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Climate change and the distribution of commercially caught marine fish species in New Zealand. Part 1: Spatio-temporal changes since 1989

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M.R. Dunn

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EXECUTIVE SUMMARY

Dunn, M.R.[1] (2022). Climate change and the distribution of commercially caught marine fish species in New Zealand. Part 1: Spatio-temporal changes since 1989.

New Zealand Aquatic Environment and Biodiversity Report No. 286. **405 p.**

The main expected effect of climate change on marine fauna is generally a poleward movement of distribution towards cooler waters. This could mean the arrival of subtropical species around northern New Zealand; species found predominantly around the North Island may increase in abundance around the South Island; species currently found around the South Island may shift towards the Campbell Plateau; and temperate species currently found on the Campbell Plateau may be restricted in their southern movement by the cold Antarctic circumpolar current, which flows around the edges of the Campbell Plateau.

This report provides a history of the distribution of New Zealand fish species in the New Zealand fisheries Quota Management System. It presents the spatial distribution of catches of each species from research vessel trawl surveys, and their distribution by depth, surface temperature, and bottom temperature, and the length composition of those catches. It also presents the spatial occurrence in trawl or line fishery catches using Fisheries New Zealand commercial fisheries data, for 10-year steps over a thirty-year historical period. The analyses of commercial catch and effort data start in 1989–90; changes in distribution before then are unknown.

Several stocks showed an increase in occurrence off the west coast South Island. These included frostfish, John dory, snapper, kahawai, and possibly trevally. Some of these increases are well-supported by published research trawl survey biomass estimates and commercial catch-per-unit-effort analyses.

Several stocks showed an increase in occurrence off the east coast South Island. These include moki, elephantfish, John dory, kahawai, silver warehou, and leatherjacket. Published research trawl survey biomass estimates substantiated some but not all of these changes.

Lookdown dory and silver warehou showed increases on Chatham Rise. Published research trawl survey biomass estimates support both of these changes. Gemfish seemed to have increased all around New Zealand. Southern blue whiting appeared to have increased around the Auckland Islands.

For commercial fisheries data, changes in catch reporting and the reporting process precluded strong conclusions. Some patterns seemed more likely an artefact from reporting, such that the historical commercial catch and effort data were better suited to hypothesis generation, than attempting to establish proof.

In the absence of reliable observations of the distribution and movements of marine fishes, and those movements in relation to physical features such as water temperature, it is difficult to show any direct causal link between climate change and species range. Therefore, consistent commercial catch and effort data reporting is needed. Consistency may be degraded not only by changes in catch and effort reporting systems, but also by mixed species commercial reporting codes, changes in fisher behaviour, and fishery management restrictions. Research vessel surveys therefore provide a more credible data source for evaluating changes in stocks, although the surveys have relatively limited spatial or temporal coverage. The correlation between research vessel catch distribution and environmental covariates, and prediction of catch distribution under climate change, are described in the second report from this project (Climate change and the distribution of commercially caught marine fish species in New Zealand. Part 2: Predicting changes in distribution).

[1] National Institute of Water and Atmospheric Research (NIWA), New Zealand.

1. INTRODUCTION

The main expected effect of climate change on marine fauna is generally a poleward movement of distribution towards cooler waters (e.g., Li & Park 2020, Gervais et al. 2021, Melbourne-Thomas et al. 2021). This could mean the arrival of subtropical species around northern New Zealand; species found predominantly around the North Island may increase in abundance around the South Island; species currently found around the South Island may shift towards the Campbell Plateau; and temperate species currently found on the Campbell Plateau may be restricted in their southern movement by the cold Antarctic circumpolar current, which flows around the edges of the Campbell Plateau (Chiswell et al. 2015).

The expected effect of climate change on New Zealand oceanography, and its potential impact on commercially caught marine fishes, was reviewed by Cummings et al. (2021). That report highlighted a lack of information on likely responses of New Zealand marine fishes to changing climate.

The information presented here was produced as part of a project to research potential spatial redistribution of fish stocks under climate change. This report constitutes an 'atlas' of distribution of commercial marine fishes and squid, including historical data on spatial changes in occurrence in commercial catches. Further literature review, and analyses of predicted fish redistributions and productivity changes, were completed under the same project, and are described in a second report (Dunn et al. 2022).

This report essentially updates information on the spatial and depth distribution of species in aggregated research vessel catches presented by Anderson et al. (1998). This report updates that research vessel information and adds information on occurrence in research catches by surface and bottom temperature, and length composition of those catches. It also presents spatial occurrence in commercial trawl or line fishery catches, in 10-year steps between 1989 and 2020, for the year groups (1) 1989–90, 1990–91, and 1991–92, (2) 1998–99, and 1999–2000, (3) 2008–09 and 2009–10, and (4) 2018–19 and 2019–20. Anderson et al. (1998) included both Quota Management System (QMS) and non-QMS species; here only QMS species are described, with one exception; pink maomao. The species included in this report are given in Table 1.

1.1 Objectives

This report was produced as part of Fisheries New Zealand project ZBD2018-02: Climate change, fish distribution meta-analysis. The overall objective of this research was to assess the resilience and diversity of marine living resources under regime shifts and climatic trends in New Zealand waters. The specific objectives were:

(1) Explore data time series and biological data for evidence of spatial change in living marine resources that may be consistent with climate change or regime shifts.

(2) Investigate novel approaches to identify ecologically relevant change by examining species and community relationships between the organisms and their environment.

(3) Identify fisheries, communities, and locations that are most vulnerable or will remain stable under the response to climate change effects on the ocean.

The research presented here is the key output from Specific Objective One.

Table 1: English common name, species code, and Latin name, for the commercial (QMS) species codes included in this report. Where research and commercial codes differ, both are given.

English common name	Species code		Latin name
Alfonsino	Research	BYS	*Beryx splendens*
		BYD	*Beryx decadactylus*
	Commercial, BYX		*Beryx* spp. (likely mostly *B. splendens*)
Anchovy	ANC		*Engraulis australis*
Arrow squid	Research:	NOS	*Nototodarus gouldi*
		NOG	*Nototodarus sloanii*
	Commercial, SQU		*Nototodarus* spp. (species depends on location)
Barracouta	BAR		*Thyrsites atun*
Black cardinalfish	Research, EPT		*Epigonus telescopus*
	Commercial, CDL		
Blue cod	BCO		*Parapercis colias*
Blue mackerel	EMA		*Scomber australasicus*
Blue moki	MOK		*Latridopsis ciliaris*
Blue warehou	WAR		*Seriolella brama*
Bluenose	BNS		*Hyperoglyphe antarctica*
Butterfish	BUT		*Odax pullus*
Elephantfish	ELE		*Callorhinchus milii*
Flatfish	Research:	LSO	*Pelotretis flavilatus*
		ESO	*Peltorhamphus novaezeelandiae*
		SFL	*Rhombosolea plebeian*
		BFL	*Rhombosolea retiaria*
		BRI	*Colistium guntheri*
		YBF	*Rhombosolea leporine*
		TUR	*Colistium nudipinnis*
		GFL	*Rhombosolea tapirina*
	Commercial, FLA		Mixtures of the above
Frostfish	FRO		*Lepidopus caudatus*
Garfish	GAR		*Hyporhamphus ihi*
Gemfish	Research, SKI		*Rexea solandri*
	Commercial, SKI		Stated as *Rexea* spp.; likely almost all *R. solandri*
Dark ghost shark	GSH		*Hydrolagus novaezealandiae*
Pale ghost shark	GSP		*Hydrolagus bemisi*
Grey mullet	GMU		*Mugil cephalus*
Groper	Research:	HAP	*Polyprion oxygeneios*
		BAS	*Polyprion americanus*
	Commercial, HPB		*Polyprion* spp.
Hake	HAK		*Merluccius australis*
Hoki	HOK		*Macruronus novaezelandiae*
Jack mackerel	Research:	JMN	*Trachurus novaezelandiae*
		JMM	*Trachurus murphyi*
		JMD	*Trachurus declivis*
	Commercial, JMA		*Trachurus* spp.
John dory	JDO		*Zeus faber*
Kahawai	Research	KAH	*Arripis trutta*
		NKA	*Arripis xylabion*
	Commercial	KAH	*Arripis* spp. (virtually all *A. trutta*)
Leatherjacket	LEA		*Meuschenia scaber*
Ling	LIN		*Genypterus blacodes*
Lookdown dory	LDO		*Cyttus traversi*
Orange roughy	ORH		*Hoplostethus atlanticus*
Oreos	Research:	BOE	*Allocyttus niger*
		SSO	*Pseudocyttus maculatus*
		SOR	*Neocyttus rhomboidalis*
		WOE	*Allocyttus verucosus*
	Commercial:	BOE	*Allocyttus niger*
		SSO	*Pseudocyttus maculatus*

Table 1 (cont.): English common name, species code, and Latin name, for the commercial (QMS) species codes included in this report. Where research and commercial codes differ, both are given.

English common name	Species code		Latin name
Oreos		OEO	Mixtures of above
Parore	PAR		*Girella tricuspidata*
Pilchard	PIL		*Sardinops sagax*
Pōrae	POR		*Nemadactylus douglasii*
Redbait	RBT		*Emmelichthys nitidus*
Red cod	RCO		*Pseudophycis bachus*
Red gurnard	GUR		*Chelidonichthys kumu*
Red snapper	RSN		*Centroberyx affinis*
Ribaldo	RIB		*Mora moro*
Rig	SPO		*Mustelus lenticulatus*
Rubyfish	RBY		*Plagiogeneion rubiginosum*
School shark	SCH		*Galeorhinus galeus*
Sea perch	Research:	SPE	*Helicolenus* spp.
		HBA	*Helicolenus percoides*
		HPC	*Helicolenus barathri*
	Commercial, SPE		Stated as *H. percoides*; other spp. not recognised
Silver warehou	SWA		*Seriolella punctata*
Rough skate	RSK		*Zearaja nasuta*
Smooth skate	SSK		*Dipturus innominatus*
Snapper	SNA		*Chrysophrys auratus*
Southern blue whiting	SBW		*Micromesistius australis*
Spiny dogfish	SPD		*Squalus acanthias*
Sprat	Research	APS	*Sprattus antipodum*
		SMP	*Sprattus muelleri*
	Commercial, SPR		*Sprattus* spp.
Stargazer	Research:	GIZ	*Kathetostoma giganteum*
		BGZ	*Kathetostoma binigrasella*
	Commercial, STA		Stated as *K. giganteum*; other sp. not recognised
Tarakihi	Research:	TAR	*Nemadactylus macropterus*
		KTA	*Nemadactylus* sp.
	Commercial, TAR		*Nemadactylus* spp. (virtually all *N. macropterus*)
Trevally	TRE		*Pseudocaranx dentex*
Trumpeter	TRU		*Latris lineata*
White warehou	WWA		*Seriolella caerulea*
Yelloweye mulletYEM			*Aldrichetta forsteri*
Ray's bream	Research	RBM	*Brama brama*
		SRB	*Brama australis*
	Commercial, RBM		*Brama* spp.
Kingfish	KIN		*Seriola lalandi*
Mako shark	MAK		*Isurus oxyrinchus*
Moonfish	MOO		*Lampris guttatus*
Porbeagle shark	POS		*Lamna nasus*
Southern bluefin tuna	STN		*Thunnus maccoyii*
Broadbill swordfish	SWO		*Xiphias gladius*
Pacific bluefin tuna	TOR (previously NTU)		*Thunnus orientalis*
Yellowfish tuna	YFN		*Thunnus albacares*
Albacore	ALB		*Thunnus alalunga*
Skipjack	SKJ		*Katsuwonus pelamis*
Pink maomao	Research (non-QMS) PMA		*Caprodon longimanus*

2. METHODS

2.1 Commercial fish catch and effort data

Commercial fisheries catch and effort data were requested from Fisheries New Zealand to characterise spatial and temporal distribution of catch. Because the commercial catch and effort data set is very large, only a subset of fishing methods and years were requested. Data were requested for all trips that used fishing methods bottom trawl (BT), bottom pair trawl (BPT), precision bottom trawl (PRB), midwater trawl (MW), midwater pair trawl (MPT), precision midwater trawl (PRM), surface longline (SLL), trolling (T), pole and line (PL), handline (HL), drop line (DL), and trot line (TL), for the fishing years 1989–90, 1990–91, 1991–92, 1998–99, 1999–2000, 2008–09, 2009–10, 2018–19 and 2019–20. Information for all species caught and landed was obtained, with all effort details, including latitude and longitude (where reported) at the highest resolution possible.

2.2 Research survey data analyses

Catch by species and station details data were also extracted for all research vessel trawl trips using bottom or midwater trawl (there are no survey series using lines). Research survey data were analysed using Generalised Additive Models (GAMs) to characterise the probability of occurrence for each species with geographical location, depth, surface temperature, and bottom temperature. Research survey data are more consistent than commercial fishing data but have relatively small spatial and/or temporal coverage. Surveys also provide much more detailed information on fishing gear and operation. To reduce confounding of estimated patterns by combining surveys with disparate spatial and seasonal survey coverage, and from combining fishing gears, the species characteristics were estimated only for sets of consistent or adjacent survey series. The sets of survey series combined were:

(1) Summer Chatham Rise and sub-Antarctic RV *Tangaroa* middle-depth (generally 200–800 m depth) trawl surveys. Two survey series: sub-Antarctic (Nov-Dec), and Chatham Rise (Jan-Feb). Survey codes tan9105, tan9211, tan9310, tan0012, tan0118, tan0219, tan0317, tan0414, tan0515, tan0617, tan0714, tan0813, tan0911, tan1117, tan1215, tan1412, tan1614, tan1811, tan9106, tan9212, tan9401, tan9501, tan9601, tan9701, tan9801, tan9901, tan0001, tan0101, tan0201, tan0301, tan0401, tan0501, tan0601, tan0701, tan0801, tan0901, tan1001, tan1101, tan1201, tan1301, tan1401, tan1601, tan1801.

(2) Spring North Island RV *Kaharoa* inshore trawl surveys. Two survey series: Hauraki Gulf & Bay of Plenty (Oct-Dec), and west coast North Island (Oct-Dec). Survey codes kah8612, kah8715, kah8918, kah9111, kah9410, kah9615, kah9915, kah8810, kah8917, kah9016, kah9212, kah9311, kah9411, kah9702, kah0012, kah8421, kah8517, kah8613, kah8716.

(3) Autumn South Island RV *Kaharoa* inshore trawl surveys. Two survey series: west coast (Mar-Apr), and east coast (Apr-Jun). Survey codes kah9204, kah9404, kah9504, kah9701, kah0004, kah0304, kah0503, kah0704, kah0904, kah1104, kah1305, kah1503, kah1703, kah1902, kah9105, kah9205, kah9306, kah9406, kah9606, kah0705, kah0806, kah0905, kah1207, kah1402, kah1605, kah1803.

(4) Autumn RV *Tangaroa* deepwater (generally 800–1300 m depth) trawl surveys. Mid-East Coast (Mar-Apr) and Chatham Rise (May-Jun). Survey codes tan9203, tan9303, tan9403, tan1003, tan9406.

Data were only used where the gear performance was rated as 1 or 2 (i.e., the net fished well, and data could be used for biomass index estimation). Only results from those survey series data sets that caught the focal species are reported.

2.3 Commercial catch and effort data analyses

Analyses are presented only for species occurrence, rather than abundance, to reduce the confounding of results by changes in stock size resulting from fishing rather than the environment. It is therefore assumed that occurrence is less influenced by population size than abundance.

Occurrence was calculated as the proportion of trips in a temporal and spatial stratum that recorded each species. Data were grouped to include only effort that was likely to catch the species, so as not to include effort in the occurrence calculation that would never have caught that species. The main influences on whether a particular species was caught or not was assumed to be fishing method (trawl or line) and depth. However, depth was lacking in historical data records, therefore the recorded target species accounting for 95% of events in the chosen depth range was identified from all data having both depth and target species records, and those target species were then used as a depth proxy to subset the data across all time periods (for consistency). This was only done for the trawl records. The line method data set did not include bottom longline data, because it was assumed such species would be adequately described by the bottom trawl analyses. Rather, longline data were included to describe species that were pelagic and rarely or never caught by trawls, and it was assumed that any surface-based effort could have caught any of the pelagic species, and that bottom depth was irrelevant. As a result, the depth and target species criteria for longline data was constant across all species.

Two analyses were conducted on the commercial catch and effort data, having different spatial resolutions but each with different limitations on interpretation:

(1) Trip level data, for trips that fished only one statistical area. Statistical area is the finest spatial resolution comprehensively available before 2007–08. These data include all catches for all QMS species, but if the vessel fished over multiple statistical areas within a single trip then those data were excluded; this exclusion was necessary to maintain the spatial resolution of the data (the statistical area). Most offshore vessels are relatively large and fish over wide areas, so offshore stocks may be poorly represented by these data.

(2) Fishing event-level data (i.e., one tow, one longline set, etc.), summarised by 0.5 degree latitude and longitude cells. These data have routinely been provided by larger offshore vessels, but by most inshore vessels only since about 2007–08. These data include the top five or eight species recorded from each fishing event. A rarer or non-target QMS species may therefore not be recorded, leading to false negatives, which may be more pronounced towards the edges of a species range where it is naturally rarer, and prevalent for low-value bycatch.

The only environmental data included in analyses were from the research surveys. No environmental data were linked to the commercial fisheries data. This was because the only environmental data that could be linked to commercial data were remote-sensed (sea surface), requiring locational data for individual fishing events, which was rarely available for inshore fisheries until after 2007. Further, the remote-sensed data would be unsuitable for many of these analyses because surface conditions can be poorly correlated to those at the depths inhabited by the fish (see Dunn et al. 2022). Credible analyses of environmental influences on catches would require more detailed and appropriate data analyses for specific species and/or regions (Dunn et al. 2009, Taheri et al. 2021), which were beyond the broad-scale approach taken in this project.

3. RESULTS AND CONCLUSIONS

The purpose of this study was to examine existing data for changes in historical fish species distribution. A number of changes in fish distribution were identified that were consistent with the expected impact of climate change, being a poleward redistribution of fish. These changes were more apparent around the South Island than the North Island.

3.1 North Island changes in fish distribution

Red cod (RCO) appeared to have less frequently been caught in commercial catches around the northern North Island. Pink maomao (PMA), a non-QMS species generally thought of as a northern vagrant visitor to New Zealand waters, appeared to have more frequently been caught around northern North Island. The analyses in this report focused on QMS species because they are required by law to be reported. However, pink maomao (PMA) was a non-QMS species, yet was still reported. Because of this status, the reports of pink maomao (PMA) are dubious, but included to demonstrate that data are available for some non-QMS species.

Some species showed particularly high variability in their distribution, but because coverage by the fisheries was patchy, it was unclear whether these constituted any real change. Examples include mackerel (EMA), ghost sharks (GSP, GSH), and most of the stocks where the data were from line fisheries. Line fisheries may be able to target where the fish are present (e.g., where isotherms are targeted, or spotter planes are used), such that measurements of where they are absent, are sparse.

Bluenose (BNS) showed a contraction in distribution, but this was potentially due to increasingly restrictive catch limits, and avoidance of bluenose by fishers.

There were many cases where an increase in occurrence in commercial catches happened around the North Island. However, where this increase took place between the first two sets of years and the last two sets of years, i.e., between 2000–01 and 2008–09, and was seen clearly in the 0.5-degree cell analysis, but not in the trip level analysis, then it was concluded that the change was most likely a result of the change in forms used (from daily summary to event-based recording). Examples include arrow squid (SQU), rig (SPO), tarakihi (TAR), and rough skate (RSK).

3.2 South Island changes in fish distribution

Several stocks showed an increase in occurrence in catches off the west coast South Island that would be consistent with a southward redistribution of fish stocks. These included frostfish (FRO), John dory (JDO), snapper (SNA), kahawai (KAH), and possibly trevally (TRE). Some of these potential increases were also well-supported by research trawl survey biomass estimates (MacGibbon 2019); in research surveys, frostfish (FRO) biomass has increased about 40-fold since the early 1990s and roughly doubled over the last two decades; John dory (JDO) had increased two or three-fold since the early 1990s; snapper (SNA) had increased about 10-fold since 2011.

Several stocks showed an increase in occurrence off the east coast South Island. These included moki (MOK), elephantfish (ELE), John dory (JDO), kahawai (KAH), silver warehou (SWA), and leatherjacket (LEA). Increases in John dory and leatherjacket would be consistent with a southward redistribution of fish stocks. Research trawl survey biomass estimates (MacGibbon et al. 2019) showed an increase for elephantfish (ELE) and silver warehou (SWA), but biomass increases in red gurnard (GUR) and rough skate (RSK), for example, were not reflected in species occurrence changes from commercial catches. This may be because these species were relatively ubiquitous, such that an increase in biomass is due to increases in abundance (i.e., occurrence is effectively saturated).

Lookdown dory (LDO) and silver warehou (SWA) showed increases on Chatham Rise, including a notable increase in occurrence towards the east. Trawl survey biomass estimates (Stevens et al. 2018) showed lookdown dory (LDO) increasing since 2011, and silver warehou (SWA) biomass was higher in recent years but with poorly estimated (high CVs). Gemfish (SKI) seemed to have increased everywhere. Southern blue whiting (SBW) appeared to have increased around the Auckland Islands.

3.3 Issues with the data

As the study progressed, it became clear that changes in catch reporting, and the reporting process, precluded strong conclusions. Some patterns, for example an increased occurrence of arrow squid around the North Island, seemed more likely to be an artefact from reporting rather than a true distributional change. Therefore, it was found that the historical commercial catch and effort data had limited value for measuring fish stock distributional changes. To better separate potential environmentally driven distributional shifts from other factors such as catch limits or gear patterns would require more detailed analyses than presented here. The focus here was to look for broad-scale changes across multiple species, to lead into subsequent cause and effect analyses (see Introduction). The use of commercial catch and effort data as indicators of fish distribution was therefore compromised by temporal and spatial variability and trends in the way fishing took place and was reported. The issues can be summarised as:

Data limitations

- Date of entry into the QMS influences catch reporting. Whilst landings of QMS species must be reported, the date when the species entered the QMS is variable. An increase in species catch rate or occurrence after the species entered the QMS is more likely an influence of mandatory catch reporting than any population change. The plenary document should be consulted for details on when each species entered the QMS (Fisheries New Zealand 2021).
- Limited reporting possible on event-based forms. The number of species that could be reported on an event-based form was initially the top five (by weight), then this increased to eight species from 2007–08, with offshore vessels asked to report eight species (the top five QMS species and the top three non-QMS species). An increase in reports of a bycatch species after the mid-2000s may therefore be a consequence of more species being reported, not fish occurrence or abundance.
- Changes in usage of event-level forms (more widely used from 2007–08). Prior to the mid-2000s most inshore vessels reported catch and effort as daily summaries. These forms allowed the top five species caught per day to be recorded, with all QMS species only reported for the trip landings. After the event-based forms were introduced, which varied by location and time, the probability of a bycatch species being recorded increased, because it was more likely for a bycatch species to appear once across, for example, five event forms than in a daily summary. Analyses of catch per unit effort (CPUE) that span the change in forms are required to 'roll-up' the data from 2007–08 into a daily summary equivalent form, effectively 'dumbing down' the data from 2007–08 onwards (Starr 2007).
- The recent change to an Electronic Reporting System is also likely to have an influence on catch reporting.
- Because data come from commercial fishing, there will be changes in the spatial and temporal coverage, and modifications to the fishing method or fisher behaviour. These biases are well known, and standardised catch per unit effort analyses are routinely conducted which attempt to correct for some of these covariates. An increase in species catch may therefore be a result of improved fishing methods, or fine-scale changes in place and time fished. These potential biases may be lower for species occurrence than abundance (i.e., new technology may affect whether a species is caught less than how much is caught).

Confounded data

- There are several species that are reported as mixed-species groups. For example, flatfish (FLA), sea perch (SPE), arrow squid (SQU), and jack mackerels (JMA).
- There are some species where it is not clear if species are confounded. An example is spiny dogfish (SPD), where the QMS species *Squalus acanthias* may well be confounded with the warmer-water congener *S. griffini*.
- There are a few cases where species codes have changed. In others, species identification may be unreliable. In others, both may occur. An example is Pacific bluefin tuna, where the code changed

from NTU to TOR, and there was potential confounding of species, particularly in earlier (NTU) years.
- Fishing effort and catches may be confounded by management decisions. In particular, the influence of restrictive catch limits can encourage avoidance of a species, or an increased catch limit or reduced deemed value can encourage targeting of a species. An example where the catch limit was assumed to have modified catches and effort was bluenose (BNS; Dunn et al.2021).
- There is also confounding in the sense that changes in distribution may be a consequence of a fish population contracting or expanding in response to changes in fishing mortality, not in response to the environment. For example, the increase in occurrence of snapper (SNA) off the west coast South Island has been attributed to a stock rebuild following overfishing, not to a shift in overall stock distribution (Fisheries New Zealand 2021).

Limited environmental data
- Analyses were restricted by the lack of paired catch and environmental data from the commercial fishing fleet.

Consequently, readers are encouraged to be cautious and consider the results in light of the above potential biases, and alongside other sources, in particular the plenary report (Fisheries New Zealand 2021).

3.4 Bottom water temperature ranges

Research trawl catches provided information on species distribution by location, depth, and temperature. Each survey series sampled specific areas and seasons, giving a snapshot of species occurrence at that place and time, but none covered the entire environmental range over which the species might occur. An estimate of the range of bottom temperature over which each species occurred was therefore made by eye, synthesising over the available survey data. The estimates of species bottom temperature range are given in Table 2. Species towards the top of the table may be more at risk from warming water temperatures, and include deepwater species such as oreos (WOE, BOE, SSO) and orange roughy (ORH). For these species, the relatively cold-water temperatures were those associated with great depth (> 800 m), where environmental conditions may be relatively stable and temperature less influenced by climate change. The relatively cold-water species dark ghost shark (GSH) and white warehou (WWA) have potentially increased in occurrence off the west coast South Island and in the Subantarctic (see Sections 23 and 60, respectively). The shallower-water species with colder temperature ranges included moki (MOK) and kahawai (KAH), both of which were noted to have increased in occurrence around the South Island (Section 3.2). The data for the relatively shallow and (apparently) cool-water species trumpeter (TRU) and red snapper (RSN) were sparse, and the estimated temperature ranges were therefore not reliable. Data were also sparse for several other species, including for example grey mullet (GMU), sprat (SPR), and southern Ray's bream (SRB). Species towards the bottom of Table 2 were associated with relatively warm temperatures, and they might therefore benefit from climate change. These include snapper (SNA), John dory (JDO), jack mackerel (JMN), yellowbelly flounder (YBF), and anchovy (ANC). A potential increase in occurrence of snapper and John dory around the South Island was identified in Section 3.2.

Table 2: Summary of species (codes see Table 1) bottom water temperature range (°C) of occurrence synthesised (by eye) across the available research trawl survey data (see Sections 7–62). Ordered by ascending upper temperature bound. Light grey shaded cells indicate distribution likely extends to temperatures below/above.

Species		Temperature (°C)																				
code	Range	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
WOE	3–7																					
BOE	<3–8																					
SSO	<3–8																					
ORH	<3–9																					
GSP	3–10																					
RIB	4–10																					

Table 2 (cont.): Summary of species (codes see Table 1) bottom water temperature range (°C) of occurrence synthesised (by eye) across the available research trawl survey data (see Sections 7–62). Ordered by ascending upper temperature bound. Light grey shaded cells indicate distribution likely extends to temperatures below/above.

Species code	Range	Temperature (°C) 2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
SOR	4–10																					
SBW	5–10																					
EPT	6–10																					
BNS	7–11																					
BAS	6–12																					
WWA	6–12																					
BYS	7–12																					
SRB	11–12																					
LDO	5–13																					
TRU	6–13																					
SKI	6–14																					
RBY	10–14																					
RBT	5–15																					
GSH	6–15																					
MOK	7–15																					
BGZ	8–15																					
JMM	6–16																					
SSK	6–16																					
RSN	13–16																					
HOK	3–17																					
NOS	5–17																					
RBM	5–17																					
HAP	7–17																					
NOG	14–17																					
GIZ	6–18																					
JMD	8–18																					
KAH	8–18																					
FRO	8–18																					
GLF	10–18																					
TUR	11–18																					
BRI	11–18																					
POR	15–18																					
LIN	5–19																					
RSK	5–19																					
RCO	6–19																					
SPE	6–19																					
SWA	6–19																					
ELE	7–19																					
ESO	8–19																					
GUR	8–19																					
PAR	14–19																					
EMA	13–>19																					
HAK	3–20																					
SPD	5–20																					
TAR	6–20																					
SPO	8–20																					
LEA	10–20																					
SPR	10–20																					
PIL	11–20																					
YEM	11 – 20																					
TRE	12 – 20																					
GMU	18–20																					
BAR	<6–>20																					
BCO	6–>20																					
LSO	7–>20																					
SCH	8–>20																					
WAR	8–>20																					
SFL	8–>20																					
ANC	12–>20																					
YBF	12–>20																					
SNA	12–>20																					
JDO	12–>20																					
JMN	10–>21																					

4. DISCUSSION

Strong conclusions about fish redistribution around New Zealand are difficult to derive from the broad-scale analyses of commercial catch and effort data conducted here. Several species showed an increase in occurrence around the South Island that would be consistent with a poleward redistribution, including snapper, John dory, moki, leatherjacket, kahawai, frostfish, elephantfish, and possibly trevally. Increases in occurrence and/or abundance of some of these species, including John dory, snapper, leatherjacket, and elephantfish, have been substantiated by South Island research trawl biomass estimates and/or commercial fishery catch-per-unit-effort analyses (Fisheries New Zealand 2021).

However, factors other than climate change may also play a role in these redistributions, such as changes in fishing mortality or fishing practices. Fishing mortality may be a more important factor than climate change: Neubauer et al. (in press a,b) found that trends in average temperature and primary productivity consistent with those expected from climate change were expected to produce changes in stock productivity that were trivial compared with those expected from density dependence, i.e., caused by fishing reducing stock size. Some of the apparent spatial redistributions reported here might also be artefacts caused by changes in data collection (discussed further below). The data presented here might therefore be better suited to hypothesis generation than drawing conclusions about climate change impacts. For example, hypotheses include:

- Several warmer-water species that are familiar around the North Island will redistribute to the south and increase in occurrence and/or abundance around the South Island. In some species this has already started, e.g., snapper, John dory, leatherjacket.

- Some warmer-water species that are sub-tropical and infrequently seen around New Zealand will increase in occurrence and/or abundance around the North Island. These may include some QMS species, such as red snapper, and some species that have not yet been thought of as commercially important, and so were not included in the QMS, such as pink maomao (for other possible candidates see Middleton et al. 2021).

- Some species, for example those foraging on pelagic prey whose distribution is strongly influenced by oceanographic conditions, may redistribute or show increasing variability in distribution as oceanographic conditions become more variable (e.g., Salinger et al. 2019, Misra et al. 2021), e.g., silver warehou, southern blue whiting.

Moving beyond hypotheses requires information from detailed analyses of the specific species and fisheries, in particular, evaluating covariates (such as fishing mortality rate) that might equally explain the observations, allowing one to potentially partition the effects that contribute to perceived distribution shifts. The reader is therefore encouraged to refer to any available specific analyses for a given species before drawing conclusions (e.g., Fisheries New Zealand 2021). A limitation to current analyses is that the commercial catch and effort data earlier than 1989–90 are less reliable, due to data availability and changes in data reporting systems. Consistent commercial catch and effort data reporting are required to establish changes in catch and species distribution. Data reporting has not been consistent in the past, and it is unclear whether it will improve in the future. At the very least, active fisheries management within the QMS will, by definition, introduce restrictive catch limits for some species, which will likely change fishing behaviour. The research vessel surveys therefore provide a more consistent data source for evaluating changes in stocks, although are relatively limited in spatial and temporal coverage. The biomass trends estimated from surveys were not analysed here because they have previously been reported; the reader is referred to the relevant survey reports published following each survey (references can be found in Fisheries New Zealand 2021).

Targeted and more detailed studies of species and/or areas are required to attribute distributional changes to climate change. Such studies should attempt to partition the influence of climate from other factors such as density dependence and changes in data reporting. The summary of New Zealand fisheries research provided by Fisheries New Zealand (2021) shows that inclusion of environmental covariates in detailed analyses of research survey or commercial fisheries catch rates has, to date, been uncommon. The standard assumptions used in stock assessment models mean that changes in abundance actually caused by fish redistribution would most likely be attributed to temporal changes in within-stock reproduction; i.e., changes in year class strengths, these being the only time-varying parameters in most stock assessment models. Stock structure also remains poorly known for many species, with assumed stock structure and Quota Management Areas following the default Fishery Management Areas (anecdotally, this author believes these were derived from Ministry office locations and coverage, rather than any biogeographical consideration). Ideally, analyses of the evidence for changes in stock structure and distribution, and for the potential influence of environment, should be a routine objective of the tactical and detailed research projects used to advise on fish stock status (Fisheries New Zealand 2021).

5. ACKNOWLEDGEMENTS

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7. Alfonsino (Research, BYS; Commercial, BYX)

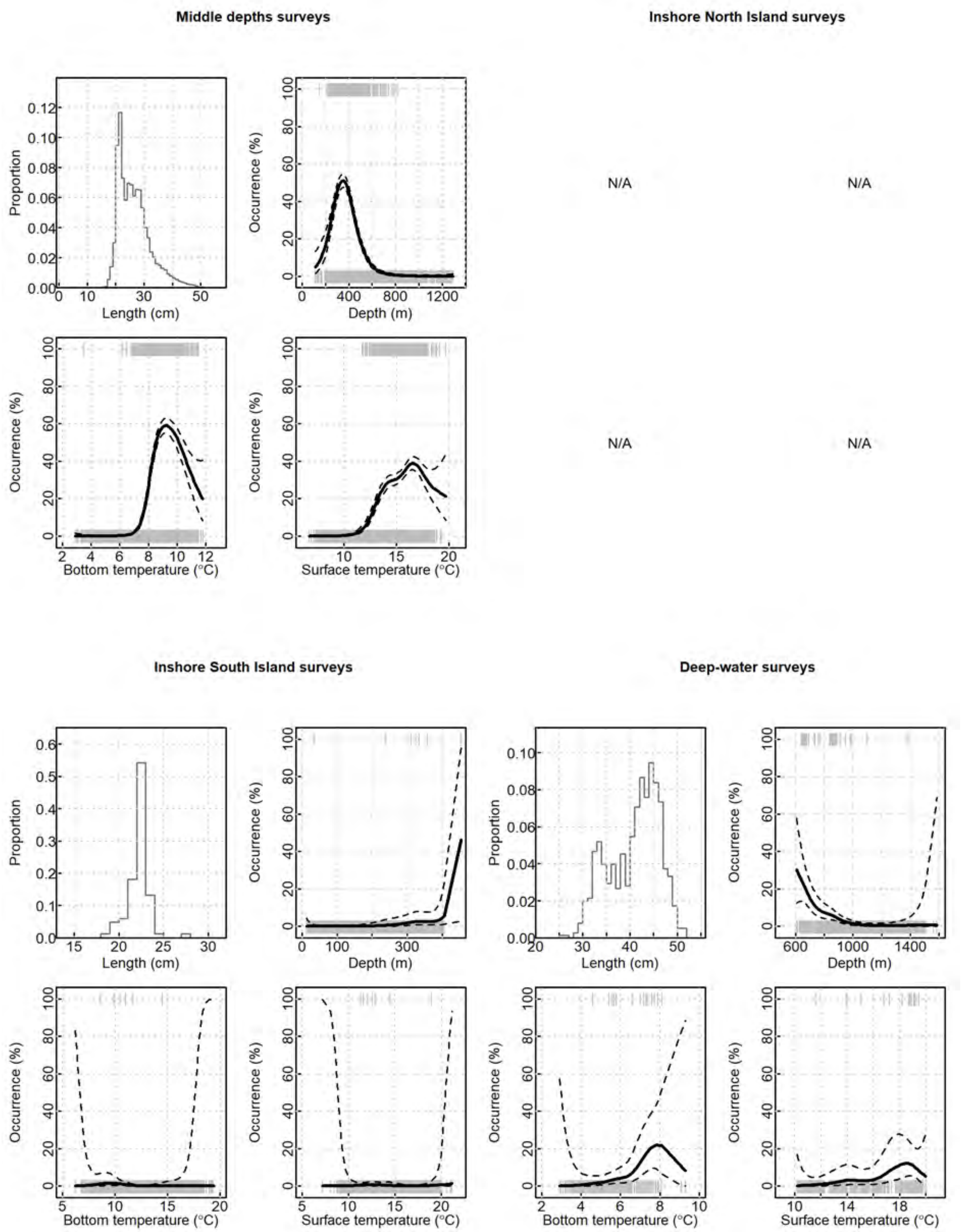


Figure 7.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to alfonsino occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

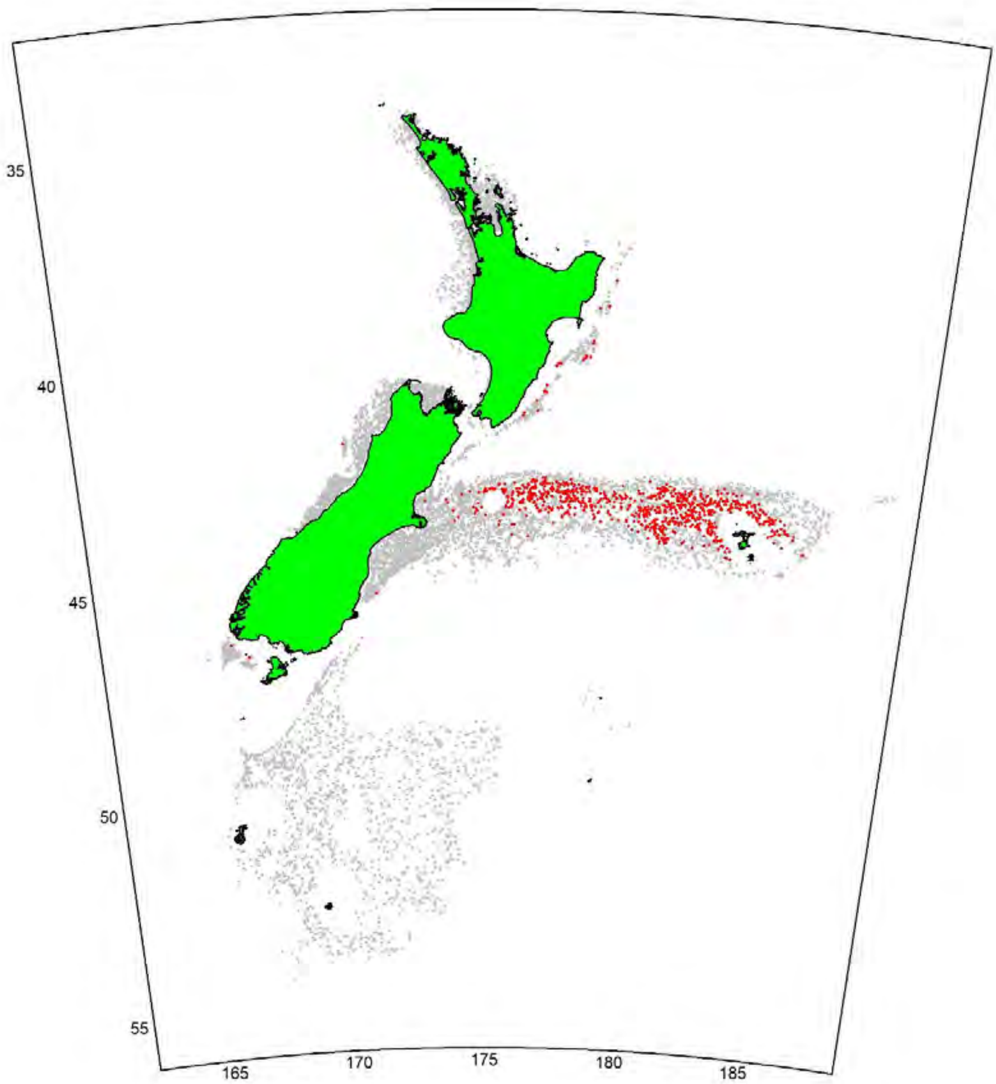


Figure 7.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where alfonsino was caught (red points).

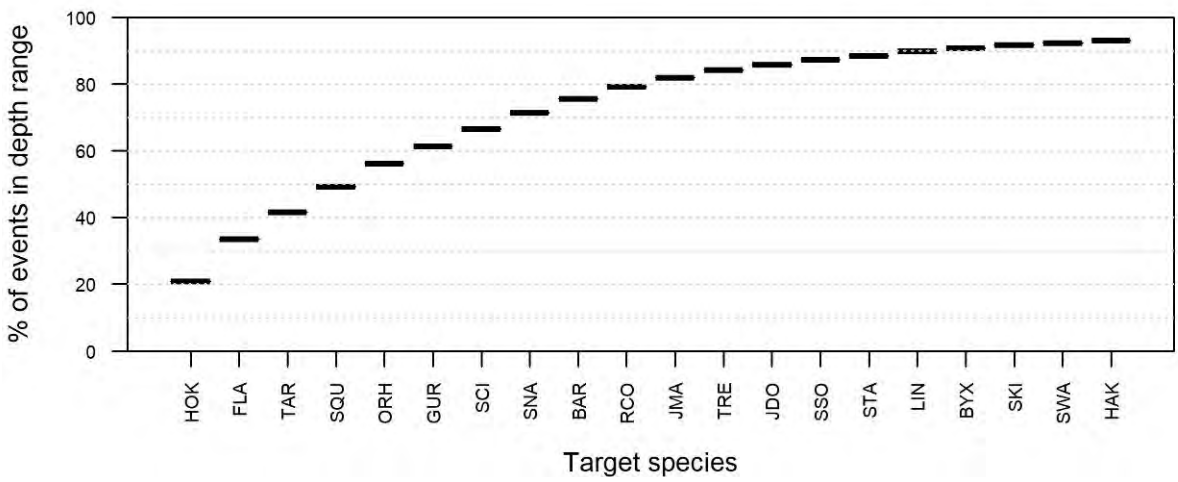


Figure 7.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for alfonsino (150–600 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.

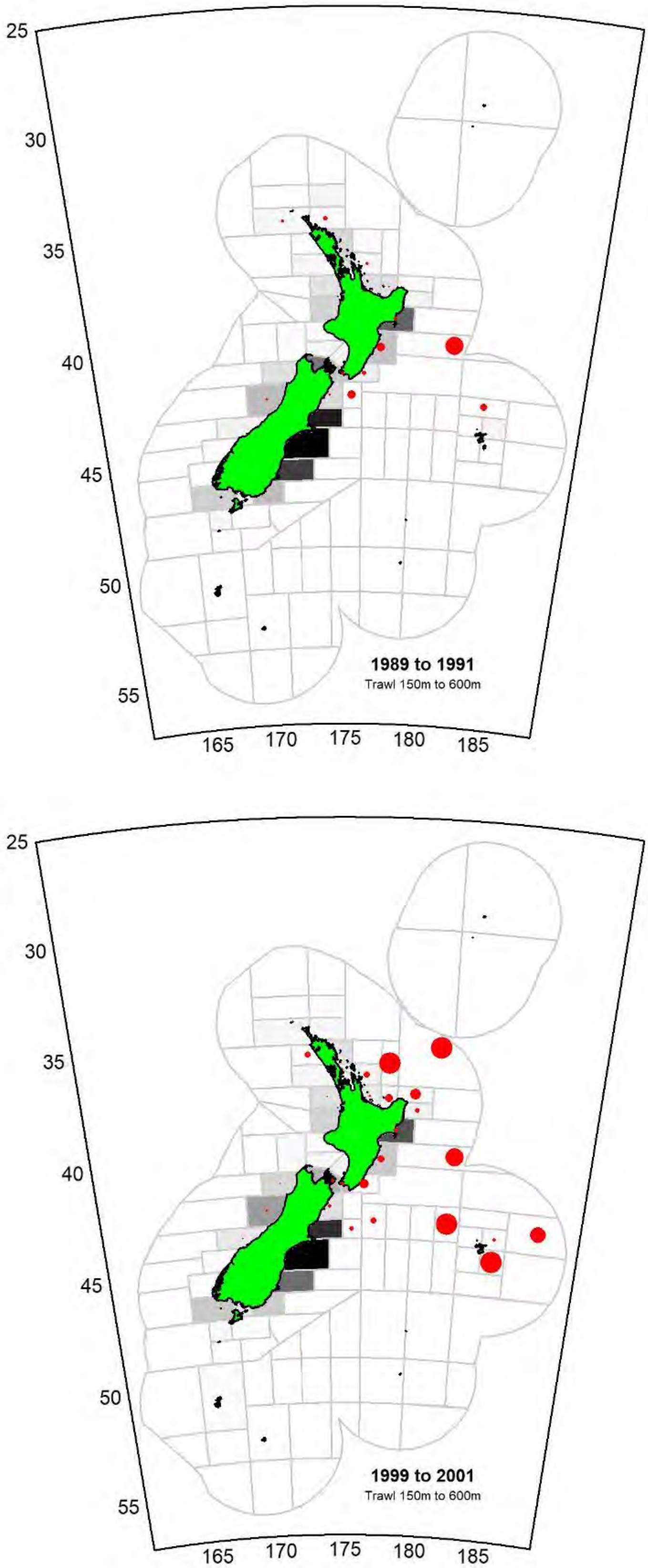
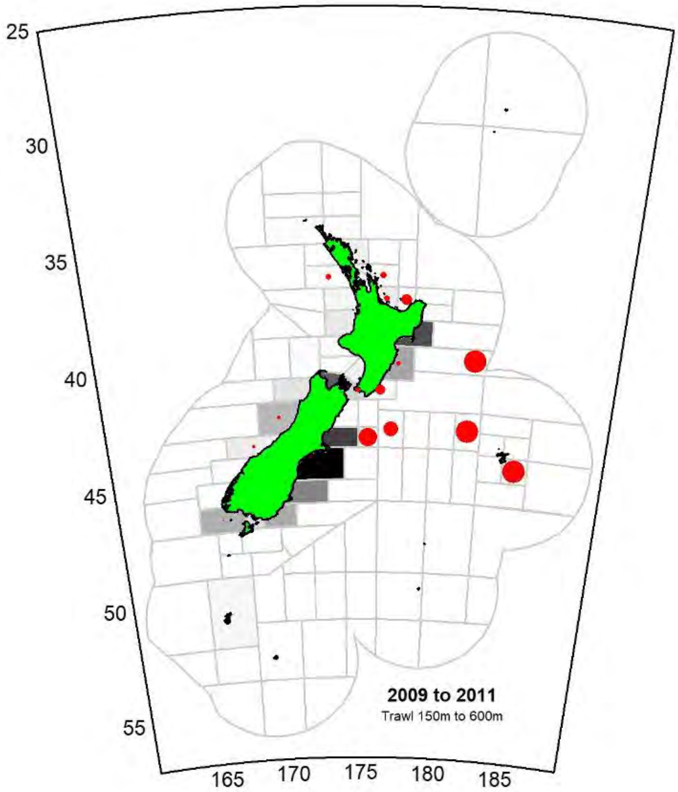


Figure 7.4: Maps of alfonsino occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



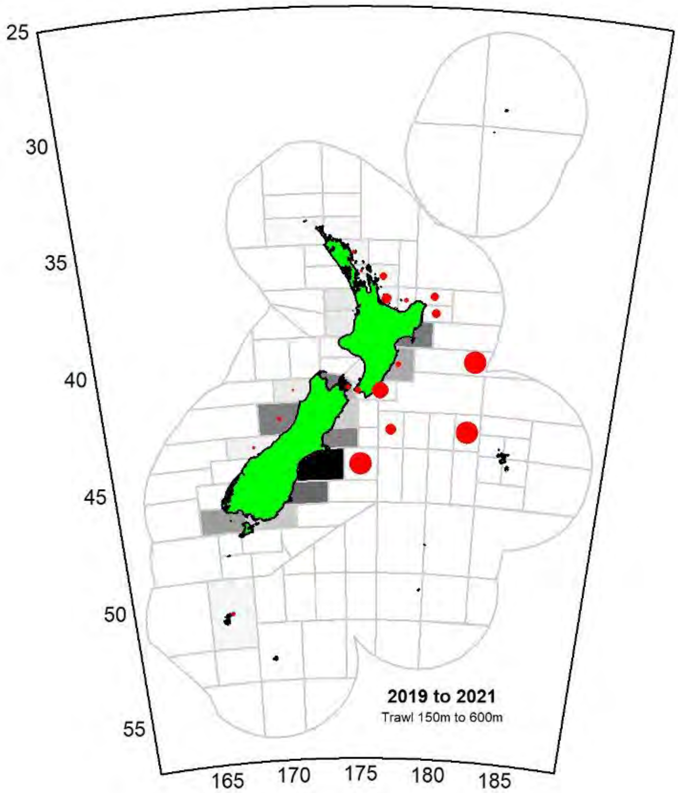


Figure 7.4 (cont.): Maps of alfonsino occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

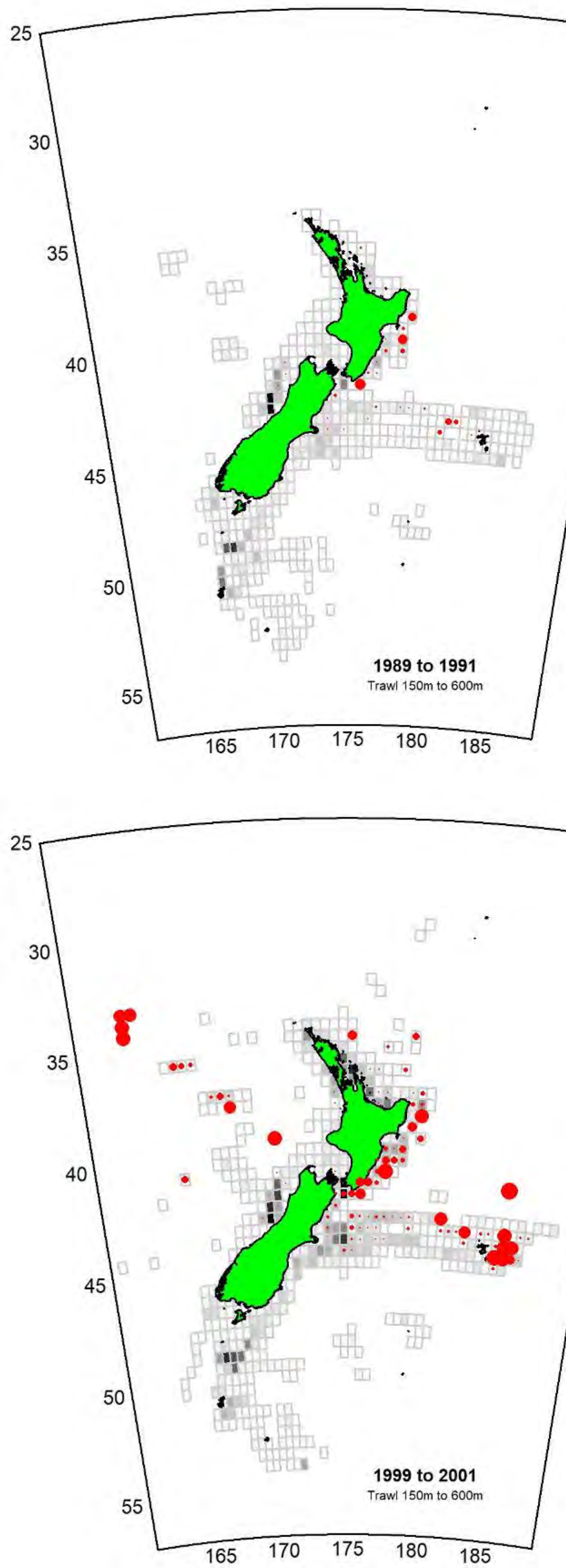
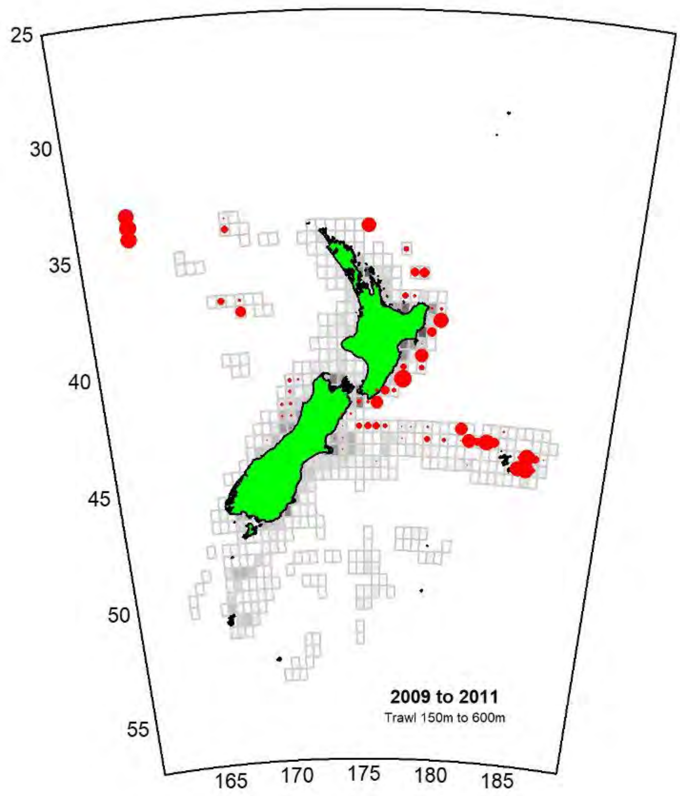


Figure 7.5: Maps of alfonsino occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



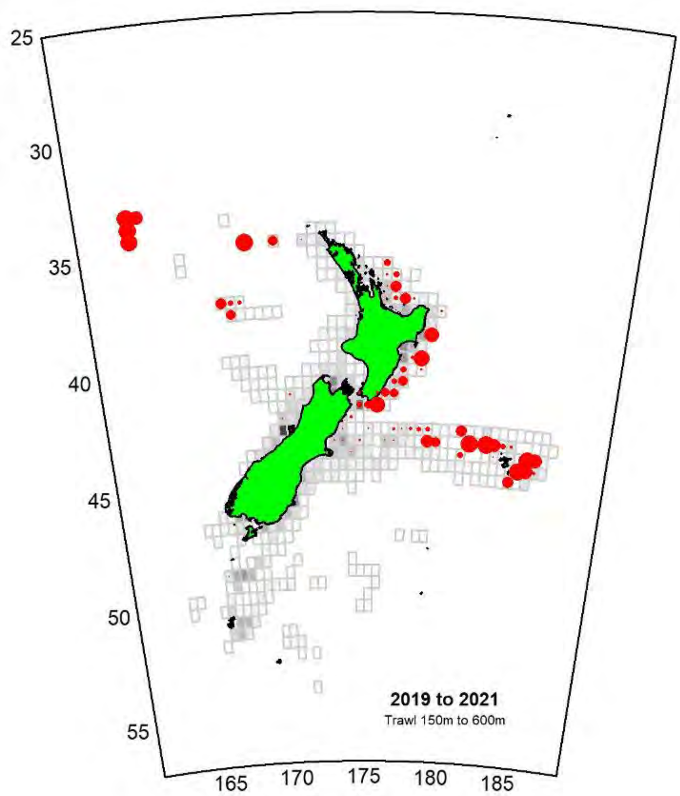


Figure 7.5 (cont.): Maps of alfonsino occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

8. Anchovy (ANC)

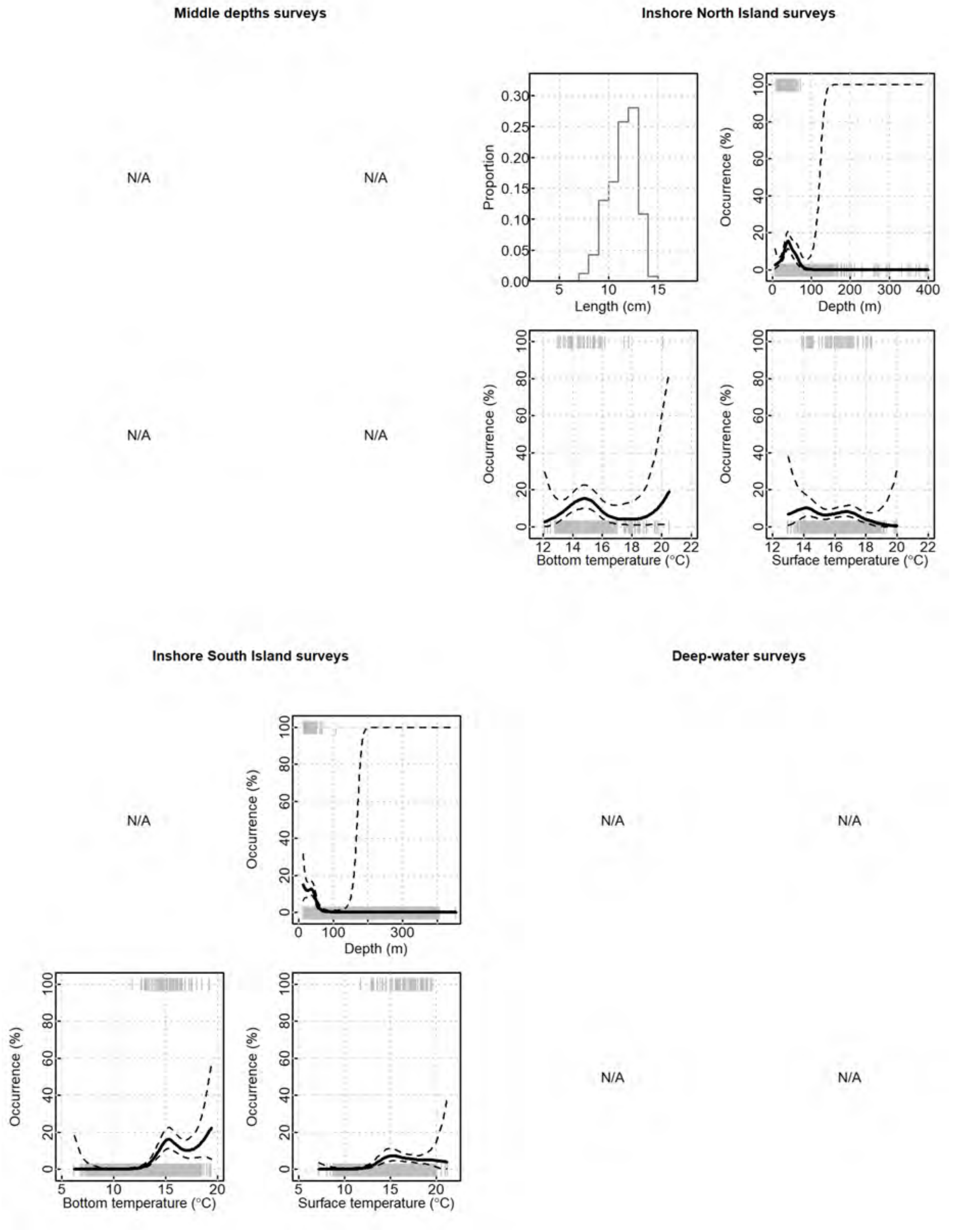


Figure 8.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to anchovy occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

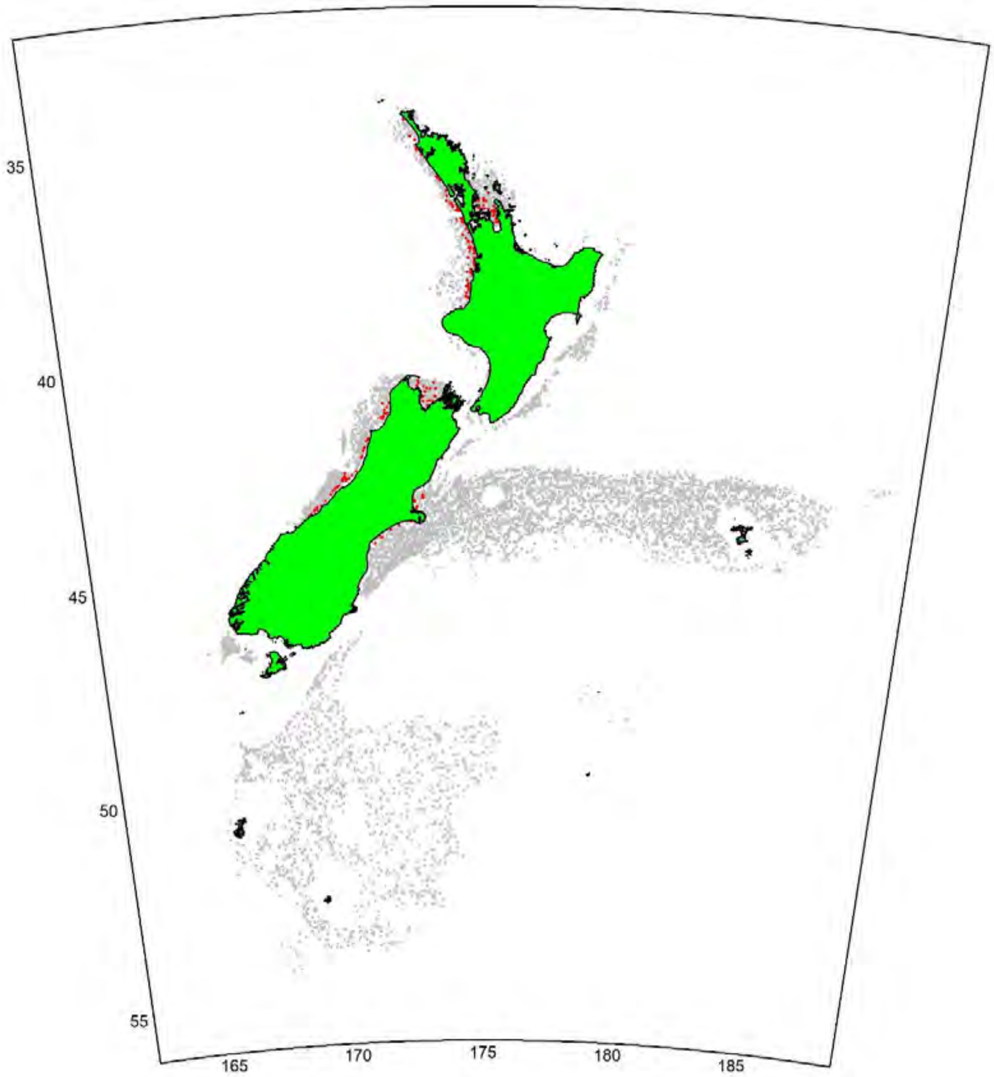


Figure 8.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where anchovy was caught (red points).

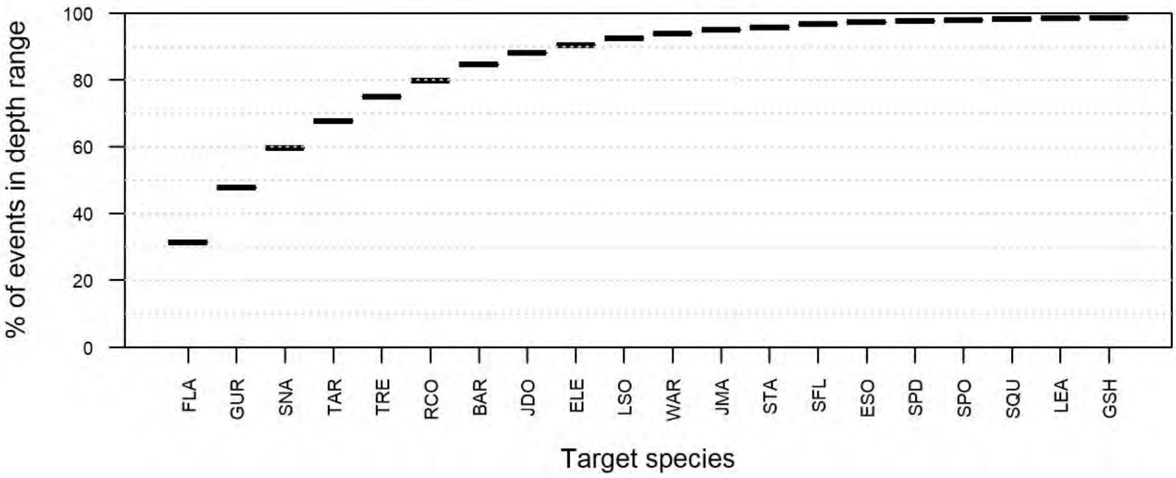
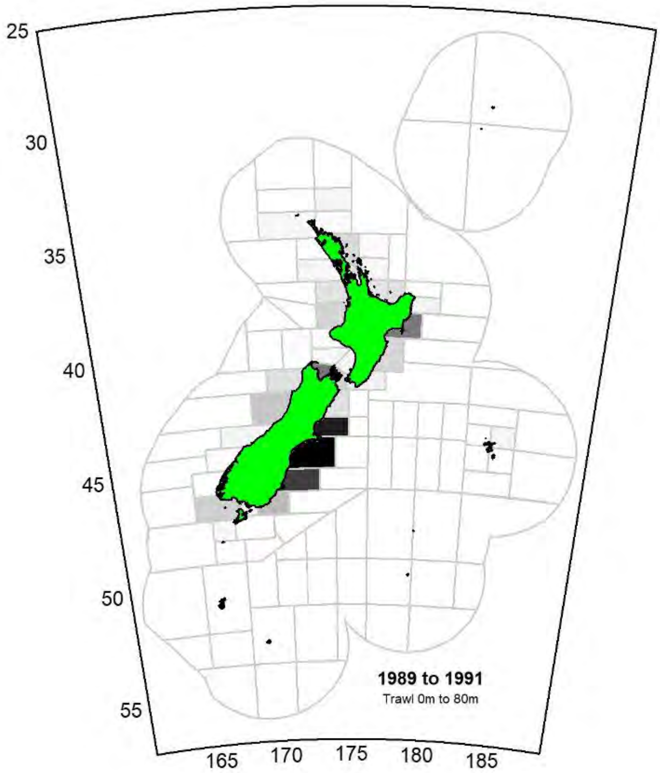


Figure 8.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for anchovy (0–80 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.



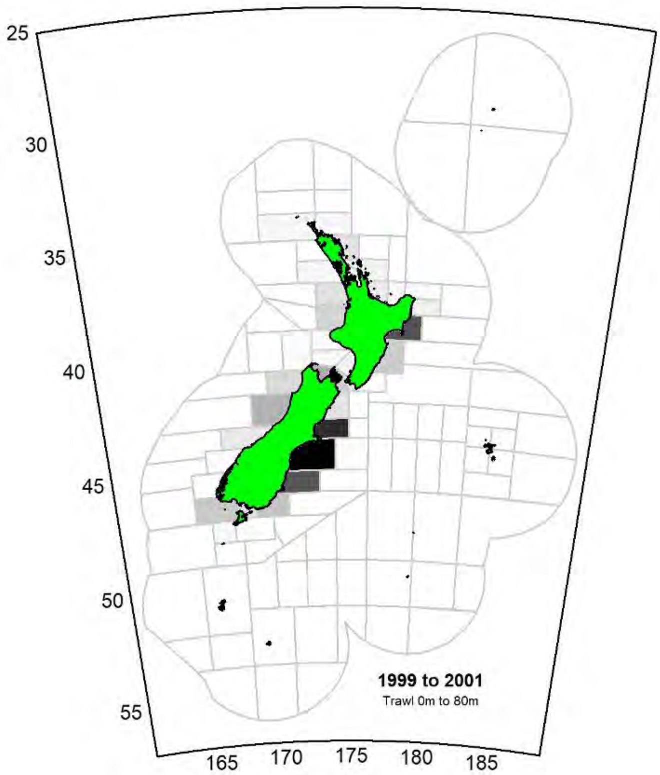
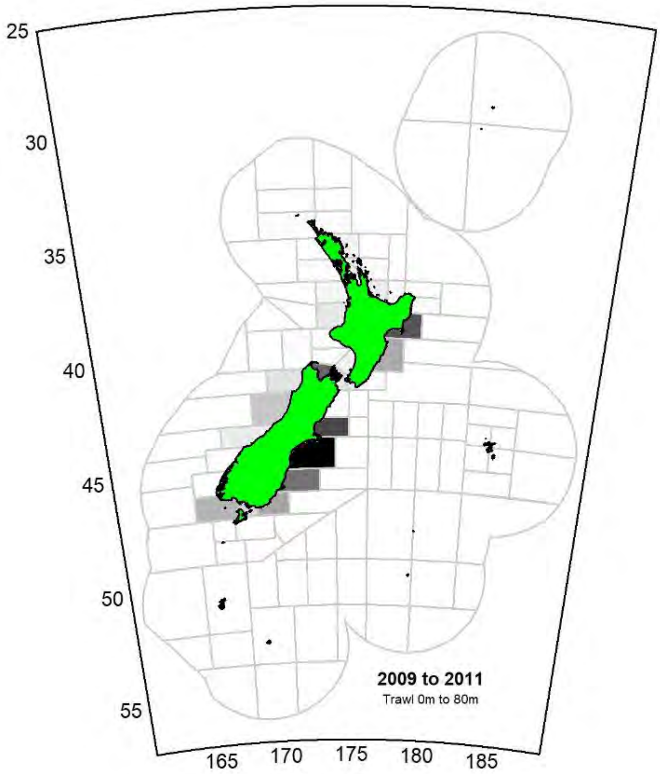


Figure 8.4: Maps of anchovy occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



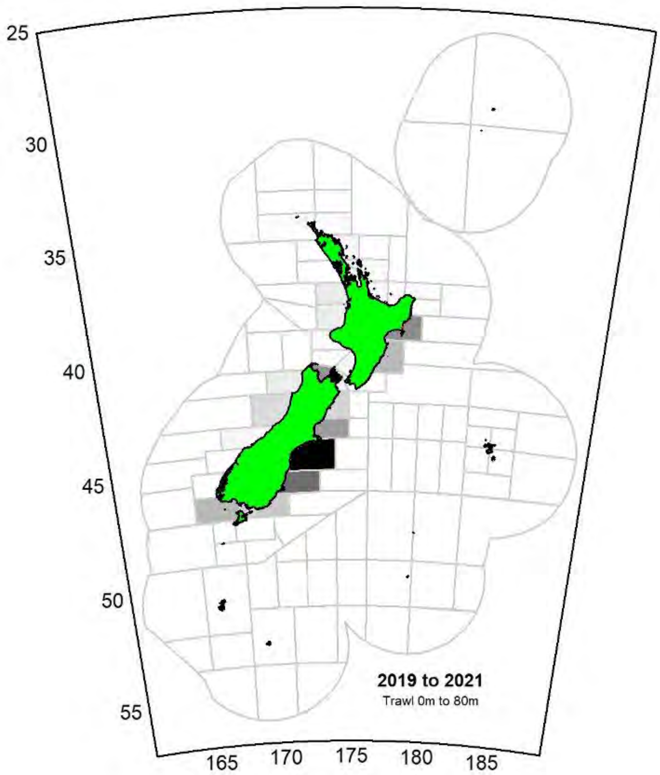


Figure 8.4 (cont.): Maps of anchovy occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

9. Arrow Squid (Research, NOS, NOG; Commercial, SQU)

Nototodarus gouldi

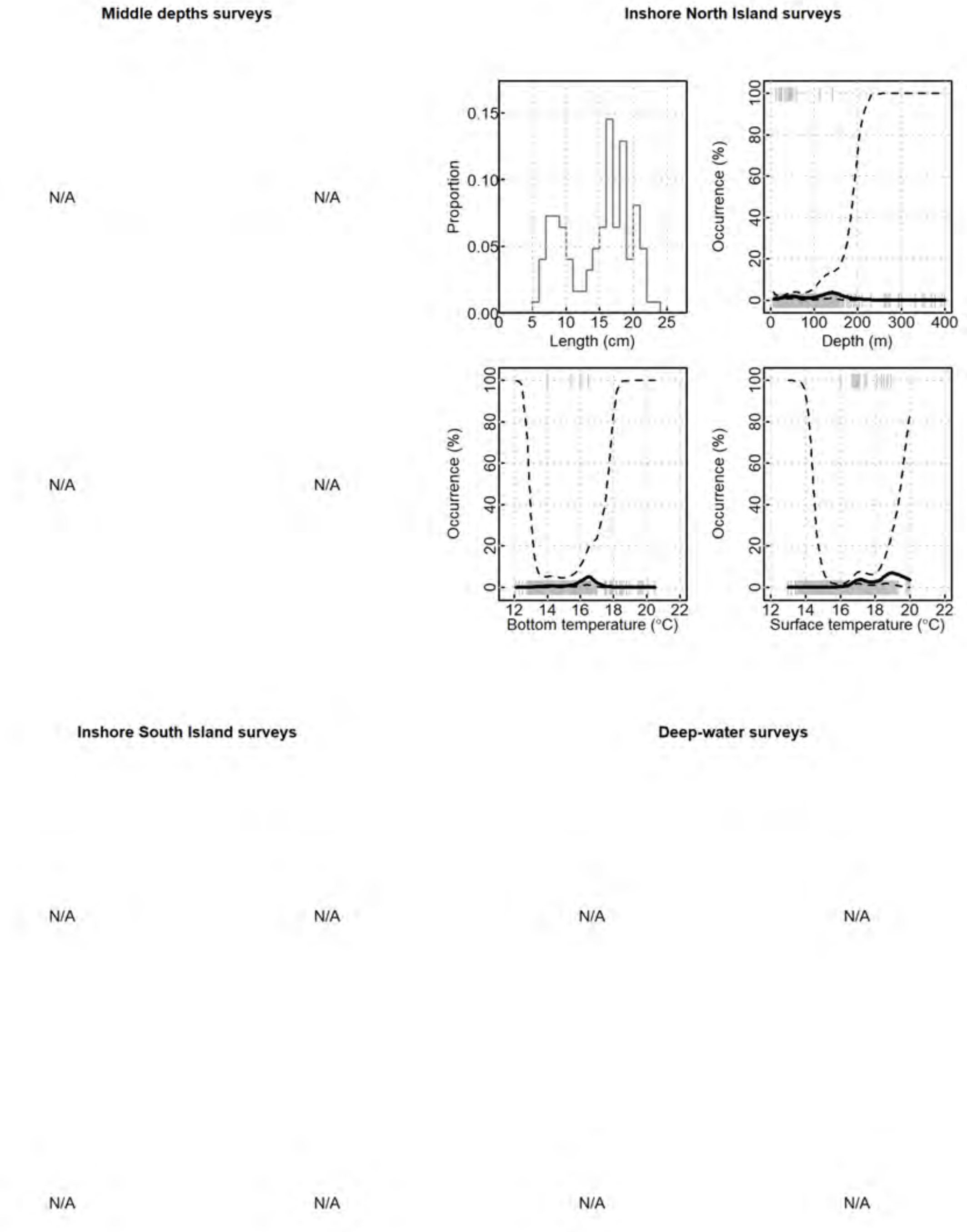


Figure 9.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to *Nototodarus gouldi* occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

Nototodarus gouldi

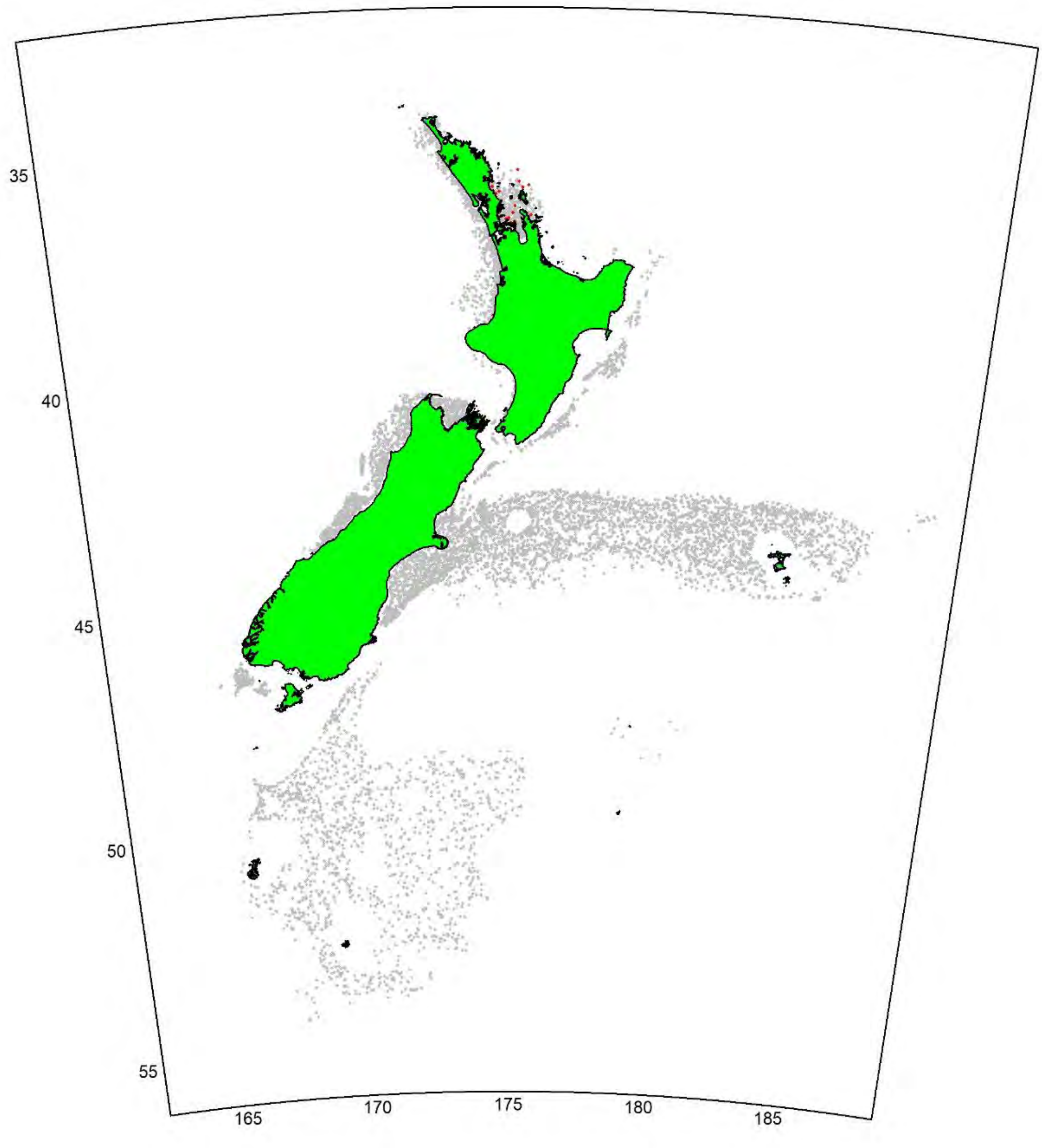


Figure 9.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where *Nototodarus gouldi* was caught (red points).

Nototodarus sloanii

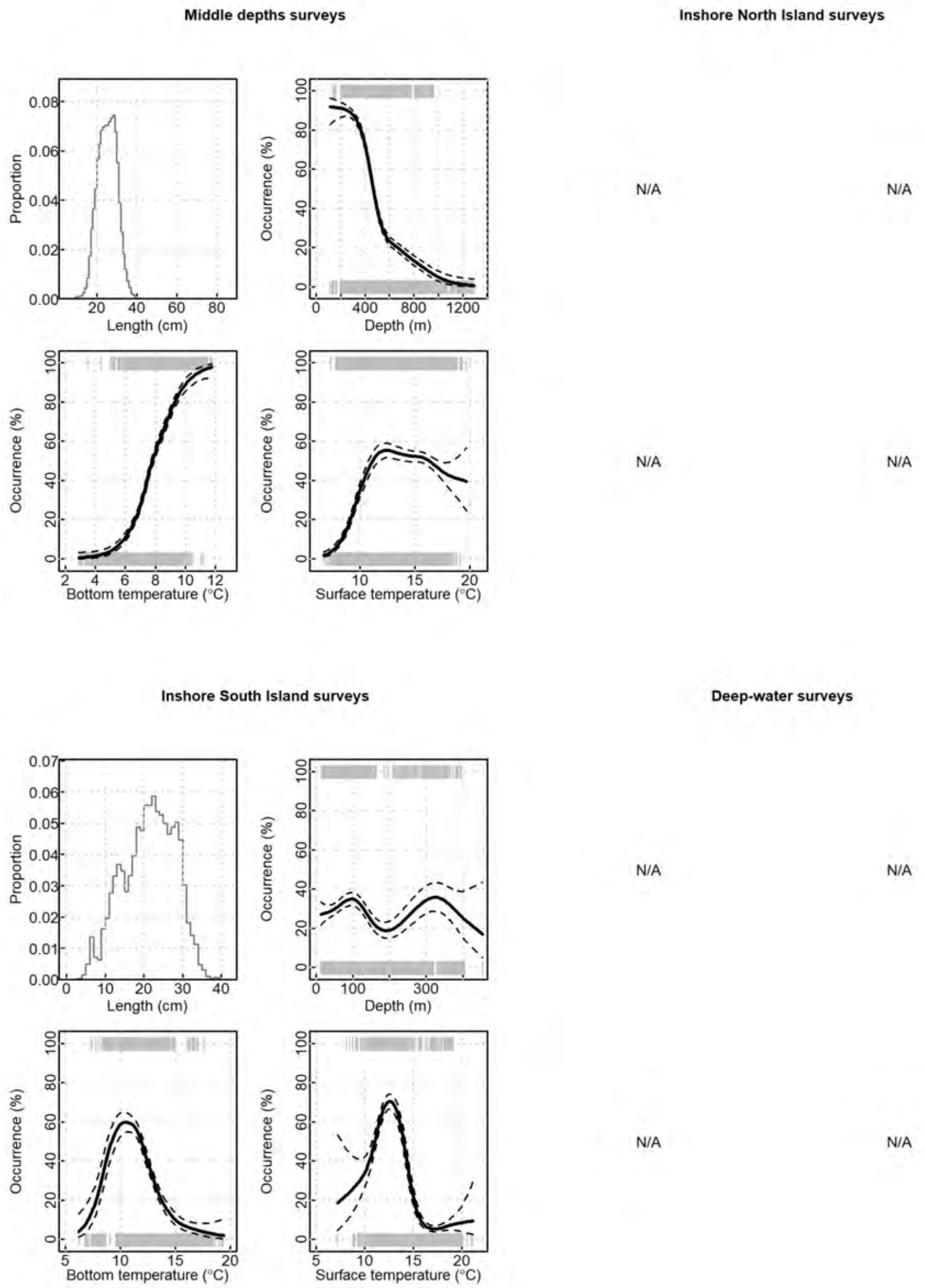


Figure 9.3: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to *Nototodarus sloanii* occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

Nototodarus sloanii

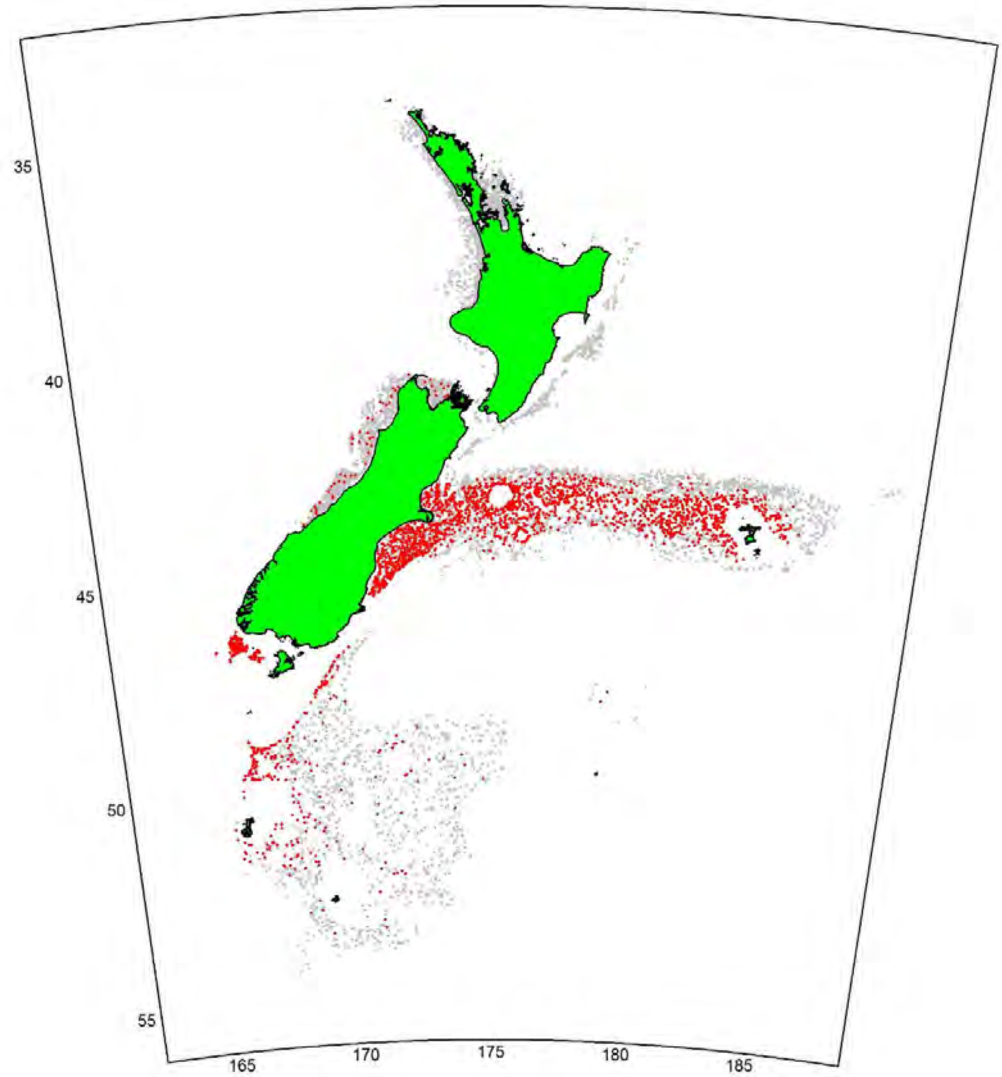


Figure 9.4: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where *Nototodarus sloanii* was caught (red points).

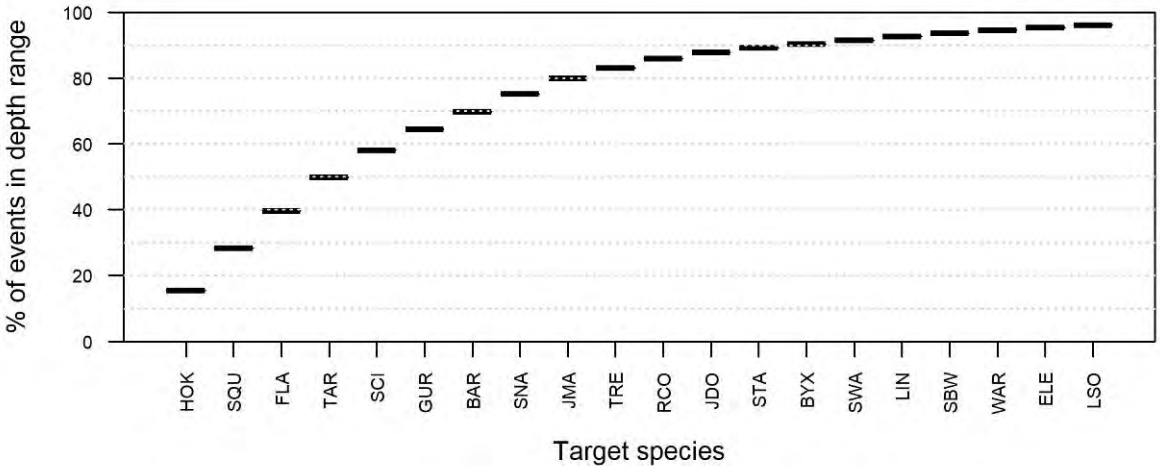
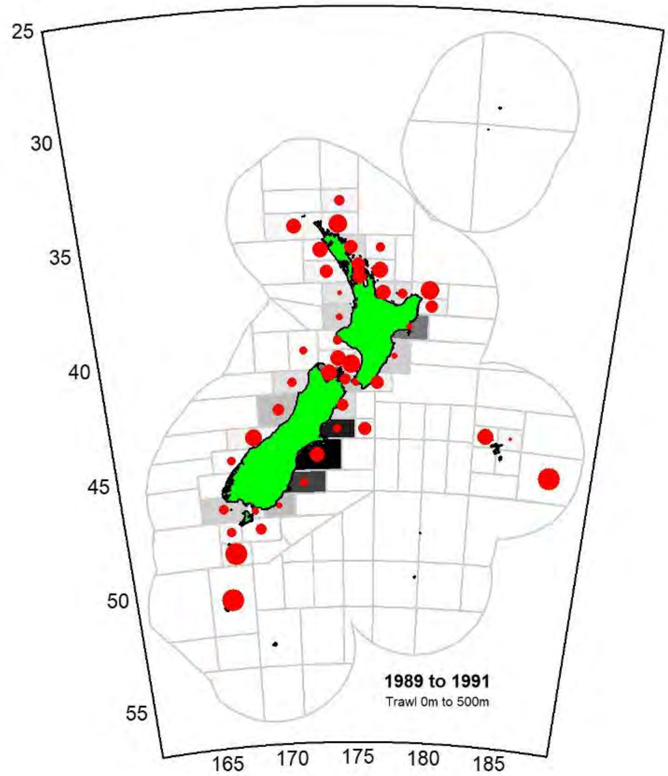


Figure 9.5: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for *Nototodarus* spp. (0–500 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.



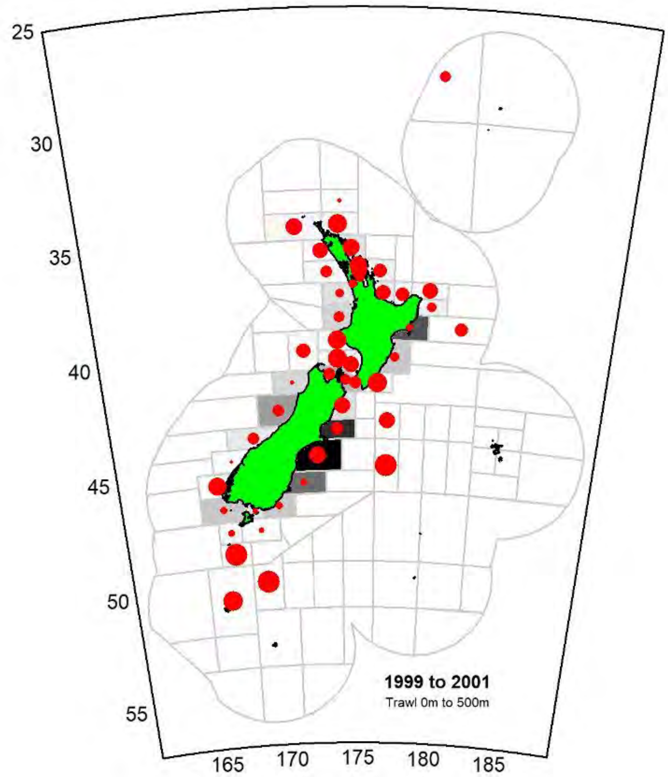
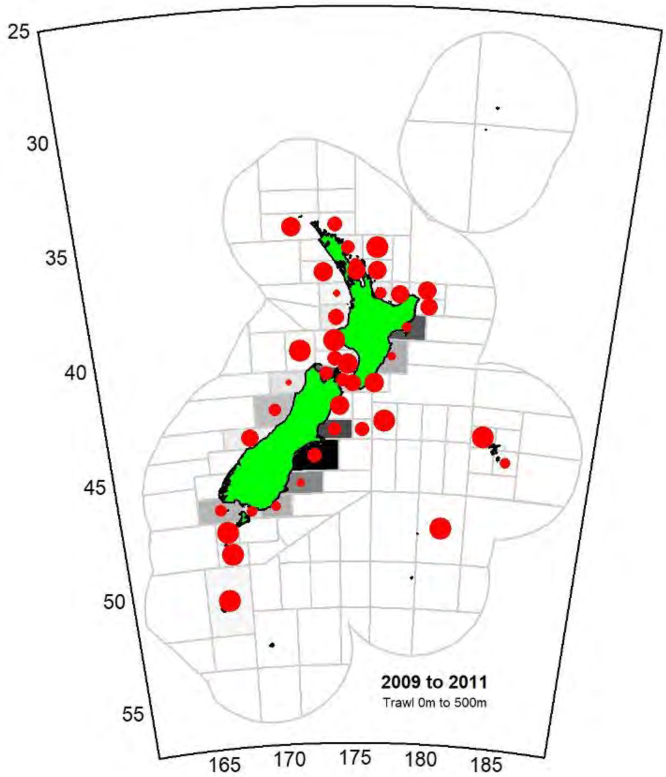


Figure 9.6: Maps of *Nototodarus* spp. occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



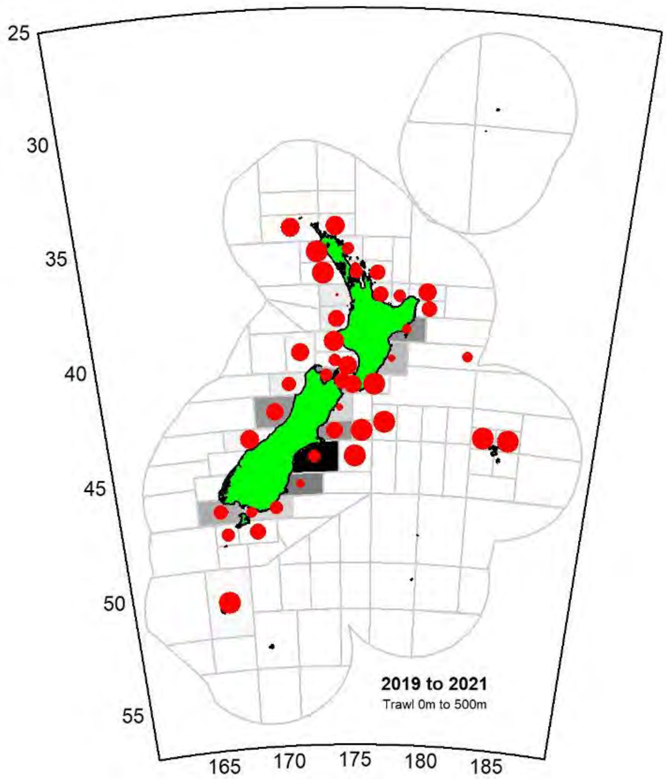


Figure 9.6 (cont.): Maps of *Nototodarus* spp. occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

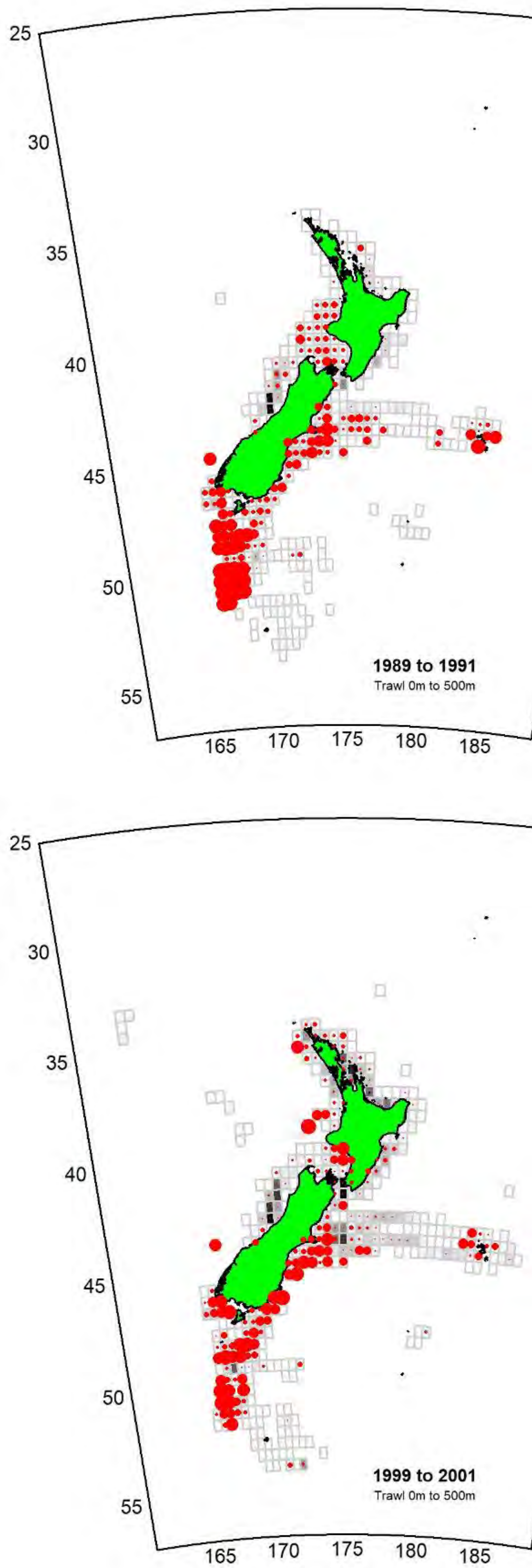
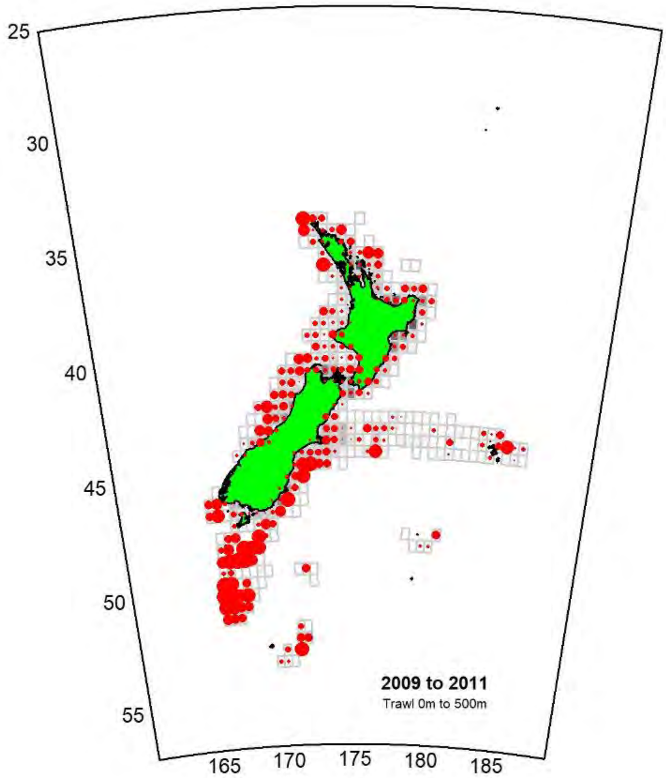


Figure 9.7: Maps of *Nototodarus* spp. occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



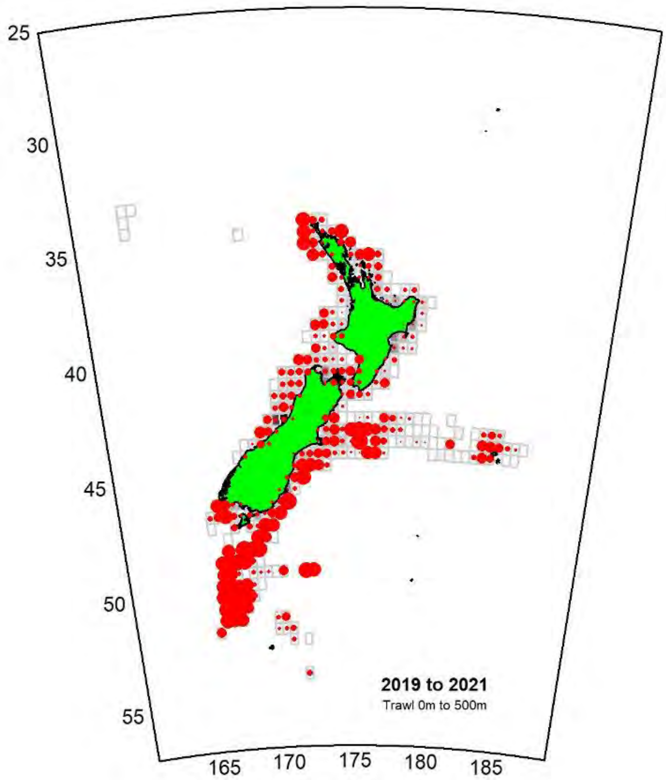


Figure 9.7 (cont.): Maps of *Nototodarus* spp. occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

10. Barracouta (BAR)

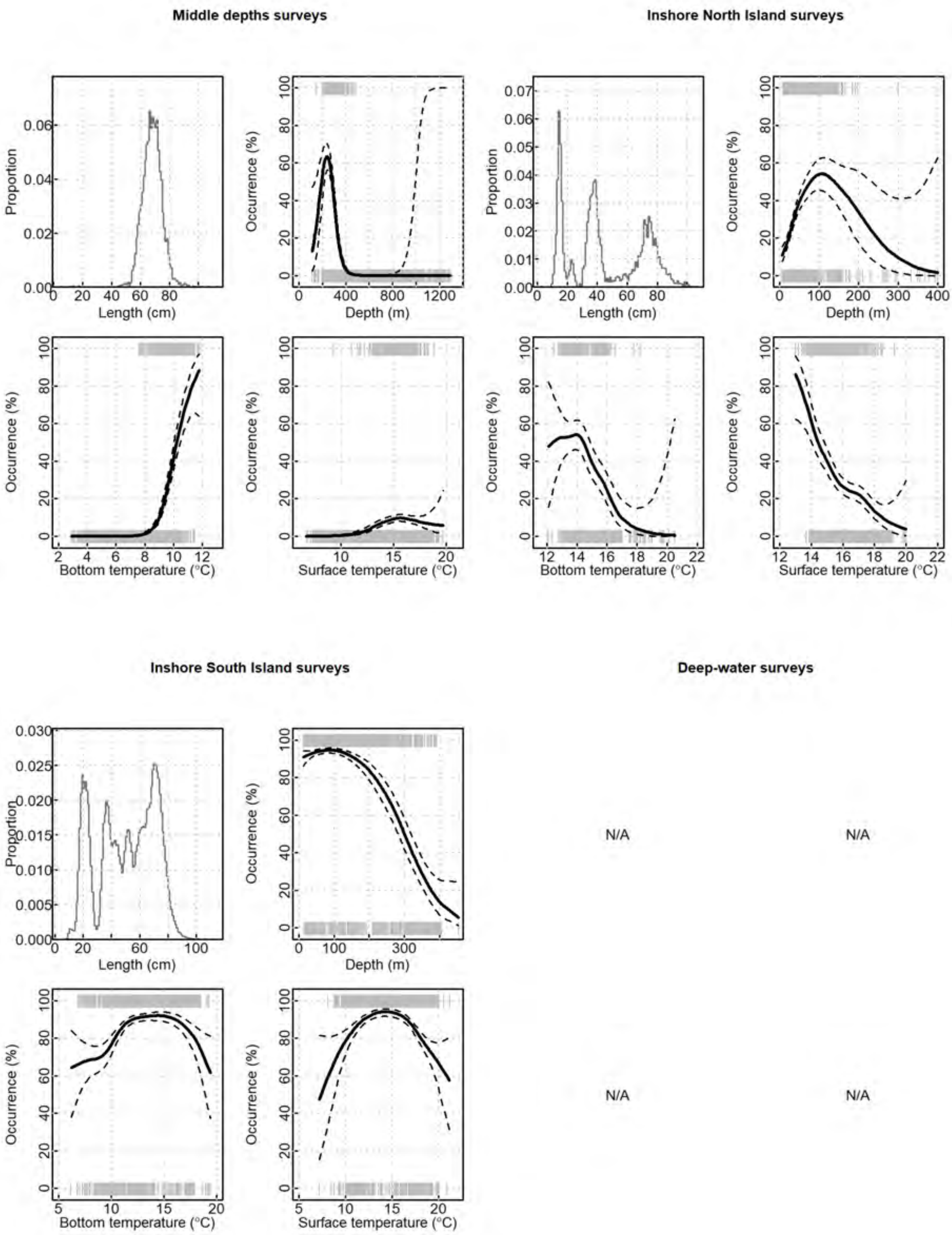


Figure 10.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to barracouta occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

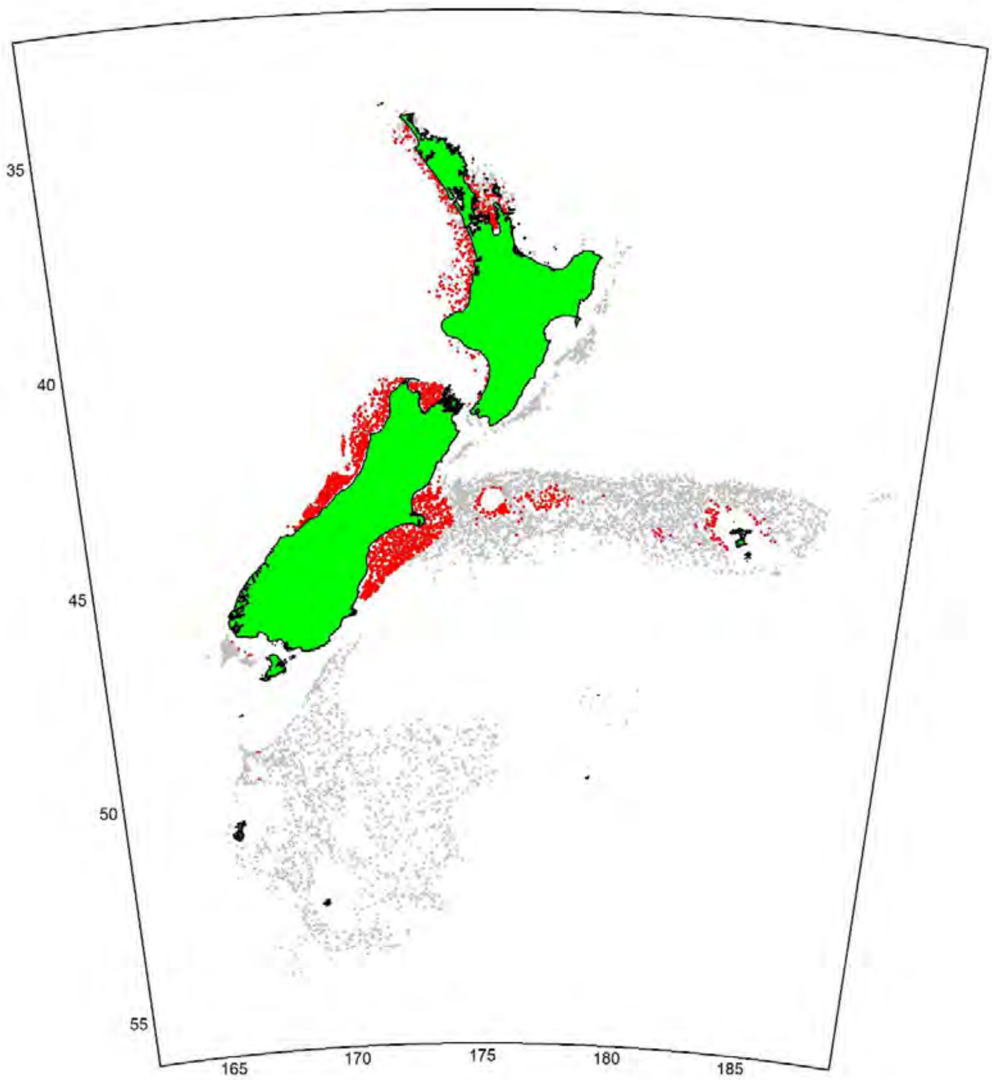


Figure 10.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where barracouta was caught (red points).

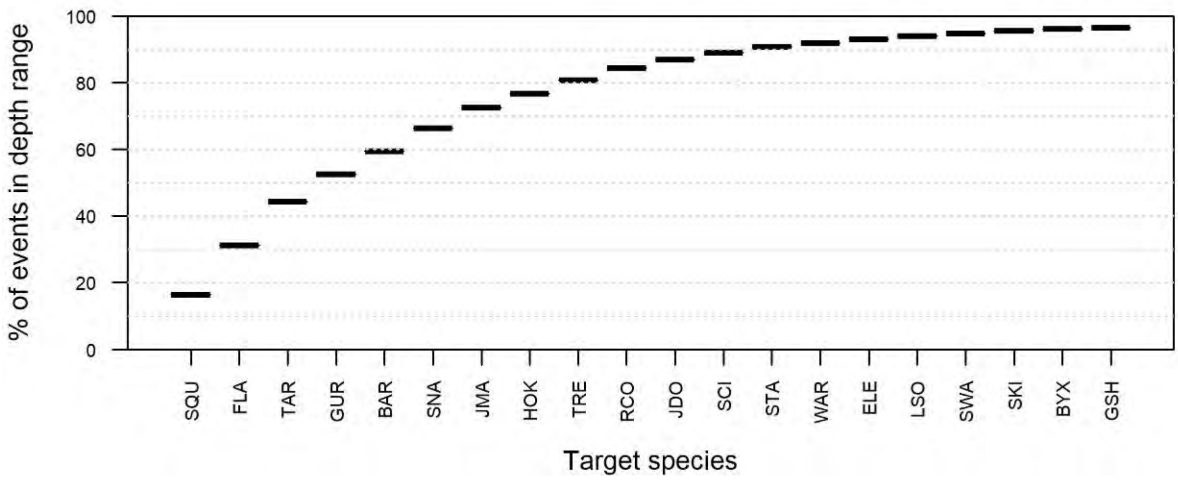
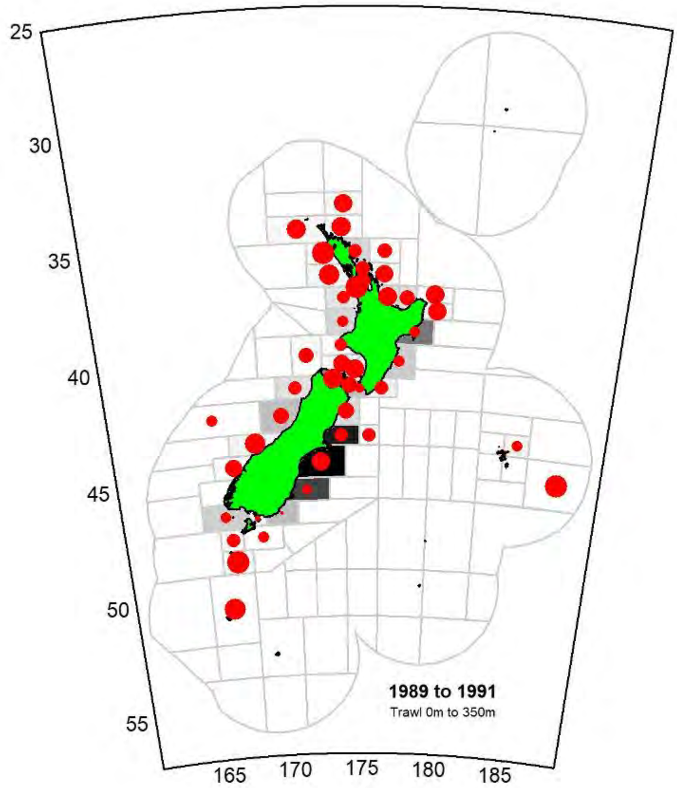


Figure 10.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for barracouta (0–350 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.



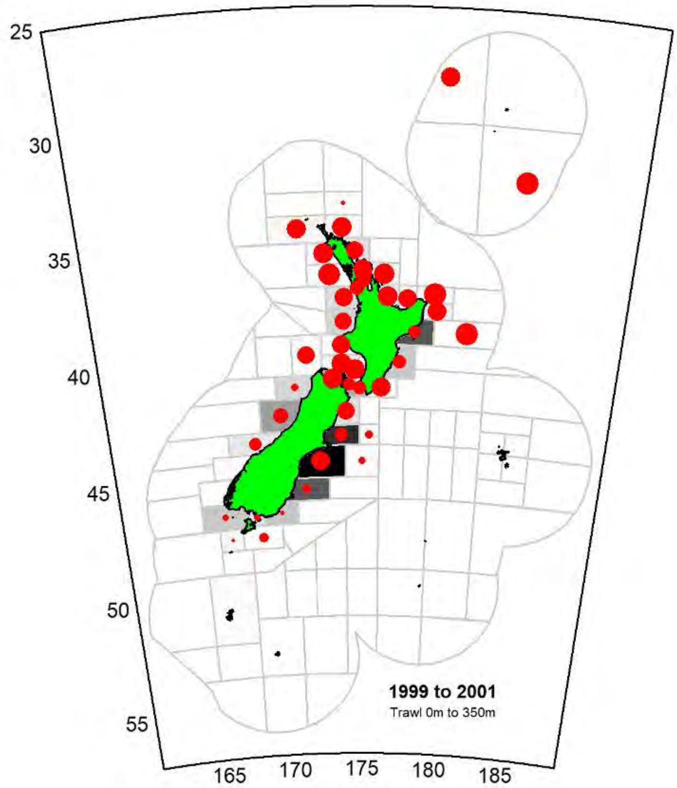
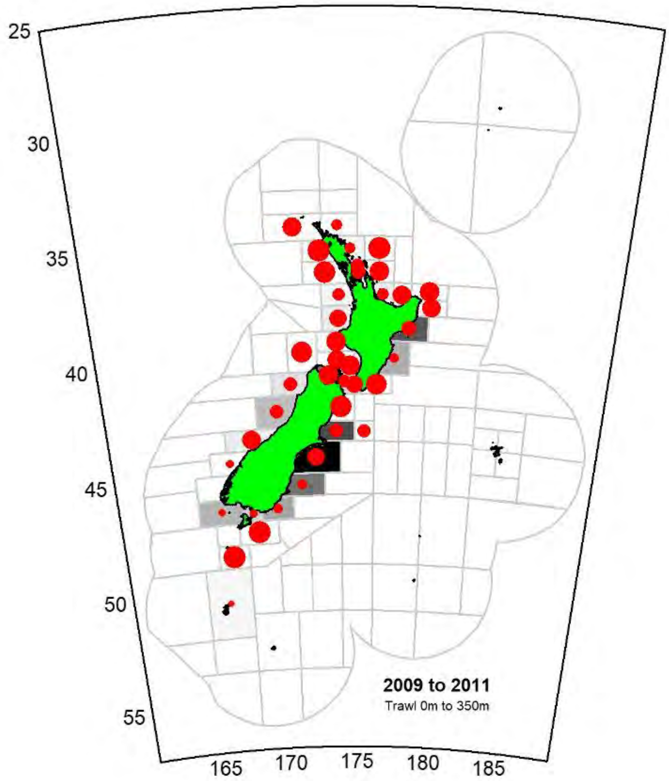


Figure 10.4: Maps of barracouta occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



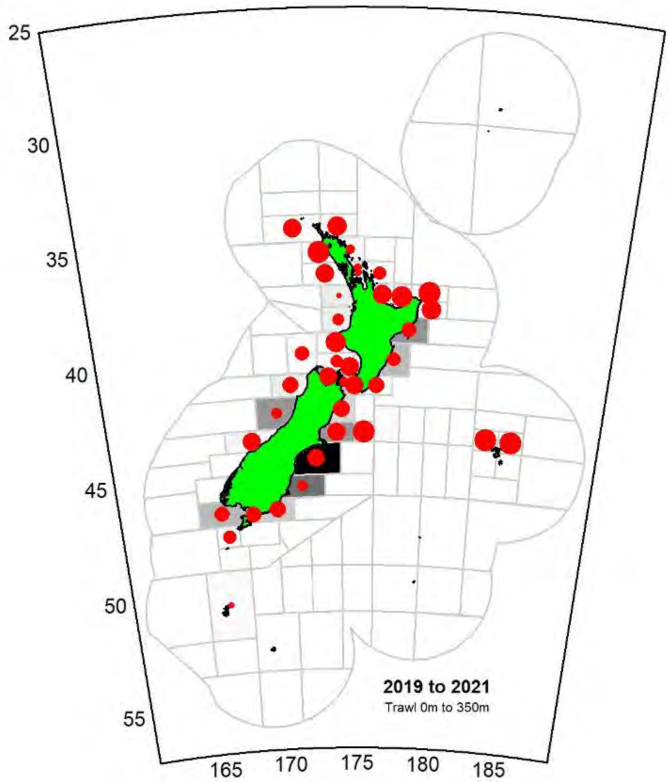


Figure 10.4 (cont.): Maps of barracouta occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

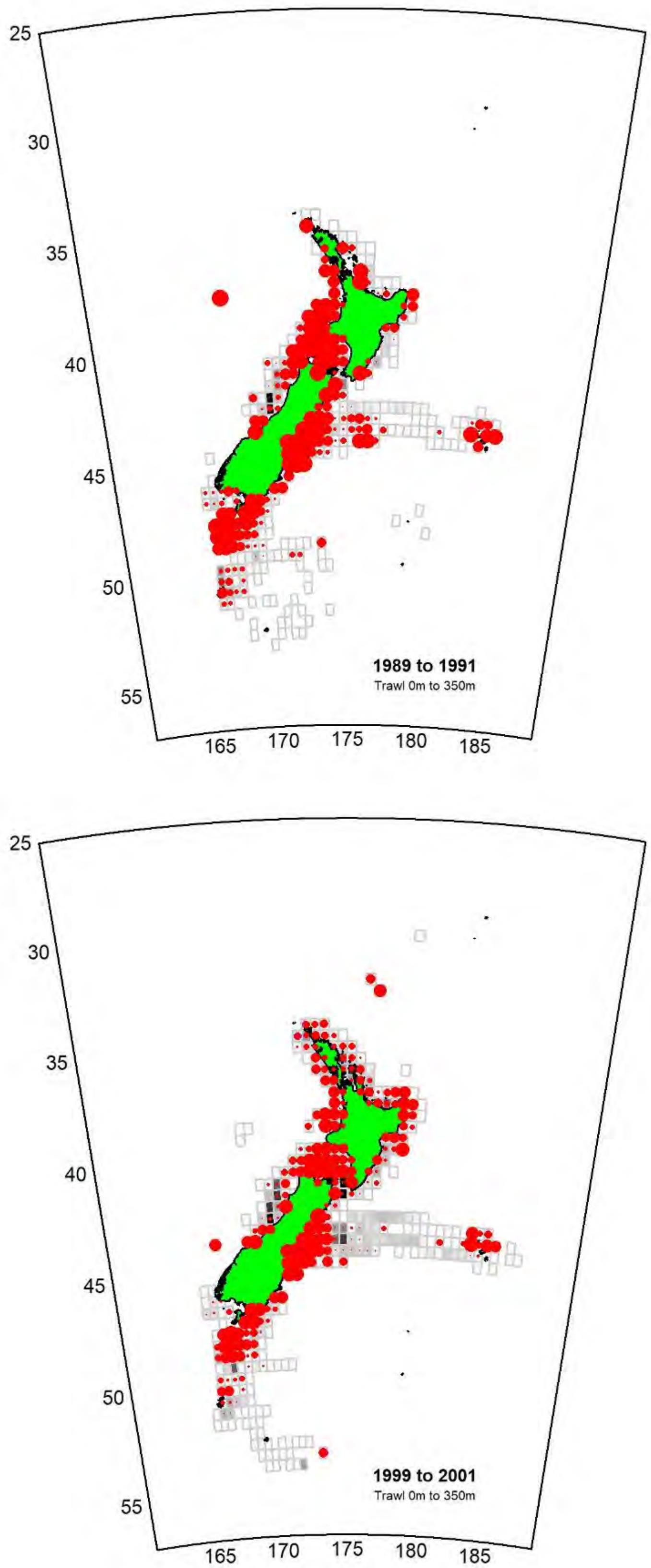
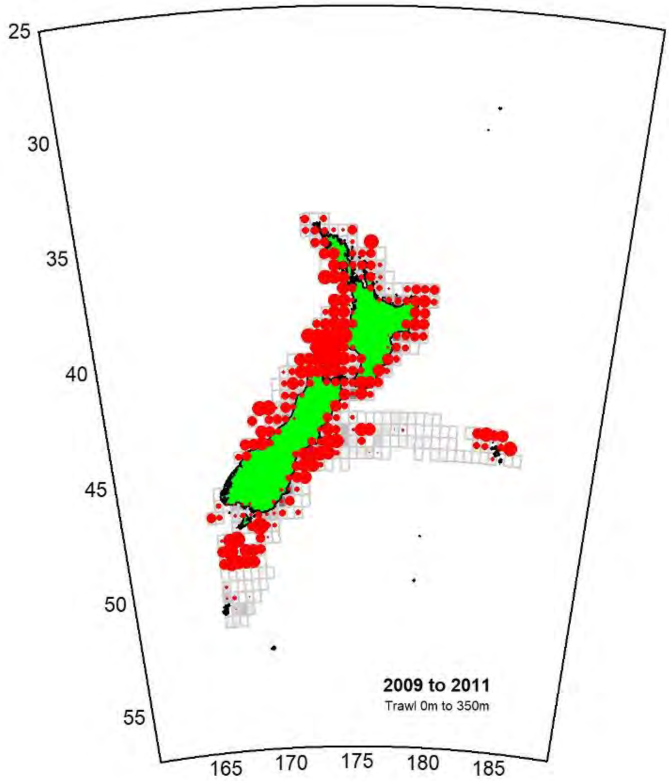


Figure 10.5: Maps of barracouta occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



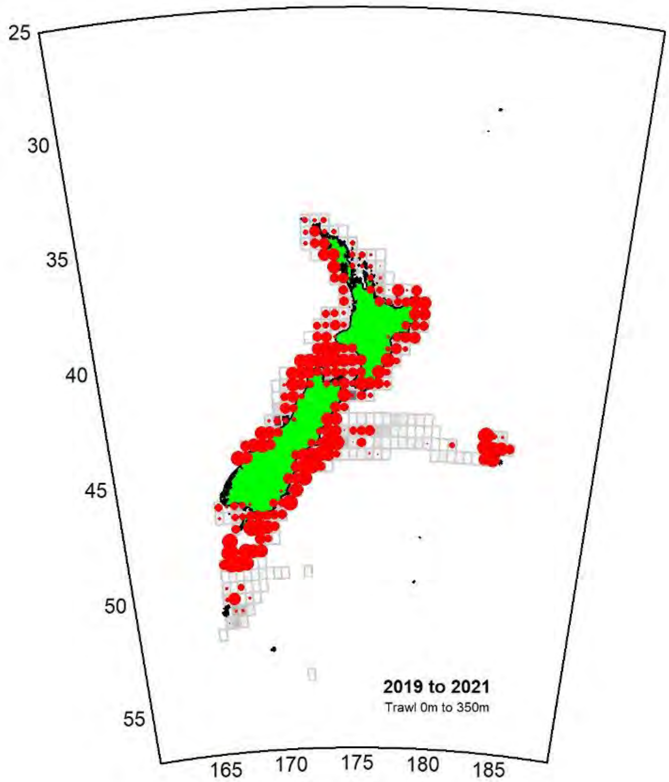


Figure 10.5 (cont.): Maps of barracouta occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

11. Black cardinalfish (Research, EPT; Commercial, CDL)

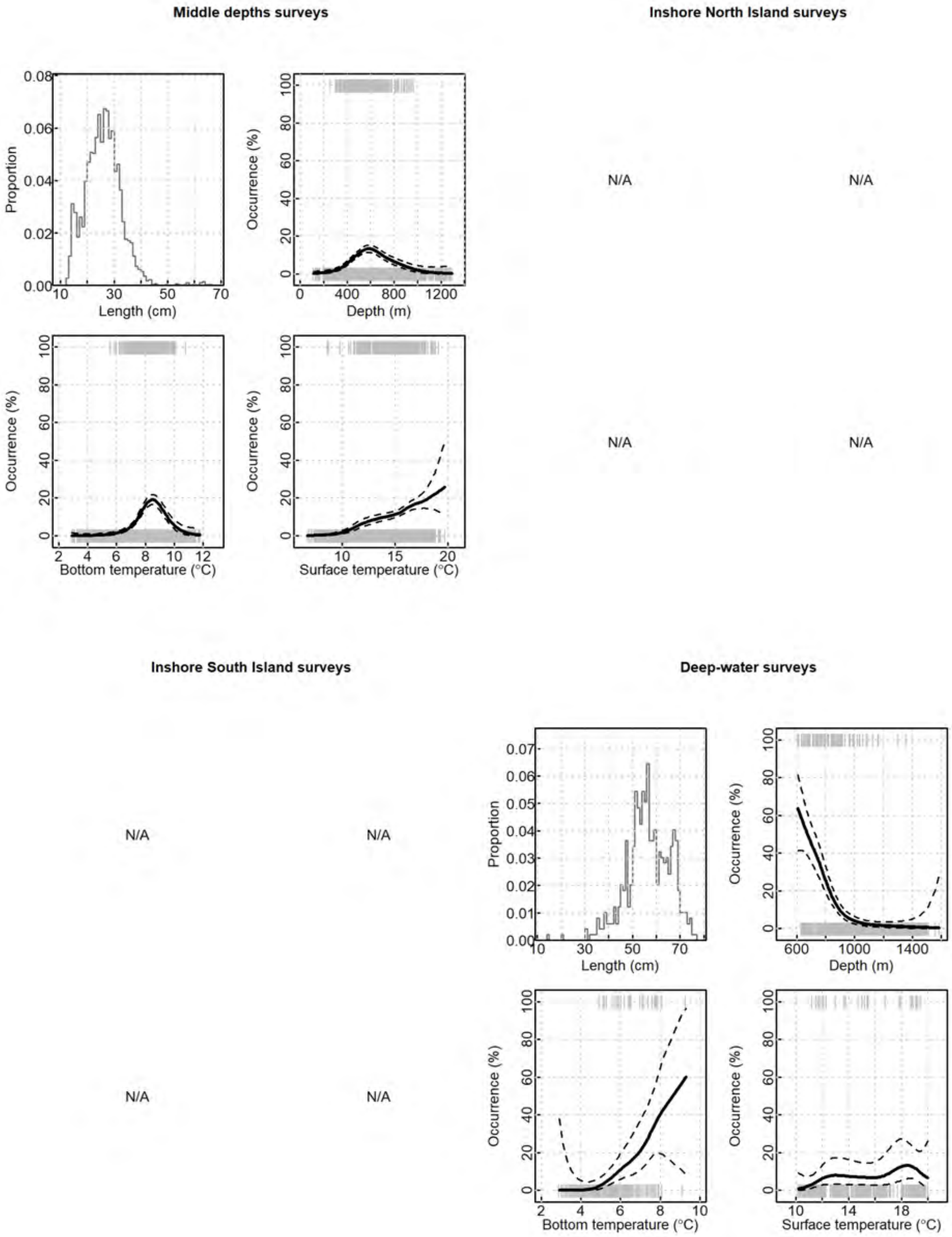


Figure 11.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to black cardinalfish occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

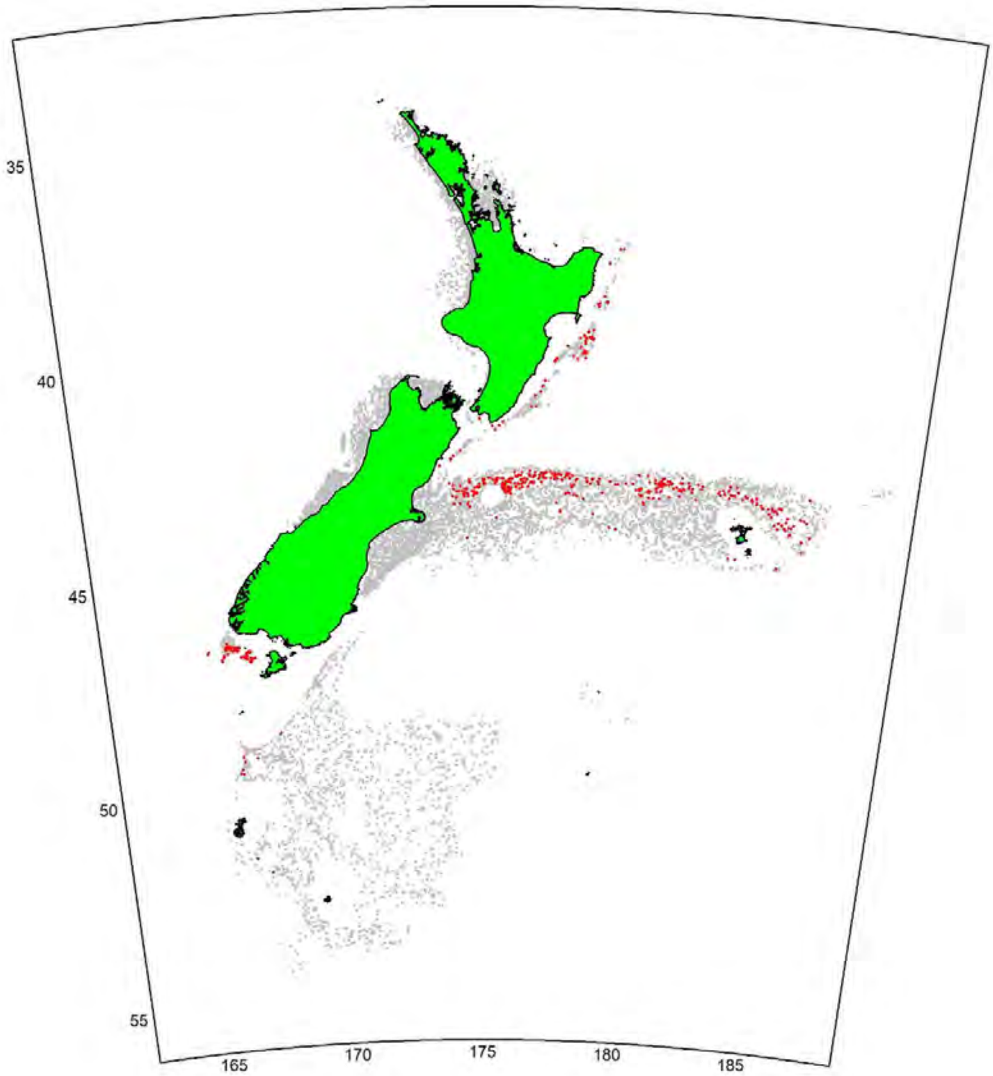


Figure 11.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where black cardinalfish was caught (red points).

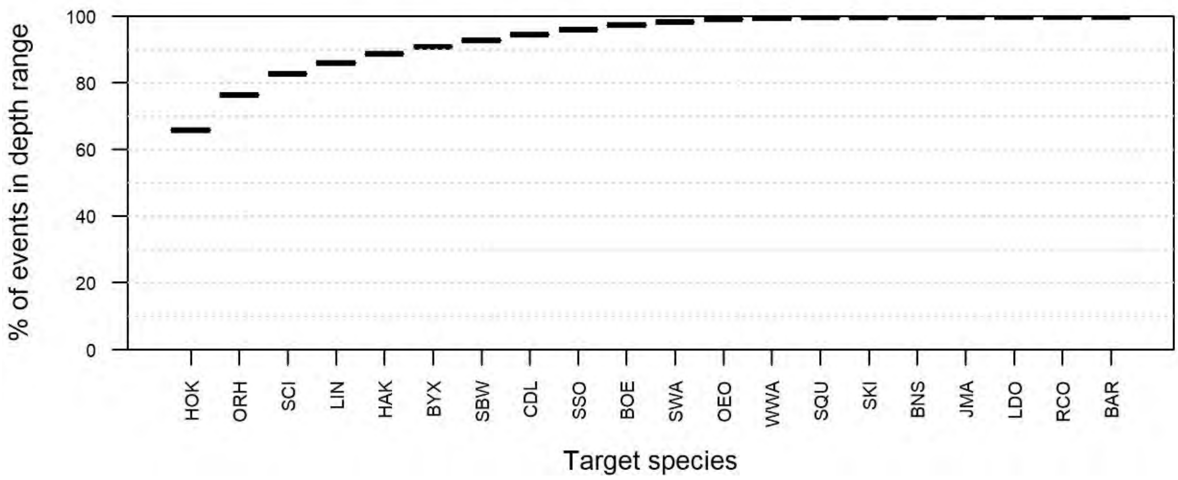


Figure 11.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for black cardinalfish (400–900 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.

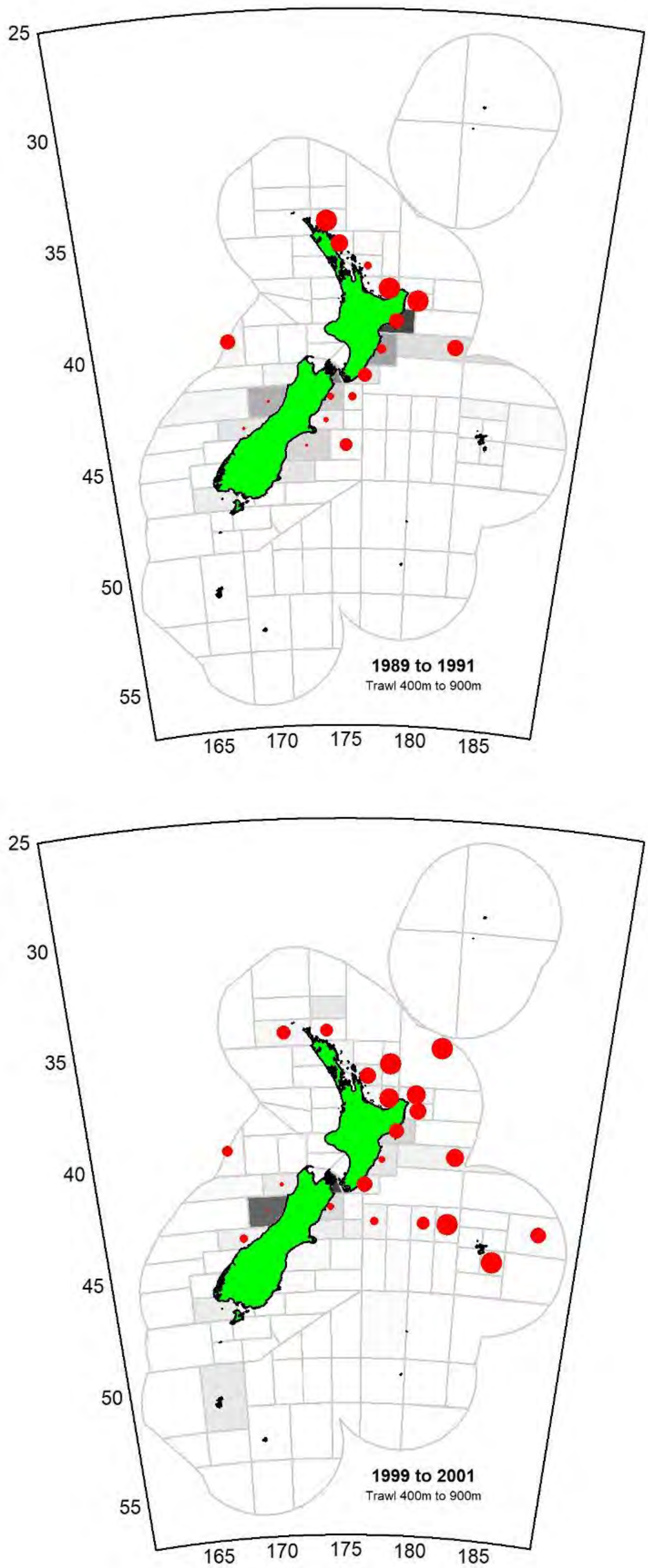
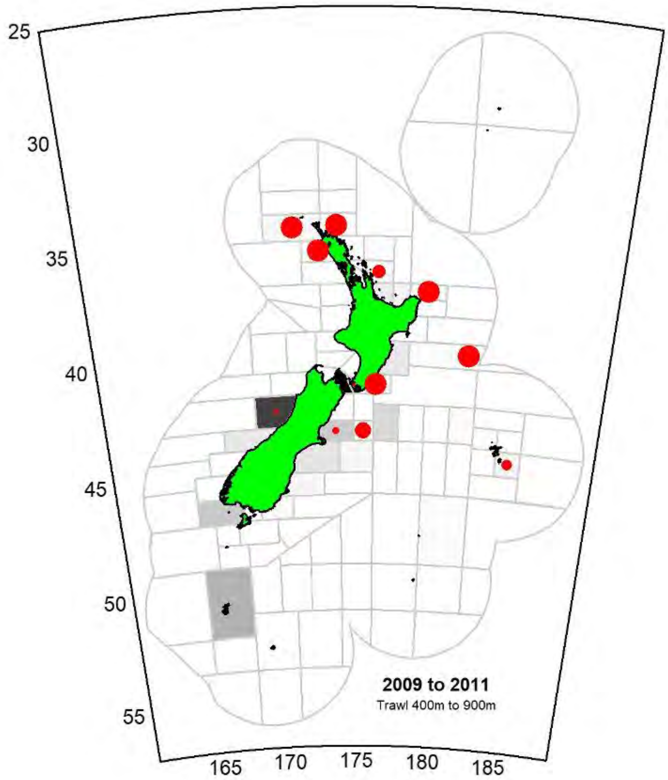


Figure 11.4: Maps of black cardinalfish occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



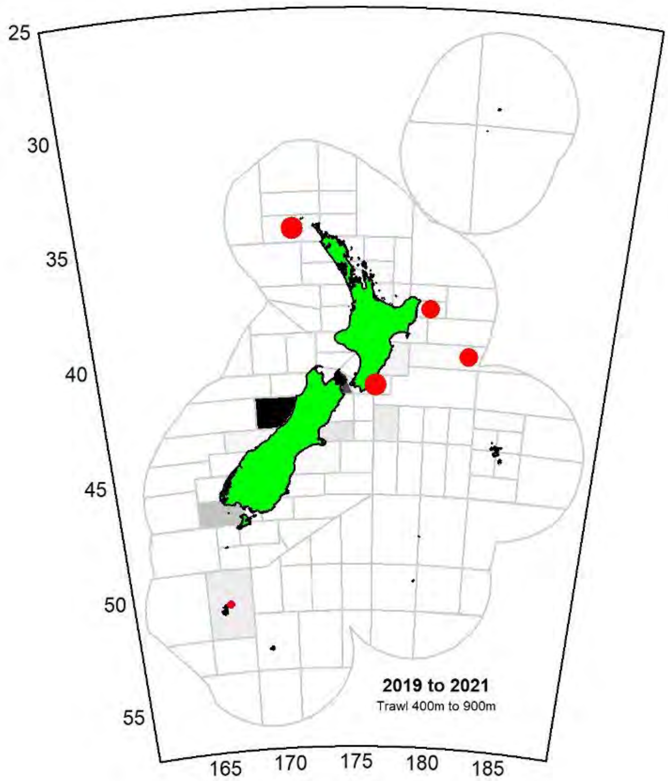


Figure 11.4 (cont.): Maps of black cardinalfish occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

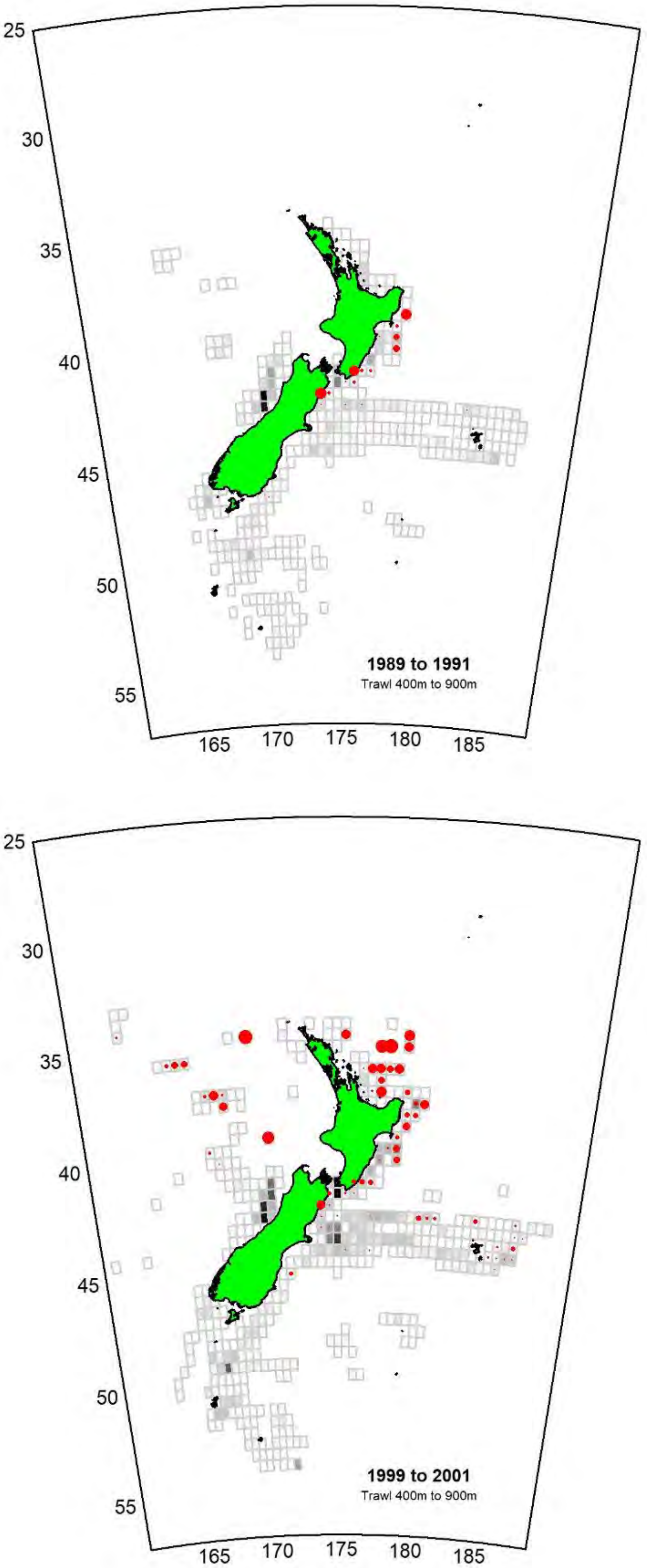
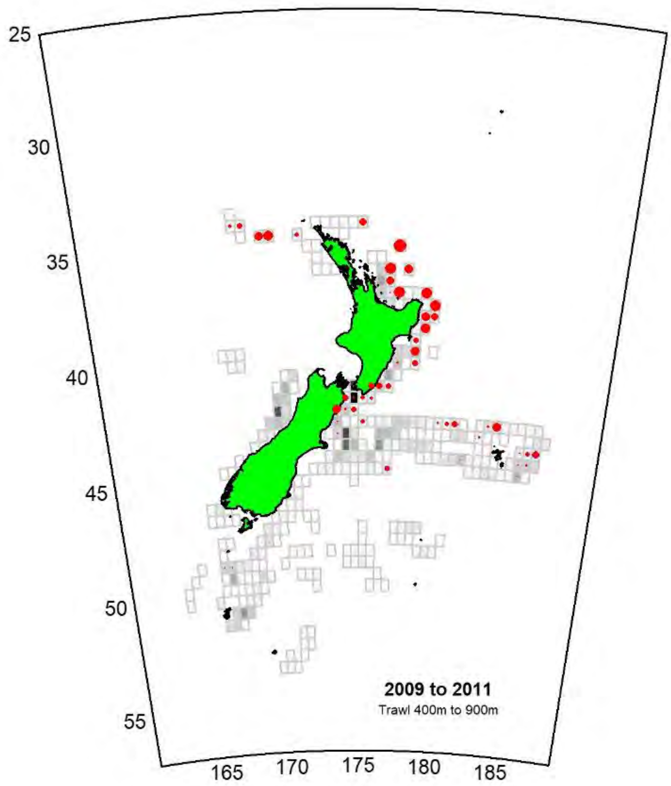


Figure 11.5: Maps of black cardinalfish occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



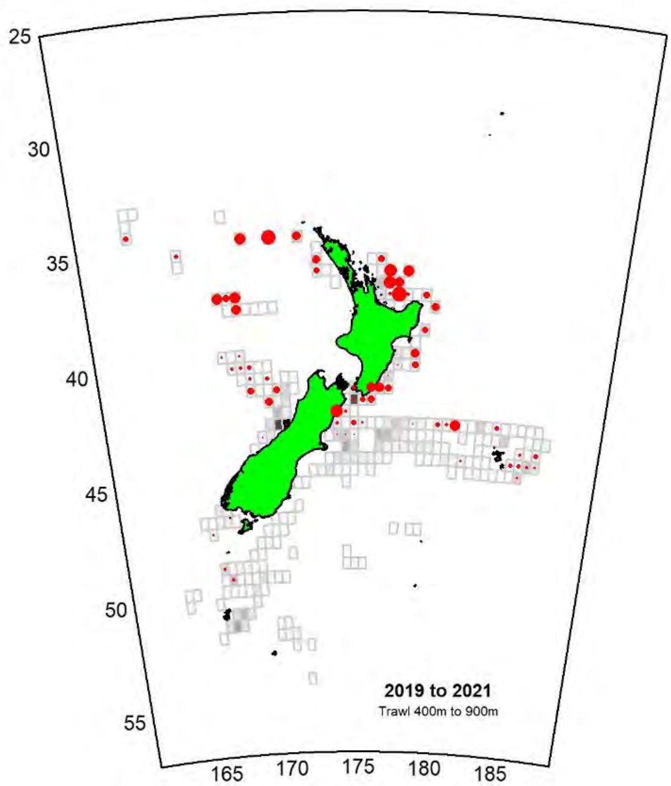


Figure 11.5 (cont.): Maps of black cardinalfish occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

12. Blue cod (BCO)

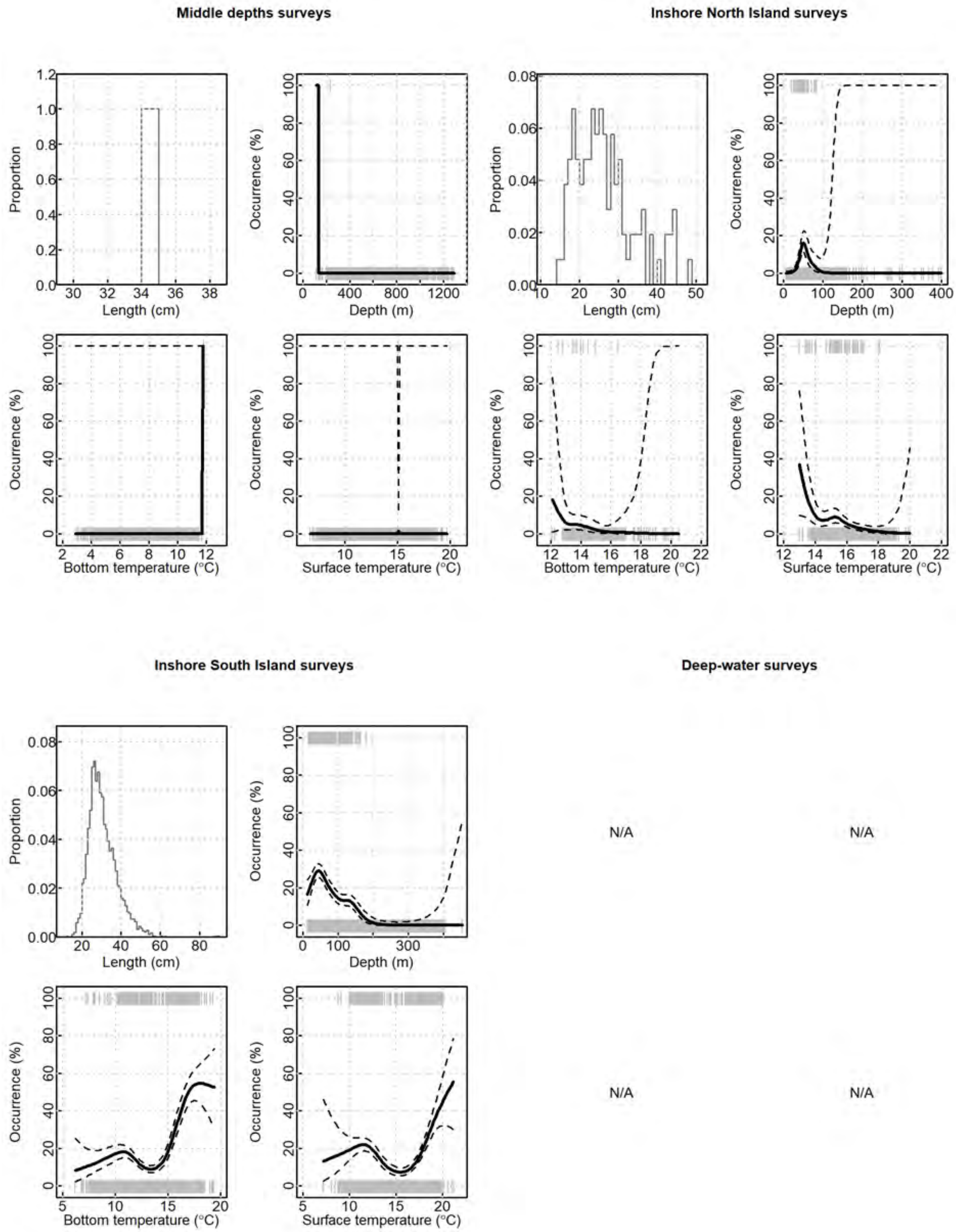


Figure 12.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to blue cod occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

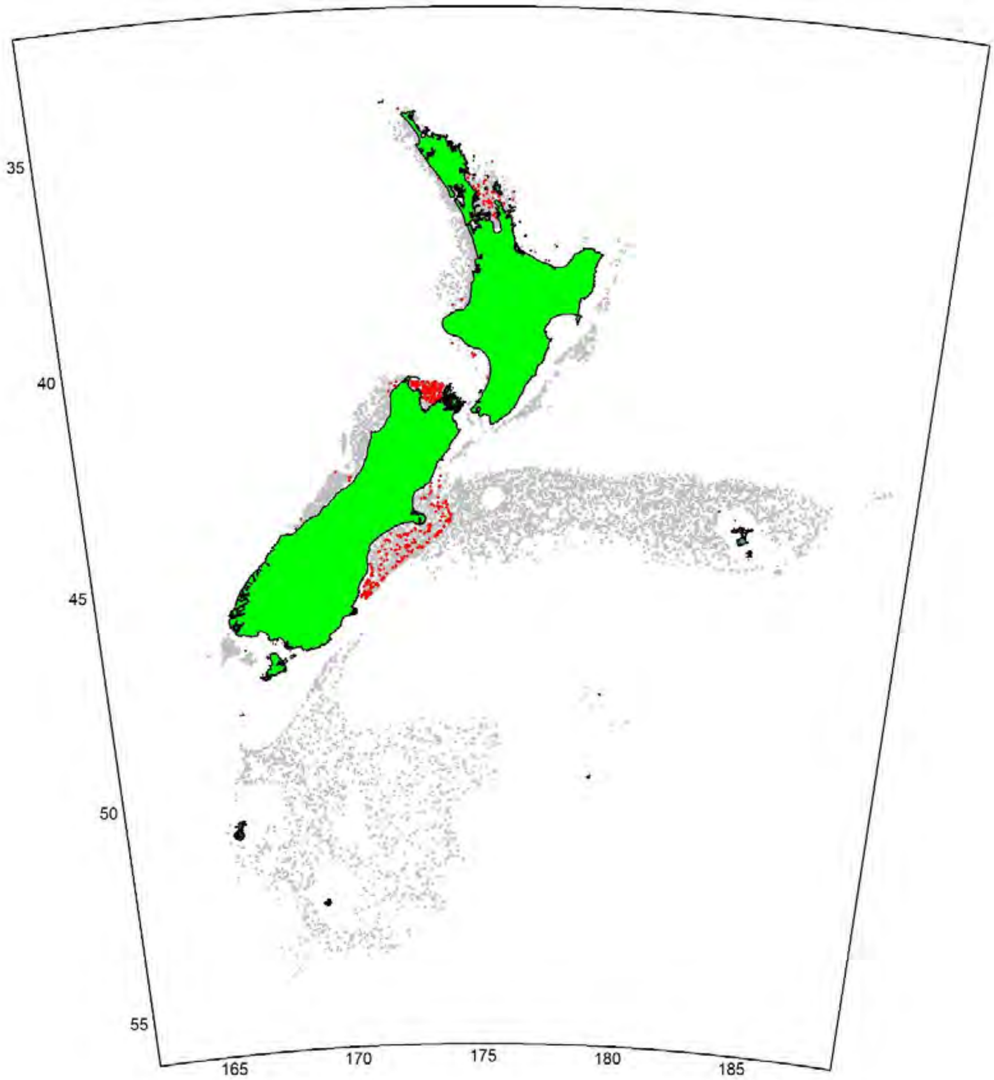


Figure 12.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where blue cod was caught (red points).

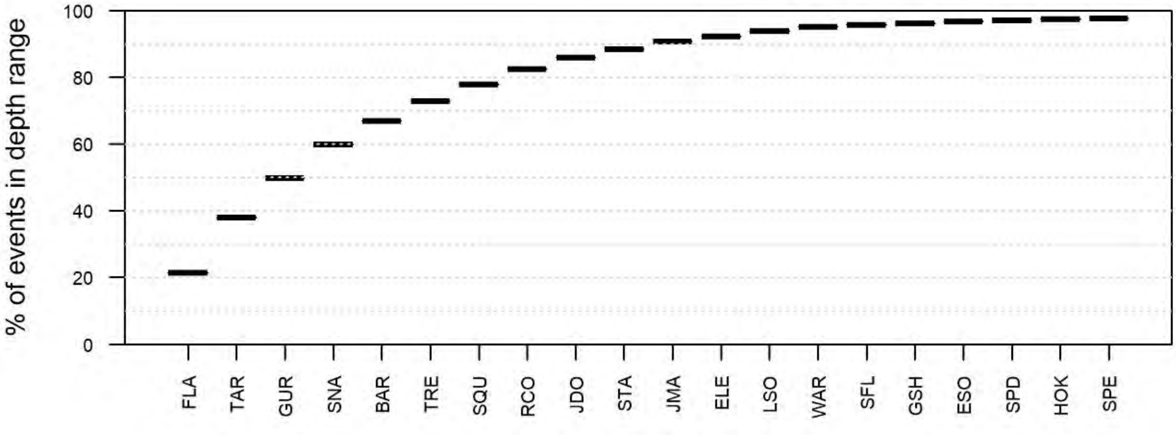


Figure 12.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for blue cod (0–180 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.

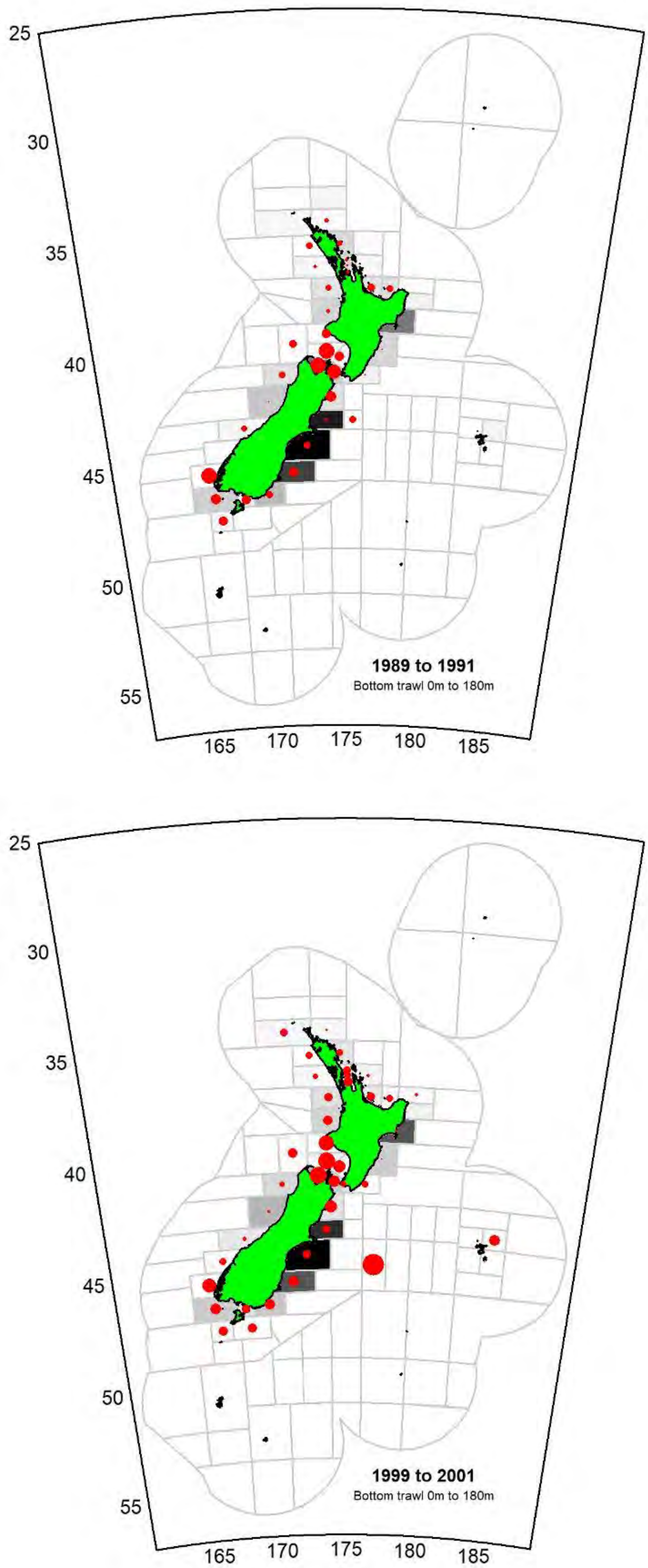
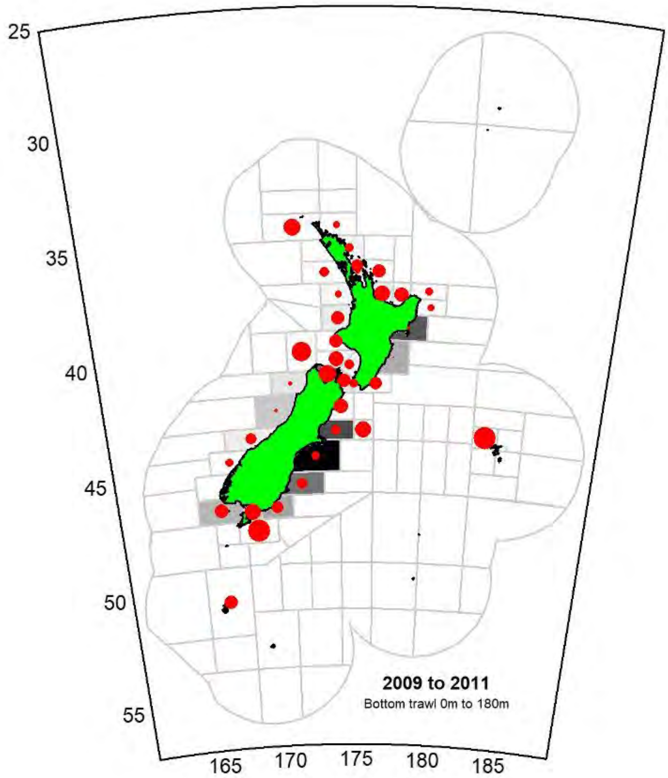


Figure 12.4: Maps of blue cod occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



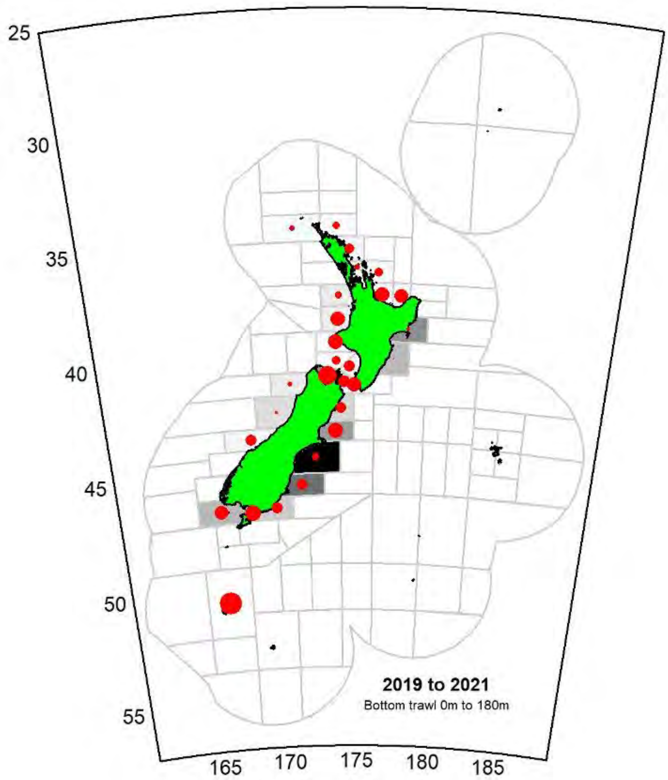
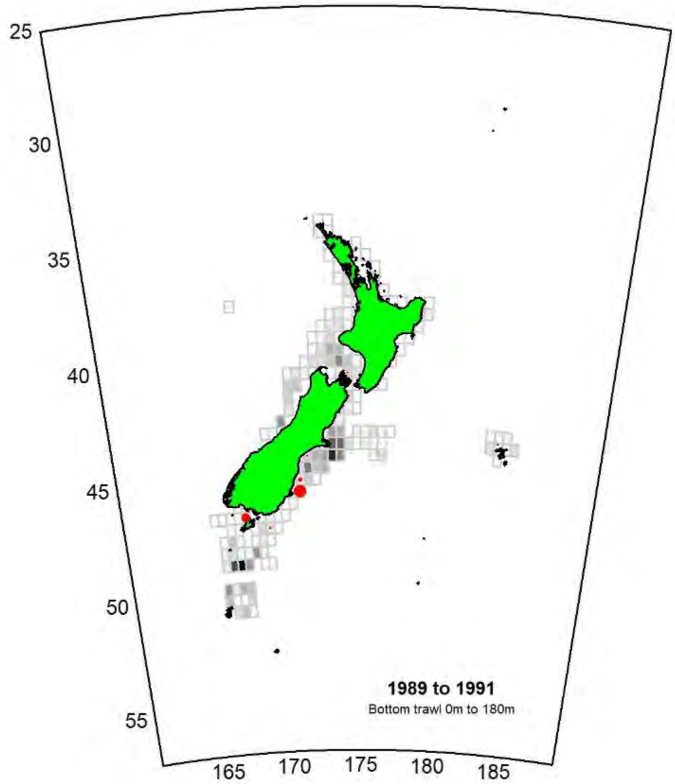


Figure 12.4 (cont.): Maps of blue cod occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



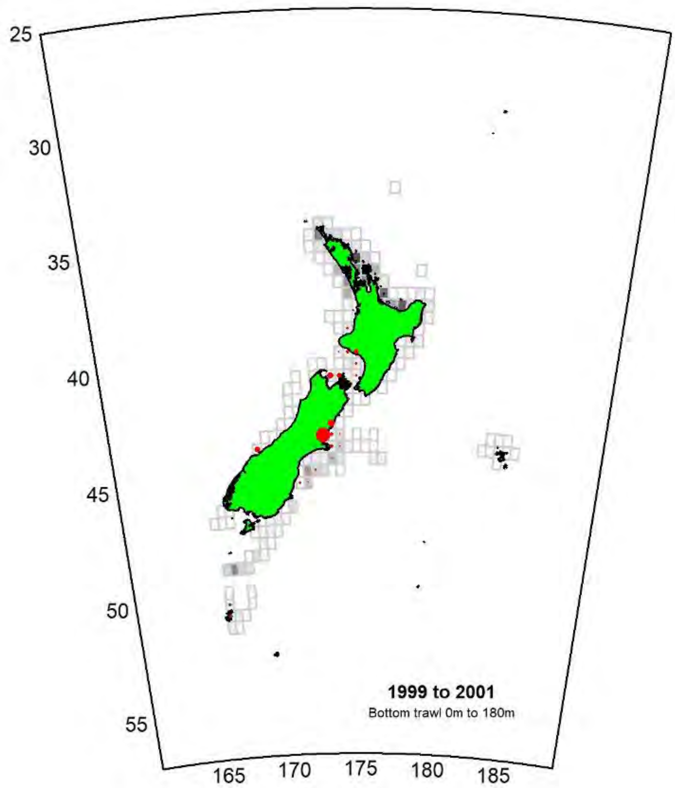
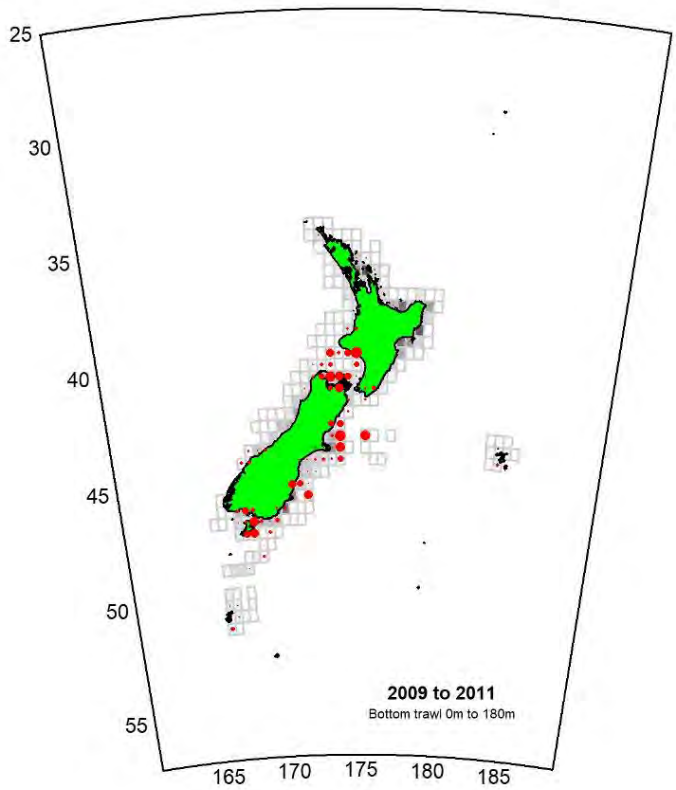


Figure 12.5: Maps of blue cod occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



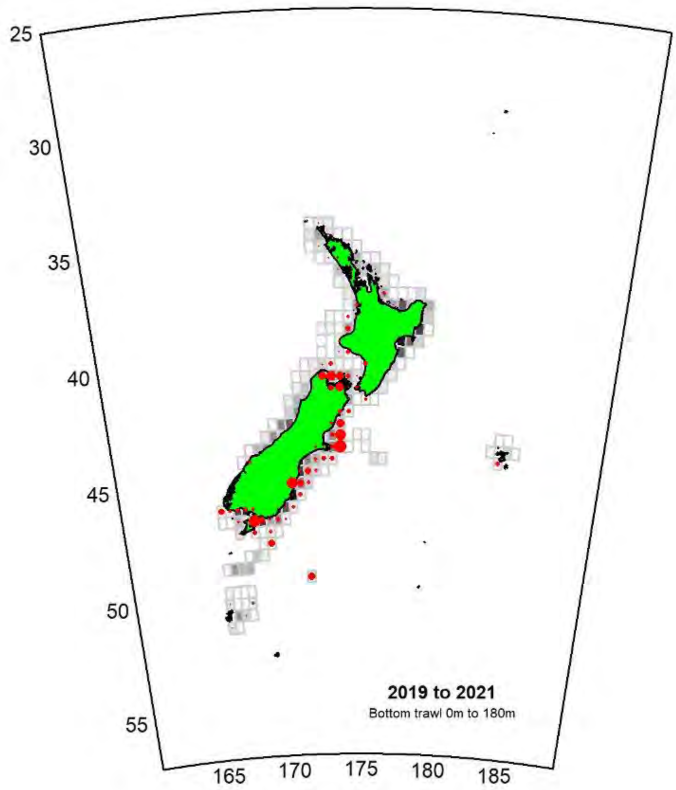


Figure 12.5 (cont.): Maps of blue cod occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

13. Blue mackerel (EMA)

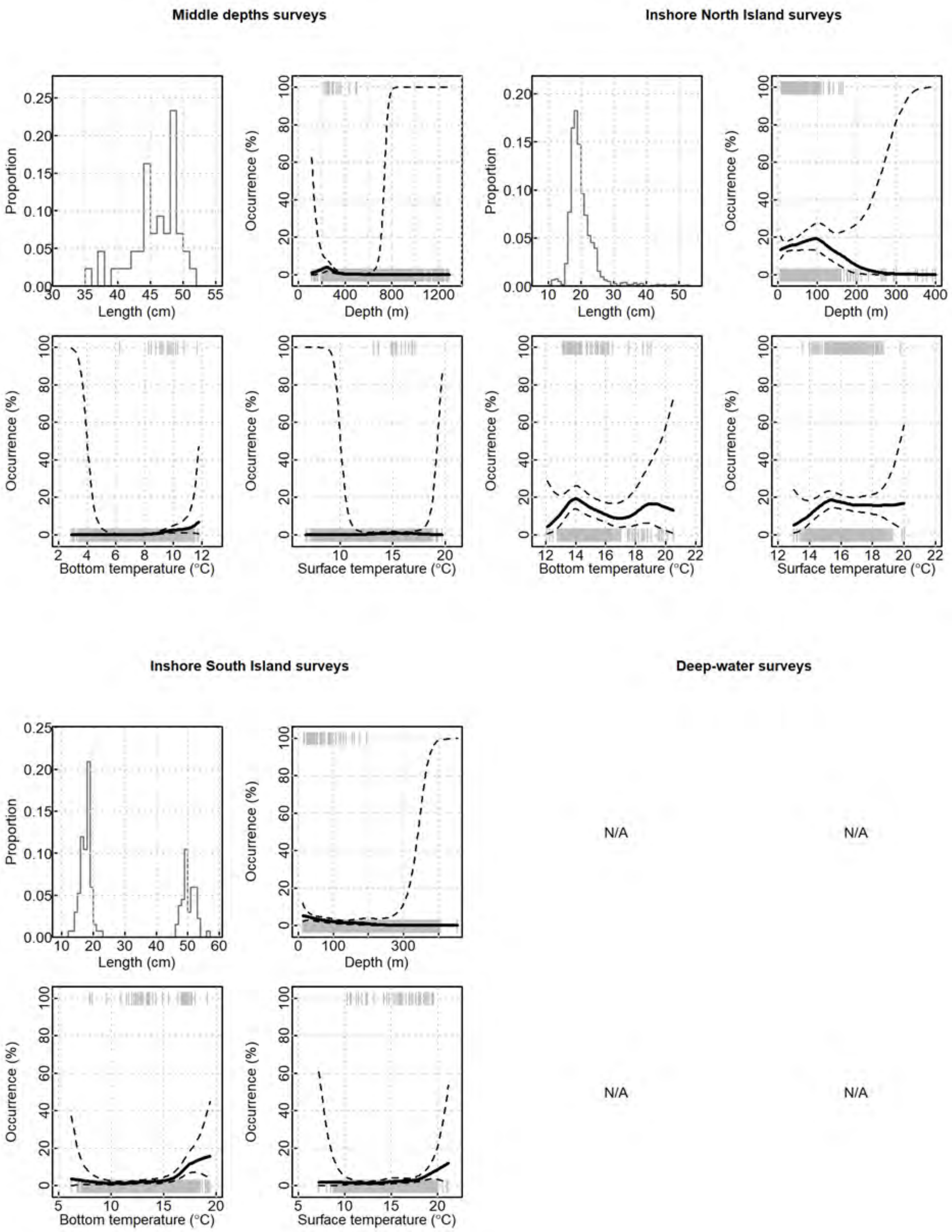


Figure 13.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to blue mackerel occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

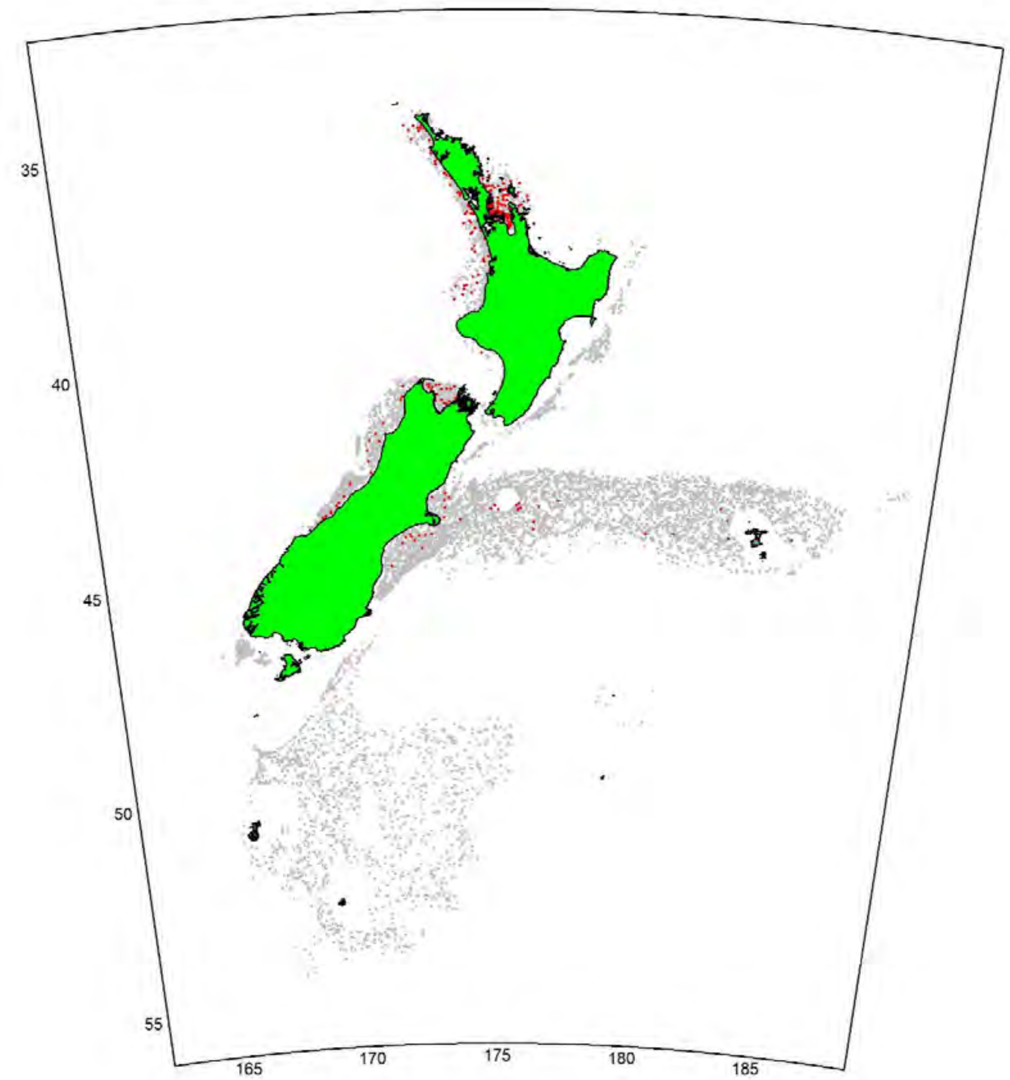


Figure 13.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where blue mackerel was caught (red points).

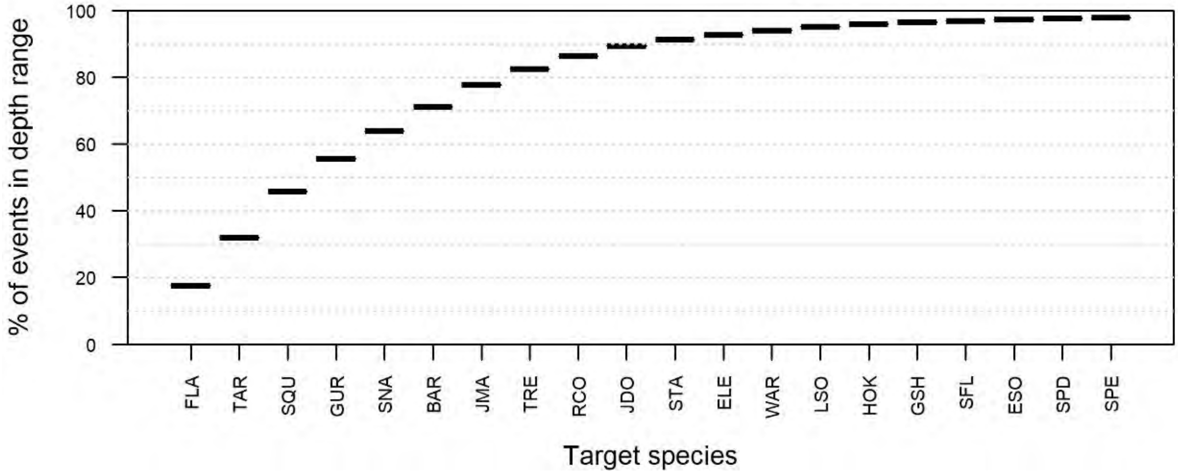
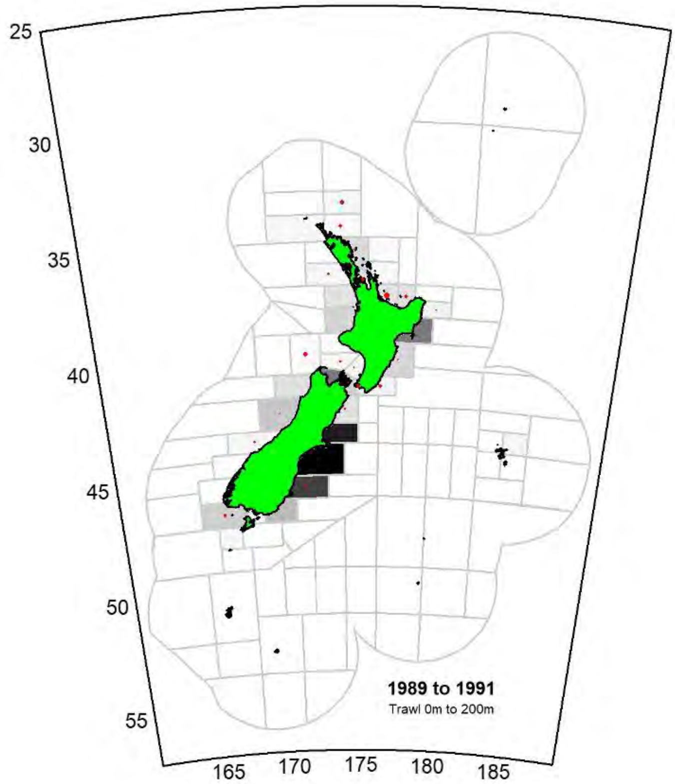


Figure 13.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for blue mackerel (0–200 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.



