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Monitoring commercial eel fisheries in 2003–04 and 2004–05

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EXECUTIVE SUMMARY

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This report provides the results of a programme that monitors size grades, species composition, and location of catch from virtually all freshwater eel (longfin, *Anguilla dieffenbachii*; shortfin *A. australis*) landings in the 2003–04 and 2004–05 fishing years from North Island factories. In the South Island, annual summary data on size grades and species composition (without catch location) were provided by the main processor for the years 2003–04 to 2005–06, and these data were analysed with previous historical data that dates back to the mid 1970s.

A pilot programme implemented in 2003–04 to record processor size grades, species composition, and catch location from North Island individual landings is now ongoing and the first 2 years of data for 2003–04 and 2004–05 have been analysed. Data are presented by three geographical levels of scale (4 QMAs, 12 ESAs, and 65 subareas). Subareas (broadly equivalent to catchments) are subsets of the 12 ESAs. Size grades were generally recorded as small (220 to 500 g), medium (500 to 1000 g or 500 to 1200 g), and large (over 1000 or 1200 g).

In 2003–04, data from 105 t (26%) of longfin and 299 t (74%) of shortfin from 1415 landings were provided by processors (89% of North Island total catch for 2003–04), and these were sourced from all 4 QMAs, 11 ESAs (no landings from ESA 11), and 50 of the 65 subareas (77%). The proportion of shortfin eels over 1000 g was between 9 and 14%, and more than one-third of longfins landed were from the large size grade (over 1000 g or 1200 g). Based on size, more than one-third of all longfins caught in 2003–04 were female, the remainder being either male or female. Differences in size distributions of both species and species composition by area for 2003–04 are described.

In 2004–05, data from 120 t (31%) of longfin and 266 t (69%) of shortfin from 1139 landings were provided by processors (90% of North Island total catch for 2004–05) and these were sourced from all 4 QMAs, all 12 ESAs, and 49 of the 65 subareas (75%). The proportion of shortfin eels over 1000 g was 14%, and more than one-third of longfins landed were from the large size grade (over 1000 g or 1200 g). Based on size, more than one-third of all longfins caught in 2004–05 were female, the remainder being either male or female. Differences in size distributions of both species, and species composition by area for 2004–05 are described.

The longfin data show a trend of progressively increasing size in both longfin and shortfin from 2001–02 to 2005–06 for the New Zealand Eel Processing Co. Limited (NZ Eel) data, and from 2003–04 to 2005–06 for longfin for the Aotearoa Fisheries Limited (AFL) data. There is no trend in the overall percent of the catch by species for either processor from 2001–02 to 2005–06 and the longfin average over this period was 20% and 31% for New Zealand Eel and AFL, respectively. The proportion of longfin in the catch is about 10 to 20% less today than in the mid 1970s to mid 1980s.

The South Island data indicate that the average size of both longfin and shortfin eels processed has progressively declined over the last 30 years, and is now based on eels in the smallest processed size grade (under 450 g). The inclusion of the most recent data, from 2003–04 to 2005–06, confirms that that has been little change since the 1990s, for either species. The proportion of longfin eels processed in the South Island declined from about 90% in the 1970s to about 50% in the early 1990s and it has since been stable (average for 2000s is 59%).

1. INTRODUCTION

This report provides the results of a programme that monitors size grades, species composition, and catch location of eel landings from North Island factories — data are here presented for 2003–04 and 2004–05 fishing years, but data have also been collected for 2005–06 and 2006–07 (EEL200501) (Beentjes in prep) and collection is in progress for 2007–08 and 2008–09 (EEL200708). In addition, we update analyses of the key South Island eel processor's records of species composition and size grades, extending the database from mid 1970s through to 2005–06.

1.1 The fishery

The commercial freshwater eel fishery developed rapidly in the mid 1960s, with a peak catch in 1972 of 2072 t. From 1973 to 1998, although catches were variable, there was no trend and the average catch over this period was 1250 t. There has been a trend of declining catches since the early 2000s and the catches in the most recent fishing years of 2003–04 and 2004–05 were about 700 t (Ministry of Fisheries 2006). The South Island eel fishery was introduced into the QMS (Quota Management System) in October 2000, followed by the North Island in October 2004. The South Island TACCs (Total Allowable Commercial Catches) have been undercaught in every year, and in 2004–05 for the North Island, which has contributed to the trend of declining catches. Landings consist of both the endemic longfin eel (*Anguilla dieffenbachii*) and the shortfin eel (*A. australis*), which is also found in southeast Australia. Landings from the north of the North Island sometimes include occasional *A. rheinhardtii*, the Australian longfin eel.

1.2 Research

Although the fishery has been operating since the 1960s, until recently, our understanding of the sustainability of harvest levels had been based on interpretation of annual catch data, knowledge of the biology of the two species, and anecdotal information from processors and fishers on catch rates. In recent years, information from sampling commercial landings (Beentjes & Chisnall 1997, 1998, Beentjes 1999, Speed et al. 2001, Beentjes 2005), catch-per-unit-effort (CPUE) analyses (Beentjes & Bull 2002, Beentjes & Dunn 2003a, 2003b), and studies on recruitment (Jellyman et al. 2000, Boubée et al. 2002) have become available. The sustainability of the fishery under current levels of harvest is unknown (Ministry of Fisheries 2006).

Commercial catches of eels from throughout New Zealand were sampled over three consecutive years between 1995–96 and 1997–98 (Beentjes & Chisnall 1997, 1998, Beentjes 1999), in 1999–2000 (Speed et al. 2001) and most recently in 2003–04 (Beentjes 2005). The results showed that the size and sex composition of longfins have been dramatically altered compared to those of shortfin. Longfin populations in the more heavily fished mainstem rivers, such as those in the lower South Island, had a strongly unimodal size structure with mean size around 50 cm, and were predominantly male. This suggests that, in some areas, females have been severely overfished relative to males and this may have implications for future recruitment of longfin eels.

The most comprehensive data sets of eel processors' historic records of species composition and size grades for both North Island and South Island indicated a clear and progressive trend of declining size from the 1970s through to the 1990s, for both eel species (Beentjes & Chisnall 1997, Beentjes 2005). There was also a general decline in the proportion of longfinned eels in the landed catches over time. These findings were supported by analyses of catch effort data from throughout New Zealand for 1990–91 to 1998–99, which showed a general decline in CPUE for longfin eels (Beentjes & Bull 2002), and subsequent analyses have reaffirmed these trends (Beentjes & Dunn 2003a, 2003b).

1.3 Objectives

This report was carried out for the Ministry of Fisheries under Project EEL2004/02.

Overall objective

1. To monitor the size grades and species composition of commercially processed eels.

Specific objective

1. To monitor size of eels by recording quantities of eels by species (shortfin and longfin) in the different commercial size grades from defined areas.

2. METHODS

2.1 North Island eel size grades, species composition, and catch location (2003–04 and 2004–05)

The pilot programme (EEL200204) implemented in the North Island to monitor size grades, species composition, and catch location from nearly all North Island landings in the 2003–04 fishing year was continued into 2004–05. The data were provided by the following North Island processors; New Zealand Eel Processing Co. Ltd (NZ Eel), Levin Eel Trading Co Ltd, Aotearoa Fisheries Ltd (AFL), and E.N. Vanderdrift (1987) Ltd. In the factory the catch is sorted into species (shortfin and longfin) and visually graded by size before weighing. The size grades recorded are processor specific, and are usually determined by market demands, although they have not varied in recent years. The information for each landing is routinely recorded on customised landing record forms by the processor and constitutes the basis of payment to fishers, as well as providing catch data for reporting to the Ministry of Fisheries. Because catch location had not been recorded on these landing forms, in October 2003 we requested that the respective forms be modified to accommodate an area field. To record location in more detail, the 12 eel ESAs (Figure 1) were divided into 65 subareas (Appendices 1 and 2) (broadly equivalent to catchments). Maps showing the subareas were provided to each processor and they were requested to record catch location for each landing. ESAs were divided into between 2 and 6 subareas except ESA 4, which has 17 subareas (Table 1). Landings with catch taken from more than one subarea was prorated across the respective areas (e.g., Area 9A, 60%; 9B, 30%; 9E, 10%).

In 2003–04 we collected data from three North Island factories (AFL in Whenuapai, NZ Eel in Te Kauwhata, and Vanderdrift in Stratford) – Levin Eel Trading did not process eels in 2003–04. The North Island eel industry underwent some changes to the processing infrastructure in 2004–05. Thomas Richards Ltd was sold to AFL, and Vanderdrift closed. In 2004–05 eels from Levin Eel Trading were processed at the Levin factory by AFL, and reported on AFL Licensed Fish Receiver Forms (LFRs). Thus, for 2004–05 data were provided by only two North Island factories (AFL and NZ Eel) which now account for nearly all the North Island eel landings.

Species composition (proportion of each species) and catch by species were analysed and plotted for all processors combined by subarea, ESA, and Quota Management Area (QMA). The QMAs for the North Island eel fishery are QMA 20 (ESAs 1 and 2), QMA 21 (ESAs 3–6), QMA 22 (ESAs 7 and 10–12), and QMA 23 (ESAs 8 and 9) (Anonymous 2004), but did not come into effect until 1 October 2004. Analyses of size grade data were carried out separately for each processor and species because of the different size grades used by the three processors, i.e., Vanderdrift recorded catch weights of eels less than 1000 g and over 1000 g for shortfin and longfin; NZ Eel record weights of longfin 200–

500 g, 500–1200 g, and over 1200 g, and weights of shortfin 200–500 g, 500–1000 g, and over 1000 g; AFL record weights of longfin and shortfin 220–500 g, 500–1000 g, and over 1000 g.

2.2 South Island eel size grades and species composition (1974–75 to 2005–06)

The initial aim of the programme was to obtain size grade, species composition, and catch location data from throughout the country, but the main South Island eel processor, Mossburn Enterprises Ltd (Invercargill) and associated fishers, were unwilling to grade and provide catch location for each landing. However, annual summary data on size grades and species composition in the South Island were provided by Mossburn Enterprises for the years 2003–04 to 2005–06, and these data were analysed with previous historical data that dates back to the mid 1970s (1974–75, 1977–78, 1978–79, and 1983–84 to 2002–03). Analyses update those carried out in 1997 (Beentjes & Chisnall 1997) and 2005 (Beentjes 2005). For each of these years, the proportions of the catch in each size grade were calculated, and for each decade, the mean proportion and standard errors in each size grade were determined. The data are pooled and presented by decade (1970s, 1980s, 1990s, and 2000s). These data were provided to NIWA in summary form and contain no information on individual landings or catch location.

The same size grades, recorded in imperial units (lbs), have been used since the mid 1970s when records began. For analysis and presentation, pounds were converted to metric units (g) and rounded (Table 2).

3. RESULTS

3.1 North Island eel size grades, species composition, and catch location (2003–04 and 2004–05).

3.1.1 Catch and species composition

2003–04

Total landings and tonnages from the three processors are combined for presentation, and include 105 t (26%) of longfin and 299 t (74%) of shortfin from 1415 landings (Table 3). The proportion of the catch that was shortfin was 84% for NZ Eel, 70% for AFL, and 45% for Vanderdrift. The catch (t) of each species by subarea, ESA, and QMA is shown in Figure 2. Catch was landed from 50 of the 65 North Island subareas (77%), and 2 landings were from unspecified locations.

On a broad-scale, the bulk of the catch (84%) was landed from QMAs 20 and 21 with major contributions from ESA 1 (Northland) and ESA 4 (Waikato)(Figure 2). At the fine scale, the subareas that contributed relatively large proportions of the catch included those surrounding Kaitaia (1A), Dargaville (1D), Warkworth (2A), Manukau Harbour (2C), Hauraki Plains (3A, 3B), Lake Waikare/Port Waikato (4L), Lake Whangape (4K), Pirongia Forest Park (4J), and Waimarama/Porangahau (7F) (Figure 2).

The species composition by subarea, ESA, and QMA is shown in Figure 3. At the QMA level, shortfin were dominant in QMAs 20, 21, and 22 (77%, 77%, and 76% shortfin), whereas QMA 23 had a greater proportion of longfin (66% longfin). Species composition expressed by ESA indicates that shortfin dominated catches in all areas except 8 and 9, where longfin made up 53% and 75% of the catch. In all other ESAs shortfin made up between 66% and 95% of the catch. At the subarea level, shortfin were dominant in 36 of 52 (67%) subareas and particularly in Northland and Waikato

subareas catchments that drain into the Waikato River. In contrast, the western draining subareas of the Waikato, Rangitikei/Wanganui, and particularly Taranaki tended to be dominated by longfin.

2004–05

Total landings and tonnages from both processors are combined for presentation, and include 120 t (31%) of longfin and 266 t (69%) of shortfin from 1139 landings (Table 3). The proportion of the catch that was shortfin was 75% for NZ Eel and 64% for AFL. The catch of each species by subarea, ESA, and QMA is shown in Figure 4. Catch was landed from a total of 49 of the 65 North Island subareas (75%).

On a broad-scale, nearly half of the catch (45%) was landed from QMA 21 and only 10% from QMA 23 (Figure 4). The major ESA contributors, in order of catch, were ESA 4 (Waikato), ESA 1 (Northland), ESA 3 (Hauraki), and ESA 7 (Hawke's Bay). At the fine scale, the subareas that contributed large proportions of the catch included Hokianga Harbour (1B), Dargaville (1D), Hauraki Plains west (3A), and Lake Waikare/Port Waikato (4L). Other subareas that contributed lesser but significant catch included Hauraki Plains east, Coromandel Peninsula, Napier, Tukituki River, Manawatu River coast, and Lake Wairarapa (Figure 4).

The species composition by subarea, ESA, and QMA is shown in Figure 5. At the QMA level, shortfin were dominant in QMAs 20, 21, and 22 (74%, 70%, and 74% shortfin), whereas QMA 23 had a greater proportion of longfin (60% longfin). Species composition expressed by ESA indicated that shortfin dominated catches in all areas except 6 and 9, where longfin made up 59% and 83% of the catch. In all other ESAs shortfin made up between 53% and 82% of the catch. At the subarea level, shortfin were the dominant species in 35 of 49 (71%) subareas, and longfin dominated only in the western draining subareas of the Waikato, in Taranaki, and east coast around Gisborne.

3.1.2 Size composition

New Zealand Eel Processing Co. Ltd (2003–04)

Shortfin – Shortfin eels processed by NZ Eel in 2003–04 were sourced from 28 subareas, 8 ESAs, and all 4 QMAs (Figure 6). The overall proportions of shortfin in the three size grades were 62%, 29%, and 9% for the 220–500 g, 500–1000 g, and over 1000 g grades, respectively (see Table 4). The shortfin size composition by QMA shows that QMA 23 had the highest proportions of larger eels, and QMA 21 the lowest. ESA 4 had the highest proportion of small eels (220–500 g, 74%) followed by areas 1, 5, and 3 (61%, 61%, and 51%). The subareas generally yielded similar size proportions except for catchments in ESA 4, most of which drain into the Waikato River and within which small eels dominated catches. In contrast, eels in 9D (Patea River inland) and 5A (Tauranga) were particularly large.

Longfin – Longfin eels processed by NZ Eel in 2003–04 were sourced from 27 subareas, 8 ESAs, and all 4 QMAs (Figure 7). The overall proportions of longfin in the three size grades were 49%, 15%, and 35% for the 220–500 g, 500–1200 g, and over 1200 g grades, respectively (Table 5). The longfin size composition by QMA shows that QMA 23 had the highest proportion of larger eels, and QMA 21 the lowest. ESAs 4 and 5 had the highest proportion of small eels (220–500 g, 58% and 57%) and ESAs 2 and 9 the largest eels (over 1200 g, both 77%). There was a wide variation in size grade composition among the 27 subareas, but eels were generally smallest in subareas of ESA 4 that drain into the Waikato River, and subareas 1D (Dargaville), 5B (Rotorua lakes), 5C (Rangitaiki River), and 5D (Whakatane River). In contrast, longfins from 2C (Manukau Harbour), 5A (Tauranga), 7E (Tukituki River), 9C (Mount Taranaki coast), and 9D (Patea River inland) were particularly large.

New Zealand Eel Processing Co. Ltd (2004–05)

Shortfin – shortfin eels processed by NZ Eel in 2004–05 were sourced from 31 subareas, 8 ESAs, and all 4 QMAs (Figure 8). The overall proportions of shortfin in the three size grades were 57%, 29%, and 14% for the 220–500 g, 500–1000 g, and over 1000 g grades, respectively (see Table 4). The shortfin size composition by QMA shows that QMA 22 had the highest proportions of larger eels, and QMA 20 the lowest. ESAs 1, 2, 4, and 5 had the highest proportions of small eels (220–500 g, about 60%) and ESAs 3 and 7 the least. The subareas generally yielded similar size proportions except for a few areas where there were high proportions of larger eels, including 3A (Hauraki Plains west), 3B (Hauraki Plains east), 4N (Kawhia Harbour), 4Q (Mokau River), and 9A (North Taranki Bight).

