Science Poli

NOR-00182

Assessment and Monitoring of Commercial Eel Fisheries

Final Research Report for
Ministry of Fisheries Research Project EEL9801

S R Speed
G N Browne
R O Boyd

KINGETT MITCHELL
& ASSOCIATES LTD.
ENVIRONMENTAL
CONSULTANTS

September 2000

Assessment and Monitoring of Commercial Eel Fisheries

Final Research Report for
Ministry of Fisheries Research Project EEL9801

S R Speed
G N Browne
R O Boyd

September 2000

Final Research Report
Ministry of Fisheries Research Project EEL9801

Objectives 1, 2 and 3

1. **Date:** 1 September 2000

2. **Contractor:** Kingett Mitchell and Associates Limited

3. **Project Title:** Assessment and Monitoring of Commercial Eel Fisheries

4. **Project Code:** EEL9801

5. **Project Leader:** Rick Boyd

6. **Duration of Project:** 1 October 1998 to 30 September 2000

7. Executive Summary

The objectives of the EEL9801 commercial eel sampling program were aimed at obtaining information on commercially fished eel populations from areas of the country that had received little attention in the past. A total of 68 different landings were sampled during this sampling round, 40 from the lower North Island and 28 from the upper South Island. The majority of the sampled landings were from areas that had previously not had any information collected from them, thus adding to the pool of data on the species composition, size structure and age of commercially fished eel populations.

The majority (81%) of the eels from the North Island samples were shortfinned *Anguilla australis*, while the majority (81%) of the eels from the upper South Island were longfinned *Anguilla dieffenbachii*. The information gathered during the 1999-2000 sampling period was comparable to those of previous sampling rounds with the majority of the catch coming from the smaller size classes. Variability in age and growth rates of eels was also evident both between and within catchments.

8. Programme Objectives

Overall Objectives:

1. To assess and monitor the commercial (*Anguilla* spp.) fisheries.

Specific Objectives:

1. To monitor the species composition and size structure of the commercial eel fishing areas of the South Island [outlined in the rationale section of the project description] by sampling 50 landings in the 1998-99 fishing year.

2. To monitor the species composition and size structure of the commercial eel fishing areas of the North Island [outlined in the rationale section of the project description] by sampling 50 landings in the 1998-99 fishing year.

3. To determine the age at minimum legal size and near the maximum size for particular commercial eel fisheries in both the North and South Islands where adequate age data has not been previously collected, by sub-sampling from the landings in objectives 1 and 2.

9. Introduction

New Zealand has 3 species of eels of which the shortfinned (*Anguilla australis*) and longfinned (*Anguilla dieffenbachii*) are by far the most dominant species relative to a small, recently discovered and as yet undetermined population of Australasian longfinned eels (*Anguilla reinhardtii*) (Beentjes and Chisnall 1998). Eel biology and ecology have been well researched in New Zealand (e.g., Cairns 1941 and Burnet 1969). New Zealand eels are widely distributed and occupy a broad range of available habitat through out the country (McDowall 1990). In general shortfinned eels are found in higher densities in lower to mid catchment waterways while longfinned eels tend to dominate in the headwater areas (McDowall 1990).

New Zealand's rivers, lakes, wetlands and estuaries support important customary and commercial eel fisheries. The commercial freshwater eel fishery in New Zealand has operated since the 1960's. Historically there has been little stock assessment research to support the management of the fishery. However, in recent years a number of reports have reviewed the commercial eel fishery. These provide information that is relevant to eel fishery management (Todd 1981, Town 1985 and Chisnall 1993).

Market sampling of New Zealand's commercial freshwater short and long finned eel fishery has been undertaken in previous years (Beentjes and Chisnall 1997, 1998). The aim of these commercial eel catch sampling programmes is to provide a baseline data set of eel size, species composition, sex and age for eel fisheries throughout the country. This report presents the results of the EEL9801 project which continues the commercial eel catch sampling programme in areas where limited data was gathered in previous programmes.

10. Review of Previous Commercial Eel Research.

The modern day fishery for eel began in the mid 1960's with catches increasing rapidly to reach a peak of 2434 t in 1975. Over the period 1983-1993, the catch appeared to have stabilised with an average annual catch of 1362 t over the latter period. The stabilisation of the annual catch over recent years is attributed, in part, to the moratorium on fishing permits since 1992 which has remained at a relatively constant level of approximately 240 issued permits.

The recent process of examining the commercial eel fishery in New Zealand began with reviews of the fishery by Jellyman (1993, 1994). These reviews described the fishery including history, methods, the amount and type of data collected, the regulatory regime and management concerns..

Jellyman (1994) estimated the mean annual commercial catch of eels for each of 22 Eel Return Areas throughout the country, of which 11 are in the North Island, 10 in the South Island and 1 in the Chatham Islands, by using existing FSU/CELR records. The areas found to produce the largest catches over the same fishing years were (in descending order from largest to smallest) Waikato, Northland, Southland, Lake Ellesmere, Otago, Hawke Bay, Manawatu, Auckland and Hauraki. These areas accounted for over two thirds of the total commercial eel catch. The remaining areas including Wairarapa, Wellington, Nelson, Marlborough and Westland each had individual contributions of less than 4% of the total catch (Jellyman 1994).

A number of concerns influencing the management needs of the eel fishery were raised by Jellyman (1994), in particular;

- The reduction in available eel habitat, both qualitatively and quantitatively through draining of wetland areas and restriction of upstream/downstream access caused by the construction of dams and weirs.
- The apparent slow and variable growth rates of eels and their consequent vulnerability to over-fishing.

The overall conclusion of Jellyman's (1994) review was that there was general agreement between the industry and managers that the fishery was fully developed with little opportunity for further expansion.

One of the potential reasons that eel populations may be vulnerable to over-fishing is the slow growth rates of eel species in New Zealand (see Horn 1996 for a comprehensive review). Some commercial eel fishers do not accept these findings and maintain that eels grow much faster.

Horn (1996) reviewed existing age and growth data from eel species in New Zealand. The available data demonstrated that growth rates for shortfinned and longfinned eels varied considerably both between and within catchments. Factors perceived as most likely affecting growth rates were eel density, food availability, interspecific interactions between the two main species and water temperature. Growth can also be variable within the life histories of individual eels (Chisnall and Hicks 1993).

Horn (1996) also found that eel fishing had the potential to alter growth rates if it resulted in significant changes to population densities. Two studies in particular have provided supporting evidence for this hypothesis, those of Chisnall and Hayes (1991) and Jellyman *et. al.,* (1995). In both studies, eels in locations originally subject to low-moderate fishing pressure were sampled. Lake Waikare was initially sampled in 1980-81 (Chisnall and Hayes 1991) and Lake Ellesmere in 1974-76 (Jellyman *et. al.*, 1995). Further samples were collected from Lake Waikare in 1987 and Lake Ellesmere in 1994-95 after the areas had been subjected to heavy fishing pressure. While the densities of eels in both locations were lower after intensive fishing, growth rates at both locations appeared to be generally higher overall (Horn 1996).

An alternative hypothesis to describe apparent changes in growth rates in response to fishing was suggested by Horn (1996) who suggested that fishing could change the apparent growth rate of eels in a catchment by altering the sex ratio of that part of the resident population of sufficient size to be caught. This would most likely appear as a reduction in growth rate caused by the removal of larger and faster growing females (Horn 1996). A lack of sufficient data examining the effects of fishing pressure on eel growth precludes any robust conclusions being drawn on the effects of fishing on growth rates of New Zealand eels.

Reported mean annual length and weight increments for New Zealand eels do appear to show slow natural growth rates compared to other temperate Anguilla species (Tesch 1977). While faster growth rates can be achieved under experimental aquaculture conditions (Jones *et. al.*, 1983 in Horn 1996), most natural growth rates for both species fall within the range of 1-3 cm per year, which Tesch (1977) considered to be slow for *Angullids.*

Due to variable in growth rates and densities for different eel populations and other information gaps it has been concluded that future yield estimates should be derived from catch data rather than from biological and biomass estimates.

Jellyman (1994) suggested that future monitoring of the size frequencies of eel landings in certain catchments would provide valuable information on the size and

composition of stocks and exploitation rates. The determination of growth rates and age structure from eel populations in the different catchment areas would also provide data that could be incorporated into a program for monitoring the well-being of New Zealand's eel stocks (Horn 1996).

Following Jellyman's (1994) review, a commercial eel catch sampling programme was first implemented to monitor the size, age and species composition of commercial eel stocks within the different catchment areas in the 1995-96 fishing year. The sampling programme was designed to provide a time-series database of size, age and species composition that could be used in future years for formulating management decisions and assessing the status of New Zealand's eel stocks.

During the initial 1995-96 and subsequent 1996-97 and 1997-98 market sampling programmes (Beentjes and Chisnall 1997, 1998, Beentjes 1998, Chisnall and Kemp 1998), catch samples were collected from the majority of the main eel fishery catchments from both the North and South Island. However, some gaps in the data still existed, most notably from the Manawatu (one of the top five catchment area contributors annually), other lower North Island catchments and the top of the South Island. The 1999-2000 market sampling programme was therefore undertaken to fill these gaps by collecting data from those areas where little catch sampling data had been gathered in the earlier programmes. A delay in the Ministry of Fisheries awarding the contract meant that the sampling period was altered to the 1999-2000 fishing year.

