

## Recruitment of freshwater eels, 2006–07 and 2007–08

M. Martin  
J. Boubée  
E. Bowman

## **Recruitment of freshwater eels, 2006–07 and 2007–08**

M. Martin  
J. Boubée  
E. Bowman

NIWA  
P O Box 11115  
Hamilton 3251

**Published by Ministry of Fisheries  
Wellington  
2009**

**ISSN 1175-1584**

©  
**Ministry of Fisheries  
2009**

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

This series continues the informal  
New Zealand Fisheries Assessment Research Document series  
which ceased at the end of 1999.

## EXECUTIVE SUMMARY

**Martin, M.; Boubée, J.; Bowman, E. (2009). Recruitment of freshwater eels, 2006–07 and 2007–08.**

*New Zealand Fisheries Assessment Report 2009/4. 68 p.*

The recruitment of freshwater eels was assessed by monitoring trapping and transfer operations at thirteen sites during the 2006–07 and 2007–08 elver migration seasons (i.e. spring–autumn). Data were obtained from four main sites (Karapiro, Matahina, Waitaki, and Arnold dams) and nine supplementary sites (Wilson's Dam<sup>1</sup>, Morrinsville Dam<sup>1</sup>, Wairere Falls Power Station, Patea Dam, Piripaua Power Station, Mangorei Power Station, Motukawa Power Station, Waihopai Dam<sup>1</sup>, and Mararoa Weir).

The data were added to the existing time series of elver catch records which is part of an ongoing programme initiated by the Ministry of Fisheries in 1995–96 to monitor the recruitment of freshwater eels in New Zealand. The study was undertaken for the Ministry of Fisheries project EEL2006/01.

At least 3.2 million elvers (about 2.6 million shortfins and 600 000 longfins) were captured and transferred to upstream locations from the 13 monitored sites in the 2006–07 season. Karapiro and Matahina provided the two largest proportions of the total elvers captured (40% and 15% respectively).

The migration of both shortfins and longfins at most sites occurred later in 2006–07 than in previous seasons, with substantial catches to the end of March at Karapiro, Matahina, Patea, Arnold and Waitaki. As for previous seasons, the elver migration occurred earlier in the North Island than the South Island.

At least 7.6 million elvers (5.3 million shortfins and 2.1 million longfins) were captured and transferred to upstream locations from 10 monitored sites in 2007–08. The total catch was over twice that of the previous season, and the largest total catch ever recorded. Large increases occurred at Matahina, Karapiro, Arnold, and Waitaki.

The total shortfin elver catch from the monitored sites in 2007–08 was 1.6 times greater than the previous maximum total catch. The total longfin elver catch for the 2007–08 season was the largest ever total recorded from the monitored sites. Almost 80% of the catch was from Karapiro and Matahina. In the South Island at Arnold and Waitaki, longfin catches were also significantly greater than in any previous season.

Shortfin and longfin migrations occurred earlier in 2007–08 than in 2006–07, with substantial catches occurring in December and early to mid January. As for previous seasons, the elver migration occurred earlier in the North Island than the South Island.

Annual longfin and shortfin elver catches from monitored sites have typically shown large variations of the timing and magnitude of migrations, with little evidence of consistent long-term trends. These differences in migration timing and magnitude are thought to be temperature related.

Despite the relative magnitude of the 2007–08 catch compared to previous seasons, there appears to be no significant long-term longfin recruitment trend. Shortfin elver catches from Karapiro and Matahina indicate that since 1995–96 recruitment has been increasing.

---

<sup>1</sup> No data received for 2007–08.

## 1. INTRODUCTION

The commercial eel fishery in New Zealand is a moderate volume fishery, in recent years yielding about 750 t per year from the North and South Islands and the Chatham Islands (MFish 2008). The commercial fishery targets both the shortfin (*Anguilla australis*) and the longfin (*A. dieffenbachii*). No data are available on the magnitude of recreational and customary catches.

The Quota Management System (QMS) was introduced into the South Island fishery in October 2000, into the Chatham Island fishery in October 2003, and into the North Island fishery in October 2004. The combined South Island landings for the 2002–03 fishing year were 296 t (combined TACC 420 t). Based on the 2004 port price (\$3.50/kg), the South Island landings were worth about \$1.03 million. North Island landings totaled 507 t, and would be valued at about \$1.78 m (MFish 2008).

A stock assessment of eels presents particular problems because of the unique life cycle of the species, which has long distance migrations of both the juvenile and adult life stages. Because of this, all eels, except possibly shortfin males, are at some time in their life at risk of being harvested before spawning (Hoyle & Jellyman 2002). Upstream migration of elvers to freshwater catchments and downstream migration of maturing adults to the sea have, in New Zealand and overseas, been impeded by structures such as dams, weirs and man-made culverts (Tesch 1977, Watene & Boubée 2005, Boubée & Williams 2006). Overseas, trapping and transfer of elvers to upstream locations and fish passes are used to mitigate the impediment to upstream migration (Sloane 1984, Knights & White 1998). In New Zealand these methods have also been used for elvers on an *ad hoc* basis by electricity generating companies up to the mid 1990s (Beentjes et al. 1997). Since then, NIWA has developed standard methods for the trapping and transfer of elvers and recording of the catches (Martin et al. 2007).

The monitoring of elver catches and transfers at hydro dams and other locations where the upstream migration is blocked provides a cost-effective means of establishing a long-term time series on the relative abundance of elvers. Provided data are collected in a consistent manner each year, the data can be used to determine overall trends in recruitment.

Although there are records of elver transfers at various locations for over 20 years, data obtained from before standardised methods were developed and introduced have year to year variability in fishing effort, unreliable species identification, and inconsistent trapping methods, which render, much of the data unreliable for establishing long-term recruitment trends. Including the 2007–08 season, the longest reliable time series available (Karapiro Dam) has 13 records, indicating that the numbers of captured elvers each season is highly variable (Martin et al. 2008). Jellyman et al. (2002) recommended the use of a nine year moving average as an appropriate smoothing technique to describe variation in glass eel abundance, and a similar analysis would probably be applicable to elver abundance data, although at least a three-year moving average may suffice for elver migration. However, the lack of reliable long-term elver abundance data currently prevents accurate use of this technique.

The Ministry of Fisheries Medium Term Eel Research Plan proposes that research on elver recruitment to establish a time series of relative abundance should be ongoing. A relative abundance index may provide information which will indicate over time the relative status of each eel stock. Research funded by the Ministry of Fisheries over the past six years (Martin et al. 2007, 2008) is establishing a times series of reliable data on the relative abundance of elvers at selected locations. This study (EEL2006/01) is a continuation of the previous research and will add to the existing dataset and move towards a reliable long-term record of elver recruitment.

During the 2006–07 and 2007–08 seasons, detailed information regarding the fishing effort, catch, and species composition of the elvers captured was collected at two North Island sites (Karapiro Dam on the Waikato River and Matahina Dam on the Rangitaiki River) and at two South Island sites (Arnold Dam on the Arnold River and Waitaki Dam on the Waitaki River) by

NIWA contracted and trained staff (Figure 1). In addition, seasonal catch records were obtained from the operators of up to nine other North Island sites (Wilson's Dam<sup>2</sup> on the Waiwarawara Stream, Morrinsville<sup>2</sup> water supply dam on the Topehaehae Stream, Wairere Falls Power Station on the Mokau River, Patea Dam on the Patea River, Piripaua Power Station in the Wairoa River catchment, Mangorei Power Station on the Waiwakaiho River, and Motukawa Power Station in the Waitara River catchment), as well as from the Mararoa Weir (Waiau River) and Waihopai Dam<sup>2</sup> (Waihopai River) in the lower South Island (Figure 1).

## **2. METHODS**

### **2.1 Data collection and reporting**

Standardised monitoring protocols and recording forms were developed by NIWA in 2001–02 (Martin et al. 2008), and supplied to the Karapiro, Matahina, Piripaua, Patea, Arnold, and Waitaki Dam operators. These protocols formed the basis of monitoring undertaken during the 2006–07 and 2007–08 seasons.

At the start of each season, permit holders and operators from the above sites, and NIWA personnel not familiar with the procedures, were given training in the data collection and recording methods and, where necessary, provided with monitoring equipment. This included the following.

- Monitoring instructions and waterproof recording sheets.
- Buckets, sieves, sorting trays, tweezers, dip nets, mesh bags for sorting juvenile eels, plastic bags, pottles, labels, etc.
- Balances (20 kg  $\pm$  20 g, and 2 kg  $\pm$  0.1 g), magnifying lenses, lighting, calculator.
- Clove oil (anaesthetic) to facilitate elver identification or where this could not be done on site, access to a freezer.

The information requested 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 subsamples (weight and number) preferably obtained at a minimum of 15-day intervals, or where species composition could not be done by the operator, preserved samples of about 100 elvers.
- Average weight of a sample of longfin and shortfin elvers obtained as often as possible.

Rainfall information for each site was obtained from either the NIWA National Climate Database (<http://clidb.niwa.co.nz/>) or from the power stations' records. Water temperatures were monitored using a HOBO water temp pro<sup>®</sup> temperature logger provided by NIWA at the start of the season. The loggers were deployed in the tailraces or in the downstream river adjacent to the elver traps, and recorded water temperature at 60 minute intervals. The records were then used to calculate average daily temperatures. At some sites, rainfall data were obtained from NIWA or from station records.

Estimates of the total weight and numbers of elvers, the average elver weights, and species composition of the catches were made from subsamples taken during the monitoring periods. Results were calculated using the methods described by Martin et al. (2007). For days where the average weight of the elvers was not measured, the closest available record was used. The catch results for each location are expressed as total catch and average daily catch. Average

---

<sup>2</sup> No data was received for this site in 2007–08.

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 cleared.

Timing of the elver migration was established using total catch records (i.e., including dead elvers). However, when total catch data were not available, the number of elvers transferred was used. From these data, the time to 50% and 95% of the total cumulative catch was calculated for the total elver catch, and for the estimated shortfin and longfin elver catch (when species composition information was available). Comparison with historical migration timing records were made, but it is important to note that the dates of the start and end of monitoring as well as methodology may have differed between years and between sites.

Details of the sites monitored (Figure 1) and procedures in place at each location have previously been described by Martin et al. (2007, 2008) and any changes or additions are included below.

### **Waitaki Dam**

The floating trap used for the 2005–06 and 2006–07 seasons was replaced with an elver brush ramp fixed to the tailrace wall by Meridian Energy in 2007–08. This ramp is connected to a new holding tank located on the penstock platform. The auxillary trap was retained in the same position as in previous seasons but the oil interceptor trap was removed before the 2007–08 season. The oil interceptor trap captured few elvers, although a small number were observed there during past site visits. Elvers continued to accumulate in small numbers in this area during the 2007–08 season.

### **Waihopai Dam**

The Waihopai concrete arch dam rises 33 metres above the riverbed to create head for the power station which was built in 1925–27 to supply electricity to the Marlborough region. The dam is about 55 km inland and is currently operated by TrustPower. An elver trap was installed at the site in 2005, before the start of the 2005–06 migration season. Twice a year, on behalf of TrustPower, Golder Kingett Mitchell staff electric fish a suite of sites upstream and downstream of the dam to assess the eel and elver populations in the river. During these visits night time observation of elvers climbing into the trap and attempting to climb over the dam slipway are also made (Golder Kingett Mitchell 2007).

## **3. RESULTS**

### **3.1 North Island main sites**

#### **Karapiro Dam**

During the last two elver seasons, the lift and stoplog traps at Karapiro Dam were operated between 1 December 2006 and 24 April 2007 (145 days), and 1 December 2007 and 31 March 2008 (122 days). The traps were usually cleared every 2–3 days in early December, but from mid December until the end of March the traps were mostly checked and cleared daily.

Trapping and transfer operations at this site are regulated by a Ministry of Fisheries permit held by Eel Enhancement Company (EECo). Permitted transfer limits are as follows: 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.

Throughout the 2006–07 and 2007–08 monitoring seasons, species composition and average elver weight for both species was obtained by EECo every time a transfer was made.

#### **2006–2007**

The species composition and average elver weights from Karapiro Dam were determined on 27 occasions in 2006–07 (Figure 2). Longfin elvers constituted 13.8% of the total number of elvers captured (Table 1). Although no individual elver weights were measured, based on the

total weight and number of elvers examined during the season, the average weight of shortfin and longfin elvers was estimated at 0.87 g ( $n = 2660$ ) and 1.66 g ( $n = 371$ ), respectively.

Over the season about 1.3 million elvers (1234 kg) were captured and transferred to reservoirs upstream of the Karapiro Dam (Table 1). In addition, 143.7 kg of juvenile eels (at least 260 eels) were also captured. The lift trap captured 78% of the total catch (Figure 2). There was no mortality recorded for the entire season. We estimate that 178 900 longfins (298 kg) and 1.1 million shortfins (944 kg) were captured (Table 1). The largest total daily catch of elvers (41.1 kg) was made on 18 February 2007 (Figure 2). The greatest daily catch of juvenile eels (8.2 kg) was made on 10 January 2007. The average daily elver catch showed two distinct peaks, due to increases in the number of shortfins in early January and mid February. The number of longfins peaked in early February (Figure 2).

Water temperature was recorded at the base of Karapiro Dam, adjacent to the lift trap. The average daily temperature ranged from 16.0 to 22.2 °C (Figure 2). As in previous seasons, elver catches tended to increase when temperature rose in early summer, and declined when temperatures fell in late summer (Figure 2).

Transfers of the catch from the Waikato hydro-electric reservoirs were undertaken every 3–7 days throughout the season. As in previous seasons, most of the catch was transferred into Lake Karapiro (31% by weight), Lake Arapuni (22% by weight), and Lake Ohakuri (23% by weight) (Table 2).

The bycatch recorded by EECO included: 380 shrimps, 23 common bullies and 5 smelt.

## **2007–2008**

During the 2007–08 season the species composition and average weight of elvers captured at Karapiro Dam was determined on 37 occasions (Figure 3). Longfin elvers constituted 26% of the total number of elvers captured (Table 1). Although no individual elver weights were measured, based on the total weight and number of elvers examined during the seasons, the average weight of shortfin and longfin elvers was estimated at 0.86 g ( $n = 3076$ ) and 1.56 g ( $n = 966$ ), respectively.

Over the season about 2 728 000 elvers (2830 kg) and 285 kg of juvenile eels were captured at the Karapiro Dam (Table 1). Although the lift trap was not fully operational until 1 December 2007, 11.74 kg of elvers were removed from the stoplog trap on 30 November. During the season, the lift trap captured 80% of the total catch (Figure 3). On 16 January 2008 about 10 kg of dead elvers were recorded in the lift trap. This mortality was attributed to a sudden increase in catch during a period of elevated water temperature.

We estimate that about 701 000 longfins (1088 kg) and 2 027 000 shortfins (1754 kg) were captured up to 31 March 2008 (see Table 1). The largest total daily catch of elvers (85 kg) occurred on 7 December 2007 (Figure 3). The greatest daily catch of juvenile eels (9.4 kg) was made on 8 December 2007.

The daily elver catch varied throughout the season (Figure 3). There were peak catches of both shortfins and longfins in early December, and again in early January (Figure 3). The longfin catch ended rather suddenly in early February, but the shortfin catch decreased only in mid February, and continued at a low level until the end of March (Figure 3).

The average daily water temperature throughout the season ranged from 19.0 to 23.2 °C (Figure 3). The average daily elver catches increased when temperature rose in early summer, and declined when temperatures fell in late summer (Figure 3). The average daily water temperature was 18.5 °C when the logger was deployed on 23 November 2007, and elvers were already present in the stoplog trap.



The bycatch recorded by EECO included: 5500 shrimps, 4200 common bullies, 440 koaro, and 1750 smelt/inanga<sup>3</sup>.

Transfers to the Waikato hydro-electric reservoirs were undertaken every 3–7 days throughout the season. An estimated 2 718 000 elvers (2830 kg) and 285 kg of juvenile eels were transferred from Karapiro Dam to upstream locations during the season (Table 2). Lake Karapiro received 24% (672 kg) of the transferred elvers, and 18% (520 kg) were transferred to Lake Arapuni. Transfers to Lake Maraetai (446.5 kg) and Lake Atiamuri (268.6 kg) exceeded the permitted limits in the 2007–08 season (Table 2).

### **Matahina Dam**

Trap and transfer operations at Matahina Dam are operated by Mr Bill Kerrison of the Kokopu Charitable Trust Inc. under contract to TrustPower. NIWA staff examined subsamples of the catch for species composition analysis at regular intervals throughout the season.

#### **2006–2007**

Trap and transfer operations at the Matahina Dam were undertaken between 28 November 2006 and 17 March 2007 (110 days). Over that period, representative samples of about 100 elvers were obtained on 10 occasions (Figure 4). The mean weights of the elvers from the 10 subsamples were 1.06 g (n = 921) for shortfins and 1.68 g (n = 231) for longfins

About 485 000 elvers (644 kg) were captured and transferred to upstream habitats from the elver trap at Matahina Dam during the season (Table 3). The greatest single daily catch (54.1 kg) was recorded on 16 January 2007, and the migration also peaked around that time (Figure 4). The catch declined markedly in early February, but increased again to a second peak in late February. Few elvers were recorded in March, and the trap was closed on 17 March. We estimate that the catch consisted of 159 000 longfins (269 kg) and 326 000 shortfins (375 kg). The proportion of longfins in the catch increased in early January, and declined in late February (Figure 4).

The average daily temperature of the Rangitaiki River downstream of the Matahina Dam ranged from 15.5 to 18.7 °C (Figure 4). Elver catches were low in December, and increased in early January when the river temperature reached about 17 °C. Catches declined when temperatures fell in early March (Figure 4).

The entire catch was transferred to locations upstream and no mortalities were recorded. Most (92%, 449 000) elvers were transferred above the Aniwhenua Dam (Table 4).

In addition to elvers, about 3800 galaxiids, 88 bullies, 2 smelt, and an unknown number of shrimp were captured between late October and early January. These galaxiids included banded kokopu and koaro. A number of juvenile eels were also captured (21) and transferred upstream.

#### **2007–2008**

The elver trap was operational from 4 November 2007 until 22 February 2008 (111 days). The first catch was recorded on 8 November, when the trap was first checked. A representative sample of about 100 elvers was examined by NIWA staff on 11 occasions over the season (Figure 5). Based on the number of elvers, the proportion of longfins increased in mid December (47% longfins), mid January (58% and 60% longfins) and early February (19% longfins). The mean weights for the season were 1.13 g (n = 831) for shortfins and 1.70 g (n = 298) for longfins

---

<sup>3</sup> Inanga were incorrectly identified as smelt on some occasions.

The total catch for the 2007–08 season was about 3 378 000 elvers (4211 kg), which was transferred to upstream habitats (see Table 3). The greatest single daily catch (324.9 kg) was recorded on 6 January 2008, and the migration also peaked around that time (Figure 5). The catch declined markedly in early February and trapping ceased in late February. We estimate that the catch consisted of about 928 500 longfins (1508 kg) and 2 450 000 shortfins (2703 kg). The proportion of longfins in the catch increased markedly in early to mid January, and declined in late February (Figure 5).

The average daily temperature of the Rangitaiki River downstream of the Matahina Dam ranged from 15.7 to 22.1 °C (Figure 5). Elver catches were higher than usual for December, but increased in early January 2008 when the river temperature reached about 18.5 °C, and very large catches occurred, which were sustained through to late January. Catches declined when temperatures fell to about 18 °C in mid February (Figure 5).

The entire catch was transferred to locations upstream and no mortalities were recorded by the operator. Most of the catch (93%, 3 155 000 elvers) was transferred above the Aniwhenua Dam (Table 4).

In addition to elvers, about 2000 galaxiids, 11 bullies, and an unknown number of shrimp were captured between late October and early January. The galaxiids included banded kokopu and koaro. Seventy-seven juvenile eels were also captured and transferred upstream.

## **3.2 North Island Supplementary Sites**

### **Wilson's Dam**

#### **2006–2007**

A monthly summary of catches and transfers from the fish trap was supplied by the Whangarei District Council from March 2006 until 31 December 2006. During the period for which records were made available, 484 elvers were trapped and transferred upstream (Table 5, Figure 6).

#### **2007–2008**

No elver catch data for the 2007–08 season have been received from the operators of Wilson's Dam.

### **Morrinsville Dam**

#### **2006–2007**

The trap was operational from 1 October 2006 until 26 March 2007 (176 days). During that period 62 elvers, 8 juvenile eels, and 1 koura were captured and transferred upstream (Table 5, Figure 6). The trap was monitored at irregular intervals on 19 occasions, but no species identification was recorded.

#### **2007–2008**

Only nine elvers have been reported as being caught during the 2007–08 season by the operators (Kaimai Valley Services) of the Morrinsville Dam.

### **Wairere Falls Power Station**

Although there is now an elver pass at Wairere Falls Power Station, resource consents still require King Country Energy (KCE) to operate trap and transfer activities from the tailrace. For monitoring purposes the total catch from the trap (i.e., all species) was transferred into a bucket, weighed, and the percentage of shrimps (by weight) in the catch visually estimated by KCE staff. The total catch was then transferred upstream of the dam.

## **2006–2007**

King Country Energy staff trapped and transferred elvers at the Wairere Falls Power Station from 1 November 2006 to 28 March 2007 (143 days). Only four frozen subsamples of the catch were made available throughout the season (Figure 7). The mean weight of the elvers from the four subsamples was 0.67 g (n = 173) for shortfins and 0.71 g (n = 57) for longfins.

The total catch for the season was 193.9 kg (294 000 elvers) (Table 6). Based on the samples, obtained we estimate that the total catch consisted of 175.1 kg (269 000) of shortfins, and 18.8 kg (25 000) of longfins.

Few elvers were caught in November and December, but the catch increased markedly in early January (Figure 7). The largest catch was on 11 January (9.5 kg), but this was for three days. The greatest average daily catch (7.8 kg) was recorded on 16 January. The catch slowly declined through February and March (Figure 7). There was no indication that rainfall influenced the average daily catch. Few elvers were caught until the average daily tailrace water temperature exceeded about 17 °C.

In addition to elvers, about 25 kg of shrimps were also captured. No other fish were recorded.

## **2007–2008**

King Country Energy staff recorded their first catch for the season on 14 November 2007, and trapping ceased on 3 April 2008 (142 days). Eight subsamples of the catch were examined during the 2007–08 season. Two were examined on site (24 December 2007, 5 January 2008) and six were frozen and analysed at the conclusion of the season (Figure 8). The mean weights from the eight subsamples were 0.73 g (n = 344) for shortfins and 0.79 g (n = 131) for longfins.

The total catch was 145.9 kg (204 000 elvers) (Table 6). Based on samples available we estimate that the total catch consisted of about 101 kg (147 000) of shortfins and 45 kg (57 000) of longfins. Few elvers were caught in November and December, but the catch increased through January to peak in late January (Figure 8). The largest average daily catch was on 29 January (9.2 kg). The catch declined through February and March (Figure 8).

Although the tailrace temperature exceeded 20 °C in late November and December 2007, few elvers were captured during these two months (Figure 8). Catches declined in mid February when the tailrace temperature was still about 21 °C (Figure 8). There was no obvious relationships between rainfall and elver catch during the season. About 6 kg of shrimps were also captured through the season.