Longfin – Longfin eels processed by NZ Eel in 2004–05 were sourced from 32 subareas, 9 ESAs, and all 4 QMAs (Figure 9). The overall proportions of longfin in the three size grades were 46%, 16%, and 38% for the 220–500 g, 500–1200 g, and over 1200 g grades, respectively (Table 5). The longfin size composition by QMA shows that QMAs 22 and 23 had the highest and similar proportions of larger eels, and QMA 20 the lowest. In general, longfin eel size appears to increase from north to south for both QMAs and ESAs. The was a wide variation in size grade composition among the 32 subareas, but eels were generally smallest in subareas of ESA 4 that drain into the Waikato River, and those in ESAs 1, 2, and 5. In contrast, longfins from 3B (Hauraki Plains east), 3C (Coromandel Peninsula), 4M (Raglan), 4N (Kawhia Harbour), 4Q (Mokau River), and subareas in ESAs 7, 8, 9, and 10 were particularly large.

E.N. Vanderdrift (1987) Ltd (2003–04)

Shortfin – Shortfin eels processed by Vanderdrift in 2003–04 were sourced from 13 subareas and 1 unknown subarea, 5 ESAs (7–10, and 12), and 2 QMAs (22 and 23) (Figure 10). Overall, 86% of shortfins were under 1 kg (see Table 4). QMA 23 had the highest proportion of larger eels (QMA 23 18%, QMA 22 10%). All five ESAs yielded eels from both size grades, but area 7 had a high proportion of eels under 1 kg (97%). ESA 9 had the highest proportion of large eels (over 1 kg, 23%). The subareas with the largest eels included 8C (Whanganui River coast), 9B (Waitara River), and 9D (Patea River inland). Those subareas with the smallest eels included 7F (Waimarama/Porangahau), 8F (Rangitikei River), 9A (North Taranaki Bight), and 9F (Waitotara River).

Longfin – Longfin eels processed by Vanderdrift in 2003–04 were sourced from 16 subareas and 1 unknown subarea, 5 ESAs (7–10, and 12), and 2 QMAs (22 and 23) (Figure 11). Overall, 63% of longfins were under 1 kg (Table 5). QMA 23 had the highest proportion of larger eels (QMA 23 40%, QMA 22 23%). All five ESAs yielded eels from both size grades, but area 12 had a high proportion of eels under 1 kg (97%). ESA 8 had the highest proportion of large eels (over 1 kg, 45%). The subareas with the largest eels include 7B (Lake Waikaremoana), 8A (Taumaranui), 8C (Whanganui River coast), 9B (Waitara River), 9C (Mount Taranaki coast), and 9F (Waitotara River). Those subareas with the smallest longfins include 9E (Patea River coast), 10A (Manawatu River coast) and 12A (Otaki).

Aotearoa Fisheries Ltd (2003–04)

Shortfin – Shortfin eels processed by AFL in 2003–04 were sourced from 31 subareas and 1 unknown subarea, 8 ESAs (1–7 and 9), and all 4 QMAs (Figure 12). The overall proportions of shortfin in the three size grades were 51%, 34%, and 14% for the 220–500 g, 500–1000 g, and over 1000 g grades, respectively (see Table 4). QMAs 20 and 23 had the highest proportion of larger eels and QMA 21 the lowest. ESA 6 had the highest proportion of small eels (220–500 g, 67%) followed by area 4 (62%), whereas the largest eels came from ESA 2 (61% over 500 g). Subareas showed considerable variability in size grades with the largest shortfins from 4B (Lake Ohakune), 4D (Lake Whakaru), 4F (Waipara River), 4I (Hamilton), and 4O (Marakopa River). Subareas with the smallest

shorfins included 3B (Hauraki Plains east), 4C (Lake Atiamuri), 4H (Lake Karapiro), 4K (Lake Whangape), 4L (Lake Waikare/Port Waikato), and 4N (Kawhia Harbour).

Longfin – Longfin eels processed by AFL in 2003–04 were sourced from 31 subareas and 1 unknown subarea, 8 ESAs (1–7, and 9), and all 4 QMAs (Figure 13). The overall proportions of longfin in the three size grades were 54%, 16%, and 30% for the 220–500 g, 500–1000 g, and over 1000 g grades, respectively (Table 5). The longfin size composition by QMAs shows that QMA 22 had the largest eels and QMA 20 the smallest. ESA 6 had the highest proportion of small eels (220–500 g, 75%) followed by ESA 1 (61%), whereas the largest eels came from ESAs 2, 4 and 7. Subareas showed considerable variability in size grades, with the largest eels taken from 4B (Lake Ohakuni), 4D (Lake Whakamaru), 4F (Waipara River), 4I (Hamilton), 4J (Pirongia Forest), 4N (Kawhia Harbour), 4O (Marakopa River), 4P (Awakino River), and 4Q (Mokau River), whereas the smallest were from 1E (Bream Bay), 4C (Lake Atiamuri), 4H (Lake Karapiro), 4K (Lake Whangape), 4L (Lake Waikare/Port Waikato), 5B (Rotorua lakes), 5C (Rangitaiki River), and 6A (Ohiwa Harbour).

Aotearoa Fisheries Ltd (2004–05)

Shortfin – Shortfin eels processed by AFL in 2004–05 were sourced from 42 subareas, all 12 ESAs, and all 4 QMAs (Figure 14). The overall proportions of shortfin in the three size grades were 52%, 34%, and 14% for the 220–500 g, 500–1000 g, and over 1000 g grades, respectively (see Table 4). QMAs 20, 22 and 23 had similar proportions of size grades, whereas QMA 21 had a higher proportion of smaller shortfins. In general, shortfins from central North Island ESAs 4, 5, 6, and 7, as well as ESA 11, were smaller than from elsewhere. Landings with the smallest shortfins were from ESA 4, and largest from ESAs 9 and 10. Subareas showed considerable variability in size grades, with the largest shortfins from the subareas in southern North Island and the smallest in two subareas close to the factory at Whenuapai, i.e., 4K (Lake Whangape) and 4L (Lake Waikare/Port Waikato).

Longfin – Longfin eels processed by AFL in 2004–05 were sourced from 41 subareas, 11 ESAs (all except ESA 12), and all 4 QMAs (Figure 15). The overall proportions of longfin in the three size grades were 46%, 18%, and 35% for the 220–500 g, 500–1000 g, and over 1000 g grades, respectively (Table 5). QMAs 23 had the highest proportion of large eels and QMA 21 the least. Longfins were smallest in ESA 5, largest in ESAs 8 and 9, and of similar size elsewhere. Subareas showed considerable variability in size grades and small and large eels were found in subareas throughout the North Island. Smallest longfins were from subarea 2B (Auckland) and largest from 9F (Waitotara River).

3.2 South Island eel size grades and species composition (1974–75 to 2005–06)

Longfins

The Mossburn Enterprises size grade data show a clear and progressive trend of declining size from the 1970s through to the 1990s (Figure 16). In the 1970s the predominant size grade was 450–900 g, but changed to the smallest size grade (under 450 g) in the 1980s and has remained so through the 1990s and into the 2000s (15% in 1970s, 44% in 1980s, 52% in 1990s, and 48% in 2000s). The increase in the proportion of the smallest size grade in the 1980s and 1990s was generally accompanied by a progressive decrease in proportions of the larger grades and most of the reduction in size of eels processed took place between the 1970s and 1980s. The size grade data from the 2000s (up until 2005–06) indicates that there has been little change relative to the 1990s in the smaller grades. In recent years Mossburn Enterprises have been live-exporting eels over about 1.2 kg (3 lb) and these eels were all recorded in the 1800–2270 g (4–5 lb) grade, whereas they could have been in any of the grades from 1360–1800 g and above. Thus, the increase in the proportion of eels in the

1800–2270 g in the 2000s, the decrease in the 1360–1800 g, and the complete absence of eels in the two largest size grades, is an artefact of reporting.

Shortfins

Trends in size grades of shortfin eels are similar to those for longfin eels with a clear and progressive decline in size from the 1970s through to the 1990s, although the size grades differ slightly and there were few eels over 2270 g landed (Figure 16). Unlike longfins, however, the proportion of the smallest size grade processed (under 500 g) increased most sharply in the 1990s compared to the 1970s and 1980s (1970s 13%, 1980s 23%, 1990s 60%, and 2000s 61%) This may be due in part, to the inclusion of Te Waihora eels from 1992–93 onward. Te Waihora is a shortfin fishery that has dispensation to target male migrating eels which would otherwise be smaller than the minimum legal size of 220 g; the average weight of shortfin migratory males is about 125 g (40 cm) (Jellyman et al. 1995, Beentjes & Chisnall 1998). Irrespective of this, for the next three size grades (500–900 g, 900–1360 g, and 1360–1800 g), the greatest differences are between the 1970s–1980s and the 1990s. No eels in the largest size grades for shortfin eels (2270–3200 g and over 3200 g) were processed in the 1980s and 1990s. There appears to be little change in the proportions of the smaller size grades processed between the 1990s and 2000s, but there has been a decline in the proportion of larger eels processed (1360–1800 g and 1800–2270 g).

Species composition

The annual proportion of eels processed at Mossburn Enterprises that was longfin has decreased over time (Figure 17). In the 1970s and early 1980s the species composition was about 90% longfin. From the late 1980s to the early 1990s this declined gradually to about 50% and in recent years about 60% of the catch processed was longfin (average for 2000s is 59%). However, in 1992–93, Mossburn Enterprises began processing eels from of Te Waihora, a predominantly shortfin eel fishery, and this has probably contributed to the increased proportion of shortfin eels processed in later years. Since 2000, however, only small quantities (less than 10 t per year) of eels have been landed from Te Waihora.

4. DISCUSSION

4.1 North Island eel size grades, species composition, and catch location

Data are presented from the first two years (2003–04 and 2004–05) of a commercial eel fishery monitoring programme that collects processor data on size grades, species composition, and catch location from North Island landings. Although this provides less information on size and sex distribution from individual landings than previous North Island catch sampling programmes (Beentjes & Chisnall 1997, 1998, Chisnall & Kemp 2000), it has the distinct advantage that it captures data from nearly all North Island eel landings, rather than a select few, thus providing a more accurate representation of the overall stock structure. Because virtually the entire annual catch is sampled, it provides an accurate estimate of the proportion of large eels in the North Island eel fishery — for longfins, this is in effect an index of potential spawning females since males migrate at a mean length of about 62 cm (Todd 1980) (equivalent to about 680 g), and so eels in the over 1000 g and over 1200 g size grades are almost certainly females. Finally, because the location of the catch is recorded at the time of landing, these variables can be related to three geographic area levels, i.e., QMA, ESA, and catchment based subarea. The shortcomings of this monitoring approach are that size grade data are coarse with only two to three size grades used, grades differ among the processors and/or species, and grades could change depending on market demands. The data also offer limited information on the sex structure of the populations, except for assumptions of sex inferred from size.

The 405 t of eels included in our analyses for 2003–04 and 386 t in 2004–05 represent 89% and 91% respectively of the landed catch for the North Island (Ministry of Fisheries 2006). The missing 10% may have been landed by smaller processors that we did not sample, or we did not receive all the data from the processors.

The relative catches by ESA are similar to long-term averages (Beentjes & Bull 2002) with ESAs 1 and 4 combined contributing about half the North Island catch (56% of the catch in 2003–04 and 46% in 2004–05). The reduction in 2004–05 reflects the higher proportion of catch landed from the lower North Island (QMA 22 and QMA 23) as Levin Eel Trading resumed processing in 2004–05 (catches were recorded against AFL LFRRs). The number of landings sourced from each ESA and QMA, was generally proportional to the catch (see Figures 2 and 4). The number of landings, however, is only a proxy of effort since it reveals nothing about the number of nets used for a given landing. Further, landing weights tend to increase with distance from the factory and are more likely to include catch from multiple days fishing, collected and tranported to the factory by tanker-truck.

The expression of catch by subarea shows that within a given ESA there is a large variation in the contribution of the various catchments, and this also varied between the years (see Figures 2 and 4). The variability is partly a reflection of the productivity of specific areas and also to effort applied to each area. For example, in 2003–04 only one landing was received from subarea 4F (Waipara River), compared with 221 landings from 4L (Lake Waikare/Port Waikato). Thus, only data from those subareas with consistently large numbers of landings are likely to be representative of the eel fishery in the short term. However, as the time series lengthens, patterns in size and species distribution will emerge, even for those subareas that yield few landings.

Overall, 74% in 2003–04 and 69% in 2004–05 of the total landed weight of eels in the North Island was shortfin, which is similar to the proportion of shortfin between 1991and 2003 (68%, estimated catch from CELRs and ECERs) (Beentjes & Dunn 2003b). The important longfin areas were 8 and 9 (Taranaki and Rangitikei/Whanganui), although a high proportion of longfins was also landed from ESA 6 in 2004–05 (see Figures 3 and 5). ESAs 8 and 9 have historically been the areas where longfin are often the dominant species in catches. There are some subareas, outside ESAs 8 and 9, however, that had catches dominated by longfin, but these need to be taken in the context of the number of landings provided by each area.

The catch by size-grade landing data provided by three North Island processors were used to calculate the proportions of several size grades and were arbitrarily defined as small, medium, and large (NZ Eel, AFL), or small and large (Vanderdrift). The proportions of eels in the three size grades of NZ eel and AFL were generally similar (see Tables 4 and 5). The main concern regarding the sustainability of the longfin eel fishery is the decline in numbers of large females and thus spawning escapement. About one-third or more of longfins landed were large eels (over 1000 g or 1200 g) and about half were larger than 500 g. Because longfins above about 700 g weight are predominantly, if not exclusively, females, it follows that less than one-half and more than one-third of all longfins caught in 2003–04 and 2004–05 were female, with the remainder being either male or female.

Size grade data for 2001–02 and 2002–02, previously provided in summary form by AFL and New Zealand eel (see Beentjes 2005), have been plotted with those from 2003–04, 2004–05, and preliminary data from 2005–06. There was little change in longfin size from 2001–02 to 2003–04 for AFL data (Figure 18), but size increased slightly between 2003–04 and 2005–06, and there was no trend in shortfin size. The longfin data for New Zealand Eel, however, show a trend of progressively increasing size in both longfin and shortfin from 2001–02 to 2005–06 (Figure 19). This trend of increasing size of eels landed is in contrast to the increased market demand for small eels, whereas there has been no change in the market demand for large eels since 2000 (John Jameson, AFL, pers. comm.). The recent increase in size may reflect a decline in catch and effort following introduction of North Island eels to the QMS in October 2004, and that some areas were not fished in 2003–04 when Levin Eel Trading did not process eels.

There is no trend in the overall percent of the catch by species for either processor from 2001–02 to 2005–06 (Figures 18 and 19), and the longfin average over this period was 20% and 31% for New Zealand Eels and AFL, respectively. The historic species composition was about 28% in the mid 1970s for New Zealand Eel, 40% for AFL in the mid to late 1980s, and 50% for Levin Eel Trading in the late 1970s to early 1980s (Beentjes 2005). This indicates that the proportion of longfin in the catch is from 10 to 20% less today than in historical catches taken during the development period of the eel fishery in the North Island.

The long-term success of this programme and the value in the time series is totally dependent on the eel processors providing timely and accurate data. The collection of size grade data and species composition by location (QMA, ESA, subarea) serves to highlight how eel populations can vary within geographic areas of different scale. For example, although ESA 4 generally had small eels, which were predominantly shortfin, there were several subareas within ESA 4 that had larger eels that were mainly longfins. Thus, the benefit of collecting landing data on a finer scale is that, given sufficient landings, the relative catch contributions, species composition, and size ranges of eels from discrete catchments can be quantified. This could be potentially useful to fisheries managers who may wish to manage fisheries within each QMA using different strategies, such as closed areas, size limits, species or catch restrictions, etc.

4.2 Historical size and species composition for the South Island

Mossburn Enterprise's historical data provide the most comprehensive time series of records on species composition and size grades processed in the South Island, and generally reflect the population structure of commercial eels in the South Island, particularly in Southland. Analysis of this time series shows that the average size of both shortfin and longfin eels processed in the South Island has progressively declined over the last 30 years and is now largely based on eels in the smallest processed size grade (under 450 g) (see Figure 16). The inclusion of data from 2003–04 to 2005–06 suggests that there has been little change since the 1990s for either species. The lumping of live-exported longfin eels into a single size grade (1800–2270 g) in recent years has introduced a bias into the dataset for the 2000s, and caution should be exercised in interpreting data for larger eels.

