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EXECUTIVE SUMMARY

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***New Zealand Fisheries Assessment Report 2009/52.* 34 p.**

This report summarises the catch and bycatch data from three observer purse seine trips that targeted blue mackerel (*Scomber australasicus*), jack mackerels (*Trachurus* spp.), and kahawai (*Arripis trutta*) in 2006–07. It also summarises data on the bycatch of kingfish (*Seriola lalandi*) during 23 inshore trawl observer trips during the 2005–06 to 2007–08 fishing years.

The purse seine trips were on three different vessels: one targeted blue mackerel in Statistical Area 003 in FMA 1, one targeted jack and blue mackerels in Statistical Area 009 in FMA 1, and one targeted blue mackerel and kahawai in Statistical Area 040 in FMA 8. Of the 47 observed sets, 34 were on one vessel which landed the target school on 11 sets. Over all the observed purse seine sets, 38% landed the whole school (or close to), 4% landed about half the school, and 58% lost the catch. Blue mackerel lengths were centred around 44 cm in FMA 1 and 47 cm in FMA 8. *Trachurus novaezelandiae* measured from sets in FMA 1 peaked between 32 and 34 cm, whereas shorter lengths with a peak at 27–28 cm were measured for this species in FMA 8. Kahawai lengths from FMA 8 ranged from 44 to 54 cm, with a peak at 49 cm, and most barracouta from FMA 1 were between 73 and 81 cm. Barracouta was the most commonly caught bycatch species, but the catches per trip were less than 1000 kg. Of the remaining 11 bycatch species (excluding any jack mackerels or kahawai on blue mackerel sets), generally only a few individuals were caught. Few seabirds and marine mammals interacted with the fishing gear; a small pod of bottlenose dolphins (*Tursiops truncatus*) was caught and released alive from one set.

A summary of the kingfish bycatch in observer inshore trawl fisheries during 2005–06 to 2007–08 is provided. The target tows included in this investigation were primarily for red gurnard (*Chelidonichthys kumu*), John dory (*Zeus faber*), snapper (*Pagrus auratus*), tarakihi (*Nemadactylus macropterus*), and trevally (*Pseudocaranx dentex*). For the three fishing years, observers reported kingfish catch from 126 of the 536 observed tows. Catches ranged from 1 kg to 607 kg, with the largest catches reported from trevally tows in the Bay of Plenty in FMA 1. Smaller catches, generally less than 60 kg per tow, were reported from trevally tows along the coast in FMA 9. Catches of kingfish in tarakihi tows were from off the Wairarapa coast in FMA 2 (maximum 212 kg) and west of Farewell Spit in FMA 7. Catches during snapper tows were mainly reported from between 35° and 37° S. Length frequency distributions from 2005–06 varied according to the area in which fish were caught. Smaller fish (of 54–66 cm) were reported from FMA 7 and FMA 9 than from in FMA 2 (although this is based on 43–67 fish per area). The distribution of the 538 kingfish lengths measured from FMA 1 in 2006–07 suggests two modes, one centred at 52–56 cm and one at 62–72 cm. Lengths ranged from 41 to 111 cm for the 107 fish measured from FMA 9 and had a fairly flat distribution. In comparison, a set of kingfish lengths measured by observers on large foreign charter trawlers targeting mainly jack mackerels in offshore waters in FMAs 7–9 during the same years indicated that these vessels caught larger kingfish, especially in FMAs 7 and 8, north of 39° S. Kingfish catches were reported from at least one tow in each of the 36 observed trips on these vessels. Catches per observed trip ranged from 12 kg to about 10 500 kg (on two trips), and 87% of observed kingfish catches per tow were less than 100 kg. The largest observed catches per tow in each year ranged between 6750 and 8465 kg; these maximum catches were from tows that targeted blue mackerel, jack mackerels and barracouta in FMA 8.

1. INTRODUCTION

Observer data have been used in New Zealand commercial fisheries, principally in midwater and deepwater trawl and longline fisheries operated by larger vessels, to describe various characteristics of the catch and effort. These descriptions have covered fishing methods, environmental factors, target and nontarget catch information, and biological parameters of the catch. Little such information has been collected from fisheries that target coastal fish species and operate in more inshore waters. Recent Ministry of Fisheries (MFish) observer programmes (for example, OBS2004/05 and OBS2005/06) were set up to specifically target data collection from purse seine fisheries for tuna (primarily skipjack, *Katsuwonus pelamis*), kahawai (*Arripis trutta*), blue mackerel (*Scomber australasicus*), and pilchard (*Sardinops sagax*), as well as inshore trawl fisheries for trevally (*Pseudocaranx dentex*) where kingfish (*Seriola lalandi*) may be caught as bycatch. This observer coverage was planned to provide data to describe the non-target catch and fishery operations for the specified fisheries; to aid in the determination of future research programmes to underpin stock assessments and assessment of stock status in pelagic fisheries; and to assess the usefulness of the data collected and the method of collection.

Six purse seine trips were observed in the first years of this coverage and a summary of these trips indicated that vessels spent much of their time (when an observer was on board) searching for schools (in association with spotter planes), steaming to new grounds, or at anchor (Baird 2009). Fishing success on the earlier observed trips was vessel-specific. The skipjack season and market demand largely determine the effort in purse seine fisheries for species such as blue mackerel, jack mackerels (*Trachurus* spp.), and kahawai (Ministry of Fisheries 2008). The species targeted depended on the quota held and this posed problems in mixed schools (for example, of jack mackerel and kahawai) as often occurs with these species (Ministry of Fisheries 2008). Gear difficulties limited the efficiency of some operations and resulted in large losses on some sets. Few non-target fish were caught and fishing appeared to pose no danger to seabirds or marine mammals. Observers were new to purse seine fisheries and developed routines around each vessel's activities. Over the duration of the trips, the development of the data collection forms evolved through feedback from observers to Ministry of Fisheries officials and allowed a general description of the fishing operations in New Zealand waters (Baird 2009).

Another key aim of these observer projects was to ascertain the degree and composition of the bycatch of kingfish (*Seriola lalandi*) during inshore trawl activities. Kingfish are generally reported as bycatch from inshore trawl, longline, and setnet fisheries and were introduced into the QMS in October 2003. In October 2005, the species was added to the Sixth Schedule of the Fisheries Act 1996 for all methods except setnets; this allows the fishers to release live fish (Ministry of Fisheries 2009). Most catch is from KIN 1 & KIN 2 (FMA 1 & FMA 2). Baird (2009) reported that length data were collected from one observed trip only in 2004–05 (the first year of coverage specifically designed to collect these data); kingfish were between 50 and 130 cm long and similar numbers of males and females were caught. Observer data from all trawl effort in northern waters indicated that most of the observed catch of kingfish was from jack mackerel midwater tows made by large foreign trawlers off the North Island west coast.

This report summarises recent observer data collected in purse seine fisheries and observed trawl fisheries with kingfish bycatch under the project PEL200802 specific objectives — *to characterise the operation of the fishery and describe the non-target bycatch in the following pelagic fisheries: the blue mackerel fisheries based on observer data collected during 2005/06 and 2006/07; and the kingfish trawl bycatch fishery based on observer data collected during 2005/06, 2006/07, and 2007/08.*

2. OBSERVER DATA COLLECTION FROM PURSE SEINE VESSELS, 2006–07

The collection of observer data from purse seine fisheries in New Zealand waters was initiated in 2004–05 to collect specified data to *describe the catch (including discards/bycatch) in the JMA, EMA, and tuna fisheries; to characterise the SKJ, PIL, and EMA fisheries; and to collect biological data about JMA, EMA, tuna, and other species as directed, from their respective fisheries. The directive is to provide "exploratory coverage of fishery characterisation", and the data is "not intended to provide a statistical sample"* (MFish Data Management Group documentation). Based on the available data, this report presents a summary of observer data collection for the observed purse seine effort for blue mackerel, jack

mackerels, and kahawai in 2006–07. A description of the main data fields reported on here is given below. Baird (2009) discussed the development of the forms and fields required under this data collection.

2.1 Purse seine data collection

Observers are required to fill out forms that relate to the fishing activity: a purse seine catch effort logbook and an activity log. Data collection for the set catch and effort included the date, position, target, spotter plane details, environmental data (sea state and temperature), time of all aspects of the fishing operation, and catch details (including losses). Codes were provided to describe the method of assessing catch (and loss). The activity log collected data on specific activities during the fishing trip (such as steaming and searching) and their duration. As with all MFish observer data collection, these forms were supplemented with diary entries which described aspects of the fishing that were not readily captured in observer logbooks, and a trip report documented the trip summary at the return of the observer. The observer forms were linked to the MFish catch and effort forms with the provision on the *Purse seine catch effort set details* form for recording the Catch Effort Landing Return form number. These observer data were loaded into the MFish *cod* database.

Observers reported vessel data, including specifications of the vessel, its storage capacity, and the gear used throughout the operation, and spotter plane details, where relevant. Data for all sets observed were recorded, regardless of the outcome. The start of a seining operation was determined by the time the skiff and the net were deployed. The start time for the main purse seine activities: set start — when skiff was unloaded; pursing — beginning (winch on) and end (rings up); net rolling — when the net was gathered to confine the catch to the bunt end; net sacking — when the catch was concentrated next to the hull; brailing — beginning and end of loading the catch onto the vessel; and set end — when the skiff was on board.

If the vessel was unable to secure any catch, the set was reported as *skunked* and the observer noted the parts of the process that were not achieved. Catch details included estimates of the total greenweight at the surface and on board; total losses and loss event; type of brail used; and the calculated greenweight of each species and the processed state (though most are landed *green*). Incidental captures of marine mammals and seabirds and observations of their activity around the vessel were recorded, as was compliance with the voluntary code of practice relating to the presence of dolphins.

Methods for summarising observed purse seine data

All available data were extracted from the MFish *cod* database as the basis for the description of the observed purse seine trips. The database was under construction during the time these data were extracted and some time was involved in checking any inconsistencies by comparing the database records with trip reports and with the catch details reported on the commercial effort forms. Comments from observer trip reports are used for further information and clarification. Specific practices used during purse seining were described by Baird (2009).

2.2 Purse seine observations, 2006–07

This project defines blue mackerel as the target species for investigation in Objective 1. The blue mackerel purse seine fishery in FMA 1 (fishstock EMA 1) accounted for 92% of the blue mackerel landed in 2004–05 (Manning et al. 2007), and in 2004–05 and 2006–07 the Total Allowable Commercial Catch of 7630 t was exceeded by the purse seine fishery in EMA 1 (Ministry of Fisheries 2009). Often trips that target blue mackerel also target jack mackerels and kahawai. Observed trips in 2005–06 where these species were targeted were reported on by Baird (2009). Three observed purse seine trips with blue mackerel, jack mackerel, or kahawai as targets were completed in 2006–07, all on vessels of similar size, and the observers used the same forms that were developed from the exploratory observation work in 2004–05 and 2005–06. Thus, this report discusses these trips and does not report on any observed effort on purse seine sets targeted at skipjack tuna (covered under a separate MFish 'tuna' project). In this context, an 'observer trip' may consist of one fishing trip or several short trips with at least a night in port between trips. All observer data were extracted from the MFish *cod* database.

The main objective of this work is to describe the operation of the fishery and the nontarget catch. The next section considers the three observed trips in 2006–07 and describes the fishing operation and success, including the target school catch and all nontarget catch. Biological data collected on each trip are summarised for all species for which there were data. From the observer notes, the vessels fished in similar ways to those described by Baird (2009).

2.2.1 Observed blue mackerel trip, 2006–07 — trip 1

Fishing strategy. Trip 1 consisted of 34 blue mackerel sets made on 12 fishing days in Statistical Area 003 in FMA 1 over a 22-day period in October 2006. The location of effort and catches is shown in Figure 1, with effort located off Cape Brett to the north and near the Poor Knights Islands. Each set targeted a blue mackerel school of between 30 and 200 t in depths of 57–232 m where sea surface temperatures were generally between 16.5 and 18 °C. Weather conditions were generally at 1 or 2 on the Beaufort scale, at most a light breeze and ripples without crests on the sea surface. All sets were made on schools that were reported as "boil ups" (that is, localised sea turbulence); although the 35 m vessel was working in association with spotter planes, 28 schools were spotted by the vessel crew and 6 by pilots.

Generally, three daylight sets were made per fishing day, with a maximum of five sets in one day. Fishing marks were spotted by plane or by crew member and the skipper directed setting from the crow's nest. The vessel did not have a skiff and used thrusters to set around the school.

The vessel's net and mesh measurements provided by the observer are given in Table 1. Setting took 4–6 minutes. Next the net was pursed by winching the ground wire (10–20 minutes). If the float line was sinking, pursing would be paused to allow the floats to rise and thus prevent fish loss. Once the net was pursed, one or two ground wire clips were raised for security, and the net was rolled by hauling through the triplex (triple roller net winch) onto the net pile at the stern. Net sacking pulled in the bottom of the net, brought it on deck and forced the school to a ball on the surface. It took between 47 and 107 minutes to purse, roll, and sack the nets and between 13 and 102 minutes to brail the catch onboard (Figure 1.1 in Appendix 1). Brailing was by scoop, and the average brail was about half the capacity of the 2 t scoop, though the amount brailed each time was quite variable. The vessel did not always brail a set with a small catch. Instead the bunt end of the net was emptied directly onto the deck.

The vessel fished with up to five vessels in the vicinity; one vessel set at a time, with competition for the school. If one vessel skunked a set, another would set on the school. The vessel followed all the voluntary codes of practice, including the codes relating to the no-fishing zone off Cape Brett lighthouse and the Poor Knights Islands.

Marine mammals and seabirds. Around Cape Brett, about 20 bottlenose dolphins (*Tursiops truncatus*) were seen during the trip, mostly at a distance from the vessel. Schools with associated dolphin activity were not targeted by this vessel; however, one set caught five bottlenose dolphins during setting and at the end of pursing five ground wire clips were released at the bunt end to give a 10 m escape hole. The net was rolled and the resulting constriction forced the dolphins to swim out along with the school of blue mackerel. About 100 Buller's shearwaters (*Puffinus bulleri*) attended the vessel during fishing activity in the Cape Brett area, with small numbers of giant petrels (*Macronectes* spp.). One giant petrel was caught in the net during net rolling when the net was in the water for longer because it had rolled up completely. Once released, it flew away. Some storm petrels found wet on the deck, after probably being attracted by lights, were released later, warm and dry.

Observer data collection. Greenweight was assessed from counts and species compositions in the brail scoops. The observer noted that the large scoop size (1–2 t) made this difficult, and there was no room to safely watch the scoop being emptied. The estimated count was calibrated using the level of fish in the designated hold based on comprehensive data sheets provided by the vessel on fill levels and fish weights. Finally, to further check the greenweight estimate (all fish were packed green), the port-unload figures were consulted and compared. Fork length measurements were made on jack mackerel and blue mackerel by choosing one brail scoop at random (100–150 fish) that was then emptied into a large plastic drum near the observer's work station. All fish bycatch were sampled.