## **Piripaua Power Station**

### **2006–2007**

Operation of the Piripaua Power Station tailrace trap was from 1 December 2006 to 27 March 2007 and the first transfer of elvers was made on 8 December. The species composition and average elver weights were analysed on four occasions by NIWA staff during the season (Figure 9). The mean weight of the elvers from the four subsamples examined was 1.13 g (n = 404) for shortfins and 1.75 g (n = 33) for longfins

A total of 4.9 kg (4180 elvers) and 10 juvenile eels (over 20 g) were collected from the trap (Table 7). Few elvers were captured in December, but numbers increased in early January (Figure 9). Shortfins dominated the catch (91% by number, or 3832 elvers). Longfins were captured mostly from early February (Figure 9).

Peak catches did not appear to be related to rainfall events. Unfortunately, the temperature logger was not installed until mid January, a few days before the migration peak, so it is not

possible to determine if downstream water temperature influenced the start of the migration at this site (Figure 9).

The entire catch was transferred to the Lake Whakamarino catchment and the Kahuitangaroa<sup>4</sup> Stream above the Tuai Power Station.

In addition to elvers, nine koaro were captured and transferred upstream.

## **2007–2008**

The elver trap at Piripaua Power Station was operated and monitored from 26 November 2007 to 16 March 2008 (112 days). Shortfins dominated the five elver samples examined during the season (Table 7). The mean weight of the elvers from the five samples examined was 1.26 g (n = 272) for shortfins and 3.19 g (n = 75) for longfins. This average longfin weight is much larger than in the previous three seasons, but similar to the 2002–03 and 2003–04 values.

We estimate that about 8.5 kg (5736 elvers) and 150 juvenile eels (over 10 g) were captured (Table 7), with most of the catch obtained in January and February (Figure 10). Based on the assessed species composition, we estimate that about 4558 shortfin elvers and 1020 longfin elvers were successfully transferred to the upstream catchment during the season. This is the highest proportion of longfins (18.3%) recorded since records began in 1996. All of the catch was transferred to the Lake Whakamarino catchment.

The number of elvers trapped was low in December, but increased to a peak in mid January 2008 (Figure 10). As in 2006–07, increases in the daily catch did not appear to correspond to rain events. The start and end of the migration occurred at an average daily river temperature of about 15–16 °C, with a marked decline in catch at the start of the season coinciding with a fall in water temperature.

## **Patea Dam**

### **2006–2007**

The elver catch at Patea Dam was monitored from 3 November 2006 to 31 March 2007 (148 days), but no elvers were captured until 6 December. The trap was cleared on at least 109 occasions, every 2–4 days at the start and end of the season, and daily from mid December to early March. The trap was overloaded in late March on seven days (24–26 and 28–31 January, and based on comments by TrustPower staff, we estimate that of 1 kg of elvers died or were lost from the trap on each occasion.

Eight subsamples of the catch were frozen and analysed by NIWA at the conclusion of the 2006–07 season. TrustPower staff weighed each sample before freezing, and this weight was then compared to the weight of the thawed elvers when analysed. There was a significant loss of weight for frozen elvers, and a factor of 1.42 was used to estimate the live weights of longfin and shortfin elvers from the frozen samples (Appendix 1). Catch results from 2005–06 were also revised using the same factor (Table 8).

Overall, 433.4 kg (896 000) elvers were estimated to have been captured at Patea Dam in 2006–07 (Table 8). Few elvers were captured until the average daily temperature exceeded about 17 °C. The peak catch occurred when the average daily water temperature was about 21 °C, but at the maximum (about 24 °C), the daily catch had declined. There were several migration peaks through the season, with the largest daily catch (10.5 kg) occurring on 23 January (Figure 11). The number of elvers declined in early February, but then increased again, peaked towards the end of February, and then fell to very low levels in early March.

---

<sup>4</sup> Referred to as Kahutangaroa Stream on NZMS260 maps.

Thereafter, variable catches were obtained until the end of March when trapping ceased (Figure 11). The entire elver catch was transferred directly above the Patea Dam to Lake Rotorangi.

In addition to elvers, 254 whitebait and other indigenous fish species<sup>5</sup> plus over 490<sup>6</sup> shrimp were captured in the trap and transferred with the elvers to Lake Rotorangi. The fish were mostly captured in December and January, and the shrimp in February and March.

Shortfins dominated the catch (94% by number or 843 000 elvers), although the proportion of longfins increased in early and mid February. The mean weight of the elvers (corrected for weight loss on freezing) was 0.48 g (n = 475) for shortfins and 0.61 g (n = 36) for longfins.

Few longfins were recorded in December and January, but at the end of January and in February the percentage of longfins increased markedly. By early March the proportion of longfins in the catch had declined to early season values (Figure 11).

Excluding the 7 kg of elvers lost in January, we estimate that about 880 000 elvers were transferred to Lake Rotorangi in the 2006–07 season.

### **2007–2008**

The Patea Dam elver trap was monitored from 1 December to 29 March 2007 (120 days), although no elvers were captured until 8 December. The trap was cleared on at least 87 occasions, every 2–4 days at the start and end of the season, and daily from mid December to early March.

Five samples of elvers were frozen and examined by NIWA at the conclusion of the 2007–08 season. Two samples of elvers were also counted and weighed by Taranaki Regional Council (TRC) staff. Using the average elver weight obtained by TRC and that of the frozen sample, a factor for weight loss through freezing was obtained. This factor (Appendix 1) was similar to the value obtained in 2006–07, so for consistency the same value (1.42) was used in 2007–08.

Based on the records available we estimated that 441.3 kg (857 000) elvers were captured at Patea Dam in 2007–08 (Table 8). Average daily catches increased markedly through December, with a large peak catch (11.2 kg) occurring on 18 December (Figure 12). Catches declined from mid January 2008, but small catches continued to the end of the season (Figure 12).

Elver catches increased at the start of the season when the average daily river temperature was about 17 °C. However, at the end of the season, although the average daily river temperature stayed above 20 °C throughout March, elver catches declined. There were several migration peaks through the season, with the largest daily catch (12.1 kg) occurring on 10 January, much earlier than in the 2006–07 season (Figure 12). The entire elver catch was transferred directly above the Patea Dam to Lake Rotorangi.

In addition to elvers, 125 whitebait and other indigenous fish species<sup>7</sup> as well as over 1300<sup>8</sup> shrimp were captured in the trap, and transferred with the elvers to Lake Rotorangi. The fish were mostly captured in December and January, and the shrimp throughout the season.

Shortfins dominated the catch (88%, 759 000 elvers), but the proportion of longfins in the catch did increase slightly in mid January (Figure 12).

---

<sup>5</sup> Whitebait/native species includes koaro, banded kokopu, inanga, koura, smelt, and torrentfish.

<sup>6</sup> Most of the shrimps were separated from the elvers and returned to the tailrace this season.

<sup>7</sup> Whitebait/native species includes koaro, banded kokopu, inanga, koura, smelt, and torrentfish.

<sup>8</sup> Most of the shrimps were separated from the elvers and returned to the tailrace this season.

## **Mangorei**

### **2006–2007**

Monitoring of the elver catch at Mangorei Power Station began on 19 October 2006, but no elvers were recorded until 3 January 2007 (Figure 13). The trap was cleared on 18 occasions, and operation ceased on 26 April 2007 (189 days). As in previous seasons, no subsamples were analysed or retained for species composition or elver weights, and water temperature was not recorded. However, of the total number of elvers transferred was estimated using data provided by Taranaki Regional Council (TRC) from one sample analysed in January 2003, which showed there were 1200 elvers/kg. The total catch was recorded as 20 kg of elvers, and hence we estimate that it would be equivalent to about 24 000 elvers (Table 9). All captured elvers were transferred to the Waiwhakaiho River upstream of the power station.

### **2007–2008**

Monitoring of the elver catch at Mangorei Power Station began on 25 November 2007, but the first catch was recorded on 13 December 2007 (Figure 13). The trap was cleared on 27 occasions throughout the season, and operations ceased on 26 March 2008. One sample of 177 elvers was collected on 23 February, frozen, and examined by NIWA staff at the end of the season. The sample contained 43% longfin elvers. The average elver weight was 0.75g<sup>9</sup>, similar to the sample analysed by TRC staff in January 2003 (0.83 g). The total catch was 25.2 kg of elvers, equivalent to about 33 000 elvers (Table 9). The location of the transfer was not specified by Trustpower, but as in past years it is likely that the entire catch was transferred to the Waiwhakaiho River upstream of the power station.

## **Motukawa**

### **2006–2007**

No starting date was provided with the records we received for the Motukawa Dam elver trap, and we have assumed the starting date to be 1 December 2006, with the first recorded catch on 19 January 2007. The trap was operated until 14 March and cleared on 11 occasions (Figure 13). As for Mangorei, there are no water temperature records or species composition. The total number of elvers transferred was estimated using data provided by TrustPower from one sample analysed in January 2006 (925 elvers/kg). The total catch was recorded as 23.2 kg, which would equate to about 21 000 elvers (Table 9). Although the exact locations of the transfers were not recorded, all of the catch was probably transferred to the Manganui River and its tributaries above the Motukawa Dam.

### **2007–2008**

Again no starting date was provided for the Motukawa Dam elver trap for the 2007–08 season, and we have assumed the starting date to be 1 December 2007, with the first recorded catch on 13 December 2007. The trap was operated until 25 March and cleared on 31 occasions (Figure 13). There were no water temperature records or samples of the catch collected by the operators. We have based an estimate of the total number of elvers transferred on data provided by TrustPower from one sample analysed in January 2006 (925 elvers/kg). The total catch was recorded as 48.6 kg, which would equate to about 45 000 elvers (Table 9). Although the exact locations of the transfers were not recorded, all of the catch was probably transferred to the Manganui River and its tributaries above the Motukawa Dam.

---

<sup>9</sup> Adjusted for weight loss following freezing and thawing by applying factor of 1.42. see Appendix 1 for details.

### **3.3 South Island main sites**

#### **Arnold Dam**

##### **2006–2007**

The trap at Arnold Dam was operated from 12 December 2006 to 29 March 2007 (108 days). Inspections of the trap were made at up to four-day intervals, and the trap was cleared on 66 occasions. In the 2006–07 season, about 107 100 elvers (162.2 kg) were captured (Table 10). The single largest catch (68.3 kg) was obtained on 21 February, which accounted for 42% of the total season's catch (Figure 14). On that occasion, a visit from NIWA staff found the water supply to the trap had failed and a large quantity of elvers had congregated at the base of the ramp. They were captured with a hand net and included as part of the catch (Figure 14). In addition to elvers, 4.7 kg of juvenile eels were caught and transferred. Some mortality occurred in the trap due to water failure on 21 February (8 kg).

Samples of the catch (c. 100 elvers) were examined by NIWA staff on 11 occasions during the season (Figure 14). Based on these analyses, we estimate that about 52 000 longfin elvers and 55 000 shortfin elvers were captured during the season. Excluding the dead elvers, about 49 000 longfin elvers and 53 000 shortfin elvers were transferred to the Arnold River above the dam. Based on the total weight and number of elvers examined, the average weight of shortfin and longfin elvers are estimated to be 1.01 g ( $n = 859$ ) and 1.93 g ( $n = 452$ ), respectively.

##### **2007–2008**

The elver trap at Arnold Dam began operating on 16 December 2007, and continued until 14 March 2008 (88 days). Inspection and clearing of the trap was mostly undertaken at 2–4 day intervals, and the trap was cleared on 53 occasions.

Samples of the catch (about 100 elvers) were examined by NIWA staff on 13 occasions during the season (Figure 15). Based on the total weight and number of elvers examined, the average weight of shortfin and longfin elvers are estimated to be 1.08 g ( $n = 656$ ) and 1.92 g ( $n = 563$ ), respectively.

Based on these analyses, we estimate that 78 400 longfin elvers and 108 000 shortfin elvers were captured during the season. The total elver catch for the season was 266.9 kg (186 000 elvers) (Table 10). The catch included elvers from behind the dam wingwall (87.9 kg), and the weir pond (7.3 kg), which were checked and cleared weekly in January and February (Figure 15). In addition to elvers, 31 kg of juvenile eels were caught and transferred. Some mortality occurred in the trap (2 kg) on eight occasions in January and February. The cause of the mortality is unknown. Excluding the dead elvers, about 78 000 longfin elvers and 107 000 shortfin elvers were transferred to the Arnold River immediately above the dam.

Elvers were captured the first night the trap was operated in December 2007. Water temperature at the time was about 19 °C. Both the start and end of the migration appear to be temperature related (Figure 15). The peak catches were made in early–mid January and declined through February (Figure 15). The single largest catch (30.2 kg) was obtained on 11 January (Figure 15). The proportion of longfin elvers increased in early January, declined in mid January, and increased again to a peak of 83% in mid February (Figure 15).

#### **Waitaki Dam**

##### **2006–2007**

Operation of the elver traps at the Waitaki Dam began on 9 December 2006, but no elvers were captured until 26 December. Trapping continued until 20 April 2007 (133 days of operation). During most of the season, the trap was checked at 1–3 day intervals, but towards

the end the trap was checked only every 4–7 days. A site visit by NIWA staff on 7 February found that water to the spillway ramp that attracts elvers to the auxillary trap was turned off. Furthermore, although elvers were present in the oil interceptor well, they were unable or unwilling to access the ramp to the trap.

During the season, either the entire catch or a subsample was examined by the contractor undertaking the transfer on behalf of Meridian Energy to determine species composition and the average elver weight captured. Individual elver weights of the entire catch were measured on 30 occasions. On a further 34 occasions the average elver weight was calculated from the total weight of catch divided by the number of elvers in the catch. There were no shortfins identified during the season, and we assume that the entire catch was longfins. Based on the combined data, the average weight of longfin elvers captured at Waitaki Dam was 4.96 g ( $n = 1967$ ).

The total catch for the season was 16.3 kg (3252 elvers) (Table 11). The auxillary trap captured 56% of the total catch, the floating trap 43%, and the oil interceptor trap only a few elvers (1%). A very small number of elvers were caught in December and January, but catches increased in February (Figure 16). The largest daily catch (1.9 kg) occurred on 28 February, but the catch then declined markedly with very few elvers caught in March and April (Figure 16).

A small proportion of the captured elvers (0.6%) were transferred to Lake Waitaki, with most (95%) transferred to Lake Benmore and headwater streams. The transfer locations of the remainder of the catch were not recorded.

## **2007–2008**

In 2007–08 trapping of elvers at Waitaki Dam began on 17 December 2007 and ended on 15 March 2008 (89 days). During most of the season, the trap was checked at 1–3 day intervals, but towards the end of the season in mid March the trap was checked only every 4–7 days. Although a temperature logger was provided to the operator it was not deployed, and no record of the water temperature was obtained.

During the season, either the entire catch or a subsample of the catch was examined by the Meridian contractor employed for the monitoring. Individual elver weights of the entire catch were measured on 23 occasions. Based on the combined data, the average weight of longfin elvers captured at Waitaki Dam was 6.74 g ( $n = 1725$ ).

Although there were no shortfin elvers identified by the operators during the season, a sample of 36 elvers was collected at the end of the season and examined by NIWA. Twelve shortfin elvers were identified in this sample. A few shortfin elvers were reported as present during the 2003–04 season, but none since. Consequently, we have no confidence in species composition that has been reported from Waitaki Dam.

The total elver catch for the 2007–08 season was 377.7 kg (57 500 elvers) (Table 11). The new tail-race trap captured about 98% of the catch. There was a large variability of elver sizes, and based on the individual elver weights measured by the operator during the season, we estimate that 7.2% of the catch (4140) could be considered ‘true’ elvers (i.e., less than 2 g). In addition to these elvers, 65.5 kg of juvenile eels were also captured.

Few elvers were caught in December, but catches increased in January (Figure 16). The largest daily catch (24.1 kg) occurred on 13 January, after which daily catches then declined towards the end of the month (Figure 16). In February, catches increased slightly until the middle of the month then declined until the end of the season (Figure 16). Less than 1% of the captured elvers were transferred to Lake Waitaki, with the remainder transferred to Lake Benmore and headwater streams.



### **3.4 South Island supplementary sites**

#### **Mararoa Weir**

##### **2006–2007**

The elver trap at the Mararoa Weir was operational for three days in late November, but only eight elvers were captured. Trapping was discontinued until late December, when a further 11 elvers were caught, and trapping ceased until mid January (Figure 17). There were two further short periods of trapping during the season, one in mid January and the other in mid February (17 days).

The average length and weight of the elvers were determined by weighing and measuring the length of 20 elvers on 16 occasions. The weight was recorded to the nearest 1 g. The mean elver weight was 3.0 g (range 2.3–4.0 g), and the average length was 126.5 mm (range 112.7–230.5 mm). The subsample used to measure the weights and lengths of elvers was also examined for longfin and shortfin elvers. Although one shortfin was identified on 26 January, we have assumed that the entire catch consisted of longfins.

We estimate that 353 kg (118 000) of longfin elvers were captured through the season (Table 12). The maximum daily catch was 80 kg, on 16 February (Figure 17). The elvers were transferred to Lake Manapouri, Lake Te Anau, and the Mararoa River. Transfer locations for a small number of elvers were not recorded (Table 12).

##### **2007–2008**

The elver trap at the Mararoa Weir was operated on four occasions for several days at a time in 2007–08 (Figure 17). Trapping began in mid December 2007 for 7 days and was operational for a total of 30 days during the season.

The average length and weight of the elvers were determined by weighing and measuring the length of 20 elvers on 30 occasions. The mean elver weight was estimated by dividing the total weight of a sample by the number of elvers in the sample (about 100). The mean elver weight was 2.3 g (range 3.44–1.55 g), and the average length was 124.2 mm (range 139–110 mm). The subsample used to measure the weights and lengths of elvers was also examined for longfin and shortfin elvers. No shortfins were recorded by the operators.

The total catch was 341.7 kg (134 000 longfin elvers) for the 2007–08 season (Table 12). The maximum daily catch was 74.3 kg, on 6 February (Figure 17). The elvers were transferred to Home Creek and the Mararoa River. Transfer locations for a small number of elvers were not recorded (Table 12).

#### **Waihopai Dam**

##### **2006–2007**

The trap was first checked on 6 December 2006 and the first elver was recorded on 28 December. Throughout the season the trap was monitored at about weekly intervals, except in early February 2007, when the trap was not checked for 17 days (Figure 18).

Samples of the catch (10 elvers) were examined by the operators on seven occasions during the season (Figure 18). The sample size used for species composition analysis is well below our recommended sample size of 100 elvers (Martin et al. 2007), and is unlikely to be an accurate representation of the species composition of the catch. Based on the total weight and number of elvers examined, the average weight of shortfin and longfin elvers are estimated to be 0.83 g ( $n = 47$ ) and 1.42 g ( $n = 30$ ), respectively. An estimated 12.9 kg (12 700 elvers), consisting of about 8500 longfin elvers and 4200 shortfin elvers were captured during the season (Table 13).

The catch peaked in late February, when the maximum catch was made (3.7 kg). In addition to elvers, 108 koaro were captured. The catch was transferred to the Waihopai River, upstream of the dam.

## **2007–2008**

No records have been received for the 2007–08 season.

## **4. DISCUSSION**

### **4.1 Timing of migration**

At most of the monitored sites historical catch records are available for the entire migration period, so the dates at which 50% of the elver catch was taken gives an indication of the relative change in the timing of the start of the elver migrations over time at these sites. Similarly, the dates by which 95% of the catch is obtained may give a measure of the length of the migration season.

In the 2006–07 season, 50% of the total catches were obtained by late January to early February at most North Island sites (Figure 19). For many of these sites, and notably for Karapiro, this was an unusually late start to the season (Figures 20–24). For the Arnold and Waitaki dams in the South Island, 50% of the total catch was obtained slightly later, in mid to late February (see Tables 10 and 11).

Although the onset of migration was delayed compared to previous seasons for most sites, significant catches were made into the end of March at Karapiro, Matahina, Patea, Arnold, and Waitaki (see Figure 19).

For shortfins, 50% of the total catch was obtained by the end of January at Matahina, Wairere, Piripaua, and Patea (see Tables 3, 6, 7, 8). At Karapiro, 50% of shortfins were obtained only by mid February, the latest ever recorded (Figure 20). Similarly, for the Arnold Dam, the time when 50% of the shortfin catch was obtained was also the latest of the three season's records available (see Figure 21).

At Karapiro and Matahina, 50% of the longfin elver catch was achieved in late January (see Figures 20, 22), later than most seasons. At the Wairere, Piripaua, Patea, and Waitaki sites, 50% of the longfins were caught by early to mid February (see Tables 6, 7, 8, 11). This level of harvest was achieved at Arnold in late February, also later than in the previous two seasons (see Figure 21).

In contrast to the 2006–07 season, elver migrations at the four main sites in the 2007–08 season started earlier than usual, and in some cases first catches were made as soon as the traps began to operate. For most of the sites, 50% of the shortfin elvers were obtained by mid January (see Figure 25).

At most sites, longfin migration occurred later than that of shortfins, mostly by mid-late January 2008 (see Figure 25). However, in contrast to other years, the migration of longfins was early in 2007–08 (see Figures 20–24). Migration of shortfins and longfins occurred later in the South Island compared to the North Island (see Figure 25).

Durations of elver migration at most sites were about 2.5–3 months, though in 2007–08 due to the early start, 95% of the catches were obtained by mid–late February (see Figure 25). At Matahina, 95% of the catch was obtained on 3 February, earlier than most previous seasons, except 2003–04 (see Figure 22).

## Conclusions – timing of migration

- Migration in 2006–07 generally began later than expected at the monitored sites, but continued into March 2007 at some sites.
- In 2007–08 migration began earlier than expected at most sites, but had mostly ceased by mid–late February.
- The migration occurs later at South Island sites compared to the North Island for shortfin and longfin elvers.
- The longfin migration is of shorter duration than the shortfin migration.
- Durations of elver migrations at most sites were about 2.5–3 months.

## 4.2 Temperature

The upstream migration of elvers occurs at a relatively low speed compared to other migratory fishes, such as salmon or trout, which swim upstream to spawn (Tesch 2003). Relationships between migration and environmental factors are difficult to establish, due to possible interactions among a variety of factors that affect the migration (White & Knights 1997). The migratory activity of elvers at or above the tidal limit in England has been found to be largely dependent on water temperature. Other weak influences include rate of temperature change, and the level of glass eel recruitment in previous years (White & Knights 1997, Tesch 2003). In England, the threshold temperature for the start of migration has been found to be 14–16 °C, with maximum activity at 18–20 °C (White & Knights 1997).

For the 2006–07 season, we have water temperature records from six sites (Karapiro, Matahina, Wairere, Piripaua, Patea, and Arnold). At Matahina and Piripaua, temperature was not recorded at the beginning of the season, but at the other four sites, no elvers were captured until the average daily temperature exceeded about 17 °C. At the end of the season, catches ceased at four sites when the average daily temperature declined below about 18 °C (Table 14).