Following the introduction of South Island eels into the QMS on 1 October 2000, the number of fishers declined by about 6-fold (Victor Thompson, pers comm). This reduction in fishing effort together with poor market demand for eels, has resulted in the TACC being consistently undercaught. Given the reduction in both effort and catch, we might expect to have observed a general increase in the size of eels landed, but this has not occurred. One explanation for the status quo is that the remaining eel fishers continue to fish the main river fisheries and have not extended their effort into the smaller streams and less accessible areas that are now largely unfished (Victor Thompson, pers. comm.). As markets improve, effort will also increase and we could expect to see larger eels landed from these areas.

There was a gradual decline in the proportion of longfins processed by Mossburn Enterprises from the 1970s to the early 1990s, but since 1992–93 the proportion of longfin in the catch has been relatively stable at about 60% (see Figure 17).

4.3 Pre-fishery longfin eel populations

Although data on size of eels processed before the 1970s is lacking, studies before commercial fishing began indicate that longfin populations in Southland were dominated by large females. For instance, the average weight from more than 11 000 eels caught in tributaries of the Oreti River in 1939 was about 1400 g (Cairns 1942), which equates to a length of about 83 cm. Further, longfins from three inland Southland rivers (Waiau tributaries) sampled between 1947 and 1949 (Burnet 1952) were mainly between about 60 and 90 cm, with many eels over 100 cm in length. This contrasts markedly

with the size of longfins that are currently processed in the South Island, and provides strong evidence of a major change in the population size structure in the main stems as a result of commercial fishing.

4.4 Conclusions

North Island

1. Data are presented from the first two years (2003–04 and 2004–05) of a monitoring programme that collects size grade, species composition, and catch location data from North Island landings.
2. The analyses for 2003–04 and 2004–05 included 89% and 91% respectively, of the landed catch of eels for the North Island.
3. Overall, 74% in 2003–04 and 69% in 2004–05 of the total landed catch of eels in the North Island was shortfin.
4. There was a large variation in the landed catch from the 65 North Island catchment-based subareas, and this also varied between years.
5. Catch location for each landing has enabled species composition and size to be related to North Island geographic areas of progressively finer resolution, i.e., QMA, ESA, and catchment based subarea.
6. About one-third of North Island longfin landed weight in 2003–04 and 2004–05 was made up of eels in the largest size grade (individual weights over 1000 g or 1200 g), and by virtue of size, these were females.
7. Data in the largest size grade would be enhanced greatly if numbers of eels were provided with the landed weight, so that mean size could be estimated.

South Island

8. There was no equivalent provision of data in the South Island in 2003–04 and 2004–05, but there is an historical database that summarises annual landings by size grades for each species, from the mid 1970s to 2005–06.
9. The average size of both shortfin and longfin eels processed in the South Island has progressively declined over the last 30 years and is now largely based on eels in the smallest processed size grade (under 450 g). There has been little change since the 1990s for either species.
10. There was a gradual decline in the proportion of longfins processed in the South Island from the 1970s to the early 1990s, but since 1992–93 the proportion of longfin in the catch has been relatively stable at about 60%.

5. ACKNOWLEDGMENTS

This research was carried out by NIWA under contract to the Ministry of Fisheries (Project EEL2004/02). We are grateful to the following eel processors for providing catch data: Mossburn Enterprises Ltd. (Invercargill), New Zealand Eel Processing Co. Ltd (Te Kauwhata), Aotearoa Fisheries Ltd (Whenuapai). We also thank John McKoy and Peter Todd for reviewing the manuscript, and Mike Beardsell for editorial comments.

6. REFERENCES

Anonymous (2004). Setting of sustainability and other management controls for stocks to be introduced into the QMS on 1 October 2004. North Island shortfin and longfin eels (SFE, LFE). Initial position paper, 13 February 2004. 115 p. (Unpublished report held by Ministry of Fisheries, Wellington.)

Beentjes, M.P. (1999). Size, age, and species composition of South Island commercial eel catches from market sampling (1997–98). *NIWA Technical Report 51*. 51 p.

Beentjes, M.P. (2005). Monitoring commercial eel fisheries in 2003–04. *New Zealand Fisheries Assessment Research Report 2005/39*. 57 p.

Beentjes, M.P. (in prep). Monitoring commercial eel fisheries in 2005–06 and 2006–07. *New Zealand Fisheries Assessment report* p.

Beentjes, M.P.; Bull, B. (2002). CPUE analyses of the commercial freshwater eel fishery. *New Zealand Fisheries Assessment Report 2002/18*. 55 p.

Beentjes, M.P.; Chisnall, B.L. (1997). Trends in size and species composition and distribution of commercial eel catches. *New Zealand Fisheries Data Report 89*. 71 p.

Beentjes, M.P.; Chisnall, B.L. (1998). Size, age, and species composition of commercial eel catches from market sampling (1996–97). *NIWA Technical Report 29*. 124 p.

Beentjes, M.P.; Dunn, A. (2003a). CPUE analysis of the commercial freshwater eel fishery in selected areas, 1990–91 to 2000–01. *New Zealand Fisheries Assessment Report 2003/54*. 47 p.

Beentjes, M.P.; Dunn, A. (2003b). Species composition and CPUE analysis for North Island commercial eel fishery stocks for the period 1990-91 to 2002-03. Final Research Report for Ministry of Fisheries Research Project MOF200301A. 53 p. (Unpublished report held by Ministry of Fisheries, Wellington.)

Boubée, J.; Williams, E.; Beentjes, M.P.; Bowman, E. (2002). Recruitment of longfinned eels, 2001–02. Final Research Report for Ministry of Fisheries Research Project EEL2000/01. 52 p. (Unpublished report held by Ministry of Fisheries, Wellington.)

Burnet, A.M.R. (1952). Studies on the ecology of the New Zealand longfinned eel, *Anguilla dieffenbachii* Gray. *Australian Journal of Marine and Freshwater Research 3*: 32–63.

Cairns, D. (1942). Life-history of the two species of fresh-water eel in New Zealand. III. Development of sex. Campaign of eel destruction. *New Zealand Journal of Science and Technology 23*: 173–178.

Chisnall, B.L.; Kemp, C. (2000). Size, age, and species composition of commercial eel catches from market sampling in the North Island. *NIWA Technical Report 87*. 67 p.

Jellyman, D.J.; Chisnall, B.L.; Todd, P.R. (1995). The status of the eel stocks of Lake Ellesmere. *NIWA Science and Technology Series 26*. 62 p.

Jellyman, D.J.; Graynoth, E.; Francis, R.I.C.C.; Chisnall, B.L.; Beentjes, M.P. (2000). A review of evidence for a decline in the abundance of longfinned eels (*Anguilla dieffenbachii*) in New Zealand. Final Research Report for Ministry of Fisheries Research Project EEL9802. 76 p. (Unpublished report held by Ministry of Fisheries, Wellington.)

Ministry of Fisheries, Science Group (Comps.) (2006). Report from the Fishery Assessment Plenary, May 2006: stock assessments and yield estimates. 875p. (Unpublished report held in NIWA library, Wellington.)

Speed, S.R.; Browne, G.N.; Boyd, R.O. (2001). Assessment and monitoring of commercial eel fisheries. Final Research Report for Ministry of Fisheries Research Project EEL9801. 178 p. (Unpublished report held by Ministry of Fisheries, Wellington.)

Todd, P.R. (1980). Size and age of migrating New Zealand freshwater eels (*Anguilla* spp.). *New Zealand Journal of Marine and Freshwater Research 14*: 283–293.

Table 1: Catchment subareas, eel statistical areas, and Quota Management Areas (QMA) for the North Island eel fishery.

	Subarea		
Code	Number	Eel statistical area	QMA
1A–1E	5	1	20
2A–2C	3	2	20
3A–3C	3	3	21
4A–4Q	17	4	21
5A–5D	4	5	21
6A–6G	7	6	21
7A–7F	6	7	22
8A–8F	6	8	23
9A–9F	6	9	23
10A–10C	3	10	22
11A–11C	3	11	22
12A–12B	2	12	22
Total	65	12	4

Table 2: Longfin eel size grades used by Mossburn Enterprises and the conversions from imperial to metric unit. Shortfin size grades are identical except for the < 1 lb and 1–2 lb grades where they have used < 500 g and 500–900 g, respectively.

		Size grade
(lbs)	(g)	Rounded (g)
< 1	< 454	< 450
1–2	454–908	450–900
2–3	909–1362	901–1360
3–4	1363–1816	1361–1800
4–5	1817–2270	1801–2270
5–7	2271–3178	2271–3200
> 7	> 3178	> 3200

Table 3: Summary of landings and species weights from North Island processors in 2003–04 and 2004–05 fishing years.

	2003–04			2004–05		
Processor	No. landings	Weight SFE (kg)	Weight LFE (kg)	No. landings	Weight SFE (kg)	Weight LFE (kg)
Vanderdrift	175	18 072	21 878	0	–	–
NZ Eel	511	151 947	28 007	549	124 980	42 351
AFL	729	129 367	55 396	590	140 903	77 889
Total	1415	299 386	105 281	1139	265 883	120 240

Table 4: Summary of shortfin eel size grades from North Island processors in 2003–04 and 2004–05 fishing years. Total landings and weights are shown in Table 3.

		% SFE by size grade				
Year	Processor	220–500 g	500–1000 g	<1000 g	>1000 g	Total
2003–04	NZ Eel	62	29	–	9	100
	AFL	51	34	–	14	100
	Vanderdrift	–	–	86	14	100
2004–05	NZ Eel	57	29	–	14	100
	AFL	52	34	–	14	100

Table 5: Summary of longfin eel size grades from North Island processors in 2003–04 and 2004–05 fishing years. Total landings and weights are shown in Table 3.

		% LFE by size grade						
Year	Processor	220–500 g	500–1000 g	500–1200 g	<1000 g	>1000 g	>1200 g	TOTAL
2003–04	NZ Eel	49	–	15	–	–	35	100
	AFL	54	16	–	–	30	–	100
	Vanderdrift	–	–	–	63	37	–	100
2004–05	NZ Eel	46	–	16	–	–	38	100
	AFL	46	18	–	–	35	–	100

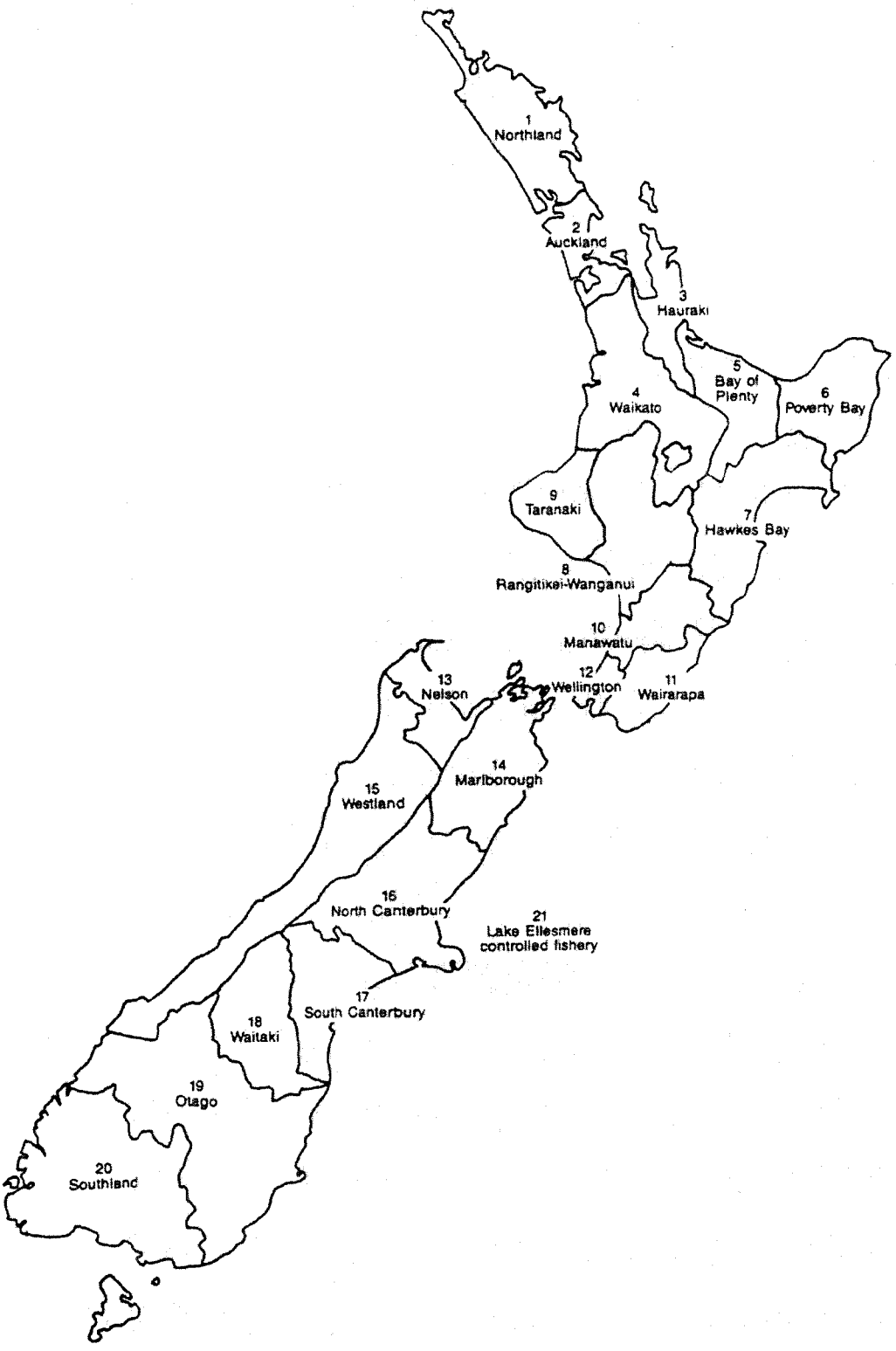


Figure 1. Eel statistical areas (ESAs).