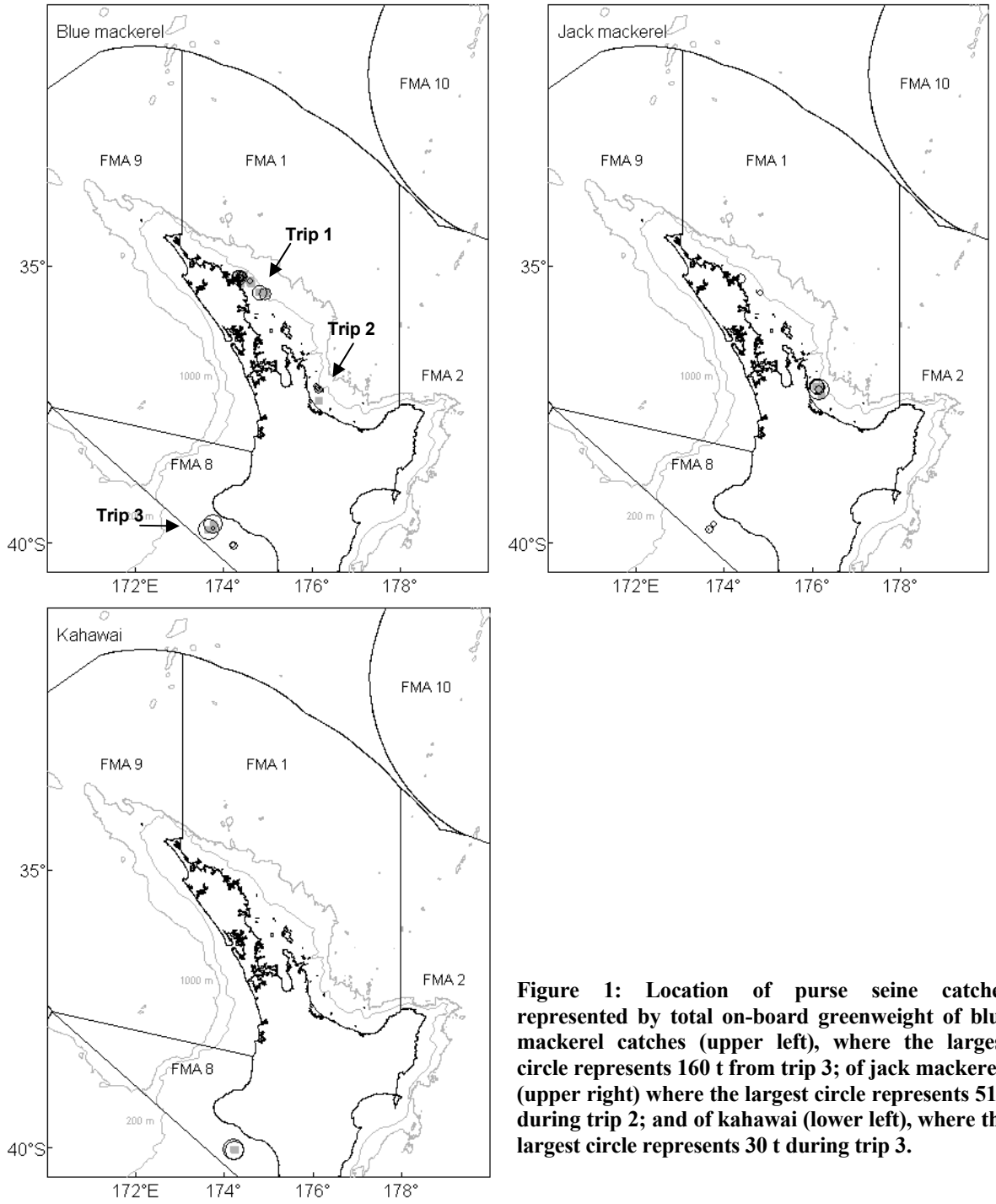

Figure 1: Location of purse seine catches represented by total on-board greenweight of blue mackerel catches (upper left), where the largest circle represents 160 t from trip 3; of jack mackerels (upper right) where the largest circle represents 51 t during trip 2; and of kahawai (lower left), where the largest circle represents 30 t during trip 3.

Catch summary. All or most of the catch was successfully brailed onboard on 11 sets and landed directly on deck on one set. Six of these sets caught the whole school and estimated greenweights of blue mackerel at the surface for these catches ranged from 30 to 145 t; more than half of the latter school was brailed onto another vessel. Losses of either blue mackerel or jack mackerel ranged from about 10% to 86% on the five other sets with some catch (Figure 2). Figure 1 shows locations of catches. The remaining 22 sets were unsuccessful: 20 sets were skunked, and 10 of these reported some small bycatch.

Estimated greenweights of the catch species by trip are given in Table 2. Barracouta (*Thyrsites atun*) was the most commonly caught bycatch species, with between 2 and 150 kg (estimated greenweight) of barracouta landed in 13 sets. Catches of other bycatch species were generally on one set; these species were skipjack tuna, frostfish (*Lepidopus caudatus*), slender tuna (*Allothunnus fallai*), leatherjacket (*Parika scaber*), unspecified wrasses, electric ray (*Torpedo fairchildi*), blue maomao (*Scorpis violacea*), pink maomao (*Caprodon longimanus*), and jellyfish.

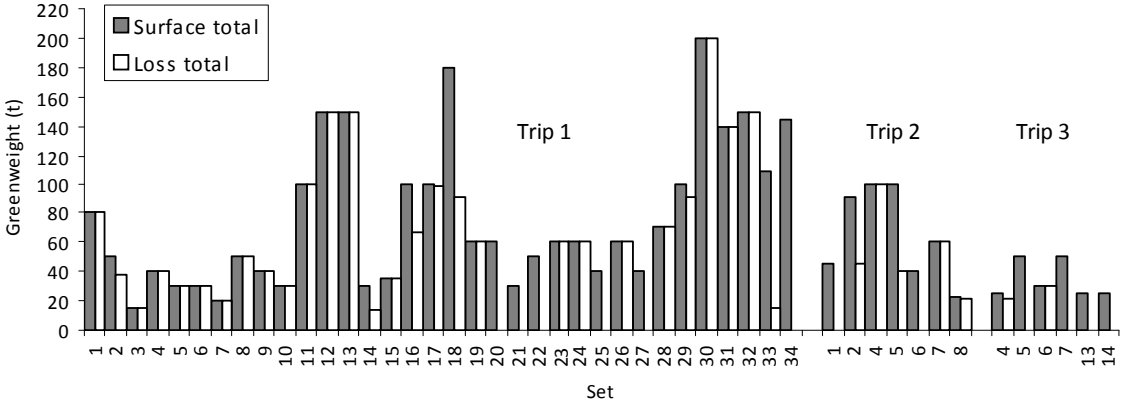

Figure 2: Estimated greenweight (t) of surface catch and catch loss for each set on the three observed trips in 2006–07 for those sets that targeted blue mackerel, jack mackerels, or kahawai.

Reasons for set failures included: vessel failed to completely encircle school; fish changed direction at start of setting; school escaped under net during setting, on one occasion as a result of net rolling up; school escaped during pursing (including one occasion when five bottlenose dolphins were released from the net); when seal scare explosives were used to scare fish away from under the boat; and part of the catch was lost when the school escaped during brailing. On one set, at the end of net rolling, 110 kg slender tuna were released by unclipping buoys and tuna swam away.

Length frequency data. Length frequency data were collected for blue mackerel, barracouta, jack mackerel, frostfish, slender tuna, and skipjack tuna (Table 1.2 in Appendix 1). Blue mackerel lengths ranged between 34 and 58 cm (Figure 3). Similar numbers of male and female blue mackerel were measured and males peaked at about 43–44 cm and females tended to be slightly longer with the peak about 43–47 cm. About 65% of the 115 jack mackerels (*Trachurus declivis*) measured were males and, apart from the peak at 36 cm (which is assumed to be correct), most males were between 41 and 43 cm long (Figure 4). Females peaked at about 41–43 cm. About 95% of the measured female blue mackerel and jack mackerel were recorded as having ripening gonads.

Table 1: Vessel and gear characteristics reported by the observer for blue mackerel, jack mackerel, or kahawai purse seine trips, 2006–07.

Trip	Net size	Mesh size	Scoops	Buoys	Sinkers	Holds
Trip 1 October 2006	750 x 60 m (7 panels)	5/6.4 cm main; 5 cm bunt	1–2 t	3000: 20x18 cm	59 CLIP: 25x15 cm; 5 kg	6 holds: 250 t
Trip 2 March 2007	680 x 90 m (20 panels)	2" main; 2" bunt	1.5 t (100 t/h)	2000 foam 9"	4350 lead 16 oz	4 holds: 180 t
Trip 3 April 2007	1064 x 73 m (8 panels)	5.5 cm (main); 5.5 cm (bunt)	1 t	3192 polystyrene floats 18 cm (500 g)	Chain sinkers	4 holds: 180 t

Table 2: Catch weight (kg) data by processed state from the observed trips in 2006–07 where the target species was blue mackerel, jack mackerels, or kahawai. [Table 1.1 in Appendix 1 gives species codes and scientific names.]

Trip target	Species	Greenweight (kg)	Discarded (kg)	Retained (kg)	Galley (kg)	Total (kg)
EMA	Barracouta	896	0	0	0	896
	Blue maomao	2	0	0	0	2
	Blue mackerel	492 131	8	4	0	492 143
	Electric ray	2	0	0	0	2
	Frostfish	80	0	0	0	80
	Jellyfish	0	10	0	0	10
	Jack mackerel (*T. declivis*)	17 503	0	0	0	17 503
	Leatherjacket	21	0	0	1	22
	Pink maomao	2	0	0	0	2
	Skipjack tuna	112	0	0	0	112
	Slender tuna	65	0	0	0	65
	Wrasses	15	0	0	0	15
	All	510 829	18	4	1	510 852
JMA/EMA	Blue mackerel	77 000	0	0	0	77 000
	Flying fish	10	0	0	0	10
	Jack mackerel (*T. novaezelandiae*)	113 000	0	0	0	113 000
	Skipjack tuna	35	0	0	0	35
	Striped marlin	0	150	0	0	150
	All	190 045	150	0	0	190 195
EMA/KAH	Barracouta	550	0	0	0	550
	Blue mackerel	179 000	0	0	0	179 000
	Jack mackerel (*T. declivis*)	4	0	0	0	4
	Jack mackerel (*T .murphyii*)	2	0	0	0	2
	Jack mackerel (*T. novaezelandiae*)	7 030	200	0	0	7 030
	Kahawai	42 000	0	0	0	42 000
	Squid	0	0	0	3	3
	All	228 586	200	0	3	228 789

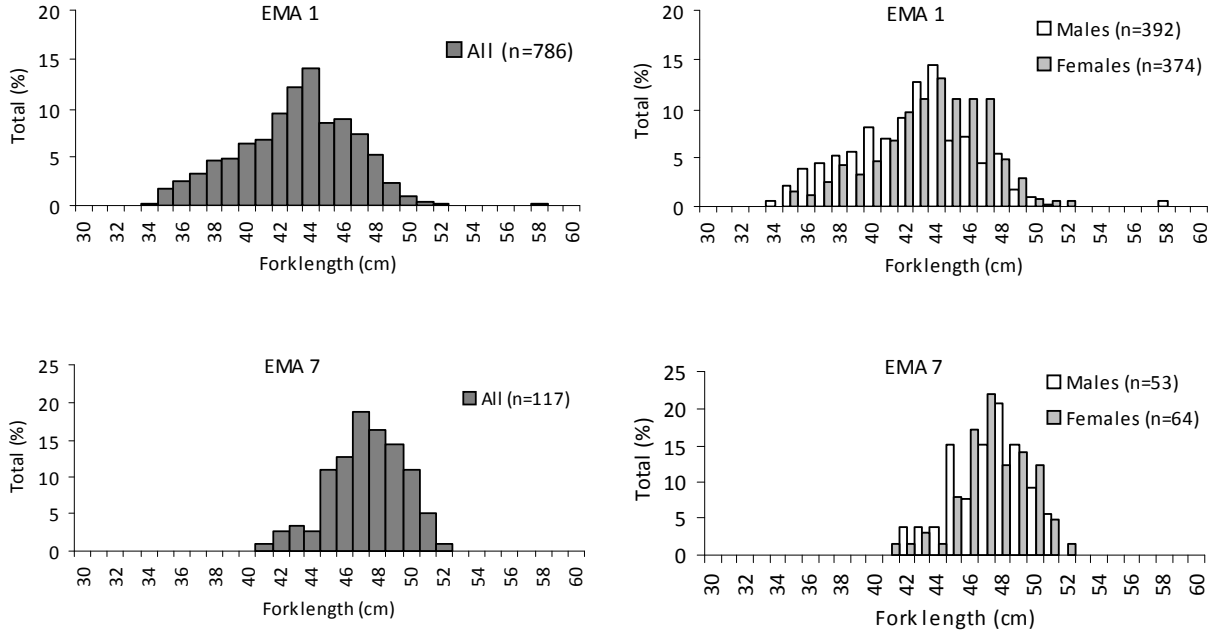

Figure 3: Length frequency distribution of blue mackerel (EMA) sampled from each observed trip in 2006–07. EMA 1 is equivalent to FMA 1, and EMA 7 (trip 3 only) includes FMAs 7–9.

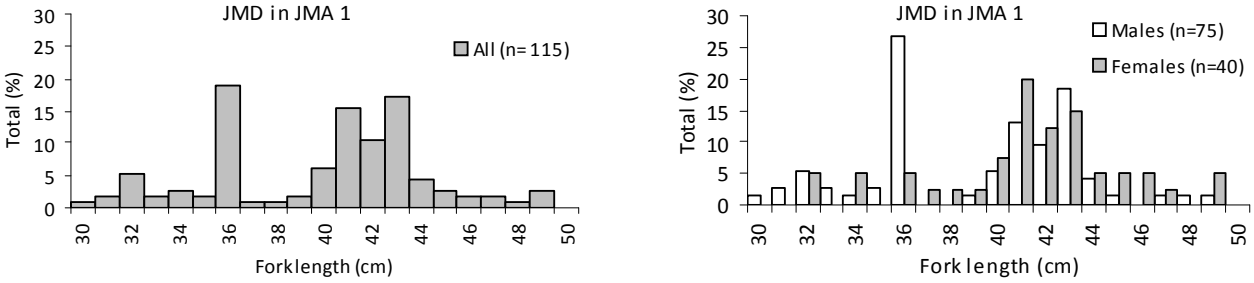

Figure 4: Length frequency distributions of all jack mackerel (*T. declivis*) (left) and males and females (right) sampled from Trip 1. JMA 1 is equivalent to FMAs 1 & 2.

2.2.2 Observed blue mackerel/jack mackerel trip, 2006–07 — trip 2

Fishing strategy. Trip 2 targeted jack mackerel on six sets, blue mackerel on one set, and skipjack tuna on two sets over eight days on two separate fishing trips in the Bay of Plenty in Statistical Area 009 during March 2007 (see Figure 1). Fishing took place in 40–130 m in waters with sea surface temperatures of 20.9–21.7 °C in Beaufort conditions of 2 or 3 (light-gentle breeze with small-large wavelets). Schools were located by a spotter plane, from the crow's nest, or with sonar. Of the four mackerel schools detected by the spotter plane, three were seen beneath the surface and one was a 'boil up', and the other three mackerel schools were seen by the vessel, one as beneath the surface and two as 'boil ups'.

