Fisheries New Zealand
Tini a Tangaroa

Recruitment of freshwater eels 1995–2025

New Zealand Fisheries Assessment Report 2026/29

S.K. Crow,
S.H. Nuri,
R.S.A. White,
P.W. Lambert.

ISSN 1179-5352 (online)
ISBN 978-1-997337-70-6 (online)

August 2026

Te Kāwanatanga o Aotearoa
New Zealand Government

Disclaimer

Requests for further copies should be directed to:

Fisheries Science Editor
Fisheries New Zealand
Ministry for Primary Industries
PO Box 2526
Wellington 6140
NEW ZEALAND

Email: Fisheries-Science.Editor@mpi.govt.nz
Telephone: 0800 00 83 33

This publication is also available on the Ministry for Primary Industries websites at:
http://www.mpi.govt.nz/news-and-resources/publications
http://fs.fish.govt.nz go to Document library/Research reports

Please cite this report as:

Crow, S.K.; Nuri, S.H.; White, R.S.A.; Lambert, P.W. (2026). Recruitment of freshwater eels 1995–2025. *New Zealand Fisheries Assessment Report 2026/29.* 115 p.

TABLE OF CONTENTS

PLAIN LANGUAGE SUMMARY

This study aimed to compile elver catch data for longfin and shortfin eels from hydroelectric dam sites during the 2022–23 to 2024–25 migration seasons. It continues a long-running monitoring programme designed to track juvenile abundance and support management of future adult eel stocks. Over the last three seasons, shortfin catches were generally low to moderate, while longfin catches were relatively high at the same sites. The average annual shortfin catch for the three fishing years was 2.6 million elvers, and was below the historical median, mainly because the Wairua Dam elver traps did not operate for two seasons and the Matahina Dam elver trap was being redesigned and did not capture elvers effectively for two seasons. If both sites had functioned normally, shortfin catch may have been closer to 6–7 million nationally. In contrast, the average annual longfin catch for the three fishing years was 721 061, which was above the historical median. Age structure differed markedly among sites and between seasons, showing that continued ageing work is needed to estimate recruitment strength accurately for individual years. Recruitment indices suggested that both shortfin and longfin recruitment have remained broadly stable over time, despite high year-to-year variability. Modelling results showed that water temperature was associated with daily longfin and shortfin catches at Karāpiro and Patea Dams. Other environmental variables such as moon phase, daylength, and seven-day mean river flow were also associated with daily elver catches, but their importance varied by species and site. Future work could expand modelling to more sites, account for age class specific patterns, and include broader climate indices to better understand the drivers of eel recruitment into New Zealand.

EXECUTIVE SUMMARY

Crow, S.K.[1]; Nuri, S.H.[1]; White, R.S.A.[1]; Lambert, P.W.[1] (2026). Recruitment of freshwater eels 1995–2025. ***New Zealand Fisheries Assessment Report 2026/29.*** **115 p.**

The aim of the present study was to collate data on elver (approximately < 20 g in weight and <200 mm length) catches of longfin (*Anguilla dieffenbachii*) and shortfin (*A. australis*) eels from over ten hydroelectric dam sites or associated structures nationally during the 2022–23 to 2024–25 fishing year elver migration seasons. This project is a continuation of a monitoring programme that has collected data on elver abundance since 1995–96 with the same consistent methodology.

Over the three seasons (2022–23 to 2024–25), national elver catches generally showed low to moderate shortfin catches relative to previous years but higher longfin catches relative to previous years at the same sites. The average annual shortfin elver catch over the last three seasons was 2.6 million, which was below the long term median annual catch of 3.1 million elvers. The lower shortfin catch was a result of the Wairua Dam elver traps not operating for two seasons and the Matahina Dam elver trap was being redesigned and did not capture elvers effectively for two seasons. In contrast, the average annual longfin elver catch over the three seasons was 721 061 elvers and was above the long term median annual catch of 472 979.

Age structure varied considerably among sites, and within sites between seasons, indicating that ongoing ageing is needed to reliably estimate year-class strength and freshwater entry for individual seasons. Several strong cohorts could be partially followed across multiple seasons at Karāpiro and Patea Dams, highlighting the reliability of the ageing data. Ruahihi Dam appears to be a promising future recruitment-monitoring site because catches were dominated by 0+ elvers for both shortfin and longfin.

Combined elver recruitment indices among all sites and all seasons showed that shortfin and longfin recruitment is variable within and between sites but overall, these have fluctuated without trend across the timeseries indicating that recruitment of elvers into New Zealand has remained stable within the time frames of the available datasets.

Mixed effects models explained a high proportion of daily elver catch at the two sites where the analysis was completed (Karāpiro and Patea Dams). Water temperature was the only covariate selected in all models and was the strongest or second-strongest predictor of daily catch, reinforcing its key role in influencing elver migration timing and the length of the migration season. Other covariates such as moon phase, daylength, and seven-day mean flow were also associated with daily elver catches, but their importance varied by species and site. Future models could be further explored and expanded to include other sites, disaggregate catch into age classes (e.g., running the model separately for each age class), and use a delta or Poisson-link model. The Southern Oscillation Index or Interdecadal Pacific Oscillation could also be integrated into future analyses as similar climate indices have been linked with recruitment of other eel species internationally. This would provide an indication of environmental drivers affecting the total number of elvers recruiting to New Zealand and not just factors affecting the rate of migration within systems.

[1] Earth Sciences New Zealand.

1. INTRODUCTION

The order Anguilliformes (Schrank 1798) incorporates 20 families, 147 genera and 820 species across marine and freshwater environments (Arai 2020; Froese & Pauly 2025). Within this order, the family Anguillidae is unique because it is the only group with a catadromous life-cycle that migrates between freshwater and marine environments (McDowall 1988). There are 19 species and sub-species within the *Anguilla*[2] genus *of* Anguillidae (Griffin 1936; Ege 1939; Watanabe et al. 2004; Watanabe et al. 2009; Watanabe et al. 2013; Watanabe et al. 2014a; Watanabe et al. 2014b; Arai 2016; Arai 2020; Goymer et al. 2023), all of which spawn in marine environments before their transparent larvae (leptocephali) migrate back to freshwater (Tesch 2003; Arai 2016). Upon reaching freshwater/brackish environments the leptocephali metamorphose into glass eels and then elvers as they enter and establish themselves in these habitats (Bertin 1956; Jellyman 1977; Jellyman & Todd 1982; Jellyman & Ryan 1983; Tesch 2003; Arai 2016). All *Anguilla* species (eels hereafter) then feed and grow in these habitats (referred to as the yellow eel phase) for up to 106 years before maturing and migrating back out to sea where they spawn and die, i.e., semelparous life cycle where they reproduce only once during their lifetime and then die (Jellyman 1995; Tesch 2003).

A variety of the eel life history phases are used to supply the growing international eel trade, with 80 000–280 000 tonnes being traded annually (Monticini 2014; European Union 2025). Based on the Global Production Database maintained by the Food and Agriculture Organization of the United Nations (FAO), eel aquaculture accounted for 88% of the eel market global trade for the last 10 years which utilises wild captured glass eels and/or elvers. The remaining 12% of the global eel trade focusses on wild captured yellow phase eels. With no captive spawning and rearing being possible at present, the entire international eel trade is dependent on wild captured fish. Unfortunately, there is also an illegal trade of eel products (primarily glass eels) (Crook & Nakamura 2013; Stein et al. 2016; Goymer et al. 2023), which compromises the long-term sustainability of eel populations and undermines management strategies. The International Union for Conservation of Nature's (IUCN) Red List cites the declining eel stocks, habitat loss and concerns around the illegal eel trade as justification to classify two *Anguilla* species as Vulnerable, one species as Near Threatened, three species as Endangered and one species as Critically Endangered. The European eel (*A. anguilla*) has been included in the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Appendix II since 2009, but international trade in other *Anguilla* species is not yet regulated through CITES. In June 2025 the European Union applied to CITES to include *A. japonica* and *A. rostrata* in Appendix II because of concerns for these species' populations and the ongoing illegal trade of glass eels. Specifically, the critically endangered *A. anguilla* is still being traded internationally to glass eel on-growing facilities (Goymer et al. 2023), despite being on Appendix II of CITES. The illegal trade of *A. anguilla* has presumably continued because of the challenges identifying different species at the glass eel phase, which the 2025 European Union CITES application has referenced as justification to include all *Anguilla* species on Appendix II. If the application is accepted, CITES restrictions on trade would come into effect in 2027, which will include the two eel species[3] found in New Zealand. The New Zealand longfin (*A. dieffenbachii*) is classified as Endangered under the IUCN Red List and At Risk-Declining under the New Zealand Threat Classification system (Dunn et al. 2017; Dunn et al. 2025). The shortfin eel (*A. australis*[4]) is classified as Not Threatened by both the IUCN Red List and the New Zealand Threat Classification system.

The New Zealand commercial eel industry is unique internationally because the fishery is entirely focussed on yellow eels and there is no aquaculture. The Australian eel fishery also includes a heavy focus on wild captured yellow eels (Victorian Fisheries Authority 2017; Hall 2021; Victorian Fisheries

[2] There is only a single genus within the family *Anguillidae*

[3] The Australian longfin eel (*A. reinhardtii*) is occassionally captured in New Zealand but does not make up any considerable proportion of the commercial landings (Fisheries New Zealand 2025).

[4] *A. australis* has been suggested to contain two sub-species; *A. australis australis* in Australia and *A. australis schmidtii* in New Zealand (Griffin 1936, Watanabe et al. 2006). For clarity and consistency with international and national threat ranking systems we have opted to use the species name *A. australis*.

Authority et al. 2023), but harvests of glass eels/elvers are permitted for on-growing, which is currently illegal in New Zealand given the minimum legal size of 220 g[5]. New Zealand also includes a maximum size limit of 4 kg (Fisheries New Zealand 2025) to protect large female longfin eels (*A. dieffenbachii*). Further fishery restrictions are in place in New Zealand that recognise the importance of eels (tuna) to Māori. There are freshwater Mātaitai reserves and designated customary fishery management areas in place across the South Island, while in the North Island the Waikato and Waipa Rivers are managed by mana whenua (Waikato Tainui Fisheries Area) in accordance with the plans and bylaws proposed by their Iwi Governance bodies (Fisheries New Zealand 2025). Within the Waikato Tainui Fisheries Area there is a larger minimum legal size and smaller maximum legal size than elsewhere. The South Island eel stock entered the Quota Management System in 2000, with the Chatham and North Island eel stocks entering the QMS in 2003 and 2004 respectively. The Department of Conservation also requires fisherman to apply for (and be granted) a concession before Public Conservation land can be accessed for commercial eel fishing. These regulations govern the operation of the New Zealand commercial eel industry, with 214–755 tonnes being captured annually from 2011–2025 (Fisheries New Zealand 2025).

The status of the New Zealand eel fishery is monitored through a series of complementary data sources managed by Fisheries New Zealand. Compared with many marine fishes, monitoring the stock of freshwater eels in New Zealand is difficult because of their complicated life history and many knowledge gaps relating to spawning location, migration pathways, and environmental drivers of these migrations. Commercial catches of yellow eel are monitored regularly to examine trends in catch rates across a variety of spatial scales (Beentjes 2008; Beentjes & Dunn 2010; Beentjes & Dunn 2014; Beentjes 2020; Beentjes 2021; Beentjes 2022; Beentjes 2025). Habitat models combined with information about commercial fishing locations have also been used to estimate the amount of longfin habitat that is commercially fished (Beentjes et al. 2016; Beentjes & Shankar 2025). These data all relate to yellow eel stages, but information is collected on recruitment of both species across New Zealand. As elvers undertake their upstream migration, abundance can be monitored by capturing them at hydroelectric Dams or any other location where upstream migration is blocked or significantly impeded. Capturing elvers at these barriers is a cost-effective means for establishing a long-term data series on the relative abundance of elvers. Provided that abundance data are collected in a consistent manner each year, they can be used in conjunction with existing age data to estimate overall recruitment trends for subsequent age classes. Recruitment data were identified as an essential data source for monitoring New Zealand eel stocks by an international review panel (Haro et al. 2015). The review panel examined the efficacy of current and potential methods used for monitoring and assessing trends of freshwater eels in New Zealand in 2013 and concluded that monitoring of elver catches at hydroelectric Dams was an effective method for assessing general recruitment trends (of multiple size classes) into freshwater habitats. Fisheries New Zealand has been supporting a research programme that has monitored elver recruitment at hydroelectric Dams for the past 30 years (referred to as the elver recruitment programme) (Martin et al. 2009; Martin et al. 2013; Crow et al. 2020; Crow et al. 2023). This programme has established a time series of relative catch abundance for elvers at selected locations across New Zealand beginning in 1995–96, which forms a nationally significant dataset used to monitor recruitment of eels. There are now up to 30 seasons of catch data at some sites and this research on recruitment monitoring is intended to be ongoing.

1.1 Aims

The aim of the present study was to collect and collate longfin (*A. dieffenbachii*) and shortfin (*A. australis*) elver catch data from hydroelectric dam sites (or associated structures) for the 2022–23, 2023–24 and 2024–25 migration seasons (i.e., period from 1st August to 31st July the following year). This project is a continuation of several three-yearly projects that have collected data on elver abundance with the same consistent methodology. After collating the last three seasons of recruitment data, the present study integrated these recent results with data collected from all the previous

[5] Within Te Waihora (Lake Ellesmere) fishers are permitted to harvest any male migrant shortfin eel below 300 g captured within the designated migration area.

recruitment projects dating back to 1995–96 for some sites and generated time series of catch indices for specific sites and overall. The catch indices were then used to assess catch trends over time. Catch data at two sites (Karāpiro and Patea Dams) were then used to examine environmental drivers of daily shortfin and longfin elver catches. The project specific objectives were as follows:

1. To contribute to a time series of data to monitor the relative recruitment of shortfin and longfin eels by co-ordinating, to specific standards, the collection of data on abundance, timing of migration and species composition of elver runs at six primary sites: Wairua, Karāpiro, Matahina, Patea, Arnold, and either the Roxburgh or Waitaki for the elver migrations in 2022–23, 2023–24 and 2024–25.
2. To co-ordinate and analyse data from all secondary dam sites where catch and transfer of eels is undertaken.
3. To describe the length distribution of longfin and shortfin elvers during the 2022–23, 2023–24, and 2024/25 migration seasons at the key locations and to collect otoliths from both species at these sites to determine age composition of elvers present each season.
4. To age otoliths from key sites for all years listed in Specific Objective 3.
5. To investigate the correlation between elver movement and environmental factors such as water temperature and flow.

2. METHODS

A brief overview of the sites monitored and procedures in place at each site are given below. These have been described in previous reports in detail (Martin et al. 2009; Martin et al. 2013; Crow et al. 2020; Crow et al. 2023).

2.1 Study Sites

Detailed information regarding fishing effort, catch weight, and species composition of elver catches was collected at 6 primary sites and 13 secondary sites by trained Earth Science New Zealand (ESNZ) staff and/or accredited personnel (Figure 1). There are four primary sites in the North Island (Sites 1–4) and two primary sites in the South Island (Sites 5 and 6):

1. Wairua/Titoki Dam, Wairua River (Northland).
2. Karāpiro Dam, Waikato River (Waikato).
3. Matahina Dam, Rangitāiki River (Bay of Plenty).
4. Patea Dam, Patea River (Taranaki).
5. Arnold Dam, Arnold River (West Coast).
6. Waitaki Dam, Waitaki River (Canterbury).

In addition, catch data were also obtained from eight secondary sites in the North Island (Sites 1–8) and five secondary sites in the South Island (Sites 9–13) (Figure 1):

1. Waitākere Ranges water supply reservoirs (combined catch from Lower Huia Dam, Lower Nihotupu Dam, and the Waitakere Dam) (Auckland).
2. Hunua Ranges water supply reservoirs (combined catch Cossey's Dam and Hays Creek Dam) (Auckland).
3. Wairere Falls Power Station, Mokau River (Waikato).
4. Mokauiti Power Station, Mokauiti Stream (Waikato).
5. Piripaua Power Station, Wairoa River (Hawke's Bay).
6. Lake Otamangakau compensation flow valve, Upper Whanganui River (Manawatu-Whanganui).
7. Mangorei Power Station, Waiwhakaiho River (Taranaki).
8. Motukawa Power Station, Waitara River (Taranaki).
9. Waihopai Dam, Waihopai River (Marlborough).
10. Branch River Power Scheme, Branch River (Marlborough).
11. Roxburgh Dam, Clutha River (Otago).

12. Mataura Falls, Mataura River (Southland).
13. Mararoa Lake Control Structure, Waiau River (Southland).

Ruahihi Dam, which is located on the Wairoa River, Tauranga was also explored during the present study as a potential new site for monitoring elver catch. This site was discussed as a potential site at the 2022–23 Fisheries New Zealand Eel Working Group (EWG) and additional ageing and catch data were requested for this site, which have been included in the present study. In previous years, recruitment data have also been collected from the sites listed below, but records were either not available, or the sites were no longer being monitored during the present study:

- Wilson's Dam, Waiwarawara Stream.
- Morrinsville Dam, Topehaehae Stream.
- Turitea Dam, Turitea Stream.
- Lake Waikare fish pass (discontinued in 2004).

2.2 Ensuring data collection consistency and accuracy

Standard monitoring protocols[6] and recording forms developed by ESNZ (Boubée et al. 2002, Martin et al. 2007) were supplied to the operators at the six primary sites (Wairua, Karāpiro, Matahina, Piripaua, Arnold, Waitaki) and two secondary sites (Roxburgh and Mararoa). Operators, contractors, and ESNZ personnel not familiar with the standardised monitoring protocols at these sites were given training in data collection, sample collection, species identification, and data recording methods. At the remaining secondary sites, operators recorded catches and observations on daily log sheets throughout the season. Operators and contractors at these secondary sites have all previously received training from ESNZ or have been given written instructions on data collection and recording methods. Monitoring equipment was provided to all primary and secondary sites, where required.

Fortnightly check-in visits were made by ESNZ staff to Matahina and Karāpiro Dams to answer any questions from the operators with regards to the standard monitoring guidelines. Monthly check-in visits and/or calls were completed at the Wairua Dam by a ESNZ contractor, whereas the Arnold Dam was visited daily because all data were collected by ESNZ staff. Waitaki, Roxburgh, and Mararoa were visited annually because the same operators have been working at these sites for a long period of time and were very experienced with the data collection protocols. Patea Dam was not visited by ESNZ staff, but operators at this site were supervised by 4Sight Consulting and overseen by the Taranaki Regional Council in collaboration with ESNZ.

2.3 Elver sampling and otolith collection

To ensure consistency in the size of elvers being monitored, data collectors at any site where catches contained a mix of larger eels and elvers were required to separate the catch by size. The differences in sizes of eels occurred because some of the low altitude sites generally only captured small elvers, but the higher altitude sites contained a variety of elver sizes and larger juvenile eels. The proportions of elvers and juvenile eels present in the catches can also be influenced by the trap designs, which vary with the specific needs and logistical constraints associated with each site. Separation of the elvers and larger eels was accomplished by passing the catch through a 16 mm (stretched mesh) catch bag. Any eels passing through the catch bag were classified as elvers, while any eels retained in the bag were classified as juvenile eels. Generally, this separation corresponded to an approximate weight cut-off of about 20 g (approximately 200 mm in total length depending on the condition of the fish). Information relating to the catch of the juvenile eels is not reported in the present study.

Elver sampling at the six primary sites was carried out each season by completing the following four components:

[6] Standardised reporting requirements and data recording sheets are now included in MPI Special Permits issued for elver trap and transfer operations.

1. Measure and record the total weight of elvers (< 20 g) and juvenile eels (> 20 g) for every transfer. The frequency with which the transfers were completed varied between sites based on catch size. At some North Island sites, transfers were daily, whereas at some sites, a transfer was only made every 3–7 days. The date of transfers was required to be recorded, and this information was then used to calculate fishing time and catch per day for sites that were not cleared daily.
2. Identify and count any bycatch species (e.g., galaxiids, bullies, shrimps).
3. Analyse the species composition, length, and weight[7] of elvers. A random sub-sample of about 100 elvers was taken from the elver transfer tank after all traps had been emptied. All elvers in the transfer tank were mixed thoroughly before the random sample was taken. The mixing ensured that a representative sample was collected to determine the relative proportion of each species and their size distribution. All elvers were anaesthetised before being identified to species level, measured for total length (mm) and individual weight (g), and then returned to the transfer tank. This random sub-sample was completed weekly because species proportions and elver weights change continuously throughout the season. These data were then used in Step 1 above to estimate:
    a. Total weight of longfin and shortfin elvers in the catch weight recorded.
    b. Total number of longfin and shortfin elvers in the daily catch weight.
4. Collect a random sample of 50 elvers (25 of each species) for age analysis. The sample was collected from the same random sub-sample outlined in Step 3 above, with the first 25 elvers of each species being collected for ageing. If there were fewer than 25 of one species present in the sample, Step 3 was repeated up to another three times, and each new sample was checked for more of the missing species. In some instances, obtaining 25 elvers of both species was not possible because one species was not present in sufficient numbers even after completing Step 3 a further three times. Ageing samples were completed four times a season with approximately two weeks between collections at most sites. Elvers were humanely euthanised with an overdose of anaesthetic before being measured for total length and weight and then transferred into an individually labelled and sealed plastic bag. All elvers were then frozen until otoliths could be removed and ageing could be completed.

2.4 Elver ageing

Ageing was completed from a sub-sample of the primary sites each year in consultation with the EWG. The Fisheries New Zealand elver ageing protocol (Walsh et al. 2016) was used to prepare and age all elver otoliths collected during component 4 outlined in Section 2.3. In brief, the crack and burn method (see Jellyman (1974) was used to prepare otoliths for ageing before two otolith readers independently estimated ages of all otoliths. Before completing the age estimates, each reader was required to age 50 otoliths from the Fisheries New Zealand reference collection and achieve an Index of Average Percent Error (IAPE) and coefficient of variation (CV) of 2.5% and 3.4% or less (Walsh et al. 2016), respectively. In the situation where the two readers disagreed on age estimates, the readers conferred before coming to an agreement on age.

2.5 Annual elver catch and recruitment indices

Annual elver catches were converted to normalised catch indices (catch indices hereafter) and recruitment indices, which were then used to visually examine temporal trends in elver abundance for each site and across New Zealand. Catch indices for each site were calculated by transforming annual elver abundance data from each site to the same unitless scale. This catch index was calculated using methods outlined by Durif et al. (2008), where a normalised annual catch index was calculated for each species and site as follows:

[7] For some sites, this component was completed by ESNZ from frozen elver samples. Freezing samples reduces the weight and length of elvers, which can then lead to overestimates of elver numbers in the total daily catch weights. Fresh weights of shortfins and longfins were estimated from thawed weights, with an averaged correction factor of 1.25 × thawed weight for shortfins and 1.17 × thawed weight for longfins (Earth Sciences New Zealand unpublished data).

$$\text{Normalised catch index} = (x - \mu)/\sigma$$

where x = elver catch at a site for a season, μ = mean annual elver catch at a site for all seasons, and σ = standard deviation of annual elver catch at a site for all seasons. Catch indices were calculated for the six key sites and two secondary sites (Piripaua Dam, and Mararoa Lake Control Structure) where regular and accurate catch analysis and species compositions have been done over many seasons.

Normalised catch indices for each species and site were offset by median age to estimate the year of recruitment into freshwater. Catch indices offset by age from each site were then overlayed onto a single plot and used to complete an assessment[8] of national scale trends in elver recruitment (recruitment index hereafter). The recruitment index was more reliable than catch indices when examining temporal trends among all sites because they reduce the influence of age differences between sites. Adjusting for age is important when examining trends among all sites because age composition differs dramatically between sites. For example, most of the elvers captured at Wairua Dam arrived at the site when they were 0+ years old, whereas elvers at Karāpiro Dam can be up to 7 years old. This age difference meant that elvers captured at Karāpiro could have entered freshwater 7 years before the elvers captured at the Wairua site during the same season. This age variability made it difficult to identify strong/weak recruitment years across New Zealand because there was a lag of up to 7 years between when elvers from the same cohort were captured at the Wairua and Karāpiro Dams. Unfortunately, ageing data were not available for all sites, which meant recruitment indices could not be calculated for all sites.

2.6 Modelling the relationships between daily elver catch and environmental conditions

Generalised Additive Mixed Models (GAMMs) in the R package *mgcv* (Wood 2011) were used to examine the relationship between environmental conditions and daily catch of shortfin and longfin elvers at Karāpiro and Patea Dams, sites with the most comprehensive temporal data sets. Seven-day mean flow, seven-day mean water temperature, lunar phase, day length, and total daily rainfall were the environmental covariates selected for the models (Table 1). Selection of these environmental covariates was based on published literature that identified these environmental variables as key drivers of elver and/or glass eel recruitment (Naismith & Knights 1988; Jellyman 2003; Jellyman et al. 2009). Daily flow and daily water temperature were averaged over the seven consecutive days leading up to the day elver traps were cleared because elvers were expected to be responding to the conditions in the river leading up to their capture, not to what was occurring on that single day. Daily elver catch, seven-day mean flow and rainfall were $\log_{10}(x+1)$ transformed to reduce the effects of outliers, i.e., single days with extreme catches or extreme amounts of rain and/or flow. The number of fishing days (number of days since the traps were cleared) were included as a covariate to account for the impact of fishing effort (i.e., number of days the traps were fishing without being cleared), which was $\log_{10}(x+1)$ transformed to reduce the effects of outliers.

The recruitment season (e.g., 2023–24 year) (i.e., period from 1st August to 31st July the following year) was included as a random effect in the model; this identified the recruitment season that the elvers were captured in. Season was included as a random effect in the model because the study was interested in broad level environmental drivers of elver catches within seasons and not drivers of inter-season variability. The large amounts of inter-season variability in elver catches were likely to obscure any environmental relationships within seasons; therefore, treating season as a random effect in the model helped account for inter-season drivers in catches.

A correlation matrix was included in the model to reduce the influence of temporal autocorrelation between daily elver catches. Inspection of an autocovariance analysis revealed that daily elver catches

[8] Trend assessment was completed during a workshop with the EWG (8/12/2025)

were highly autocorrelated for both species. The autocorrelation matrix included in the model was created by nesting the Julian day[9] within season. The autocorrelation matrix used a nested structure because the autocorrelation between successive daily catches was only likely to occur within seasons. The autocorrelation matrix was created using the function *corARMA* from the R package *nlme* (Pinheiro & Bates 2000). We also utilised the *auto.arima* function from the *forecast* package (Hyndman et al. 2023) in R to identify the best performing parameters that define the autoregressive order and the moving average order of the ARMA structure in the *corARMA* function.

A penalised cubic spline process was used to identify the most parsimonious model for each species and site (Hoyle et al. 2024). Initially, a GAMM was fitted for each species and site with an identity link and gaussian error distribution that included all the environmental covariates, a random effect for season, and the correlation matrix. Cubic spline smoothing terms fitted for each covariate (Wood 2017) were then penalised to automatically select the appropriate degrees of freedom and drop terms without the need for a stepwise process, by shrinking effects to 0 (Marra & Wood 2011). Covariates with smoothing terms shrunk to 0 were excluded from the final model. To reduce model overfitting, we set the gamma parameter to 1.4 (Kim & Gu 2004) and final smoothers were fitted using restricted maximum likelihood (REML). Model fits were explored using the standard R diagnostic plots as implemented in the *mgcViz* package (Fasiolo et al. 2018). These include a Q-Q plot with theoretical quantiles based on normalised deviance residuals and a histogram of the residuals. We then prepared a scatter plot of the predicted versus observed values for the entire time series and within each season.

2.7 Sen's slope analysis of annual elver catch and weight

After discussions with the EWG (8/12/2025), there was agreement that a trial analysis should be done on the trends in annual elver catch data (in addition to the visual assessments which were collectively discussed amongst the EWG). We used a Sen's Slope to identify trend direction and magnitude at six sites for longfin and shortfin annual elver catches. Sen's Slope analysis has been used to assess temporal trends for many freshwater resources in New Zealand (Whitehead et al. 2021; White et al. 2023; Stoffels & White 2026). The Sen slope, b, of a series is the median of slopes measured between all pairs of points of a series (there are $n(n-1)/2$ such slopes from a series of n years) (Sen 1968). The intercept, a, of that Sen slope is the median of the residuals, median(y_i-bx_i), calculated from each pair of points in the series. We used only reliable annual catch data outlined in Appendix 1. A Wilcoxon sign rank test was used to test the statistical significance of the Sen's Slopes. We also used Sen's Slopes and the Wilcoxon sign rank test to identify trend direction and significance for mean annual elver catch weights for the Wairua, Karāpiro, Matahina, Patea, Piripaua, Waitaki, Roxburgh, Arnold and Mararoa Dams.

3. RESULTS

3.1 2022–23 elver season summary

Elver migration periods and catches

The elver migration period (i.e., period when elvers were captured in the traps) occurred from October 2022 to March 2023, with catches mostly occurring from the beginning of December 2022 until the middle of March 2023 (Table 2). The migration period was longer in the North Island, with the mean (± standard error (s.e.)) migration period for the North Island and South Island sites being 109 (± 15) and 75 (± 12) days, respectively. Generally, the North Island elver catches started earlier and finished about the same time as South Island sites (Table 2).

The Waitākere Ranges had the first elver catch of the season at the start of October 2022 and Patea Dam had longest migration period of 145 days, followed very closely by the Waitākere Ranges where

[9] Julian day was calculated as the sequential day of the recruitment season from 1 August until 31 July the following year.

the migration lasted 144 days (Table 2). The first elver catches of the season for the remaining sites occurred between November and December, while catches at Waihopai and Whanganui started in January and Matahina catches did not start until February. Catches at Matahina started late and finished early (season only lasted 22 days) because the trap was only operated for part of the season. Waihopai had the same length season as Matahina (22 days), which was the shortest of all sites.

Among all sites in the 2022–23 season, a total of 1.5 million elvers (2053 kg) were captured and transferred to upstream habitats (Table 3). This was a low national total catch, which was caused by Wairua Dam not operating (mean annual capture of 2.9 m elvers) and Matahina Dam (mean annual capture of 1.9 m elvers) only operating for a small part of the season. Karāpiro Dam had the largest elver catch of any site in 2022–23 (565 321 elvers), which was 37 % of the national total. The second highest catch was at Arnold Dam, with 448 054 elvers, followed by Patea Dam with 182 398 elvers. The largest weight of elvers captured was at Arnold Dam (590.06 kg), followed by Karāpiro Dam (500.43 kg).

Catches at most North Island sites in 2022–23 generally started later compared with previous seasons (Figure 2). Catch peaked in mid-to-late January and early February and diminished from mid-February into March across most North Island sites.

In the South Island, the 2022–23 elver run at the Mararoa Lake Control Structure started at a similar time to other seasons, but all other sites generally started earlier (Figure 3). The daily catches at all sites were higher than previous seasons during January–February, which led to Arnold Dam recording its highest longfin catch.

The national longfin elver catch from all sites in 2022–23 was 542 993 (Table 3), which was higher than the median of 472 979 (Table 4). A large proportion (84%) of the total longfin catch came from the South Island sites, with Arnold and Mararoa combined contributing 72% of the national longfin catch.

The national shortfin elver catch from all sites in 2022–23 was 975 382 (Table 3), which is less than one-third of the median (3.14 million) (Table 4). The low shortfin catch was associated with no catches being recorded from Wairua (median catch of 2.9 million) and the Matahina trap only operating for part of the season. Karāpiro made up 51% of the national shortfin catch which was followed by Arnold (18% of the total catch) and Patea Dams (17% of the total catch).

Elver average weights

The elvers of both species collected at the North Island sites in 2022–23 were generally smaller than elvers collected at the South Island sites (Table 5). The smallest average shortfin weight was 0.55 g recorded from Patea Dam, which was followed by Karāpiro Dam, with an average weight of 0.87 g. The largest average shortfin weight was recorded at Roxburgh Dam with an average weight of 2.85 g. Longfin elvers showed a similar pattern to shortfin elvers, with the smaller average weights recorded at Patea (0.76 g) and Karāpiro Dams (1.22 g), and larger elvers from sites further inland (e.g., Waitaki Dam, 11.41 g) (Table 5).

3.2 2023–24 elver season summary

Elver migration periods and catches

The elver migration period occurred from September 2023 to April 2024, with catches mostly occurring from December 2023 until the middle of March 2024 (Table 2). The migration period was longer in the North Island, with the mean (±s.e.) migration period for the North Island and South Island sites being 120 (± 37) and 77 (± 25) days, respectively. Generally, the North Island elver catches started earlier and finished about the same time as South Island sites (Table 2).

The Hunua Dam had the first elver catch of the season at the end of September 2023 and the longest migration period of 180 days, followed by the Ruahihi Dam where the migration lasted 153 days

(Table 2). The first elver catches of the season for the remaining sites occurred between October and December, while catches at the Branch started in January. Catches at Matahina again started late and finished early (season only lasted 59 days) because the trap was only operated for part of the season. Waihopai had the shortest migration season, only recording catches over 31 days.

Catches at most North Island sites in 2023–24 generally started later compared with previous seasons (Figure 2). Catch peaked in mid-to-late January and early February and diminished from mid-February into March across most North Island sites.

In the South Island, the 2023–24 elver run started early compared to all previous seasons (Figure 3). The daily catches at all sites were higher than previous seasons during December–January, which led to Waitaki Dam recording its highest longfin catch.

The national longfin elver catch from all sites in 2023–24 was 652 289 (Table 3), which was higher than the median of 472 979 (Table 4). Karāpiro had the largest longfin catch (35% of the total catch), followed by Arnold (21% of the total catch) and Patea (12% of the total catch) Dams. The remaining sites each recorded less than 13% of the total catch.

The national shortfin elver catch from all sites in 2023–24 was 1.38 million (Table 3), which is 45% of the median (3.1 million) (Table 4). The low shortfin catch was associated with no catches being recorded from Wairua Dam (median catch of 2.9 million) and the Matahina Dam trap only operating for part of the season. Karāpiro Dam made up 65% of the national shortfin catch which was followed by Arnold (18% of the total catch) and Matahina Dams (19% of the total catch). The remaining sites each recorded less than 2% of the total catch.

Elver average weights

Consistent with 2022–23, the 2023–24 season elvers of both species collected at the North Island sites were smaller than elvers collected at the South Island sites (Table 5). The smallest average shortfin weight was 0.45 g recorded from Patea Dam and followed closely by Ruahihi Dam with an average weight of 0.52 g. The largest average shortfin weight was recorded at Mararoa Lake Control Structure with an average weight of 1.89 g. The smallest average longfin elver weight was recorded at Ruahihi Dam (0.68 g) and Patea Dams (0.72 g), and larger elvers from sites further inland (e.g., Waitaki Dam, 11.86 g) (Table 5).

3.3 2024–25 elver season summary

Wairua Dam elver traps began operating again this season, but the traps were only operational for part of the season and were closed in the middle of the season. Matahina traps were also fully operational for the entire season, which was the first time since the 2021–22 season.

Elver migration periods and catches

The elver migration period occurred from October 2024 to April 2025, with catches mostly occurring from December 2024 until the middle of March 2025 (Table 2). The migration period was longer in the North Island, with the mean (± s.e.) migration period for the North Island and South Island sites being 131 (± 23) and 101 (± 13) days, respectively. Generally, the North Island elver catches started earlier and finished about the same time as South Island sites (Table 2).

The Hunua Dam had the first elver catch of the season at the end of October 2024 and the longest migration period of 172 days, followed by the Waitakere Dam where the migration lasted 157 days (Table 2). The first elver catches for the remaining sites occurred between October and December. Catches at Matahina again started late and finished early (season only lasted 59 days) because the trap was only operated for part of the season. The Arnold Dam had the shortest migration season of 81 days, which was followed by Mararoa with a season length of 95 days.

Catches at most North Island sites in 2024–25 generally started earlier compared with previous seasons, particularly for Matahina and Piripaua Dams (Figure 2). Catch peaked at most sites around late December to January, except for the Patea Dam where the highest shortfin catches occurred during February. Catches diminished at all sites from the end of February into March across most North Island sites.

In the South Island, the 2024–25 elver run started early compared to all previous seasons (Figure 3) except for Roxburgh where catches started slightly later. The daily catches at all sites were higher than most previous seasons during December–January, especially for shortfins at Roxburgh and Waitaki Dam where both sites recorded their highest shortfin catches by a large margin.

The national longfin elver catch from all sites in 2024–25 was 967 902 (Table 3), which was more than double the median of 472 979 (Table 4). The high national longfin catch was associated with the Matahina site operating again for the full season and recording one of its largest longfin catches (Figure 2). Matahina and Karāpiro Dams had the two largest catches of longfins, recording 34% and 21 % of the total catch respectively. The remaining sites each recorded less than 17% of the total catch.

The national shortfin elver catch from all sites in 2024–24 was 3.6 million (Table 3), which was above the median (3.1 million) (Table 4). The high national shortfin catch was associated with the Matahina site operating again for the full season and recording a large shortfin catch (Figure 2). Matahina Dam made up 44 % of the national shortfin catch, followed by Karāpiro Dam with 22% of the national shortfin catch. The remaining sites each recorded less than 6% of the total catch.

Elver average weights

Consistent with the two previous seasons, elvers of both species collected at the North Island sites were smaller than elvers collected at the South Island sites (Table 5). The smallest average shortfin weight was 0.46 g recorded from Patea and Ruahihi Dams and followed closely by Wairua Dam (0.58 g). The largest average shortfin weight of 2.39 g was recorded at Mararoa Lake Control Structure. The smallest average longfin elver weight was recorded at Wairua Dam (0.37 g), followed by Patea Dam (0.39 g). Largest average longfin weight was recorded at Waitaki Dam (6.49 g) (Table 5).

3.4 Elver age compositions

Karāpiro Dam

There was a large overlap in shortfin length between consecutive age classes for some years over the 10 years of ageing (2015–16 to 2024–25) (Figure 4). In 2018–19, there was a large amount of overlap in lengths of all age classes, with the median length of age 4 fish being lower than age 3 fish. Similarly, in the 2016–17 and 2024–25 seasons, the 0+ shortfins had a higher median length than the age 1 shortfins (Figure 4). The latest 2024–25 shortfin 0+ cohort was the largest observed since 2015–16.

The proportion at age of shortfin in the catch was inconsistent across seasons (Figure 5). Progression of 0+ cohorts (0+) could be inferred over subsequent seasons, assuming that the 0+ age cohort was not fully recruited to the traps, and that some natural mortality was operating to reduce numbers at each subsequent year. Across all seasons, the dominant shortfin age class at Karāpiro Dam was age 1 (40.1%) followed by age 2 (36.6%) with all other age classes making up less than 11% of the total catch (Figure 5). Shortfin median age was 2 across all samples (Table 6).

As with shortfins, there was a large overlap in longfin lengths between consecutive age classes in some years (Figure 6). For example, in the 2020–21 season the median length of age 2 and age 3 longfins was almost identical. The smallest overlap between age classes was between 0+ fish and 1-year-old fish (Figure 6). The proportion of longfin age classes in the catch was inconsistent across seasons, but individual cohort progression could be inferred across seasons (Figure 7). The latest

2024–25 longfin 0+ cohort was the largest observed over the last 10 years. Longfin median age was 2 across all samples (Table 6).

Patea Dam

Shortfin lengths increased with age with overlapping length at age in some years (Figure 8). The length distributions of age 0+ and 1+ elvers were very similar in the 2019–20 season and this overlap was also evident again one season later when the elvers were ages 1 and 2, indicating that the similar length distributions of these two cohorts was likely to be real. Similarly, age 3 shortfins in 2023–24 had a smaller median length than age 2 shortfins. There was strong shortfin cohorts over the last two seasons.

The proportion of shortfin age classes in the catch varied markedly between years, and more than for Karāpiro ages (Figure 9). Strong 0+ year classes were apparent in 2016–17 and 2020–21. As for Karāpiro, progression of the 0+ cohorts could be inferred over subsequent seasons, assuming that the 0+ age cohort was not fully recruited to the traps, and that some natural mortality was operating to reduce numbers at each subsequent year. Shortfin median age was 1 across all samples (Table 6).

Longfin length at age was fairly consistent between seasons with overlapping length at age in some years (Figure 10). Across all years, this site was dominated by 0+ longfins (44.7%), and cohort progression could be inferred (Figure 11). Longfin median age was 1 across all samples (Table 6).

Matahina Dam

Few 0+ samples collected for both species resulted in little information being available for this age class in most seasons and there was poor differentiation in growth of individual cohorts seen through the large length overlap between ages for shortfins (Figure 12) and fairly consistent age structures between seasons (Figure 13). Longfins showed overlap in lengths between age (Figure 14) and age structure was less consistent between seasons compared with shortfins (Figure 15). Shortfin and longfin median age across all samples was 2 and 3 respectively (Table 6).

Arnold Dam

Both species at this site showed the largest length overlap between successive age classes of all the sites (Figure 16, Figure 17). Over all seasons, the shortfin catch was dominated by age 2 shortfins (37.5%), but this was followed closely by the proportion of age 3 fish (32.6%) (Figure 18). Longfin catches were dominated by age 3 fish (31.9%) (Figure 19). Shortfin and longfin median age across all samples was 2 and 4 respectively (Table 6).

Waitaki Dam

Both species were aged from this site for the first time from the 2021–22 season, and both species showed a large overlap in length between age classes (Figure 20, Figure 21). Waitaki shortfins were dominated by age 3 fish (42.7%) followed by age 4 (28%) and age 5 (16%) (Figure 22). Longfins were older than shortfins, with the catch being dominated by age 5 (45.3%) followed by age 4 (28%) and age 6 (17.3%) (Figure 23). Shortfin and longfin median age across all samples was 3 and 5 respectively (Table 6).

Mararoa Lake Control Structure

Both species were aged from this site for the first time from the 2022–23 season, and both species showed a large overlap in length between age classes (Figure 24, Figure 25). Shortfin catch was dominated by age 3 (45.6%) and age 2 (32.8%) with the other age classes making up less than 12% of the total catch (Figure 26). Longfin catch had a wide age range from 1–13 years but was dominated by age 3 (44%) and 4 (32%) with the remaining age classes making up less than 11% (Figure 27). Shortfin and longfin median age was 3 across all samples (Table 6).

Ruahihi Dam
Ruahihi Dam elvers were aged from the 2023–24 season, the first season that elver catch was available for this site. As with other sites, longfins and shortfins showed large overlaps in lengths between age classes (Figure 28, Figure 29). Shortfin catch was dominated by 0+ fish (71.9%) followed by age 1 (21.9%) and with other age classes making up less than 3.1% (Figure 30). Longfin catch was also dominated by 0+ fish, with age 1 and age 2 fish making up 30% and 10%, respectively (Figure 31).

3.5 Trends in elver catches for each site

Elver normalised catch indices for both species were highly variable within sites among seasons but relatively stable at most North Island sites, except for Matahina, Patea and Piripaua Dams (Figure 32, Table 7). For example, at Matahina Dam in the 2016–17 season, only 369 600 shortfin elvers were captured, but in the 2015–16 season, 6.4 million shortfin elvers were captured (Table 4). Similarly, 5900 longfins were captured in 2016–17 at Matahina but 771 100 longfin elvers were captured the previous season. At Matahina Dam shortfin elver catch has been increasing at about [10] 55 000 elvers each season while at the Patea Dam shortfin elver catch has been declining at about 11 500 elvers each season (Table 7). At Piripaua Dam, shortfin and longfin elvers have been increasing at about 2 500 and 450 elvers each season respectively.

In the South Island, catch indices have been increasing over the last ten years, although variable, for both species at Arnold Dam (Figure 33, Table 7). At Arnold Dam longfin and shortfin elver catches have been increasing by about 10 000 and 9000 elvers each season, respectively (Table 7). At Waitaki Dam, longfin elver catch has remained stable (post trap update) while shortfin elver catch has been increasing at about 2000 each season. Mararoa Dam showed a similar pattern to Waitaki Dam, with stable longfin catch and increasing shortfin catch at about 3000 elvers each season. Catches were stable for Roxburgh Dam, but with only four seasons of data available this result will be unreliable.

3.6 Trends in recruitment indices

Recruitment indices (adjusted for age) for all sites and all seasons showed that shortfin and longfin recruitment was variable within and between sites but overall has remained stable across the entire time series with a large degree of interannual variability (Figure 34). This indicates that recruitment of elvers into New Zealand, despite the high interannual variability, has remained stable over the last 30 years, i.e., within the time frame of the datasets available.

3.7 Predictors of daily elver catches

Karāpiro Dam
The final shortfin GAMM explained 71.0 % of the variability in observed daily catch abundance of shortfin elvers. The model fitted the data well, with error distributions showing small deviations in Q-Q plots and residual histograms being approximately normally distributed (Figure 35). The observed and predicted values for shortfin elver catches across all years showed that the relationship was very close to 1:1 (i.e., perfectly predicted catches), but there was a lot of variability (Figure 36).

The most informative environmental covariate in the shortfin model was days fished, followed by seven-day mean water temperature, lunar phase, day length, rainfall, and seven-day mean flow (Table 8). All the environmental covariates were retained in the final shortfin model because they had p-values of ≤ 0.002. When days fished (log transformed) ranged from 0.5–0.7, daily shortfin elver catch increased, but catches decreased below and above this range (Figure 37). Shortfin daily elver catch steadily increased with seven-day mean water temperature (Figure 37). Daily shortfin elver catches decreased around the waxing and waning phases of the full moon (lunar phase stage 3), but daily

[10] Rates of change are taken from the Sen's Slope analysis (Table 7)

catches increased leading up to the new moon phase (lunar phase 6) and after the new moon (lunar phase 0) when the sky was darkest (Figure 37). Elver catch was variable during the shortest days but increased steadily once day length was above 12 hours. Elver catch increased with rainfall and seven-day mean flow, but there was a large amount of uncertainty associated with these covariates.

The final longfin GAMM explained 75.0% of the variability in observed daily catch abundance of longfin elvers. The model fitted the data reasonably well, with the residual histograms being approximately normally distributed, but the error distributions showed some deviations in the Q-Q plots that indicated that the predictions were slightly underestimated in the lower and higher ranges of the data and slightly overestimated in the mid-range of the data (Figure 35). The observed and predicted values for longfin elver catch across all years indicated that the relationship was close to 1:1 (i.e., perfectly predicted catches) (Figure 38), but there was considerably more variability than in the shortfin model, including zero catches that the model struggled to predict.

The most informative environmental covariate in the longfin model was day length, followed by days fished, seven-day mean water temperature, and rainfall (Table 8). Lunar phase and seven-day mean flow had p-values >0.2 and were not included in the final longfin model. Longfin daily elver catch declined slightly as day length increased up to 12 hours, but then daily longfin elver catches steadily increased with increasing day length from around 13 hours onwards (Figure 39). When days fished (log transformed) ranged from 0.3 to 0.6, longfin daily elver catch increased, but catches decreased above this range (Figure 39). Longfin daily elver catch steadily increased with seven-day mean water temperature (Figure 39). Longfin daily elver catch increased with seven-day mean flow (log transformed), but this effect was associated with large amounts of uncertainty (Figure 39).

Patea Dam

The final shortfin GAMM explained 88.2 % of the variability in observed daily catch abundance of shortfin elvers. The model fitted the data well, with error distributions showing small deviations in Q-Q plots and residual histograms being approximately normally distributed (Figure 40). The observed and predicted values for shortfin elver catches across all years showed that the relationship was very close to 1:1 (Figure 41). There were fewer observations compared to Karāpiro Dam catch data because the environmental data only covered 11 seasons (2014–15 season onwards) and the catch was only recorded approximately every 7 days (i.e., traps were only cleared weekly on average at Patea Dam compared to being cleared daily at Karāpiro Dam).