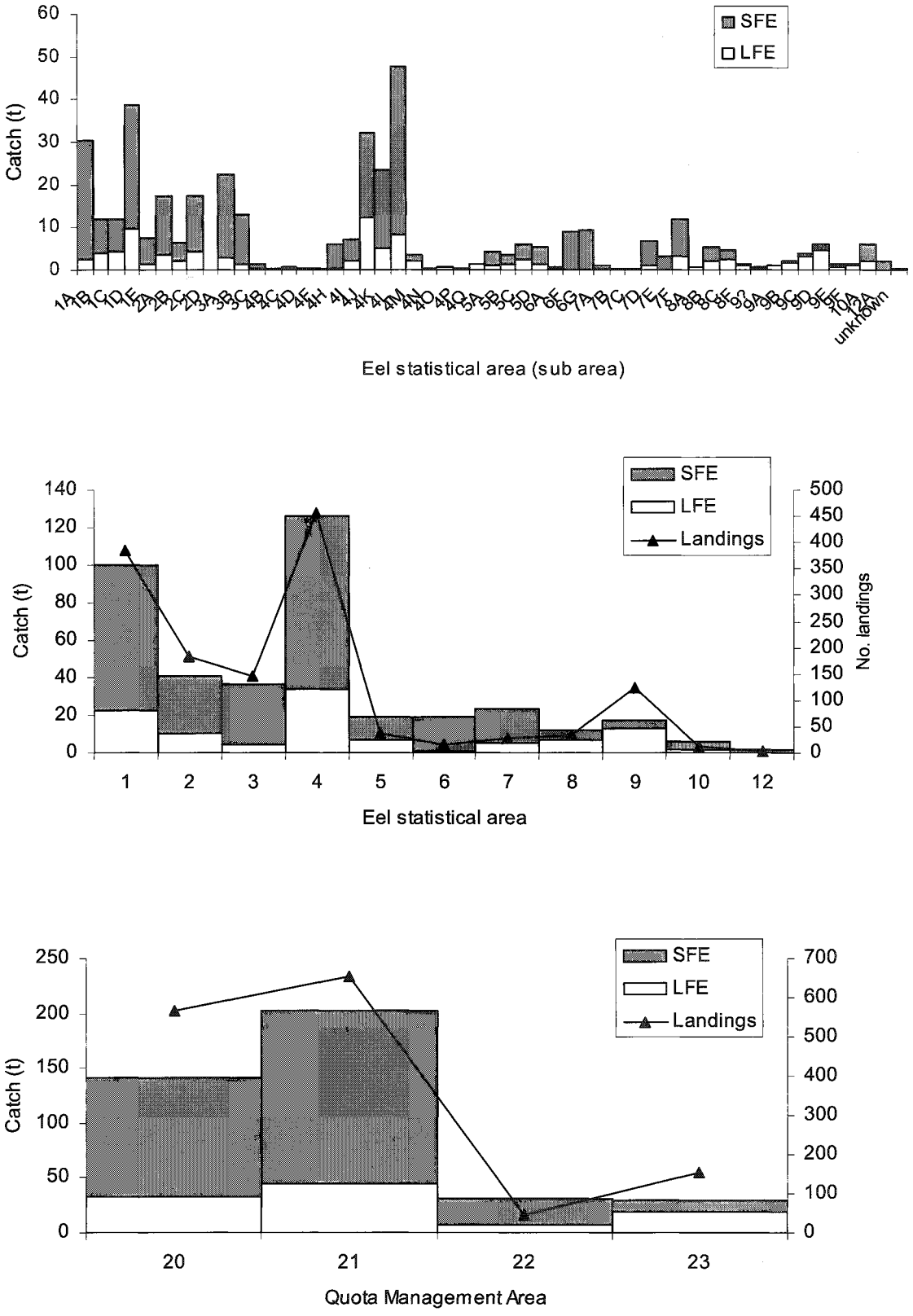
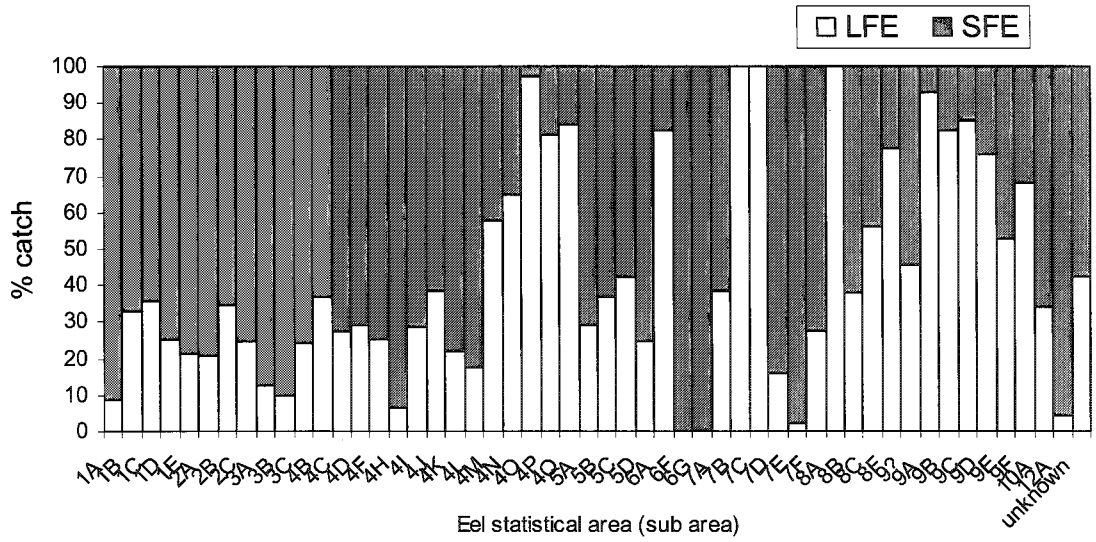
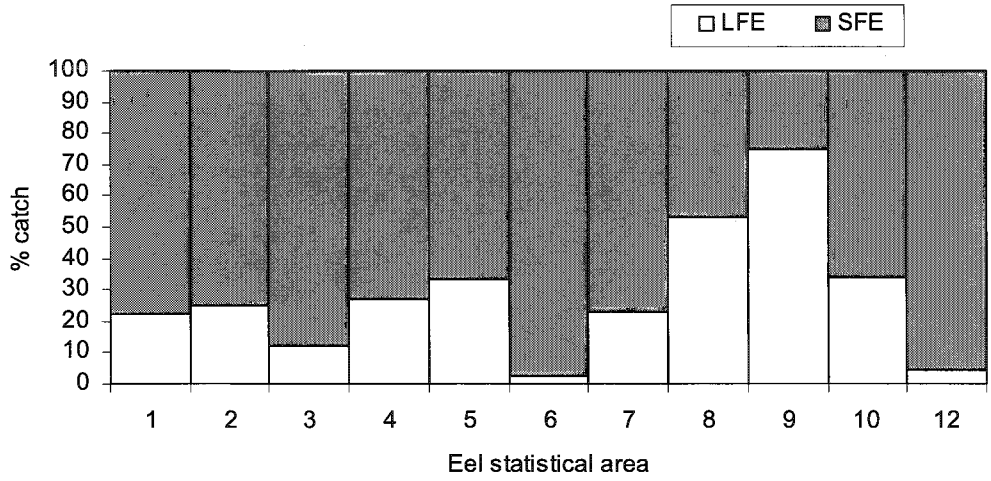


Figure 2: Catch (t) of shortfin (SFE) and longfin (LFE) eels and landings in 2003–04, grouped by area. Data are from North Island processors' records. See Table 3 for landings and tonnages.





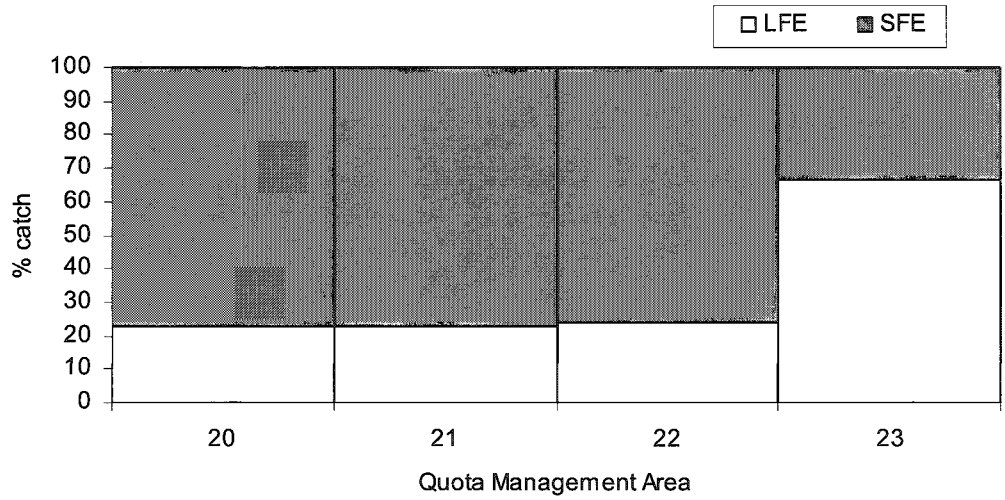


Figure 3: Species composition of shortfin (SFE) and longfin (LFE) eels in 2003–04. Data are from North Island processors' records. See Table 3 for landings and tonnages. The overall proportion of shortfin was 74%.

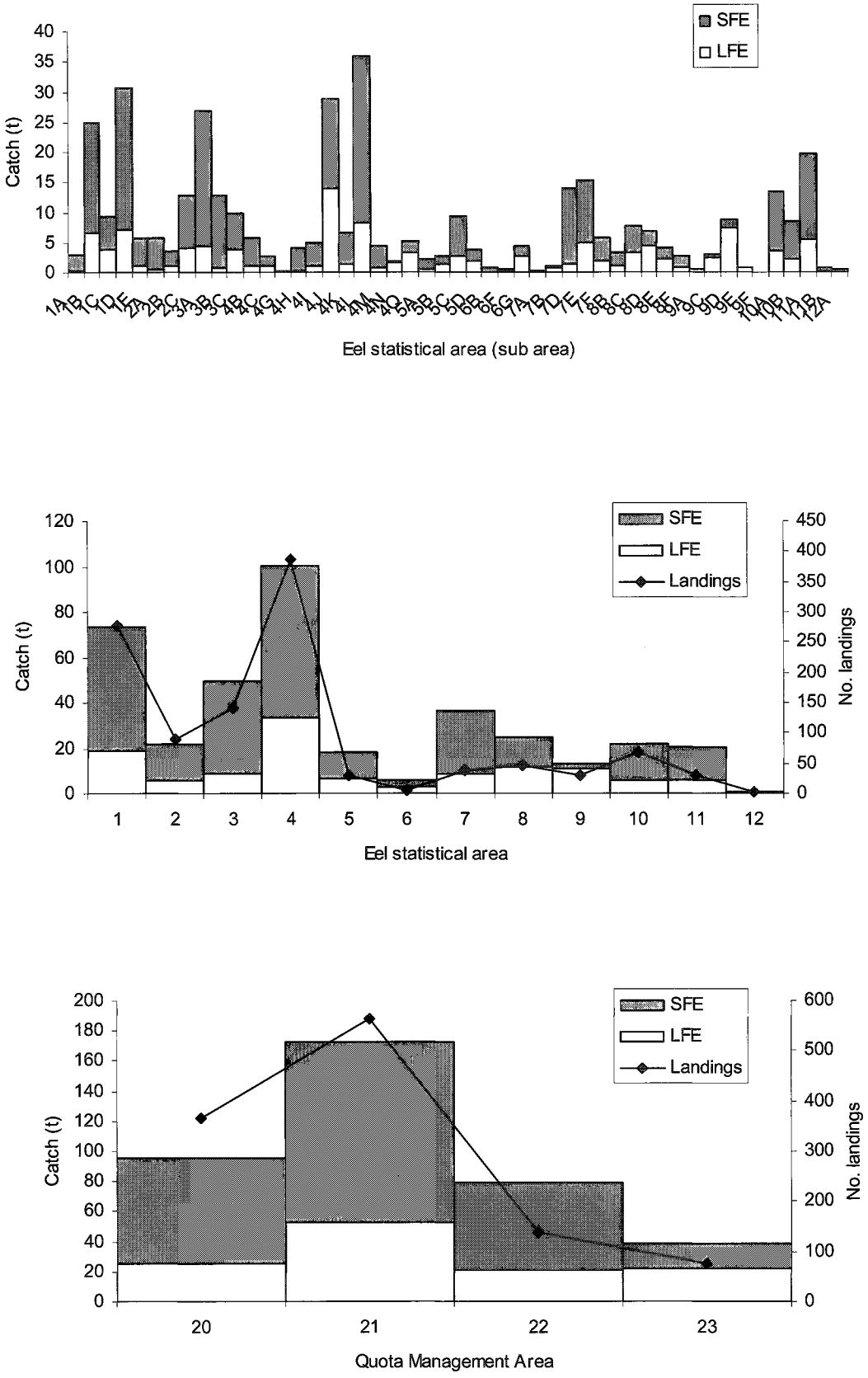


Figure 4: Catch (t) of shortfin (SFE) and longfin (LFE) eels and landings in 2004–05, grouped by area. Data are from North Island processors' records. See Table 3 for landings and tonnages.

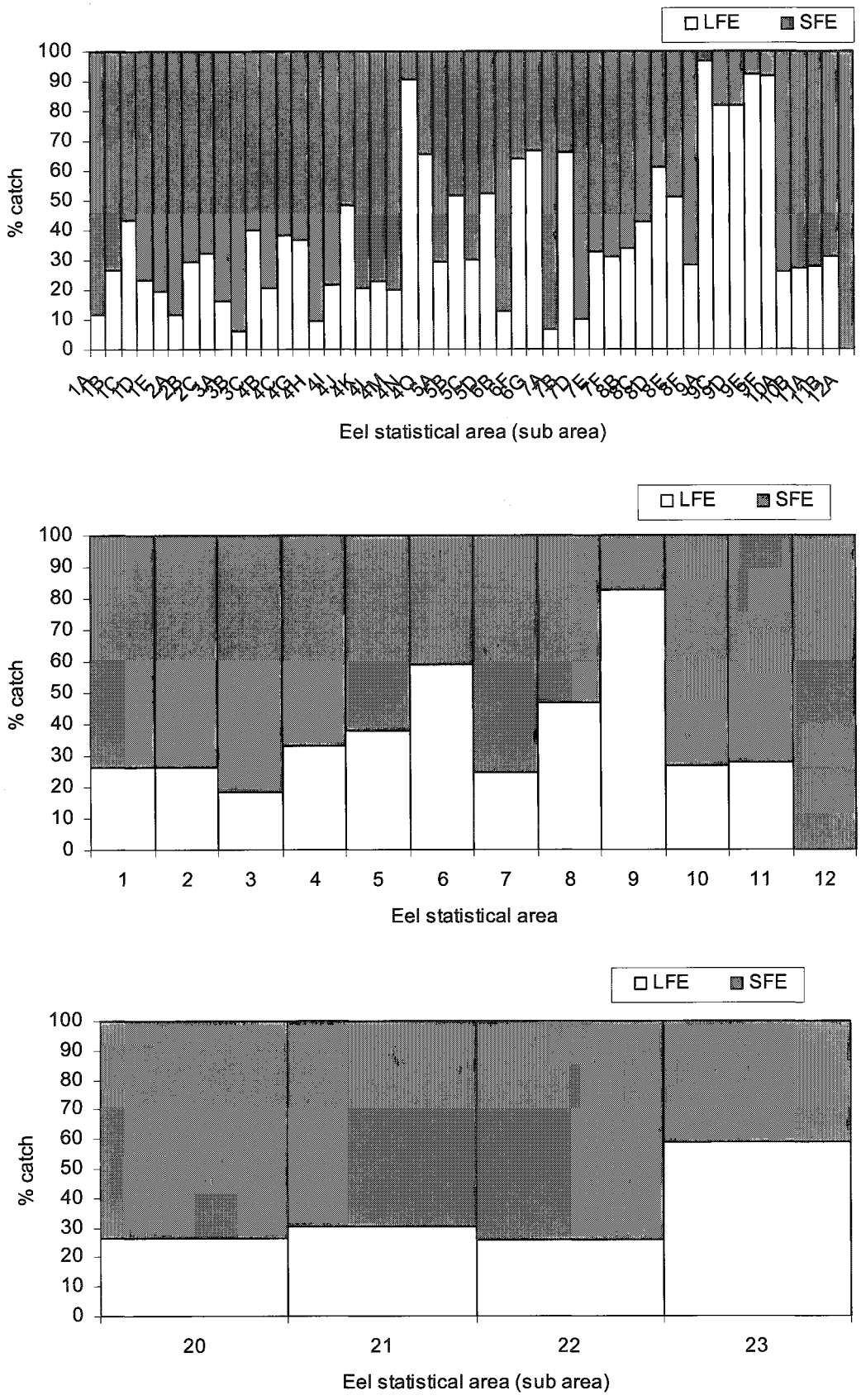


Figure 5: Species composition of shortfin (SFE) and longfin (LFE) eels in 2004–05. Data are from North Island processors' records. See Table 3 for landings and tonnages. The overall proportion of shortfin was 69%.

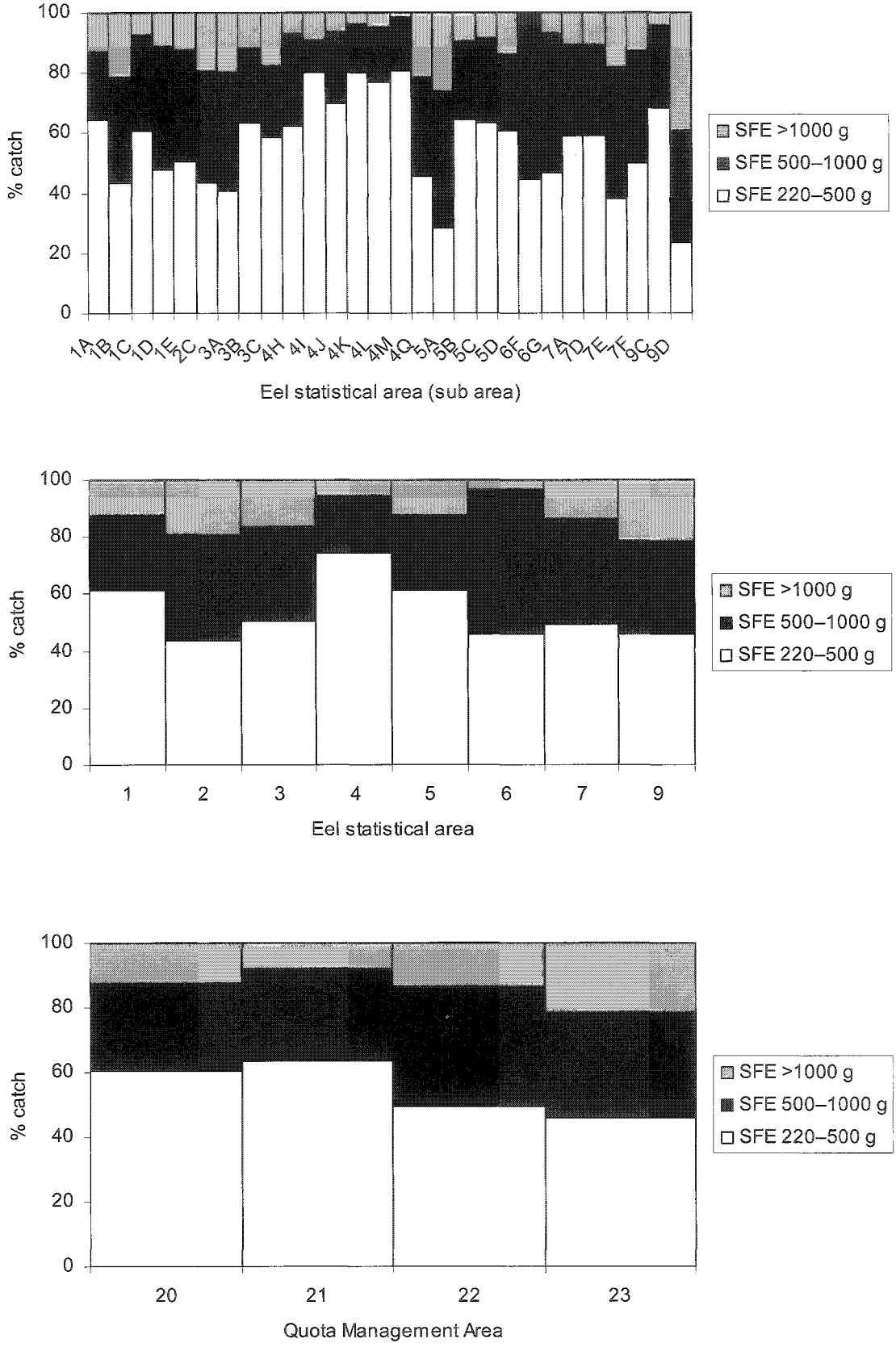


Figure 6: Proportion of shortfin (SFE) catch in three size grades, by area, processed by NZ Eel in 2003–04. See Table 3 for landings and tonnages and Table 4 for overall proportions in each size grade.

