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Monitoring commercial eel fisheries: 2018–19 to 2020–21

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EXECUTIVE SUMMARY

Beentjes, M.P.[1] (2022). Monitoring commercial eel fisheries: 2018–19 to 2020–21.

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The commercial freshwater eel (ANG: longfin, *Anguilla dieffenbachii*; shortfin, *A. australis*) monitoring programme began in the North Island in 2003–04, capturing processor data on size grades, species composition, and catch location from individual landings. In the South Island, processor data were provided initially in 2006–07 for Quota Management Area ANG 15 only (Southland/Otago), but no details on specific catch locations were recorded. Provision of complete data, similar to the North Island, has occurred for the South Island since the 2010–11 fishing year. This report provides results from the 2018–19, 2019–20, and 2020–21 fishing years and examines trends in the 18 years of landing data from the North Island, 15 years of landing data from ANG 15, and 11 years of landing data from the entire South Island. Factors that may have contributed to observed trends are considered. Additionally, historical commercial eel landing data dating back to the 1970s are examined.

North Island shortfin

Shortfin in the North Island were caught from nearly all subareas (63 of the possible 65) over the 18 years, but the catch was highly aggregated, with nearly one-third of the catch originating from just three subareas: AA4 (Dargaville), AD12 (Lake Waikare, Port Waikato), and AC1 (Hauraki plains west). Shortfin total landed catch and catch within the three size grades over the 18-year period shows no consistent trend, notwithstanding the low catches in the last two years and the under-sampled catch in 2003–04. The fluctuations from year to year in catch and size proportions have been influenced by factors such as Total Allowable Commercial Catch (TACC) reductions, market demands, annual rainfall, increases in the escape tube opening size, quota/Annual Catch Entitlement (ACE) availability, closure of a processing factory in Levin in 2020, and COVID19. There are no indications from the landed and processed North Island shortfin catch since 2003–04 that abundance or size has declined due to fishing. The spatial pattern of shortfin landings by subarea was generally similar over the first fifteen years, but, in the last three years, the number of subareas fished has declined, indicating a slight contraction in spatial effort by fishers targeting shortfin, and this is consistent with an observed decline in fisher numbers and effort.

North Island longfin

Longfin were landed from 63 of the possible 65 subareas over the 18 years, but the catch was highly aggregated with 36% of the catch originating from just four subareas: AA4 (Dargaville), AD12 (Lake Waikare, Port Waikato), AD10 (Waipa River), and AL1 (Lake Wairarapa). North Island commercial longfin total landed catches over the 18-year period have fluctuated but overall have declined, although catch within the three size grades showed no trend. Factors that influenced annual longfin catches, overall and within size ranges, include the 58% TACC reductions for North Island stocks for the 2007–08 fishing year and a further 32% reduction in 2018–19, volatile market demands, a progressive decline in the availability of ACE to fishers, economics of fishing, and, more recently, the closure of a processing factory in Levin in 2020 and COVID19. There are no indications from the landed and processed North Island longfin catch since 2003–04 that abundance or size has declined due to fishing. The North Island longfin catch since 2001–02 was strongly correlated with the numbers of permits fished and fishing events, which in turn reflects the economics of fishing for longfin. The spatial pattern of longfin landings by subarea was generally similar over the first fifteen years, but, in the last three years, the number of subareas providing landings has declined, indicating a moderate contraction in spatial effort by fishers targeting longfin.

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

South Island shortfin

Shortfin in the South Island were caught from most subareas (51 of the possible 58) over the 11 years, but 77% of the catch originated from just two areas: Te Waihora (AS1 and AS2) and Lake Brunner (AX4). There was a declining trend in shortfin total landed catches over the 11-year period, particularly in the last three years, with a similar decline in the proportions of large shortfin. Factors that influenced shortfin total catches, landed and within size ranges, include flood conditions, the split into separate shortfin and longfin stocks in 2016–17 (reducing fishing effort in the north-east of the South Island), fisher retirements, declining permits fished and fishing events, availability of ACE, a decline and eventually an end to catch contribution from AS2 (Te Waihora migration area), and, in the last few years, poor market demands and COVID19. There are no indications from the landed and processed South Island shortfin catch since 2010–11 that abundance or size has declined due to fishing. The spatial pattern of South Island shortfin landed catch by subarea is generally similar over the first six years, except that AS1 and AS2 catches tend to display opposite trends, and there were no catches from AS2 in the last three years. The number of subareas with shortfin landings declined dramatically from 2016–17 onward in LFE 11, LFE 12, and LFE 14 when ANG were split into shortfin and longfin. Fishing for shortfin in these areas subsequently became unviable because of the unwanted bycatch of longfin.

South Island longfin

Longfin in the South Island were caught from most subareas (53 of the possible 58) over the 11 years and, although less aggregated than shortfin, half of the catch originated from just seven subareas: AW11 (Mataura River coast), AW9 (Oreti River coast), AW3 (Oreti River inland down to Bog Burn), AV10 (Clutha River coast), AV11 (Pomahaka River), AW10 (Mataura River—Riversdale to Gore), and AX3 (Grey River, Arnold River). The South Island commercial longfin catch shows recent trends of declining annual catch, but no trend in the proportions of large eels. As for shortfin, similar factors have contributed to the amount and size of longfin that was caught and processed annually in the South Island, particularly the split into separate shortfin and longfin stocks in 2016–17 and subsequent ACE imbalances resulting from the nominal 1 t TACCs set in LFE 11, LFE 12, and LFE 14. Fisher retirements culminating in a trend of declining permits fished and fishing events and, in the last few years, poor market demands and COVID19 have also resulted in low catches. There are no indications from the landed and processed South Island longfin catch since 2010–11 that abundance or size has declined due to fishing. The spatial pattern of South Island longfin landed catch by subarea is generally similar over the first six years and, from 2016–17 onward, the number of subareas with longfin landings declined dramatically in LFE 11, LFE 12, and LFE 14 when ANG were split into shortfin and longfin. Fishing for longfin in these areas subsequently became unviable.

1. INTRODUCTION

The commercial eel monitoring programme began in 2003–04 in the North Island with the collation of processor data on all freshwater eel (ANG) weight grades, species composition, and fine scale catch location from individual eel landings (Appendix 1). In the South Island, data were provided for the first time in 2006–07 for Quota Management Area (QMA) ANG 15 (Southland/Otago) only, but no details were provided on catch location other than that all landings were from ANG 15. Full reporting of South Island landings began in 2010–11. In this report, details of catch for the fishing years 2018–19, 2019–20, and 2020–21 are presented, as well as trends in 18 years of landing data from the North Island, 15 years of landings data from ANG 15, and 11 years of landing data from the entire South Island.

1.1 The commercial fishery

The New Zealand commercial freshwater eel fishery began in the mid-1960s. Landings consist of both the endemic longfin eel (*Anguilla dieffenbachii*), and the native shortfin eel (*A. australis*) which is also found in southeast Australia. Landings from the top of the North Island can include the occasional Australian longfin eel (*A. reinhardtii*) (Jellyman et al. 1996). Total eel catches peaked in 1972 at about 2100 t (Figure 1) and, from 1972 to 1999, the catch fluctuated somewhat with no clear trend, around an annual average catch of about 1300 t. Since then, catches have fluctuated, but progressively declined to a low of about 310 t in 2020–21, the most recent fishing year.

The North Island has contributed 60% (range 51 to 72%) of the total New Zealand eel catch since 1984 (Figure 1). In the North Island, shortfin has consistently been the dominant species, representing 74% of the catch since 1984. The proportion of shortfin has been increasing and, over the last 10 years, the average proportion was 87%. After 1995–96, North Island shortfin catch fluctuated, but progressively declined to a low of 136 t in 2019–20 (Figure 1). Similarly, North Island longfin catch peaked at 480 t in 1990–91, declined steeply until 2008–09, and then gradually thereafter, although catches over the last three years have been stable at about 20 t (Figure 1).

In the South Island, there was initially little difference between the reported longfin and shortfin catches, but, in the last 10 years, shortfin landings have exceeded those of longfin, comprising two-thirds (66%, range 53 to 78%) of the South Island landed catch (Figure 1). South Island catches of both species have gradually declined since the mid-1990s. Shortfin catch stabilised with the introduction of the Quota Management System (QMS) in the 2000–01 fishing year, but declined sharply in the last three years with the lowest landed catch in 2020–21. Longfin landings have fluctuated more than three-fold over the last 10 years, with the smallest catches of 44, 45, and 45 t recorded in the three most recent fishing years.

The onset of the shortfin and longfin declines in catches preceded the introduction of eels into the QMS in both the North Island and South Island. These declines may, in part, have been the result of effort restrictions imposed on the fishery in the early 1990s. In the South Island, the decline may also be related to the voluntary incremental increase in the fyke net escape tube openings from 25 to 26 mm in 1990–91, to 27 mm in 1993–94, to 28.5 mm in 1994–95, and finally to 31 mm in 1997–98 (Vic Thompson, Mossburn Enterprises, pers. comm.).

The South Island eel fishery was introduced into the QMS on 1 October 2000 and Total Allowable Commercial Catches (TACCs) were set in six QMAs (ANG 11–ANG 16) for both species combined, totalling 421 t (Table 1, Figures 1 and 2). ANG TACCs were consistently under-caught in all South Island QMAs, with the exception of ANG 13 (Te Waihora), where catches were often close to the TACC (Fisheries New Zealand 2022). On average the South Island ANG TACC was about two-thirds caught (range 51 to 85%) with the highest proportion caught in 2012–13. In 2016–17, shortfin and longfin in the South Island were split into separate stocks (SFE 11–SFE 16 and LFE 11–LFE 16). South Island TACCs were set at 242 t for shortfin and 81 t for longfin, representing a 98 t (23%) net reduction in the South Island total eel TACC, although the TACC for Te Waihora, where only shortfin are taken, was increased from 122 t (ANG13) to 134 t (SFE15). Further, the longfin TACCs in LFE 11–LFE 14 were set at a nominal 1 t, in effect closing the longfin target fishery in the north and north-east of the South Island.

The North Island eel fishery was introduced into the QMS on 1 October 2004 with four separate QMAs allocated to each species (SFE 20–23 and LFE 20–23) (Table 1, Figure 2). The initial shortfin TACC of 467 t was reduced to 347 t in 2007–08 and, on average, has been 75% caught (range 39 to 98%) over the last 17 years (Figure 1). The initial longfin TACC was also reduced in 2007–08 from 194 t to 82 t and again in 2018–19 to 56 t, which equates to TACC reductions of 71% since longfin were introduced into the QMS. The North Island longfin TACC has been, on average, 55% caught (range 26 to 94%) with about 30 to 40% of the TACC caught in the last three fishing years (Figure 1).

1.2 Stock assessment information

Until the mid-1990s, knowledge of the sustainability of the eel fishery was based mainly on the interpretation of annual commercial catch data recorded on fisher and processor reporting forms (i.e., catch effort landing returns, CELR; eel catch effort returns, ECER; eel catch landing returns, ECLR; and monthly harvest returns, MHR) and knowledge of the biology of the two species. Improved knowledge has stemmed from sampling of commercial landings (Beentjes & Chisnall 1997, 1998, Beentjes 1999, Speed et al. 2001, Beentjes 2005), ongoing monitoring recruitment of elvers and glass eels (Jellyman et al. 2000, Boubée et al. 2002, Martin et al. 2009, Martin & Bowman 2016, Crow et al. 2020), and the collection of data on catch by size-grade, species composition, and catch location from commercial landings (i.e., the subject of this report) (Beentjes 2005, 2008a, 2008b, 2011, 2013, 2016, 2019). Geographic Information System studies have also included attempts to estimate longfin eel biomass in New Zealand rivers based on physical variables such as river gradient and flow (Graynoth & Niven 2004) and, more recently, mapping of longfin commercial fishing effort throughout New Zealand and the proportion of habitat that is fished (Beentjes et al. 2016).

Analyses to assess New Zealand eel stocks include routine catch-per-unit-effort (CPUE) analyses (Beentjes & Bull 2002, Beentjes & Dunn 2003a, 2003b, 2008, 2010, 2013, 2014a, 2014b, 2015, Beentjes & McKenzie 2017, Beentjes 2020, 2021) and stock assessment modelling for the longfin fishery in Southland and subsequently New Zealand wide (Dunn et al. 2009, Fu et al. 2012). Fisheries New Zealand (previously Ministry for Primary Industries) rejected the stock assessment models because the underlying assumptions on estimates of longfin commercial catches and recruitment from individual eel statistical areas further complicated the analyses because eels do not move between catchments and mixing with catchments is limited. A study investigating the feasibility of eel stock assessment methods concluded that a conventional stock assessment for eels is unlikely to be successful and recommended that any future modelling will need to use a spatial modelling approach (Hoyle 2016). Subsequently, a study using this approach was carried out in 2021 using a vector autoregressive spatio-temporal (VAST) model that, in general, performed well at investigating trends in eel density (Hoyle et al. 2021). Analysis of longfin and shortfin eels presence/absence records in the New Zealand Freshwater Fish Database has also been shown to be a useful tool for interpreting trends in relative abundance of eels (Crow & Dunn 2014).

1.3 Objectives

This in the final reporting requirement for Fisheries New Zealand research project EEL2018-02.

Overall objective

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

Specific objective

1. To monitor size and species of eels by recording quantities of eels in the different commercial size grades and link this to catch location in 2018–19, 2019–20, and 2020–21.

2. METHODS

2.1 North Island

2.1.1 Eel processors

Four main eel processors have operated in the North Island since 2003–04 when this programme began: E.N. Vanderdrift Ltd in Stratford, Levin Eel Trading Ltd (LET) in Levin, Aotearoa Fisheries Ltd (AFL) in Whenuapai, and New Zealand Eel Processing Company Limited (NZEel) in Te Kauwhata.

All four companies have provided catch data to the National Institute of Water and Atmospheric Research Ltd (NIWA) under this programme, although there have been a number of changes in the North Island processing sector over the 18 years that data have been collected: Vanderdrift Ltd provided catches only for 2003–04 before closing; AFL closed its factory in 2008–09 with the processing operation transferred to LET in Levin and, in this report, all landings data from both processors are referred to as AFL-LET; the AFL-LET factory in Levin closed operations at the end of March 2020 and fishers then landed eel catches to NZEel in Te Kauwhata. Hence, from this time, NZEel became the only major eel processor in the North Island.

2.1.2 Sampling of the catch

As in previous years, following delivery to the factory, the catch from each landing was sorted into species (shortfin and longfin) and visually graded by size before weighing, i.e., eels were sorted into weight grades by eye and a total weight of each species in each grade was recorded. The weight grades are processor specific, usually determined by market demands, and hence have sometimes changed slightly over time (Table 2).

Catch location was recorded at the subarea level, e.g., the Waikato River catchment has twelve subareas that correspond to individual waterbodies, several of which are the hydro lakes. Each of the 12 North Island Eel Statistical Areas (ESA) were subdivided in this way, resulting in 65 North Island ESA subareas (Table 1, Figure 3). ESAs have between one and seven subareas except ESA AD, which has 17 subareas (Table 3). Maps showing the marked subareas and ESAs were provided to each processor to assist fishers and processors with assignment of the location that the eels were caught. Data were provided to NIWA by the eel processors on a regular basis (usually monthly) for checking, collation, and entry into a customised database.

Previous reports before (2016) used subarea codes based on the historic numeric ESA codes, i.e., subarea 1A was within ESA 1 (see Table 1 for equivalent numeric codes; in this report North Island ESAs are referred to by their correct alpha codes). Similarly, subareas are also referred to by their alpha codes consistent with the ESA alpha codes.

2.1.3 Data analyses

The commercial eel monitoring programme catch database and analyses were updated with North Island landings from 2018–19, 2019–20, and 2020–21 provided by NZEel and AFL-LET (Appendix 1).

Catch weight

As in previous years, to allow for the slightly different weight grades used by North Island processors, data from the various size grades were combined and assigned into one of three categories; small, medium, or large (Table 2). This was necessary to continue the time series comparison and to avoid creating multiple fragmented series of data whenever minor changes to the size grades are made by the processors.

The total landed catch by species and catch in each weight grade by species are tabulated and plotted by year and location (subarea and ESA) for the three most recent years (2018–19, 2019–20, and 2020–21).

The total landed catch by species and catch in each weight grade by species are also tabulated and plotted by year for the complete North Island time series (2003–04 to 2020–21). To further examine both temporal trends in catch and spatial distribution of catch and fishing effort over the 18-year time series, catch by subarea and year are presented as bubble plots and as colour shaded maps.

Historic catch data that predate this programme were provided to NIWA by NZEel and AFL-LET during earlier analyses. These data were compared with the time series data to give an historical perspective to species composition and size.

There were 14 t of longfin and 16 t of shortfin from Vanderdrift in 2003–04, where catch was recorded in the size grade of less than 1000 g. This was included in the species total eel catches, but not in the size grade analyses.

Catch numbers

Numbers of eels landed in each weight grade were not recorded, but were estimated as follows:

1. During previous analyses from the monitoring commercial eel fisheries programme (Beentjes 2011), length frequency data for each eel species collected during the North Island catch sampling undertaken in 1995–96, 1996–97, and 1997–98 (Beentjes & Chisnall 1997, 1998, Beentjes 1999) were extracted from the MPI *market* database and scaled to landed weight using the catch-at-age program (Bull & Dunn 2002) (Figure 4). These represent the overall recruited size distribution of the North Island longfin and shortfin eel populations for the mid-1990s.
2. The scaled length frequency data were then plotted as cumulative distributions and the weight grades converted to the equivalent length grades using the length-weight relationship taken from the South Island catch sampling programme where length-weight sampling was comprehensive (Table 4, Figure 4). To simplify the estimation of eel numbers, it was assumed that the North Island shortfin and longfin weight grades were 300–500 g, 500–1000 g, and 1000–4000 g, despite some minor variation over time (see Table 2).
3. The length corresponding to the mid-point (cumulative percent) of each length grade range was determined and then converted back to a weight (mid-point weight) (Table 4). The total landed weight in each size grade was then divided by the mid-point weight to provide an estimate of the numbers of eels in each weight grade.

These mid-points are the same as those used by Beentjes (2013, 2016, 2019), but differ slightly from those used by Beentjes (2011) when the exact grades for each processor and year were used. A 4 kg maximum limit was also used throughout the time series, even though this did not come into effect in the North Island until March 2007.

Eel number estimates are presented in table format as total numbers of each species by year, together with the mean individual eel weight (total weight of eels divided by the total number of eels in each year).

Ancillary data analyses

The total catches of each species in the processor data were compared against landed catches from Eel Catch Landing Records (ECLR) (Tables 4, 5, and 6 of Fisheries New Zealand 2022) to determine the proportions of catch included in these analyses.

Data were requested and provided by Fisheries New Zealand for the following:

1. Quantities of eels over the maximum legal size (2 kg in Waikato Tainui Fisheries Area, otherwise 4 kg) released and recorded in disposal reports under code ‘G’ (Fish above a maximum legal size or weight) by fish stock and date, from the Electronic Reporting System (ERS) from when records began (September 2019) to end of September 2021.
2. Total Annual Catch Entitlement (ACE) for shortfin and longfin fish stock for fishing years 2001–02 to 2020–21.

3. Summary of total eel permits actively fished and total fishing events for each fishing year for the North Island from Eel Catch Effort Landing (ECE) records for the 2001–02 to 2020–21 fishing years.

2.2 South Island

2.2.1 Eel processors

Three main eel processors have operated in the South Island during this programme and all three have provided data to NIWA: Mossburn Enterprises Ltd (Mossburn) in Invercargill, Independent Fisheries Ltd (Independent) in Christchurch, and Levin Eel Trading Ltd (AFL-LET) in Levin. Independent processed shortfin catches exclusively from Te Waihora (AS1 and AS2) between 2010–11 and 2017–18 (Figure 5). AFL-LET processed catches of both species throughout the South Island between 2009–10 and 2019–20, with most shortfins coming from Te Waihora (subareas AS1 and AS2) and most longfins from the north of the South Island. Mossburn has been the largest processor by volume and has processed catches of both species throughout the South Island between 2006–07 and 2020–21, although in the first three years, data were restricted to ANG 15 (SFE 15 and LFE 15, Otago–Southland, see Figure 2) without the detailed subarea or ESA catch location.

2.2.2 Sampling of the catch

In the same way as the North Island, processors of South Island eels sorted the catch from each landing into species (shortfin and longfin) and then visually graded by size before weighing. Catch location was also recorded by the fisher at the time of landing using maps showing ESAs and subareas.

2.2.3 Data analyses

The commercial eel monitoring programme catch database and analyses were updated with South Island landings from Mossburn and AFL-LET for the fishing years 2018–19, 2019–20, and 2020–21 (Appendix 1).

Catch weight

The size grades used by the three South Island processors are shown in Table 5. Although up to three size grades have been used by processors, the data were assigned to two generic size grades (small and large) for each species because of the difficulty in combining South Island data processed in the North Island (AFL-LET) and South Island (Mossburn and Independent) in any meaningful way (Table 5).

Tabulation and plotting of the data are the same as for the North Island. However, there are two time series for the South Island, ANG 15 from 2006–07 to 2020–21 (15 years without ESA and subarea location) and all South Island from 2010–11 to 2020–21 (11 years with ESA and subarea location).

Catch numbers

Numbers of eels processed in the South Island were estimated using the North Island scaled length frequency data and the methods described above. Scaled length frequency data from the South Island catch sampling programmes were not used in the estimate of numbers because sampled landings were targeted from predominantly heavily fished mainstem rivers and tended to contain smaller eels on average than that of all landings. In addition, eels landed from AS2 (Te Waihora, shortfin male migration area), by Independent and AFL-LET in the South Island, are smaller than the estimated mid-point weight for the small grade category (see Table 4). Numbers of small South Island shortfin are therefore underestimated.

Eel number estimates are presented in table format as described for the North Island.

Ancillary data analyses

Ancillary analyses are the same as described for the North Island, i.e., quantities of eels over the maximum legal size released, ACE holdings by fish stock, and fished permits and fishing events.

2.3 Markets and port prices

As for the previous report (Beentjes 2019), commercial eel processors were contacted and asked for information relating to markets for both species and weight grades.

The previous report (Beentjes 2019) included analyses on port prices paid to fishers for each species and weight grade by fishing year. There was generally poor correlation between port price and landings by size grade, and hence this has not been updated in the current analyses.

3. RESULTS

3.1 North Island

3.1.1 Landings and catch (2003–04 to 2020–21)

A summary of landings, species tonnages, sampling proportions, and species composition from North Island processors between 2003–04 and 2020–21 is shown in Table 6a and the catch by species in Figure 6. Catches of shortfin remained reasonably stable between 230 and 340 t over the first fifteen years, with no trend, before roughly halving in 2019–20 and 2020–21. Longfin catch was between 100 and 120 t at the start of the monitored period but has generally declined since 2006–07, with catches in the last three years between 18 and 22 t. The proportion of shortfin overall was 82%, and the continued decline in longfin and stabilisation of shortfin, notwithstanding the last two years, has caused the shortfin proportion of the catch to rise in recent years. Comparison of catches reported to Fisheries New Zealand from ECERs and/or MHRs (Fisheries New Zealand 2022) and those provided to NIWA by processors in this programme showed a close match from 2006–07 onward for both species combined (Table 6a, Figure 7).

Estimated numbers of eels and species composition from North Island landings between 2003–04 and 2020–21 are shown in Table 7a. Numbers have varied from about 300 000 to 700 000 shortfin eels and from about 25 000 to 200 000 longfin eels per year. The proportions of shortfin in the total eel landings were slightly higher when estimated by number than by weight because landed longfins had a larger mean weight than shortfins (compare Tables 6a and 7a). The mean weight for shortfin has been stable at about 500 g throughout the monitoring period, but longfin mean weight was more variable (overall mean = 639 g), reflecting the more volatile markets for the various longfin size grades (Table 7a).

Individual landing weights (both species combined) were mostly between 50 and 400 kg, with a common weight of about 100 to 150 kg and the largest over 2000 kg (Figure 8). The largest landings were likely to be from multiple days fishing that were combined and trucked to the factory as a single landing.

3.1.2 2018–19 fishing year (North Island)

Catch location

Subarea – The catches of each species by subarea for 2018–19 are shown in Figure 9. Shortfin were landed from 36 of the 65 North Island subareas (55%), but about half (54%) of the catch was from just five subareas, in decreasing order of catch: AA4 (Dargaville), AG5 (Napier), AC2 (Hauraki Plains east), AD11 (Lakes Whangape, Waahi, Rotongaro), and AD12 (Lake Waikare/Port Waikato) (Figures 9 and 10). Longfin were also landed from 29 of the 65 North Island subareas (45%), but about half (50%) of the catch was from just four subareas, in decreasing order of catch: AD12 (Lake Waikare/Port Waikato), AA4 (Dargaville), AD11 (Lakes Whangape, Waahi, Rotongaro), and AG5 (Tukituki River) (Figures 9 and 11).

ESA – The catches of each species by ESA for 2018–19 are shown in Figure 12. Shortfin were landed from ten of the twelve ESAs, with no catch from AF (Poverty Bay) or AM (Wellington) (Figures 12 and 13). The major contributors by statistical area, in descending catch order, were AD (Waikato), AG (Hawke's Bay), AC (Hauraki), and AA (Northland), which together accounted for about three-quarters (76%) of the shortfin catch. Longfin were landed from nine of the twelve ESAs with no catch from AF (Poverty Bay), AM (Wellington), or AH (Rangitikei-Wanganui) (Figures 12 and 14). The major contributors by statistical area, in descending catch order, were AD (Waikato), AA (Northland), AB (Auckland), and AG (Hawke's Bay), which together accounted for three quarters (79%) of the longfin catch.

Species and size composition

The overall species composition of the North Island catch in 2018–19 was 91.7% shortfin (Table 6a). Shortfin was also the dominant species in all subareas and ESAs in 2018–19 (Figures 9 and 12).

The overall proportions by weight of shortfin in the three weight grades for 2018–19 were 50.1%, 40.6%, and 9.3% for small, medium, and large, respectively (Table 8a). The equivalent proportions by number were 65.6%, 30.6%, and 3.8%, respectively (Table 8a). The three weight grades were present in all subareas (Figure 10).

The overall proportions by weight of longfin in the three weight grades were 40.6%, 27.0%, and 32.3% for the small, medium, and large, respectively (Table 9a). The equivalent proportions by number were 63.7%, 23.0%, and 13.4%, respectively (Table 9a). Where longfin were landed, the three weight grades were present in all but two subareas, where catches were negligible (Figure 11).

3.1.3 2019–20 fishing year (North Island)

Catch location

Subarea – The catches of each species by subarea for 2019–20 are shown in Figure 9. Shortfin were landed from 26 of the 65 North Island subareas (40%), but about half (48%) of the catch was from just five subareas, in decreasing order of catch: AG4 (Napier), AA4 (Dargaville), AD12 (Lake Waikare/Port Waikato), AC2 (Hauraki Plains east), and AK1 (Manawatu River coast) (Figures 9 and 10). Longfin were landed from 23 of the 65 North Island subareas (35%), but about half (53%) of the catch was from just five subareas, in decreasing order of catch: AD12 (Lake Waikare/Port Waikato), AA4 (Dargaville), AC2 (Hauraki Plains east), AB1 (Warkworth), and AC1 (Hauraki Plains west) (Figures 9 and 11).

ESA – The catches of each species by ESA for 2019–20 are shown in Figure 12. Shortfin were landed from ten of the twelve ESAs, with no catch from AF (Poverty Bay) and AM (Wellington) (Figures 12 and 13). The major contributors by statistical area, in descending catch order, were AD (Waikato), AG (Hawke's Bay), AC (Hauraki), and AB (Auckland), which together accounted for about three-quarters (74%) of the shortfin catch. Longfin were landed from nine of the twelve ESAs, with no catch from AF (Poverty Bay), AM (Wellington), or AJ (Taranaki) (Figures 12 and 14). The major contributors by statistical area, in descending catch order, were AD (Waikato), AC (Hauraki), and AA (Northland), which together accounted for nearly three quarters (69%) of the longfin catch.

Species and size composition

The overall species composition of the North Island catch in 2019–20 was 87.3% shortfin (Table 6a, Figure 9). Shortfin was also the dominant species in all subareas except AA2 (Hokianga Harbour) and in all ESAs in 2019–20 (Figures 9 and 12).

The overall proportions by weight of shortfin in the three weight grades for 2019–20 were 51.3%, 40.3%, and 8.4% for small, medium, and large, respectively (Table 8a). The equivalent proportions by number were 66.5%, 30.1%, and 3.4%, respectively (Table 8a). The three shortfin weight grades were present in all subareas where shortfin were landed (Figure 10).

The overall proportions by weight of longfin in the three weight grades were 33.0%, 29.5%, and 37.5% for small, medium, and large, respectively (Table 9a). The equivalent proportions by number were 56.0%, 27.2%, and 16.8%, respectively (Table 9a). The three weight grades were present in all but one subarea where longfin were landed (Figure 11).

3.1.4 2020–21 fishing year (North Island)

Catch location

Subarea – The catches of each species by subarea for 2020–21 are shown in Figure 9. Shortfin were landed from 35 of the 65 North Island subareas (54%), but about half (52%) of the catch was from just five subareas, in decreasing order of catch: AC1 (Hauraki Plains west), AA4 (Dargaville), AK1 (Manawatu River), AD12 (Lake Waikare/Port Waikato), and AL1 (Lake Wairarapa) (Figures 9 and 10). Longfin were landed from 29 of the 65 North Island subareas (45%), but half (50%) of the catch was from just four subareas, in decreasing order of catch: AD12 (Lake Waikare/Port Waikato), AA4 (Dargaville), AL1 (Lake Wairarapa), and AC1 (Hauraki Plains west) (Figures 9 and 11).

ESA – The catches of each species by ESA for 2020–21 are shown in Figure 12. Shortfin were landed from ten of the twelve ESAs, with no catch from AF (Poverty Bay) or AM (Wellington) (Figures 12 and 13). The major contributors by statistical area, in descending catch order, were AD (Waikato), AC (Hauraki), AK (Manawatu), AA (Northland), and AB (Auckland), which together accounted for about three-quarters (78%) of the shortfin catch. Longfin were landed from ten of the twelve ESAs, with no catch from AF (Poverty Bay) or AM (Wellington) (Figures 12 and 14). The major contributors by statistical area, in descending catch order, were AD (Waikato), AC (Hauraki), AA (Northland), and AL (Wairarapa), which together accounted for about three quarters (75%) of the longfin catch.

Species and size composition

The overall species composition of the North Island catch in 2020–21 was 89.8% shortfin (Table 6a, Figure 9). Shortfin was also the dominant species in all but one subarea (AD13, Raglan Harbour), and in all ESAs in 2020–21 (Figures 9 and 12).

The overall proportions by weight of shortfin in the three weight grades were 51.1%, 40.9%, and 8.0% for small, medium, and large, respectively (Table 8a). The equivalent proportions by number were 66.2%, 30.5%, and 3.2%, respectively (Table 8a). The three weight grades were present in all subareas where shortfin were landed (Figure 10).

The overall proportions by weight of longfin in the three weight grades 2020–21 were 28.3%, 26.7%, and 44.9% for small, medium, and large, respectively (Table 9a). The equivalent proportions by number were 51.8%, 26.5%, and 21.7%, respectively (Table 9a). The three weight grades were present in all but two subareas where longfin were landed (Figure 11).

3.2 Time series trends in the North Island (2003–04 to 2020–21)

3.2.1 Shortfin

Temporal trends in shortfin catch and size of eels

The North Island commercial shortfin catch over the 18-year period from 2003–04 to 2020–21 showed no consistent trend in annual landed catch, notwithstanding the low catches in the last two years, while the proportion of the large size grade has declined by about a half in the last six years (Table 8a, Figure 15). Despite the generally stable temporal pattern in North Island shortfin catch, a number of regulatory changes, quota availability issues, and economic drivers may have influenced annual shortfin catches, overall and within size ranges. Some of these factors are annotated on Figure 15 and include, in chronological order:

1. 1 October 2004: North Island shortfin introduced into the Quota Management System.
2. 1 October 2007: TACC reductions of 26% for North Island shortfin stocks.
3. September 2011: Access to Taiwan market lost.

4. 2008–09 to 2010–11: Shelving of SFE 22 began (about 10% shelved).
5. 2007–08 to 2018–19: Shelving of SFE 23 began and increased each year (14% to 41%).
6. 1 October 2013: fyke net escape tube size increased from 25 mm to 31 mm (legislated).
7. 2012–13: Strong demand from Russian markets.
8. 2013–14 and 2014–15: Weak demand from Russian markets due to conflicts in Ukraine and weak Chinese market demand due to increased supply of glass eels from Europe. Longfin more affected than shortfin because the latter is the preferred species.
9. 2014–15: 35-mm escape tubes used voluntarily by some fishers to reduce catch of small eels, mainly in the south of North Island. Most fishers have continued to use the 31-mm escape tubes.
10. 2014–15 to 2018–19: Shelving of SFE 22 (range 14% to 24%).
11. 2015–16: European and Russian frozen eel demand low, but improving.
12. 2015–16 to 2017–2018: Demand for shortfin high across the weight ranges.
13. 2016–17 to 2017–18: Dry summers reduced catch.
14. 2018–19: Live eel exports continue to Korea, the United States, China, Canada, and Europe.
15. 2020–21: Impact of COVID19 reduced market demand and closure of eel processing factories during the 2020 lockdown.
16. 2020–21: LET closed Levin factory, leaving NZEel as the only major North Island processor. Some fishers retired.
17. 2020–21: Strong markets for shortfin into China, United Kingdom, and United States, with live exports of larger shortfin eels.
18. 2020–21: Lack of access to shortfin ACE due to shelving.

Despite the various factors listed above and shown in Figure 15, there does not appear to be any clear driver of shortfin total catch and size composition which, until recently, was surprisingly stable over time. LET processed catch predominantly from southern North Island fishers and with the closure of the Levin factory on March 2020, those catches were subsequently landed into NZEel in Te Kauwhata. This geographic change in eel processors, combined with the impacts of the COVID pandemic on markets, may have been the driver for lower shortfin landings in the last two years. Currently the international market demand for North Island shortfin eels is high for all sizes, including a strong live export market for medium and large shortfin.

Impacts of port price, effort, and ACE availability on shortfin catch

Market demand often drives the shortfin eel port price paid to fishers and it might also be expected to impact the effort applied to the fishery. Shortfin eel port price can differ for the three weight grades (small, medium, and large) among and within fishing years with higher prices offered for larger eels. Previous analyses of North Island shortfin port price by weight grade showed poor correlation (Beentjes 2019) and were therefore not updated. There have been strong markets for North Island shortfin of all sizes in recent years and, as all three weight grades were generally caught in all subareas, it seems likely that fishers land their entire legal sized ungraded shortfin catch without regard to the port price. NZEel have not placed a premium on any particular shortfin size grade in the last three years and have strong markets internationally for all sizes (Karen Elliot, NZEel, pers. comm.).

Both total and shortfin North Island eel catches showed good correlation with both the numbers of permits that have been fished and the number of fishing events in a year, indicating that the catches of both species were strongly related to effort (Figure 16). The number of permits fished has declined from about 80 in 2001–02 to 20 in 2020–21 with a corresponding drop in annual fishing events from about 7000 to 1000, respectively. The target species for events fished was unknown but, in recent years, would be predominantly shortfin.

For each QMA, the total quota shares are converted into ACE, which is required by a commercial fisher to legally fish and land eels. There is provision to carry over an amount of unfished ACE[2] into the following fishing year so the total ACE can be greater than the TACC in a given fishing year. There is no legal requirement for Quota holders to lease their ACE shares and, if this is not done, the ACE is termed 'shelved'. Most fishers do not own quota and source ACE from the processor that receives their catch, which, since 2020, has been mostly NZEel in the North Island. ACE is usually allocated to fishers at the start of the season and, if the allocation is insufficient to cover the catch, fishers can either attempt to acquire more ACE or return the eels to the water. NZEel have limited ACE and are not always able to source sufficient additional ACE to cover fishers' potential landings because it is often withheld from the quota market or effectively 'shelved' (Karen Elliot, NZEel, pers. comm.).

In the last report, NZEel provided a qualitative assessment of the ACE made available to fishers by QMA and year from 2006–07 to 2017–18 (Beentjes 2019). These data were not available for the last three years. However, the start of fishing year shortfin ACE versus landed catch are plotted by QMA and fishing year to look at the extent of the unfished ACE and hence potential shelving by area (Figure 17). Landed shortfin catch is less than the total ACE for all years in all four QMAs and this discrepancy has been growing over time (Figure 17). The difference is most marked in SFE 23 where over the last six years, on average, only about one-third of the ACE has been caught. Based on the previous analyses and recent discussions with processors, much of this discrepancy is due to shelving of ACE by some quota holders (Beentjes 2019).

Spatial trends in shortfin catch

Spatial and temporal trends in the North Island catch of shortfin by subarea from 2003–04 to 2020–21 are shown in Figure 18. Catch of shortfin is also plotted by mapped North Island subareas aggregated for the fishing years 2003–04 to 2020–21 (Figure 19), demonstrating the geographic contribution of catches throughout the North Island over the last 18 years, contrasting high and low volume subareas.

Over this period, shortfin was landed from 63 of the possible 65 subareas with no landings from East Cape AF3 (Cape Runaway) or AF4 (Waiapu River) (see Figure 3). Of these 63 subareas, AA4 (Dargaville), AD12 (Lake Waikare, Port Waikato), and AC1 (Hauraki plains west) were consistently the main contributors to the North Island shortfin annual landings, making up almost one-third (30%) of the catch over the 18 years (Figures 18 and 19). For other subareas, catches were more variable among years, but the most important subareas, in descending order of catch, include: AC2 (Hauraki Plains east), AK1 (Manawatu River coast), AG4 (Napier), and AG5 (Tukituki River). Together these seven subareas have contributed over half (52%) of the shortfin landings from 2003–04 to 2020–21. The pattern of landings by subarea was generally similar over the first fifteen years, but, in the last three years, the number of subareas providing landings has declined (Figure 18). For example, in the most recent three years (2018–19 to 2020–21), 71% of subareas had shortfin landings compared with 80% in the previous three years (2015–16 to 2017–18), indicating a slight contraction in spatial effort.

3.2.2 Longfin

Temporal trends in longfin catch and size

North Island commercial longfin catches over the 18-year period from 2003–04 to 2020–21 have fluctuated more than seven-fold and were characterised by low catches from 2008–09 to 2010–11 and an overall progressive trend of declining landed catch, with the lowest catch of 18 t landed in the last year (Figure 20). The medium longfin weight grade was poorly represented in the three years from 2008–09 to 2010–11. There were a number of regulatory changes, quota availability issues, and economic drivers that may have influenced annual longfin catches, overall and within size ranges. Some of these factors are annotated on Figure 20 and include, in chronological order:

[2]For ACE holders, if their annual catch is less than their ACE holding, they are entitled to an underfishing allocation of 10% of the ACE they held at the end of the fishing year, or the difference between their ACE and the reported catch for that year, whichever is the lesser. This is referred to as a 'carry over' and is allocated in the following fishing year.

1. 1 October 2004: North Island longfin introduced into the Quota Management System.
2. 1 October 2007: TACC reductions of 58% for North Island longfin stocks.
3. 1 April 2007: 4-kg maximum size limit introduced for longfin in the North Island.
4. 2007–08 to 2018–19: Shelving of LFE 23 began and generally increased each year (28% to 86% shelved).
5. 2008–09 to 2017–18: Shelving of LFE 22 began and generally increased each year (range 11% to 44% shelved).
6. 2008–09 to 2010–11: Limited market for longfin eels in the medium weight grade (500–1000 g) and fishers actively discouraged from landing eels in this grade (both AFL-Levin and NZ Eel).
7. 2010–11: Aotearoa Fisheries Ltd (AFL) did not lease longfin quota to North Island fishers, which resulted in most fishers having insufficient ACE to cover their catch. As a result, some fishers sorted their catch at or near the capture point and released longfin.
8. 2011–12: Access to AFL longfin quota restored to North Island fishers.
9. 2011–12: All weight grades of both species in high demand and no restrictions imposed on fishers not to land medium sized longfin.
10. September 2011: Access to Taiwan market lost. Predominantly longfin market.
11. 2012–13: Strong demand from Russian market.
12. 1 October 2013: Fyke net escape tube size increased from 25 mm to 31 mm (legislated).
13. 2013–14 and 2014–15: Weak demand from Russian markets (see shortfin factors). Longfin more affected than shortfin because the latter is the preferred species.
19. 2014–15: 35-mm escape tubes used voluntarily by some fishers to reduce catch of small eels, mainly in the south of North Island. Most fishers continued to use the 31-mm escape tubes.
20. 2015–16: European and Russian frozen eel demand low, but improving.
21. 2015–16: Smaller weight grade of longfin not wanted by AFL-LET and fishers advised not to land longfin of this size.
22. 2016–17 to 2017–18: Dry summers reduced catch.
23. 2016–17 to 2017–18: NZEel indicated that longfin demand was reasonably high for gutted and de-slimed eel across the size ranges, but no markets for live export in last few years.
24. Four years up to 2018–19: AFL-LET had a market in Europe for eels under 700 g, but no market for eels over 700 g; fishers discouraged from targeting longfins and avoided longfin areas.
25. 2018–19: TACC reductions of 32% for North Island longfin stocks.
26. 2018–19: Marked increase in ACE shelving in all areas (LFE 20 59%, LFE 21 44%, LFE 22 52%, and LFE 3 86% shelved) impacted longfin fisheries in the lower North Island.
27. 2020–21: Impact of COVID19 reduced market demand and closure of eel processing factories during the 2020 lockdown.
28. 2020–21: LET closed Levin factory, leaving NZEel as the only major North Island processor. Some fishers retired.
29. 2020–21: All longfin sold solely to domestic market.
30. 2020–21: Lack of access to longfin ACE due to shelving.