11. Methods

11.1 Overall Approach

In previous eel sampling programmes, comparatively few samples had been collected for rivers in the top half of the South Island and the bottom half of the North Island. Therefore, this study focussed on collecting information from these areas where only small amounts of data had previously been collected. Catches from the lower North Island and the upper South Island were targeted. These areas produce just under one third of the total annual commercial eel landings (Jellyman 1994, Horn 1996).

The majority of the eel catch from these regions is processed through the *Levin Eel Trading Company* and this was where most of the 1999-2000 eel catch sampling effort was directed,

In order to maintain consistency of data, the methods adopted in previous commercial eel catch sampling programmes (Beentjes and Chisnall 1997, 1998) were generally followed where appropriate for this project. However, the Ministry of Fisheries requested that the removal of otoliths for ageing and sex determination be restricted to 20 eels at minimum legal size and near maximum size for each sample,

rather than from random samples from the different size classes within the catch. Details of the sampling programme and methods follow.

11.2 North Island

The 1999-2000 North Island catch sampling programme was based at *the Levin Eel Trading Company Limited* (Levin, Horowhenua). The sampling strategy employed was based on an individual landing basis due to the nature of the fishery in the lower North Island and was aimed at obtaining samples from areas that had previously not been sampled. The sampling programme in this area was highly reliant on the co-operation of the individual fishermen in the targeted areas to provide accurate information on harvest locations.

Participating fishermen were provided with maps for use in identifying harvest locations, 'Allflex' cattle ear tags for tagging catches along with instructions and data sheets to enable accurate recording of catches. Fishers were instructed to keep each catch in separate catch bags labelled using the cattle tags. Where catches were too large to be kept in bags they were kept in separate compartments of the delivery truck.

At the factory, landing weight (species unsorted) was recorded when possible and sub-samples were taken by either randomly selecting several of the holding bags or by dip netting a sample of unsorted free swimming eels from the tanker truck. For smaller landings the entire catch was sampled. In all cases, care was taken to ensure that samples were representative of the total landing. Eels were handled using standard processing methods at the factory including de-sliming which results in a estimated weight loss of 3% (Beentjes and Chisnall 1998). Species, length (to the nearest cm below) and weight (to the nearest gram below) were recorded for each eel in the sample. The twenty largest and smallest eels in each catch were also sampled for sex and maturity and saggital otoliths removed and stored in numbered plastic vials for later ageing. The samples usually contained a mix of both longfinned and shortfinned eels and these were sorted as the samples were processed.

Sex and maturity of eels was determined using the methods described in Beentjes and Chisnall (1997, 1998) with eels being categorised as either male, female or immature. If sex was assigned, they were assigned a stage from 1 to 4 based on gonad maturity described in Beentjes and Chisnall (1998).

Two methods of data recording were used depending on conditions at the factory. Where possible, voice activated data recorders were used using standard protocols to ensure all data was obtained and recorded accurately. Voice activated data recorders proved effective in most instances except when factory noise interference prevented effective use. Recorders were checked at the start of each day to ensure reliable data collection. Where conditions did not permit the use of the tape recorders, standard field sheets were used instead, with sample data recorded

manually and later keypunched into an Excel database. Data from recorders was transcribed directly into the database.

11.2.1 Length-weight relationship and condition index

The length-weight relationship for each species for each landing was determined from the equation:

$$W = ae^{bL}$$

where W is weight (g), and L is length (cm). The condition index was defined as the weight of an individual eel at a length of 45 cm (which corresponds to the minimum legal size of 220 g for longfinned eels) calculated from the length-weight relationship. No adjustment was made for the estimated 3% weight loss resulting from the de-sliming process.

11.2.2 Otolith Preparation

Otolith analysis was conducted by *Charles Mitchell and Associates* using the crack and burn method of Hu and Todd (1981). Otolith halves were mounted in silicone rubber sealant on microscope slides and observed under x10 - x100 microscope. Hyaline zones (or winter rings) were counted and age was expressed as years spent in fresh water by ignoring the central area of oceanic larval growth (Jellyman 1979).

11.2.3 Age-weight, age-length relationships and annual growth increments

Growth was described by least-squares linear regression of length at age and weight at age for samples collected from individual landings. Mean annual length and weight increments were also derived by dividing the length (minus 50 mm, the size at recruitment into freshwater) or weight by river age for each aged eel (Beentjes and Chisnall 1998).

11.3 South Island

Much of the South Island catch sampling programme was also based at the *Levin Eel Trading Company Limited* (Levin, Horowhenua) as we determined that much of the commercial eel harvest from the upper South Island was being processed through this plant. Further South Island samples were also collected from *Mossburn Enterprises Limited* (Invercargill) where catches from the upper West Coast region of the South Island were being landed. Sex, maturity and ages for South Island eels were determined in the same manner as described for the North Island samples.

12. Results

12.1 North Island

12.1.1 Sample Coverage and Species Composition

A total of 40 landings were sampled from the Lower North Island between November 1999 and April 2000 with 10 individual fishers participating in the programme. The most intensively sampled region was the Manawatu with samples obtained from most of the major rivers in the district including the Turakina River, Rangitikei River, Oroua River, Manawatu River and the Ohau River. Ten landings were also sampled from the Hawke Bay region including the Ngaruroro River, Tukituki River, and Porangahau River. Six landings were sampled in the Wairarapa/Wellington regions; from the Ruamahanga River, Hutt River, Tauherenikau River and Waiohine River. Locations of all the North Island landings sampled in the 1999-2000 programme are shown on Figure 1 along with the landing locations from previous catch sampling programmes.

A total of 4,077 eels were sampled from the North Island strata with the predominant species being shortfinned eels (81% of the catch). Median lengths and weights of the sampled catch were 57 cm and 330 g for shortfinned and 54 cm and 356 g for longfinned eels. Both length and weight data for North Island Shortfinned and Longfinned eels were skewed to the right.

The majority of the catches from the North Island contained mostly shortfinned eels (32 of the 40 landings consisted of over 50% shortfinned eels). Exceptions include the 3 landings sampled from the Waihou River catchment in the Thames Coromandel District, 1 sample from the Waiohine River and 1 from the Kopuaranga River in the Wairarapa District, which all had 10 or fewer shortfinned eels. The Ohau River landing in the Manawatu District was the only sample from the North Island to contain no shortfinned eels. Two samples collected from the Porangahau River also contained less than 50% shortfinned eels.

A number of landings (23%) from the North Island contained no longfinned eels, many of which were from lakes, ponds and dams. Landings where no longfinned eels were present included Lake Hatuma, ponds and dams in Flemington, Lake Alice, Waipukurau dam, Oroua River, Koputaroa dam 2, Papamoa drain, Turakina dam, and Lake Shannon.

In keeping with their known distribution patterns, longfinned eels were predominant in the more upland river regions of the Waihou River catchment, and the middle of the Kopuaranga and Porangahau Rivers. The dominance of longfinned eels in the lower reaches of the Ohau River was the only exception.

Shortfinned eels were dominant in the lowland reaches of river areas and also where samples were collected from ponds, dams and drains flowing to the main river systems. This is also in keeping with their known distribution patterns.

The Australasian longfinned eel *Anguilla reinhardtii* which is known to occur in the North Island was not identified from any of the landings sampled.

12.1.2 Length Frequency Distributions

Histograms depicting length distributions of the North Island shortfinned and longfinned eel catches by landing are presented in Figures 2 and 3 respectively. Mean lengths, standard errors, and ranges for shortfinned and longfinned eels are also provided by landing in Tables 1 and 2 respectively. The overall median length for the North Island shortfinned eels was 57 cm (mean of 58.6 cm) with the shortest median lengths occurring in the lower Manawatu and Hutt River drain (51 cm) and the longest median lengths from Lake Shannon (65.5 cm) and Rangiotu drain (64.5cm). The overall median length for the North Island longfinned eels was 54 cm (mean of 57.12 cm) with the shortest median lengths occurring in the lower Manawatu River (47 cm), Ruamahanga River (48.5 cm) and Turakina River (50.25 cm) and the longest median lengths from Kakahu Stream (63.5 cm), Tauherenikau River (61 cm) and Kopuaranga River (60.85 cm).

For landings where sufficient shortfinned eels were analysed in the North Island, length frequency distributions were generally unimodal between 40-70 cm with the mode most frequently found between 55-60 cm. Frequency distributions were mostly skewed to the right (mean skewness 0.58) which is likely to be due to the restrictions imposed on net mesh size effectively reducing the catch of smaller eels. A number of landings did show left skewed distributions however, including landings from the drain to the Manawatu River (skewness –0.91), Lake Shannon (skewness –0.6) and the drain to the Oroua River (skewness –0.44). Each of these landings had median lengths greater than 60 cm, which are larger than the overall mean. Some landings also showed slight bimodality in the length frequency distributions including the lower Manawatu River, Rangiotu Drain and Turakina Dam 2.

