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Tini a Tangaroa

A rapid update of CPUE for the blue mackerel fishery in EMA 7 to 2024

New Zealand Fisheries Assessment Report 2025/45

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PLAIN LANGUAGE SUMMARY

Blue mackerel are mainly caught in commercial fisheries on the east and west coasts of the North Island.

In the Taranaki Bight, on the west coast of the North Island, and the northern west coast of the South Island (management area EMA 7), blue mackerel have principally been taken by the midwater trawl fishery that targets jack mackerels. Some catch is also taken by purse seining.

As part of its management within the Quota Management System, blue mackerel abundance in EMA 7 is monitored using catch-per-unit-effort (CPUE) from the midwater trawl fishery. In this report, this information is given for 2003 to 2024, updating the previous assessment that ended in 2022.

In 2024, the EMA 7 stock abundance was assessed to be substantially above the target level as a result of large increases during 2022 to 2024. Observer data also indicated recent recruitment to the fishery.

EXECUTIVE SUMMARY

Middleton, D.A.J.¹ (2025). A rapid update of CPUE for the blue mackerel fishery in EMA 7 to 2024.

New Zealand Fisheries Assessment Report 2025/45. 65 p.

A rapid update of the fishery characterisation and CPUE analysis was undertaken for blue mackerel in EMA 7, adding data from the 2023 and 2024 fishing years.

The EMA 7 catch is principally by midwater trawling targeting jack mackerels, but purse seining took around a third of the catch during 2022 to 2024. Catches exceeded the TACC in 2022 and 2024.

The updated CPUE analyses indicated that abundance increased substantially from 2022 to 2024, with observer sampling from the midwater trawl fishery showing evidence of stronger year classes entering the fishery in 2018, 2020 and 2024. The EMA 7 stock was assessed as Very Likely (> 90%) to be at or above the target level in 2023–24.

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1. INTRODUCTION

The fishery for blue mackerel in EMA 7 (Figure 1) was characterised using data to the end of the 2022 fishing year² by Middleton (2024). A standardised catch-per-unit-effort (CPUE) series beginning in 2003—after the stock had entered the Quota Management System (QMS)—was accepted as an index of abundance, and a partial quantitative assessment was undertaken.

This report provides an updated assessment using data to the end of the 2024 fishing year. In 2022, 2023 and 2024, the commercial catch of EMA 7 was at or above the Total Allowable Commercial Catch (TACC), with the 2024 catch representing a 35% overrun (Figure 2, Table B.1). The TACC has been at its current level (Table 1, Figure 2) since the stock was introduced into the QMS in 2002.

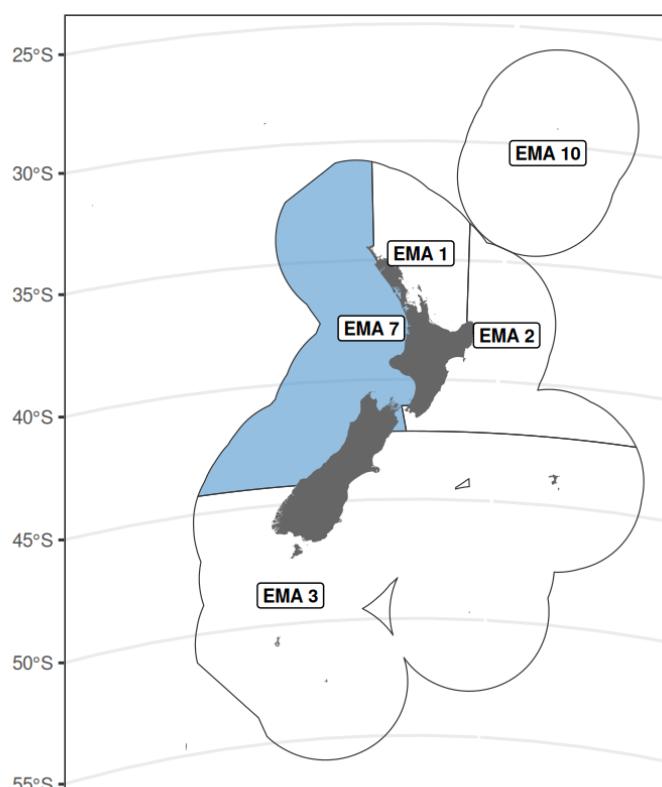


Figure 1: Quota Management Areas for blue mackerel with EMA 7 highlighted.

Table 1: Total Allowable Catch (TAC), Total Allowable Commercial Catch (TACC), and allowances (all tonnes) for EMA 7, as at 1 October 2024.

Stock	TAC	TACC	Allowances		
			Customary	Recreational	Other mortality
EMA 7	3 352	3 350	1	1	0

²where the 2022 fishing year was 1 October 2021 to 30 September 2022

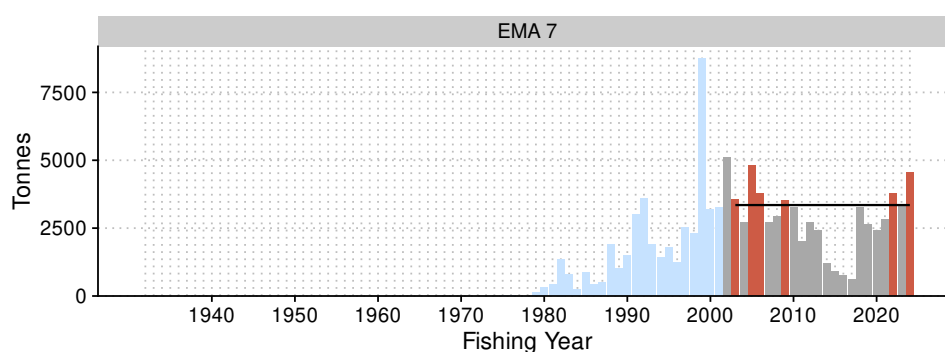


Figure 2: Total Allowable Commercial Catch (TACC; black line) and Monthly Harvest Return/Quota Management Report totals (bars) for EMA 7 from 2002 to 2024. Years where the TACC was exceeded are highlighted in red. Catches prior to 2002 are shown in blue using the information compiled in the Fisheries Assessment Plenary Report (Fisheries New Zealand 2024). Monthly Harvest Return data reported by Fisheries Management Area (FMA) prior to QMS introduction are recoded to the corresponding Quota Management Area (QMA) where this is unambiguous (i.e., for FMAs that map to only one QMA). Tabulated data are provided in Table B.1.

2. METHODS

Extracts (report logs 13159, 17044) of statutory commercial catch, effort, and landings data were provided by Fisheries New Zealand and processed using standardised grooming routines (Appendix A). Methods used for the characterisation and CPUE analyses were as described by Middleton (2024).

3. FISHERY CHARACTERISATION

A close correspondence between aggregated catches from the groomed landings data and MHR/QMR totals has continued in 2023 and 2024, with the majority of the catch landed to a Licensed Fish Receiver (Figure 3). A small proportion of the catch has been converted to fishmeal since the mid 2010s, but otherwise fish have usually been landed in an unprocessed (green) or dressed state (Figure 4). There have been no recent changes in conversion factors applicable to blue mackerel. Total catches also correspond closely with catches that were allocated to fishing events in the characterisation dataset (Figure 5).

Purse seine catches represented around a third of the EMA 7 catches during 2022 to 2024. An increase in the midwater trawl catch was apparent in 2024 (Figure 6), although very little of the blue mackerel catch by midwater trawling in 2023 and 2024 was target catch (Figure 7).

The distribution of catch and effort in both the midwater trawl and purse seine fisheries has remained consistent with that described by Middleton (2024).

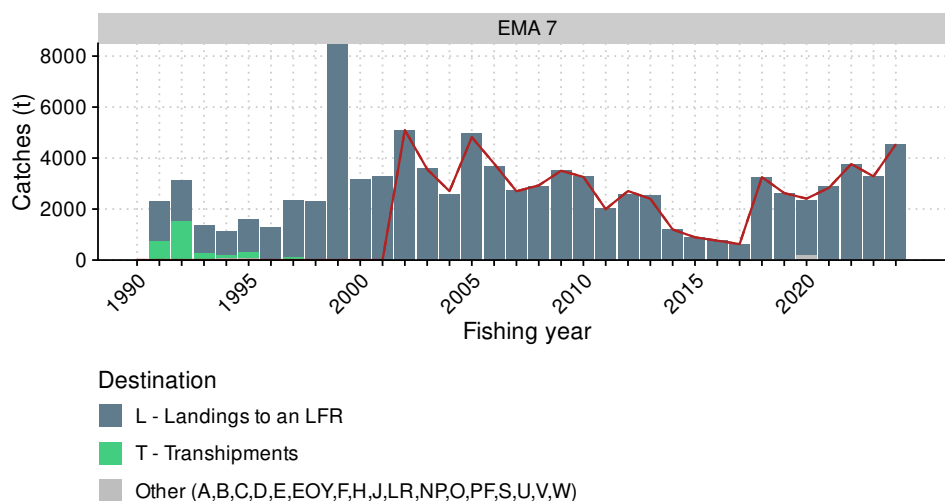


Figure 3: Catches of blue mackerel by destination (bars), compared with Monthly Harvest Return / Quota Management Report (MHR/QMR) totals (line), for Quota Management Area EMA 7. Destination codes are defined in Table F.6 and tabulated catches are given in Appendix B.

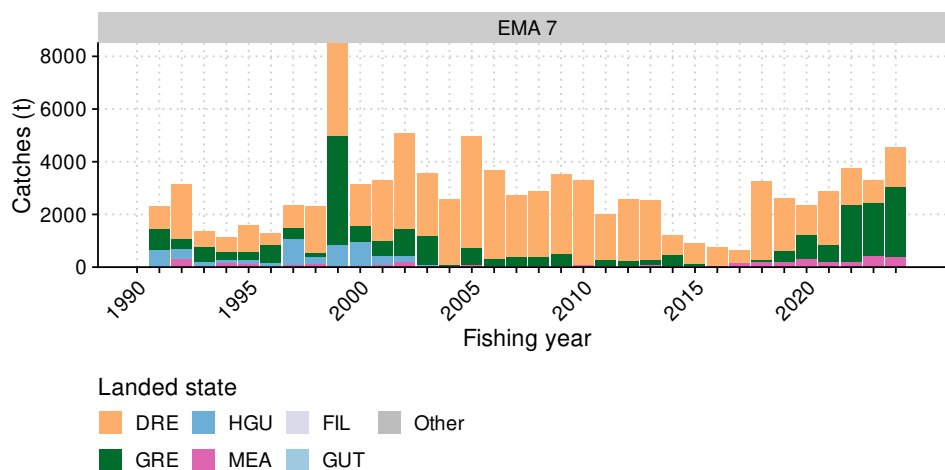


Figure 4: Product state of blue mackerel landings from Quota Management Area EMA 7. Catches are tabulated in Appendix B, and product state codes are defined in the glossary Table F.1.

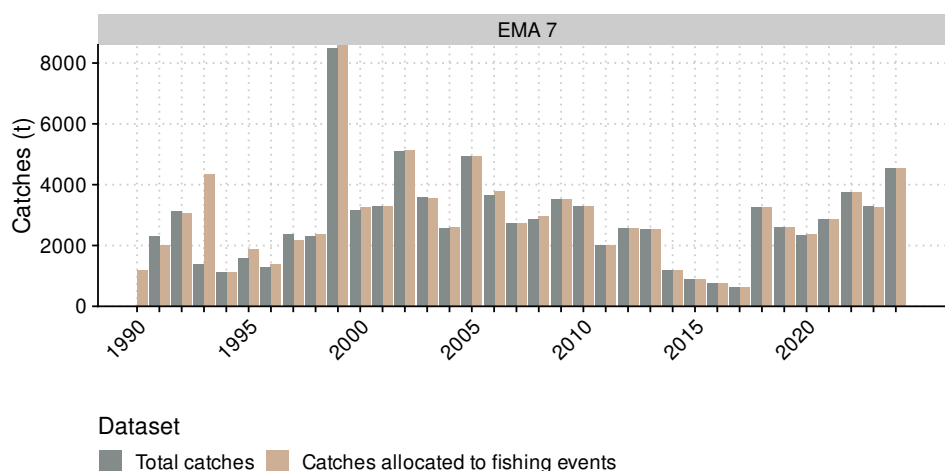


Figure 5: Total catches (t) of blue mackerel from EMA 7 in comparison with catches allocated to fishing events in the characterisation dataset.

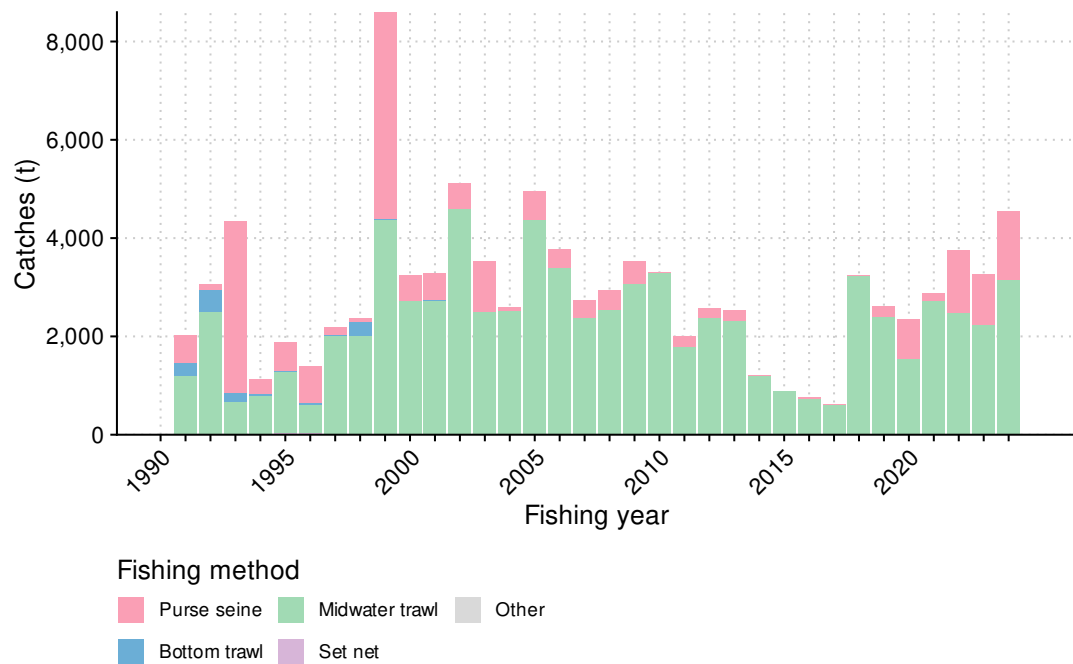


Figure 6: Catches of blue mackerel by fishing method, for events within the EMA 7 Quota Management Area. Methods grouped as Other include: BLL, BPT, BS, CP, DL, DS, FP, HL, MPT, PL, PRB, PRM, PSH, RLP, T. Tabulated results are provided in Appendix B, and a list of the main fishing method codes is included in the glossary Table F.3.

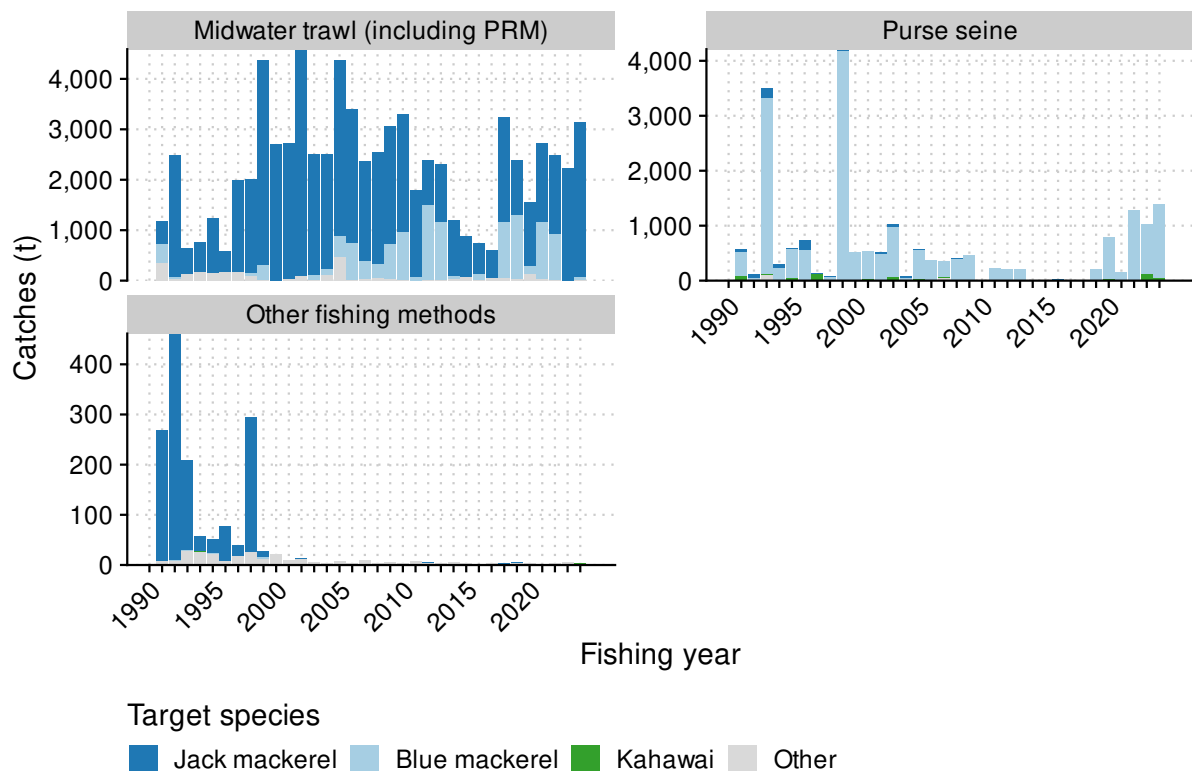


Figure 7: Catches of blue mackerel by fishing method and declared target species, for events within the EMA 7 Quota Management Area. Precision midwater trawl (PRM) catches are included with conventional midwater trawl (MW) catches. Fishing methods grouped as Other include: BLL, BPT, BS, BT-PRB, CP, DL, DS, FP, HL, MPT, PL, PSH, RLP, SN, T. Species grouped as Other include target species with less than 20% of the blue mackerel catch within the EMA 7 Quota Management Area in a fishing year.

4. CATCH-PER-UNIT-EFFORT

Updated event resolution CPUE series for EMA 7 were fitted to fisher reported data (1992 to 2024) and observer data (2001 to 2024) from the midwater trawl fishery (Table 2). Standard diagnostics for these series are provided in Appendix C, and the resulting series are compared with those provided by Middleton (2024), that used data to 2022, in Appendix D.

In the updated EMA7 MW MACK event series, one additional vessel entered the core fleet (Figure C.2). The same terms were retained after stepwise selection in both the occurrence and positive catch models, with similar estimated effects. Fitted terms in the EMA7 MW MACK observer, and the effect of standardisation, were also similar for the previous and updated series.

Table 2: Summary of models constructed for CPUE standardisation.

Series name	Data resolution	Response variable	Explanatory variable selection process	Core fleet years	Core fleet trips	Assumed error distribution
EMA7 MW MACK event	event	allockg_top5	Stepwise	5	3	Weibull
EMA7 MW MACK observer	observer	obskg	Stepwise	5	1	lognormal

Both EMA 7 CPUE series suggest a recent increase in abundance. This is most notable after 2021, but an increasing trend is evident since 2014 (Figure 8). The increase is evident a year earlier in the observer series, which showed a large increase from 2021 to 2022—and a further increase to 2023—before dropping slightly in 2024. The primary EMA7 MW MACK event series showed large increases during 2022 to 2024.

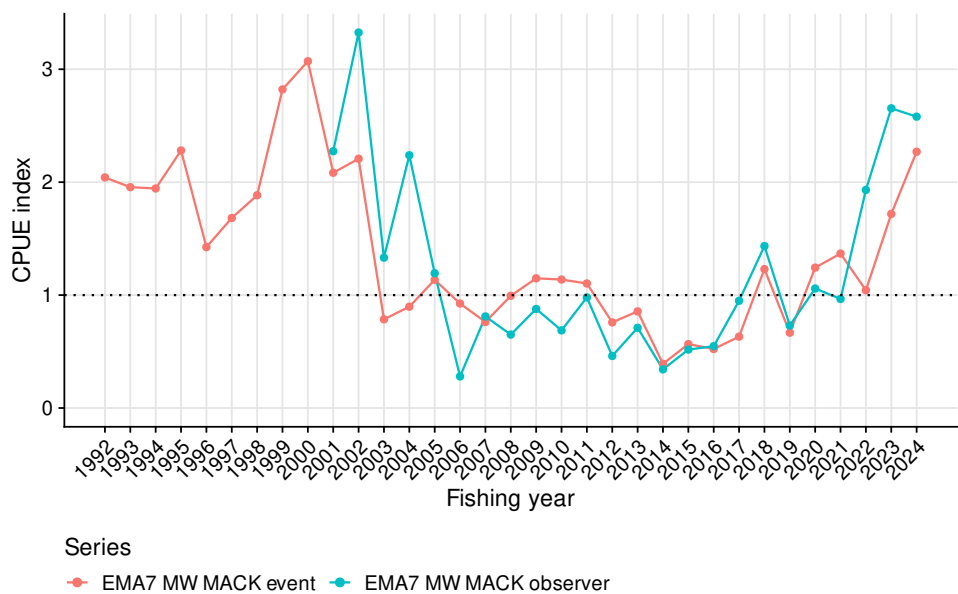


Figure 8: Comparison between the EMA 7 CPUE series using fisher reported and observer datasets. Indices are scaled to a geometric mean of one for the years in common.

5. DISCUSSION

The rapid increase in the EMA7 MW MACK event CPUE series from 2022 to 2024 has the consequence that the abundance index in 2024 was substantially higher than the target (the geometric mean CPUE for the period 2005 to 2010; Figure 9) and, despite an increase in catches, the relative exploitation rate was below the overfishing threshold in 2023 and 2024.

Observer sampling of the EMA 7 midwater trawl fishery is summarised in Appendix E; over the last decade this has been reasonably representative both temporally (Figure E.1) and spatially (Figure E.2), although there has been a tendency to under-sample in the latter part of the fishing year and at the northern or southern extents of the fishery. Scaled length-frequency distributions (Figure E.3) show that a large mode of fish under 40 cm was sampled in 2024. Similar modes were evident in 2018 and 2020, suggesting that the increase in abundance evident in the CPUE indices was the result of a series of strong year classes entering the fishery.

In 2022 the Deepwater Fisheries Assessment Working Group, and a stock assessment Plenary meeting, considered that the EMA 7 stock was Likely (> 60%) to be at or above the target; as a result of the recent increase in abundance, the Deepwater Fisheries Assessment Working Group agreed that the stock in 2024 was Very Likely (> 90%) to be at or above the target.

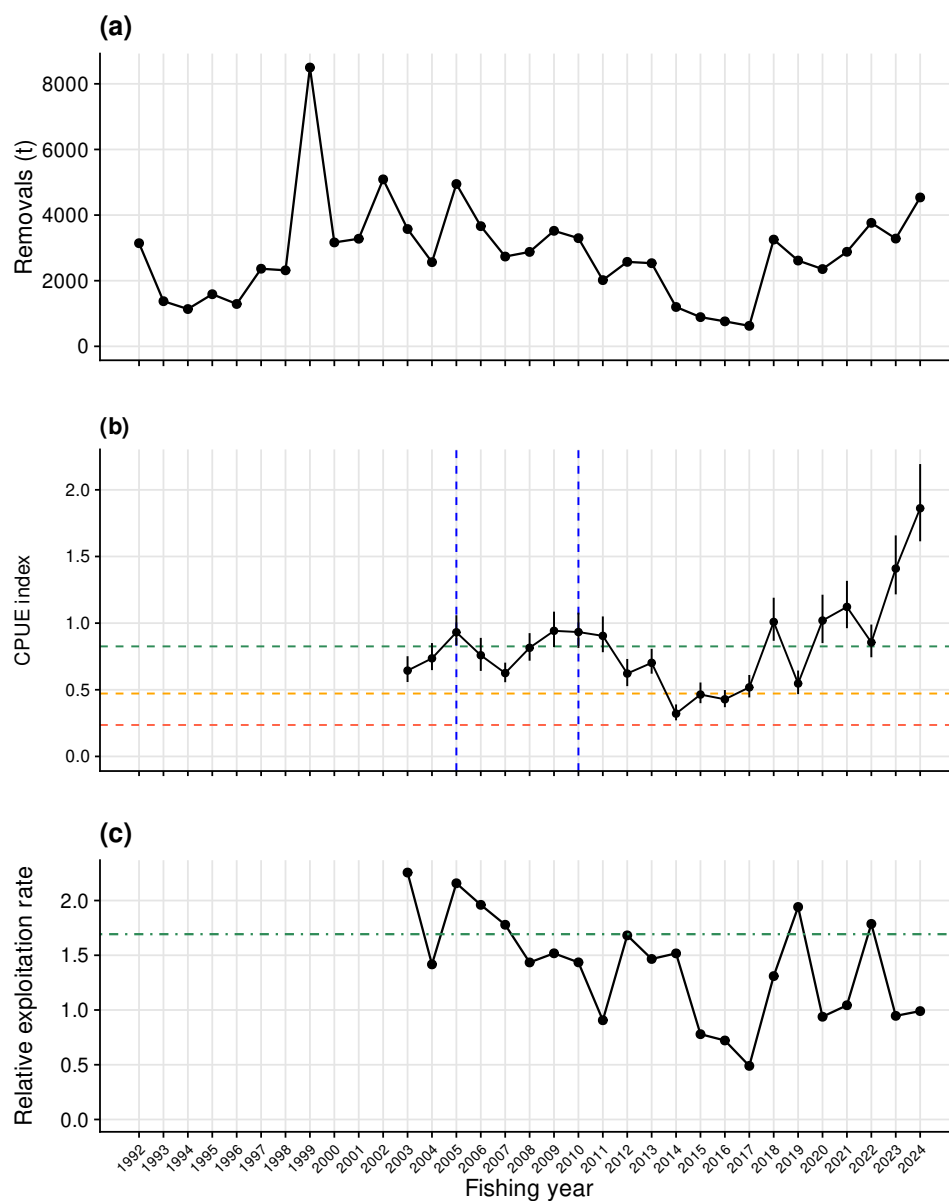


Figure 9: Stock status of EMA relative to the reference period (2005–2010, indicated by dashed vertical lines in panel b), with geometric mean CPUE in this period considered to represent the target and indicated by the horizontal green dashed line. The hard and soft limits are represented by horizontal dashed red and orange lines, respectively.

6. ACKNOWLEDGEMENTS

This work was funded by the Seafood New Zealand Deepwater Council. Access to the required data was granted by Fisheries New Zealand. Analyses were carried out using the Kahawai Collective's reproducible research platform. This report updates analyses that were developed in Fisheries New Zealand project SEA2021-20. Review by the Deepwater Fisheries Assessment Working Group is gratefully acknowledged.

7. REFERENCES

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APPENDIX A: DATA GROOMING

Grooming of the statutory commercial catch, effort and landings data followed the approach of Starr (2007), with a set of rules defined for each of the different types of data (Bentley 2012).

A.1 Landings

Table A.1: Grooming rules applied to landings data.

Rule	Effect	Description
LADTI	Flag	Invalid landing destination
LAQMS	Fix	Replace pre-QMS pseudo-stock with the post-QMS stock code
LADTH	Drop	Retained (non-final) landings
LADTT	Flag	Vessel received transhipments
LASCF	Fix	Correct some state codes
LASCI	Flag	Landings to invalid state code
LASCD	Drop	Drop landings of secondary product states
LADUP	Drop	Duplicate landings
LACFM	Fix	Replace missing conversion factors with the median over all years
LAGWI	Fix	Estimate missing greenweights
LAGWM	Drop	Missing greenweights that cannot be estimated
LAGWO	Fix	Identify and fix order of magnitude errors in landings

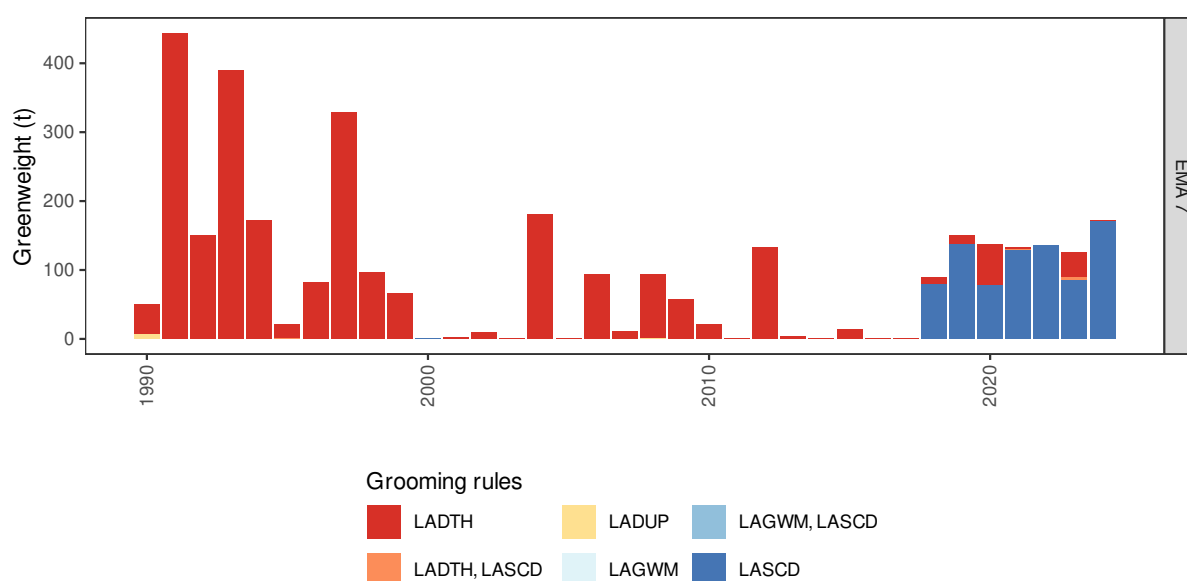


Figure A.1: The quantity of landings dropped, with the relevant grooming rules indicated, by stock and fishing year.

