

Recruitment of Freshwater Eels: 2003–2004

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7. **Executive Summary:**

The primary objective of this project was to monitor the catch of shortfin and longfin elvers at Karapiro (Waikato R.), Matahina (Rangitaiki R.), Waitaki (Waitaki R.), and Roxburgh (Clutha R.) dams so that trends in elver recruitment could be established. The secondary objective was to distribute monitoring instructions to individuals/organisations undertaking elver transfer activities at other sites around the country, and to collate, analyse and archive the information collected.

In addition to the four primary sites monitored, information on elver catch and transfer, and in some cases species composition, was obtained at the Lake Waikare flood gates, Wairere Falls Power Station (Mokau R.), Piripaua Power Station (Wairoa R. catchment), Patea Dam (Patea R.), and Mararoa Weir (Waiau R.).

During the 2003–04 season, over 3,200,000 (3,100 kg) shortfin elvers and close to 370,000 (850 kg) longfin elvers are known to have been captured at the seven sites for which a species composition was available. Examination of the records indicated that over 75% of this catch was obtained at Karapiro and Matahina Dams. In addition to this, about 330,000 elvers (c. 240 kg) were caught and transferred at Wairere Falls Power Station and some 175,000 elvers (c. 200 kg) are estimated to have used the fish pass at the Lake Waikare gates. Thus, about four million elvers (c. 4,400 kg) used the eel/elver passage facilities that were monitored in 2003–04.

Shortfin elvers dominated the catch (by number) at each of the individual sites sampled in the North Island, constituting 91% of the total catch at Karapiro Dam; 99% at Lake Waikare; 93% at Matahina Dam; 96% at Piripaua Power Station, and virtually 100% at Patea Dam. In contrast, few shortfin elvers were caught at the three sites monitored in the South Island. Overall, shortfin elvers dominated the total North Island elver catch, contributing 93% of the catch by number

and 87% by weight (not including Wairere Falls). South Island operations contributed 28% of the total national longfin elver catch by number and 43% by weight (not including Wairere Falls).

Catches obtained in 2002–03 are estimated to have been approximately one million elvers higher than in 2001–02. However, the total catch in 2003–04 was slightly lower than last season's record catch. The number of longfinned elvers captured in the South Island has increased, although this was mainly due to a significant increase in the catch of elvers at the Mararoa Weir.

Comparison of catches obtained in 2003–04 with historical records indicated that the numbers of shortfin elvers captured at Karapiro Dam has increased markedly in the last two seasons, however there are indications that the number of longfins has declined, especially in term of proportion of the total elver catch. Insufficient reliable data are available from other sites for any further trends to be discerned.

Based on the information collected, we recommend that the key sites continue to be monitored, at least from 15 December to 15 March. In the South Island, the migration period appears to occur later than in the North, and at existing sites no major loss of data would result if monitoring was limited to early January through to March. However, we do recommend that migration periods be confirmed at any new monitoring sites before shorter monitoring times are instigated.

In the last three years, very low elver catches were obtained at both Roxburgh and Waitaki Dams. While the Waitaki catches probably accurately reflect the number of elvers in the tailrace, we suspect that this is not the case at Roxburgh. Consequently, omitting Roxburgh would not compromise the long-term aims of the project. Furthermore, we consider that there would be value in monitoring a site on the west coast of the South Island. Enquiries indicate that a site could be established on the Arnold River and we recommend that the assistance of Ngāi Tahu, the Department of Conservation, the West Coast Regional Council, TrustPower and commercial eel fishing interests be sought in establishing this site prior to the 2004–05 season.

Although valuable information on the number of elvers transferred has been gathered at locations outside the four main monitoring sites, reliable recruitment data can only be gained at permanent and well-run operations. Given the difficulties (and costs) in obtaining information from sites additional to the four main ones, we recommend that only sites operated under well-defined and strictly enforced operating permits be monitored in future. Monitoring procedures at these sites should include: 1) recognition, separation and accurate recording of by-catch (including eels); 2) accurate measuring of elver catches; 3) accurate measuring of average elver weight at regular intervals through the season; and 4) accurate and regular identification of elvers (or preservation of samples) throughout the season so that the composition of the catch can be estimated. Such monitoring provisions are time demanding and, unless well resourced, will invariably conflict with the primary aim of the operators – which is to maximise the number of elvers transferred, with the minimum of effort.

8. Objectives:

8.1 Overall Objectives

1. To monitor the recruitment of freshwater eels.

8.2 Specific Objectives

1. To establish a time series of data to monitor the relative recruitment of longfin eels by co-ordinating to specific standards the collection of data on effort, timing of migration, and species composition of elver runs at locations where transplant activities are being undertaken under authorisation (Karapiro, Waikare, Wairere Falls, Matahina, Piripaua, Patea, Roxburgh, Mararoa, Waitaki, and any other authorised future initiatives for enhancement).
2. To provide an annual report on the recruitment of elvers at the authorised locations that provides analysis of trends in effort, timing of migration, and species composition of elver migrations.
3. To instruct the authorised persons undertaking the elver transplant activities to carry out any necessary trapping operations and data collection to a standard required to maintain consistency over time and consistency between locations.

9. Introduction:

The New Zealand freshwater eel is important economically, culturally, and ecologically. The two native species are the longfin (*Anguilla dieffenbachii*) and the shortfin (*A. australis*) (McDowall 1990). Commercial catches have remained relatively stable over the period 1988-89 to 2001-2001 [c. 1,400t] when landings dropped to 1,079 tonnes (Annala et al. 2003). Eels, or tuna, also constitute a traditional customary fishery of great importance to Māori, but currently there are little data available on the annual customary catch.

Freshwater eels are migratory, and have extended growth periods in coastal, estuarine, and freshwater habitats. Transparent glass eels migrate into freshwaters between August and December, and develop into juvenile eels, known as elvers, which undertake further migration up stream. Although there are few glass eel data sets there is evidence to suggest that an annual decline of 7% in the recruitment of glass eels has occurred since 1980 (Jellyman et al. 2002).

Declining recruitment of glass eels is not restricted to New Zealand. A similar trend has also been noted for the Atlantic eel fisheries, which are based on the European eel *A. anguilla* and the American eel *A. rostrata*. Glass eel fisheries and elver migration data for these species show a steady decline in recruitment over the past 20 years (e.g. Dekker 2002). Factors contributing to this decline are likely to include climatic change, loss of habitat, parasite infestation, pollutants, over fishing, and obstacles to migration (Feunteun 2002).

Elver migration can be blocked by in-stream structures such as hydro-dams, and elvers congregate below these structures where they may be caught and transferred up stream. The trap and transfer of elvers and juvenile eels are well established as viable methods of enhancing eel populations and increasing productivity in areas where recruitment is limited or restricted (Annala et al. 2002, Beentjes et al. 1997).

Trap and transfer operations at hydro-dams are sometimes included as resource consents conditions for the dams, and electricity generating companies actively support transfers by providing site access, monitoring, staff and equipment. In some instances, private groups undertake the transfer operations (e.g. Eel Enhancement Co. Ltd. at Karapiro, and the Kokopu Charitable Trust Inc. at Matahina). There is also evidence that Māori undertook enhancement operations of traditional eel fisheries well before the arrival of Europeans to New Zealand, and probably still do currently, although no records are available regarding the extent and magnitude of these operations.

The monitoring of elver recruitment at trap and transfer operations based at hydro-dams offers an opportunity to establish long-term data sets on the relative abundance of elvers. Including data from the current season (2003–04), there are now 22 years of records documenting elver transfers at hydro-dams. Some of the earlier data may be rudimentary as it was collected before methods were standardised. However, improvements in species identification and the monitoring and recording of data over the last five years have greatly improved the reliability of transfer records.

During the summer of 2003–04, information regarding the fishing effort, catch, and species composition of elvers trapped at two North Island (Karapiro Dam on the Waikato R. and Matahina Dam on the Rangitaiki R.) and two South Island sites (Roxburgh Dam on the Clutha R. and Waitaki Dam on the Waitaki R.) were collected by NIWA. In addition information was obtained from four other North Island sites (Lake Waikare outlet in the Waikato, Wairere Falls Power Station on the Mokau R., Patea Dam on the Patea R. and Piripaua Power Station in the Wairoa R. catchment), as well as from the Mararoa Weir (Waiau R.) in the lower South Island (Figure 1).

9.1 Description of Sites and Operations

During the summer of 2003–04, trap and transfer operations at most sites were essentially the same as those described by Williams & Boubée (2003). These operations are summarised below and any significant changes described where relevant.

Karapiro Dam

There are two traps at Karapiro Dam, a lift trap near the transformer cooling water outfall and a static trap in the stoplog area. Currently, Mighty River Power maintains the trapping facilities and the Eel Enhancement Co. Ltd. (EEco) undertakes all operations under a permit issued by the Ministry of Fisheries. Permitted transfer limits are: Lake Karapiro, no limit; Lake Arapuni, 550 kg; Lake Waipapa, 100 kg; Lake Maraetai, 250 kg; Lake Whakamaru, 450 kg; Lake Atiamuri, 140 kg; Lake Ohakuri, 750 kg. During the 2002–03 season, elvers were transferred into all of these reservoirs.

Lake Waikare Fish Pass

A radial arm steel gate that forms part of the Waikato River flood management scheme controls water levels in Lake Waikare. This structure, installed in 1963, and currently operated by Environment Waikato (EW), is a barrier to upstream fish migration. An elver ladder was installed in 1984 and upgraded in 1994, but was poorly maintained. Although some manual transfers of elvers from the base of the gates were made, elver mortalities occurred regularly during summer. The manual transfer operations were more regular in summer of 2002–03, and the catch records obtained by EW.

A “nature-like” fish pass was constructed in 2003 (Plate 1) and monitored over the summer 2003–04 by EW. Monitoring consisted of setting fine mesh traps in the fish pass channel where it crossed the stop bank (Plate 2). During 2003–04, trapping was undertaken on 18 occasions, each over a 24 hour period, and this information was used to estimate how many elvers were using the fish pass during the migration season.

Wairere Falls Power Station

King Country Energy maintains a ramp and trap system in each of the two tailraces at the Wairere Falls Power Station. Station staff undertook all operations at this site. There are plans to build an elver ladder at this side and to discontinue trap and transfer operations.

Matahina Dam

At Matahina Dam there is a trap located on the right bank of the tailrace near the outlet of the transformer cooling water outfall. In 2003–04, all trap and transfer operations were undertaken by the Kokopu Charitable Trust Inc. It is understood that the elver ladder present at this site was not operational in 2003–04. The elver ladder may be revamped in future.

Piripaua Power Station

Elver trapping facilities at Piripaua Power Station (part of the Waikaremoana Power Scheme) consist of a trap on the right bank of the tailrace with a ramp leading to the trap. During the 2003–04 season, operations were undertaken by Margaret Tipuna (under contract to Genesis), with the assistance of station staff.



Plate 1. Lake Waikare “nature like” fish pass (on left) looking downstream from the control structure.



Plate 2. Lake Waikare fish pass water level control structure where the channel crosses the stop bank. Note fine mesh traps used for monitoring fish migration.

Patea Dam

A trap and transfer operation at the base of the Patea Dam is now permanently operated during spring and summer and the elver ladder has been mothballed. TrustPower staff undertook all the operations at this site in 2003–04.

Roxburgh Dam

There are two traps on the right abutment of the Roxburgh Power Station tailrace. Both have long, steep access ramps that are believed to limit catches. Minor changes to the ramps were made prior to the 2003–04 season; the ramps now enter the holding bins from the side so that elvers are free to swim directly into them without the need of a flushing flow. During the 2003–04 season, trap and transfer operations at Roxburgh Dam were completed by Rodney Trainer (Hokonui Runanga) with some assistance from NIWA staff.

Mararoa Weir

During the summer of 2003–04, elver trap and transfer operations at the Mararoa Weir were undertaken by George Ryan (under contract to Meridian Energy). The trap consists of a floating box with a brush-lined access ramp. The trap is set, when flow conditions permit, below the radial gates and is lifted to deck level with a winch and boom. The vertical slot fish pass on the left bank remains operational at all times.

Waitaki Dam

Two traps are present at the Waitaki Dam. Monitoring at this site was contracted to the Waitaki Property Management Co. under a joint arrangement between NIWA and Meridian Energy.

10. Methods:

10.1 Development of Data Collection Reporting Standards

As described by Williams and Boubée (2003), monitoring instructions and recording forms were developed in 2002–03 in order to standardise the methods of collecting data at all sites. The process was broken down into four procedures:

1. Equipment monitoring,
2. Catch monitoring,
3. Elver transfer monitoring,
4. Species composition analysis.

The resulting monitoring procedures and recording forms (Appendix 1) provide the protocols for the monitoring undertaken in the 2003–04 season.

At the start of the season, permit holders from each site and NIWA personnel were given hands-on instructions and, where necessary, provided with monitoring equipment. This included:

- Monitoring instructions and waterproof recording sheets (see Appendix I), pencils, calculators, etc.
- Buckets, sieves, sorting trays, tweezers, dip nets, mesh bag for sorting juvenile eels, etc.
- Plastic bags, pottles, labels, etc.
- Balances (20 kg \pm 20 g, and 2 kg \pm 0.1 g), magnifying lenses, lighting.
- Clove oil (anaesthetic) and where no freezers are present, preservative (formalin).

10.2 Data Analysis

The information requested or obtained at each site included:

- Total catch of elvers as a weight or number for each visit.
- Total catch of juvenile eels (i.e., eels larger than 20 g) as a weight or number.
- Weight or number of elvers found dead.
- Weight or number of other species captured.
- Weight or number of all transfers made and location of release sites.
- Species composition of sub-samples in terms of weight and number obtained at a minimum of 15 day intervals.
- Average weight of a sample of longfin and shortfin elvers obtained as often as possible.

The estimated total weight of longfin elvers (W_{Lf}) captured over the season was calculated from:

$$W_{Lf} = \Sigma(\text{estimated total weight of longfin elvers captured on each collection})$$

where:

$$\text{Estimated total weight of longfin elvers captured on each collection} = (\text{total weight of elver catch}) * (\% \text{ longfin elvers by weight} / 100).$$

and:

$$\% \text{ longfin elvers by weight} = (\text{weight of longfin elvers in sub-sample}) / (\text{total weight of sub-sample}).$$

For collections where catch figures were available but species composition was not obtained, the closest species composition record available was used.

Similarly, the estimated total number of longfin elvers (N_{Lf}) captured over the season was calculated either from:

$$N_{Lf} = \Sigma((\text{total number of elvers captured on day of collection}) * (\% \text{ longfin elvers by number} / 100)).$$

or:

$$N_{Lf} = \Sigma((\text{estimated total weight of longfin elvers captured on each collection}) / (\text{average weight of longfins})).$$

The average weight of longfins was obtained from the species composition sub-sample. For days where the average weight of longfin elvers was not measured, the closest available record was used.

The same calculations were used to estimate the weight and number of shortfin elvers collected.

The catch results for each location are expressed as total catch and average daily catch. Average daily catch was calculated by dividing the weight or number of elvers obtained on each collection by the number of days since the traps were last emptied.

All of the raw data available for each site and year since operations began were examined in order to produce estimates regarding the timing of the elver migration. Generally, the timing of the elver migration was established using the actual total catch data (i.e., including dead elvers). However, when total catch data was not available, the numbers of elvers transferred were used. From these data, the time to 50 and 95% of the total cumulative catch was established for the total elver catch, and for the estimated shortfin and longfin elver catch (when species composition information was available). It is important to note that the season start and finish dates and the methodology used to capture elvers may have differed between years and sites and may contribute to some of the differences observed.

10.3 Trapping Methods and Monitoring Procedures at Each Site

Karapiro Dam

During the 2003–04 season, the lift and stoplog traps were operational between 1 December 2003 and 16 March 2004 (i.e., 107 days). The lift and stoplog traps catches were transferred into holding tanks every 1–2 days between 8 December 2003 and 1 March 2004. After 1 March, transfers were made less frequently. The lift trap operated effectively for the entire season. The stoplog trap was submerged and unable to be cleared because of high water levels in the tailrace between 1–6 March 2004.

EEco members undertook the day-to-day operations at Karapiro Dam. This involved inspecting and processing the catch, including removing the elvers from the traps, weighing the catch, and transferring the elvers into a holding bin or directly into the transporting tank. When present, the number of any by-catch species captured (e.g., shrimp and smelt) was also recorded.

The number/weight of juvenile eels (>20 g) was generally determined by trapping the eels in a 10 mm mesh holding bag when the catch was released, but sometimes only a visual estimate was made. The weight of juvenile eels caught on any single day is an estimate based

on the total weight of juvenile eels released divided by the number of days over which they were trapped. All catch records were maintained by EEco members on data sheets provided by NIWA.

Representative samples of approximately 100 elvers were examined by EEco members on 30 occasions during the season. In addition to this, samples were examined by NIWA staff on six occasions. The composition, weight, and number of each eel species in these samples were then used to estimate the composition of the total elver catch, and the average weight of elvers.

Water temperatures at the Karapiro Dam were monitored in the lift and stoplog traps and the holding tank using Optic StowAway[®] temperature loggers. The temperature was recorded every 60 minutes, and these data were used to derive average daily temperature values.

Elver transfers to the Waikato hydro-lakes were generally undertaken every 2–4 days between mid December 2003 and mid February 2004, and at 5–7 day intervals in early December 2003 and between late February and early March 2004.

Lake Waikare Fish Pass

Trapping commenced on 5 November 2003, and was undertaken on 18 occasions, each over a 24 hour period. The final sampling was undertaken on 22 March 2004. Monitoring occurred weekly from November through to February, and fortnightly in March. All of the fish caught were weighed, counted, identified, and transferred up stream. Data from the 24 hour catch was used to estimate total elver passage during the preceding week.

A sub-sample of the elver catch was examined on seven occasions. The composition, weight, and number of each eel species in these samples were then used to estimate the composition of the total elver catch and the average weight of the elvers.

Wairere Falls Power Station

King Country Energy staff provided elver catch records for the Wairere Falls Power Station between 3 January and 11 February 2004 (i.e., 40 days). An additional transfer was made on 15 March 2004.

To obtain an estimate of elver weight, the total catch (i.e., all species) was transferred into a bucket, weighed, and the percentage of shrimps (by weight) in the catch estimated. All elvers were immediately transferred up stream into the Mokau River. As the average weight of elvers was not measured during the 2003–04 season, data collected last year was used to get an estimate of the total number of elvers captured.

One sample of eleven elvers was retained and frozen by King Country Energy staff on 2 February 2004 and sent to NIWA for analysis. As this was the only sample available, the species composition of elvers transferred could not be estimated.

Rainfall information for this site was also provided by King Country Energy staff.

Matahina Dam

During the 2003–04 season, elver trap and transfer operations at the Matahina Dam were undertaken on 113 occasions between 9 November 2003 and 29 February 2004. Typically, the trap was emptied every 2–4 days by Mr Bill Kerrison of the Kokopu Charitable Trust Inc. All catch records were maintained on data sheets provided by NIWA and in a personal diary.

Representative samples of approximately 100 elvers were obtained by NIWA staff on eight occasions during the season. The composition, weight, and number of each eel species in these samples were then used to estimate the composition of the total catch.

Transfers were typically undertaken every 2–5 days during the season. Elvers were transferred to locations upstream of the Matahina Dam, including Lake Matahina and Lake Aniwhenua.