For landings where sufficient longfinned eels were analysed in the North Island, length frequency distributions were generally unimodal between 40-60 cm with the mode most frequently found between 50-55 cm. Frequency distributions were mostly skewed to the right (mean skewness 0.92) which, once again, is likely to be due to the minimum net mesh size and escape tubes which reduces the retention of smaller eels. No landings of longfinned eels showed any length frequency distributions that were skewed to the left.

12.1.3 Length and Weight Relationship

Length versus weight relationship scatter-plots for the North Island sampling program are provided in Figure 4. Where both longfinned and shortfinned eels were present in the same landing, data are plotted on the same graph in order to more clearly depict the differences in growth patterns between the two species. Trend lines have also been included on the graphs.

The overall trends in length weight relationship between the two species show that shortfinned eels are generally longer at a given weight than longfinned eels. The graphs also show the spread of lengths to weights are relatively constrained with all values falling on or close to the trendline.

12.1.4 Weight and Condition

Mean weights, standard errors, ranges, regression coefficients and condition indices are provided by landing for North Island shortfinned and longfinned eels in Tables 1 and 2 respectively. The overall median weight for the North Island shortfinned eels was 330 g (mean of 411.31 g) with the lowest median weights occurring Lake Hatuma (222.0 g) and the highest median weights from Lake Shannon (505.0 g) and Rangiotu drain (568.5 g). The overall median weight for the North Island longfinned eels was 356 g (mean of 511.32 g) with the lowest median weights occurring in the lower Manawatu River (229.0 g) and the Ruamahanga River (238.5 g) and the highest median weights from Kakahu Stream (601.5 g), Tauherenikau River (486.0 g) and Kopuaranga River (430.0 g).

Weight frequency distributions were strongly right skewed to the larger weight classes for both shortfinned (median skewness 1.54) and longfinned eels (median skewness 2.17).

Figure 5 shows the condition index of sampled North Island shortfinned and longfinned eels ranked from highest to lowest. The overall mean condition index for all catchments containing shortfinned eels was 178.6 g. Shortfinned eels with the best condition index were from Turakina dam (222.8 g), Waiomou Stream 2 (203.8 g), Rangiotu drain (198 g) and Linton Drain (194.5 g). Areas with the poorest condition index for North Island shortfinned eels were Lake Shannon (145.8 g), Lake Hatuma (156.3 g) and lower Manawatu River 3 (156.7 g).

The overall mean condition index for all catchments containing longfinned eels was 212.0 g. Longfinned eels with the best condition index were from Waiomou Stream (245.4 g), Kakahu Stream (244.2 g), and Ngaruroro River (230.4 g). Areas with the poorest condition index for North Island longfinned eels were the lower Manawatu River 3 (153.8 g), Ruamahanga River (188.1 g), lower Manawatu River (193.9 g) and Hutt River Drain (201.0 g) where enough eels were sampled.

12.2 South Island

12.2.1 Sample Coverage and Species Composition

A total of 28 landings were sampled from the Upper South Island between November 1999 and April 2000 with 5 individual fishers participating in the programme. Thirteen landings from the Nelson Marlborough region were sampled at *Levin Eel Trading Company Limited* (Levin, Horowhenua). Samples were collected from the Paturau River, Aorere River, Takaka River, Motueka River, Rai River and Wairau River. Five samples were collected from the North Canterbury region, 2 from the Waimakariri River catchment and 3 from the Heathcote River. These samples were also collected at Levin. The remaining 10 samples were obtained from eels processed at *Mossburn Enterprises Limited.* Two landings were obtained from the Buller region with the remaining 8 catches obtained from the Grey River catchment. Locations of all the South Island landings are shown on Figure 1 along with the approximate landing locations from previous catch sampling programmes.

A total of 2,508 eels were sampled from the South Island landings with the predominant species being longfinned (81% of the catch) in contrast to the high proportion of shortfinned eels sampled from the North Island. Median lengths and weights of the sampled catch were 59 cm and 374 g for shortfinned eels and 52 cm and 315 g for longfinned eels. Both length and weight data for South Island shortfinned and longfinned eels were generally skewed to the right.

The majority of the catches from the South Island contained mostly longfinned eels. Out of 28 landings, 24 consisted of over 50% longfinned eels. Exceptions include landings sampled from the Aorere River in the Nelson District, 2 samples from the Marlborough District, (Wairau River and Taylor Dam), and one from the Heathcote River in the Canterbury District, all of which had less than 50% longfinned eels. Taylor Dam in the Marlborough District was the only landing from the South Island that contained no longfinned eels.

A number of landings (21%) from the South Island contained no shortfinned eels. Landings where no shortfinned eels were present included Coal Creek, Kokatahi River, Motueka River, Seven Mile Creek, and 3 from the Paturau River.

12.2.2 Length Frequency Distributions

Histograms depicting length distributions of the South Island shortfinned and longfinned eel catches by landing are presented in Figures 6 and 7 respectively. Mean lengths, standard errors and ranges for shortfinned and longfinned eels are also provided by landing in Tables 3 and 4 respectively. The overall median length for the South Island shortfinned eels was 59 cm (mean of 61.58 cm) with the shortest median lengths occurring in the Wairau River (53.5 cm) and Heathcote River 3 (54.5 cm). The longest median lengths for shortfinned eels were from Lake Kangaroo (82.0 cm) and Lake Hordern (77.0 cm). The overall median length for the South

Island longfinned eels was 52 cm (mean of 54.80 cm) with the shortest median lengths occurring in Bradshaw Creek and Motueka River (49 cm), and Lake Brunner (50.0 cm). The longest median lengths for longfinned eels were from Lake Hordern (68.0 cm), Heathcote River 2 (62.5 cm) and Raleigh Creek (60.0 cm).

For landings where sufficient shortfinned eels were present for analysis in the South Island, length frequency distributions were generally unimodal between 50-70 cm with the mode most frequently found between 55-60 cm. Frequency distributions were mostly skewed to the right (mean skewness 0.19) which is likely to be due to the restrictions imposed on net mesh size and escape tubes reducing the retention of smaller eels.

For landings where sufficient longfinned eels were present for analysis, length frequency distributions were generally unimodal between 40-60 cm with the mode most frequently found between 50-60 cm. Frequency distributions were mostly skewed to the right (mean skewness 1.48) which, once again is likely to be due to the restrictions imposed on net mesh size and escape tubes effectively reducing the catch of smaller eels. One landing, Lake Kangaroo, showed a length frequency distributions that was skewed to the left (mean skewness –0.49). Two landings show possible slight bimodality, Upper Aorere River and Coal Creek, however the results are inconclusive.

12.2.3 Length and Weight Relationship

Length versus weight relationship scatterplots for the South Island sampling program are provided in Figure 8. Where both longfinned and shortfinned eels were present in the same landing, data are plotted on the same graph in order to more clearly depict the differences in growth patterns between the two species. Trend lines have also been included on the graphs.

The overall trends in length weight relationship between the two species show that shortfinned eels are generally longer at a given weight than longfinned eels. The graphs also show the spread of lengths to weights are relatively constrained with all values falling on or close to the trendline.

12.2.4 Weight and Condition

Mean weights, standard errors, ranges, regression coefficients and condition indices are provided by landing for South Island shortfinned and longfinned eels in Tables 3 and 4 respectively. The overall median weight for the South Island shortfinned eels was 374 g (mean of 489.16 g) with the lowest median weights occurring in Wairau River (254.5 g) and the highest median weights from the Upper Aorere River (719.0 g) and Ahaura River (675.0 g)(where enough shortfinned eels were sampled). The overall median weight for the South Island longfinned eels was 315 g (mean of

419.26 g) with the lowest median weights occurring in Bradshaw Creek (255.0 g), Motueka River (269.0 g) and Lake Brunner (273.5 g) and the highest median weights from Lake Hordern (807.0 g), Upper Aorere River (751.0 g) and Raleigh Creek (521.5 g).

Weight frequency distributions were right skewed to the heavier weight classes for both shortfinned (median skewness 0.52) and longfinned eels (median skewness 2.72).

Figure 9 shows the condition index of sampled South Island shortfinned and longfinned eels ranked from highest to lowest. The overall mean condition index for all catchments containing shortfinned eels was 198.8 g. Shortfinned eels with the best condition index were from the Heathcote River Estuary (246.6 g), Ahaura River (244.0 g), Upper Aorere River (240.1 g) and Okari River (211.5 g). Areas with the poorest condition index for South Island shortfinned eels were Taylor Dam (158.1 g), Wairau River (166.4 g) and Heathcote River 3 (173.7 g).

The overall mean condition index for all catchments containing longfinned eels in the South Island was 217.8 g. Longfinned eels with the best condition index were from the Upper Aorere River (263.8 g), Lake Hordern (262.6 g), and Seven Mile Creek (241.2 g). Areas with the poorest condition index for South Island longfinned eels were Coal Creek (189.5 g), Mid Aorere River (199.8 g), Lower Takaka River (201.0 g) and the Mid Takaka River (204.1 g).

12.3 Age and Growth

12.3.1 North Island

Otoliths from 20 eels near the minimum legal size and from the larger size classes of the individual landings (where available), were collected for ageing. Some samples were deficient in either large or small eels of the required size range resulting in a reduced number of otoliths collected for some areas. A total of 712 otolith samples were collected from the North Island, 494 from shortfinned eels and 218 from longfinned eels.