Temperature records were obtained from six sites (Karapiro, Matahina, Wairere, Piripaua, Patea, and Arnold) for the 2007–08 season. At Karapiro and Piripaua elvers began to be captured before the water temperature loggers were deployed, so the temperature which triggered the migration at these sites is not known. At the remaining four sites, elver captures began when average daily tailrace or river temperature reached 18.5–19.5 °C, and also ceased in a similar range (Table 14). Therefore, for both 2006–07 and 2007–08 seasons, the threshold temperatures for start and finish of elver migration is about 17–19 °C and similar to that found in Europe by White & Knights (1997).

In comparison to the 2005–06 season, the average daily temperature in December 2006 and January 2007 for Karapiro was relatively low, but after that, temperatures remained high for longer (Figure 26). The elver migration peak recorded at this site in January corresponded to a sharp increase in the average daily tailrace temperature and it was during the extended period of high water temperature that the second migration peak was recorded (see Figure 2).

At Matahina, the peak catch for 2006–07 occurred in mid to late January, when the average daily water temperature was approaching the maximum for the season (see Figure 4). Similarly, the peak catches at Wairere and Arnold occurred when the average daily temperatures were at or close to the maximum for the season (see Figures 7 and 14). Therefore, as in Europe, peaks in water temperature generally correspond to peak elver activity.

The average daily water temperatures at Karapiro, Matahina, and Arnold were higher in December 2007 than in most previous seasons. At Karapiro, the maximum average daily

tailrace temperature was the second highest since 2002 (Figure 26). At Matahina and Arnold, the maximum average daily water temperature was the highest recorded. Peaks in the average daily catches at Karapiro and Matahina usually corresponded to a sharp increase in water temperature (see Figures 3 and 5). At Matahina a second migration peak corresponded to the maximum average daily river temperature (see Figure 5). No comparison of catches and water temperature can be made for the Arnold Dam as elver catches there are confounded by the accumulation of elvers behind the dam wingwall.

### **Conclusions – temperature**

- For both the 2006–07 and 2007–08 seasons, the threshold temperatures for start and finish of elver migration was about 17–18 °C.
- Maximum activity occurs near or at the maximum average daily water temperature.
- Sharp increases in water temperature may result in migration pulses at some sites.

### **4.3 Total catch**

During the 2006–07 season, we estimate that 3107 kg (3.3 million elvers) were captured from all the monitored sites. The catch consisted of 2.6 million shortfin (1966 kg) and 584 000 longfin elvers (1067 kg) (Table 15).

The total catch recorded during the 2007–08 season (8709 kg and about 7.6 million elvers) was considerably greater than in 2006–07. The catch consisted of 5.3 million shortfin (5069 kg) and 2.1 million longfin elvers (3566 kg) (Table 15). The largest catch of both shortfins and longfins was recorded at Karapiro (Table 15). The total catch was over twice that of the previous season, and the largest total catch ever recorded. Large increases occurred at Matahina, Karapiro, Arnold, and Waitaki (Table 16).

The North Island sites contributed 98% of the number of shortfins and 69% of the total number of longfins captured in 2006–07. In the 2007–08 season 98% of shortfins and 87% of longfins captured were from North Island sites (see Table 15). In 2006–07 the largest number of both shortfins and longfins were captured at Karapiro, but in 2007–08 the greatest catches of both species were made at Matahina (see Table 15).

### **Conclusions – total catch**

- The 2006–07 total catch was lower than in the previous five seasons.
- The 2007–08 total catches at Karapiro and Matahina were the largest recorded.

### **4.4 Recruitment trends**

Capture and monitoring procedures have remained consistent at both Karapiro and Matahina for a number of years so annual catch figures from these sites are reliable and comparable and provide the best records to discern trends in annual recruitment. Records from the other sites monitored are either too short, catches too low, or records too inaccurate to be used for trend analysis so are not discussed further.

Including the 2007–08 season, there are now 13 years of reliable records for Karapiro and 9 from Matahina (Table 17). We have long suspected that the 1997–98 species composition for Karapiro was probably not accurate. A review of the historical longfin catch patterns indicated that an increase in the number of longfin elvers probably did occur that season, but it was unlikely to be as large as previously reported by Martin et al. (2007). Based on the 1996–97 and 1998–99 longfin composition data we now estimate that the catch consisted of

1529.5 kg (1 529 500) of shortfin elvers and 1019.7 kg (509 850) of longfin elvers. Details of the calculations are included in Appendix 2.

Overall the records show large variations in the total catch as well as in the number of shortfins and longfins captured (Tables 17, 18, and 19). Despite the exceptionally large recruitment of longfins noted for the 2007–08 season at Karapiro and Matahina, there appears to be no significant long-term trend to longfin recruitment at both Karapiro and Matahina since the 1995–96 season (Figure 27). However, since about 2000–01, annual recruitment of longfin elvers, although variable, has tended to increase (Figure 27). Shortfin catches at Karapiro show a trend of increasing recruitment since 1995–96 (Figure 27). At Matahina, although shortfin recruitment appeared to be in decline since 2002–03, the 2007–08 catches have reversed the trend (Figure 27).

## **Conclusions – recruitment trends**

- Total catches show large annual variations at most of the monitored sites.
- Although the size of the 2007–08 catch is notable, there appears to be no significant long-term trend for longfin recruitment at Karapiro and Matahina since the 1995–96 season.
- Recruitment of longfin elvers, although variable, has tended to increase at Karapiro and Matahina since 2000–01.
- Shortfin catches at Karapiro show a trend of increasing recruitment since 1995–96.
- At Matahina, although shortfin recruitment appeared to be in decline since 2002–03, the 2007–08 catches have reversed the trend.

## **5. SUMMARY**

Monitoring of the elver catches at sites where trap and transfer operations are undertaken has shown that the timing and magnitude of shortfin and longfin elver migrations can be variable. Martin et al. (2008) suggested that low water temperatures early in the migration season (i.e., November to mid December) delay the start of migration, and reduce the magnitude of the migration. Following a cold season, migration may begin early and be relatively large, due to the accumulation of elvers that had not migrated in the previous season.

The elver catch data for 2006–07 and 2007–08 showed a similar pattern. Migration began relatively late in 2006–07, when early season water temperatures were relatively low. The total catch for the 2006–07 season was similar to that in previous years. In 2007–08 at both Karapiro and Matahina, migration began early, with significant numbers of elvers captured on the first day of trapping. At both sites in 2007–08 catches of shortfin and longfin elvers were the largest ever recorded.

Although the 2007–08 catches at Karapiro and Matahina indicate an exceptionally large recruitment of longfins, there appears to be no long-term trend since records began in the 1995–96 season. Since about 2000–01, annual recruitment of longfin elvers, although variable, has tended to increase at Matahina. Shortfin catches at Karapiro show a trend of increasing recruitment since 1995–96. At Matahina, although shortfin recruitment appeared to be in decline since 2002–03, the 2007–08 catches have reversed the trend.

Because of the variability and subsequent unpredictability of the timing of the elver migration, monitoring should continue to be undertaken continuously from at least 1 December through to at least 15 March at the four main sites (Karapiro and Matahina in the North Island, Waitaki and Arnold Dam in the South Island).

Although reliable records have been obtained from a number of sites in the North Island, a variety of problems (e.g., inconsistent fishing effort, unreliable species identification) have occurred at the three South Island sites rendering the records virtually worthless for examining long-term elver recruitment trends.

Site visits were made to supplementary sites to provide advice and give training, but collating and analysing data from some of these sites has once again proven difficult and time consuming, and some of the data is of little value for predicting recruitment trends. We recommend that until a shift of attitude occurs, collection of records from supplementary sites should be discontinued and resources concentrated on obtaining accurate and reliable records at the two main North Island (Karapiro and Matahina) and the two main South Island (Waitaki and Arnold) sites. Future projects should continue to include objectives to train operators to achieve an acceptable standard. Inclusion of compulsory standards of reporting in resource consents may prove a useful tool to encourage operators to comply with monitoring and reporting standards.

## **6. ACKNOWLEDGMENTS**

Compilation of the elver transfer operations being undertaken nationwide would not have been possible without the assistance of numerous people from a wide variety of public and private organisations. We are also grateful to the many iwi, hapū, and runanga members who gave their support and blessing to ensure the study could be undertaken.

Particular thanks are due to the following individuals for assistance and support: Mike Holmes and John Jeffcote (EECo) and Mighty River Power for the Waikato/Karapiro records; Bill Kerrison (Kokopu Charitable Trust Inc.) and TrustPower for the Rangitaiki/Matahina records; TrustPower for records from Patea and other Taranaki stations; Margaret Tipuna and Genesis Power Limited for the Waikaretaheke/Piripaua records; Des Sweeney and TrustPower for the Arnold Dam records; John Currie and Meridian Energy for the Waitaki records; and George Ryan and Meridian Energy for the Mararoa Weir records. Other organisations/individuals provided information from other sites.

We acknowledge the assistance of the many NIWA staff members who participated in the study, in particular Mike O'Driscoll for diligently supervising the trapping operations at the Arnold Dam and Mike Beentjes who reviewed the manuscript.

This work was carried out by NIWA under contract to the Ministry of Fisheries (Project: EEL2006/01).

## 7. REFERENCES

- Beentjes, M.P.; Chisnall, B.L.; Boubée, J.A.T.; Jellyman, D.J. (1997). Enhancement of the New Zealand eel fishery by elver transfers. *New Zealand Fisheries Technical Report No. 45*. 44 p.
- Boubée, J.A.T.; Williams, E.K. (2006). Downstream passage of silver eels at a small hydroelectric facility. *Fisheries Management and Ecology* 13: 165–176.
- Golder Kingett Mitchell (2007). Elver trap and transfer monitoring. *Locally Speaking* 2: 3.
- Hoyle, S.D.; Jellyman, D.J. (2002). Longfin eels need reserves: modelling the effects of commercial harvest on stocks of New Zealand eels. *Marine and Freshwater Research* 53: 887–895.
- Jellyman, D.J.; Chisnall, B.L.; Sykes, J.R.E.; Bonnett, M.L. (2002). Variability in spatial and temporal abundance of glass eels (*Anguilla* spp.) in New Zealand waterways. *New Zealand Journal of Marine and Freshwater Research* 36: 511–517.
- Knights, B.; White, E.M. (1998). Enhancing immigration and recruitment of eels: the use of passes and associated trapping systems. *Fisheries Management and Ecology* 5: 459–471.
- Martin, M.L.; Boubée, J.A.T.; Bowman, E.J.; Griffin, D. (2008). Recruitment of freshwater eels: 2004–2005 and 2005–2006. *New Zealand Fisheries Assessment Report 2008/16*. 97 p.
- Martin, M.L.; Boubée, J.A.T.; Williams, E.; Bowman, E.J. (2007). Recruitment of freshwater eels: 2002–2003 and 2003–2004. *New Zealand Fisheries Assessment Report 2007/38*. 108 p.
- MFish (2008). Freshwater eels. Fisheries Assessment Plenary, pp 243–255. Ministry of Fisheries, Wellington. <http://fpcs.fish.govt.nz/science/Plenary.aspx> accessed 25/7/08.
- Sloane, R.D. (1984). Upstream migration by young pigmented freshwater eels (*Anguilla australis australis* Richardson) in Tasmania. *Australian Journal of Marine and Freshwater Research* 35: 61–73.
- Tesch, F.W. (1977). The Eel – biology and management of anguillid eels. Chapman and Hall, London. 434 p.
- Tesch, F.W. (2003). Post larval ecology and behaviour. *In: The eel*. Thorpe, J.E. (ed.) pp 119–212. Blackwell Science Ltd and The Fisheries Society of the British Isles, Oxford. 408 p.
- Watene, E.M.; Boubée, J.A.T. (2005). Selective opening of hydroelectric dam spillway gates for downstream migrant eels in New Zealand. *Fisheries Management and Ecology* 12: 69–75.
- White, E.M.; Knights, B. (1997). Environmental factors affecting migration of the European eel in the Rivers Severn and Avon, England. *Journal of Fish Biology* 50(5): 1104–1116.

**Table 1:**

**Estimated total number of elvers (in 1000s) captured at Karapiro Dam for 1995–96 to 2007–08 seasons. Date when 50 and 95% of total catch was made is also shown. Note that the total includes dead elvers (LF, longfin elvers; SF, shortfin elvers).**

Total elvers caught	95–96 <sup>1</sup>	96–97	97–98 <sup>2</sup>	98–99	99–00	00–01	01–02	02–03	03–04	04–05	05–06	06–07	07–08	Total
50% of total catch	1 155	1 220	2 039	1 097	892	782	1 596	1 942	2 131	1 333	2 177	1 296	2 728	<b>20 388</b>
95% of total catch	20–22 Jan	26–Jan	6–Jan	14–Jan	29 Jan–3 Feb	14–Jan	28–Jan	19–Jan	21–Jan	5–Feb	1–Feb	9–Feb	17–Jan	
	1–5 Mar	6–Mar	26–Feb	10–Mar	5–10 Mar	28–Feb	25–Feb	9–Mar	27–Feb	22–Mar	24–Feb	14–Mar	25–Feb	
Estimated total SF caught	822	974	1 529	756	798	627	1 351	1 766	1 931	1 201	1 695	1 117	2 027	<b>16 594</b>
50% of total catch	25–Jan	27–Jan	9–Jan	19–Jan	3–8 Feb	11–Jan	26–Jan	21–Jan	21–Jan	6–Feb	5–Feb	12–Feb	20–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	23–Mar	27–Feb	15–Mar	29–Feb	
Estimated total LF caught	333	246	510	341	94	155	245	176	200	132	482	179	701	<b>3 794</b>
50% of total catch	13–15 Jan	22–Jan	4–Jan	11–Jan	7–11 Jan	14–Jan	28–Jan	7–Jan	25–Jan	3–Feb	20–Jan	31–Jan	11–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	24–Feb	5–Feb	18–Feb	4–Feb	
% LF	29	20	25	31	11	20	15	9	9	10	22	14	26	<b>19</b>

<sup>1</sup> Transferred elvers only as total catch data not recorded.

<sup>2</sup> 1997–98 data revised – see Appendix 3 for details.



**Table 2: Estimated total weight and number of elvers transferred from the Karapiro Dam traps to the Waikato hydro-electric lake reservoirs in the 2006–07 and 2007–08 seasons.**

	Reservoir	Estimated weight (kg)			Estimated number			Percentage based on kg		
		Longfin	Shortfin	Total	Longfin	Shortfin	Total	Longfin	Shortfin	Total
<b>2006-07</b>	Karapiro	78.7	308.9	387.6	48 179	379 897	428 076	27	33	31
	Arapuni	68.4	199.7	268.0	42 915	243 926	286 842	24	21	22
	Waipapa	24.9	57.4	82.3	12 592	57 873	70 465	9	6	7
	Maraetai	24.4	36.7	61.1	16 288	38 005	54 293	8	4	5
	Whakamaru	26.7	40.7	67.4	16 362	45 919	62 280	9	4	5
	Atiamuri	7.1	70.9	78.0	4 365	78 562	82 926	2	8	6
	Ohakuri	59.2	230.6	289.8	38 201	272 810	311 011	20	24	23
	<b>Total</b>	<b>289.2</b>	<b>944.9</b>	<b>1 234.1</b>	<b>178 901</b>	<b>1 116 992</b>	<b>1 295 893</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>
<b>2007-08</b>	Karapiro	167.8	504.0	671.9	105 699	610 615	716 314	15	29	24
	Arapuni	213.6	306.6	520.2	130 543	337 143	467 686	20	18	18
	Waipapa	39.9	17.8	57.7	25 112	15 980	41 093	4	1	2
	Maraetai	204.2	242.3	446.5	139 593	289 270	428 863	19	14	16
	Whakamaru	171.4	268.4	439.8	104 248	297 063	401 311	16	15	16
	Atiamuri	111.7	156.9	268.6	69 612	174 654	244 266	10	9	9
	Ohakuri	176.1	251.3	427.3	123 432	295 198	418 631	16	14	15
	<b>Total</b>	<b>1 084.7</b>	<b>1 747.3</b>	<b>2 832.0</b>	<b>698 240</b>	<b>2 019 923</b>	<b>2 718 164</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>

**Table 3:** Estimated total number of elvers (in 1000s) captured at Matahina Dam for 1996–97 to 2007–08 seasons. The date when 50 and 95% of the total catch was made is also shown. Years with accurate records for most of the season are in *italics* (–, no records available; LF, longfin; SF, shortfin).

Total caught 50% of total catch 95% of total catch	96–97 <sup>1</sup>	97–98 <sup>2</sup>	98–99 <sup>3</sup>	99–00 <sup>3</sup>	00–01 <sup>3</sup>	01–02	02–03	03–04	04–05	05–06	06–07	07–08	Total
elvers													
	14	615	1 002	2 001	2 054	619	1 484	945	1 117	1 193	485	3 379	<b>14 908</b>
	7–10 Feb	30-Jan	–	–	–	8-Jan	10-Jan	19-Dec	3-Feb	28-Jan	30-Jan	11-Jan	
	10–13 Mar	23-Feb	–	–	–	16-Feb	19-Feb	28-Jan	24-Feb	19-Feb	1-Mar	7-Feb	
Estimated SF caught	10	478	–	–	–	592	1 360	881	1 102	965	326	2 450	<b>8 164</b>
50% of total catch	12–16 Feb	23-Feb	–	–	–	8-Jan	10-Jan	19-Dec	3-Feb	28-Jan	4-Feb	11-Jan	
95% of total catch	10–13 Mar	26-Feb	–	–	–	16-Feb	19-Feb	28-Jan	24-Feb	19-Feb	1-Mar	7-Feb	
Estimated LF caught	4	136	–	–	–	27	124	64	15	228	159	928	<b>1 685</b>
50% of total catch	3–7 Feb	5-Jan	–	–	–	24-Dec	12-Jan	20-Dec	29-Jan	27-Jan	23-Jan	12-Jan	
95% of total catch	28 Feb–3 Mar	13-Feb	–	–	–	6-Feb	13-Feb	5-Jan	17-Feb	15-Feb	22-Feb	3-Feb	
% LF	29	22	–	–	–	4	8	7	1	19	33	27	<b>11</b>

<sup>1</sup> Boubée et al. (1997) reported 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.

<sup>2</sup> A further 107 kg of elvers and eels were reported transferred to Lake Aniwhenua (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.

<sup>3</sup> Kokopu Charitable Trust Inc. reported catching 2001 kg of elvers in 1999–00 and 2045 kg in 2001 (Bill Kerrison, Murupara, pers. comm.). Estimated number shown is based on an average weight of 1 g. It is possible that the catch includes some juvenile eels.

**Table 4:** Estimated total weight and number of elvers transferred from Matahina Dam elver trap to the upper Rangitaiki catchment during the 2006–07 and 2007–08 seasons.

Location	Estimated weight transferred kg			Estimated number transferred		
	Longfin	Shortfin	Total	Longfin	Shortfin	Total
<b>2006-07</b>						
<b>Lake Matahina:</b>						
Lake Matahina	5.1	36.7	41.7	3 251	33 179	36 430
<b>Lake Aniwhenua:</b>						
Aniwhenua at Dam	107.2	135.8	242.9	62 917	115 476	178 393
Upper Rangitaiki	47.6	36.3	83.8	27 652	32 903	60 555
River	108.9	165.3	274.2	65 655	142 649	208 304
Kopuriki	0.0	0.3	0.3	0	331	331
Waihua	0.0	1.2	1.2	0	1 391	1 391
Mangapapa						
<b>Total</b>	<b>268.7</b>	<b>375.4</b>	<b>644.2</b>	<b>159 475</b>	<b>325 929</b>	<b>485 404</b>
<b>2007-08</b>						
<b>Lake Matahina</b>						
Lake Matahina	57.0	209.8	266.8	36 619	186 760	223 379
<b>Lake Aniwhenua:</b>						
Aniwhenua at Dam	331.0	392.6	723.5	184 239	354 494	538 734
Upper Rangitaiki	343.1	673.5	1 016.7	219 860	606 495	826 355
River	390.5	649.1	1 039.6	238 013	600 672	838 685
Kopuriki	368.2	721.1	1 089.3	236 270	646 319	882 589
Whirinaki	14.81	44.99	59.8	11 615	44 798	56 413
Pokereiti	0.55	2.20	2.8	330	1 792	2 122
Waihua	2.55	10.24	12.8	1 533	8 335	9 868
Mangamako						
<b>Total</b>	<b>1 507.7</b>	<b>2 703.5</b>	<b>4 211.1</b>	<b>928 479</b>	<b>2 449 666</b>	<b>3 378 144</b>

**Table 5: Total number of elvers captured and transferred from Wilson's Dam and Morrinsville Dam during the 2006–07 season.**

		2004–05	2005–06	2006–07	2007–08	Total
<b>Wilson's Dam</b>	Monitoring period	28/2/05–31/8/2005	1/9/05–28/2/06	1/10/06–31/12/06		
	Total elvers caught	26	528	484	No data	<b>1 038</b>
	50% of total catch		5-Dec			
	95% of total catch		6-Feb			
<b>Morrinsville Dam</b>	Monitoring period		29/11/05–27/3/06	5/10/06–26/3/07		
	Total elvers caught		427	62	No data	<b>489</b>
	50% of total catch		30-Jan	16-Feb		
	95% of total catch		2-Mar	4-Mar		

**Table 6:** Estimated total weight (kg) of elvers captured at Wairere Falls Power Station for 1999–2000 to 2007–08 seasons. The date when 50 and 95% of the total catch was made is also shown. Species composition information available for 2002–03 and 2004–05 to 2007–08 seasons. Years with accurate records for most of season are in *italics* (–; no species composition or elver weights available; LF, longfin elvers; SF, shortfin elvers).

	1999–00 <sup>1</sup>	2000–01	2001–02	2002–03	2003–04	2004–05	2005–06	2006–07	2007–08	Total
Monitoring period	20/12/99– 16/3/0	22/11/00– 22/3/01	8/12/01– 10/5/02	1/12/02– 19/4/03	2/1/03– 11/2/04	6/1/04– 22/3/05	14/11/05– 1/5/06	6/11/06– 28/3/07	14/11/07– 3/4/08	
Total elvers caught	181	208	141	169	241	119	214	194	146	<b>1 613</b>
50% of total catch	29-Jan	17-Jan	31-Jan	2-Feb	19-Jan	2-Feb	3-Jan	26-Jan	25-Jan	
95% of total catch	10-Mar	11-Mar	13-Mar	4-Mar	8-Feb	8-Mar	6-Feb	27-Feb	24-Feb	
Total SF caught	–	–	–	147	–	103	135	175	101	<b>661</b>
50% of total catch						2-Feb	28-Dec	25-Jan	25-Jan	
95% of total catch						8-Mar	7-Dec	22-Feb	24-Feb	
Total LF caught	–	–	–	22	–	13	28	19	45	<b>127</b>
50% of total catch						1-Feb	29-Jan	14-Feb	25-Jan	
95% of total catch						8-Mar	4-Feb	13-Mar	24-Feb	
% LF	–	–	–	13	–	11	17.2	9.7	31	<b>8</b>

<sup>1</sup> Total catch data supplied in litres and converted to kg using Weight = 0.33 + 0.91 litres (NIWA unpublished data).

Table 7:

Estimated total number (in 1000s) of elver catch at Piripaua Power Station for 1999–00 to 2007–08 seasons. The date when 50 and 95% of the total catch was made is also shown. Years with accurate records for the most of season are in italics (–; no species composition or elver weights available; LF, longfin elvers; SF, shortfin elvers).