Piripaua Power Station

Operation of the Piripaua Power Station tailrace trap began on 4 December 2003 and the first transfer of elvers was made on 8 December 2003. The trap was operated for 112 days and closed down on 24 March 2004. High mortality (939 elvers) occurred in the trap from mid January to early February, and the trap was temporarily closed on three occasions between 15–19 January, 21–29 January, and 3–8 February 2004 while the causes of mortality were investigated.

Super-saturation of the water supply was eventually identified as the cause of the mortality. The water valve causing the problem was replaced, an air supply added to the trap and the trap operated continuously until 24 March 2004 without further mortalities. Further details of the operations at Piripaua Power Station are presented in Bowman et al. (2004).

Monitoring of the catch consisted of weighing the elvers after the juvenile eels (>20 g) were removed. Any by-catch was recorded separately. Elver numbers were estimated by dividing the total weight of elvers captured by the average weight of elvers obtained during NIWA site visits and from samples of frozen elvers. Representative samples of elvers were analysed for species composition on nine occasions.

As in previous years, elvers were transferred in a sealed plastic box or bucket with a small amount of moist fibrous material in the bottom. Most of the catch was transferred to the Kahutangaroa River above the Tuai Power Station, but a small number was also released into Lake Whakamarino.

Rainfall information for Waikaremoana was obtained from the NIWA National Climate Database (<http://clidb.niwa.cri.nz>).

Patea Dam

Monitoring the elver catch at Patea Dam began in late October 2003. Between 20 October 2003 and 1 November 2003, no elvers were caught. However, the majority of the whitebait by-catch (N = 500) was captured during this period. More comprehensive monitoring, including recording elver weights, was undertaken between the 1 November 2003 and 10 May 2004 (i.e., 191 days); data collected during this period are used in this report. During this time the trap was checked and emptied approximately every 1–5 days. In late February and early March 2004, the trap was checked approximately every 7–10 days. When present, the number of any by-catch species (e.g., shrimp and common bullies) was also recorded. Day-to-day operations were undertaken by John Dignan of TrustPower (Taranaki Generation). All catch records were maintained on data sheets provided by NIWA.

Monitoring consisted of weighing the elvers after the juvenile eels (>20 g) were removed. TrustPower staff obtained representative samples of approximately 100 elvers on 17 occasions during the season. These samples were frozen and made available to NIWA for

analysis. The composition, weight, and number of each eel species in these samples were used to estimate the composition of the total elver catch.

Water temperature in the elver trap at the Patea Dam was monitored throughout the season using an Optic StowAway[®] temperature logger. The temperature was recorded every 30 minutes, and these data were used to derive average daily temperature values.

The majority of the elver catch was transferred directly above the Patea Dam by TrustPower staff. However, on one occasion the catch was transferred to the headwaters of the Patea River.

Roxburgh Dam

During the 2003–04 season, both traps at Roxburgh Dam operated between 27 December 2003 and 16 March 2004 (i.e., 81 days). The traps were inspected on eight occasions, approximately every 1–2 weeks, and elvers were transferred on the same day. When present, the number of any by-catch species was also recorded. All catch records were maintained on forms provided by NIWA.

Monitoring the elver catch consisted of inspecting the traps, identifying the species present, counting and weighing the elvers. Three elver samples were checked by NIWA staff for species composition and weight. The catch was transferred into an aerated bin for transport to the release site at the Lake Dunstan boat-ramp above Clyde Dam.

Mararoa Weir

Trapping below the Mararoa Weir gates was undertaken by George Ryan between 10 January and 29 January 2004. The trap was damaged during a storm between 1–4 February 2004 and, although the trap was repaired, it was not reset.

The total weight of elvers captured and a sample of 20 elvers was obtained daily by Mr. Ryan during the short season. The species composition, weight (to nearest g), and length of the elvers in the sub-samples were determined on site, and the average weight used to estimate the number of elvers in the total catch.

Transfers were typically undertaken every time the weir was checked and the catch was generally transferred into Lake Te Anau.

Waitaki Dam

Elver trapping commenced at the Waitaki Dam on 6 January 2004 and continued until 15 March 2004 (i.e., 69 days). During the majority of this period, the trap was checked at 1–4 day intervals, although towards the end of the season, the trap was checked approximately every eight days. Trapping and transfer operations were controlled by Meridian Energy, but all monitoring was undertaken by a NIWA contractor.

Monitoring the elver catch consisted of inspecting the trap, counting and weighing the elvers, as well as determining the species composition of the catch. All catch records were maintained on data sheets provided by NIWA.

The elver catch was transferred to Sailors Cutting, Lake Benmore on 24 occasions.

11. Results:

11.1 Karapiro Dam

Trap operation

A total of around 2,330 kg of elvers and 67 kg of juvenile eels (>20 g) were captured over the 107 days between 1 December 2003 and 16 March 2004 at Karapiro Dam. As in previous seasons, the lift trap was more effective than the stoplog trap, capturing approximately 2,090 kg (90%) of elvers (Figure 2). However, the stoplog trap was partially submerged and unable to be emptied for several days in early March due to high water levels in the tailrace. On 7 February 2004, an estimated 20 kg of elvers died in the lift trap due to overloading, and the entire catch of approximately 80 kg was returned to the Waikato River. The trap was reset and 7.5 kg of elvers were captured and subsequently included in the scheduled transfer the following day.

Excluding the 100 or so kg of elvers caught on 7 February, the largest total 24 hour catch (85.3 kg) was made on 4 February 2004 (Figure 2). The greatest 24 hour juvenile eel catch (4 kg) occurred later in the season on 23 February 2004 (Figure 3).

The average daily temperature during the season ranged from 19.2–23.7°C in the lift trap, and 18.1–24.1 C in the stoplog trap. As in previous seasons, elver catches tended to increase when temperature rose in early summer, and declined when temperature fell in late summer (Figure 2).

The number or weight of by-catch species were not consistently recorded. However, based on the information available, shrimps, common bullies, inanga and smelt were caught in the traps (Table 1). Observations made by NIWA staff indicate that a few koaro and banded kokopu juveniles were also captured in early December.

Species composition

Species composition analyses of elver sub-samples were undertaken on 36 occasions during the season (Figure 4). The results of the NIWA and EEco analysis were similar, therefore, when species composition information was available from both organisations, the results were combined. Examination of the proportion of longfins in the catch, compared to the number of elvers examined, confirmed that the identification of 100 elvers gives a reliable estimate of the species composition (Appendix 2).

Based on the species composition analyses we estimate that a total of 2,131,000 elvers were captured at Karapiro Dam during the 2003–04 season, consisting of approximately 200,000 longfin elvers (c. 370 kg) and 1,931,000 shortfin elvers (c. 1,960 kg). Longfin elvers constituted approximately 16% of the weight of the total catch and 9% by number (Table 2).

Average daily catch estimates of shortfins through the season largely followed the total catch of elvers, with catches increasing through December, declining in early January, but increasing to a second peak in late January. Catches then declined through to early February when the third and largest peak was recorded. With longfins, daily catches increased from mid December through to early January, remained low through most of January, but increased to a peak in late January/early February (Figure 5).

No individual weights of elvers were obtained. However, based on the total weight and number of elvers examined during species composition analyses, the average weight of

shortfin and longfin elvers was estimated at 1.05 g (N = 3,580) and 1.93 g (N = 352), respectively.

Elver transfer

An estimated 2,250 kg of elvers and 67 kg of juvenile eels were transferred from Karapiro Dam to upstream locations during the 2003–04 season (Table 3). The majority of the catch was transferred into Lake Karapiro (25% by weight) and Lake Arapuni (20% by weight). We estimate the total number of elvers released into the Waikato hydro-lakes since the 1992–93 season to be c. 13,073,000, of which c. 2,901,000 were longfins (Table 4).

11.2 Lake Waikare Fish Pass

Trap operation

Close to 23,000 elvers (29.1 kg) were caught during the eighteen 24 hour periods the traps were set in the Waikare fish pass (Figure 6). In addition, approximately 1,600 juvenile eels (>20g) were also captured (Figure 7).

The greatest 24 hour catch of elvers occurred in mid December (c. 6,000) and early February (c. 7,000) (Figure 6). The largest number of juvenile eels migrated through the pass in February (Figure 7).

Species composition

The proportion of shortfin elvers was over 97% in all the seven sub-samples analysed during the season. The average weight of elvers examined was 0.87 g (N = 570) for shortfin and 0.66 (N = 5) for longfins.

Based on the 24 hour catch data we estimated that a minimum of 174,400 (c. 196 kg) elvers and 15,200 juvenile eels used the fish pass and gained access to Lake Waikare during summer 2003–04 (Tables 5). Shortfin elvers made up most (c. 195 kg or 99.5 % of the estimated total) of the elvers migrating through the pass (Table 6).

The timing of the migration of shortfin and longfin was similar, with increased numbers of both species recorded in mid December, early February, and late February (Figure 6).

11.3 Wairere Falls Power Station

Trap operation

In 2003–04, the traps at Wairere Falls were only operated from early January to mid February when a major flood disrupted trapping. During this period, an estimated 241 kg of elvers were captured and transferred above the falls (Table 7). In addition to the elvers, an estimated 4.7 kg of shrimp were caught and transferred, however no other by-catch species were recorded.

Two main peaks in the total elver catch were observed, one in mid January and the other in late January/early February 2004 (Figure 8). For the brief period the traps were operating, rainfall did not appear to greatly influence the average daily catch (Figure 9)

Species composition

Only one sample of eleven elvers captured on 2 March 2004 was retained during the season. All eleven elvers were shortfins but as this single sample was collected well after the bulk of

the catch was obtained, an accurate estimate of the number of longfin and shortfin elvers captured cannot be made.

The mean weight of the elvers in the sub-sample collected on 2 March 2004 was 0.73 g (range 0.52 - 0.88 g). As this sample was small we used the average weight of elvers captured in 2002–03 instead and estimate that approximately 330,000 elvers were caught and transferred during 2003–04.

11.4 Matahina Dam

Trap operation

The trapping facility at Matahina Dam was operational for 113 days, and a total of c. 1,039 kg of elvers were captured (Figure 10). In addition to elvers c. 110 kokopu/koaro juveniles were captured, most in early November.

The elver catch peaked in mid December, with the greatest catch (344.5 kg) occurring on 17 December (Figure 10). Half of the total number of elvers captured over the entire season was obtained by 19 December 2003 and 95% by 28 January 2004 (Table 8).

Species composition

Species composition analysis was undertaken on eight occasions during the season (Figure 11). The average weight of longfin elvers was 2 g (N = 94) and 1.07 for shortfins (N = 1,141). Based on these analyses we estimate that 945,000 elvers, consisting of approximately 64,000 longfins and 881,000 shortfins, were captured. Therefore, approximately 7% of the elver catch in 2003–04 were longfins.

The average daily total catch of shortfin and longfin elvers peaked in mid December (Figure 12). No rain was recorded over that period (NIWA unpublished records). The bulk of the longfin catch was obtained by 5 January 2004 (Table 8). In contrast, 95% of the shortfin catch was only obtained by 28 January 2004.

Elver transfer

Some elver deaths (68.8 kg) were recorded on 17 December 2003 when the catch suddenly increased from c 30 kg two days previously to c. 340 kg. Number transferred is therefore lower than the number captured. Overall, about 880,900 (c. 970 kg) of elvers, consisting of 820,700 (c. 858 kg) shortfin elvers and 60,200 (c. 112 kg) longfin elvers, were transferred from the Matahina Dam to upstream locations during the 2003–04 season (Table 9). The majority of the catch (89%) was transferred into locations upstream of the Aniwhenua Dam, with approximately 94,200 (111 kg) elvers transferred to Lake Matahina (Tables 9 & 10).

11.5 Piripaua Power Station

Trap operation

The trapping facilities at Piripaua Power Station were operated for a total of 94 days between 4 December 2003 and 24 March 2004. Over this period, the trap was closed for 17 days while causes of elver mortality in the trap were investigated. In total, approximately 5,000 elvers and 19 juvenile eels were collected. A relatively large proportion of the catch (N = 939) died in the trap. At least 22 juvenile koaro were also captured.

The number of elvers trapped was relatively steady through December, but increased markedly on 6 and 7 January (Figure 13).

Species composition

Species composition analysis was undertaken on 10 occasions during the season (Figure 14). Average daily catch of shortfins peaked in early January and that of longfins in late January (Figure 15). As found at Matahina, the peak migrations did not correlate with high rainfall.

No individual weights of elvers were obtained this season, however, based on the total weight and number of elvers examined for species composition, the average weight of shortfin and longfin elvers was 1.12 g (N = 799) and 3.24 g (N = 45) respectively.

Based on these analyses we estimate that a total of c. 4,890 elvers, consisting of c. 200 longfins and c. 4,690 shortfins, were captured during the season. Therefore, longfins made up about 4% of the total elver catch (Table 11).

Elver transfer

Based on the species composition analyses of the sub-samples, we estimate that about 3,950 elvers were successfully transferred to habitats upstream of the Tuai Power Station during the season (Table 12). Approximately 160 of these elvers were longfins.

11.6 Patea Dam

Trap operation

The trapping facilities at the Patea Dam were monitored for a total of 191 days between 1 November 2003 and 10 May 2004. During this period, approximately 221 kg of elvers were captured, with peak catches made in mid January 2004 (Figure 16). Most (i.e., 95%) of the catch was made by 12 February 2004 (Table 13).

In addition to elvers, it is estimated that more than 6,000 freshwater shrimp, at least 44 bullies (common bully and redfinned bully), and about 2,190 whitebait/indigenous fish species (including torrentfish, koaro, banded kokopu, inanga and smelt) were caught during the season (Table 14).

Species composition

Species composition analysis was undertaken on 14 occasions during the season (Figure 17). Seasonal trends in the average daily catch of shortfins were similar to the total catch of elvers with a single peak in January (Figure 18). A small number of longfins were recorded at the end of January.

No individual weights of elvers were obtained this season, but based on the total weight and number of elvers examined for species composition, the average weight of shortfin and longfin elvers is estimated at 0.63 g (N = 1,187) and 1.09 g (N = 8) respectively.

Based on these analyses we estimate that approximately 1,000 (c. 2 kg) longfin elvers and 390,000 (c. 219 kg) shortfin elvers were caught. Therefore, longfin elvers constituted approximately 0.9% of the catch by weight and 0.2% of the number (Table 13). The small catch of longfins was made in early December and late January (Figure 24).

Elver transfer

Numbers of elvers transferred were slightly lower than the number of elvers caught as about 7 kg of elvers died in the trap at various times through the season. The majority of the catch (96%) was transferred directly above the dam into Lake Rotorangi, and approximately 11 kg was transferred to the headwaters (Table 15). Although the weight of the catch was slightly higher than in 2002–03, the numbers transferred were similar (Table 16).

11.7 Roxburgh Dam

Trap operation

Trapping operations at Roxburgh Dam began on 27 December 2003 and continued until 16 March 2004 (i.e., 81 days). During this time, a total of 1,385 (3.82 kg) of elvers were captured (Figure 19). Both traps caught approximately the same amount of elvers (Table 17). In addition to elvers 32 koaro were captured, most in January.

Most of the catch was obtained during the 18 February 2004 visit, and by 2 March 2004 95% of the total catch had been made (Table 18).

Species composition

A sub-sample for species composition analysis was undertaken on three occasions, and indicates that the entire catch consisted of longfin elvers, ranging between 115 and 175 mm in length (mean 138 mm, N = 210). The average weight of these elvers was 2.5 g.

Average daily catch of elvers (all longfins) peaked in January (Figure 20).

Elver transfer

The small catch obtained meant that only eight transfers were necessary through the season. All 1,385 elvers caught were transferred above the Clyde Dam.

11.8 Mararoa Weir

Trap operation

The elver transfer programme at the Mararoa Weir was operational for 21 days between 10 and 29 January 2004. During a total of about 348 kg of elvers were captured and transferred (Table 19). The catch increased sharply after the first week of trapping, peaking on 18 January 2004 (110 kg). Catches then remained fairly steady, between 20–40 kg, until trapping ceased (Figure 21).

Species composition

A sample of 19–20 elvers was obtained on 19 occasions during the season (Table 19). Based on this data it appears that the entire catch at the Mararoa Weir consisted of longfin elvers.

The average length and weight of the 376 elvers examined was 138 mm (range 101–204) and 2–5 g¹, respectively (Table 19).

Based on the information available, we estimate that over the season 98,300 longfin elvers were captured and transferred to upstream habitats (mostly Lake Te Anau).

¹ Note: individual elver weight recorded to nearest gram.

11.9 Waitaki Dam

Trap operation

The traps at Waitaki Dam were operating for 70 days, between 6 January and 15 March 2004. During this time 13.7 kg of elvers were captured in the two traps (Figure 22). A small number (c. 10-20) of juvenile eel (>20g) were also captured. Highest catches of elvers were recorded in mid January and again in mid February 2004 (Figure 22).

Species composition

The catch was dominated by longfin elvers (99.8%) with only nine shortfin elvers recorded in early January (Table 20). As expected from this species composition, the average daily catch of longfins closely followed the total catch of elvers with peaks observed in mid January and mid February (Figure 23).

The average weight of longfins in the samples examined ranged between 1.1–7.7 g and the overall average was 3.08 g (N = 1,212). Overall, we estimate that nine shortfin and c. 4,640 longfin elvers were captured during the season (Table 20).

Elver transfer

Apart from 161 g of elvers found dead in the trap all the catch was transferred to Sailors Cutting, Lake Benmore.

12. Discussion

12.1 Effort

At the eight hydro-dams sites monitored during 2003–04, about 3.9 million elvers (c. 4.2 tons) were captured and transferred to upstream habitats (Table 21). The largest catches were obtained at Karapiro Dam (2,330 kg), followed by Matahina (1,039 kg).

Apart from effort, the locality, efficiency of the system installed, and timing of the operation have the potential to have the greatest effect on catches. In order to discern long-term recruitment trends, Boubée et al. (2002) suggested the use of an index of catch per unit effort (CPUE) based on the number of days the trap and transfer system was operational. Given that migration timing is variable and that during the season very large catches can be obtained on a single day (as seen at Matahina in 2003–04), we consider that such an index would not achieve its aim. Instead, we recommend that the key sites continue to be monitored between 15 December and 15 March, and that comparisons between years and sites be made for that period. Examination of the cumulative annual catch obtained over the last eight years at Karapiro Dam (Figure 24), four years at Matahina Dam (Figure 25) and three years at Patea (Figure 26) support this recommendation, at least for the North Island sites. In the South Island, the migration period appears to occur later and no major loss of information would result if monitoring was limited to early January through to March. However, we do recommend that the migration period be confirmed if any new monitoring sites are implemented.

12.2 Historical Records

A full description of the historical records and observations for the monitored sites is given in Williams & Boubée (2003), and is not repeated here. The following section places the 2003–04 catches in the context of these historical records.

The accuracy of the existing catch and species composition data is highly dependant on the analysis undertaken, the number of elvers examined, and time the samples were obtained. These factors must be carefully considered before any attempts to discern trends in the recruitment of the two eel species are made.

Total catch

The total numbers of elvers caught at Karapiro Dam, Wairere Falls, and Mararoa Weir during the 2003–04 season are the highest on record for these sites (Table 22). In contrast, catches at the Matahina and Patea Dams and at Piripaua Power Station were lower than some previous records.