All otoliths were prepared and read by *Charles Mitchell and Associates* with independent verification of a random sample of 100 otoliths undertaken by Helen McCaughan from the *University of Auckland*. Verification of the otolith readings proved the readings to be highly consistent with a correlation coefficient of 0.94 between readers.

Scatterplots of length and age data collected during the 1999-2000 sampling round for shortfinned and longfinned eels are presented in Figures 10 and 11 respectively. There was generally a large range of scatter evident in the plots which indicates that

length or weight at age is highly variable between individuals resulting in low correlation coefficients on the regressions fitted to the plots.

Length range, age range, length at age coefficients and annual length increments are provided by landing for North Island shortfinned and longfinned eels in Table 5. Weight range, age range, weight at age coefficients, annual weight increments, calculated minimum legal size and near maximum size are provided by landing for North Island shortfinned and longfinned eels in Table 6. The overall median age at minimum legal size for the North Island shortfinned eels was 15.7 years (mean of 16.0 years) with the youngest ages at minimum legal size occurring in the Turakina Dam (6.1 years), Linton Drain (8.5 years), Drain to Manawatu River (9.6 years) and Manawatu River (10.6 years). The oldest ages at minimum legal size for North Island shortfinned eels were landings from Waiomou Stream (30.8 and 25.9 years), Hutt River Drain (25.5 years) and Lake Shannon (24.0 years).

The overall median age at near maximum size for North Island shortfinned eels was 47.7 years (mean of 48.7 years). The youngest ages at near maximum size for shortfinned eels occurred in a dam near Waipukurau (14.9 years), the dam at Turakina (16.9 years), at Wallingford 2 (18.4 years), and the Horseshoe Lake (26.9 years). The oldest ages at near maximum size for North Island shortfinned eels were landings from Turakina Dam 2 (87.1 years), Hut River Drain (72.9 years), and the Porangahau River (71.1 years).

The median annual length increments calculated from aged shortfinned eels from the North Island was 3.57 cm (mean of 3.60). Landings with the largest annual length increment were Turakina Dam (7.83 cm), Linton Drain (5.14 cm) and Rangiotu Drain (4.84 cm). Landings with the smallest annual length increment were Waiomou Stream (2.2 and 2.37 cm), Hutt River Drains (2.27 cm) and Tauherenikau River (2.44 cm). The median annual weight increments calculated from aged shortfinned eels from the North Island was 34.71 g (mean of 36.22 g). Landings with the largest annual weight increments were Turakina Dam (110.5 g), Horseshoe Lake (56.4 g) and Ngaruroro River (55.5 g). Landings with the smallest annual weight increments were Lake Hatuma (15.9 g), Waiomou Stream (15.9 and 20.5 g), Hutt River Drains (18.2 g) and Tauherenikau River (19.3 g).

The overall median age at minimum legal size for the North Island longfinned eels was 19.6 years (mean of 19.4 years) with the youngest ages at minimum legal size occurring in the Manawatu River (10.3 and 13.9 years), Tukituki River (13.5 years) and Lake Alice (14.0 years). All other sampled landings took over 14 years for longfinned eels to reach minimum legal size. The oldest ages at minimum legal size for North Island longfinned eels were landings from the drain at Tokomaru River (30.8 years), Kopuaranga River (26.5 years) and the Tauherenikau River (25.7 years).

The overall median age at near maximum size for the North Island longfinned eels was 33.5 years (mean of 35.9 years). The youngest ages at near maximum size for

longfinned eels occurred in the Tukituki River (13.6 years), Manawatu River 2 (16.8 years), and the Ngaruroro River (21.1 years) (where enough longfinned eels were present). The oldest ages at near maximum size for North Island longfinned eels were landings from Lake Alice (93.5 years), Hutt River Drain (78.0 years), and Ruamahanga river (55.7 years).

The median annual length increments calculated from aged longfinned eels from the North Island was 3.0 cm (mean of 3.1 cm). Landings with the largest annual length increment were Lower Manawatu River II (5.13 cm), Tukituki River (4.13 cm) and Ngaruroro River (3.7 cm) (where N is greater than three). Landings with the smallest annual length increment were Hutt River Drains (1.99 cm), Kopuaranga River (2.02 cm) and Turakina River (2.06 cm). The median annual weight increments calculated from aged longfinned eels from the North Island was 32.7 g (mean of 45.0 g). Landings with the largest annual weight increments were Lower Manawatu River II (129.9 g), Ngaruroro River (54.7 g) and Tauherenikau River (50.1 g) (where enough longfinned eels were sampled). Landings with the smallest annual weight increments were Ruamahanga River (16 g), Turakina River (17.1 g), and Hutt River Drain (17.9 g).

Histograms depicting landings ranked by age at minimum legal size and age at near maximum size for North Island shortfinned eels are shown in Figure 12. Histograms depicting landings ranked by age at minimum legal size and age at near maximum size for North Island longfinned eels are shown in Figure 13.

Means, standard errors and ranges for length, weight and age data collected from the smallest shortfinned and longfinned eels sampled for otoliths from each catch are provided in Table 7. Means, standard errors and ranges for length, weight and age data collected from the largest shortfinned and longfinned eels sampled for otoliths from each catch are provided in Table 8.

12.3.2 South Island

Otolith from 20 eels of approximate near minimum legal size and from the larger size classes of the individual landings (where available) were collected for ageing. Some samples contained few of the required size range resulting in a reduced number of otoliths collected for some strata. A total of 614 otolith samples were collected from the South Island, 170 from shortfinned and 444 from longfinned eels.

All otoliths were prepared and read by *Charles Mitchell and Associates* with a random sample of 100 otoliths independently verified by Helen McCaughan from the *University of Auckland.* Verification of the otolith readings showed a high degree of consistency between readers with a correlation coefficient of 0.94.

Scatterplots of length and age data collected during the 1999-2000 sampling round for South Island shortfinned and longfinned eels are presented in Figures 14 and 15

respectively. There was generally a large range of scatter evident in the plots which indicates that length or weight at age is highly variable between individuals resulting in low correlation coefficients on the regressions fitted to the plots.

Length range, age range, length at age coefficients and annual length increments are provided by landing for South Island shortfinned and longfinned eels in Table 9. Weight range, age range, weight at age coefficients, annual weight increments, calculated minimum legal size and near maximum size are provided by landing for South Island shortfinned and longfinned eels in Table 10. The overall median age at minimum legal size for the South Island shortfinned was 22.2 years (mean of 22.7 years) with the youngest ages at minimum legal size occurring in the upper Takaka River (11.8 years), Bradshaw creek (13.1 years), and the lower Aorere River (15.1). The oldest ages at minimum legal size for South Island shortfinned eels were landings from Seven Mile Creek (36.9 years) and Coal Creek (30.7 years).

The overall median age at near maximum size for the South Island shortfinned eels was 42.2 years (mean of 50.2 years). The youngest ages at near maximum size for shortfinned eels occurred in the Crooked River (8.3 years), Ahaura River (9.7 years), and Heathcote River 2 (16.3 years). The oldest eels at near maximum size for South Island shortfinned eels were landings from Heathcote river 3 (66.9 years), Taylor Dam (63.6 years), and the Bradshaw Creek (63.5 years).

The median annual length increments calculated from aged shortfinned eels from the South Island was 2.72 cm (mean of 2.79 cm). Landings with the largest annual length increments were Upper Takaka River (3.98 cm), Ahaura River (3.51 cm) and Bradshaw Creek (3.35 cm). Landings with the smallest annual length increments were Lake Brunner (2.14 cm), Lower Aorere River (2.19 cm) and Heathcote River 3 (2.38 cm). The median annual weight increments calculated from aged shortfinned eels from the South Island was 28.31 g (mean of 29.2 g). Landings with the largest annual weight increments were Upper Takaka River (52.7 g), Ahaura River (40.0 g) and Upper Aorere River (36.3 g). Landings with the smallest annual weight increments were the Lower Aorere River (17.8 g), Wairau River (19.0 g), and Taylor Dam (19.3 g).

The overall median age at minimum legal size for the South Island longfinned eels was 22.2 years (mean of 22.7 years) with the youngest eels at minimum legal size occurring in the Okari River (16.9 years), Mid Aorere River (17.5 years) and Upper Takaka River (17.6 years). The oldest longfinned eels at minimum legal size in the South Island were from the Motueka River (15.1 years), Lower Aorere River (20.5 years) and Waimakariri River (23.3 years).

The overall median age at near maximum size for South Island longfinned eels was 38.7 years (mean of 38.5 years). The youngest longfinned eels at near maximum size occurred in the Crooked River landing (8.3 years), Ahaura River (9.7 years), and the Heathcote River 2 (16.3 years). The oldest longfinned eels at near maximum

size in the South Island were from Heathcote River 3 (66.9 years), Taylor Dam (63.6 years), and Bradshaw Creek (63.5 years).