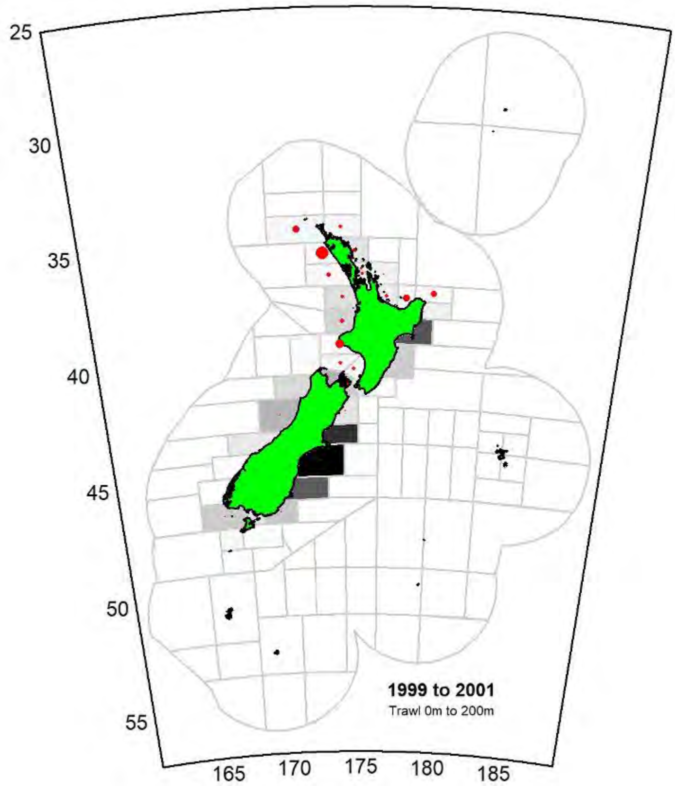
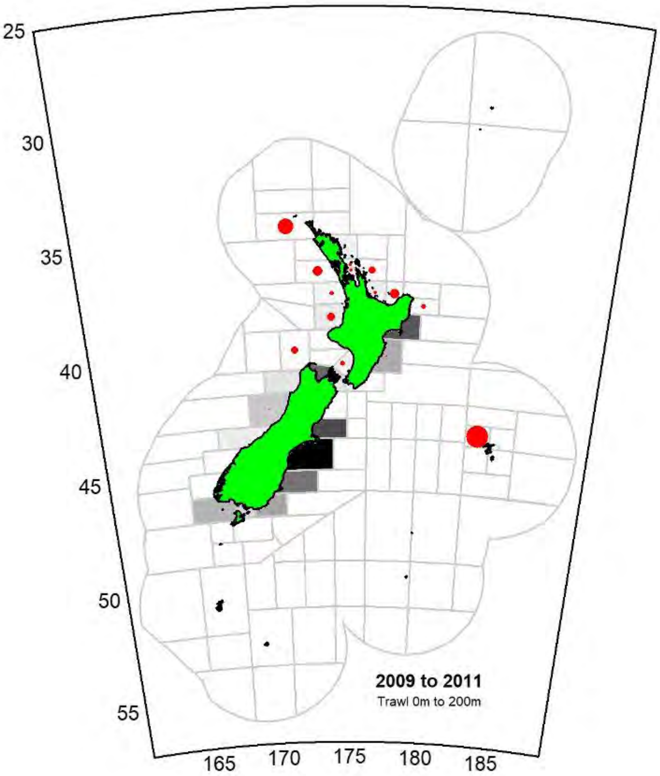


Figure 13.4: Maps of blue mackerel occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



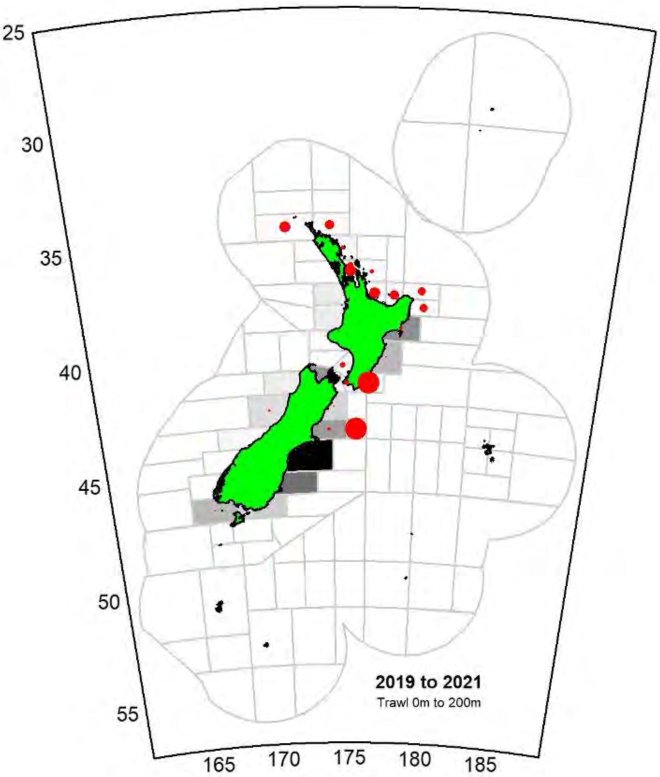
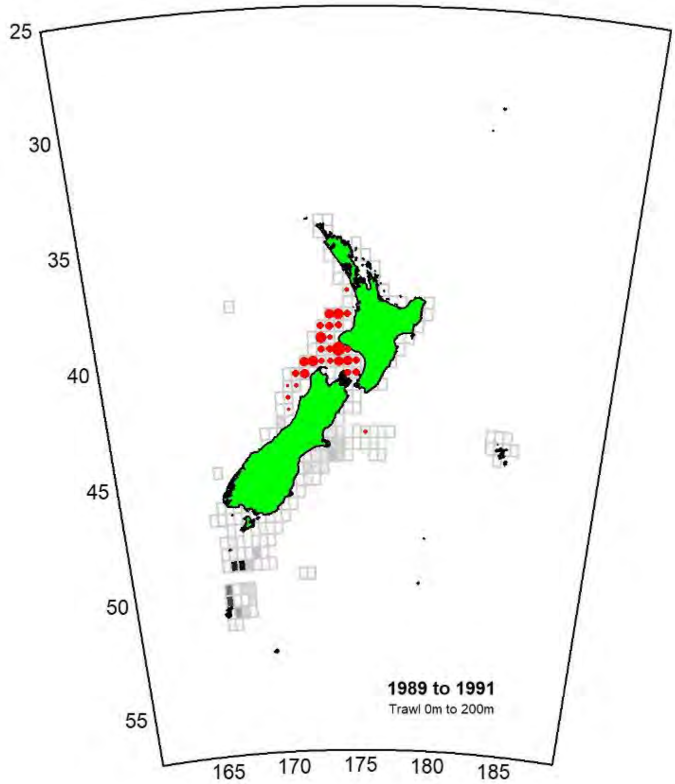


Figure 13.4 (cont.): Maps of blue mackerel occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



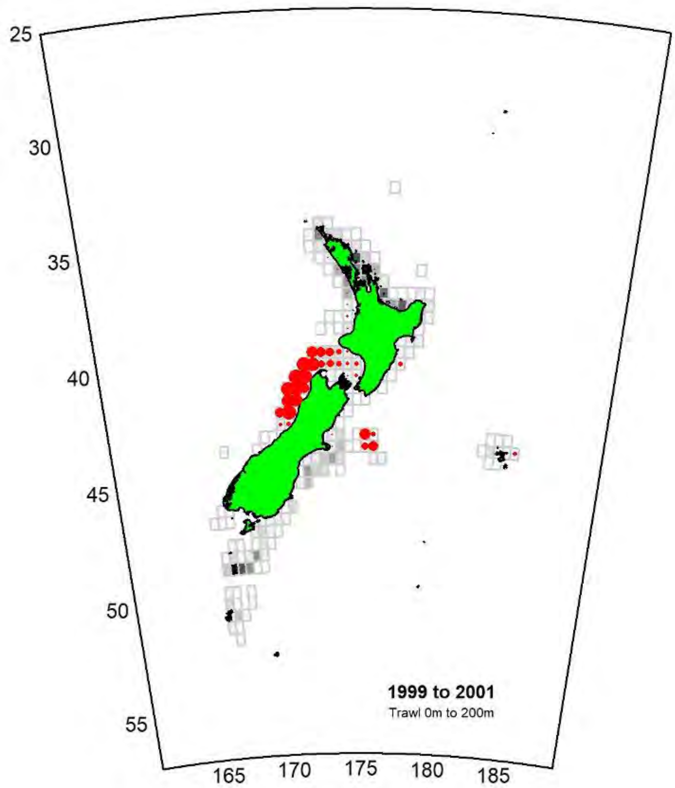
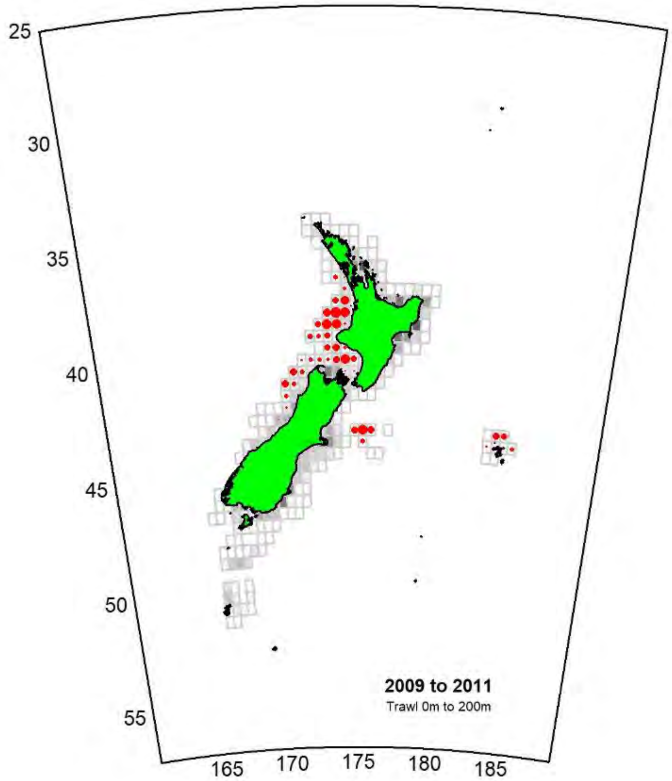


Figure 13.5: Maps of blue mackerel occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



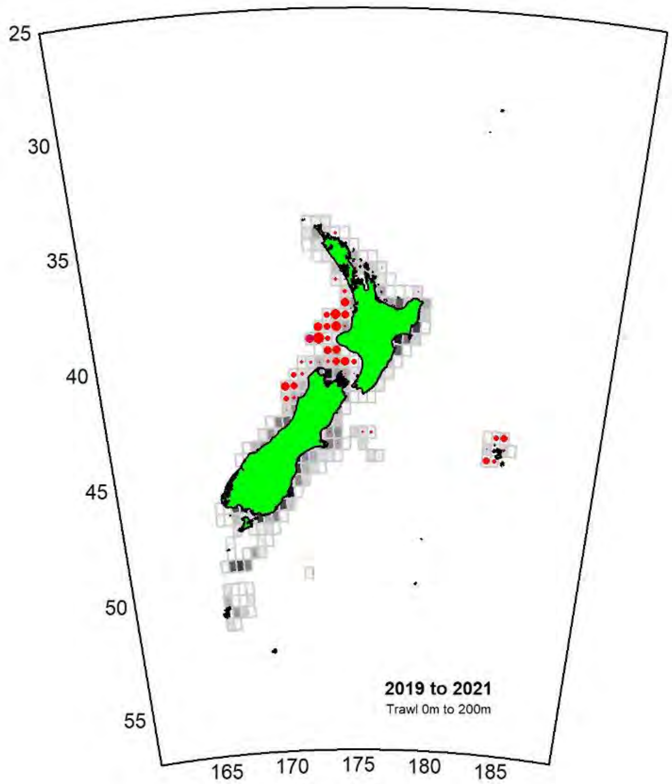


Figure 13.5 (cont.): Maps of blue mackerel occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

14. Blue moki (MOK)

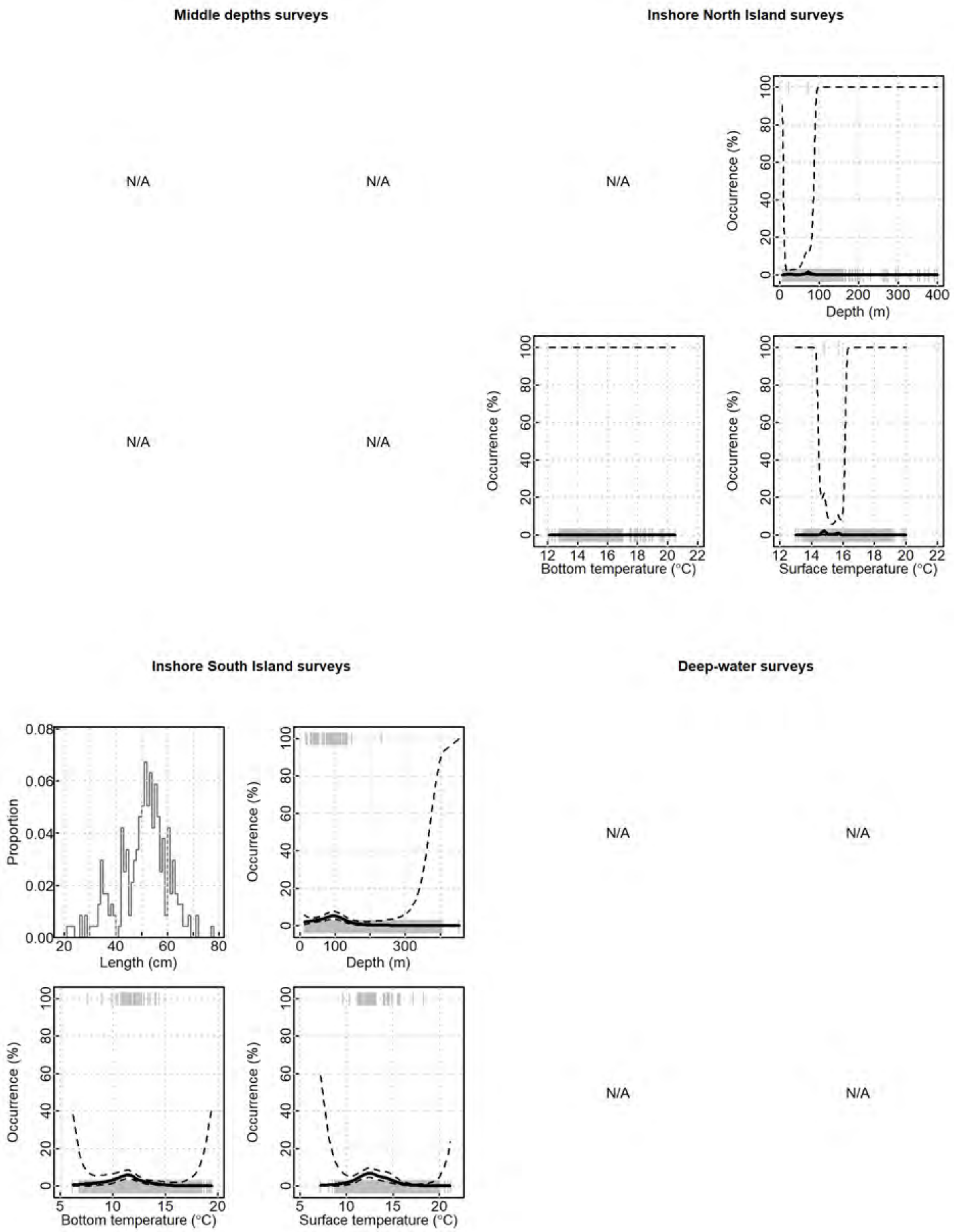


Figure 14.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to blue moki occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

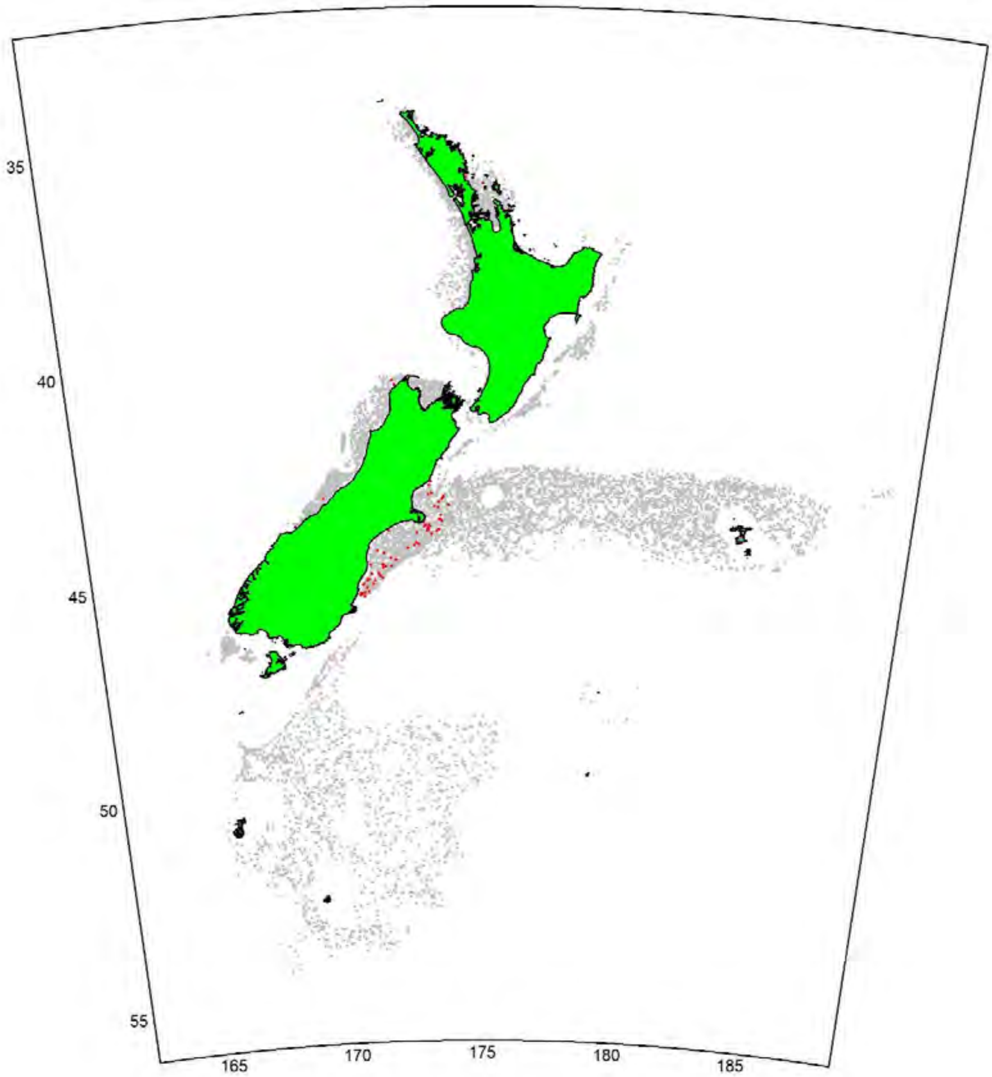


Figure 14.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where blue moki was caught (red points).

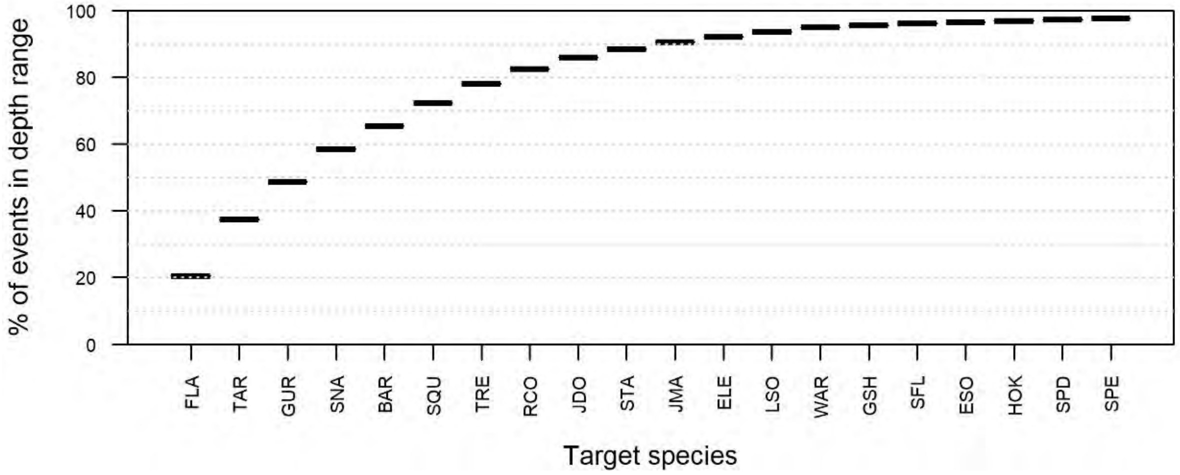


Figure 14.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for blue moki (0–200 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.

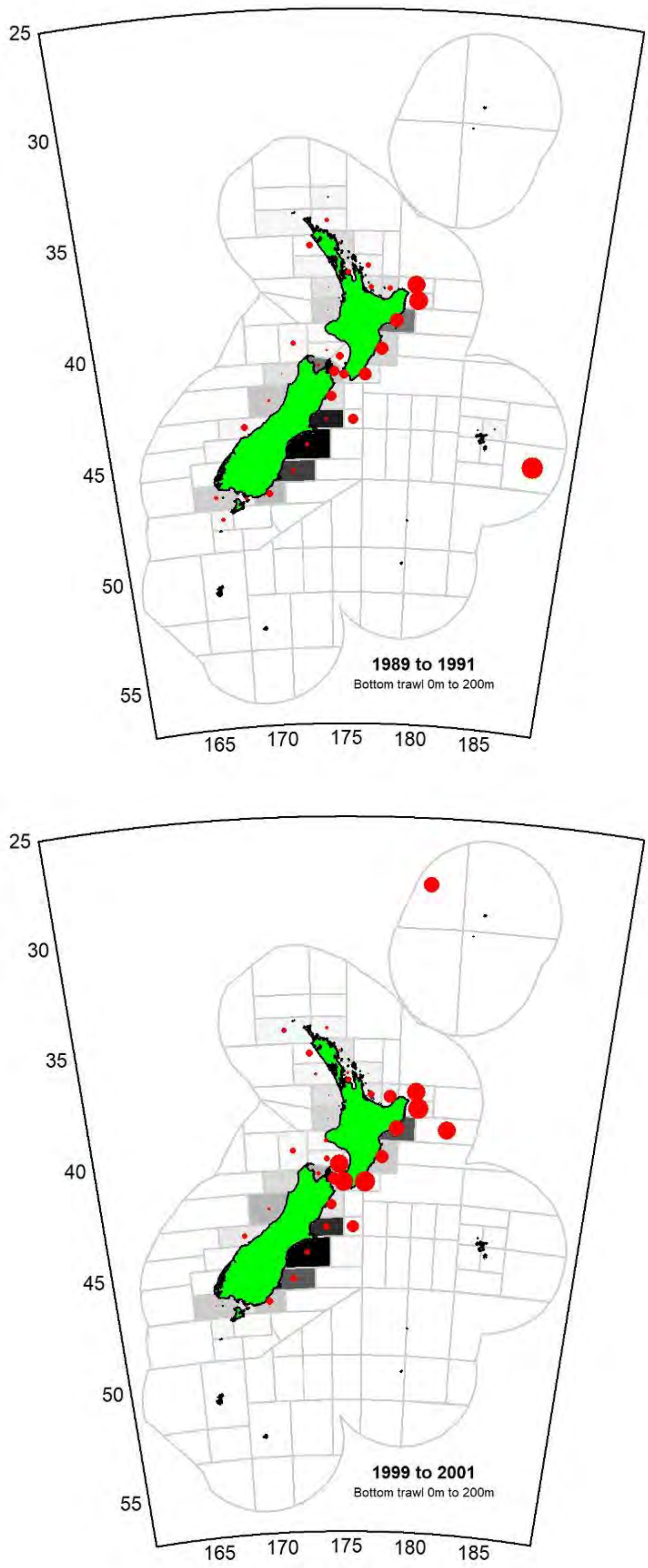
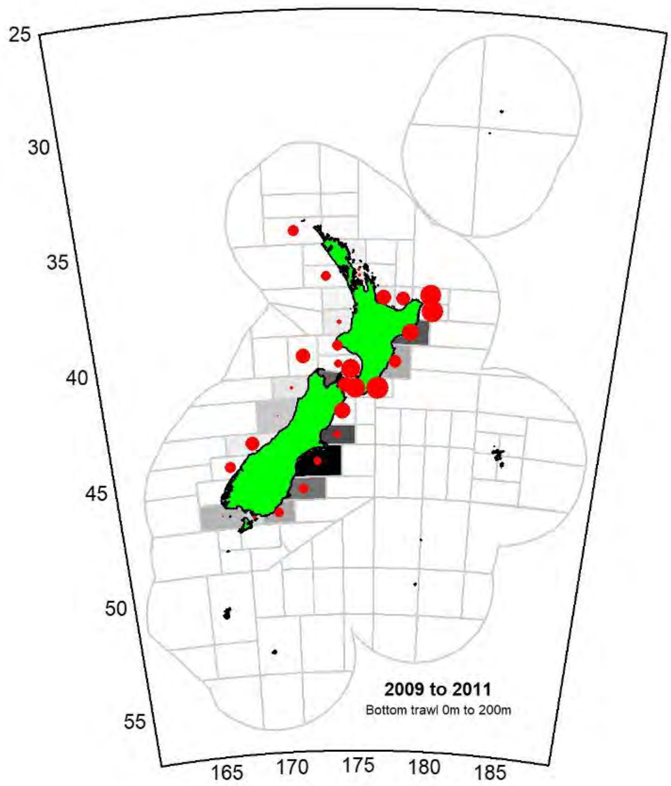


Figure 14.4: Maps of blue moki occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



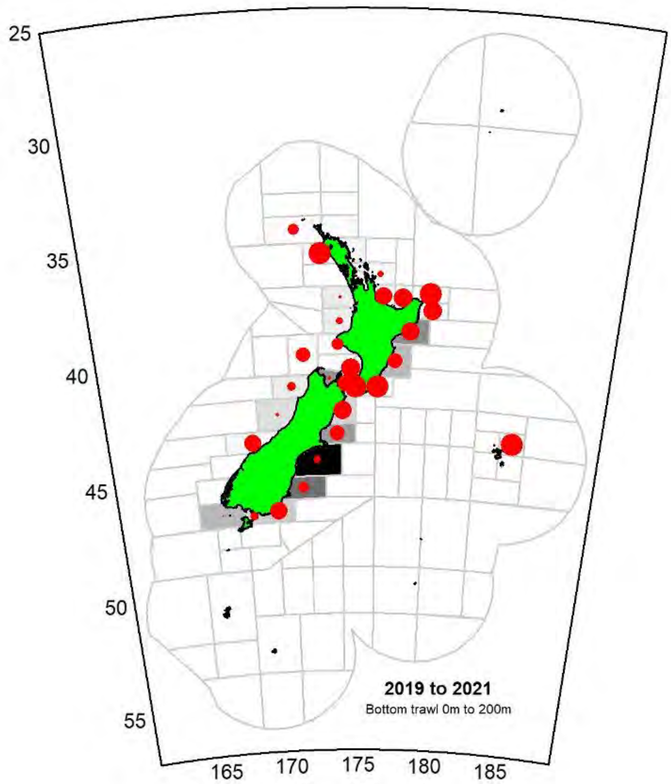
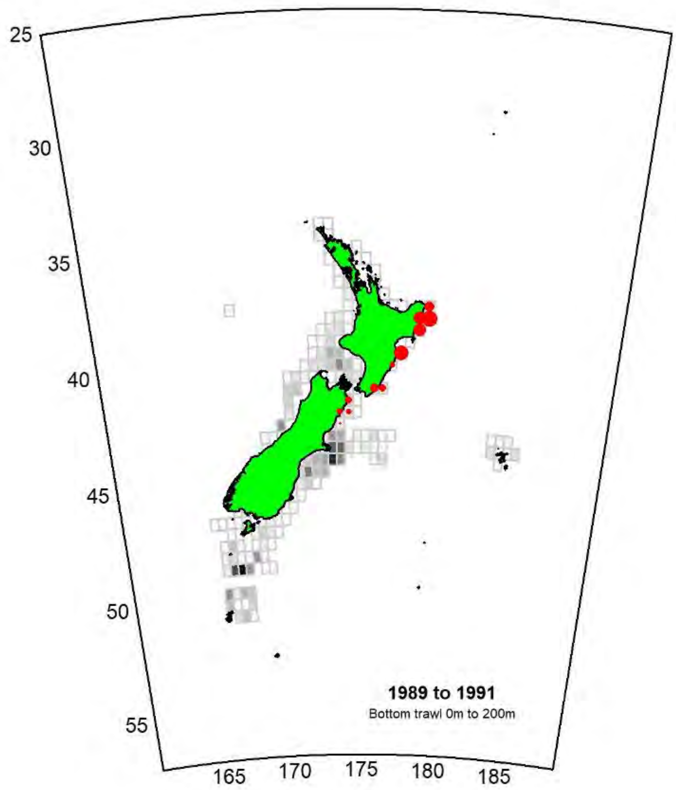


Figure 14.4 (cont.): Maps of blue moki occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



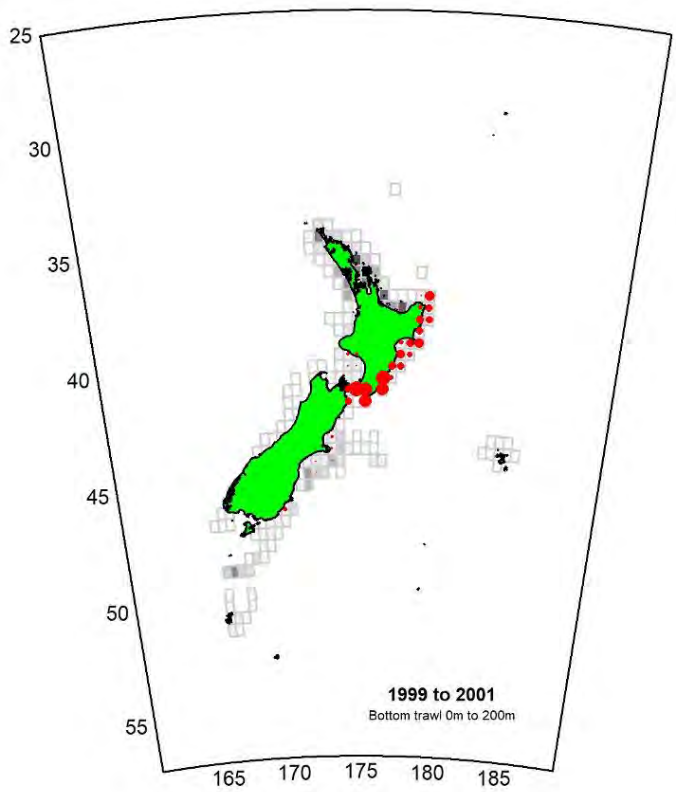
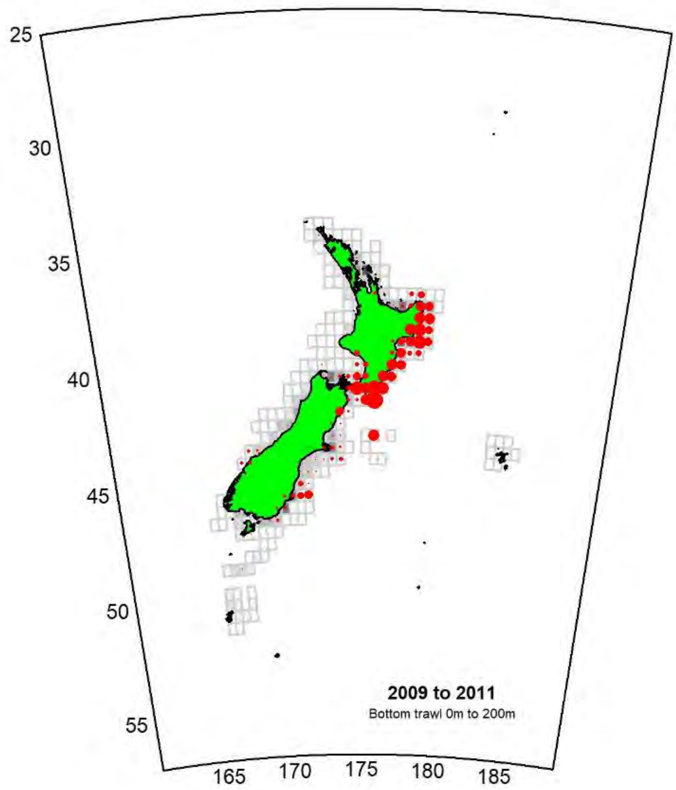


Figure 14.5: Maps of blue moki occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



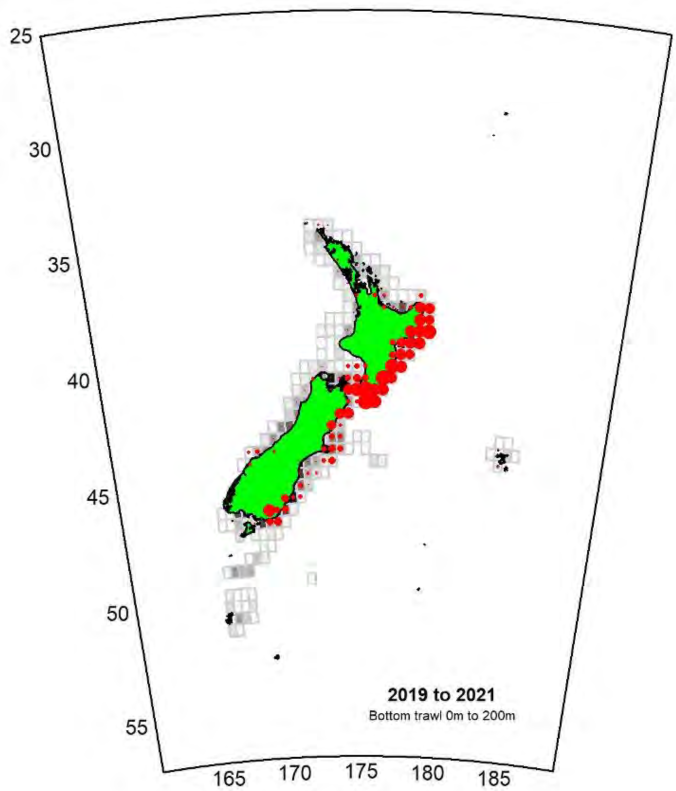


Figure 14.5 (cont.): Maps of blue moki occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

15. Blue warehou (WAR)

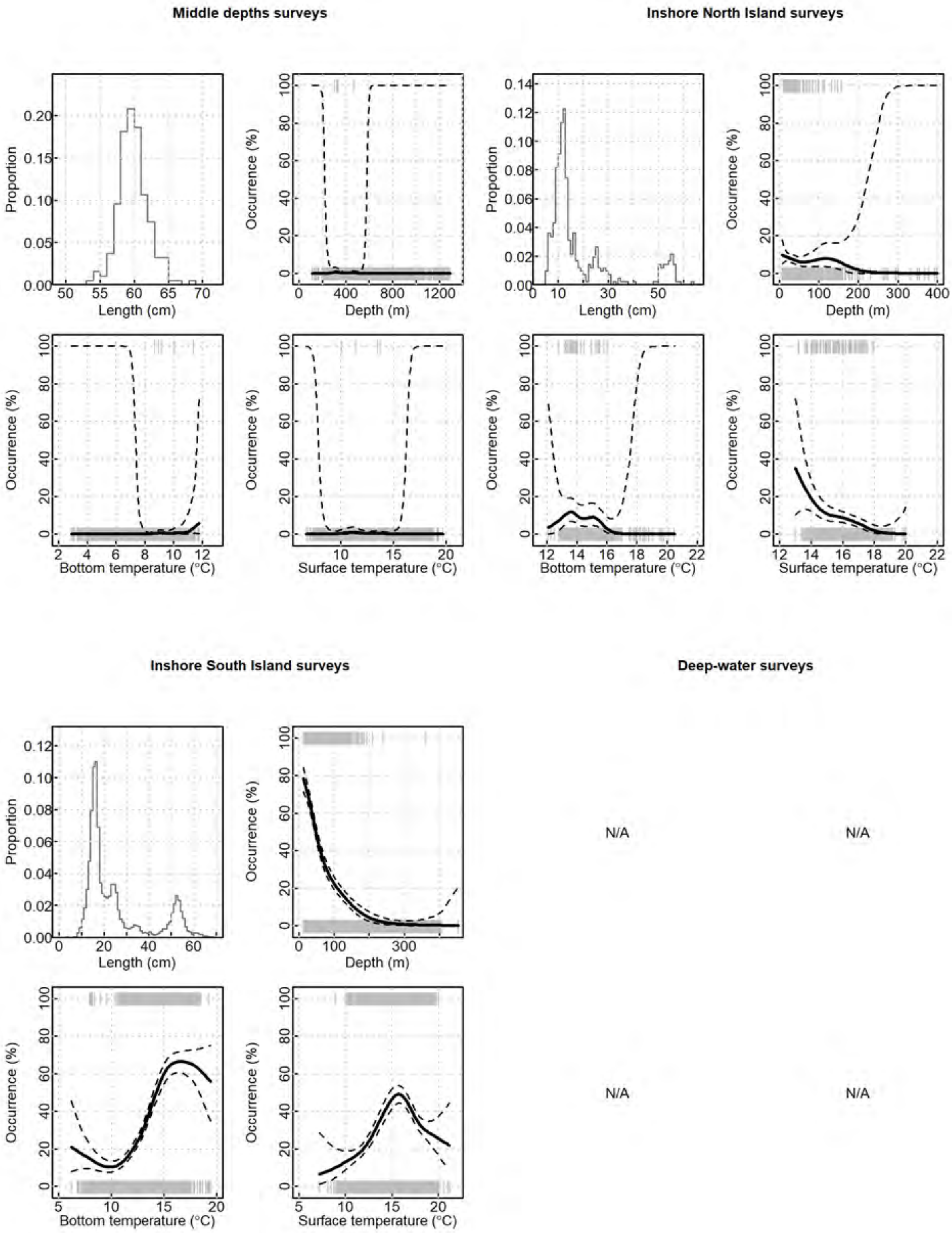


Figure 15.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to blue warehou occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

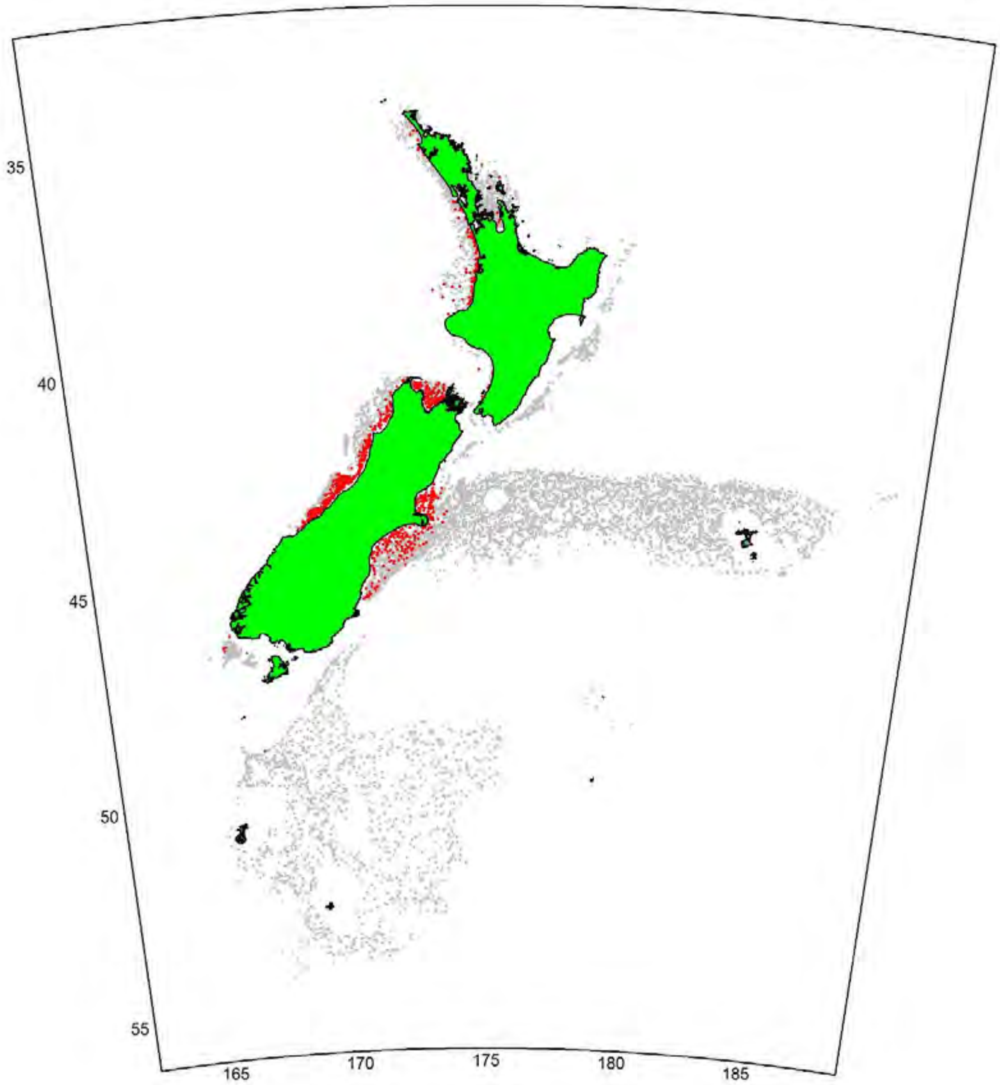


Figure 15.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where blue warehou was caught (red points).

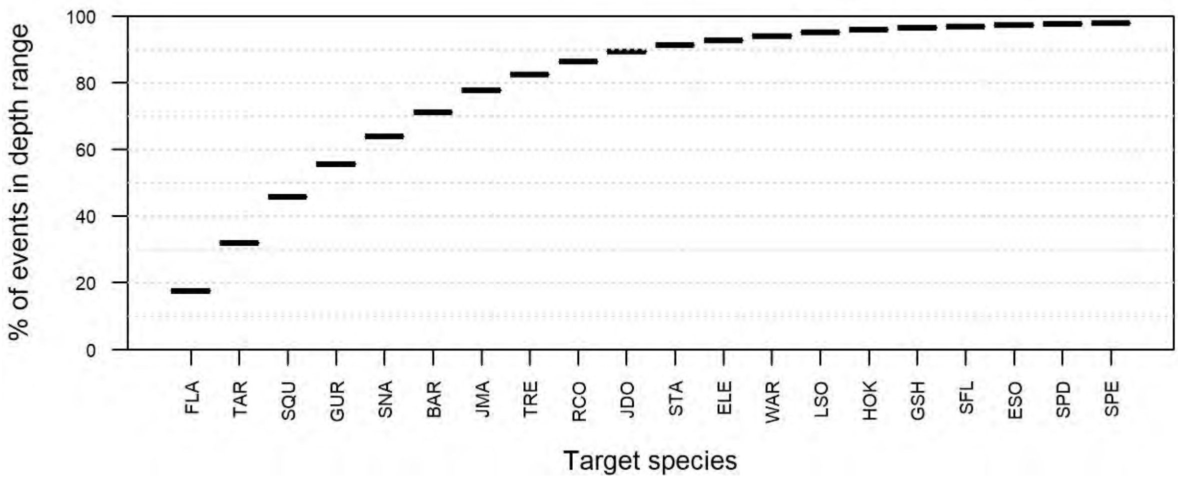
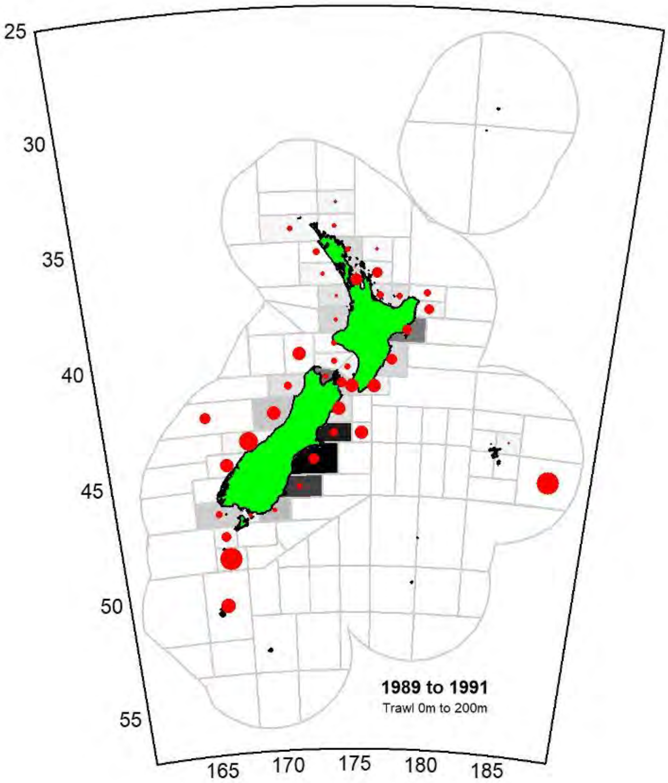


Figure 15.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for blue warehou (0–200 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.



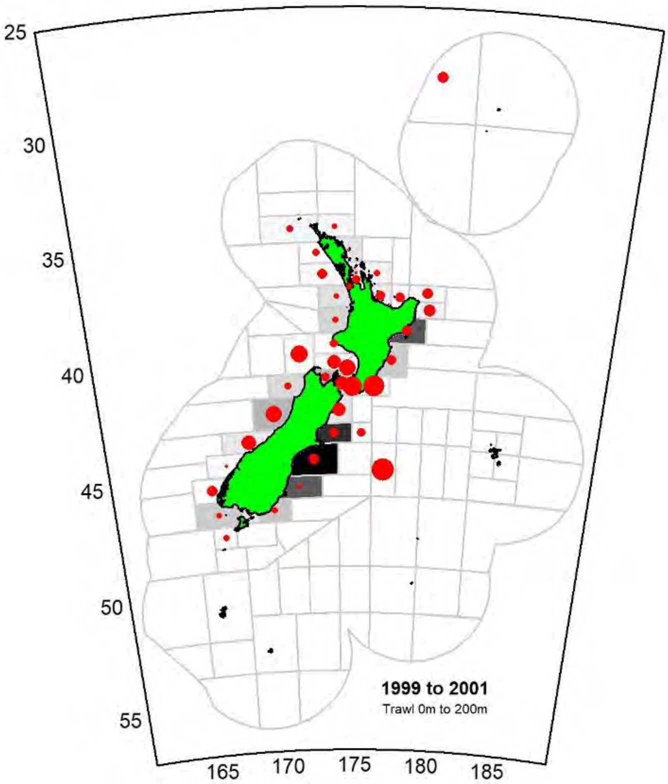
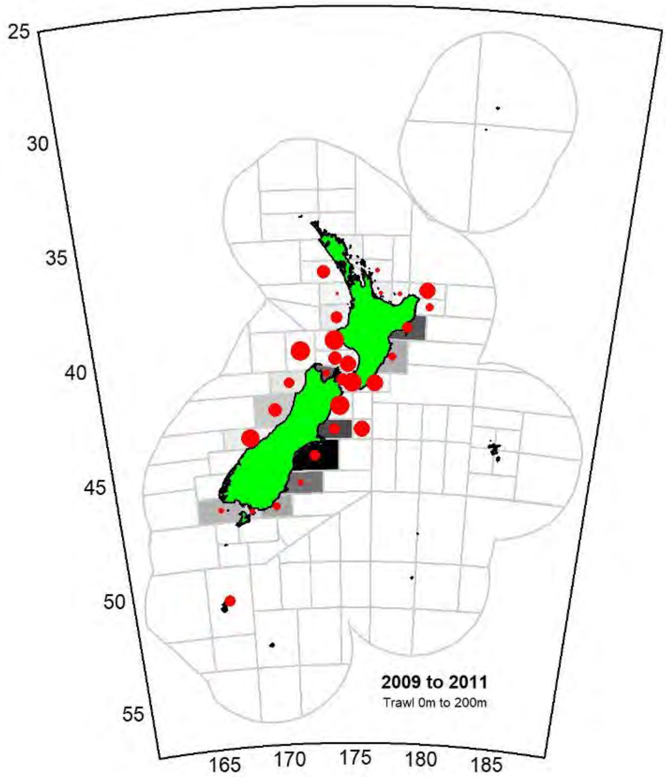


Figure 15.4: Maps of blue warehou occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



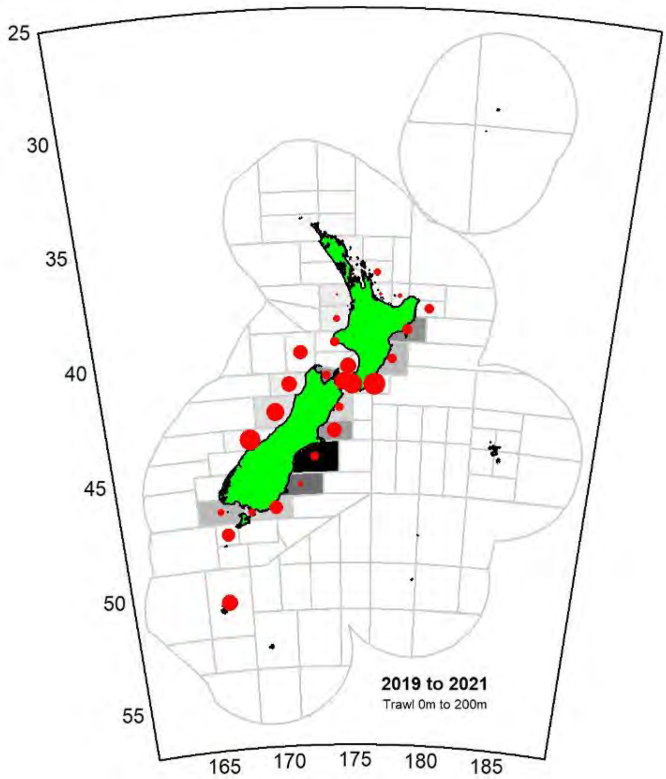
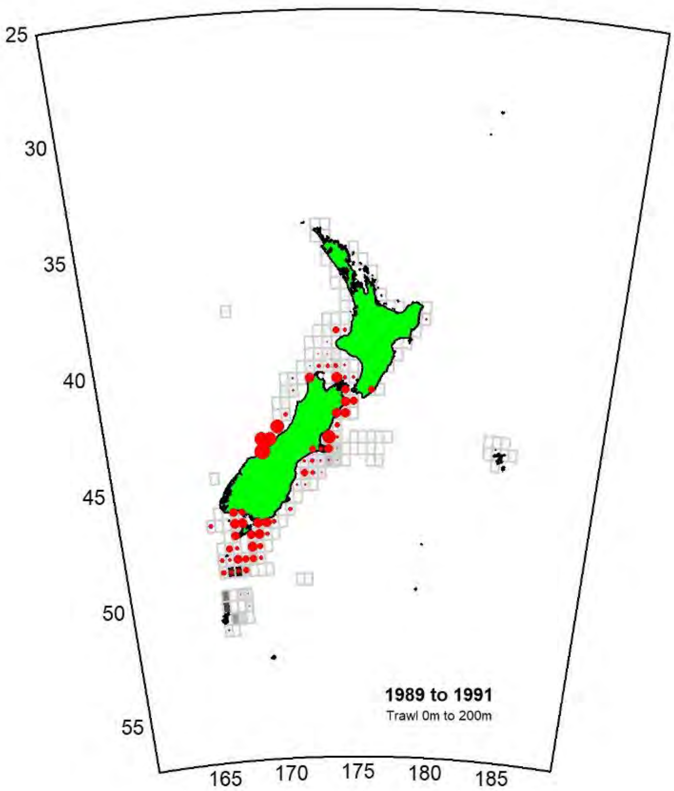


Figure 15.4 (cont.): Maps of blue warehou occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



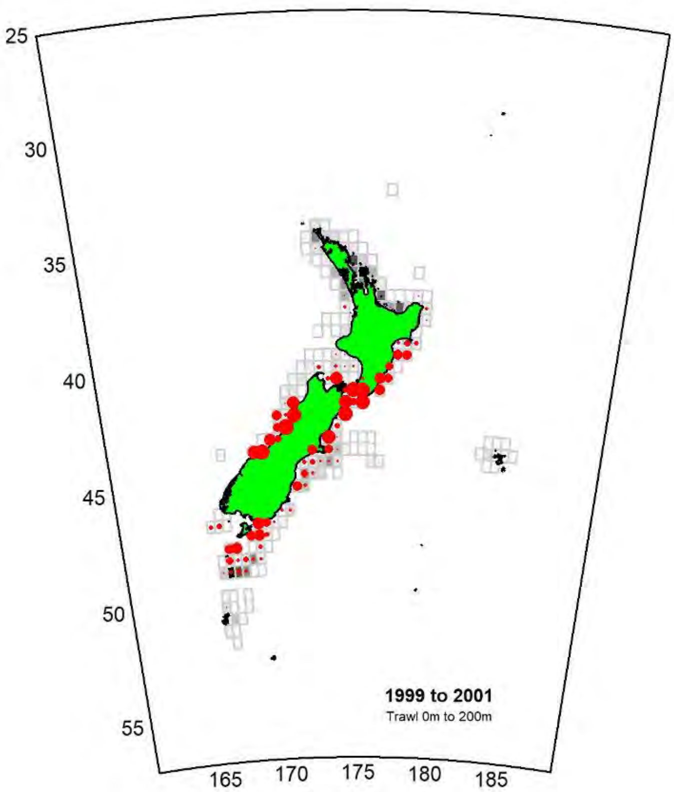
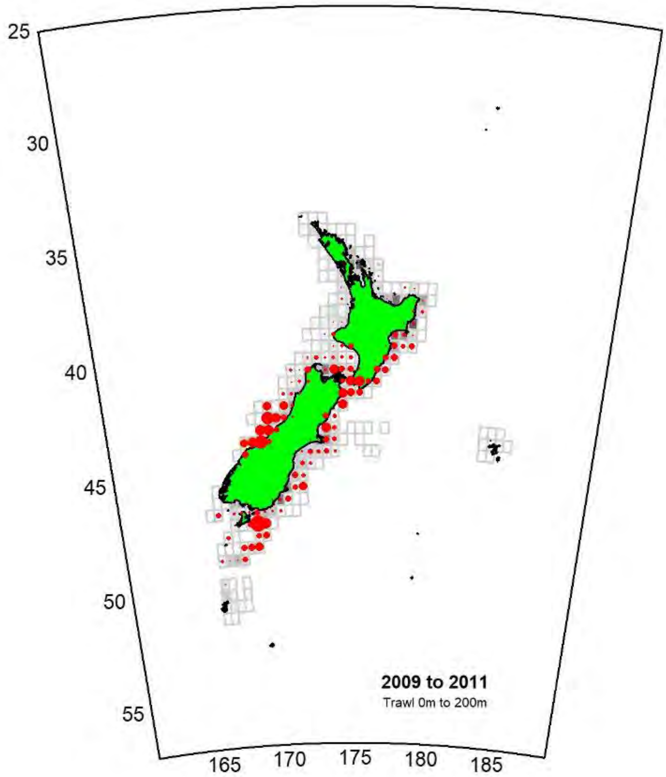


Figure 15.5: Maps of blue warehou occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



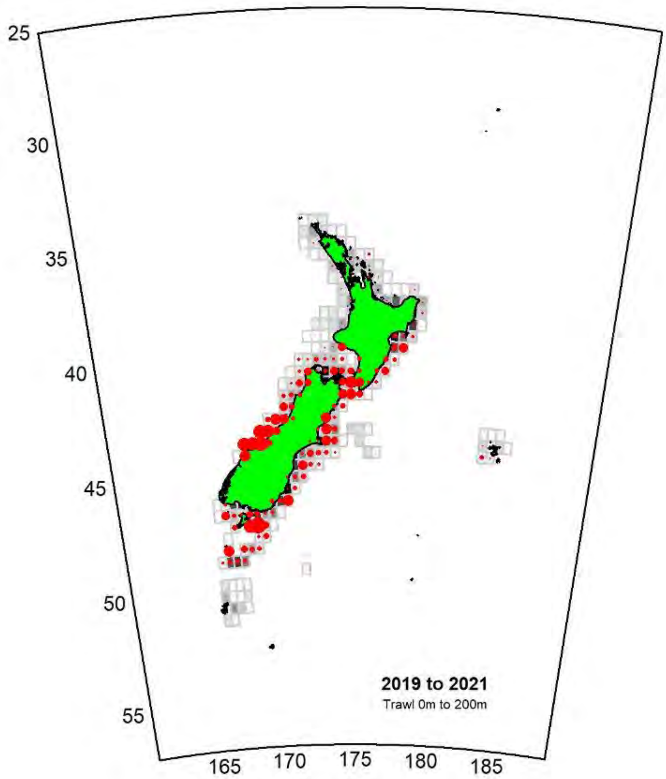


Figure 15.5 (cont.): Maps of blue warehou occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

16. Bluenose (BNS)

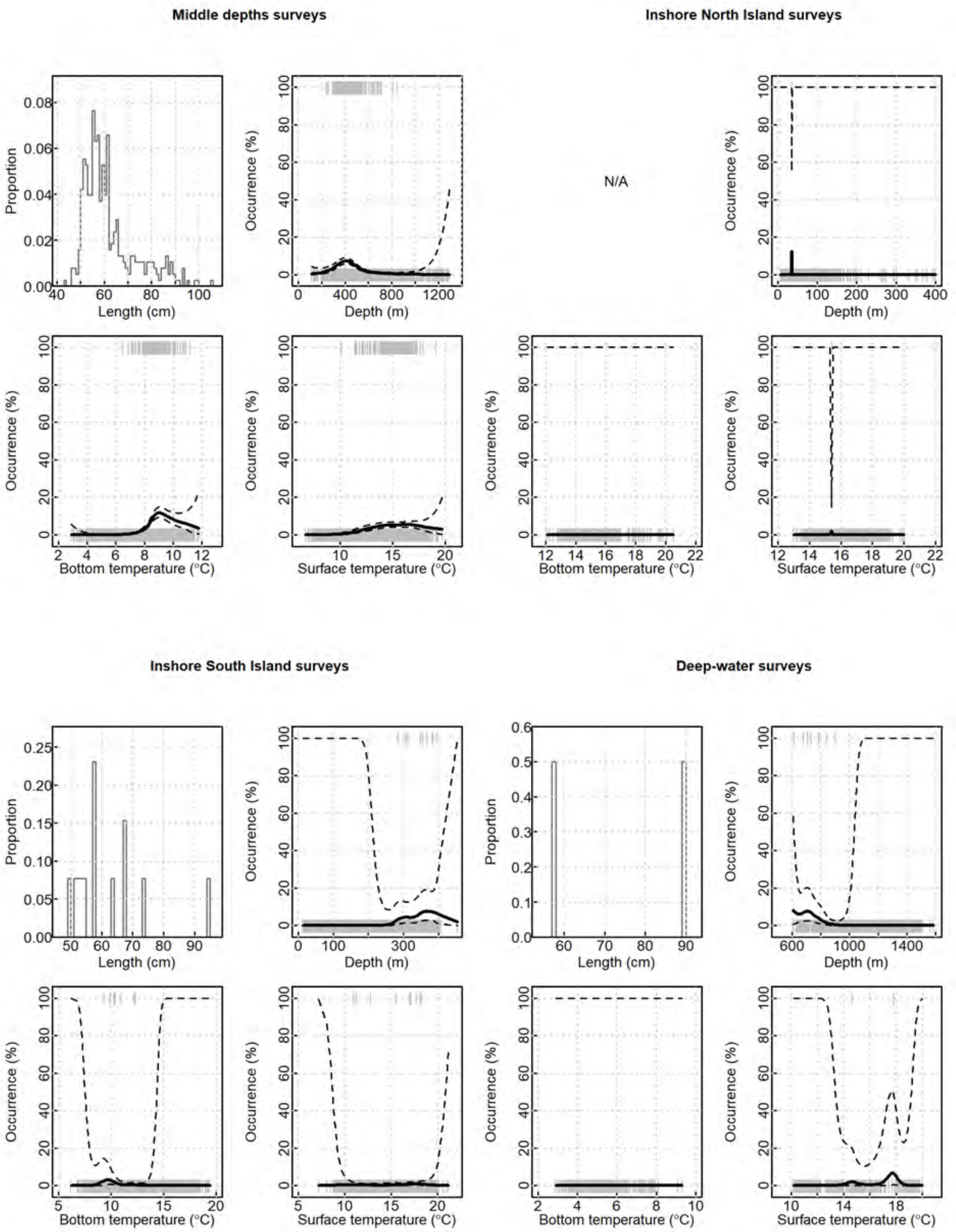


Figure 16.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to bluenose occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

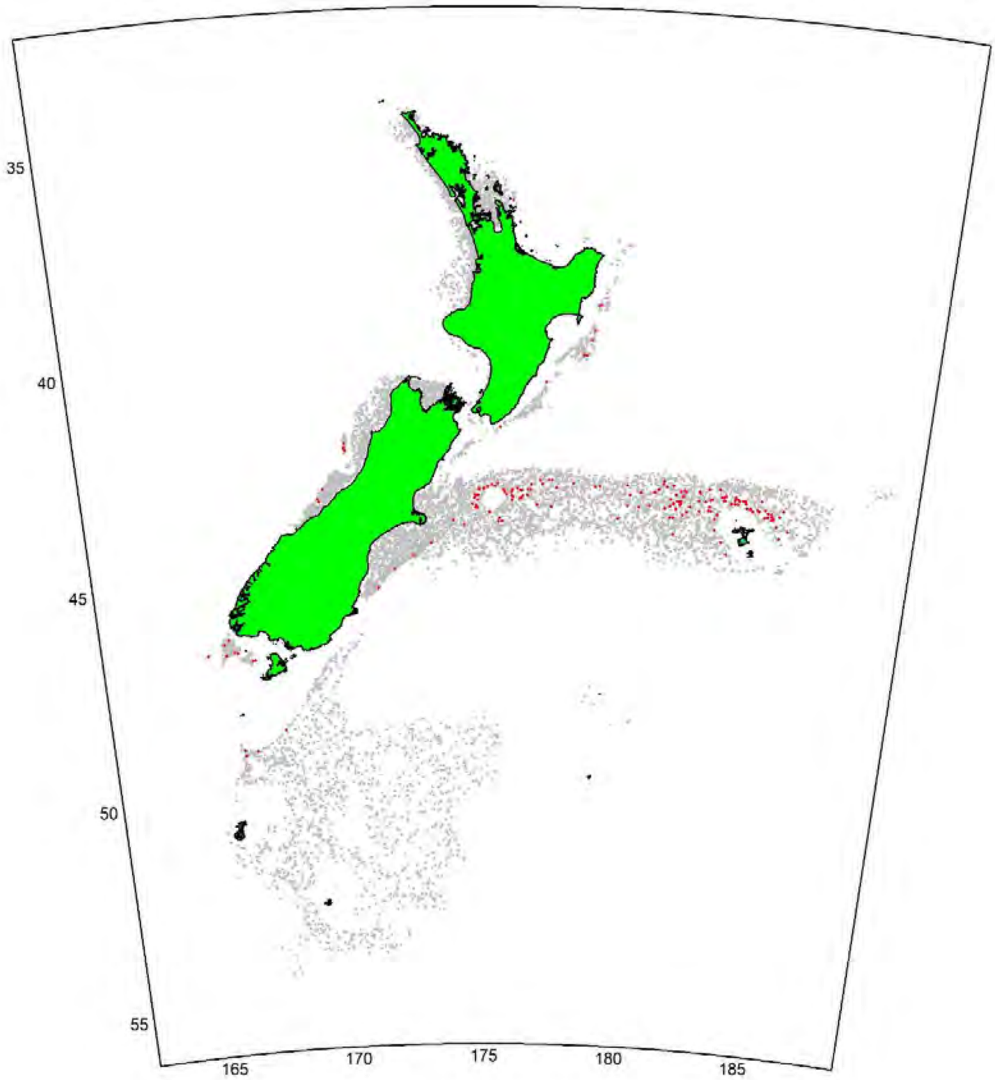


Figure 16.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where bluenose was caught (red points).

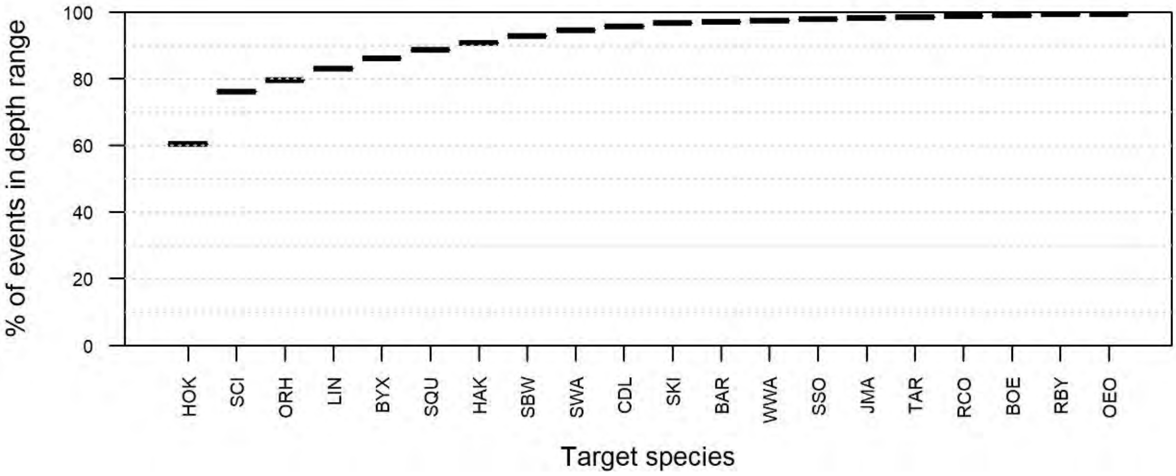
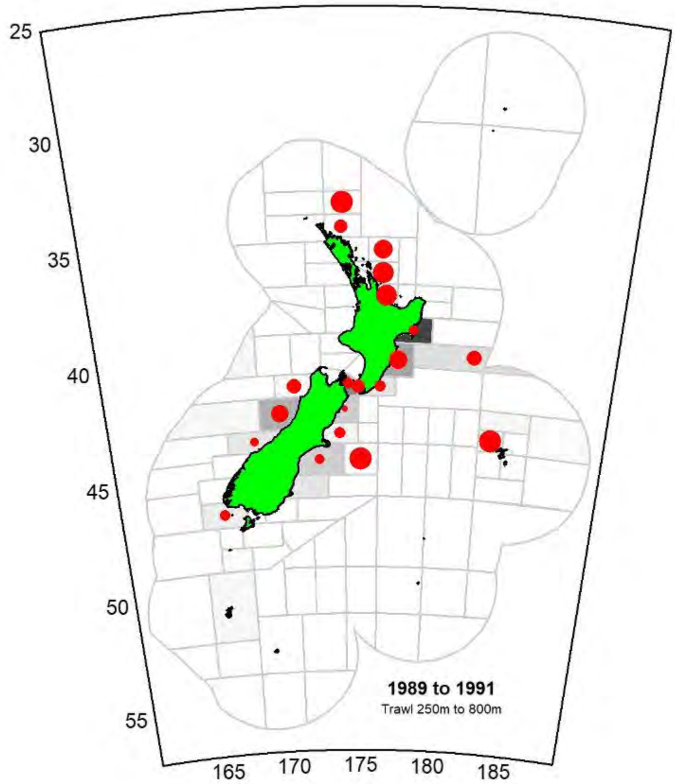


Figure 16.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for bluenose (250–800 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.



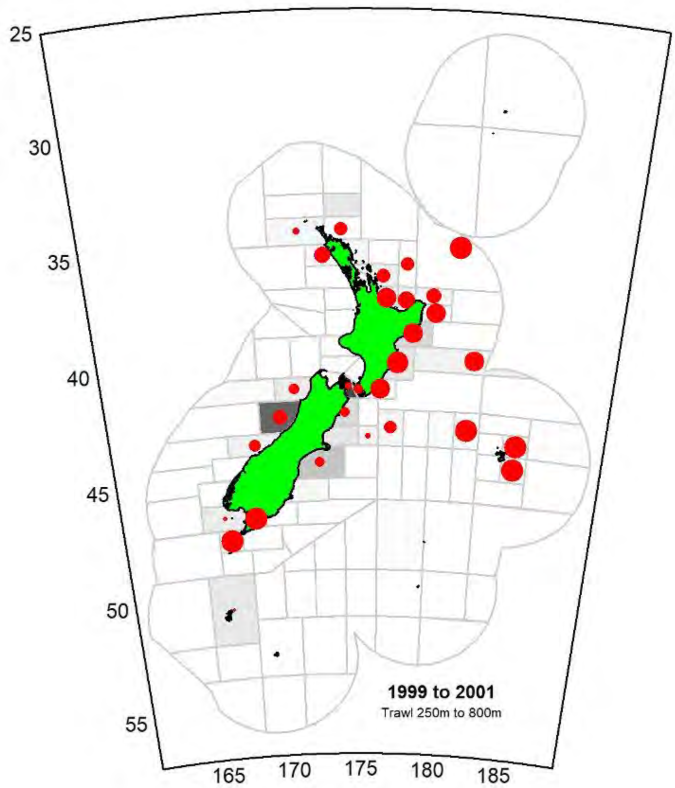
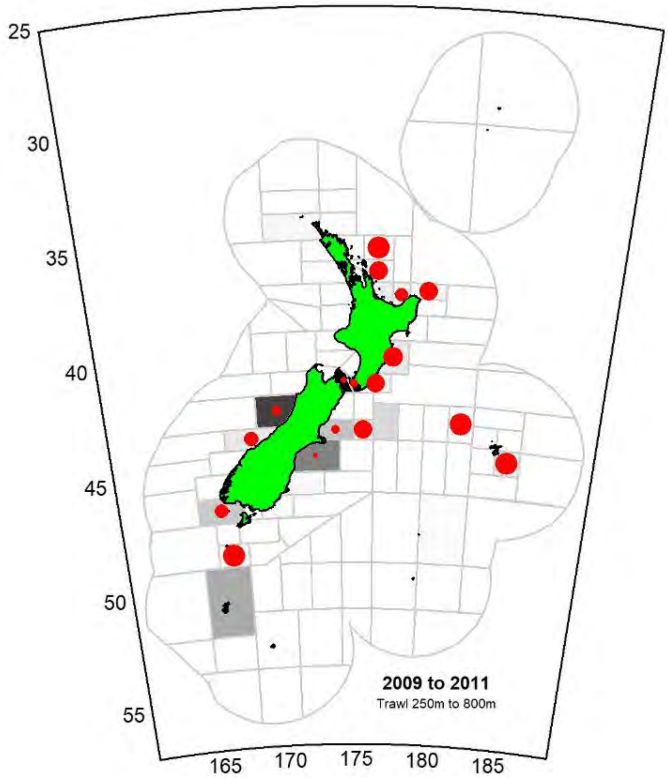


Figure 16.4: Maps of bluenose occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



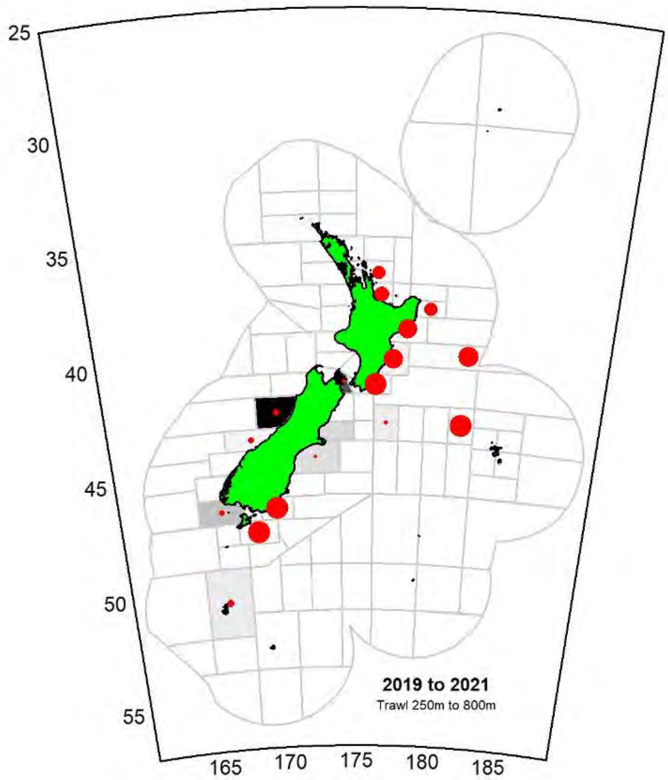


Figure 16.4 (cont.): Maps of bluenose occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

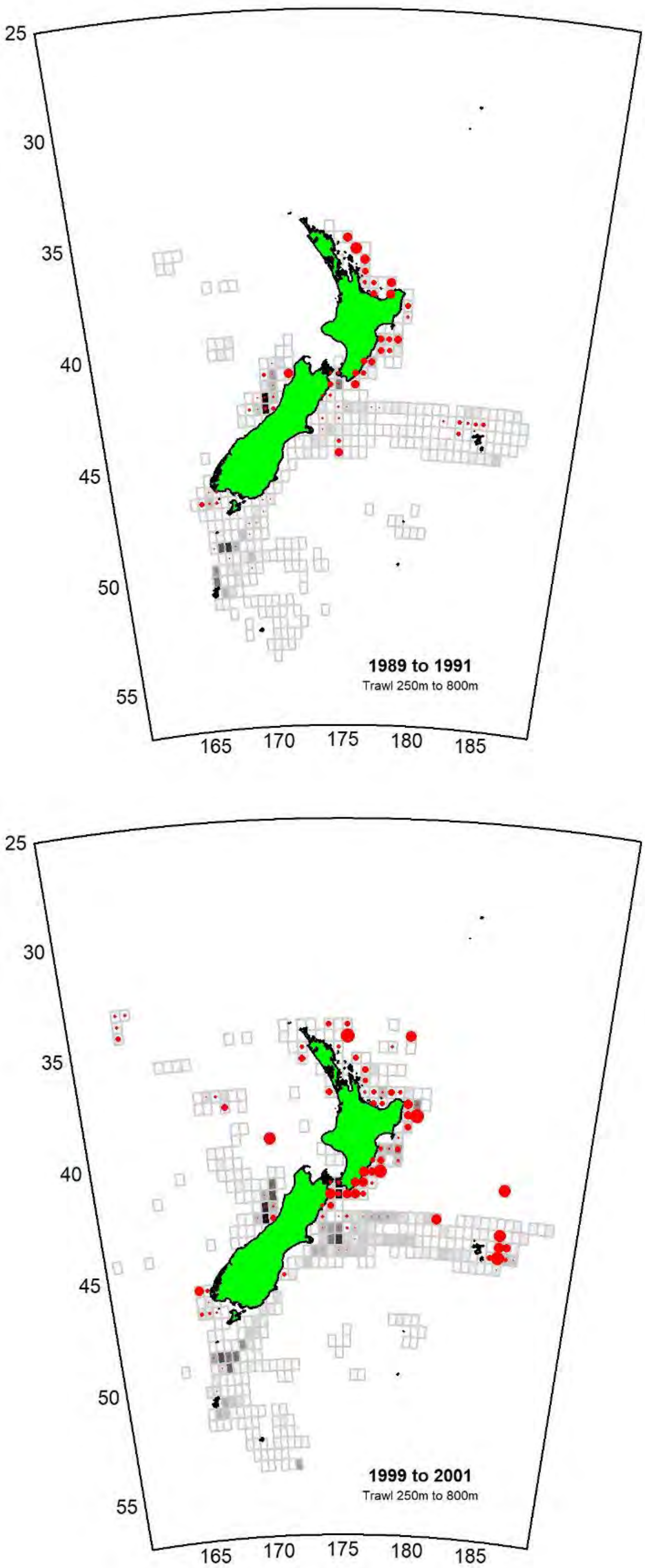
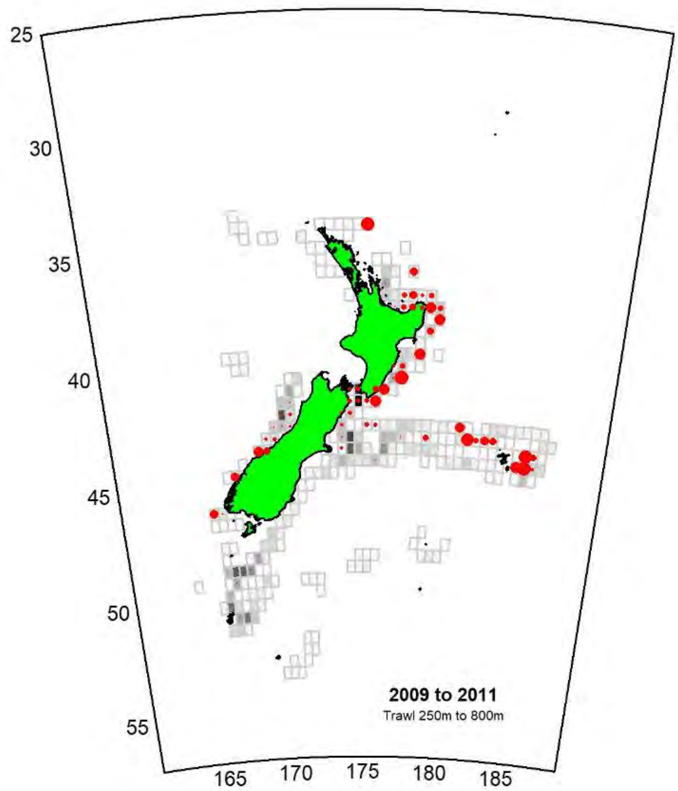


Figure 16.5: Maps of bluenose occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



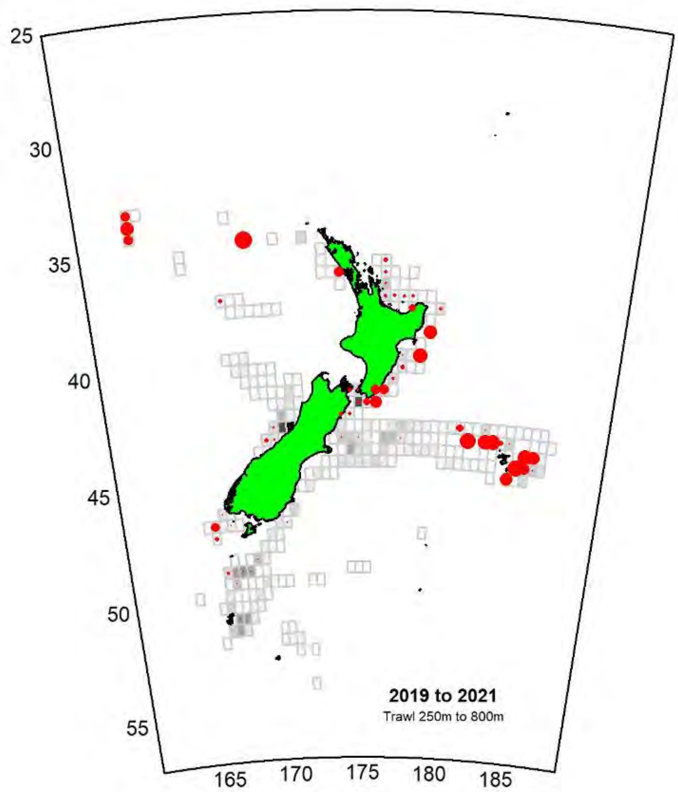


Figure 16.5 (cont.): Maps of bluenose occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

17. Butterfish (BUT)

Insufficient data exist in the research trawl data set or in the trawl or line commercial catch and effort data set.

18. Elephantfish (ELE)

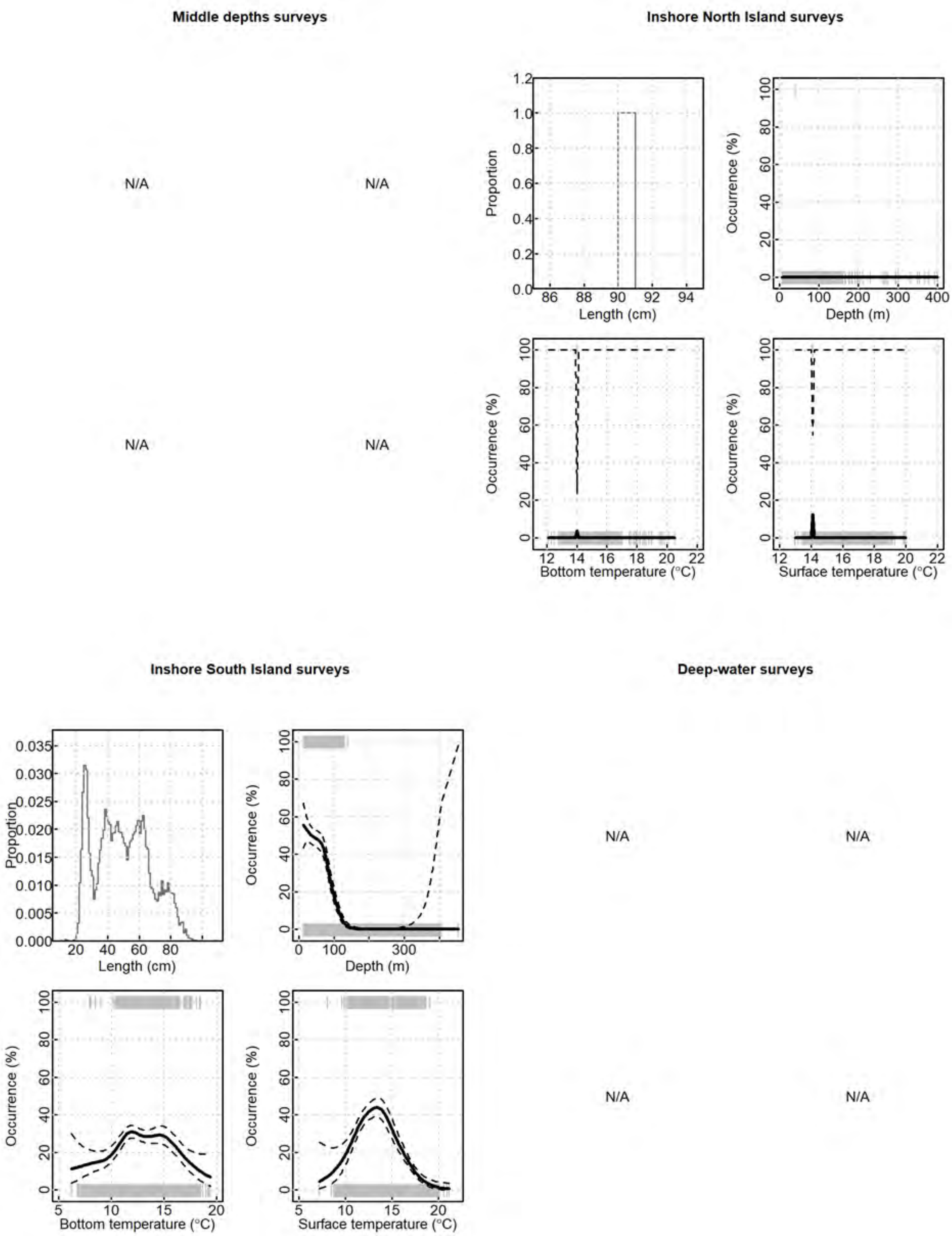


Figure 18.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to elephantfish occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

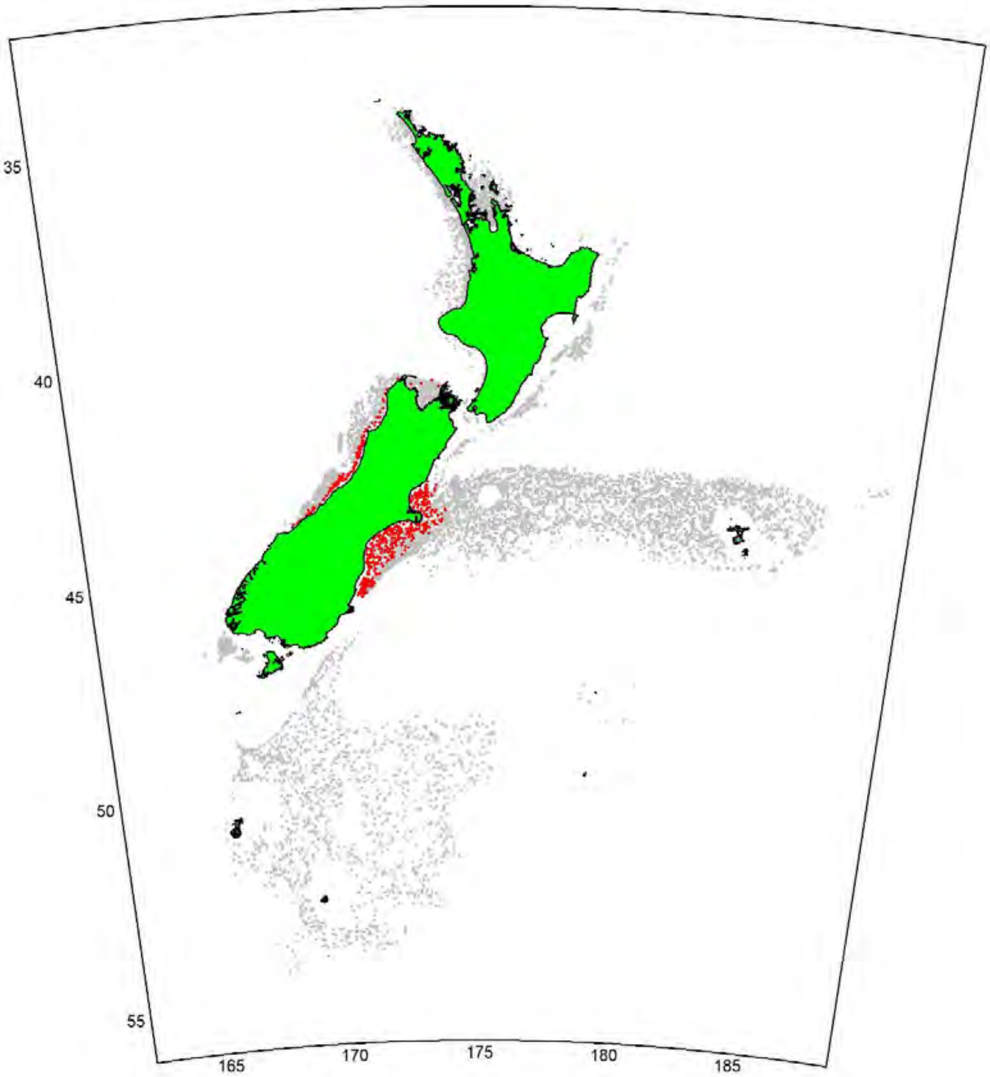


Figure 18.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where elephantfish was caught (red points).

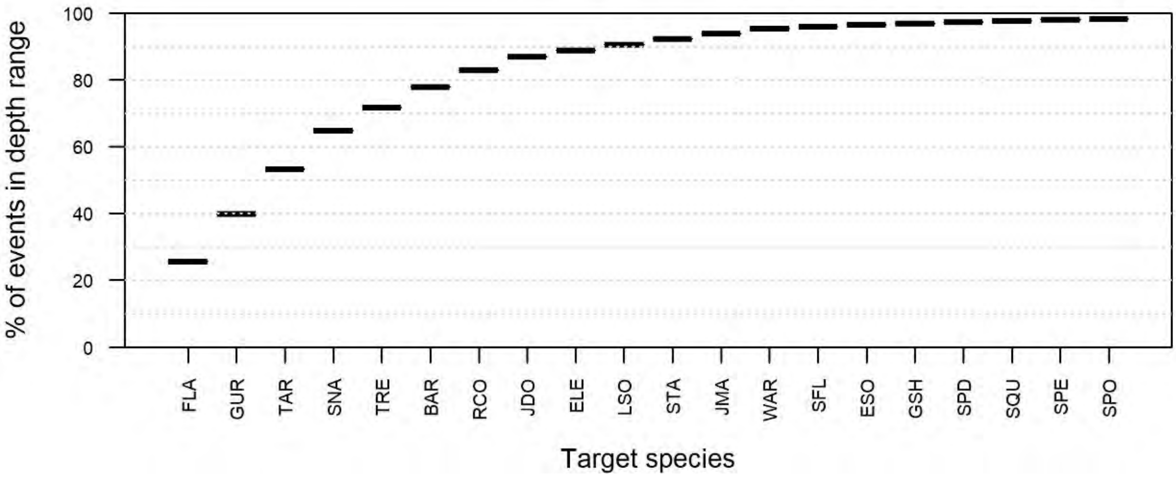


Figure 18.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for elephantfish (0–120 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.

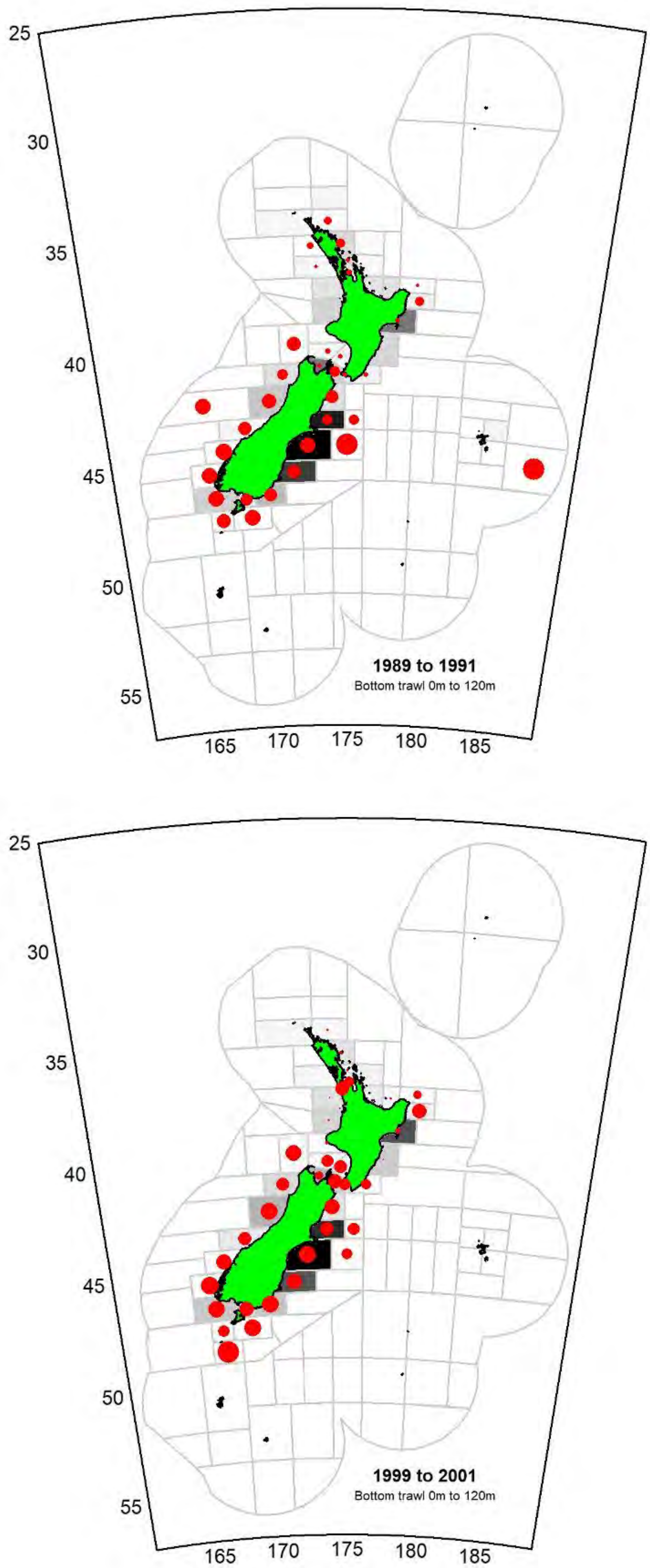
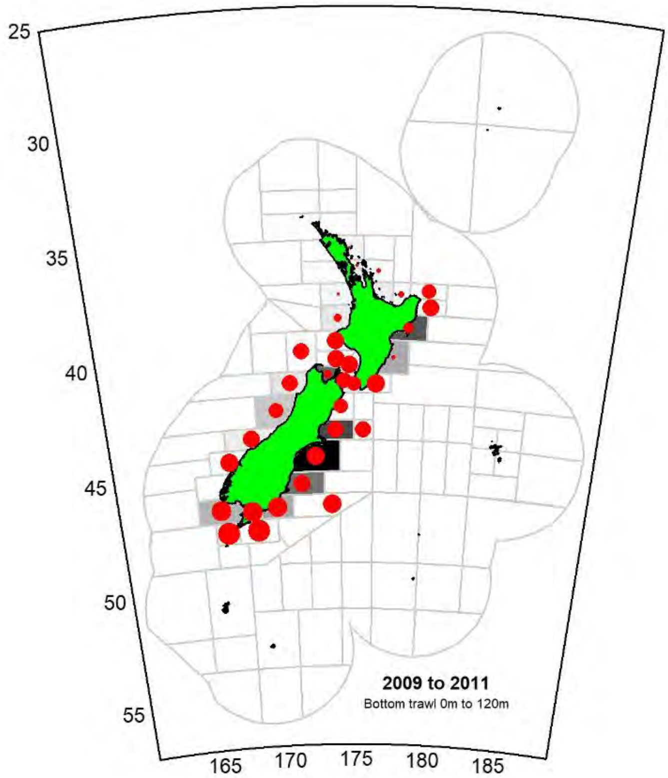


Figure 18.4: Maps of elephantfish occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



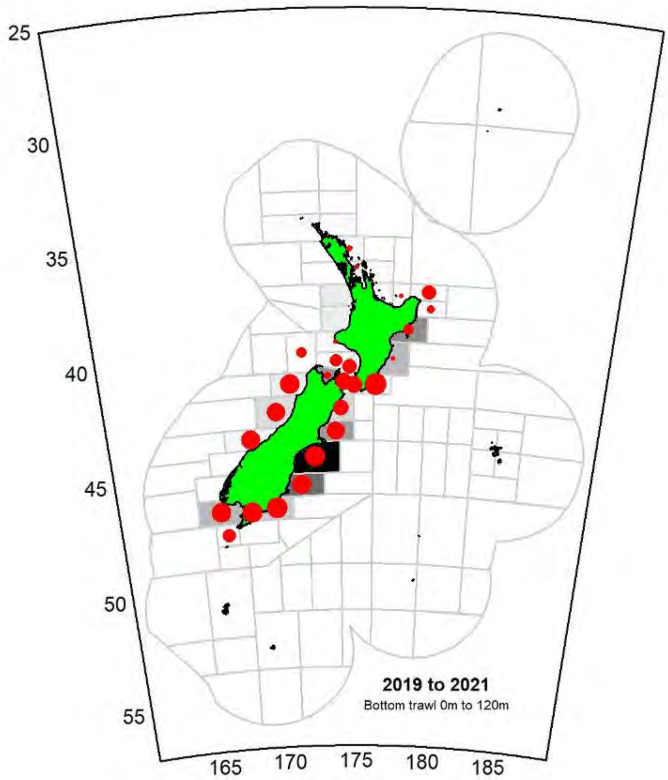
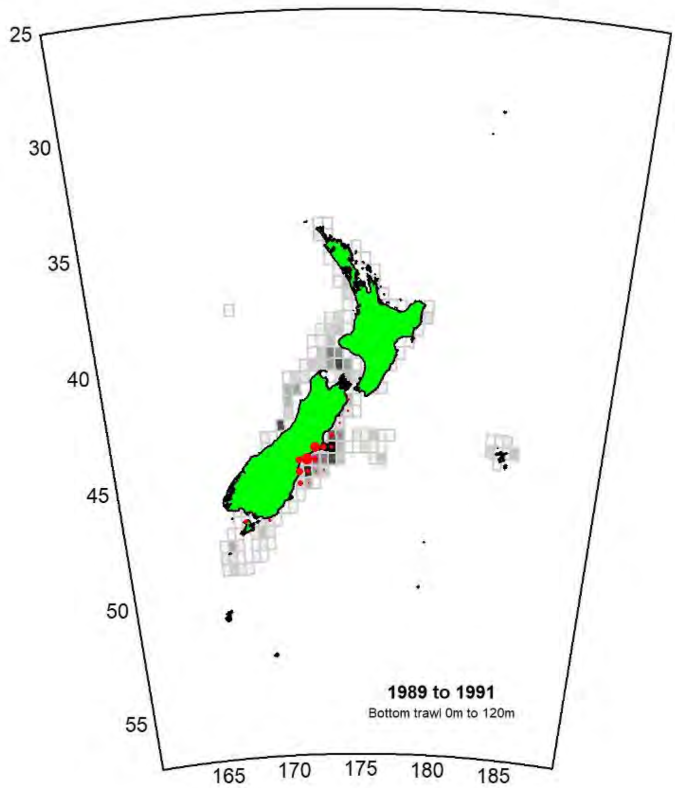


Figure 18.4 (cont.): Maps of elephantfish occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



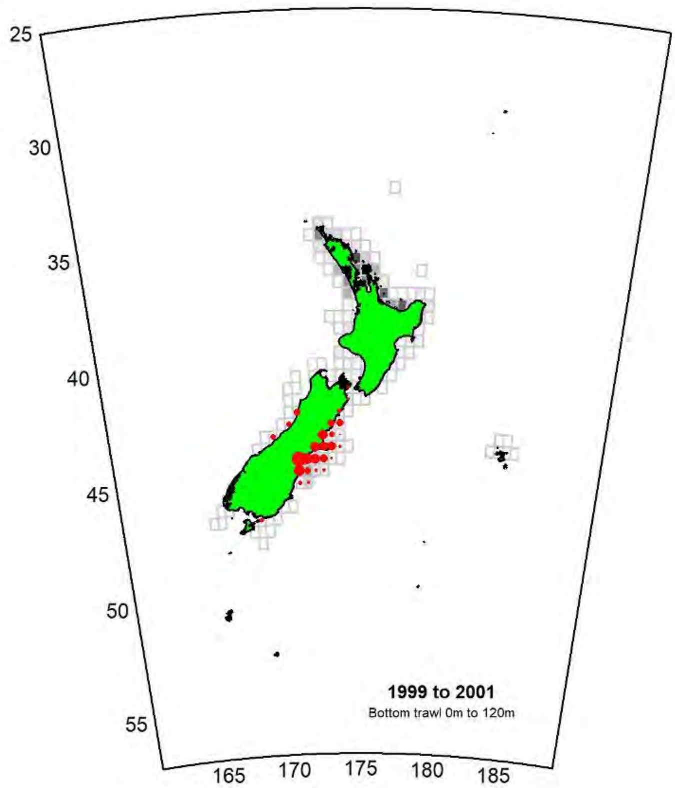
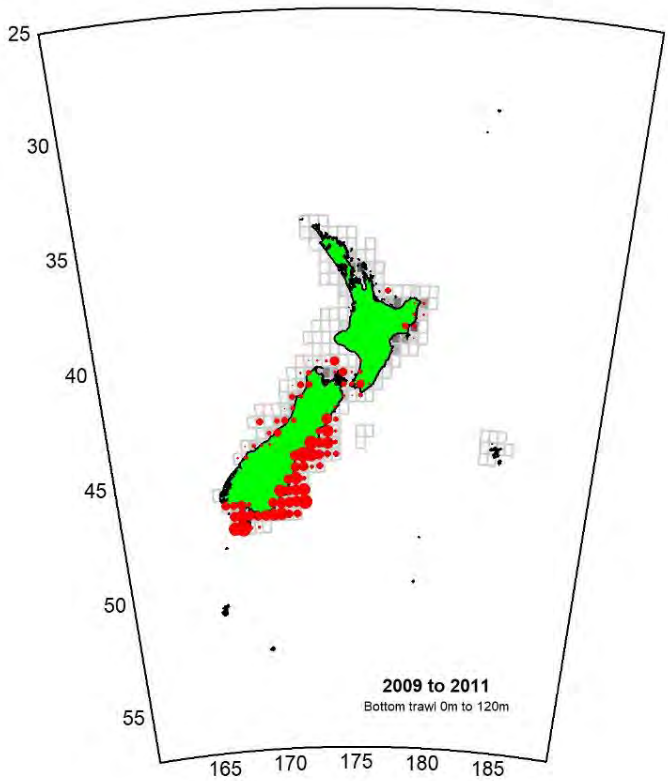


Figure 18.5: Maps of elephantfish occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



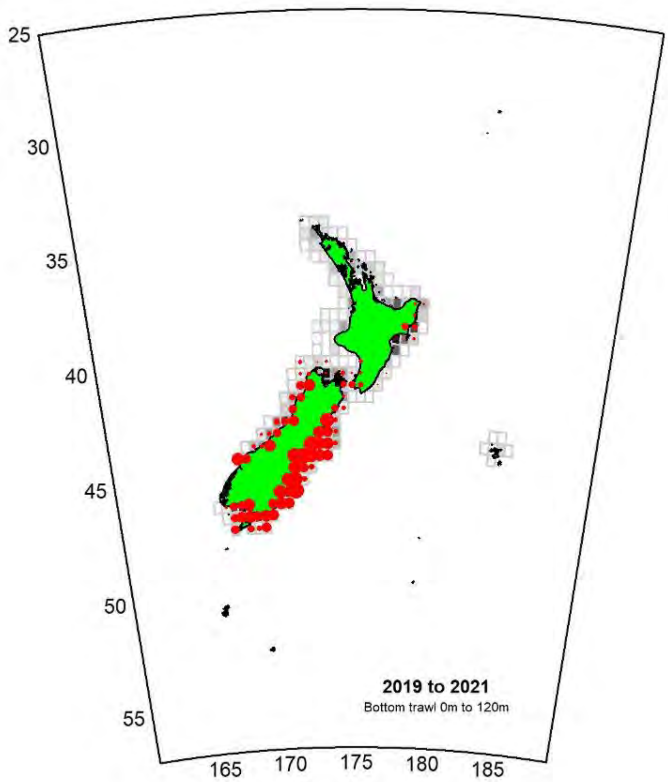


Figure 18.5 (cont.): Maps of elephantfish occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

19. Flatfish (Research, LSO, ESO, SFL, BFL, BRI, YBF, TUR, GFL; Commercial, FLA)

The commercial catch code FLA represents a group of eight species, without a single dominant species. Therefore, only research data are shown for each species here.

LSO

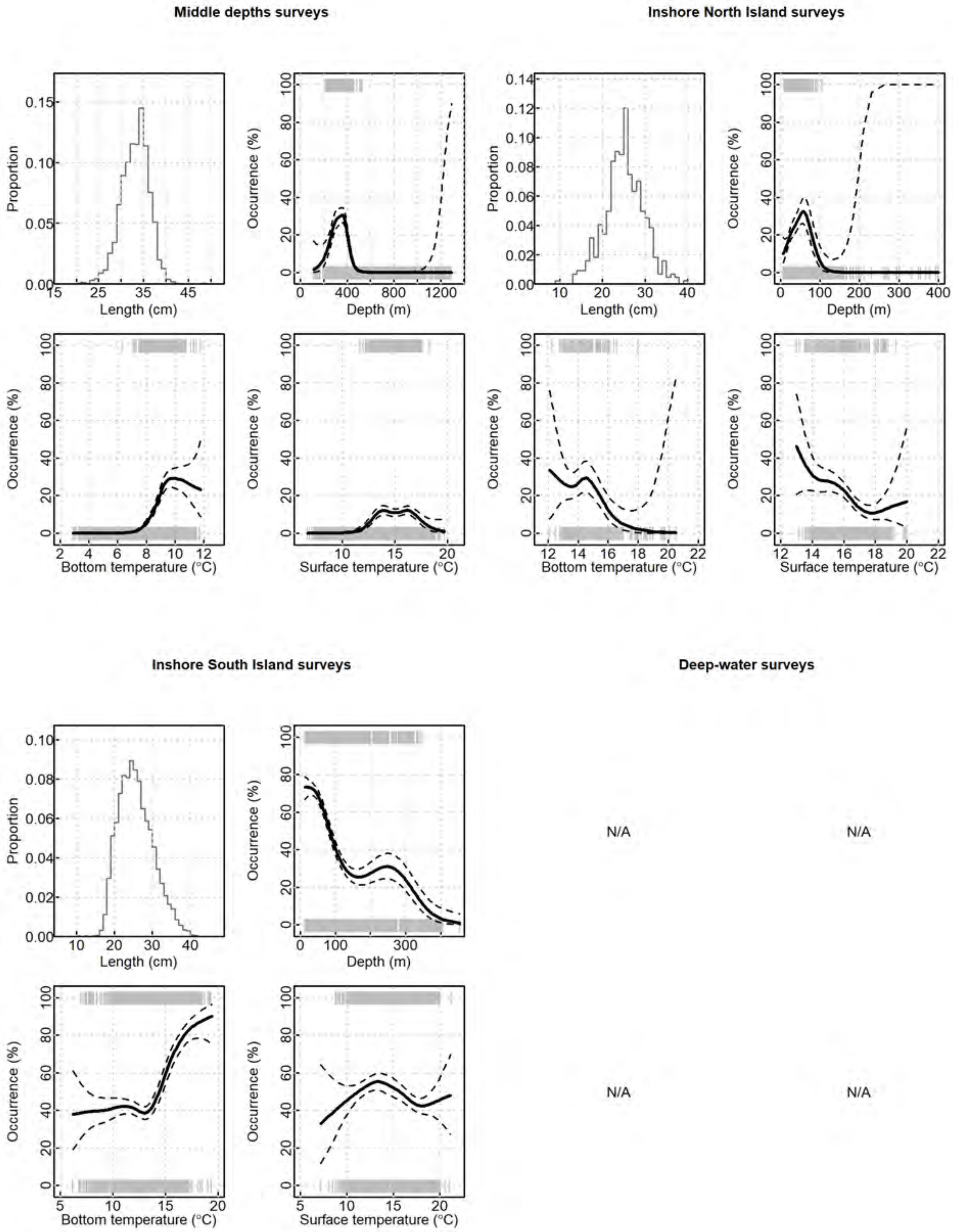


Figure 19.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to lemon sole occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

LSO

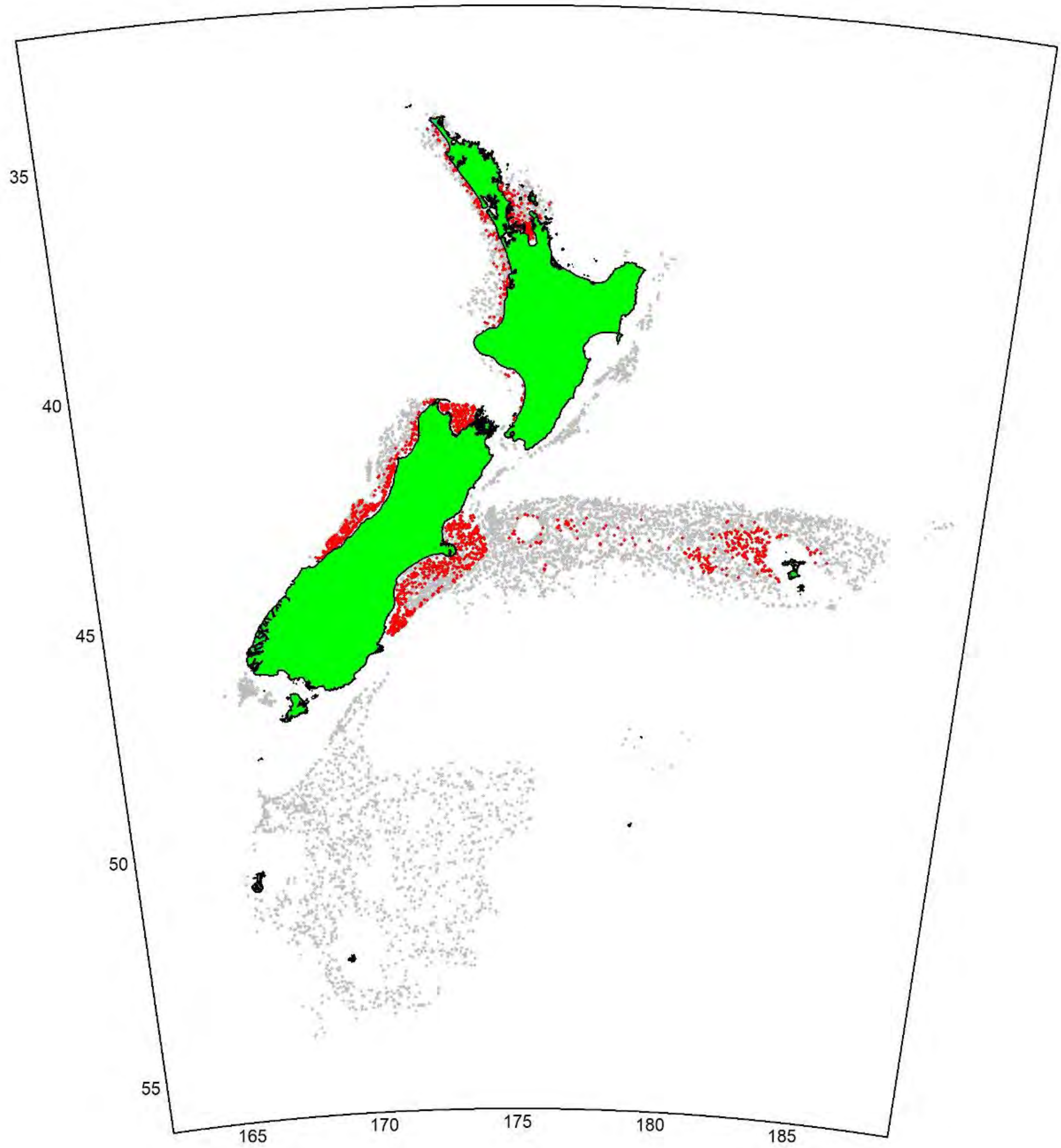


Figure 19.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where lemon sole was caught (red points).

ESO

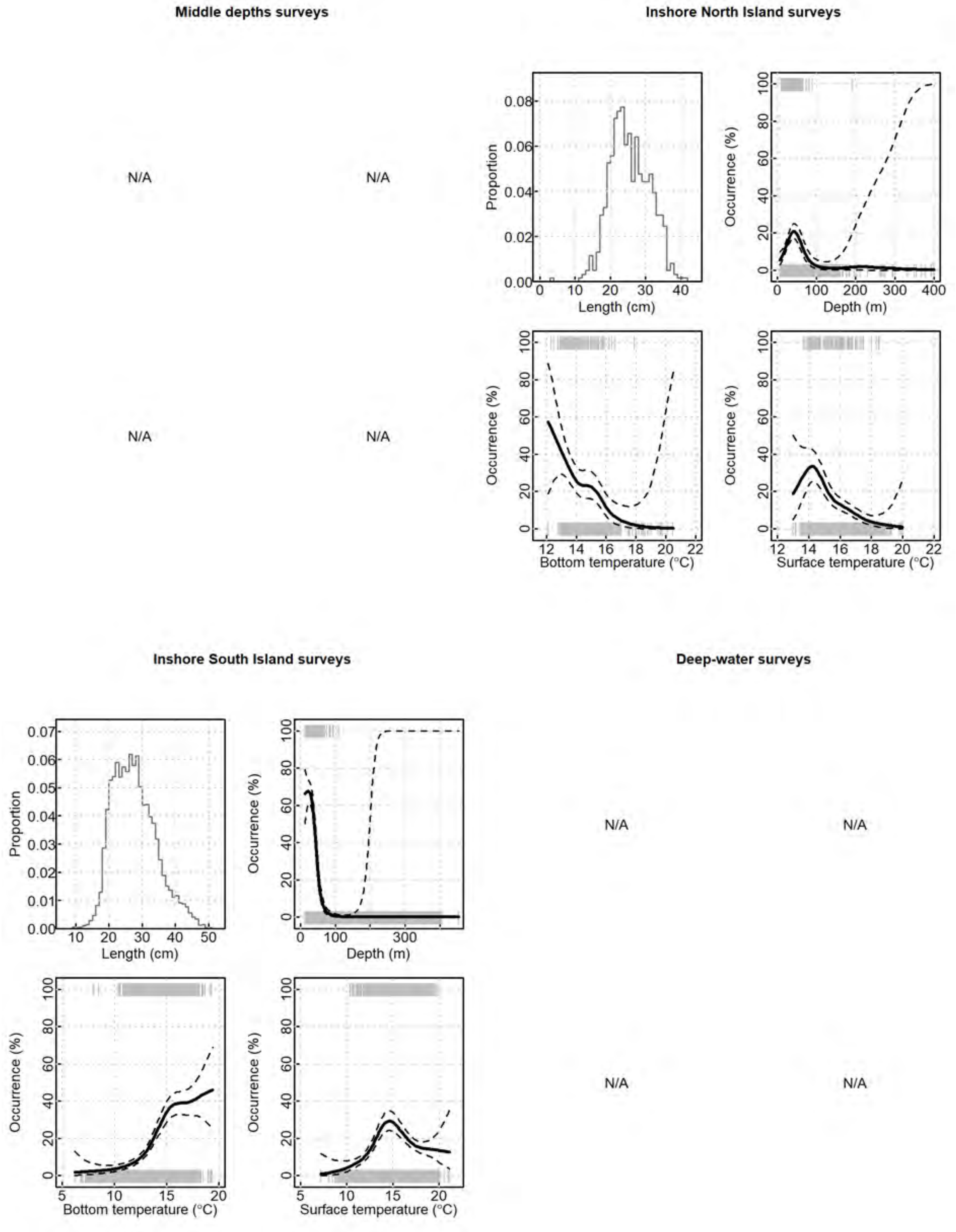


Figure 19.3: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to New Zealand sole occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

ESO

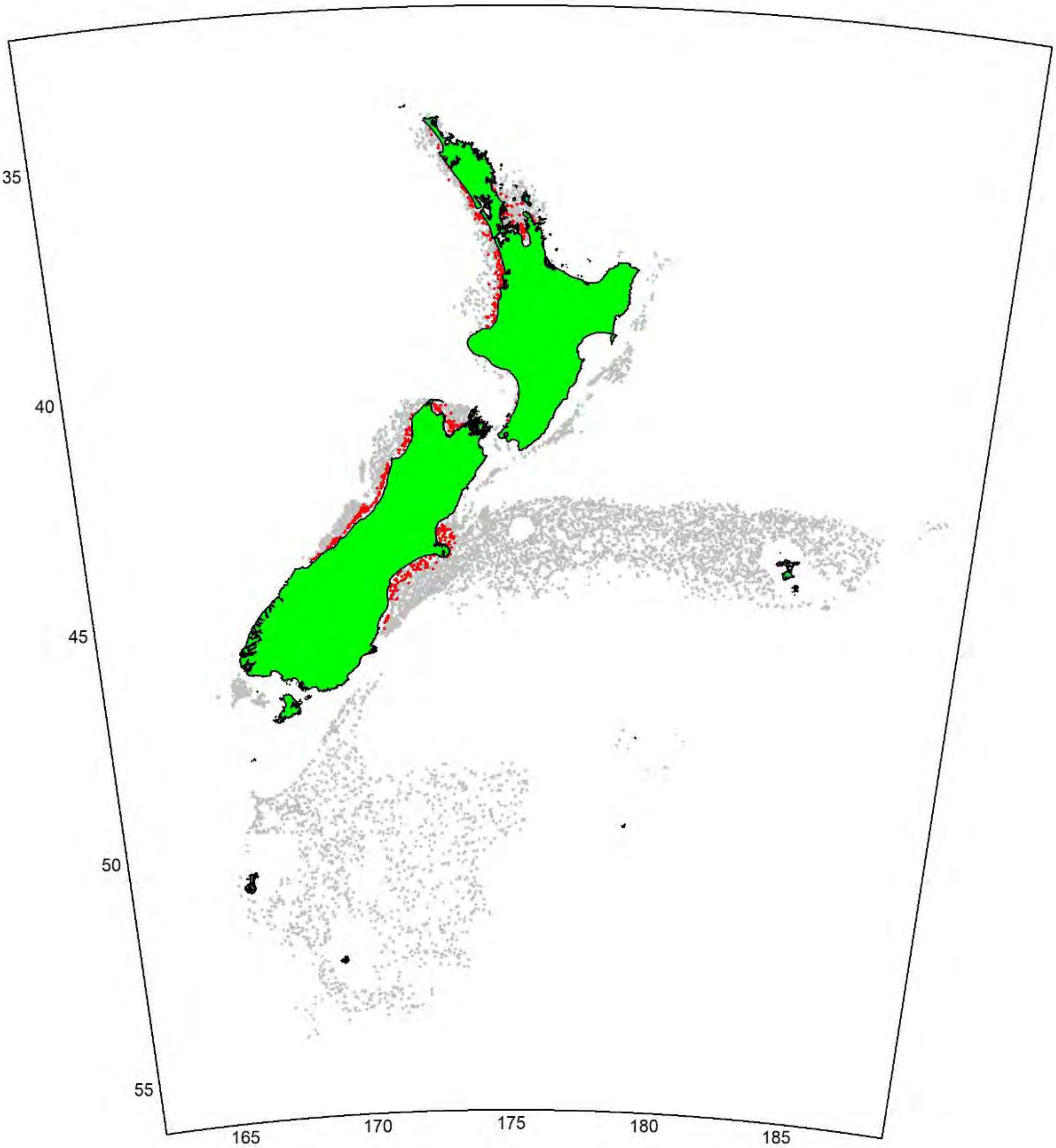


Figure 19.4: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where New Zealand sole was caught (red points).

SFL

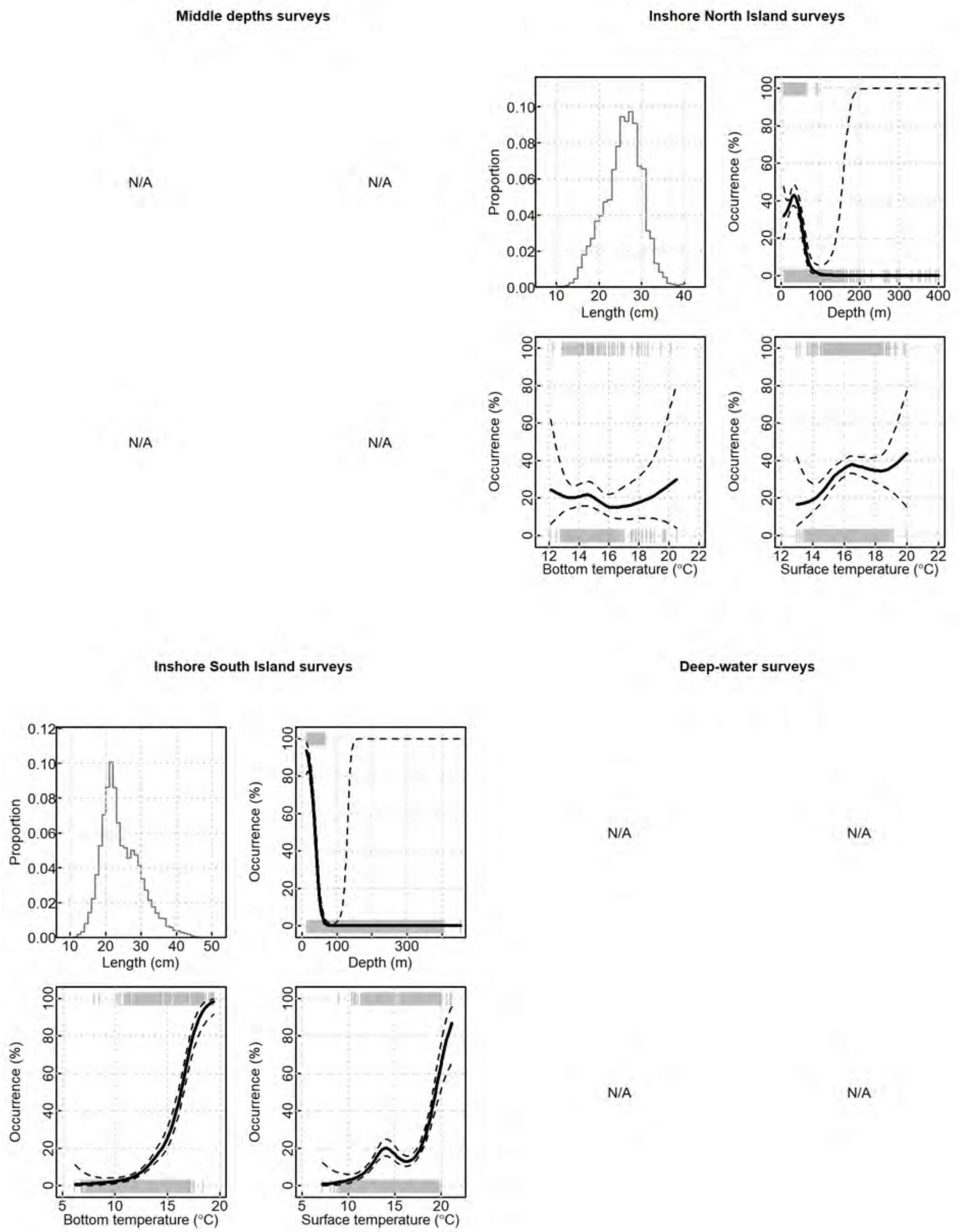


Figure 19.5: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to sand flounder occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

SFL

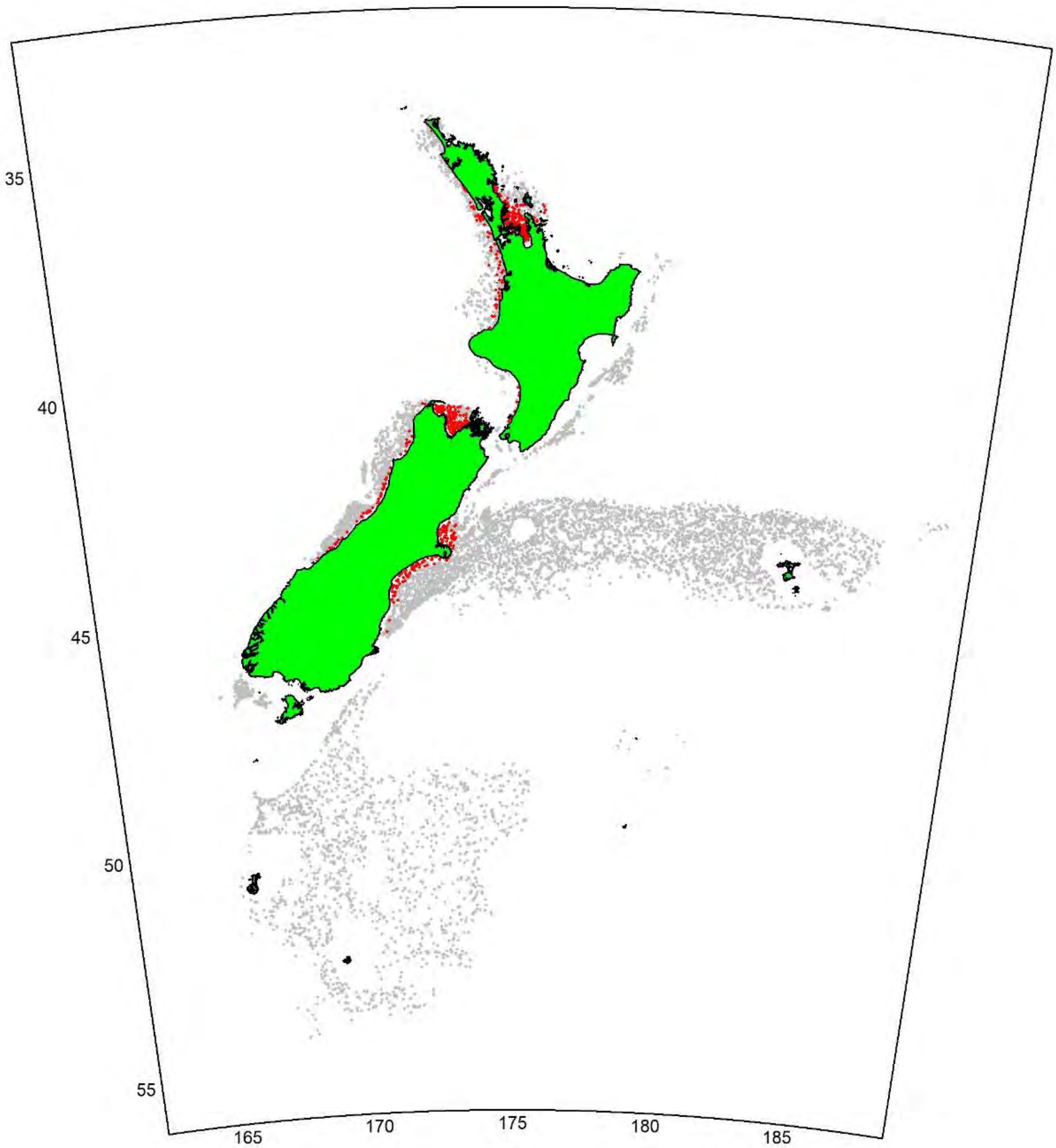


Figure 19.6: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where sand flounder was caught (red points).

GFL (BFL)

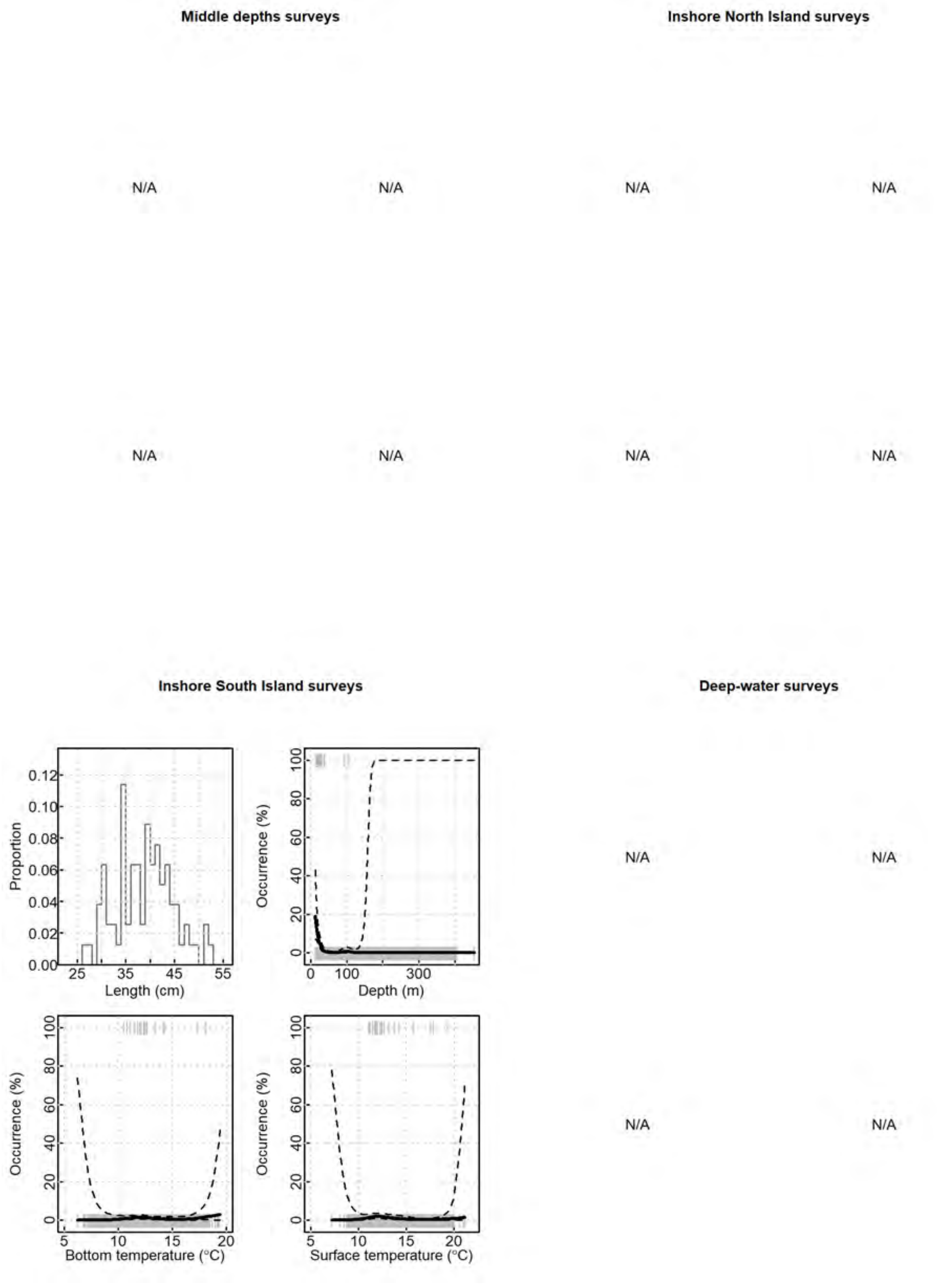


Figure 19.7: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to black flounder occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

BFL – no data

GFL

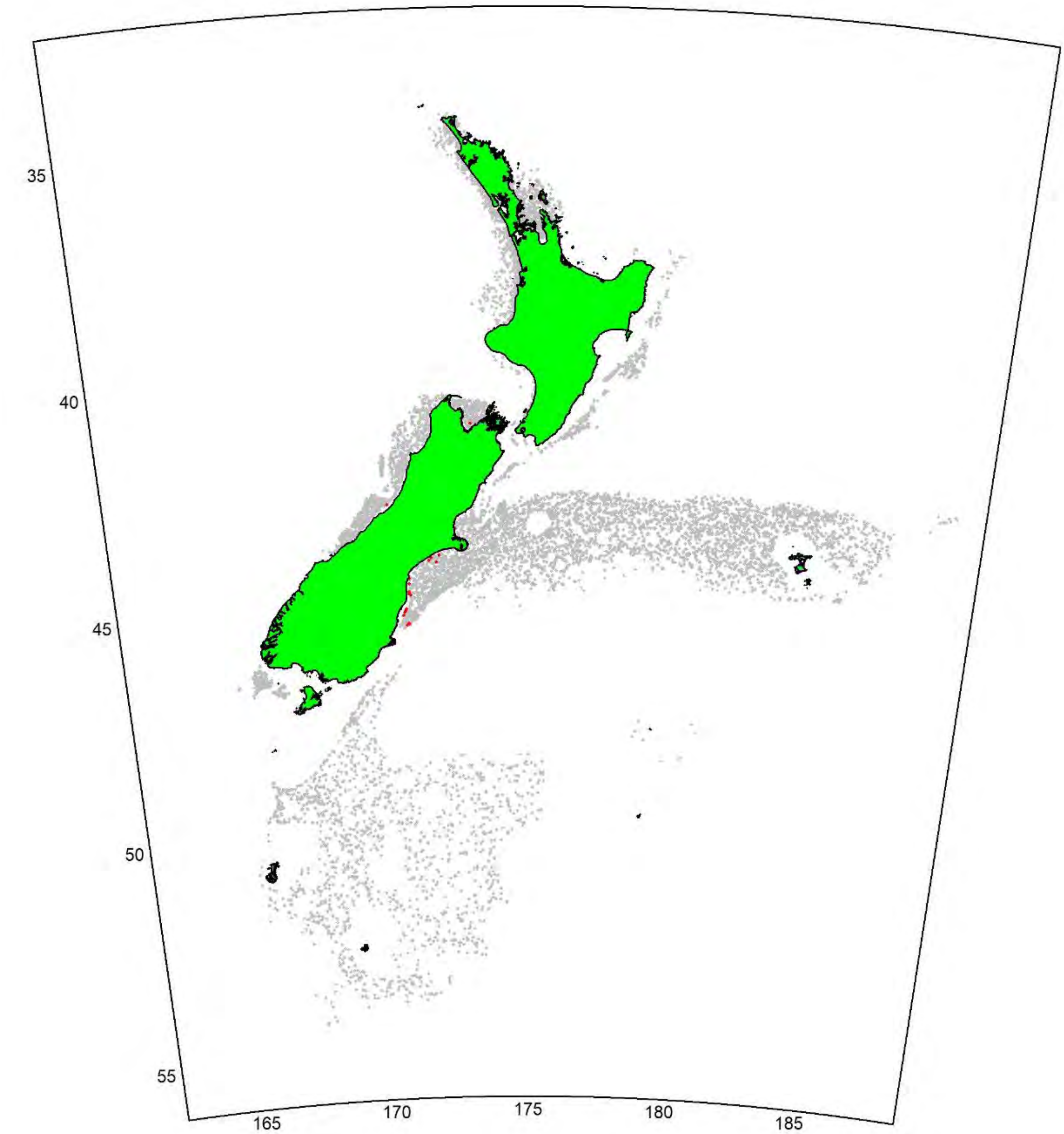


Figure 19.8: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where greenback flounder was caught (red points).

BRI

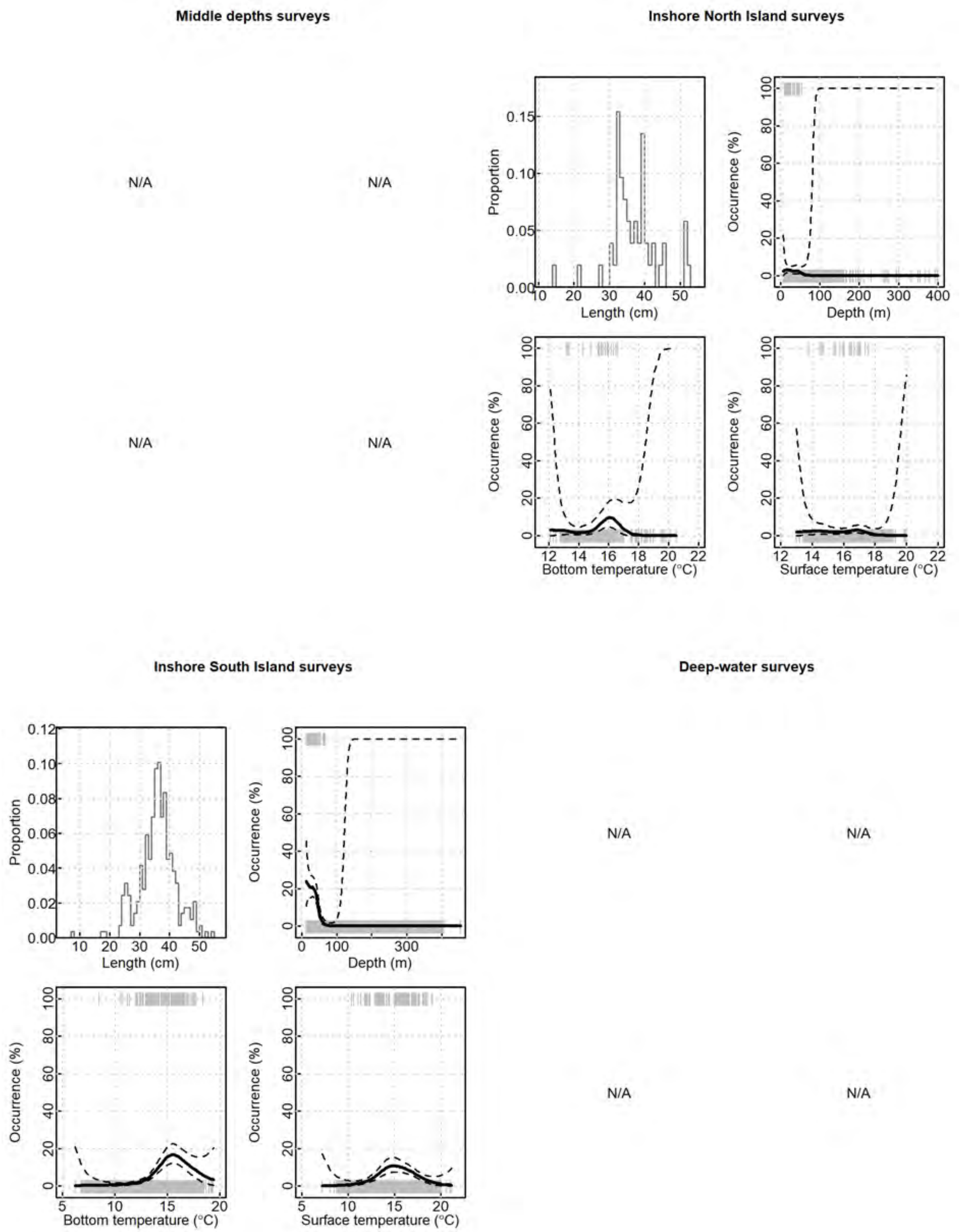


Figure 19.9: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to brill occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

BRI

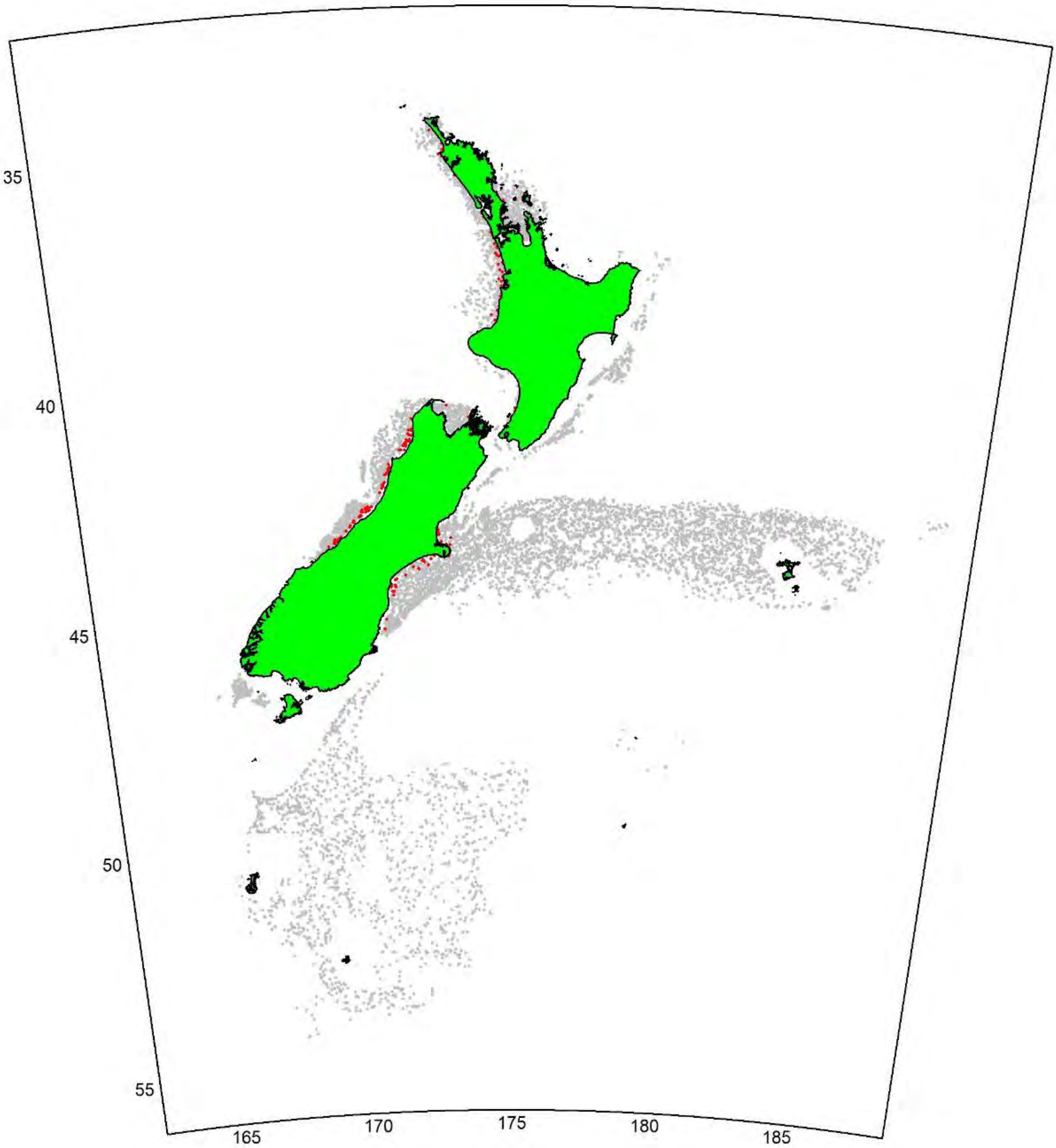


Figure 19.10: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where brill was caught (red points).

YBF

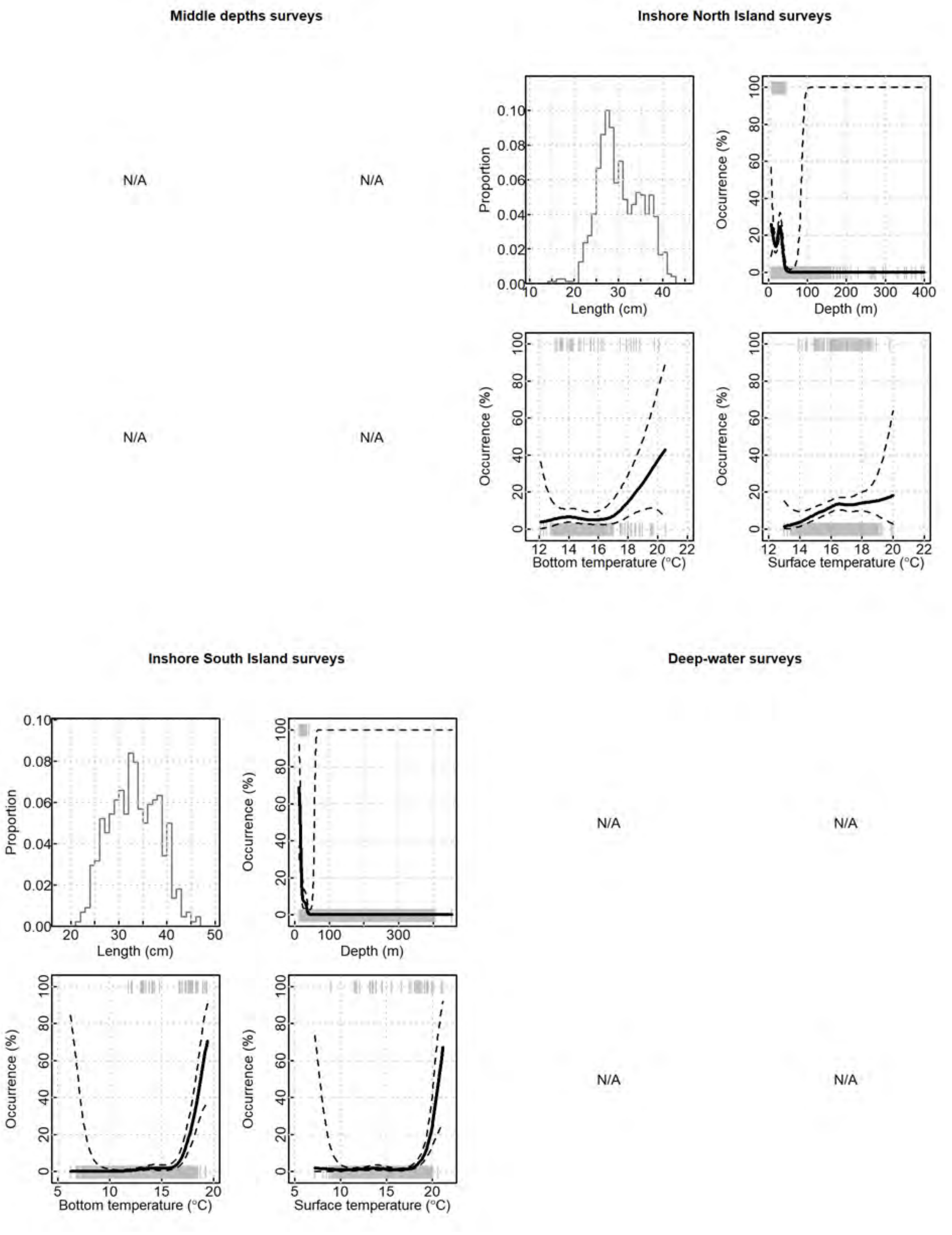


Figure 19.11: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to yellowbelly flounder occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

YBF

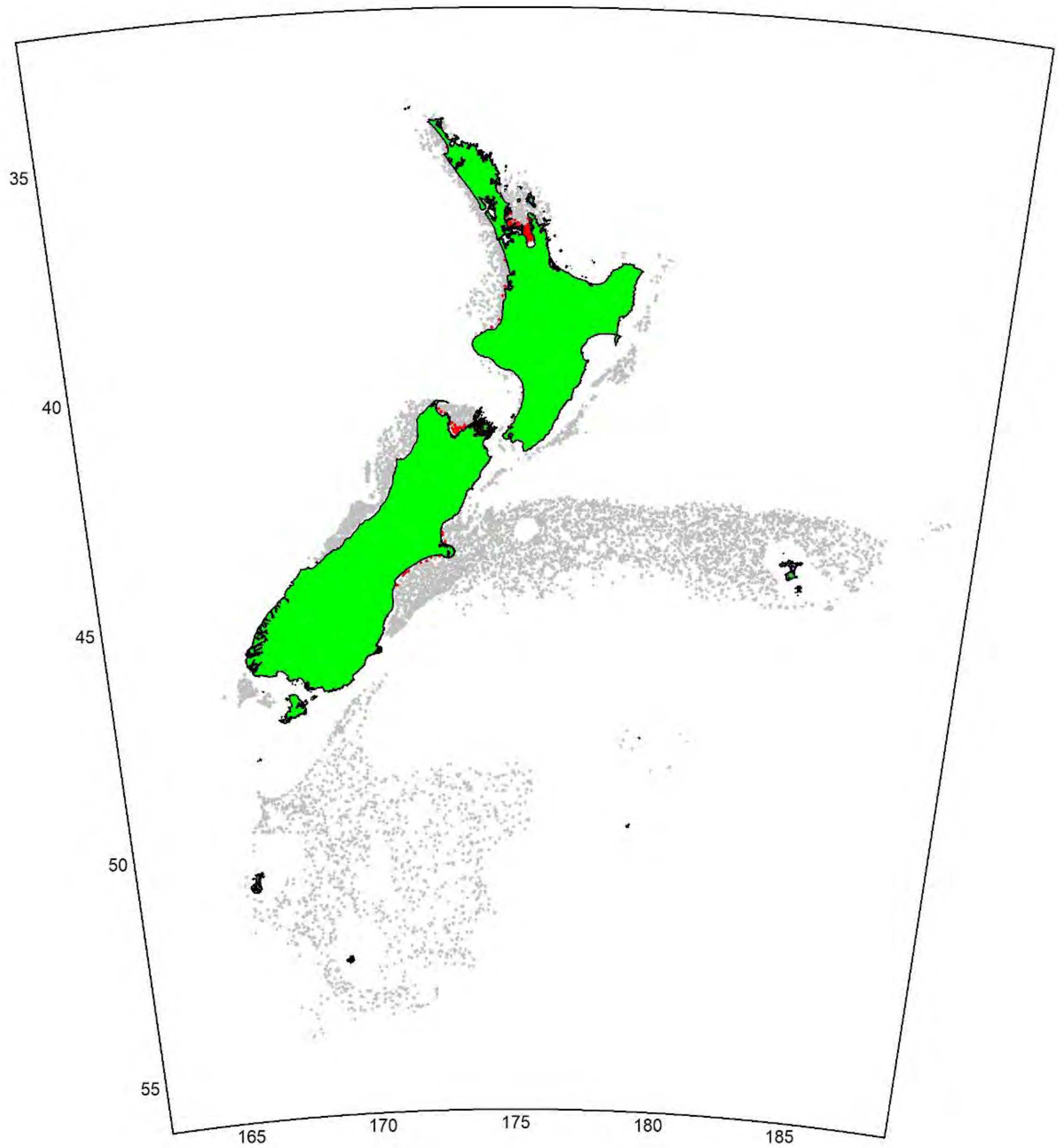


Figure 19.12: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where yellowbelly flounder was caught (red points).

TUR

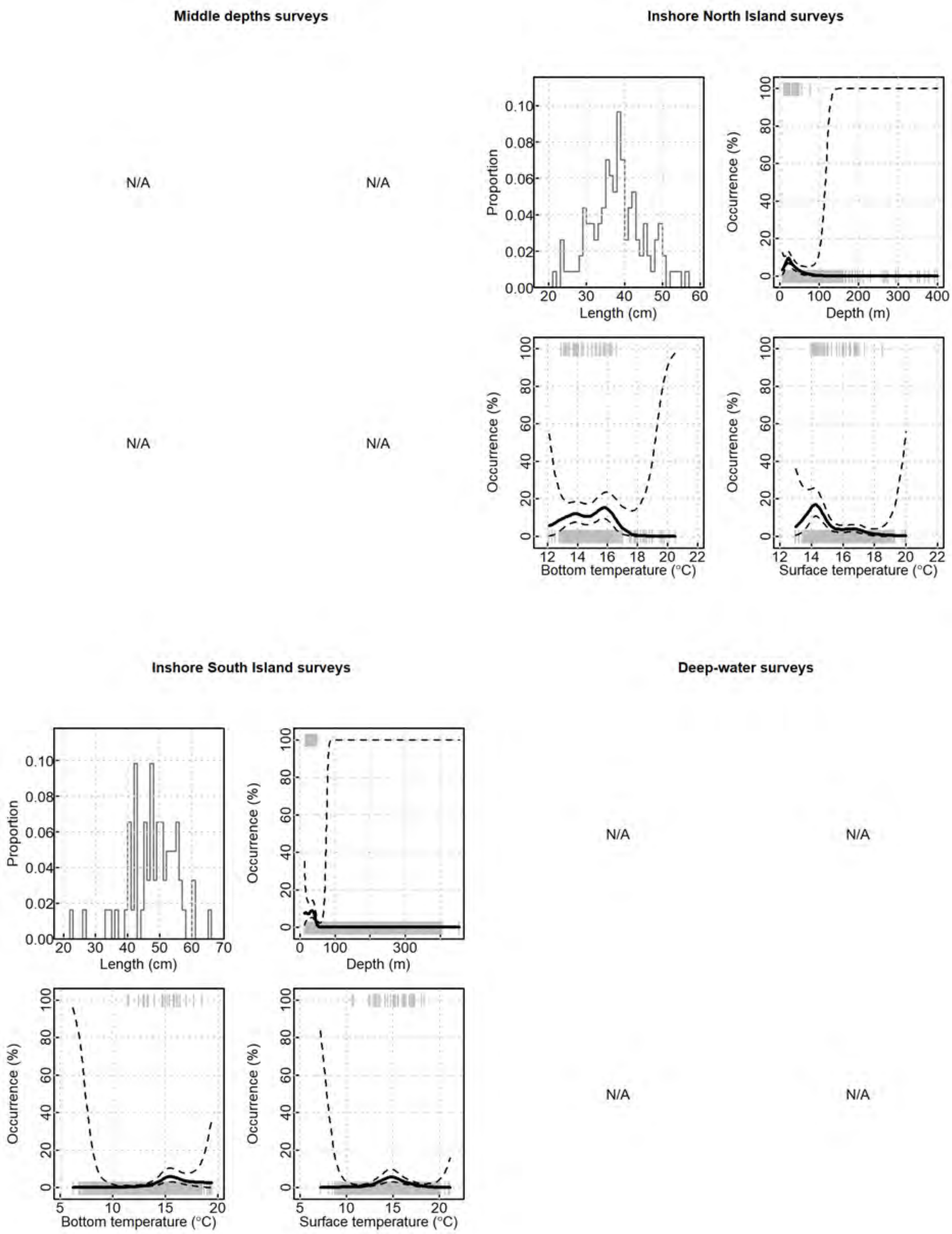


Figure 19.13: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to turbot occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

TUR

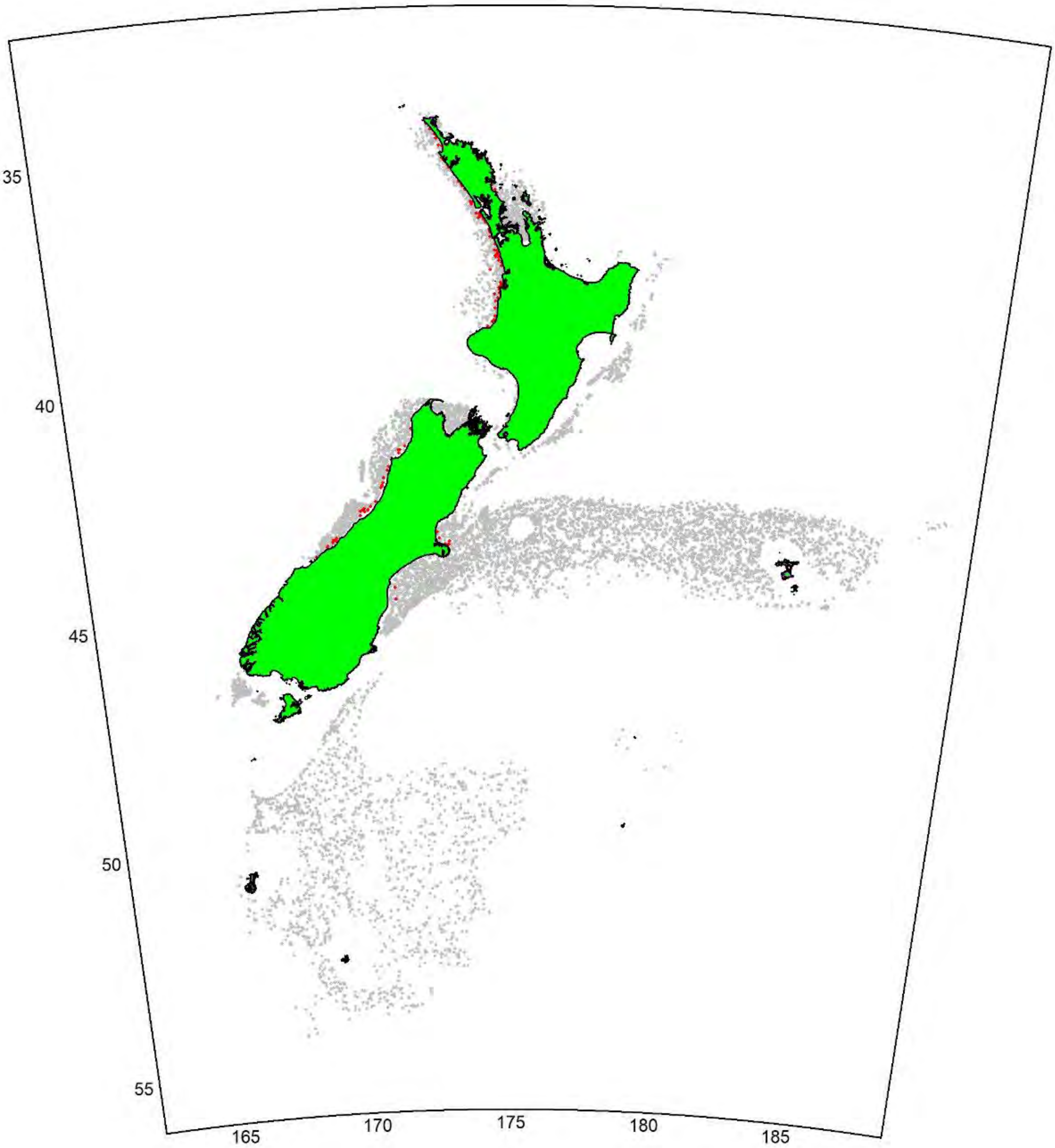


Figure 19.14: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where turbot was caught (red points).

FLA

No maps of flatfish distribution are provided because of the high confounding of species under the FLA code.

20. Frostfish (FRO)

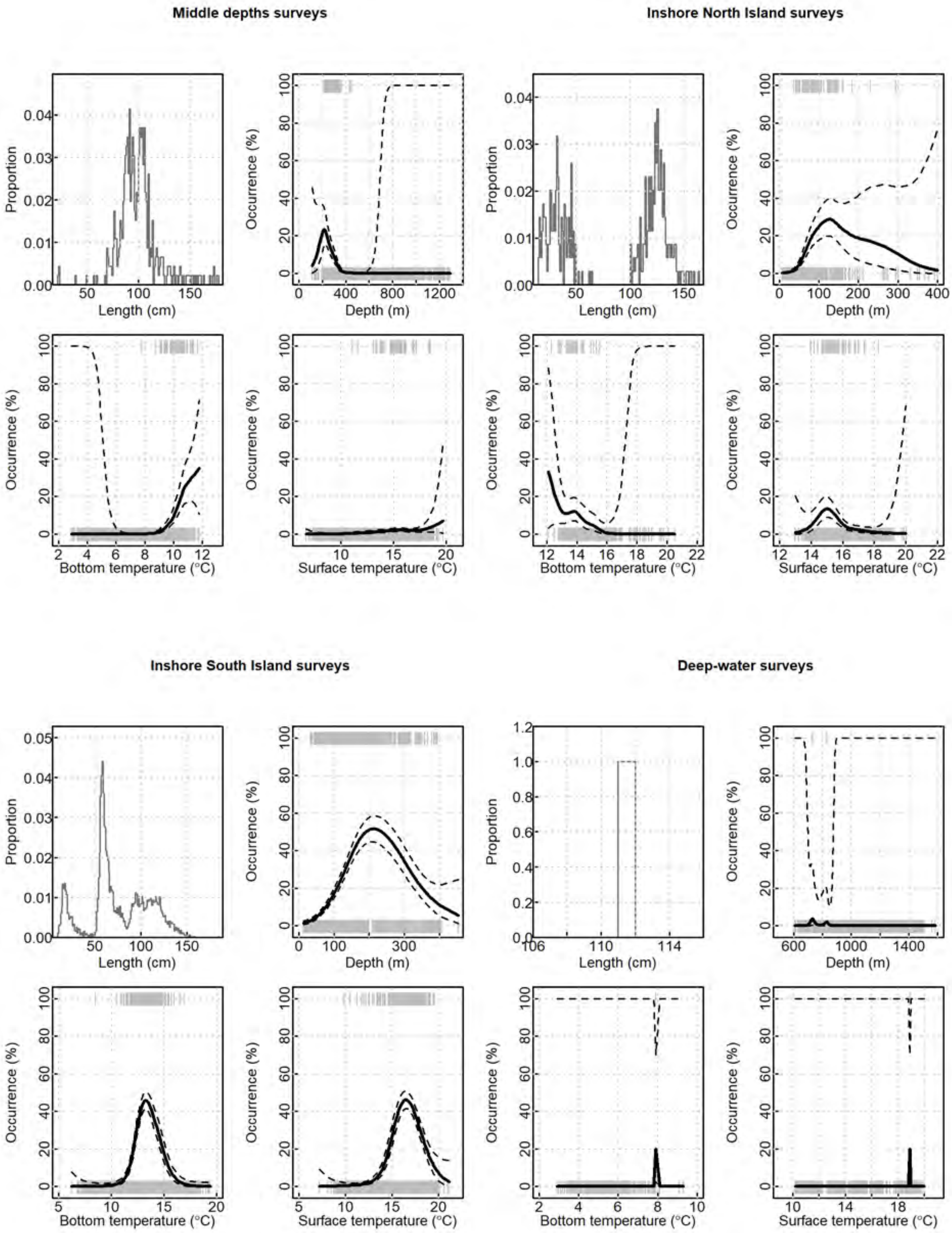


Figure 20.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to frostfish occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

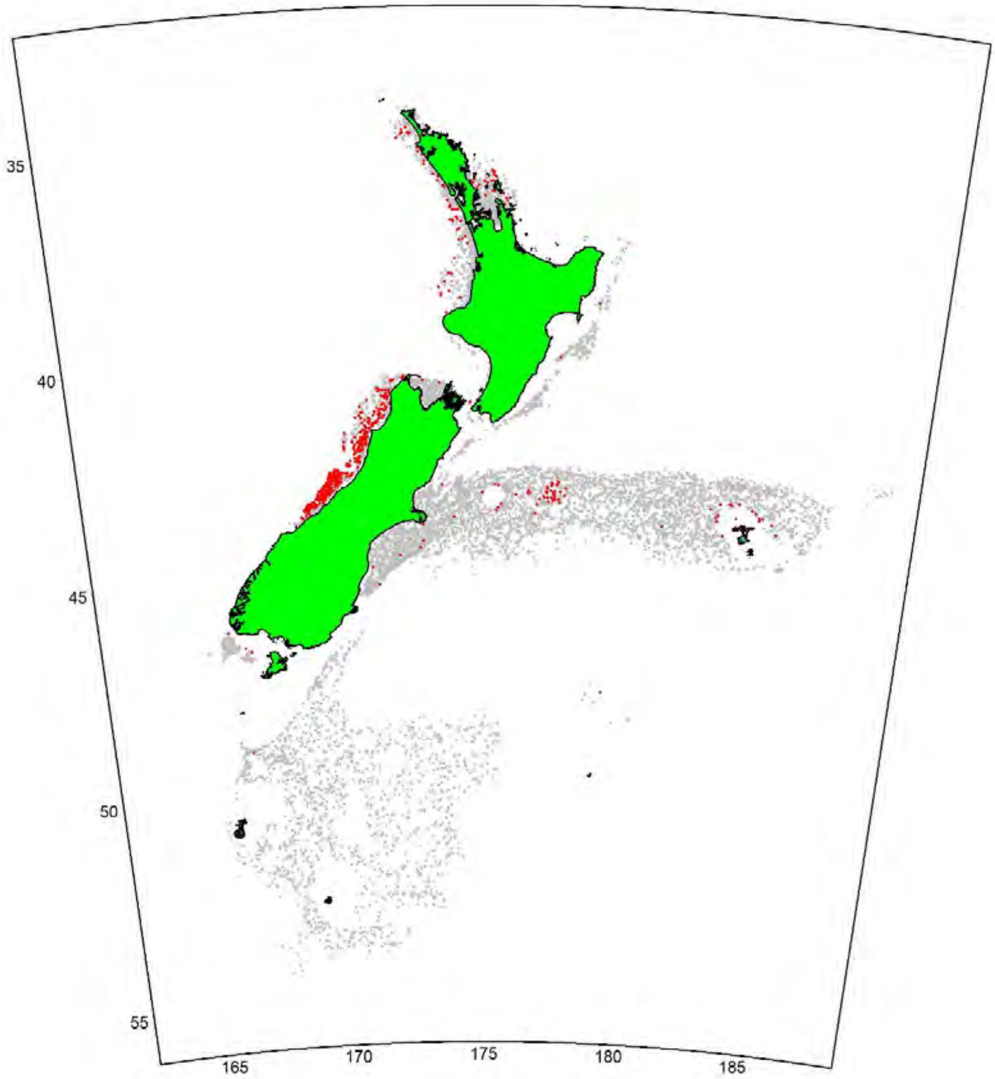


Figure 20.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where frostfish was caught (red points).

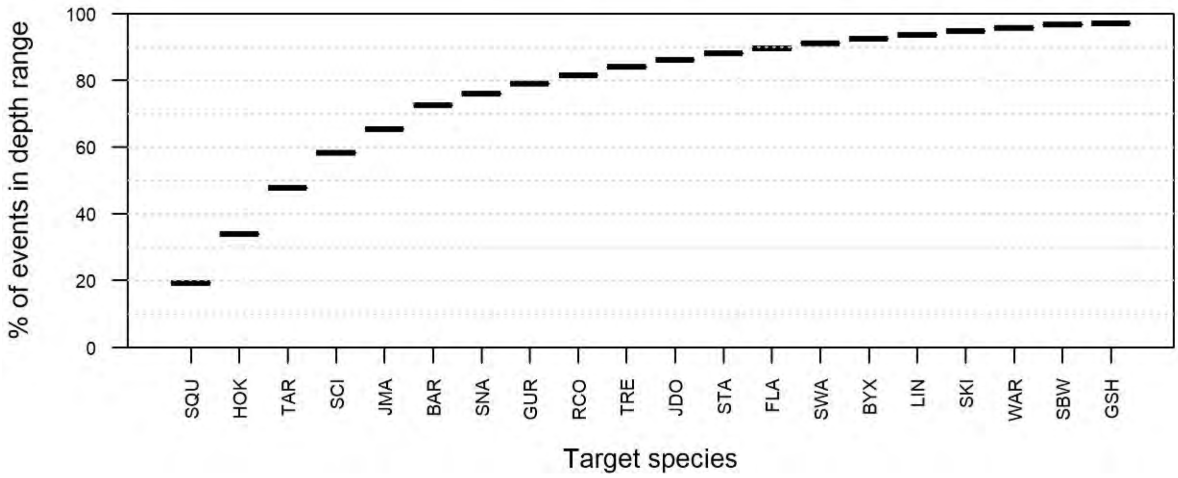


Figure 20.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for frostfish (50–450 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.

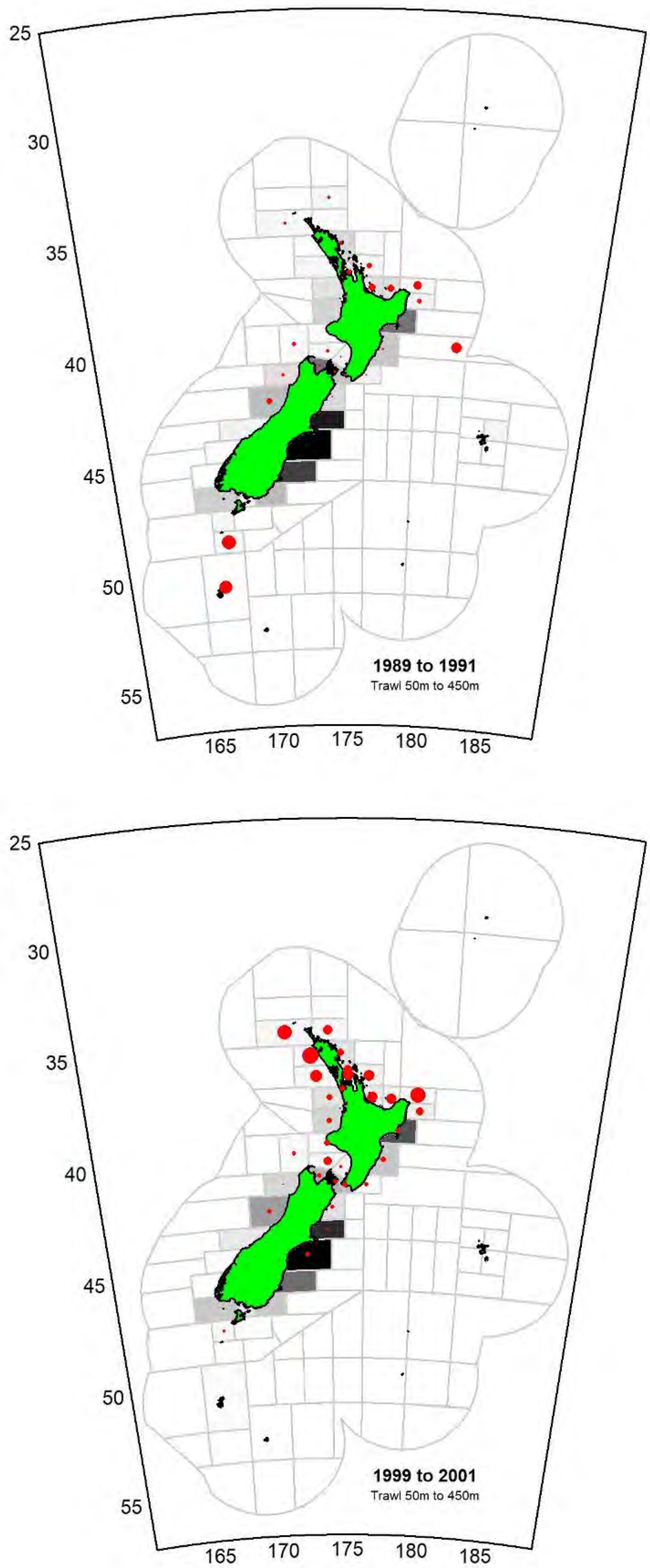
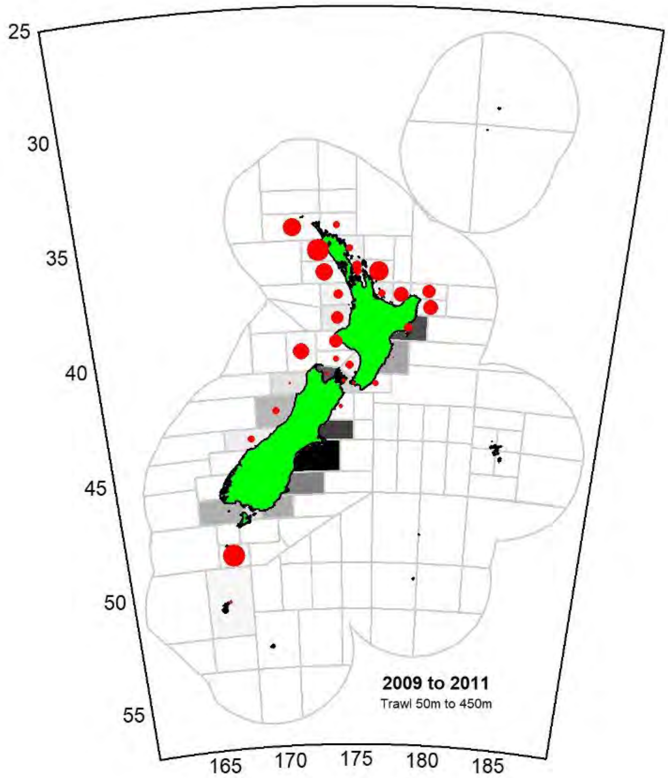


Figure 20.4: Maps of frostfish occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



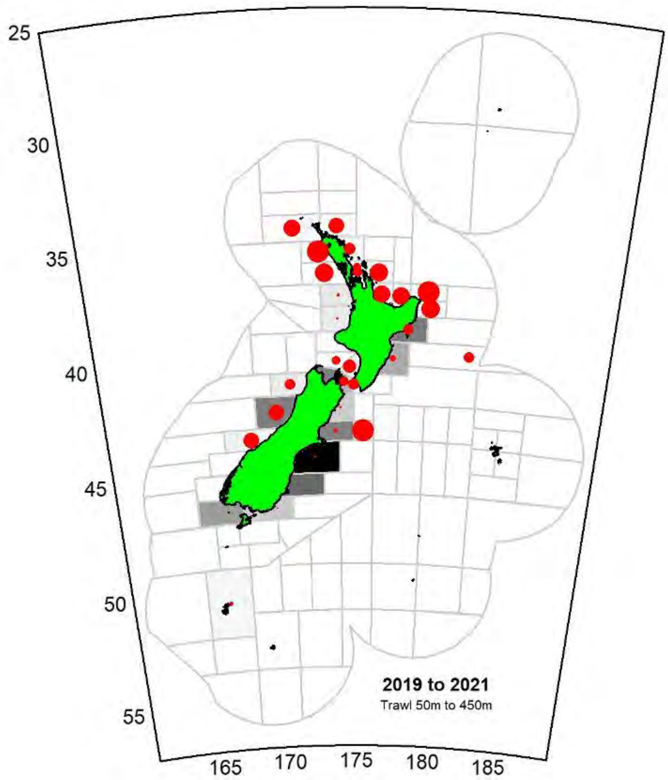
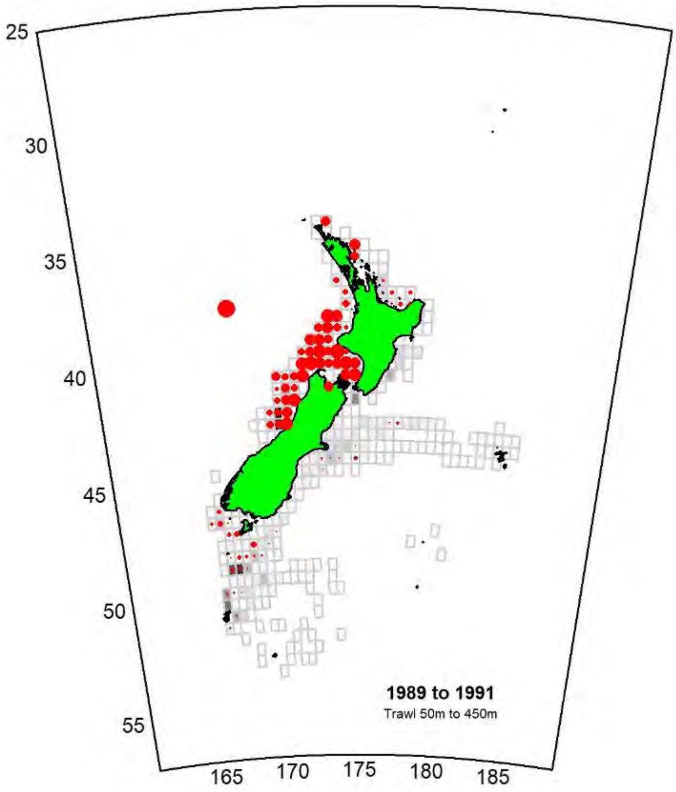


Figure 20.4 (cont.): Maps of frostfish occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



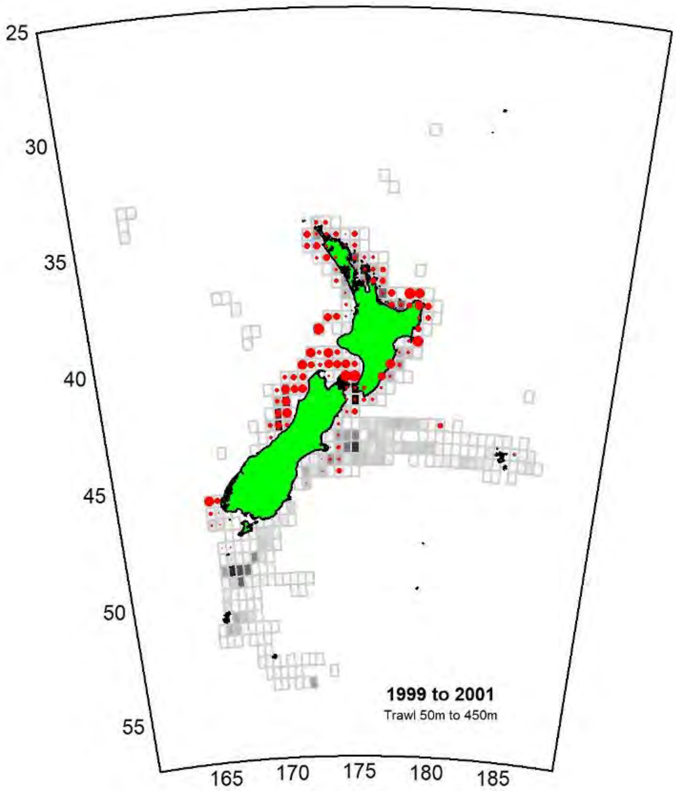
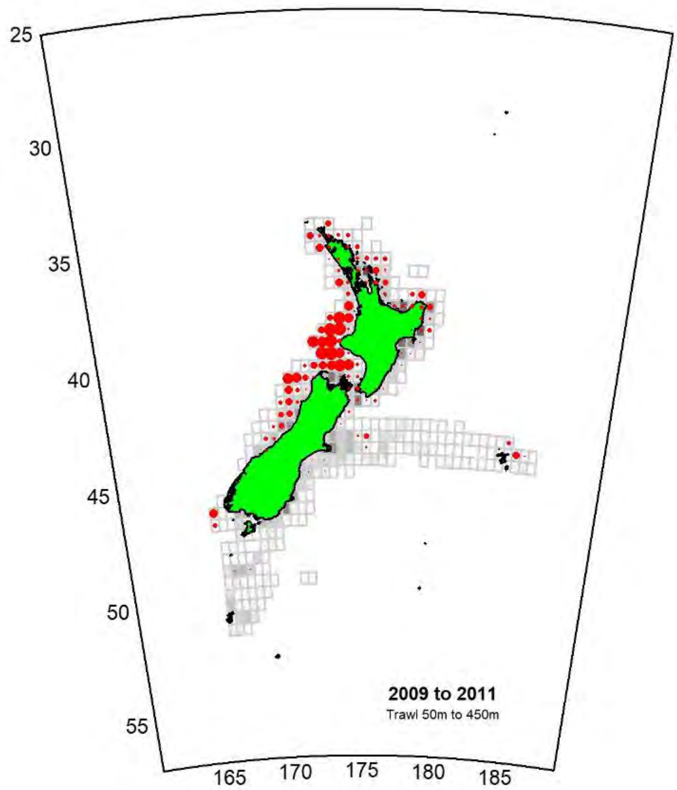


Figure 20.5: Maps of frostfish occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



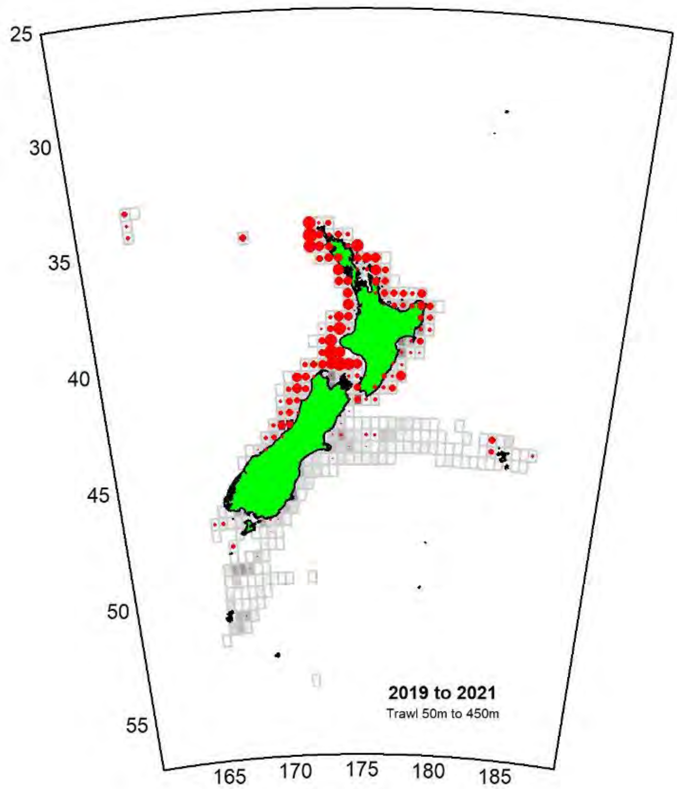


Figure 20.5 (cont.): Maps of frostfish occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

21. Garfish (GAR)

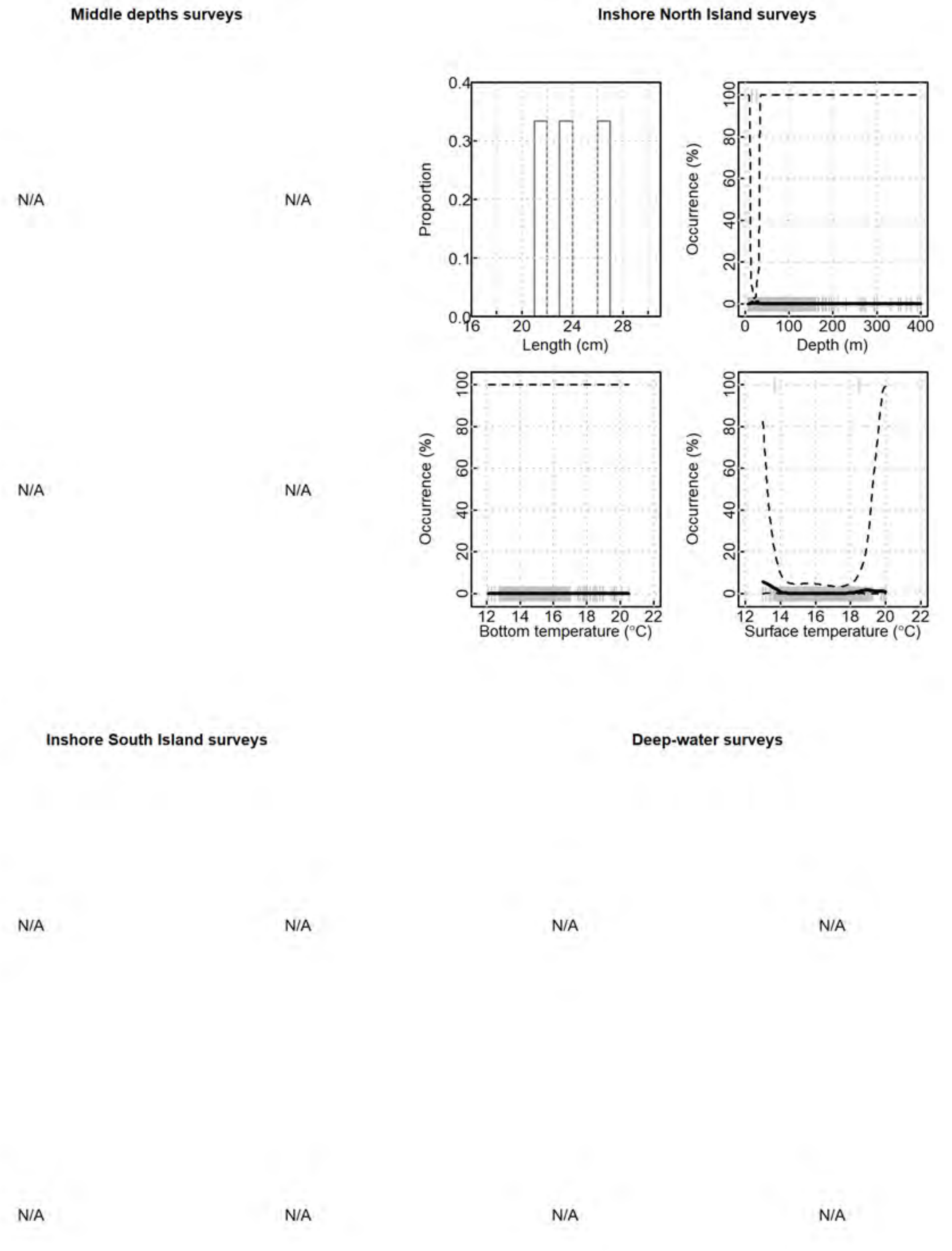


Figure 21.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to garfish occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

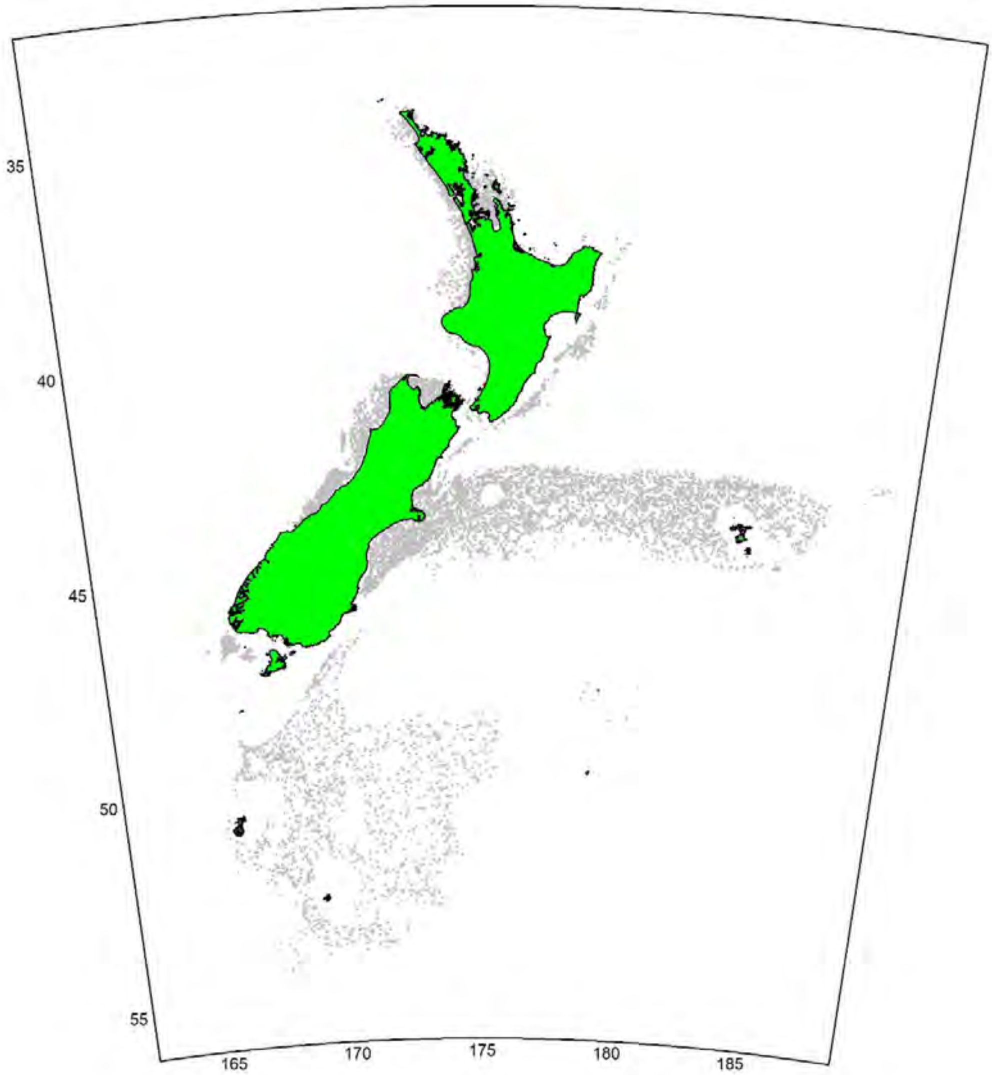


Figure 21.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where garfish was caught (red points; located at top of northwest North Island).

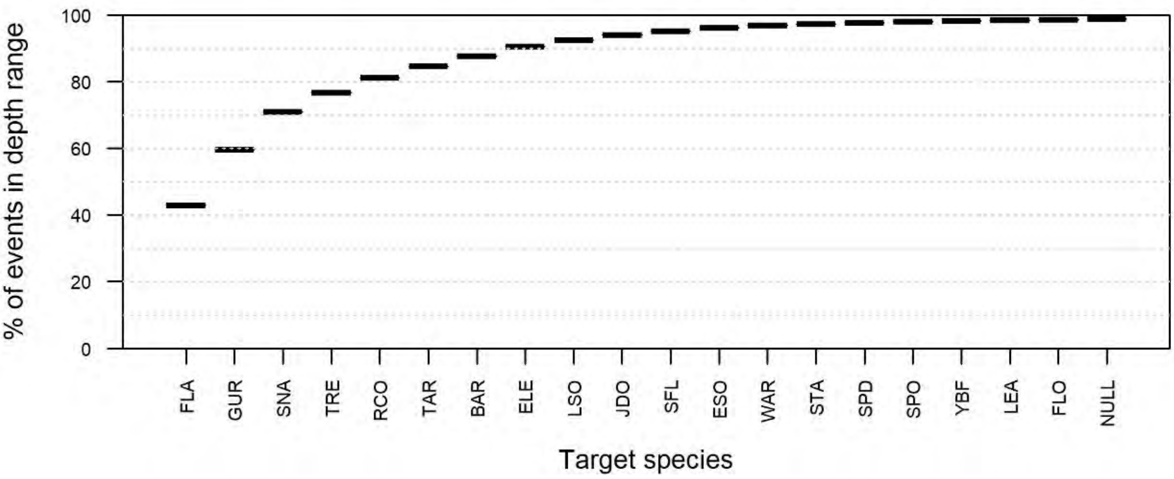
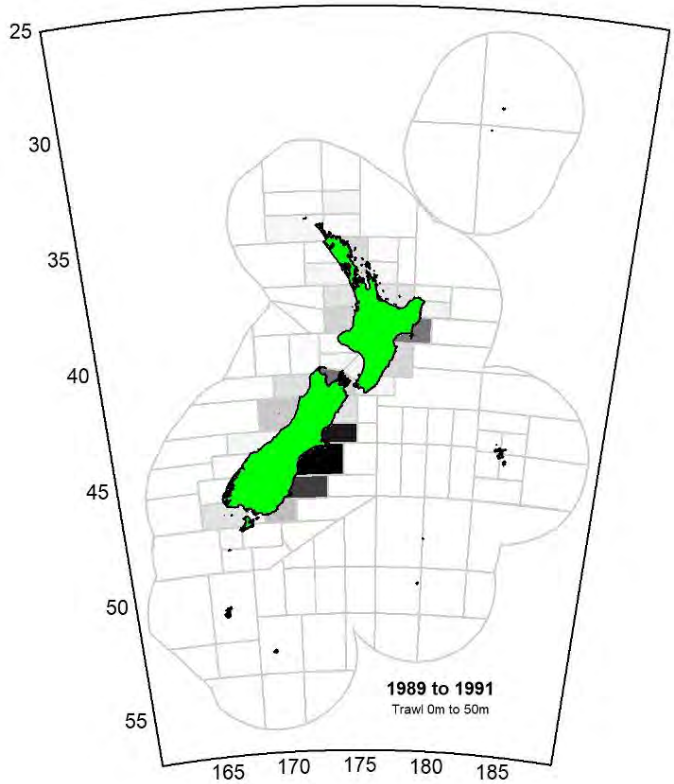


Figure 21.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for garfish (0–50 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.