An increase in catch over last year was recorded at Waitaki Dam, but numbers collected remain low in comparison to what has been observed there historically (*see* Williams & Boubée 2003). Similarly, catches at Roxburgh Dam, although slightly higher than in the last two seasons, remain low. This may indicate that recruitment in the on the east coast of the South Island has declined, but we suspect that the low catches at Roxburgh Dam, may simply reflect the type and state of the traps rather than the size of the migration.

Estimates of the elver migration through the fish pass at Lake Waikare during 2003–04 are lower than the number manually shifted from the base of the gates last year and the number known to have migrated through the elver ladder in 1996–97. As passage of elvers through the fish pass is difficult to monitor without considerable effort, a comparison between the present migration estimate and past records is not reliable and we do not recommend that this site be used to monitor recruitment in future.

Recruitment of shortfins and longfins.

Based on species composition analyses, we estimate that during the 2003–04 season 200,000 longfin and 1,931,000 shortfin elvers were captured at Karapiro Dam. This catch of shortfins is higher than in 2002–03, but numbers of longfins captured in the last two seasons are similar (Tables 23 & 24). There are now eight years of accurate catch records for this site and over this period there appears to be a decline in the catch of longfins, especially in term of the proportion of the total catch (Figure 27).

Data from the Lake Waikare Fish Pass shows a decline in longfin recruitment compared to 1996–97 (Table 24). In term of numbers this may simply reflect inaccuracies in estimating the elver migration in the fish pass but such sampling difficulties should not have affected the proportion of longfins in the catch which also shows a major decline from 19% to 0.5% (Table 6).

The species composition at Matahina Dam shows that 7% (64,000) of the elvers captured in 2003–04 were longfins. There are only four years of accurate records for this site and this shows that catches of both shortfins and longfins have been highly variable (Tables 23 & 24).

Historical records indicate that the number longfin elvers captured at Piripaua Power Station has been low but relatively stable (Table 24). Shortfin numbers have varied between 2,000 and 10,000 with the highest catch recorded in 2002–03 (Table 23).

A sharp decline in the number of longfins has been observed at Patea Dam over the last two years. Catches of shortfins have also decreased in the last two summers (Tables 23 & 24)

Only longfin elvers have been recorded in the catch from Roxburgh Dam and Mararoa Weir, and in 2003–04 only a small number of shortfins were caught at Waitaki Dam. Catches of longfins have increased markedly at Mararoa Weir over the last three years (Table 23) but this could reflect improved capture procedures rather than an increase in recruitment. Nevertheless, the increased catch at this site is of particular interest as the fish pass that exists at this site, although designed for salmonids, may also cater for elvers. No trends in recruitment are discernable at the other two South Island sites monitored.

In summary, both the total elver catch and the estimated number of longfin elvers captured was highest at Karapiro Dam than at any other site. The next highest total elver catch was at Matahina Dam, but more longfins were caught at Mararoa Weir than at Matahina.

Shortfin elvers dominated the total North Island elver catch constituting 93% of the catch by number and 87% by weight (not including Wairere Falls). South Island operations contributed 28% of the total national longfin elver catch by number and 43% by weight (not including Wairere Falls). Very few shortfin elvers (N = 9) were caught at the three sites sampled in the South Island.

With the exception of the Mararoa Weir site, there are indications that over time the catches of longfins have been stable or decreased at most sites (Table 24).

12.4 Recommendations

Four sites (Karapiro and Matahina in the North Island, Waitaki and Roxburgh in the South Island) are currently monitored by NIWA as part of this programme. At **Karapiro Dam** NIWA contracted EEco to carry out the day-to-day monitoring, with regular checks on species composition and monitoring procedures. EEco carried out all transfers and Mighty River Power staff assisted with site entry and equipment maintenance. These arrangements proved highly effective and no changes in the procedures are recommended. Furthermore, as long as EEco personnel remains the same, regular checks of species identification and methodology could be omitted in future without any loss of data reliability. The only concern we have is that current resource consents do not oblige Mighty River Power to continue with the present arrangements and should EEco choose, or be unable to continue with current arrangements, this valuable monitoring site could be lost.

The Kokopu Charitable Trust carried out the weighing and transfers of the catch at **Matahina Dam**, with NIWA staff from Rotorua collecting regular samples for species composition, etc. As far as we could ascertain, the process currently followed suits most of the stakeholders involved and we recommend that the present arrangements continue. As at Karapiro, the operation depends on a party taking responsibility for the day-to-day running of the trap. Bill Kerrison of the Kokopu Charitable Trust has indicated that these operations are time demanding, and that in future he would like to see a revamped elver ladder reinstated, with the trap and transfer operations limited to the peak of the season. Should this occur, the value of the data gathered may be compromised.

Operations at **Waitaki Dam** are now undertaken by a sub-contractor as part of an arrangement between NIWA and Meridian Energy. This is the most cost effective means of running this site, although stakeholders may dispute this. Apart from some minor changes to the climbing media of the ramps, no changes to current procedures are recommended and monitoring at this site should continue.

In terms of effort and results, the 2003–04 monitoring at **Roxburgh Dam** has proved once again to be the least effective of the four main sites monitored in this project. This year NIWA provided some assistance for a Hokonui member to travel to the site and carry out the monitoring with help from our Alexandra team. This interim measure is not sustainable given the effort required from the person concerned. Furthermore, as the trapping system (in particular the ramps) is ineffective, the catches are unlikely to truly reflect the number of elvers and eels in the tailrace. Unless this system is considerably modified, the monitoring procedures revamped, and monitoring resources adjusted, we again recommend that Roxburgh Dam be omitted as a main monitoring site.

Of the four intensively monitored sites, the Matahina and Karapiro sites are on opposite coasts of the North Island. However, the two South Island sites are on the east coast and relatively close to each other. In the last three years, very low catches were obtained at both Roxburgh and Waitaki Dams. While the Waitaki catches probably accurately reflect the number of elvers in the tailrace, we suspect that this is not the case at Roxburgh. Consequently, omitting this site would not compromise the long-term aims of the project. Furthermore, there would be value in monitoring a site on the west coast of the South Island as it would complement information gathered on the east coast rather than duplicate information collected at Waitaki.

Enquiries made indicate that elvers were collected in significant quantities at the Arnold Dam on the west coast of the South Island in the late 1970s. Discussions held with Des Sweeney (retired power station operator) and examination of the site indicates that traps could easily be reinstated. A trap and transfer operation at this site would also benefit recruitment to the upstream catchment, which includes Lake Brunner. Although there are plans to modify and extend power generation on the Arnold River, we do not believe that this would compromise the establishment of a long-term monitoring site in this catchment. Consequently, we recommend that a permanent monitoring site be established on the Arnold River prior to the 2004–05 migration season, and that assistance from Ngai Tahu, the Department of Conservation, the West Coast Regional Council, TrustPower and commercial eel fishing interests be sought in establishing this site.

Data collection outside of the main monitoring sites only proved valuable at permanent and well-run operations. Thus, although reliable data has been collected from **Patea Dam** and **Piripaua Power Station**, changes in the operations at other sites means that a comparison between years is impossible. In particular:

- **Lake Waikare** - a change from an unmonitored elver ladder to a “bucket rescue operation” and eventually to a “nature-like” fish pass.
- **Wairere Falls Power Station** - a change from trap and transfer operating over the whole season to a peak migration operation with no means of determining species composition, or the number of elvers transferred.
- **Mararoa Weir** - a change in trapping location and a shortening of the season. Also, the effectiveness of the fish pass as a means of passage for eels and elvers has never been established.

Although valuable information on the number of elvers transferred can still be obtained at these additional sites, the data should not be used for monitoring recruitment until permanent facilities and procedures are established. Monitoring procedures at these sites should include:

- recognition, separation, and accurate recording of by-catch (including juvenile eels);
- accurate measurement of elver catch;
- accurate measurements of average elver weight at regular intervals during the season (this to be obtained by weighing a known number of elvers to at least the nearest gram);
- if possible, accurate and regular identification of elvers (or preservation of samples) during the season so that a composition of the catch can be estimated.

Such monitoring provisions are time demanding, and to some extent conflict with the primary aim of the operators, which is to maximise the number of elvers transferred while minimising effort. Thus, we recommend that only sites operated under well-defined and strictly enforced operating permits be monitored in future.

13. Data Storage

All of the data collected during the 2003–04 season has been recorded manually (by operators) and transferred into an Excel spreadsheet archived at NIWA, Hamilton. The records from the 2003–04 season have been compiled and added to the previous seasons data for future trend analysis.

14. Acknowledgements

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Table 1. By-catch (number of individuals) from the Karapiro Dam for the 2003–04 monitoring season (1 Dec 2003 – 16 Mar 2004).

Month	By-catch species			
	Smelt	Inanga	Common bully	Shrimp
December 2003	0	11	23	3
January 2004	0	4	20	0
February 2004	0	12	64	20
March 2004	6	0	2	0
Total	6	27	109	23

Table 2. Estimated total number of elvers (in 1000s) captured at Karapiro Dam from 1992–93 season to present. Date when 50 and 95% of total catch was made is also shown. Years with accurate records for most of season are shaded. Note that the total includes any dead elvers captured. (LF, longfin elvers; SF, shortfin elvers).

	Season								
	95–96 ¹	96–97	97–98	98–99	99–00	00–01	01–02	02–03	03–04
Total elvers caught	1,155	1,220	1,699	1,097	892	782	1,596	1,942	2,131
50% of total catch	20–22 Jan	26 Jan	6 Jan	14 Jan	29 Jan–3 Feb	14 Jan	28 Jan	19 Jan	21 Jan
95% of total catch	1–5 Mar	6 Mar	26 Feb	10 Mar	5–10 Mar	28 Feb	25 Feb	9 Mar	27 Feb
Estimated total SF caught	822	974	835	756	798	627	1,351	1,766	1,931
50% of total catch	25 Jan	27 Jan	9 Jan	19 Jan	3–8 Feb	11 Jan	26 Jan	21 Jan	21 Jan
95% of total catch	1–5 Mar	6 Mar	28 Feb	16 Mar	5–10 Mar	22 Mar	3 Mar	11 Mar	29 Feb
Estimated total LF caught	333	246	864	341	94	155	246	176	200
50% of total catch	13–15 Jan	22 Jan	4 Jan	11 Jan	7–11 Jan	14 Jan	28 Jan	7 Jan	25 Jan
95% of total catch	9–12 Feb	10 Feb	23 Feb	9 Feb	12–19 Feb	9 Feb	13 Feb	6 Feb	9 Feb
% LF	29	20	51	31	11	20	15	9	9

¹ Transferred elvers only as total catch data not available.

Table 3. Estimated total weight and numbers of elvers transferred to the Waikato hydro-lakes during the 2003–04 season. The numbers in brackets are the percentage of the total weight of elvers transferred to each location.

Hydro-lake	Estimated weight transferred (kg)			Estimated number transferred		
	Longfin	Shortfin	Total	Longfin	Shortfin	Total
Karapiro	110 (30)	452 (24)	562 (25)	60,602	453,075	513,677
Arapuni	76 (21)	367 (19)	443 (20)	38,641	357,613	396,254
Waipapa	31 (8)	95 (5)	126 (6)	19,371	92,059	111,430
Maraetai	24 (7)	262 (14)	286 (12)	14,172	263,319	277,491
Whakamaru	48 (13)	228 (12)	276 (12)	24,652	222,198	246,850
Atiamuri	10 (3)	146 (8)	157 (7)	5,647	128,110	133,757
Ohakuri	67 (18)	334 (18)	401 (18)	32,025	319,926	351,951
Total	366	1,884	2,250	195,110	1,836,301	2,031,411

Table 4. Estimated total number of elvers (in 1000s) transferred from Karapiro Dam to upstream hydro-lakes from 1992–93 to present. The best available estimate of the numbers (in 1000s) of longfin (LF) elvers in the catch is given in brackets. Years with accurate records for most of season are shaded.

Hydro-lake	1992–93	1993–94	1994–95	1995–96	1996–97	1997–98	1998–99	1999–00	2000–01	2001–02	2002–03	2003–04	TOTAL
Karapiro	92 (31)	267 (91)	264 (90)	504 (190)	130 (27)	273 (122)	488 (107)	397 (23)	316 (57)	645 (129)	171 (2)	514 (61)	4,061 (930)
Arapuni	0	251 (85)	8 (3)	459 (96)	343 (74)	389 (168)	108 (60)	119 (20)	200 (38)	379 (57)	321 (38)	396 (39)	2,973 (678)
Waipapa	0	0	4 (1)	123 (33)	62 (13)	68 (29)	60 (6)	63 (6)	15 (2)	69 (0)	58 (7)	111 (19)	633 (116)
Maraetai	0	0	6 (2)	70 (14)	92 (28)	161 (81)	0	0	0	0	281 (16)	277 (14)	887 (155)
Whakamaru	0	0	0	0	173 (28)	246 (167)	109 (38)	14 (1)	97 (20)	145 (23)	453 (18)	247 (25)	1,484 (320)
Atiamuri	0	0	0	0	80 (26)	57 (25)	37 (7)	123 (13)	72 (18)	94 (2)	83 (20)	134 (6)	680 (117)
Ohakuri	0	0	0	0	327 (48)	483 (267)	215 (81)	153 (30)	74 (19)	261 (37)	490 (71)	352 (32)	2,355 (585)
Total elvers	92	518	282	1,156	1,207	1,677	1,017	869	774	1,593	1,857	2,031	13,073
Total LF	31	176	96	333	244	859	299	93	154	248	172	196	2,901
% LF	34	34	34	29	20	51	29	11	20	16	9	10	22

Table 5. Estimated total weight and number of elvers and eels (>20 g) passing through the Lake Waikare fish pass during the 2003–04 season (5 Nov 2003 – 21 Mar 2004).

Month	Estimated weight (kg)			Estimated number			Eels > 20 g
	Longfin	Shortfin	Total	Longfin	Shortfin	Total	Number
November	0	3.15	3.15	0	3,440	3,440	60
December	0.29	89.09	89.38	750	55,600	56,350	500
January	0.01	17.11	17.12	30	26,800	26,830	2,270
February	0.71	70.50	71.21	900	68,600	69,500	9,030
March	0.25	15.39	15.64	320	18,010	18,330	3,370
Total	1.26	195.24	196.50	2000	172,450	174,450	15,230

Table 6. Total elver passage (kg) at the Lake Waikare gates 1996–97, 2002–03 and 2003–04 seasons. Dates when 50 and 95% of the total catch was collected is also shown. (–, not available or irrelevant due to short monitoring season; LF, longfin elvers; SF, shortfin elvers).

	Season		
	1996–97 ¹	2002–03 ²	2003–04 ³
Monitoring period	21/1/97 – 24/4/97	5/12/02 – 21/3/03	5/11/03– 22/3/04
Total elvers caught (kg)	606	223	196
50% of total catch	–	18 Dec	14 Jan
95% of total catch	–	7 Jan	4 Mar
Total SF caught (kg)	488	–	195
50% of total catch			8 Jan
95% of total catch			4 Mar
Total LF caught (kg)	117	–	1
50% of total catch			18 Feb
95% of total catch			28 Feb
% LF	19	–	0.5

¹ Elver ladder

² Manual transfer from base of gate

³ Fishway estimated from regular 24 hour sampling through season.

Table 7. Total elver catch (kg) at Wairere Falls Power Station, including date when 50 and 95% of the total catch was collected. Species composition information available only for 2002–03 season. (–, no species composition or elver weights available; LF, longfin elvers; SF, shortfin elvers).

	Season				
	1999–00 ¹	2000–01	2001–02	2002–03	2003–04
Monitoring period	20/12/99 – 16/3/00	22/11/00 – 22/3/01	8/12/01 – 10/5/02	1/12/02 – 19/4/03	2/1/03 – 11/2/04
Total elvers caught	181	208	141	169	241
50% of total catch	29 Jan	17 Jan	31 Jan	2 Feb	19 Jan
95% of total catch	10 Mar	11 Mar	13 Mar	4 Mar	8 Feb
Total SF caught	–	–	–	147	–
50% of total catch					
95% of total catch					
Total LF caught	–	–	–	22	–
50% of total catch					
95% of total catch					
% LF	–	–	–	13	–

¹ Total catch data supplied in litres and converted to kg using $\text{Weight} = 0.33 + 0.91 \text{ litres}$ (as per Boubée & Barrier 1996).

Table 8. Estimated total number of elvers (in 1000s) captured at Matahina Dam from 1996–97 to 2003–04. The date when 50 and 95% of the total catch was made is also shown. Years with accurate records for most of season are shaded (–, no records available; LF, longfin; SF, shortfin).

	Season							
	1996–97 ¹	1997–98 ²	1998–99 ³	1999–00 ³	2000–01 ³	2001–02	2002–03	2003–04
Total elvers caught	14	615	1,002	2,001	2,054	619	1,484	945
50% of total catch	7–10 Feb	30 Jan	–	–	–	8 Jan	10 Jan	19 Dec
95% of total catch	10–13 Mar	23 Feb	–	–	–	16 Feb	19 Feb	28 Jan
Estimated total SF caught	10	478	–	–	–	592	1,360	881
50% of total catch	12–16 Feb	23 Feb	–	–	–	8 Jan	10 Jan	19 Dec
95% of total catch	10–13 Mar	26 Feb	–	–	–	16 Feb	19 Feb	28 Jan
Estimated total LF caught	4	136	–	–	–	27	124	64
50% of total catch	3–7 Feb	5 Jan	–	–	–	24 Dec	12 Jan	20 Dec
95% of total catch	28 Feb–3 Mar	13 Feb	–	–	–	6 Feb	13 Feb	5 Jan
% LF	29	22	–	–	–	4	8	7

¹ Boubée et al. (1997) reports that an additional 84.5 kg of elvers and eels were caught and transferred into Lake Aniwhenua by the Kokopu Charitable Trust Inc. As the proportion of eels in this catch was not recorded, this record has been omitted from the table.

² A further 107 kg of elvers and eel were reported transferred to Lake Aniwhenua (Lee et al. 1998; Kokopu Charitable Trust Inc. pers. comm. 1999). As the proportion of eels in this catch was not recorded this record has been omitted from the table.

³ Kokopu Charitable Trust Inc. (Bill Kerrison, Murupara, pers. comm.). Number shown is based on an average weight of 1 g. It is possible that the catch includes some juvenile eels.

Table 9. Estimated total weight and numbers of elvers transferred from Matahina Dam to the upper Rangitaiki catchment during the 2003–04 season. The numbers in italics indicate the percentage of the total weight of elvers transferred to each location.

Location	Estimated weight transferred (kg)			Estimated number transferred		
	Longfin	Shortfin	Total	Longfin	Shortfin	Total
Lake Matahina						
Lake Matahina	21 (<i>19</i>)	90 (<i>10</i>)	111 (<i>11</i>)	9,901	84,307	94,209
Lake Aniwhenua						
Aniwhenua	29 (<i>26</i>)	217 (<i>25</i>)	246 (<i>25</i>)	16,150	210,897	227,047
Upper Rangitaiki River	15 (<i>13</i>)	65 (<i>8</i>)	80 (<i>8</i>)	8,160	61,302	69,462
Kopuriki	35 (<i>31</i>)	389 (<i>45</i>)	424 (<i>44</i>)	19,778	374,849	394,627
Whirinaki	11 (<i>10</i>)	65 (<i>8</i>)	77 (<i>8</i>)	5,631	58,967	64,598
Pokereiti	1 (<i>1</i>)	32 (<i>4</i>)	33 (<i>3</i>)	556	30,415	30,971
Total	112	858	970	60,176	820,738	880,914

Table 10. Estimated total number of elvers (in 1000s) transferred from Matahina Dam to the upper Rangitaiki catchment, 1982–83 to present. Permanent trapping facilities were installed in 1997–98. The best available estimate of the numbers (in 1000s) of longfin eels in the catch is given in brackets. Unless noted as otherwise, pre 1998–99 records are from Boubée et al. (1997) & Chisnall et al. (1998). Years with accurate records for the majority of the season are shaded. (LF, longfin elvers; –, no data available).