The median annual length increments calculated from aged longfinned eels from the South Island was 2.55 cm (mean of 2.52 cm). Landings with the largest annual length increment were the Upper Takaka River (3.75 cm), Upper Aorere River (3.28 cm) and Lower Aorere River (3.05 cm) (where N is greater than three). Landings with the smallest annual length increment were from Lake Brunner (1.63 cm), Coal Creek (1.68 cm) and Seven Mile Creek (1.75 cm). The median annual weight increments calculated from aged longfinned eels from the South Island was 30.17 g (mean of 30.74 g). The largest annual weight increments were from the Upper Aorere River (63.2 g), Heathcote River 3 (48.2 g) and Takaka River (44.8 g). Eels with the smallest annual weight increments were from Lake Kangaroo (12.9 g), Lake Brunner (13.2 g), and Coal Creek (15.8 g).

Histograms depicting landings ranked by age at minimum legal size and age at near maximum size for South Island shortfinned eels are shown in Figure 16. Histograms depicting landings ranked by age at minimum legal size and age at near maximum size for South Island longfinned eels are shown in Figure 17.

Means, standard errors and ranges for length, weight and age data collected from the smallest shortfinned and longfinned eels sampled for otoliths from each catch are provided in Table 11. Means, standard errors and ranges for length, weight and age data collected from the largest shortfinned and longfinned eels sampled for otoliths from each catch are provided in Table 12.

12.4 Sex and Maturity

Only those eels from which otoliths were removed were sexed during this sampling round. It is worth noting that sampling of eels for sex determination and otoliths was purposefully biased by sampling only the largest and smallest eels in each landing.

12.4.1 North Island

Table 13 provides the summary statistics for sexed eels from the North Island landings. Table 14 provides summary information on pooled North Island shortfinned and longfinned eels grouped by gonad stage. Figures 18 and 19 show the combined North Island landing size frequency of immature, male and female for shortfinned and longfinned eels, respectively. Figures 20 and 21 shows the combined North Island landing size frequency and gonad stage of immature, male and female shortfinned and longfinned eels, respectively.

Of the 492 shortfinned eels sexed from the North Island landings, 88.8% were female, 9.6% male and only 1.6% were considered to be immature. Female shortfinned eels from the North Island generally had a wide distribution of size

classes from about 45 cm to over 100 cm. The frequency distribution was bimodal with modes of approximately 55 cm and 75 cm. This bimodality was most likely due to the sampling design employed that biased against the mid-range size classes. There was a clear relationship between length and gonad maturity in North Island female shortfinned eels with the median length at maturity increasing from 50 cm for gonad stage 1, to 80.5 cm for gonad stage 4.

Of the North Island female shortfinned eels sampled, 35.2% were at gonad stage 1 (median length 50 cm), 22.4% were gonad stage 2 (median length 68.5 cm), 27.2% were gonad stage 3 (median length 74 cm) and 15.1% were at gonad stage 4 (median length 84 cm).

Only 47 male shortfinned eels were identified from the North Island. They fell into a much narrower length range with the majority in the 45-60 cm size range with a mode of around 50 cm. There was no clear relationship between length and gonad maturity in male shortfinned eels with the median length at each of the four gonad stages between 47.5 and 76.25 cm. Of the North Island male shortfinned eels sampled, 29.8% were at gonad stage 1 (median length 47.5 cm), 8.51% were gonad stage 2 (median length 47.75 cm), 29.8% were gonad stage 3 (median length 76.25 cm) and 31.9% were at gonad stage 4 (median length 48 cm).

Where sex could not be determined, shortfinned eels were classed as immature. Only eight shortfinned eels could not be sexed from the North Island landings, all of which were less than 53 cm long.

Of the 217 longfinned eels sexed from the North Island landings the overall proportions of sexes were 41.9% female and 46.5% male. Only 11.5% were considered to be immature. Female longfinned eels from the North Island generally had a wide distribution of size classes ranging from about 50 cm to over 120 cm. The frequency distribution was unimodal with a peak of between 80-90 cm in length. There was a clear relationship between length and gonad maturity in North Island female longfinned eels with the median length at maturity increasing from 59.5 cm for gonad stage 1 to 98.5 cm for gonad stage 4. Of the North Island female longfinned eels sampled, 26.4% were at gonad stage 1 (median length 59.5 cm), 38.5% were gonad stage 2 (median length 78 cm), 20.9% were at gonad stage 3 (median length 85 cm) and 14.3% were at gonad stage 4 (median length 98.5 cm).

A total of 101 male longfinned eels were identified from the North Island. They had a narrow range of lengths with most between 45 and 60 cm and a mode between 45-50 cm. There was a slight relationship between length and gonad maturity in North Island male longfinned eels with the median length at maturity increasing from 47 cm for gonad stage 1 to 68 cm for gonad stage 4. Of the North Island male longfinned eels sampled, 36.6% were at gonad stage 1 (median length 47 cm), 39.7% were gonad stage 2 (median length 48 cm), 20.8% were at gonad stage 3 (median length 52 cm) and 12.9% were at gonad stage 4 (median length 68 cm).

Where sex could not be determined, longfinned eels were classed as immature. Only 25 longfinned eels could not be sexed from the North Island landings, all of which were less than 53 cm long.

12.4.2 South Island

Table 15 provides the summary statistics for sexed eels from the South Island landings. Table 16 provides summary information on pooled South Island shortfinned and longfinned eels grouped by gonad stage. Figures 22 and 23 show the combined South Island landing size frequency of immature, male and female shortfinned and longfinned eels, respectively. Figures 24 and 25 show the combined South Island landing size frequency and gonad stage of immature, male and female shortfinned and longfinned eels, respectively.

Of the 170 shortfinned eels sexed from the South Island landings, 93.5% were female and 5.9% male. Only 0.6% were considered to be immature. Female shortfinned eels generally had a wide distribution of sizes from about 50 cm to over 90 cm. The frequency distribution was similar to the results from the North Island, being bimodal with one mode at around 55 cm and another around 75 cm. This bimodality was most likely due to the sampling design which was biased against the mid-range size classes. There was a clear relationship between length and gonad maturity in South Island female shortfinned eels with the median length at maturity increasing from 53 cm for gonad stage 1 to 84 cm for gonad stage 4. Of the South Island female eels sampled, 27% were at gonad stage 1 (median length 53 cm), 35.2% were gonad stage 2 (median length 65.5 cm), 25.2% were at gonad stage 3 (median length 77 cm) and 12.6% were at gonad stage 4 (median length 84 cm).

Only 10 male shortfinned eels were identified from the South Island. They had a narrow length range with most between 45 and 60 cm. There was no clear relationship between length and gonad maturity in male shortfinned eels. Two South Island male shortfinned eels were gonad stage 1 (median length 49 cm), only one was sampled at gonad stage 2 (length 49 cm), four were gonad stage 3 (median length 67 cm) and three were at gonad stage 4 (median length 49 cm).

Where sex could not be determined, eels were classed as immature. Only one shortfinned eel measuring 40 cm could not be sexed from the South Island landings.

Of the 454 longfinned eels sexed from the South Island landings, 42.7% were female and 41.2% male. A total of 16.1% were considered to be immature. Female longfinned eels from the South Island generally spanned a wide range of sizes from about 50 cm to over 110 cm. The frequency distribution was unimodal with a peak between 70-80 cm in length. There was a clear relationship between length and gonad maturity in South Island female longfinned eels with the median length at maturity increasing from 60 cm for gonad stage 1 to 94 cm for gonad stage 4. Of the South Island female longfinned eels sampled, 30.9% were at gonad stage 1 (median

length 60 cm), 39.2% were gonad stage 2 (median length 73 cm), 20.6% were gonad stage 3 (median length 81 cm) and 9.28% were at gonad stage 4 (median length 94 cm).

In total, 187 male longfinned eels were identified from the South Island. They were smaller and spanned a much narrower length range than females, with most between 45-70 cm and a clearly defined modal length between 45 and 50 cm. As with South Island male shortfinned eels, there was also no clear relationship between length and gonad maturity in South Island male longfinned eels. Of South Island male shortfinned eels sampled, 45.5% were at gonad stage 1 (median length 49 cm), 23% were gonad stage 2 (median length 47 cm), 17.6% were gonad stage 3 (median length 49 cm) and 13.9% were at gonad stage 4 (median length 48.5 cm).

Where sex could not be determined, the eels were classed as immature. In total, 73 longfinned eels could not be sexed from the South Island landings, most of which were less than 55 cm long.

13. Discussion

13.1 North Island

Catch sampling from the lower North Island was based at the *Levin Eel Trading Company Limited (Levin, Horowhenua)* which receives the majority of the eel catch from the region along with a good percentage of the catch from the upper South Island. Excellent support was given to the project from Mark Kuijten and his team at the processing factory which enabled a good spread of landings to be sampled. A total of 40 samples were obtained from North Island locations, the majority coming from areas that had previously had no catch sample information attributable to them.

Overall, individual fisher support from the region was mixed with some apprehension towards the incoming QMS system for eels reducing the support level from some fishers. However those who did contribute to the program provided sufficient catch details to allow the harvest location to be accurately established. Their support ensured the success of the programme. It was initially anticipated that some landings from the Hawke Bay region may have been able to be sampled from an Auckland based eel processing factory. However this was not possible due to an inability of the company concerned to separate individual catches during transportation.

A number of areas in the lower North Island also have strong Maori management involvement with little or no commercial catch taken from those areas. These areas included the Wanganui River and Lake Horowhenua in particular, from which no harvest information was available.