The reduced catches after 2006–07 were, to some extent, driven by the 58% TACC reduction in 2007–08, followed by a fall in demand for medium sized longfin eels from 2008–09 to 2010–11, which explained the low proportions of medium sized eels in the catch over this period (Figure 20). AFL quota was not leased to fishers in 2010–11 resulting in further reductions to landed catch. The increase in total longfin catch and of the medium weight grade in 2011–12 reflected both an improved market for this grade and restoration of AFL quota for lease. Although markets into Taiwan and Russia were poor from 2011–12 to 2014–15, only the 2014–15 catch appeared to have been affected. The 2014–15 fishing year may also have been impacted by the 35-mm escape tube incorporated into fyke nets by some fishers in the lower North Island, although the proportion of small longfin eels did not appear to have been affected (Figure 20). The longfin landed catch in the four years up to 2017–18 was partly a result of the poor demand for large longfin by AFL-LET, who advised fishers to avoid targeting longfin. Shortfin is still the preferred species and, unlike shortfin which has strong international markets, in the last three years all longfin has been sold domestically.

Impacts of port price, effort, and ACE availability on longfin catch

Market demand can affect port price of longfin eels where port price has historically differed for the three weight grades (small, medium, and large) among and within fishing years but has generally been higher for larger eels. Previous analyses of North Island longfin port price by weight grade showed little or inconsistent correlation (Beentjes 2019) and were therefore not updated. For longfin eels, port prices and markets were not the key driver for landed catch as fishers have recently been encouraged to land all legal sized eels caught in the net, assuming they have ACE or can access ACE upon landing. Often fishers avoid areas where longfin catch is likely and/or return eels to the water. This has purportedly resulted in longfin abundance increasing in many areas, exacerbating the problem.

Both total and longfin eel catches showed good correlation with both the numbers of permits that have been fished and the number of fishing events in a year, suggesting that the catches of both species were related to effort (see Section 3.1.5.1, see Figure 16).

As described for North Island shortfin, data on ACE availability to fishers were not available for the last three years; however, longfin ACE versus landed longfin catch are plotted by QMA and year to look at unfished ACE and hence potential shelving by area (Figure 21). Landed longfin catch was less than the total ACE for all years in all four QMAs; this discrepancy has been growing over time and was considerably higher than for shortfin (Figure 21). The difference was most marked in LFE 22 and particularly LFE 23, where over the last three years the total ACE caught has been only 4 to 11%. Based on the previous analyses and communications with NZEel, much of this discrepancy was likely due to shelving of ACE (Beentjes 2019), but economics and markets may also be a factor when the cost of catching exceeds the return to fishers and longfin is not the desired species. The longfin TACC in LFE 23 was only 5 t, which essentially relegates longfin to a bycatch species in the Taranaki/Rangitikei regions.

Spatial trends in longfin catch

Spatial and temporal trends in the North Island catch of longfin by subarea from 2003–04 to 2020–21 are shown in Figure 22. Catch of longfin is also plotted by mapped North Island subareas aggregated for the fishing years 2003–04 to 2020–21 (Figure 23), demonstrating the geographic contribution of catches throughout the North Island over the last 18 years, contrasting high and low volume subareas.

Longfin have been landed from 63 of the possible 65 subareas with no landings from East Cape AF3 (Cape Runaway) or AF4 (Waiapu River). Of these 63 subareas, AA4 (Dargaville), AD12 (Lake Waikare, Port Waikato), AD10 (Waipa River), and AL1 (Lake Wairarapa) were consistently the main contributors to the North Island longfin annual landings, making up over one-third (36%) of the catch (Figures 22 and 23). For other subareas, catches were more variable among years, but the most important subareas, in order of contribution were: AK1 (Manawatu River coast), AB3 (Manukau Harbour), AG5 (Tukituki River), and AC1 (Hauraki Plains west). Together these eight subareas have contributed half (52.4%) of the longfin catch from 2003–04 to 2020–21 (Figure 22). The catches for the four main subareas (AA4, AD10, AD12, and AL1) varied among years with indications of a declining trend in catch in these subareas in recent years. For the minor subareas, there was more variation among years as catch was not always landed from these subareas every year, particularly in recent years. The pattern of catches by subarea was generally similar over the first fifteen years but, in the last three years, the number of subareas with longfin landings has declined (Figure 22). For example, in the most recent three years (2018–19 to 2020–21), catch was landed from 63% of subareas compared with 76% in the previous three years (2015–16 to 2017–18), indicating a contraction in effort. For some subareas, where zero annual longfin catch has been reported, longfin may have been caught and released while targeting shortfin.

3.3 South Island

3.3.1 Landings and catch

ANG 15 (2006–07 to 2020–21)

A summary of landings, species tonnages, sampling proportions, and species composition from eel processors between 2006–07 and 2020–21 for ANG 15 is shown in Table 6b and the species catch plotted in Figure 24. Catches of shortfin have ranged from about 11 t to 28 t with no consistent trend. Longfin catch was between 33 t and 91 t, with lowest catches in 2008–09 to 2009–10 and over the last five years. The proportion of shortfin in the total eel catch over this 15-year period was 25%, but this has varied annually between 16% and 42% (Table 6b). Comparison of catches reported to Fisheries New Zealand from ECERs (Fisheries New Zealand 2022) and those provided to NIWA in this programme showed a close match for most years (Table 6b), suggesting that the data used in the present report were an accurate reflection of the commercial landings.

The estimated annual commercial catch by number of eels from ANG 15 has varied between about 23 000 and 45 000 shortfin and 52 000 to 173 000 longfin over the fifteen years (Table 7b). The proportions of shortfin by number were similar to that derived from actual catch weights (compare Tables 6b and 7b). The mean individual weight for landed shortfin was about 600 g for the first half of the time series, with a subsequent decline to about 500 g; overall averaging about 560 g. Longfin mean individual weight was more variable, ranging from 520 to 740 g, averaging about 560 g (Table 7b).

All South Island (2010–11 to 2020–21)

A summary of landings, tonnages by species, proportion of landings examined, and species composition for all South Island catches from 2010–11 to 2020–21 is shown in Table 6c. Catch by species from the same records is plotted in Figure 25. Catches of shortfin have ranged from about 68 to 193 t with the lowest catches in the last three years. Longfin catch has ranged from 39 to 160 t, with the lowest catches in the last three years and a generally declining trend. The proportion of shortfin has varied greatly from 47% to 78% (overall 64%). Comparison of catches reported to Fisheries New Zealand from ECERs and/or MHRs (Fisheries New Zealand 2022) and those provided to NIWA by processors in this programme showed a close match for most years for both species combined (Table 6c). The value of 114% in 2010–11was anomalous. The relationship of landed catches by individual species showed good correlation with data provided by processors for longfin, with more variation for shortfin (Figure 26).

Estimated numbers of eels and species composition from all South Island landings from 2010–11 to 2020–21 are shown in Table 7c. The annual commercial catch has ranged from 146 000 to 375 000 for shortfin and from 65 000 to 292 000 for longfin over the eleven years. The proportions of shortfin in the estimated total number of eels were similar to those derived from actual catch weights (compare Tables 6c and 7c). The mean weight for shortfin has ranged from about 460 to 600 g (average about 530 g) and for longfin, from about 450 to 700 g (average about 570 g) (Table 7c).

Individual landing weight (both species combined) was most commonly between 50 and 300 kg, with the largest landings over 2500 kg (Figure 27). The largest landings were likely to be from extended fishing periods with the catch from multiple days fishing landed to the processor as a single landing.

3.3.2 2018–19 fishing year (South Island)

Catch location

Subarea – The catches of each species by subarea for 2018–19 are shown in Figure 28. Shortfin were landed from 22 of the 58 South Island subareas (38%), but three-quarters (74%) of the catch was from Te Waihora (AS1, excludes migration area). Other key shortfin areas in decreasing order of catch were: AX4 (Lake Brunner), AW11 (Mataura River coast), AV9 (Lake Waihola and Waipori River), and AV10 (Clutha River coast) (Figures 28 and 29). Longfin were landed from 21 of the 58 South Island subareas (36%), but over half (54 %) of the catch was from just five subareas, in decreasing order of catch: AW11 (Mataura River coast), AW5 (Waikaka River), AW9 (Oreti River coast), AV10 (Clutha River coast), and AW10 (Mataura River from Riversdale to Gore). Other key longfin areas in decreasing order of

catch are: AW3 (Oreti River inland down to Bog Burn), AV11 (Pomahaka River), and AX3 (Grey and Arnold Rivers) (Figures 28 and 30).

ESA – The catches of each species by ESA for 2018–19 are shown in Figure 31. Shortfin were landed from all South Island ESAs except AP (Marlborough), AS2 (Te Waihora migration area), or AU (Waitaki) (Figures 31 and 32). Nearly three quarters (74%) of the South Island shortfin catch was from AS1 (Te Waihora, excluding migration area). Longfin were landed from just four of the 12 ESAs (AW Southland, AV Otago, AX Westland, AR North Canterbury) (Figures 31 and 33). Otago and Southland contributed nearly 90% of the longfin catch.

Species and size composition

The overall species composition of the South Island catch in 2018–19 was 71.7% shortfin (Table 6c, Figure 28). Longfin was the dominant species in 18 of the 26 subareas where eels were caught, with only longfin landed from AV4, AW2, and AW5. Shortfin were the only species landed from AN2, AQ1, AR1, and AS1, and AT2 (Figure 28).

The overall proportions by weight of shortfin in the two weight grades in 2018–19 were 88% and 12% for small and large, respectively (Table 8c). The equivalent proportions by eel numbers were 95% and 5%, respectively (Table 8c). The two weight grades were present in all but four subareas and in all ESAs except AT, where shortfin catch was over 5 kg (Figures 29 and 32).

The overall proportions by weight of longfin in the two weight grades were 64% and 36% for the small and large, respectively (Table 9c). The equivalent proportions by eel numbers were 86% and 14%, respectively (Table 9c). The two weight grades were present in all subareas and ESAs where longfin were landed (Figures 30 and 33).

3.3.3 2019–20 fishing year (South Island)

Catch location

Subarea – The catches of each species by subarea for 2019–20 are shown in Figure 28. Shortfin were landed from 19 of the 58 South Island subareas (33%), but more than three quarters (79%) of the catch was from AS1 (Te Waihora, excluding migration area) (Figures 28 and 29). Other key areas in decreasing order of catch were: AX4 (Lake Brunner), AW11 (Mataura River coast), and AW9 (Oreti River coast). Longfin were landed from 21 of the 58 South Island subareas (36%), but over half (53%) of the catch was from just four subareas, in decreasing order of catch: AW11 (Mataura River coast), AV11 (Pomahaka River), AW5 (Waikaka River), and AW9 (Oreti River coast) (Figure 28 and 30).

ESA – The catches of each species by ESA for 2019–20 are shown in Figure 31. Shortfin were landed from six of the eleven South Island ESAs, but more than three quarters (79%) of catch was from just AS1 (Te Waihora, excluding migration area) (Figures 31 and 32). Longfin were landed from only four of the eleven ESAs, with 99.9% of the catch from AW (Southland), AV (Otago), and AX (Westland) (Figures 31 and 33).

Species and size composition

The overall species composition of the South Island catch in 2019–20 was 76% shortfin (Table 6c). Shortfin was the dominant species in 7 of the 23 subareas where eels were caught, with only shortfin landed from AS1 (Te Waihora, excluding migration area) and AT2 (Rangitata River) (Figure 28). Longfin was the dominant species in 16 of the 23 subareas and was the only species landed from AV5, AV6, AV7, and AX6 (Figure 28). Shortfin was the dominant species in ESAs AN, AQ, AR, AS1, AT, and AX; and longfin in AW and AV (Figure 31).

The overall proportions by weight of shortfin in the two weight grades in 2019–20 were 89% and 11% for small and large, respectively (Table 8c). The equivalent proportions by eel numbers were 96% and 4%, respectively (Table 8c). Where shortfin was landed, the two shortfin weight grades were present in all subareas except AR3 or AW5, and all ESAs except AT (Figures 29 and 32).

The overall proportions by weight of longfin in the two weight grades were 66% and 34% for the small and large, respectively (Table 9c). The equivalent proportions by eel numbers were 87% and 13%, respectively (Table 9c). The two longfin weight grades were present in all subareas and ESAs where longfin was landed (Figures 30 and 33).

3.3.4 2020–21 fishing year (South Island)

Catch location

Subarea – The catches of each species by subarea for 2020–21 are shown in Figure 28. Shortfin were landed from 20 of the 58 South Island subareas (34%), but three quarters (75%) of the catch was from AS1 (Te Waihora, excluding migration area) (Figures 28 and 29). Longfin were landed from 22 of the 58 South Island subareas (38%), but just over half (57%) of the catch was from just five subareas, in decreasing order of catch: AW11 (Mataura River coast), AW10 (Mataura River from Riversdale to Gore), AW4 (Waikaka River), AW9 (Oreti River coast), and AV10 (Clutha River coast) (Figures 28 and 30).

ESA – The catches of each species by ESA for 2020–21 are shown in Figure 31. Shortfin were landed from six of the eleven South Island ESAs, but over three quarters (76%) of the South Island shortfin catch was from AS1 (Te Waihora, excluding migration area) (Figures 31 and 32). Longfin were landed from five of the eleven ESAs, with 99% of the catch from AW (Southland), AV (Otago), and AX (Westland) (Figures 31 and 33).

Species and size composition

The overall species composition of the South Island catch in 2020–21 was 61% shortfin (Table 6c). Shortfin was the dominant species in 8 of the 26 subareas where eels were caught. Shortfin was the only eel species landed from four subareas (AQ2, AT2, AW6, AS1) (Figure 28) but were absent in landings from AR3, AV4, AV6, AW2, AW4, AW5, and AX6. Shortfin was the dominant species in three of the seven ESAs where eels were caught (AQ, AS1, AT) (Figure 31).

The overall proportions by weight of shortfin in the two weight grades in 2020–21 were 88% and 12% for small and large, respectively (Table 8c). The equivalent proportions by eel numbers were 95% and 5%, respectively (Table 8c). Where shortfin were landed, the two weight grades were present in all but one subarea (AV8, Taieri River coast, where there were no large shortfin eels) and in all ESAs (Figures 29 and 32).

The overall proportions by weight of longfin in the two weight grades were 58% and 42% for the small and large, respectively (Table 9c). The equivalent proportions by eel numbers were 82.5% and 17.5%, respectively (Table 9c). Where longfin were landed, the two weight grades were present in all subareas except AV8 (Taieri River coast) and all ESAs (Figures 30 and 33).

3.4 Time series trends in the South Island

3.4.1 Temporal trends in catch and size of eels

Shortfin – The ANG 15 commercial shortfin catch over the 15-year period from 2006–07 to 2020–21 has varied more than two-fold among years without a clear trend, while the proportion of large shortfin has varied nearly five-fold and showed indications of a declining trend (Figure 34). The lowest proportion of large eels in the recent years was likely to be due, in part, to the increase in the upper range from over 800 g to over 1000 g in 2017–18 (see Table 5).

The South Island commercial shortfin catch over the 11-year period from 2010–11 to 2020–21 showed a declining trend, particularly in the last three years. Similarly, the proportions in the large weight grade showed a declining trend (Figure 35). As for ANG 15, the lowest proportion of large eels in the most recent year was likely to be partly due to the increase in the upper range from over 800 g to over 1000 g in 2017–18 (see Table 5).

Longfin – The ANG 15 commercial longfin catch over the fifteen-year period from 2006–07 to 2020–21 has varied nearly three-fold among years, while the proportion of large longfin has varied more than four-fold, excluding 2016–17, where landings of large longfin were negligible (Figure 36). Both the ANG 15 and the South Island commercial longfin catch showed recent trends of declining annual catch, but had no trend in the proportions of large eels (Figures 36 and 37). The proportions of large eels may have been slightly inflated by the reduction in the upper range of large eels from 1000 g to 750 g from 2017–18 onward (see Table 5).

Market factors affecting South Island eel catch

2010–11 to 2017–18 – The port price for shortfin eels paid by Mossburn Enterprises to fishers in the South Island was largely stable over the period for which this was available (2010–11 to 2017–18), with little difference paid for small and large shortfins. Markets were consistently strong during this time for shortfins, which were exported to Germany, Asia, the United States, and the United Kingdom, either live or frozen. Longfin markets were similar to those for shortfin, but there was no live export of longfin and, from about to 2013–14 to 2017–18, the port price for larger shortfin eels was less than half that of small eels, reflecting specific market demands evident in the data (see Figures 34 and 35).

South Island longfin are more marketable than those from the North Island because they tend to be in better condition, and there are different markets for these eels. The low proportions of large longfin in 2015–16 and 2016–17 was in part because fishers were advised not to land eels over 2 kg, as these could potentially be migrating females, thus effectively reducing the maximum size landed to 2 kg (see Figures 36 and 37).

2018–19 to 2020–21 – The catches and size of eels of both species in the South Island in the last three years have been severely affected by low market demand and latterly COVID19 (Mark Thompson, Manager Mossburn Enterprises, pers. comm.). The landed and processed catch tended to reflect the requirements of international markets and hence what the South Island processor instructed fishers to deliver. For example, the most marketable size for shortfin in recent years has been small eels and fishers have been actively discouraged from landing larger shortfins, catching only what was needed and what could be sold. The lower proportions of large shortfin in recent years were explicable in this regard (see Figures 34 and 35). The economic incentive to apply more fishing effort was low because too much of the catch comprised larger shortfin eels (over 1000 g) that were not marketable and therefore were often released at the riverbank. Combined with escalating fuel prices and a net decline in fisher numbers over time, less areas were being fished and many historical areas were not fished.

To improve processing efficiency, Mossburn voluntarily increased the acceptable minimum size of shortfin eels landed from Te Waihora to about 400 g (previously 300 g).

For longfin eels, there has been a strong market for smaller eels from cruise ships and from ‘Farmers Markets’ in Russia and Ukraine.

General factors affecting South Island eel catch

Separate TACCs for South Island shortfin and longfin were introduced in 2016–17, set at a nominal 1 t in LFE 11, LFE 12, LFE 13, and LFE 14. This essentially closed these regions to longfin targeting and discouraged fishers from targeting shortfin in these areas because of the inevitable bycatch of legal sized longfin, which, without ACE, must be released and catch must be entered as destination X on ECLRs. Before 2016–17, the South Island catch of shortfin relative to longfin could vary because both eel species were managed under a single eel catch quota for each QMA (ANG 11–16) and hence the entire annual catch could conceivably have been made up of a single species. In reality, the relative catches of each species have not changed to any extent following the species separation, with the annual shortfin and longfin catches and size largely determined by market demands, areas fished (whether shortfin or longfin fisheries, or mixed fisheries), fishing effort, and environmental conditions, with small shortfins targeted more often when rivers are high and longfins targeted during dry conditions.

A number of long-term experienced fishers have retired over the last six years, resulting in a marked reduction in effort (Vic Thompson, Mossburn Enterprises, pers. comm.). Permits fished have more than halved from 40 in 2006–07 to 17 in 2020–21, and fishing events have dropped by three-quarters from 2090 in 2001–02 to 550 in 2020–21 (Figure 38). The total landed eel catch shows good correlation with both the numbers of permits that have been fished and the number of fishing events in a year, suggesting that the catches of both species are related to effort, but particularly longfin (Figure 38).

While availability of ACE in the South Island has not generally been an issue, in 2015–16 to 2017–18, 20% of ACE in LFE 11 and SFE 11 was shelved by the eight iwi of the Te Tau Ihu area (top of the South Island) (i.e., 200 kg of longfin and 3.8 t of shortfin), and some retired fishes did not lease their quota. The extent of shelving in the South Island in the last three years is not known, but discussions with the main South Island processor indicate that this is not affecting catches (Mark Thompson, Mossburn Enterprises, pers. comm.). The landed catch and ACE in each QMA for the last five years since the species were separated in the QMS are shown in Figures 39 and 40. In the last three years, the shortfin catch relative to ACE was almost negligible in QMAs SFE 11, SFE 12, and SFE 14, a half to a third caught in SFE 15 and SFE 16, respectively, and about a half caught in SFE 13 (Te Waihora) (Figure 39). Similarly, there was no longfin catch landed in LFE 11 and LFE 13, very little longfin catch relative to ACE in LFE 12 and LFE 14, and, for the main longfin areas of Otago/Southland (LFE15) and Westland (LFE16), ACE was only about two-thirds to a third caught (Figure 40). To catch the entire TACC for each species each year, all ACE would need to be available, fishers would require access to a balanced and flexible ACE portfolio that allows fishing for both species, and, most importantly, international markets need to exist for both species to the level of the TACCs that would promote an increase in fishing effort through financial incentives.

Factors that may have affected North Island eel catch, such as introduction to the QMS, introduction of a 4-kg longfin maximum legal size, and increases to escape tube sizes, all pre-date the time series for ANG 15 and the South Island.

3.4.2 Spatial trends in catch

Shortfin

Spatial and temporal trends in the South Island landed catch of shortfin by subarea from 2010–11 to 2020–21 are shown in Figure 41. Catch of shortfin is also plotted by mapped South Island subareas aggregated for the fishing years 2010–11 to 2020–21 (Figure 42), demonstrating the geographic contribution of shortfin catches throughout the South Island over the last 11 years, contrasting high and low volume subareas.

Shortfin were landed from 51 of the possible 58 subareas (88%). Of these 51 subareas, AS1 (Te Waihora excluding migration area), AS2 (Te Waihora migration area), and AX4 (Lake Brunner) were the main contributors making up three-quarters (76.7%) of the catch over the 11 years (Figures 41 and 42). For other subareas, catches were more variable among years and only AW9 (Oreti River coast), AW11 (Mataura River coast), AV9 (Lakes Waihola and Waipori), and AR3 (Waimakariri River) contributed 2% or more of the shortfin catch over the 11 years. AS1 and AS2 catches displayed opposite trends, i.e., large catches from the lake resulted in small catches from the migration area and vice versa. The catches for the three main subareas varied among years with no trend in catch in AS1 and AX4, while AS2 catch declined sharply after the first two years, with no catch in the last three years (Figure 41). For the minor subareas, there was more variation among years as shortfin catch was not always landed from these subareas every year, particularly in recent years. The pattern of catches by subarea was generally similar over the 11 years except for those in SFE 11 (AN and AP), SFE 12 (AQ and AR), and SFE 14 (AT and AU), where the number of subareas with shortfin landings declined from 2016–17 onward when ANG was split into shortfin and longfin in the QMS (Figures 41 and 43). For example, before 2016–17, on average, 52% of subareas within SFE 11, SFE 12, and SFE 14 were fished annually, compared with 15% from 2016–17 onward, indicating a substantial reduction in effort. This marked reduction in effort and catch in these areas was because of the unwanted bycatch of longfin, given the very low TACC of 1 t for longfin in each of these three QMAs.

Longfin

Spatial and temporal trends in the South Island landed catch of longfin by subarea from 2010–11 to 2020–21 are shown in Figure 44. Catch of longfin is also plotted by mapped South Island subareas aggregated for the fishing years 2010–11 to 2020–21 (Figure 45), demonstrating the geographic contribution of longfin catches throughout the South Island over the last 11 years, contrasting high and low volume subareas.

Longfin were landed from 53 of the possible 58 subareas (91%). Of these 53 subareas, AW11 (Mataura River coast), AW9 (Oreti River coast), AW3 (Oreti River inland down to Bog Burn), AV10 (Clutha River coast), AV11 (Pomahaka River), AW10 (Mataura River – Riversdale to Gore), and AX3 (Grey River, Arnold River) were consistently the main contributors to the South Island longfin annual landings, making up half (50.2%) of the catch over the eleven years (Figures 44 and 45). For other subareas, catches were more variable among years, and only AU5 (Waitaki River), AX2 (Buller River), and AW8 (Aparima River coast) have contributed more than 3% of the longfin catch over the eleven years (Figure 44). The pattern of catches by subarea was generally similar over the 11 years except for those in LFE 11 (AN and AP), LFE 12 (AQ and AR), and LFE 14 (AT and AU), where the number of subareas with longfin landings declined from 2016–17 onward when the species were split into shortfin and longfin in the QMS (Figures 44 and 46). For example, before 2016–17, on average, 55% of subareas within LFE 11, LFE 12, and LFE 14 were fished annually, compared with only 8% from 2016–17 onward. The substantial reduction in effort and catch was due to the reduction in the longfin TACC to 1 t in these QMAs, making target fishing for longfin unviable.

4. DISCUSSION

4.1 Data collection

2018–19 to 2020–21

Eel landed catch data are analysed and presented in detail for three fishing years from 2018–19 to 2020–21 of the commercial eel fishery monitoring programme, meeting the objective to monitor size and species of eels by recording quantities of eels in the different commercial size grades and linking this to catch location. The North Island has had full participation since the inception of the monitoring programme in 2003–04, whereas the South Island processors have provided limited data from ANG 15 (Otago and Southland) since 2006–07 and complete data for the entire South Island from 2010–11. Data are presented on species commercial catch by processed weight grades and catch location.

Future of the eel monitoring programme

The Fisheries New Zealand Eel Working Group (17 June 2021) agreed to discontinue the eel monitoring programme following the collection of data from the 2020–21 fishing year. The electronic reporting system introduced in the commercial eel fishery from mid-2019 records latitude and longitude data from the start and end of eel fyke net sets, making the provision of catch by subarea information redundant. Electronic reporting does not, however, collect data on size of eels except for those over 4 kg (2 kg in the Waikato-Tainui Area), which must be released.

The time series data have been useful for monitoring temporal and spatial patterns in catch and size of each species. The spatial catch time series can potentially be continued by converting the electronic position data collected by the ERS to subarea location and updating the spatial plots of catch by subarea (see Figures 18, 22, 41, 44) with the caveat that reported catches associated with ERS position data are estimated at the riverbank and not weighed.

4.2 Data quality

Captured data

The eel catches included in these analyses do not always match exactly the reported landed catch for the North Island as documented by Fisheries New Zealand (2022) (see Table 6, see Figure 7). It is not clear

which dataset is more accurate since Fisheries New Zealand catches from Eel Catch Landing Returns (ECLRs) often differ from those reported from Monthly Harvest Returns (MHR). Despite the possibility that there are missing catch data in some years, this is unlikely to bias the patterns or trends shown by the data captured in this programme.

Limitations of the data

The shortcomings of the commercial eel monitoring programme are: 1) weight grade data are coarse with only two to three weight grades recorded; 2) grades may differ among the processors and/or species; 3) grades have changed in response to market demands or regulation changes affecting size limits (e.g., the 4-kg maximum size limit, escape tube size); 4) the data offer limited information on the sex structure of the populations, except where the sex of eels may be assumed from size, i.e., all shortfin caught outside Te Waihora migration area (AS2) and all longfin in the large weight grade are female; 5) non-marketable sized eels that enter nets are often returned to the water, hence the size composition of the landed catch is not always representative of eels that are caught in the fishery.

Dealing with different size grades

In this and the three previous commercial eel monitoring reports (Beentjes 2013, 2016, 2019), the weight grade catch data were combined for all processors, despite some minor differences in the grades used (i.e., those processors landing North Island or South Island caught eels). In the South Island, there have been three processors (Mossburn, AFL-LET, and Independent Fisheries) providing catch data for this programme and, because of the difference in weight grades used between Mossburn and AFL-LET, it was necessary to amalgamate each species into two weight grades, not three as for the North Island. The rationale for using generic weight grades is that weight grades have changed over time, grading is done by eye, and our goal is to provide an overall picture of the size of eels that are commercially landed. Hence, minor changes to the ranges of a weight grade are not likely to mask any gross changes in size that might be occurring over time. This has simplified the analyses and the outputs allowing a continuous time series to be constructed for each island. As a consequence, this makes comparison between the South Island and North Island difficult for shortfin because the cut-off of large shortfin is 800 g for most South Island processed shortfin eels (until 2017–18 when it changed to 1000 g), and 1000 g for the North Island shortfin. Further, the small shortfin grade in the South Island also includes male eels less than 300 g caught from Te Waihora migration area (before 2018–19), so would be biased in some years depending on the extent of the catch from this part of the lake. Because of this, comparison of catch by weight grades for either species between North Island and South Island is not valid, perhaps with the exception of large longfin over 1000 g.

Estimating eel numbers

Numbers of eels in the weight grades were not provided by the processors in the monitoring programme, but instead were estimated, allowing the overall mean weight of individual eels of each species in each year to be calculated. Estimates of eel numbers were particularly important for the North Island large weight grade where, until March 2007, there was no upper limit and the catch could contain a few very large eels, or many smaller eels. The estimated eel numbers that are presented in this report are based on various assumptions about the population length-frequency distribution and involve the amalgamation of different processor weight grades. More accurate estimates of numbers would require collection of detailed length and weight records at regular intervals.

4.3 Efficacy of the data

Because the location of the catch is recorded at the time of landing, species catch and size can be examined at three geographic spatial scales, i.e., QMA, ESA, and, most importantly, the catchment-based subarea. The latter two spatial area data are unique to this programme, although catch has been estimated (not weighed) by species and recorded by ESA as part of the mandatory reporting by individual commercial fishers using ECERs.

Although the commercial eel monitoring programme provides less information on size and sex distribution from individual landings than the historical catch sampling programmes (Beentjes &

Chisnall 1997, 1998, Beentjes 1999, Chisnall & Kemp 2000, Beentjes 2005), it captures data from nearly all North Island and South Island commercial eel landings, providing a more accurate and unbiased representation of the spatial stock structure.

An accurate estimate of the proportion of large eels landed by the commercial eel fishery is obtained because virtually the entire annual catch was sampled (see Table 6). For longfin eels, this provides an index of under 4-kg potentially spawning females in the population from the commercially fished habitat, notwithstanding fluctuations in market demands for different sizes. Longfin eels over 1000 g or about 70 cm (i.e., large weight grade) are almost certainly females because males migrate at a mean length of about 62 cm, equivalent to about 680 g (Todd 1980). Longfin females mature and migrate from about 90 cm or 2 kg depending on condition (see review in Fu et al. 2012). The maximum longfin size limit for commercial harvest is 4 kg (about 108 cm). Therefore, where commercial fishing takes place, the maturing and potentially migrating females (between 2 and 4 kg) are vulnerable to capture[3]. Common practice, however, is for commercial fishers to voluntarily release eels that display morphological signs of migration, even if they are below 4 kg and, in the South Island, fishers have been discouraged from landing all eels over 2 kg. Commercial fishers also tend to avoid waterways when mature longfins are migrating downstream.

4.4 Release and recording of longfins over 4 kg

The full extent of the over 4-kg longfin eel releases was unknown before the introduction of the ERS. Before mid-2019, voluntary recording of these data by some South Island eel fishers showed that more than 1400 longfins over 4 kg were caught and released in 2013–14 (Bill Chisolm, pers. comm.), some of which were purportedly as large as 16 kg. This equates conservatively to about six tonnes of longfin eels which would have corresponded to about 12% of the 2013–14 South Island longfin landed catch by weight.

Similarly, a North Island voluntary logbook programme initiated in 2015 included seven fishers, predominantly in the Waikato area (Statistical Area AD). A total of 918 over-sized eels (4 kg or over) were released between 2014–15 and 2018–19, equating to 3.7 tonnes of eels, if all eels were 4 kg. While this was not representative of the entire North Island and all fishers, it suggests that the numbers released North Island-wide over this 5-year period were substantial. The capture of longfin eels over 4 kg was anecdotally reported by fishers to be increasing over the logbook period.

Reporting by ERS from about mid-2019 has required fishers to record all eels over the maximum legal size that are released. The ERS data for 2019–20 indicate that New Zealand-wide, nearly six tonnes and 1200 longfin eels were released, equating to an average size of 4.8 kg (Figure 47, Table 10). Most of this was from Otago/Southland (LFE15), Northland/Auckland (LFE 20), and central North Island (LFE 21). The total catch of released eels as a proportion of the total landed catch in 2019–20 was 11% (range 6 to 22%) (Figure 47, Table 10). Similarly, for the 2020–21 fishing year, nearly 13 tonnes and 5000 longfin eels were released (Figure 47), equating to an average size of 2.6 kg. The smaller average size of less than 4 kg in 2020–21 indicates that either fishers were releasing eels below 4 kg in LFE 20, or that the weight and/or count estimates are incorrect (Table 10). Sixty percent of the released catch in 2020–21 was from Northland /Auckland (LFE 20). The total catch of released eels as a proportion of the total landed eel catch in 2020–21 was double that in the previous year at 22% (range 5 to 161%) with 61% more over-sized eels released in LFE 20 than legal sized eels landed (Table 10). The collection of these data on the ERS now provides a means to temporally and spatially quantify the capture of large female longfins in fyke nets in the entire commercial fishery, assuming that these data are accurate and complete. Some of these over 4-kg eels caught and released are likely to have been recaptures. Not all fish stocks show that over 4-kg eels have been released each year, reflecting the areas that are fished and/or reporting anomalies.

[3] In the Waikato-Tainui Fisheries Area, the legal size range for longfin eels is 0.4–2.0 kg, and the take of longfin female migrant eels is also prohibited. The Waikato-Tainui Fisheries Area includes all tributaries, streams, and water courses that flow into the Waikato River equivalent to subareas 4L, 4K, 4I, and the northern third of 4J.

4.5 Longfin spawning escapement

A major concern for the sustainability of the longfin eel fishery relates to spawning escapement and the reduction in numbers of large females in mainstem rivers compared with historical levels, resulting from commercial fishing (Dunn et al. 2009, Fu et al. 2012). In 2011–12, when there were restrictions on quota or marketable sizes in the North Island, about half of the longfin catch (by weight) comprised eels over 1000 g and less than 4000 g. Because longfins above about 700 g are predominantly, if not exclusively female, more than half the longfin caught in 2011–12 were female, with the remainder being either male or female (see Figure 20, Table 9a). Using estimates of eel numbers rather than catch weight, about one-quarter (24%) of longfins were female and the remainder were either male or female (see Table 9a). The proportion of eels within any weight grade in the catch, as discussed, is related to market demands, regulation changes, and fishing practices. The proportion of large longfin caught is likely to be higher than the values presented (see Tables 9a, 9b, 9c) because fishers frequently release eels in spawning condition that are of legal size, as well as those over the maximum legal size of 4 kg. Overall, however, both the North Island and South Island fisheries continue to land large longfin eels with no apparent trend. Indeed, anecdotal reports by fishers suggest that capture of large longfin eels over 4 kg is becoming increasingly common and causing problems with fishing operations. Further, the presence of large longfin eels in a stretch of water often results in poor catches of smaller eels. The proportion of longfin habitat fished in 2012–13 to 2013–14 was estimated at 27% New Zealand-wide, with much of the unfished habitat located in inaccessible back country areas, Department of Conservation estate, and Fisheries New Zealand closed areas, where large female longfins are often abundant (Beentjes et al. 2016).

4.6 North Island eel fishery summary

Shortfin

The North Island commercial shortfin landed catch from data provided by processors over the 18-year period shows no consistent trend, notwithstanding the low catches in the last two years and the under sampled catch in 2003–04, nor does the distribution of these catches in the three weight grades used (see Figure 15). The fluctuations from year to year in catch and size proportions have been influenced by one or more factors, such as TACC reductions, market demands, annual rainfall, escape tube size increases, and, most importantly in recent years, by quota/ACE availability, closure of the LET processing factory in Levin in 2020, and COVID19. The total eel catch since 2001–02 was strongly correlated with the numbers of permits fished and fishing events, which, in turn, is a reflection of the economics of fishing, although this applies more to longfin than shortfin (see Figure 16).

Longfin

North Island commercial longfin landed catches from data provided by processors over the 18-year period have fluctuated more than shortfin and are characterised by an overall trend of declining catch (see Figure 20). Like shortfin, there were various factors that influenced annual longfin catches, overall and within size ranges. Key drivers include the 58% TACC reductions for North Island longfin stocks for the 2007–08 fishing year and a further of 32% reductions in 2018–19, market demands, a progressive decline in the availability of ACE to fishers, economics of fishing, and, more recently, the closure of the LET processing factory in Levin in 2020 and COVID19. The North Island longfin fishery is more prone to market demand fluctuations than the shortfin fishery because longfin is the less desirable species of eel. There are no indications from the landed and processed North Island longfin catch since 2003–04 that abundance or size has declined due to fishing.

The longfin catch since 2001–02 was strongly correlated with the number of permits fished and fishing events, which in turn is a reflection of the economics of fishing for longfin (see Figure 16). During a 2015 survey looking at where commercial eel fishers had caught longfin (Beentjes et al. 2016), many fishers commented that they do not bother fishing for longfin or specific grades when demand is low.

The pattern of longfin landings by subarea was generally similar over the first fifteen years, but, in the last three years, the number of subareas providing landings has declined, indicating a moderate contraction in spatial effort by fishers targeting longfin (see Figure 22).

4.7 South Island eel fishery summary

Shortfin

There was a declining trend in South Island shortfin landed catches from data provided by processors over the 11-year period, particularly in the last three years, with a similar decline in the proportions of large shortfin (see Figure 35). There were a number of factors that have influenced annual South Island shortfin landed catches, overall and within size ranges. These include flood conditions that can increase the catch of smaller shortfin (Vic Thompson, pers. comm.), the increase in small weight grade range in 2017–18, the split into separate shortfin and longfin stocks in 2016–17, and subsequent ACE imbalances resulting from the nominal 1 t TACCs set in LFE 11, LFE 12, and LFE 14. In addition, several key fisher retirements culminating in a trend of declining permits fished and fishing events (see Figure 38), withheld quota, a declining and eventually an end to catch contribution from AS2 (Te Waihora migration area), and, in the last few years, poor market demands and COVID19 have also contributed to the annual shortfin catches. There are no indications from the landed and processed South Island shortfin catch since 2010–11 that abundance or size has declined due to fishing.

The pattern of South Island shortfin landed catch by subarea is generally similar over the first six years, except that AS1 and AS2 catches tend to display opposite trends, i.e., large catches from the lake relate to small catches from the migration area and vice versa (see Figure 41) because Te Waihora quota (SFE 13) can be filled from either the lake (AS1) or the migration area (AS2). There were no catches from AS2 in the last three years. The number of subareas with shortfin landings declined dramatically from 2016–17 onward in LFE 11, LFE 12, and LFE 14 when ANG were split into shortfin and longfin in the QMS. Fishing for shortfin in these areas subsequently became unviable because of the unwanted bycatch of longfin.

Longfin

The South Island commercial longfin catch shows recent trends of declining annual catch but no trend in the proportions of large eels (see Figure 37). As for shortfin, similar factors have contributed to the amount and size of longfin that was caught and processed annually in the South Island, particularly the split into separate shortfin and longfin stocks in 2016–17 and subsequent ACE imbalances resulting from the nominal 1 t TACCs set in LFE 11, LFE 12, and LFE 14. Fisher retirements culminating in a trend of declining permits fished and fishing events (see Figure 38) and, in the last few years, poor market demands and COVID19 have also resulted in low catches. There are no indications from the landed and processed South Island longfin catch since 2010–11 that abundance or size has declined due to fishing.

The pattern of South Island longfin landed catch by subarea is generally similar over the first six years, (see Figure 44). The number of subareas with longfin landings, however, declined dramatically from 2016–17 onward in LFE 11, LFE 12, and LFE 14 when ANG were split into shortfin and longfin in the QMS. Fishing for longfin in these areas subsequently became unviable.

4.8 Long-term trends in species composition and size

Data on landed catch and weight grades by species from processors in the lower North Island and South Island dating back to the 1970s were provided to NIWA before the commercial eel monitoring programme was officially implemented. These data were combined with the North Island eel monitoring data from 2003–04 and the South Island eel monitoring data from 2010–11. The historical weight grade data were provided in more than six grades for each species and these were re-grouped into those comparable with the current weight grades from the eel monitoring programme to make a continuous time series dating back to 1979 for the North Island and, except for some missing years, back to 1975 for the South Island.

