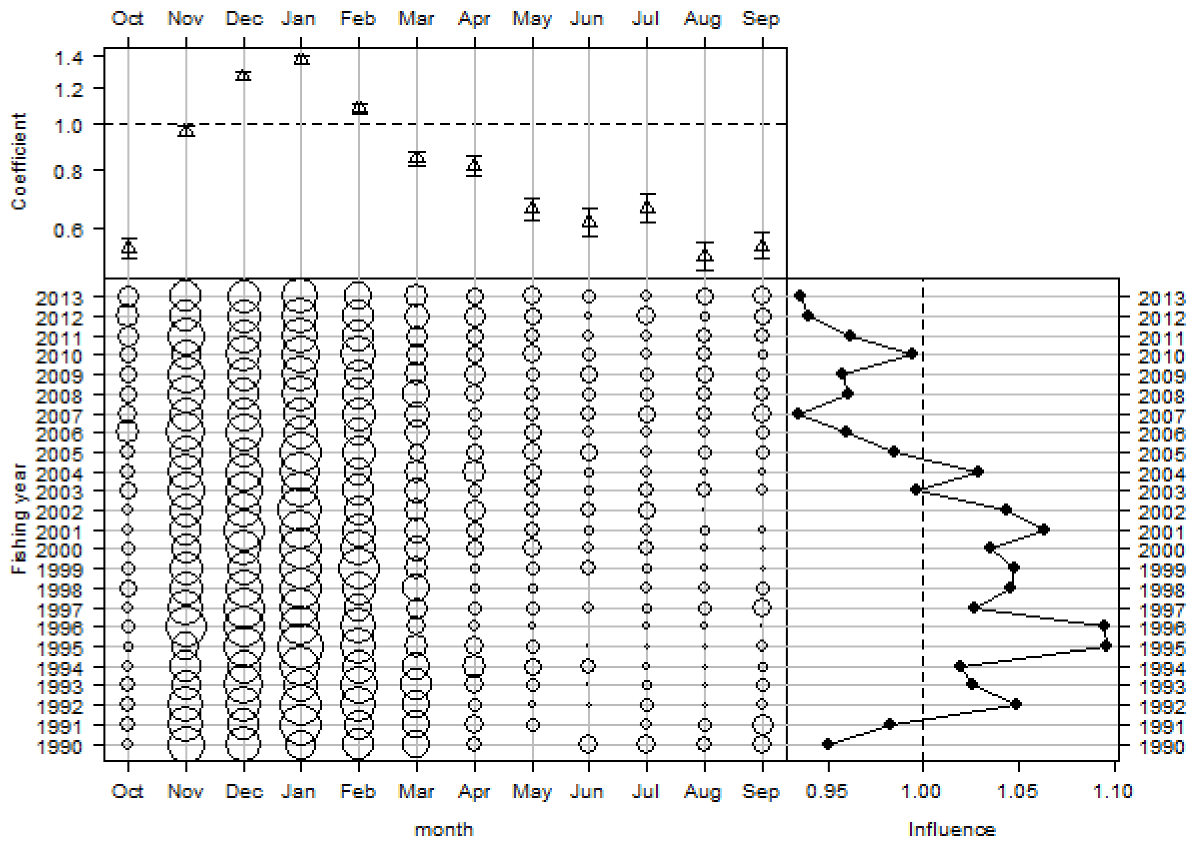

Figure M.9: Effect of month in the lognormal model for the school shark SN-3S5(MIX) fishery. Top: effect by level of variable (left-axis: log space additive; right-axis: natural space multiplicative). Bottom-left: distribution of variable by fishing year. Bottom-right: cumulative effect of variable by fishing year (bottom-axis: log space additive; top-axis: natural space multiplicative).

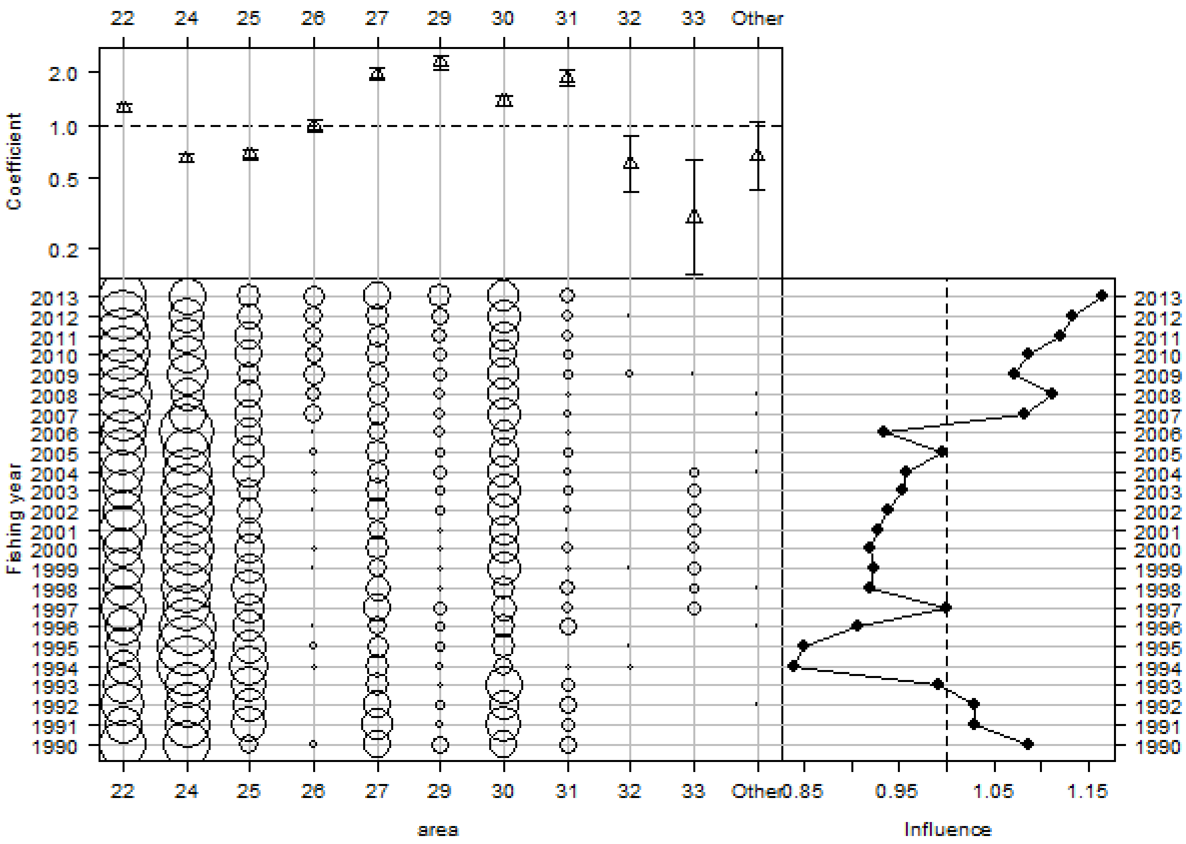

Figure M.10: Effect of area in the lognormal model for the school shark SN-3S5(MIX) fishery. Top: effect by level of variable (left-axis: log space additive; right-axis: natural space multiplicative). Bottom-left: distribution of variable by fishing year. Bottom-right: cumulative effect of variable by fishing year (bottom-axis: log space additive; top-axis: natural space multiplicative).

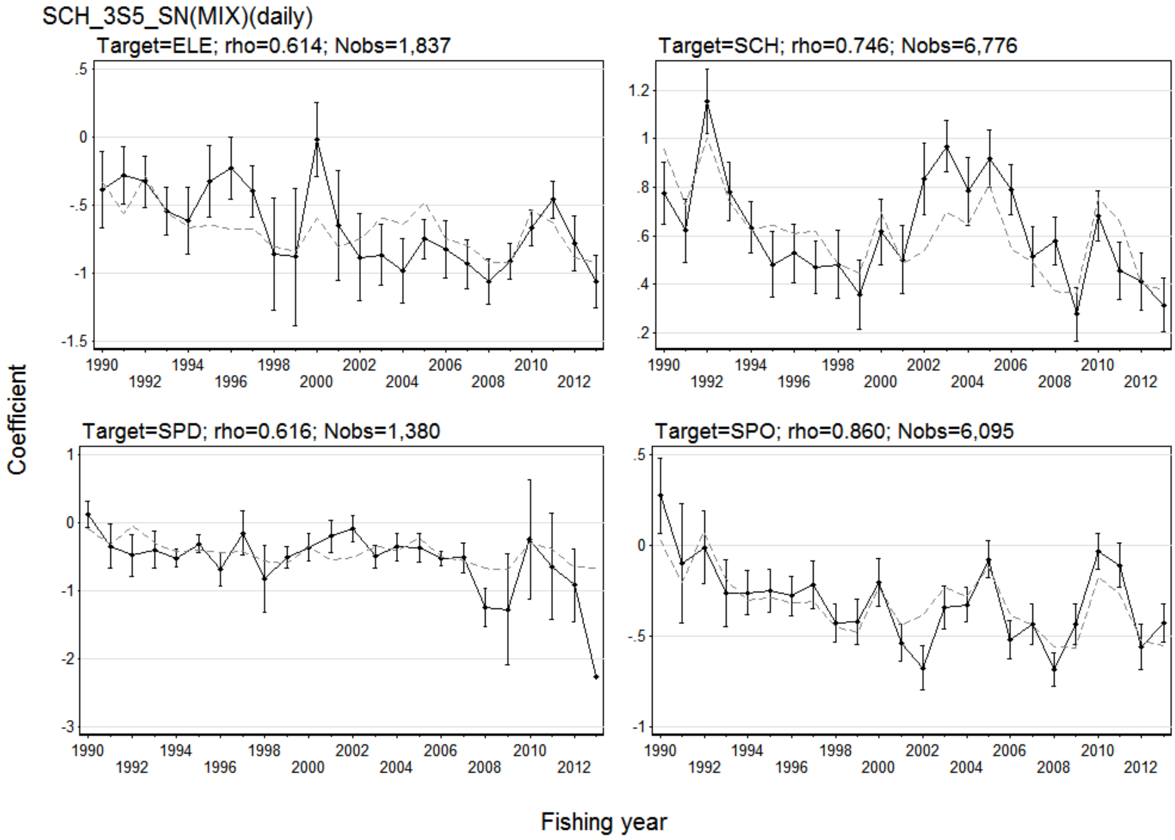

Figure M.11: Residual implied coefficients for target×fishing year interaction (not offered) in the school shark SN-3S5(MIX) lognormal model. Implied coefficients (black points) are calculated as the normalised fishing year coefficient (grey line) plus the mean of the standardised residuals in each fishing year and area. These values approximate the coefficients obtained when an area × year interaction term is fitted, particularly for those area × year combinations which have a substantial proportion of the records. The error bars indicate one standard error of the standardised residuals. The information at the top of each panel identifies the plotted category, provides the correlation coefficient (*rho*) between the category year index and the overall model index, and the number of records supporting the category.

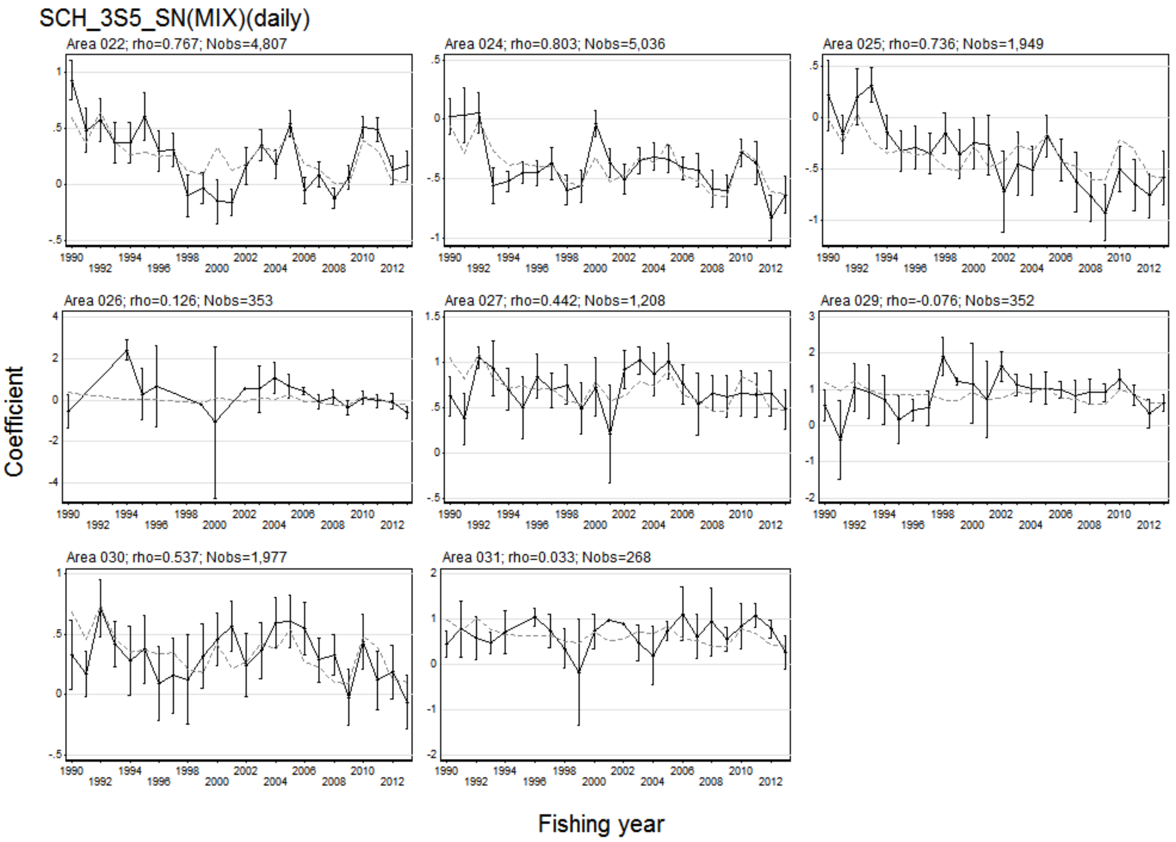

Figure M.12: Residual implied coefficients for area×fishing year interaction (not offered) in the school shark SN-3S5(MIX) lognormal model. Implied coefficients (black points) are calculated as the normalised fishing year coefficient (grey line) plus the mean of the standardised residuals in each fishing year and area. These values approximate the coefficients obtained when an area × year interaction term is fitted, particularly for those area × year combinations which have a substantial proportion of the records. The error bars indicate one standard error of the standardised residuals. The information at the top of each panel identifies the plotted category, provides the correlation coefficient (*rho*) between the category year index and the overall model index, and the number of records supporting the category.

M.11 CPUE INDICES

Table M.3: Arithmetic indices for the total and core data sets, geometric and lognormal standardised indices and associated standard error for the core data set by fishing year for the school shark SN-3S5(MIX) analysis.

Fishing	All vessels			Core vessels	
year	Arithmetic	Arithmetic	Geometric	Standardised	SE
1990	0.781	1.009	1.151	1.414	0.0667
1991	1.000	0.974	1.433	1.121	0.0671
1992	1.128	1.197	1.307	1.479	0.0668
1993	1.050	1.055	1.108	1.139	0.0628
1994	0.799	0.826	0.906	1.012	0.0505
1995	0.918	0.819	0.821	1.031	0.0519
1996	1.060	0.955	0.867	0.998	0.0554
1997	0.913	0.846	0.964	1.007	0.0558
1998	1.062	1.021	0.958	0.877	0.0569
1999	1.043	1.068	0.775	0.848	0.0540
2000	1.112	1.137	1.094	1.086	0.0527
2001	1.066	1.062	0.717	0.882	0.0488
2002	1.040	1.039	0.821	0.931	0.0538
2003	0.966	0.900	0.963	1.088	0.0504
2004	0.880	0.900	1.018	1.036	0.0516
2005	1.158	1.070	1.058	1.221	0.0476
2006	0.732	0.748	0.750	0.933	0.0463
2007	1.568	1.673	1.179	0.884	0.0477
2008	0.999	1.001	0.914	0.785	0.0458
2009	0.938	0.888	0.995	0.780	0.0467
2010	1.111	1.071	1.314	1.153	0.0463
2011	0.968	0.976	1.143	1.048	0.0477
2012	1.048	1.122	1.027	0.809	0.0496
2013	0.935	0.953	1.096	0.790	0.0487

Appendix N. DIAGNOSTICS AND SUPPORTING ANALYSES FOR LOWER SCH 3 & SCH 5 BOTTOM LONGLINE [BLL-3S5(MIX)] CPUE STANDARDISATION

N.1 INTRODUCTION

The basis for the selection of this region for monitoring school shark with this capture method is provided in Section 2.3.3.6 and summarised in Table 14.

N.2 FISHERY DEFINITION

BLL-3S5(MIX): The fishery is defined from bottom longline fishing events which fished in Statistical Areas 022, 023, 024, 025, 026, 027, 028, 029, 030, 031, 032, 033 declaring target species HPB, BNS, SCH, LIN.

N.3 CORE VESSEL SELECTION

The criteria used to define the core fleet were those vessels that had fished for at least 3 trips in each of at least 3 years using trips with at least 1 kg of catch. These criteria resulted in a core fleet size of 23 vessels which took 75% of the catch (Figure N.1).

N.4 DATA SUMMARY

Table N.1: Number of number of core vessels, trips, daily effort strata, number of events that have been "rolled up" into daily effort strata, calculated number of events per daily-effort stratum, number of sets, number hooks (in 1000s), sum of landed SCH (t), proportion of trips with catch and proportion of daily-effort strata with catch by fishing year for core vessels (based on a minimum of 3 trips per year in at least 3 years) in the BLL-3S5(MIX) fishery.

Fishing year	Vessels	Trips	Daily effort strata	Events	Events per stratum	Number of sets	Number hooks ('000s)	Catch (t)	Trips with catch (%)	Strata with catch (%)
1990	4	20	123	135	1.098	170.0	165	4.6	100.00	69.92
1991	4	26	143	143	1.000	156.0	136	2.4	84.62	39.86
1992	7	52	276	277	1.004	295.0	301	4.2	71.15	32.25
1993	10	77	352	355	1.009	427.0	382	9.6	68.83	34.38
1994	10	70	313	317	1.013	364.0	394	4.7	61.43	28.75
1995	12	78	252	253	1.004	260.0	353	3.2	55.13	35.32
1996	9	99	256	256	1.000	257.0	398	7.1	65.66	43.36
1997	8	97	262	263	1.004	285.0	420	9.6	48.45	32.44
1998	7	40	169	170	1.006	182.0	390	1.5	57.50	26.04
1999	11	64	237	241	1.017	270.0	455	13.9	85.94	46.84
2000	10	95	320	321	1.003	417.0	543	18.2	69.47	53.75
2001	10	93	370	374	1.011	467.0	597	24.1	84.95	55.68
2002	10	96	343	344	1.003	451.0	481	21.1	84.38	54.52
2003	10	117	413	414	1.002	510.0	630	35.9	96.58	60.77
2004	10	97	391	420	1.074	482.0	662	28.8	85.57	47.31
2005	11	107	466	512	1.099	602.0	1 004	34.6	72.90	35.84
2006	10	97	384	400	1.042	419.0	733	29.3	91.75	54.95
2007	12	118	536	561	1.047	673.0	1 205	42.1	87.29	44.22
2008	12	127	555	733	1.321	737.0	1 197	52.6	77.95	47.93
2009	12	125	455	558	1.226	558.0	1 198	40.5	82.40	41.98
2010	11	117	470	538	1.145	538.0	1 299	67.8	82.05	51.06
2011	9	125	507	1 044	2.059	1 044.0	1 251	22.9	80.80	57.79
2012	10	120	509	890	1.749	890.0	1 310	22.6	85.83	53.83
2013	9	95	385	630	1.636	630.0	924	24.1	87.37	58.96

N.5 CORE VESSEL SELECTION

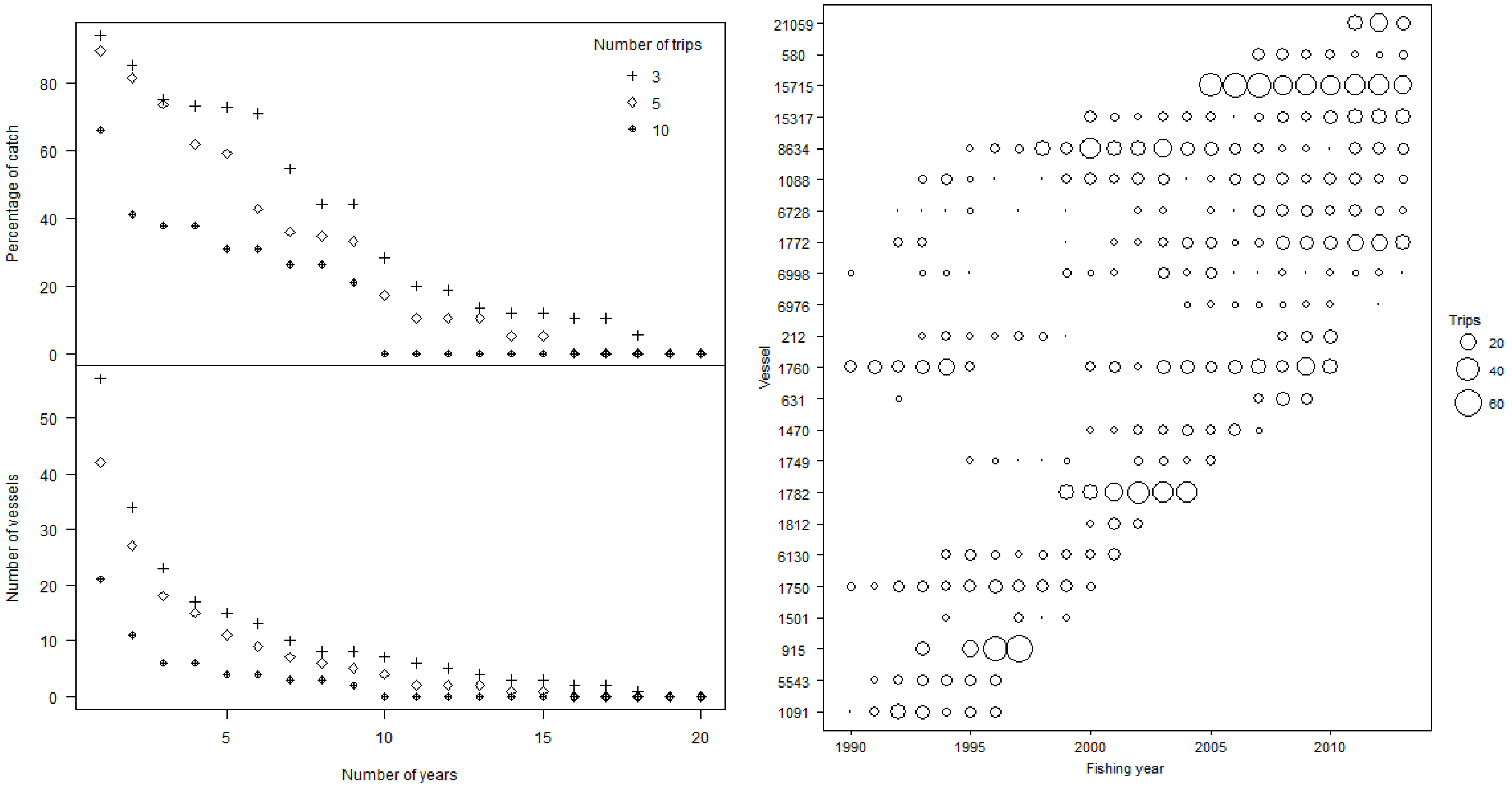

Figure N.1: [left panel] total landed SCH and number of vessels plotted against the number of years used to define core vessels participating in the BLL-3S5(MIX) dataset. The number of qualifying years (minimum number of trips per year) for each series is indicated in the legend. [right panel]: bubble plot showing the number of daily-effort strata for selected core vessels (based on at least 3 trips in 3 or more fishing years) by fishing year.

N.6 EXPLORATORY DATA PLOTS FOR CORE VESSEL DATA SET

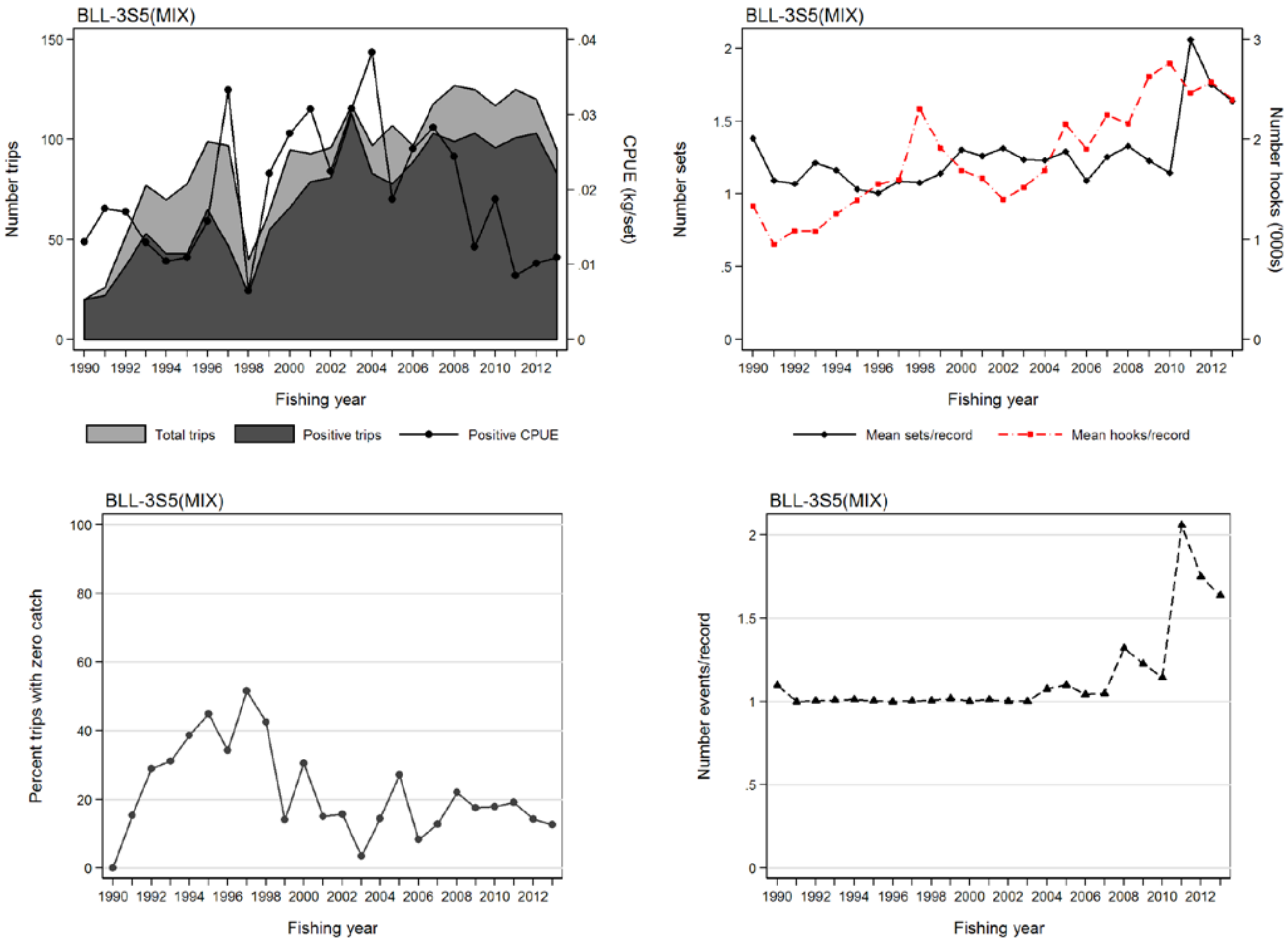

Figure N.2: Core vessel summary plots by fishing year for model BLL-3S5(MIX): [upper left panel]: total trips (light grey) and trips with school shark catch (dark grey) overlaid with median annual arithmetic CPUE (kg/set) for all trips *i* with positive catch: $A_y = \text{median}\left(C_{y,i}/E_{y,i}\right)$**; [upper right panel]: mean number of sets and mean number of hooks per daily-effort stratum record; [lower left panel]: proportion of trips with no catch of school shark; [lower right panel]: mean number of events per daily-effort stratum record.**

N.7 Selection of distribution for positive catch records

The best distribution was lognormal.