Shortfinned eels were the predominant species landed by commercial fishers in the lower North Island during this catch sampling round which is consistent with previous catch sampling surveys (Beentjes and Chisnall 1997, 1998, Beentjes 1998, Chisnall and Kemp 1998), and also with the nature of the waterways from which catches were sampled. The majority of the landings were from lowland waters or from slower moving water habitats such as drains to main rivers, ponds and dams. These habitats are generally considered to be the preferred habitat types for shortfinned eels.

Longfinned eels generally prefer faster moving, more inland waters (McDowell 1990). Landings where longfinned eels were the predominant species were typically from inland waters including those landings from the upper reaches of the Hauraki Plains rivers and the inland Kopuaranga River landing in the Wairarapa district. The Ohau River was an exception to the above distributions with the catch coming from a relatively lowland site but consisting exclusively of longfinned eels. The Ohau River has a relatively steep catchment and is moderately fast flowing, a preferred habitat type for longfinned eels. Two landings from the Porangahau River had mixed catches containing both longfinned and shortfinned eels.

The average length and condition of both species from the lower North Island landings were similar to those reported from North Island landings in the past. Size frequency distributions were skewed towards the smaller sizes which appears to be a common feature for eel populations from lowland habitats (Beentjes and Chisnall 1998). Direct comparison with previous landings from similar areas is of limited value due to the inherent variability of eel populations both between and within similar locations. For example, two samples were collected from different dams in the Turakina region, one of which had the best condition index while the other had a condition index below the median.

Age and growth information from these regions of the North Island are generally comparable with those previously reported. Growth was typically variable for both shortfinned and longfinned eels sampled from the lower North Island. Areas with the fastest calculated growth rates for both shortfinned and longfinned eels were from the lower Manawatu River catchment with the lowland main river drains supporting noticeably faster growth rates for shortfinned eels. Growth rates of shortfinned eels generally exceeded those of longfinned eels.

Maturity information shows a generally trend towards greater gonad maturity with length for both shortfinned and longfinned males and females.

Several shortfinned and longfinned eels sexually differentiated as males during this sampling round (and also during previous sampling rounds) exceeded the size generally associated for the sex. It is possible that the macroscopic gonad identification method may result in some mis-reporting of the sexes. In future sampling programmes it may be worthwhile to preserve samples from suspected

large male eels for later confirmation of sex using microscopic analysis. This would help verify the size range of mature male eels for both species in New Zealand.

13.2 South Island

Catch sampling from the upper South Island was conducted at the Levin Eel Trading Company Limited (Levin, Horowhenua) and also at Mossburn Enterprises Limited (Invercargill). Difficulties in obtaining samples meant that the number of landings sampled was much lower than planned. The upper South Island eel fishery differs from most eel landing areas in New Zealand with no large scale eel processing factories present in the region to receive landings directly from the fishermen. Eel landings are therefore transported considerable distances for processing, either north to Levin or to processing factories in the lower South Island. Eel collections for processing are also intermittent which in some circumstances can make it difficult for fishermen to keep individual catches in bags for the extended period of time before collection. The upper South Island fishery also contributes a relatively small percentage of the total annual eel catch and fishers do not regularly fish some of the areas where samples were sought. These factors reduced opportunities to collect samples from some of the targeted South Island catchments.

Longfinned eels were the predominant species landed by commercial fishers in the upper South Island during this sampling period. This species composition is consistent with previous surveys (Beentjes and Chisnall 1997, 1998, Beentjes 1998, Chisnall and Kemp 1998). It was also consistent with the habitat distribution of the sampled catches, most of which were collected from the main stems of rivers. Only a small number of South Island landings were dominated by shortfinned eels. Taylor Dam in the Marlborough region was the only landing consisting entirely of shortfinned eels. Lake Otarawao, the only other lowland lake previously sampled in the Marlborough region also contained mostly shortfinned eels. The lower reaches of the Aorere River, Wairau River and Heathcote river also had over 50% shortfinned eels, these areas being mostly lowland in nature. Lake Brunner also had a large number of shortfinned eels in the sampled landing though the catch was still dominated by longfinned eels. Samples from Lake Brunner during previous surveys also found a well mixed catch composition of both shortfinned and longfinned eels (Beentjes and Chisnall 1997, 1998).

The average length and condition of both species of eels from the upper South Island landings were similar to those previously reported in the past from the lower South Island. Size frequency distributions were typically dominated by the smaller size classes of between 50-60 cm length. This appears to be a common trend throughout much of the New Zealand fishery. Longfinned eels generally had the higher condition index as would be expected from the different growth strategies of the two species.

Age and growth results for the South Island samples were similar to the North Island, being variable for both shortfinned and longfinned eels. Unlike the North Island however, the calculated mean age at minimum legal size was similar for both species while calculated age at near maximum size was younger for shortfinned than longfinned eels. Maturity information collected also showed a general trend towards greater gonad maturity with increased length for both shortfinned and longfinned eels. Male shortfinned eels were scarce in the catches examined from the upper South Island.

14. Acknowledgements

This research was funded by the Ministry of Fisheries contract EEL9801. A special acknowledgement is made to Mark Kuijten and his team at Levin for all their assistance and support during the project. Thanks also go to Mossburn Enterprises and to the many commercial eel fishermen in the North and South Islands who contributed catch information and made catches available for sampling. We also acknowledge the valuable contribution of Charles Mitchell.

15. References

Beentjes, M. P.; Chisnall, B. L. 1997: Trends in size and species composition and distribution of commercial eel catches. New Zealand Fisheries Data Report No. 89

Beentjes, M. P.; Chisnall, B. L. 1998: Size, age and species composition of commercial eel catches from market sampling. NIWA Technical Report No. 29

Burnett, A. M. R. 1969: The growth of New Zealand freshwater eels in three Canterbury streams. New Zealand journal of marine and freshwater research 3: 376-384.

Cairns, D. 1941: Life history of two species of New Zealand freshwater eel: Taxonomy, age, growth, migration and distribution. New Zealand journal of science and technology 23B: 53-72.

Chisnall, B. L. and Hayes, J. W.. 1991: Age and growth of shortfinned eels (*Anguilla australis)* in the lower Waikato basin, North Island, New Zealand. New Zealand journal of marine and freshwater research 25: 71-80.

Chisnall, B. L. and Hicks, B. J. 1993: Age and growth of long finned eels (*Anguilla dieffenbachii*) in pastoral and forested streams in the Waikato basin, and in two hydro-electric lakes in the North Island, New Zealand. New Zealand journal of marine and freshwater research 27: 331-346.

Horn, P. L., 1994: A review of age and growth data for New Zealand freshwater eels (*Anguilla spp.*). New Zealand Fisheries Assessment Research Document No. 96/6. pp 23.

Hu, L. C., Todd, P. R.; 1981: An improved technique for preparing eel otoliths for ageing. New Zealand journal of marine and freshwater research 15: 445-446.

Jellyman, D. J. 1979: Scale development and age determination in New Zealand freshwater eels (Anguilla spp). New Zealand journal of marine and freshwater research 13: 23-30.

Jellyman, D. J. 1993: A review of the fishery for freshwater eels in New Zealand. New Zealand freshwater research report No. 10. pp 51.

Jellyman, D. J. 1994: The fishery for freshwater eels (*Anguilla spp.*) in New Zealand. New Zealand Fisheries Assessment Research Document No. 94/14. pp 15.

Jellyman, D. J., Chisnall, B. L., Todd, P. R., 1995: The status of the eel stocks of Lake Ellesmere. NIWA Science and Technology Series 26. pp 62.

McDowall, R. M.; 1990: New Zealand Freshwater Fishes: A natural history and guide. Heinemann Reed MAF publishing group Auckland 1993.

Tesch, F. W.; 1977: The eel. Biology and management of anguillid eels. Chapman and Hall, London. 434 p.

Todd, P. R.; 1980: Size and age of migrating New Zealand freshwater eels (Anguilla spp. New Zealand journal of marine and freshwater research 14: 283-293.

Town, J. C. 1985: Commercial freshwater eel fishery. New Ministry of Agriculture and Fisheries FMP Series No. 12 pp 24.

16. Data Storage

Data and otoliths from EEL9801 have been provided to the Ministry of Fisheries for storage in the Ministry's database.

Table 1: Length, weight, regression coefficients and condition index for shortfinnned eels from the North Island. (N= number, SE= standard error).