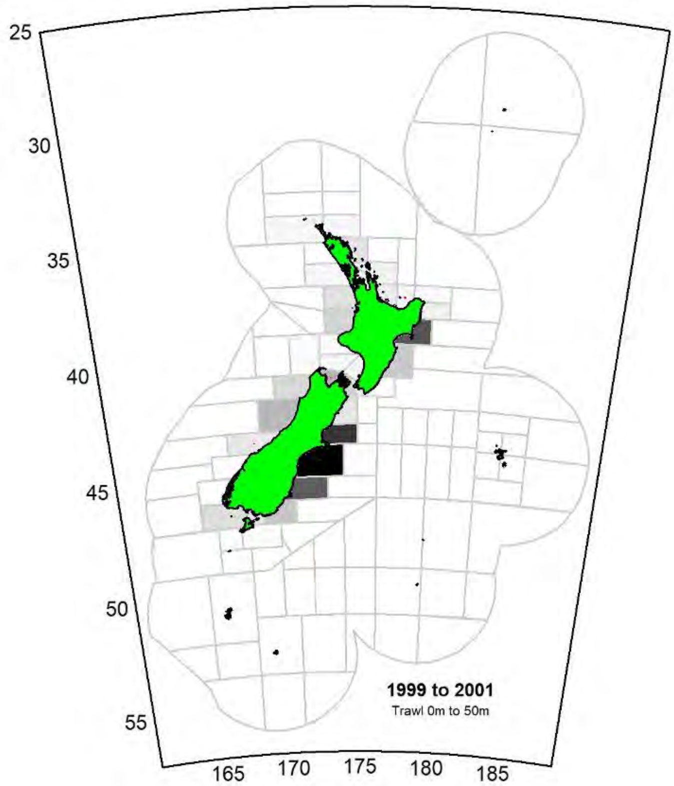
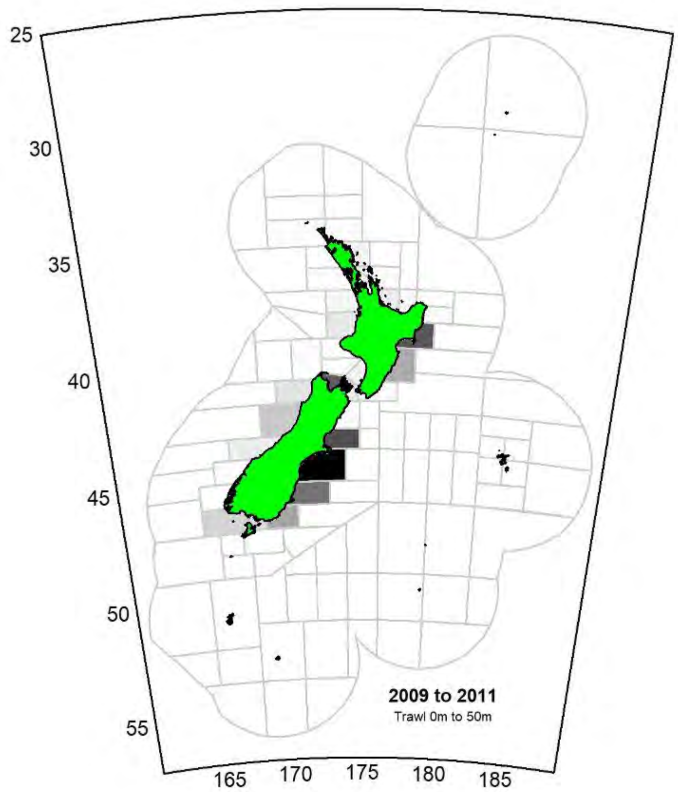


Figure 21.4: Maps of garfish occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



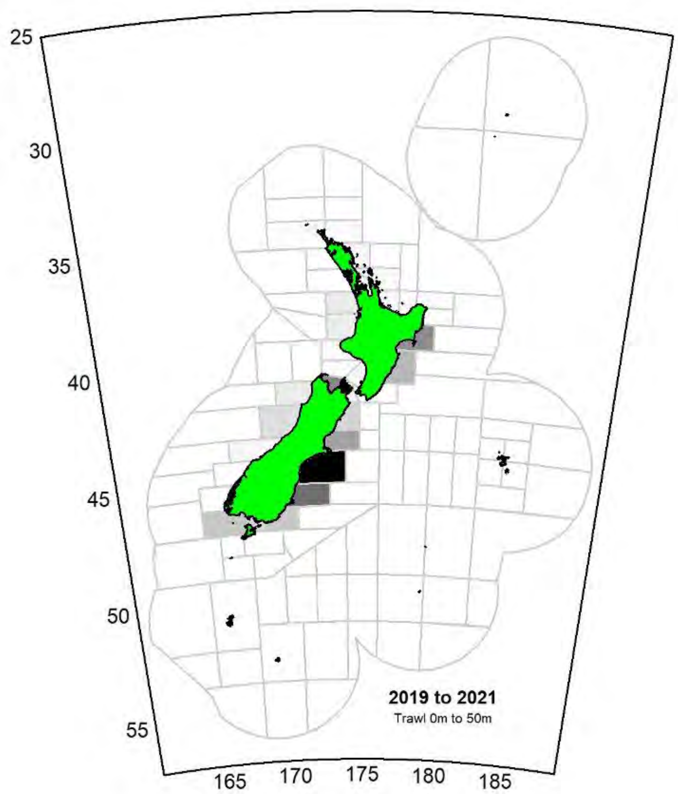


Figure 21.4 (cont.): Maps of garfish occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

22. Gemfish (SKI)

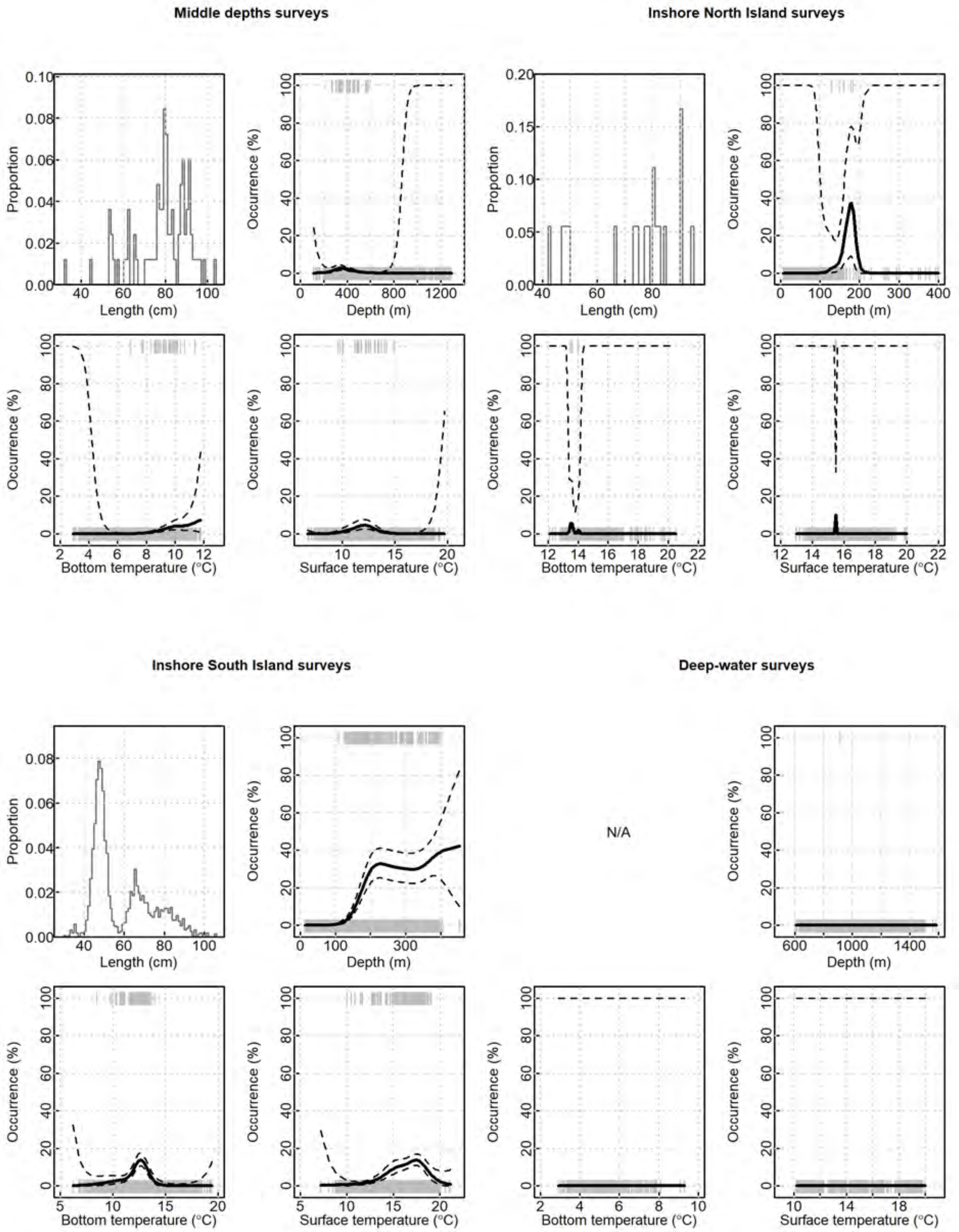


Figure 22.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to gemfish occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

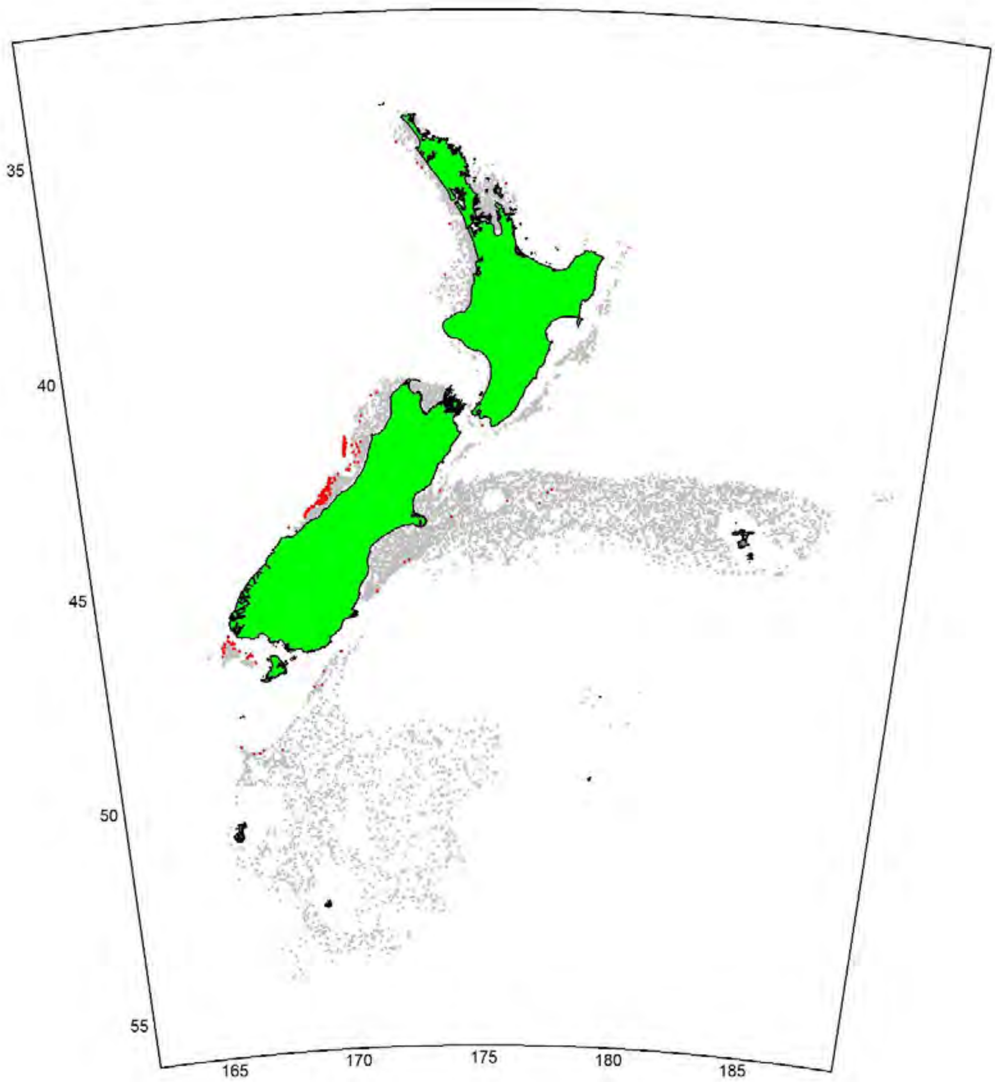


Figure 22.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where gemfish was caught (red points; located at top of northwest North Island).

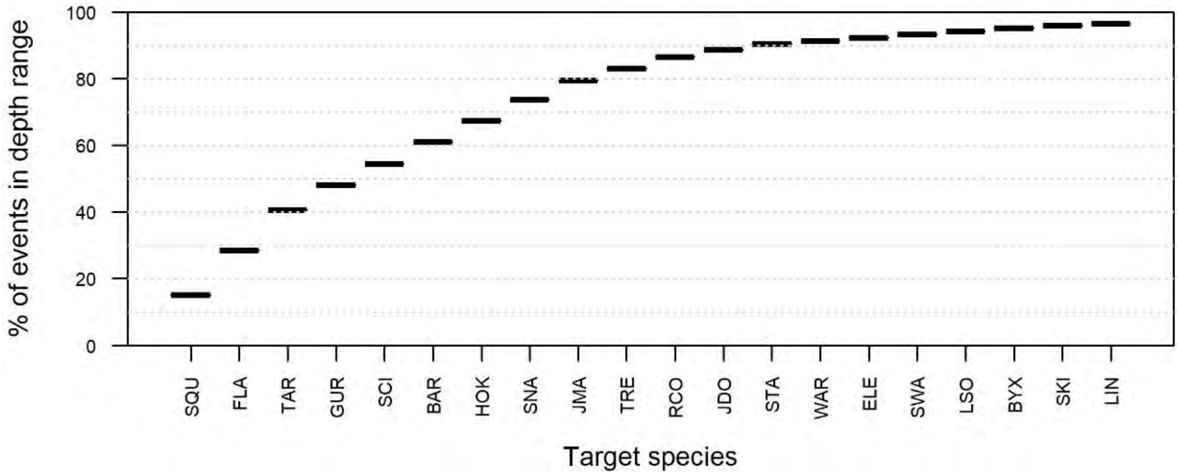


Figure 22.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for gemfish (0–400 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.

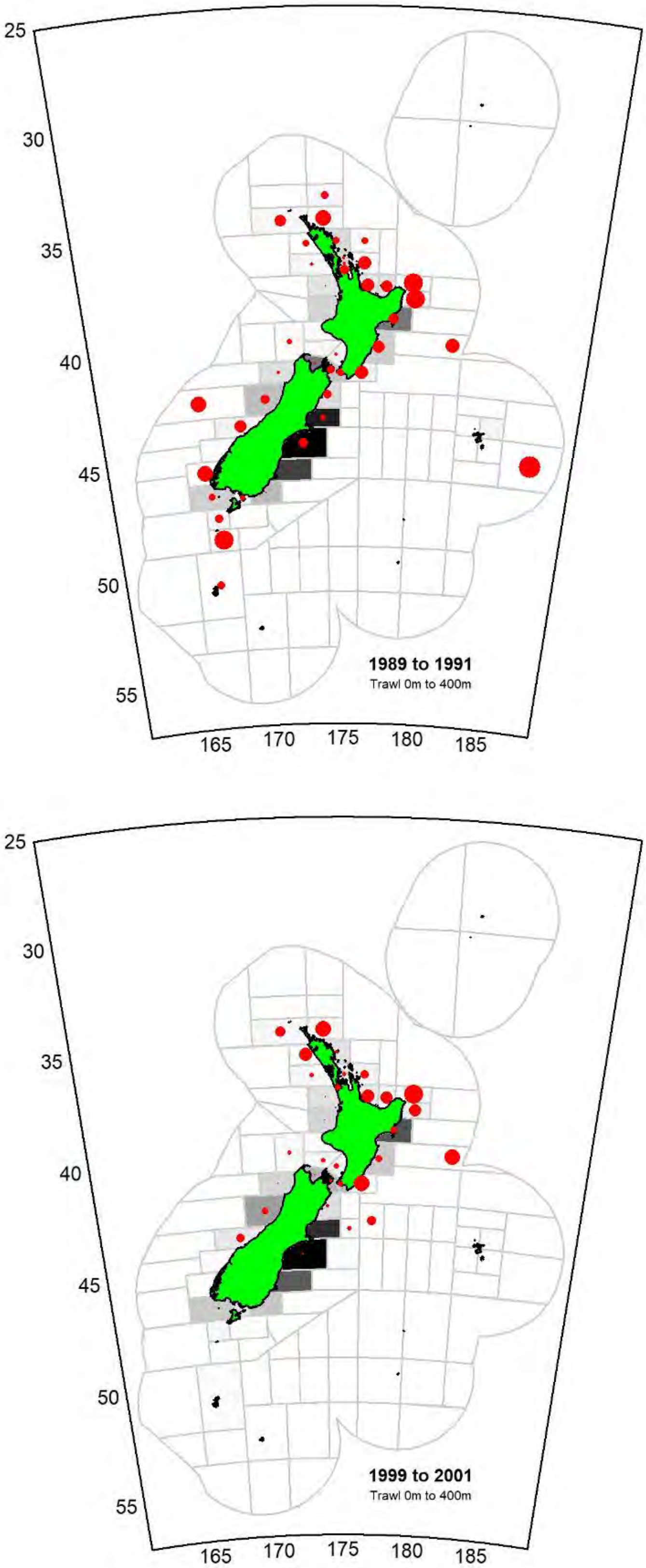
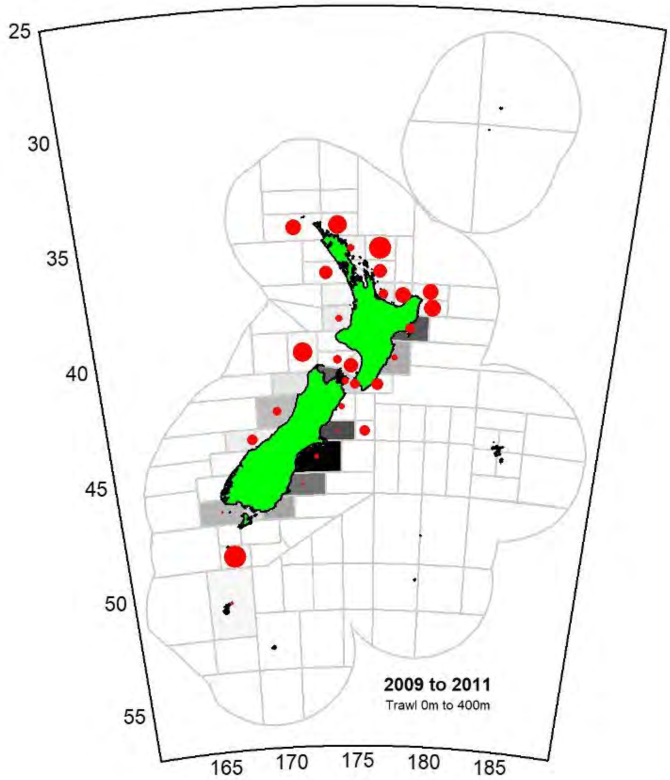


Figure 22.4: Maps of gemfish occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



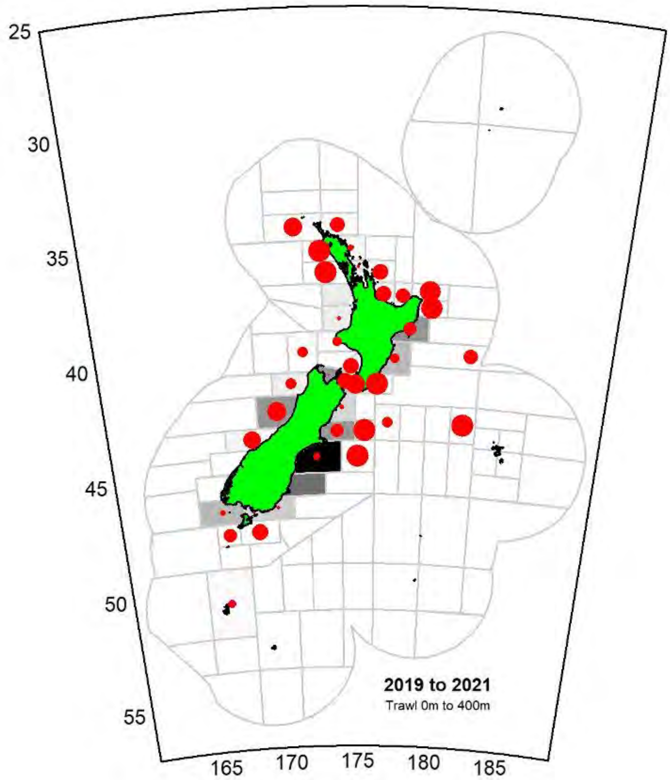
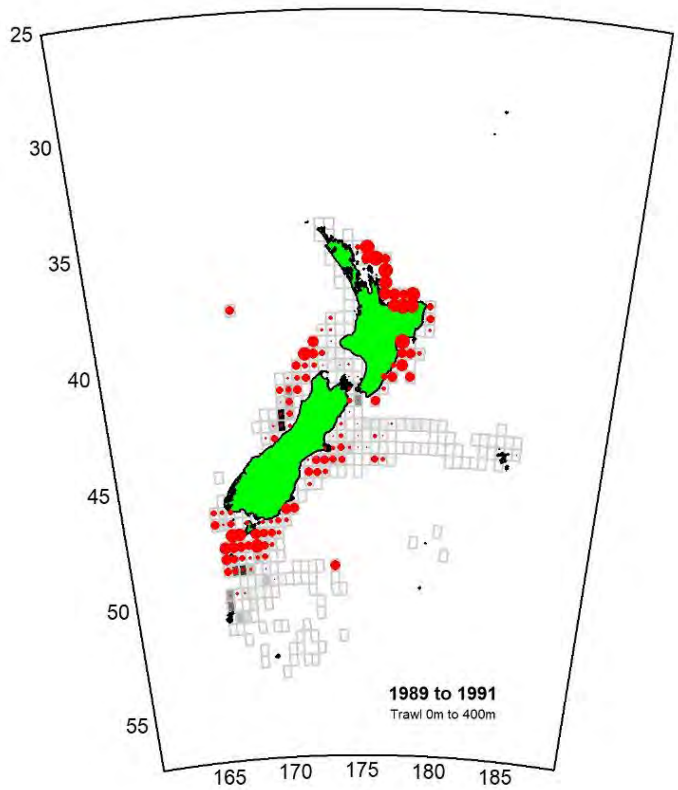


Figure 22.4 (cont.): Maps of gemfish occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



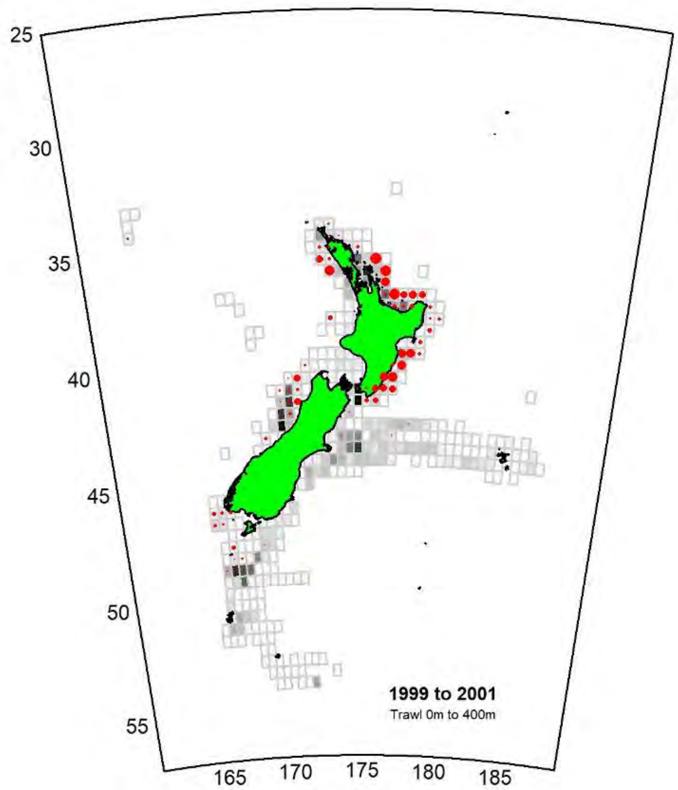
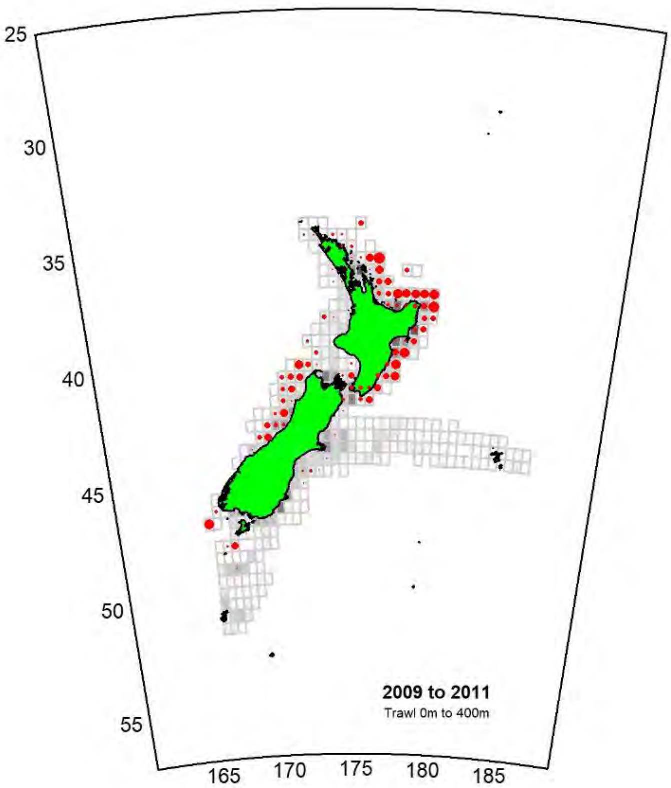


Figure 22.5: Maps of gemfish occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



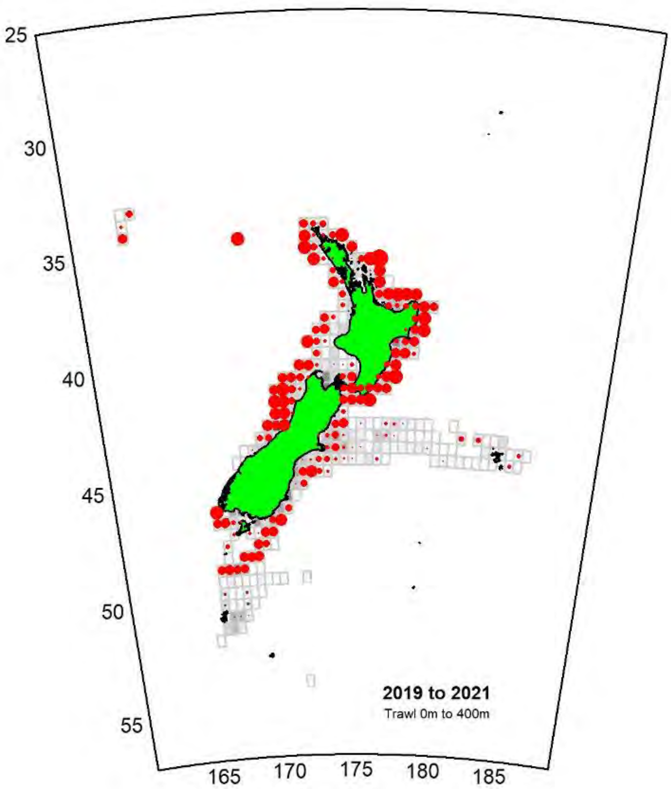


Figure 22.5 (cont.): Maps of gemfish occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

23. Dark ghost shark (GSH)

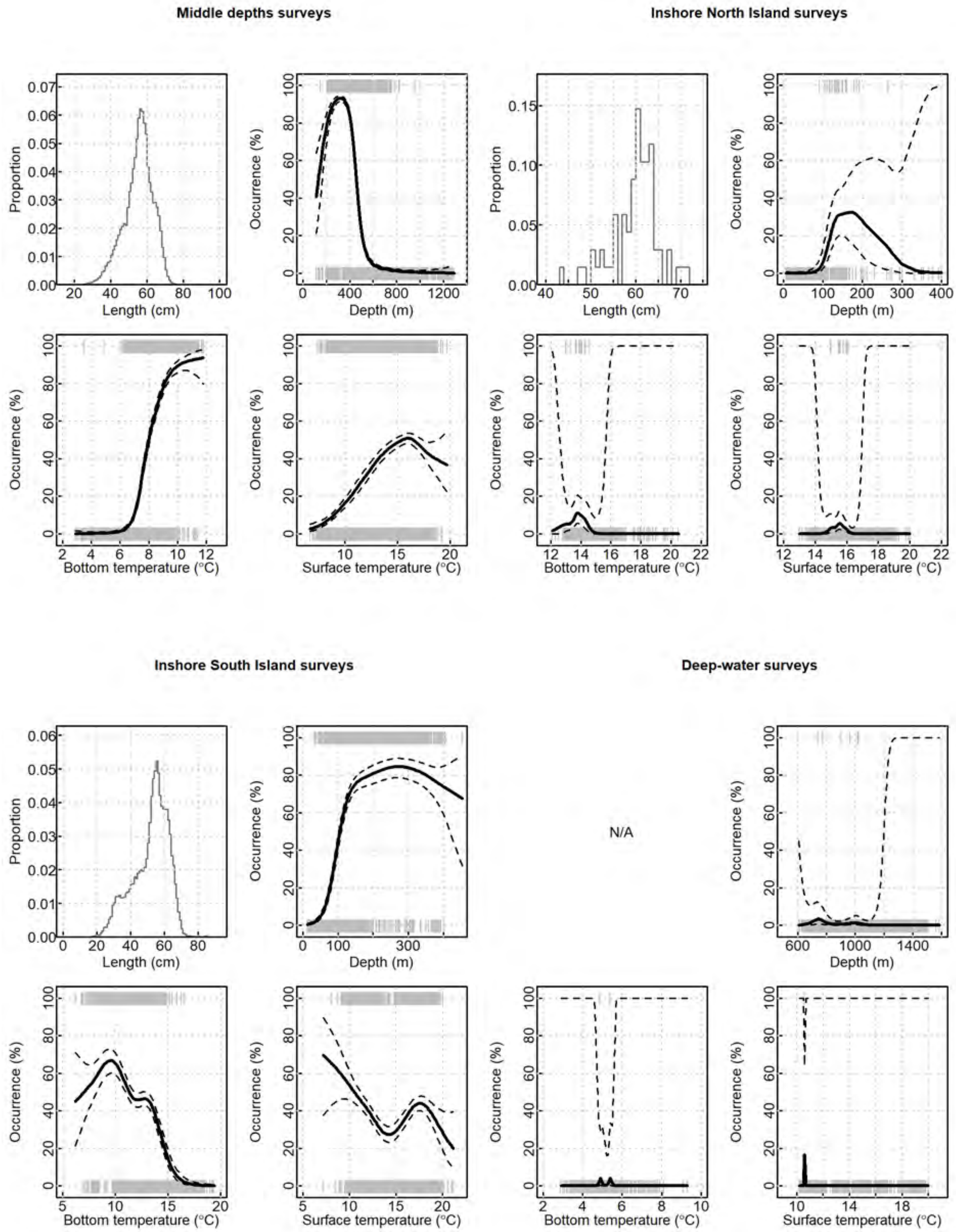


Figure 23.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to dark ghost shark occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

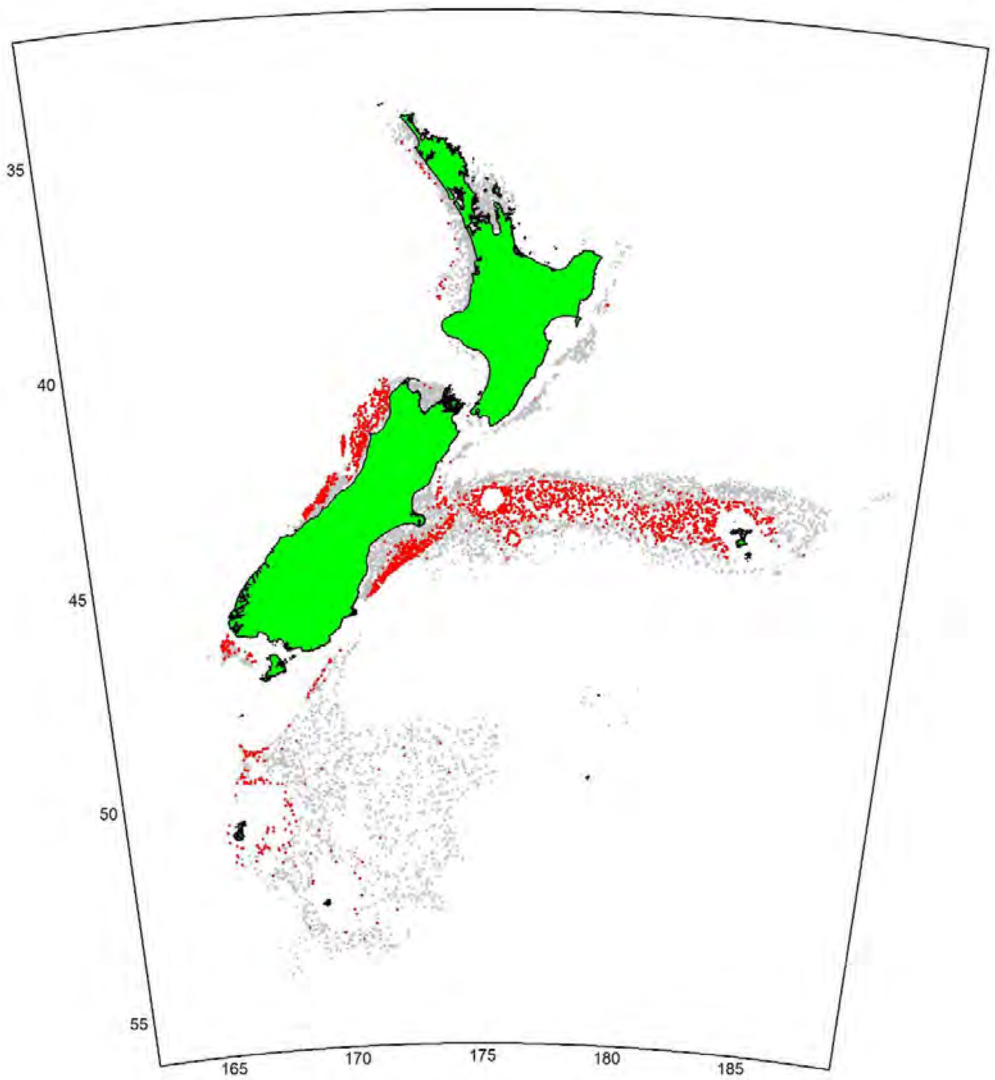


Figure 23.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where dark ghost shark was caught (red points).

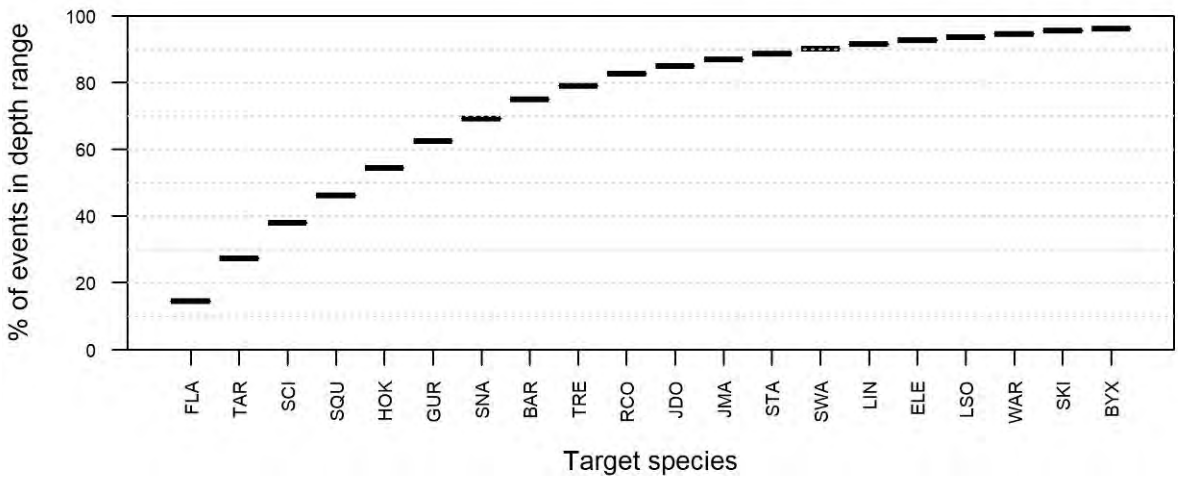


Figure 23.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for dark ghost shark (0–500 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.

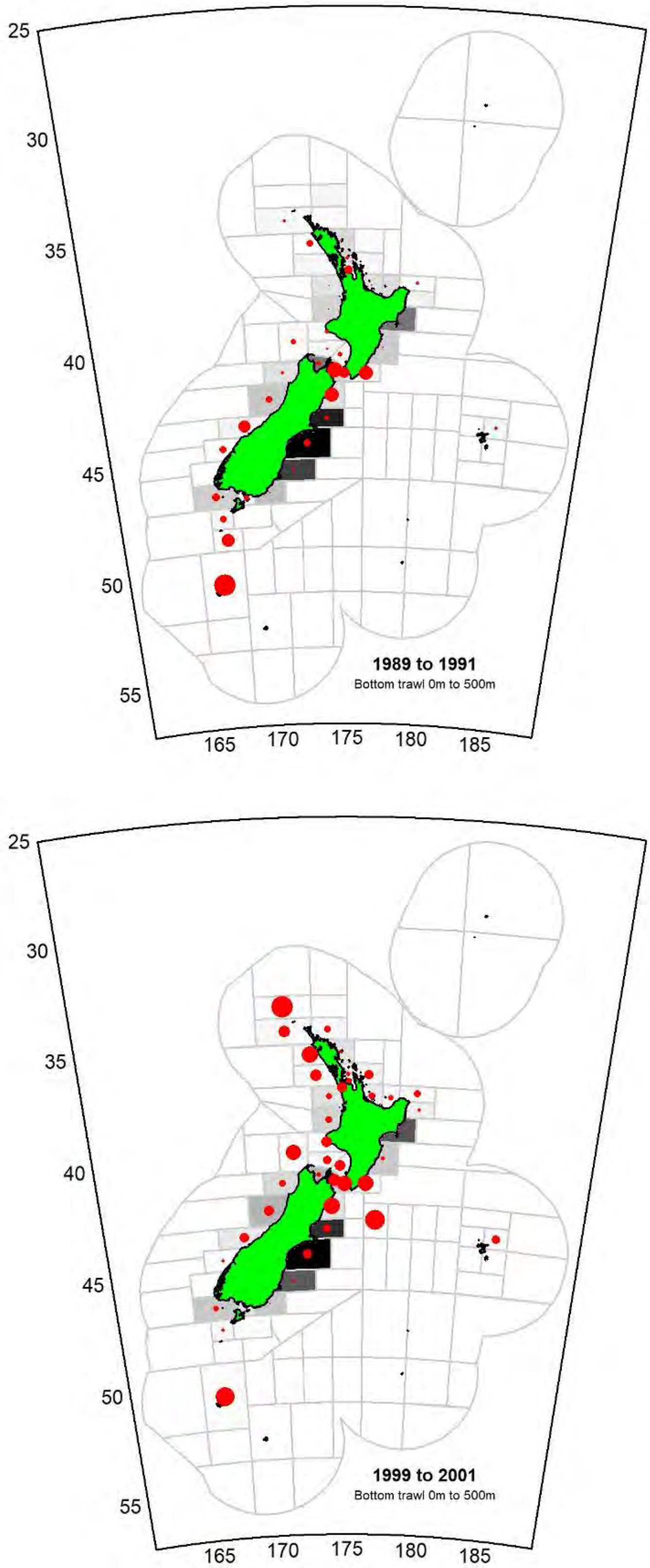
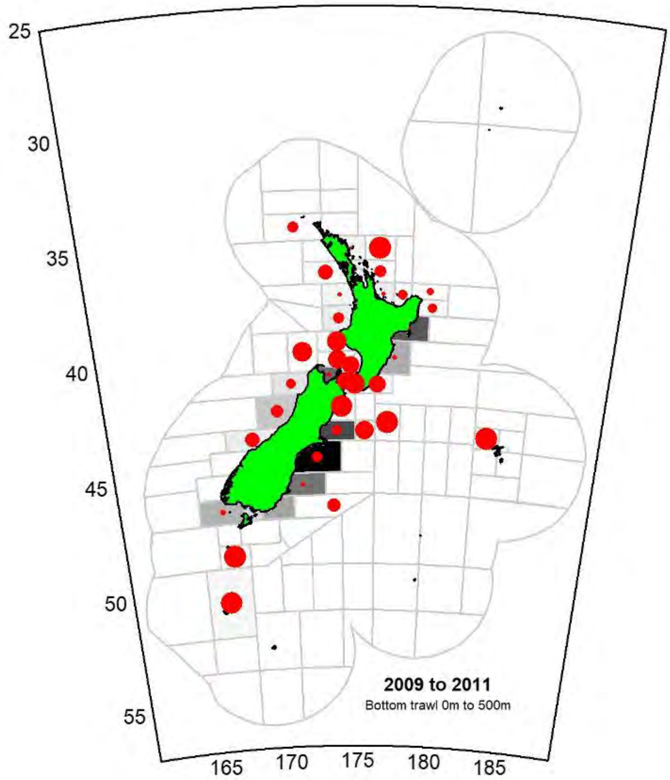


Figure 23.4: Maps of dark ghost shark occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



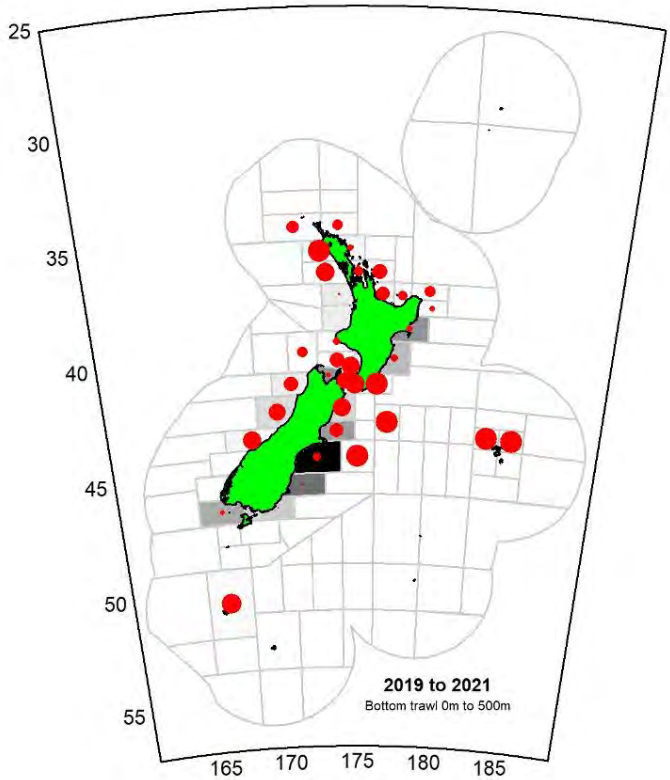
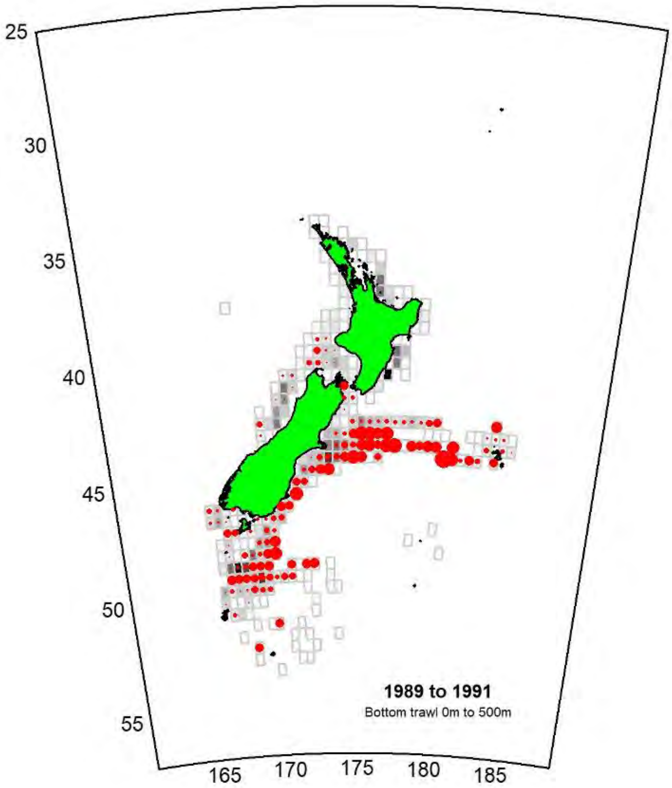


Figure 23.4 (cont.): Maps of dark ghost shark occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



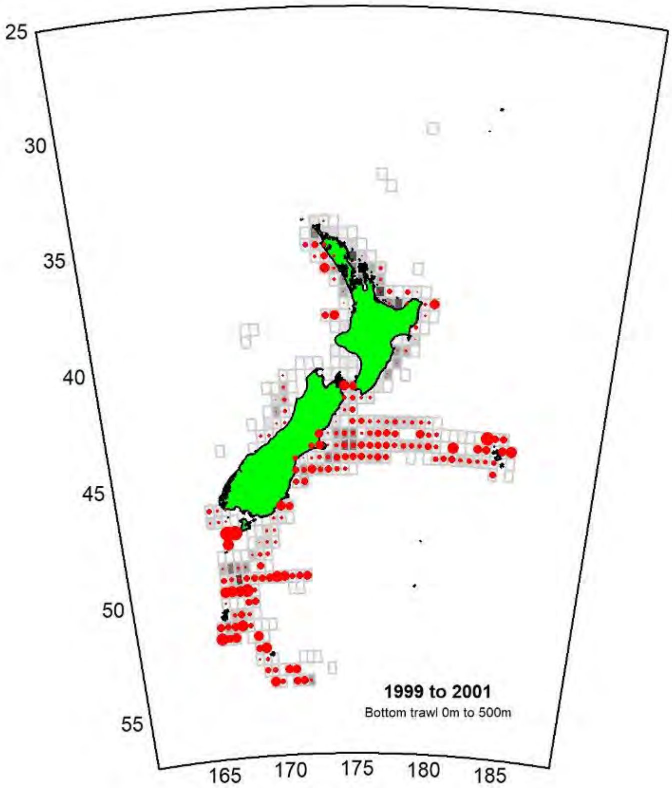
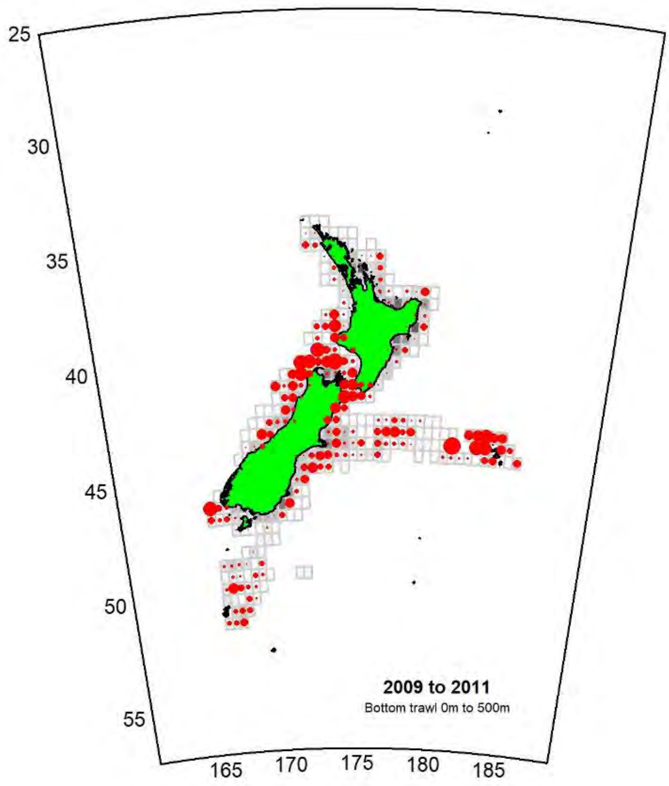


Figure 23.5: Maps of dark ghost shark occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



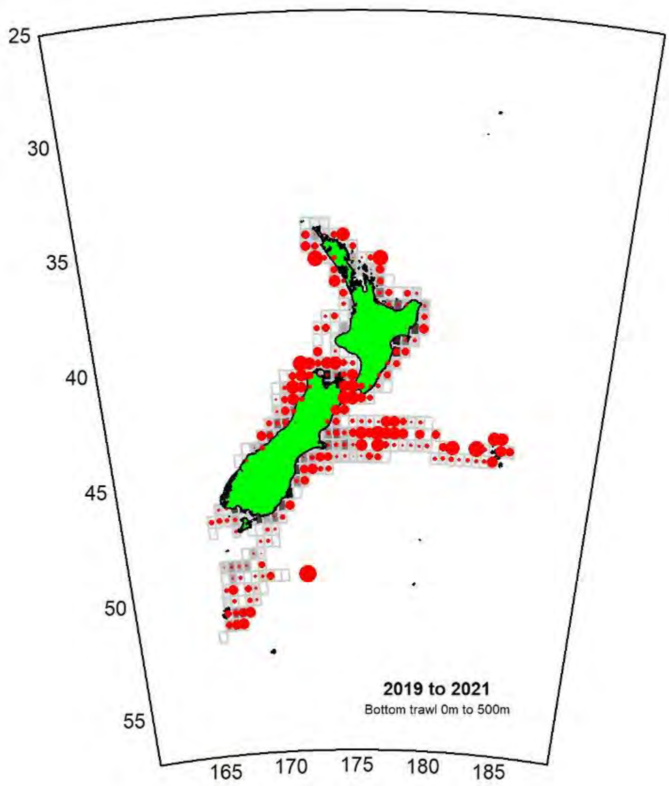


Figure 23.5 (cont.): Maps of dark ghost shark occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

24. Pale ghost shark (GSP)

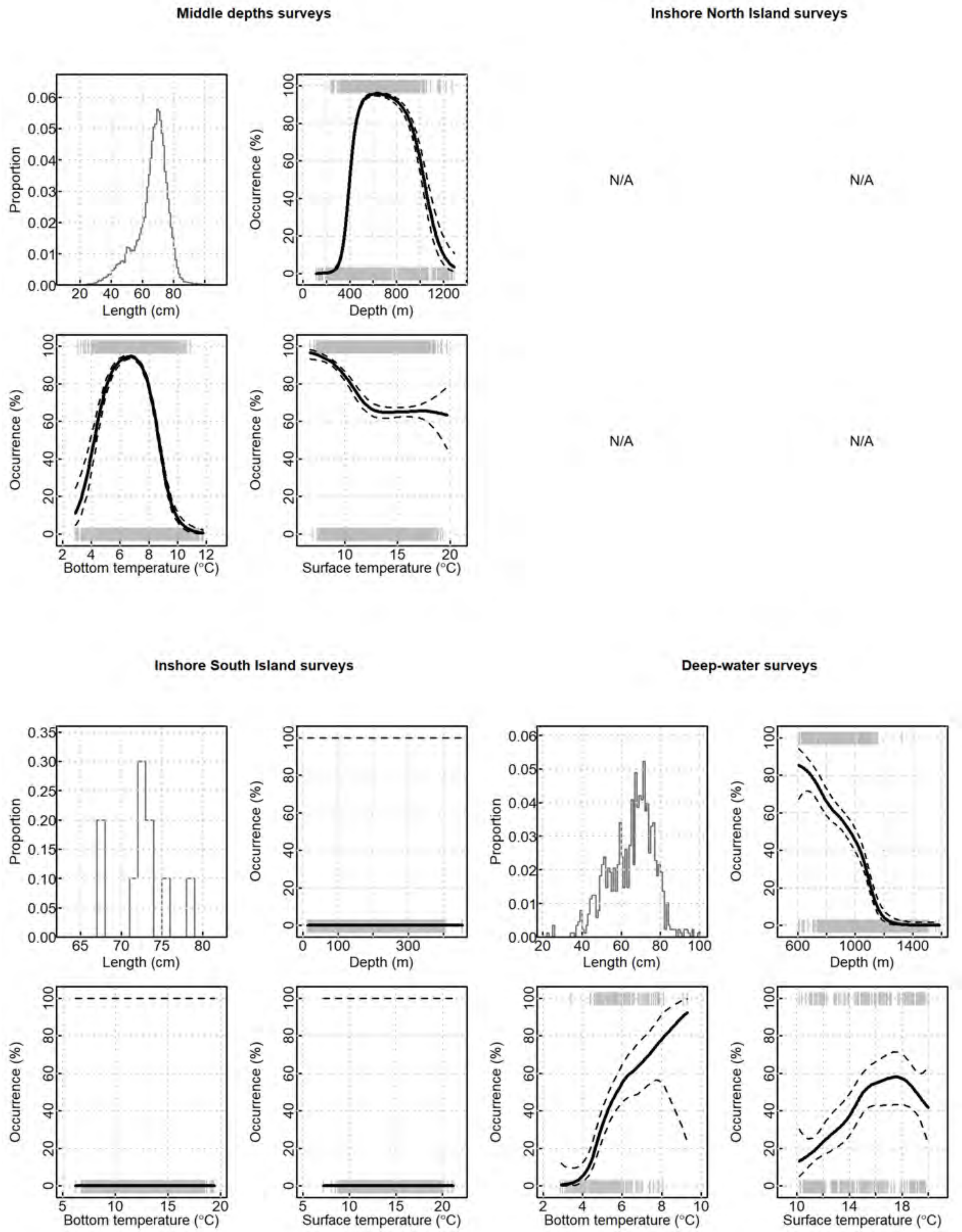


Figure 24.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to pale ghost shark occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

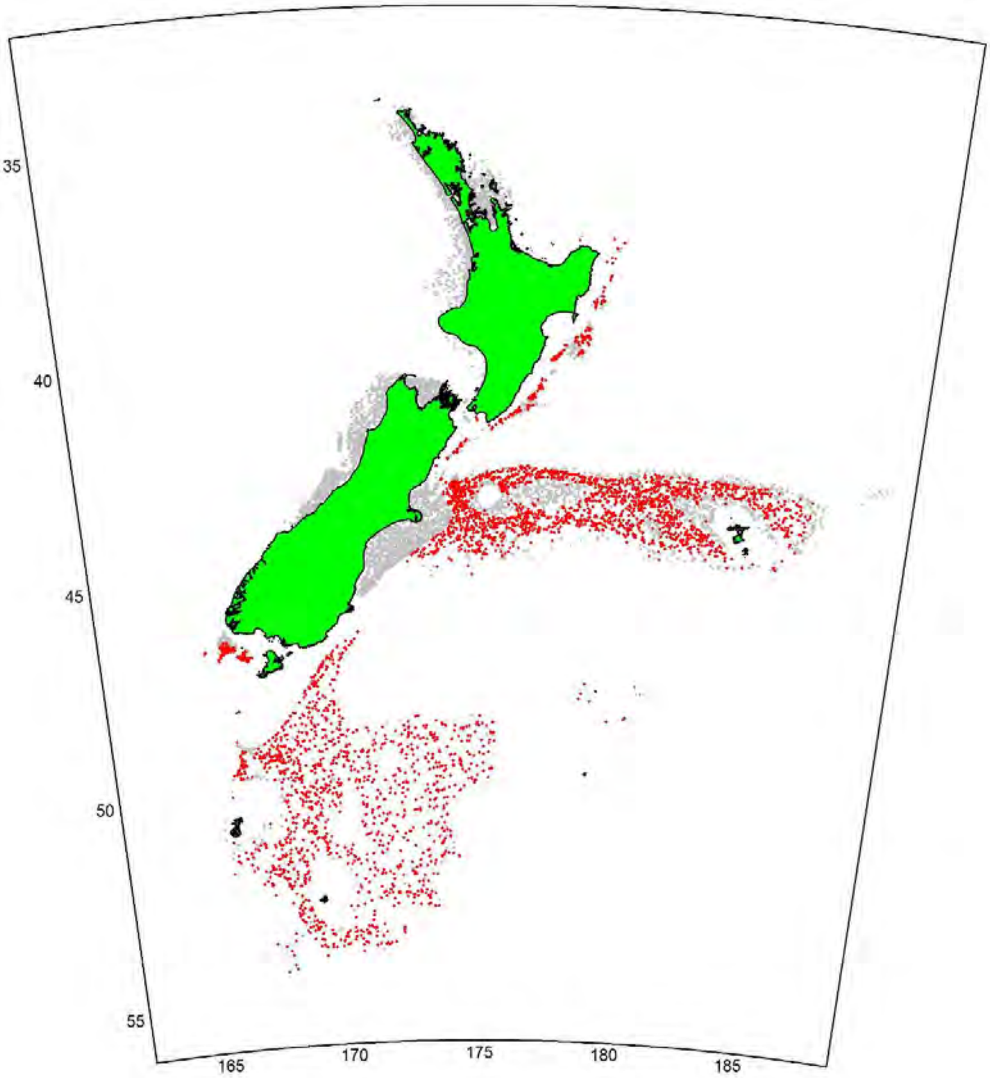


Figure 24.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where pale ghost shark was caught (red points).

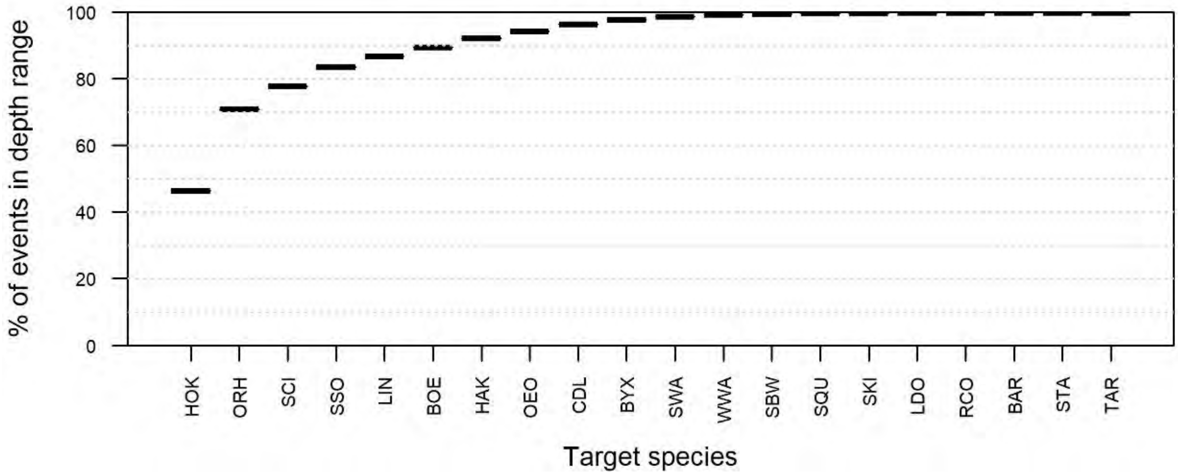
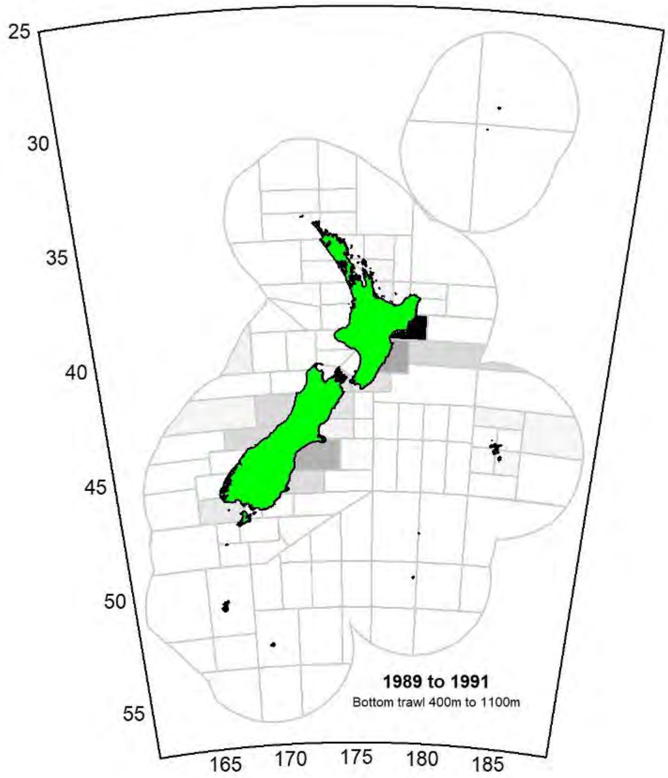


Figure 24.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for pale ghost shark (400–1100 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.



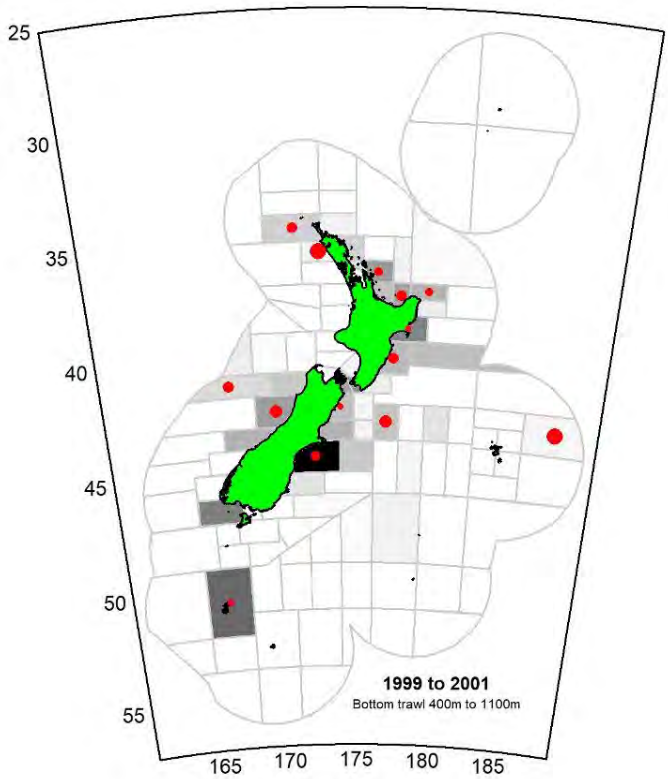
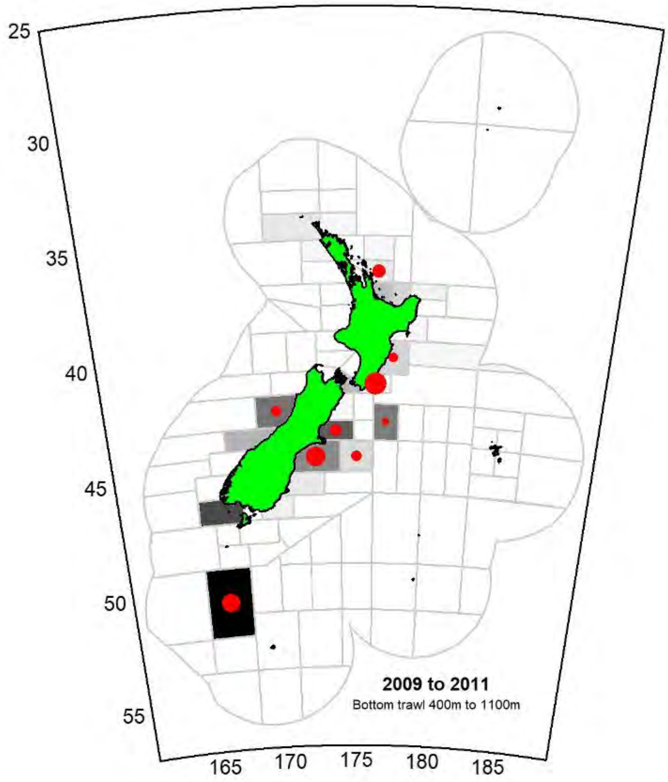


Figure 24.4: Maps of pale ghost shark occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



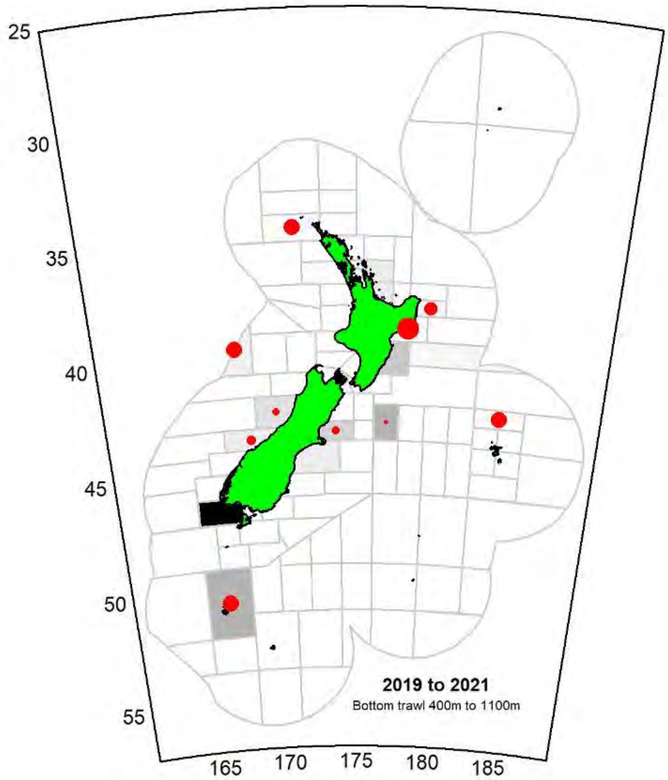


Figure 24.3 (cont.): Maps of pale ghost shark occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

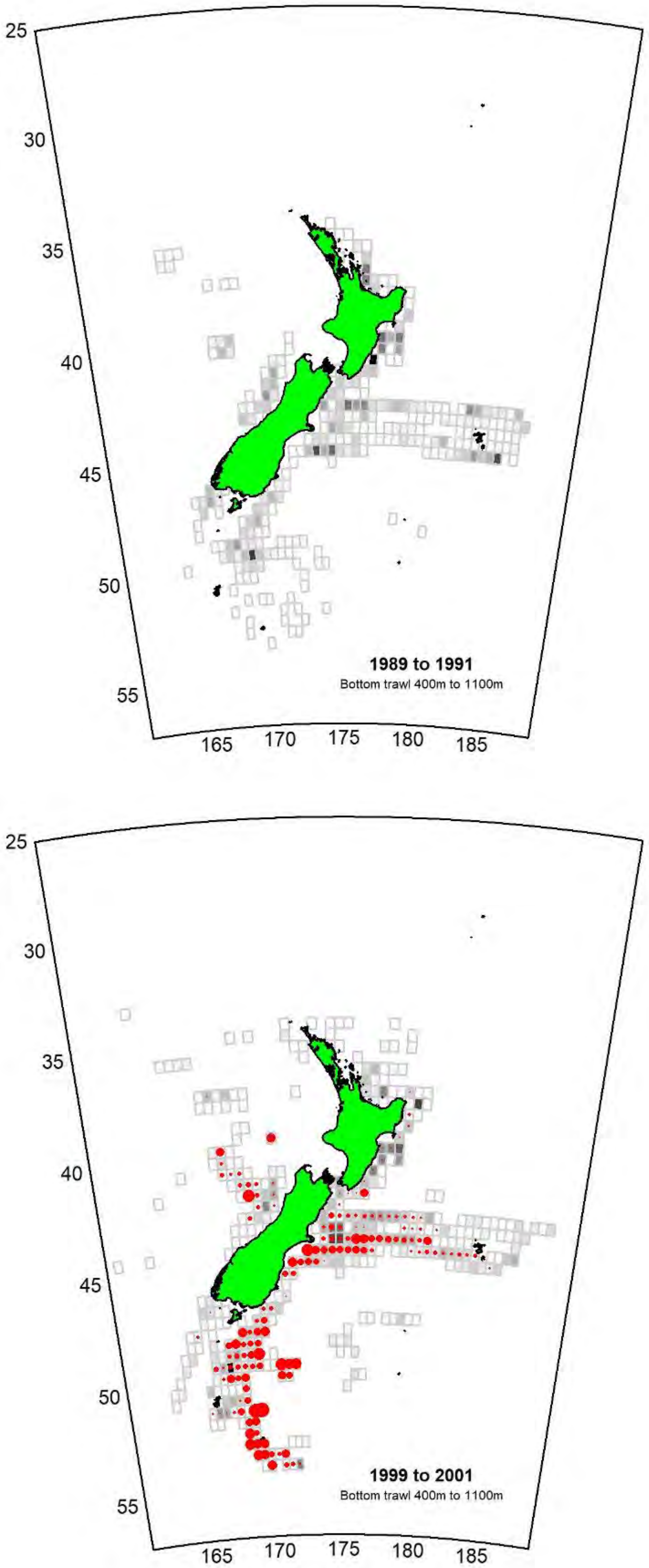
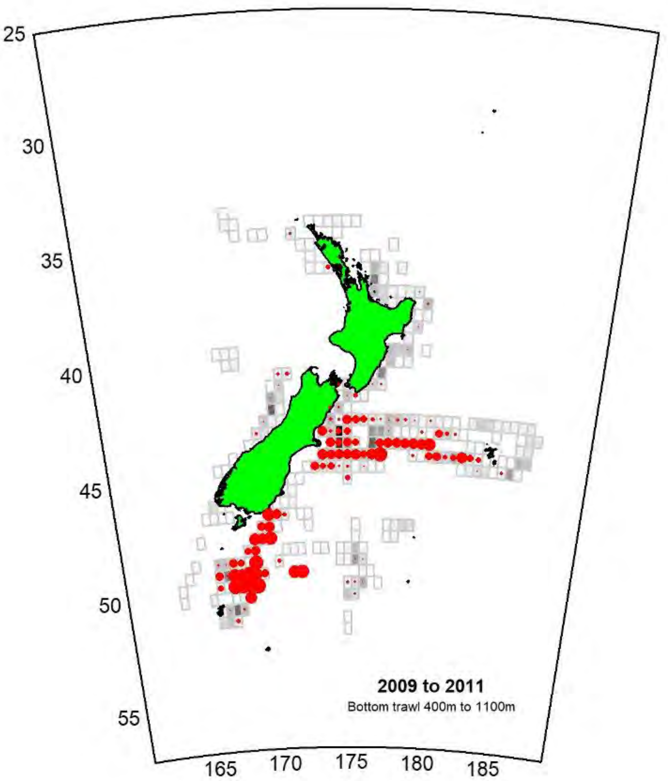


Figure 24.5: Maps of pale ghost shark occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



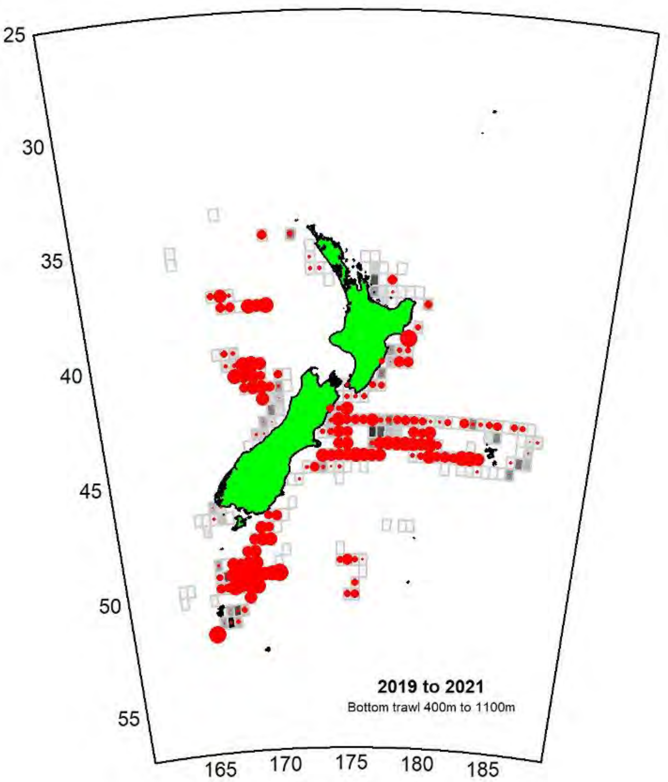


Figure 24.5 (cont.): Maps of pale ghost shark occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

25. Grey mullet (GMU)

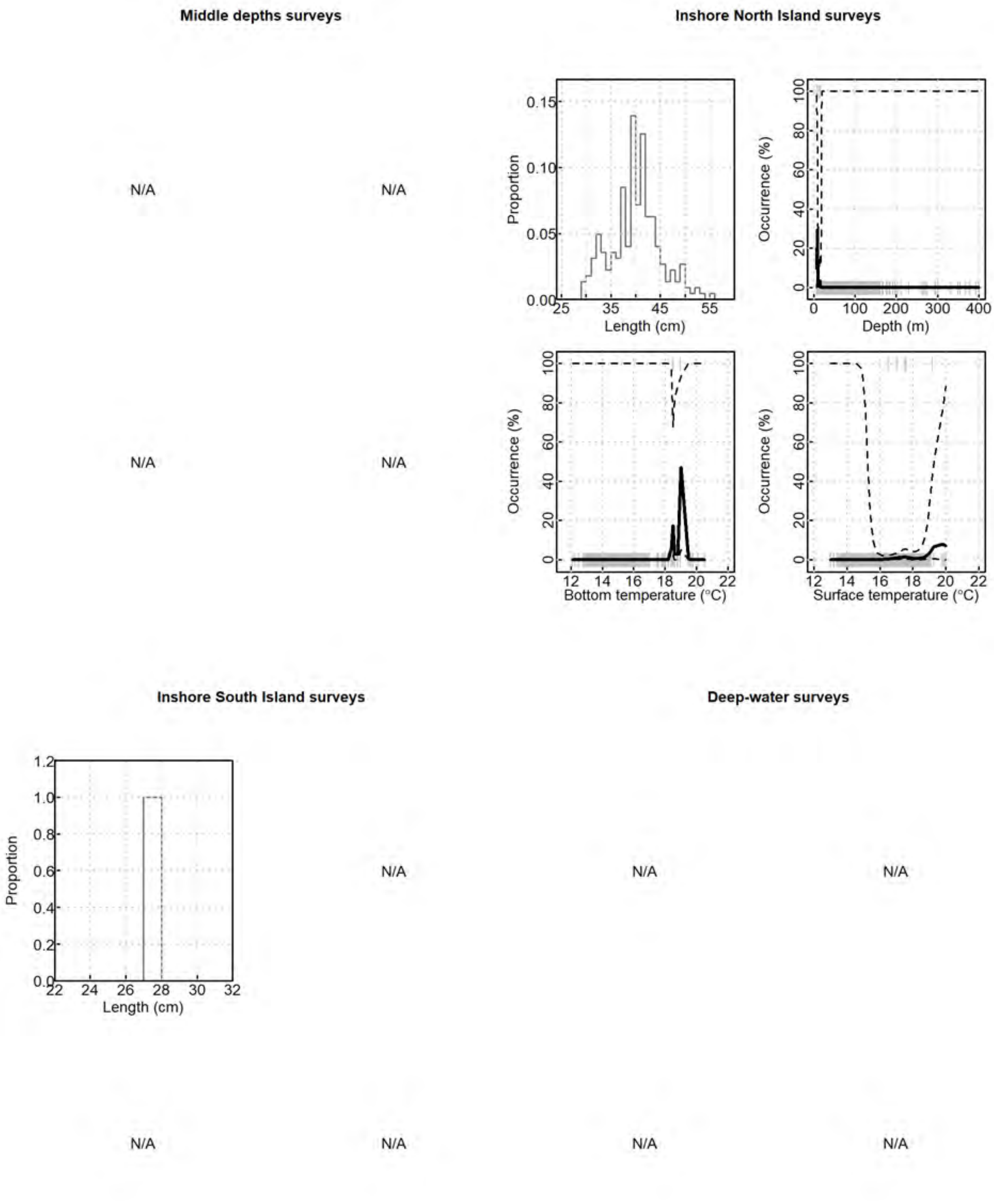


Figure 25.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to grey mullet occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

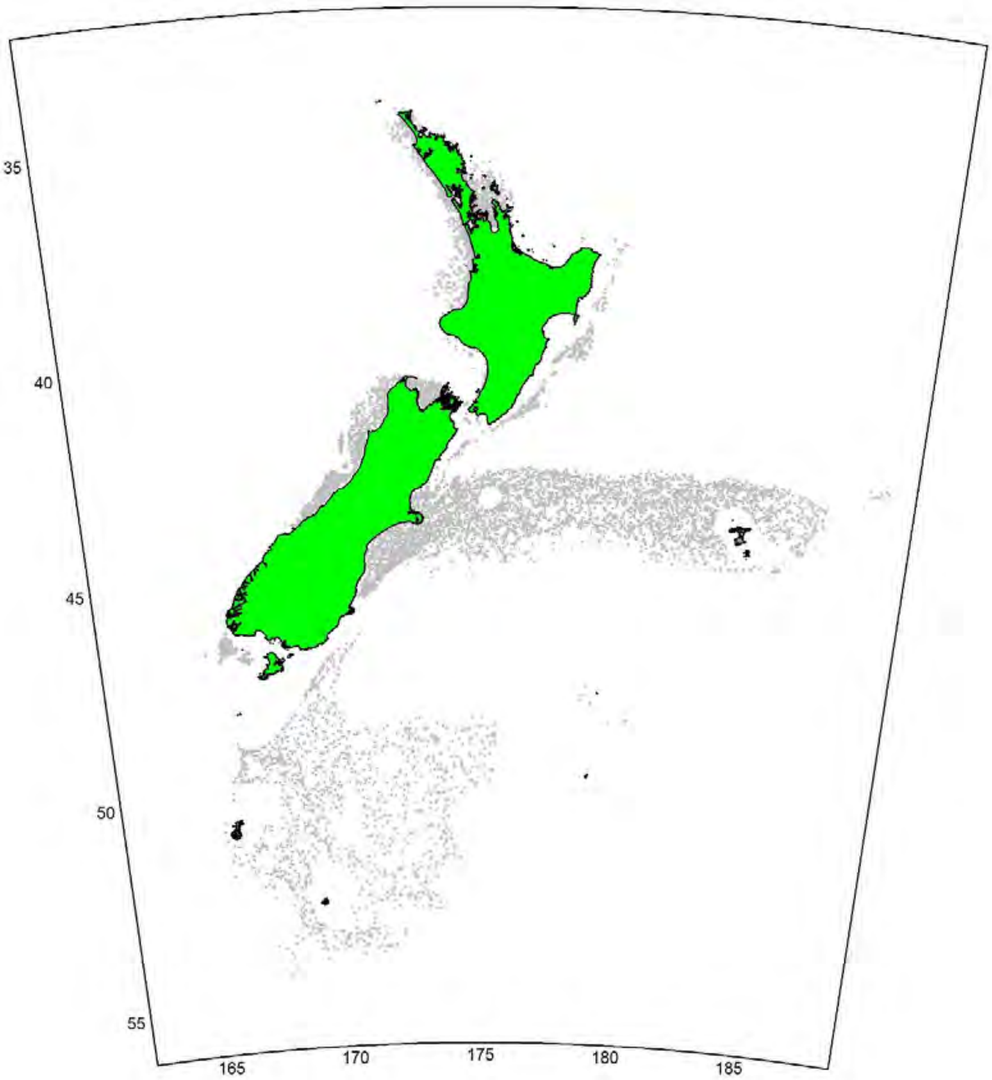


Figure 25.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where grey mullet was caught (red points).

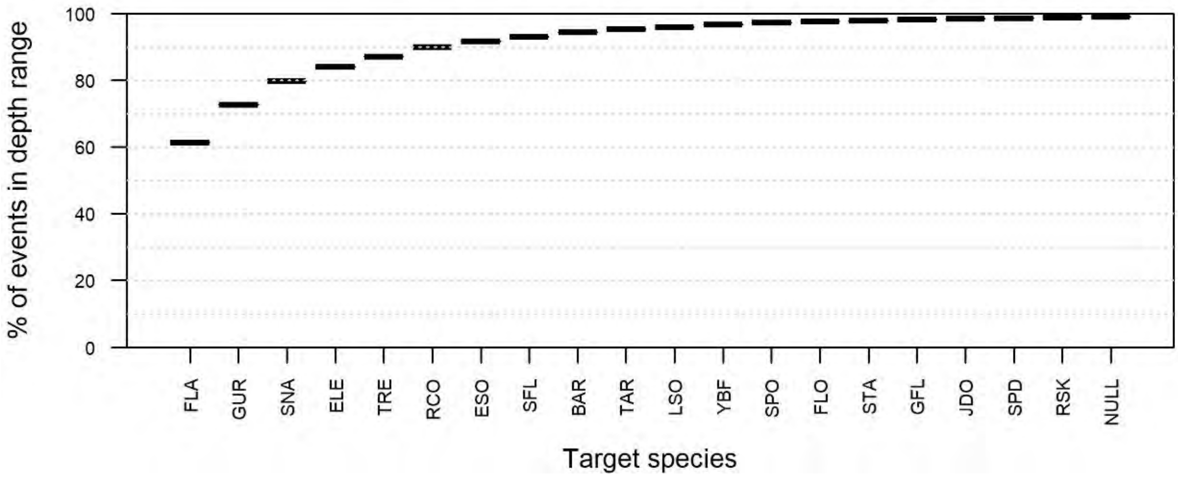
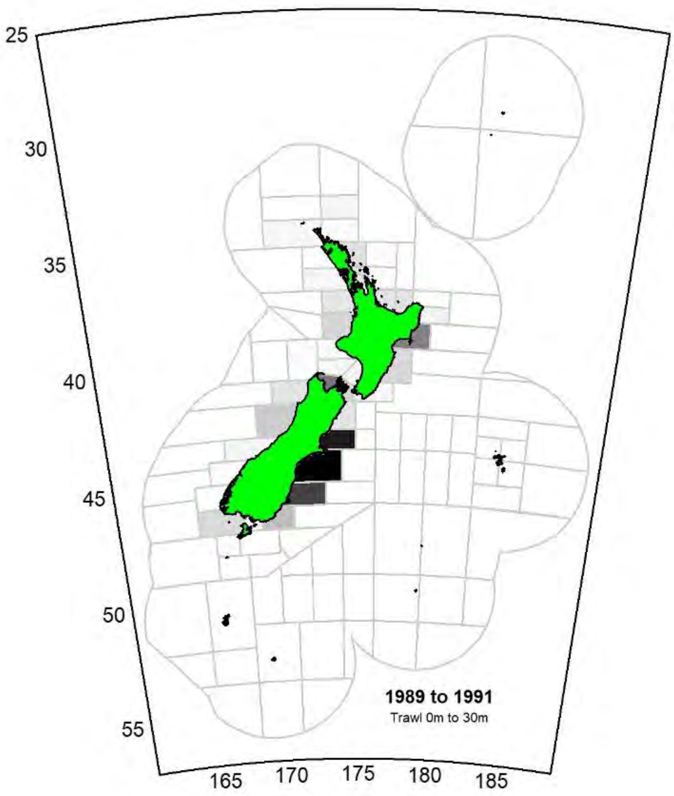


Figure 25.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for grey mullet (0–30 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.



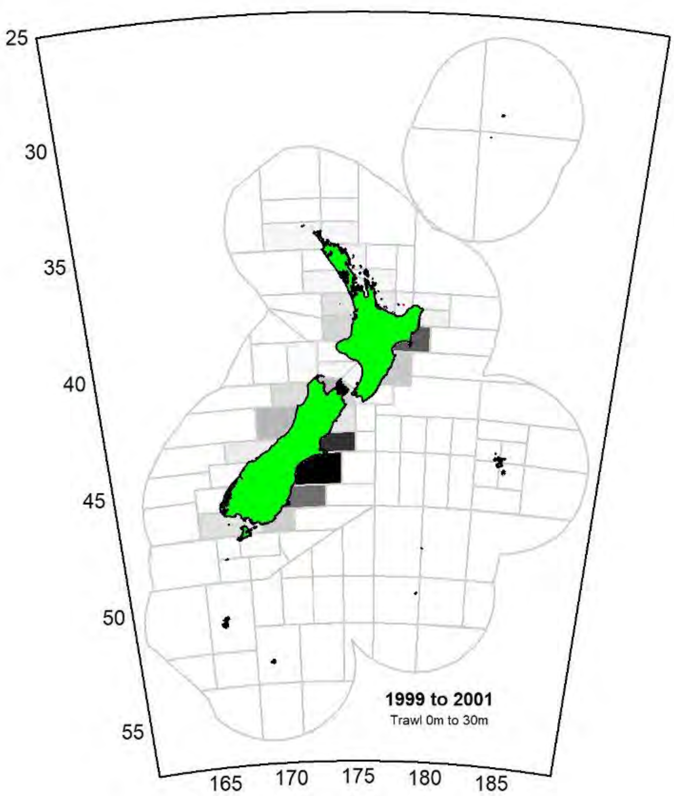
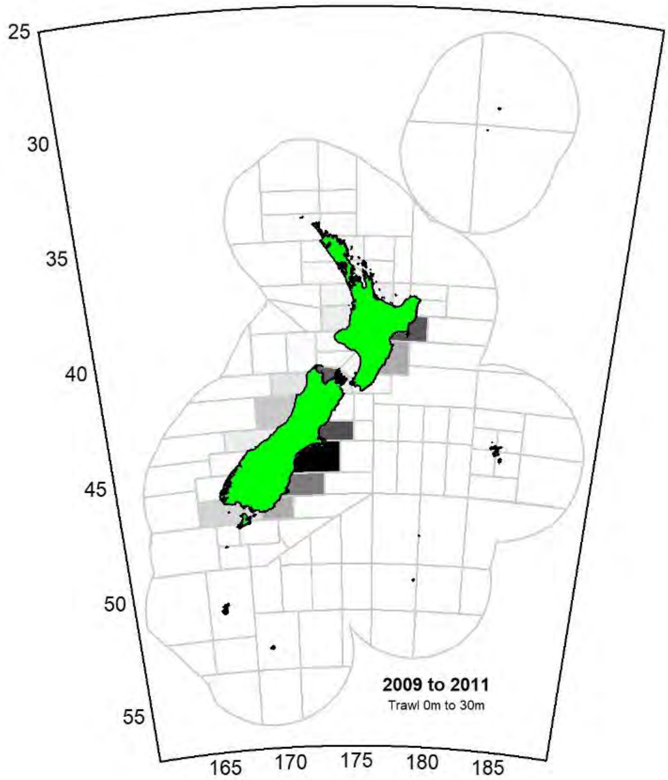


Figure 25.4: Maps of grey mullet occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



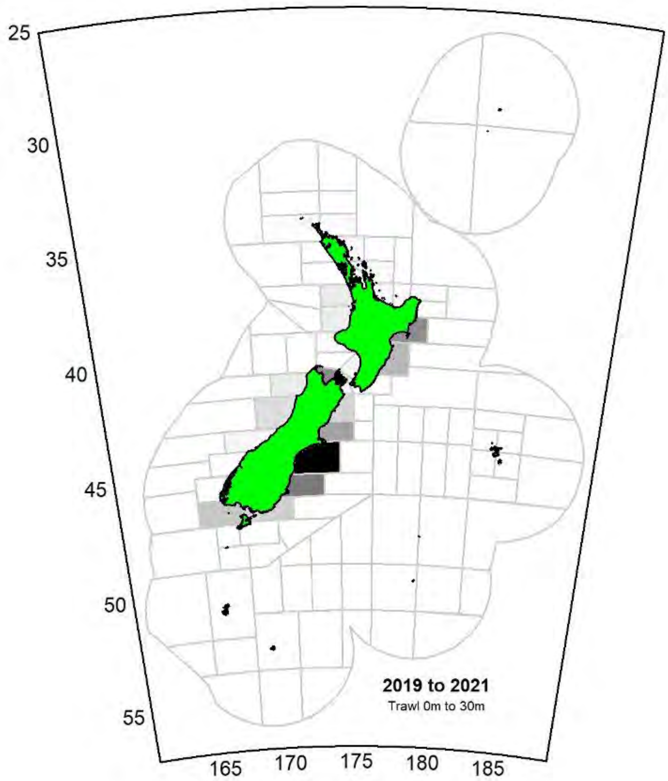


Figure 25.4 (cont.): Maps of grey mullet occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

26. Groper (Research, HAP, BAS; Commercial, HPB)

BAS

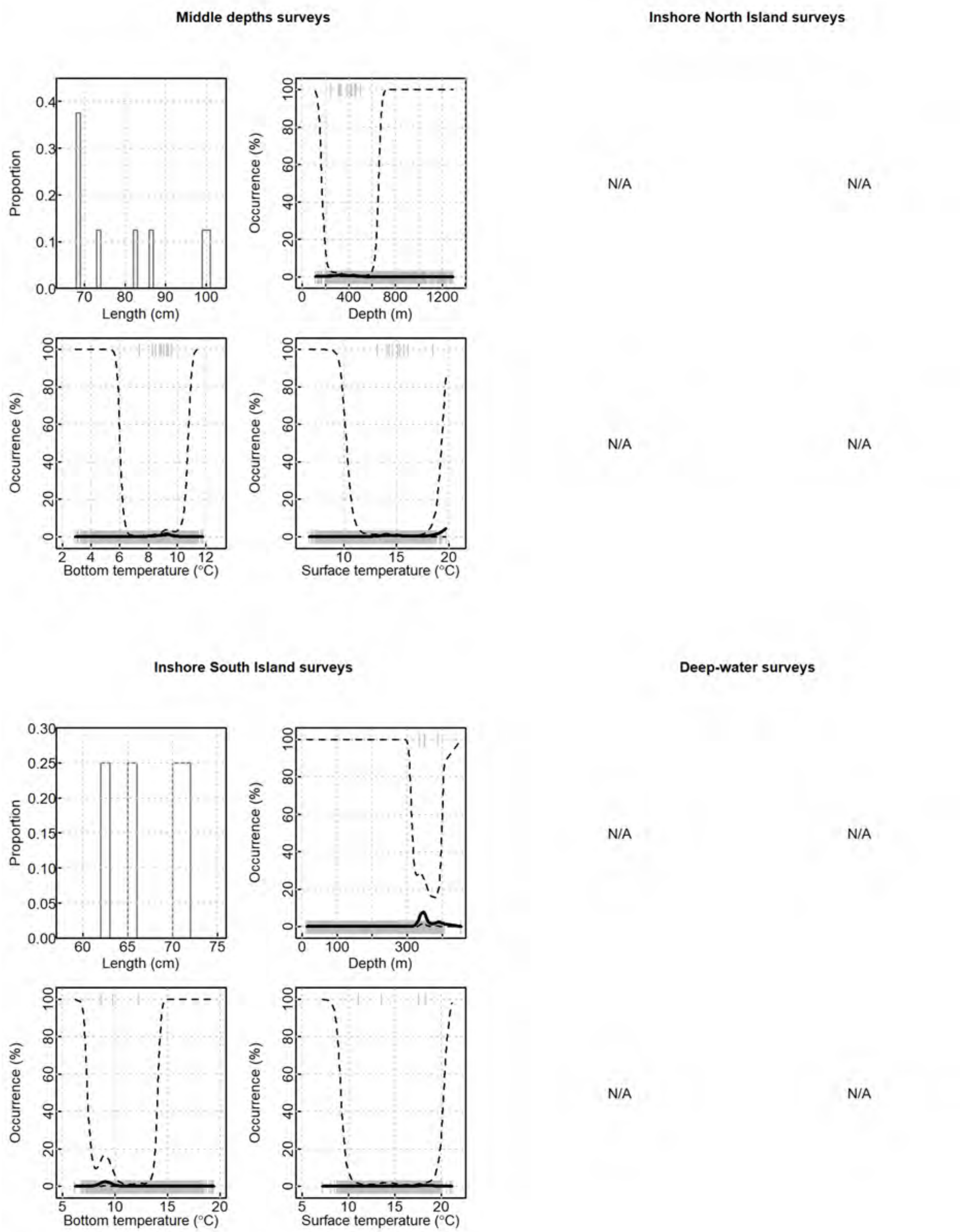


Figure 26.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to bass occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

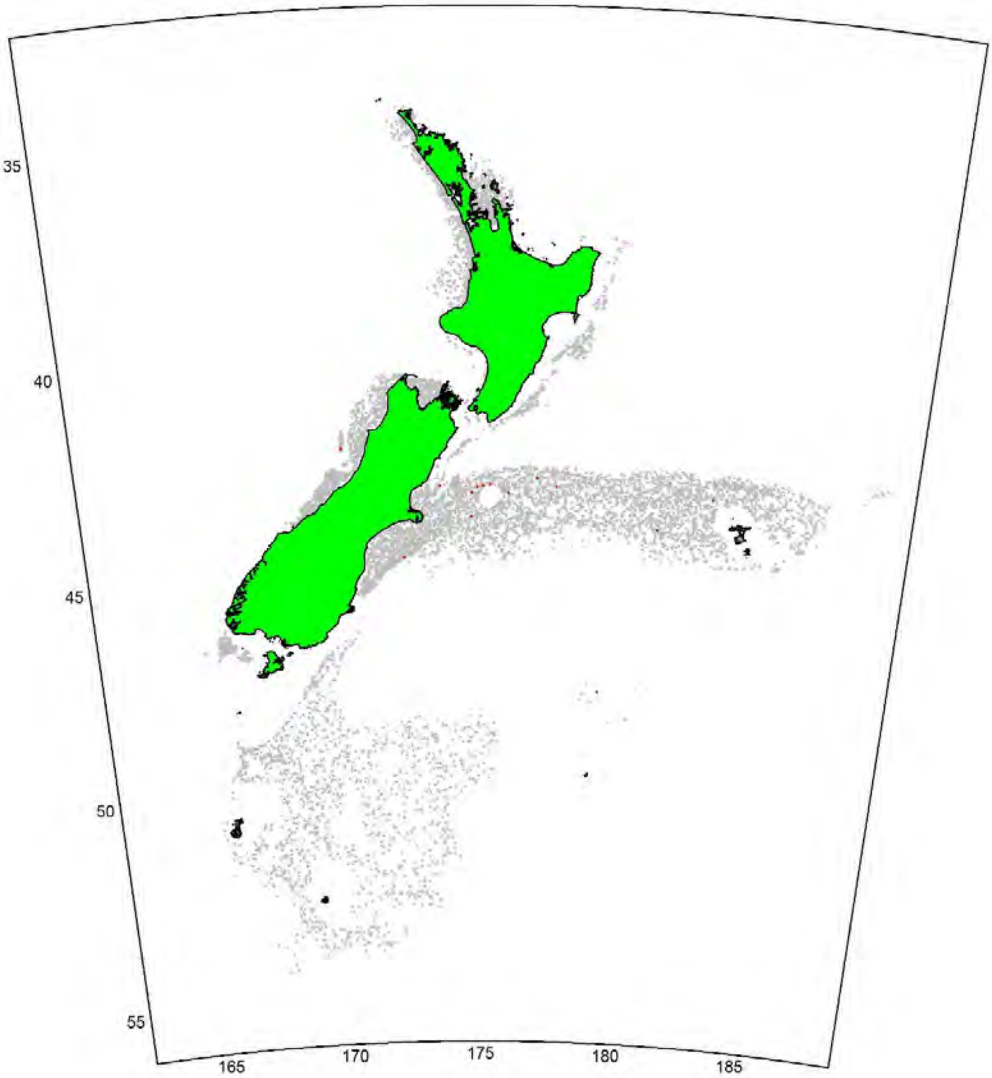


Figure 26.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where bass was caught (red points).

HAP

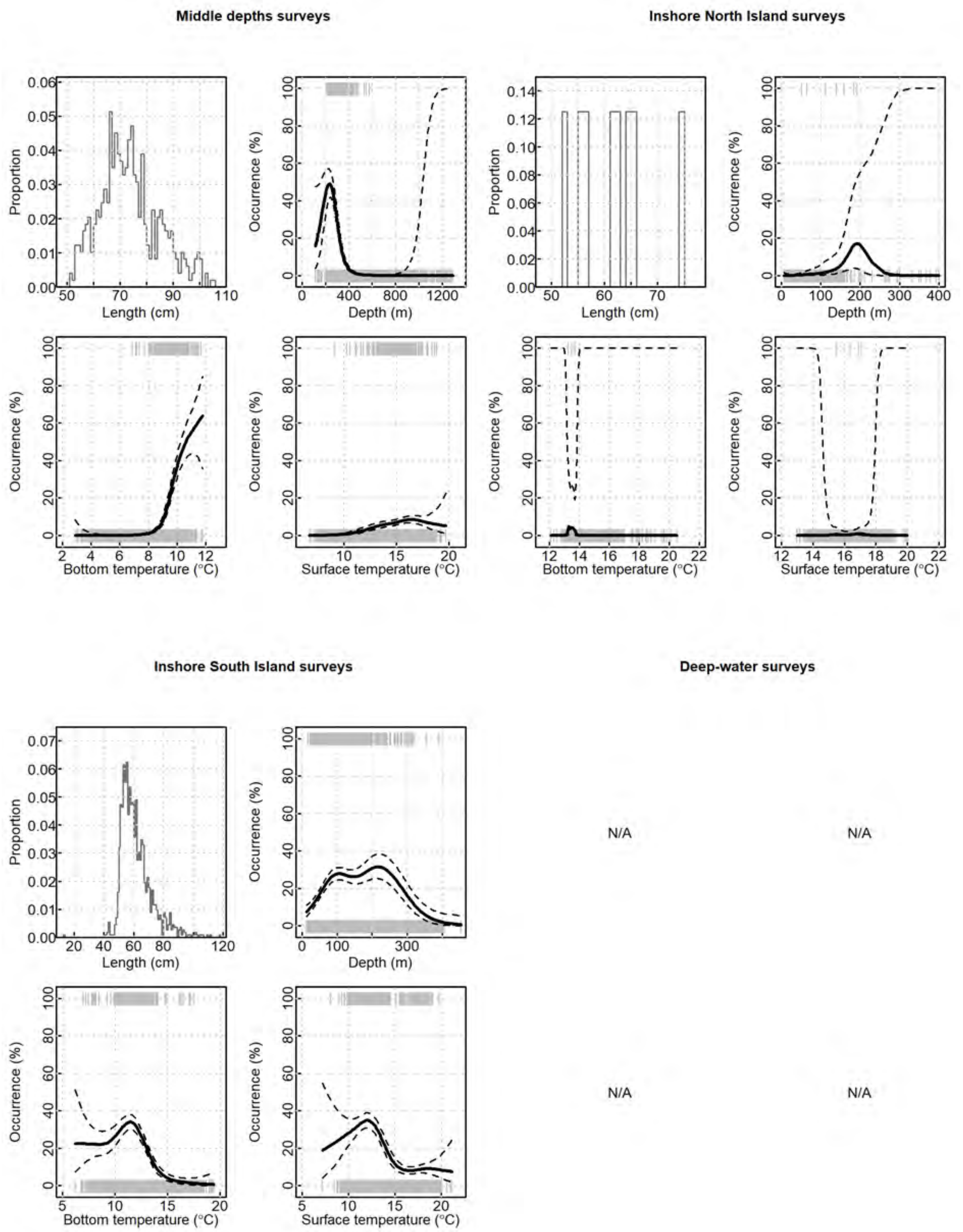


Figure 26.3: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to hāpuku occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

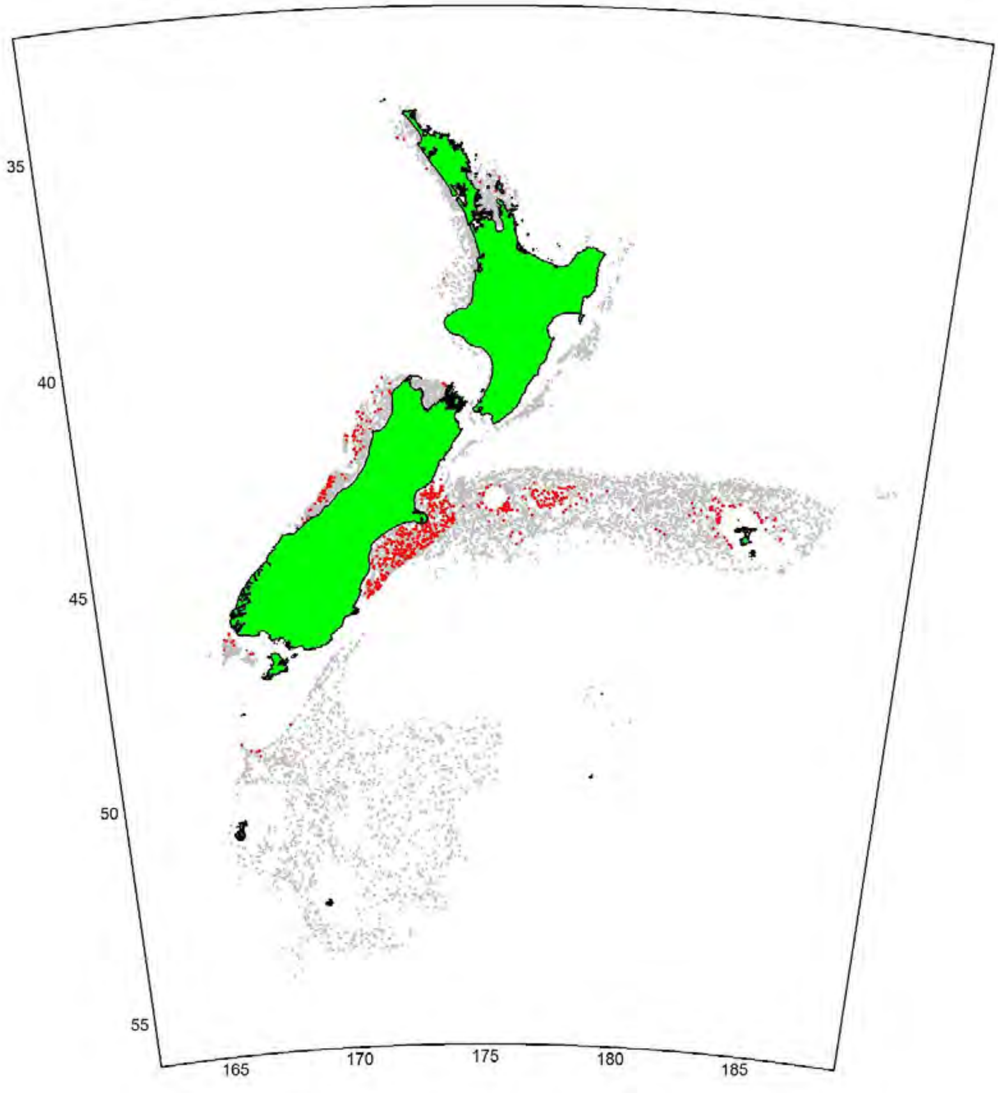


Figure 26.4: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where hāpuku was caught (red points).

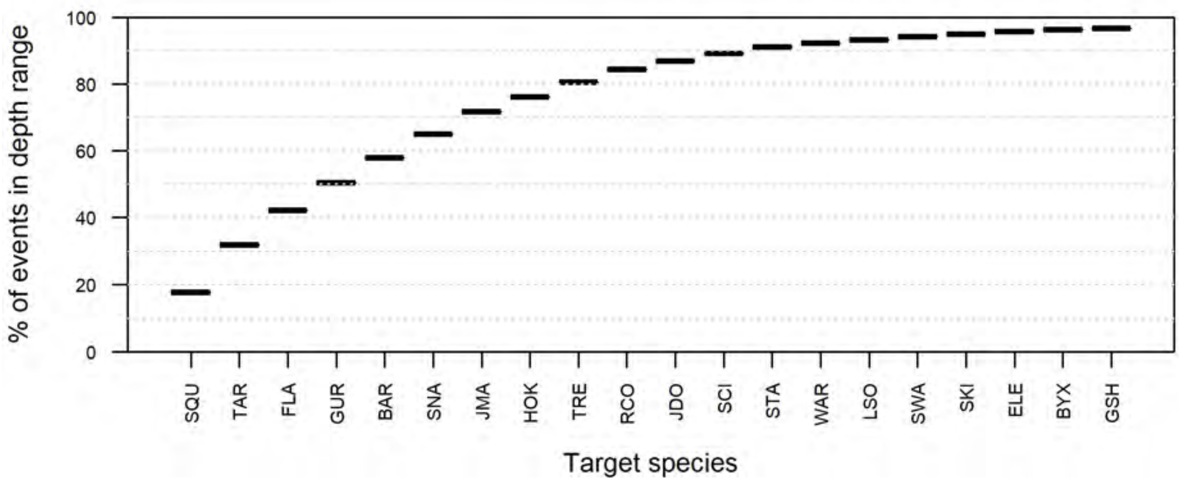
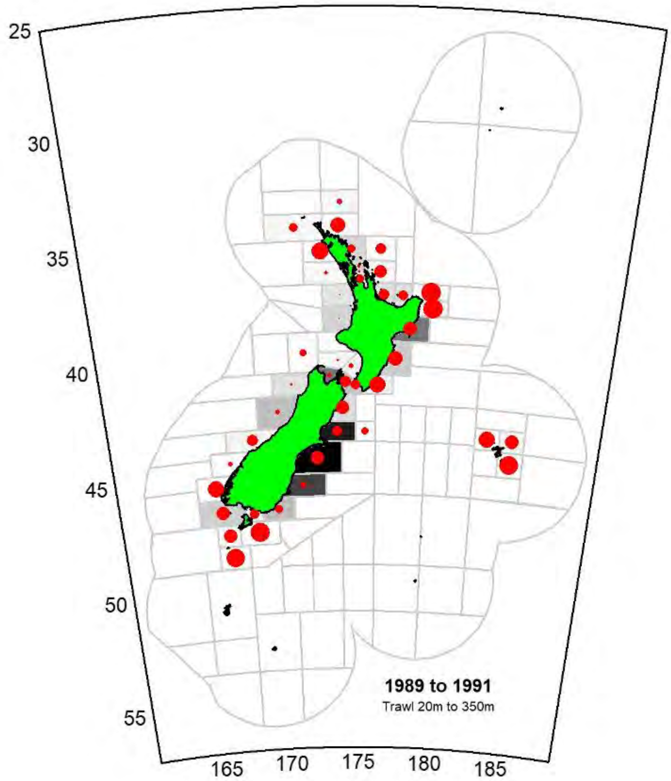


Figure 26.5: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for hāpuku or bass (20–350 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.



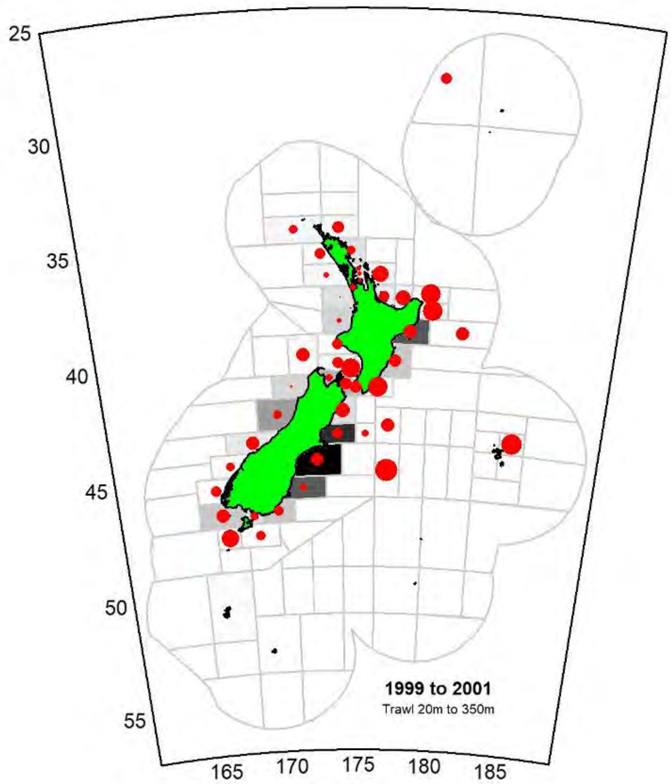
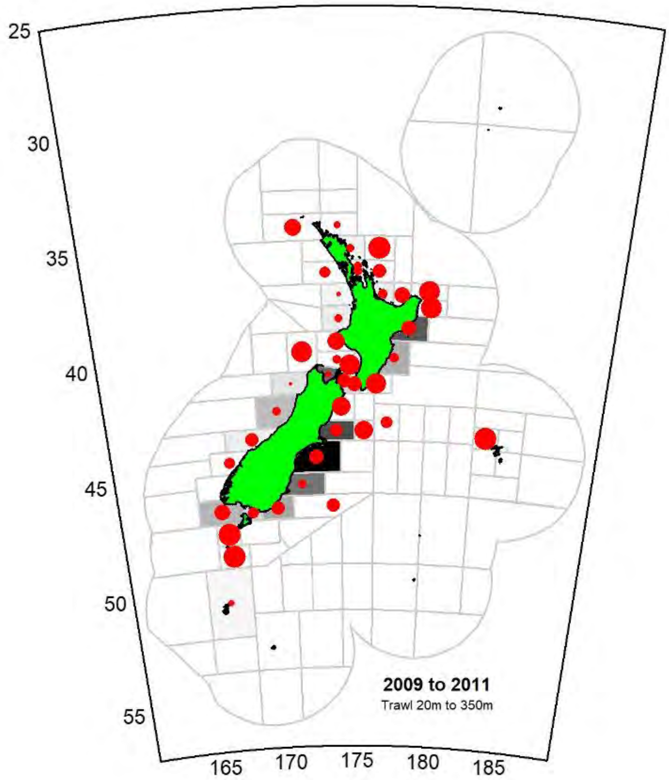


Figure 26.6: Maps of hāpuku or bass occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



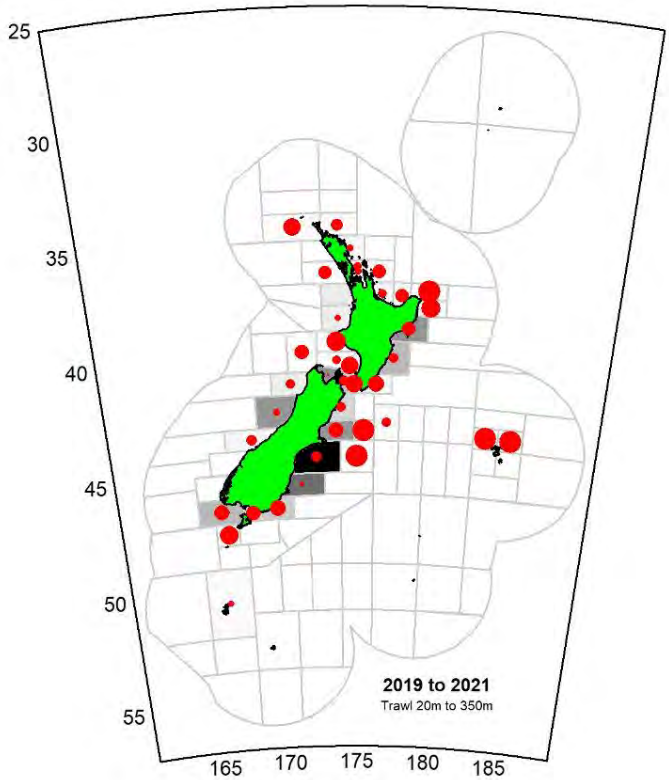


Figure 26.6 (cont.): Maps of hāpuku or bass occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

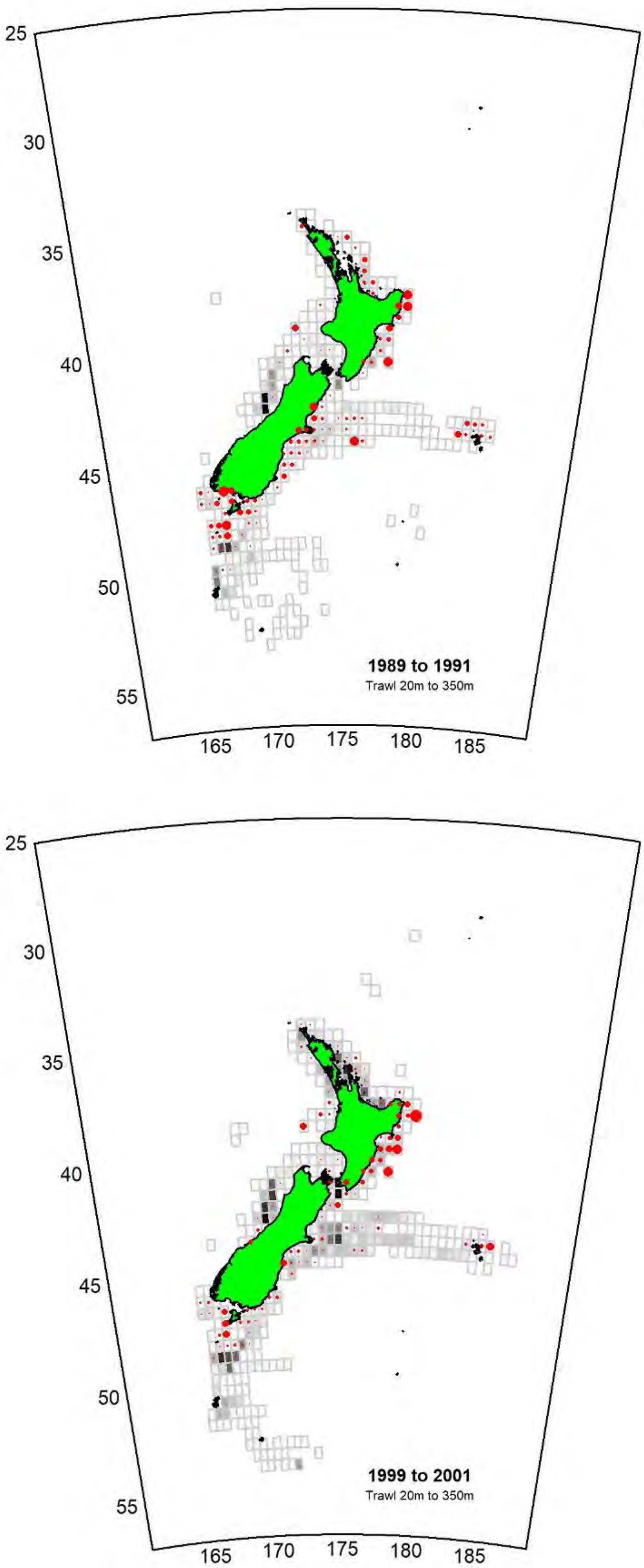
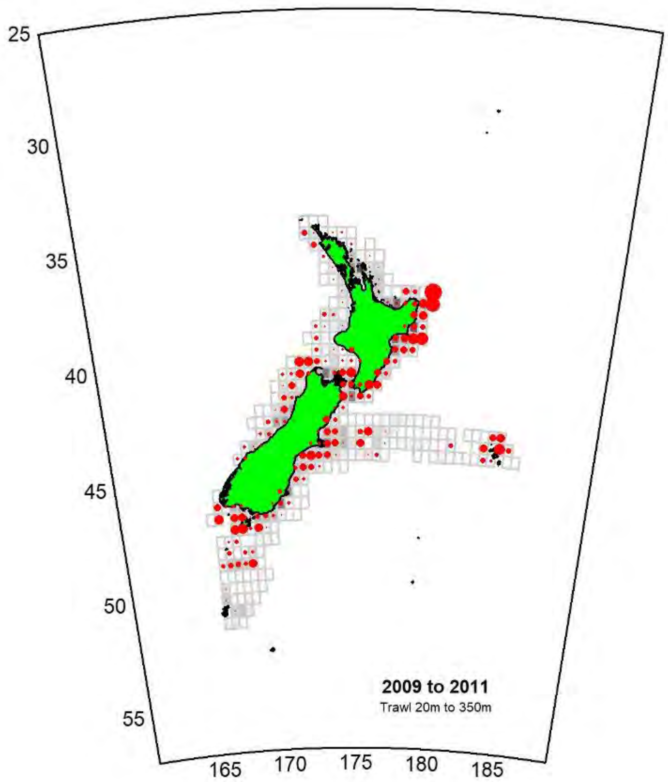


Figure 26.7: Maps of hāpuku or bass occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



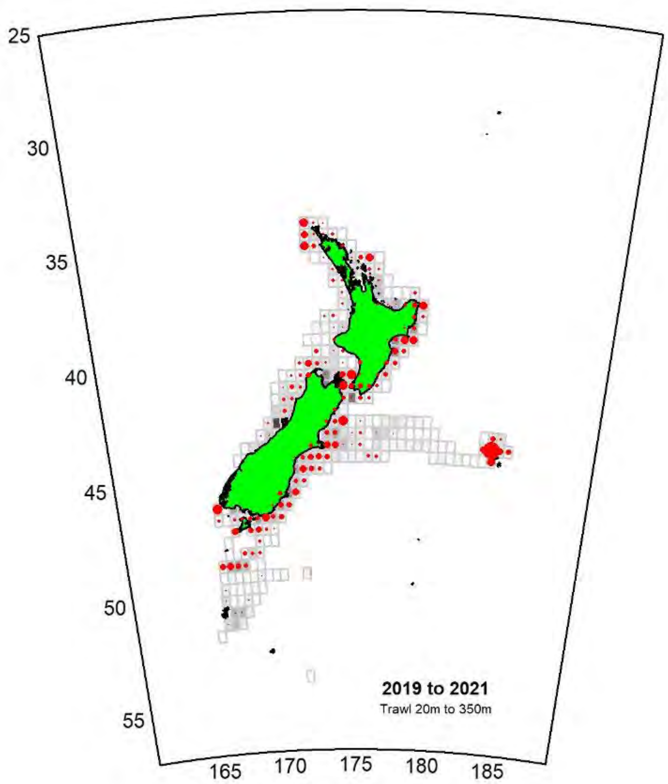


Figure 26.7 (cont.): Maps of hāpuku or bass occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

27. Hake (HAK)

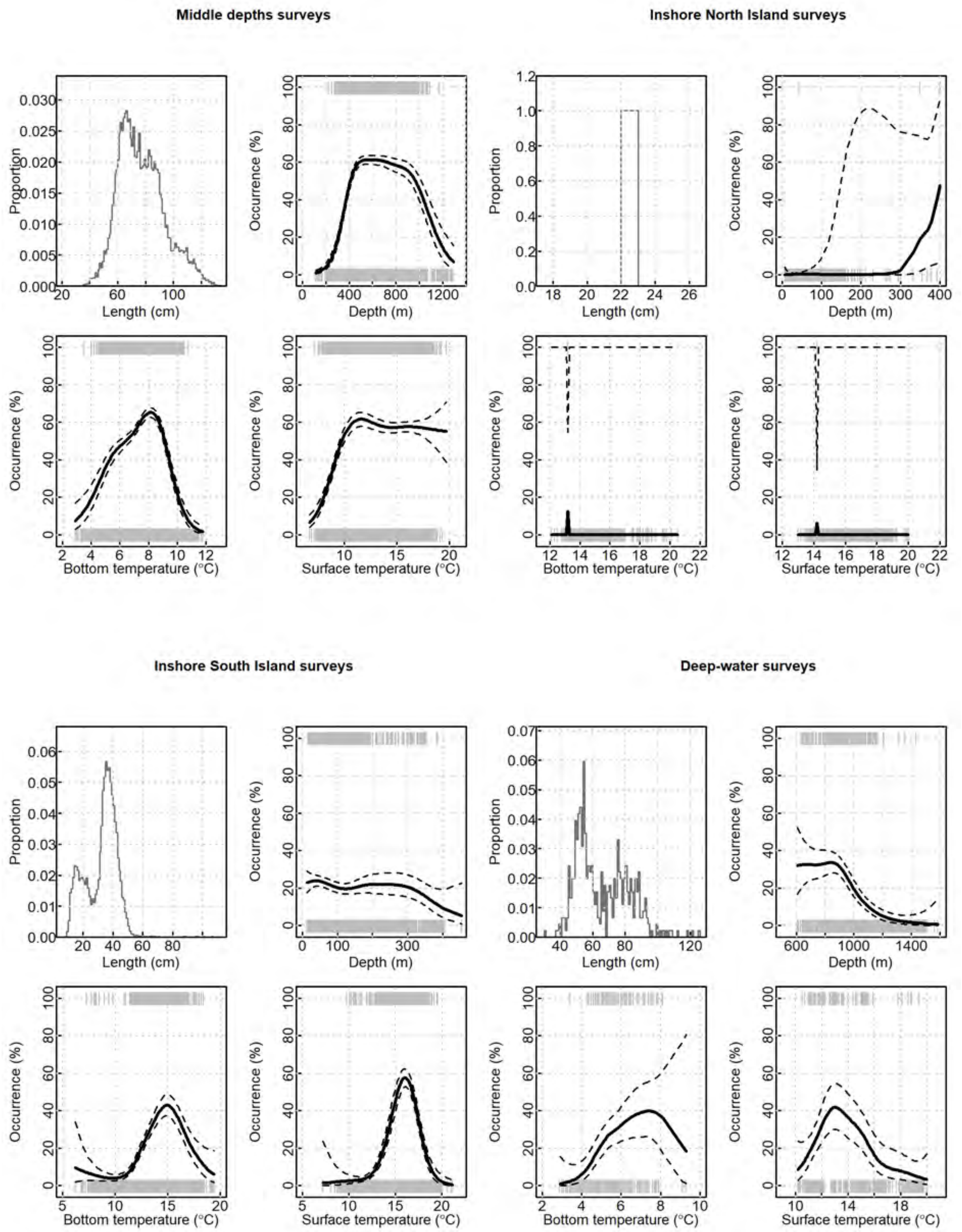


Figure 27.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to hake occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

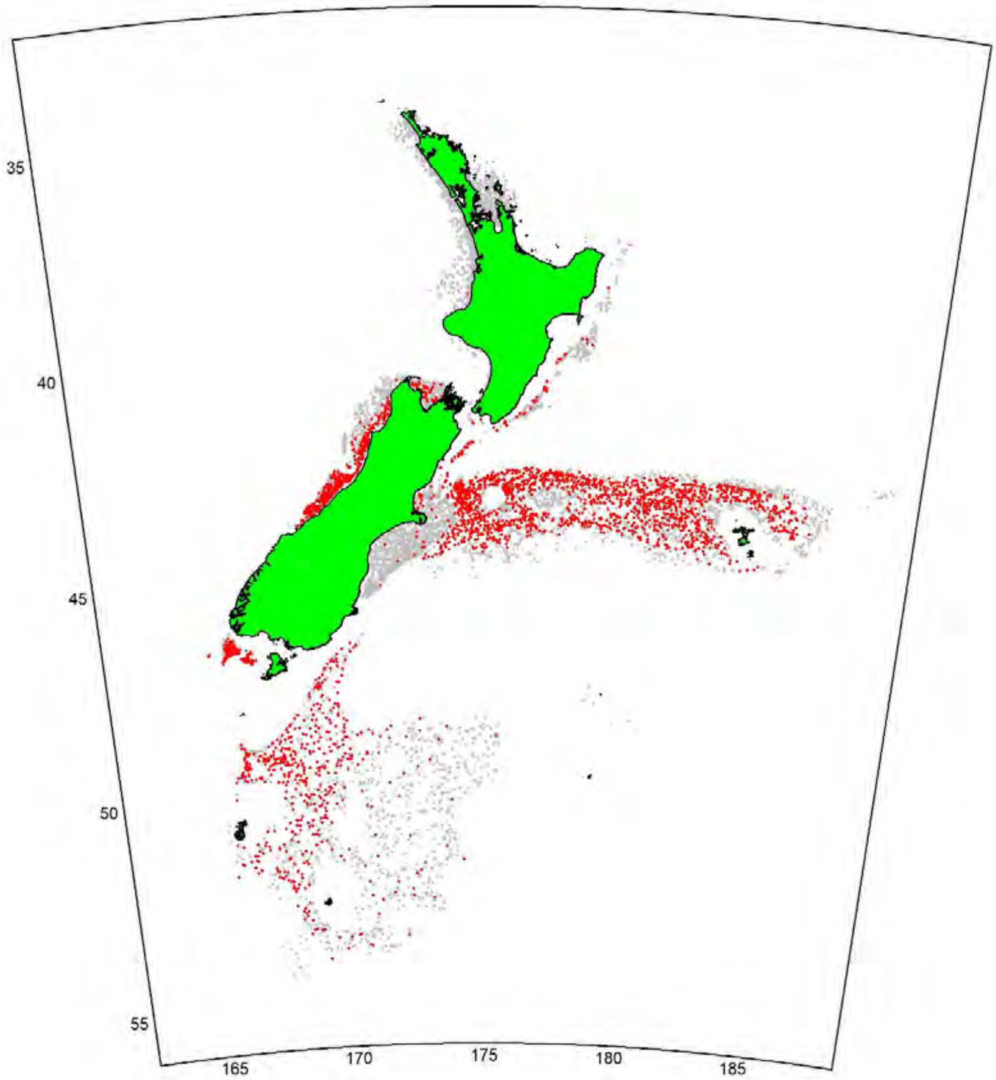


Figure 27.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where hake was caught (red points).

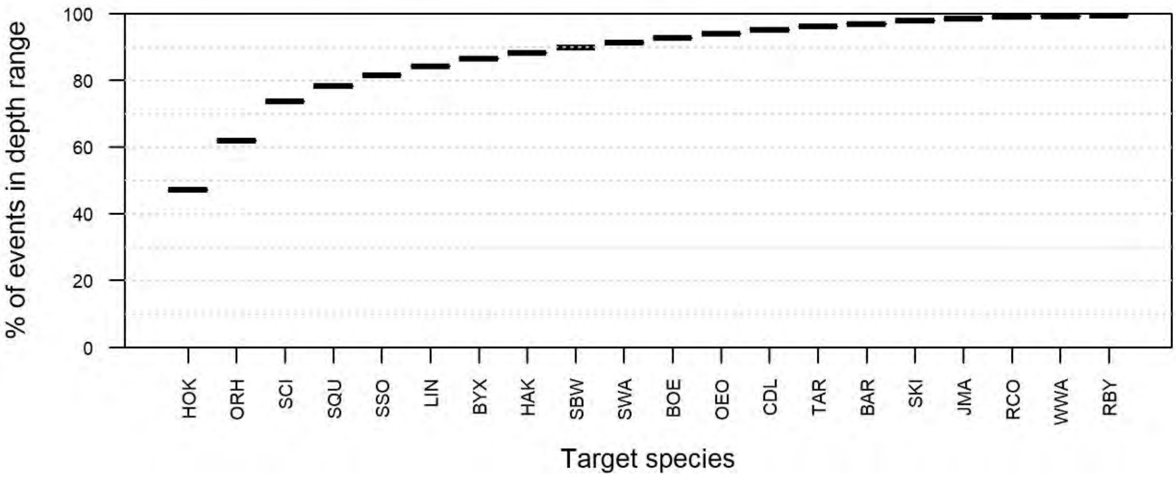
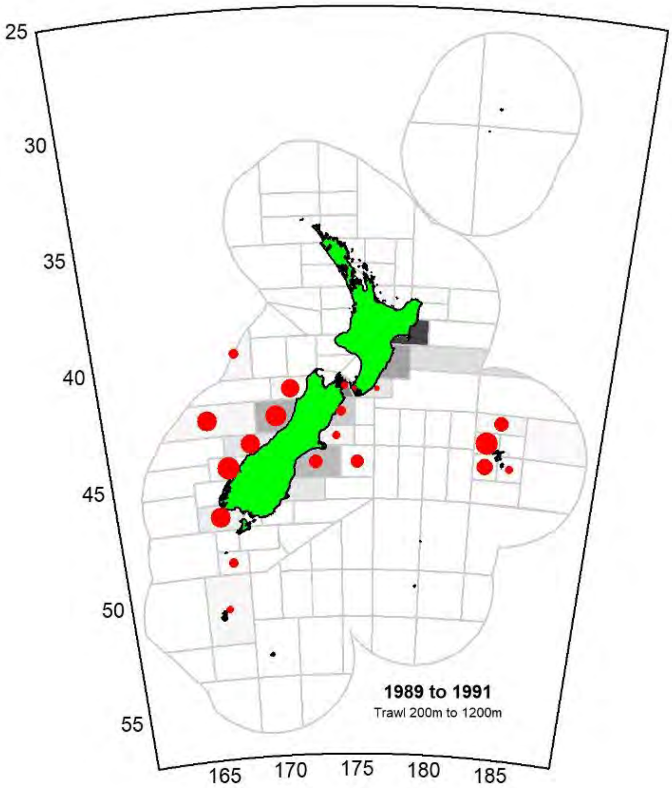


Figure 27.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for hake (200–1200 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.



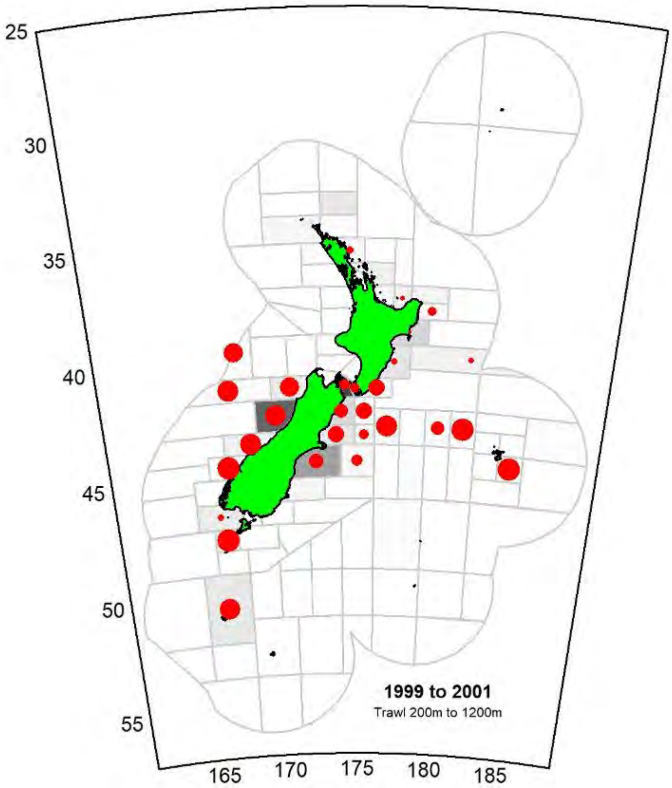
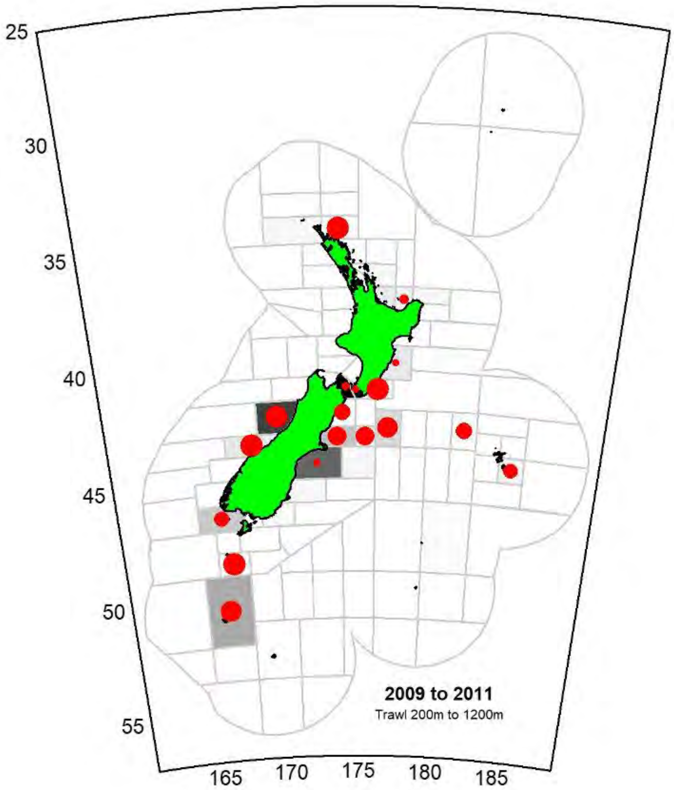


Figure 27.4: Maps of hake occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



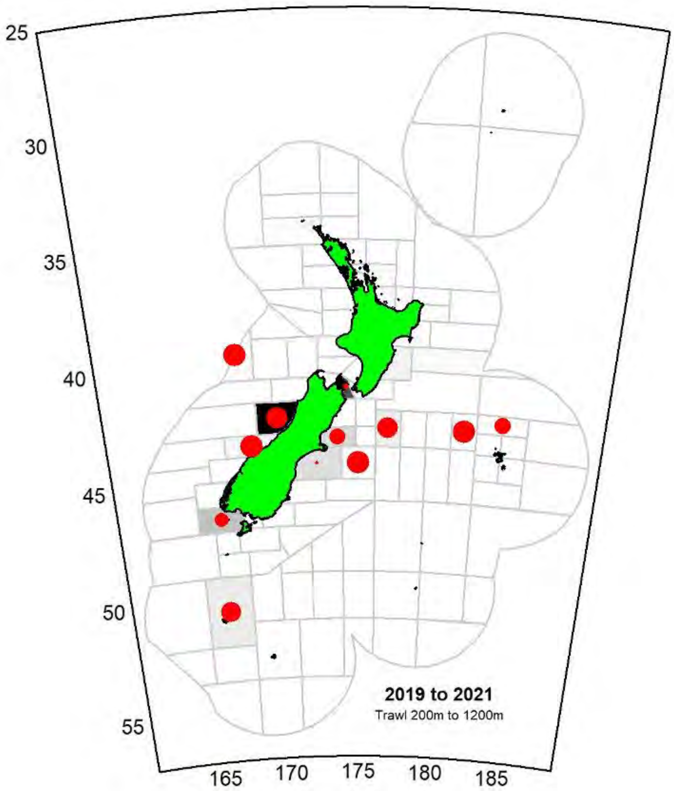


Figure 27.4 (cont.): Maps of hake occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

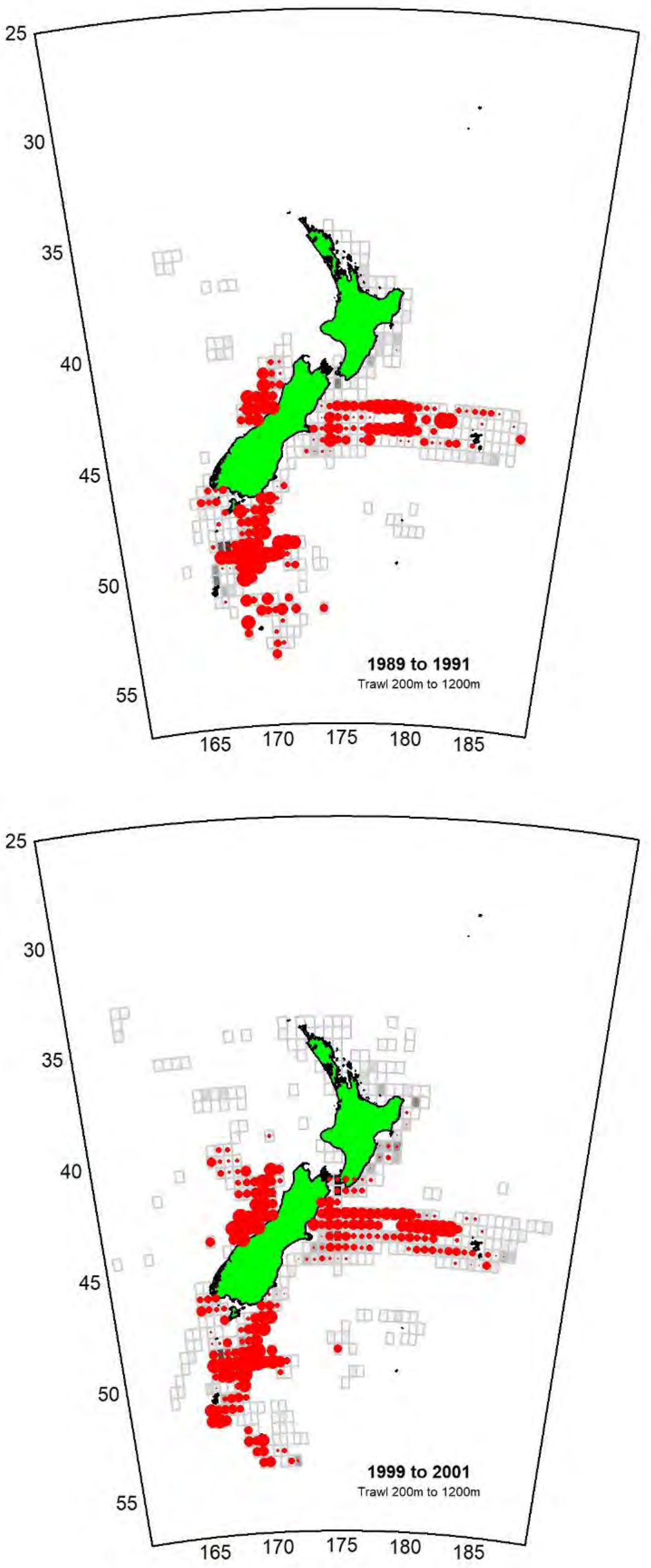
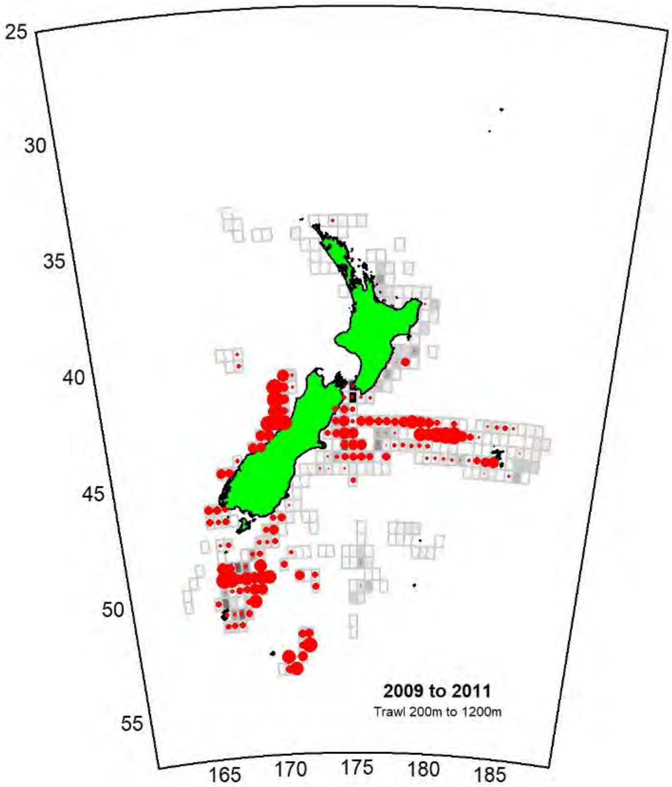


Figure 27.5: Maps of hake occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



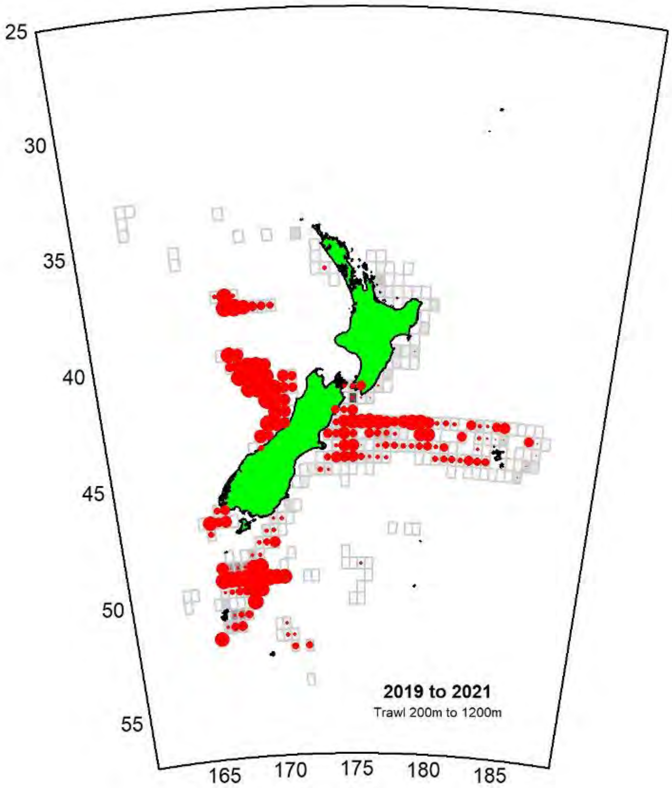


Figure 27.5 (cont.): Maps of hake occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

28. Hoki (HOK)

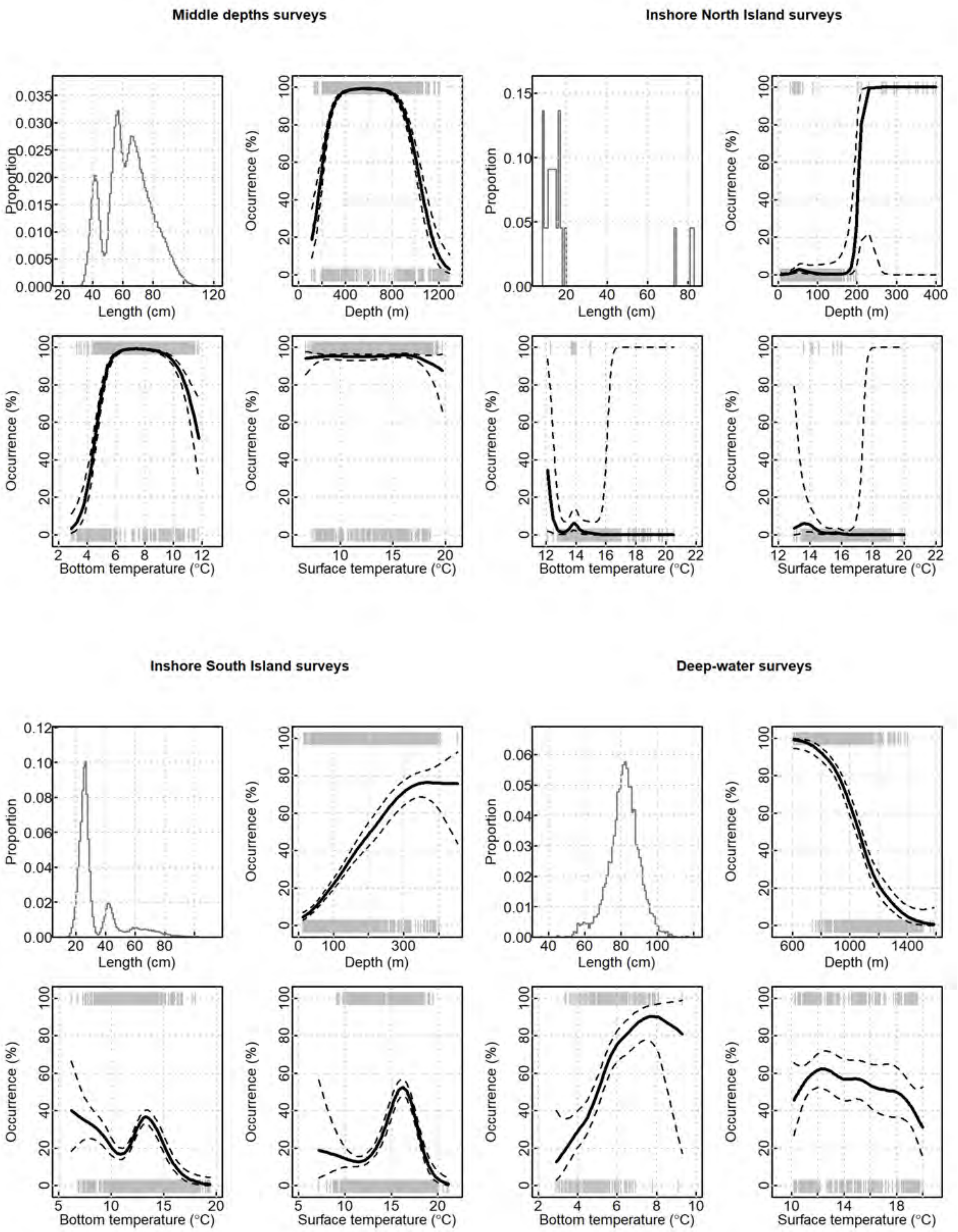


Figure 28.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to hoki occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

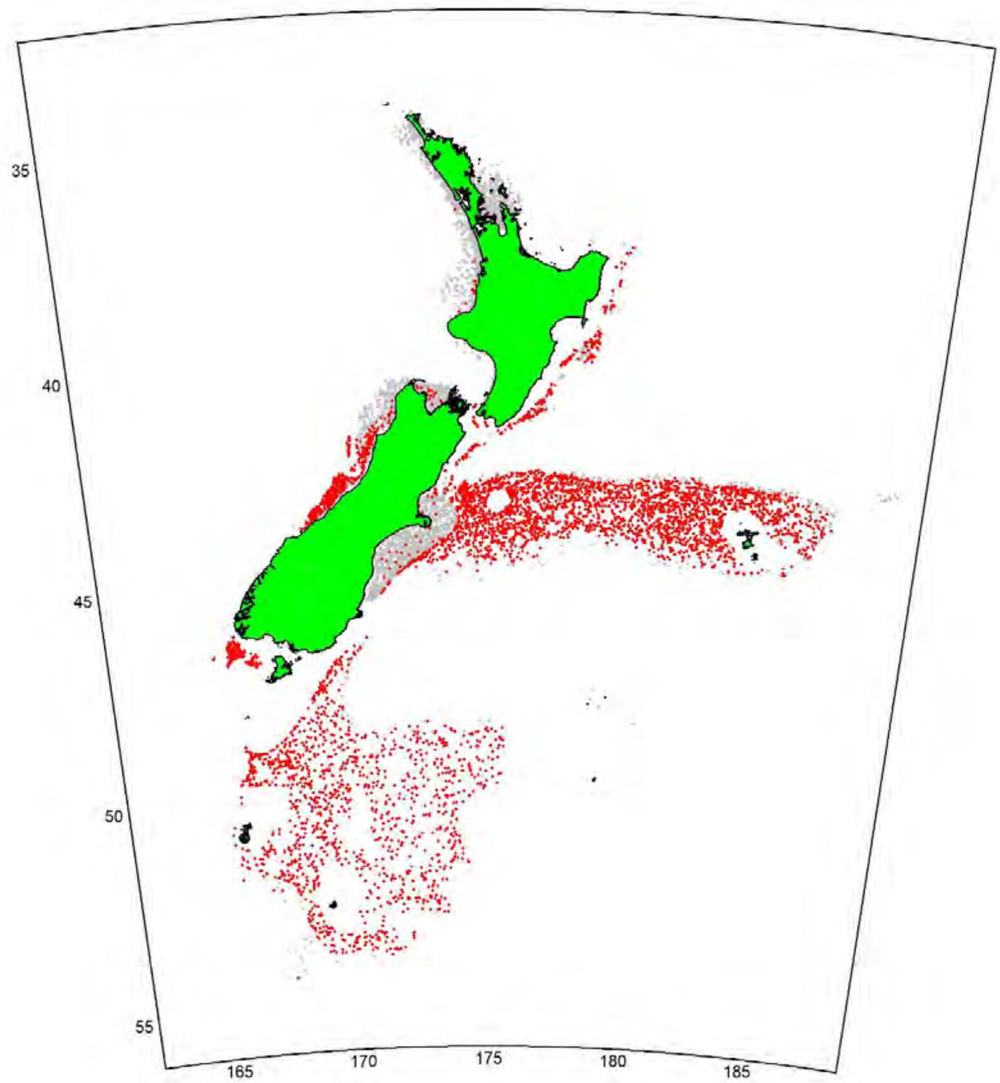


Figure 28.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where hoki was caught (red points).

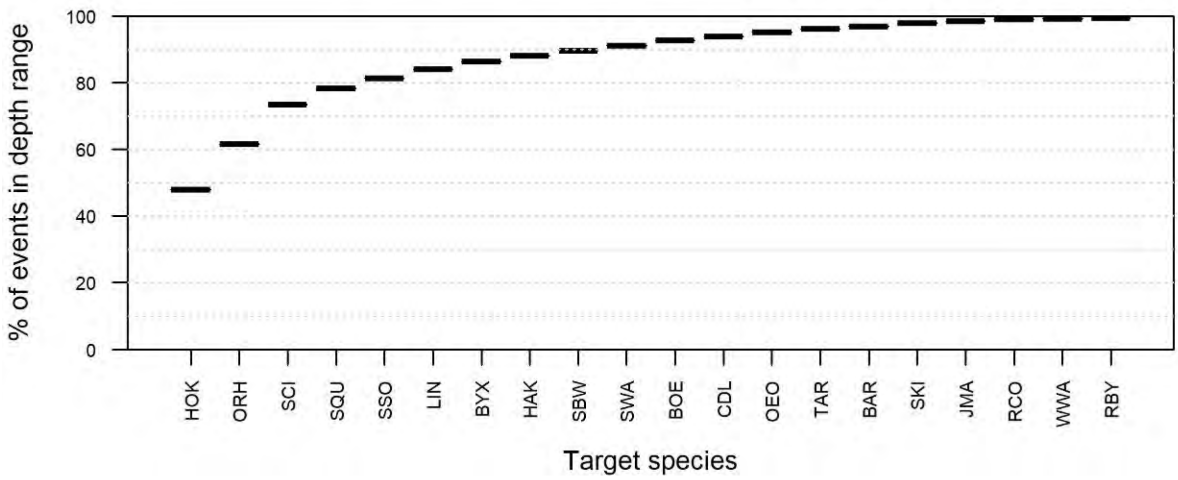


Figure 28.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for hoki (200–1100 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.

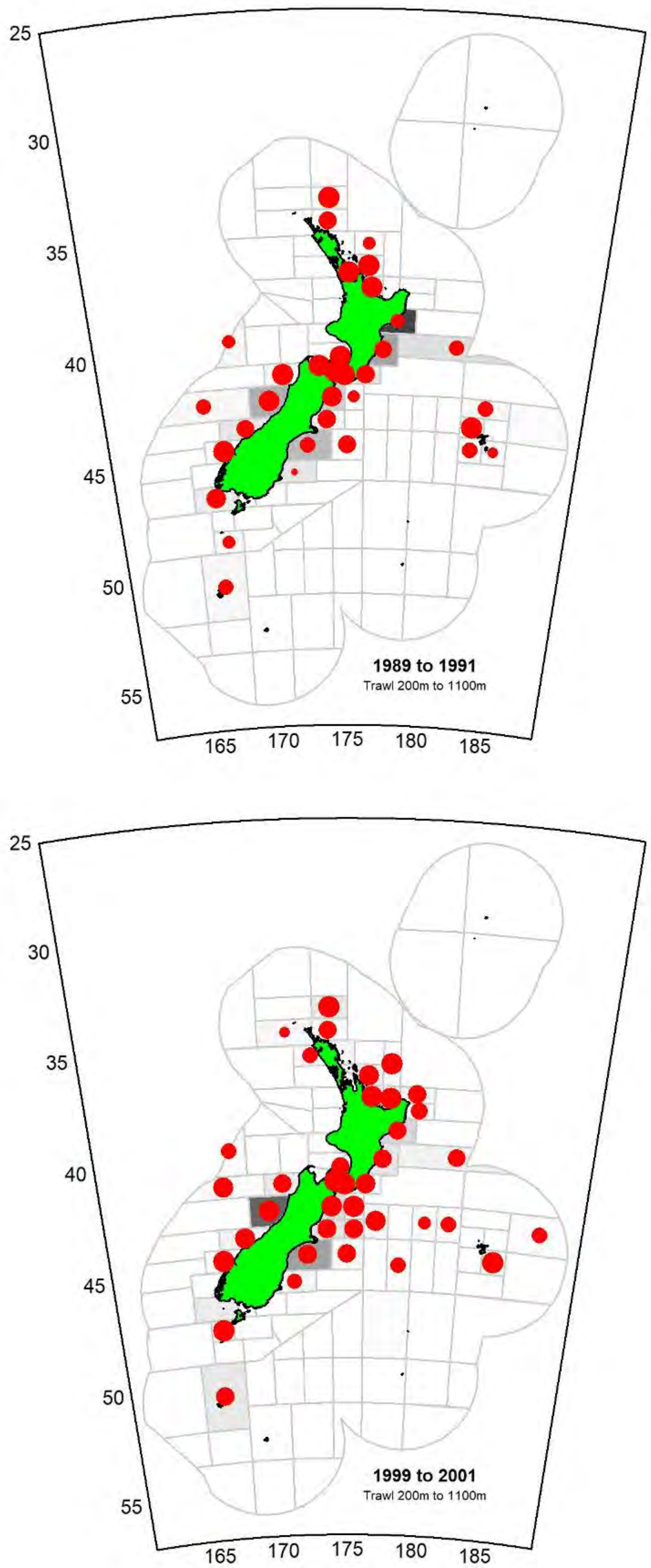
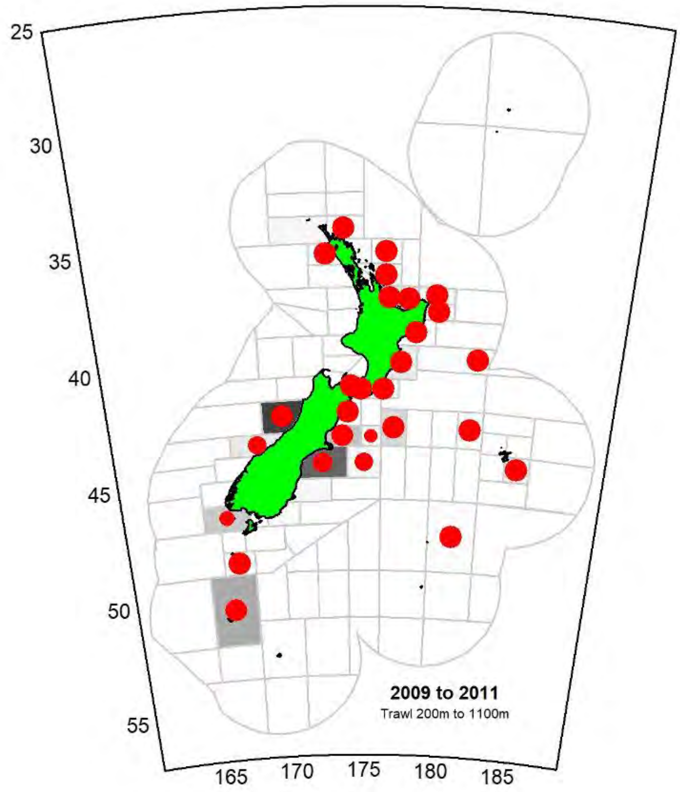


Figure 28.4: Maps of hoki occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



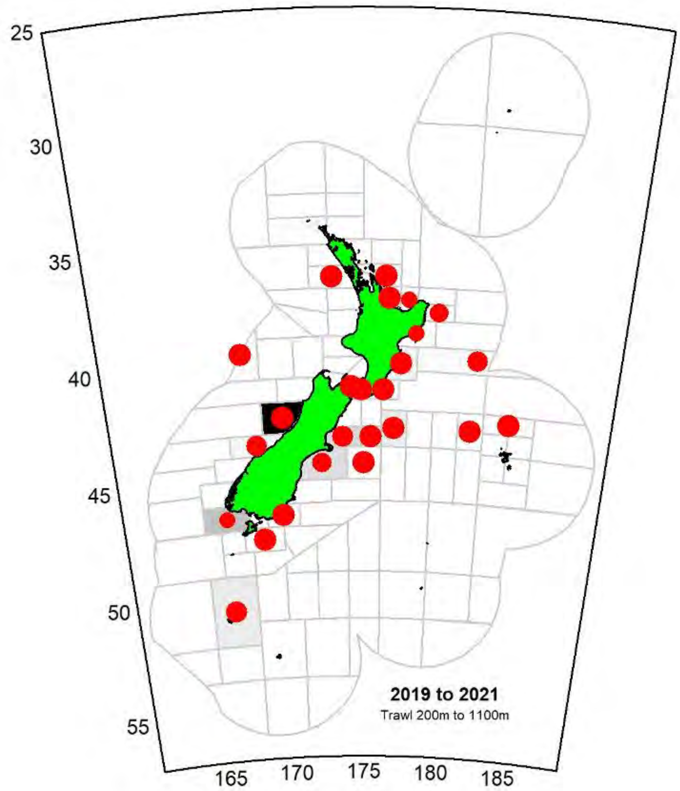
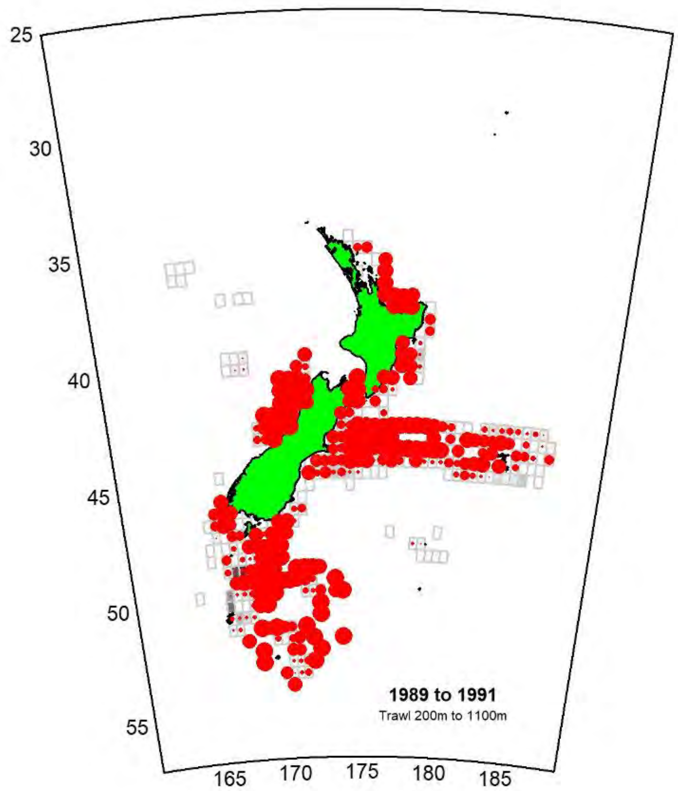


Figure 28.4 (cont.): Maps of hoki occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



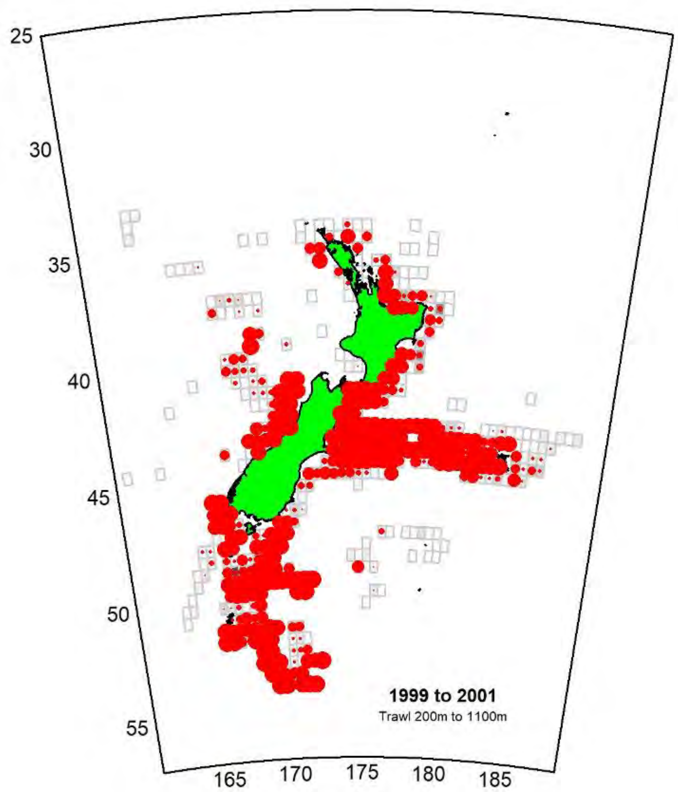
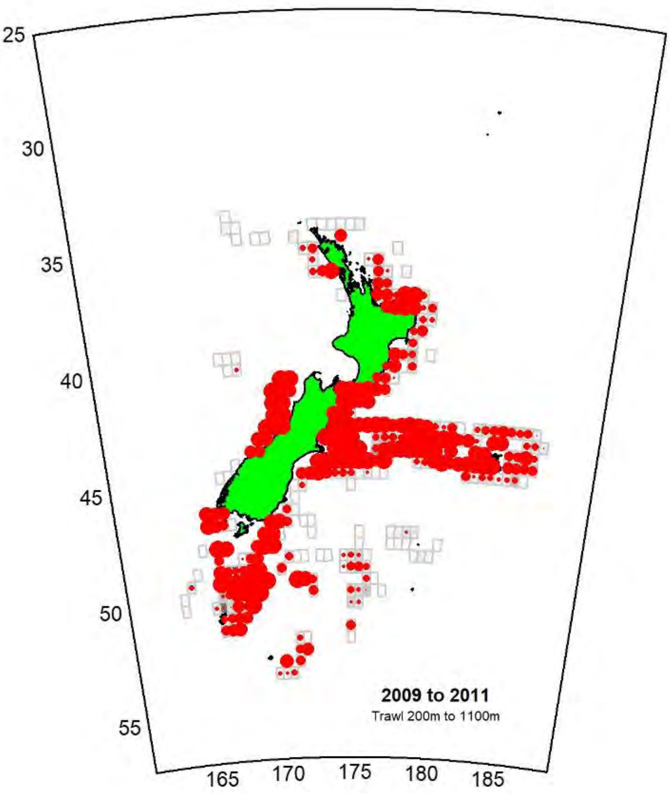


Figure 28.5: Maps of hoki occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



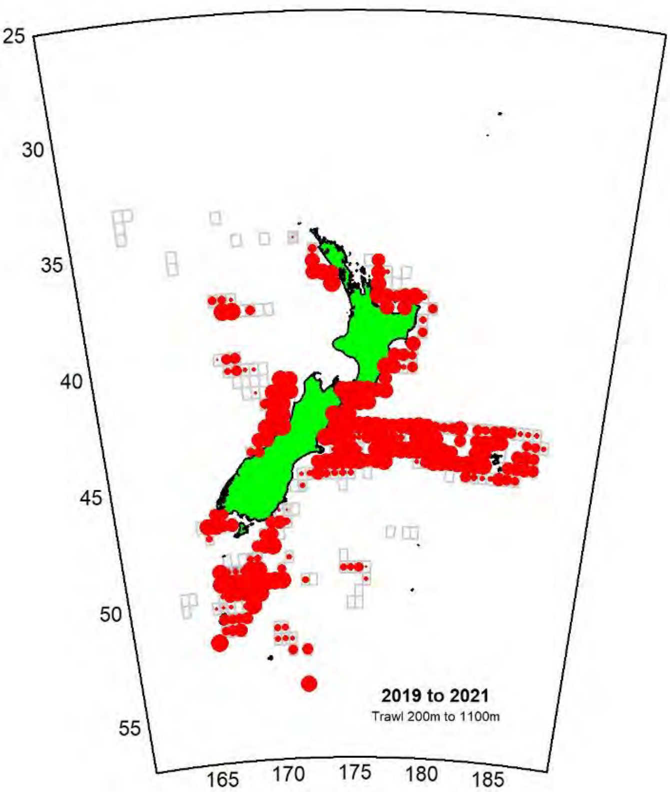


Figure 28.5 (cont.): Maps of hoki occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

29. Jack mackerel (Research JMN, JMM, JMD; Commercial, JMA)

JMN

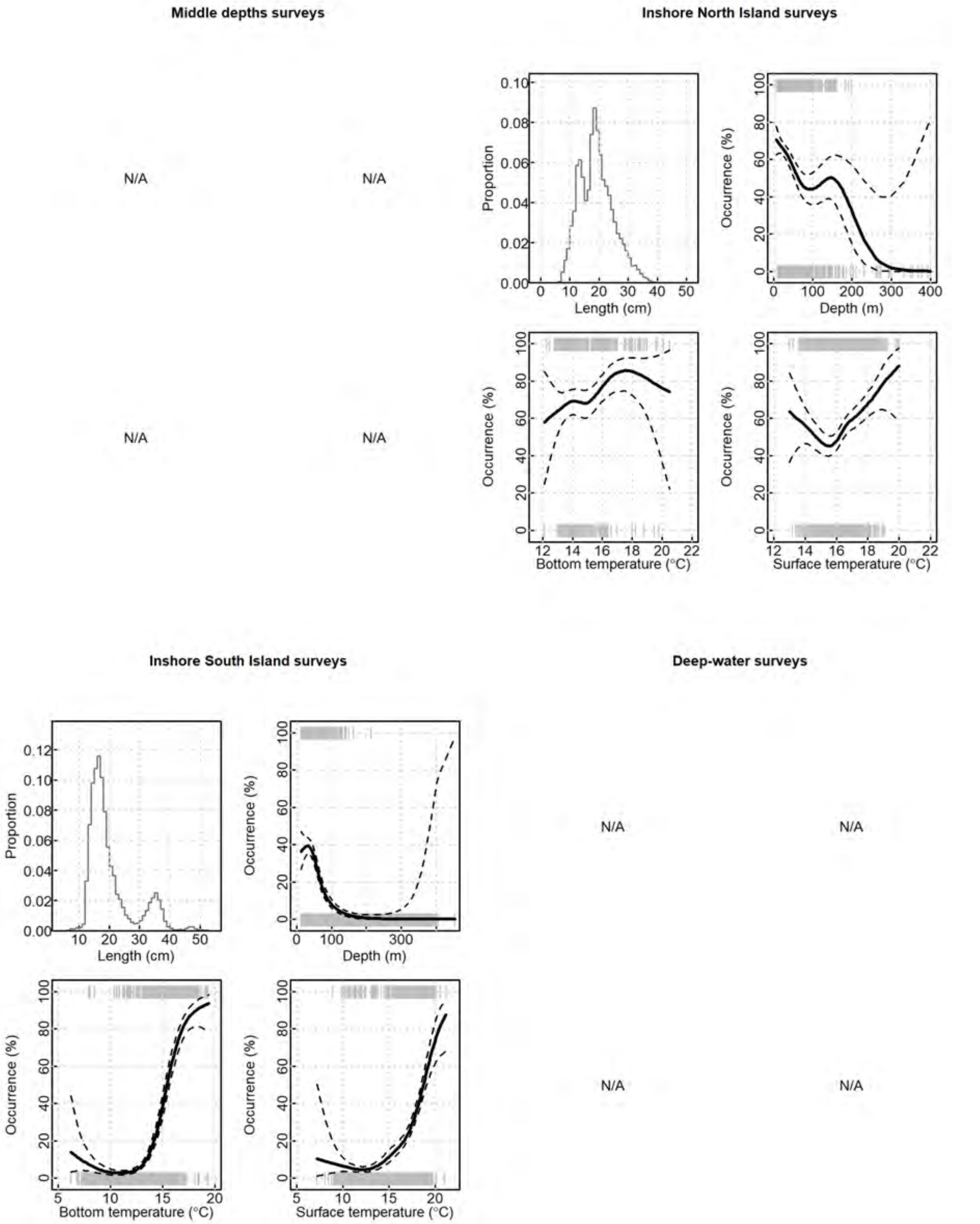


Figure 29.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to *Trachurus novaezelandiae* occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

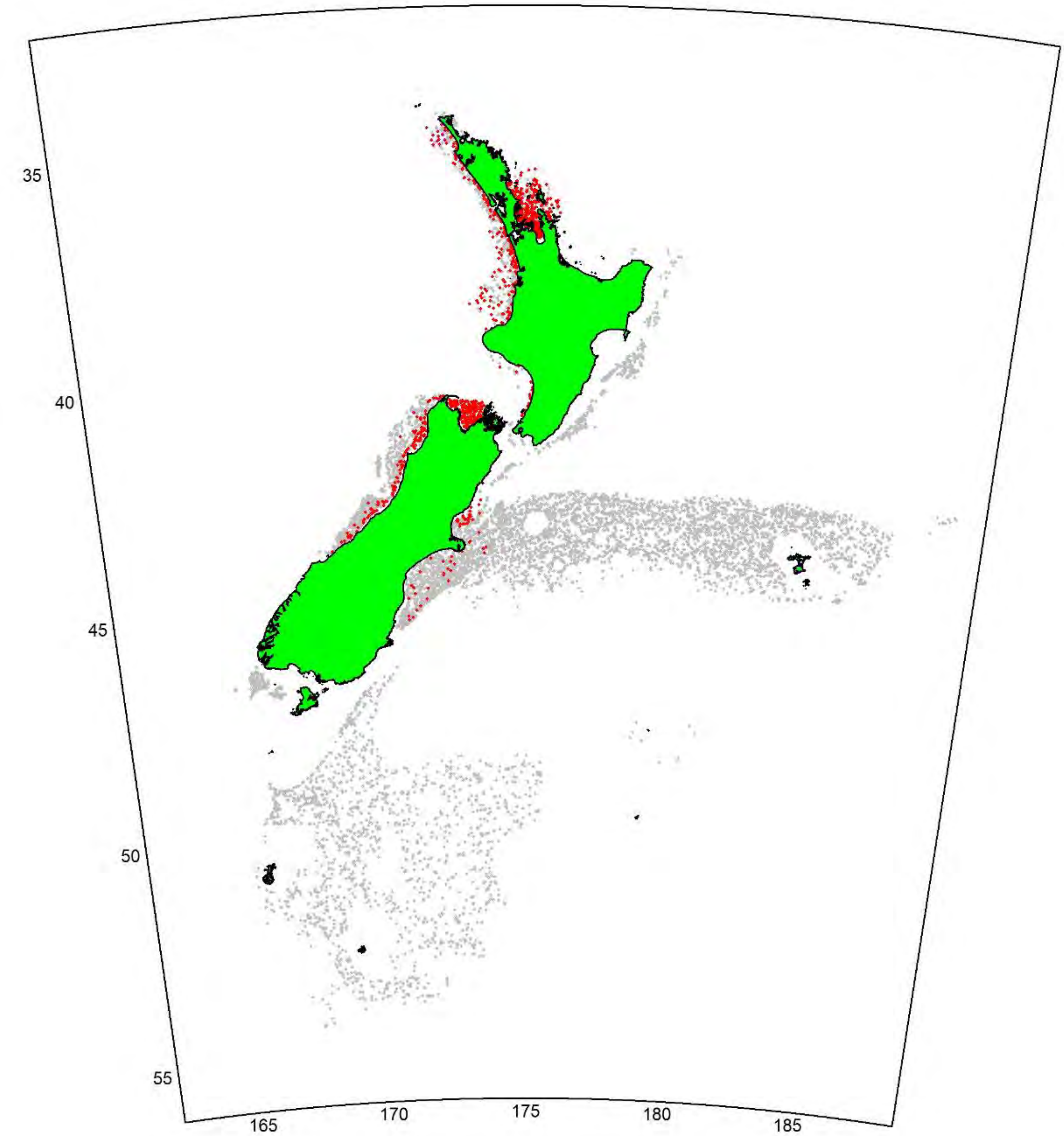


Figure 29.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where *Trachurus novaezelandiae* was caught (red points).

JMM

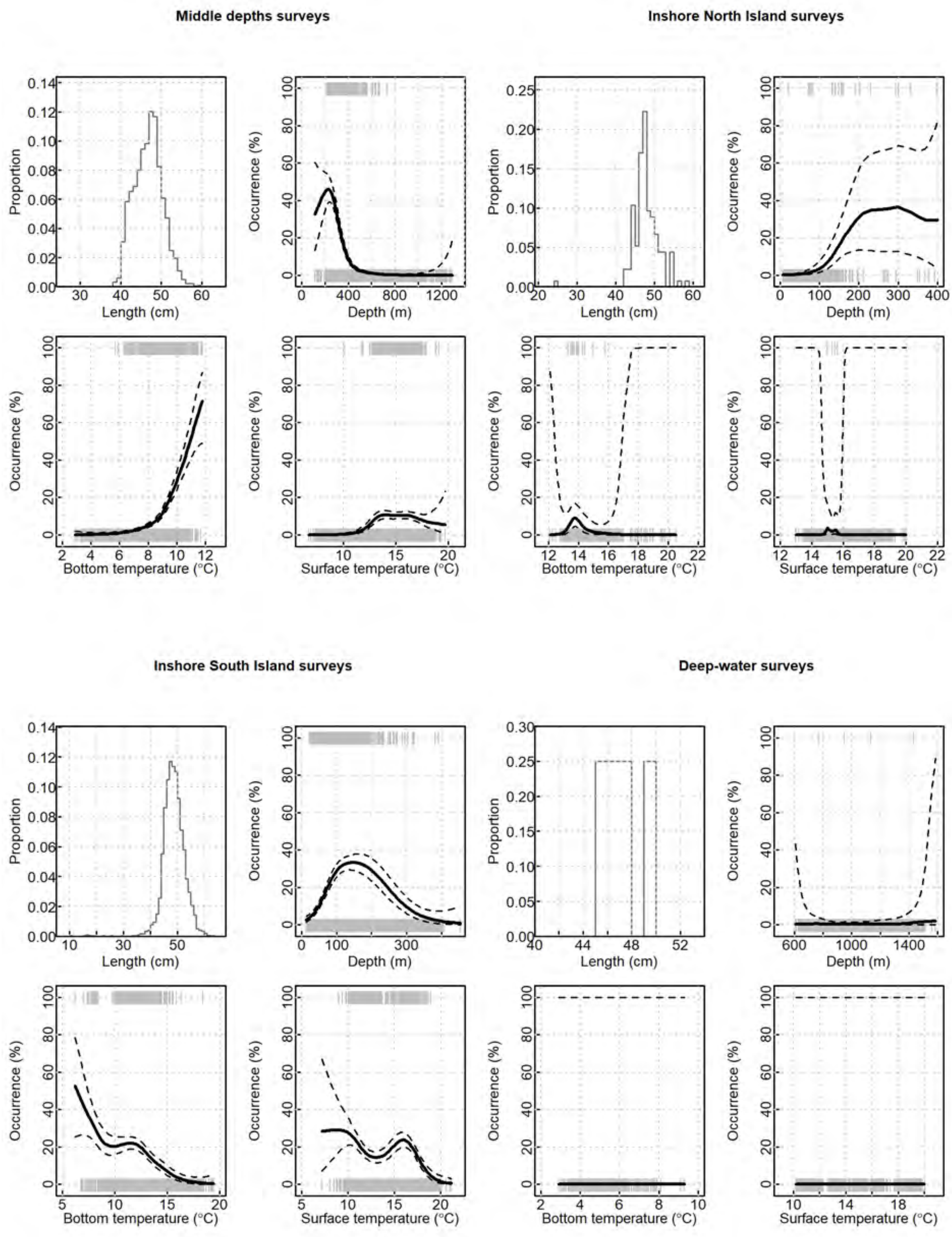


Figure 29.3: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to *Trachurus murphyi* occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

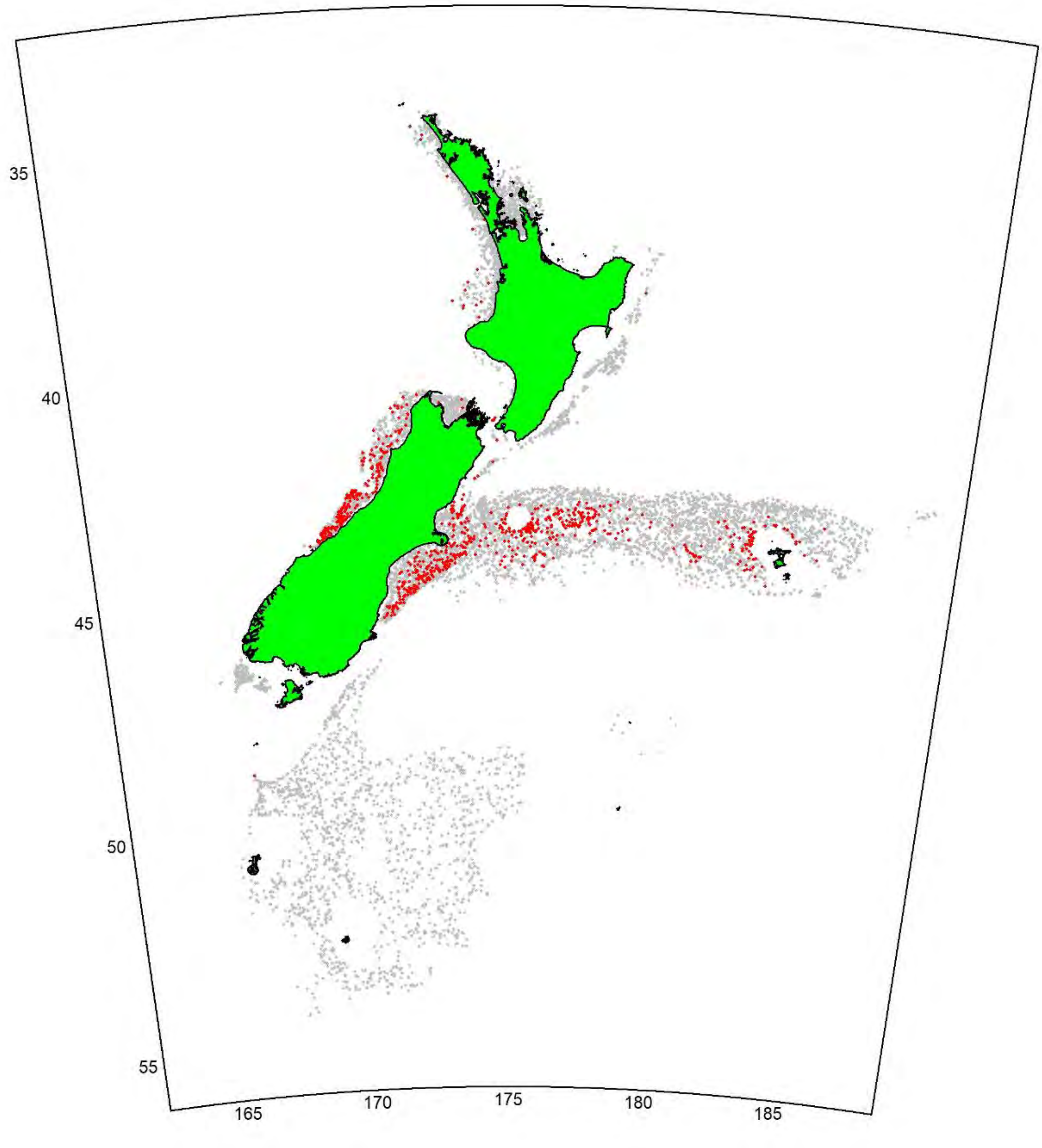


Figure 29.4: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where *Trachurus murphyi* was caught (red points).

JMD

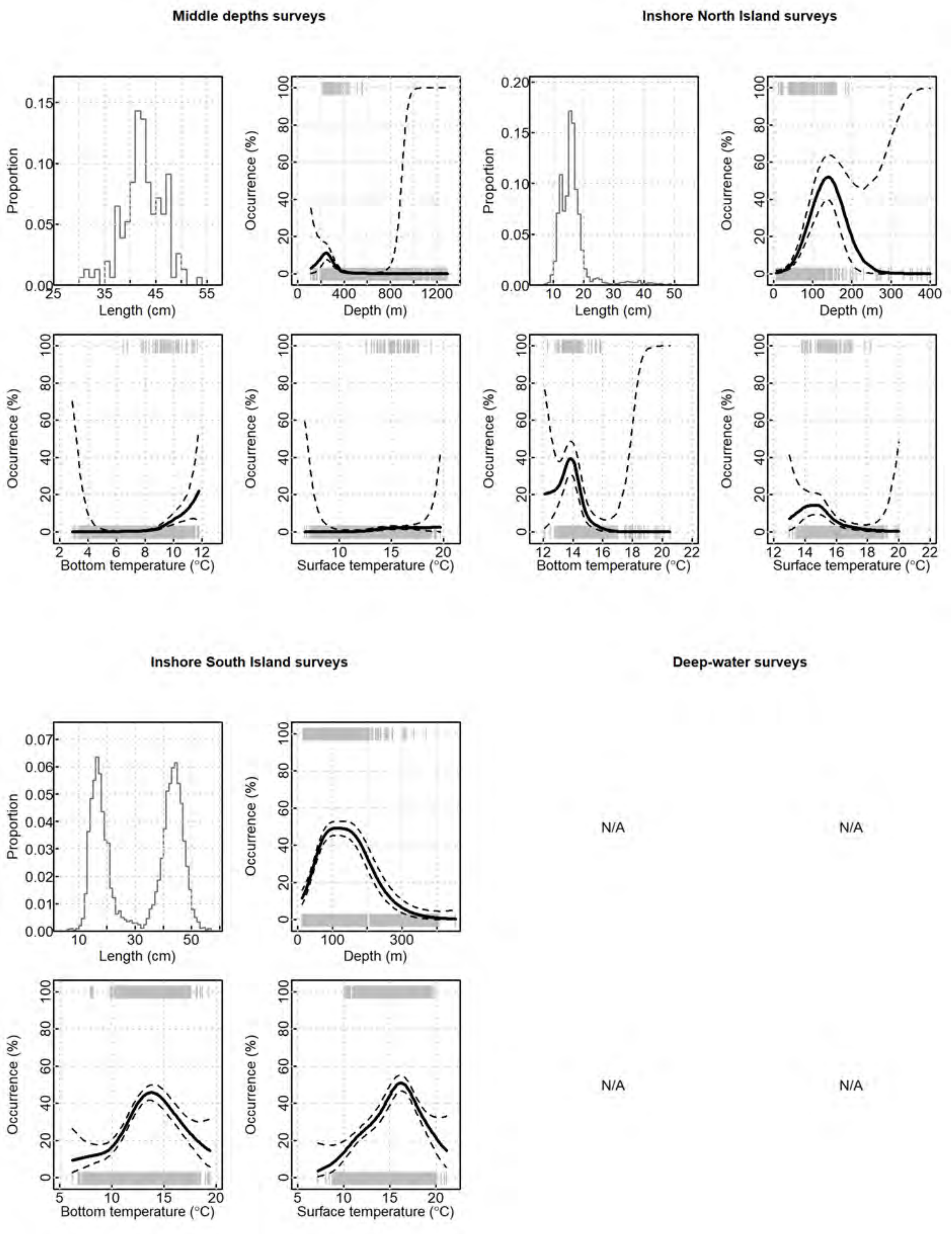


Figure 29.5: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to *Trachurus declivis* occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

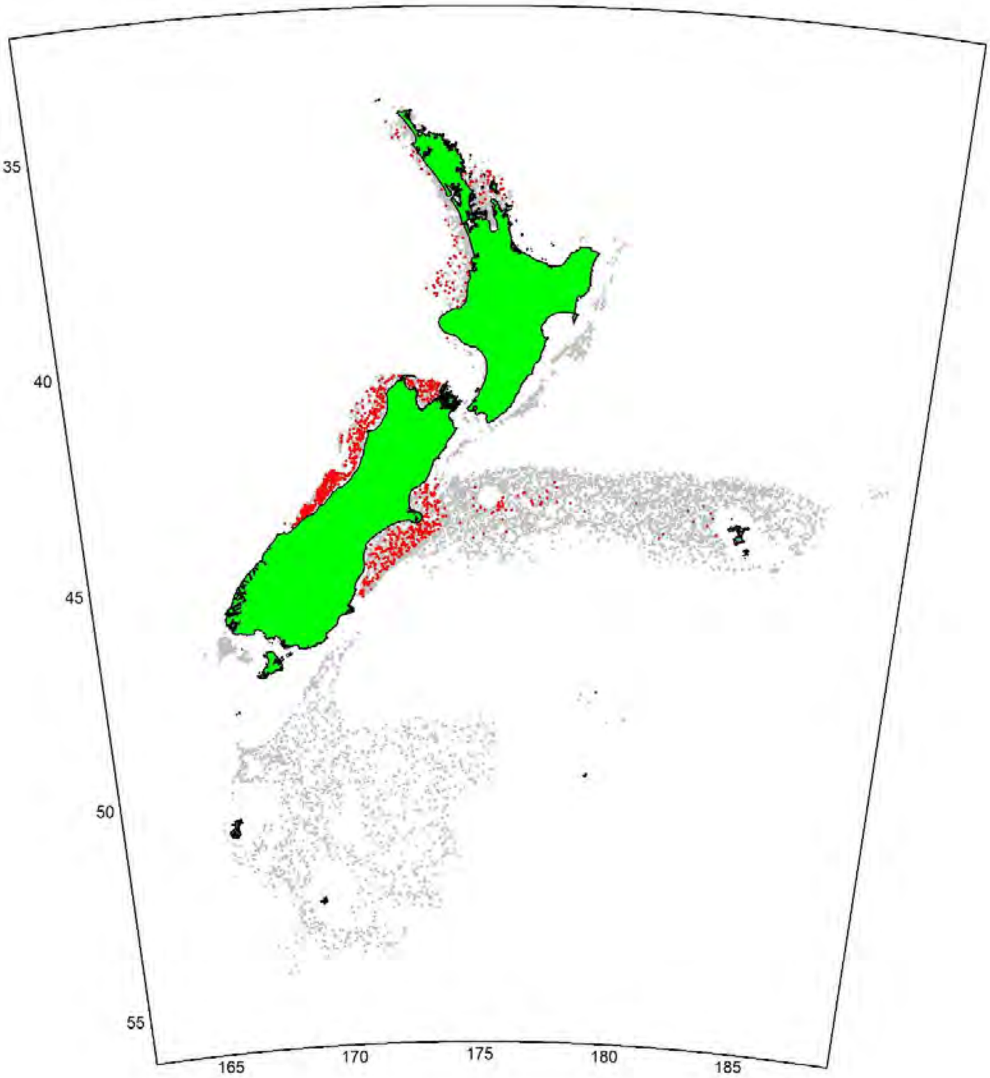


Figure 29.6: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where *Trachurus declivis* was caught (red points).

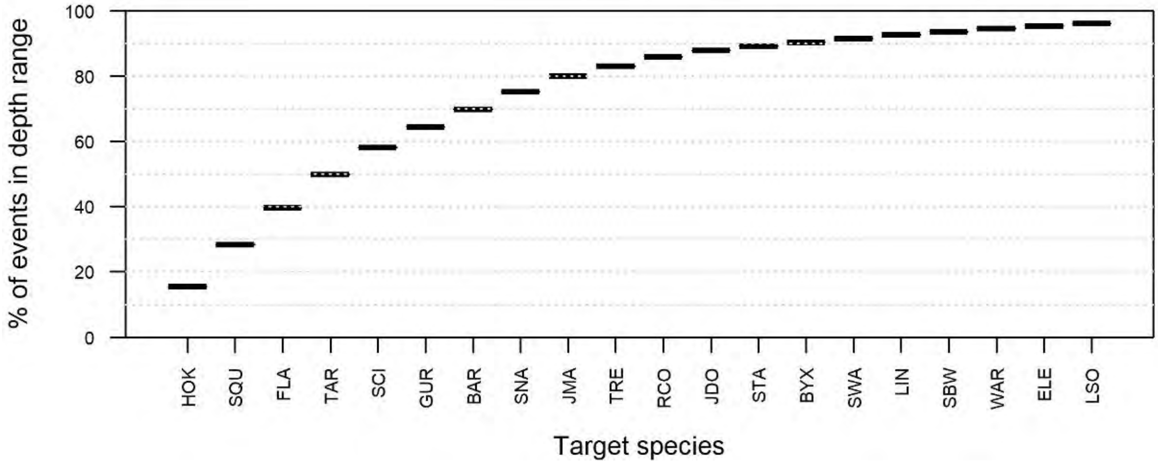
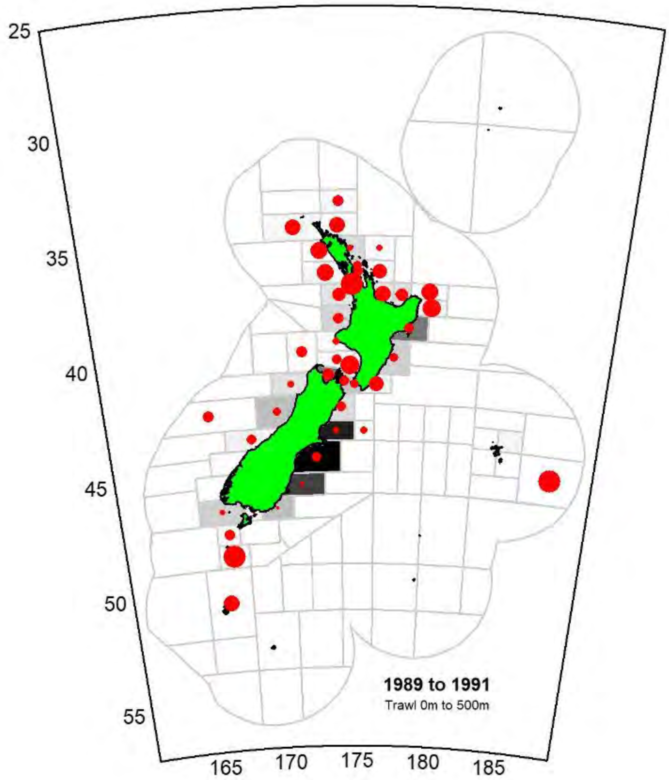


Figure 29.7: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for *Trachurus* spp. (0–500 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.