The lower North Island data indicate that longfin eels contributed as much as half the landed eel catch in the late 1970s (Figure 48) and the proportion of longfin to shortfin, with some fluctuations, has generally declined over the forty-two years, averaging 9% longfin in the last three years (no catch in 2020–21). The longfin weight grade data indicate that the proportions of eels over about 600 g captured and processed has declined over time (Figure 48). The North Island shortfin weight grade data, apart from the first few years when medium and large eels dominate and the last two years, have a reasonably stable mix of the three weight grades.

The South Island wide data show similar trends to the lower North Island, suggesting that longfin have become increasingly less abundant in the commercial landed catch than shortfin and have also been subject to a reduction in mean size, particularly after the 1970s (Figure 49). These data begin in 1979, about 10 to 15 years after commercial fishing for eels had begun (see Figure 1), and it seems likely that had the data been collated at the start of the fishery in the mid-1960s, the observed trends for longfin eel would be more pronounced.

Any long-terms trends should be considered with respect to the factors that have influenced species composition and size during the eel monitoring programme.

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7. TABLES

Table 1: Quota Management Areas (QMA) and Eel Statistical Areas (ESA) for longfin (LFE), shortfin (SFE) eels, and both species combined (ANG) in the South Island. Before 2016–17, South Island QMAs were not separated into shortfin and longfin and were both prefaced with ANG, e.g., ANG 15 for both SFE 15 and LFE 15.

Area	QMA		ESA (alpha) (after 1 Oct 2001)	ESA (numeric) (before 1 Oct 2001)
	LFE	SFE		
Northland	LFE 20	SFE 20	AA	1
Auckland	LFE 20	SFE 20	AB	2
Hauraki	LFE 21	SFE 21	AC	3
Waikato	LFE 21	SFE 21	AD	4
Bay of Plenty	LFE 21	SFE 21	AE	5
Poverty Bay	LFE 21	SFE 21	AF	6
Hawke's Bay	LFE 22	SFE 22	AG	7
Rangitikei-Wanganui	LFE 23	SFE 23	AH	8
Taranaki	LFE 23	SFE 23	AJ	9
Manawatu	LFE 22	SFE 22	AK	10
Wairarapa	LFE 22	SFE 22	AL	11
Wellington	LFE 22	SFE 22	AM	12
Nelson	LFE 11	SFE 11	AN	13
Marlborough	LFE 11	SFE 11	AP }	14
South Marlborough	LFE 12	SFE 12	AQ }	14
Westland	LFE 16	SFE 16	AX	15
North Canterbury	LFE 12	SFE 12	AR	16
South Canterbury	LFE 14	SFE 14	AT	17
Waitaki	LFE 14	SFE 14	AU	18
Otago	LFE 15	SFE 15	AV	19
Southland	LFE 15	SFE 15	AW	20
Te Waihora (outside Migration Area)	LFE 13	SFE 13	AS1 }	21
Te Waihora Migration Area	LFE 13	SFE 13	AS2 }	21
Chatham Islands	LFE 17	SFE 17	AZ	22
Stewart Island	LFE 15	SFE 15	AY	23

Table 2: Chronology of eel weight grades and changes, used by the North Island eel processors from 2003–04 to 2020–21. The various grades have been assigned to three weight grade categories: small, medium, and large. There have been no changes to weight grades since 2014–15 for shortfin and 2009–10 for longfin. LFE, longfin; SFE, shortfin; NZ Eel, New Zealand Eel Processors; AFL-LET, Aotearoa Fisheries and Levin Eel Trading. *300–1000 g not included in size grade data analyses.

Year	Processor	Species	Weight grade (g)		
			Small	Medium	Large
2003–04	Vanderdrift	LFE	*	*	over 1000
2003–04	NZ Eel	LFE	220–500	500–1200	over 1200
2006–07			300–500	500–1200	over 1200
2008–09			300–500	500–1000	over 1000
2003–04	AFL-LET	LFE	220–500	500–1000	over 1000
2009–10			300–500	500–1000	over 1000
2003–04	Vanderdrift	SFE	*	*	over 1000
2003–04	NZ Eel	SFE	220–500	500–1000	over 1000
2009–10			300–500	500–1000	over 1000
2003–04	AFL-LET	SFE	220–500	500–1000	over 1000
2008–09			220–650	650–1000	over 1000
2009–10			300–650	650–1000	over 1000
2012–13			300–600	600–1000	over 1000
2014–15			300–500	500–1000	over 1000

Table 3: Subareas, Eel Statistical Areas (ESA alpha and numeric codes) and Quota Management Areas (QMA). Eel Statistical Area alpha codes replaced numeric codes on 1 October 2001.

	Subarea		Eel Statistical Area		
Island	Code	Number	Numeric	Alpha	QMA
North	AA1–AA5	5	1	AA	20
	AB1–AB3	3	2	AB	20
	AC1–AC3	3	3	AC	21
	AD1–AD17	17	4	AD	21
	AE1–AE4	4	5	AE	21
	AF1–AF7	7	6	AF	21
	AG1–AG6	6	7	AG	22
	AH1–AH6	6	8	AH	23
	AJ1–AJ6	6	9	AJ	23
	AK1–AK4	4	10	AK	22
	AL1–AL3	3	11	AL	22
	AM2	1	12	AM	22
	Sub total	65	12	12	4
South	AN1–AN3	3	13	AN	11
	AP1–AP2	2	14	AP	11
	AQ1–AQ2	2	14	AQ	12
	AR1–AR5	5	16	AR	12
	AS1	1	21	AS1	13
	AS2	1	21	AS2	13
	AS1A	1	21	AS1	13
	AT1–AT4	4	17	AT	14
	AU1–AU5	5	18	AU	14
	AV1–AV12	12	19	AV	15
	AW1–AW12	12	20	AW	15
	AX1–AX10	10	15	AX	16
	Sub total	58	9	11	6
	Total	123	21	23	10

Table 4: Weight grades and equivalent length ranges, with mid-point length and weight derived from the cumulative length frequency distribution from the 1990s catch sampling data (see Figure 4). Mid-point weight was used to estimate total numbers of eels in each weight grade (total landed weight in each weight grade divided by the mid-point weight). See Tables 2 and 5 for weight grades corresponding to small, medium, and large categories. Maximum size was about 100 cm for shortfin and 125 cm for longfin in the catch sampling data. For longfin, 108 cm length is equivalent to 4 kg, the maximum legal size. *Shortfin eels landed from AS2 (Te Waihora migration area) are under 300 g but are still included in the small grade.

			Weight grade		Mid-point	
Island	Species	Grade	Weight range (g)	Length range (cm)	Length (cm)	Weight (g)
North	SFE	Small	300–500	50–59	54	375
		Medium	500–1000	59–75	64.5	651
		Large	over 1000	75–100	78.5	1 197
North	LFE	Small	300–500 g	48–59	52	391
		Medium	500–1000 g	59–70	63	721
		Large	over 1000 g	70–108	79	1 484
South	SFE	Small	300–1000	*50–75	56.5	432
		Large	over 1000	75–100	78.8	1 197
South	LFE	Small	300–1000	48–70	54	441
		Large	over 1000	70–108	79	1 484

Table 5: Summary of chronology of changes to weight grades used in the South Island from 2006–07 to 2020–21. There have been no changes to weight grades since 2017–18 for shortfin and longfin. Mossburn, Mossburn Enterprises; AFL-LET, Aotearoa Fisheries and Levin Eel Trading; Independent, Independent Fisheries. – indicates no eels landed in this grade.

Year	Processor	Species	Weight grade (g)	
			Small	Large
2006–07	Mossburn	LFE	300–1000	1000–1500 and over 1500
2017–18			300–750	over 750
2010–11	AFL-LET	LFE	300–500 and 500–1000	over 1000
2006–07	Mossburn	SFE	300–800	over 800
2017–18			300–1000	over 1000
2009–10	AFL-LET	SFE	300–650 and 650 to 1000 and AS2 migrating males (below 300 g)	over 1000
2012–13			300–600 and 600 to 1000	over 1000
2014–15			300–500 and 500 to 1000	over 1000
2010–11	Independent	SFE	AS2 migrating males (below 300 g)	–
2015–16			AS2 migrating males (below 300 g) and AS1 eels 300–800 g	–

Table 6: Summary of landings and species-specific landed weights from North Island processors from 2003–04 to 2020–21 (a), South Island ANG 15 from 2006–07 to 2020–21 (b), and the entire South Island from 2010–11 to 2020–21 (c). % catch sampled = percent of total reported landed weight sampled in this programme, where the reported landings are from eel catch landings records (ECL) in tables 4 to 6 of the 2022 plenary document (Fisheries New Zealand 2022) except 2003–04 in the North Island, where data are from Monthly Harvest Returns (MHR) (table 2 of the 2022 plenary document). No. lndg, number of landings; SFE, shortfin eel; LFE, longfin eel; – no landings.

(a) North Island

	Vanderdrift			New Zealand Eel			AFL-LET			All processors combined				
	No.	Weight (kg)		No.	Weight (kg)		No.	Weight (kg)		No.	Weight (kg)		% catch	%
Year	lndg	SFE	LFE	lndg	SFE	LFE	lndg	SFE	LFE	lndg	SFE	LFE	sampled	SFE
2003–04	176	18 072	21 878	511	151 947	28 007	736	129 367	55 396	1 423	299 386	105 281	89.0	74.0
2004–05	–	–	–	549	124 980	42 351	595	140 903	77 889	1 144	265 883	120 240	90.4	68.9
2005–06	–	–	–	561	160 725	38 654	694	173 725	63 948	1 255	334 450	102 602	87.4	76.5
2006–07	–	–	–	532	152 902	29 572	773	185 996	70 265	1 305	338 898	99 837	99.7	77.2
2007–08	–	–	–	525	148 891	26 488	460	148 652	46 572	985	297 543	73 060	99.6	80.3
2008–09	–	–	–	306	130 366	15 711	407	122 352	26 586	713	252 718	42 297	97.7	85.7
2009–10	–	–	–	417	140 544	15 702	359	123 879	30 592	776	264 423	46 294	97.7	85.1
2010–11	–	–	–	474	202 940	23 883	399	125 155	17 248	873	328 095	41 131	111.9	88.9
2011–12	–	–	–	537	193 235	36 862	465	145 830	39 944	1 002	339 065	76 806	99.5	81.5
2012–13	–	–	–	461	167 290	26 397	409	125 339	41 600	870	292 629	67 997	99.1	81.1
2013–14	–	–	–	457	164 502	23 409	372	136 507	39 128	829	301 009	62 537	99.1	82.8
2014–15	–	–	–	477	169 481	12 552	291	92 792	21 897	768	262 273	34 449	96.0	88.4
2015–16	–	–	–	373	145 858	11 882	236	81 734	8 186	609	227 592	20 068	97.7	91.9
2016–17	–	–	–	314	156 742	19 062	226	105 870	13 351	540	262 612	32 413	99.3	89.0
2017–18	–	–	–	373	163 354	20 425	178	90 356	18 512	551	253 710	38 937	98.8	86.7
2018–19	–	–	–	424	170 977	18 517	146	72 228	3 531	570	243 205	22 048	98.9	91.7
2019–20	–	–	–	252	95 796	17 456	68	39 943	2 244	320	135 739	19 700	99.6	87.3
2020–21	–	–	–	393	156 155	17 643	–	–	–	393	156 155	17 643	97.0	89.8
Totals	176	18 072	21 878	7 936	2 796 685	424 573	6 814	2 040 628	576 889	14 926	4 855 385	1 023 340	97.7	81.7

Table 6 – *continued*

(b) South Island (ANG 15)

	Mossburn			AFL-LET			All processors combined				
	No.	Weight (kg)		No.	Weight (kg)		No.	Weight (kg)		% catch	%
Year	Lndg	SFE	LFE	Lndg	SFE	LFE	Lndg	SFE	LFE	samp.	SFE
2006–07	299	17 425	63 941	–	–	–	299	17 425	63 941	101.2	21.4
2007–08	367	21 033	69 132	–	–	–	367	21 033	69 132	95.7	23.3
2008–09	204	14 879	34 882	–	–	–	204	14 879	34 882	98.9	29.9
2009–10	314	28 427	38 515	–	–	–	314	28 427	38 515	96.9	42.5
2010–11	276	21 442	71 657	–	–	–	276	21 442	71 657	99.8	23.0
2011–12	381	19 883	78 829	3	1 354	3 054	384	21 237	81 883	96.6	20.6
2012–13	365	17 511	89 596	2	680	1 796	367	18 191	91 392	104.1	16.6
2013–14	281	11 034	70 375	5	2 180	1 130	286	13 214	71 505	94.6	15.6
2014–15	270	14 385	54 628	–	–	–	270	14 385	54 628	97.6	20.8
2015–16	227	22 018	42 467	–	–	–	227	22 018	42 467	98.2	34.1
2016–17	237	20 602	32 931	–	–	–	237	20 602	32 931	99.0	38.5
2017–18	238	14 574	36 975	–	–	–	238	14 574	36 975	100.5	28.3
2018–19	203	12 225	34 193	–	–	–	203	12 225	34 193	99.8	26.3
2019–20	238	18 271	34 722	–	–	–	238	18 271	34 722	95.0	34.5
2020–21	183	11 149	38 276	–	–	–	183	11 149	38 276	99.8	22.6
Totals	4 083	264 858	791 118	10	4 214	5 980	4 093	269 072	797 098	98.5	25.2

Table 6 – *continued*

(c) South Island

	Mossburn			AFL-Levin			Independent		All processors combined				
	No.	Weight (kg)		No.	Weight (kg)		No.	Weight (kg)					
Year	Lndg	SFE	LFE	Lndg	SFE	LFE	Lndg	SFE	Lndg	SFE	LFE	% catch sampled	% SFE
2010–11	363	101 232	94 631	33	30 547	14 463	100	61 115	496	192 894	109 094	114.3	63.9
2011–12	513	85 466	133 669	39	34 050	13 905	98	58 415	650	177 931	147 574	98.5	54.6
2012–13	558	92 454	140 752	65	38 356	18 862	18	13 250	641	144 060	159 614	84.6	47.4
2013–14	522	118 801	117 278	46	45 904	11 488	14	13 890	582	178 595	128 766	99.6	58.1
2014–15	431	82 775	70 121	57	70 582	6 755	8	4 347	496	157 704	76 876	99.4	67.2
2015–16	385	67 722	55 699	28	42 438	1 114	33	26 188	446	136 348	56 813	95.0	70.6
2016–17	513	83 955	47 037	4	17 960	0	42	37 382	559	139 297	47 037	87.0	74.8
2017–18	481	93 625	47 979	15	31 854	0	42	48 944	538	174 423	47 979	106.5	78.4
2018–19	378	92 208	38 769	5	6 091	0	–	–	383	98 299	38 769	88.5	71.7
2019–20	354	67 208	40 285	31	59 297	0	–	–	385	126 505	40 285	98.2	75.8
2020–21	323	68 437	44 322	–	–	–	–	–	323	68 437	44 322	85.6	60.7
Totals	4 821	953 883	830 542	323	377 079	66 587	355	263 531	5 499	1 594 493	897 129	96.5	64.0

Table 7: Estimated total number of shortfins (SFE) and longfins (LFE) landed for North Island processors from 2003–04 to 2020–21 (a), for South Island ANG 15 from 2006–07 to 2020–21 (b), and the entire South Island from 2010–11 to 2020–21 (c). The proportion (%) of shortfin in the catch and the estimated mean weight of individual eels (i.e., total weight divided by the number of eels) are also shown.

(a) North Island

	Numbers			Mean eel weight (kg)	
Fishing year	SFE	LFE	% SFE	SFE	LFE
2003–04	628 027	184 360	77.3	0.477	0.571
2004–05	546 491	200 716	73.1	0.487	0.599
2005–06	680 971	167 177	80.3	0.491	0.614
2006–07	710 267	162 416	81.4	0.477	0.615
2007–08	610 114	124 396	83.1	0.488	0.587
2008–09	545 231	70 963	88.5	0.464	0.596
2009–10	542 389	71 838	88.3	0.488	0.644
2010–11	655 583	49 082	93.0	0.500	0.838
2011–12	676 403	105 935	86.5	0.501	0.725
2012–13	584 299	106 518	84.6	0.501	0.638
2013–14	596 883	103 775	85.2	0.504	0.603
2014–15	508 118	56 442	90.0	0.516	0.610
2015–16	466 586	31 094	93.8	0.488	0.645
2016–17	537 982	52 230	91.2	0.488	0.621
2017–18	532 602	64 772	89.2	0.476	0.601
2018–19	495 492	35 979	93.2	0.491	0.613
2019–20	279 160	29 669	90.4	0.486	0.664
2020–21	321 368	24 664	92.9	0.486	0.715
Total	9 917 966	1 642 027	85.8	0.489	0.639

(b) South Island (ANG 15)

	Numbers			Mean eel weight (kg)	
Fishing year	SFE	LFE	% SFE	SFE	LFE
2006–07	28 229	116 466	19.5	0.617	0.549
2007–08	33 749	127 363	20.9	0.623	0.543
2008–09	22 662	65 368	25.7	0.657	0.534
2009–10	43 998	52 056	45.8	0.646	0.740
2010–11	34 846	120 758	22.4	0.615	0.593
2011–12	31 907	126 853	20.1	0.666	0.645
2012–13	30 716	173 273	15.1	0.592	0.527
2013–14	25 530	133 838	16.0	0.518	0.534
2014–15	24 925	104 761	19.2	0.577	0.521
2015–16	44 787	87 331	33.9	0.492	0.486
2016–17	43 531	74 084	37.0	0.473	0.445
2017–18	31 050	67 229	31.6	0.469	0.550
2018–19	24 921	58 697	29.8	0.491	0.583
2019–20	37 453	60 197	38.4	0.488	0.577
2020–21	24 012	61 404	28.1	0.464	0.623
Total	482 315	1 429 678	25.2	0.559	0.563

Table 7 – *continued*

(c) South Island

Fishing year	Numbers SFE	Numbers LFE	% SFE	Mean eel weight (kg) SFE	Mean eel weight (kg) LFE
2010–11	356 152	178 283	66.6	0.542	0.612
2011–12	311 468	209 182	59.8	0.571	0.705
2012–13	253 551	292 535	46.4	0.568	0.546
2013–14	297 886	235 720	55.8	0.600	0.546
2014–15	277 211	144 358	65.8	0.569	0.533
2015–16	241 808	114 680	67.8	0.564	0.495
2016–17	276 473	103 096	72.8	0.504	0.456
2017–18	375 030	86 219	81.3	0.465	0.556
2018–19	210 393	65 786	76.2	0.467	0.589
2019–20	271 726	69 509	79.6	0.466	0.580
2020–21	146 229	71 080	67.3	0.468	0.624
Total	3 017 926	1 570 449	65.8	0.526	0.567

Table 8: Distribution (%) of landed shortfin catch by weight and estimated number for each weight grade for the North Island (2003–04 to 2020–21 (a), South Island ANG 15 (2006–07 to 2020–21 (b), and for the entire South Island (2010–11 to 2020–21 (c). See Tables 2 and 5 for weight grades.

(a) North Island (shortfin)

Fishing year	Percent of landed shortfin catch, Weight grade: Small	Medium	Large	Percent of landed shortfin numbers, Weight grade: Small	Medium	Large
2003–04	56.4	31.1	12.5	72.1	22.9	5.0
2004–05	54.5	31.8	13.8	70.7	23.7	5.6
2005–06	53.7	30.9	15.4	70.4	23.3	6.3
2006–07	57.4	29.9	12.7	73.0	21.9	5.1
2007–08	53.6	33.2	13.1	69.8	24.9	5.4
2008–09	62.7	24.9	12.4	77.5	17.7	4.8
2009–10	54.5	31.0	14.4	70.9	23.2	5.9
2010–11	49.9	35.6	14.5	66.5	27.4	6.1
2011–12	49.0	37.4	13.6	65.5	28.8	5.7
2012–13	49.0	37.7	13.3	65.5	29.0	5.6
2013–14	47.2	40.5	12.3	63.4	31.4	5.2
2014–15	43.9	42.4	13.6	60.5	33.6	5.9
2015–16	51.5	38.9	9.7	66.9	29.1	3.9
2016–17	50.5	41.0	8.4	65.8	30.8	3.4
2017–18	54.6	37.8	7.7	69.3	27.6	3.1
2018–19	50.1	40.6	9.3	65.6	30.6	3.8
2019–20	51.3	40.3	8.4	66.5	30.1	3.4
2020–21	51.1	40.9	8.0	66.2	30.5	3.2

Table 8 – *continued*

(b) South Island (ANG 15 shortfin)

	Percent of landed shortfin catch Weight grade		Percent of landed shortfin numbers Weight grade	
Fishing year	Small	Large	Small	Large
2006–07	53.0	47.0	75.8	24.2
2007–08	52.0	48.0	75.0	25.0
2008–09	46.5	53.5	70.6	29.4
2009–10	48.1	51.9	72.0	28.0
2010–11	54.5	45.5	76.9	23.1
2011–12	45.1	54.9	69.5	30.5
2012–13	57.7	42.3	79.1	20.9
2013–14	74.1	25.9	88.8	11.2
2014–15	60.7	39.3	81.0	19.0
2015–16	81.0	19.0	92.2	7.8
2016–17	86.4	13.6	94.6	5.4
2017–18	87.5	12.5	95.1	4.9
2018–19	81.3	18.7	92.3	7.7
2019–20	82.1	17.9	92.7	7.3
2020–21	89.1	10.9	95.8	4.2

(c) All South Island (shortfin)

	Percent of landed shortfin catch Weight grade		Percent of landed shortfin numbers Weight grade	
Fishing year	Small	Large	Small	Large
2010–11	68.5	31.5	85.8	14.2
2011–12	62.1	37.9	82.0	18.0
2012–13	62.5	37.5	82.2	17.8
2013–14	56.3	43.7	78.1	21.9
2014–15	62.3	37.7	82.1	17.9
2015–16	63.4	36.6	82.8	17.2
2016–17	77.7	22.3	90.6	9.4
2017–18	88.9	11.1	95.7	4.3
2018–19	88.2	11.8	95.4	4.6
2019–20	88.7	11.3	95.6	4.4
2020–21	88.0	12.0	95.3	4.7

Table 9: Distribution (%) of landed longfin catch by weight and estimated number for each weight grade for the North Island (2003–04 to 2020–21) (a), South Island SFE 15 (2006–07 to 2020–21) (b), and for the entire South Island (2010–11 to 2020–21) (c). See Tables 2 and 5 for weight grades.

(a) North Island (longfin)

	Percent of landed longfin catch Weight grade			Percent of landed longfin numbers Weight grade		
Fishing year	Small	Medium	Large	Small	Medium	Large
2003–04	47.5	14.6	37.9	72.6	12.1	15.3
2004–05	46.2	17.6	36.2	70.8	14.6	14.6
2005–06	43.8	18.2	38.0	68.8	15.5	15.7
2006–07	44.6	15.9	39.5	70.1	13.6	16.4
2007–08	47.8	17.9	34.3	71.9	14.6	13.6
2008–09	49.8	9.3	40.9	75.9	7.7	16.4
2009–10	44.4	5.9	49.7	73.1	5.3	21.6
2010–11	26.2	3.6	70.2	56.2	4.2	39.6
2011–12	29.6	20.6	49.7	55.0	20.7	24.3
2012–13	39.5	20.9	39.6	64.4	18.5	17.0
2013–14	45.0	19.5	35.6	69.3	16.3	14.5
2014–15	42.4	23.3	34.3	66.2	19.7	14.1
2015–16	37.6	23.4	39.0	62.1	21.0	16.9
2016–17	40.7	23.8	35.4	64.7	20.5	14.8
2017–18	44.0	22.6	33.4	67.6	18.8	13.5
2018–19	40.6	27.0	32.3	63.7	23.0	13.4
2019–20	33.0	29.5	37.5	56.0	27.2	16.8
2020–21	28.3	26.7	44.9	51.8	26.5	21.7

(b) South Island (ANG 15 longfin)

	Percent of landed longfin catch Weight grade		Percent of landed longfin numbers Weight grade	
Fishing year	Small	Large	Small	Large
2006–07	72.0	28.0	89.6	10.4
2007–08	73.3	26.7	90.2	9.8
2008–09	75.3	24.7	91.1	8.9
2009–10	42.5	57.5	71.3	28.7
2010–11	63.8	36.2	85.6	14.4
2011–12	57.5	42.5	82.0	18.0
2012–13	76.7	23.3	91.7	8.3
2013–14	75.2	24.8	91.1	8.9
2014–15	78.0	22.0	92.3	7.7
2015–16	86.8	13.2	95.7	4.3
2016–17	98.9	1.1	99.7	0.3
2017–18	71.8	28.2	89.6	10.4
2018–19	65.4	34.6	86.4	13.6
2019–20	66.5	33.5	87.0	13.0
2020–21	58.4	41.6	82.5	17.5

Table 9 – *continued*

(c) All South Island (longfin)

	Percent of landed longfin catch Weight grade		Percent of landed longfin numbers Weight grade	
Fishing year	Small	Large	Small	Large
2010–11	60.5	39.5	83.7	16.3
2011–12	49.5	50.5	76.7	23.3
2012–13	72.7	27.3	90.0	10.0
2013–14	72.6	27.4	89.9	10.1
2014–15	75.5	24.5	91.2	8.8
2015–16	84.4	15.6	94.8	5.2
2016–17	95.2	4.8	98.5	1.5
2017–18	70.5	29.5	88.9	11.1
2018–19	64.2	35.8	85.8	14.2
2019–20	66.0	34.0	86.7	13.3
2020–21	58.3	41.7	82.5	17.5

Table 10: Summary data from Fisheries New Zealand Electronic Reporting System (ERS) on longfin eels over the maximum legal size captured and released, by fish stock for the 2019–20 to 2020–21 fishing years. The maximum legal size is 4 kg except in the Waikato-Tainui Area, where it is 2 kg. The total eel catch is from the Eel Catch Landing Records (ECLR). The % catch was calculated from catch of released eels/total eel catch. The mean size (kg) was calculated from the catch of released eels/number of released eels.

	Fish stock						
2019–20	LFE 11	LFE 14	LFE 15	LFE 20	LFE 21	LFE 23	Totals
Released eels (*N*)	44	17	431	209	468	12	1 181
Released eels (kg)	216	78	2 083	1 271	1 974	66	5 688
Total eel catch (kg)	0	0	36 900	5 900	10 800	300	53 900
% catch	–	–	5.6	21.5	18.3	22.0	10.6
Mean size (kg)	4.9	4.6	4.8	6.1	4.2	5.5	4.8

	Fish stock					
2020–21	LFE 12	LFE 15	LFE 16	LFE 20	LFE 21	Totals
Released eels (*N*)	14	452	125	3 756	501	4 848
Released eels (kg)	70	2 081	760	7 726	2 207	12 844
Total eel catch (kg)	400	38 200	7 300	4 800	8 900	59 600
% catch	17.5	5.4	10.4	161.0	24.8	21.6
Mean size (kg)	5.0	4.6	6.1	2.1	4.4	2.6

8. FIGURES

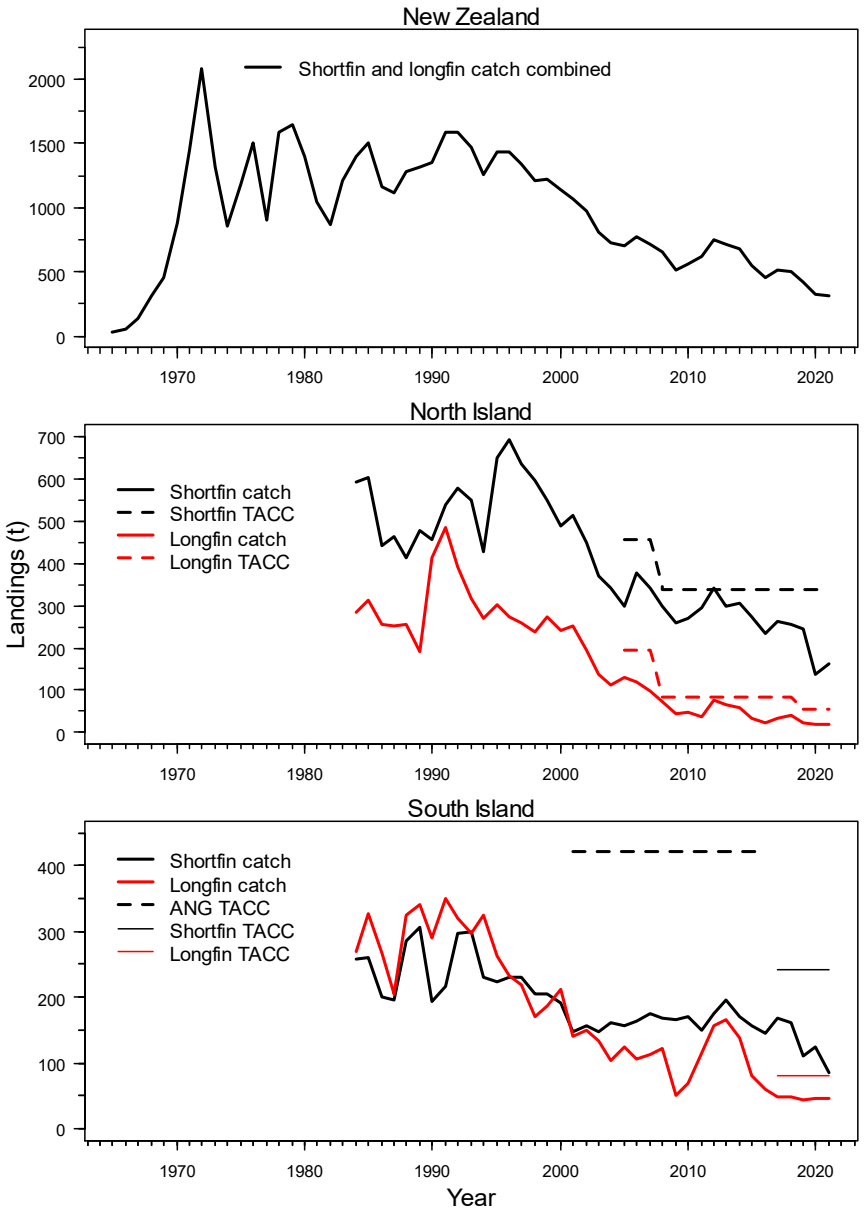

Figure 1: **New Zealand eel catch from 1965 to 2020–21 (top), North Island (centre), and South Island (bottom) catch by species from 1984 to 2020–21. Species Total Allowable Commercial Catches (TACCs) are also denoted. Species catch was estimated from species proportions in catch effort data (FSU, CELR, ECER) in the South Island before 2001 and in the North Island before 2005. Subsequent species data are from landings reported on ECLRs (Fisheries New Zealand 2022). Before 2016–17 in the South Island, there was a single TACC (ANG) for both species combined. Catches are expressed by calendar year until 1988 and thereafter by fishing year. 2010 = 2009–10. South Island shortfin catch of 84 t in 2001–02 was changed to 156 t (estimated catch) because the value of 84 t in the table 5 of the plenary (Fisheries New Zealand 2022) is exceptionally low and is not consistent with other catch data in the plenary document.**

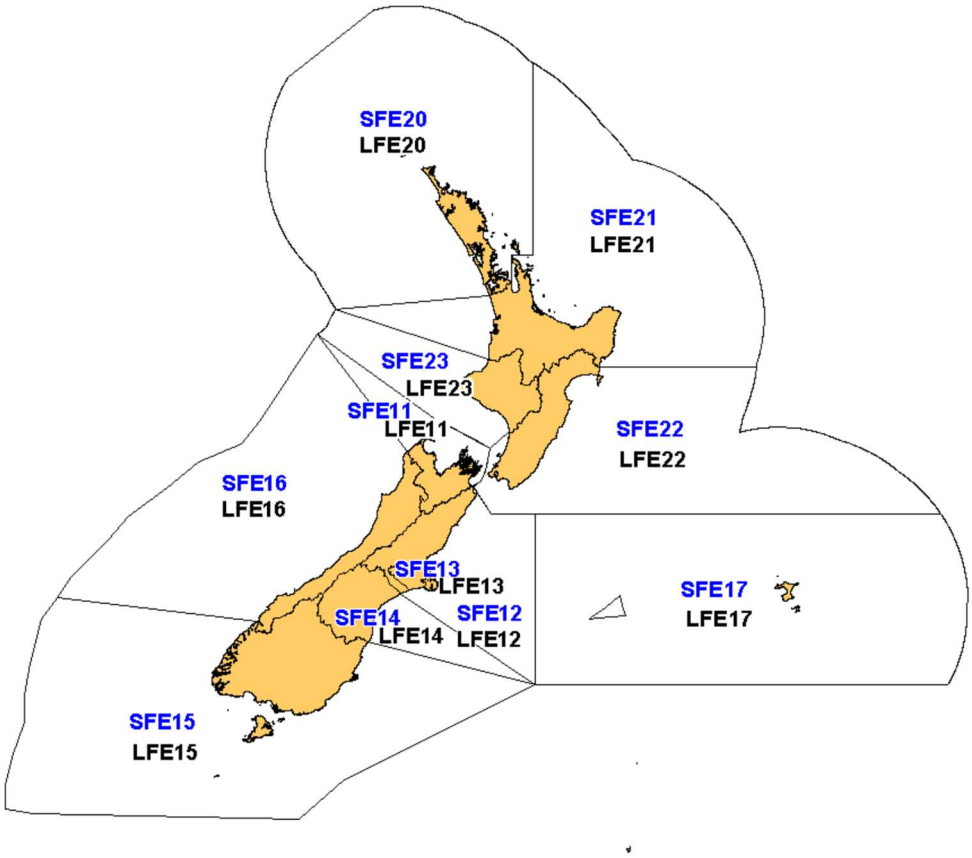

Figure 2: Quota Management Areas for the New Zealand eel fishery (see Table 1 for breakdown by Eel Statistical Areas and subareas). Figure from Fisheries New Zealand (2022).

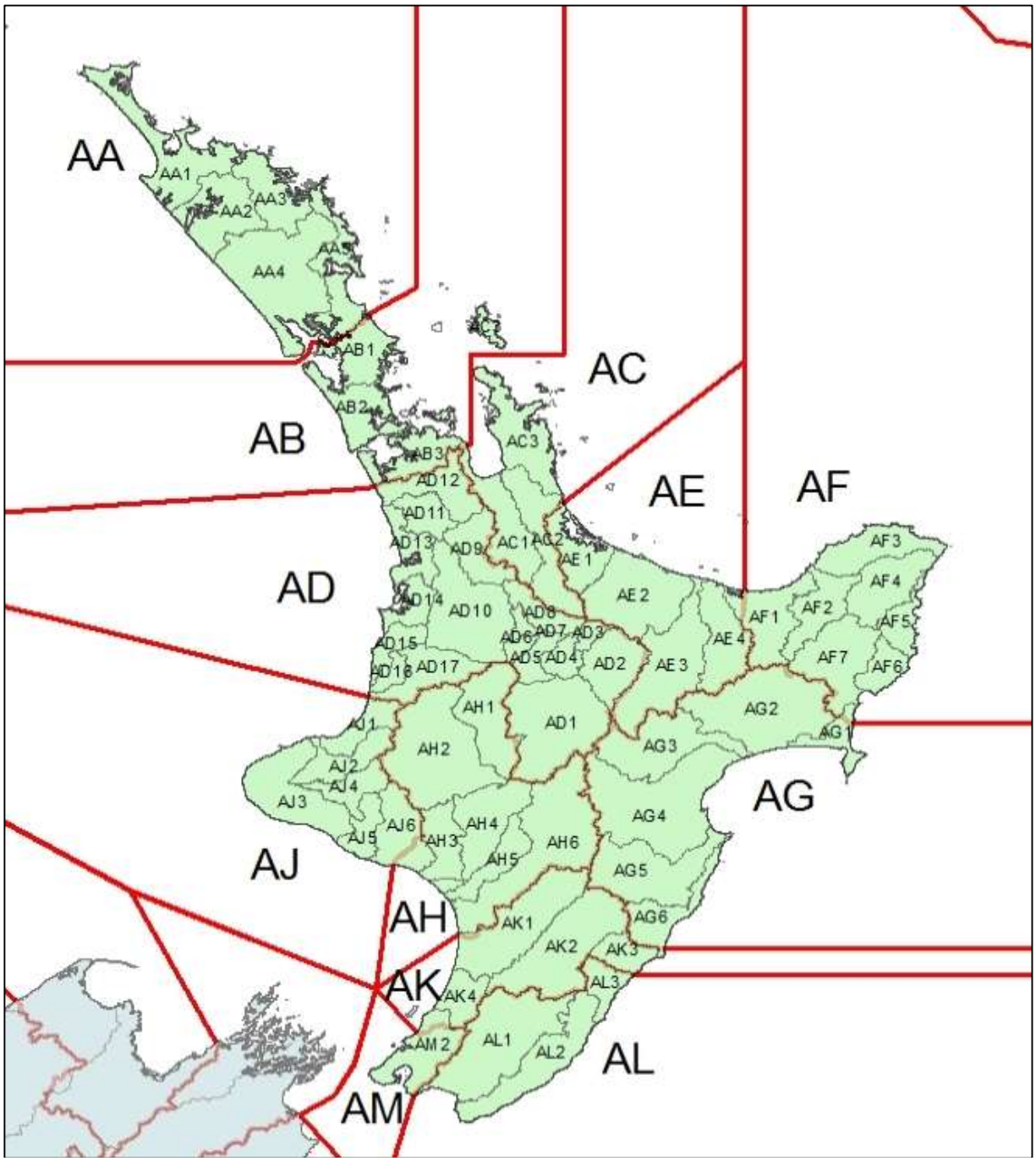

Figure 3: North Island Eel Statistical Area subareas (AA1 to AM2) and Eel Statistical Areas (ESAs AA to AM) overlaid, showing the shared boundaries (red). Subarea locations are defined in Appendix 2 and ESA areas are defined in Table 1.

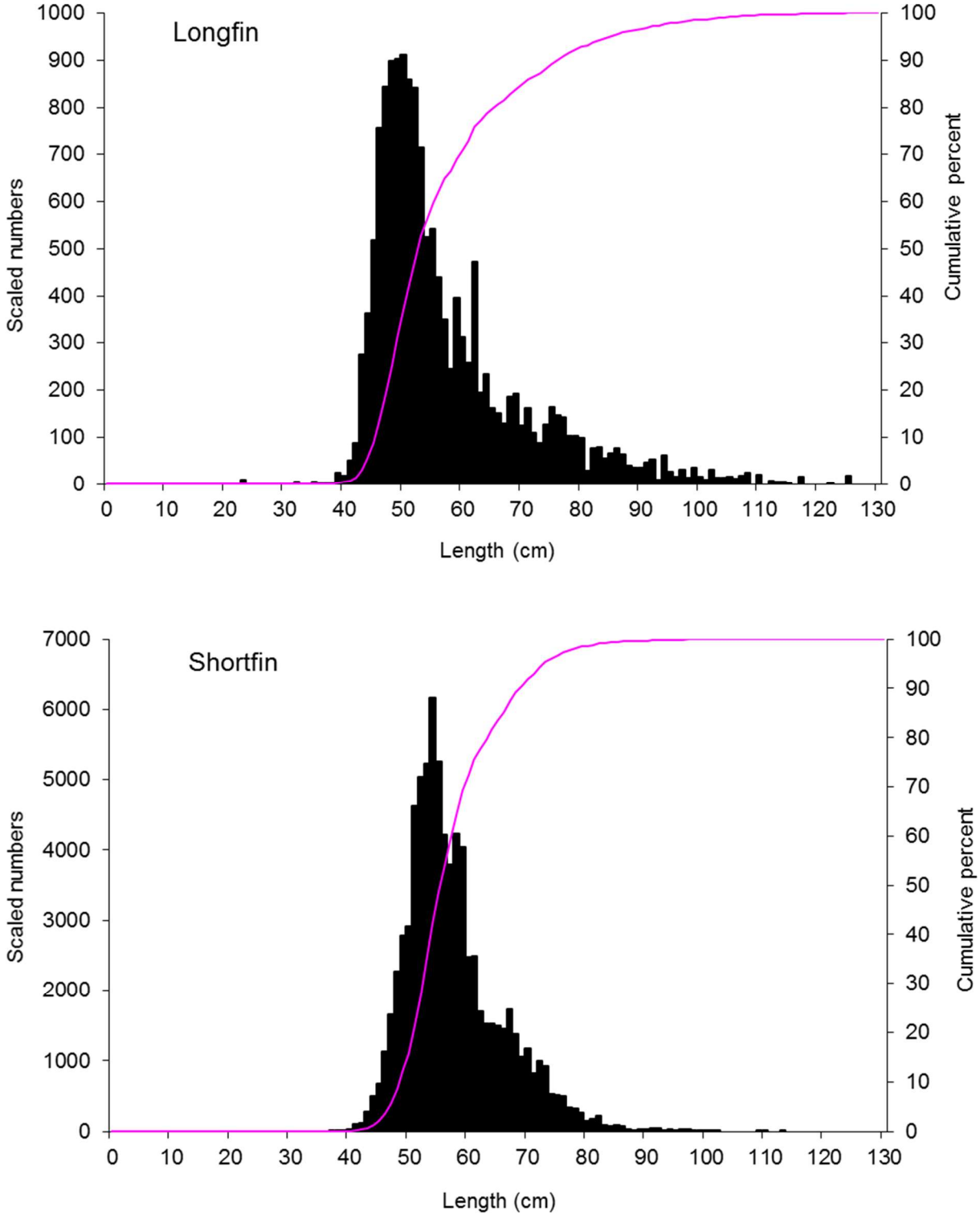

Figure 4: Scaled length frequency distributions and cumulative percent of longfin (top) and shortfin (bottom) from North Island commercial fishery catch sampling in 1995–96, 1996–97, and 1997– 98.