	1996–97	1997–98 <sup>1</sup>	1998–99	1999–00	2000–01 <sup>2</sup>	2001–02	2002–03 <sup>3</sup>	2003–04 <sup>4</sup>	2004–05 <sup>5</sup>	2005–06	2006–07	2007–08	Total
Total elvers caught	2 100	7 339	3 141	2 577	5 964	4 084	10 185	4 886	8 127	2 760	4 180	5 736	<b>61 079</b>
50% of total catch	26-Feb	5-Feb	19-Jan	21–28 Jan	21–28 Jan	21-Jan	3-Feb	10-Jan	4-Feb	30-Jan	26-Jan	17-Jan	
95% of total catch	11-Mar	18-Mar	18-Mar	21–25 Feb	24-Feb	27-Mar	4-Mar	20-Feb	28-Feb	22-Feb	24-Feb	16-Feb	
Estimated total SF caught	2 100	–	2 732	2 529	5 432	3 656	10 001	4 685	7 669	2 613	3 832	4 685	<b>49 934</b>
50% of total catch	26-Feb		19-Jan	21–28 Jan	21–28 Jan	21-Jan				30-Jan	24-Jan	15-Jan	
95% of total catch	11-Mar		18-Mar	21–25 Feb	22-Feb	4-Apr				2-Mar	21-Feb	14-Feb	
Estimated total LF caught	0	–	409	48	224	428	184	201	458	147	348	1051	<b>3 498</b>
50% of total catch	–		19-Jan	14–21 Jan	19-Feb	14-Jan				3-Feb	7-Feb	21-Jan	
95% of total catch	–		7-Feb	21–28 Jan	7-Mar	8-Mar				7-Mar	7-Mar	2-Mar	
% LF	0	6	13	1.9	3.7	10.4	1.8	4.1	5.6	5.3	8.3	18.3	<b>6</b>

<sup>1</sup> Longfin proportion based on one subsample.

<sup>2</sup> Species composition information available for transferred catch only.

<sup>3</sup> Dates for shortfin and longfin elvers not included as only 3 subsamples analysed over entire season.

<sup>4</sup> Dates for shortfin and longfin elvers not included as traps were closed intermittently through the season.

<sup>5</sup> Dates for shortfin and longfin elvers not included as only 5 subsamples analysed over entire season.

**Table 8: Estimated total number (in 1000s) of elvers captured at Patea Dam for 1999–2000 to 2007–08 seasons. The date when 50 and 95% of the total catch was made is also shown. Years with accurate records for most of season are in italics (–; no species composition or elver weights available; LF, longfin elvers; SF, shortfin elvers).**

	1999–00	2000–01	2001–02	2002–03	2003–04	2004–05	2005–06 <sup>1</sup>	2006–07 <sup>1,2</sup>	2007–08 <sup>3</sup>	Total
Total elvers caught	461	495	754	380	391	450	562	896	857	<b>5 246</b>
50% of total catch	–	<i>9–11 Jan</i>	<i>22-Jan</i>	<i>23-Jan</i>	<i>19-Jan</i>	<i>3-Feb</i>	<i>2-Jan</i>	<i>27-Jan</i>	<i>11-Jan</i>	
95% of total catch	–	<i>27–30 Mar</i>	<i>8-Mar</i>	<i>10-Mar</i>	<i>12-Feb</i>	<i>21-Feb</i>	<i>21-Feb</i>	<i>19-Mar</i>	<i>18-Feb</i>	
Estimated total SF caught	–	–	707	372	390		475	843	759 <sup>4</sup>	<b>3 546</b>
50% of total catch			<i>22-Jan</i>	<i>23-Jan</i>	<i>19-Jan</i>		<i>4-Jan</i>	<i>26-Jan</i>	<i>11-Jan</i>	
95% of total catch			<i>8-Mar</i>	<i>10-Mar</i>	<i>12-Feb</i>		<i>24-Feb</i>	<i>19-Mar</i>	<i>18-Feb</i>	
Estimated total LF caught	–	–	48	8	<i>1</i>		87	53	98 <sup>4</sup>	<b>295</b>
50% of total catch			<i>14-Jan</i>	<i>23-Jan</i>	<i>25-Jan</i>		<i>25-Dec</i>	<i>15-Feb</i>	<i>11-Jan</i>	
95% of total catch			<i>25-Feb</i>	<i>10-Mar</i>	<i>25-Feb</i>		<i>30-Jan</i>	<i>18-Mar</i>	<i>18-Feb</i>	
% LF			6	2	0.3		15	6	11	<b>6</b>

<sup>1</sup> Number of elvers have been adjusted to allow for weight loss of frozen samples.

<sup>2</sup> Due to method used for assessing catch weight and shrimp content, the number of elvers maybe inaccurate.

<sup>3</sup> Based on 2 samples examined by Taranaki Regional Council staff of 1960 & 1470 elvers kg<sup>-1</sup>, on 12 February and 29 March 2008 respectively.

<sup>4</sup> Based on species composition from 6 frozen samples analysed by NIWA at end of season.

**Table 9: Estimated total number of elvers captured at Mangorei and Motukawa Dams for 2002–03 to 2007–08 seasons. Date to 50 and 95% of total catch is also shown.**

	2002–03	2003–04	2004–05	2005–06	2006–07	2007–08	Total
<b>Mangorei</b>							
Monitoring period	9/1/02–11/4/03	1/12/03–10/6/04	13/01/05–21/3/05	30/11/05–20/3/06	19/10/06–26/4/07	25/11/07–26/3/08	
Total elvers caught	18 000	19 600	9 800	20 208 <sup>1</sup>	24 000 <sup>1</sup>	33 000 <sup>3</sup>	<b>124 608</b>
50% of total catch	27-Jan	19-Jan	24-Jan	3-Feb	2-Feb	16-Jan	
95% of total catch	25-Mar	17-Feb	2-Mar	24-Feb	30-Mar	11-Mar	
<b>Motukawa</b>							
Monitoring period	1/12/02–22/2/03	15/11/03–19/2/04	1/12/04–30/4/05	8/12/05–17/2/06	1/12/06–20/4/07	13/12/07–25/3/08	
Total elvers caught	45 500	64 400	94 000	57 800 <sup>2</sup>	21 000 <sup>2</sup>	45 000 <sup>2</sup>	<b>327 700</b>
50% of total catch	13-Jan	24-Jan	11-Feb	5-Jan	29-Jan	16-Jan	
95% of total catch	22-Feb	13-Feb	16-Mar	7-Feb	23-Feb	3-Mar	
<b>Total</b>	<b>63 500</b>	<b>84 000</b>	<b>103 800</b>	<b>78 008</b>	<b>45 000</b>	<b>78 000</b>	<b>452 308</b>

<sup>1</sup> Based on 1 sample in 2003 1200 elvers/kg.

<sup>2</sup> Based on 1 sample in 2005 925 elvers/kg.

<sup>3</sup> Based on 1 sample 23 February 2008, average elver weight 0.75g (1330 elvers/kg).



**Table 10: Estimated total weight and numbers of elvers caught at Arnold Dam for the 2004–05 to 2007–08 seasons. Date to 50 and 95% of total catch also shown. All years have accurate records for most of season (LF, longfin; SF, shortfin).**

	2004–05	2005–06	2006–07	2007–08	Total
Total elvers caught	27 516	14 510	107 100	186 153	<b>335 279</b>
50% of total catch	10-Feb	26-Jan	21-Feb	24-Jan	
95% of total catch	18-Feb	10-Feb	12-Mar	17-Feb	
Estimated total SF caught	20 385	6 218	55 242	107 743	<b>189 588</b>
50% of total catch	10-Feb	2-Feb	21-Feb	20-Jan	
95% of total catch	18-Feb	10-Feb	16-Mar	8-Feb	
Estimated total LF caught	7 131	8 292	51 858	78 410	<b>145 691</b>
50% of total catch	10-Feb	3-Jan	21-Feb	31-Jan	
95% of total catch	18-Feb	7-Feb	7-Mar	21-Feb	
%LF	26	57	48	42	<b>43</b>

**Table 11: Estimated total number of elvers caught at Waitaki Dam for 1999–00 to the 2007–08 seasons. Date to 50 and 95% of total catch also shown. Years with accurate records for most of season are in italics (LF, longfin; SF, shortfin).**

	1999–00 <sup>1</sup>	2000–01	2001–02	2002–03 <sup>4</sup>	2003–04	2004–05	2005–06 <sup>5</sup>	2006–07	2007–08 <sup>6</sup>	Total
Total elvers caught	–	2 061 <sup>2</sup>	(65 kg <sup>3</sup> )	56	4 652	1 559	4 683	3 252	57 550	<b>73 813</b>
50% of total catch	–	30-Jan	–	3-Feb	31-Jan	14-Feb	31-Jan	14-Feb	17-Jan	
95% of total catch	–	5-Mar	–	13-Feb	27-Feb	3-Mar	18-Feb	18-Mar	15-Feb	
Estimated total SF caught	–	–	–	0	9	0	0	0	0	<b>9</b>
50% of total catch	–	–	–		6-Jan					
95% of total catch	–	–	–		7-Jan					
Estimated total LF caught	–	–	–	56	4 643	1 559	4 683	3 252	57 550	<b>71 743</b>
50% of total catch	–	–	–	3-Feb	31-Jan	14-Feb	31-Jan	14-Feb	17-Jan	
95% of total catch	–	–	–	13-Feb	27-Feb	3-Mar	18-Feb	18-Mar	15-Feb	
% LF				100	99.8	100	100	100	100	<b>&gt;99</b>

<sup>1</sup> Traps installed.

<sup>2</sup> Mostly juvenile eels (>20g).

<sup>3</sup> Catch was 65 kg, but full season records not available, and most of the catch was juvenile eels (>20 g).

<sup>4</sup> Traps altered, including change of substrate on ramps.

<sup>5</sup> An additional floating trap installed in tailrace.

<sup>6</sup> Floating trap replaced by fixed ramp in 2007–08. Mostly large elvers – 92.8% elvers were > 2g.

**Table 12: Estimated total weight, numbers of elvers caught, and transfers locations at Mararoa Weir during the 2006–07 and 2007–08 seasons.**

	2006–07		2007–08	
	kg	No.	kg	No.
Lake Manapouri	45.25	15 432		
Lake Te Anau	300.50	100 977		
Not recorded	1.25	410	14.00	7 413
Home Creek			6.00	3 409
Mararoa River	6.25	1 563	321.66	122 700
<b>Total</b>	<b>353.25</b>	<b>118 381</b>	<b>341.70</b>	<b>133 522</b>

**Table 13: Estimated total number of elvers caught at Waihopai Dam during the 2006–07 and 2007–08 seasons. Date to 50 and 95% of total catch also shown. Years with accurate records for most of season are in italics (LF, longfin; SF, shortfin).**

	2006–07	2007–08	Total
Monitoring period	6/12/06–20/4/07	No data	
Total elvers caught	12 712		<b>12 712</b>
50% of total catch	24-Feb		
95% of total catch	9-Mar		
Estimated total SF caught	4 264		<b>4 264</b>
50% of total catch	24-Feb		
95% of total catch	16-Mar		
Estimated total LF caught	8 448		<b>8 448</b>
50% of total catch	24-Feb		
95% of total catch	9-Mar		
%LF	66		66

**Table 14: Estimated average daily temperature when elver captures began and ceased at Karapiro, Matahina, Wairere, Piripaua and Arnold for the 2006–07 and 2007–08 seasons.**

		Catch starts		Catch ends	
		Date	°C	Date	°C
<b>2006–07</b>	Karapiro	3-Dec	17.4	24-Feb	17.1
	Matahina	1-Dec	no record	17-Mar	16.7
	Wairere	6-Nov	17.9	28-Mar	17.8
	Piripaua	8-Dec	no record	20-Mar	16.5
	Patea	24-Dec	17.4	After 31 Mar <sup>2</sup>	–
	Arnold	7-Jan	17.2	16-Mar	16.9
<b>2007–08</b>	Karapiro	2-Dec	19.5 <sup>1</sup>	17-Mar	21.8
	Matahina	28-Nov	18.0	14-Feb	18.0
	Wairere	31-Dec	19.4	7-Mar	19.4
	Piripaua	15-Dec	16.0 <sup>1</sup>	7-Mar	16.4
	Patea	9-Dec	18.2	28-Mar	20.7
	Arnold	5-Dec	19.5	28-Mar	19.0

<sup>1</sup> Elvers captured when logger deployed.

<sup>2</sup> Elvers active after 31 March.

**Table 15: Estimated elver catches at the monitored sites for the 2006–07 and 2007–08 seasons.**

Site	Shortfin elvers		Longfin elvers		Total	
	Number	Weight kg	Number	Weight kg	Number	Weight kg
<b>2006–07</b>						
Karapiro	1 116 992	944.9	178 901	298.2	1 295 893	1 243.1
Wairere Falls	269 108	175.1	25 135	18.8	294 243	193.9
Matahina	325 930	375.4	159 475	268.7	485 405	644.1
Piripaua	3 832	4.3	348	0.6	4 180	4.9
Patea	843 346	407.5	52 743	25.9	896 089	433.4
Wilson's	162		322		484	
Morrinsville					62	
Mangorei					24 000	20.0
Motukawa					21 000	23.2
Arnold	55 242	58.6	51 858	103.6	107 100	162.2
Waitaki			3 252	16.3	3 252	16.3
Waihopai	4 264	5.9	8 448	7.0	12 712	12.8
Mararoa Weir			118 381	353.3	118 381	353.3
<b>Total</b>	<b>2 618 876</b>	<b>1971.7</b>	<b>598 863</b>	<b>1092.3</b>	<b>3 262 801</b>	<b>3 107.2</b>
<b>2007–08</b>						
Karapiro	2 027 497	1 754.0	700 748	1 088.0	2 727 974	2 842.0
Wairere Falls	146 794	101.0	56 969	44.9	203 763	145.9
Matahina	2 449 666	2 703.5	928 479	1 507.7	3 378 144	4 211.2
Piripaua	4 685	5.7	1 051	2.9	5 736	8.5
Patea	758 917	391.2	98 034	50.1	856 951	441.3
Mangorei					32 751	25.2
Motukawa					44 954	48.6
Arnold	107 743	113.6	78 410	153.3	186 153	266.9
Waitaki			57 550	377.7	57 550	377.7
Mararoa Weir			133 522	341.7	133 522	341.7
<b>Total</b>	<b>5 495 302</b>	<b>5 069.0</b>	<b>2 054 763</b>	<b>3 566.3</b>	<b>7 627 498</b>	<b>8 709.0</b>

Table 16:

Summary of the estimated total number (1000s) of elvers captured each season at monitored sites. *Italicised regions are records we consider to be representative of the elver run and where control over the quality of the data has been maintained.*

<b>North Island</b>	Karapiro	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
	Lake Waikare											92	518	282
	Wairere Falls					19		18	46		>24	>32	>215	>39
	Matahina	20	21	23	6									
	Piripaua													
<b>South Island</b>	Patea													
	Waitaki													
	Roxburgh													
	Mararoa Weir													
	<b>Total</b>	<b>20</b>	<b>21</b>	<b>23</b>	<b>6</b>	<b>19</b>		<b>18</b>	<b>46</b>		<b>&gt;24</b>	<b>&gt;124</b>	<b>&gt;733</b>	<b>&gt;321</b>
<b>North Island</b>	Karapiro	95–96	96–97	97–98	98–99	99–00	00–01	01–02	02–03	03–04	04–05	05–06	06–07	07–08
	Lake Waikare	<i>1 155</i>	<i>1 220</i>	2040	<i>1 097</i>	892	782	<i>1 596</i>	<i>1 942</i>	<i>2 131</i>	<i>1 333</i>	<i>2 178</i>	<i>1 296</i>	<i>2 728</i>
	Wairere Falls		540						256	175				
	Matahina	>144	14	615	1 002	2 001	2 054	619	1 484	945	155	163	294.2	204
	Wilson's <sup>2</sup>										1 117	1 193	485.4	3 378
<b>South Island</b>	Morrinsville										<0.1	0.5	0.5	1.0
	Piripaua		2.1	7.3	3.1	2.6	6	4.1	10.2	4.9	8.1	2.8	4.2	0.5
	Patea				461		495	754	380	391	450	562	896	61
	Mangorei								18	19.6	10	20.2	24	57
	Motukawa								45.5	64.4	94	57.8	21	124
	Arnold Dam										27.5	14.5	107	328
	Waitaki						– <sup>1</sup>		<0.1	4.6	1.5	4.7	3.3	335
	Roxburgh		0.3	11	7.4			1	0.1	1.4				72
	Mararoa Weir				43.7	90	28		36	97.8	64.1	46	118	21
	Waihopai												12.7	657
<b>Totals</b>		<b>&gt;1 299</b>	<b>1 776</b>	<b>2 673</b>	<b>2 153</b>	<b>3 613</b>	<b>3 556</b>	<b>3 104</b>	<b>4 141</b>	<b>4 081</b>	<b>3 260</b>	<b>4 243</b>	<b>3 262</b>	<b>7 628</b>
														<b>&gt;46 548</b>

<sup>1</sup> 2061 elvers not included as they were mostly small eels.

Table 17:

Summary of estimated number (in 1000s) of shortfin elvers captured each season at monitored sites. *Italicised regions are records we consider to be representative of the elver run and where control over the quality of the data has been maintained.*

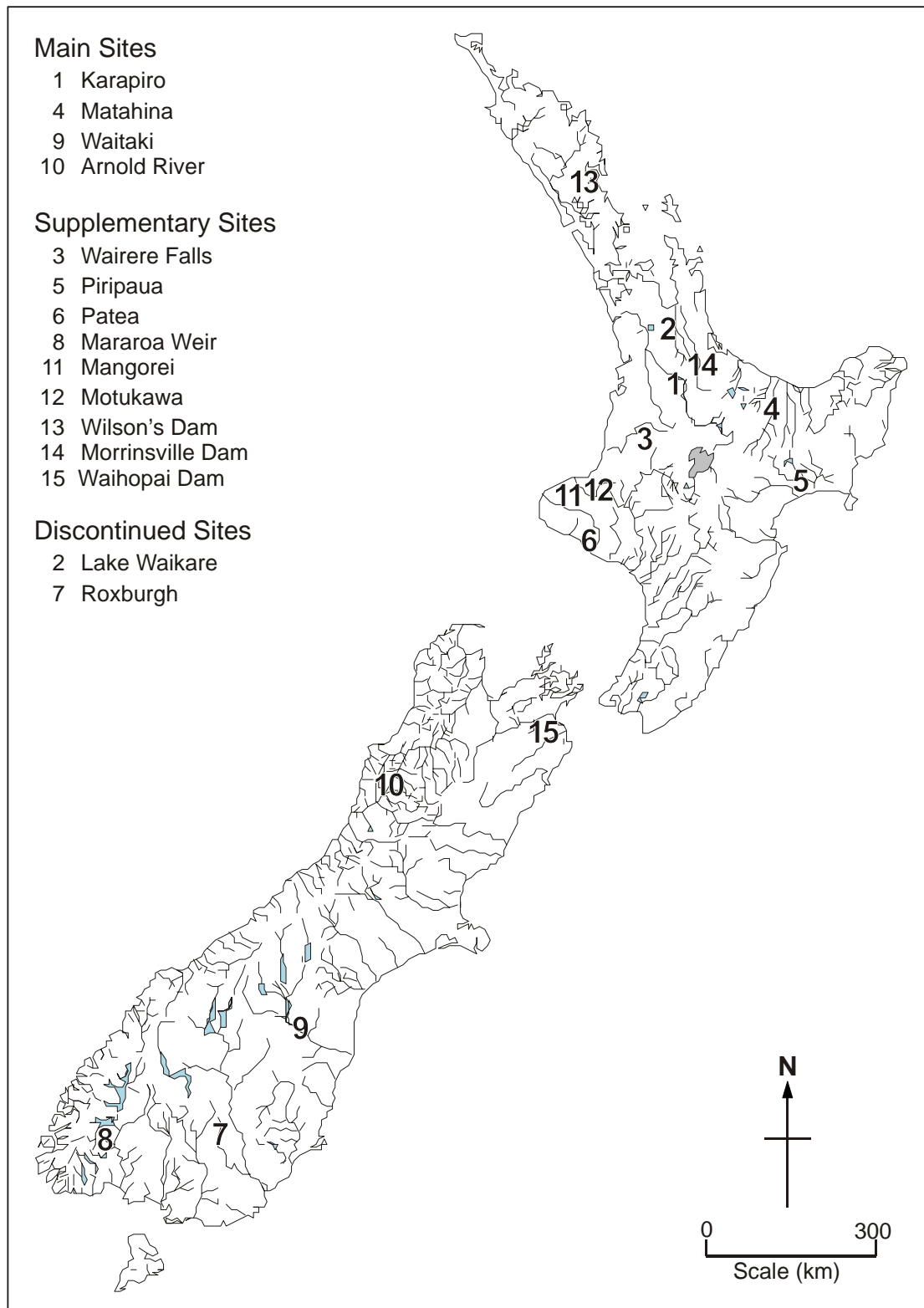
North Island	Karapiro																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
--------------	----------	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

**Table 18: Summary of estimated number (in 1000s) of longfin elvers captured each season at monitored sites. Italicised regions are records we consider to be representative of the elver run and where control over the quality of the data has been maintained.**

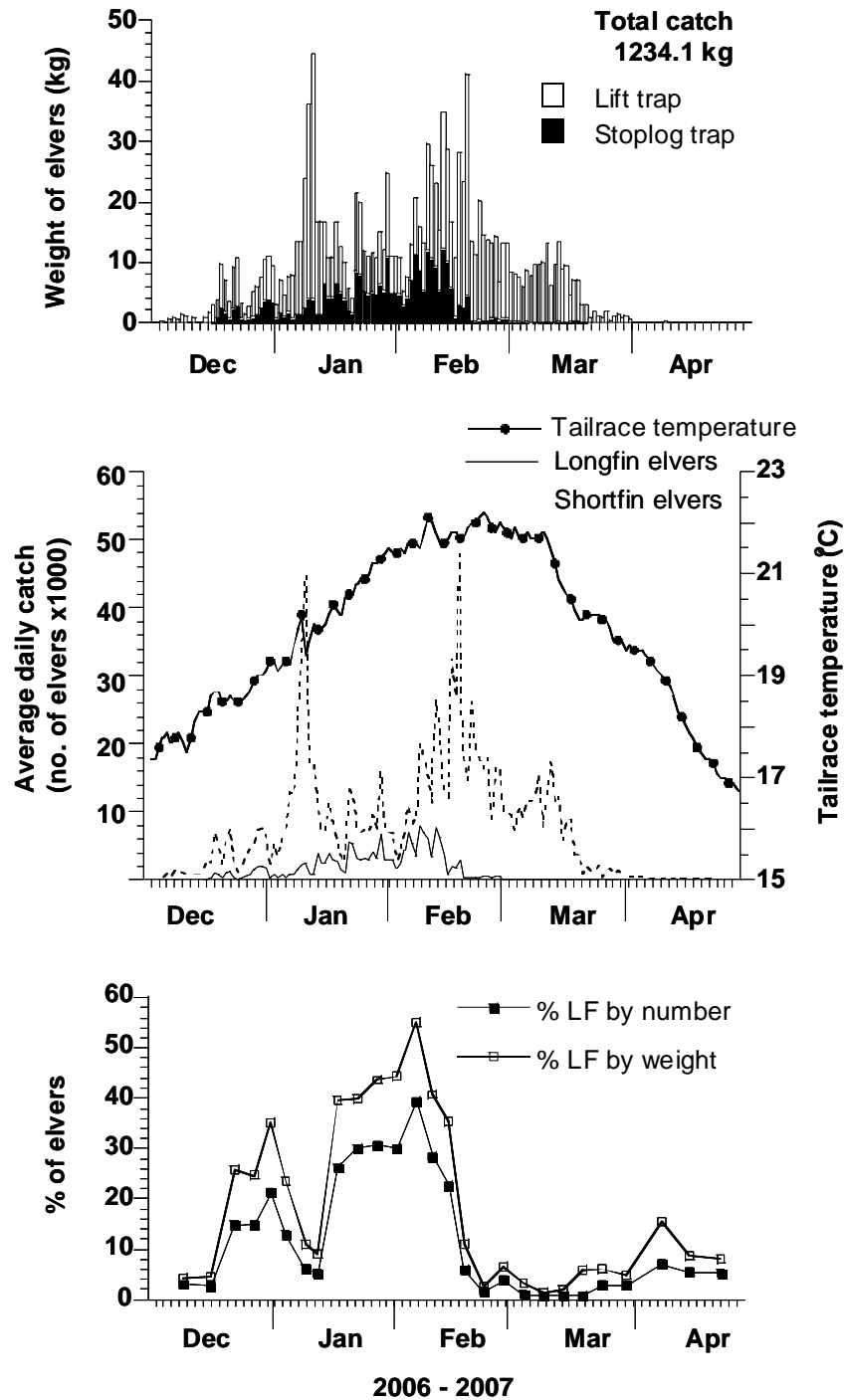
North Island	Karapiro											31	176	96	
	Lake Waikare														
	Wairere Falls														
	Matahina														
	Piripaua														
South Island	Patea														
	Arnold Dam														
	Waitaki														
	Roxburgh														
	Mararoa Weir														
	Total	0	10	5	1	11	0	2	0	0	7	33	176	96	
North Island	Karapiro	95–96	96–97	97–98	98–99	99–00	00–01	01–02	02–03	03–04	04–05	05–06	06–07	07–08	Total
	Lake Waikare	333	246	510	341	94	155	246	176	200	132	483	179	701	4 099
	Wairere Falls		431							2					>433
	Matahina		4	136			–	27	124	64	15.2	228	160	929	>1 724
	Piripaua		0	–	0.4	<0.1	0.2	0.4	0.2	0.2	0.5	0.15	0.35	1.1	>3.5
South Island	Patea						–	48	8	1	0.7	87	52.7	98	>295
	Arnold Dam														146
	Waitaki						– <sup>1</sup>		<0.1	4.6	1.5	4.7	3.3	57.6	72
	Roxburgh		0.3	11	7.4			1	0.1	1.4					21.2
	Mararoa Weir			42.6	90		28		36	97.8	64.1	46.1	118	133.5	656
	Waihopai												8.4		8.4
	Total	333	681	657	391	184	183	322	366	390	235	885	598	2,055	>7 622.3

<sup>1</sup> 2061 elvers not included as they were mostly small eels.