	Season																					
	82– 83 ¹	83– 84	84– 85	85– 86	86– 87	87– 88	88– 89	89– 90	90– 91	91– 92	92– 93	93– 94	94– 95	95– 96	96– 97 ²	97– 98 ³	98– 99 ⁴	99– 00 ⁵	00– 01 ⁵	01– 02	02– 03	03– 04
Aniwhenua	20 (–)	21 (10)	23 (5)	6 (1)	19 (11)	–	–	40 (–)	–	–	–	149 (–)	39 (–)	144 (–)	14 (4)	587 (133)	–	–	–	341 (18)	1169 (102)	787 (50)
Matahina	–	–	–	–	–	–	18 -2	6 (–)	–	>24 (>7)	>32 (>2)	>66 (–)	– (–)	– (–)	–	28 (3)	– (–)	– (–)	– (–)	278 (9)	308 (22)	94 (10)
Total elvers	20	21	23	6	19	–	18	46	–	>24	>32	>215	>39	>144	14	615	1,002	2,001	2,054	619	1,477	881
Total LF	–	10	5	1	11	–	2	–	–	>7	>2	–	–	–	4	136	–	–	–	27	124	60

¹ Department of Conservation (1999).

² Boubée et al. (1997) report that an additional 84.5 kg of elvers and eels were transferred into Lake Aniwhenua by the Kokopu Charitable Trust Inc. As the proportion of eels in this catch was not recorded, this record has been omitted from the table. Note that monitoring of the trap only started on 16 January.

³ A further 107 kg of elvers and eel were reported transferred to Lake Aniwhenua (Lee et al. 1998; Kokopu Charitable Trust Inc. pers. comm. 1999). As the proportion of eels in this catch was not recorded this record has been omitted from the table.

⁴ The Kokopu Charitable Trust Inc. (1999) reports that 1,002 kg of elvers were transferred to Lake Matahina and Lake Aniwhenua. Estimated number shown is based on an average weight of 1 g. It is possible that the catch included some eels.

⁵ The Kokopu Charitable Trust Inc. reports catching 2001 kg of elvers in 1999–00 and 2054 kg in 2000–01 (Bill Kerrison, Murupara, pers. comm.). Estimated number shown is based on an average weight of 1 g.

Table 11. Estimated total number of elvers captured at Piripaua Power Station (Genesis & NIWA records). Date on which 50 and 95% of total catch was made is also shown. Years with accurate records for most of season are shaded. (LF, longfin; SF, shortfin; –, data not available).

	Season							
	1996–97	1997–98 ¹	1998–99	1999–00	2000–01 ²	2001–02	2002–03 ³	2003–04 ⁴
Total elvers caught	2,100	7,339	3,141	2,577	5,964	4,084	10,185	4,886
50% of total catch	26-Feb	5-Feb	19-Jan	21–28 Jan	21–28 Jan	21-Jan	3-Feb	10-Jan
95% of total catch	11-Mar	18-Mar	18-Mar	21–25 Feb	24-Feb	27-Mar	4-Mar	20-Feb
Estimated total SF caught	2,100	–	2,732	2,529	5,432	3,656	10,001	4,685
50% of total catch	26-Feb		19-Jan	21–28 Jan	21–28 Jan	21-Jan		
95% of total catch	11-Mar		18-Mar	21–25 Feb	22-Feb	4-Apr		
Estimated total LF caught	0	–	409	48	224	428	184	201
50% of total catch	–		19-Jan	14–21 Jan	19-Feb	14-Jan		
95% of total catch	–		7-Feb	21–28 Jan	7-Mar	8-Mar		
% LF	0	6	13	1.9	3.7	10.4	1.8	4.1

¹ % longfin based on one sub-sample.

² Species composition information available for transferred catch only.

³ Dates not included as only 3 sub-samples analysed over entire season.

⁴ Dates not included as traps were closed intermittently through the season.

Table 12. Summary of the number of elvers transferred from the Piripaua Power Station, Waikaremoana Power Scheme, since the transfer programme was initiated (Genesis & NIWA records). Years with accurate records for most of season are shaded.

Location	Season								Total
	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	
Kahutangaroa R. at Tuai	900	980	370	20	450	3,636	9,771	3,947	20,074
Mangaone Stm. at Miromiro	500	2,170	2,700	320	1,150				6,840
Mangaone Stm. at Kuha		1,440		390	950				2,780
Waikaretaheke R. above Tuai	700	630		20	70				1,420
Lake Kaitawa		1,240		1,400	1,150				3,790
Lake Whakamarino		710		230	430				1,370
Lake Waikaremoana ¹		160							160
Others			70		1,450	157	120		1,797
Total	2,100	7,330	3,140	2,380	5,650	3,793	9,891	3,947	38,231

¹ Not a permitted release site.

Table 13. Estimated total number of elvers (in 1000s) captured at Patea Dam, 1999-00 to present. Date to 50 and 95% of total catch also shown. Years with accurate records for most of season are shaded (– , species composition data not available; LF, longfin; SF, shortfin).

	Season				
	1999–00	2000–01	2001–02	2002–03	2003–04
Total elvers caught	461	495	754	380	391
50% of total catch	–	9–11 Jan	22 Jan	23 Jan	19 Jan
95% of total catch	–	27–30 Mar	8 Mar	10 Mar	12 Feb
Estimated total SF caught	–	–	707	372	390
50% of total catch			22 Jan	23 Jan	19 Jan
95% of total catch			8 Mar	10 Mar	12 Feb
Estimated total LF caught	–	–	48	8	1
50% of total catch			14 Jan	23 Jan	25 Jan
95% of total catch			25 Feb	10 Mar	25 Feb
% LF			6	2	0.2

Table 14. By-catch (number of individuals) collected from the elver trap at Patea Dam during the 2003–04 season.

Month/Year	By-catch species		
	Whitebait/native species ¹	Bully species ²	Shrimp
October 2003	511	0	50
November 2003	120	1	230
December 2003	49	6	950
January 2004	1,140	31	27
February 2004	357	4	25
March 2004	4	2	3,215
April 2004	5	0	1,050
May 2004	4	0	500
Total	2,190	44	6,047

¹ Whitebait/native species includes koaro, banded kokopu, inanga, smelt and torrentfish.

² Bully species include common bully and redfined bully.

Table 15. Estimated total weight and numbers of elvers transferred at Patea Dam during the 2003–04 season.

Location	Estimated weight transferred (kg)			Estimated number transferred		
	Longfin	Shortfin	Total	Longfin	Shortfin	Total
Lake Rotorangi (main lake)	1.5	201.5	203.0	902	362,901	363,803
Headwaters	0	11.0	11.0	0	14,316	14,316
Total	1.5	212.5	214.0	902	377,217	378,119

Table 16. Summary of species composition information for the elver trap and transfer programme at Patea Dam from 1983-84 to present. Years with accurate records for most of season are shaded. (– no data available).

Season	Number and weight of elvers	Source	Species composition	
			No. of elvers examined during season	% LF
1983–84	–	MFish	119	18
1985–86	–	MFish	512	16
1996–97	–	pers comm., G. Williams	150	33
1997–98	–	pers comm., G. Williams	150	24
1998–99	–	NIWA	100	12
2000–01	495,000 (198 kg)	Taranaki Regional Council; G. Williams pers. comm.; NIWA	401	5
2001–02	754, 000 (213 kg)	TrustPower and NIWA	1,158	6
2002–03	380,000 (150 kg)	TrustPower and NIWA	1,866	2
2003–04	391,000 (221 kg)	TrustPower and NIWA	1,195	0.3

Table 17. Estimated total weight and numbers of longfin elvers caught at the Roxburgh Dam during the 2003–04 season.

Date	Total catch (kg)		Number of elvers	By-catch
	Trap 1 (downstream)	Tank 2 (upstream)		Koaro
27 December	0	0	0	6
2 January	0	0	0	12
9 January	0	0	0	7
23 January	0.092 ¹	0.000	37	23
2 February	0.073	0.359	192	0
18 February	1.625	1.391	1,045 ²	0
2 March	0.102	0.054	60	1
16 March	0.072 ¹	0.055 ¹	51	8
Total	1.965	1.858	1,385	32

¹ Estimated weight based on species composition information obtained at a later date.

² Includes four dead elvers, which were not transferred.

Table 18. Total number of longfin elvers caught at Roxburgh Dam 1996-97 to present. Date to 50 and 95% of total catch also shown. Years with accurate records for most of season are shaded (–, data not available or facility not operated).

	Season							
	1996–97	1997–98	1998–99	1999–00	2000–01	2001–02	2002–03	2003–04
Total LF caught (number)	325	11,000	7,400	–	–	1,002	127	1,385
Total LF caught (kg)	1.3	22	–	–	–	2.6	0.39	3.82
50% of total catch	–	–	–	–	–	1 Mar	17 Feb	18 Feb
95% of total catch	–	–	–	–	–	22 Mar	17 Mar	2 Mar

Table 19. Numbers of longfin elvers caught and transferred from the Mararoa Weir to upstream habitats (mostly Lake Te Anau), 2003–04 (–, no catch recorded).

Date	Catch (kg)	Estimated No. caught	Measured catch		
			Number	Average weight (g) [†]	Average length (mm)
10 Jan	2.54	630	19	4	131
11 Jan	2.36	780	20	3	133
12 Jan	2.83	570	19	5	154
13 Jan	4.1	1020	20	4	138
14 Jan	2.08	520	20	4	137
15 Jan	2.19	550	20	4	140
16 Jan	1.2	600	20	2	125
17 Jan	11.91	3870	19	3	135
18 Jan	110.2	27550	20	4	140
19 Jan	47.75	11940	20	4	149
20 Jan	3.3	1650	20	2	127
21 Jan	–	–	–	–	–
22 Jan	18.25	9120	20	2	126
23 Jan	30.25	10080	20	3	136
24 Jan	4.25	1060	20	4	139
25- Jan	23.75	7920	20	3	138
26 Jan	23	5750	20	4	149
27 Jan	3.25	1080	19	3	141
28 Jan	13.25	3310	20	4	143
29 Jan	41.25	10310	20	4	140
30 Jan	–	–	–	–	–
Total	347.71	98,310	376		
Mean				4	138

[†] Elver weights were recorded to nearest gram.

Table 20. Estimated total number (in 1000s) or, when not available, weight of elvers captured at Waitaki Dam, 1999-00 to present. Date to 50 and 95% of total catch also shown. Years with accurate records for most of season are shaded (–, data not available; LF, longfin; SF, shortfin).

	Season				
	1999–00 ¹	2000–01	2001–02	2002–03 ⁴	2003–04
Total elvers caught	–	2061 ²	(65 kg ³)	56	4652
50% of total catch	–	30 Jan	–	3 Feb	31 Jan
95% of total catch	–	5 Mar	–	13 Feb	27 Feb
Estimated total SF caught	–	–	–	0	9
50% of total catch	–	–	–		6 Jan
95% of total catch	–	–	–		7 Jan
Estimated total LF caught	–	–	–	56	4643
50% of total catch	–	–	–	3 Feb	31 Jan
95% of total catch	–	–	–	13 Feb	27 Feb
% LF				100	99.8

¹ Traps installed.

² Mostly juvenile eels (>20g).

³ Full season records not available, most of this catch was juvenile eels (>20 g).

⁴ Traps altered, including change of substrate on ramps.

Table 21. Summary of estimated total number and weight of elvers captured at trap and transfer operations monitored during the 2003–04 migration season. (– data not available)

Site	Shortfin elvers		Longfin elvers		Total	
	Number	Weight (kg)	Number	Weight (kg)	Number	Weight (kg)
Karapiro	1,931,000	1,960	200,000	370	2,131,000	2,330
Wairere Falls	–	–	–	–	330,000	241
Matahina	881,000	921	64,000	118	945,000	1,039
Piripaua	4,700	4.5	200	0.5	4,900	5
Patea	390,000	219	1,000	2	391,000	221
Waitaki	10	0.01	4,630	13.7	4,640	13.7
Roxburgh	0	0	1,385	3.8	1,385	3.8
Mararoa Weir	0	0	97,800	348	97,800	348
Total	3,206,710	3,105	369,015	856	3,905,725	4,202

Table 22. Summary of estimated total annual catch of elvers (in 1000s) at monitored sites around New Zealand. Shaded regions are records we consider to be representative of the elver run and where control over the quality of the data has been maintained.

	Season																					
	82– 83	83– 84	84– 85	85– 86	86– 87	87– 88	88– 89	89– 90	90– 91	91– 92	92– 93	93– 94	94– 95	95– 96	96– 97	97– 98	98– 99	99– 00	00– 01	01– 02	02– 03	03– 04
North Island																						
Karapiro											92	518	282	1,155	1,220	1,699	1,097	892	782	1,596	1,942	2,131
Lake Waikare															540					256	175 ¹	
Wairere Falls																	181	208	141	289	330	
Matahina	20	21	23	6	19		18	46		>24	>32	>215	>39	>144	14	615	1,002	2,001	2,054	619	1,484	945
Piripaua															2.1	7.3	3.1	2.6	6.0	4.1	10.2	4.9
Patea																			495	754	380	391
South Island																						
Waitaki																					<0.1	4.6
Roxburgh															0.3	11.0	7.4		1.0	0.1	1.4	
Mararoa Weir																43.7				36.0	97.8	
Total	20	21	23	6	19		18	46		>24	>124	>733	>321	>1,299	1,236	2,332	2,153	3,077	3,545	3,115	4,141	4,081

¹ estimated migration through fish pass.

Table 23. Summary of estimated annual catch of shortfin elvers (in 1000s) at monitored sites around New Zealand. Shaded regions are records we consider to be representative of the elver run and where control over the quality of the data has been maintained.

	Season																						
	82– 83	83– 84	84– 85	85– 86	86– 87	87– 88	88– 89	89– 90	90– 91	91– 92	92– 93	93– 94	94– 95	95– 96	96– 97	97– 98	98– 99	99– 00	00– 01	01– 02	02– 03	03– 04	
North Island																							
Karapiro											61	342	186	822	974	835	756	798	627	1,351	1,766	1,931	
Lake Waikare														108								173	
Wairere Falls																		–	–	–	147	–	
Matahina	–	11	18	5	8		16	–	–	>17	>30	–	–	–	10	479	–	–	–	592	1,360	881	
Piripaua														2.1	–	2.7	2.5	5.4	3.7	10.0	4.7		
Patea																			–	707	372	390	
South Island																							
Waitaki																					0	<0.1	
Roxburgh														0	0	0			0	0	0	0	
Mararoa Weir																1.1				0	0	0	

[†] estimated migration through fish pass

Table 24. Estimated annual catch of longfin elvers (in 1000s) at monitored sites around New Zealand. Shaded regions are records we consider to be representative of the elver run and where control over the quality of the data has been maintained.

	Season																						
	82– 83	83– 84	84– 85	85– 86	86– 87	87– 88	88– 89	89– 90	90– 91	91– 92	92– 93	93– 94	94– 95	95– 96	96– 97	97– 98	98– 99	99– 00	00– 01	01– 02	02– 03	03– 04	
North Island																							
Karapiro											31	176	96	333	246	864	341	94	155	246	176	200	
Lake Waikare														431								2 [†]	
Wairere Falls																		–	–	–	22	–	
Matahina	–	10	5	1	11	–	2	–	–	>7	>2	–	–	–	4	136	–	–	–	27	124	64	
Piripaua														0	–	0.4	<0.1	0.2	0.4	0.2	0.2		
Patea																			–	48	8	1	
South Island																							
Waitaki																					<0.1	4.6	
Roxburgh														0.3	11.0	7.4				1.0	0.1	1.4	
Mararoa Weir																42.6					36.0	97.8	

[†] estimated migration through fish pass

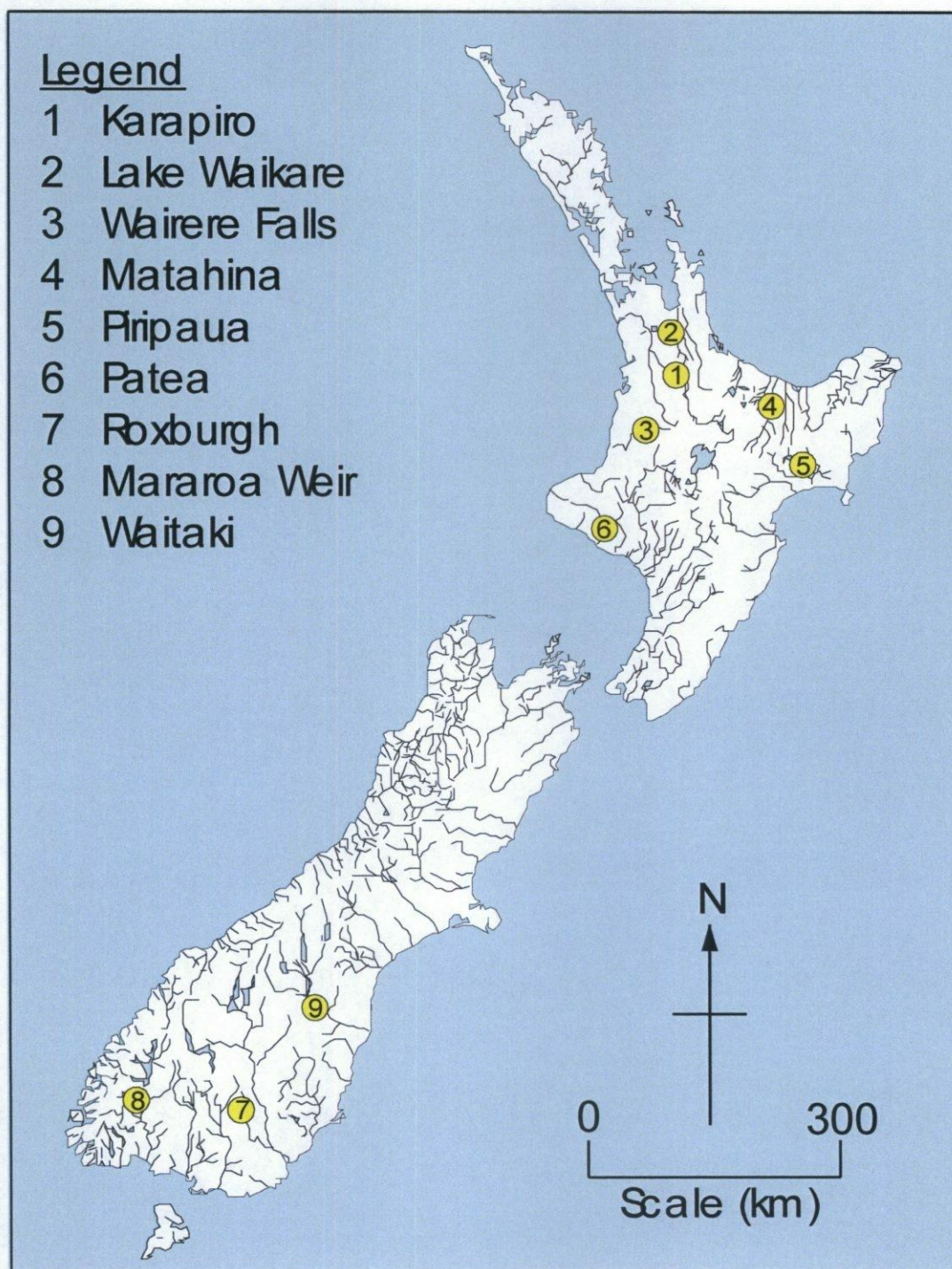


Figure 1. Locations of the nine sites around New Zealand where elver catches and transfer activities were monitored during the 2003–04 season.