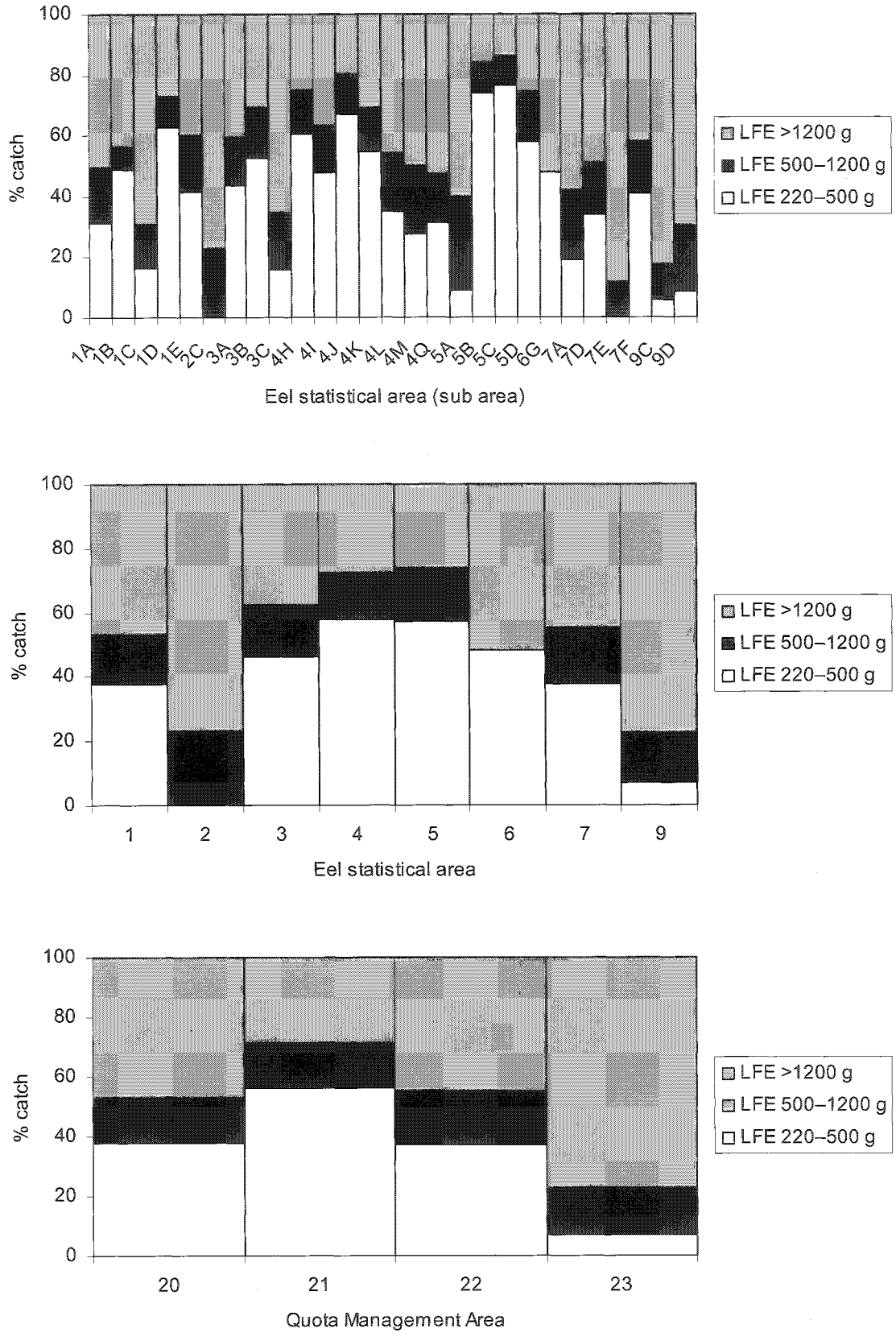


Figure 7: Proportion of longfin (LFE) catch in three size grades, by area, processed by NZ Eel in 2003–04. See Table 3 for landings and tonnages and Table 4 for overall proportions in each size grade.

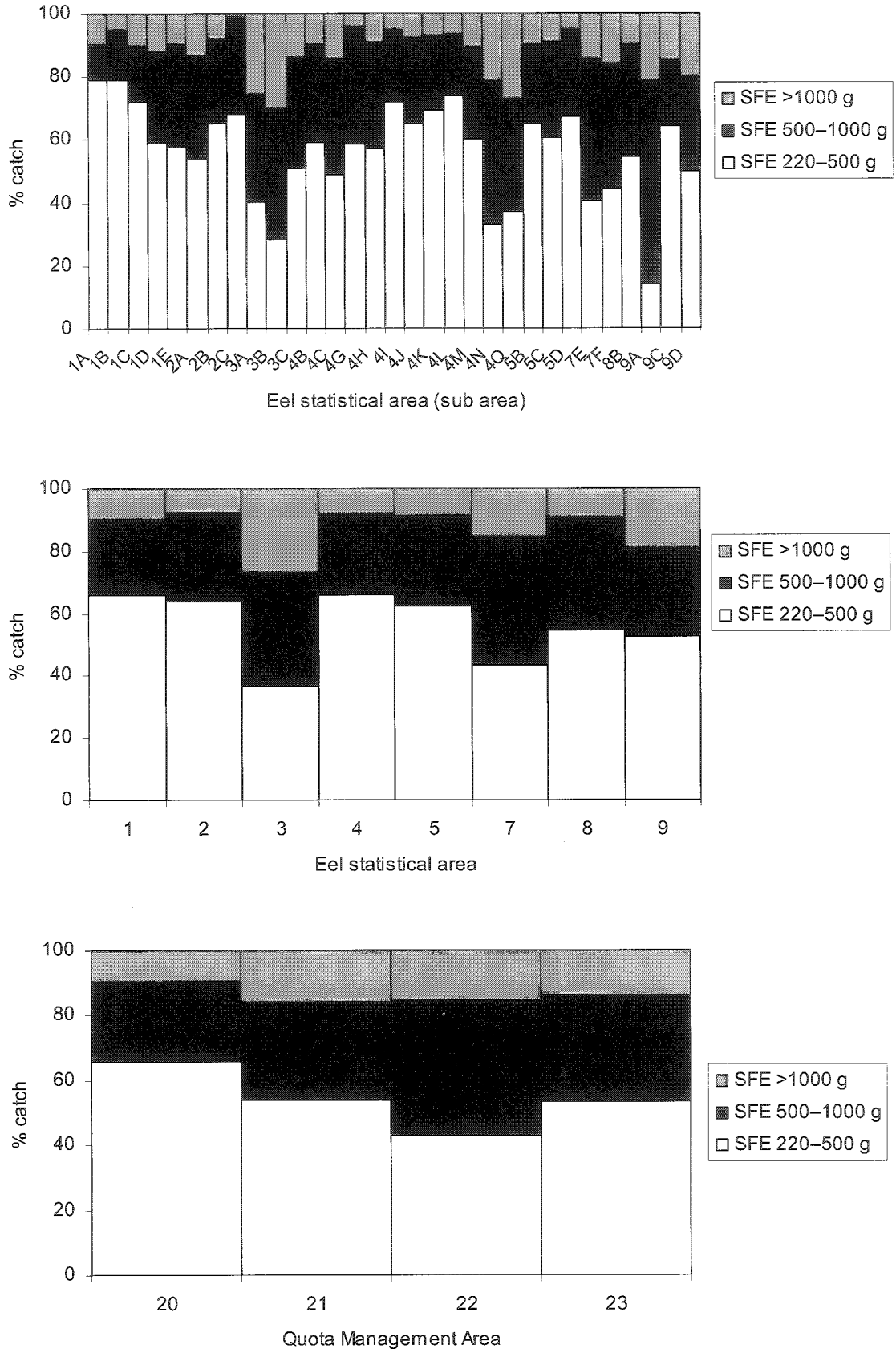


Figure 8: Proportion of shortfin (SFE) catch in three size grades, by area, processed by NZ Eel in 2004–05. See Table 3 for landings and tonnages, and Table 4 for overall proportions in each size grade.

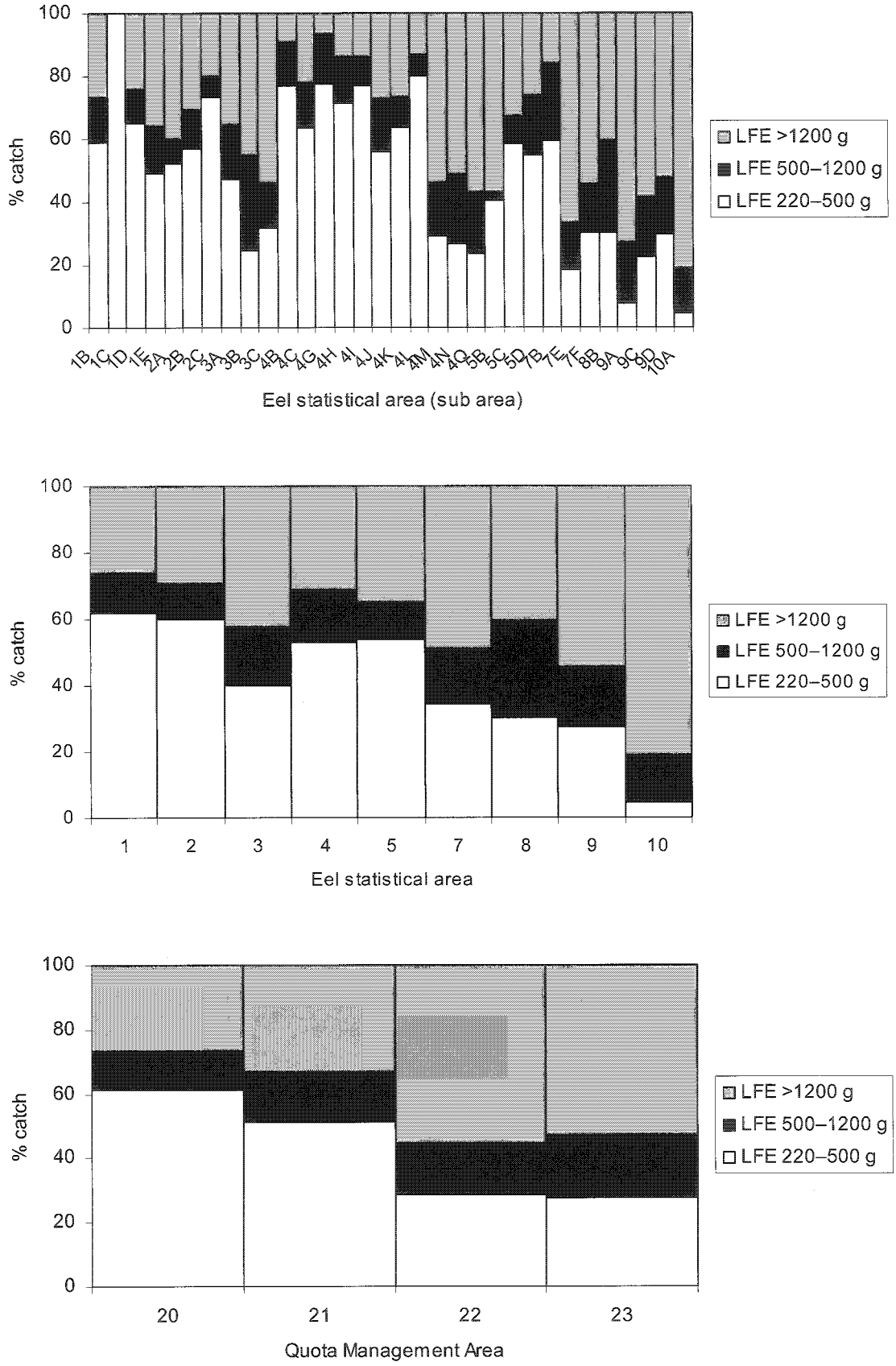


Figure 9: Proportion of longfin (LFE) catch in three size grades, by area, processed by NZ Eel in 2004–05. See Table 3 for landings and tonnages, and Table 5 for overall proportions in each size grade.

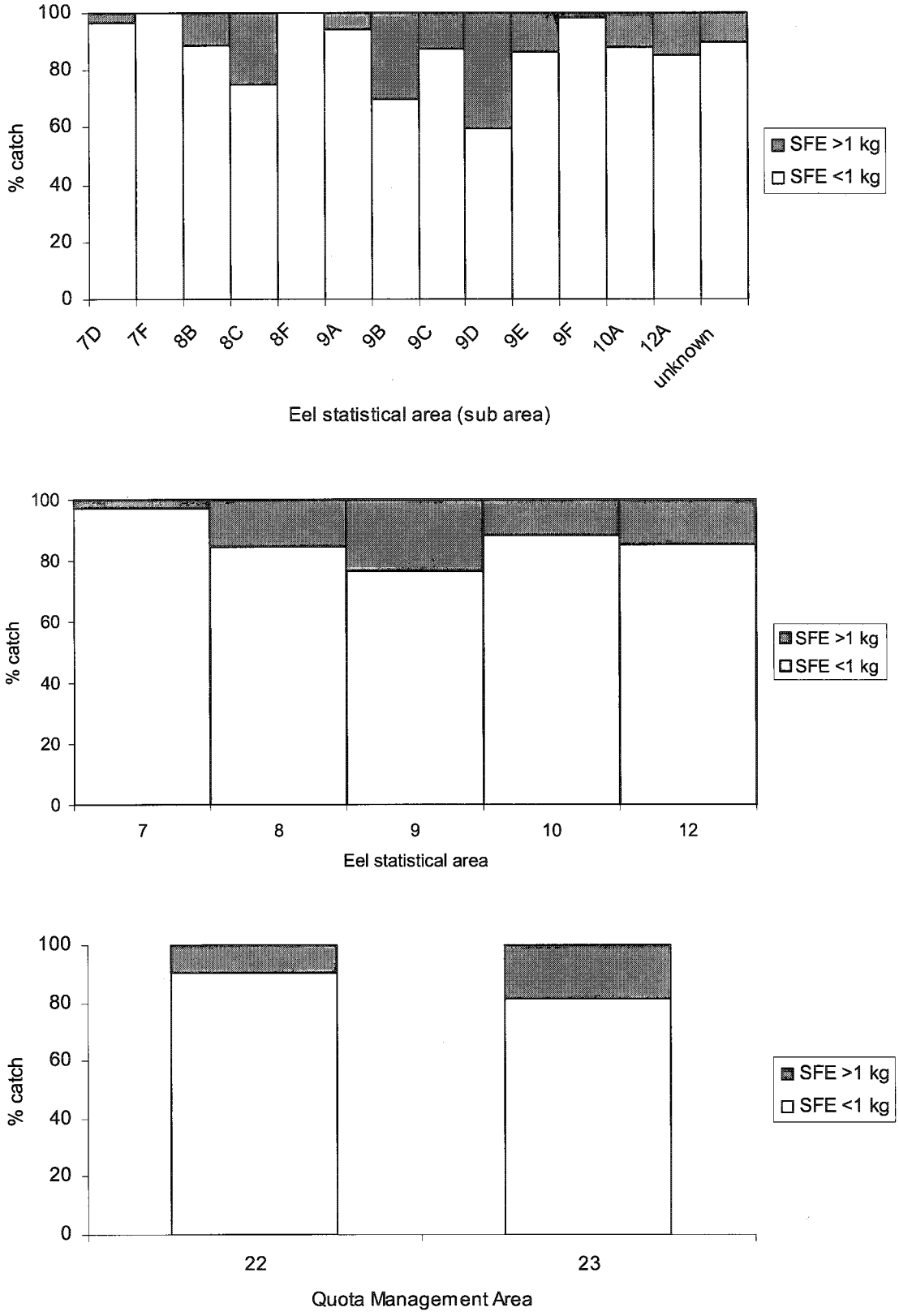


Figure 10: Proportion of shortfin (SFE) catch in two size grades, by area, processed by Vanderdrift in 2003–04. See Table 3 for landings and tonnages, and Table 4 for overall proportions in each size grade.