The vessel's net and mesh measurements provided by the observer are given in Table 1. Other than the one net set during mid morning, all sets started between about 1430 and 1830 h and fishing was generally completed by about 2000 h. Three sets were made on one day, and single sets on the remaining days. The net size and mesh measurements provided by the observer are given in Table 1. The fishing operation from pursing the net through to net sacking generally took about 65–78 minutes, and brailing by scoop took 24–48 minutes (Figure 1.1 in Appendix 1). The vessel followed the voluntary codes of practice relating to exclusion zones and marine mammal activity. Some fishing was restricted by a game fishing competition.

Marine mammals and seabirds. Common dolphins (*Delphinus delphis*) were sighted around the vessel on four occasions, in pods of about 6–12 animals, but did not interact with the vessel during fishing. Birds numbered between 0 and 50 at first daybreak sets (average of 20), with 40% "seagulls", 20% flesh-footed shearwaters (*Puffinus carneipes*), 20% black petrels (*Procellaria parkinsoni*), 7% gannets (*Morus serrator*), and another 13% assigned an "unknown" code. Birds generally flew away during setting and pursing, but occasionally returned during net rolling and pumping to feed on krill and "floaters". All catch was packed green, so there was little fish waste.

Observer data collection. Catch greenweight was assessed as the catch was pumped on board. The skipper estimated the percentage composition of major species, jack mackerel, and blue mackerel, by eye. An estimate of the proportion of the hold taken by the catch was made by observer and skipper or engineer. The percentage composition by species was applied to the estimated total greenweight onboard to get species weights for jack mackerel and blue mackerel. Estimates were by eye for some minor bycatch species during pumping (for example, flying fish); by counts of fish x estimated fish weight (striped marlin, *Tetrapturus audax*); or by bin count x estimated bin weight (skipjack tuna). Catch losses during setting or pursing were calculated by subtraction of the species greenweight onboard from the original estimate of greenweight (for example, by the spotter plane pilot).

Fork length measurements of 100 fish of the target species and biological data collection of 20 fish of bycatch species were completed on the first successful set of each day. Biological samples were collected by placing a bin under the hold-filling chute during fish pumping. Three samples of about 40 kg were taken at 15 minute intervals during pumping. Each sample was sorted by species and subsamples of 100 fish and 20 bycatch fish were taken.

Catch summary. Three sets with schools with estimated greenweights of 22 000 kg, 60 000 kg, and 100 000 kg were skunked (see Figure 2). These unsuccessful sets occurred when the school was lost at the start of the set, during net rolling, or during pursing. Two sets caught the whole school: one with an estimated greenweight of 45 000 kg (similar amounts of jack mackerel (identified as *T. novaezelandiae*) and blue mackerel) and the second 40 000 kg school was also mixed but contained mainly jack mackerel. Two further sets that targeted mackerels lost 40% and 50% of schools estimated at 100 000 kg and 90 150 kg respectively. The location of target catches is shown in Figure 1. Small catches of flying fish (species unidentified), skipjack tuna (*Katsuwonus pelamis*), and slender tuna (*Allothunnus fallai*) were made on three sets (see summary data in Table 2).

Length frequency data. Length frequency data were collected from 47 blue mackerel and 201 jack mackerel over three sets. The blue mackerel lengths were within the range seen from the larger sample measured during trip 1 (see Figure 3). In the jack mackerel sample, the number of females measured was twice that of males (Figure 5); the distributions are similar. About 95% of female blue mackerel and jack mackerel were recorded as having maturing gonads.

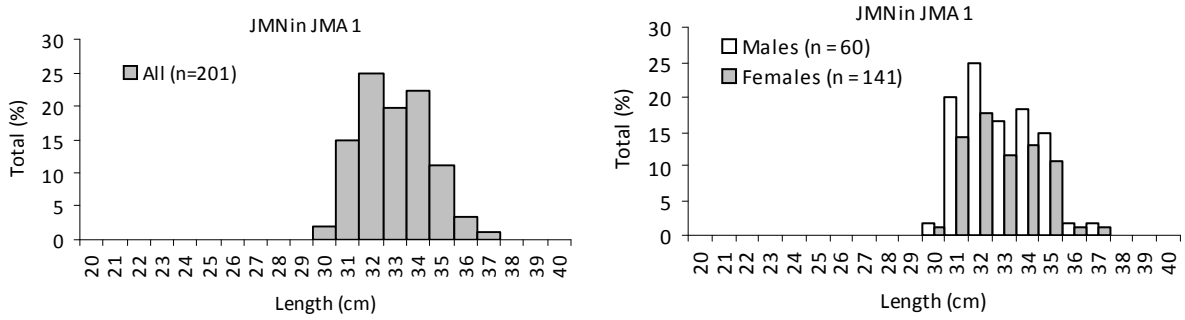

Figure 5: Length frequency distribution of jack mackerel (*T. novaezelandiae*) sampled from Trip 2.

2.2.3 Observed blue mackerel/kahawai trip, 2006–07 — trip 3

Fishing strategy. This observer trip included four fishing trips, but only two included purse seine sets. All were in southern waters of FMA 8 (see Figure 1). Purse seine nets for blue mackerel and kahawai were set during daylight hours and fishing began between about 0840 and 1800 h and was usually completed by 2000 h. Weather conditions were never greater than Beaufort scale of 2, with several sets made in flat calm conditions, and sea surface temperatures were between 16 and 17 °C. A total of six sets targeted these species in 67–88 m. The vessel's net and mesh measurements provided by the observer are given in Table 1. The time taken to complete a set to the end of net sacking took between 57 and 84 minutes and another 26–57 minutes were taken to brail the catch (Figure 1.1 in Appendix 1). Up to five vessels fished nearby, but the observer noted that this did not affect catch rates.

Observer data collection. All fish were packed green. Catch quantification was completed at the end of each set as the catch was brailed or pumped and counts of each brail or total running time of the fish pump were used to calculate catch. For the main target species, the greenweight assessment was initially made by the pilot (tonnage and species composition). Target greenweight calculations were made by multiplying the time taken to pump the catch onboard in minutes by the average estimated weight per minute. Fish samples were weighed using motion-compensating scales. Samples were collected from two or three brails per catch. Fork length measurements were taken for blue mackerel, jack mackerel, and kahawai.

Marine mammals and seabirds. No marine mammals were sighted. Few seabirds were in the vicinity, with small numbers of the following species reported by the observer: gannets, fairy prions (*Pachyptila turtur*), white-capped albatross (*Thalassarche steadi*), and unspecified petrels. Seabirds were mostly uninterested in the fishing operations.

Catch summary. Of the four blue mackerel sets, two landed the full catch, and in both blue mackerel accounted for about 95% of the estimated greenweights of 75 200 kg and 84 253 kg. The other two blue mackerel sets were less successful, with one school (estimated at about 30 000 kg) skunked and 4000 kg of blue mackerel landed from an estimated 25 000 kg school (see Figure 2). Two sets targeted kahawai and caught mixed schools of kahawai and blue mackerel, with no losses: of an estimated 41 000 kg school, an estimated 30 000 kg of kahawai and 11 000 kg of blue mackerel were landed and the second school of about 24 000 kg comprised an estimated 12 000 kg of blue mackerel and 12 000 kg of kahawai. Bycatch species in these sets included barracouta, jack mackerel species, and squid (see Table 2).

Length frequency data. A total of 45 jack mackerel (*T. novaezelandiae*) from one set, 117 blue mackerel from two sets, and 89 kahawai from one set were measured and length frequency distributions are shown in Figures 3 and 6. Most females of these species were recorded as having gonads that were immature or resting.

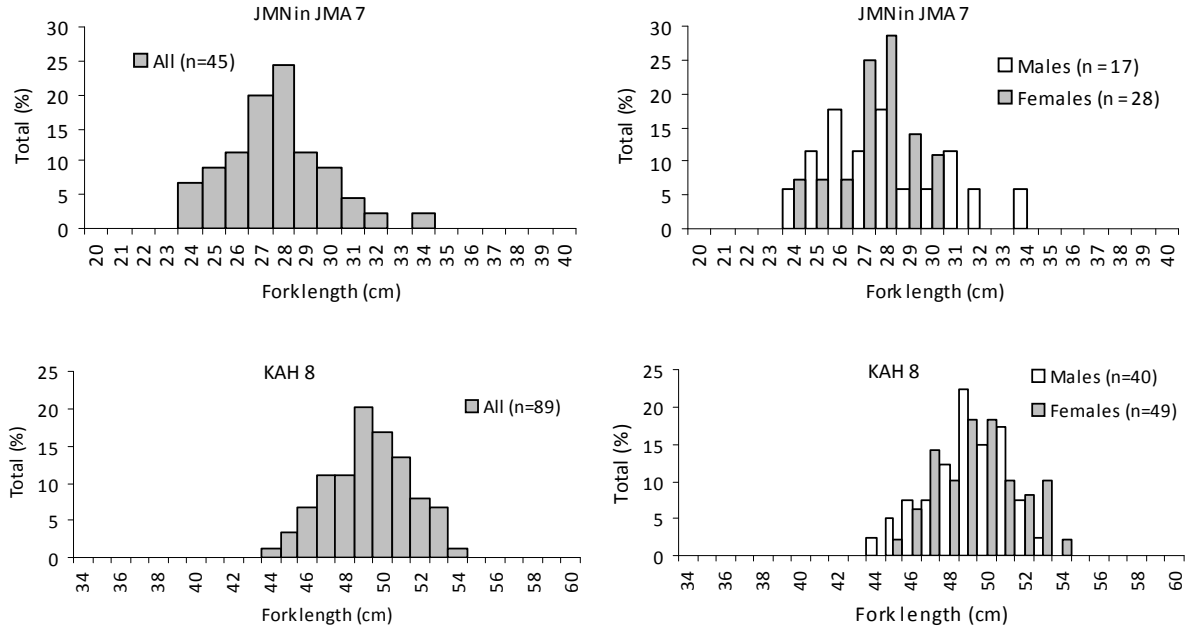

Figure 6: Length frequency distribution of *T. novaezelandiae* and kahawai sampled from Trip 3.

2.3 Non-target bycatch in observed purse seine fisheries, 2006–07

Generally, if a purse seine set was successful, the catches were reasonably clean, with either a school of one species or mixed schools (for example, blue mackerel and kahawai or blue mackerel and jack mackerel). Observed catches of the target school and associated species are given in Table 1.2 in Appendix 1 for each trip. Most fish were kept green and small amounts of nontarget species were discarded, retained, or used in the galley. Nontarget species were reported from nets that had lost the target catch.

A larger diversity of species was reported from the first trip and the target on all sets was blue mackerel. With 34 observed sets, this trip accounted for 72% of the observed effort. Barracouta was the most commonly caught nontarget species, with catches of between 20 and 150 kg per set reported from 13 sets. Other nontarget species were caught on one set only: blue maomao, pink maomao, electric ray, frostfish, jellyfish, squid, and skipjack tuna. Several sets caught small amounts of unspecified wrasses, slender tuna, and leatherjacket. Sets with nontarget catches were generally in waters 50–100 m deep close inshore just south of 35° in FMA 1 (Statistical Area 003). Sets with jellyfish, electric ray, and skipjack tuna were in over 100 m deep waters further offshore. Slender tuna were reported from sets in both depths.

On the second trip in the western Bay of Plenty in Statistical Area 009, the major catch species (blue and jack mackerels) were caught as mixed schools on four sets. Three nontarget species were recorded from this trip, with small amounts of striped marlin and flying fish caught on different sets, but both caught with

mixed blue mackerel and jack mackerel schools of about 45 t, made in depths of 93–130 m. The set with a small catch of skipjack tuna was a skunked set made in about 40 m.

Barracouta catches of 50–200 kg were made on the three sets that caught blue mackerel (2000–80 000 kg), with small catches of *T. novaezelandiae* (2000 and 4200 kg) on two of the sets. Barracouta, *T. declivis*, and *T. novaezelandiae* were the only catch from one skunked school. All catches were made in depths of about 67–88 m. The small amount of squid was caught in association with the large school of blue mackerel (80 000 kg). The kahawai targeted schools were mixed schools of kahawai and blue mackerel.

Length frequency data were collected for the following nontarget species: barracouta (n = 64), frostfish (n = 14), slender tuna (n = 6), and skipjack tuna (n = 6). Barracouta were from five sets on Trip 1 and ranged between 68 and 87 cm in length, with 72% between 73 and 81 cm (Figure 7). The 29 female barracouta were staged: 11 were immature or resting (70–83 cm), 13 were maturing (71–85 cm), and 5 were mature fish (68–83 cm). Frostfish from one set in the same area were between 103 and 118 cm. The slender tuna were caught in about 130 m and measured between 71 and 84 cm. Skipjack tuna were from Trip 1 and were 62–76 cm long.

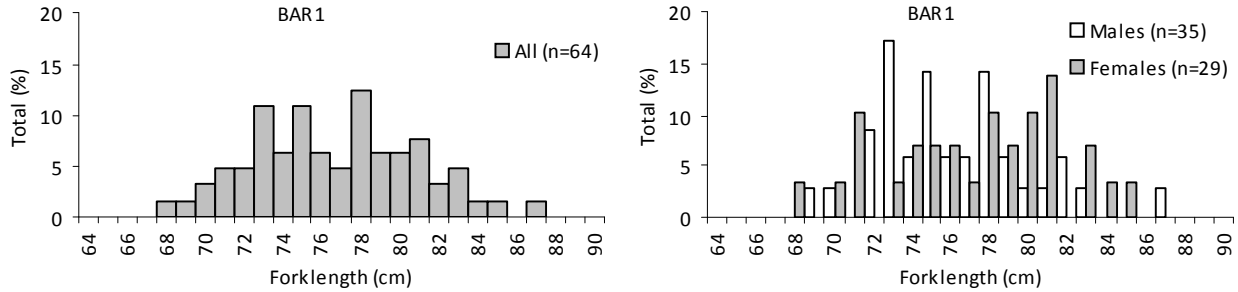

Figure 7: Length frequency distribution of kahawai sampled from Trip 3. All fish were from one set.

3. KINGFISH BYCATCH DURING OBSERVED TRAWLS, 2005–06 TO 2007–08

Observer datasets were extracted from the MFish database *cod* where observed fishing trips targeted inshore trawl fisheries, mainly for John dory (*Zeus faber*), red gurnard (*Chelidonichthys kumu*), snapper (*Pagrus auratus*), tarakihi (*Nemadactylus macropterus*), and trevally (*Pseudocaranx dentex*) during 2005–06, 2006–07, and 2007–08. The observed data extracts included catch weight, length measurement, and processed state data relating to kingfish bycatch. Kingfish greenweights reported here were estimated by the observers.

Data were groomed for obvious outliers or typographic or punching errors and amended where possible. The position data for all observed tows were plotted and observed tows that targeted deepwater targets (mainly orange roughy, *Hoplostethus atlanticus*) and tows that targeted ling (*Genypterus blacodes*) in deeper waters were deleted from the final observed datasets. From a total of 24 trips over the three fishing years, 23 trips were retained. This gave a total of 536 tows for inshore target species. Several position data were amended because the given latitude and longitude values were beyond sensible distances from nearby tows, did not match the depths fished, or were on land. The truncated position values available in *cod* result in some of the shallow positions close inshore appearing to occur very close to (or on) the coast. All but two of the observed tows had 'BT' code for bottom trawl gear. The headline heights recorded for the two tows that were coded with 'MW' for midwater trawl gear were very small and thus, in consideration of the target species and the depth fished, these gear records were considered incorrect and amended to 'BT'. Two tows with kingfish length frequency records had no kingfish catch weight data.