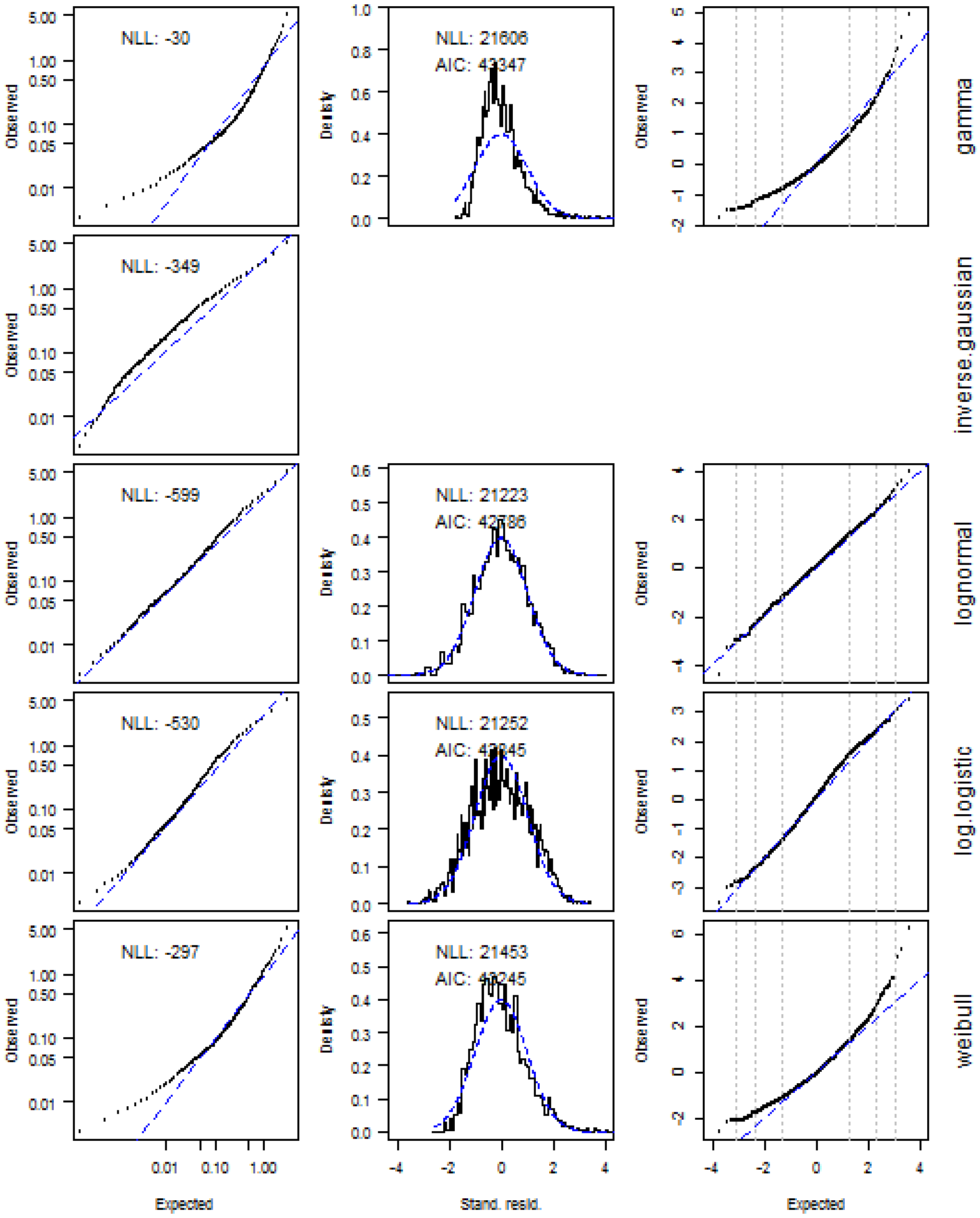

Figure N.3: Diagnostics for alternative distributional assumptions for catch in the school shark BLL-3S5(MIX) model. Left: quantile-quantile plot of observed catches (centred (by mean) and scaled (by standard deviation) in log space) versus maximum likelihood fit of distribution (missing panel indicates that the fit failed to converge); Middle: standardised residuals from a generalised linear model fitted using the formula catch ~ fyear + month +area+ vessel + log(sets) and the distribution (missing panel indicates that the model failed to converge); Right: quantile-quantile plot of model standardised residuals against standard normal (vertical lines represent 0.1%, 1% and 10% percentiles). NLL = negative log-likelihood; AIC = Akaike information criterion.

N.8 POSITIVE CATCH MODEL SELECTION TABLE

Four explanatory variables entered the model after fishing year (Table N.2), with number of hooks and form type non-significant. A plot of the model is provided in Figure N.4 and the CPUE indices are listed in Table N.4.

Table N.2: Order of acceptance of variables into the lognormal model of successful catches in the BLL-3S5(MIX) fishery model for core vessels based on the vessel selection criteria of at least 3 trips in 3 or more fishing years, with the amount of explained deviance and R^2 for each variable. Variables accepted into the model are marked with an *, and the final R^2 of the selected model is in bold. Fishing year was forced as the first variable.

Variable	DF	Neg. Log likelihood	AIC	R^2	Model use
fishing year	24	-7 605	15 260	6.06	*
target	27	-6 988	14 032	31.62	*
vessel	49	-6 800	13 700	37.97	*
month	60	-6 668	13 458	42.07	*
area	70	-6 562	13 265	**45.18**	*
poly(log(hooks), 3)	73	-6 551	13 250	45.49	
form	76	-6 544	13 241	45.70	

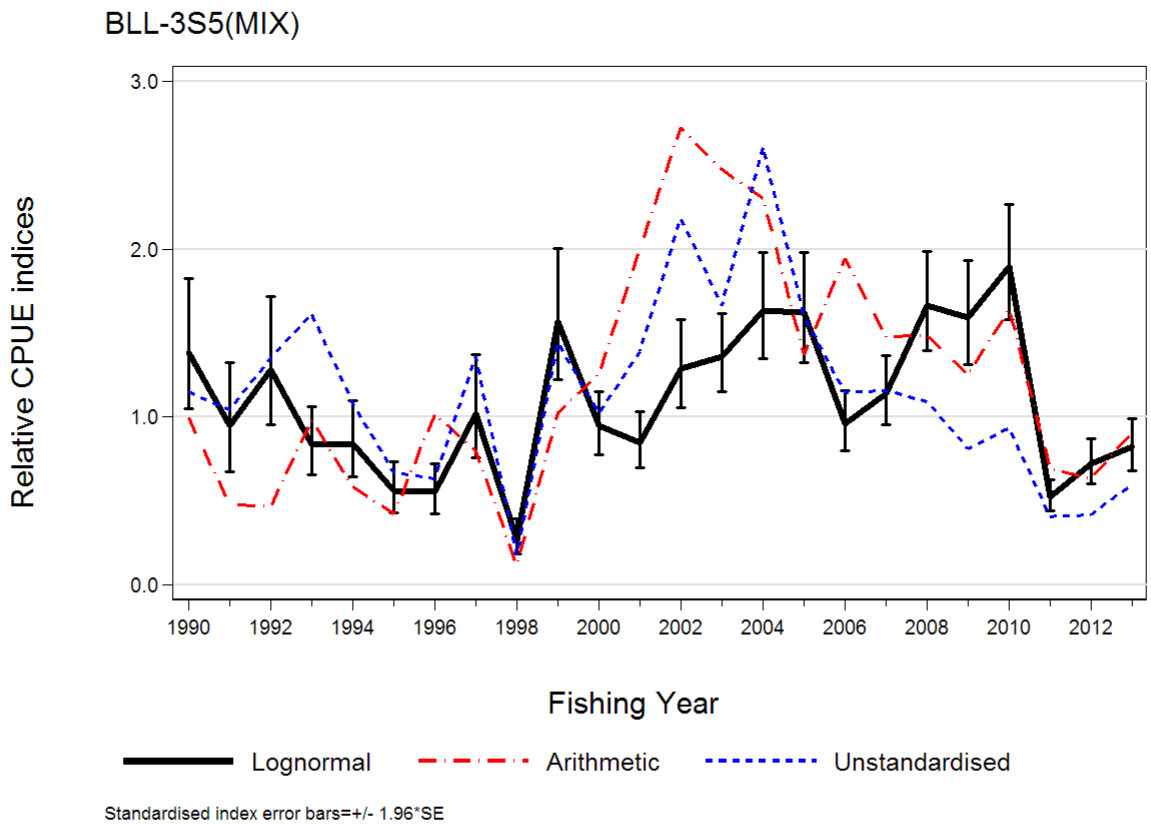

Figure N.4: Relative CPUE indices for school shark using the lognormal non-zero model based on the BLL-3S5(MIX) fishery definition. Also shown are two unstandardised series from the same data: a) Arithmetic (Eq. H.1) and b) Unstandardised (Eq. H.2).

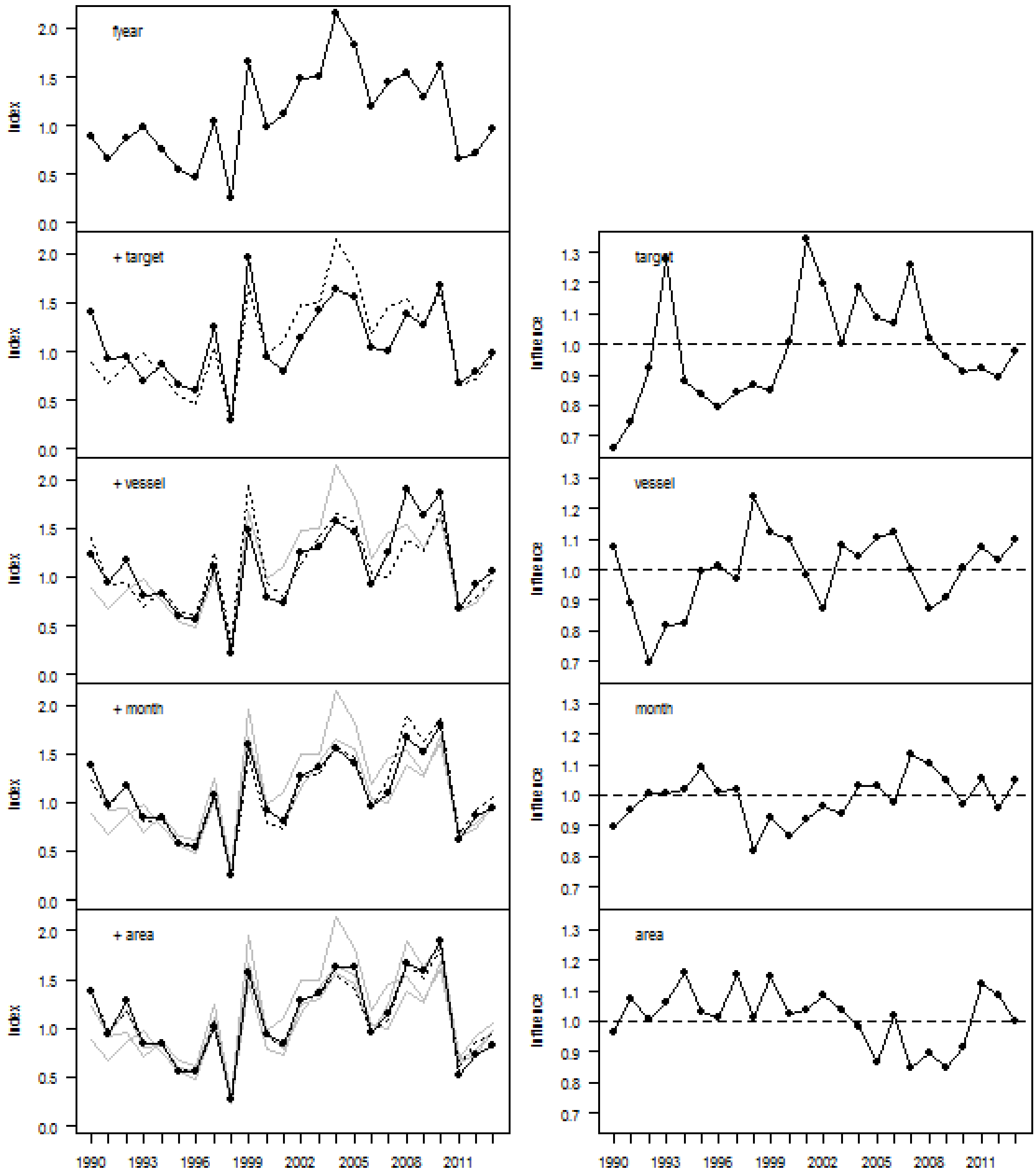

Figure N.5: [left column]: annual indices from the lognormal model of BLL-3S5(MIX) at each step in the variable selection process; [right column]: aggregate influence associated with each step in the variable selection procedure.

N.9 RESIDUAL AND DIAGNOSTIC PLOTS

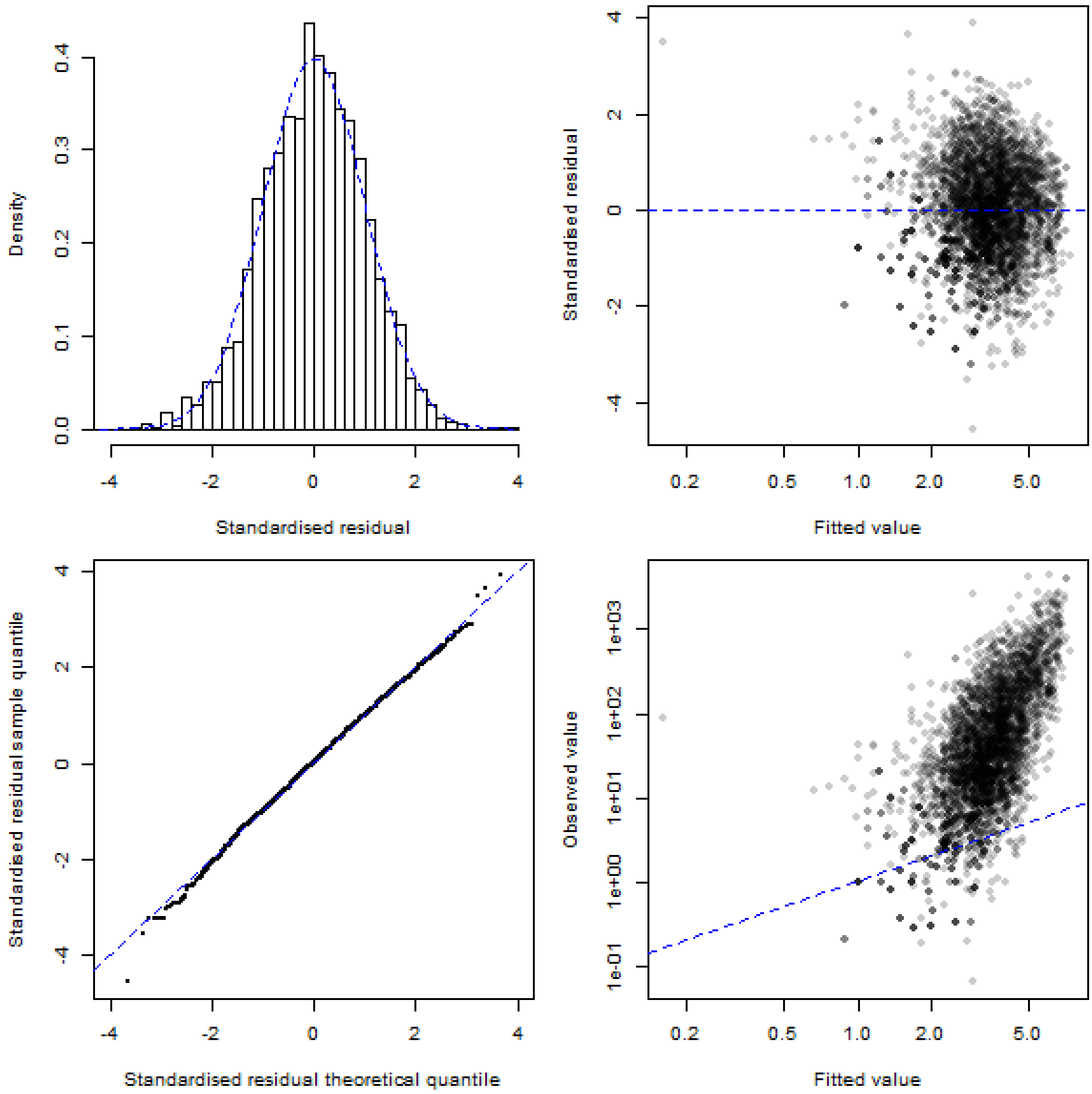

Figure N.6: Plots of the fit of the lognormal standardised CPUE model to successful catches of school shark in the BLL-3S5(MIX) fishery. [Upper left] histogram of the standardised residuals compared to a lognormal distribution (SDSR: standard deviation of standardised residuals. MASR: median of absolute standardised residuals); [Upper right] Q-Q plot of the standardised residuals; [Lower left] Standardised residuals plotted against the predicted model catch per trip; [Lower right] Observed catch per record plotted against the predicted catch per record.

N.10 MODEL COEFFICIENTS

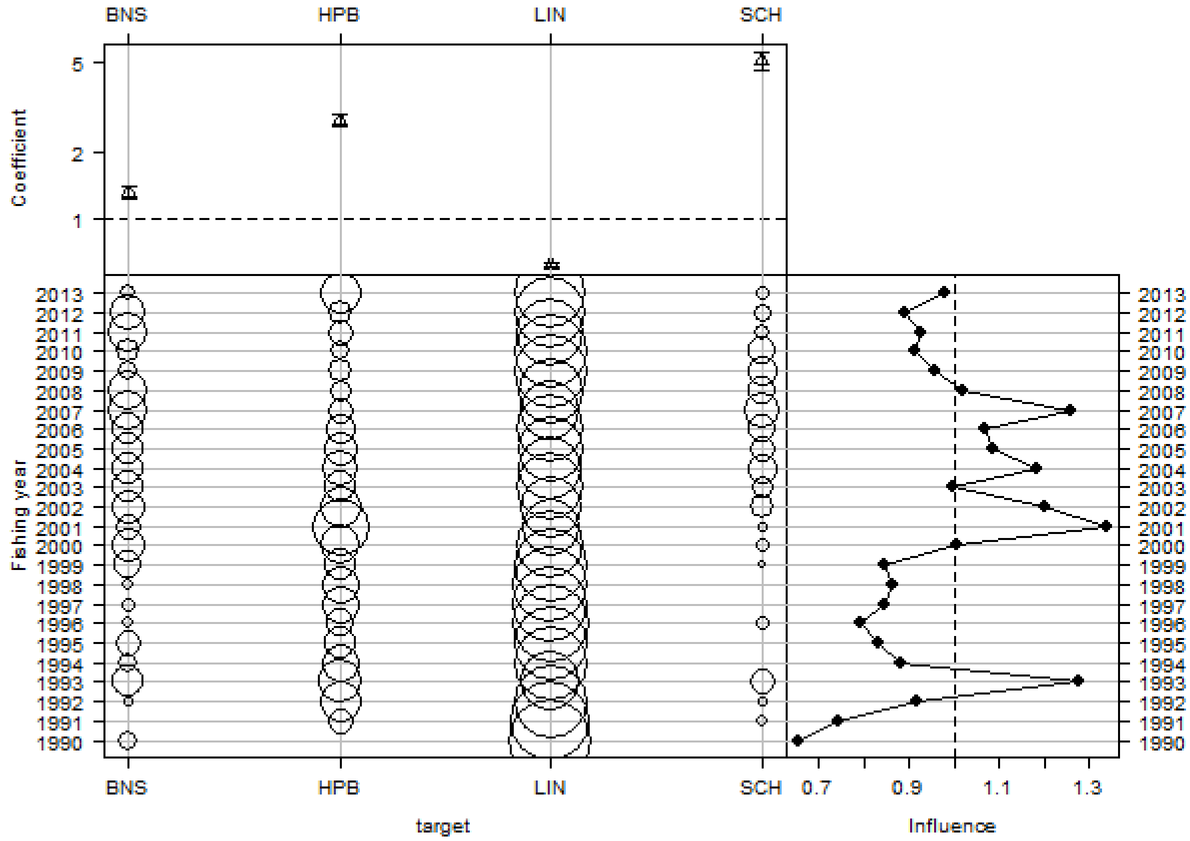

Figure N.7: Effect of target species in the lognormal model for the school shark BLL-3S5(MIX) fishery. Top: effect by level of variable (left-axis: log space additive; right-axis: natural space multiplicative). Bottom-left: distribution of variable by fishing year. Bottom-right: cumulative effect of variable by fishing year (bottom-axis: log space additive; top-axis: natural space multiplicative).

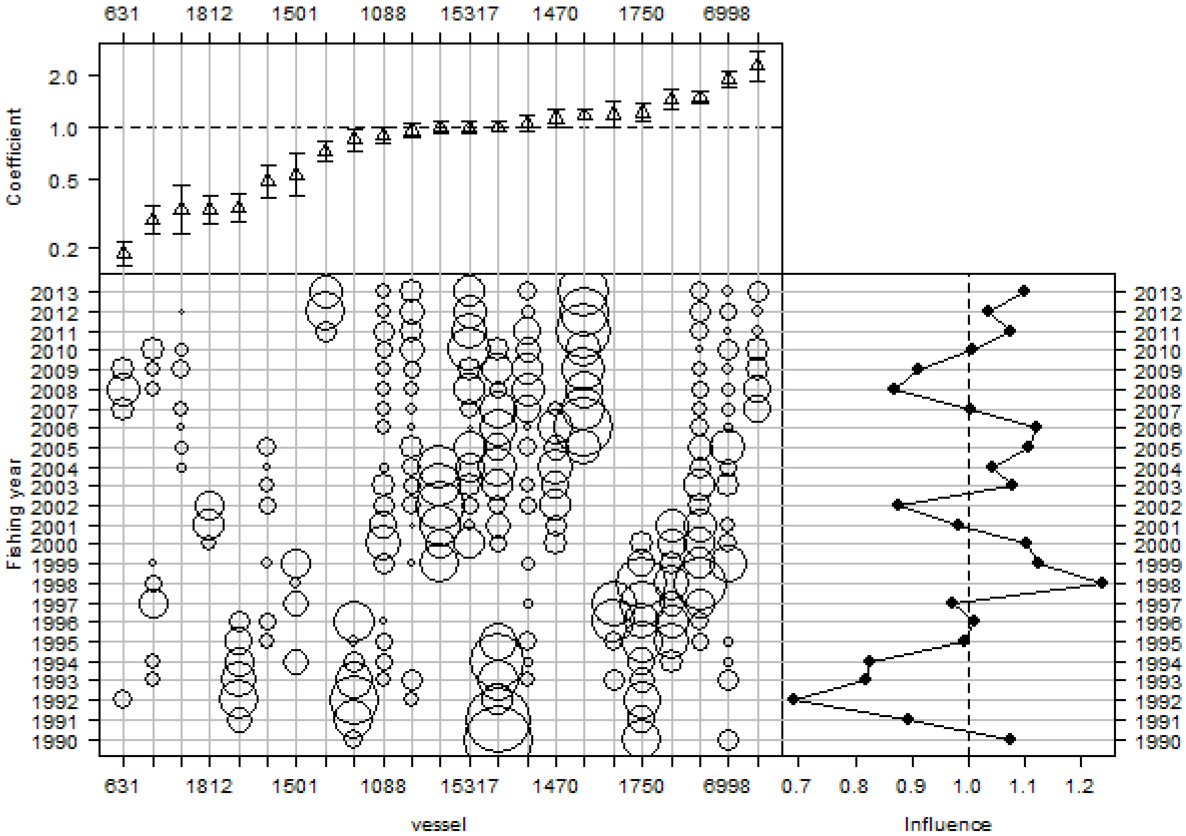

Figure N.8: Effect of vessel in the lognormal model for the school shark BLL-3S5(MIX) fishery. Top: effect by level of variable (left-axis: log space additive; right-axis: natural space multiplicative). Bottom-left: distribution of variable by fishing year. Bottom-right: cumulative effect of variable by fishing year (bottom-axis: log space additive; top-axis: natural space multiplicative).

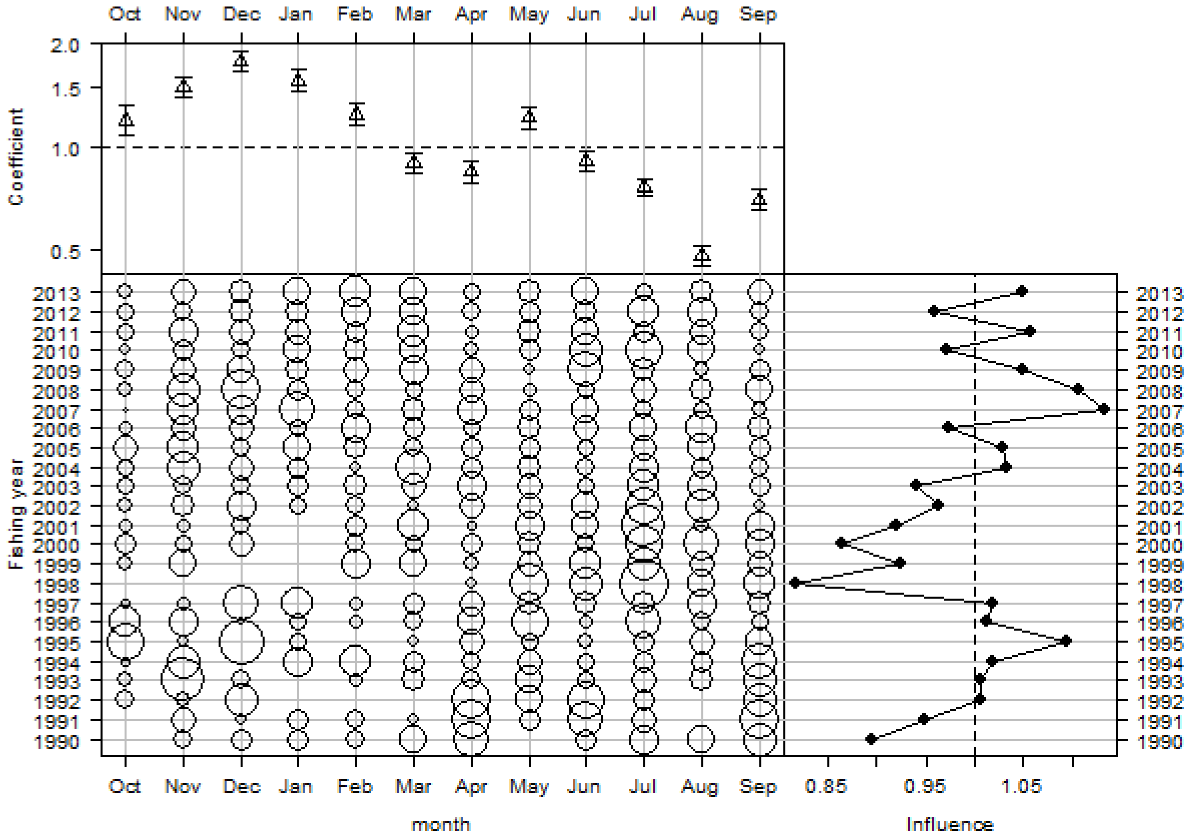

Figure N.9: Effect of month in the lognormal model for the school shark BLL-3S5(MIX) fishery. Top: effect by level of variable (left-axis: log space additive; right-axis: natural space multiplicative). Bottom-left: distribution of variable by fishing year. Bottom-right: cumulative effect of variable by fishing year (bottom-axis: log space additive; top-axis: natural space multiplicative).

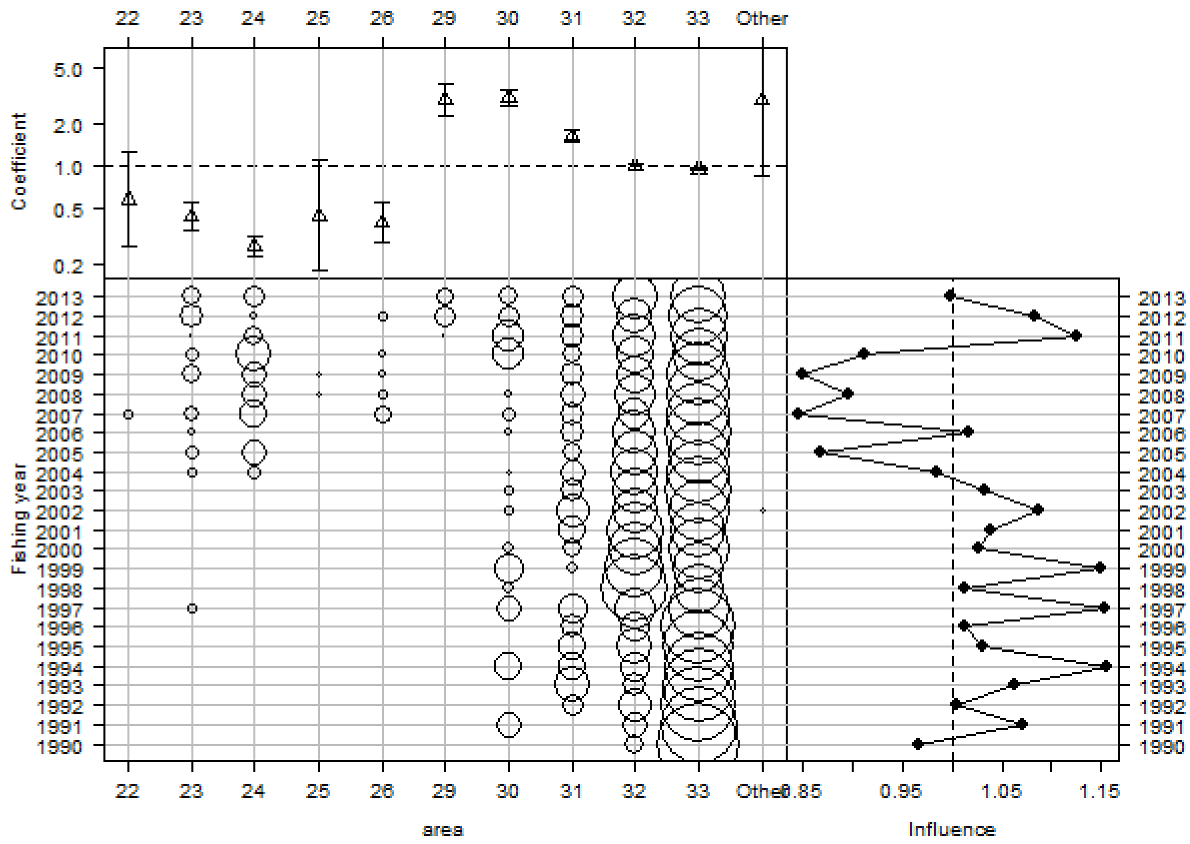

Figure N.10: Effect of area in the lognormal model for the school shark BLL-3S5(MIX) fishery. Top: effect by level of variable (left-axis: log space additive; right-axis: natural space multiplicative). Bottom-left: distribution of variable by fishing year. Bottom-right: cumulative effect of variable by fishing year (bottom-axis: log space additive; top-axis: natural space multiplicative).