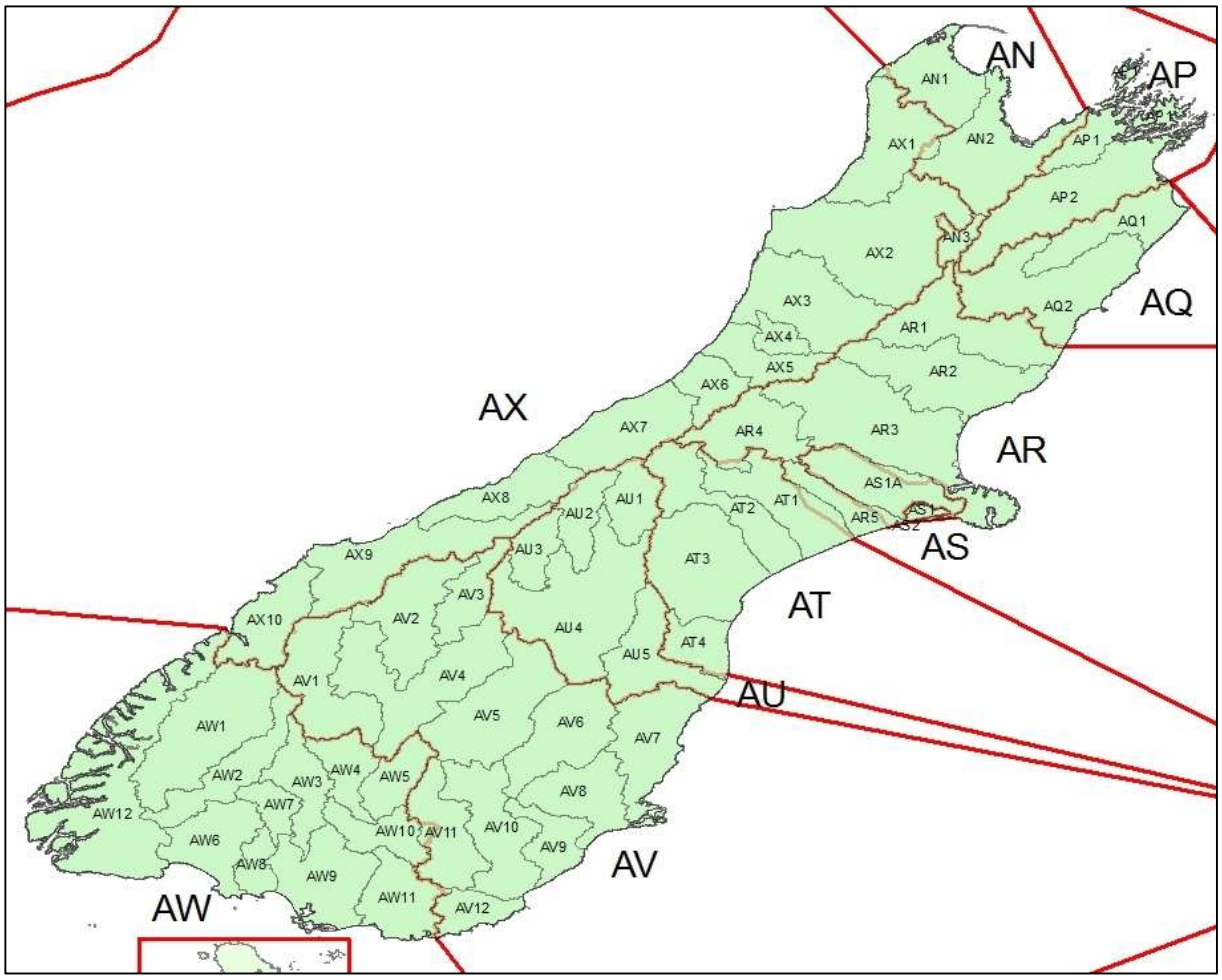

Figure 5: South Island Eel Statistical Area subareas (AN1 to AX10) and Eel Statistical Areas (AN to AX) overlaid, showing the shared boundaries (red). Subarea locations are defined in Appendix 2 and ESA areas are defined in Table 1.

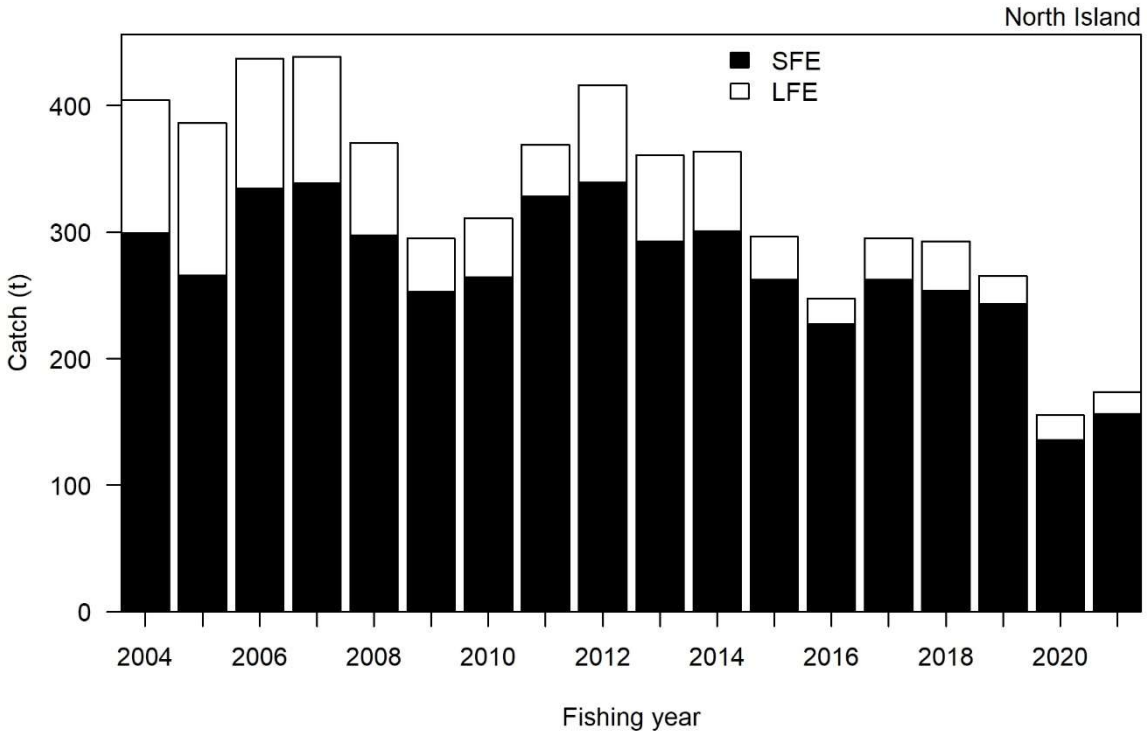

Figure 6: North Island total commercial catch (t) of shortfin (SFE) and longfin (LFE) eels for the years 2003–04 to 2020–21.

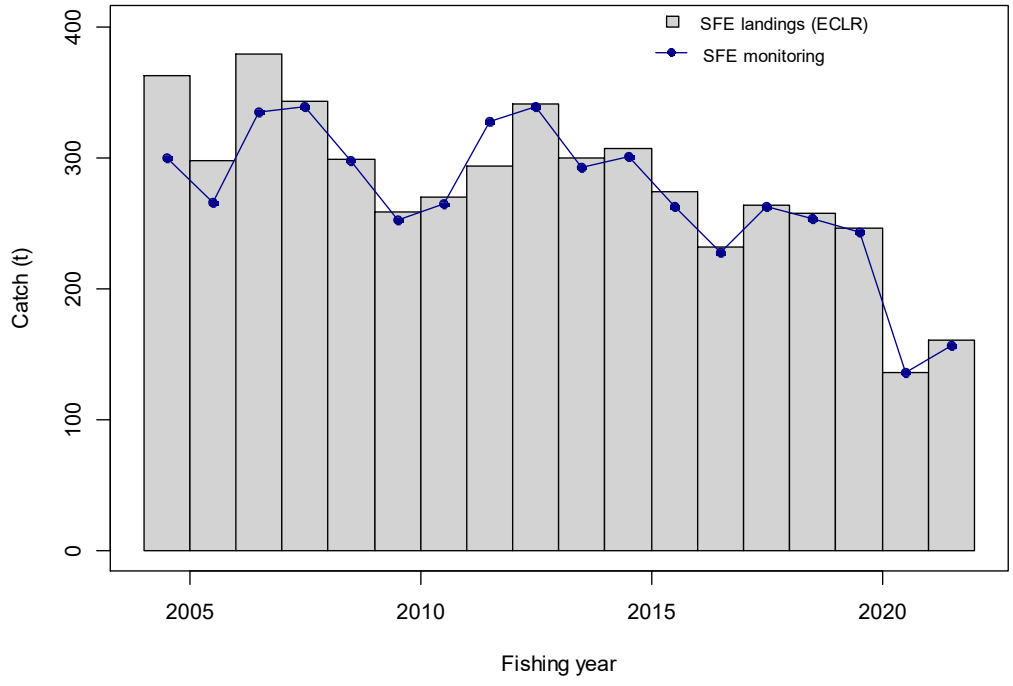

Figure 7: Catch of North Island shortfin eel (top panel) and longfin eel (bottom panel) by fishing year, recorded from the commercial eel monitoring programme and from Eel Catch Landing Records (ECLR) (Fisheries New Zealand 2022). (continued on next page)

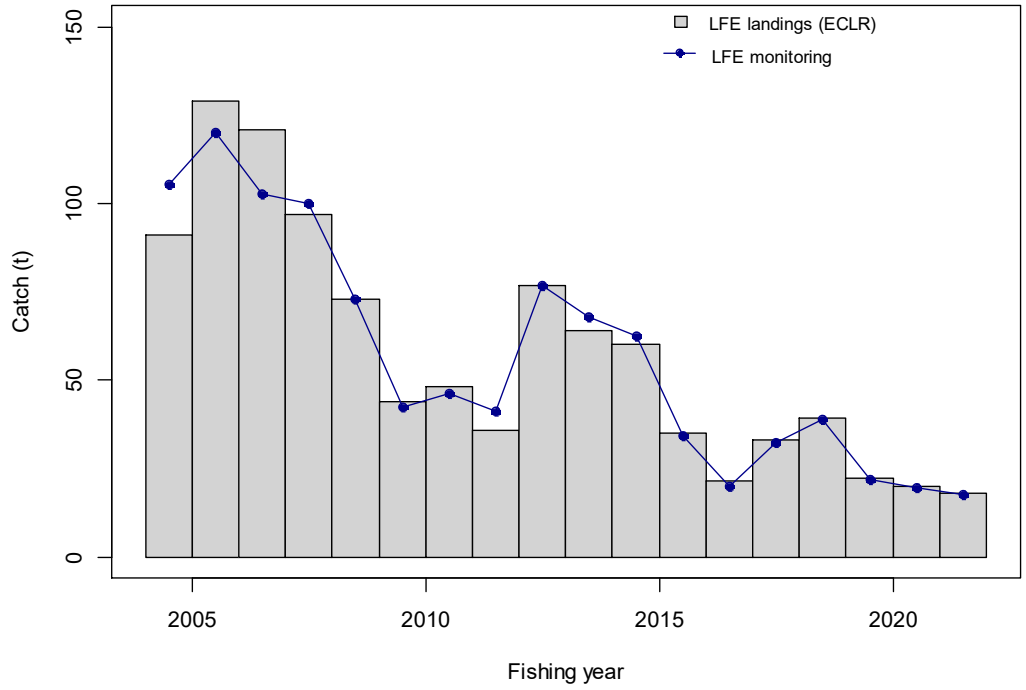

Figure 7 – ***continued***

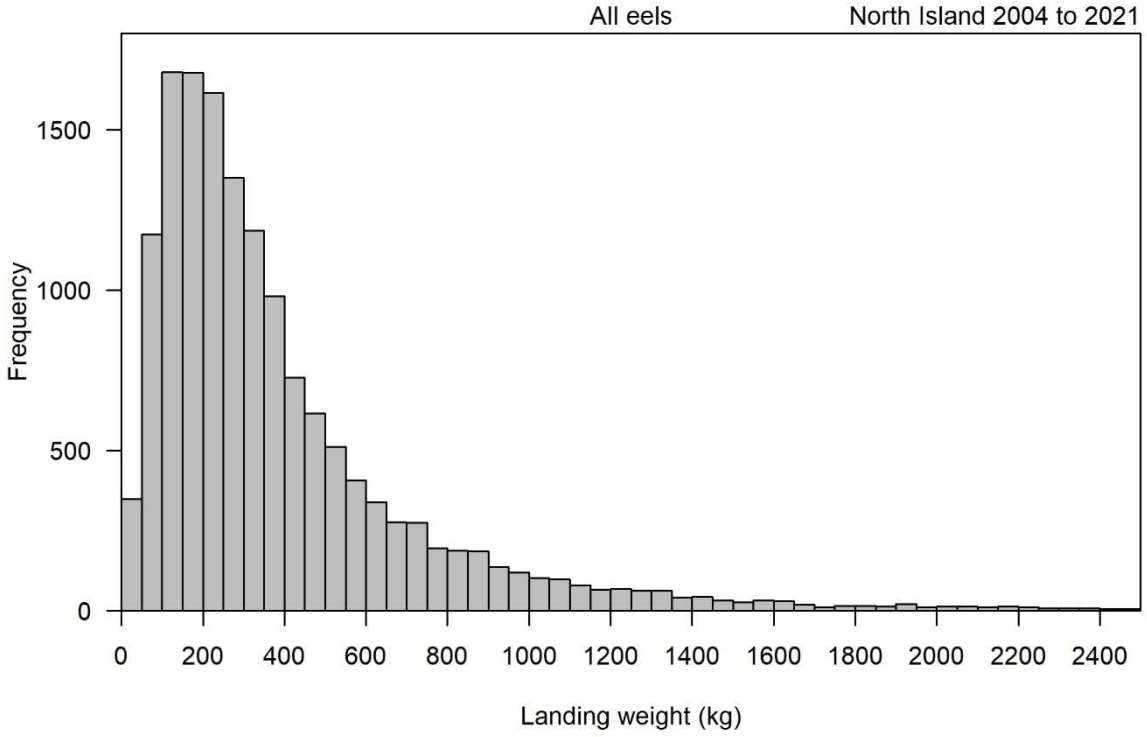

Figure 8: Distribution of individual eel landing weights in the North Island from 2003–04 to 2020–21. Landings include both shortfin and longfin eels.

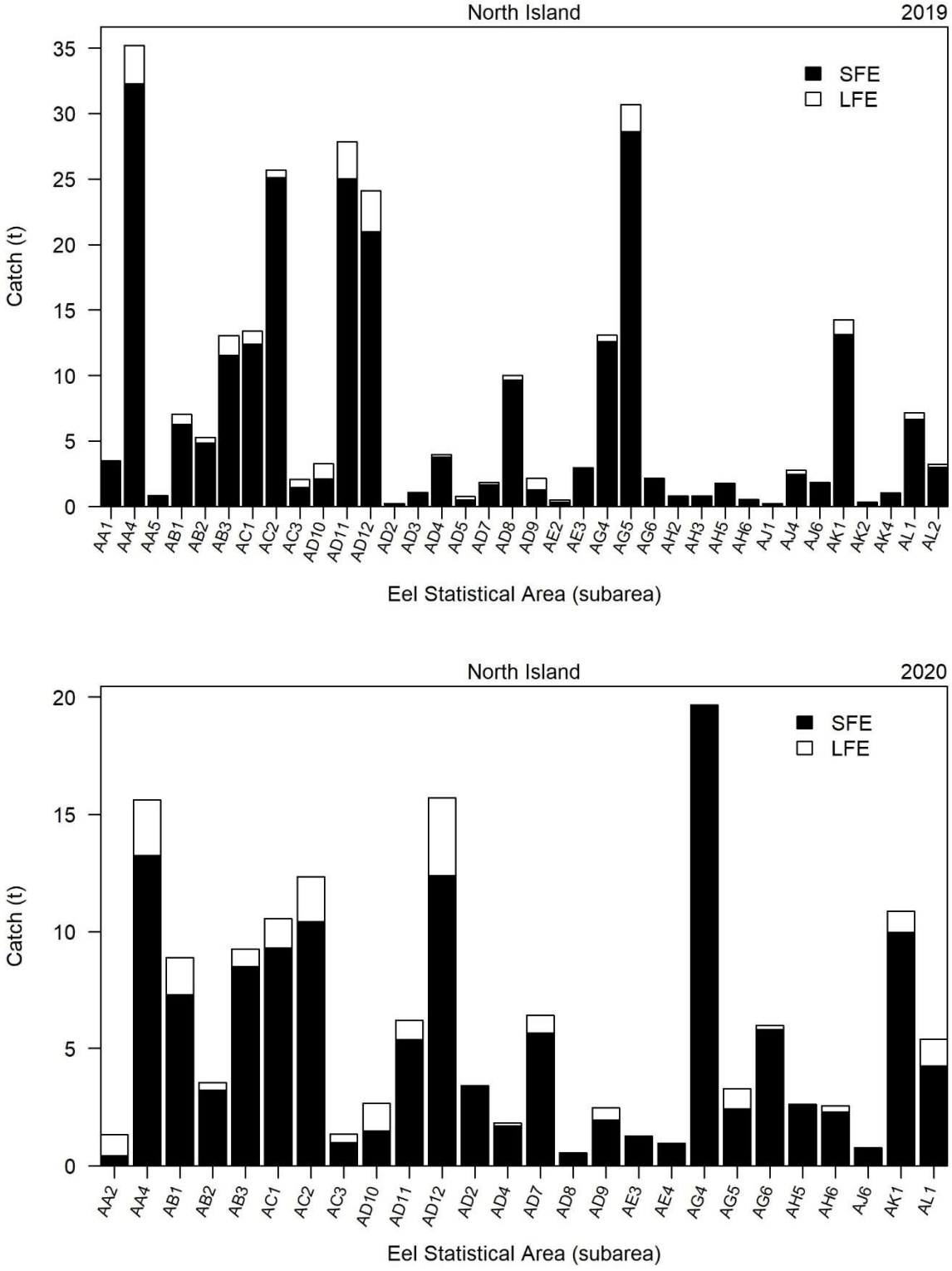

Figure 9: Catch of North Island shortfin (SFE) and longfin (LFE) eels by Eel Statistical Area subareas for fishing years 2018–19 (2019), 2019–20 (2020), and 2020–21 (2021). Only subareas with recorded catch are presented.

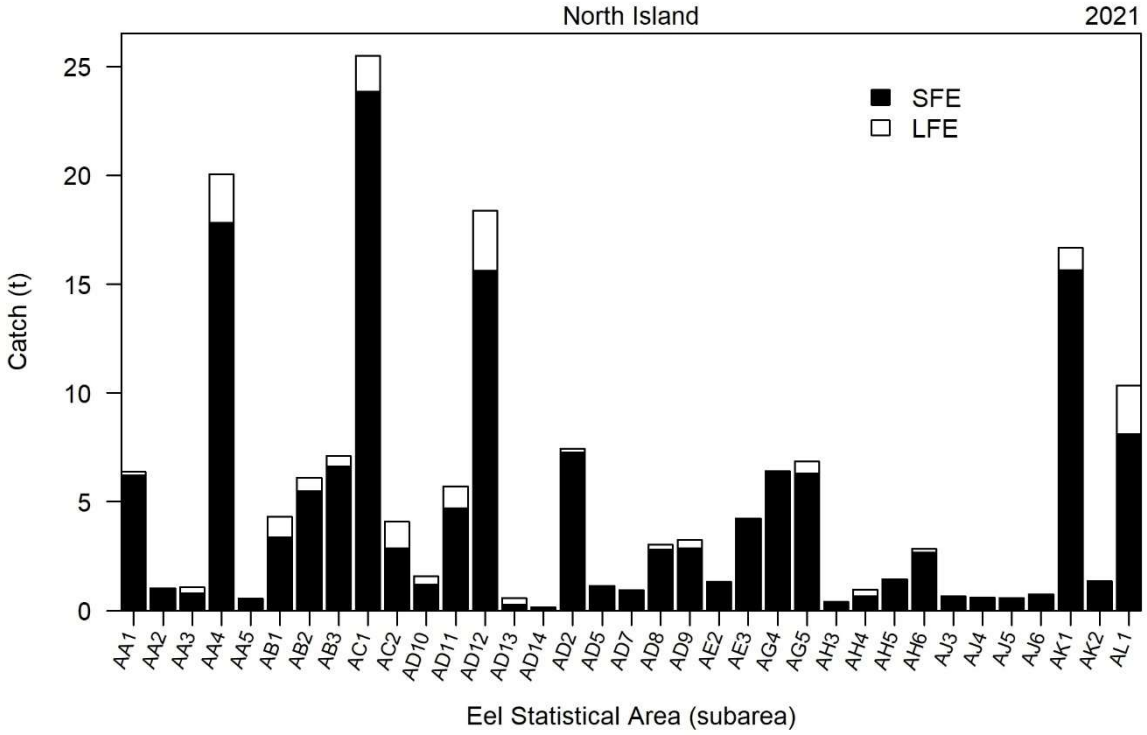

Figure 9 – ***continued***

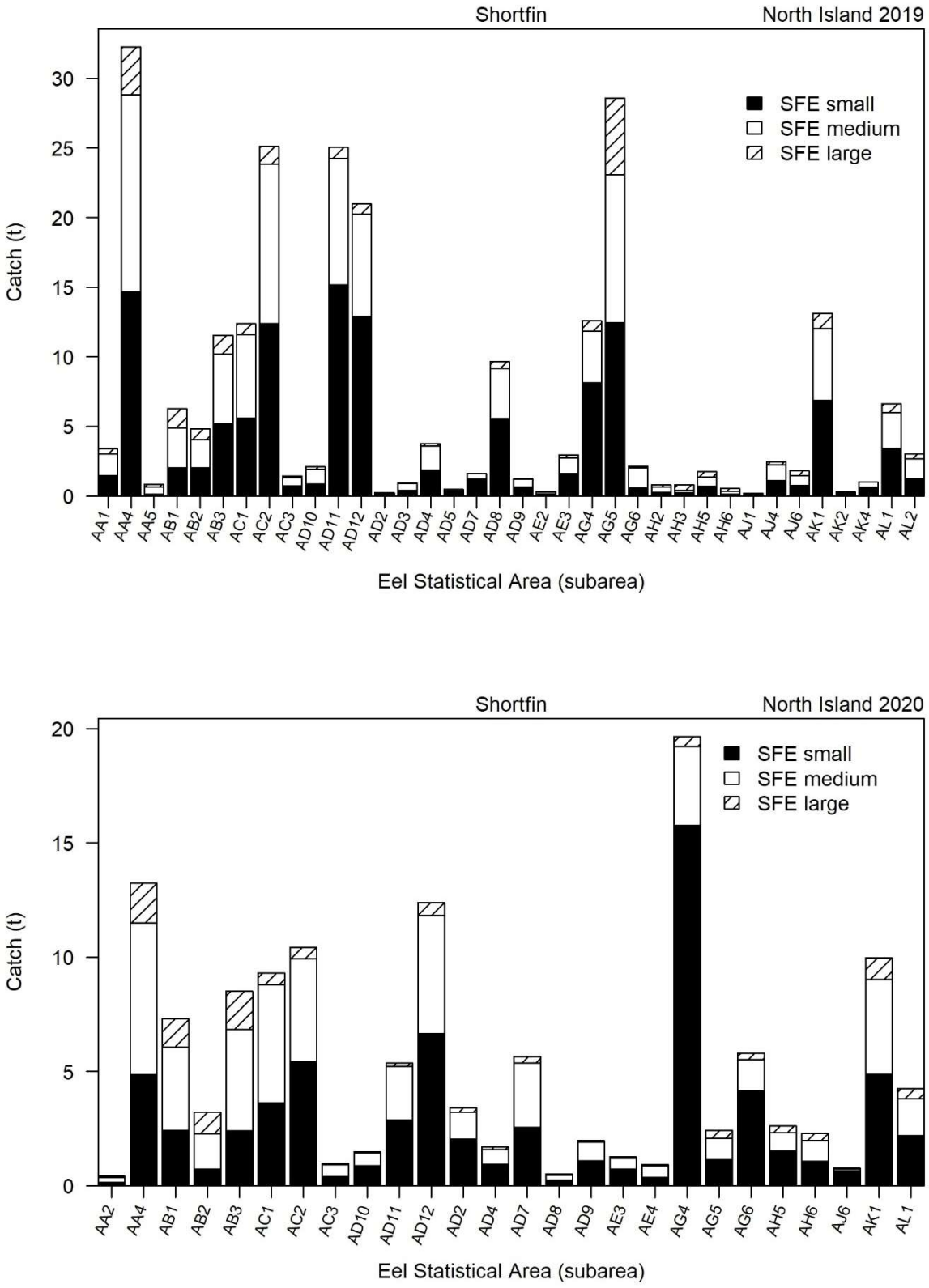

Figure 10: Catch of shortfin (SFE) eels by weight grade for North Island Eel Statistical Area subareas for fishing years 2018–19 (2019), 2019–20 (2020), and 2020–21 (2021). Only subareas with recorded catch are presented.

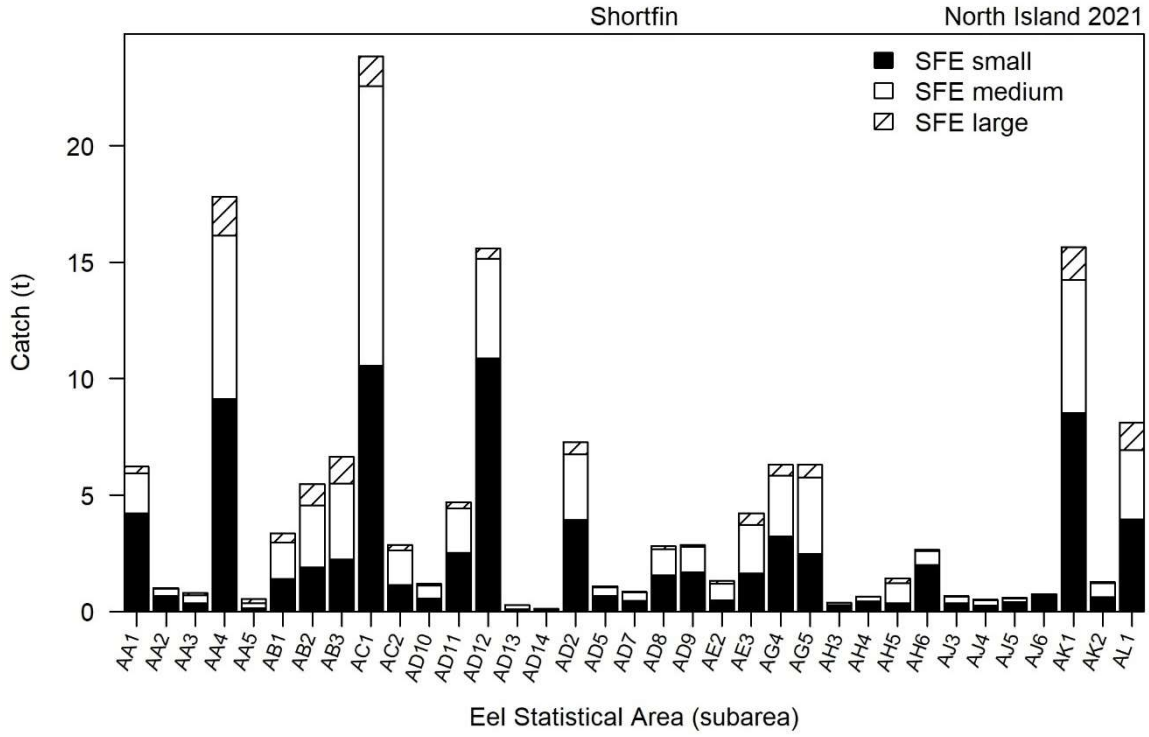

Figure 10 – ***continued***

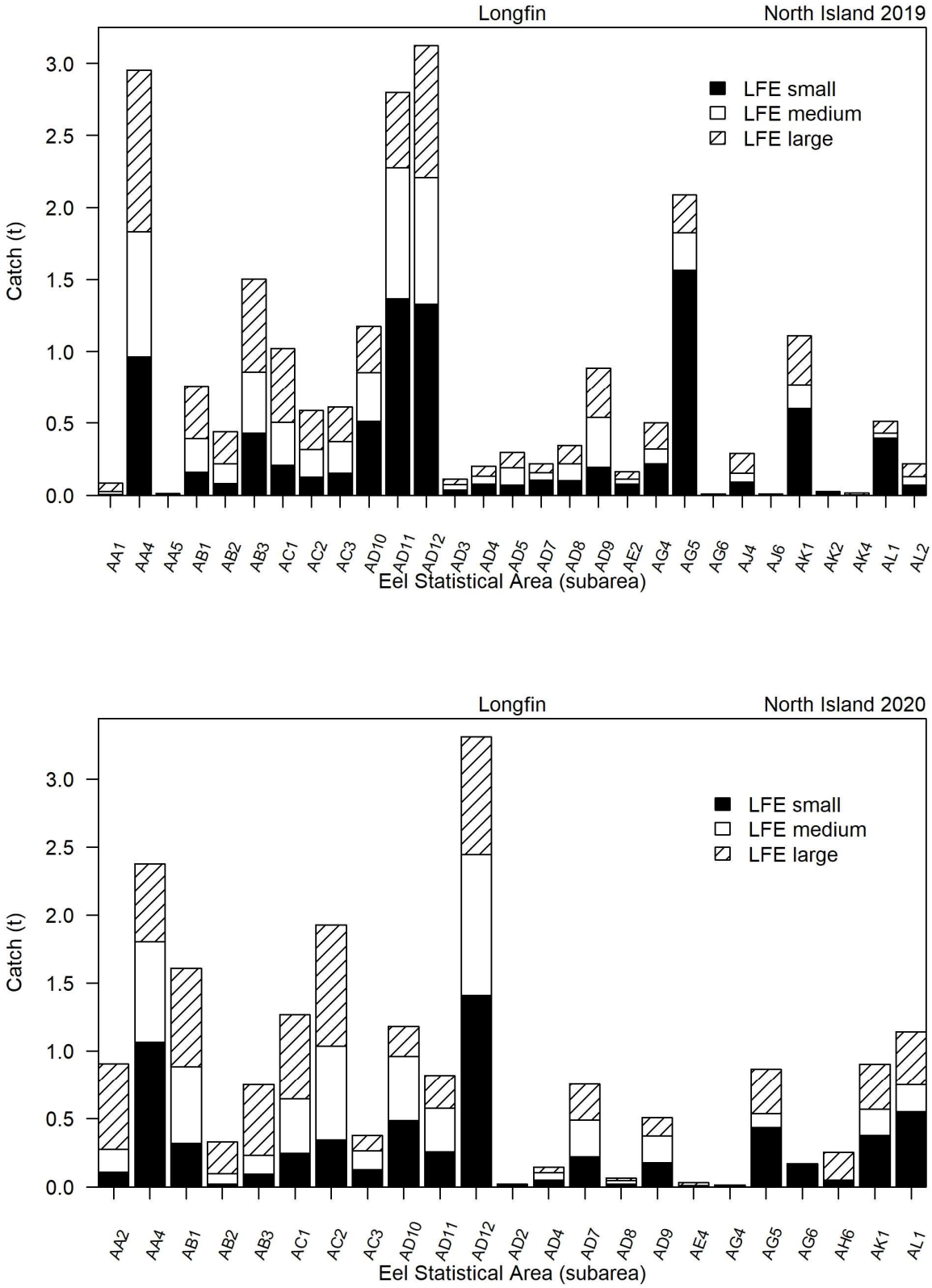

Figure 11: Catch of longfin (LFE) eels by weight grade and North Island Eel Statistical Area subarea for fishing years 2018–19 (2019), 2019–20 (2020), and 2020–21 (2021). Only subareas with recorded catch are presented.

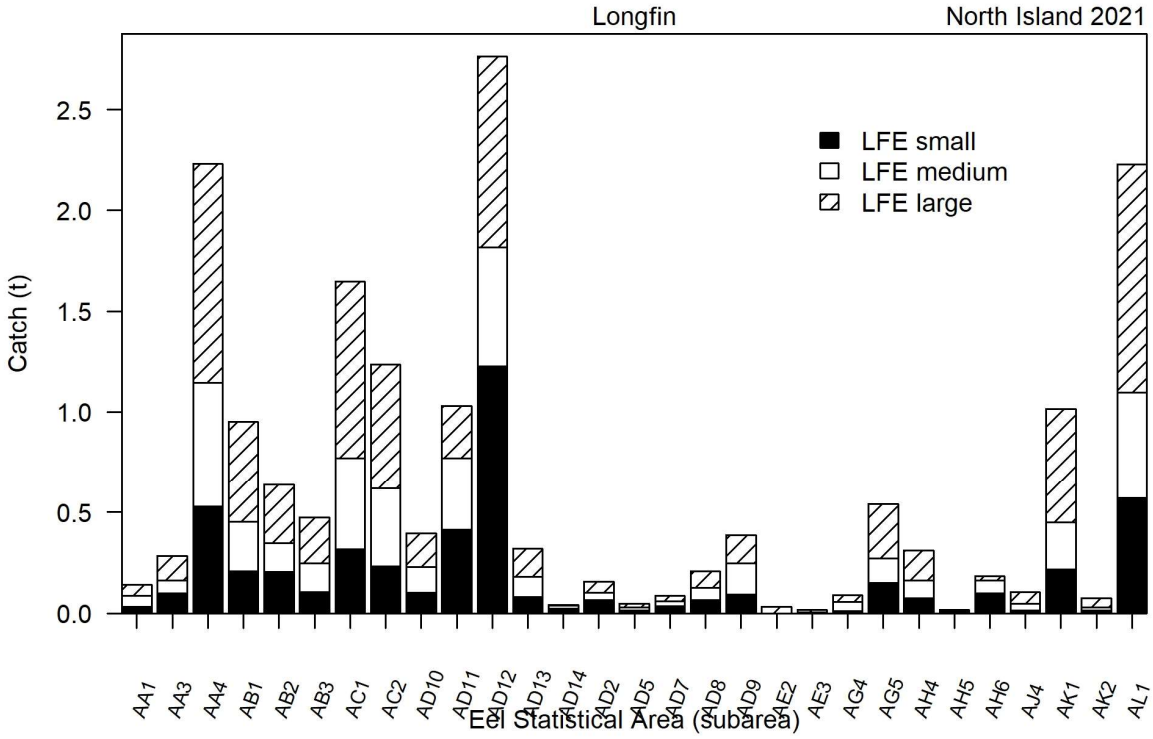

Figure 11 – ***continued***

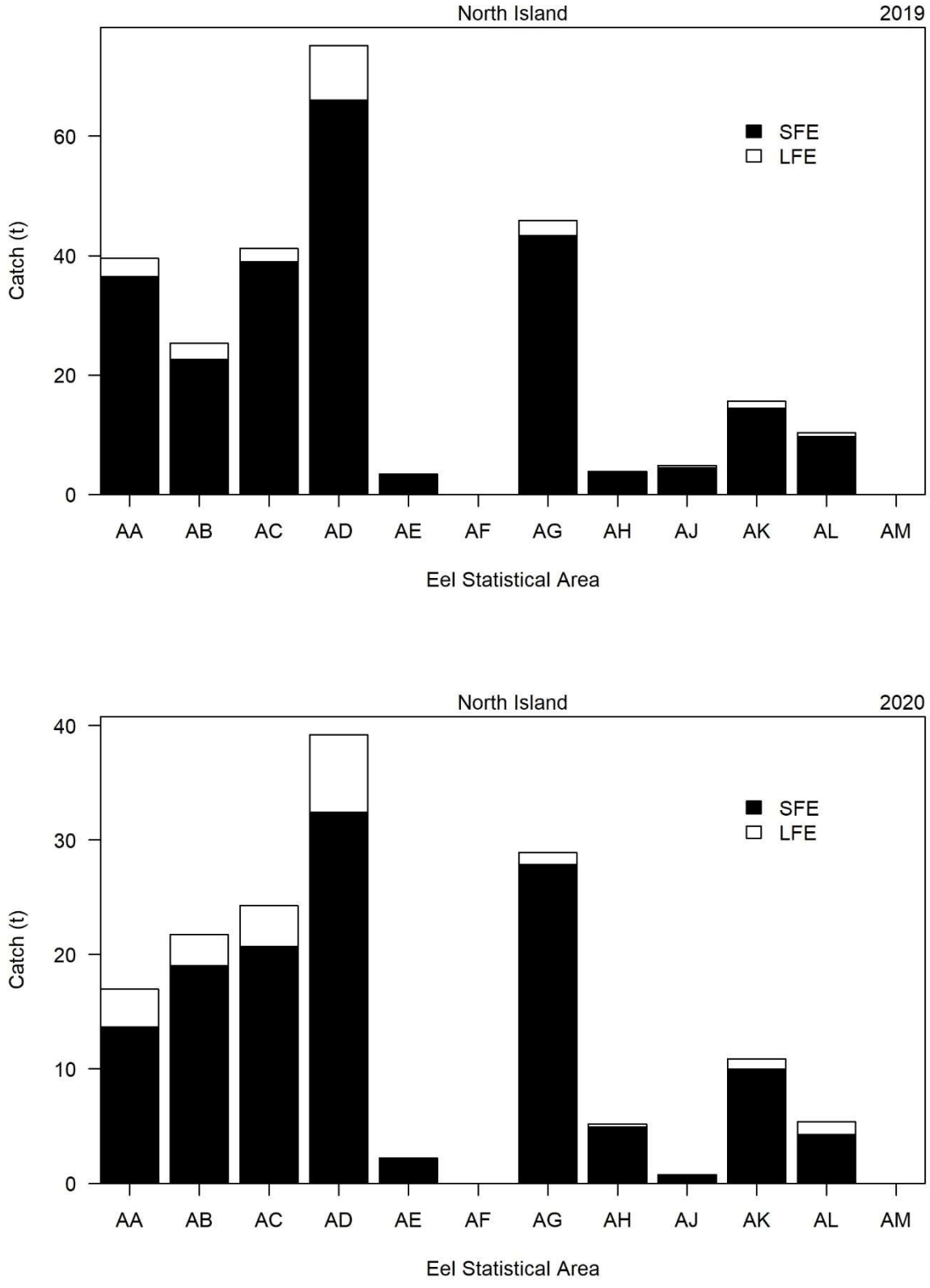

Figure 12: Catch of North Island shortfin (SFE) and longfin (LFE) eels by Eel Statistical Area for fishing years 2018–19 (2019), 2019–20 (2020), and 2020–21 (2021).