The most informative environmental covariate in the shortfin model was seven-day mean water temperature followed by day length, days fished and seven-day mean flow (Table 8). Lunar phase and rainfall were not included in the final model because they did not explain significant amounts of variation. Shortfin daily elver catch steadily increased with seven-day mean water temperature but plateaued from around 21 °C onwards (Figure 42). The shortest days had a positive effect on catch (11 hours) with catch declining through to values of 12 hours, then catches progressively increased with daylength (Figure 42). Catches increased with days fished (log transformed) up to values of 0.6 and then declined, but there was a large amount of uncertainty across all these values (95% confidence interval spanned 0 across the entire range of data) (Figure 42). Seven-day mean flow (log transformed) had no effect on catches up to values of around 4.25 and then catches increased with increasing flow (Figure 42).

The final longfin GAMM explained 78.6% of the variability in observed daily catch abundance of longfin elvers. The model fitted the data reasonably well, with error distributions only showing deviations in Q-Q plots and residual histograms showing some departure from the normal distribution (Figure 40). The observed and predicted values for longfin elver catch across all years indicated that the relationship was close to 1:1 (Figure 43), but consistent with the Karāpiro results, the Patea longfin model showed more variability than the Patea shortfin model and struggled to predict zero catches.

The most informative environmental covariate in the longfin model was seven-day mean water temperature followed by mean flow (no other co-variates were statistically significant and they were therefore excluded from the final model) (Table 8). Longfin daily elver catch steadily increased with seven-day mean water temperature and seven-day mean flow (Figure 44).

3.8 Spatial and temporal variations in elver weight

North Island sites had smaller elvers of both species compared with South Island sites (Table 5). Shortfin elvers in the South Island were roughly twice the weight of North Island elvers, with the mean (± s.e.) weight of North and South Island shortfins being 0.88 (±0.08) g and 1.51 (±0.02) g respectively (Table 5). The difference in size between islands was more pronounced for longfins. The longfin elver weight was nearly threefold larger in the South Island, with the mean (±s.e.) longfin weight of North and South Island elvers being 1.30 g (±0.20) and 3.68 g (±0.05) respectively. The size difference between the two islands was most likely to be associated with older (and hence larger) fish being present in the South Island.

In the North Island, the average weight of longfin and shortfin elvers has declined at Karāpiro Dam at an estimated rate[11] of 0.040 g and 0.008 g each season respectively (Figure 45, Table 9). At Matahina Dam, shortfin weight has remained stable, but longfin weight has declined at an estimated rate of 0.022 g each season. At Patea Dam longfin weight has remained stable, but shortfin weight has declined at an estimated rate of 0.004 g each season. At Piripaua Dam, shortfin weight has remained stable but longfin elver weight has declined at an estimated rate of 0.025 g each season.

In the South Island, at Waitaki Dam the longfin elver weight increased at an estimate rate of 0.298 g each season while shortfin elver weight was declining at an estimated rate of 0.047 g each season (Figure 45, Table 9). At the Arnold Dam shortfin weight has remained stable while longfin weight has declined at an estimated rate of 0.015 g each season.

4. DISCUSSION

4.1 Migration timing

The annual elver migration season in New Zealand runs from late spring until early autumn, with migration periods in the North Island being roughly twice the length of those in the South Island. Across the last three seasons, the mean (± s.e) migration periods for the North Island and South Island were 121.6 (± 6.2) and 84.7 (± 9.0) days, respectively. The difference in migration period appears to be predominantly associated with the start of the season, with North Island elver catches starting earlier but finishing about the same time as catches at the South Island. This difference is likely associated with cooler water temperatures in the South Island. Martin et al. (2013) found that recruitment periods at most sites appeared to consistently start and finish at around 17–19 °C. The GAMM results in the present study are consistent with this observation, suggesting that temperatures above 21°C are associated with higher catches of longfin and shortfin elvers.

4.2 Elver catch summary

National elver catches over the last three seasons (2022–23 to 2024–25) generally contained low–moderate catches of shortfins, but higher catches of longfins at the same sites compared to historical data. Average national shortfin catch over the last three seasons was 2.6 million which was lower than the median national catch of 3.1 million. This lower catch, however, was caused by the Wairua Dam (median longfin catch of 11 700 longfins and 3.0 m shortfins) not operating for two seasons and only partially operating in the third season. Similarly, Matahina Dam (median annual catch of 124 000 longfins and 1.3 m shortfins) was operating ineffectively for two seasons while a new trap was being designed and installed. If both these sites had been operating effectively the average national shortfin elver catch would have been much higher (potentially around 6–7 million if both sites recorded close

[11] Rates of change are taken from the Sen's Slope analysis (Table 9)

to their median annual shortfin catches each season). The east coast sites in the South Island (Waitaki and Roxburgh Dams) both experienced very large shortfin catches in the 2024–25 season, 40-fold higher than their historical mean shortfin catches, suggesting an unusually strong recruitment event occurred recently at these two sites. Unfortunately, no concurrent age data are available at these sites to confirm this.

Average national longfin catch over the last three seasons was 721 061 which was higher than the 472 979 recorded for the national median. The national longfin elver catch would have been even higher if the Matahina Dam site had been operating effectively over the last three seasons. The national longfin catch in the present study was very close to the national median of 751 982 recorded from 2019–19 to 2021–22 (Crow et al. 2023). These combined results suggest that the last seven seasons have generally contained average catches of shortfins, but higher than average catches of longfins across New Zealand.

4.3 Elver age composition

Age structure differed between sites and within sites during the 2022–23 to 2024–25 seasons. The variability in age structure at all sites suggests that ongoing ageing would be required to accurately back-calculate year class strength for individual years. Ageing data was used to estimate year of entry to freshwater and recruitment indices, and the level of variability suggests that averaged age structure estimates will be inaccurate for any single year. Both Burnet (1969) and Jellyman (1974) have previously outlined large variations in length at age relationships between rivers and seasons, which they attribute to food type and availability, population density, and environmental factors. There were indications that the strong cohorts could be partially tracked through time at multiple sites for both species, which suggests that the ageing estimates were accurate.

Ruahihi Dam elvers were aged from the 2023–24 season and the high proportion of 0+ elvers make this a promising site to use for monitoring recruitment in the future. Shortfin catch was dominated by 0+ fish (71.9%) followed by age 1 (21.9%), and the remaining age classes made up less than 3.1%. Longfin catch was also dominated by 0+ fish (60%), with age 1 and age 2 fish making up 30% and 10% respectively. Although this site only contained small catches of both species it will be an informative site to use for monitoring recruitment and should be included within the secondary site list in future analyses.

4.4 Catch index and abundance trends at individual sites

Elver normalised catch indices in New Zealand were highly variable within sites between seasons (years), which makes assessing trends difficult. A good example of this variability can be seen at Matahina Dam, where catch differed by a magnitude of up to 54-fold over three seasons (see Figure 32). Assessment of shortfin catch index trends within each site showed one decreasing but variable trend (Patea Dam), five increasing but variable trends (Mararoa Lake Control Structure, Arnold, Waitaki, Matahina and Piripaua Dams), and the remaining three sites were stable but highly variable (Table 10). Longfin catch index trends showed two increasing but variable trends (Piripaua and Waitaki Dams), while catches at the remaining seven sites were stable but variable. All trends were weak and were generally overshadowed by the catch variability between seasons. The declining trend in shortfin catch at Patea Dam was also reported in the two previous elver recruitment reports (Crow et al. 2020; Crow et al. 2023) (Table 10). Shortfin catch at Patea Dam has been consistently below the mean annual shortfin catch after the 2009–10 season, except for the 2015–16 season and the latest 2024–25 season.

All shortfin trends identified in the present study were consistent with those identified in the previous elver recruitment reports (Crow et al. 2020; Crow et al. 2023) (Table 10). Longfin trends have changed at three sites compared to the previous report of Crow et al. (2023). The longfin trends at Matahina and Piripaua Dams are now increasing, but trends at both sites were reported as being stable in the previous two reports. Waitaki Dam longfin catch is now stable, which is consistent with Crow et al. (2020) but differs from the increasing trend reported in Crow et al. (2023). It is unlikely that these different trends were associated with the new Sen's slope analysis that was used for the first time in the present report as these trends were in agreement with those assigned by the Eel Working Group (8/12/2025). This suggests that the Sen's slope will be an informative and objective tool to assess elver catch trends in future reports.

4.5 Trends in recruitment indices

Recruitment indices (adjusting the catch index by the median age of elvers) among all sites and all seasons suggest that shortfin and longfin recruitment into rivers is variable within, and between sites, but has remained stable with a large degree of interannual variability. This was consistent with the findings in the previous elver recruitment reports (Martin & Bowman 2016, Crow et al. 2020, Crow et al 2023), suggesting that recruitment of elvers into New Zealand has remained stable within the time frames of the available datasets.

Converting catch to recruitment indices reduces the influence of age differences between sites by estimating year of entry into freshwater, allowing catches from all sites to be overlaid and examined together to see if there are any consistent increases or decreases in catches across sites. At present, the recruitment indices are calculated by offsetting catch indices by the median age for the site. Although this is likely to correctly estimate year of entry for the majority of the elvers, it will incorrectly estimate year of entry for some of the younger and older elvers. Future versions of the recruitment index could use the average age distribution at a site to calculate year of entry rather than simply using the median and may be a more accurate method to estimate age of entry. Age data within each season could also be used where available, but these data are only available for recent years and will not be collected each year for all sites (except for Karāpiro Dam). This approach would help account for the age differences between seasons as much as possible, while recognising that no individual age data are available for historical catches.

4.6 Relationships between elver catches and environmental data

GAMM models of longfin and shortfin elver catch at Karāpiro Dam explained 71.0% and 75.0% of the variation in daily catch abundance, respectively. GAMM models explained larger amounts of variation in daily elver catch abundance at Patea Dam, with the shortfin and longfin models explaining 88.2% and 78.6% respectively. Compared with the previous GAMM analysis (Crow et al. 2023), the Karāpiro Dam models in the present study showed similar performance, but the new Patea Dam models performed unexpectedly well. The higher performance of the Patea Dam models compared to Karāpiro Dam was surprising given that the dataset is shorter (only 11 seasons compared to 29 from Karāpiro) and the catches are recorded less often at Patea Dam with fewer observations available for the analysis. It may be that daily catch is easier to predict for younger elvers because both species have a median age of 1 year old at Patea Dam while both species have a median age of 2 years old at Karāpiro Dam. This could be further explored, by running the GAMM model for the Wairua Dam where 99% of the catch are 0+ fish. It may not be possible to complete this analysis for longfins at this site, however, because they are uncommon in the catch.

Water temperature was the only covariate selected in all models, which is consistent with findings in other studies. Moreover, water temperature was the most influential covariate for both species models from Patea Dam and the second most influential covariate for both species models from Karāpiro Dam. Positive correlations between elver catches and temperature have previously been observed at Karāpiro Dam (Crow et al. 2020; Crow et al. 2023), but the present study extends this observation to Patea Dam. Water temperature has also been found to be associated with glass eel migrations in New Zealand (August & Hicks 2007). Glass eels migrating upstream in New Zealand showed a clear preference for water temperatures between 12 and 20 °C, with an optimum of 16.5 °C (August & Hicks 2007). Similarly, glass eel and elver catches of the American eel (*A. rostrata*) have been shown to positively correlate with temperature (Martin 1995), which is consistent with results for both longfin and shortfin elver catches observed in the present study. Glass eel catches in New Zealand have been shown to plateau at around 22 °C (August & Hicks 2007), which was observed in the partial dependence plot for shortfin elvers at Patea Dam (see Figure 42). If elver catches follow a similar response to temperature as glass eels, then it is possible that future global warming scenarios may create a plateau in the catches during the warmest periods of the season and possibly longer migration periods. This may mean that median age at dam sites declines, which would need to be accounted for when adjusting for median age.

Inspection of the partial effects for moon phase in the final Karāpiro shortfin model suggests that new moon phase had a positive effect on catches, whereas full moon had a negative effect on catches (see Figure 37). Moon phase was the third strongest environmental covariate related to shortfin catches, but it was not important for predicting longfin catches at Karāpiro or either species at Patea Dam (see Table 8). Lunar phase was also linked to recruitment of glass eels by Jellyman & Lambert (2003), who found that peak recruitment was during times of the new-moon spring tides because these periods were associated with very dark skies and large tides. The larger tides passively transport glass eels and the association with new moon phase is thought to be caused by glass eels being sensitive to light (Jellyman 1977; Jellyman 2003; Jellyman 2012). The present study is consistent with observations of glass eels indicating that shortfin elver catches increase during the new moon associated with dark night skies (and decrease during the full moon).

Inspection of the partial effects for daylength in the models of both sites and species suggests that the longest days generally had larger catches of both species (see Figure 37, Figure 39, Figure 42, Figure 44) It has been suggested that once glass eels are beyond the tidal influence, upstream migration is delayed as glass eels adapt to freshwater and undergo some physiological transformations into elvers, after which the upstream migration recommences (Jellyman 1979; Ciccotti et al. 1995). Elvers have been suggested to be less inhibited by daylight than glass eels (Jellyman 1979; Sorensen 1986), because elver migrations have often been observed during the day (Jellyman 1979; Gascuel 1986). The present study partially supports this given that elver catches were higher during the longest days, but we cannot be sure if the catches occurred during the day or during the night, given traps are only cleared every 24 hours. A change in sampling procedure to clear the traps in both the morning and at night would be needed to determine this with any degree of certainty.

Seven-day mean flow was also an important covariate associated with catches of both species at Patea Dam but appears less important for catches of either species at Karāpiro Dam. Although seven-day mean flow was significantly associated with shortfin catch only at Karāpiro Dam, this covariate had the weakest association with shortfin catch. For the three models that included seven-day mean flow, all partial dependence plots showed increasing catches with increasing flows. These results suggest that higher flows had a positive effect on catches of both species at Patea Dam and for shortfins at Karāpiro Dam, which contrasts with the patterns seen for glass eel recruitment of both these species. Glass eel catches of *A. rostrata* were found to increase with lower river flows (Martin 1995), while glass eel catches of both species in New Zealand have been shown to decline at higher flows (Jellyman et al. 2009). This is because of behavioural and/or ecological differences associated with the two life stages. Glass eels rely on tidal transport (Jellyman & Lambert 2003), which is likely to be higher and more effective during lower flows. In contrast, tidal transport processes are not available to elvers once they move into riverine habitats and outside the tidal zone.

5. POTENTIAL RESEARCH

The Karāpiro and Patea GAMM models could be expanded and applied to data from other sites. The current analysis combined all age classes, but disaggregating catch into age classes would allow more options for improving model performance as different factors may be important for specific age (and size) classes. The high proportion of zeros in the longfin catches also suggests that delta or Poisson-link models could improve performance of longfin models (Thorson 2017).

Although no studies have been found that link New Zealand eel dispersal to the Southern Oscillation Index (SOI) or Interdecadal Pacific Oscillation (IPO), links to similar climate indices have been found for *A. japonica* (Japanese eel). *Anguilla japonica* larvae disperse on the North Equatorial Current (NEC), and the circulation patterns of the NEC have been found to be associated with a climate index known as the Philippines-Taiwan Oscillation (PTO). The PTO represents oscillations in oceanic thermoclines and currents (Chang & Oey 2012) and has subsequently been shown to be important for dispersal patterns of *A. japonica* recruitment (Chang et al. 2015). IPO and SOI should be integrated into the GAMM analysis in the future as their incorporation may generate more robust results because they would potentially standardise for the number of glass eels entering the system

6. FULFILMENT OF BROADER OUTCOMES

The recruitment programme has delivered on multiple broader outcomes across New Zealand. We have supported the development of research capacity and capability within our Māori research partners, community groups and regional businesses (e.g., hydro companies). Our Māori research partners have developed new skills in data recording, randomised sub-sampling processes, freshwater fish species identification and catch processing techniques, which are transferrable skills that can be applied throughout the broader freshwater research sector operating in New Zealand. During this capacity building we have also supported mana whenua (in collaboration with hydro companies) into roles where they are leading the elver trap and transfers programmes within their rohe (tribal areas). As a result of this transition, mana whenua are leading the elver trap and transfer programmes (and associated research projects) and completing all the data requirements for the present study at four of the six primary sites.

We have also provided three annual research partnership updates on the national elver catches (see Appendix 2 for example from the 2024–25 season), which are designed to keep our Māori research partners, hydro-electric companies, freshwater researchers, Government agencies and community groups abreast of the latest findings in the elver recruitment programme. This has allowed our broad partnerships to utilise the most up-to-date elver catch information to inform their environmental decision-making processes relating to freshwater eels.

7. ACKNOWLEDGEMENTS

Compilation of the elver trap and transfer data from operations being undertaken nationwide would not have been possible without the assistance of numerous passionate people. We are grateful to the many rūnanga, iwi, and hapū members who execute elver transfers across Aotearoa and to those who gave their support and blessing to ensure that the present programme was executed successfully.

We are thankful to the following team that supported the elver data collection, logistics and elver transfers at Karāpiro: Erina Watene, Aiden Riki-Te Kanawa, Inia Murch, Tetua Tumahai, Casey Iorangi and Murray Motutere, Waikato and Waipā River Iwi Tuna Collective, Leah Wyatt and other Mercury staff that assisted with the running of the elver trap at Karāpiro Dam. Harry Tuhiwai (Te Parawhau ki Korokota) and Shane Hewson with support of Northpower provided elver catch records from the Wairua Power Station. Ian Tarei and the Omataroa Kaitiaki team, together with Carwyn Kerrison, ensured all the elver data collection and transfers were completed in collaboration with ESNZ and Contact Energy at the Rangitaiki/Matahina Dam. We thank Contact Energy staff and SLR Consulting for elver records from Patea Dam and other Taranaki stations. Mika Turipa and Waylon Waiwai with support of Genesis provided elver catch records and species composition from the Piripaua Power Station (Waikaremoana Power Scheme). Anne Lemieux, Ollies Barnsdall, Andrew McCarthy (Mokau Ki Runga) and KCE (now Contact Energy) provided elver catch and species composition records from the Wairere Falls and Mokauiti power stations. Contact Energy supplied data in collaboration with ESNZ for the Arnold Dam. Whiria te Waitaki on behalf of Ngā Waitaki Rūnaka (Te Rūnanga o Moeraki / Te Rūnanga o Waihao Te Rūnanga o Arowhenua) and Meridian Energy collected and supplied the elver catch records from the Waitaki Dam. Contact Energy, Jenny Bullock and Caleb Sjardin supplied elver data for the Roxburgh Dam. We thank Saird & Rhys Ferguson, Chris Thomson, Jason Holland, Gail Thompson and whānau from Te Rūnanga o Awarua for the Mararoa Lake Control Structure records. We thank Te Rūnanga o Hokonui for the Mataura

Falls records, John Morgan, Lena Bell (Ngāti-Hikairo-ki Tongariro), and Genesis for the Upper Whanganui records. Contact Energy and Richard Allibone for the Waihopai records. Watercare for the Waitākere Ranges and Hunua catchment records. We thank William Ihaka Kaiawha Tai (Willie Tai), Karamaene Kaiawha and Contact Energy for elvers catch records and species composition records from the Ruahihi Power Station (Kaimai Power Scheme). A special thanks to Dr. Jacques Boubée, who continues to collaborate with ESNZ, electricity generators, iwi, and eel fishers to ensure the ongoing success of the elver trap and transfer programme. Following retirement from ESNZ in 2016, Jacques continues to make himself available to support the elver transfer programme in any capacity that he is required, which we greatly appreciate.

All operators and contractors working at monitoring sites that supplied data to the present programme were required to comply with the Health and Safety guidelines of the hydro-power company and/or ESNZ Health and Safety guidelines before any data collection could be completed. We acknowledge the assistance of the power companies with the co-development of specific Health and Safety guidelines and plans for each of the sites.

We acknowledge the assistance and enthusiasm of ESNZ staff, notably Paul Lambert, Mike O'Driscoll, and Julie Proud. Mike Beentjes and Darren Parsons reviewed the draft report and made numerous useful suggestions that have improved the final report. This work was carried out by ESNZ under contract to Fisheries New Zealand (Project EEL2022-01). Project funding from Fisheries New Zealand is managed by Dr. Marc Griffiths and we thank him for his continued support with the project direction, research content, statistical analyses, and support with the logistical management of this complex research programme. We also thank Marianne Vignaux for her formatting and editorial support which improved the clarity of the present report.

8. REFERENCES

Arai, T. (2016). Biology and Ecology of Anguillid eels. Boca Raton, CRC Press.

Arai, T. (2020). Ecology and evolution of migration in the freshwater eels of the genus *Anguilla* Schrank, 1798. Heliyon 6:e05176:

August, S.M.; Hicks, B.J. (2007). Water temperature and upstream migration of glass eels in New Zealand: implications of climate change. *Journal of Fish Biology 74*: 195–205.

Beentjes, M.P. (2008). Monitoring commercial eel fisheries in 2005–06 and 2006–07. *New Zealand Fisheries Assessment Report 2008/64*. 67 p.

Beentjes, M.P. (2020). Catch per unit effort (CPUE) analyses and characterisation of the North Island commercial freshwater eel fishery,1990–91 to 2017–18. *New Zealand Fisheries Assessment Report 2020/24.* 58 p.

Beentjes, M.P. (2021). Catch per unit effort (CPUE) analyses and characterisation of the South Island commercial freshwater eelfishery, 1990–91 to 2018–19. *New Zealand Fisheries Assessment Report 2021/50*. 193 p.

Beentjes, M.P. (2022). Monitoring commercial eel fisheries: 2018–19 to 2020–21. *New Zealand Fisheries Assessment Report 2022/58*. 97 p.

Beentjes, M.P. (2025). Catch per unit effort (CPUE) analyses and characterisation of the South Island commercial freshwater eel fishery, 1990–91 to 2022–23. *New Zealand Fisheries Assessment Report 2025/25.* 174 p.

Beentjes, M.P.; Dunn, A. (2010). CPUE analyses of the North Island commercial freshwater eel fishery. 1990–91 to 2006–07. *New Zealand Fisheries Assessment Report 2010/05.* 100 p.

Beentjes, M.P.; Dunn, A. (2014). Catch per unit effort (CPUE) analyses and characterisation of Te Waihora commercial freshwater eel fishery, 1990–91 to 2011–12. *New Zealand Fisheries Assessment Report 2014/17*. 50 p.

Beentjes, M.P.; Shankar, U. (2025). Estimates of the total wetted-area commercially fished for eels inthe South Island (2020 to 2023), and the proportion of longfin habitat fished. *New Zealand FisheriesAssessment Report 2025/26.* 26 p.

Beentjes, M.P.; Sykes, J.; Crow, S.K. (2016). GIS mapping of the longfin eel commercial fishery throughout New Zealand, and estimates of longfin habitat and proportion fished. *New Zealand Fisheries Assessment Report 2016/32*. 53 p.

Bertin, L. (1956). Eels, a biological study. London, Cleaver-Hume Press Ltd.

Boubée, J.; Williams, E.; Beentjes, M.; Bowman, E. (2002). Recruitment of longfinned eels 2001–2002. Final Research Report for Ministry of Fisheries Research Project EEL2000/01. 53 p.

Burnet, A.M.R. (1969). The Growth of New Zealand Freshwater Eels in Three Canterbury Streams. *Australian Journal of Marine and Freshwater Research 3*: 376–384.

Chang, Y.L.; Oey, L.Y. (2012). The Philippines–Taiwan Oscillation: Monsoon like Interannual Oscillation of the Subtropical–Tropical Western North Pacific Wind System and Its Impact on the Ocean. *Journal of Climate 25*: 1597–1618.

Chang, Y.L.; Sheng, J.; Ohashi, K.; Begur-Pon, M.; Miyazawa, Y. (2015). Impacts of the Interannual Ocean Circulation variability on Japanese eel larval migration in the western North Pacific Ocean. *PLoS ONE 10*: e0144423.

Ciccotti. E.; Ricci, T.; Scardi, M.; Fresi, E.; Cataudella, S. (1995). Intraseasonal characterization of glass eel migration in the River Tiber: space and time dynamics. *Journal of Fish Biology 47*: 248–255.

Crook, V.; Nakamura, M. (2013). Glass eels: assessing supply chain andmarket impacts of a CITES listing on *Anguilla* species. *Traffic Bulletin 25*: 24–30.

Crow, S.K.; Jellyman, P.J.; Martin, M.L.; Bowman, E. (2020). Recruitment of freshwater eels 1995–2018. *New Zealand Fisheries Assessment Report 2020/36*. 124 p.

Crow, S.K.; Lambert, P.; Egan, E.M.; Bowman, E. (2023). Recruitment of freshwater eels, 1995–2022. *New Zealand Fisheries Assessment Report 2023/52*. 94 p.

Dunn, N.R.; Allibone, R.M.; Closs, G.P.; Crow, S.K.; David, B.O.; Goodman, J.M.; Griffiths, M.; Jack, D.C.; Ling, N.; Waters, J.M.; Rolfe, J.R. (2017). Conservation status of New Zealand freshwater fishes, 2017. *Department of Conservation New Zealand Threat Classification Series 24*. 11 p.

Dunn, N.R.; Closs, G.P.; Crow, S.K.; David, B.O.; Goodman, J.M.; Griffiths, M.; Hicks, A.S.; Hickford, M.J.H.; Jack, D.C.; Kitson, J.C.; Ling, N.; Waters, J.M.; Wylie, M.J.; Hitchmough, R.A.; Makan, T. (2025). Conservation status of New Zealand freshwater fishes, 2023. *Department of Conservation New Zealand Threat Classification Series 46*. 66 p.

Durif, C.M.F.; Knutsen, J.A.; Johannessen, T.; Vollestad, L.A. (2008). Analysis of European eel (*Anguilla anguilla*) time series from Norway. *Institute of Marine Research Fisken Og Havet Report No. 8/2008*. 22 p.

Ege, V. (1939). A revision of the genus *Anguilla* Shaw, a systematic, phylogenetic and geographical study. *Dana Report 16*: 1–256.

European Union (2025). To include *Anguilla japonica* and *Anguilla rostrata* in CITES Appendix II, in accordance with Article II, Paragraph 2 (a) of the Convention and Criterion B of Annex 2a, and to include all non-CITES species of the genus *Anguilla* in CITES Appendix II in accordance with Article II, Paragraph 2 (b) of the Convention and satisfying Criterion A of Annex 2b of Resolution Conf. 9.24 (Rev. CoP17) for reasons of similarity to *A. anguilla*, or to one of the proposed species (*Anguilla japonica* and *Anguilla rostrata*) in live/processed form. *CoP20 Prop. 35* 1–76.

Fasiolo, M.; Nedellec, R.; Goude, Y.; Wood, S.N. (2018). Scalable visualisation methods for modern Generalized Additive Models. arXiv preprint. https://arxiv.org/abs/1809.10632.

Fisheries New Zealand (2025). Freshwater Eels (SFE, LFE, ANG) – Fisheries Assessment Plenary May 2025 Volume 1. 406–495.

Froese, R.; Pauly, D. (2025). FishBase. Anguilla Schrank, 1798. Accessed through: World Register of Marine Species at: https://www.marinespecies.org/aphia.php?p=taxdetails&id=125620 on 2025-07-13.

Gascuel, D. (1986). Flow-carried and active swimming migration of the glass eel (*Anguilla anguilla*) in the tidal area of a small estuary on the French Atlantic coast. *Helgolander Meeresuntersuchungen 40*: 321–326.

Goymer, A.; Steel, K.; Jenkins, F.; Burgess, G.; Andrews, L.; Baumgartner, N.; Gubili, C.; Griffiths, A.M. (2023). For R-eel?! Investigating international sales of critically endangered species in freshwater eel products with DNA barcoding. *Food Control 150*: 1–10.

Griffin, L.T. (1936). Revision of the eels of New Zealand. *Transactions and Proceedings of the Royal Society of New Zealand 66*: 12–26.

Hall, K.C. (2021). NSW Stock Status Summary 2018/19 – Southern Shortfin Eel (*Anguillaaustralis*). NSW Department of Primary Industries, Fisheries NSW, Coffs Harbour 8 p.

Haro, A.; Dekker, W.; Bentley, N. (2015). 2013 Independant review of the information available for monitoring trends and assessing the status of New Zealand freshwater eels. *New Zealand Fisheries Science Review 2015/2*: 39 p.

Hoyle, S.D.; Campbell, R.A.; Ducharme-Barth, N.D.; Grüss, A.; Moore, B.R.; Thorson, J.T.; Tremblay-Boyer, L.; Winker, H.; Zhou, S.; Maunder, M.N. (2024) Catch per unit effort modelling for stock assessment: A summary of good practices. *Fisheries Research 269:*

Hyndman, R.; Athanasopoulos, G.; Bergmeir, C.; Caceres, G.; Chhay, L.; Kuroptev. K.; Mücke, M.; O'Hara-Wild, M.; Petropoulos, F.; Razbash, S.; Wang, E.; Yasmeen, F (2026). forecast: Forecasting functions for time series and linear models. doi:10.32614/CRAN.package.forecast. R package version 9.0.2.9000, https://pkg.robjhyndman.com/forecast/.

Jellyman, D.J. (1974). Aspects of the biology of juvenile freshwater eels (*Anguillidae*) in New Zealand. Thesis. Victoria University.

Jellyman, D.J. (1977). Invasion of a New Zealand freshwater stream by glass-eels of two *Anguilla* spp. *New Zealand Journal of Marine and Freshwater Research 11:* 193–209.

Jellyman, D.J. (1979). Upstream migration of glass-eels (*Anguilla* spp.) in the Waikato River. *New Zealand Journal of Marine and Freshwater Research 13*: 13–22.

Jellyman, D.J. (1995). Longevity of longfinned eels *Anguilla dieffenbachii* in a New Zealand high country lake. *Ecology of Freshwater Fish 4*: 106–112.

Jellyman, D.J. (2012). Fish recruitment into Te Waihora/Lake Ellesmere. A consideration of the requirements of key species. NIWA Client Report, CHC2011-094 75 p.

Jellyman, D.J.; Booker, D.J.; Watene, E.M. (2009). Recruitment of *Anguilla* spp. glass eels in the Waikato River, New Zealand. Evidence of declining migrations? *Journal of Fish Biology 74*: 2014–2033.

Jellyman, D.J.; Lambert, P. (2003). Factors affecting recruitment of glass eels into the Grey River. *New Zealand Journal of Fish Biology 63*: 1067–1079.

Jellyman, D.J.; Ryan, C.M. (1983). Seasonal migration of elvers (*Anguilla* spp.) into Lake Pounui, New Zealand, 1974–1978. *New Zealand Journal of Marine and Freshwater Research 17*: 1–15.

Jellyman, D.J.; Todd, P.R. (1982). New Zealand freshwater eels: their biology and fishery. New Zealand Ministry of Agriculture and Fisheries, Fisheries Research Division Information Leaflet 11: 19.

Kim, Y.J.; Gu, C. (2004). Smoothing spline Gaussian regression: more scalable computation via efficient approximation. *Journal of the Royal Statistical Society: Series B (Statistical Methodology) 66*: 337–356.

Lazaridis, E. (2022). *lunar: Calculate Lunar Phase & Distance, Seasons and Related Environmental Factors*.

Luedeling, E.; Caspersen, L.; Fernandez, E. (2023). *chillR: Statistical Methods for Phenology Analysis in Temperate Fruit Trees*.

Marra, G.; Wood, S.N. (2011). Practical variable selection for generalized additive models. *Computational Statistics and Data Analysis 55*: 2372–2387.

Martin, M.H. (1995). The effects of temperature, river flow, and tidal cycles on the onset of glass eel and elver migration into fresh water in the American eel. *Journal of Fish Biology 46*: 891–902.

Martin, M.L.; Boubée, J.A.; Bowman, E. (2009). Recruitment of freshwater eels 2006–07 and 2007–08. *New Zealand Fisheries Assessment Report 2009/04.* 68 p.

Martin, M.L.; Boubée, J.A.; Bowman, E. (2013). Recruitment of freshwater elvers 1995–2012. *New Zealand Fisheries Assessment Report 2013/50*. 115 p.

Martin, M.; Boubée, J.; Williams, E.; Bowman, E. (2007). Recruitment of freshwater eels 2002–03 and 2003–04. *New Zealand Fisheries Assessment Report 2007/38*. 105 p.

Martin, M.L.; Bowman, E. (2016). Recruitment of freshwater eels 1995–2015. *New Zealand Fisheries Assessment Report No. 2007/38.* 96 p.

McDowall, R.M. (1988). Diadromy in fishes: migrations between freshwater and marine environments. London, Croom Helm.

Monticini, P. (2014). Eel (*Anguilla* spp.): Production and trade according to Washington Convention Legislation. *FAO GLOBEFISH Research Programme 114*. 78 p.

Naismith, I.A.; Knights, B. (1988). Migrations of elvers and juvenile European eels, *Anguilla anguilla* L., in the River Thames. *Journal of Fish Biology 33*: 161–175.

Pinheiro, J.C.; Bates, D.M. (2000). Mixed-Effects Models in S and S-PLUS. Springer.

Schrank, FvP (1798). Fauna Boica, durchgedachte Geschichte der in Baiern einheimischen und zahmen Thiere. Erster Band. Stein'sche Buchhandlung, Nürnberg v. 1: i-xii: 1–720.

Sen, P.K. (1968). Estimates of the regression coefficient based on Kendall's tau. *Journal of the American Statistics Association 63*: 1379–1389.

Sorensen, P.W.; Bianchini, M.L. (1986). Environmental correlates of the freshwater migration of elvers of the American eel in a Rhode Island brook. *Transactions of the American Fisheries Society 115:* 258–268.

Stein, F.M.; Wong, J.C.Y.; Sheng, V.; Law, C.S.W.; Schroder, B.; Baker, D.M. (2016). First genetic evidence of illegal trade in endangered European eel (*Anguilla anguilla*) from Europe to Asia. *Conservation Generic Resources 8*: 533–537.

Stoffels, R.J.; White, R.S.A. (2026). Are trends in species occupancy or an index of biotic integrity more useful for guiding fish conservation planning? *Ecological Indicators 182*:114538:

Tesch, F.-W. (2003). The eel. Oxford, Blackwell Science. 408 p.

Thorson, J.T. (2017). Three problems with the conventional delta-model for biomass sampling data, and a computationally efficient alternative. *Canadian Journal of Fisheries and Aquatic Sciences 75*: 1369–1382.

Victorian Fisheries Authority (2017). Victorian Eel Fishery Management Plan 2017. Victorian Fisheries Authority. 20 p.

Victorian Fisheries Authority (2023). Status of Australian fish stocks report: Southern Shortfin Eel 2023. 9 p.

Walsh, C.; Beentjes, M.P.; Kelly, G. (2016). Age determination protocol for freshwater eels (*Anguilla dieffenbachii, Anguilla australis*). *New Zealand Fisheries Assessment Report 2016/02*. 40 p.

Watanabe, S.; Aoyama, J.; Hagihara, S.; Ai, B.; Azanza, R.V.; Tsukamoto, K. (2013). *Anguilla huangi* Teng, Lin, and Tzeng, 2009, is a junior synonym of *Anguilla luzonensis* Watanabe, Aoyama, and Tsukamoto, 2009. *Fisheries Science 79:* 375–383.

Watanabe, S.; Aoyama, J.; Tsukamoto, K. (2004). Reexamination of Ege's (1939) use of taxonomic characters of the genus *Anguilla*. *Bulletin of Marine Science 74*: 337–351.

Watanabe, S.; Aoyama, J.; Tsukamoto, K. (2009). A new species of freshwater eel, *Anguilla luzonensis* (Teleostei: Anguillidae) from Luzon Island of the Philippines. *Fisheries Science 75*: 3857–392.

Watanabe, S.; Aoyama, J.; Tsukamoto, K. (2014a). On the Identities of *Anguilla borneensis*, *A. malgumora*, and *Muraena malgumora*. *Copeia 3*: 568–576.

Watanabe, S.; Miller, M.J.; Aoyama, J.; Tsukamoto, K. (2014b). Evaluation of the population structure of *Anguilla bicolor* and *A. bengalensis* using total number of vertebrae and consideration of the subspecies concept for the genus *Anguilla*. *Ecology of Freshwater Fish 23*: 77–85.

White, R.S.A.; Stoffels, R.J.; Whitehead, A.L. (2023). Assigning trend-based conservation status despite high uncertainty. *Conservation Biology 37*:e14084:

Whitehead, A.L.; Fraser, C.; Snelder, T.; White, R.S.A. (2021). Water quality state and trends in New Zealand lakes. NIWA Client Report 2021297CH

Wood, S.N. (2011). Fast stable restricted maximum likelihood and marginal likelihood estimation of semiparametric generalized linear models. *Journal of the Royal Statistical Society (B) 73*: 3–36.

Wood, S.N. (2017). *Generalized Additive Models: An Introduction with R. Second Edition.* Chapman and Hall/CRC.

9. TABLES

Table 1: Environmental variables obtained for Karāpiro and Patea Dams.

Variable name	Description	Data source
Seven-day mean flow (m^3)	Average of the mean daily flow recorded over the seven consecutive days leading up to the day of capture.	Obtained from the hydro generation company or from the nearest downstream gauging site.
Moon (unitless)	Moon phase for each day of year estimated as radians. Values ranged from 0–6.28, where 0 refers to new moon, $\pi/2$ refers to first quarter, π refers to full moon, $3\pi/2$ refers to the last quarter.	Calculated using R-package *lunar* (Lazaridis 2022) with the function *lunar.phase.*
Seven-day mean water temperature (°C)	Average of the mean daily water temperature recorded over the seven consecutive days leading up to the day of capture.	Obtained from the hydro generation company.
Rain (mm)	Total amount of daily rainfall.	Climate and weather stations (managed by ESNZ).
Day length (hr)	Time between sunrise and sunset,	Calculated using R-package *chillR* (Luedeling et al. 2023) with the function *daylength*.

Table 2: Migration period for the 2022–23, 2023–24, 2024–25 seasons at all primary (bold) and secondary sites. Migration period is defined as the time between the first and last elver catches (either species). – indicates sites where no data were available. (Continued next page)

Season	Island	Site	Migration Started	Migration Finished	Migration Period (Days)
2022–23	North	**Wairua**	–	–	–
		Karāpiro	2-Dec	24-Mar	112
		Matahina[12]	1-Feb	23-Feb	22
		Patea	3-Nov	28-Mar	145
		Piripaua	–	–	–
		Wairere	14-Nov	22-Mar	128
		Mokauiti	4-Nov	1-Mar	117
		Mangorei	–	–	–
		Motukawa	–	–	–
		Whanganui	4-Jan	22-Mar	77
		Waitakere	7-Oct	28-Feb	144
		Hunua	9-Nov	22-Mar	133
		Ruahihi	–	–	–
	South	**Arnold**	20-Dec	2-Mar	72
		Waitaki	25-Nov	7-Mar	102
		Mararoa	11-Dec	10-Mar	89
		Waihopai	5-Jan	27-Jan	22
		Branch	22-Dec	3-Mar	71
		Mataura	–	–	–
		Roxburgh	16-Dec	24-Mar	98
2023–24	North	**Wairua**	–	–	–
		Karāpiro	2-Dec	28-Mar	117
		Matahina	25-Dec	22-Feb	59
		Patea	2-Nov	25-Mar	144
		Piripaua	4-Jan	15-Mar	71
		Wairere	3-Nov	15-Mar	133
		Mokauiti	6-Dec	8-Mar	93
		Mangorei	–	–	–
		Motukawa	–	–	–
		Whanganui	10-Dec	4-Apr	116
		Waitakere	13-Nov	27-Mar	135
		Hunua	28-Sep	26-Mar	180
		Ruahihi	28-Oct	29-Mar	153
	South	**Arnold**	12-Dec	26-Feb	76
		Waitaki	18-Dec	20-Mar	93
		Mararoa	2-Dec	12-Mar	101
		Waihopai	18-Dec	18-Jan	31
		Branch	11-Jan	21-Mar	70
		Mataura	–	–	–
		Roxburgh	18-Dec	18-Mar	91

[12] Trap only operational for part of the season

Table 2: continued

Season	Island	Site	Migration Started	Migration Finished	Migration Period (Days)
2024–25	North	**Wairua**	14-Nov	26-Feb	104
		Karāpiro	7-Dec	28-Mar	111
		Matahina	5-Nov	1-Apr	147
		Patea	3-Dec	7-Apr	125
		Piripaua	10-Dec	29-Mar	109
		Wairere	1-Nov	13-Mar	132
		Mokauiti	1-Nov	13-Mar	132
		Mangorei	–	–	–
		Motukawa	–	–	–
		Whanganui	12-Dec	26-Mar	104
		Waitakere	10-Nov	16-Apr	157
		Hunua	20-Oct	10-Apr	172
		Ruahihi	9-Nov	11-Apr	153
	South	**Arnold**	20-Dec	11-Mar	81
		Waitaki	3-Dec	17-Mar	104
		Mararoa	5-Dec	10-Mar	95
		Waihopai	17-Dec	24-Mar	97
		Branch	3-Dec	27-Mar	114
		Mataura	–	–	–
		Roxburgh	20-Dec	17-Apr	118

Table 3: Total elver catch for the 2022–23, 2023–24, 2024–25 seasons at all primary (bold) and secondary sites. Sites that did not supply any data are shown as –. Site names with * indicate that no species composition data were available and therefore only information on total elver numbers and/or total elver weights are available. (Continued next page).

Season	Island	Site	Shortfin elver	Longfin elver	Total elver	
			Numbers	Numbers	Numbers	kg
2022–23	North	**Wairua**	–	–	–	–
		Karāpiro	500 071	65 250	565 321	500.43
		Matahina	66 123	0	66 123	75.70
		Patea	160 615	21 783	182 398	125.19
		Piripaua	–	–	–	–
		Wairere*				34.68
		Mokauiti*				8.65
		Mangorei	–	–	–	–
		Motukawa	–	–	–	–
		Whanganui*			62	
		Waitakere*			1 080	
		Hunua*			88	
		Ruahihi	–	–	–	–
	South	**Arnold**	174 907	273 147	448 054	590.06
		Waitaki	9 687	12 073	21 760	150.10
		Mararoa	62 758	118 039	180 797	386.44
		Waihopai	457	172	629	1.11
		Branch	409	63.00	472	0.91
		Mataura	–	–	–	–
		Roxburgh	355	52 466	52 821	180.04
	TOTAL		975 382	542 993	1 519 605	2 053.31
2023–24	North	**Wairua**	–			
		Karāpiro	895 696	226 117	1 121 813	1 330.22
		Matahina	6 341	125 809	132 150	156.20
		Patea	170 873	20 699	191 572	93.20
		Piripaua	16 183	886	17 069	18.74
		Wairere*				84.95
		Mokauiti*				6.29
		Mangorei	–	–	–	–
		Motukawa	–	–	–	–
		Whanganui*			1 262	
		Waitakere*			6 222	
		Hunua*			1 228	
		Ruahihi	30 462	9 423	39 885	20.64
	South	**Arnold**	246 758	137 461	384 219	596.60
		Waitaki	7 686	14 366	22 052	176.86
		Mararoa	3 844	85 187	89 031	220.75
		Waihopai	372	82	454	0.58
		Branch	4 804	434	5 238	6.96
		Mataura	–	–	–	–
		Roxburgh	1 936	31 825	33 761	95.57
	TOTAL		1 384 955	652 289	2 045 956	2 807.56

Table 3: Continued

Season	Island	Site	Shortfin elver	Longfin elver	Total elver	
			Numbers	Numbers	Numbers	kg
2024–25	North	**Wairua**	202 775	1 365	204 140	71.95
		Karāpiro	785 245	204 319	989 564	787.17
		Matahina	1 575 864	332 999	1 908 863	2 048.14
		Patea	560 740	37 180	597 920	272.9
		Piripaua	59 190	9 815	69 005	88.35
		Wairere*				27.81
		Mokauiti*				12.95
		Mangorei	–	–	–	–
		Motukawa	–	–	–	–
		Whanganui	4 809	600	5 409	
		Waitakere*				5.1
		Hunua*				1.4
		Ruahihi	25 915	12 072	37 987	18.76
	South	**Arnold**	208 739	167 390	376 129	448.47
		Waitaki	73 347	8 301	81 648	172.93
		Mararoa	41 819	160 269	202 088	440.17
		Waihopai	949	337	1 286	2.38
		Branch	3 853	61	3 914	4.19
		Mataura	–	–	–	–
		Roxburgh	62 655	33 194	95 849	165.22
	TOTAL		3 605 900	967 902	4 369 662	4 567.89

Table 4: Estimated annual total number (in 1000s) of longfin and shortfin elvers captured at the primary (*) and secondary sites that have a reliable time series of catch data available. Unreliable annual records for individual sites have been removed (see Appendix 1) (Continued next page).