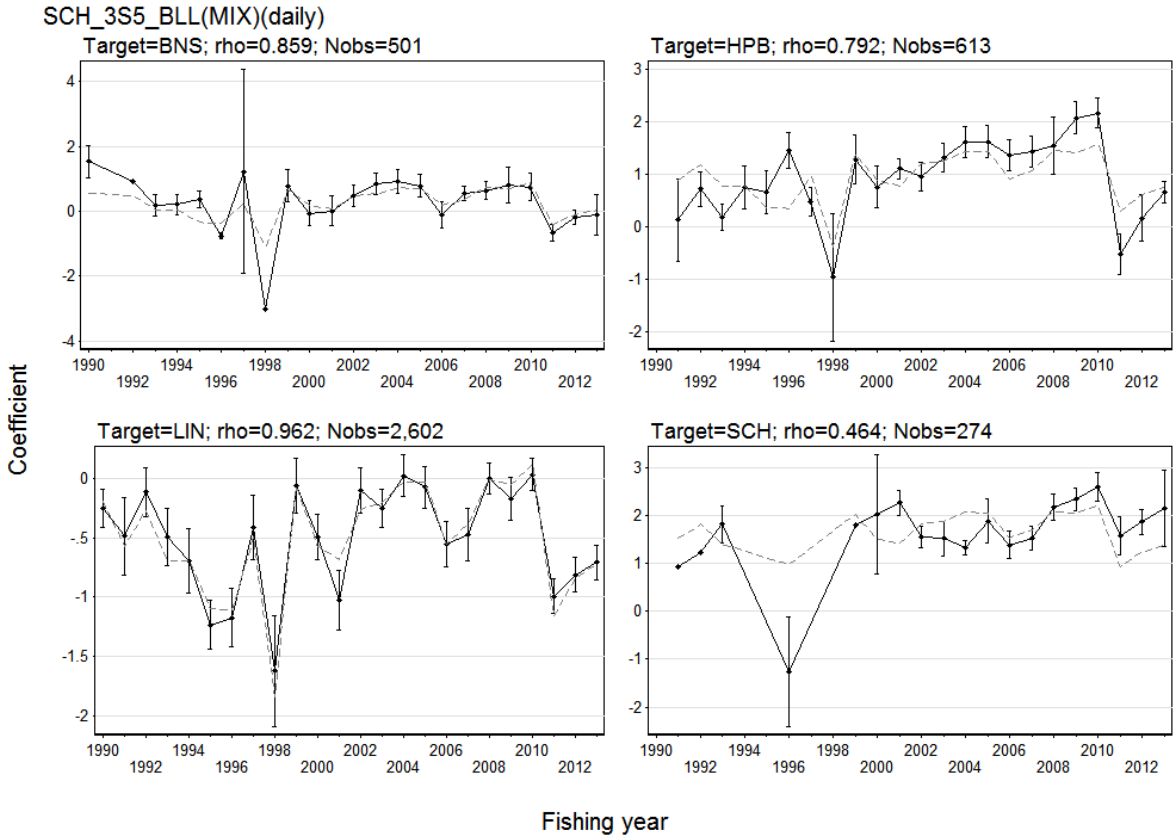

Figure N.11: Residual implied coefficients for target×fishing year interaction (not offered) in the school shark BLL-3S5(MIX) lognormal model. Implied coefficients (black points) are calculated as the normalised fishing year coefficient (grey line) plus the mean of the standardised residuals in each fishing year and area. These values approximate the coefficients obtained when an area × year interaction term is fitted, particularly for those area × year combinations which have a substantial proportion of the records. The error bars indicate one standard error of the standardised residuals. The information at the top of each panel identifies the plotted category, provides the correlation coefficient (*rho*) between the category year index and the overall model index, and the number of records supporting the category.

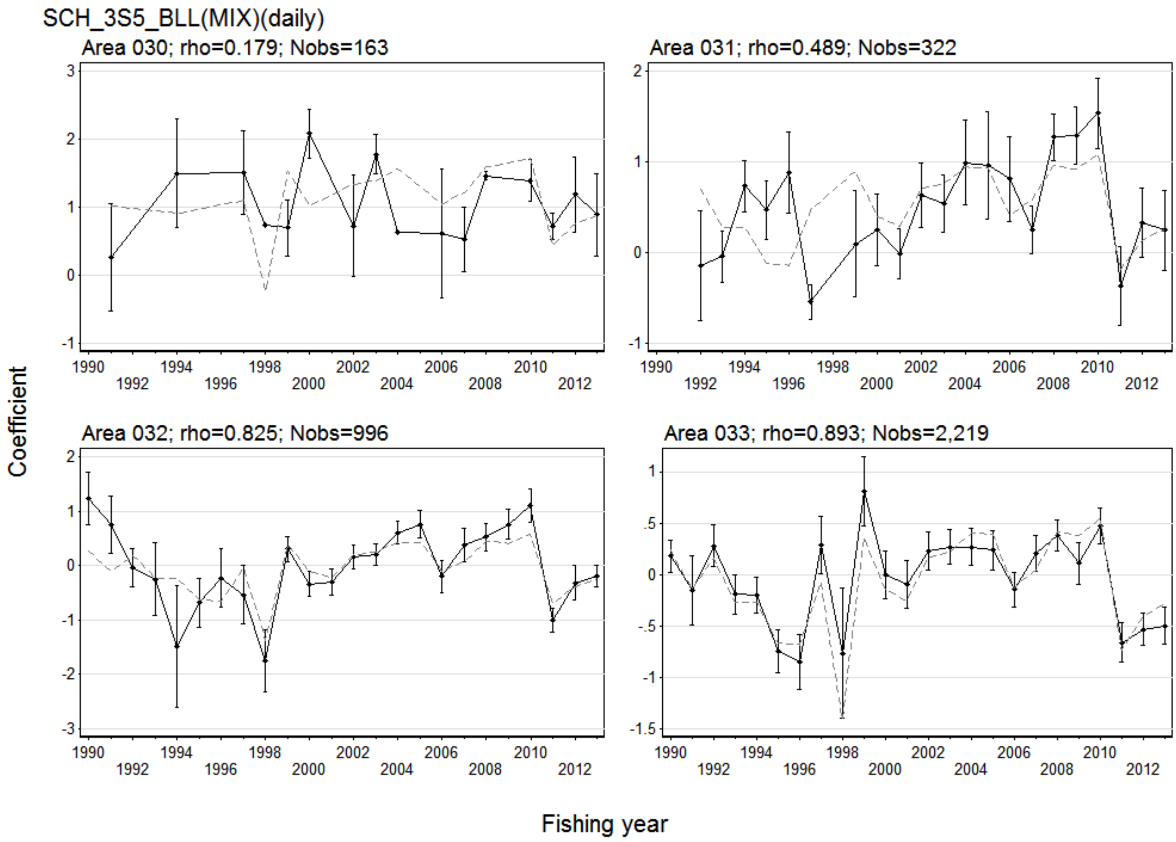

Figure N.12: Residual implied coefficients for area×fishing year interaction (not offered) in the school shark BLL-3S5(MIX) lognormal model. Implied coefficients (black points) are calculated as the normalised fishing year coefficient (grey line) plus the mean of the standardised residuals in each fishing year and area. These values approximate the coefficients obtained when an area × year interaction term is fitted, particularly for those area × year combinations which have a substantial proportion of the records. The error bars indicate one standard error of the standardised residuals. The information at the top of each panel identifies the plotted category, provides the correlation coefficient (*rho*) between the category year index and the overall model index, and the number of records supporting the category. Categories with fewer than 10 observations or short time series are not plotted.

N.11 LOGISTIC (BINOMIAL) MODEL SELECTION TABLE

Four explanatory variables entered the model after fishing year (Table N.3), with number of hooks and form type non-significant. A plot of the binomial model and the combined delta-lognormal model is provided in Figure N.13 and the CPUE indices are listed in Table N.4.

Table N.3: Order of acceptance of variables into the binomial (logistic) model of successful catches in the BLL-3S5(MIX) fishery model for core vessels based on the vessel selection criteria of at least 3 trips in 3 or more fishing years), with the amount of explained deviance and R^2 for each variable. Variables accepted into the model are marked with an *, and the final R^2 of the selected model is in bold. Fishing year was forced as the first variable.

Variable	DF	Neg. Log likelihood	AIC	R^2	Model use
fishing year	24	-5 695	11 438	5.32	*
target	27	-5 341	10 736	15.57	*
vessel	49	-5 192	10 482	19.65	*
month	60	-5 108	10 337	21.87	*
area	70	-5 066	10 272	**22.98**	*
poly(log(hooks), 3)	73	-5 045	10 235	23.53	

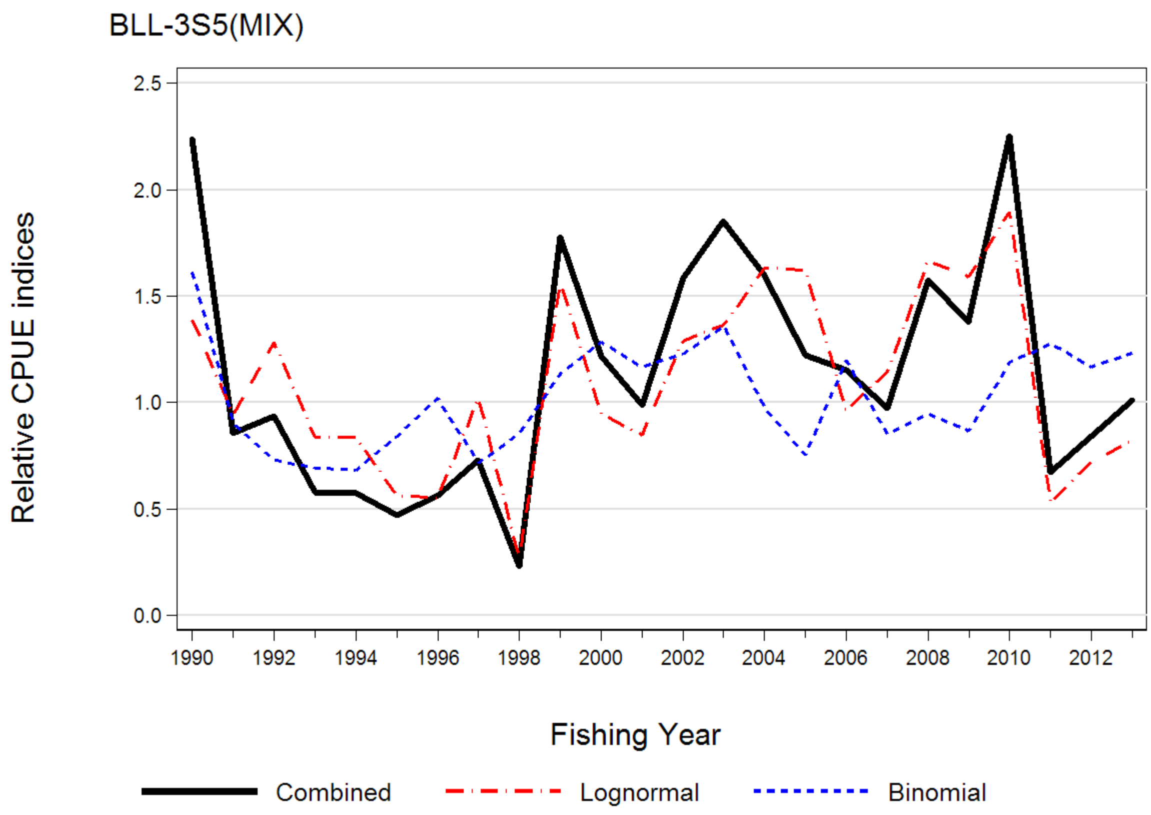

Figure N.13: Relative CPUE indices for school shark using the lognormal non-zero model based on the BLL-3S5(MIX) fishery definition, the binomial standardised model using the logistic distribution and a regression based on presence/absence of SCH, and the combined model using the delta-lognormal procedure suggested by Vignaux (1994).

N.12 CPUE INDICES

Table N.4: Arithmetic indices for the total and core data sets, geometric and lognormal standardised indices and associated standard error (SE) for the core data set by fishing year for the school shark BLL-3S5(MIX) analysis. All series (except SE) standardised to geometric mean=1.0.

Fishing	All vessels						Core vessels
year	Arithmetic	Arithmetic	Geometric	Standardised	SE	Binomial	Combined
1990	1.404	0.994	1.151	1.387	0.1407	0.740	2.239
1991	0.919	0.481	1.042	0.946	0.1712	0.414	0.854
1992	1.241	0.465	1.352	1.282	0.1495	0.334	0.934
1993	1.198	0.983	1.616	0.837	0.1227	0.317	0.579
1994	0.383	0.585	1.083	0.839	0.1367	0.313	0.573
1995	0.578	0.423	0.670	0.561	0.1383	0.385	0.471
1996	1.333	1.017	0.633	0.552	0.1379	0.467	0.563
1997	0.987	0.802	1.361	1.019	0.1522	0.328	0.730
1998	0.094	0.118	0.175	0.267	0.1940	0.392	0.228
1999	1.126	1.026	1.443	1.567	0.1264	0.520	1.777
2000	1.120	1.254	1.025	0.946	0.1012	0.589	1.216
2001	1.929	2.002	1.389	0.847	0.1003	0.535	0.989
2002	6.095	2.729	2.186	1.291	0.1035	0.563	1.586
2003	2.077	2.475	1.663	1.363	0.0868	0.623	1.853
2004	2.057	2.306	2.611	1.634	0.0991	0.448	1.596
2005	0.824	1.373	1.600	1.622	0.1023	0.345	1.221
2006	1.048	1.943	1.147	0.962	0.0951	0.549	1.153
2007	0.920	1.476	1.157	1.142	0.0922	0.390	0.971
2008	1.073	1.488	1.094	1.665	0.0904	0.433	1.574
2009	0.968	1.249	0.812	1.592	0.0987	0.397	1.379
2010	1.254	1.644	0.935	1.895	0.0918	0.544	2.250
2011	0.652	0.692	0.407	0.525	0.0882	0.585	0.671
2012	0.503	0.632	0.417	0.722	0.0940	0.535	0.842
2013	0.886	0.913	0.599	0.820	0.0974	0.565	1.011

Appendix O. DIAGNOSTICS AND SUPPORTING ANALYSES FOR CHATHAM RISE (SCH 4) BOTTOM LONGLINE [BLL-CHATRISE(MIX)] CPUE STANDARDISATION

O.1 INTRODUCTION

The basis for the selection of this region for monitoring school shark with this capture method is provided in Section 2.3.3.6 and summarised in Table 14.

O.2 FISHERY DEFINITION

BLL-ChatRise(MIX): The fishery is defined from bottom longline fishing events which fished in Statistical Areas 019, 020, 021, 049, 050, 051, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412 declaring target species HPB, BNS, SCH, LIN.

The analysis was constrained to the period 2003–04 to 2012–13 because of the lack of continuity among vessels before 2001 and after 2003 (see Figure O.1). Furthermore, there was a sharp rise in the catches associated with this fishery after 2001–02, with little catch available for analysis before 2003–04 (Figure O.2).

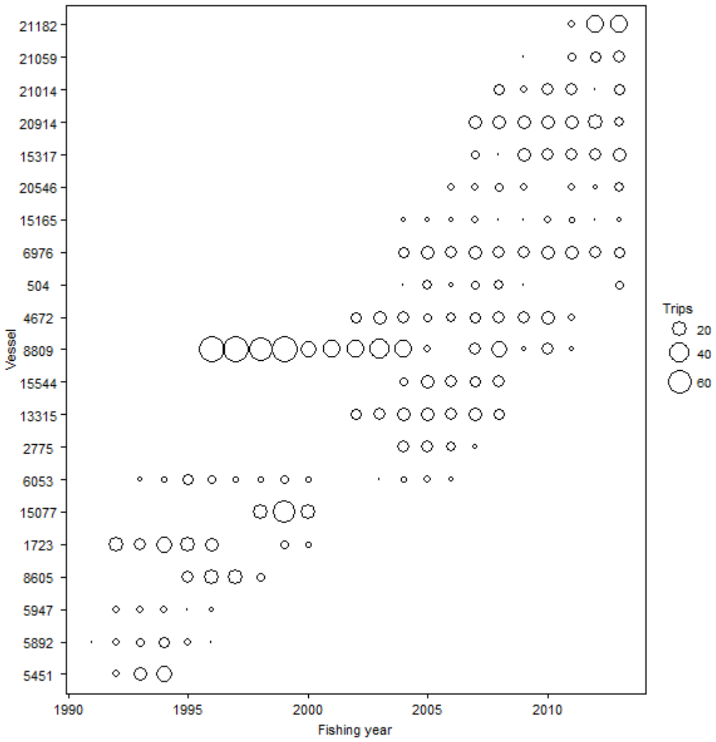

Figure O.1: Bubble plot showing the number of daily-effort strata for BLL-ChatRise(MIX) vessels by fishing year when applying the vessel selection procedure to the full data set, beginning in 1990. Note the complete lack of overlap between the block of vessels before 2001 and after 2003, with the exception of vessel 8809.

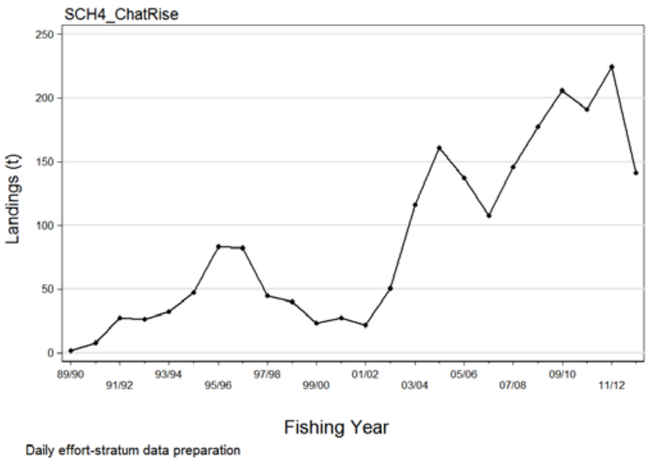

Figure O.2: Annual BLL catches in the BLL-ChatRise(MIX) fishery.

O.3 CORE VESSEL SELECTION

The criteria used to define the core fleet were those vessels that had fished for at least 3 trips in each of at least 3 years using trips with at least 1 kg of catch. These criteria resulted in a core fleet size of 14 vessels which took 80% of the catch (Figure O.3).

O.4 DATA SUMMARY

Table O.1: Number of number of core vessels, trips, daily effort strata, number of events that have been “rolled up” into daily effort strata, calculated number of events per daily-effort stratum, number of sets, number hooks (in 1000s), sum of landed SCH (t), proportion of trips with catch and proportion of daily-effort strata with catch by fishing year for core vessels (based on a minimum of 3 trips per year in at least 3 years) in the BLL-ChatRise(MIX) fishery.

Fishing year	Vessels	Trips	Daily effort strata	Events	Events per stratum	Number of sets	Number hooks (‘000s)	Catch (t)	Trips with catch (%)	Strata with catch (%)
2004	8	96	449	1 203	2.679	1 528	5 125.3	28.14	73.96	67.48
2005	8	89	691	2 369	3.428	2 508	10 045.5	34.14	86.52	70.91
2006	8	70	609	2 390	3.924	2 450	9 533.0	28.11	84.29	58.13
2007	11	110	844	2 936	3.479	3 060	11 303.5	31.07	78.18	55.57
2008	11	117	757	2 854	3.770	2 854	8 652.6	34.57	87.18	54.03
2009	10	79	587	2 145	3.654	2 145	7 713.6	54.64	83.54	67.46
2010	7	98	738	2 995	4.058	2 995	12 357.0	47.23	86.73	76.42
2011	10	88	765	3 242	4.238	3 242	11 285.4	41.25	94.32	66.54
2012	8	90	710	3 192	4.496	3 192	9 648.1	57.75	87.78	77.46
2013	9	107	747	2 469	3.305	2 469	9 196.6	39.78	83.18	61.04

O.5 CORE VESSEL SELECTION

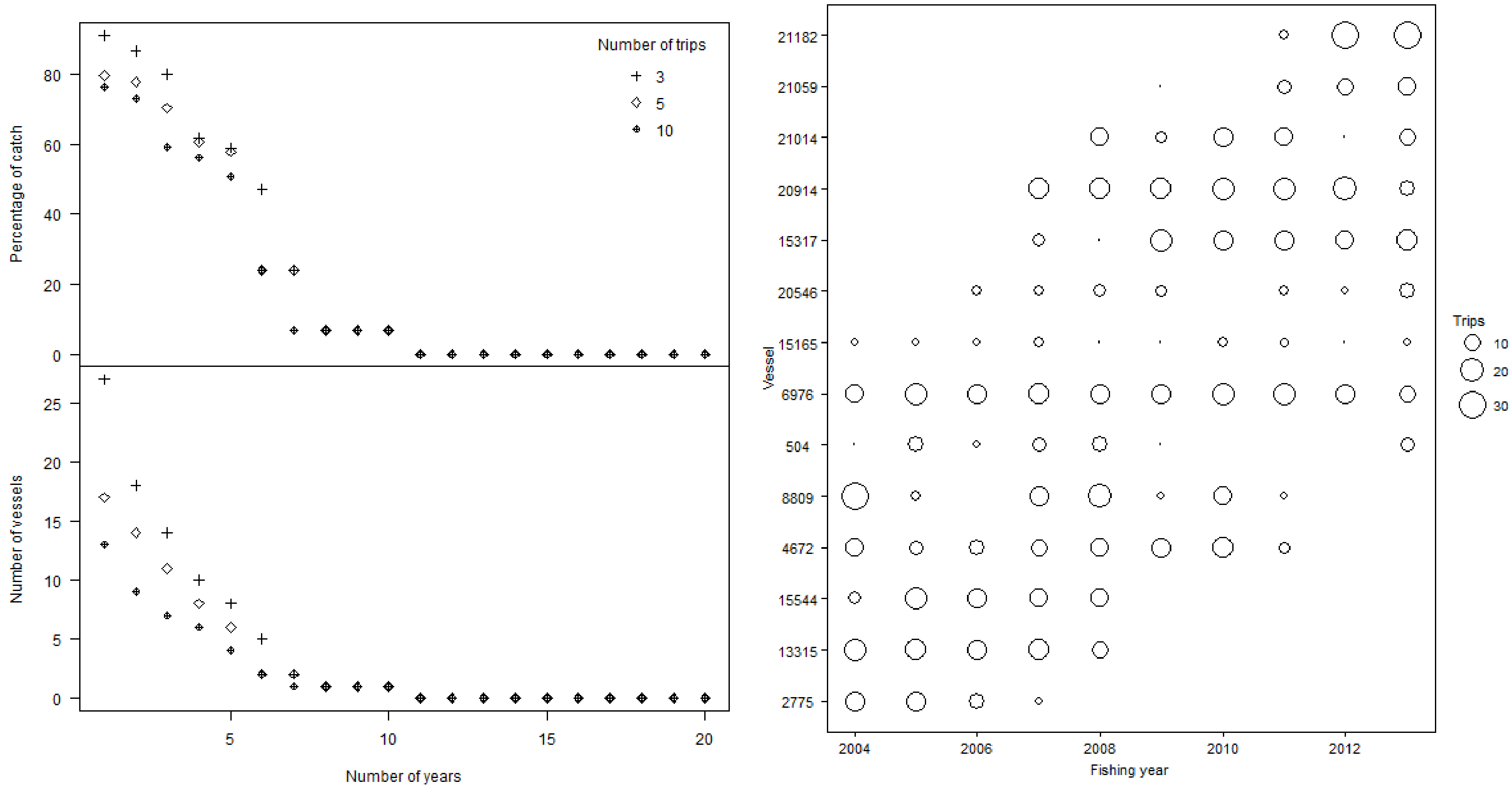

Figure O.3: [left panel] total landed SCH and number of vessels plotted against the number of years used to define core vessels participating in the BLL-ChatRise(MIX) dataset. The number of qualifying years (minimum number of trips per year) for each series is indicated in the legend. [right panel]: bubble plot showing the number of daily-effort strata for selected core vessels (based on at least 3 trips in 3 or more fishing years) by fishing year

O.6 EXPLORATORY DATA PLOTS FOR CORE VESSEL DATA SET

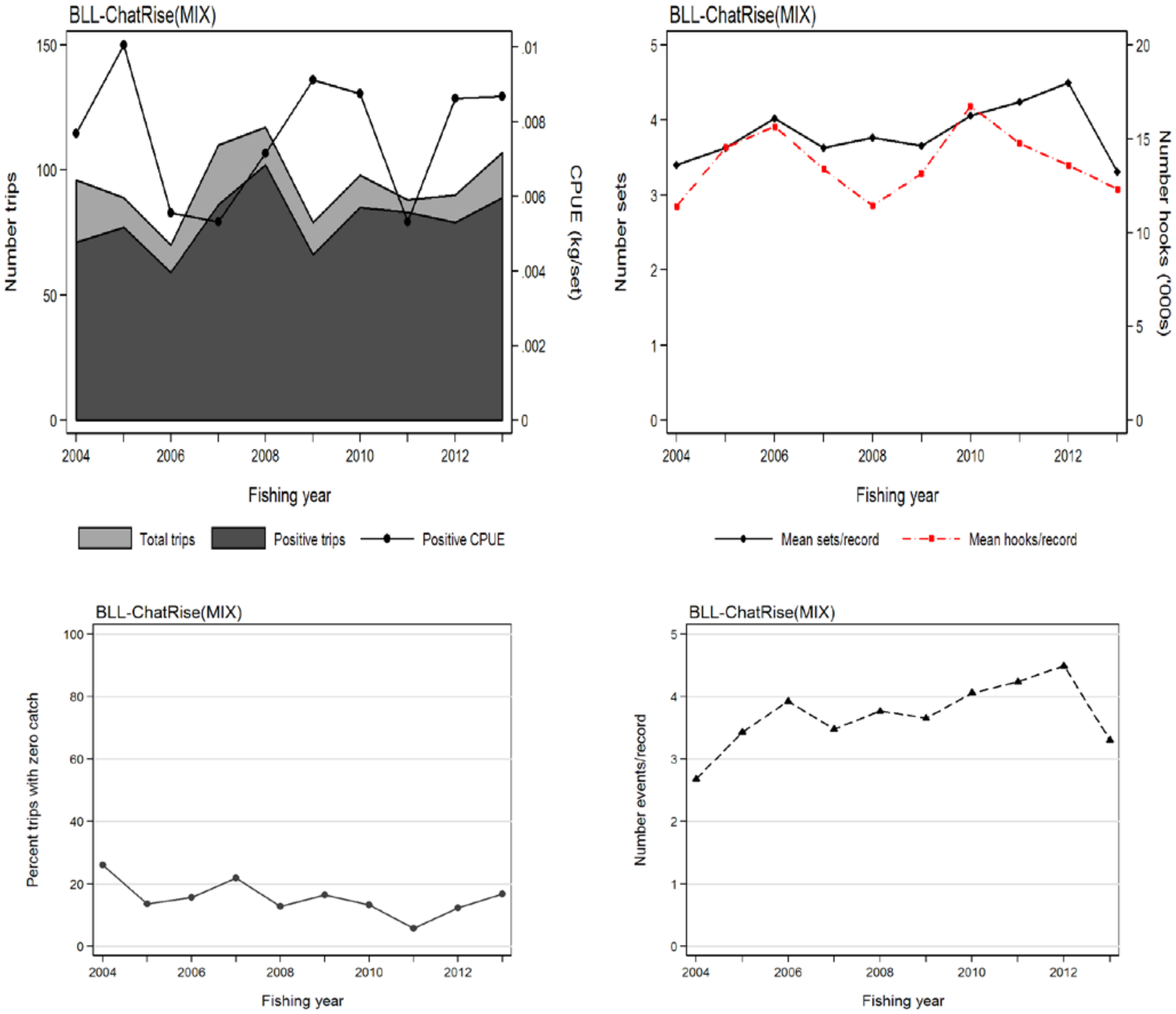

Figure O.4: Core vessel summary plots by fishing year for model BLL-ChatRise(MIX): [upper left panel]: total trips (light grey) and trips with school shark catch (dark grey) overlaid with median annual arithmetic CPUE (kg/set) for all trips *i* with positive catch: $A_y = \text{median}\left(C_{y,i} / E_{y,i}\right)$; [upper right panel]: mean number of sets and mean number of hooks per daily-effort stratum record; [lower left panel]: proportion of trips with no catch of school shark; [lower right panel]: mean number of events per daily-effort stratum record.

O.7 SELECTION OF DISTRIBUTION FOR POSITIVE CATCH RECORDS

The best distribution was lognormal.