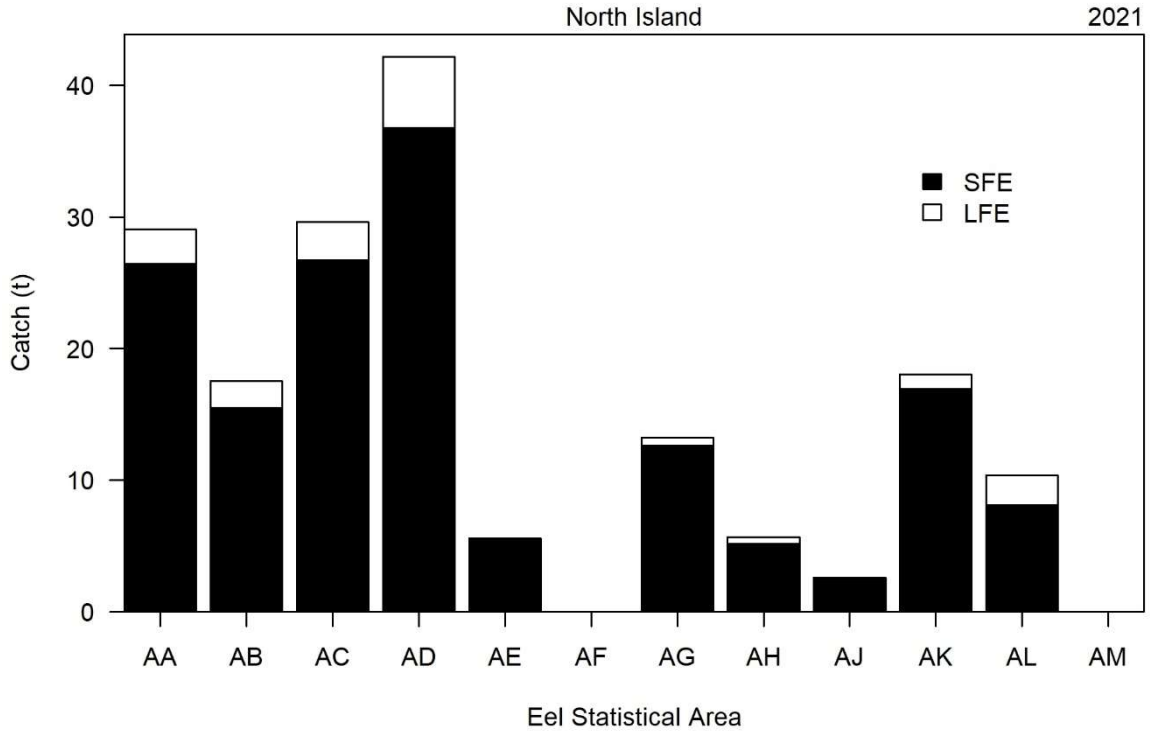

Figure 12 – ***continued***

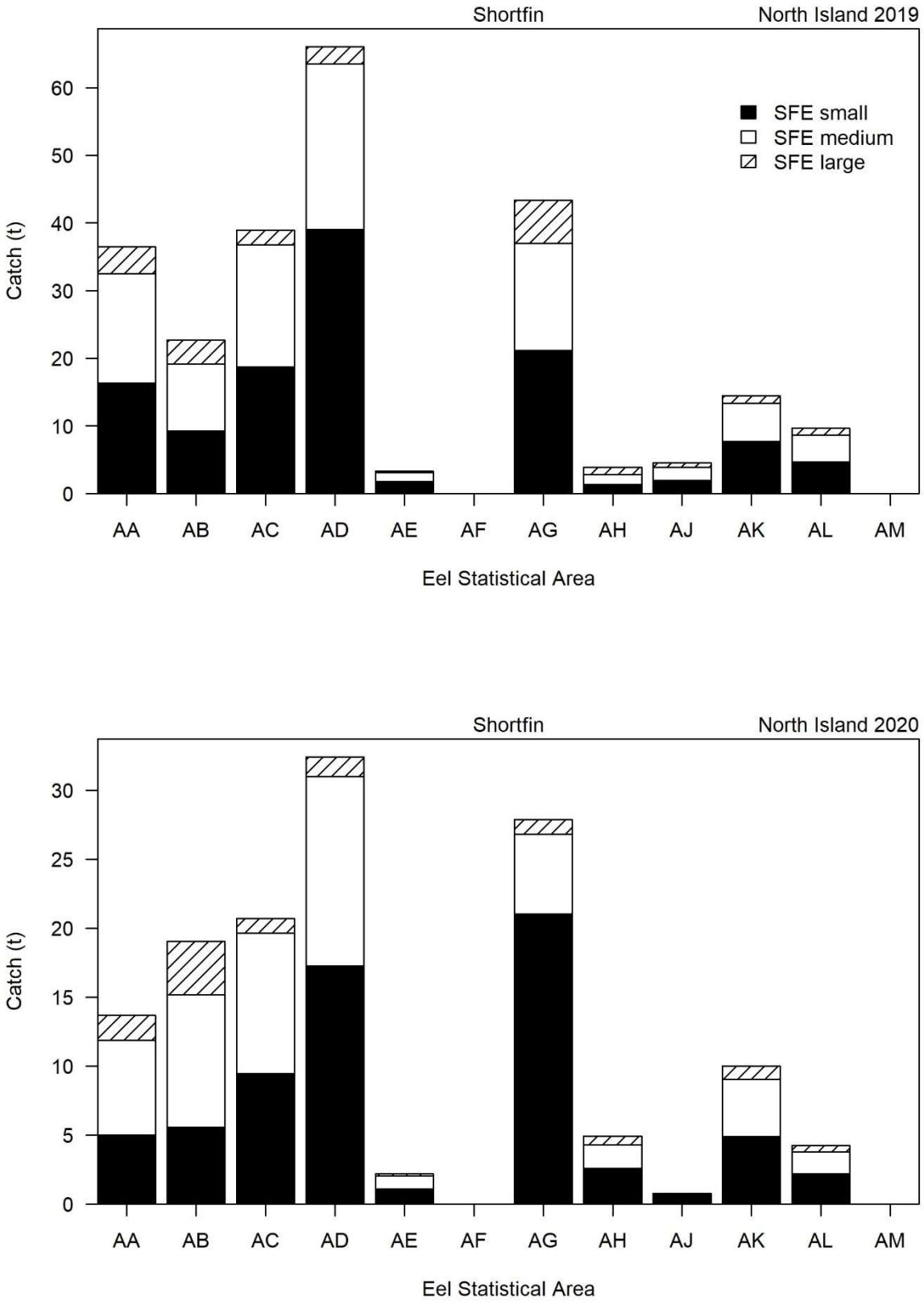

Figure 13: Catch of shortfin (SFE) eels by weight grade for North Island Eel Statistical Area for fishing years 2018–19 (2019), 2019–20 (2020), and 2020–21 (2021).

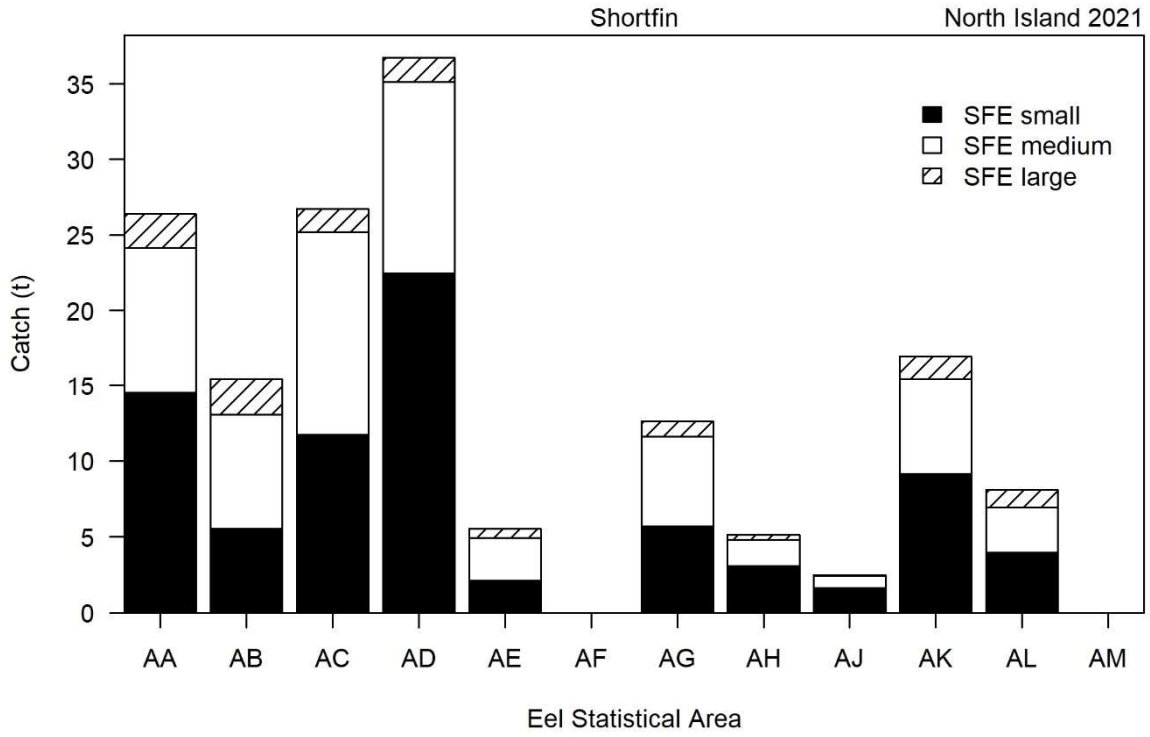

Figure 13 – ***continued***

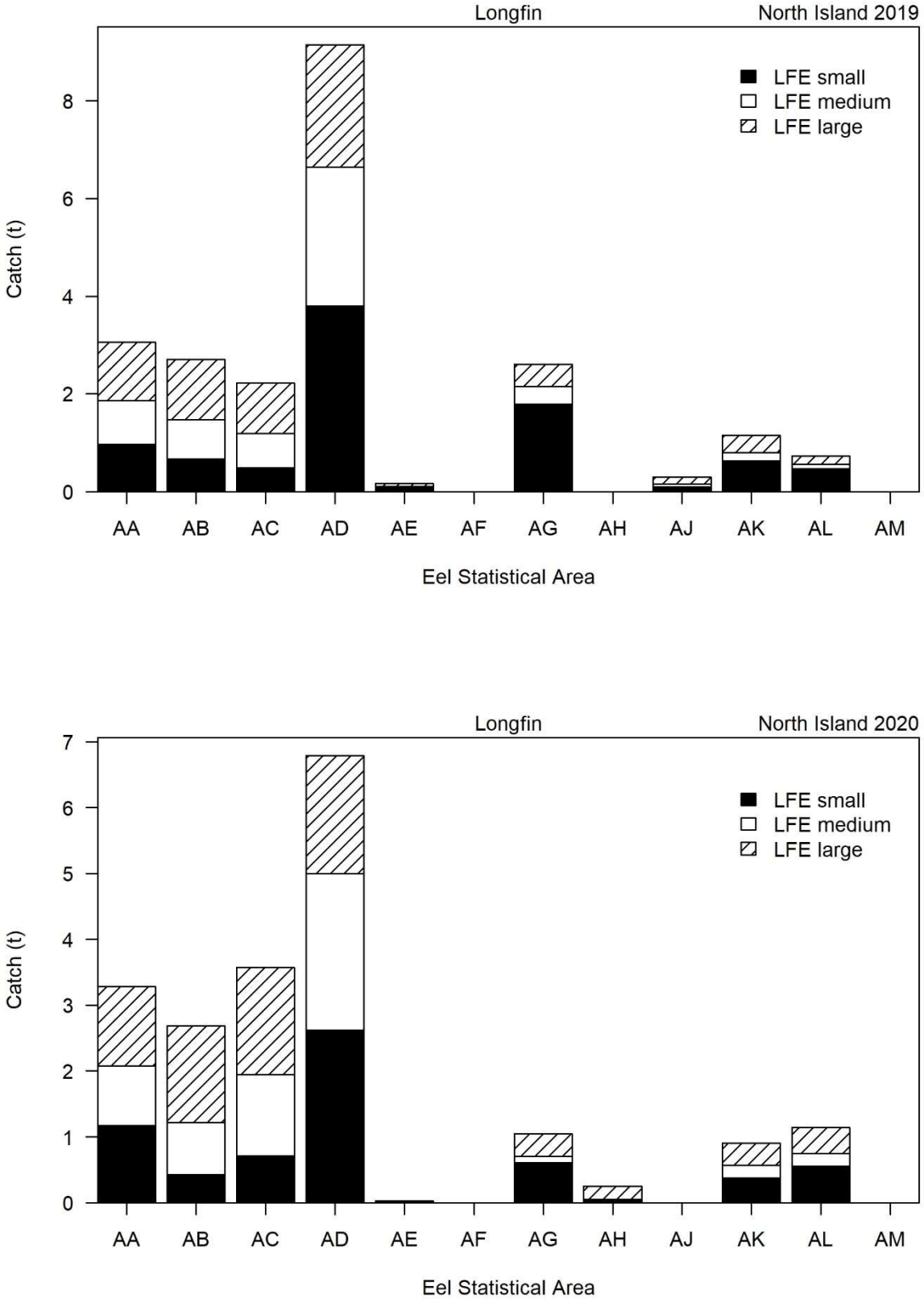

Figure 14: Catch of longfin (LFE) eels by weight grade and North Island Eel Statistical Area for fishing years 2018–19 (2019), 2019–20 (2020), and 2020–21 (2021).

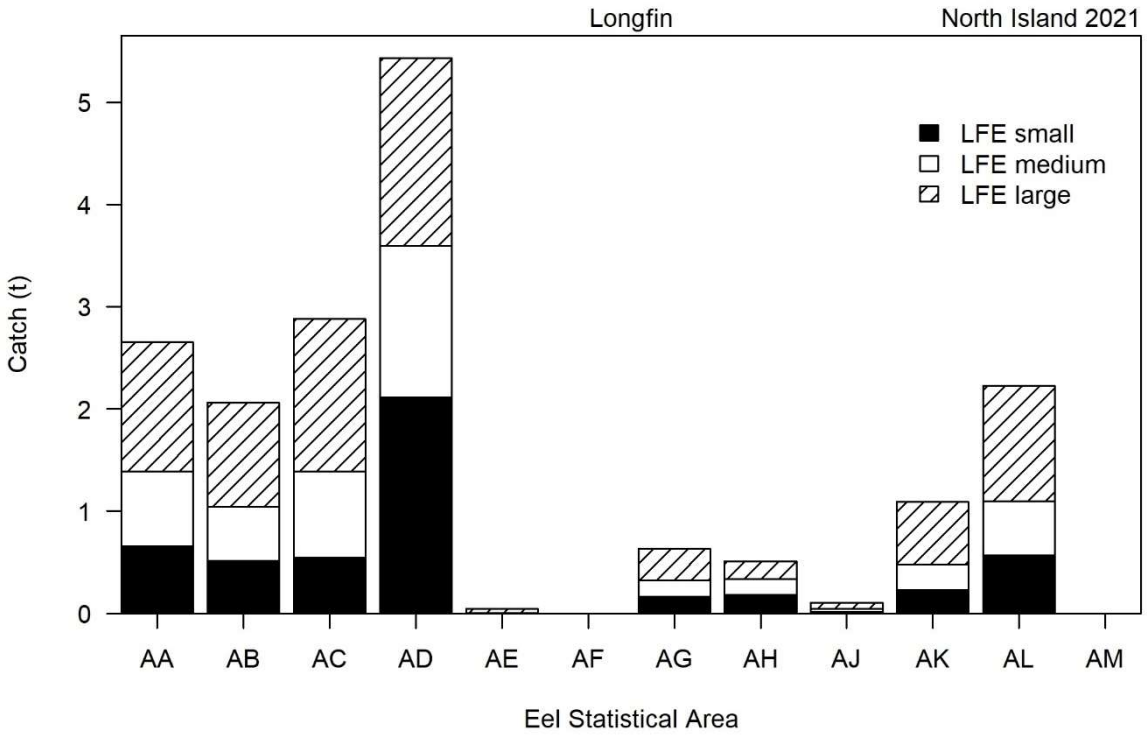

Figure 14 – *continued*

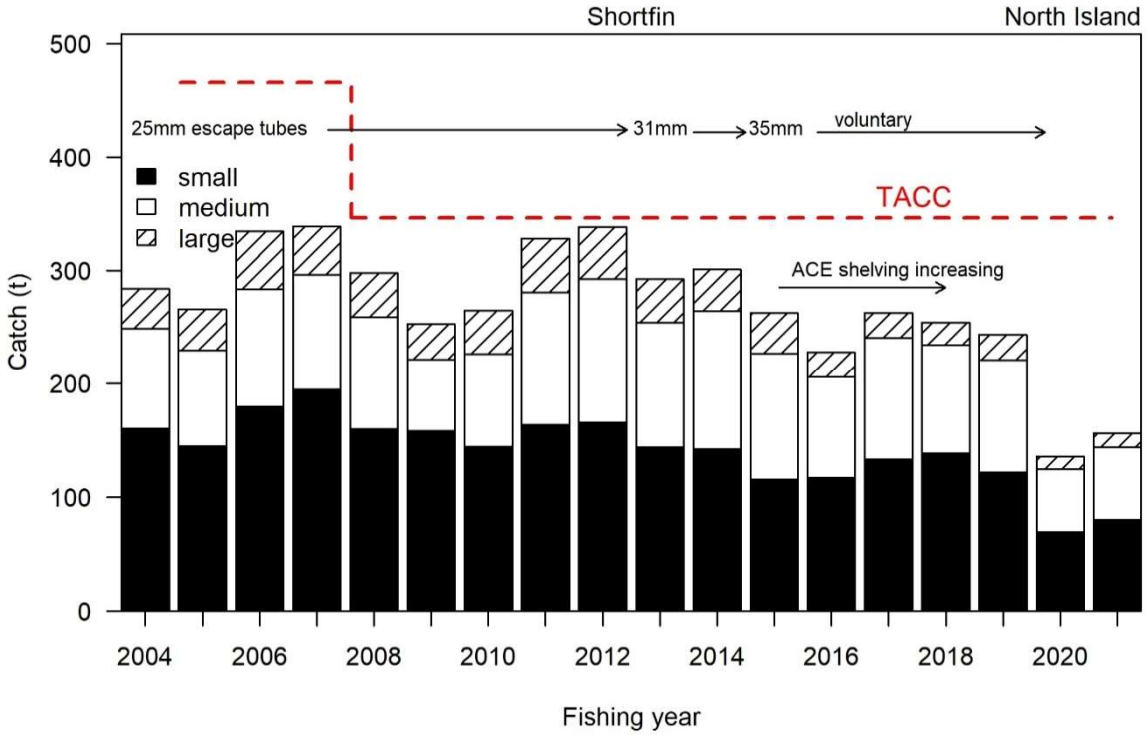

Figure 15: North Island shortfin eel landed catch by weight grade from 2003–04 to 2020–21. Events that may have impacted on the catch are annotated on the plot.

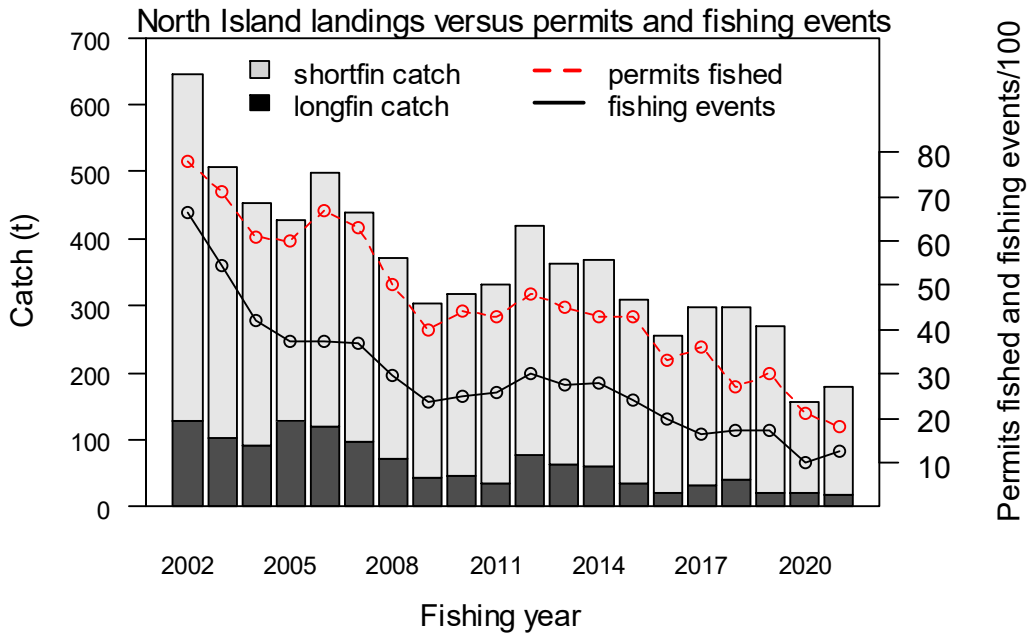

Figure 16: North Island catch of shortfin and longfin eels, number of permits fished, and fishing events by fishing year. A fishing event is where a number of fyke nets was set overnight. Data are from Fisheries New Zealand Eel Catch Landing Records (ECLR), Eel Catch Effort Records (ECER), and Electronic Reporting System (ERS).

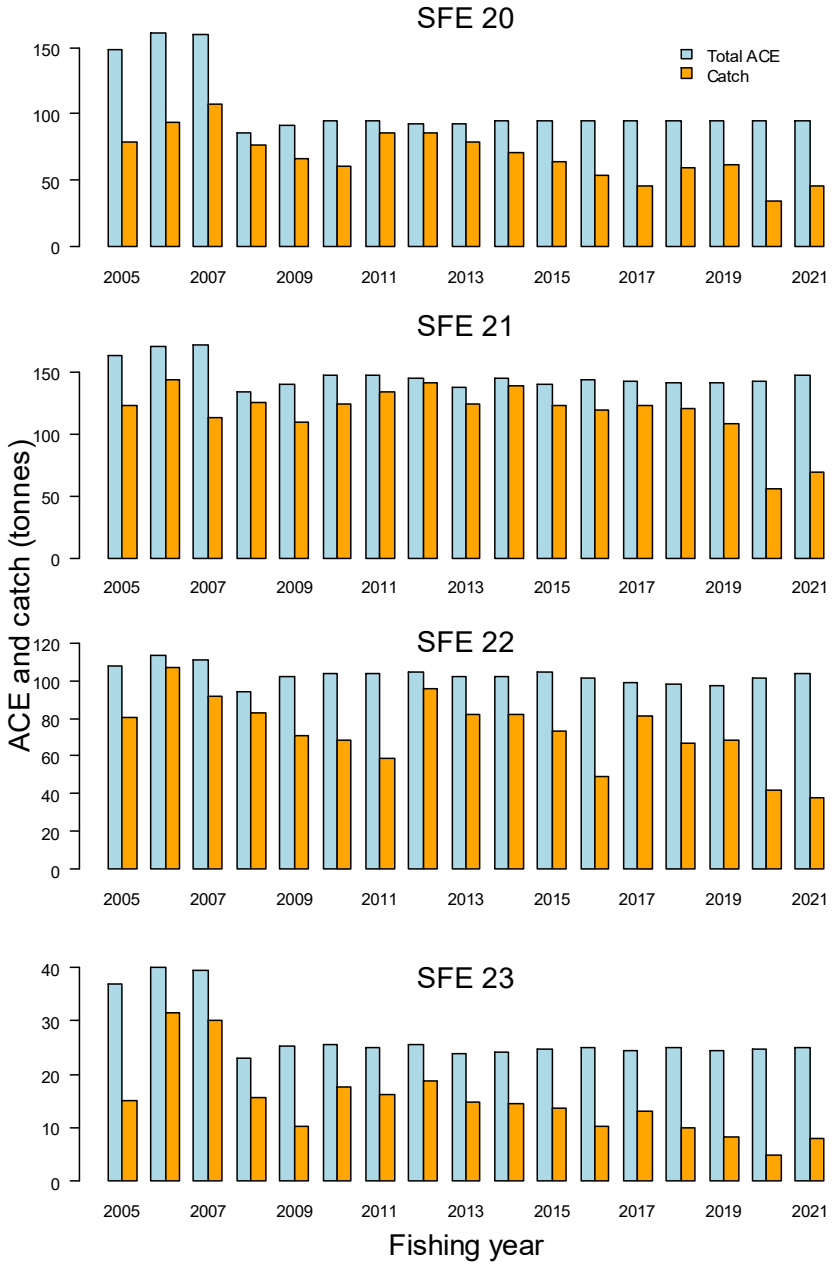

Figure 17: North Island annual shortfin ACE (annual catch entitlement) and landed catch by Quota Management Area from 2004–05 to 2020–21. Total ACE is the total amount of ACE that can be leased to fishers based on quota shares and carry overs. Data were provided by Fisheries New Zealand.

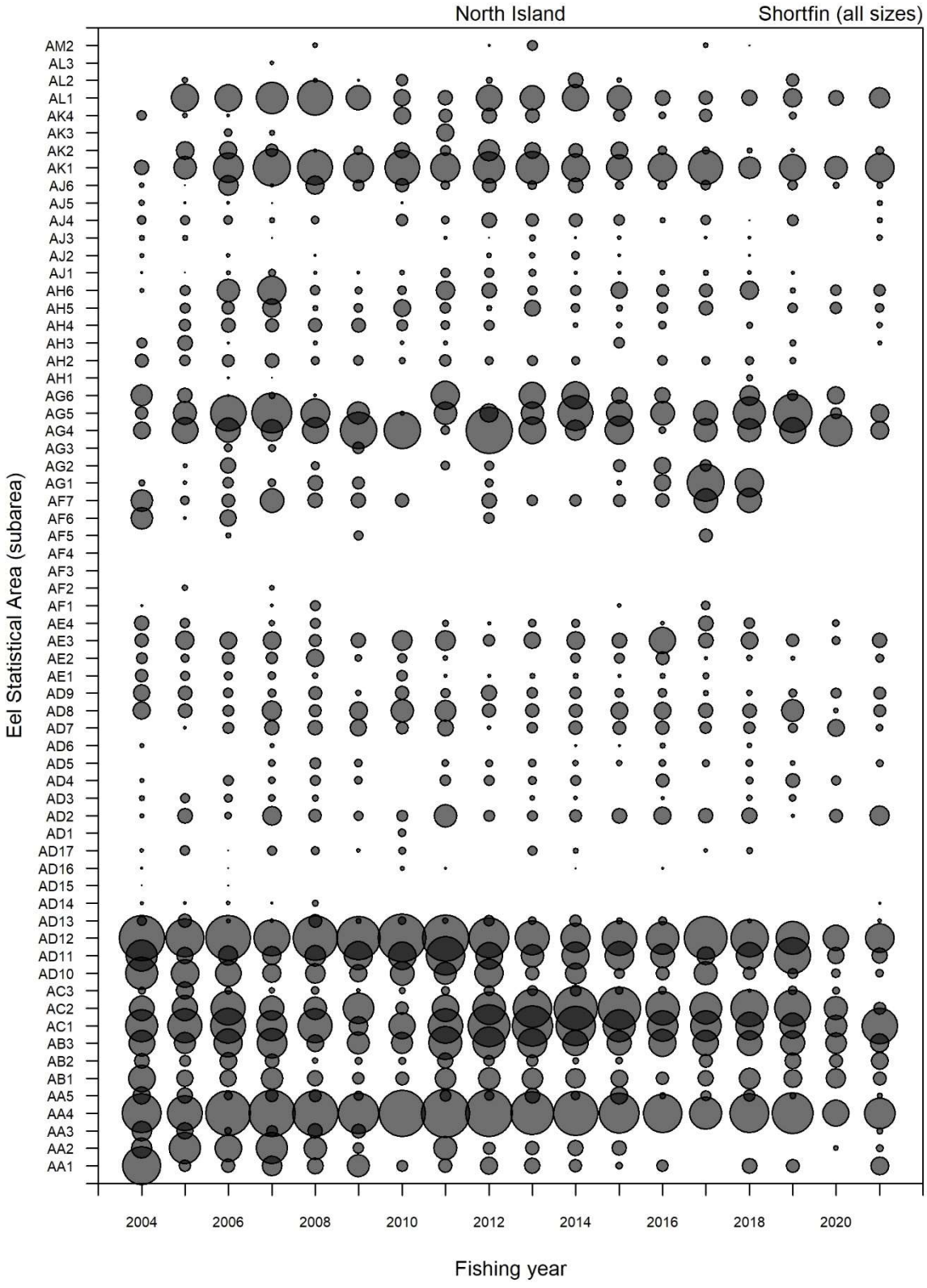

Figure 18: North Island shortfin catch by Eel Statistical Area subarea from 2003–04 to 2020–21. Maximum = 44.7 t. All 65 North Island subareas are shown.

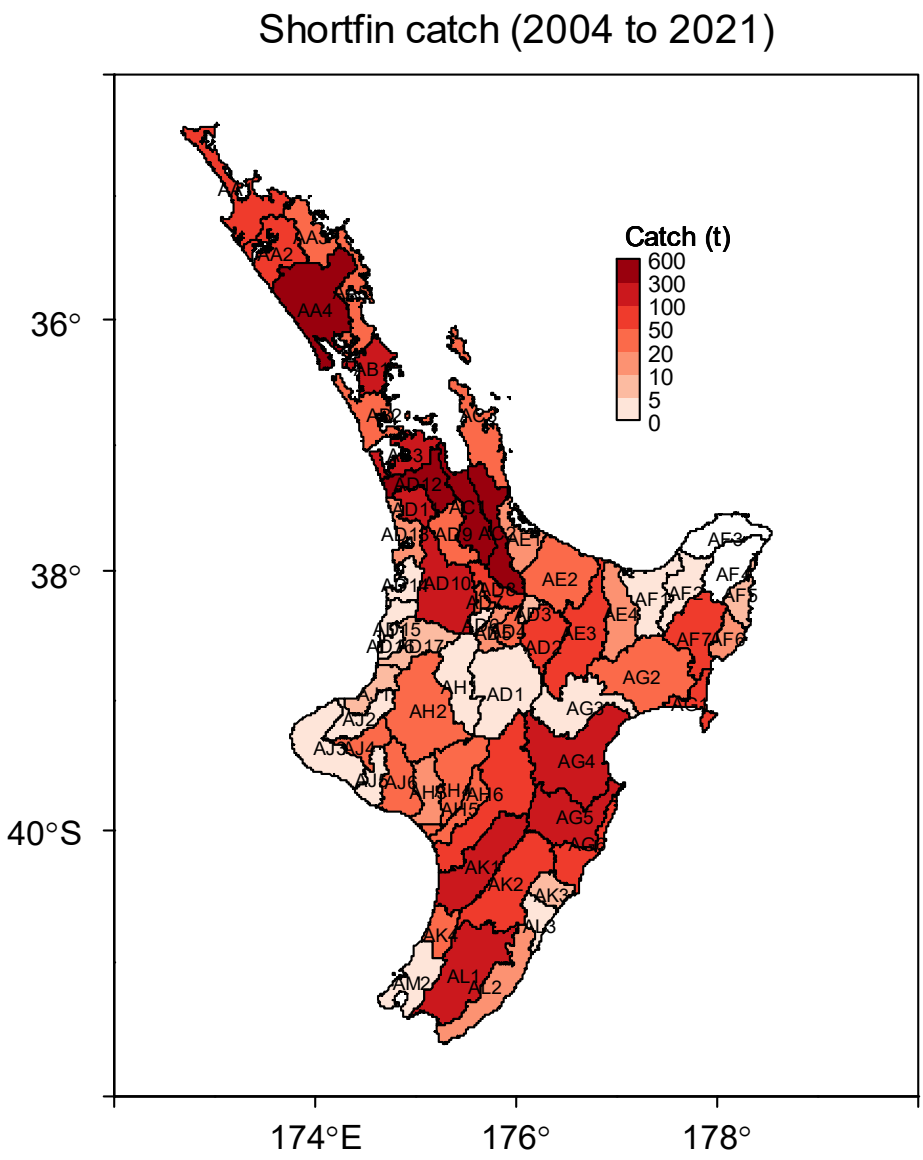

Figure 19: Catch of North Island shortfin plotted by subarea aggregated for the fishing years 2003–04 to 2020–21. Zero catch is white, the lightest red colour represents > 0 to 5 t and the darkest red colour 300 to 600 t of shortfin catch. The maximum catch is 572 t in subarea AA4.

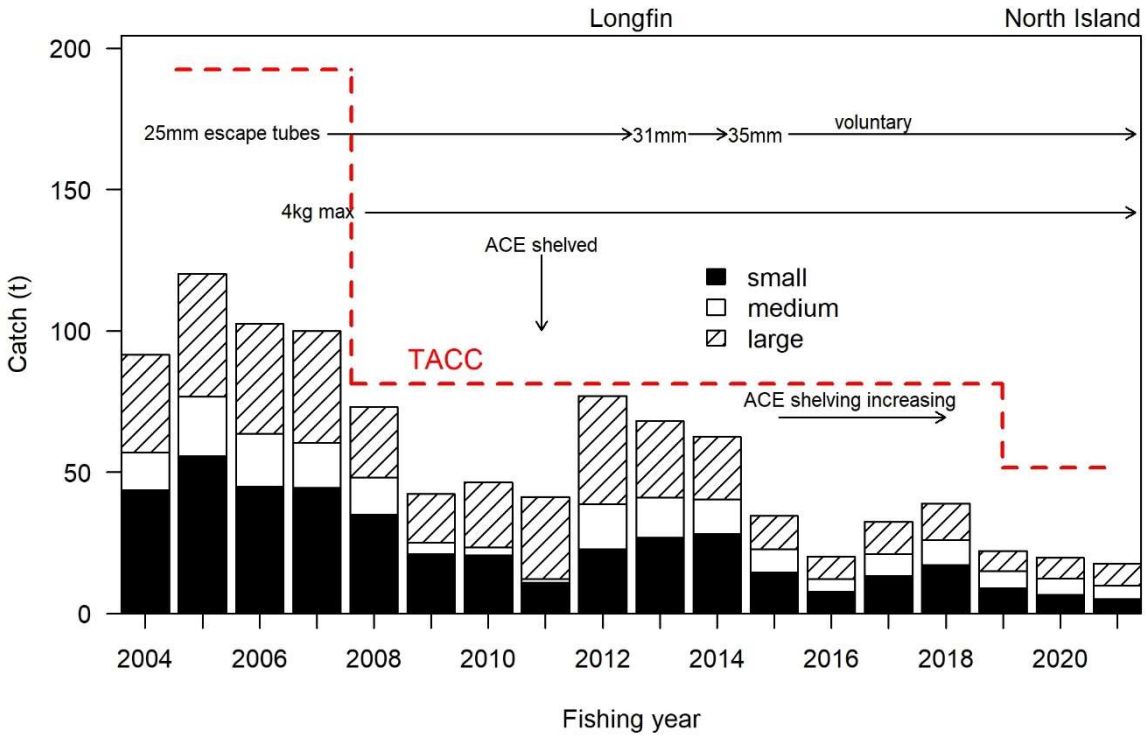

Figure 20: North Island longfin eel landed catch by weight grade from 2003–04 to 2020–21. Events that may have impacted on the catch are annotated on the plot.

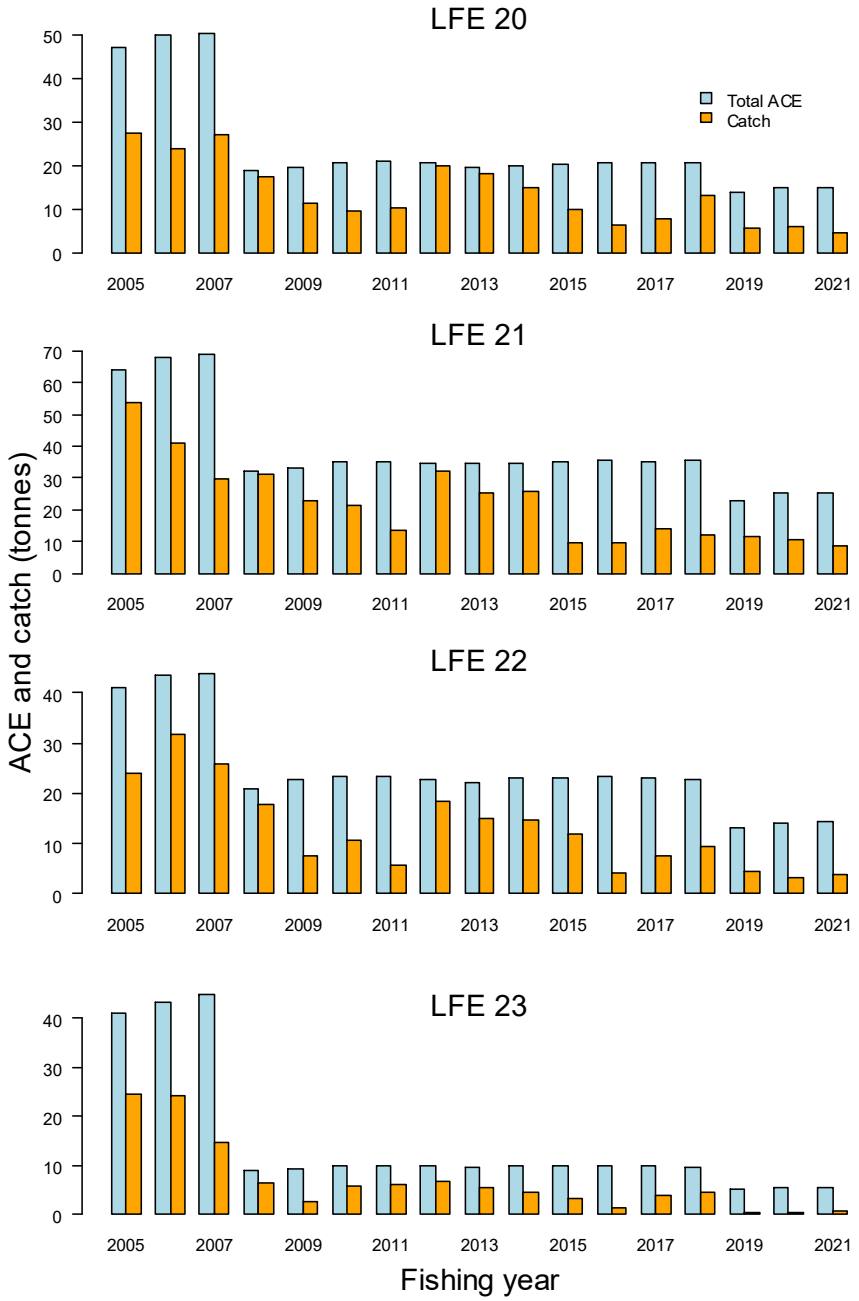

Figure 21: North Island annual longfin ACE (annual catch entitlement) and landed catch by Quota Management Area from 2004–05 to 2020–21. Total ACE is the total amount of ACE that can be leased to fishers based on quota shares and carry overs. Data were provided by Fisheries New Zealand.

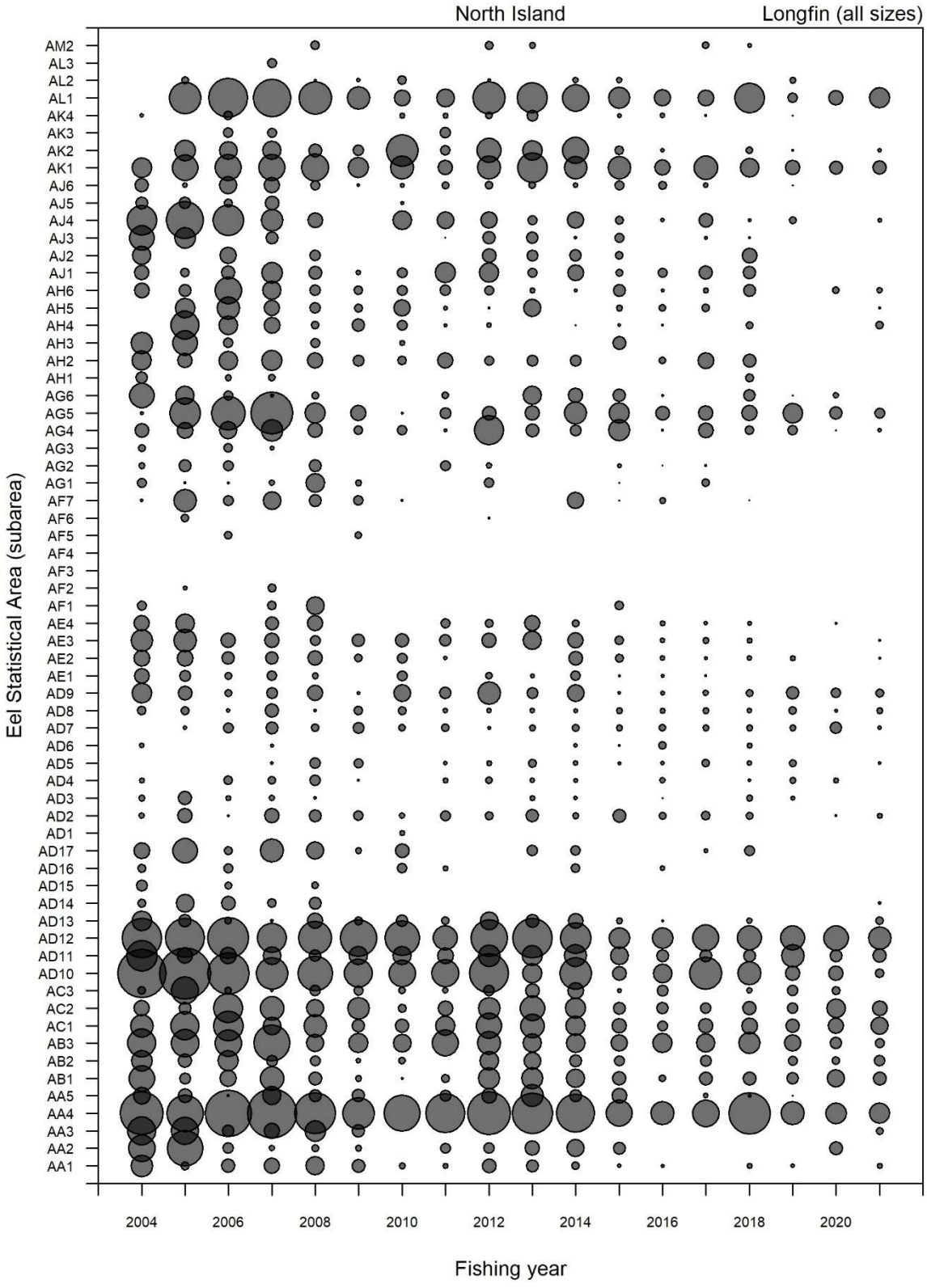

Figure 22: North Island longfin catch by Eel Statistical Area subarea from 2003–04 to 2020–21. Maximum = 13.9 t. All 65 North Island subareas are shown.