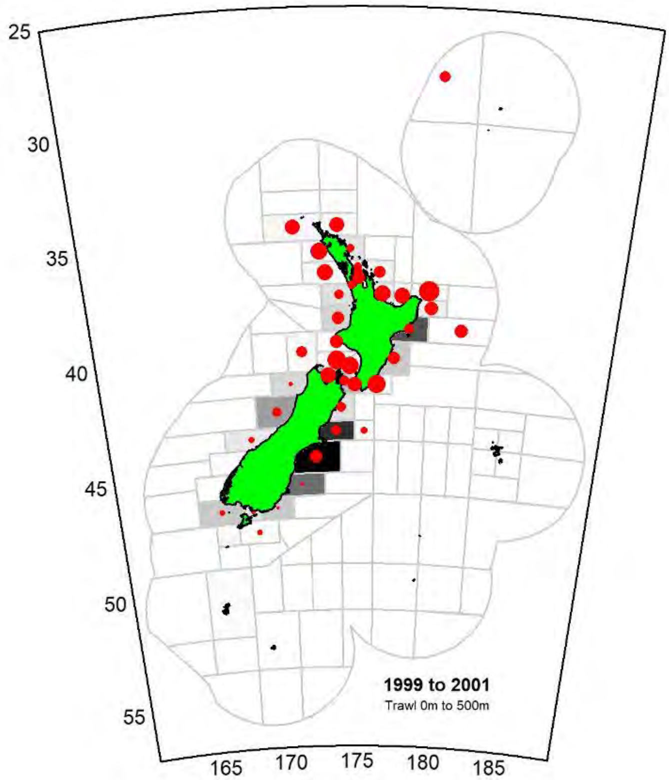


Figure 29.8: Maps of *Trachurus* spp. occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

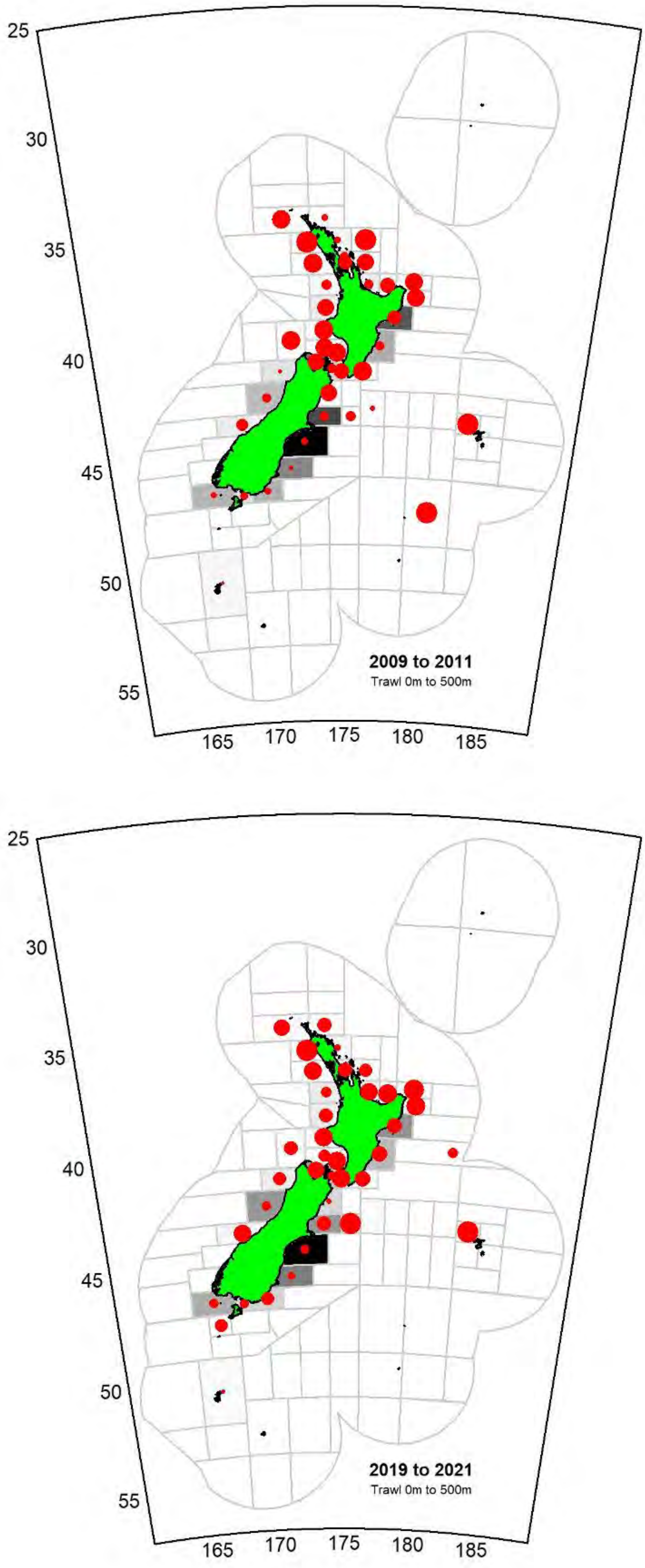
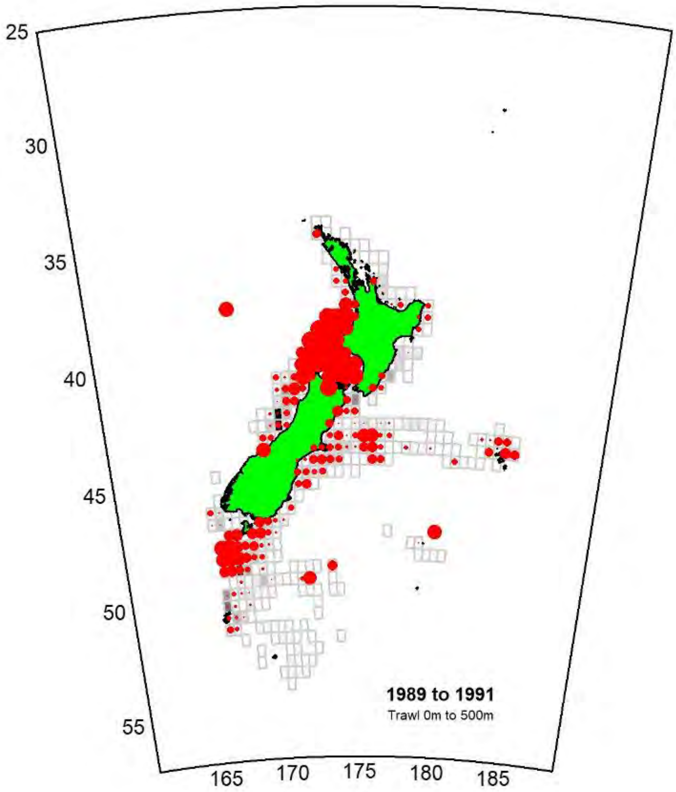


Figure 29.8 (cont.): Maps of *Trachurus* spp. occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



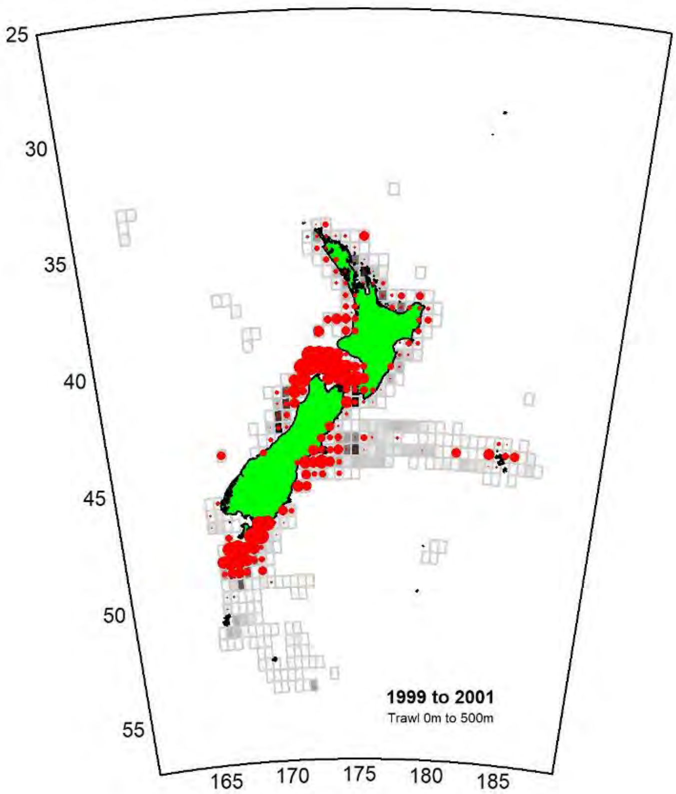
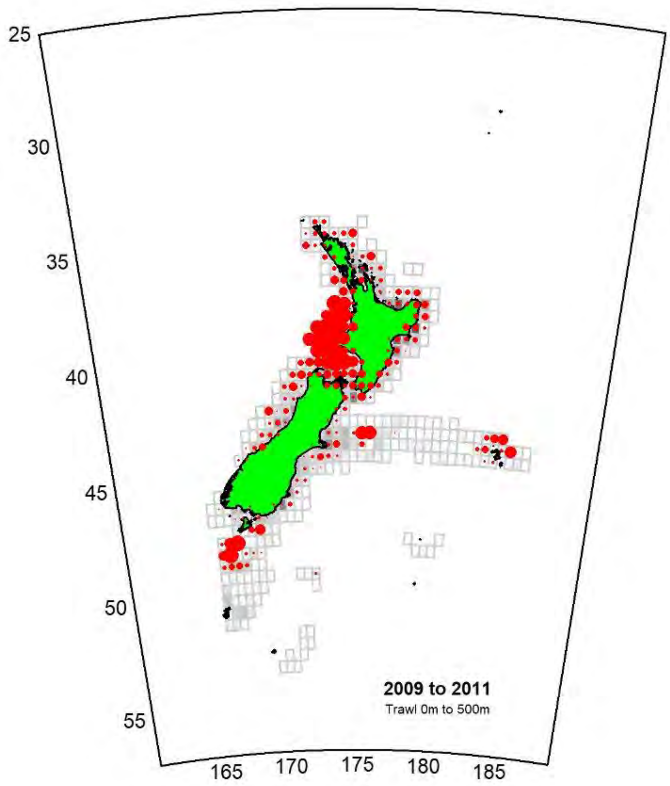


Figure 29.9: Maps of *Trachurus* spp. occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



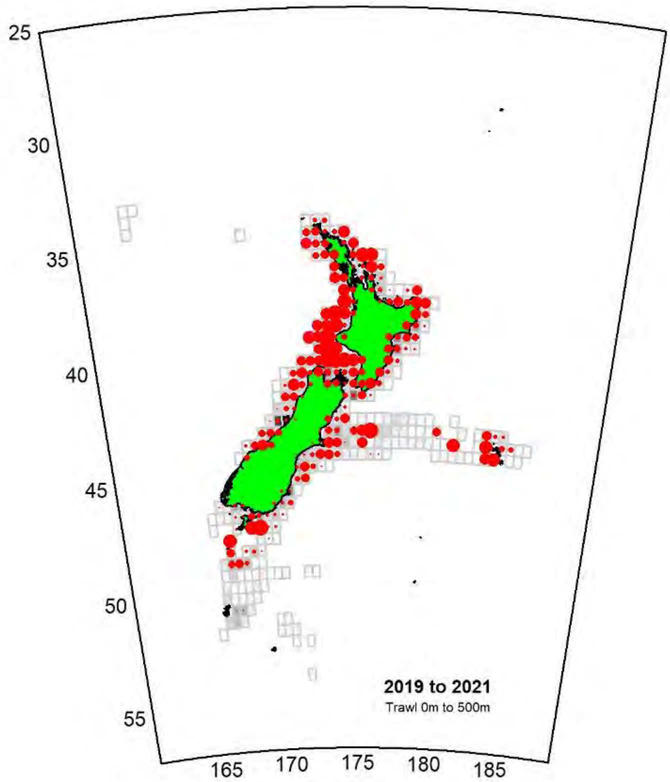


Figure 29.9 (cont.): Maps of *Trachurus* spp. occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

30. John dory (JDO)

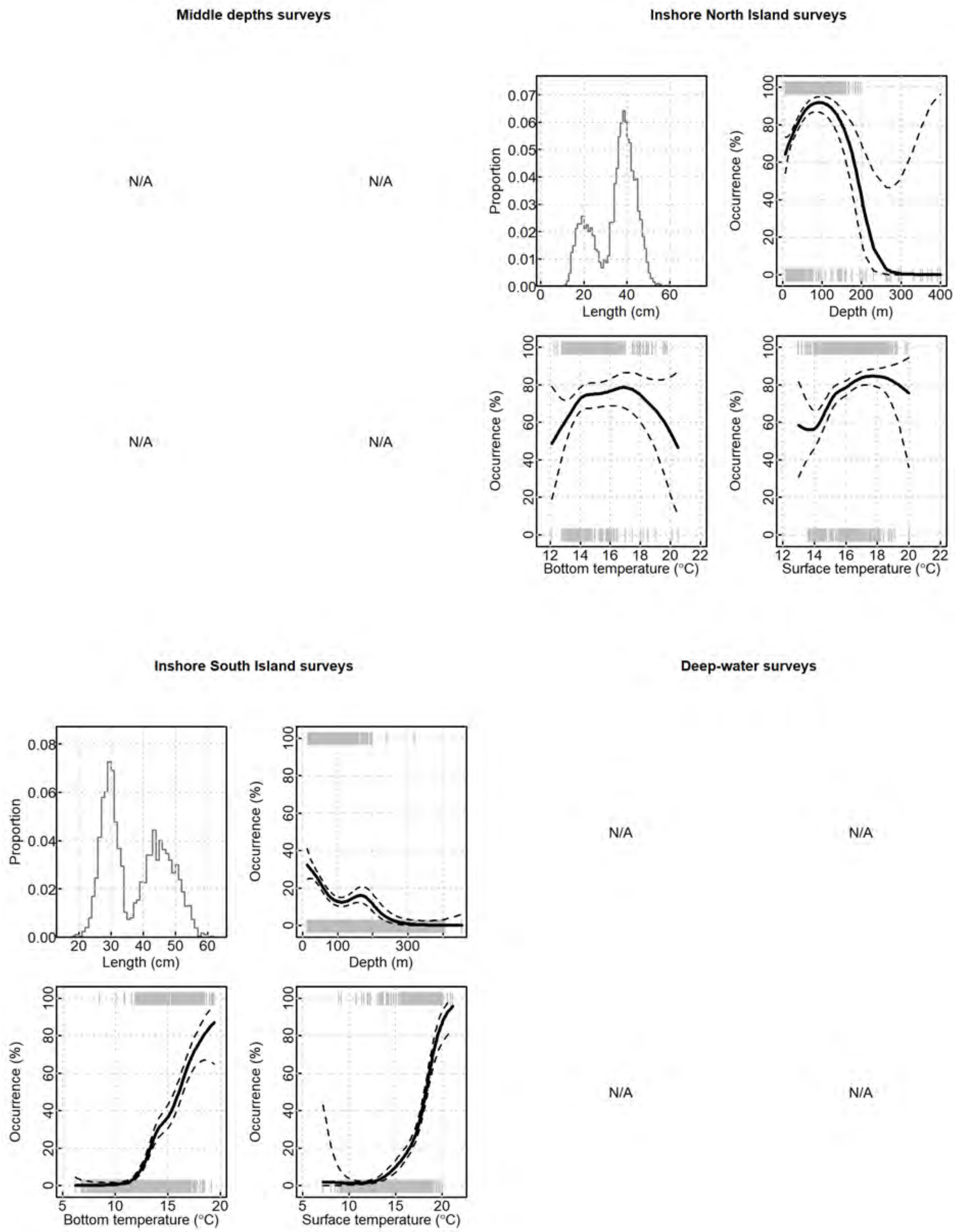


Figure 30.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to John dory occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

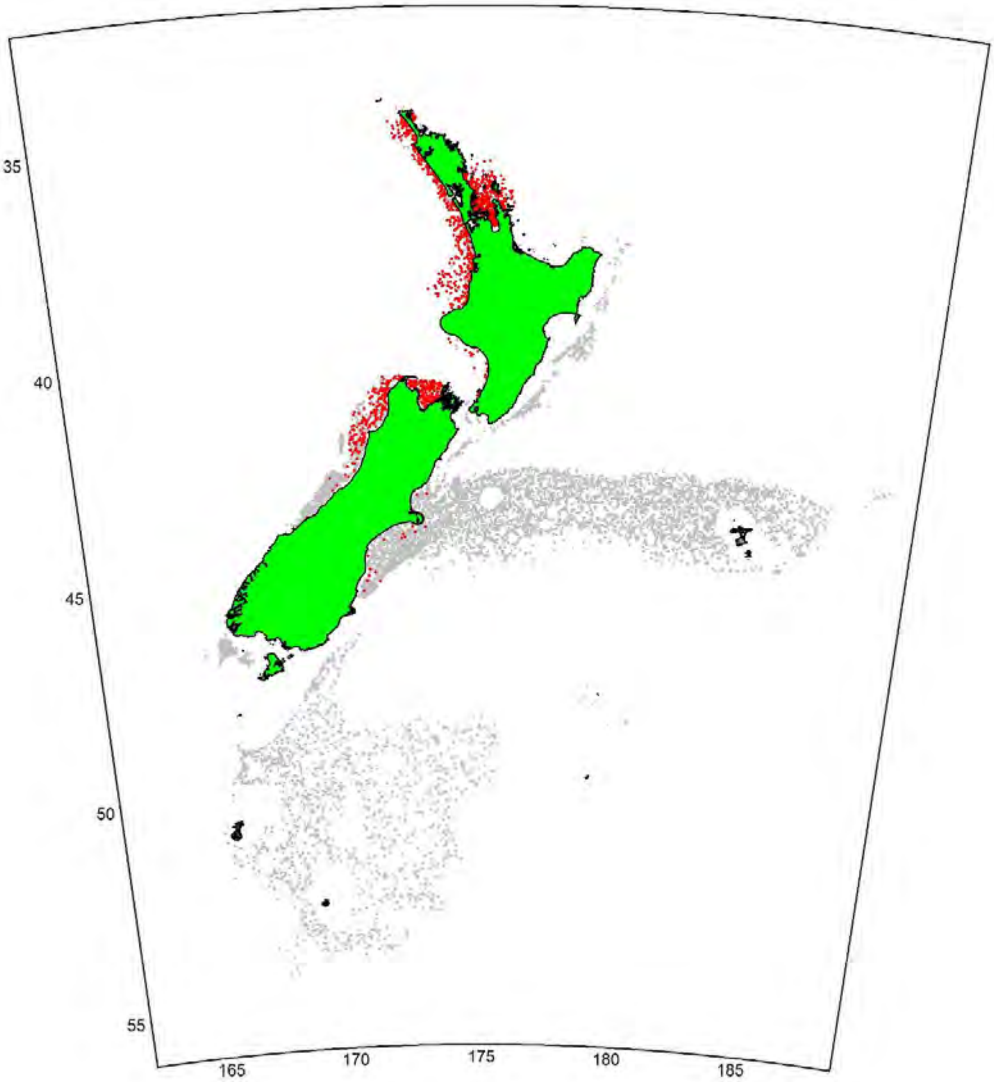


Figure 30.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where John dory was caught (red points).

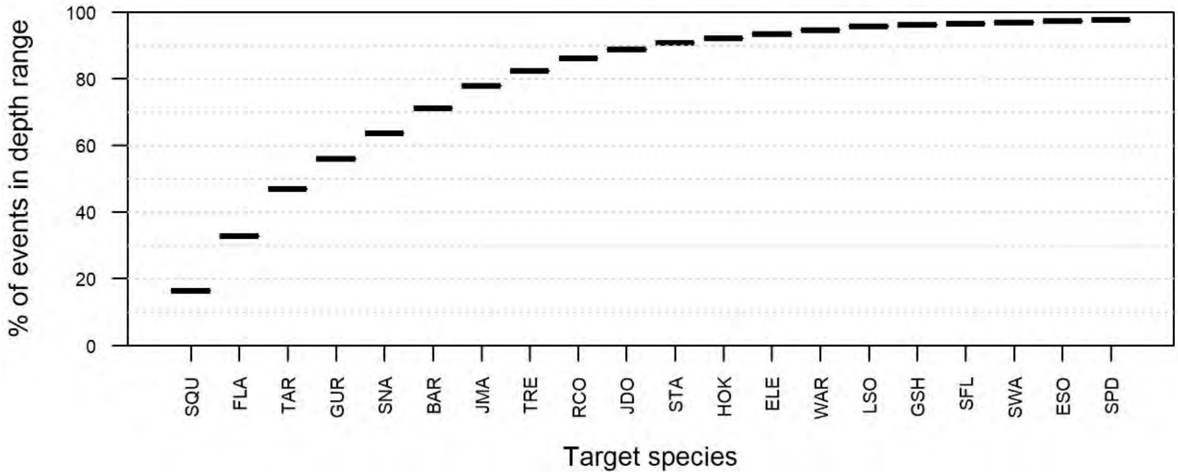
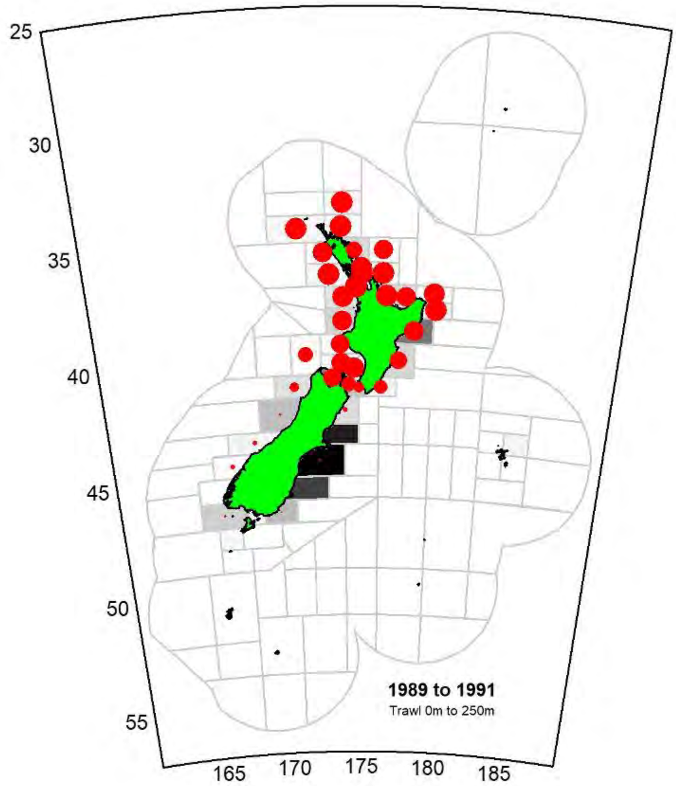


Figure 30.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for John dory (0–250 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.



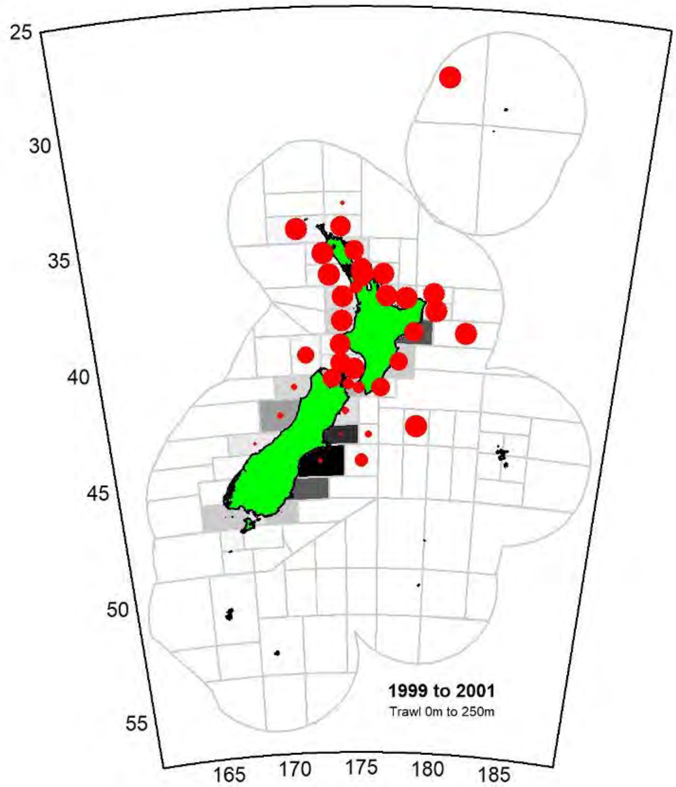
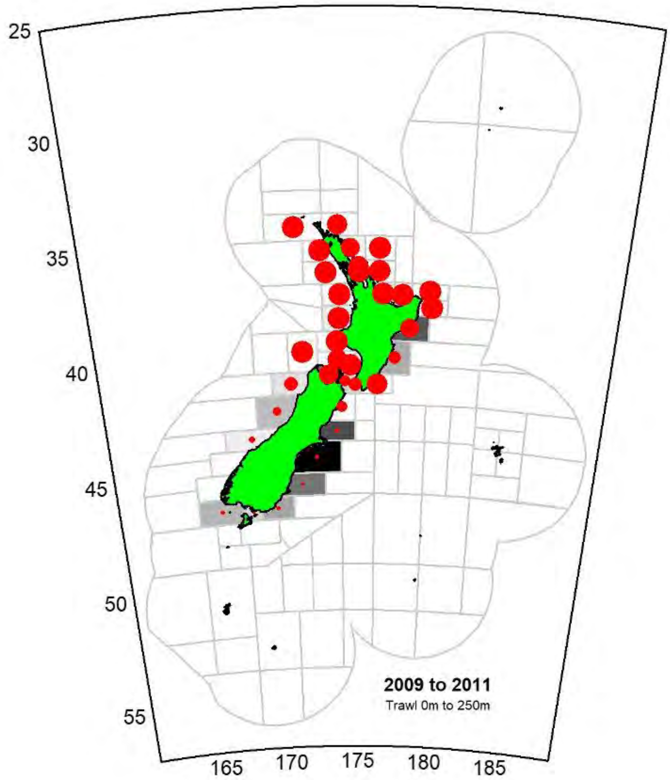


Figure 30.4: Maps of John dory occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



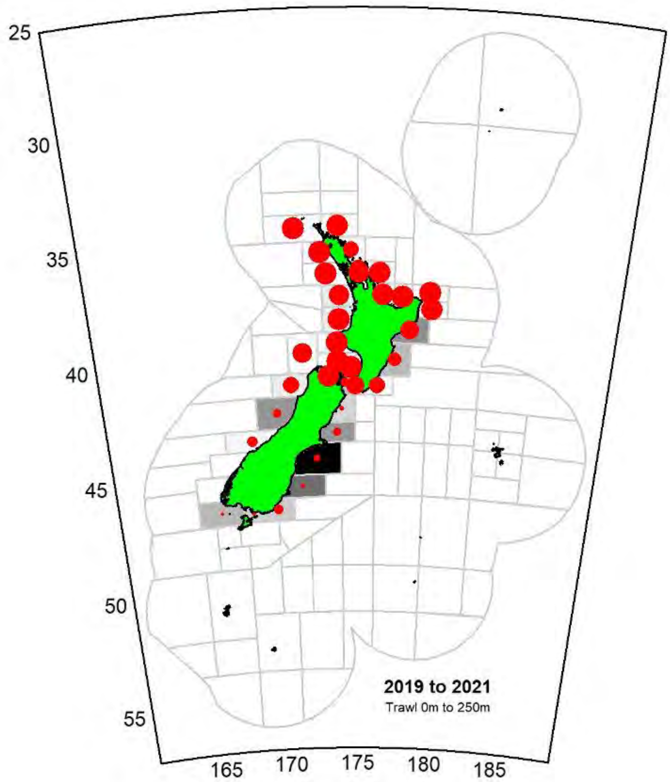


Figure 30.4 (cont.): Maps of John dory occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

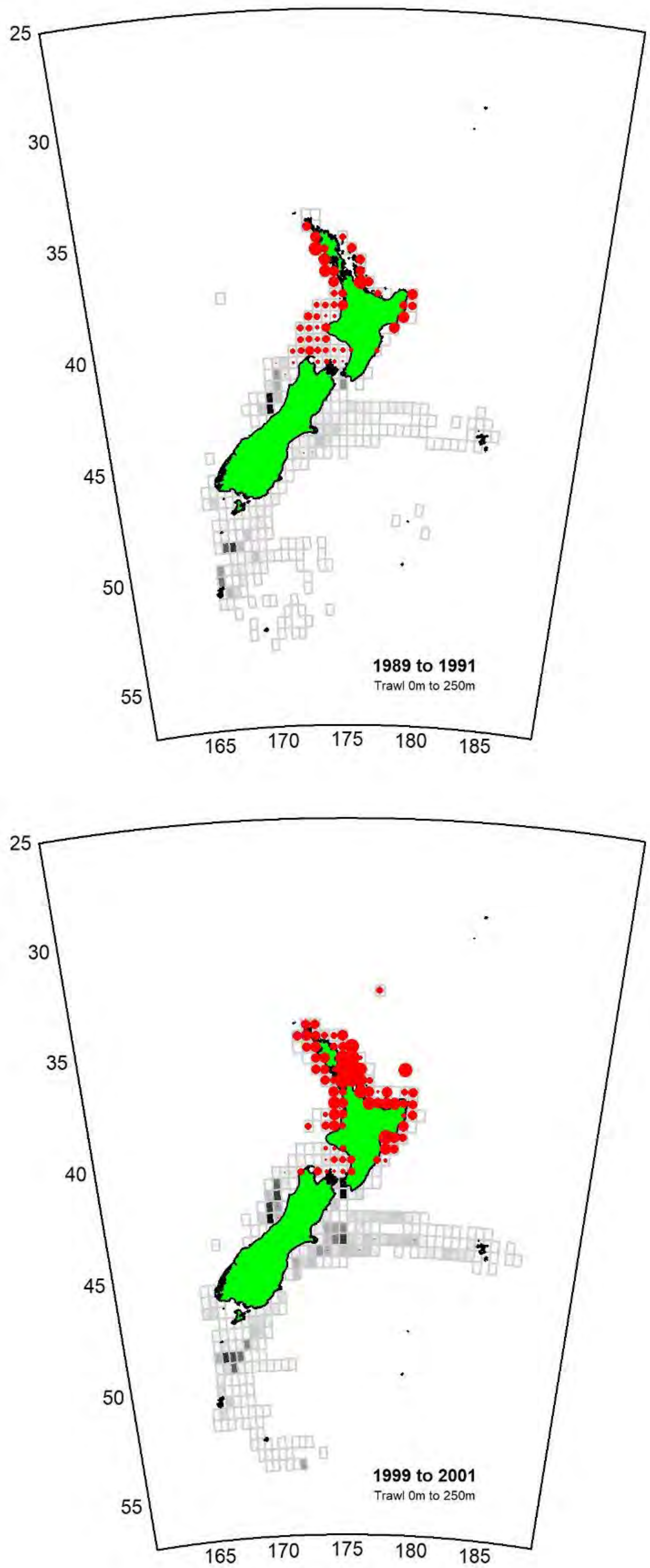
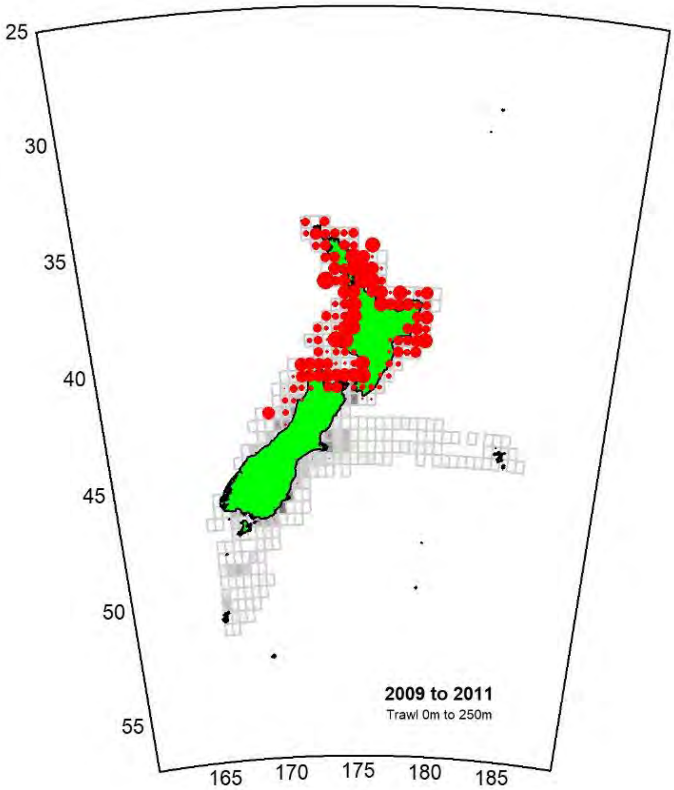


Figure 30.5: Maps of John dory occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



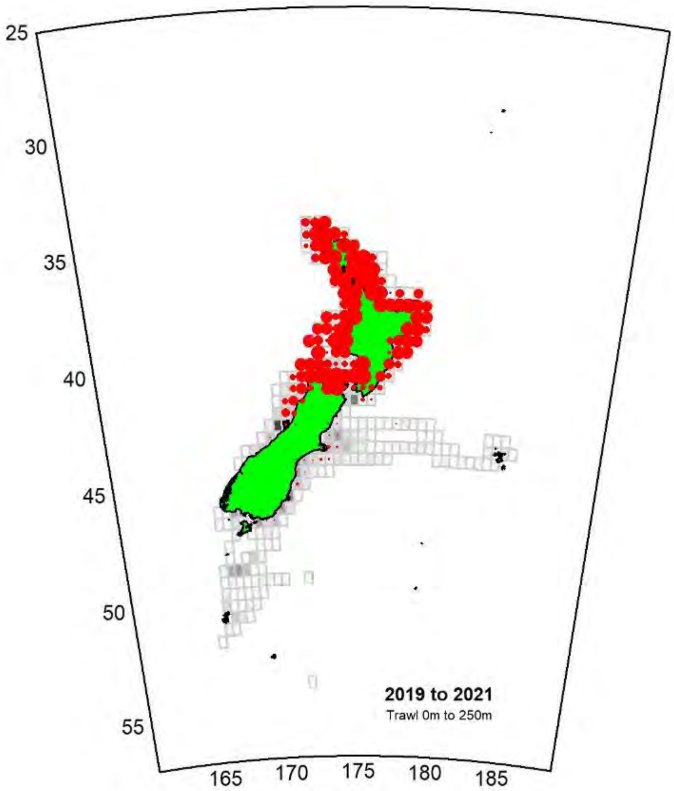


Figure 30.5 (cont.): Maps of John dory occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

31. Kahawai (KAH)

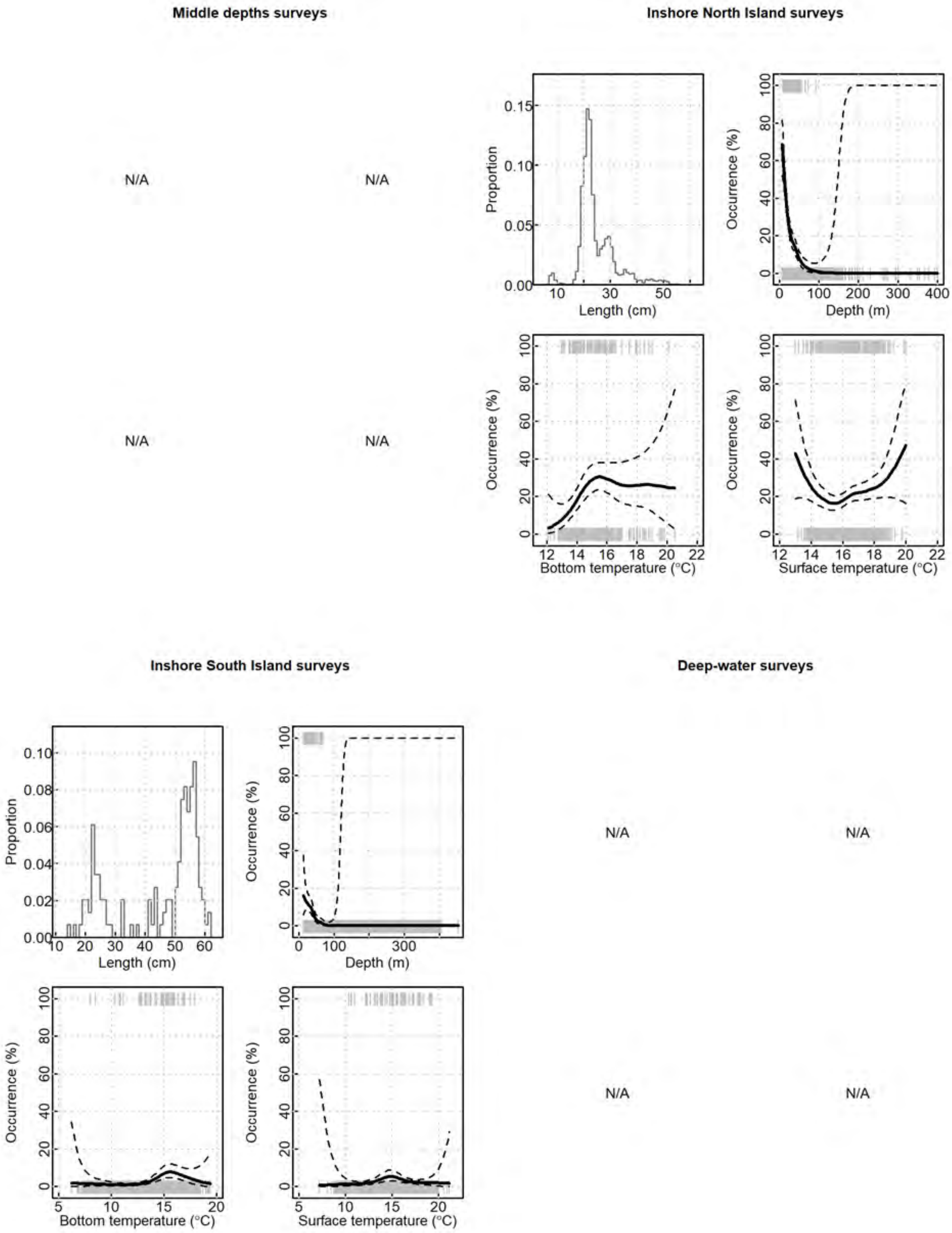


Figure 31.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to kahawai occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

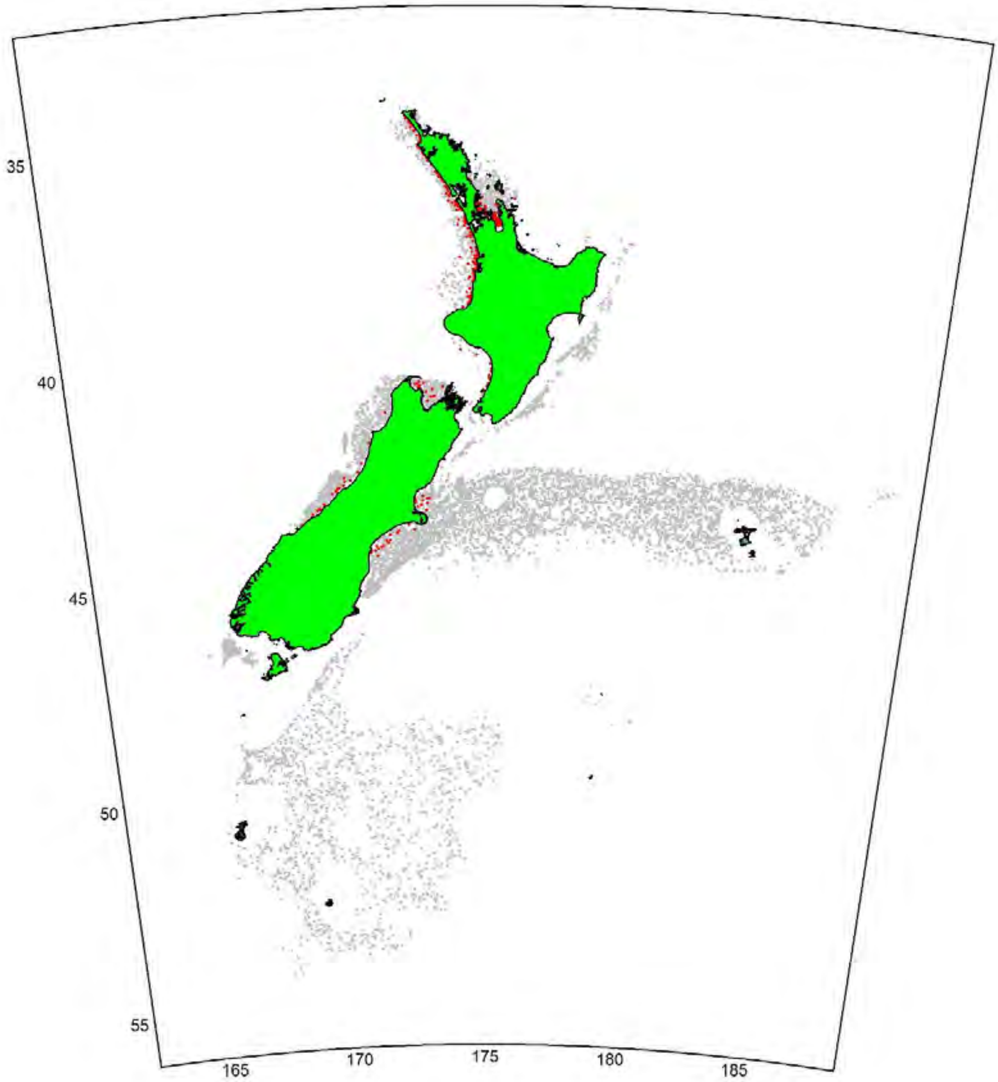


Figure 31.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where kahawai was caught (red points).

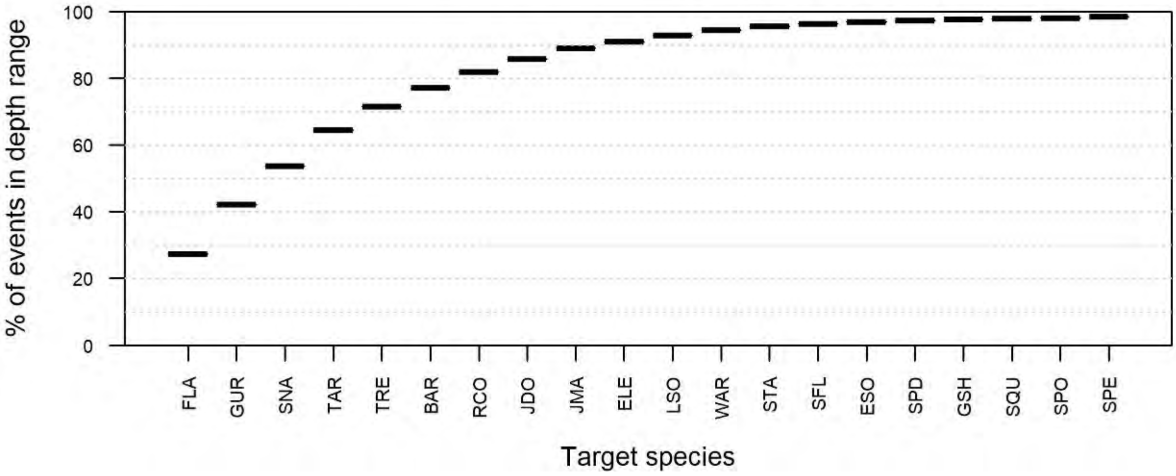
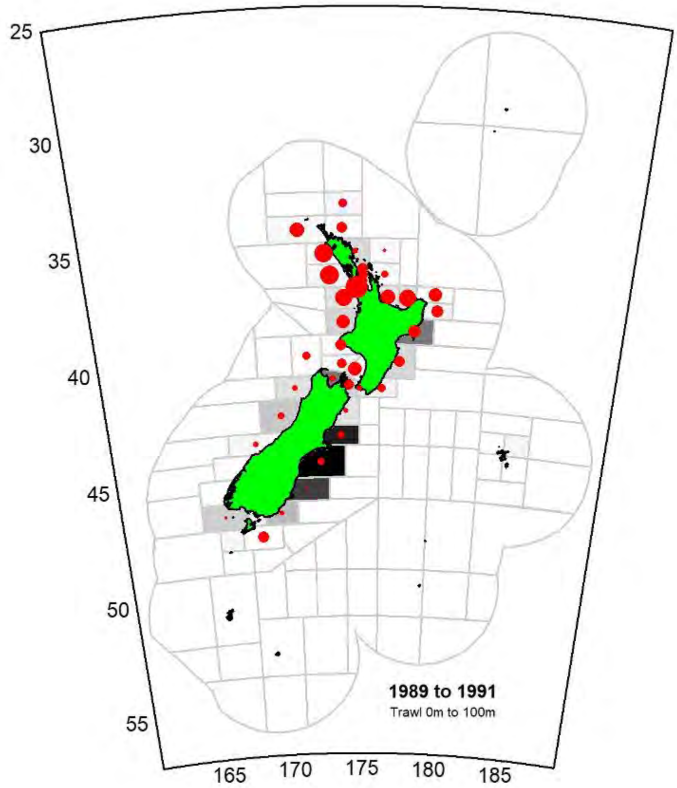


Figure 31.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for kahawai (0–100 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.



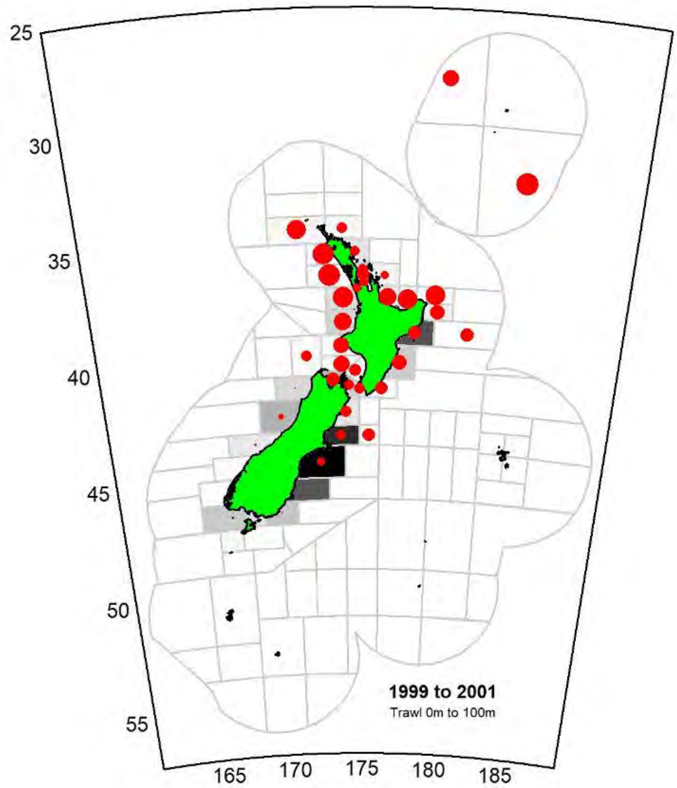
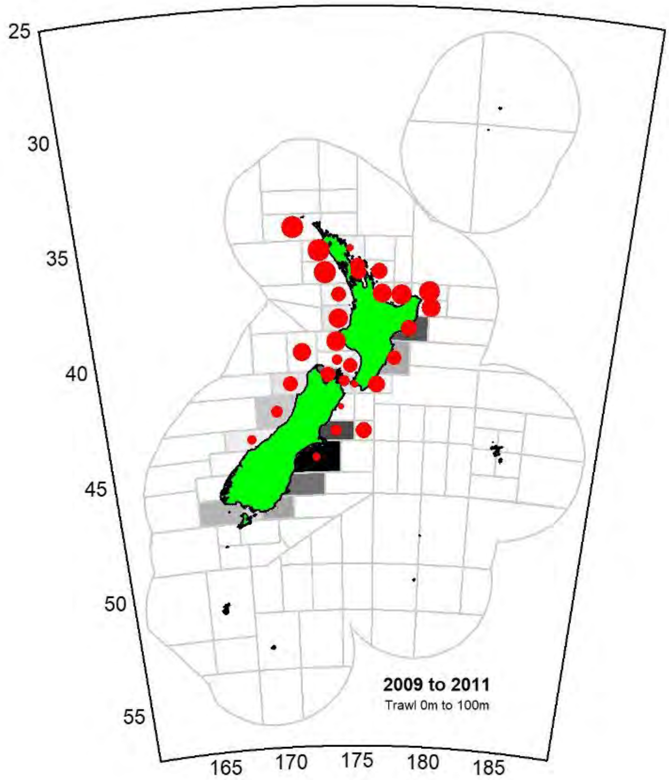


Figure 31.4: Maps of kahawai occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



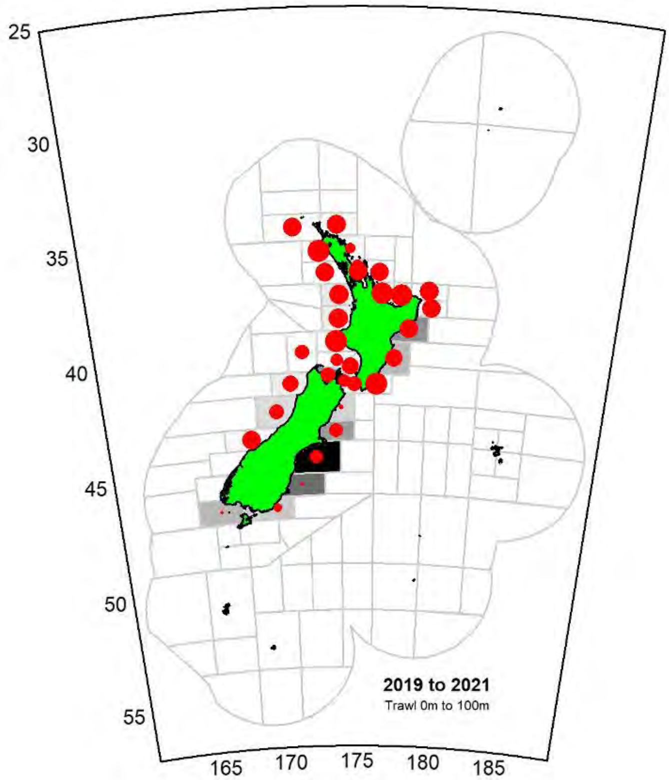
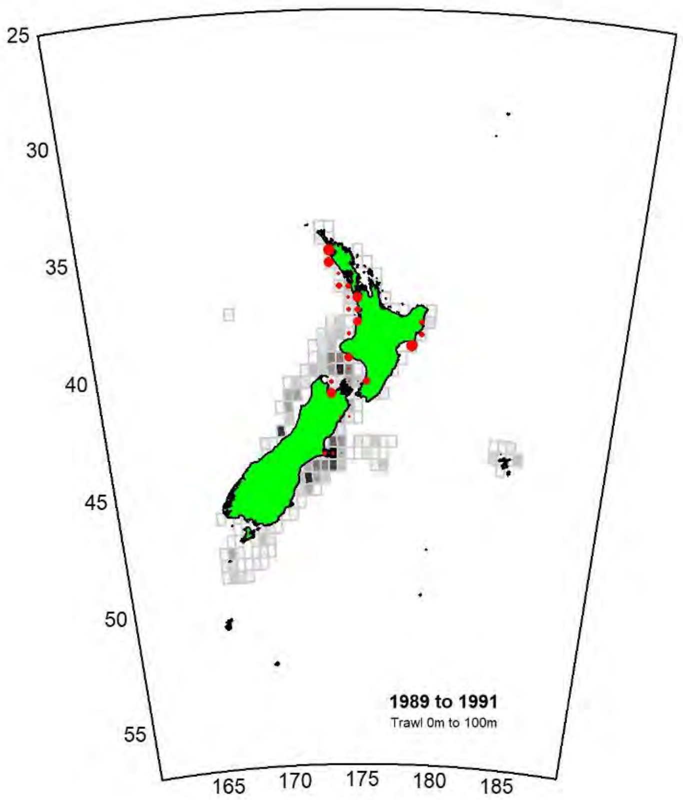


Figure 31.4 (cont.): Maps of kahawai occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



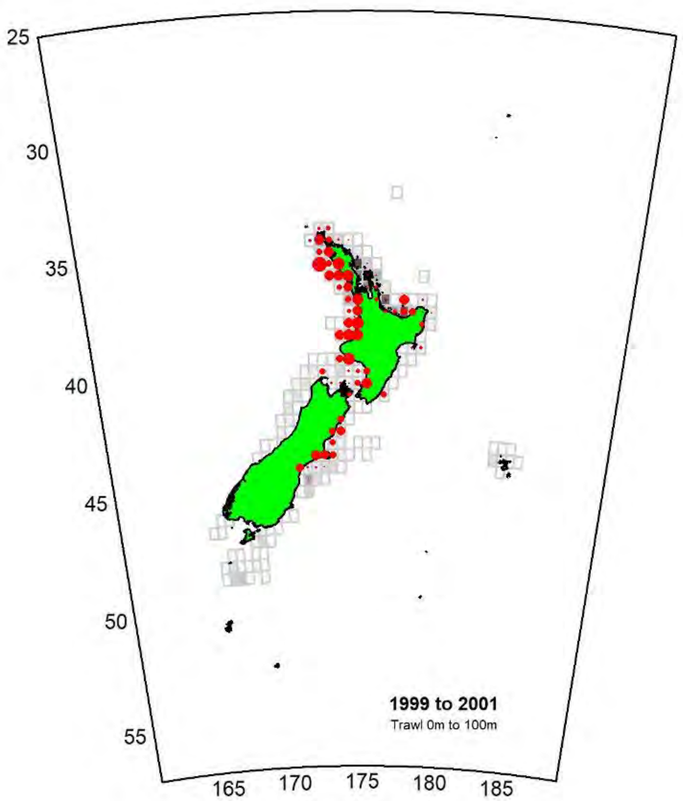
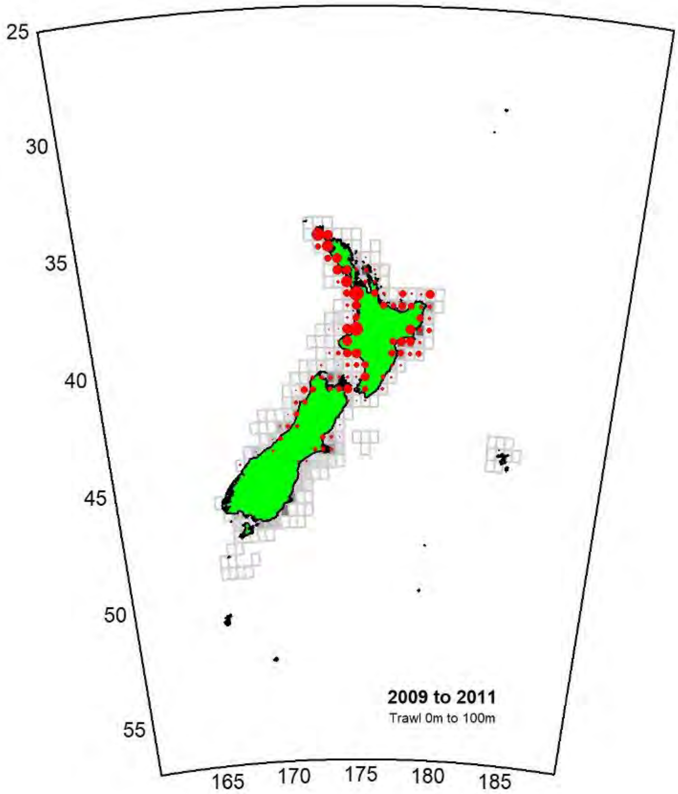


Figure 31.5: Maps of kahawai occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



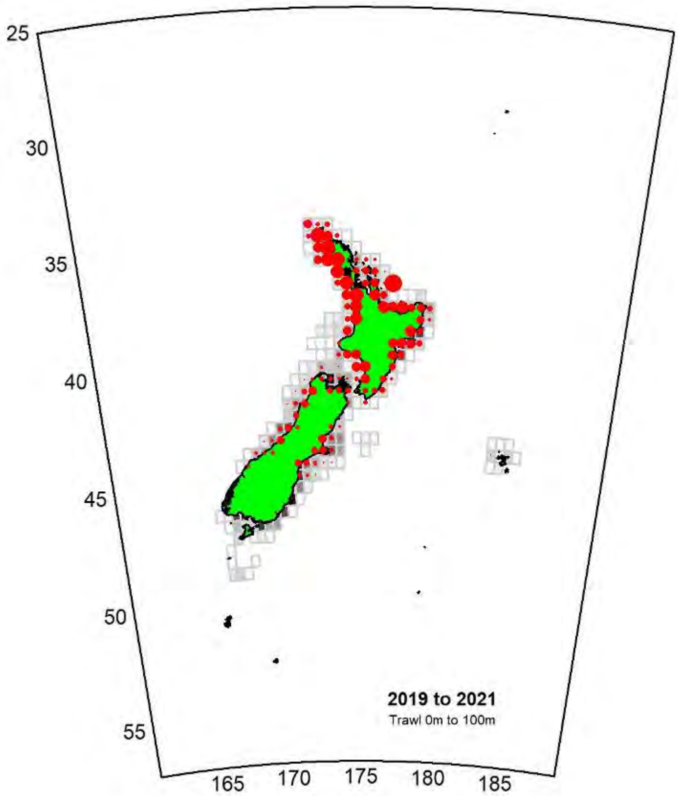


Figure 31.5 (cont.): Maps of kahawai occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

32. Leatherjacket (LEA)

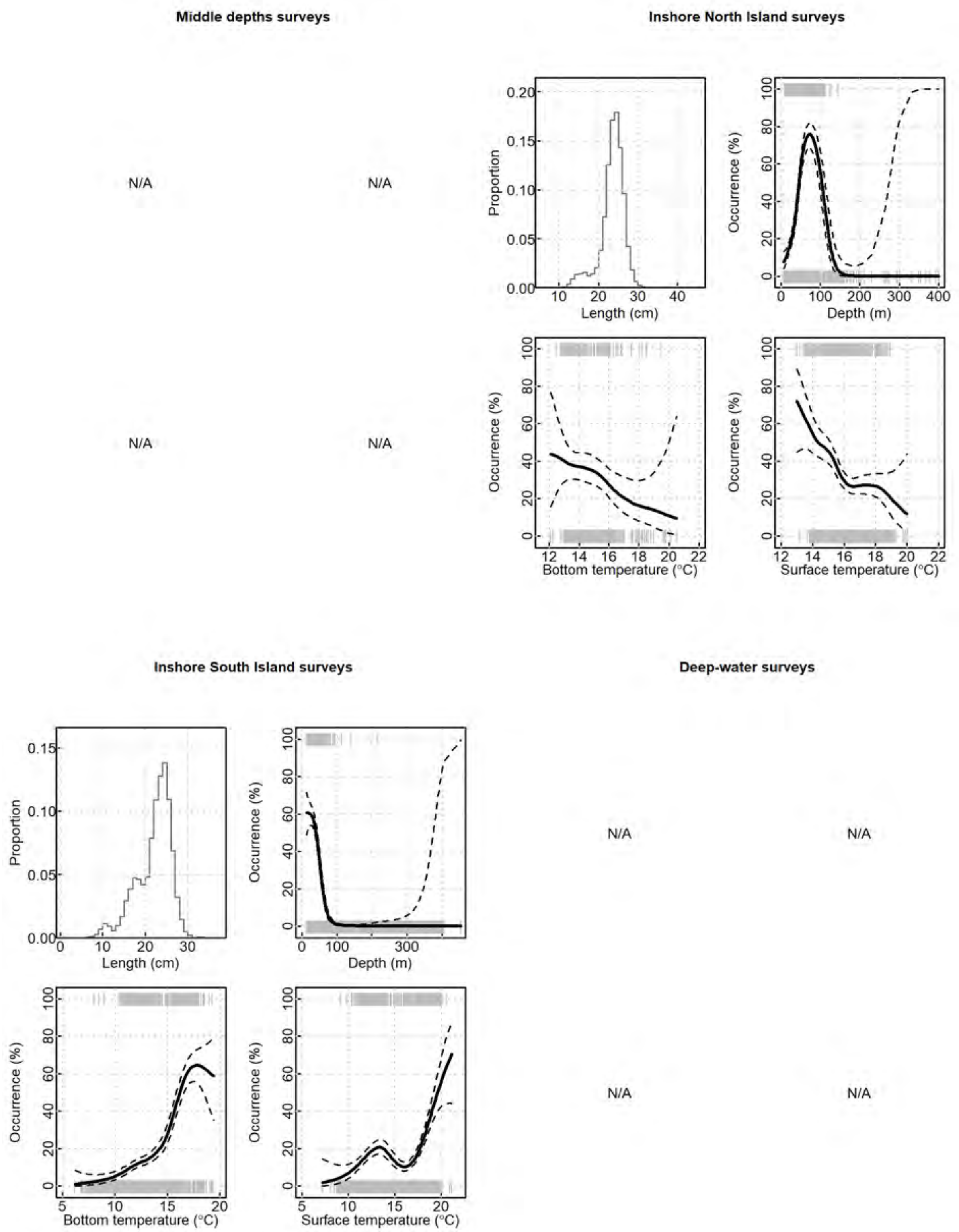


Figure 32.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to leatherjacket occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

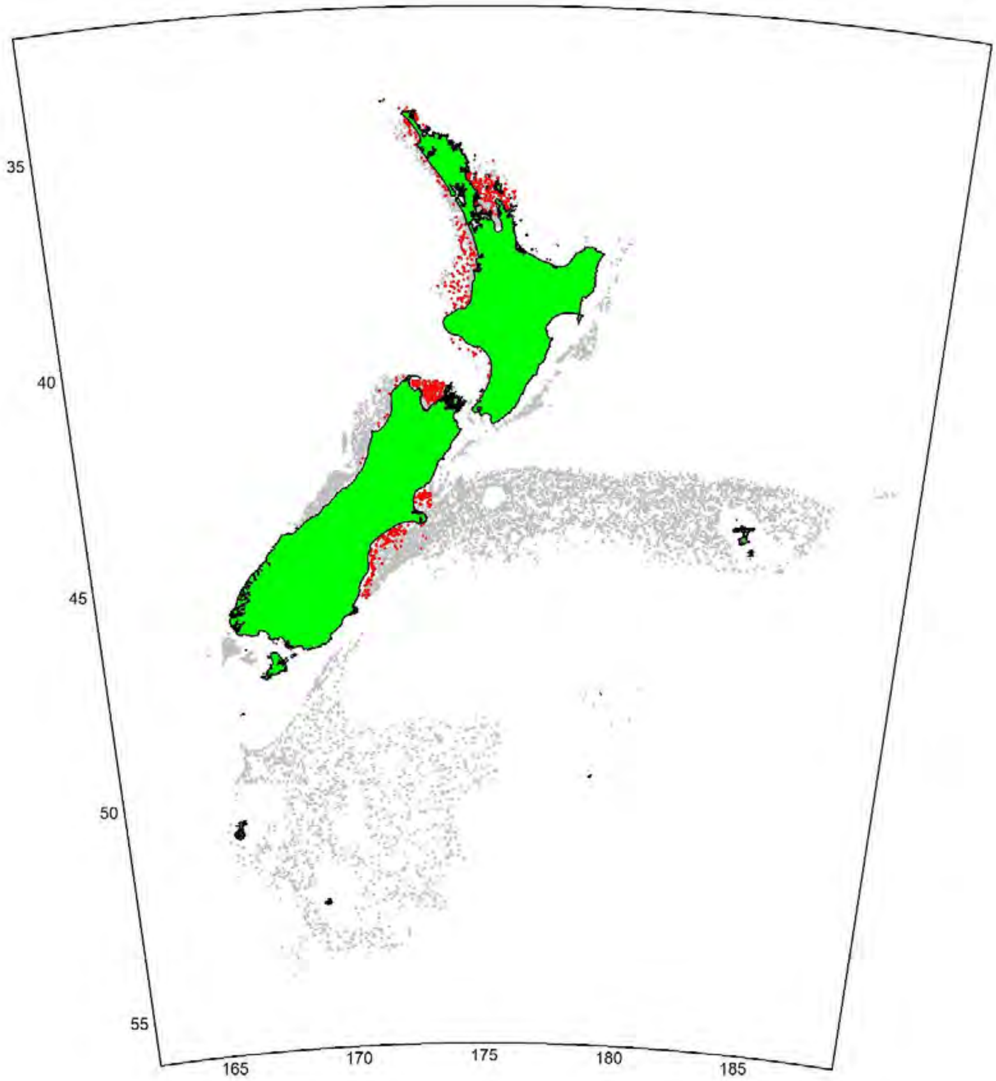


Figure 32.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where leatherjacket was caught (red points).

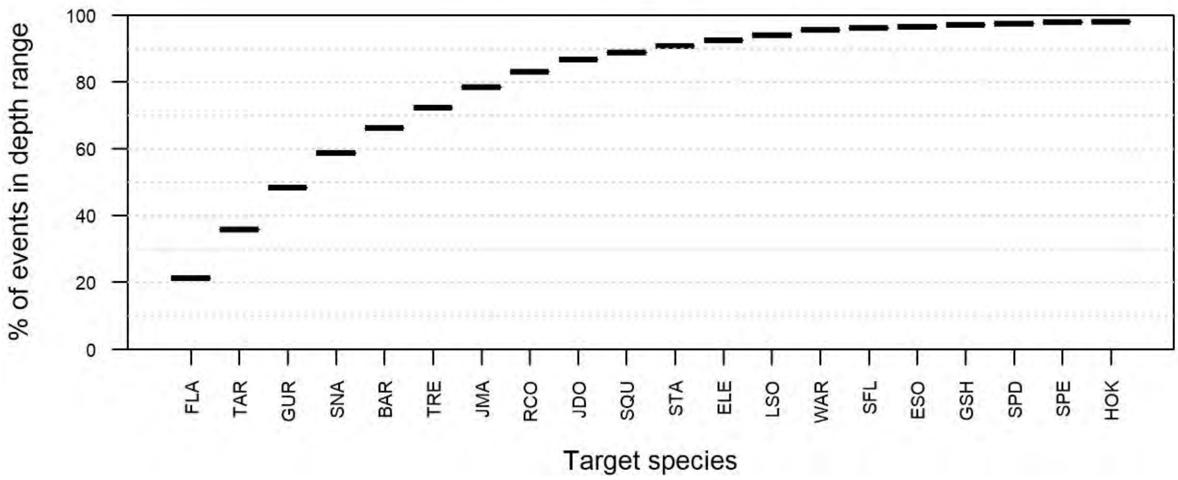
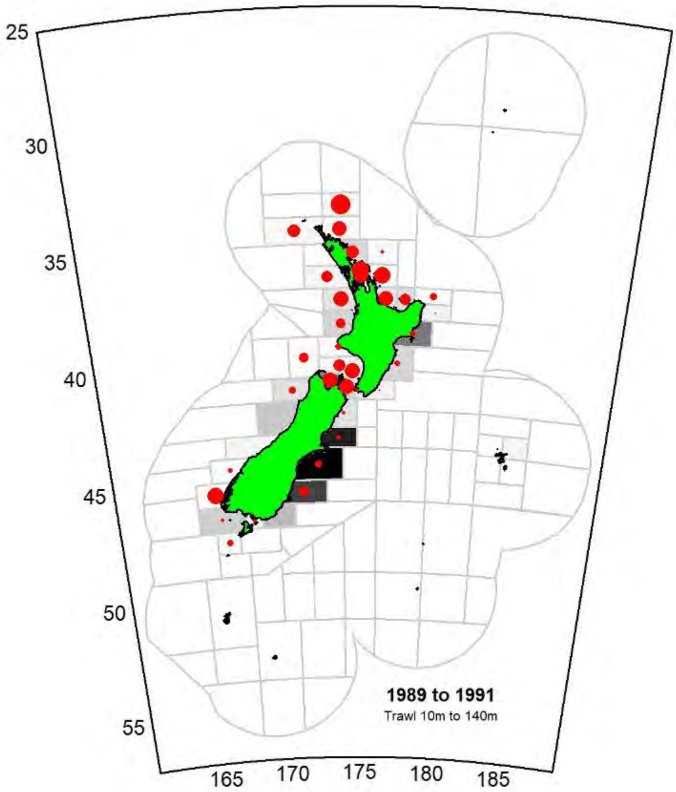


Figure 32.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for leatherjacket (10–140 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.



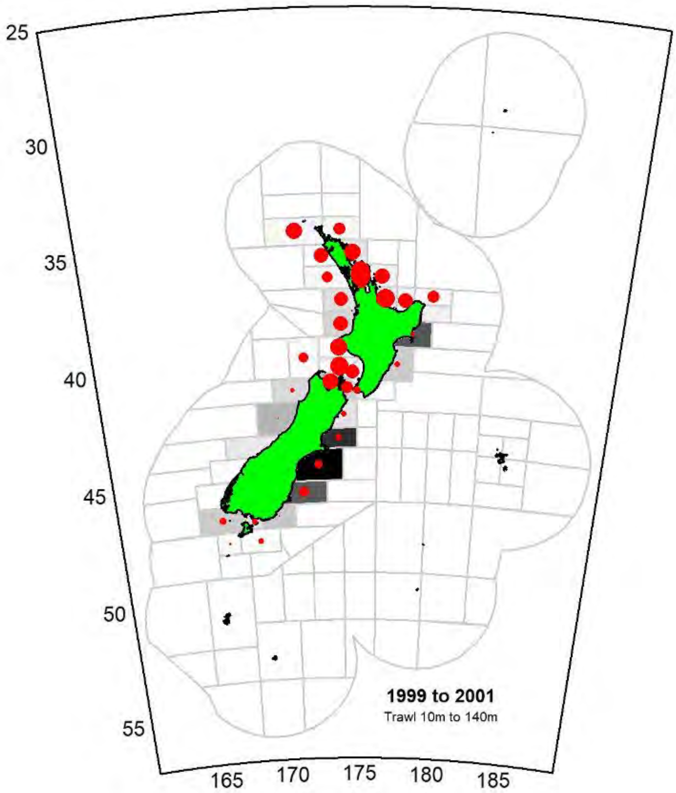
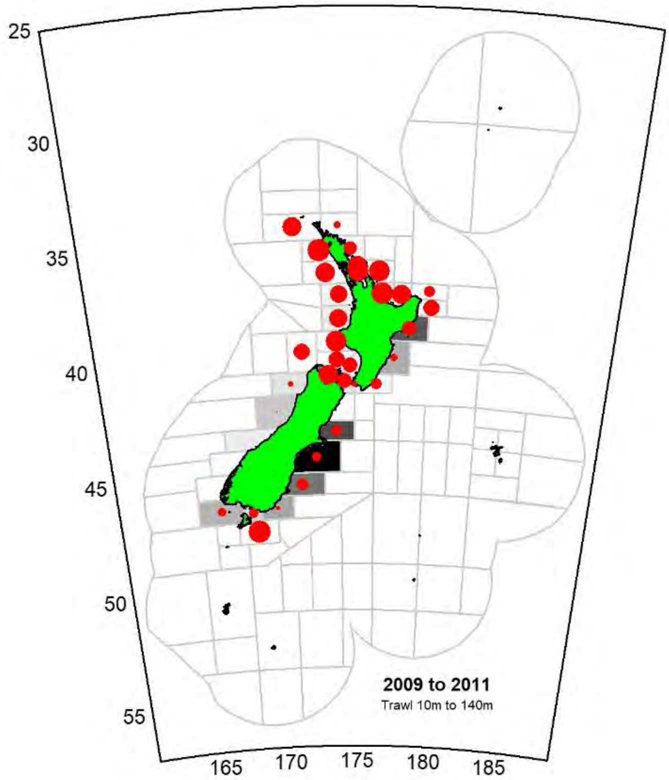


Figure 32.4: Maps of leatherjacket occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



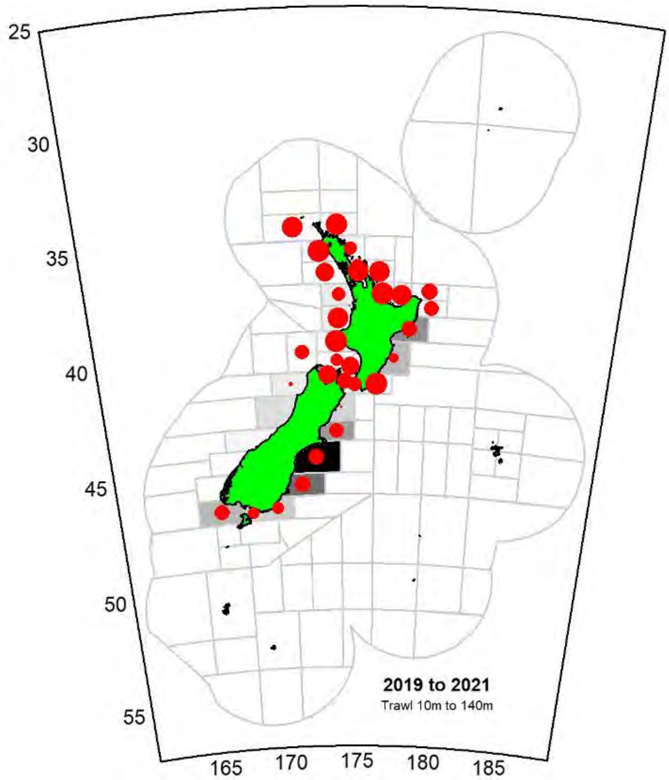


Figure 32.4 (cont.): Maps of leatherjacket occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

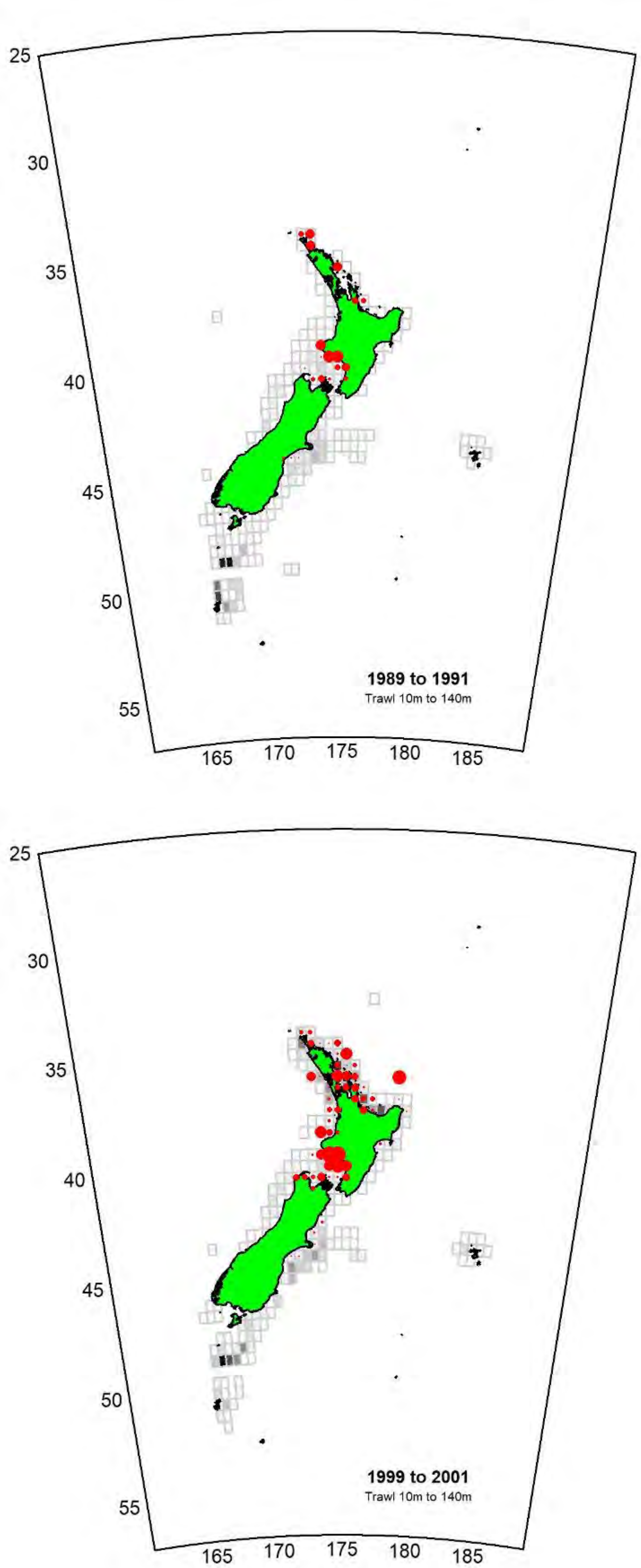
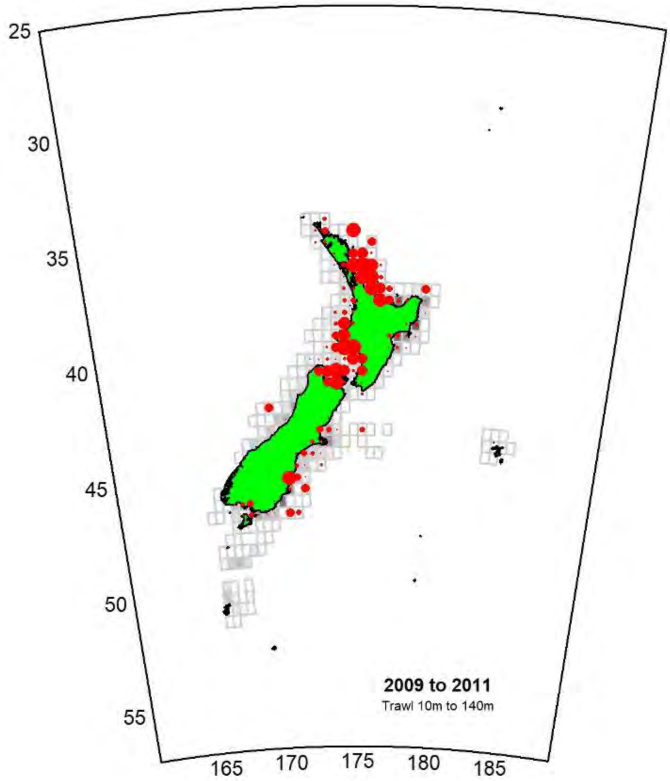


Figure 32.5: Maps of leatherjacket occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



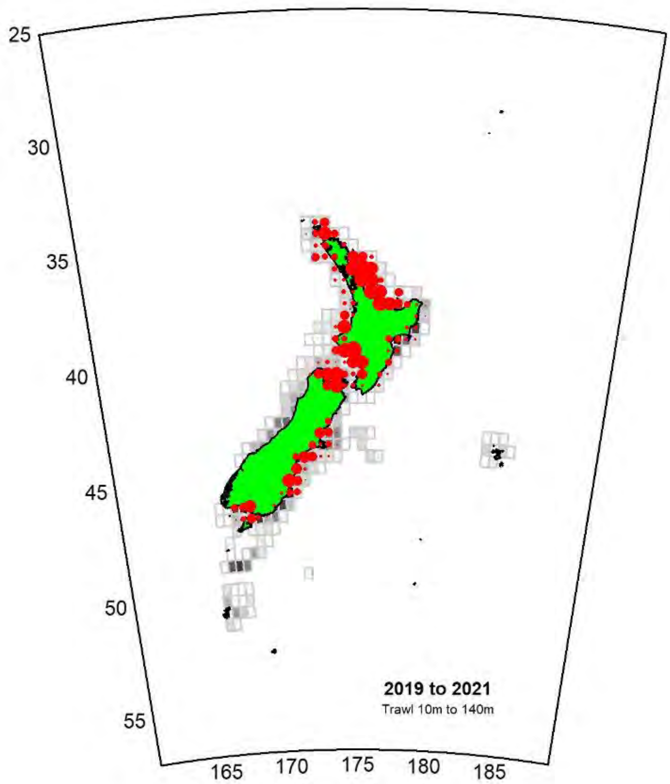


Figure 32.5 (cont.): Maps of leatherjacket occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

33. Ling (LIN)

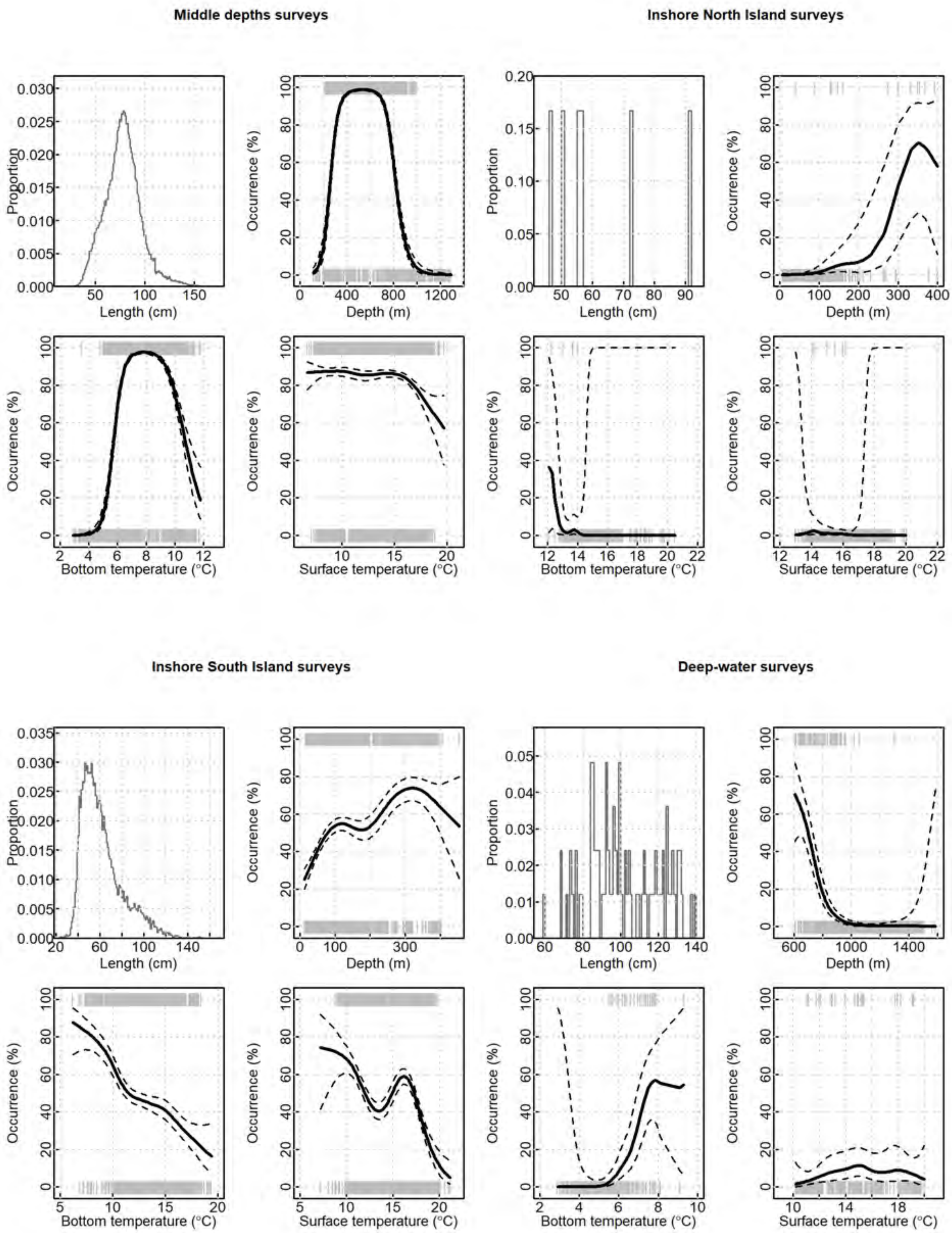


Figure 33.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to ling occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

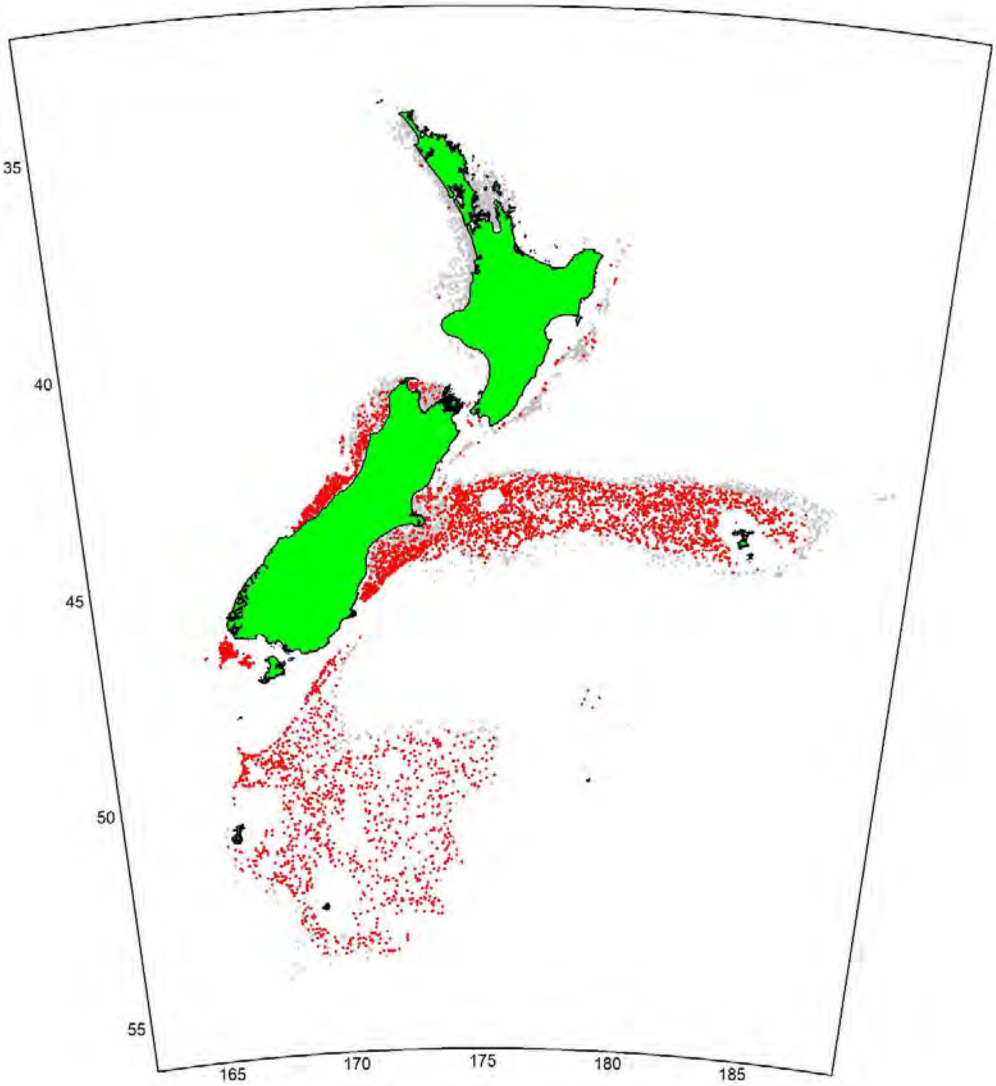


Figure 33.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where ling was caught (red points).

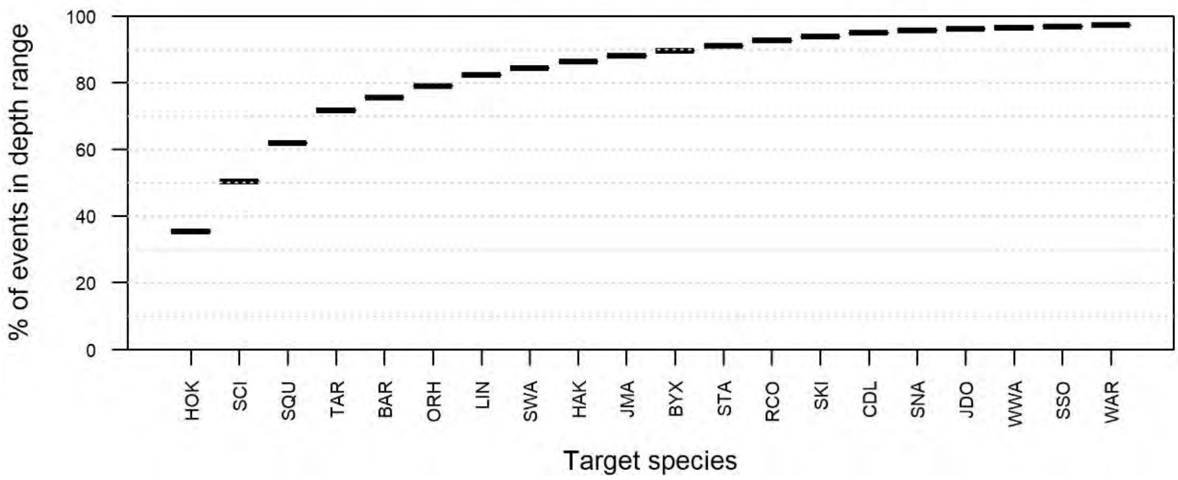
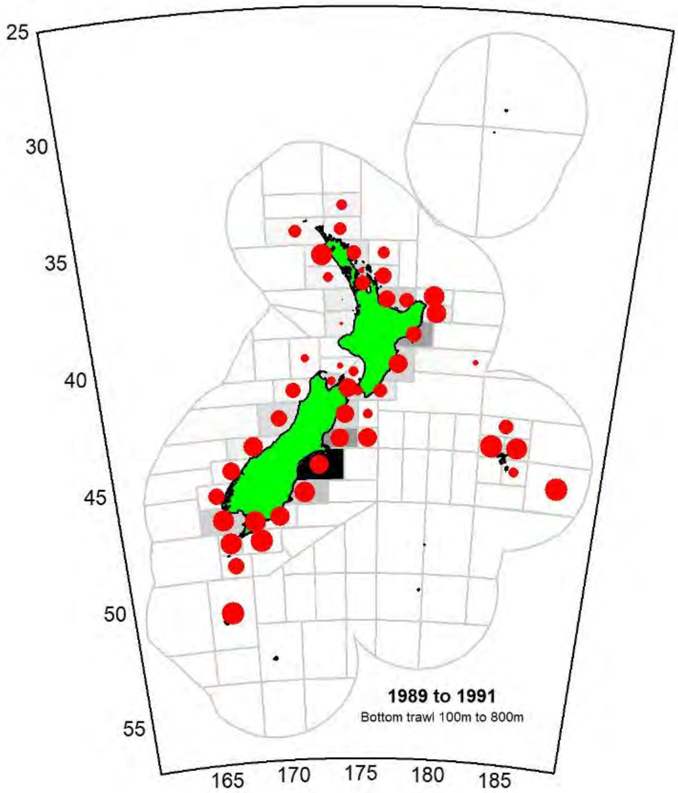


Figure 33.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for ling (100–800 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.



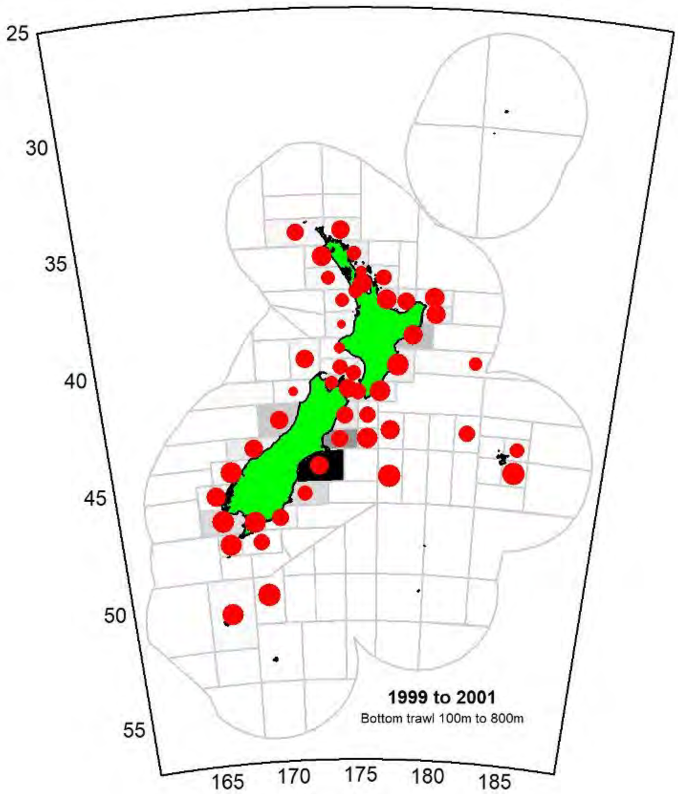
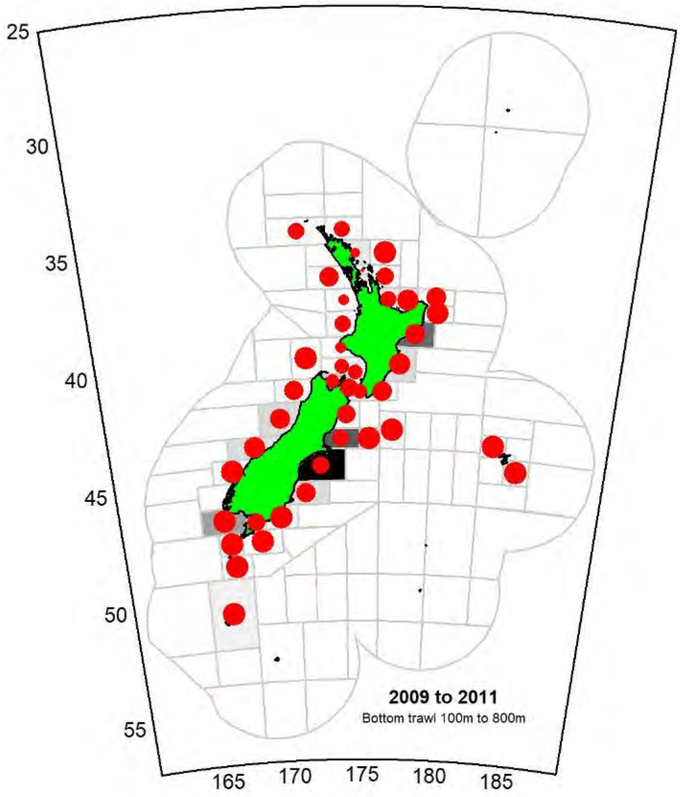


Figure 33.4: Maps of ling occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



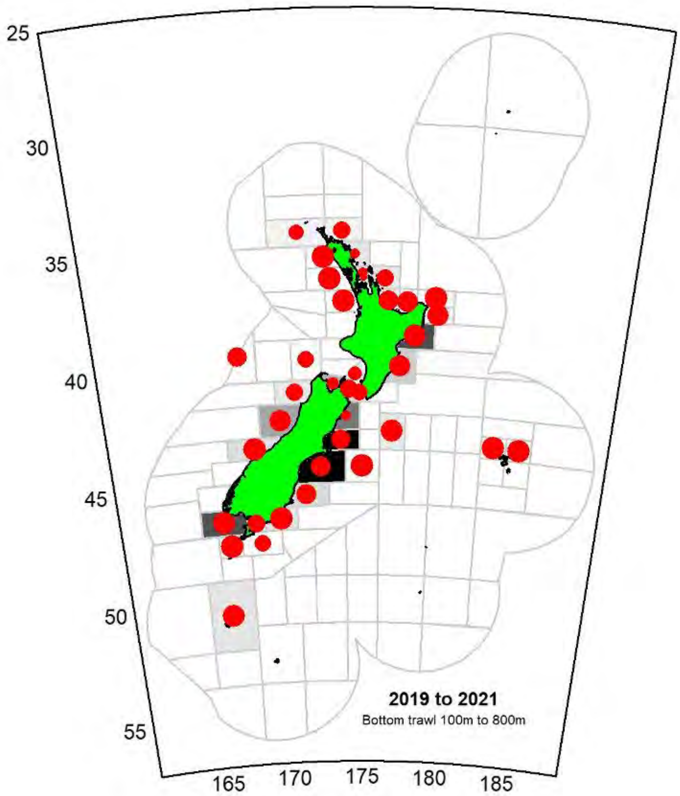


Figure 33.4 (cont.): Maps of ling occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

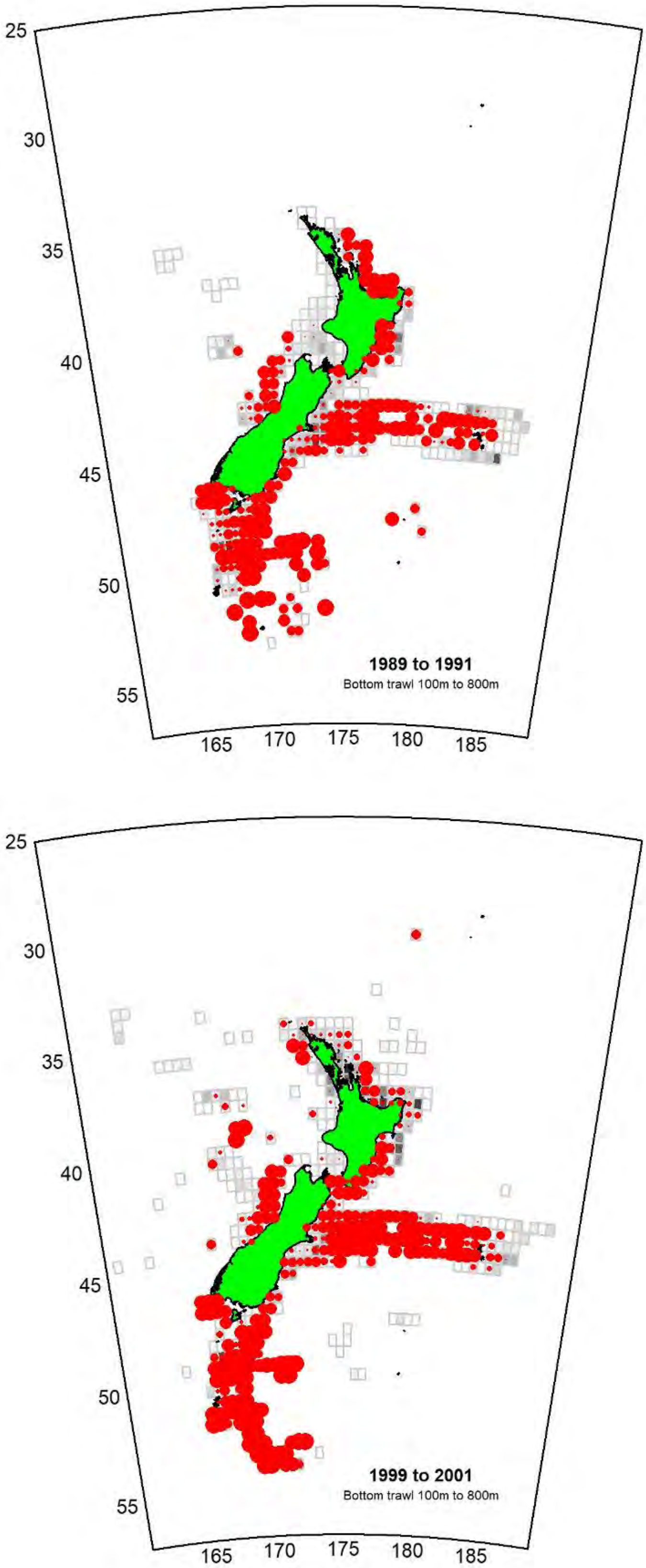
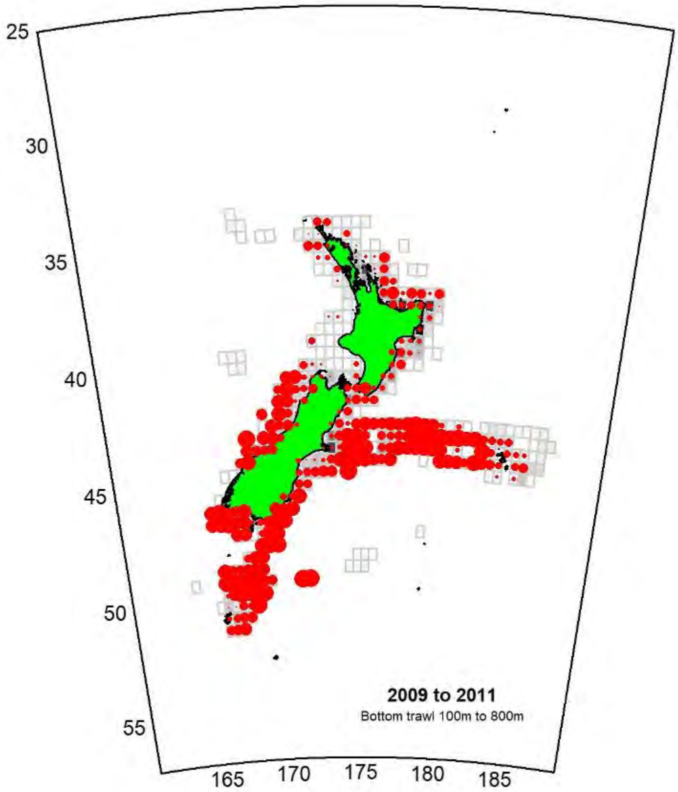


Figure 33.5: Maps of ling occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



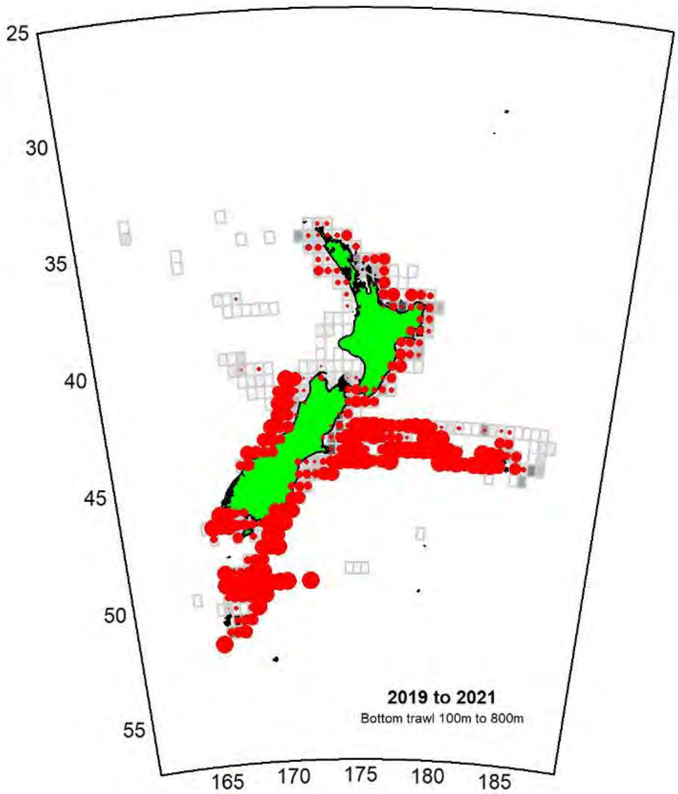


Figure 33.5 (cont.): Maps of ling occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

34. Lookdown dory (LDO)

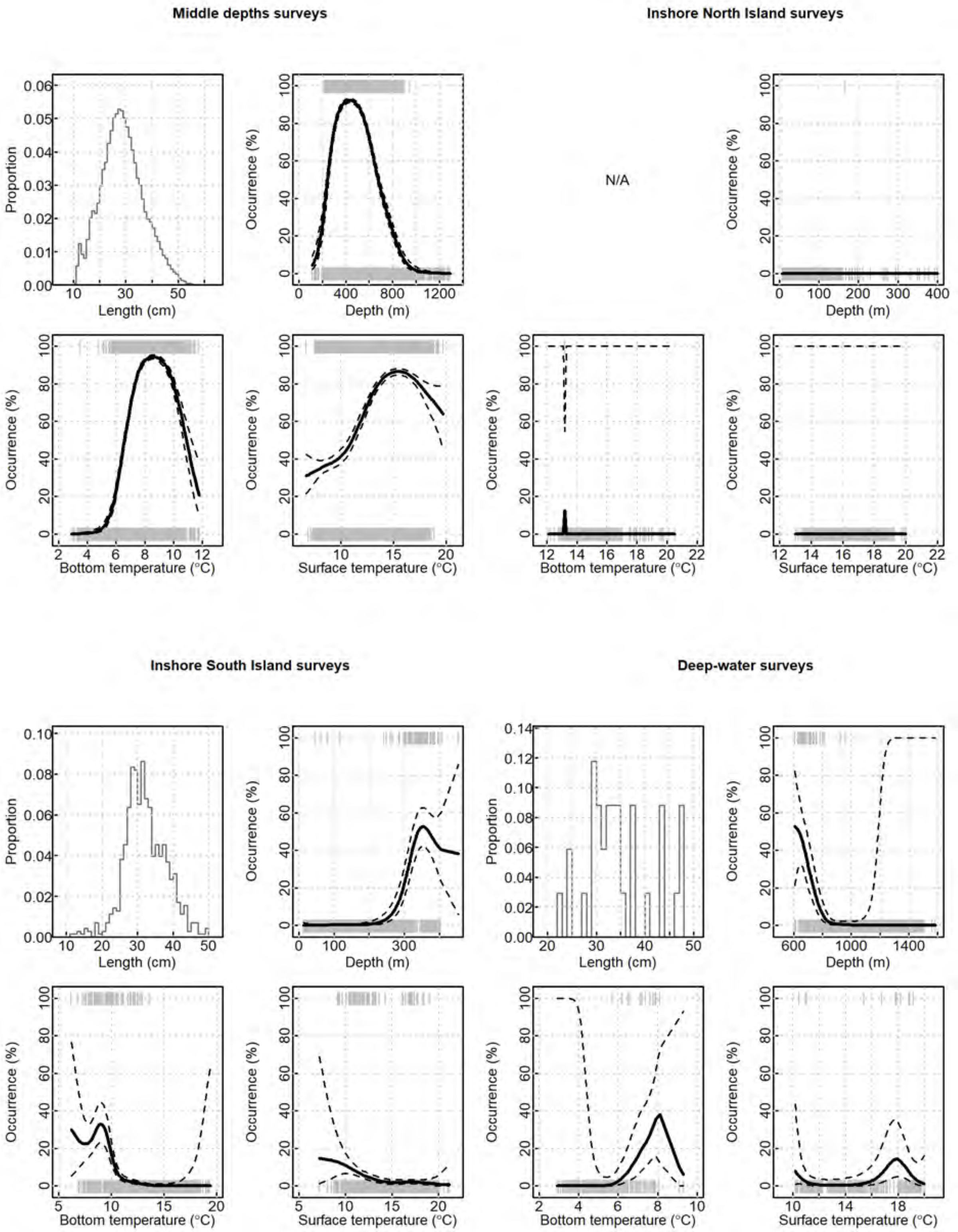


Figure 34.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to lookdown dory occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

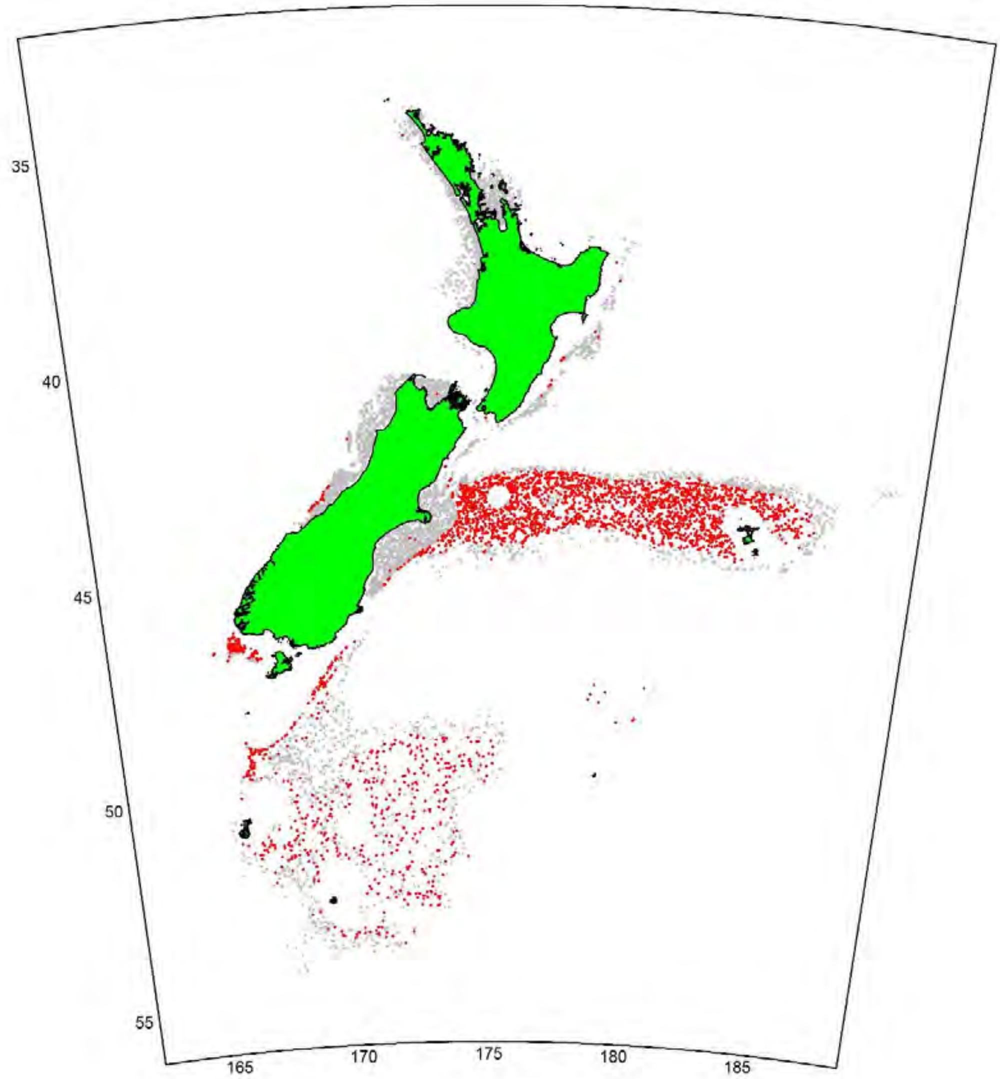


Figure 34.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where lookdown dory was caught (red points).

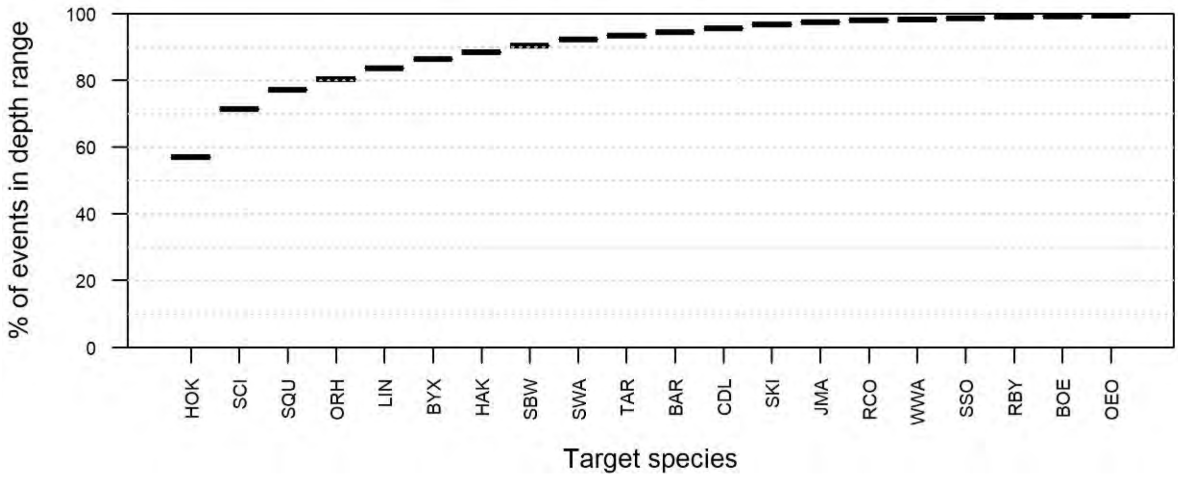
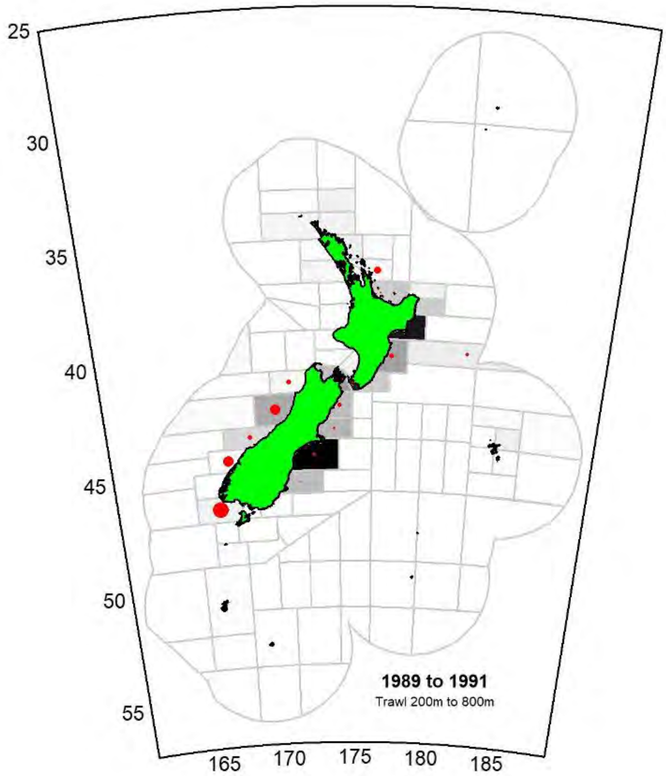


Figure 34.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for lookdown dory (200–800 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.



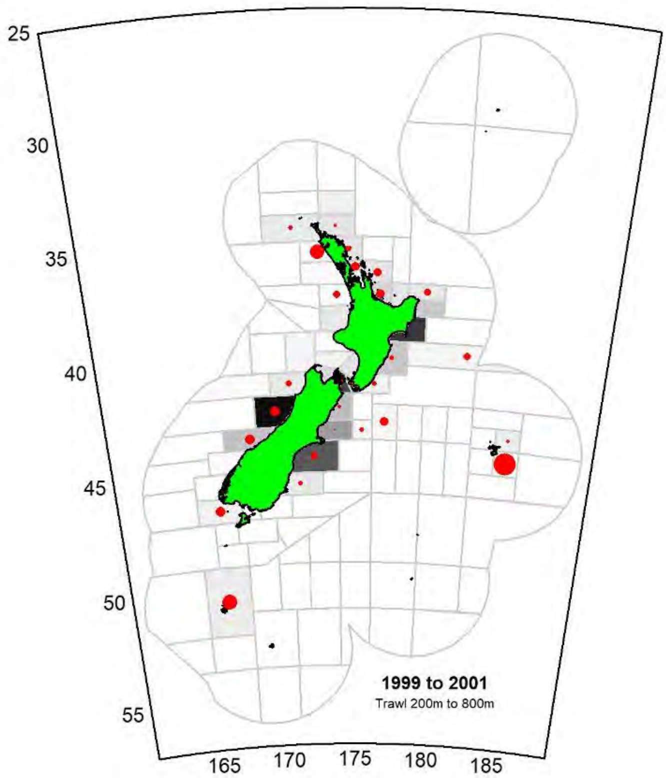
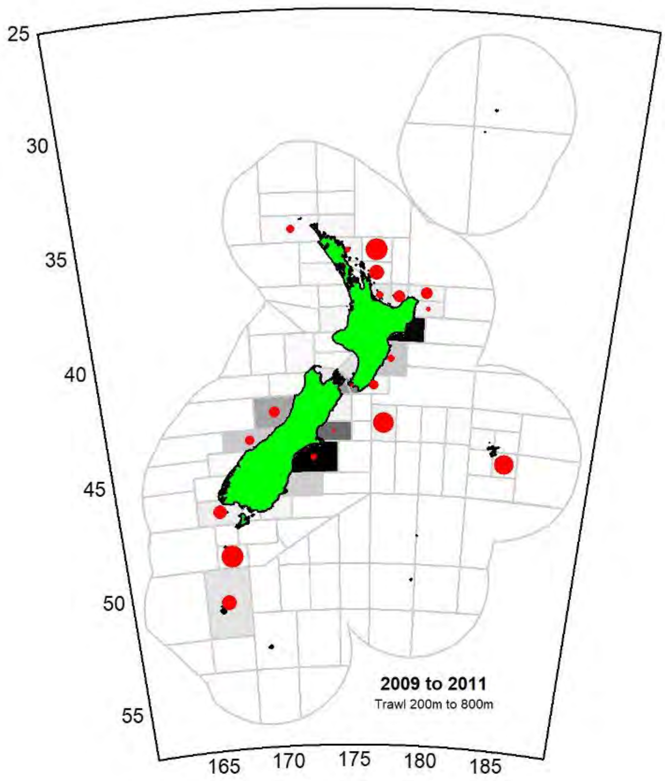


Figure 34.4: Maps of lookdown dory occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



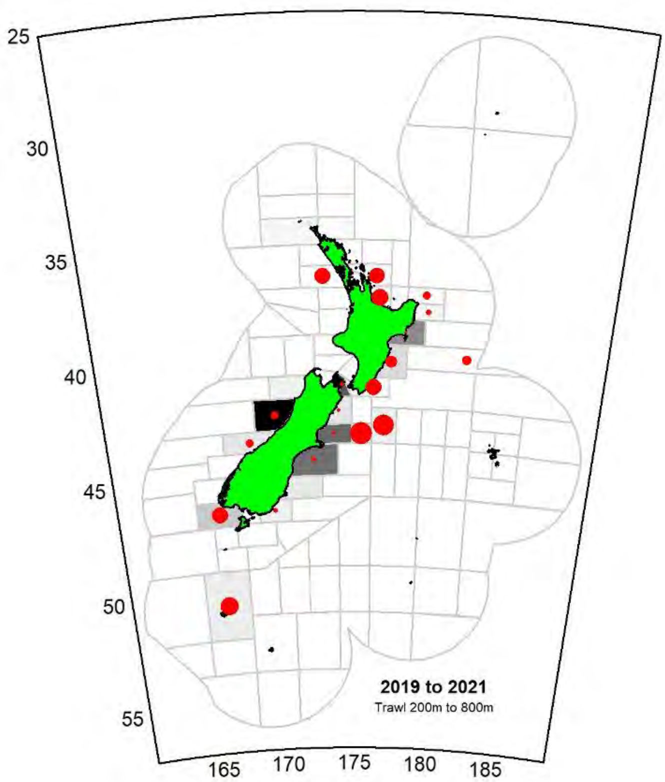


Figure 34.4 (cont.): Maps of lookdown dory occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

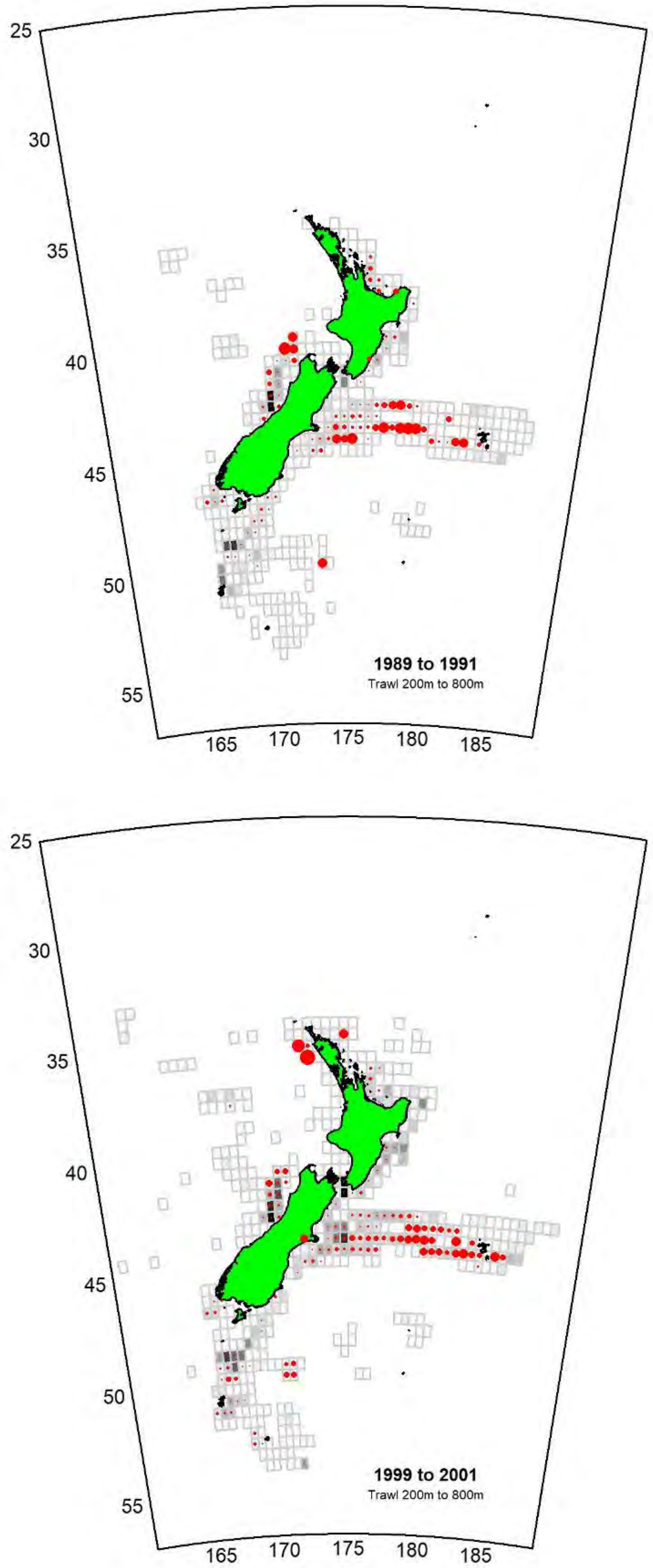
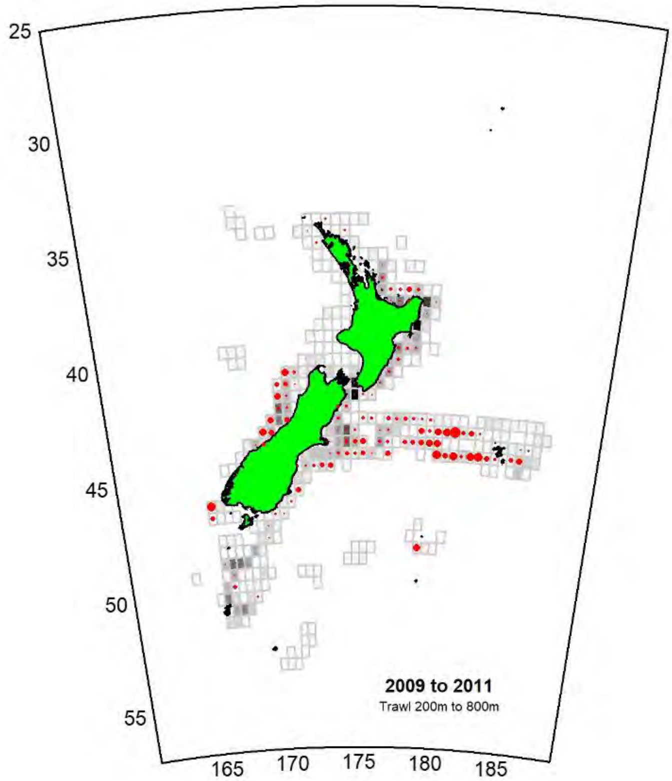


Figure 34.5: Maps of lookdown dory occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



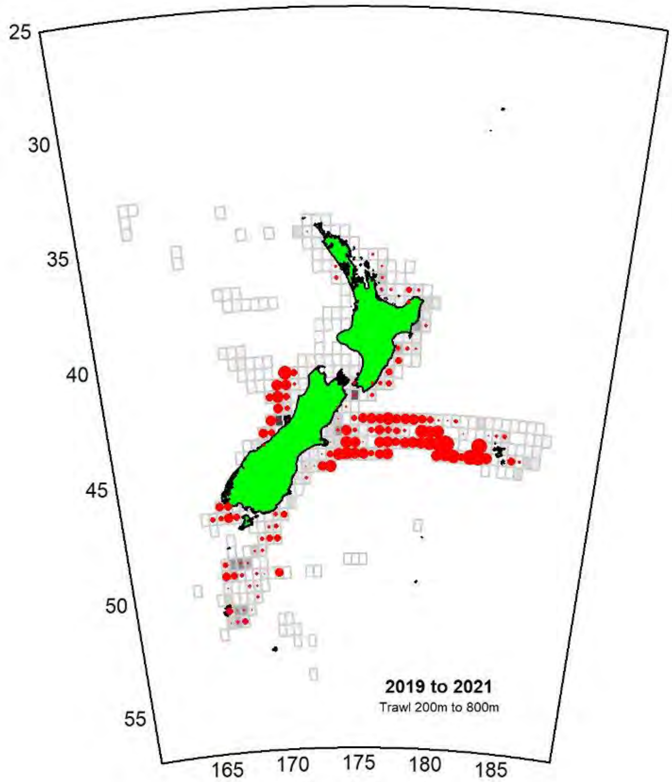


Figure 34.5 (cont.): Maps of lookdown dory occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

35. Orange roughy (ORH)

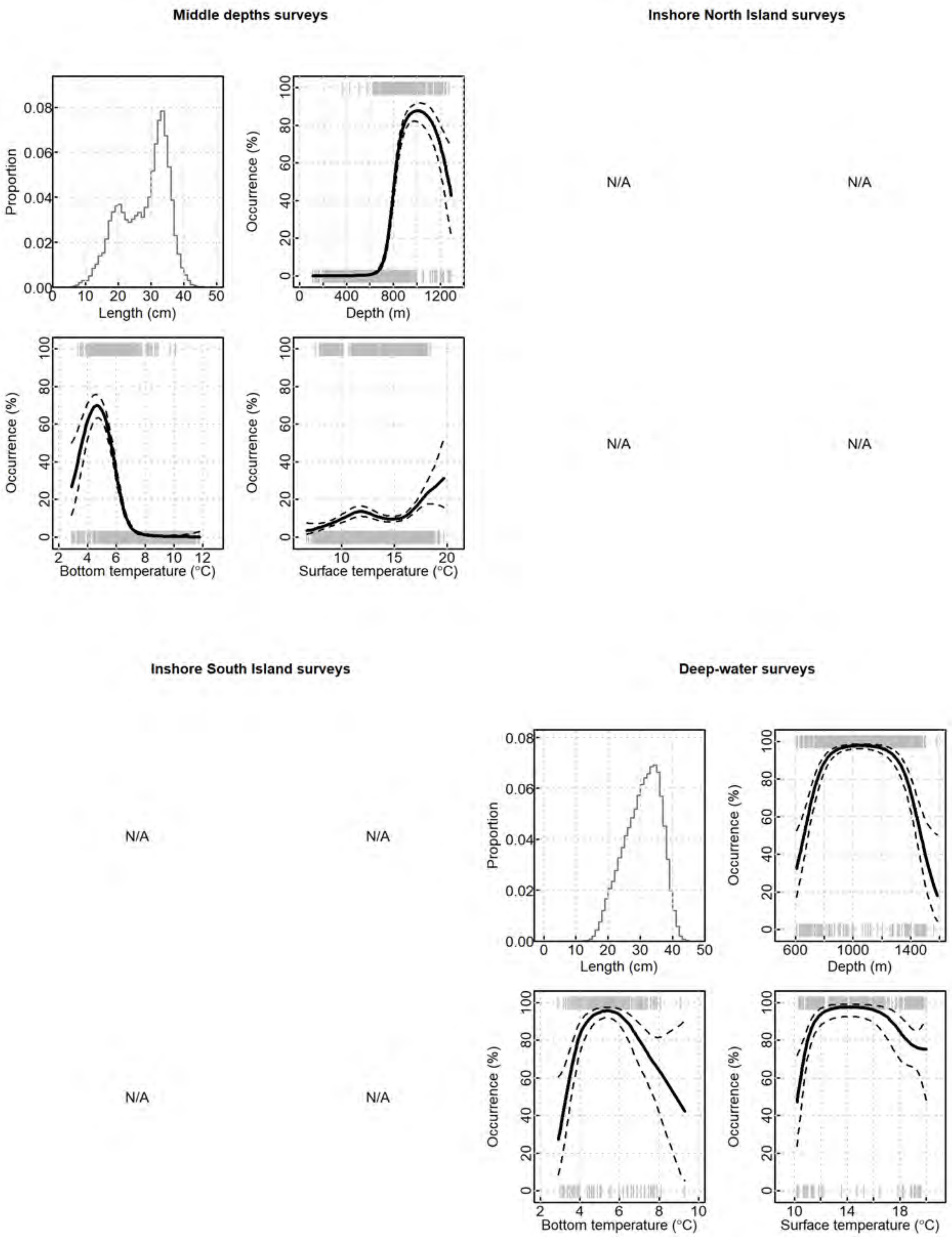


Figure 35.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to orange roughy occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

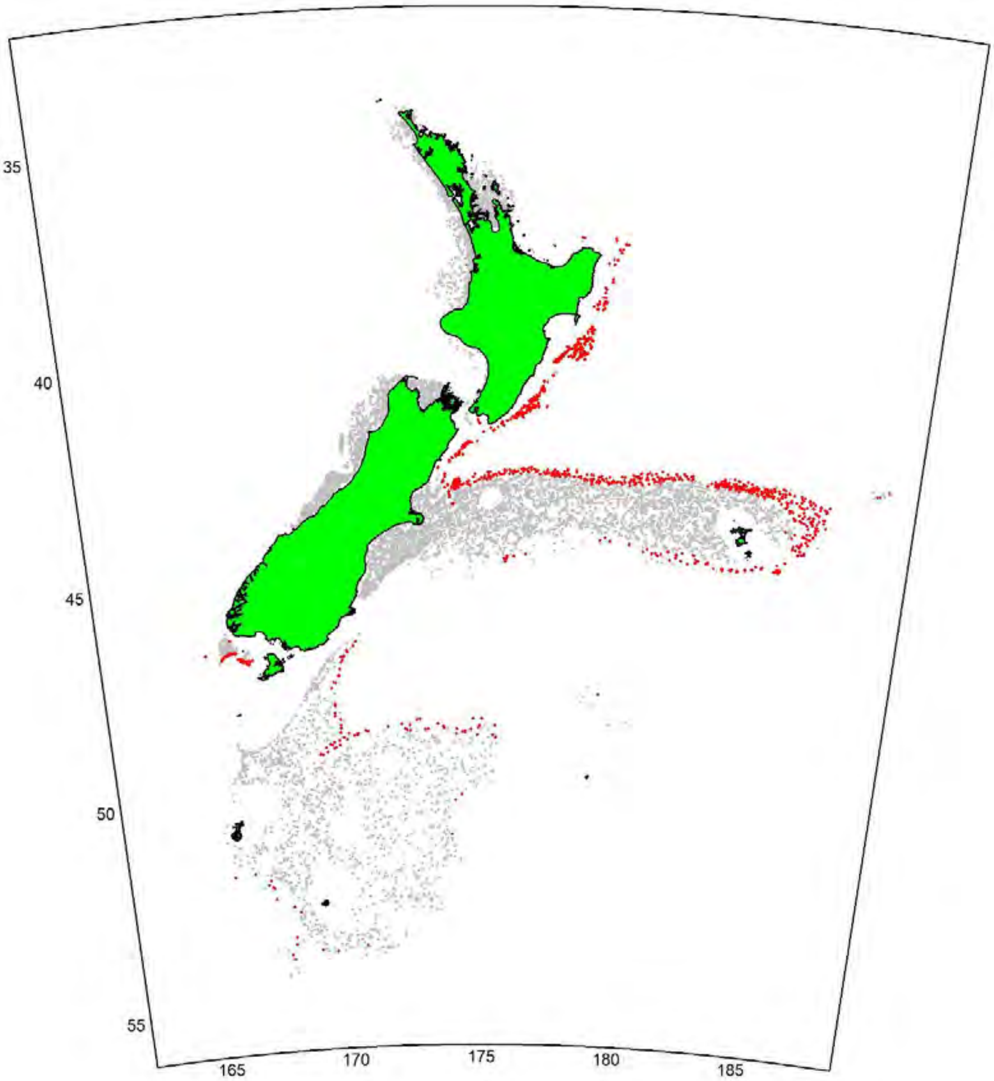


Figure 35.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where orange roughy was caught (red points).

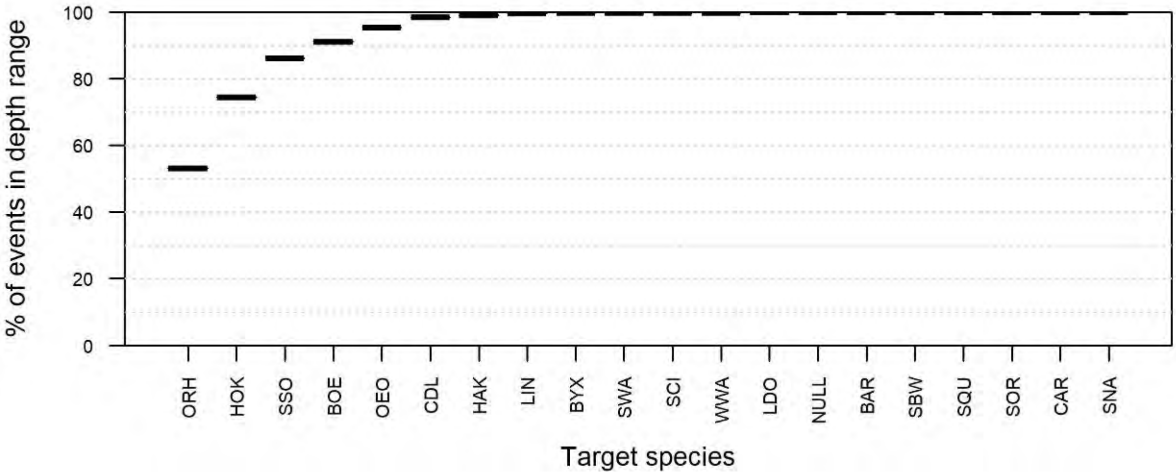
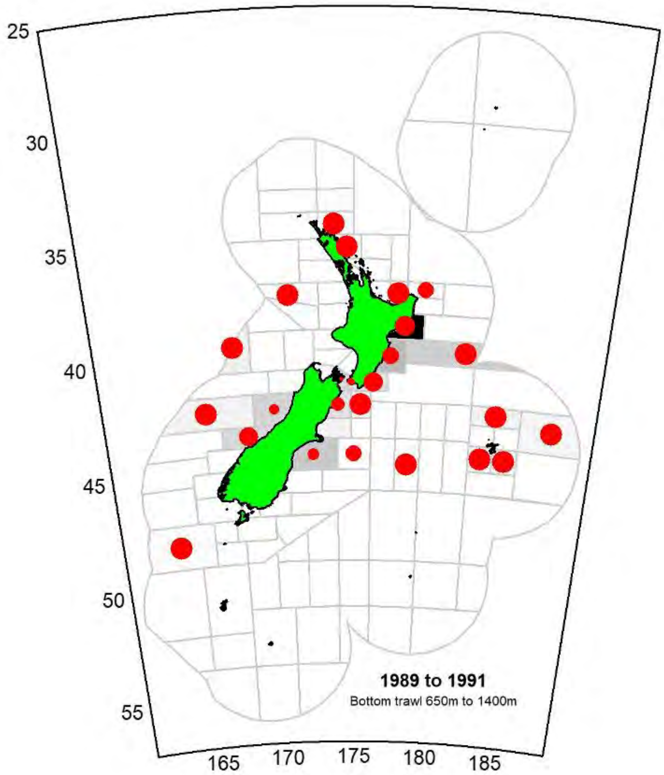


Figure 35.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for orange roughy (650–1400 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.



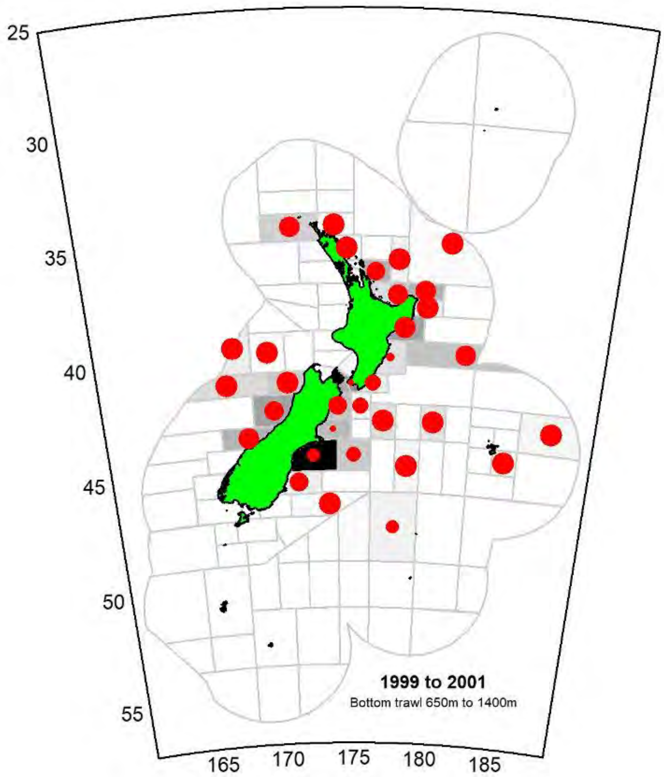
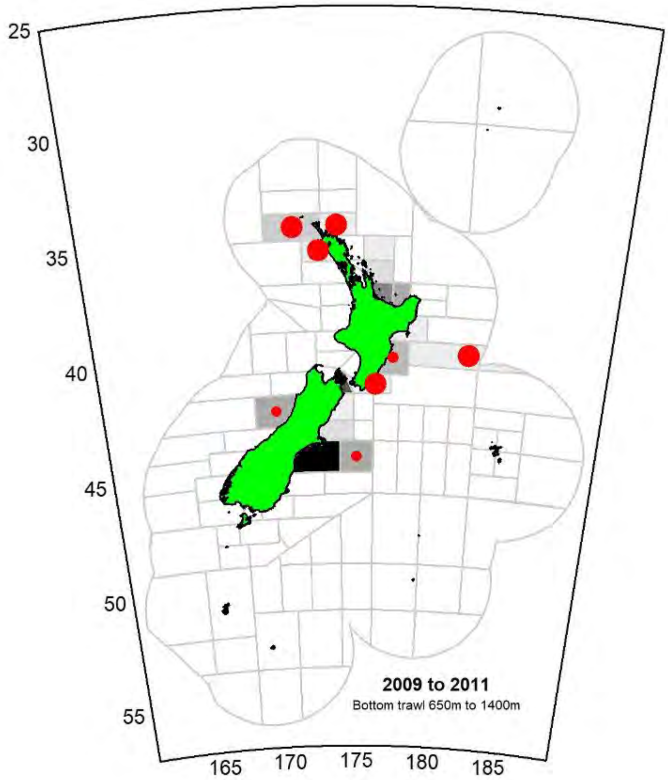


Figure 35.4: Maps of orange roughy occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



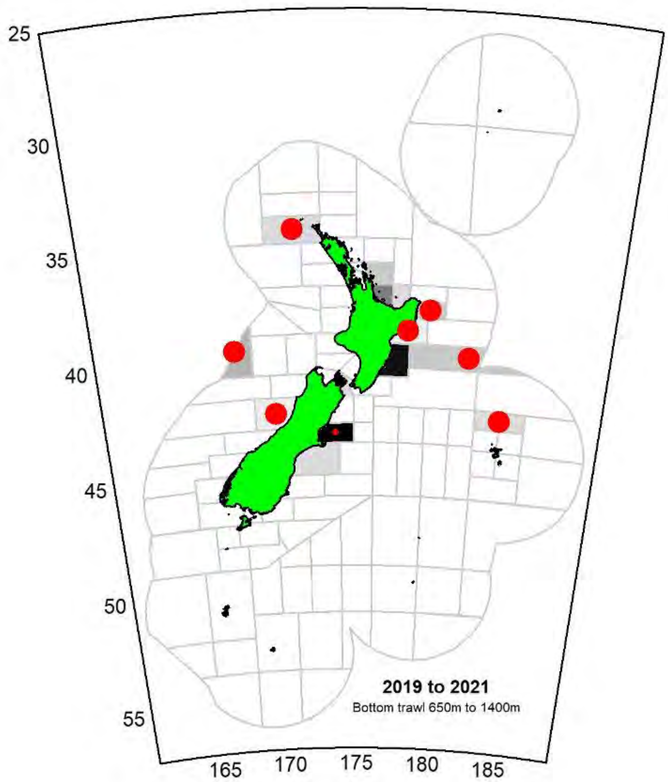


Figure 35.4 (cont.): Maps of orange roughy occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

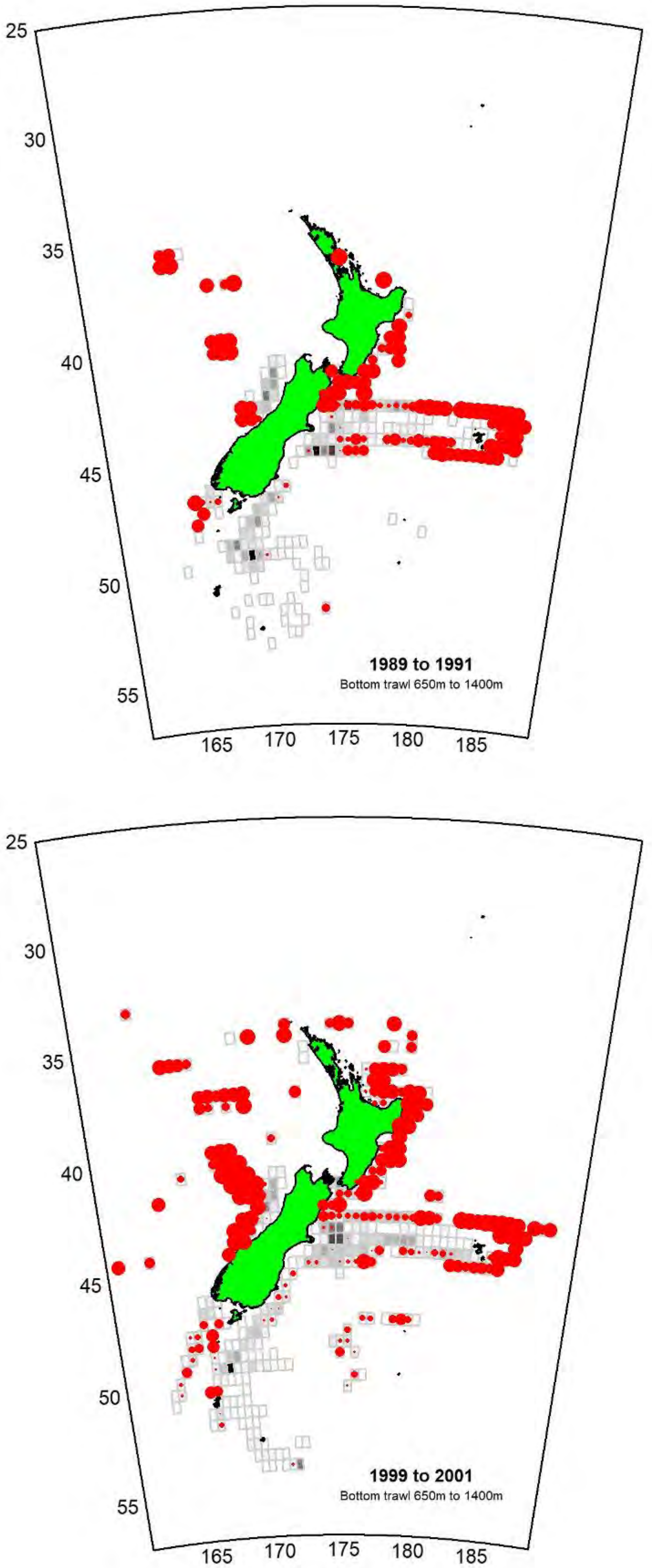
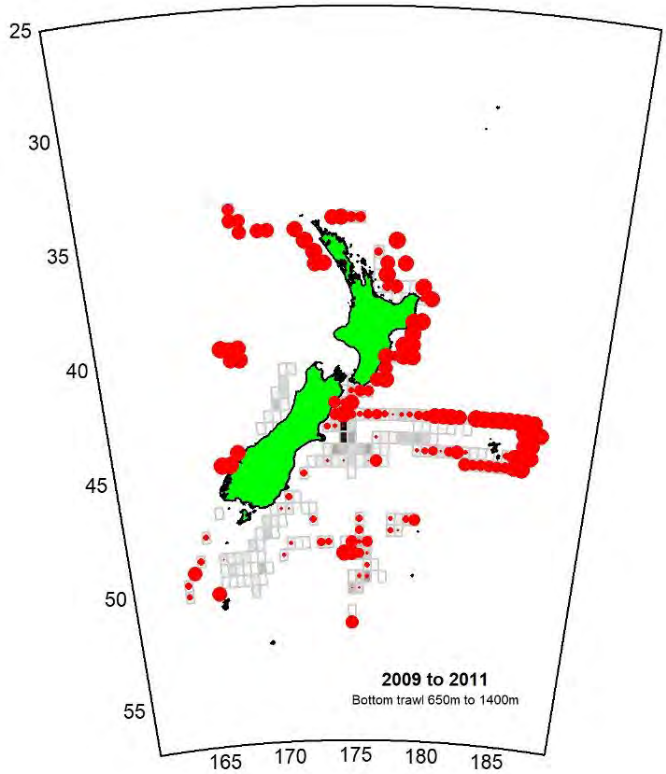


Figure 35.5: Maps of orange roughy occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



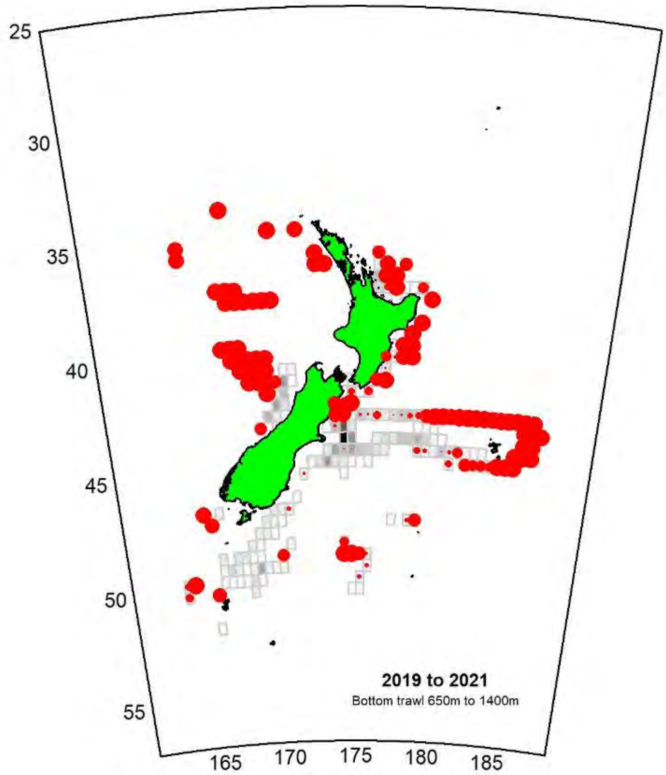


Figure 35.5 (cont.): Maps of orange roughy occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

36. Oreos (Research, BOE, SSO, SOR, WOE; Commercial, BOE, SSO, OEO)

BOE

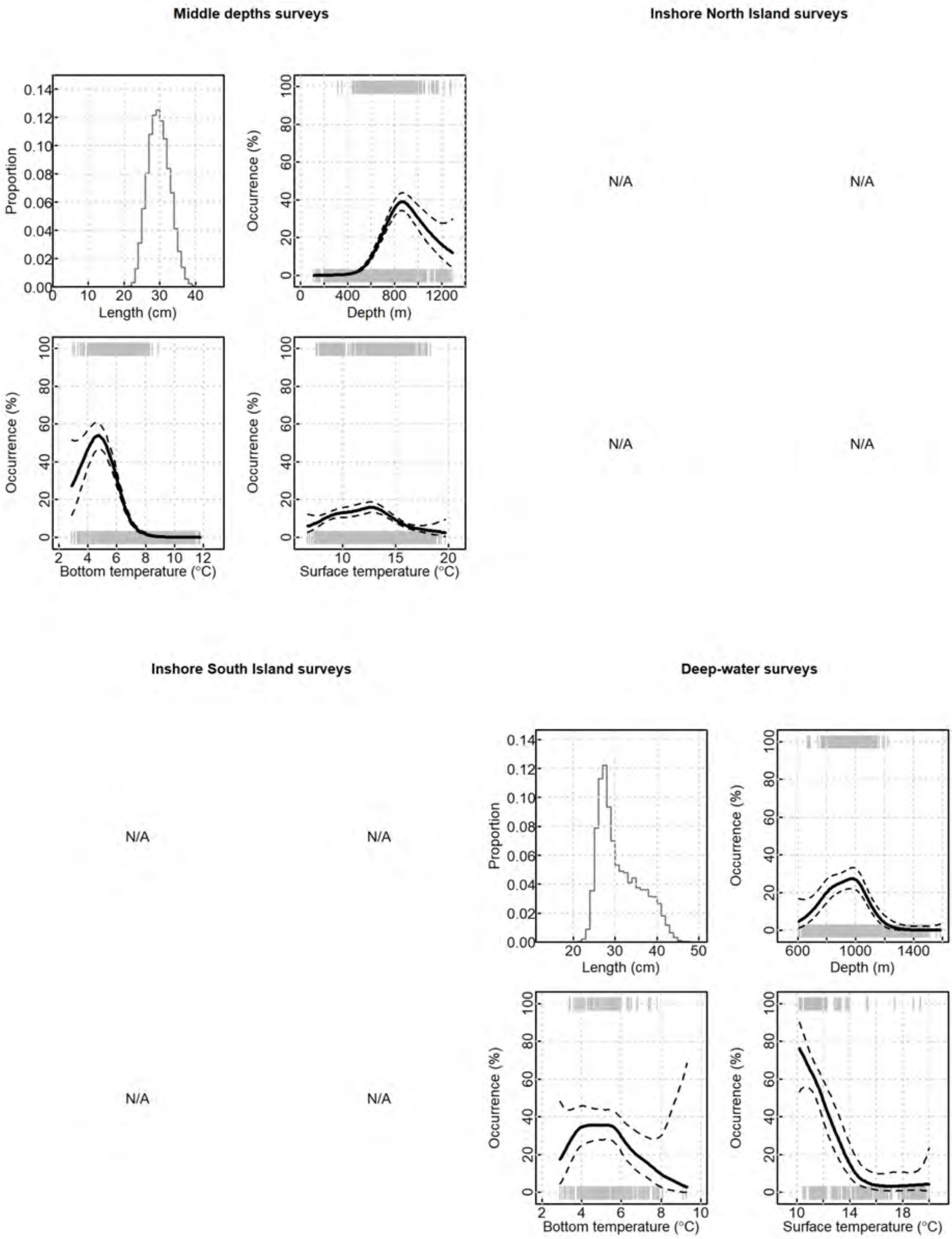


Figure 36.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to black oreo occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

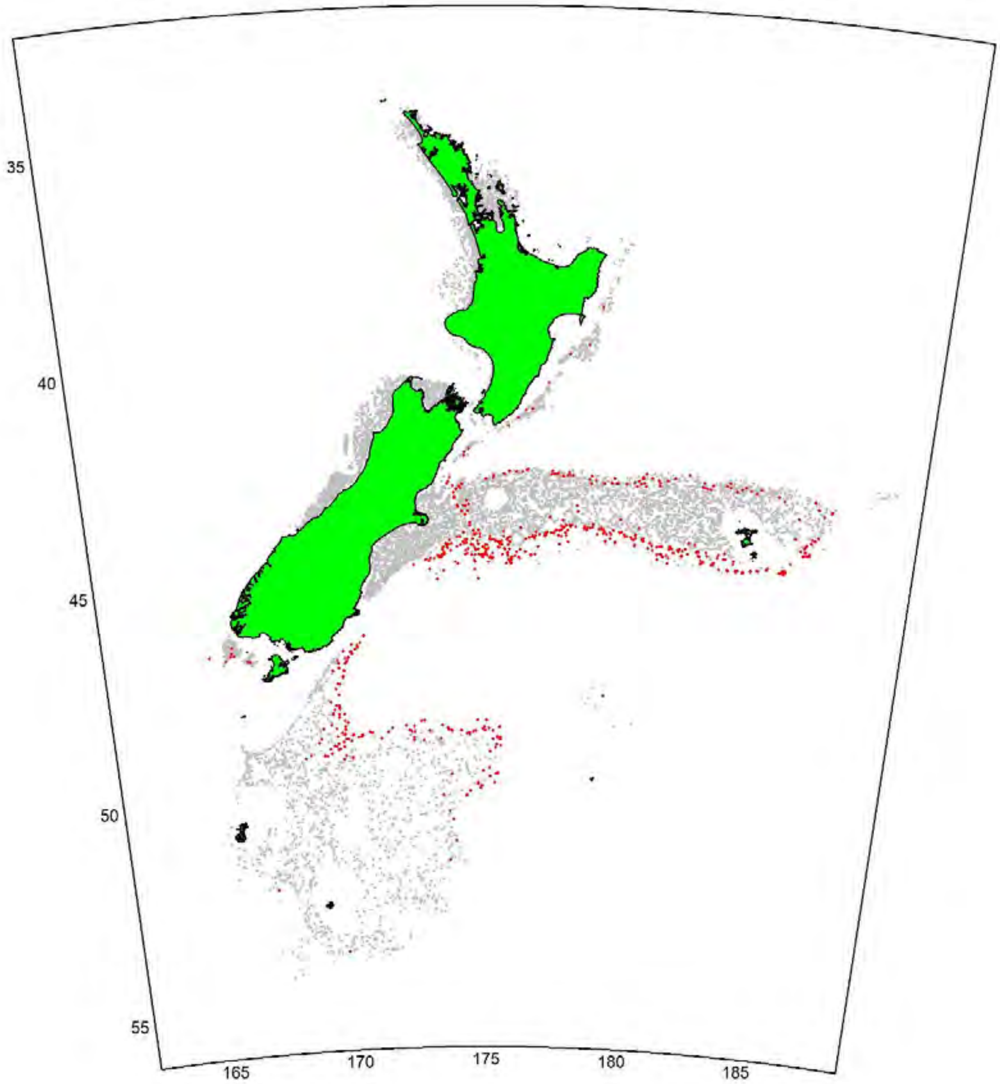


Figure 36.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where black oreo was caught (red points).

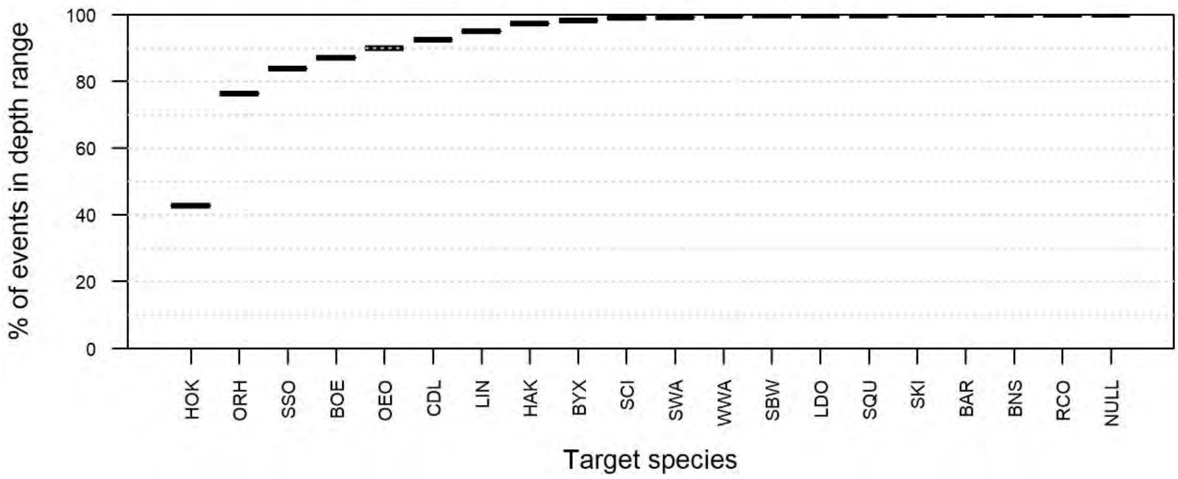


Figure 36.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for black oreo (500–1200 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.

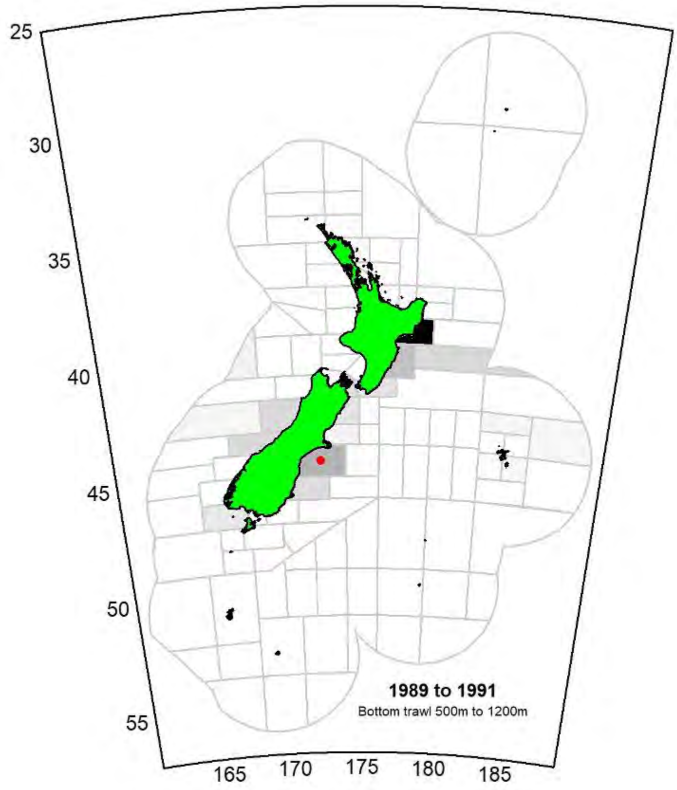
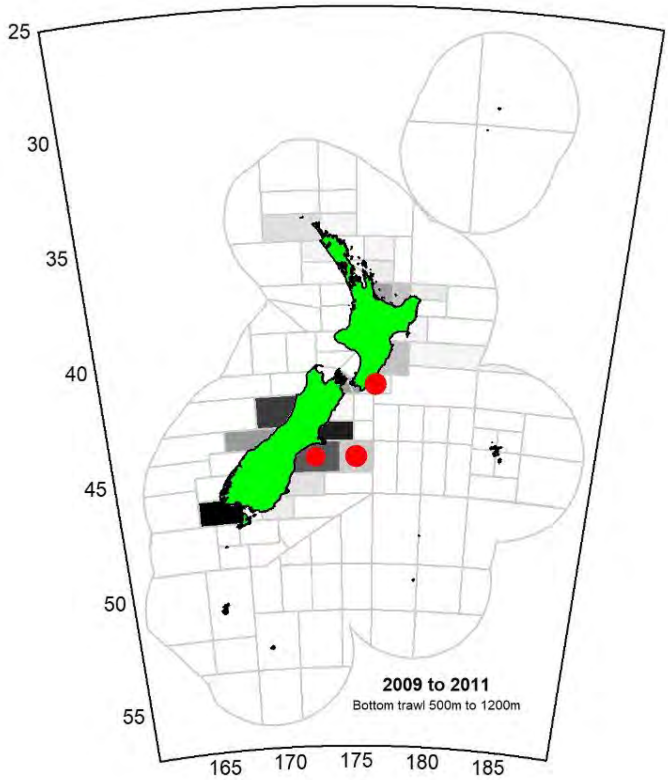


Figure 36.4: Maps of black oreo occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



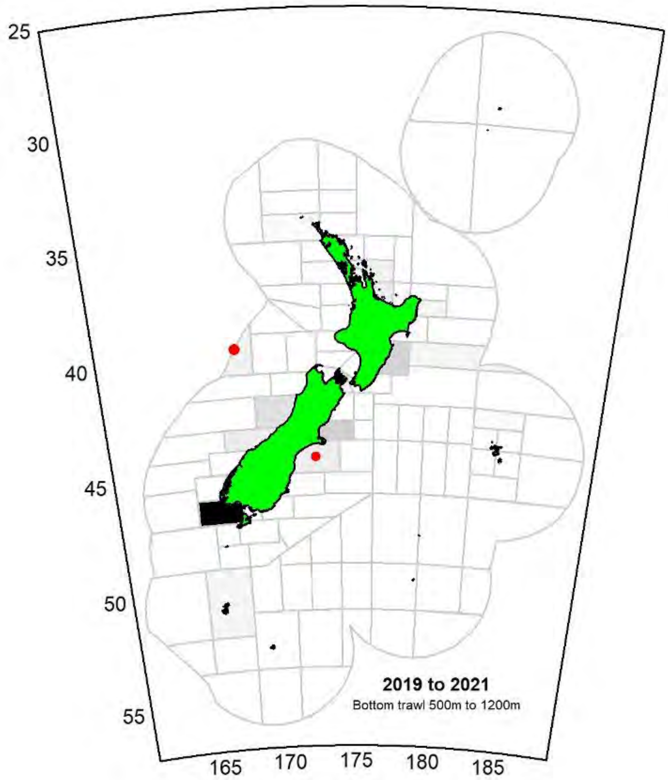
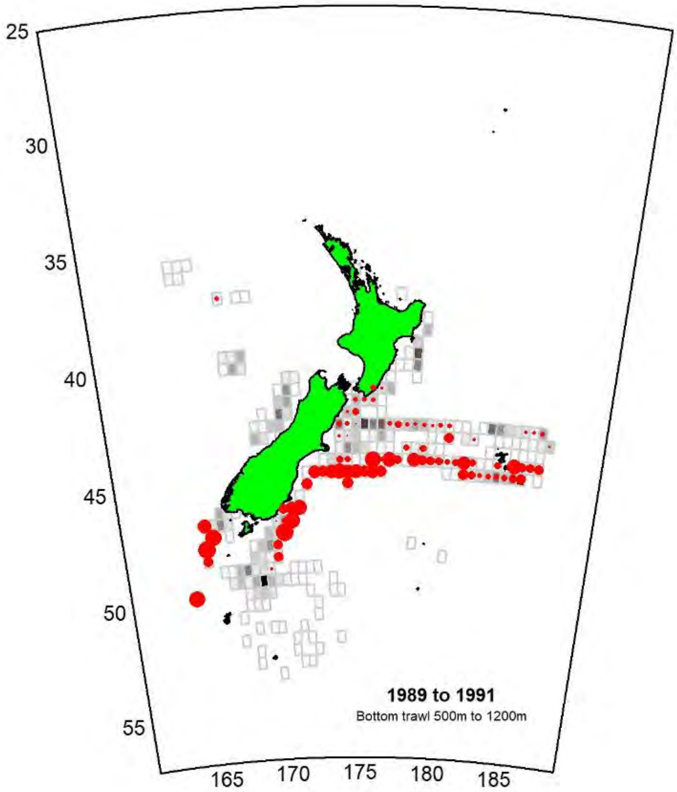


Figure 36.4 (cont.): Maps of black oreo occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



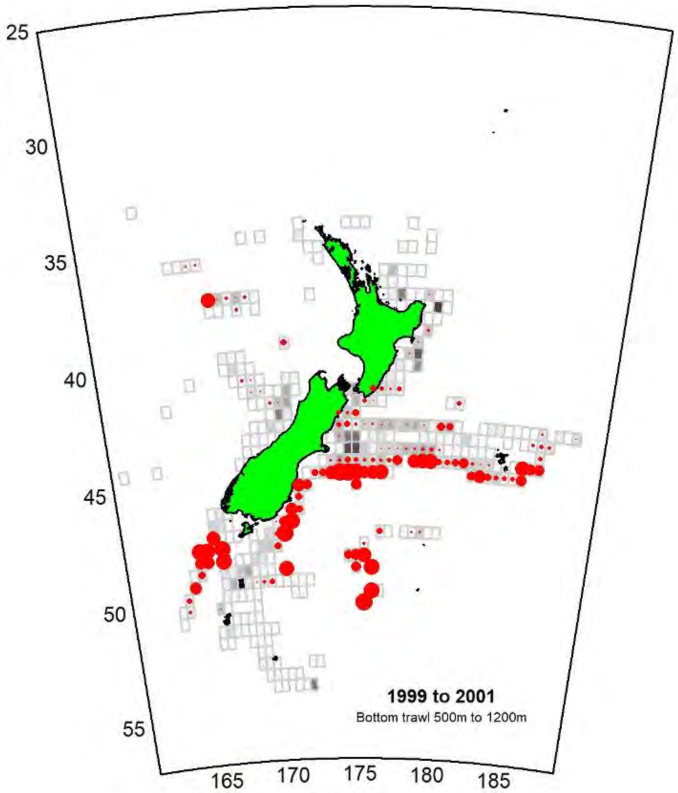
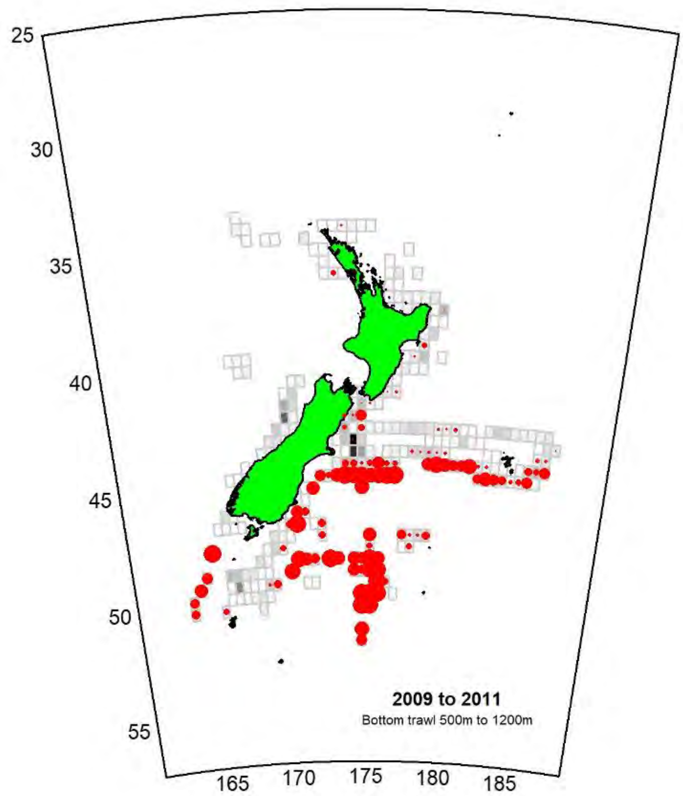


Figure 36.5: Maps of black oreo occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



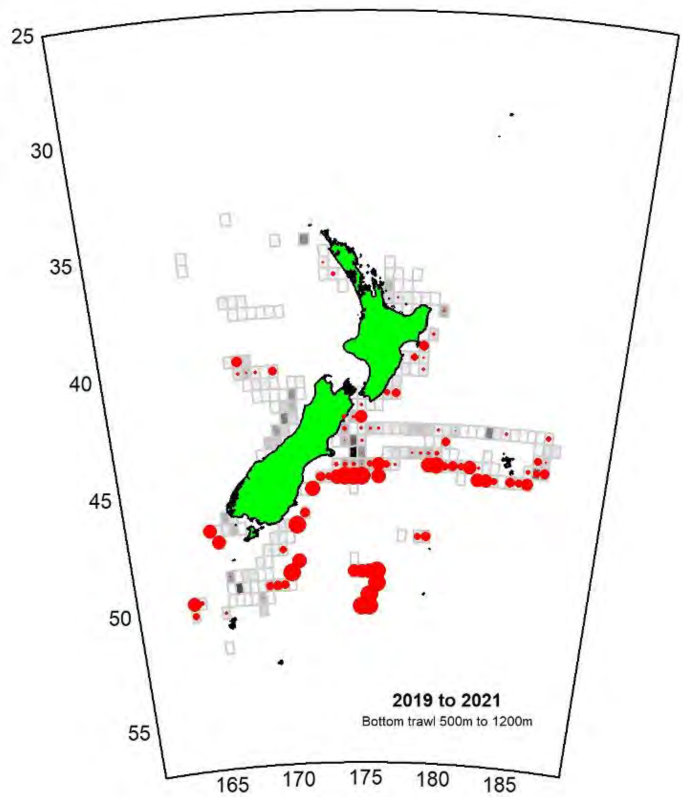


Figure 36.5 (cont.): Maps of black oreo occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

SSO

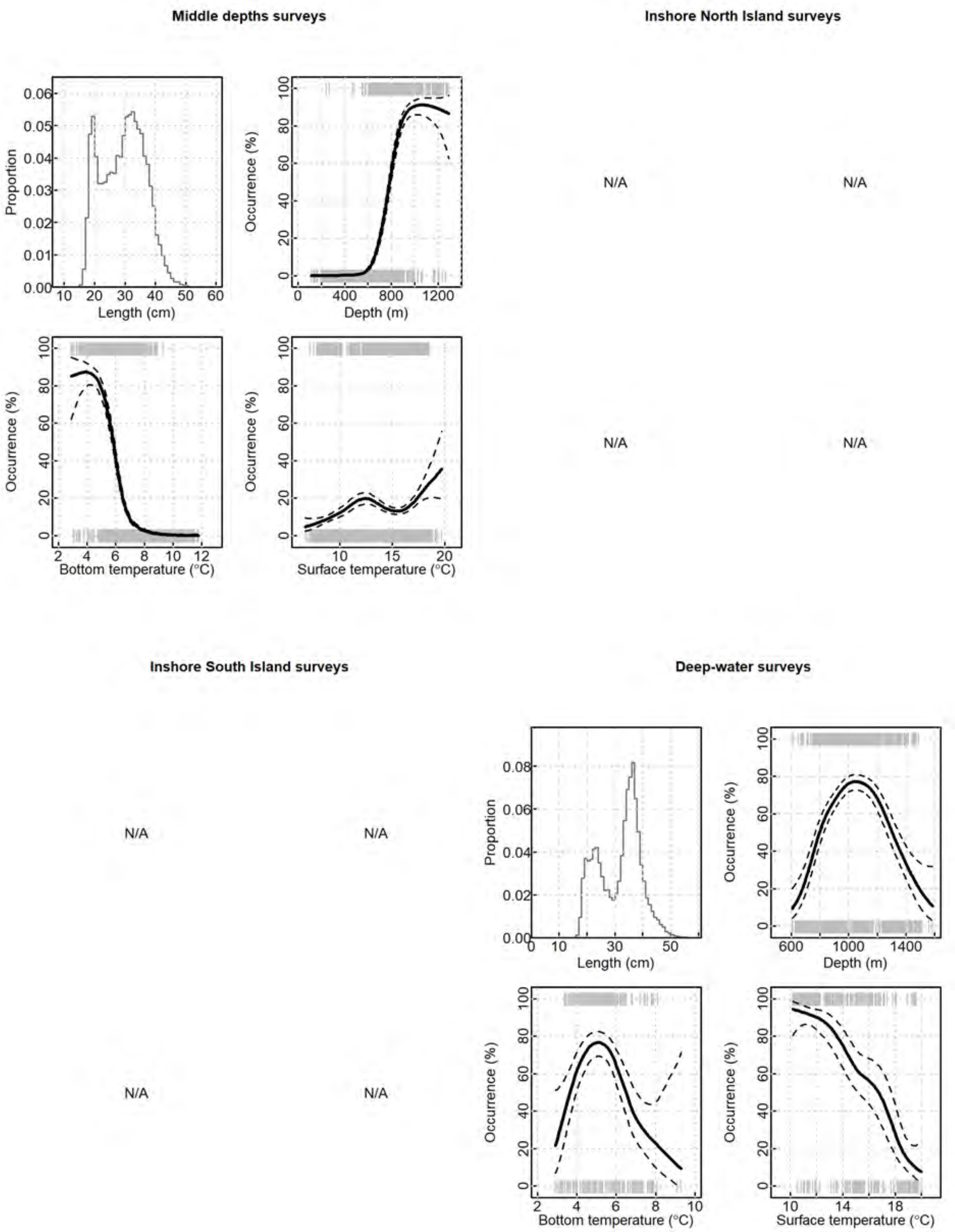


Figure 36.6: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to smooth oreo occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

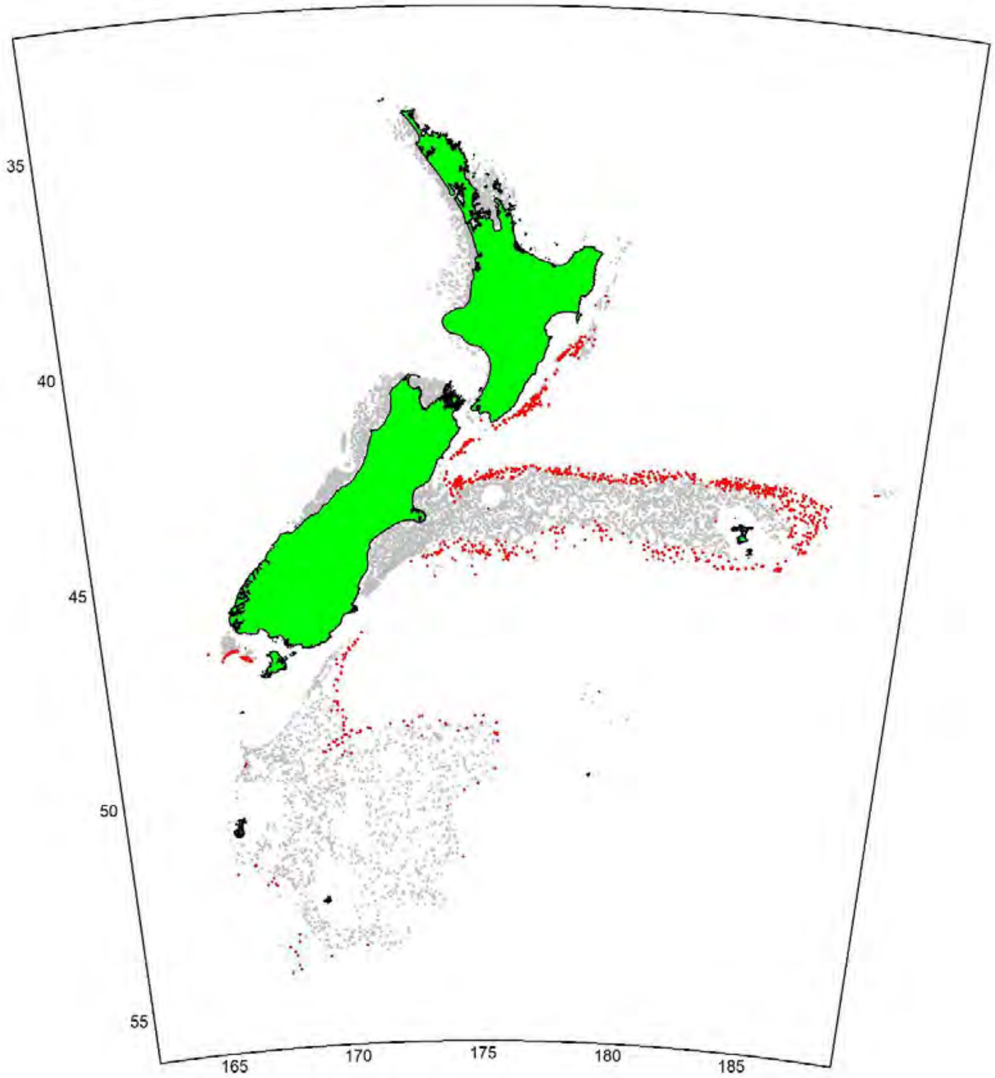


Figure 36.7: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where smooth oreo was caught (red points).

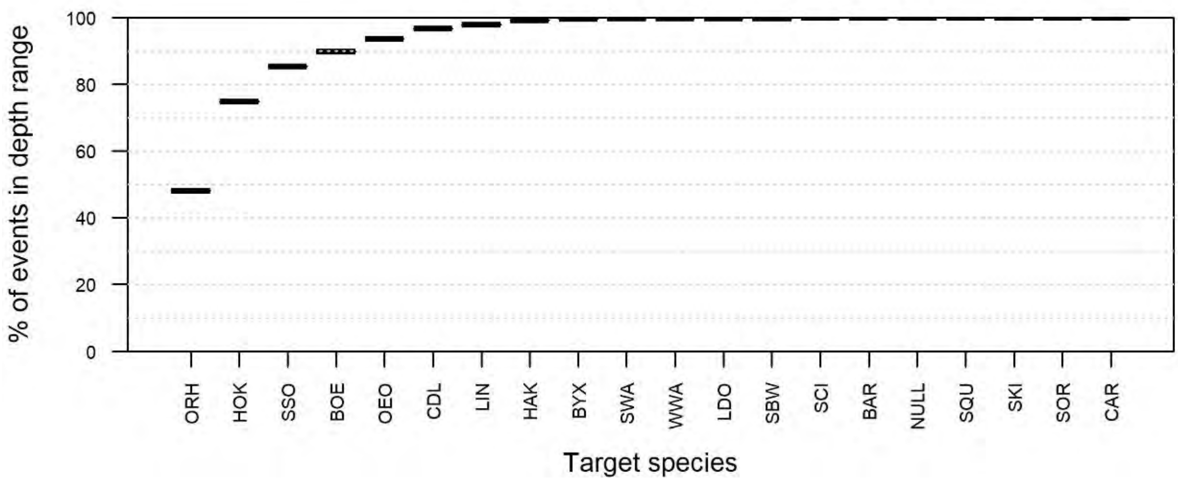
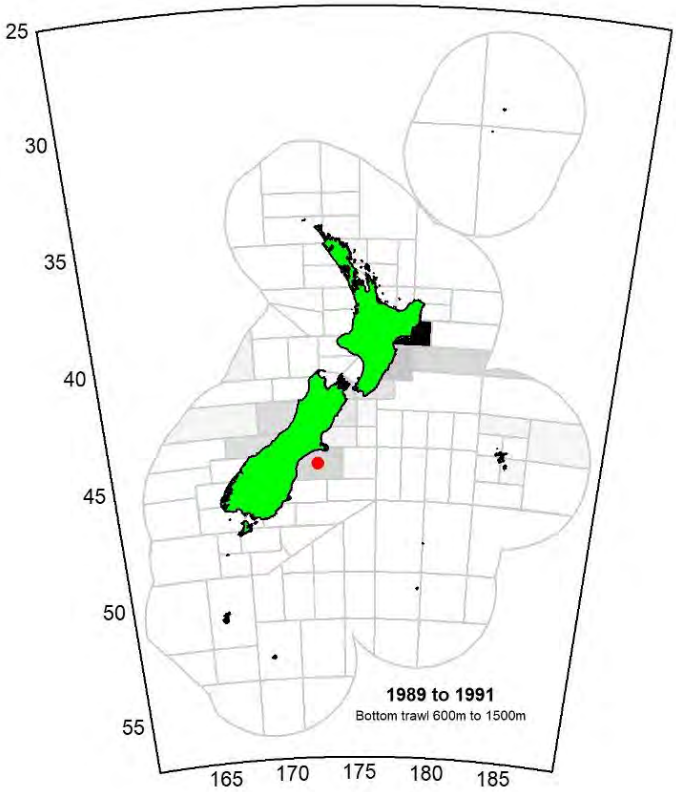


Figure 36.8: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for smooth oreo (600–1500 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.