	Arnold*			Karāpiro *			Mararoa		
Season	Longfin	Shortfin	Total	Longfin	Shortfin	Total	Longfin	Shortfin	Total
1995–1996				332.9	822.3	1 155.1			
1996–1997				305.0	668.2	973.2			
1997–1998				366.6	1 658.2	2 024.7			
1998–1999				341.4	607.3	948.7			
1999–2000				65.8	677.8	743.6			
2000–2001				153.2	618.0	771.2			
2001–2002				245.6	1 347.9	1 593.5			
2002–2003				172.1	1 680.5	1 852.7			
2003–2004				199.4	1 840.6	2 040.0			
2004–2005				131.7	1 200.8	1 332.5			
2005–2006				479.8	1 517.9	1 997.7			
2006–2007	51.9	55.2	107.1	178.9	1 117.0	1 295.9			
2007–2008	78.4	107.7	186.2	698.2	2 019.9	2 718.2			
2008–2009	86.9	96.2	183.1	298.5	1 989.9	2 288.4			
2009–2010				245.4	1 484.2	1 729.5			
2010–2011	49.2	64.6	113.8	174.7	1 259.7	1 434.4			
2011–2012	26.0	49.8	75.9	35.9	967.4	1 003.3			
2012–2013	35.6	54.8	90.4	139.0	1 629.7	1 768.6			
2013–2014	29.4	35.8	65.3	160.1	1 682.9	1 843.0	145.3	0.0	145.4
2014–2015	65.0	87.5	152.5	159.9	1 444.5	1 604.4	135.5	0.1	135.6
2015–2016	68.5	117.5	186.0	517.2	2 674.0	3 191.2	85.5	2.9	88.4
2016–2017	9.6	22.2	31.8	221.5	2 312.5	2 533.9	41.9	0.0	41.9
2017–2018	98.4	212.9	311.3	373.2	1 856.1	2 229.2	229.5	19.9	249.3
2018–2019	225.6	240.1	465.7	176.3	905.1	1 081.4	150.3	47.6	197.8
2019–2020	111.0	132.7	243.7	159.1	595.3	754.4	12.5	6.7	19.3
2020–2021	97.4	185.4	282.7	330.4	752.2	1 082.6	47.9	15.6	63.5
2021–2022	125.7	187.4	313.1	464.8	1 115.1	1 579.9	102.6	65.0	167.5
2022–2023	273.1	174.9	448.1	65.3	500.1	565.3	118.0	62.7	180.7
2023–2024	246.8	137.5	384.2	226.1	895.7	1 121.8	85.2	3.8	89.0
2024–2025	167.4	208.7	376.1	204.3	785.2	989.6	160.3	41.8	202.1
Median	82.7	112.6	186.1	212.9	1 230.3	1 507.1	110.3	11.2	140.5
Mean	102.6	120.6	223.2	254.1	1 287.5	1 541.6	109.5	22.2	131.7
Std Dev	77.9	67.8	136.0	147.3	566.5	644.0	60.0	25.2	71.4
Max	273.1	240.1	465.7	698.2	2 674.0	3 191.2	229.5	65.0	249.3
Min	9.6	22.2	31.8	35.9	500.1	565.3	12.5	0.0	19.3

Table 4: Continued

	Matahina*			Patea*			Piripaua		
Season	Longfin	Shortfin	Total	Longfin	Shortfin	Total	Longfin	Shortfin	Total
1995–1996									
1996–1997									
1997–1998	136.1	478.4	614.5						
1998–1999									
1999–2000									
2000–2001									
2001–2002	27.0	591.6	618.7	47.8	706.6	754.4	0.4	3.7	4.1
2002–2003	124.0	1 359.8	1 483.8	8.5	371.7	380.2	0.2	9.7	9.9
2003–2004	64.3	881.6	945.9	1.1	390.1	391.2	0.2	4.7	4.9
2004–2005	15.2	1 101.9	1 117.1				0.5	7.6	8.1
2005–2006	228.1	965.0	1 193.2	122.3	674.3	796.6	0.1	2.6	2.7
2006–2007	159.5	325.9	485.4	52.7	843.3	896.1	0.3	3.8	4.2
2007–2008	928.5	2 449.7	3 378.1	98.0	758.9	857.0	1.1	4.7	5.7
2008–2009	516.5	3 790.9	4 307.4	81.8	398.6	480.4	2.2	7.3	9.5
2009–2010	78.1	924.3	1 002.4	20.0	289.5	309.5	2.9	7.1	10.0
2010–2011	83.9	1 758.1	1 841.9	19.9	226.6	246.5	2.5	9.3	11.8
2011–2012	14.6	666.1	680.6	8.5	82.0	90.5	3.1	12.5	15.6
2012–2013	317.2	2 103.7	2 420.9	50.7	183.3	234.0	5.2	27.8	33.0
2013–2014	219.9	1 847.9	2 067.8	23.6	170.1	193.7	7.9	60.8	68.7
2014–2015	275.4	4 460.4	4 735.8	23.1	237.5	260.6	4.7	56.5	61.2
2015–2016	771.1	6 412.9	7 184.0	179.5	555.7	735.2	15.6	144.9	160.5
2016–2017	5.9	369.6	375.5	56.2	230.0	286.2	1.3	27.9	29.2
2017–2018	7.7	125.0	132.7	103.0	308.0	410.9	5.7	64.3	69.9
2018–2019	323.8	2 393.8	2 717.6	67.1	206.5	273.6	1.4	55.6	57.0
2019–2020	80.1	1 399.5	1 479.6	41.6	186.2	227.8	10.3	100.5	110.9
2020–2021	114.3	1 206.2	1 320.5	71.6	285.2	356.8	4.0	37.4	41.4
2021–2022	56.9	1 511.6	1 568.5	38.6	242.8	281.4	9.7	44.7	54.4
2022–2023				21.8	160.6	182.4			
2023–2024				20.7	170.9	191.6	0.9	16.2	17.1
2024–2025	333.0	1 575.9	1 908.9	37.2	560.7	597.9	9.8	59.2	69.0
Median	124.0	1 359.8	1 479.6	41.6	285.2	309.5	2.5	16.2	17.1
Mean	212.2	1 682.6	1 894.8	52.0	358.2	410.2	3.9	33.4	37.3
Std Dev	241.3	1 477.5	1 662.0	42.6	217.8	240.9	4.2	36.2	39.9
Max	928.5	6 412.9	7 184.0	179.5	843.3	896.1	15.6	144.9	160.5
Min	5.9	125.0	132.7	1.1	82.0	90.5	0.1	2.6	2.7

Table 4: Continued

	Roxburgh			Wairua*			Waitaki			Total	
Season	Longfin	Shortfin	Total	Longfin	Shortfin	Total	Longfin	Shortfin	Total	Longfin	Shortfin
1995–1996										332.9	822.3
1996–1997										305.0	668.2
1997–1998										502.6	2 136.6
1998–1999										341.4	607.3
1999–2000										65.8	677.8
2000–2001										153.2	618.0
2001–2002										320.9	2 649.8
2002–2003										304.8	3 421.7
2003–2004										265.0	3 116.9
2004–2005										147.3	2 310.4
2005–2006										830.4	3 159.9
2006–2007										443.3	2 345.3
2007–2008										1 804.2	5 340.9
2008–2009							3.5	1.2	4.7	989.3	6 284.2
2009–2010							2.1	0.3	2.4	348.5	2 705.3
2010–2011										330.1	3 318.3
2011–2012				9.5	3 123.6	3 133.0				97.6	4 901.4
2012–2013	13.7	0.0	13.7	98.7	5 389.4	5 488.2	7.1	1.8	8.9	667.2	9 390.4
2013–2014	0.5	0.0	0.5	14.0	2 430.4	2 444.3	0.1	0.1	0.2	600.8	6 228.1
2014–2015	1.3	0.0	1.3	118.0	2 892.6	3 010.6	4.6	1.3	6.0	787.6	9 180.4
2015–2016	1.4	0.0	1.4	74.6	7 776.3	7 850.9	1.3	1.1	2.4	1 714.8	17 685.2
2016–2017				0.0	2 940.2	2 940.2	1.0	1.4	2.3	337.4	5 903.7
2017–2018	5.8	0.0	5.9	8.0	2 427.5	2 435.5	3.2	1.5	4.6	834.4	5 015.1
2018–2019	25.8	0.0	25.8				2.5	1.8	4.3	972.8	3 850.4
2019–2020	2.4	0.0	2.4				5.4	4.0	9.4	422.4	2 425.0
2020–2021	17.5	0.0	17.5				6.8	2.7	9.4	689.7	2 484.7
2021–2022	67.9	10.1	78.0				8.8	2.6	11.4	875.0	3 179.2
2022–2023	52.5	0.4	52.8				11.0	13.8	24.8	541.7	912.5
2023–2024	31.8	1.9	33.8				14.4	7.7	22.1	625.8	1 233.7
2024–2025	33.2	62.7	95.8	1.4	202.8	204.1	8.3	73.3	81.6	954.8	3 570.4
Median	15.6	0.0	15.6	11.7	2 916.4	2 975.4	4.6	1.8	6.0	473.0	3 138.4
Mean	21.2	6.3	27.4	40.5	3 397.8	3 438.4	5.3	7.6	13.0	586.9	3 871.4
Std Dev	22.0	18.0	32.2	48.5	2 260.3	2 288.2	4.1	18.5	20.3	417.5	3 488.9
Max	67.9	62.7	95.8	118.0	7 776.3	7 850.9	14.4	73.3	81.6	1 804.2	17 685.2
Min	0.5	0.0	0.5	0.0	202.8	204.1	0.1	0.1	0.2	65.8	607.3

Table 5: Average elver weights and weight ranges for the 2022–23, 2023–24, and 2024–25 seasons at all primary (bold) and secondary sites. Weight ranges were unavailable for some secondary sites (shown as NA) because the individual elver weights were not estimated throughout the season. *N* is the numbers of elvers. Sites that did not supply any data are shown as –.

Season	Island	Site	No. of	Shortfin			Longfin		
			Samples	N	Average (g)	Range (g)	N	Average (g)	Range (g)
2022–23	North	**Wairua**	–	–	–	–	–	–	–
		Karāpiro	20	2 000	0.87	0.41–1.25	174	1.22	0.94–2.10
		Matahina	1	87	1.14	NA	1	–	–
		Patea	11	950	0.55	0.42–0.77	106	0.76	0.62–1.09
		Piripaua	2	184	1.12	1.10–1.49	16	2.37	NA
		Wairere	–	–	–	–	–	–	–
		Mokauiti	–	–	–	–	–	–	–
		Mangorei	–	–	–	–	–	–	–
		Motukawa	–	–	–	–	–	–	–
		Whanganui	–	–	–	–	–	–	–
		Waitakere	–	–	–	–	–	–	–
		Hunua	–	–	–	–	–	–	–
		Ruahihi	–	–	–	–	–	–	–
	South	**Arnold**	17	527	1.09	0.90–1.21	733	1.46	1.37–1.85
		Waitaki	4	213	2.06	0.50–2.72	152	11.41	9.61–12.95
		Mararoa	9	408	1.83	1.47–2.25	832	2.41	1.93–3.05
		Waihopai	4	42	1.71	1.27–2.09	21	2.43	1.13–3.29
		Branch	8	92	1.85	1.01–2.62	12	3.01	0.96–16.69
		Mataura	–	–	–	–	–	–	–
		Roxburgh	2	2	2.85	–	98	3.45	3.15–3.94
2023–24	North	**Wairua**	–	–	–	–	–	–	–
		Karāpiro	26	2 442	1.14	0.47–1.26	627	1.44	1.13–1.89
		Matahina	4	484	1.15	1.00–1.25	34	2.16	1.15–2.94
		Patea	12	1073	0.45	0.32–0.63	96	0.72	0.35–0.88
		Piripaua	2	186	1.04	1.03–1.05	9	1.93	1.30–2.12
		Wairere	–	–	–	–	–	–	–
		Mokauiti	–	–	–	–	–	–	–
		Mangorei	–	–	–	–	–	–	–
		Motukawa	–	–	–	–	–	–	–
		Whanganui	–	–	–	–	–	–	–
		Waitakere	–	–	–	–	–	–	–
		Hunua	–	–	–	–	–	–	–
		Ruahihi	7	1 036	0.52	0.44–0.60	364	0.68	0.55–0.84
	South	**Arnold**	11	408	1.2	0.98–1.65	588	1.85	1.60–2.51
		Waitaki	1	78	1.31	NA	10	11.86	NA
		Mararoa	5	11	1.89	1.78–1.99	176	2.88	2.27–3.59
		Waihopai	3	15	1.4	1.08–1.78	18	2.72	1.73–3.71
		Branch	11	80	1.19	0.84–1.42	9	5.59	0.96–14.28
		Mataura	–	–	–	–	–	–	–
		Roxburgh	5	42	1.49	1.58–2.46	458	3.14	2.69–3.85

Table 5: Continued

Season	Island	Site	No. of Samples	Shortfin N	Shortfin Average (g)	Shortfin Range (g)	Longfin N	Longfin Average (g)	Longfin Range (g)
2024–25	North	**Wairua**	18	673	0.58	0.26–0.70	6	0.37	0.33–0.55
		Karāpiro	24	1 903	0.77	0.69–0.85	492	0.89	0.70–1.11
		Matahina	6	1 774	1.01	0.84–1.05	309	1.42	1.21–1.52
		Patea	14	1 679	0.46	0.41–0.56	125	0.53	0.42–0.99
		Piripaua	3	257	1.19	1.09–1.31	39	1.78	1.61–1.81
		Wairere	–	–	–	–	–	–	–
		Mokauiti	–	–	–	–	–	–	–
		Mangorei	–	–	–	–	–	–	–
		Motukawa	–	–	–	–	–	–	–
		Whanganui	–	–	–	–	–	–	–
		Waitakere	–	–	–	–	–	–	–
		Hunua	–	–	–	–	–	–	–
		Ruahihi	14	1 036	0.46	0.20–0.66	88	0.39	0.14–0.66
	South	**Arnold**	12	826	0.99	0.72–1.24	541	1.67	0.91–2.10
		Waitaki	3	863	1.68	1.59–1.85	320	6.49	5.81–7.31
		Mararoa	5	70	2.39	1.75–3.95	405	2.77	2.17–3.25
		Waihopai	11	179	1.53	0.64–1.97	62	3.08	1.02–5.15
		Branch	15	103	1.27	0.69–6.98	4	3.63	0.96–9.26
		Mataura	–	–	–	–	–	–	–
		Roxburgh	3	109	1.45	1.42–1.60	48	2.77	2.26–4.59

Table 6: Shortfin and longfin median age data used to calculate the recruitment indices. All age summary information was calculated from data collected in the present study, except for sites identified with *, where median age data were taken from Martin et al. (2013). –, no data

Species	Site	Samples	Median	Mean	s.d.	s.e.	Min	Max
Shortfin	Arnold	773	2	2.56	1.12	0.04	0	9
	Karāpiro	1 412	2	1.62	0.96	0.03	0	6
	Mararoa	125	3	2.71	0.91	0.08	1	6
	Matahina	601	2	2.31	1.13	0.05	0	7
	Patea	1 806	1	0.92	0.95	0.02	0	5
	Piripaua*	–	1	–	–	–	–	–
	Ruahihi	32	0	0.44	0.98	0.17	0	5
	Waitaki	75	3	3.52	0.95	0.11	2	6
	Wairua	240	0	0.05	0.24	0.02	0	2
Longfin	Arnold	771	4	3.89	1.63	0.06	0	16
	Karāpiro	1 016	2	2.24	1.23	0.04	0	7
	Mararoa	125	3	3.75	1.53	0.14	1	13
	Matahina	361	3	3.57	1.33	0.07	0	8
	Patea	1 601	1	1.03	1.05	0.03	0	5
	Piripaua*	–	2	–	–	–	–	–
	Waitaki	75	5	4.81	0.97	0.11	2	8
	Wairua	2	0	0.00	0.00	0.00	0	0

Table 7: Sen's Slope [Slope – represents annual change in catch (in 1000s)] and Wilcoxon Sign Rank Test (V) for trends in annual elver catch. Significantly increasing trends are shown in green while significantly decreasing trends are shown in red. Sen's Slope and Wilcoxon Sign Rank Test were only completed using reliable annual catch data (see Appendix 1).

Island	Site	Species	N	Slope	V	P-value
North	Wairua	Longfin	8	-3.07	4	0.058
		Shortfin	8	-197.4	8	0.182
	Karāpiro	Longfin	30	-1.54	162	0.150
		Shortfin	30	-8.16	266	0.497
	Matahina	Longfin	22	-0.11	151	0.436
		Shortfin	**22**	**54.46**	**209**	**0.008**
	Patea	Longfin	23	0.97	150	0.731
		Shortfin	**23**	**-10.62**	**31**	**<0.001**
	Piripaua	**Longfin**	**23**	**0.45**	**273**	**<0.001**
		Shortfin	**23**	**2.55**	**276**	**<0.001**
South	Waitaki	Longfin	6	2.03	20	0.059
		Shortfin	**6**	**2.11**	**21**	**0.036**
	Roxburgh	Longfin	4	-15.45	0	0.098
		Shortfin	4	1.58	7	0.581
	Arnold	**Longfin**	**18**	**9.75**	**168**	**<0.001**
		Shortfin	**18**	**9.17**	**167**	**<0.001**
	Mararoa	Longfin	12	-2.82	28	0.410
		Shortfin	**12**	**3.32**	**77**	**0.003**

Table 8: Parameter estimates for the environmental covariates chosen by the GAMM models as predictors of daily elver catches at Karāpiro and Patea Dams. Covariates with non-significant *p*-values were excluded from the final models (shown as –).

		Shortfin			Longfin		
Site	Environmental covariates	edf	F	*p*	edf	F	*p*
Karāpiro	Days fished	1.9	14.3	<0.001	1.9	7.9	<0.001
	Lunar phase	8.5	5.9	<0.001	–	–	–
	Daily rainfall	1.5	1.2	<0.001	1.0	0.4	0.049
	Day length	3.5	2.9	<0.001	5.0	12.8	<0.001
	Seven-day mean water temperature	3.7	7.7	<0.001	3.4	8.4	<0.001
	Seven-day mean flow	1.5	0.5	0.002	–	–	–
Patea	Days fished	1.2	1.9	0.045	–	–	–
	Lunar phase	–	–	–	–	–	–
	Daily rainfall	–	–	–	–	–	–
	Day length	6.0	3.4	<0.001	–	–	–
	Seven-day mean water temperature	4.3	16.2	<0.001	3.4	12.7	<0.001
	Seven-day mean flow	3.2	1	<0.001	2.4	1.4	<0.001

Table 9: Sen's Slope (Slope - represents annual change in grams across the time series) and Wilcoxon Sign Rank Test (V) results for trends in annual elver weight (g). Significantly increasing trends are shown in green while significantly decreasing trends are shown in red.

Island	Site	Species	N	Slope	V	P-value
North	Karāpiro	Longfin	28	-0.04	0	<0.001
		Shortfin	28	-0.008	43	<0.001
	Matahina	Longfin	23	-0.022	0	<0.001
		Shortfin	24	-0.004	91	0.095
	Patea	Longfin	22	-0.003	68	0.102
		Shortfin	22	-0.004	57	0.025
	Piripaua	Longfin	24	-0.025	40	0.002
		Shortfin	24	-0.001	98	0.230
South	Waitaki	Longfin	22	0.298	229	<0.001
		Shortfin	18	-0.047	35	0.029
	Arnold	Longfin	19	-0.015	29	0.006
		Shortfin	19	0	81	0.518

Table 10: Summary of trend directions for each of the sites discussed in Sections 3.5 and 3.6. Increasing trends are shown in green text, declining trends are shown in red text while stable trends are shown in black text.

	Shortfins			Longfins		
Site	Crow et al. (2020)	Crow et al. (2023)	Present study	Crow et al. (2020)	Crow et al. (2023)	Present study
Wairua	Stable	Stable	Stable	Stable	Stable	Stable
Karāpiro	Increasing	Stable	Stable	Stable	Stable	Stable
Matahina	Stable	Stable	Stable	Stable	Stable	Increasing
Patea	Declining	Declining	Declining	Stable	Stable	Stable
Arnold	Stable	Increasing	Increasing	Stable	Increasing	Increasing
Mararoa	Stable	Increasing	Increasing	NA	Stable	Stable
Waitaki	Stable	Increasing	Increasing	Stable	Increasing	Stable
Piripaua	Increasing	Increasing	Increasing	Stable	Stable	Increasing
Roxburgh	NA	NA	Stable	NA	NA	Stable
All sites	Stable	Stable	Stable	Stable	Stable	Stable

10. FIGURES

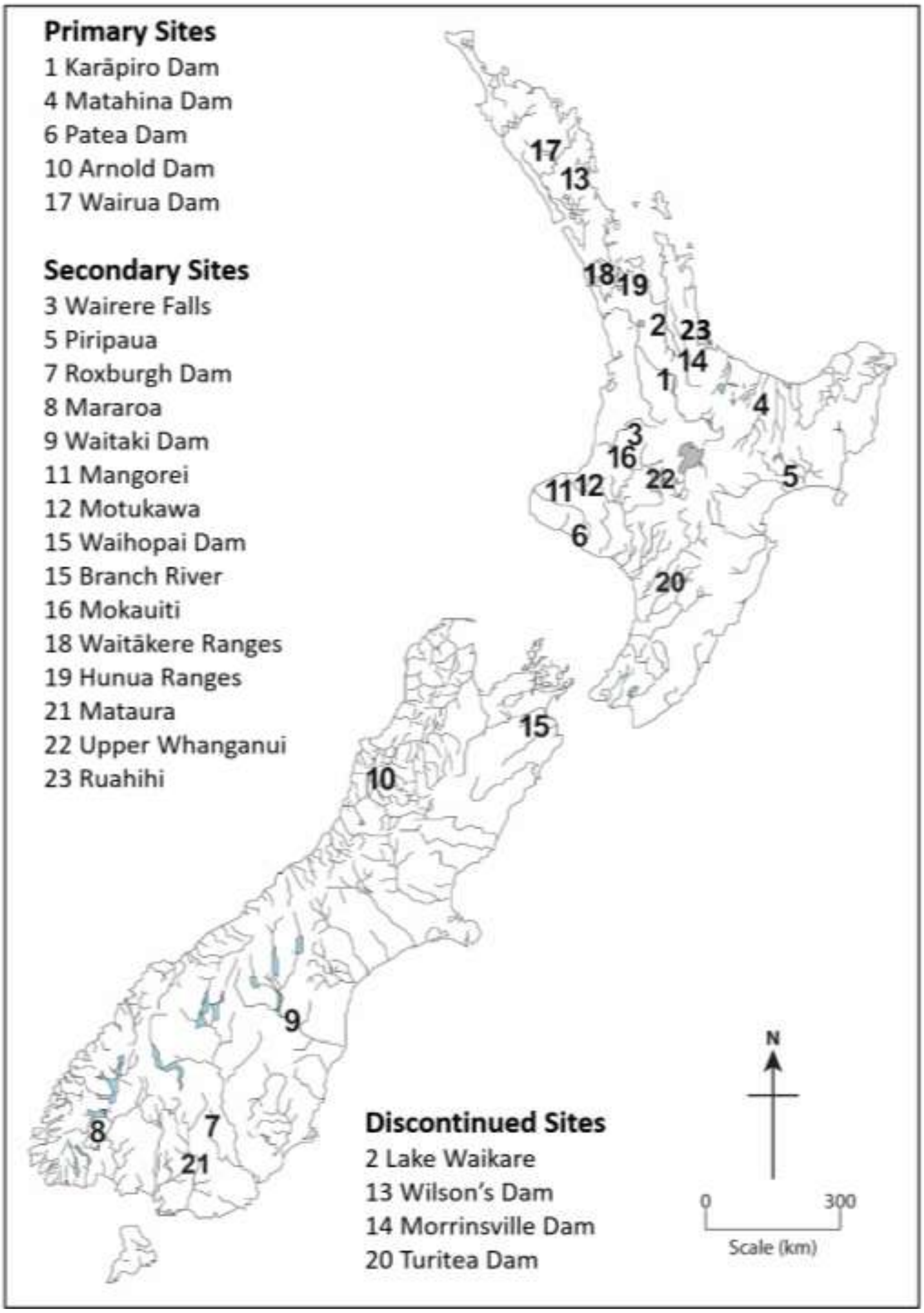


Figure 1: Location of the monitored elver catch and transfer sites from 1982 to 2024–25.

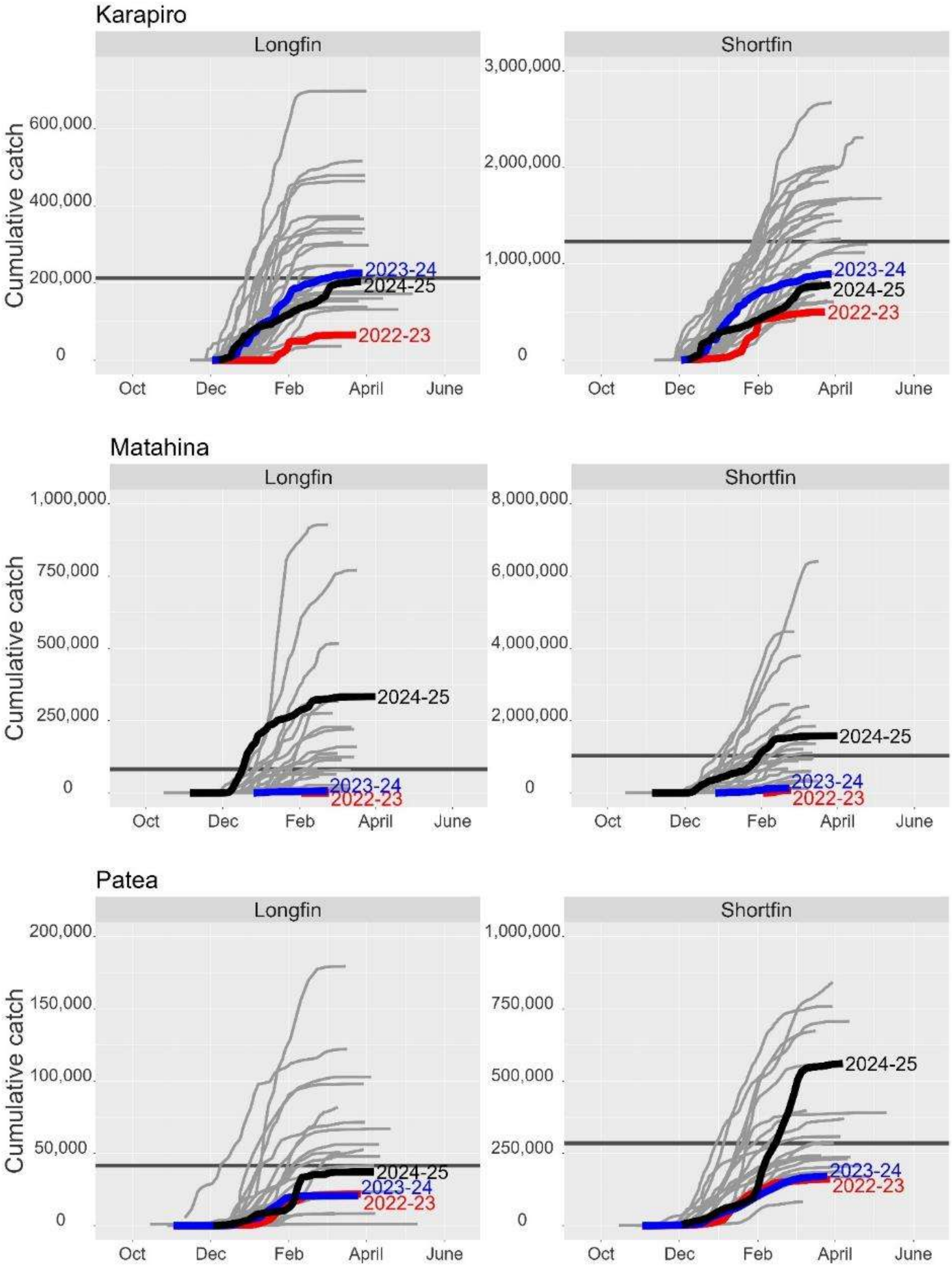


Figure 2: Cumulative elver catches of longfin (left) and shortfin (right) for the 2022–23 (red), 2023–24 (blue) and 2024–25 (black) seasons from North Island sites, including four primary and one secondary (Piripaua). The horizontal black line shows the median catch from Table 4 and cumulative catches for all seasons prior to the 2022–23 season are shown in grey. (Continued next page).

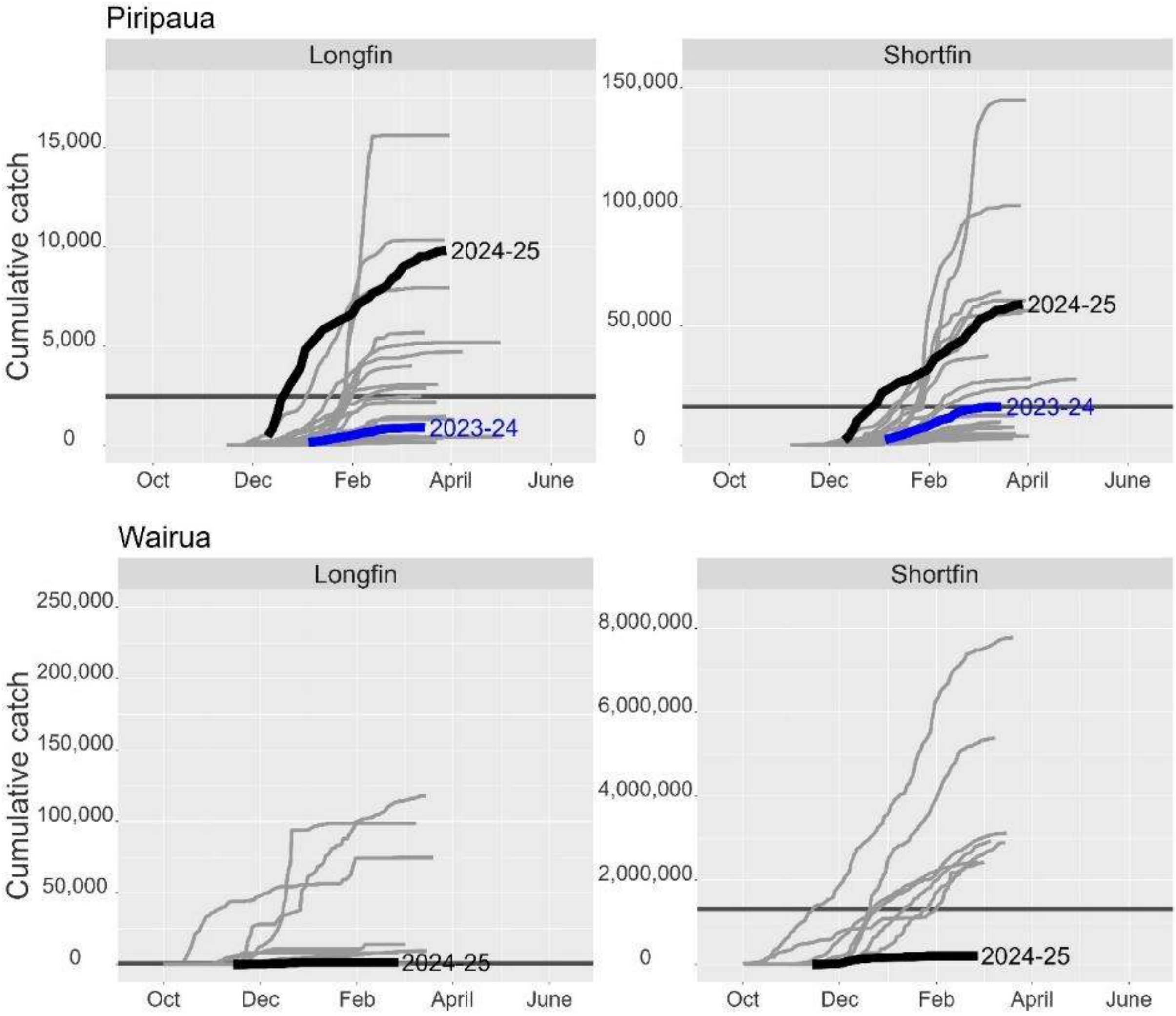


Figure 2: continued

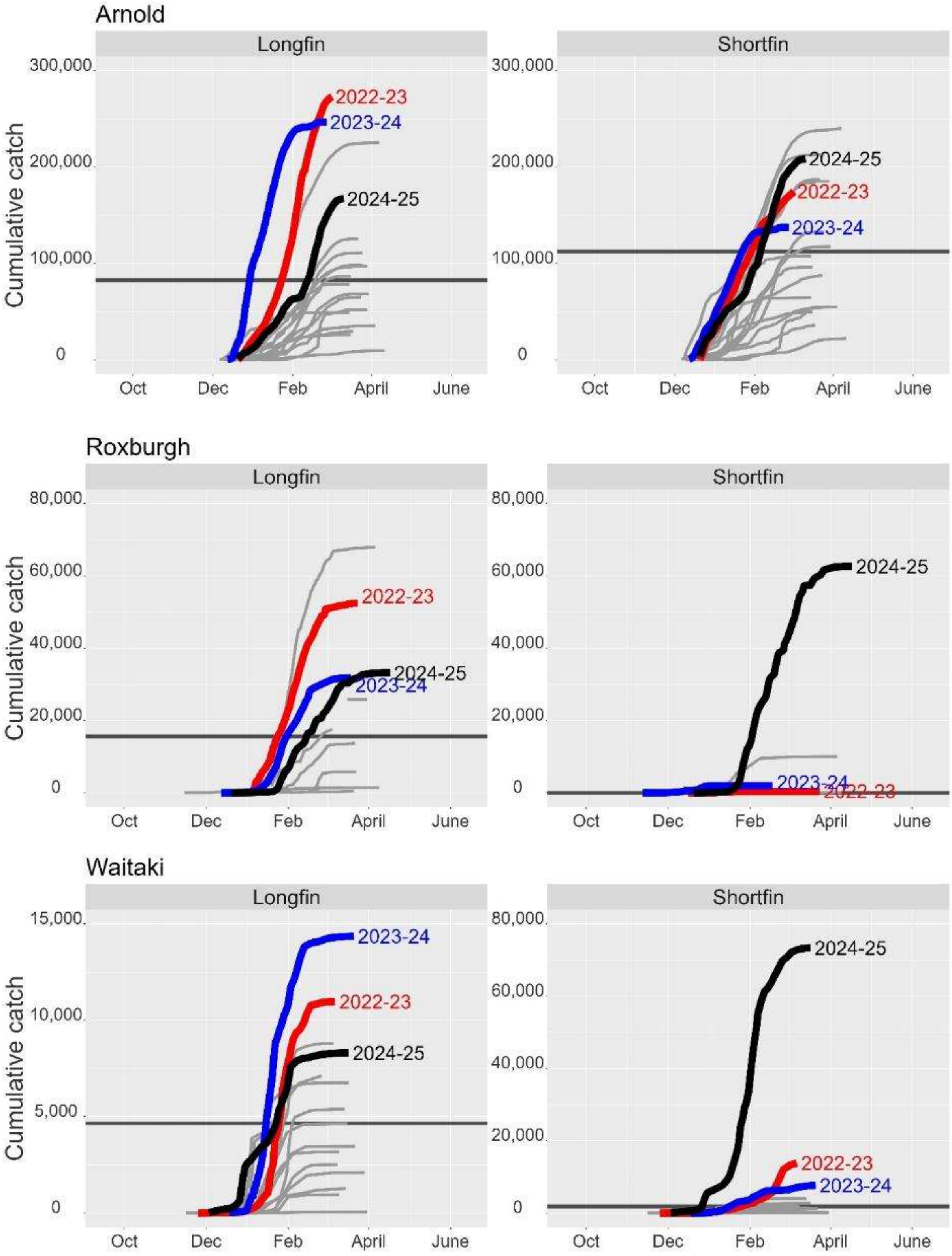


Figure 3: Cumulative elver catches of longfin (left) and shortfin (right) for the 2022–23 (red), 2023–24 (blue) and 2024–25 (black) seasons for South Island sites with reliable times series, including two primary (Waitaki Dam and Arnold Dam) and two secondary (Roxburgh Dam and Mararoa Weir). The horizontal black line shows the median catch from Table 4. **(Continued next page)**

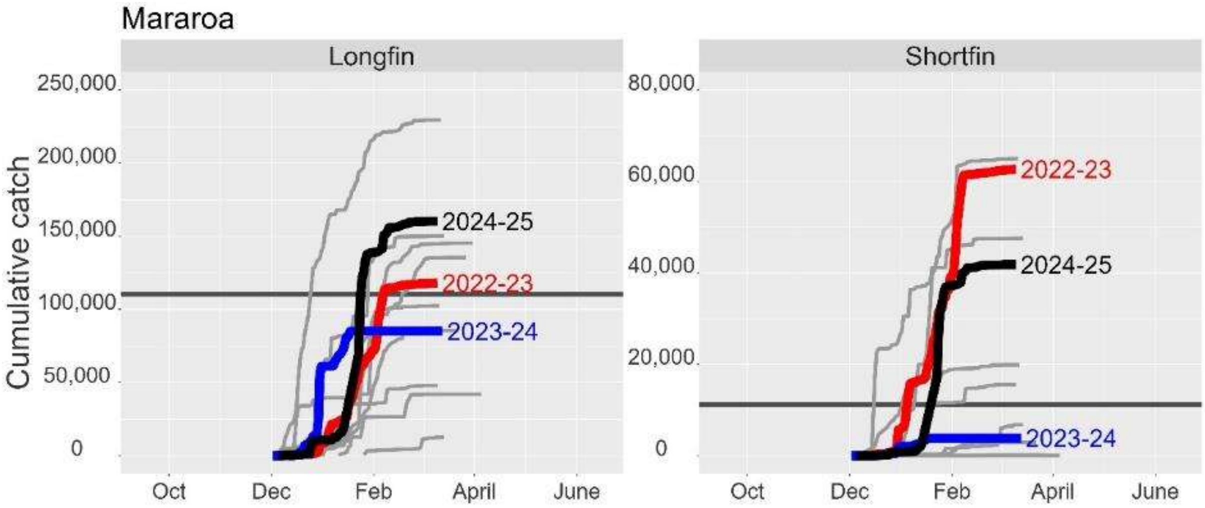


Figure 3: Continued

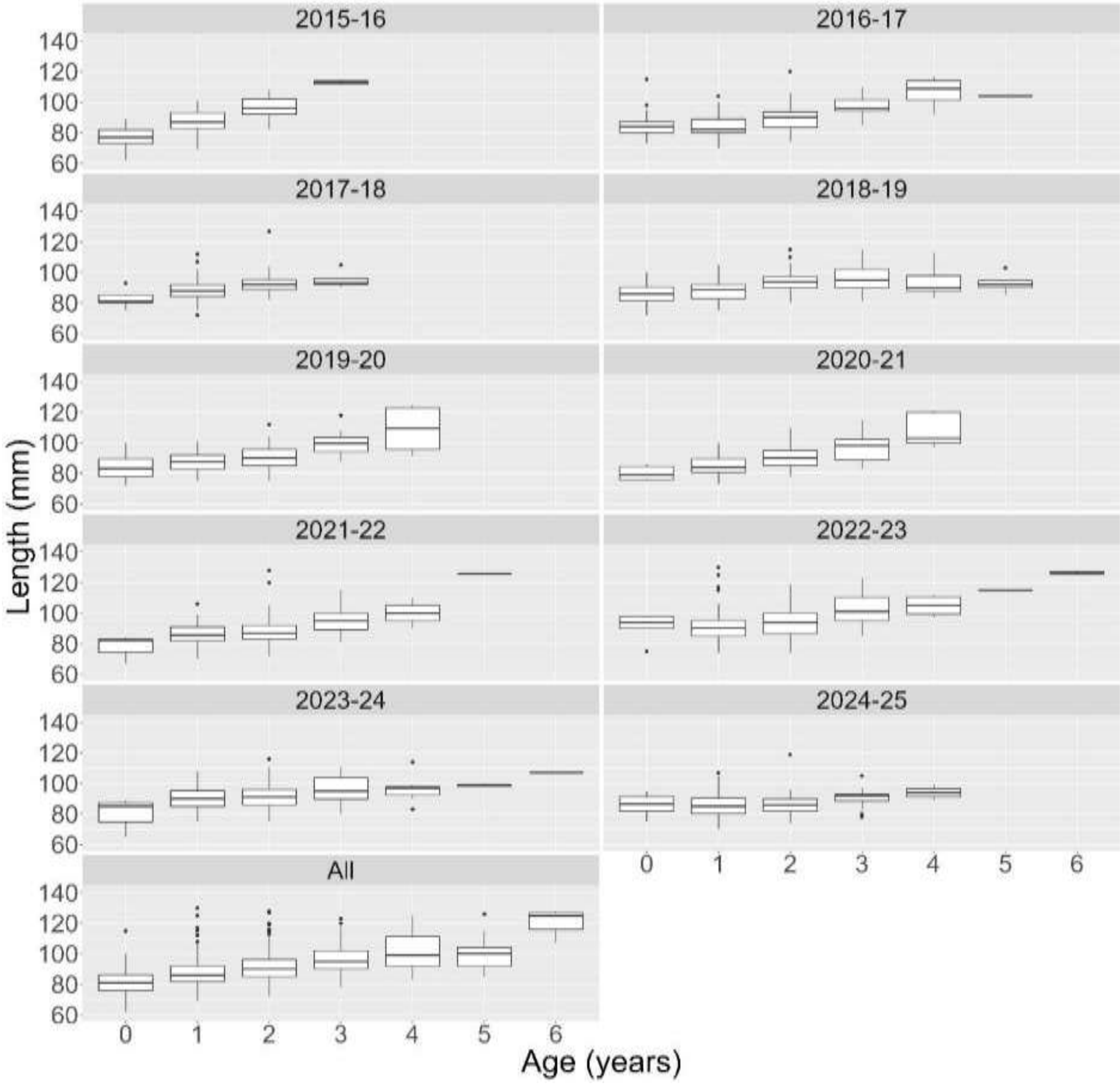


Figure 4: Shortfin length distributions for each age class collected from Karāpiro Dam from the 2015–16 to 2024–25 seasons and all seasons combined. Box plots show median, interquartile range, outliers (dots), and the range of lengths for each age class.

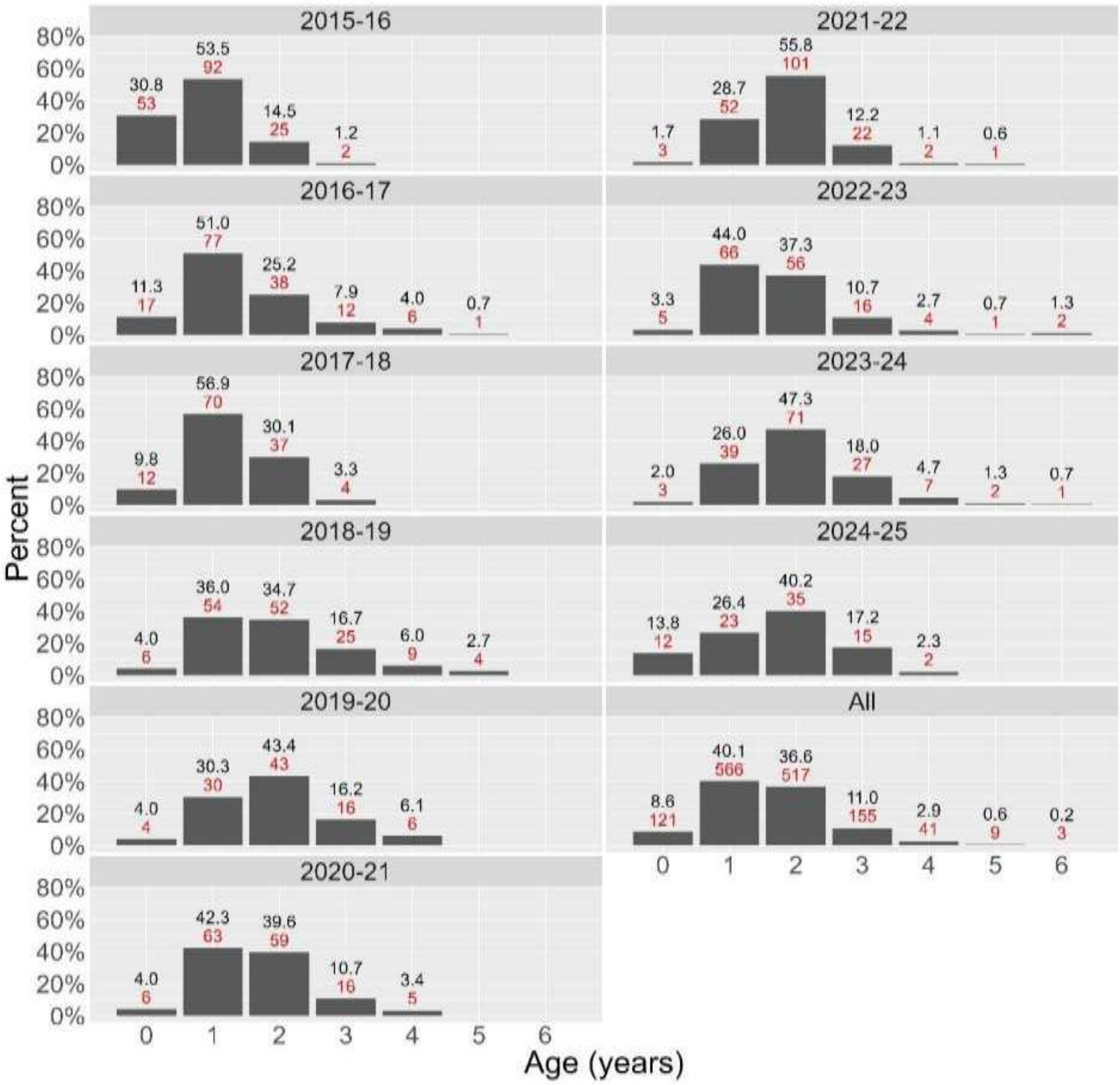


Figure 5: Shortfin age composition for each season at Karāpiro Dam between 2015–16 and 2024–25 and all seasons combined. The sample size of age classes collected each season is shown in red and the annual percentage of each age class is shown in black.

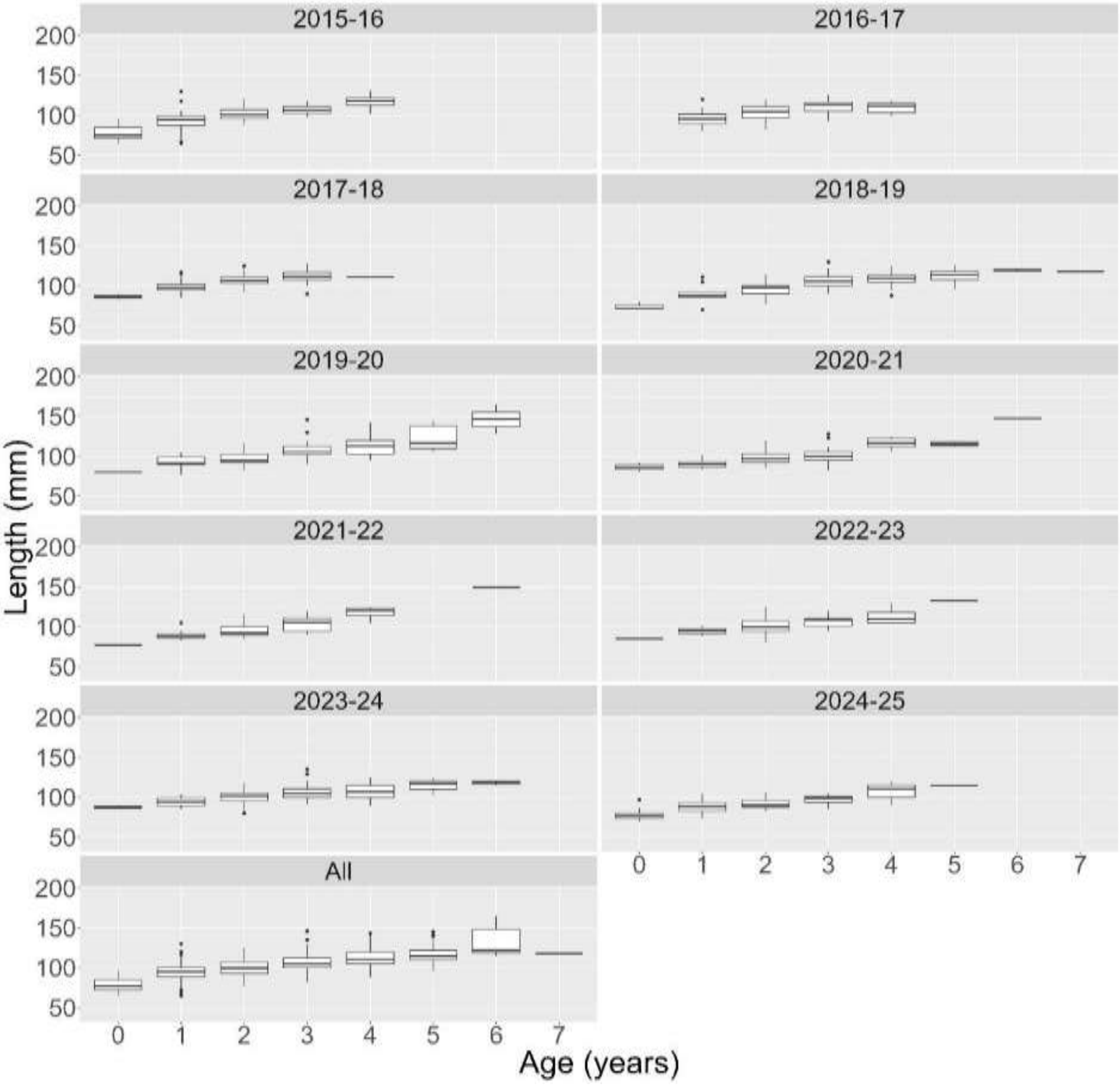


Figure 6: Longfin length distributions for each age class collected from Karāpiro Dam from the 2015–16 to 2024–25 seasons and all seasons combined. Box plots show median, interquartile range, outliers (dots), and the range of lengths for each age class.