Observers have previously collected length data on kingfish caught during midwater trawl effort by large vessels off the west coast of the North Island (Baird 2009). To complement the inshore trawl kingfish data, a second dataset was extracted from *cod* for observed effort on seven large foreign chartered trawlers that fished primarily for jack mackerels. The effort for these vessels was confined to FMAs 7, 8, & 9

(equivalent to JMA 7) for 2005–06 to 2007–08. A similar grooming process to that described above was undertaken and a total of 36 trips were included.

3.1 Observer coverage on inshore vessels

3.1.1 2005–06

In 2005–06, observers were placed on three inshore trawlers and observed 107 tows that targeted snapper (FMAs 1 & 9), tarakihi (FMAs 2, 7, & 9), or trevally (FMA 9) (Table 3). Observed snapper tows were in December and January off the east and west coasts of the North Island between 36° and 37° S in 30–100 m depths (Figure 8). Tarakihi was targeted in FMA 9 in January in 135–180 m, FMA 2 in July in 100–174 m, and FMA 7 in August in 82–116 m. Observed tows that targeted trevally were in December and January in FMA 9.

Observers on all three vessels reported kingfish bycatch, but kingfish catches were reported from tarakihi and trevally observed tows only; none were reported from observed snapper tows (Table 2.2 in Appendix 2). Larger kingfish catches were reported from tows with under 5000 kg total greenweight (all species) (Figure 2.1 in Appendix 2). About 50% of the observed tarakihi tows had no reported kingfish catch, 19% had catches under 20 kg, 19% had 20–99 kg catches, and 12% had 100–212 kg per observed tow. The catches were reported from tows made between about 40°–41° S off the Wairarapa coast in FMA 2 and west of the tip of the South Island in FMA 7, in waters of less than 150 m (Figure 8, Figure 2.2 in Appendix 2). Kingfish catches in observed trevally tows were reported from 38% of tows; 22% had catches of under 20 kg and 16% had catches of 20–80 kg per tow. Catches were reported from trevally tows in depths of under 100 m (see Figure 2.2).

3.1.2 2006–07

Observers were placed on 11 vessels (13 trips, 281 observed tows) in 2006–07 (Table 3). About 45% of the 281 observed inshore tows were during March and April in FMA 1 where the main targets were John dory, tarakihi, and trevally (Table 2.3 in Appendix 2). About 30% was in FMA 9 mainly targeting red gurnard, snapper, and tarakihi during October, February–April, and June. Most of the remaining effort took place in waters south of 40° S mainly for tarakihi in depths of 48–156 m in FMA 3 during August–September and in 40–240 m depths in FMA 7 during February–April (Figure 8, Table 2.3 and Figure 2.2 in Appendix 2). The few observed tows off the coastline in the northwest section of FMA 5 were part of the trip that fished in the southern waters of FMA 7. A few red gurnard tows were observed in FMA 8.

Observers on six of the vessels reported kingfish bycatch. Small catches of kingfish were reported from most of the observed effort in FMA 1 where the targets were John dory and snapper (Table 2.3). Trevally tows accounted for most of the kingfish catch in this area, with the largest catches of 288 kg and 607 kg per tow during March in the western Bay of Plenty at around 37° S.

The largest catch was reported from the deepest tow at over 150 m (Figure 2.2). Overall, 58% of the 59 observed trevally tows, 22% of the 32 snapper tows, 20% of the 20 red gurnard tows, 14% of the 63 John dory tows and 1% of 91 tarakihi tows had kingfish bycatch. Catches in observed red gurnard, John dory, and snapper tows were between 3 and 45 kg. The one tarakihi tow with kingfish (10 kg) was in FMA 2 and from the same trip as the trevally tows with large kingfish catches.

3.1.3 2007–08

In 2007–08, observers were placed on six vessels (eight trips) and reported 148 tows for inshore target species. About 35% of observed fishing was during October–November in FMA 7 where tarakihi (in 155–200 m) and flatfish (in 28–35 m) were the main targets. Another 35% was in FMA 9 in October–November, mainly for snapper in 40–70 m and in May for John dory and red gurnard in 35–60 m. The rest of the observed effort was mainly in FMA 1 in September for snapper (in 43–55 m), trevally (in 50–130 m), and tarakihi (150–160 m).

Observers on two vessels reported kingfish bycatch: one fishing in FMA 1 and the other in FMA 9. Catches were reported mainly from snapper tows in under 50 m and trevally tows in 46–130 m. The largest catches were from snapper tows (101 kg in November in FMA 9 and 68 kg in FMA 1 in September). Catches in trevally tows were small, with a maximum of 25 kg per tow (Figures 2.1 & 2.3).

3.1.4 Processed state of observed kingfish

Processing data were available for kingfish caught on all three observed trips in 2005–06 and the six trips in 2006–07, but not for the 2007–08 trips. The processing data for two records (tows) were unable to be reconciled between the database tables and are not included in this summary (total of 23 kg). The processing group numbers matched the tow numbers so it was straightforward to link processing details to the tow record. For all the data for the two fishing years, 41% of the 96 observed tows with kingfish kept fish whole and 22% discarded the entire kingfish catch. Thus, 61% of the total calculated greenweight for these nine trips (3602 kg) was kept unprocessed (green), 39% was discarded, and a very small percent was kept for the galley.

Table 3: Details for observed trips on inshore trawlers that caught kingfish (KIN) during 2005–06 to 2007–08. Trips 7 and 21 are the same observer trip (straddled the 2006–07 and 2007–08 fishing years). Species codes are given in Table 2.1 in Appendix 2.

					Total tows		KIN
Trip	Month	Area	Target	Gear	No.	% with KIN	(kg)
2005–06							
1	Dec	FMA 9	SNA, TRE	BT	23	9	6
2	Jul, Aug	FMA 2, 7	TAR	BT	30	53	860
3	Dec, Jan	FMA 1, 9	SNA,TAR,TRE	BT	54	44	597
2006–07							
4	Mar, Apr	FMA 1	GUR,JDO,TAR,TRE	BT	78	17	175
5	Sep	FMA 3	SPD, TAR	BT	14	0	0
6	Jun	FMA 1	SNA	BT	2	50	5
7	Sep	FMA 8	GUR	BT	2	0	0
8	Aug	FMA 3	TAR	BT	13	0	0
9	Jun	FMA 9	GUR,TAR,TRE	BT	7	0	0
10	Mar	FMA 9	GUR,TAR,TRE	BT	14	36	112
11	Feb–Apr	FMA 7	STA,TAR	BT	26	0	0
12	Feb	FMA 3, 5, 7	TAR,WAR	BT	18	0	0
13	Mar–Apr	FMA 1, 9	JDO,RBY,SNA,SQU,TAR,TRE	BT	52	40	1 377
14	Oct	FMA 9	SNA,TRE	BT	38	37	420
15	Feb	FMA 9	SNA,TAR,TRE	BT	16	6	21
16	Oct	FMA 9	SNA	BT	1	0	0
2007–08							
17	Nov	FMA 9	SNA	BT	9	22	23
18	May	FMA 9	FLA,GUR,JDO	BT	17	0	0
19	Oct	FMA 9	SNA	BT	26	31	177
20	Oct-Nov	FMA 7	FLA,TAR	BT	28	0	0
21	Oct	FMA 7,8	BAR,GUR,TAR	BT	12	0	0
22	Sep	FMA 1	SNA,TAR,TRE	BT	39	49	240
23	Oct	FMA 7	GSH,GUR,SNA,TAR	BT	17	0	0

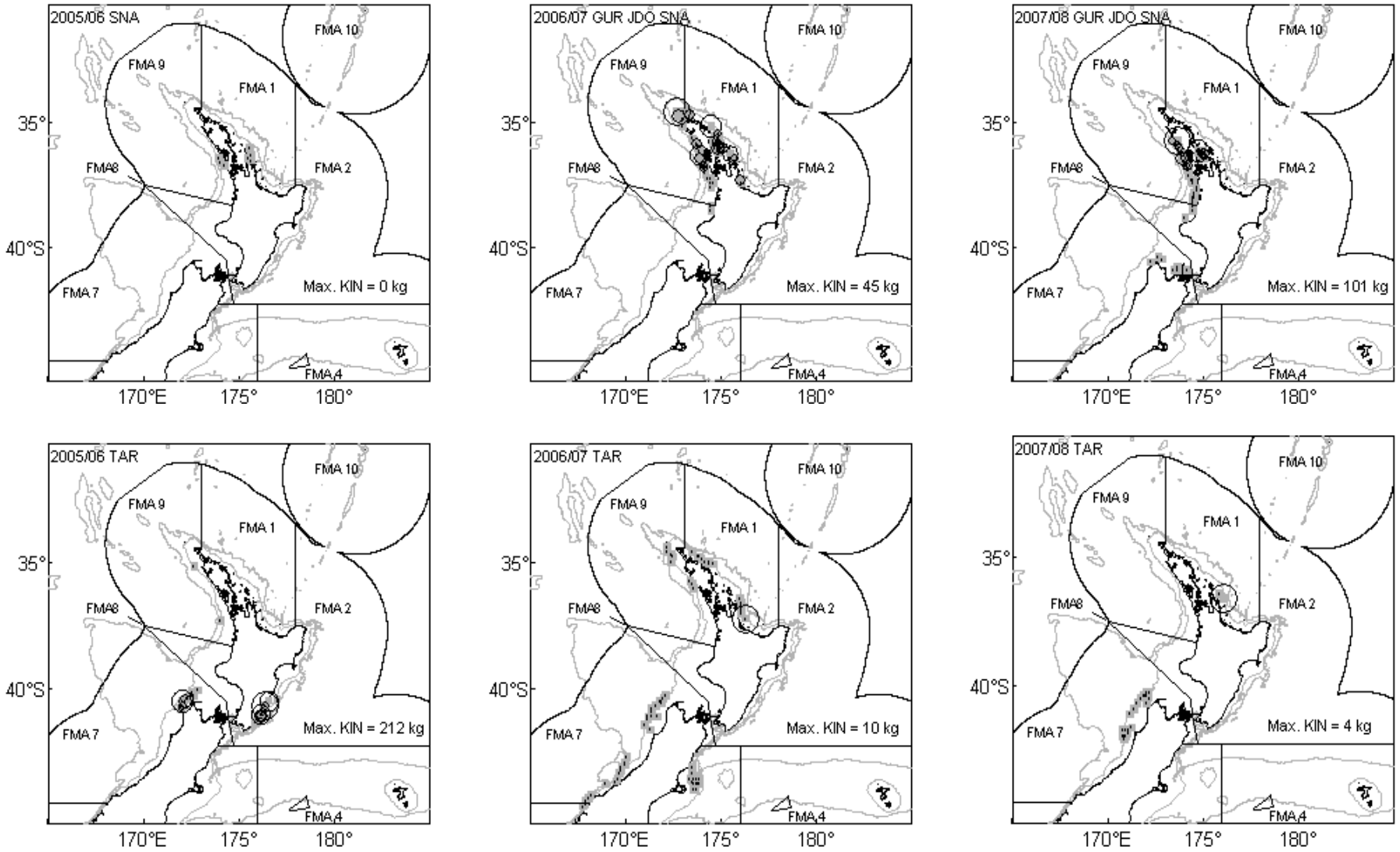

Figure 8: Observed catches of kingfish (kg) reported by observers on inshore trawl vessels, by fishing year and main target species, 2005–06 to 2007–08, showing start of tow location (■) and relative size of kingfish catches. The maximum kingfish catch per observed tow is given on each plot; thus the catch scale is different on each map. Species codes are defined in Table 2.1 of Appendix 2.

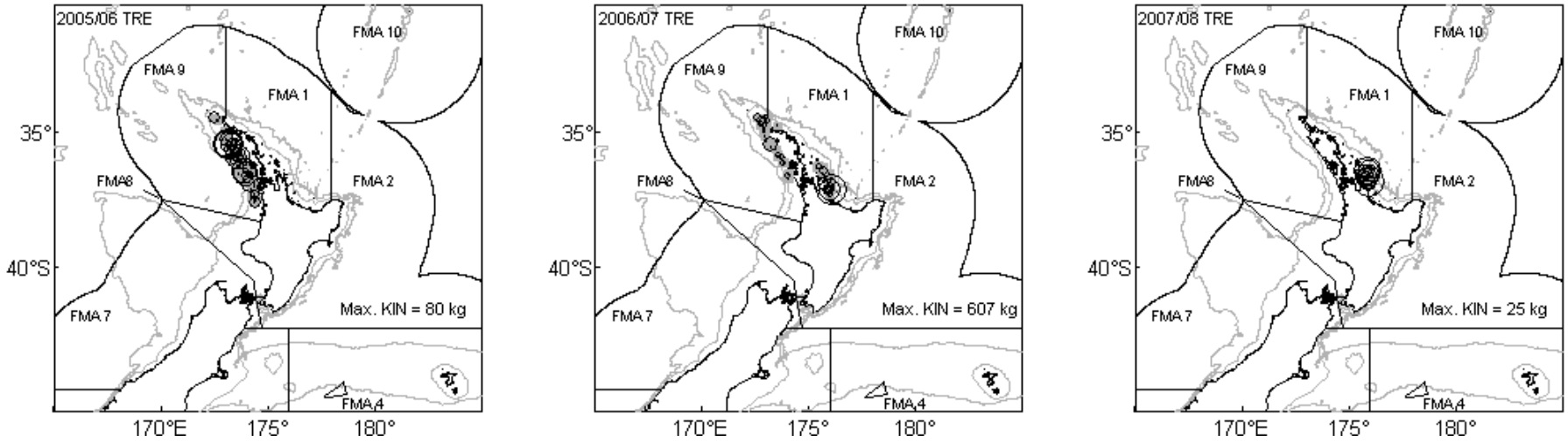

Figure 8 — ***continued.***

3.1.5 Length frequency of observed kingfish from inshore trips, 2005–06 to 2007–08

Observers measured 810 kingfish on inshore vessels during 2005–06 to 2007–08. The capture of length frequency data was not evenly spread across trips, with 78% of these records from 2006–07, and in that year 80% of the 635 measured kingfish were from the trevally trip with the largest kingfish catch, in the western Bay of Plenty in FMA 1.

Overall, trevally tows accounted for 83% of the fish measured, 12% were from tarakihi tows, 3% from snapper tows, and the remainder from John dory and gurnard tows. About 67% were caught in FMA 1, 21% in FMA 9, and the rest were from FMA 2 and FMA 7.

Only 15 kingfish were measured in 2007–08, from snapper and trevally tows in waters east of Coromandel Peninsula in FMA 1 (see Figure 8), and the lengths ranged from 64 to 107 cm. For 2005–06 and 2006–07 data, fish ranged in length from 39 to 120 cm (Figure 9). Observers recorded the sex of 218 fish, with similar sizes reported for males and females. Most sexed fish were from the Bay of Plenty trevally tows; these fish accounted for 76% of the 101 females and 83% of the males. Length data from 2005–06 show a wide spread and this is largely determined by the catch of different sizes of fish from the different FMAs (Figure 2.3 in Appendix 2): data for FMA 9 are from one trip in December; data for FMA 2 are from one July trip, and the FMA 7 data are from an August trip. Fish from FMA 2 appear to be larger than those in the other areas, but the sample size is small for each area. The distribution of lengths measured in a 2004–05 trip in FMA 2 ranged between 50 and 125 cm, with most fish between 50 and 80 cm (Baird 2009).