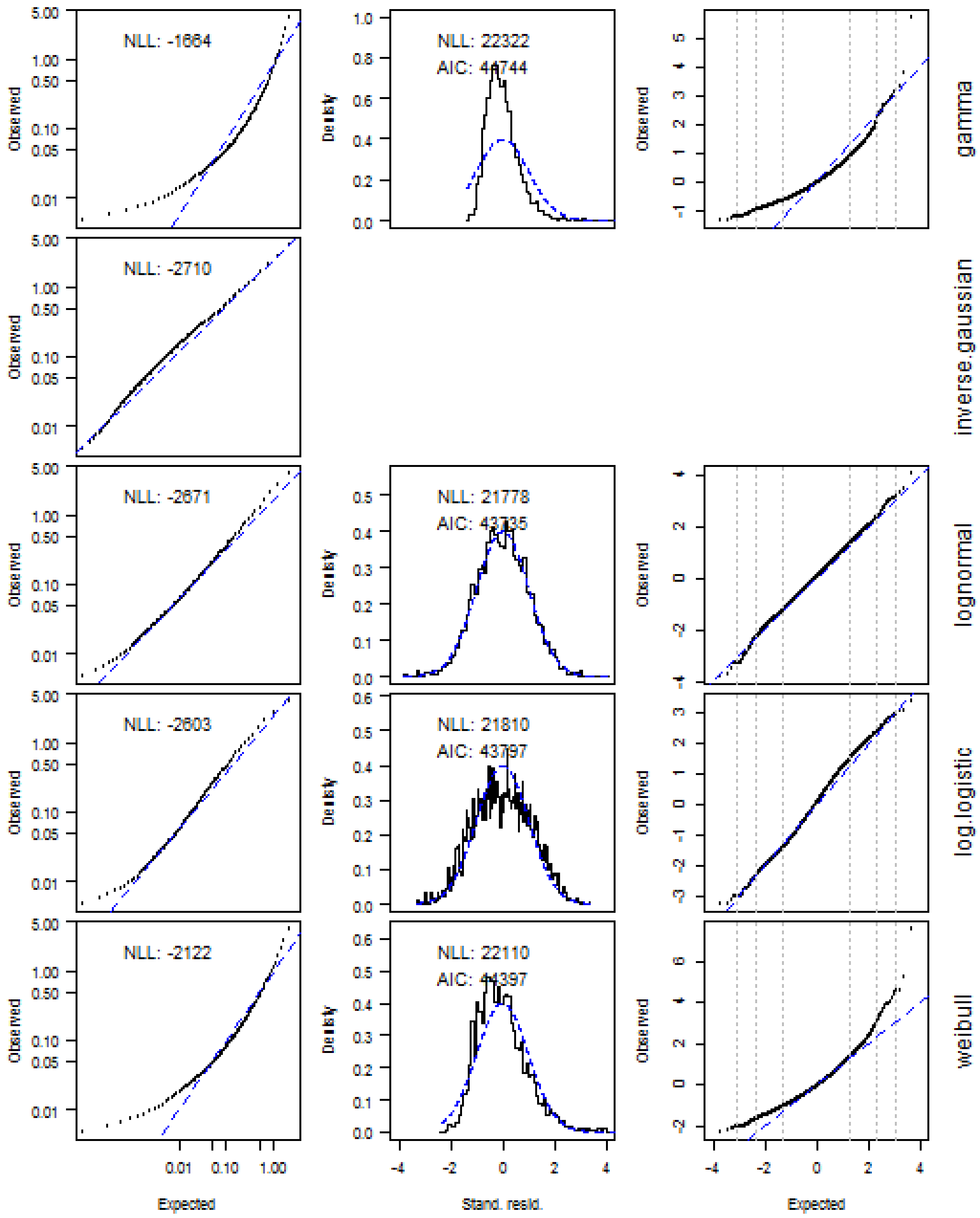

Figure O.5: Diagnostics for alternative distributional assumptions for catch in the school shark BLL-ChatRise(MIX) model. Left: quantile-quantile plot of observed catches (centred (by mean) and scaled (by standard deviation) in log space) versus maximum likelihood fit of distribution (missing panel indicates that the fit failed to converge); Middle: standardised residuals from a generalised linear model fitted using the formula catch ~ fyear + month +area+ vessel + log(sets) and the distribution (missing panel indicates that the model failed to converge); Right: quantile-quantile plot of model standardised residuals against standard normal (vertical lines represent 0.1%, 1% and 10% percentiles). NLL = negative log-likelihood; AIC = Akaike information criterion.

O.8 POSITIVE CATCH MODEL SELECTION TABLE

Four explanatory variables entered the model after fishing year (Table O.2), with number of hooks and form type non-significant. A plot of the model is provided in Figure O.6 and the CPUE indices are listed in Table O.4.

Table O.2: Order of acceptance of variables into the lognormal model of successful catches in the BLL-ChatRise(MIX) fishery model for core vessels based on the vessel selection criteria of at least 3 trips in 3 or more fishing years, with the amount of explained deviance and R^2 for each variable. Variables accepted into the model are marked with an *, and the final R^2 of the selected model is in bold. Fishing year was forced as the first variable.

Variable	DF	Neg. Log likelihood	AIC	R^2	Model use
fishing year	10	-8 408	16 837	1.23	*
target	13	-7 697	15 421	28.64	*
vessel	26	-7 499	15 052	34.85	*
area	41	-7 421	14 926	37.16	*
month	52	-7 378	14 861	**38.40**	*
form	54	-7 362	14 834	38.83	
poly(log(hooks), 3)	57	-7 350	14 817	39.17	

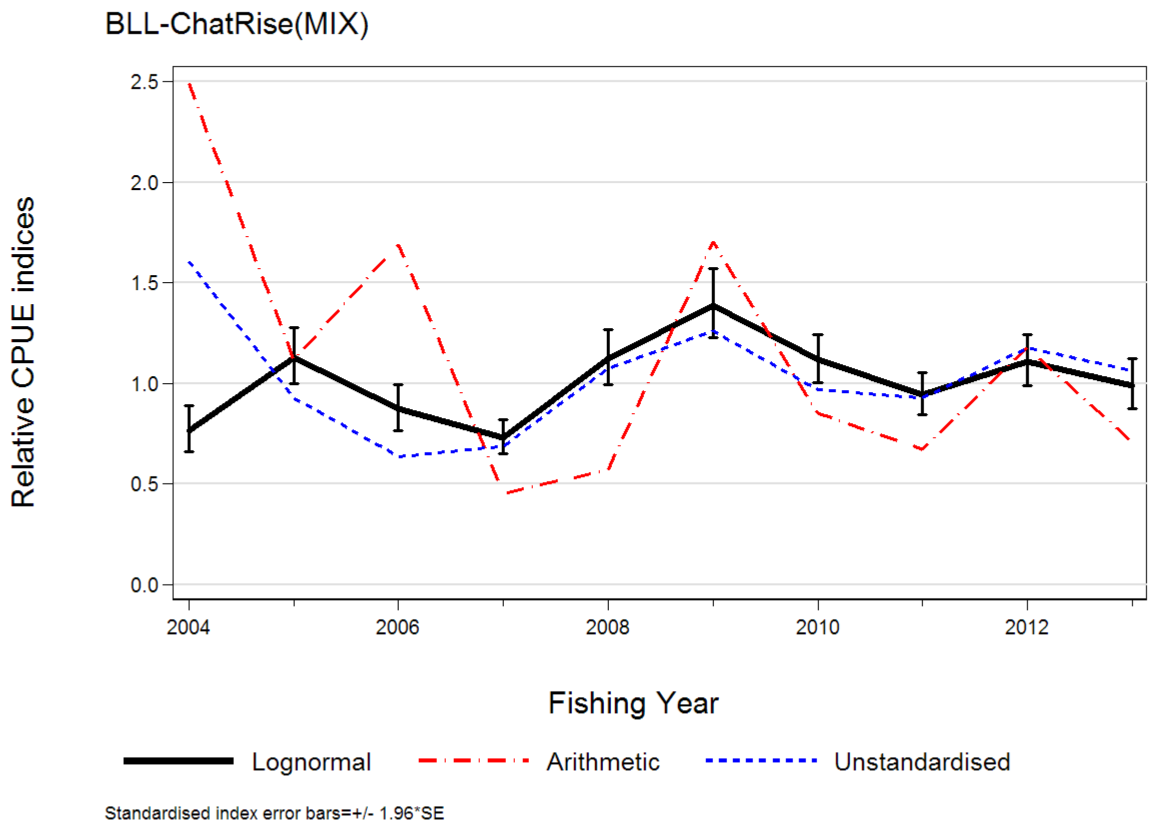

Figure O.6: Relative CPUE indices for school shark using the lognormal non-zero model based on the BLL-ChatRise(MIX) fishery definition. Also shown are two unstandardised series from the same data: a) Arithmetic (Eq. H.1) and b) Unstandardised (Eq. H.2).

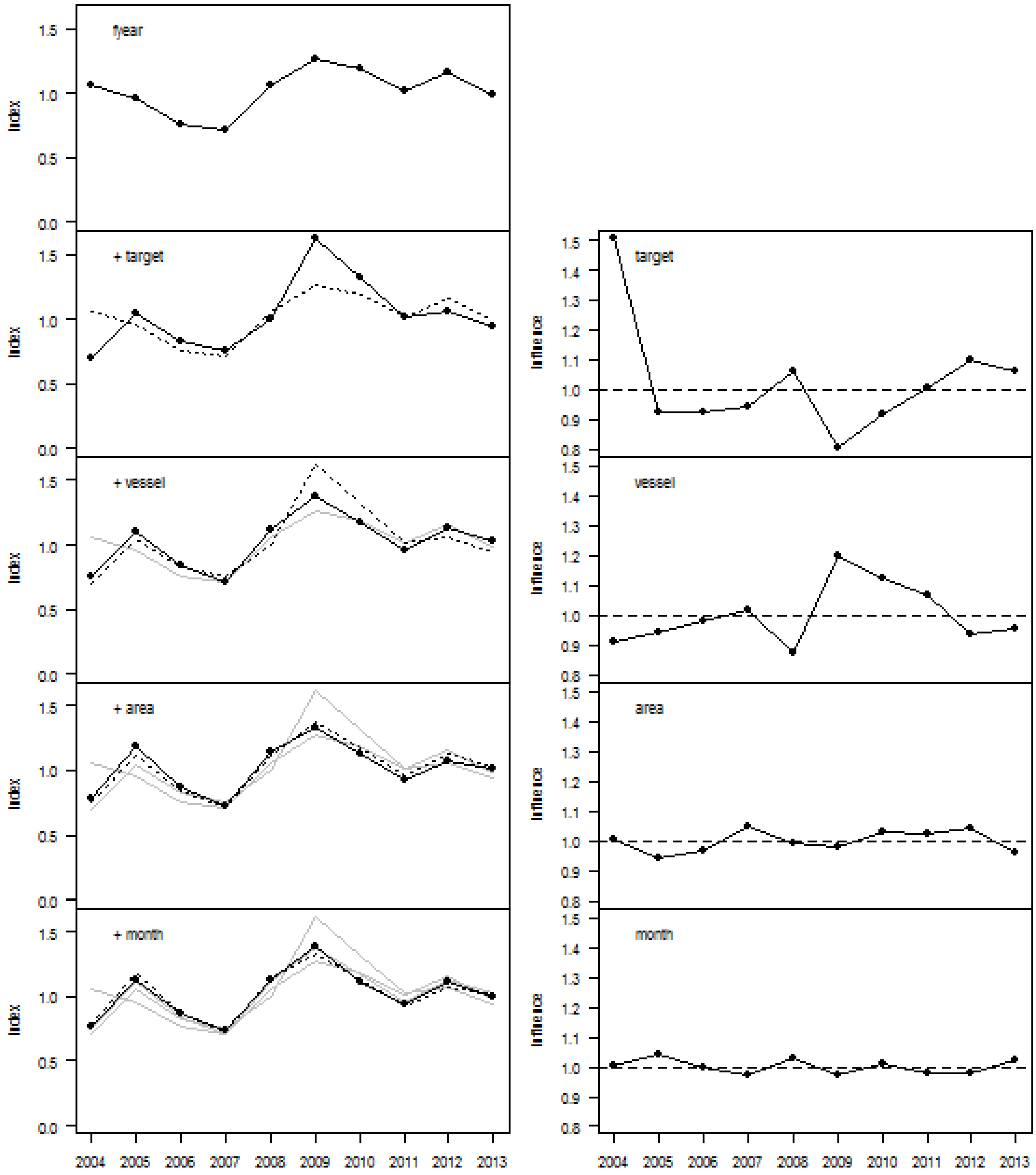

Figure O.7: [left column]: annual indices from the lognormal model of BLL-ChatRise(MIX) at each step in the variable selection process; [right column]: aggregate influence associated with each step in the variable selection procedure.

O.9 RESIDUAL AND DIAGNOSTIC PLOTS

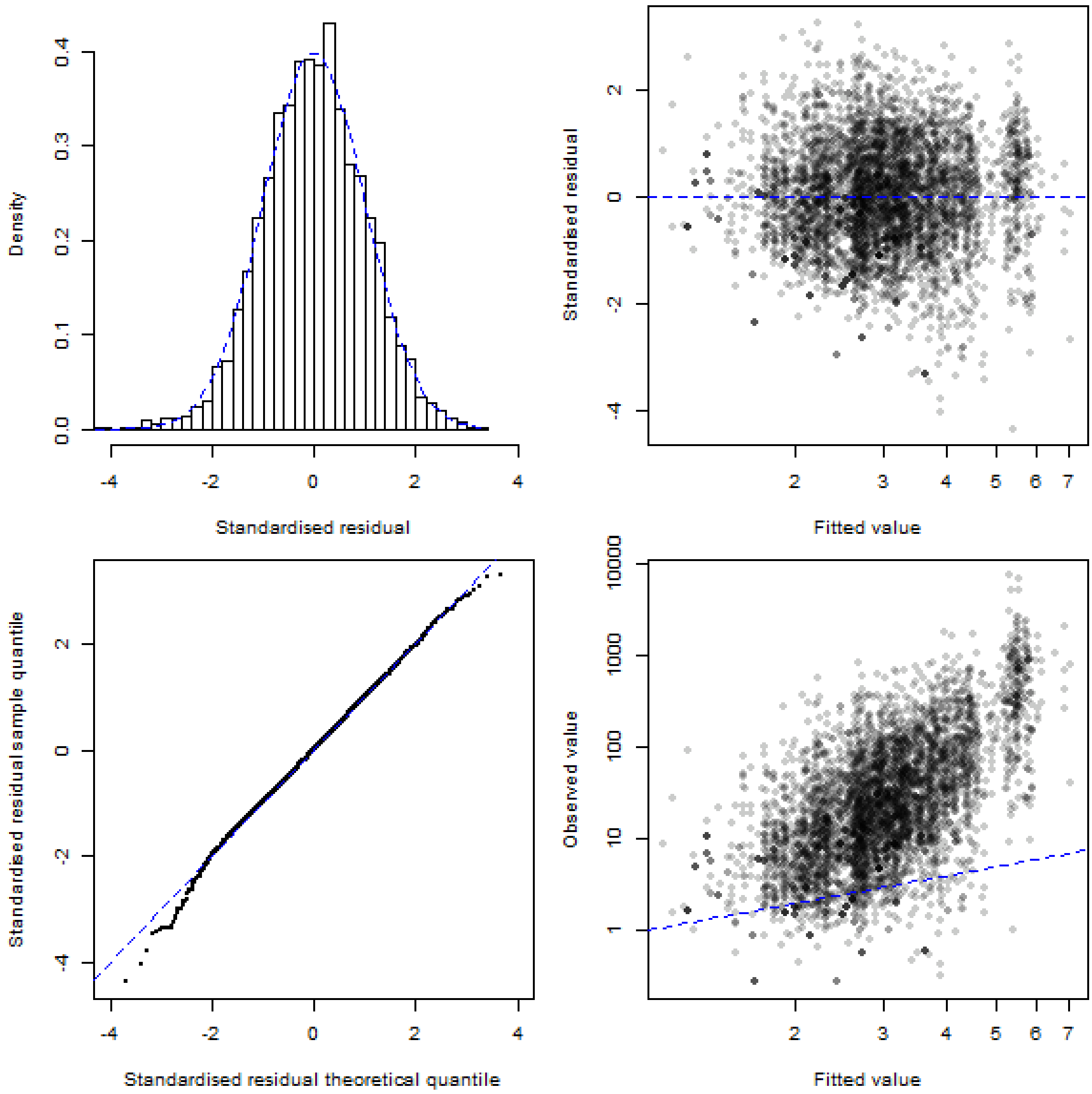

Figure O.8: Plots of the fit of the lognormal standardised CPUE model to successful catches of school shark in the BLL-ChatRise(MIX) fishery. [Upper left] histogram of the standardised residuals compared to a lognormal distribution (SDSR: standard deviation of standardised residuals. MASR: median of absolute standardised residuals); [Upper right] Q-Q plot of the standardised residuals; [Lower left] Standardised residuals plotted against the predicted model catch per trip; [Lower right] Observed catch per record plotted against the predicted catch per record.

O.10 MODEL COEFFICIENTS

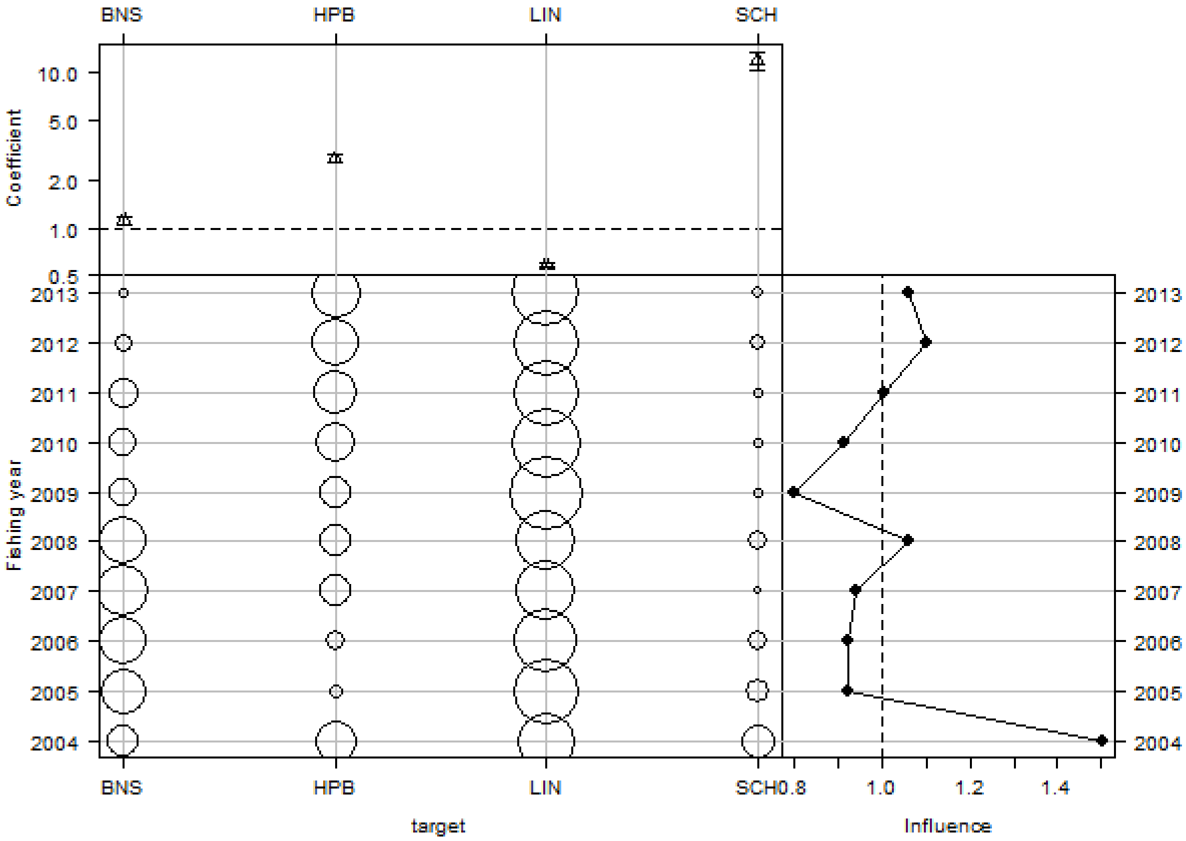

Figure O.9: Effect of target species in the lognormal model for the school shark BLL-ChatRise(MIX) fishery. Top: effect by level of variable (left-axis: log space additive; right-axis: natural space multiplicative). Bottom-left: distribution of variable by fishing year. Bottom-right: cumulative effect of variable by fishing year (bottom-axis: log space additive; top-axis: natural space multiplicative).

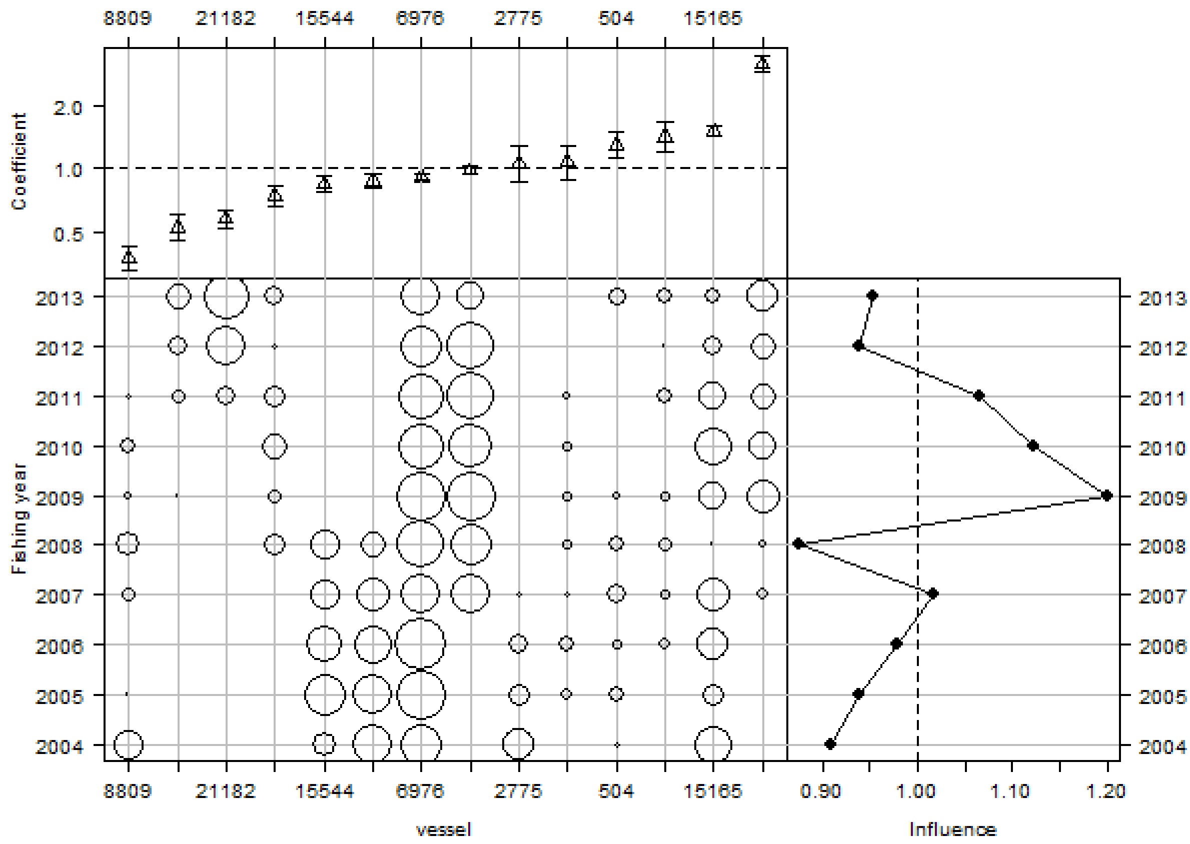

Figure O.10: Effect of vessel in the lognormal model for the school shark BLL-ChatRise(MIX) fishery. Top: effect by level of variable (left-axis: log space additive; right-axis: natural space multiplicative). Bottom-left: distribution of variable by fishing year. Bottom-right: cumulative effect of variable by fishing year (bottom-axis: log space additive; top-axis: natural space multiplicative).

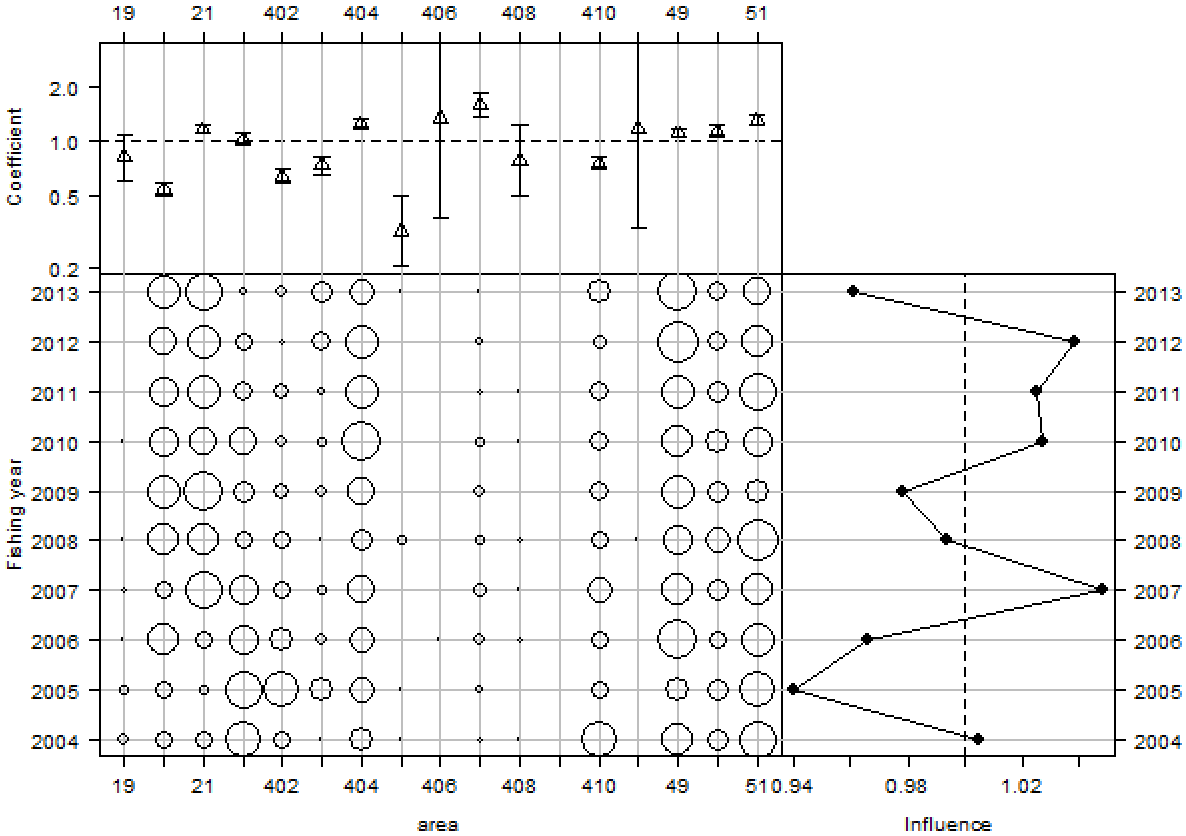

Figure O.11: Effect of area in the lognormal model for the school shark BLL-ChatRise(MIX) fishery. Top: effect by level of variable (left-axis: log space additive; right-axis: natural space multiplicative). Bottom-left: distribution of variable by fishing year. Bottom-right: cumulative effect of variable by fishing year (bottom-axis: log space additive; top-axis: natural space multiplicative).

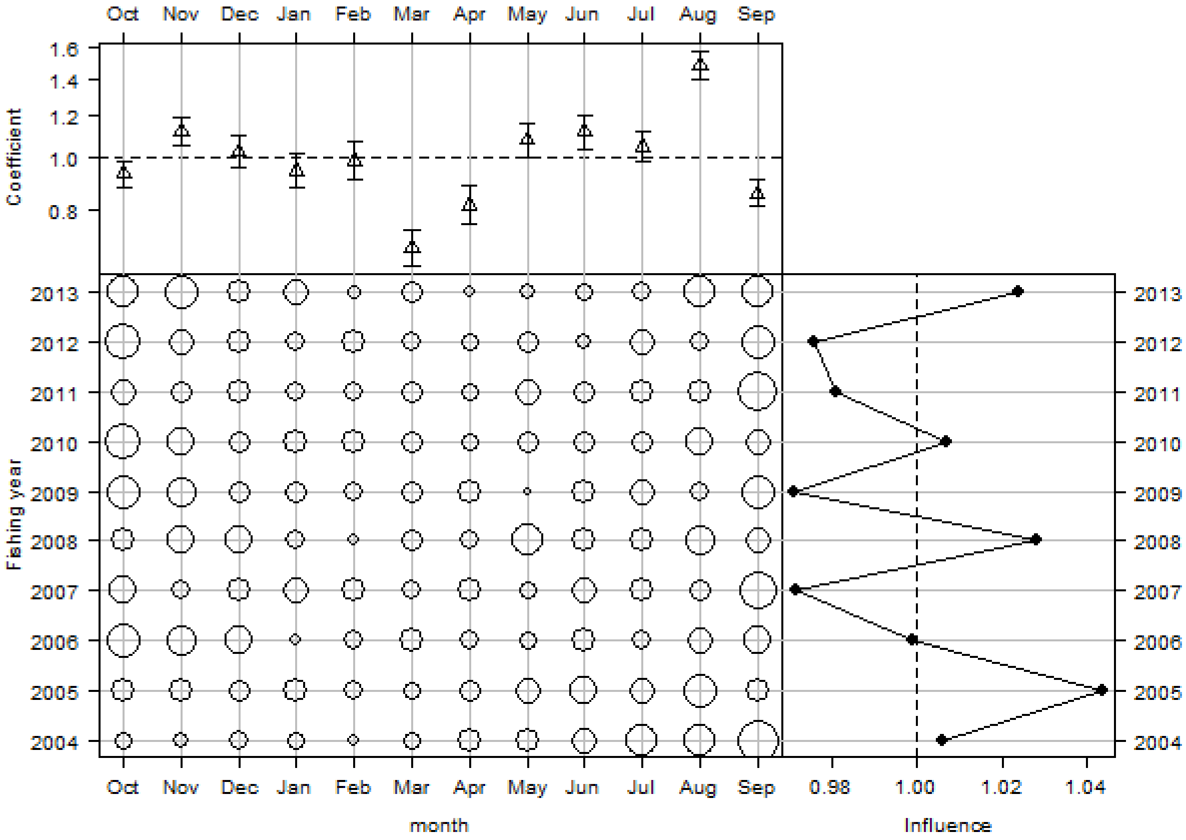

Figure O.12: Effect of month in the lognormal model for the school shark BLL-ChatRise(MIX) fishery. Top: effect by level of variable (left-axis: log space additive; right-axis: natural space multiplicative). Bottom-left: distribution of variable by fishing year. Bottom-right: cumulative effect of variable by fishing year (bottom-axis: log space additive; top-axis: natural space multiplicative).