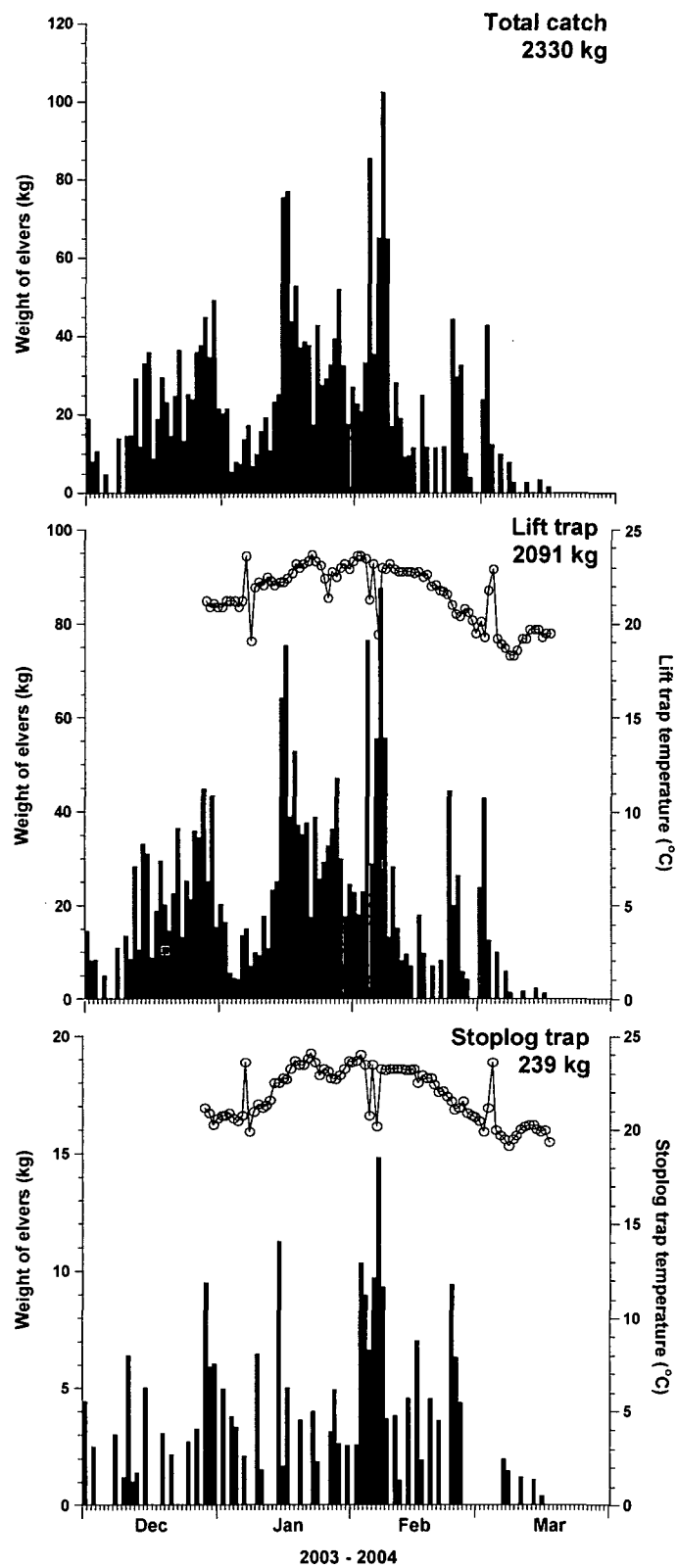


Figure 2. Total elver catch and individual trap records for Karapiro Dam during the 2003–04 season (1 Dec 2003 – 16 Mar 2004).

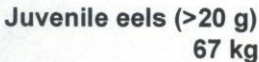


Figure 3. Total catch of juvenile eels (>20 g) for Karapiro Dam during the 2003–04 season (1 Dec 2003 – 16 Mar 2004).



Figure 4. Species composition (by weight and number) of 34 sub-samples of elvers examined from Karapiro Dam during the 2003–04 season (1 Dec 2003 – 16 Mar 2004). LF = longfin elvers.

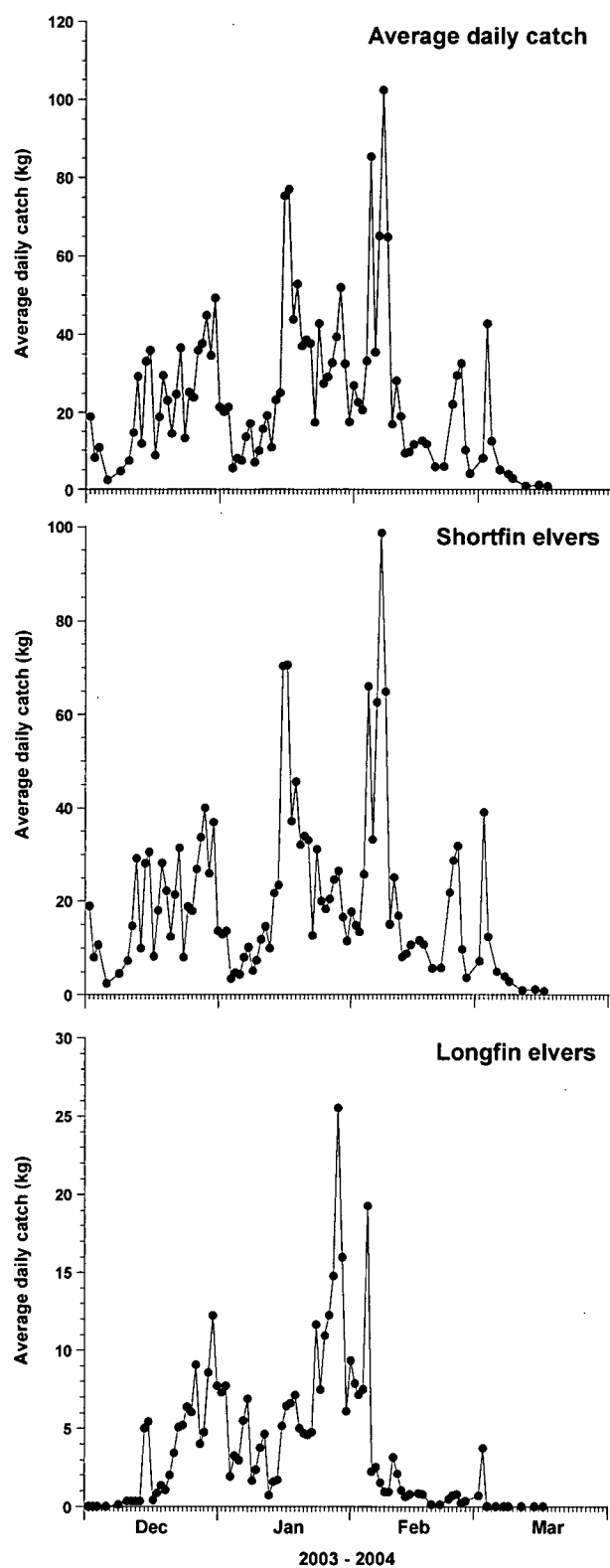


Figure 5. Average daily elver catch for Karapiro Dam during the 2003–04 season (1 Dec 2003 – 16 Mar 2004).

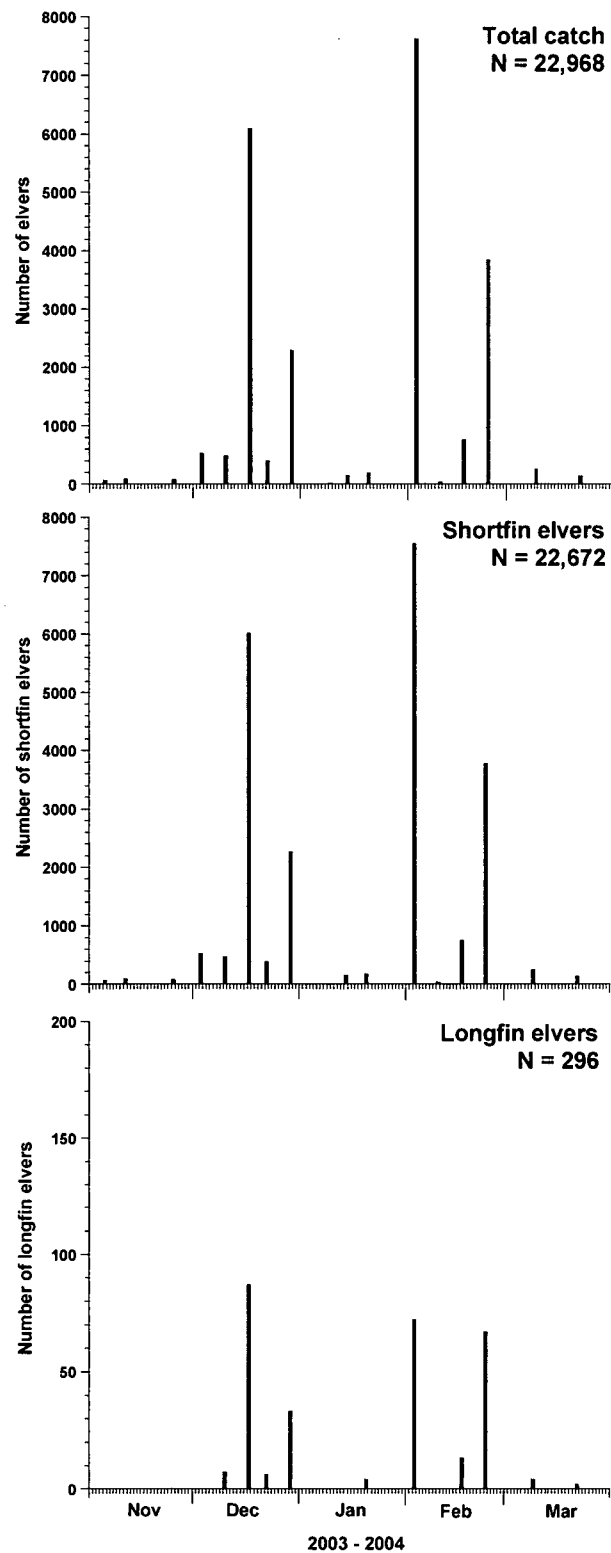


Figure 6. Daily (24 hour) elver catch (top) and estimated number of shortfin (middle) and longfin (bottom) elvers, for Lake Waikare fish pass during the 2003–04 season (1 Nov 2003 – 22 Mar 2004).

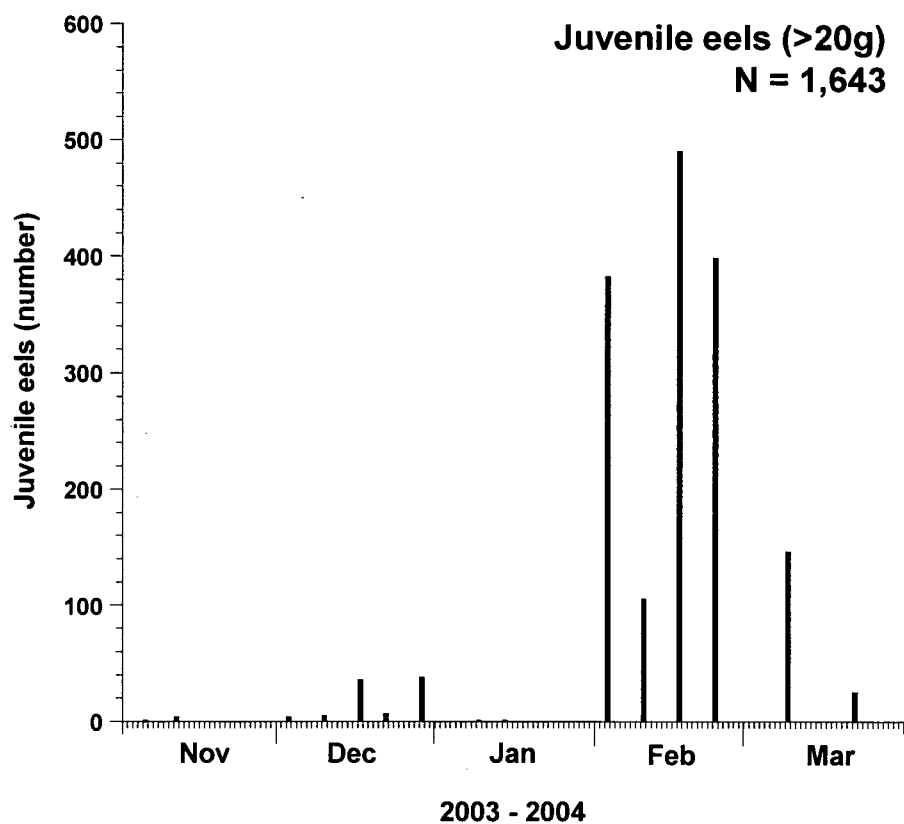


Figure 7. Daily (24 hour) catch of juvenile eels (> 20g) for Lake Waikare fish pass during the 2003–04 season (1 Nov 2003 – 22 Mar 2004).

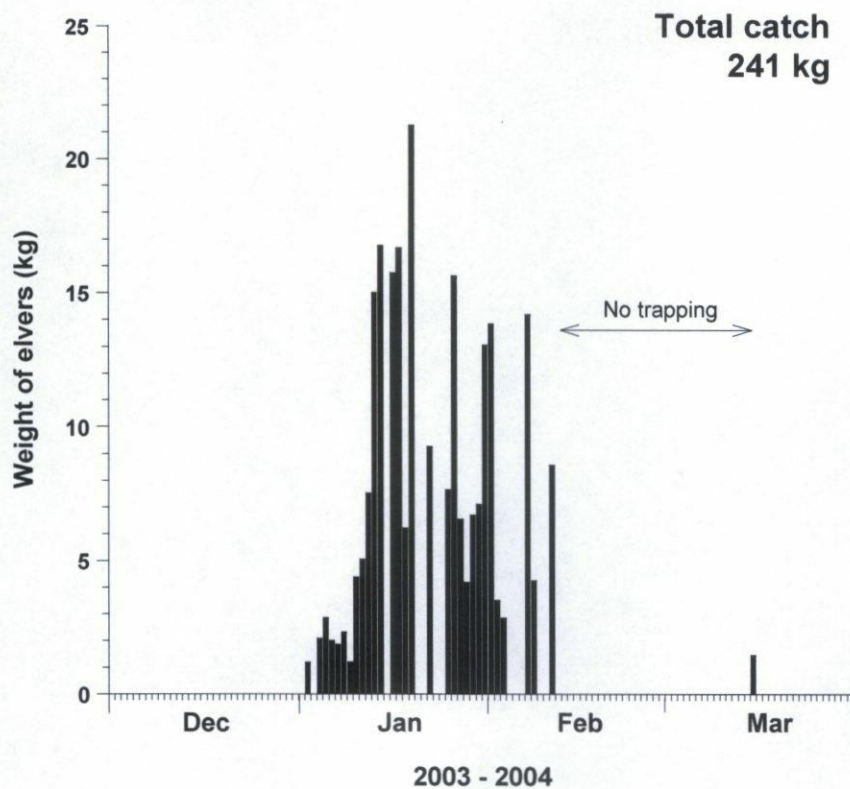


Figure 8. Total elver catch for Wairere Falls Power Station during the 2003–04 season (1 Jan 2004 – 15 March 2004).

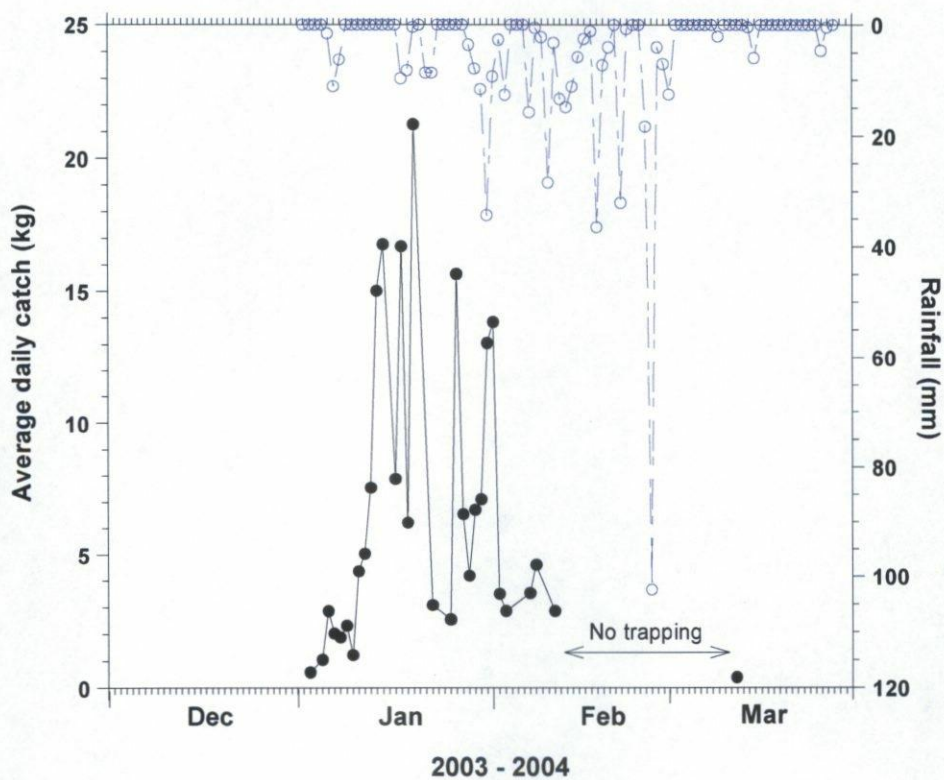


Figure 9. Average daily elver catch (solid circles) and rainfall (open circles) for Wairere Falls Power Station during the 2003–04 season (1 Jan 2004 – 15 March 2004).