The length frequency distribution from 2006–07 is strongly influenced by data from one trevally trip in FMA 1 in March–April. Most of these data are confined to between 48 and 72 cm (see Figure 9 and Figure 2.4 in Appendix 2). The distribution of the smaller FMA 9 dataset (based on fish from two trips during October and March) is wider (range 41–111 cm). These distributions appear to sampling the lower end of the distribution reported from measurements made by recreational fishers in FMAs 1 & 9 (Holdsworth et al. 2008).

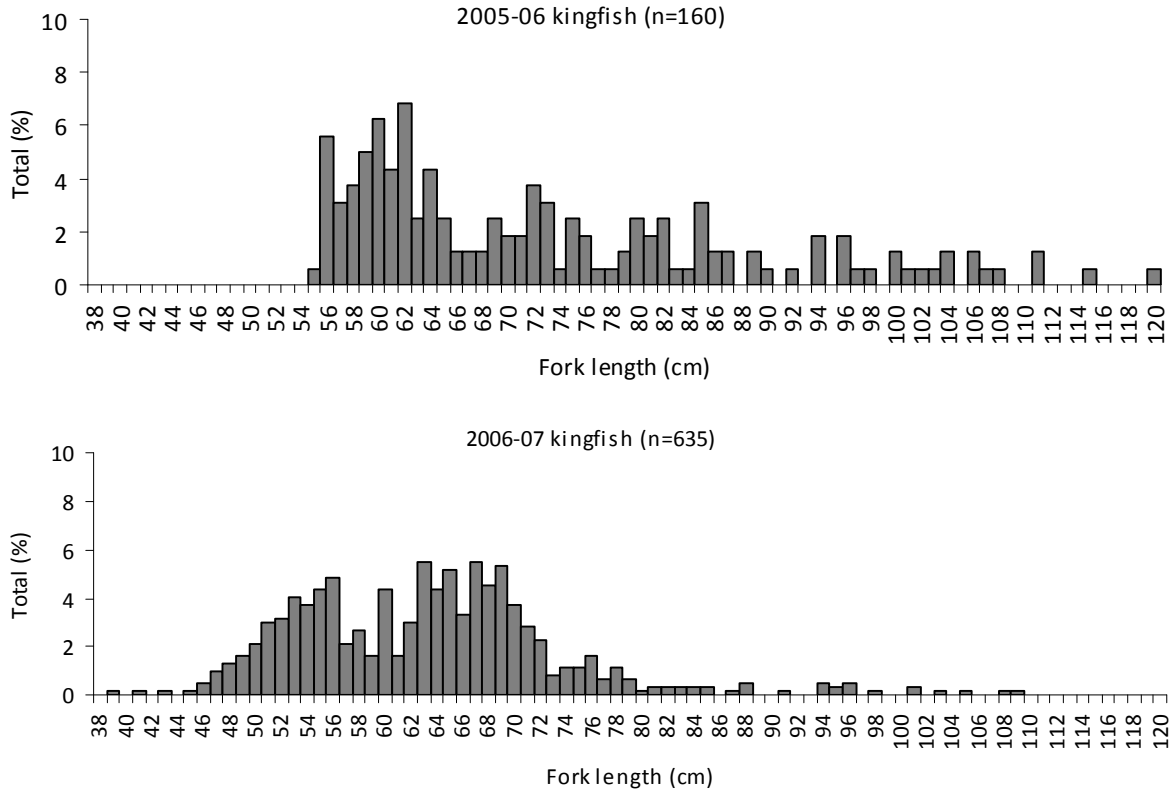

Figure 9: Length frequency distributions for kingfish caught as bycatch during observed tows on inshore vessels during 2005-06 and 2006-07. The 15 fish measured in 2007–08 were within the extent shown here.

3.2 Length frequency distribution of kingfish caught during observer coverage on large foreign charter vessels off the west coast North Island, 2005–06 to 2007–08

At least one observed tow on each of the 36 observed trips in FMAs 7, 8, and 9 on the seven large foreign trawlers caught at least one kingfish. These vessels operate further offshore than the inshore domestic vessels. Kingfish captures were reported from jack mackerel, blue mackerel, and barracouta observed tows. The distribution of catches is shown in Figure 10. All catches of more than 1000 kg per observed tow, except one, were in an area bounded by about 173° and 174° E and 37.7° and 38.7° S.

3.2.1 Observer coverage, 2005–06 to 2007–08

In 2005–06, observers were placed on seven large foreign trawlers during November–December in more northern waters off the North Island west coast where the main targets were jack mackerels and in June–July on multi-target trips generally south of Taranaki Bight in FMAs 7 and 8 (Table 4, Figure 10). Kingfish catches were reported from between 4 and 37% of tows in each trip, and about 85% targeted jack mackerel. Catches were generally from tows in 70–240 m and 77 of the 90 tows with kingfish caught less than 100 kg, 11 caught between 100 and 600 kg, and the two largest catches were of about 2000 kg and 7385 kg. These larger catches were from blue mackerel tows in FMA 8 in about 140 m.

In 2006–07, the observed effort on these vessels in FMAs 7–9 was distributed throughout the year and a range of species was targeted (Table 4) in 65–214 m on 15 trips. Observed tows with kingfish captures numbered 193, 182 of which targeted jack mackerels, 10 targeted barracouta, and 1 targeted blue mackerel. Catches of kingfish were reported from between 1 and 31% of tows in a trip, and ranged between 2 and 6750 kg, with 91% of less than 100 kg. The two largest catches of 1667 kg and 6750 kg were in jack mackerel tows in about 130 m in FMA 7 and in about 160 m in FMA 8, respectively (see Figure 10).

Another 14 trips were observed on these vessels in 2007–08 (see Table 4). Observers recorded kingfish captures on between 5 and 39% of tows on each observed trip. Of the 179 tows with kingfish catches, 163 targeted jack mackerels, 14 barracouta, and 2 blue mackerel. Fishing depths of these tows ranged from about 75 to 400 m, and the six catches of 1200–2400 kg were made in FMA 8 in jack mackerel and barracouta tows in about 150 m. Most catches per tow (84%) were less than 100 kg, another 12% were between 100 and 1000 kg, and 4% were more than 1000 kg. The largest catch of 8465 kg was from a tow targeting barracouta.

3.2.2 Length frequency of observed kingfish from large trawlers fishing in FMAs 7–9

Length data for 25 fish measured during four observed trips on these vessels in 2005–06 ranged between 63 and 117 cm and were collected from blue mackerel, jack mackerel, and barracouta tows in FMAs 7 and 8. Observers measured 499 kingfish in 2006–07, with at least one fish measured per trip (range of 1–145 fish measured in a trip) and at least 20 fish were measured from 7 of the 15 trips. About 92% were from tows that targeted jack mackerels, from the catches in FMAs 7 and 8. Lengths ranged from 49 to 179 cm, with most between 89 and 109 cm (Figure 11), and the distributions of males and females were similar (Figure 2.5 in Appendix 2). The large catch in FMA 7 contributed most length data for that area, and fish measured from FMA 7 catches showed a wider spread, but appeared to have a higher proportion of larger fish in the 95–109 cm range than the FMA 8 fish for which the sampling was more evenly spread between several larger catches (Figure 2.5). Fewer fish were measured from FMA 9 and the length data fit the spread of the other two areas; most of these data were from two trips.

In 2007–08, 732 kingfish were measured from 11 trips, with more than 20 fish measured on 6 trips (range of 3–193 fish) with more sampling from the larger catches. Fish lengths ranged from 55 to 129 cm (Figure 11), and there appeared to be a higher proportion of smaller fish than in the previous year. This peak at about 68–84 cm comes mainly from the catches in FMA 9 (Figure 2.6 in Appendix 2), where few fish were outside the distribution centred about 72–75 cm. Larger fish were caught in FMA 8 and FMA 9. The spread of lengths in FMA 8, from where about 63% of the data were collected, showed a reasonably flat distribution generally spread between 68 and 110 cm. The distributions of males and females were similar (Figure 2.6).

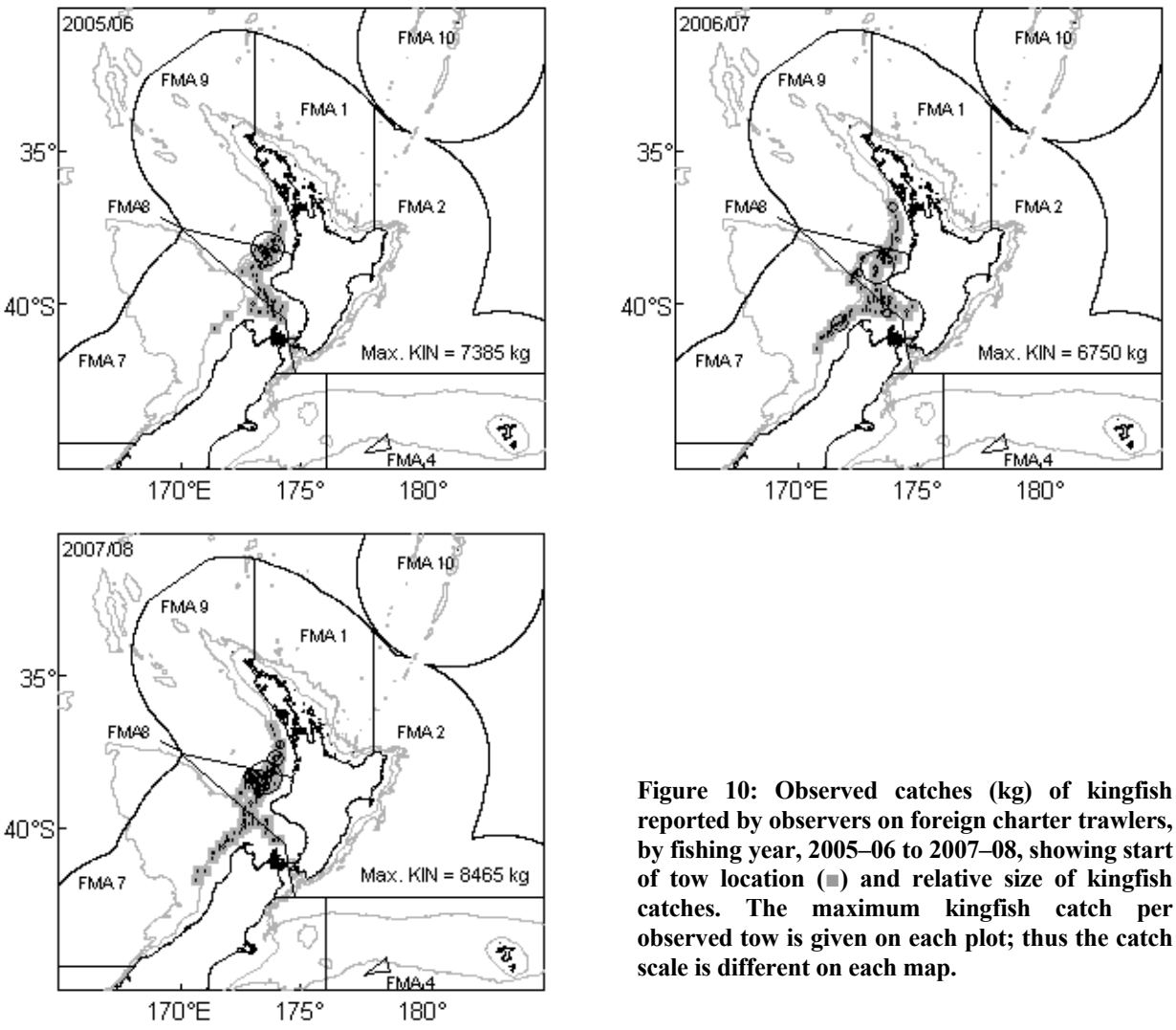

Figure 10: Observed catches (kg) of kingfish reported by observers on foreign charter trawlers, by fishing year, 2005–06 to 2007–08, showing start of tow location (■) and relative size of kingfish catches. The maximum kingfish catch per observed tow is given on each plot; thus the catch scale is different on each map.

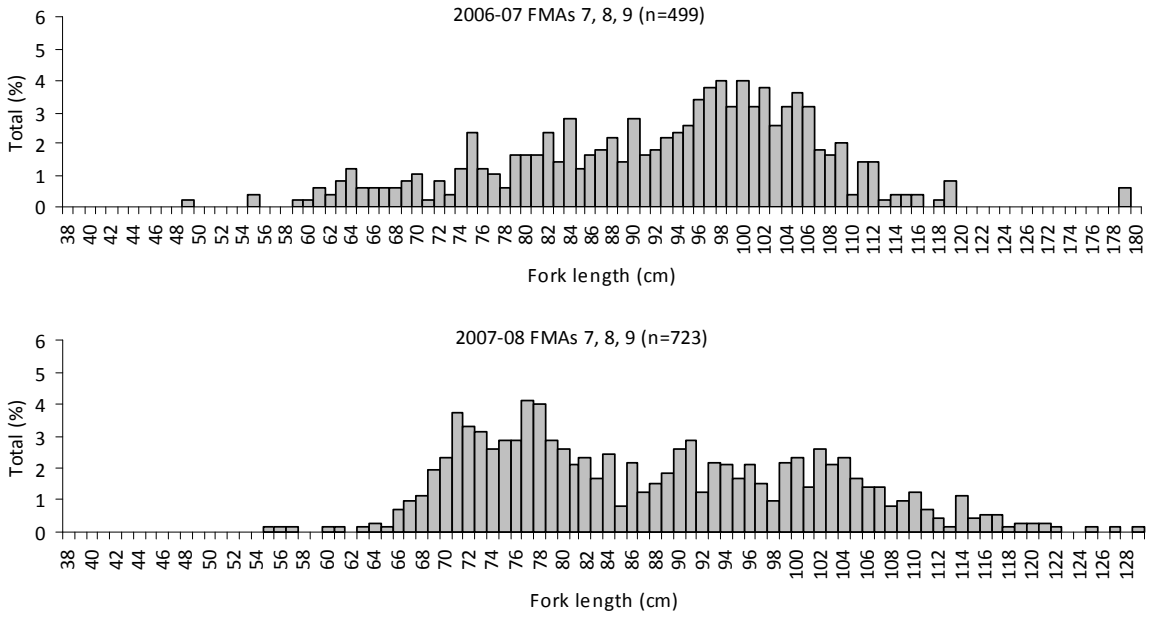

Figure 11: Length frequency distributions for kingfish caught as bycatch during observed tows on foreign charter vessels during 2006–07 and 2007–08.

Table 4: Details for observed trips on foreign charter trawlers that caught kingfish (KIN) during 2005–06 to 2007–08. Species codes are given in Table 2.1 in Appendix 2. These data represent the subset of observed trips where the target species was blue mackerel, jack mackerel, or barracouta.