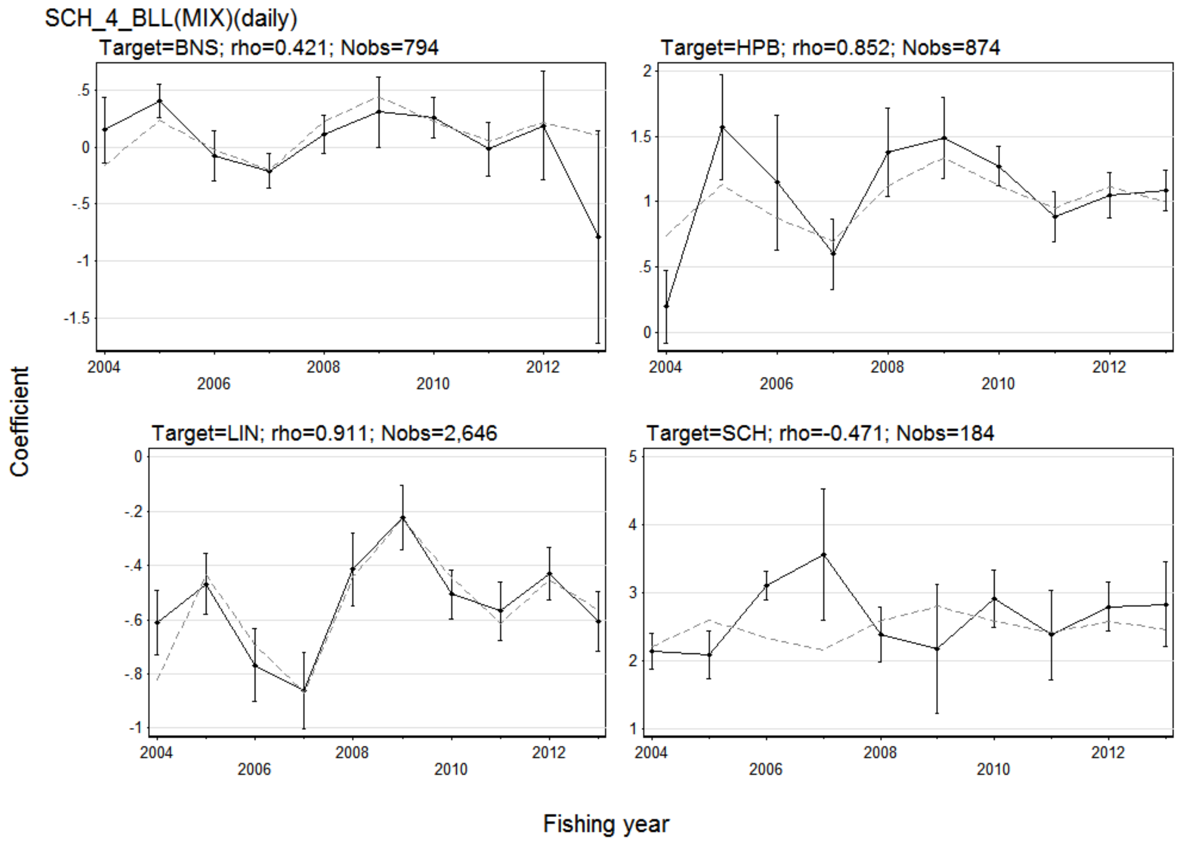

Figure O.13: Residual implied coefficients for target×fishing year interaction (not offered) in the school shark BLL-ChatRise(MIX) lognormal model. Implied coefficients (black points) are calculated as the normalised fishing year coefficient (grey line) plus the mean of the standardised residuals in each fishing year and area. These values approximate the coefficients obtained when an area × year interaction term is fitted, particularly for those area × year combinations which have a substantial proportion of the records. The error bars indicate one standard error of the standardised residuals. The information at the top of each panel identifies the plotted category, provides the correlation coefficient (*rho*) between the category year index and the overall model index, and the number of records supporting the category.

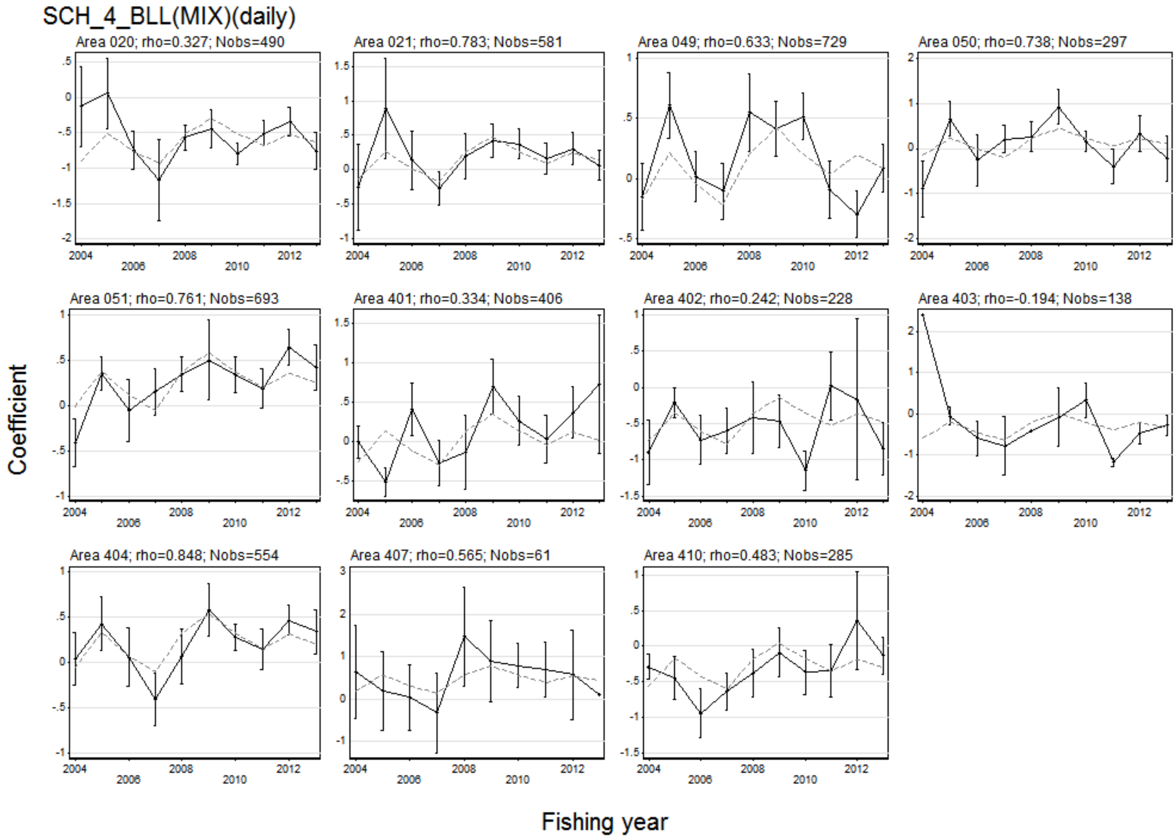

Figure O.14: Residual implied coefficients for area×fishing year interaction (not offered) in the school shark BLL-ChatRise(MIX) lognormal model. Implied coefficients (black points) are calculated as the normalised fishing year coefficient (grey line) plus the mean of the standardised residuals in each fishing year and area. These values approximate the coefficients obtained when an area × year interaction term is fitted, particularly for those area × year combinations which have a substantial proportion of the records. The error bars indicate one standard error of the standardised residuals. The information at the top of each panel identifies the plotted category, provides the correlation coefficient (*rho*) between the category year index and the overall model index, and the number of records supporting the category. Categories with fewer than 10 observations are not plotted.

O.11 LOGISTIC (BINOMIAL) MODEL SELECTION TABLE

Five explanatory variables entered the model after fishing year (Table O.3), with only form type non-significant. A plot of the binomial model and the combined delta-lognormal model is provided in Figure O.15 and the CPUE indices are listed in Table O.4.

Table O.3: Order of acceptance of variables into the binomial (logistic) model of successful catches in the BLL-ChatRise(MIX) fishery model for core vessels based on the vessel selection criteria of at least 3 trips in 3 or more fishing years), with the amount of explained deviance and R^2 for each variable. Variables accepted into the model are marked with an *, and the final R^2 of the selected model is in bold. Fishing year was forced as the first variable.

Variable	DF	Neg. Log likelihood	AIC	R^2	Model use
fishing year	10	-4 355	8 730	3.93	*
vessel	23	-4 038	8 122	15.7	*
target	26	-3 912	7 876	20.08	*
month	37	-3 795	7 664	24.01	*
poly(log(hooks), 3)	40	-3 724	7 528	26.33	*
area	56	-3 646	7 404	**28.82**	*

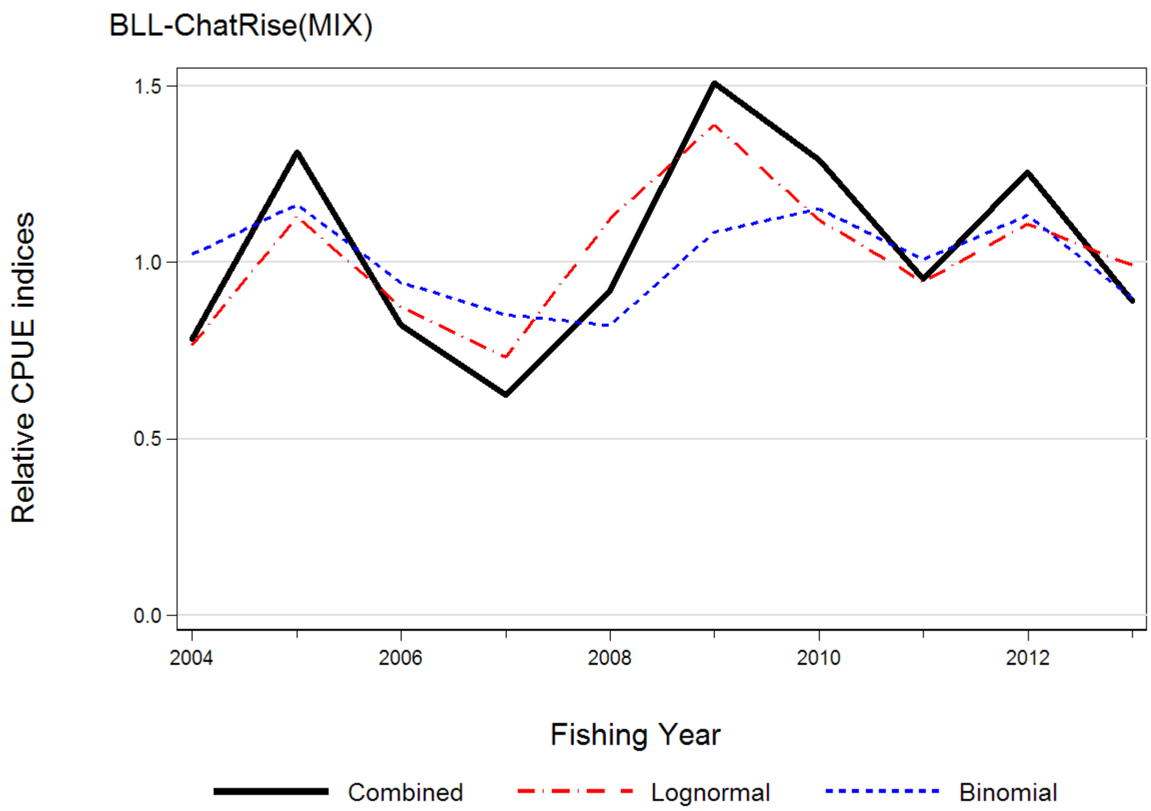

Figure O.15: Relative CPUE indices for school shark using the lognormal non-zero model based on the BLL-ChatRise(MIX) fishery definition, the binomial standardised model using the logistic distribution and a regression based on presence/absence of SCH, and the combined model using the delta-lognormal procedure suggested by Vignaux (1994).

O.12 CPUE INDICES

Table O.4: Arithmetic indices for the total and core data sets, geometric and lognormal standardised indices and associated standard error (SE) for the core data set by fishing year for the school shark BLL-ChatRise(MIX) analysis. All series (except SE) standardised to geometric mean=1.0.

Fishing	All vessels						Core vessels
year	Arithmetic	Arithmetic	Geometric	Standardised	SE	Binomial	Combined
2004	1.974	2.493	1.607	0.766	0.0757	0.662	0.783
2005	1.071	1.118	0.929	1.129	0.0632	0.753	1.313
2006	1.367	1.693	0.637	0.873	0.0670	0.610	0.822
2007	0.946	0.455	0.689	0.731	0.0580	0.551	0.623
2008	0.615	0.572	1.074	1.123	0.0614	0.531	0.921
2009	1.173	1.705	1.261	1.389	0.0626	0.702	1.507
2010	1.008	0.852	0.970	1.119	0.0544	0.745	1.288
2011	0.975	0.672	0.928	0.945	0.0562	0.652	0.951
2012	0.970	1.180	1.177	1.109	0.0581	0.733	1.256
2013	0.532	0.707	1.064	0.991	0.0647	0.581	0.889

Appendix P. DIAGNOSTICS AND SUPPORTING ANALYSES FOR SCH 7, SCH 8 & LOWER SCH 1W SETNET [SN-781W(MIX)] CPUE STANDARDISATION

P.1 INTRODUCTION

The basis for the selection of this region for monitoring school shark with this capture method is provided in Section 2.3.3.6 and summarised in Table 14.

P.2 FISHERY DEFINITION

SN-781W(MIX): The fishery is defined from setnet fishing events which fished in Statistical Areas 016, 017, 034, 035, 036, 037, 038, 039, 040, 041, 042, 801 declaring target species SNA, TRE, SPO, SCH, SPD, GUR.

P.3 CORE VESSEL SELECTION

The criteria used to define the core fleet were those vessels that had fished for at least 5 trips in each of at least 5 years using trips with at least 1 kg of catch. These criteria resulted in a core fleet size of 44 vessels which took 90% of the catch (Figure P.1).

P.4 DATA SUMMARY

Table P.1: Number of number of core vessels, trips, daily effort strata, number of events that have been “rolled up” into daily effort strata, calculated number of events per daily-effort stratum, total length (km) of net set, sum of duration fished, sum of landed SCH (t), proportion of trips with catch and proportion of daily-effort strata with catch by fishing year for core vessels (based on a minimum of 5 trips per year in at least 5 years) in the SN-781W(MIX) fishery.

Fishing year	Vessels	Trips	Daily effort strata	Events	Events per stratum	Length of net set (km)	Duration (h)	Catch (t)	Trips with catch (%)	Strata with catch (%)
1990	17	471	590	616	1.044	1 202.5	9 834	187.2	68.15	70.34
1991	17	498	631	640	1.014	1 304.3	9 882	227.6	68.07	70.68
1992	21	684	902	925	1.025	1 865.2	14 635	254.4	59.94	59.76
1993	22	898	1 202	1 266	1.053	2 406.0	21 375	270.2	53.45	52.58
1994	28	897	1 270	1 312	1.033	2 771.2	19 093	351.8	57.08	56.30
1995	28	1 111	1 482	1 591	1.074	2 940.3	23 538	343.9	45.18	48.58
1996	28	736	1 125	1 180	1.049	2 440.7	15 971	380.2	52.17	55.02
1997	27	600	955	980	1.026	2 228.1	12 598	317.3	52.67	56.75
1998	26	688	1 032	1 059	1.026	2 311.5	14 082	370.9	65.26	61.63
1999	25	732	1 094	1 113	1.017	2 296.6	13 818	342.7	57.24	59.23
2000	24	596	946	958	1.013	2 133.7	11 479	291.9	62.08	60.78
2001	24	677	1 119	1 128	1.008	2 315.5	14 733	441.6	55.10	57.73
2002	21	528	968	986	1.019	2 093.0	12 894	423.7	70.83	65.08
2003	21	431	856	869	1.015	1 998.2	11 191	419.4	68.68	64.72
2004	20	502	1 068	1 097	1.027	2 412.9	14 298	407.0	80.48	66.95
2005	19	412	1 086	1 101	1.014	2 773.9	14 346	518.2	85.19	69.98
2006	17	288	952	967	1.016	2 495.9	12 489	509.5	88.19	72.69
2007	17	303	946	1 069	1.130	2 635.2	15 269	525.1	90.10	80.02
2008	16	315	885	1 083	1.224	2 586.2	14 925	474.3	86.98	81.13
2009	15	348	896	1 016	1.134	2 529.3	14 527	539.7	87.36	84.04
2010	14	332	826	928	1.123	2 316.5	13 925	402.2	84.94	78.93
2011	15	318	869	979	1.127	2 357.4	14 018	500.0	87.42	81.93
2012	14	325	751	854	1.137	2 031.2	12 339	337.5	80.92	76.17
2013	9	190	491	609	1.240	1 404.6	9 122	260.3	87.89	80.04

P.5 CORE VESSEL SELECTION

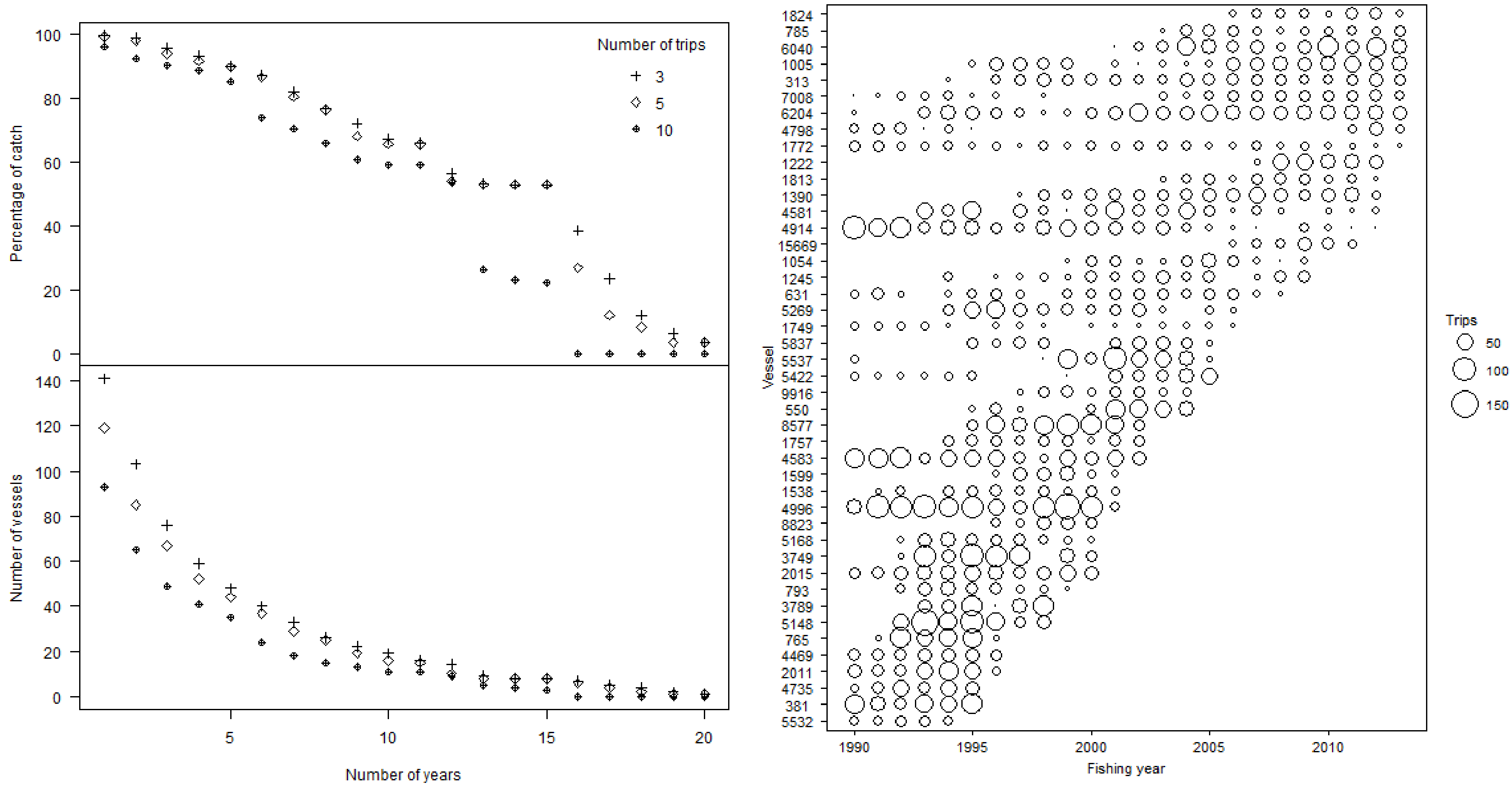

Figure P.1: [left panel] total landed SCH and number of vessels plotted against the number of years used to define core vessels participating in the SN-781W(MIX) dataset. The number of qualifying years (minimum number of trips per year) for each series is indicated in the legend. [right panel]: bubble plot showing the number of daily-effort strata for selected core vessels (based on at least 5 trips in 5 or more fishing years) by fishing year.

P.6 EXPLORATORY DATA PLOTS FOR CORE VESSEL DATA SET

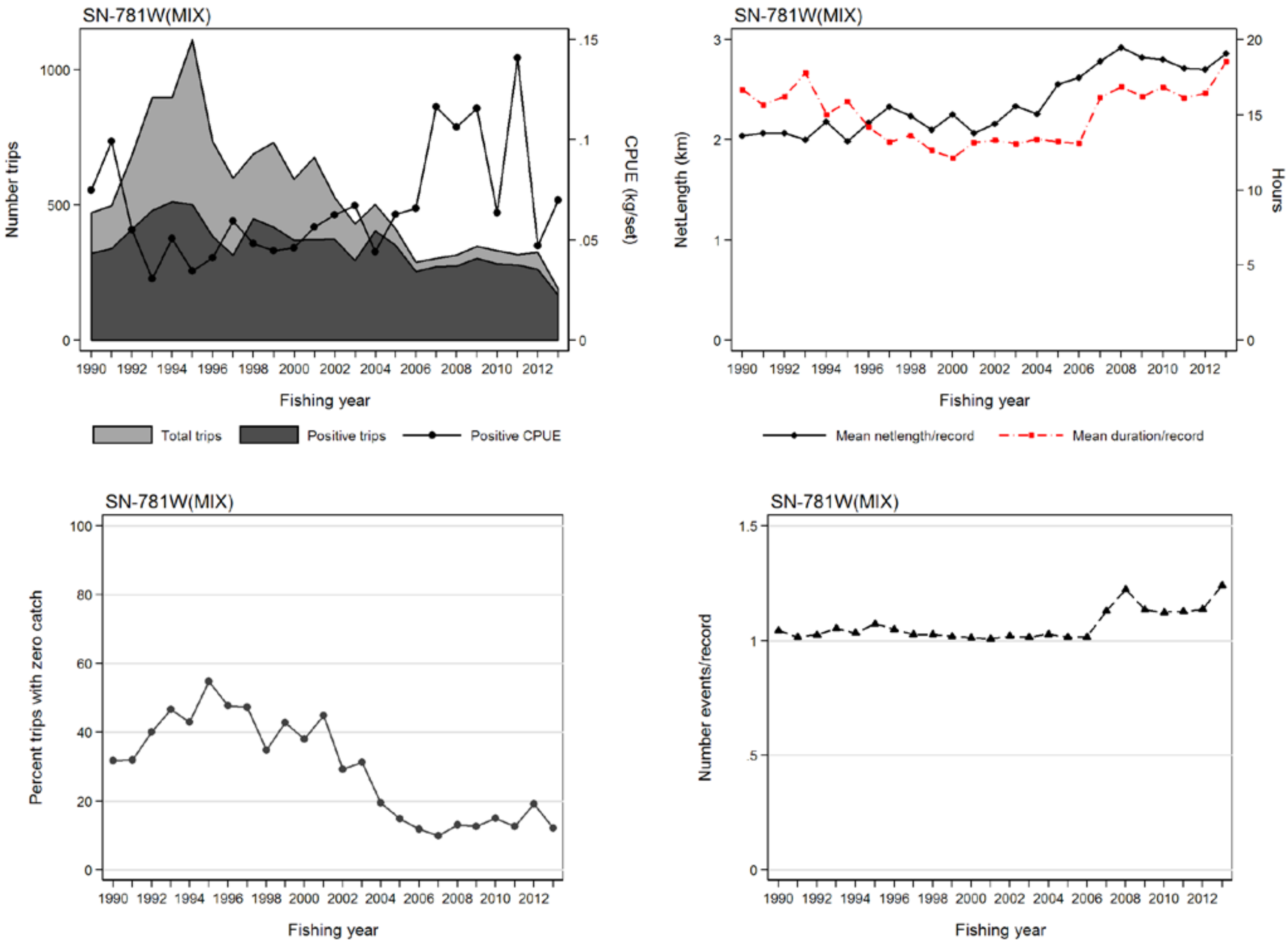

Figure P.2: Core vessel summary plots by fishing year for model SN-781W(MIX): [upper left panel]: total trips (light grey) and trips with school shark catch (dark grey) overlaid with median annual arithmetic CPUE (kg/set) for all trips *i* with positive catch: $A_y = \text{median}\left(C_{y,i} / E_{y,i}\right)$; [upper right panel]: mean net length (km) and mean duration per daily-effort stratum record; [lower left panel]: proportion of trips with no catch of school shark; [lower right panel]: mean number of events per daily-effort stratum record.

P.7 SELECTION OF DISTRIBUTION FOR POSITIVE CATCH RECORDS

The best distribution was Weibull.
The distribution was forced to lognormal.

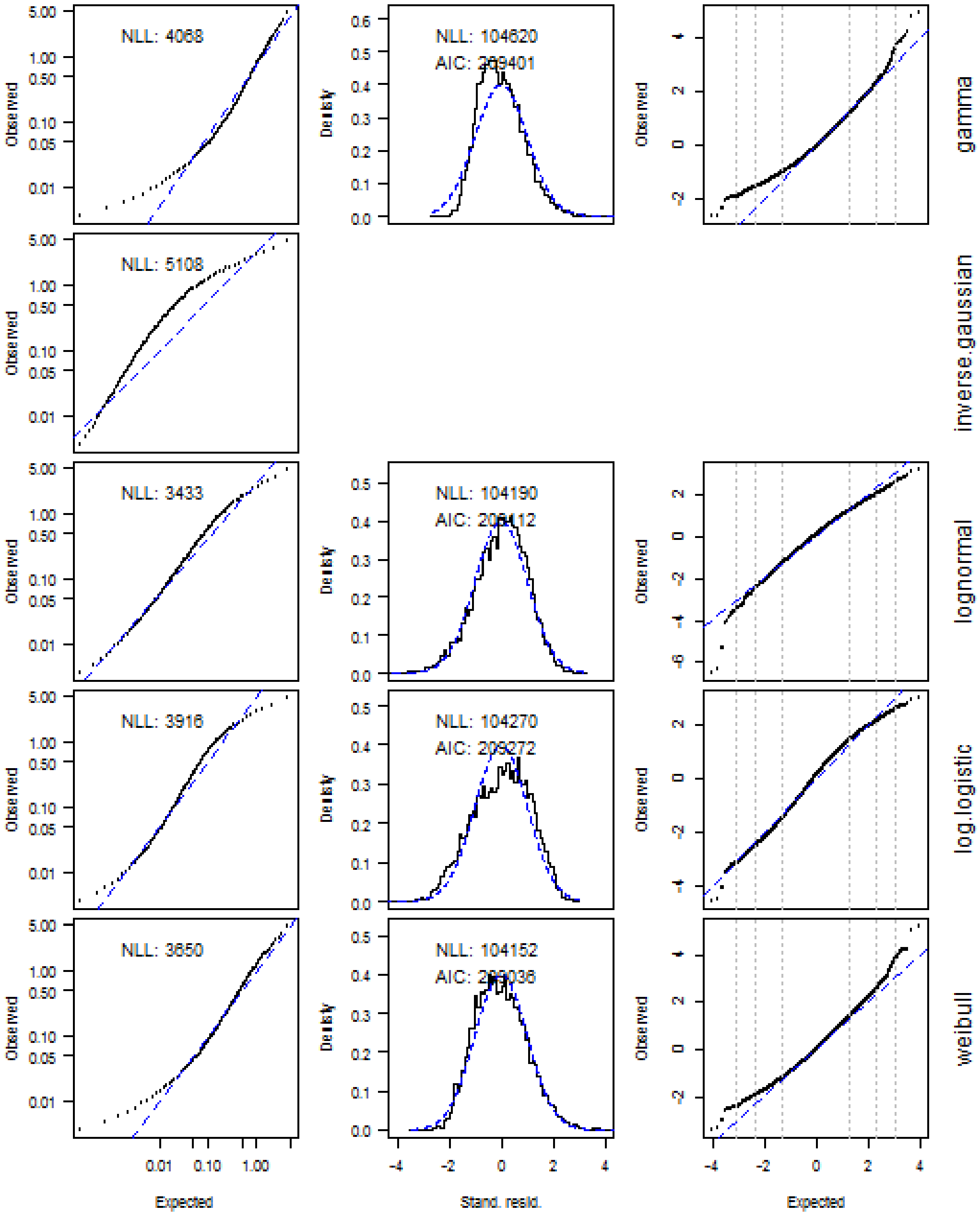

Figure P.3: Diagnostics for alternative distributional assumptions for catch in the school shark SN-781W(MIX) model. Left: quantile-quantile plot of observed catches (centred (by mean) and scaled (by standard deviation) in log space) versus maximum likelihood fit of distribution (missing panel indicates that the fit failed to converge); Middle: standardised residuals from a generalised linear model fitted using the formula catch ~ fyear + month +area+ vessel + log(sets) and the distribution (missing panel indicates that the model failed to converge); Right: quantile-quantile plot of model standardised residuals against standard normal (vertical lines represent 0.1%, 1% and 10% percentiles). NLL = negative log-likelihood; AIC = Akaike information criterion.

P.8 MODEL SELECTION TABLE

Four explanatory variables entered the model after fishing year (Table P.2), with neither effort variable (net length and hours fishing) significant. Note that hours fishing dropped completely out of the regression, without registering in the final selection table. A plot of the model is provided in Figure P.4 and the CPUE indices are listed in Table P.3.