**Figure 1:** Location of the twelve current and two discontinued elver catch and transfer sites for the 2006–07 and 2007–08 elver migration seasons.



**Figure 2:** Karapiro Dam elver catch for the 2006–07 season (upper, total daily catch for each trap; middle, average daily catch of shortfin and longfin elvers and tailrace temperature; lower, estimated proportion of longfin elvers in catch. LF, longfin).

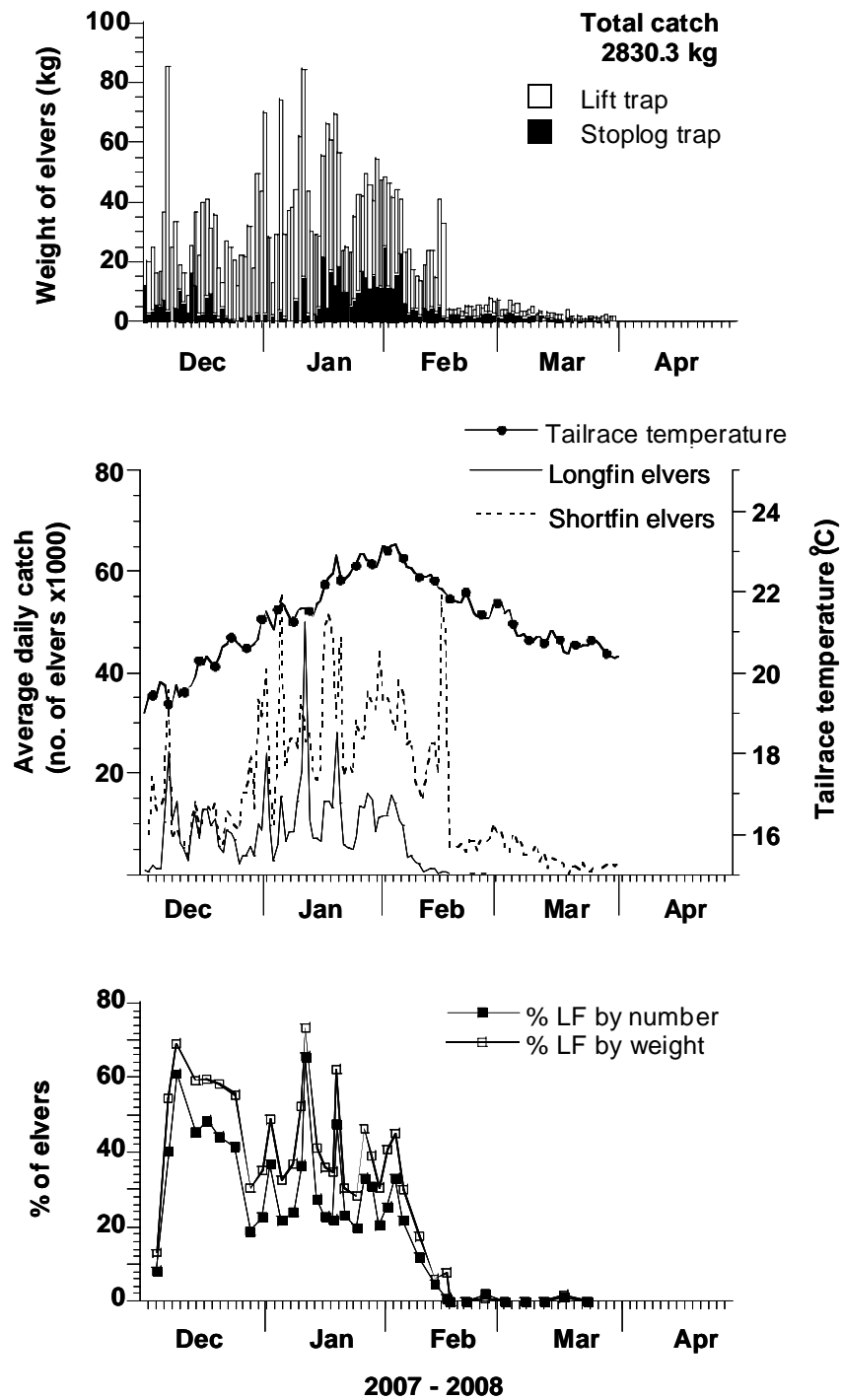
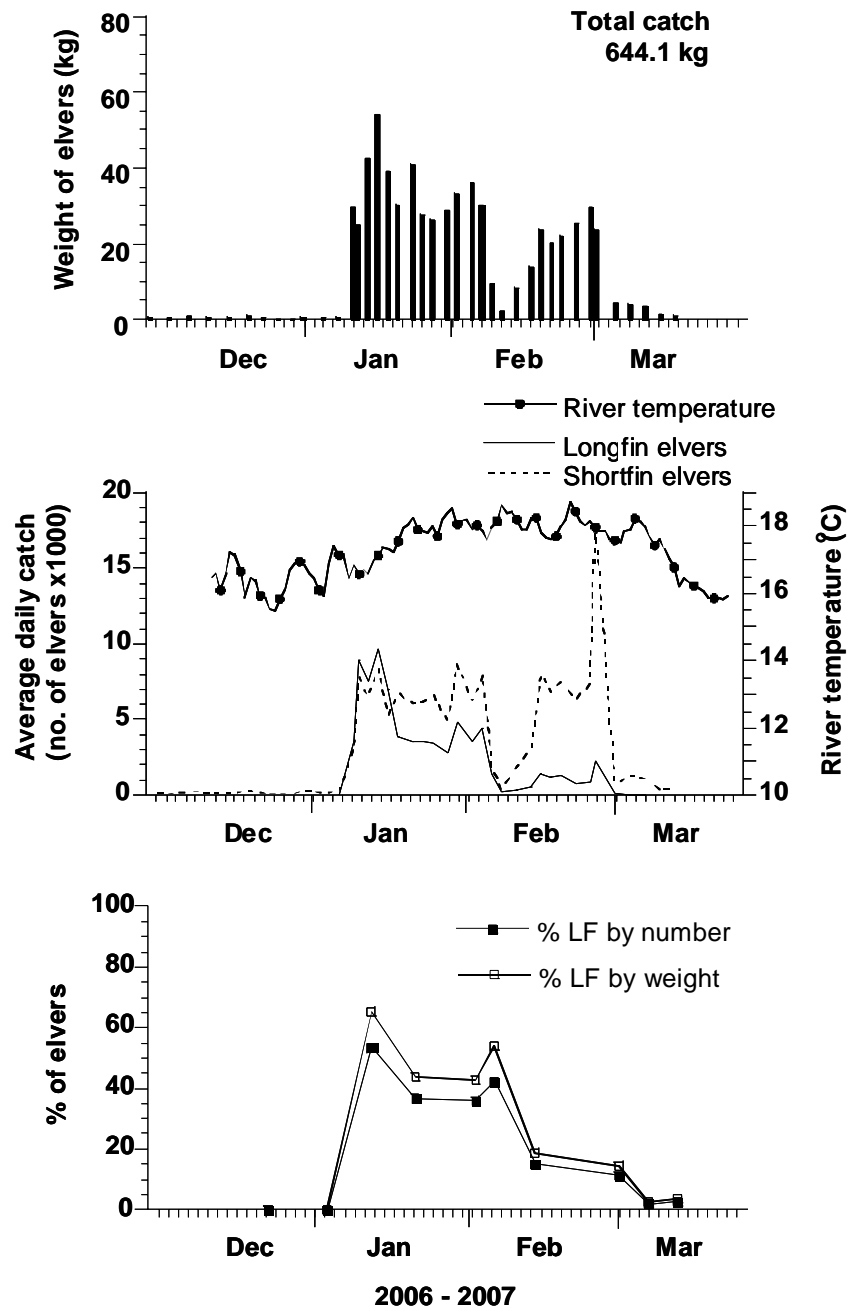
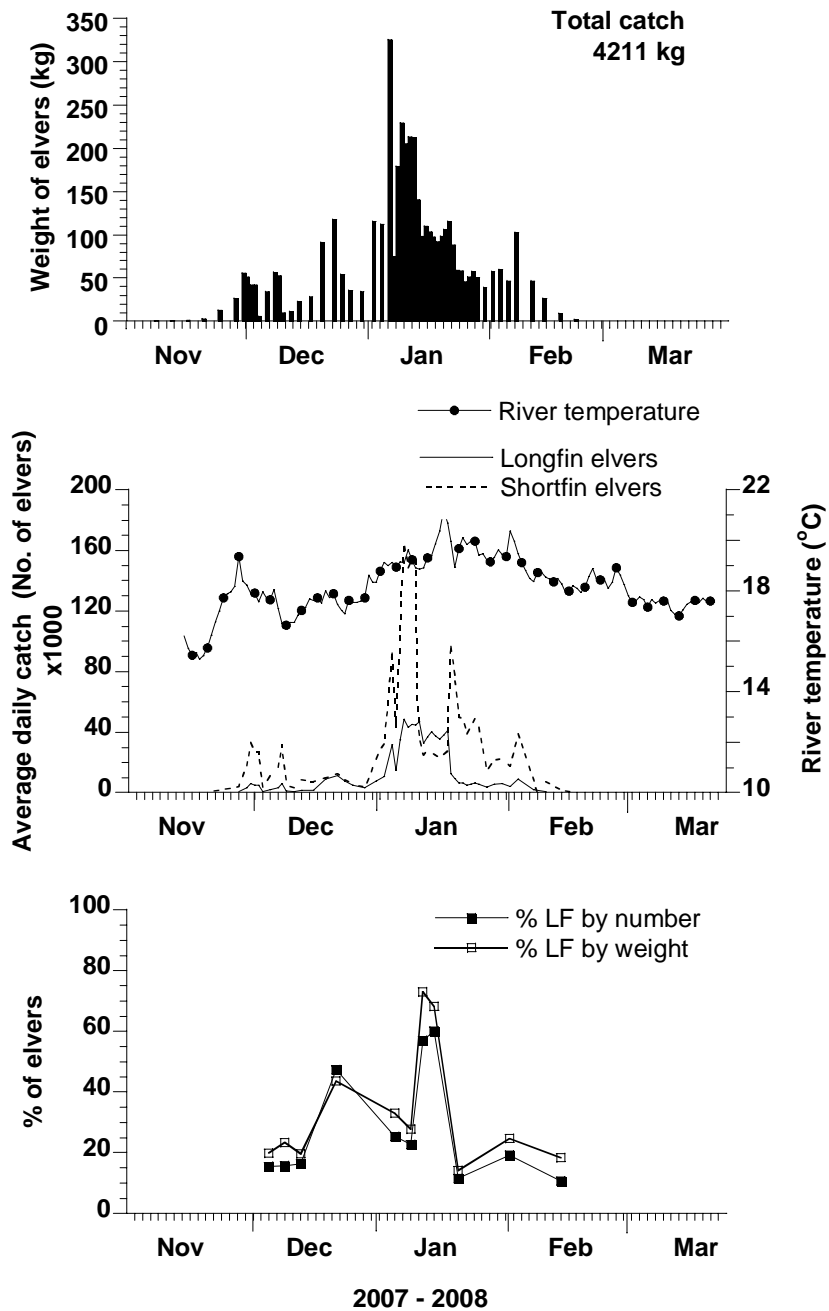


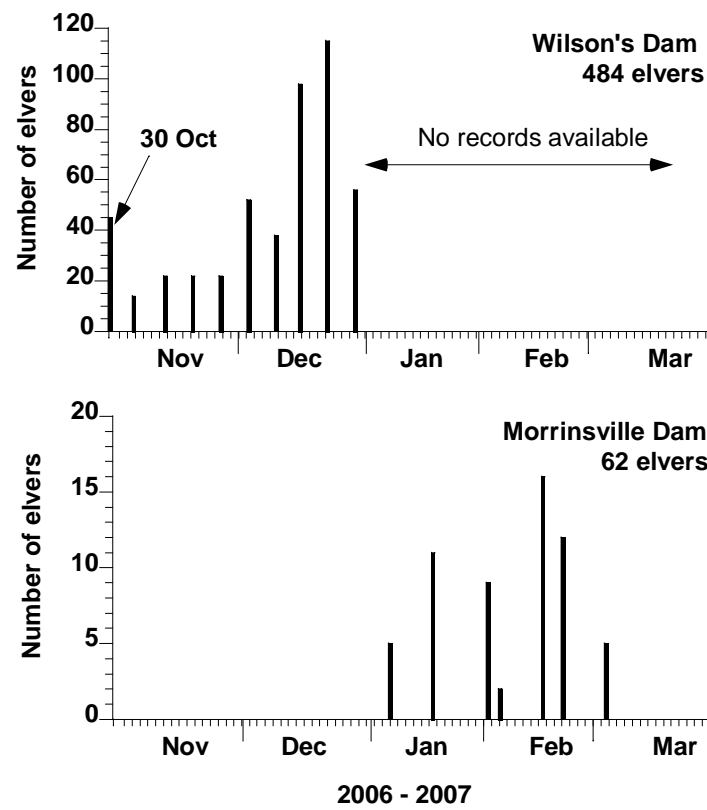
Figure 3: Karapiro Dam elver catch for the 2007–08 season (upper, total daily catch for each trap; middle, average daily catch of shortfin and longfin elvers and tailrace temperature; lower, estimated proportion of longfin elvers in catch. LF, longfin).



**Figure 4:** Matahina Dam elver catch for 2006–07 season (upper, daily catch; middle, average daily catch and Rangitaiki River temperature; lower, proportion longfin elvers. LF, longfin).



**Figure 5:** Matahina Dam elver catch for 2007–08 season (upper, daily catch; middle, average daily catch and Rangitaiki River temperature; lower, proportion longfin elvers. LF, longfin).



**Figure 6: Total elver catches for Wilson's Dam (upper) and Morrinsville Dam (lower) for 2006–07 season.**

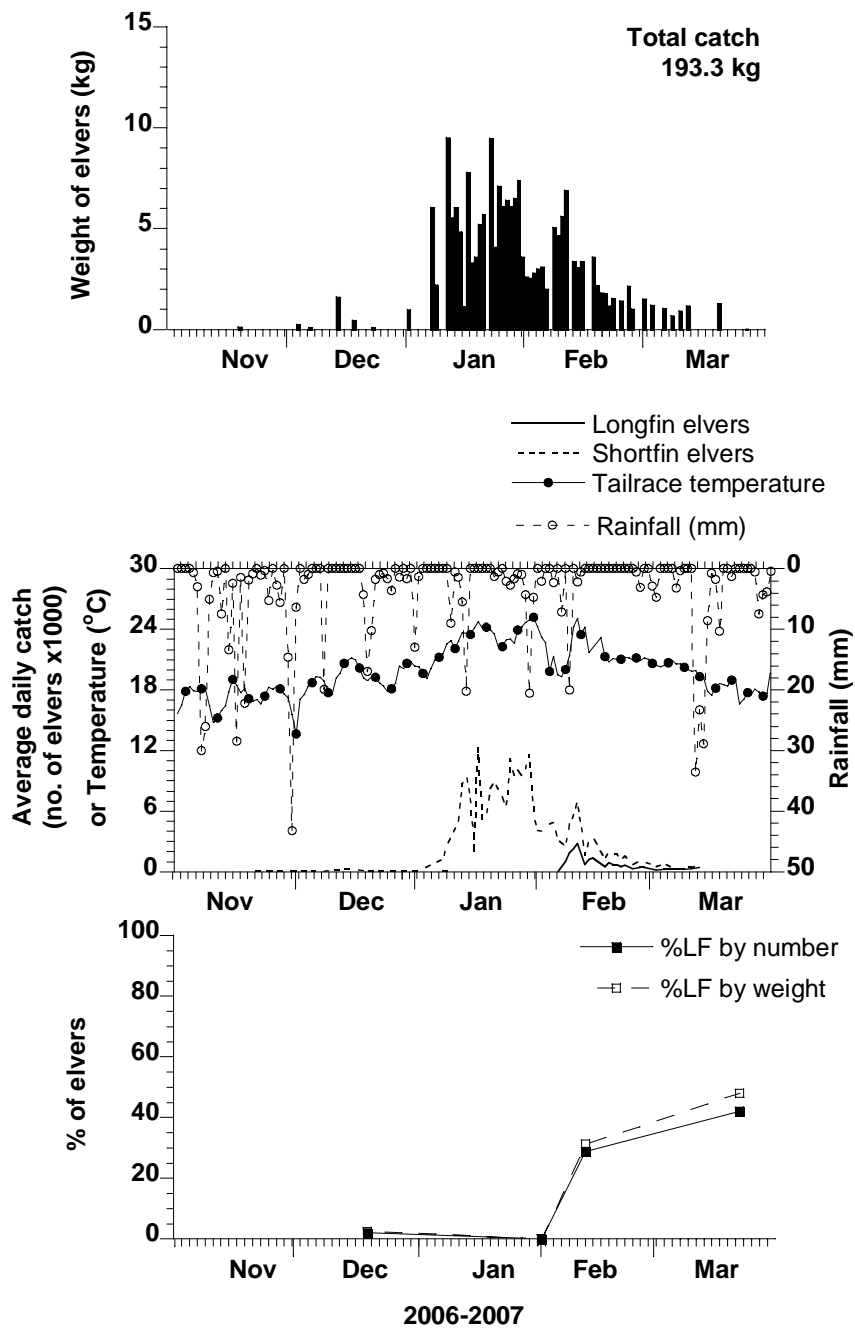


Figure 7: Wairere Falls elver catch for the 2006–07 season (upper, daily catch; middle, average daily catch, rainfall and tailrace temperature; lower, proportion longfin elvers. LF, longfin).

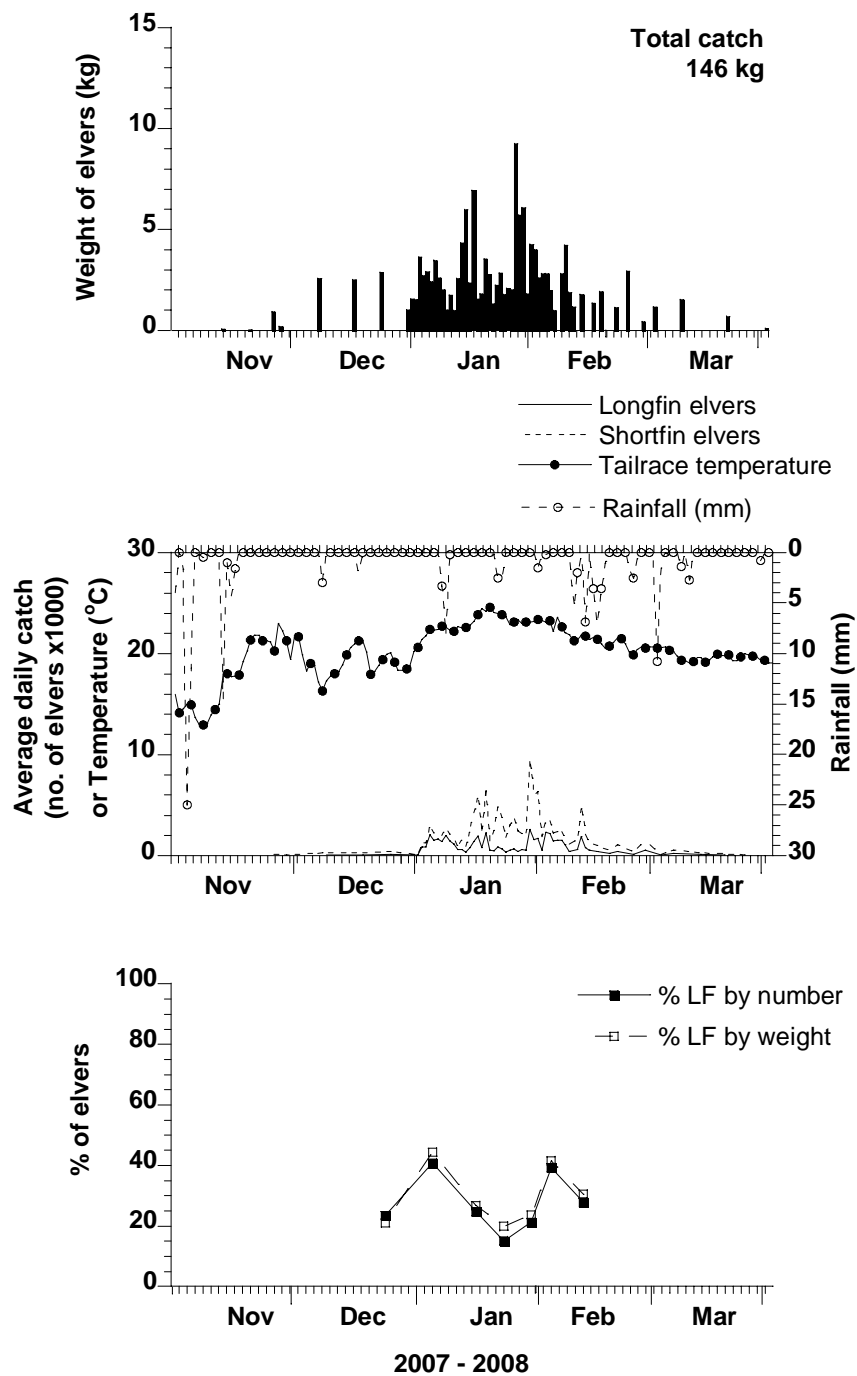


Figure 8: Wairere Falls elver catch for the 2007–08 season (upper, daily catch; middle, average daily catch, rainfall and tailrace temperature; lower, proportion longfin elvers. LF, longfin).