Trip	Month	Area	Target	Gear	No.	Total tows % with KIN	KIN (kg)
2005–06							
1	Nov, Dec	FMA 7, 8, 9	BAR, JMA	MW	82	18	376
2	Nov, Dec	FMA 7, 8, 9	JMA	MW	128	9	169
3	Jun, Jul	FMA 7, 8, 9	HAK,HOK,JMA	MW	76	37	2 210
4	Jun, Jul	FMA 7, 8	BAR,EMA, HAK,HOK,JMA	MW	149	9	10 428
5	Nov, Dec	FMA 7, 8, 9	BAR,JMA	MW	96	4	48
6	Nov, Dec	FMA 7, 8, 9	BAR,JMA	MW	104	8	154
7	Nov, Dec	FMA 7, 8, 9	JMA	MW	121	8	267
2006–07							
8	Apr	FMA 7, 8	JMA	MW	36	36	534
9	Jun, Jul	FMA 7, 8	HAK,HOK,JMA	MW	133	33	3 466
10	Jul	FMA 7, 8	HAK,HOK,JMA, RBT	MW	82	2	49
11	Oct	FMA 7, 8, 9	BAR,JMA	MW	67	30	1 506
12	Apr	FMA 7, 8	JMA	MW	36	33	285
13	Sep	FMA 7, 8	HAK,JMA	MW	9	22	40
14	Jul, Aug	FMA 7, 8	EMA,HAK,HOK,JMA	MW	125	3	7 327
15	Jul	FMA 7, 8, 9	EMA,HAK,HOK,JMA	MW	45	4	307
16	Jun, Jul	FMA 7, 8	BAR,HOK,JMA	MW	120	16	1 506
17	Sep	FMA 7, 8, 9	JMA	MW	29	7	25
18	Nov, Dec	FMA 7, 8, 9	JMA	MW	71	31	380
19	Jul, Aug	FMA 7, 8	HAK,HOK,JMA,SQU	MW	68	1	12
20	Dec, Jan	FMA 7, 8	BAR,JMA	MW	104	12	254
21	Dec, Jan	FMA 7, 8, 9	JMA	MW	134	26	870
22	Oct	FMA 7, 8	BAR,EMA,JMA	MW	68	6	522
2007–08							
23	Nov, Dec	FMA 8,9	JMA	MW	67	27	280
24	Jan	FMA 7, 8	JMA	MW	14	14	39
25	Aug	FMA 7	BAR, HAK,HOK,JMA	MW	22	5	13
26	Jun, Jul	FMA 7, 8, 9	BAR, HAK,HOK,JMA	MW	89	39	2 345
27	Jul	FMA 7, 8, 9	HOK,JMA	MW	80	15	5 026
28	Jun	FMA 7, 8	BAR, FRO,HAK,JMA	MW	116	25	1 286
29	Nov, Dec	FMA 7, 8, 9	JMA	MW	96	9	205
30	Oct	FMA 7, 8, 9	JMA	MW	82	28	1 357
31	Nov, Dec	FMA 8, 9	JMA	MW	106	13	242
32	Nov, Dec	FMA 8, 9	EMA,JMA	MW	109	6	107
33	Jun, Jul	FMA 7, 8, 9	BAR, HOK,JMA	MW	96	8	10 502
34	Jul, Aug, Sep	FMA 7, 8	BAR, HAK,HOK,JMA	MW	78	5	167
35	Jul, Aug	FMA 7, 8, 9	BAR,EMA,HAK,HOK,JMA	MW	82	11	2 040
36	Oct	FMA 7, 8, 9	JMA	MW	36	31	5 555

4. CONCLUSIONS

4.1 Observed purse seine data

Of the 47 observed purse seine sets that targeted blue mackerel, jack mackerel, or kahawai in 2006–07, 38% were successful in that the total catch, or close to, was landed on the vessel. Another 4% landed about half the catch, and 58% lost the catch, though may have landed small amounts of bycatch species. These data though are influenced by the activity of one vessel on which 34 sets (11 of which landed the target school) were observed compared with 6 or 7 sets on the other two vessels. This trip (trip 1) also provided most of the blue mackerel, *T. declivis*, and barracouta length frequency data, whereas trip 2 provided most of the length data for *T. novaezelandiae* and trip 3 provided the kahawai length data.

The range of blue mackerel lengths (from 10 observed sets in October and March) was similar to that collected by observers in December 2004 in the same area in EMA 1 (FMA 1) and matched the distribution of the cumulative proportions-at-length based on fish measured from a large proportion of the landed catch from four years (between 1997–98 to 2004–05) where the length distributions were centred around 43–47 cm and most of these fish were aged at between 5 and 15 years old (Manning et al. 2007). The lengths collected during trip 3 from two sets in April in EMA 7 (FMAs 7–9) appeared to be slightly larger than the EMA 1 fish as was also shown by Manning et al. (2007).

Length distributions for *T. declivis* caught in JMA 1 show two modes, one centred around 28–32 cm and another at 41–45 cm (Taylor 2002). The data collected during trip 1 were from one set and the spike at 36 cm has not been verified; certainly it appears anomalous to the range given by Taylor (2002). The small peak at around 41–43 cm falls within the second mode given by Taylor (2002). The distribution for *T. novaezelandiae* in JMA 1, based on 201 fish from trip 2 fits the single mode given by Taylor (2002), with most between 31 and 35 cm. Fish of this species were smaller in the sample collected from JMA 7 on trip 3 (peak at 27–28 cm), though only 45 fish were measured. Taylor (2002) gives two possible modes in one year, at around 23–25 cm and 32–35 cm; however, this sample of 804 fish was from observed trawl effort and the smaller mode represents sampling in September and the larger one February–May.

Although fewer than 100 kahawai were measured from one set on trip 3 in KAH 8, there was an obvious mode at 49–50 cm and this was very similar to the mode from observed trawl effort in this area in 2005–06 (Devine 2007).

A greater variety of bycatch species was landed from the observed blue mackerel purse seine fishing in FMA 1 off the northern east coast (trip 1) than reported from previous observed effort in which the target blue mackerel schools were caught with some *T. declivis* and a small amount of *T. novaezealandiae*, sun fish (*Mola mola*), and porcupine fish (*Allomycterus jaculiferus*) (Baird 2009). In the more southern effort in FMA 1, *T. novaezelandiae* (59%) and blue mackerel (40%) made up most of the catch, whereas in previous observed effort in these waters, *T. novaezelandiae* was predominant (96%) and kahawai was the next largest catch (3%), with some blue mackerel and small amounts of barracouta, frostfish, kingfish, porcupine fish and slender tuna. As with previous observer reports from observed purse seine effort, there was generally little interest in the fishing by seabirds and marine mammals, apart from the one set from which trapped dolphins were successfully released.

4.2 Kingfish bycatch

Observers on inshore domestic vessels reported relatively small catches of kingfish on about half of the 23 observed trips during 2005–06 to 2007–08. These vessels mainly fished in shallow waters close to shore in FMAs 1, 2, 7, and 9, and captures were more likely to be reported from trevally and tarakihi tows, and all catches were from waters north of 41° S. The largest catch per tow of 607 kg in the western Bay of Plenty in FMA 1 was substantially lower than the largest catches reported by observers on the large foreign charter vessels (up to 8465 kg) that fished mainly for jack mackerels off the west coast of the North Island. These vessels operated large midwater nets and caught kingfish on each of the 36 trips and fished more offshore than the domestic vessels, in the southern part of FMA 9, FMA 8, and the northern waters of FMA 7. The larger catches reported from the large vessels were generally restricted to waters between 38° and 40° S, where most tows targeted jack mackerels, blue mackerel, and barracouta. However, most catches on the observed vessels in both fleets were less than 100 kg.

The sampling effort for length frequency measurements was spread over more tows for the foreign observed trips than the domestic inshore trips. The length frequency data from the observed effort from the two fleets showed little overlap. From the inshore vessels' effort, there appeared to be a bimodal distribution for the kingfish from one 2006–07 trip in FMA 1, with most fish between 48 and 72 cm. Fish measured from foreign charter effort in FMAs 7 and 8 in 2007–08 were between 80 and 112 cm, whereas the distribution in FMA 9 was centred on 72–75 cm. Kingfish lengths from FMA 9 domestic effort provided a relatively flat distribution, but the data were few. These fish were sampled from effort close inshore and further north in FMA 9 than the foreign effort. There were no differences in the length distributions of males and females, where these data were available.

5. ACKNOWLEDGMENTS

Thanks to the MFish observers for their data collection, Alan Martin of the MFish Observer Programme, and to Brian Sanders (NIWA) for his *cod* database work. This work was completed for the Ministry of Fisheries under project PEL2008/02.

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APPENDIX 1: OBSERVED PURSE SEINE DATA

Table 1.1: Species reported caught from observed blue mackerel, jack mackerel, or kahawai purse seine sets, 2006–07.

Code	Scientific name	Common name
BAR	*Thyrsites atun*	Barracouta
BMA	*Scorpis violacea*	Blue maomao
EMA	*Scomber australasicus*	Blue mackerel
ERA	*Torpedo fairchildi*	Electric ray
FLY	Exocoetidae	Flying fish
FRO	*Lepidopus caudatus*	Frostfish
JFI		Jellyfish
JMD	*Trachurus declivis*	Jack mackerel
JMN	*Trachurus novaezelandiae*	Jack mackerel
JMA	*T. declivis, T. murphyi*, *T. novaezelandiae*	Jack mackerels
KAH	*Arripis trutta*	Kahawai
LEA	*Parika scaber*	Leatherjacket
PMA	*Caprodon longimanus*	Pink maomao
SKJ	*Katsuwonus pelamis*	Skipjack tuna
SQU	*Nototodarus sloanii, N. gouldi*	Arrow squid
STM	*Tetrapturus audax*	Striped marlin
STU	*Allothunnus fallai*	Slender tuna
WSE	Labridae	Wrasses

Table 1.2: Numbers of measured fish from each observed purse seine trip, 2006–07.

Species code	No. sets sampled	No. fish	No. males	No. females	Gonad stage (% females)			Length range (cm)
Trip 1					1	2	3	
BAR	5	64	35	29	38	45	17	68–87
EMA	7	719	372	347	1	4	95	34–58
FRO	10	14	8	6	33	67	0	103–118
JMD	1	115	75	40	5	0	95	30–49
SKJ	1	6	2	4	25	75	0	62–76
STU	2	6	1	5	0	100	0	71–84
All	16	924	493	431	–	–	–	–
Trip 2								
EMA	3	67	20	27	4	96	0	37–48
JMN	3	311	60	141	6	94	0	30–37
All	3	378	80	168	–	–	–	–
Trip 3								
EMA	2	117	53	64	77	23	0	41–52
JMN	1	45	17	28	96	4	0	24–34
KAH	1	89	40	49	86	14	0	44–54
All	4	251	110	141	–	–	–	–

Appendix 1 — *continued*

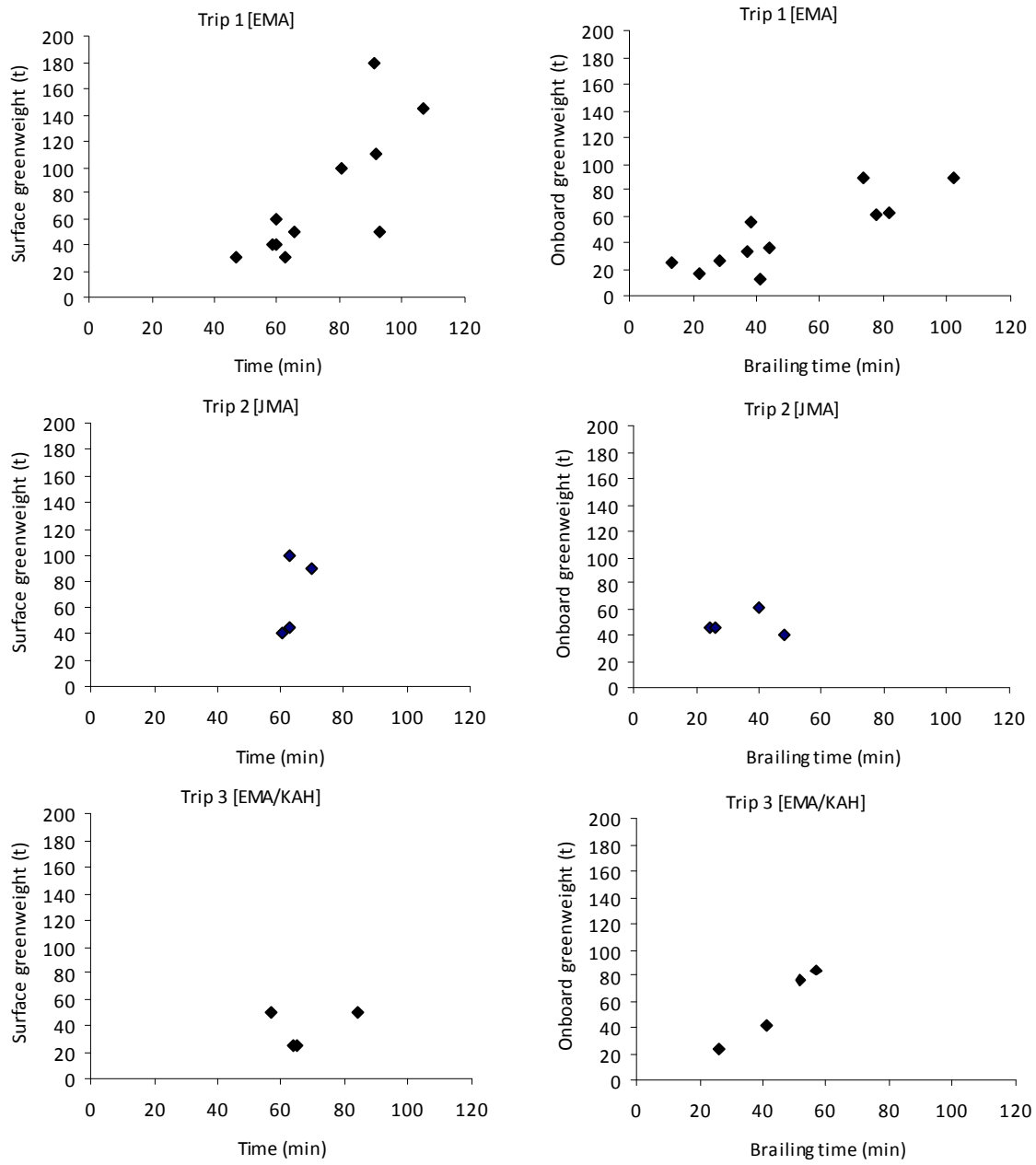

Figure 1.1: Time taken to purse the net for a estimated surface greenweights (left) and time taken to brail the estimated onboard greenweight (right) for observed sets where the total catch was landed.

APPENDIX 2: OBSERVED KINGFISH BYCATCH DATA

Table 2.1: Target species reported for observed inshore trawl effort, 2005–06 to 2007–08.

Code	Scientific name	Common name
BAR	*Thyrsites atun*	Barracouta
GUR	*Chelidonichthys kumu*	Red gurnard
FLA		Flatfish species
GSH	*Hydrolagus novaezealandiae*	Ghost shark
JDO	*Zeus faber*	John dory
RBY	*Plagiogeneion rubiginosum*	Rubyfish
SQU	*Nototodarus sloanii, N. gouldi*	Arrow squid
SNA	*Pagrus auratus*	Snapper
SPD	*Squalus acanthias*	Spiny dogfish
STA	*Kathetostoma giganteum*	Stargazer
TAR	*Nemadactylus macropterus*	Tarakihi
TRE	*Pseudocaranx dentex*	Trevally
WAR	*Seriolella brama*	Common warehou

Table 2.2: Number of observed tows and reported kingfish greenweight (kg) from observed tows, by Fishery Management Area (FMA), target species, and month for domestic inshore vessels, 2005–06.