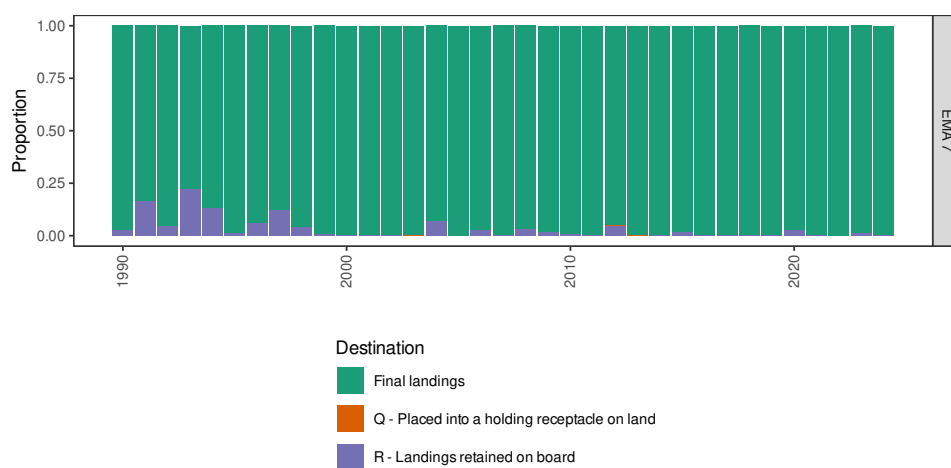


Figure A.2: The proportion of total (final and non-final) landings that are initially to non-final destinations, by stock and fishing year.

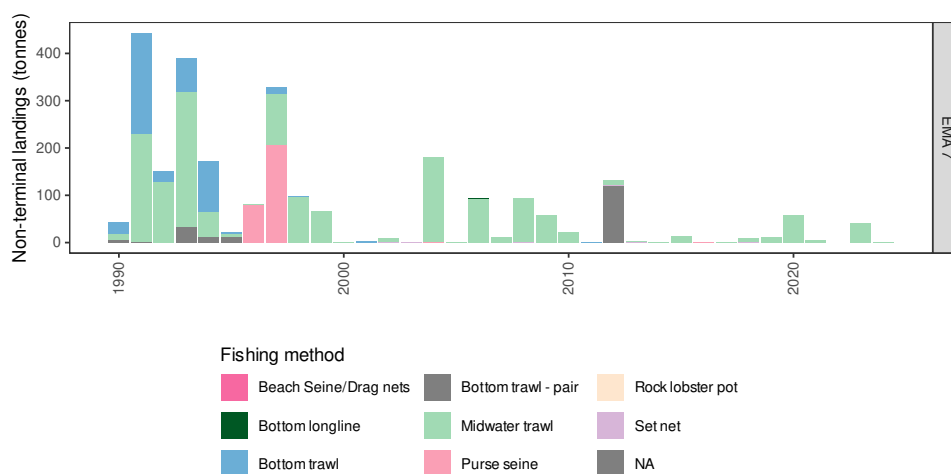


Figure A.3: The quantity of non-final landings, by stock, fishing year, and the modal fishing method used on the trip.

Table A.2: Annual number of trips, and affected greenweight quantity, where the LAGWO rule indicated an order of magnitude error in the landing weight and this was adjusted.

QMA	Fishing year	Trips	Greenweight (kg)	
			Original	Adjusted
EMA 7	1991	1	98 608.0	821.7333
EMA 7	1995	1	66.0	0.6600
EMA 7	1998	1	10 800.0	10.8000
EMA 7	1999	1	267 491.0	2 674.9100
EMA 7	2000	1	3 754.0	37.5400
EMA 7	2007	1	452.0	4.5200
EMA 7	2009	1	172.0	1.7200
EMA 7	2019	1	12 237.0	1.2237
EMA 7	2020	1	5 742.4	5.7424
EMA 7	2022	1	1 192.0	11.9200
EMA 7	2023	1	393.0	3.9300

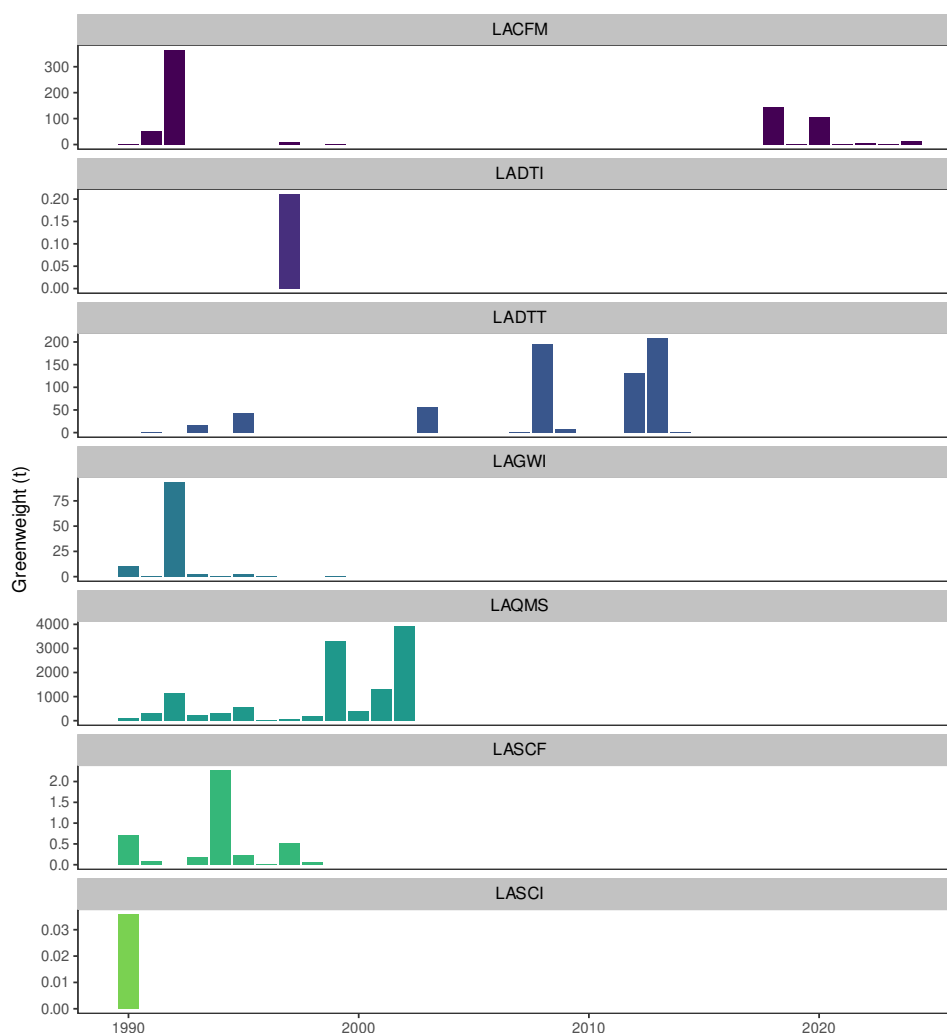


Figure A.4: The quantity of landings flagged by the grooming rules, or where fixes were applied to fields other than the landed greenweight. Note that some landing events may be affected by multiple rules.

A.2 Effort

Table A.3: Grooming rules applied to effort data.

Rule	Effect	Description
FEPMN	Fix	Add PSH as a method code for certain vessels if method is null
FEPMI	Fix	Replace missing methods if there is only one method used on the trip (by form type)
FEPMM	Flag	Flag trips if any events have a missing method
FESAI	Fix	Substitute the modal statistical area from a trip for missing areas
FESAM	Flag	Flag events with missing statistical areas
FESAF	Flag	Flag non RLP events using RL statistical area codes
FETSE	Fix	Set target species to group code for HPB and FLA species
FETSW	Fix	Flag and set target species to null if target species is not a valid species code
FETSI	Fix	Replace missing target species with the modal value for a trip
FEETN	Fix	Flag and fix some CP effort errors
FEEHN	Fix	Fix transposed effort numbers for lining methods on CELR forms
FEEMU	Fix	Fix SN mesh sizes recorded in inches
FEMEM	Flag	Flag events where the primary effort measure is missing
FEHDE	Flag	Flag records where the maximum daily effort is out of range
FEDBE	Fix	Transpose bottom and effort depths if reported effort depth > bottom depth

Table A.4: Grooming rules applied to estimated catch data.

Rule	Effect	Description
ESTGT	Fix	Create estimated catch records for events with a total catch weight only

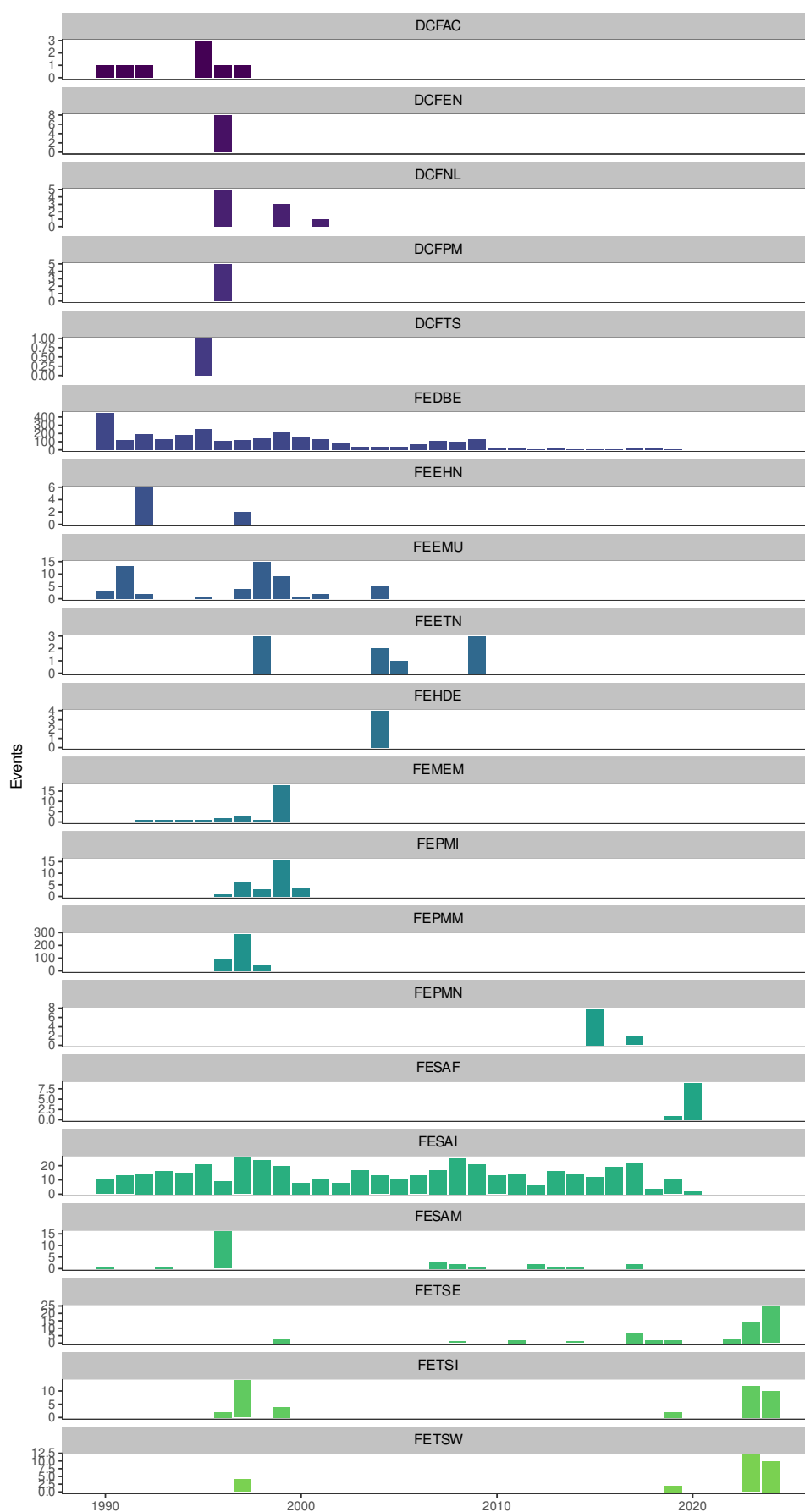


Figure A.5: The number of fishing events flagged or fixed by the grooming rules. Note that some events may be affected by multiple rules.

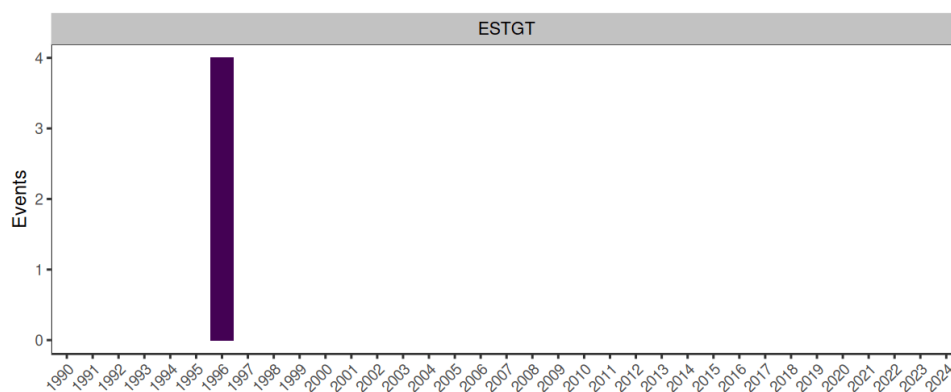


Figure A.6: The number of fishing events where the estimated catch of blue mackerel was flagged or fixed by the grooming rules. Note that some events may be affected by multiple rules.

APPENDIX B: TABULATED FISHERIES CHARACTERISATION DATA

Table B.1: Annual Total Allowable Commercial Catch (TACC; t) and Monthly Harvest Return/Quota Management Report totals (t) for EMA 7 from 1990 to 2024.

Fishing year	EMA 7	
	TACC	MHR/QMR
1990	-	-
1991	-	-
1992	-	-
1993	-	-
1994	-	-
1995	-	-
1996	-	-
1997	-	-
1998	-	-
1999	-	-
2000	-	-
2001	-	-
2002	-	5 100.40
2003	3 350.00	3 561.57
2004	3 350.00	2 700.67
2005	3 350.00	4 817.32
2006	3 350.00	3 783.83
2007	3 350.00	2 698.01
2008	3 350.00	2 928.73
2009	3 350.00	3 503.22
2010	3 350.00	3 260.07
2011	3 350.00	1 996.35
2012	3 350.00	2 707.00
2013	3 350.00	2 400.61
2014	3 350.00	1 199.62
2015	3 350.00	891.75
2016	3 350.00	761.18
2017	3 350.00	624.71
2018	3 350.00	3 253.74
2019	3 350.00	2 626.22
2020	3 350.00	2 409.03
2021	3 350.00	2 832.20
2022	3 350.00	3 766.49
2023	3 350.00	3 281.66
2024	3 350.00	4 537.37

Table B.2: Annual EMA 7 catches (t) from the different sources of data used in the fishery characterisation. QMR = Quota Management Reports; MHR = Monthly Harvest Returns. Catches represent groomed (Appendix A) landings/discards data summed by stock (see Table F.6 for destination codes included). Allocated catch represents catches allocated to fishing events in the characterisation dataset, with the percentage taken by key fishing methods indicated. Target catch is the allocated catch taken on fishing events where blue mackerel was targeted. – : no observations.

Fishing year	QMR/MHR (t)	Catches (t)	Allocated catches			Target catches	
			Total (t)	MW-PRM (%)	PS (%)	tonnes	%
1990	-	1 495.39	1 189.45	4.89	83.81	629.46	52.92
1991	-	2 305.91	2 025.53	58.65	28.11	834.46	41.20
1992	-	3 143.04	3 064.04	81.17	3.78	99.18	3.24
1993	-	1 375.82	4 353.82	14.86	80.34	3 215.64	73.86
1994	-	1 136.42	1 124.56	68.37	26.50	228.07	20.28
1995	-	1 588.31	1 870.50	66.42	30.85	528.36	28.25
1996	-	1 290.59	1 393.63	41.32	53.15	554.60	39.80
1997	-	2 365.03	2 174.50	91.56	6.62	10.30	0.47
1998	-	2 316.88	2 375.13	84.56	3.04	113.21	4.77
1999	-	8 497.05	8 595.46	50.69	48.99	4 484.23	52.17
2000	-	3 166.31	3 247.60	83.53	15.83	501.13	15.43
2001	-	3 278.77	3 280.13	83.02	16.68	526.95	16.07
2002	5 100.40	5 088.43	5 118.49	89.64	10.08	482.56	9.43
2003	3 561.57	3 575.12	3 543.39	70.64	29.24	1 040.86	29.37
2004	2 700.67	2 565.74	2 586.76	96.93	2.95	181.47	7.02
2005	4 817.32	4 946.54	4 950.34	88.25	11.60	953.48	19.26
2006	3 783.83	3 662.51	3 777.14	90.04	9.86	1 105.69	29.27
2007	2 698.01	2 736.30	2 740.08	86.52	13.17	658.23	24.02
2008	2 928.73	2 877.56	2 949.30	86.20	13.67	683.68	23.18
2009	3 503.22	3 520.49	3 520.36	86.96	12.89	1 150.53	32.68
2010	3 260.07	3 296.41	3 296.66	99.88	0.00	948.04	28.76
2011	1 996.35	2 018.19	2 017.89	88.53	11.08	301.27	14.93
2012	2 707.00	2 574.02	2 580.12	92.22	7.63	1 679.75	65.10
2013	2 400.61	2 533.89	2 523.67	91.52	8.33	1 364.63	54.07
2014	1 199.62	1 198.89	1 198.94	99.55	0.02	67.87	5.66
2015	891.75	890.28	878.50	99.63	0.00	-	-
2016	761.18	761.13	766.63	96.55	3.22	104.31	13.61
2017	624.71	624.46	621.56	97.55	1.99	-	-
2018	3 253.74	3 252.95	3 244.73	99.56	0.36	1 124.14	34.65
2019	2 626.22	2 614.05	2 612.88	91.70	8.10	1 493.07	57.14
2020	2 409.03	2 354.96	2 356.94	65.94	33.95	958.18	40.65
2021	2 832.20	2 880.65	2 879.19	94.56	5.38	1 294.50	44.96
2022	3 766.49	3 762.58	3 763.35	65.90	34.03	2 186.39	58.10
2023	3 281.66	3 283.99	3 261.75	68.25	31.62	916.33	28.09
2024	4 537.37	4 537.35	4 537.64	69.21	30.71	1 418.98	31.27

Table B.3: Annual blue mackerel catches (t) by destination code for the EMA 7 Quota Management Area. L = Landings to an LFR, T = Transshipments. A complete list of destination codes is provided in Table F.6. – : no observations.

Fishing year	L	T	Other	Total
1990	1 306.93	184.27	4.19	1 495.39
1991	1 561.50	740.64	3.77	2 305.91
1992	1 628.71	1 511.21	3.12	3 143.04
1993	1 091.72	263.24	20.86	1 375.82
1994	935.12	147.08	54.22	1 136.42
1995	1 272.10	269.79	46.42	1 588.31
1996	1 254.14	34.94	1.51	1 290.59
1997	2 269.44	83.76	11.83	2 365.03
1998	2 270.85	34.63	11.40	2 316.88
1999	8 484.27	0.29	12.49	8 497.05
2000	3 164.62	-	1.69	3 166.31
2001	3 275.30	-	3.47	3 278.77
2002	5 085.03	-	3.40	5 088.43
2003	3 573.17	-	1.95	3 575.12
2004	2 563.03	-	2.70	2 565.74
2005	4 943.47	-	3.07	4 946.54
2006	3 660.12	-	2.39	3 662.51
2007	2 732.22	-	4.08	2 736.30
2008	2 874.92	-	2.63	2 877.56
2009	3 517.71	-	2.78	3 520.49
2010	3 293.55	-	2.86	3 296.41
2011	2 015.62	-	2.57	2 018.19
2012	2 570.35	-	3.66	2 574.02
2013	2 529.89	-	4.00	2 533.89
2014	1 194.79	-	4.10	1 198.89
2015	887.08	-	3.20	890.28
2016	758.12	-	3.02	761.13
2017	621.05	-	3.41	624.46
2018	3 236.56	-	16.39	3 252.95
2019	2 607.29	-	6.76	2 614.05
2020	2 189.95	-	165.01	2 354.96
2021	2 877.79	-	2.86	2 880.65
2022	3 758.68	-	3.90	3 762.58
2023	3 241.93	-	42.06	3 283.99
2024	4 523.65	-	13.70	4 537.35

Table B.4: Annual catches (t) by landed state of blue mackerel from the EMA 7 Quota Management Area. DRE = Dressed, FIL = Fillets: skin-on, GRE = Green (or whole), GUT = Gutted, HGU = Headed and gutted, MEA = Fish meal. A complete list of product state codes is provided in Table F.1. – : no observations. Records where the landed state was missing were excluded.

Fishing year	DRE	GRE	HGU	MEA	FIL	GUT	Other	Total
1990	-	1 303.52	191.78	-	0.06	-	-	1 495.35
1991	888.97	766.48	643.33	6.15	0.97	-	-	2 305.91
1992	2 095.94	354.12	407.16	284.34	1.48	-	-	3 143.04
1993	603.11	567.75	183.36	21.50	-	0.10	-	1 375.82
1994	569.78	320.19	101.56	144.89	-	-	-	1 136.42
1995	1 012.44	310.28	164.65	100.20	0.15	0.58	-	1 588.31
1996	459.20	687.75	132.33	11.30	-	0.00	-	1 290.59
1997	903.00	423.48	962.70	75.18	0.50	-	-	2 364.87
1998	1 803.49	124.23	284.91	104.21	0.03	0.00	0.00	2 316.88
1999	3 546.45	4 144.78	761.76	44.05	-	-	-	8 497.05
2000	1 628.17	595.24	916.14	26.76	-	-	-	3 166.31
2001	2 292.72	589.53	313.17	83.35	-	-	-	3 278.77
2002	3 656.44	1 013.93	246.47	171.49	-	-	0.11	5 088.43
2003	2 379.35	1 138.29	12.19	45.29	-	-	-	3 575.12
2004	2 480.12	60.61	-	25.00	0.01	-	-	2 565.74
2005	4 219.15	670.85	-	56.55	-	-	-	4 946.54
2006	3 357.18	266.14	-	39.19	-	-	-	3 662.51
2007	2 341.20	366.30	-	22.57	-	6.23	-	2 736.30
2008	2 499.82	336.44	-	40.24	-	1.06	-	2 877.56
2009	3 028.97	461.39	-	30.13	-	0.00	-	3 520.49
2010	3 228.71	6.48	-	61.21	-	-	-	3 296.41
2011	1 761.47	233.87	-	22.86	-	-	-	2 018.19
2012	2 342.26	197.58	-	34.17	-	-	-	2 574.02
2013	2 265.70	216.04	-	52.15	-	-	0.00	2 533.89
2014	735.72	430.38	-	32.79	-	-	-	1 198.89
2015	761.22	100.49	-	28.57	-	-	-	890.28
2016	706.88	29.36	-	24.47	0.41	0.02	-	761.13
2017	457.52	21.36	-	145.42	0.16	-	-	624.46
2018	2 997.65	64.61	-	188.02	2.68	-	-	3 252.95
2019	2 008.76	443.06	-	158.86	3.38	-	-	2 614.05
2020	1 141.64	924.15	-	274.55	14.62	-	-	2 354.96
2021	2 064.83	631.47	-	183.67	0.68	-	-	2 880.65
2022	1 419.59	2 151.64	-	191.32	-	0.04	-	3 762.58
2023	881.60	1 982.54	-	419.74	0.10	0.01	-	3 283.99
2024	1 520.10	2 644.82	-	372.43	-	-	-	4 537.35

Table B.5: Annual modal conversion factor reported for product state codes of blue mackerel from the EMA 7 Quota Management Areas. DRE = Dressed, FIL = Fillets: skin-on, GRE = Green (or whole), GUT = Gutted, HDS = Heads, HGU = Headed and gutted, MEA = Fish meal, SKF = Fillets: skin-off. – : no observations.

Fishing year	FIL	GRE	HGU	DRE	MEA	GUT	HDS	SKF
1990	2.50	1.00	1.50	-	-	-	-	-
1991	2.50	1.00	1.50	1.80	5.60	-	-	-
1992	2.50	1.00	1.50	1.80	5.60	-	-	-
1993	-	1.00	1.50	1.80	5.60	1.10	-	-
1994	-	1.00	1.50	1.80	5.60	-	-	-
1995	2.50	1.00	1.50	1.80	5.60	1.10	-	-
1996	-	1.00	1.50	1.80	5.60	1.10	-	-
1997	2.50	1.00	1.50	1.50	5.60	-	-	-
1998	2.50	1.00	1.50	1.50	5.60	1.10	0.00	-
1999	-	1.00	1.50	1.50	5.60	-	-	-
2000	-	1.00	1.50	1.50	5.60	-	-	-
2001	-	1.00	1.50	1.50	5.60	-	-	-
2002	-	1.00	1.50	1.50	5.60	-	-	-
2003	-	1.00	1.50	1.50	5.60	-	-	-
2004	2.50	1.00	-	1.50	5.60	-	-	-
2005	-	1.00	-	1.50	5.60	-	-	-
2006	-	1.00	-	1.50	5.60	-	-	-
2007	-	1.00	-	1.50	5.60	1.10	-	-
2008	-	1.00	-	1.50	5.60	1.10	-	-
2009	-	1.00	-	1.50	5.60	1.10	-	-
2010	-	1.00	-	1.50	5.60	-	-	-
2011	-	1.00	-	1.50	5.60	-	-	-
2012	-	1.00	-	1.50	5.60	-	-	-
2013	-	1.00	-	1.50	5.60	-	-	3.10
2014	-	1.00	-	1.50	5.60	-	-	-
2015	-	1.00	-	1.50	5.60	-	-	-
2016	2.50	1.00	-	1.50	5.60	1.10	-	-
2017	2.50	1.00	-	1.50	5.60	-	-	-
2018	2.50	1.00	-	1.50	5.60	-	-	-
2019	2.50	1.00	-	1.50	5.60	-	-	-
2020	2.50	1.00	-	1.50	-	-	-	-
2021	2.50	1.00	-	1.50	-	-	-	-
2022	-	1.00	-	1.50	-	1.10	-	-
2023	2.50	1.00	-	1.50	-	1.10	-	-
2024	-	1.00	-	1.50	-	-	-	-

Table B.6: Reporting forms used for effort on trips landing blue mackerel from the EMA 7 Quota Management Area in terms of data records and their allocated catches. A complete list of form type codes is provided in Table F.2. – : no observations.