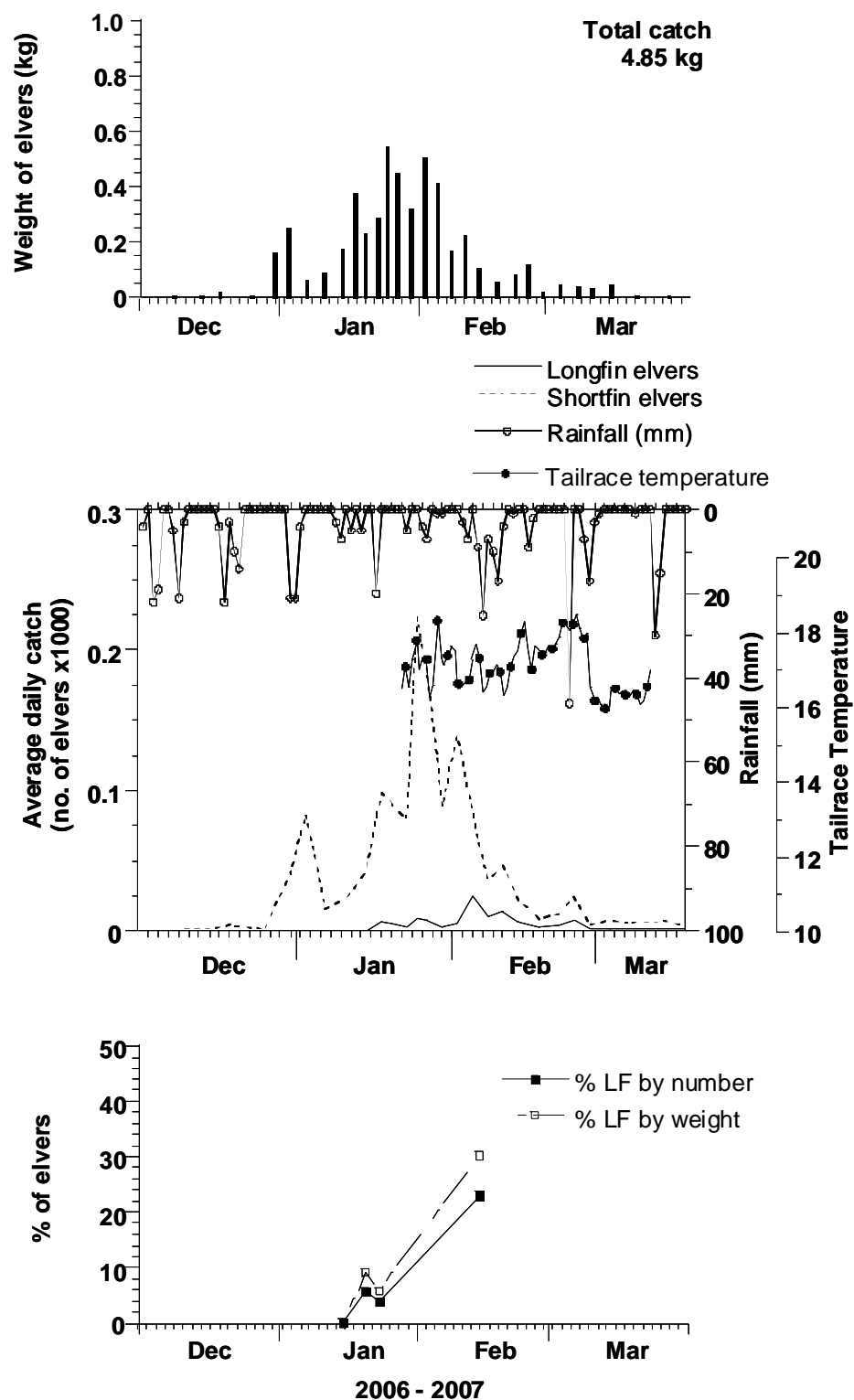


Figure 9: Piripaua Power Station elver catch for the 2006–07 season (upper, daily catch; middle, average daily catch, rainfall and tailrace temperature; lower, proportion longfin elvers; LF, longfin).

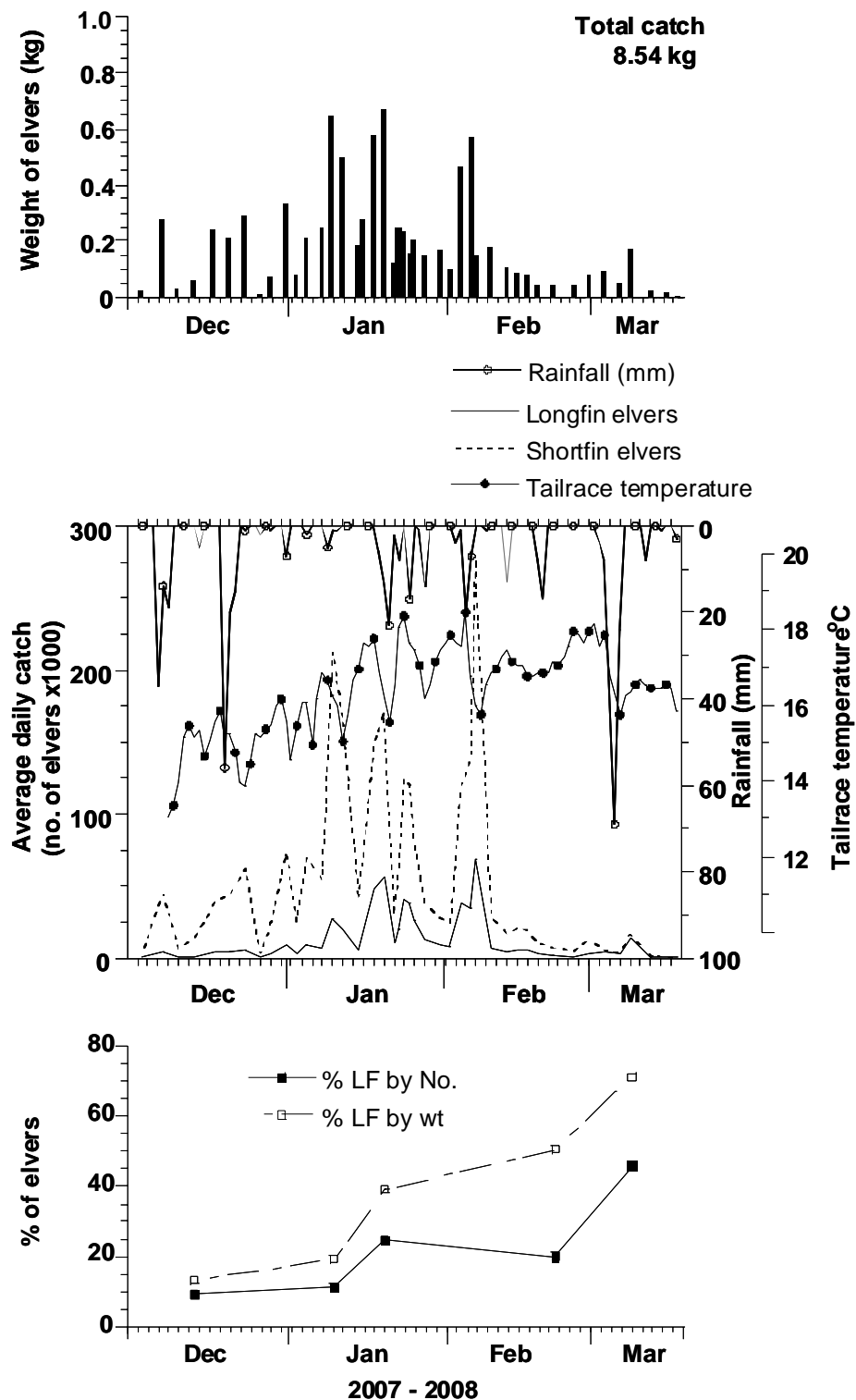


Figure 10: Piripaua Power Station elver catch for the 2007–08 season (upper, daily catch; middle, average daily catch, rainfall and tailrace temperature; lower, proportion longfin elvers. LF, longfin).

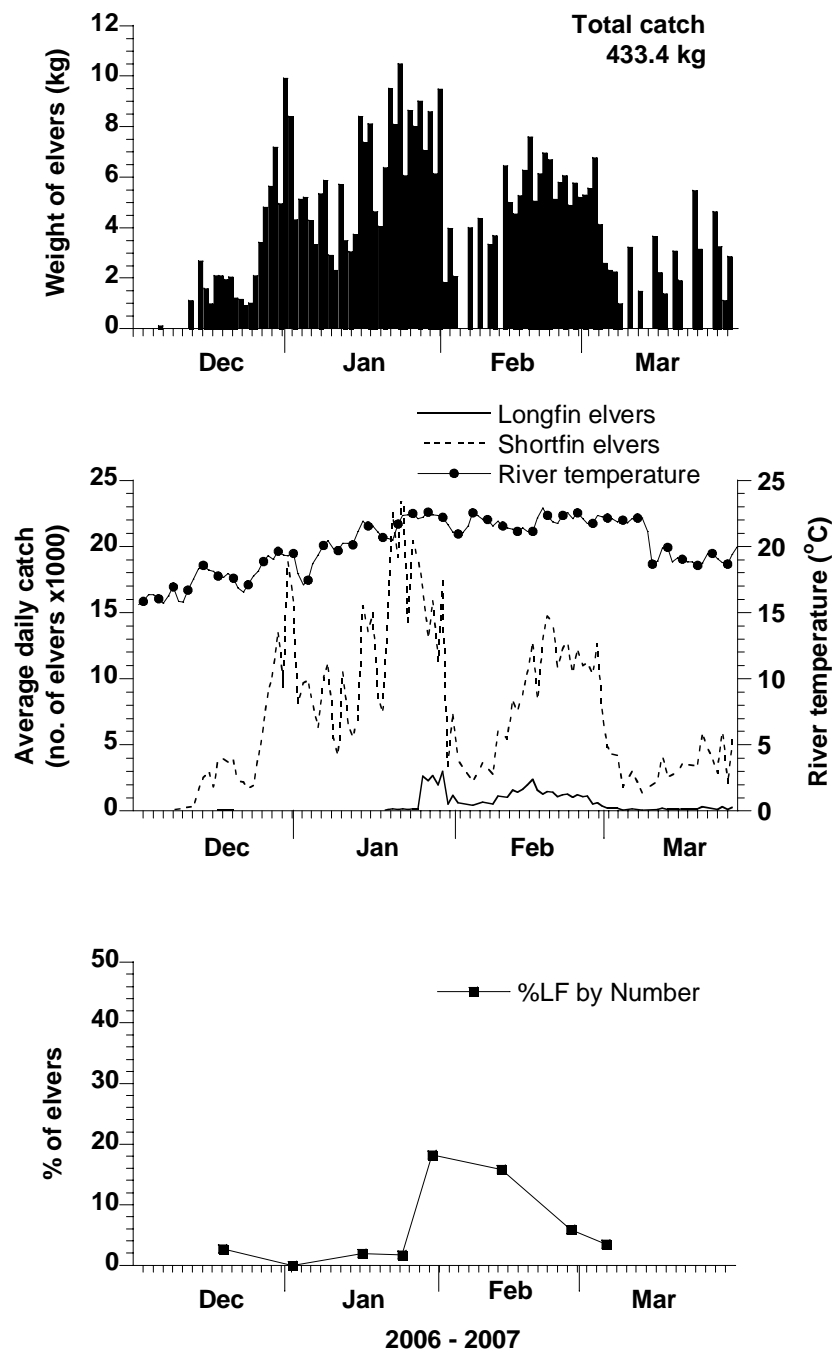
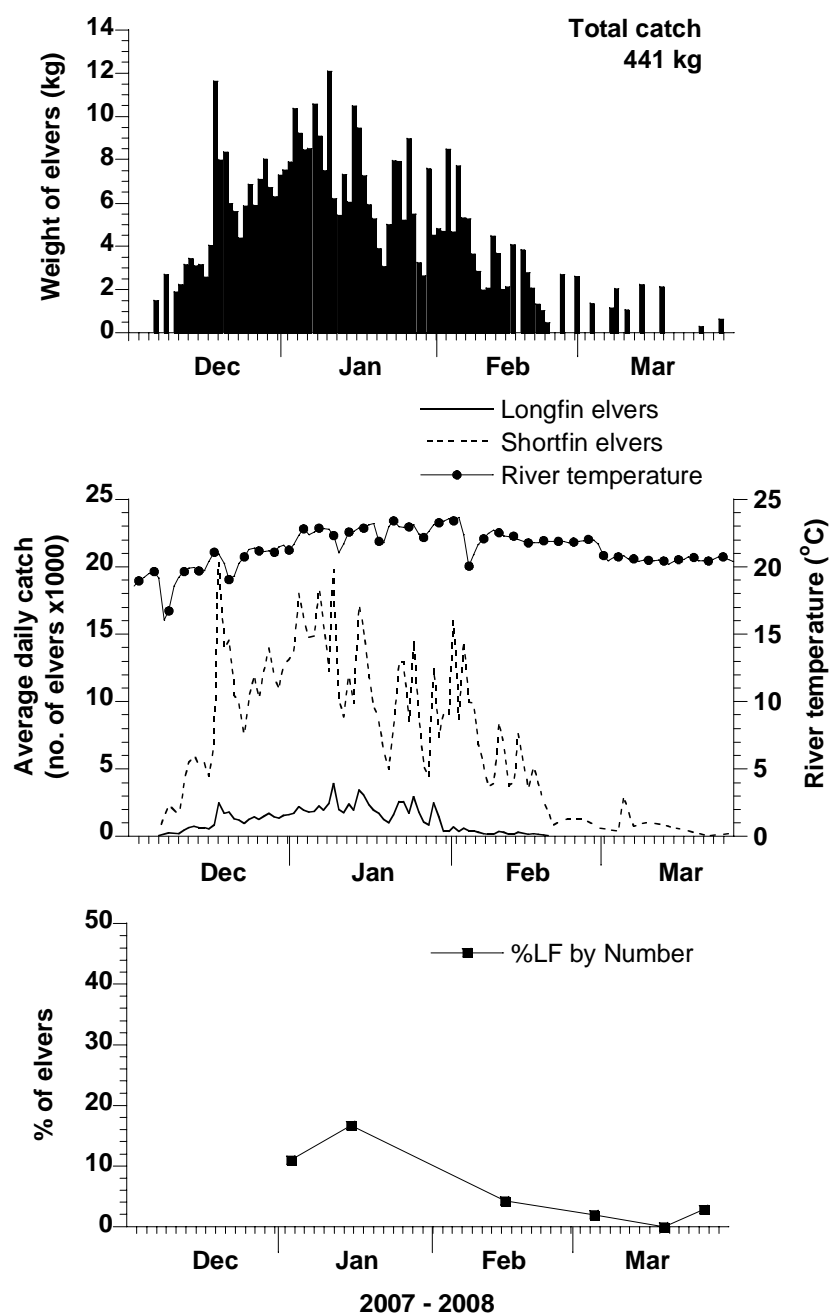
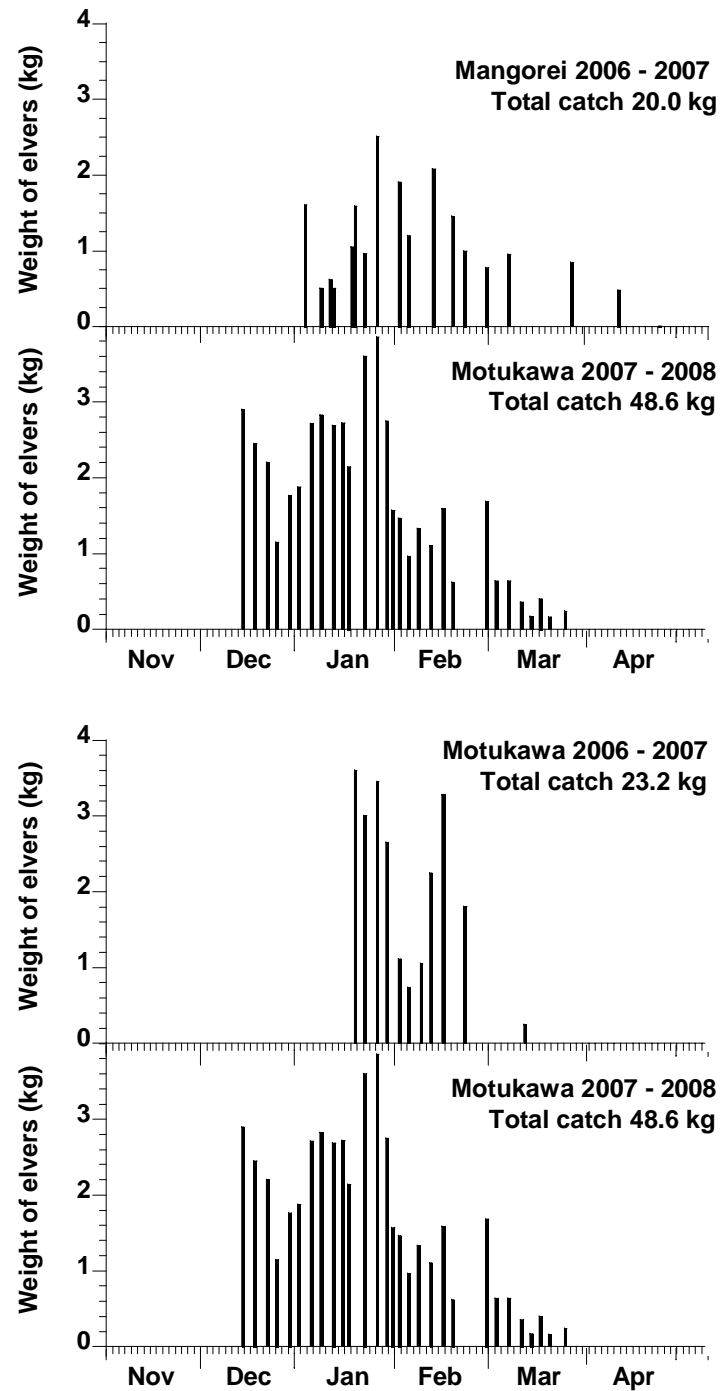


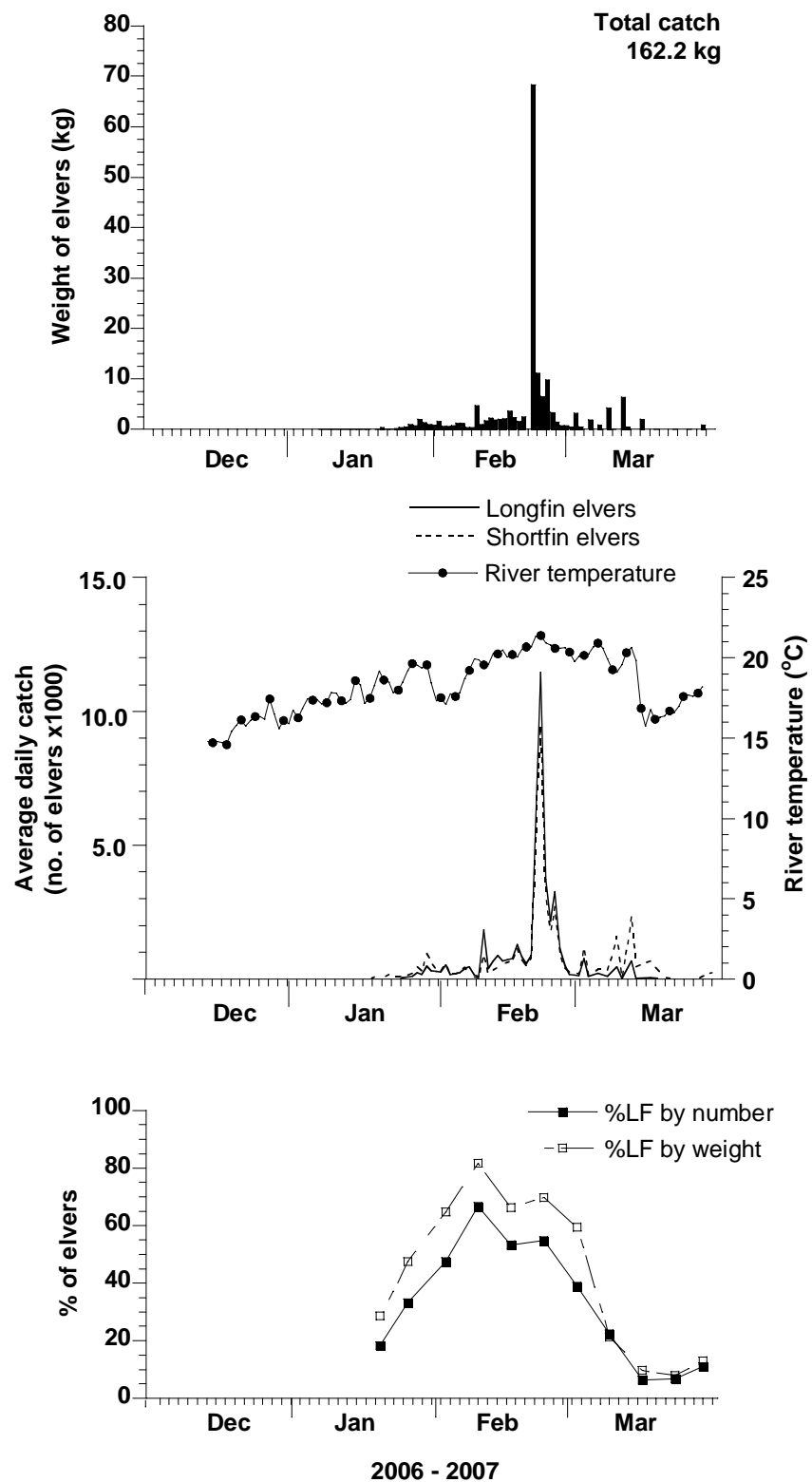
Figure 11: Patea Dam elver catch for the 2006–07 season (upper, daily catch; middle, average daily catch; lower, proportion longfin elvers; LF, longfin).