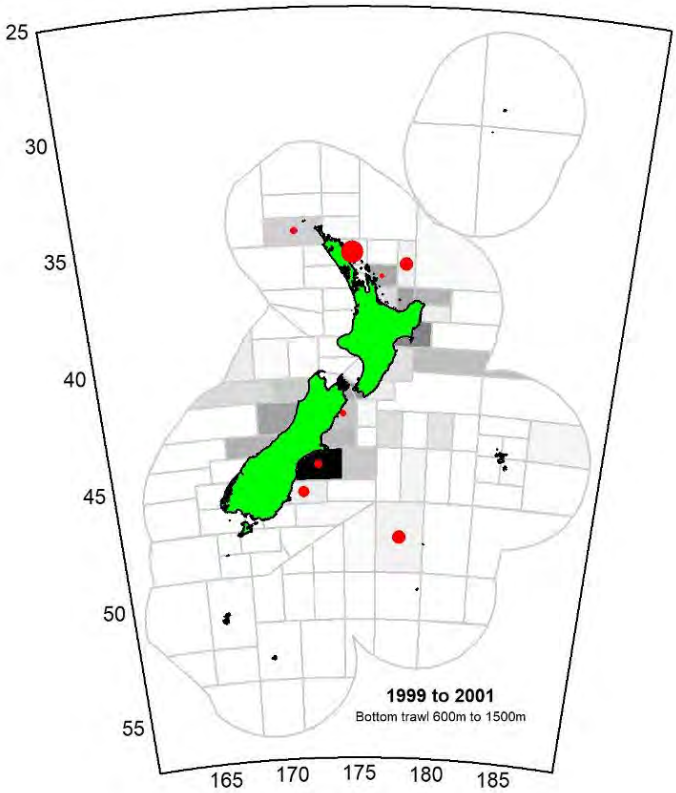
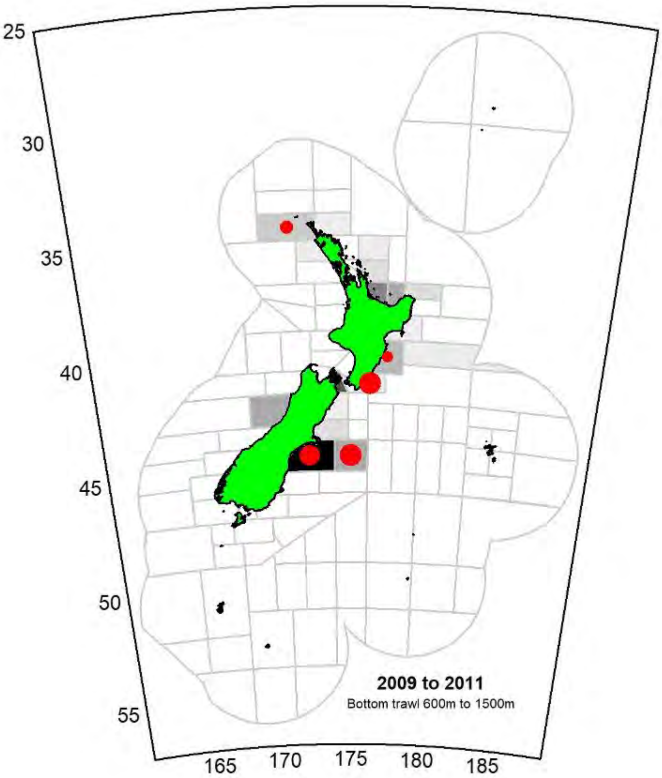


Figure 36.9: Maps of smooth oreo occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



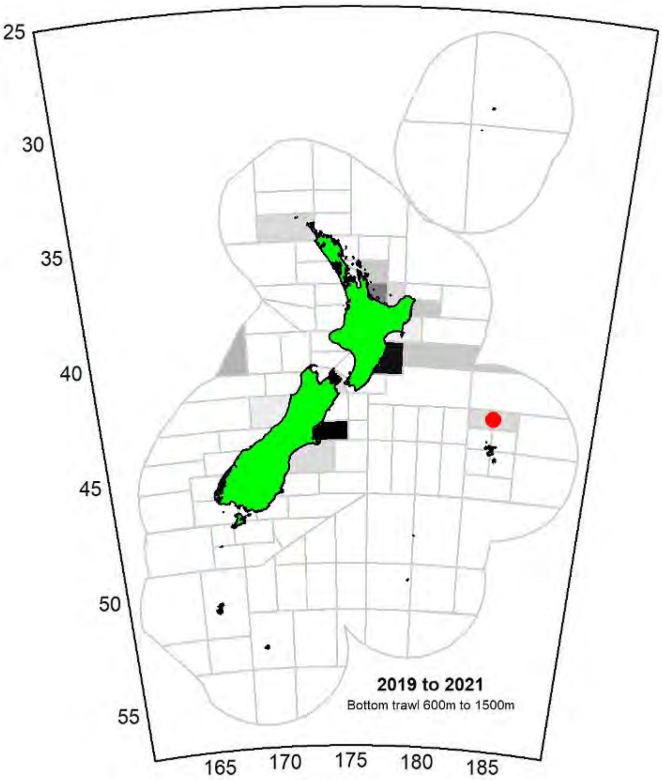


Figure 36.9 (cont.): Maps of smooth oreo occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

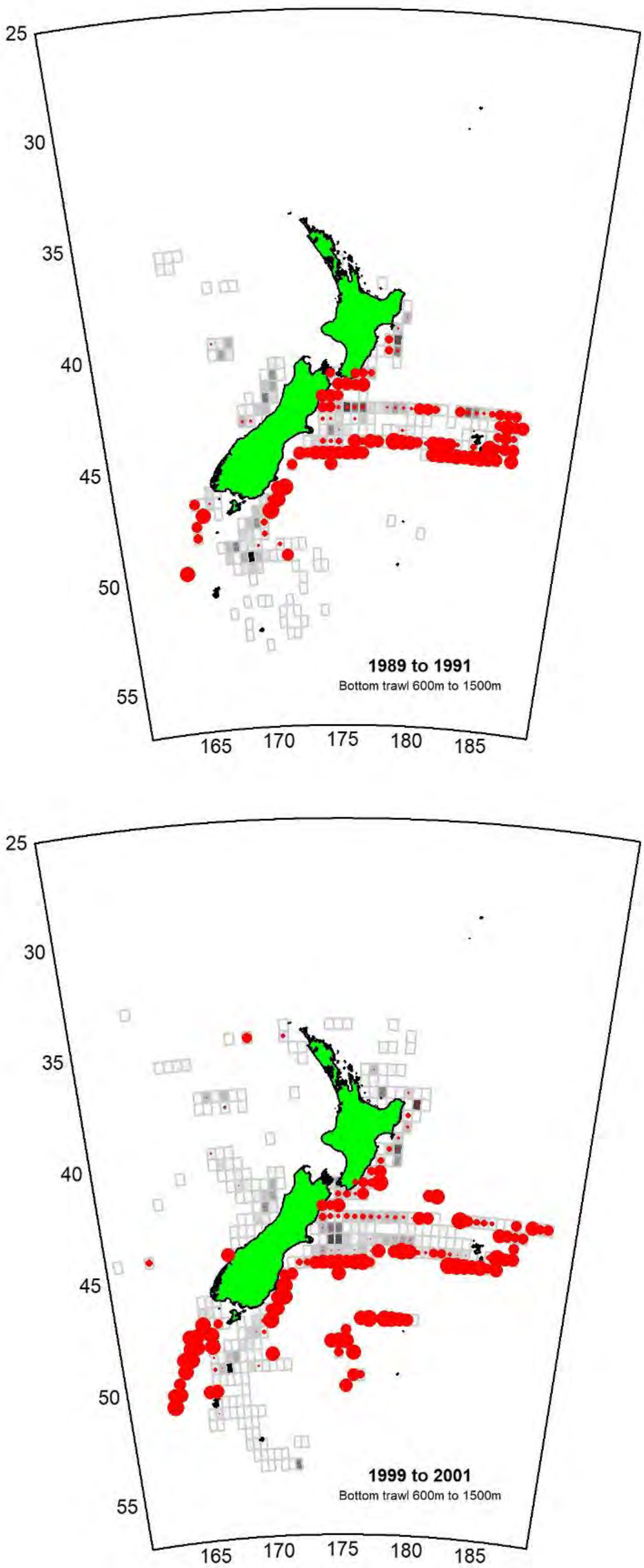
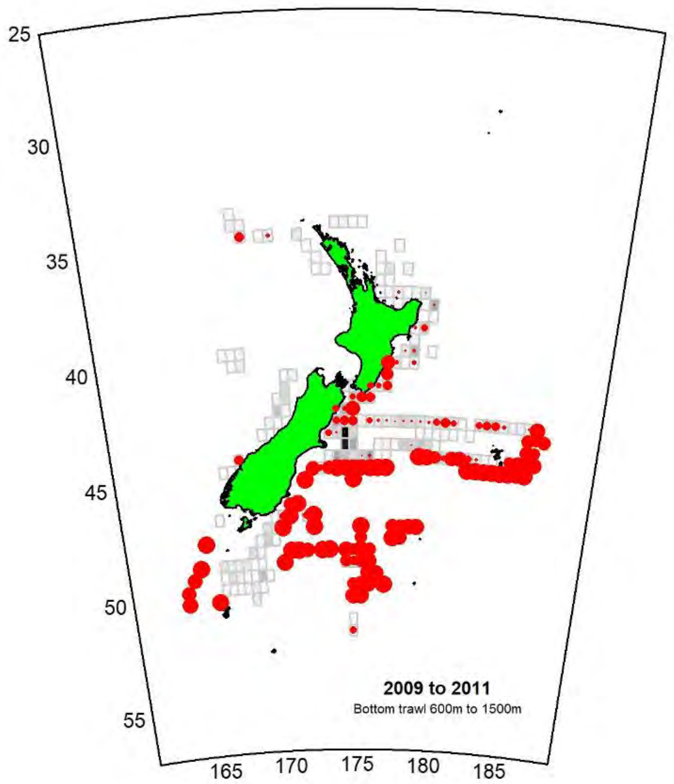


Figure 36.10: Maps of smooth oreo occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



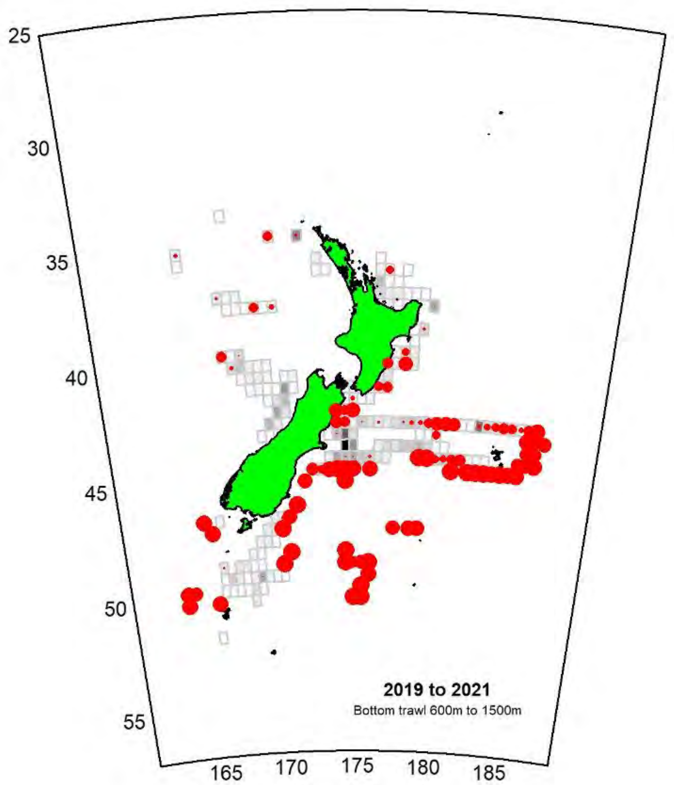


Figure 36.10 (cont.): Maps of smooth oreo occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

SOR

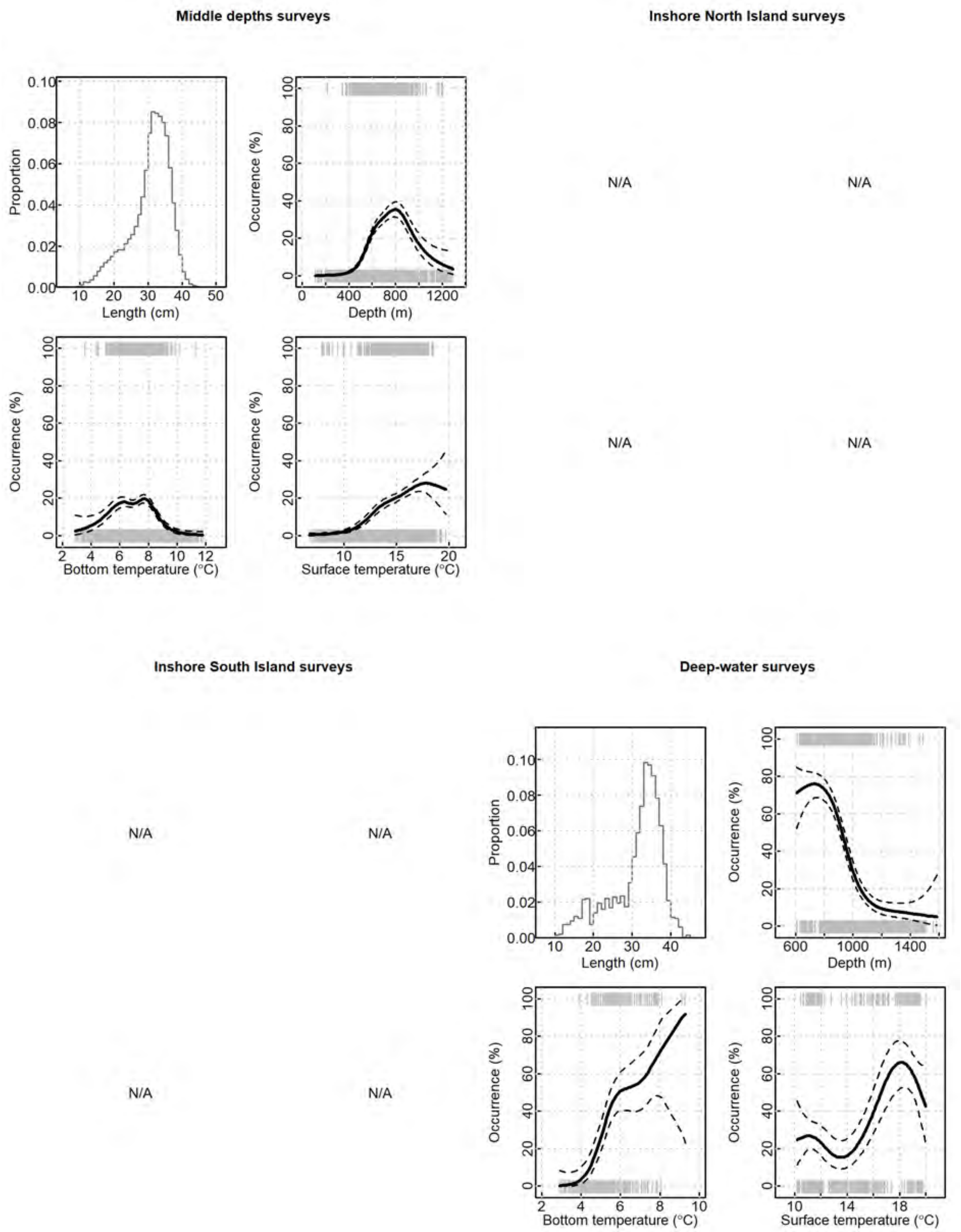


Figure 36.11: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to spiky oreo occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

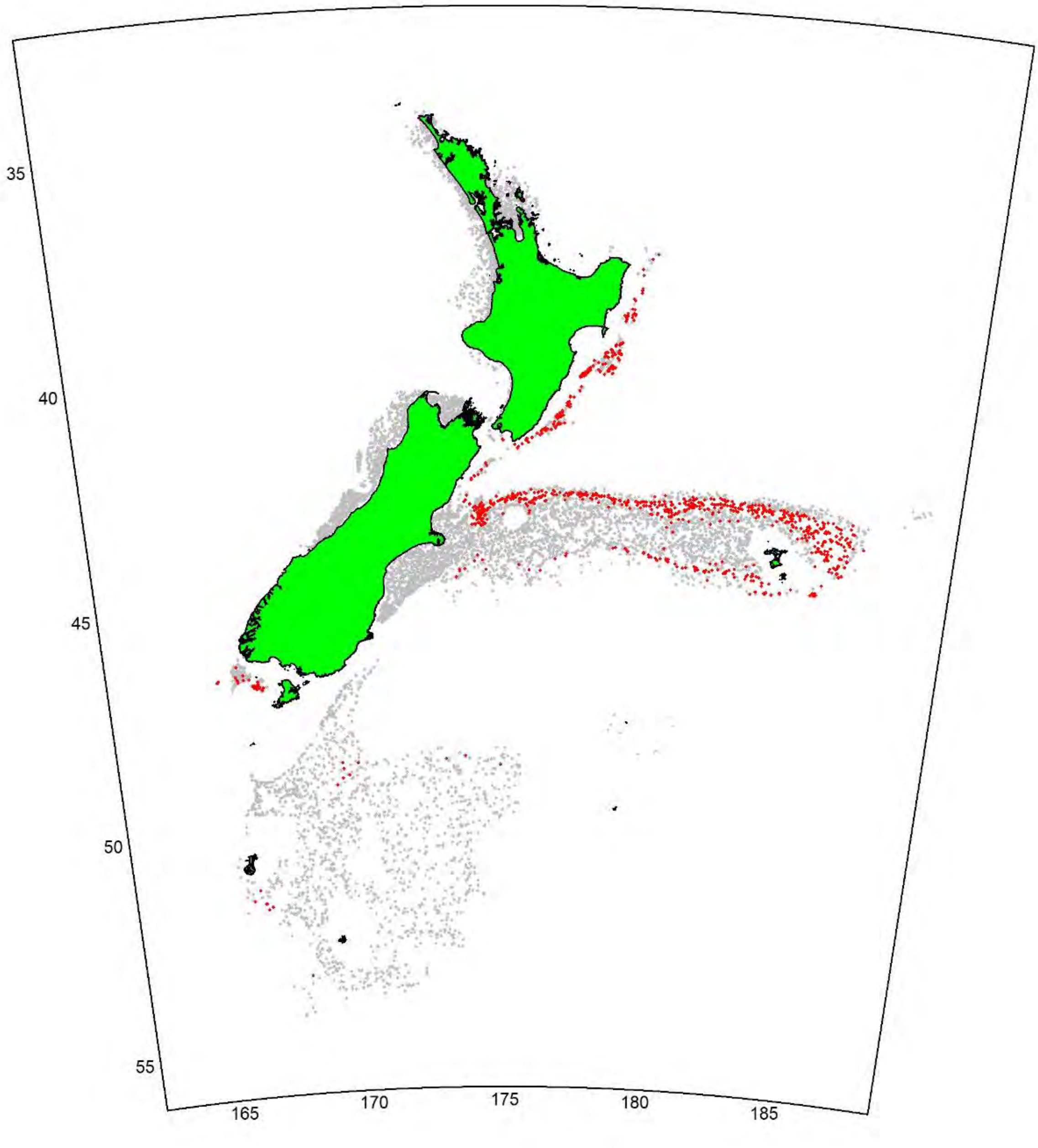


Figure 36.12: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where spiky oreo was caught (red points).

WOE

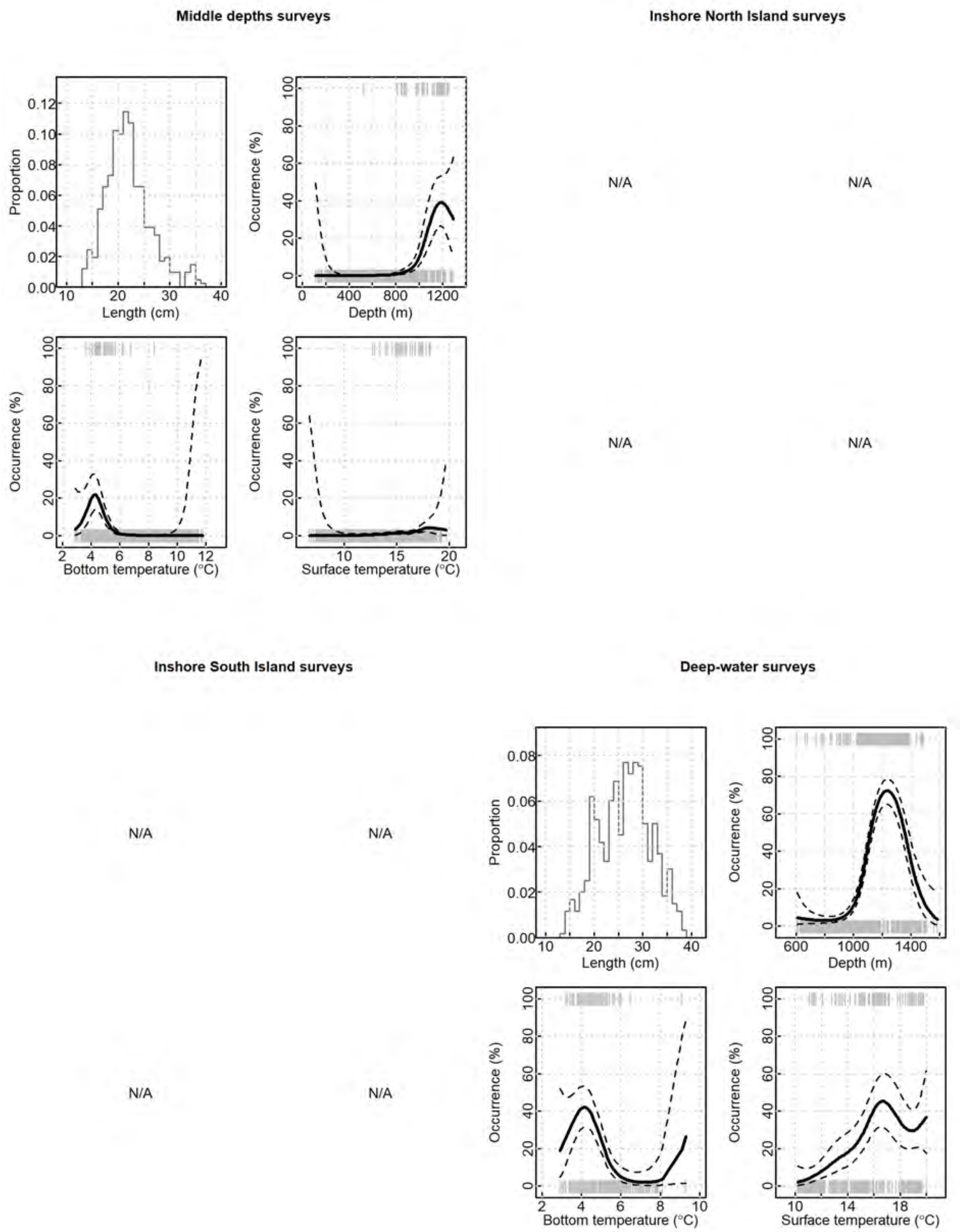


Figure 36.13: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to warty oreo occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

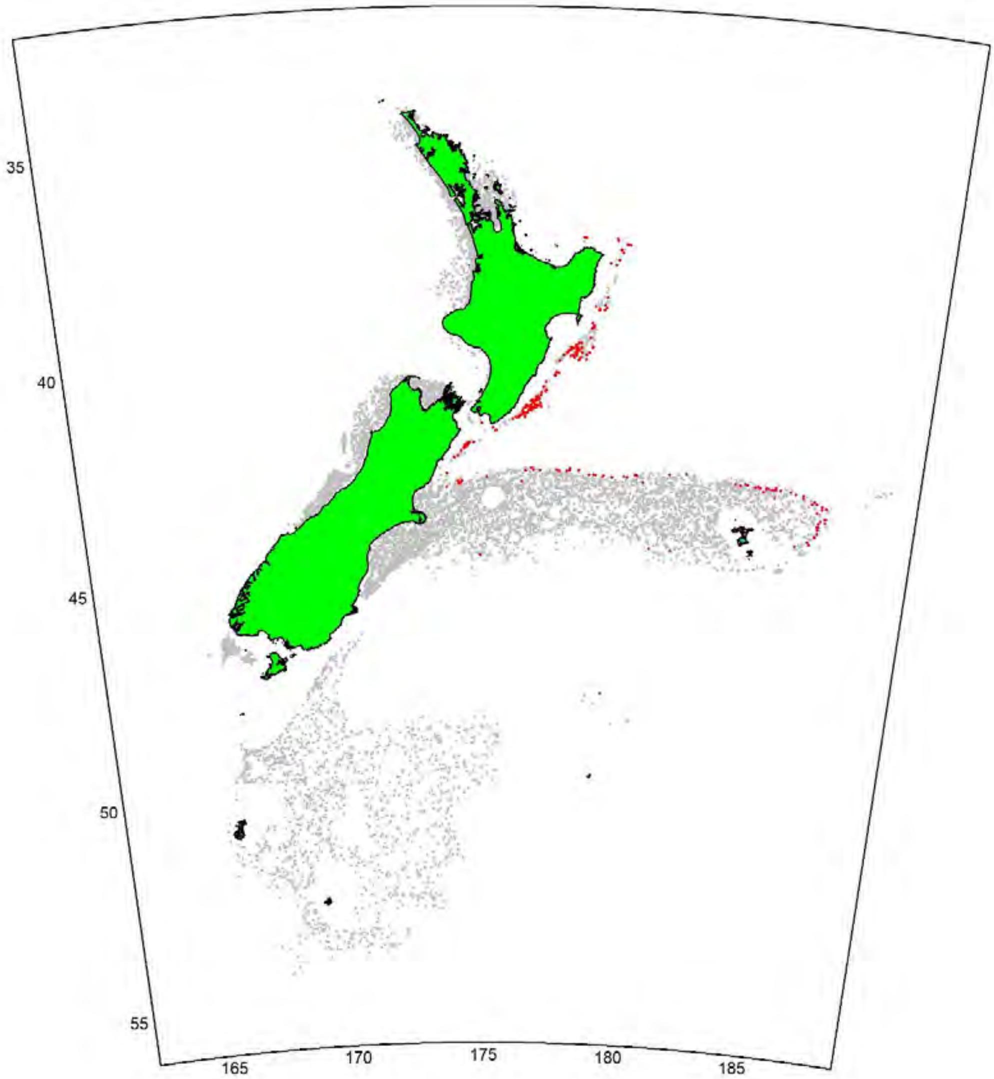


Figure 36.14: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where warty oreo was caught (red points).

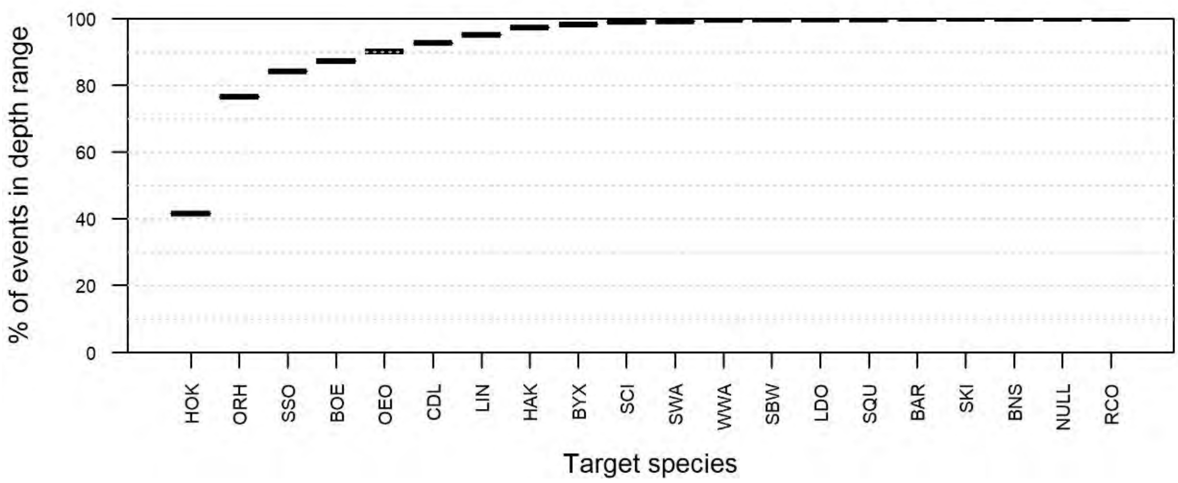
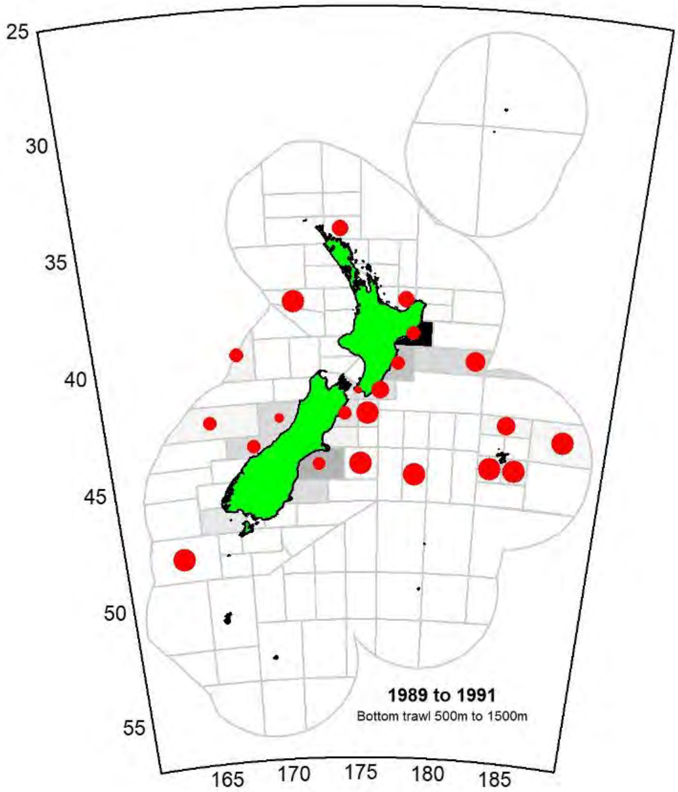


Figure 36.15: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for oreos (500–1500 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.



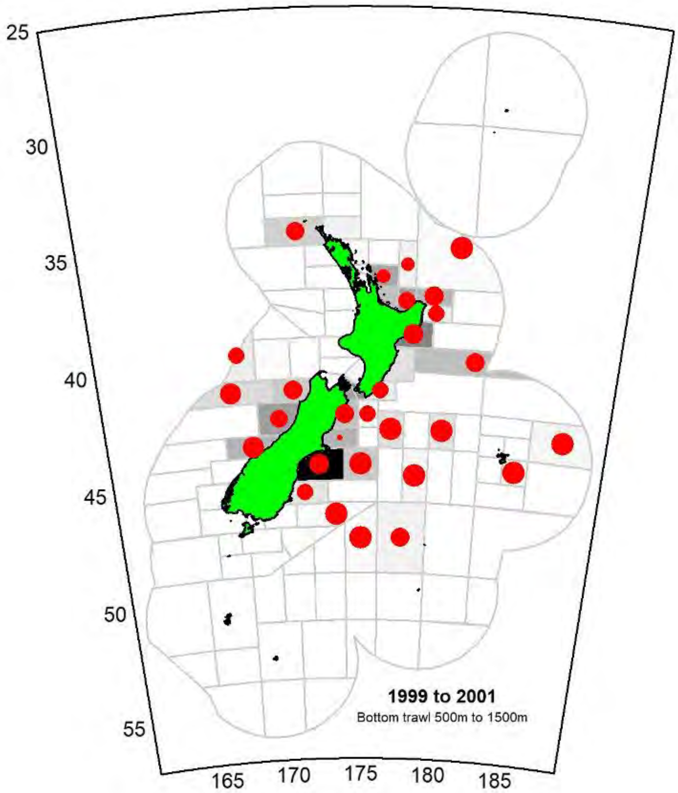


Figure 36.16: Maps of oreos occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

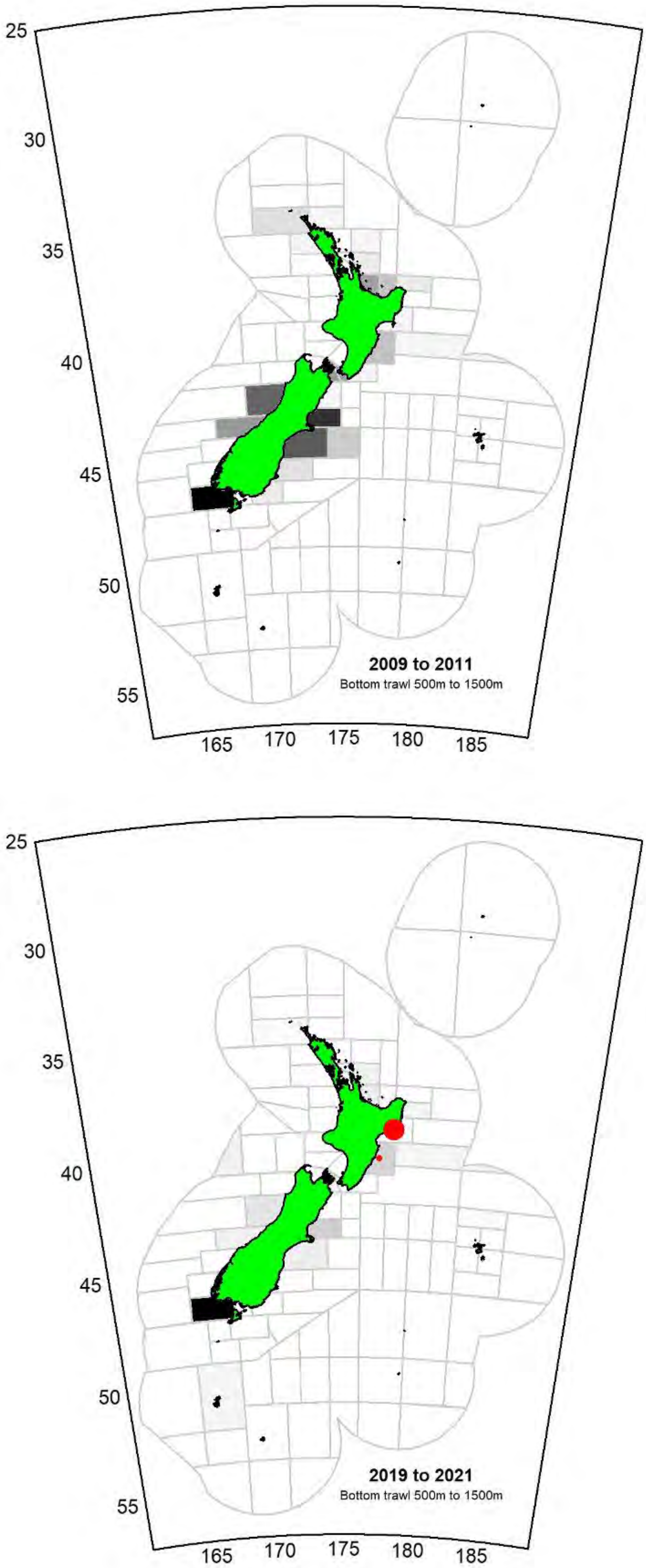


Figure 36.16 (cont.): Maps of oreos occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

37. Parore (PAR)

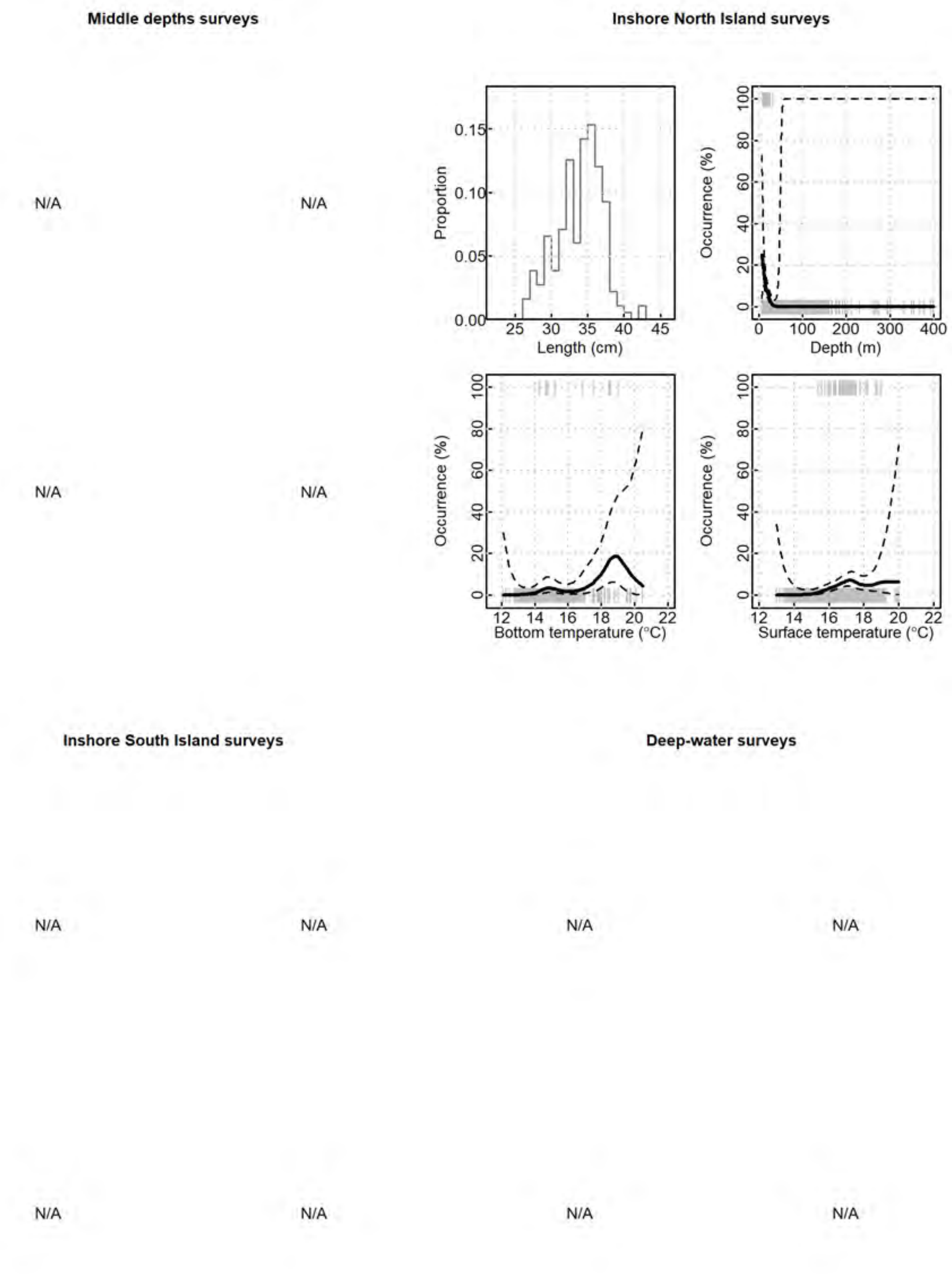


Figure 37.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to parore occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

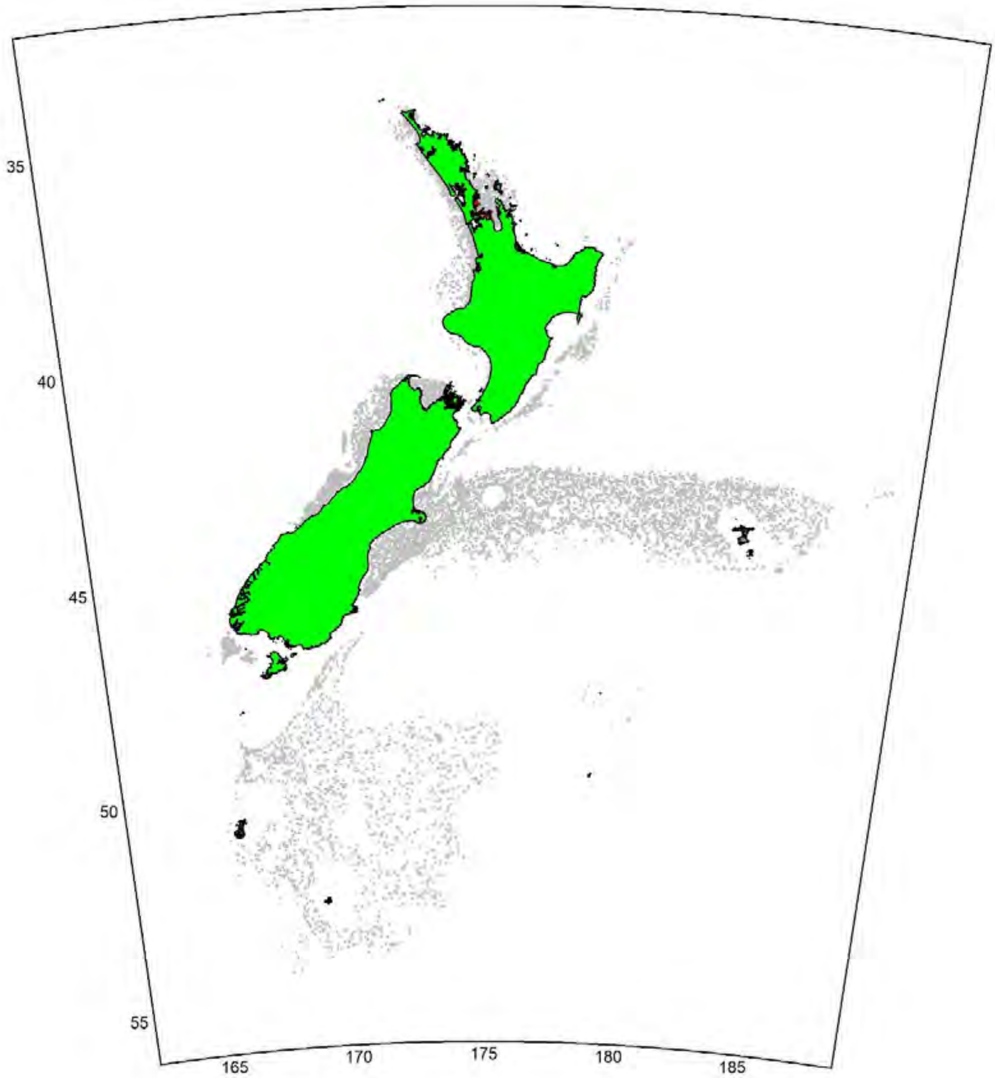


Figure 37.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where parore was caught (red points).

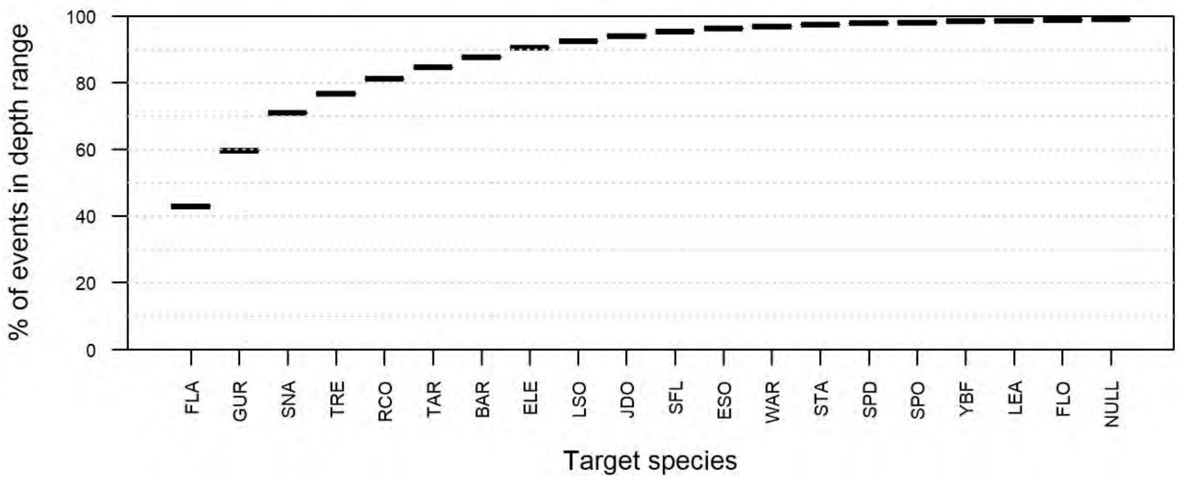
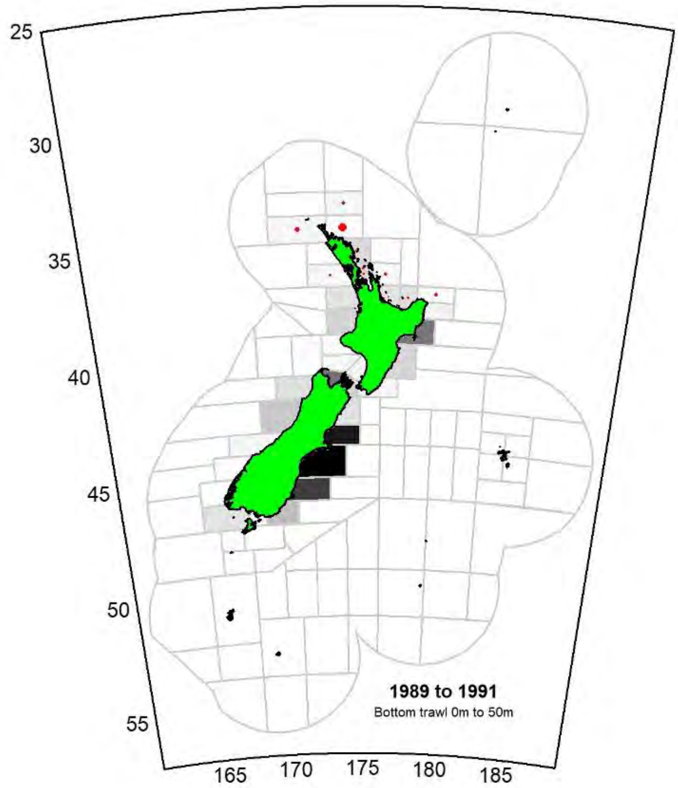


Figure 37.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for parore (0–50 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.



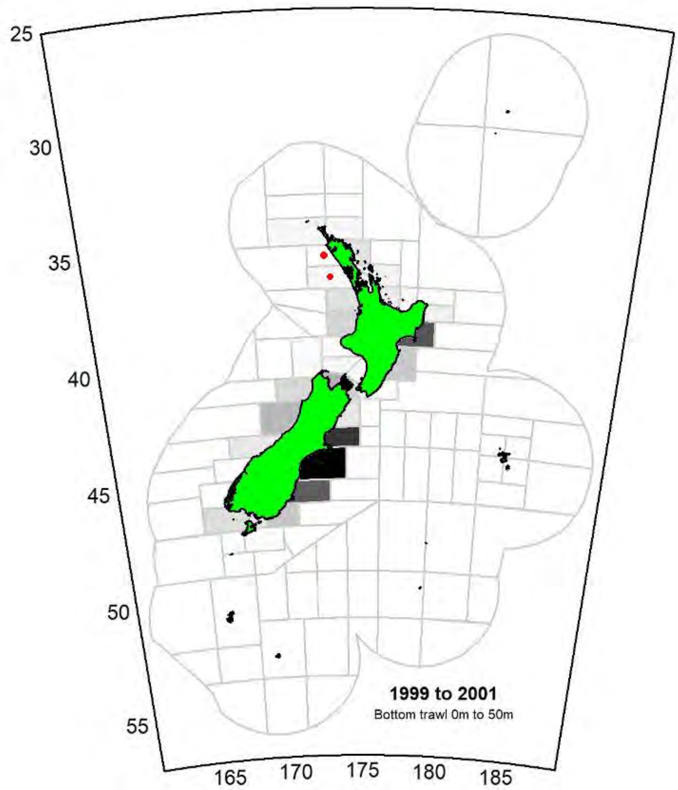
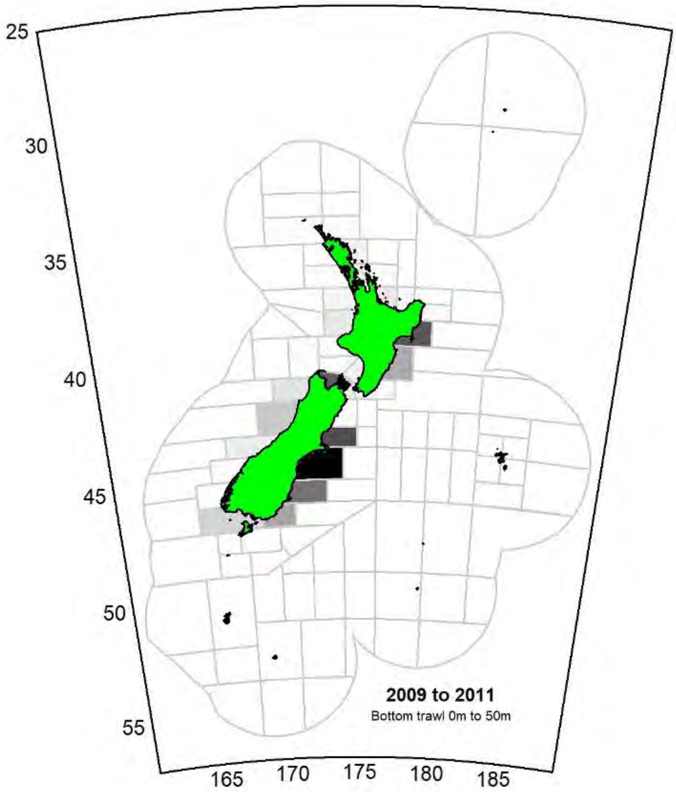


Figure 37.4: Maps of parore occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



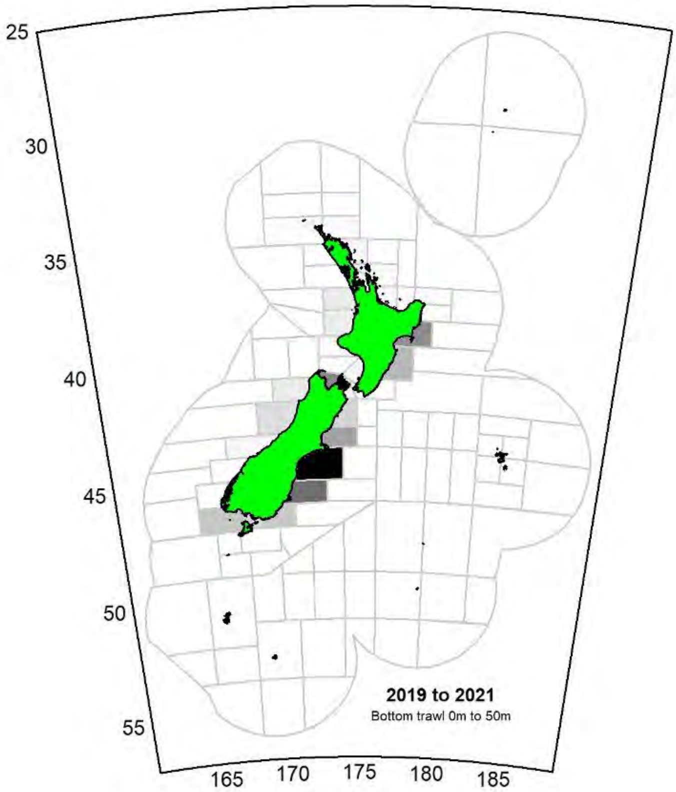


Figure 37.4 (cont.): Maps of parore occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

38. Pilchard (PIL)

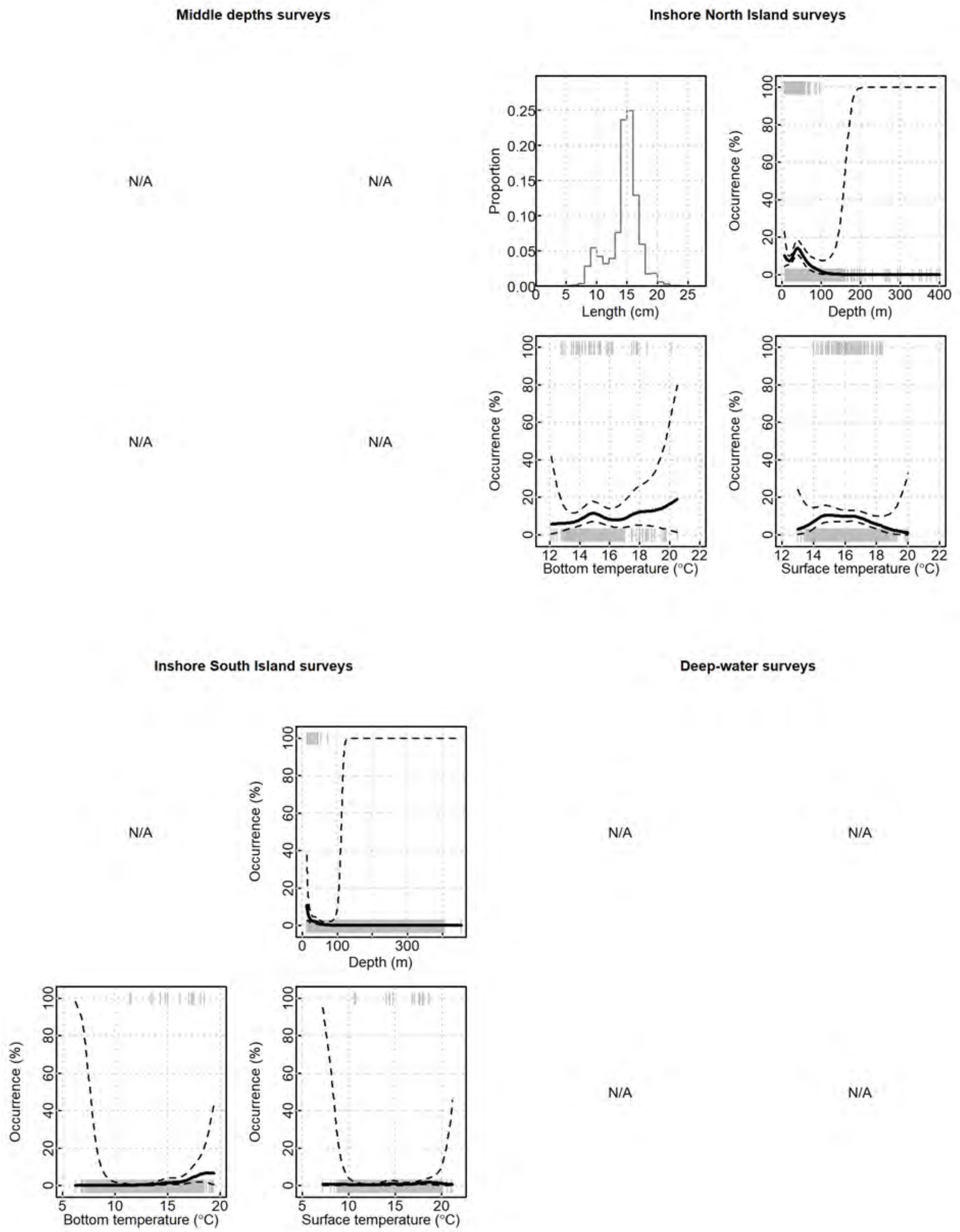


Figure 38.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to pilchard occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

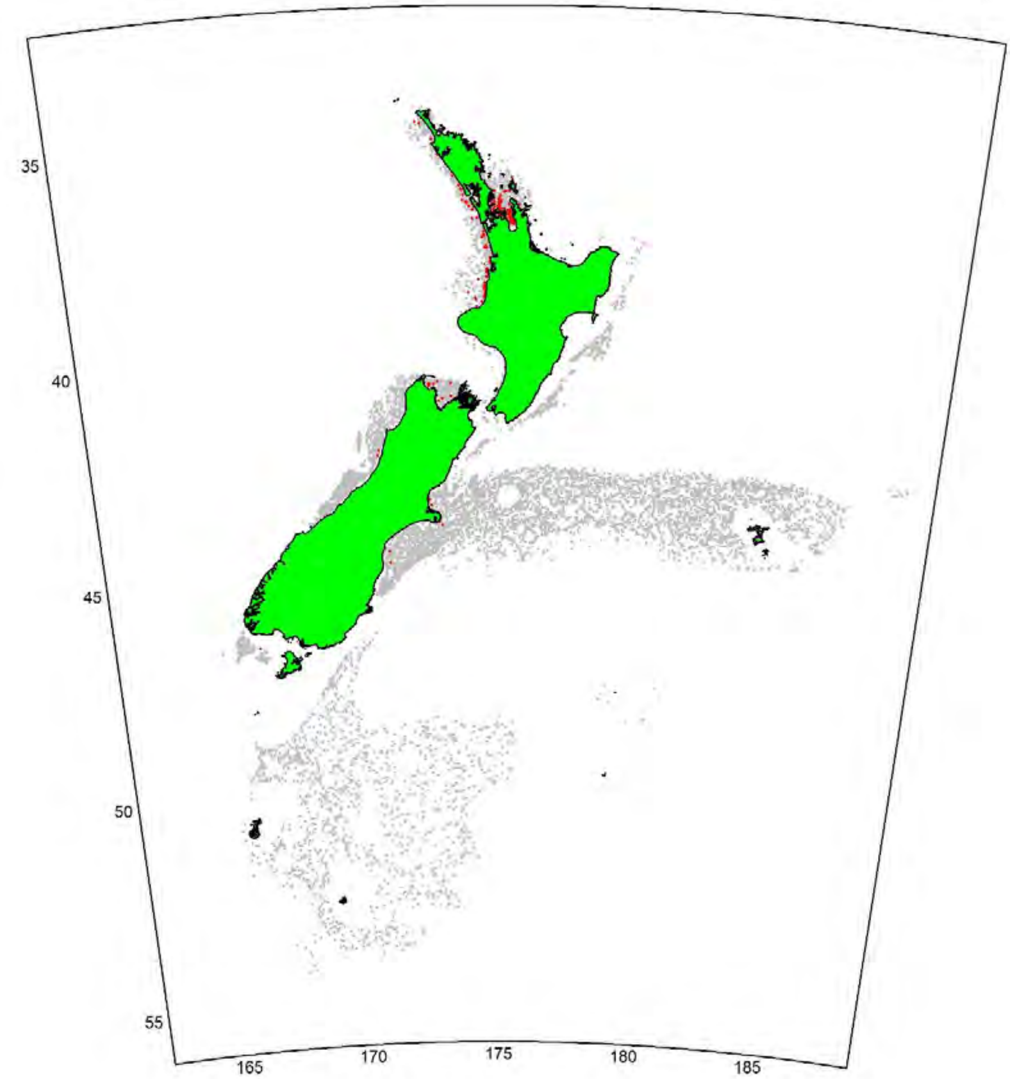


Figure 38.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where pilchard was caught (red points).

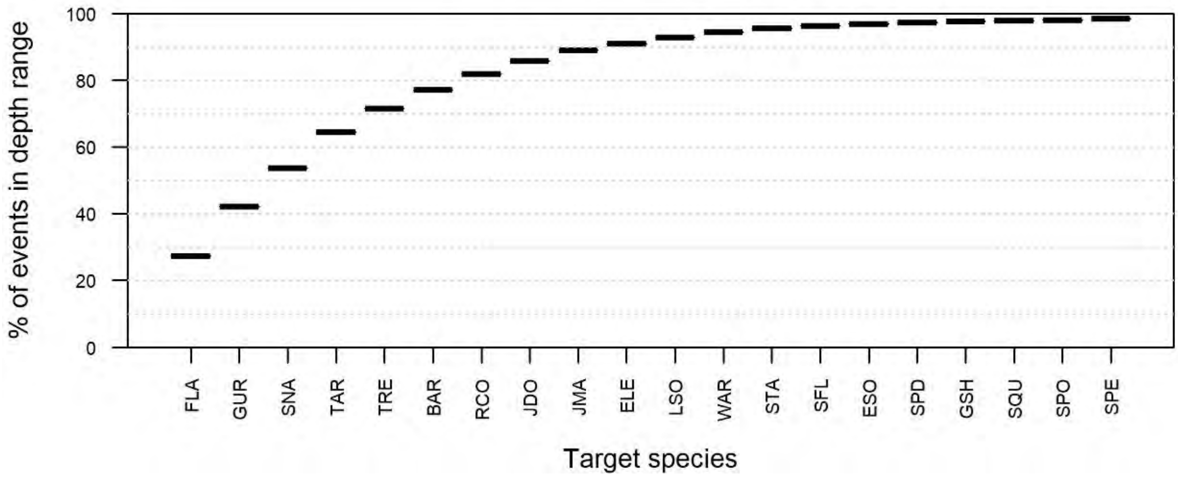


Figure 38.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for pilchard (0–100 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.

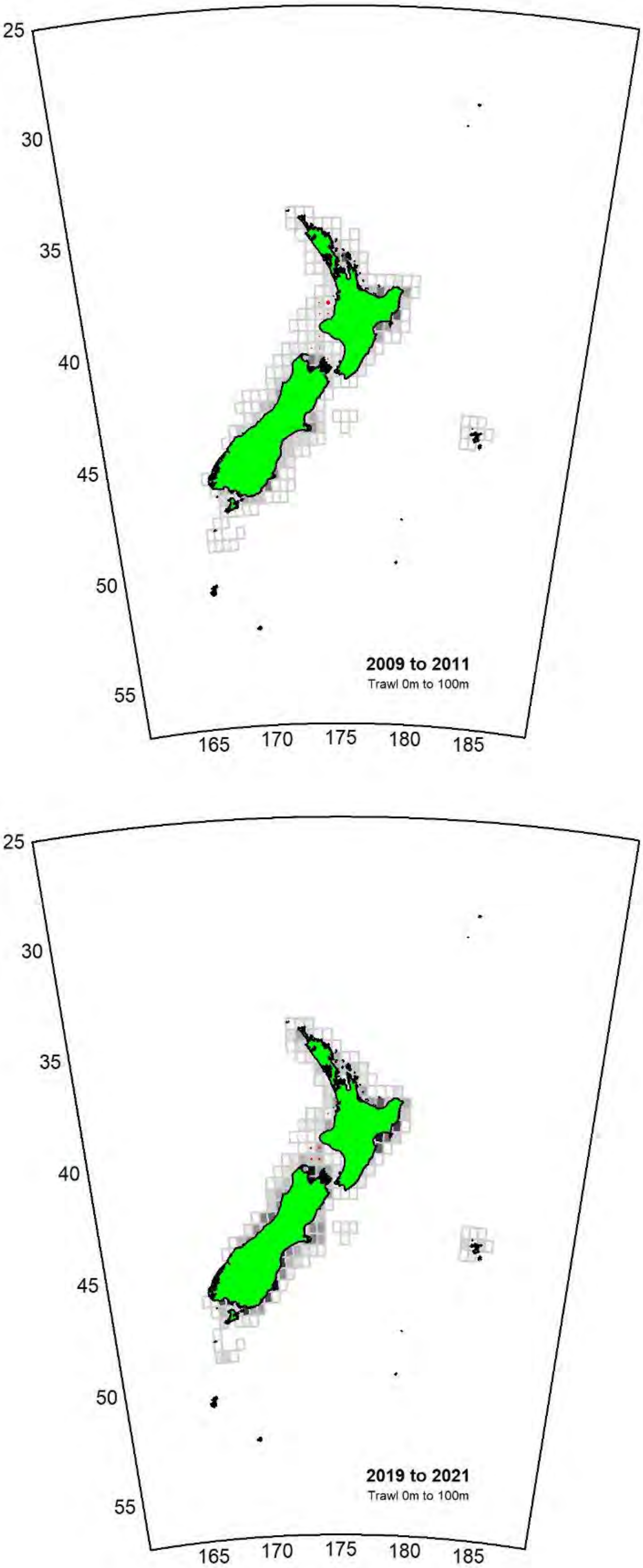


Figure 38.4: Maps of pilchard occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89). Maps included no data for the periods analysed prior to 2009–11 and when analysed by statistical area.

39. Pōrae (POR)

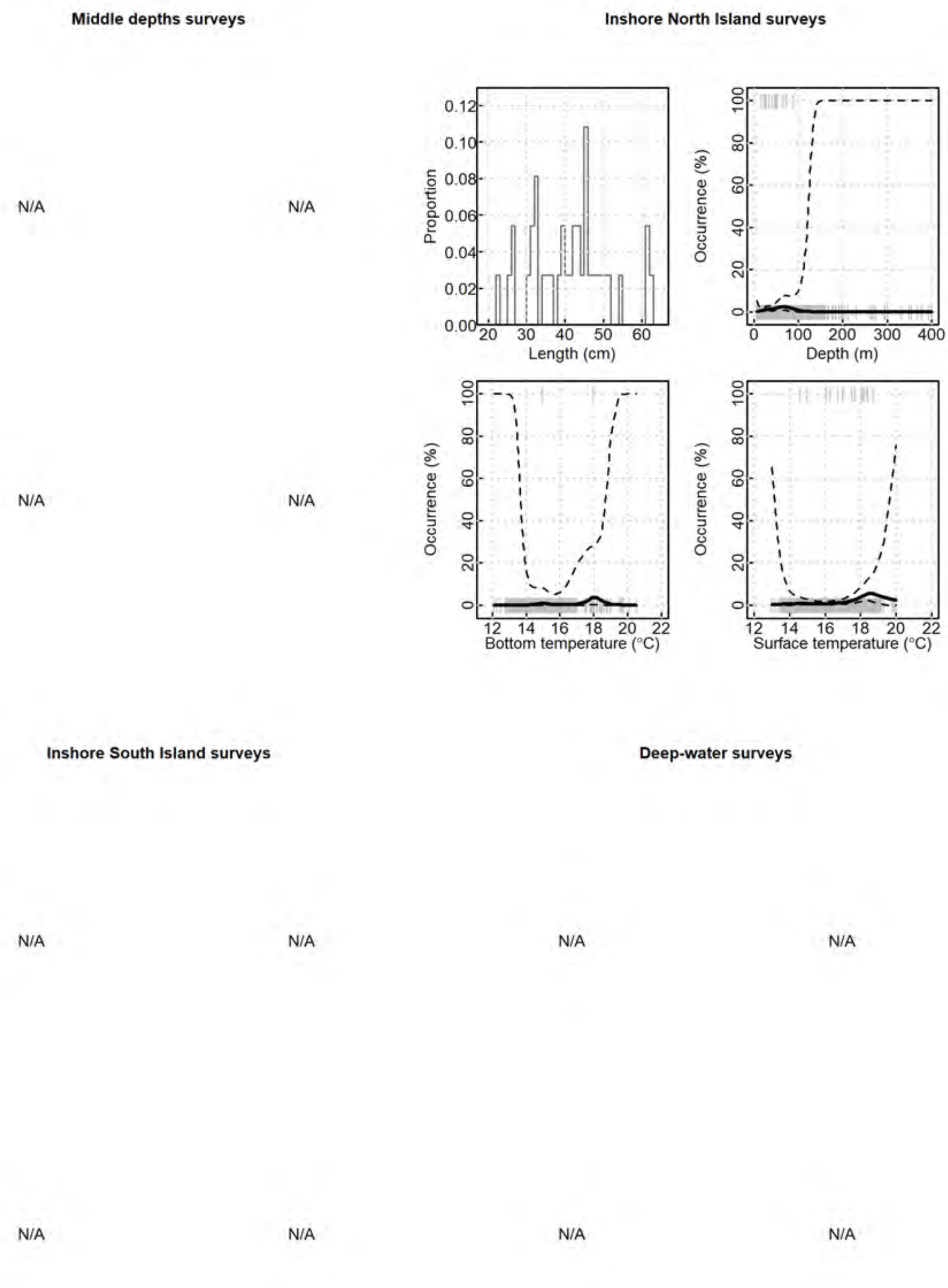


Figure 39.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to pōrae occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

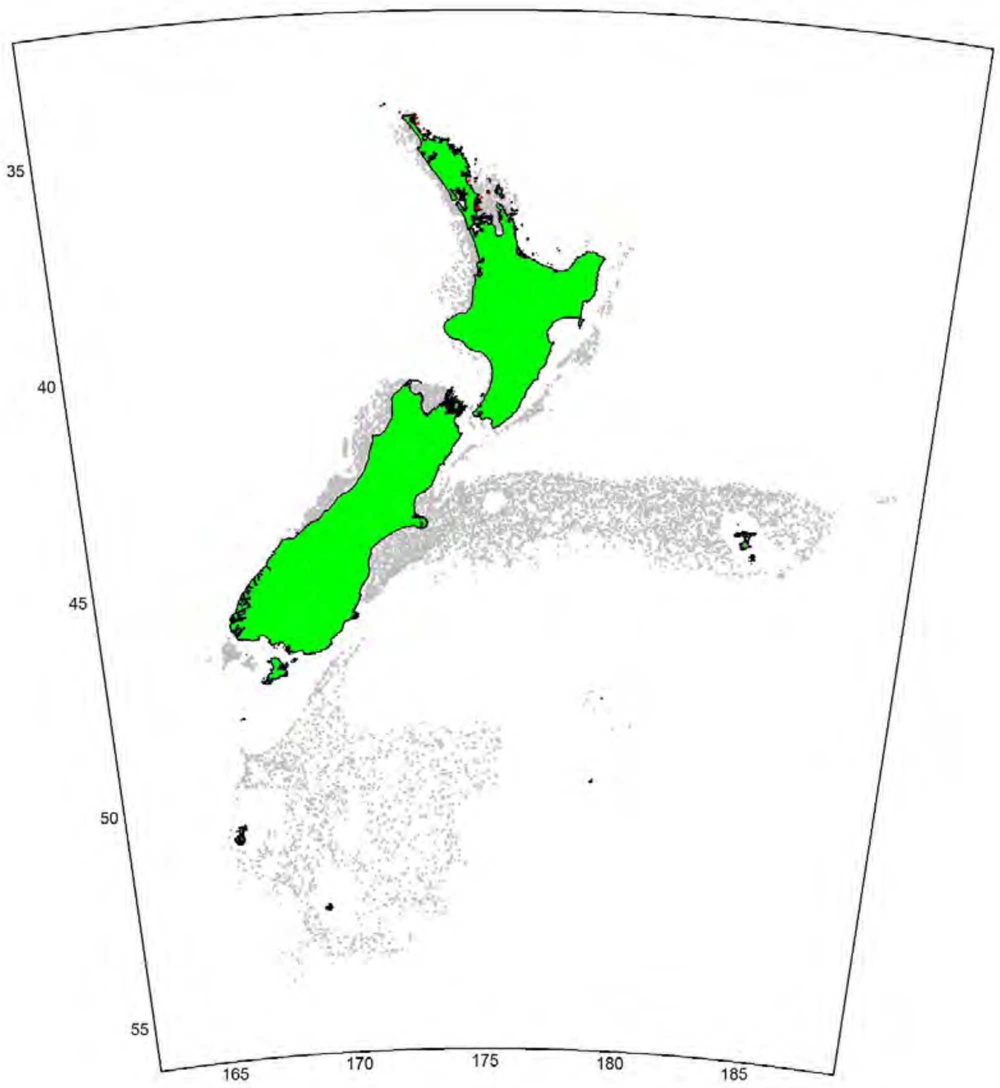


Figure 39.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where pōrae was caught (red points).

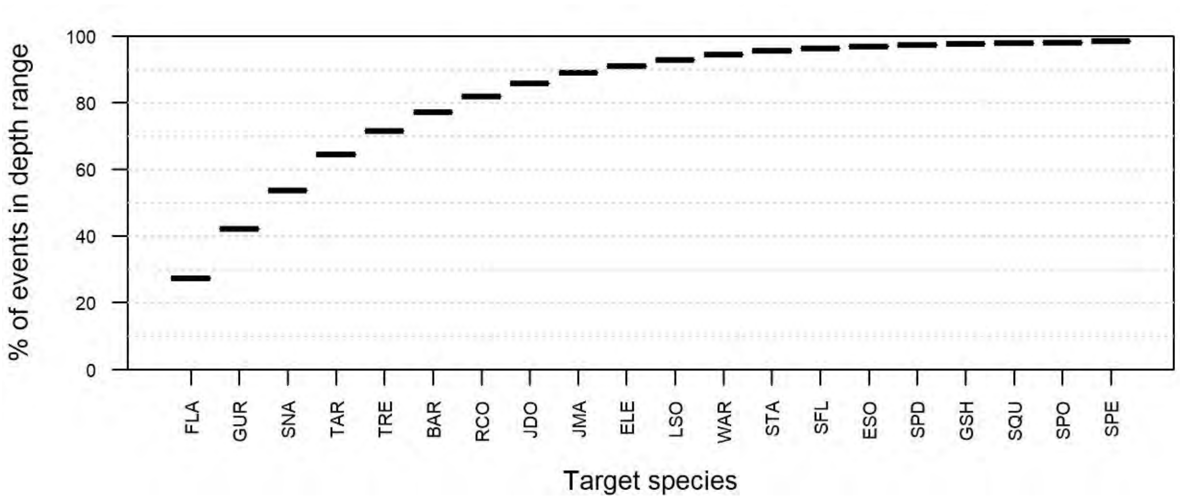


Figure 39.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for pōrae (0–100 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.

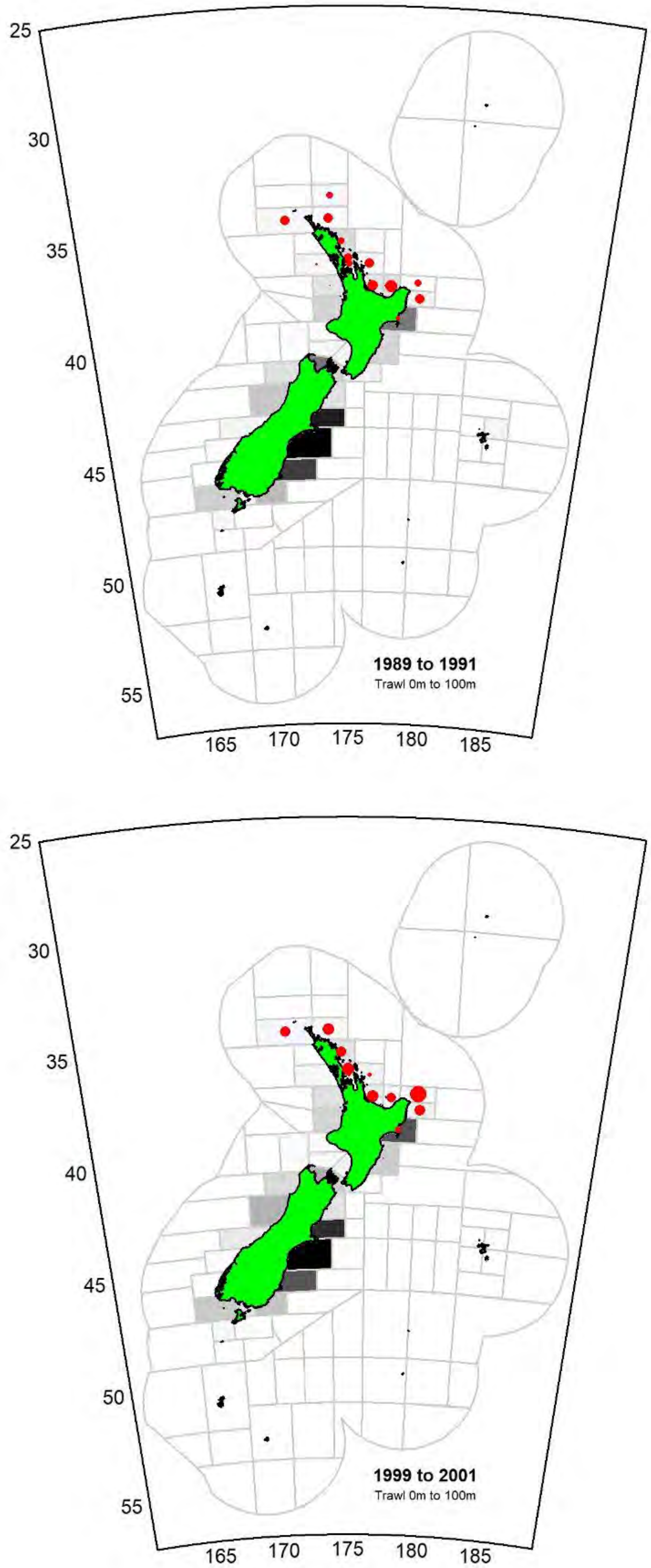
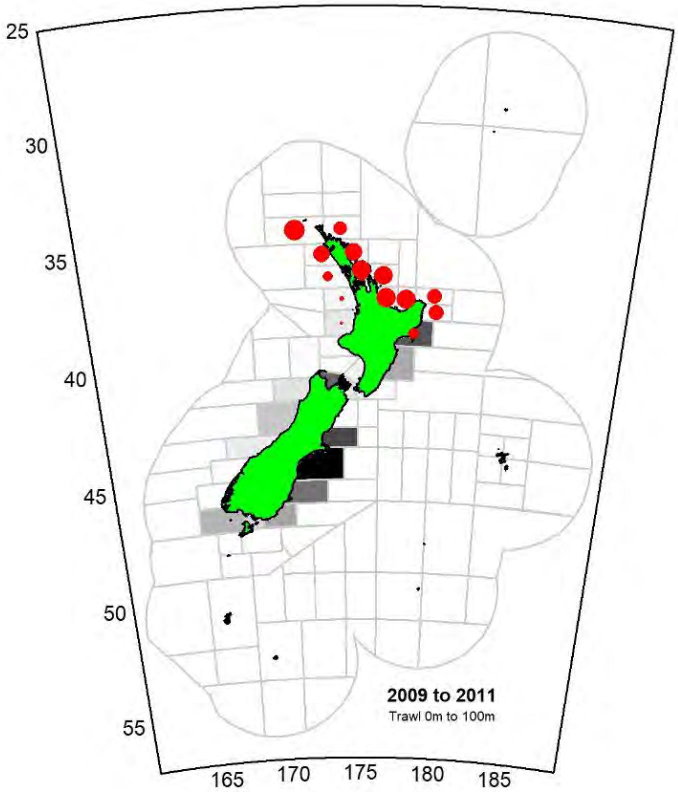


Figure 39.4: Maps of pōrae occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



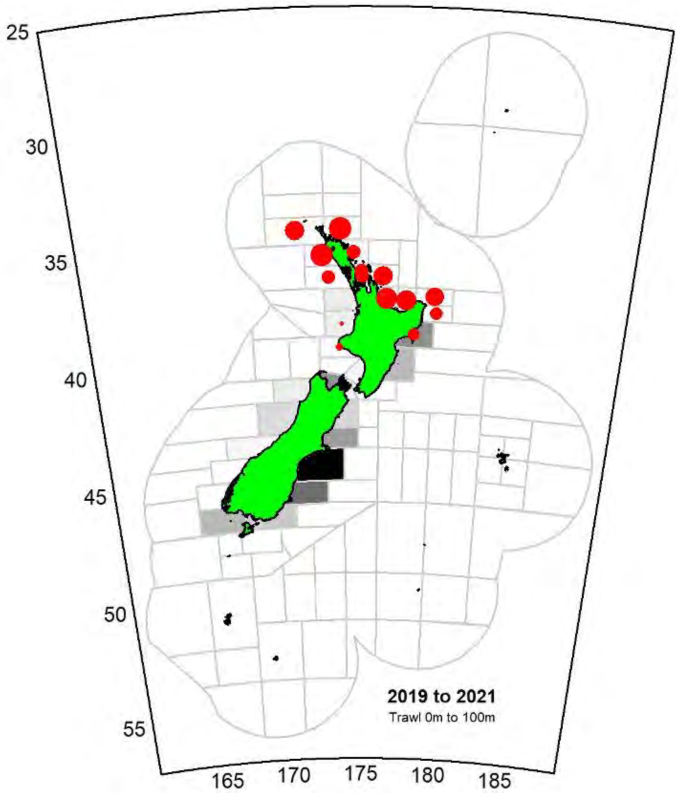
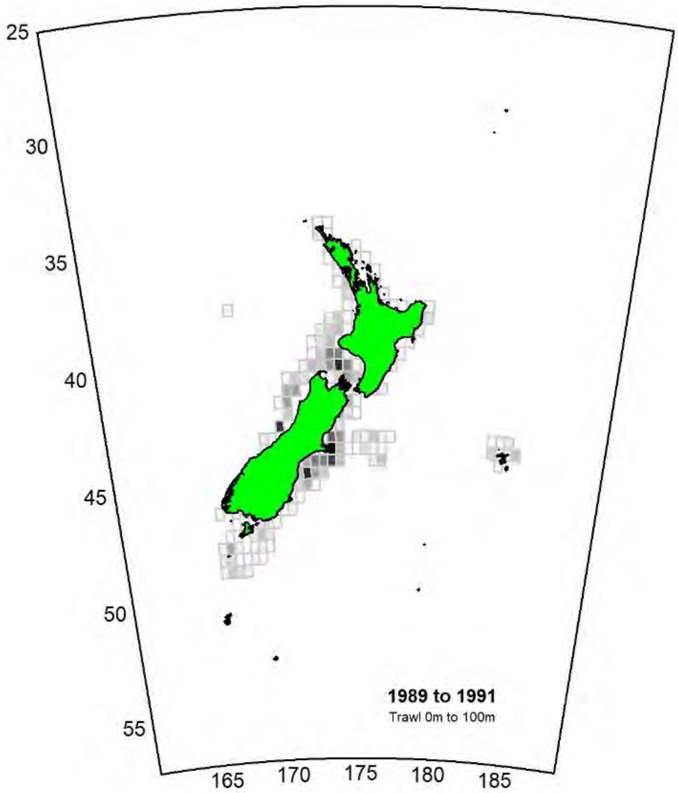


Figure 39.4 (cont.): Maps of pōrae occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



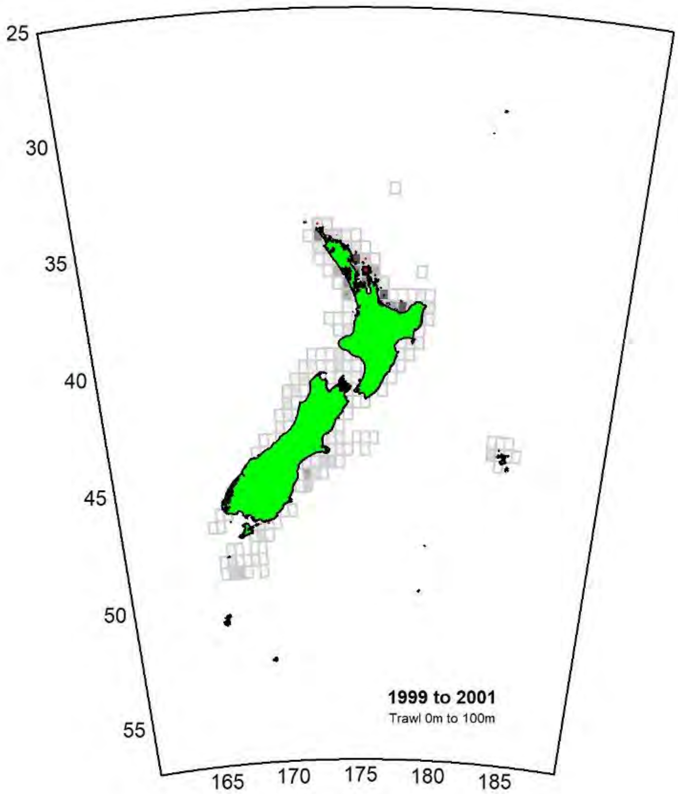
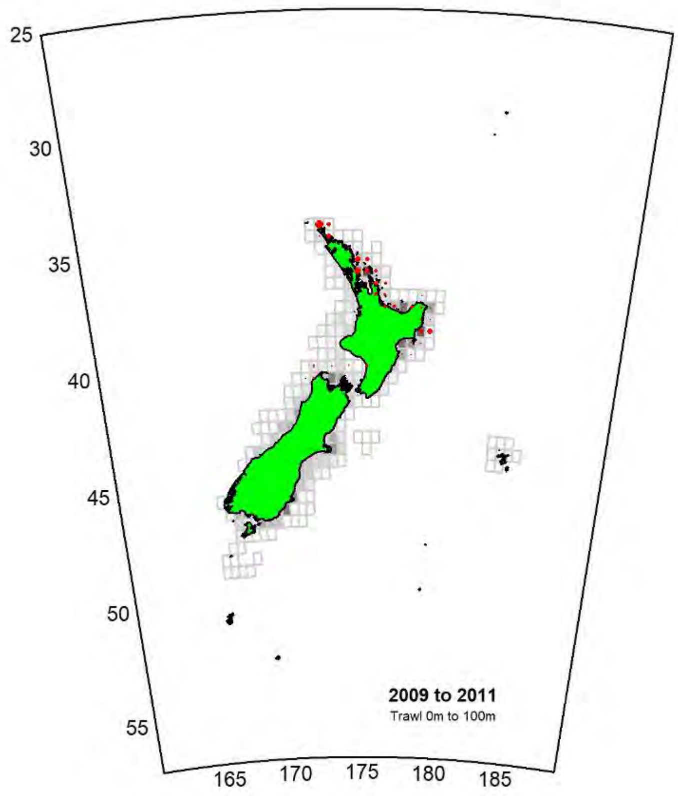


Figure 39.5: Maps of pōrae occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



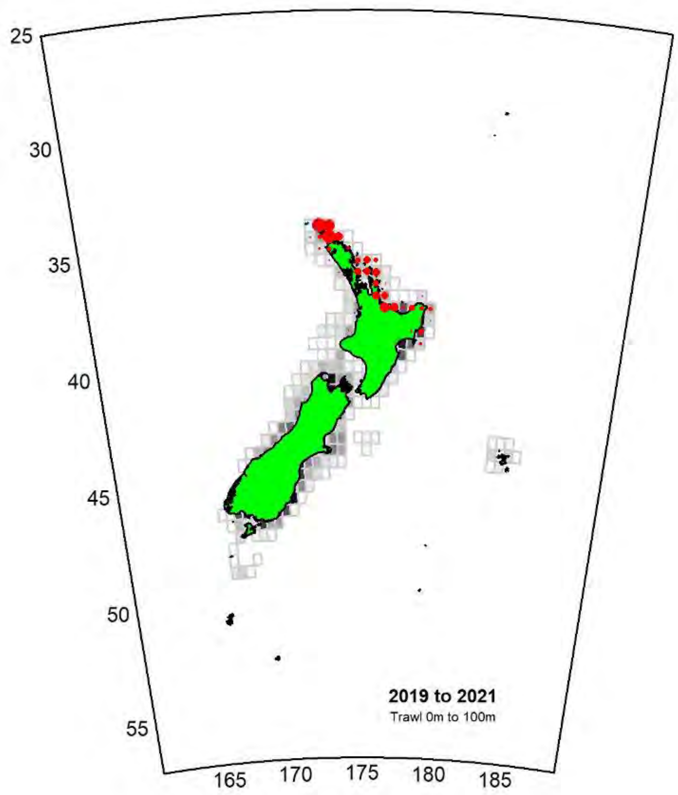


Figure 39.5 (cont.): Maps of pōrae occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

40. Redbait (RBT)

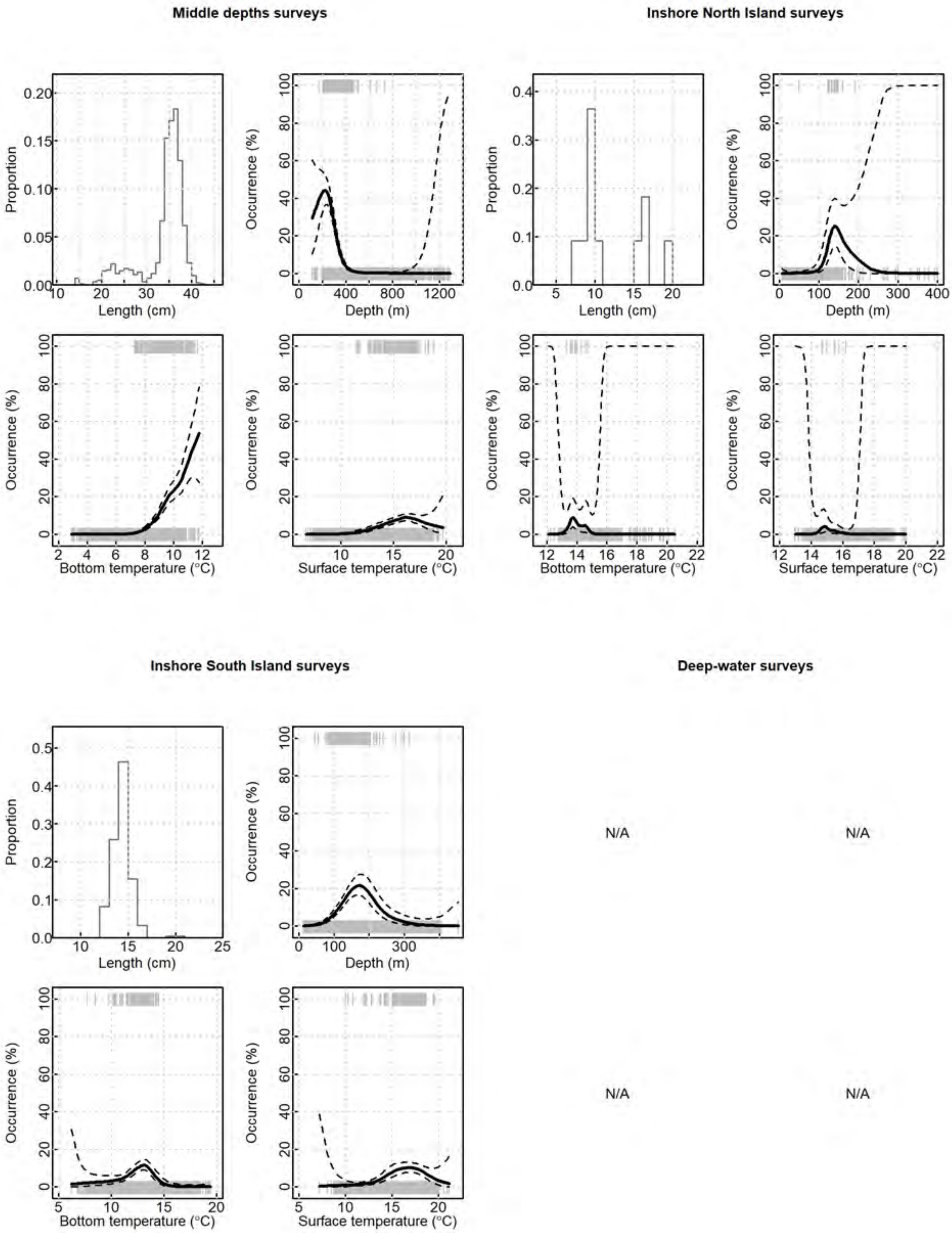


Figure 40.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to redbait occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

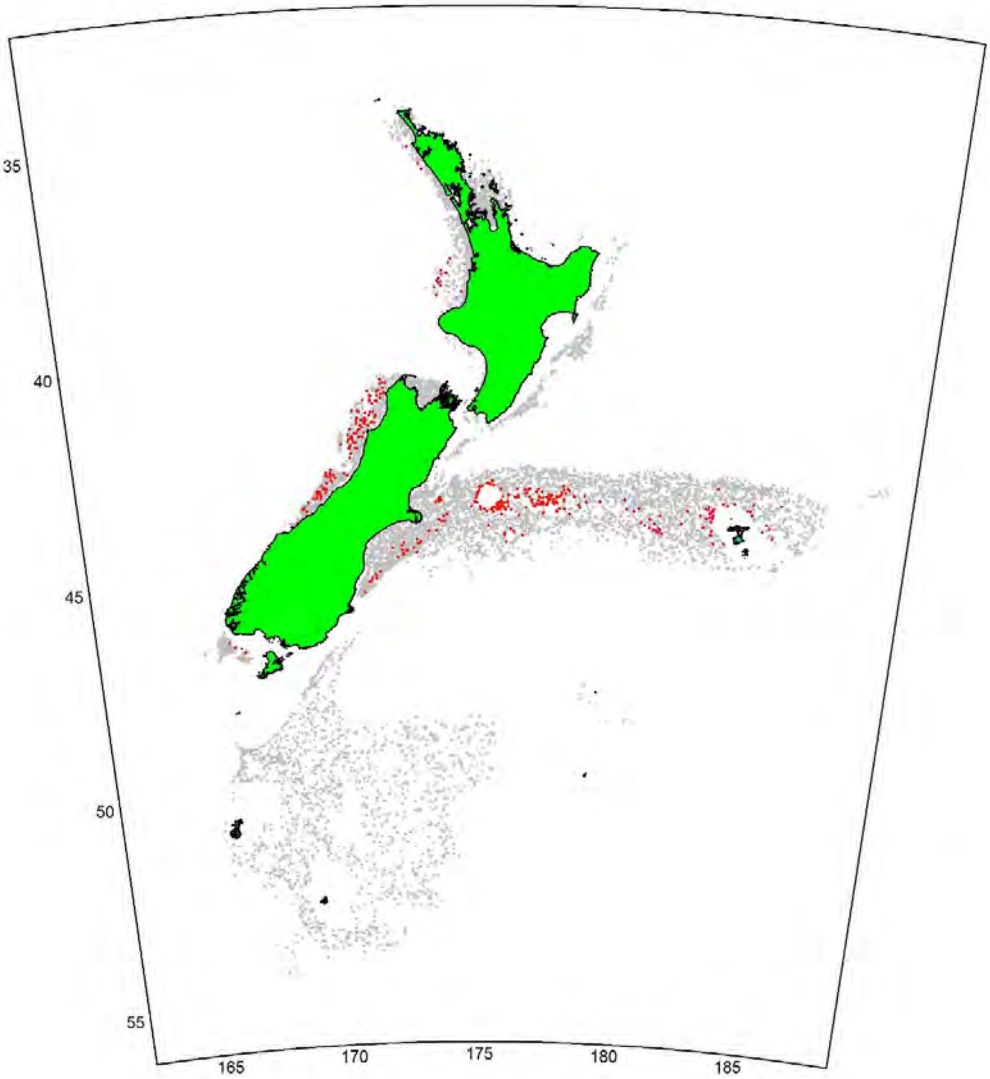


Figure 40.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where redbait was caught (red points).

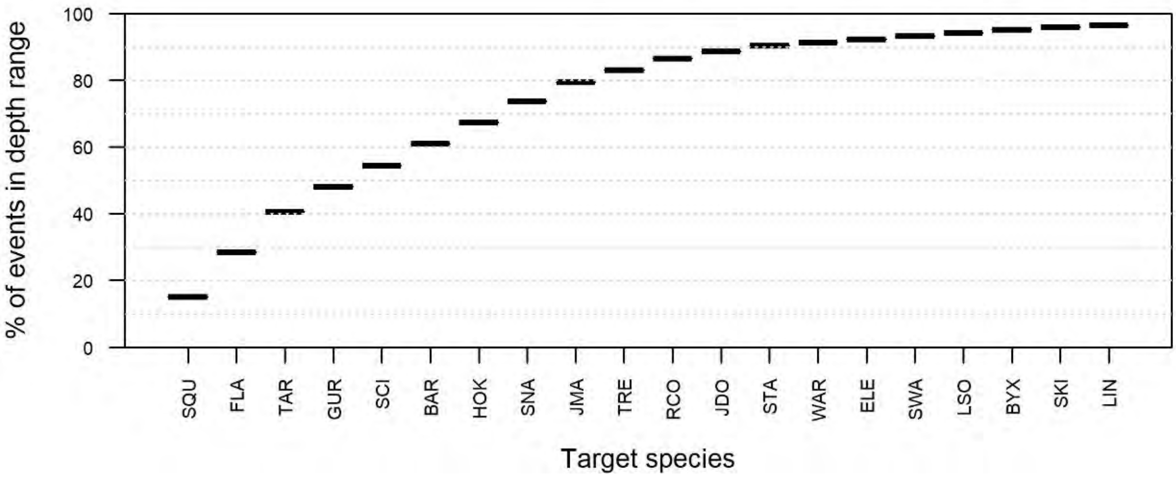
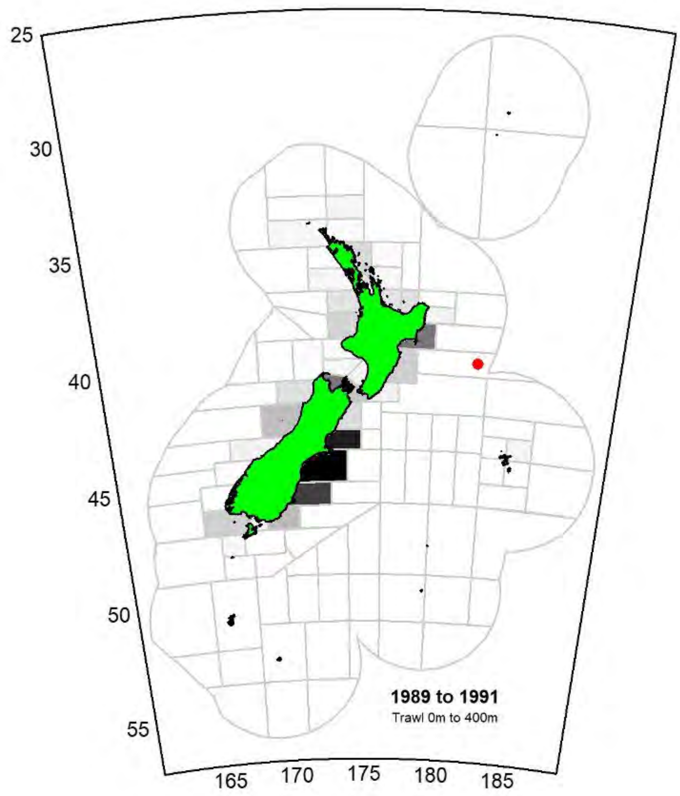


Figure 40.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for redbait (0–400 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.



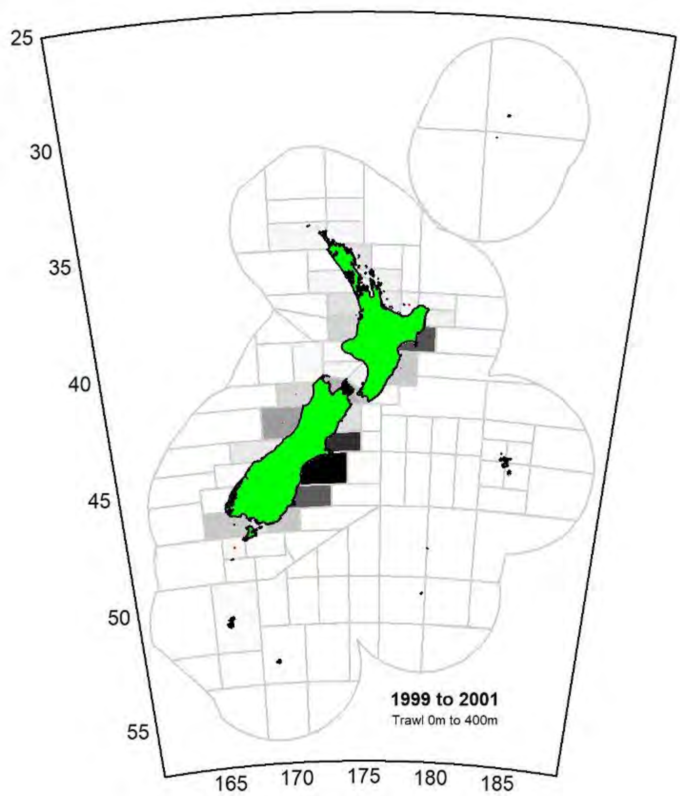
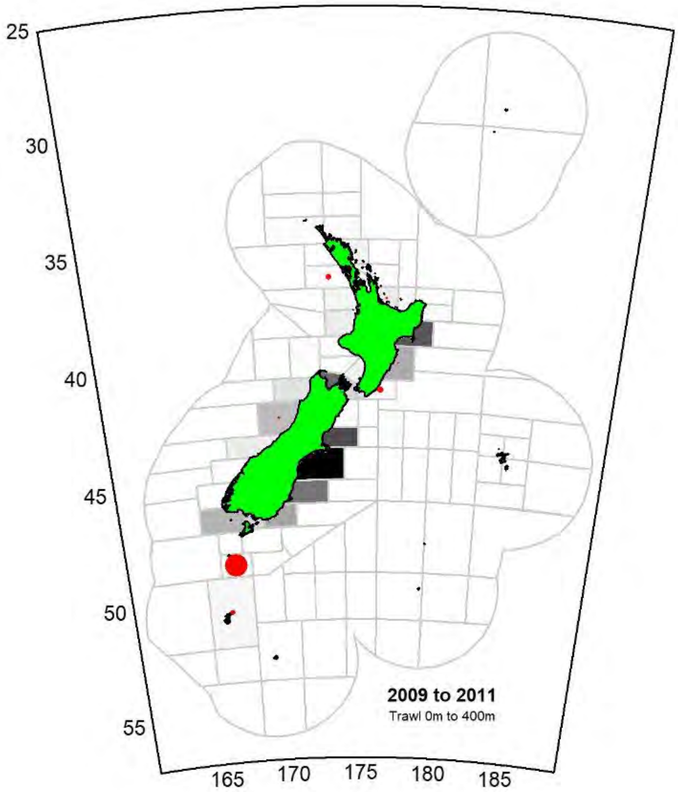


Figure 40.4: Maps of redbait occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



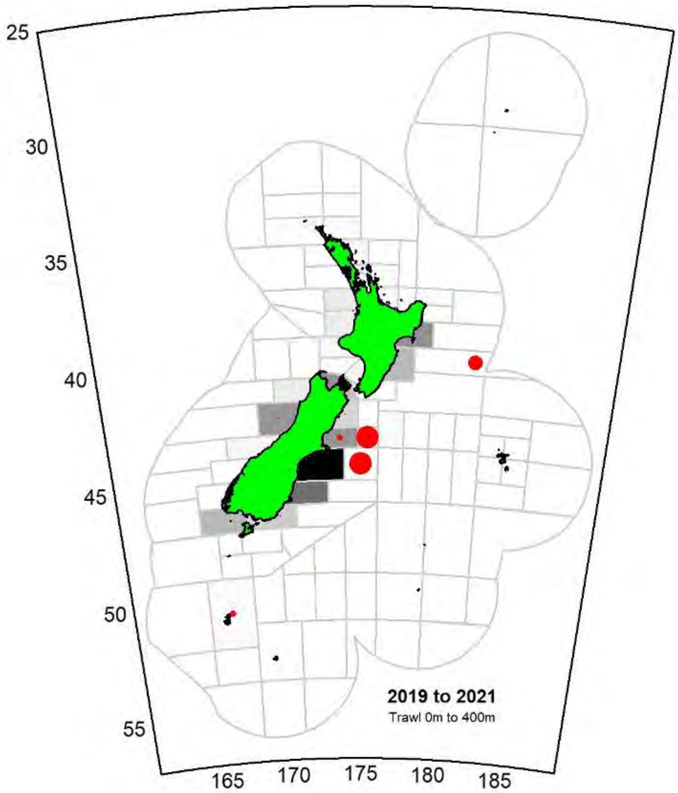
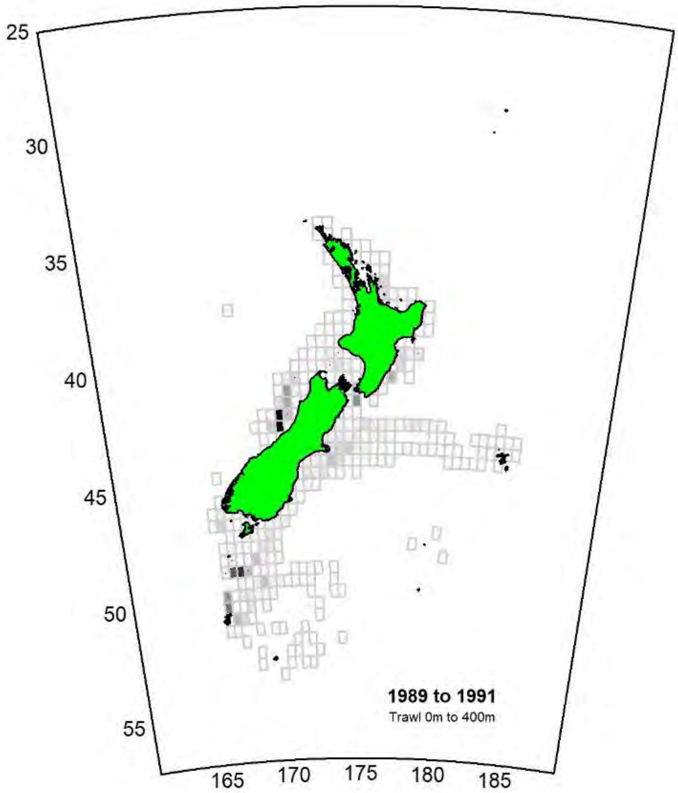


Figure 40.4 (cont.): Maps of redbait occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



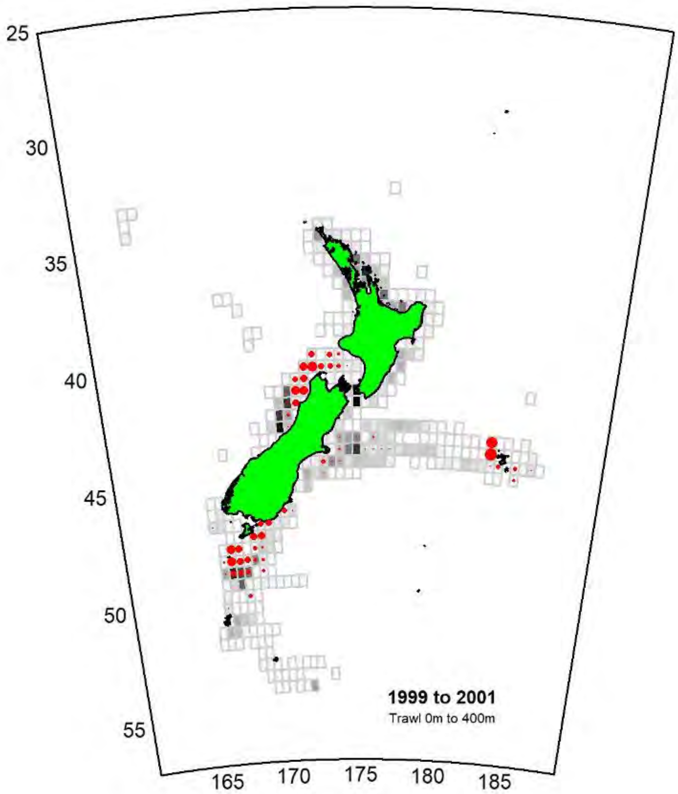


Figure 40.5: Maps of redbait occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

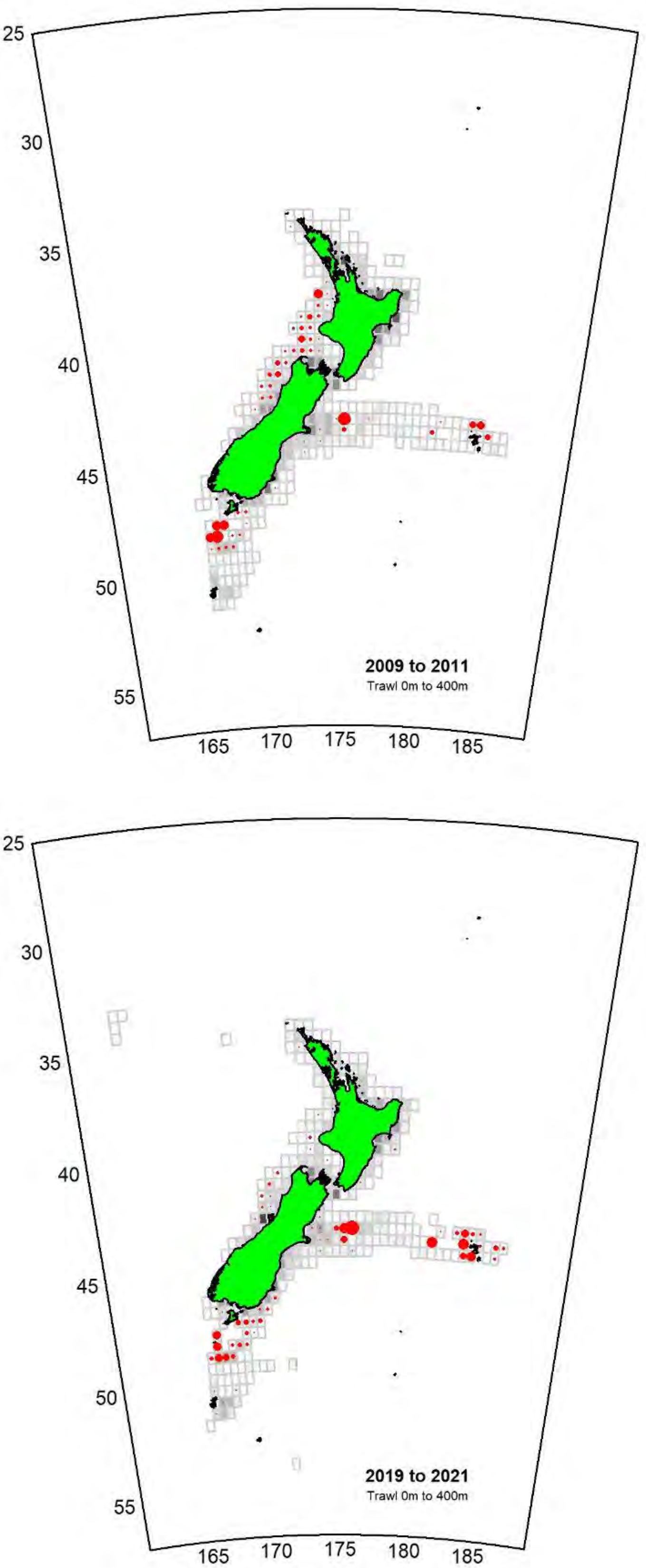


Figure 40.5 (cont.): Maps of redbait occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

41. Red cod (RCO)

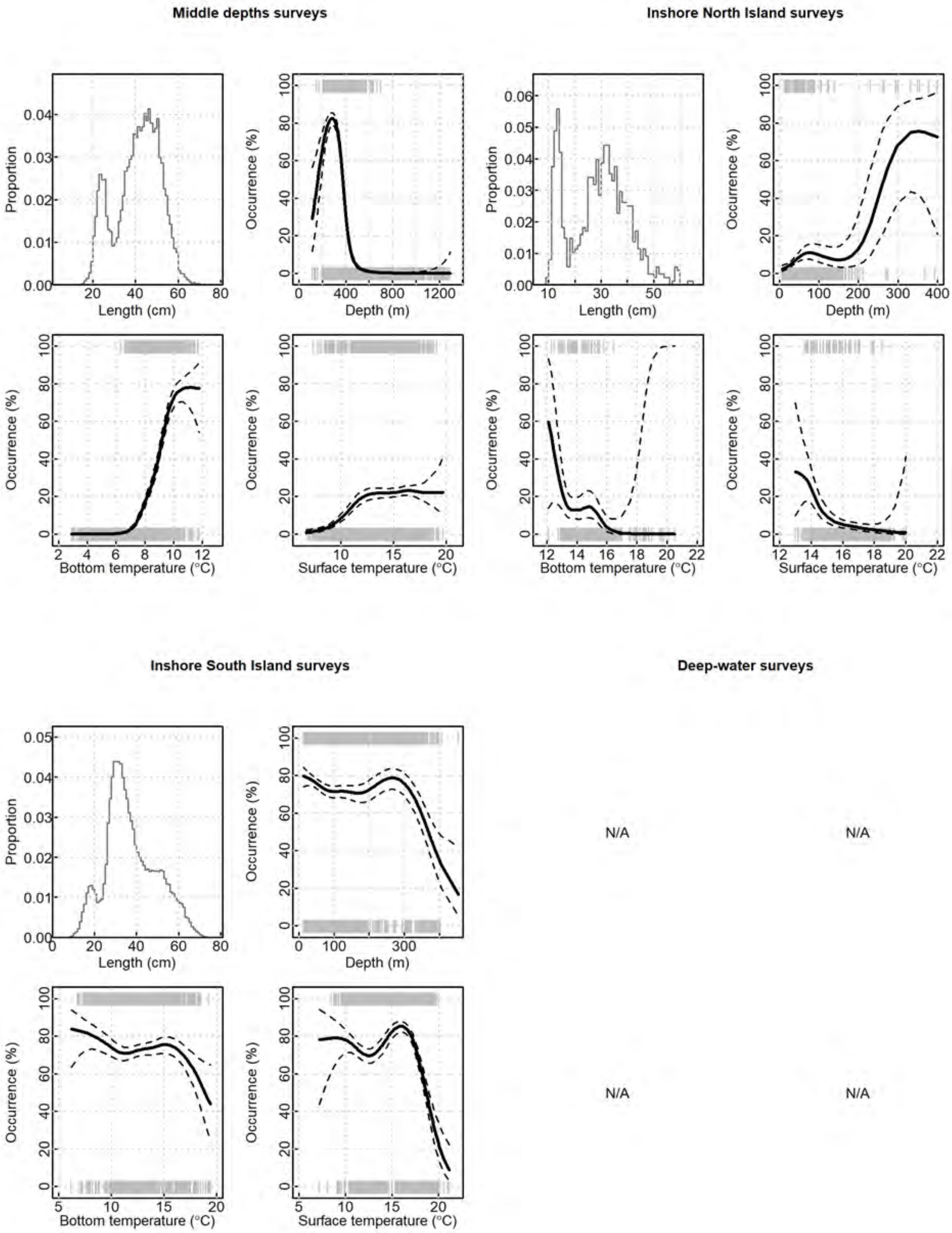


Figure 41.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to red cod occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

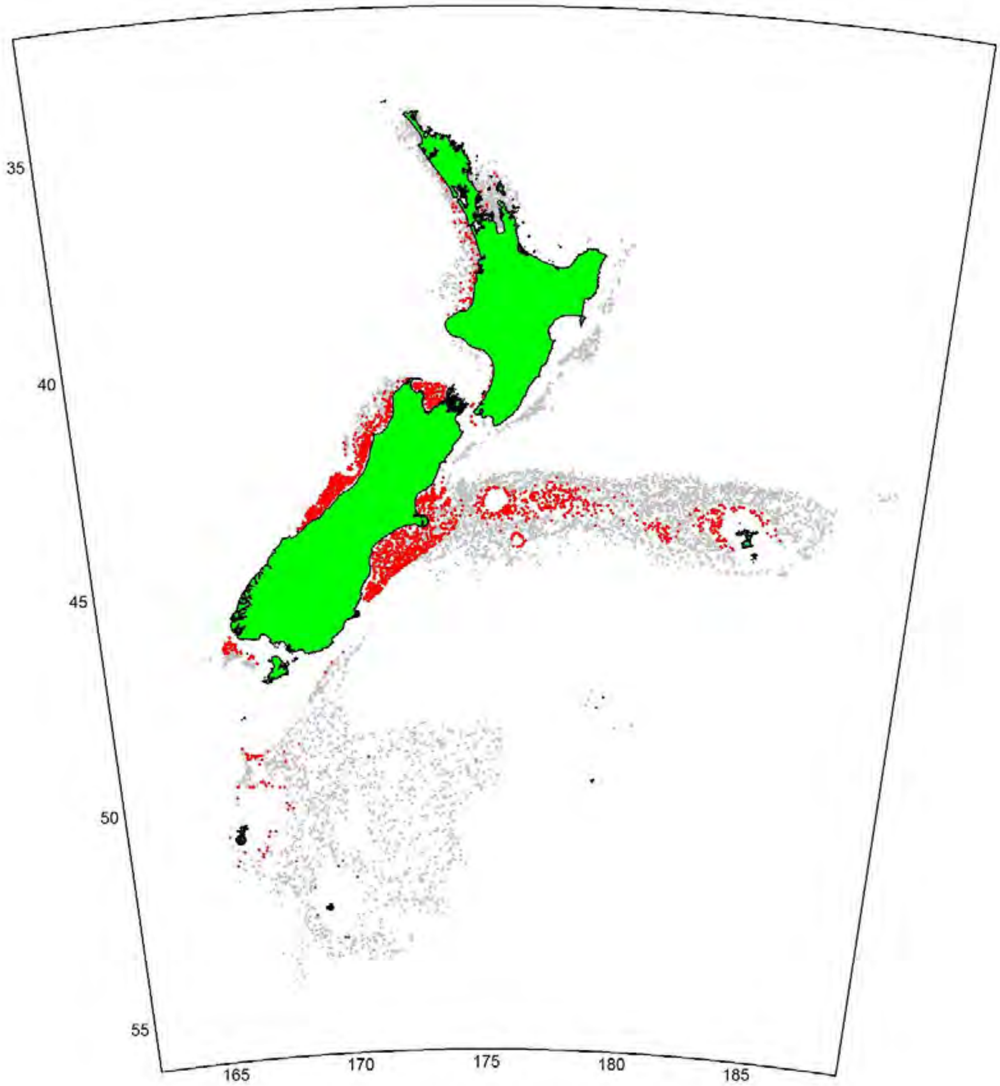


Figure 41.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where red cod was caught (red points).

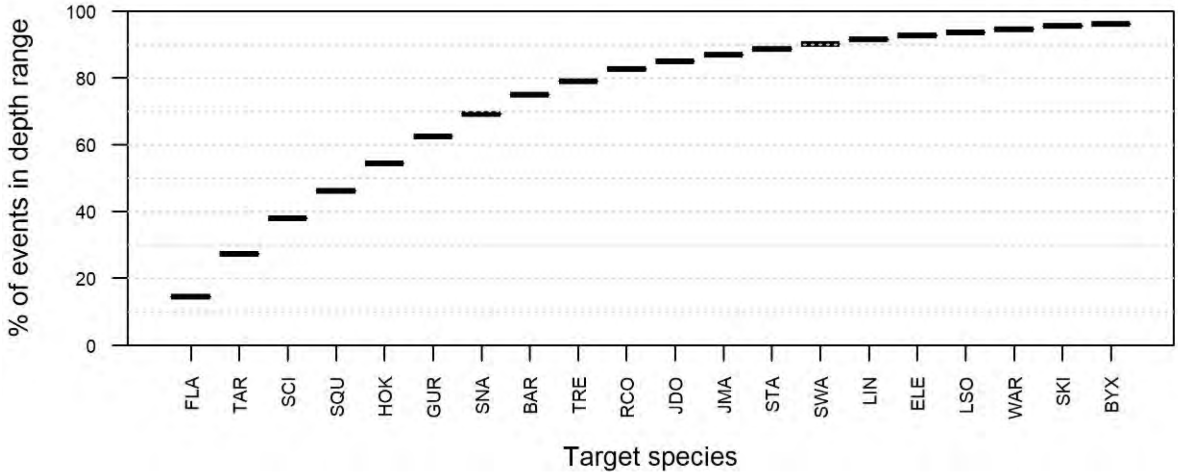


Figure 41.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for red cod (0–500 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.

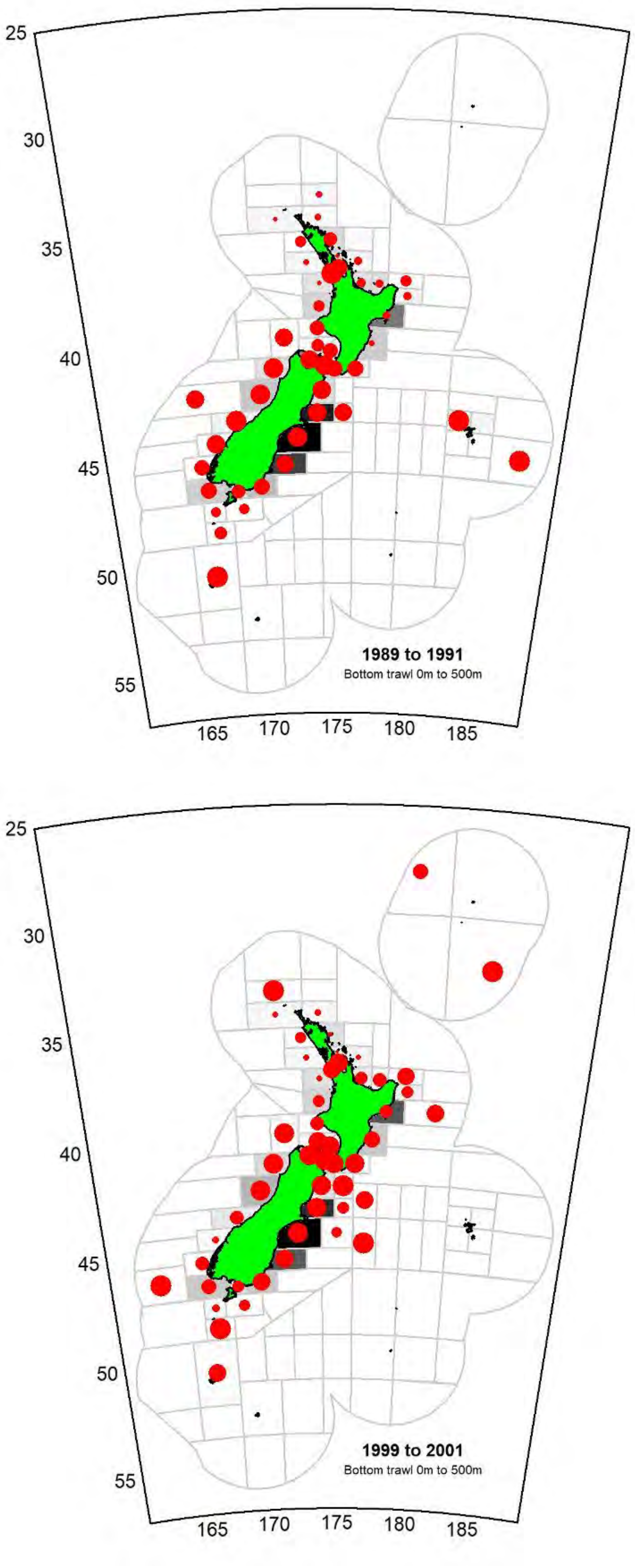
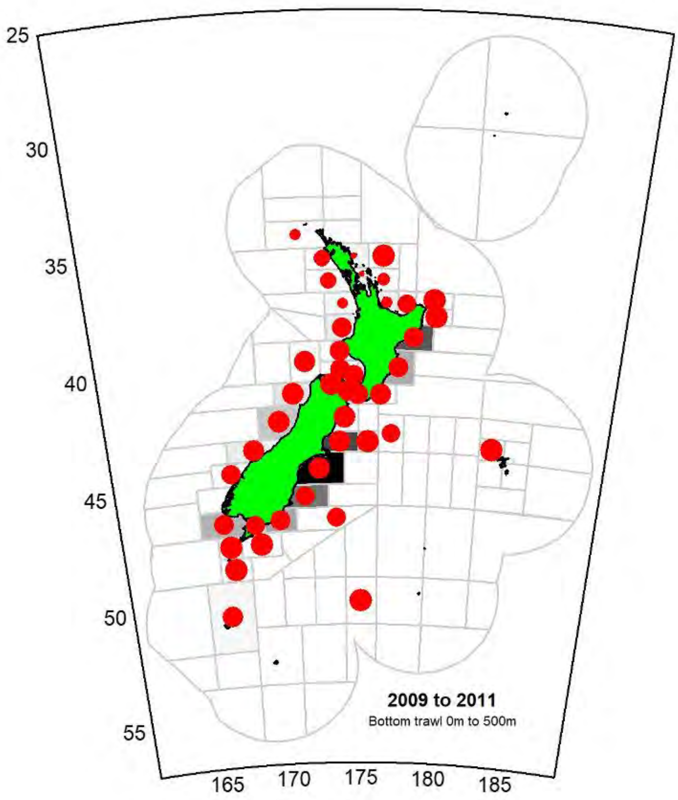


Figure 41.4: Maps of red cod occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



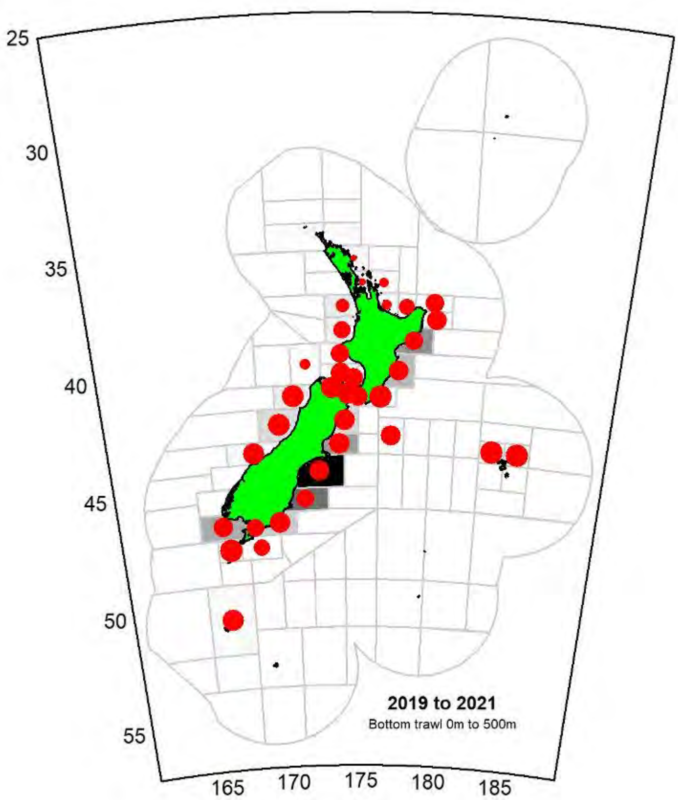
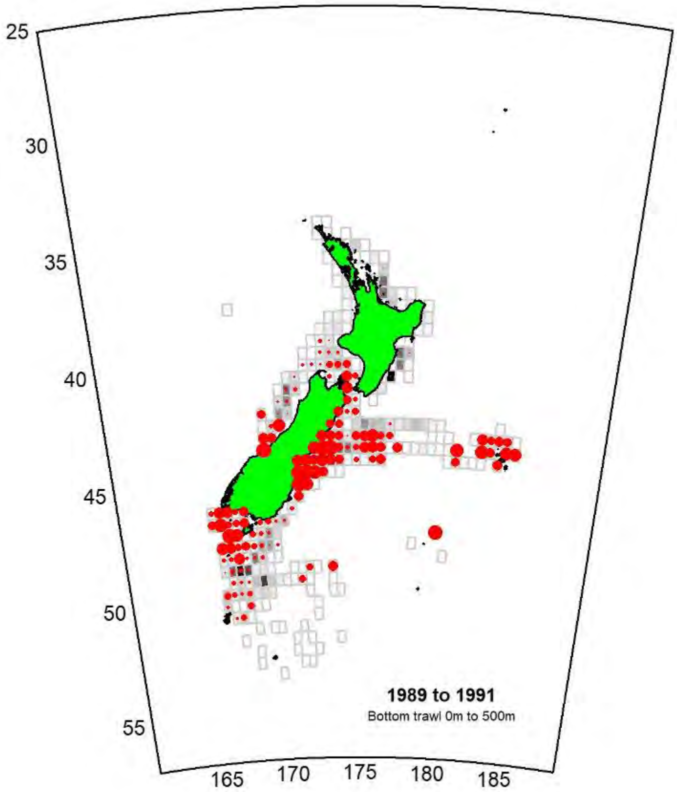


Figure 41.4 (cont.): Maps of red cod occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



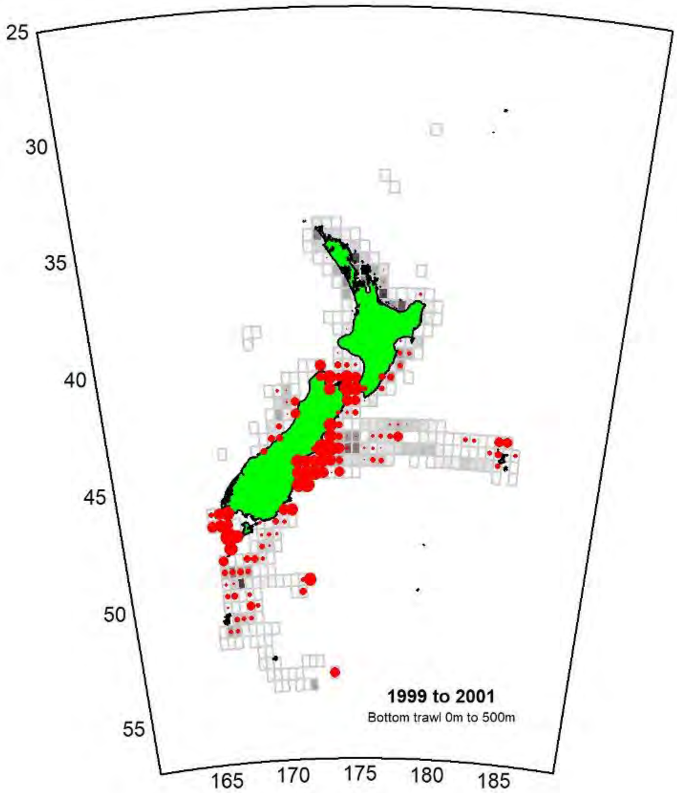
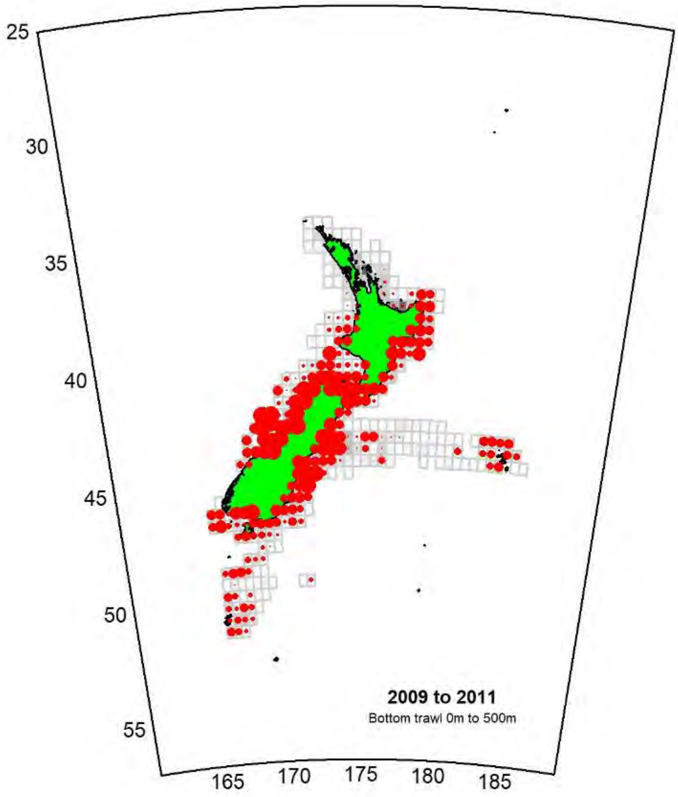


Figure 41.5: Maps of red cod occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



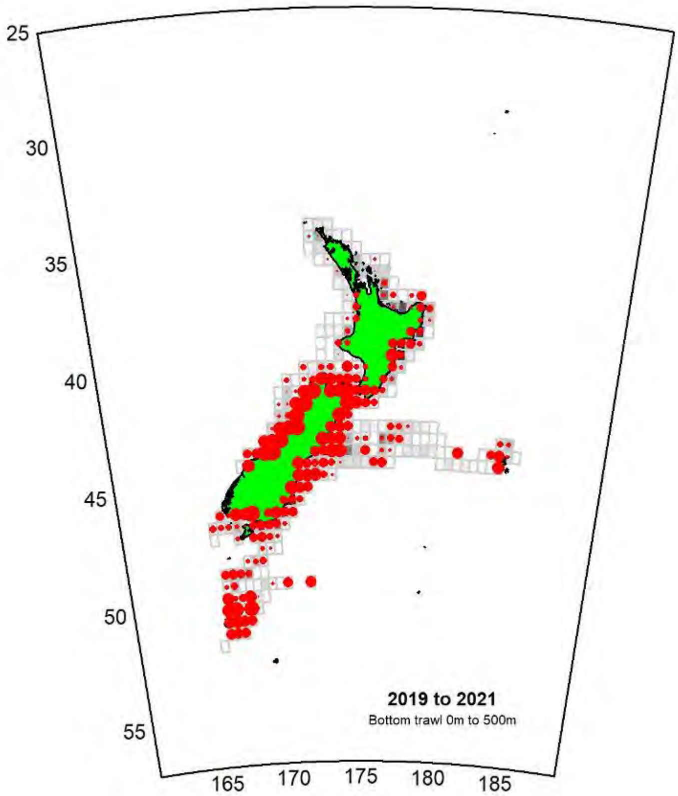


Figure 41.5 (cont.): Maps of red cod occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

42. Red gurnard (GUR)

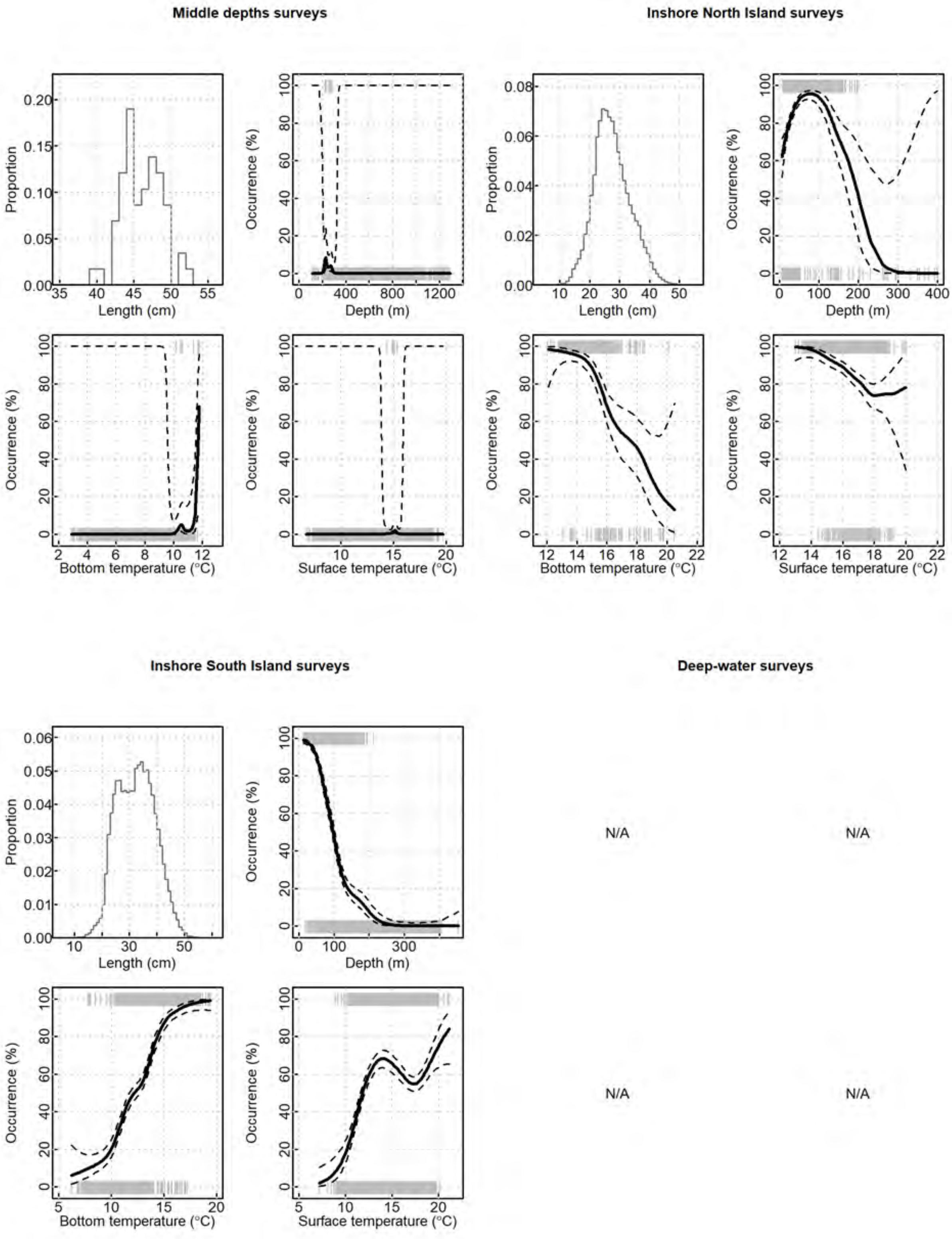


Figure 42.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to red gurnard occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

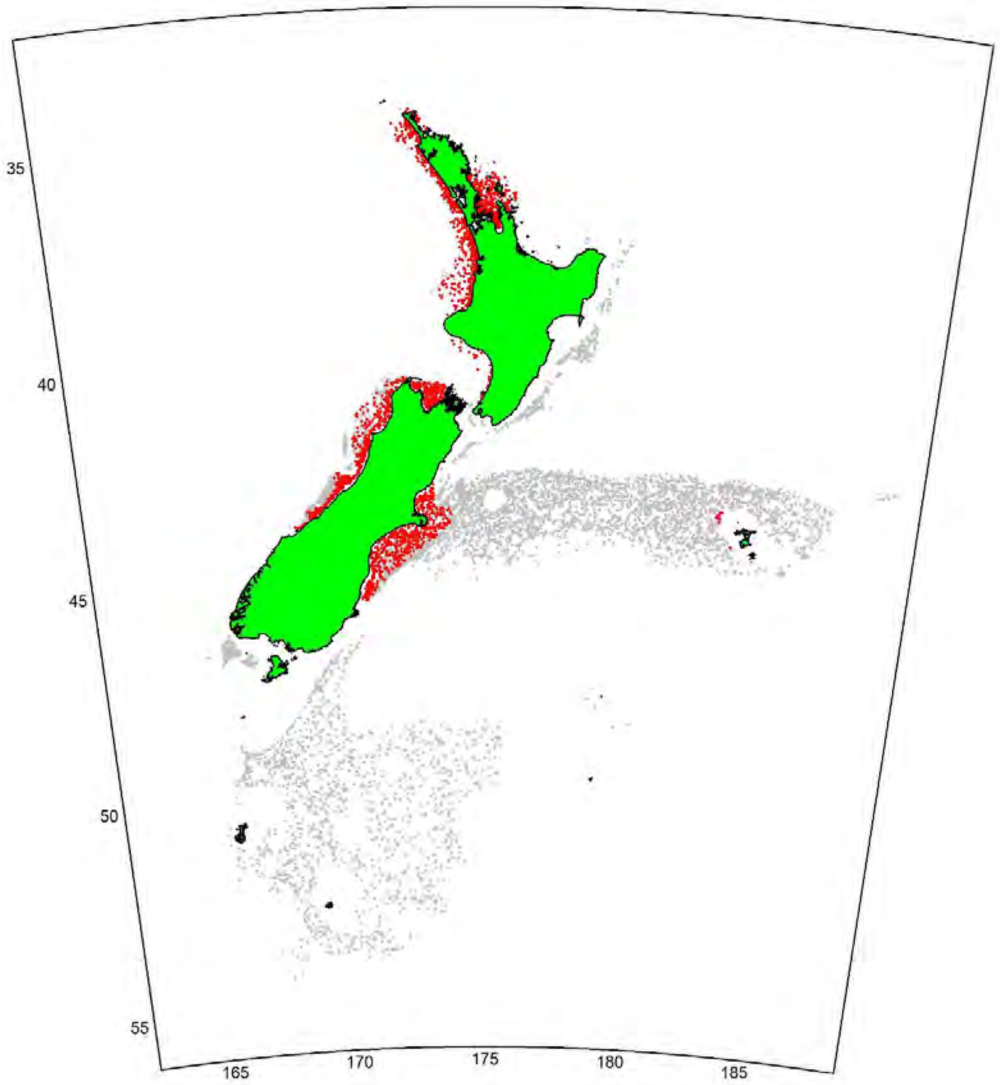


Figure 42.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where red gurnard was caught (red points).

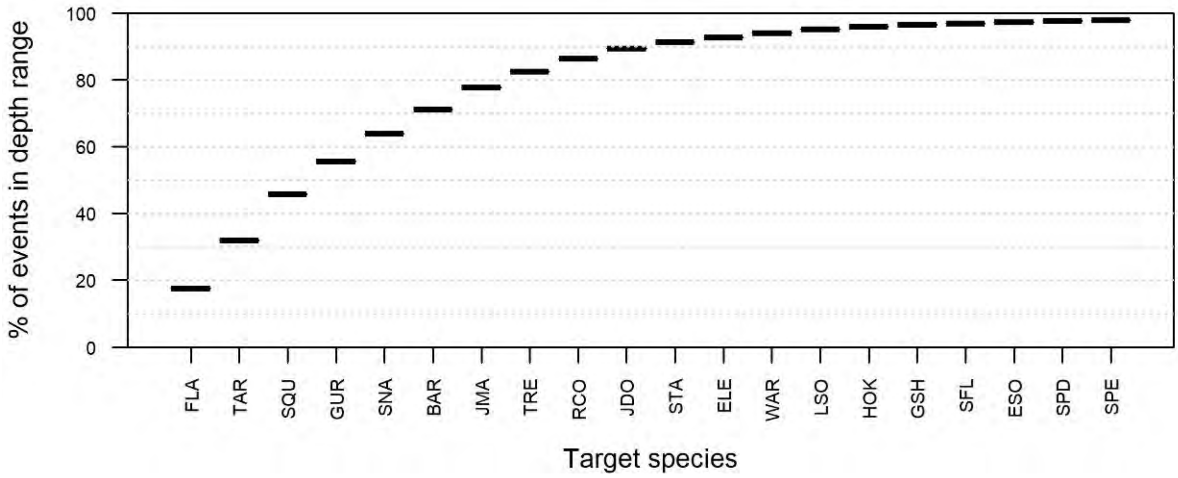
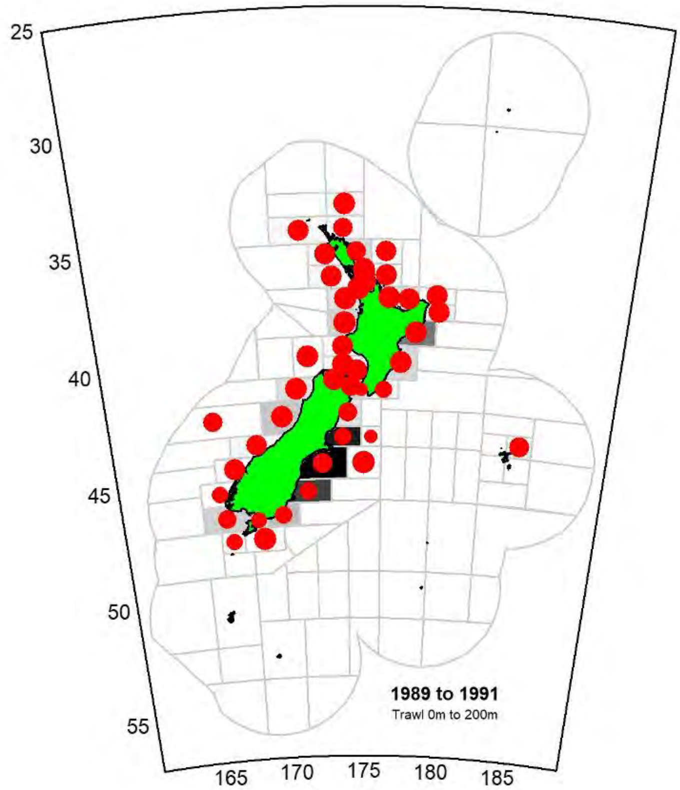


Figure 42.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for red gurnard (0–200 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.



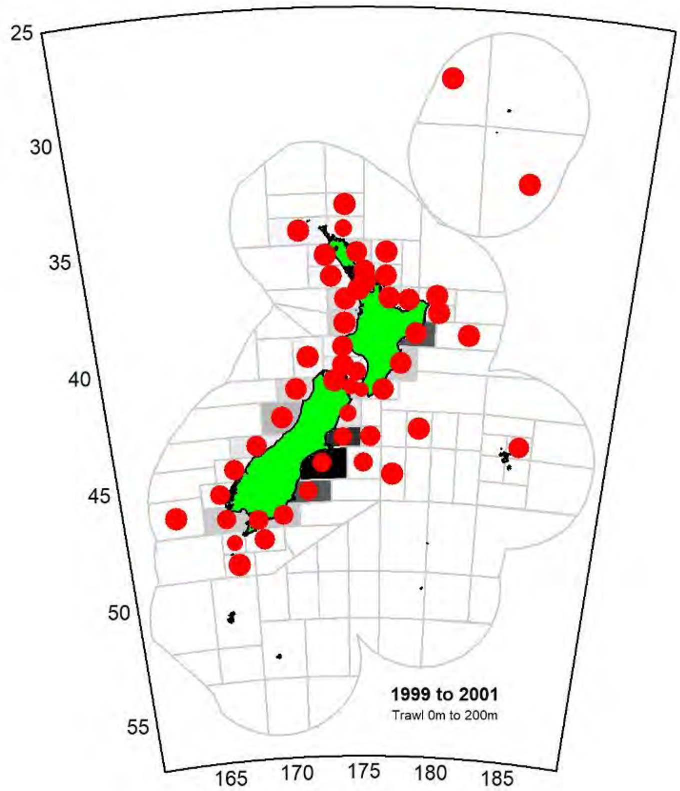
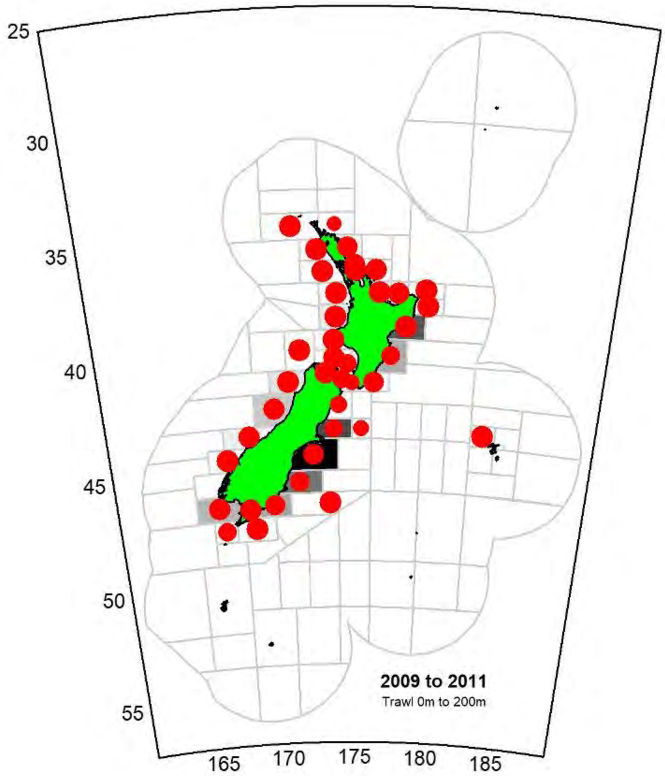


Figure 42.4: Maps of red gurnard occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



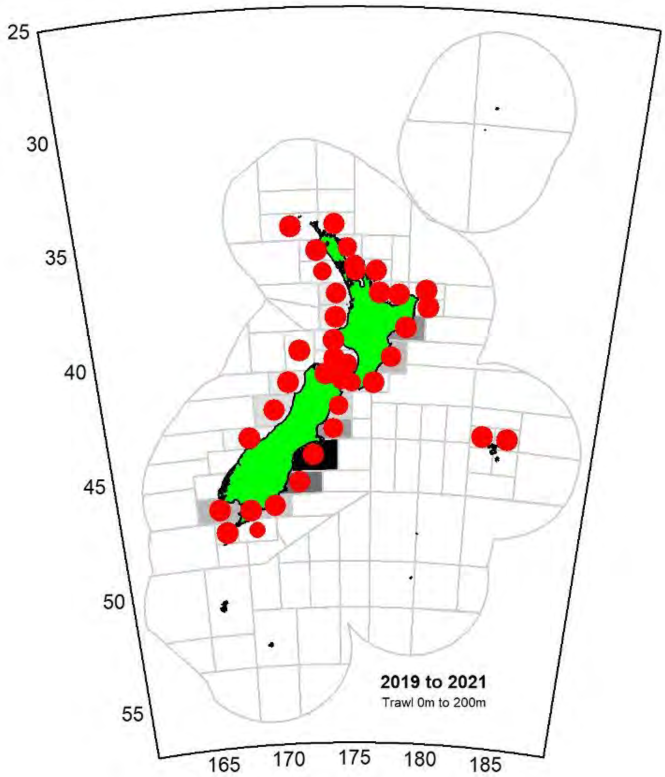
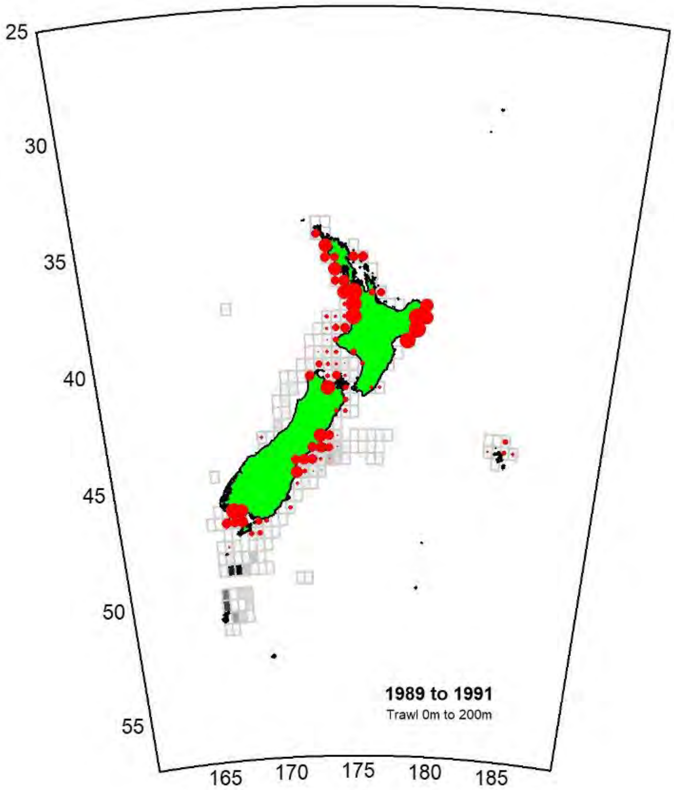


Figure 42.4 (cont.): Maps of red gurnard occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



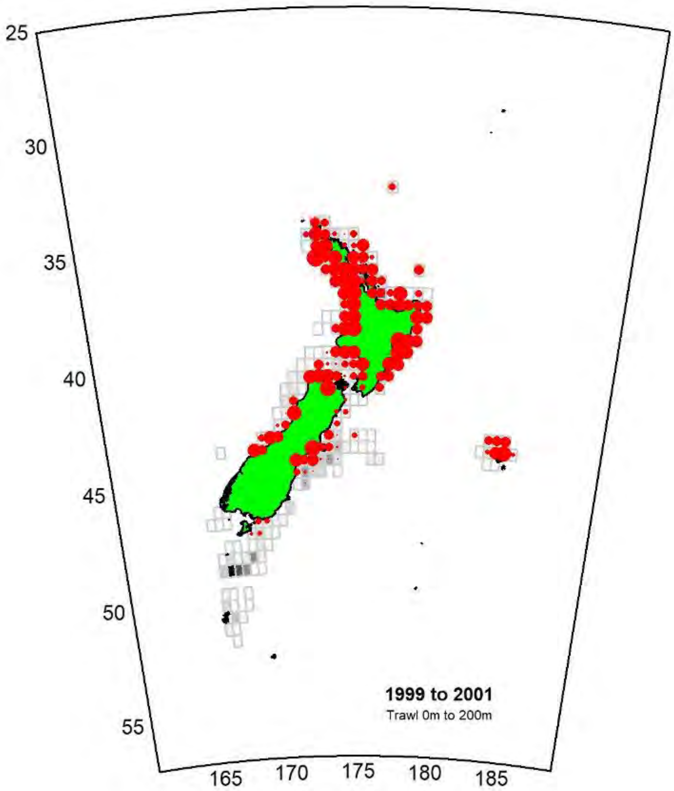
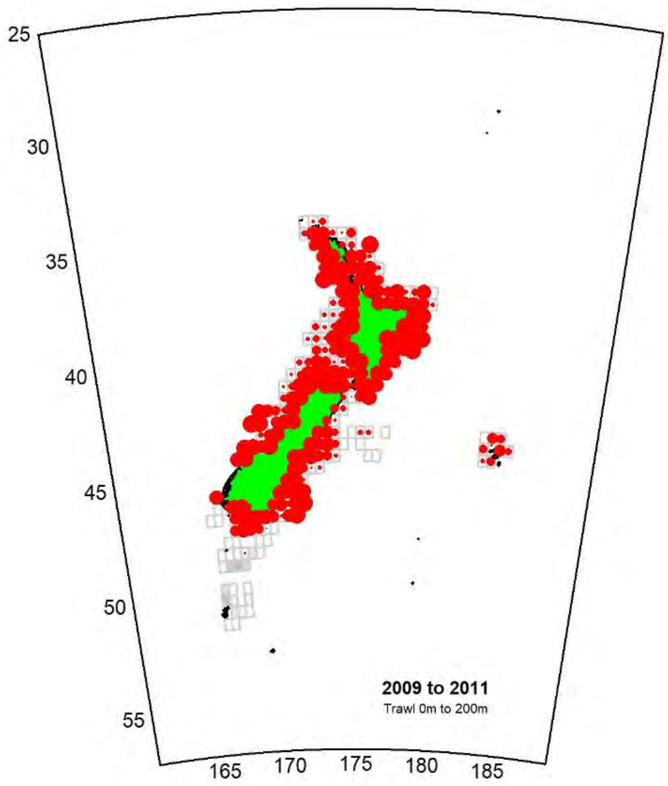


Figure 42.5: Maps of red gurnard occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



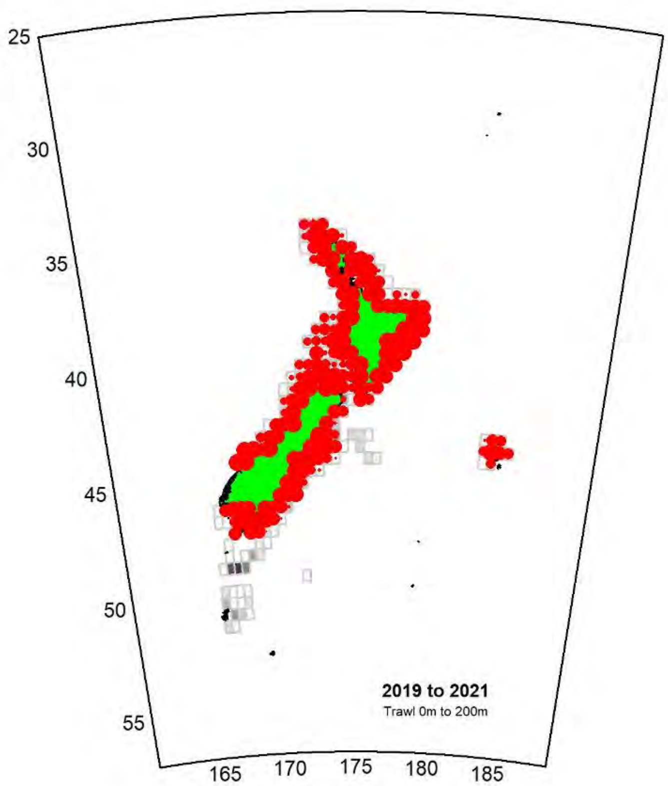


Figure 42.5 (cont.): Maps of red gurnard occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

43. Red snapper (RSN)

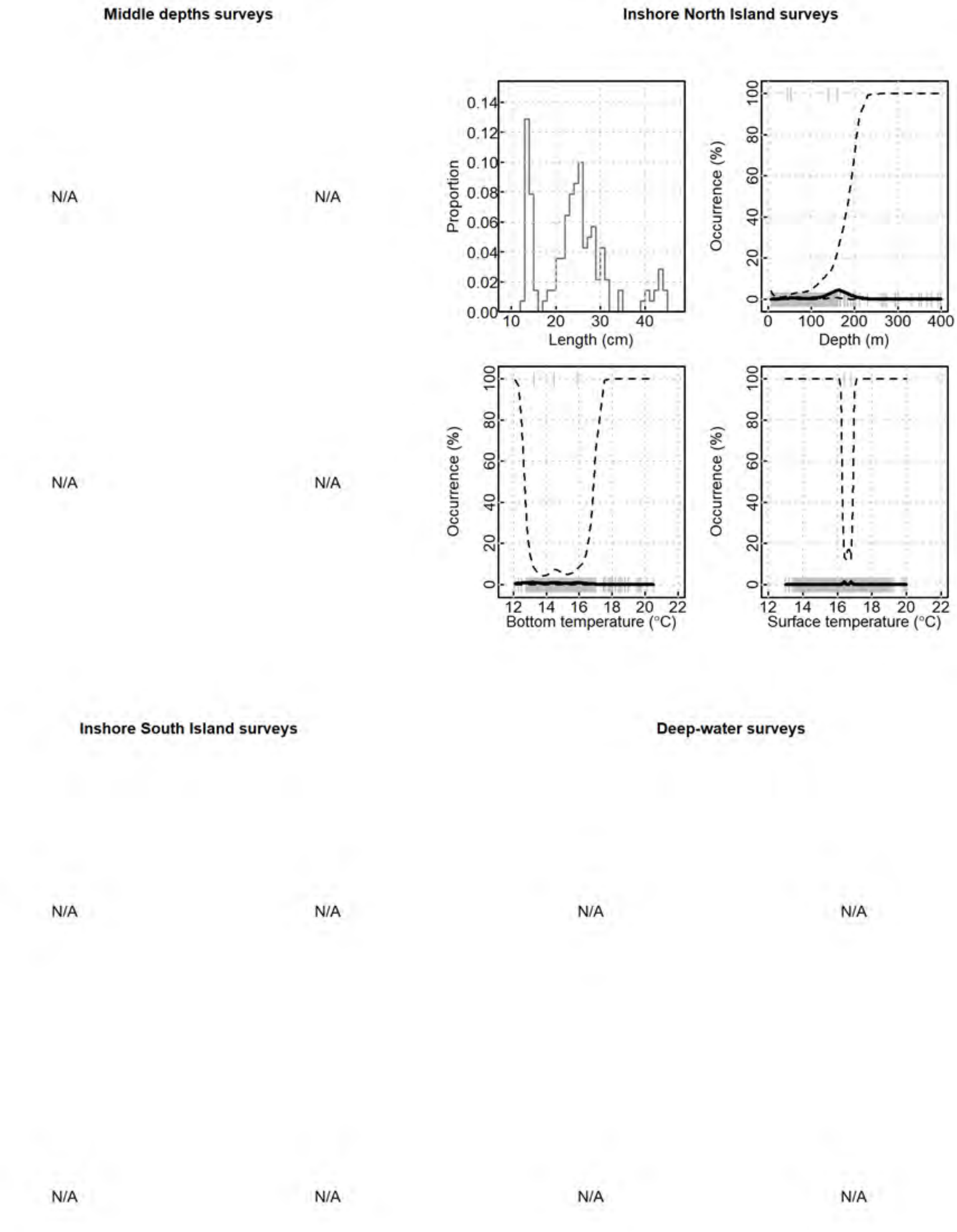


Figure 43.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to red snapper occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

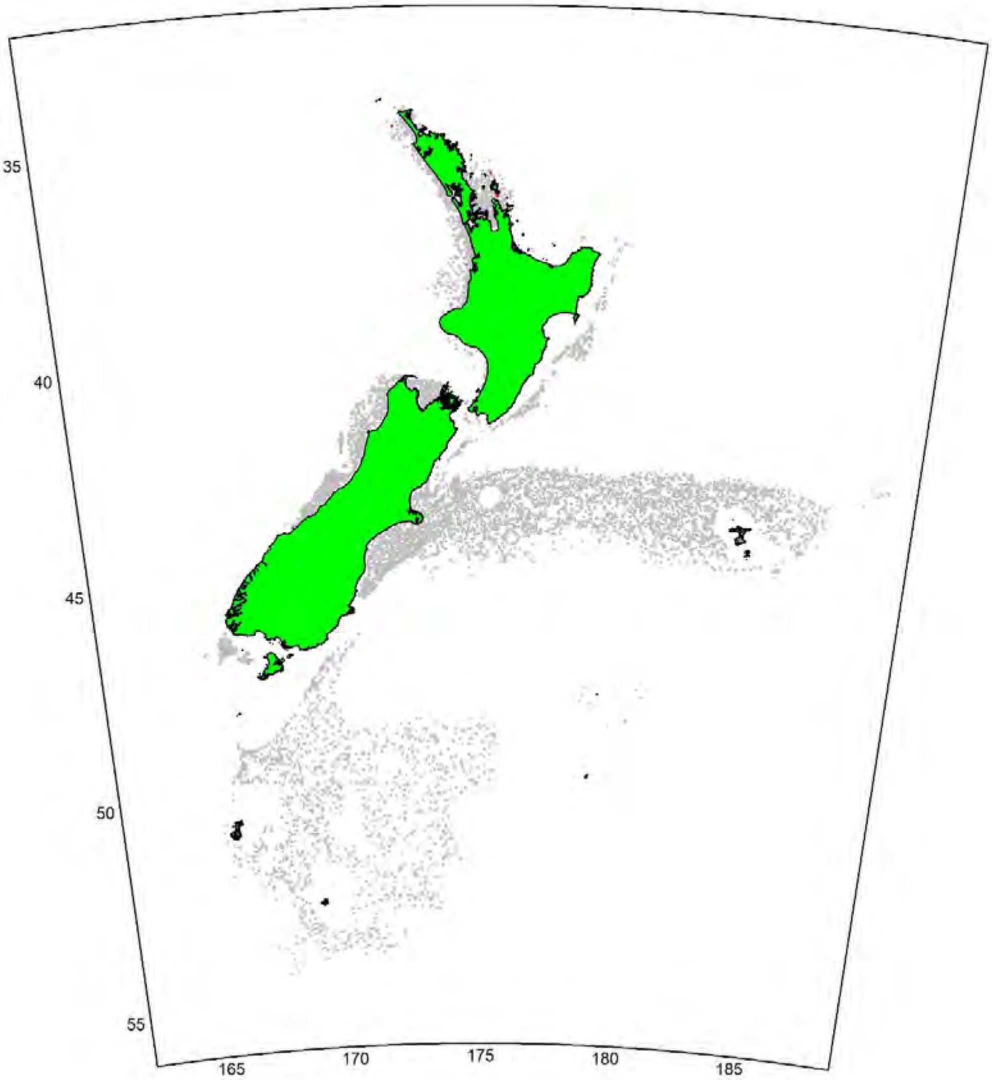


Figure 43.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where red snapper was caught (red points).

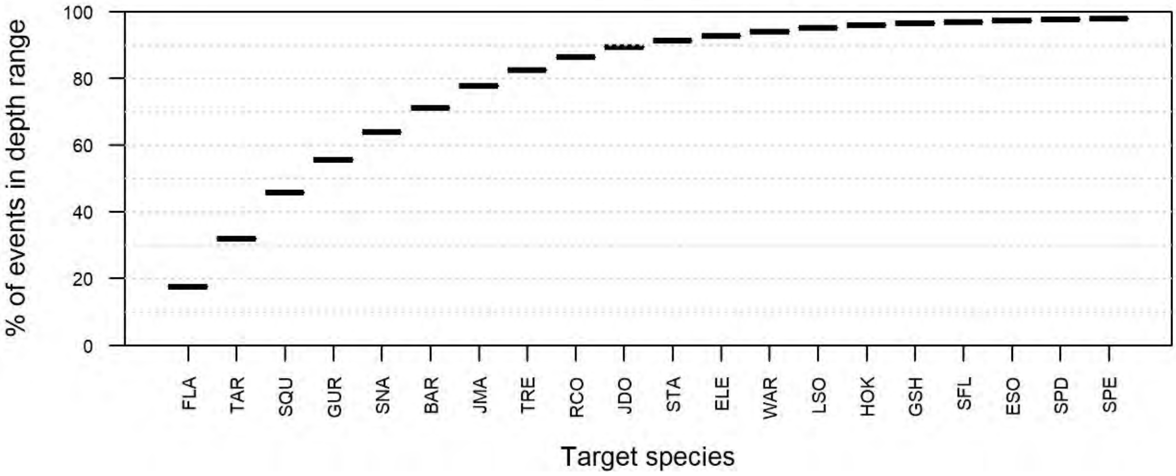
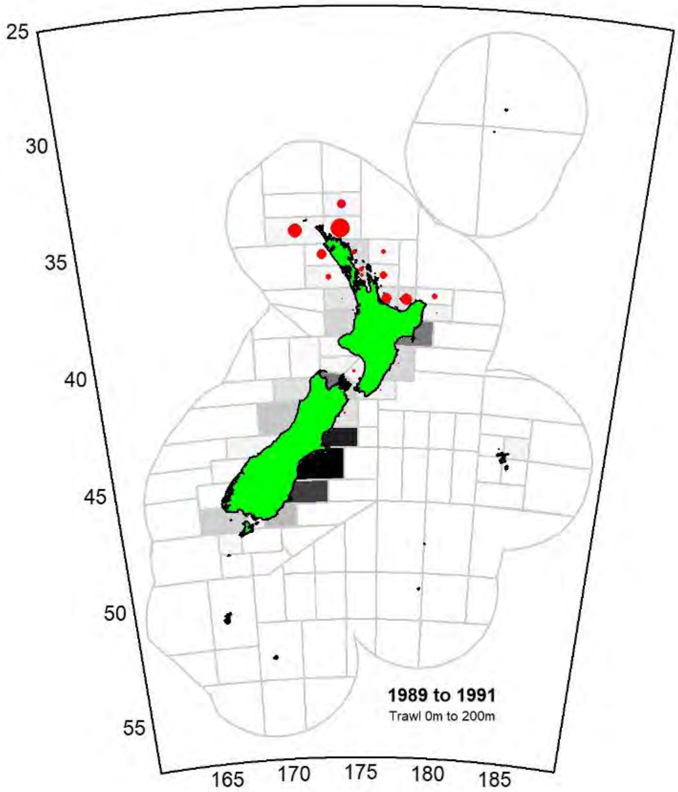


Figure 43.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for red snapper (0–200 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.



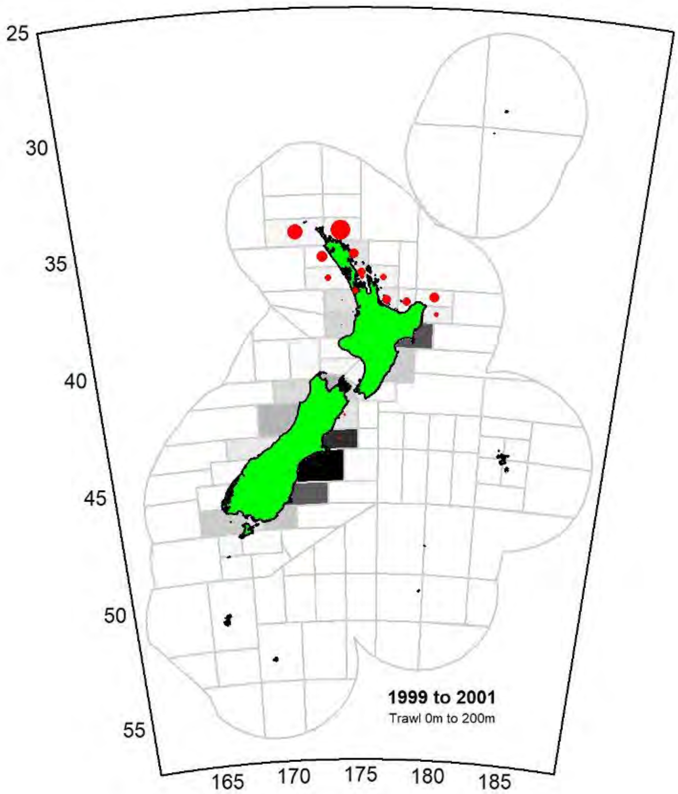
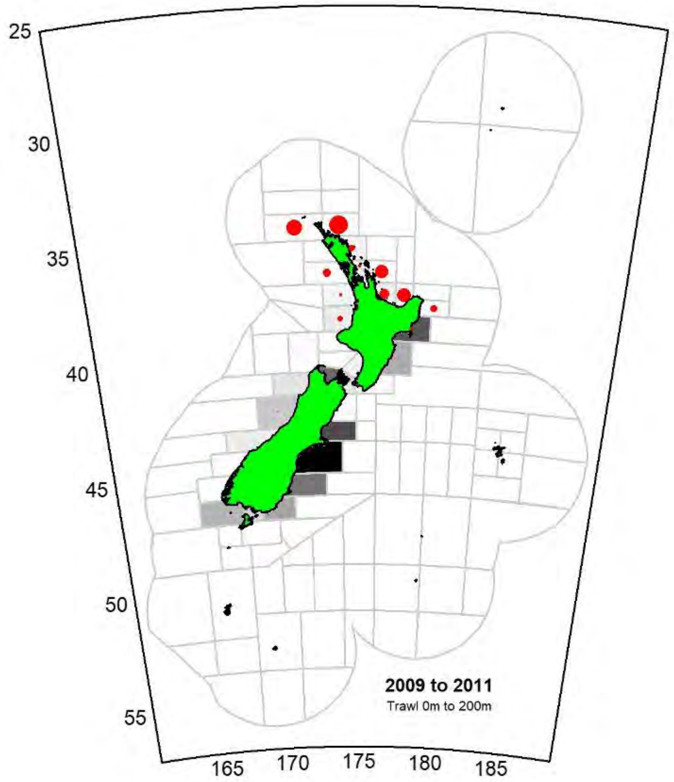


Figure 43.4: Maps of red snapper occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



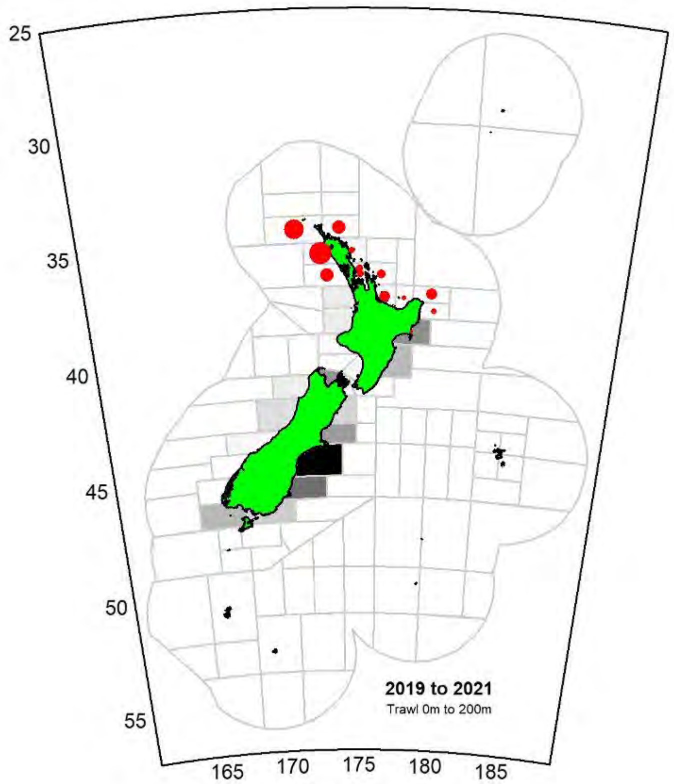
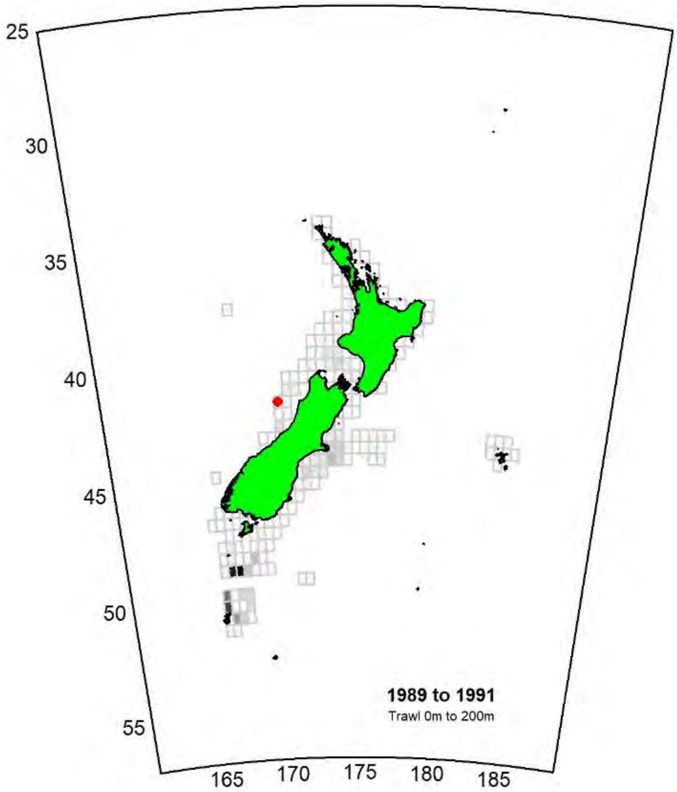


Figure 43.4 (cont.): Maps of red snapper occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



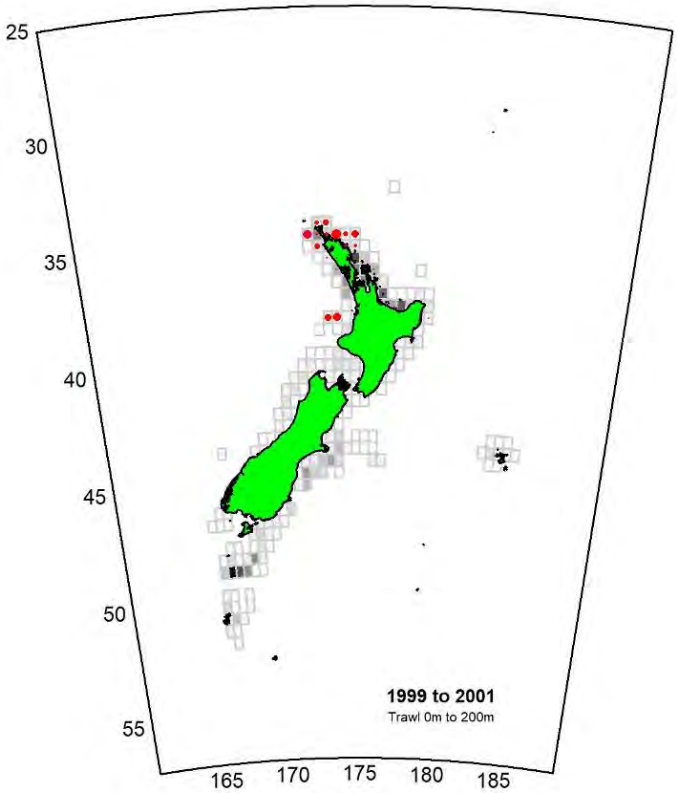
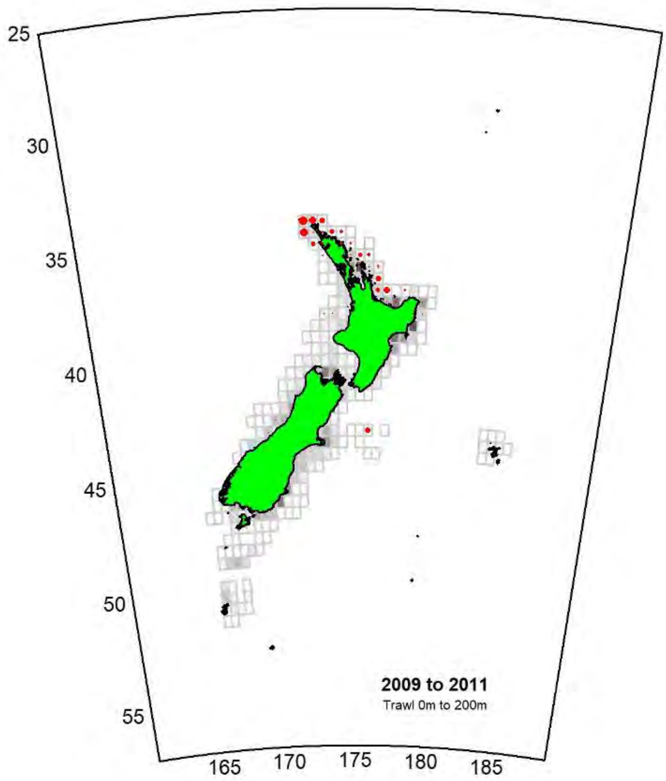


Figure 43.5: Maps of red snapper occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



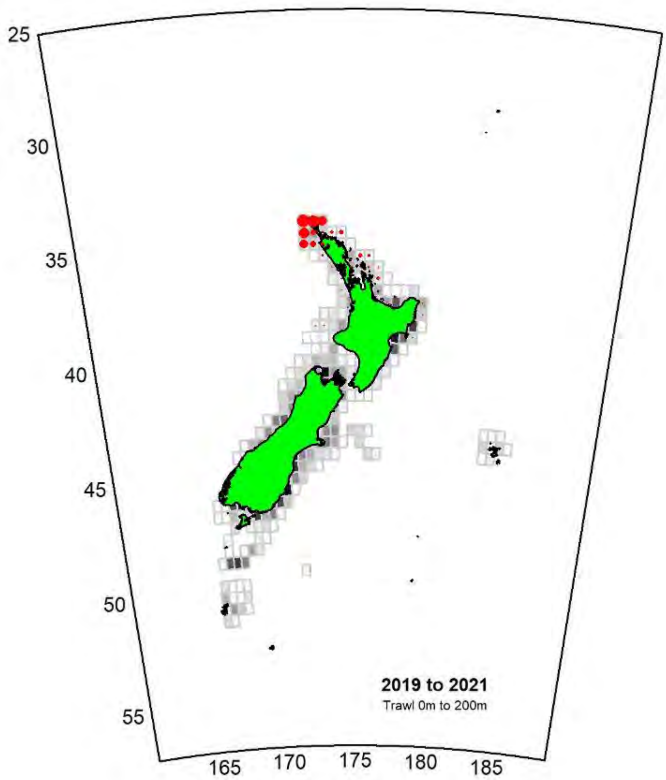


Figure 43.5 (cont.): Maps of red snapper occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

44. Ribaldo (RIB)

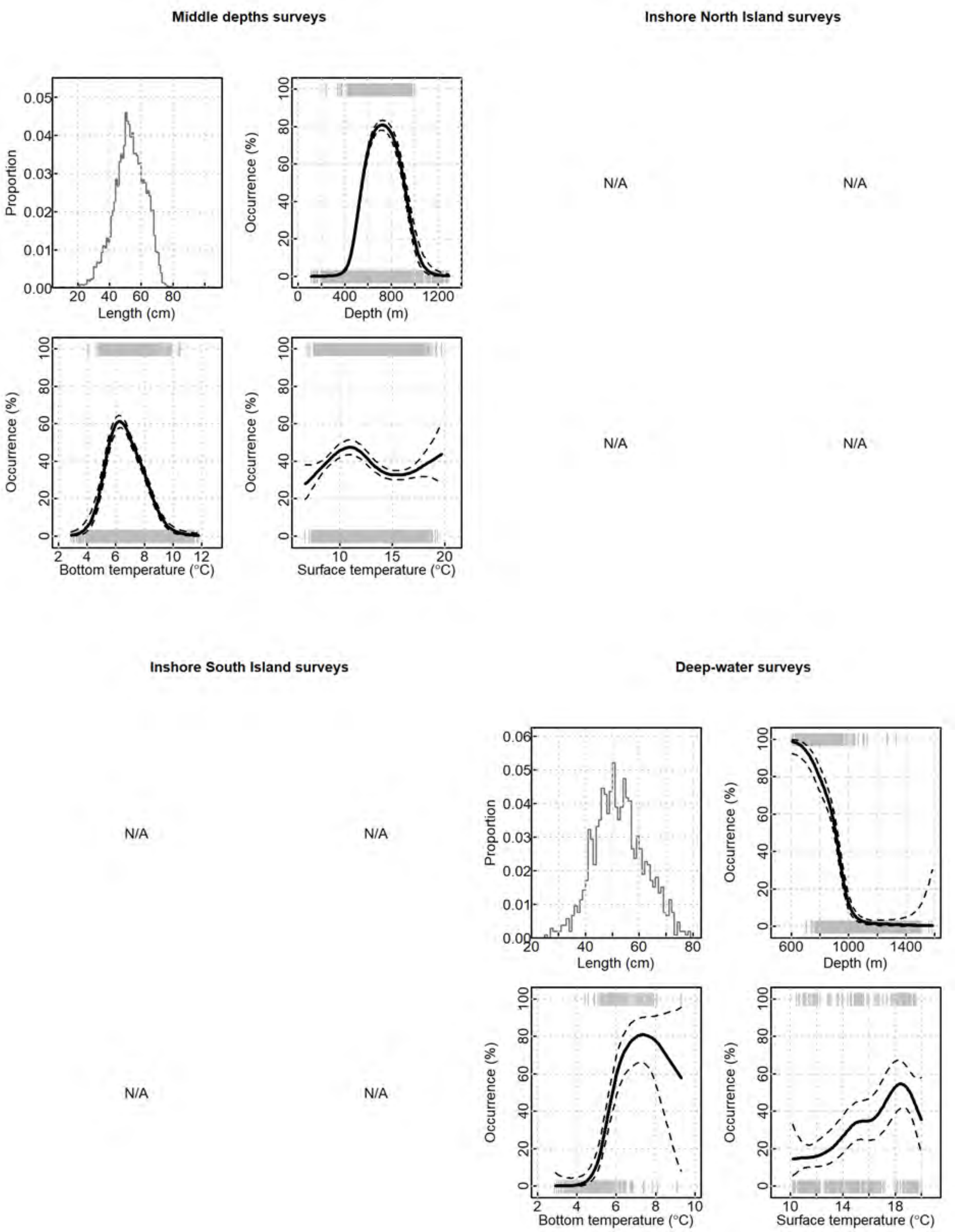


Figure 44.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to ribaldo occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

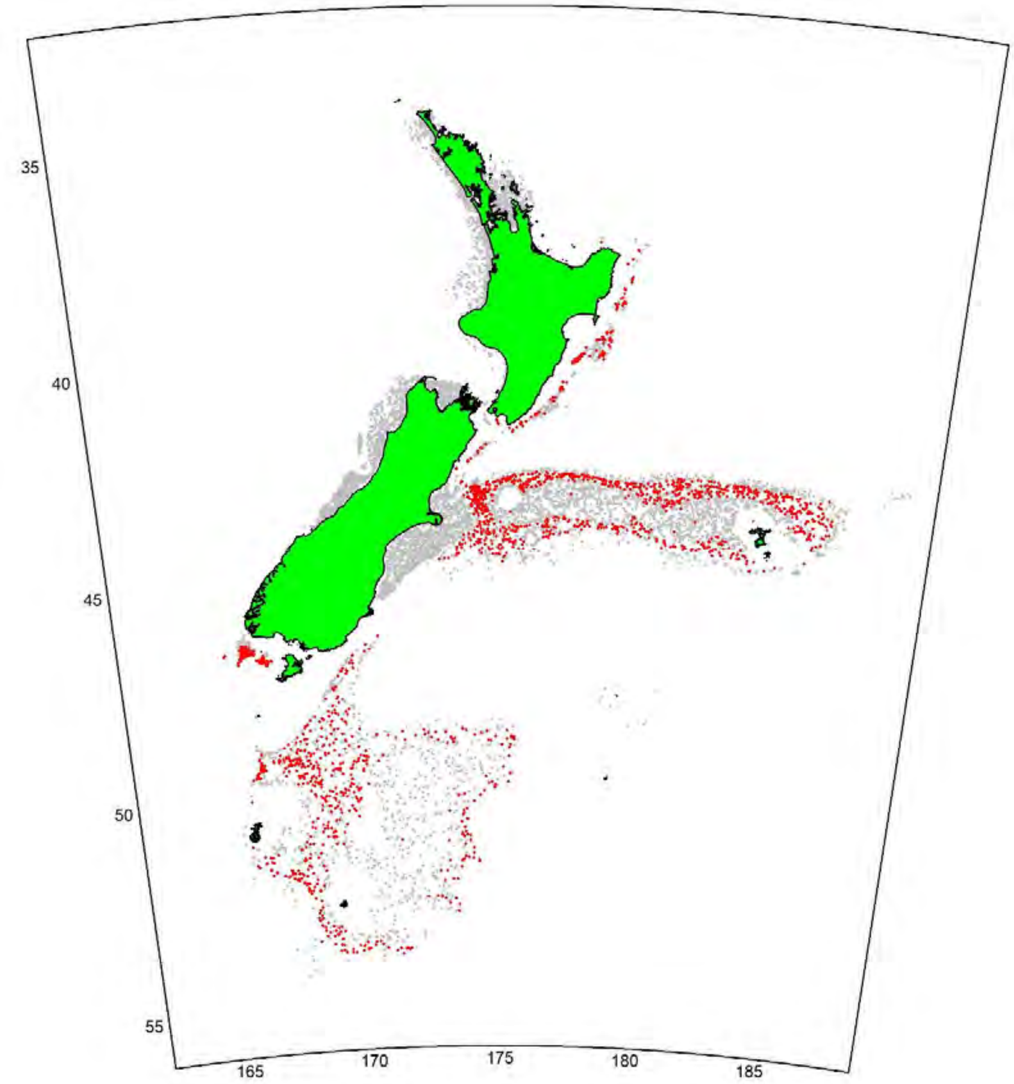


Figure 44.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where ribaldo was caught (red points).

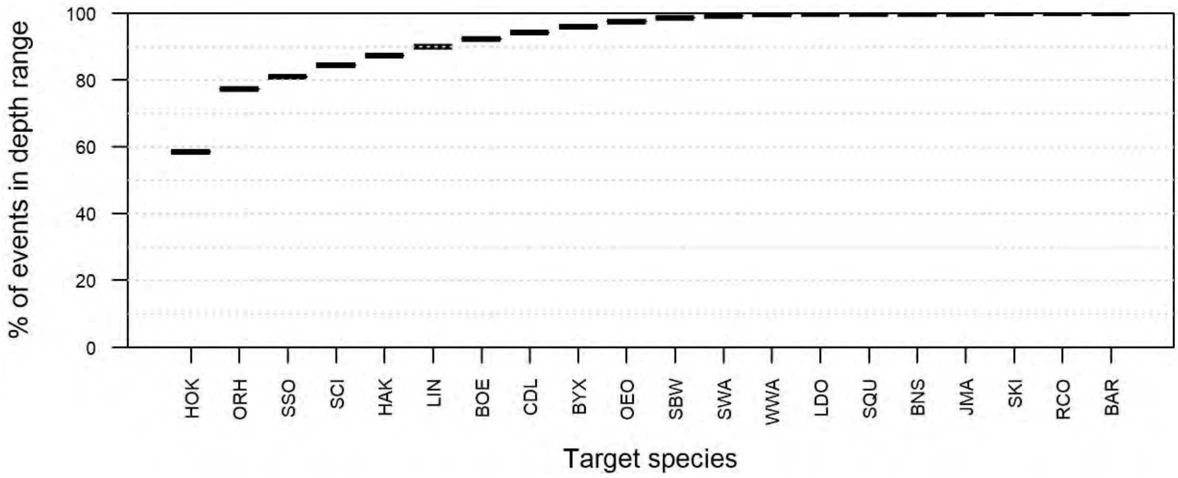
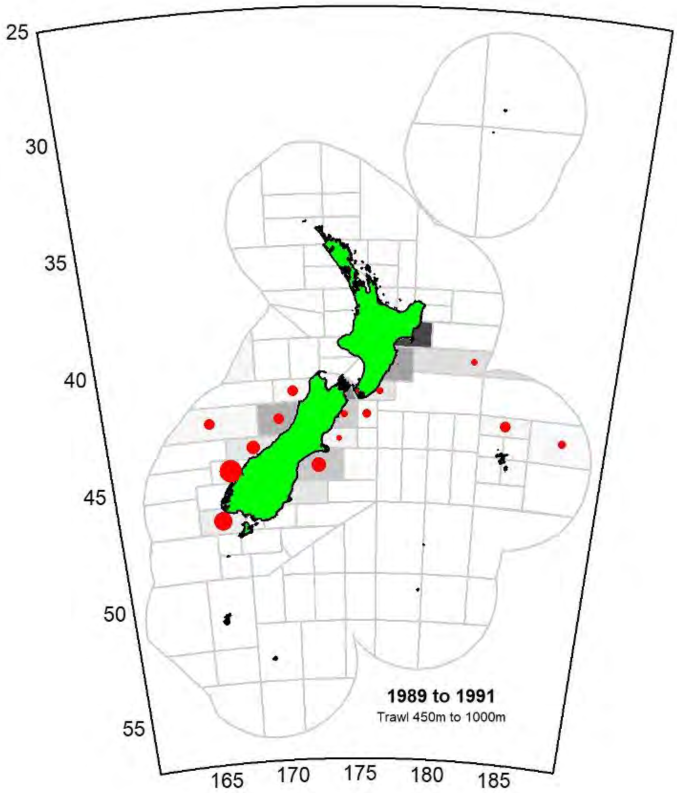


Figure 44.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for ribaldo (450–1000 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.