Fishing year	Records (N)											Allocated catches (t)										
	TCP	CEL	Other	NCE	TCE	LTC	ERS - Trawl	ERS - Netting	ERS - Lining	ERS - Seining	Total	TCP	CEL	Other	NCE	TCE	LTC	ERS - Trawl	ERS - Netting	ERS - Lining	ERS - Seining	Total
1990	2313	200	-	-	-	-	-	-	-	-	2513	189.88	999.57	-	-	-	-	-	-	-	-	1189.45
1991	3229	197	-	-	-	-	-	-	-	-	3426	1451.76	573.77	-	-	-	-	-	-	-	-	2025.53
1992	3681	270	-	-	-	-	-	-	-	-	3951	2941.47	122.57	-	-	-	-	-	-	-	-	3064.04
1993	3797	633	-	-	-	-	-	-	-	-	4430	835.11	3518.70	-	-	-	-	-	-	-	-	4353.82
1994	4783	577	-	-	-	-	-	-	-	-	5360	808.41	316.14	-	-	-	-	-	-	-	-	1124.56
1995	5004	524	-	-	-	-	-	-	-	-	5528	1271.22	599.29	-	-	-	-	-	-	-	-	1870.50
1996	3584	298	-	-	-	-	-	-	-	-	3882	647.42	746.21	-	-	-	-	-	-	-	-	1393.63
1997	4766	200	-	-	-	-	-	-	-	-	4966	2024.45	150.05	-	-	-	-	-	-	-	-	2174.50
1998	4917	172	-	-	-	-	-	-	-	-	5089	2297.75	77.38	-	-	-	-	-	-	-	-	2375.13
1999	6017	228	-	-	-	-	-	-	-	-	6245	4380.45	4215.02	-	-	-	-	-	-	-	-	8595.46
2000	4197	203	-	-	-	-	-	-	-	-	4400	2726.94	520.66	-	-	-	-	-	-	-	-	3247.60
2001	4428	145	-	-	-	-	-	-	-	-	4573	2728.88	551.24	-	-	-	-	-	-	-	-	3280.13
2002	5203	129	-	-	-	-	-	-	-	-	5332	4600.50	517.99	-	-	-	-	-	-	-	-	5118.49
2003	5064	182	1	-	-	-	-	-	-	-	5247	2505.82	1037.57	0.00	-	-	-	-	-	-	-	3543.39
2004	4908	196	-	-	-	-	-	-	-	-	5104	2508.63	78.14	-	-	-	-	-	-	-	-	2586.76
2005	5073	124	-	-	-	-	-	-	-	-	5197	4374.89	575.45	-	-	-	-	-	-	-	-	4950.34
2006	4083	134	-	-	-	-	-	-	-	-	4217	3403.52	373.62	-	-	-	-	-	-	-	-	3777.14
2007	4717	110	-	86	-	-	-	-	-	-	4913	2377.20	361.12	-	1.76	-	-	-	-	-	-	2740.08
2008	4845	71	-	182	288	4	-	-	-	-	5390	2544.18	403.26	-	1.65	0.19	0.03	-	-	-	-	2949.30
2009	3710	70	-	207	248	1	-	-	-	-	4236	3062.13	454.26	-	3.88	0.09	0.00	-	-	-	-	3520.36
2010	3797	55	4	222	281	7	-	-	-	-	4366	3293.24	0.30	0.00	2.83	0.25	0.04	-	-	-	-	3296.66
2011	3168	114	-	246	547	6	-	-	-	-	4081	1787.07	223.62	-	7.10	0.11	0.00	-	-	-	-	2017.89
2012	3212	44	-	174	153	13	-	-	-	-	3596	2380.27	196.85	-	2.92	0.06	0.02	-	-	-	-	2580.12
2013	3571	42	-	252	379	4	-	-	-	-	4248	2310.15	210.38	-	2.90	0.24	0.01	-	-	-	-	2523.67
2014	3197	141	-	255	331	3	-	-	-	-	3927	1193.62	0.26	-	4.88	0.18	0.00	-	-	-	-	1198.94
2015	3341	60	-	207	452	11	-	-	-	-	4071	875.73	0.08	-	2.38	0.29	0.02	-	-	-	-	878.50
2016	2961	110	-	257	388	12	-	-	-	-	3728	740.42	24.72	-	1.35	0.12	0.01	-	-	-	-	766.63
2017	3329	51	-	243	407	35	-	-	-	-	4065	606.62	12.36	-	2.32	0.16	0.10	-	-	-	-	621.56
2018	294	61	-	260	419	64	3097	-	-	-	4195	977.12	11.69	-	0.99	0.48	0.08	2254.37	-	-	-	3244.73
2019	-	53	9	180	305	41	3166	29	36	-	3819	-	211.64	0.01	3.34	0.12	0.05	2397.56	0.16	0.01	-	2612.88
2020	-	-	62	6	-	-	3384	324	120	24	3920	-	-	0.09	0.01	-	-	1554.19	2.29	0.29	800.07	2356.94
2021	-	-	37	-	-	-	2910	155	99	35	3236	-	-	0.01	-	-	-	2722.68	1.36	0.12	155.02	2879.19
2022	-	-	27	-	-	-	2793	256	116	59	3251	-	-	0.04	-	-	-	2480.33	1.90	0.32	1280.76	3763.35
2023	-	-	17	-	-	-	3166	347	159	47	3736	-	-	0.01	-	-	-	2226.87	3.01	0.63	1031.23	3261.75
2024	-	-	10	-	-	-	2878	332	169	42	3431	-	-	0.01	-	-	-	3140.65	2.88	0.45	1393.65	4537.64

Table B.7: Allocated catches (t) of blue mackerel in EMA 7 by method of capture and fishing year. A complete list of fishing method codes is provided in Table F.3. – : no observations.

Fishing year	BT	MW	PS	SN	Other	Total
1990	131.87	58.15	996.89	1.73	0.81	1 189.45
1991	263.94	1 187.90	569.29	3.79	0.61	2 025.53
1992	454.43	2 487.07	115.79	5.43	1.32	3 064.04
1993	194.79	647.04	3 497.83	12.48	1.67	4 353.82
1994	40.74	768.90	298.03	16.56	0.31	1 124.56
1995	28.86	1 242.36	576.99	21.36	0.94	1 870.50
1996	53.93	575.89	740.70	4.79	18.32	1 393.63
1997	33.45	1 991.03	144.06	5.57	0.39	2 174.50
1998	289.36	2 008.46	72.16	4.83	0.32	2 375.13
1999	22.57	4 356.65	4 211.16	0.67	4.41	8 595.46
2000	19.05	2 712.73	514.11	1.30	0.41	3 247.60
2001	5.56	2 723.32	547.17	3.56	0.52	3 280.13
2002	12.06	4 588.37	516.03	1.34	0.69	5 118.49
2003	3.06	2 502.88	1 036.04	1.32	0.08	3 543.39
2004	1.20	2 507.43	76.19	1.82	0.13	2 586.76
2005	5.52	4 368.92	574.14	1.27	0.49	4 950.34
2006	1.95	3 400.91	372.58	0.97	0.72	3 777.14
2007	6.46	2 370.78	360.92	1.76	0.15	2 740.08
2008	2.10	2 542.21	403.24	1.65	0.10	2 949.30
2009	0.74	3 061.45	453.75	4.38	0.04	3 520.36
2010	0.71	3 292.77	0.10	2.95	0.13	3 296.66
2011	0.76	1 786.41	223.60	7.10	0.03	2 017.89
2012	1.05	2 379.27	196.79	2.92	0.08	2 580.12
2013	0.70	2 309.68	210.34	2.91	0.03	2 523.67
2014	0.29	1 193.51	0.25	4.88	0.01	1 198.94
2015	0.77	875.25	0.04	2.39	0.05	878.50
2016	0.30	740.21	24.65	1.36	0.10	766.63
2017	0.38	606.36	12.35	2.32	0.16	621.56
2018	0.63	3 230.48	11.68	0.99	0.96	3 244.73
2019	1.54	2 396.11	211.61	3.53	0.10	2 612.88
2020	0.10	1 554.08	800.07	2.31	0.38	2 356.94
2021	0.20	2 722.44	155.02	1.36	0.18	2 879.19
2022	0.08	2 480.15	1 280.76	1.90	0.47	3 763.35
2023	0.47	2 226.29	1 031.23	3.01	0.75	3 261.75
2024	0.14	3 140.45	1 393.63	2.88	0.54	4 537.64

APPENDIX C: CPUE SERIES DIAGNOSTICS

C.1 EMA7 MW MACK event

Table C.1: Definition for the dataset, core fleet criteria, and Generalised Linear Modelling approach used in the catch-per-unit-effort (CPUE) standardisation for the EMA7 MW MACK event CPUE series.

Series	EMA7 MW MACK event
QMS stock	EMA 7
Reporting forms	TCP, ERS - Trawl
Fishing methods	MW
Target species	JMA, JMD, JMM, JMN, EMA
Statistical Areas	034, 035, 036, 037, 039, 040, 041, 042, 045, 801
Period	1991-10-01, 2024-09-30
Resolution	Fishing event
Core fleet years	5
Core fleet trips	3
Default model	$\text{allockg_top5} \sim \text{fyear} + \text{month} + \text{vessel_key} + \text{stat_area} + \text{target_species} + \text{ns}(\log(\text{fishing_duration}), 3) + \text{bs}(\text{start_latitude}, 3) + \text{bs}(\text{effort_width}, 3) + \text{bs}(\text{effort_height}, 3) + \text{bs}(\text{bottom_depth}, 3) + \text{bs}(\text{effort_speed}, 3) + \text{bs}(\text{hour}(\text{start_datetime}), 3) + \text{bs}(\text{SeasonDay}, 3)$
Stepwise selection	Yes
Positive catch distribution	Weibull

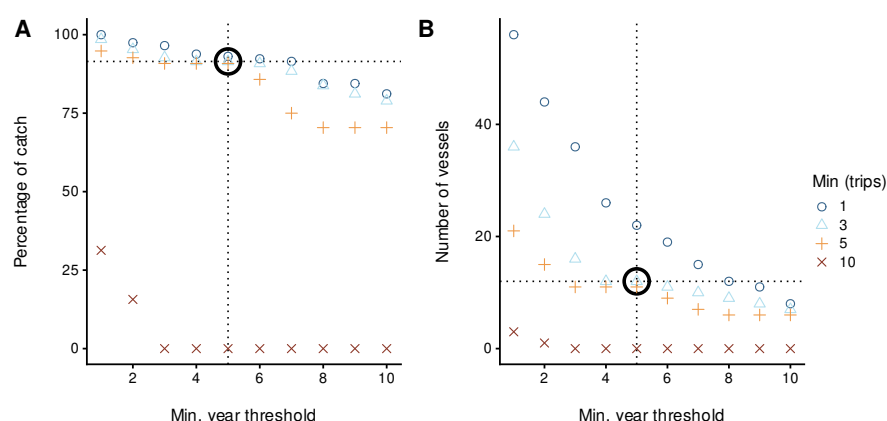


Figure C.1: Percentage of catch and number of vessels for different core vessel selection criteria for the EMA7 MW MACK event CPUE series. The bold open circle represents the core vessel selection criteria applied in the modelling dataset, specified by the number of years a vessel participated in the fishery and the number of trips per year.

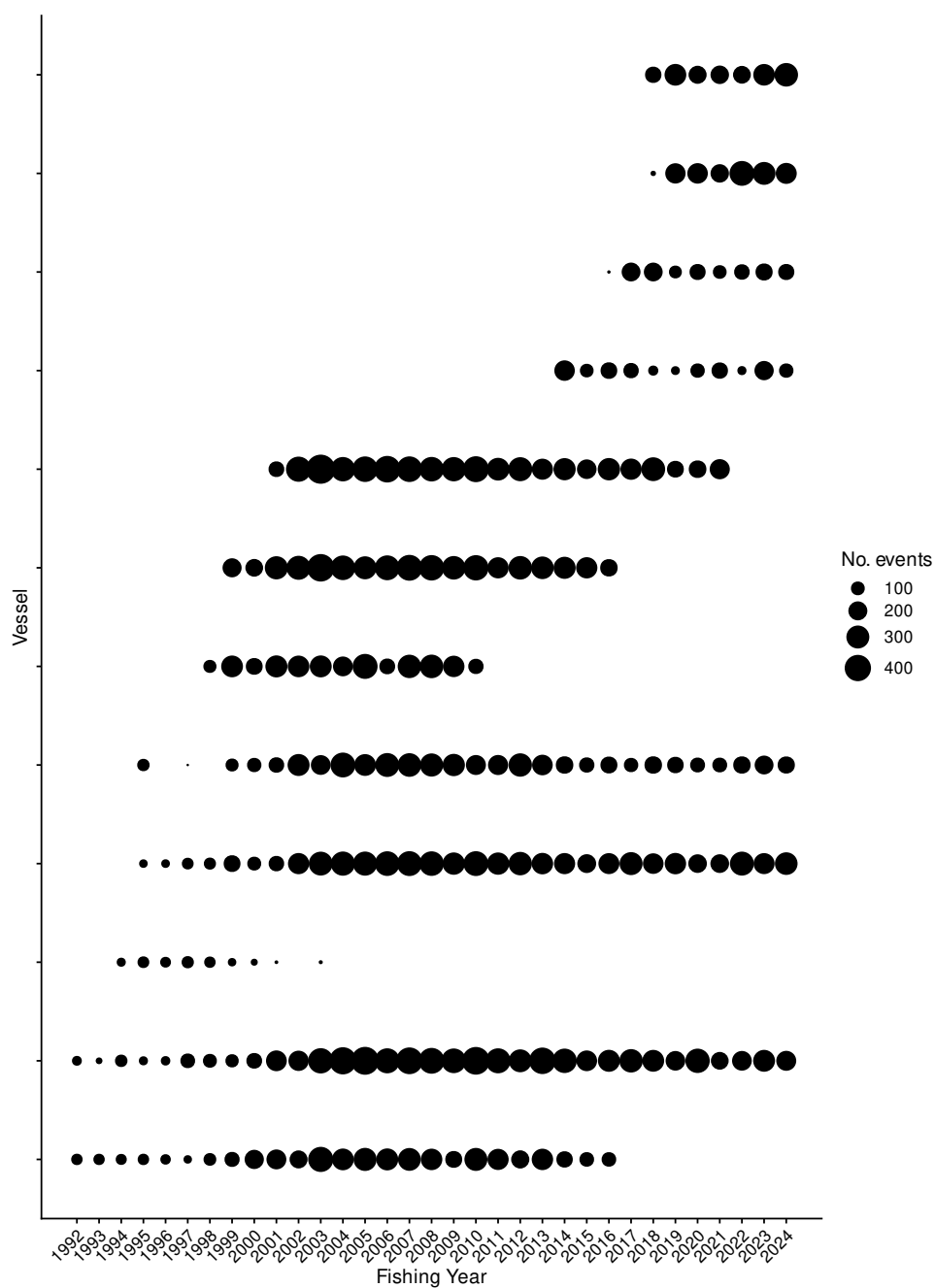


Figure C.2: Number of events by fishing year for core vessels in the EMA7 MW MACK event series. The area of the circles is proportional to the number of events undertaken by a vessel in a fishing year.

Table C.2: Summary of the EMA7 MW MACK event dataset total catch (tonnes) and number of records (n), by fishing year after the application of various filters. The first row gives the catch and number of records before filters were applied (ungroomed data). Subsequent rows display the remaining catch (and percent of catch), and the number of records, after the specified filter was applied. (Continued on next page)

Filter	1992	1993	1994	1995	1996	1997	1998	1999	2000
Ungroomed data	2452 (100%) n: 1146	499 (100%) n: 592	593 (100%) n: 931	1071 (100%) n: 1365	427 (100%) n: 632	1912 (100%) n: 1281	1818 (100%) n: 1039	4355 (100%) n: 1346	2679 (100%) n: 937
Fishing duration is not NA	2452 (100%) n: 1146	499 (100%) n: 592	593 (100%) n: 931	1071 (100%) n: 1365	427 (100%) n: 632	1912 (100%) n: 1281	1818 (100%) n: 1039	4355 (100%) n: 1346	2679 (100%) n: 937
Positive fishing duration	2452 (100%) n: 1146	499 (100%) n: 591	593 (100%) n: 931	1071 (100%) n: 1365	427 (100%) n: 631	1912 (100%) n: 1280	1818 (100%) n: 1034	4355 (100%) n: 1345	2679 (100%) n: 937
Headline height < 100m	2452 (100%) n: 1146	499 (100%) n: 591	593 (100%) n: 931	1071 (100%) n: 1365	427 (100%) n: 630	1376 (72%) n: 1194	1815 (100%) n: 1032	4355 (100%) n: 1344	2679 (100%) n: 937
Core fleet selection	272 (11%) n: 113	194 (39%) n: 84	286 (48%) n: 180	378 (35%) n: 288	168 (39%) n: 190	530 (28%) n: 296	1175 (65%) n: 416	2832 (65%) n: 959	2652 (99%) n: 898
Filter	2001	2002	2003	2004	2005	2006	2007	2008	2009
Ungroomed data	2693 (100%) n: 1482	4497 (100%) n: 2106	2492 (100%) n: 2610	2532 (100%) n: 2299	3770 (100%) n: 2415	3509 (100%) n: 2269	2289 (100%) n: 2518	2399 (100%) n: 2341	3070 (100%) n: 1999
Fishing duration is not NA	2693 (100%) n: 1482	4497 (100%) n: 2106	2492 (100%) n: 2610	2532 (100%) n: 2299	3770 (100%) n: 2415	3509 (100%) n: 2269	2289 (100%) n: 2518	2399 (100%) n: 2341	3070 (100%) n: 1999
Positive fishing duration	2693 (100%) n: 1481	4497 (100%) n: 2106	2492 (100%) n: 2609	2532 (100%) n: 2297	3770 (100%) n: 2414	3509 (100%) n: 2269	2289 (100%) n: 2517	2399 (100%) n: 2341	3070 (100%) n: 1997
Headline height < 100m	2693 (100%) n: 1481	4497 (100%) n: 2103	2491 (100%) n: 2607	2453 (97%) n: 2295	3770 (100%) n: 2413	3509 (100%) n: 2269	2289 (100%) n: 2517	2399 (100%) n: 2341	3068 (100%) n: 1996
Core fleet selection	2656 (99%) n: 1441	4413 (98%) n: 1896	2481 (100%) n: 2486	2453 (97%) n: 2294	3770 (100%) n: 2394	3380 (96%) n: 2210	2267 (99%) n: 2461	2396 (100%) n: 2332	3068 (100%) n: 1984

Filter	2010	2011	2012	2013	2014	2015	2016	2017	2018
Ungroomed data	3243 (100%) n: 2265	1749 (100%) n: 1675	2493 (100%) n: 1758	2171 (100%) n: 1864	1160 (100%) n: 1995	806 (100%) n: 1460	714 (100%) n: 1398	546 (100%) n: 1302	3189 (100%) n: 1402
Fishing duration is not NA	3243 (100%) n: 2265	1749 (100%) n: 1675	2493 (100%) n: 1758	2171 (100%) n: 1864	1160 (100%) n: 1995	806 (100%) n: 1460	714 (100%) n: 1398	546 (100%) n: 1302	3189 (100%) n: 1402
Positive fishing duration	3243 (100%) n: 2265	1749 (100%) n: 1675	2493 (100%) n: 1758	2171 (100%) n: 1864	1160 (100%) n: 1993	806 (100%) n: 1460	714 (100%) n: 1397	546 (100%) n: 1302	3189 (100%) n: 1402
Headline height < 100m	3243 (100%) n: 2265	1749 (100%) n: 1675	2493 (100%) n: 1758	2171 (100%) n: 1864	1157 (100%) n: 1992	806 (100%) n: 1459	714 (100%) n: 1397	546 (100%) n: 1302	3189 (100%) n: 1402
Core fleet selection	3237 (100%) n: 2206	1749 (100%) n: 1667	2493 (100%) n: 1753	2133 (98%) n: 1704	781 (67%) n: 1700	705 (88%) n: 1245	714 (100%) n: 1397	546 (100%) n: 1302	3189 (100%) n: 1402

Filter	2019	2020	2021	2022	2023	2024
Ungroomed data	2370 (100%) n: 1396	1488 (100%) n: 1487	2657 (100%) n: 1342	2477 (100%) n: 1408	2222 (100%) n: 1646	3138 (100%) n: 1492
Fishing duration is not NA	2370 (100%) n: 1396	1488 (100%) n: 1487	2657 (100%) n: 1342	2477 (100%) n: 1408	2222 (100%) n: 1646	3138 (100%) n: 1492
Positive fishing duration	2370 (100%) n: 1396	1488 (100%) n: 1487	2657 (100%) n: 1342	2477 (100%) n: 1408	2222 (100%) n: 1646	3138 (100%) n: 1492
Headline height < 100m	2370 (100%) n: 1396	1488 (100%) n: 1487	2657 (100%) n: 1342	2477 (100%) n: 1408	2222 (100%) n: 1646	3138 (100%) n: 1492
Core fleet selection	2370 (100%) n: 1396	1488 (100%) n: 1487	2657 (100%) n: 1334	2477 (100%) n: 1408	2222 (100%) n: 1646	3138 (100%) n: 1492

Table C.3: Summary of the EMA7 MW MACK event dataset after core fleet selection. ‘Records’ indicates the number of rows (events) in the dataset, and ‘Records caught’ indicates the percentage of events with catches of blue mackerel.

Fishing year	Vessels	Trips	Records	Hours	Catch (t)	Records caught
1992	2	3	113	264.72	272.22	33.63
1993	2	2	84	187.67	194.35	33.33
1994	3	9	180	341.50	286.08	47.78
1995	5	13	288	618.48	378.26	53.12
1996	4	9	190	376.30	168.09	33.68
1997	5	16	296	720.07	530.41	39.53
1998	5	22	416	841.55	1 175.08	48.08
1999	7	35	959	1 980.13	2 832.36	47.24
2000	7	26	898	1 952.27	2 651.69	55.57
2001	8	37	1 441	3 644.55	2 656.36	39.97
2002	7	38	1 896	5 019.12	4 412.99	36.87
2003	8	50	2 486	7 302.32	2 480.78	27.07
2004	7	45	2 294	6 795.18	2 452.87	35.44
2005	7	38	2 394	7 384.59	3 770.16	46.03
2006	7	39	2 210	7 555.82	3 380.46	25.84
2007	7	52	2 461	9 115.57	2 267.20	35.84
2008	7	51	2 332	8 688.53	2 396.28	34.52
2009	7	40	1 984	7 667.46	3 067.56	33.37
2010	7	40	2 206	8 760.52	3 237.12	31.19
2011	6	34	1 667	7 681.33	1 748.80	34.19
2012	6	44	1 753	7 775.97	2 492.62	28.41
2013	6	44	1 704	7 512.18	2 133.48	41.37
2014	7	43	1 700	7 594.73	780.68	24.47
2015	7	40	1 245	5 635.51	704.90	38.07
2016	8	43	1 397	5 764.45	714.16	36.01
2017	6	46	1 302	6 069.05	545.97	34.33
2018	8	44	1 402	7 406.92	3 188.51	38.30
2019	8	48	1 396	6 436.90	2 369.71	40.19
2020	8	50	1 487	6 910.37	1 488.36	33.09
2021	8	48	1 334	6 149.75	2 656.79	53.82
2022	7	46	1 408	6 238.50	2 477.08	47.09
2023	7	44	1 646	9 114.43	2 222.46	58.93
2024	7	42	1 492	8 205.67	3 137.99	64.68

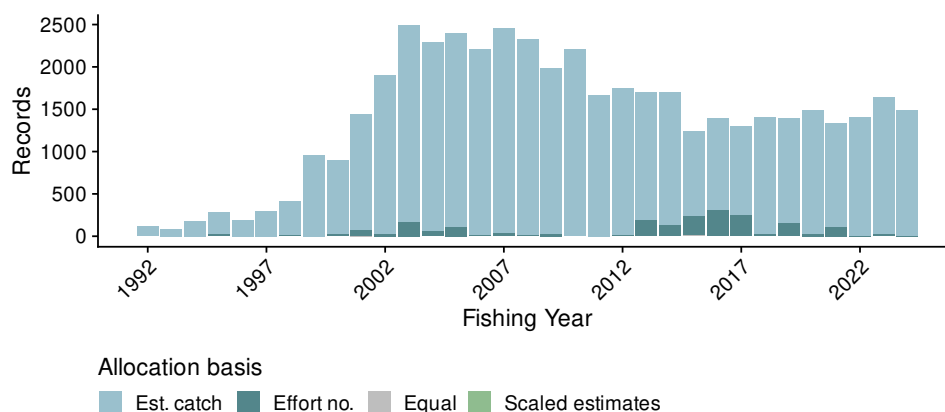


Figure C.3: Allocation basis for attributing landings to records in the EMA7 MW MACK event catch-per-unit-effort dataset. Allocation basis is in terms of estimated catch, effort number, and/or equal.

Table C.4: Summary of stepwise selection for occurrence of positive catch in the EMA7 MW MACK event series. Model terms are listed in the order of acceptance to the model. AIC: Akaike Information Criterion; *: Term included in final model.

Predictor	df	AIC	% deviance	addl. % deviance	Included
fyear	31	59 556	2.9	2.9	*
+ stat_area	9	57 980	5.5	2.6	*
+ bs(effort_height, 3)	3	57 021	7.1	1.6	*
+ vessel_key	11	56 196	8.5	1.4	*
+ month	11	55 519	9.6	1.1	*
+ target_species	1	55 134	10.3	0.6	
+ ns(log(fishing_duration), 3)	3	54 903	10.7	0.4	
+ bs(bottom_depth, 3)	3	54 736	10.9	0.3	
+ bs(start_latitude, 3)	3	54 696	11.0	0.1	
+ bs(effort_speed, 3)	3	54 669	11.1	0.1	
+ bs(effort_width, 3)	3	54 662	11.1	0.0	
+ bs(hour(start_datetime), 3)	3	54 658	11.1	0.0	

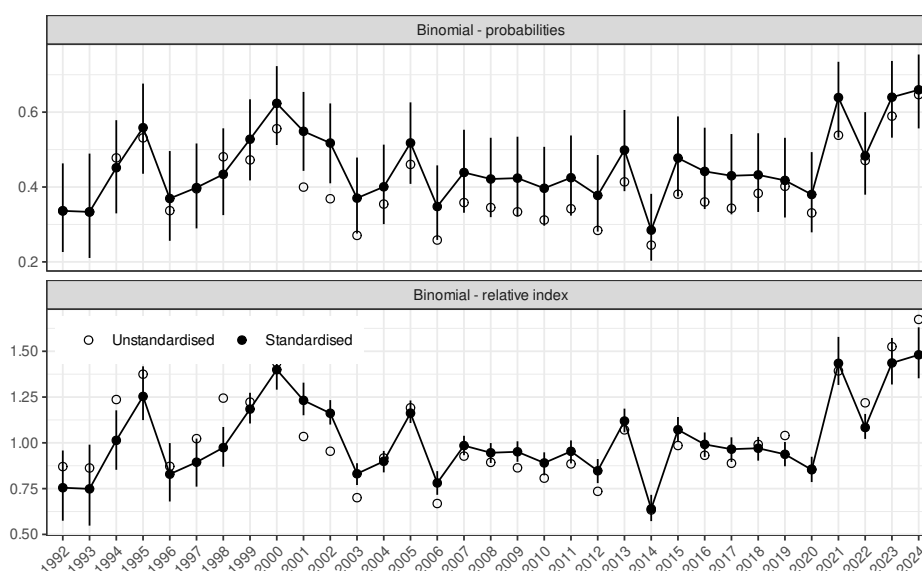


Figure C.4: Unstandardised (geometric mean; open circles) and standardised indices (black circles) for occurrence of catch in the EMA7 MW MACK event dataset, plotted as both probability of occurrence and as a relative index standardised to the geometric mean.

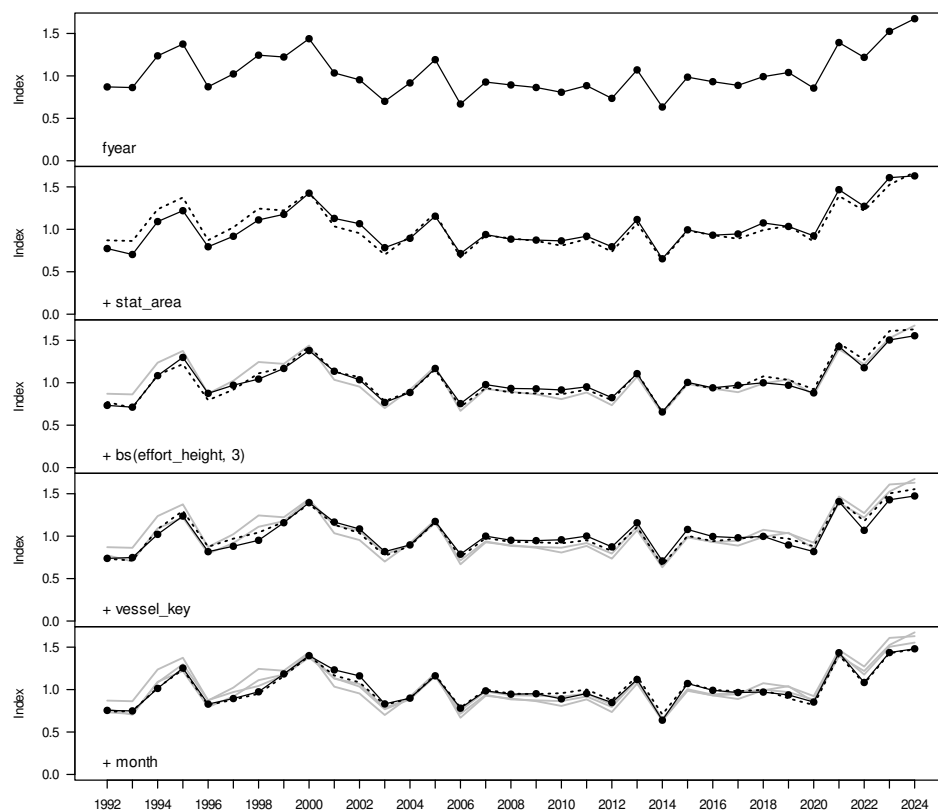


Figure C.5: Step plot for occurrence of catch in the EMA7 MW MACK event dataset.