**Figure 12:** Patea Dam elver catch for the 2007–08 season (upper, daily catch; middle, average daily catch and temperature; lower, proportion longfin elvers; LF, longfin).



**Figure 13:** Mangorei Dam (upper) and Motukawa Dam (lower) elver catches for the 2006–07 and 2007–08 seasons.



**Figure 14:** Arnold Dam elver catch for the 2006–07 season (upper, daily catch; middle, average daily catch and temperature; lower = proportion longfin elvers. LF, longfin).

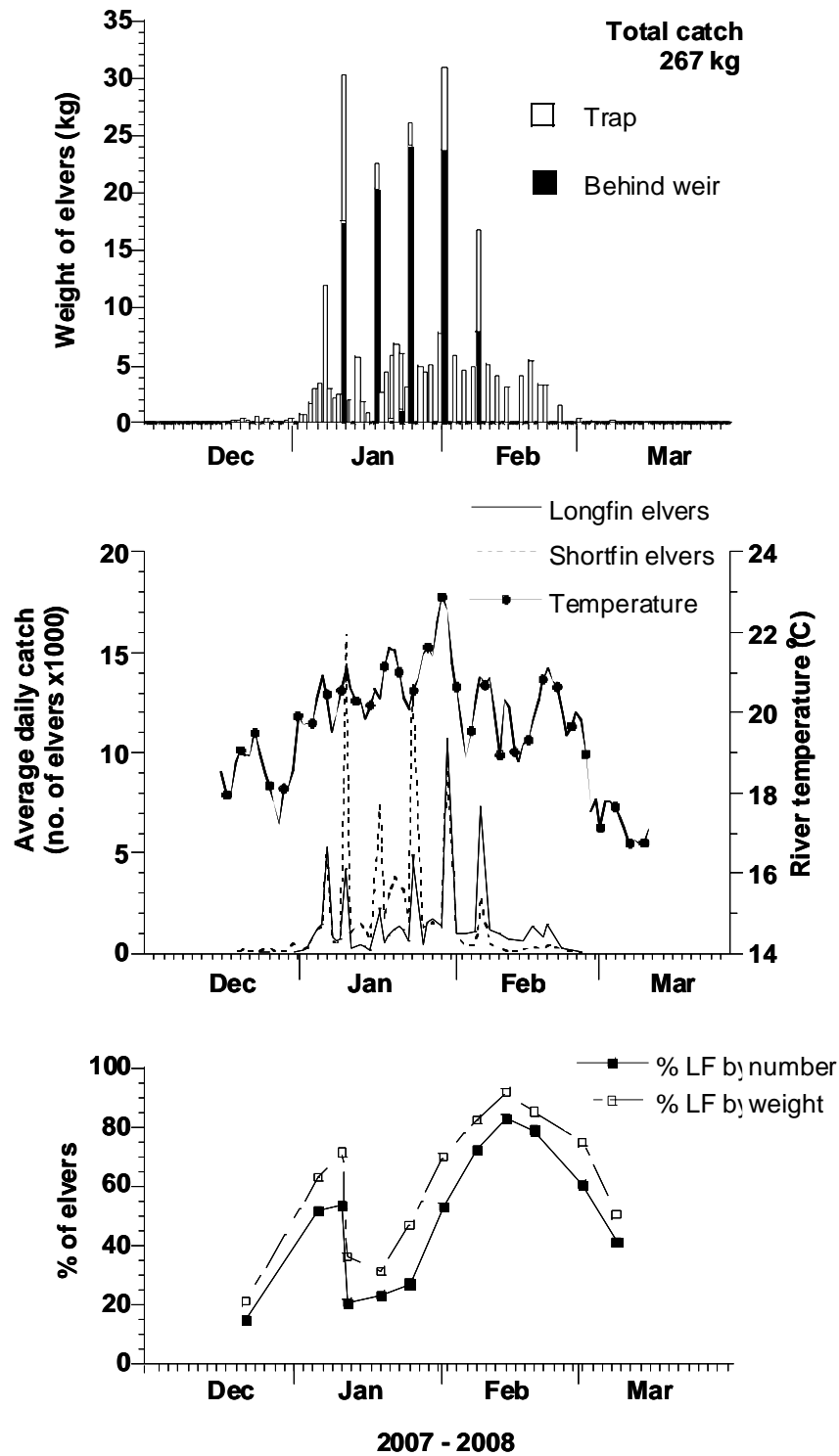
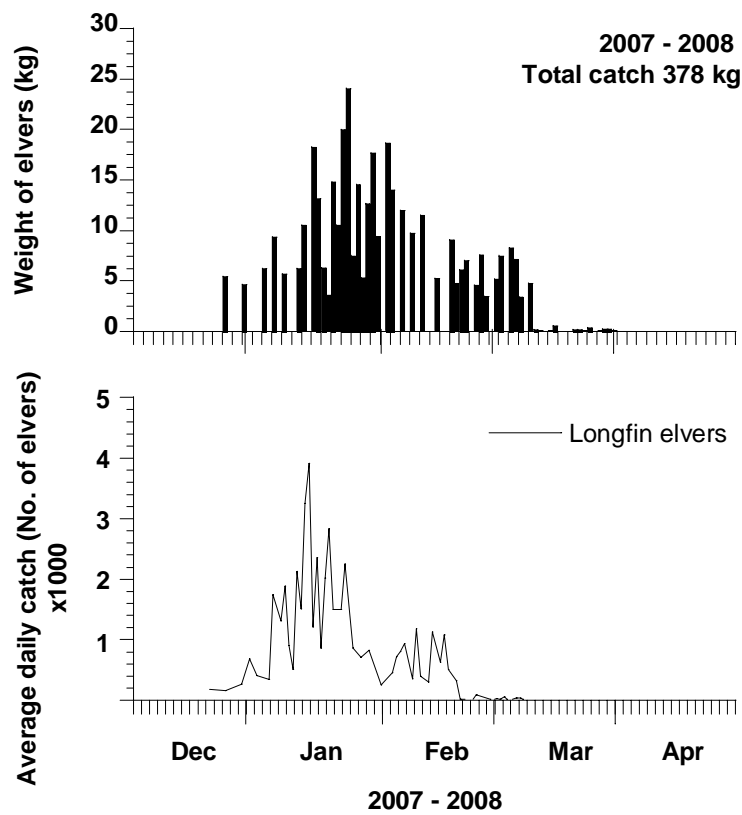
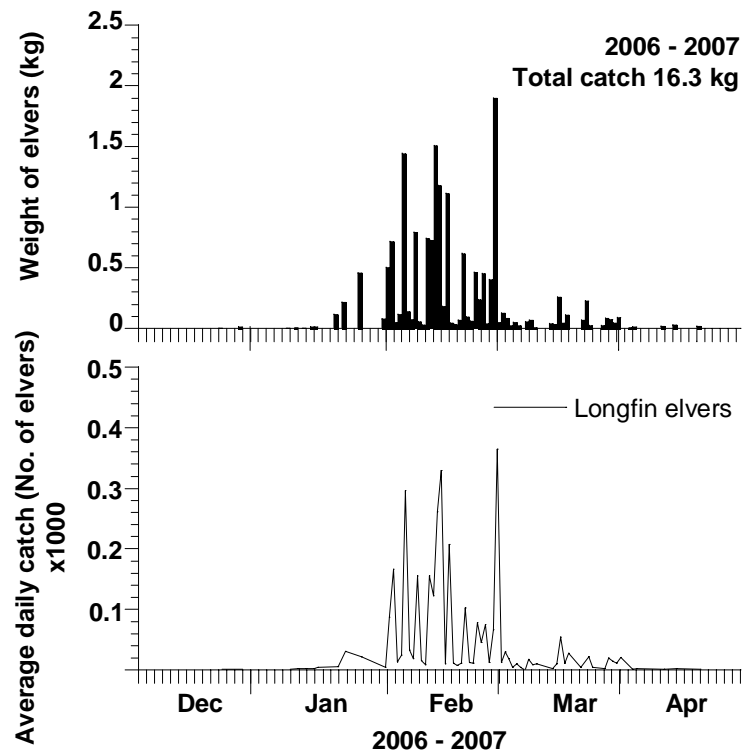


Figure 15: Arnold Dam elver catch for the 2007–08 season (upper, daily catch; middle, average daily catch and temperature; lower, proportion longfin elvers. LF, longfin).



**Figure 16:** Waitaki Dam elver catches for the 2006–07 (upper) and 2007–08 (lower) seasons.



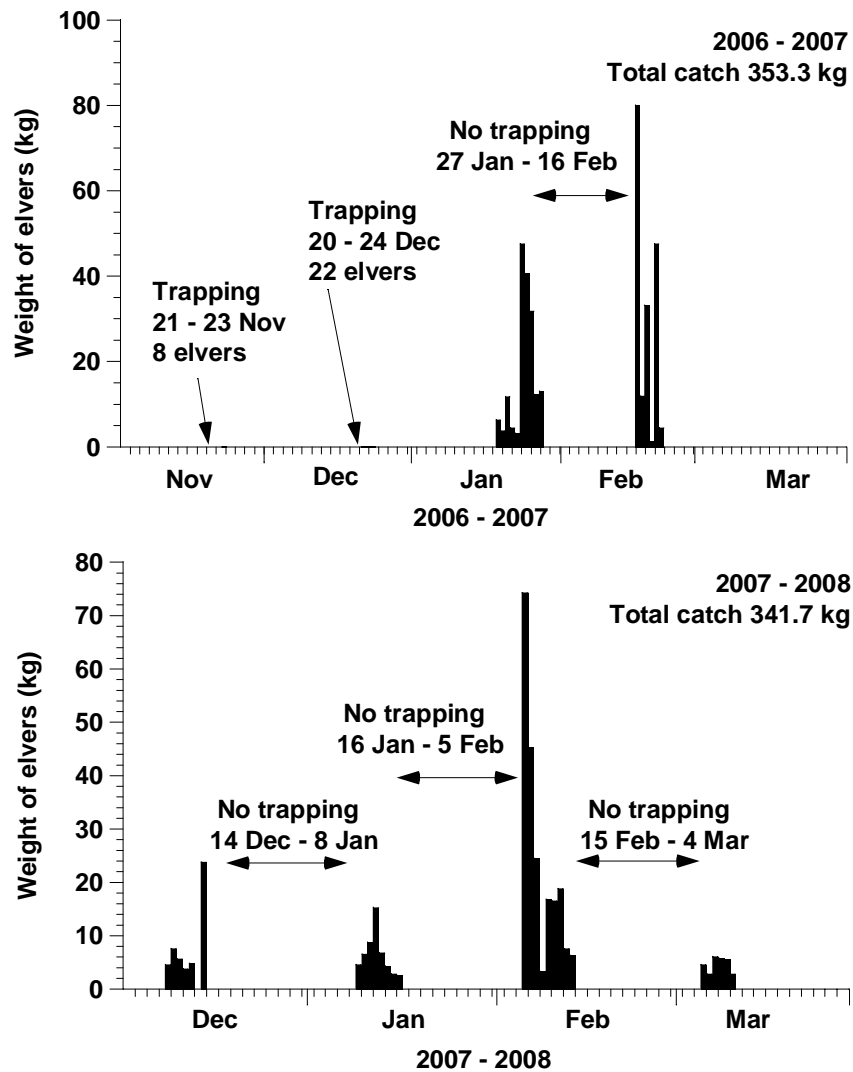
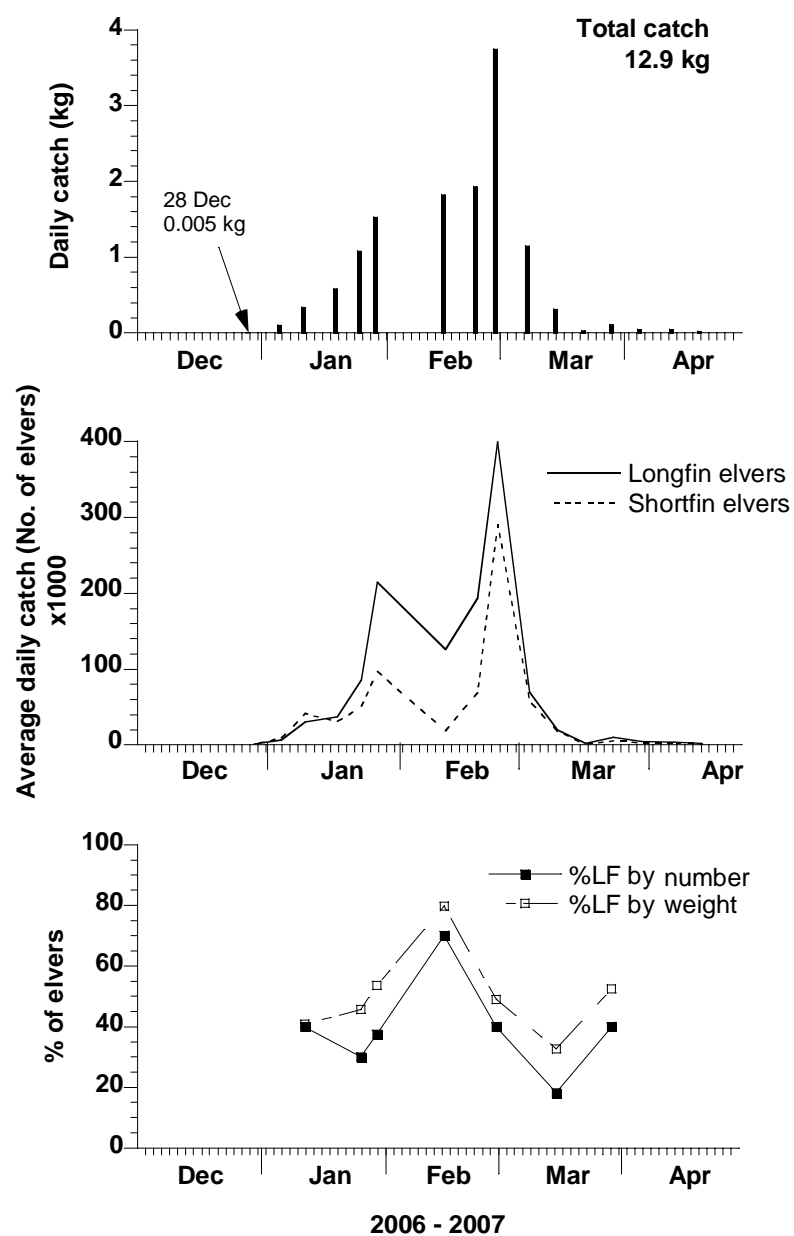
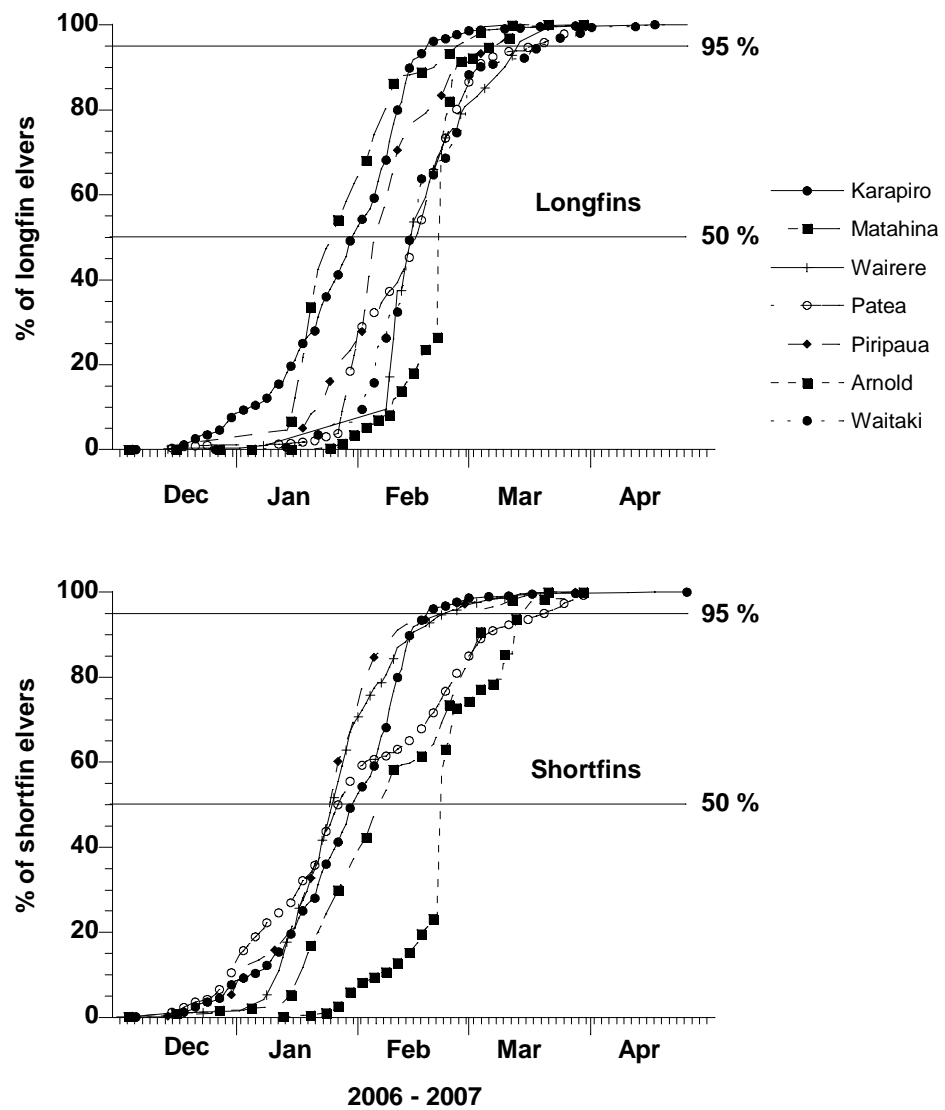


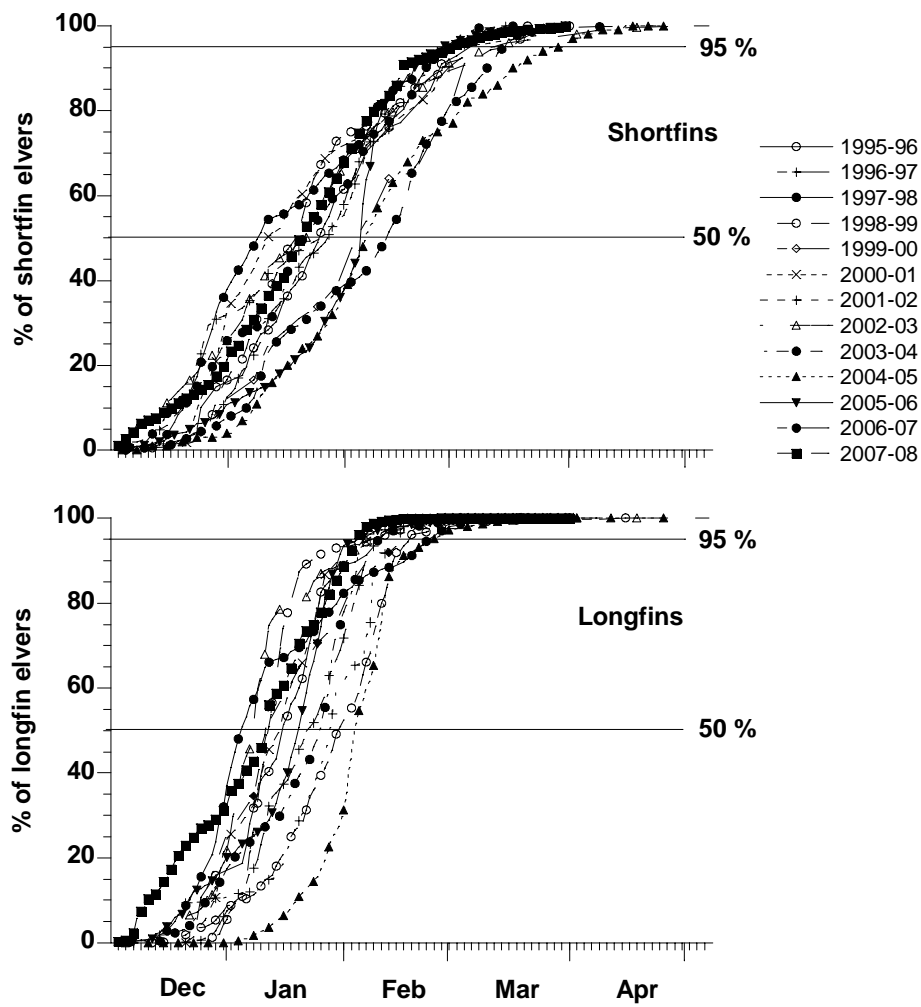
Figure 17: Mararoa Weir elver catch for the 2006-07 (upper) and 2007-08 (lower) seasons.



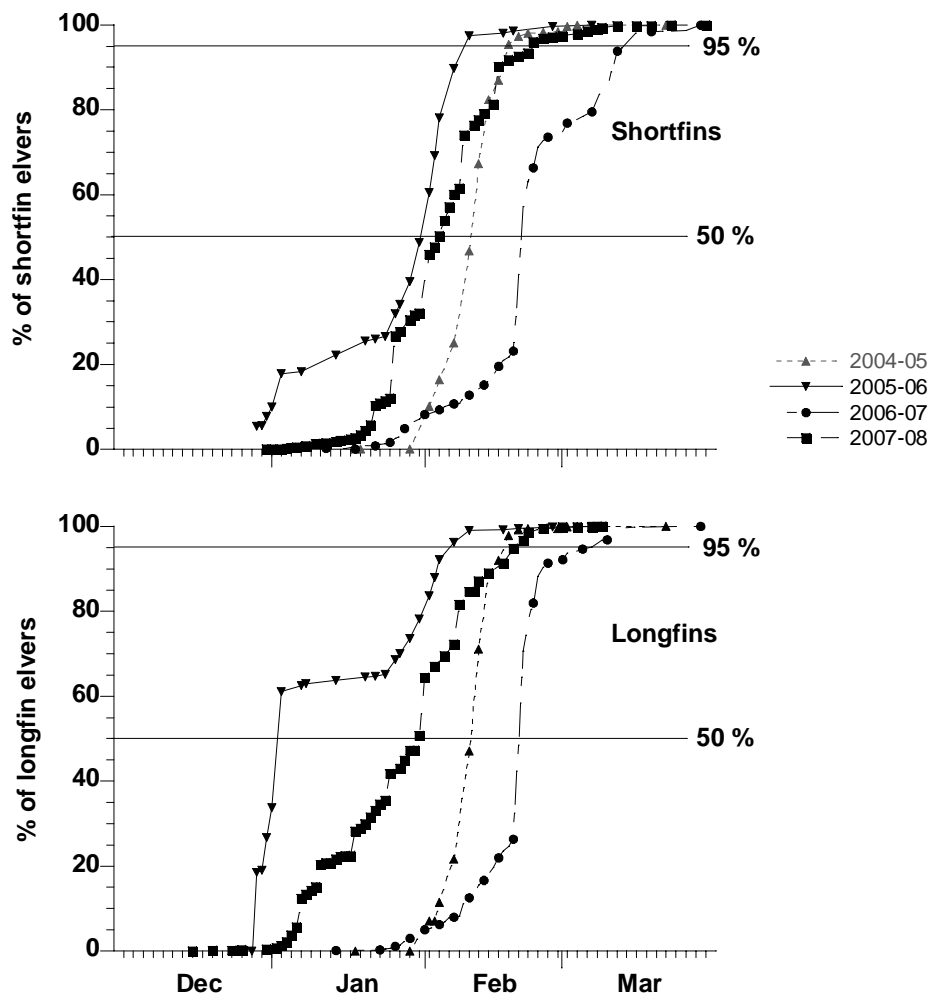
**Figure 18:** Waihopai Dam elver catch for the 2006-07 season (upper, daily catch; middle, average daily catch; lower, proportion longfin elvers. LF, longfin).