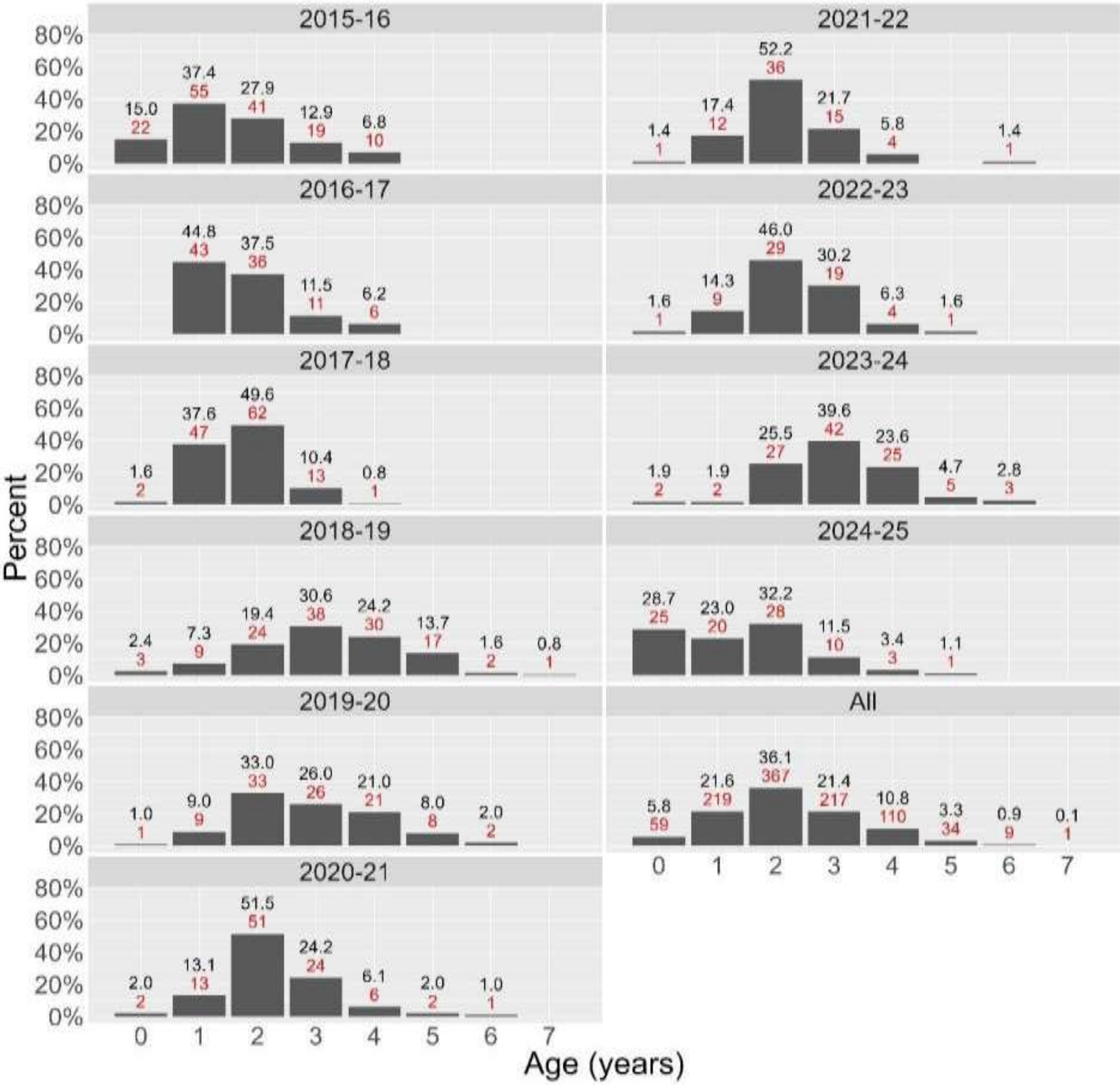


Figure 7: Longfin age composition for each season at Karāpiro Dam between 2015–16 and 2024–25 and all seasons combined. The sample size of age classes collected each season is shown in red and the annual percentage of each age class is shown in black.

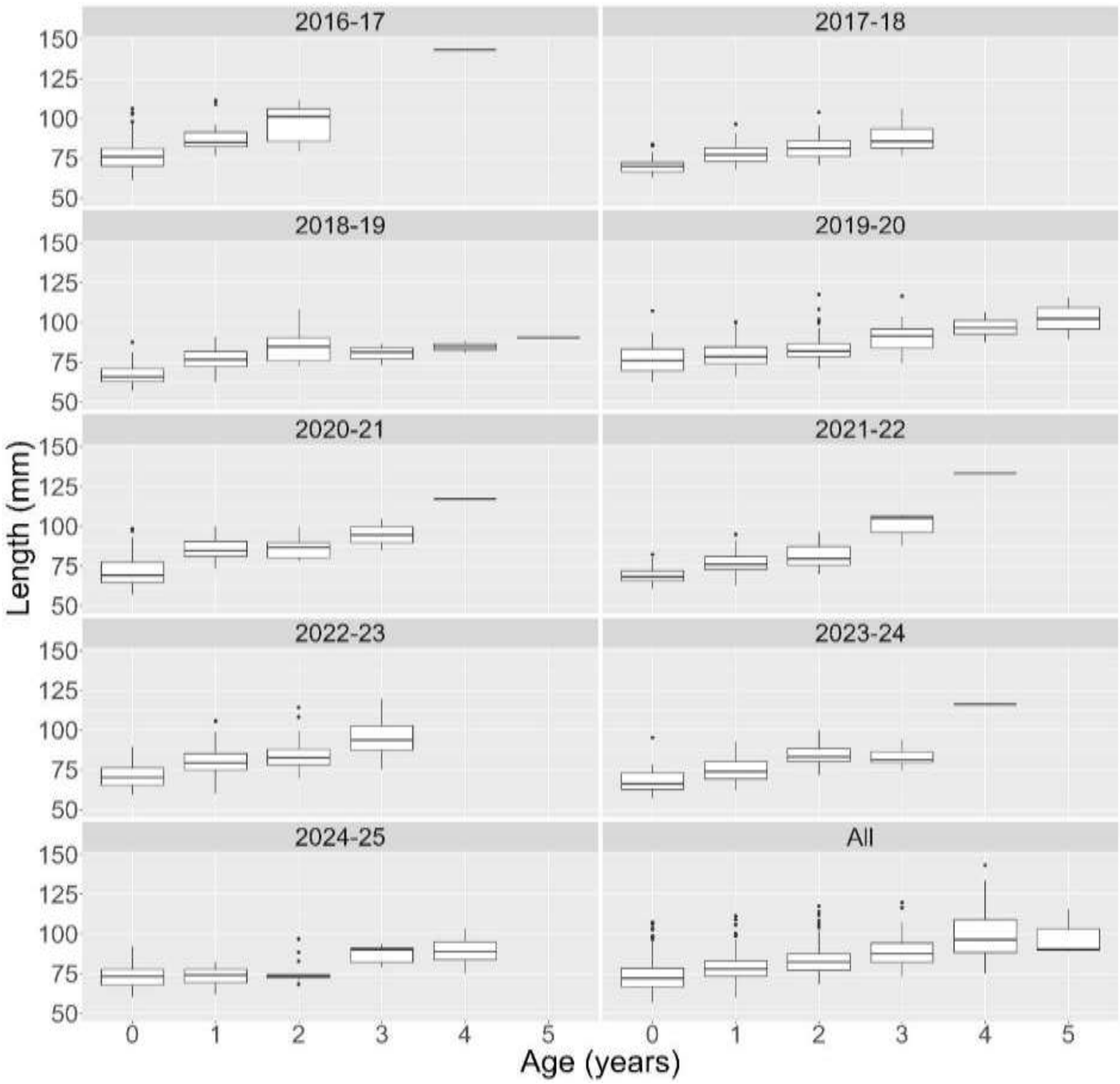


Figure 8: Shortfin length distributions for each age class collected from Patea Dam from the 2016–17 to 2024–25 seasons and all seasons combined. Box plots show median, interquartile range, outliers (dots), and the range of lengths for each age class.

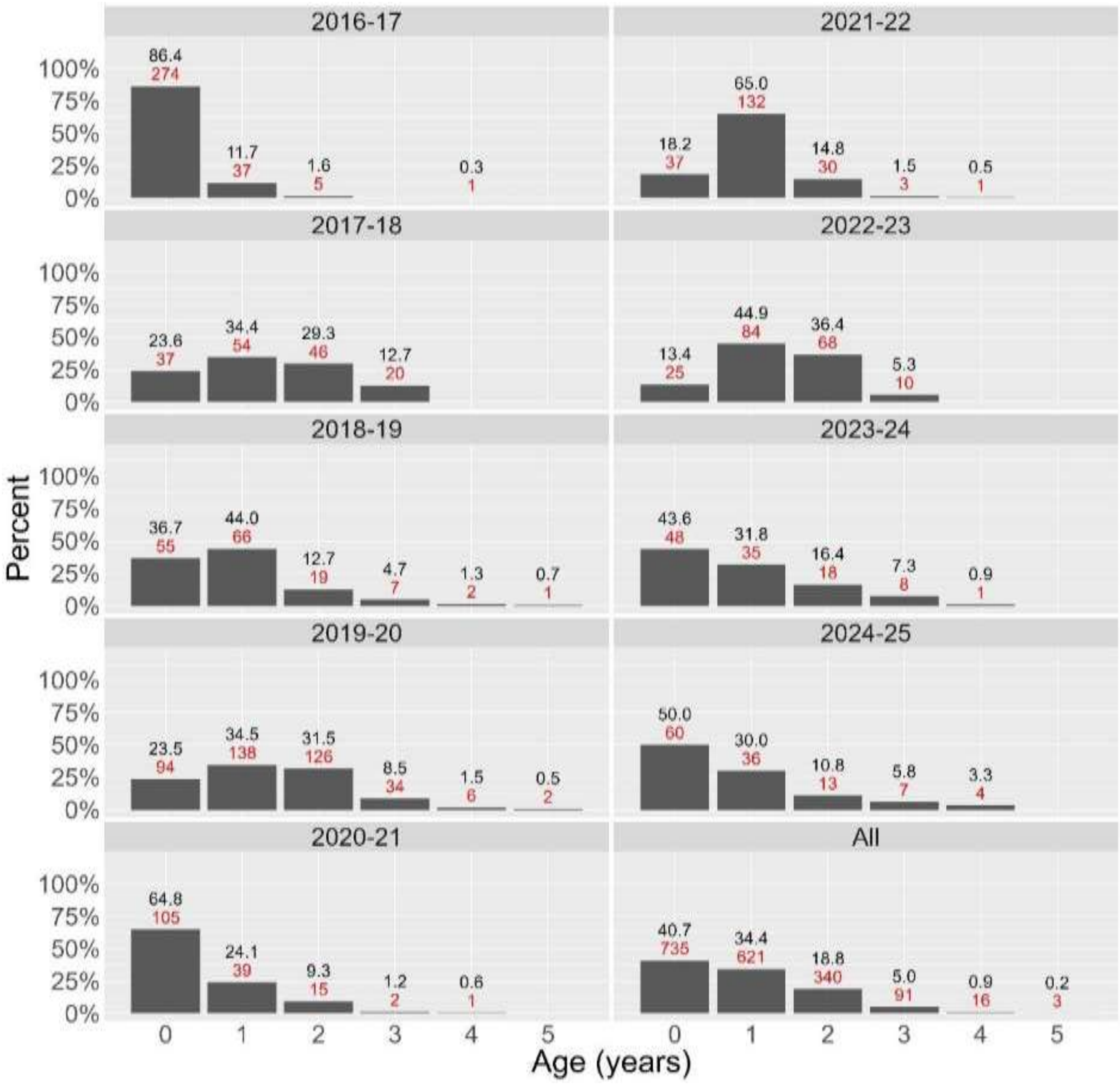


Figure 9: Shortfin age composition for each season at Patea Dam between 2016–17 and 2024–25 and all seasons combined. The sample size of age classes collected each season is shown in red and the annual percentage of each age class is shown in black.

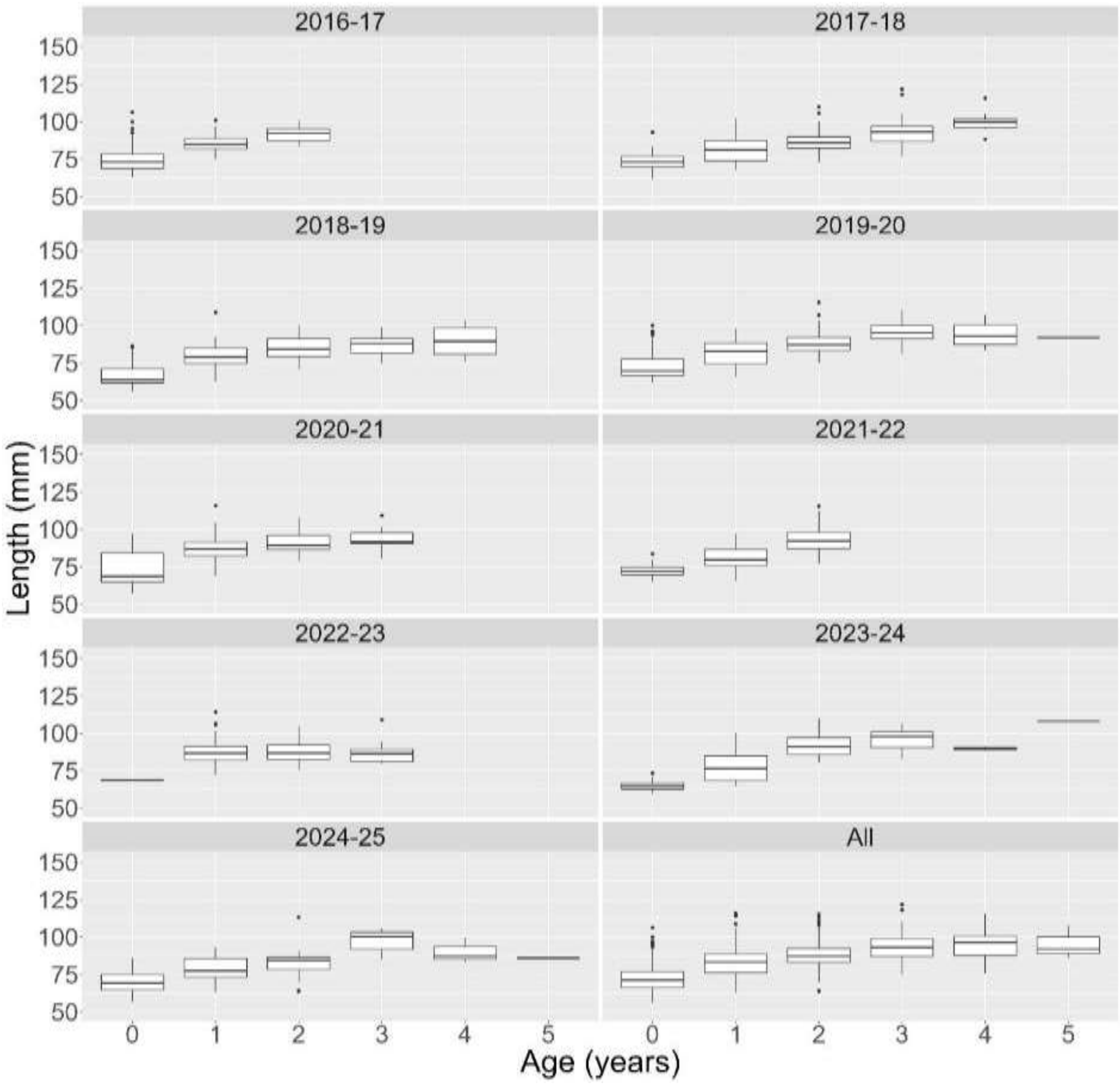


Figure 10: Longfin length distributions for each age class collected from Patea Dam from the 2016–17 to 2024–25 seasons and all seasons combined. Box plots show median, interquartile range, outliers (dots), and the range of lengths for each age class.

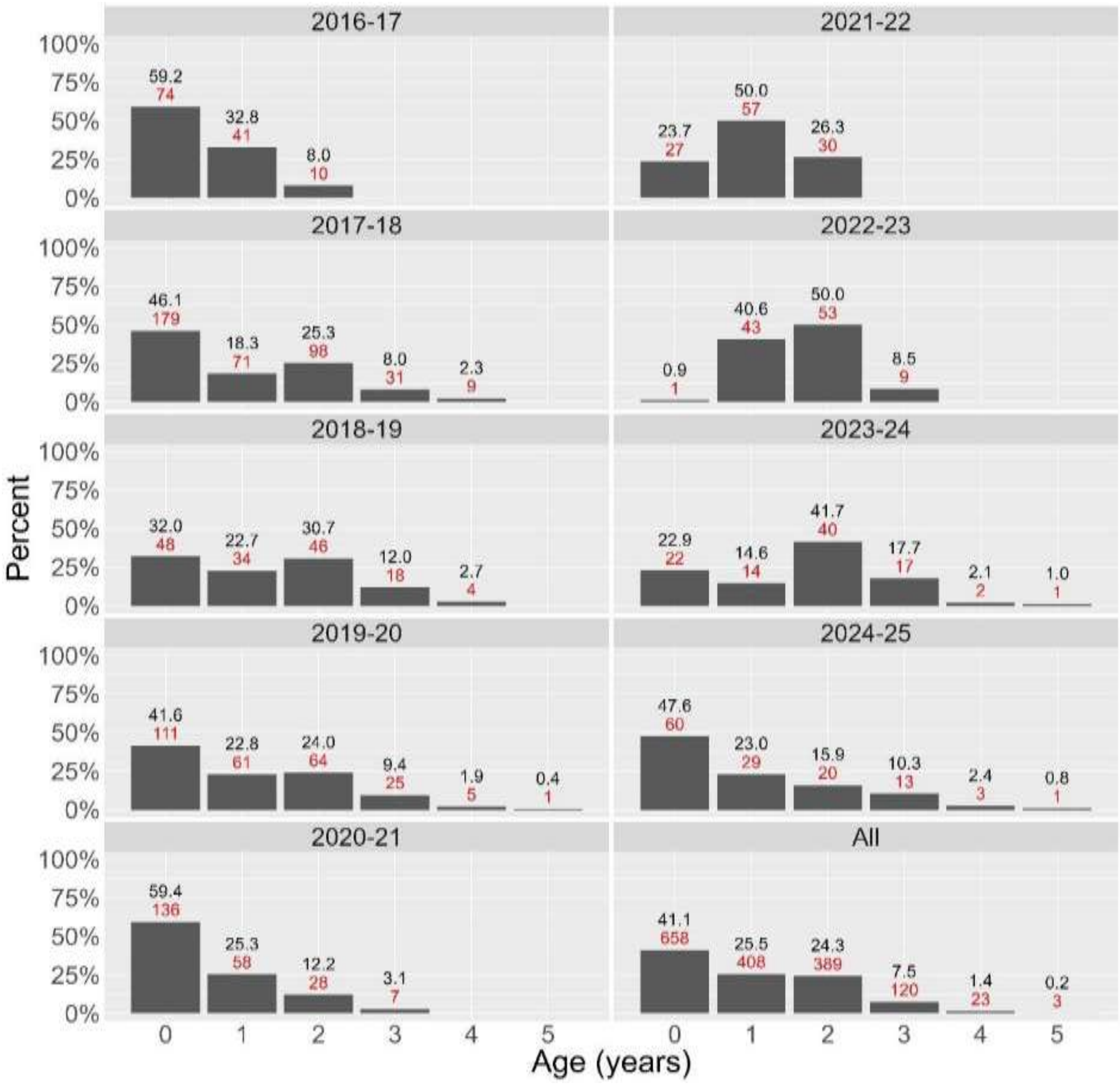


Figure 11: Longfin age composition for each season at Patea Dam between 2016–17 and 2024–25 and all seasons combined. The sample size of age classes collected each season is shown in red and the annual percentage of each age class is shown in black.

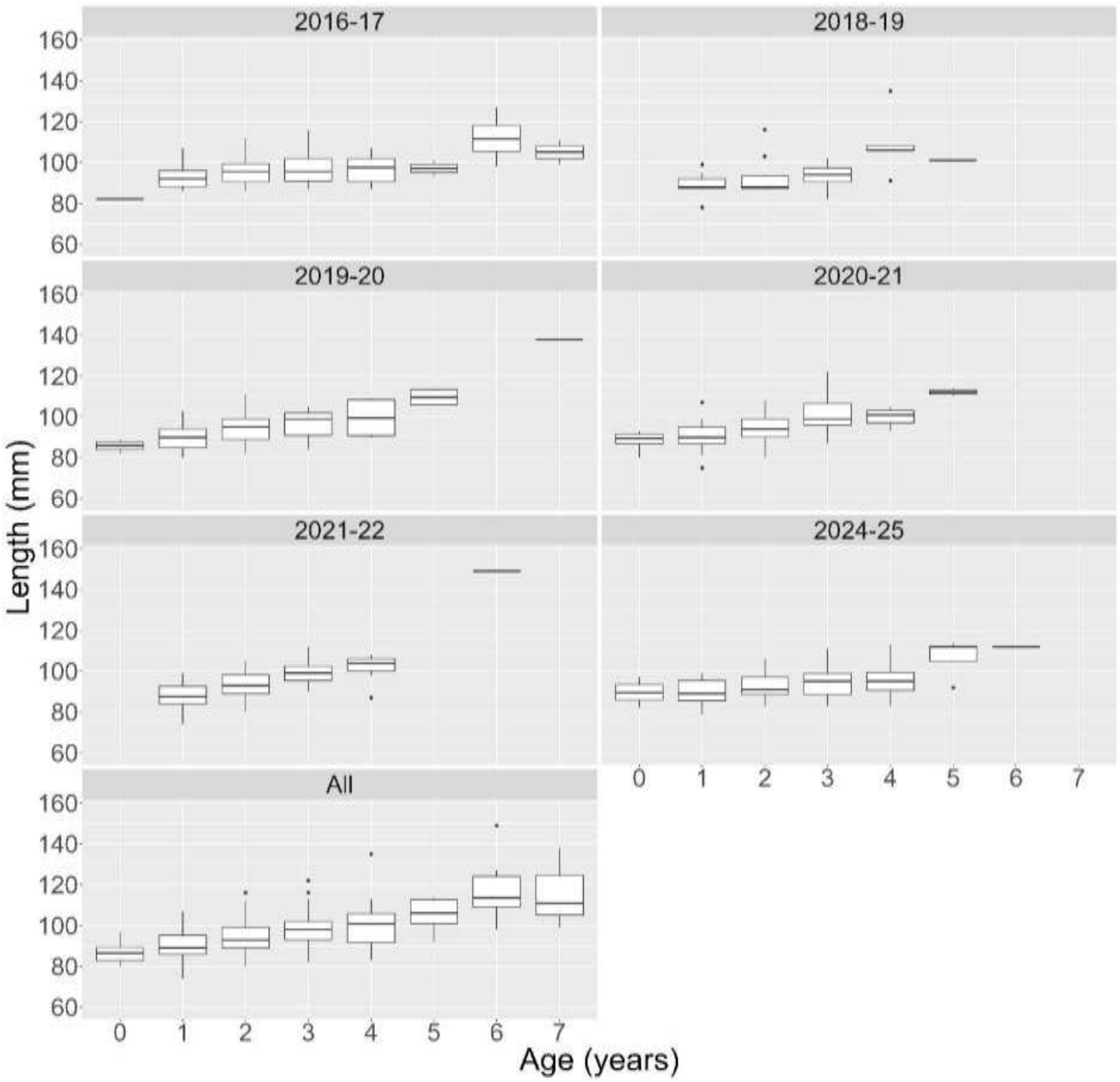


Figure 12: Shortfin length distributions for each age class collected from Matahina Dam from the 2016–17 to 2024–25 seasons and all seasons combined. Box plots show median, interquartile range, outliers (dots), and the range of lengths for each age class.

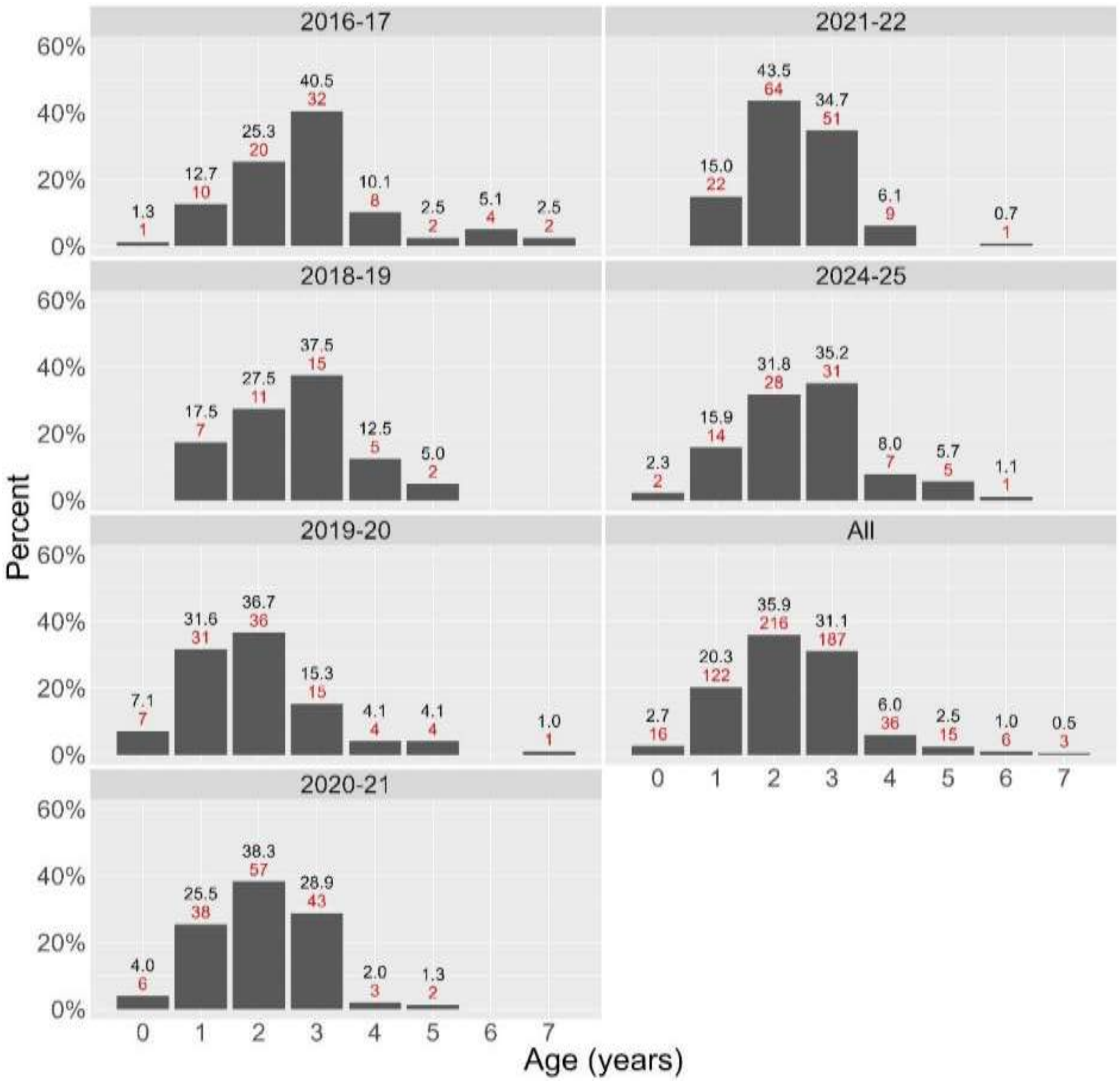


Figure 13: Shortfin age composition for each season at Matahina Dam between 2016–17 and 2024–25 and all seasons combined. The sample size of age classes collected each season is shown in red and the annual percentage of each age class is shown in black.

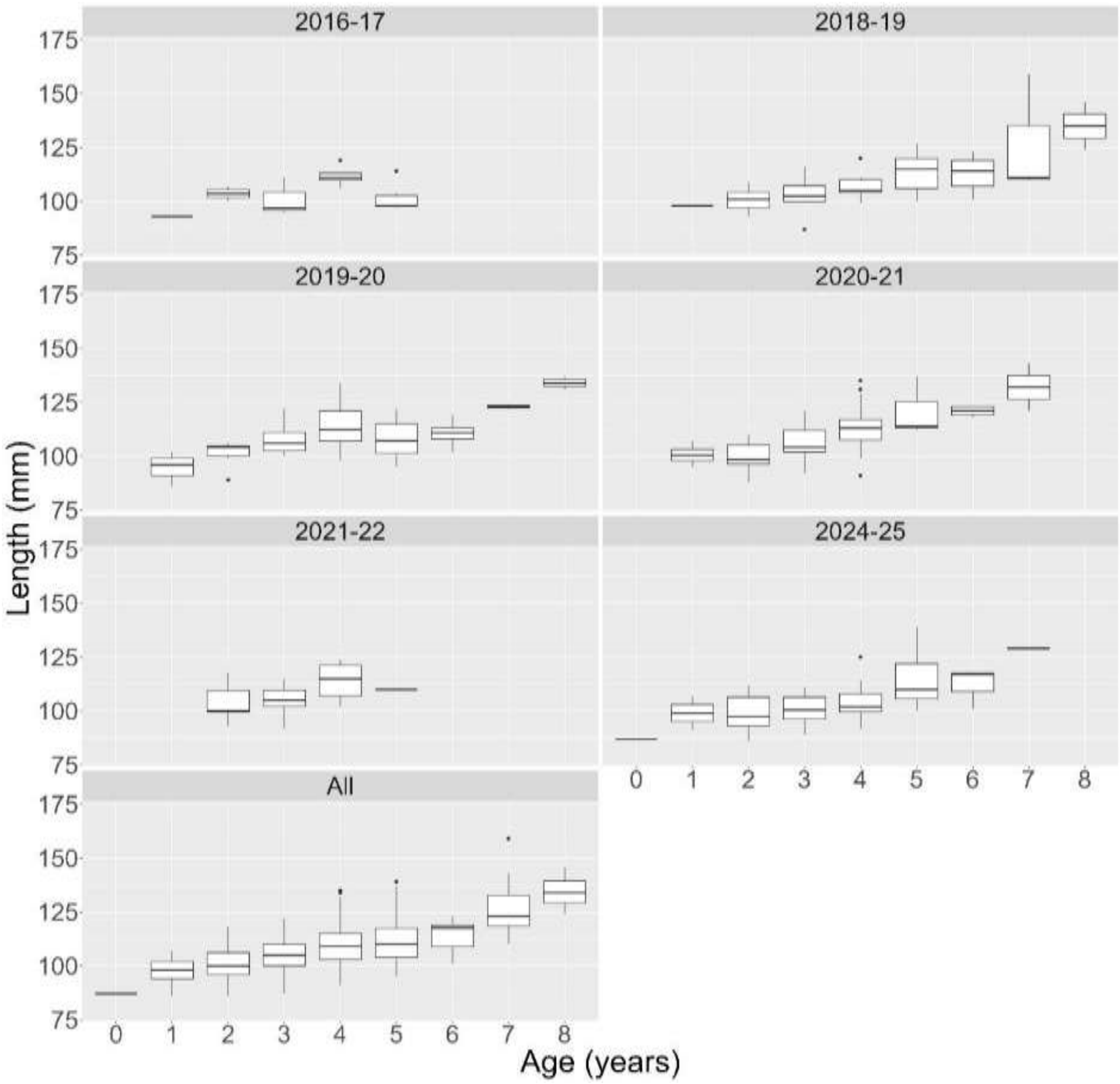


Figure 14: Longfin length distributions for each age class collected from Matahina Dam from the 2016–17 to 2024–25 seasons and all seasons combined. Box plots show median, interquartile range, outliers (dots), and the range of lengths for each age class.

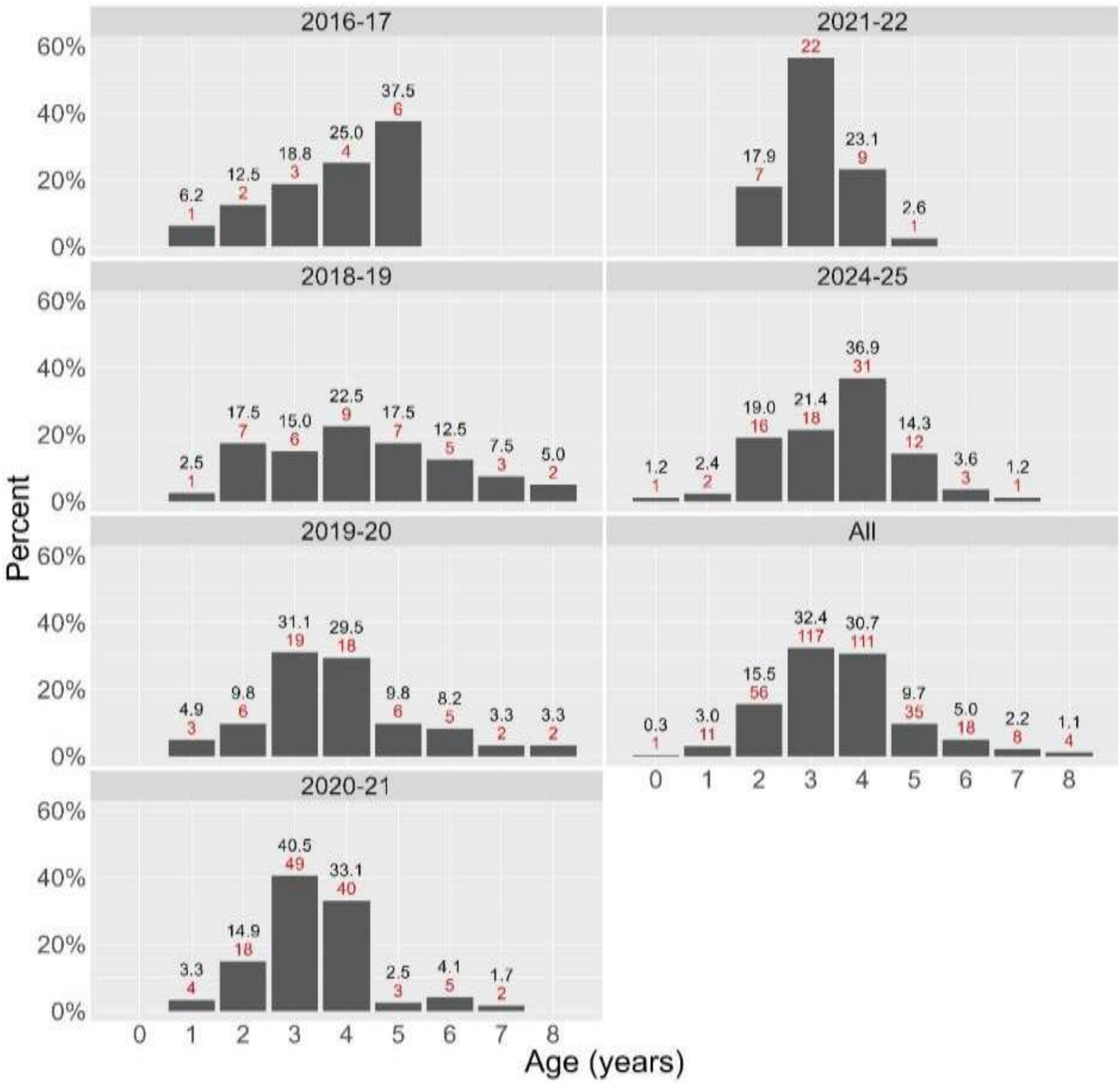


Figure 15: Longfin age composition for each season at Matahina Dam between 2016–17 and 2024–25 and all seasons combined. The sample size of age classes collected each season is shown in red and the annual percentage of each age class is shown in black.

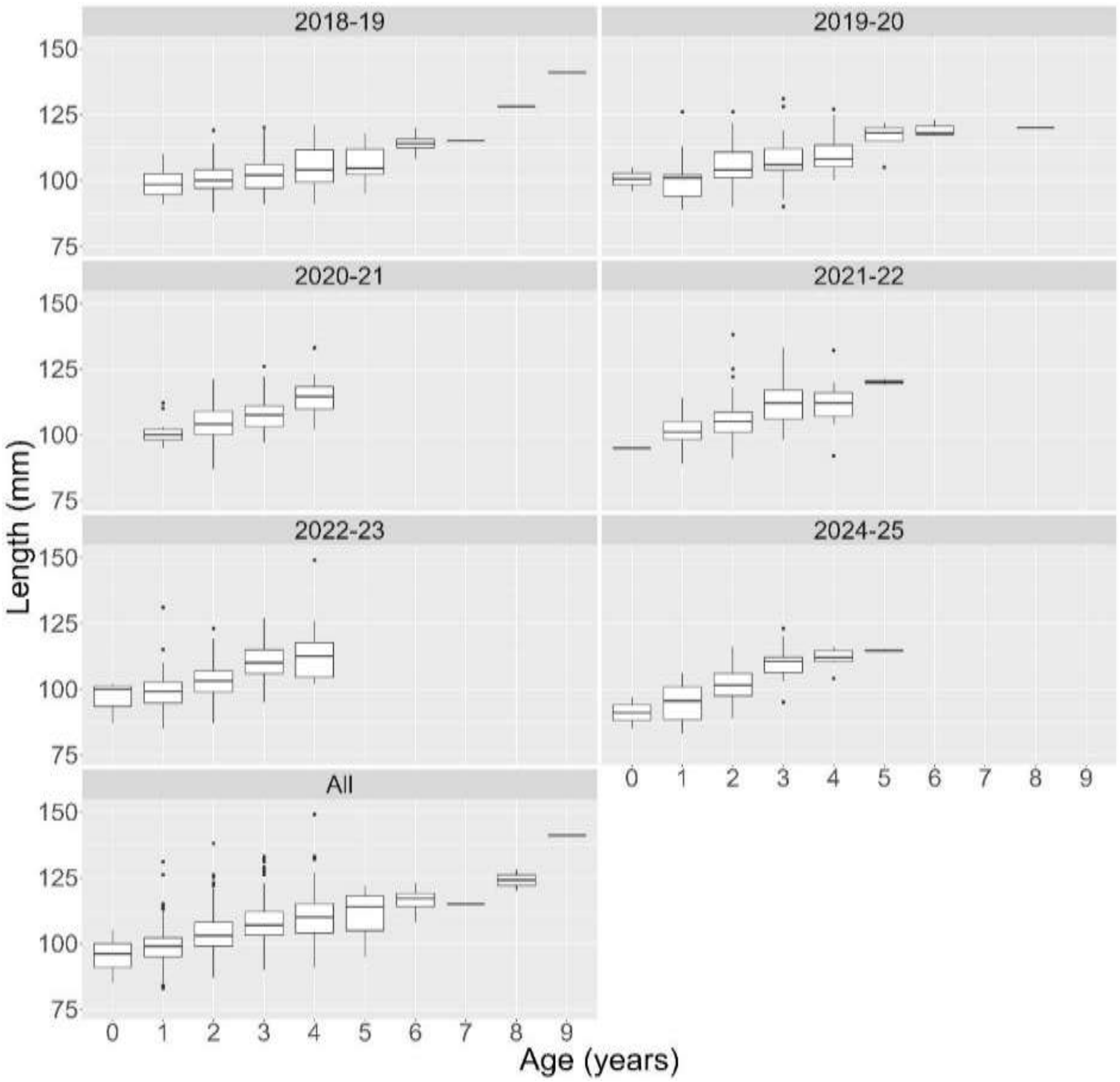


Figure 16: Shortfin length distributions for each age class collected from Arnold Dam from the 2018–19 to 2024–25 seasons and all seasons combined. Box plots show median, interquartile range, outliers (dots), and the range of lengths for each age class.

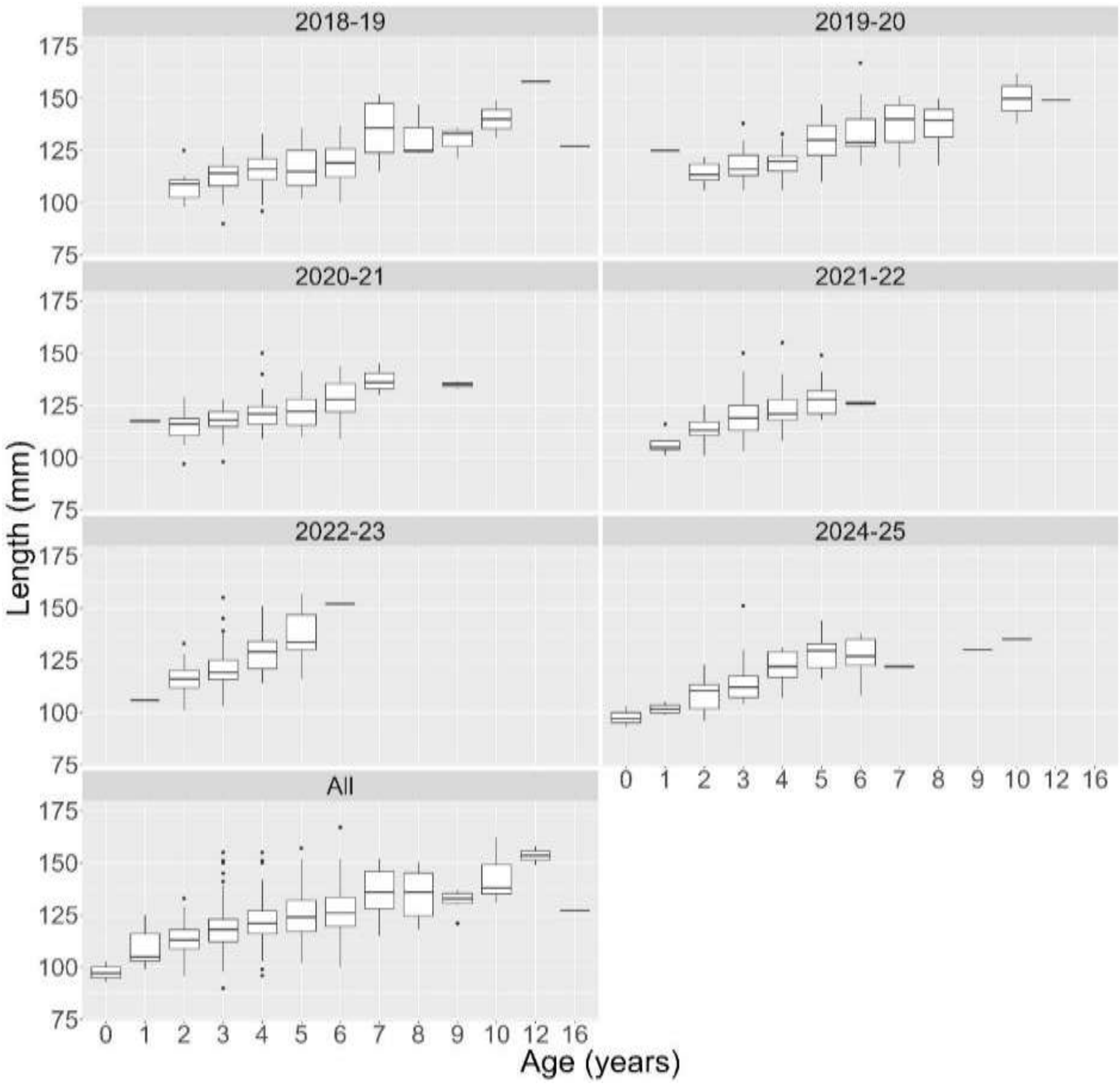


Figure 17: Longfin length distributions for each age class collected from Arnold Dam from the 2018–19 to 2024–25 seasons and all seasons combined. Box plots show median, interquartile range, outliers (dots), and the range of lengths for each age class.

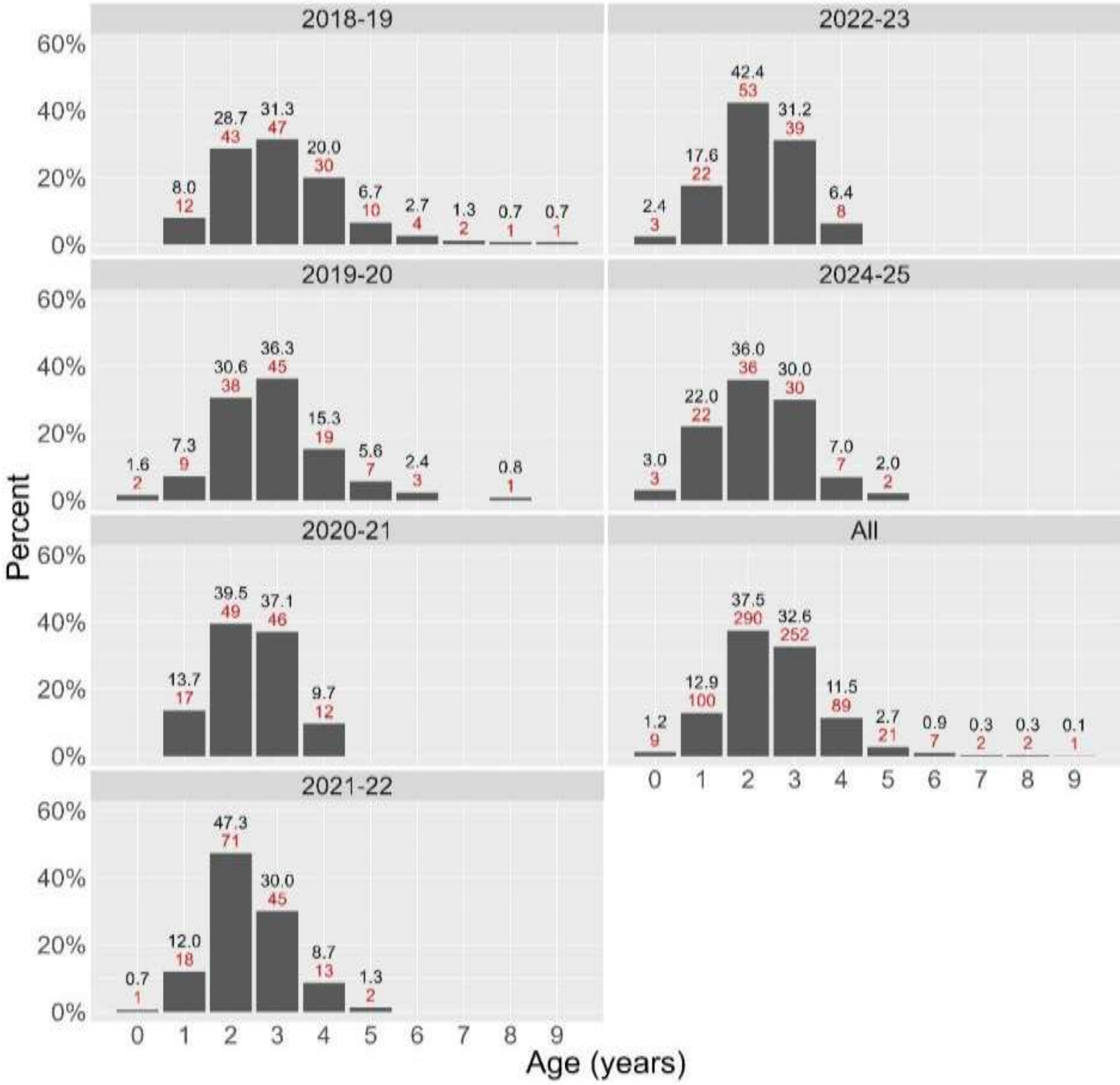


Figure 18: Shortfin age composition for each season at Arnold Dam between 2018–19 and 2024–25 and all seasons combined. The sample size of age classes collected each season is shown in red and the annual percentage of each age class is shown in black.