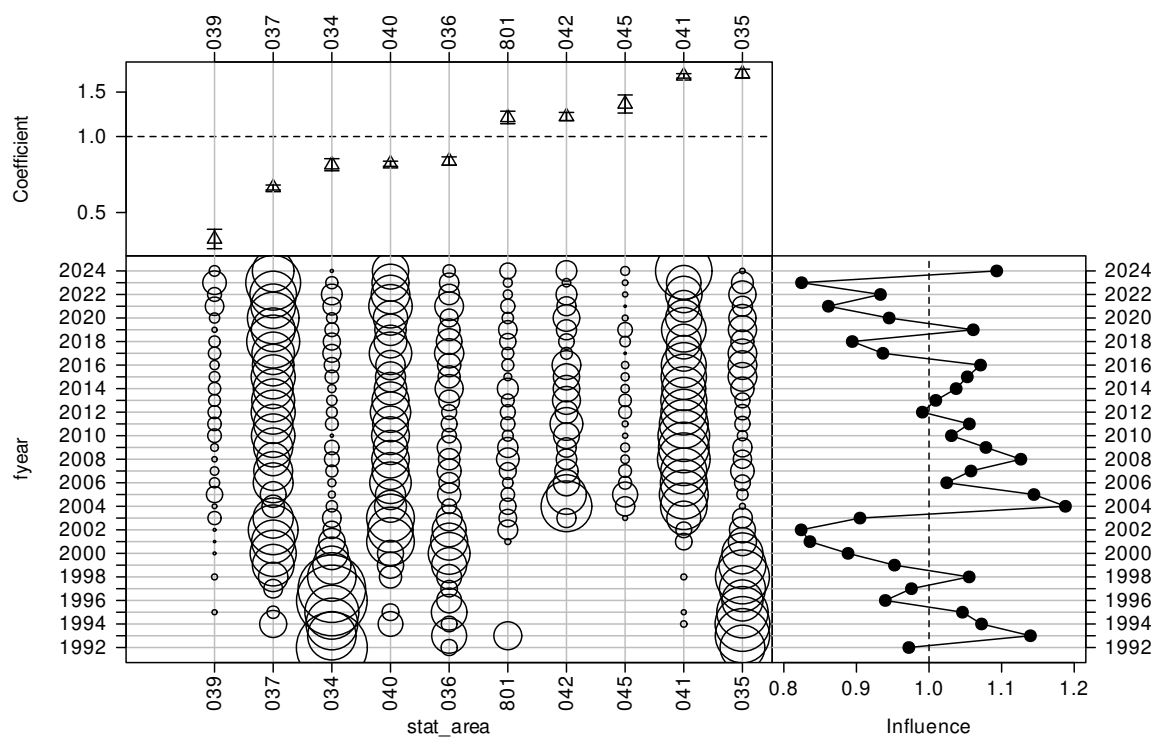


Figure C.6: CDI plot for statistical area for the occurrence of positive catch in the EMA7 MW MACK event catch-per-unit-effort dataset.

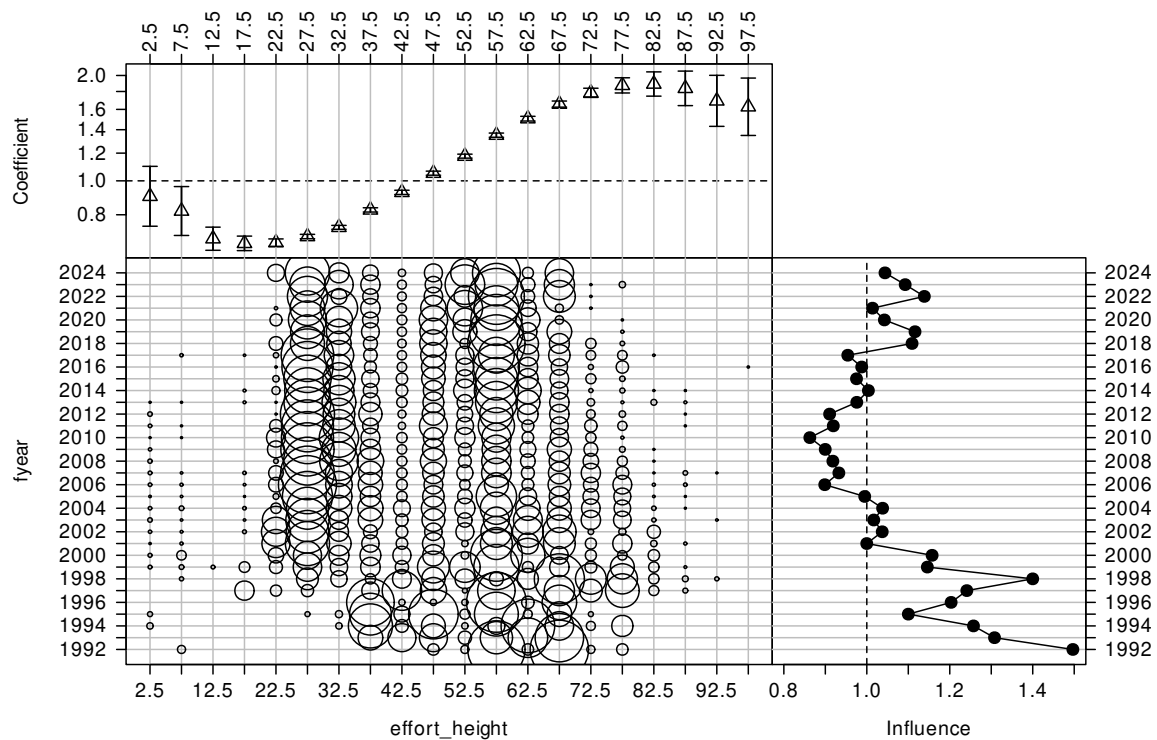


Figure C.7: CDI plot for effort height (m) for the occurrence of positive catch in the EMA7 MW MACK event catch-per-unit-effort dataset.

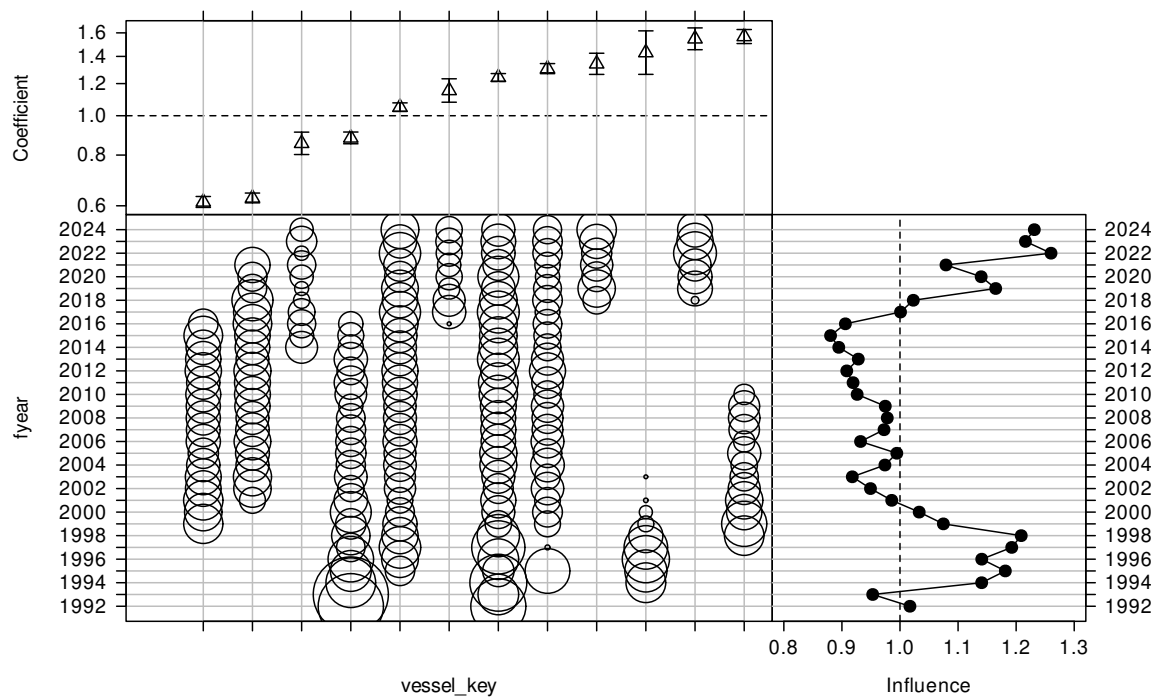


Figure C.8: CDI plot for vessel key for the occurrence of positive catch in the EMA7 MW MACK event catch-per-unit-effort dataset.

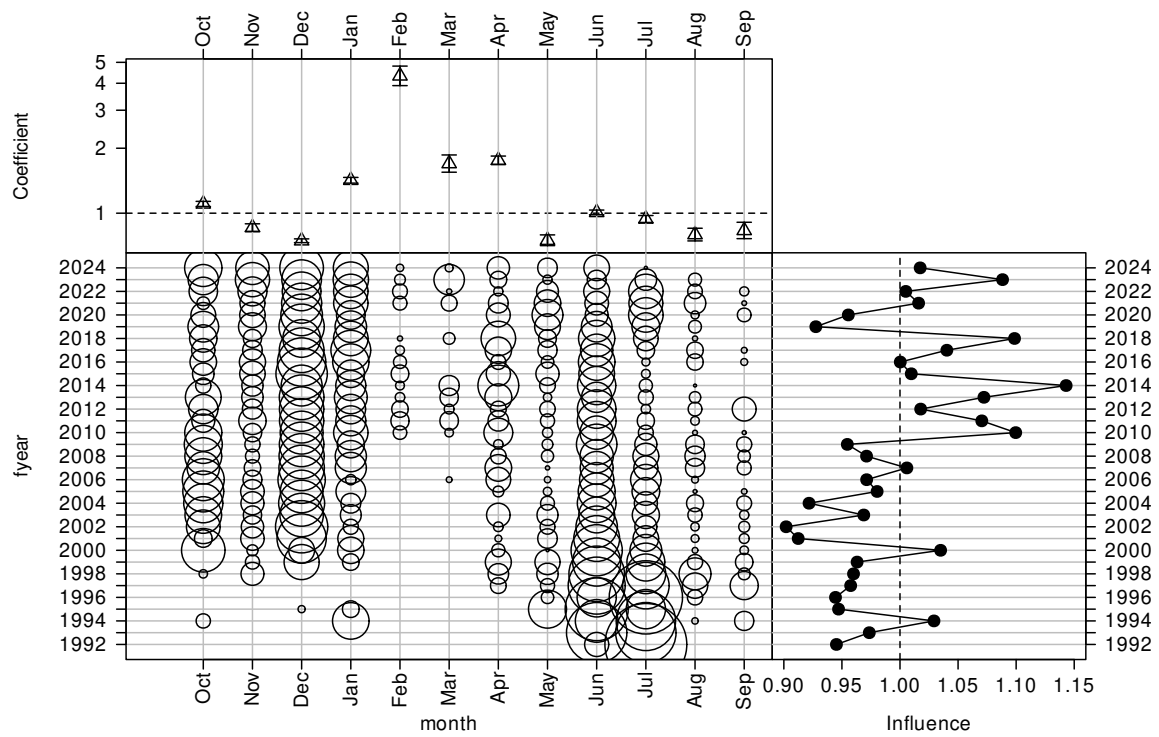


Figure C.9: CDI plot for month for the occurrence of positive catch in the EMA7 MW MACK event catch-per-unit-effort dataset.

Table C.5: Summary of stepwise selection for the Weibull model for positive catches in the EMA7 MW MACK event series. Model terms are listed in the order of acceptance to the model. AIC: Akaike Information Criterion; *: Term included in final model.

Predictor	df	AIC	% deviance	addl. % deviance	Included
fyear	34	306 203	5.2	5.2	*
+ stat_area	9	304 450	14.6	9.4	*
+ month	11	303 239	21.2	6.5	*
+ target_species	1	302 705	24.0	2.8	*
+ bs(effort_height, 3)	3	302 318	26.1	2.1	*
+ vessel_key	11	301 896	28.4	2.4	*
+ ns(log(fishing_duration), 3)	3	301 720	29.4	1.0	*
+ bs(SeasonDay, 3)	3	301 609	30.0	0.6	
+ bs(start_latitude, 3)	3	301 562	30.3	0.3	
+ bs(effort_speed, 3)	3	301 533	30.5	0.2	
+ bs(effort_width, 3)	3	301 522	30.6	0.1	
+ bs(hour(start_datetime), 3)	3	301 512	30.7	0.1	
+ bs(bottom_depth, 3)	3	301 504	30.7	0.1	

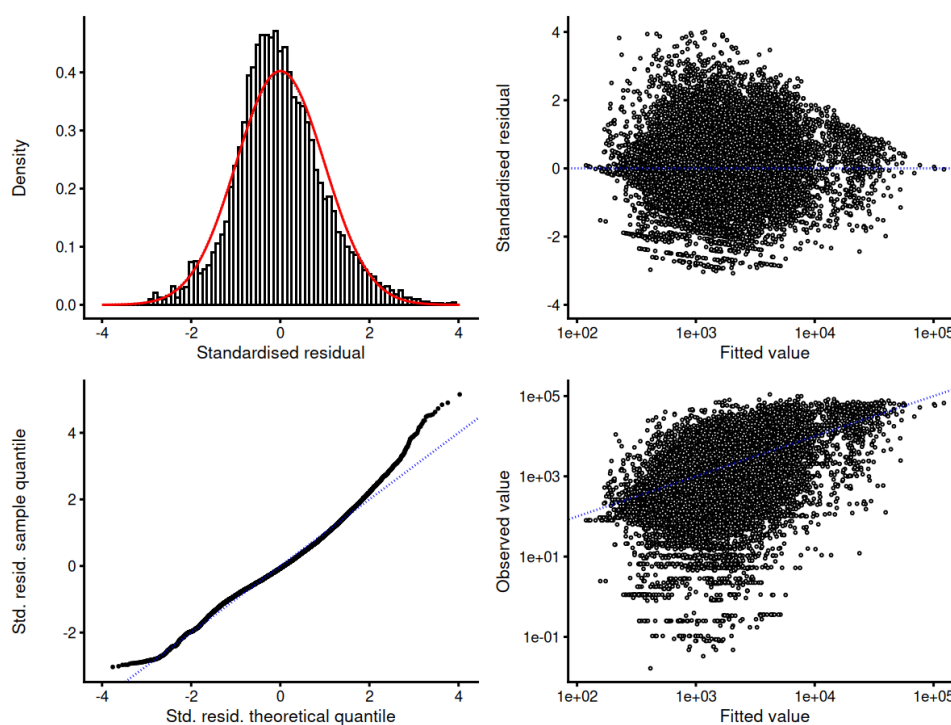


Figure C.10: Diagnostic plots for the selected Weibull model for positive catches in the EMA7 MW MACK event dataset.

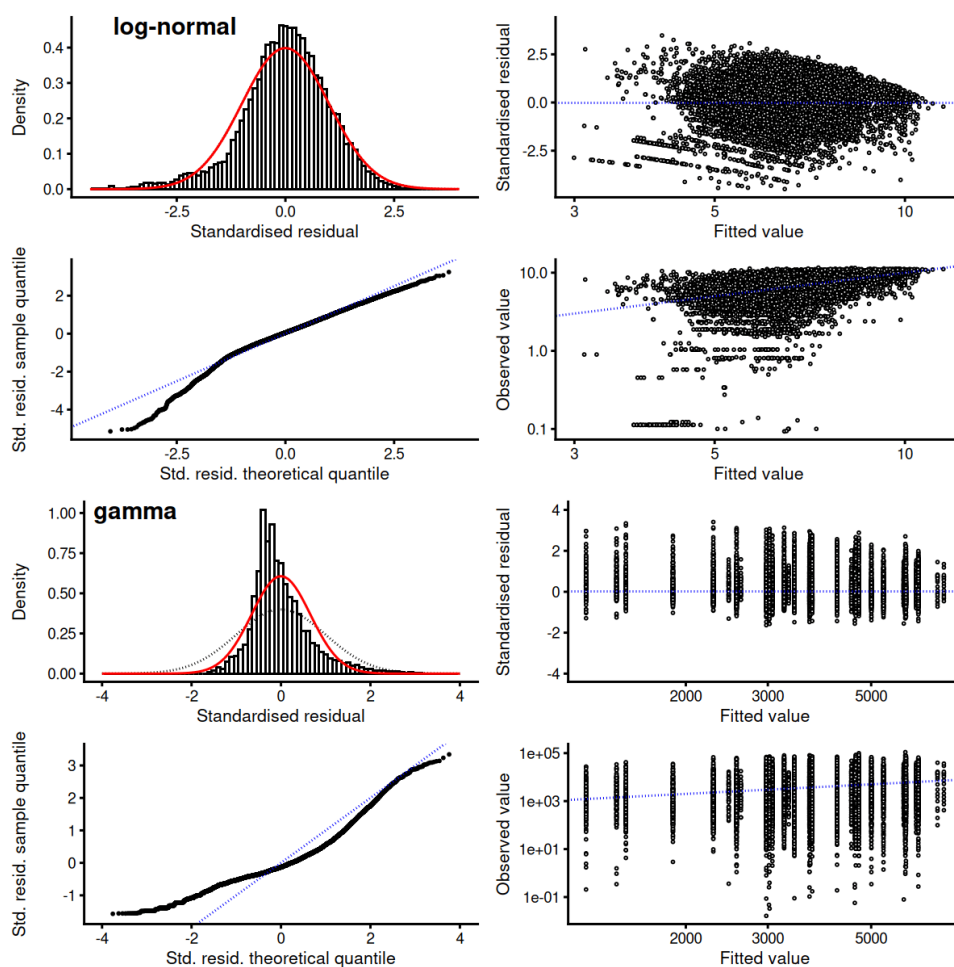


Figure C.11: Diagnostic plots for the alternative log-normal and gamma models considered for positive catches in the EMA7 MW MACK event dataset.

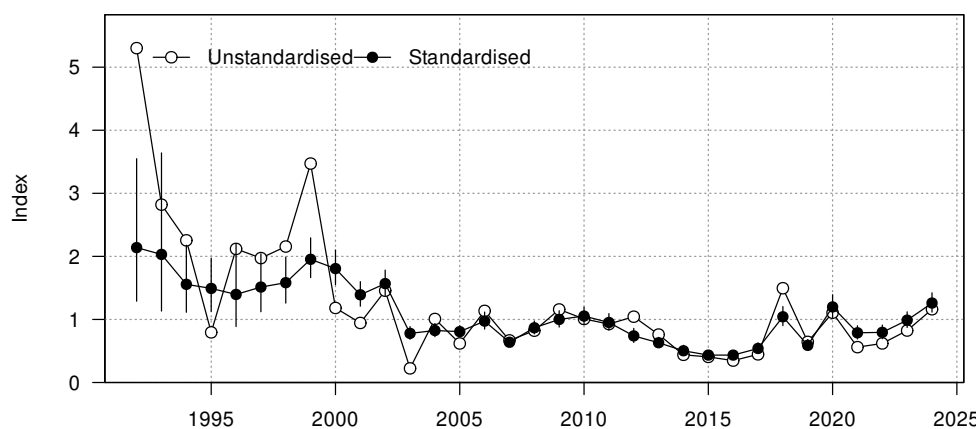


Figure C.12: Unstandardised (geometric mean; open circles) and standardised indices (black circles) for positive catch using the Weibull model for the EMA7 MW MACK event dataset.

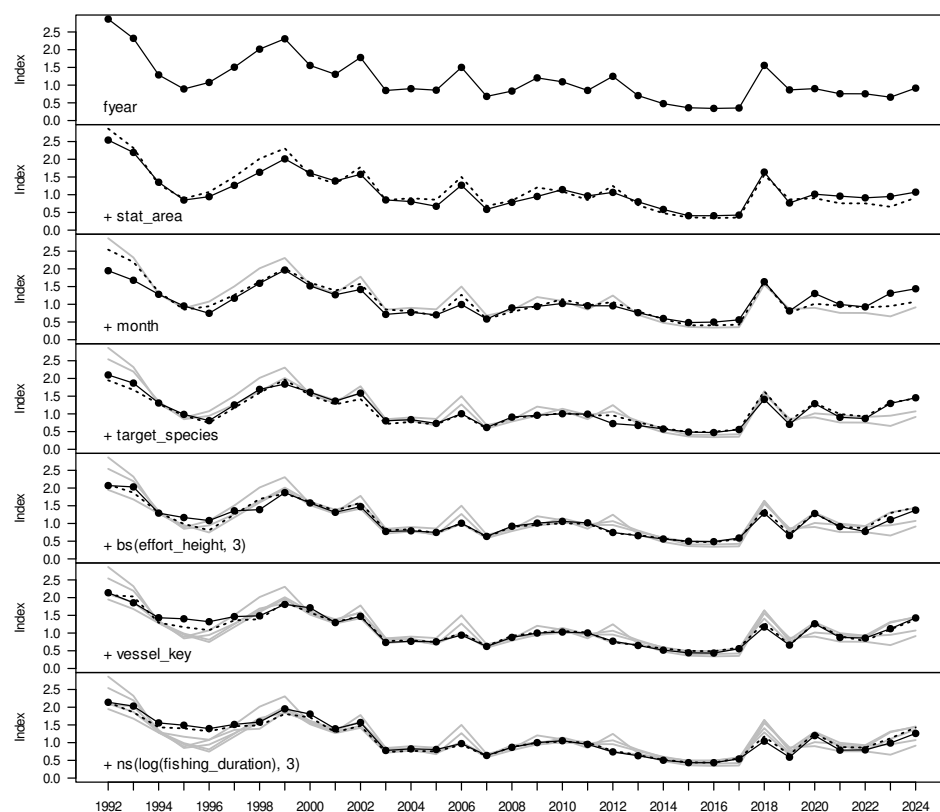


Figure C.13: Changes to the EMA7 MW MACK event positive catch index as terms are successively entered into the Weibull model.

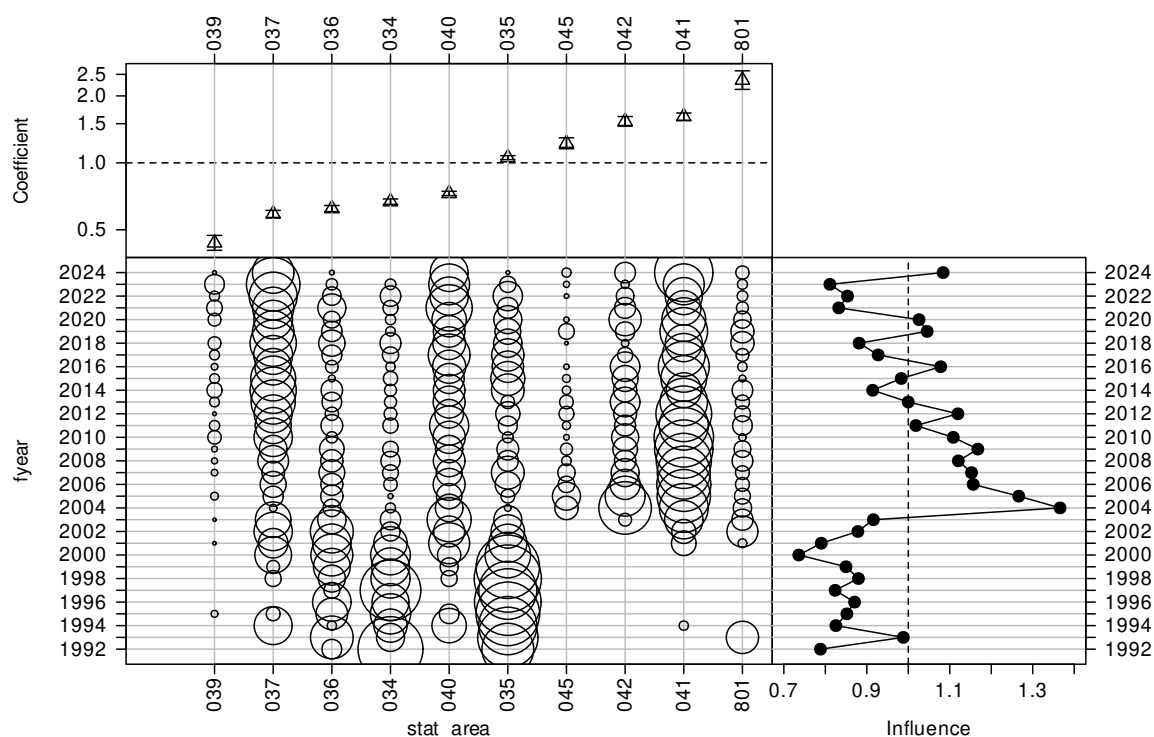


Figure C.14: CDI plot for statistical area for the Weibull model of positive catches in the EMA7 MW MACK event catch-per-unit-effort dataset.

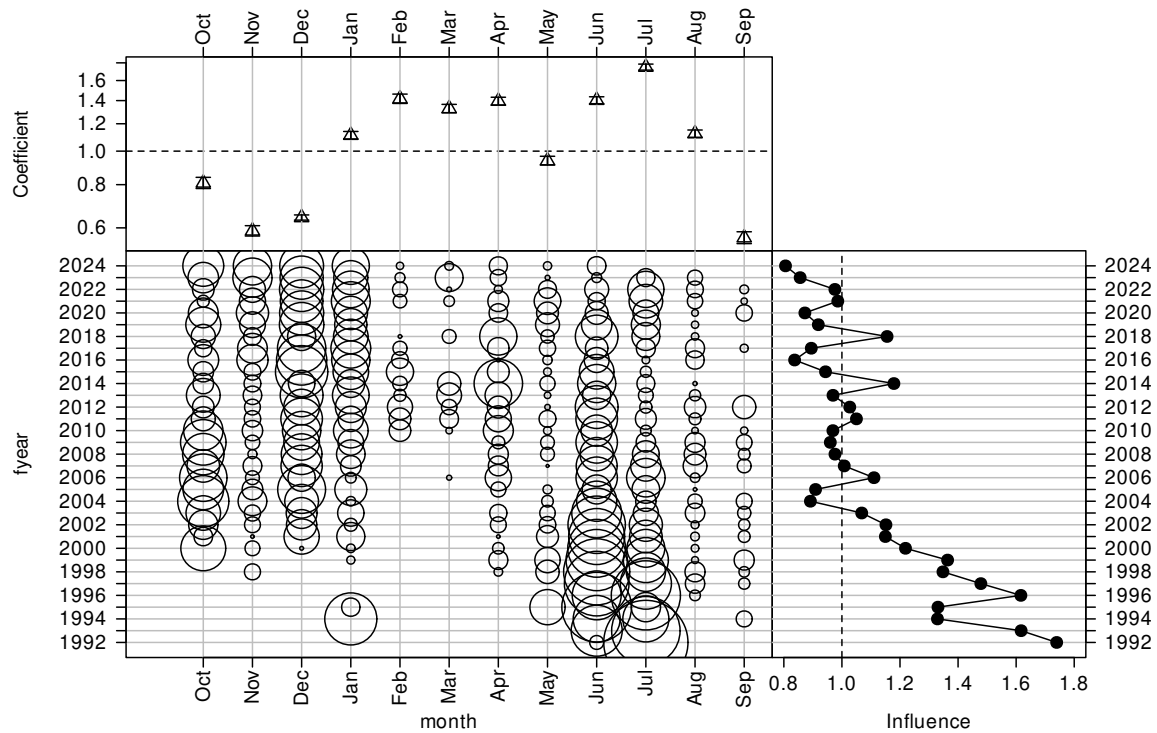


Figure C.15: CDI plot for month for the Weibull model of positive catches in the EMA7 MW MACK event catch-per-unit-effort dataset.