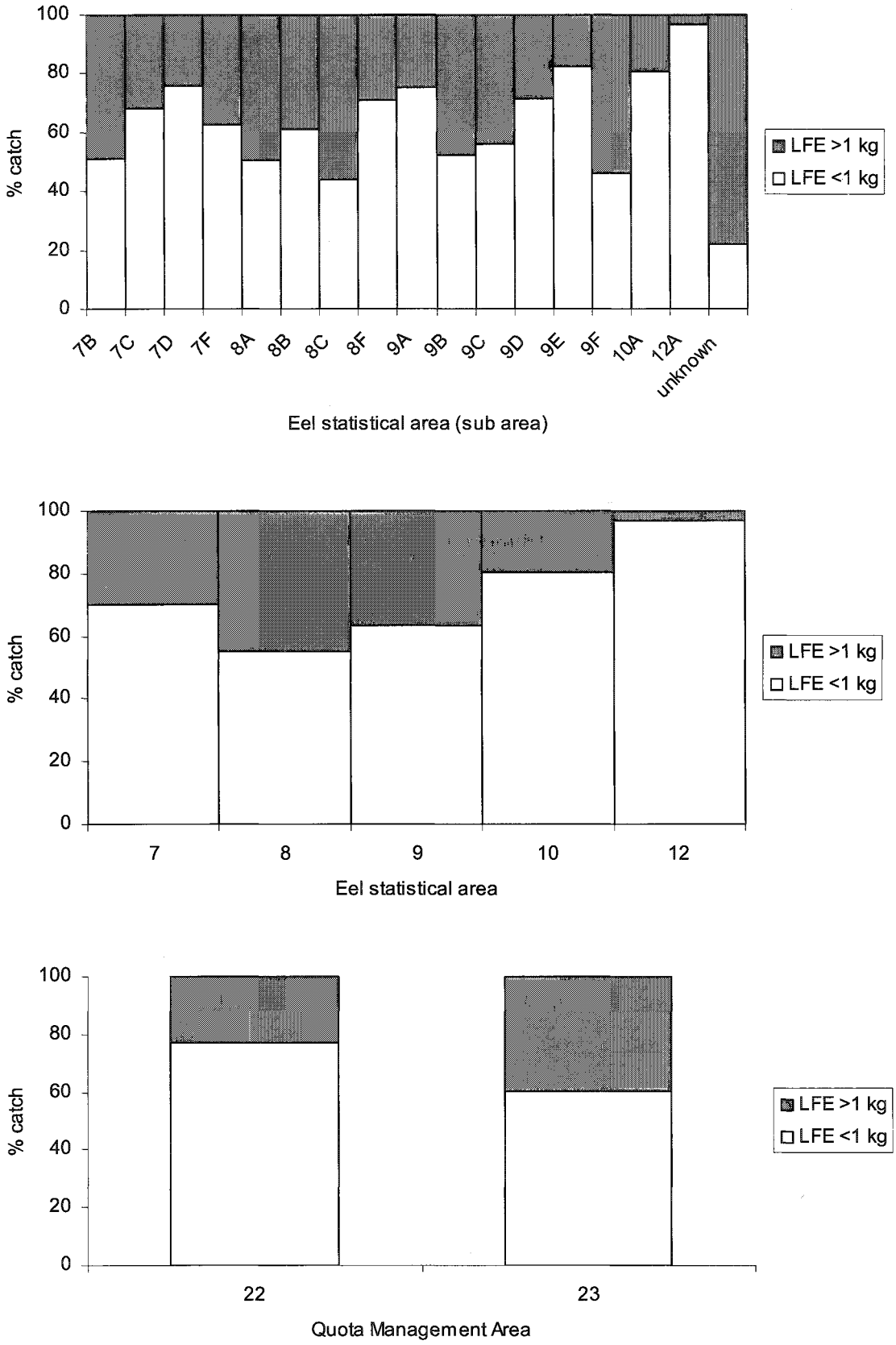


Figure 11: Proportion of longfin (LFE) catch in two size grades, by area, processed by Vanderdrift in 2003–04. See Table 3 for landings and tonnages, and Table 5 for overall proportions in each size grade.

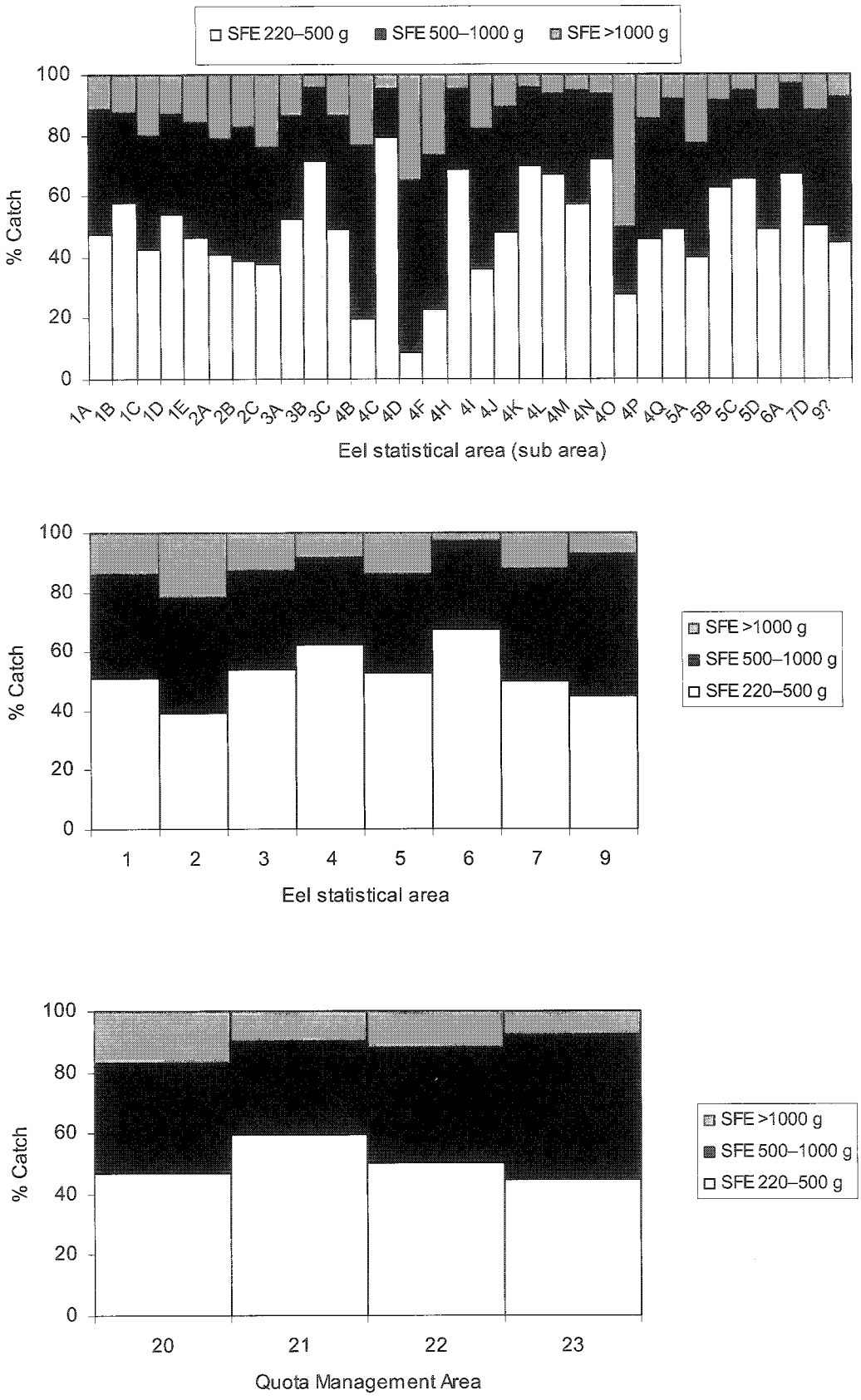


Figure 12: Proportion of shortfin (SFE) catch in three size grades, by area, processed by AFL in 2003–04. See Table 3 for landings and tonnages, and Table 4 for overall proportions in each size grade.

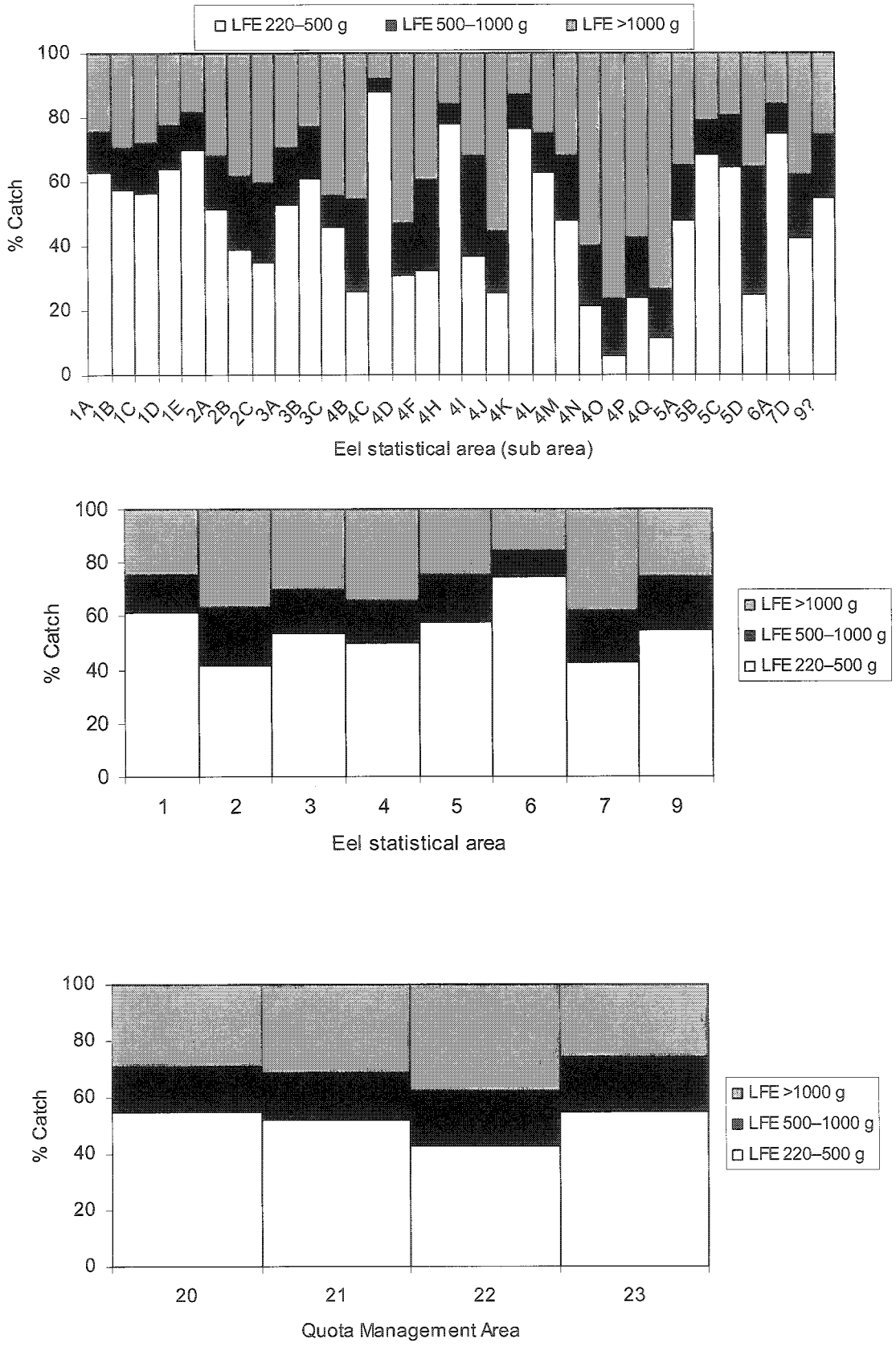


Figure 13: Proportion of longfin (LFE) catch in three size grades, by area, processed by AFL in 2003–04. See Table 3 for landings and tonnages, and Table 5 for overall proportions in each size grade.

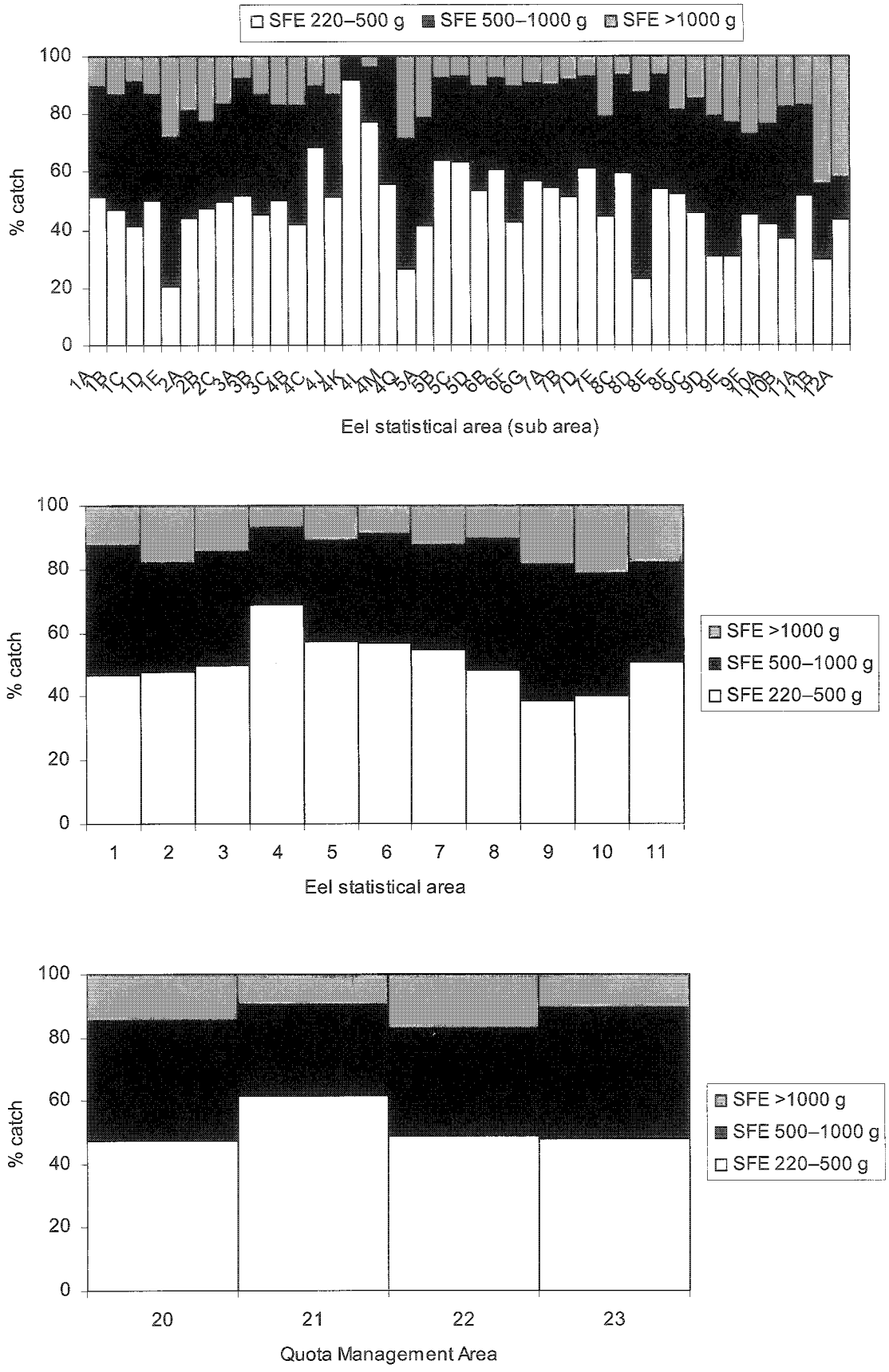


Figure 14: Proportion of shortfin (SFE) catch in three size grades, by area, processed by AFL in 2004–05. See Table 3 for landings and tonnages, and Table 4 for overall proportions in each size grade.