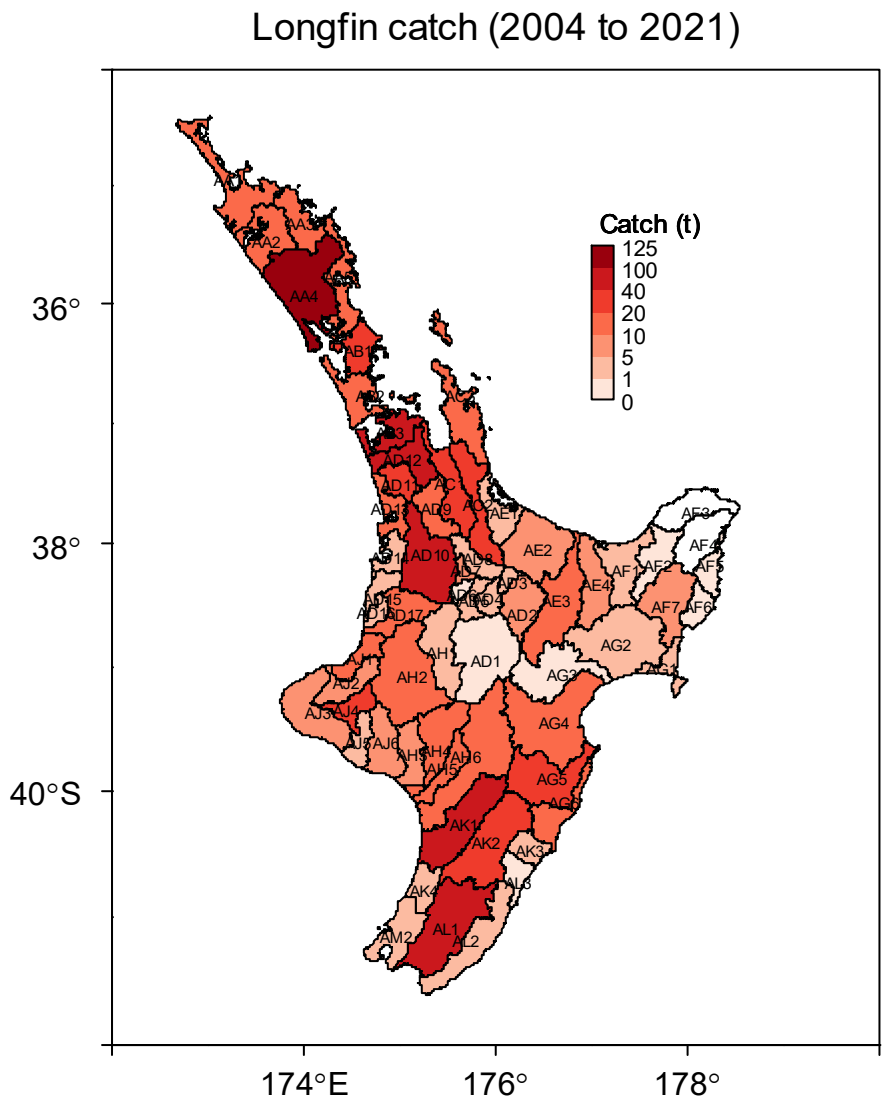

Figure 23: Catch of North Island longfin plotted by subarea aggregated for the fishing years 2003–04 to 2020–21. Zero catch is white, the lightest red colour represents > 0 to 1 t and the darkest red colour 100 to 125 t of longfin catch. The maximum catch is 124 t in subarea AA4.

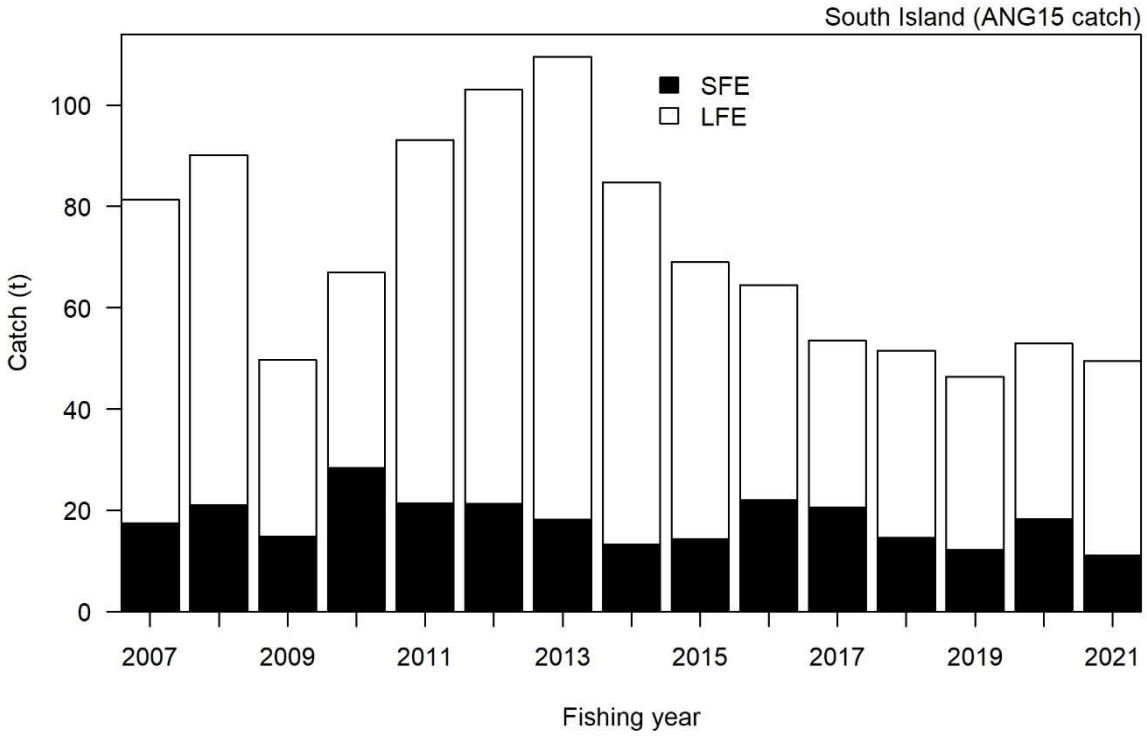

Figure 24: ANG 15 total commercial catch (t) of shortfin (SFE), longfin (LFE) for the years 2006–07 to 2020–21.

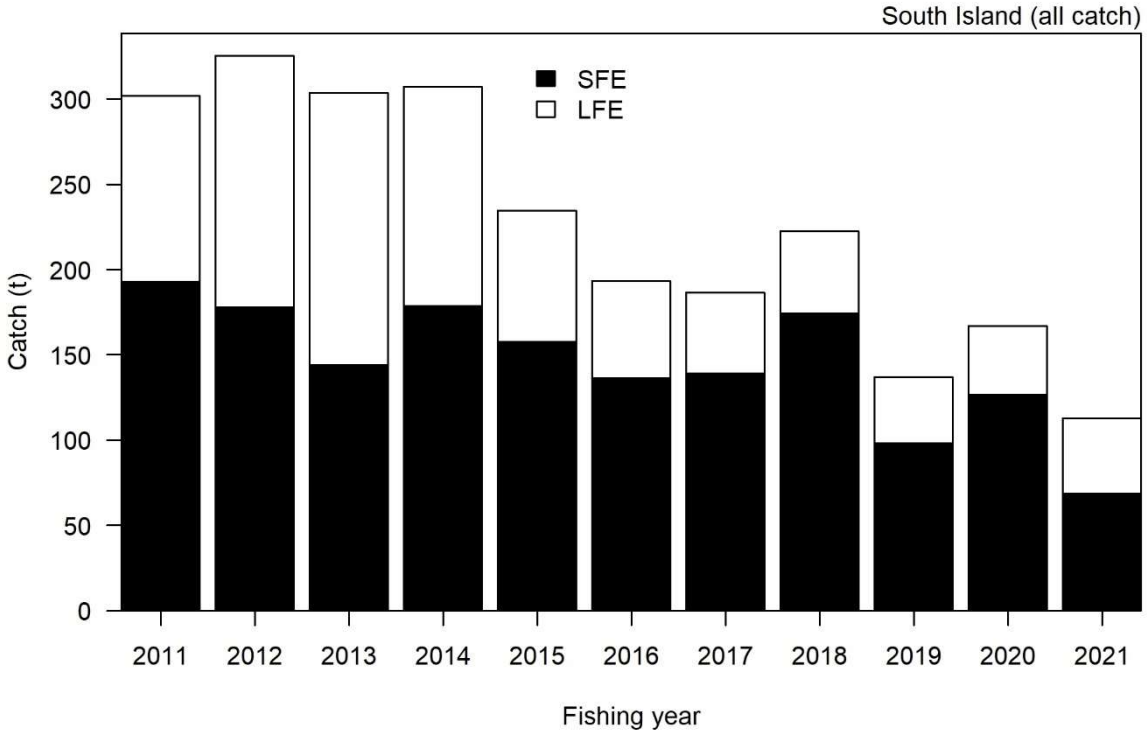

Figure 25: South Island commercial catch (t) of shortfin (SFE) and longfin (LFE) eels for the years 2010–11 to 2020–21.

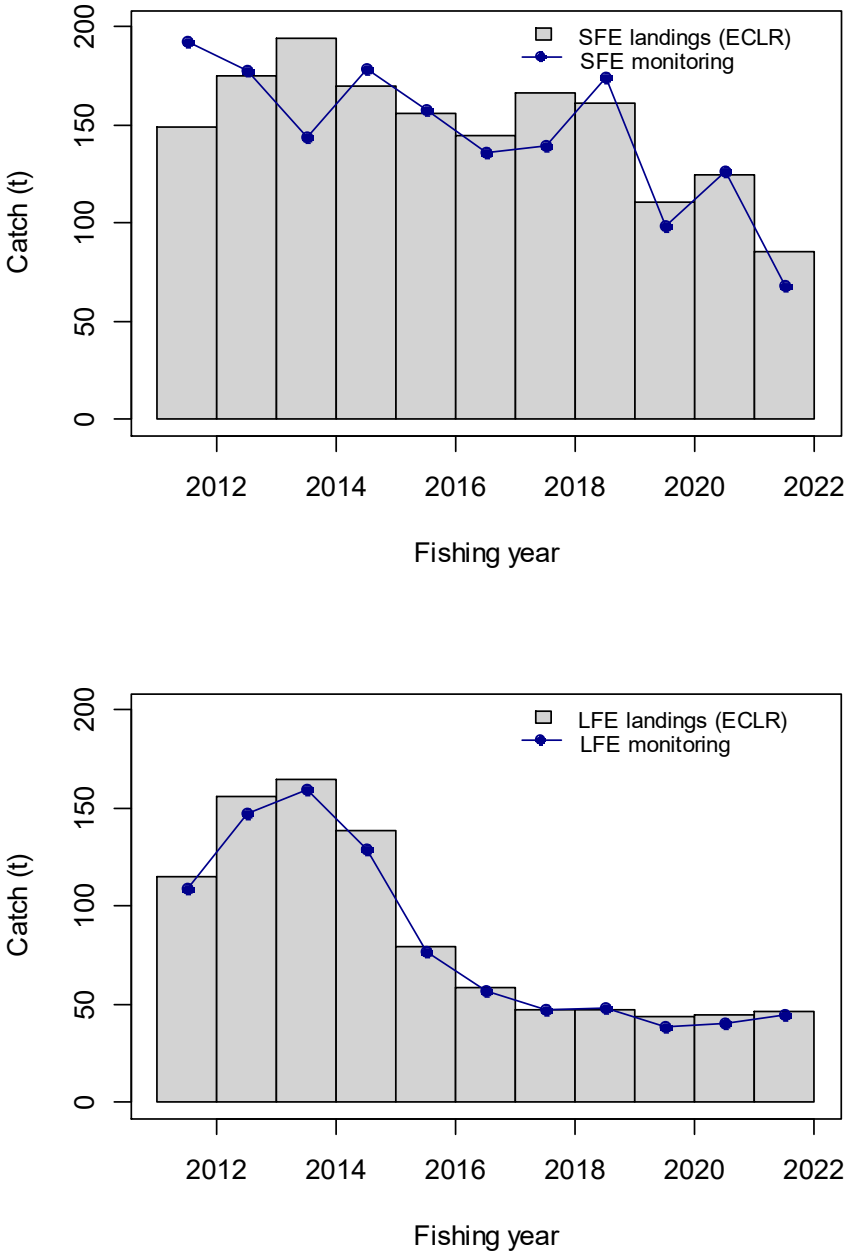

Figure 26: Catch of South Island shortfin eel (top panel) and longfin eel (bottom panel) by fishing year, recorded from the commercial eel monitoring programme and from Eel Catch Landing Records (ECLR).

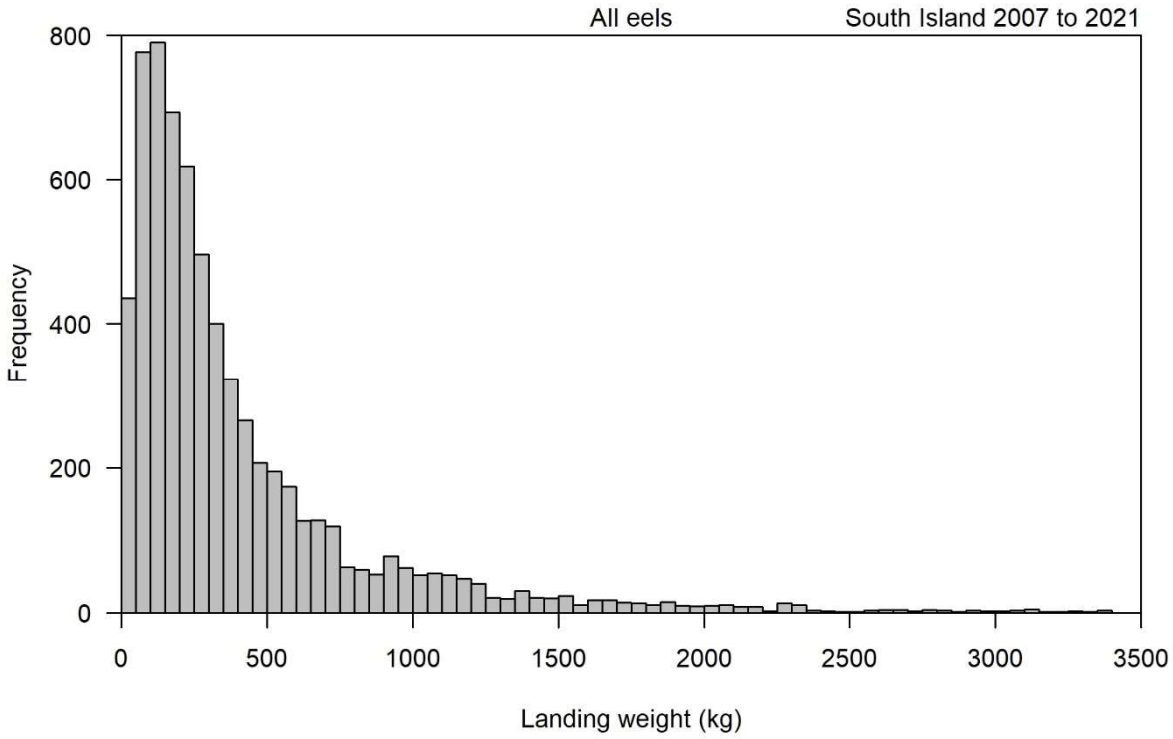

Figure 27: Distribution of individual eel landing weights in the South Island for 2006–07 to 2020–21. Landings include both shortfin and longfin eels, and the period 2006–07 to 2009–10 is for ANG 15 only.

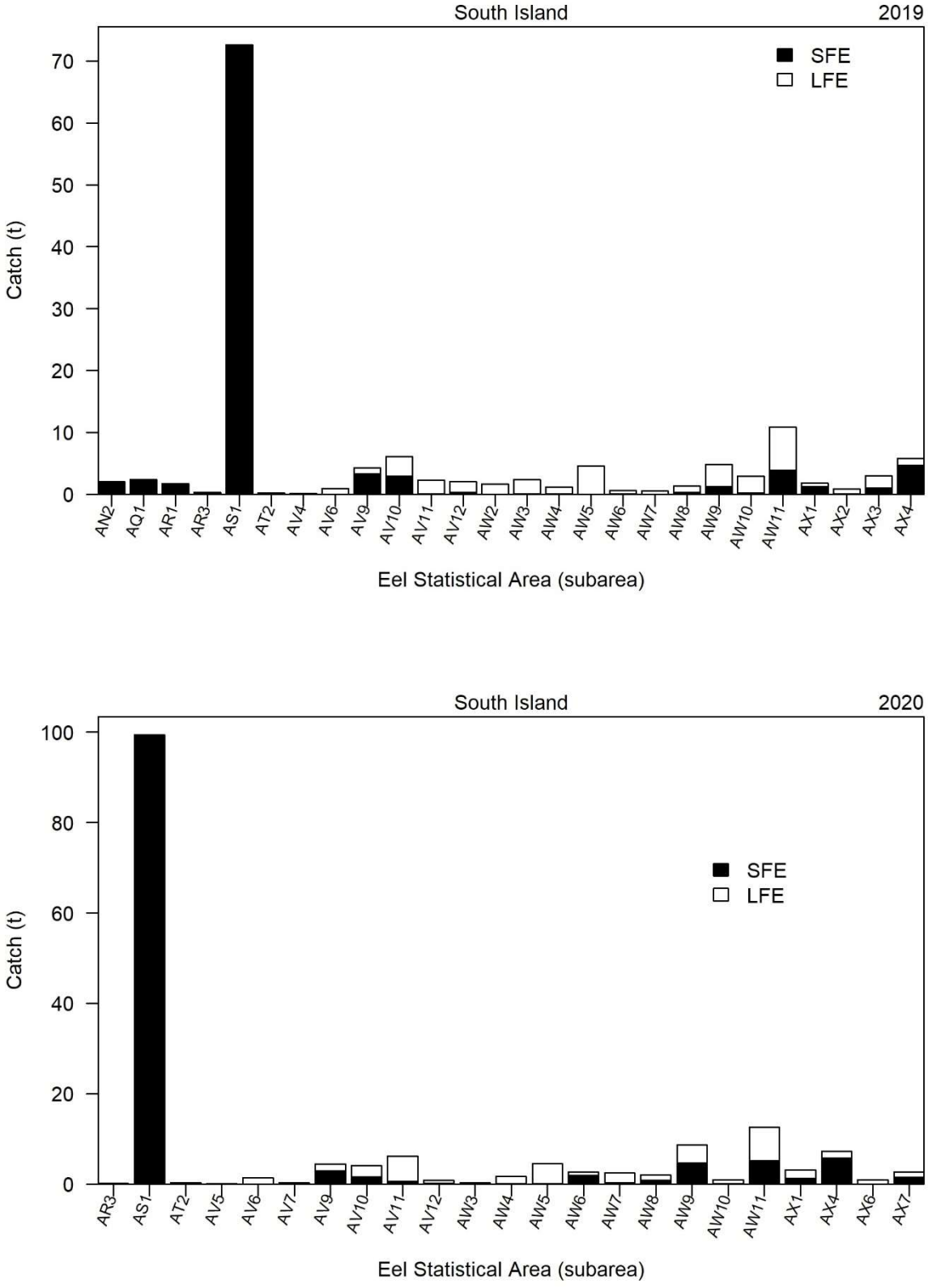

Figure 28: Catch of South Island shortfin (SFE) and longfin (LFE) by Eel Statistical Area subareas for fishing years 2018–19 (2019), 2019–20 (2020), and 2020–21 (2021). Only subareas with recorded catch are presented.

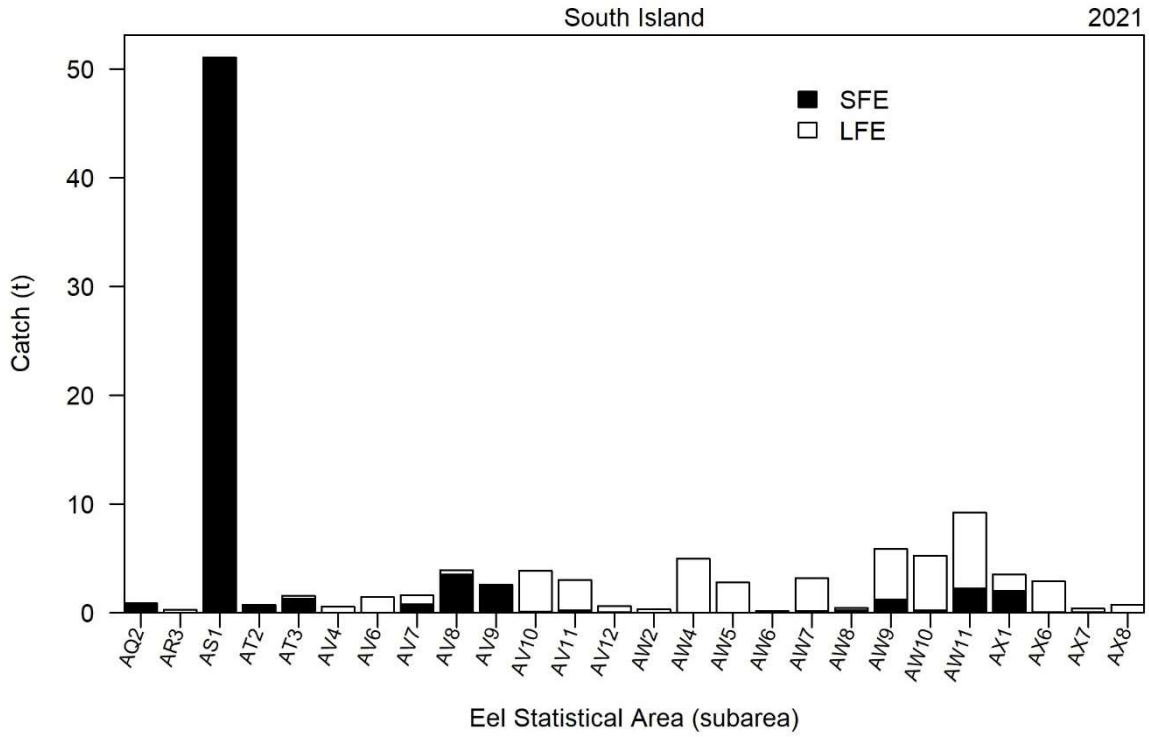

Figure 28 – *continued*

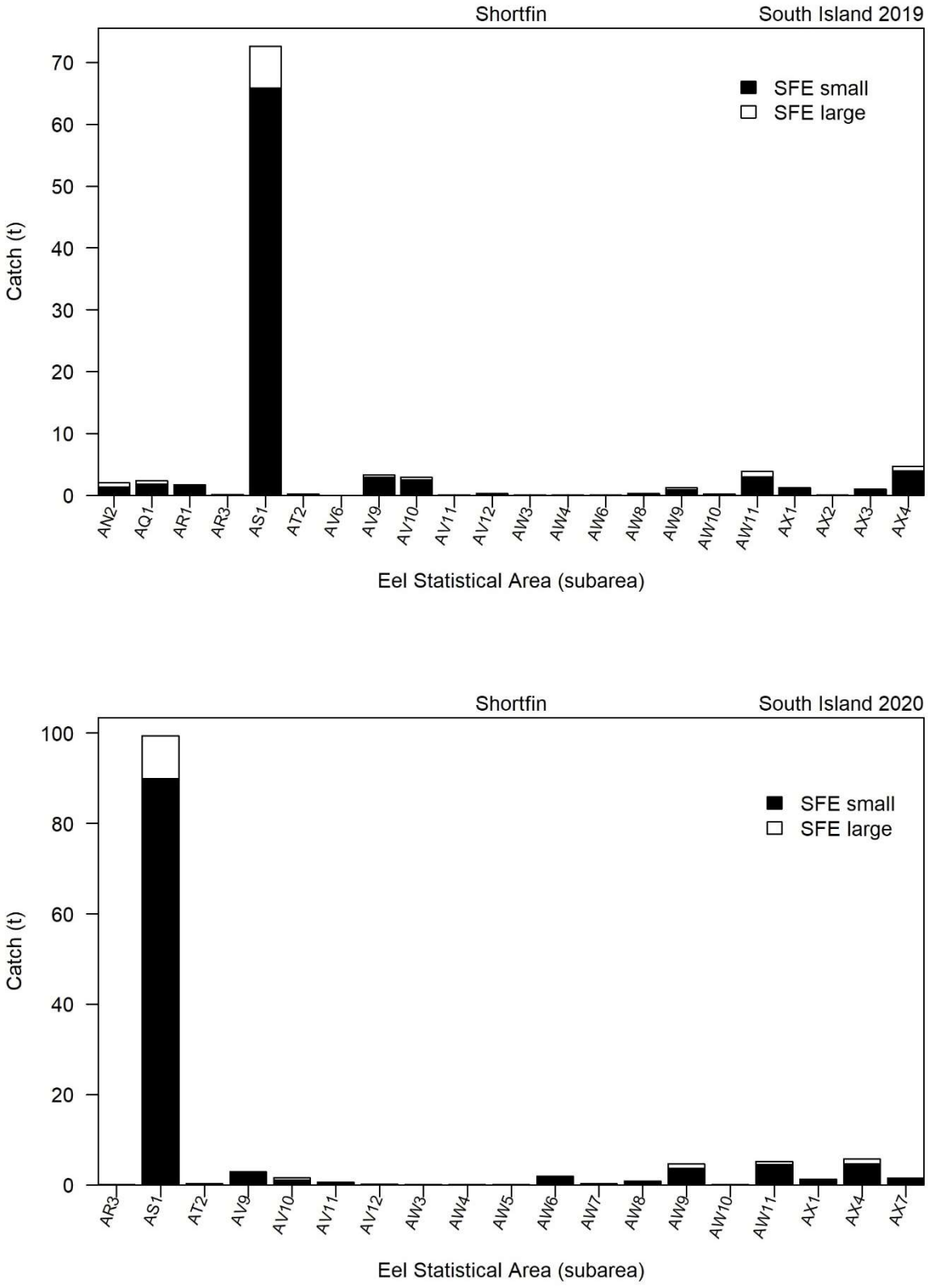

Figure 29: Catch of shortfin (SFE) eels by weight grade for South Island Eel Statistical Area subareas for fishing years 2018–19 (2019), 2019–20 (2020), and 2020–21 (2021). Only subareas with recorded catch are presented.

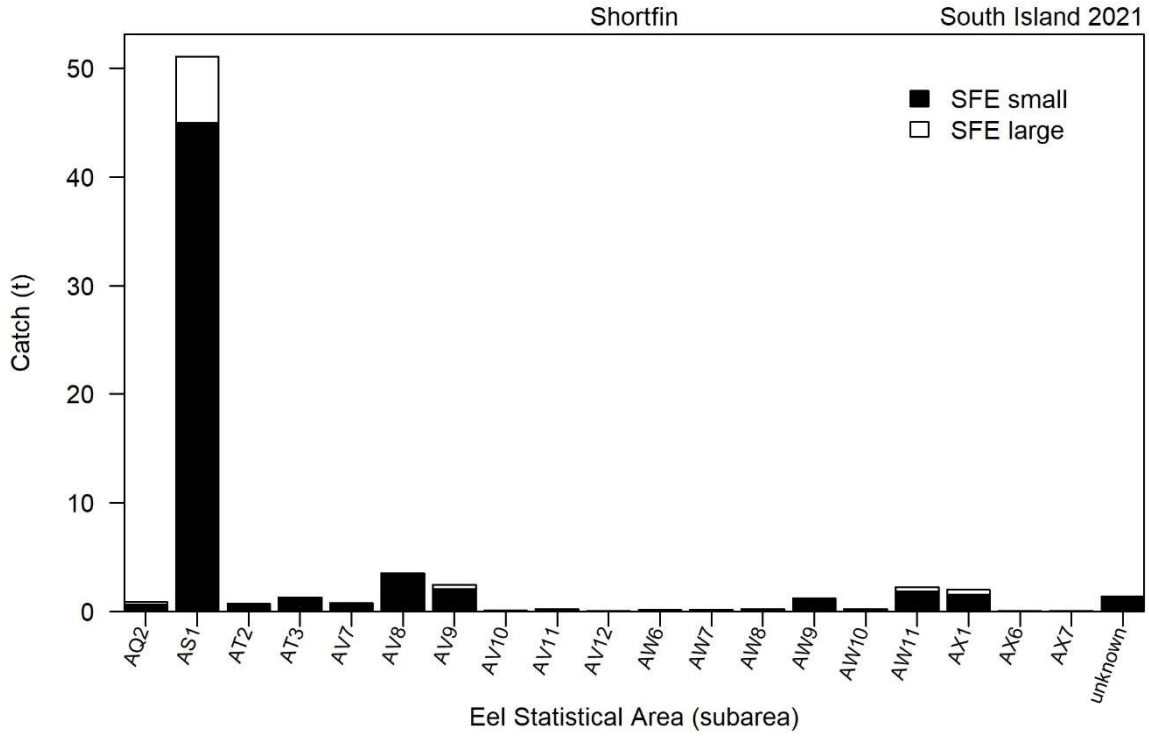

Figure 29 – *continued*

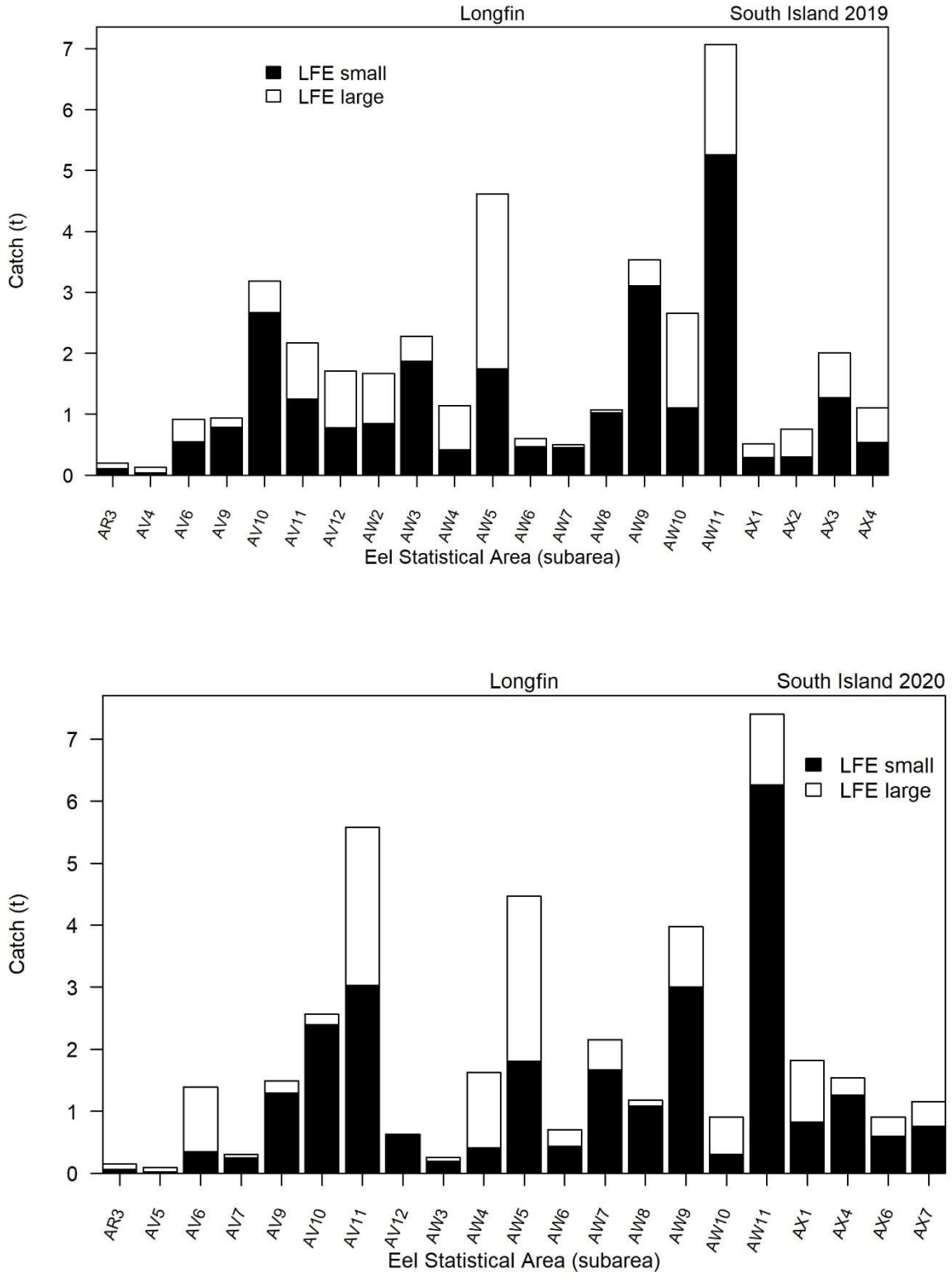

Figure 30: Catch of longfin (LFE) eels by weight grade for South Island Eel Statistical Area subareas for fishing years 2018–19 (2019), 2019–20 (2020), and 2020–21 (2021). Only subareas with recorded catch are presented.

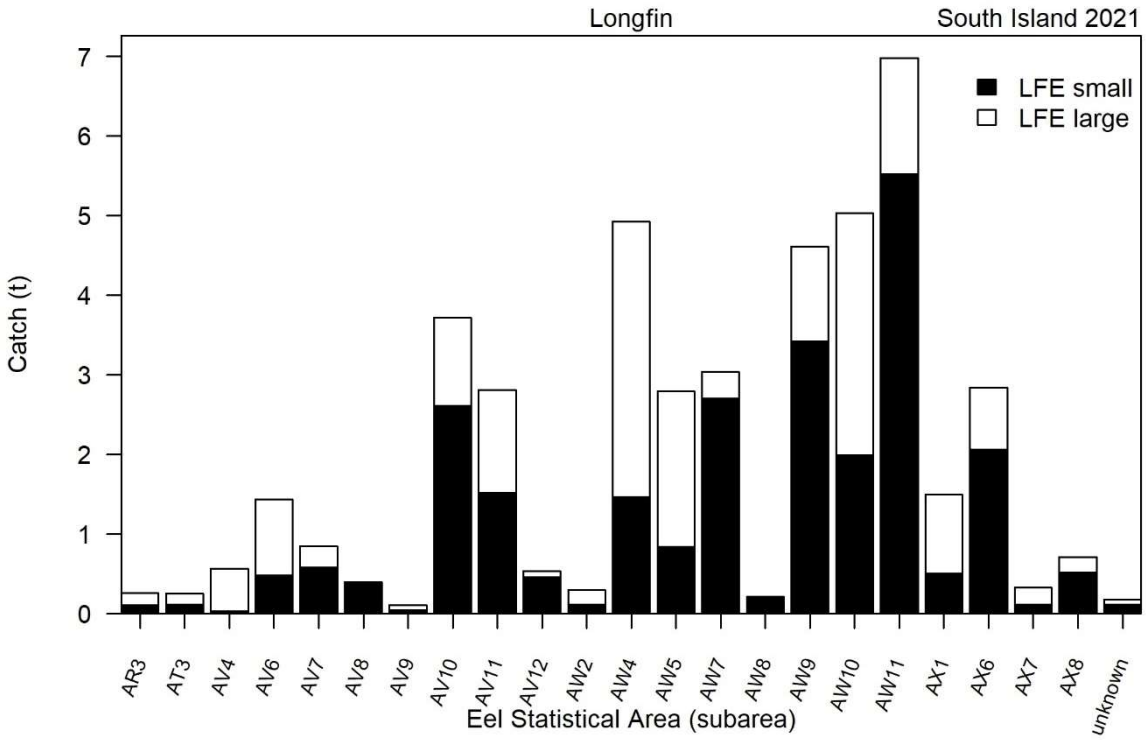

Figure 30 – *continued*

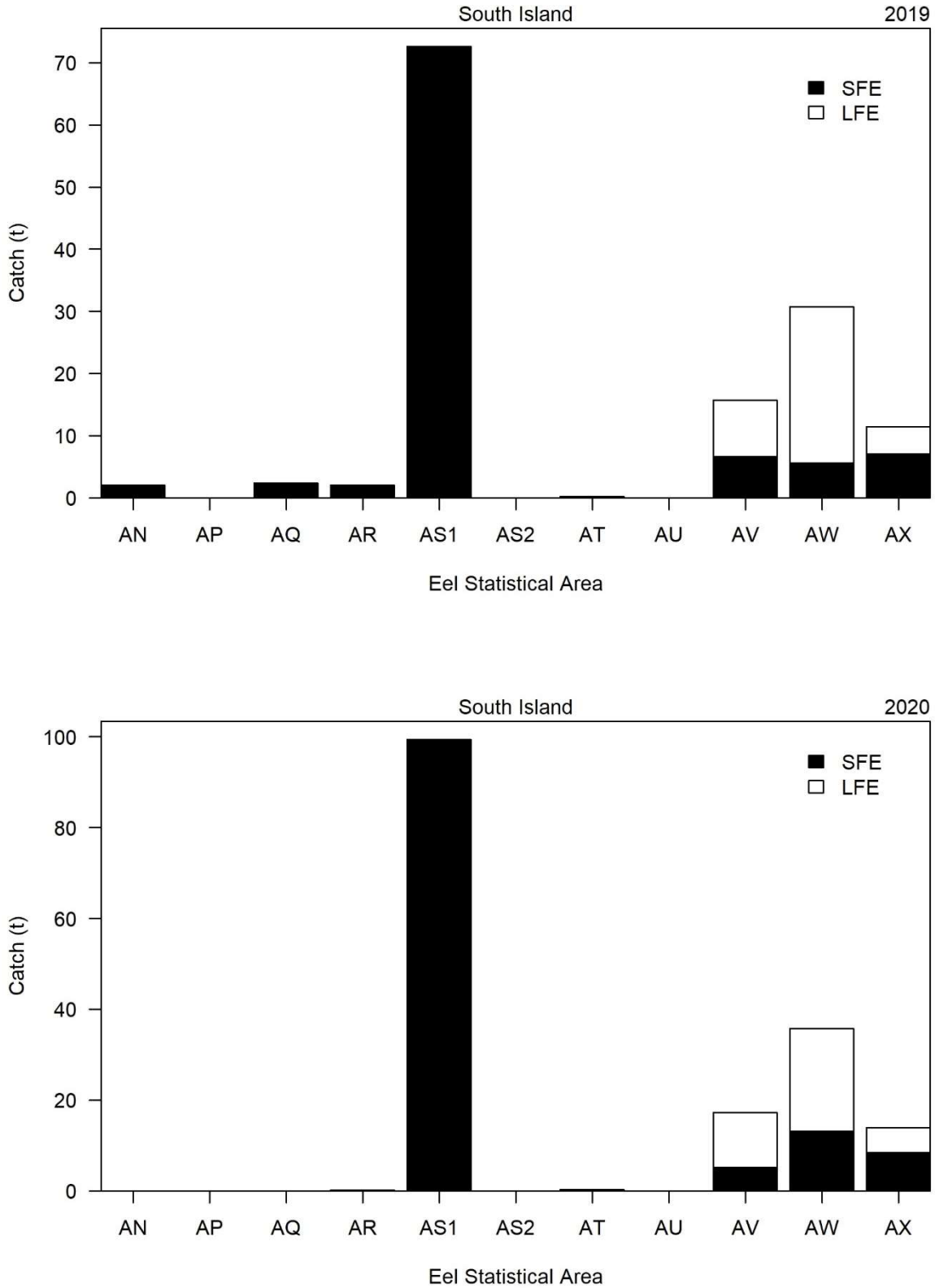

Figure 31: Catch of South Island shortfin (SFE) and longfin (LFE) eels by Eel Statistical Area subarea for fishing years 2018–19 (2019), 2019–20 (2020), and 2020–21 (2021).