Table P.2: Order of acceptance of variables into the lognormal model of successful catches in the SN-781W(MIX) fishery model for core vessels based on the vessel selection criteria of at least 5 trips in 5 or more fishing years), with the amount of explained deviance and R^2 for each variable. Variables accepted into the model are marked with an *, and the final R^2 of the selected model is in bold. Fishing year was forced as the first variable.

Variable	DF	Neg. Log likelihood	AIC	R^2	Model use
fishing year	24	-31 085	62 220	2.17	*
target	29	-28 228	56 515	33.60	*
vessel	72	-26 781	53 709	45.50	*
area	83	-26 455	53 078	47.88	*
month	94	-26 282	52 755	**49.10**	*
poly(log(netlength), 3)	97	-26 160	52 517	49.94	

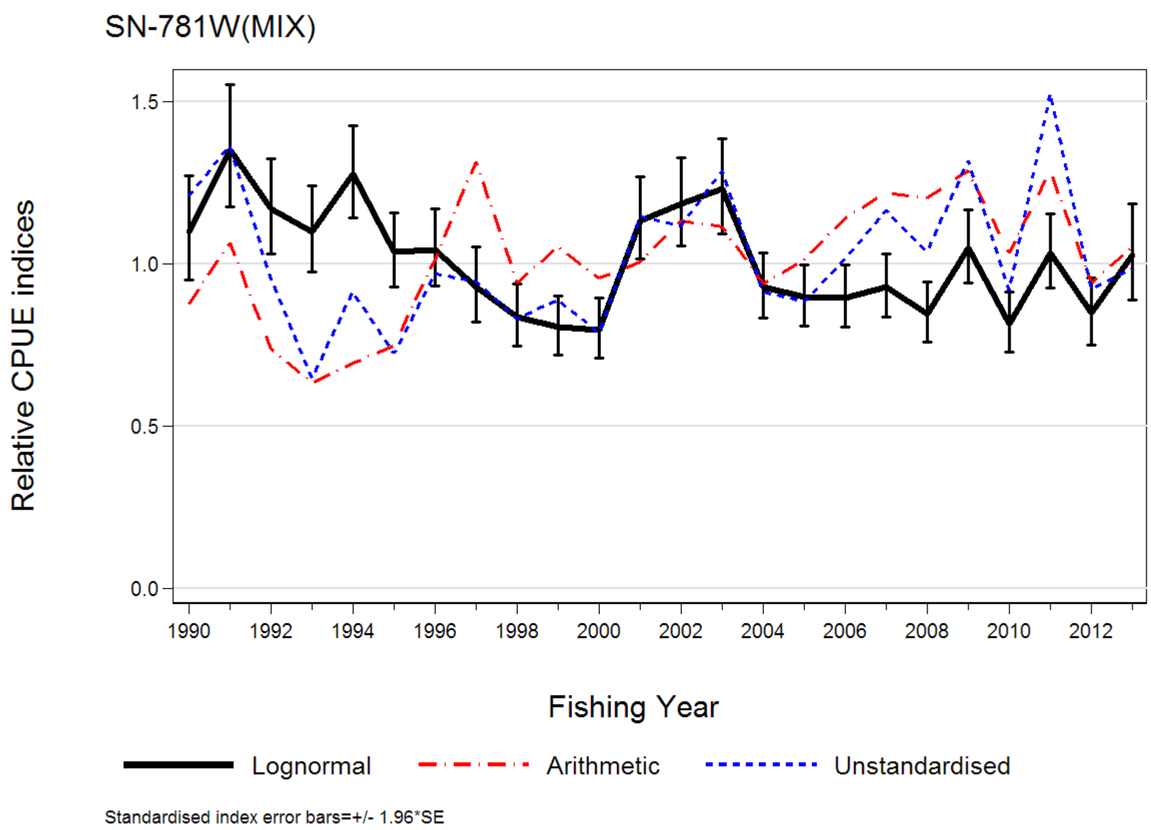

Figure P.4: Relative CPUE indices for school shark using the lognormal non-zero model based on the SN-781W(MIX) fishery definition. Also shown are two unstandardised series from the same data: a) Arithmetic (Eq. H.1) and b) Unstandardised (Eq. H.2).

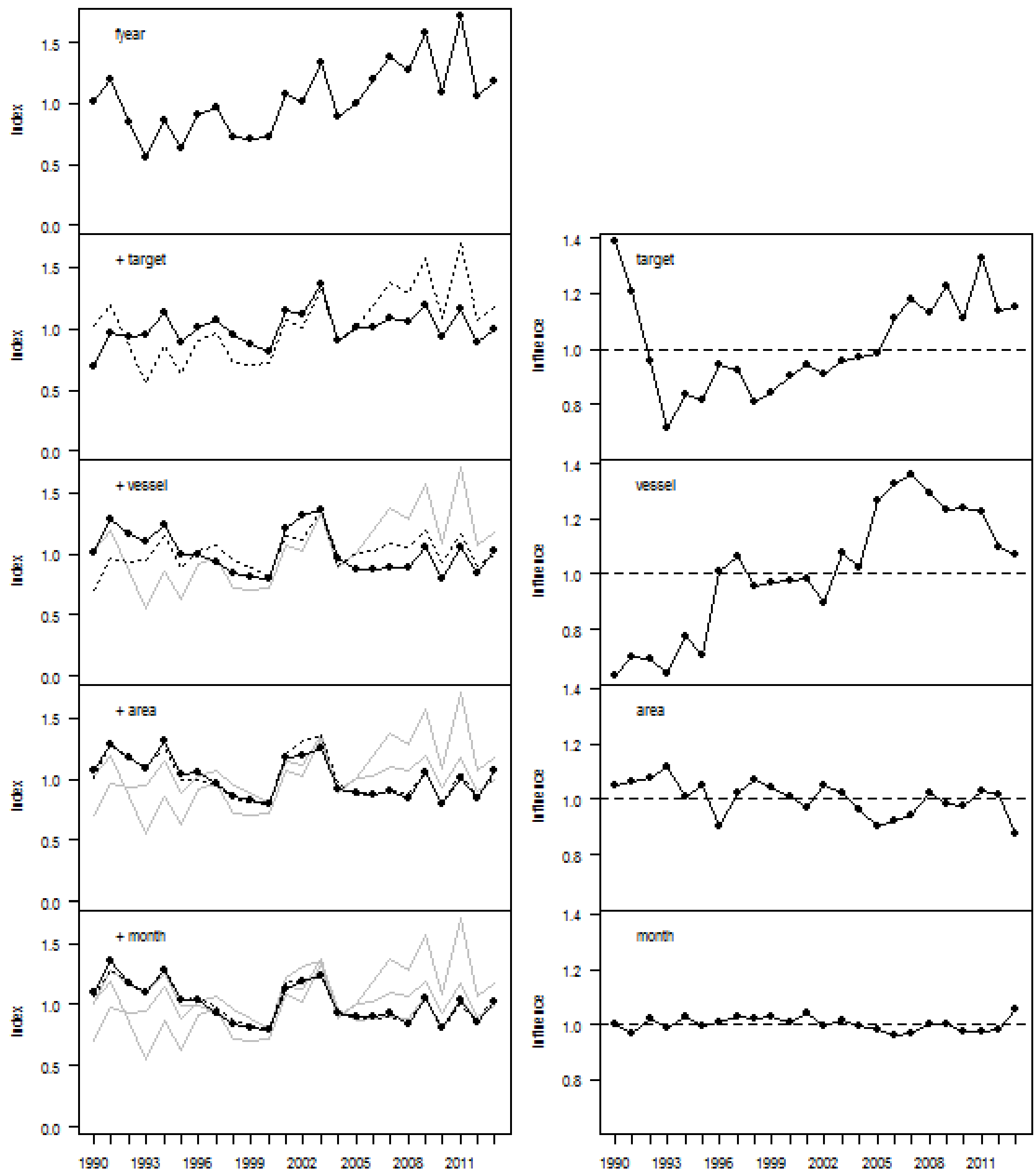

Figure P.5: [left column]: annual indices from the lognormal model of SN-781W(MIX) at each step in the variable selection process; [right column]: aggregate influence associated with each step in the variable selection procedure.

P.9 RESIDUAL AND DIAGNOSTIC PLOTS

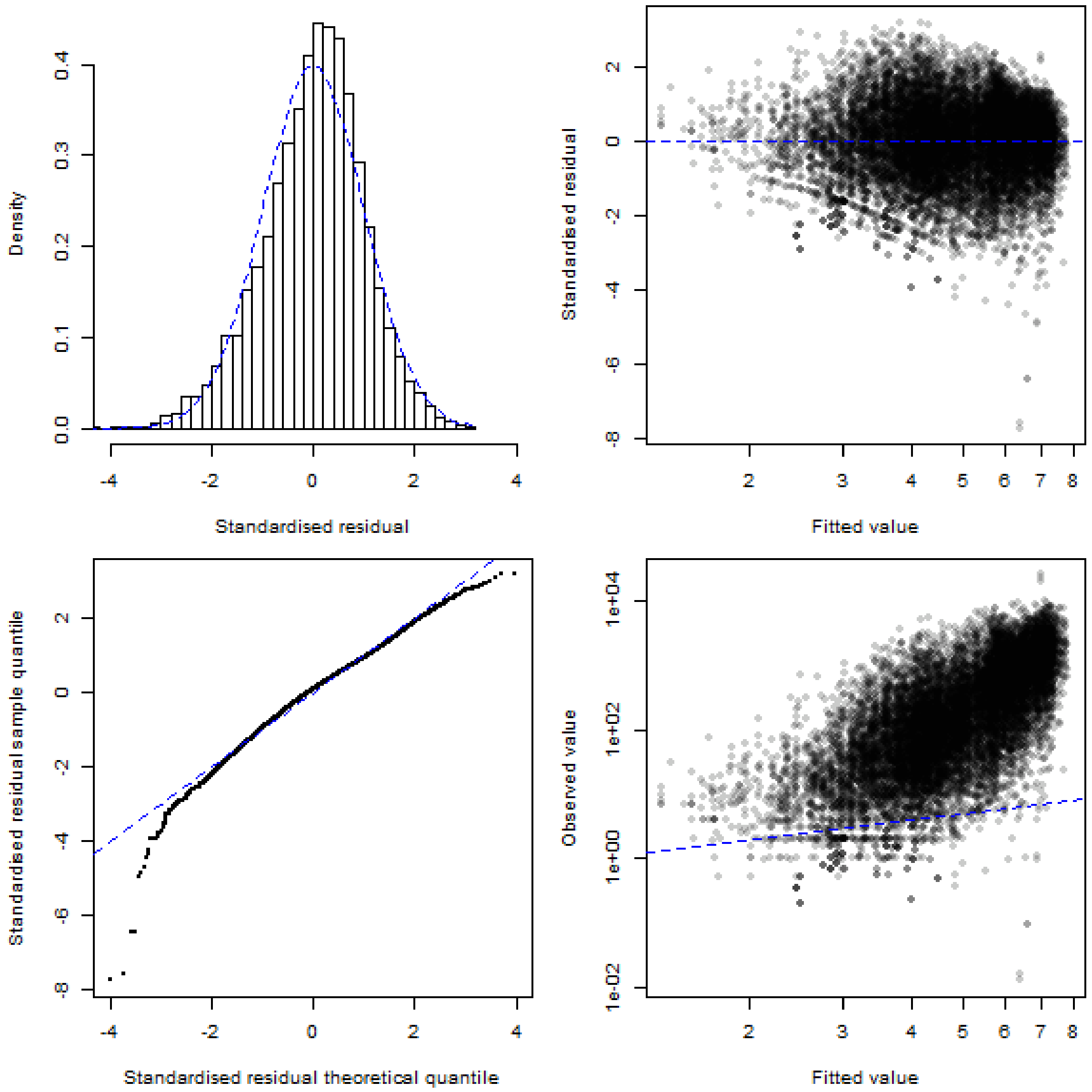

Figure P.6: Plots of the fit of the lognormal standardised CPUE model to successful catches of school shark in the SN-781W(MIX) fishery. [Upper left] histogram of the standardised residuals compared to a lognormal distribution (SDSR: standard deviation of standardised residuals. MASR: median of absolute standardised residuals); [Upper right] Q-Q plot of the standardised residuals; [Lower left] Standardised residuals plotted against the predicted model catch per trip; [Lower right] Observed catch per record plotted against the predicted catch per record.

P.10 MODEL COEFFICIENTS

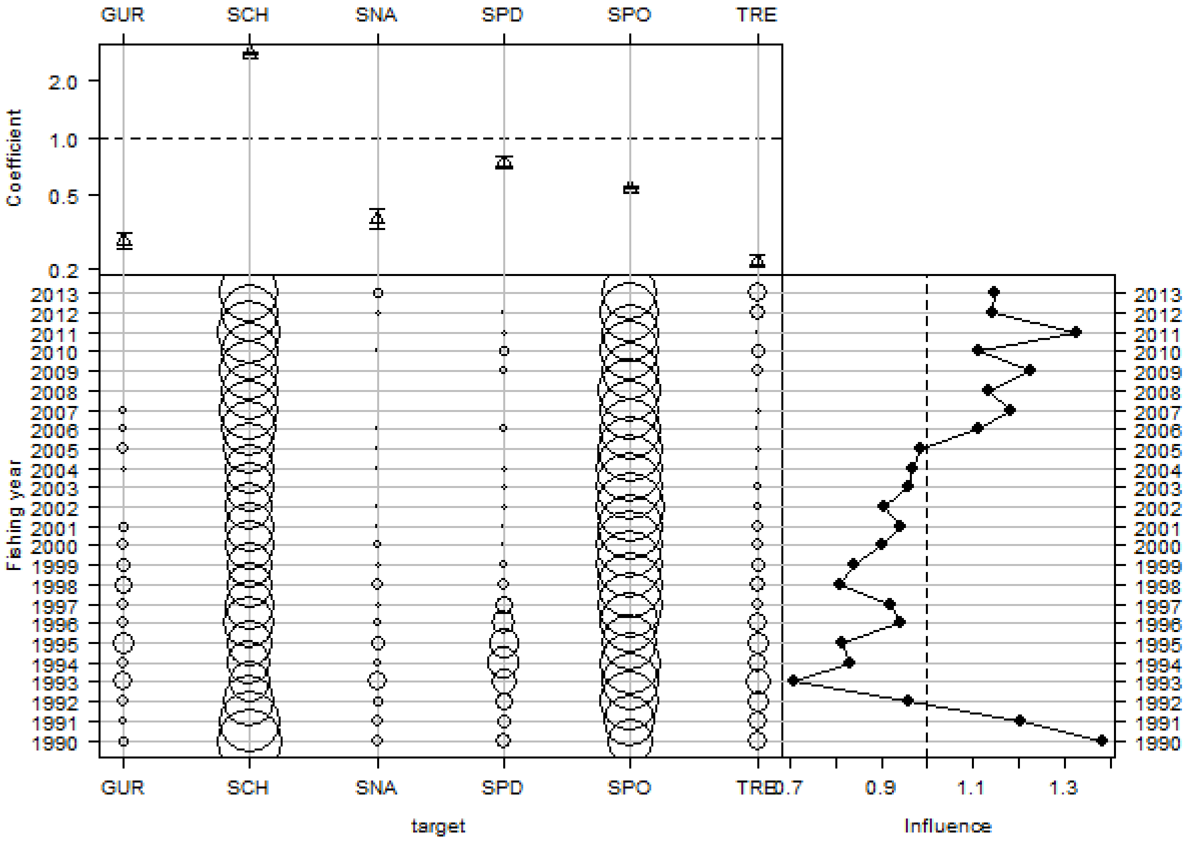

Figure P.7: Effect of target species in the lognormal model for the school shark SN-781W(MIX) fishery. Top: effect by level of variable (left-axis: log space additive; right-axis: natural space multiplicative). Bottom-left: distribution of variable by fishing year. Bottom-right: cumulative effect of variable by fishing year (bottom-axis: log space additive; top-axis: natural space multiplicative).

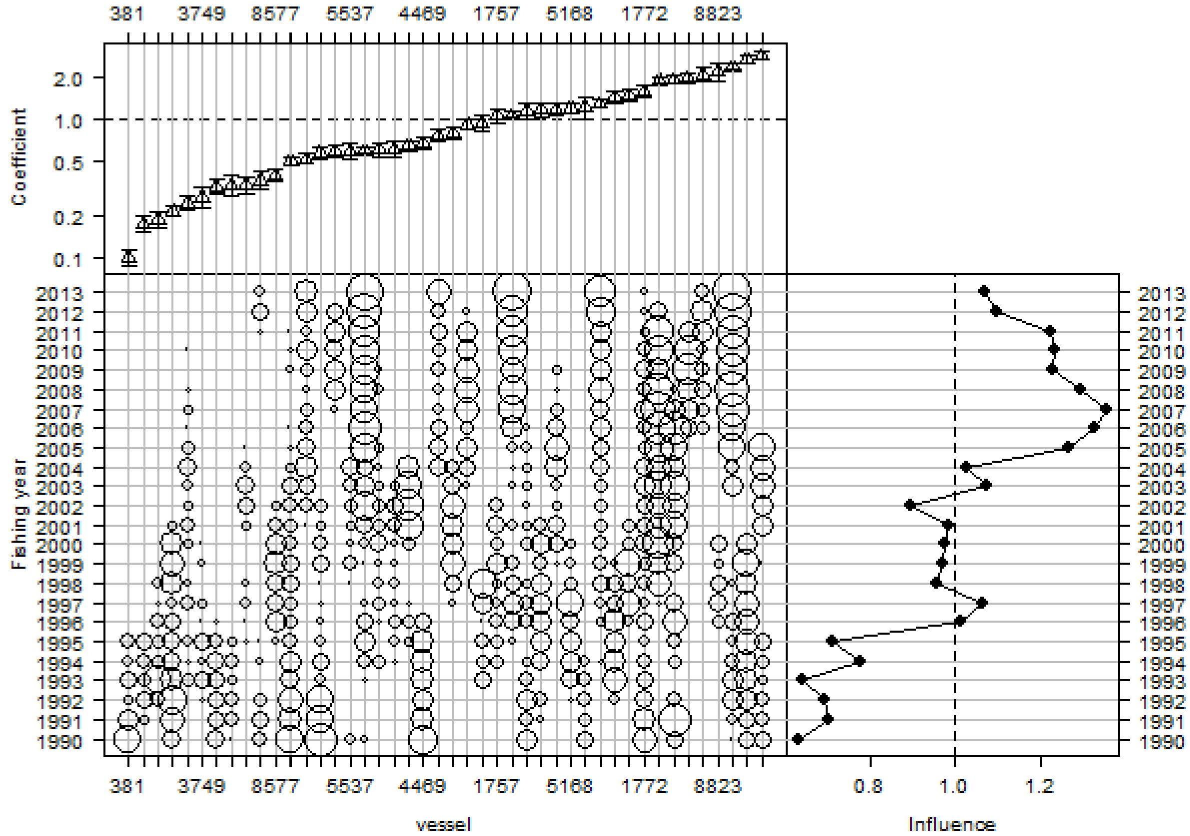

Figure P.8: Effect of vessel in the lognormal model for the school shark SN-781W(MIX) fishery. Top: effect by level of variable (left-axis: log space additive; right-axis: natural space multiplicative). Bottom-left: distribution of variable by fishing year. Bottom-right: cumulative effect of variable by fishing year (bottom-axis: log space additive; top-axis: natural space multiplicative).

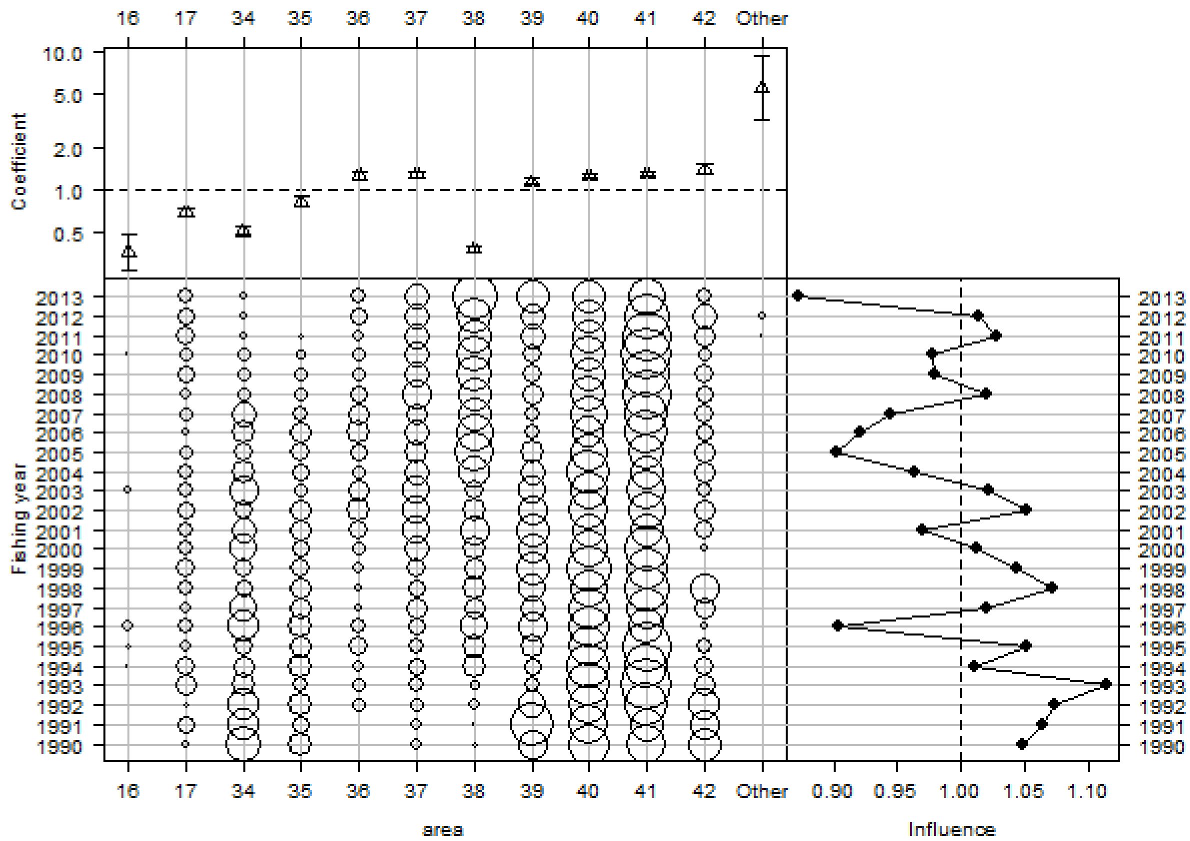

Figure P.9: Effect of area in the lognormal model for the school shark SN-781W(MIX) fishery. Top: effect by level of variable (left-axis: log space additive; right-axis: natural space multiplicative). Bottom-left: distribution of variable by fishing year. Bottom-right: cumulative effect of variable by fishing year (bottom-axis: log space additive; top-axis: natural space multiplicative).

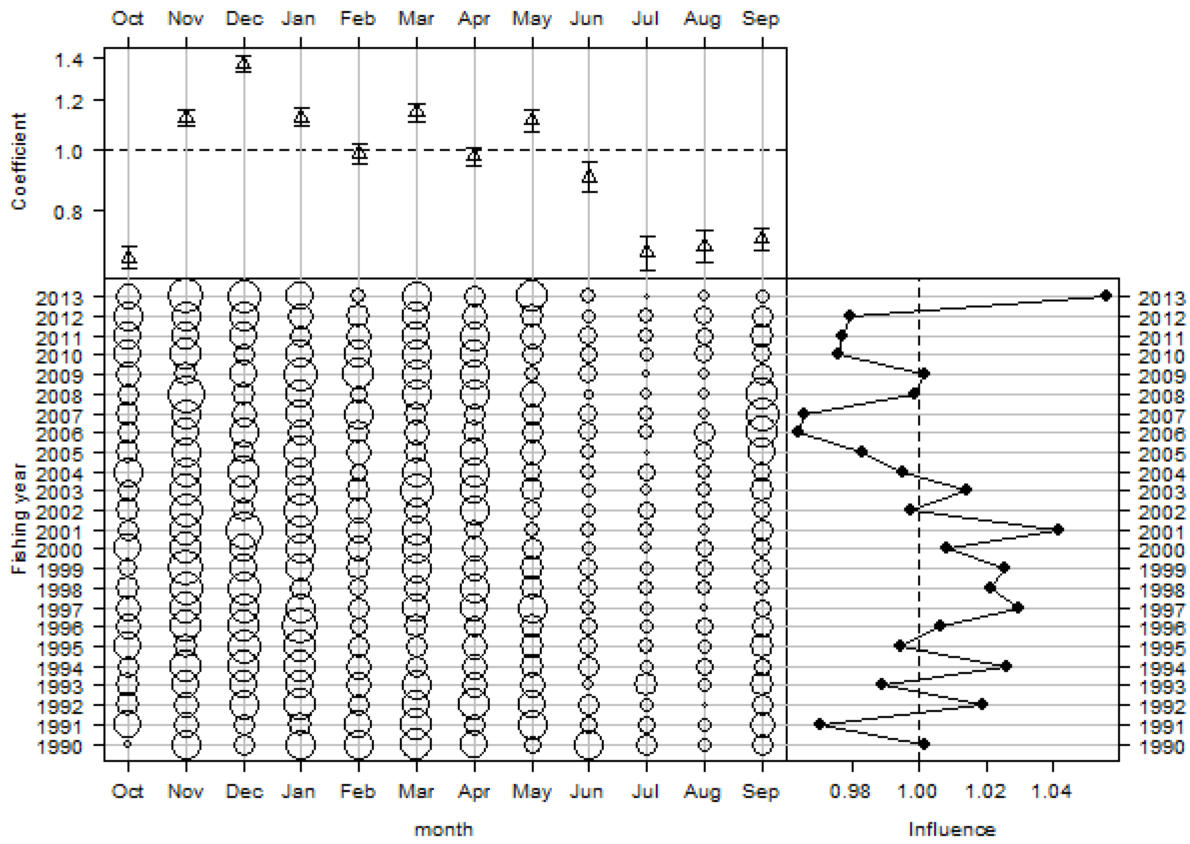

Figure P.10: Effect of month in the lognormal model for the school shark SN-781W(MIX) fishery. Top: effect by level of variable (left-axis: log space additive; right-axis: natural space multiplicative). Bottom-left: distribution of variable by fishing year. Bottom-right: cumulative effect of variable by fishing year (bottom-axis: log space additive; top-axis: natural space multiplicative).

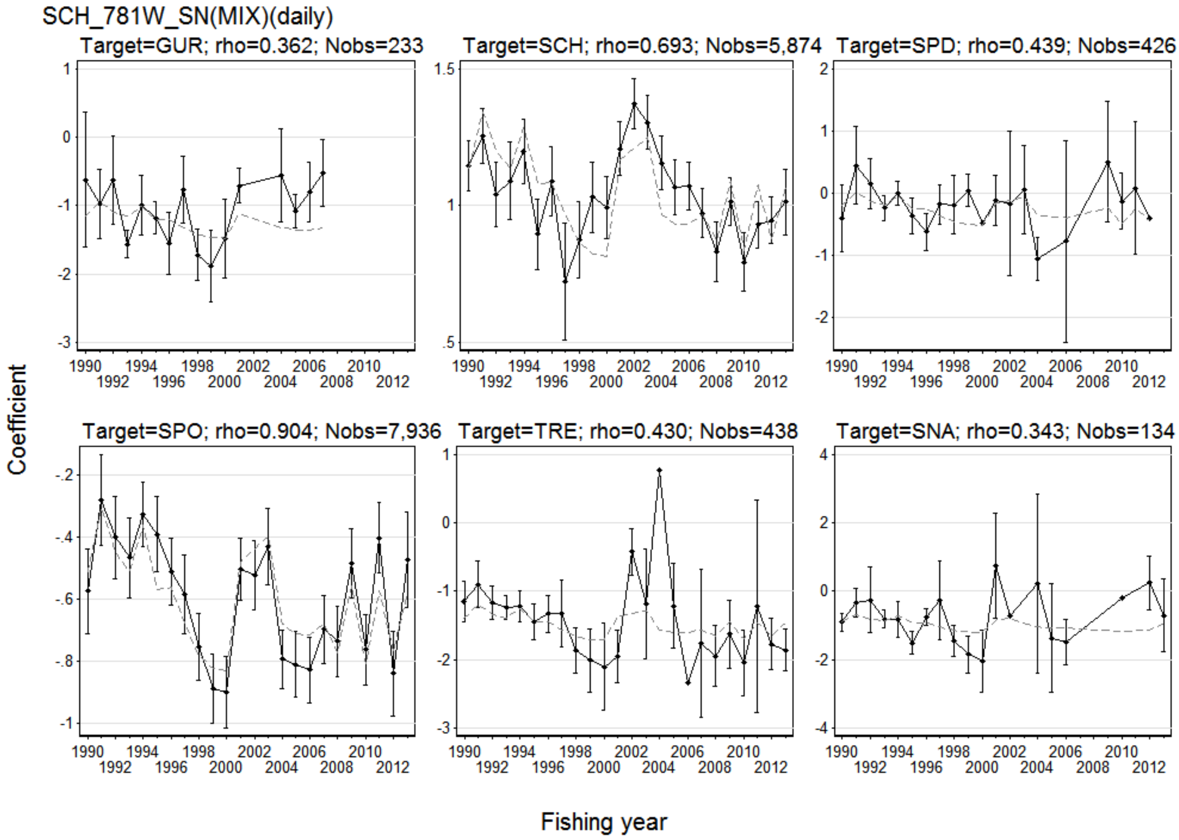

Figure P.11: Residual implied coefficients for target×fishing year interaction (not offered) in the school shark SN-781W(MIX) lognormal model. Implied coefficients (black points) are calculated as the normalised fishing year coefficient (grey line) plus the mean of the standardised residuals in each fishing year and area. These values approximate the coefficients obtained when an area × year interaction term is fitted, particularly for those area × year combinations which have a substantial proportion of the records. The error bars indicate one standard error of the standardised residuals. The information at the top of each panel identifies the plotted category, provides the correlation coefficient (*rho*) between the category year index and the overall model index, and the number of records supporting the category.