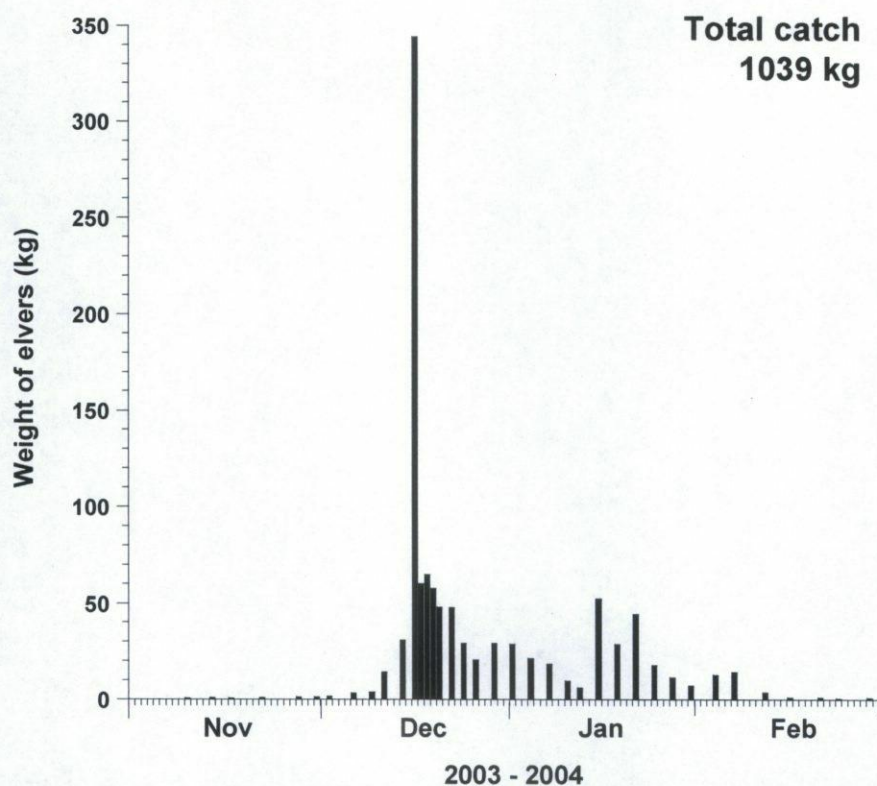


Figure 10. Total elver catch for Matahina Dam during the 2003–04 season (9 Nov 2003 – 29 Feb 2004).

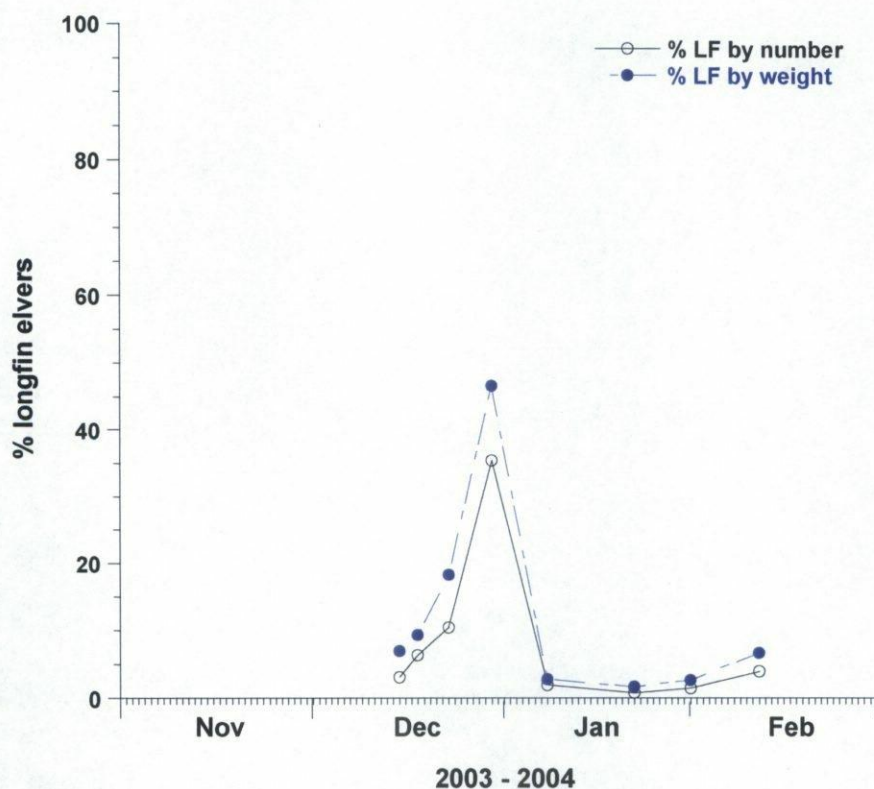


Figure 11. Species composition (by weight and number) of 8 sub-samples of elvers examined from Matahina Dam during the 2003–04 season (9 Nov 2003 – 29 Feb 2004). LF = longfin elvers.

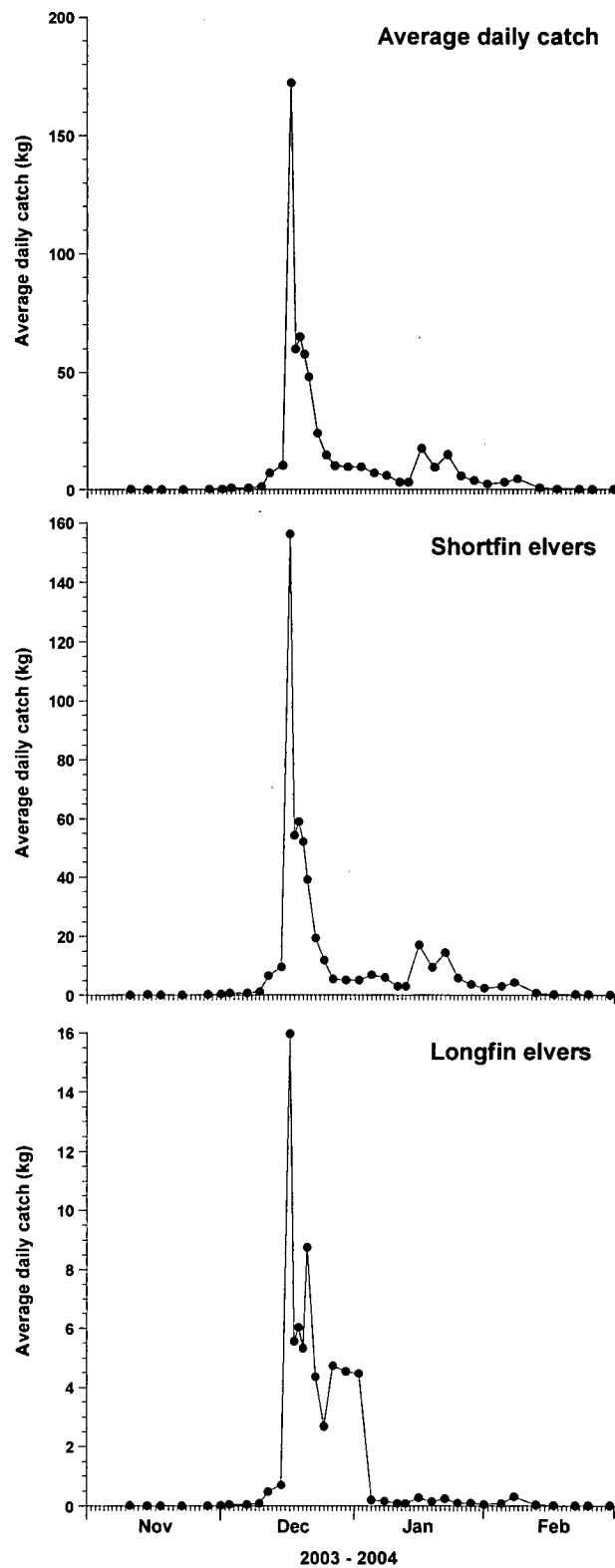


Figure 12. Average daily elver catch for Matahina Dam during the 2003–04 season (9 Nov 2003 – 29 Feb 2004).

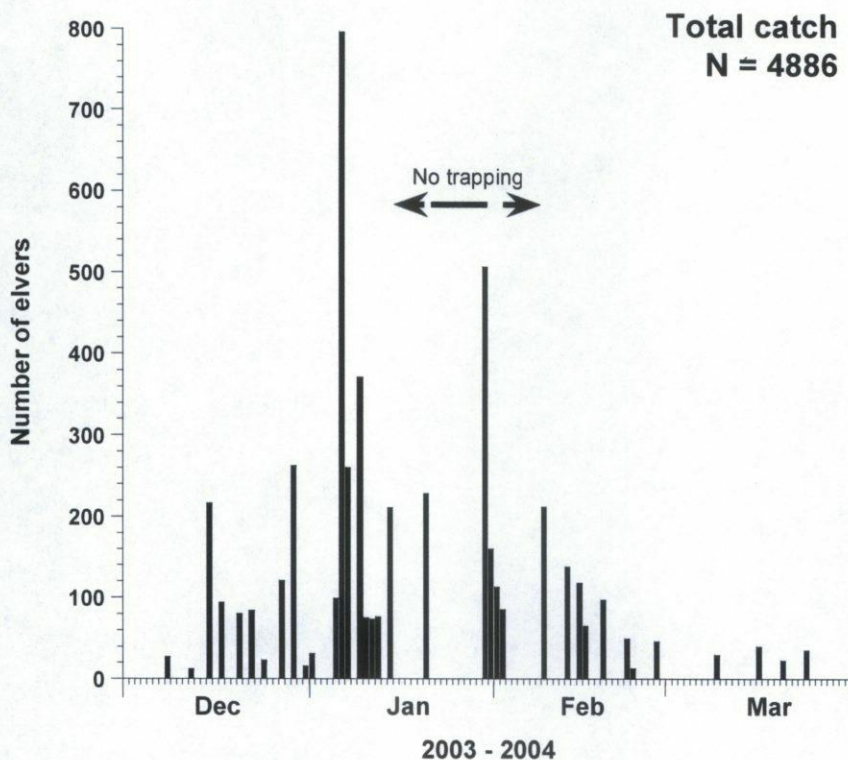


Figure 13. Total elver catch for Piripaua Power Station during the 2003–04 season (4 Dec 2003 – 24 Mar 2004).

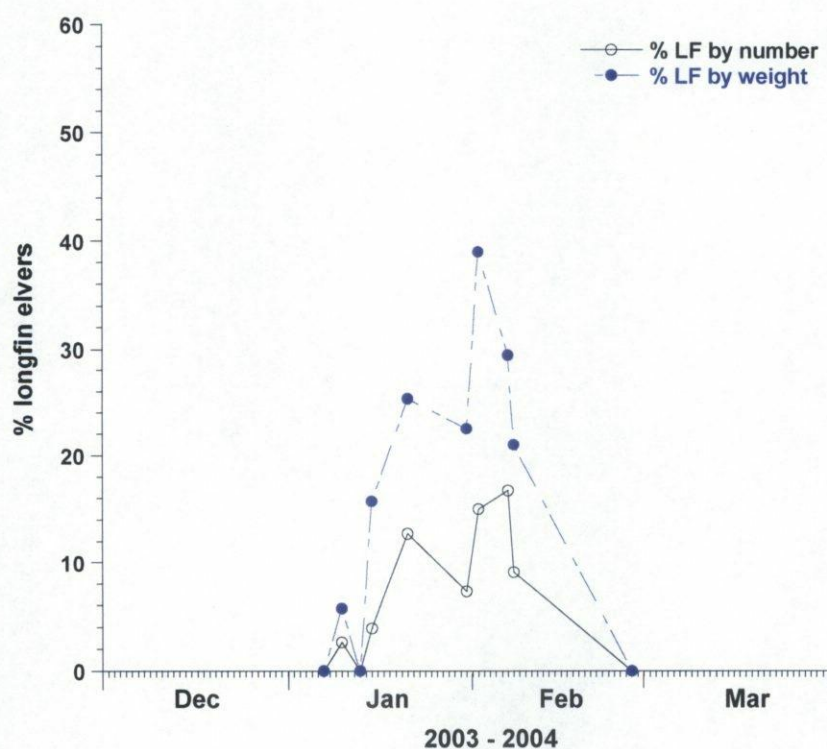


Figure 14. Species composition (by weight and number) of 10 sub-samples of elvers examined from Piripaua Power Station during the 2003–04 season (4 Dec 2003 – 24 Mar 2004). LF = longfin elvers.

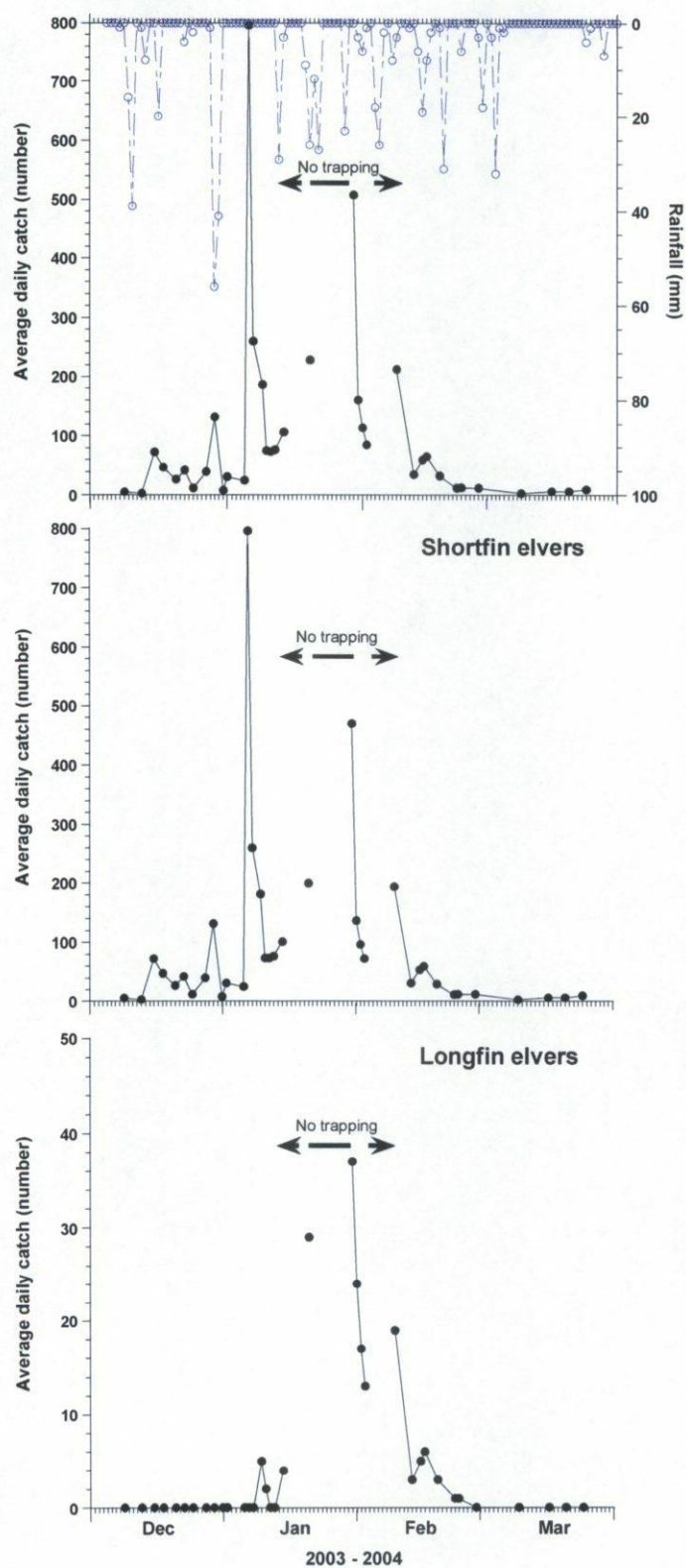


Figure 15. Average daily elver catch for Piripaua Power Station during the 2003–04 season (3 Dec 2003 – 24 Mar 2004).

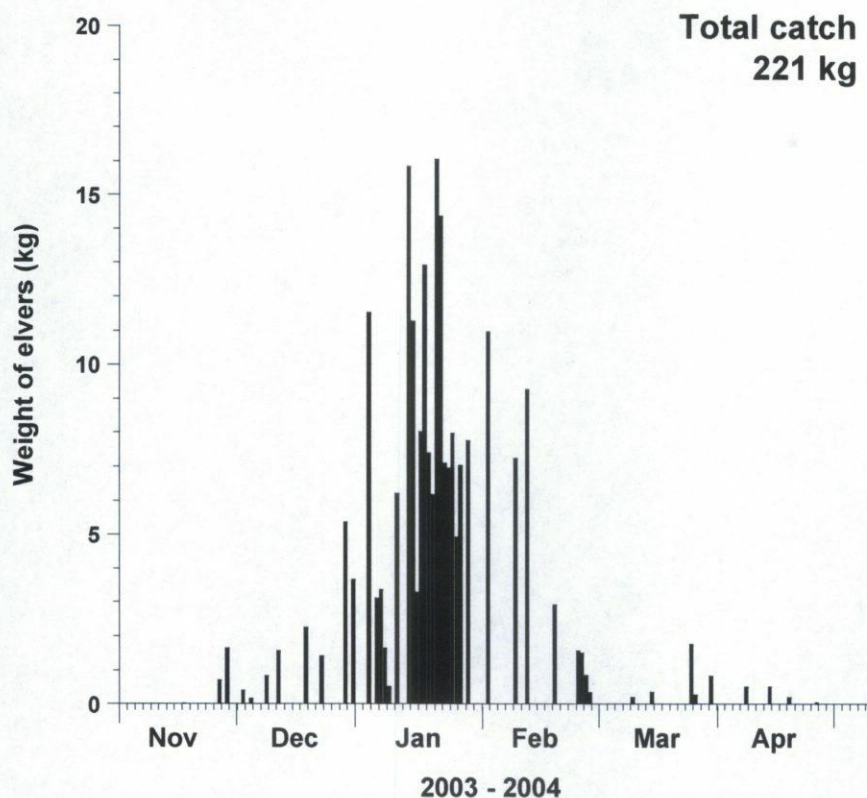


Figure 16. Total elver catch for Patea Dam during the 2003–04 season (1 Nov 2003 – 10 May 2004).

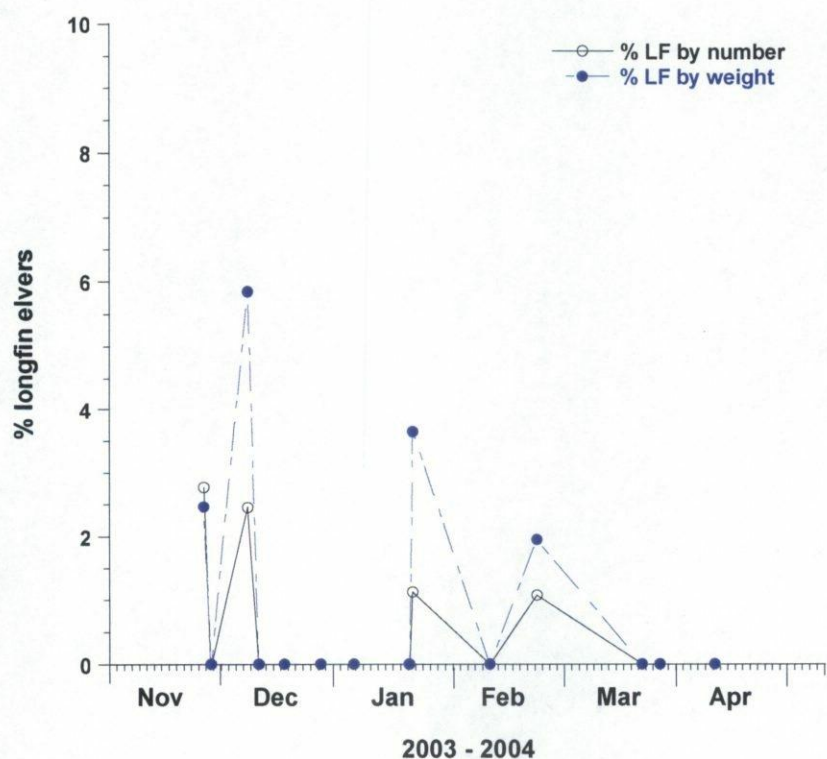


Figure 17. Species composition (by weight and number) of 14 sub-samples of elvers examined from Patea Dam during the 2003–04 season (1 Nov 2003 – 10 May 2004). LF = longfin elvers.