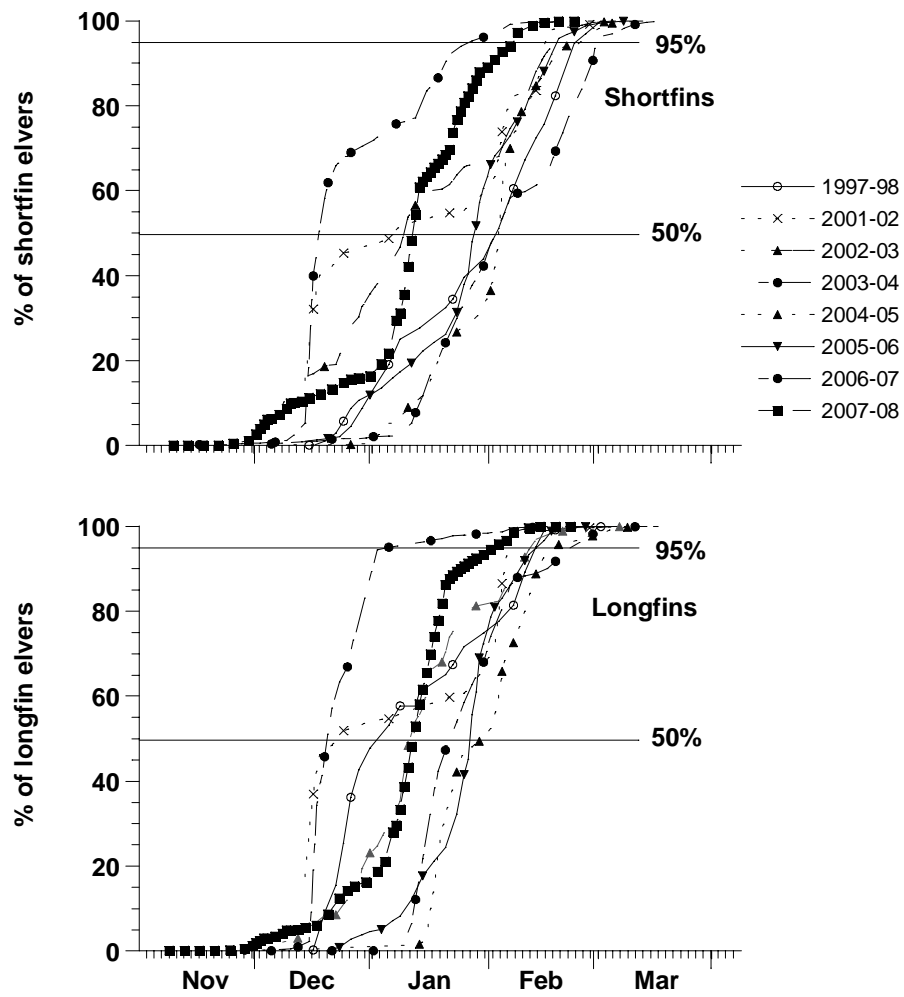
**Figure 19:** Cumulative proportions of the longfin (upper) and shortfin (lower) elver catches at Karapiro, Matahina, Wairere, Patea, Piripaua, Arnold, and Waitaki dams for 2006–07 season (Mararoa, Mangorei, Motukawa, Wilson's, and Morrinsville catches omitted due to incomplete data).



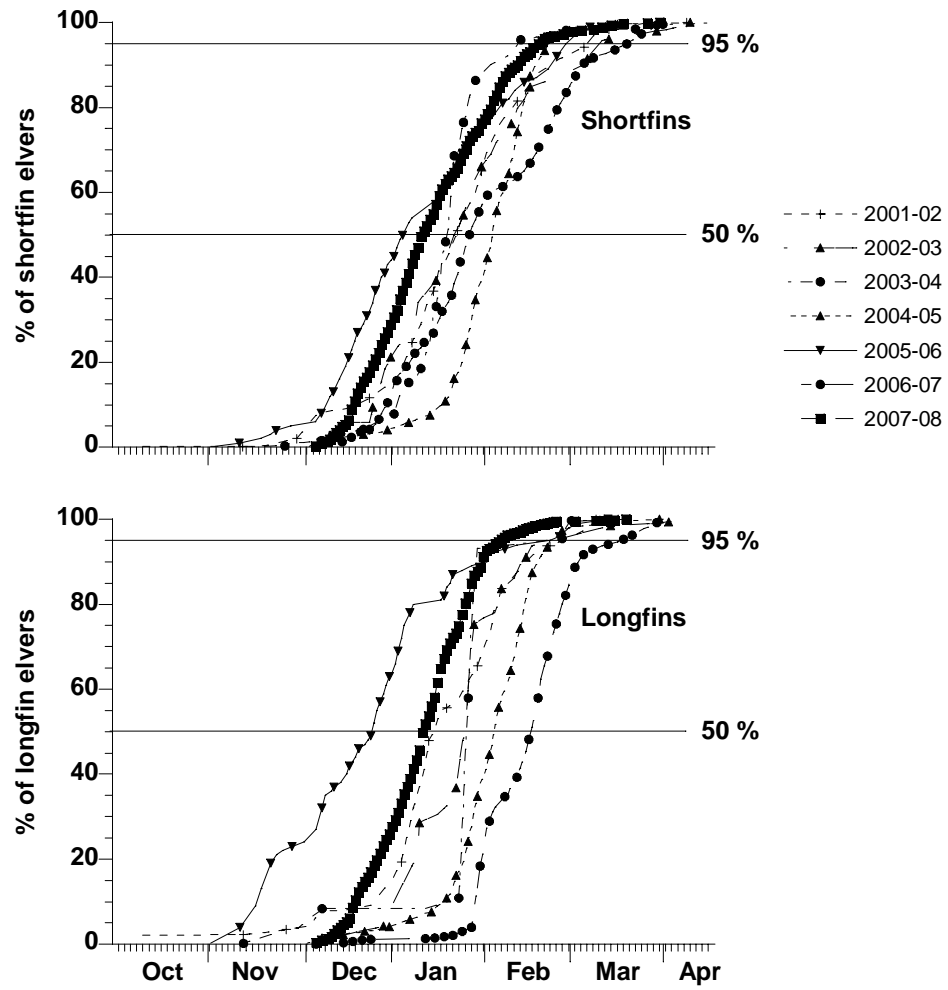
**Figure 20:** Cumulative proportions of the total shortfin (upper) and longfin (lower) catches at Karapiro Dam for 1995–96 to 2007–08 seasons.



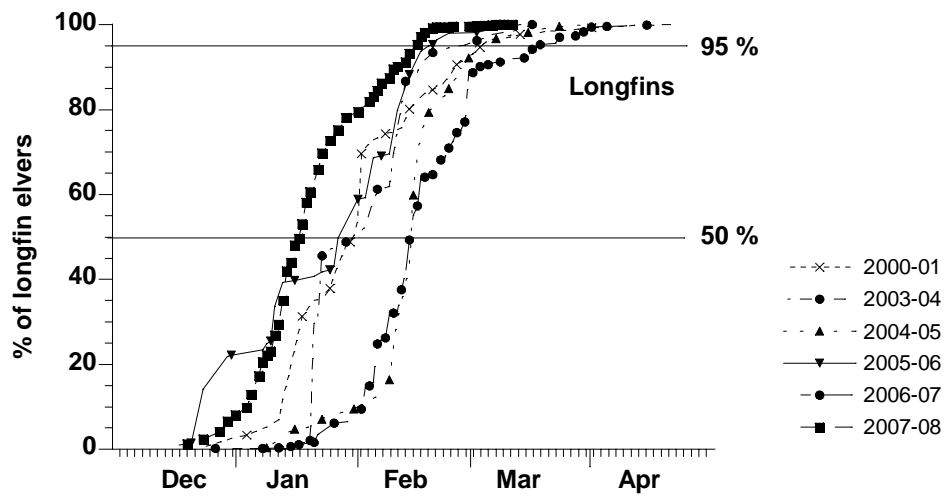
**Figure 21:** Cumulative proportions of the total shortfin (upper) and longfin (lower) catches at Arnold Dam for 2004–05 to 2007–08 seasons.



**Figure 22:** Cumulative proportions of the total shortfin (upper) and longfin (lower) catches at Matahina Dam for 1997-98 to 2007-08 seasons (1998-99, 1999-00, 2000-01 data omitted because of accuracy concerns).



**Figure 23:** Cumulative proportion of the shortfin (upper) and longfin (lower) elver catches total elver catches at Patea Dam for 2001–02 to 2007–08 seasons.



**Figure 24:** Cumulative proportions of the total longfin elver catches at Waitaki Dam for 2000–01 to 2007–08 seasons (2001–02 data omitted because of accuracy concerns; 2002–03 data omitted due to low catch).



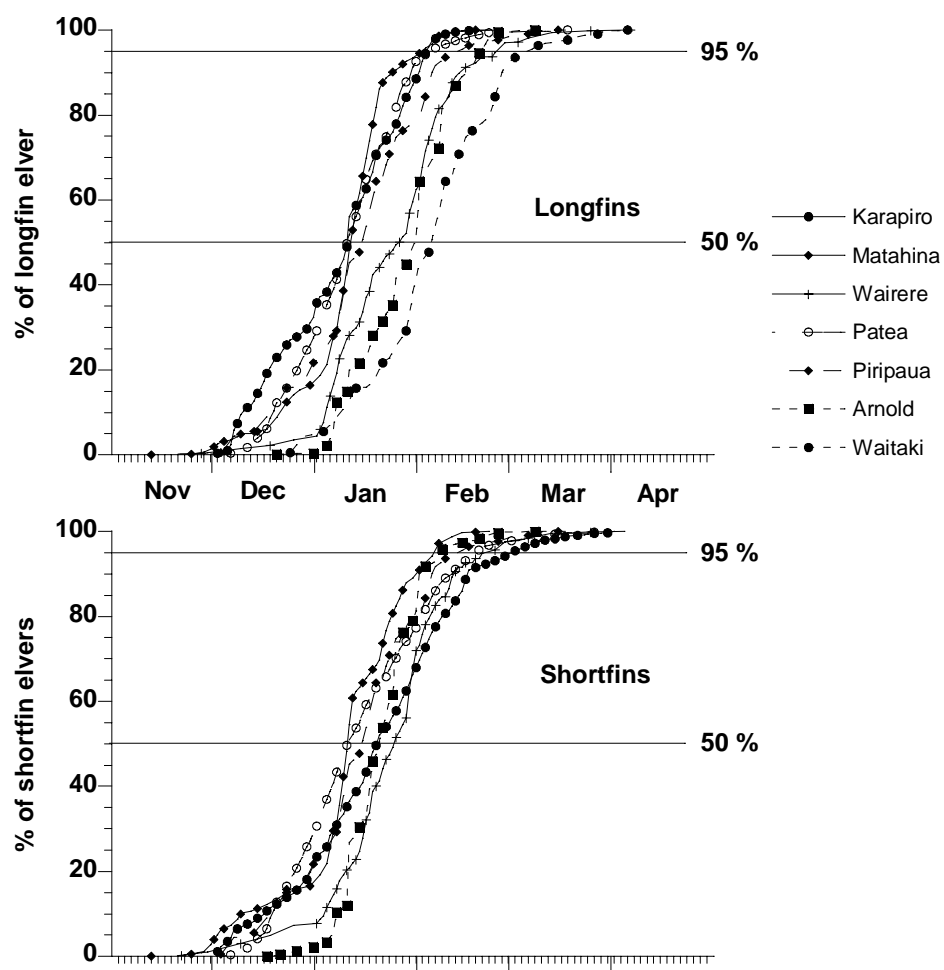
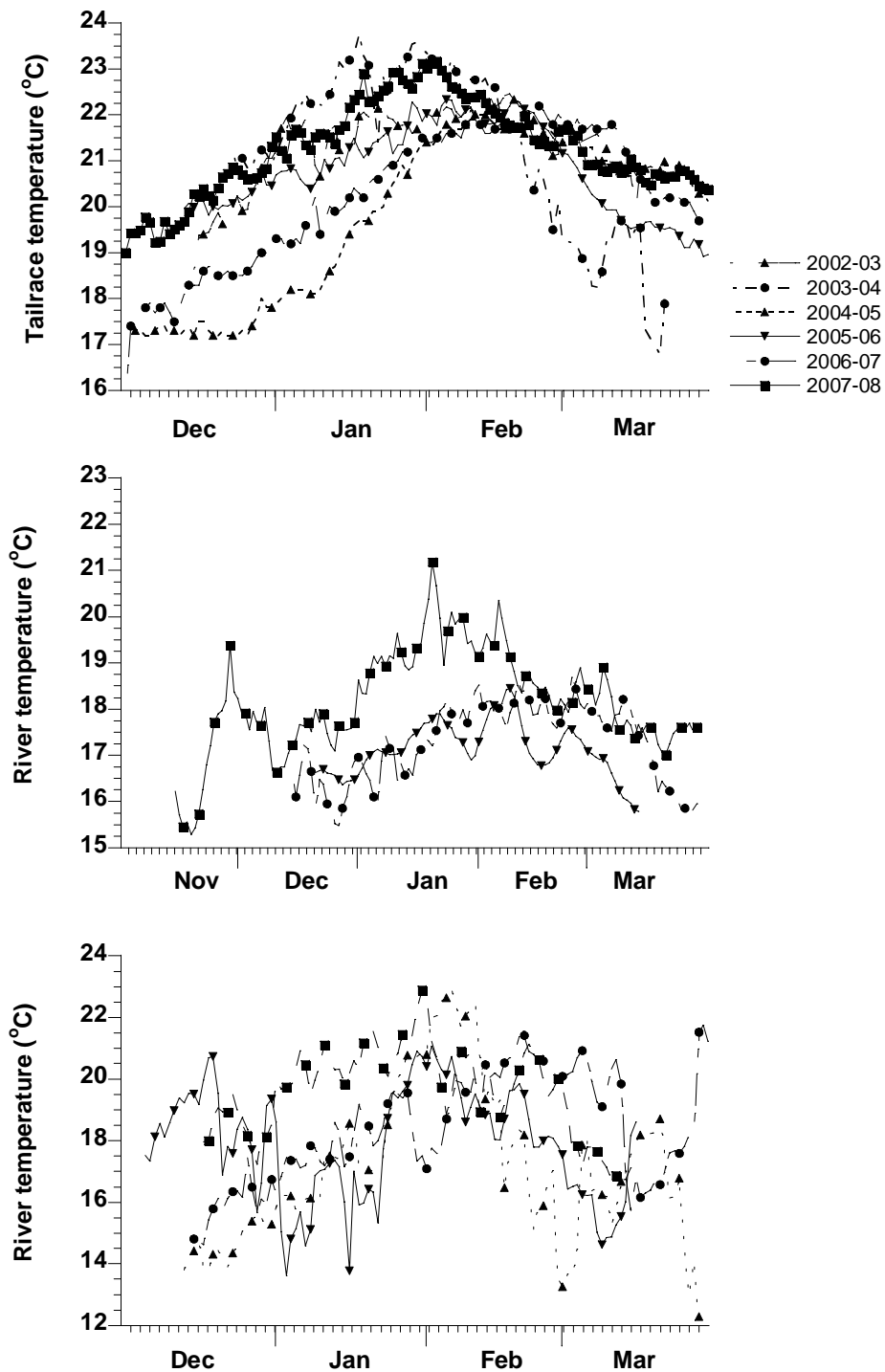


Figure 25: Cumulative proportions of the longfin (upper) and shortfin (lower) elver catches at Karapiro, Matahina, Wairere, Patea, Piripaua, Arnold and Waitaki dams for 2007–08 season (Mararoa, Mangorei, Motukawa, Wilson's and Morrinsville catches omitted due to incomplete data).



**Figure 26:** Average daily tailrace or river temperatures at Karapiro (upper), Matahina (middle) and Arnold (lower) for the 2002–03 to 2007–08 seasons (Note: 2004–05 Karapiro estimated from Waikato River temperature at Hamilton – data supplied by Environment Waikato).

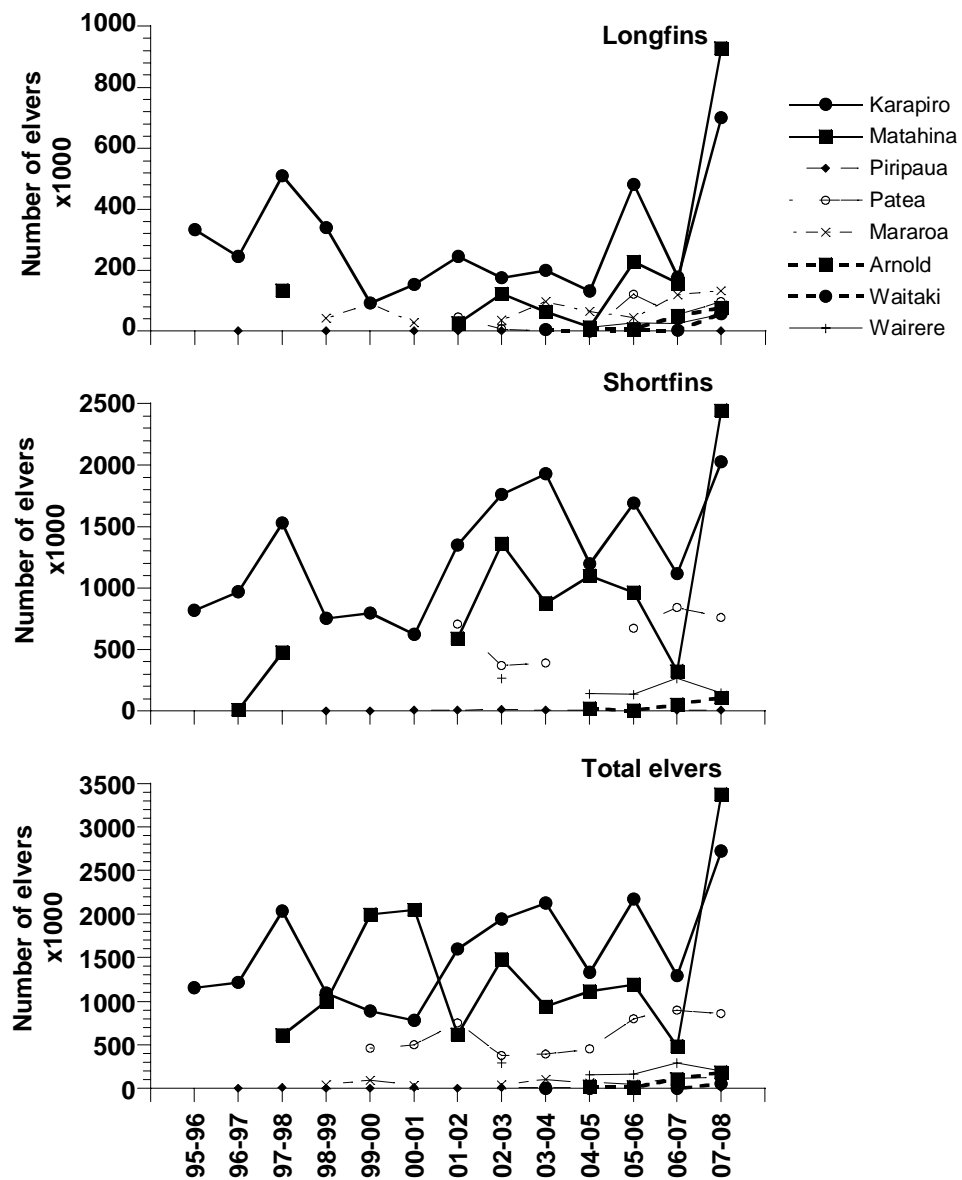


Figure 27: Annual catches of longfin elvers (upper), shortfin elvers (middle) and total elvers (lower) from 1995–96 to 2007–08 for monitored and supplementary sites throughout New Zealand.

## Appendix 1. Record of weight loss for frozen elver samples from Patea Dam.

Samples obtained during the 2006–07 season that were weighed on collection and reweighed on thawing at the end March 2007.

Date	Initial wt g	Frozen/thaw g	Loss g	Factor
18/12/2006	42	27.66	14.34	1.52
1/01/2007	16	14.12	1.88	1.13
15/01/2007	34	21.00	13	1.62
23/01/2007	24	17.94	6.06	1.34
29/01/2007	44	29.12	14.88	1.51
12/02/2007	26	20.17	5.83	1.29
26/02/2007	36	25.67	10.33	1.40
5/03/2007	32	20.74	11.26	1.54
<b>Mean</b>				<b>1.42</b>

Samples obtained during the 2007–08 season that were weighed on thawing and compared to fresh weight of elvers obtained by the Taranaki Regional Council (TRC) at a similar time (LF = longfin elver).

Date	%LF by No.	Average weight (g)		Factor
		TRC	Frozen sample	
12/02/2008		0.51		
14/02/2008	4.2		0.38	1.34
25/03/2008			0.43	1.58
29/03/2008	2.8	0.68		

## Appendix 2. Review of 1997–98 species composition for Karapiro Dam.

### Rationale

Over more than 10 years of monitoring at Karapiro Dam (and elsewhere), there have never been marked changes in species composition. The species composition (by number) that was provided for 1997–98 was exactly 50% shortfins and 50% longfins. We suspect that these records are inaccurate as the proportion of longfins in the catch has never been that high. We concluded that it was best to use an average species composition based on the 1996–97 and 1998–99 year to estimate the number of shortfins and longfins captured in 1997–98. The proportion used and the results of this estimation are shown below.

Season		Catch		Catch		Mean weight g	Reference
		kg	%	number	%		
<b>1996–97 (actual)</b>	Shortfin	1 331	70	974 000	80	1.37	Martin et al (2008)
	Longfin	571	30	246 000	20	2.32	
	Total	1 902		1 220 000			
<b>1998–99 (actual)</b>	Shortfin	708	52	756,000	69	1.06	Martin et al (2008)
	Longfin	655	48	341,000	31	2.13	
	Total	1 363		1 097 000			
<b>1997–98 (estimated)</b>	Shortfin	1 529.5	60	1 529 500	75	1.0	This report
	Longfin	1 019.7	40	509 850	25	2.0	
	Total	2 549.2		2 039 350			