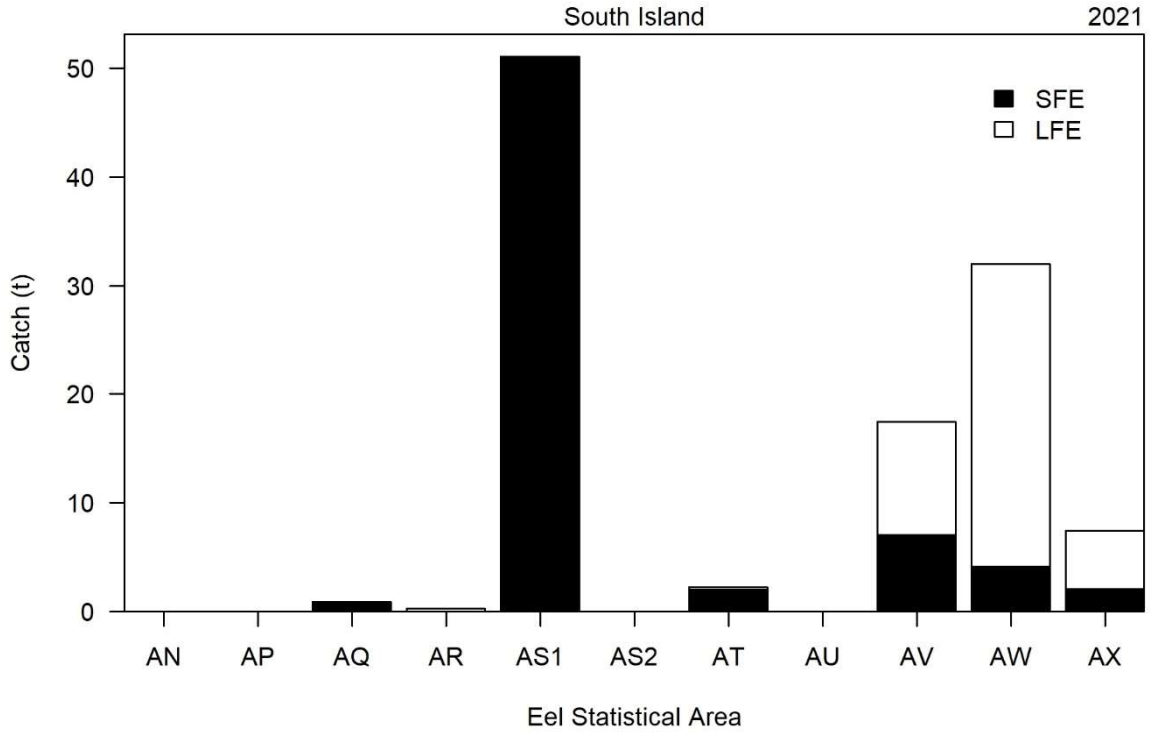

Figure 31 – *continued*

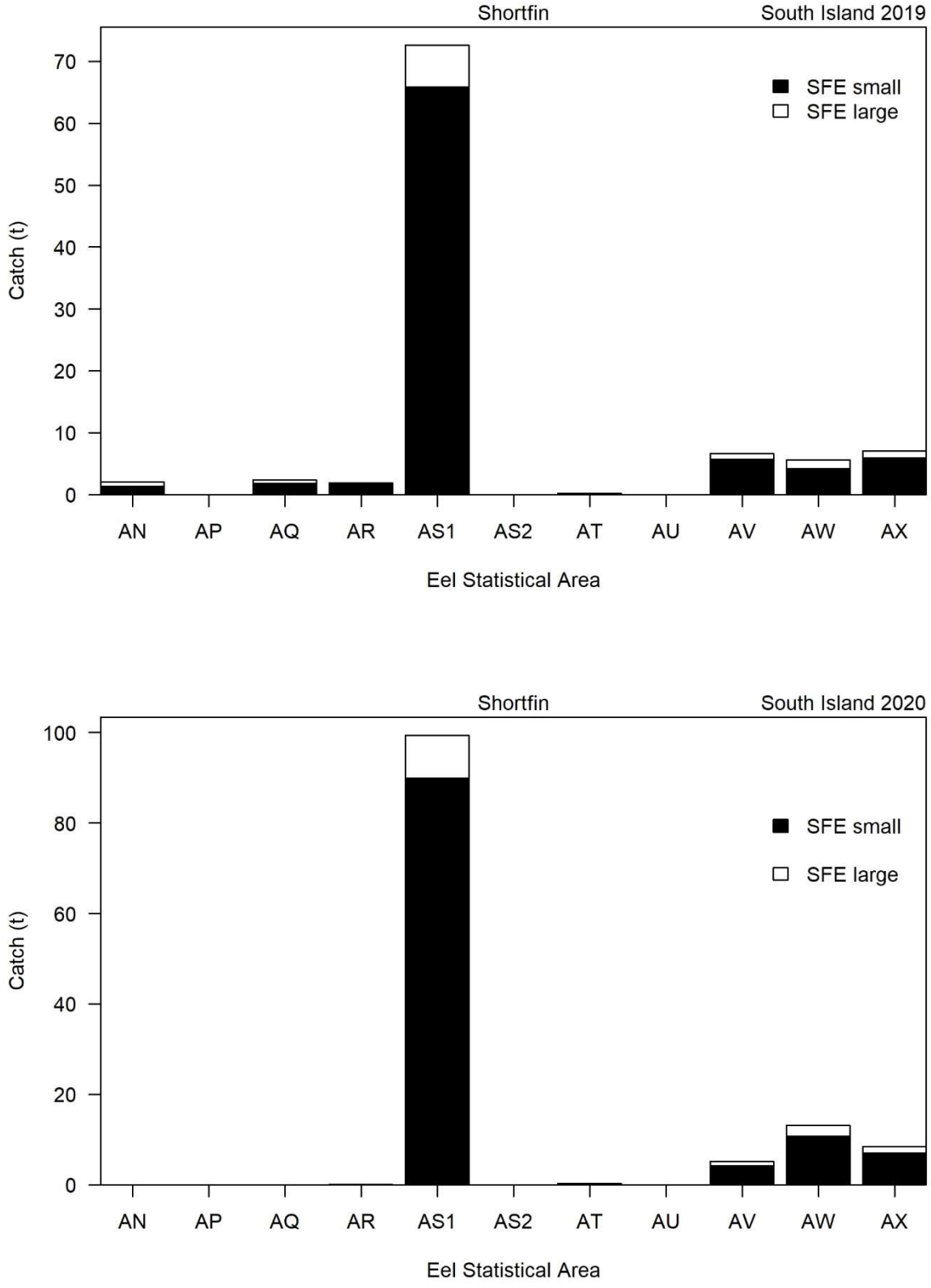

Figure 32: Catch of South Island shortfin (SFE) by weight grade by Eel Statistical Area for 2018–19 (2019), 2019–20 (2020), and 2020–21 (2021).

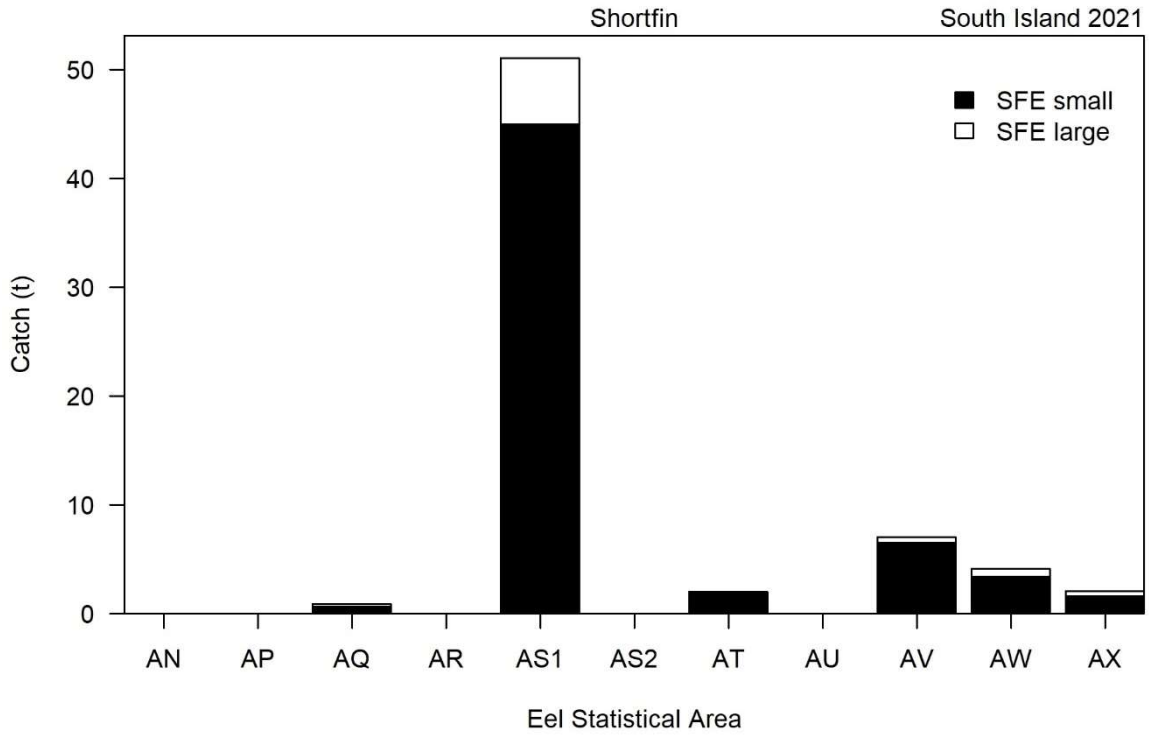

Figure 32 – ***continued***

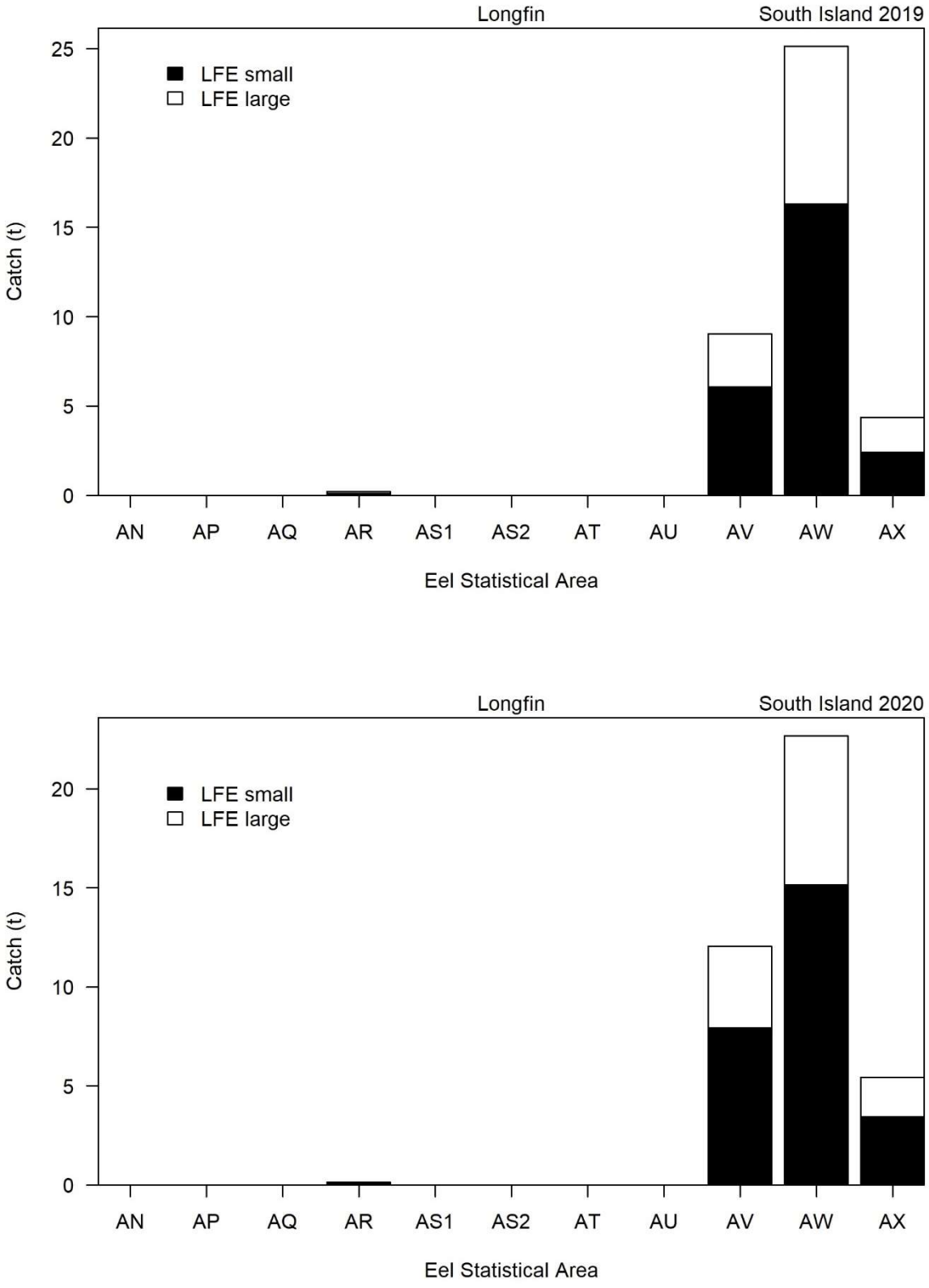

Figure 33: Catch of South Island longfin (LFE) by weight grade by Eel Statistical Area for 2018–19 (2019), 2019–20 (2020), and 2020–21 (2021).

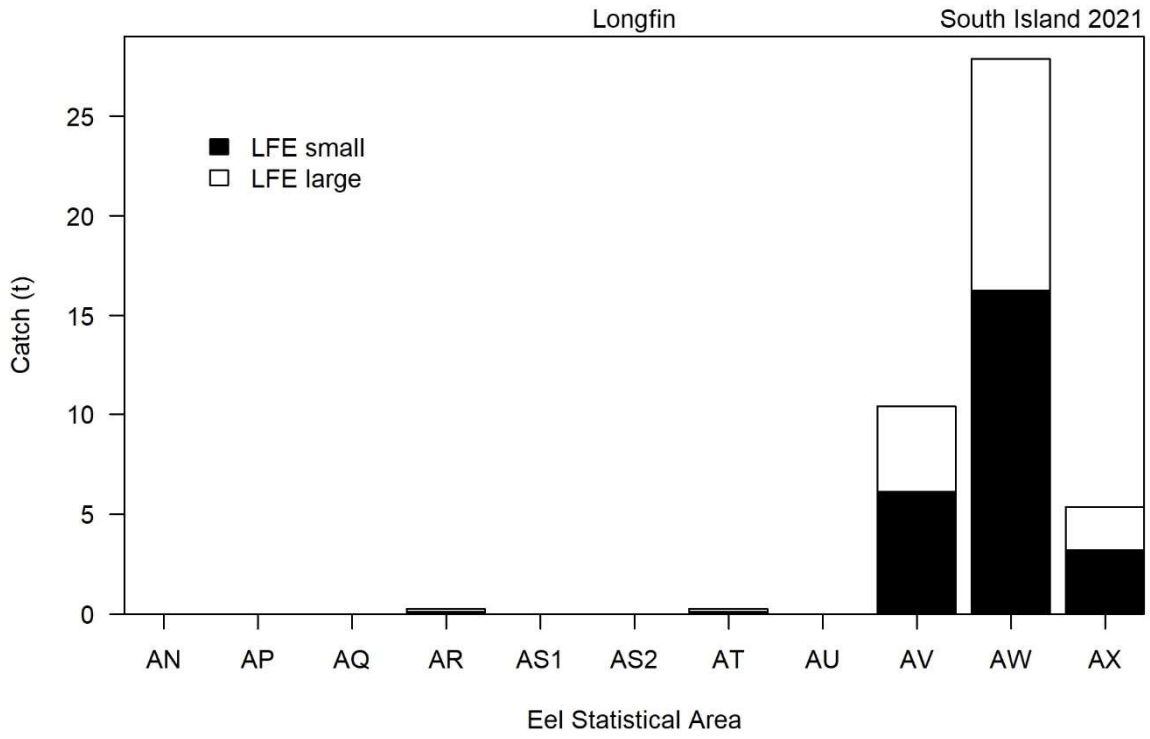

Figure 33 – *continued*

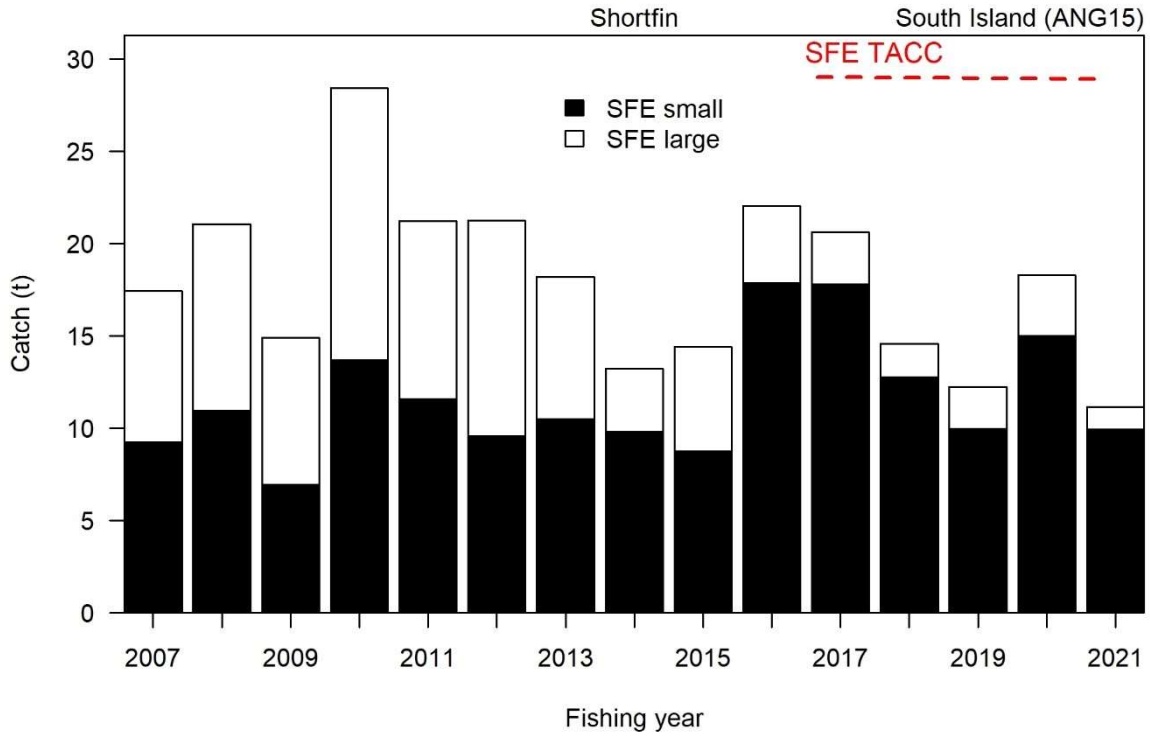

Figure 34: ANG 15 shortfin eel (SFE) catch by weight grade from 2006–07 to 2020–21.

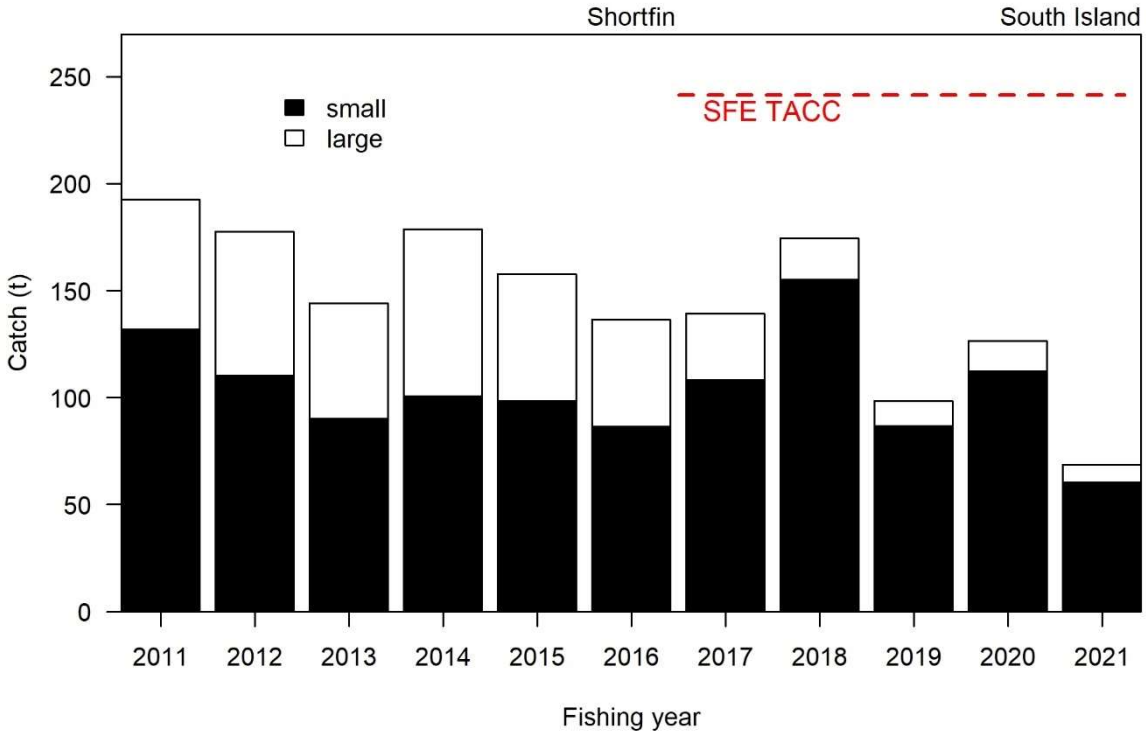

Figure 35: South Island shortfin eel (SFE) landed catch by weight grade from 2010–11 to 2020–21.

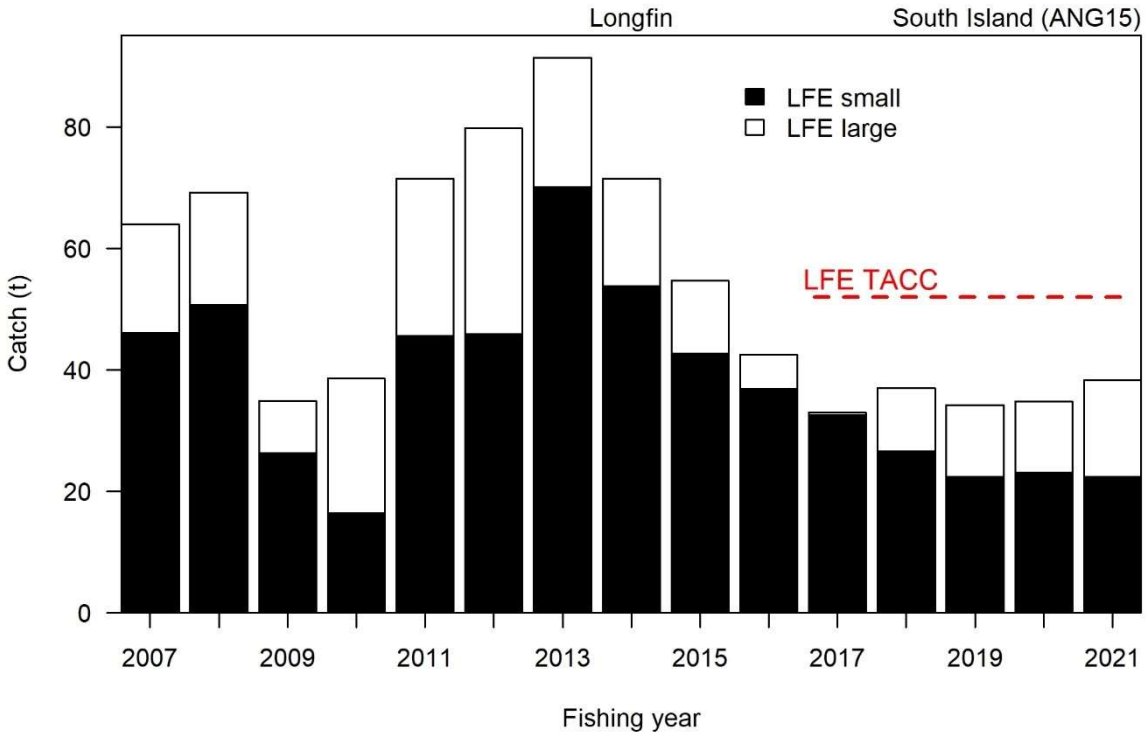

Figure 36: ANG 15 longfin eel (LFE) catch by weight (t) by weight grade from 2006–07 to 2020–21.

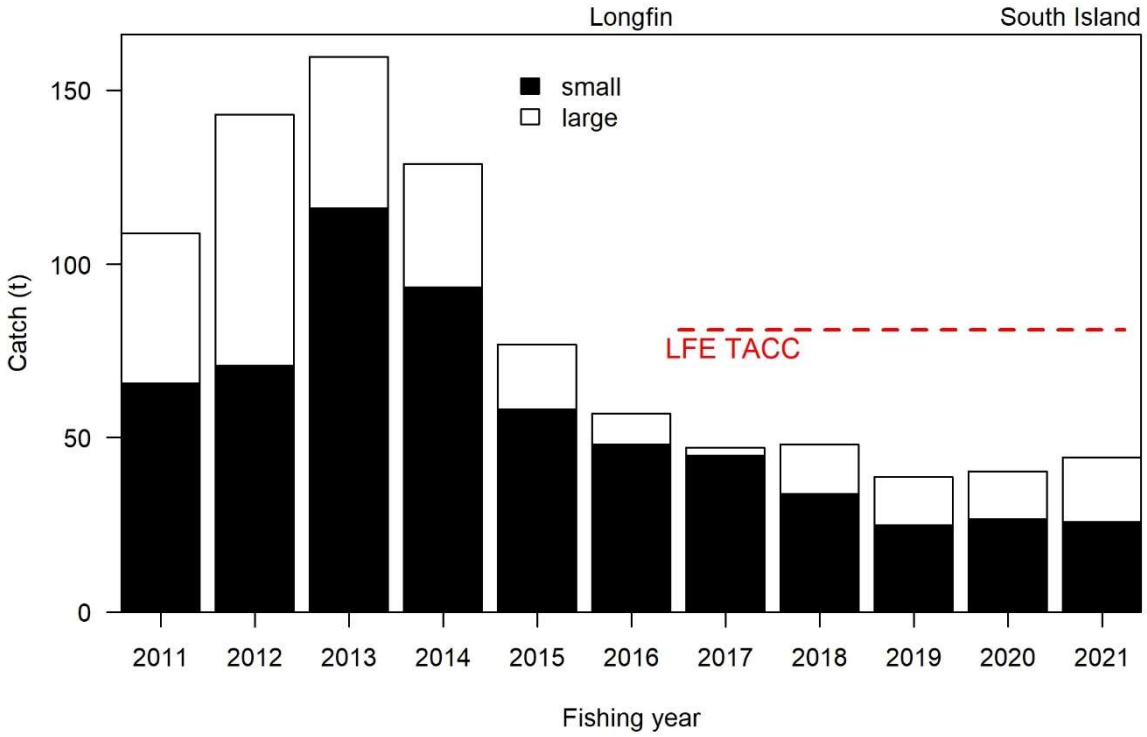

Figure 37: South Island longfin eel (LFE) landed catch by weight grade from 2010–11 to 2020–21.

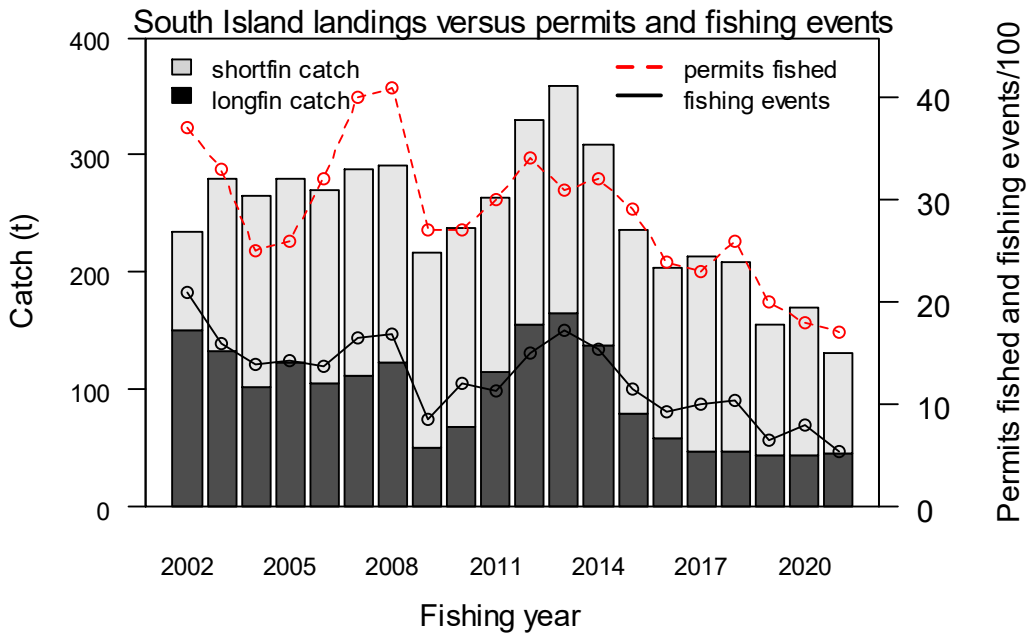

Figure 38: South Island catch of shortfin and longfin eels, number of permits fished, and number of fishing events by fishing year. A fishing event is where a number of fyke nets was set overnight. Data are from Fisheries New Zealand Eel Catch Landing Records (ECLR), Eel Catch Effort Records (ECER), and Electronic Reporting System (ERS).

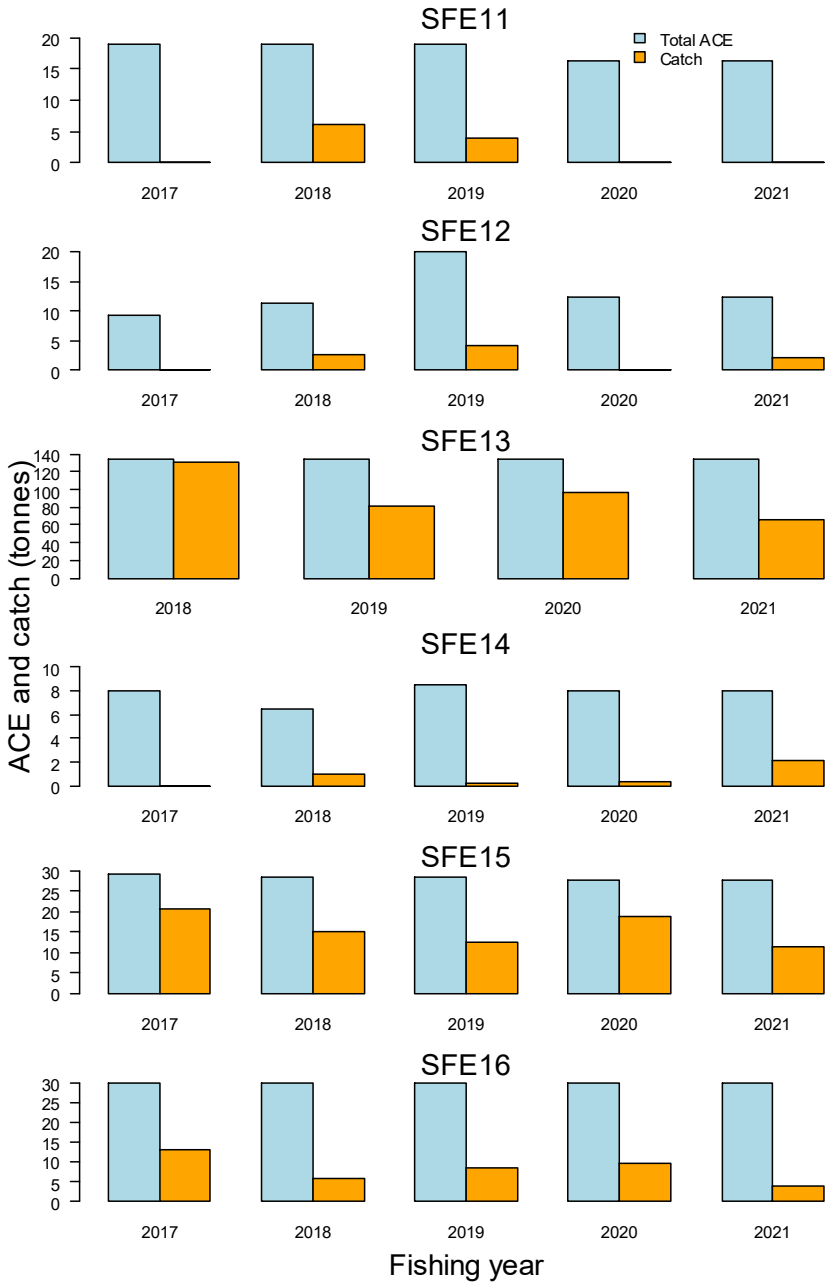

Figure 39: South Island annual shortfin ACE (annual catch entitlement) and landed catch by Quota Management Area from 2016–17 to 2020–21. Total ACE is the total amount of ACE that can be leased to fishers based on quota shares and carry overs. Data were provided by Fisheries New Zealand.

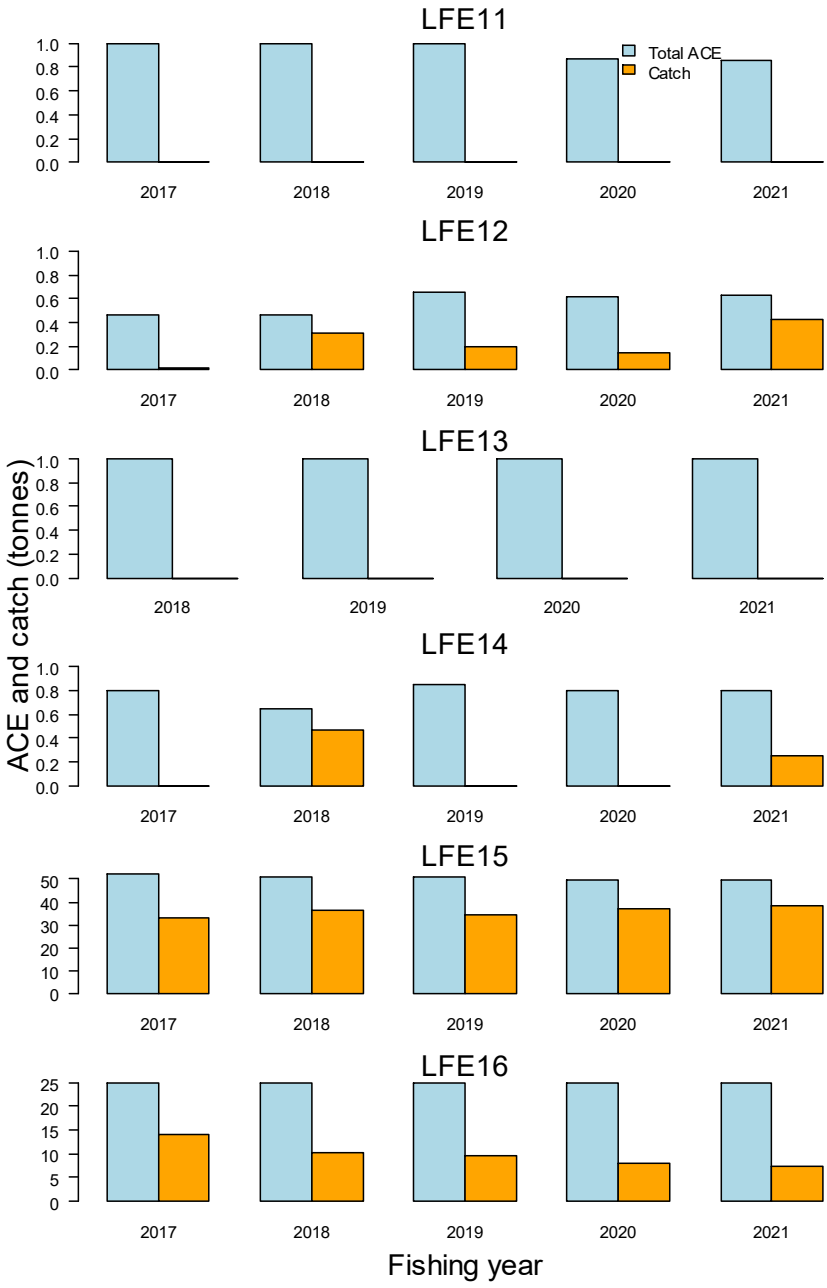

Figure 40: South Island annual longfin ACE (annual catch entitlement) and landed catch by Quota Management Area from 2016–17 to 2020–21. Total ACE is the total amount of ACE that can be leased to fishers based on quota shares and carry overs. Data were provided by Fisheries New Zealand.

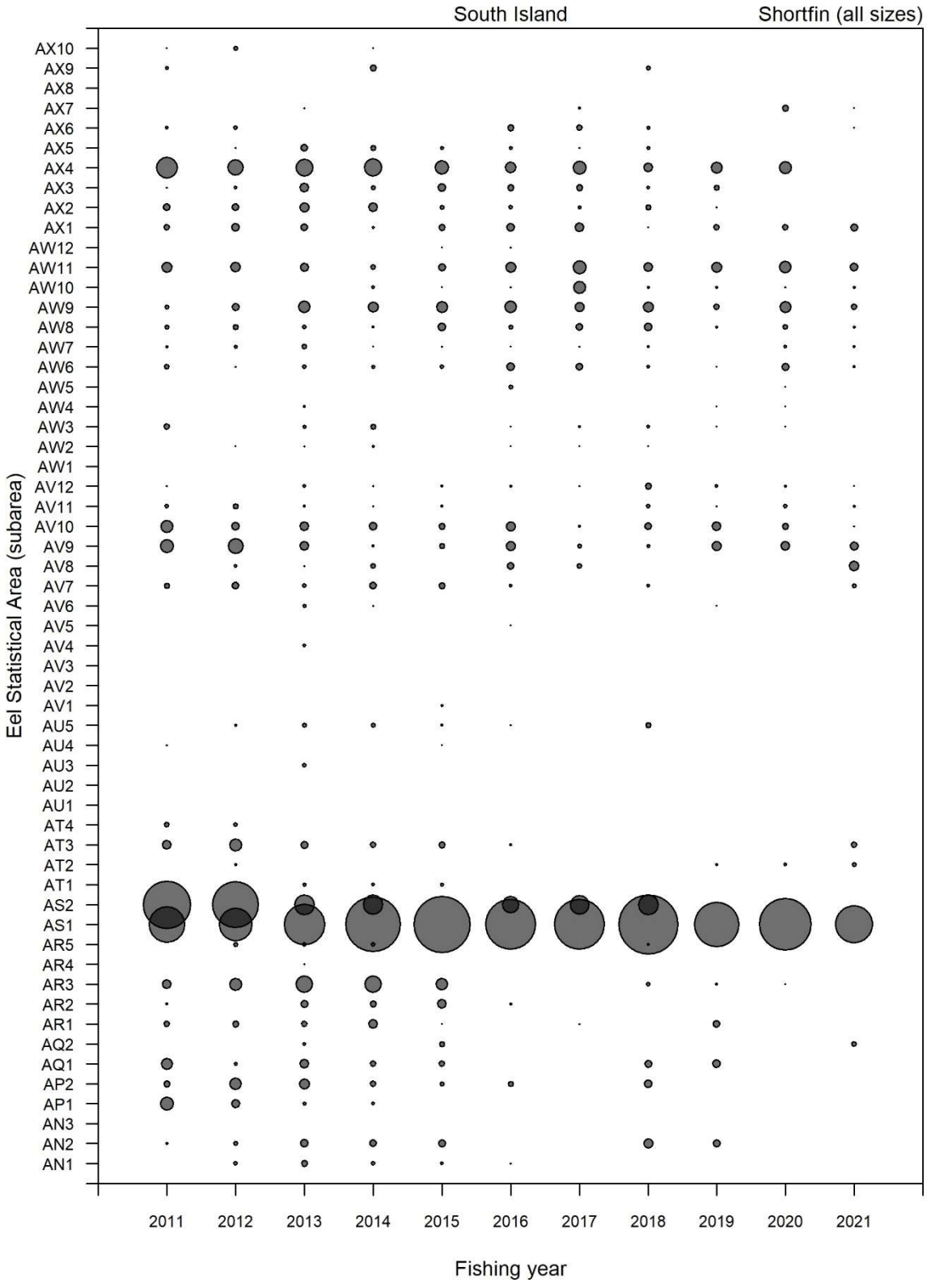

Figure 41: South Island shortfin catch by Eel Statistical Area subarea from 2010–11 to 2020–21. Maximum = 117 t. All 58 South Island subareas are shown.