FMA	Target	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	All
2005–06 No. observed tows *(n* = 107)														
FMA 1	SNA	–	–	–	4	–	–	–	–	–	–	–	–	4
FMA 2	TAR	–	–	–	–	–	–	–	–	–	14	–	–	14
FMA 7	TAR	–	–	–	–	–	–	–	–	–	–	16	–	16
FMA 9	SNA	–	–	3	–	–	–	–	–	–	–	–	–	3
FMA 9	TAR	–	–	–	2	–	–	–	–	–	–	–	–	2
FMA 9	TRE	–	–	33	35	–	–	–	–	–	–	–	–	68
All		–	–	36	41	–	–	–	–	–	14	16	–	107
2005–06 Total kingfish greenweight (kg)														
FMA 1	SNA	–	–	–	0	–	–	–	–	–	–	–	–	0
FMA 2	TAR	–	–	–	–	–	–	–	–	–	561	–	–	561
FMA 7	TAR	–	–	–	–	–	–	–	–	–	–	299	–	299
FMA 9	TRE	–	–	0	–	–	–	–	–	–	–	–	–	0
FMA 9	TRE	–	–	–	0	–	–	–	–	–	–	–	–	0
FMA 9	TRE	–	–	247	356	–	–	–	–	–	–	–	–	603
All		–	–	247	356	–	–	–	–	–	561	299	–	1 463

Appendix 2 — *continued*

Table 2.3: Number of observed tows and reported kingfish greenweight (kg) from observed tows, by Fishery Management Area (FMA), target species, and month for domestic inshore vessels, 2006–07.

FMA	Target	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	All
2006–07 No. observed tows *(n* = 281)														
FMA 1	GUR	–	–	–	–	–	2	–	–	–	–	–	–	2
FMA 1	JDO	–	–	–	–	–	10	53	–	–	–	–	–	63
FMA 1	SNA	–	–	–	–	–	3	3	–	2	–	–	–	8
FMA 1	SQU	–	–	–	–	–	2	2	–	–	–	–	–	4
FMA 1	TAR	–	–	–	–	–	17	4	–	–	–	–	–	21
FMA 1	TRE	–	–	–	–	–	25	4	–	–	–	–	–	29
FMA 3	SPD	–	–	–	–	–	–	–	–	–	–	–	3	3
FMA 3	TAR	–	–	–	–	1	–	–	–	–	–	13	11	25
FMA 5	TAR	–	–	–	–	4	–	–	–	–	–	–	–	4
FMA 7	STA	–	–	–	–	–	2	–	–	–	–	–	–	2
FMA 7	TAR	–	–	–	–	10	15	8	–	–	–	–	–	33
FMA 7	WAR	–	–	–	–	4	–	–	–	–	–	–	–	4
FMA 8	GUR	–	–	–	–	–	–	–	–	–	–	–	2	2
FMA 9	GUR	–	–	–	–	–	11	–	–	5	–	–	–	16
FMA 9	RBY	–	–	–	–	–	–	1	–	–	–	–	–	1
FMA 9	SNA	25	–	–	–	1	–	–	–	–	–	–	–	26
FMA 9	TAR	–	–	–	–	1	2	4	–	1	–	–	–	8
FMA 9	TRE	14	–	–	–	14	1	–	–	1	–	–	–	30
All		39	–	–	–	35	90	79	–	9	–	13	16	281
2006–07 Total kingfish greenweight (kg)														
FMA 1	GUR	–	–	–	–	–	0	0	–	–	–	–	–	0
FMA 1	JDO	–	–	–	–	–	26	36	–	–	–	–	–	62
FMA 1	SNA	–	–	–	–	–	8	34	–	5	–	–	–	47
FMA 1	SQU	–	–	–	–	–	0	0	–	–	–	–	–	0
FMA 1	TAR	–	–	–	–	–	0	0	–	–	–	–	–	0
FMA 1	TRE	–	–	–	–	–	1 433	5	–	–	–	–	–	1 438
FMA 3	SPD	–	–	–	–	–	–	–	–	–	–	–	0	0
FMA 3	TAR	–	–	–	–	0	–	–	–	–	–	0	0	0
FMA 5	TAR	–	–	–	–	0	–	–	–	–	–	–	–	0
FMA 7	STA	–	–	–	–	–	0	–	–	–	–	–	–	0
FMA 7	TAR	–	–	–	–	0	0	0	–	–	–	–	–	0
FMA 7	WAR	–	–	–	–	0	–	–	–	–	–	–	–	0
FMA 8	GUR	–	–	–	–	–	–	–	–	–	–	–	0	0
FMA 9	GUR	–	–	–	–	–	88	–	–	–	–	–	–	88
FMA 9	RBY	–	–	–	–	–	–	0	–	–	–	–	–	0
FMA 9	SNA	16	–	–	–	0	–	–	–	–	–	–	–	16
FMA 9	TAR	–	–	–	–	0	0	0	–	0	–	–	–	0
FMA 9	TRE	404	–	–	–	21	24	–	–	–	–	–	–	449
All		420	–	–	–	21	1 589	75	–	5	–	0	0	2 110

Appendix 2 — *continued*

Table 2.4: Number of observed tows and reported kingfish greenweight (kg) from observed tows, by Fishery Management Area (FMA), target species, and month for domestic inshore vessels, 2007–08.

FMA	Target	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	All
2007–08	**No. observed tows *(n* = 148)**													
FMA 1	SNA	–	–	–	–	–	–	–	–	–	–	–	23	23
FMA 1	TAR	–	–	–	–	–	–	–	–	–	–	–	2	2
FMA 1	TRE	–	–	–	–	–	–	–	–	–	–	–	14	14
FMA 7	BAR	2	–	–	–	–	–	–	–	–	–	–	–	2
FMA 7	FLA	3	11	–	–	–	–	–	–	–	–	–	–	14
FMA 7	GSH	2	–	–	–	–	–	–	–	–	–	–	–	2
FMA 7	GUR	5	–	–	–	–	–	–	–	–	–	–	–	5
FMA 7	SNA	4	–	–	–	–	–	–	–	–	–	–	–	4
FMA 7	TAR	11	14	–	–	–	–	–	–	–	–	–	–	25
FMA 8	GUR	5	–	–	–	–	–	–	–	–	–	–	–	5
FMA 9	FLA	–	–	–	–	–	–	–	1	–	–	–	–	1
FMA 9	GUR	–	–	–	–	–	–	–	9	–	–	–	–	9
FMA 9	JDO	–	–	–	–	–	–	–	7	–	–	–	–	7
FMA 9	SNA	26	9	–	–	–	–	–	–	–	–	–	–	35
All		58	34	–	–	–	–	–	17	–	–	–	39	148
2007–08	**Total kingfish greenweight (kg)**													
FMA 1	SNA	–	–	–	–	–	–	–	–	–	–	–	106	106
FMA 1	TAR	–	–	–	–	–	–	–	–	–	–	–	4	4
FMA 1	TRE	–	–	–	–	–	–	–	–	–	–	–	130	130
FMA 7	BAR	0	–	–	–	–	–	–	–	–	–	–	–	0
FMA 7	FLA	0	0	–	–	–	–	–	–	–	–	–	–	0
FMA 7	GSH	0	–	–	–	–	–	–	–	–	–	–	–	0
FMA 7	GUR	0	–	–	–	–	–	–	–	–	–	–	–	0
FMA 7	SNA	0	–	–	–	–	–	–	–	–	–	–	–	0
FMA 7	TAR	0	0	–	–	–	–	–	–	–	–	–	–	0
FMA 8	GUR	0	–	–	–	–	–	–	–	–	–	–	–	0
FMA 9	FLA	–	–	–	–	–	–	–	0	–	–	–	–	0
FMA 9	GUR	–	–	–	–	–	–	–	0	–	–	–	–	0
FMA 9	JDO	–	–	–	–	–	–	–	0	–	–	–	–	0
FMA 9	SNA	177	23	–	–	–	–	–	–	–	–	–	–	200
All		177	23	–	–	–	–	–	0	–	–	–	240	440

Appendix 2 — *continued*

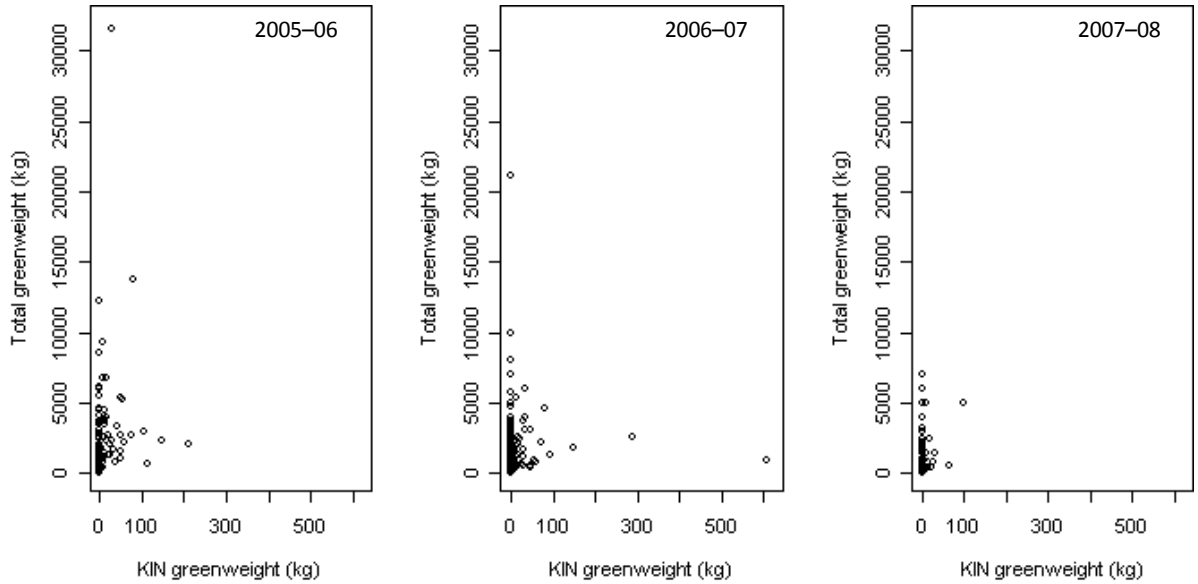

Figure 2.1: Observed catches of kingfish (estimated greenweight in kg) reported by observers on inshore trawl vessels, relative to total estimated greenweight reported for each observed tow for each fishing year, 2005–06 to 2007–08.

Appendix 2 — *continued*

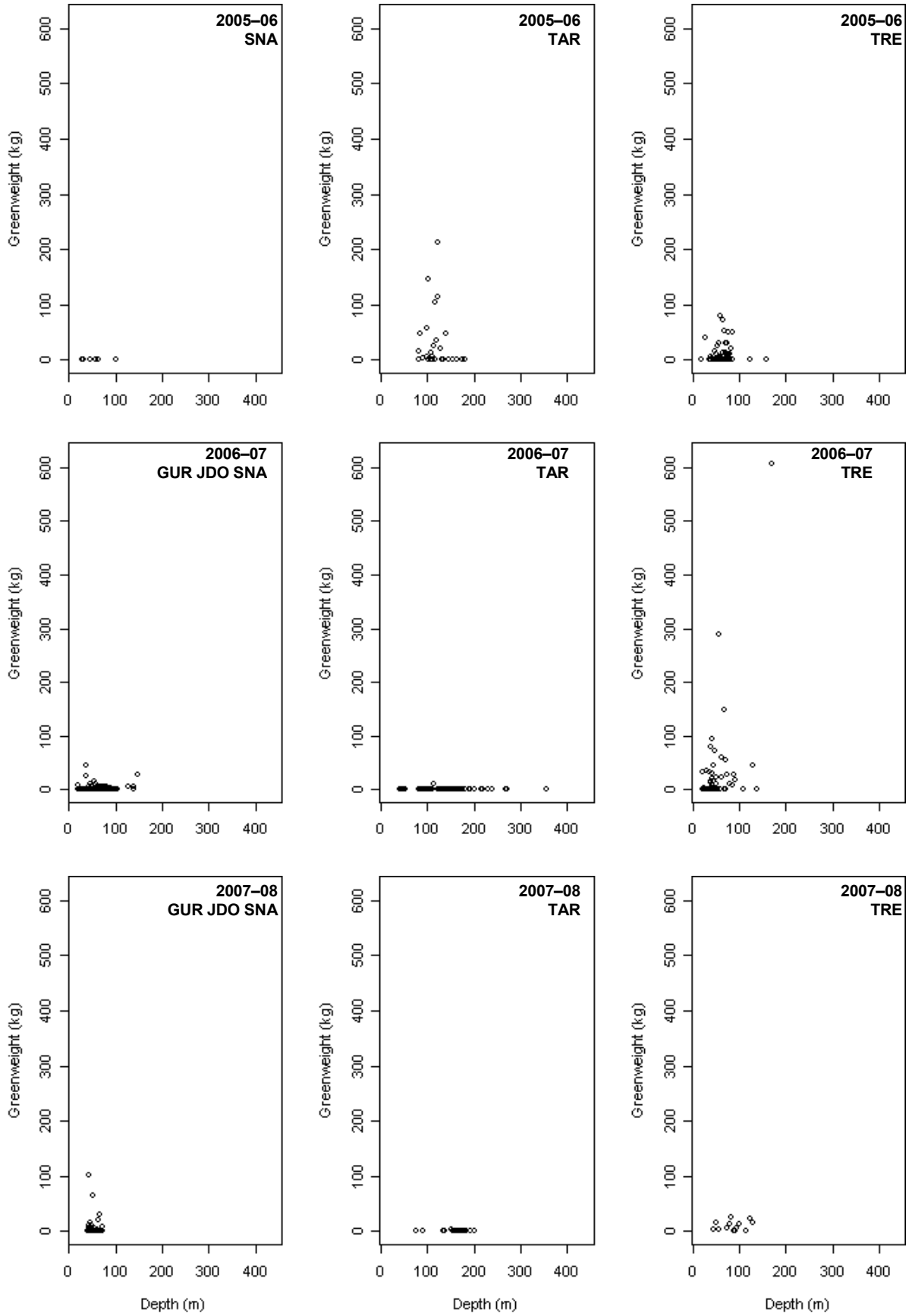

Figure 2.2: Reported catches of kingfish (kg) by observers on inshore trawl vessels, by depth for each fishing year 2005–06 to 2007–08, where the main targets were red gurnard (GUR), John dory (JDO), snapper (SNA), tarakihi (TAR), and trevally (TRE).