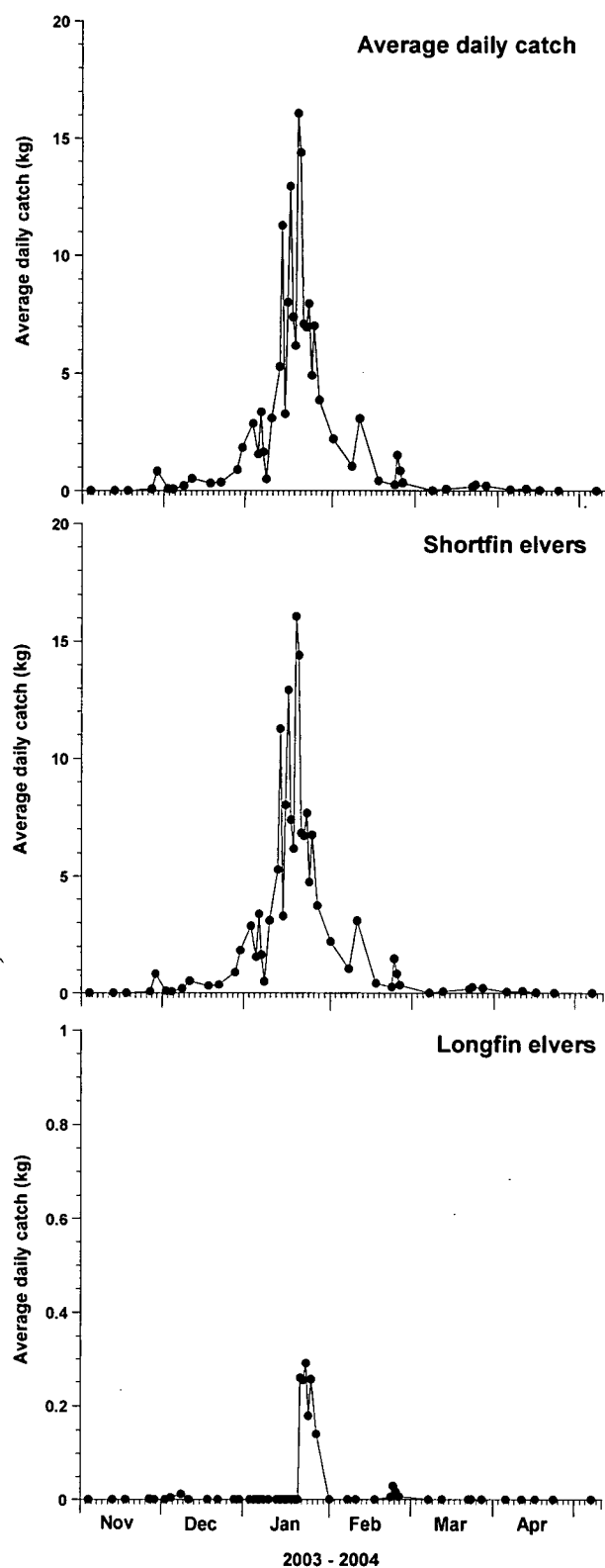


Figure 18. Average daily elver catch for Patea Dam during the 2003–04 season (1 Nov 2003 – 10 May 2004).

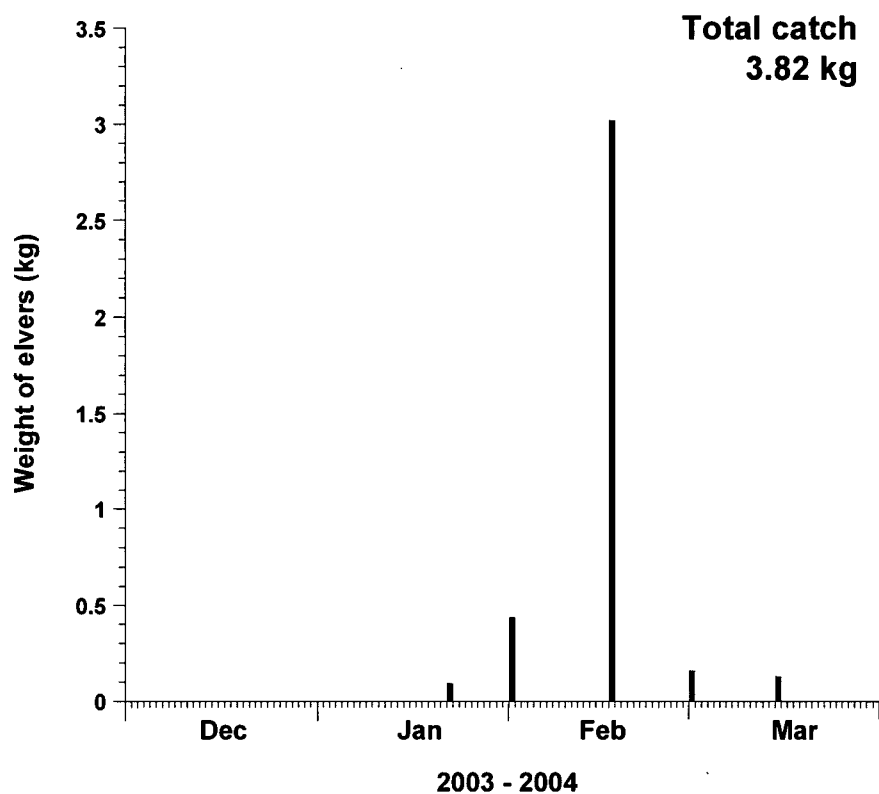


Figure 19. Total longfin elver catch for Roxburgh Dam during the 2003–04 season (26 Dec 2003 – 17 Mar 2004).

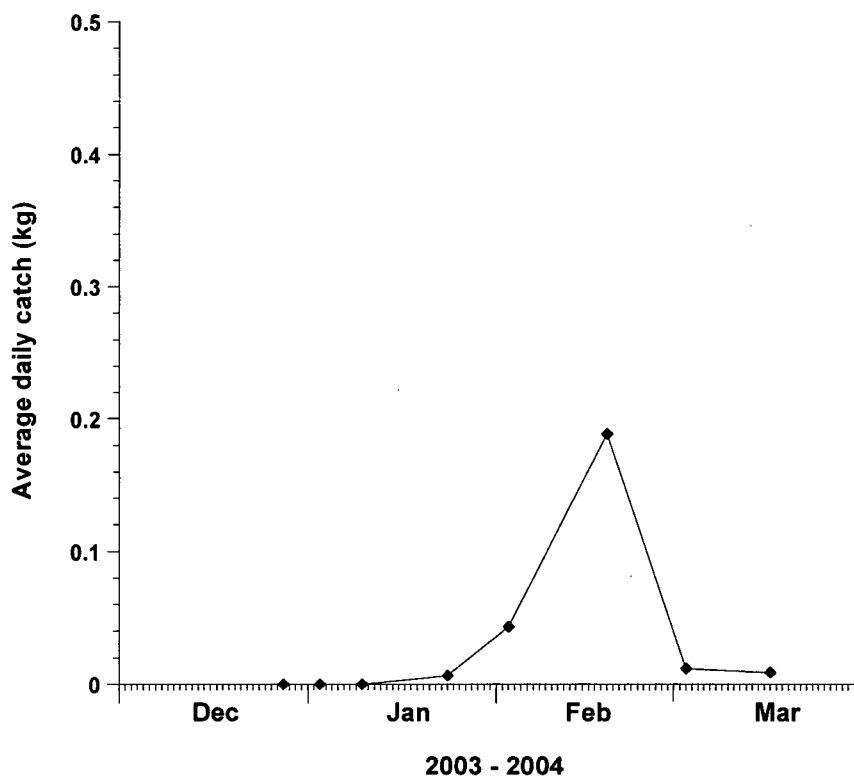


Figure 20. Average daily elver catch for Roxburgh Dam during the 2003–04 season (26 Dec 2003 – 17 Mar 2004).

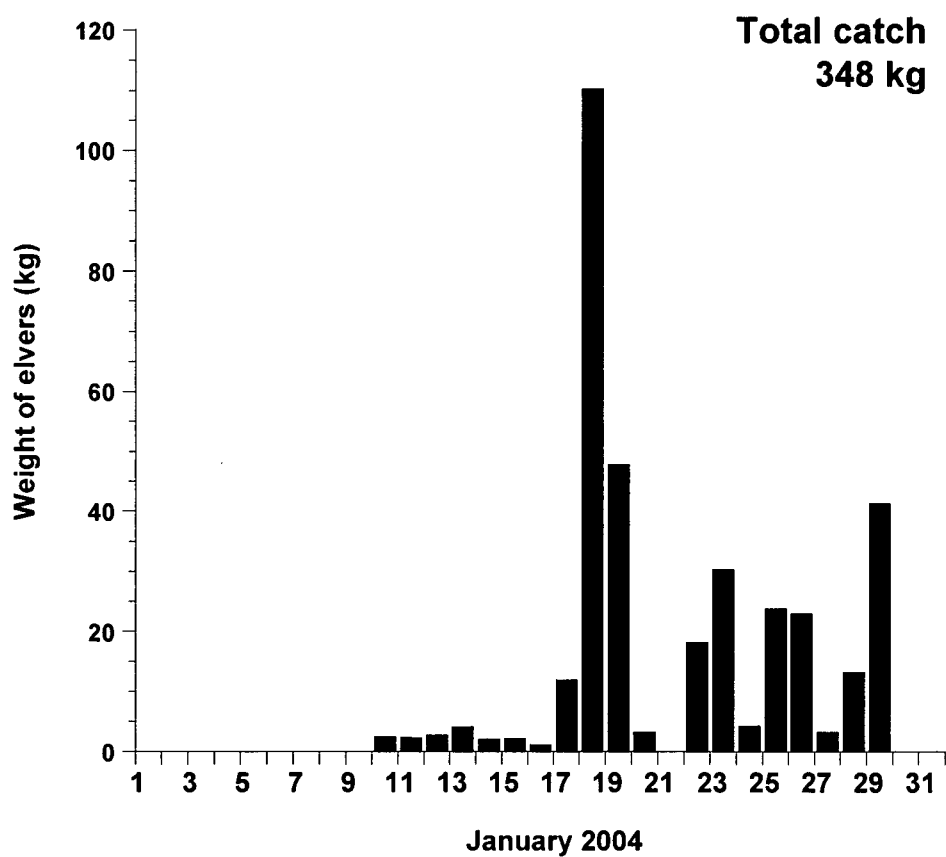


Figure 21. Total longfin elver catch for Mararoa Weir during the 2003–04 season (10 Jan to 29 Jan 2004).

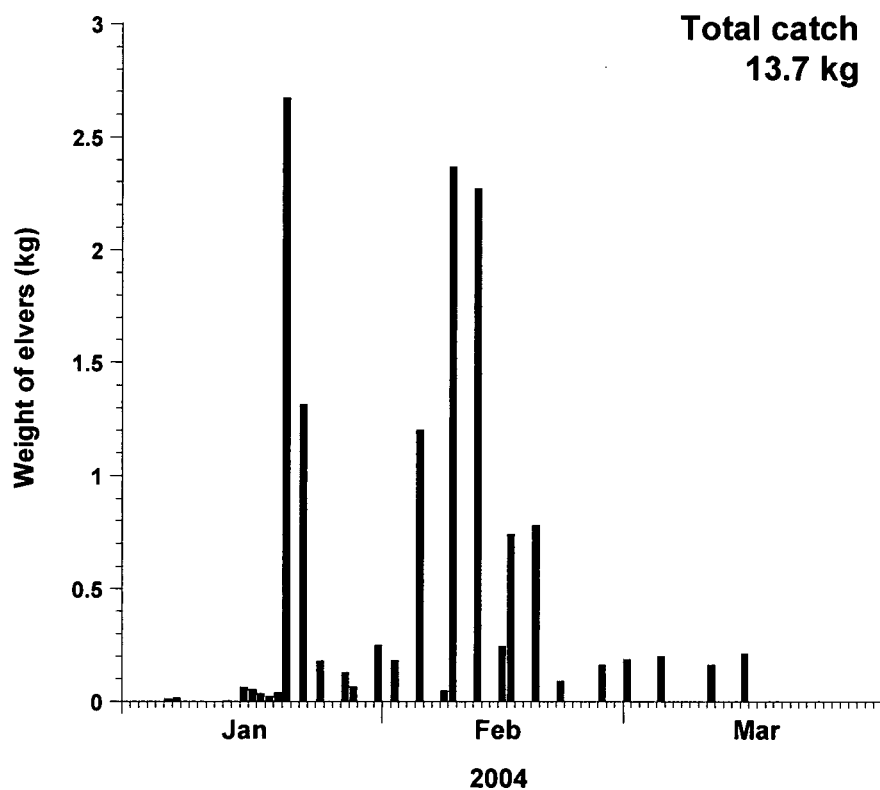


Figure 22. Total longfin elver catch for Waitaki Dam during the 2003–04 season (6 Jan to 15 Mar 2004).

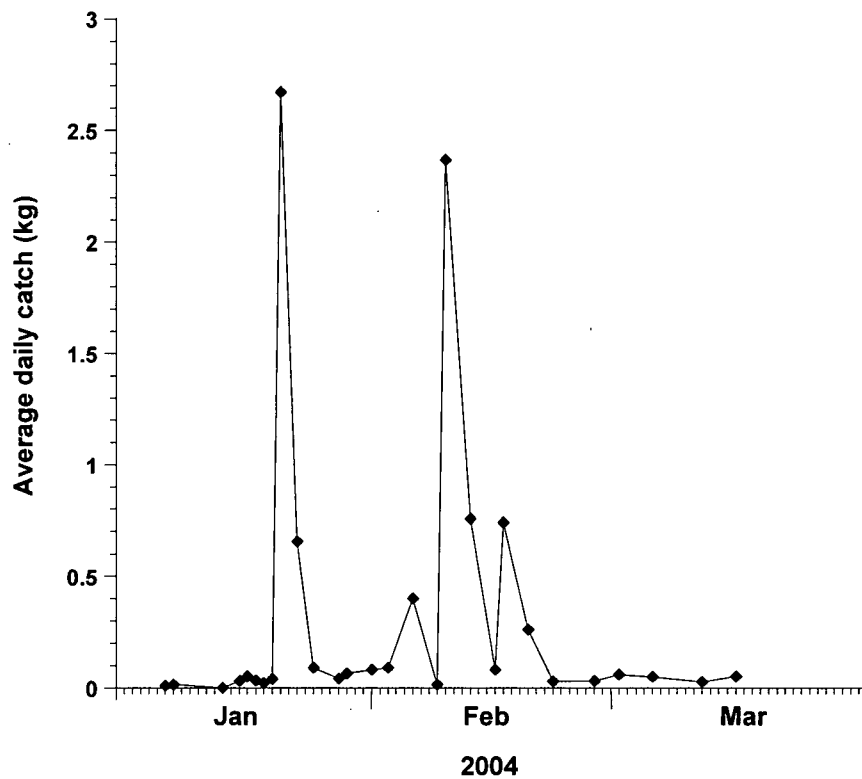


Figure 23. Average daily longfin elver catch for Waitaki Dam during the 2003–04 season (6 Jan 2003 – 15 Mar 2004).

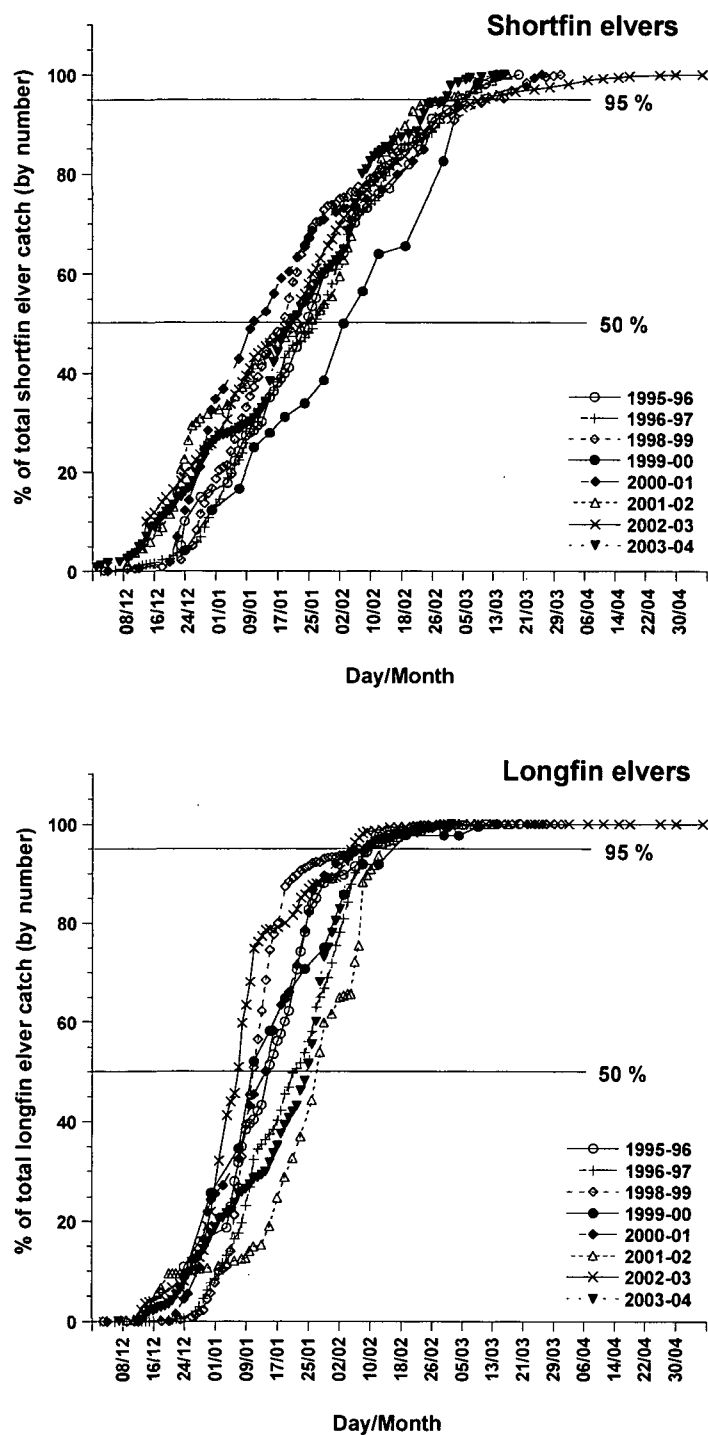


Figure 24. Cumulative proportion of the total shortfin (top) and longfin (bottom) elver catch (by number) obtained through each season from 1996 to 2004 at Karapiro Dam. Information from the 1997–98 season omitted due to concerns with data quality.