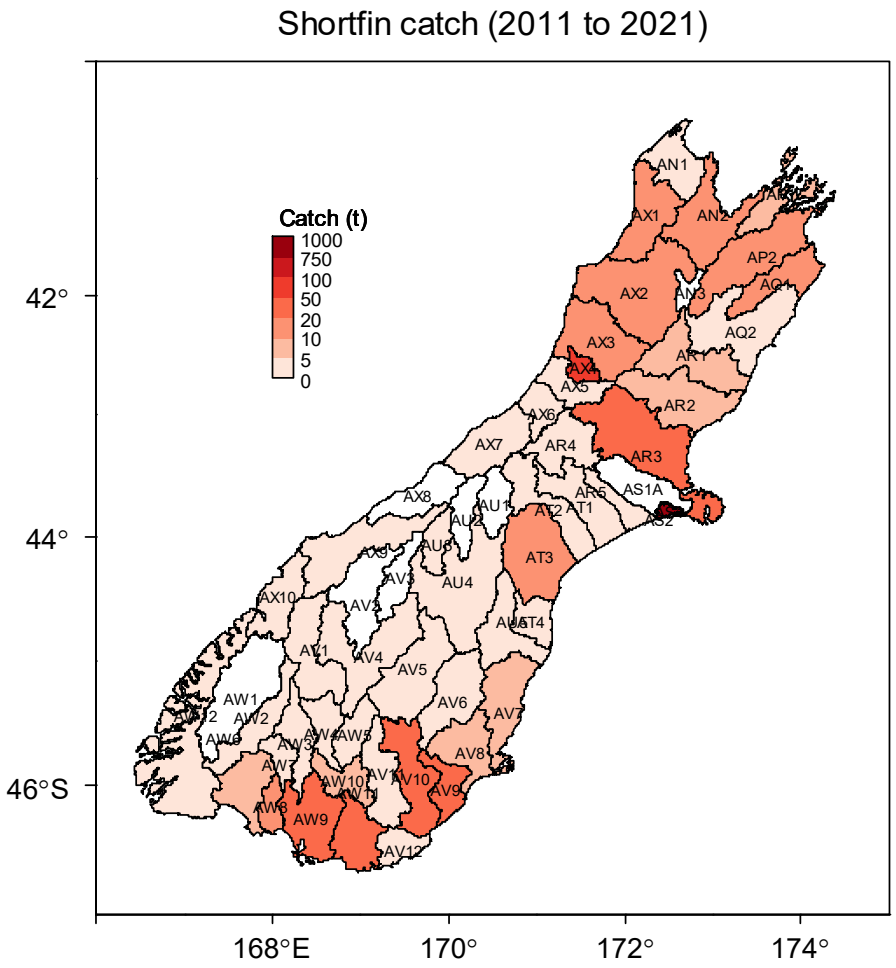

Figure 42: Catch of South Island shortfin plotted by subarea aggregated for the fishing years 2010–11 to 2020–21. Zero catch is white, the lightest red colour represents > 0 to 5 t and the darkest red colour 750 to 1000 t of shortfin catch. The maximum catch is 912 t in subarea AS1 (Te Waihora).

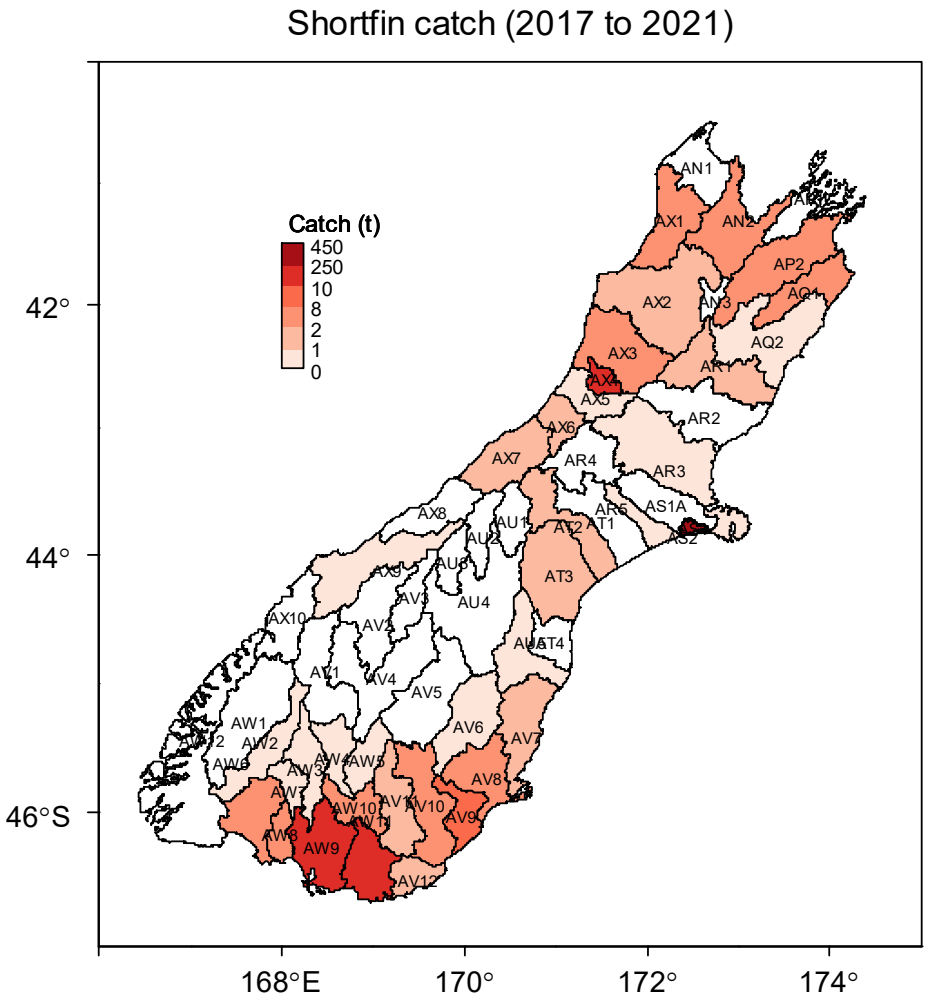

Figure 43: Catch of South Island shortfin plotted by subarea aggregated for the fishing years 2016–17 to 2020–21. TACCs in LFE 11 to LFE 14 were set at a nominal 1 tonne in 2016–17 when ANG was split into shortfin and longfin stocks. Zero catch is white, the lightest red colour represents > 0 to 1 t and the darkest red colour 10 to 450 t of shortfin catch. The maximum catch is 445 t in subarea AS1 (Te Waihora).

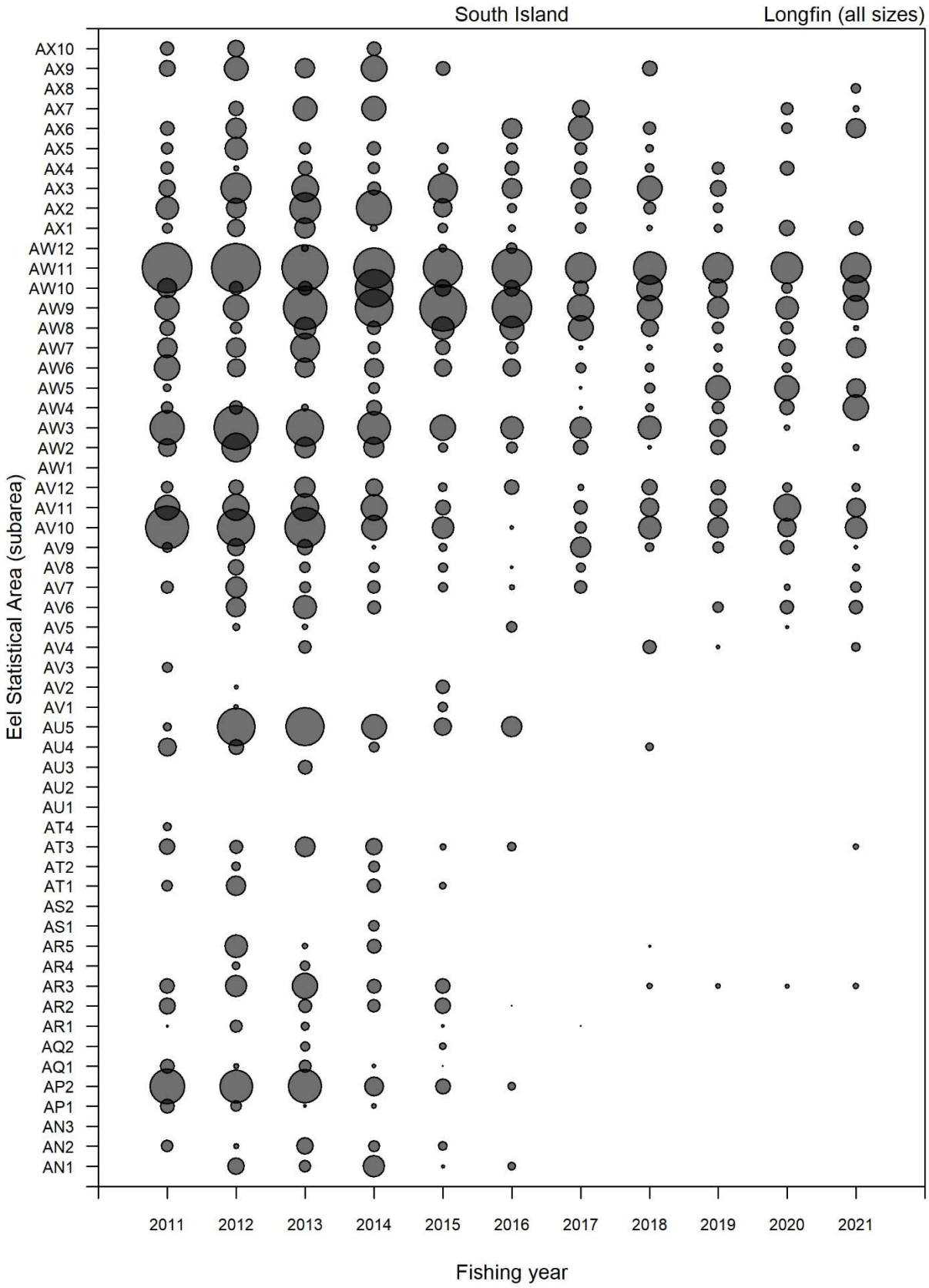

Figure 44: South Island longfin catch by Eel Statistical Area subarea from 2010–11 to 2020–21. Maximum = 19 t. All 58 South Island subareas are shown.

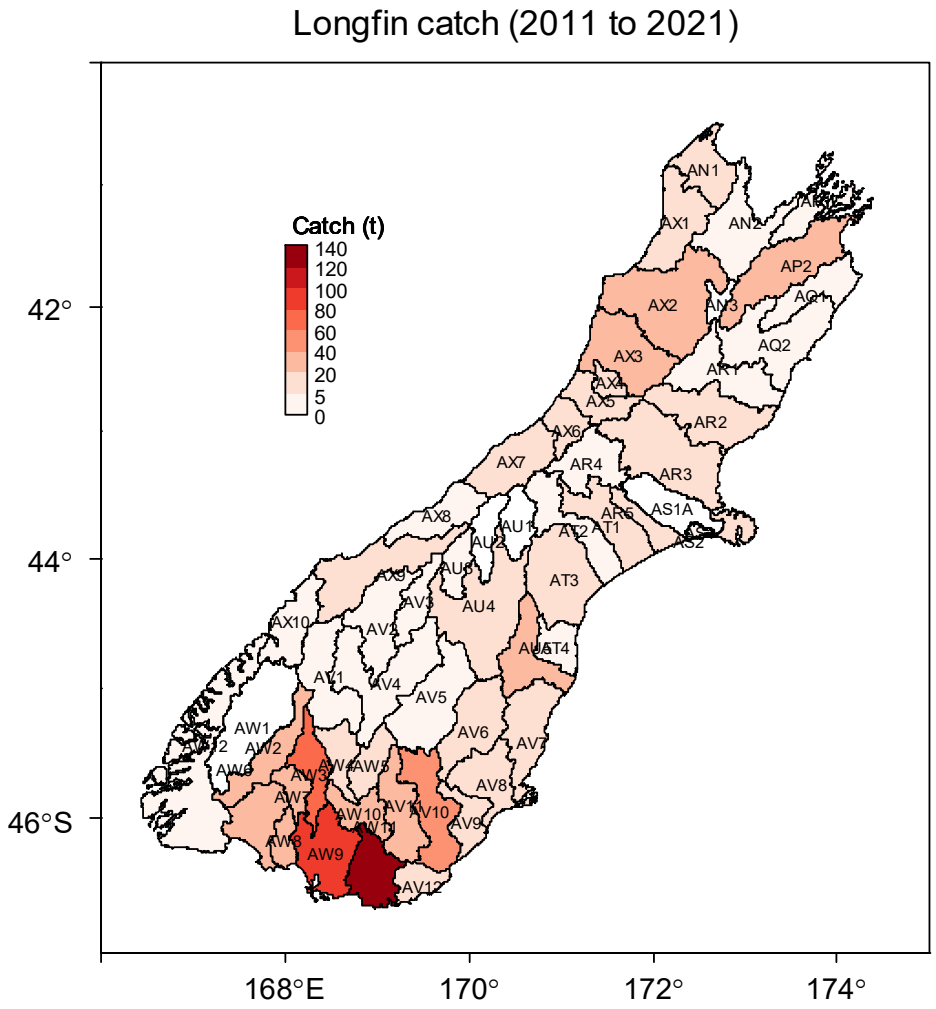

Figure 45: Catch of South Island longfin plotted by subarea aggregated for the fishing years 2010–11 to 2020–21. Zero catch is white, the lightest red colour represents > 0 to 5 t and the darkest red colour 120 to 140 t of longfin catch. The maximum catch is 125 t in subarea AW11 (Mataura River coast).

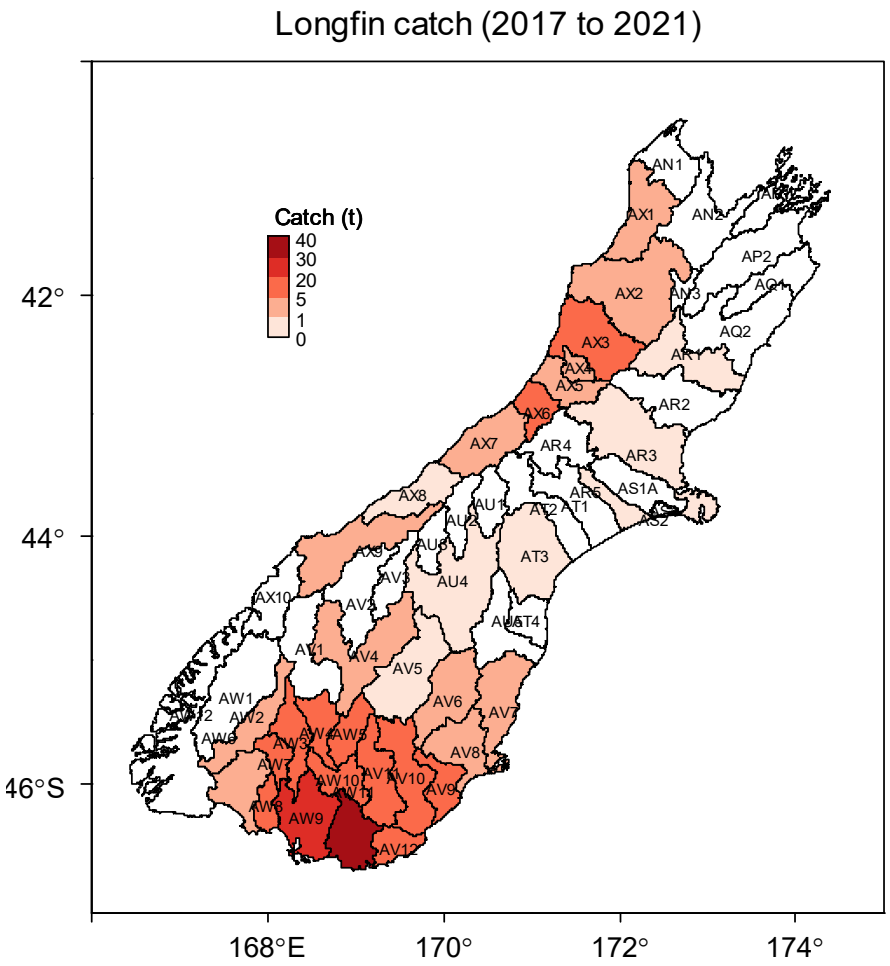

Figure 46: Catch of South Island longfin plotted by subarea aggregated for the fishing years 2016–17 to 2020–21. TACCs in LFE 11 to LFE 14 were set at a nominal 1 tonne in 2016–17 when ANG was split into shortfin and longfin stocks. Zero catch is white, the lightest red colour represents > 0 to 1 t and the darkest red colour 30 to 40 t of longfin catch. The maximum catch is 36 t in subarea AW11 (Mataura River coast).

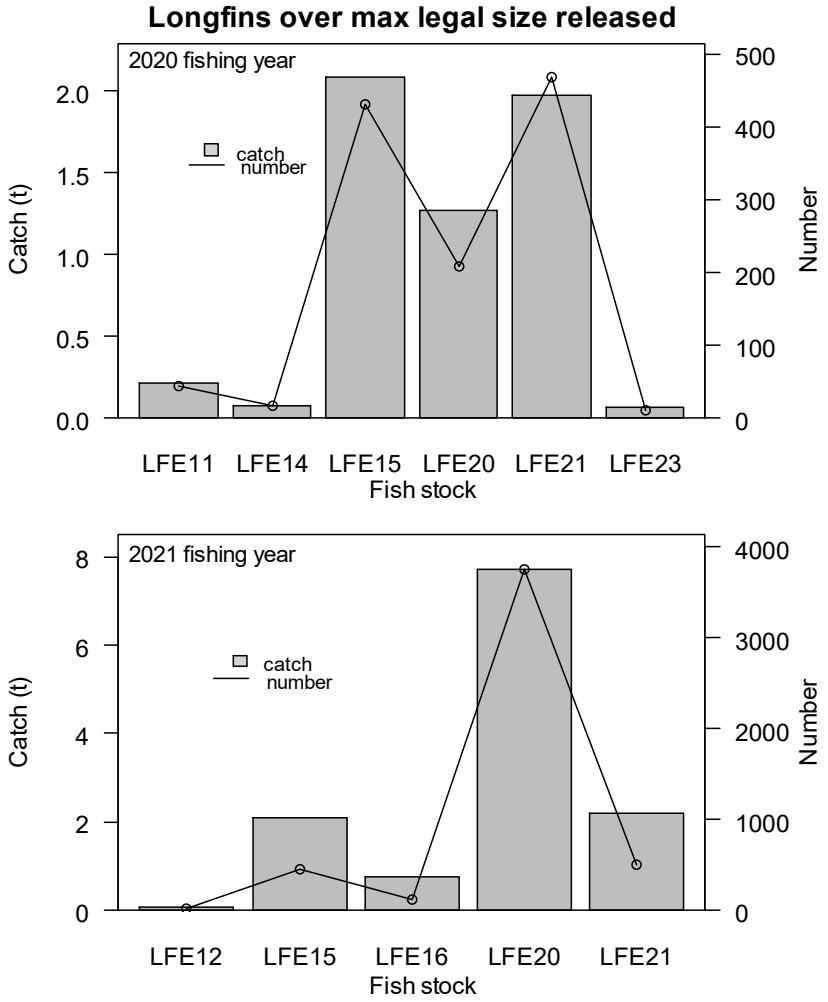

Figure 47: Electronic Reporting System (ERS) records on longfin eel catch and numbers over the maximum legal size captured and released, by fish stock for the 2019–20 and 2020–21 fishing years. The maximum legal size is 4 kg, except in the Waikato-Tainui Area where it is 2 kg.

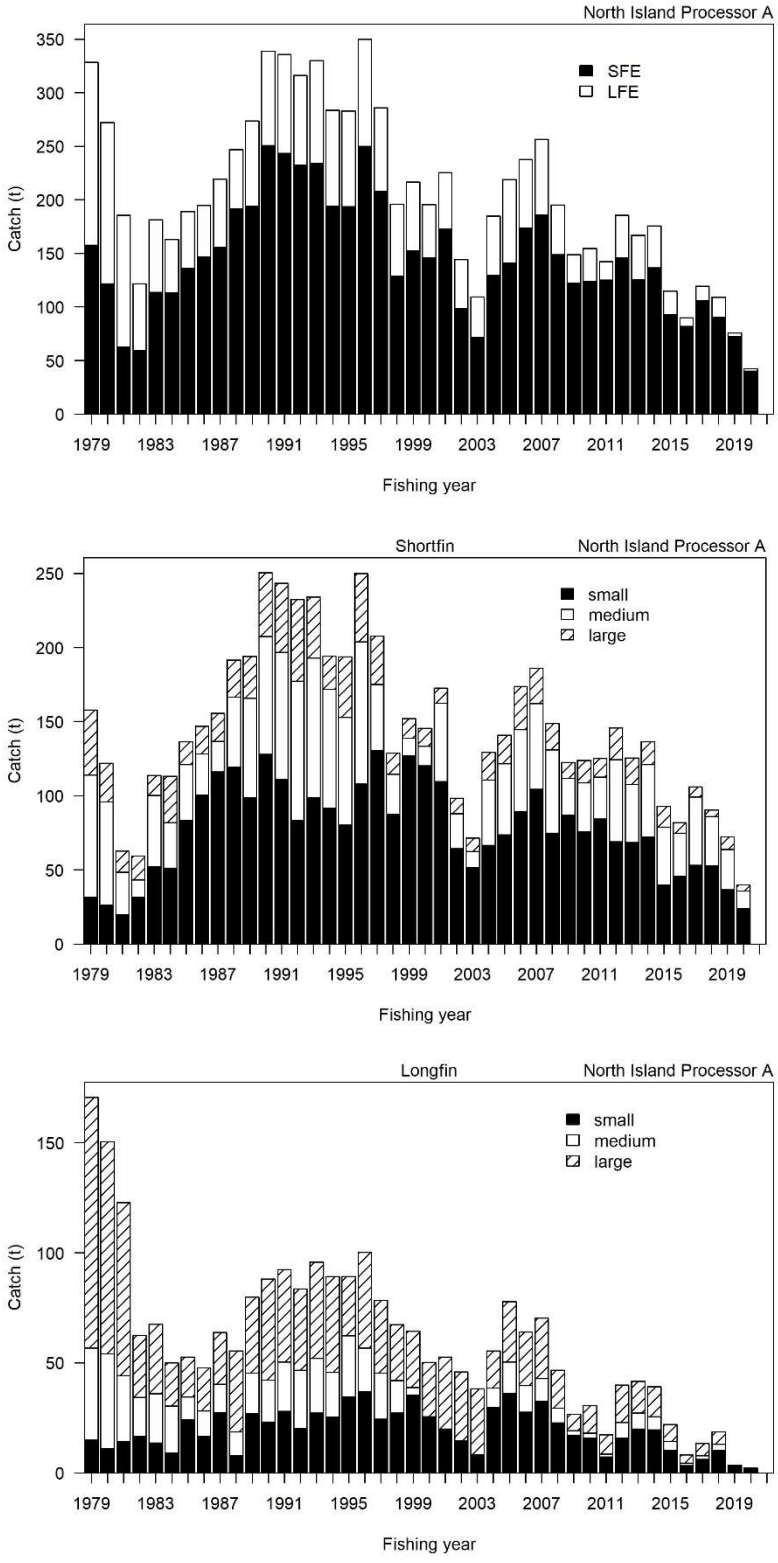

Figure 48: Landed eel catch from North Island eel processor A from 1979 to 2020–21. Top panel: shortfin and longfin landed catch. Middle panel: Shortfin landed catch by weight grade. Bottom Panel: Longfin landed catch by weight grade. Data before 2003–04 were provided to NIWA by Processor A and subsequent data are from the commercial eel monitoring programme.

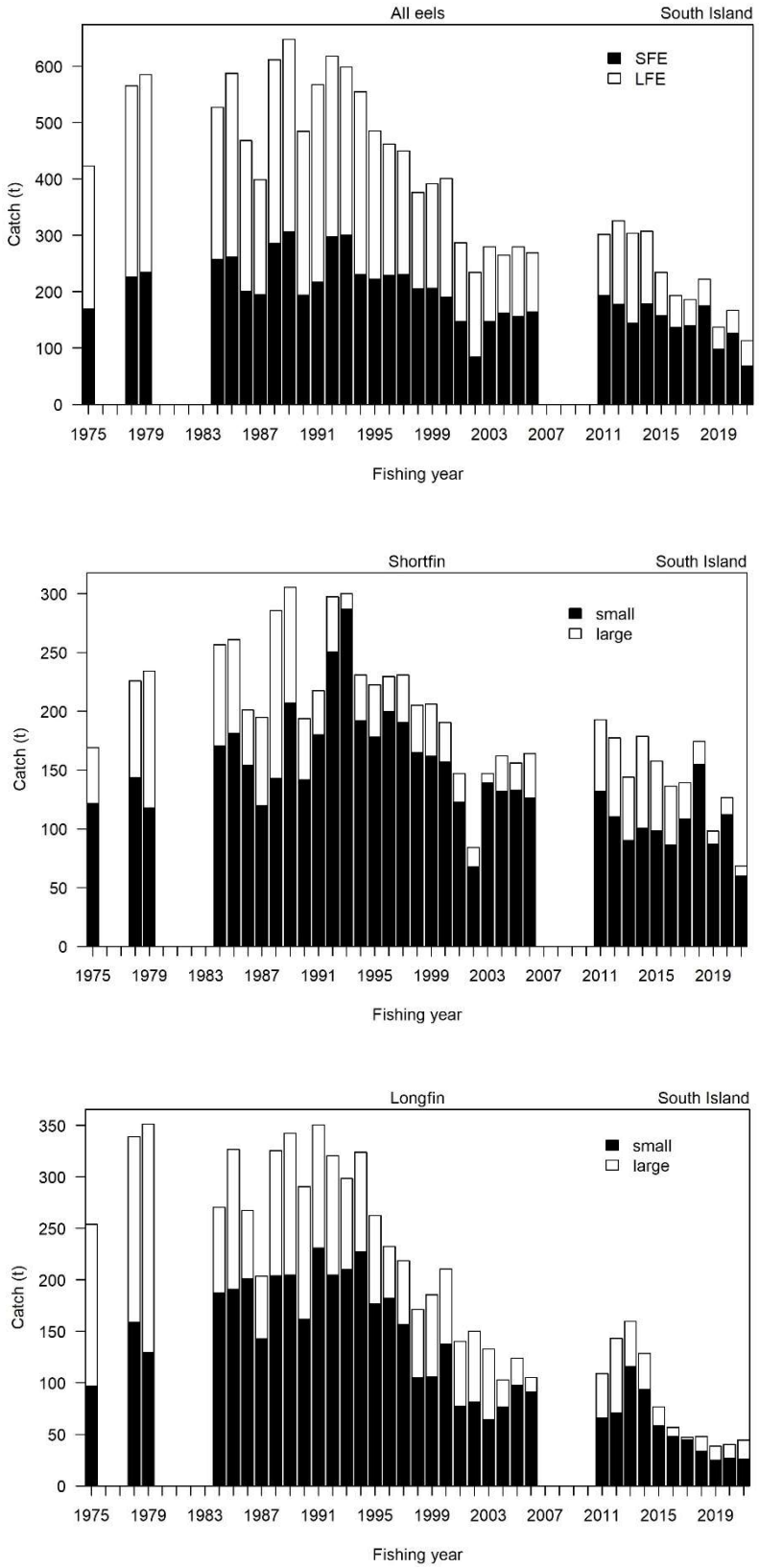

Figure 49: Landed eel catch from the South Island from 1975 to 2020–21. Top panel: shortfin and longfin landed catch. Middle panel: Shortfin landed catch by weight grade. Bottom Panel: Longfin landed catch by weight grade. Data before 2003–04 were provided to NIWA by a South Island processor and subsequent data are from the commercial eel monitoring programme.

9. APPENDICES

Appendix1: Summary of data collection from the commercial eel monitoring programme. ANG 15 landings did not have location data. *ANG 15 only in 2006–07.

Fishing year	North Island	South Island	Data collected	Project code
2003–04 (pilot)	All landings	No data	Species size, landing weight, location	EEL200204
2004–05	All landings	No data	Species size, landing weight, location	EEL200402
2005–06 and 2006–07*	All landings	ANG 15 landings	Species size, landing weight, location	EEL200501
2007–08 and 2008–09	All landings	ANG 15 landings	Species size, landing weight, location	EEL200708
2009–10	All landings	ANG 15 landings	Species size, landing weight, location	IPA200907
2010–11 and 2011–12	All landings	All landings	Species size, landing weight, location	EEL201002
2012–13 to 2014–15	All landings	All landings	Species size, landing weight, location	EEL201202
2015–16 to 2017–18	All landings	All landings	Species size, landing weight, location	EEL201502
2018–19 to 2020–21	All landings	All landings	Species size, landing weight, location	EEL201802

Appendix 2: North Island and South Island subarea codes (n = 65, n = 58) with general locations and the matching Eel Statistical Area (ESA) and Quota Management Area (QMA). The number of the alphanumeric 'Subarea' code refers to the historical numeric ESA within which the subarea is located, and 'Subarea2' letters refer to the current alpha code of the ESA. In our reporting we have used the variable 'Subarea2' codes. (Continued on next two pages)

Subarea	Subarea2	Subarea location	Island	ESA	QMA (LFE)	QMS (SFE)
1A	AA1	Kaitaia	North	AA	LFE 20	SFE 20
1B	AA2	Hokianga Harbour	North	AA	LFE 20	SFE 20
1C	AA3	Bay of Islands	North	AA	LFE 20	SFE 20
1D	AA4	Dargaville	North	AA	LFE 20	SFE 20
1E	AA5	Bream Bay	North	AA	LFE 20	SFE 20
2A	AB1	Warkworth	North	AB	LFE 20	SFE 20
2B	AB2	Auckland	North	AB	LFE 20	SFE 20
2C	AB3	Manukau Harbour	North	AB	LFE 20	SFE 20
3A	AC1	Hauraki Plains west	North	AC	LFE 21	SFE 21
3B	AC2	Hauraki Plains east	North	AC	LFE 21	SFE 21
3C	AC3	Coromandel Peninsula	North	AC	LFE 21	SFE 21
4A	AD1	Lake Taupo	North	AD	LFE 21	SFE 21
4B	AD2	Lake Ohakuri	North	AD	LFE 21	SFE 21
4C	AD3	Lake Atiamuri	North	AD	LFE 21	SFE 21
4D	AD4	Lake Whakamaru	North	AD	LFE 21	SFE 21
4E	AD5	Lake Maraetai	North	AD	LFE 21	SFE 21
4F	AD6	Lake Waipapa	North	AD	LFE 21	SFE 21
4G	AD7	Lake Arapuni	North	AD	LFE 21	SFE 21
4H	AD8	Lake Karapiro	North	AD	LFE 21	SFE 21
4I	AD9	Hamilton	North	AD	LFE 21	SFE 21
4J	AD10	Waipa River (formerly Pirongia Forest)	North	AD	LFE 21	SFE 21
4K	AD11	Lakes Whangape, Waahi and Rotongaro	North	AD	LFE 21	SFE 21
4L	AD12	Lake Waikare/Port Waikato	North	AD	LFE 21	SFE 21
4M	AD13	Raglan Harbour	North	AD	LFE 21	SFE 21
4N	AD14	Kawhia Harbour	North	AD	LFE 21	SFE 21
4O	AD15	Marakopa River	North	AD	LFE 21	SFE 21
4P	AD16	Awakino River	North	AD	LFE 21	SFE 21
4Q	AD17	Mokau River	North	AD	LFE 21	SFE 21
5A	AE1	Tauranga	North	AE	LFE 21	SFE 21
5B	AE2	Rotorua Lakes	North	AE	LFE 21	SFE 21
5C	AE3	Rangitaiki River	North	AE	LFE 21	SFE 21
5D	AE4	Whakatane River	North	AE	LFE 21	SFE 21
6A	AF1	Ohiwa Harbour	North	AF	LFE 21	SFE 21
6B	AF2	Motu River	North	AF	LFE 21	SFE 21
6C	AF3	Cape Runaway	North	AF	LFE 21	SFE 21
6D	AF4	Waiapu River	North	AF	LFE 21	SFE 21
6E	AF5	Tolaga Bay	North	AF	LFE 21	SFE 21
6F	AF6	Gisborne	North	AF	LFE 21	SFE 21
6G	AF7	Waipaoa River	North	AF	LFE 21	SFE 21
7A	AG1	Mahia Peninsula	North	AG	LFE 22	SFE 22
7B	AG2	Lake Waikaremoana	North	AG	LFE 22	SFE 22
7C	AG3	Mohaka River	North	AG	LFE 22	SFE 22
7D	AG4	Napier	North	AG	LFE 22	SFE 22
7E	AG5	Tukituki River	North	AG	LFE 22	SFE 22
7F	AG6	Waimarama/Porangahau	North	AG	LFE 22	SFE 22
8A	AH1	Taumarunui	North	AH	LFE 23	SFE 23
8B	AH2	Whanganui River inland	North	AH	LFE 23	SFE 23
8C	AH3	Whanganui River coast	North	AH	LFE 23	SFE 23
8D	AH4	Whangaehu River	North	AH	LFE 23	SFE 23
8E	AH5	Turakina River	North	AH	LFE 23	SFE 23
8F	AH6	Rangitikei River	North	AH	LFE 23	SFE 23

Subarea	Subarea2	Subarea location	Island	ESA	QMA (LFE)	QMS (SFE)
9A	AJ1	North Taranaki Bight	North	AJ	LFE 23	SFE 23
9B	AJ2	Waitara River	North	AJ	LFE 23	SFE 23
9C	AJ3	Mount Taranaki coast	North	AJ	LFE 23	SFE 23
9D	AJ4	Patea River inland	North	AJ	LFE 23	SFE 23
9E	AJ5	Patea River coast	North	AJ	LFE 23	SFE 23
9F	AJ6	Waitotara River	North	AJ	LFE 23	SFE 23
10A	AK1	Manawatu River coast	North	AK	LFE 22	SFE 22
10B	AK2	Manawatu River Inland	North	AK	LFE 22	SFE 22
10C	AK3	Akitio River	North	AK	LFE 22	SFE 22
10D	AK4	Otaki	North	AM	LFE 22	SFE 22
11A	AL1	Lake Wairarapa	North	AL	LFE 22	SFE 22
11B	AL2	Wairarapa coast	North	AL	LFE 22	SFE 22
11C	AL3	Castle point	North	AL	LFE 22	SFE 22
12B	AM2	Wellington	North	AM	LFE 22	SFE 22
AN1	AN1	Kahurangi National Park/Takaka	South	AN	ANG 11	ANG 11
AN2	AN2	Motueka River/Tasman Bay	South	AN	ANG 11	ANG 11
AN3	AN3	Lakes Rotoroa and Rotoiti	South	AN	ANG 11	ANG 11
AP1	AP1	Pelorus River/Pelorus Sounds	South	AP	ANG 11	ANG 11
AP2	AP2	Wairau River	South	AP	ANG 11	ANG 11
AQ1	AQ1	Awatere River	South	AQ	ANG 12	ANG 12
AQ2	AQ2	Clarence and Conway Rivers	South	AQ	ANG 12	ANG 12
AR1	AR1	Waiau River (north)	South	AR	ANG 12	ANG 12
AR2	AR2	Hurunui River	South	AR	ANG 12	ANG 12
AR3	AR3	Waimakariri River	South	AR	ANG 12	ANG 12
AR4	AR4	Upper Rakaia River/Lake Coleridge	South	AR	ANG 12	ANG 12
AR5	AR5	Rakaia River coast	South	AR	ANG 12	ANG 12
AS1	AS1	Te Waihora (lake only)	South	AS1	ANG 13	ANG 13
AS2	AS2	Te Waihora Concession Area	South	AS2	ANG 13	ANG 13
AS1A	ASA	Selwyn catchment (excluding the lake)	South	AS1	ANG 13	ANG 13
AT1	AT1	Ashburton River	South	AT	ANG 14	ANG 14
AT2	AT2	Rangitata River	South	AT	ANG 14	ANG 14
AT3	AT3	Opihi and Orari Rivers	South	AT	ANG 14	ANG 14
AT4	AT4	Wainono Lagoon/Pareora River	South	AT	ANG 14	ANG 14
AU1	AU1	Lake Tekapo	South	AU	ANG 14	ANG 14
AU2	AU2	Lake Pukaki	South	AU	ANG 14	ANG 14
AU3	AU3	Lake Ohau	South	AU	ANG 14	ANG 14
AU4	AU4	Lakes Benmore, Aviemore and Waitaki	South	AU	ANG 14	ANG 14
AU5	AU5	Waitaki River	South	AU	ANG 14	ANG 14
AV1	AV1	Lake Wakatipu	South	AV	ANG 15	ANG 15
AV2	AV2	Lake Wanaka	South	AV	ANG 15	ANG 15
AV3	AV3	Lake Hawea	South	AV	ANG 15	ANG 15
AV4	AV4	Kawarau and upper Clutha Rivers down to Cromwell	South	AV	ANG 15	ANG 15
AV5	AV5	Clutha River from Cromwell to Roxburgh Dam	South	AV	ANG 15	ANG 15
AV6	AV6	Taieri River above Middlemarch	South	AV	ANG 15	ANG 15
AV7	AV7	Kakanui, Shag and Waikouaiti Rivers	South	AV	ANG 15	ANG 15
AV8	AV8	Taieri River coast	South	AV	ANG 15	ANG 15
AV9	AV9	Lake Waihola and Waipori River	South	AV	ANG 15	ANG 15
AV10	AV10	Clutha River coast	South	AV	ANG 15	ANG 15
AV11	AV11	Pomahaka River	South	AV	ANG 15	ANG 15
AV12	AV12	Catlins and Tahakopa River	South	AV	ANG 15	ANG 15
AW1	AW1	Lakes Te Anau and Manapouri	South	AW	ANG 15	ANG 15
AW2	AW2	Waiau and Mararoa Rivers down to Monawai	South	AW	ANG 15	ANG 15
AW3	AW3	Oreti River inland down to Bog Burn	South	AW	ANG 15	ANG 15
AW4	AW4	Mataura River inland down to Riversdale	South	AW	ANG 15	ANG 15
AW5	AW5	Waikaka River	South	AW	ANG 15	ANG 15
AW6	AW6	Waiau River coast	South	AW	ANG 15	ANG 15

Subarea	Subarea2	Subarea location	Island	ESA	QMA (LFE)	QMS (SFE)
AW7	AW7	Aparima River inland down to Wreys Bush	South	AW	ANG 15	ANG 15
AW8	AW8	Aparima River coast	South	AW	ANG 15	ANG 15
AW9	AW9	Oreti River coast	South	AW	ANG 15	ANG 15
AW10	AW10	Mataura River from Riversdale to Gore	South	AW	ANG 15	ANG 15
AW11	AW11	Mataura River coast	South	AW	ANG 15	ANG 15
AW12	AW12	Fiordland National Park	South	AW	ANG 15	ANG 15
AX1	AX1	Karamea and Mokihinui Rivers	South	AX	ANG 16	ANG 16
AX2	AX2	Buller River	South	AX	ANG 16	ANG 16
AX3	AX3	Grey River, Arnold River	South	AX	ANG 16	ANG 16
AX4	AX4	Lake Brunner	South	AX	ANG 16	ANG 16
AX5	AX5	Taramakau River	South	AX	ANG 16	ANG 16
AX6	AX6	Hokitika River	South	AX	ANG 16	ANG 16
AX7	AX7	Mikonui River to Waikukupa River	South	AX	ANG 16	ANG 16
AX8	AX8	Cook River to Waita River	South	AX	ANG 16	ANG 16
AX9	AX9	Arawata and Haast Rivers	South	AX	ANG 16	ANG 16
AX10	AX10	Sutherland Sound to George River	South	AX	ANG 16	ANG 16