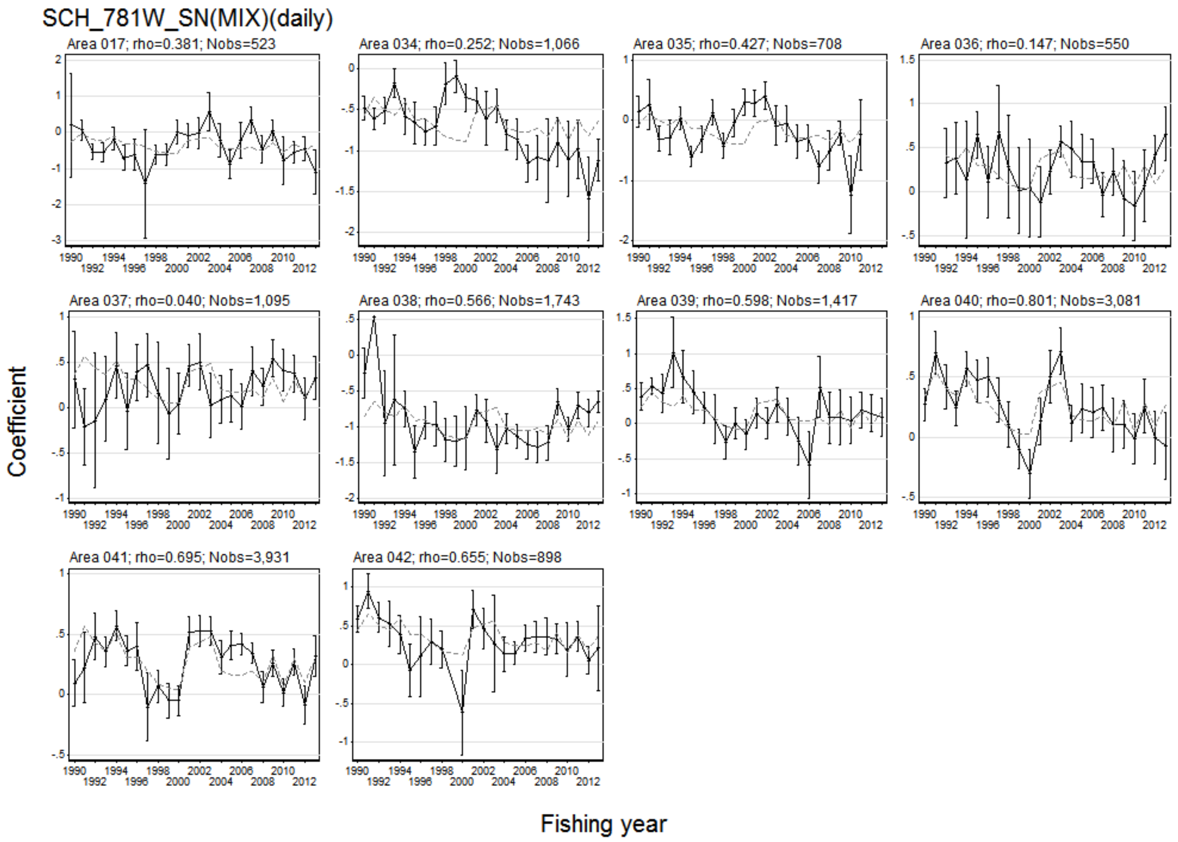

Figure P.12: Residual implied coefficients for area×fishing year interaction (not offered) in the school shark SN-781W(MIX) lognormal model. Implied coefficients (black points) are calculated as the normalised fishing year coefficient (grey line) plus the mean of the standardised residuals in each fishing year and area. These values approximate the coefficients obtained when an area × year interaction term is fitted, particularly for those area × year combinations which have a substantial proportion of the records. The error bars indicate one standard error of the standardised residuals. The information at the top of each panel identifies the plotted category, provides the correlation coefficient (*rho*) between the category year index and the overall model index, and the number of records supporting the category. Categories with fewer than 10 observations are not plotted.

P.11 CPUE INDICES

Table P.3: Arithmetic indices for the total and core data sets, geometric and lognormal standardised indices and associated standard error for the core data set by fishing year for the school shark SN-781W(MIX) analysis.

Fishing	All vessels			Core vessels	
year	Arithmetic	Arithmetic	Geometric	Standardised	SE
1990	0.889	0.878	1.210	1.100	0.0736
1991	0.814	1.065	1.366	1.352	0.0706
1992	0.648	0.739	0.954	1.170	0.0638
1993	0.504	0.635	0.648	1.100	0.0611
1994	0.691	0.695	0.914	1.278	0.0566
1995	0.797	0.749	0.725	1.039	0.0560
1996	0.929	1.014	0.971	1.044	0.0578
1997	1.142	1.317	0.947	0.930	0.0629
1998	0.936	0.943	0.831	0.838	0.0583
1999	1.199	1.055	0.890	0.805	0.0580
2000	1.084	0.957	0.788	0.798	0.0595
2001	1.084	1.006	1.147	1.135	0.0568
2002	1.065	1.134	1.119	1.185	0.0581
2003	0.980	1.115	1.288	1.232	0.0606
2004	0.908	0.939	0.914	0.929	0.0546
2005	1.084	1.013	0.884	0.898	0.0530
2006	1.168	1.142	1.016	0.897	0.0550
2007	1.271	1.221	1.166	0.929	0.0534
2008	1.258	1.203	1.038	0.846	0.0555
2009	1.364	1.289	1.319	1.049	0.0550
2010	1.147	1.033	0.918	0.816	0.0579
2011	1.390	1.289	1.526	1.034	0.0560
2012	1.102	0.942	0.922	0.849	0.0618
2013	1.191	1.052	0.985	1.027	0.0728

Appendix Q. DIAGNOSTICS AND SUPPORTING ANALYSES FOR SCH 7, SCH 8 & LOWER SCH 1W BOTTOM LONGLINE [BLL-781W(MIX)] CPUE STANDARDISATION

Q.1 INTRODUCTION

The basis for the selection of this region for monitoring school shark with this capture method is provided in Section 2.3.3.6 and summarised in Table 14.

Q.2 FISHERY DEFINITION

BLL-781W(MIX): The fishery is defined from bottom longline fishing events which fished in Statistical Areas 016, 017, 018, 034, 035, 036, 037, 038, 039, 040, 041, 042, 801 declaring target species SNA, HPB, BNS, SCH, LIN.

Q.3 CORE VESSEL SELECTION

The criteria used to define the core fleet were those vessels that had fished for at least 5 trips in each of at least 4 years using trips with at least 1 kg of catch. These criteria resulted in a core fleet size of 42 vessels which took 78% of the catch (Figure Q.1).

Q.4 DATA SUMMARY

Table Q.1: Number of number of core vessels, trips, daily effort strata, number of events that have been "rolled up" into daily effort strata, calculated number of events per daily-effort stratum, number of sets, number hooks (in 1000s), sum of landed SCH (t), proportion of trips with catch and proportion of daily-effort strata with catch by fishing year for core vessels (based on a minimum of 5 trips per year in at least 4 years) in the BLL-781W(MIX) fishery.

Fishing year	Vessels	Trips	Daily effort strata	Events	Events per stratum	Number of sets	Number hooks ('000s)	Catch (t)	Trips with catch (%)	Strata with catch (%)
1990	15	134	229	231	1.009	661	142.7	27.6	66.42	58.95
1991	16	203	364	366	1.005	857	367.0	40.2	69.46	59.34
1992	22	226	454	462	1.018	1 227	490.5	59.8	69.47	60.79
1993	22	231	570	572	1.004	1 456	801.2	106.4	73.59	58.95
1994	26	270	609	629	1.033	1 455	1 037.0	100.0	65.93	59.11
1995	26	379	769	798	1.038	1 530	1 139.6	107.5	54.35	55.40
1996	24	314	685	693	1.012	1 436	1 188.9	92.4	64.01	60.29
1997	25	277	678	680	1.003	1 467	1 170.1	107.5	69.31	63.72
1998	24	236	572	583	1.019	1 320	930.5	77.4	73.73	64.16
1999	24	254	672	680	1.012	1 550	1 228.5	92.7	70.87	58.78
2000	26	286	681	692	1.016	1 507	998.5	113.9	68.53	64.76
2001	22	239	614	622	1.013	1 253	866.2	99.9	74.48	65.47
2002	18	216	486	490	1.008	962	628.8	88.3	69.91	63.37
2003	19	258	597	599	1.003	1 234	766.9	77.5	68.22	57.79
2004	21	239	636	639	1.005	1 189	950.4	94.1	72.38	58.33
2005	17	278	770	784	1.018	1 514	1 410.5	105.1	63.67	57.92
2006	16	201	563	580	1.030	1 055	859.4	110.1	68.16	62.88
2007	18	198	545	599	1.099	971	1 015.1	80.6	72.22	55.78
2008	16	136	435	717	1.648	775	1 010.4	119.2	82.35	67.59
2009	14	190	485	740	1.526	834	841.0	97.5	83.16	73.40
2010	14	164	450	660	1.467	731	735.8	109.4	80.49	75.33
2011	12	163	519	868	1.672	959	895.9	150.1	87.12	75.53
2012	12	137	413	682	1.651	746	813.6	105.5	85.40	78.93
2013	13	150	484	691	1.428	756	921.9	121.9	82.67	71.69

Q.5 CORE VESSEL SELECTION

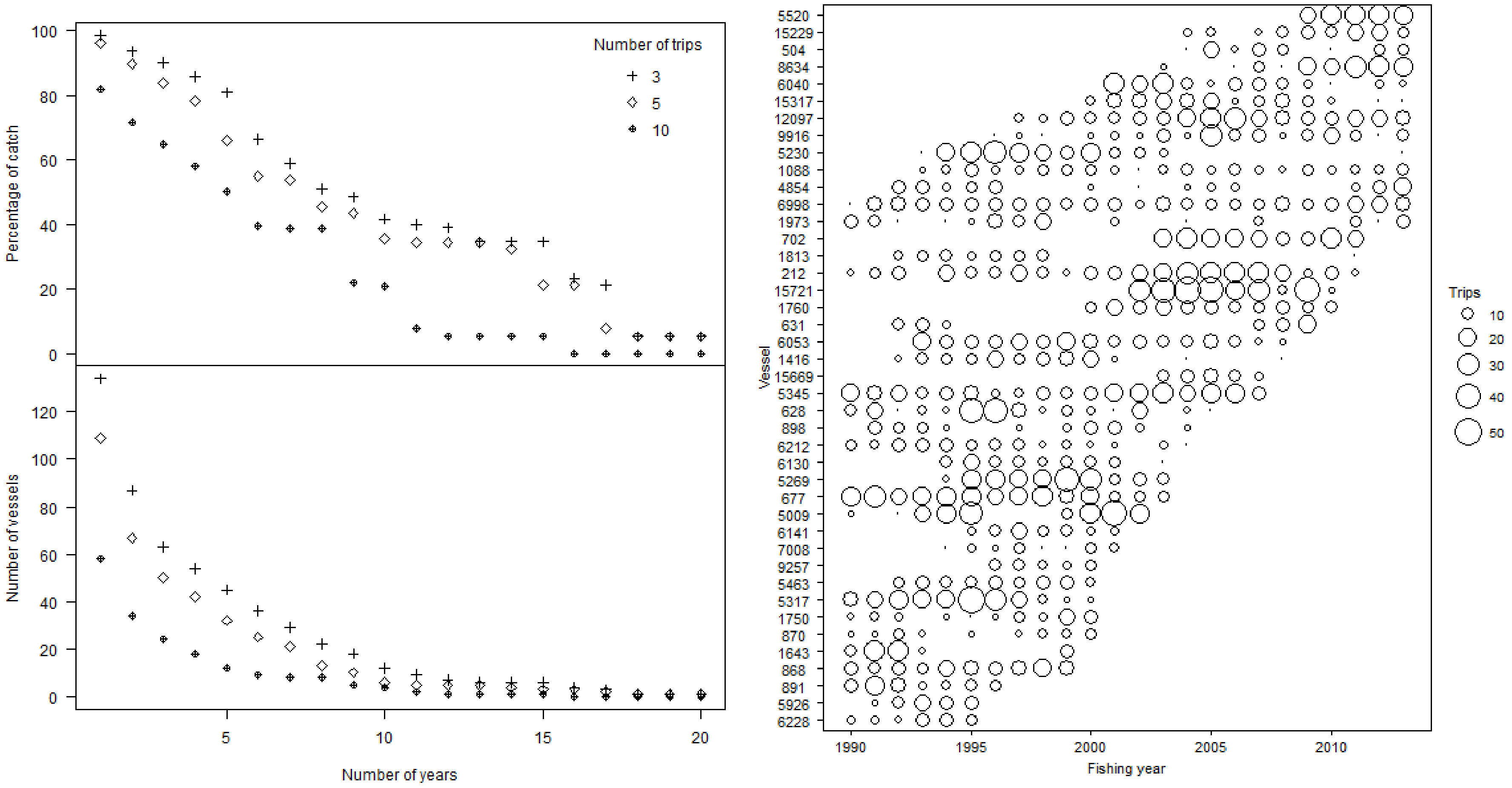

Figure Q.1: [left panel] total landed SCH and number of vessels plotted against the number of years used to define core vessels participating in the BLL-781W(MIX) dataset. The number of qualifying years (minimum number of trips per year) for each series is indicated in the legend. [right panel]: bubble plot showing the number of daily-effort strata for selected core vessels (based on at least 5 trips in 4 or more fishing years) by fishing year.

Q.6 EXPLORATORY DATA PLOTS FOR CORE VESSEL DATA SET

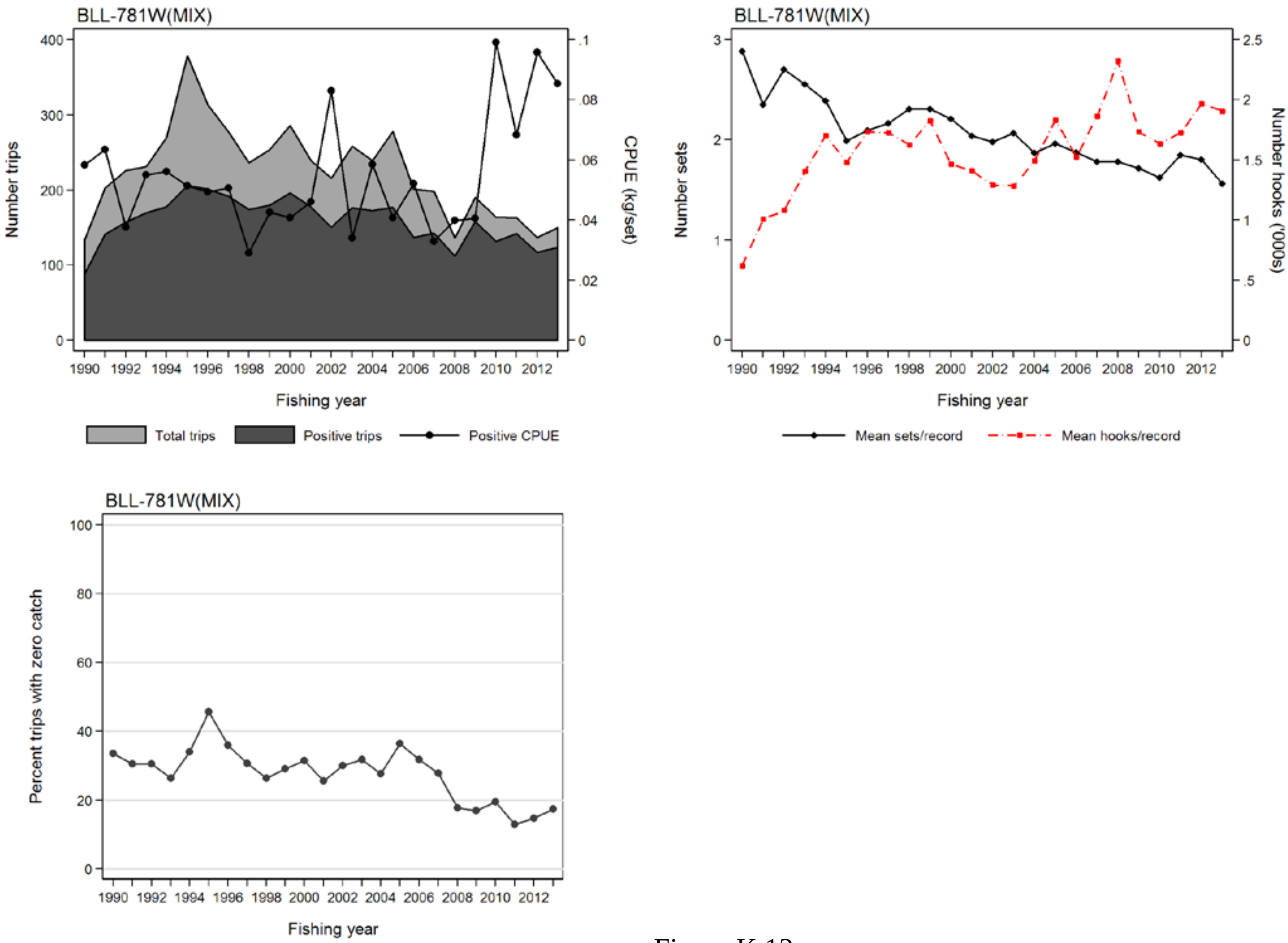

Figure K.12

Figure Q.2: Core vessel summary plots by fishing year for model BLL-781W(MIX): [upper left panel]: total trips (light grey) and trips with school shark catch (dark grey) overlaid with median annual arithmetic CPUE (kg/set) for all trips *i* with positive catch: $A_y = \text{median}\left(C_{y,i}/E_{y,i}\right)$**; [upper right panel]: mean number of sets and mean number of hooks per daily-effort stratum record; [lower left panel]: proportion of trips with no catch of school shark; [lower right panel]: mean number of events per daily-effort stratum record.**

Q.7 SELECTION OF DISTRIBUTION FOR POSITIVE CATCH RECORDS

The best distribution was lognormal.

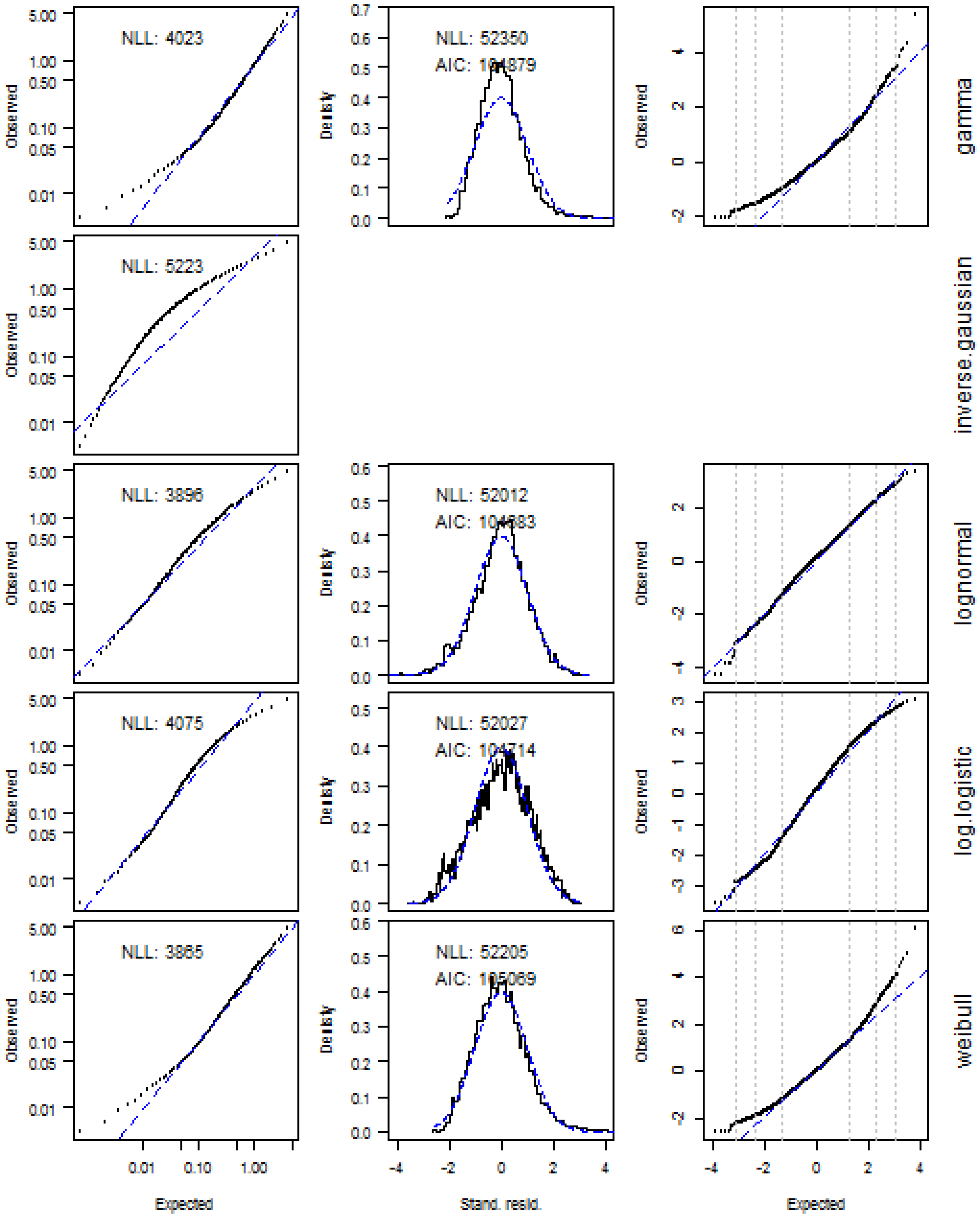

Figure Q.3: Diagnostics for alternative distributional assumptions for catch in the school shark BLL-781W(MIX) model. Left: quantile-quantile plot of observed catches (centred (by mean) and scaled (by standard deviation) in log space) versus maximum likelihood fit of distribution (missing panel indicates that the fit failed to converge); Middle: standardised residuals from a generalised linear model fitted using the formula catch ~ fyear + month +area+ vessel + log(sets) and the distribution (missing panel indicates that the model failed to converge); Right: quantile-quantile plot of model standardised residuals against standard normal (vertical lines represent 0.1%, 1% and 10% percentiles). NLL = negative log-likelihood; AIC = Akaike information criterion.

Q.8 POSITIVE CATCH MODEL SELECTION TABLE

Three explanatory variables entered the model after fishing year (Table Q.2), with number of hooks, month and form type non-significant. A plot of the model is provided in Figure Q.4 and the CPUE indices are listed in Table Q.4.

Table Q.2: Order of acceptance of variables into the lognormal model of successful catches in the BLL-781W(MIX) fishery model for core vessels based on the vessel selection criteria of at least 5 trips in 4 or more fishing years, with the amount of explained deviance and R^2 for each variable. Variables accepted into the model are marked with an *, and the final R^2 of the selected model is in bold. Fishing year was forced as the first variable.

Variable	DF	Neg. Log likelihood	AIC	R^2	Model use
fishing year	24	-16 183	32 416	0.94	*
target	28	-14 081	28 219	40.86	*
vessel	69	-13 249	26 638	51.89	*
area	81	-13 122	26 409	**53.38**	*
month	92	-13 050	26 286	54.22	
poly(log(hooks), 3)	95	-13 018	26 227	54.58	
form	97	-12 994	26 185	54.85	

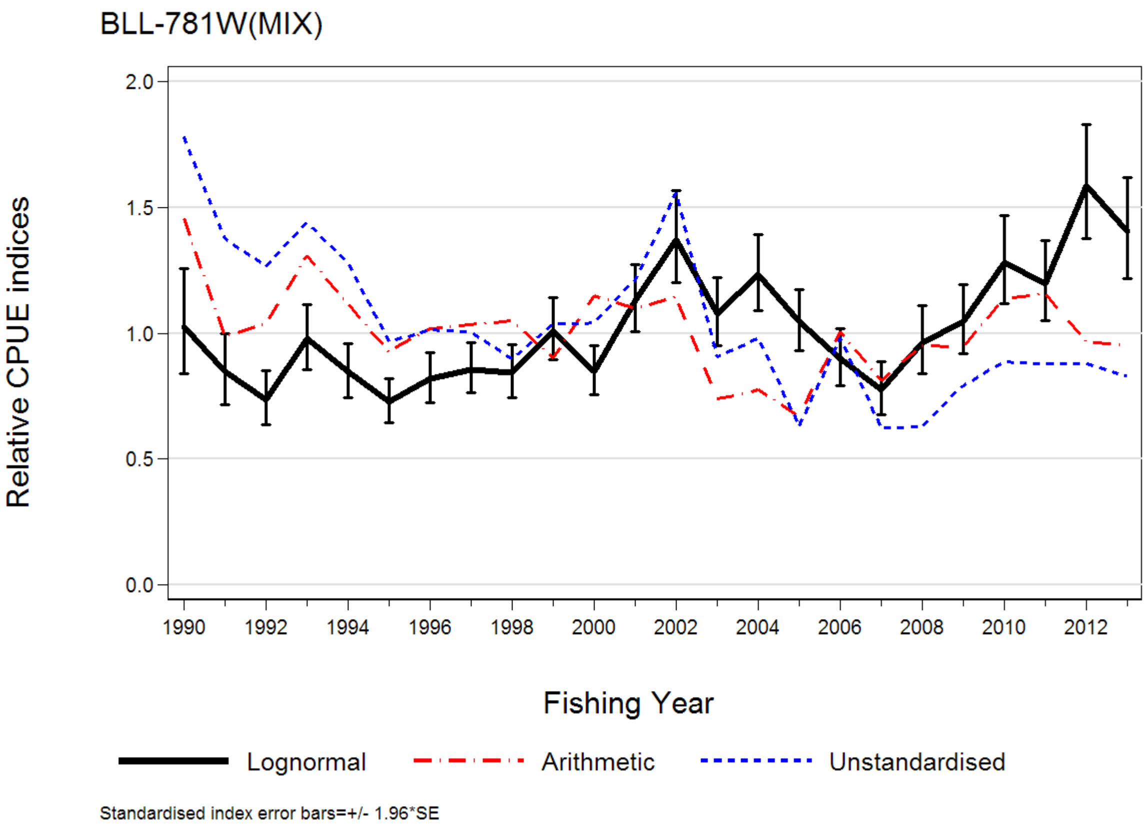

Figure Q.4: Relative CPUE indices for school shark using the lognormal non-zero model based on the BLL-781W(MIX) fishery definition. Also shown are two unstandardised series from the same data: a) Arithmetic (Eq. H.1) and b) Unstandardised (Eq. H.2).

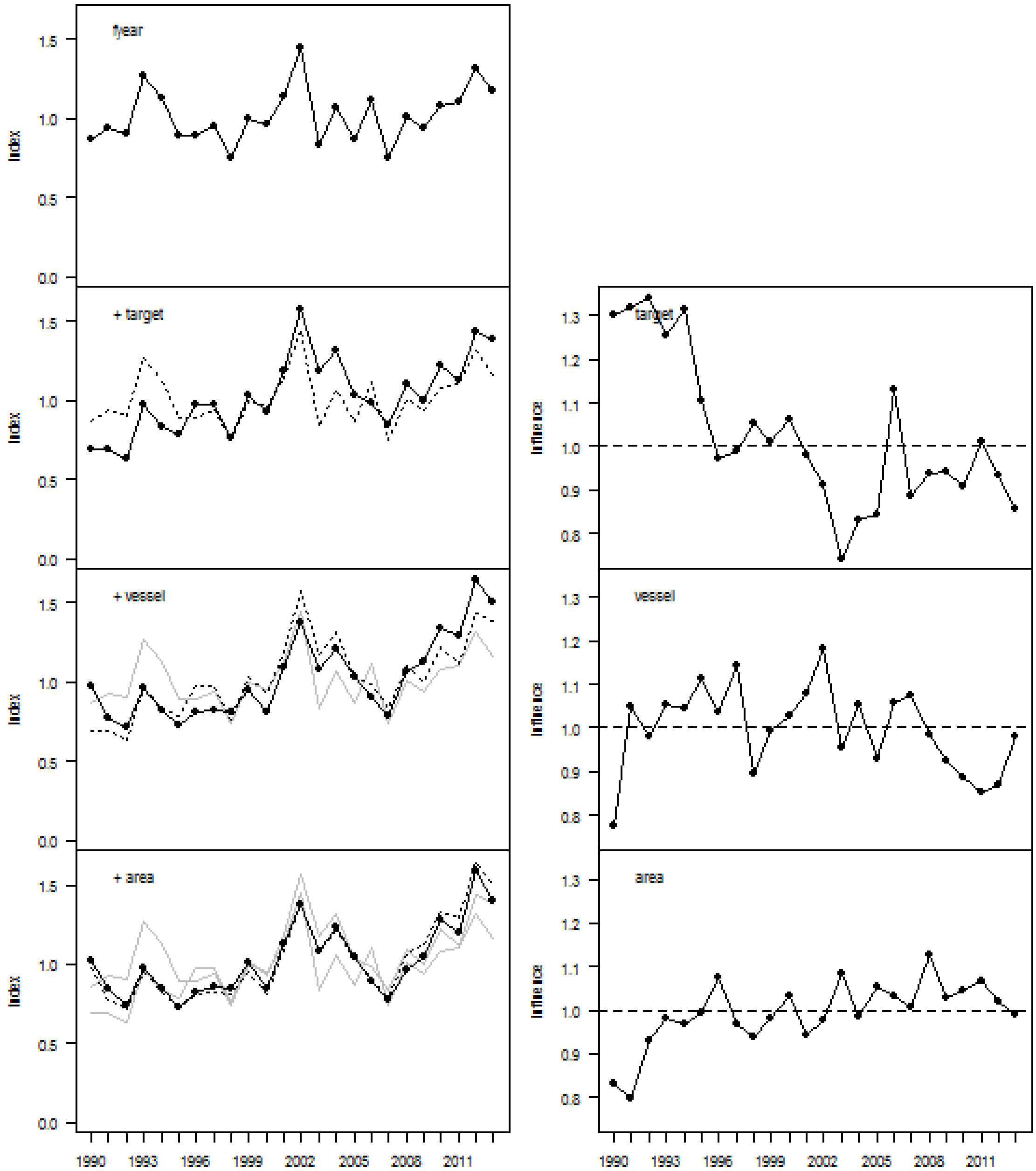

Figure Q.5: [left column]: annual indices from the lognormal model of BLL-781W(MIX) at each step in the variable selection process; [right column]: aggregate influence associated with each step in the variable selection procedure.