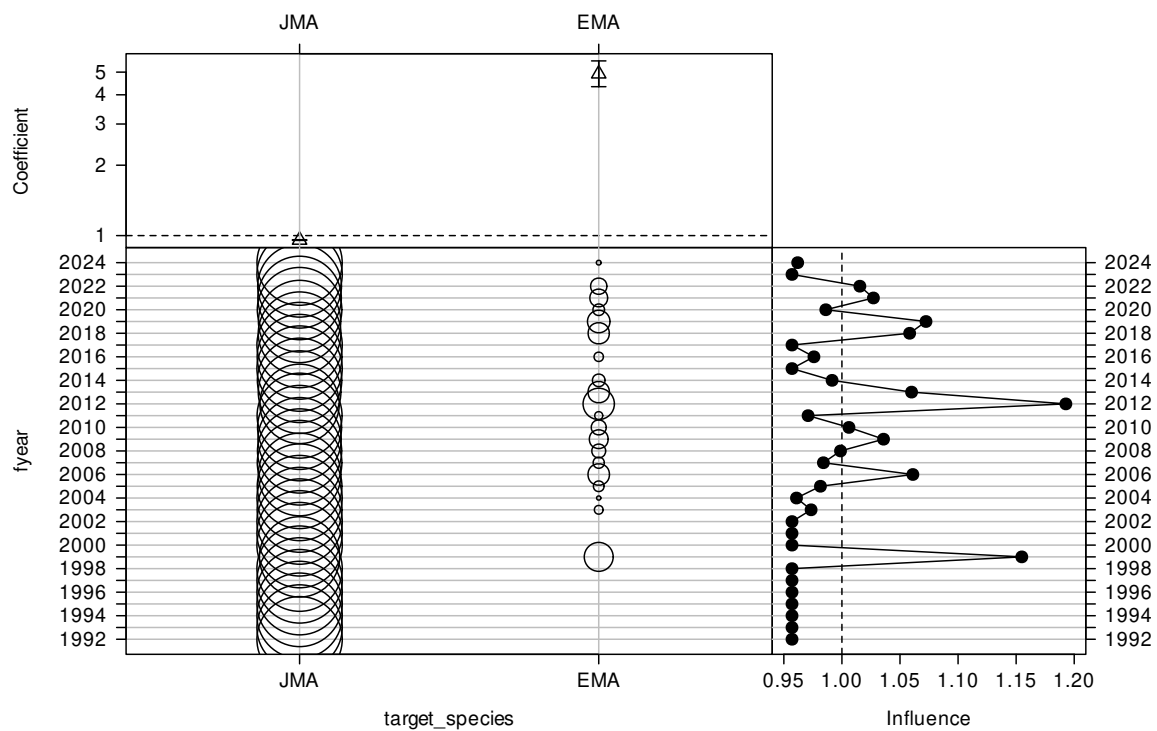


Figure C.16: CDI plot for target species for the Weibull model of positive catches in the EMA7 MW MACK event catch-per-unit-effort dataset.

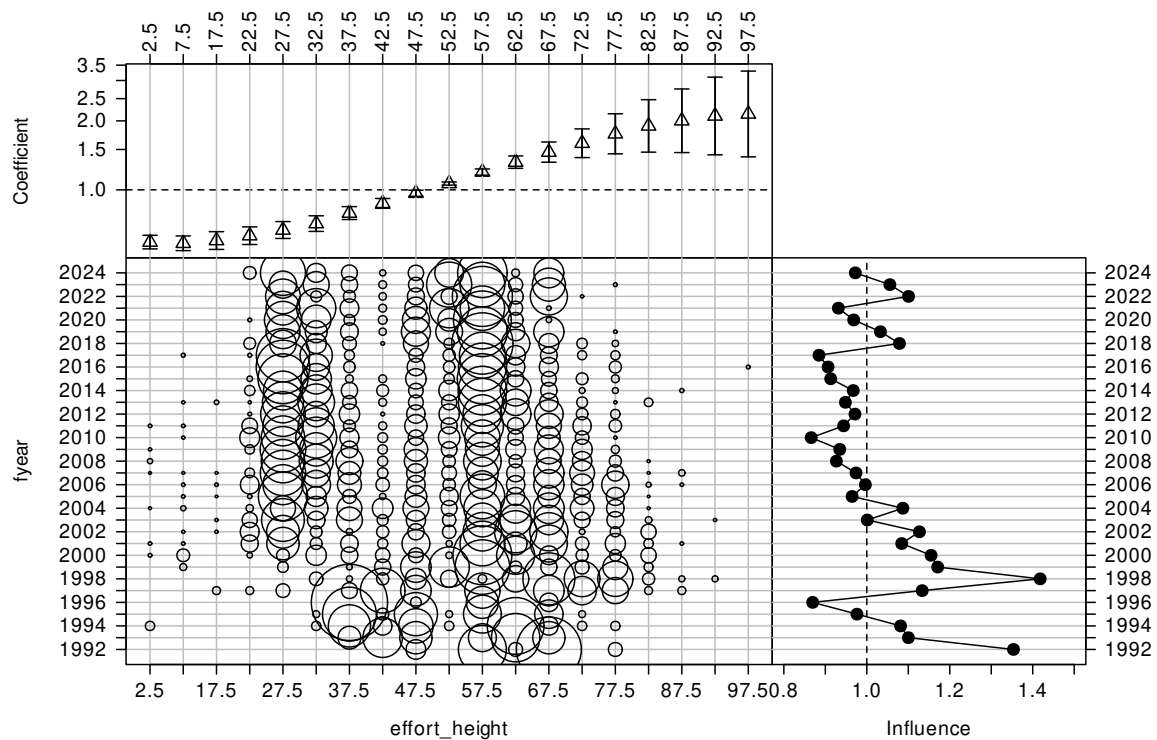


Figure C.17: CDI plot for effort height (m) for the Weibull model of positive catches in the EMA7 MW MACK event catch-per-unit-effort dataset.

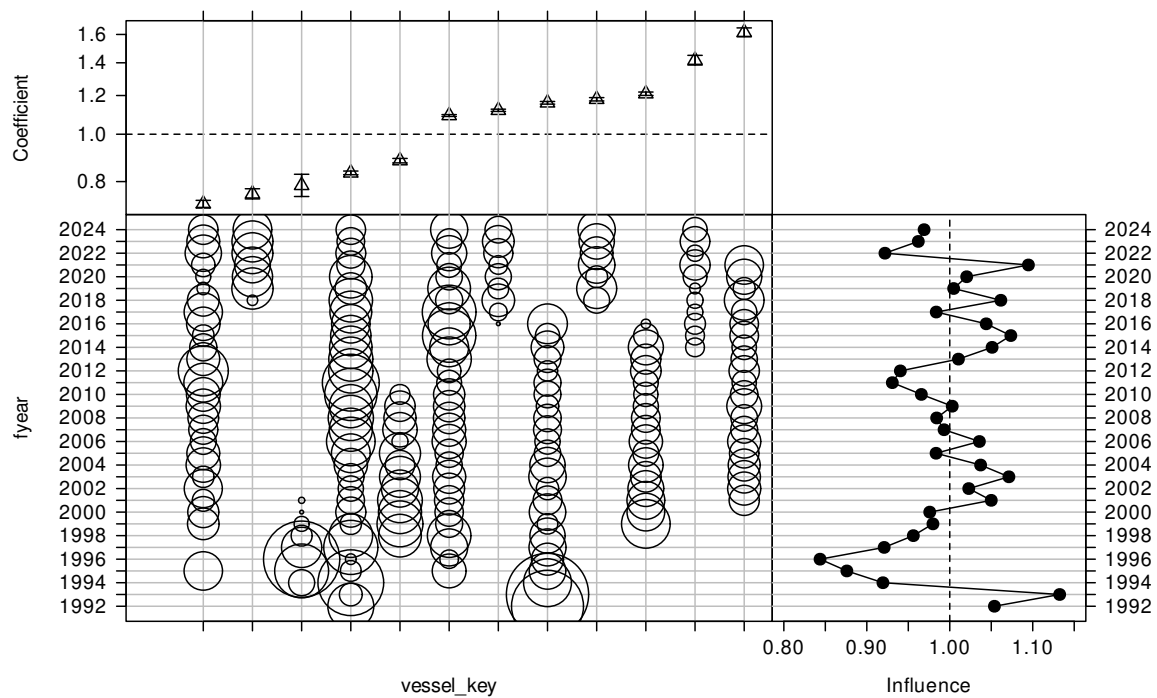


Figure C.18: CDI plot for vessel key for the Weibull model of positive catches in the EMA7 MW MACK event catch-per-unit-effort dataset.

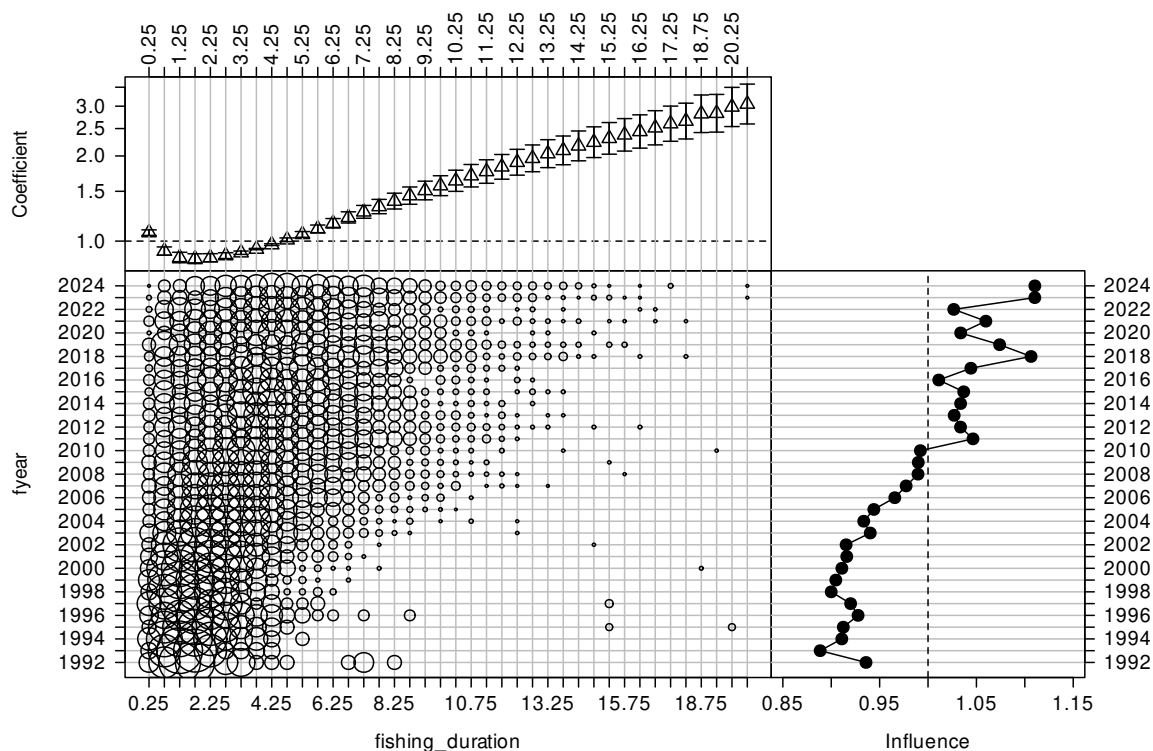


Figure C.19: CDI plot for fishing duration (h) for the Weibull model of positive catches in the EMA7 MW MACK event catch-per-unit-effort dataset.

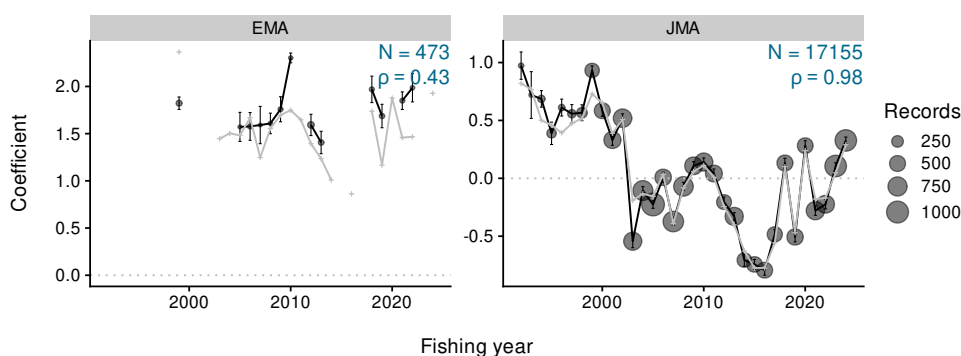


Figure C.20: Residual implied coefficients for target-year in the Weibull positive catch model for the EMA7 MW MACK event dataset (black points, mean +/- one standard error). The dark grey circles indicate the number of data points. Implied coefficients are only plotted when there are at least 10 data points in a target-year stratum. The light grey line and points indicate the overall year indices; these are only plotted where there are data in a stratum.

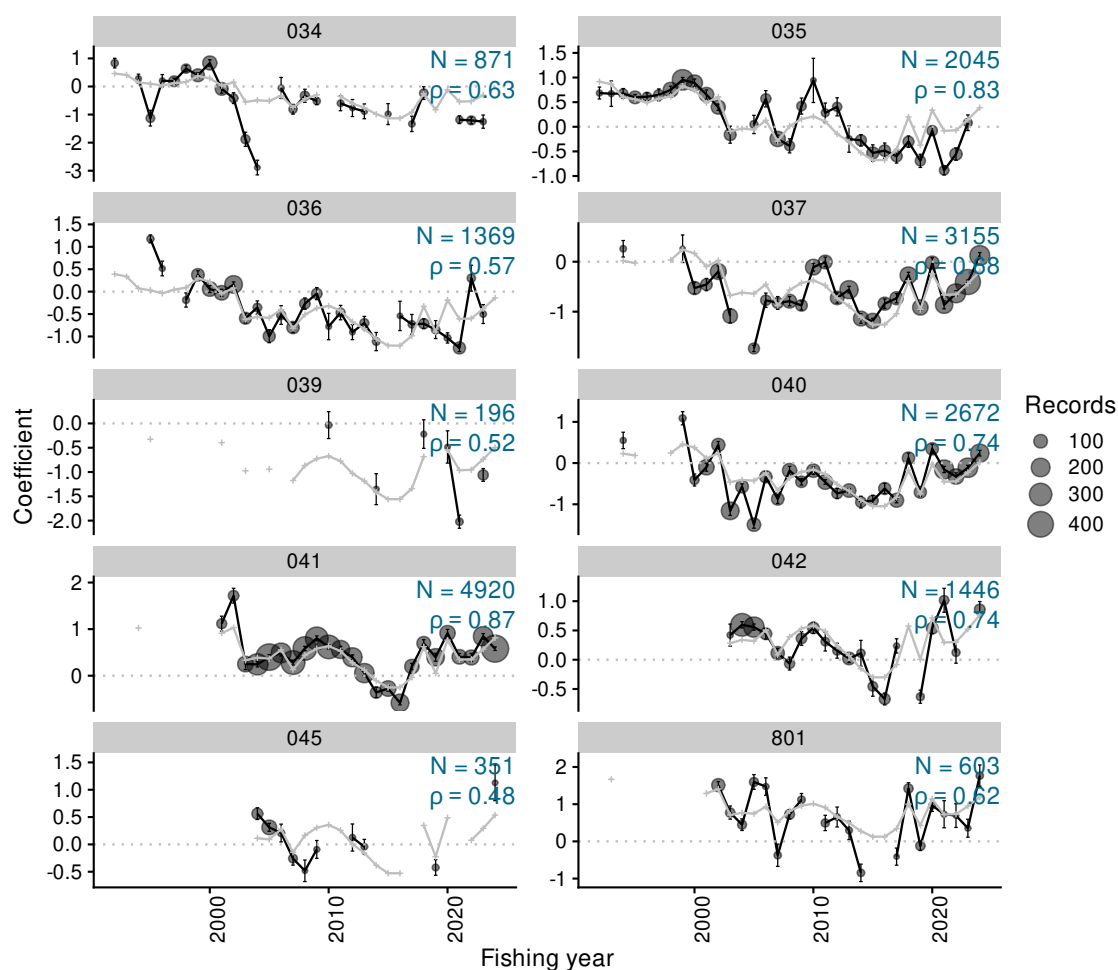


Figure C.21: Residual implied coefficients for area-year in the Weibull positive catch model for the EMA7 MW MACK event dataset (black points, mean $\pm$ one standard error). The dark grey circles indicate the number of data points. Implied coefficients are only plotted when there are at least 10 data points in an area-year stratum. The light grey line and points indicate the overall year indices; these are only plotted where there are data in a stratum.

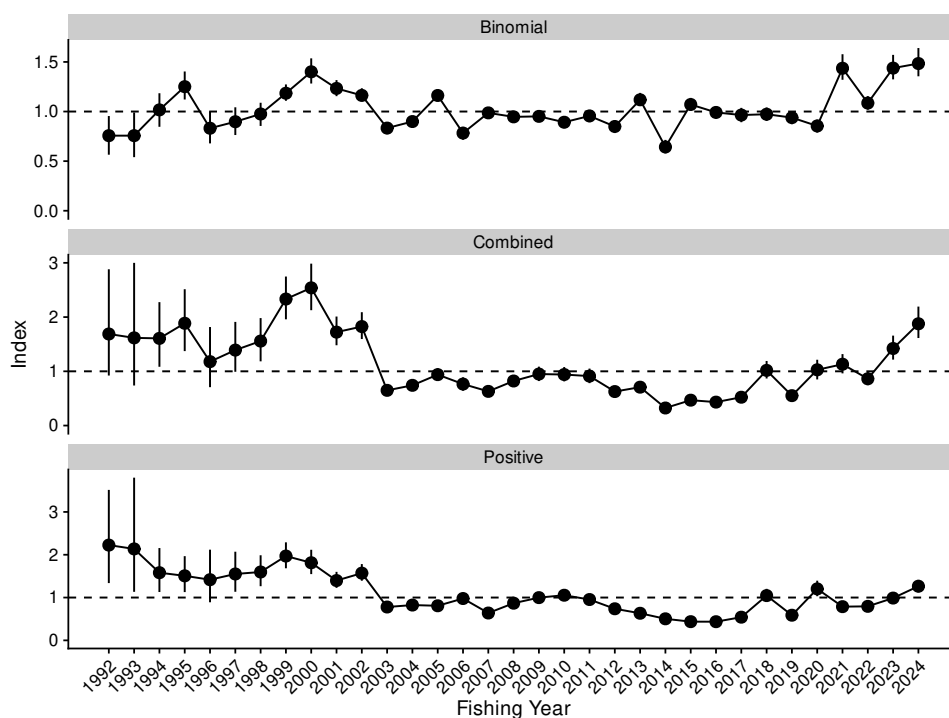


Figure C.22: Standardised indices and 95% confidence intervals for the EMA7 MW MACK event dataset.

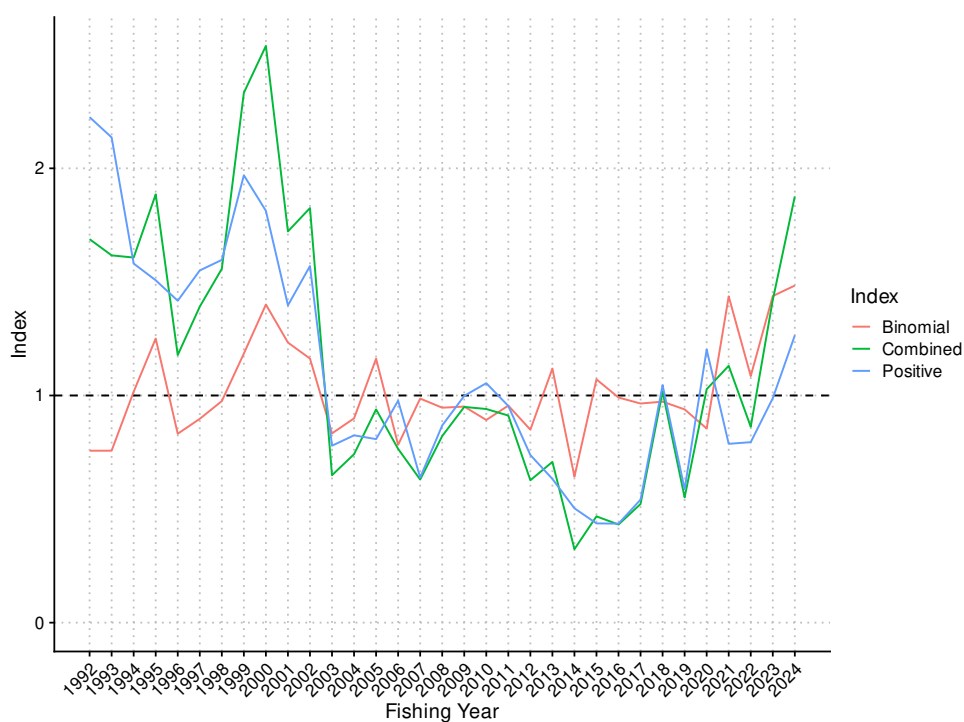


Figure C.23: Standardised indices for the EMA7 MW MACK event dataset.

Table C.6: Annual indices and standard errors, with upper and lower bounds (LCI: 2.5%, UCI: 97.5%) for each model in EMA7 MW MACK event.

Fishing year	Binomial				Combined				Positive			
	index	SE	LCI	UCI	index	SE	LCI	UCI	index	SE	LCI	UCI
1992	0.757	0.099	0.565	0.955	1.688	0.500	0.922	2.881	2.225	0.555	1.338	3.515
1993	0.757	0.115	0.540	0.990	1.617	0.577	0.738	3.000	2.136	0.680	1.134	3.800
1994	1.017	0.086	0.846	1.184	1.607	0.304	1.084	2.275	1.581	0.262	1.130	2.156
1995	1.251	0.072	1.121	1.404	1.885	0.291	1.373	2.514	1.507	0.214	1.128	1.967
1996	0.832	0.082	0.679	1.000	1.178	0.283	0.708	1.816	1.417	0.313	0.890	2.118
1997	0.897	0.071	0.763	1.043	1.391	0.235	0.991	1.911	1.550	0.239	1.135	2.071
1998	0.975	0.060	0.855	1.088	1.558	0.203	1.184	1.981	1.597	0.184	1.265	1.988
1999	1.185	0.042	1.108	1.273	2.333	0.201	1.959	2.748	1.969	0.155	1.684	2.290
2000	1.400	0.065	1.282	1.536	2.539	0.219	2.127	2.985	1.813	0.145	1.548	2.116
2001	1.233	0.041	1.155	1.317	1.722	0.135	1.480	2.010	1.397	0.095	1.227	1.600
2002	1.163	0.034	1.102	1.235	1.825	0.126	1.595	2.090	1.570	0.099	1.393	1.782
2003	0.833	0.030	0.771	0.890	0.649	0.049	0.558	0.752	0.779	0.051	0.687	0.887
2004	0.899	0.029	0.840	0.954	0.742	0.052	0.647	0.850	0.825	0.050	0.731	0.929
2005	1.162	0.031	1.104	1.224	0.939	0.057	0.835	1.059	0.808	0.045	0.722	0.899
2006	0.783	0.033	0.715	0.845	0.765	0.063	0.642	0.889	0.977	0.070	0.846	1.119
2007	0.986	0.027	0.933	1.038	0.630	0.037	0.557	0.704	0.639	0.035	0.570	0.706
2008	0.946	0.027	0.891	0.997	0.821	0.053	0.718	0.925	0.868	0.052	0.765	0.967
2009	0.951	0.028	0.895	1.007	0.950	0.068	0.820	1.086	0.998	0.063	0.878	1.125
2010	0.892	0.030	0.831	0.948	0.940	0.068	0.814	1.079	1.054	0.066	0.931	1.190
2011	0.956	0.032	0.893	1.017	0.912	0.068	0.782	1.050	0.954	0.062	0.832	1.076
2012	0.849	0.032	0.783	0.907	0.627	0.052	0.527	0.731	0.738	0.054	0.634	0.846
2013	1.118	0.032	1.063	1.188	0.708	0.048	0.621	0.807	0.633	0.038	0.561	0.710
2014	0.643	0.035	0.578	0.714	0.324	0.030	0.271	0.390	0.503	0.040	0.428	0.586
2015	1.071	0.033	1.008	1.137	0.468	0.040	0.399	0.555	0.437	0.034	0.377	0.508
2016	0.991	0.032	0.928	1.053	0.432	0.033	0.369	0.498	0.436	0.030	0.380	0.498
2017	0.965	0.037	0.892	1.037	0.522	0.043	0.443	0.611	0.542	0.039	0.468	0.622
2018	0.973	0.035	0.905	1.041	1.017	0.082	0.868	1.191	1.045	0.077	0.903	1.204
2019	0.939	0.034	0.872	1.005	0.551	0.045	0.467	0.644	0.587	0.043	0.507	0.676
2020	0.855	0.034	0.788	0.919	1.028	0.093	0.850	1.213	1.202	0.092	1.031	1.394
2021	1.436	0.066	1.320	1.578	1.131	0.091	0.962	1.317	0.787	0.052	0.689	0.893
2022	1.085	0.035	1.018	1.155	0.862	0.063	0.744	0.989	0.795	0.052	0.699	0.902
2023	1.438	0.063	1.324	1.571	1.421	0.113	1.216	1.658	0.988	0.064	0.868	1.118
2024	1.484	0.073	1.355	1.640	1.877	0.148	1.614	2.193	1.265	0.075	1.119	1.413

C.2 EMA7 MW MACK observer

Table C.7: Definition for the dataset, core fleet criteria, and Generalised Linear Modelling approach used in the catch-per-unit-effort (CPUE) standardisation for the EMA7 MW MACK observer CPUE series.

Series	EMA7 MW MACK observer
QMS stock	EMA 7
Reporting forms	Observer data collection
Fishing methods	MW
Target species	JMA, JMD, JMM, JMN, EMA
Statistical Areas	034, 035, 036, 037, 039, 040, 041, 042, 045, 801
Period	2000-10-01, 2024-09-30
Resolution	Observed event
Core fleet years	5
Core fleet trips	1
Default model	obskg ~ fyear + month + vessel_key + stat_area + target_species + ns(log(fishing_duration), 3) + bs(start_latitude, 3) + bs(hour(start_datetime), 3) + bs(SeasonDay, 3) + ns(log(start_seabed_depth), 3) + ns(log(headline_height), 3) + ns(fishing_speed, 3)
Stepwise selection	Yes
Positive catch distribution	Lognormal

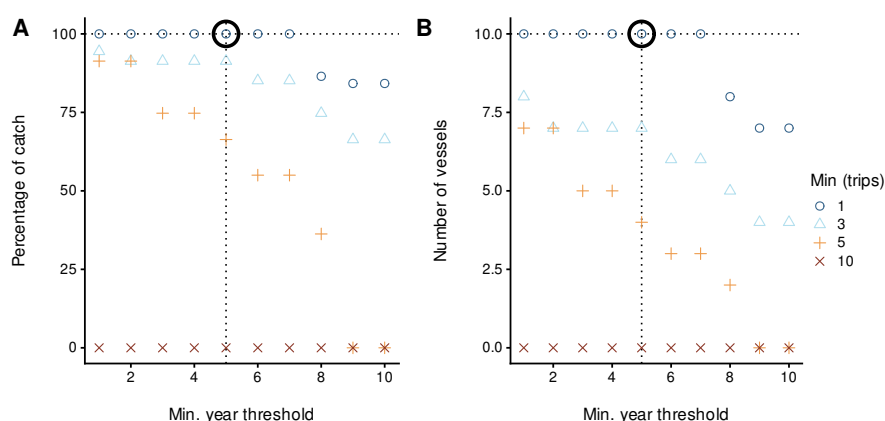


Figure C.24: Percentage of catch and number of vessels for different core vessel selection criteria for the EMA7 MW MACK observer CPUE series. The bold open circle represents the core vessel selection criteria applied in the modelling dataset, specified by the number of years a vessel was observed in the fishery and the number of observed trips per year.

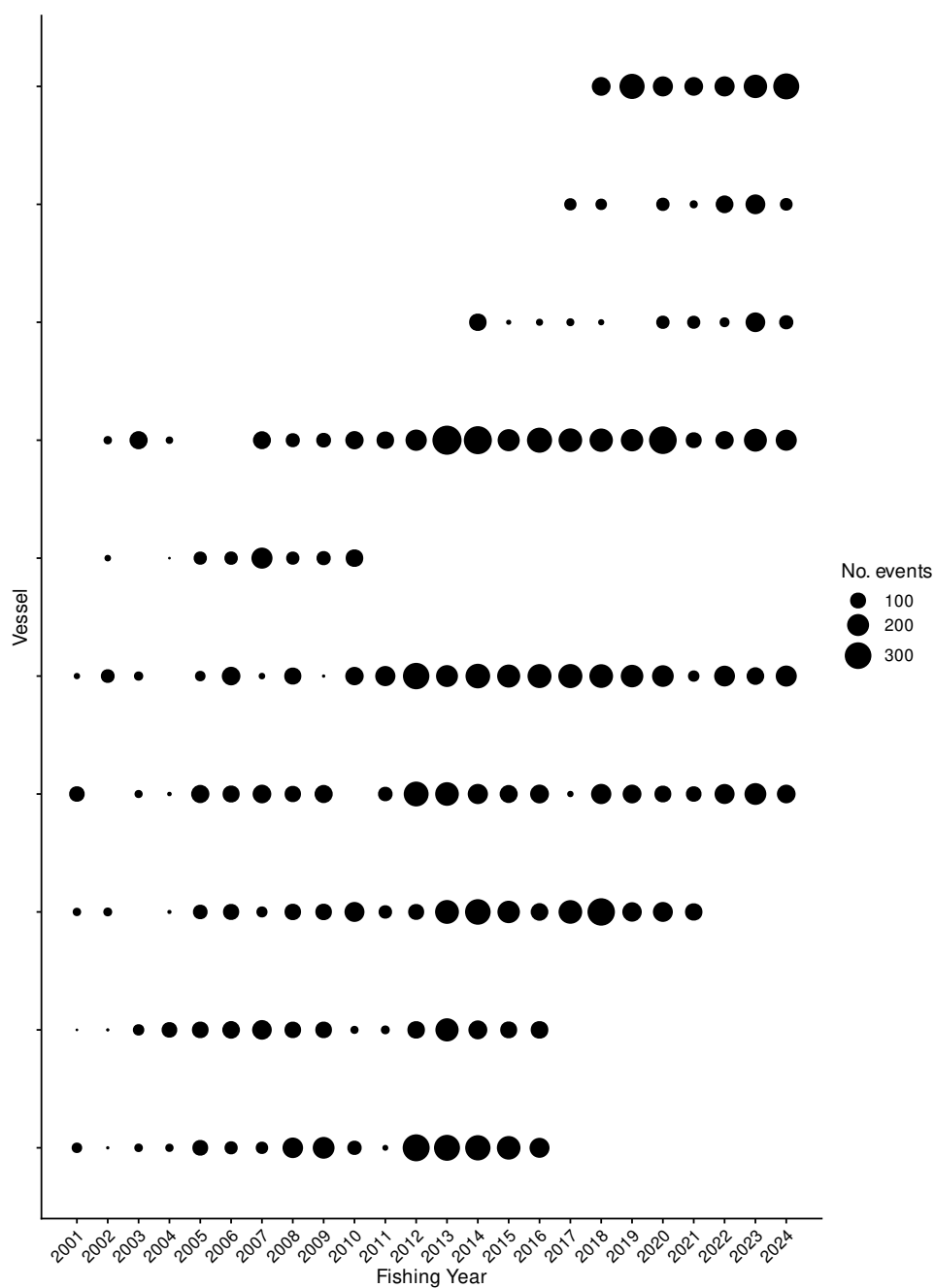


Figure C.25: Number of events by fishing year for core vessels in the EMA7 MW MACK observer series. The area of the circles is proportional to the number of events undertaken by a vessel in a fishing year.