Area	N	Length Mean	Length SE	Length Range	Weight Mean	Weight SE	Weight Range	Equation constant	Equation e^x	R^2	Condition Index (g)
Buckleys Drain	122	60.8	1.1	39-96	481.4	27.2	114-1432	20.52	0.049	0.97	186.9
Drain to Manawatu River	15	59.6	2.5	47-79	561.3	94.9	241-1609	14.73	0.057	0.94	187.2
Drain to Oroua River	67	58.7	1.0	47-79	410.8	28.1	189-1097	15.01	0.054	0.94	172.1
Flemington	111	54.3	1.1	37-99	447.9	38.2	106-2671	19.26	0.050	0.95	184.3
Horseshoe Lake	64	53.4	0.9	38-74	283.6	17.0	93-731	19.30	0.051	0.96	188.2
Hutt River Drains	107	56.9	0.9	44-97	481.9	35.5	182-2807	8.14	0.067	0.97	165.3
Kakahu Stream	88	63.2	0.9	46-82	500.9	23.3	183-1207	-	-	-	-
Kaputaroa Dam	44	57.6	1.7	47-94	512.7	77.0	206-2624	16.00	0.053	0.96	176.1
Kaputaroa Dam 2	33	62.6	1.4	49-84	472.7	38.2	212-1170	16.86	0.053	0.95	185.5
Kopuaranga River	1	56.0	-	56-56	385.0	-	385-385	-	-	-	-
Lake Alice	88	63.9	1.0	44-84	556.6	27.6	179-1253	18.70	0.050	0.97	177.4
Lake Hatuma	3	62.0	13.0	48-88	841.0	590.0	238-2021	16.77	0.050	0.81	156.3
Lake Shannon	34	59.9	1.8	44-89	450.8	58.5	190-1978	11.52	0.056	0.97	145.8

Table 1 cont.

Area	N	Length Mean	Length SE	Length Range	Weight Mean	Weight SE	Weight Range	constant	Equation e^x	R^2	Condition Index (g)
Linton Drain	16	50.1	1.5	43-66	280.7	34.3	165-679	19.86	0.051	0.98	194.5
Manawatu River	110	54.6	0.7	45-94	318.8	19.1	169-1782	17.74	0.052	0.94	187.5
Manawatu River (floodplain)	36	63.3	2.2	45-91	648.5	74.9	171-1700	16.49	0.054	0.95	184.8
Manawatu River (lower 2)	61	59.9	0.8	44-72	400.6	16.2	163-666	12.98	0.056	0.96	163.6
Manawatu River (lower 3)	3	65.3	11.0	47-85	931.0	532.5	227-1975	13.98	0.054	0.96	156.7
Manawatu River (lower)	29	61.5	2.4	47-89	484.3	64.0	174-1197	18.97	0.050	0.96	181.6
Ngaruroro River	2	93.8	4.8	89-98.5	2434.0	621.0	1813-3055	15.45	0.054	0.97	174.0
Papamoa Drain	91	58.9	0.8	36-81	410.4	19.2	77-1088	13.18	0.056	0.94	161.7
Porangahau River	25	58.4	2.1	46-84	550.8	74.5	223-1834	21.19	0.049	0.95	189.6
Porangahau River 2	284	55.4	0.5	36-94	344.4	11.7	66-1919	20.49	0.049	0.95	183.3
Rangiotu Drain	48	64.1	2.6	44-110	734.7	102.1	181-3157	21.73	0.049	0.94	198.0
Rangitikei River Drain	1	62.0	-	62-62	622.0	-	622-622	20.01	0.049	0.96	183.1
Ruamahanga River	82	62.7	0.9	46-78.5	497.7	24.2	179-1003	16.93	0.052	0.95	175.7

Table 1 cont.

Area	N	Length Mean	Length SE	Length Range	Weight Mean	Weight SE	Weight Range	Equation constant	Equation e^x	R^2	Condition Index (g)
Tauherenikau River	24	53.9	2.0	45.5-90	417.0	75.4	204-2002	16.60	0.052	0.95	174.6
Tokomaru River	74	57.4	0.9	45.5-82.5	377.8	22.5	173-1142	18.26	0.050	0.98	170.9
Tokomaru River Drain	115	56.2	1.0	42-105	446.7	33.6	139-2532	18.23	0.051	0.95	183.4
Tukituki River	1	77.5	-	77.5-77.5	946.0	-	946-946	14.25	0.056	0.94	173.9
Turakina Dam	25	57.2	3.0	43-122	571.2	184.0	185-4933	30.91	0.044	0.99	222.8
Turakina Dam 2	11	57.3	2.9	47-75	404.1	72.5	181-850	15.97	0.053	0.97	175.8
Turakina River	58	55.5	1.0	45-77	434.6	29.9	200-1298	18.34	0.051	0.96	182.0
Waiohine River	6	62.8	4.2	44-71	507.5	78.9	200-738	-	-	-	-
Waiomou Stream	119	62.1	0.9	45-86	456.2	20.4	143-1208	12.13	0.059	0.98	169.4
Waiomou Stream 2	1	51.0	-	51-51	292.0	-	292-292	25.15	0.047	0.98	203.8
Waipukarau Dam	151	64.1	0.7	48-92	505.5	20.3	210-1731	14.75	0.053	0.97	162.3
Wallingford 1	9	61.1	4.0	46-82	579.9	145.5	207-1486	20.01	0.049	0.87	179.9
Wallingford 2	133	64.9	0.8	47-90	526.2	24.7	160-1786	18.15	0.050	0.95	172.2

Table 2: Length, weight, regression coefficients and condition index for longfinned eels from the North Island. (N= number, SE= standard error).

Area	N	Length Mean	Length SE	Length Range	Weight Mean	Weight SE	Weight Range	Equation constant	Equation e^x	R^2	Condition Index (g)
Buckleys Drain	4	60.0	7.8	**49-82**	641.5	291.1	244-1493	21.22	0.052	0.99	223.3
Drain to Manawatu River	45	59.8	1.6	47-86	445.1	39.3	200-1315	-	-	-	-
Horseshoe Lake	1	48.0	-	48-48	271.0	-	271-271	-	-	-	-
Hutt River Drains	50	60.1	1.1	34-75	476.4	24.2	68-896	17.30	0.055	0.97	201.0
Kakahu Stream	54	62.2	1.1	41-80	477.6	25.8	103-1076	33.41	0.044	0.97	244.2
Kaputaroa Dam	110	63.1	0.9	35-84	507.3	21.3	67-1356	-	-	-	-
Kopuaranga River	1	47.0	-	47-47	218.0	-	218-218	21.63	0.051	0.96	213.7
Lake Alice	91	61.0	1.0	42-97	475.3	29.0	139-1896	-	-	-	-
Manawatu River	11	56.2	3.4	45-83	452.9	106.4	186-1380	-	-	-	-
Manawatu River (floodplain)	91	50.4	0.9	33-72	274.0	14.9	52-751	-	-	-	-
Manawatu River (lower 2)	24	67.5	2.9	50-99	803.1	109.9	241-2143	25.44	0.047	0.98	213.8
Manawatu River (lower 3)	1	68.0	-	68-68	610.0	-	610-610	4.09	0.081	0.95	153.8
Manawatu River (lower)	1	80.0	-	80-80	1285.0	-	1285-1285	9.55	0.067	0.98	193.9
Ngaruroro River	55	55.9	1.2	39-82	356.1	25.7	103-1062	23.53	0.051	0.83	230.4

Table 2 cont.

Area	N	Length Mean	Length SE	Length Range	Weight Mean	Weight SE	Weight Range	Equation constant	Equation e^x	R^2	Condition Index (g)
Ohau River	49	59.5	0.8	47-71	422.6	19.9	212-756	19.24	0.054	0.95	215.6
Porangahau River	94	60.9	1.5	35-106	641.0	58.0	71-3346	20.70	0.053	0.97	221.7
Porangahau River 2	1	69.0	-	69-69	581.0	-	581-581	20.40	0.052	0.97	208.9
Rangiotu Drain	2	51.0	4.0	47-55	317.0	95.0	222-412	-	-	-	-
Rangitikei River Drain	189	59.9	0.9	41-99	452.1	22.4	125-2069	18.21	0.054	1.00	202.2
Ruamahanga River	243	52.2	0.3	40-67	229.1	3.4	99-489	10.95	0.063	0.95	188.1
Tauherenikau River	61	64.3	1.6	37-87	531.1	38.3	68-1619	22.56	0.050	0.97	211.1
Tokomaru River	36	63.5	1.7	50-88	573.8	55.3	252-1484	15.55	0.057	1.00	202.2
Tokomaru River Drain	2	58.5	1.5	57-60	529.0	68.0	461-597	-	-	-	-
Tukituki River	54	55.3	1.0	45-75	335.0	19.0	186-727	19.39	0.054	0.96	224.3
Turakina Dam 2	1	48.0	-	48-48	260.0	-	260-260	-	-	-	-
Turakina River	135	58.1	0.7	44-84	412.4	18.2	175-1350	21.52	0.052	0.95	220.4
Waiohine River	18	58.0	4.4	44-115	719.3	286.4	163-4725	20.78	0.051	0.95	209.0
Waiomou Stream	227	52.5	0.6	37-85	285.5	11.5	84-1110	38.26	0.041	0.96	245.4

Table 2 cont.

Area	N	Length Mean	Length SE	Length Range	Weight Mean	Weight SE	Weight Range	Equation constant	Equation e^x	R^2	Condition Index (g)
Waiomou Stream 2	6	50.3	1.3	46-54	243.5	27.8	174-341	18.50	0.055	0.93	220.7
Wallingford 1	95	56.0	1.0	37-91	338.5	27.8	79-2010	14.05	0.057	0.99	184.3
Wallingford 2	33	48.6	1.3	36-73	283.2	33.4	92-1129	-	-	-	-

Table 3: Length, weight, regression coefficients and condition index for shortfinned eels from the South Island. (N= number, SE= standard error).