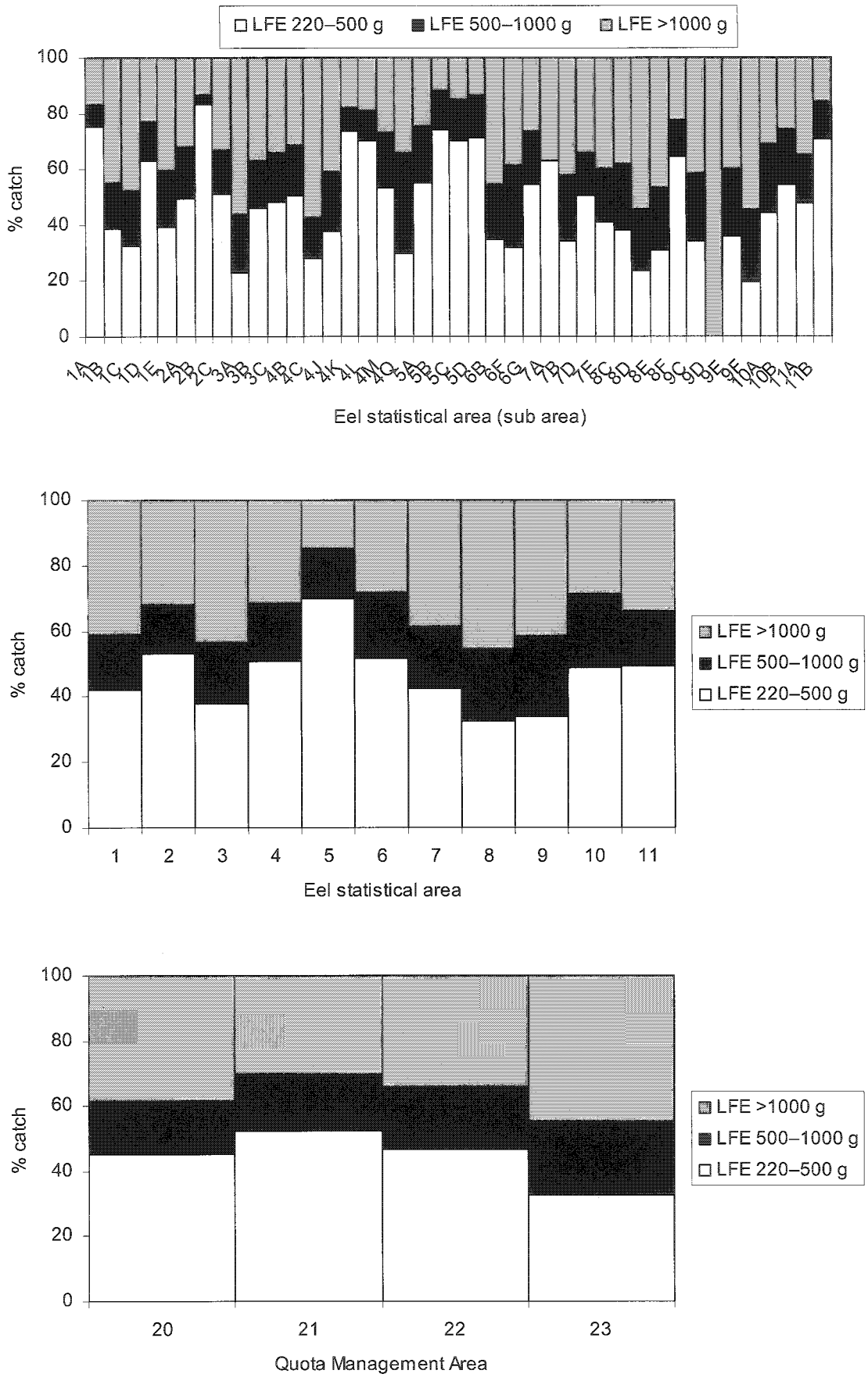


Figure 15: Proportion of longfin (LFE) catch in three size grades, by area, processed by AFL in 2004–05. See Table 3 for landings and tonnages, and Table 5 for overall proportions in each size grade.

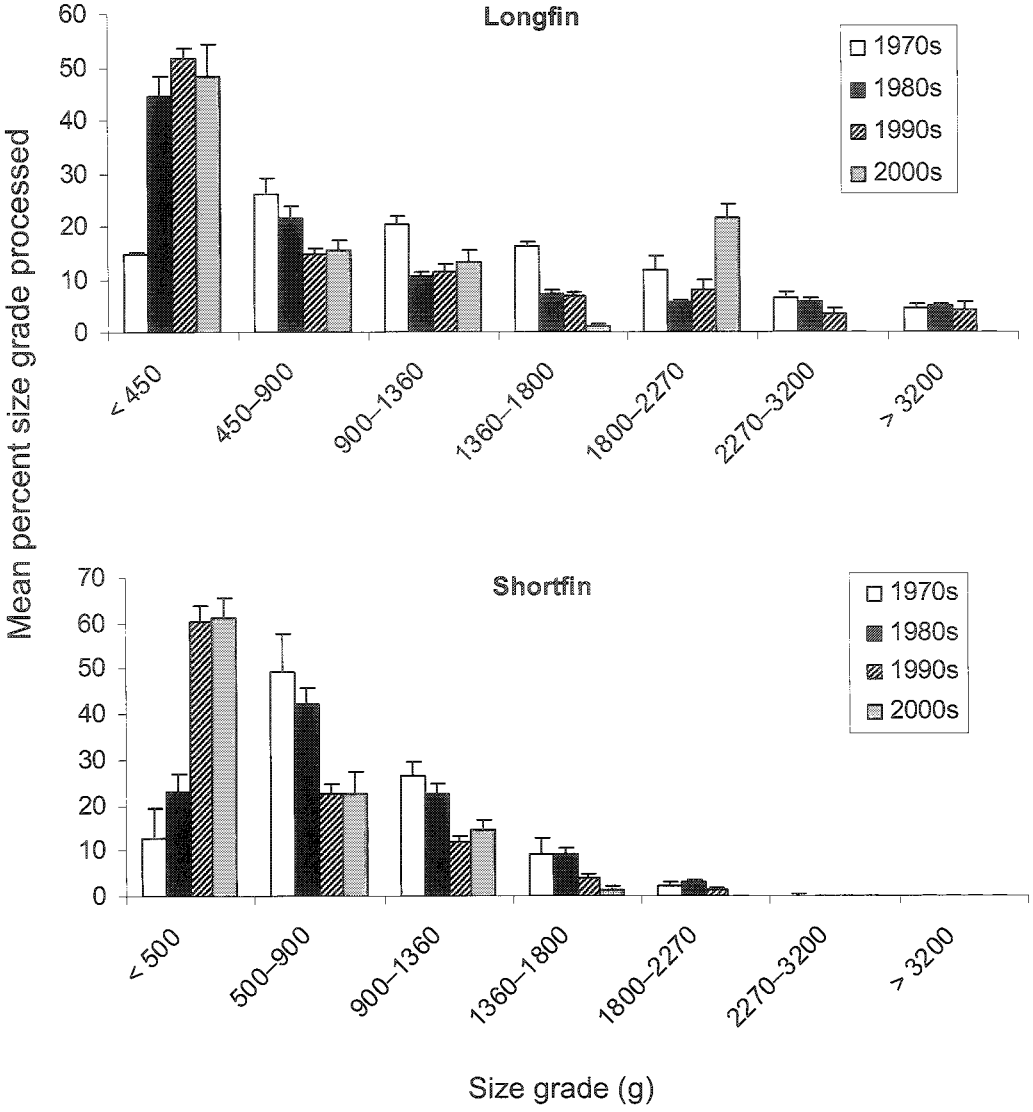


Figure 16: Size grades of longfin and shortfin eels processed at Mossburn Enterprises Ltd (Invercargill) in the 1970s, 1980s, 1990s, and 2000s. 1970s years: 1974–75, 1977–78 and 1978–79; 1980s years: 1983–84 to 1988–89; 1990s years: 1989–90 to 1998–99: 2000s years: 1999–2000 to 2005–06. Error bars represent standard errors.

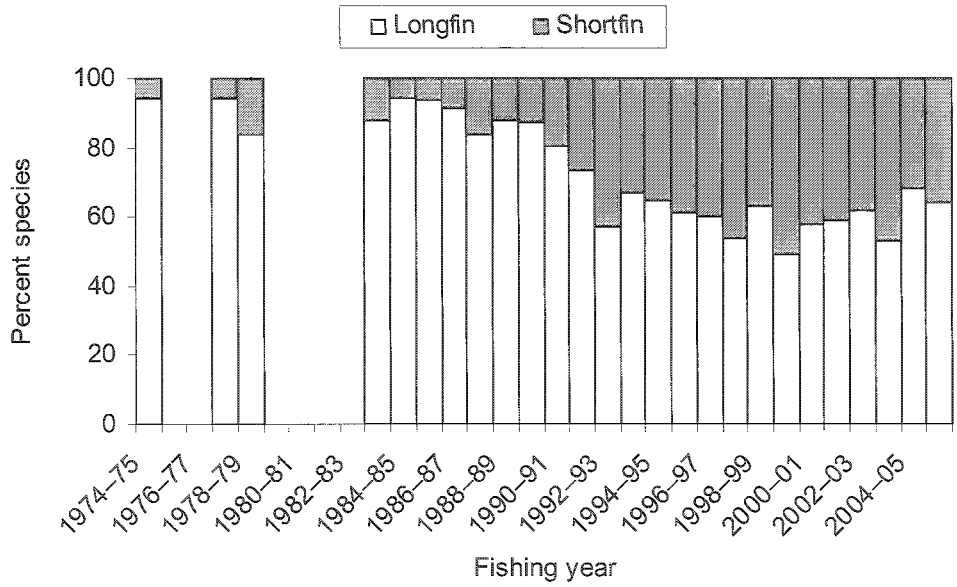


Figure 17: Proportion of eel species (longfin and shortfin eels) processed at Mossburn Enterprises Ltd (Invercargill) from 1974–75 to 2005–06 fishing years.

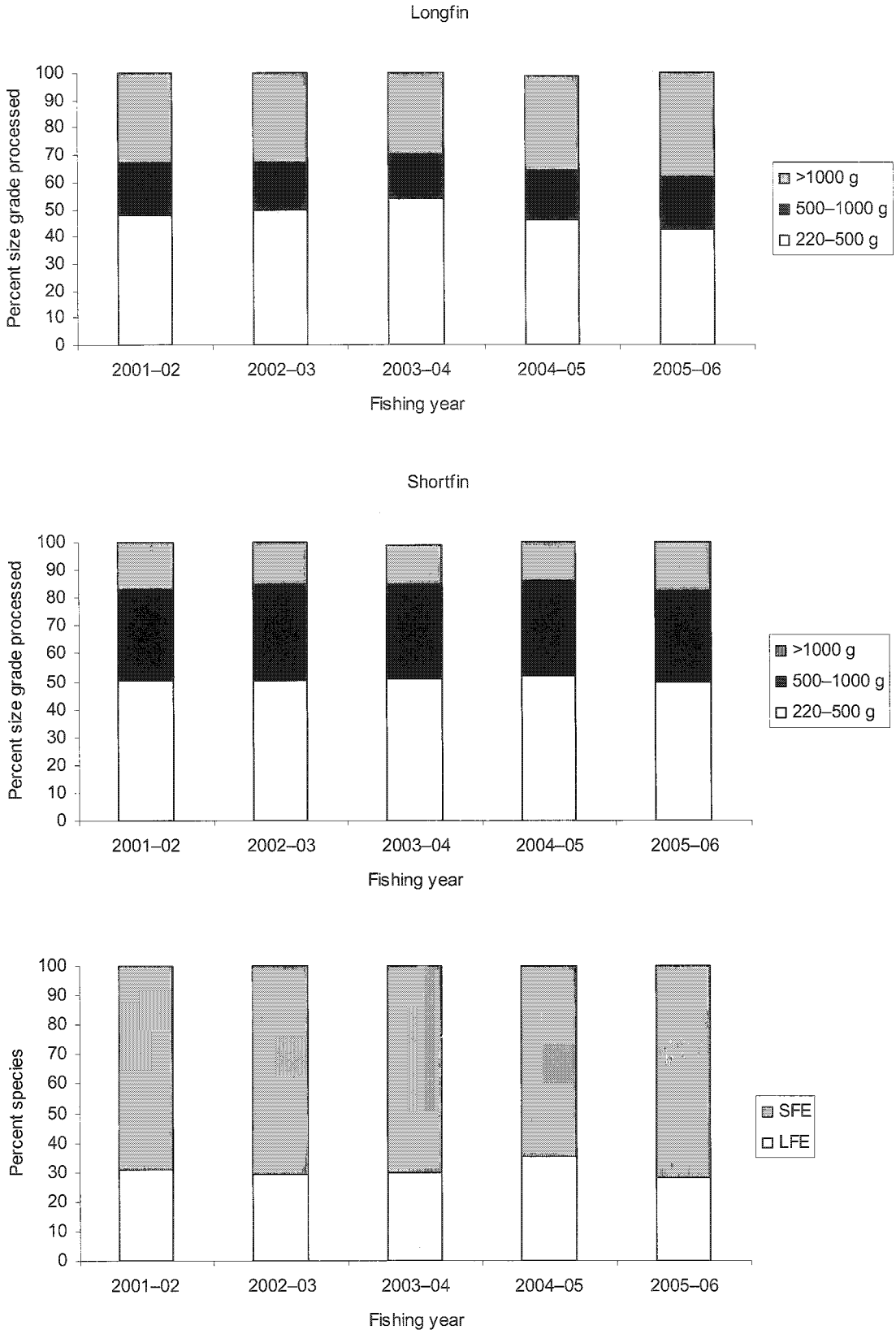


Figure 18: Proportion of longfin and shortfin eels in three size grades, and percent species processed at AFL (Whenuapai) in 2001–02 to 2005–06. 2005–06 is provisional and includes data up until July 2006.