Table C.8: Summary of the EMA7 MW MACK observer dataset total catch (tonnes) and number of records (n), by fishing year after the application of various filters. The first row gives the catch and number of records before filters were applied (ungroomed data). Subsequent rows display the remaining catch (and percent of catch), and the number of records, after the specified filter was applied. (Continued on next 3 pages)

Filter	2001	2002	2003	2004	2005	2006	2007	2008	2009
Ungroomed data	226 (100%) n: 186	276 (100%) n: 152	77 (100%) n: 265	253 (100%) n: 152	740 (100%) n: 550	863 (100%) n: 631	824 (100%) n: 758	690 (100%) n: 781	1400 (100%) n: 762
Vessels over 100m	226 (100%) n: 176	276 (100%) n: 152	77 (100%) n: 265	253 (100%) n: 152	740 (100%) n: 550	863 (100%) n: 631	822 (100%) n: 753	690 (100%) n: 781	1400 (100%) n: 761
Fishing speed not NA	213 (94%) n: 173	276 (100%) n: 152	77 (100%) n: 265	253 (100%) n: 151	739 (100%) n: 548	863 (100%) n: 631	820 (100%) n: 751	690 (100%) n: 780	1400 (100%) n: 760
Start datetime not NA	213 (94%) n: 173	276 (100%) n: 152	77 (100%) n: 265	253 (100%) n: 151	739 (100%) n: 548	863 (100%) n: 631	820 (100%) n: 751	690 (100%) n: 780	1400 (100%) n: 760
End datetime not NA	213 (94%) n: 173	276 (100%) n: 152	77 (100%) n: 265	253 (100%) n: 151	739 (100%) n: 548	863 (100%) n: 631	820 (100%) n: 751	690 (100%) n: 780	1400 (100%) n: 760
Seabed depth not NA	213 (94%) n: 173	276 (100%) n: 152	77 (100%) n: 265	253 (100%) n: 151	739 (100%) n: 548	863 (100%) n: 631	816 (99%) n: 749	684 (99%) n: 777	1382 (99%) n: 733
Headline height not NA	213 (94%) n: 173	276 (100%) n: 152	76 (99%) n: 264	253 (100%) n: 151	739 (100%) n: 548	863 (100%) n: 631	811 (98%) n: 746	684 (99%) n: 776	1360 (97%) n: 726
Fishing speed over 3.5knots	213 (94%) n: 173	276 (100%) n: 152	76 (99%) n: 264	253 (100%) n: 151	739 (100%) n: 548	863 (100%) n: 631	811 (98%) n: 745	678 (98%) n: 775	1360 (97%) n: 726
Headline height at least 15m	213 (94%) n: 173	276 (100%) n: 152	76 (99%) n: 263	253 (100%) n: 151	739 (100%) n: 546	863 (100%) n: 630	805 (98%) n: 741	678 (98%) n: 775	1360 (97%) n: 724
Headline height no more 90m	213 (94%) n: 173	276 (100%) n: 152	76 (99%) n: 262	253 (100%) n: 151	739 (100%) n: 545	863 (100%) n: 630	805 (98%) n: 740	677 (98%) n: 774	1360 (97%) n: 724
Fishing duration greater 15mins	213 (94%) n: 172	248 (90%) n: 150	76 (99%) n: 261	253 (100%) n: 150	738 (100%) n: 541	858 (99%) n: 626	805 (98%) n: 736	677 (98%) n: 771	1358 (97%) n: 723
Seabed depth at least 50m	213 (94%) n: 172	248 (90%) n: 150	76 (99%) n: 261	253 (100%) n: 150	738 (100%) n: 541	858 (99%) n: 626	805 (98%) n: 736	677 (98%) n: 771	1358 (97%) n: 721
Seabed depth no greater 400m	213 (94%) n: 172	248 (90%) n: 146	76 (99%) n: 260	253 (100%) n: 148	737 (100%) n: 538	858 (99%) n: 626	805 (98%) n: 736	676 (98%) n: 768	1358 (97%) n: 719
Start time positive	213 (94%) n: 172	236 (86%) n: 141	76 (99%) n: 258	245 (97%) n: 147	736 (99%) n: 532	857 (99%) n: 619	799 (97%) n: 727	676 (98%) n: 757	1263 (90%) n: 713
Core fleet selection	213 (94%) n: 172	236 (86%) n: 141	76 (99%) n: 258	245 (97%) n: 147	736 (99%) n: 532	857 (99%) n: 619	799 (97%) n: 727	676 (98%) n: 757	1263 (90%) n: 713

Filter	2010	2011	2012	2013	2014	2015	2016	2017	2018
Ungroomed data	1177 (100%) n: 742	380 (100%) n: 502	1378 (100%) n: 1389	1871 (100%) n: 1627	933 (100%) n: 1764	702 (100%) n: 1298	595 (100%) n: 1202	361 (100%) n: 886	2525 (100%) n: 1209
Vessels over 100m	1171 (100%) n: 690	380 (100%) n: 495	1378 (100%) n: 1389	1871 (100%) n: 1626	595 (64%) n: 1601	632 (90%) n: 1181	595 (100%) n: 1202	361 (100%) n: 886	2525 (100%) n: 1209
Fishing speed not NA	1171 (100%) n: 687	380 (100%) n: 495	1378 (100%) n: 1388	1868 (100%) n: 1622	595 (64%) n: 1600	632 (90%) n: 1181	595 (100%) n: 1201	360 (100%) n: 883	2525 (100%) n: 1208
Start datetime not NA	1171 (100%) n: 687	380 (100%) n: 495	1378 (100%) n: 1388	1868 (100%) n: 1622	595 (64%) n: 1600	632 (90%) n: 1181	595 (100%) n: 1201	360 (100%) n: 883	2525 (100%) n: 1208
End datetime not NA	1171 (100%) n: 687	380 (100%) n: 495	1378 (100%) n: 1388	1868 (100%) n: 1622	595 (64%) n: 1600	632 (90%) n: 1181	595 (100%) n: 1201	360 (100%) n: 883	2525 (100%) n: 1208
Seabed depth not NA	1150 (98%) n: 682	377 (99%) n: 489	1267 (92%) n: 1311	1657 (89%) n: 1583	594 (64%) n: 1595	625 (89%) n: 1147	594 (100%) n: 1195	358 (99%) n: 874	2525 (100%) n: 1207
Headline height not NA	1149 (98%) n: 673	377 (99%) n: 488	1257 (91%) n: 1299	1650 (88%) n: 1568	593 (64%) n: 1591	624 (89%) n: 1143	594 (100%) n: 1192	356 (99%) n: 869	2523 (100%) n: 1204
Fishing speed over 3.5knots	1149 (98%) n: 673	377 (99%) n: 488	1257 (91%) n: 1298	1650 (88%) n: 1568	593 (64%) n: 1590	624 (89%) n: 1141	593 (100%) n: 1191	356 (99%) n: 869	2523 (100%) n: 1204
Headline height at least 15m	1149 (98%) n: 671	377 (99%) n: 488	1257 (91%) n: 1297	1632 (87%) n: 1560	593 (64%) n: 1589	623 (89%) n: 1137	593 (100%) n: 1191	356 (99%) n: 867	2523 (100%) n: 1203
Headline height no more 90m	1149 (98%) n: 671	375 (99%) n: 487	1257 (91%) n: 1296	1600 (86%) n: 1559	593 (64%) n: 1588	623 (89%) n: 1131	593 (100%) n: 1191	356 (99%) n: 867	2523 (100%) n: 1199
Fishing duration greater 15mins	1149 (98%) n: 670	375 (99%) n: 484	1248 (91%) n: 1294	1600 (86%) n: 1548	590 (63%) n: 1583	588 (84%) n: 1126	591 (99%) n: 1185	356 (99%) n: 863	2522 (100%) n: 1195
Seabed depth at least 50m	1149 (98%) n: 669	375 (99%) n: 484	1248 (91%) n: 1292	1600 (86%) n: 1547	590 (63%) n: 1583	575 (82%) n: 1124	591 (99%) n: 1184	356 (99%) n: 863	2522 (100%) n: 1193
Seabed depth no greater 400m	1002 (85%) n: 666	375 (99%) n: 484	1244 (90%) n: 1282	1600 (86%) n: 1545	590 (63%) n: 1580	567 (81%) n: 1120	591 (99%) n: 1182	356 (99%) n: 863	2521 (100%) n: 1191
Start time positive	1001 (85%) n: 661	374 (98%) n: 479	1233 (89%) n: 1273	1597 (85%) n: 1539	585 (63%) n: 1565	561 (80%) n: 1116	579 (97%) n: 1175	350 (97%) n: 858	2513 (100%) n: 1188
Core fleet selection	1001 (85%) n: 661	374 (98%) n: 479	1233 (89%) n: 1273	1597 (85%) n: 1539	585 (63%) n: 1565	561 (80%) n: 1116	516 (87%) n: 1076	348 (97%) n: 797	2363 (94%) n: 1150

Filter	2019	2020	2021	2022	2023	2024
Ungroomed data	1761 (100%) n: 1082	1005 (100%) n: 1122	1546 (100%) n: 768	1819 (100%) n: 971	1164 (100%) n: 1162	1845 (100%) n: 1042
Vessels over 100m	1730 (98%) n: 1054	1005 (100%) n: 1122	1411 (91%) n: 632	1780 (98%) n: 909	1130 (97%) n: 1116	1641 (89%) n: 949
Fishing speed not NA	1729 (98%) n: 1050	1004 (100%) n: 1116	1409 (91%) n: 629	1723 (95%) n: 906	1130 (97%) n: 1114	1641 (89%) n: 949
Start datetime not NA	1729 (98%) n: 1050	1004 (100%) n: 1116	1409 (91%) n: 629	1723 (95%) n: 906	1130 (97%) n: 1114	1641 (89%) n: 949
End datetime not NA	1729 (98%) n: 1050	1004 (100%) n: 1116	1409 (91%) n: 629	1723 (95%) n: 906	1130 (97%) n: 1114	1641 (89%) n: 949
Seabed depth not NA	1729 (98%) n: 1050	1004 (100%) n: 1104	1391 (90%) n: 607	1590 (87%) n: 814	1130 (97%) n: 1113	1641 (89%) n: 949
Headline height not NA	1723 (98%) n: 1048	1004 (100%) n: 1101	1391 (90%) n: 607	1555 (86%) n: 812	1127 (97%) n: 1103	1641 (89%) n: 948
Fishing speed over 3.5knots	1723 (98%) n: 1048	1004 (100%) n: 1101	1391 (90%) n: 606	1555 (86%) n: 812	1127 (97%) n: 1102	1641 (89%) n: 948
Headline height at least 15m	1723 (98%) n: 1048	1003 (100%) n: 1099	1391 (90%) n: 606	1553 (85%) n: 811	1126 (97%) n: 1099	1641 (89%) n: 948
Headline height no more 90m	1723 (98%) n: 1048	1003 (100%) n: 1099	1391 (90%) n: 606	1551 (85%) n: 809	1122 (96%) n: 1093	1638 (89%) n: 947
Fishing duration greater 15mins	1723 (98%) n: 1043	1003 (100%) n: 1099	1390 (90%) n: 600	1551 (85%) n: 808	1122 (96%) n: 1091	1638 (89%) n: 946
Seabed depth at least 50m	1723 (98%) n: 1043	1003 (100%) n: 1099	1390 (90%) n: 600	1551 (85%) n: 808	1122 (96%) n: 1091	1638 (89%) n: 944
Seabed depth no greater 400m	1722 (98%) n: 1036	1003 (100%) n: 1099	1390 (90%) n: 598	1551 (85%) n: 805	1122 (96%) n: 1090	1638 (89%) n: 943
Start time positive	1691 (96%) n: 1029	1000 (100%) n: 1094	1389 (90%) n: 594	1551 (85%) n: 805	1122 (96%) n: 1088	1638 (89%) n: 943
Core fleet selection	1618 (92%) n: 982	1000 (100%) n: 1094	1389 (90%) n: 594	1551 (85%) n: 805	1122 (96%) n: 1088	1635 (89%) n: 931

Table C.9: Summary of the EMA7 MW MACK observer dataset after core fleet selection. ‘Records’ indicates the number of rows (events) in the dataset, and ‘Records caught’ indicates the percentage of events with catches of blue mackerel.

Fishing year	Vessels	Trips	Records	Hours	Catch (t)	Records caught
2001	5	8	172	469.02	213.04	62.79
2002	6	6	141	419.82	236.43	75.89
2003	5	7	258	796.65	76.20	70.54
2004	6	6	147	553.28	245.03	70.75
2005	6	10	532	1 669.40	735.84	72.18
2006	6	9	619	2 171.53	857.45	41.84
2007	7	16	727	2 589.65	798.56	67.26
2008	7	18	757	2 934.18	675.73	66.45
2009	7	16	713	2 737.27	1 263.04	63.39
2010	6	11	661	2 650.22	1 001.48	68.23
2011	6	8	479	2 041.12	374.24	76.62
2012	6	24	1 273	5 814.67	1 232.95	62.53
2013	6	36	1 539	6 847.08	1 597.41	71.35
2014	7	36	1 565	7 004.55	584.63	70.54
2015	7	33	1 116	5 073.68	561.35	75.81
2016	7	32	1 076	4 627.88	515.87	75.93
2017	6	28	797	3 876.02	348.47	81.18
2018	7	30	1 150	6 148.12	2 363.25	83.91
2019	5	24	982	4 600.12	1 618.06	80.96
2020	7	32	1 094	5 309.62	1 000.36	76.69
2021	7	19	594	2 782.80	1 388.76	73.06
2022	6	21	805	3 575.75	1 551.26	83.35
2023	6	17	1 088	6 179.30	1 122.17	81.53
2024	6	18	931	5 389.80	1 635.24	82.49

Table C.10: Summary of stepwise selection for occurrence of positive catch in the EMA7 MW MACK observer series. Model terms are listed in the order of acceptance to the model. AIC: Akaike Information Criterion; *: Term included in final model.

Predictor	df	AIC	% deviance	addl. % deviance	Included
fyear	22	21 655	3.2	3.2	*
+ stat_area	9	21 182	5.4	2.2	*
+ month	11	20 902	6.7	1.4	*
+ ns(log(start_seabed_depth), 3)	3	20 634	8.0	1.2	*
+ ns(log(headline_height), 3)	3	20 484	8.7	0.7	
+ ns(log(fishing_duration), 3)	3	20 325	9.4	0.7	
+ bs(hour(start_datetime), 3)	3	20 232	9.9	0.4	
+ vessel_key	9	20 160	10.3	0.4	
+ target_species	2	20 105	10.5	0.3	
+ bs(start_latitude, 3)	3	20 066	10.7	0.2	
+ bs(SeasonDay, 3)	3	20 054	10.8	0.1	
+ ns(fishing_speed, 3)	3	20 046	10.9	0.1	

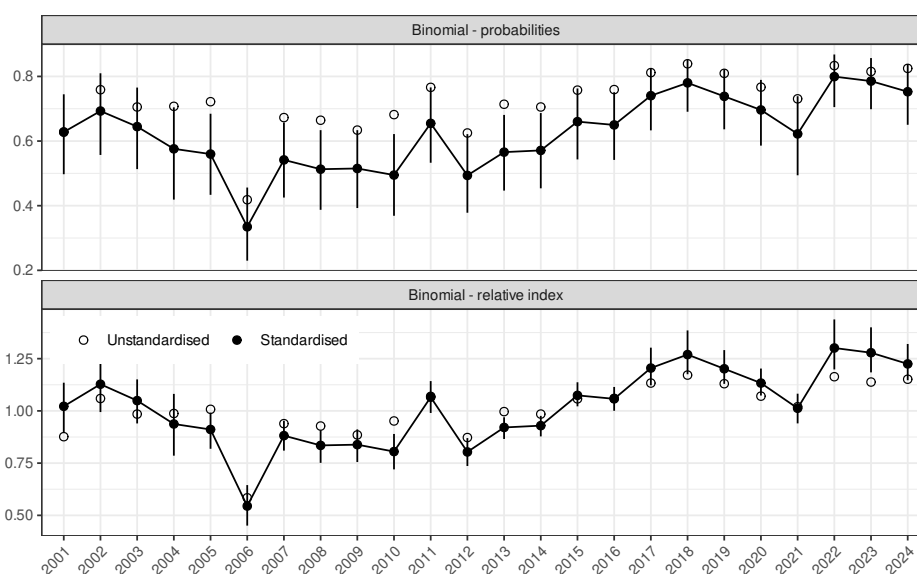


Figure C.26: Unstandardised (geometric mean; open circles) and standardised indices (black circles) for occurrence of catch in the EMA7 MW MACK observer dataset, plotted as both probability of occurrence and as a relative index standardised to the geometric mean.

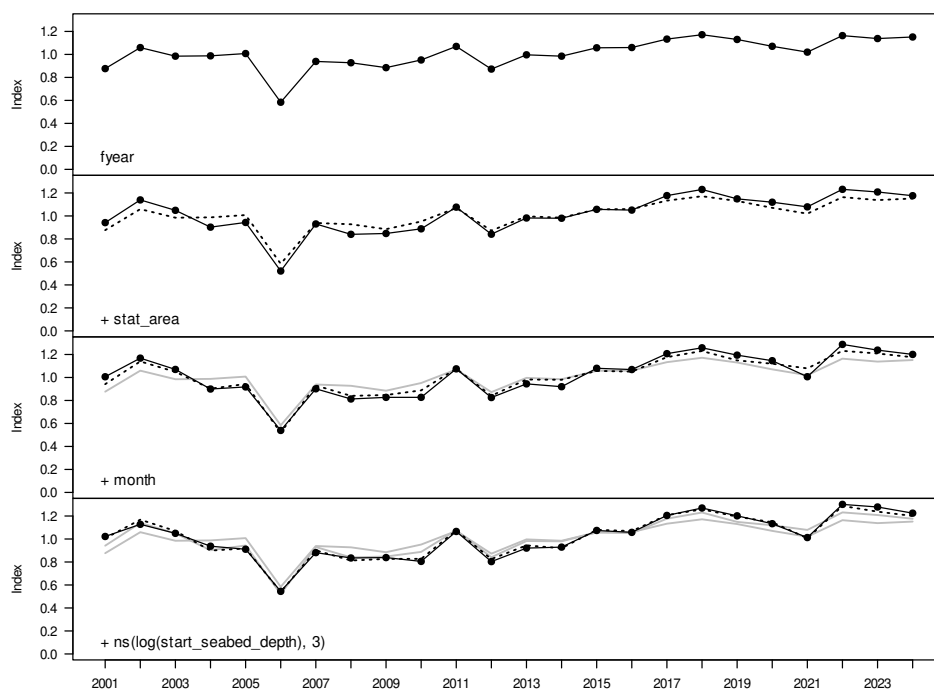


Figure C.27: Step plot for occurrence of catch in the EMA7 MW MACK observer dataset.

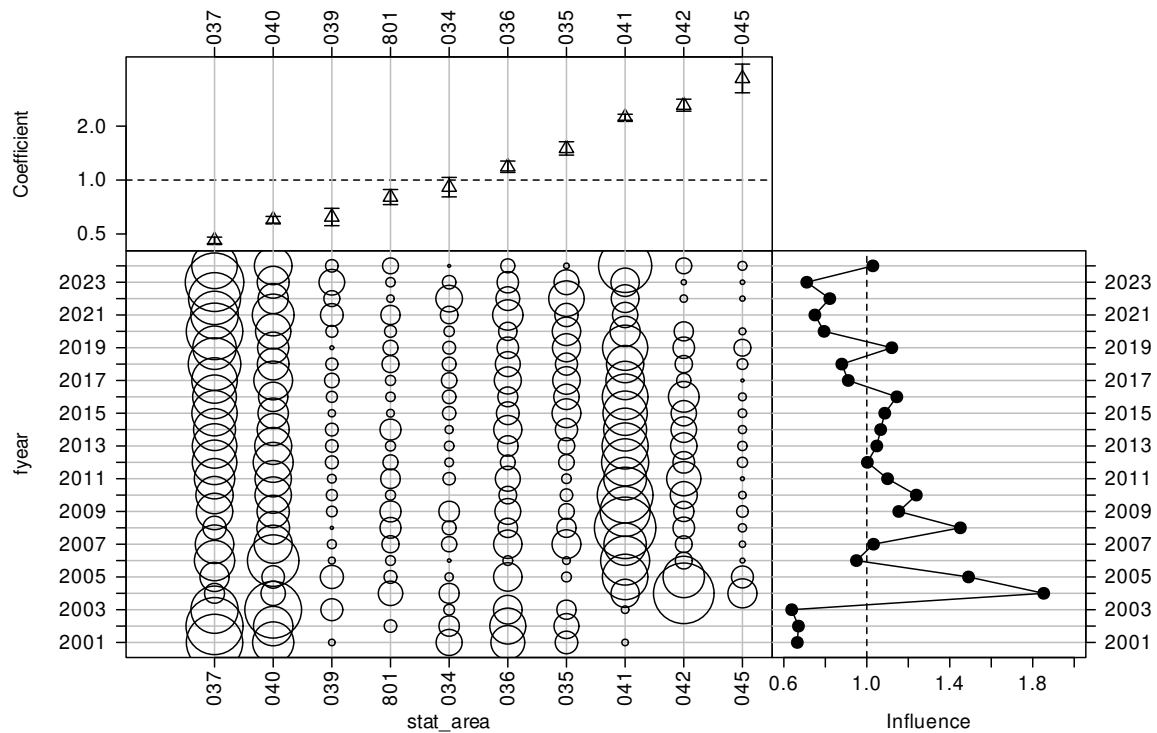


Figure C.28: CDI plot for statistical area for the occurrence of positive catch in the EMA7 MW MACK observer catch-per-unit-effort dataset.

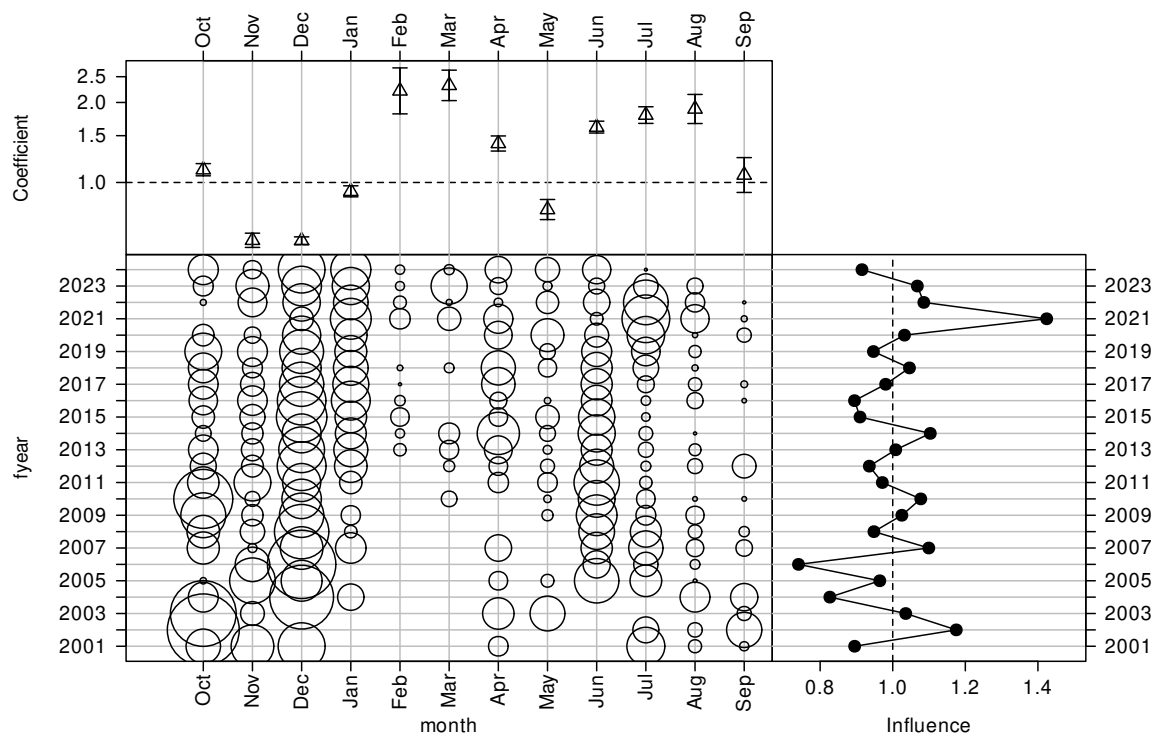


Figure C.29: CDI plot for month for the occurrence of positive catch in the EMA7 MW MACK observer catch-per-unit-effort dataset.

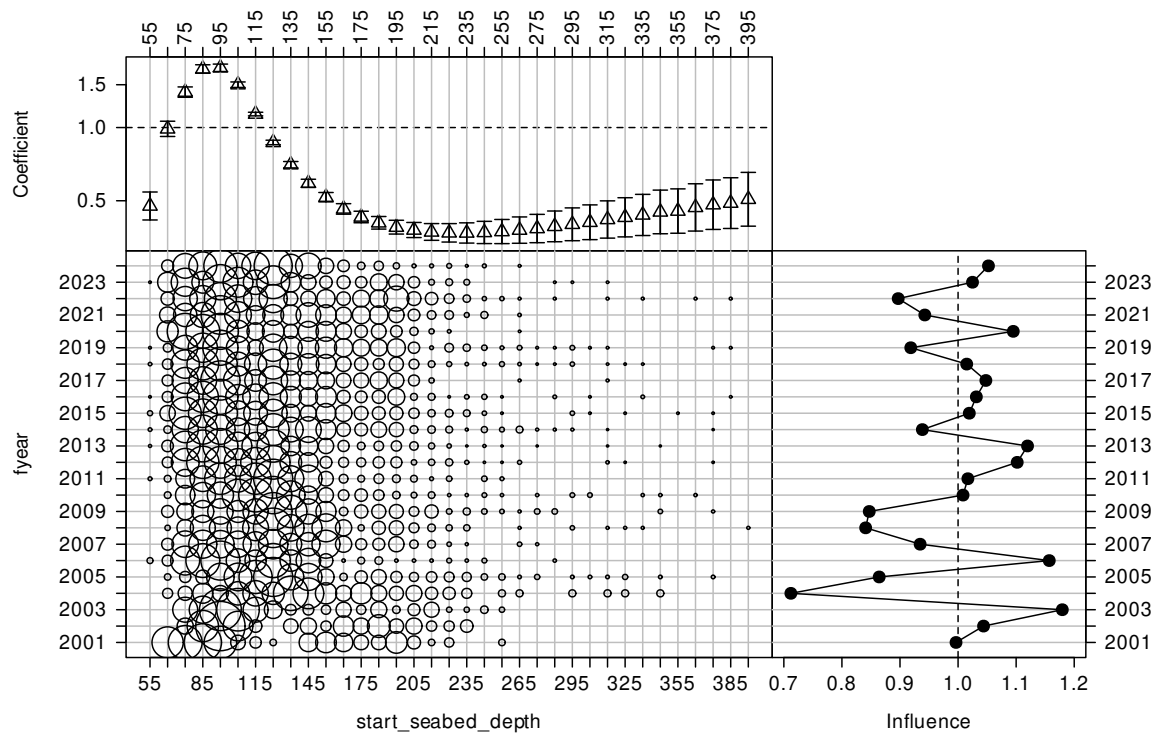


Figure C.30: CDI plot for start seabed depth (m) for the occurrence of positive catch in the EMA7 MW MACK observer catch-per-unit-effort dataset.