Appendix 2 — *continued*

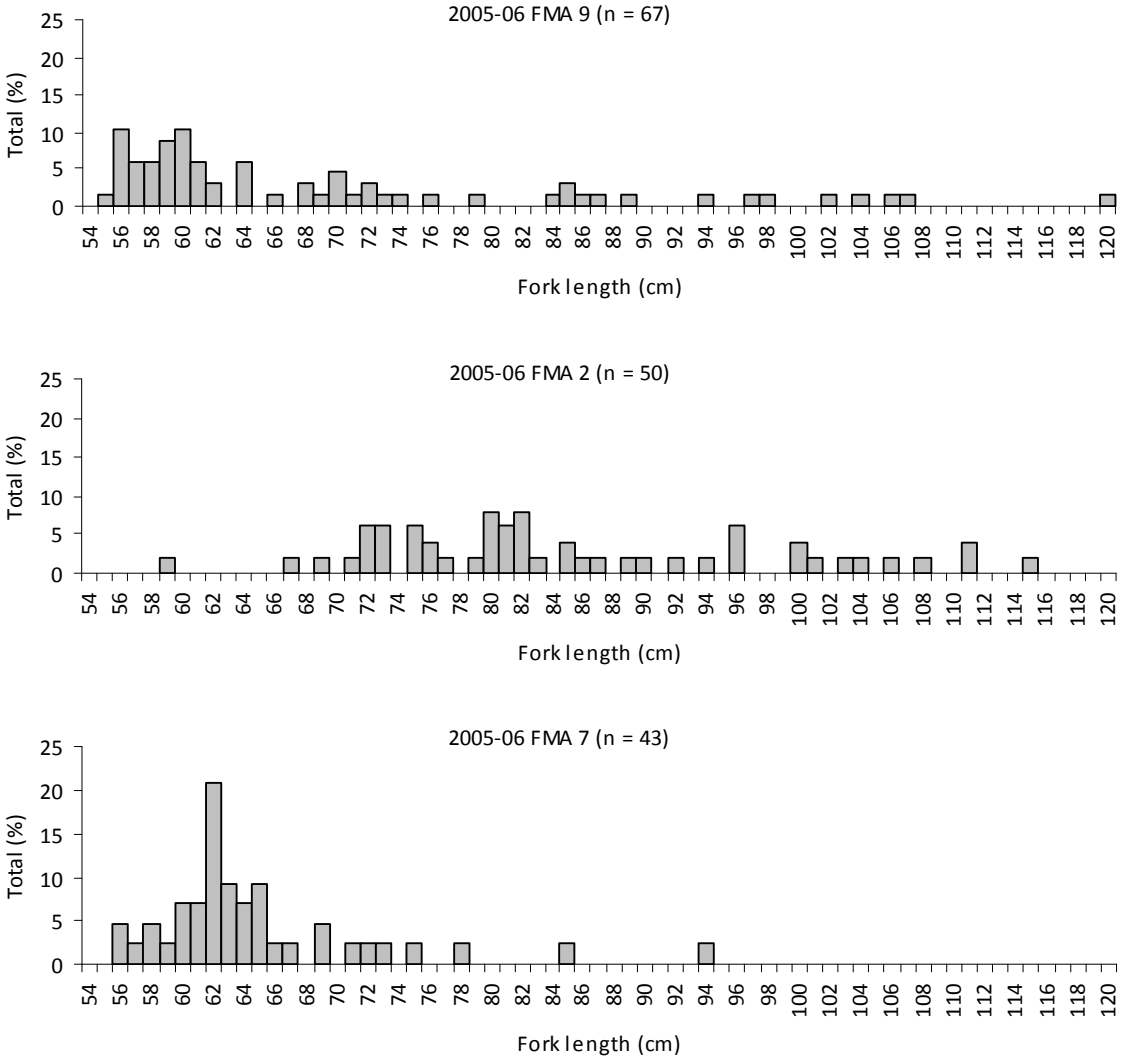

Figure 2.3: Length frequency distribution of kingfish caught during inshore observed trips in 2005–06, by FMA.

Appendix 2 — *continued*

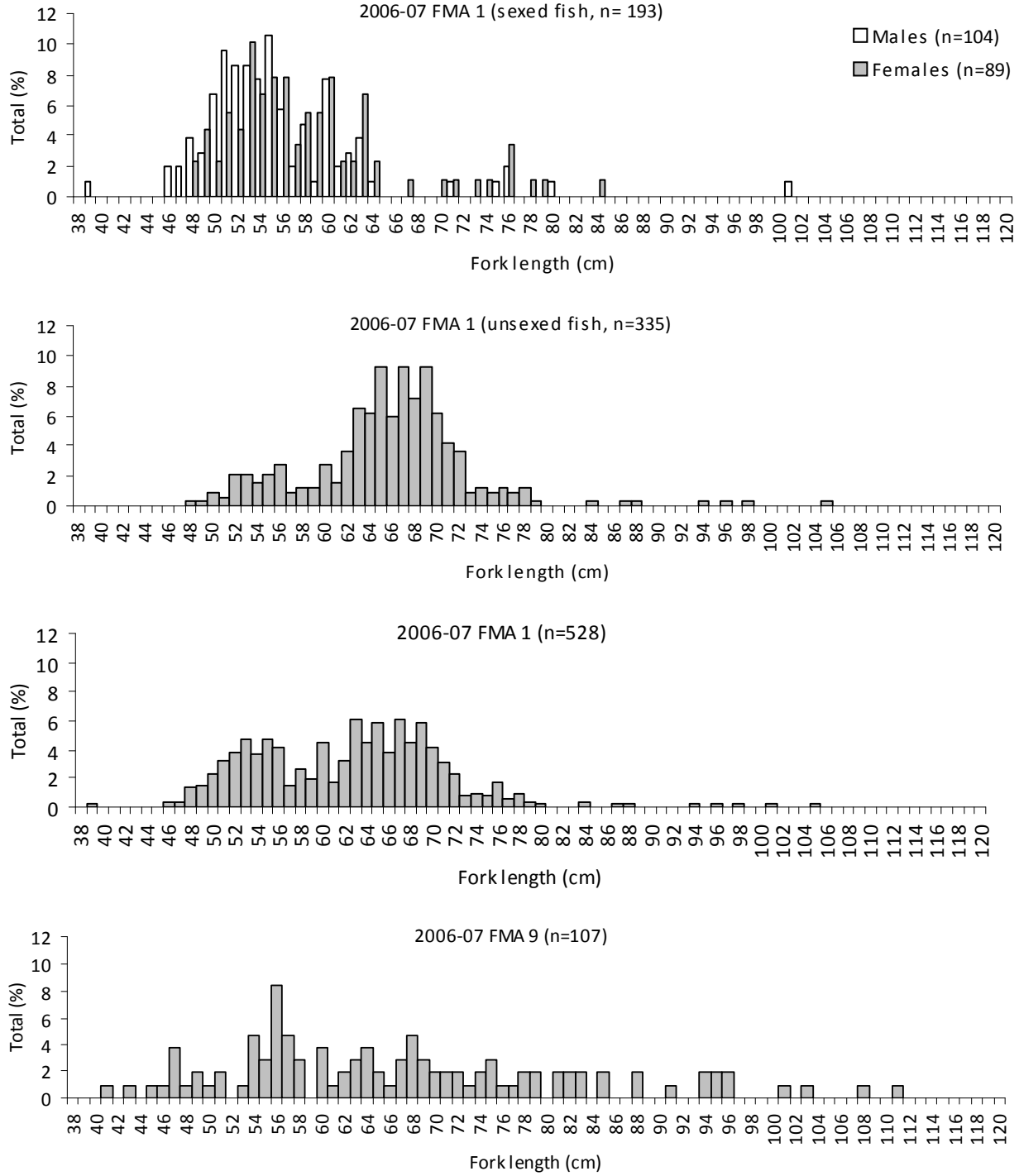

Figure 2.4: Length frequency distribution of kingfish caught during inshore observed trips in 2006–07, for males, females, and unsexed fish in FMA 1, and for all fish in FMA 1 and FMA 9.

Appendix 2 — *continued*

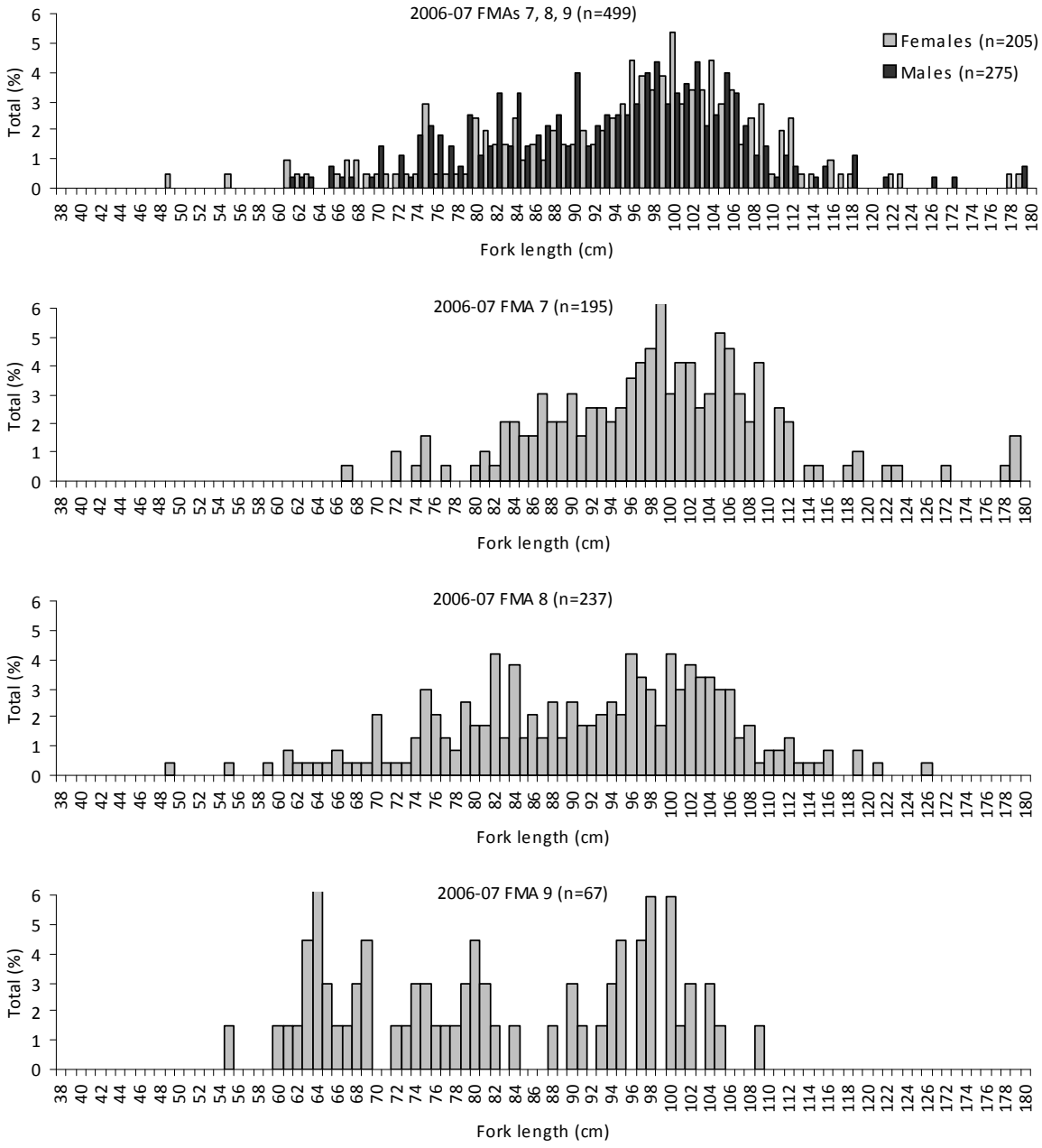

Figure 2.5: Length frequency distribution of kingfish caught during observed trips on foreign charter trawlers in 2006–07, for males and females and for all fish in FMAs 7, 8, & 9.

Appendix 2 — *continued*

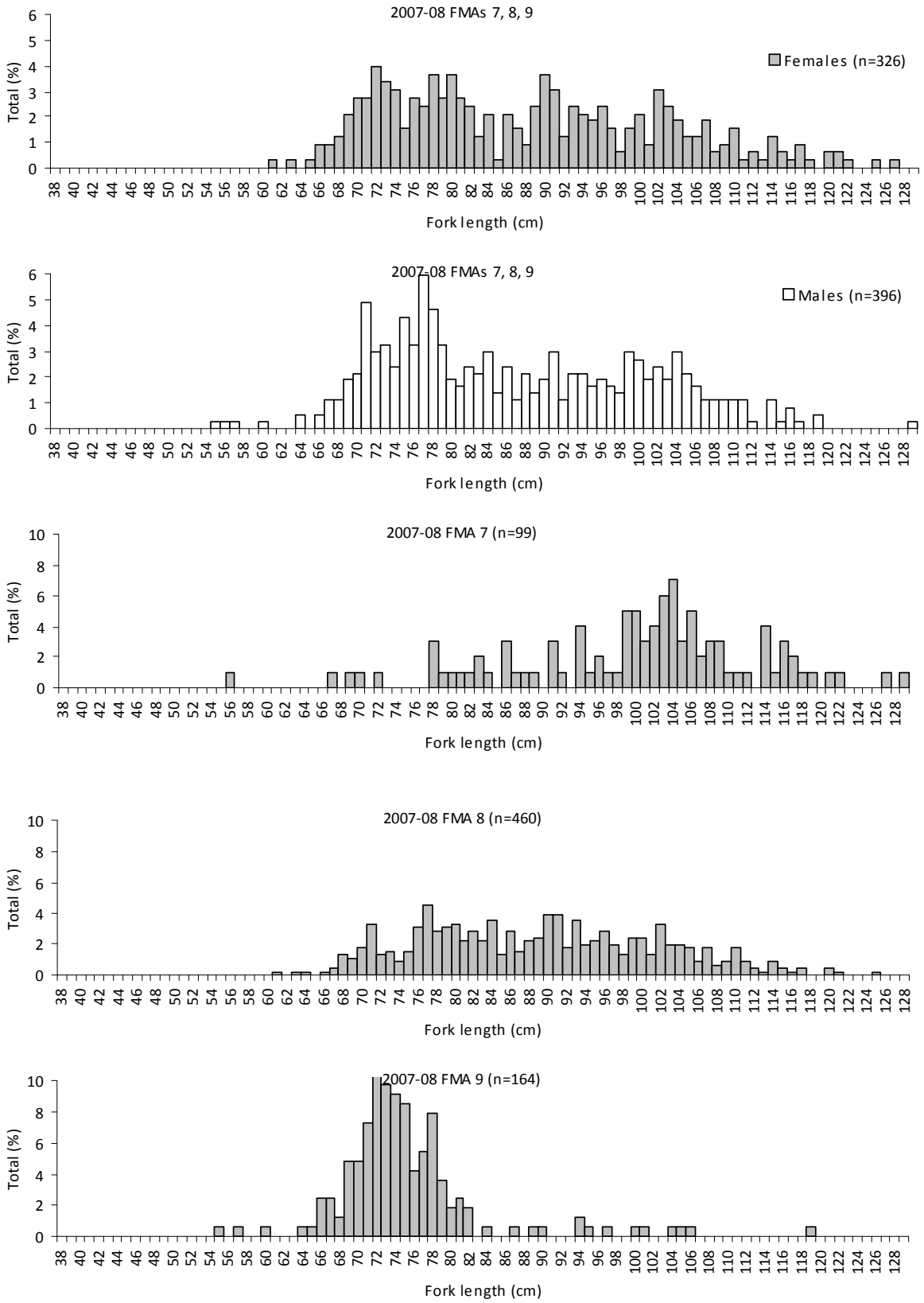

Figure 2.6: Length frequency distribution of kingfish caught during observed trips on foreign charter trawlers in 2007–08, for males and females and for all fish in FMAs 7, 8, & 9.