Q.9 RESIDUAL AND DIAGNOSTIC PLOTS

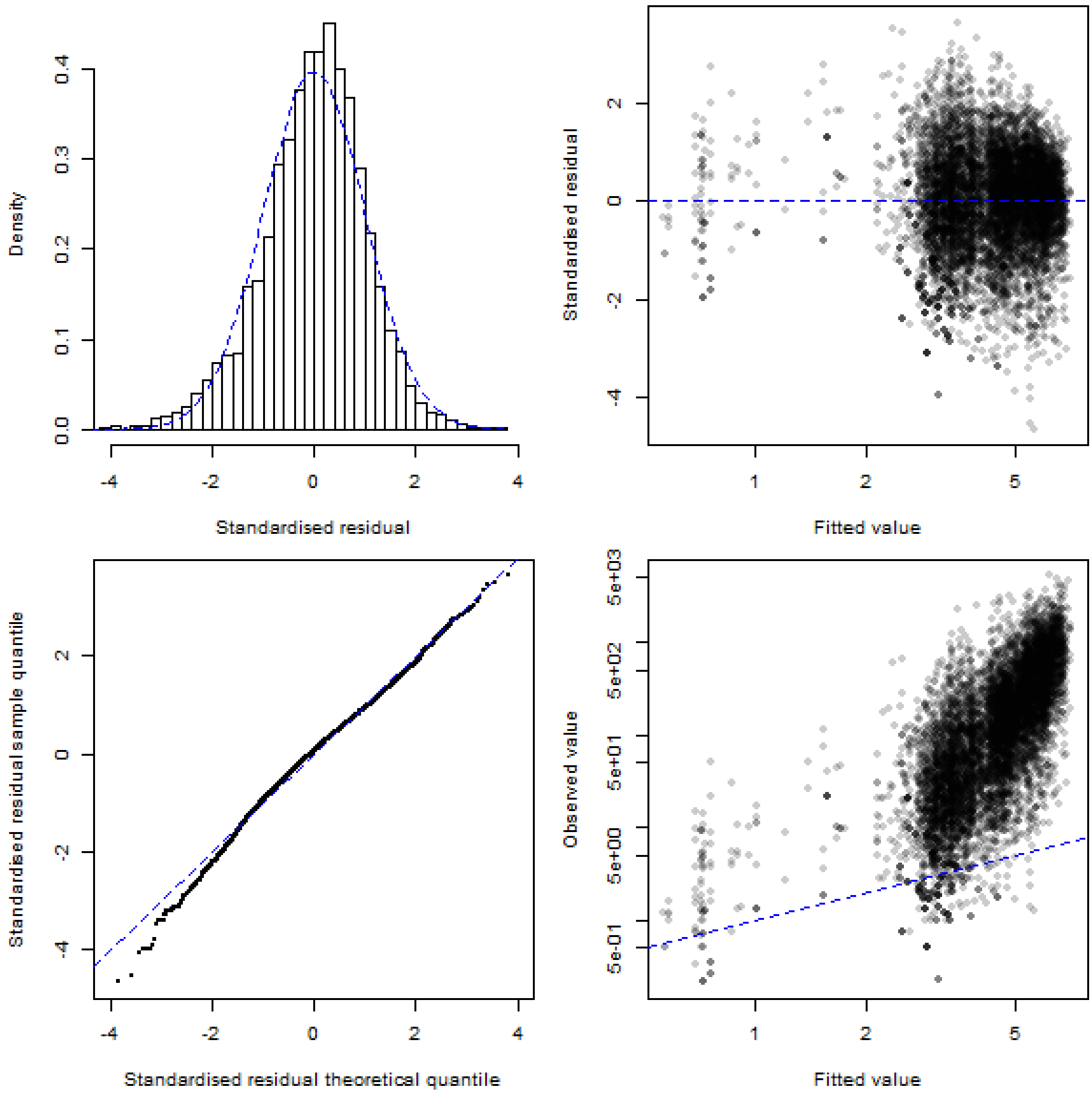

Figure Q.6: Plots of the fit of the lognormal standardised CPUE model to successful catches of school shark in the BLL-781W(MIX) fishery. [Upper left] histogram of the standardised residuals compared to a lognormal distribution (SDSR: standard deviation of standardised residuals. MASR: median of absolute standardised residuals); [Upper right] Q-Q plot of the standardised residuals; [Lower left] Standardised residuals plotted against the predicted model catch per trip; [Lower right] Observed catch per record plotted against the predicted catch per record.

Q.10 MODEL COEFFICIENTS

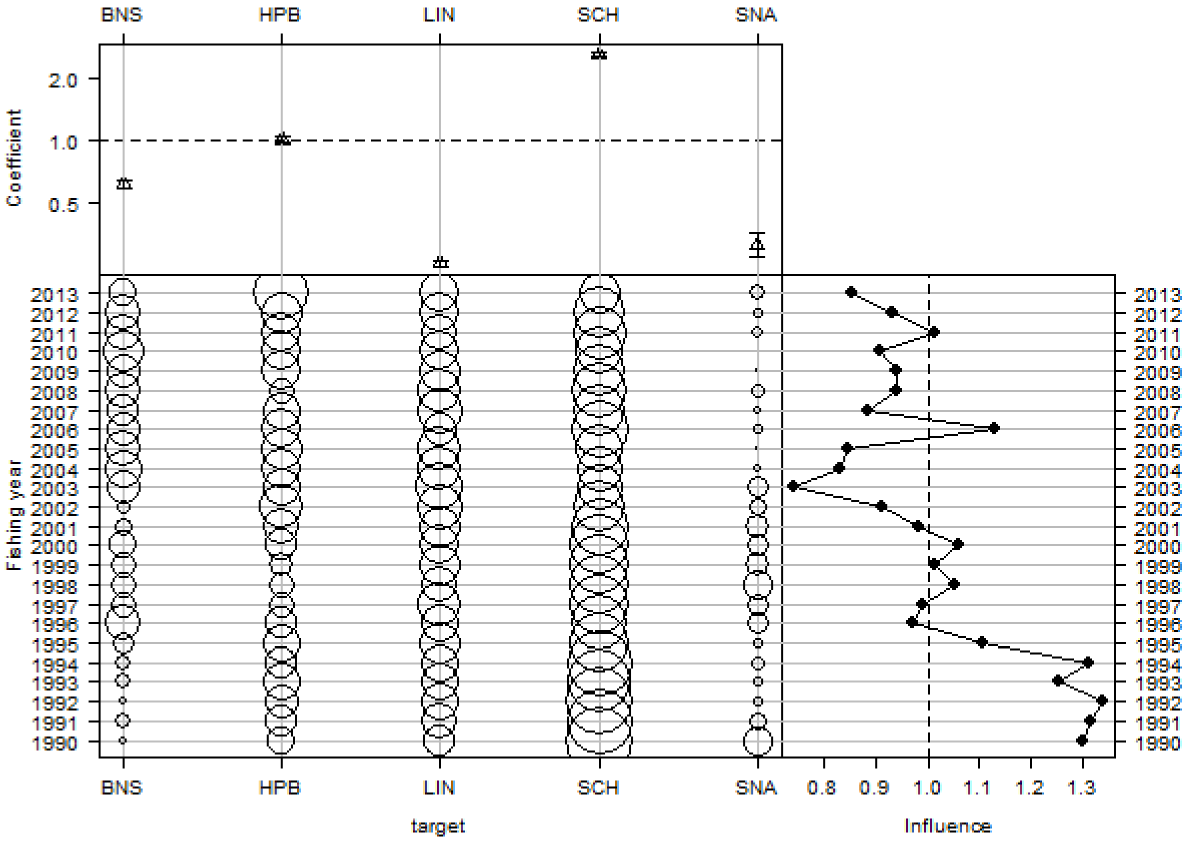

Figure Q.7: Effect of target species in the lognormal model for the school shark BLL-781W(MIX) fishery. Top: effect by level of variable (left-axis: log space additive; right-axis: natural space multiplicative). Bottom-left: distribution of variable by fishing year. Bottom-right: cumulative effect of variable by fishing year (bottom-axis: log space additive; top-axis: natural space multiplicative).

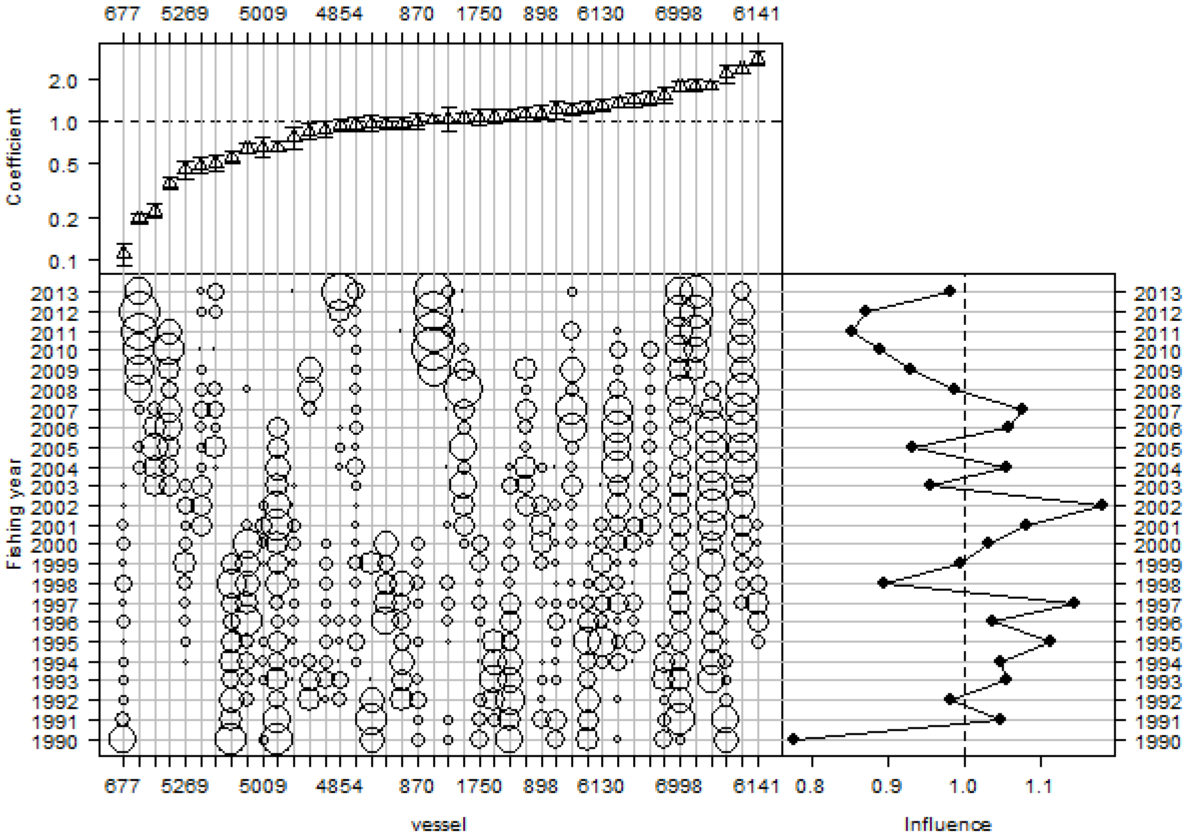

Figure Q.8: Effect of vessel in the lognormal model for the school shark BLL-781W(MIX) fishery. Top: effect by level of variable (left-axis: log space additive; right-axis: natural space multiplicative). Bottom-left: distribution of variable by fishing year. Bottom-right: cumulative effect of variable by fishing year (bottom-axis: log space additive; top-axis: natural space multiplicative).

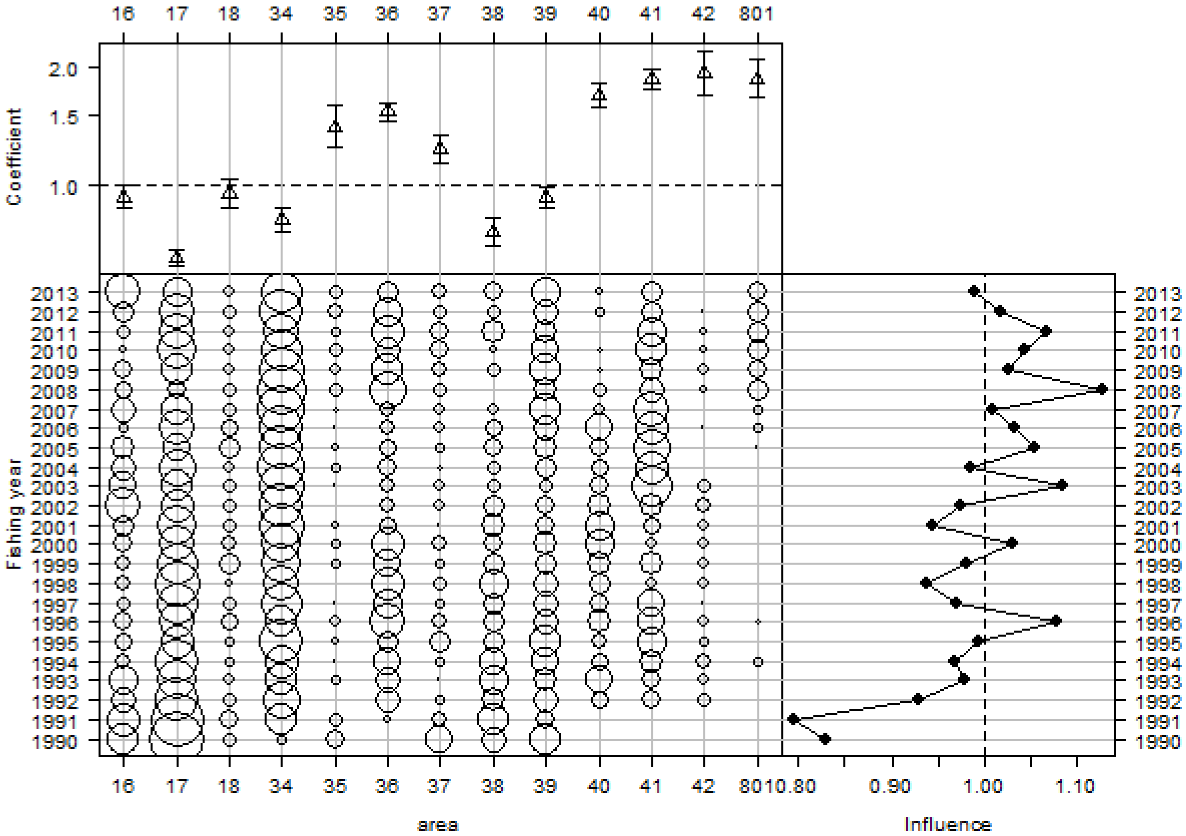

Figure Q.9: Effect of area in the lognormal model for the school shark BLL-781W(MIX) fishery. Top: effect by level of variable (left-axis: log space additive; right-axis: natural space multiplicative). Bottom-left: distribution of variable by fishing year. Bottom-right: cumulative effect of variable by fishing year (bottom-axis: log space additive; top-axis: natural space multiplicative).

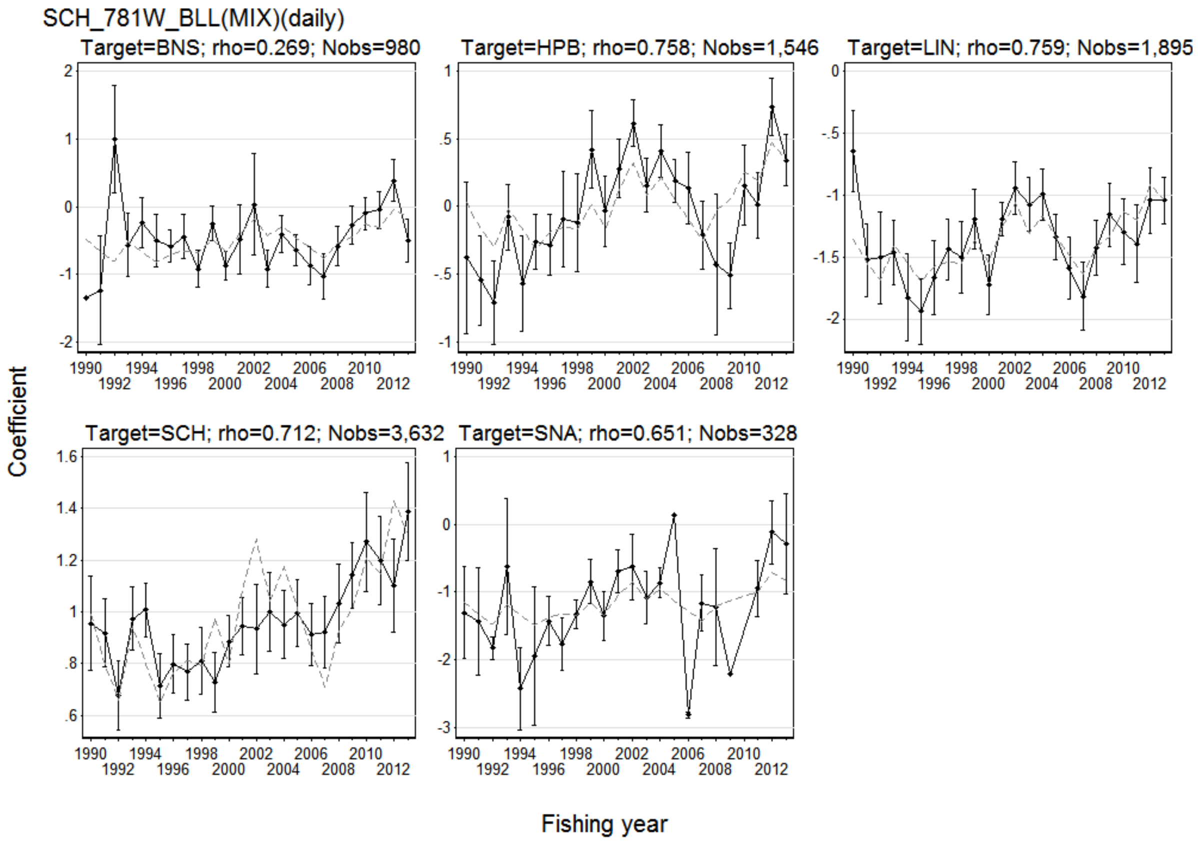

Figure Q.10: Residual implied coefficients for target×fishing year interaction (not offered) in the school shark BLL-781W(MIX) lognormal model. Implied coefficients (black points) are calculated as the normalised fishing year coefficient (grey line) plus the mean of the standardised residuals in each fishing year and area. These values approximate the coefficients obtained when an area × year interaction term is fitted, particularly for those area × year combinations which have a substantial proportion of the records. The error bars indicate one standard error of the standardised residuals. The information at the top of each panel identifies the plotted category, provides the correlation coefficient (*rho*) between the category year index and the overall model index, and the number of records supporting the category.

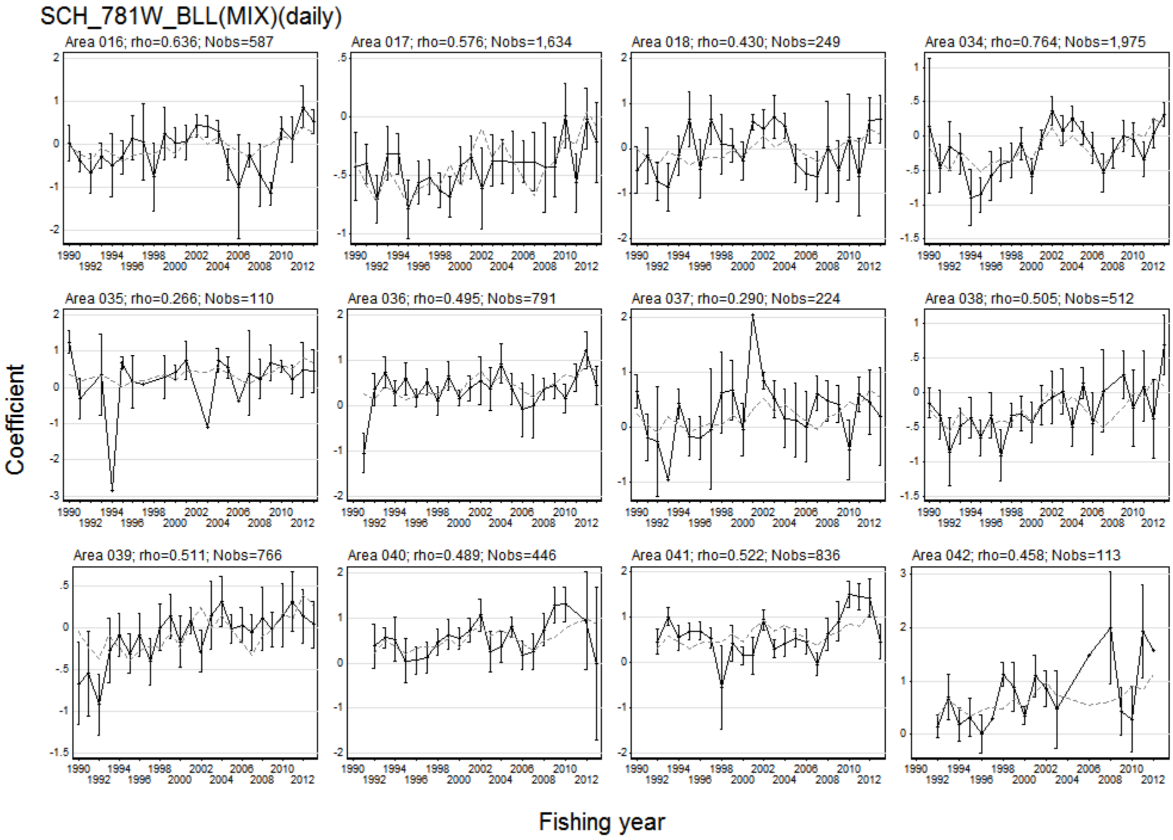

Figure Q.11: Residual implied coefficients for area×fishing year interaction (not offered) in the school shark BLL-781W(MIX) lognormal model. Implied coefficients (black points) are calculated as the normalised fishing year coefficient (grey line) plus the mean of the standardised residuals in each fishing year and area. These values approximate the coefficients obtained when an area × year interaction term is fitted, particularly for those area × year combinations which have a substantial proportion of the records. The error bars indicate one standard error of the standardised residuals. The information at the top of each panel identifies the plotted category, provides the correlation coefficient (*rho*) between the category year index and the overall model index, and the number of records supporting the category. Category 801 not plotted due to short time series.

Q.11 LOGISTIC (BINOMIAL) MODEL SELECTION TABLE

Two explanatory variables entered the model after fishing year (Table Q.3), with number of hooks, area, month and form type non-significant. Number sets was discarded by the model. A plot of the binomial model and the combined delta-lognormal model is provided in Figure Q.12 and the CPUE indices are listed in Table Q.4.

Table Q.3: Order of acceptance of variables into the binomial (logistic) model of successful catches in the BLL-781W(MIX) fishery model for core vessels based on the vessel selection criteria of at least 3 trips in 3 or more fishing years), with the amount of explained deviance and R^2 for each variable. Variables accepted into the model are marked with an *, and the final R^2 of the selected model is in bold. Fishing year was forced as the first variable.

Variable	DF	Neg. Log likelihood	AIC	R^2	Model use
fishing year	24	-8 625	17 299	2.40	*
target	28	-7 409	14 874	24.87	*
vessel	69	-6 811	13 760	34.49	*
area	81	-6 757	13 675	35.32	
poly(log(hooks), 3)	84	-6 719	13 606	35.90	
month	95	-6 679	13 549	36.50	
form	97	-6 668	13 531	36.66	

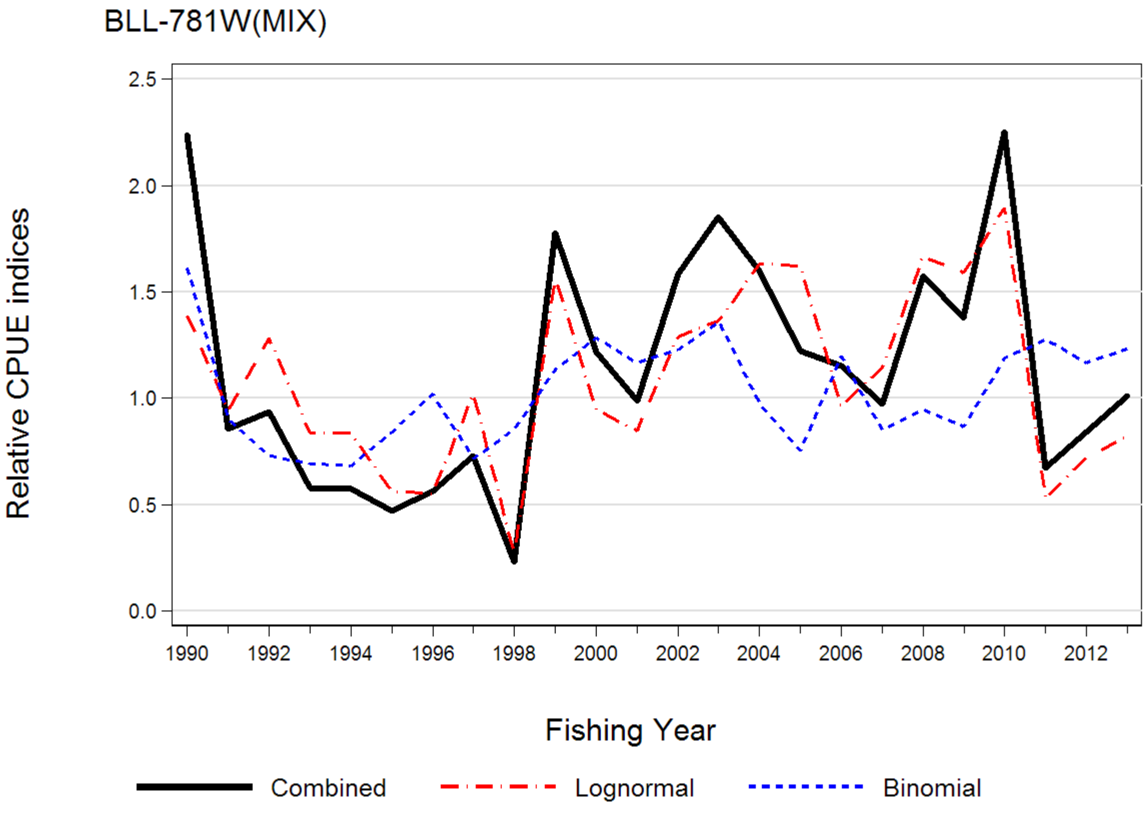

Figure Q.12: Relative CPUE indices for school shark using the lognormal non-zero model based on the BLL-781W(MIX) fishery definition, the binomial standardised model using the logistic distribution and a regression based on presence/absence of SCH, and the combined model using the delta-lognormal procedure suggested by Vignaux (1994).

Q.12 CPUE INDICES

Table Q.4: Arithmetic indices for the total and core data sets, geometric and lognormal standardised indices and associated standard error (SE) for the core data set by fishing year for the school shark BLL-781W(MIX) analysis. All series (except SE) standardised to geometric mean=1.0.

Fishing	All vessels						Core vessels
year	Arithmetic	Arithmetic	Geometric	Standardised	SE	Binomial	Combined
1990	1.359	1.455	1.781	1.026	0.1035	0.569	0.934
1991	0.690	0.987	1.376	0.845	0.0840	0.564	0.763
1992	0.791	1.040	1.266	0.736	0.0735	0.437	0.515
1993	1.135	1.308	1.440	0.977	0.0673	0.516	0.806
1994	1.049	1.117	1.281	0.845	0.0649	0.527	0.713
1995	0.975	0.927	0.967	0.727	0.0609	0.533	0.620
1996	1.088	1.020	1.014	0.819	0.0617	0.613	0.803
1997	0.988	1.034	1.005	0.857	0.0594	0.636	0.872
1998	1.051	1.052	0.897	0.841	0.0637	0.633	0.853
1999	1.062	0.901	1.036	1.010	0.0621	0.571	0.923
2000	1.176	1.151	1.041	0.847	0.0588	0.671	0.909
2001	1.128	1.100	1.211	1.131	0.0604	0.707	1.279
2002	1.727	1.145	1.561	1.372	0.0679	0.706	1.549
2003	1.061	0.738	0.905	1.077	0.0647	0.665	1.146
2004	0.849	0.774	0.981	1.232	0.0624	0.647	1.276
2005	0.676	0.670	0.630	1.045	0.0590	0.609	1.018
2006	1.022	1.006	0.982	0.898	0.0644	0.626	0.900
2007	0.821	0.812	0.623	0.774	0.0689	0.583	0.722
2008	0.885	0.951	0.628	0.964	0.0715	0.668	1.030
2009	0.903	0.947	0.793	1.047	0.0666	0.741	1.242
2010	1.017	1.139	0.887	1.280	0.0697	0.744	1.525
2011	1.009	1.159	0.878	1.198	0.0677	0.715	1.370
2012	0.973	0.966	0.880	1.587	0.0727	0.754	1.915
2013	1.036	0.952	0.830	1.404	0.0723	0.693	1.556