Table C.11: Summary of stepwise selection for the lognormal model for positive catches in the EMA7 MW MACK observer series. Model terms are listed in the order of acceptance to the model. AIC: Akaike Information Criterion; *: Term included in final model.

Predictor	df	AIC	% deviance	addl. % deviance	Included
fyear	22	62 135	4.3	4.3	*
+ target_species	2	61 214	10.4	6.1	*
+ stat_area	9	60 628	14.2	3.8	*
+ ns(log(headline_height), 3)	3	60 273	16.4	2.2	*
+ month	11	59 923	18.5	2.2	*
+ ns(log(fishing_duration), 3)	3	59 625	20.3	1.7	*
+ ns(log(start_seabed_depth), 3)	3	59 504	21.0	0.7	
+ vessel_key	9	59 461	21.3	0.3	
+ bs(start_latitude, 3)	3	59 429	21.5	0.2	
+ bs(SeasonDay, 3)	3	59 418	21.6	0.1	
+ bs(hour(start_datetime), 3)	3	59 409	21.7	0.1	
+ ns(fishing_speed, 3)	3	59 404	21.8	0.1	

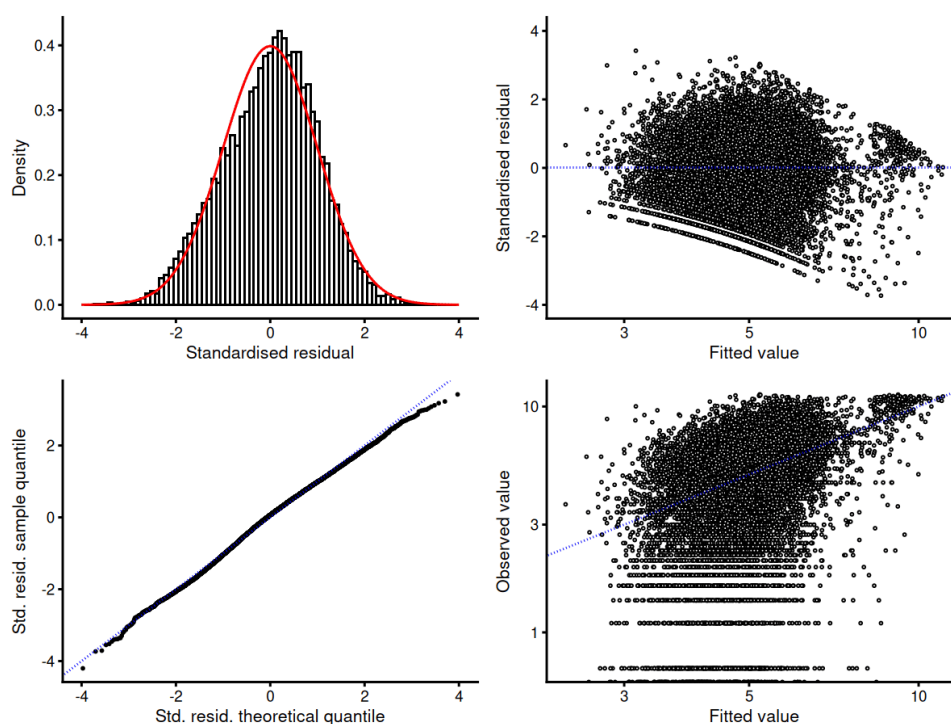


Figure C.31: Diagnostic plots for the selected lognormal model for positive catches in the EMA7 MW MACK observer dataset.

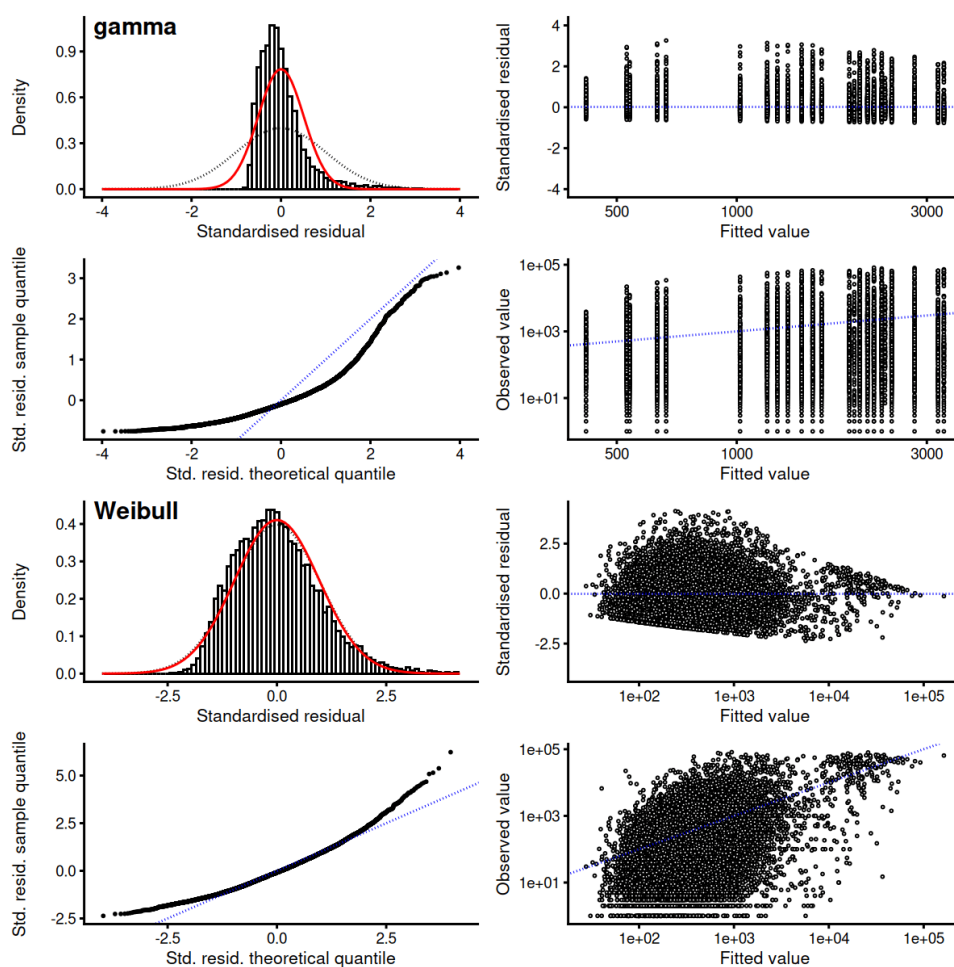


Figure C.32: Diagnostic plots for the alternative gamma and Weibull models considered for positive catches in the EMA7 MW MACK observer dataset.

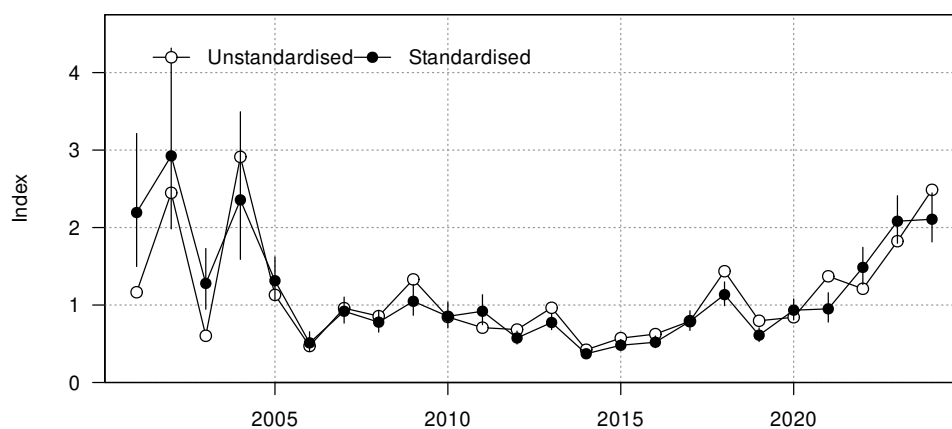


Figure C.33: Unstandardised (geometric mean; open circles) and standardised indices (black circles) for positive catch using the lognormal model for the EMA7 MW MACK observer dataset.

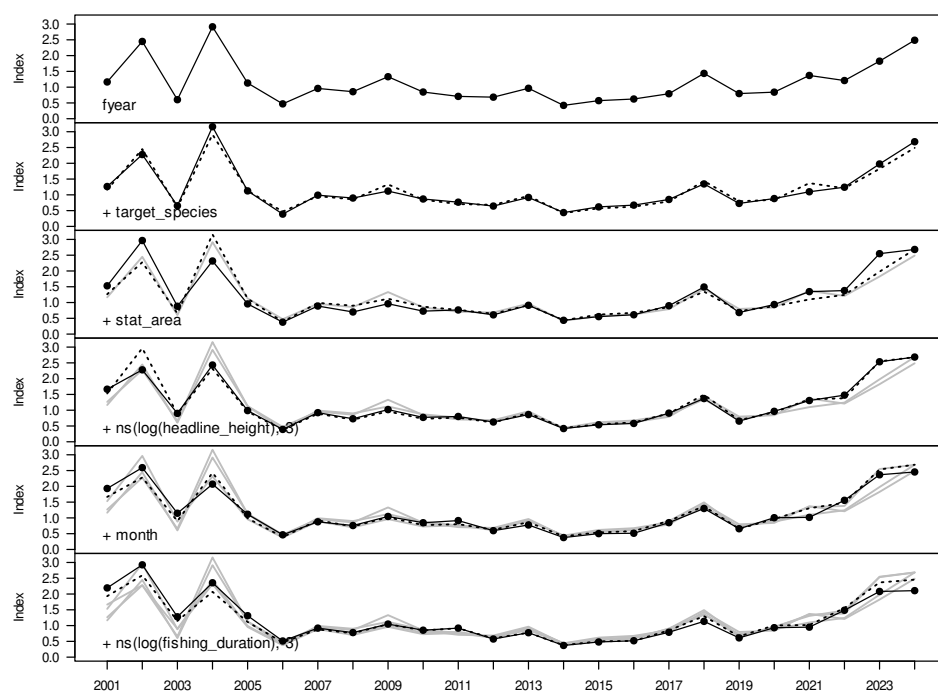


Figure C.34: Changes to the EMA7 MW MACK observer positive catch index as terms are successively entered into the lognormal model.

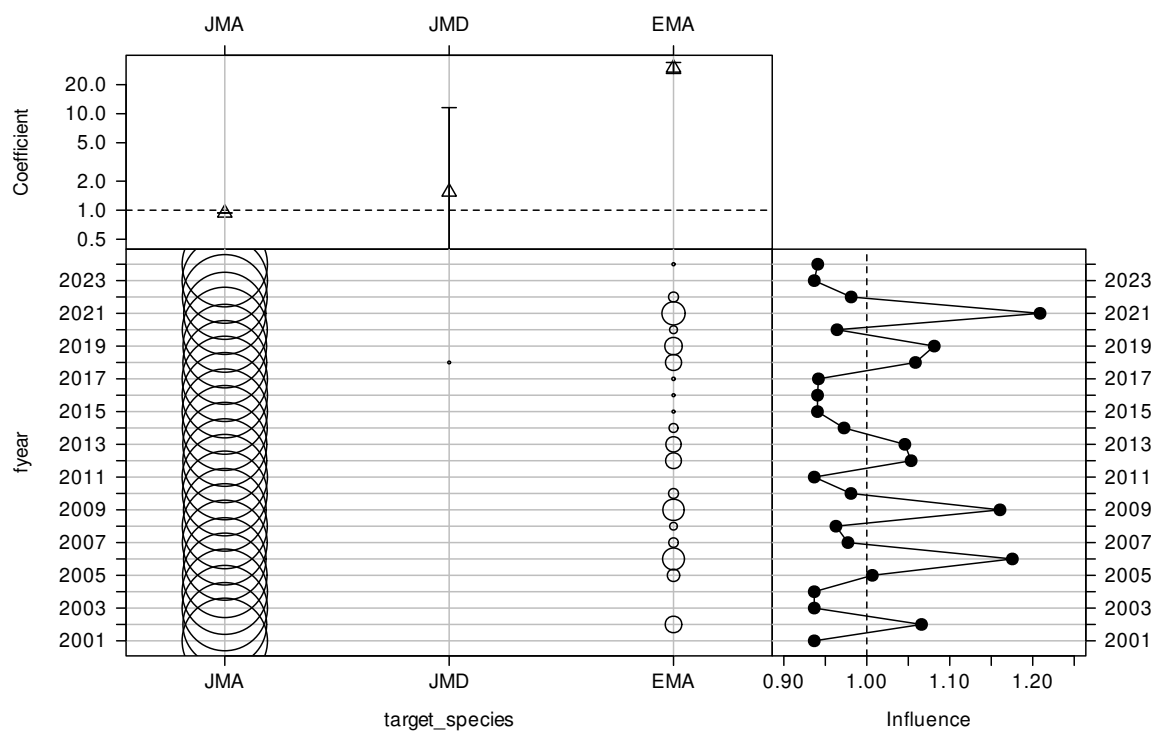


Figure C.35: CDI plot for target species for the lognormal model of positive catches in the EMA7 MW MACK observer catch-per-unit-effort dataset.

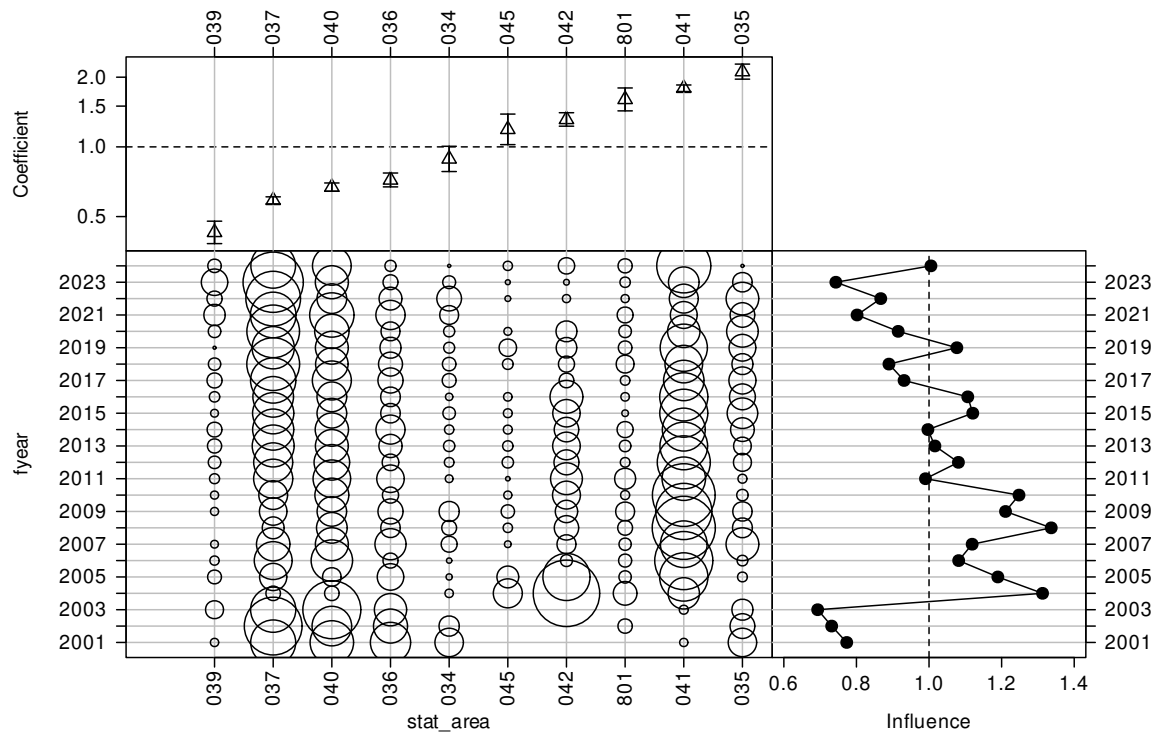


Figure C.36: CDI plot for statistical area for the lognormal model of positive catches in the EMA7 MW MACK observer catch-per-unit-effort dataset.

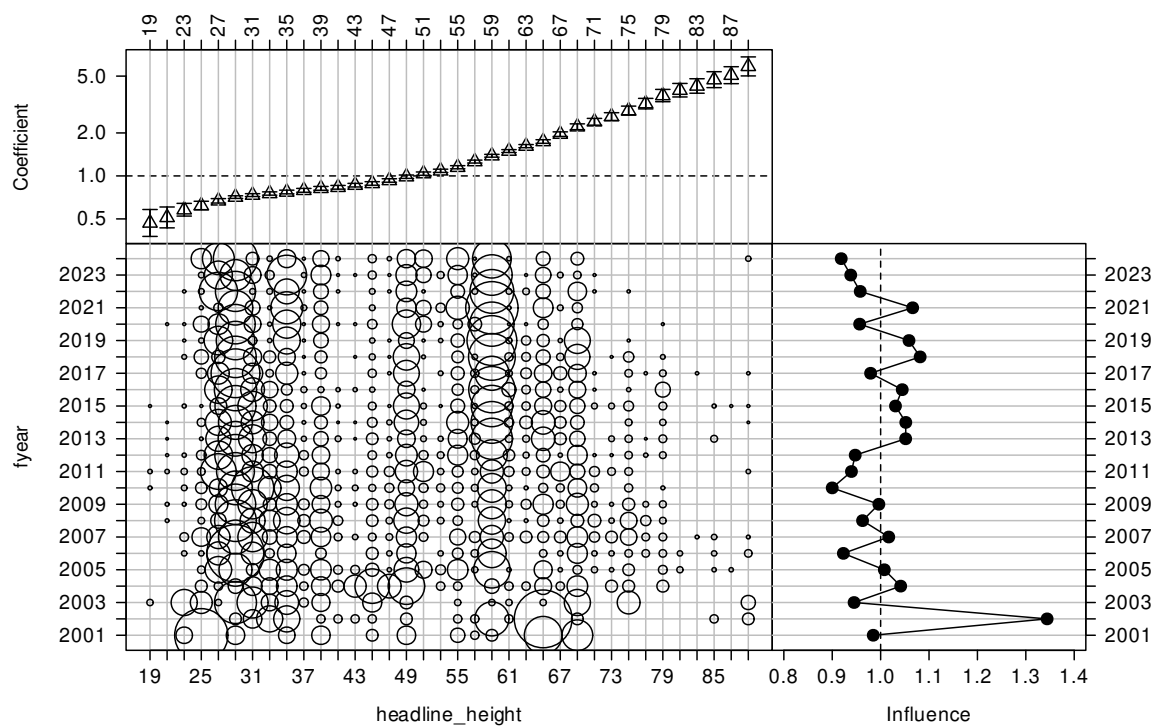


Figure C.37: CDI plot for headline height (m) for the lognormal model of positive catches in the EMA7 MW MACK observer catch-per-unit-effort dataset.

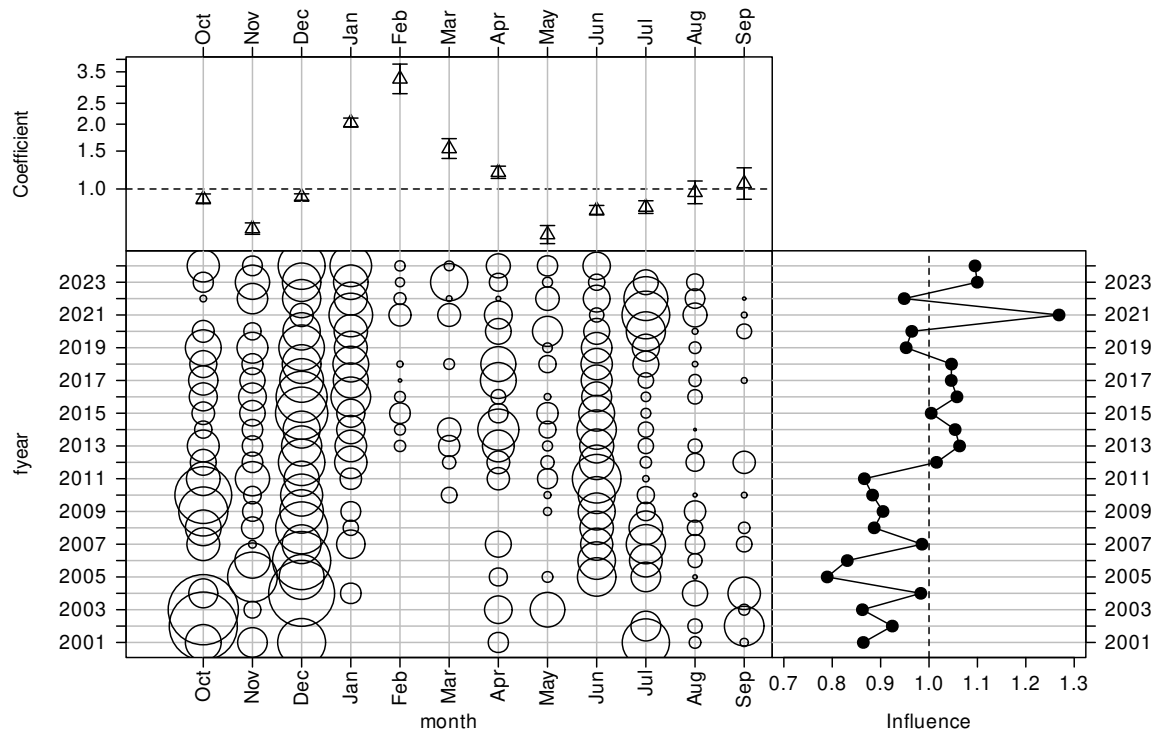


Figure C.38: CDI plot for month for the lognormal model of positive catches in the EMA7 MW MACK observer catch-per-unit-effort dataset.

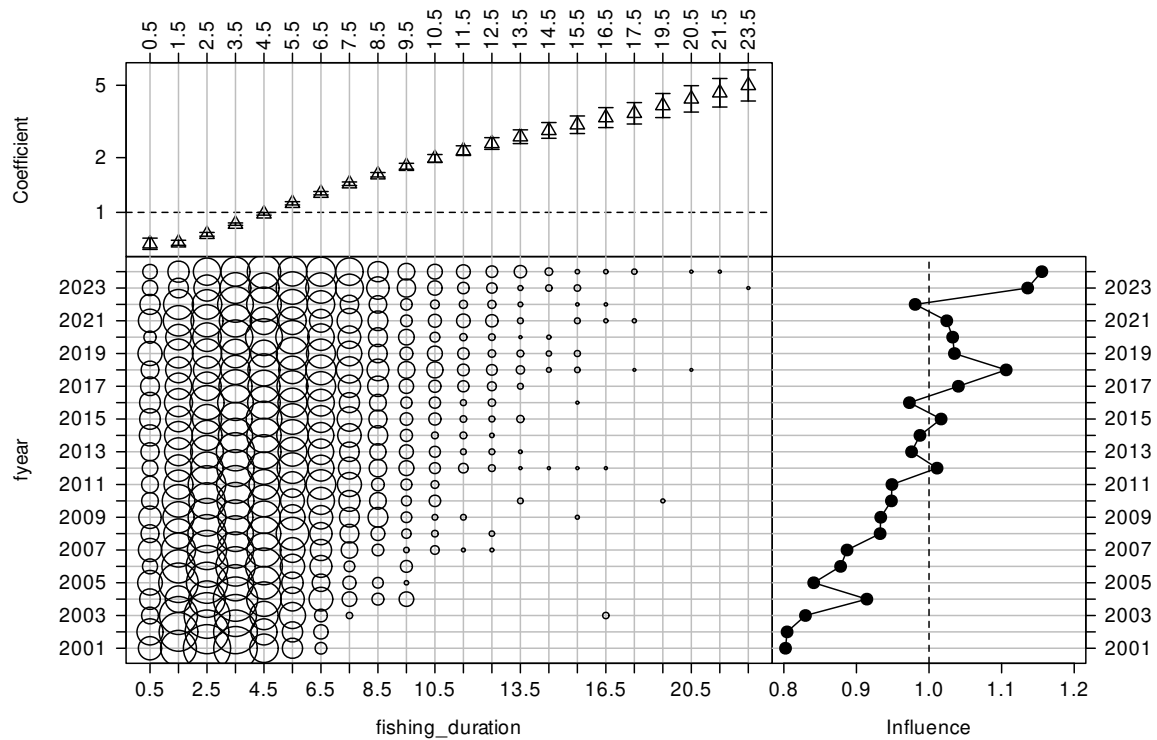


Figure C.39: CDI plot for fishing duration (h) for the lognormal model of positive catches in the EMA7 MW MACK observer catch-per-unit-effort dataset.

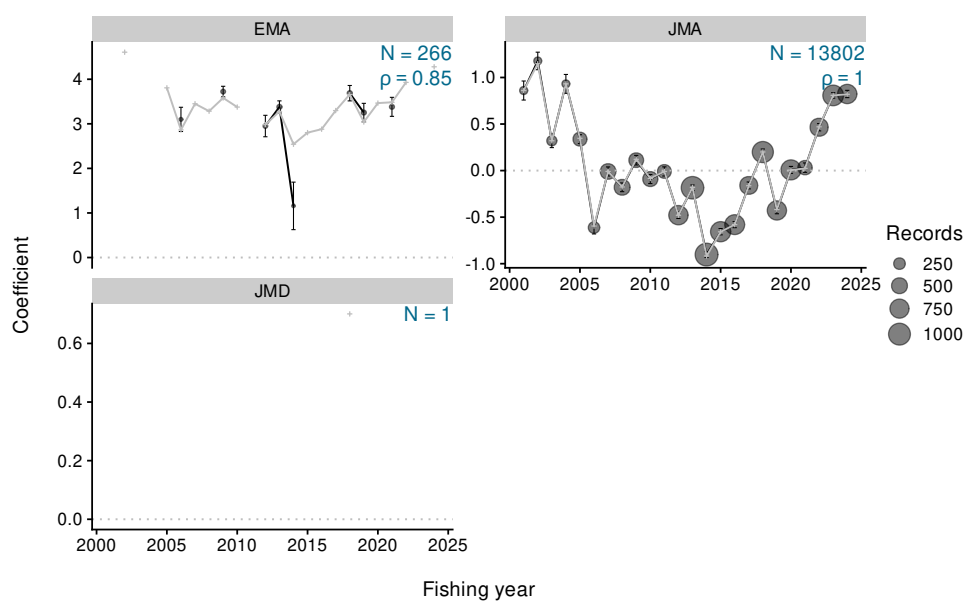


Figure C.40: Residual implied coefficients for target-year in the lognormal positive catch model for the EMA7 MW MACK observer dataset (black points, mean $\pm$ one standard error). The dark grey circles indicate the number of data points. Implied coefficients are only plotted when there are at least 10 data points in a target-year stratum. The light grey line and points indicate the overall year indices; these are only plotted where there are data in a stratum.

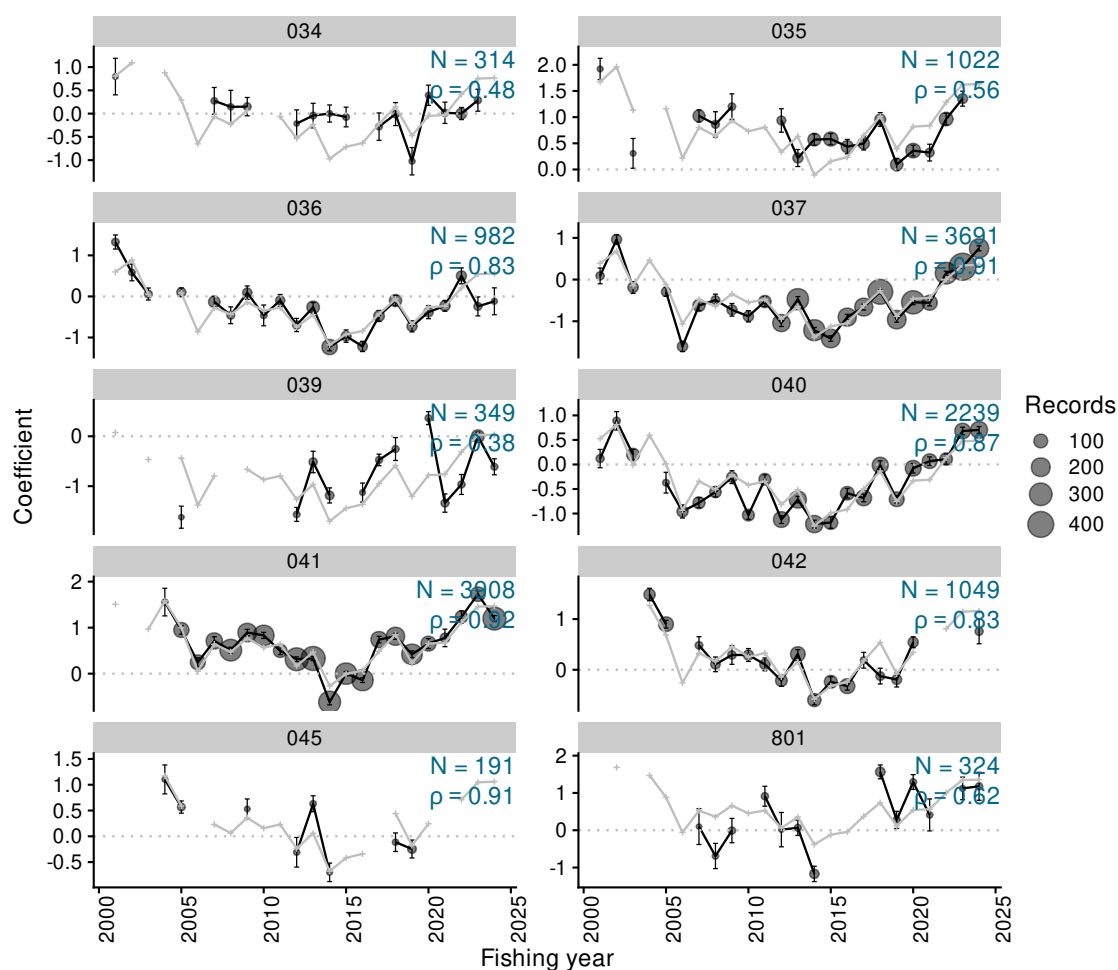


Figure C.41: Residual implied coefficients for area-year in the lognormal positive catch model for the EMA7 MW MACK observer dataset (black points, mean +/- one standard error). The dark grey circles indicate the number of data points. Implied coefficients are only plotted when there are at least 10 data points in an area-year stratum. The light grey line and points indicate the overall year indices; these are only plotted where there are data in a stratum.