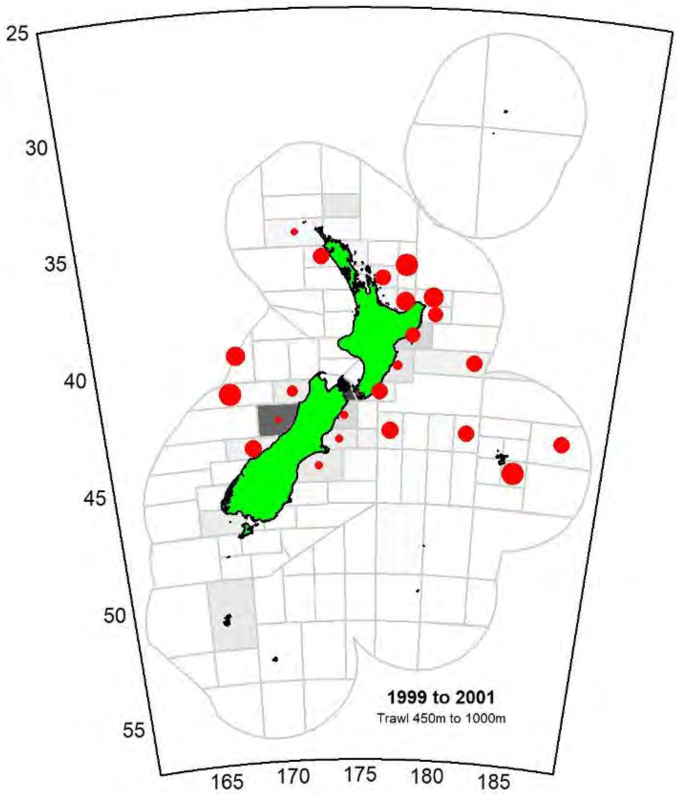
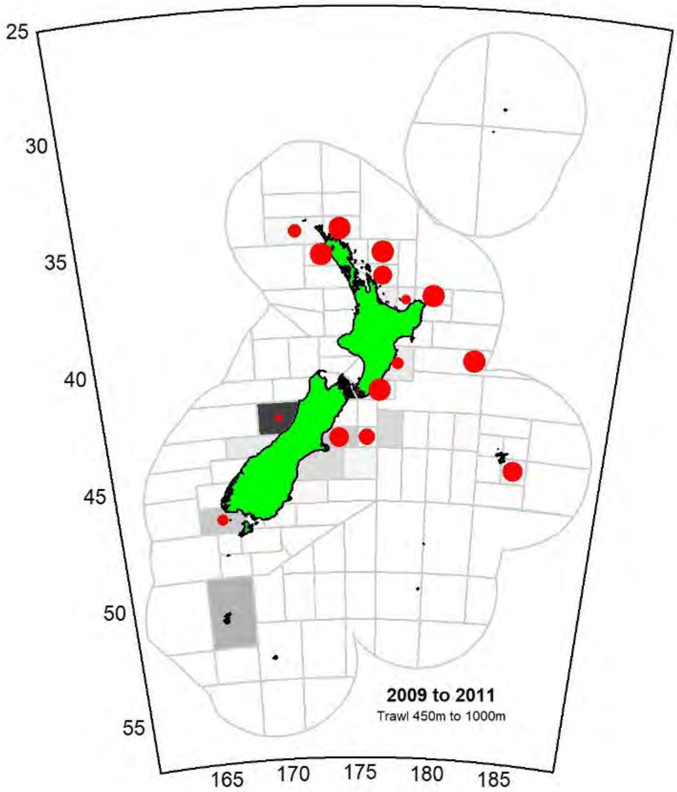


Figure 44.4: Maps of ribaldo occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



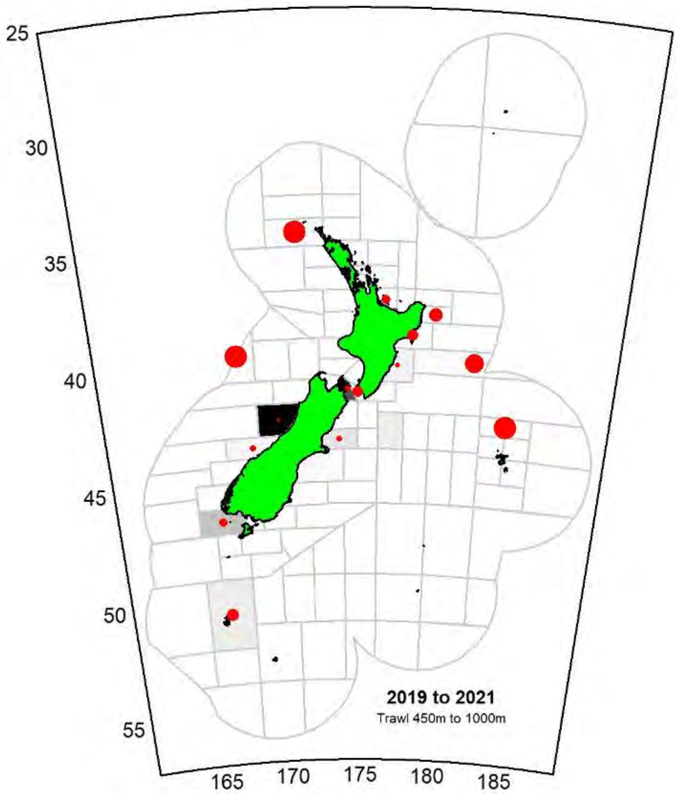


Figure 44.4 (cont.): Maps of ribaldo occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

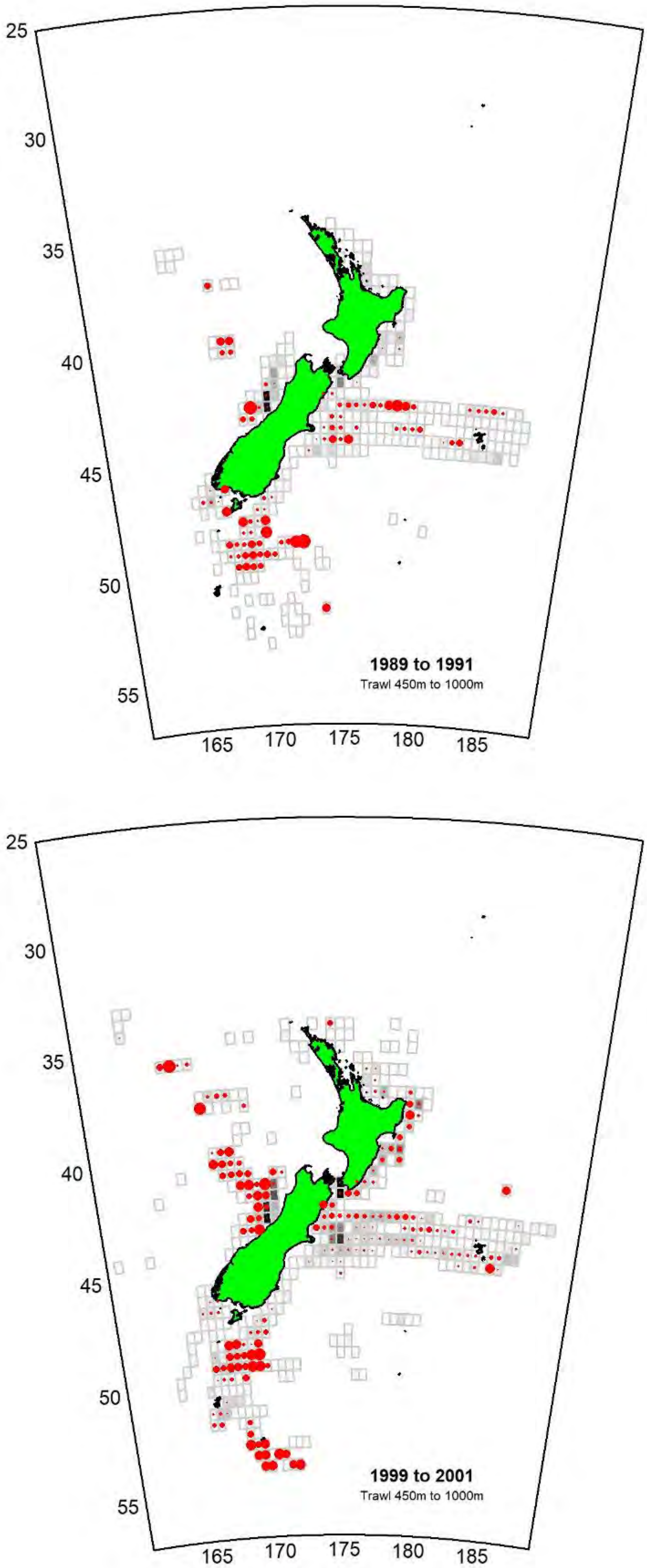
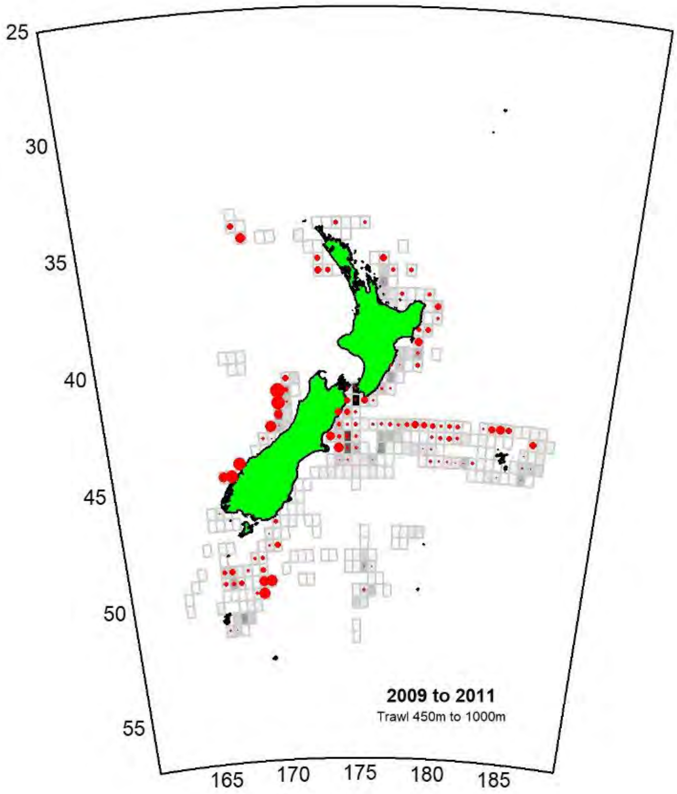


Figure 44.5: Maps of ribaldo occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



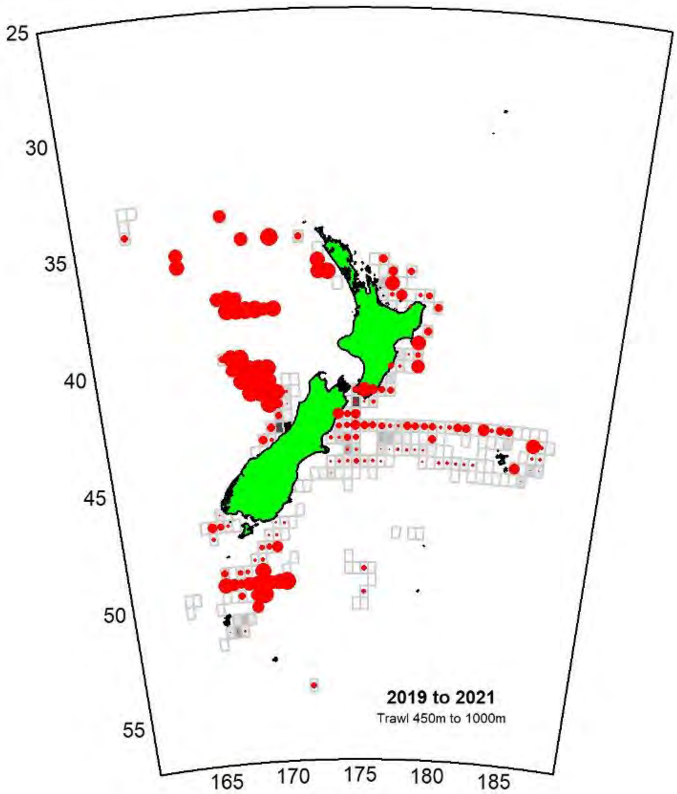


Figure 44.5 (cont.): Maps of ribaldo occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

45. Rig (SPO)

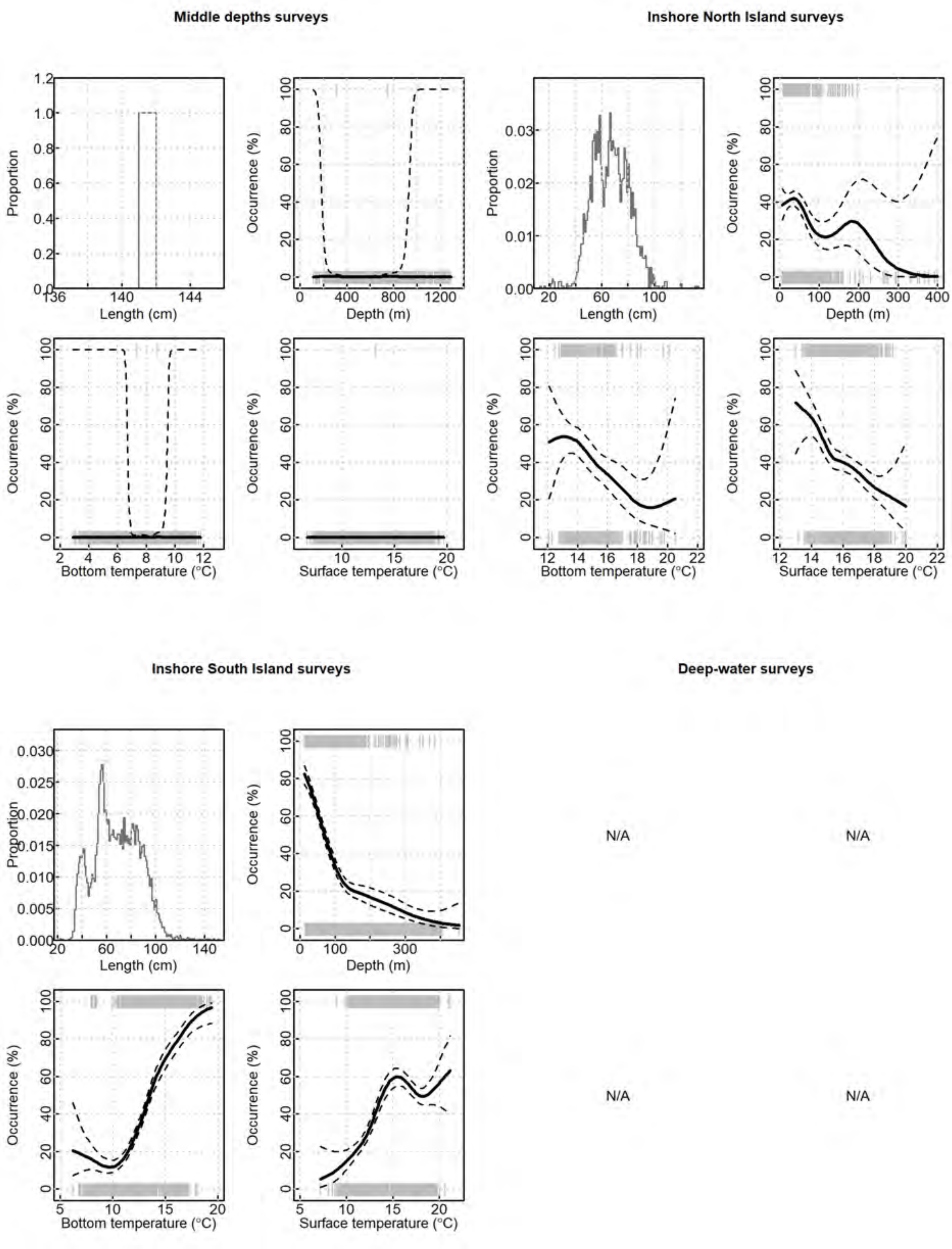


Figure 45.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to rig occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

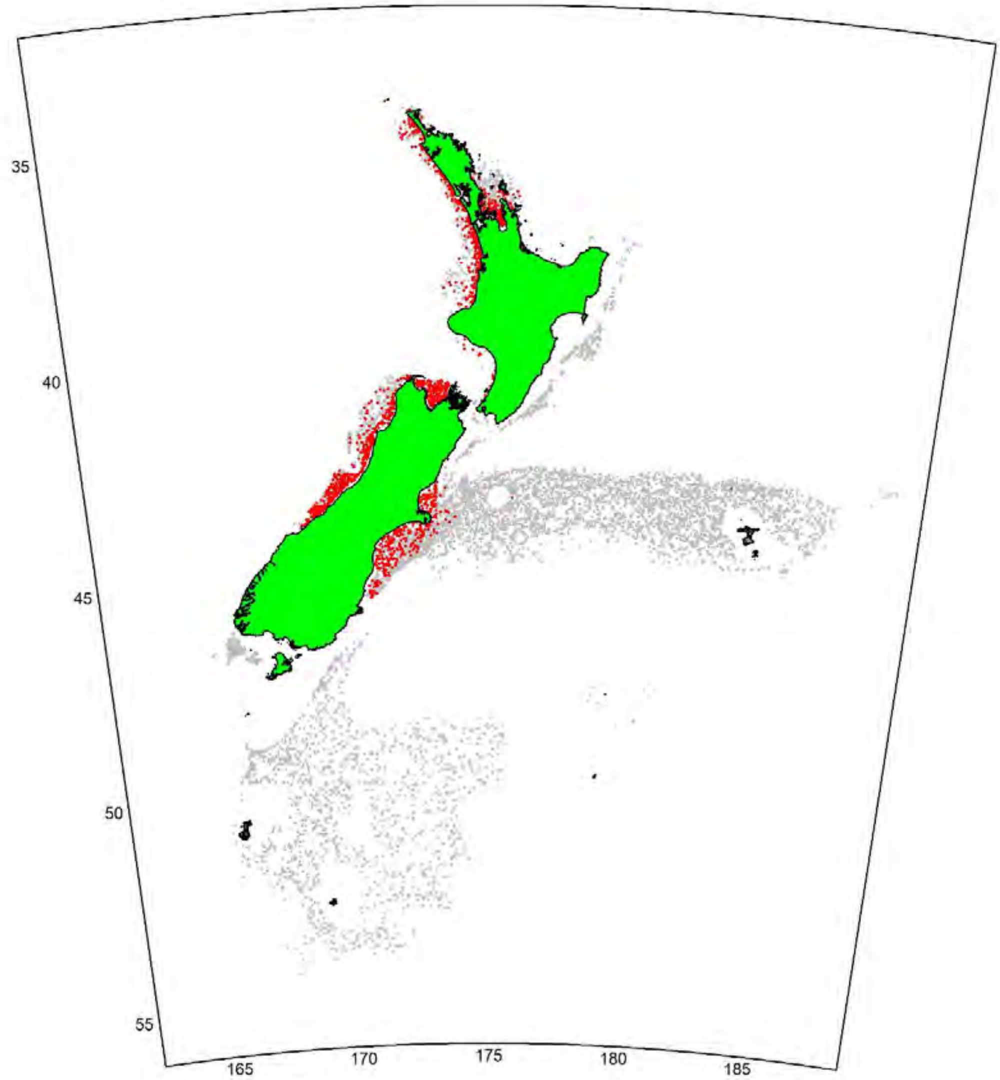


Figure 45.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where rig was caught (red points).

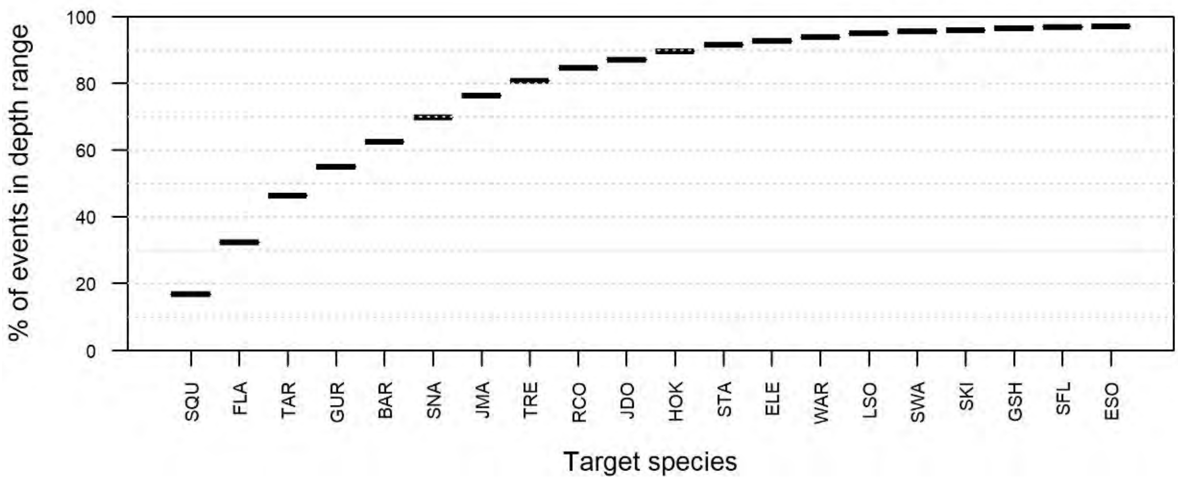
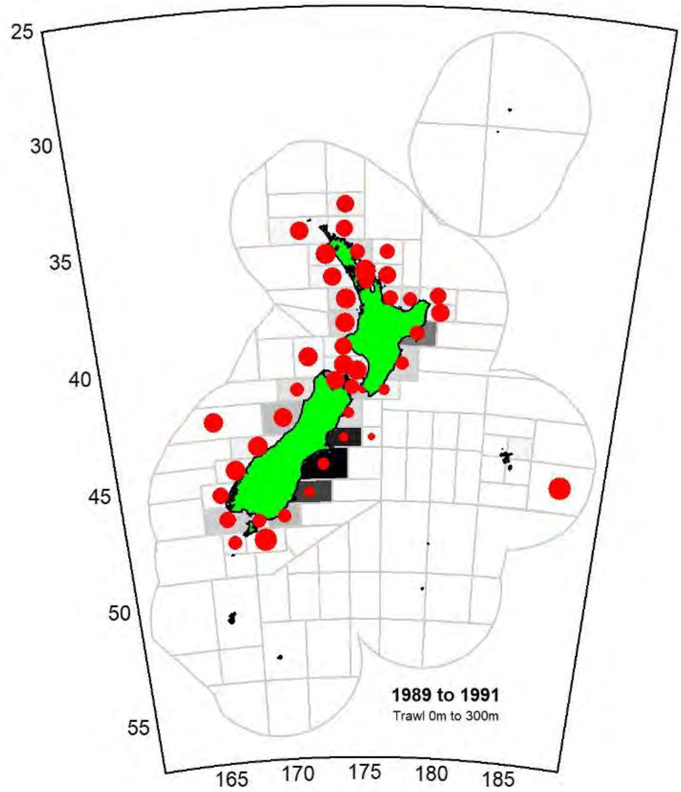


Figure 45.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for rig (0–300 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.



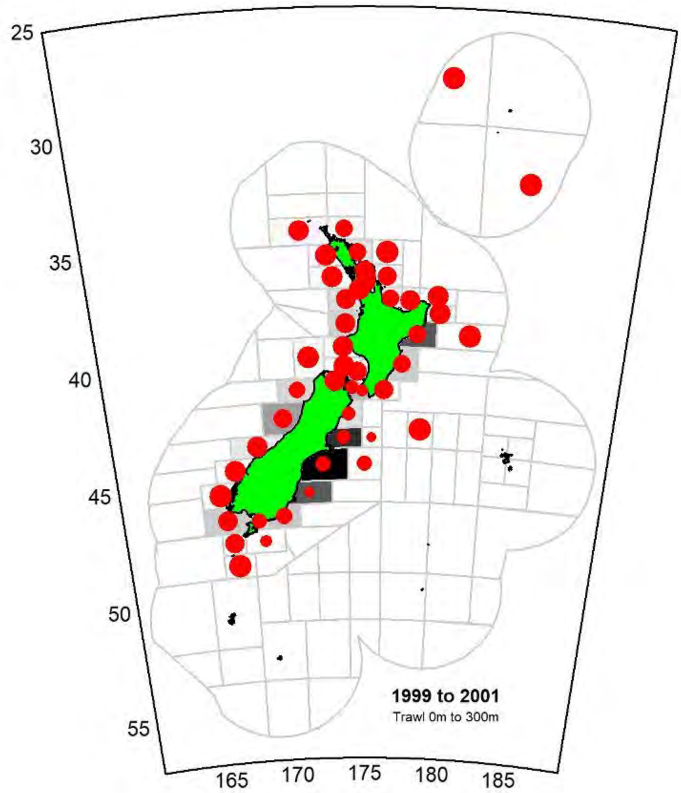
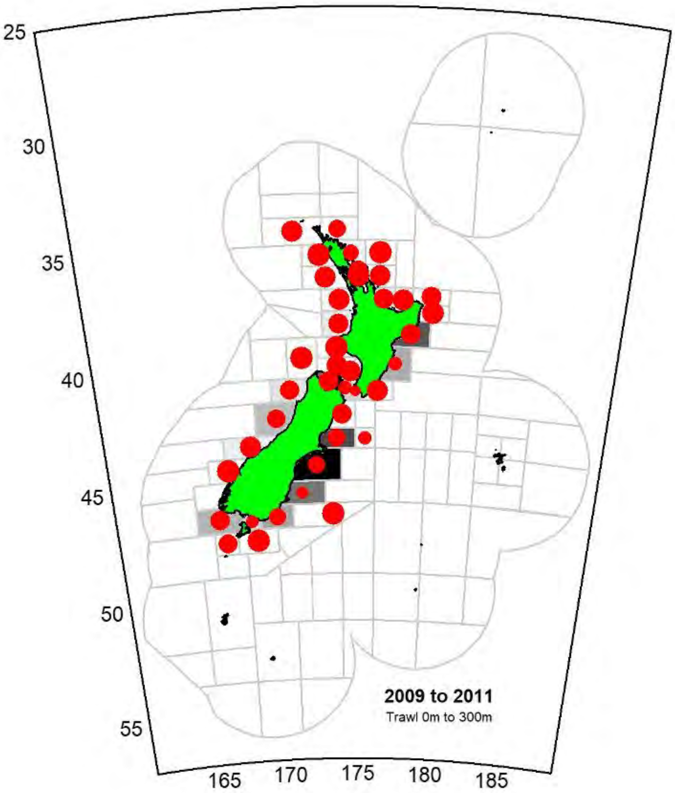


Figure 45.4: Maps of rig occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



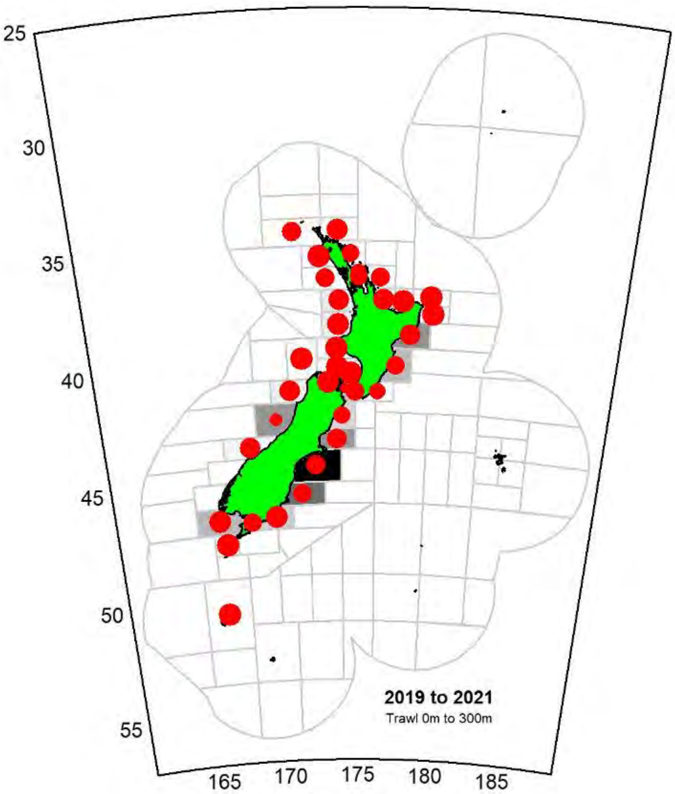


Figure 45.4 (cont.): Maps of rig occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

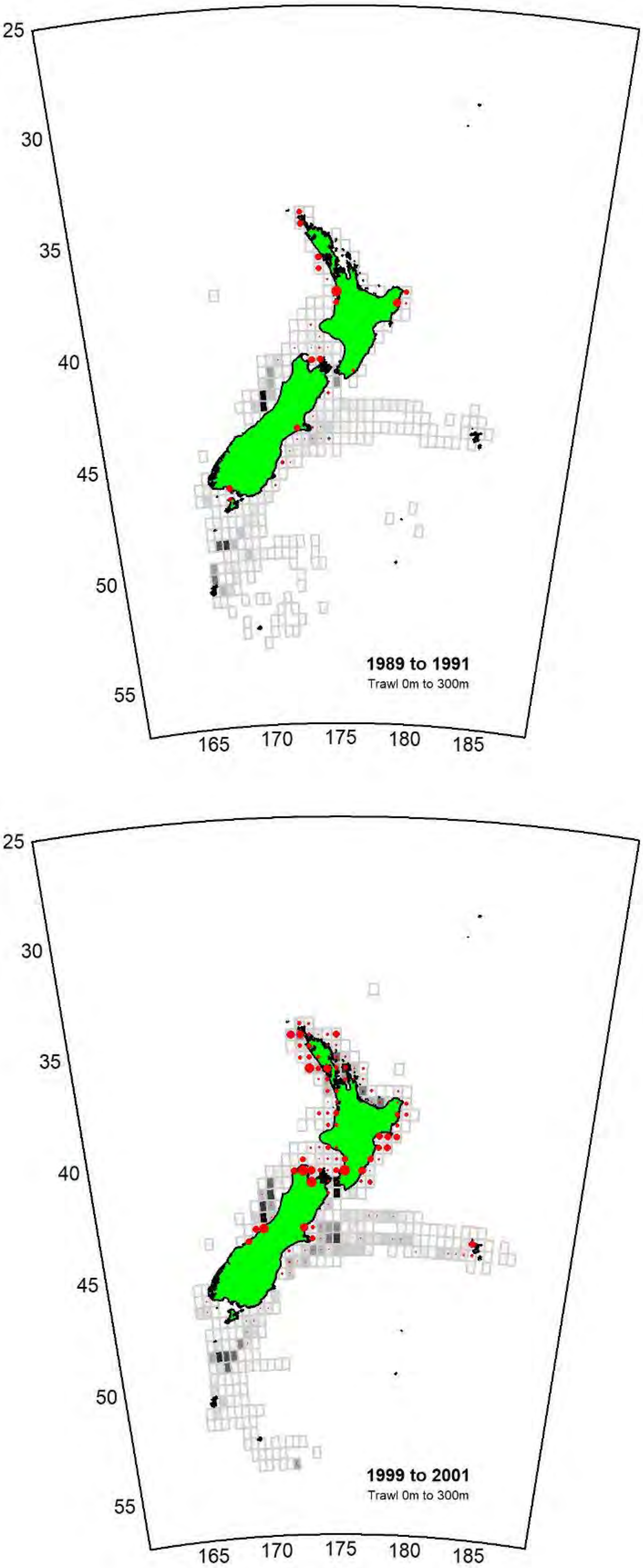
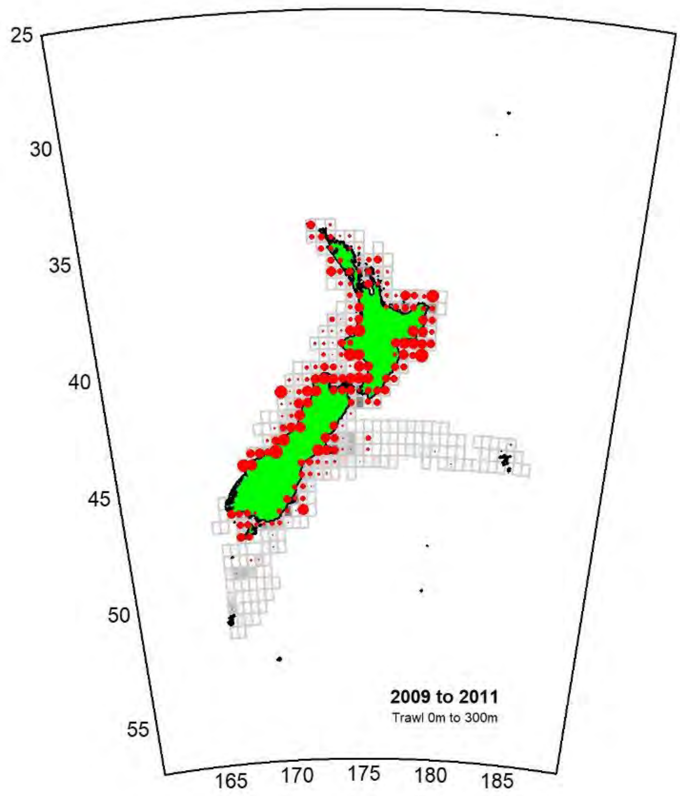


Figure 45.5: Maps of rig occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



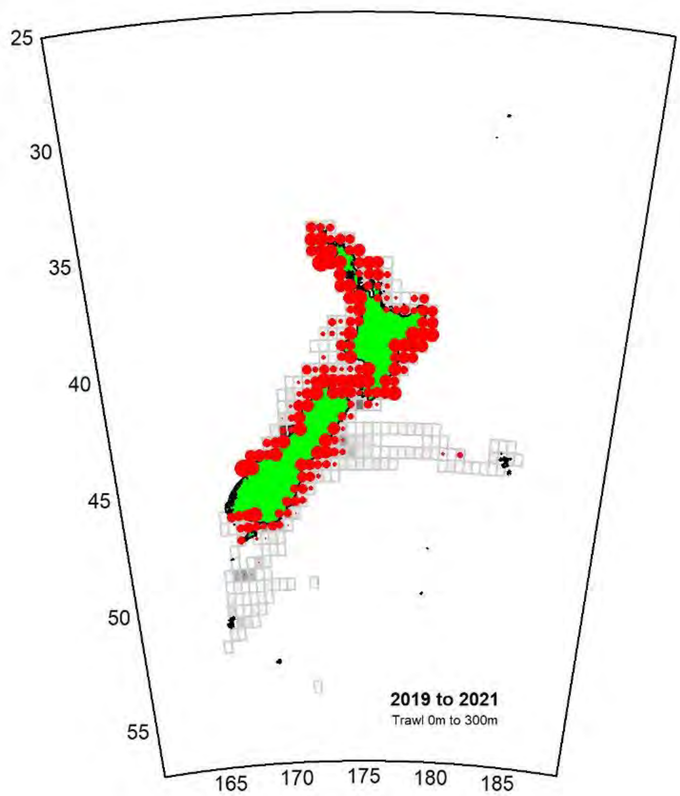


Figure 45.5 (cont.): Maps of rig occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

46. Rubyfish (RBY)

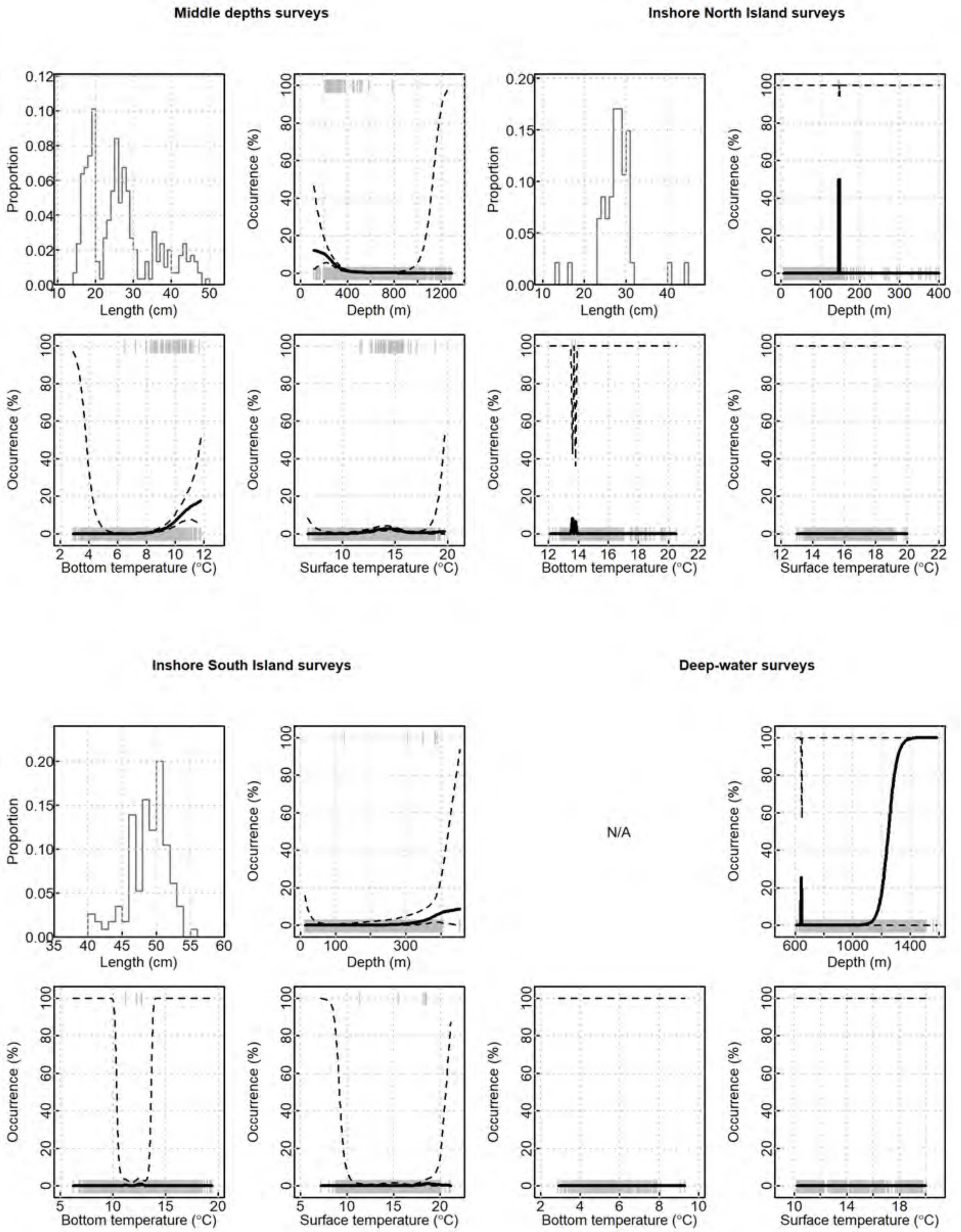


Figure 46.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to rubyfish occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

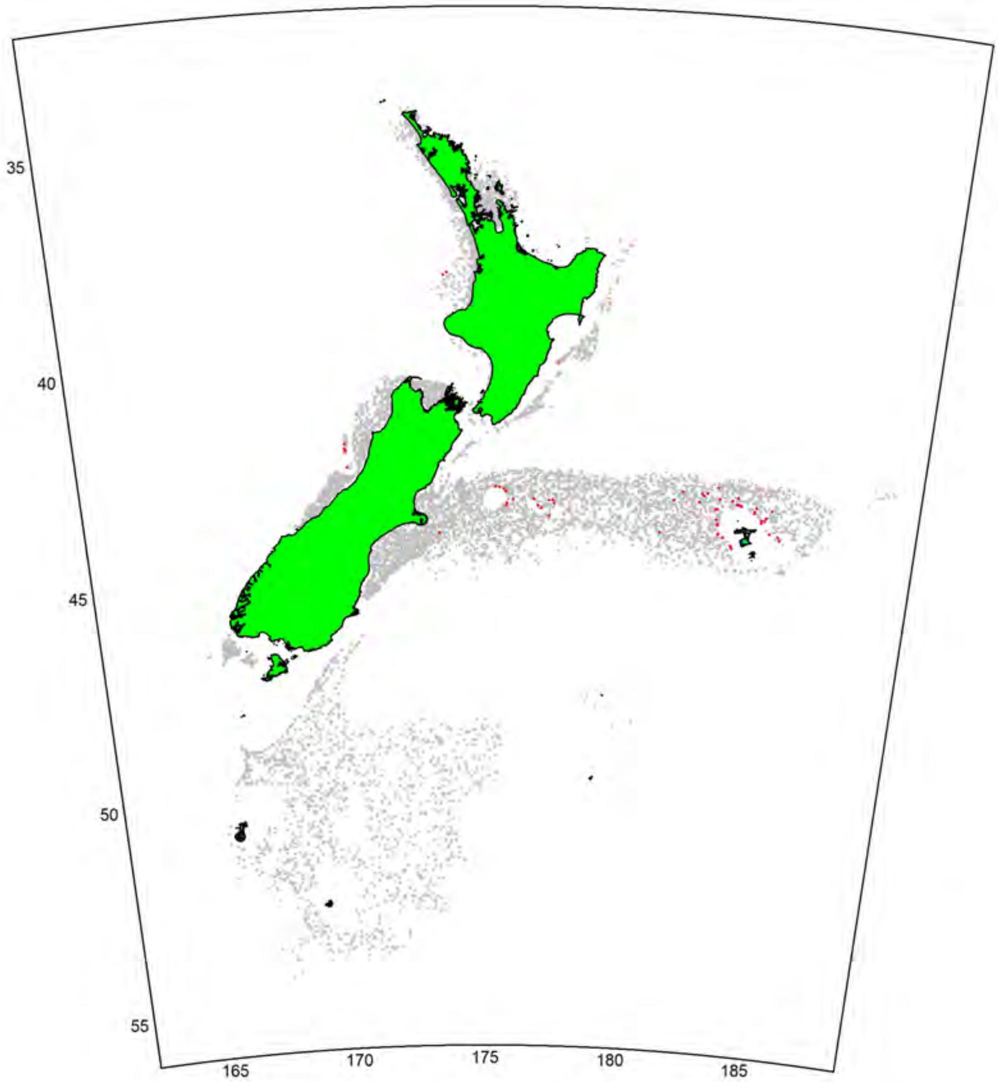


Figure 46.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where rubyfish was caught (red points).

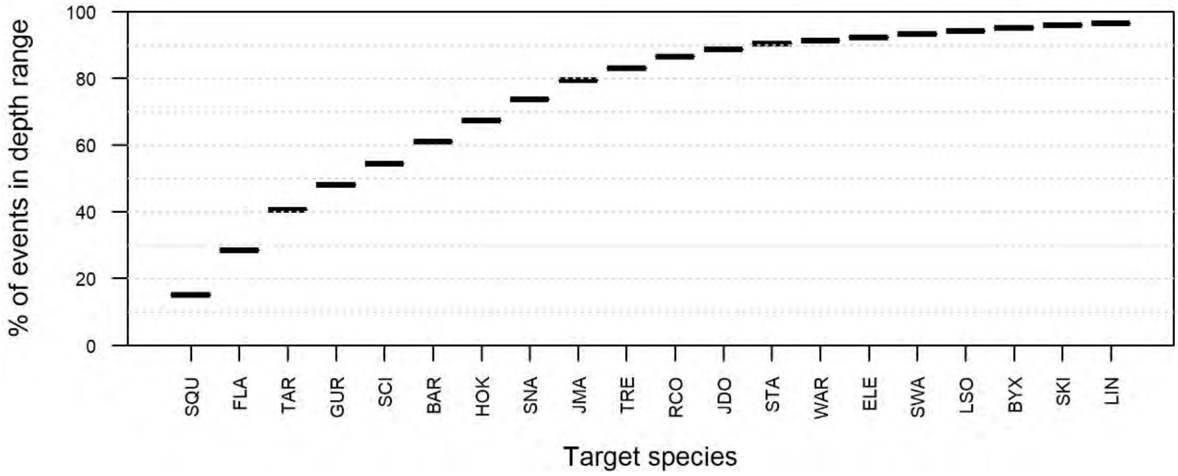
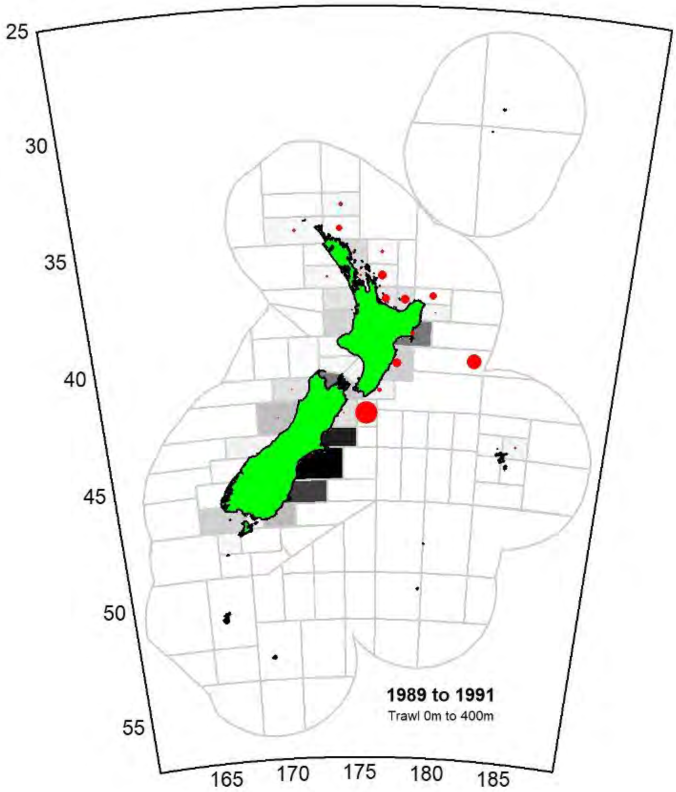


Figure 46.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for rubyfish (0–400 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.



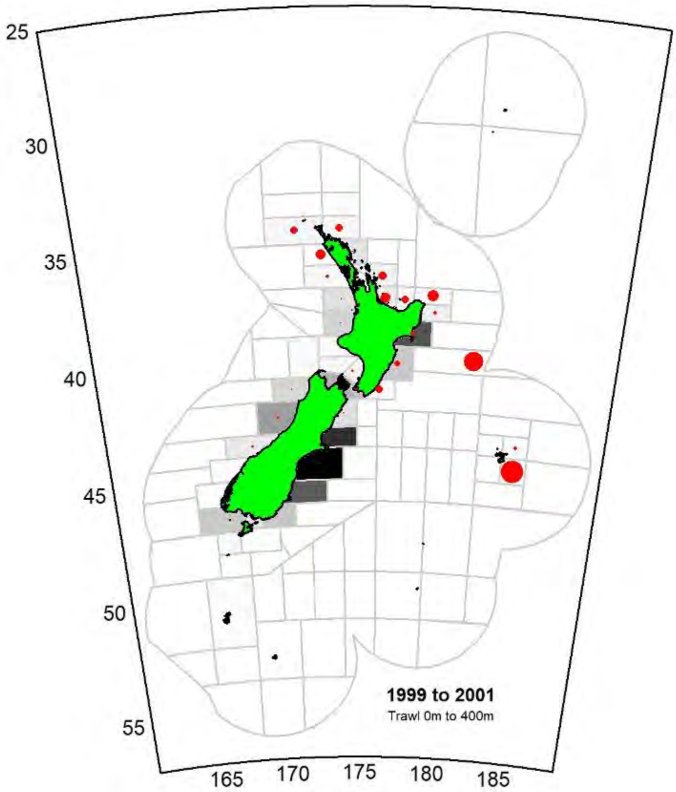
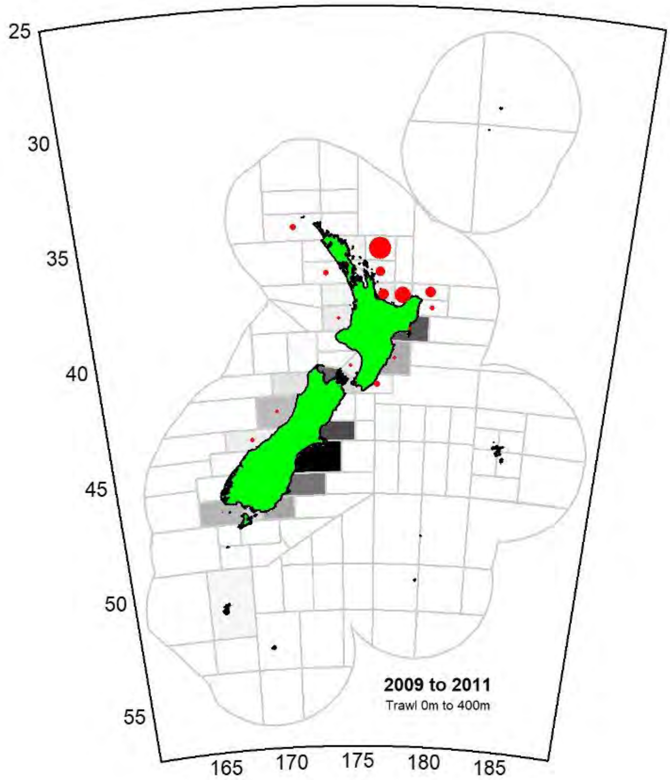


Figure 46.4: Maps of rubyfish occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



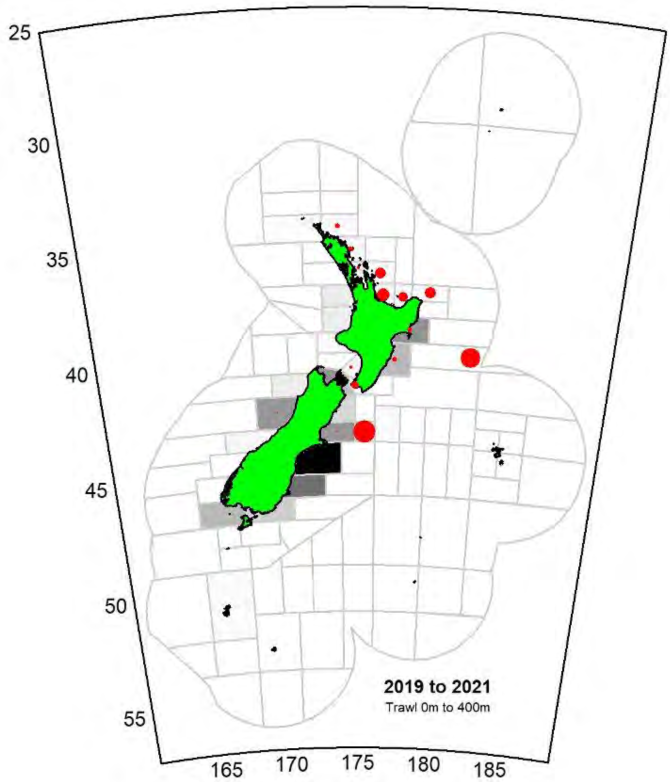


Figure 46.4 (cont.): Maps of rubyfish occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

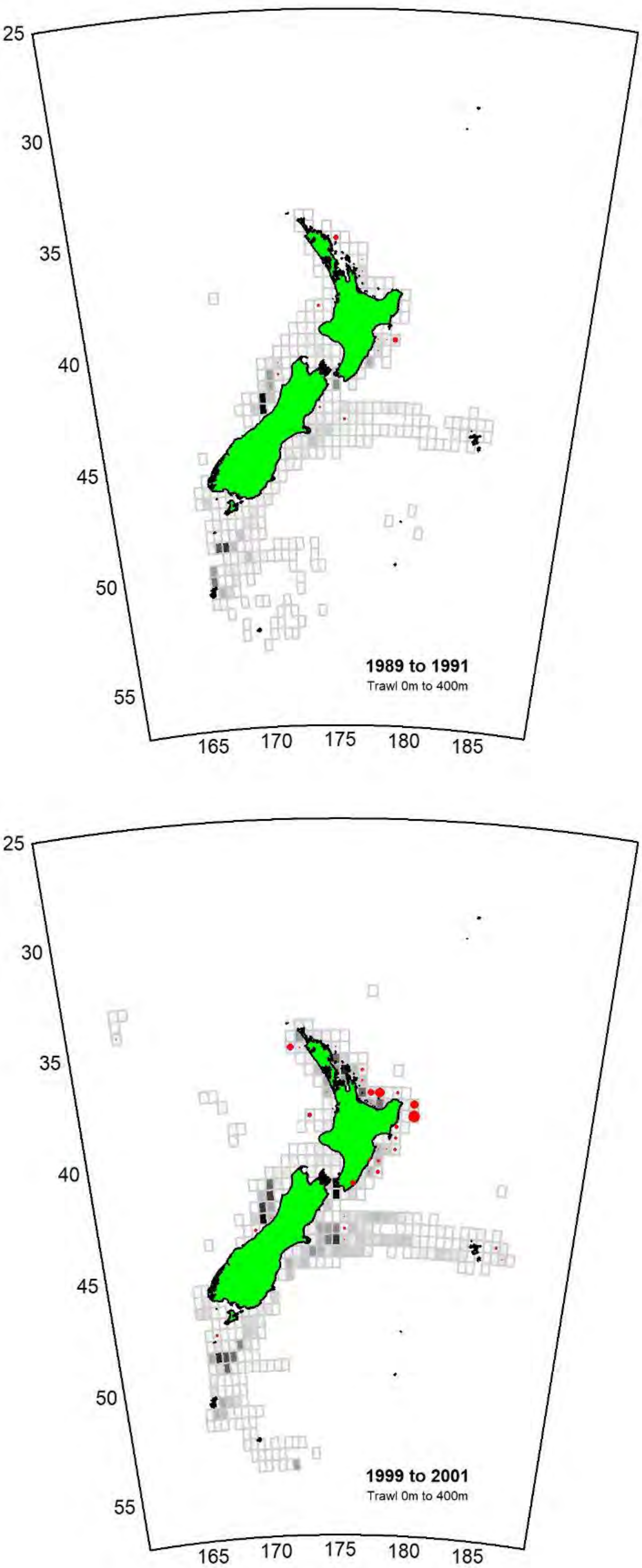
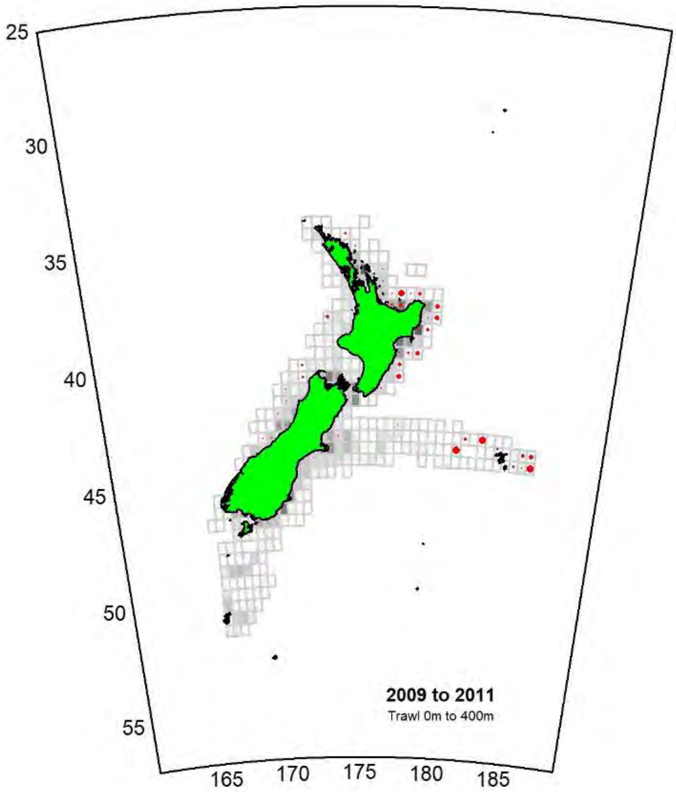


Figure 46.5: Maps of rubyfish occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



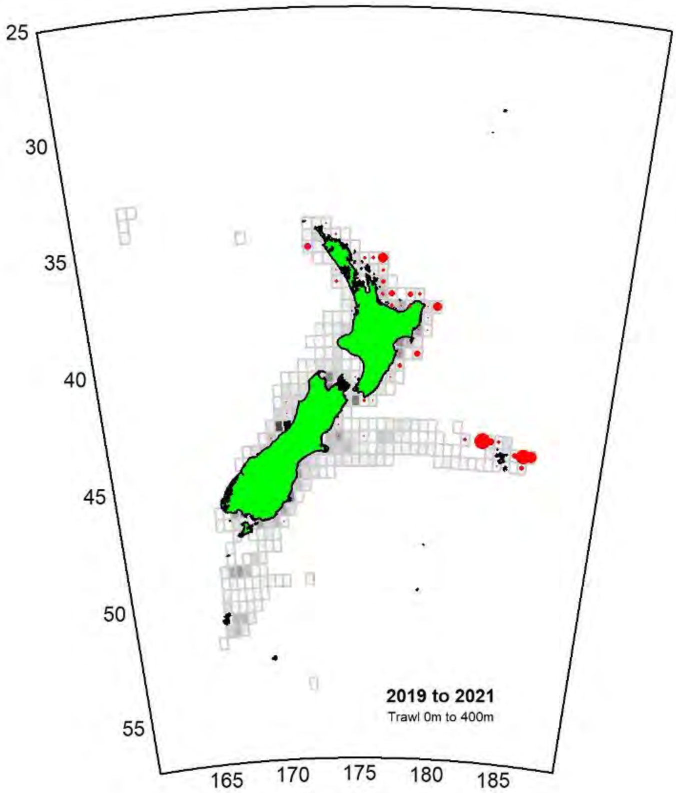


Figure 46.5 (cont.): Maps of rubyfish occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

47. School shark (SCH)

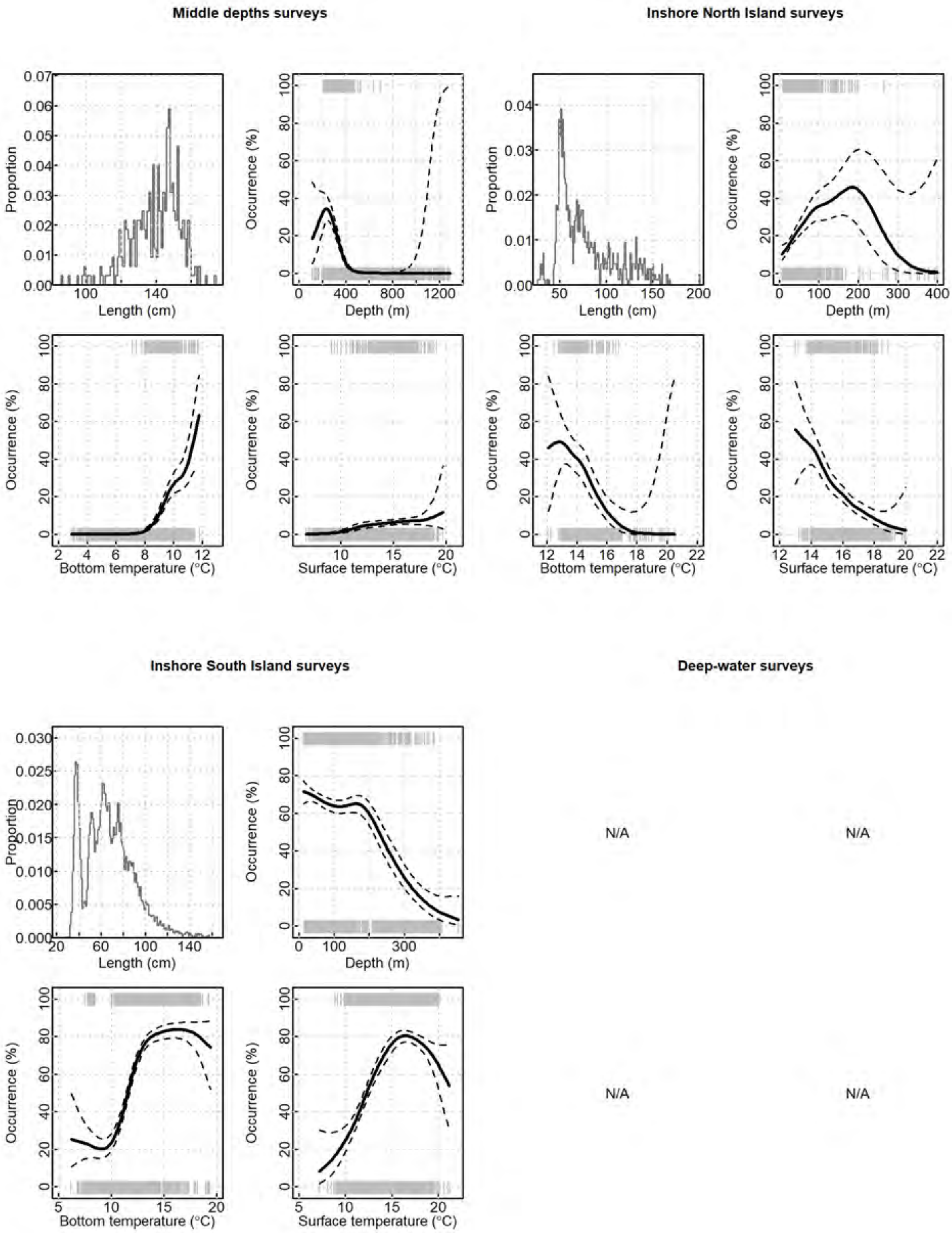


Figure 47.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to school shark occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

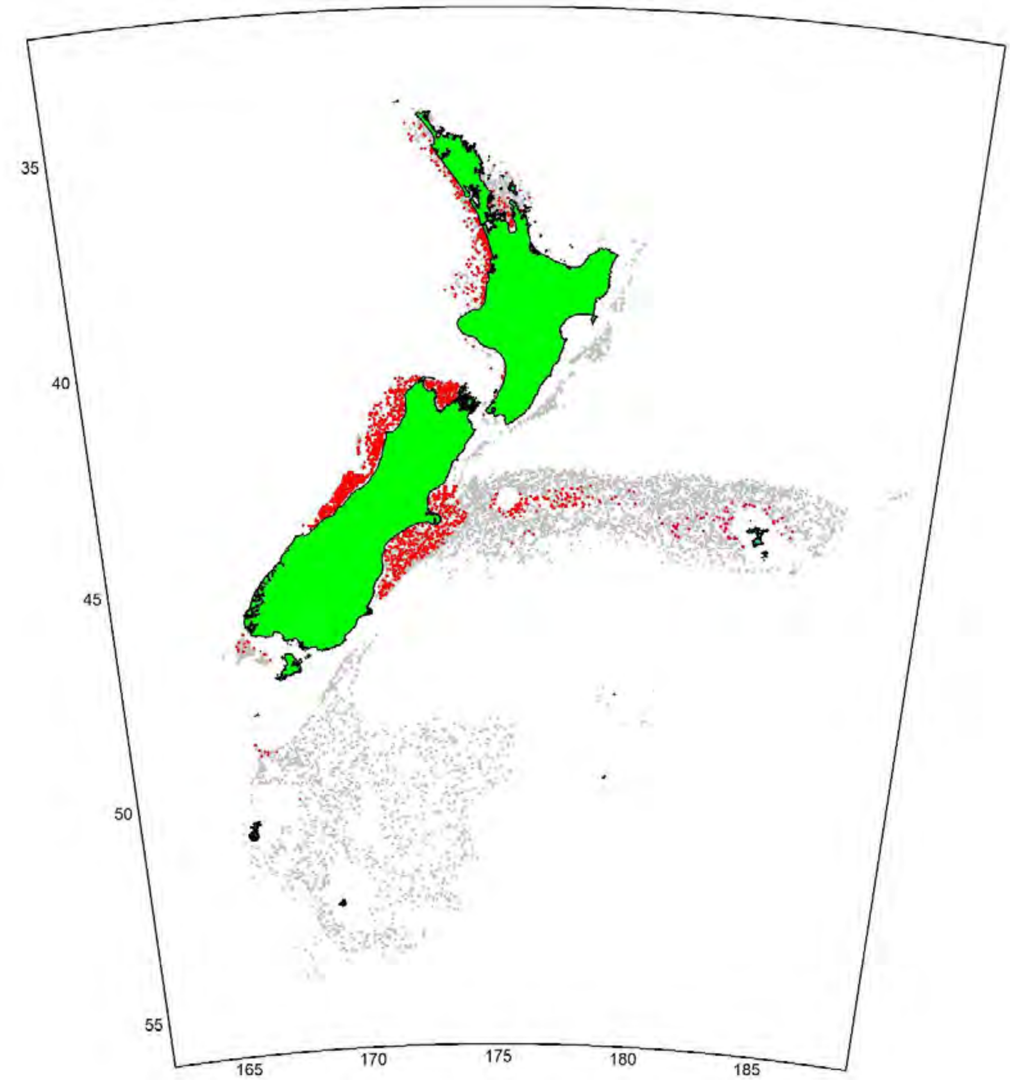


Figure 47.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where school shark was caught (red points).

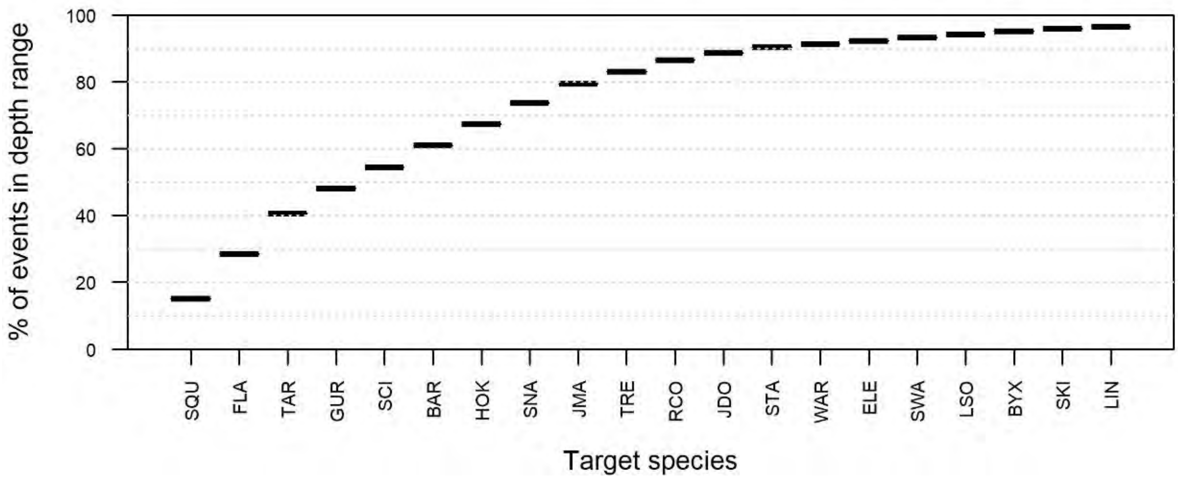
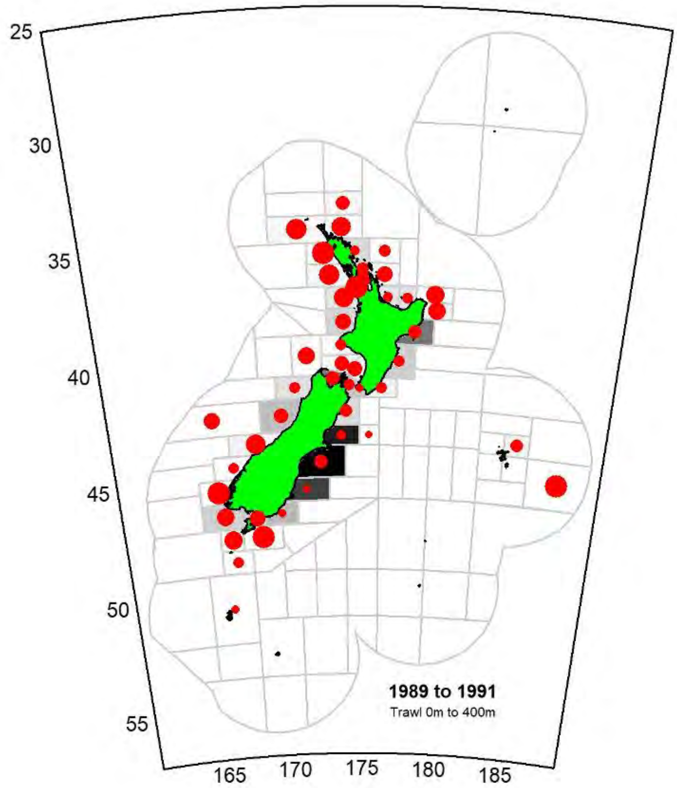


Figure 47.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for school shark (0–400 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.



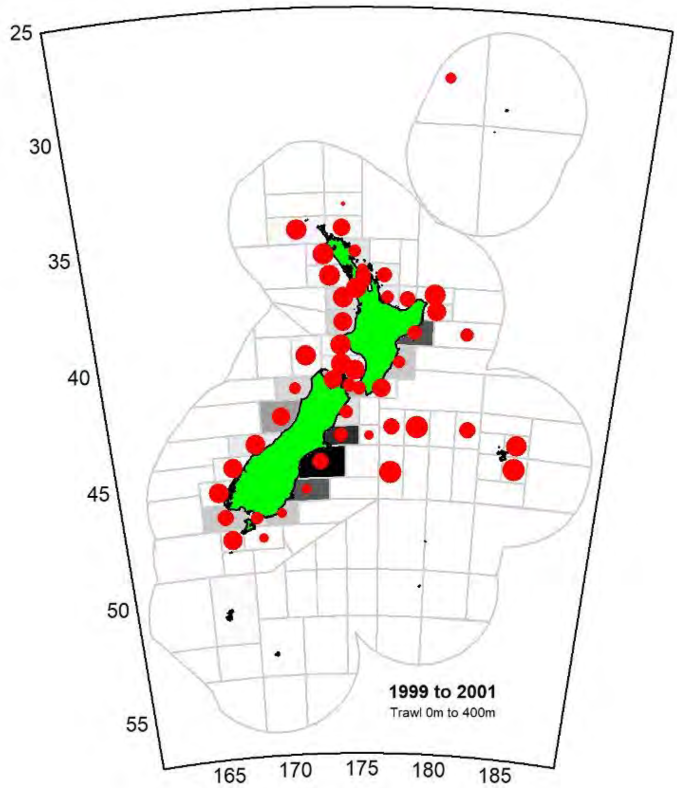
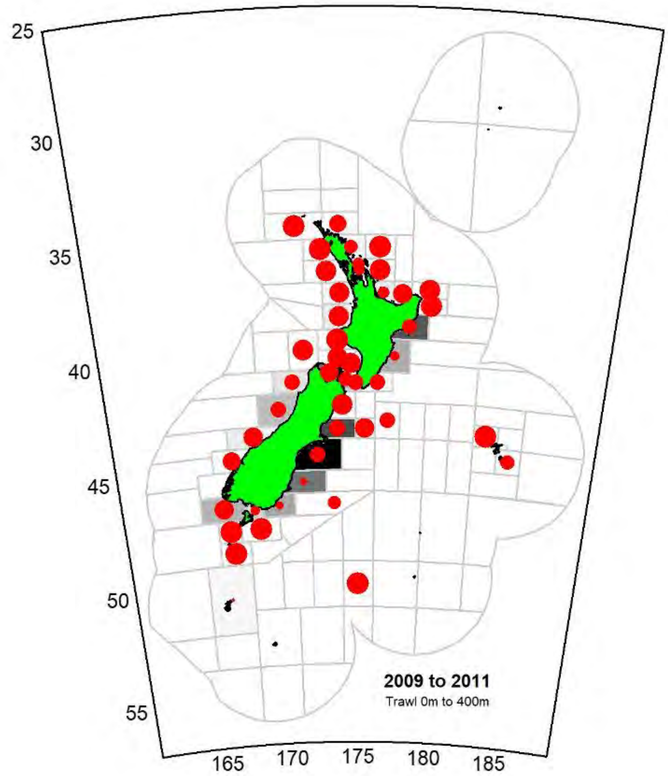


Figure 47.4: Maps of school shark occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



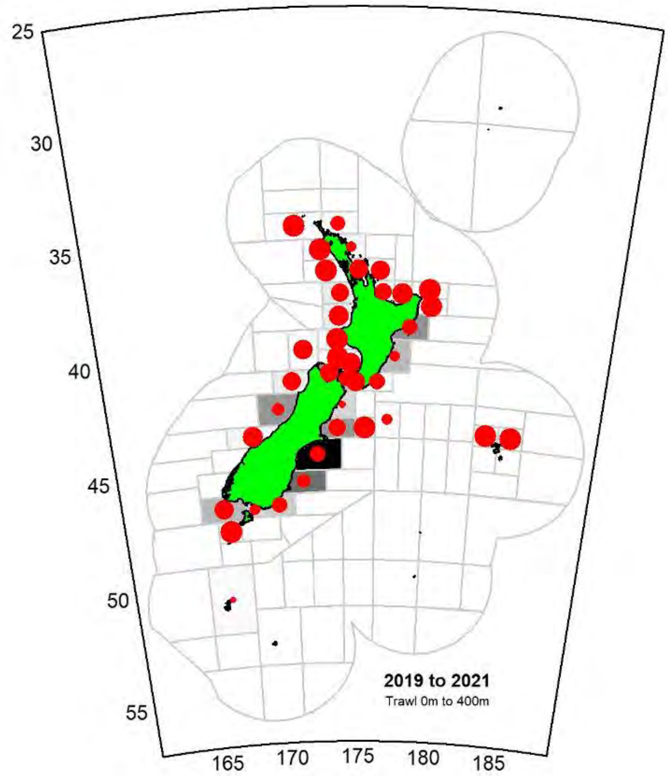


Figure 47.4 (cont.): Maps of school shark occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

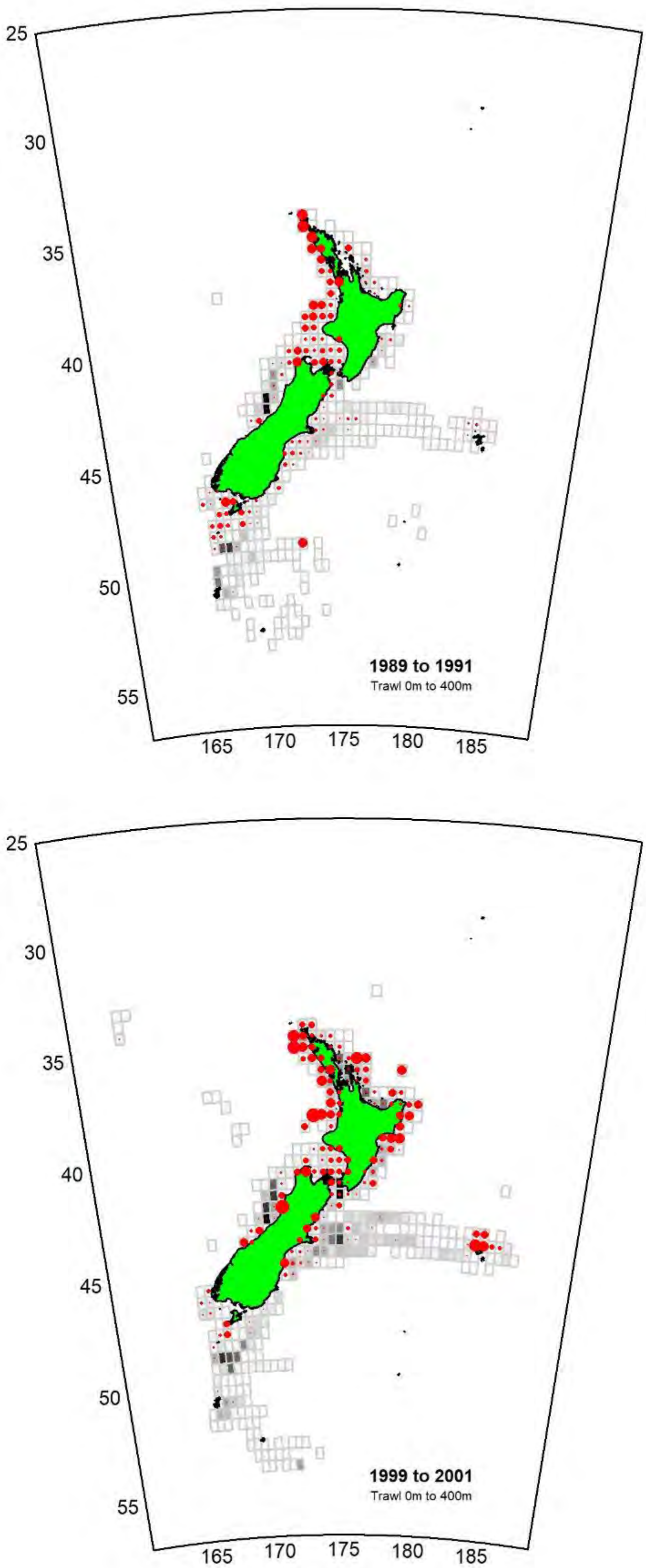
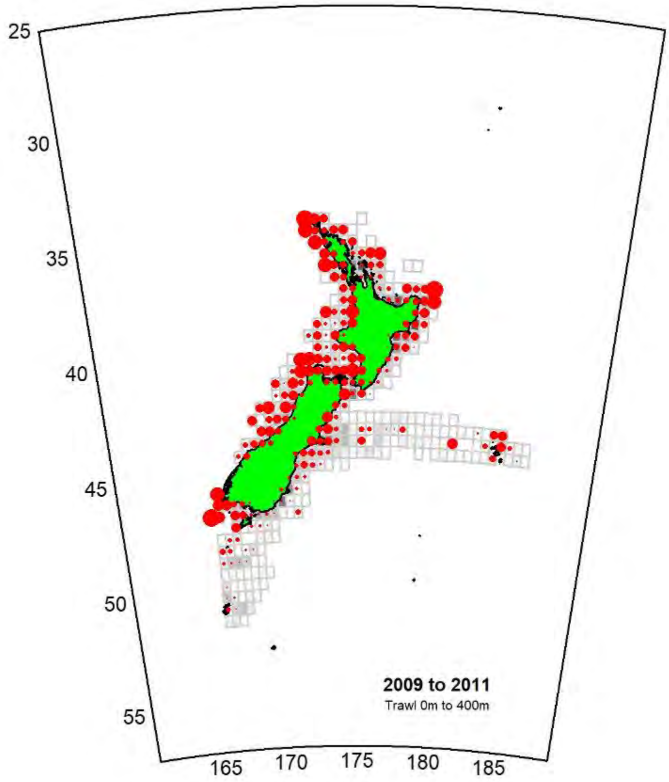


Figure 47.5: Maps of school shark occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



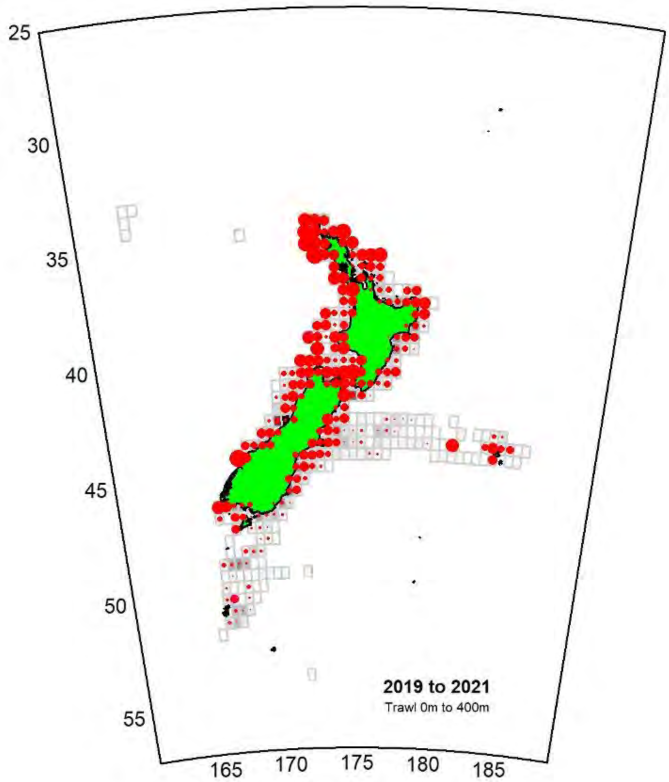


Figure 47.5 (cont.): Maps of school shark occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

48. Sea perch (Research, SPE, HBA, HPC; Commercial, SPE)

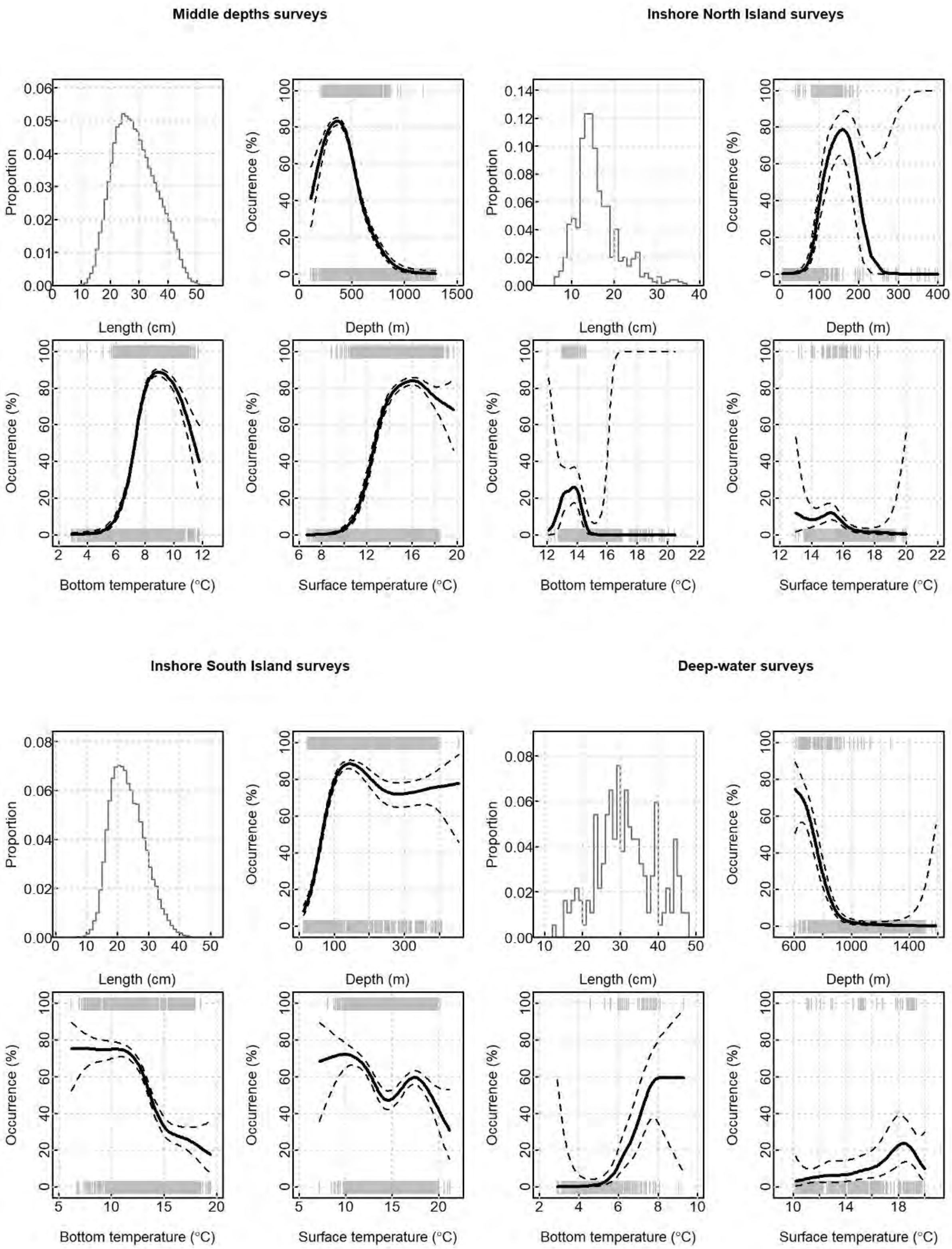


Figure 48.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to sea perch (SPE) occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data. There were insufficient data to conduct analyses for HBA and HPC.

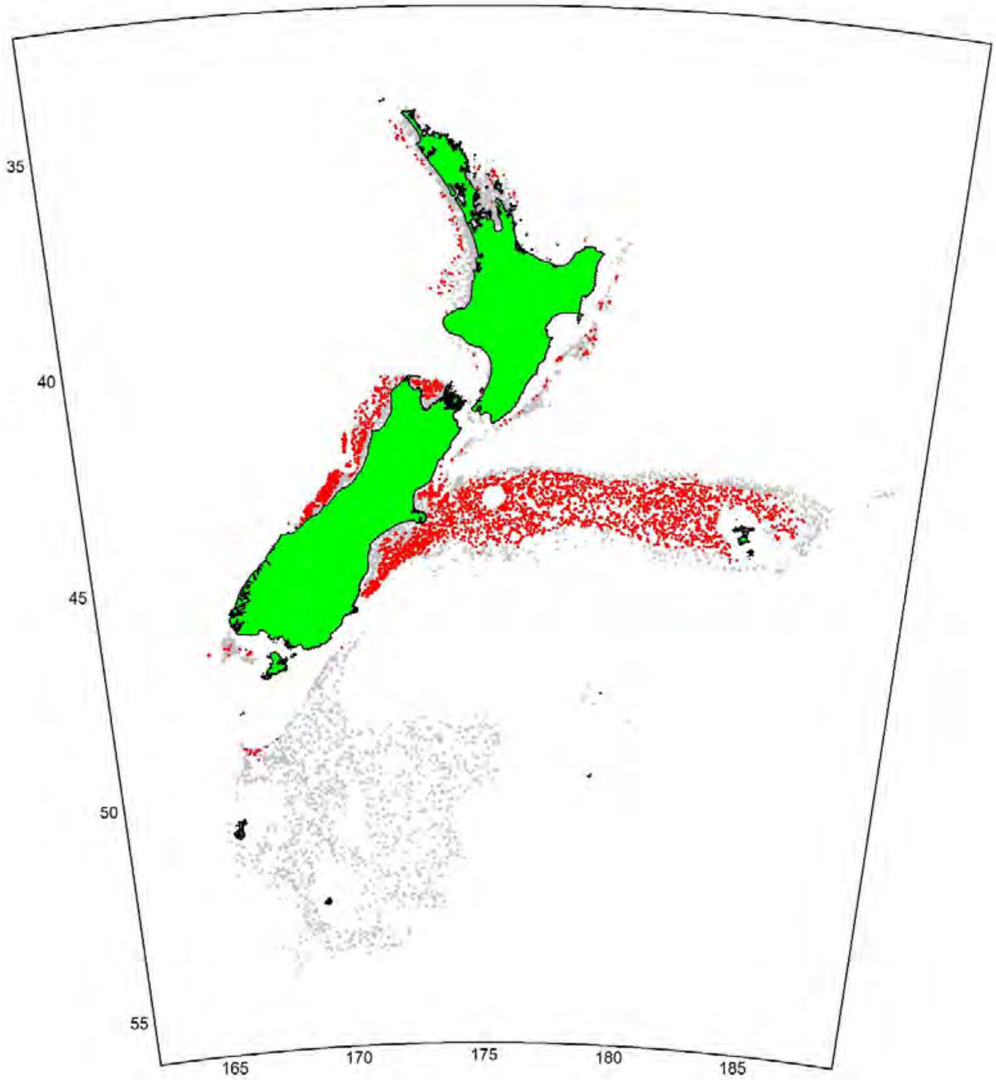


Figure 48.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where sea perch (SPE) was caught (red points). There were insufficient data to conduct analyses for HBA and HPC.

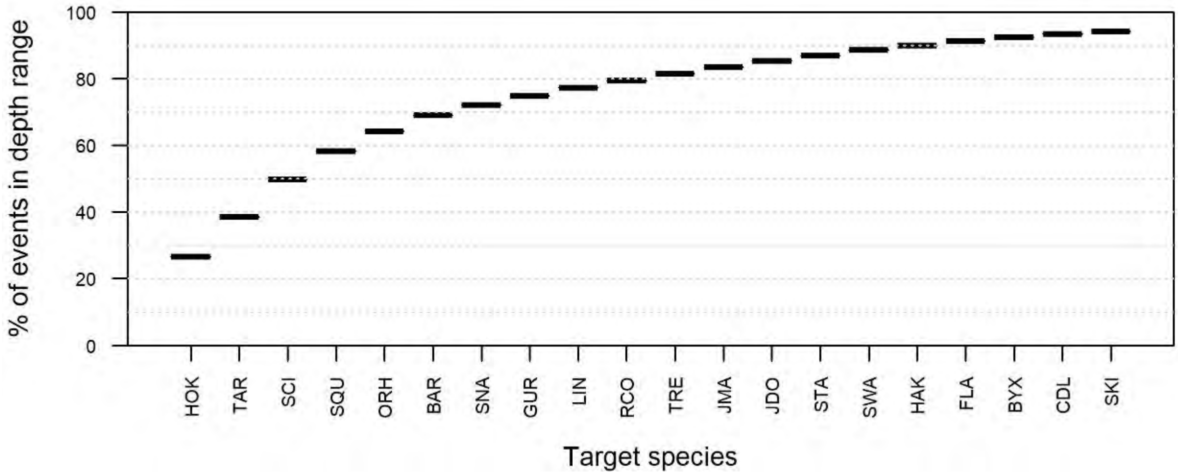
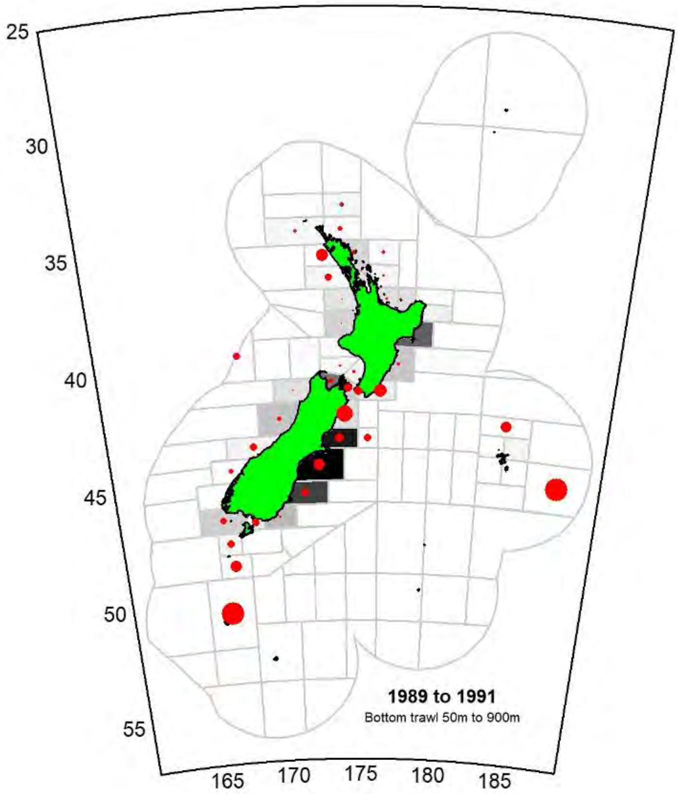


Figure 48.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for sea perch (50–900 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.



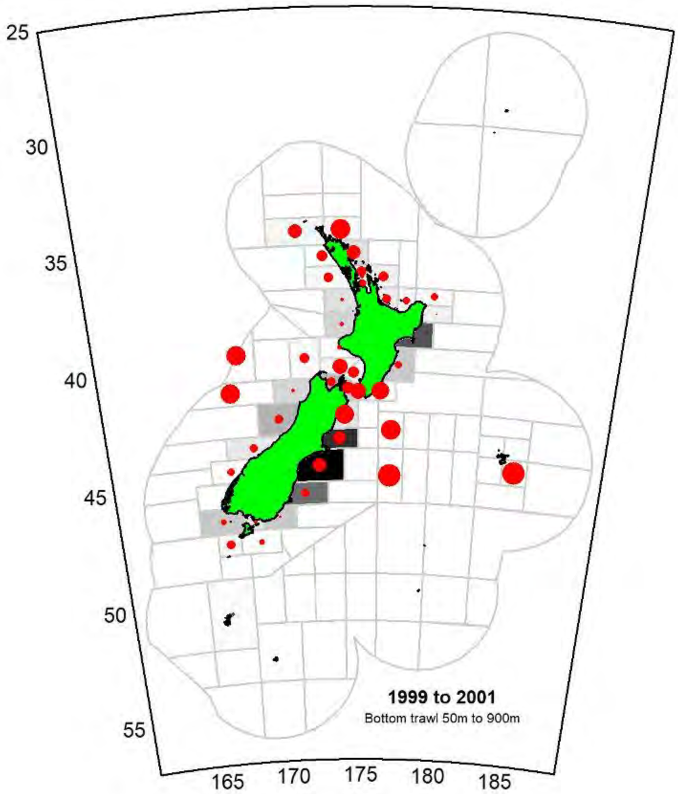
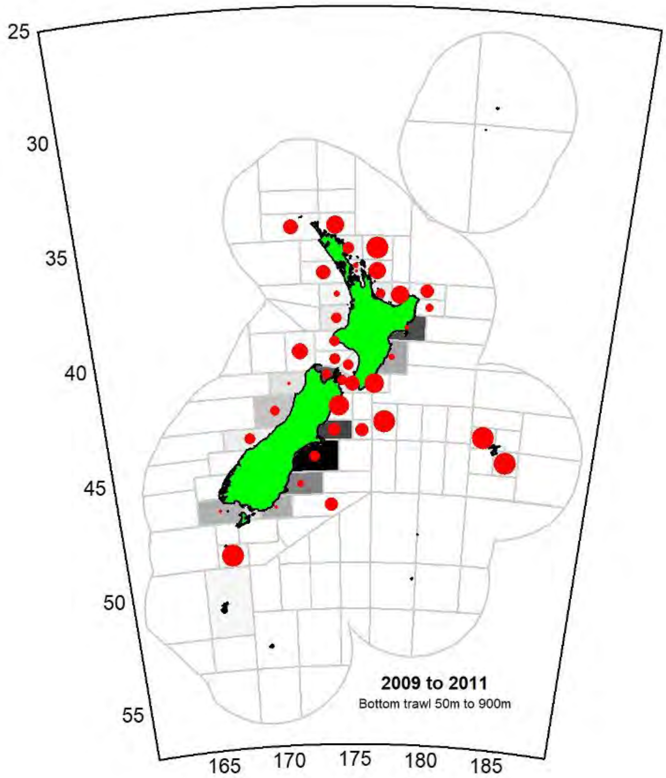


Figure 48.4: Maps of sea perch occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



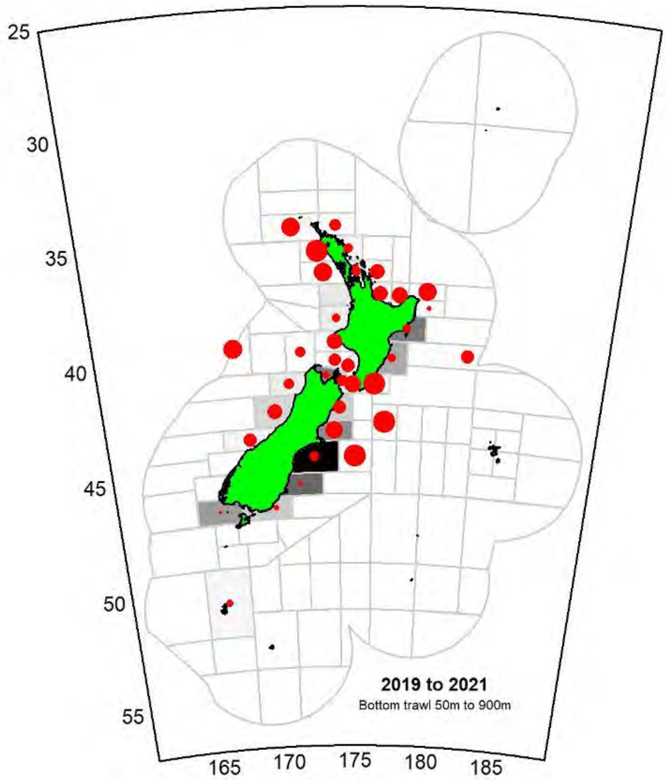
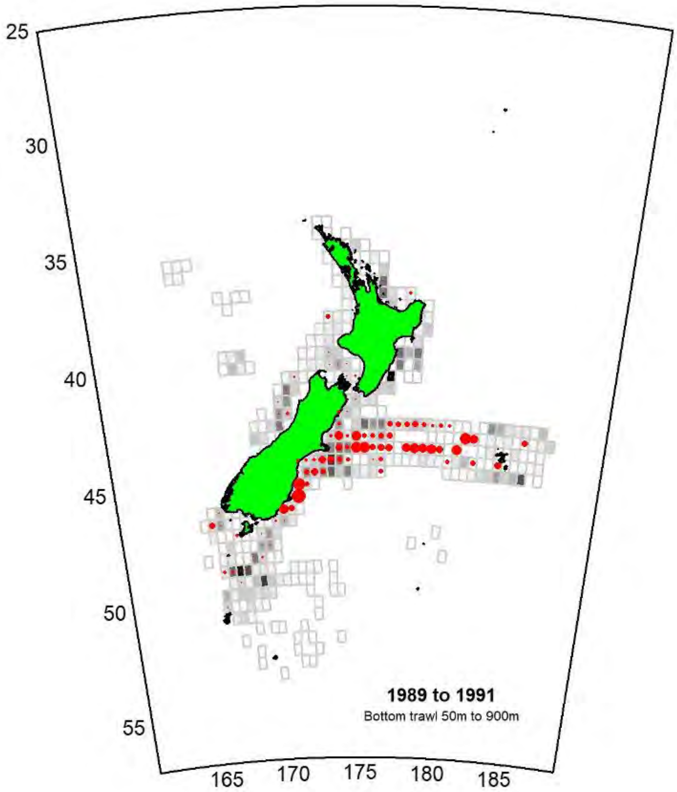


Figure 48.4 (cont.): Maps of sea perch occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



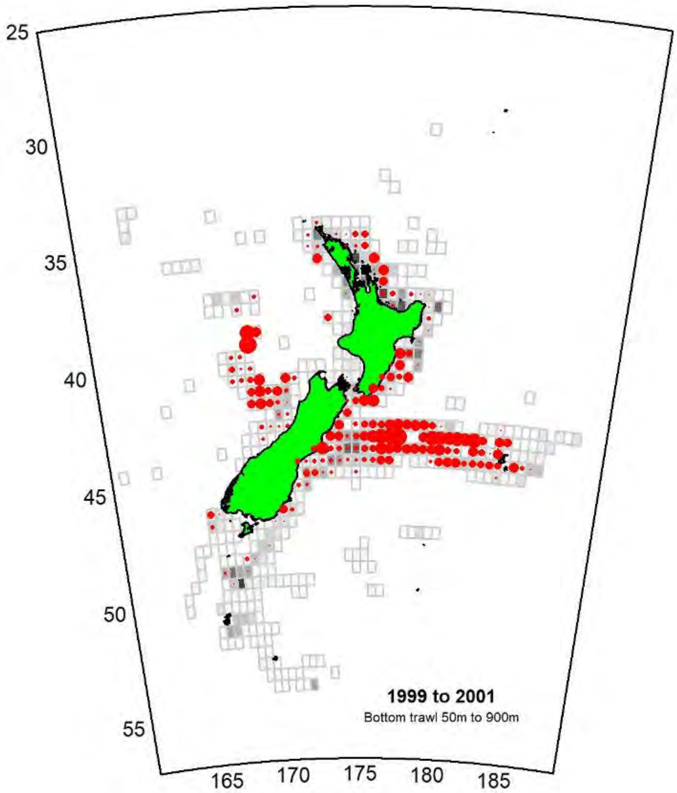
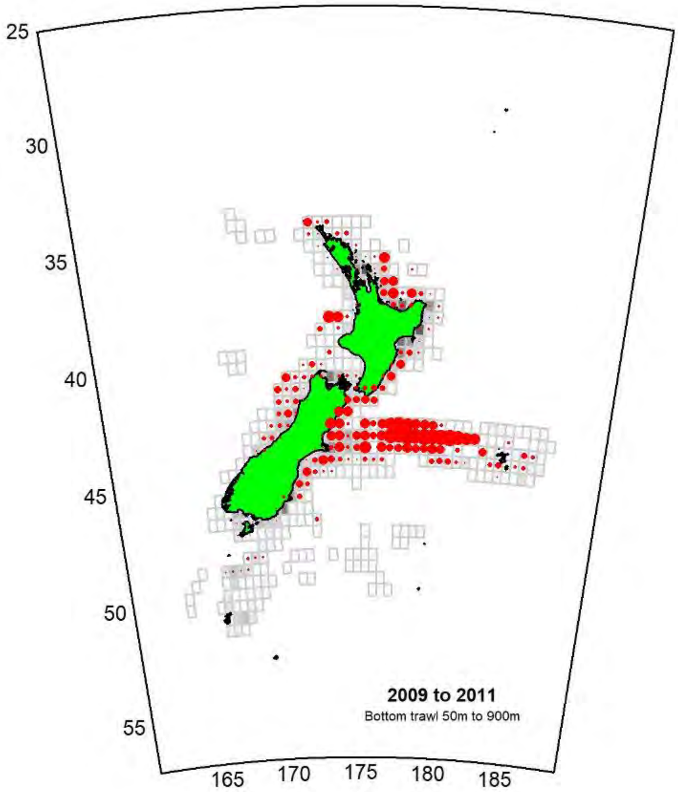


Figure 48.5: Maps of sea perch occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



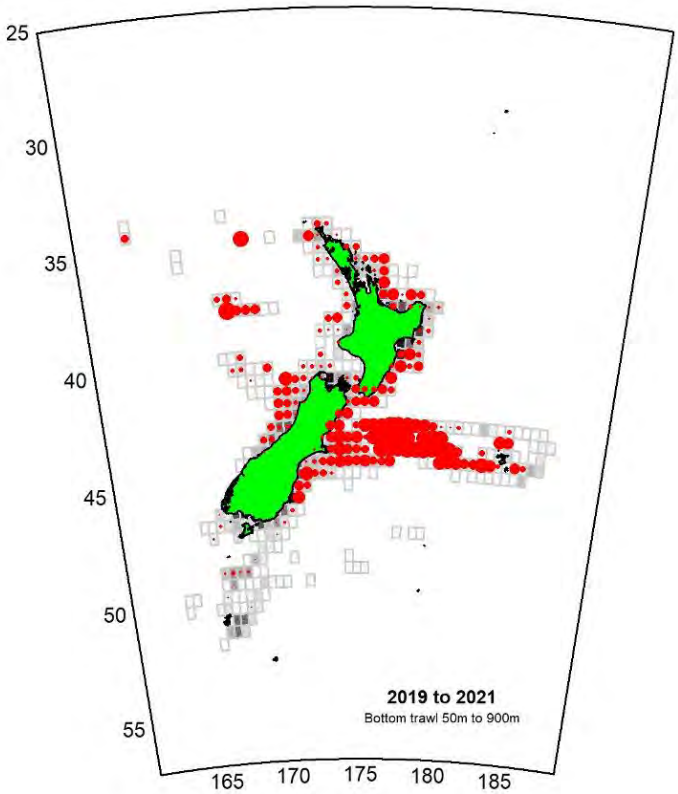


Figure 48.5 (cont.): Maps of sea perch occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

49. Silver warehou (SWA)

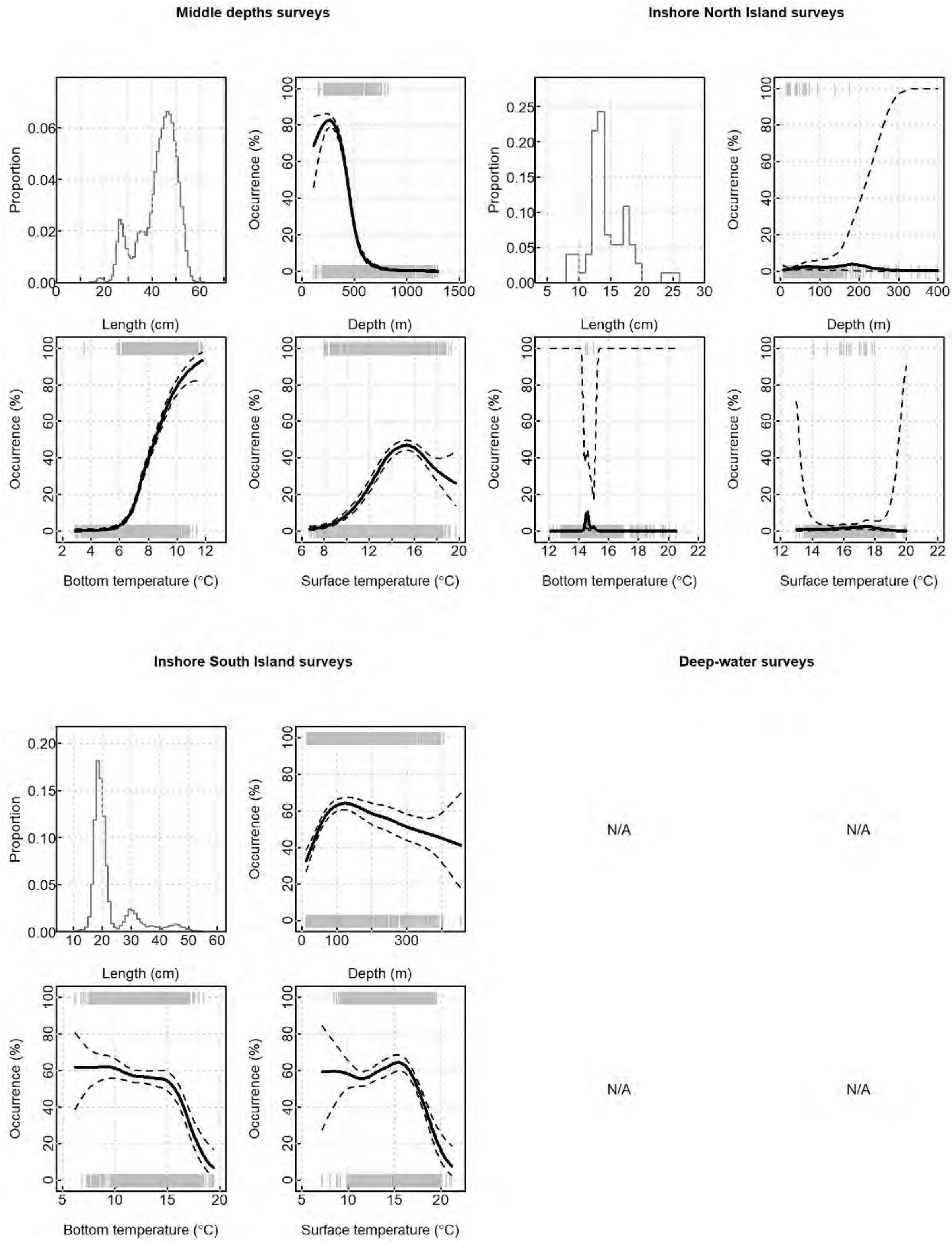


Figure 49.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to silver warehou occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

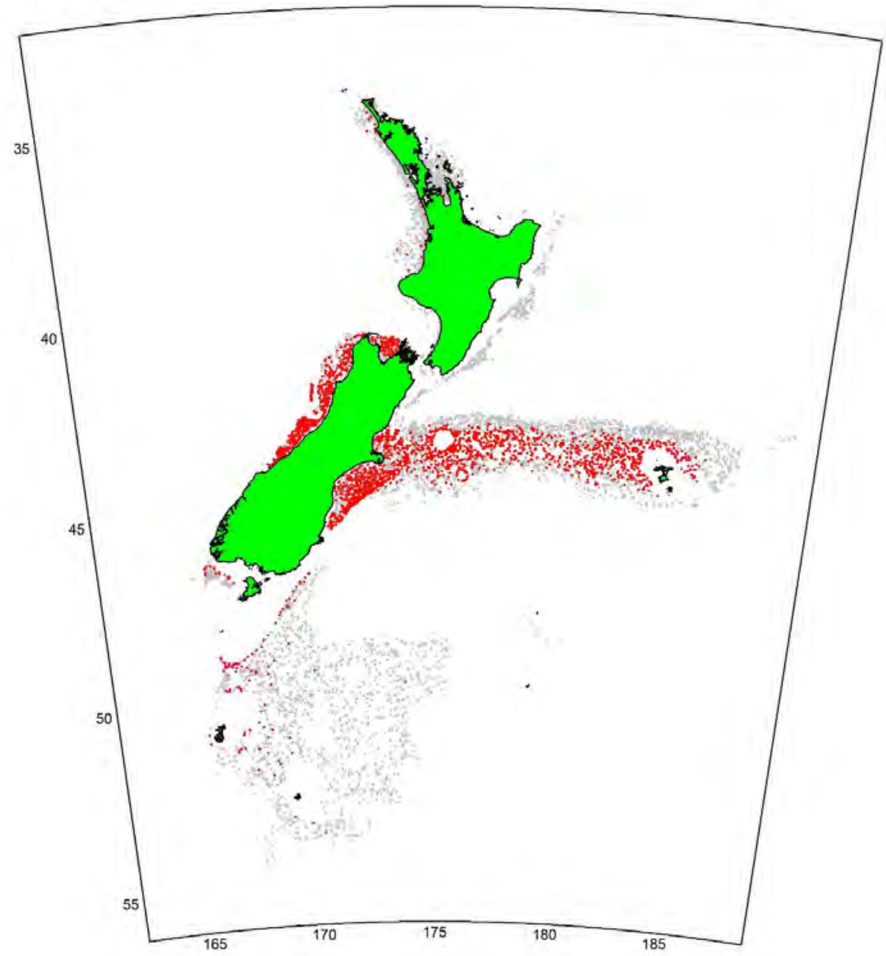


Figure 49.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where silver warehou was caught (red points).

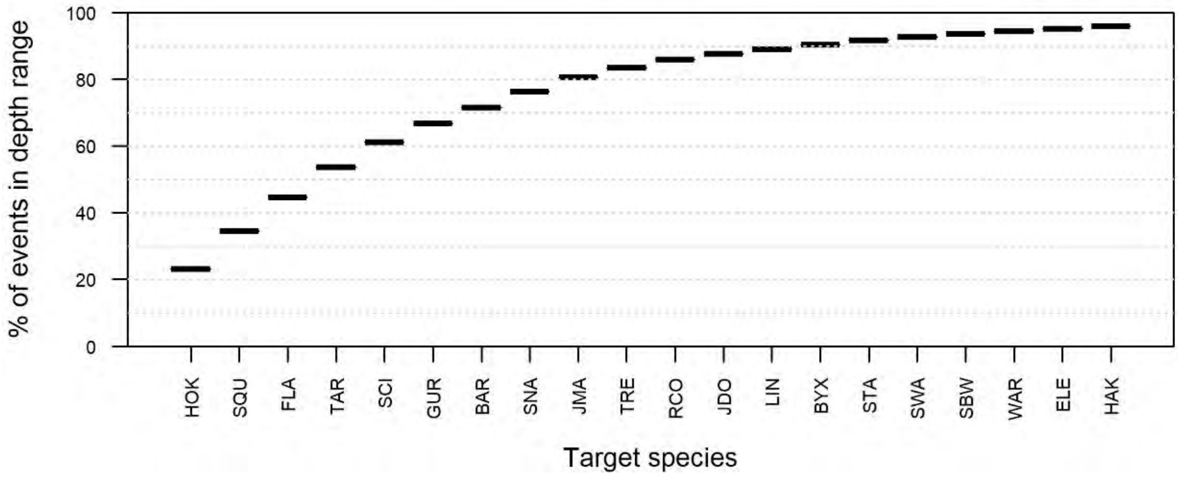


Figure 49.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for silver warehou (0–600 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.

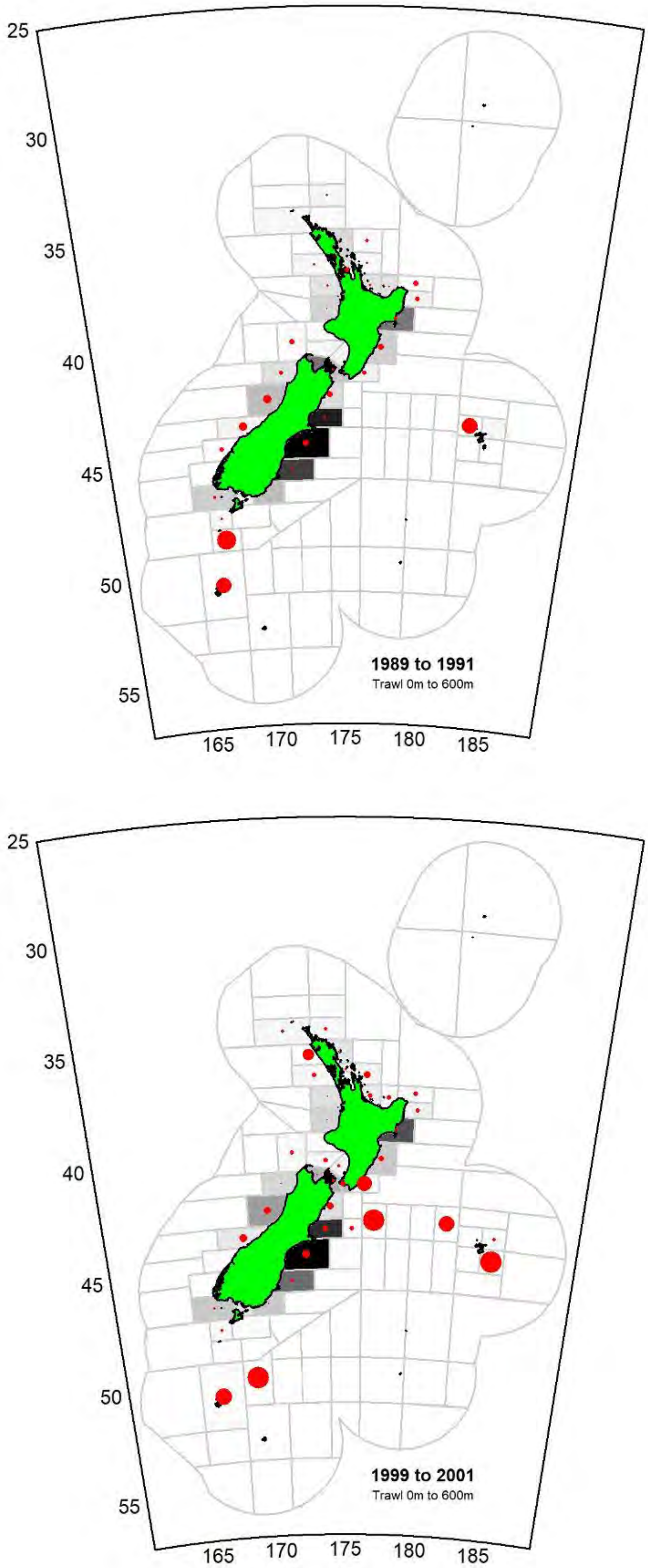
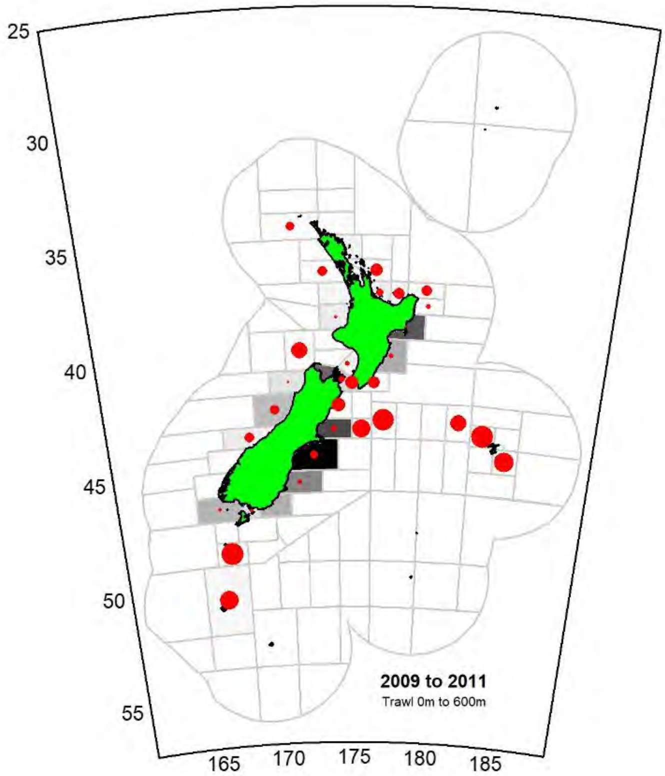


Figure 49.4: Maps of silver warehou occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



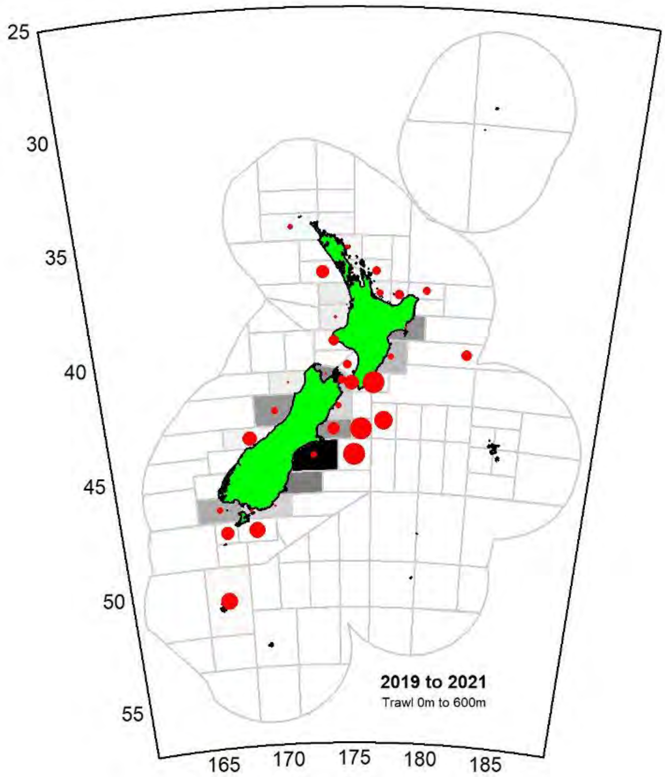


Figure 49.4 (cont.): Maps of silver warehou occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

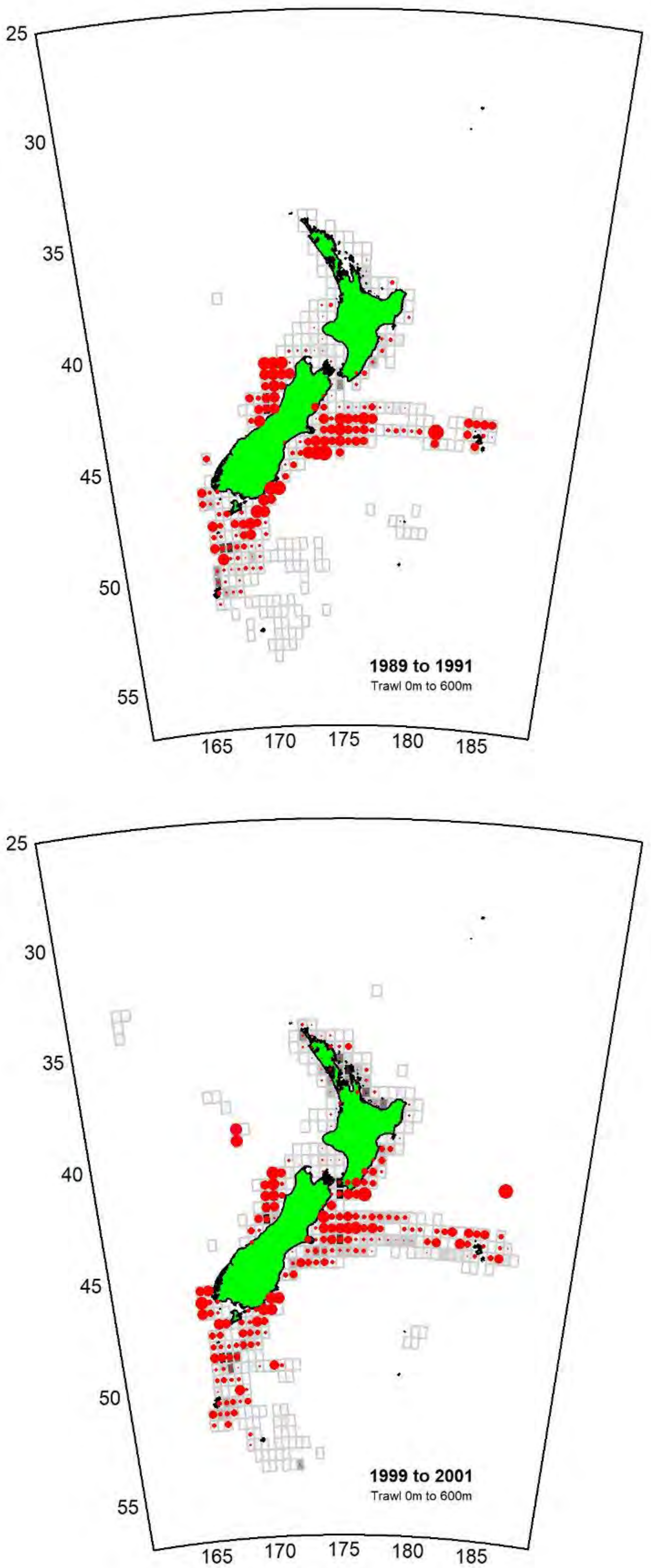
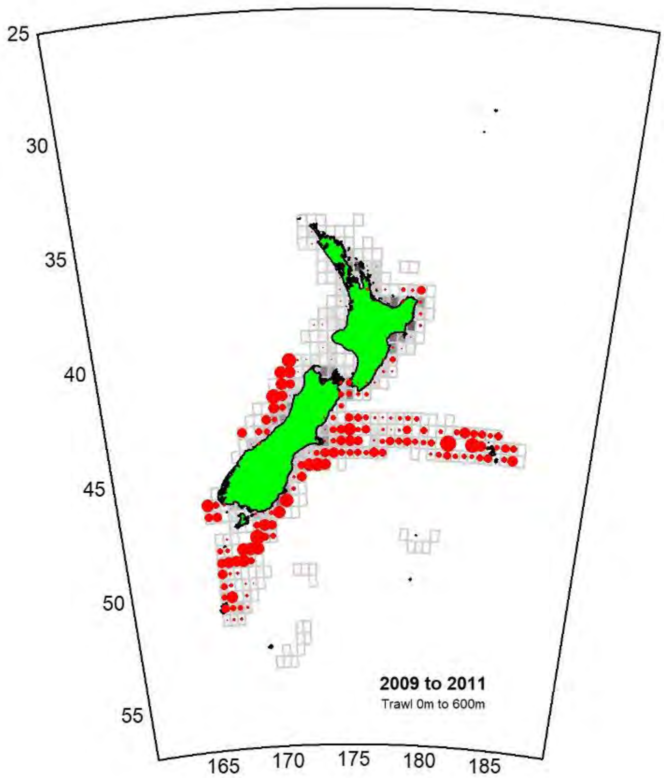


Figure 49.5: Maps of silver warehou occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



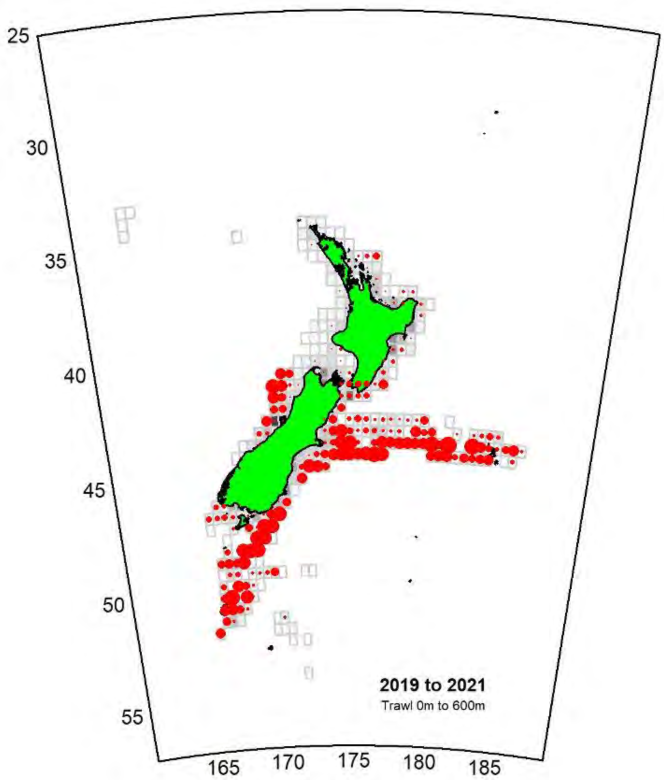


Figure 49.5 (cont.): Maps of silver warehou occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

50. Rough skate (RSK)

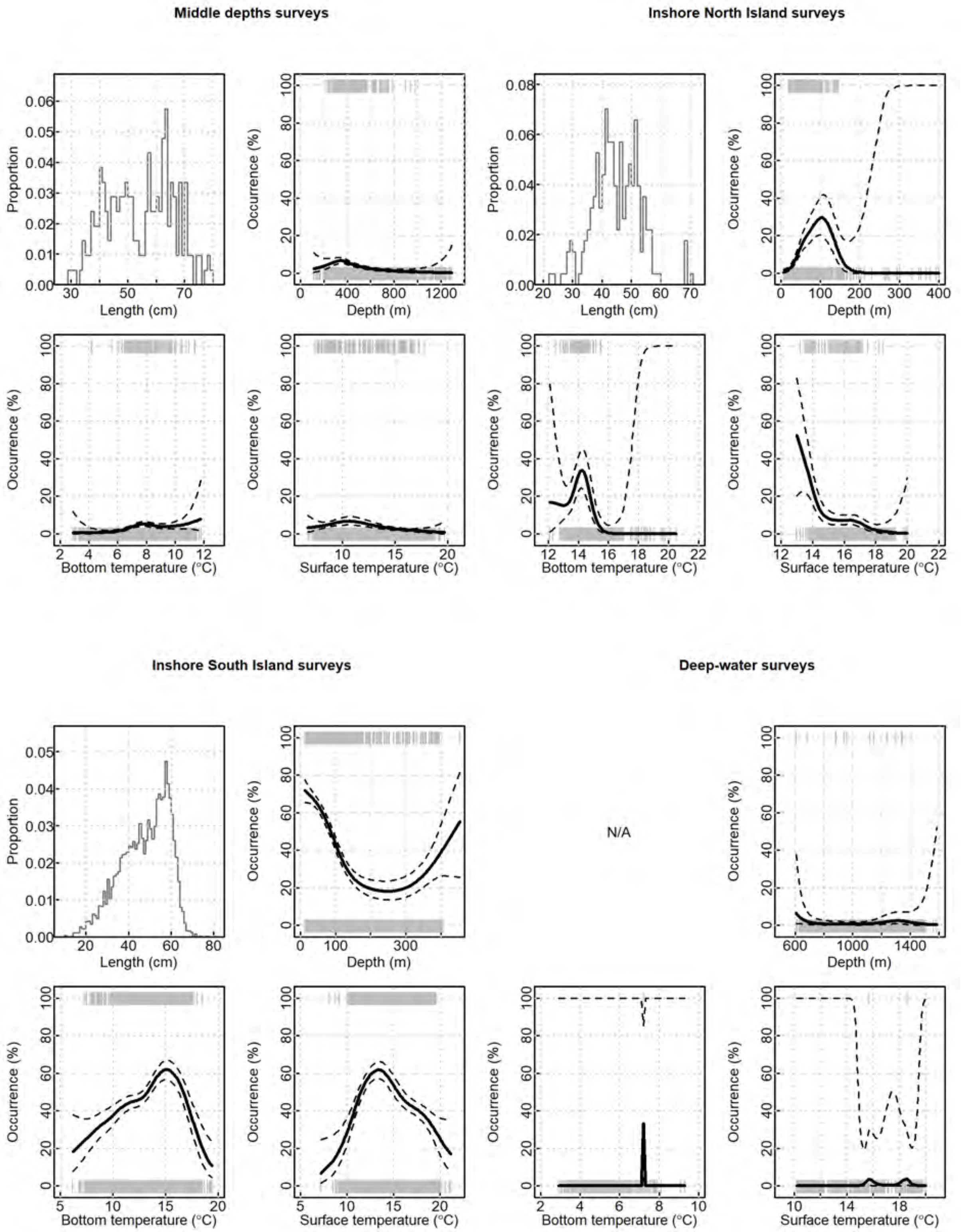


Figure 50.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to rough skate occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

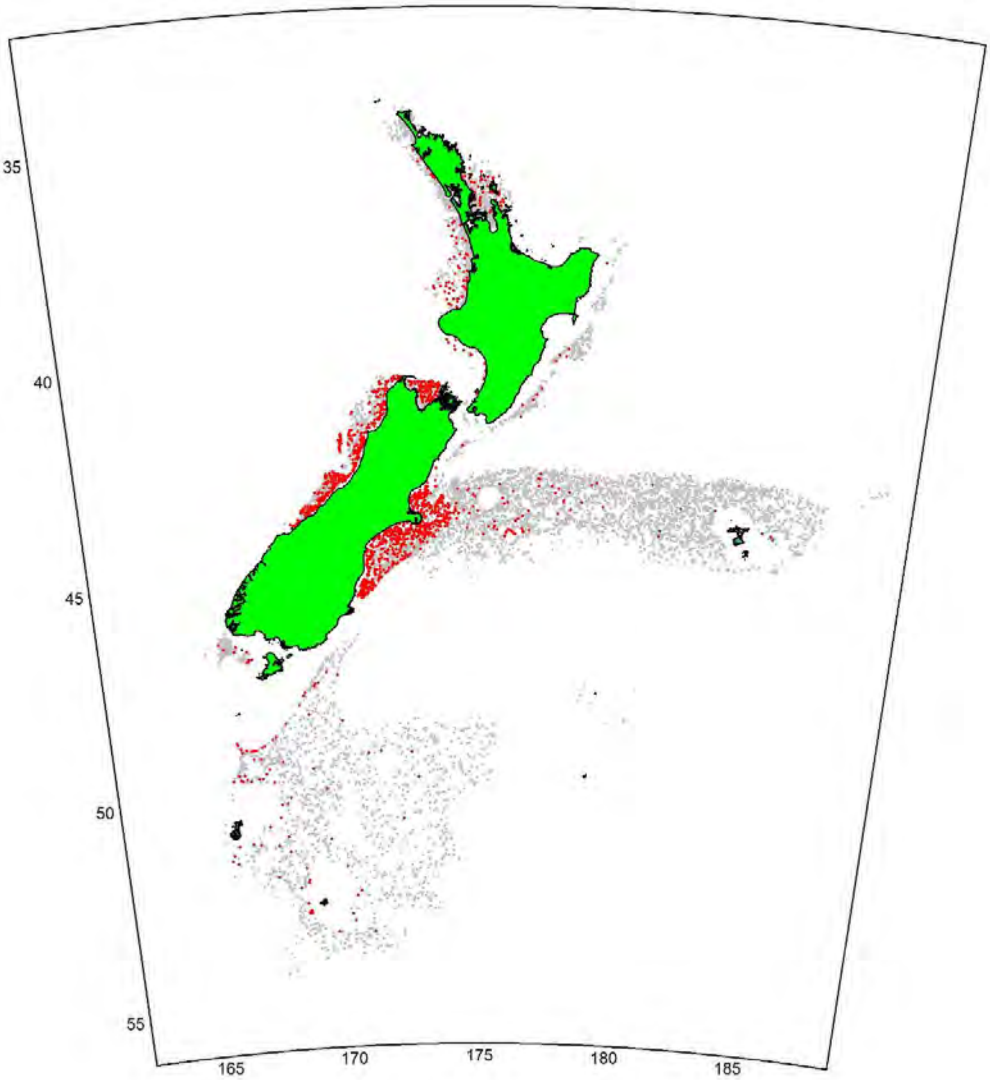


Figure 50.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where rough skate was caught (red points).

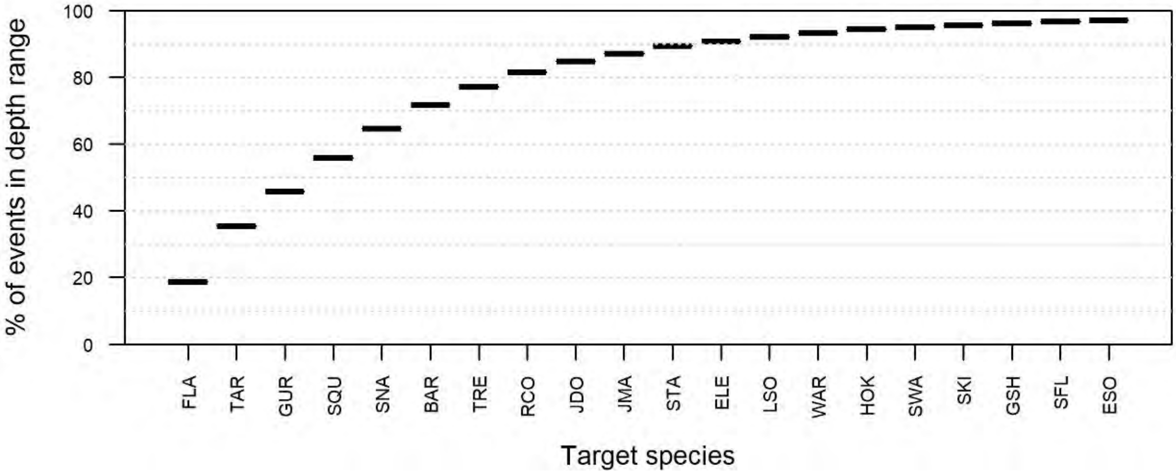
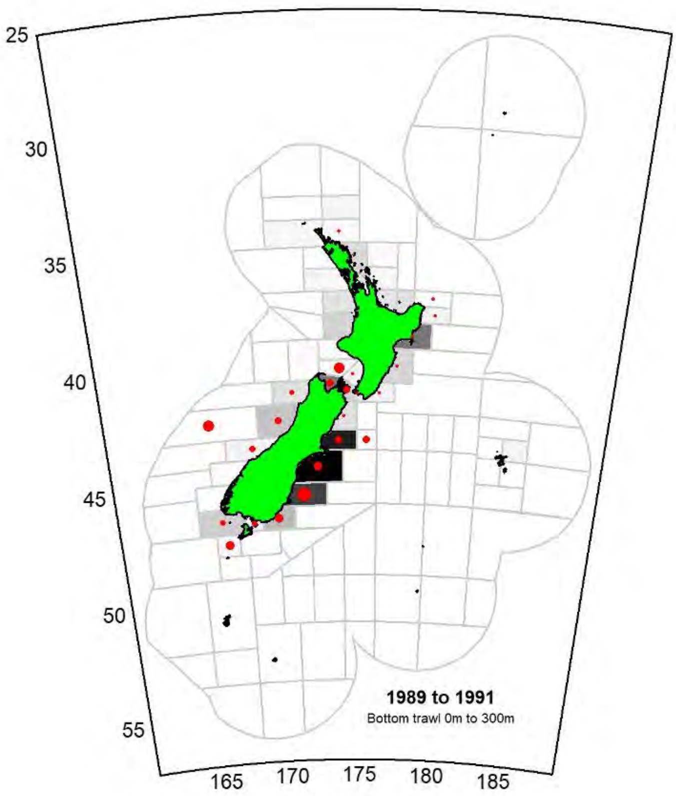


Figure 50.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for rough skate (0–300 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.



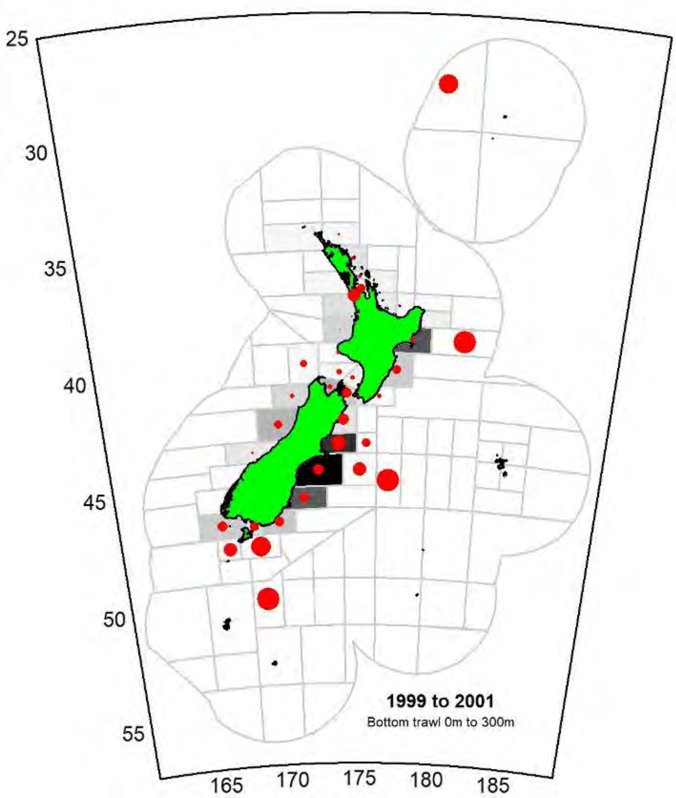
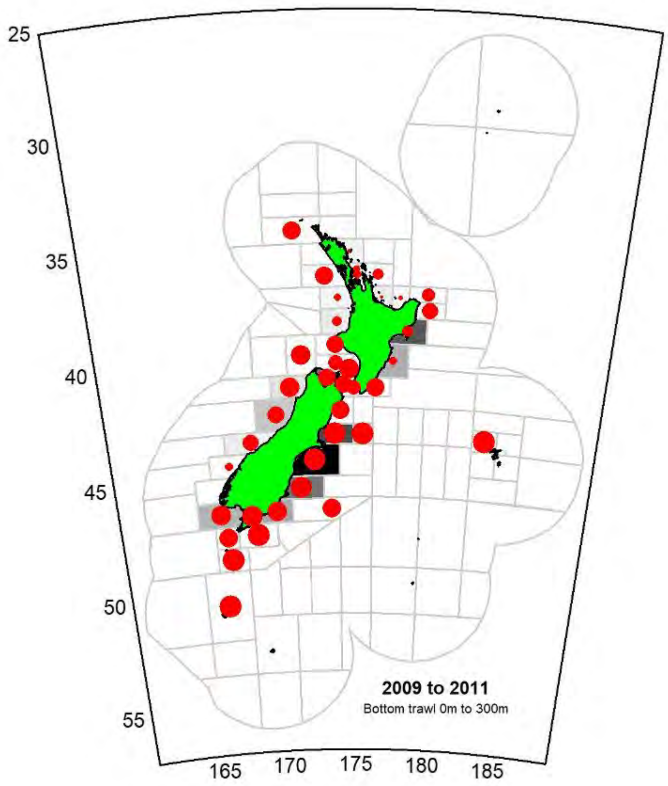


Figure 50.4: Maps of rough skate occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



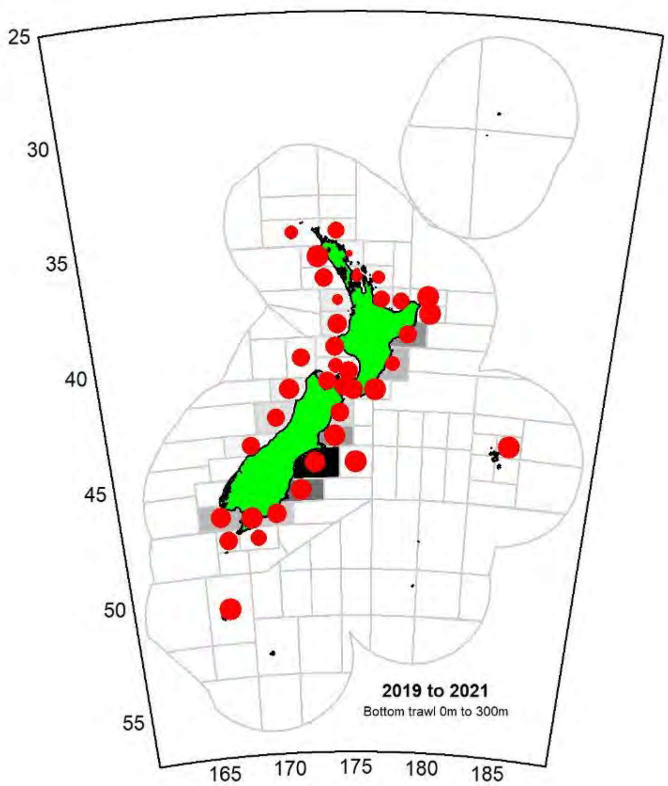


Figure 50.4 (cont.): Maps of rough skate occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

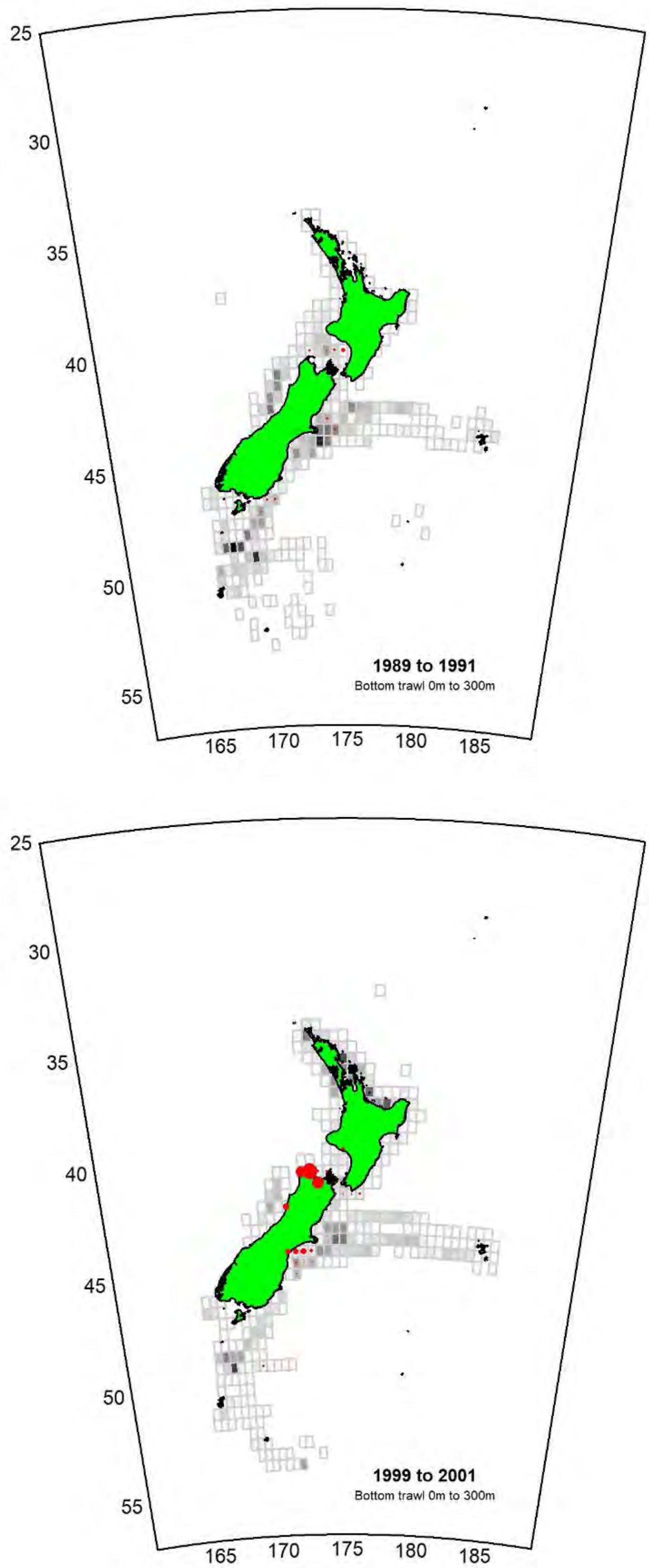


Figure 50.5: Maps of rough skate occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

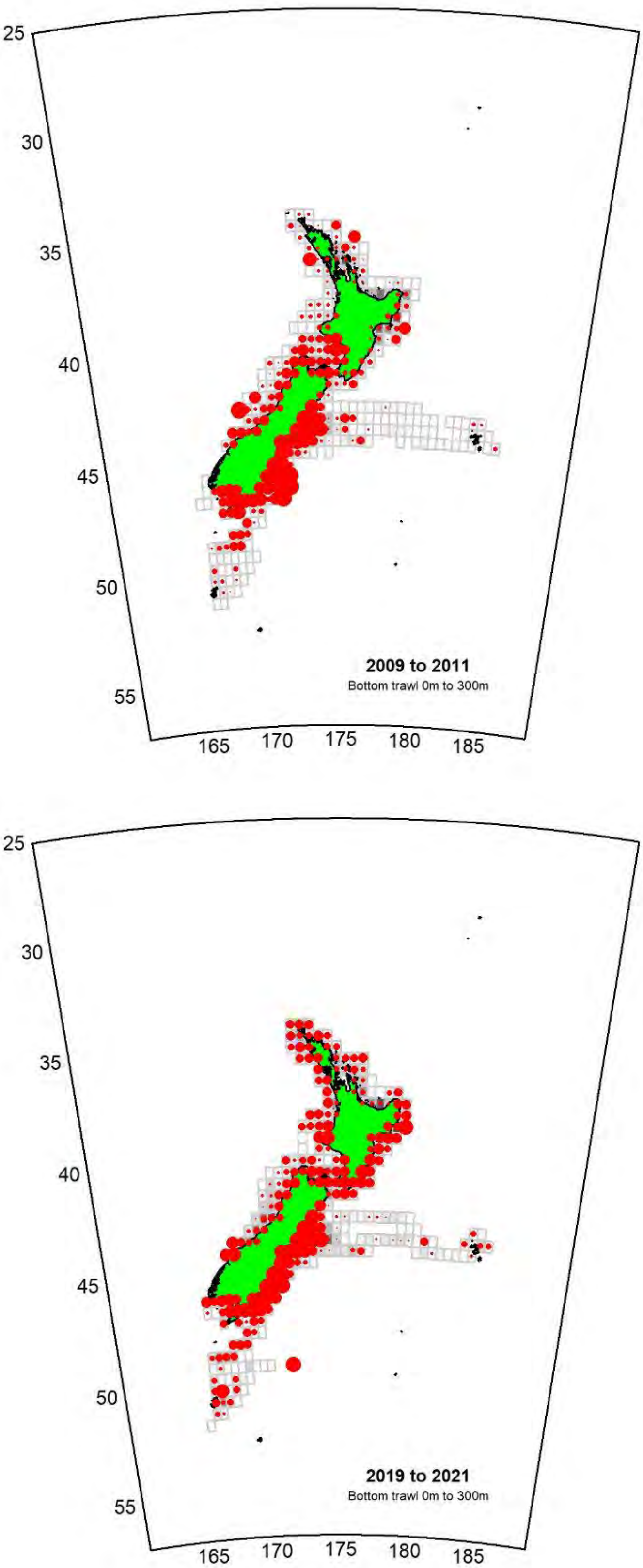


Figure 50.5 (cont.): Maps of rough skate occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

51. Smooth skate (SSK)

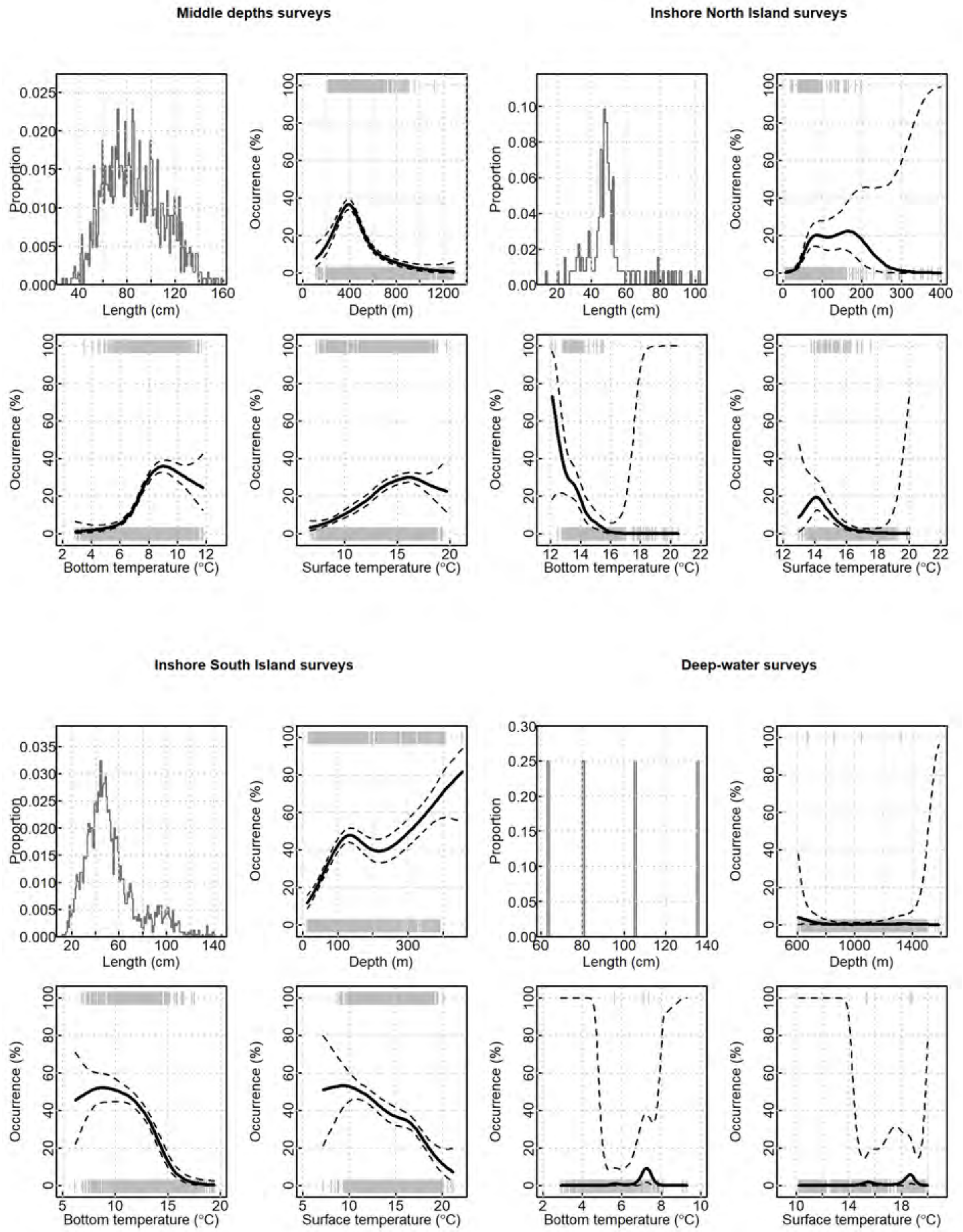


Figure 51.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to smooth skate occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

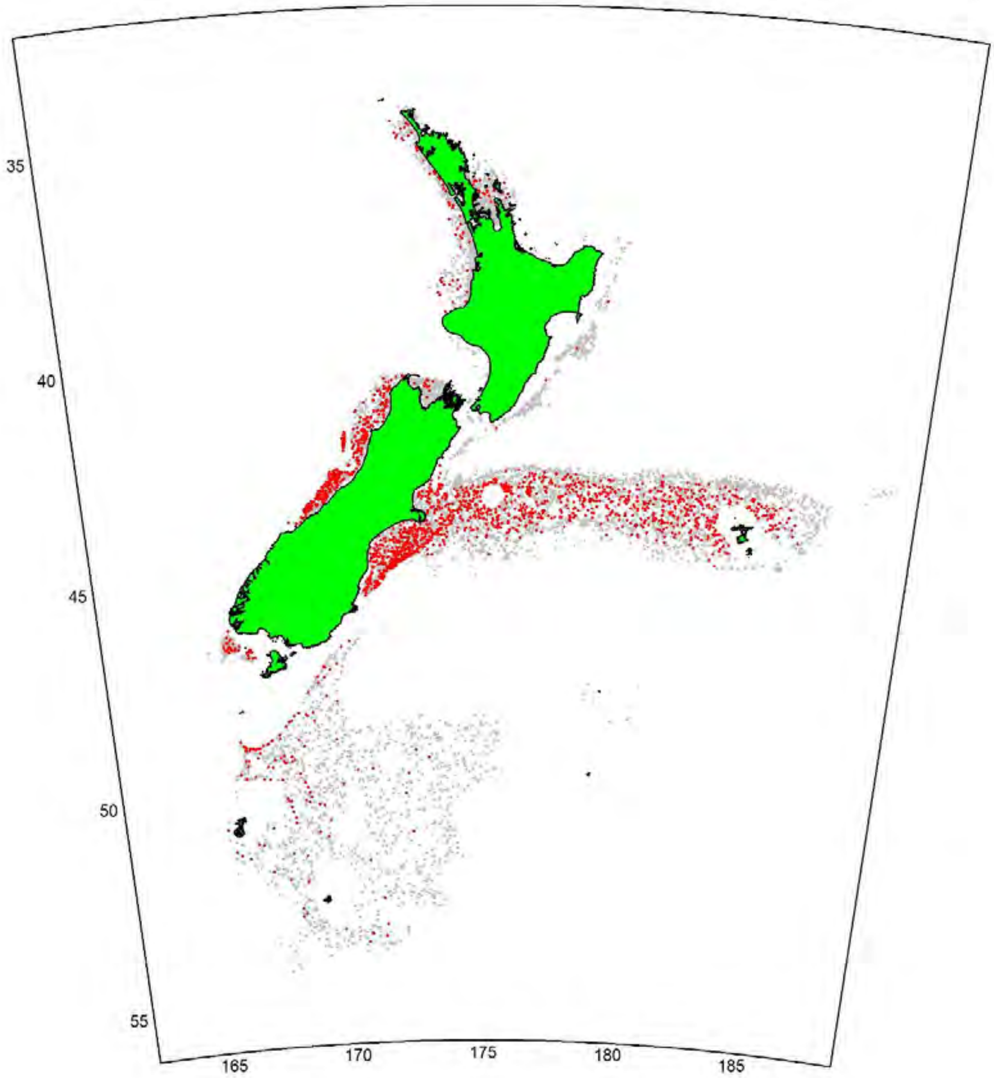


Figure 51.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where smooth skate was caught (red points).

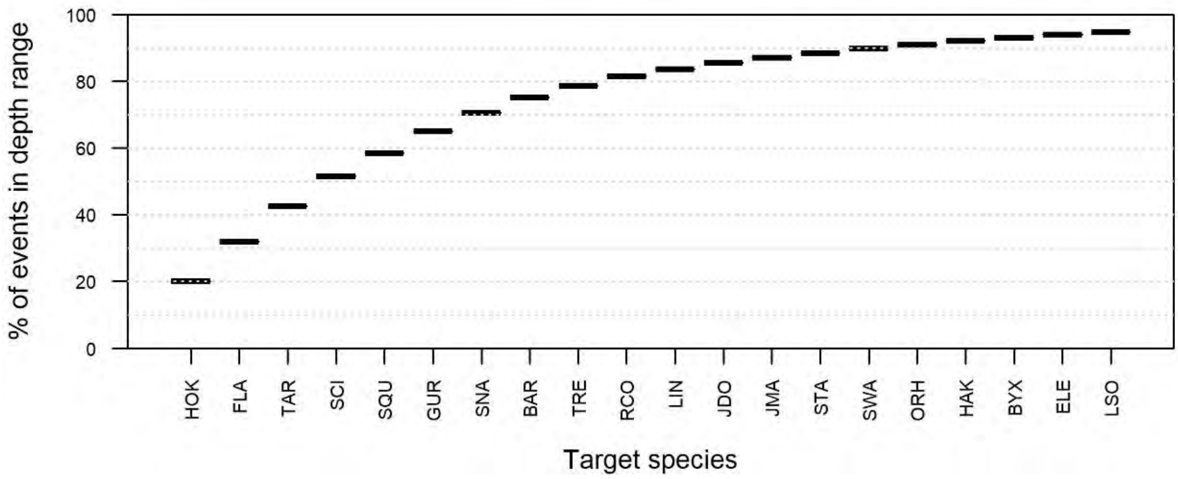
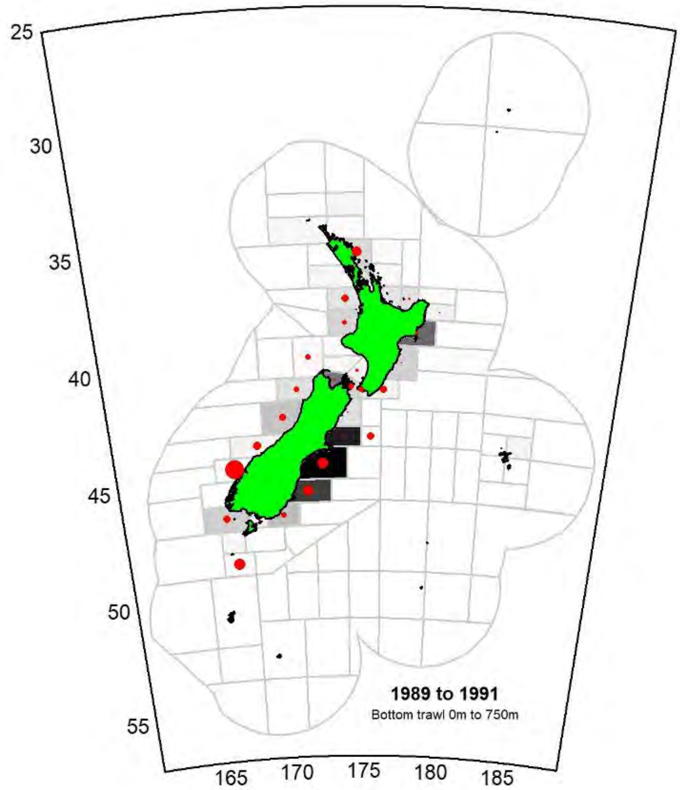


Figure 51.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for smooth skate (0–750 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.



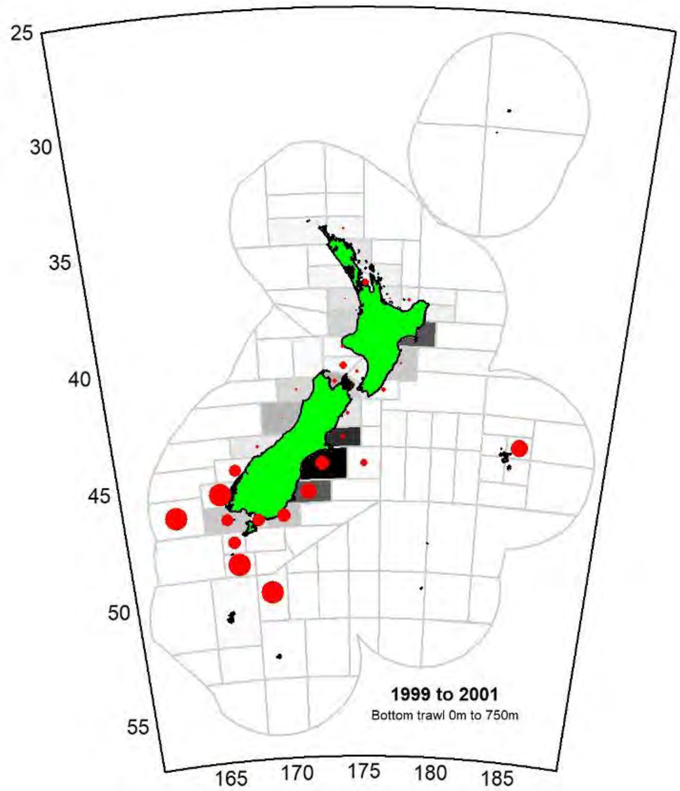
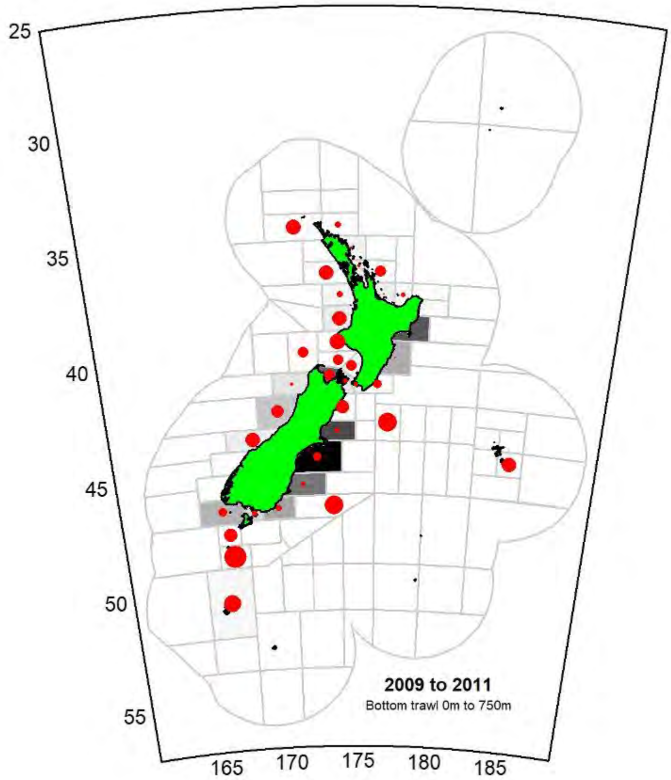


Figure 51.4: Maps of smooth skate occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



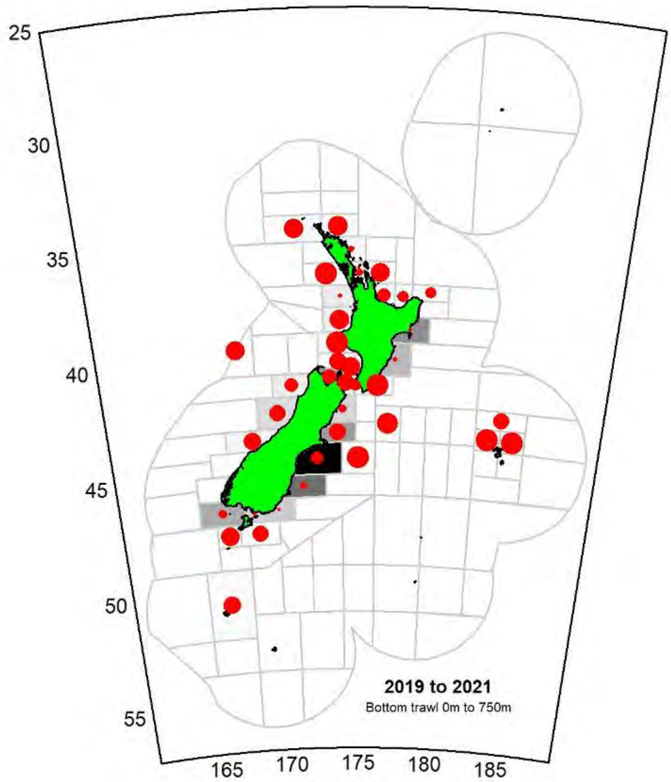
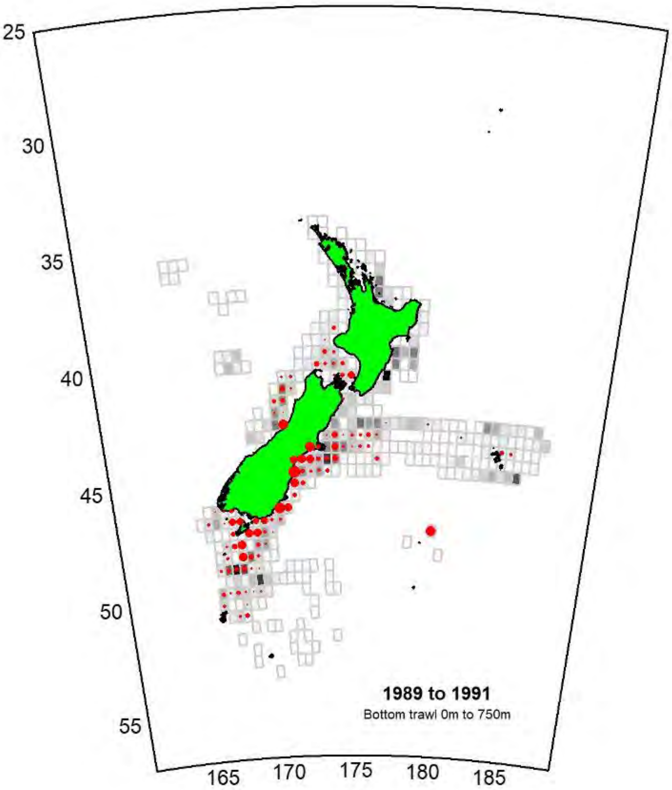


Figure 51.4 (cont.): Maps of smooth skate occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



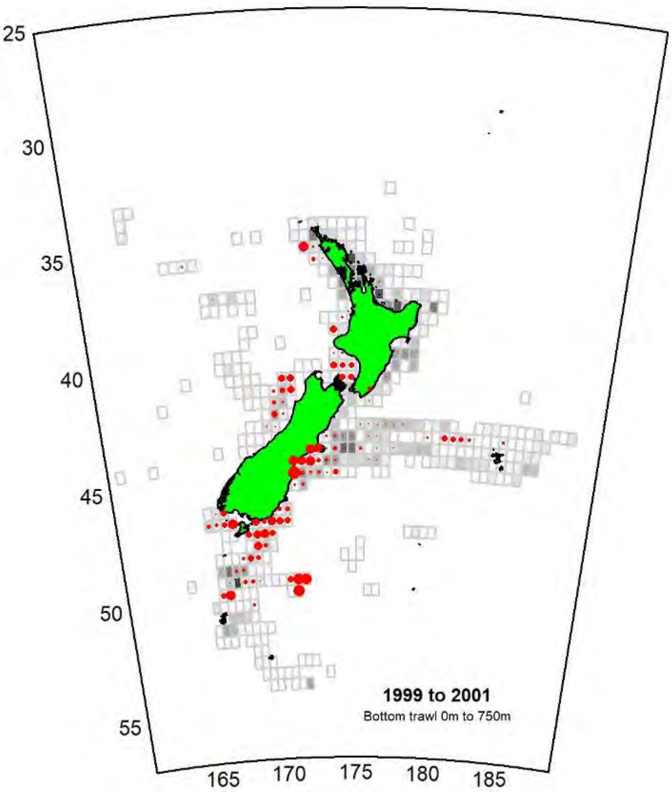
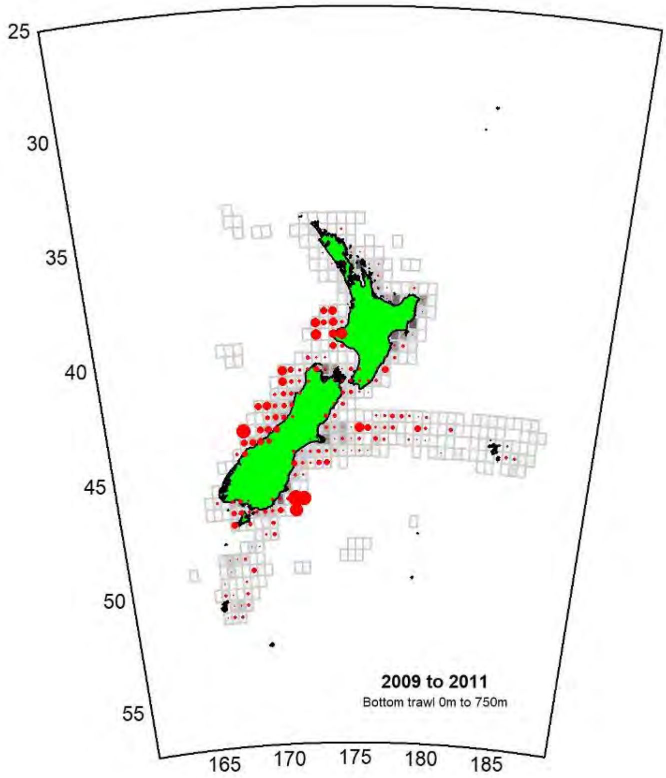


Figure 51.5: Maps of smooth skate occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



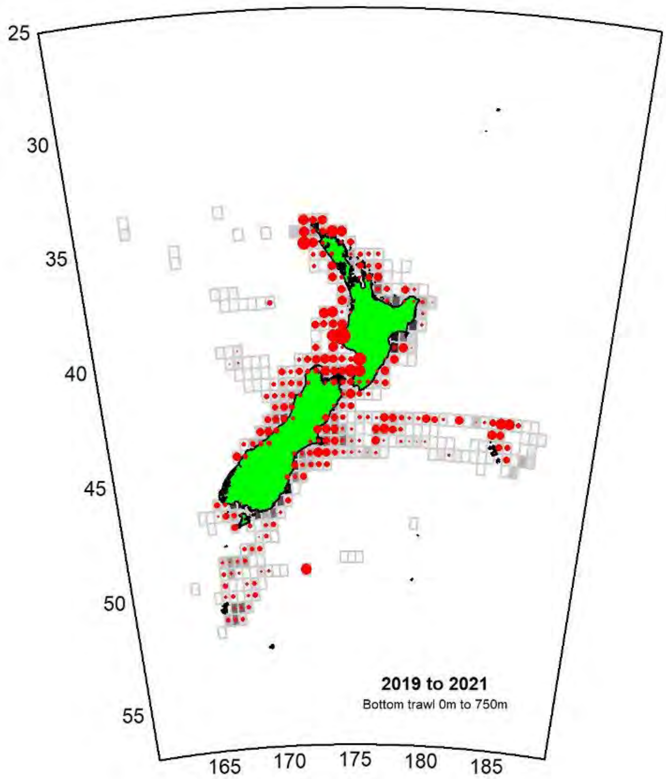


Figure 51.5 (cont.): Maps of smooth skate occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

52. Snapper (SNA)

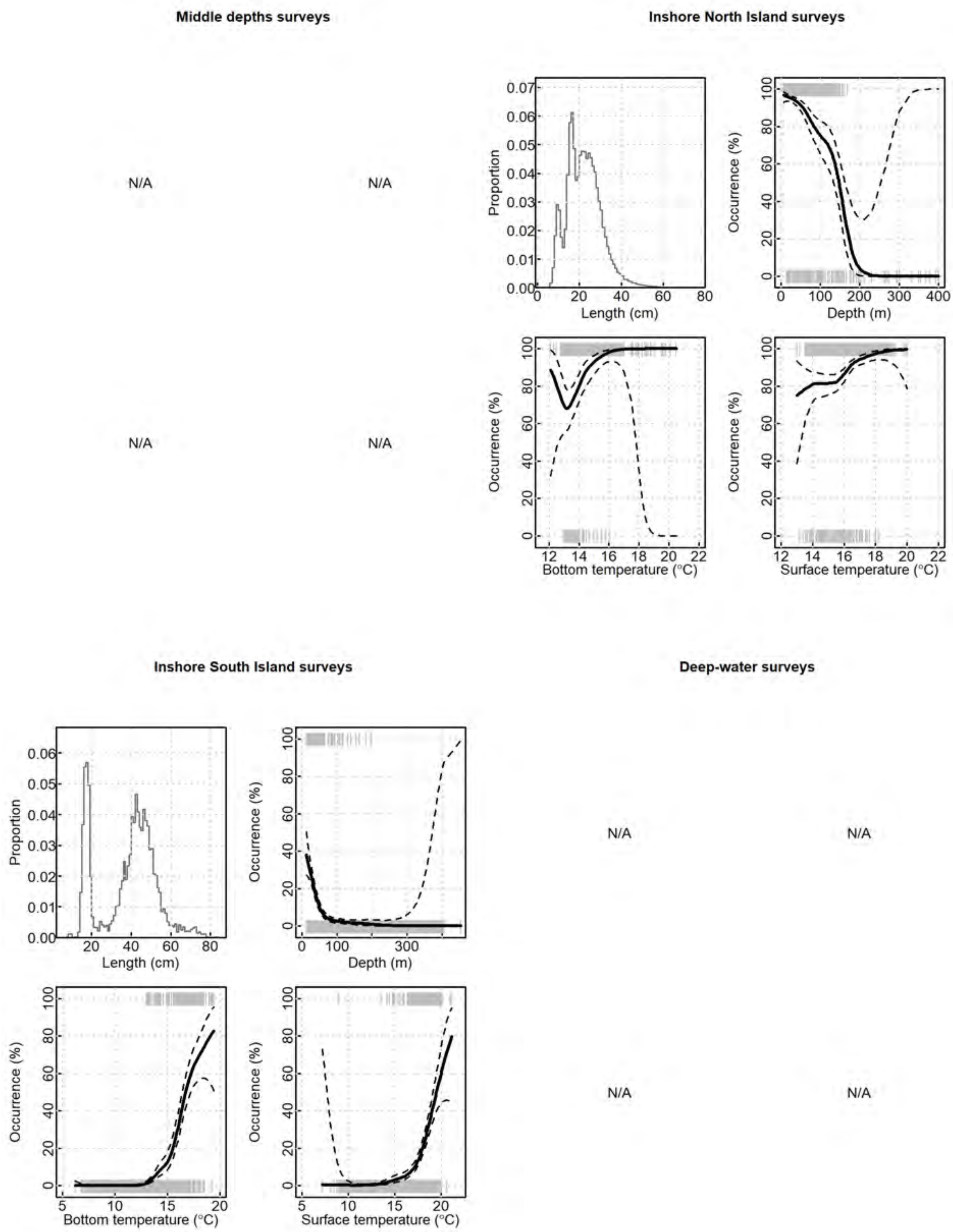


Figure 52.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to snapper occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

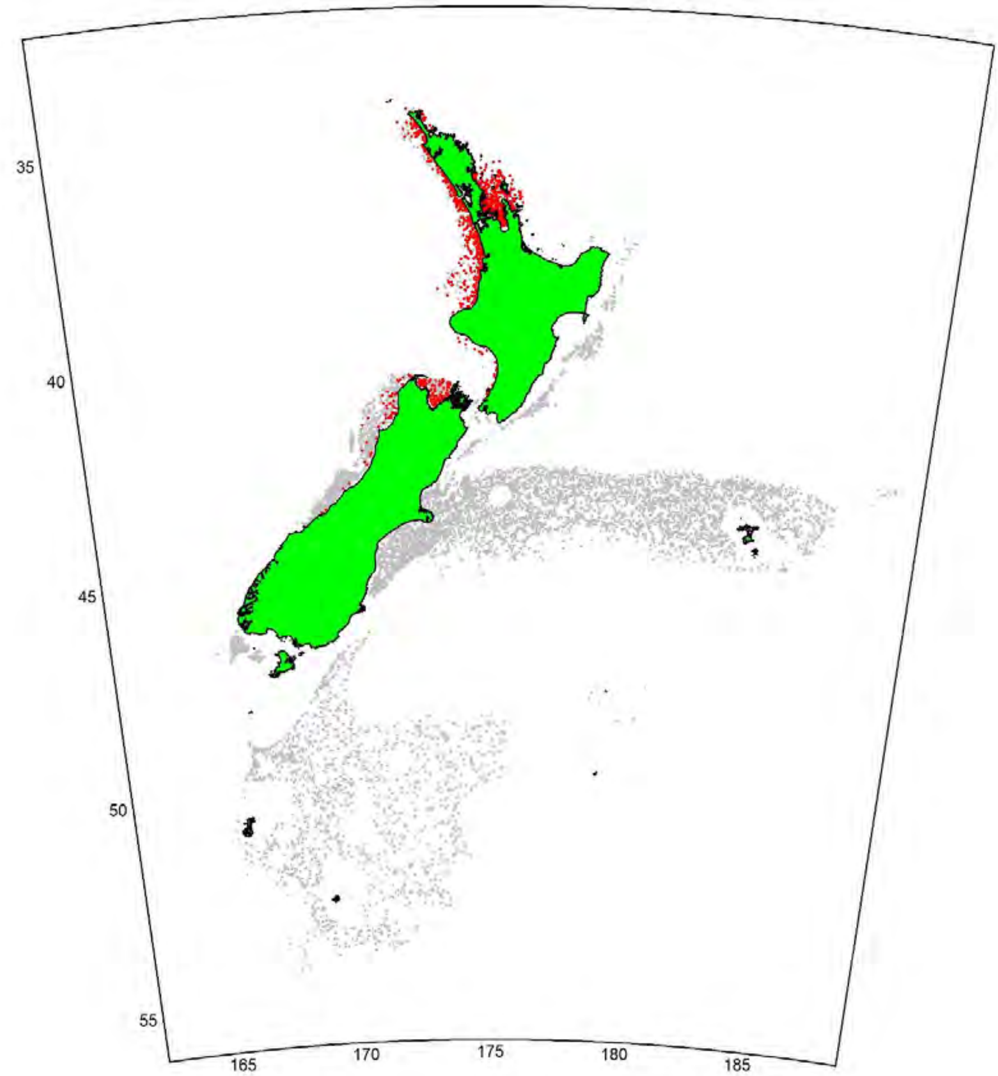


Figure 52.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where snapper was caught (red points).

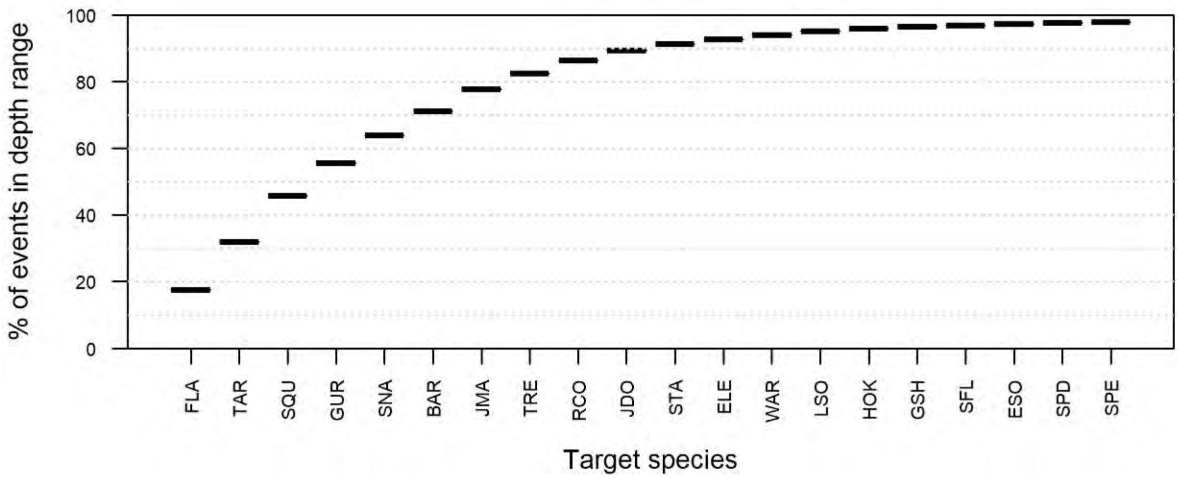
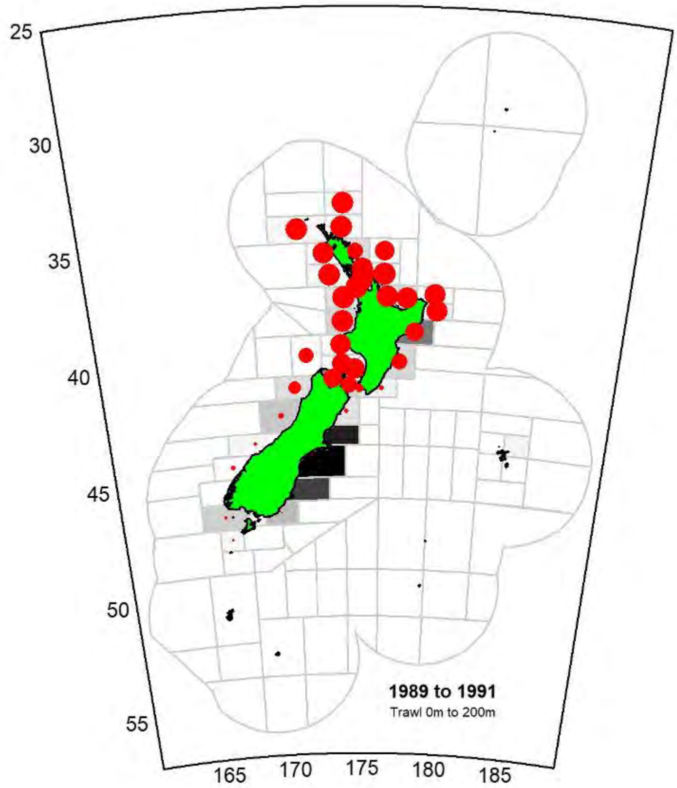


Figure 52.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for snapper (0–200 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.



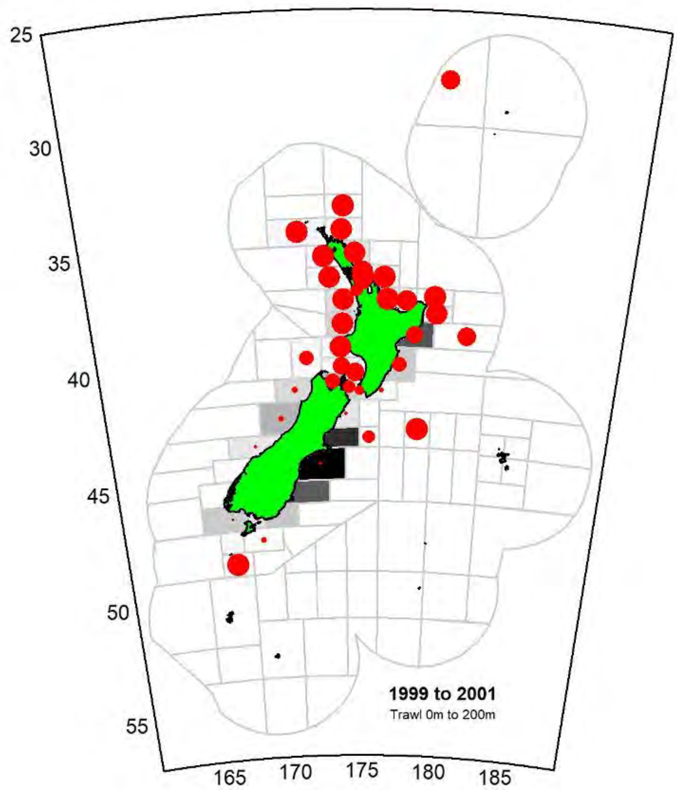
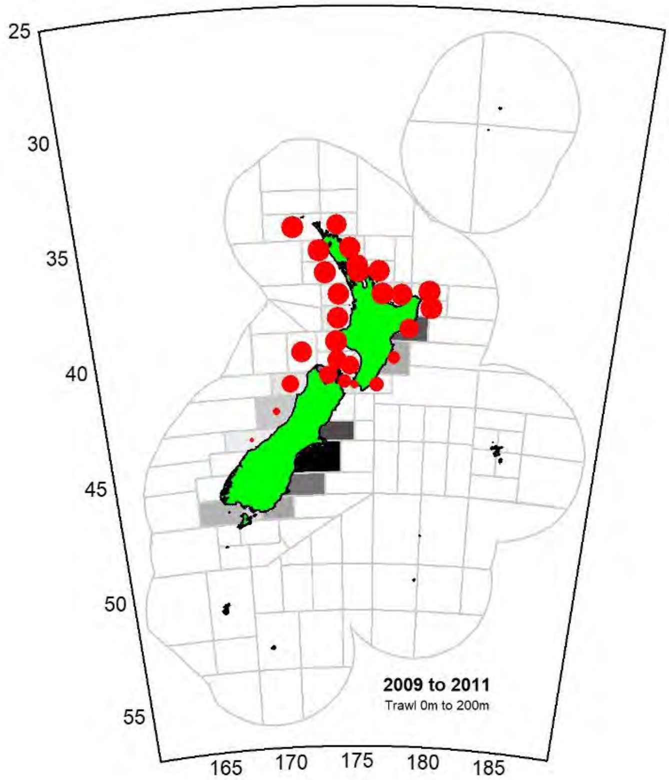


Figure 52.4: Maps of snapper occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



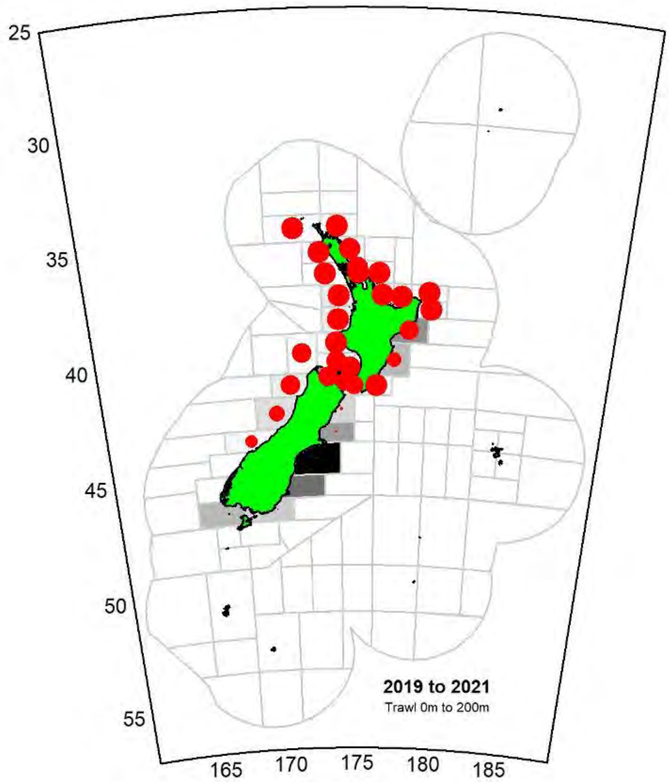


Figure 52.4 (cont.): Maps of snapper occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

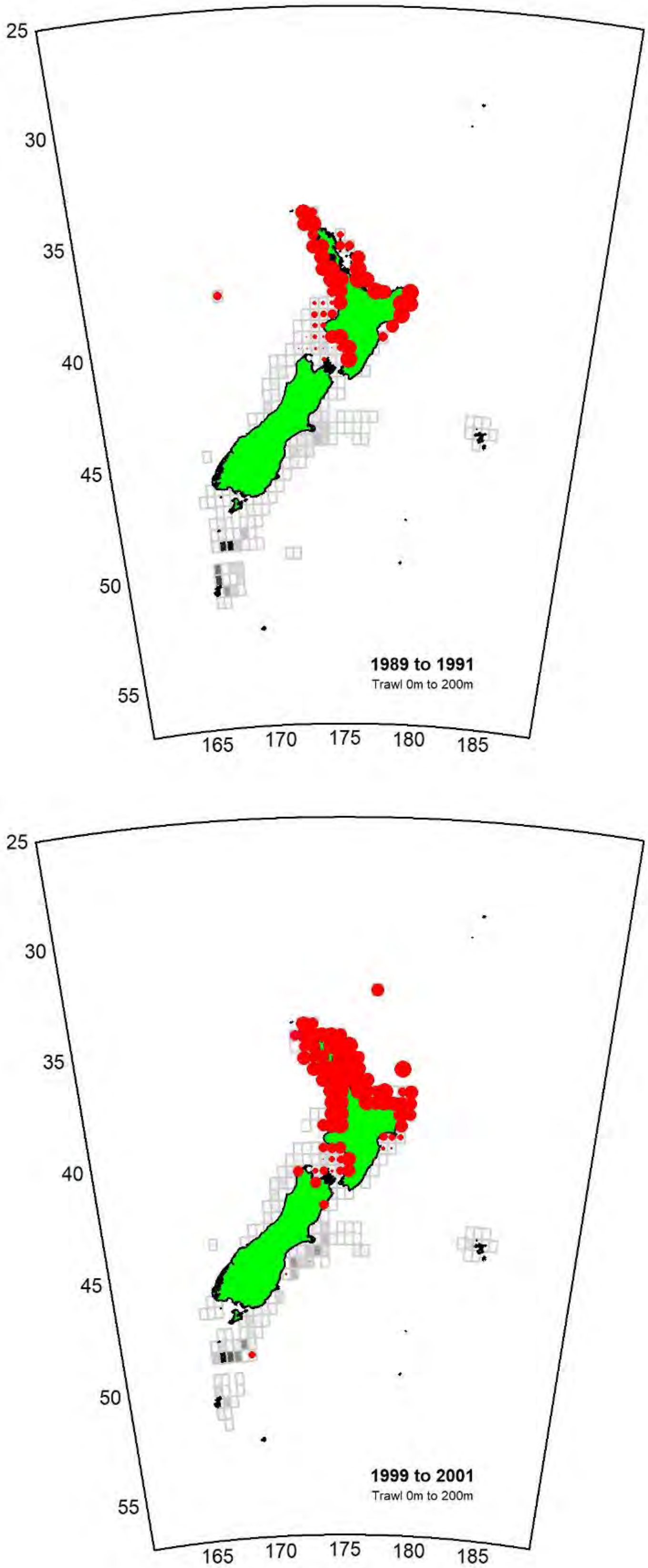
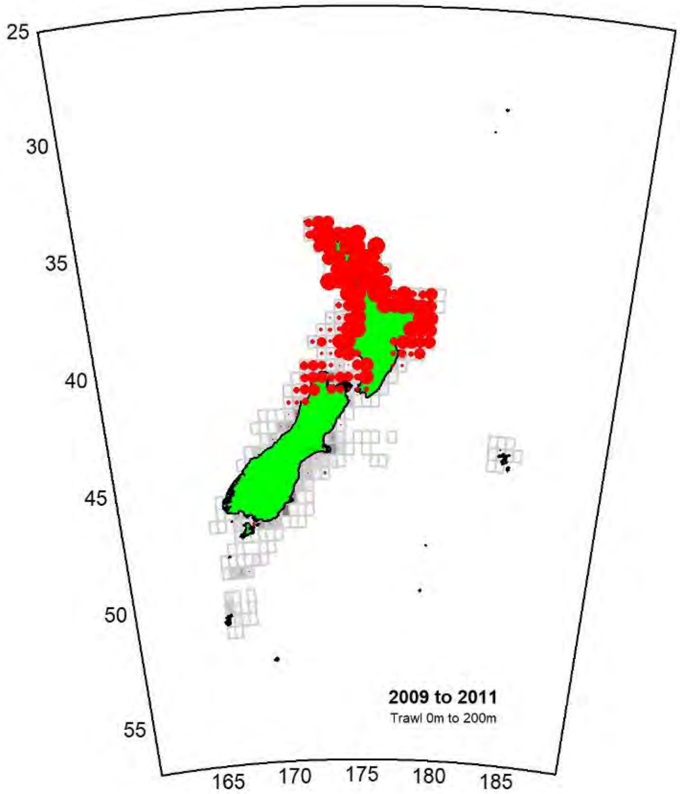


Figure 52.5: Maps of snapper occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



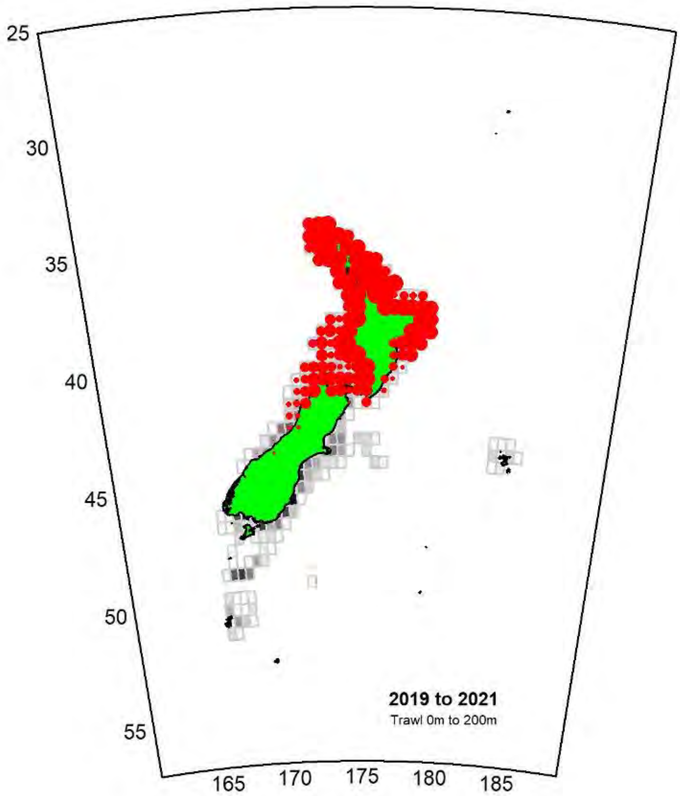


Figure 52.5 (cont.): Maps of snapper occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

53. Southern blue whiting (SBW)

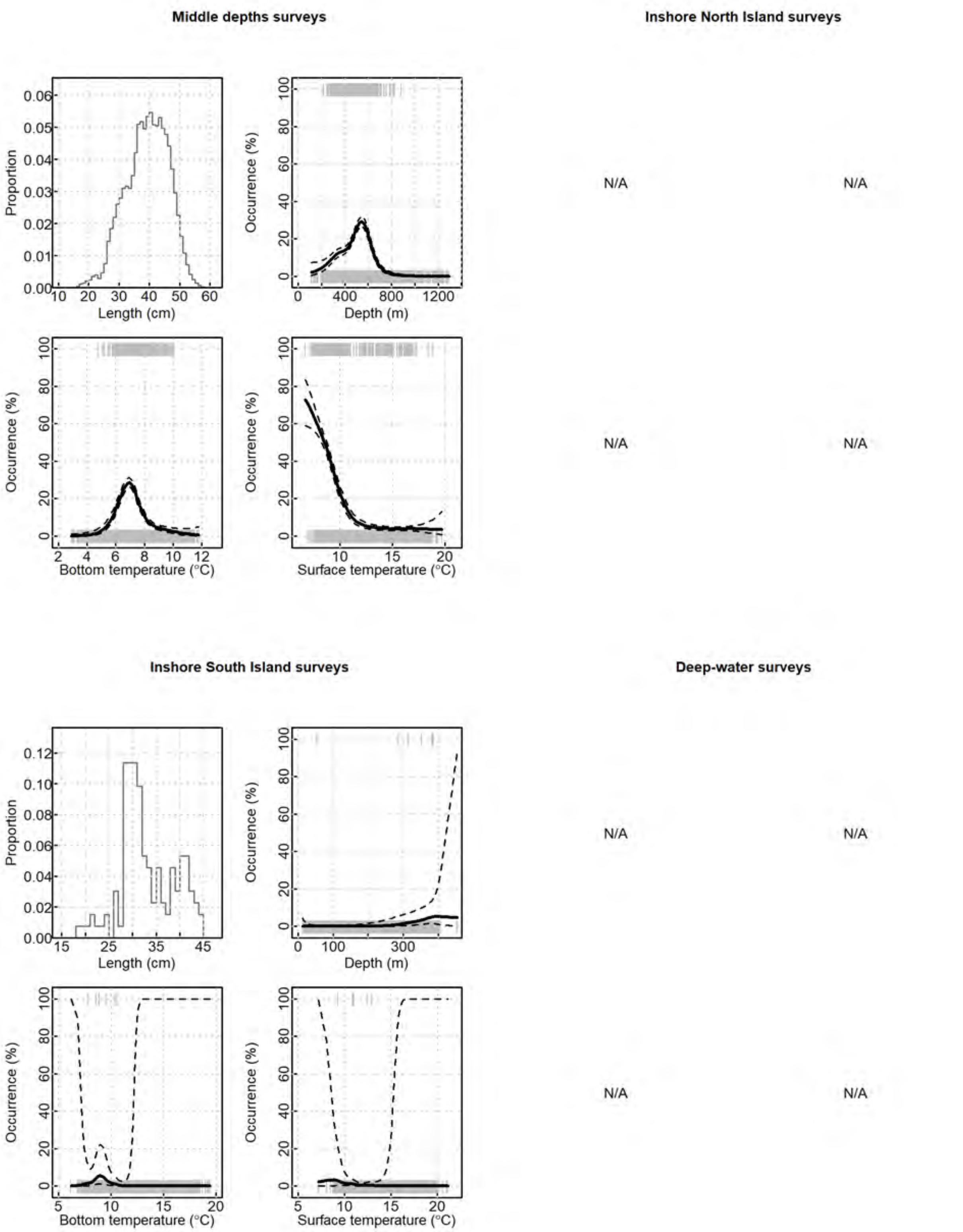


Figure 53.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to southern blue whiting occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

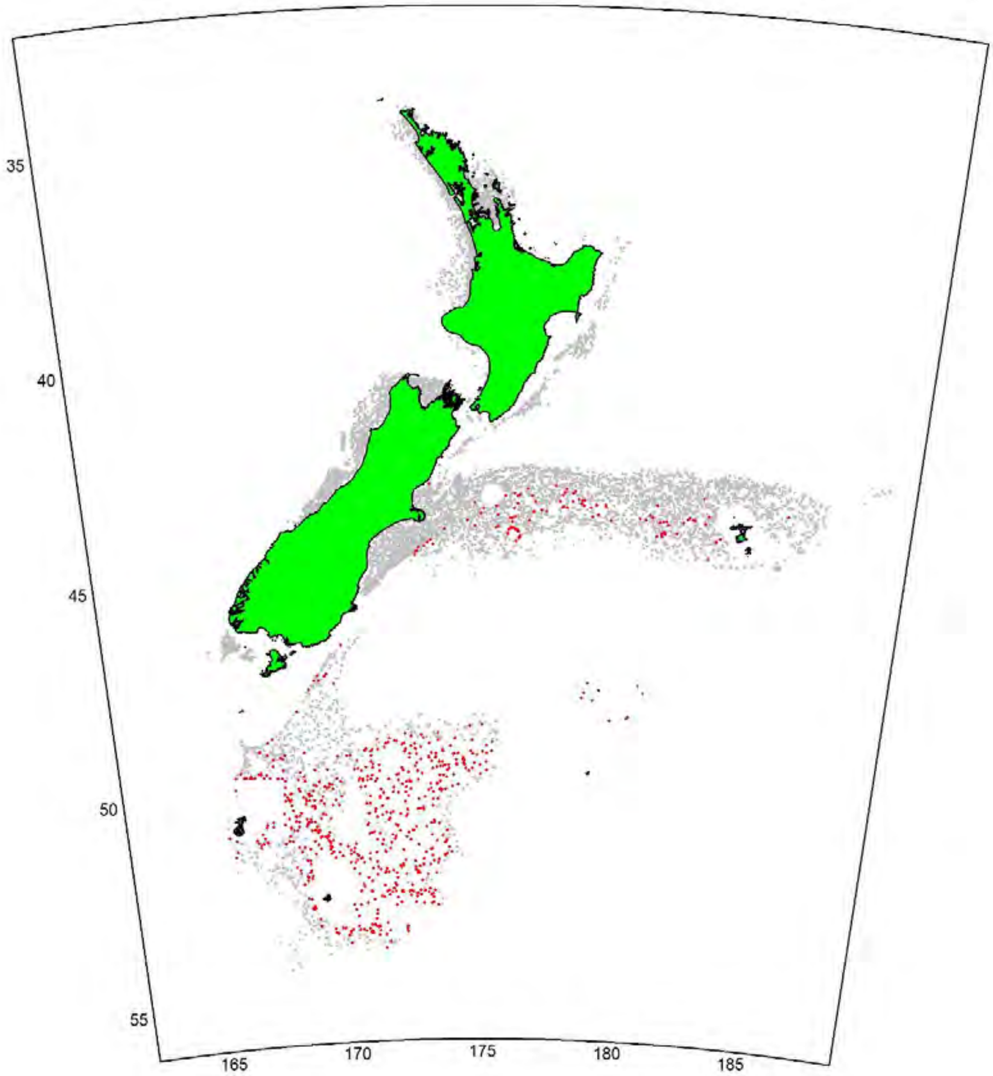


Figure 53.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where southern blue whiting was caught (red points).