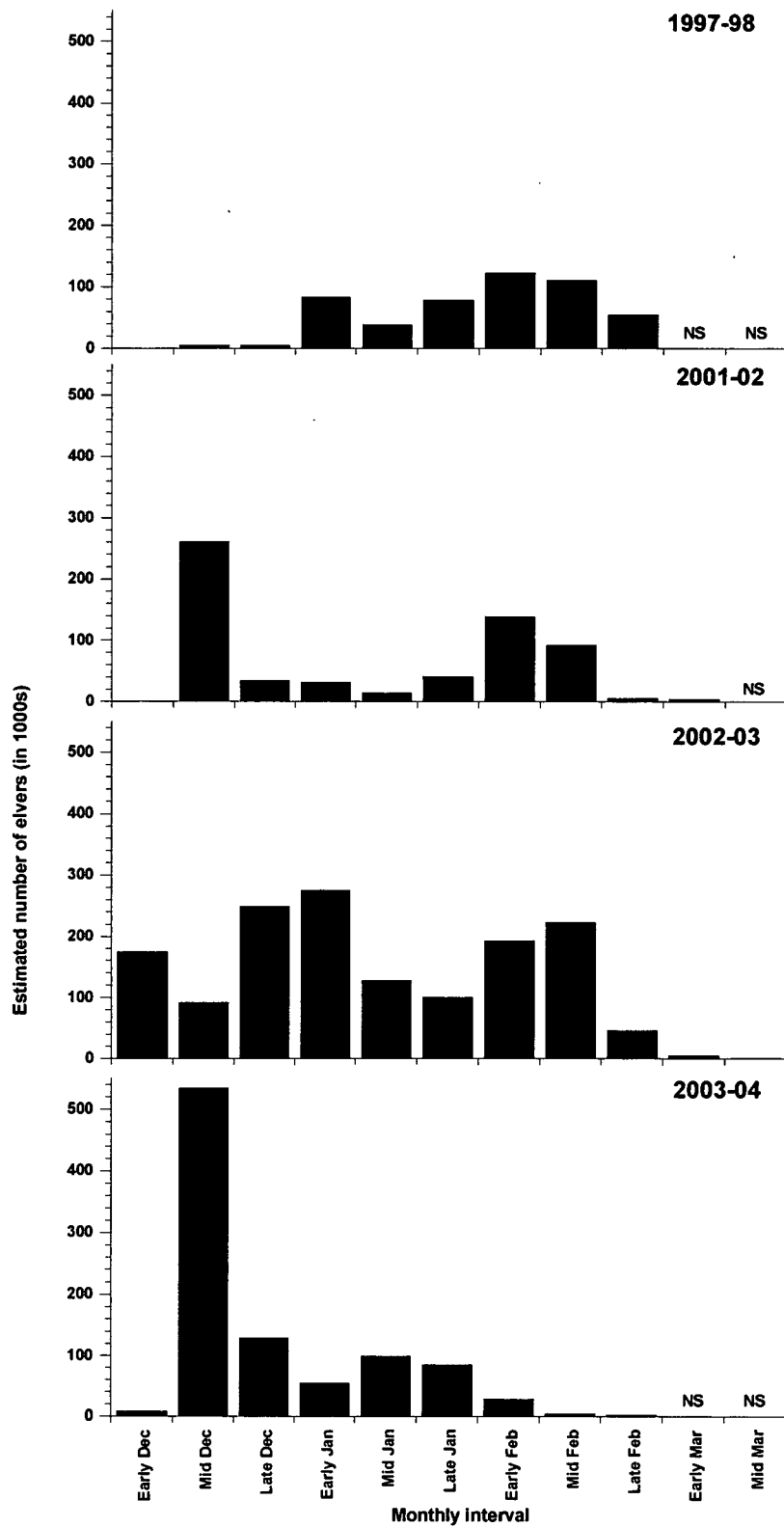


Figure 25. Estimated number of elvers (in 1000s) caught per monthly interval at Matahina Dam during the 1997–98, 2001–02, 2002–03 and 2003–04 seasons (*see* Williams & Boubée (2003) definition of intervals). NS, not sampled.

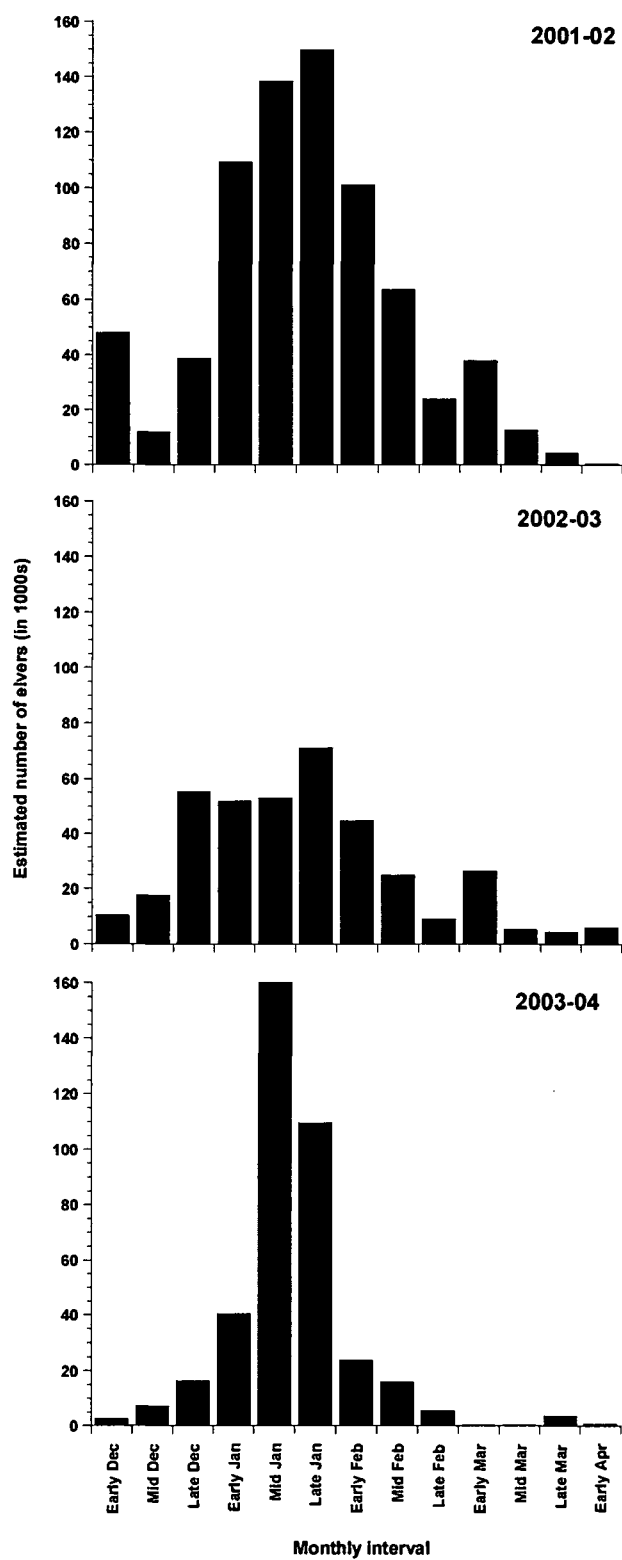


Figure 26. Estimated number of elvers (in 1000s) caught per monthly interval at Patea Dam during the 2001-02, 2002-03, and 2003-04 seasons (*see* Williams & Boubée (2003) definition of intervals).

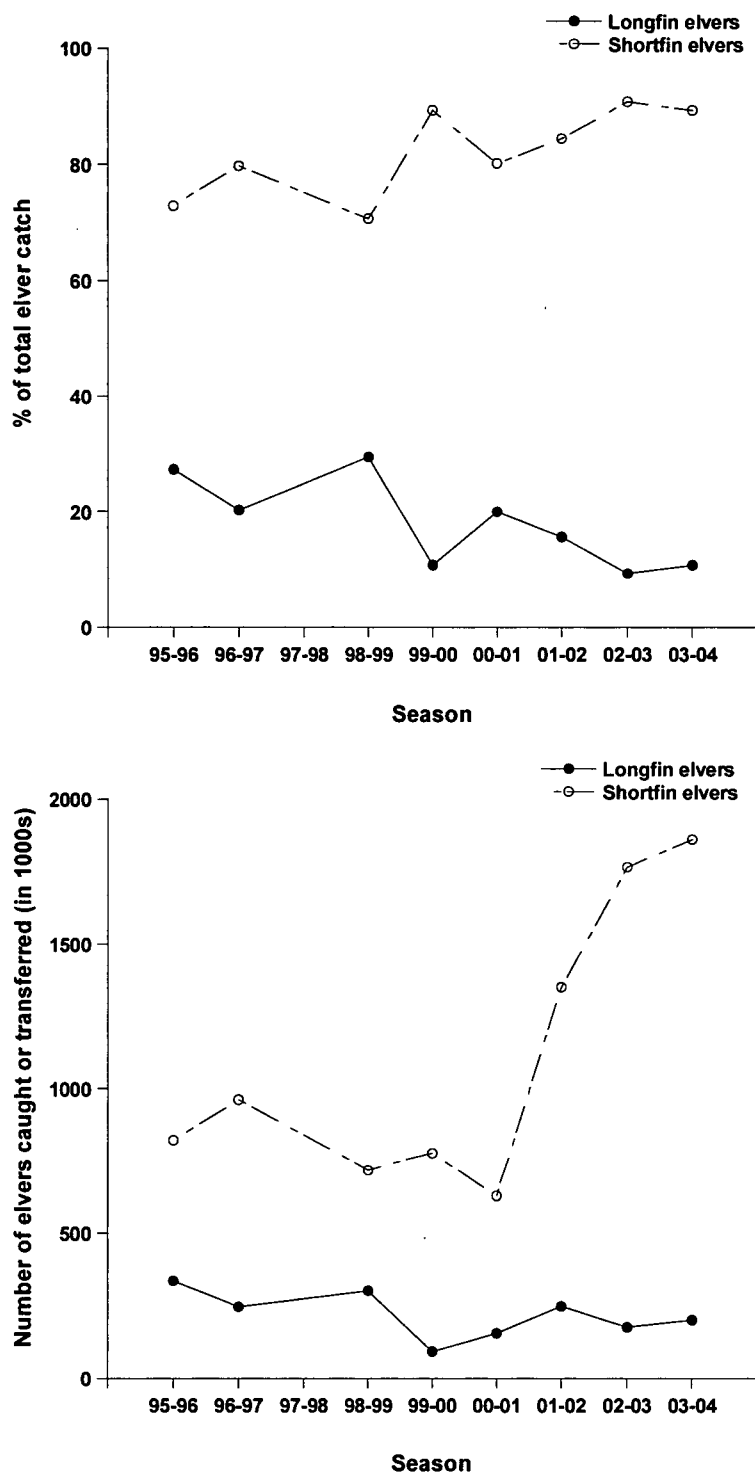


Figure 27. Estimated % composition of the annual catch and number of longfin and shortfin elvers captured at Karapiro Dam between 1995 and 2004. **Note:** some data from 1992-93, 1993-94, 1994-95, and 1997-98 has been omitted because of quality concerns.

Appendix 1. Monitoring procedures and recording sheets used during the 2003-04 season.

- 1) Equipment Monitoring.
- 2) Catch Monitoring.
- 3) Elver Transfer Records.
- 4) Species Composition Analysis.

1. EQUIPMENT MONITORING

1. **Check for aggregation** of elvers around ramps and trap. Report any changes.
2. Determine if **number of elvers present warrant** a transfer.
3. **Check water supply.**
4. Record weather, water level, number of turbines operating, trap temperature and if possible attraction flow temperature. Note any changes observed. **Examine catch for sign of stress or disease.**
5. Clean water supply filters if installed. **Check for bad smell** and if present open all valves to check for source.
6. Open all valves fully and flush until water runs clear of silt. Return valves to original positions.
7. Check ramps. Clean if required.
8. If silt has accumulated in tank flush and clean with pressure hose and brush. Use weak Janola solution and **rinse well** if sign of fungal infection detected on elvers.
9. Adjust attraction and flushing flows on ramp.
10. Record any malfunctions on sheet provided.

(For further information contact J. Boubée, Box 11 115 Hamilton, Tel 0274 799 485)

Equipment Monitoring Sheet

Location:

Date:

Time:

Operator:

Reason for visit

Weather

Tailrace level

Which turbines operating?

Water temperature, tailrace

Attraction flow temperature

Elvers seen (Y/N) ?

--

If yes, where?

Water supply OK ?

--

If not, what is the problem ?

Any signs of disease or bad smells ?

--

If so where and what type?

Water filter cleaned ?

--

Water valves open fully and reset?

--

Water tanks clean ?

--

If not, flush and scrub

Janola solution used

ACTIONS TAKEN TODAY

Elver catch transferred to holding bin

Elver transfer undertaken

Trapping re-started (& where)

Traps lifted (state which)

Water turned off (& where)

Water turned on (& where)

COMMENTS

2. CATCH MONITORING

- 1) Collect elvers from tank (no more than 5 kg at any time in bucket).
- 2) Remove eels greater than 20 g (pencil size), count, and place in separate bucket.
- 3) Weigh **eel** catch and record on **Catch Record Form**. (Note: if the numbers of eels are large it may be easier to record this when releases are made. See Book 3, items 8 and 9.)
- 4) Remove any **other species**, identify (or freeze), count and/or weigh, record as by-catch.
- 5) Drain elvers and remove any that are dead. (Note: if very large numbers of elvers have died and sorting is impossible, weigh catch and return entire catch to tailrace.)
- 6) Weigh live elvers. Record on **Catch Record Form**.
- 7) Weigh dead elvers. Record on **Catch Record Form**.
- 8) Transfer eel and elver catch record onto **Transfer Form**.
- 9) Collect sample for species identification, preferably every time a transfer is made but at least once a week. (Note: mix elvers well before taking sub-sample).
- 10) Process sample as per instructions for **Species Composition** (Book 4).
- 11) Check that **Catch Record** and **Transfer Record** forms are filled out correctly.

(For further information contact J. Boubée, Box 11 115 Hamilton, Tel 0274 799 485.)

Catch Record for:

Date:

Date of last removal:

Time:

Operator:

CAPTURES - TAP 1

Eels separated from elvers? (circle) YES / NO

Elvers - Live			
Total wt	Bucket	Net Wt.	Count
COLUMN TOTAL			

Elvers - Dead			
Total wt	Bucket	Net Wt.	Count
COLUMN TOTAL			

Eels (>20g)			
Total wt	Bucket	Net Wt.	Count
COLUMN TOTAL			

CAPTURES - TAP 2

Eels separated from elvers? (circle) YES / NO

Elvers - Live			
Total wt	Bucket	Net Wt.	Count
COLUMN TOTAL			

Elvers - Dead			
Total wt	Bucket	Net Wt.	Count
COLUMN TOTAL			

Eels (>20g)			
Total wt	Bucket	Net Wt.	Count
COLUMN TOTAL			

BYCATCH

Species

Number

Weight

LOCATION OF RELEASE:

.....

COMMENTS

.....

3. ELVER TRANSFER RECORDS

- 1) Empty trap(s) and complete elver **Transfer Record Form**.
- 2) Take out a random sample of about 100 elvers (can preserve/freeze) and analyse as per instructions.
- 3a) **For small numbers of elvers:** Place catch in a bin or bucket with lid. Add wet moss or similar to keep elvers moist. Keep container cool with ice.
- 3b) **For a large amount of elvers (over 2 kg):** fill transport tanks with water and turn air supply on. Transfer catch to transport tank(s) (no more than about 25 kg per 175 litres of water.)
- 4) Determine where transfers are to be made and complete **Transfer Record Form** before leaving.
- 5) Re-check load, air supply etc.
- 6) Check that transfer permit is at hand. Do not release elvers outside the area stipulated.
- 7) If transport tank has heated up during travel, add fresh water to gradually cool the elvers down before release.
- 8) If required, empty transport container into eel holding bag held in river/lake. (Release elvers in areas where there is plenty of cover.)
- 9) If required, weigh eels and record. Count number of eels.
- 10) Check if any elvers have died during transport and record in diary (make sure that this information is transferred to the Elver Transfer Record Form)

(For further information contact J. Boubée Box 11 115 Hamilton, Tel 0274 799 485.)

4. SPECIES COMPOSITION ANALYSIS

Catch analysis (to be done weekly):

1. **Do not smoke or eat** when processing elvers with anaesthetic. Keep hands clear of mouth and eyes.
2. **Mix catch and obtain a sample of about 100 elvers.**
3. **Identify and count by-catch.** If required collect and, preserve any by-catch either frozen or in formalin (4%).
4. Prepare 3 buckets. Fill two with clean fresh water and label as SF and LF.
5. In third bucket place about 5 l of water and clove oil from vials provided. Mix well.
6. Place a small number of elvers (about 10) in anaesthetic.
7. Quickly **identify each and record.** Place in SF or LF fresh water bucket as appropriate.
8. **Repeat until sample is processed.**
9. **Sieve the sorted elvers to drain out water and weigh** each lot of sorted elvers separately.
10. **Record number and weight on form.**
11. Return elvers to tank for transport.
12. **Complete form and fax to NIWA** at 07 856 0151, attention J. Boubée.
13. If required save a sample of elvers for checking (1 sample every 15 days) either frozen or in formalin (4%). Send ANY (including by-catch) samples to J Boubée NIWA, PO Box 11-115, Hamilton.
14. Rinse all equipment and wipe clean. Wash hand with copious water.

(For further information contact J. Boubée, Box 11 115 Hamilton, Tel 0274 799 485)

Species Composition

Location

Date _____

Operator

[illegible]

1		
2		
3		
4		
5		
6		
7		
8		
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41		
42		
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45		
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47		
48		
49		
50		

[illegible]

	Shortfins counts	
1	51	
2	52	
3	53	
4	54	
5	55	
6	56	
7	57	
8	58	
9	59	
10	60	
11	61	
12	62	
13	63	
14	64	
15	65	
16	66	
17	67	
18	68	
19	69	
20	70	
21	71	
22	72	
23	73	
24	74	
25	75	
26	76	
27	77	
28	78	
29	79	
30	80	
31	81	
32	82	
33	83	
34	84	
35	85	
36	86	
37	87	
38	88	
39	89	
40	90	
41	91	
42	92	
43	93	
44	94	
45	95	
46	96	
47	97	
48	98	
49	99	
50	100	

Longfins counts	
1	51
2	52
3	53
4	54
5	55
6	56
7	57
8	58
9	59
10	60
11	61
12	62
13	63
14	64
15	65
16	66
17	67
18	68
19	69
20	70
21	71
22	72
23	73
24	74
25	75
26	76
27	77
28	78
29	79
30	80
31	81
32	82
33	83
34	84
35	85
36	86
37	87
38	88
39	89
40	90
41	91
42	92
43	93
44	94
45	95
46	96
47	97
48	98
49	99
50	100

Extras

Sample weight (g)

Numbers of elvers in sample

Shortfins

Longfins

Shortfins

Longfins

Total weight of sample (g)

Total number of eiders in sample

Shaded cells must be filled in

Appendix 2. Plots of cumulative proportion (%) of longfin elvers vs number of elvers examined for ten sub-samples obtained from Karapiro Dam in 2003-04. Results confirm that to obtain a reliable species composition, a sample of at least 60 elvers should be examined. [Recommend 100].