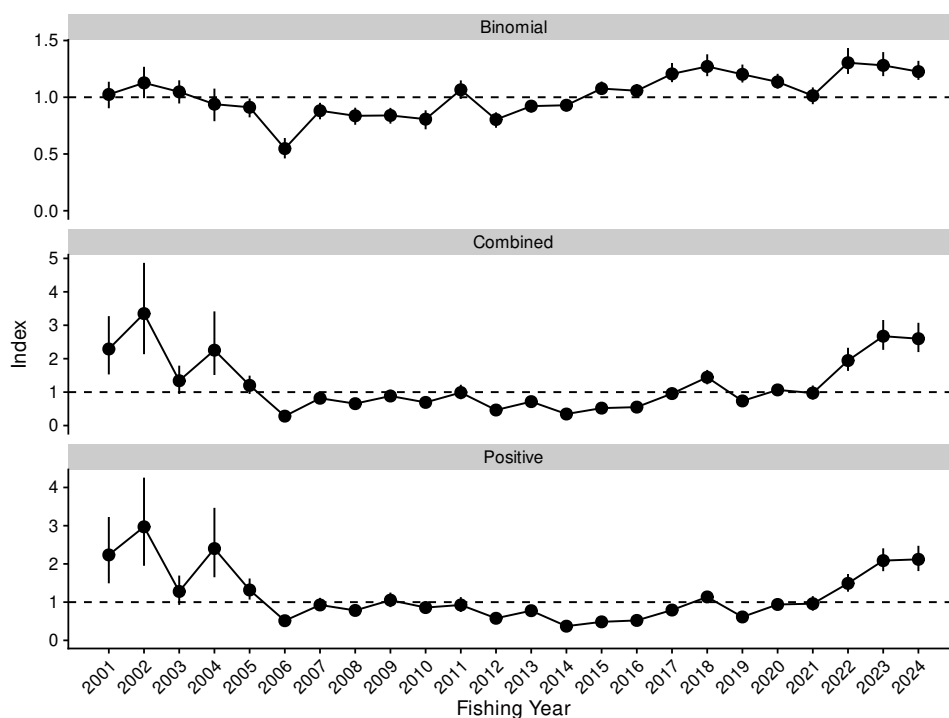


Figure C.42: Standardised indices and 95% confidence intervals for the EMA7 MW MACK observer dataset.



Figure C.43: Standardised indices for the EMA7 MW MACK observer dataset.

Table C.12: Annual indices and standard errors, with upper and lower bounds (LCI: 2.5%, UCI: 97.5%) for each model in EMA7 MW MACK observer.

Fishing year	Binomial				Combined				Positive			
	index	SE	LCI	UCI	index	SE	LCI	UCI	index	SE	LCI	UCI
2001	1.025	0.060	0.903	1.137	2.290	0.445	1.529	3.273	2.235	0.443	1.492	3.227
2002	1.127	0.070	0.992	1.268	3.348	0.697	2.135	4.866	2.971	0.588	1.952	4.256
2003	1.048	0.052	0.945	1.149	1.341	0.216	0.946	1.791	1.279	0.196	0.927	1.695
2004	0.939	0.073	0.789	1.076	2.254	0.485	1.512	3.415	2.401	0.463	1.651	3.467
2005	0.912	0.042	0.823	0.989	1.202	0.140	0.946	1.492	1.318	0.141	1.067	1.619
2006	0.548	0.046	0.461	0.641	0.282	0.042	0.209	0.373	0.514	0.061	0.406	0.645
2007	0.881	0.037	0.806	0.951	0.816	0.084	0.664	0.995	0.926	0.087	0.770	1.112
2008	0.836	0.038	0.757	0.908	0.655	0.065	0.531	0.787	0.783	0.072	0.651	0.933
2009	0.840	0.035	0.768	0.906	0.883	0.092	0.708	1.070	1.052	0.097	0.870	1.250
2010	0.807	0.043	0.718	0.885	0.692	0.076	0.549	0.846	0.858	0.080	0.711	1.027
2011	1.066	0.042	0.986	1.148	0.986	0.111	0.786	1.220	0.926	0.099	0.743	1.131
2012	0.804	0.035	0.731	0.867	0.464	0.039	0.390	0.542	0.578	0.044	0.493	0.664
2013	0.922	0.027	0.866	0.971	0.715	0.051	0.624	0.824	0.776	0.048	0.685	0.873
2014	0.930	0.026	0.875	0.979	0.345	0.023	0.303	0.393	0.371	0.024	0.326	0.419
2015	1.076	0.030	1.022	1.139	0.521	0.041	0.446	0.605	0.484	0.036	0.418	0.559
2016	1.057	0.029	1.003	1.116	0.551	0.041	0.472	0.633	0.521	0.038	0.446	0.595
2017	1.206	0.043	1.133	1.302	0.956	0.084	0.804	1.133	0.793	0.064	0.679	0.930
2018	1.271	0.049	1.186	1.378	1.444	0.110	1.233	1.664	1.136	0.076	0.992	1.289
2019	1.202	0.040	1.130	1.288	0.736	0.061	0.626	0.864	0.612	0.047	0.529	0.713
2020	1.135	0.033	1.075	1.206	1.066	0.075	0.933	1.228	0.939	0.063	0.821	1.070
2021	1.014	0.038	0.939	1.087	0.972	0.107	0.777	1.197	0.959	0.097	0.776	1.157
2022	1.304	0.058	1.205	1.434	1.945	0.176	1.635	2.326	1.491	0.118	1.274	1.736
2023	1.281	0.054	1.186	1.398	2.673	0.228	2.265	3.157	2.087	0.153	1.810	2.408
2024	1.226	0.043	1.153	1.321	2.598	0.223	2.198	3.074	2.120	0.169	1.813	2.474

APPENDIX D: COMPARISON WITH PREVIOUS SERIES

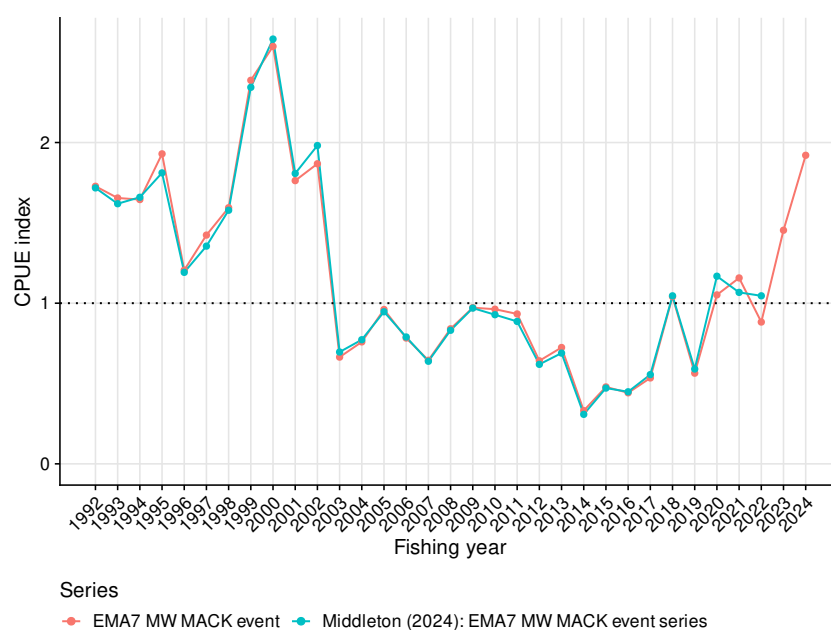


Figure D.1: Comparison between the EMA7 MW MACK event series and the previous update to 2022 (Middleton 2024). All series are scaled to a geometric mean of one for the years in common.

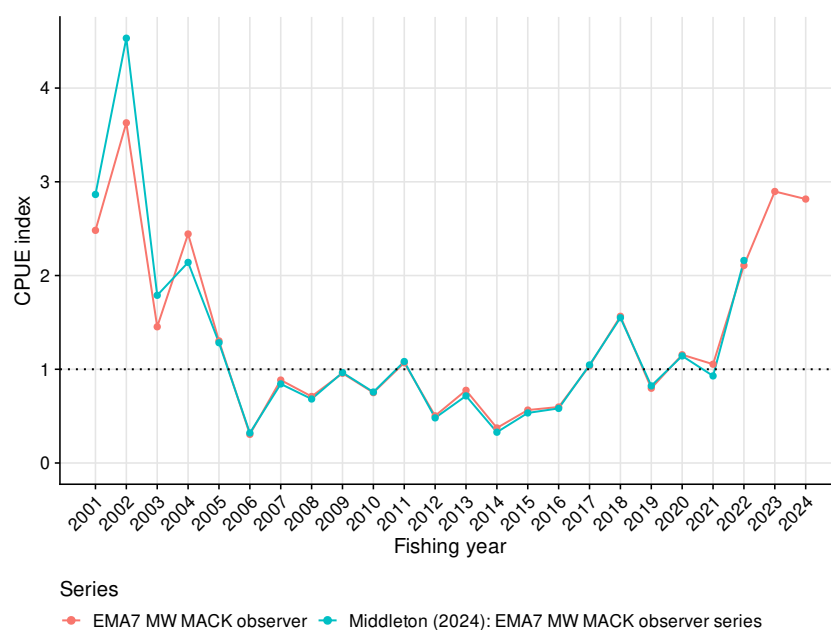


Figure D.2: Comparison between the EMA7 MW MACK observer series and the previous update to 2022 (Middleton 2024). All series are scaled to a geometric mean of one for the years in common.

APPENDIX E: OBSERVER DATA

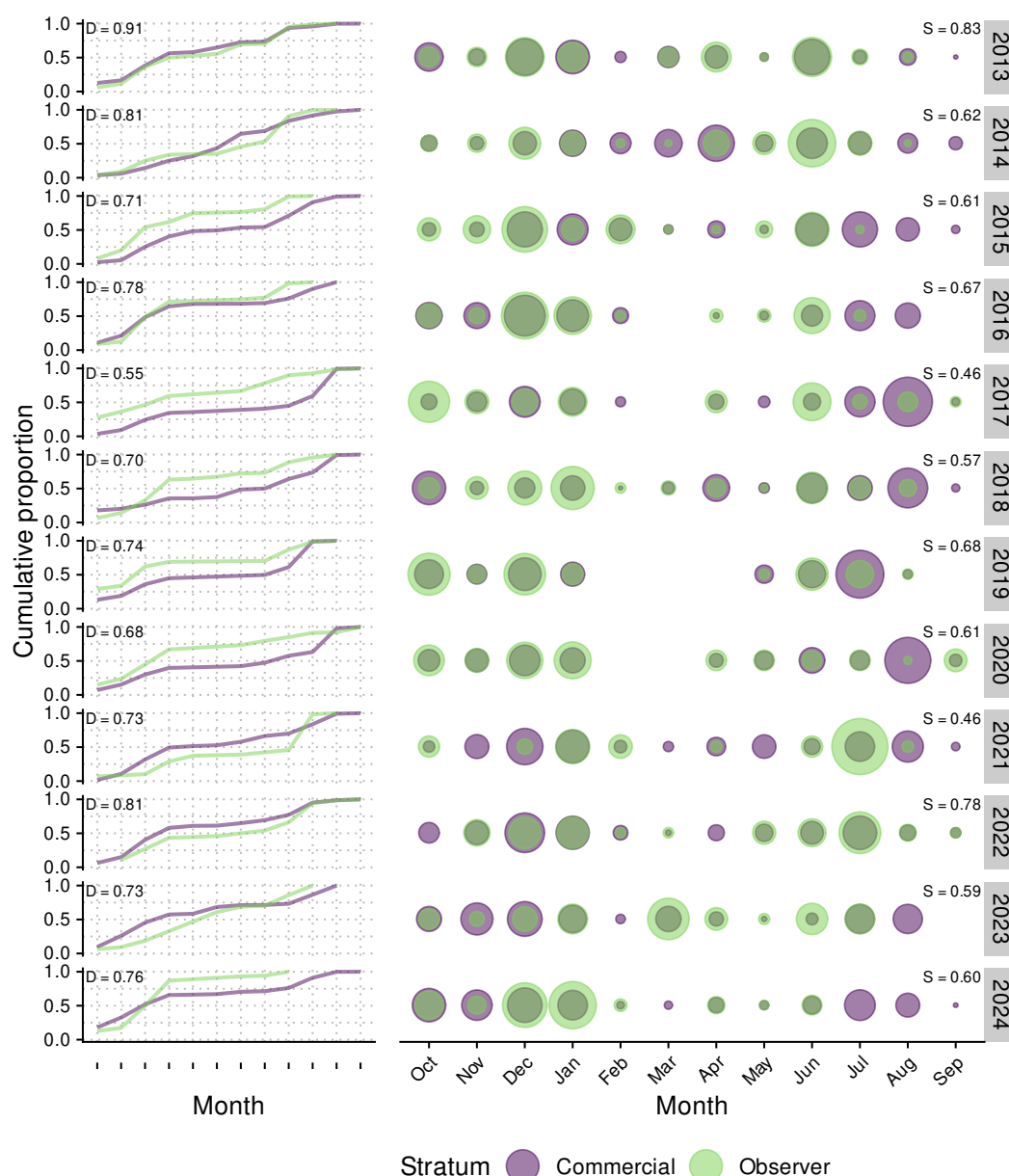


Figure E.1: Representativeness of observer sampling coverage of midwater trawl fishing events that caught blue mackerel (commercial) in 2013 to 2024 by fishing year and month. Observer data are for observed events with length sampling. Circle area is proportional to the proportion of events in a month, with proportions summing to one within each fishing year. D: Kolmogorov-Smirnov maximum absolute difference; S: Manhattan block distance.

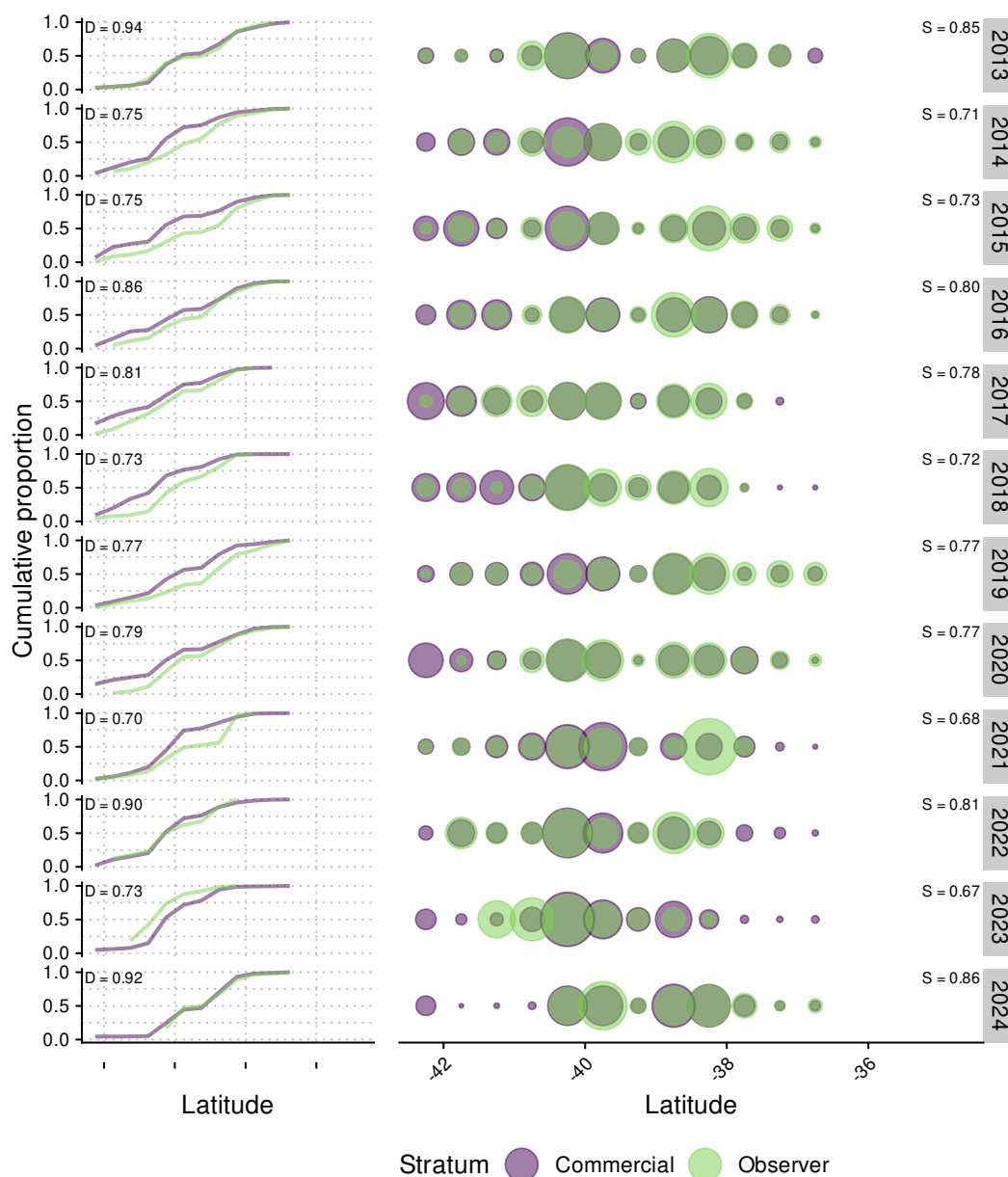


Figure E.2: Representativeness of observer sampling coverage of midwater trawl fishing events that caught blue mackerel (commercial) in 2013 to 2024 by fishing year and latitude. Observer data are for observed events with length sampling. Circle area is proportional to the proportion of events in a latitude bin, with proportions summing to one within each fishing year.

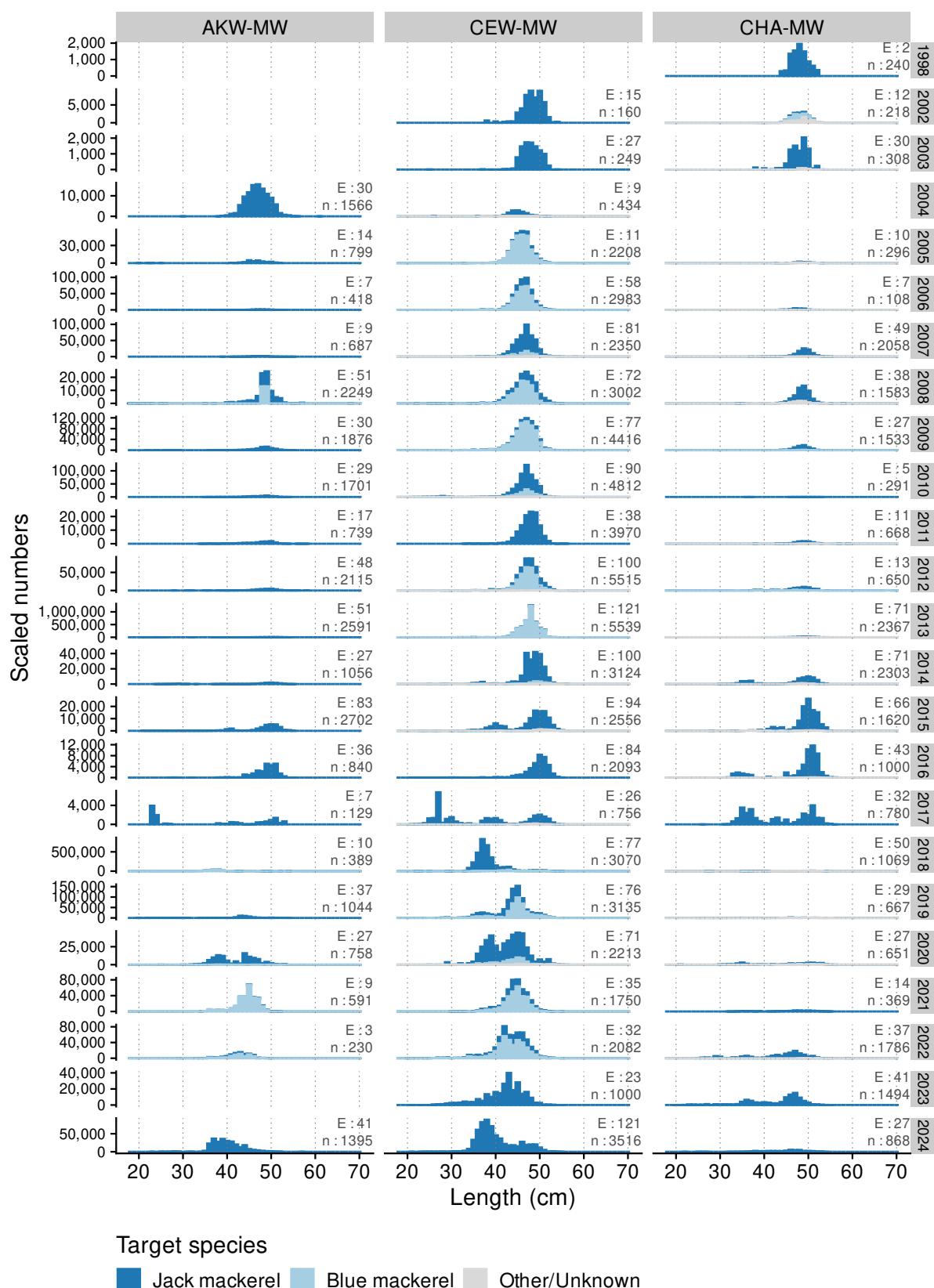


Figure E.3: Length-frequency distributions for blue mackerel caught in the midwater trawl fishery, by area, fishing year, and target species. Annotations indicate the number of unique sampling events (E) and sampled number of fish (n) for each area, target and year. Sampled numbers are scaled to the catch weight in each sampled event. Observer area codes are defined in the glossary. The Other grouping includes both minor target species and events where the target species was not recorded.

APPENDIX F: GLOSSARY

Table F.1: Product state codes used in this report.

Code	Description
DRE	Dressed
FIL	Fillets: skin-on
GRE	Green (or whole)
GUT	Gutted
HDS	Heads
HGU	Headed and gutted
MEA	Fish meal
SKF	Fillets: skin-off

Table F.2: Form type codes used in this report.

Code	Description
CEL	Catch, Effort and Landing Return (CELR)
ERS - Diving	Electronic Reporting System - Diving
ERS - Lining	Electronic Reporting System - Lining
ERS - Netting	Electronic Reporting System - Netting
ERS - Potting	Electronic Reporting System - Potting
ERS - Seining	Electronic Reporting System - Seining
ERS - Trawl	Electronic Reporting System - Trawl
LTC	Lining Trip Catch Effort Return (LTCER)
NCE	Netting Catch, Effort and Landing Return (NCELR)
SJC	Squid Jigging Catch and Effort Return (SJCER)
TCE	Trawl Catch Effort Return (TCER)
TCP	Trawl Catch, Effort and Processing Return (TCEPR)
TUN	Tuna Longlining Catch Effort Return (TLCER)

Table F.3: Fishing method codes used in this report.

Code	Description
BT	Bottom trawl
MW	Midwater trawl
PRB	Precision bottom trawl
PRM	Precision midwater trawl
PS	Purse seine
SN	Set net

Table F.4: Species codes used in this report.

Code	Common name	Scientific name
EMA	Blue mackerel	<i>Scomber australasicus</i>
JMA	Jack mackerel	<i>Trachurus declivis</i> , <i>Trachurus murphyi</i> , <i>Trachurus novaezelandiae</i>
JMD	Greenback jack mackerel	<i>Trachurus declivis</i>
JMM	Slender jack mackerel	<i>Trachurus murphyi</i>
JMN	Yellowtail jack mackerel	<i>Trachurus novaezelandiae</i>
KAH	Kahawai	<i>Arripis trutta</i> , <i>Arripis xylabion</i>

Table F.5: Area codes for Observer data used in this report.

Code	Description
AKW	Auckland (West) (FMA 9)
CEW	Central (Egmont) (FMA 8)
CHA	Challenger/Central (Plateau) (FMA 7)

Table F.6: Destination codes used in reporting of landings and disposals, with introduction date for codes that were not defined in the original Fisheries (Reporting) Regulations 1990. The inclusion of the landing/disposal in subsequent MHR returns is indicated in circulars issued under the Fisheries (Reporting) Regulations 2017. Only categories that are legally retainable, and considered final, are included in the catches and removals for a stock. LFR = Licensed Fish Receiver.

Code	Description	Date		Final	Retainable	Included in		
		Introduced	Revoked			MHR	Catches	Removals
A	Accidental losses	-	-	Y	Y	Y	Y	Y
B	Retained for use as bait	-	-	Y	Y	Y	Y	Y
E	Catch eaten on board	-	-	Y	Y	Y	Y	Y
EOY	End of year landings	2017-10-01	-	Y	Y	Y	Y	Y
H	Losses from holding receptacles	-	2018-06-30	Y	Y	Y	Y	Y
HL	Losses from holding receptacles on land	2018-07-01	-	Y	Y	Y	Y	Y
HW	Losses from holding receptacles in the water	2018-07-01	-	Y	Y	Y	Y	Y
J	Observer or Fishery Officer authorised returns	2013-10-01	-	Y	Y	Y	Y	Y
L	Landings to an LFR	-	-	Y	Y	Y	Y	Y
LFL	Fish landed after being held live on land	2019-01-10	-	Y	Y	Y	Y	Y
LP	Final landing of fish from holding receptacles at sea	2018-07-01	2019-01-09	Y	Y	Y	Y	Y
LR	Final landing of retained fish	2017-10-01	-	Y	Y	Y	Y	Y
M	Sixth schedule returns (spiny dogfish)	2004-10-01	-	Y	Y	Y	Y	Y
O	Catch transported outside the EEZ	-	-	Y	Y	Y	Y	Y
PF	Predated fish	2018-07-01	-	Y	Y	Y	Y	Y
QL	Landings to an LFR after storing in a holding receptacle on land	2018-07-01	-	Y	Y	Y	Y	Y
S	Catch taken by a Fishery Officer or observer	-	-	Y	Y	Y	Y	Y
T	Transhipments	-	2018-06-30	Y	Y	Y	Y	Y
TL	Transhipments, reported as landed by the catching vessel	2018-07-01	-	Y	Y	Y	Y	Y
U	Used as bait	-	-	Y	Y	Y	Y	Y
W	Wharf sales	-	-	Y	Y	Y	Y	Y
Z	Returns to the sea (certain sharks, dead or near-dead)	2014-10-01	-	Y	Y	Y	Y	Y
BS	Biotoxin samples	2019-11-26	-	Y	Y	N	Y	Y
CS	Customary catch	2017-10-01	2019-11-25	Y	Y	N	Y	Y
D	Non-QMS returns	-	-	Y	Y	N	Y	Y
F	Landings as recreational entitlement	2002-07-11	-	Y	Y	N	Y	Y
I	Returns for safety of protected species	2022-11-01	-	Y	Y	N	Y	Y
V	Observer samples	2017-10-01	-	Y	Y	N	Y	Y
X	Permitted returns	2006-10-01	-	Y	Y	N	Y	N
C	Disposal to the Crown	-	2001-09-30	Y	Y	-	Y	Y
G	Returns above legal size	2018-07-01	-	Y	N	N	N	N
K	Lobster required returns (not sub-MLS)	2018-07-01	-	Y	N	N	N	N
Y	Sub-MLS returns	2017-10-01	-	Y	N	N	N	N
LF	Live fish held on land	2019-01-10	-	N	Y	N	N	N
N	Removals from holding receptacles at sea	2018-07-01	-	N	Y	N	N	N
P	Placed into a holding receptacle at sea	-	-	N	Y	N	N	N
Q	Placed into a holding receptacle on land	-	2018-06-30	N	Y	N	N	N
R	Landings retained on board	-	-	N	Y	N	N	N
TT	Transhipments, reported as landed by the receiving vessel	2017-10-01	-	N	Y	N	N	N