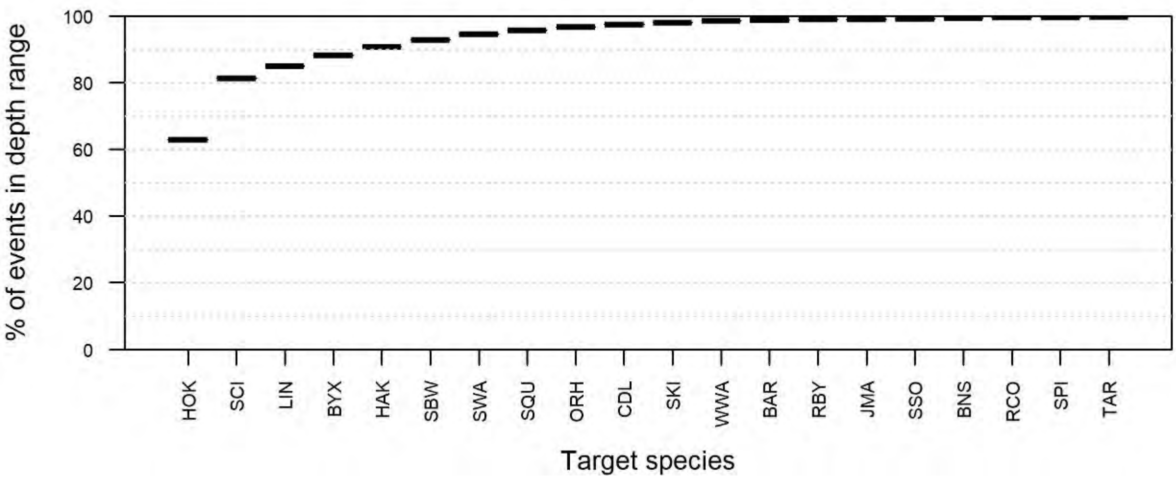


Figure 53.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for southern blue whiting (300–700 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.

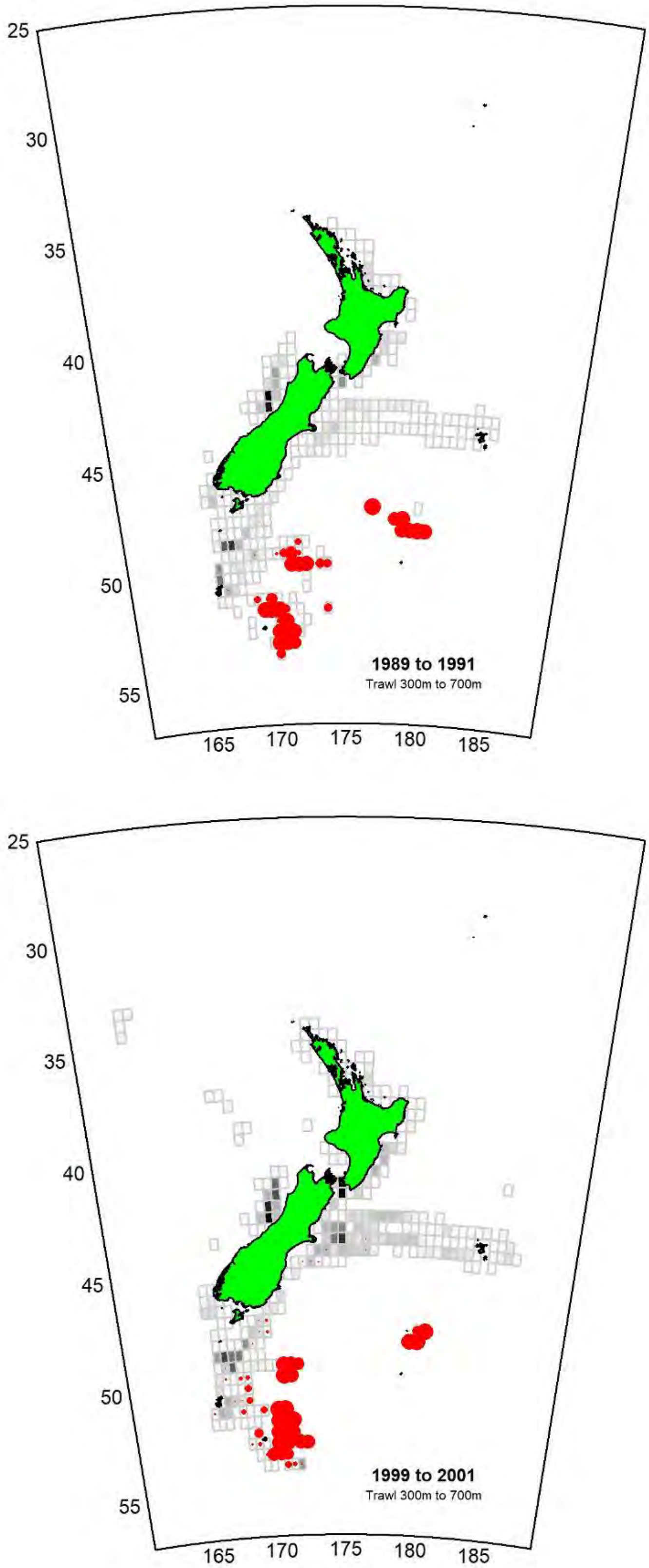
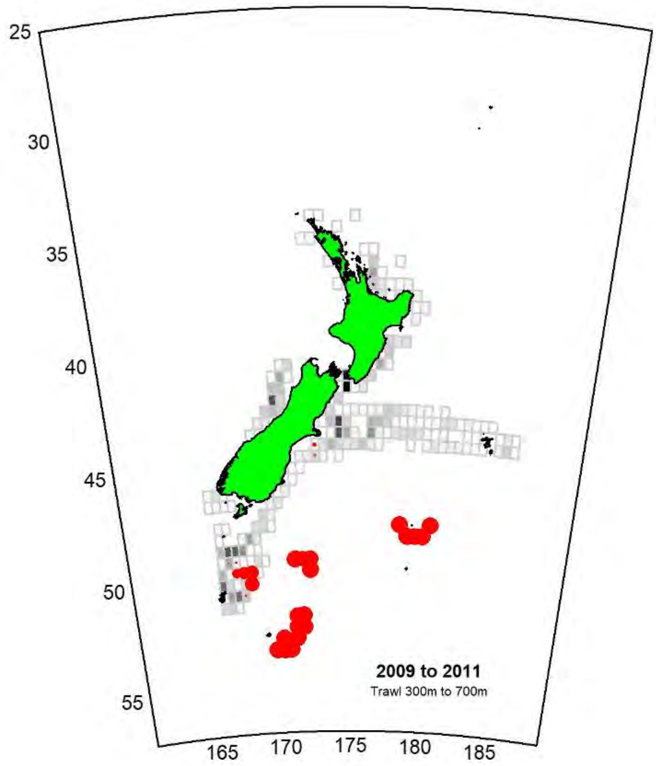


Figure 53.4: Maps of southern blue whiting occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



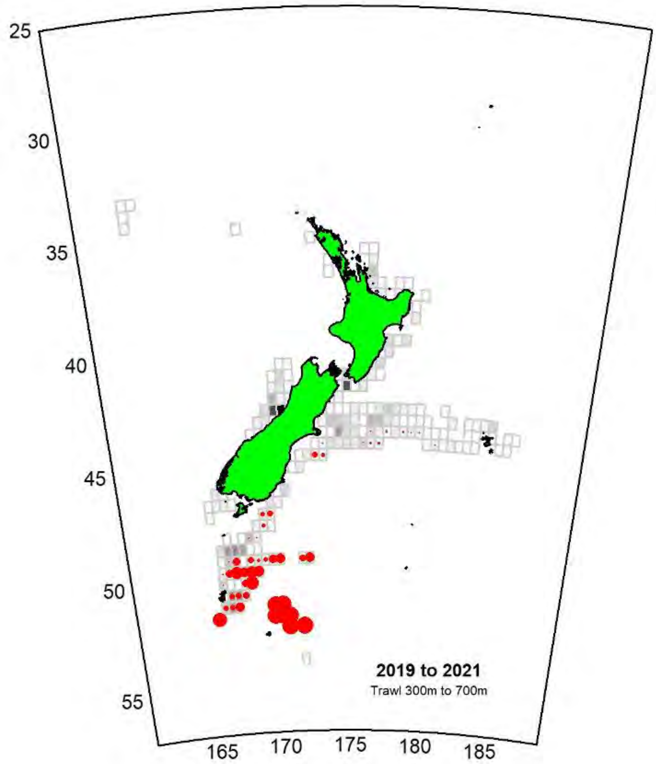


Figure 53.4 (cont.): Maps of southern blue whiting occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

54. Spiny dogfish (SPD)

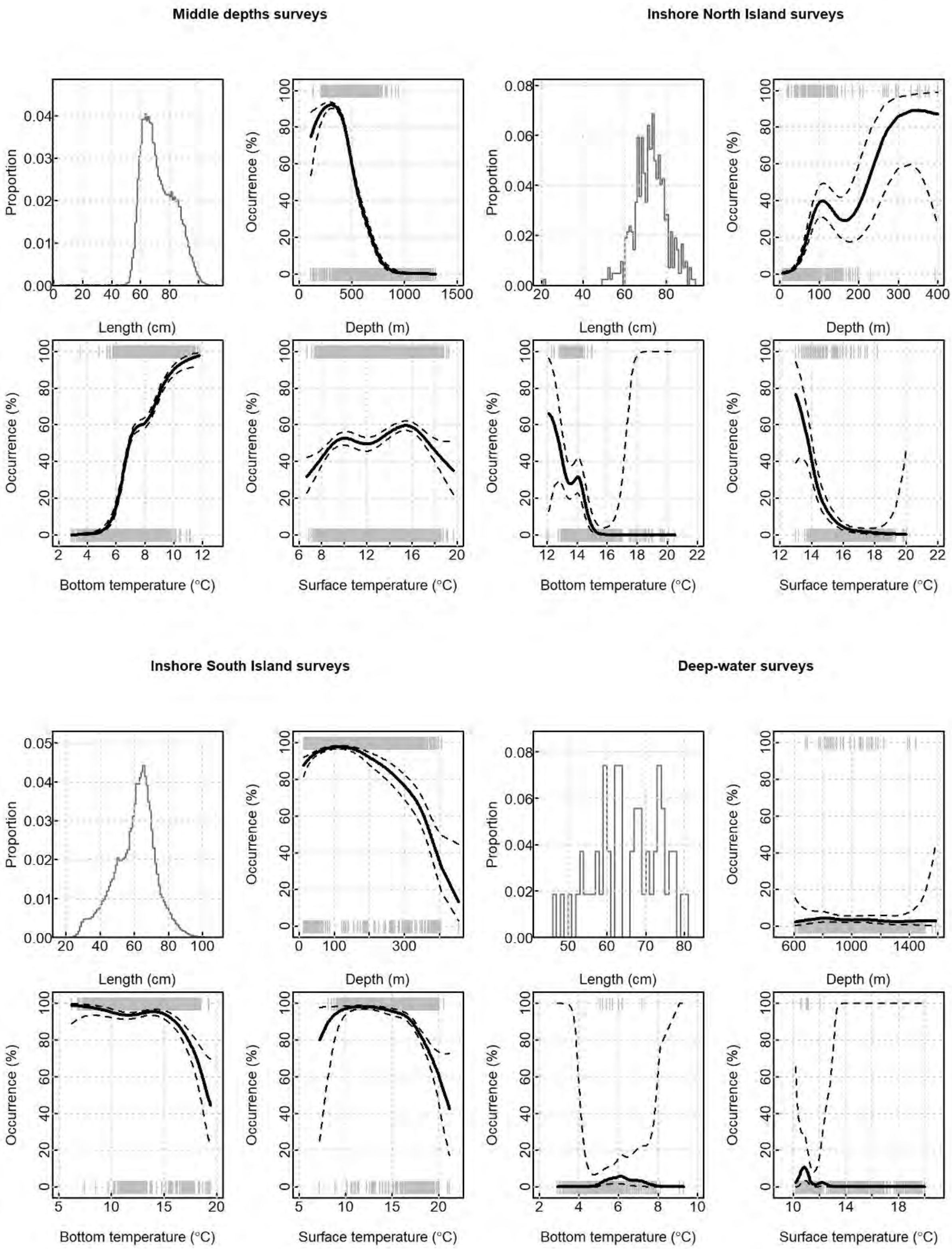


Figure 54.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to spiny dogfish occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

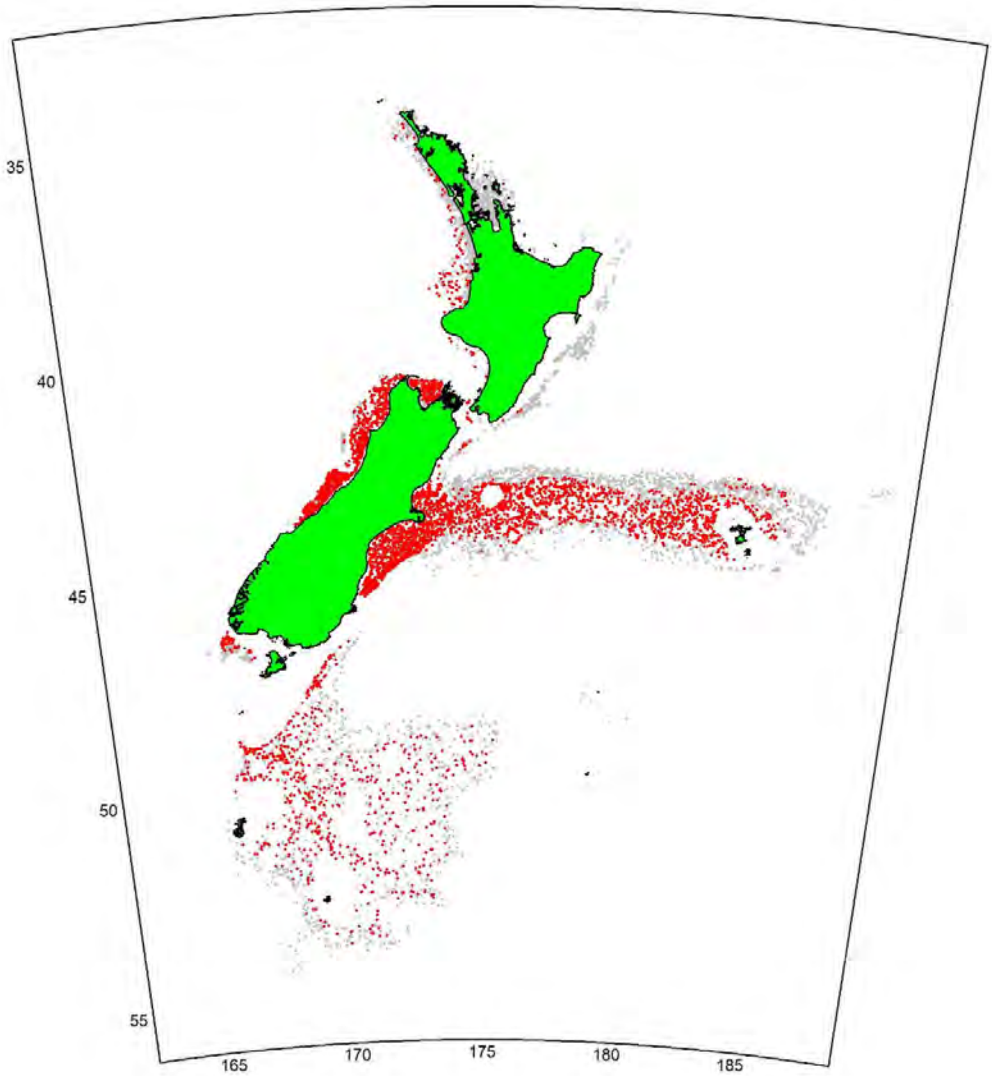


Figure 54.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where spiny dogfish was caught (red points).

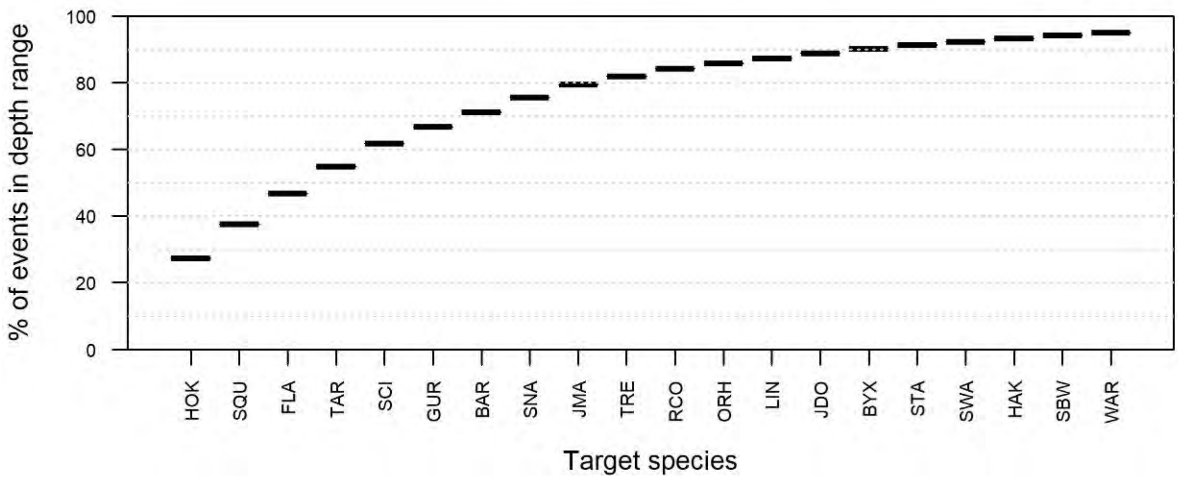


Figure 54.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for spiny dogfish (0–800 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.

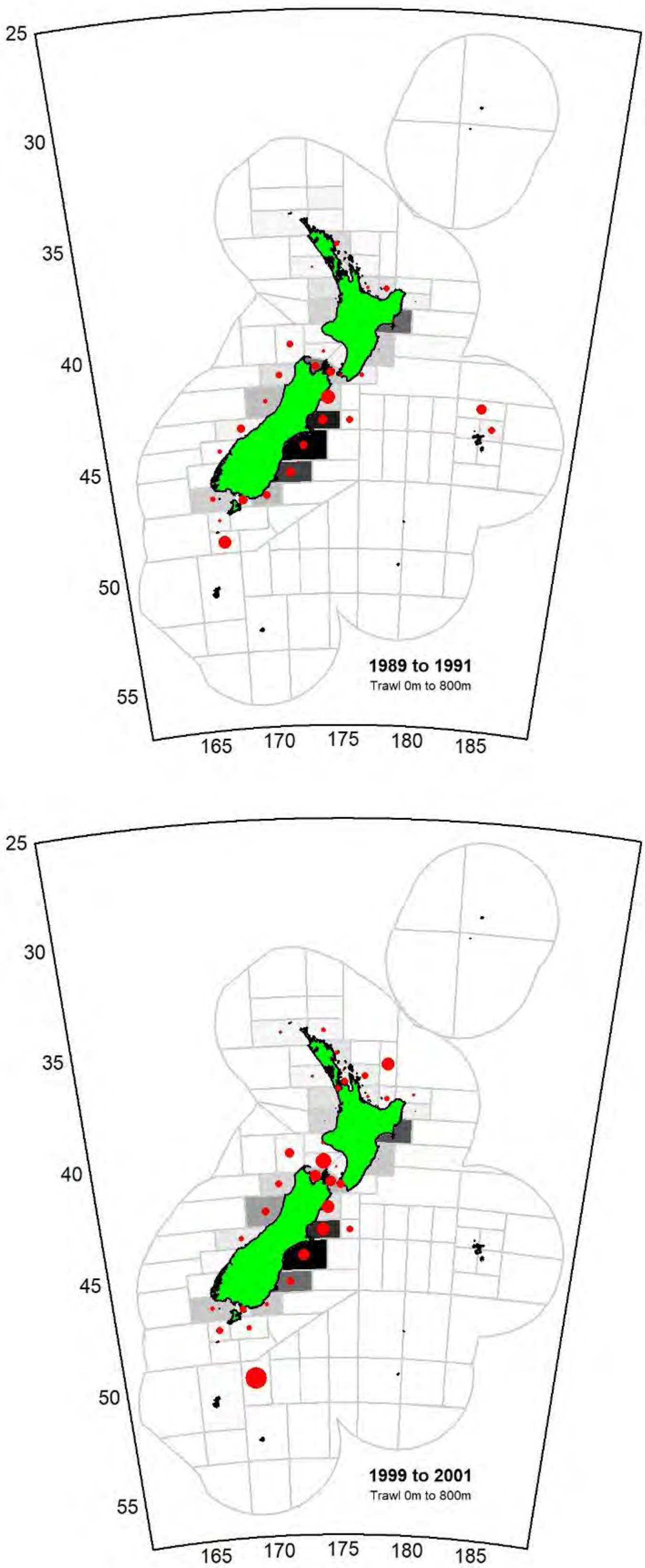
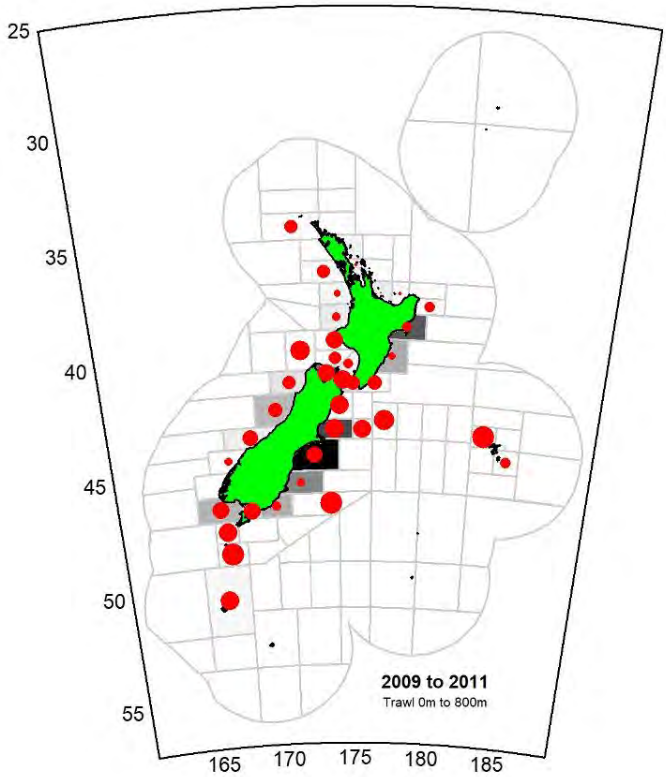


Figure 54.4: Maps of spiny dogfish occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



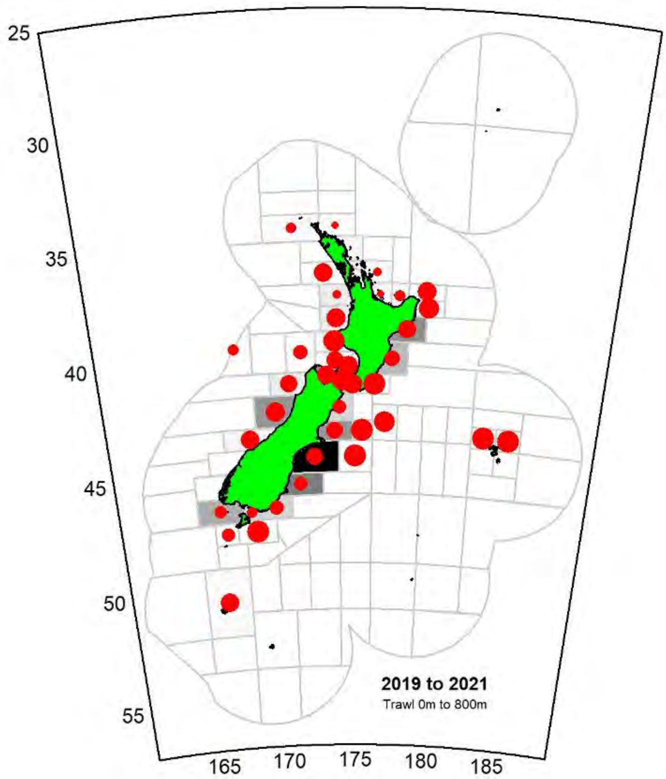


Figure 54.4 (cont.): Maps of spiny dogfish occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

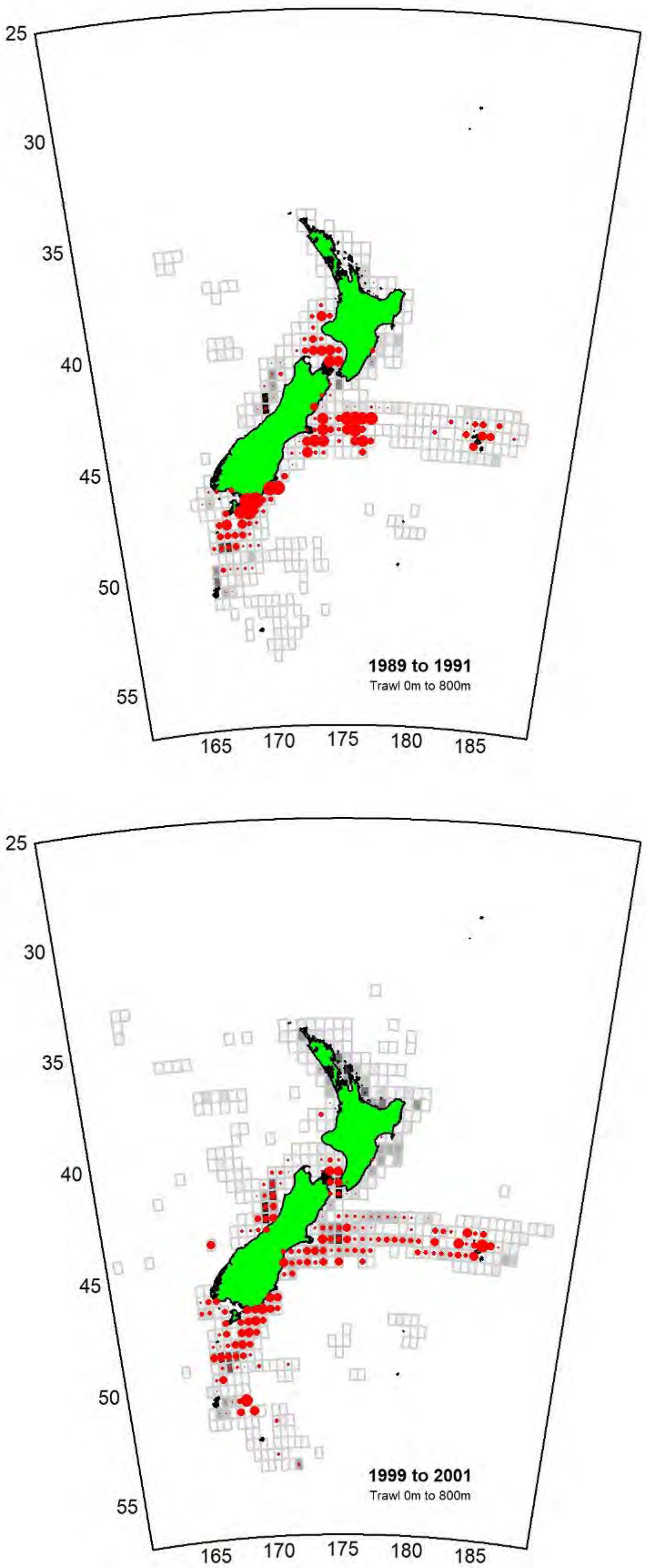
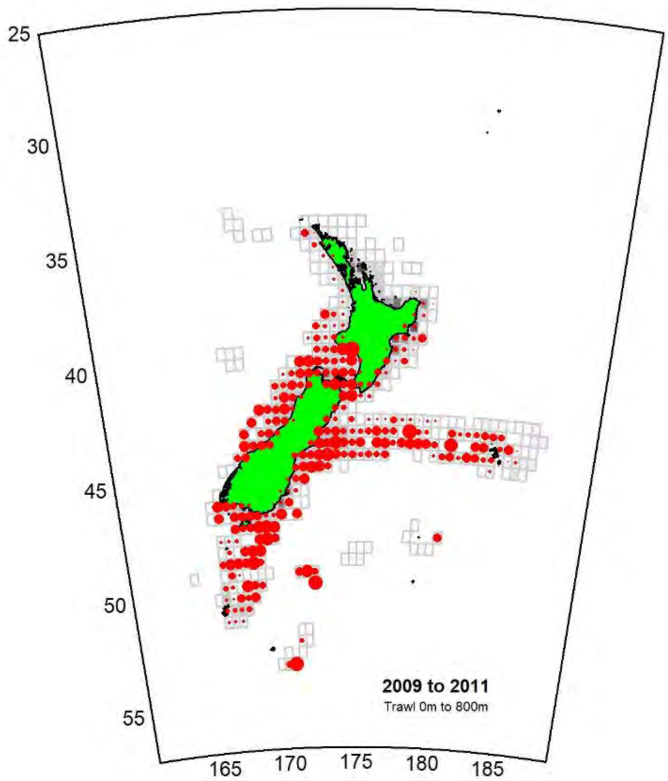


Figure 54.5: Maps of spiny dogfish occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



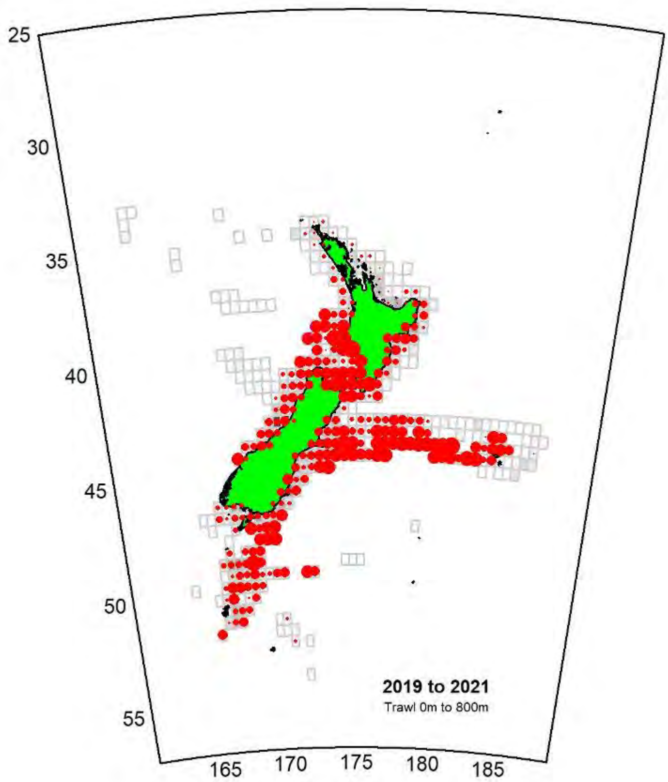


Figure 54.5 (cont.): Maps of spiny dogfish occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

55. Sprat (SPR)

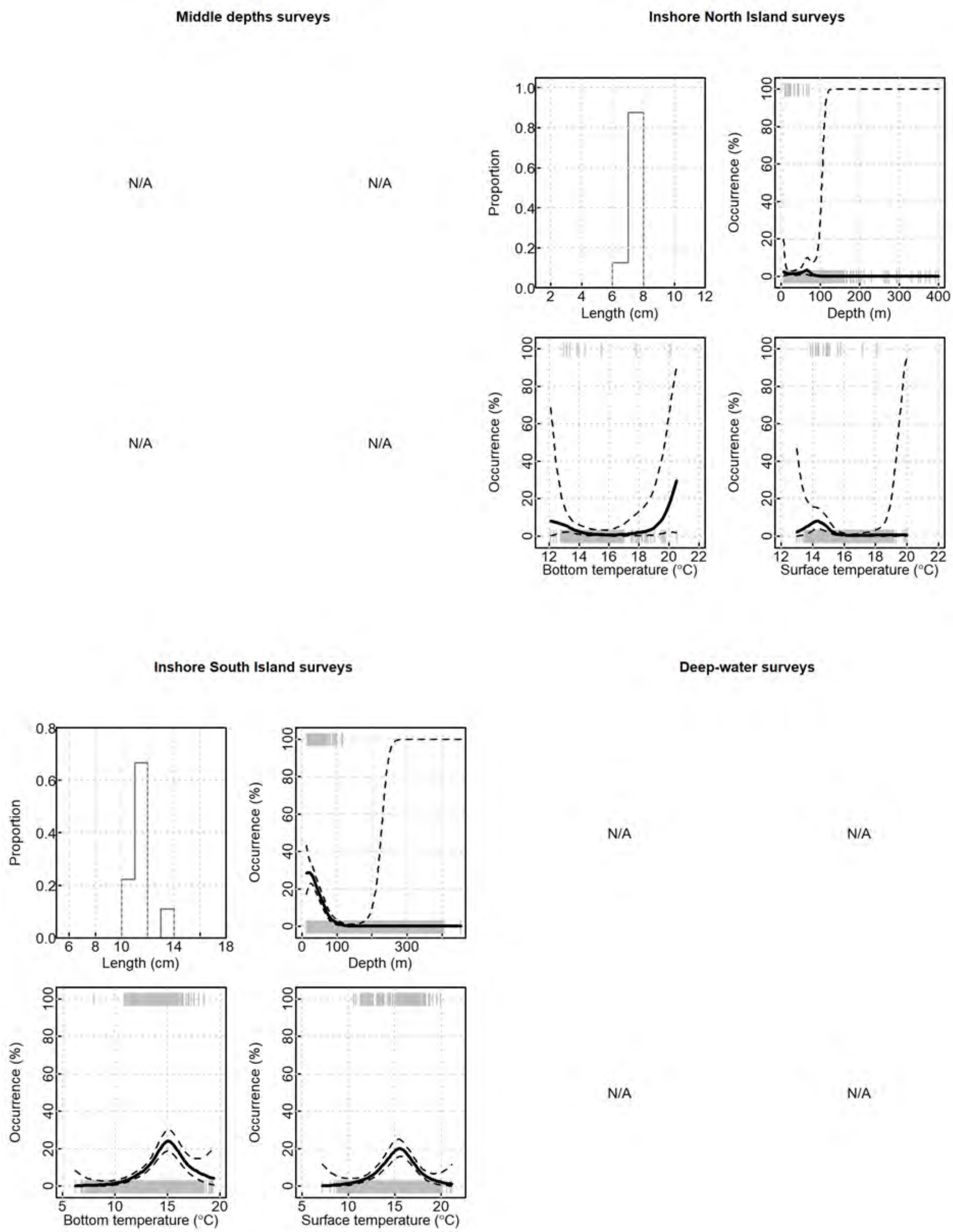


Figure 55.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to sprat occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

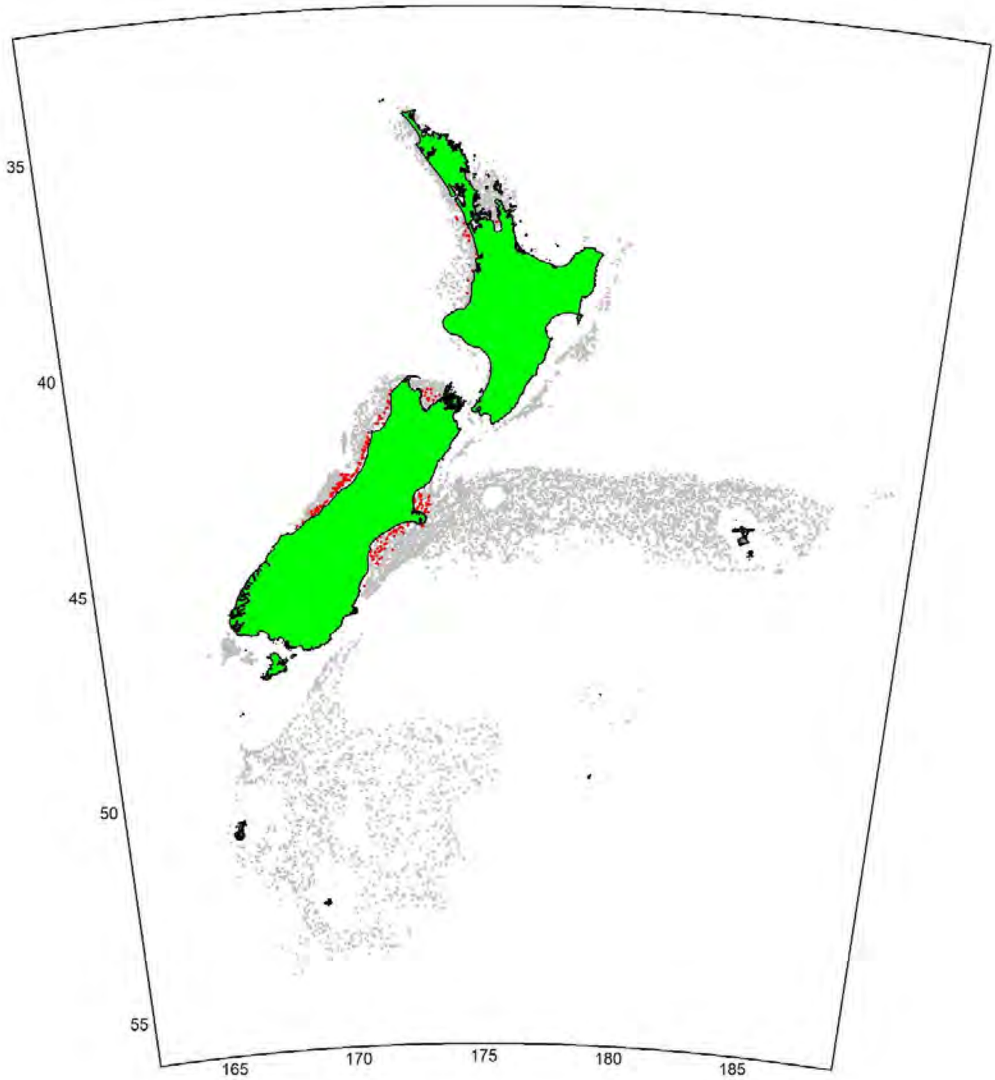


Figure 55.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where sprat was caught (red points).

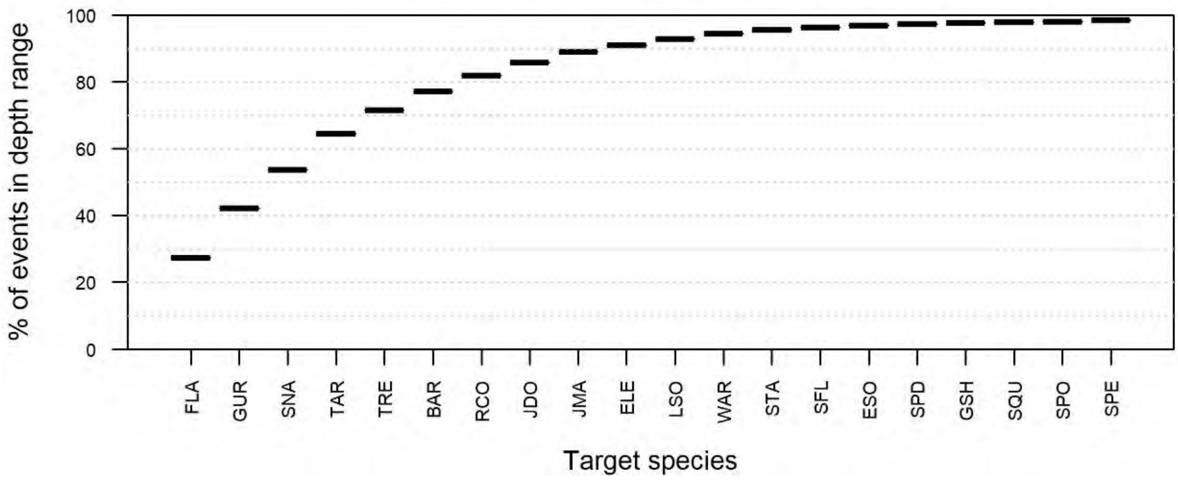


Figure 55.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for sprat (0–100 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.

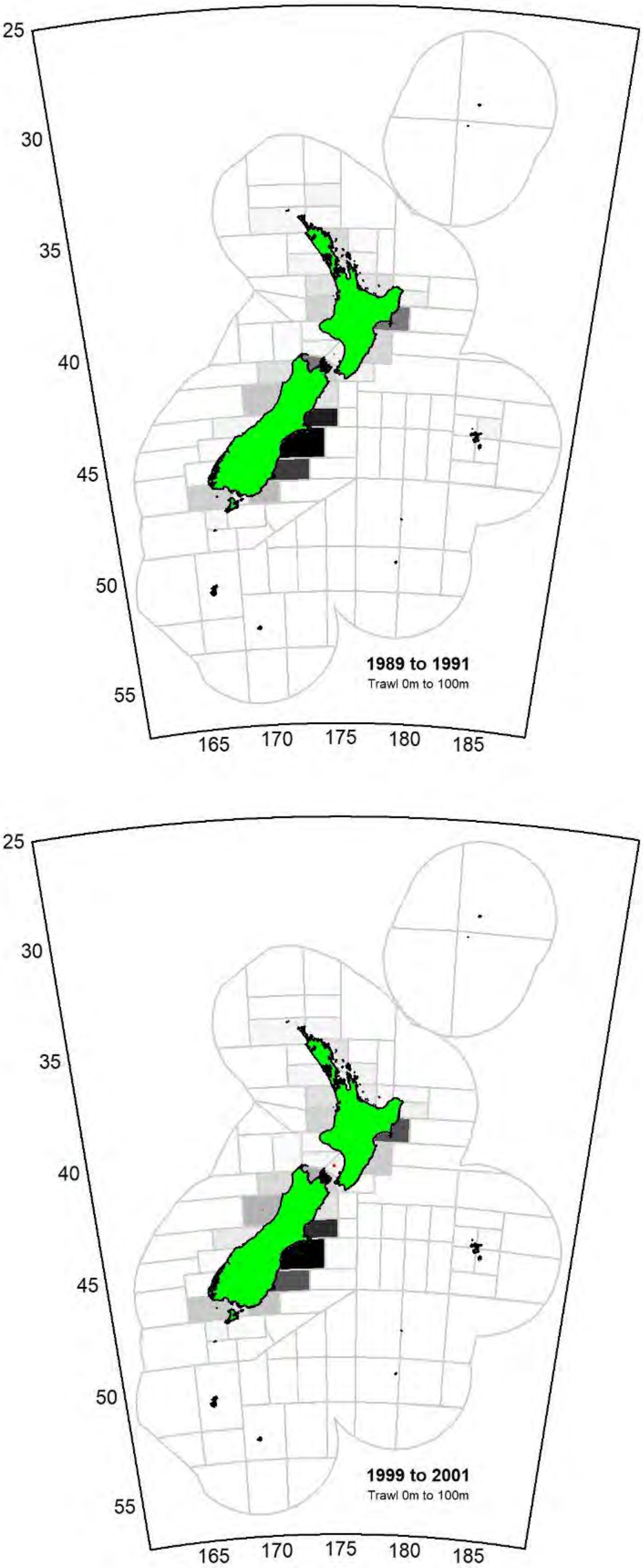
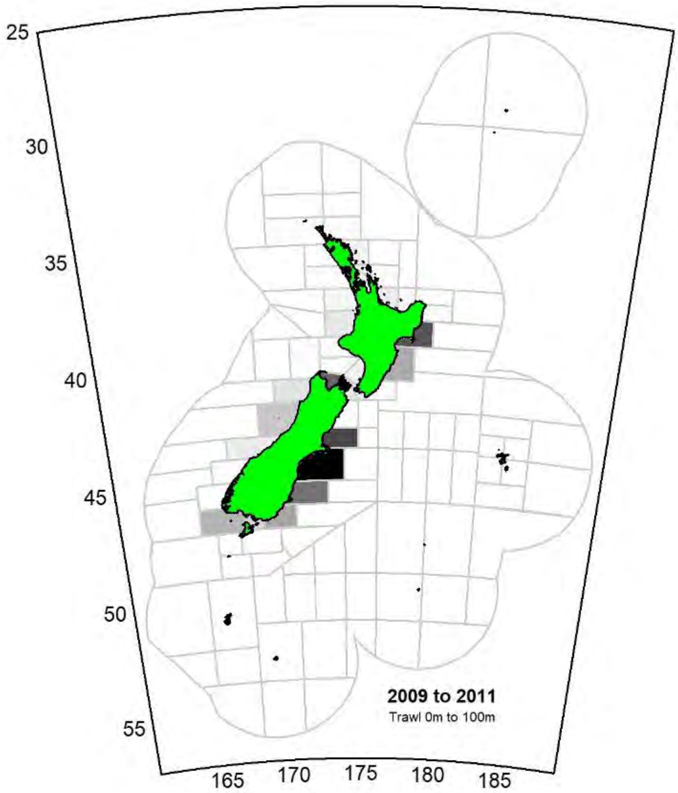


Figure 55.4: Maps of sprat occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



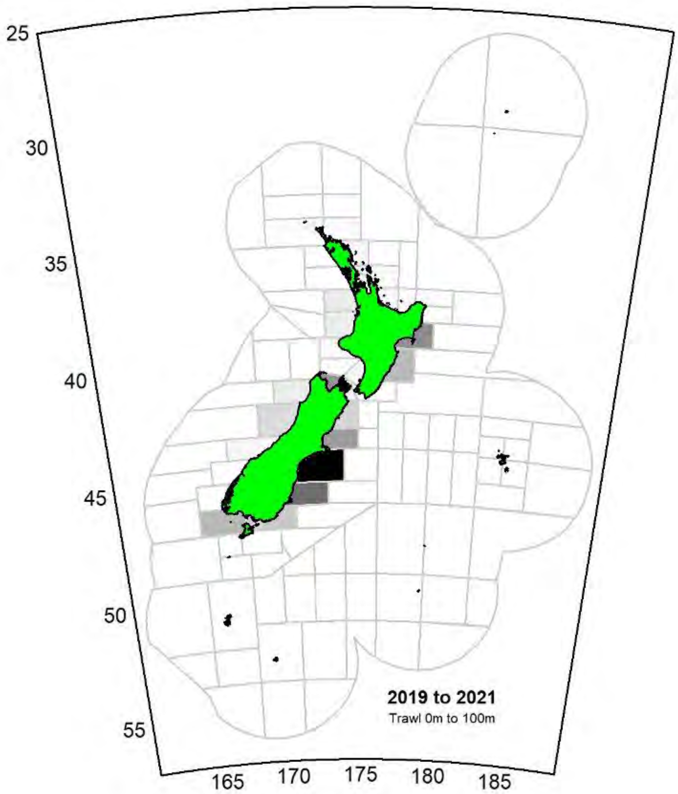


Figure 55.4 (cont.): Maps of sprat occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

56. Stargazer (Research GIZ; BGZ; Commercial, STA)

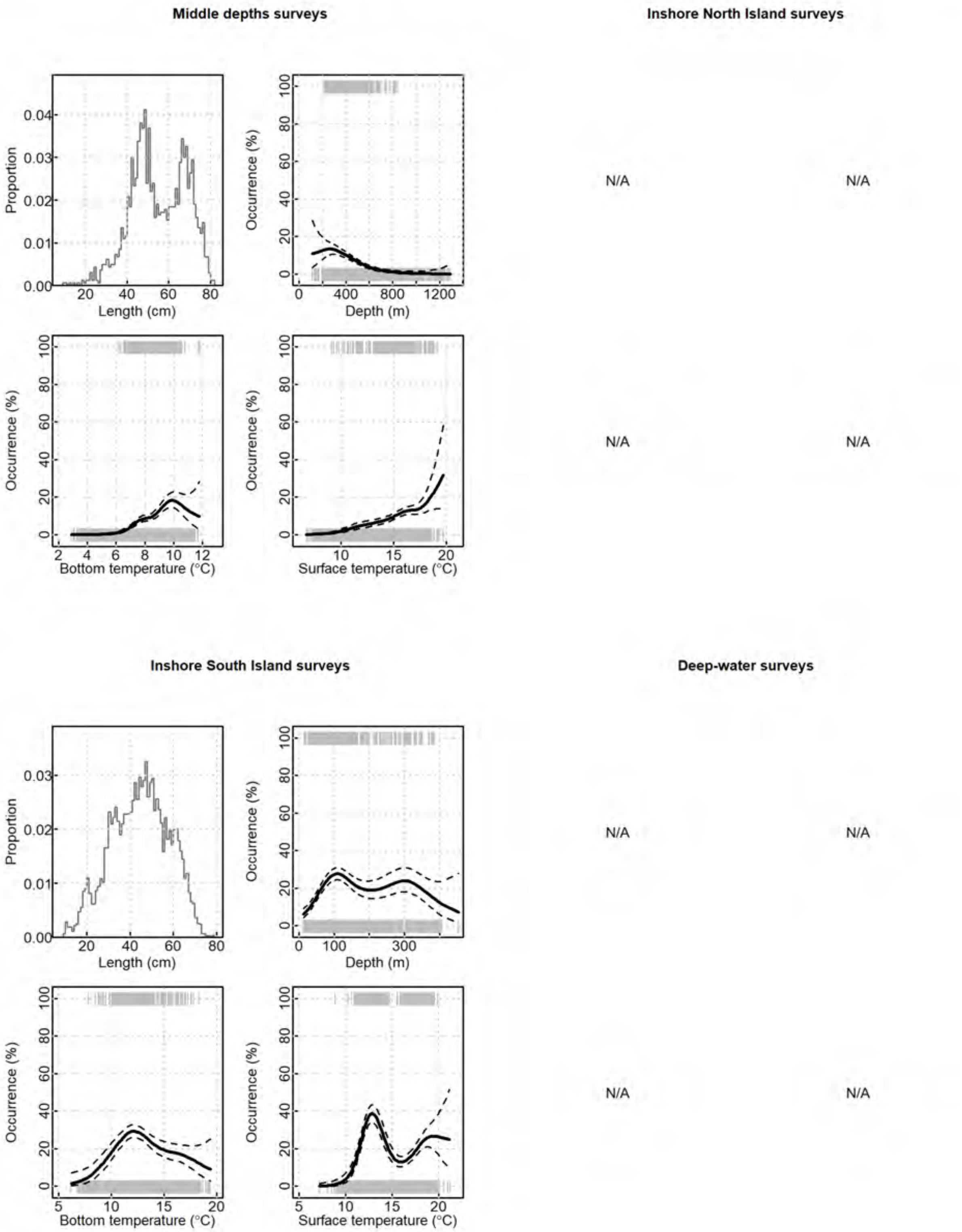


Figure 56.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to GIZ occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

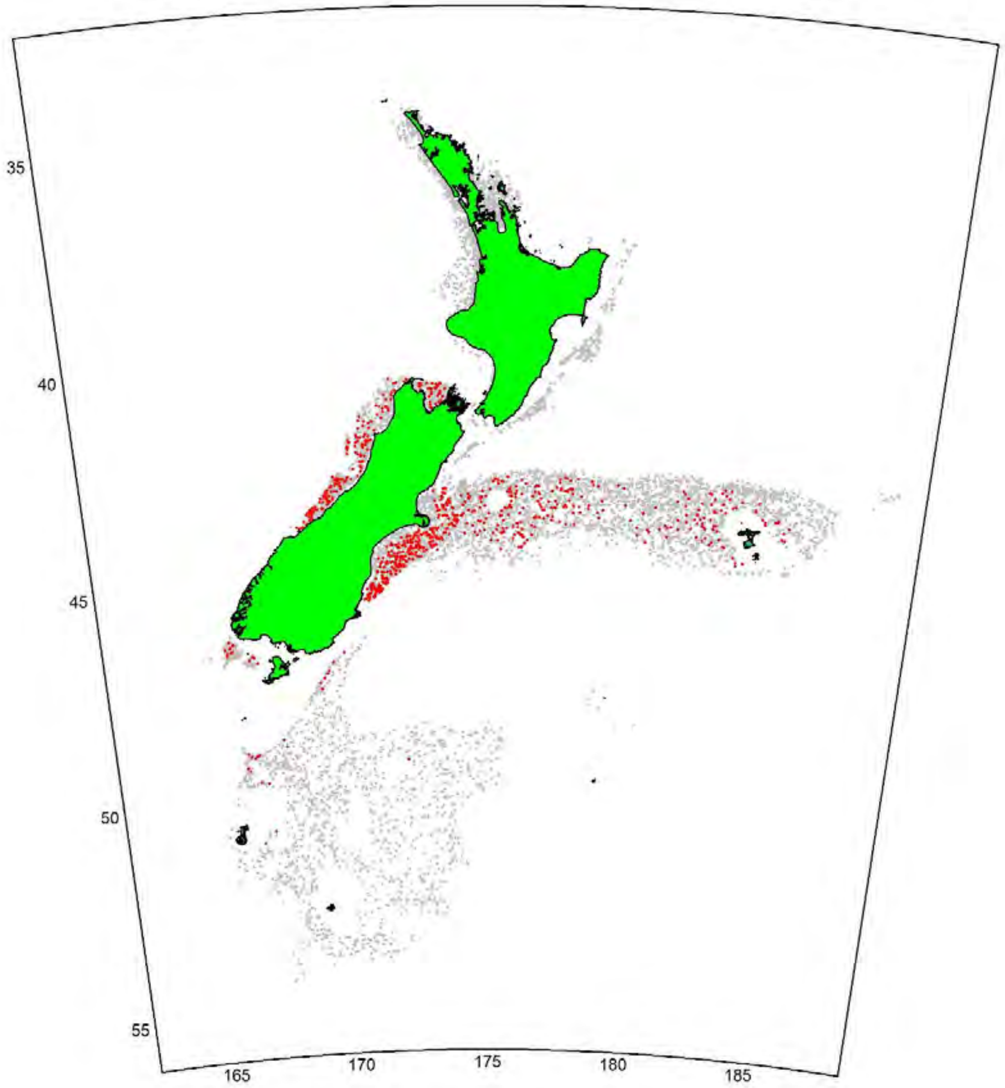


Figure 56.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where GIZ was caught (red points).

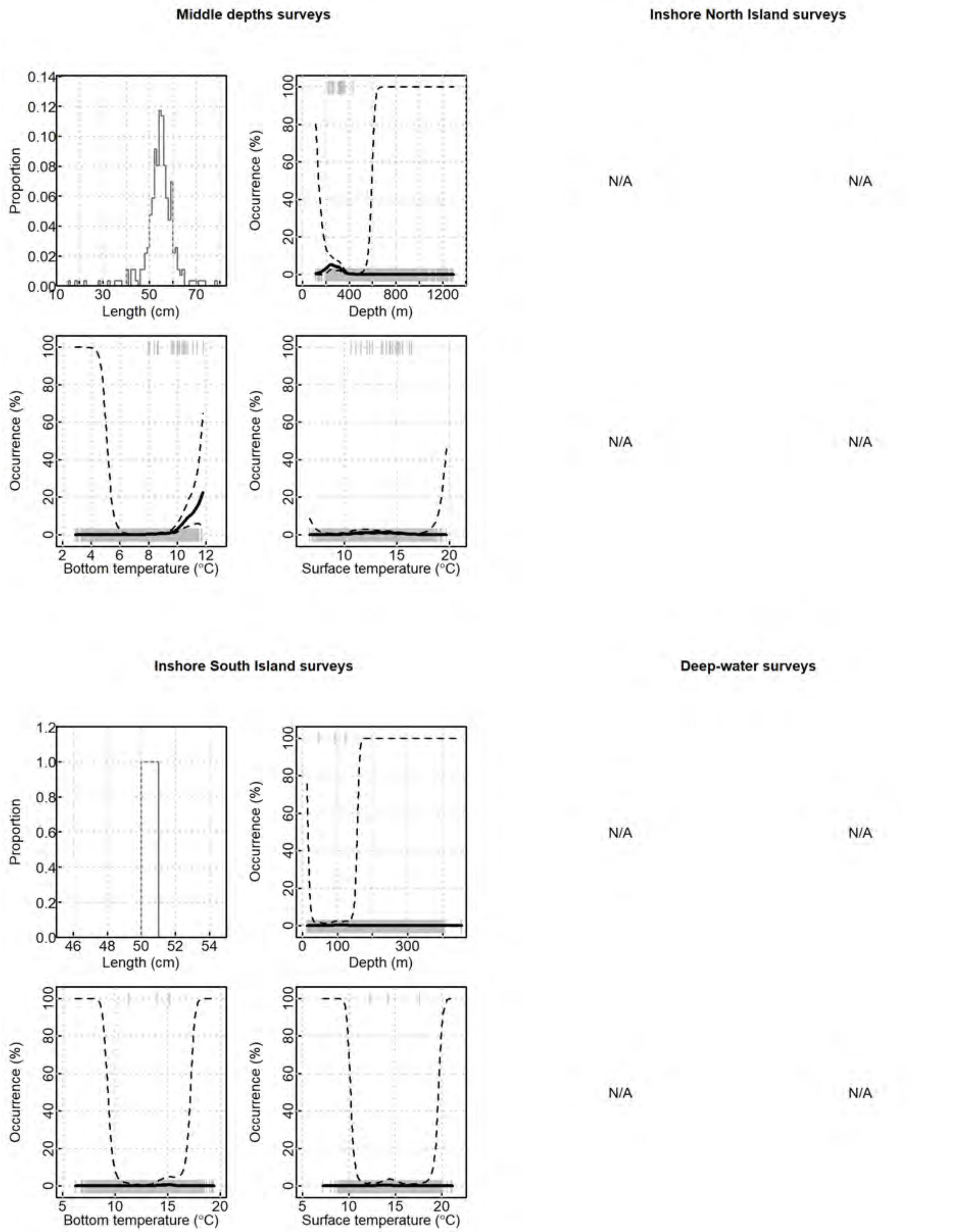


Figure 56.3: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to BGZ occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

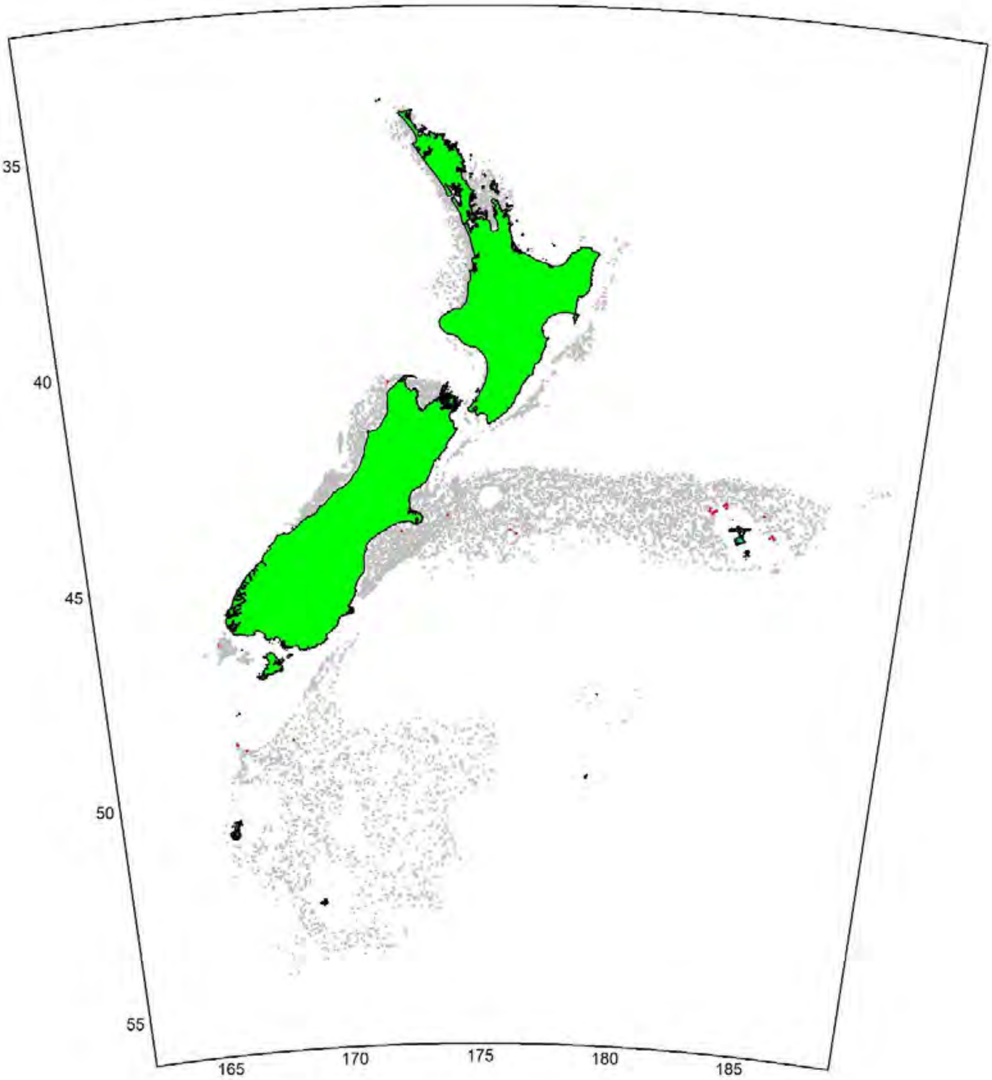


Figure 56.4: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where BGZ was caught (red points).

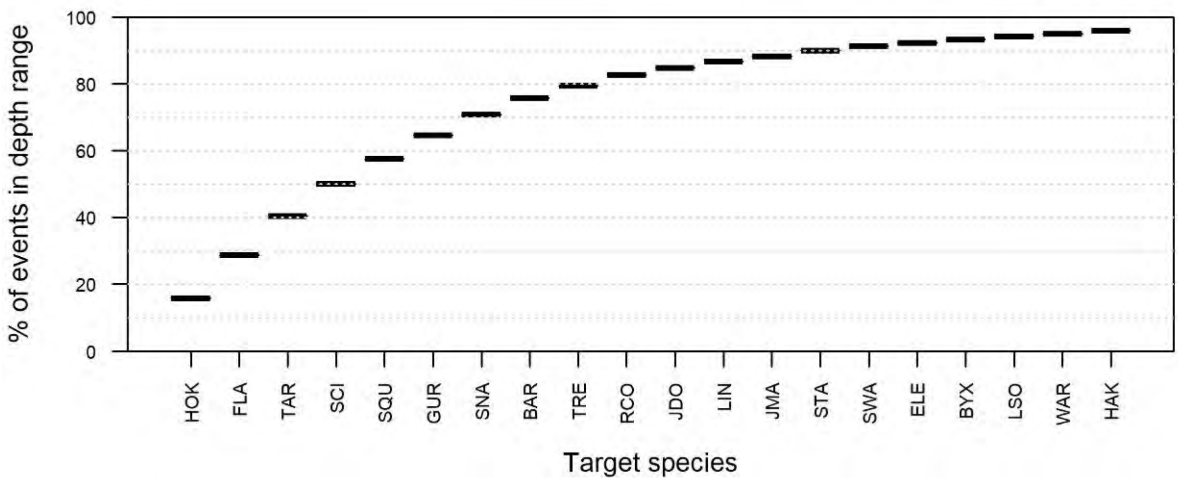
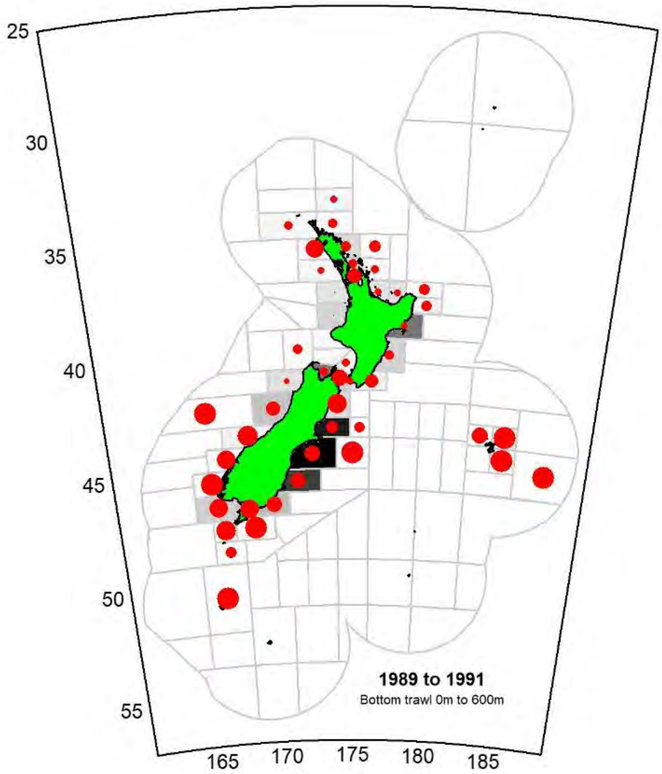


Figure 56.5: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for stargazer (STA) (0–600 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.



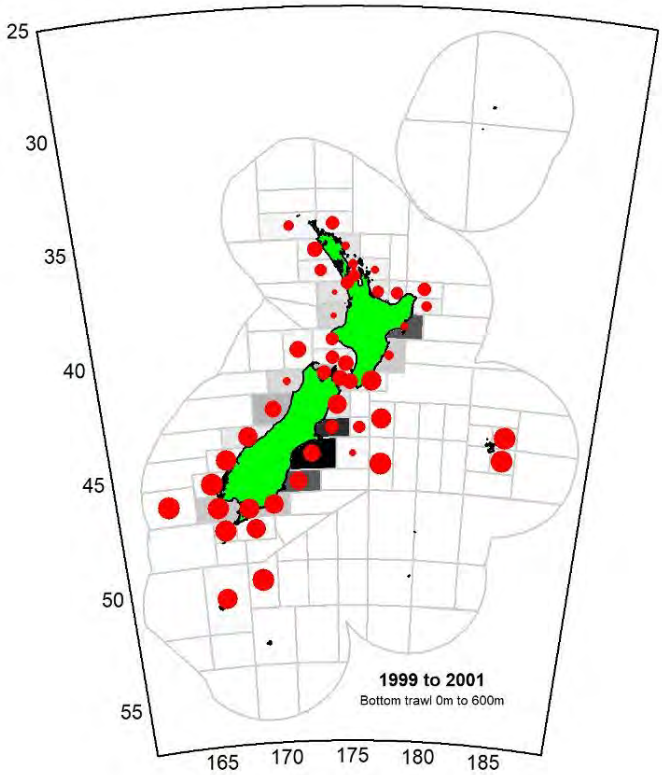
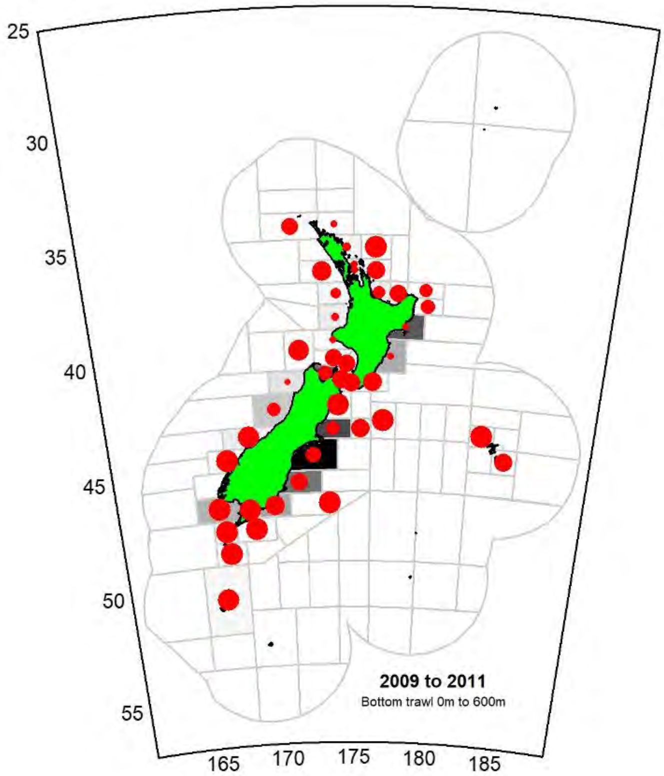


Figure 56.6: Maps of stargazer (STA) occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



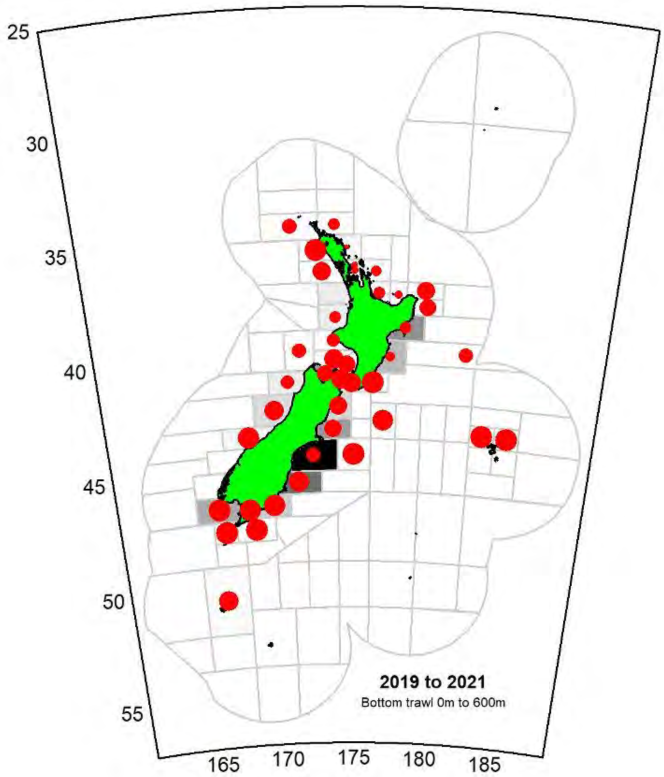


Figure 56.6 (cont.): Maps of stargazer (STA) occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

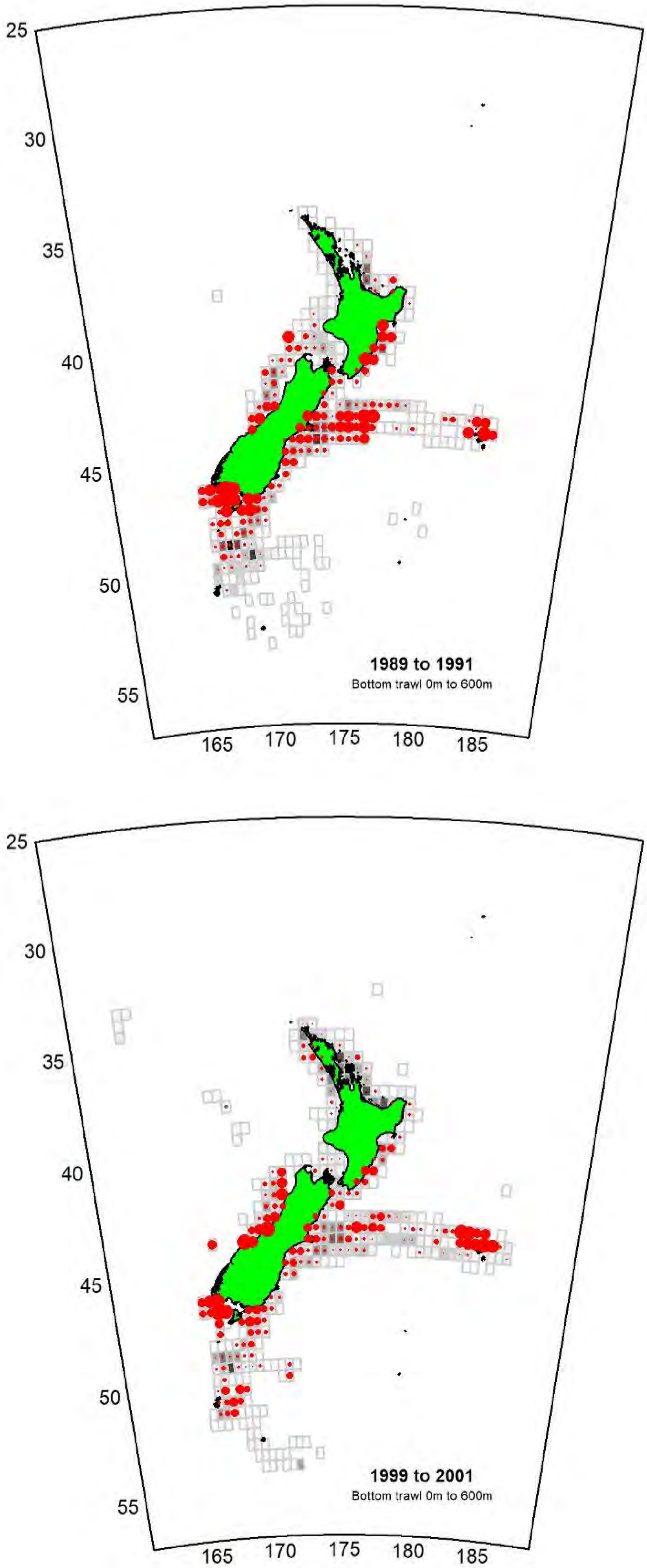
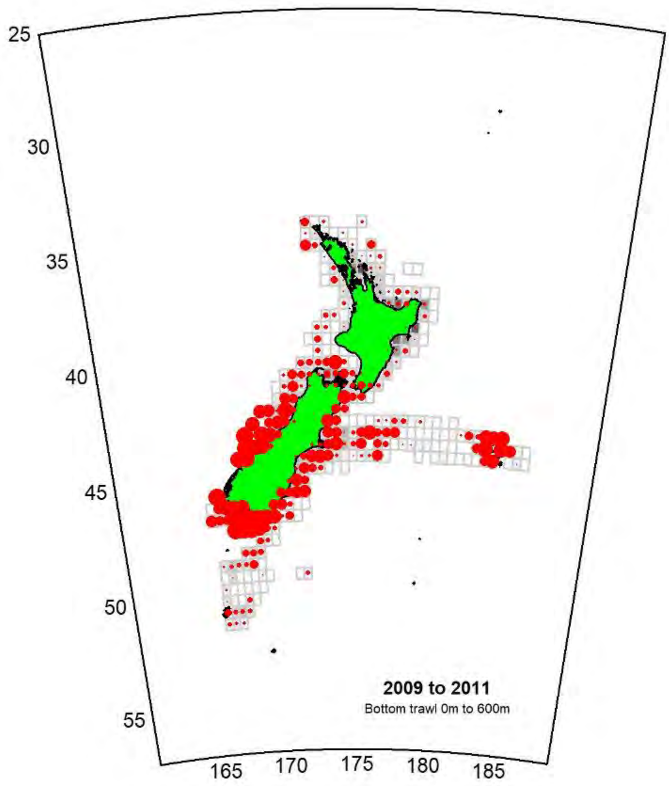


Figure 56.7: Maps of stargazer (STA) occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



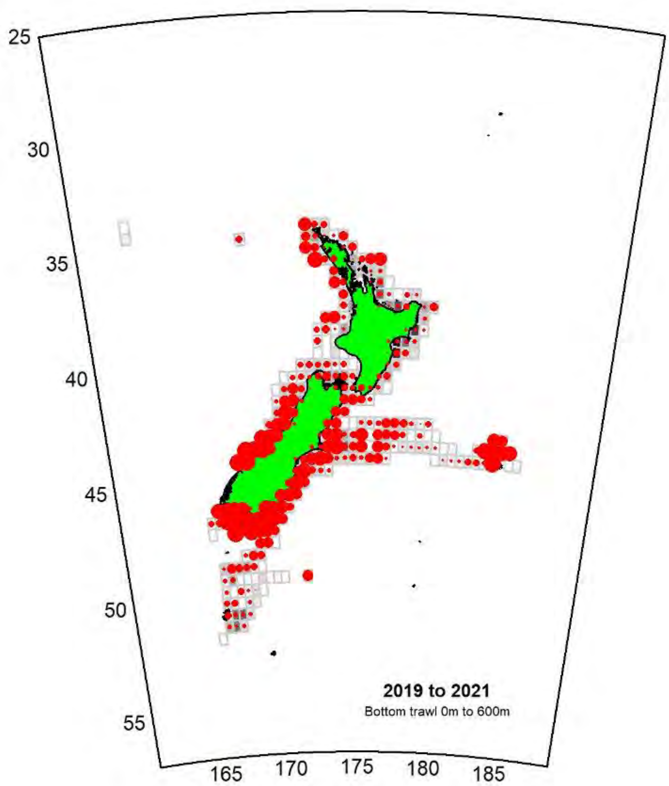


Figure 56.7 (cont.): Maps of stargazer (STA) occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

57. Tarakihi (TAR)

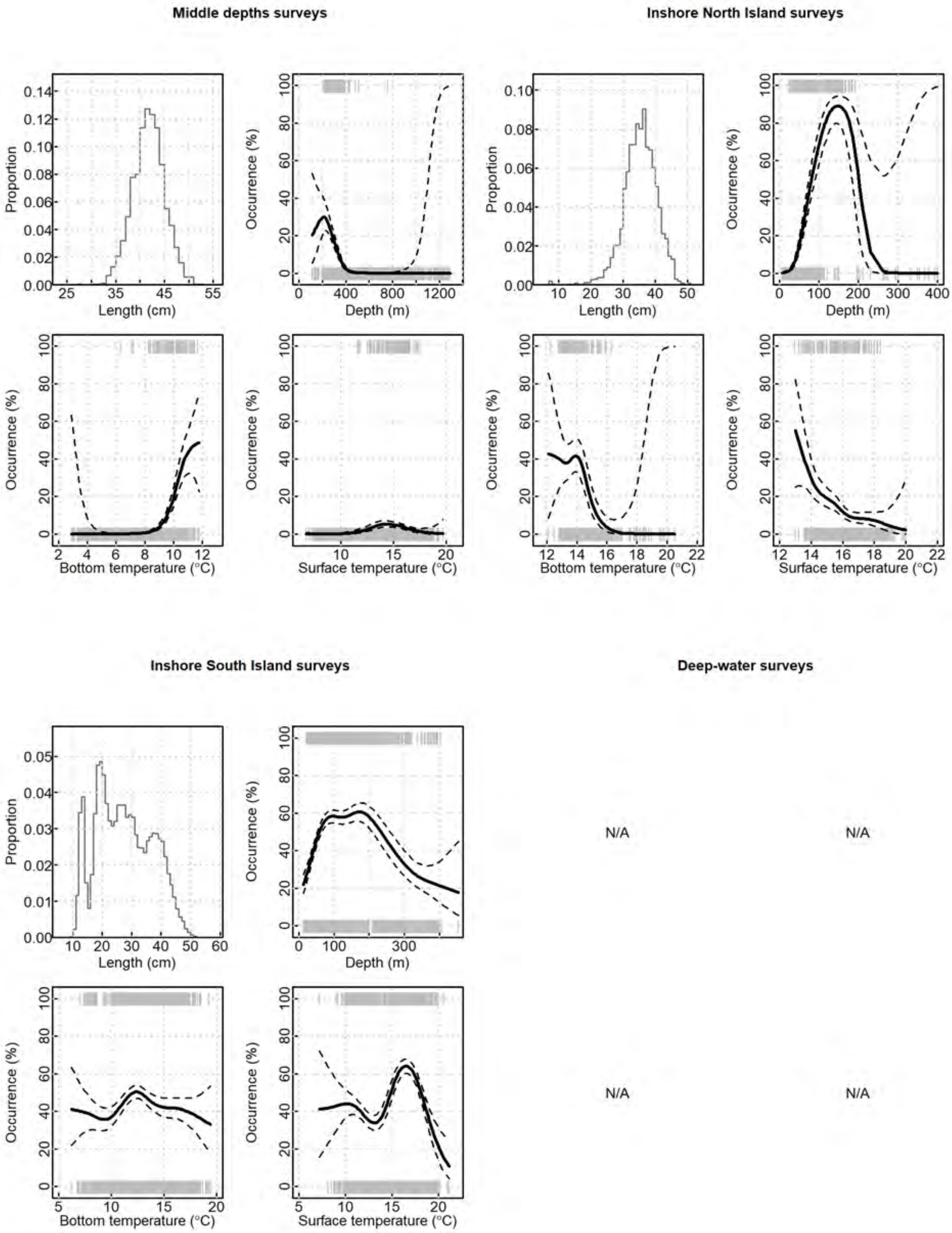


Figure 57.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to tarakihi occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

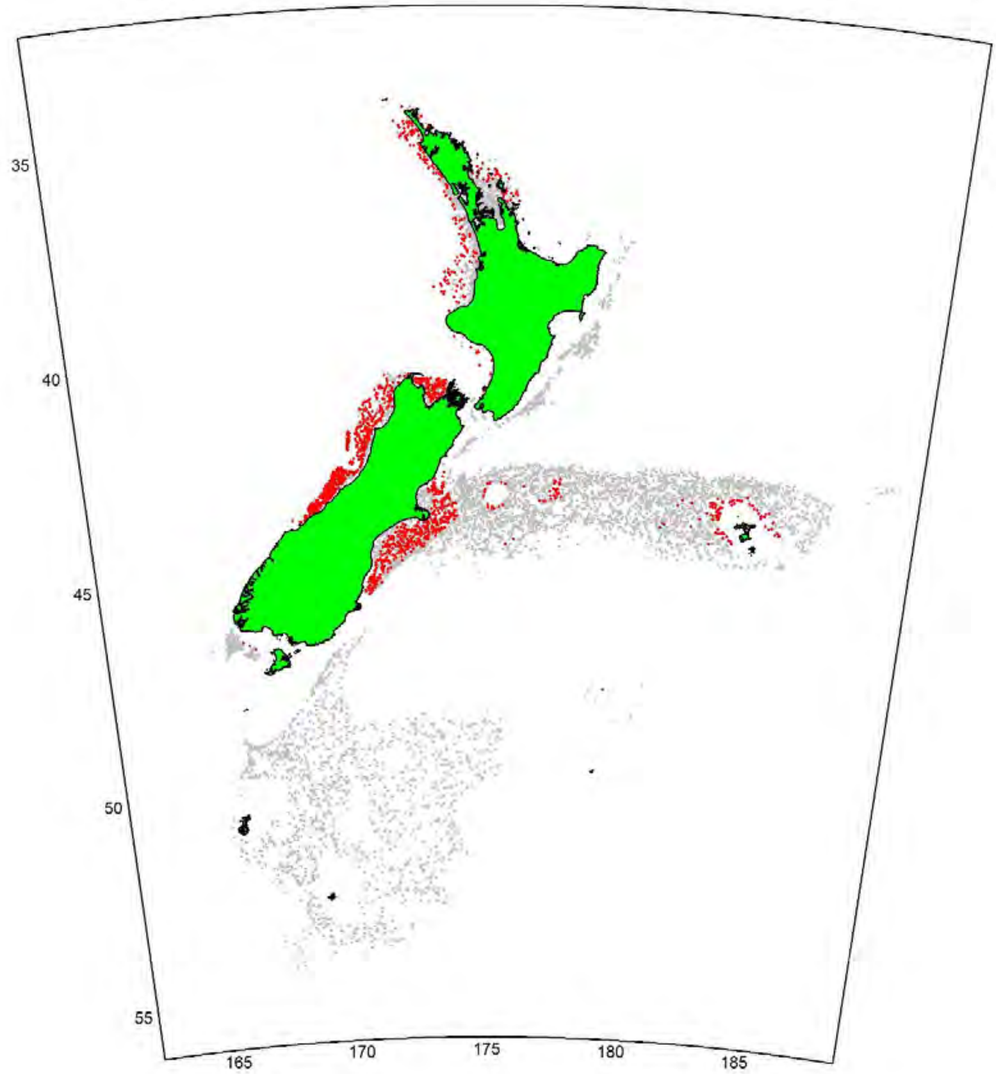


Figure 57.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where tarakihi was caught (red points).

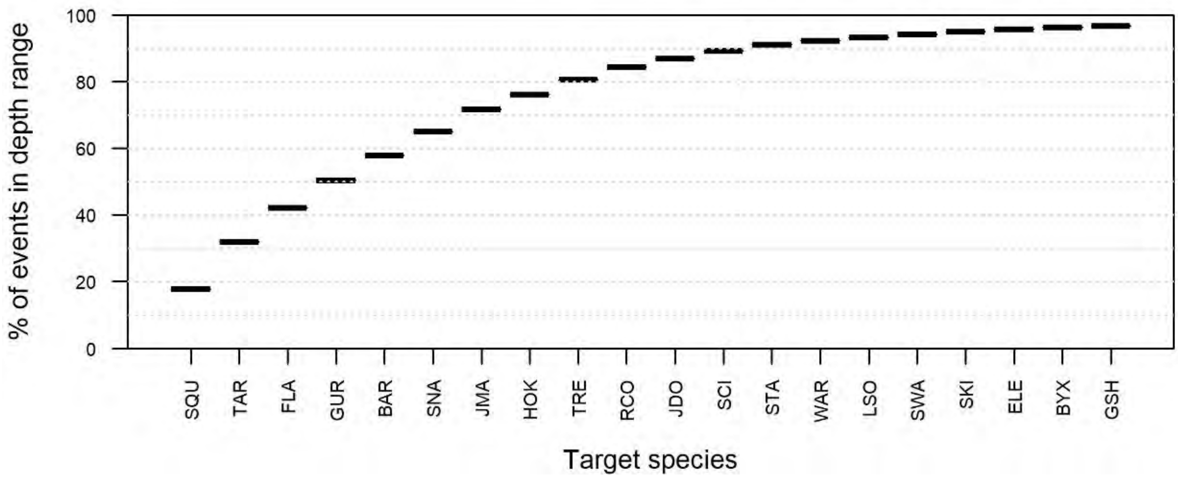
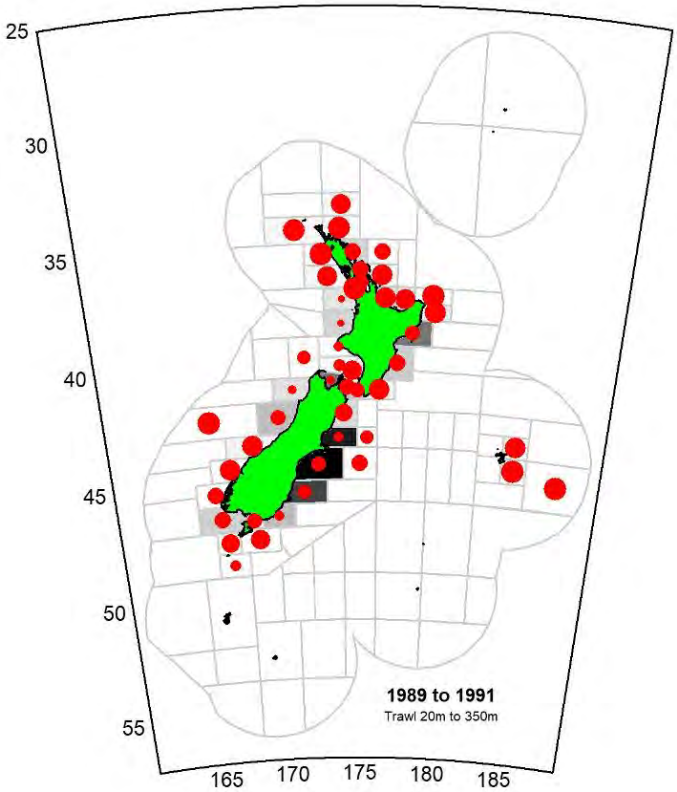


Figure 57.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for tarakihi (20–350 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.



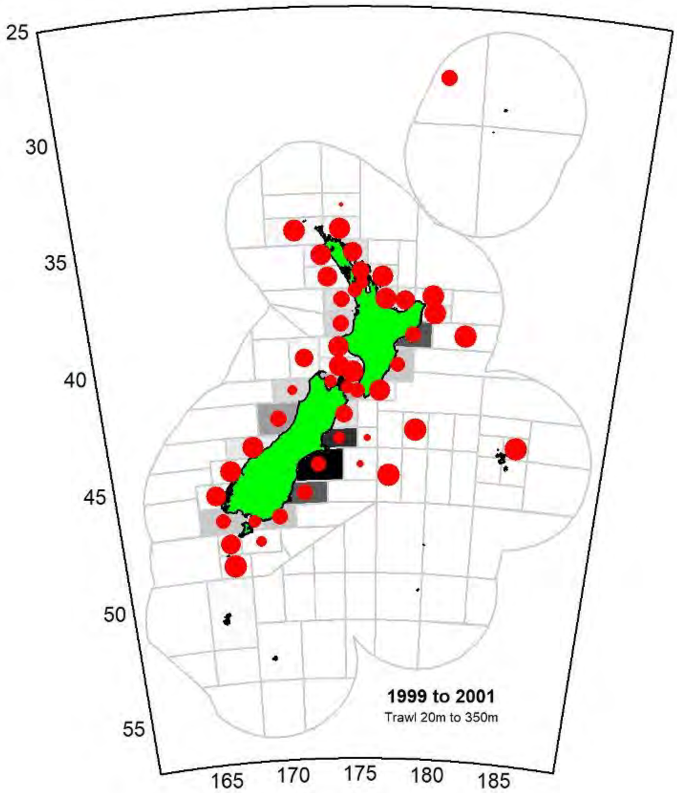
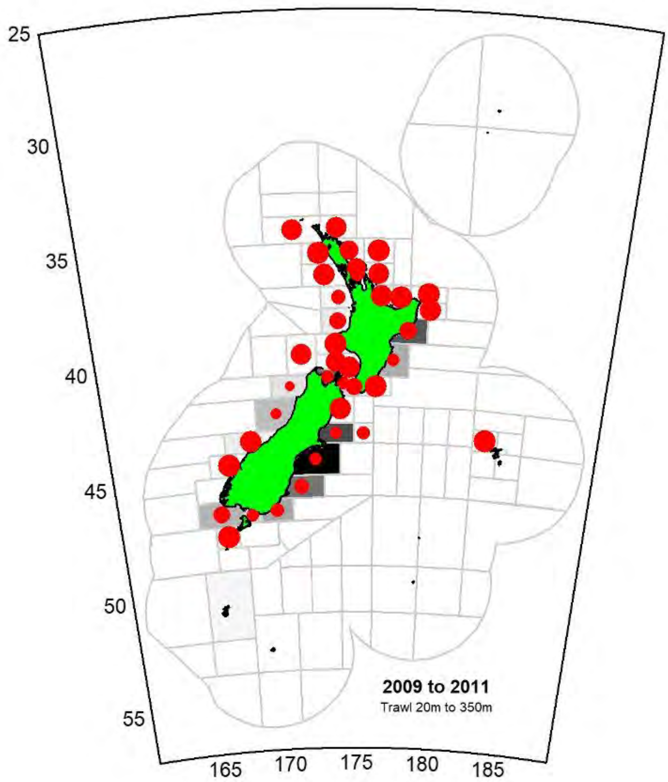


Figure 57.4: Maps of tarakihi occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



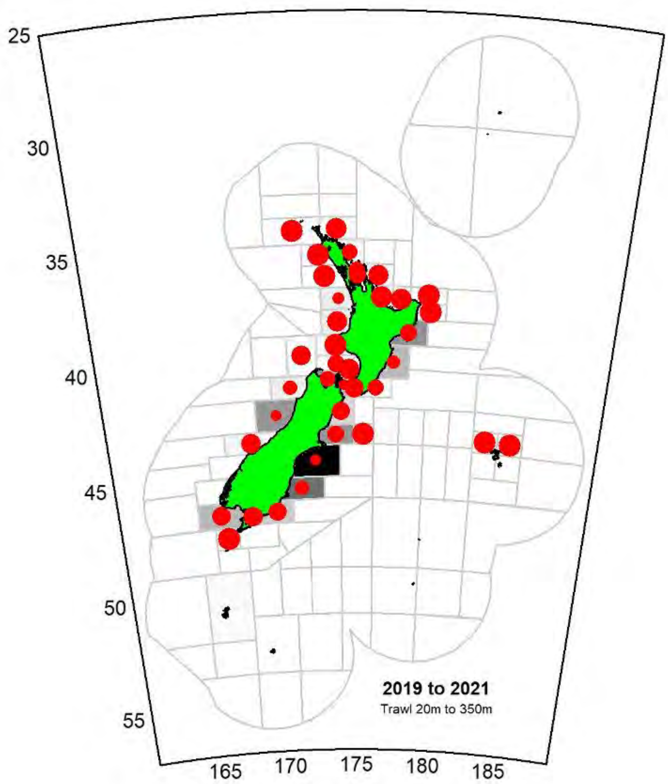
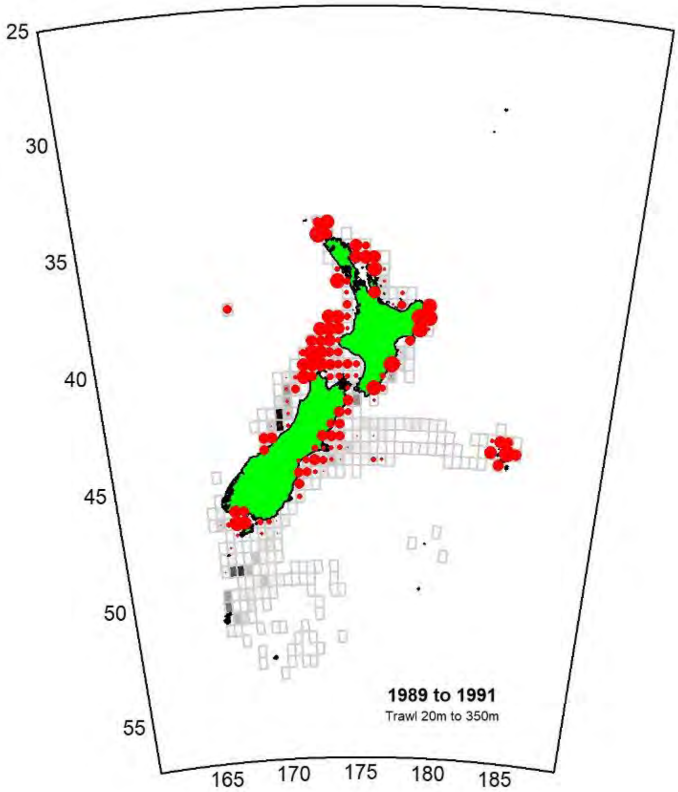


Figure 57.4 (cont.): Maps of tarakihi occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



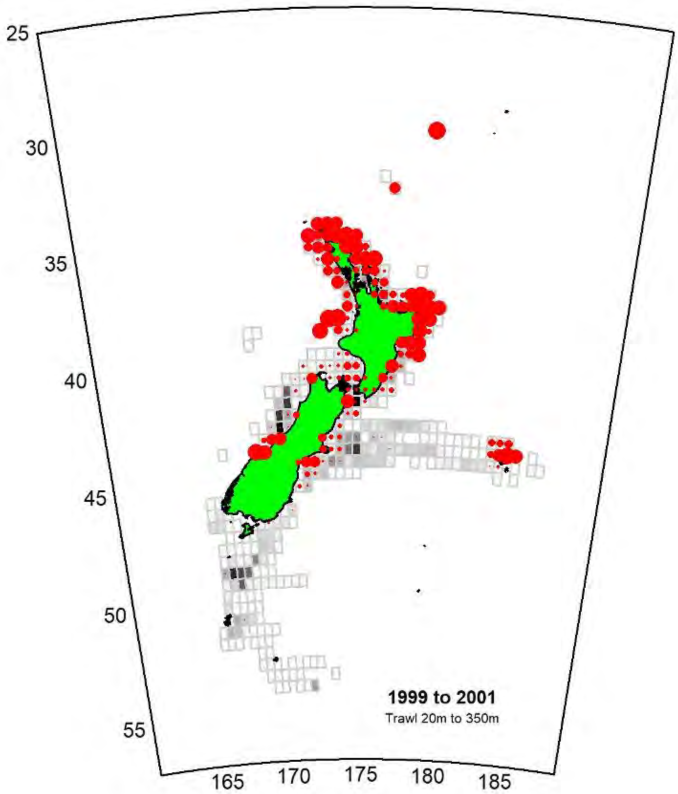
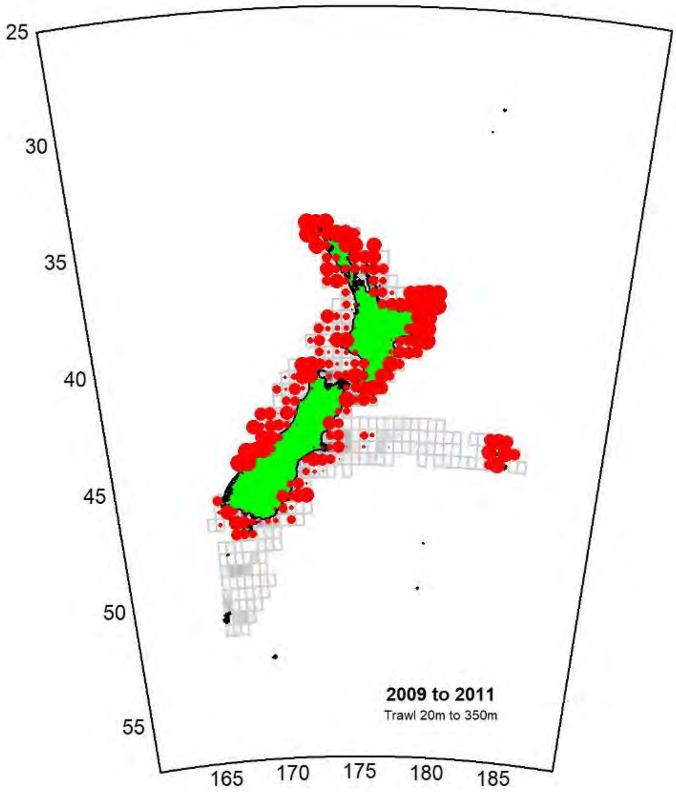


Figure 57.5: Maps of tarakihi occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



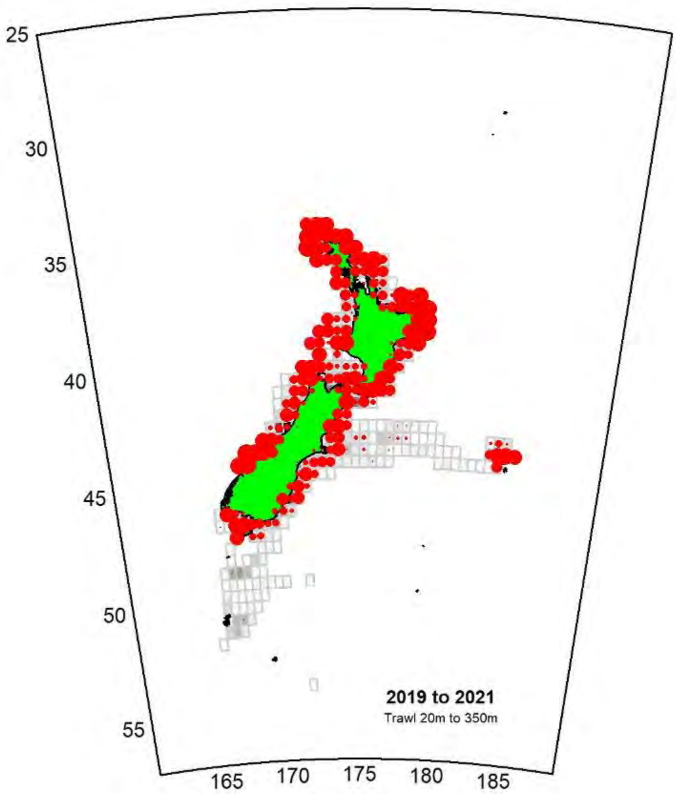


Figure 57.5 (cont.): Maps of tarakihi occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

58. Trevally (TRE)

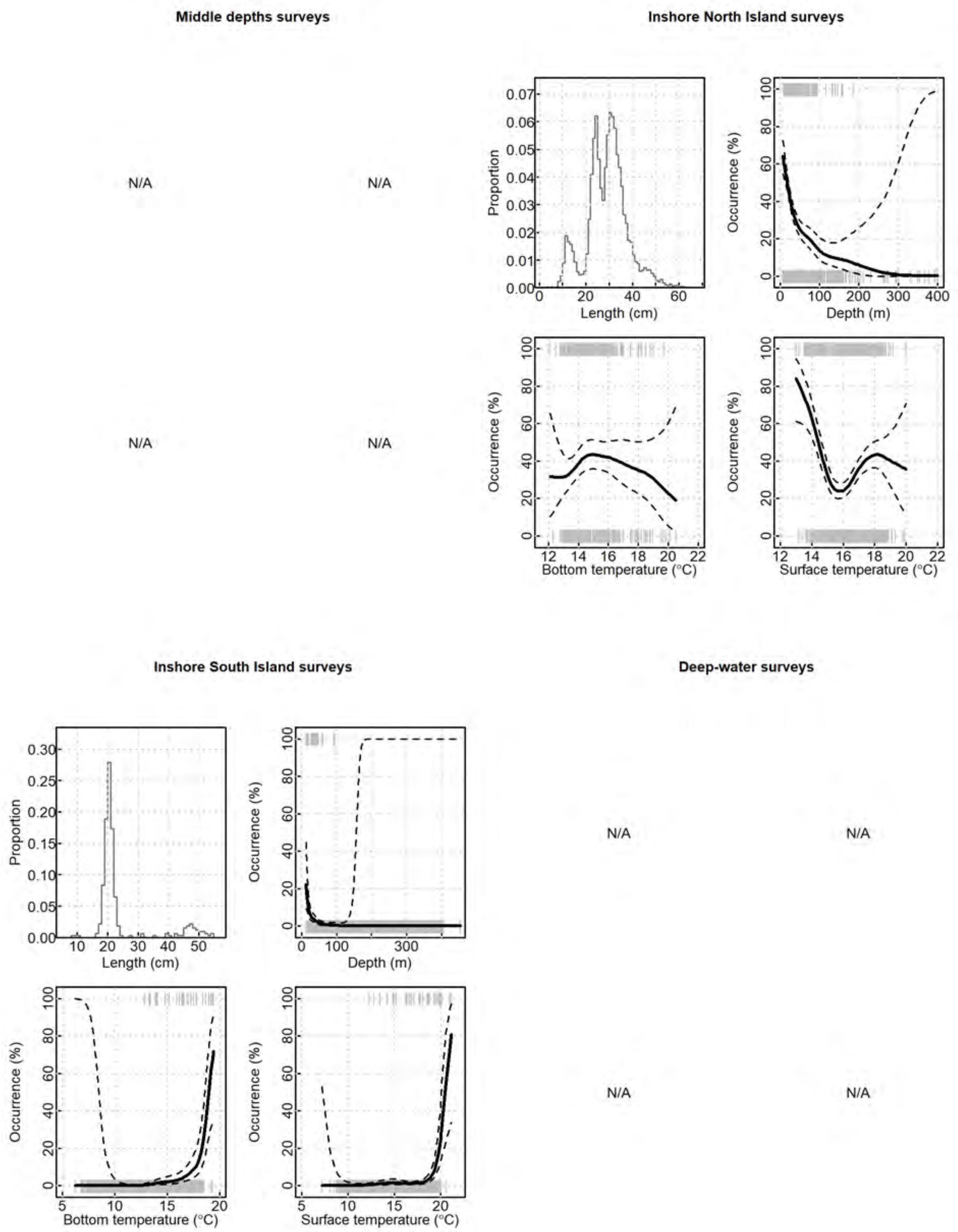


Figure 58.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to trevally occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

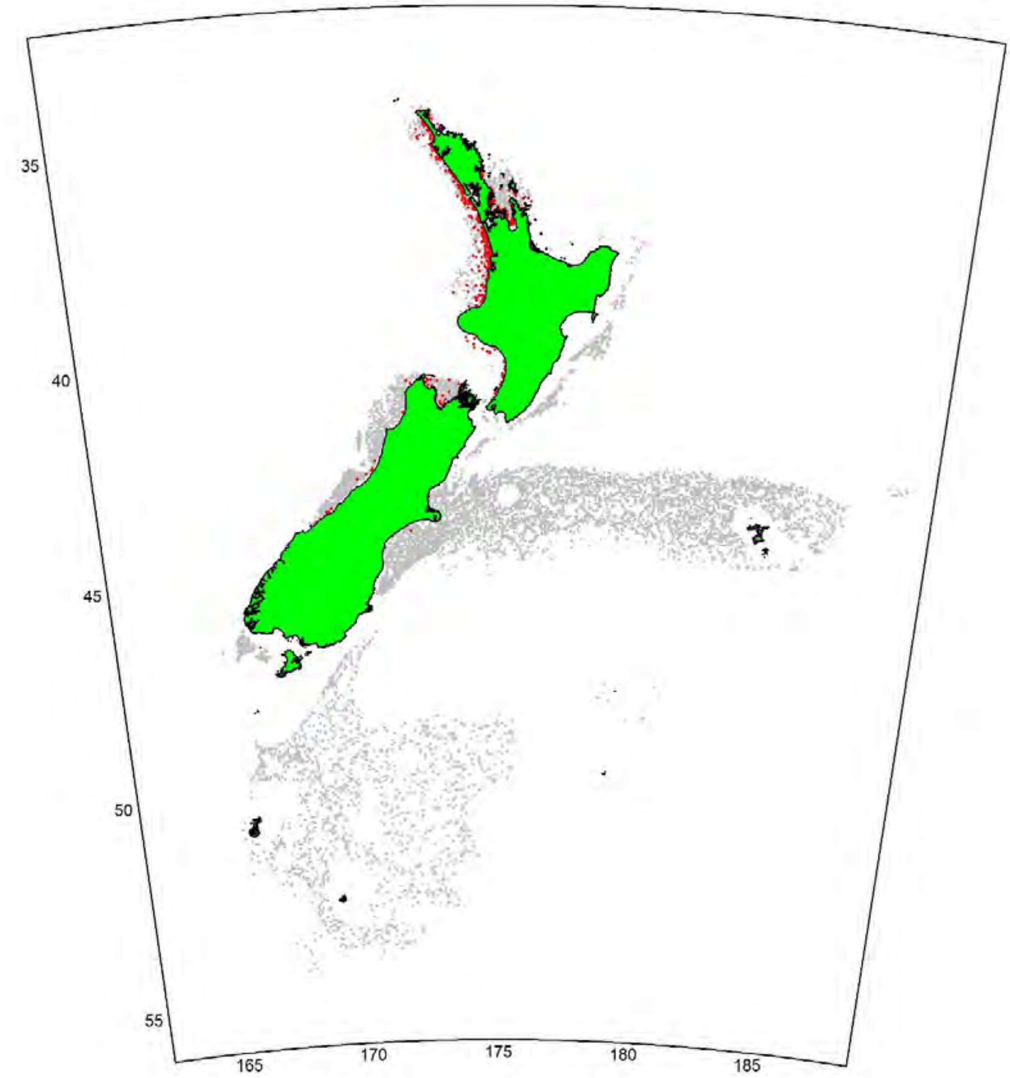


Figure 58.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where trevally was caught (red points).

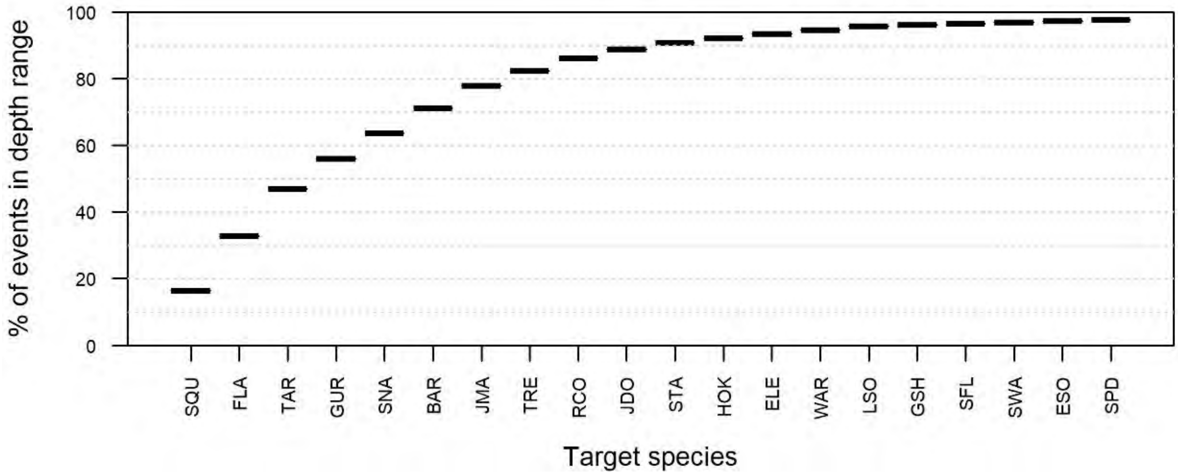
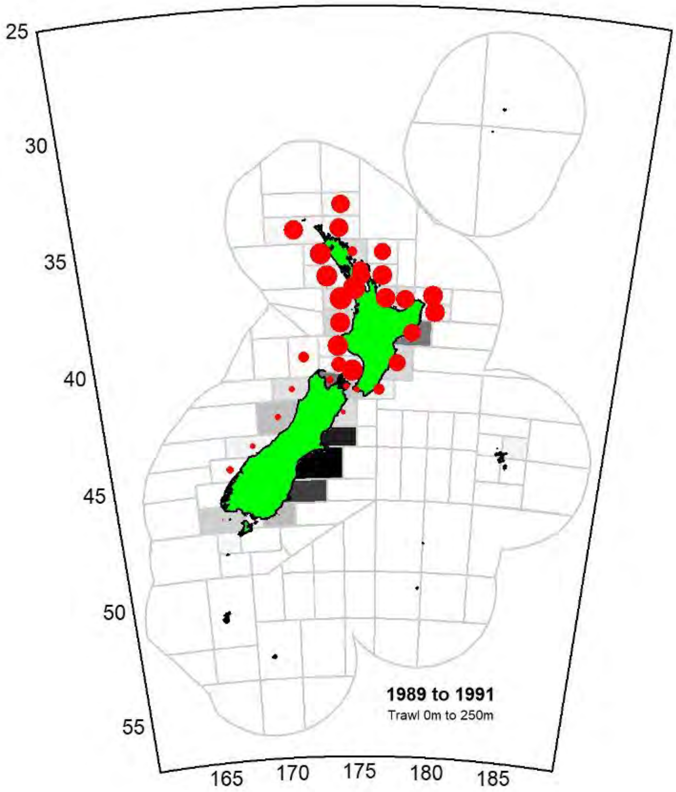


Figure 58.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for trevally (0–250 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.



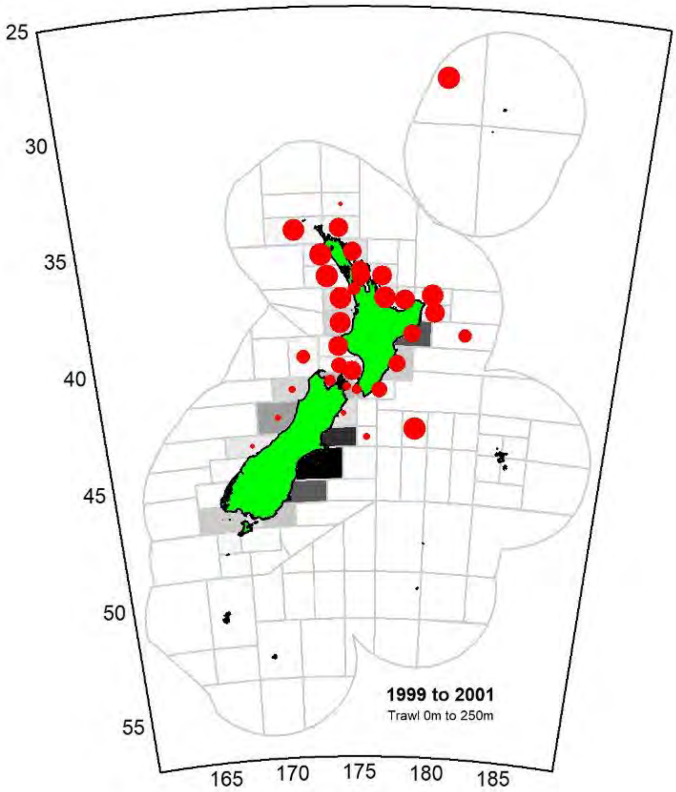
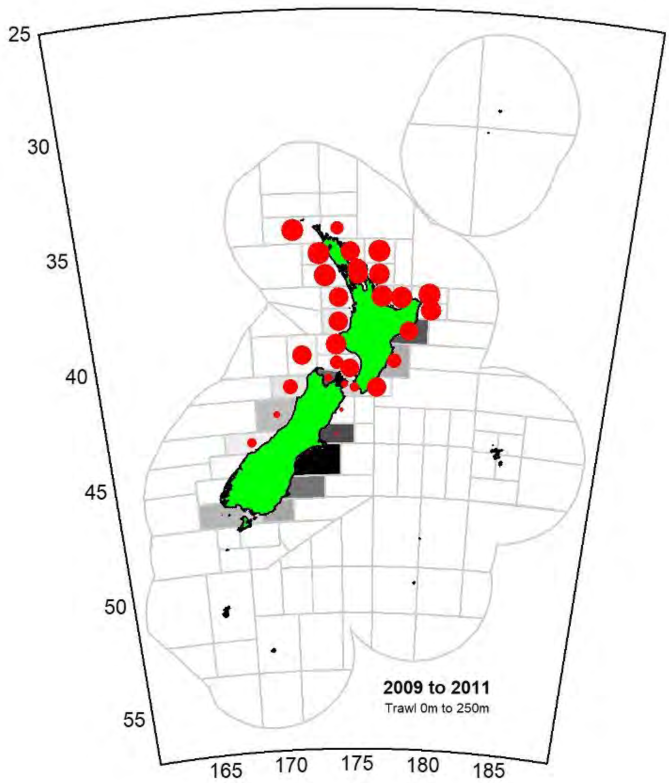


Figure 58.4: Maps of trevally occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



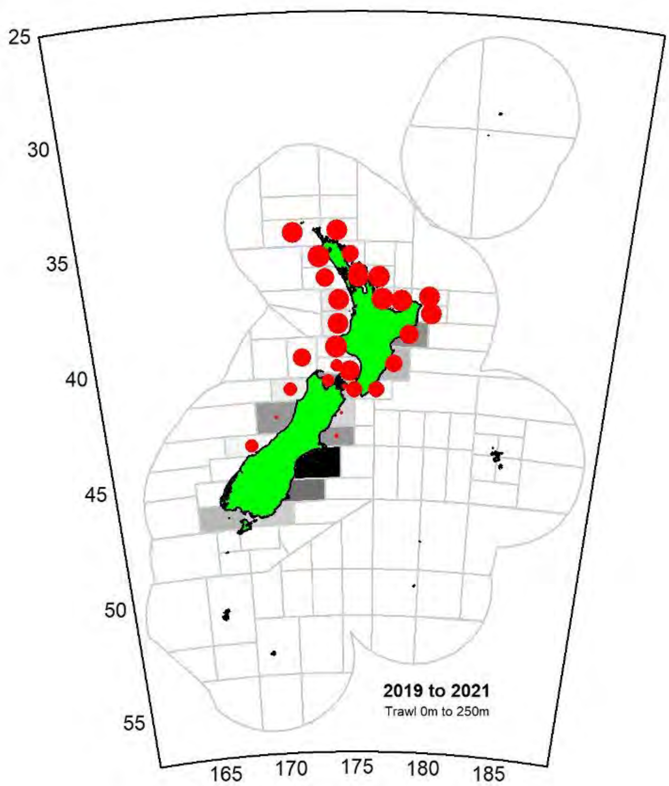
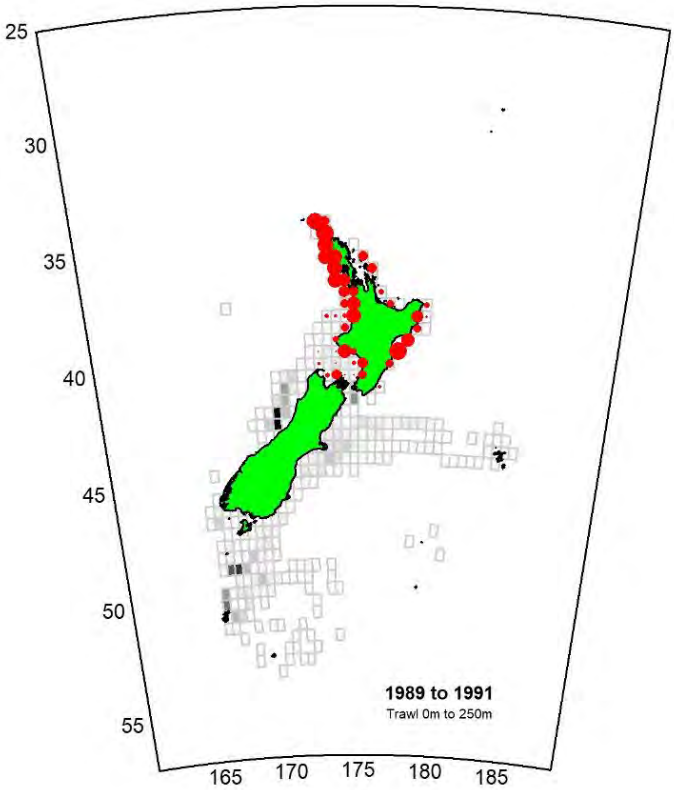


Figure 58.4 (cont.): Maps of trevally occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



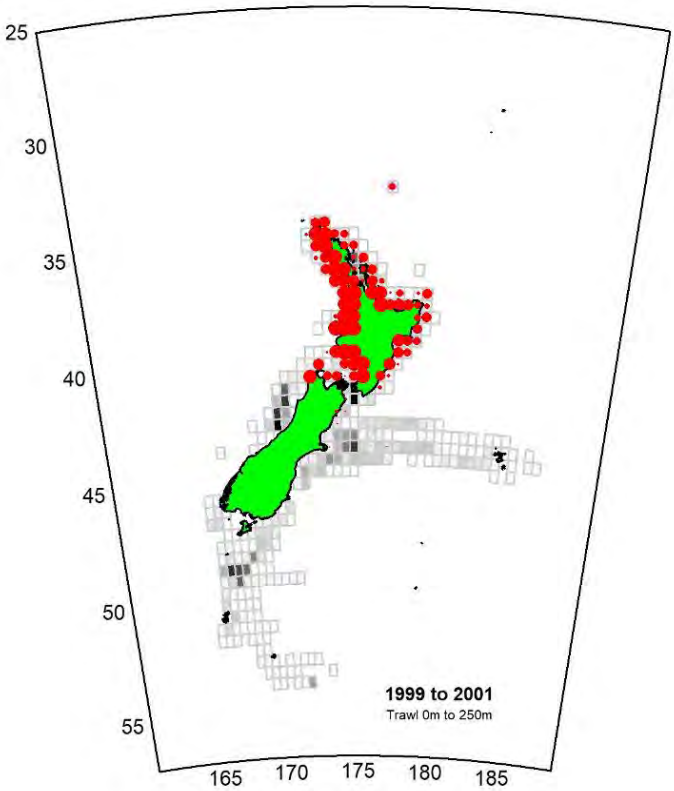
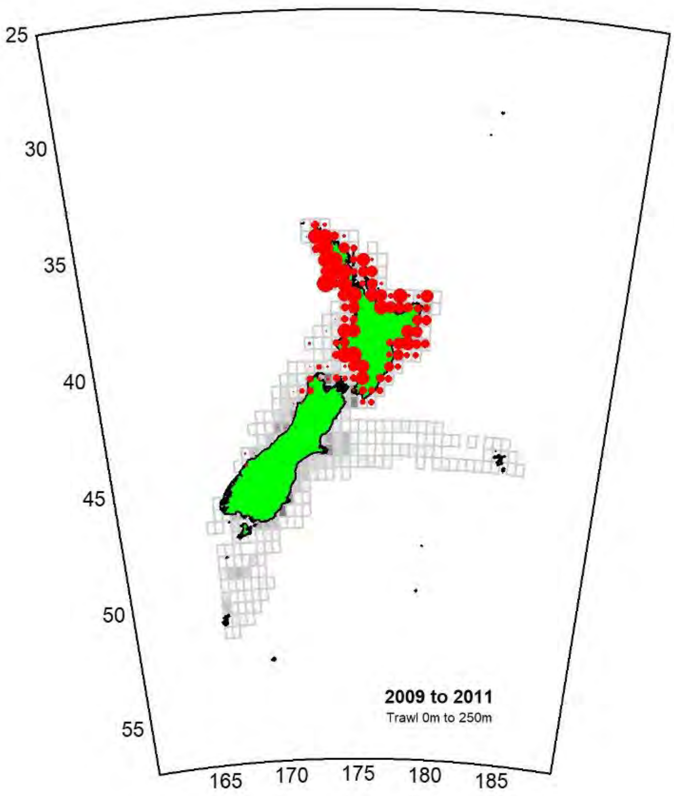


Figure 58.5: Maps of trevally occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



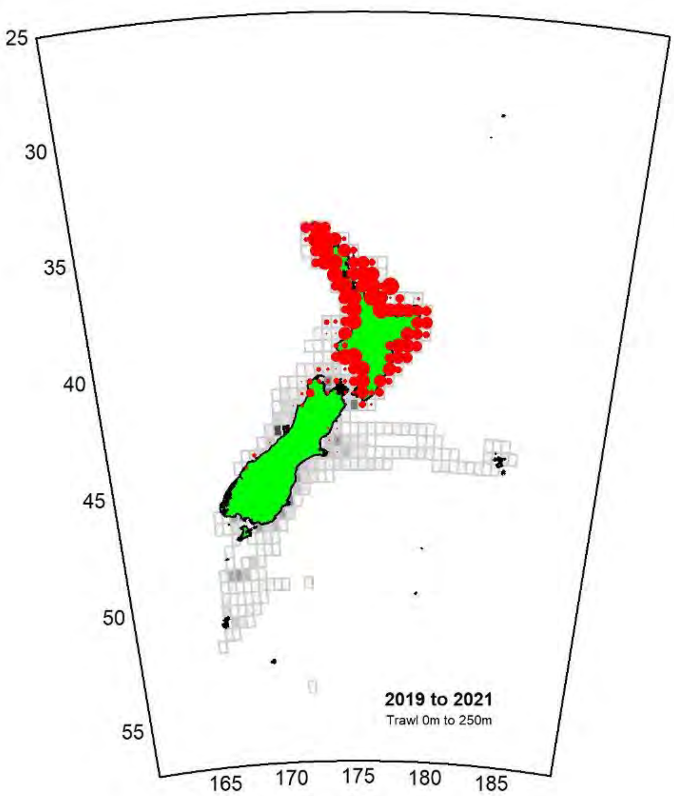


Figure 58.5 (cont.): Maps of trevally occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

59. Trumpeter (TRU)

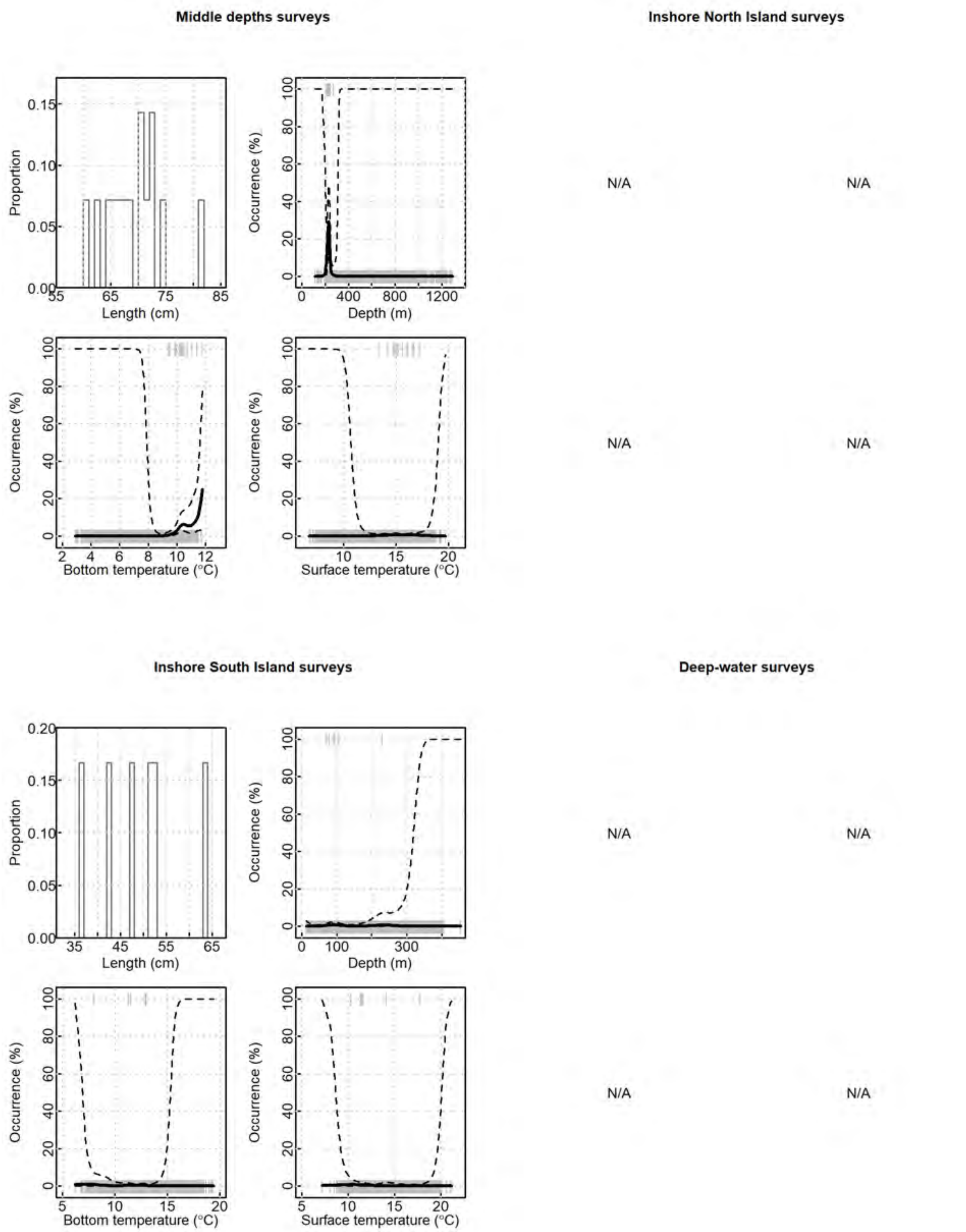


Figure 59.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to trumpeter occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

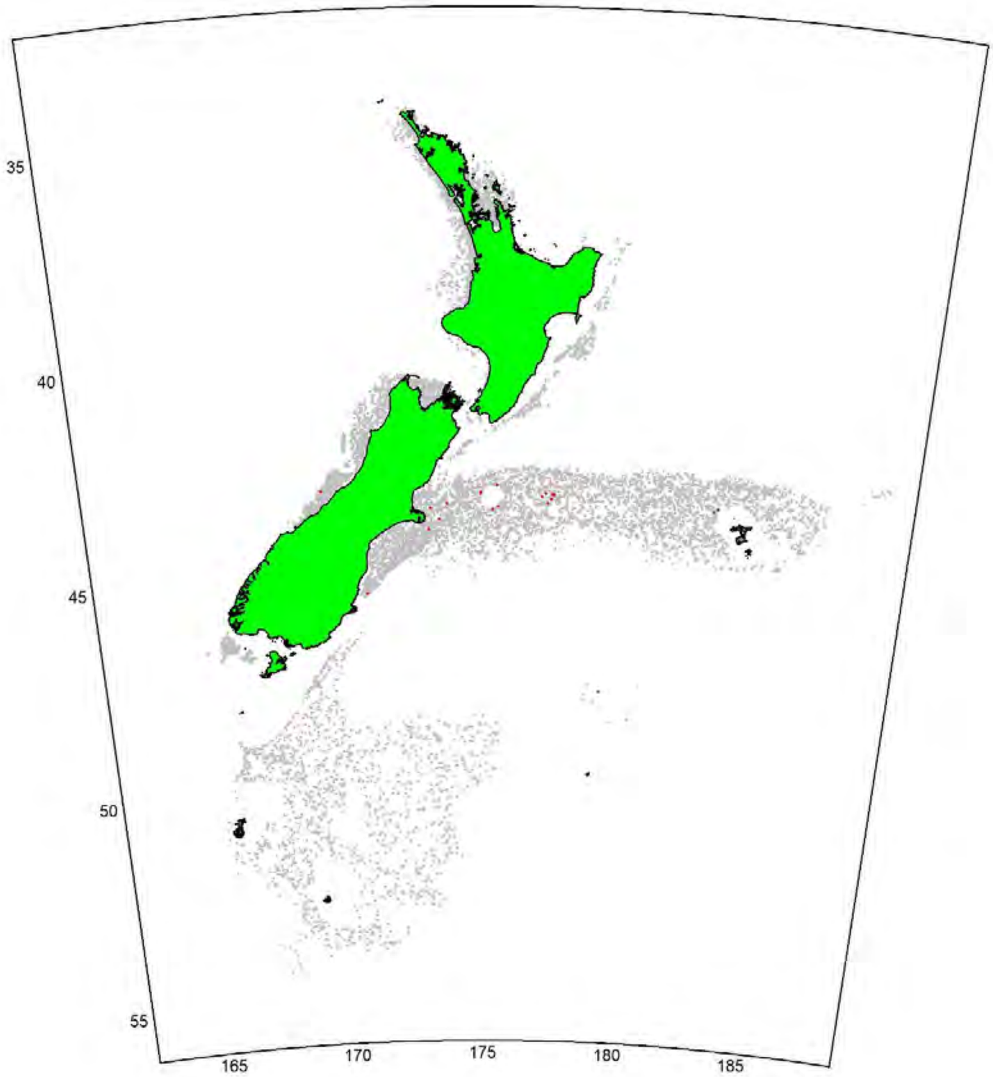


Figure 59.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where trumpeter was caught (red points).

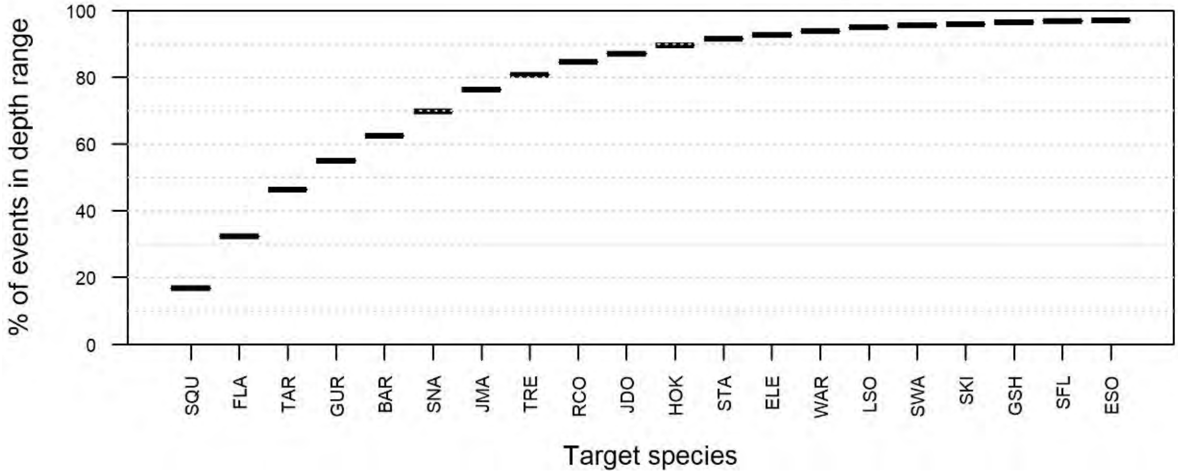
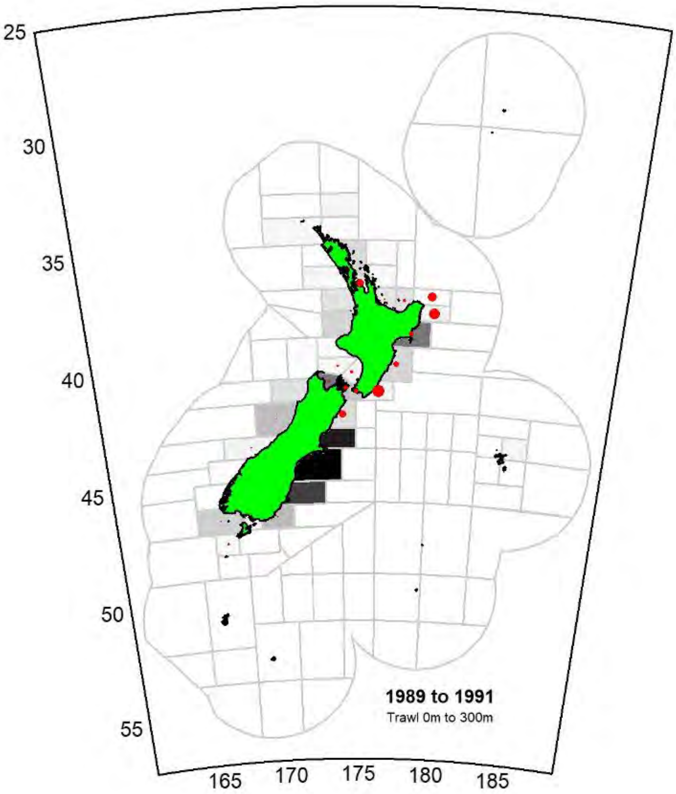


Figure 59.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for trumpeter (0–300 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.



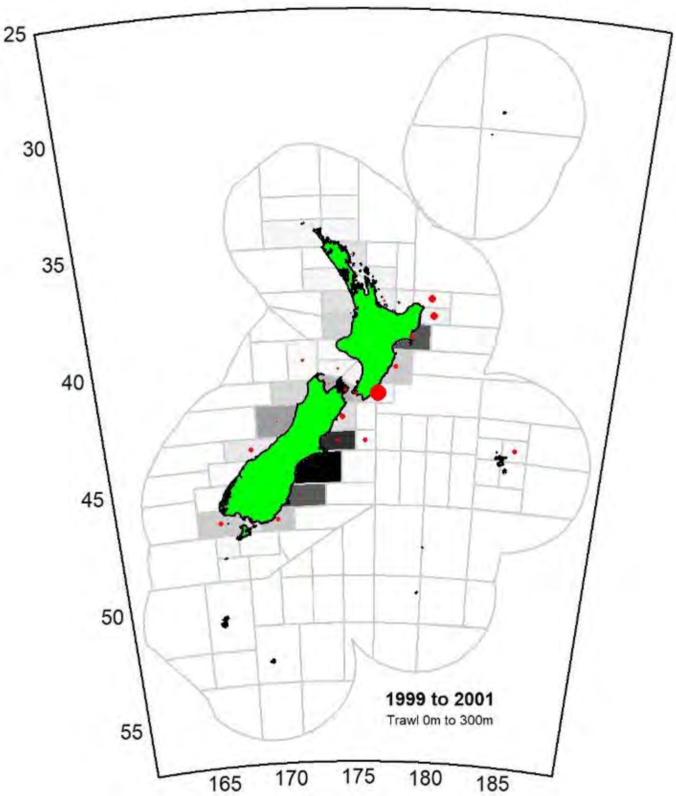
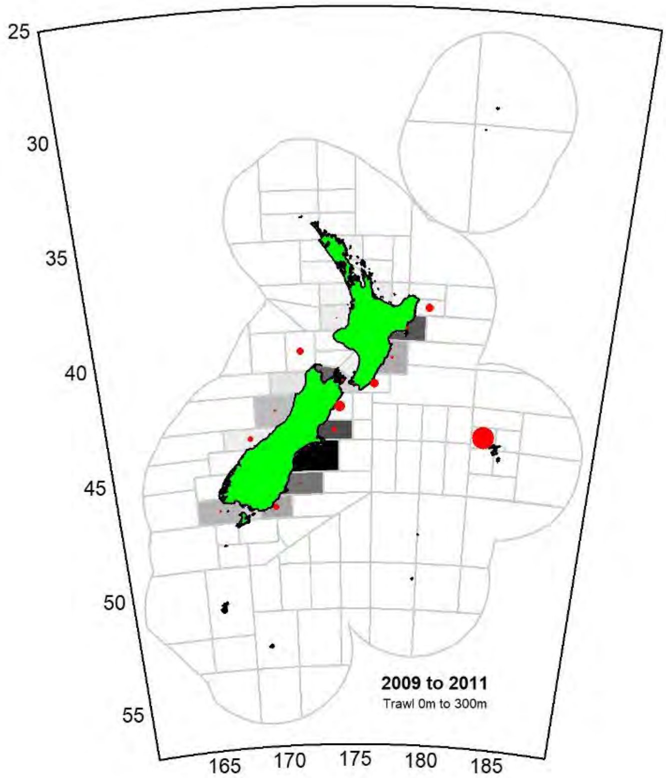


Figure 59.4: Maps of trumpeter occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



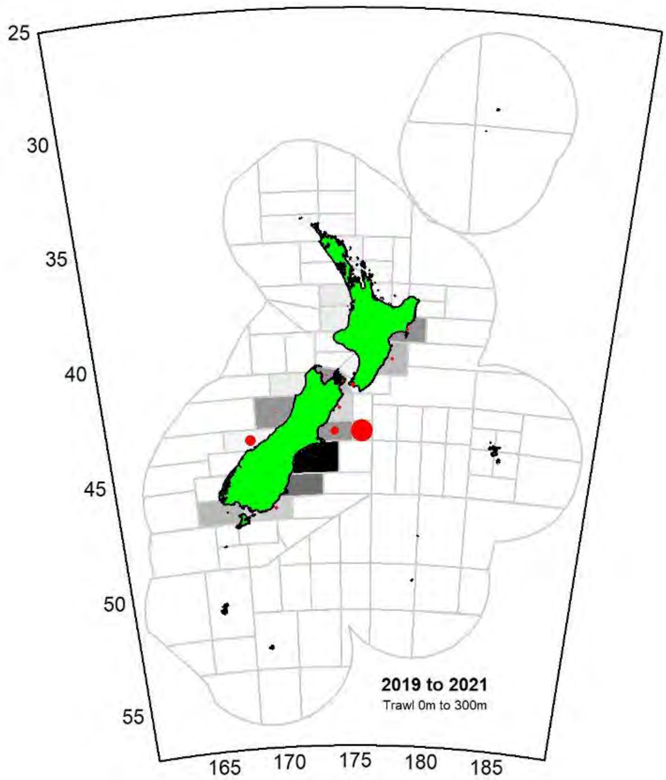
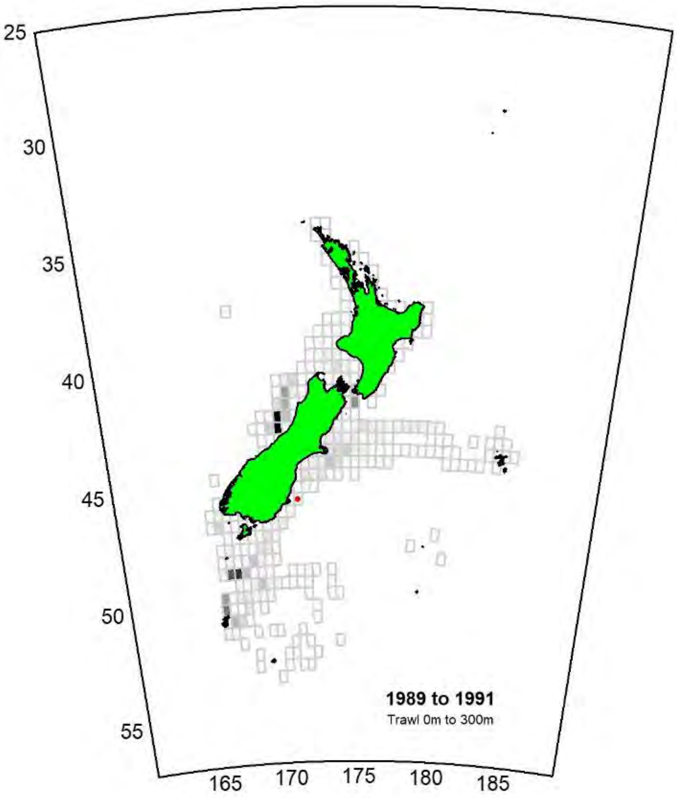


Figure 59.4 (cont.): Maps of trumpeter occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



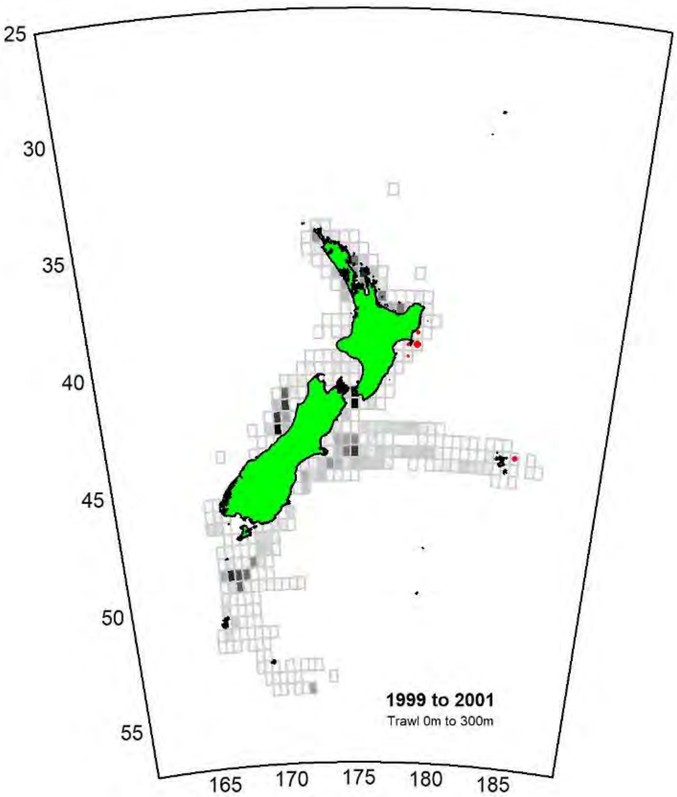
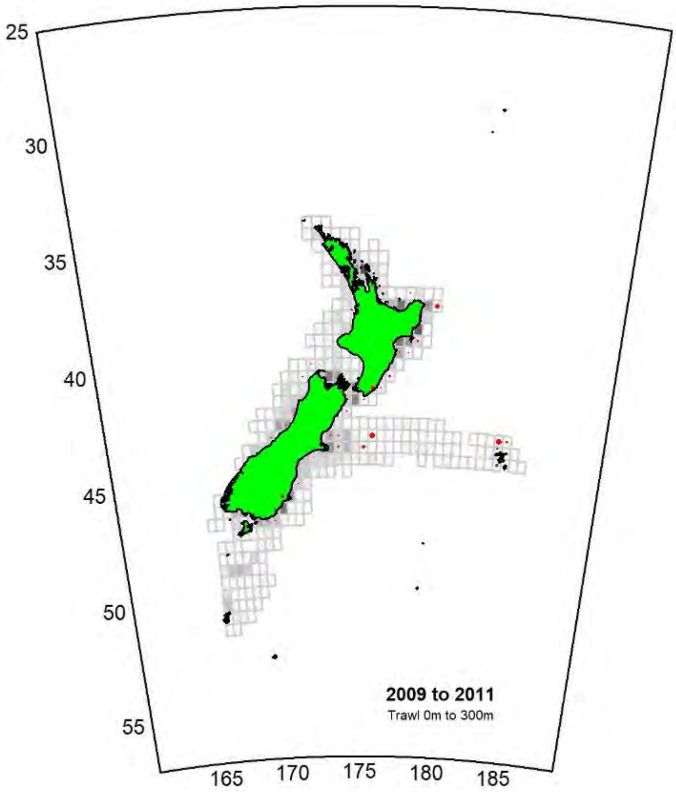


Figure 59.5: Maps of trumpeter occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



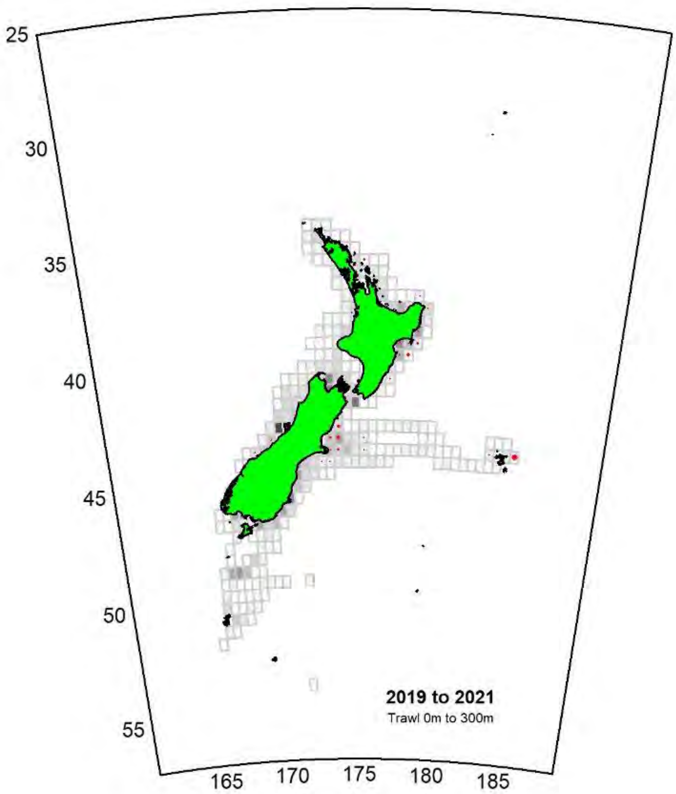


Figure 59.5 (cont.): Maps of trumpeter occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

60. White warehou (WWA)

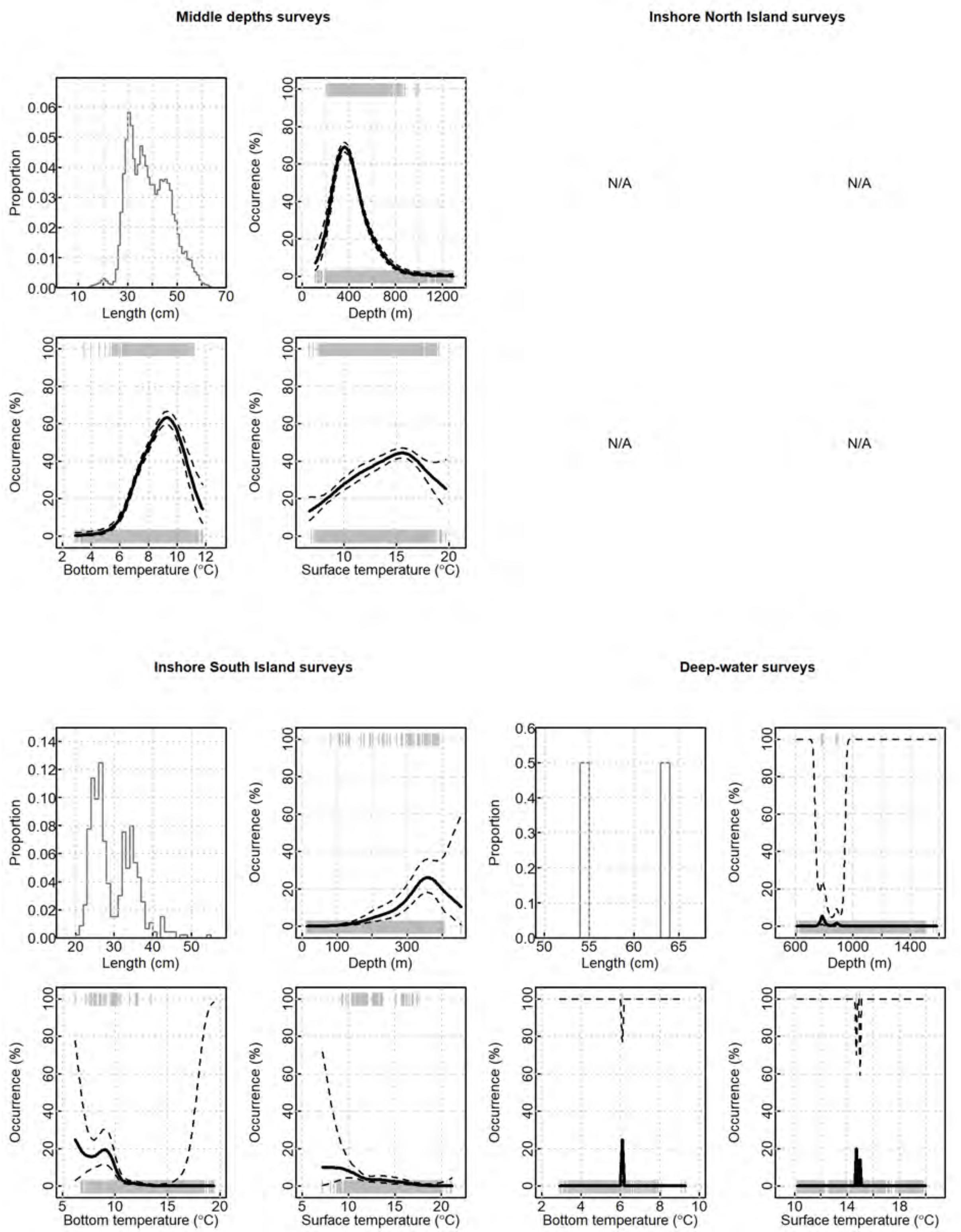


Figure 60.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to white warehou occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

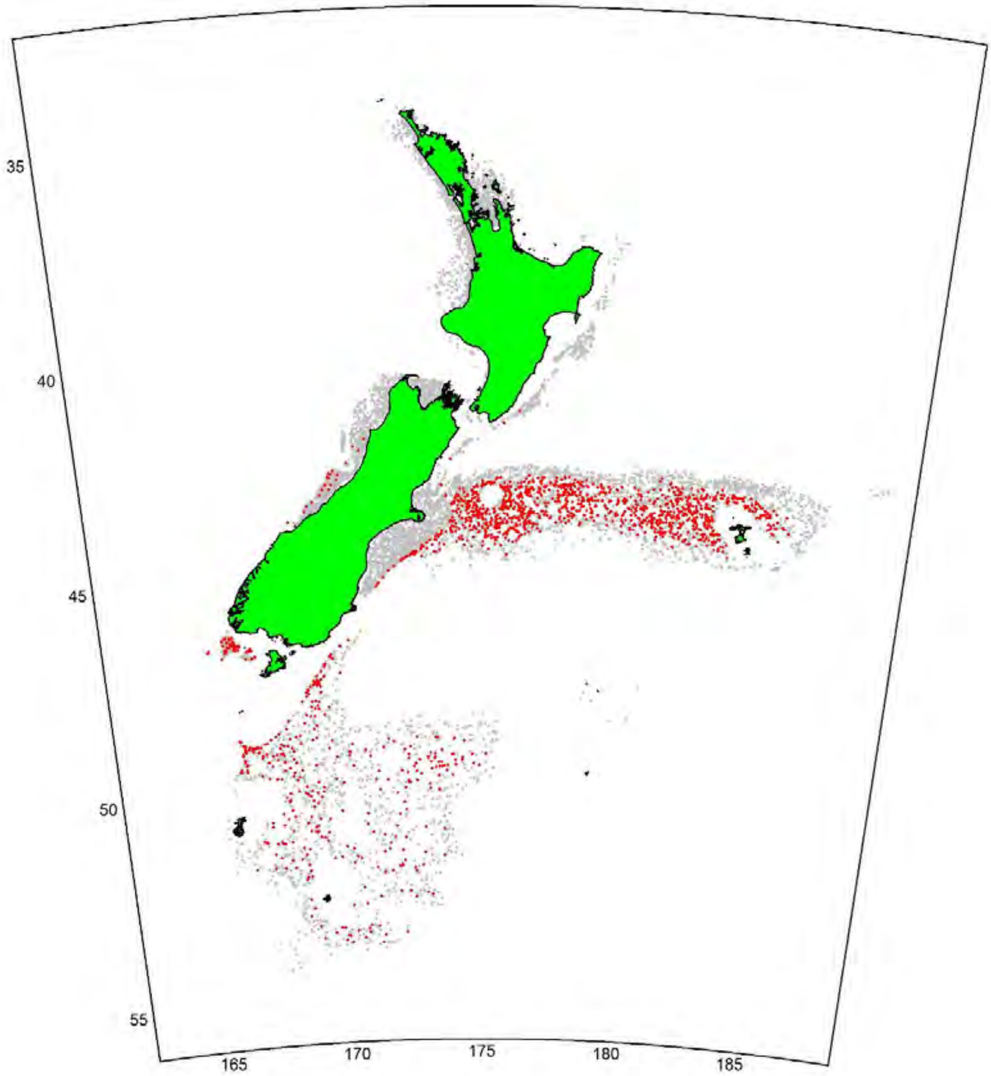


Figure 60.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where white warehou was caught (red points).

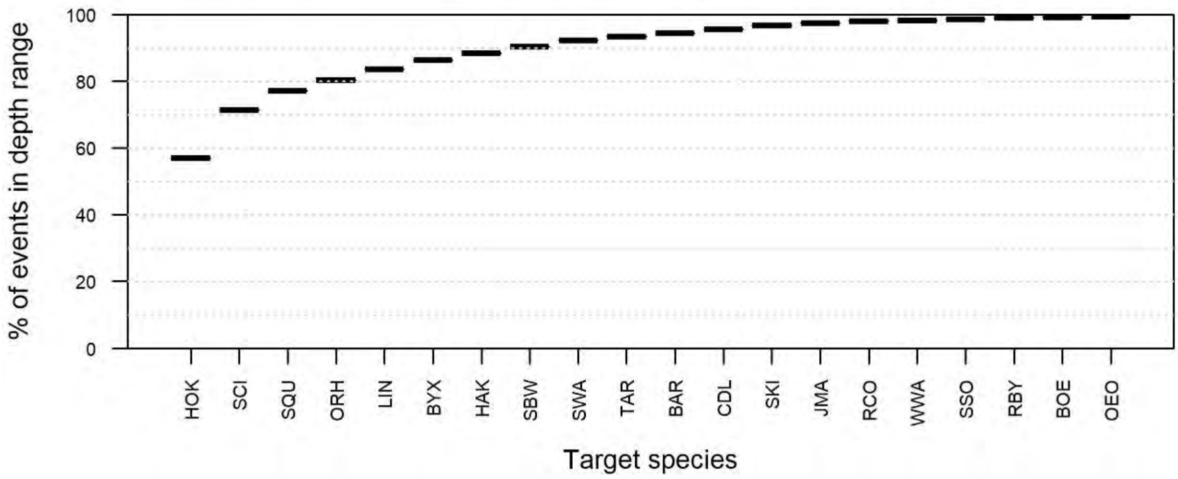
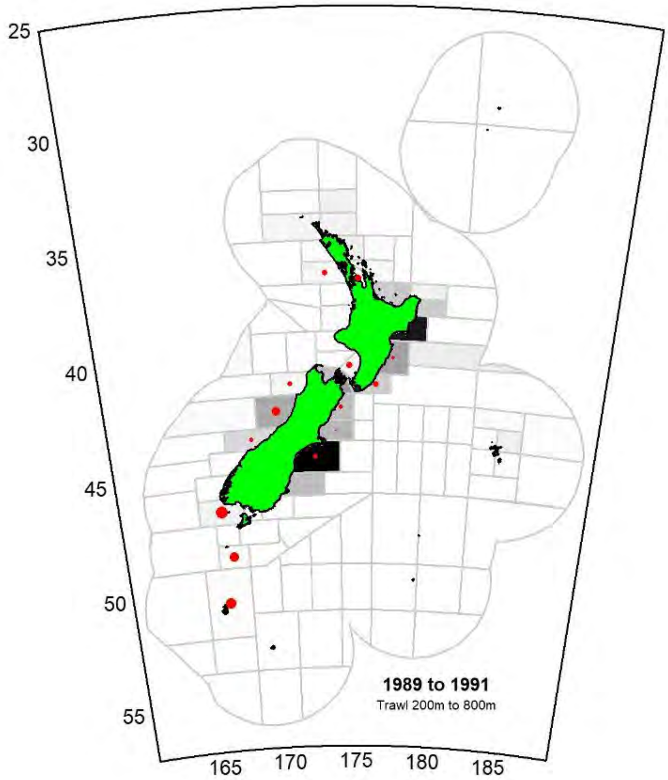


Figure 60.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for white warehou (200–800 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.



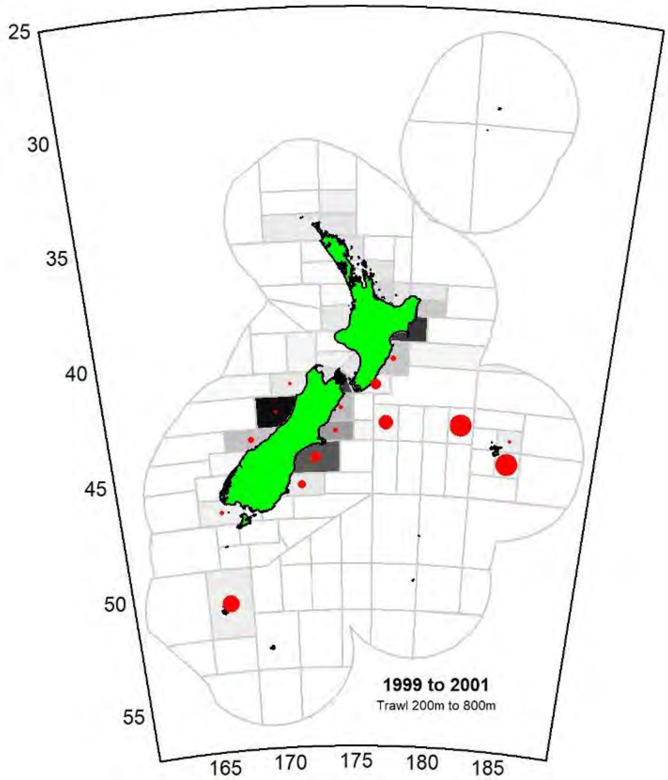
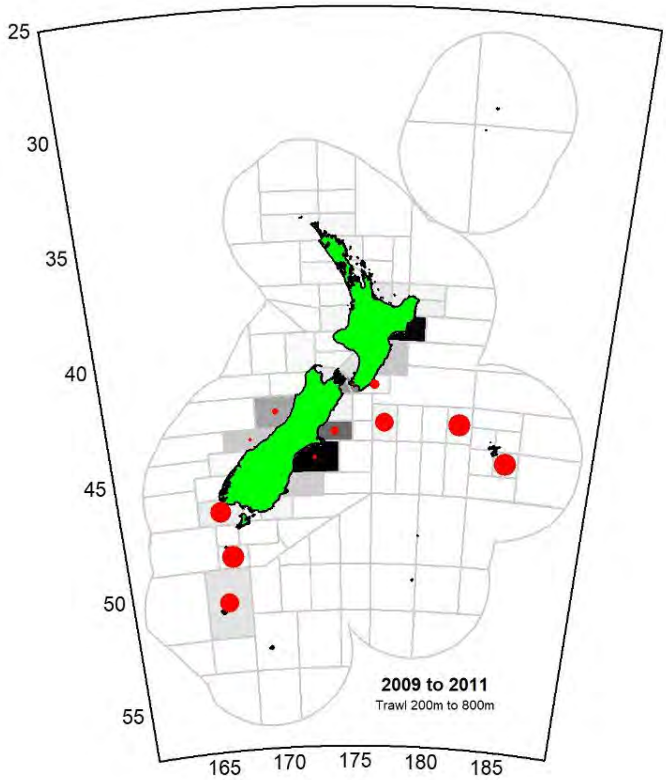


Figure 60.4: Maps of white warehou occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



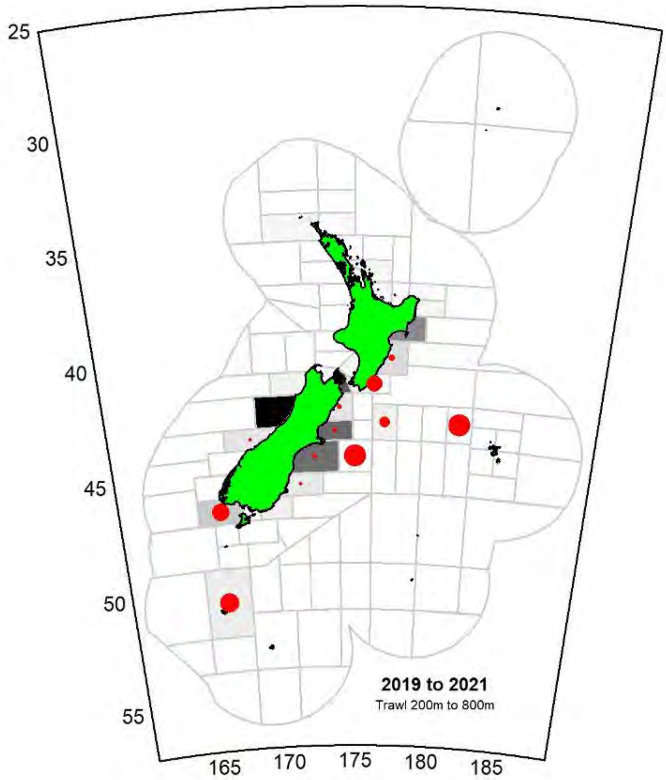


Figure 60.4 (cont.): Maps of white warehou occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

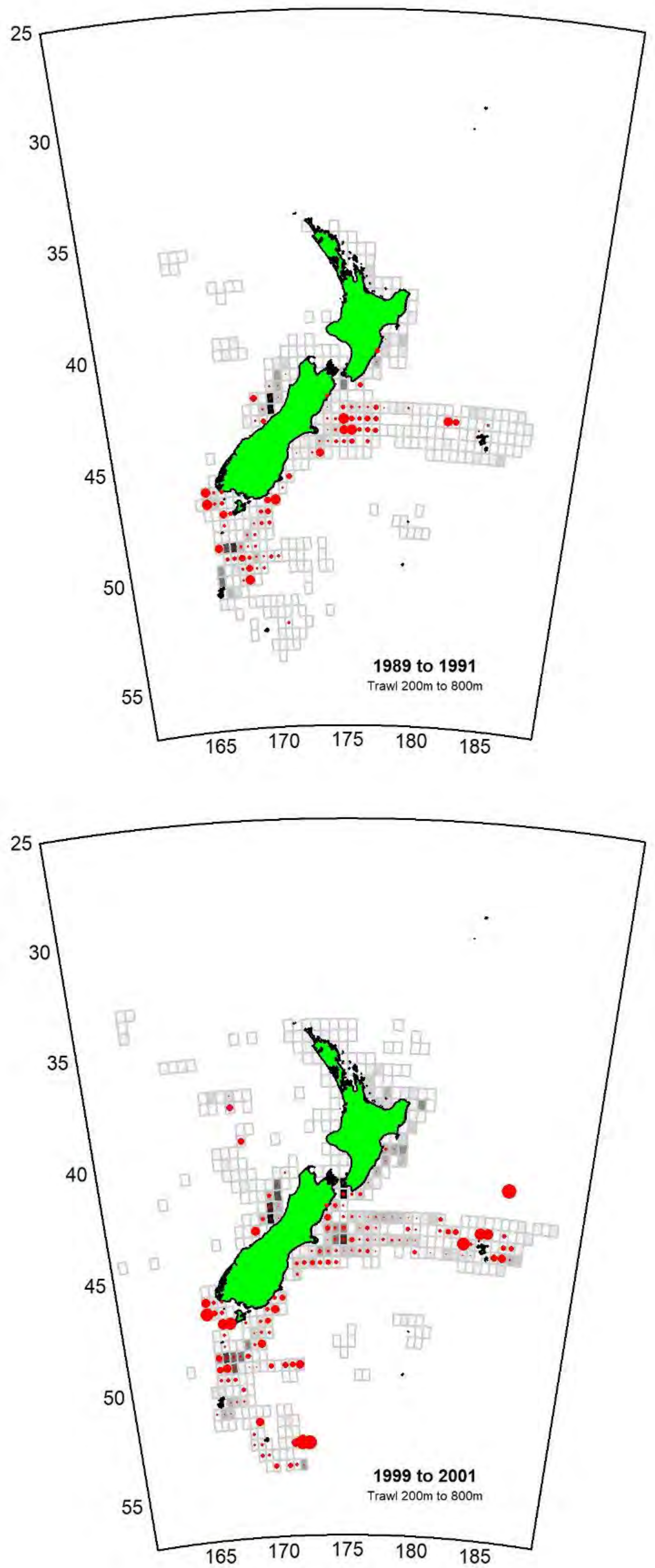
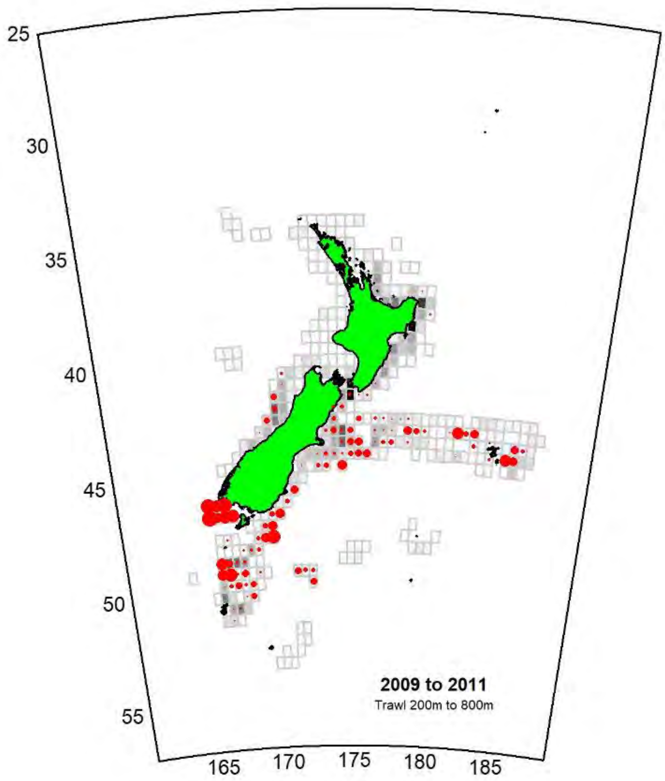


Figure 60.5: Maps of white warehou occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



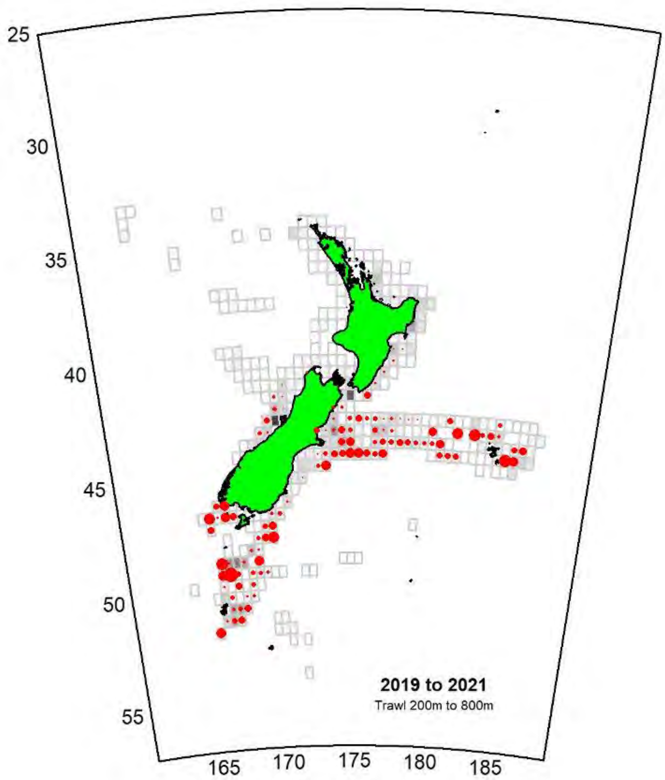


Figure 60.5 (cont.): Maps of white warehou occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

61. Yelloweye mullet (YEM)

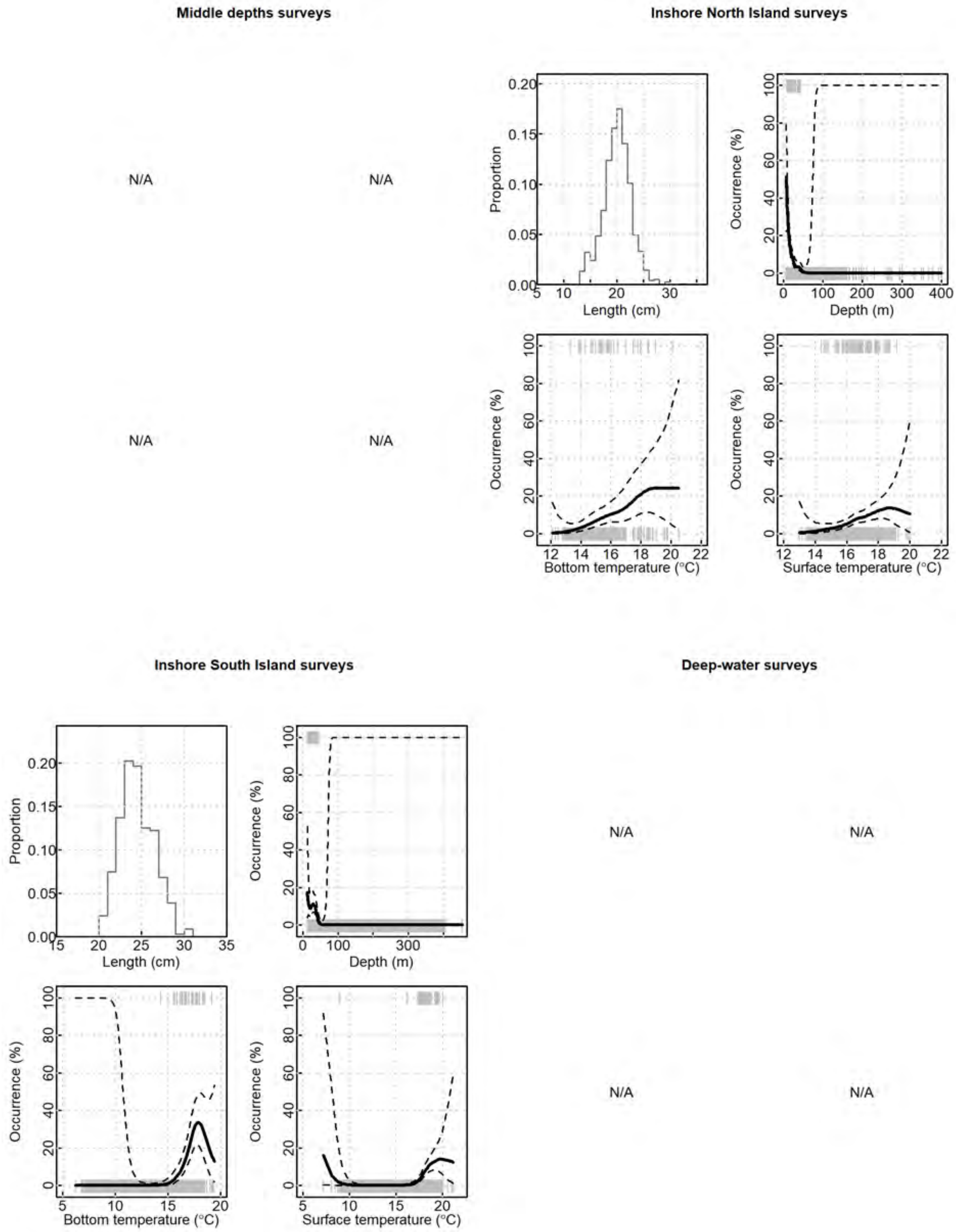


Figure 61.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to yelloweye mullet occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

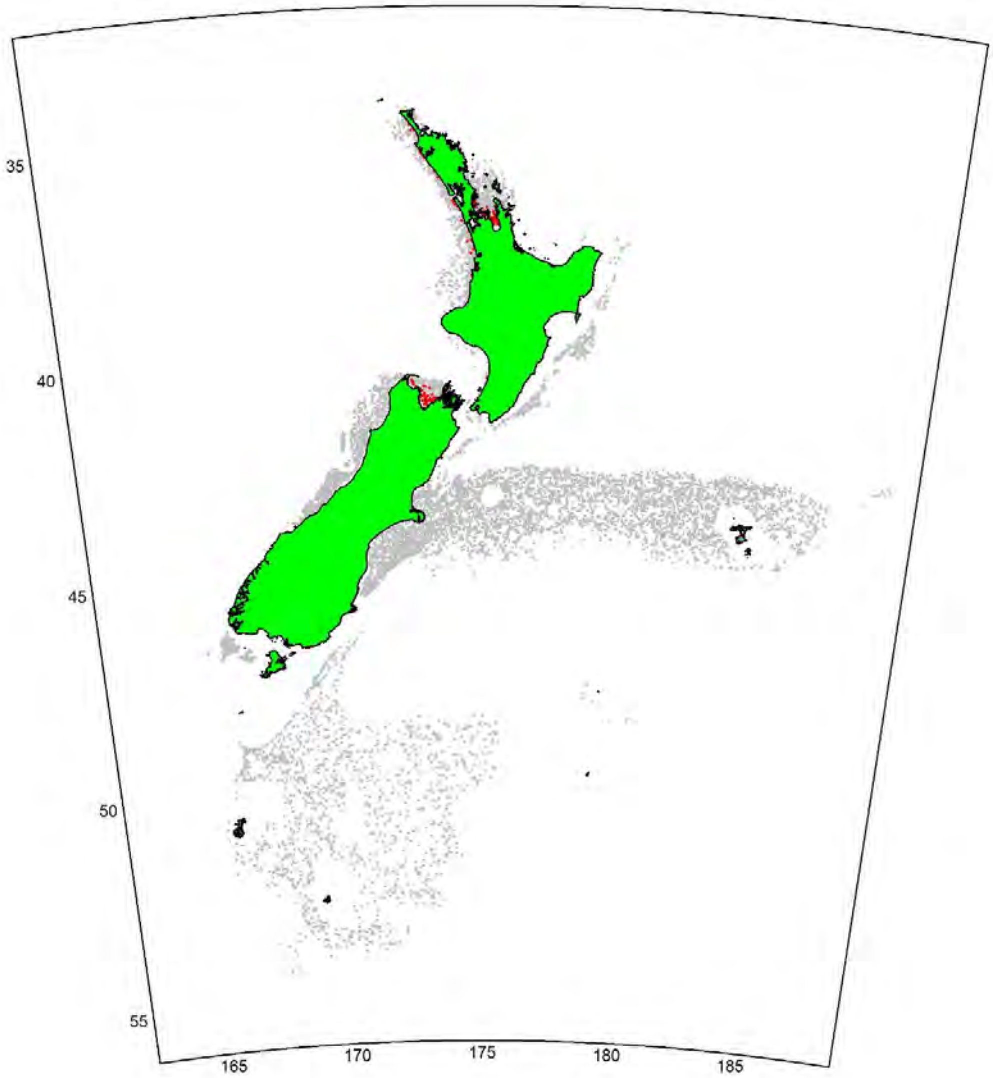


Figure 61.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where yelloweye mullet was caught (red points).

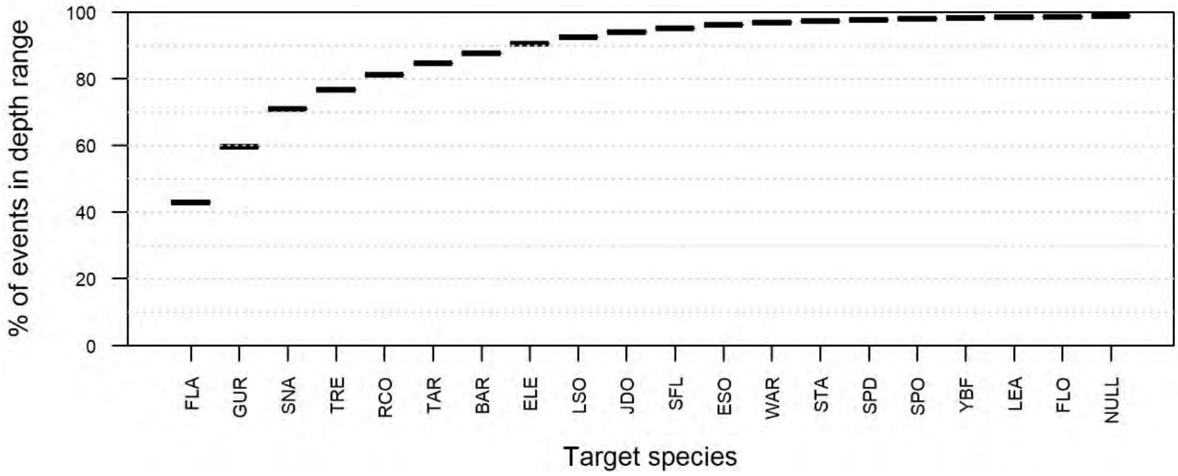
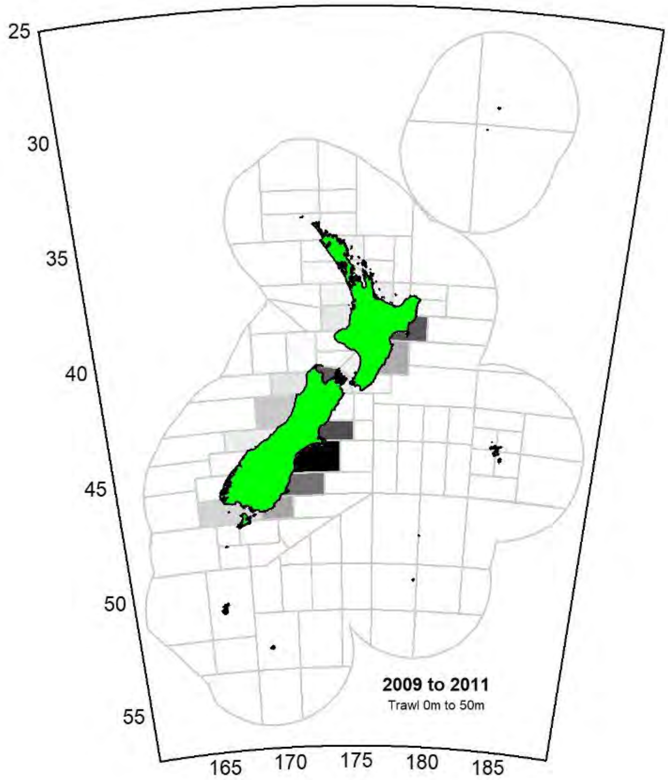


Figure 61.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for yelloweye mullet (0–50 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.