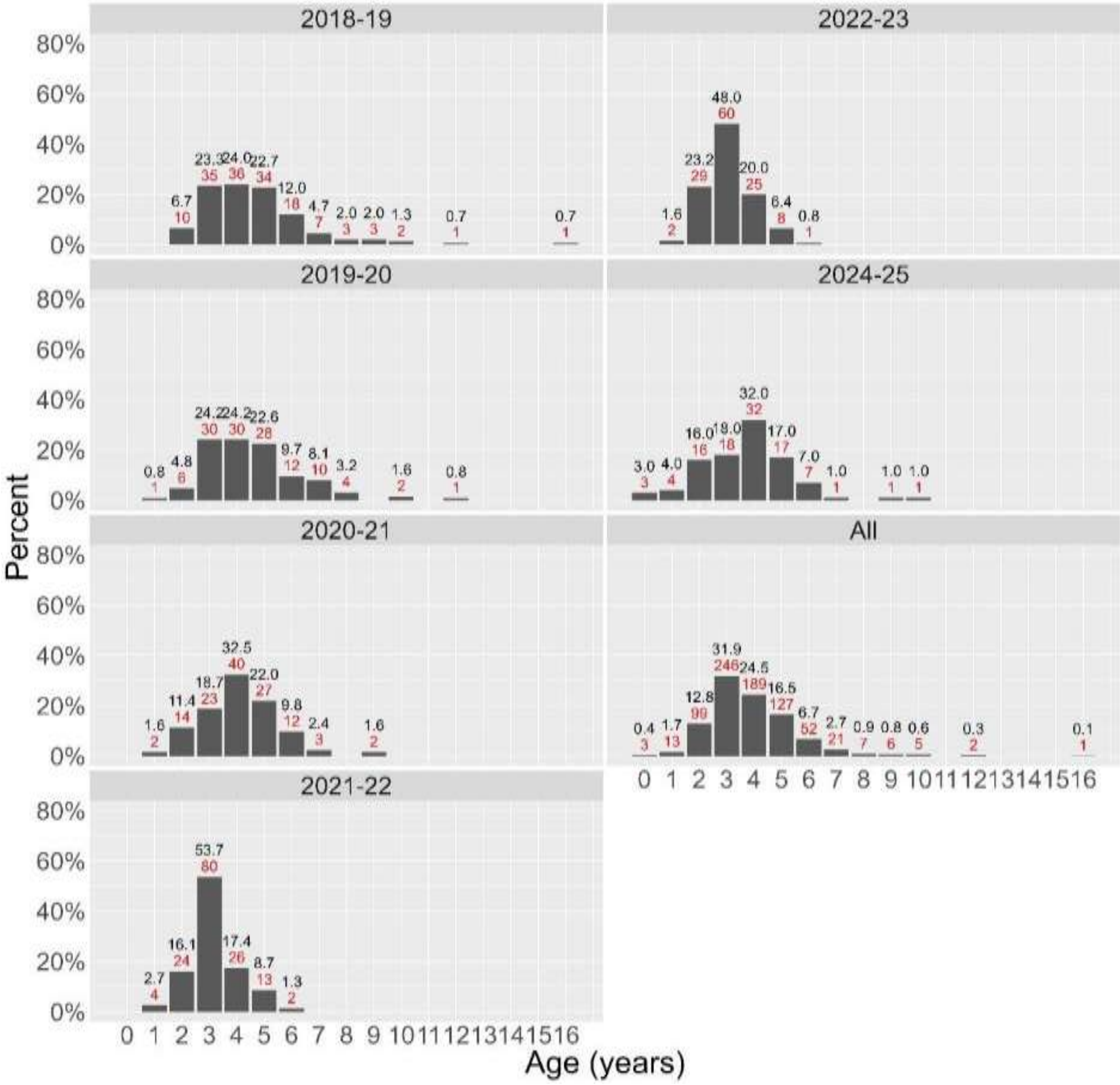


Figure 19: Longfin age composition for each season at Arnold Dam between 2018–19 and 2024–25 and all seasons combined. The sample size of age classes collected each season is shown in red and the annual percentage of each age class is shown in black.

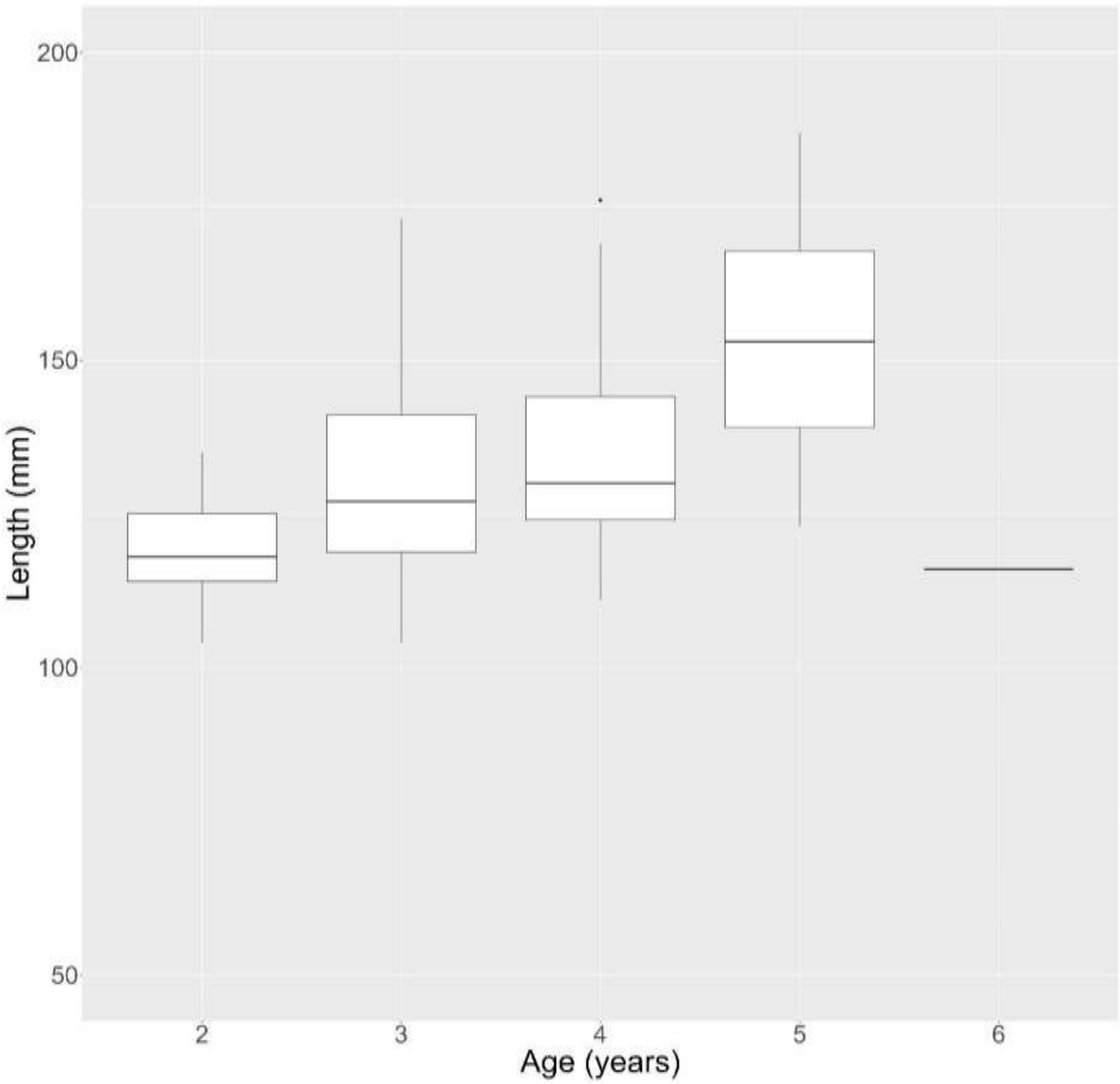


Figure 20: Shortfin length distributions for each age class at the Waitaki Dam from the 2021–22 season. Box plots show median, interquartile range, outliers (dots), and the range of lengths for each age class.

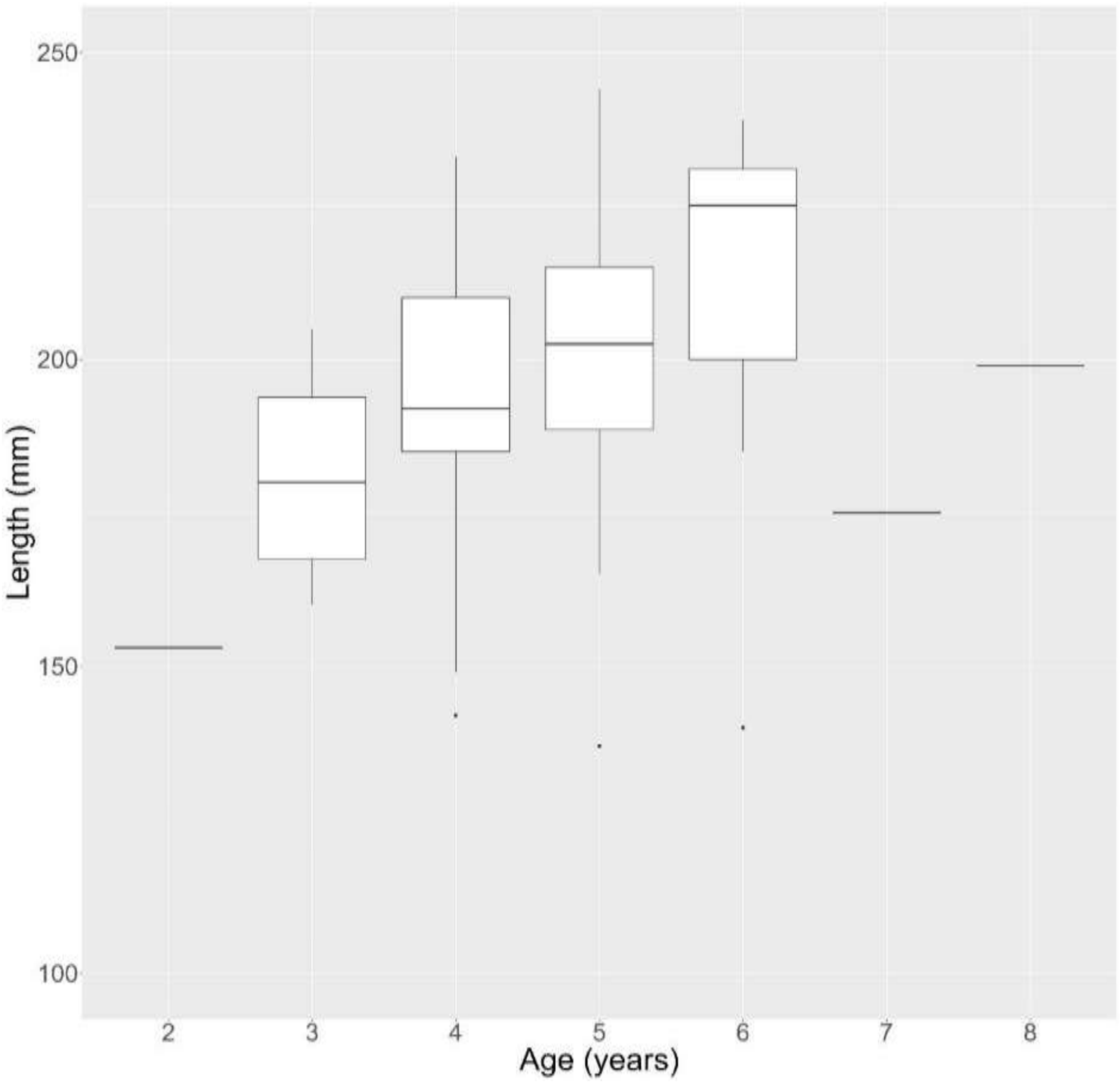


Figure 21: Longfin length distributions for each age class at the Waitaki Dam from the 2021–22 season. Box plots show median, interquartile range, outliers (dots), and the range of lengths for each age class.

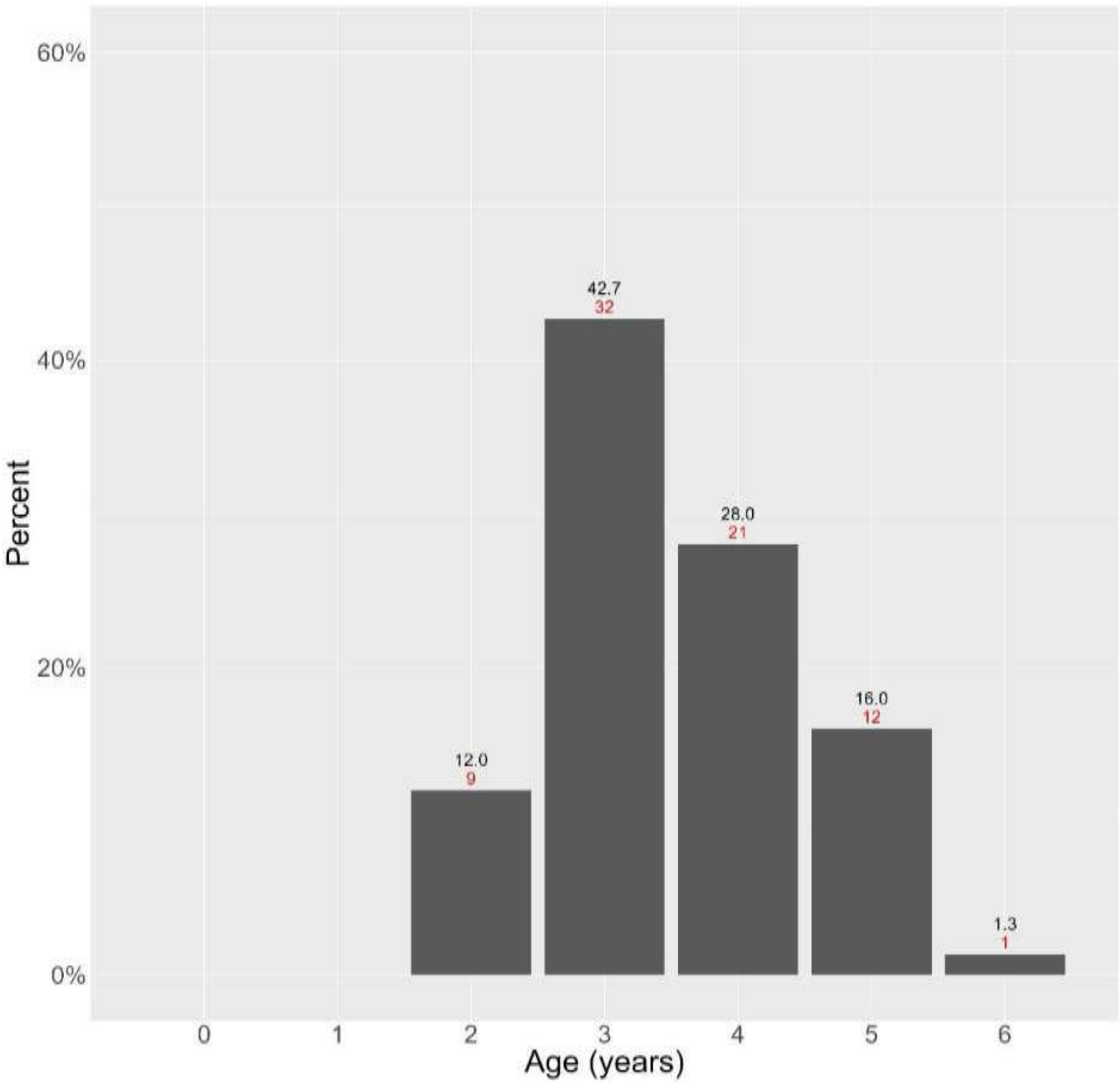


Figure 22: Shortfin age composition for the Waitaki Dam from the 2021–22 season. The sample size of age classes collected each season is shown in red and the annual percentage of each age class is shown in black.

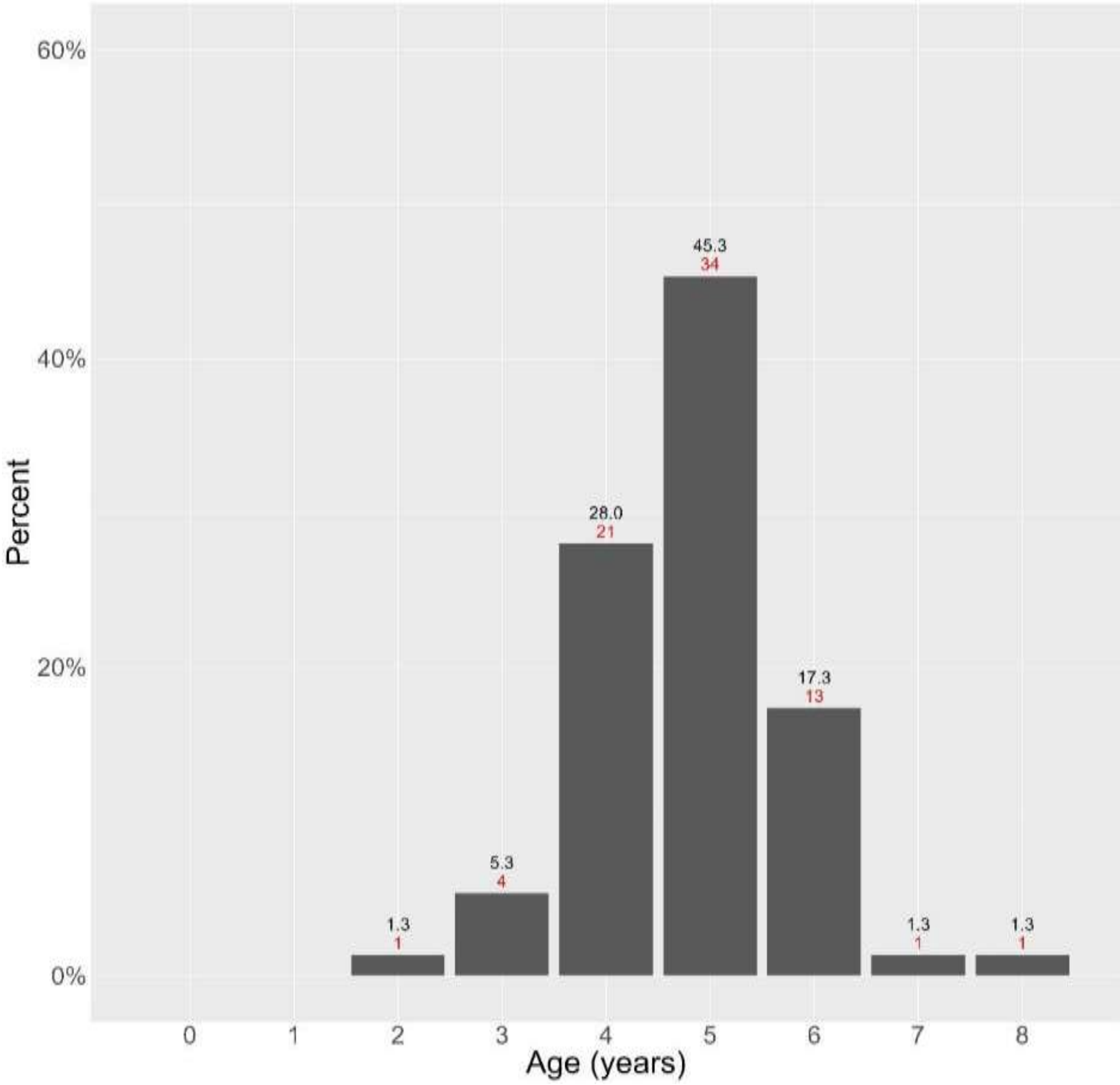


Figure 23: Longfin age composition for the Waitaki Dam from the 2021–22 season. The sample size of age classes collected each season is shown in red and the annual percentage of each age class is shown in black.

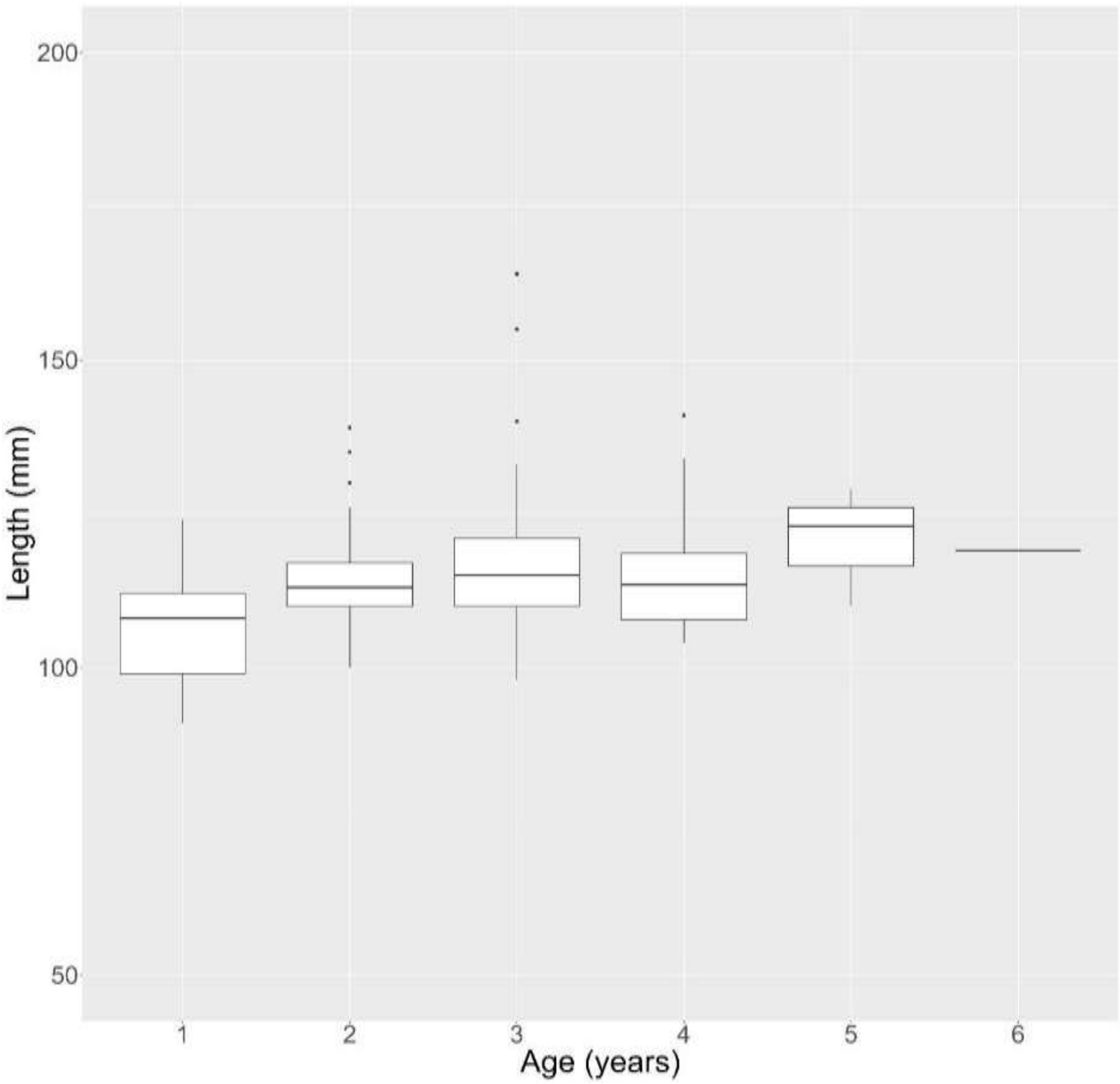


Figure 24: Shortfin length distributions for each age class at the Mararoa Lake Control Structure from the 2022–23 season. Box plots show median, interquartile range, outliers (dots), and the range of lengths for each age class.

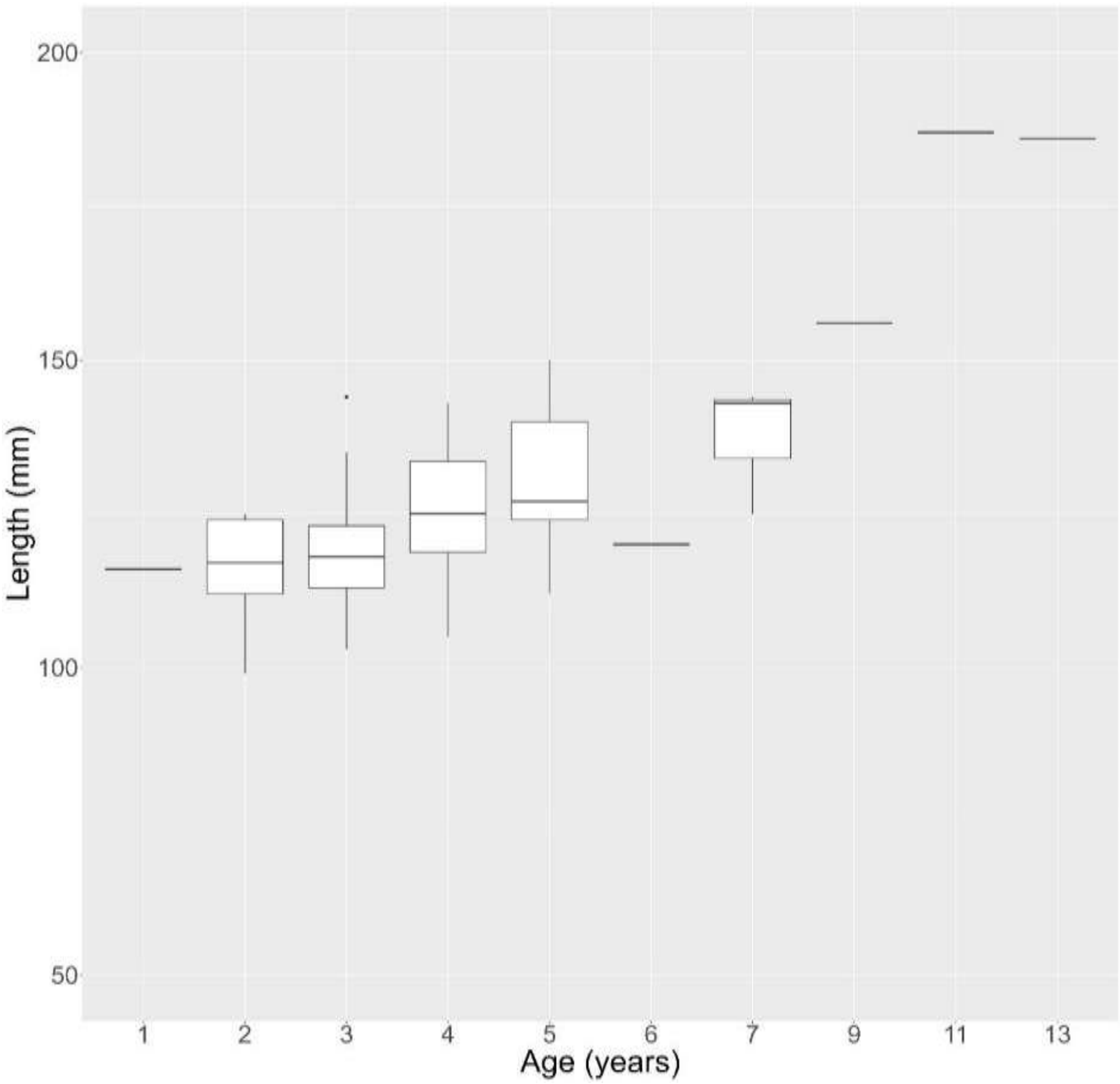


Figure 25: Longfin length distributions for each age class at the Mararoa Lake Control Structure from the 2022–23 season. Box plots show median, interquartile range, outliers (dots), and the range of lengths for each age class.

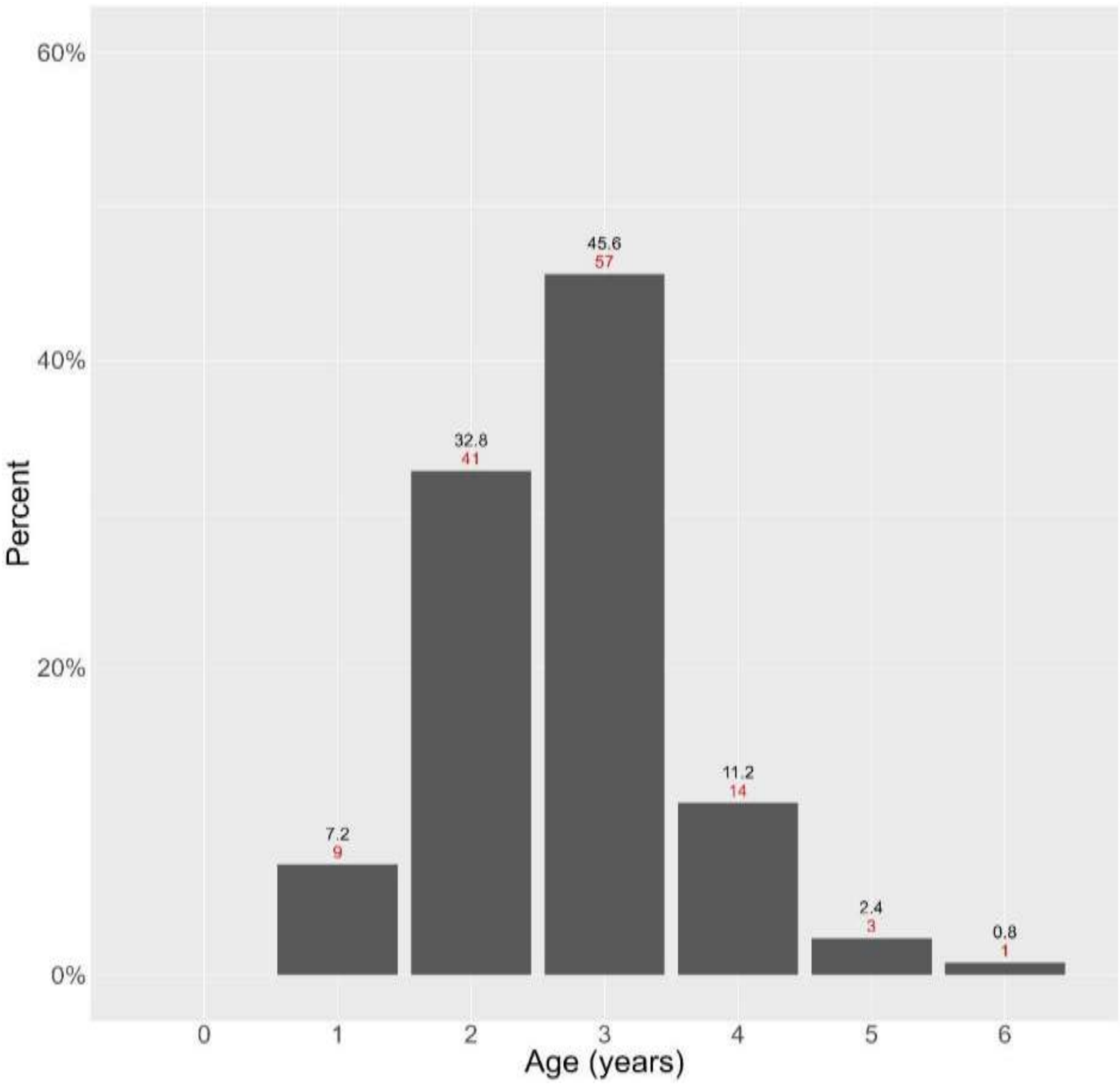


Figure 26: Shortfin age composition for each season for the Mararoa Lake Control Structure from the 2022–23 season. The sample size of age classes collected each season is shown in red and the annual percentage of each age class is shown in black.

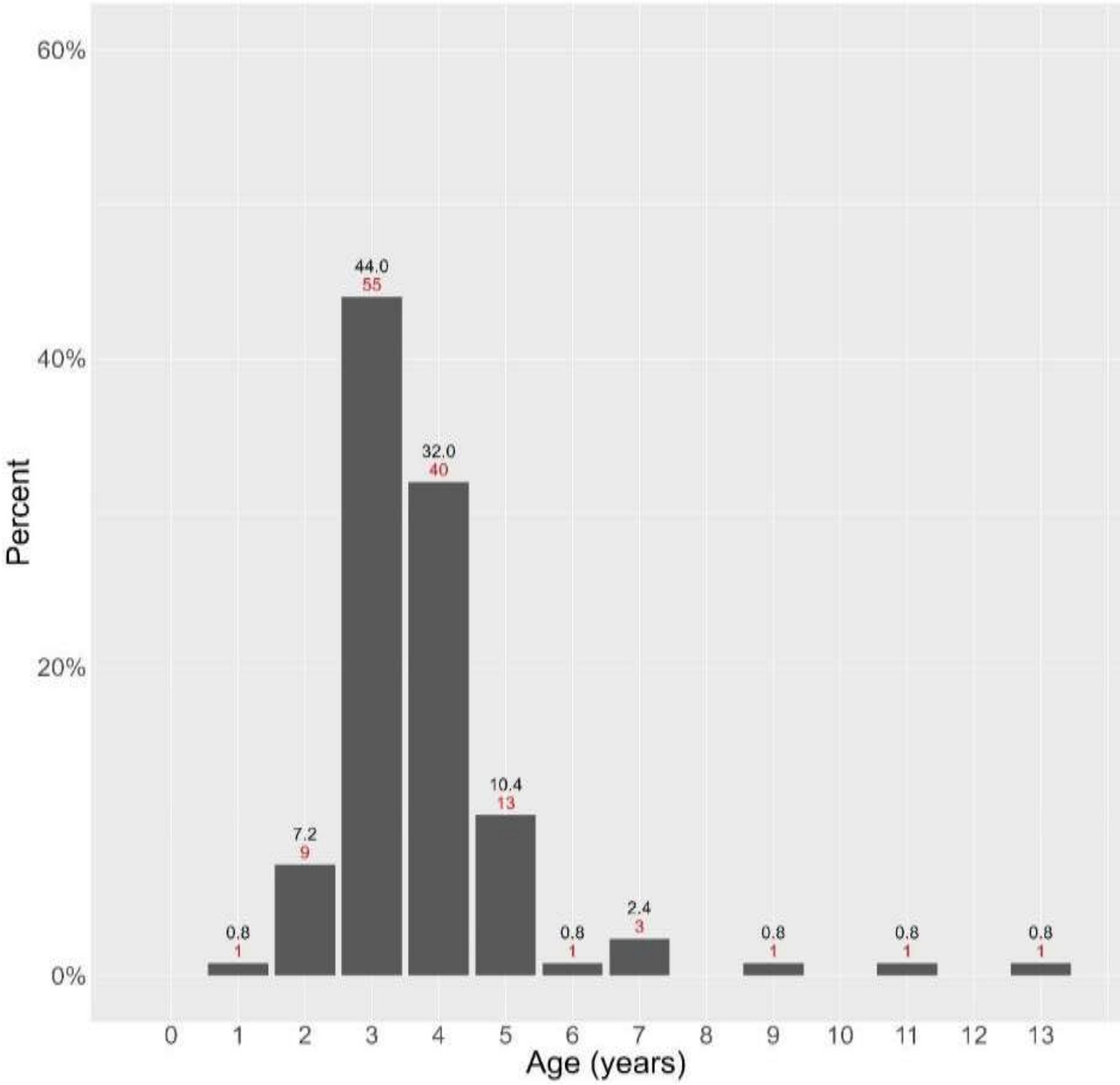


Figure 27: Longfin age composition for the Mararoa Lake Control Structure from the 2022–23 season. The sample size of age classes collected each season is shown in red and the annual percentage of each age class is shown in black.

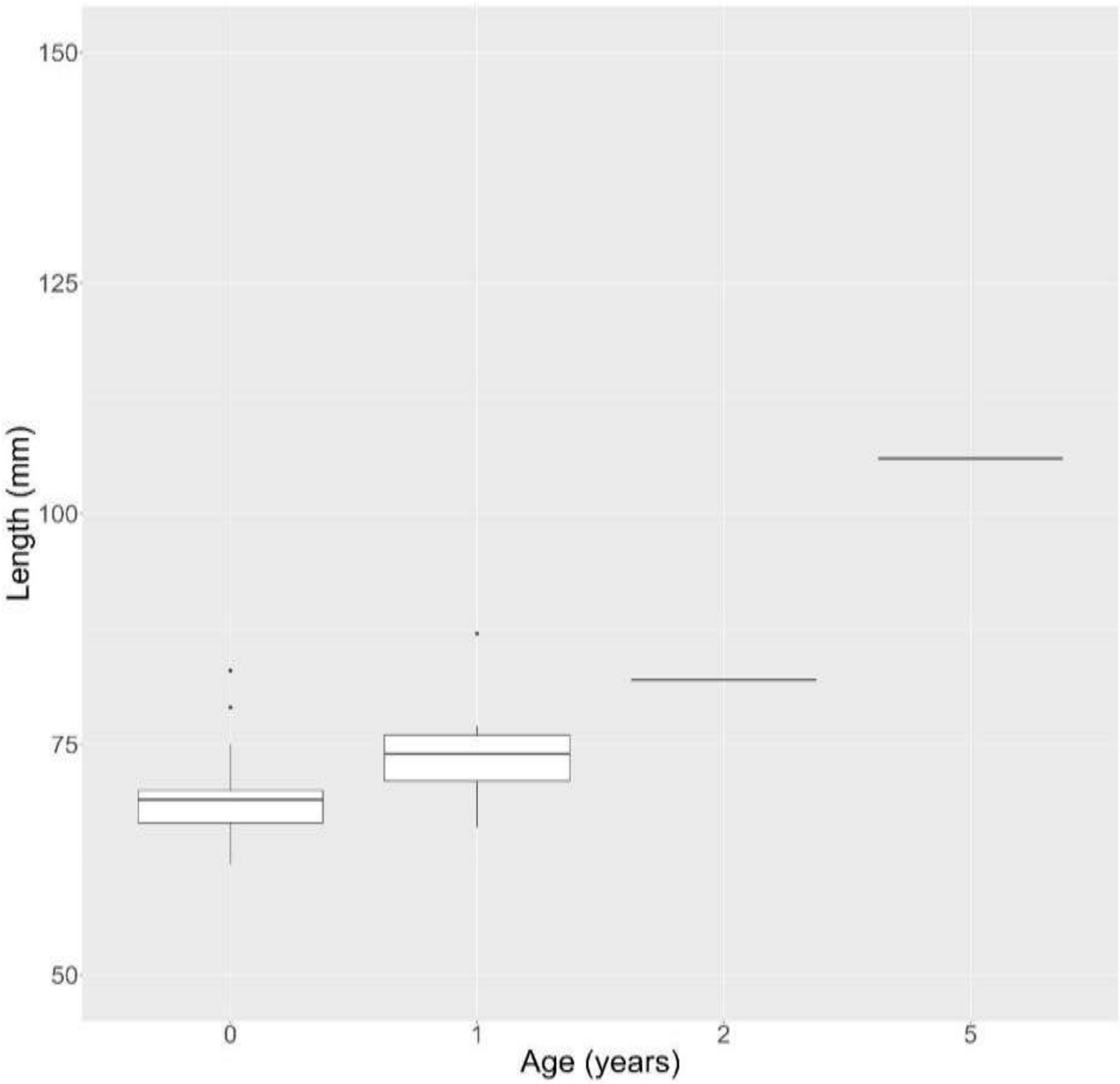


Figure 28: Shortfin length distributions for each age class at the Ruahihi Dam from the 2023–24 season. Box plots show median, interquartile range, outliers (dots), and the range of lengths for each age class.

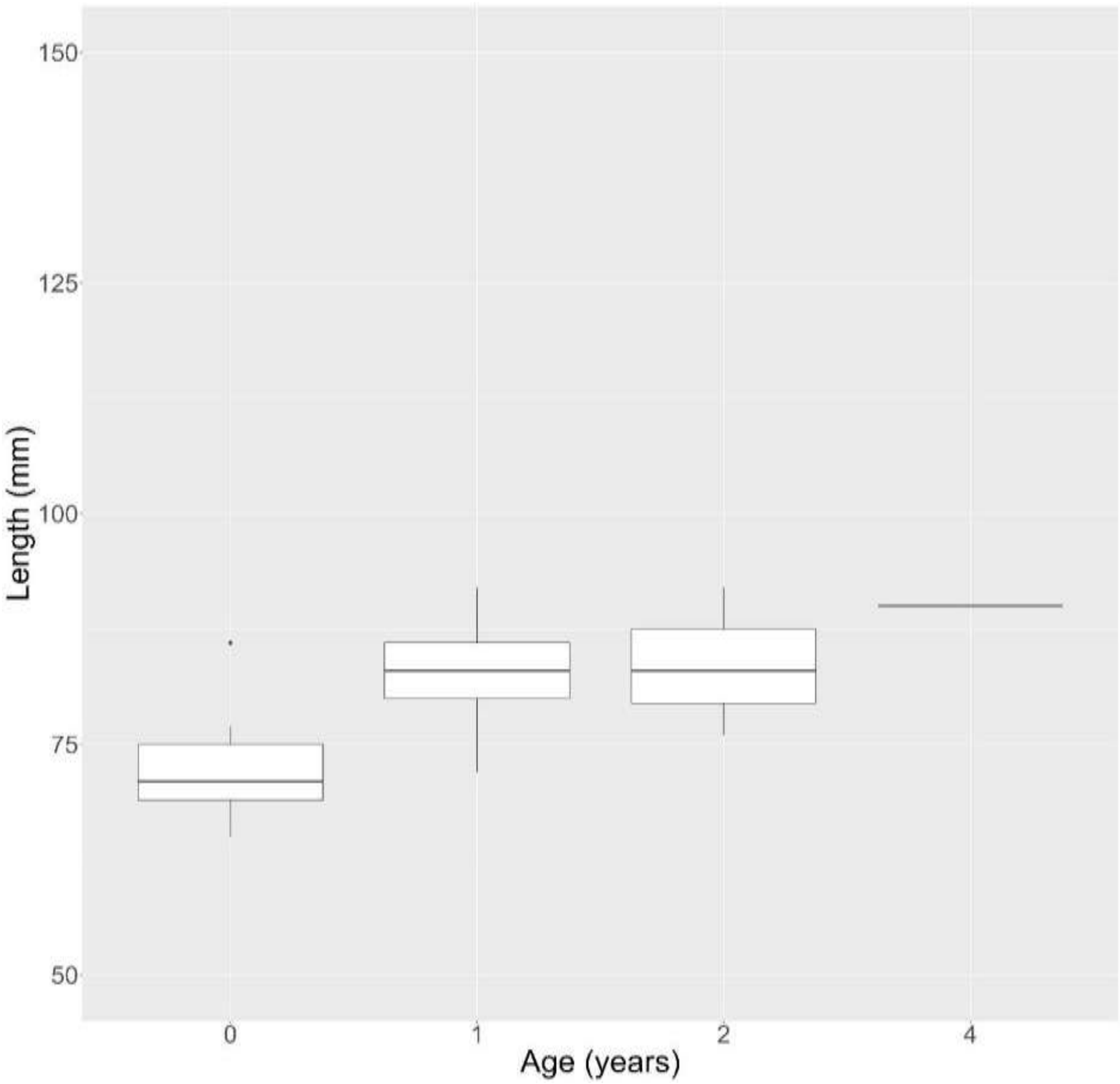


Figure 29: Longfin length distributions for each age class at the Ruahihi Dam from the 2023–24 season. Box plots show median, interquartile range, outliers (dots), and the range of lengths for each age class.

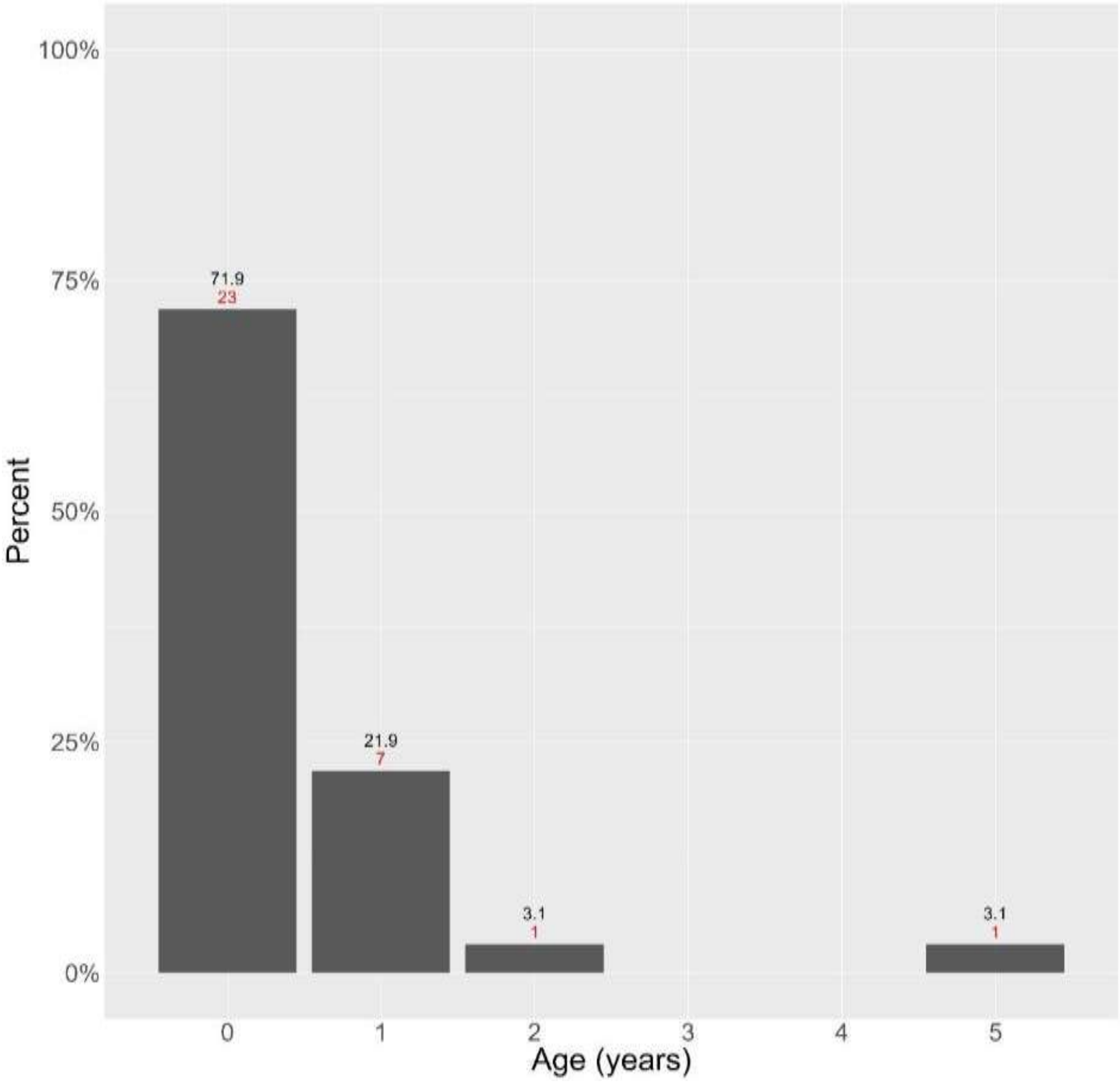


Figure 30: Shortfin age composition for the Ruahihi Dam from the 2023–24 season. The sample size of age classes collected each season is shown in red and the annual percentage of each age class is shown in black.