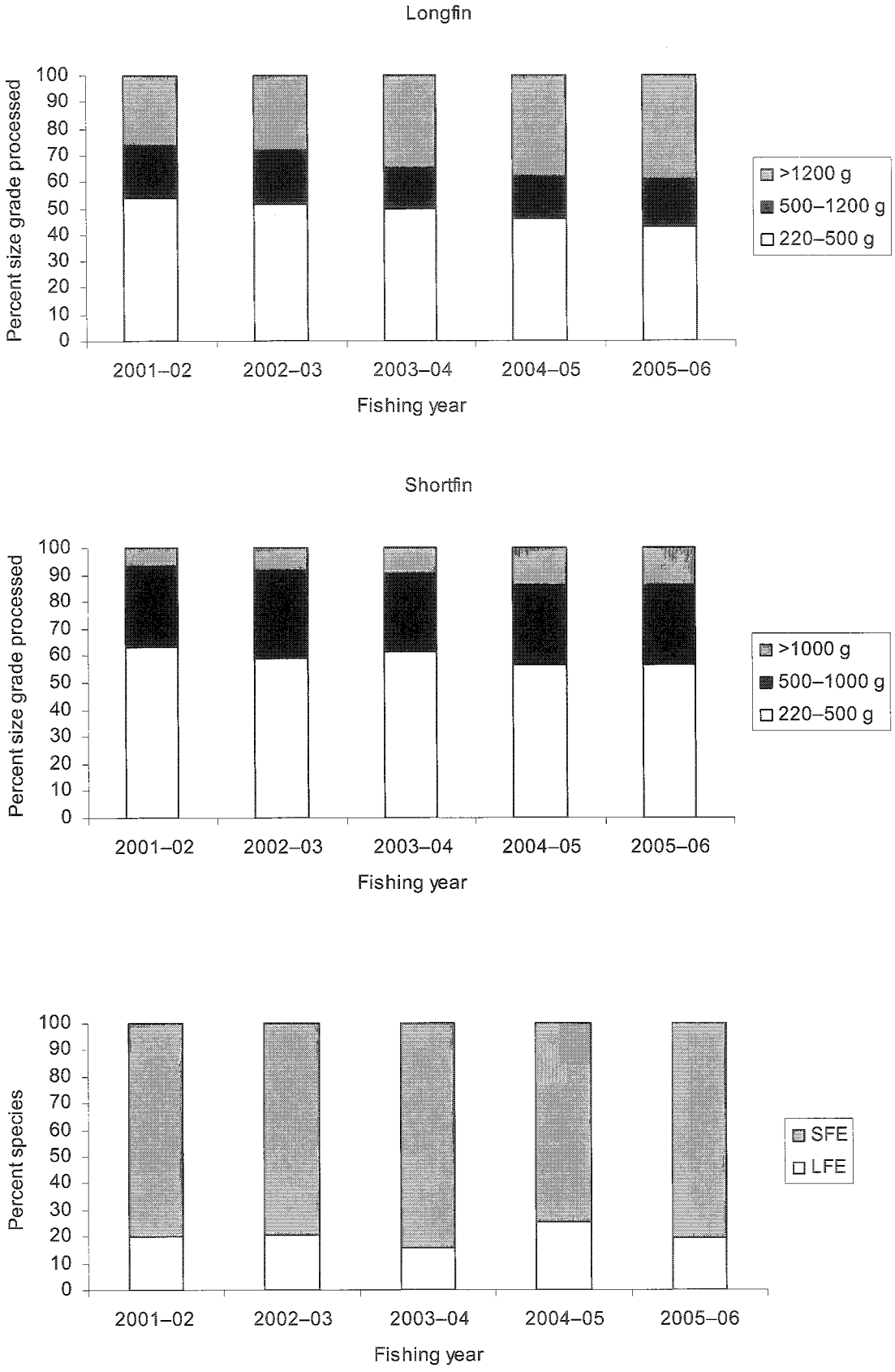
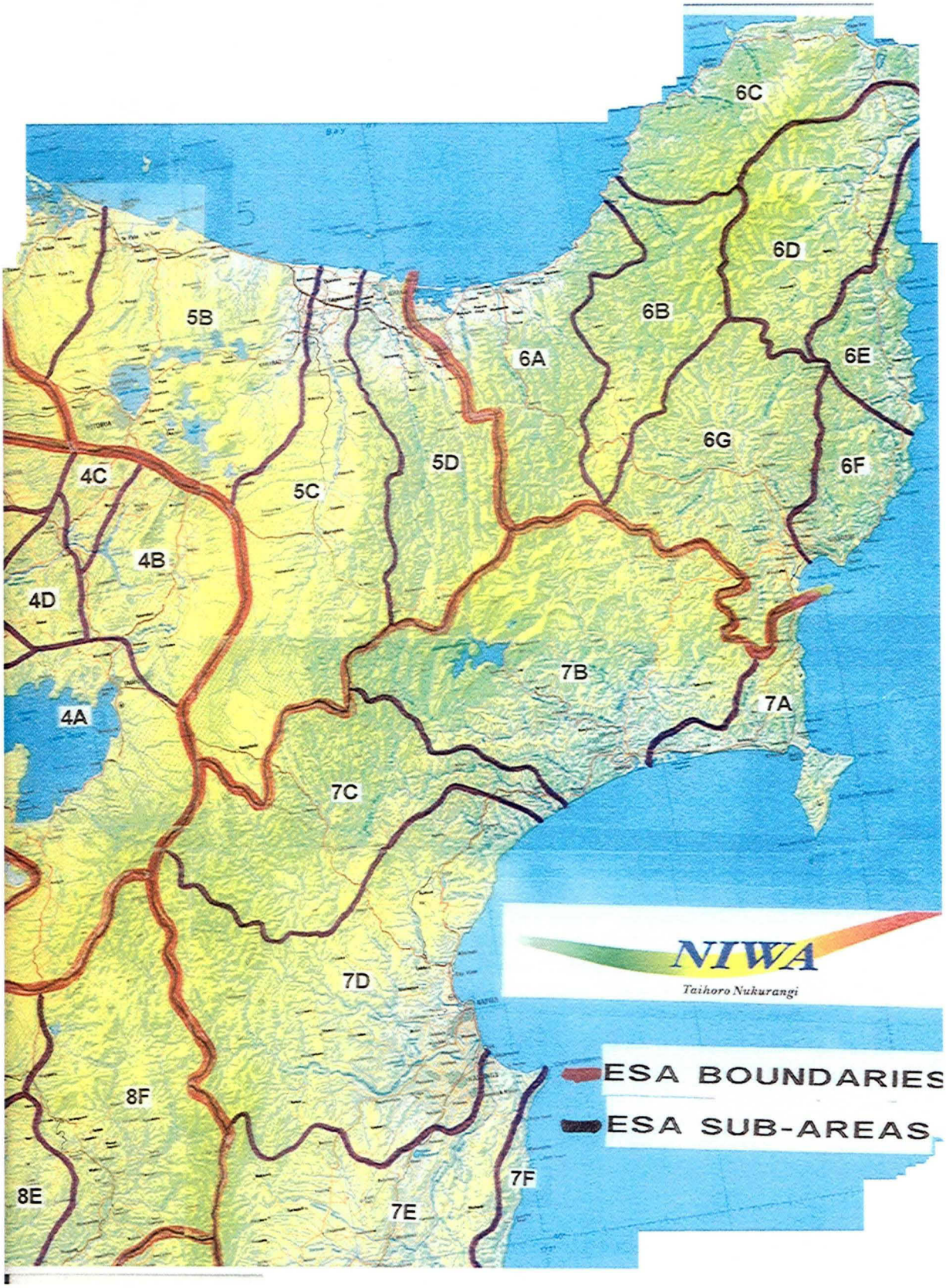


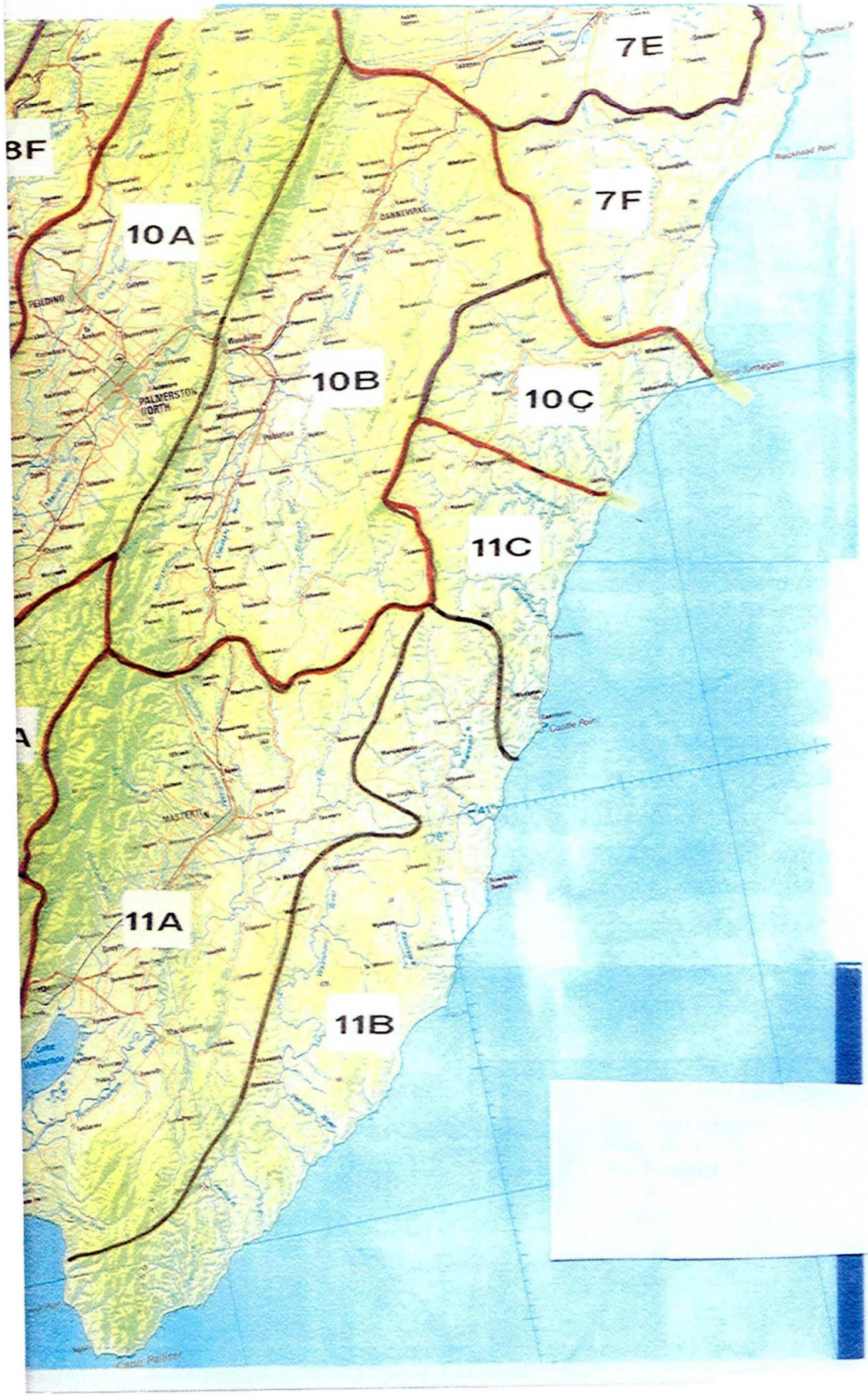
Figure 19: Proportion of longfin and shortfin eels in three size grades, and percent species processed at NZ Eel (Te Kauwhata) in 2001–02 to 2005–06. 2005–06 is provisional and includes data up until August 2006.

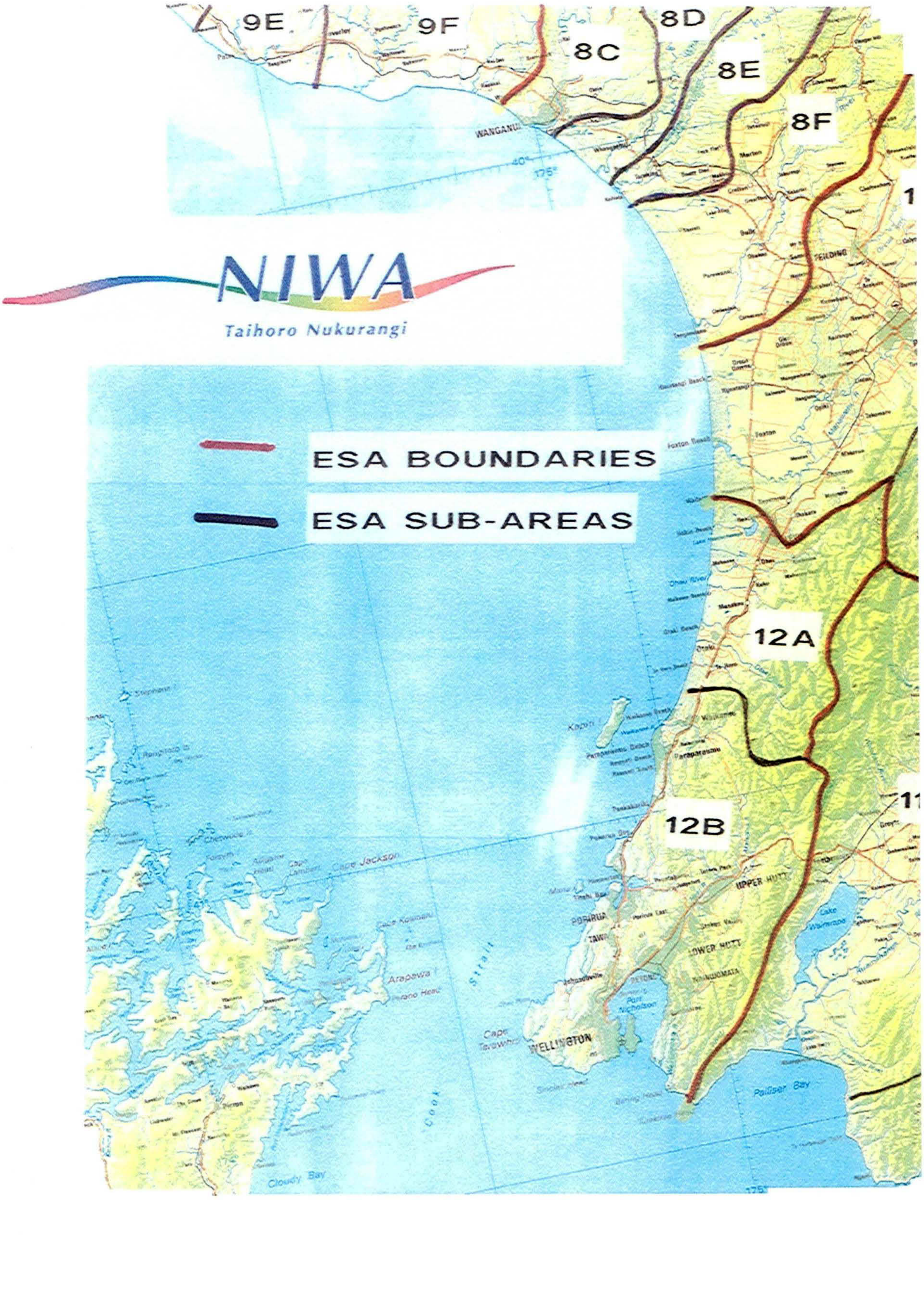
Appendix 1: Eel statistical area (ESA) and subarea boundaries for reporting species and size grade of commercial landings. Reproduced by permission of Land Information New Zealand. Red borders indicate ESAs and black borders ESA subareas.


ESA BOUNDARIES
ESA SUB-AREAS
1E
2A
2B
2C
3A
3B
3C
4L
GREAT BARRIER ISLAND
AUCKLAND
CORONAN PENINSULA


3C
4L
3A
3B
4K
5A
4M
4I
4H
4J
4C
4N
4G
4F
4B
4O
4E
4D
4Q
4P
4A
8A
9A
8B
9B
9D
8F
9C
8D
9F
8C
8E
9E


6C
6D
6B
6E
6A
6G
6F
5B
5D
5C
4C
4B
4D
4A
7B
7A
7C
7D
8F
8E
7F
7E
NIWA
Taihoro Nukurangi
ESA BOUNDARIES
ESA SUB-AREAS


7E
7F
10A
10B
10C
11C
11A
11B
PALMERSTON NORTH
MASTERTON
DANNEVIRKE
Castle Point


9E
9F
8D
8C
8E
8F
NIWA
Taihoro Nukurangi
ESA BOUNDARIES
ESA SUB-AREAS
12A
12B
WANGANUI
WELLINGTON
UPPER HUTT
LOWER HUTT
PORIRUA
Cape Jackson
Cook Strait
Palliser Bay
Cloudy Bay
Lake Wairarapa

Appendix 2. The 65 North Island subarea codes with general locations. The number of the alphanumeric subarea code refers to the eel statistical area within which the subarea is located.

Subarea code	Location
1A	Kaitaia
1B	Hokianga Harbour
1C	Bay of Islands
1D	Dargaville
1E	Bream Bay
2A	Warkworth
2B	Auckland
2C	Manukau Harbour
3A	Hauraki Plains west
3B	Hauraki Plains east
3C	Coromandel Peninsula
4A	Lake Taupo
4B	Lake Ohakuri
4C	Lake Atiamuri
4D	Lake Whakamaru
4E	Lake Maraetai
4F	Lake Waipapa
4G	Lake Arapuni
4H	Lake Karapiro
4I	Hamilton
4J	Pirongia Forest Park
4K	Lake Whangape
4L	Lake Waikare/Port Waikato
4M	Raglan Harbour
4N	Kawhia Harbour
4O	Marakopa River
4P	Awakino River
4Q	Mokau River
5A	Tauranga
5B	Rotorua Lakes
5C	Rangitaiki River
5D	Whakatane River
6A	Ohiwa Harbour
6B	Motu River
6C	Cape Runaway
6D	Waiapu River
6E	Tolaga Bay
6F	Gisborne
6G	Waipaoa River
7A	Mahia Peninsula
7B	Lake Waikaremoana
7C	Mohaka River
7D	Napier
7E	Tukituki River
7F	Waimarama/Porangahau
8A	Taumarunui
8B	Whanganui River inland
8C	Whanganui River coast
8D	Whangaehu River

8E	Turakina River
8F	Rangitikei River
9A	North Taranaki Bight
9B	Waitara River
9C	Mount Taranaki coast
9D	Patea River inland
9E	Patea River coast
9F	Waitotara River
10A	Manawatu River coast
10B	Manawatu River Inland
10C	Akitio River
11A	Lake Wairarapa
11B	Wairarapa coast
11C	Castle point
12A	Otaki
12B	Wellington