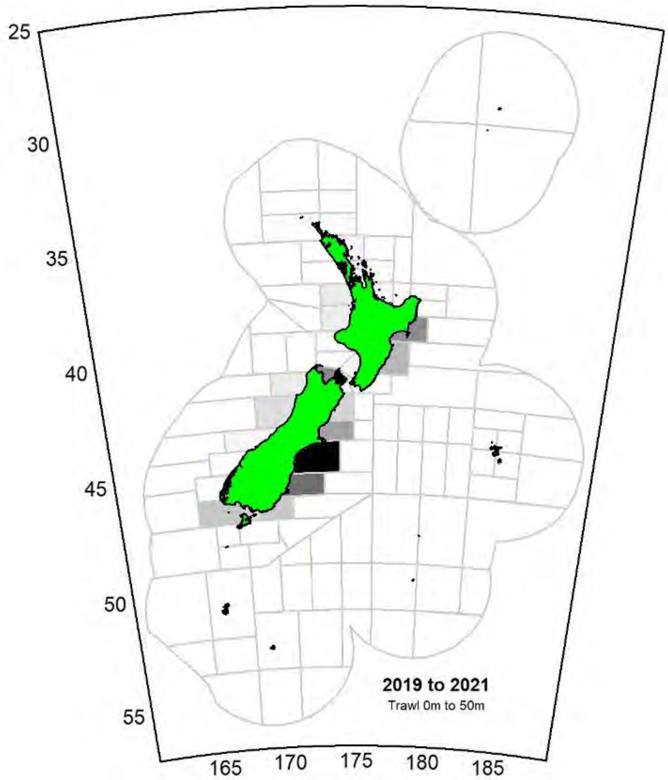
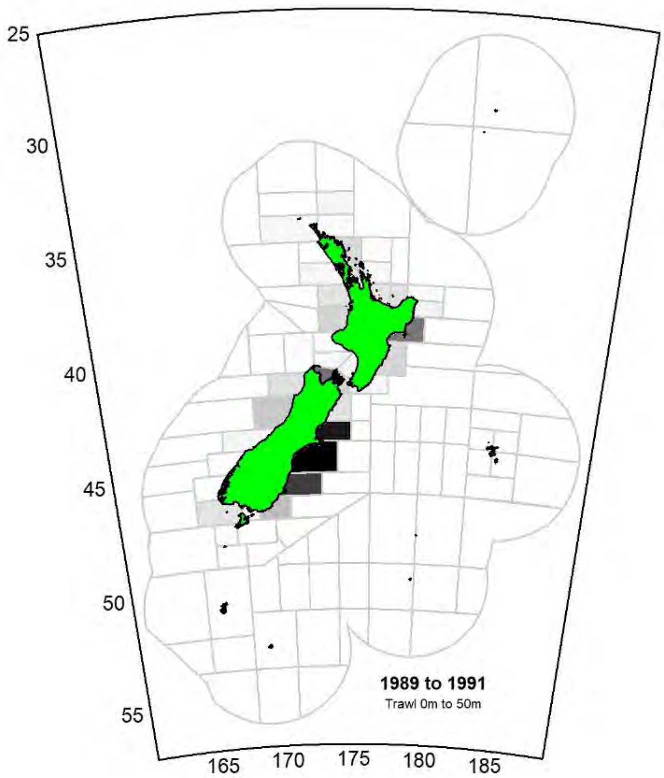


Figure 61.4: Maps of yelloweye mullet occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



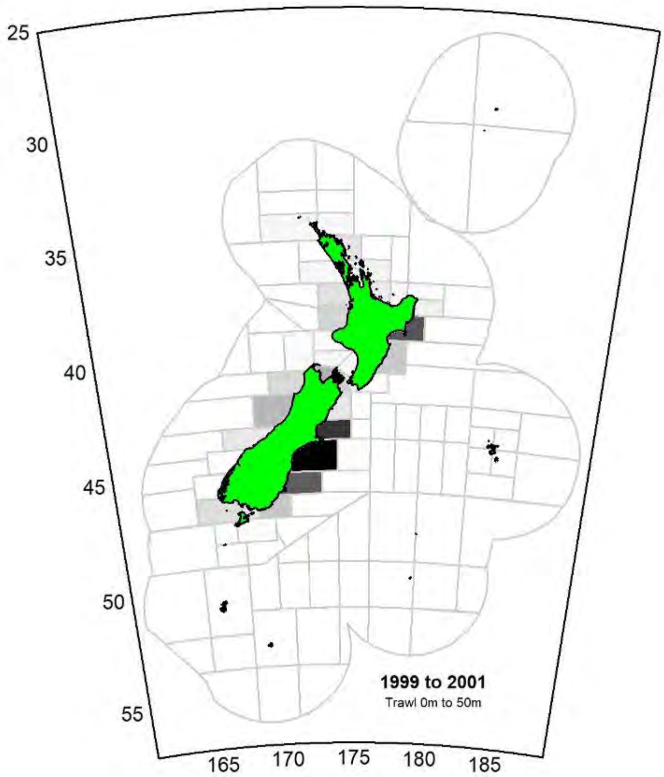


Figure 61.4 (cont.): Maps of yelloweye mullet occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

62. Ray’s bream (Research RBM, SRB; Commercial, RBM)

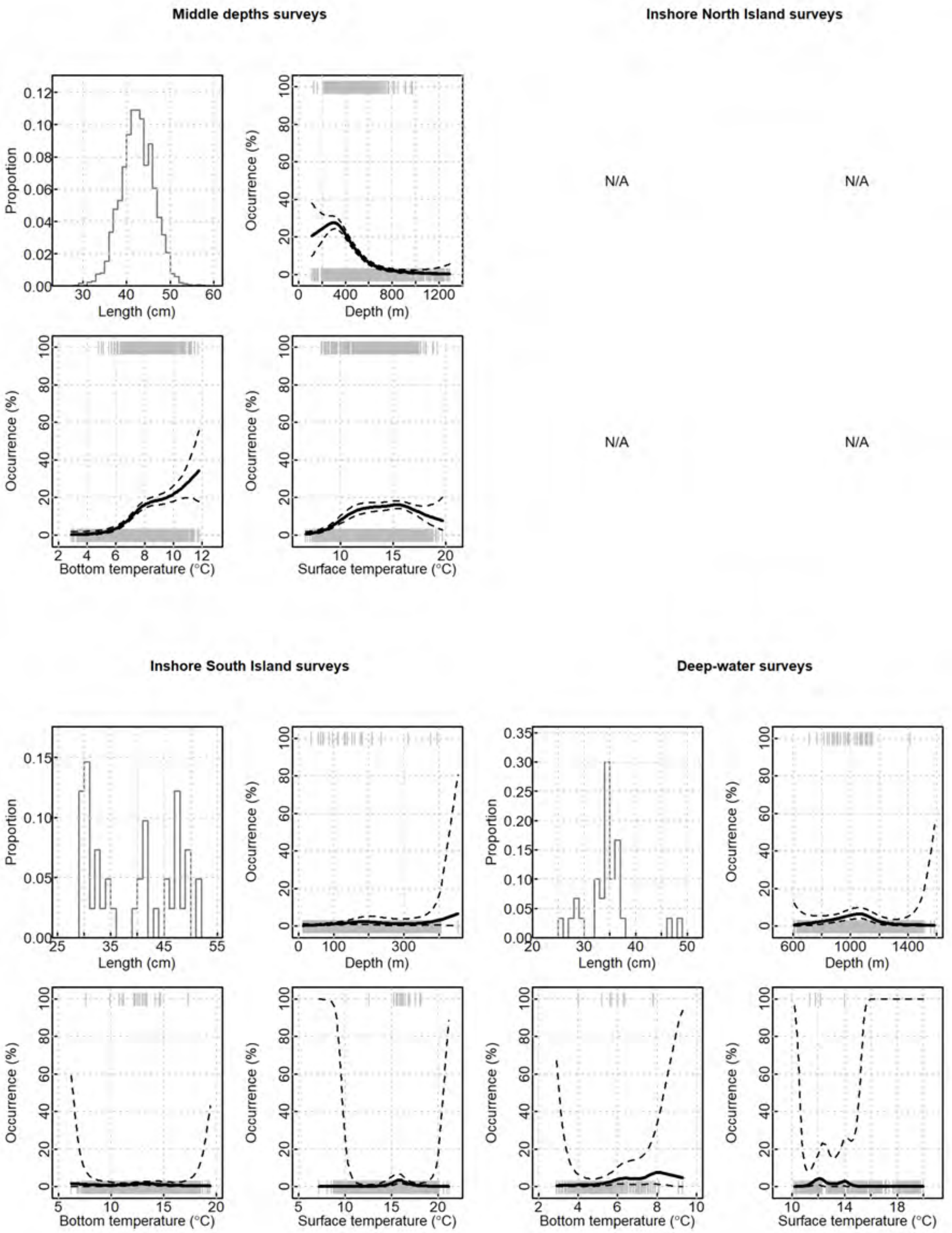


Figure 62.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to Ray’s bream occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

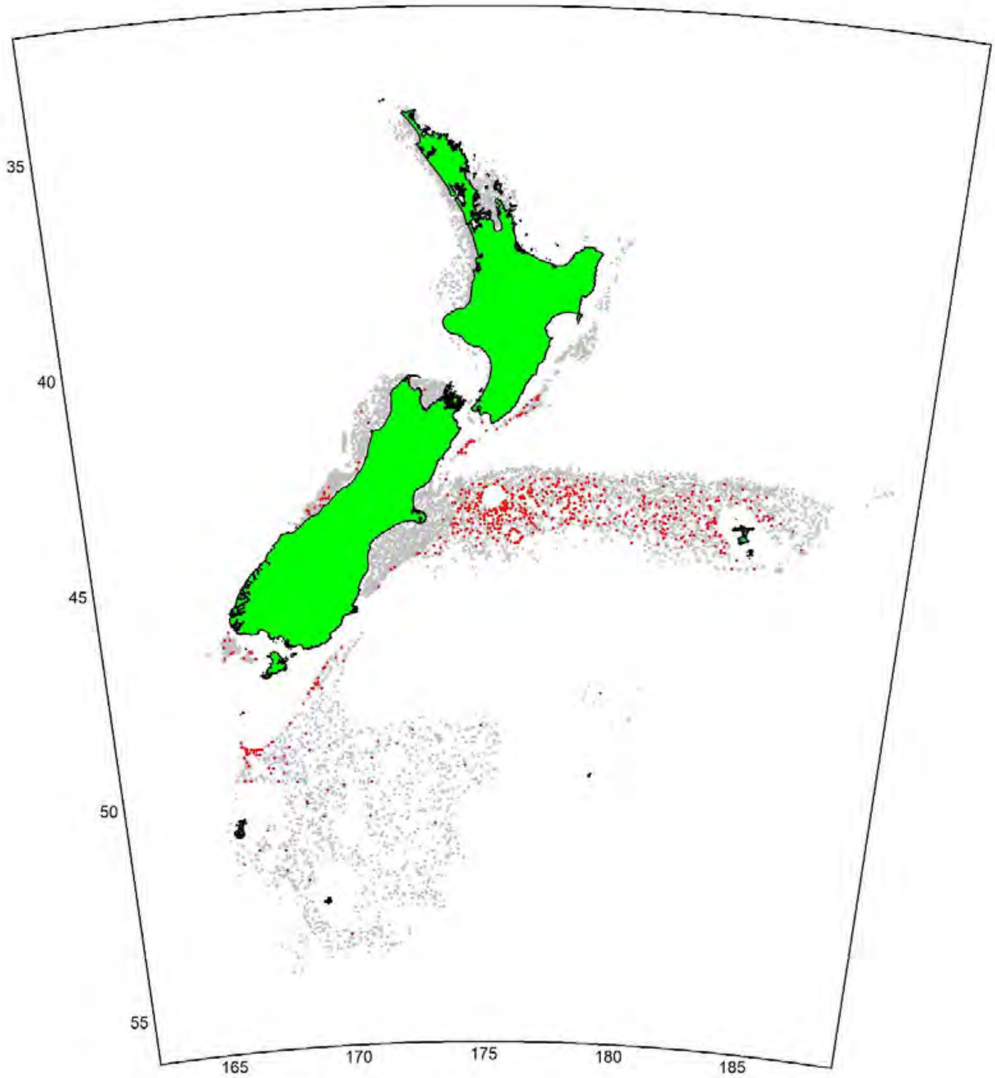


Figure 62.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where Ray's bream was caught (red points).

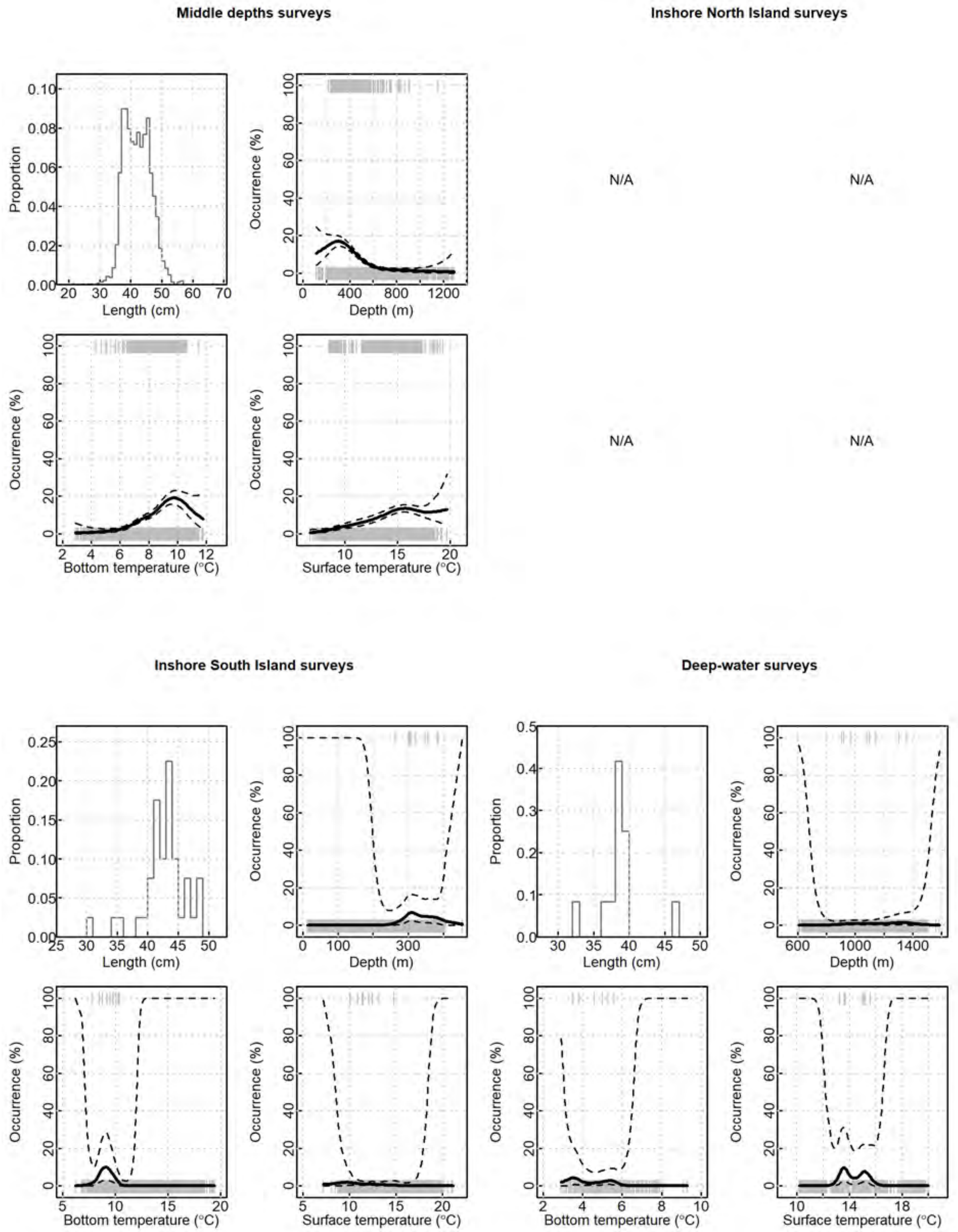


Figure 62.3: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to southern Ray's bream occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

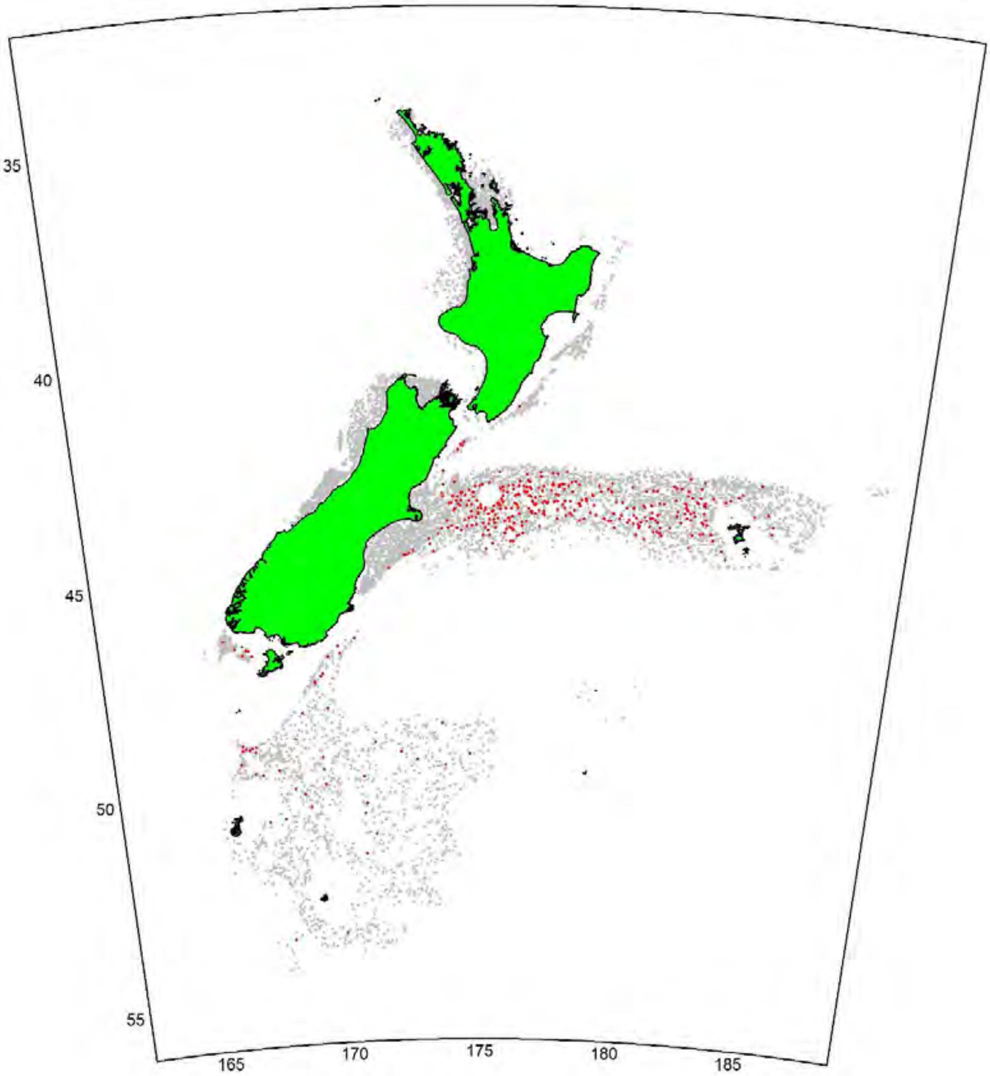


Figure 62.4: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where southern Ray's bream was caught (red points).

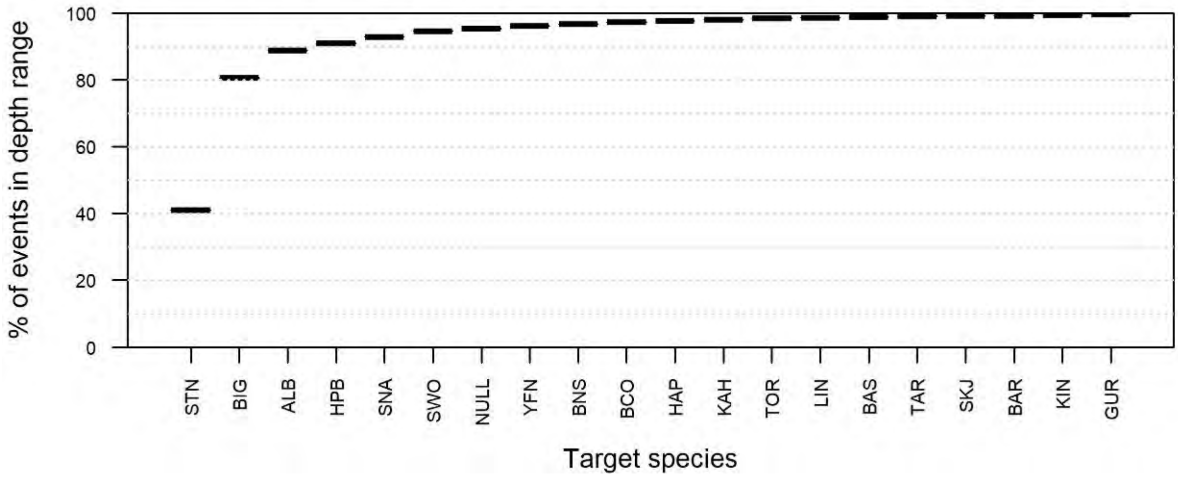


Figure 62.5: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for all Ray's bream (0–5000 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.

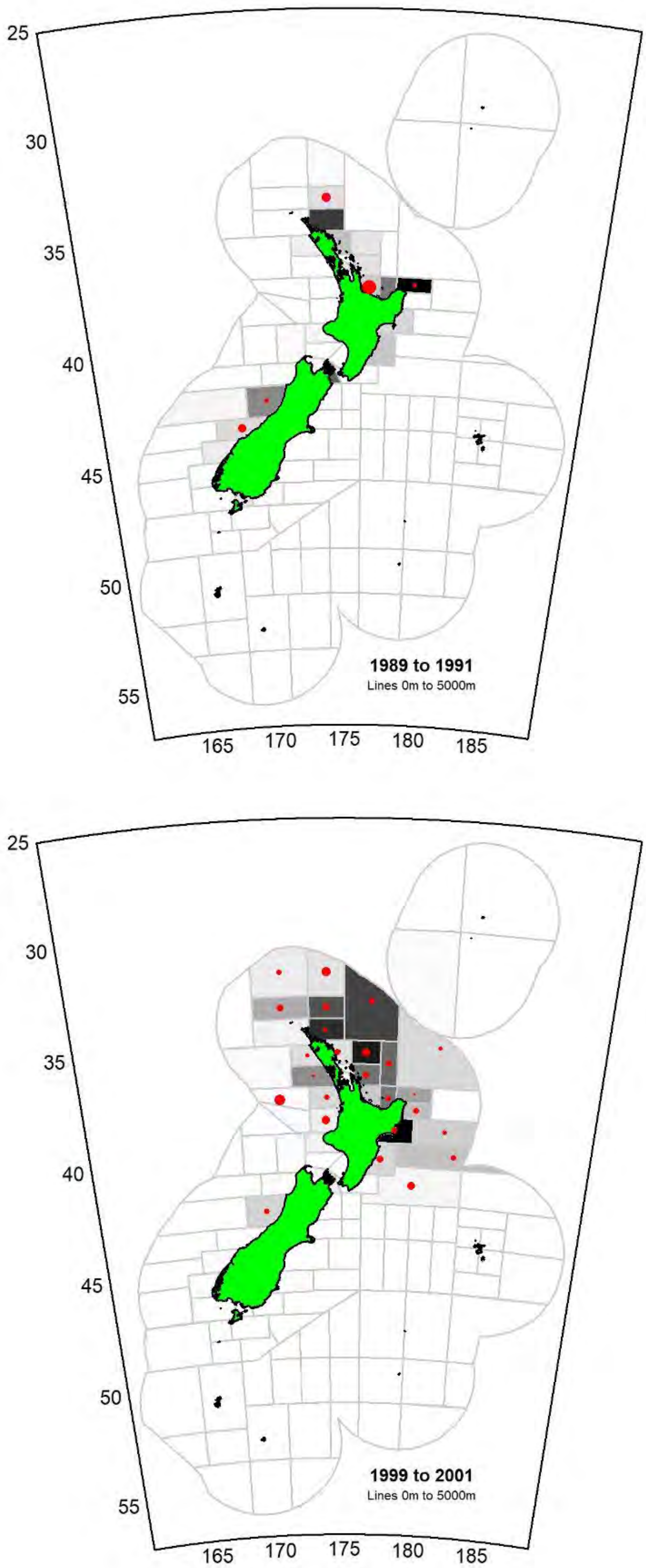
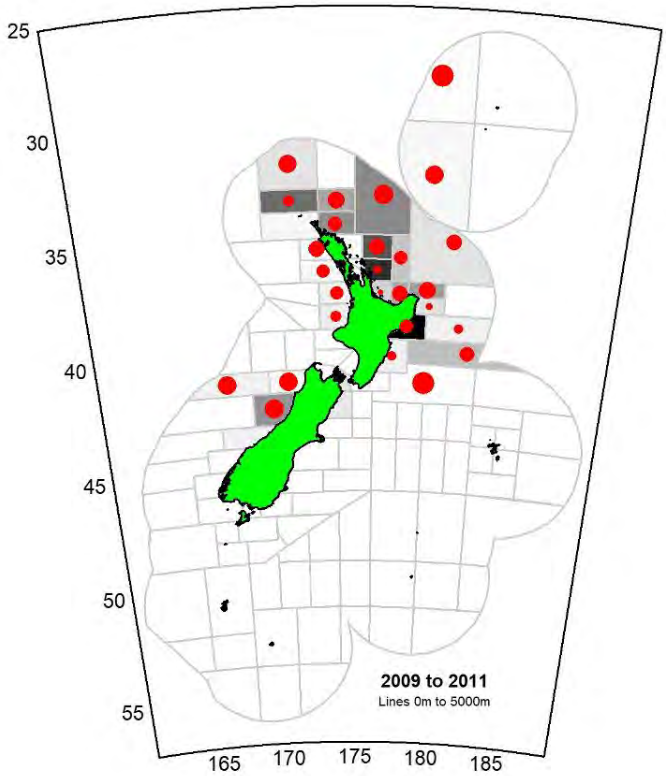


Figure 62.6: Maps of all Ray's bream occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



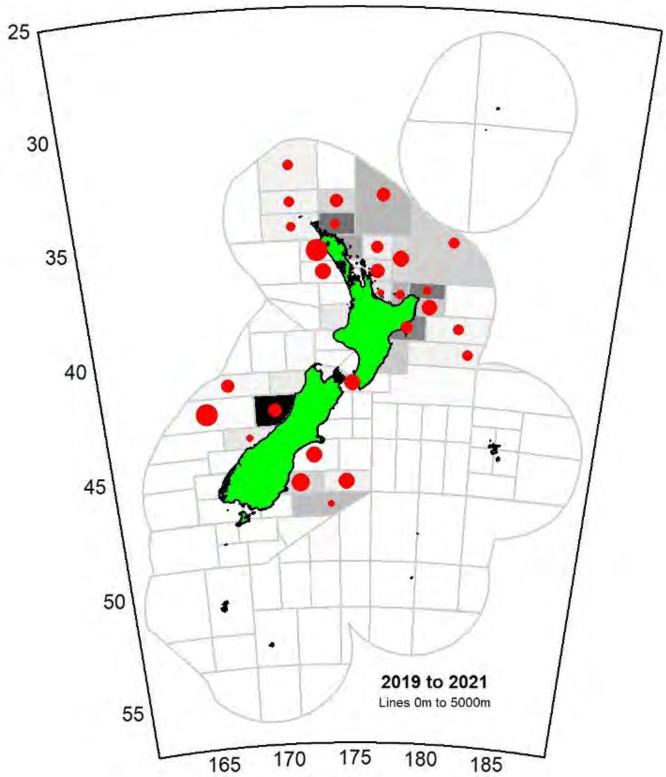
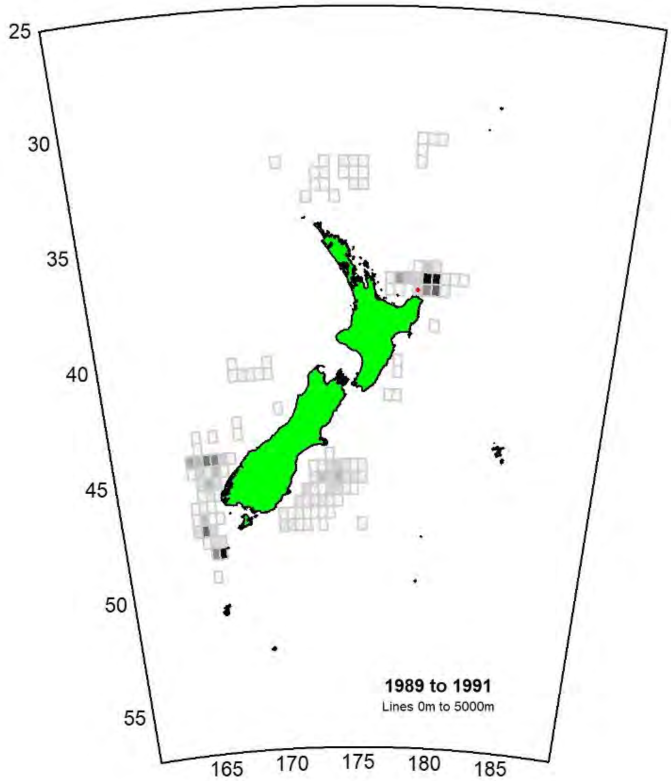


Figure 62.6 (cont.): Maps of all Ray's bream occurrence in the commercial catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



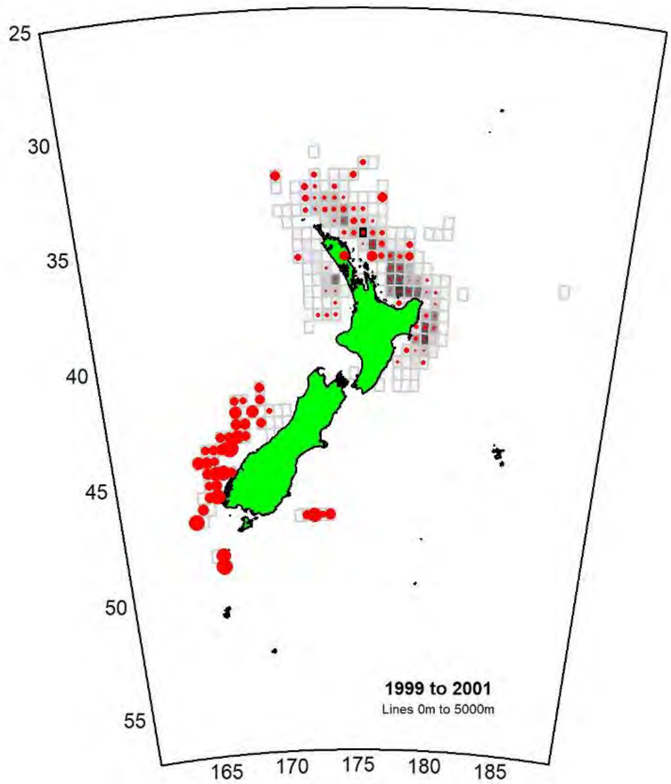
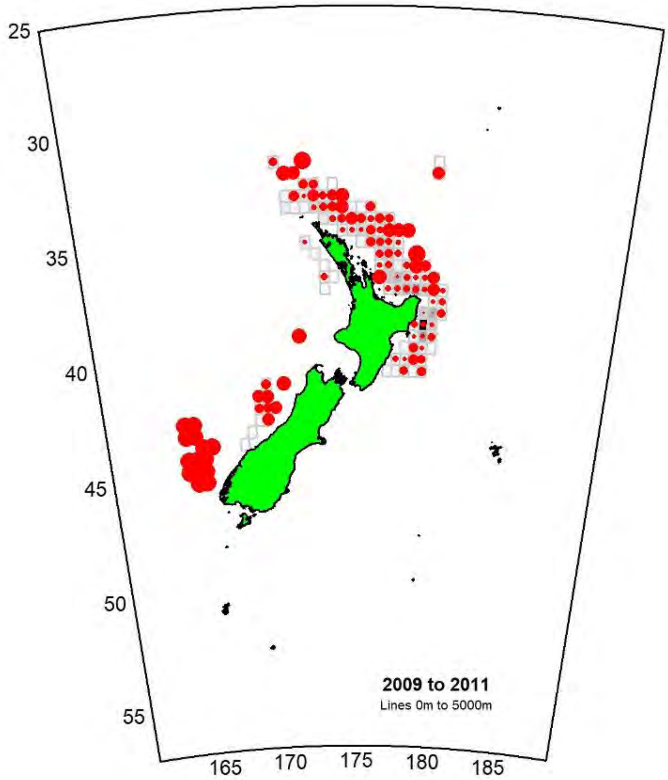


Figure 62.7: Maps of all Ray's bream occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



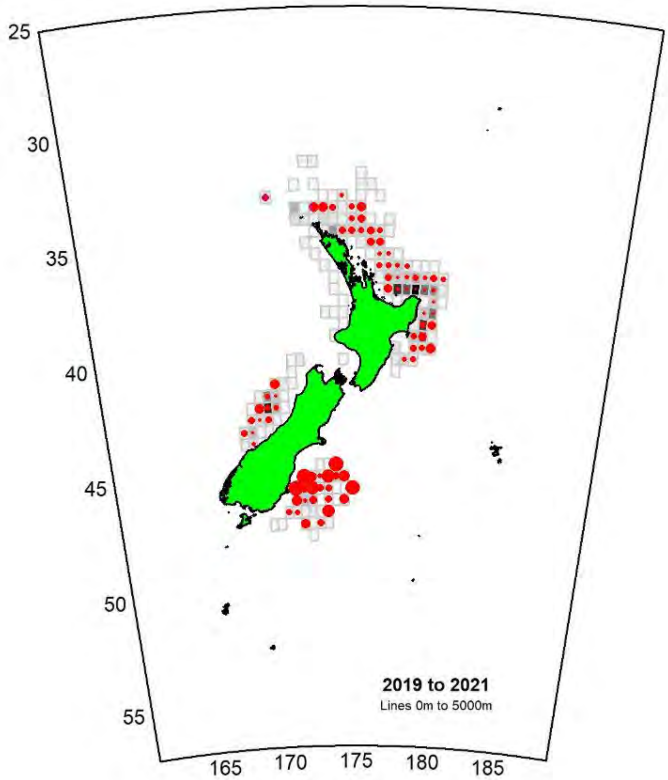
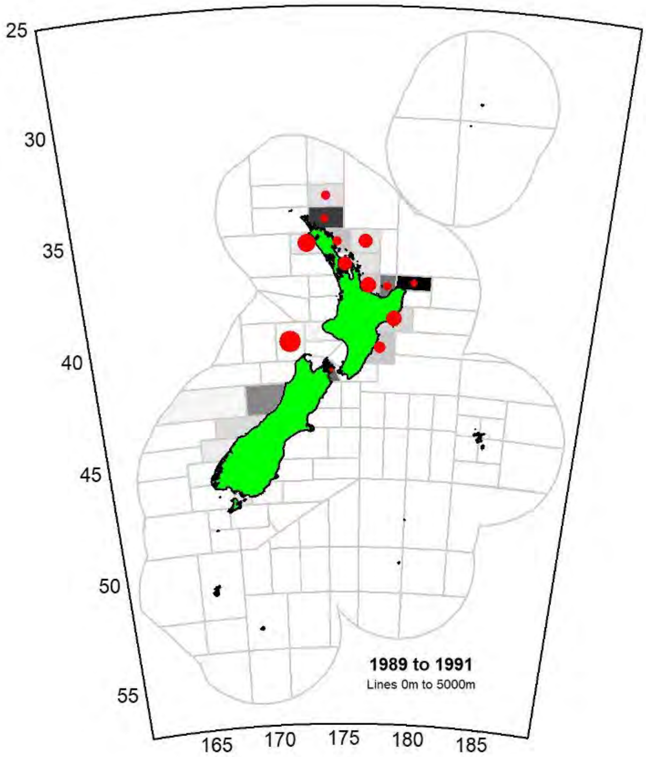


Figure 62.7 (cont.): Maps of all Ray's bream occurrence in the commercial catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

63. Kingfish (KIN)



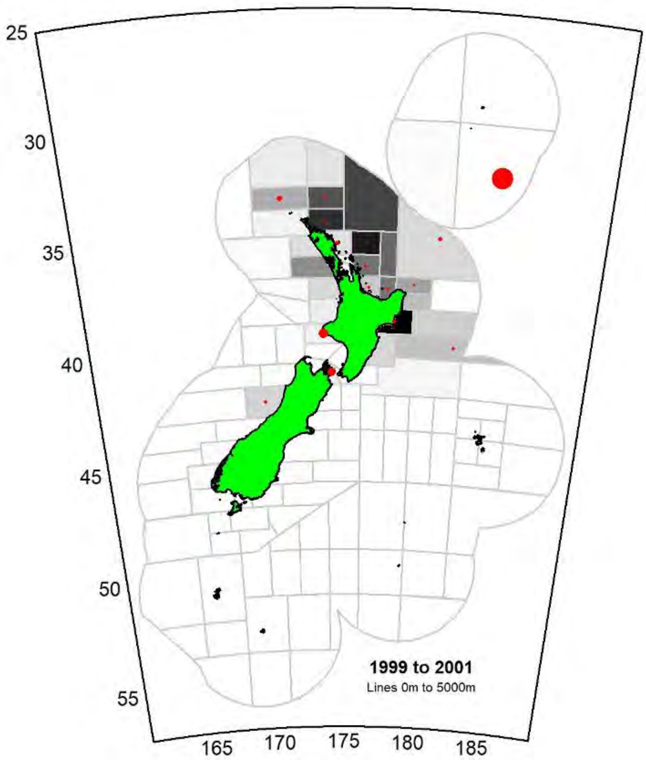
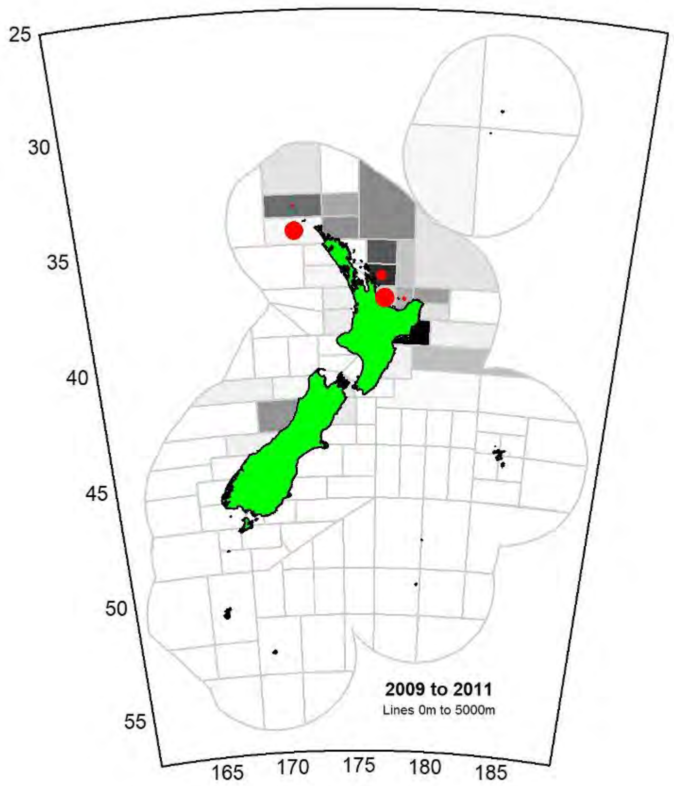


Figure 63.1: Maps of kingfish occurrence in the commercial line catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



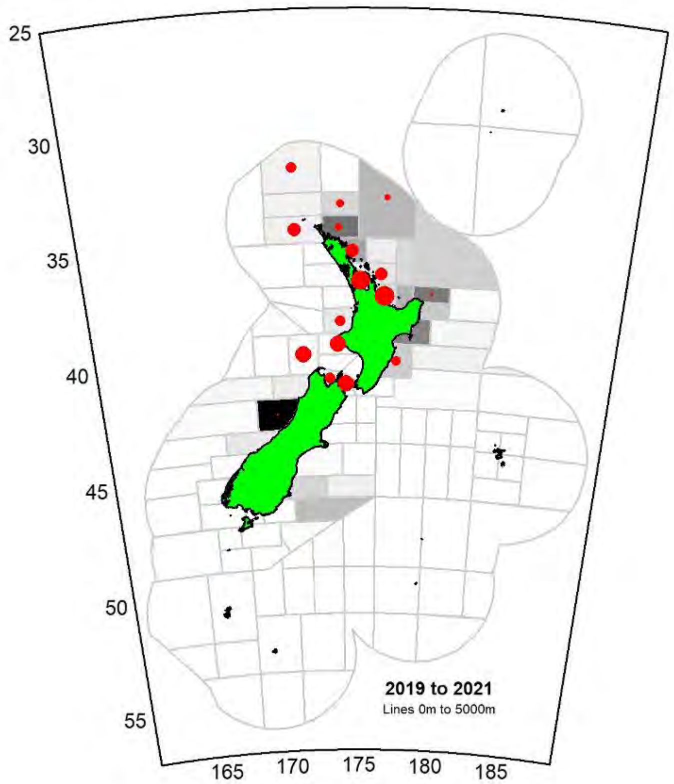
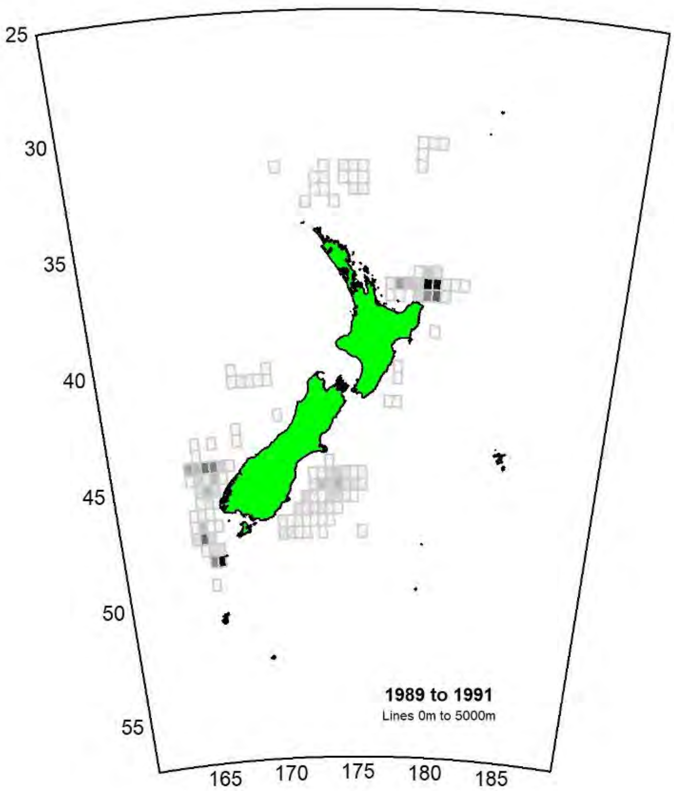


Figure 63.1 (cont.): Maps of kingfish occurrence in the commercial line catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



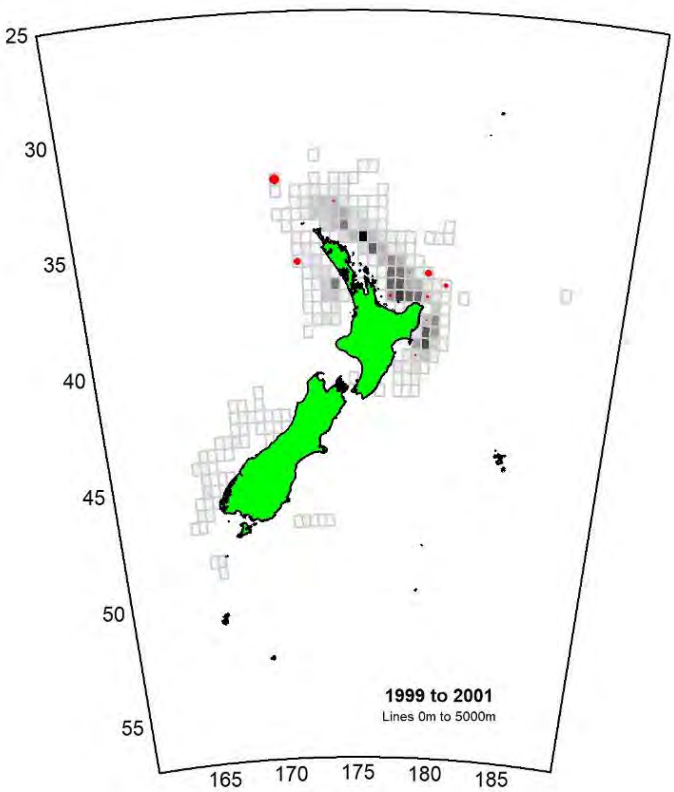
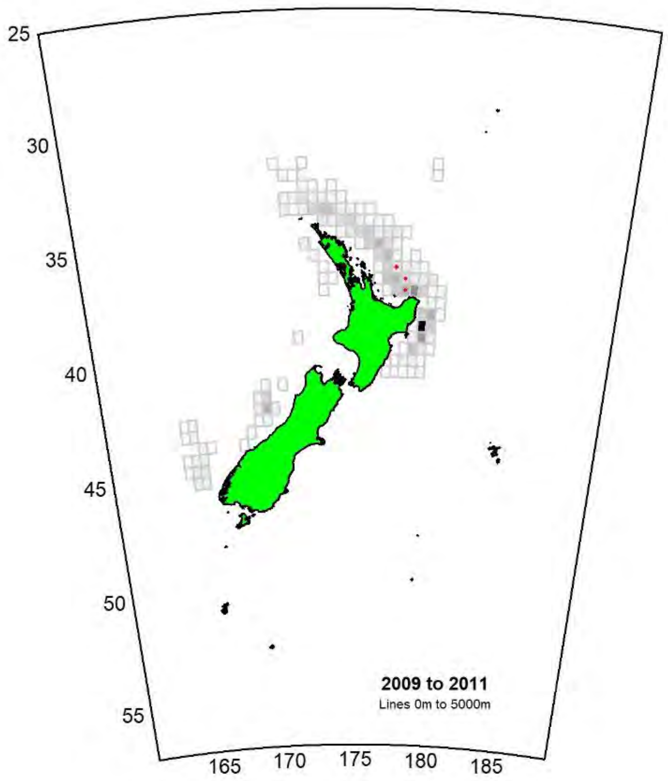


Figure 63.2: Maps of kingfish occurrence in the commercial line catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



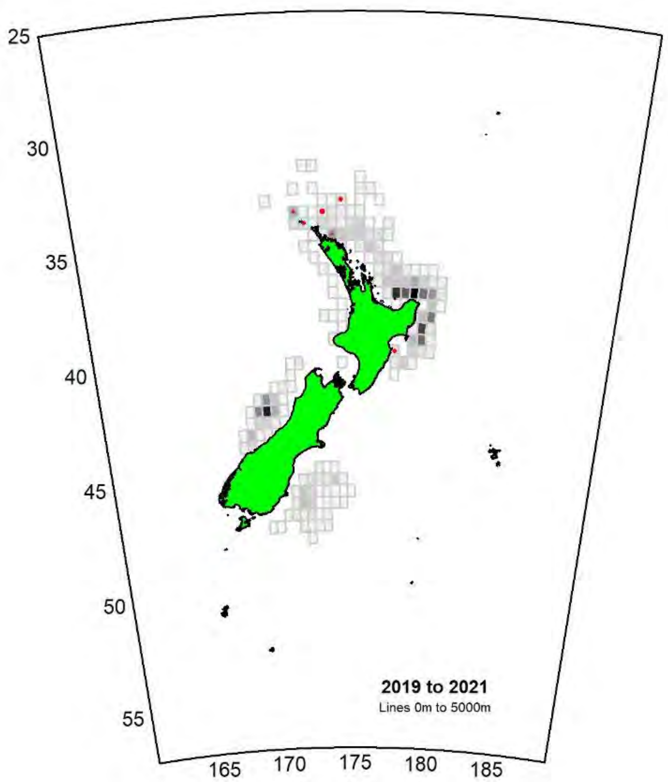
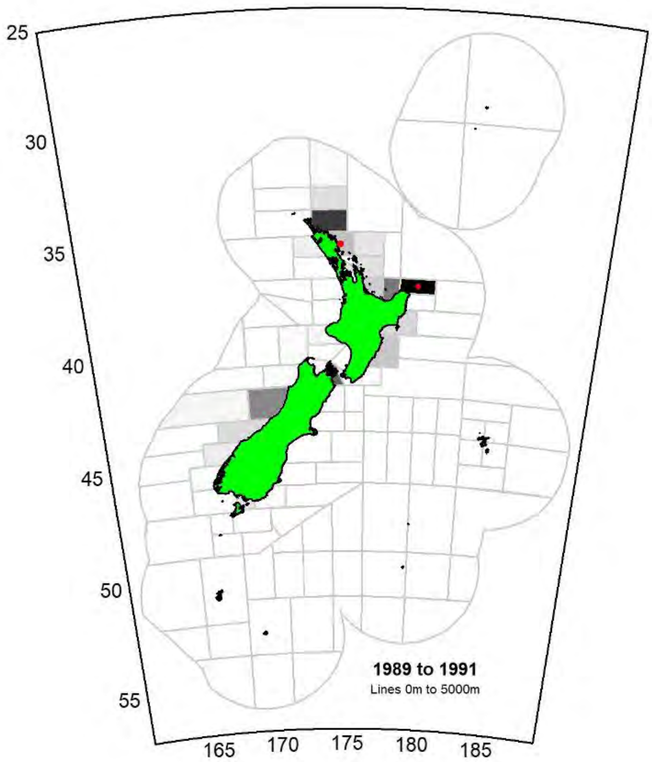


Figure 63.2 (cont.): Maps of kingfish occurrence in the commercial line catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

64. Mako shark (MAK)



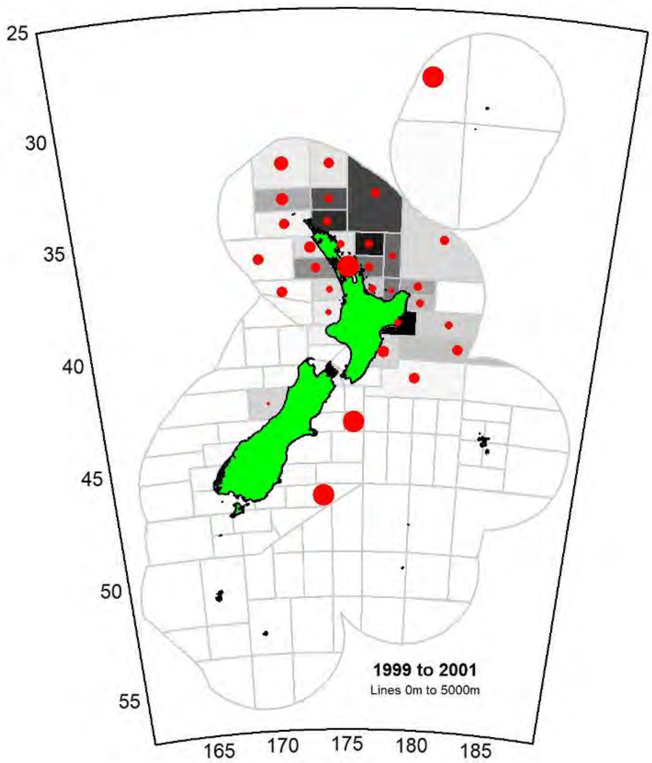
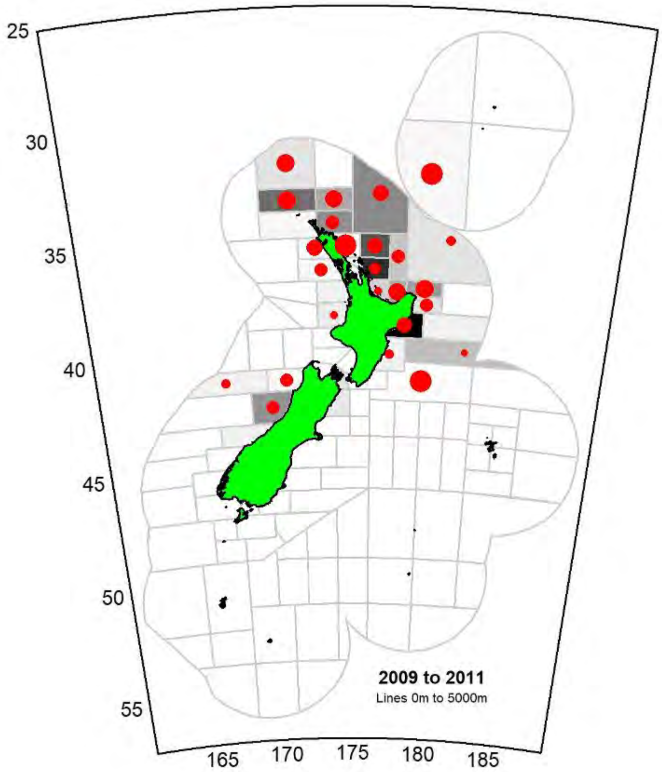


Figure 64.1: Maps of mako occurrence in the commercial line catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



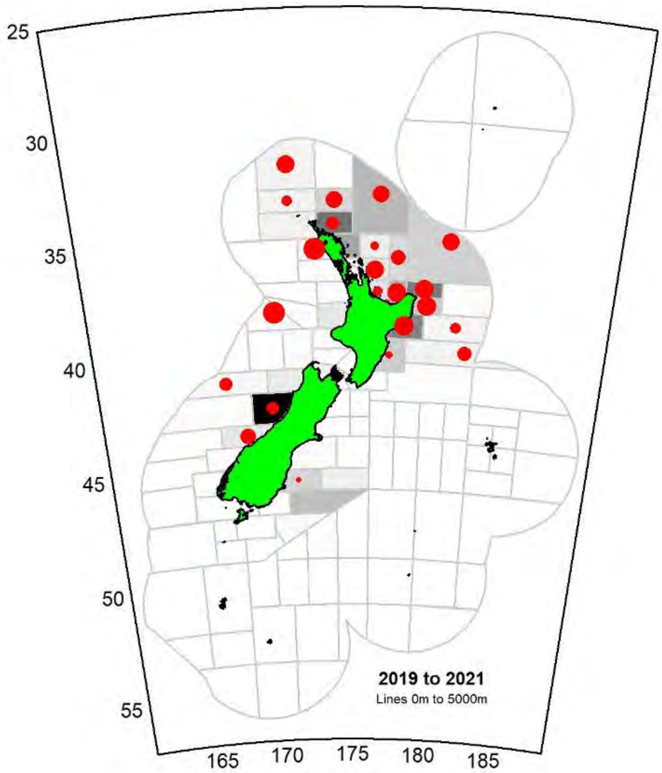


Figure 64.1 (cont.): Maps of mako occurrence in the commercial line catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

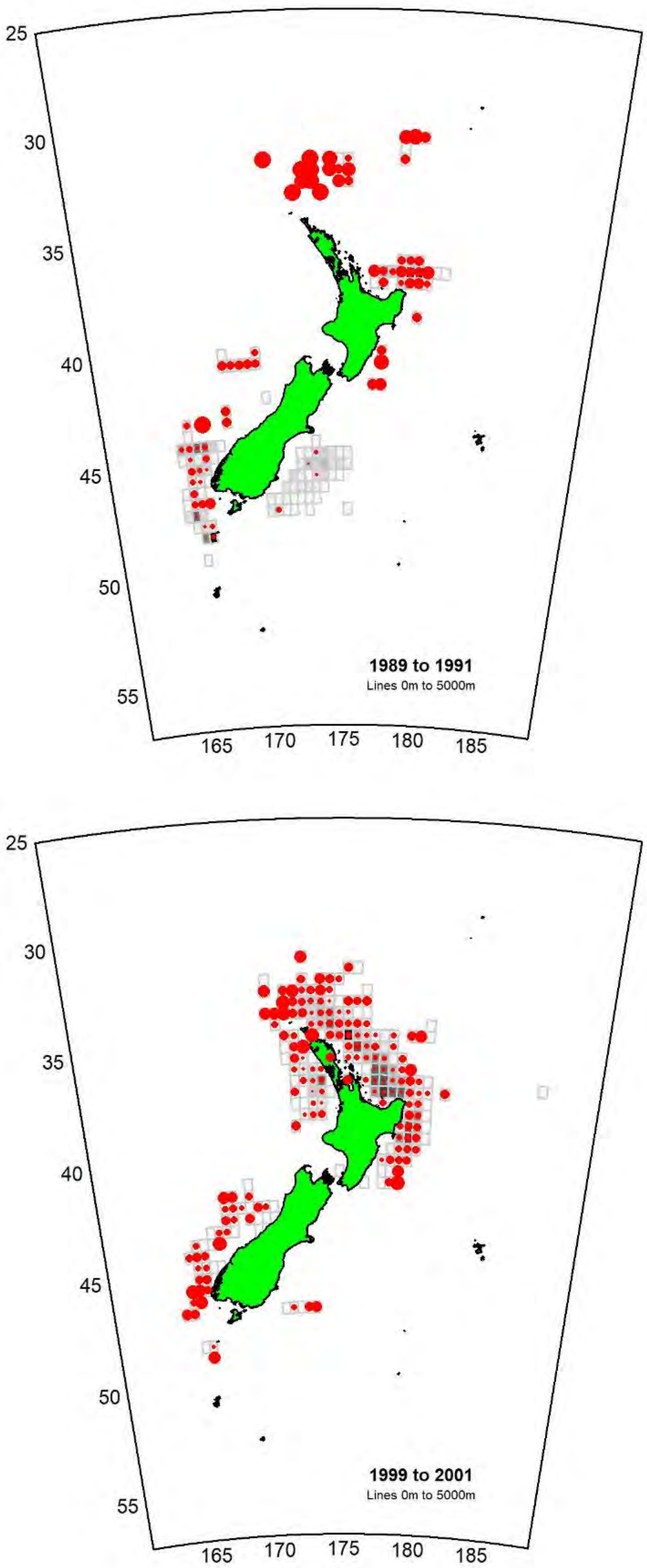


Figure 64.2: Maps of mako occurrence in the commercial line catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

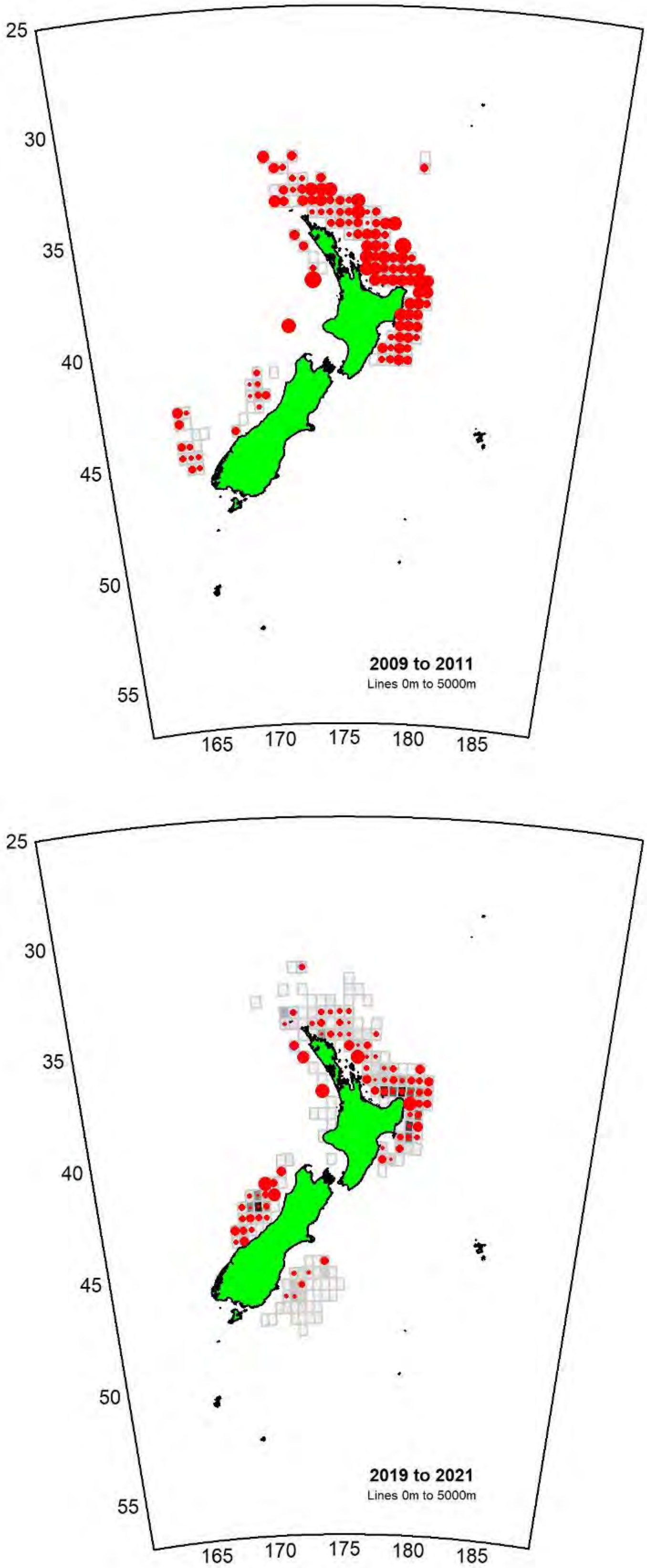
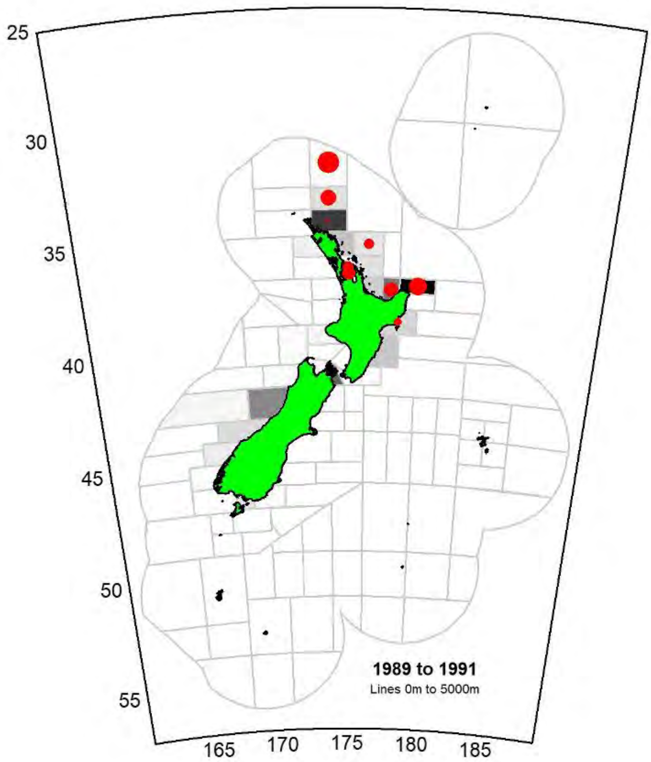


Figure 64.2 (cont.): Maps of mako occurrence in the commercial line catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

65. Moonfish (MOO)



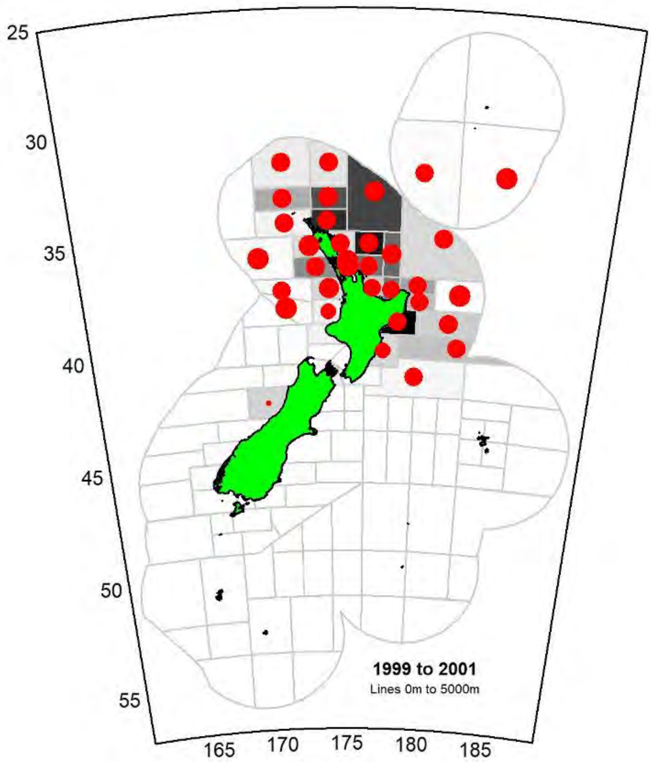
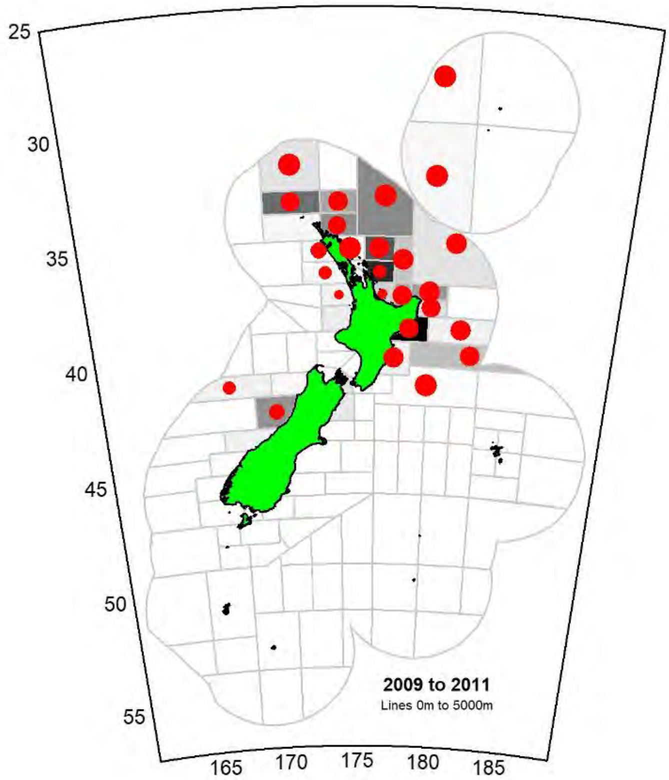


Figure 65.1: Maps of moonfish occurrence in the commercial line catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



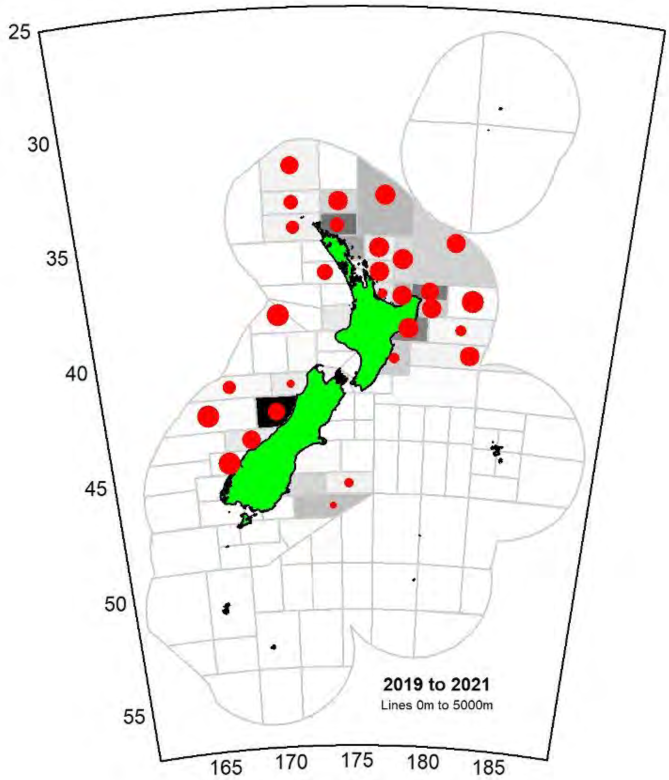
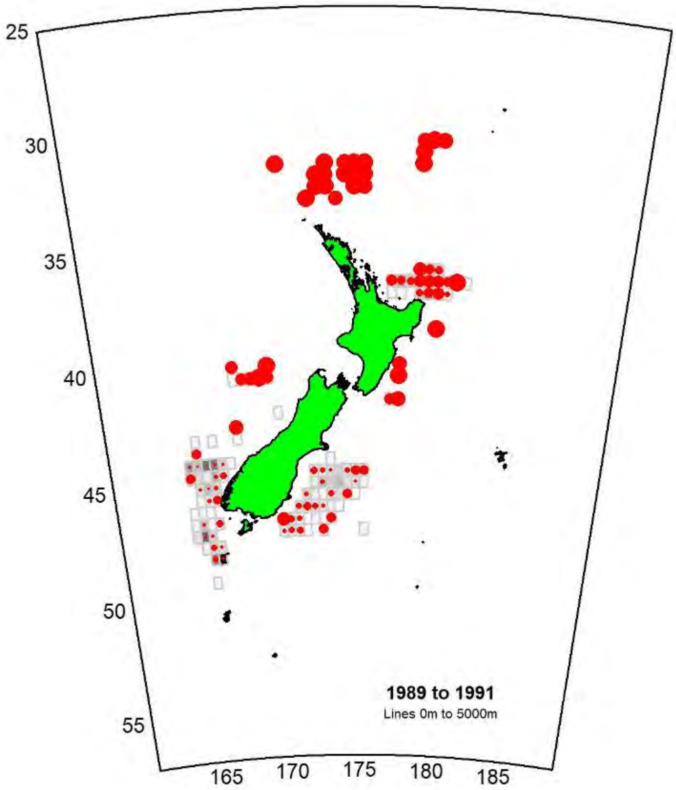


Figure 65.1 (cont.): Maps of moonfish occurrence in the commercial line catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



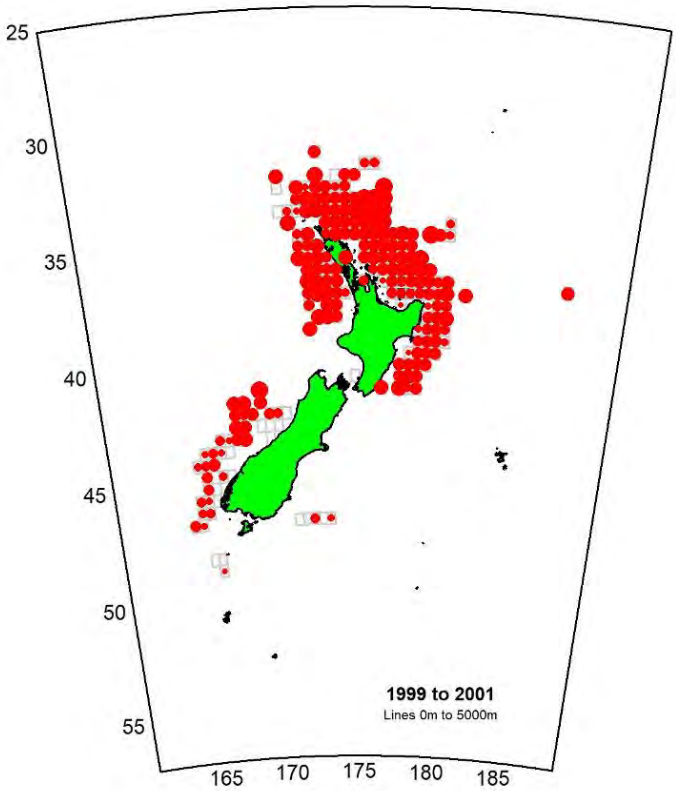


Figure 65.2: Maps of moonfish occurrence in the commercial line catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

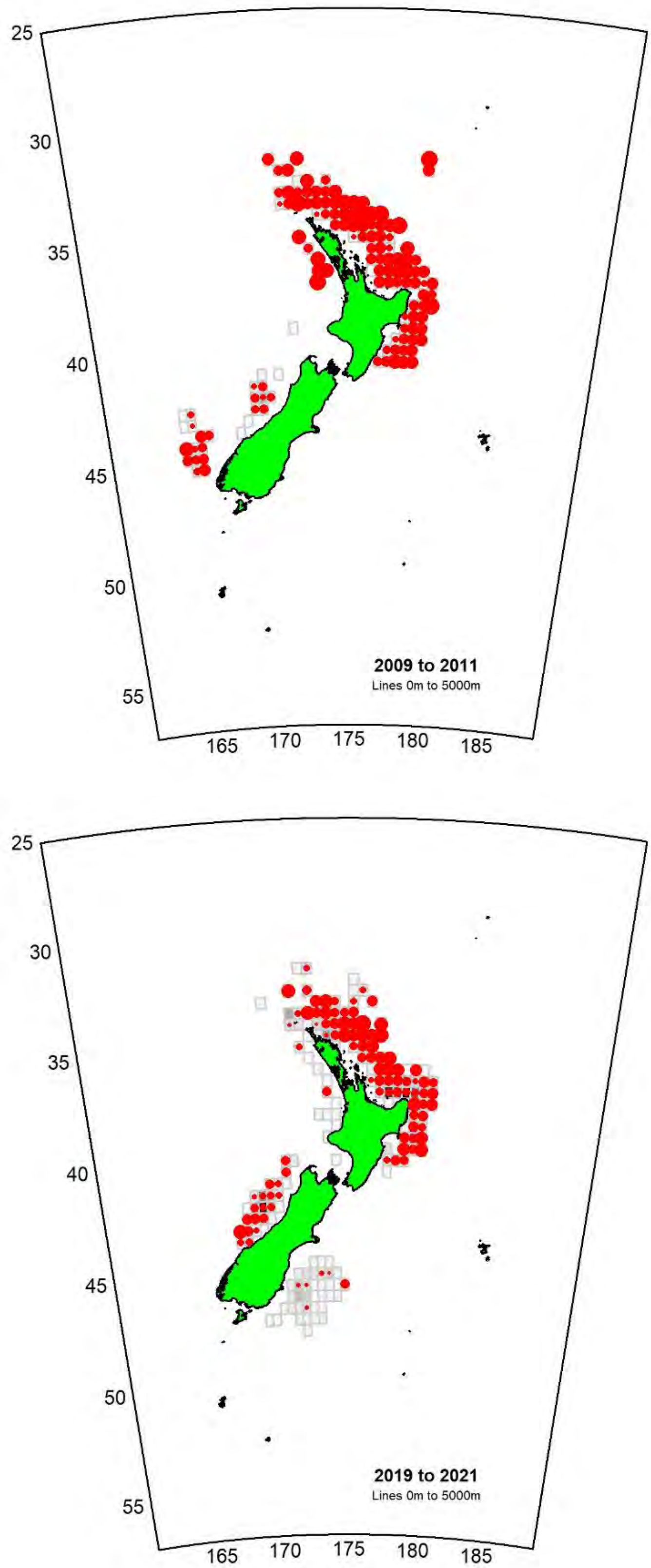
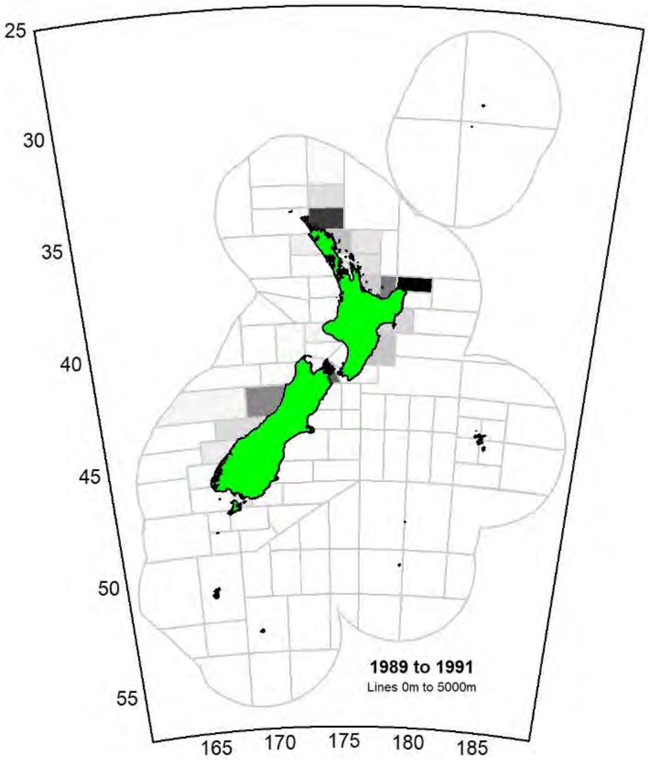


Figure 65.2 (cont.): Maps of moonfish occurrence in the commercial line catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

66. Porbeagle shark (POS)



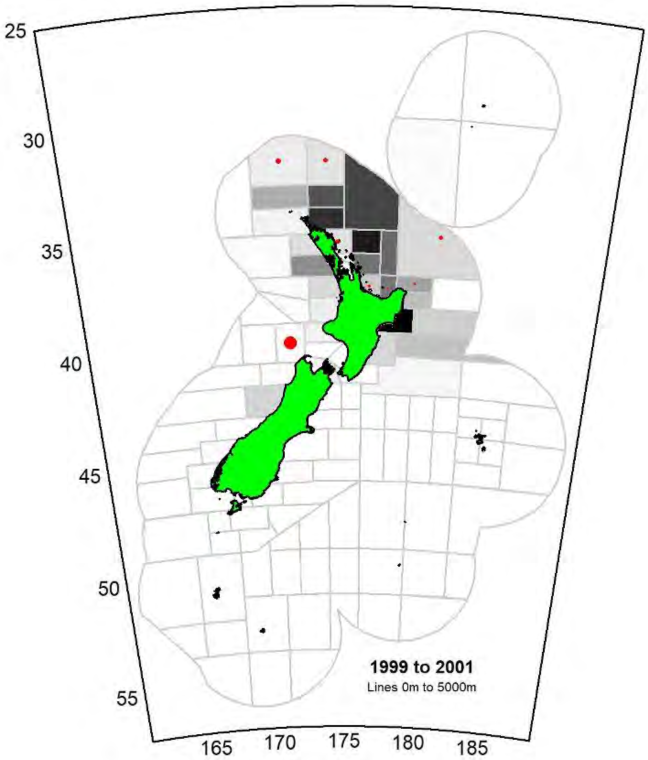
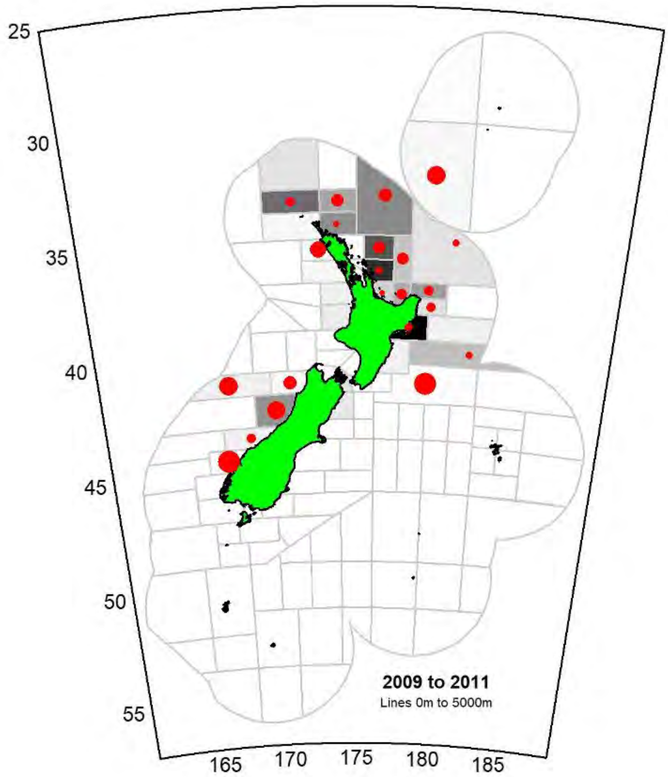


Figure 66.1: Maps of porbeagle occurrence in the commercial line catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



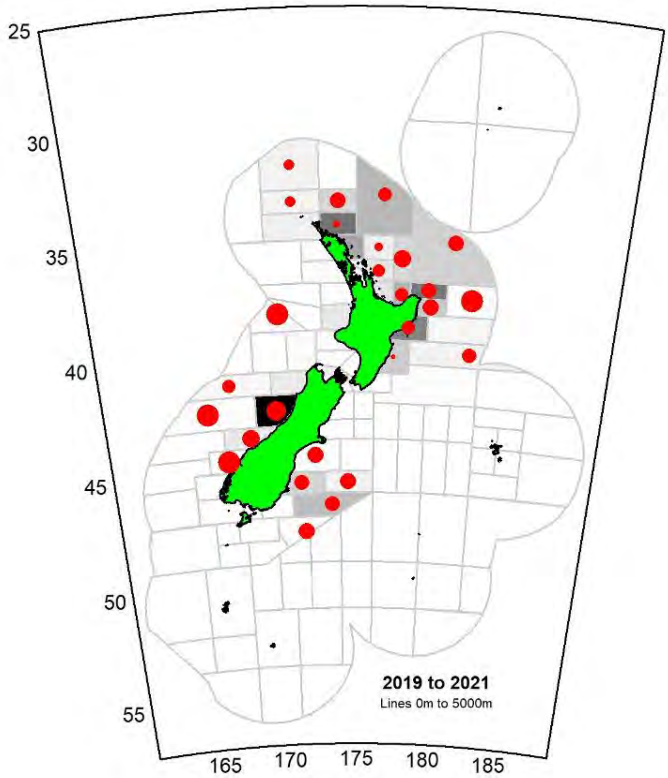
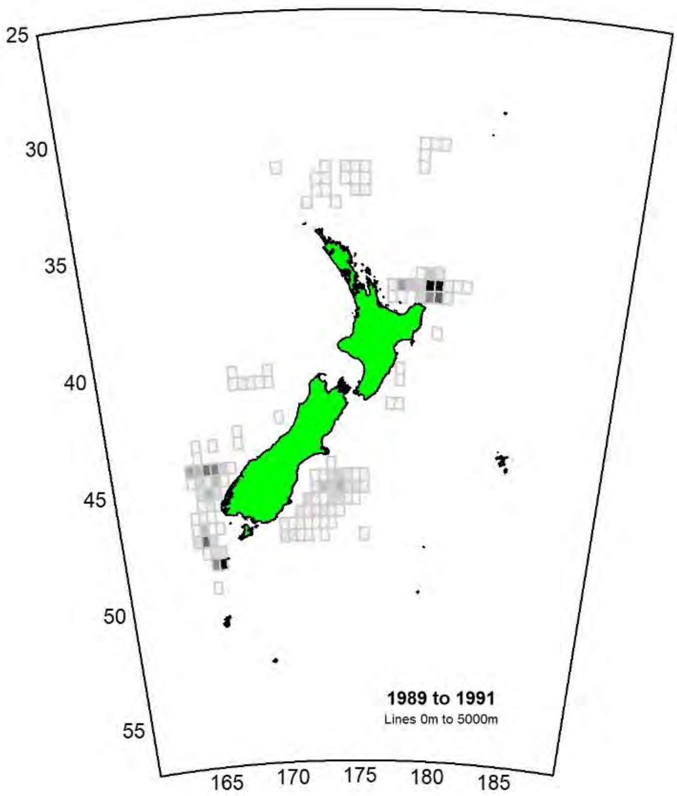


Figure 66.1 (cont.): Maps of porbeagle occurrence in the commercial line catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



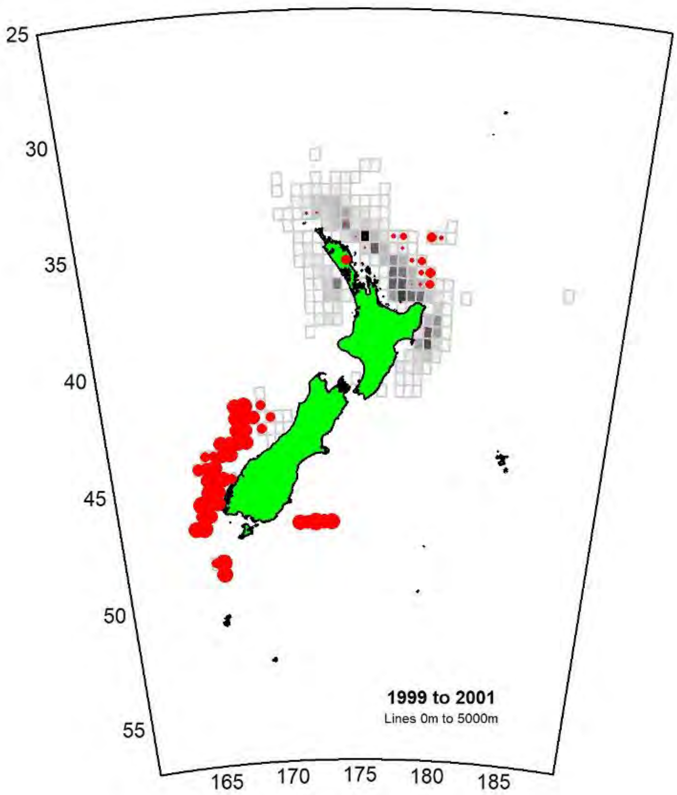
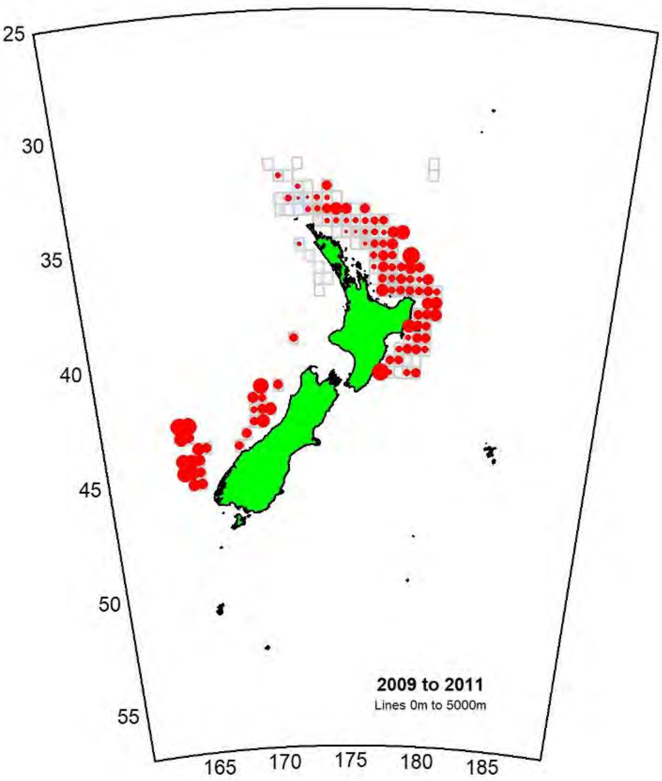


Figure 66.2: Maps of porbeagle occurrence in the commercial line catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



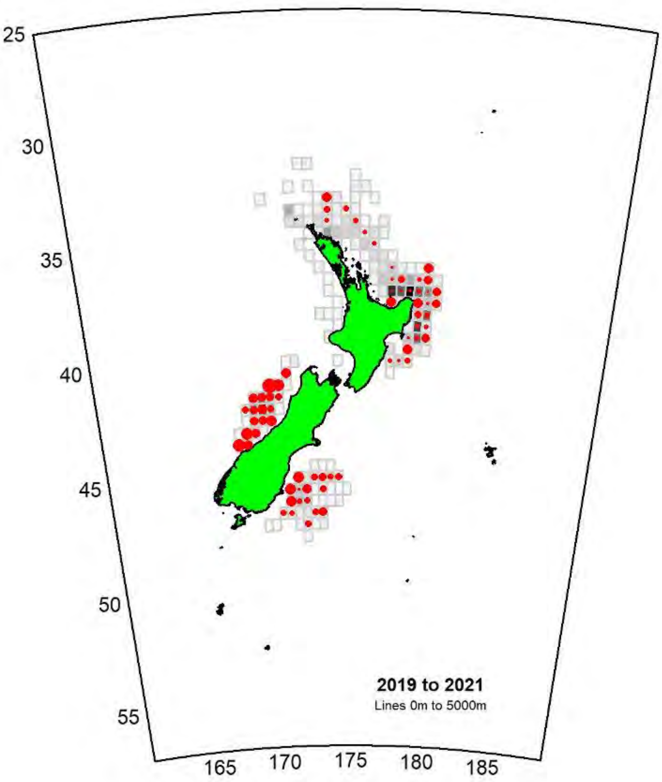
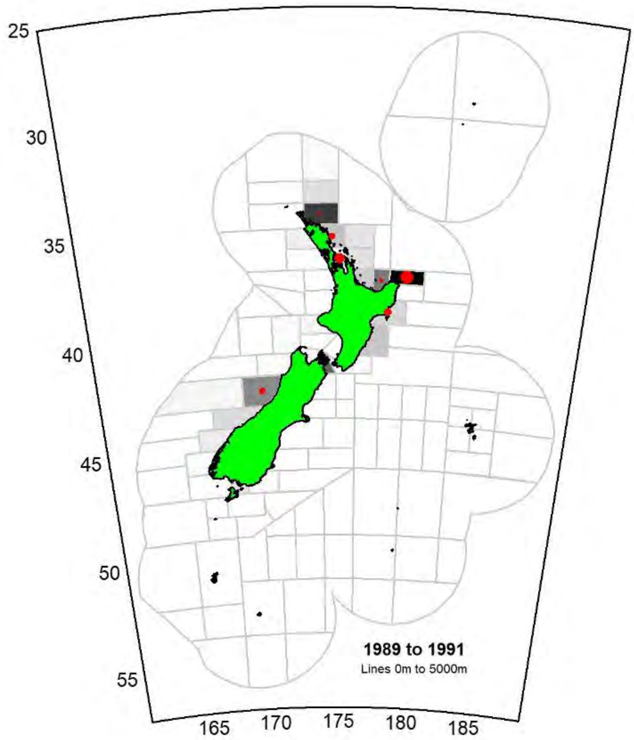


Figure 66.2 (cont.): Maps of porbeagle occurrence in the commercial line catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

67. Southern bluefin tuna (STN)



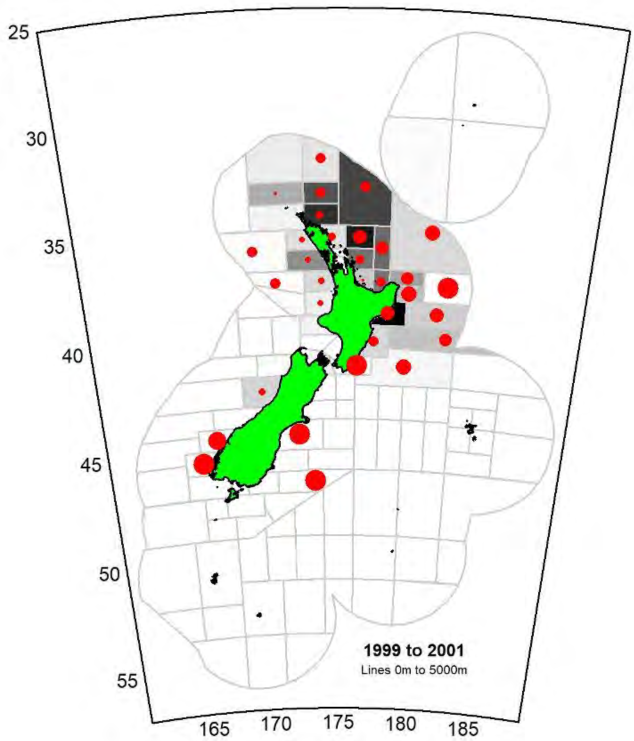
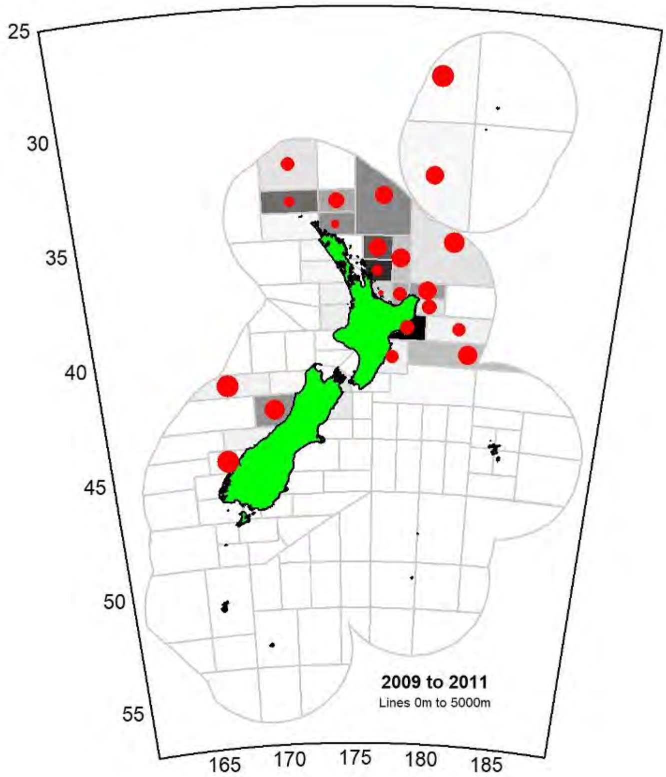


Figure 67.1: Maps of southern bluefin tuna occurrence in the commercial line catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



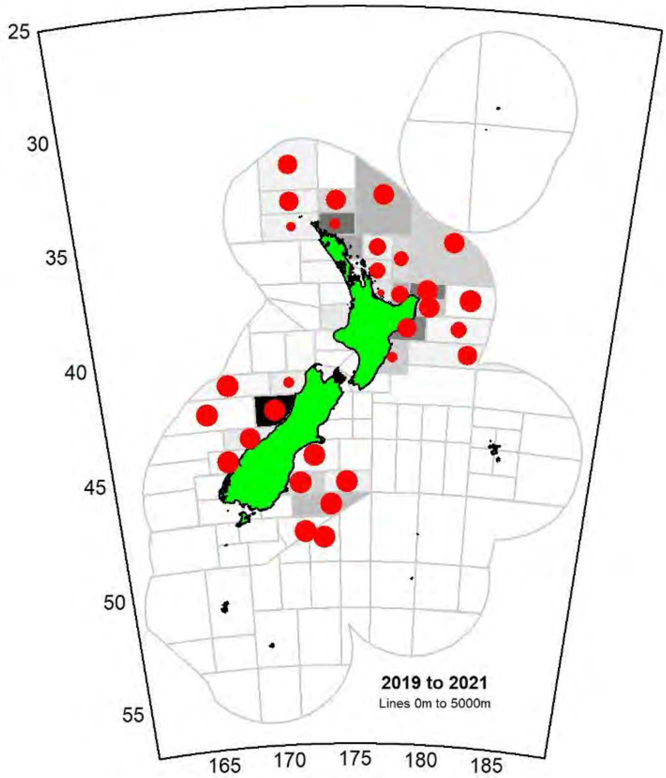
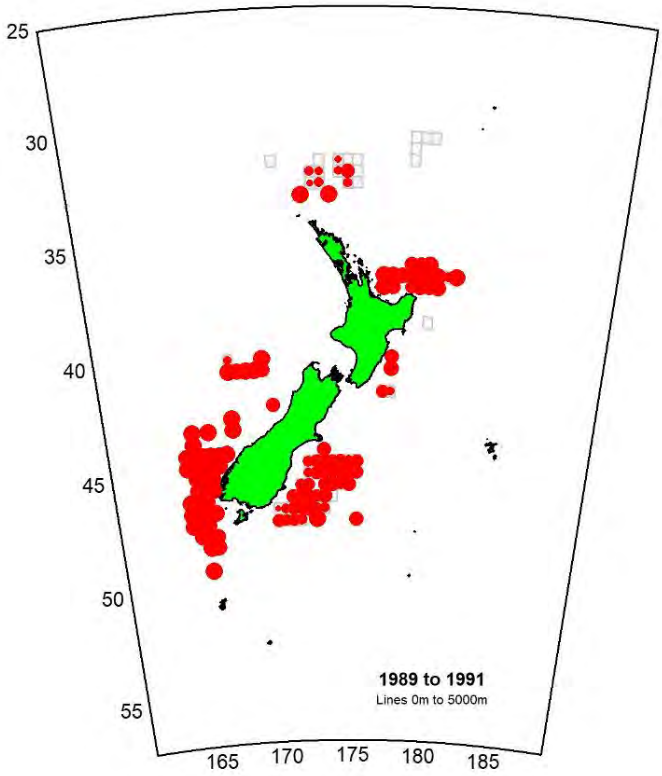


Figure 67.1 (cont.): Maps of southern bluefin tuna occurrence in the commercial line catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



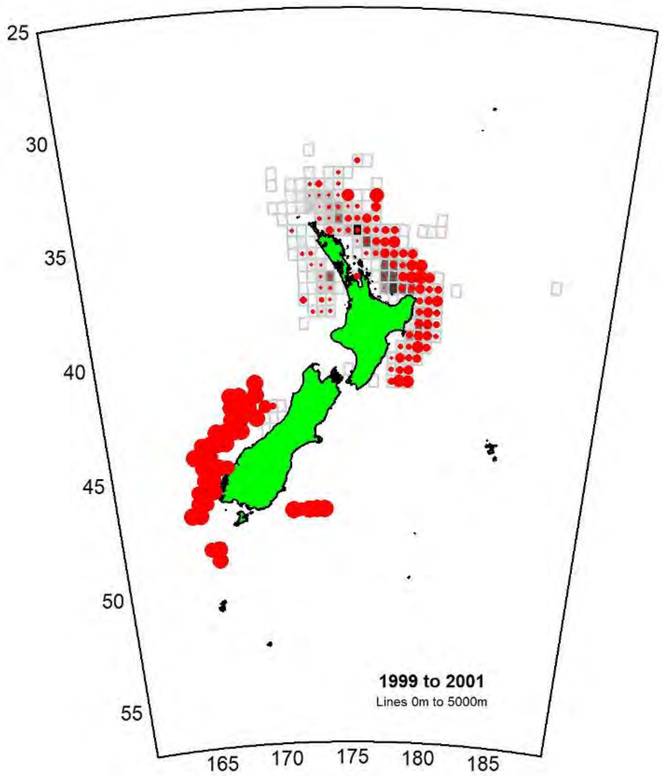
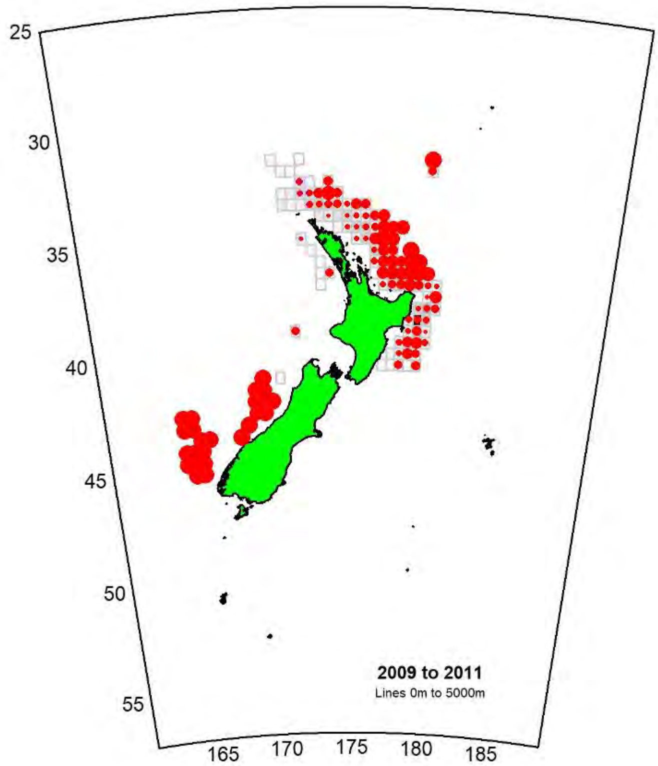


Figure 67.2: Maps of southern bluefin tuna occurrence in the commercial line catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



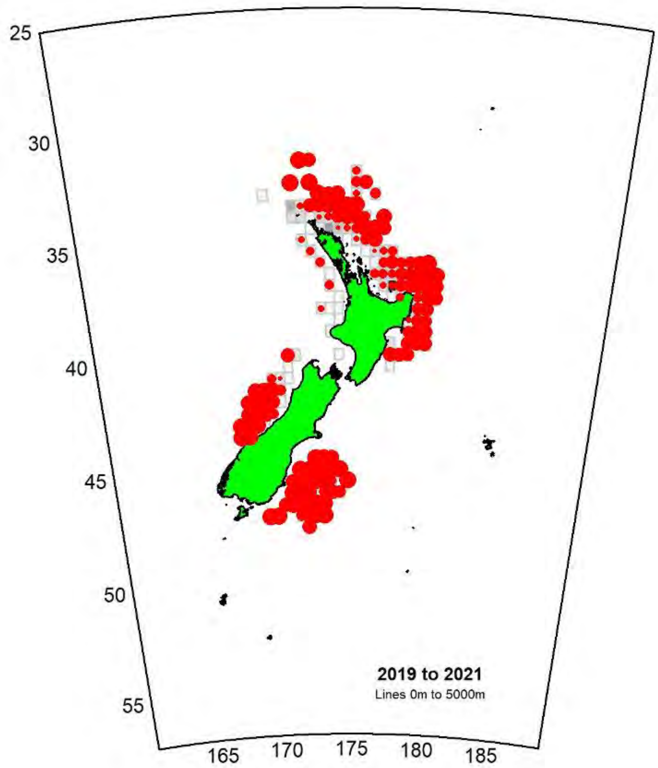


Figure 67.2 (cont.): Maps of southern bluefin tuna occurrence in the commercial line catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

68. Broadbill swordfish (SWO)

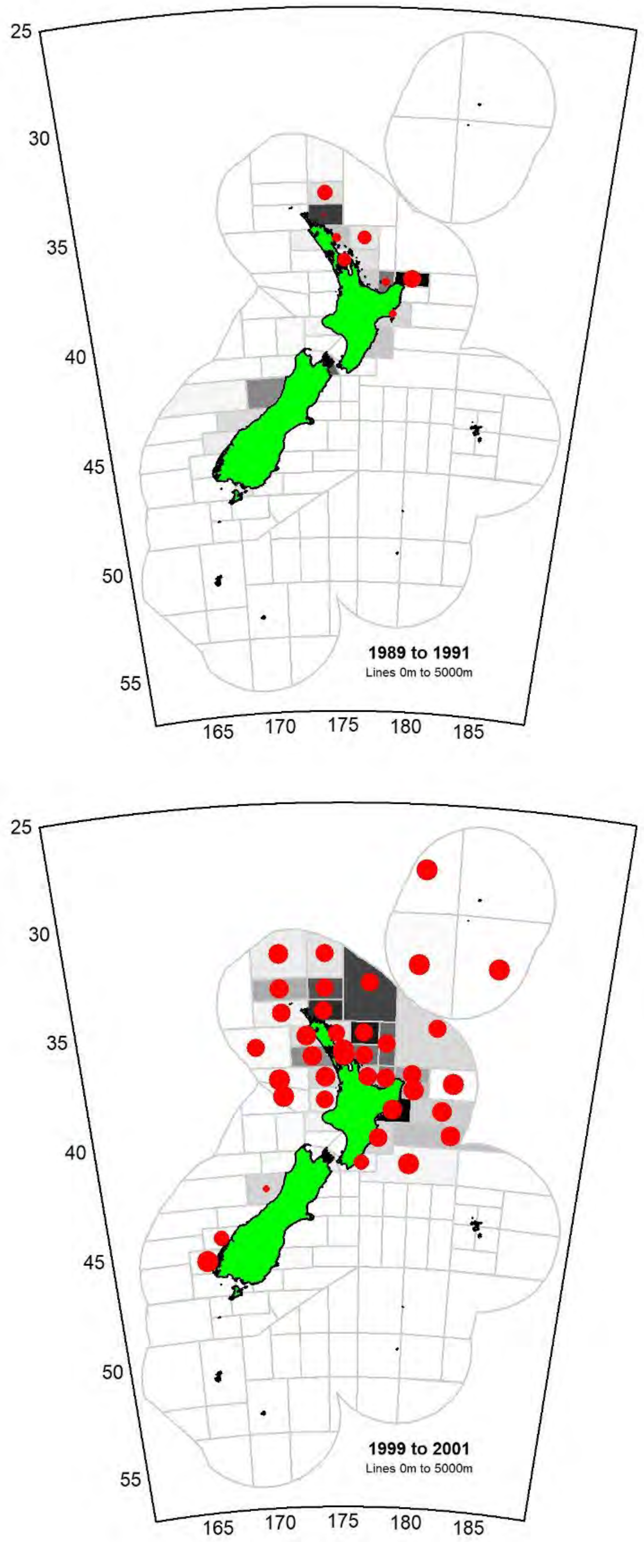
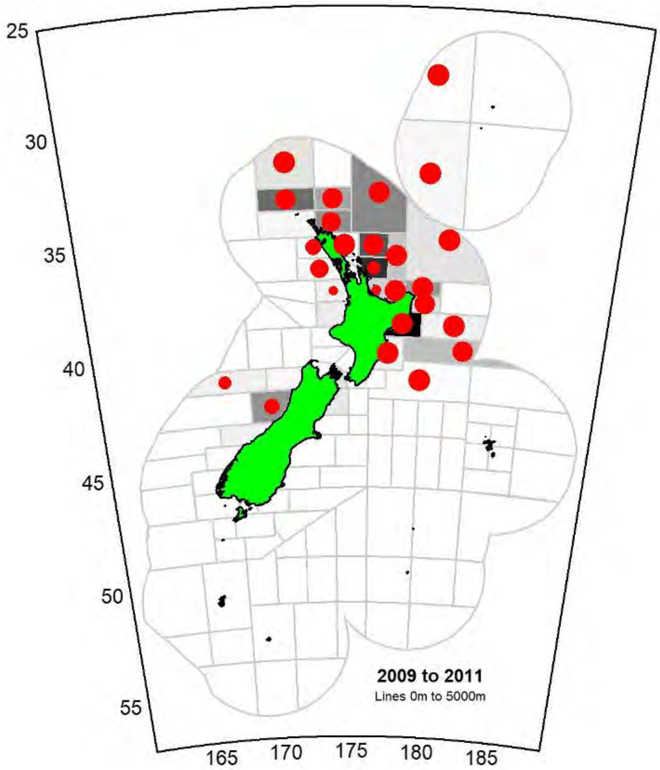


Figure 68.1: Maps of broadbill swordfish occurrence in the commercial line catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



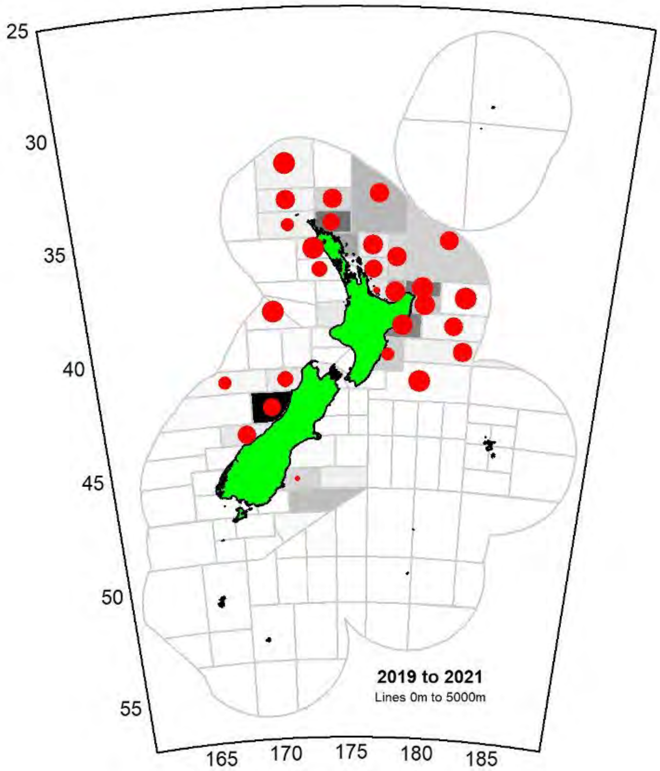
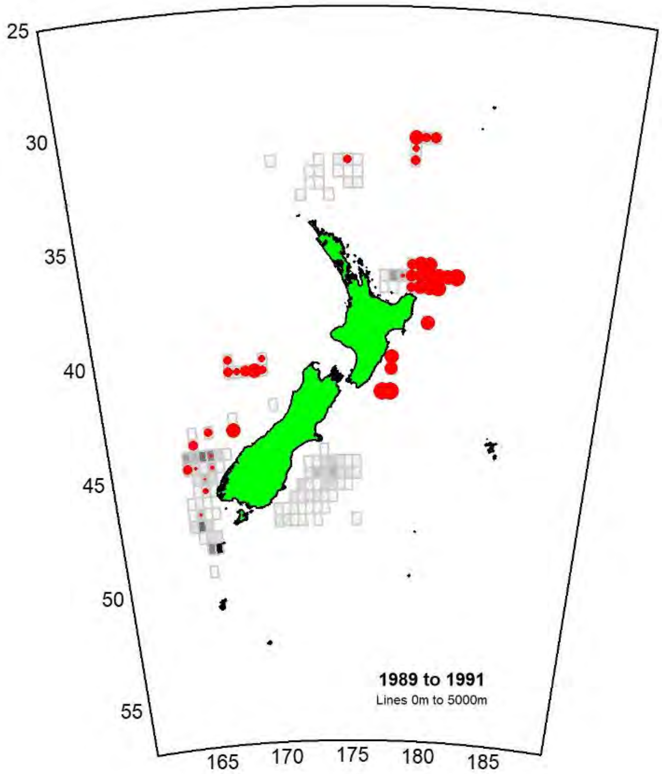


Figure 68.1 (cont.): Maps of broadbill swordfish occurrence in the commercial line catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



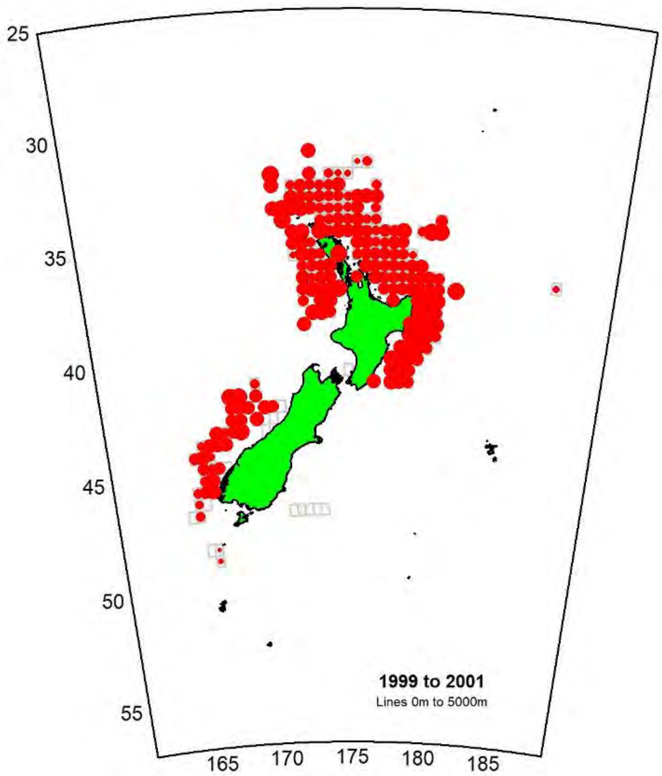
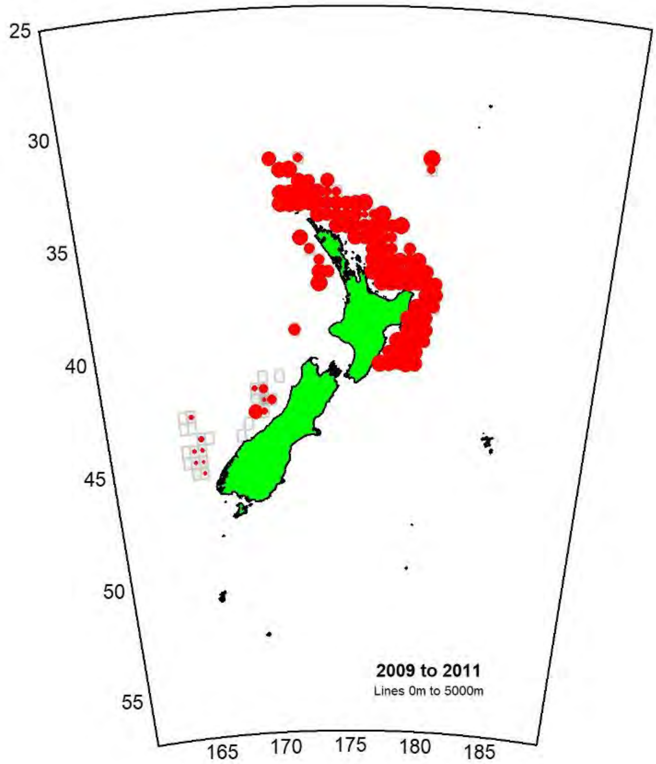


Figure 68.2: Maps of broadbill swordfish occurrence in the commercial line catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



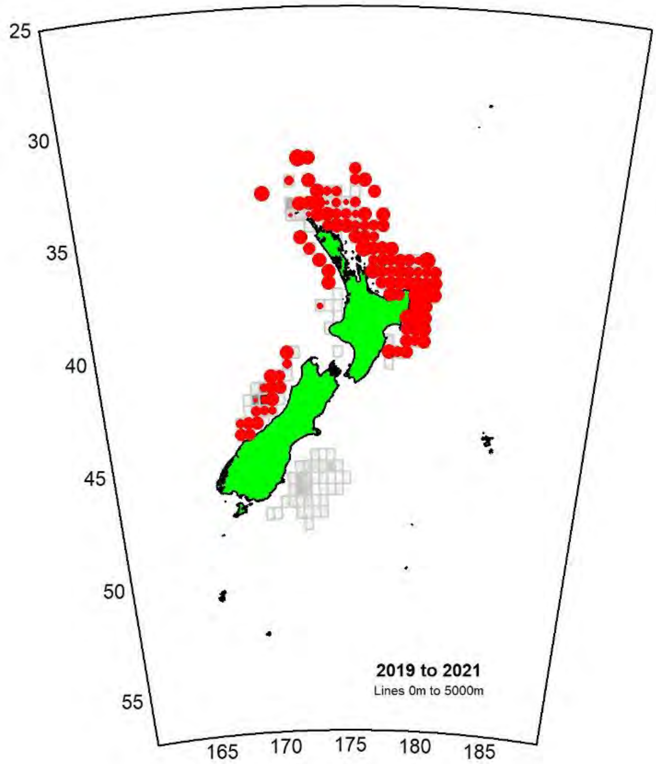
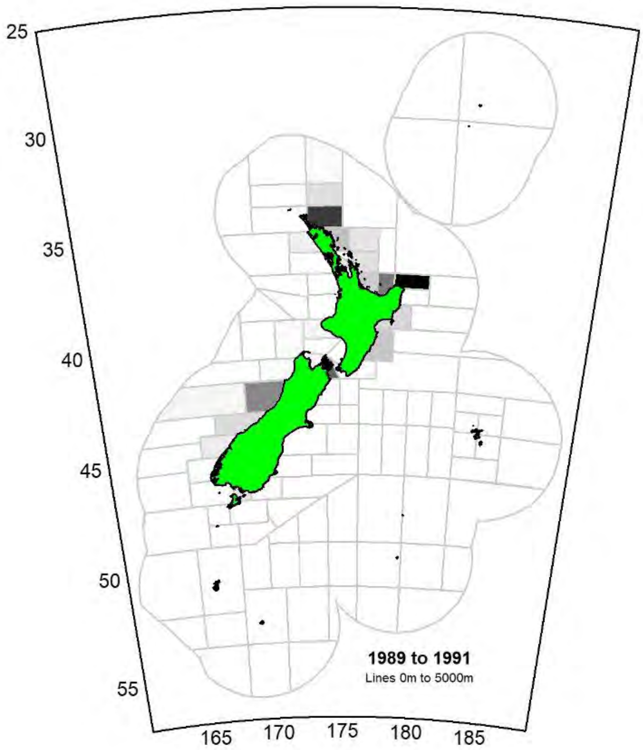


Figure 68.2 (cont.): Maps of broadbill swordfish occurrence in the commercial line catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

69. Pacific bluefin tuna (TOR, NTU)



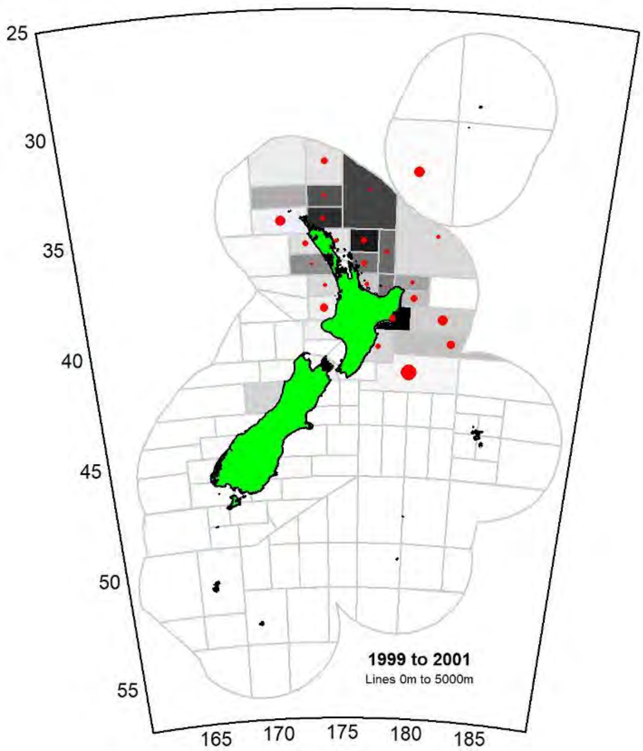
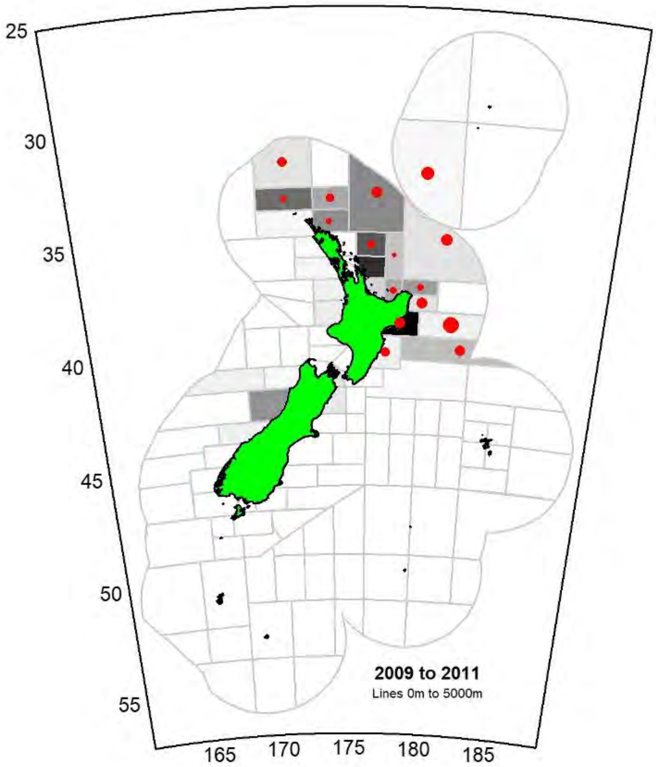


Figure 69.1: Maps of Pacific bluefin tuna occurrence in the commercial line catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



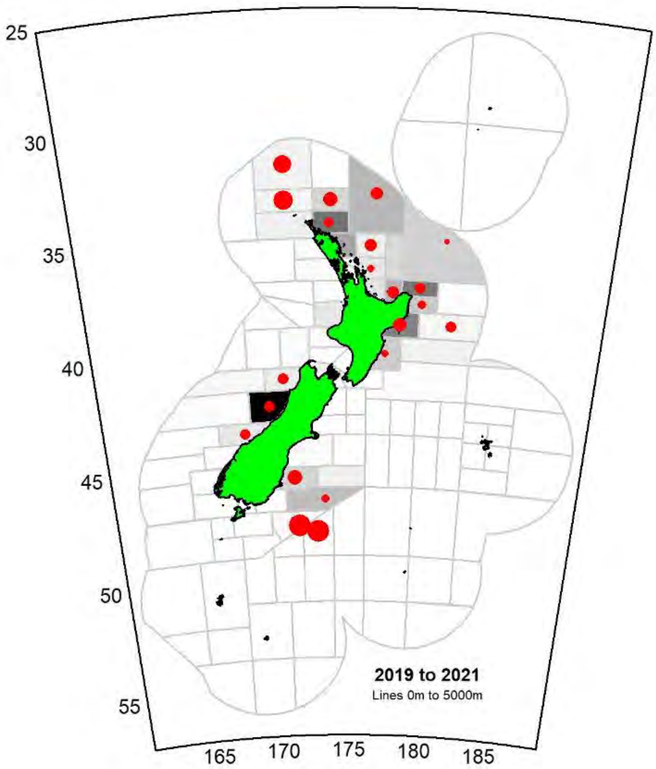


Figure 69.1 (cont.): Maps of Pacific bluefin tuna occurrence in the commercial line catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

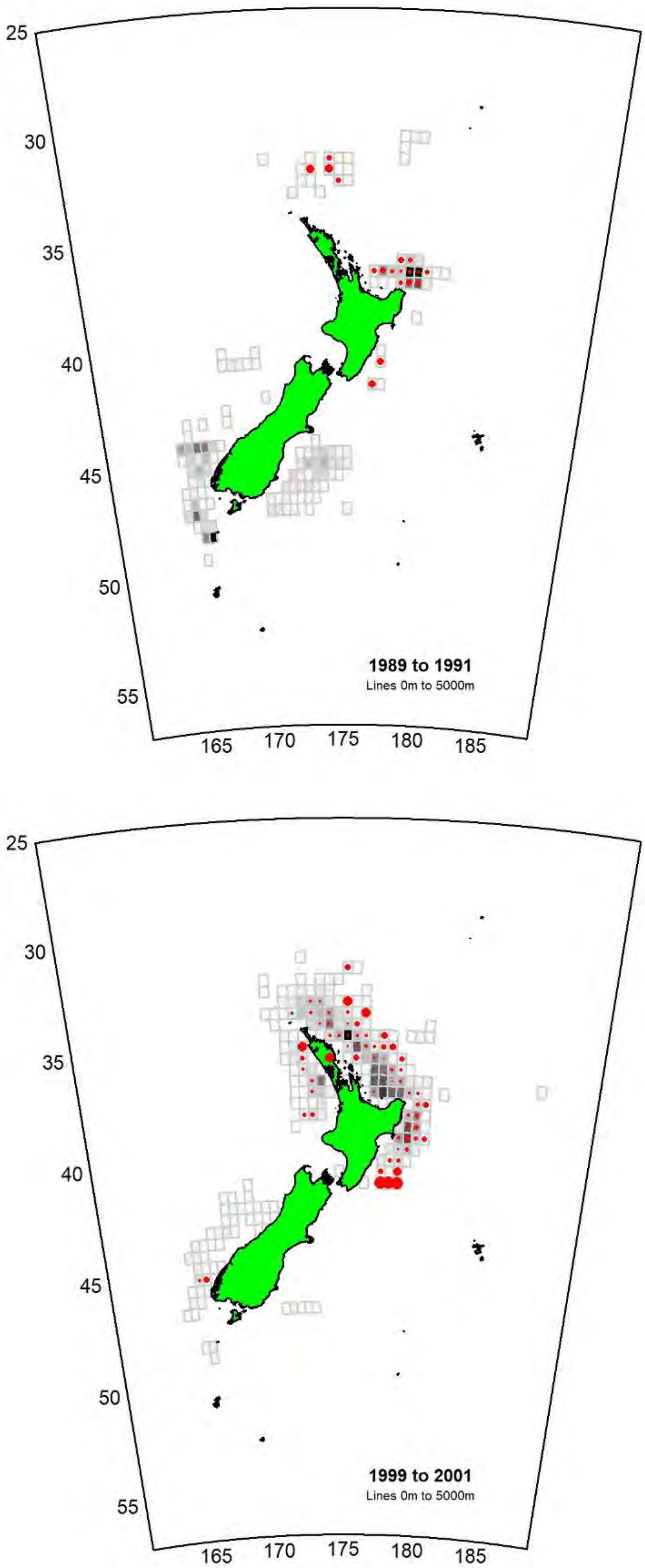
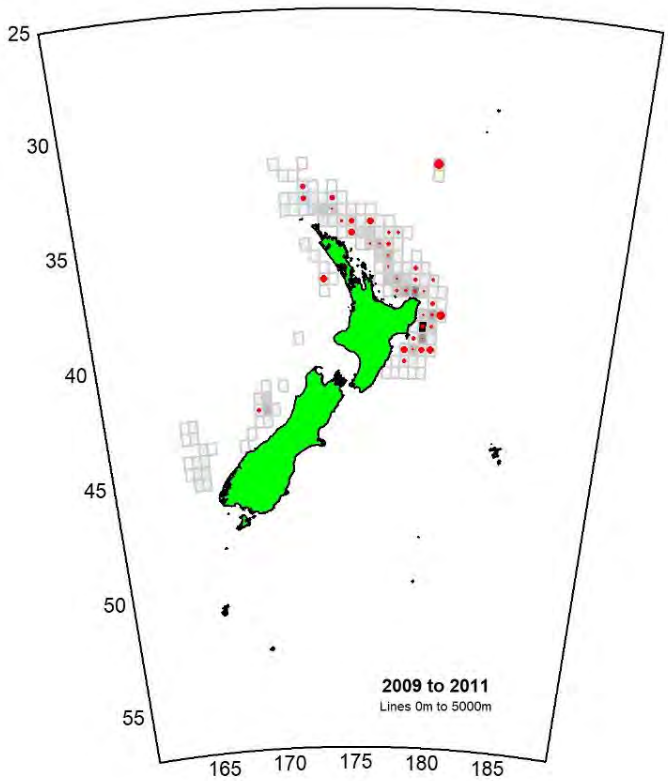


Figure 69.2: Maps of Pacific bluefin tuna occurrence in the commercial line catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



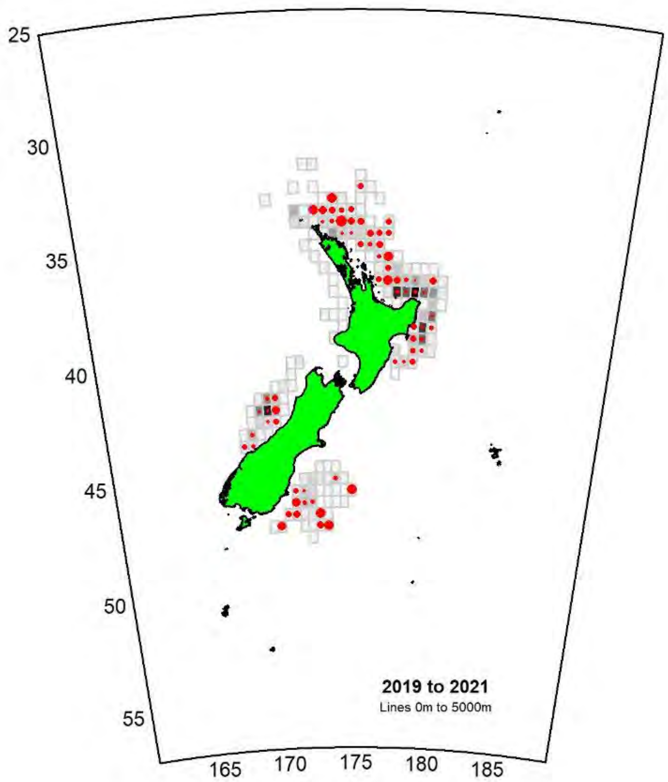


Figure 69.2 (cont.): Maps of Pacific bluefin tuna occurrence in the commercial line catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

70. Yellowfin tuna (YFN)

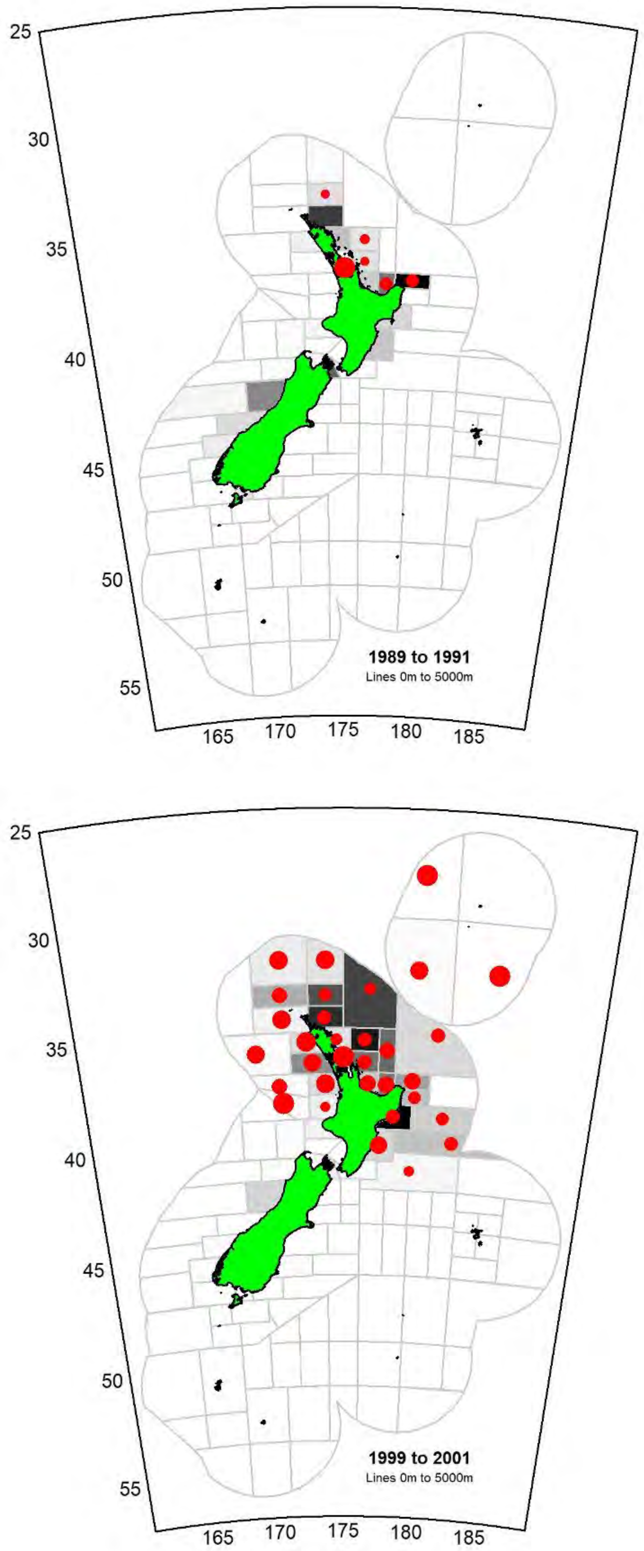
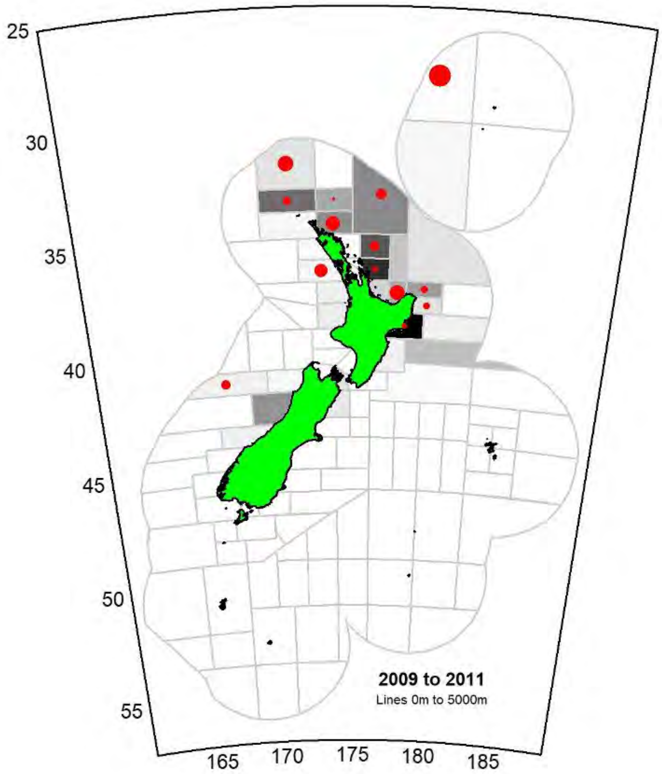


Figure 70.1: Maps of yellowfin tuna occurrence in the commercial line catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



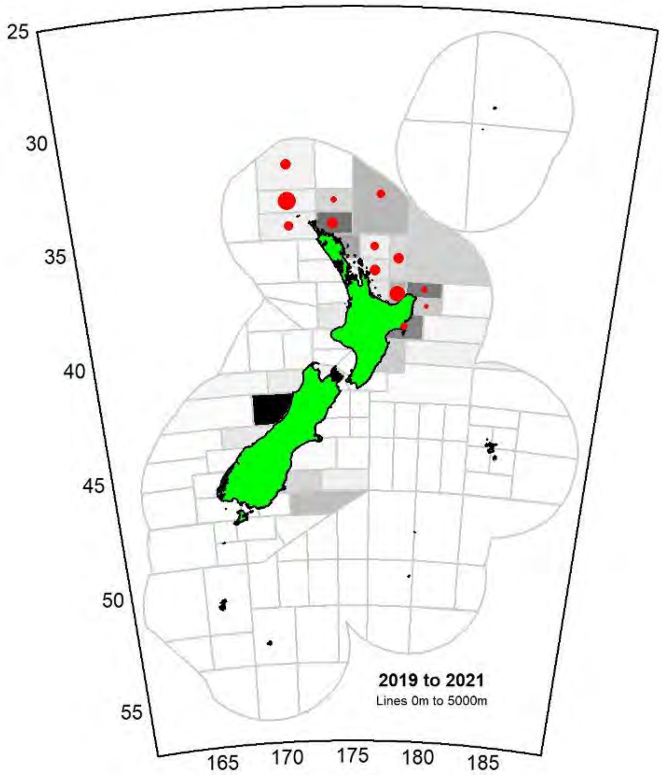
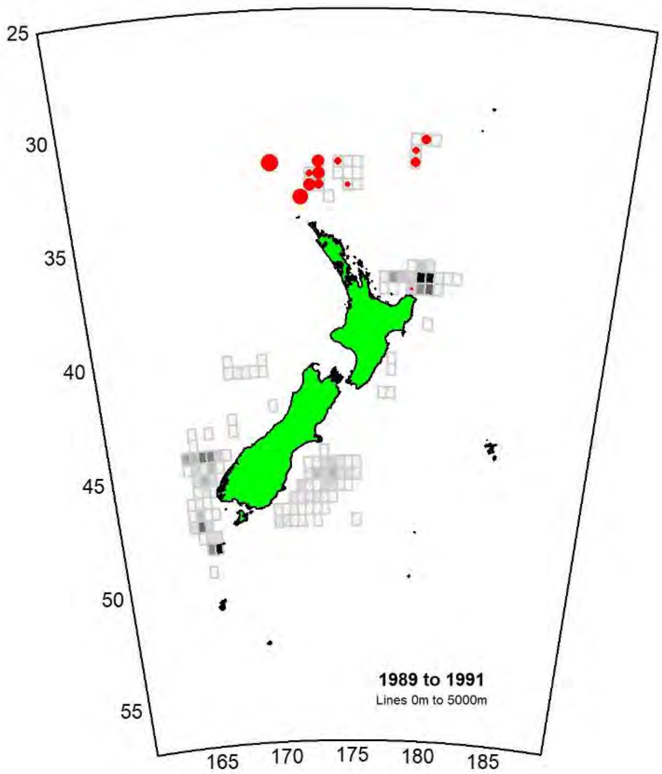


Figure 70.1 (cont.): Maps of yellowfin tuna occurrence in the commercial line catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



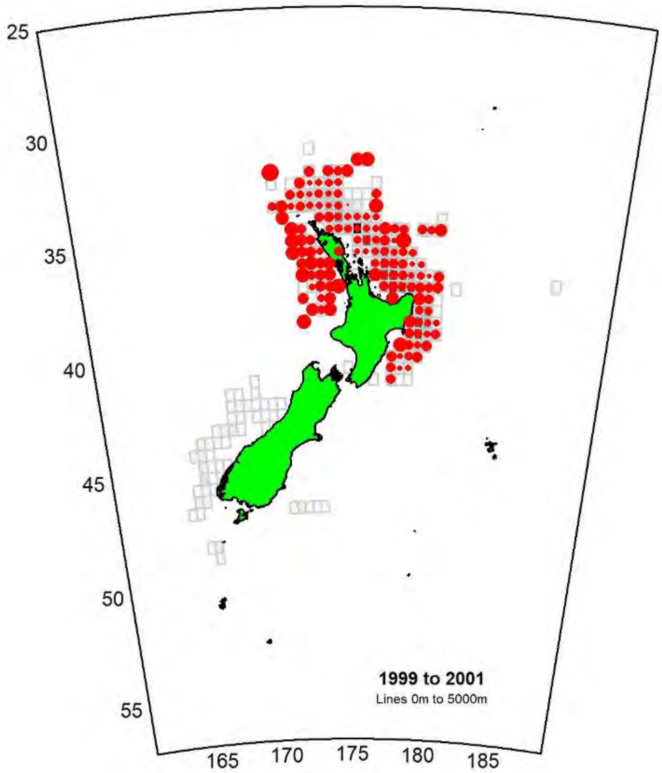


Figure 70.2: Maps of yellowfin tuna occurrence in the commercial line catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

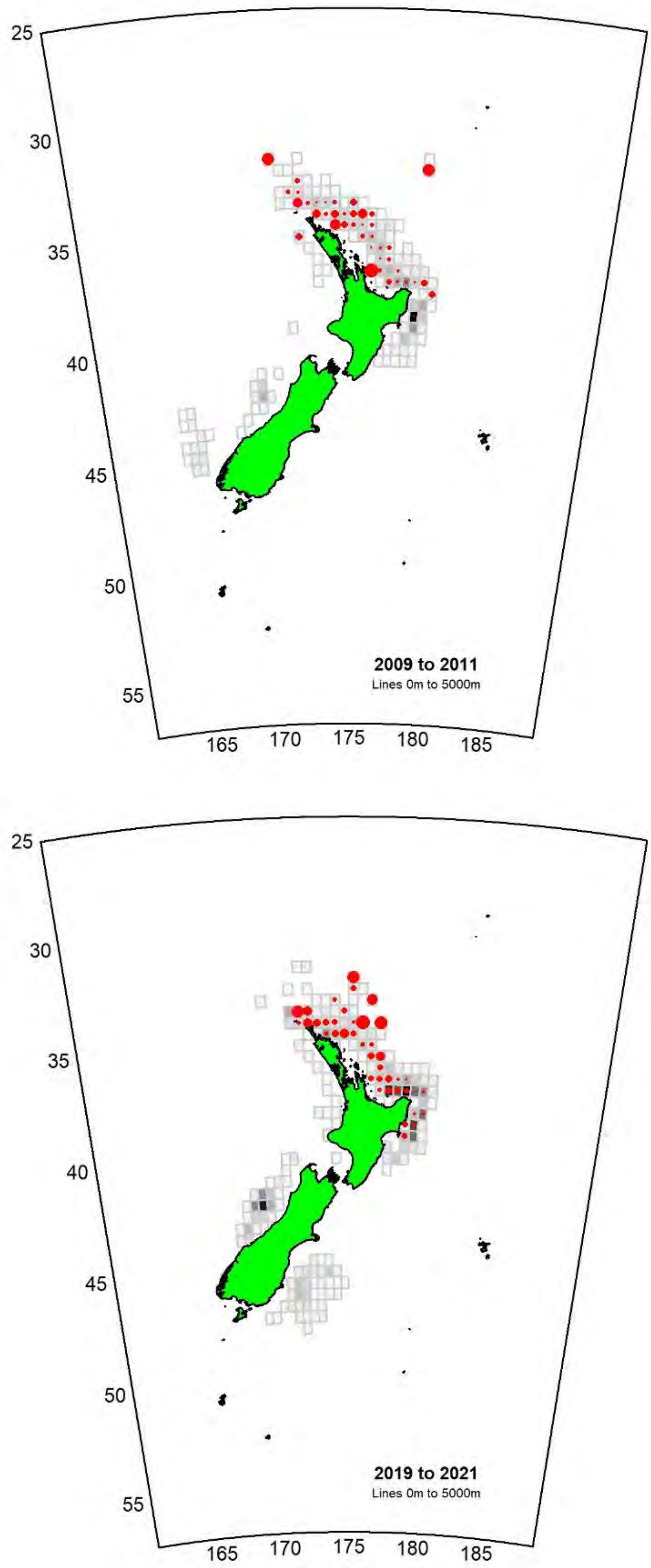
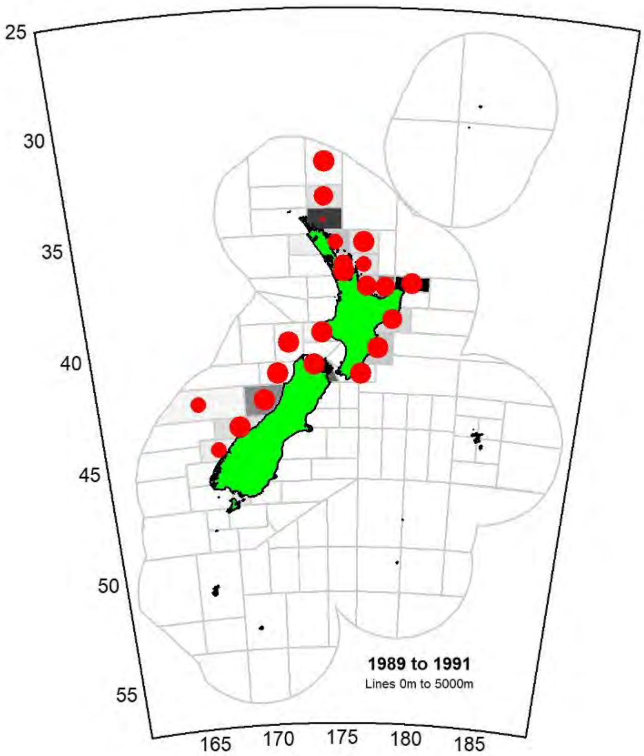


Figure 70.2 (cont.): Maps of yellowfin tuna occurrence in the commercial line catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

71. Albacore (ALB)



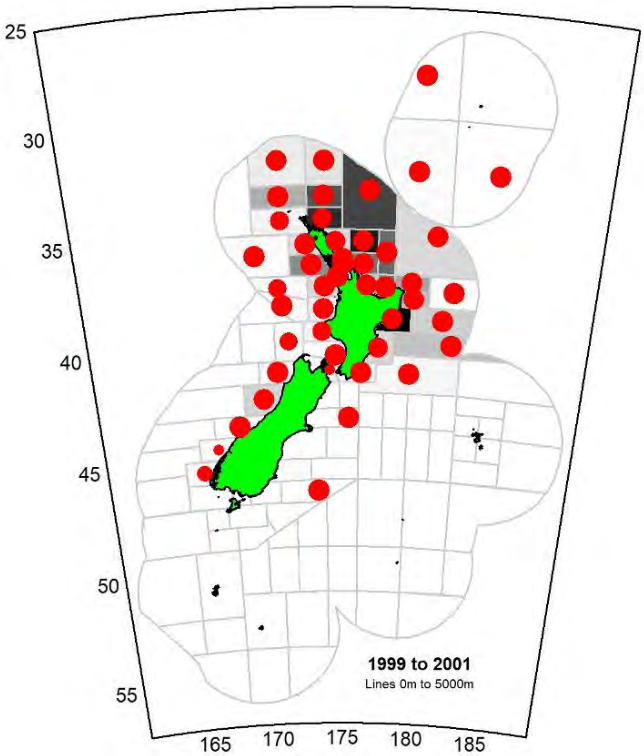
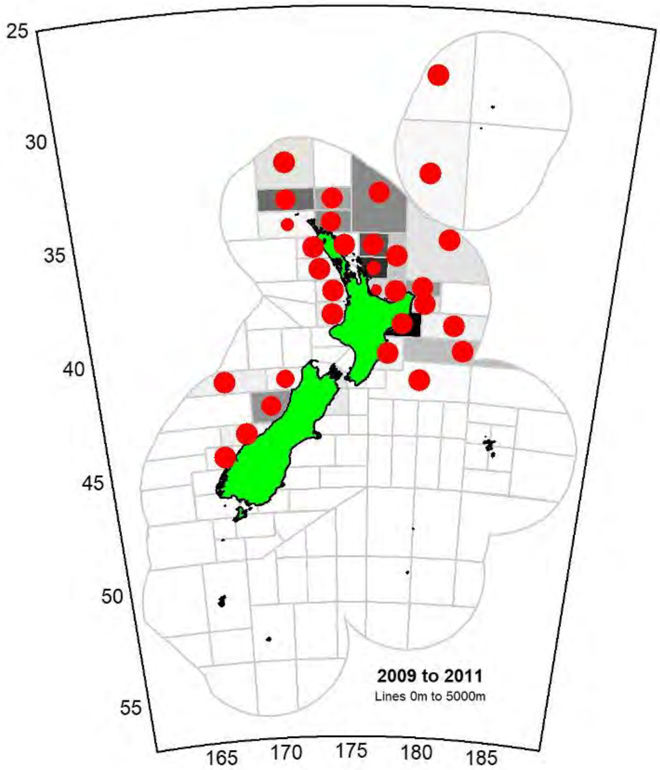


Figure 71.1: Maps of albacore occurrence in the commercial line catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



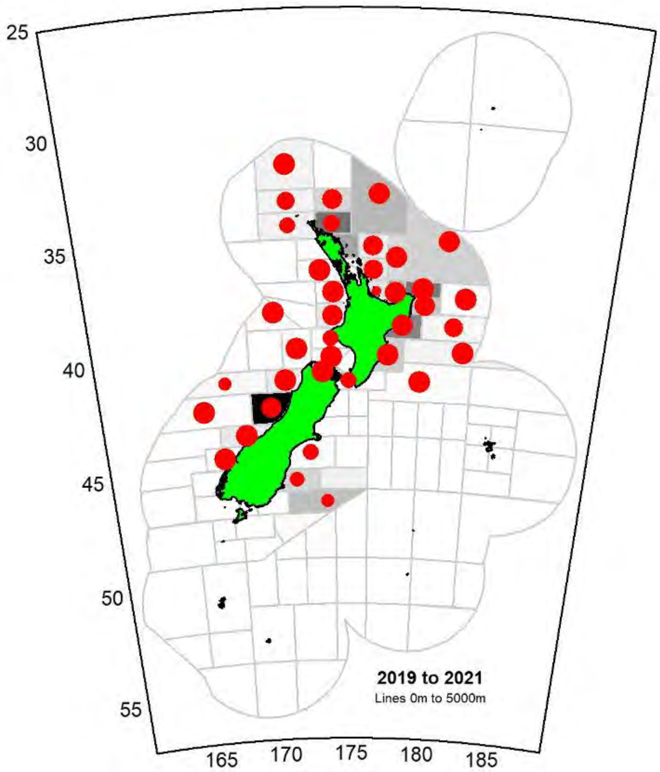
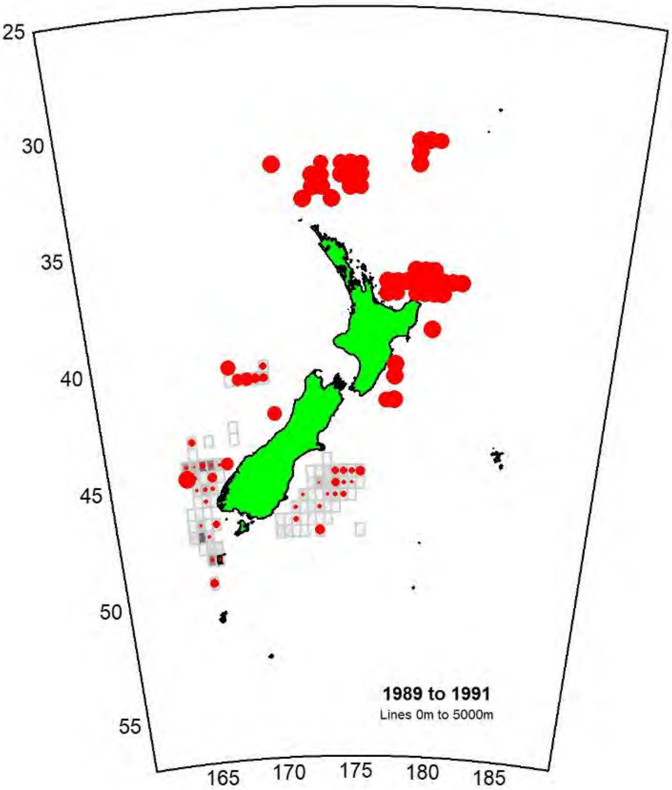


Figure 71.1 (cont.): Maps of albacore occurrence in the commercial line catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



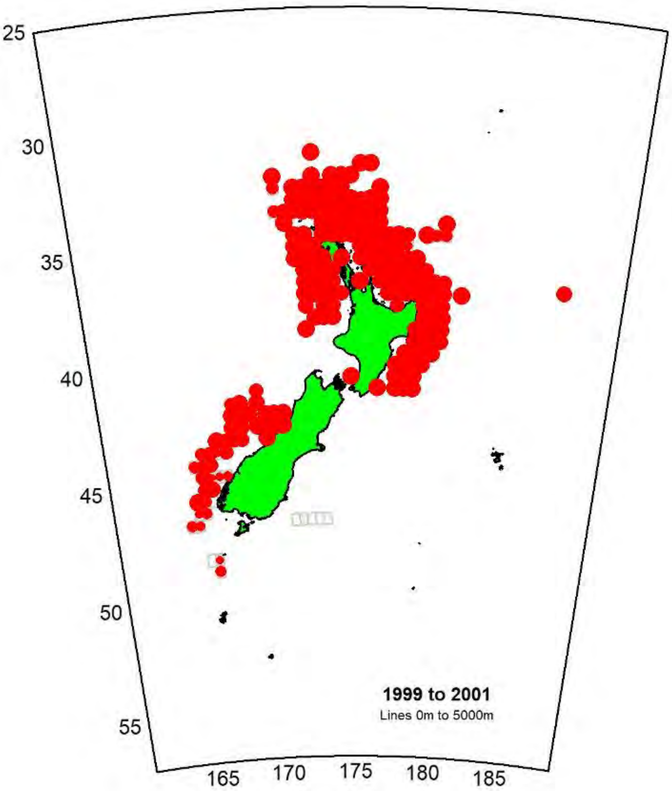
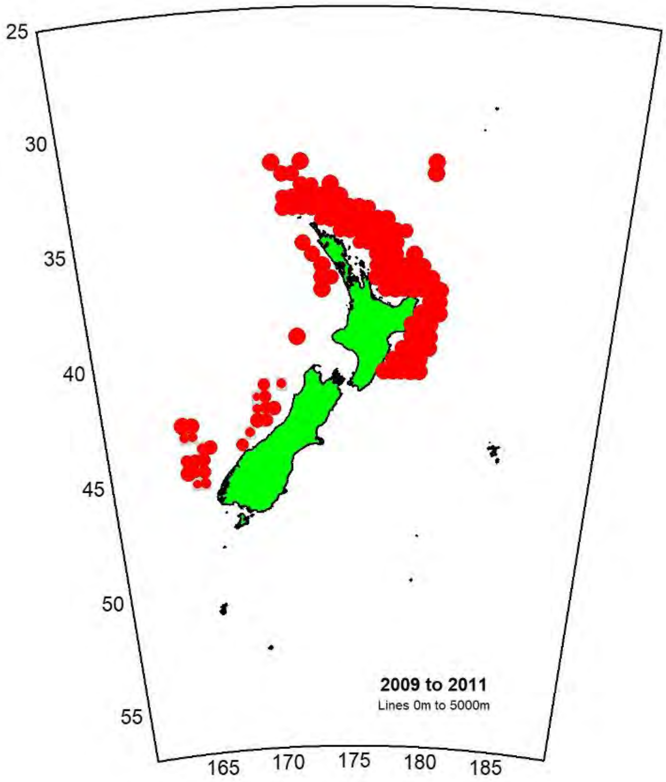


Figure 71.2: Maps of albacore occurrence in the commercial line catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



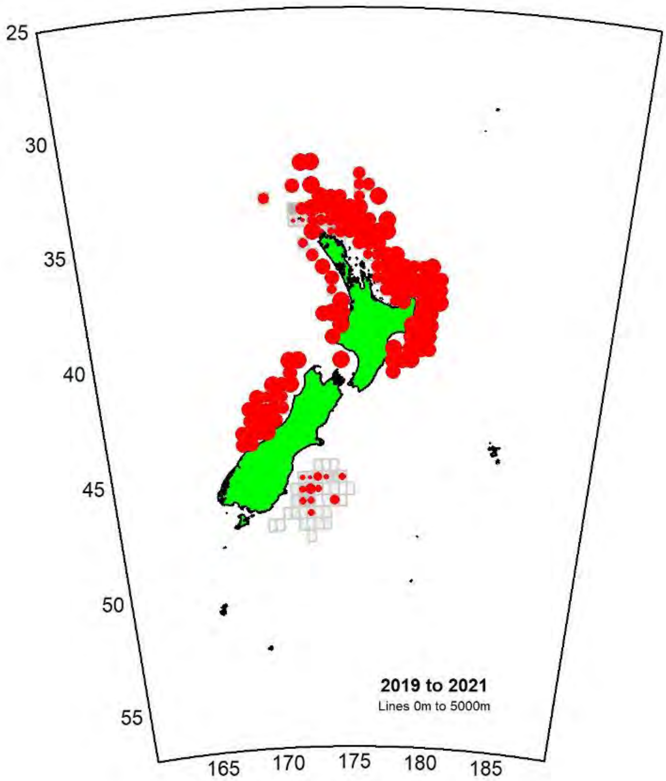
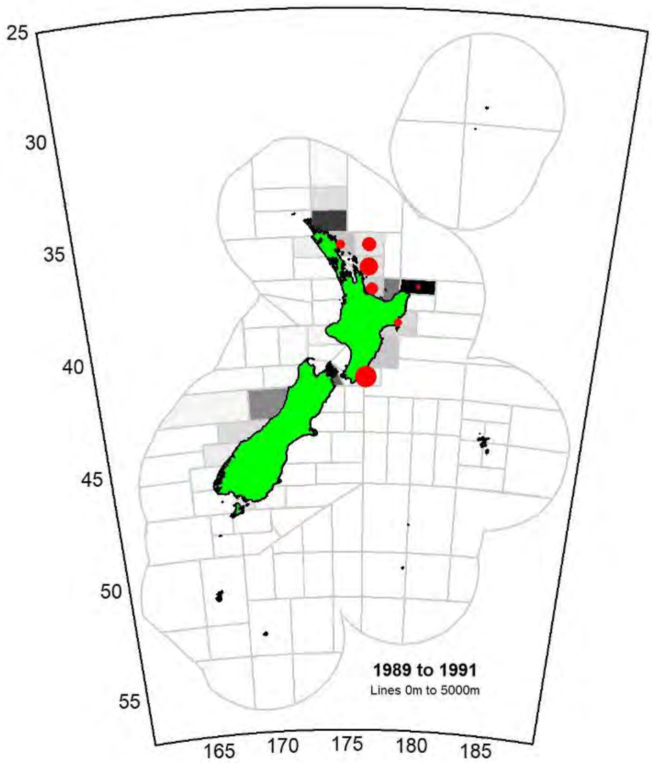


Figure 71.2 (cont.): Maps of albacore occurrence in the commercial line catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

72. Skipjack (SKJ)



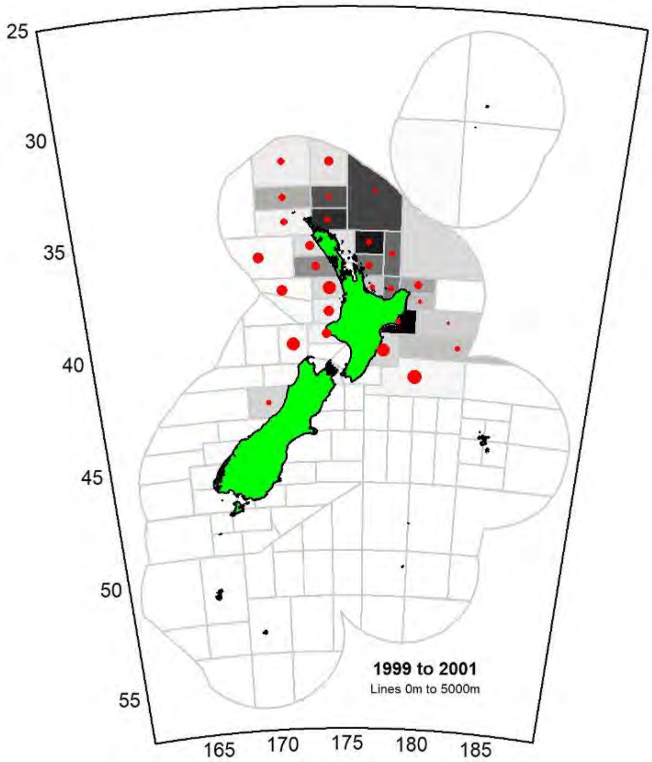
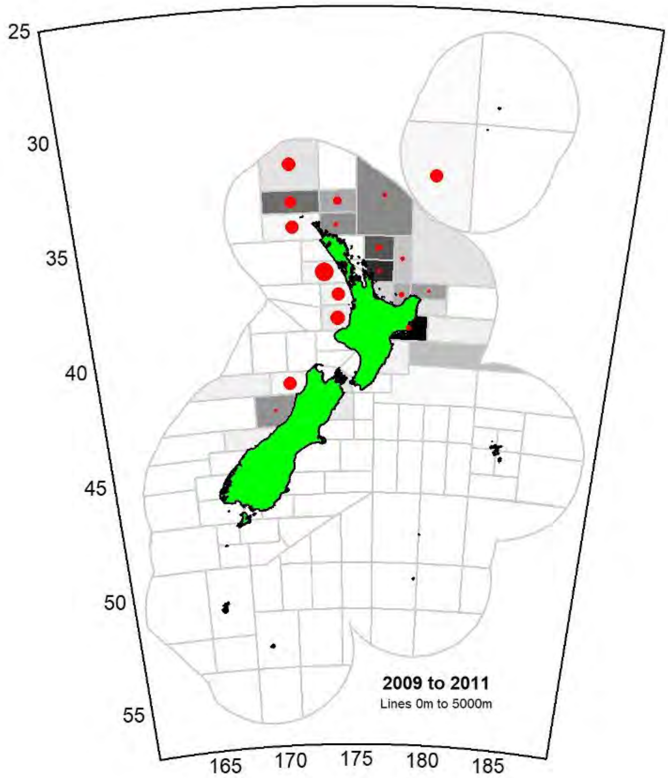


Figure 72.1: Maps of skipjack occurrence in the commercial line catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



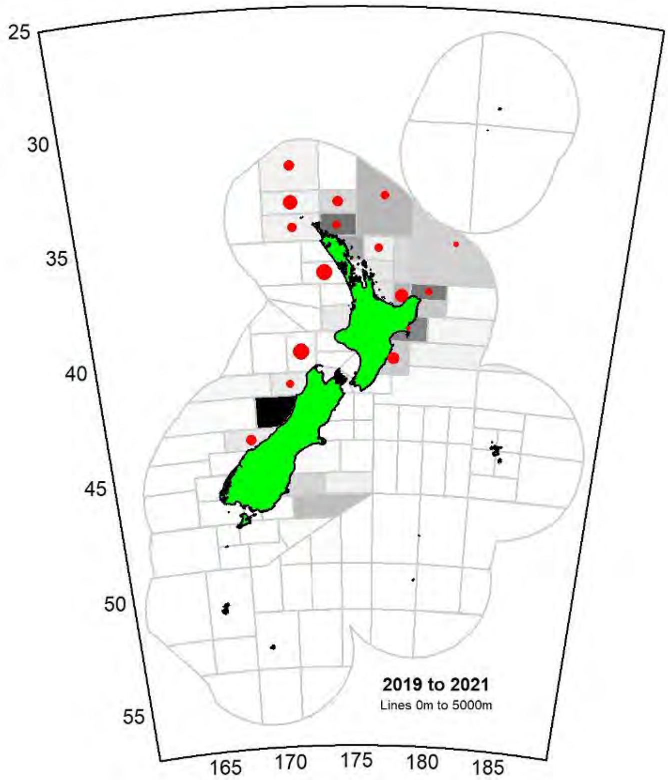


Figure 72.1 (cont.): Maps of skipjack occurrence in the commercial line catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

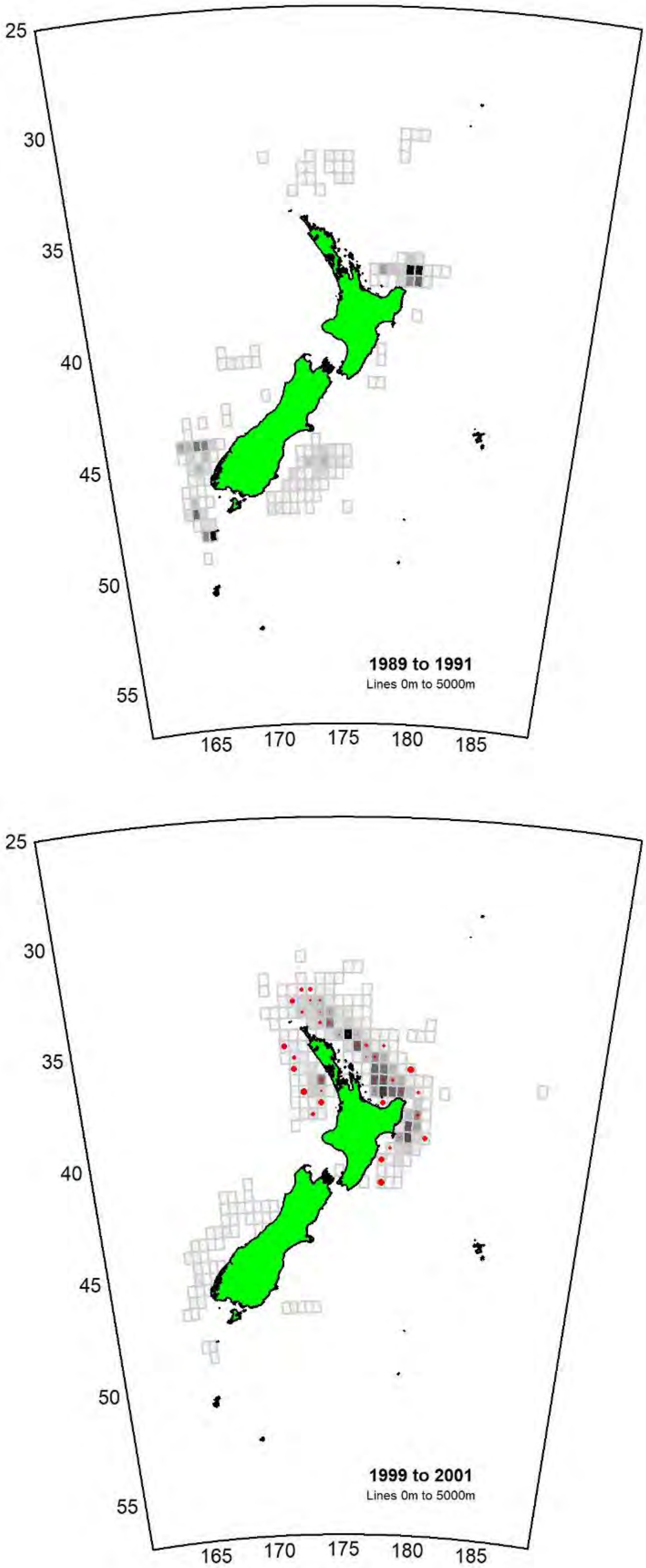


Figure 72.2: Maps of skipjack occurrence in the commercial line catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

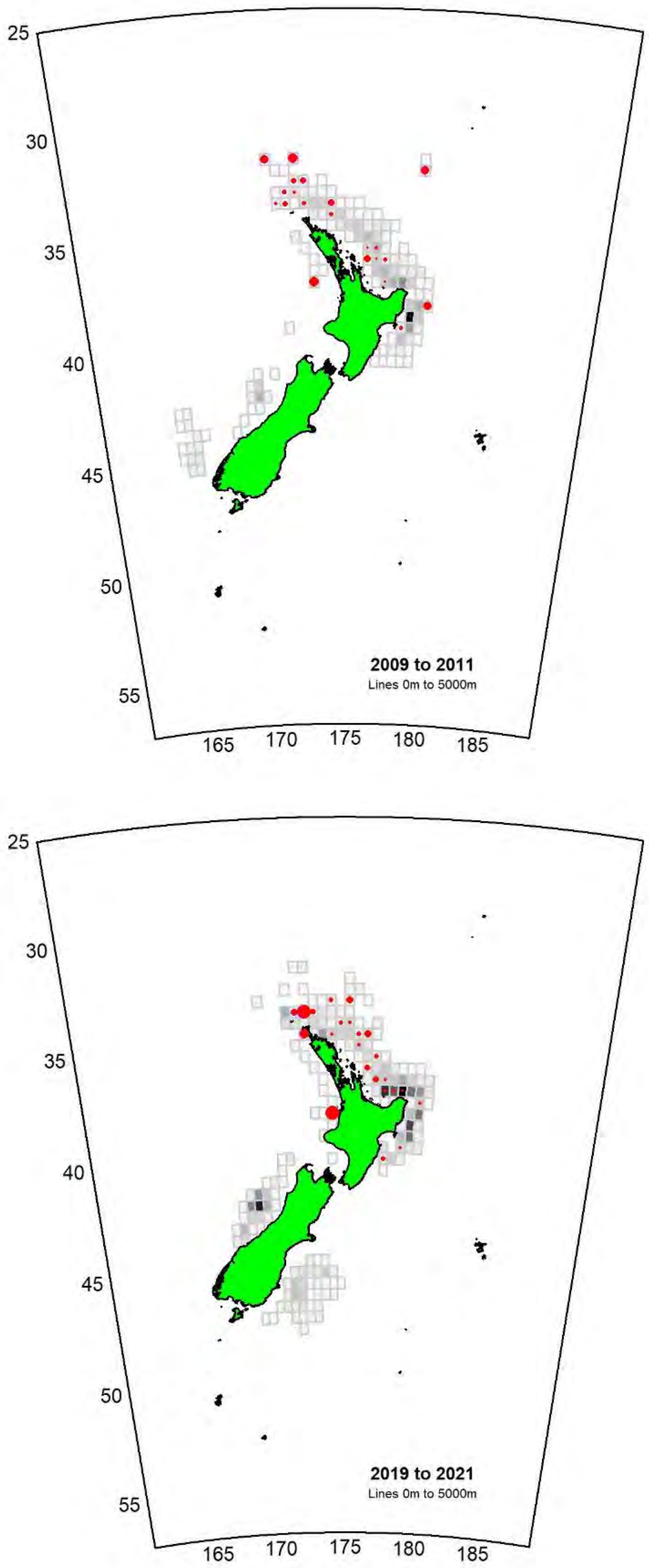


Figure 72.2 (cont.): Maps of skipjack occurrence in the commercial line catch and effort data by half-degree latitude and longitude cells and groups of years. Cells are shaded according to the sum of events (more events are shaded darker). Cells were only kept in the analyses when there were at least three events in that cell. The red dots indicate the occurrence in each cell, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).

73. Pink maomao (PMA)

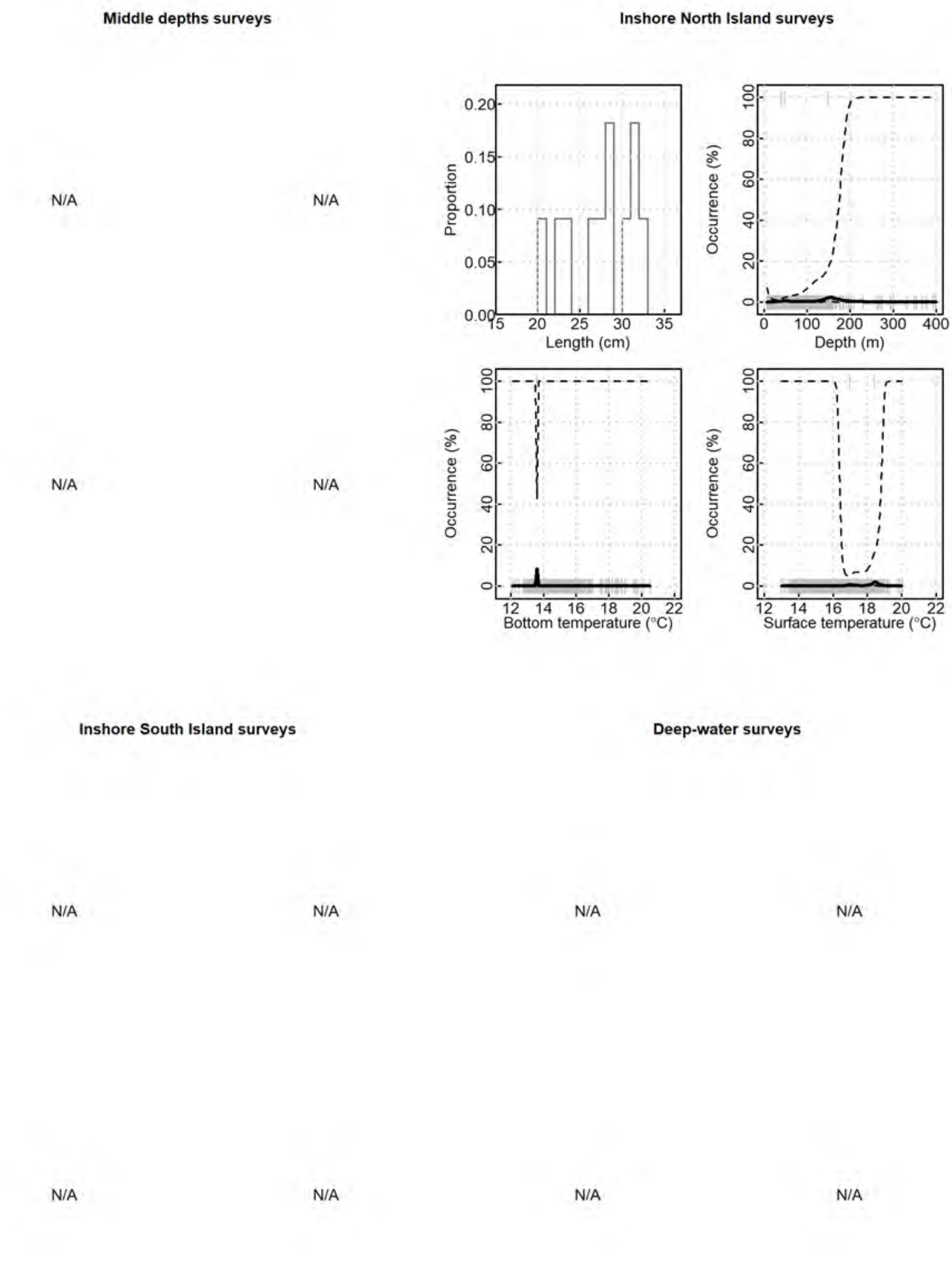


Figure 73.1: For each survey series, the four panels show the sampled length frequency distribution and binomial GAM fits to pink maomao occurrence in the catch, by depth and surface and bottom temperatures. In each occurrence plot, the top data rug indicates occurrence, and bottom data rug absences. Broken lines indicate 2×SE around the mean (solid line). Where the panels show N/A there were no data.

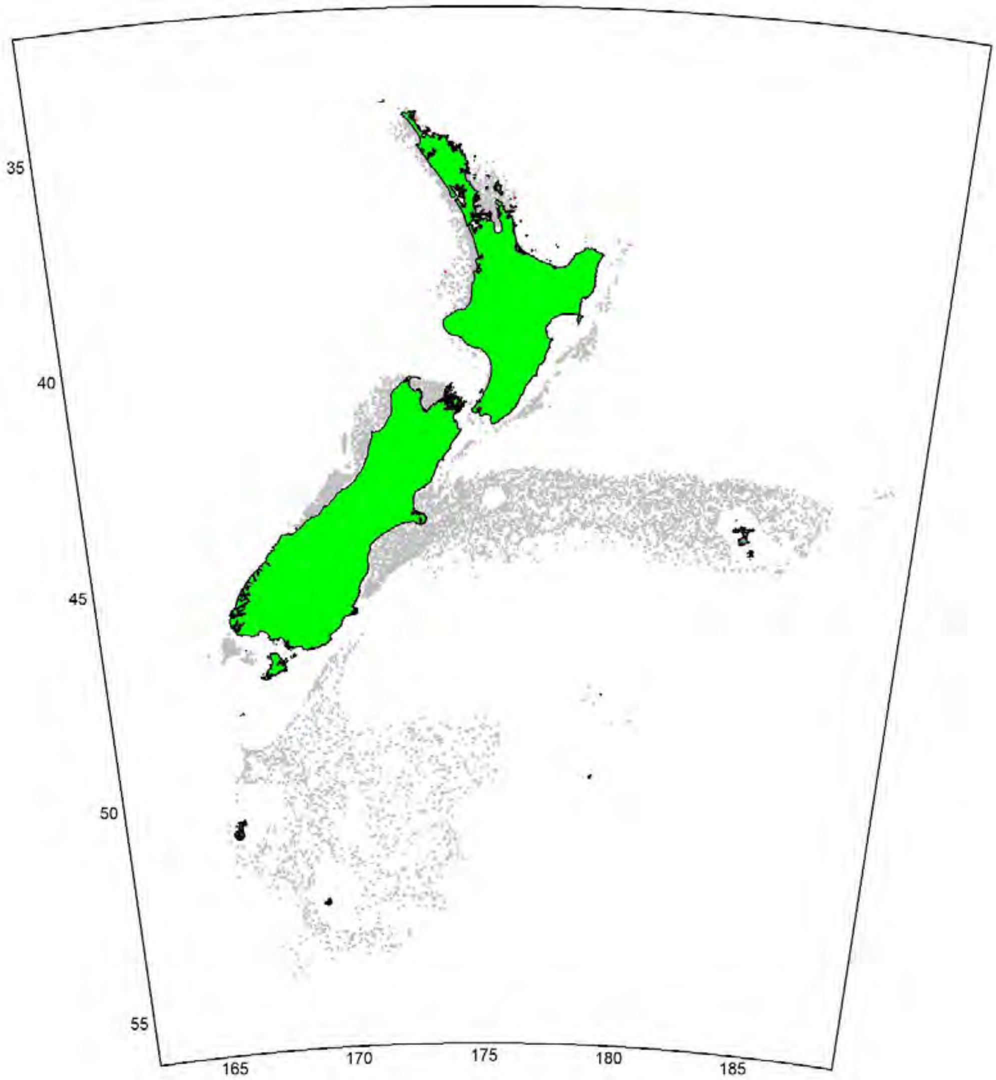


Figure 73.2: Map of the occurrence in the trawl surveys, with all surveyed locations (grey points), and locations where pink maomao was caught (red points).

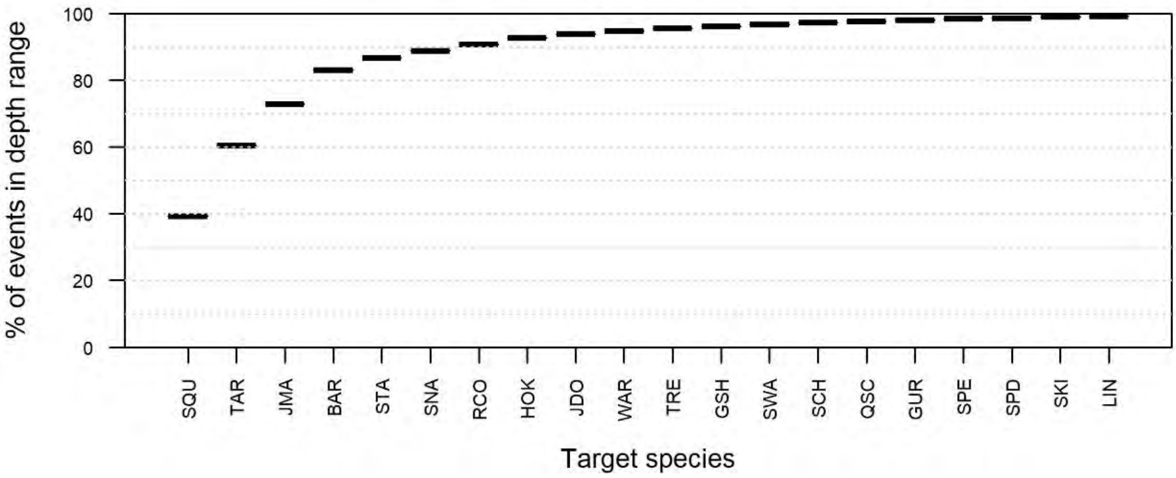
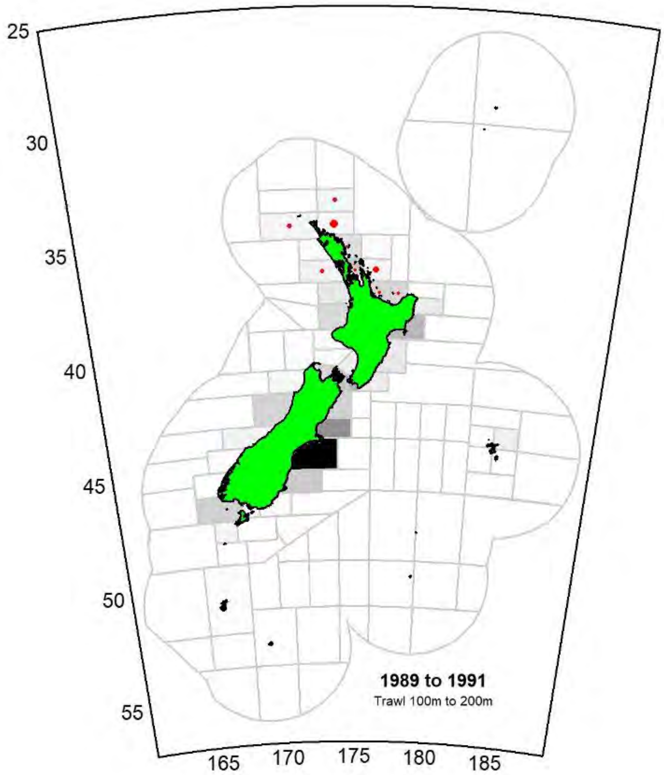


Figure 73.3: Cumulative percentage of the events (trawl tows or line sets) by reported target species within the depth range selected for pink maomao (100–200 m). The cut-off for inclusion of a target species in the data selection criteria for the subsequent maps was set at 95%.



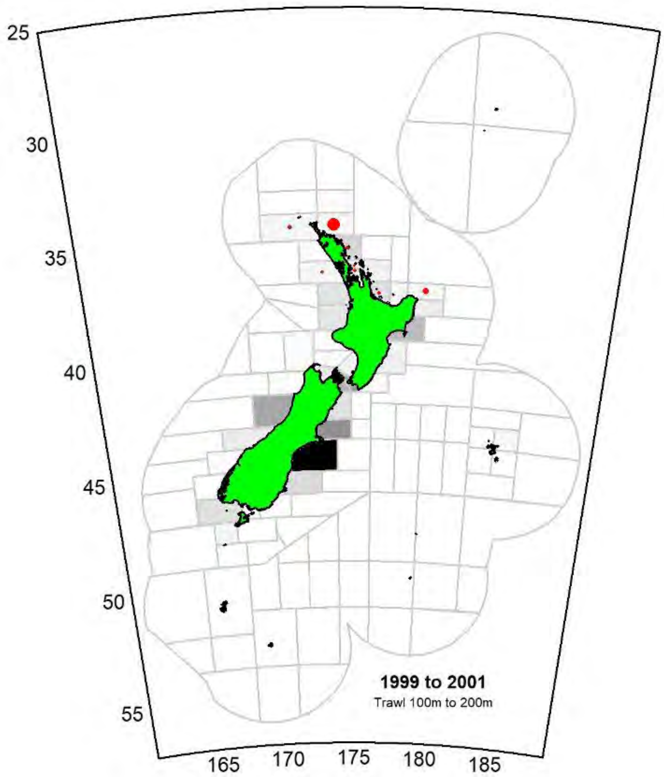
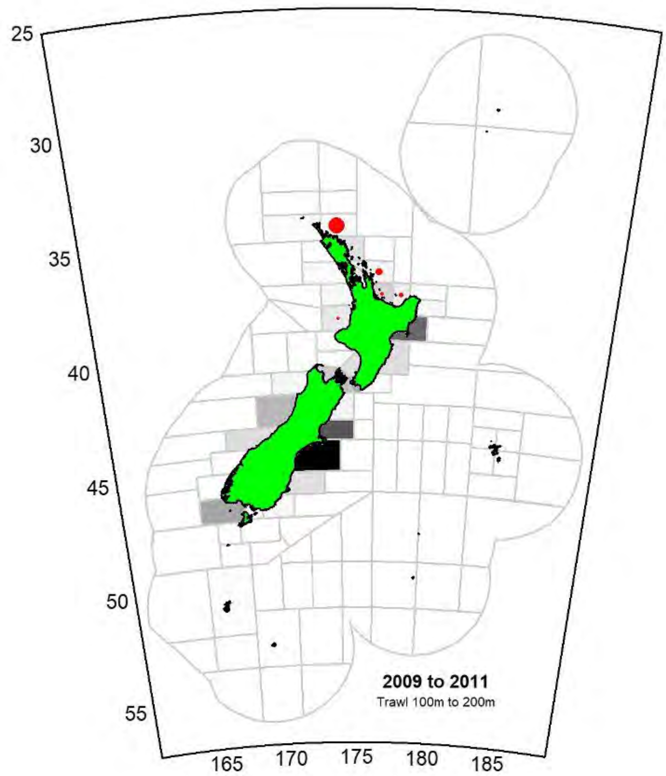


Figure 73.4: Maps of pink maomao occurrence in the commercial line catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).



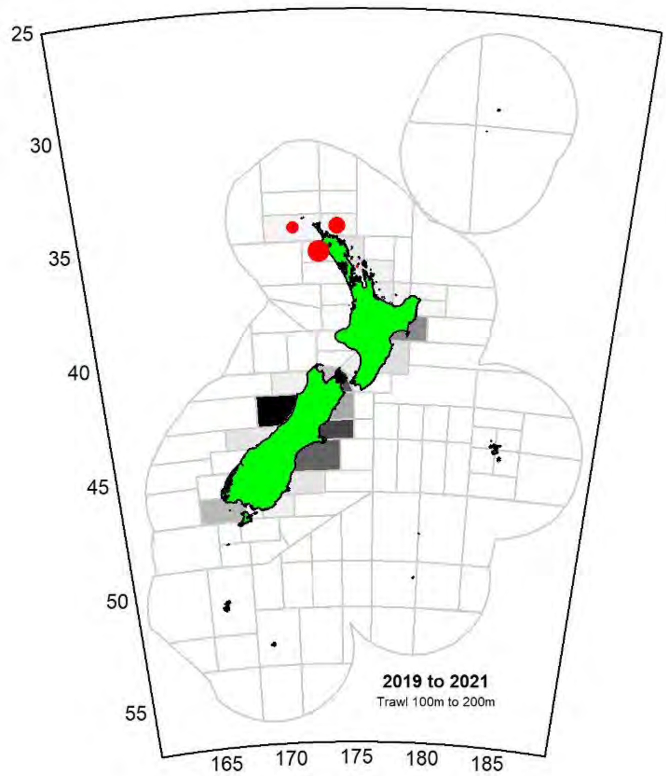


Figure 73.4 (cont.): Maps of pink maomao occurrence in the commercial line catch and effort data by statistical area and groups of years. Statistical areas are shaded according to the sum of events in that area (more events are shaded darker). Areas were only kept in the analyses when there were at least three events in that area. The red dots indicate the occurrence in each area, with larger dots indicating greater probability of occurrence (scaled by circle area). Fishing years labelled as year-ending (i.e., 1989 means 1988-89).