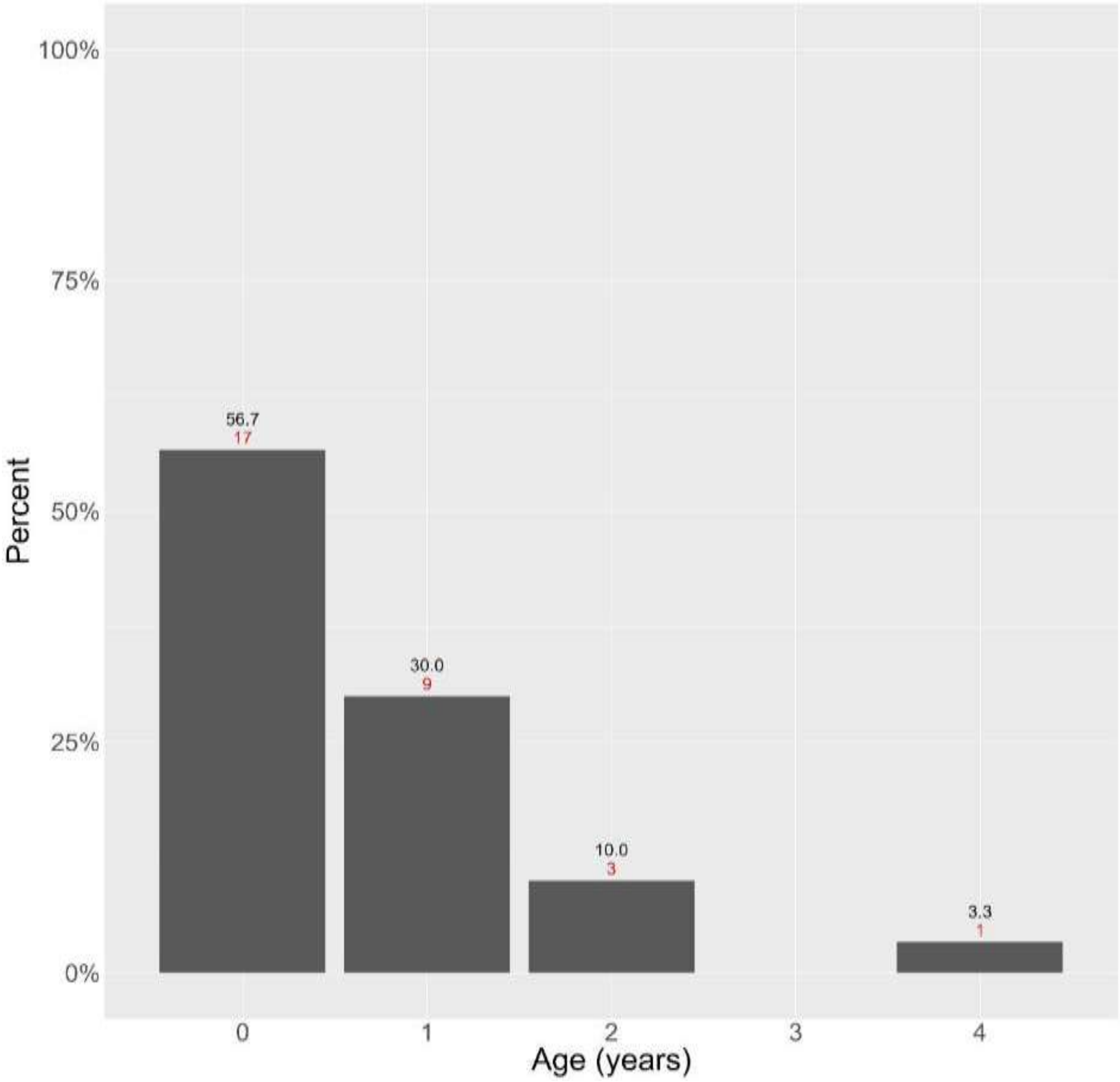


Figure 31: Longfin age composition for the Ruahihi Dam from the 2023–24 season. The sample size of age classes collected each season is shown in red and the annual percentage of each age class is shown in black.

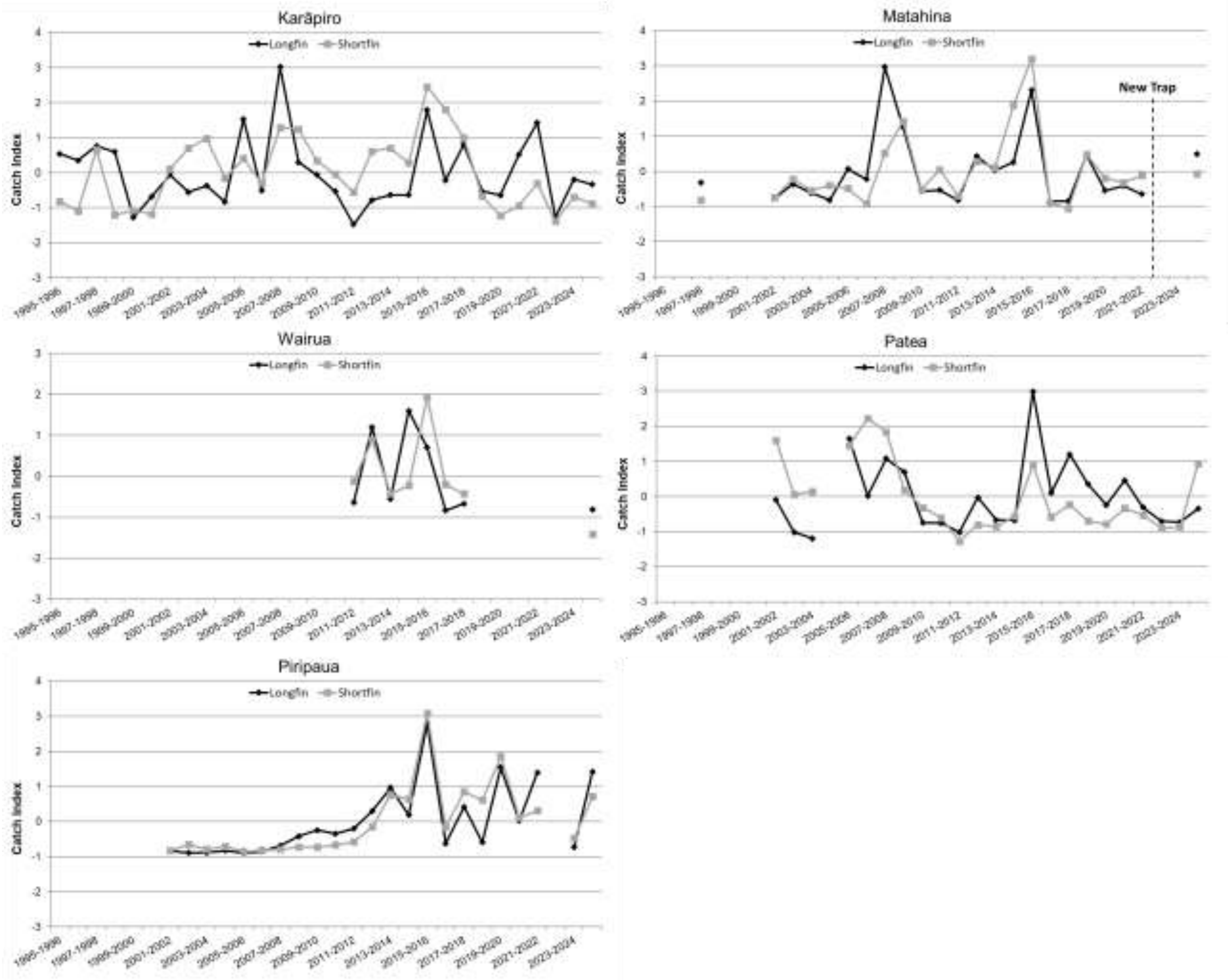


Figure 32: Longfin and shortfin normalised catch indices for North Island sites between 1995–96 and 2024–25. A value of 0 indicates the mean annual catch for each site.

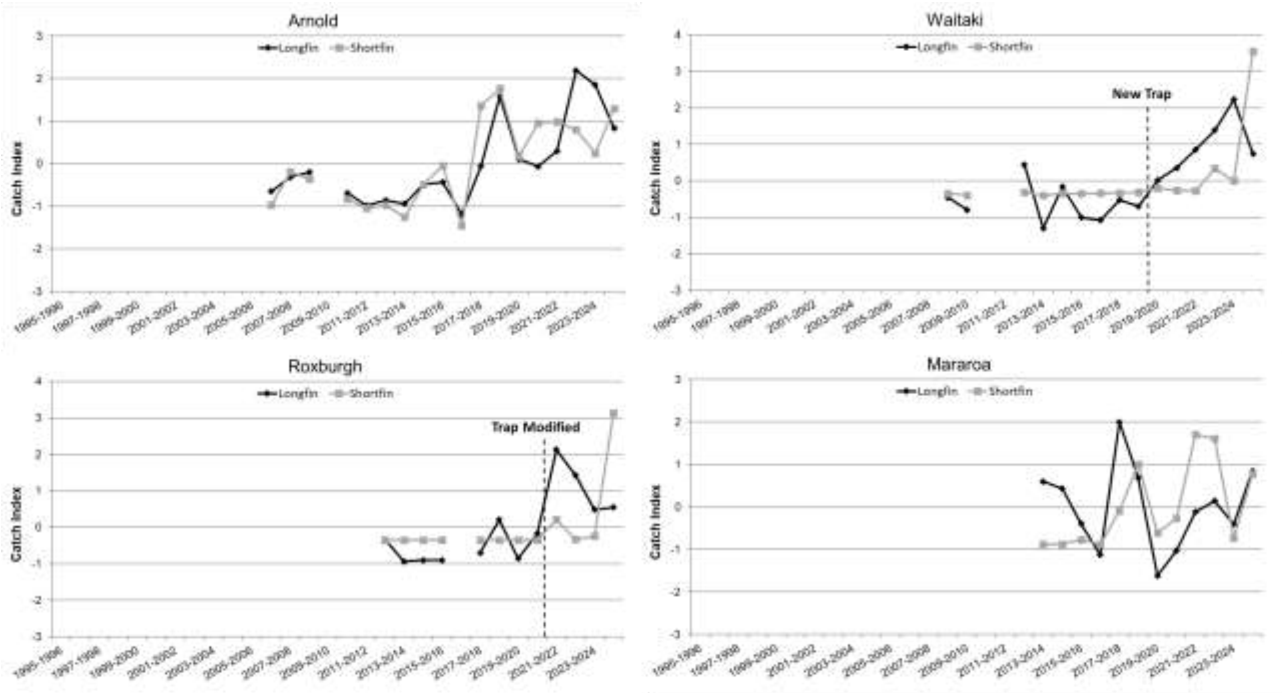
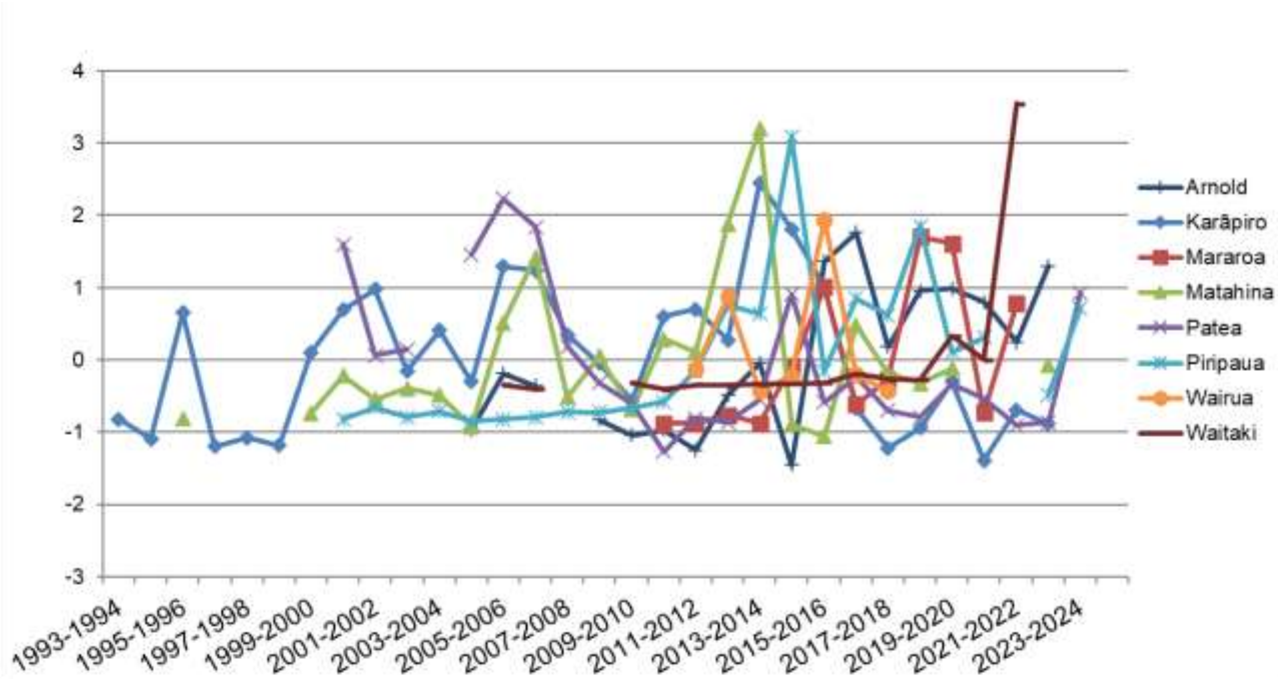


Figure 33: Longfin and shortfin normalised catch indices for South Island sites by season between 2007–08 and 2024–25. A value of 0 indicates the mean annual catch for each site.



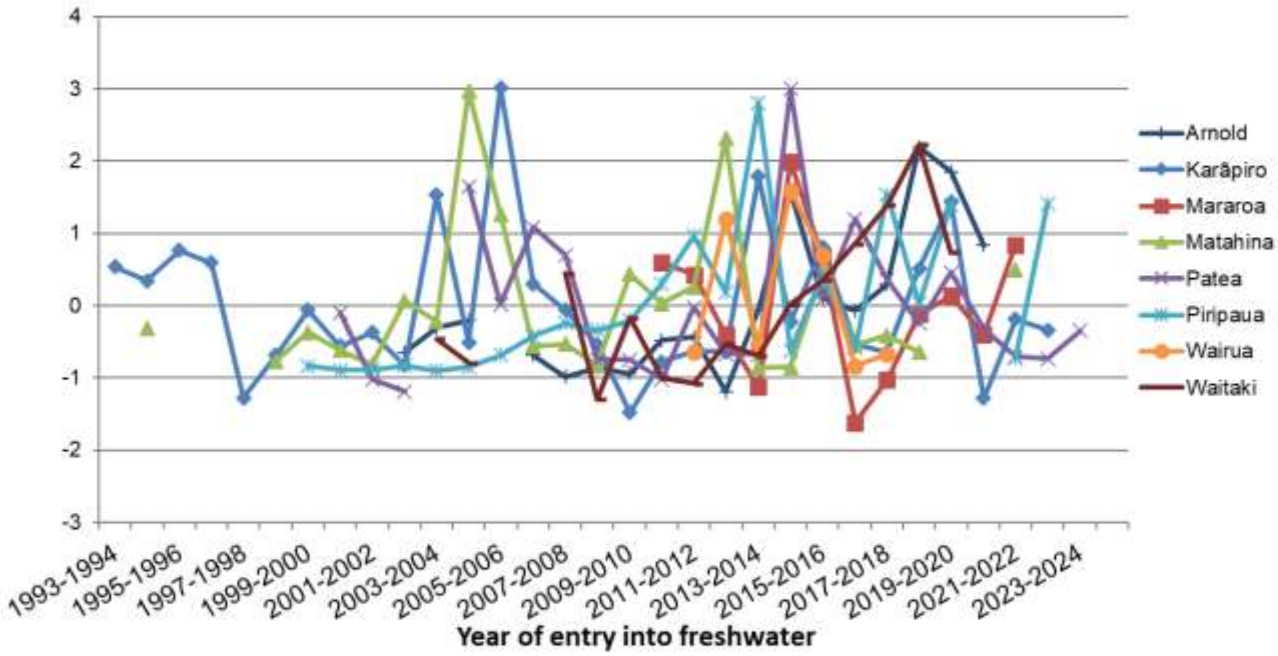


Figure 34: Shortfin (top) and longfin (bottom) recruitment indices (i.e., catch indices offset by median age) by season between 1992–93 and 2024–25. Plots are for all primary sites, Piripaua, and the Mararoa Lake Control Structure. A value of 0 indicates the mean recruitment for each site.

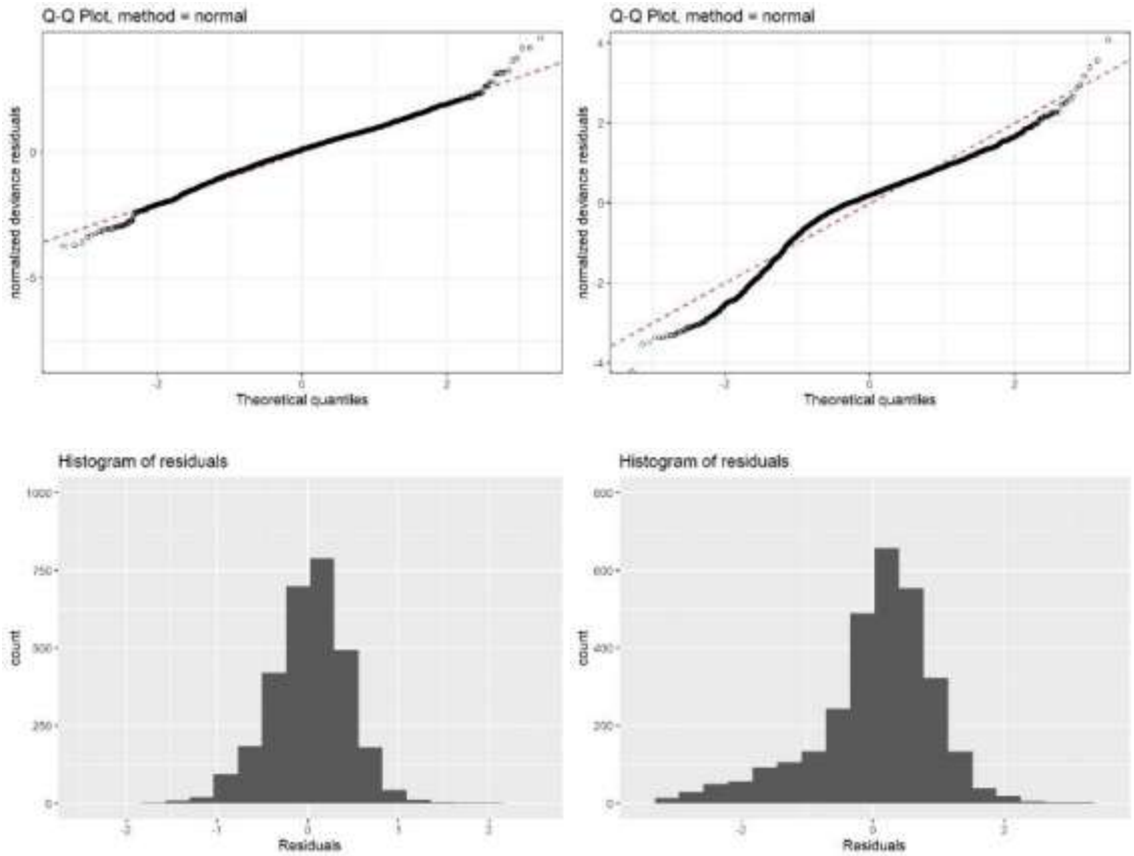


Figure 35: Diagnostic plots for the final shortfin (left) and longfin (right) models completed for Karāpiro Dam.

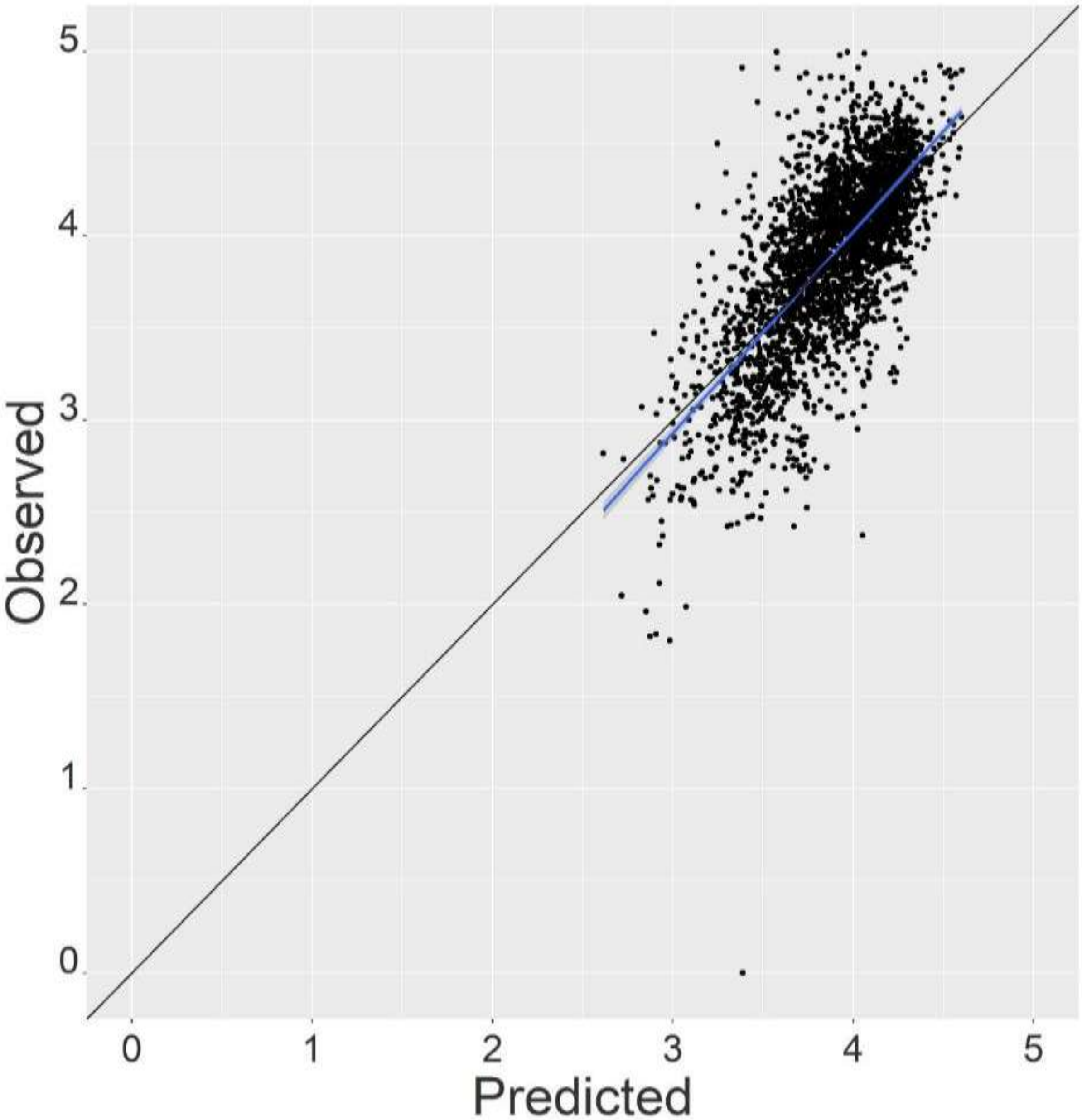


Figure 36: Observed vs. predicted shortfin elver log-transformed catches at Karāpiro Dam. The black line shows the locations of perfectly predicted catches. The blue line shows the relationship between the observed vs. predicted values. The shaded grey area around the blue line shows the 95% confidence interval of the relationship between the observed vs. predicted values.

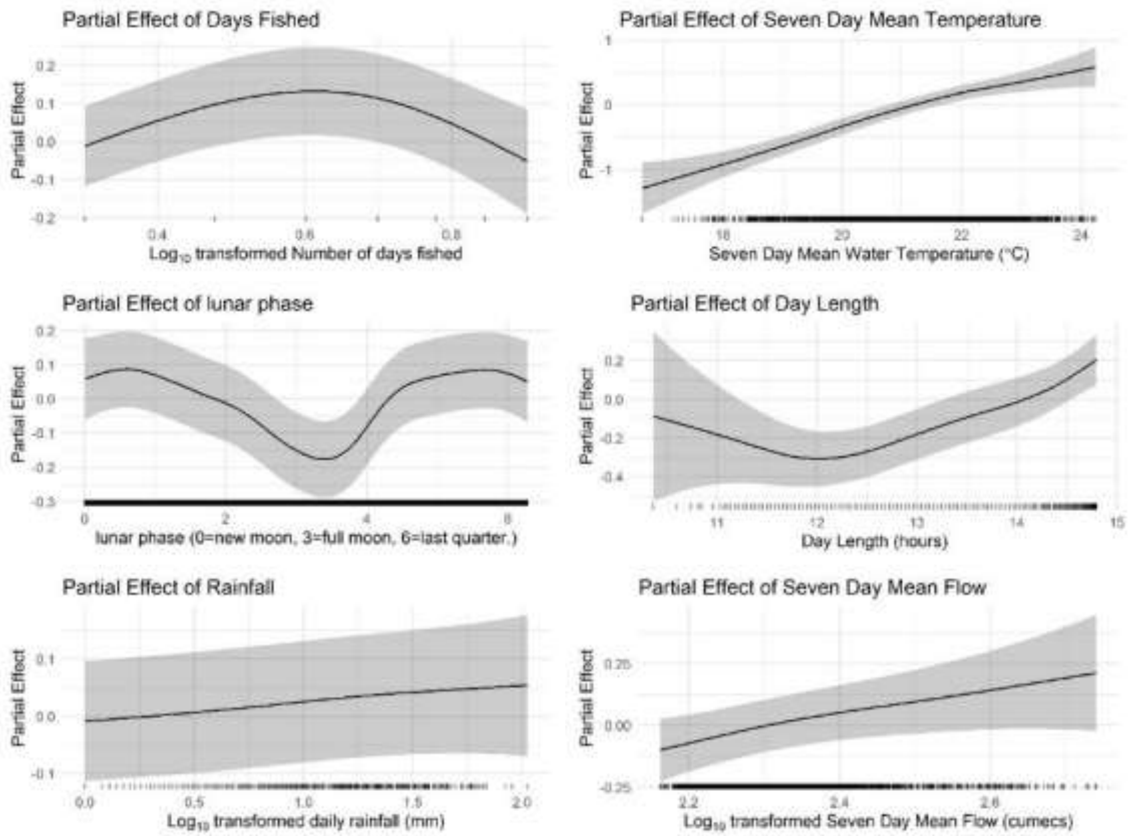


Figure 37: Partial dependence plots for the environmental covariates used in the final Karāpiro shortfin model. Plots are ordered from highest (top left) to the lowest F- value shown in Table 8. Lines display the best fit for the relationship between log-transformed daily catch abundance and environmental covariates. Gray bars represent 95% confidence interval.

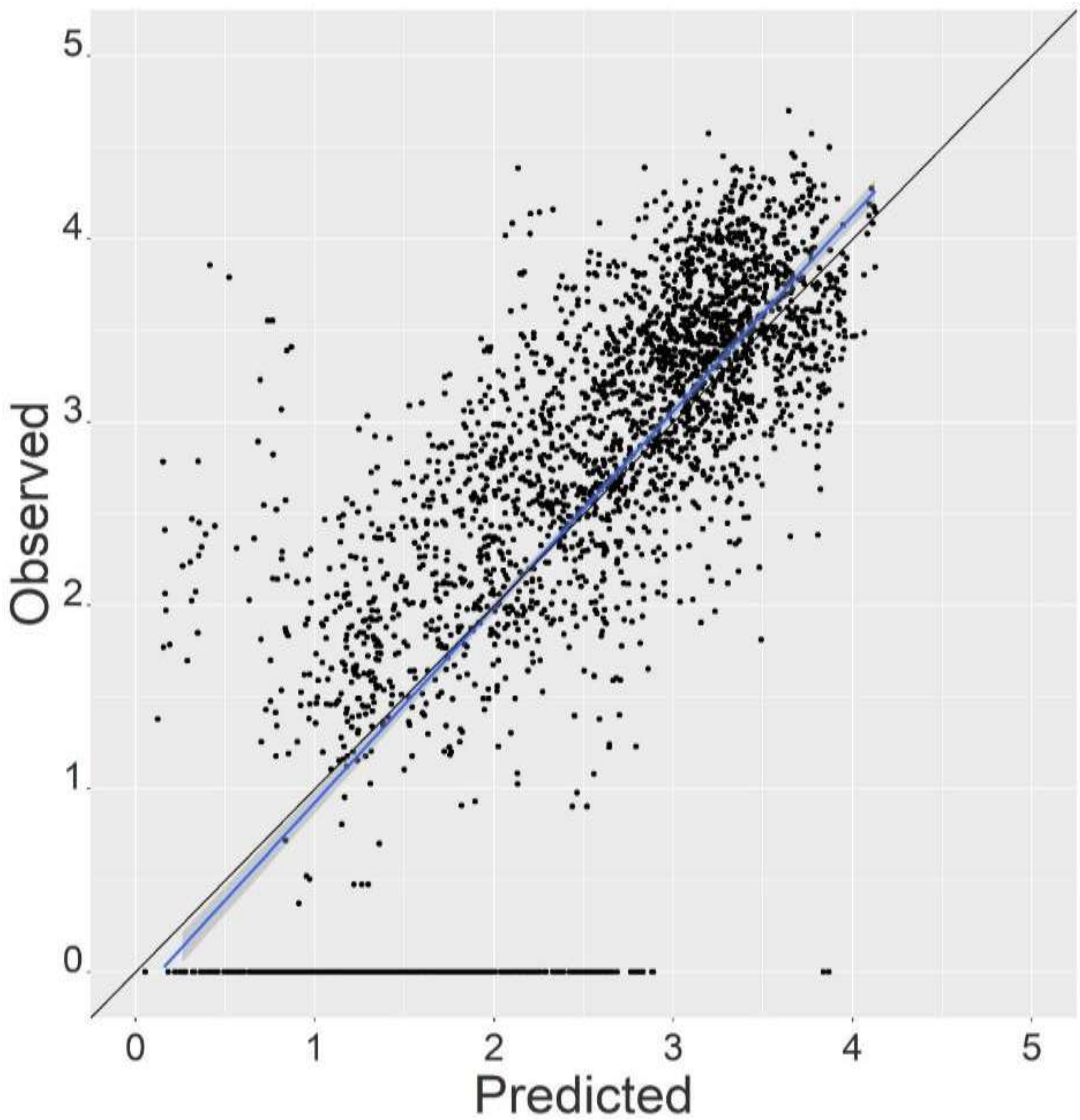


Figure 38: Observed vs. predicted longfin elver log-transformed catches at Karāpiro Dam. The black line shows the locations of perfectly predicted catches. The blue line shows the relationship between the observed vs. predicted values. The shaded grey area around the blue line shows the 95% confidence interval of the relationship between the observed vs. predicted values.

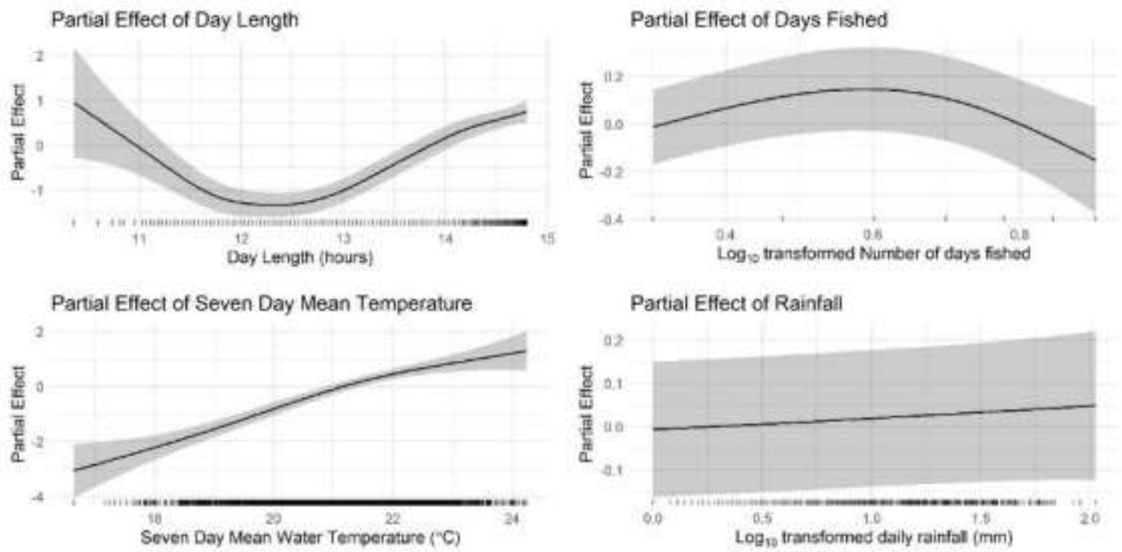


Figure 39: Partial dependence plots for the environmental covariates used in the final Karāpiro longfin model. Plots are ordered from highest (top left) to the lowest F- value shown in Table 8. Lines display the best fit for the relationship between log-transformed daily catch abundance and environmental covariates. Gray bars represent 95% confidence interval.

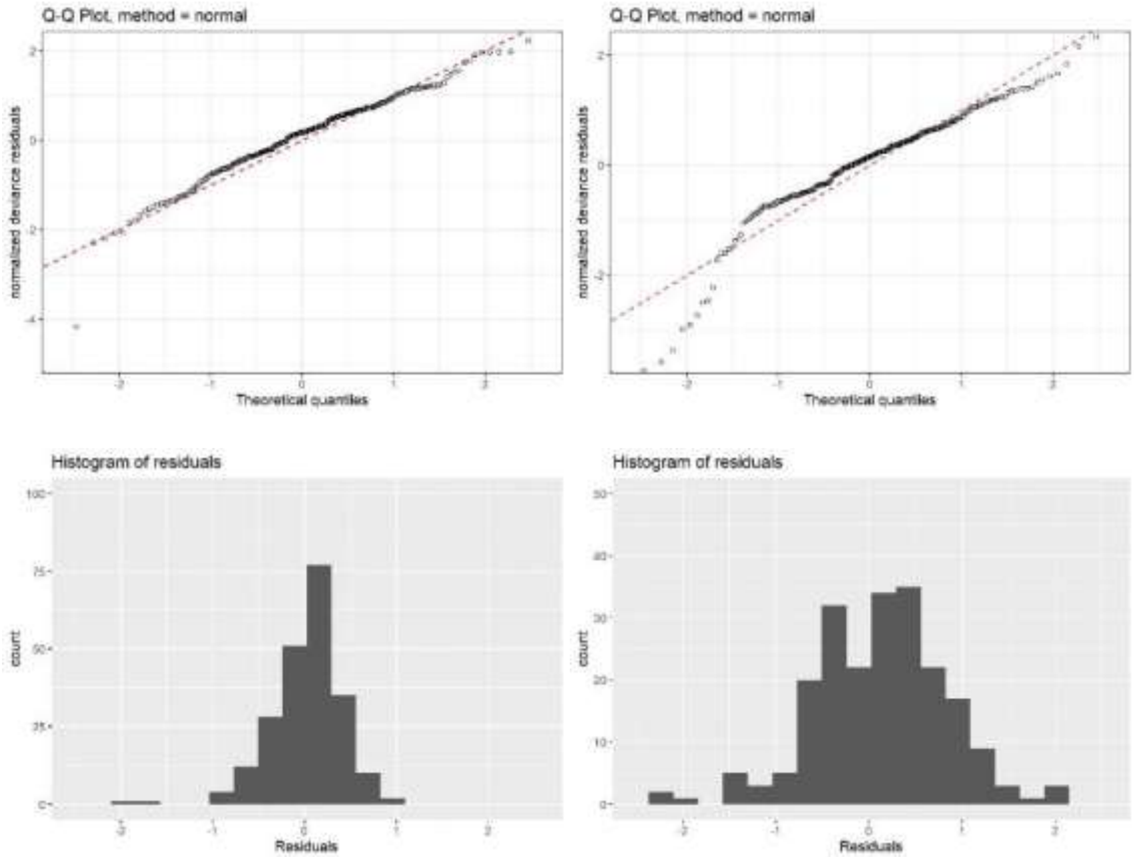


Figure 40: Diagnostic plots for the final shortfin (left) and longfin (right) models completed for Patea Dam.

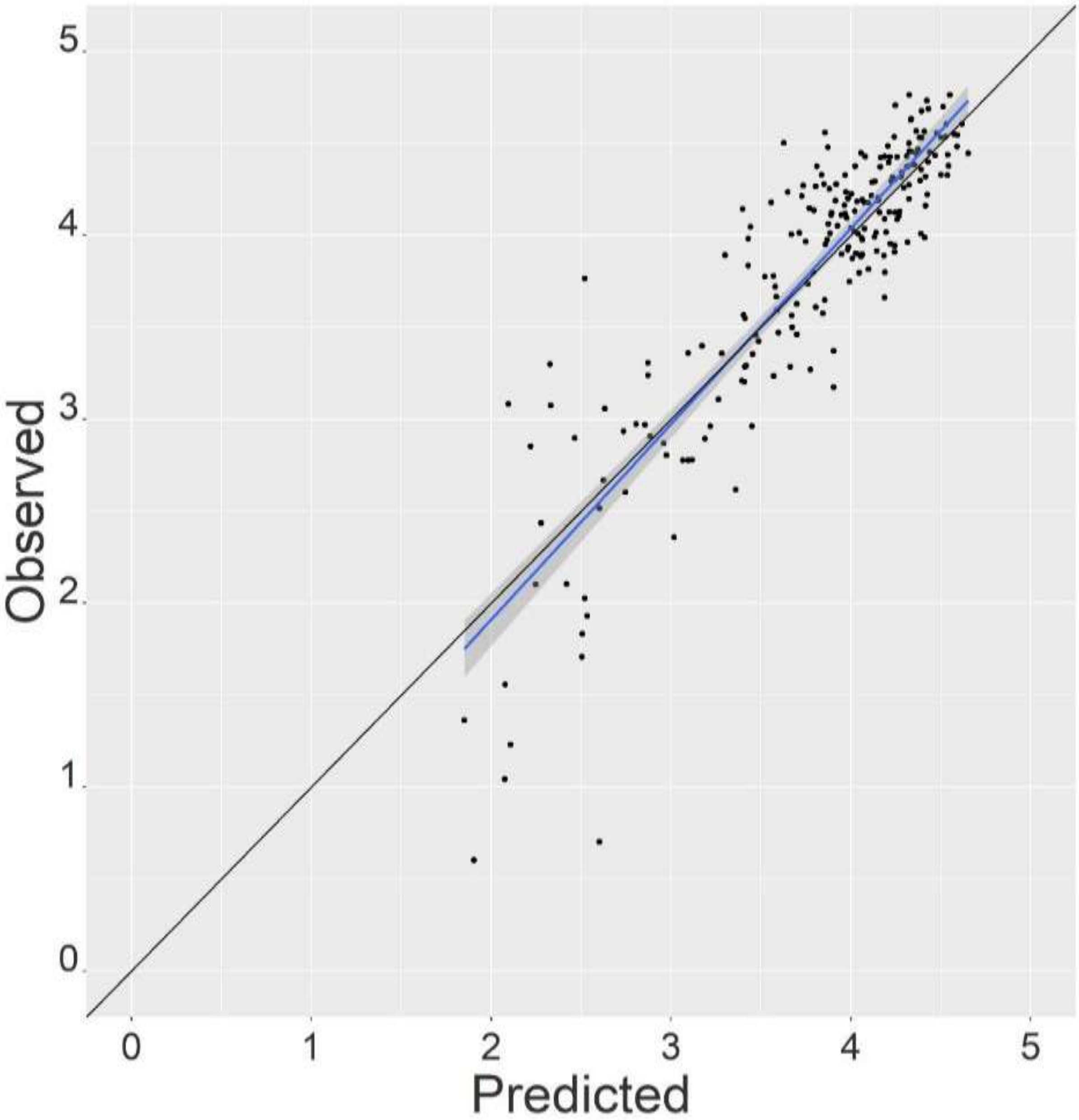


Figure 41: Observed vs. predicted shortfin elver log-transformed catches at Patea Dam. The black line shows the locations of perfectly predicted catches. The blue line shows the relationship between the observed vs. predicted values. The shaded grey area around the blue line shows the 95% confidence interval of the relationship between the observed vs. predicted values.

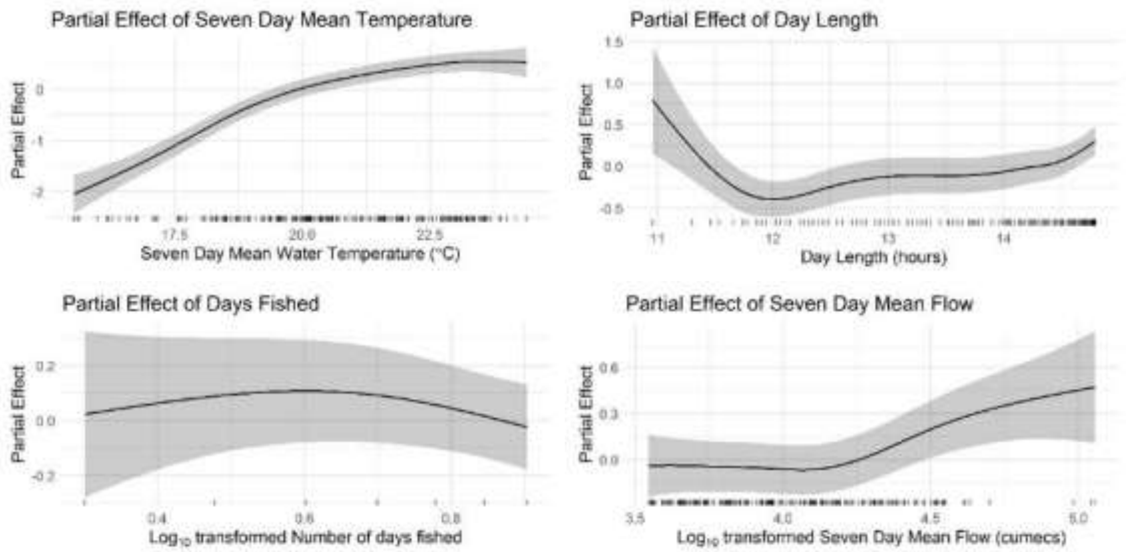


Figure 42: Partial dependence plots for the environmental covariates used in the final Patea shortfin model. Plots are ordered from highest (top left) to the lowest F- value shown in Table 8. Lines display the best fit for the relationship between log-transformed daily catch abundance and environmental covariates. Gray bars represent 95% confidence interval.

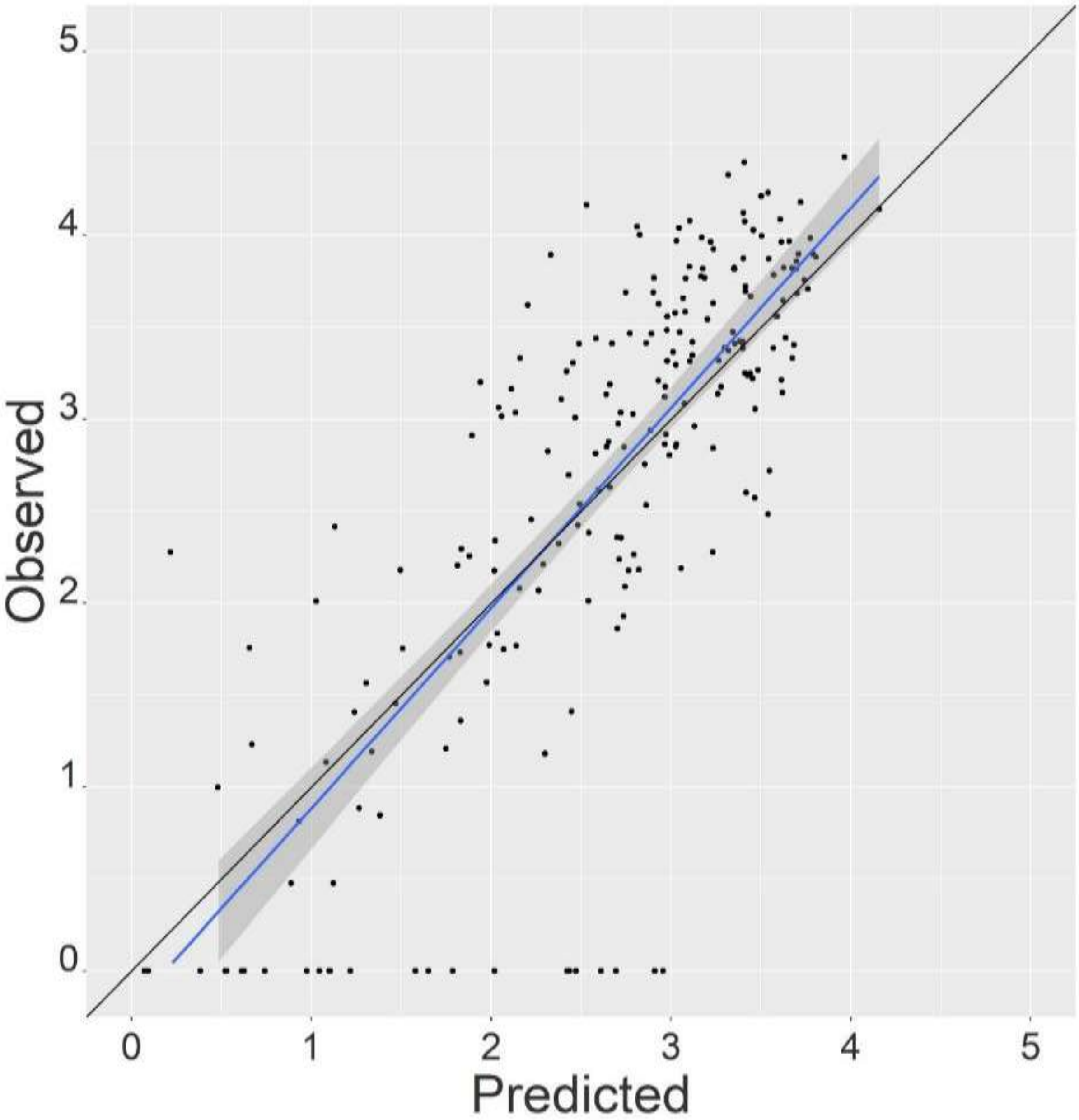


Figure 43: Observed vs. predicted longfin elver log-transformed catches at Patea Dam. The black line shows the locations of perfectly predicted catches. The blue line shows the relationship between the observed vs. predicted values. The shaded grey area around the blue line shows the 95% confidence interval of the relationship between the observed vs. predicted values.

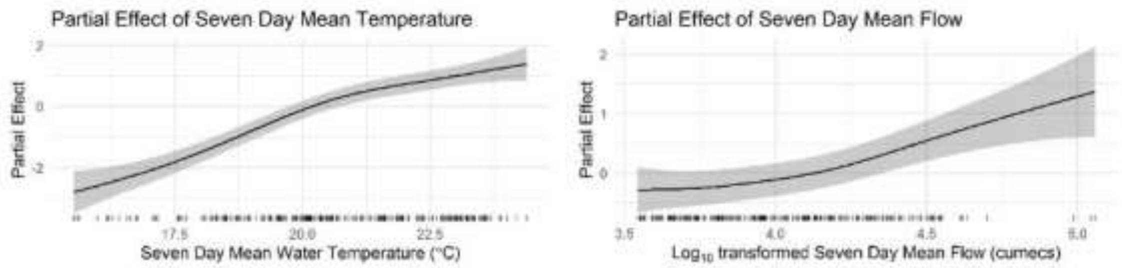


Figure 44: Partial dependence plots for the environmental covariates used in the final Patea longfin model. Plots are ordered from highest (top left) to the lowest F- value shown in Table 8. Lines display the best fit for the relationship between log-transformed daily catch abundance and environmental covariates. Gray bars represent 95% confidence interval.

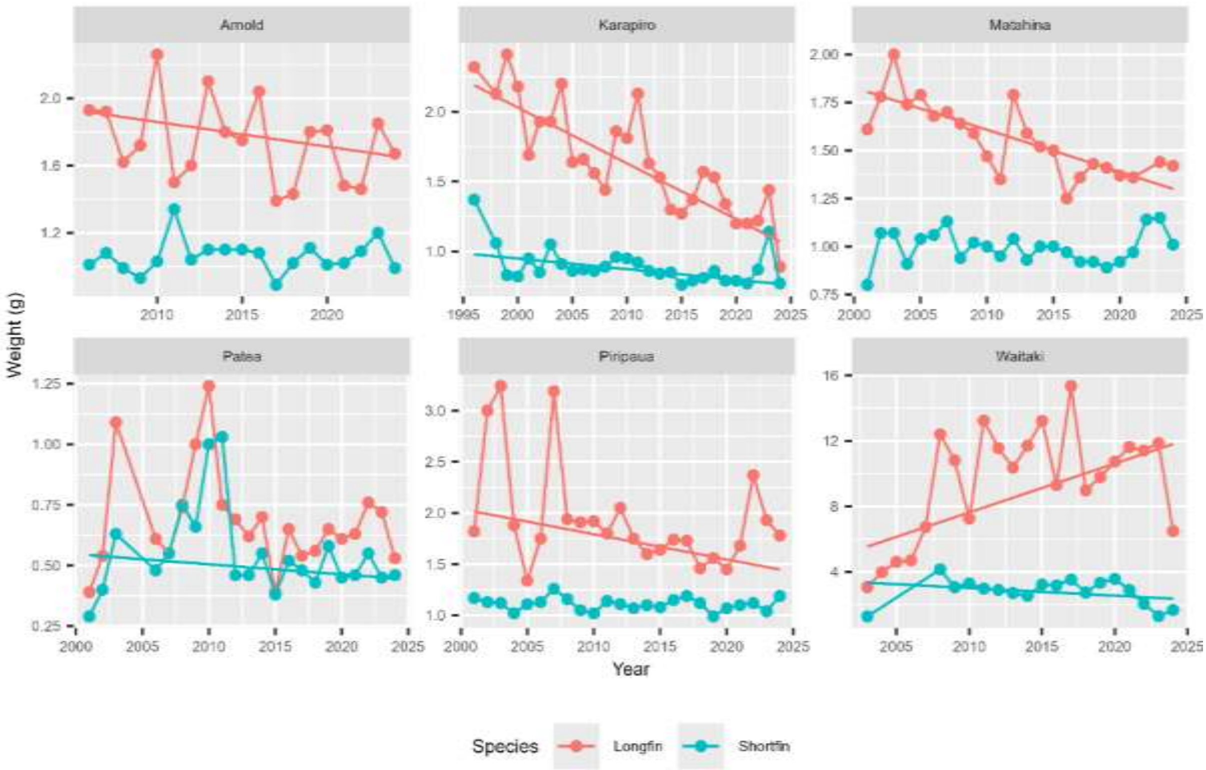


Figure 45: Mean annual weight (g) of shortfin and longfin elvers from selected sites. Sen's Slopes (lines on individual plots) are shown for significant relationships only (see Table 9).

APPENDIX 1: SITE TIMELINES

Note:

1. Location and site numbering are as shown in Figure 1.

2. References are shown in square brackets and given in full at the end of this Appendix.

3. Shaded dates are considered unsuitable for trend analysis.

Primary sites

Karāpiro Dam (1)

Pre-1984	Dam completed in 1948. Elvers able to climb spillway and siphons overflow when wet. Electric barrier initially installed on spillway to stop elvers climbing but no longer in use by the 1980s [Ref 2]. Some monitoring of elver was made at Karāpiro in the 1970s [Ref 3, 23].
1984–1992	Some monitoring of elvers made by the dam operator but records are unsuitable for use in trend analysis [Boubée pers. obs.].
1992–93	Dip netting at various location by eel fishers. Development and testing of a floating trap concept. Some records are available but not suitable for use in trend analysis [Ref 2].
1993–94	Further capture trials undertaken. Transfer made to lakes Karāpiro, Arapuni and Waikare. Some records are available but not suitable to use in trend analysis [Ref 2].
1994–95	Further capture trials were undertaken with traps also installed on the spillway and tailrace embankments. Transfer to lakes Karāpiro, Arapuni, Waikare, Waipapa and Maraetai. Some catch records available, but these are considered unsuitable for any trend analysis [Ref 2].
1995–96	Permanent trap installed consisting of two ramps and traps attached to a pontoon moored near the transformer cooling water outlet. A ramp and trap also installed on the stop log platform. A trap was still in operation on the spillway and abutment but caught very few elvers. A spray of water was introduced at the crest of one of the spillway siphons to see if elvers would use such a “natural route” but performance proved very poor. A transfer permit was issued by the Ministry of Fisheries, and this stipulated the maximum weight of elvers able to be released in each reservoir up to and including Maraetai. Extensive monitoring was undertaken by NIWA under contract to ECNZ. Result provided in a NIWA report and summarised under MFish contract INEE01. Records usable for trend analysis from this date [Ref 1, 2].
1996–97	No change from 1995–96 except that the abutment trap was removed because of low catches obtained there in the previous season. Most of the catch was obtained on the pontoon traps [Ref 31].
1997–98	Pontoon traps operating. Stop log trap rebuilt to make it easier to operate. Spillway ramp damaged by winter spills and not repaired because overall this trap caught very few elvers in the past. Species composition reported as 50 % longfins but, because this was markedly different from any other records, this was adjusted using the mean of records from the previous and following years [Ref 28, 11].
1998–99	Lift trap installed to replace pontoon that broke away during winter floods. Stop log trap operating. [Ref 29].
1999–00	No change to trapping and monitoring operations. Samples of the catches were not analysed for elver weights and lengths.
2000–01	Lift trap and stop log trap operated by Tainui Tuna (Eel) Working Group and monitored by NIWA. No change in mechanism except that the trap access ramps were lined with brushes instead of gravel [Ref 13].

2001–02	Lift trap and stop log trap operated by Tainui Tuna (Eel) Working Group and monitored by NIWA [Ref 33].
2002–03	Lift and stop log traps operated by the eel enhancement Company (EECo). All monitoring undertaken by EECo under NIWA's supervision [Ref 24].
2003–04	Lift and stop log traps operated by EECo. All monitoring undertaken by EECo under NIWA's supervision [Ref 24].
2004–05	Lift and stop log traps operated by EECo. All monitoring undertaken by EECo under NIWA's supervision [Ref 25].
2005–06	Lift and stop log traps operated by EECo. All monitoring undertaken by EECo under NIWA supervision [Ref 25].
2006–07	Lift trap and stoplog trap operated by EECo and monitored by NIWA [Ref 11].
2007–08	Lift trap and stoplog trap operated by EECo and monitored by NIWA [Ref 11].
2008–09	Lift trap and stoplog trap operated by EECo and monitored by NIWA [Ref 8].
2009–10	Lift trap and stoplog trap operated by EECo and monitored by NIWA. [Ref 26]
2010–11	Lift trap and stoplog trap operated by EECo and monitored by NIWA [Ref 27].
2011–12	Lift trap and stoplog trap operated by EECo and monitored by NIWA [Ref 34].
2012–13	Lift trap and stoplog trap operated by EECo and monitored by NIWA [Ref 54].
2013–14	Lift trap and stoplog trap operated by EECo and monitored by NIWA. Video monitoring of lift trap [Ref 54].
2014–15	Lift trap and stoplog trap operated by EECo and monitored by NIWA. Video monitoring not commissioned [Ref 54].
2015–16	Lift trap and stoplog trap operated by EECo and monitored by NIWA. Video monitoring not commissioned [this study].
2016–17	Lift trap and stoplog trap operated by EECo and Mercury Energy. Monitored by NIWA. Holes in lift trap mesh & not operational 1,2, 3 Mar. Flooded Stoplog 8 Mar, 14 Apr [this study].
2017–18	Lift trap and stoplog trap operated by EECo and Mercury Energy. Monitored by NIWA. Special Permit 646 came into effect on 1 December 2017 and prohibited transfers into Lake Atiamuri and Lake Ohakuri. The temperature logger was removed from Karāpiro on 14 March 2018 when the operator informed NIWA that the traps were to be shut for the season. However, the traps were not shut down and continued until 27 March [Ref 62].
2018–19	Lift trap and stoplog trap operated by EECo and monitored by NIWA.
2019–20	Lift trap and stoplog trap operated by EECo and monitored by NIWA.
2020–21	Lift trap and stoplog trap operated by EECo and monitored by NIWA.
2021–22	Lift trap and stoplog trap operated by EECo and monitored by NIWA.
2022–23	Lift trap and stoplog trap operated by Waikato and Waipā River Iwi Tuna Collective in collaboration with NIWA.
2023–24	Lift trap and stoplog trap operated by Waikato and Waipā River Iwi Tuna Collective in collaboration with ESNZ.
2024–25	Lift trap and stoplog trap operated by Waikato and Waipā River Iwi Tuna Collective in collaboration with ESNZ.

Matahina (4)

Pre-1984	Matahina Dam completed in 1967. No fish pass included in original design.
1983–84	Collection of elvers from the transformer cooling water outlet made by the then Internal Affairs (now DoC) from about 1982. Transfers made to upper catchment and some transfer records are available [Ref 2].
1984–85	Some transfer made by various groups but limited records available [Ref 2].
1985–86	Some transfer as per previous years by various groups. Limited transfer records available [Ref 2].

1986–87	Some transfer as per previous years by various groups. Limited transfer records available [Ref 2].
1987–88	Some transfer probably done as per previous years by various groups. No records available [Ref 2].
1988–89	Some transfer as per previous years by various groups. Limited transfer records available [Ref 2].
1989–90	Some transfer as per previous years by various groups. Limited transfer records available [Ref 2].
1990–91	Elver ladder installed. No records available [Ref 2].
1991–92	Elver ladder operating. Estimates of elver usage made [Ref 4].
1992–93	Elver ladder operating. Estimates of elver usage made [Ref 4.]
1993–94	Elver ladder operating. Estimates of elver usage made [Ref 4].
1994–95	No monitoring of elver ladder. Some manual transfers made but limited records available [Ref 2].
1995–96	No monitoring of elver ladder. Some manual transfers made but limited records available [Ref 2].
1996–97	Reservoir lowered so the earthquake damaged dam could be repaired. Elver ladder not usable. Temporary traps installed on each bank of the tail race and monitored by NIWA under contract to ECNZ [Ref 14, 15, 16 and 22].
1997–98	Elver ladder still not usable because of on-going dam repairs. Temporary trap on right bank of tail race (at outlet of transformer cooling water outfall) replaced by a permanent structure and monitored by NIWA under contract to ECNZ. First set of records usable for trends analysis [Ref 17].
1998–99	Existing trap at transformer cooling water outlet operated by Kokopu Trust on behalf of TrustPower. Records incomplete [Ref 33].
1999–00	Trap operated by Kokopu Trust but records incomplete [Ref 33].
2000–01	Trap operated and monitored by Kokopu Trust. No subsamples analysed and reported elver catch weight probably included eels as well as elvers [Ref 33].
2001–02	Trap operated and monitored by Kokopu Trust using standardised monitoring procedures. Records from this date usable for trend analysis [Ref 33].
2002–03	As above [Ref 24].
2003–04	As above [Ref 24].
2004–05	Trap damaged by winter flood but repaired in time for start of season [Ref 25].
2005–06	Trap operated by Kokopu Trust on behalf of TrustPower and species composition monitored by NIWA [Ref 25].
2006–07	Trap operated by Kokopu Trust on behalf of TrustPower and species monitored by NIWA [Ref 11].
2007–08	Trap operated by Kokopu Trust on behalf of TrustPower and species monitored by NIWA [Ref 11].
2008–09	Trap operated by Kokopu Trust on behalf of TrustPower and species monitored by NIWA [Ref 8].
2009–10	Normal operation continues [Ref 26].
2010–11	Normal operation continues [Ref 27].
2011–12	Normal operation continues but unusually low catch early in season. Season also ended early. Reason(s) for these unusual records is unclear [Ref 34].
2012–13	Trap operated by Kokopu Trust on behalf of TrustPower and species compositions analysed by NIWA on site [Ref 54].
2013–14	Trap operated by Kokopu Trust on behalf of TrustPower and species compositions analysed by NIWA on site [Ref 54].
2014–15	Trap operated by Kokopu Trust on behalf of TrustPower and species compositions analysed by NIWA on site [Ref 54].
2015–16	Trap operated by Kokopu Trust on behalf of TrustPower and species compositions analysed by NIWA on site. Large daily catches in middle of season required two transfers on some days [Ref 62].

2016–17	Trap operated by Kokopu Trust on behalf of TrustPower and species compositions analysed by NIWA on site. Very low catches this season [Ref 62].
2017–18	Trap was rebuilt in 2017, following flooding damage in April. Trap operated by Kokopu Trust on behalf of TrustPower and species compositions analysed by NIWA on site. First catch on 2 Jan 2018, low catches, and poor season. NIWA visited site in December; no elvers were seen [Ref 62].
2018–19	Trap operated by Kokopu Trust on behalf of TrustPower and species compositions analysed by NIWA on site.
2019–20	Trap operated by Kokopu Trust on behalf of TrustPower and species compositions analysed by NIWA on site.
2020–21	Trap operated by Kokopu Trust on behalf of TrustPower and species compositions analysed by NIWA on site.
2021–22	Trap operated by Kokopu Trust on behalf of TrustPower and species compositions analysed by NIWA on site.
2022–23	Trap operated by Kokopu Trust on behalf of TrustPower and species compositions analysed by NIWA on site. Site was under maintenance for much of the season and the trap only operated for a short period of time, which led to low catches. Given the reducing fishing effort, the catch data for this season should not be used to assess long-term trends in elver catches
2023–24	Trap operated by Kokopu Trust on behalf of TrustPower and species compositions analysed by NIWA on site. Trap was being reconstructed, which led to it being operational for roughly half the season. Given the reducing fishing effort, the catch data for this season should not be used to assess long-term trends in elver catches
2024–25	Trap operated by Kokopu Trust on behalf of Contact Energy and species compositions analysed by NIWA on site. Trap completed and elver catches recorded for the full season. Elver catch suitable for trend assessments but should be considered as a separate timeseries from this season onwards because the new trap design will have differing capture efficiency compared to the previous trap design.

Patea (6)

Pre-1984	Patea Dam completed in 1984. Fish pass retrofitted once dam built.
1984–85	Brush elver ladder installed and began to operate in Jan 1985 [Ref 2].
1985–86	Estimate of elver ladder passage per hour made [Ref 2].
1986 to 1992	No monitoring or maintenance made and by 1992 the brush core had rusted away making the pass un-usable.
1992–93	Brush removed from elver ladder and pipelined with gravel [Ref 2].
1993–94	Estimate of elver ladder usage made [Ref 2].
1994–95	No records available [Ref 2].
1995–96	Estimate of elver ladder usage made [Ref 2].
1996–97	Elver pass operating but attempt to monitor passage with an electronic counter failed [Ref 16].
1997–98	Elver ladder in operation but multiple water supply failures are known to have occurred.
1998–99	A temporary trap installed at the edge of the tailrace by Grant Williams, a commercial eel fisher who operated in the Taranaki area. Elver ladder still operating but usage relative to the trap found to be minimal [Ref 33].
1999–00	Tailrace elver trap improved [Ref 33].
2000–01	Elver trap further improved and standard monitoring procedures implemented. Records usable for trend analysis from this date, but no species information available [Ref 18, 33].
2001–02	Trap and transfer as well as standardised monitoring procedures operated by station staff [Ref 33].
2002–03	The elver ladder no longer functioning but trap and transfer operations fully implemented [Ref 24].

2003–04	Trap and transfer operations. Subsample of catch retained for NIWA to analyse [Ref 24].
2004–05	Trap and transfer operations. No subsample of catch retained for analysis through the season, but Taranaki RC did analyse one sample [Ref 25].
2005–06	Trap and transfer operations. Twelve frozen sub-sample of catch provided to NIWA for analysis [Ref 25].
2006–07	Trap operated over entire season by TrustPower, and eight frozen sub-samples of the catch analysed by NIWA [Ref 11].
2007–08	Trap operated over entire season by TrustPower, and five frozen sub-samples of the catch analysed by NIWA [Ref 11].
2008–09	Trap operated over entire season by TrustPower, and six frozen sub-samples of the catch eventually sent to NIWA for analysis [Ref 8].
2009–10	Trap operated over entire season by TrustPower, and six frozen sub-samples of the catch analysed by NIWA [Ref 26].
2010–11	Trap operated over entire season by TrustPower, and five frozen sub-samples of the catch analysed by NIWA [Ref 27].
2011–12	Monitoring undertaken by Ryder Consulting Ltd under contract to TrustPower. Some catch records obtained at the end of the season, but no details were forwarded to NIWA until 2013. Trap clearance effort has substantially declined in the last two years [Ref 34].
2012–13	Monitoring of traps and daily operations undertaken by Trustpower staff and supervised by Ryder Consulting Ltd. New transfer permit received late January 2013, records received late in season [Ref 36].
2013–14	Monitoring of traps and daily operations undertaken by Trustpower staff and supervised by Ryder Consulting Ltd. Data received throughout the season [Ref 38].
2014–15	Monitoring of traps and daily operations undertaken by Trustpower staff and supervised by Ryder Consulting Ltd. Data received throughout the season. [Ref 47].
2015–16	Monitoring of traps and daily operations undertaken by Trustpower staff and supervised by Ryder Consulting Ltd. Data received electronically throughout the season.
2016–17	Monitoring of traps and daily operations undertaken by Trustpower staff and supervised by Ryder Consulting Ltd. Data received electronically throughout the season.
2017–18	Monitoring of traps and daily operations undertaken by Trustpower staff and supervised by Ryder Consulting Ltd. Data received electronically throughout the season. Samples frozen and retained for ageing. Traps added with heat insulation. Unwanted attractant flows from leaking pipes around the traps have been eliminated [Ref 61].
2018–19	Monitoring of traps and daily operations undertaken by Trustpower staff and supervised by Ryder Consulting Ltd. Data received electronically throughout the season. Samples frozen and retained for ageing.
2019–20	Monitoring of traps and daily operations undertaken by Trustpower staff and supervised by Ryder Consulting Ltd. Data received electronically throughout the season. Samples frozen and retained for ageing.
2020–21	Monitoring of traps and daily operations undertaken by Trustpower staff and supervised by Ryder Consulting Ltd. Data received electronically throughout the season. Samples frozen and retained for ageing.
2021–22	Monitoring of traps and daily operations undertaken by Trustpower staff and supervised by 4Sight Consulting Ltd. Data received electronically throughout the season. Samples frozen and retained for ageing.
2022–23	Monitoring of traps and daily operations undertaken by Trustpower staff and supervised by 4Sight Consulting Ltd. Data received electronically throughout the season. Samples frozen and retained for ageing.
2023–24	Monitoring of traps and daily operations undertaken by Trustpower staff and supervised by 4Sight Consulting Ltd. Data received electronically throughout the season. Samples frozen and retained for ageing.
2024–25	Monitoring of traps and daily operations undertaken by Contact Energy staff and supervised by 4Sight Consulting Ltd. Data received electronically throughout the season. Samples frozen and retained for ageing.

Wairua (17)

pre-1984	Power Station built in the early 1900s but revamped several times since. No fish passage provisions included in original design.
1994–95	About 1 kg of elvers transferred from the power station tailrace to upstream habitat by eel industry [Ref 2].
2010–11	Equipment and instruction provided to stakeholders by NIWA, but flooding prevented any trapping. No records obtained [Ref 27].
2011–12	Temporary trap installed and operating over summer. Several subsamples examined by NIWA [Ref 32].
2012–13	Trap operated by Hoori George Tuhiwai. Canal dewatering 30 October to 9 November. Used pump from tailrace to operate the tailrace trap. Spillway trap non-functional over repair period. Repair to penstock, elvers attracted to penstock leakage during repairs. Trap and netting carried out to save elvers attracted there. Recorded as trap 2 or penstock trap and were mostly larger elvers. Severe drought country wide. By mid-February virtually no water to run the station except at peak time. Tailrace mostly dry. Catch data received late May and not included in MPI progress report [Ref 54].
2013–14	Trap operated by Hoori George Tuhiwai. Canal dewatered 3 March 2014, no further operations [Ref 54].
2014–15	Trap operated by Hoori George Tuhiwai [Ref 54].
2015–16	Trap operated by Hoori George Tuhiwai [Ref 62].
2016–17	Trapping and transfers operated by Korokota Marae of Te Parawhau Hapu and Northpower Ltd.
2017–18	Trap and transfers operated by Korokota Marae of Te Parawhau Hapu and Northpower Ltd. Station trap was shut down on 3 February as few elvers were being caught in the trap. Longfin elvers captured in November, but not in the rest of the season.
2018–19	Trapping and transfers operated by Korokota Marae of Te Parawhau Hapu and Northpower Ltd.
2019–20	No Data
2020–21	No Data
2021–22	No Data
2022–23	No Data received. Station damaged by flooding
2023–24	No Data
2024–25	Traps only operational for part of the season and were closed in the middle of the season. Data not considered suitable for trend analysis given the reduction in operating time for the season.

Waitaki (9)

Pre-1984	Dam completed in 1935. A pool and weir salmon pass was installed when the dam was constructed but was abandoned when the station was revamped in 1951. Report of high numbers of elvers present below the dam in the 1980s [Ref 5, 23].
1992–93	An elver ladder installed on dam face [Ref 2].
1993–94	Elver ladder operating but only six elvers used it [Ref 2]. Unlike previous years very few elvers seen in the stop-log area [Ref 24].
1994–95	Elver ladder operating but only one elver used it [Ref 24].
1995–96	Elver ladder operating but only three elvers used it [Ref 24].
1996–97	Elver ladder operating but only three elvers used it [Ref 24].
1997–98	Elver ladder operating and six elvers used it. Considerably more elvers seen in the transformer cooling water outlet than in the last few years [Ref 24].
1998–99	Two elver traps installed in the stop-log area of tailrace. No catch records available.
1999–00	No records available.
2000–01	No records available.

2001–02	A total of 2061 eels reported as caught but most of the catch appear to be eels rather than elvers so records not usable for trends analysis [Ref 24].
2002–03	Access ramps to traps upgraded. Full season monitoring undertaken, but records not judged suitable for trend analysis [ref 24].
2003–04	Two traps were again operated and monitored for the full season. Total catch records usable for trend analysis but it is possible that the contractor did not recognise that a small proportion of the catch were shortfins, which makes catch unreliable for the season [Ref 24].
2004–05	Oil interceptor (Trap 2) and auxiliary traps (Trap 1) operating. Monitoring undertaken by local contractor with assistance from Meridian Energy. Presence of shortfins in the catch may have been missed, which makes catch unreliable for the season [Ref 25].
2005–06	Traps operated from turbine 1 outlet (Trap 1) and oil interceptor (Trap 2). A floating trap also operated in Turbine 3 outlet. Presence of shortfins in the catch may have been missed, which makes catch unreliable for the season [Ref 11, 25].
2006–07	Trap 1, and floating trap in Turbine 3 outlet operated. Oil interceptor (trap 2) decommissioned as it no longer receives flows from transformer cooling system (now air cooled). Presence of shortfins in the catch may have been missed, which makes catch unreliable for the season [Ref 11].
2007–08	Trap 1, and floating trap in Turbine 3 outlet operated. New fixed trap installed in decommissioned Turbine 3 outlet. Presence of shortfins in the catch may have been missed, which makes catch unreliable for the season [Ref 11].
2008–09	The elver ladder over the dam was decommissioned and modified to provide a pathway for elvers between the spillway and the tailrace where Trap 1 is located. Small modifications to Trap 3 outflow made. Floating trap decommissioned. Operation and monitoring by G Hughes under contract to Meridian [Ref 8].
2009–10	Normal operation continued by G Hughes under contract to Meridian [Ref 26].
2010–11	Floods damaged the traps. Records available are not for the entire migration season [Ref 27].
2011–12	Normal operation continued by G Hughes under contract to Meridian. However, no species composition was collected in January which is normally the peak of migration season. Omit record for trend analysis [Ref 34].
2012–13	Normal operation continued by G Hughes under contract to Meridian. Operations adversely impacted during February 2013 when high river flows flooded the platform where the traps were located and damaged the traps. Video monitoring of holding tank G3 commissioned [Ref 54].
2013–14	Normal operation continued by G Hughes under contract to Meridian. Video monitoring of holding tank G3. Video monitoring of salmon ladder 21 January 2014 no elvers were seen [Ref 54].
2014–15	Normal operation continued by G Hughes under contract to Meridian. Video monitoring not commissioned. It was not possible to assemble and operate G1 elver ramp and trap due to construction work on the sluice gate pier [Ref 54].
2015–16	Normal operation continued by G. Hughes under contract to Meridian. Video monitoring not commissioned. G1 incorporates a climbing ramp from the far side of the sluice gate and a ramp from G1 tailrace via the auxiliary tailrace. G3 has been moved to G5 tailrace. The floating trap no longer operates. The 3rd trap and ramp are situated at the Oil separator drain situated between G3 and G4. [Ref 62].
2016–17	Three traps – G1+spillway, oil interceptor, G5. Graeme Hughes operated the traps, in conjunction with Meridian Energy. Four samples examined [Ref 62].
2017–18	Three traps – G1+spillway, oil interceptor, G5. Graeme Hughes replaced by Dave Merrett. Eleven samples collected. New mesh bag for separating eel and elvers [Ref 62].
2018–19	Three traps – G1+spillway, oil interceptor, G5 operated by Dave Merrett. Ageing samples collected.
2019–20	Four traps – G1+spillway, oil interceptor, G5, G7 operated by Dave Merrett. Ageing samples collected. G7 new trap installed. High flows prevented trapping from

	10/12/2019 to 16/12/2019 but very early in the season. High flows continued to occur throughout the season but with short duration impact on trapping.
2020–21	Four traps – G1+spillway, oil interceptor, G5, G7 operated by Dave Merrett. Ageing samples collected.
2021–22	Four traps – G1+spillway, oil interceptor, G5, G7 operated by Ngai Tahu. Ageing samples collected.
2022–23	Four traps – G1+spillway, oil interceptor, G5, G7 operated by Meridian.
2023–24	Four traps – G1+spillway, oil interceptor, G5, G7 operated by Meridian and Whiria te Waitaki on behalf of Ngā Waitaki Rūnaka (Te Rūnanga o Moeraki / Te Rūnanga o Waihao / Te Rūnanga o Arowhenua).
2024–25	Four traps – G1+spillway, oil interceptor, G5, G7 operated by Meridian and Whiria te Waitaki on behalf of Ngā Waitaki Rūnaka (Te Rūnanga o Moeraki / Te Rūnanga o Waihao / Te Rūnanga o Arowhenua).

Arnold (10)

Pre-1984	Dam commissioned in 1932. A fish pass was included in the original design, but this was closed when the dam was raised in 1938.
2004–05	Trapping trials begin December 2004. Upgrades made Feb. 2005. Samples of the catch analysed by NIWA. Omit records for trend analysis as further trap modifications were made in 2006 [Ref 25].
2005–06	Trap and transfer operations continue. Omit records for trend analysis as further trap modifications were made in 2006 [Ref 25].
2006–07	Trap installed below flow measuring weir and monitored over entire season, but water supply problem found and considerable number of elvers were found to bypass the trap and accumulated in a leakage pool below the dam wall. These were manually collected by NIWA in February 2007 and number collected added to the trap records. Sub–samples examined by NIWA. Records are considered comparable to those obtained in following years [Ref 11].
2007–08	Trap below the flow measuring weir operated and monitored regularly over entire season. Sub-samples analysed by NIWA [Ref 11].
2008–09	Land slip over winter destroyed the existing trap. A trap with a different configuration was re-installed in this area. A second trap was also installed at a higher level on the dam. This later was also damaged by a further land slip in December and had to be moved. This new trap proved to be more attractive to elvers than the lower trap. Subsamples of catch analysed by NIWA. [Ref 8].
2009–10	Major repairs to dam in progress and this affected trapping operations. Records not usable for recruitment trend analysis [Ref 26].
2010–11	Return to normal trapping and monitoring operation for the entire migration season [Ref 27].
2011–12	Normal trapping and monitoring undertaken through entire migration season [Ref 34].
2012–13	Normal trapping and monitoring undertaken by NIWA staff through entire migration season [Ref 54].
2013–14	Normal trapping and monitoring undertaken by NIWA staff through entire migration season [Ref 54].
2014–15	Normal trapping and monitoring undertaken through entire migration season [Ref 54].
2015–16	Normal trapping and monitoring undertaken through entire migration season [[Ref 62]Temperature logger damaged by vandals in January, data unable to be extracted. Replaced 21st January.
2016–17	Normal trapping and monitoring undertaken by NIWA staff through entire migration season, only 100g in December [Ref 62].
2017–18	Normal trapping and monitoring undertaken by NIWA staff through entire migration season, good catches in December (average 4.9 kg/d) [Ref 62].

2018–19	Normal trapping and monitoring undertaken by NIWA and Manawa Energy staff through entire migration season.
2019–20	Normal trapping and monitoring undertaken by NIWA and Manawa Energy staff through entire migration season.
2020–21	Normal trapping and monitoring undertaken by NIWA and Manawa Energy staff through entire migration season.
2021–22	Normal trapping and monitoring undertaken by NIWA and Manawa Energy staff through entire migration season.
2022–23	Normal trapping and monitoring undertaken by NIWA and Manawa Energy staff through entire migration season.
2023–24	Normal trapping and monitoring undertaken by NIWA and Contact Energy staff through entire migration season.
2024–25	Normal trapping and monitoring undertaken by Earth Sciences New Zealand and Contact Energy staff through entire migration season.

Secondary sites

Waikare gates (2)

Pre-1984	Flood control gates installed in 1963 with no fish passage provision included in design. Elvers and other fish congregated below the weir in large numbers.
1983–84	Brush elver ladder installed on dam face in 1984 but this was poorly maintained. No monitoring results available [Ref 2].
1984 to 1994	Elver ladder not maintained and eventually breaks apart over this decade.
1994–95	Gravel lined elver ramp installed but no monitoring undertaken [Ref 2].
1995–96	Elver ladder possibly working but no records available.
1996–97	Trap installed on outlet of fish ladder and catch monitored January through to March [Ref 16].
1997–02	Unclear if elver ladder in operation but little or no appear to have been made over this period.
2002–03	Manual trap and transfer undertaken by members of the eel industry and a local farmer. Some monitoring records made available by EW. [Ref 24].
2003–04	“Nature like” fish pass installed. Monitoring results made available by EW. [Ref 24].
2004–05	No further monitoring undertaken.

Wairere Falls (3)

Pre-1984	Power Station commissioned in 1925. No fish pass included in original design but some passage of elvers likely over falls and weir during spills and rain events. Station operated by King Country Energy (KCE).
1994–95	Some manual transfer made but no monitoring records available [Ref 2].
1995–96	Some manual transfer made but no monitoring records available [Ref 2].
1996–97	Possibly as above but no confirmed records available.
1997–98	Semi permanent traps installed on banks of both tail races. An elver ramp was also installed on the weir at top of the falls but this was destroyed by a flood soon after installation [Ref 24].
1998–99	Possibly as above but no confirmed records available [KCE staff pers. comm.].
1999–00	Traps operated, and some records made available, by King Country Energy. No species composition available so records not suitable for trend analysis [KCE staff pers. comm.].
2000–01	Traps operated and some records made available by King Country Energy. No species composition available so records not suitable for trend analysis [KCE staff pers. comm.].
2001–02	Traps operated and some records made available by King Country Energy. No species composition available so records not suitable for trend analysis [KCE staff pers. comm.].

2002–03	Catch records obtained from the two tailrace traps by KCE. Subsamples of catch analysed by NIWA [Ref 24].
2003–04	Catch records obtained from the two tailrace traps by KCE. Only one subsamples of the catch provided to NIWA for analysis [Ref 24].
2004–05	New elver ladder installed on weir at top of Falls. Two tailrace traps continue to be operated. Sub-samples of catch analysed by NIWA [Ref 25].
2005–06	Elver ladder installed on weir at top of falls operating but used by very few elvers. Two tailrace traps in operation and catching well. Sub-samples of catch analysed by NIWA [Ref 25].
2006–07	Elver traps operated on each of the two tailraces by KCE. Elver ladder also present on weir at top of falls. Sub-samples of catch analysed by NIWA [Ref 11].
2007–08	Elver traps operated on each of the two tailraces by KCE. Elver ladder also present on weir at top of falls. Sub-samples of catch analysed by NIWA [Ref 11].
2008–09	An elver trap operated on each of the two tailraces by KCE. Elver ladder at the weir operated by KCE and elver passage over weir also facilitated by spraying water over the abutments. Monitoring by NIWA under contract to KCE [Ref 8 and 10].
2009–10	Tailrace traps operating on each of the tailraces. Elver ladder on weir at top of falls monitored with a video camera that indicate low usage compared to tailrace traps. Sub-samples of catch analysed by NIWA [Ref 26].
2010–11	Tailrace traps operating on each of the tailraces. No sub-samples of catch provided for species composition [Ref 27].
2011–12	Tailrace traps operating on each of the tailraces. A small number of sub-samples provided to NIWA for analysis. [Ref 34].
2012–13	Traps operated by KCE staff. Few details of catch provided 2 samples of catch frozen and retained for analysis [this study].
2013–14	Traps operated by KCE staff. Few details of catch provided, no samples of catch frozen and retained for analysis [Ref 54].
2014–15	Traps operated by KCE staff. Few details of catch provided two samples of catch frozen and retained for analysis [Ref 54].
2015–16	Traps operated by KCE staff. Few details of catch provided, four samples of catch frozen, retained analysed by NIWA at end of season.
2016–17	Traps operated by KCE staff. Six samples of catch frozen, retained analysed by NIWA at end of season.
2017–18	King Country Energy (KCE) was acquired by Trustpower/Manawa Energy in March 2018 and Trustpower/Manawa Energy assumed responsibility for annual reporting to the Waikato Regional Council (WRC). Five samples retained and examined [Ref 62].
2018–19	Traps operated by KCE staff. Six samples of catch frozen, retained analysed by NIWA at end of season [Ref 62].
2019–20	Traps operated by KCE staff. Six samples of catch frozen, retained analysed by NIWA at end of season [Ref 62].
2020–21	Traps operated by KCE staff. Six samples of catch frozen, retained analysed by NIWA at end of season [Ref 62]. Penstocks dewatered & Traps off 13/02/2021 to 28/02/2021.
2021–22	No data.
2022–23	Traps operated by KCE staff.
2023–24	Traps operated by KCE staff.
2024–25	Traps operated by KCE staff.

Piripaua (5)

Pre-1984	Piripaua Power Station is part of the Waikaremoana Power Scheme and was commissioned between 1943–44. No fish passes were included in the scheme's original design, but staff did collect elvers from the turbine well during maintenance and transferred these to the upper catchment. Early publications claim that that there were no eels in Lake Waikaremoana, but this view has since been challenged and the pre-scheme

	status of the eel population remains unclear. Evidence of the presence of a few large eels within the system start to emerge by 1984.
1996–97	Elver traps installed in the tailrace and stop log, but system not operated for full season. NIWA contracted by Genesis to oversee monitoring [Ref 19].
1997–98	Traps operated in tailrace and stop log. NIWA contracted by Genesis to assist with monitoring. Species composition information possibly inaccurate and verified only once by NIWA. Only total catch records suitable for trend analysis for this season [Ref 20].
1998–99	Traps operated in tailrace and stop log. NIWA contracted by Genesis to assist with monitoring. Only small number of elvers checked for species composition. [Ref 20].
1999–00	Traps operated in tailrace and stop log. NIWA contracted by Genesis to assist with monitoring Thirteen samples analysed by Genesis contractor but not verified by NIWA. Only total catch records suitable for trend analysis for this season [Ref 21].
2000–01	Ramp to tailrace trap lined with brushes. Stop log trap dismantled as it never caught many elvers [Ref 21].
2001–02	Tailrace trap operated by Genesis and monitoring checks made by NIWA [Ref 33].
2002–03	Tailrace trap operated by Genesis and monitoring checks made by NIWA [Ref 24].
2003–04	Tailrace trap operated by Genesis and monitoring checks made by NIWA [Ref 24].
2004–05	Tailrace trap operated by Genesis and monitoring checks made by NIWA [Ref 25].
2005–06	Tailrace trap operated by Genesis and monitoring checks made by NIWA [Ref 25].
2006–07	Tailrace trap operated by Genesis and monitoring checks made by NIWA [Ref 11].
2007–08	Tailrace trap operated by Genesis and monitoring checks made by NIWA [Ref 11].
2008–09	Tailrace trap operated by Genesis contractor and monitored by NIWA under contract to Genesis [Ref. 8 and 9].
2009–10	No changes to trap and transfer operations made [Ref 26].
2010–11	No changes to trap and transfer operations made [Ref 27].
2011–12	No changes to trap and transfer operations made [Ref 34].
2012–13	No changes to trap and transfer operations made [Ref 46].
2013–14	No changes to trap and transfer operations made [Ref 46].
2014–15	No changes to trap and transfer operations made. Trapping ceased over Christmas – New Year period for 12 days [this study]. Survey of eel populations in catchments completed [Ref 48].
2015–16	Monitoring undertaken Meridian staff taking it in turn but Roha Lake and Cam Speedy did most of it. Damaged sluice gates at the Waihi Dam on Waiau River resulted in silt being discharged over summer and may have diverted elvers into Waikaretaheke River to Piripaua [Ref 52, 53].
2016–17	Monitoring undertaken Genesis staff, supervised by Jacques Boubèe.
2017–18	Monitoring undertaken Genesis staff, supervised by Jacques Boubèe.
2018–19	Monitoring undertaken Genesis staff, supervised by Jacques Boubèe.
2019–20	Monitoring undertaken Genesis staff, supervised by Jacques Boubèe.
2020–21	Monitoring undertaken Genesis staff, supervised by Jacques Boubèe.
2021–22	Monitoring undertaken Genesis staff, supervised by Jacques Boubèe.
2022–23	Elver trap not operating for most of the season because the site was being upgraded (no hydro operation occurred). Some small catches recorded during the
2023–24	Monitoring undertaken Genesis staff, supervised by Jacques Boubèe
2024–25	Monitoring undertaken Genesis staff, supervised by Jacques Boubèe

Roxburgh (7)

Pre-1984	Dam completed in 1956. No fish pass installed to protect "lake [trout] fisheries from contamination by eels and salmon' [Ref 27]. No elver reported in tailrace in 1960 [Ref 6]. Some elvers reported from the tailrace in 1971 [Ref 6,7].
1983–84	No elver run observed [Ref 8].
1994–95	Evidence of elvers in various galleries of the station reported [Ref 2].
1995–96	Floating trap trials at base of spillway, but only 40 elvers collected.

1996–97	Elver ramps and traps installed by South Island eel industry and the Araiteura Eel Management Area Committee with help from NIWA and co-funding from Fisheries New Zealand 325 elver (1.5kg) captured and transferred to L Dunstan [Ref 22].
1997–98	Elver traps operated with 22 kg captured and transferred into Lake Dunstan and Wanaka. Large numbers of lampreys used the ramps and overwhelmed the system, so the traps closed by Runanga representative because of adverse effects on lamprey.
1998–99	Traps not operated.
1999–00	Traps not operated but between January 28 and 1 April 225 kg of eels and elvers collected in No. 2 turbine sump during maintenance work. All catch transferred to L Roxburgh [Greg Ryder email to Daniel Druce of CONTACT 7 Feb 2012. Traps not operated.
2000–01	Traps not operated.
2001–02	Trap repaired and operated by NIWA and eel industry. Samples of the catch analysed. Approx. 1000 (2.5kg) LFE captured over season. 333 transferred to L Dunstan, 70 to L Roxburgh, rest retained as sample [Ref 33].
2002–03	Traps operated through season by NIWA and eel industry 127 LFE (0.39 kg captured and transferred to L Roxburgh.
2003–04	Ramps and traps operated through season by NIWA and Hokonui Runanga 1380 (3.82 kg) LFE captured.
2004–05	Trapping discontinued because of uncertainties over responsibilities [Ref 25].
2011–12	Upstream and downstream traps recommissioned, and some trials undertaken. No details provided.
2012–13	Trapping reinstated, and daily catch data received from Contact Energy. Two frozen samples analysed by NIWA. Three samples retained for ageing if required [Ref 54].
2013–14	Traps operating from early February 2014, 1 sample analysed 16 elvers [Ref 54].
2014–15	Trap operating January, February 2015, 3 samples analysed. New trap not commissioned [Ref 54].
2015–16	Trap operating from 1 December, 4 samples analysed. Upstream trap taken out of commission due to ongoing mortality issues from late February [Ref 62].
2016–17	Traps deployed, but no elvers captured in 2016–17. Operated by Contact, confident traps were working Ok [this study]. Total of 3886 g of elvers were captured from ramps leading to traps, but data not included in trend analyses.
2017–18	Three traps at Roxburgh (Upstream, Downstream and New), operated for 114 days. Two samples kept, frozen analysed for average weight by NIWA at end of season [Ref 62].
2018–19	Only a total catch for the season was reported. No details of daily catches or catch samples examined were received.
2019–20	Only a total catch for the season was reported. Two samples kept frozen. Analysed for average weight by NIWA at end of season. High flows destroyed 2017 trap in early February 2020. Trap rebuilt at the end of the season with modifications made to the ramps.
2020–21	Three traps at Roxburgh. Five samples kept, frozen analysed for average weight by NIWA at end of season.
2021–22	New Environmental Assistant takes over elver trap and transfers for the site. Regular daily sampling undertaken plus length/weight data supplied to NIWA.
2022–23	Normal trapping and monitoring undertaken by Contact Energy staff through entire migration season.
2023–24	Normal trapping and monitoring undertaken by Contact Energy staff through entire migration season
2024–25	Normal trapping and monitoring undertaken by Contact Energy staff through entire migration season.

Mararoa Lake Control Structure (8)

Pre-1984	Dam completed in 1976 with a borda orifice fish pass installed but this soon filled with gravel [Ref 30].

1995–96	Mass mortality of elvers reported below the weir. Sample of elvers measured and aged [Ref 16].
1996–98	No records.
1998–99	Vertical slot fish pass completed but use by elvers unknown. Some trapping and netting attempted.
1999–00	Limited elver capture and transfer operation continue.
2000–01	Some catch records available.
2001–02	No records.
2002–03	Some trapping and dip netting carried out below the gates [Ref 24].
2003–04	Some trapping and dip netting carried out below the gates [Ref 24].
2004–05	Two floating traps operated when condition permitted by Runanga representatives with the support of Meridian Energy. Some species composition records available, but because effort changes over time the data collected are of limited value for recruitment trend analysis. No species ID available, which makes catch data unreliable for trend analysis [Ref 25].
2005–06	Two floating traps operated when condition permitted by Runanga representative with support of Meridian Energy. No species ID available, which makes catch data unreliable for trend analysis [Ref 25].
2006–07	Trap only operated for short periods each months Dec. to Feb. A small number of elvers were weighed and measured individually through the season. No species ID available, which makes catch data unreliable for trend analysis [Ref 11].
2007–08	Trap only operated for short periods each months Dec. to Feb. A small number of elvers were weighed and measured individually through the season. No species ID available, which makes catch data unreliable for trend analysis [Ref 11].
2008–09	Trap operated by Meridian and contractor. Floods limited deployment of trap to 16 nights. No species ID available, which makes catch data unreliable for trend analysis [Ref 8].
2009–10	Trapping interrupted by Health and Safety concerns in mid Feb. Records not continuous. No species ID available, which makes catch data unreliable for trend analysis [Ref 26].
2010–11	Trapping not continuous through season but more extensive than in the past [Ref 27].
2011–12	Most extensive trapping to date. Catches highest on records but results may have been partially affected by the extra effort made. No species ID available, which makes catch data unreliable for trend analysis [Ref 34].
2012–13	Trap deployed November 2012, monitored throughout season. Interrupted by flood flows 1st to 27th Jan 2013. No species ID available, which makes catch data unreliable for trend analysis
2013–14	High rainfall 3rd to 20th January 2014 and flood flows interrupted operations. Greater catch effort, daily trapping [Ref 39].
2014–15	New contractors Gail and William Thompson and whanau from Te Runanga o Awarua. Traps deployed 9 January [Ref 54].
2015–16	Contractors Gail and William Thompson and whanau from Te Runanga o Awarua. Catch probably includes juvenile eels. The average weight of ‘eels’ recorded was similar to elver sizes, suspect wrong mesh size used to separate eels and elvers. Traps deployed 11 December [Ref 62].
2016–17	Operated by Gail and William Thompson and whanau from Te Runanga o Awarua.
2017–18	Operated by Gail and William Thompson and whanau from Te Runanga o Awarua. Traps deployed 1 December; 11 samples collected. 13 mm mesh bag used to separate elvers from juvenile eels [Ref 62].
2018–19	Operated by Gail and William Thompson and whanau from Te Runanga o Awarua. Frozen samples obtained and sent to NIWA.
2019–20	Operated by Gail and William Thompson and whanau from Te Runanga o Awarua. Large amount of spilling occurred because of high flow events, which prevents the traps from operating effectively.
2020–21	Operated by Gail and William Thompson and whanau from Te Runanga o Awarua. Frozen samples obtained and sent to NIWA.

2021–22	Operated by Gail and William Thompson and whanau from Te Runanga o Awarua. Frozen samples obtained and sent to NIWA.
2022–23	Operated by Te Runanga o Awarua. Frozen samples obtained and sent to NIWA.
2023–24	Operated by Te Runanga o Awarua. Frozen samples obtained and sent to NIWA.
2024–25	Operated by Te Runanga o Awarua. Frozen samples obtained and sent to NIWA.

Mangorei (11)

Pre-1984	Power scheme constructed around 1904 with subsequent upgrades notably in the 1930s. No fish pass provision included in the original design.
2003–04	Trap installed Jan 2003. Some analysis of catch made by Taranaki RC [Ref 24].
2004–05	Trap and transfer operation by station staff. No subsample retained for analysis [Ref 24].
2005–06	Trap and transfer operation by station staff. No samples retained for analysis [Ref 25].
2006–07	Trap operated by TrustPower. No subsample of the catch obtained [Ref 11].
2007–08	Trap operated by TrustPower. One subsample of the catch obtained [Ref 11].
2008–09	Trap operated by TrustPower. No subsamples obtained but Taranaki Regional Council did analyse one sample [Ref 8].
2009–10	Trap operated by TrustPower. No subsample of the catch obtained [Ref 26].
2010–11	Trap operated by TrustPower. No subsamples of the catch obtained [Ref 27].
2011–12	Trap operated by TrustPower. No subsample of the catch obtained [Ref 34]
2012–13	Trap operated by TrustPower. No subsample of the catch obtained [Ref 37].
2013–14	Trap operated by TrustPower. No subsample of the catch obtained [Ref 40].
2014–15	Trap operated by TrustPower. No subsample of the catch obtained [Ref 43].
2015–16	Trap operated by TrustPower. No subsample of the catch obtained [Ref 55].
2016–17	Trap operated by TrustPower. No subsample of the catch obtained [Ref 62].
2017–18	Trap operated by TrustPower. No subsample of the catch obtained [Ref 62].
2018–19	No data received.
2019–20	No data received.
2020–21	No data received.
2021–22	No data received.
2022–23	No data received.
2023–24	No data received.
2024–25	No data received.

Motukawa (12)

Pre-1984	Power scheme commissioned in 1927 with subsequent upgrades. Last turbine installed in 1939. No fish passage provision included in original design.
2002–03	Trap and transfer operated by local fisherman with support from TrustPower. Some analysis of catch made by Taranaki RC. No catch records provided [Ref 24].
2003–04	No catch records provided [Ref 24].
2004–05	Trap and transfer operated by eel industry with support from Trust Power. No subsamples retained for analysis [Ref 25].
2005–06	Trap and transfer operated by eel industry with support from Trust Power. No subsamples retained for analysis [Ref 25].
2006–07	Trap operated by TrustPower. No subsample of the catch obtained but one sample counted and weighed by TrustPower in Jan 2006 [Ref 11].
2007–08	Trap operated by TrustPower. No subsample of the catch obtained but one sample counted and weighed by TrustPower in Jan 2006 [Ref 11].
2008–09	Trap operated by TrustPower. No subsample of the catch obtained [Ref 8].
2009–10	Trap operated by TrustPower. No subsample of the catch obtained [Ref 26].

2010–11	Trap operated by TrustPower. No subsample of the catch obtained [Ref 27].
2011–12	Trap operated by TrustPower. No subsample of the catch obtained [Ref 34].
2012–13	Trap operated by TrustPower. No subsample of the catch obtained [Ref 37].
2013–14	Trap operated by TrustPower. No subsample of the catch obtained [Ref 40].
2014–15	Trap operated by TrustPower. No subsample of the catch obtained [Ref 43].
2015–16	Trap operated by TrustPower. No subsample of the catch obtained [Ref 55].
2016–17	Trap operated by TrustPower. No subsample of the catch examined [Ref 62].
2017–18	Trap operated by TrustPower. No subsample of the catch examined [Ref 62].
2018–19	No data received.
2019–20	No data received.
2020–21	No data received.
2021–22	No data received.
2022–23	No data received
2023–24	No data received.
2024–25	No data received.

Wilson's Dam (13)

Pre-2003	Water supply dam completed around 2003. Fish ladder installed as part of Consents requirements by Whangarei District Council (WDC), but the exact monitoring requirements are unclear.
2004–05	Fish pass operated and monitored by WDC. Species composition provided by the dam owner could not be confirmed [Ref 25].
2005–06	Fish pass operated and monitored by WDC. Species composition provided could not be confirmed [Ref 25].
2006–07	Elver pass monitored by Whangarei DC. Catch records provided but no species composition available [Ref 11].
2007–08	No further monitoring records made available [Ref 11].

Morrinsville Dam (14)

Pre-2001	Water supply dam for Morrinsville township. Initial construction date unknown but the dam has been upgraded several times over its life. Various attempts to pass elvers and other fish have been made in last two decades but no confirmation of what was tested is available.
2001–02	Temporary trap installed at base of dam [Ref 33].
2002–05	Unclear if the trap was operated over this period but by 2005 the trap had fallen into disrepair.
2005–06	New trap installed in Feb. 2006. No species composition available [Ref 25].
2006–07	Trap operated by Kaimai Valley services. Only total catch records obtained [Ref 11].
2007–08	Trap operated by Kaimai Valley services. No catch records obtained [Ref 11].
2008–09	No further records obtained [Ref 8].

Waihopai Dam + Branch River (15)

Pre-1984	Power scheme constructed 1925–27. No fish pass included in original design.
2005–06	Trap installed by TrustPower and monitored visually by Golder as part of a five-year requirement of Consents [Ref 11, 12].
2006–07	Trap operated by TrustPower and monitored by Golder as part of consenting [Ref 11, 12].
2007–08	Basic records obtained [Ref 11].

2008–09	Basic records obtained [Ref 8].
2009–10	Basic records obtained [Ref 26].
2010–11	No records obtained.
2011–12	No records obtained.
2012–13	Data received from Golders, including total catch for previous seasons [Ref 35].
2013–14	Data received from Golders, species composition data as proportion of catch [Ref 41].
2014–15	Raw data sheets received.
2015–16	The elver trap didn't catch anything in February due to a series of floods that kept filling the trap with mud. However, there is the potential for the elvers to bypass the trap and head up the river over the dam so the low catch may not reflect the actual elver run, but rather those that entered the trap rather than just heading upriver naturally. (Richard Allibone email 27/7/16). [Ref 56].
2016–17	Data received from Water Ways Consulting. Additional data for the Branch River Hydroelectric scheme also operated by Trustpower. [Ref 57].
2017–18	Data received from Water Ways Consulting. Additional data for the Branch River Hydroelectric scheme also operated by Trustpower. Waihopai shut down or flooded for majority if elver migration. Mussel spat rope at Branch River trap improved elver catches [Ref 59].
2018–19	Data received from Water Ways Consulting
2019–20	Data received from Water Ways Consulting.
2020–21	Data received from Water Ways Consulting.
2021–22	Data received from Water Ways Consulting. Both stations were shut down for long periods during the 2021–22 season, making this season's catch not comparable to other seasons.
2022–23	Data received from Water Ways Consulting
2023–24	Data received from Water Ways Consulting
2024–25	Data received from Water Ways Consulting

Mokauiti Dam (16)

Pre-1984	Mokauiti Power Station was commissioned in 1963. No fish pass included in original design.
2008–09	Temporary elver trap installed and monitored by NIWA under contract to King Country Energy (KCE) [Ref 8, 10].
2009–10	"Nature like" fish pass constructed. Monitoring of fish passage undertaken but only one sample retained for analysis [Ref 26].
2010–11	Fish pass modification completed in mid-January and no further monitoring done after that [Ref 27].
2011–12	Monitoring reinstated but only a few samples were provided to NIWA for species composition analysis [Ref 34].
2012–13	Monitoring ceased early February 2013, two frozen samples retained and analysed by NIWA [Ref 54].
2013–14	Monitored by KCE staff. No samples of catch analysed [Ref 54].
2014–15	Traps operated over whole season by KCE staff. Few details of catch provided; no samples of catch retained for analysis [Ref 54].
2015–16	Traps operated over whole season by KCE staff. Few details of catch provided, 2 samples of catch collected, frozen and analysed by NIWA at end of season [Ref 62].
2016–17	Traps operated by KCE staff. Five samples of catch frozen, retained analysed by NIWA at end of season [Ref 62].
2017–18	Additional trap installed at Mokauiti at the outlet of the generators and these elvers are transferred to the head pond and no longer required to swim up the residual flow path to the existing trapping site which we are still maintaining [Email Andrew Monkley 26/3/18]. King Country Energy (KCE) was acquired by Trustpower in March 2018 and

	Trustpower assumed responsibility for annual reporting to the Waikato Regional Council (WRC). Five samples retained and examined [Ref 62].
2018–19	Traps operated by KCE staff.
2019–20	Traps operated by KCE staff.
2020–21	Traps operated by KCE staff.
2021–22	No data received.
2022–23	Only total catch weight received.
2023–24	Only total catch weight received.
2024–25	Only total catch weight received.

Waitākere Ranges (18)

2008–09	Traps installed no elvers captured.
2009–10	Watercare Services reported that the first elvers were recorded at Nihotupu on 7 September. Trapping was discontinued on 25 February. The total catch for the three traps was 3.5 kg, which was estimated to be 3041 elvers. The size range was 70 to 100 mm (Watercare Services Ltd (2010). The largest proportion of the catch was made at the Lower Nihotupu Dam trap (75 %, 2269 elvers). The trap at the Huia Stream captured 411 elvers (0.6 kg), and the Waitākere River trap caught 361 elvers (0.4 kg). In addition to elvers, a single juvenile eel, 31 bullies and 3355 shrimp were also captured (Watercare Services Ltd 2010).
2010–11	No data.
2012–13	Traps operated 1 Oct to 30 Apr, about 200 elvers captured [Ref 49].
2013–14	Elvers captured in Nihotupu and Watercare Dam sites. Received data from Watercare [Ref 42].
2014–15	Traps operated 1 Sep to 22 May, about 2300 elvers captured [Ref 50].
2015–16	No data received.
2016–17	Four traps deployed (Lower Nihotupu Dam, Waitakere Dam and two at Lower Huia Dam). The design and methodology followed Watercare's Native Fisheries Programme Operations Manual for Undertaking Trap and Haul [Ref 58].
2017–18	Three traps operating, but no fish trapped at Lower Huia due to competing flow paths [Ref 60].
2018–19	Three traps operating, but no fish trapped at Lower Huia due to competing flow paths. Data extracted from Watercare Native Fisheries Annual Report. No species composition. Total weight of elvers transferred and recorded based on 1g per elver multiplied by numbers recorded and transferred.
2019–20	Three traps operating, but no fish trapped at Lower Huia due to competing flow paths. Data extracted from Watercare Native Fisheries Annual Report. No species composition. Total weight of elvers transferred and recorded based on 1g per elver multiplied by numbers recorded and transferred.
2020–21	Three traps operating, but no fish trapped at Lower Huia due to competing flow paths. Data extracted from Watercare Native Fisheries Annual Report. No species composition. Total weight of elvers transferred and recorded based on 1g per elver multiplied by numbers recorded and transferred.
2021–22	Three traps operating, but no fish trapped at Lower Huia due to competing flow paths. Data extracted from Watercare Native Fisheries Annual Report. No species composition. Total weight of elvers transferred and recorded based on 1g per elver multiplied by numbers recorded and transferred.
2022–23	No species composition. Total numbers of elvers recorded only.
2023–24	No species composition. Total numbers of elvers recorded only.
2024–25	No species composition. Total numbers of elvers recorded only.

Hunua Ranges (19)

2009–10	Elvers were not captured in the two traps in the Hunua Ranges.
2010–11	No data.
2012–13	Traps operated 1 Oct to 30 Apr, about 800 elvers captured [Ref 49].
2013–14	Elvers captured at Cosseys Dam and Hays Creek Dam. Received data from Watercare [Ref 42].
2014–15	Traps operated 1 Sep to 22 May, about 900 elvers captured [Ref 50].
2015–16	No data received.
2016–17	Three traps deployed (Hays Creek Dam, Cosseys Dam and Mangatangi Dam). The design and methodology followed Watercare's Native Fisheries Programme Operations Manual for Undertaking Trap and Haul [Ref 58].
2017–18	Cossey's fish trap did not catch any elvers due to the dam consistently spilling and compensation flows were not required. The Dams were spilling for long periods due to rain and operational reasons. Elver traps were often taken out of service by rainfall events and subsequent high flows [Ref 60].
2018–19	Data extracted from Watercare Native Fisheries Annual Report. No species composition. Total weight of elvers transferred and recorded based on 1g per elver multiplied by numbers recorded and transferred.
2019–20	Data extracted from Watercare Native Fisheries Annual Report. No species composition. Total weight of elvers transferred and recorded based on 1g per elver multiplied by numbers recorded and transferred.
2020–21	Data extracted from Watercare Native Fisheries Annual Report. No species composition. Total weight of elvers transferred and recorded based on 1g per elver multiplied by numbers recorded and transferred.
2021–22	Data extracted from Watercare Native Fisheries Annual Report. No species composition. Total weight of elvers transferred and recorded based on 1g per elver multiplied by numbers recorded and transferred.
2022–23	No species composition. Total numbers of elvers recorded only.
2023–24	No species composition. Total numbers of elvers recorded only.
2024–25	No species composition. Total numbers of elvers recorded only.

Turitea Dam (20)

2012–13	Monitoring from late November 2012 to late February 2013 by Palmerston North CC [Ref 51].
2013–14	Traps not operating.
2014–15	Traps not operating.
2015–16	Emailed Paul Horton 13/7/16, no reply yet.
2016–17	No data received.
2017–18	No data received.
2018–19	No data received.
2019–20	No data received.
2020–21	No data received.
2021–22	No data received.
2022–23	No data received.
2023–24	No data received.
2024–25	No data received.

Mataura (21)

2014–15	Trials using spat ropes and an existing trap in previous seasons. Elvers captured using hand nets from pools until new trap commissioned 23 February 2015 and modified with brush ramps [Ref 45].
2015–16	"The season at Mataura was very poor. I believe it was due to the Alliance Group Mataura Plant having a breakdown in their hydro. As a result, they spilled water all elver season, and I believe that this allowed elvers to bypass the falls. There were no accumulations of elvers at the bottom of the falls area as occurred last season." [James Holloway email 20 July 2016].
2016–17	The traps were not installed, inspections of area below the falls showed insufficient elvers were congregating. Moderate flows for a portion of the season. (James Holloway email 7 August 2017).
2017–18	No trapping done. Very few elvers were in the accumulation areas so didn't trigger the trapping requirements. We had elevated flows for much of the trapping time, and I believe that there is a flow-dependent barrier that elvers can climb once flows are in the 50 - 70 cumec range (James Holloway email 6 August 2018).
2018–19	No data received.
2019–20	No data received.
2020–21	No data received.
2021–22	No data received.
2022–23	No data received.
2023–24	No data received.
2024–25	No data received.

Upper Whanganui (22)

2014–15	Manual collection of elvers from the Otamangakau Valve at the base of the Otamangakau Reservoir and transferred to above the power scheme structures. A permanent trap is proposed for installation at this site for the 2015-16 season. Collection, transfers and data from John Morgan, Lena Bell (Ngāti-Hikairo-ki Tongariro) and Genesis [Ref 44].
2015–16	Manual collection of elvers from the Otamangakau Valve at the base of the Otamangakau Reservoir and transferred to above the power scheme structures. A permanent trap installed at this site for the 2015–16 season. Collection, transfers and data from John Morgan, Lena Bell (Ngāti-Hikairo-ki Tongariro) and Genesis [Ref 62].
2016–17	All the elvers were collected in the trap. Jacques repaired the ramp that had been smashed up by vandals early in the season. Genesis did some work to improve water supply to the ramp and trap [Ref 62].
2017–18	Elvers collected from 'Eel trap' and 'valve house' by Genesis staff and supervised by Vaipuhi Consultants [Ref 62].
2018–19	Elvers collected from 'Eel trap' and 'valve house' by Genesis staff and supervised by Vaipuhi Consultants [Ref 62]. No species composition. Regular counts of elvers supplied to NIWA.
2019–20	Elvers collected from 'Eel trap' and 'valve house' by Genesis staff and supervised by Vaipuhi Consultants [Ref 62]. No species composition. Regular counts of elvers supplied to NIWA.
2020–21	Elvers collected from 'Eel trap' and 'valve house' by Genesis staff and supervised by Vaipuhi Consultants [Ref 62]. No species composition. Regular counts of elvers supplied to NIWA.
2021–22	Elvers collected from 'Eel trap' and 'valve house' by Genesis staff and supervised by Vaipuhi Consultants. No species composition. Regular counts of elvers supplied to NIWA.

2022–23	Elvers collected from ‘Eel trap’ and ‘valve house’ by Genesis staff and supervised by Vaipuhi Consultants. No species composition. Regular counts of elvers supplied to NIWA.
2023–24	Elvers collected from ‘Eel trap’ and ‘valve house’ by Genesis staff and supervised by Vaipuhi Consultants. No species composition. Regular counts of elvers supplied to ESNZ.
2024–25	Elvers collected from ‘Eel trap’ and ‘valve house’ by Genesis staff and supervised by Vaipuhi Consultants. No species composition. Regular counts of elvers supplied to ESNZ.

Ruahihi Dam (23)

2023–24	Operated by Contact Energy. Ageing samples obtained and sent to NIWA.
2024–25	Operated by Contact Energy.

References used in Appendix 1

1 Boubée, J.; Barrier R. (1996). Elver collection and transfer programme - Karāpiro Dam, 1995–96. *NIWA, Hamilton Consultancy Report ELE602.11*. 69 p.

2 Beentjes, M.; Chisnall, B.; Boubée, J.; Jellyman, D. (1997). Enhancement of the New Zealand eel fisheries by elver transfer. *New Zealand Fisheries Technical Report No. 45*. 44 p.

3 Jellyman, D. (1977). Summer upstream migration of juvenile freshwater eels in New Zealand. *New Zealand Journal of Marine and Freshwater Research 11:* 61-71.

4 Boubée, J.; Mitchell, C. (1994). The eels that climb over a dam. *Waste and Water in New Zealand 82*: 23–26.

5 Waitaki Valley Acclimation Society (1960). Waitaki Valley Acclimation Society Annual Report No. 16.

6 Bound, R.; Cunnigham, B. (1960). An investigation of the upstream eel migration at Roxburgh Dam, on the Clutha River. Marine Department Investigational Report Job No. 23 (unpublished report held in ESNZ library, Christchurch).

7 Pack, Y.; Jellyman, D. (1988). Fish stocks and fisheries of the lower Clutha River. *New Zealand Freshwater Fisheries Report 98*. 117 p.

8 Martin, M.; Stevenson, C.; Boubée, J.; Bowman, E. (2009). Recruitment of freshwater elvers 1995–2009. *New Zealand Fisheries Assessment Report 2009/58.* 43 p.

9 Boubée, J.; Bowman, E.; Tipuna, M. (2009). Waikaremoana Power Scheme – monitoring of the Piripaua elver catch and transfer programme 2008/2009. NIWA Client Report HAM2009-073.

10 Stevenson, C.; Boubée, J. (2009). Mokauiti and Wairere Falls Power Stations: Monitoring of Fish Passage 2009. NIWA Client Report HAM2009-105.

11 Martin, M.; Boubée, J.; Bowman, E. (2009). Recruitment of freshwater eels 2006–07 and 2007–08. *New Zealand Fisheries Assessment Report 2009/4*. 68 p.

12 Golder Kingett Mitchell (2007). Elver trap and transfer monitoring. *Locally Speaking 2*: 3.

13 Williams, E.; Boubée J.; Smith, J. (2001). Karāpiro elver transfer programme 2000/2001. NIWA Client Report MRP01211, 22 p.

14 Department of Conservation (1999). Hui a tuna draws considerable interest. *He Atinga. 10.* 14 p.

15 Boubée, J.A.T.; Lee, D.; Dean, T.; Kusabs, I. (1997). Matahina Power Station - elver catch and transfer programme, 1996/97. *NIWA, Hamilton Consultancy Report ELE702.21*. 35 p.

16 Chisnall, B.; Beentjes, M.; Boubée, J.; West, D. (1998). Enhancement of New Zealand eel fisheries by elver transfer, 1996–97. *NIWA Technical Report 37.* 56 p.

17 Lee, D.; Boubée, J.; Levet, N.; Tarei, R. (1998). Matahina Power Station elver catch and transfer programme 1997/98. NIWA Client Report: ELE80221. 14 p.

18 Taranaki Regional Council (2001). Taranaki Generation Ltd. Lake Rotorangi monitoring programme. Water quality and biological programmes. Annual report 2000-2001. *Taranaki Regional Council Technical Report 2001*: *78*. 72 p.

19 Boubée, J.A.T. (1997). Piripaua Power Station - elver catch and transfer programme, 1996/97. *NIWA, Hamilton Consultancy Report ELE702.12/1*. 17 p.

20 Boubée, J.; Smith, J.; Hemepo, P.; Tipuna, M. (1999). Piripaua Power Station elver catch and transfer programme- 1997/98 & 1998/99. NIWA Client Report ELE0902.12/1. 16 p.

21 Boubée, J.; Bowman, E.; Tipuna, M. (2001). Waikaremoana Power Scheme – Monitoring of the elver catch and transfer programme 2000/2001. NIWA Client Report GPL01212. 40 p

22 J Boubée, NIWA pers. obs.

23 Jellyman, D.; Graynoth, E.; Francis, R.; Chisnall, B.; Beentjes, M. (2000). A review of evidence for a decline in the abundance of longfinned eels (*Anguilla dieffenbachii*) in New Zealand. Final Research Report for Ministry of Fisheries Research Project EEL9802. 59 p + Appendices. (Unpublished report held by Ministry for Primary Industries, Wellington.)

24 Martin, M.; Boubée, J.; Williams, E.; Bowman, E. (2007). Recruitment of freshwater eels 2002–03 and 2003–04. *New Zealand Fisheries Assessment Report 2007/38*. 105 p.

25 Martin, M.; Boubée, J.; Bowman, E.; Griffin, D. (2008). Recruitment of freshwater eels 2004–05 and 2005–06. *New Zealand Fisheries Assessment Report 2008/16.* 81 p.

26 Martin, M.; Boubée, J.; Bowman, E. (2010). Recruitment of freshwater elvers 2009–2010. Research Progress Report for Ministry of Fisheries Research Project EEL2008/01B. Objective 1. (Unpublished report held by Ministry for Primary Industries, Wellington.)

27 Martin, M.; Boubée, J.; Bowman, E. (2011). Recruitment of freshwater elvers 2010–11. Research Progress Report for Ministry of Fisheries Research Project EEL200801C. Objective 1. (Unpublished report held by Ministry for Primary Industries, Wellington.)

28 Lee, D.; Levet, N.; Magnus, S.; Boubée, J. (1998). Karāpiro Power Station elver catch and transfer programme 1997/98. NIWA Client Report: ELE80211. 16 p.

29 Williams, E.; Boubée, J.; Smith, J.; Wirihana, C. (1999). Karāpiro elver transfer programme 1998/99. NIWA Client Report ELE90211/1. 21 p.

30 Boubée, J.; Allibone, R.; Williams E. (2000). Fish distribution in the Waiau River passage requirements and options at the Mararoa Weir and Te Anau Lake control structure. NIWA Client Report MEE00201. 53 p.

31 Boubée, J.; Levet, N. (1997). Collection and transfer of elvers at Karāpiro Dam 1996/97. NIWA, Client Report ELE702.21. 24 p + Appendices.

32 Boubée, J.; Williams, E. (2012). Wairua Power Station elver trap and transfer program - 2011–12 season. NIWA Client Report: HAM2012-117. 24 p.

33 Boubée, J.; Williams, E.; Beentjes, M.; Bowman, E. (2002). Recruitment of longfinned eels 2001–2002. Final Research Report for Ministry of Fisheries Research Project EEL2000/01. 53 p. (Unpublished report held by Ministry for Primary Industries, Wellington.)

34 Martin, M.; Boubée, J.; Bowman, E. (2013). Recruitment of freshwater elvers 1995–2012. *New Zealand Fisheries Assessment Report 2013/50.* 111 p.

35 Golders (2013). Waihopai Hydroelectric Power Scheme – Elver Monitoring 2012/2013. Golders Associates Project No. 1178405532B. Dunedin. 8 p.

36 Trustpower (2013). Patea Hydroelectric Power Scheme Elver/Eel Trap and Transfer Report. Trustpower, Tauranga. 18 p.

37 Trustpower (2013). TrustPower Eel / Elver Trap and Transfer Summary Report. Trustpower, Tauranga. 7 p.

38 Ryder Consulting Ltd (2014). Summary of Upstream Fish Transfers: September 2013 – April 2014. Ryder Consulting Ltd, Dunedin. 33 p.

39 Aquatic Environmental Services (2014). Manapouri Power Scheme Long Fin Eel Mitigation Report 2013 – 2014 Season. Meridian Energy Ltd, Christchurch. 25 p.

40 Trustpower (2014). Mangorei and Motukawa Hydroelectric Power Schemes Elver/eel Trap and Transfer Report. Trustpower Ltd, Tauranga. 7 p.

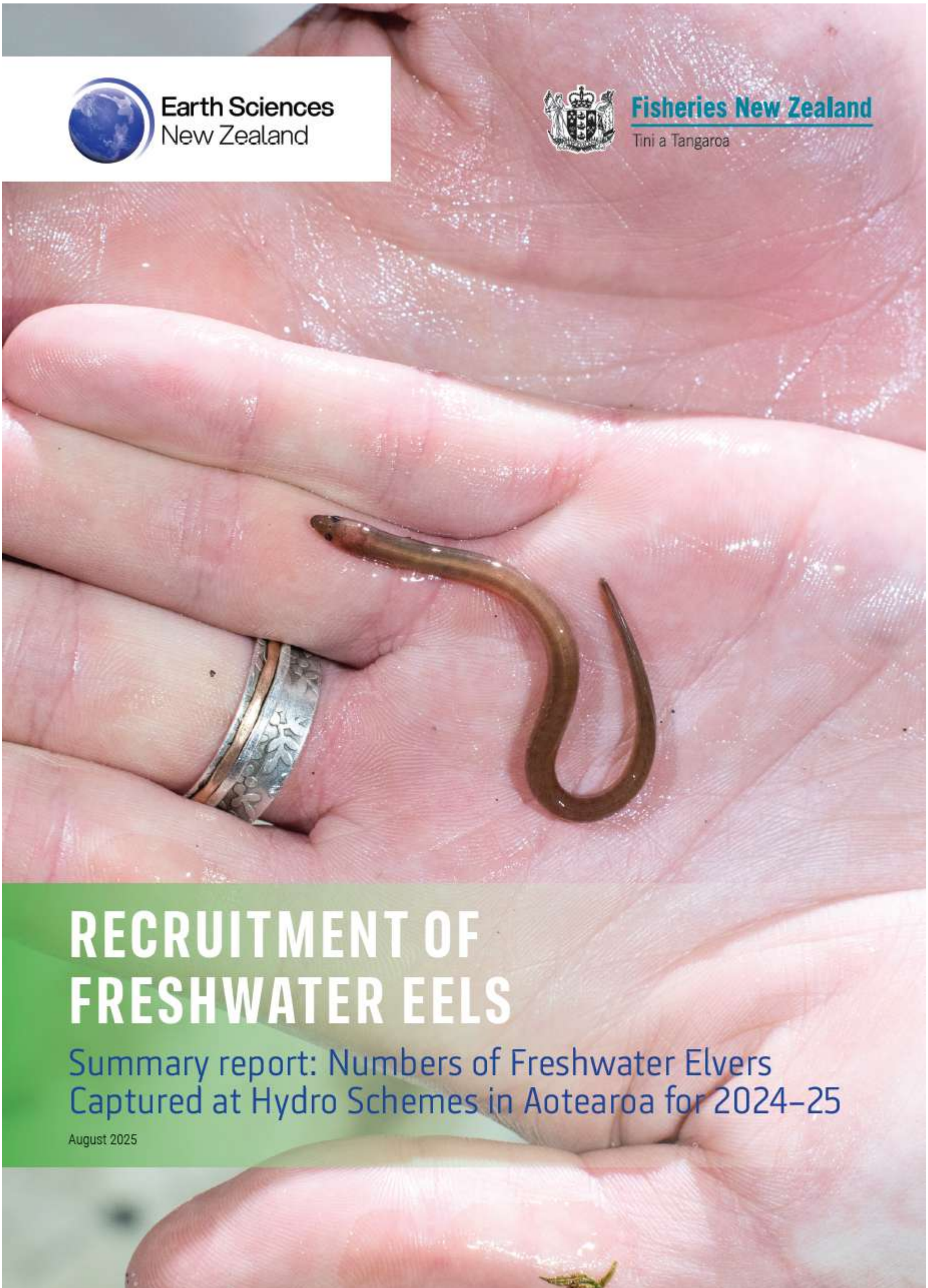
41 Golders (2014). Waihopai Hydroelectric Power Scheme – Elver Monitoring 2013/2014. Golders Associates Project No. 1378410618-LRRev0_001. Dunedin. 8 p.

42 Watercare (2014). Fisheries Report 2014. Watercare Services Ltd, Auckland. 18 p.

43 Trustpower (2015). Mangorei and Motukawa Hydroelectric Power Schemes Elver/eel Trap and Transfer Report. Trustpower Ltd, Tauranga. 7 p.

44 Smith, J.; Boubée, J.; Morgan, J.; Bell, L.; Barrett, R. (2015). TPS Western Diversion Fish Monitoring 2014/15. NIWA Client Report 2015-055 for project GPL15213. National Institute of Water and Atmospheric Research, Hamilton. 77 p.
45 Holloway Environmental Services (2015). Evaluation of elver transfer options for Mataura Industrial Estate. Holloway Environmental Services, Invercargill. 26 p.
46 Boubée, J.; Bowman, E.; Waiwai B. (2014). Waikaremoana Power Scheme – Tuna monitoring 2013/14. NIWA Client Report 2014-077. National Institute of Water and Atmospheric Research, Hamilton. 53 p.
47 Trustpower (2015). Patea Hydroelectric Power Scheme Elver / Eel Trap and Transfer Report. Trustpower Ltd, Tauranga. 11 p.
48 Boubée, J.; Bowman, E.; Waiwai B. (2015). Waikaremoana Power Scheme – Tuna monitoring 2014–15. NIWA Client Report 2015-84. National Institute of Water and Atmospheric Research, Hamilton. 52 p.
49 Watercare (2015). Fisheries Report 2014. Watercare Services Ltd, Auckland. 18 p.
50 Watercare (2015). Fisheries Report August 2014 – May 2015. Watercare Services Ltd, Auckland. 16 p.
51 Brown, L., Boubée, J., Patterson, M. (2013). Turitea Dams – Trial of a fish trap and transfer program and options for the future. Palmerston North, Horizons Regional Council: 32p.
52 Gisborne Herald (2016). Waihi Dam owners ordered to terminate silt flow. http://gisborneherald.co.nz/localnews/2105009-138/waihi-dam-owners-ordered-to-stop Accessed 15 July 2016.
53 RNZ (2016). Council knew Waihi Dam breached consent. Radio New Zealand News. http://www.radionz.co.nz/news/regional/302985/waihi-dam-breached-consent-for-years Accessed 15 July 2016.
54 Martin, M.L.; Bowman, E. (2016). Recruitment of freshwater eels 1995–2015. *New Zealand Fisheries Assessment Report No. 2007/38*. 96 p.
55 Trustpower (2016). Mangorei and Motukawa Hydroelectric Power Schemes Elver/Eel Trap and Transfer Report. Trustpower Ltd, Tauranga. 6 p.
56 Waterways Consulting Ltd (2016) Waihopai and branch power stations fish trap and transfer reporting 2015-2016. Project reference 16-2015. 4 p.
57 Waterways Consulting Ltd (2017) Waihopai Power Station and Branch River power stations elver trap and transfer reporting 2016-17. Project reference 002-2015. 5 p.
58 Watercare (2017). Native Fisheries Annual Report June 2016 – July 2017. Watercare Auckland. 21 p.
59 Waterways Consulting Ltd (2018) Waihopai Power Station and Branch River power stations elver trap and transfer reporting 2017-18. Project reference 002-2015. 5 p.
60 Watercare (2018). Native fisheries annual report June 2017 – July 2018. Watercare Services Ltd, Auckland. 20 p.
61 Trustpower_Ltd_Patea_HEP_Scheme_Monitoring_Programme_Annual_Report_2020-2021: technical report 2021-57,118 p. https://www.trc.govt.nz/assets/Documents/Environment/Monitoring-Industry/2022/MR2021-2022-TrustpowerPateaHydro.PDF
62 Crow, S.K.; Lambert, P.; Egan, E.M.; Bowman, E. (2023). Recruitment of freshwater eels, 1995–2022. New Zealand Fisheries Assessment Report 2023/52. 94 p.

APPENDIX 2: ANNUAL ELVER PARTNERSHIP UPDATE FOR THE 2024–25 SEASON


Earth Sciences New Zealand

Fisheries New Zealand
Tini a Tangaroa

RECRUITMENT OF FRESHWATER EELS

Summary report: Numbers of Freshwater Elvers Captured at Hydro Schemes in Aotearoa for 2024–25

August 2025

Effective management of any harvested fish stock requires information on adult abundance, fishing pressure, and juvenile recruitment. Understanding how these various interacting processes drive changes in population structure allows fisheries managers to make more effective management decisions.

As longfin and shortfin elvers undertake their upstream migration, juvenile abundance can be monitored by capturing them at hydroelectric dams or any other location where upstream migration is blocked or significantly impeded. Capturing elvers at these barriers is a cost-effective means for establishing a long-term data series on the relative abundance of both eel species. Provided that abundance data are collected in a consistent manner each year, they can be used in conjunction with elver age data to estimate overall recruitment trends.

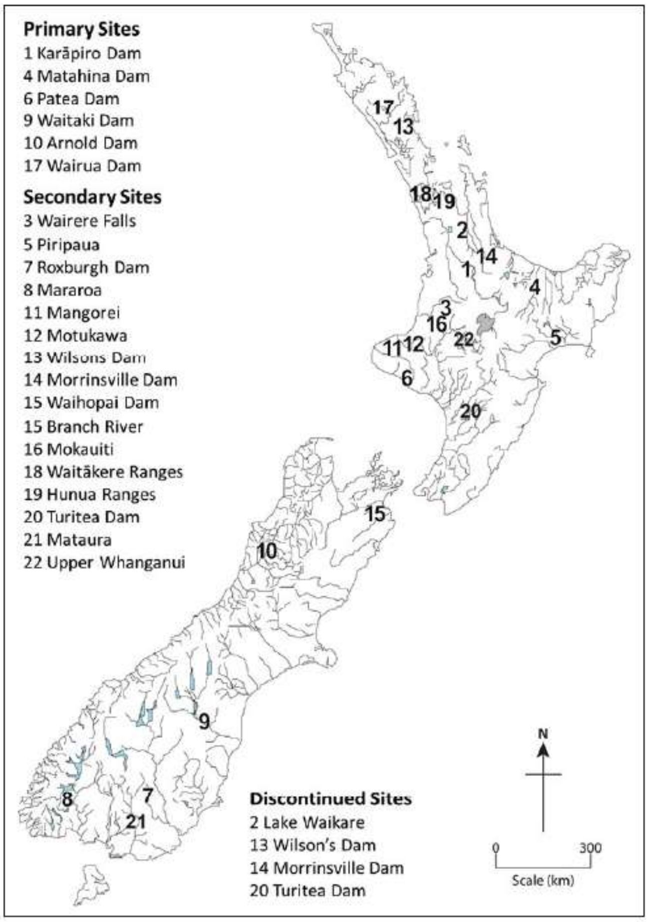
Fisheries New Zealand (FNZ) is responsible for managing the commercial fishery of freshwater eels in New Zealand and has been contracting NIWA (Earth Sciences NZ) to manage a research programme that has monitored elver recruitment at hydroelectric dams for the past 28 years (referred to as the 'elver recruitment programme'). This programme has established a time series of relative catch abundance for elvers at selected locations across New Zealand. These data have become one of the most important resources for monitoring the health of the eel population in Aotearoa.

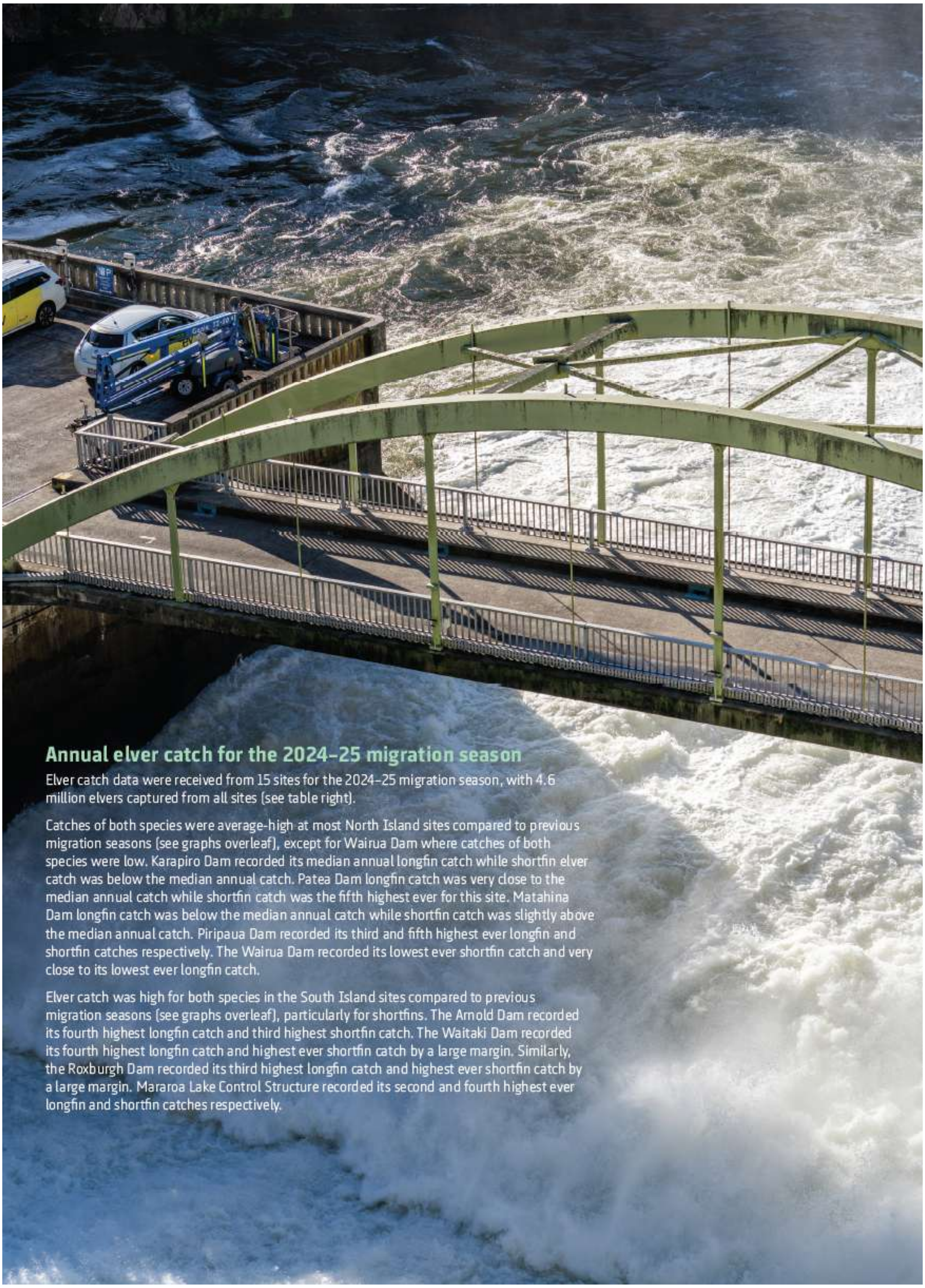
Catch trends of elvers across Aotearoa are updated and analysed every three years (for the latest version of the report see https://www.mpi.govt.nz/dmsdocument/59422-FAR-202352-Recruitment-of-freshwater-eels-19952022), but many of our partners utilise annual elver catches after each migration season finishes. The aim of the present report is to address this need and to summarise the annual elver catches from across Aotearoa for the 2024–25 migration season (October 2024–March 2025). You are receiving the present summary report because you have indicated that you would like to receive annual updates on elver catches from one or more of the monitoring sites. If you no longer wish to receive these updates, then please email Shannan.Crow@niwa.co.nz and ask to be removed from the email list.

2024-25 MONITORING SITES

Detailed information regarding fishing effort, catch weight, and species composition of elver catches was collected for each migration season at six primary sites and up to 16 secondary sites. Data collection at Primary sites was completed by trained NIWA staff and/or accredited personnel while data collection at Secondary sites was supplied voluntarily by non-NIWA staff. There are four primary sites in the North Island and two primary sites in the South Island. There are 11 secondary sites in the North Island and five secondary sites in the South Island.

In previous years, recruitment data have also been collected from four discontinued sites, but records were either not made available in recent years or the sites are no longer being monitored.





Annual elver catch for the 2024–25 migration season

Elver catch data were received from 15 sites for the 2024–25 migration season, with 4.6 million elvers captured from all sites (see table right).

Catches of both species were average-high at most North Island sites compared to previous migration seasons (see graphs overleaf), except for Wairua Dam where catches of both species were low. Karapiro Dam recorded its median annual longfin catch while shortfin elver catch was below the median annual catch. Patea Dam longfin catch was very close to the median annual catch while shortfin catch was the fifth highest ever for this site. Matahina Dam longfin catch was below the median annual catch while shortfin catch was slightly above the median annual catch. Piripaua Dam recorded its third and fifth highest ever longfin and shortfin catches respectively. The Wairua Dam recorded its lowest ever shortfin catch and very close to its lowest ever longfin catch.

Elver catch was high for both species in the South Island sites compared to previous migration seasons (see graphs overleaf), particularly for shortfins. The Arnold Dam recorded its fourth highest longfin catch and third highest shortfin catch. The Waitaki Dam recorded its fourth highest longfin catch and highest ever shortfin catch by a large margin. Similarly, the Roxburgh Dam recorded its third highest longfin catch and highest ever shortfin catch by a large margin. Mararoa Lake Control Structure recorded its second and fourth highest ever longfin and shortfin catches respectively.

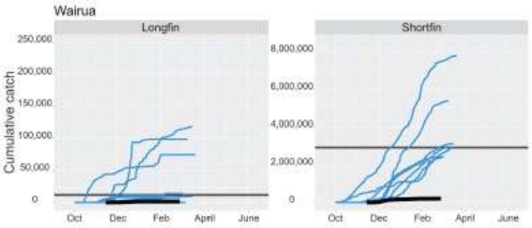
Annual elver catch from each site for the 2024-25 migration season				
	Total elver catch weight (kg)	Longfin numbers	Shortfin numbers	Total elver numbers
North Island				
Wairua Dam	71.95	1,365	202,775	204,140
Karapiro Dam	787.17	204,319	785,245	989,564
Matahina Dam	2048.14	332,999	1,575,864	1,908,863
Patea Dam	272.90	37,180	560,740	597,920
Piripaua Dam	88.35	9,815	59,190	69,005
Wairere Falls	27.81	No species composition		
Mokauiti	12.95	No species composition		
Upper Whanganui		600	4,809	5,409
Ruahihi Dam	18.76	12,072	25,915	37,987
South Island				
Arnold Dam	448.47	167,390	208,739	376,129
Waitaki Dam	172.93	8,301	73,347	81,648
Roxburgh Dam	165.22	33,194	62,655	95,849
Mararoa Lake Control Structure	440.17	160,269	41,819	202,088
Waihopai Dam	2.38	337	949	1,286
Branch River	4.19	61	3,853	3,914
Totals	**4,352.81**	**967,902**	**3,605,900**	**4,573,802**

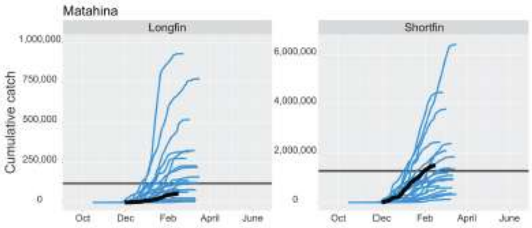
Cumulative daily catches of longfin and shortfins elvers

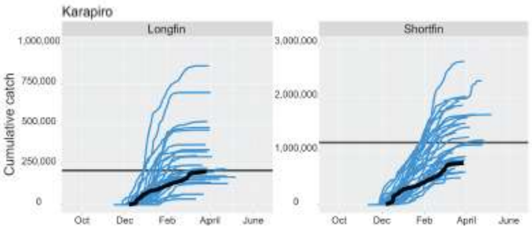
Below we display the cumulative daily catch data for a selection of sites that have the most robust data. The catch data from the 2024-25 season are shown as a black line, while previous migration seasons are shown as blue lines. The vertical axis (Y) shows the cumulative number of elvers captured throughout each migration season, while the horizontal axis shows the date the catch was recorded. The median annual catch is shown as a dark grey horizontal line on each plot.

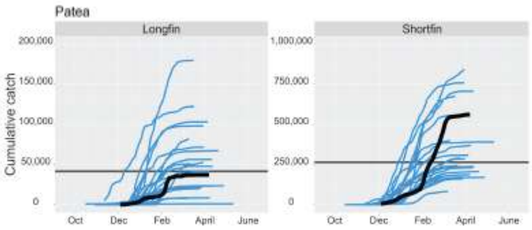
North Island

Primary sites

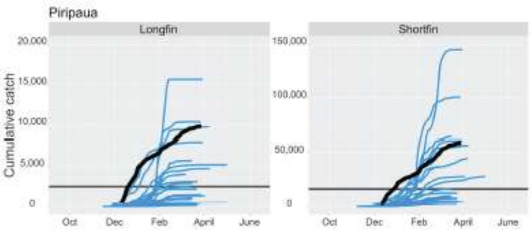






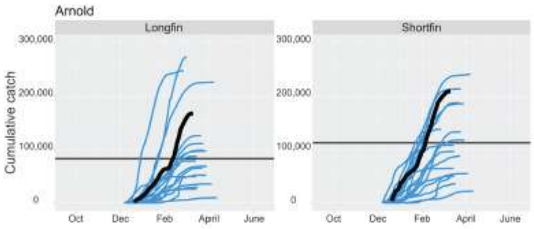


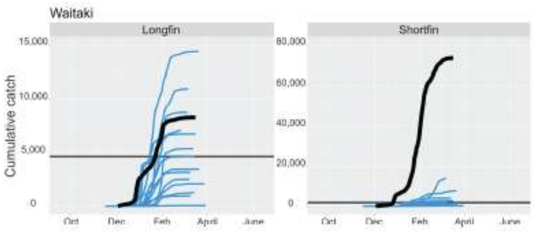
Secondary sites



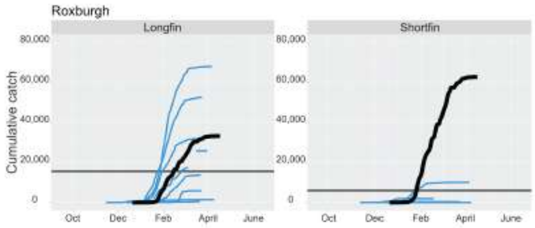
South Island

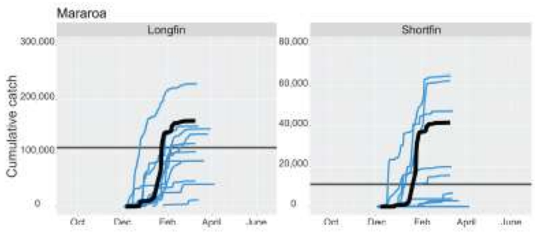
Primary sites





Secondary sites





Earth Sciences New Zealand

Compilation of the elver trap and transfer data from operations being undertaken nationwide would not have been possible without the assistance of numerous passionate people. We are grateful to the whanau, rūnanga, hapū, and iwi members who gave their support and time to ensure the present programme was executed successfully and to the numerous power company staff who supported site surveys.

This work was carried out by NIWA under contract to Fisheries New Zealand (Project EEL2022-01)

For further information about the FNZ-NIWA Recruitment of Freshwater Eels project contact:

Dr Shannan Crow
Shannan.Crow@niwa.co.nz

Find the New Zealand Fisheries Assessment Report: Recruitment of freshwater eels, 1995–2022 at:

mpi.govt.nz/dmsdocument/59422-FAR-202352-Recruitment-of-freshwater-eels-19952022