Area	N	Length Mean	Length SE	Length Range	Weight Mean	Weight SE	Weight Range	Equation constant	Equation e^x	R^2	Condition Index (g)
Ahaura River	37	59.6	1.6	49-96	559.8	75.6	249-2876	38.56	0.041	0.96	244.0
Aorere River (lower)	12	60.4	3.4	49-92	505.9	116.2	263-1695	17.19	0.053	0.92	185.0
Aorere River (mid)	135	54.6	0.7	43-89	397.6	22.0	172-1799	-	-	-	-
Aorere River (upper)	137	51.3	0.6	40-89	316.2	16.6	152-1929	35.63	0.042	0.88	240.1
Bradshaw Creek	132	54.4	0.8	39-96	416.1	29.1	135-2322	19.64	0.050	0.98	183.0
Crooked River	106	53.2	0.8	41-91	396.0	31.1	165-2114	22.34	0.048	1.00	193.7
Heathcote River	34	62.9	1.7	49-84	543.7	51.4	235-1449	40.21	0.040	0.95	246.6
Heathcote River 2	36	61.0	1.6	37-87	579.1	54.5	87-1827	20.03	0.050	0.97	186.6
Heathcote River 3	1	65.0	-	65-65	490.0	-	490-490	10.67	0.062	0.96	173.7
Lake Brunner	15	64.2	4.4	52-106	752.1	207.3	284-2765	19.93	0.050	0.94	190.8
Lake Hordern	146	54.1	0.8	39-106	395.4	33.7	118-3233	27.23	0.045	0.98	204.5
Lake Kangaroo	7	67.0	3.4	56-79	611.7	92.7	340-928	27.10	0.045	0.99	204.4
Okari River	153	51.7	0.5	43-74	327.9	13.2	151-1234	27.42	0.045	0.99	211.5

Table 3 cont.

Area	N	Length Mean	Length SE	Length Range	Weight Mean	Weight SE	Weight Range	Equation constant	Equation e^x	R^2	Condition Index (g)
Rai River	1	51.0	-	51-51	232.0	-	232-232	20.60	0.050	0.98	195.4
Raleigh Creek	91	52.6	0.6	44-76	340.4	13.3	175-926	-	-	-	-
Takaka River (lower)	31	71.1	2.4	40-92	779.7	80.6	104-1631	26.81	0.046	0.99	208.7
Takaka River (mid)	101	55.2	0.6	46-79	294.9	13.3	150-1042	-	-	-	-
Takaka River (upper)	140	53.1	0.6	43-91	380.3	22.8	190-2561	21.77	0.048	0.98	186.2
Taylor Dam	2	60.0	9.0	51-69	481.0	249.0	232-730	13.67	0.054	0.92	158.1
Waimakariri River	3	63.0	11.0	51-85	645.7	339.9	284-1325	-	-	-	-
Wairau River	48	55.9	1.1	46-87	316.9	28.2	176-1381	17.30	0.050	0.93	166.4

Table 4: Length, weight, regression coefficients and condition index for longfinned eels from the South Island. (N= number, SE= standard error).

Area	N	Length Mean	Length SE	Length Range	Weight Mean	Weight SE	Weight Range	Equation constant	Equation e^x	R^2	Condition Index (g)
Ahaura River	60	54.5	0.6	47-71	384.9	16.6	220-984	18.23	0.055	0.92	218.5
Aorere River (lower)	16	66.9	2.4	51-83	642.8	62.0	285-1111	21.48	0.051	0.97	210.3
Aorere River (mid)	54	55.5	1.5	39-102	439.9	57.0	112-2872	19.16	0.052	0.94	199.8
Aorere River (upper)	57	62.9	0.9	48-76	507.0	25.2	261-1029	32.99	0.046	0.98	263.8
Bradshaw Creek	164	54.9	0.5	42-83	360.0	13.5	171-1374	19.46	0.054	0.94	222.0
Coal Creek	2	58.5	3.5	55-62	416.5	106.5	310-523	15.18	0.056	0.97	189.5
Crooked River	36	70.1	2.0	47-100	987.8	105.1	235-3050	27.24	0.048	0.95	232.0
Heathcote River	26	70.3	1.7	54-91	754.9	58.7	362-1518	19.36	0.054	0.96	215.9
Heathcote River 2	21	50.9	2.1	39-81	361.3	60.5	121-1342	19.49	0.053	0.98	210.7
Heathcote River 3	7	61.3	4.6	46-74	474.6	95.3	170-816	23.56	0.049	0.97	208.9
Kokatahi	39	55.9	1.5	44-81	410.7	44.4	166-1274	28.43	0.047	0.94	236.7
Lake Brunner	23	57.4	2.3	48-95	506.9	93.8	254-2285	21.21	0.052	0.79	216.2
Lake Hordern	3	62.7	6.2	56-75	495.3	159.9	330-815	34.35	0.045	0.96	262.6

Table 4 cont.

Area	N	Length Mean	Length SE	Length Range	Weight Mean	Weight SE	Weight Range	Equation constant	Equation e^x	R^2	Condition Index (g)
Lake Kangaroo	70	60.4	1.1	45-82	560.7	36.2	219-1490	12.82	0.062	0.92	206.0
Motueka River	4	59.1	3.5	54-69.5	451.3	71.9	355-661	15.03	0.058	0.89	207.2
Okari River	43	64.2	2.0	44-92	740.0	83.9	169-2529	25.95	0.049	0.95	233.2
Paturau River (lower)	26	64.0	2.5	47-93	593.3	85.4	194-1891	20.22	0.052	0.96	213.7
Paturau River (mid)	42	59.6	2.3	44-114	613.6	122.4	164-4559	18.96	0.053	0.95	207.7
Paturau River (upper)	14	56.1	2.0	47-69	386.3	52.8	193-834	20.31	0.052	0.94	213.7
Rai River	42	59.2	1.5	48-102	534.1	62.0	251-2533	22.76	0.051	0.95	225.9
Raleigh Creek	70	51.9	0.8	43-72	337.2	20.4	184-987	16.29	0.056	0.94	204.3
Seven Mile Creek	64	61.1	0.8	49-80	453.2	22.5	258-1125	35.80	0.042	0.97	241.2
Takaka River (lower)	29	70.1	2.2	49-100	942.3	104.0	265-2677	18.85	0.053	0.96	201.0
Takaka River (mid)	8	75.3	4.4	56-90	897.3	154.6	318-1436	15.35	0.058	0.94	204.1
Takaka River (upper)	21	54.3	0.9	43-62.3	377.8	20.5	161-559	19.81	0.053	0.87	216.1
Waimakariri River	8	78.1	3.9	61-88	989.6	139.9	410-1358	17.32	0.056	0.95	215.3
Wairau River	191	50.4	0.4	41-79	303.5	10.0	146-1257	30.05	0.045	1.00	223.6

Table 5: Age range, length range, length at age coefficients and annual length increments for shortfinned and longfinned eels from the North Island. (N= number, MLI= mean annual length increment).

Area	Spp	N	Age Range	Length Range	Slope	Intercept	R^2	MLI
Buckleys Drain	Longfin	1	21-21	82-82	-	-	-	3.7
	Shortfin	15	10-37	47-86	0.319	-3.5	0.45	3.7
Drain to Manawatu River	Longfin	1	17-17	48-48	-	-	-	2.5
	Shortfin	14	9-22	41-75	0.336	-6.3	0.62	4.1
Drain to Oroua River	Shortfin	15	10-33	44-80	0.281	-0.7	0.31	3.6
Flemington	Shortfin	14	8-26	46-84	0.306	-3.3	0.73	3.7
Horseshoe Lake	Longfin	1	12-12	47-47	-	-	-	3.5
	Shortfin	13	10-25	49-97	0.122	6.8	0.16	4.5
Hutt River Drain	Longfin	8	15-36	45-83	0.491	-5.8	0.87	2.4
	Shortfin	14	20-42	47-72	0.322	9.4	0.16	2.0
Kakahu Stream	Longfin	8	18-46	50-99	0.214	11.2	0.20	2.7
	Shortfin	1	19-19	68-68	-	-	-	3.3
Kopuaranga River	Longfin	20	17-53	44-106	0.258	14.5	0.39	2.0
Koputaroa Dam	Longfin	1	21-21	80-80	-	-	-	3.6
	Shortfin	19	15-30	46-82	0.201	7.9	0.46	2.8
Koputaroa Dam 2	Shortfin	11	16-27	47-71	0.061	16.5	0.02	2.9
Lake Alice	Longfin	2	14-18	47-55	0.500	-9.5	1.00	2.9
	Shortfin	20	11-45	47-99	0.311	2.5	0.38	2.9
Lake Hatuma	Shortfin	20	12-21	40-67	0.176	6.5	0.45	3.0
Lake Shannon	Shortfin	12	18-45	55-87	0.188	12.0	0.05	2.8
Linton Drain	Shortfin	17	8-28	50-88	0.269	-5.1	0.53	5.1

Table 5 cont.

Area	Spp	N	Age Range	Length Range	Slope	Intercept	R^2	MLI
Manawatu River	Longfin	2	17-18	57-60	-0.333	37.0	1.00	3.1
	Shortfin	20	7-21	45-75	0.283	-3.2	0.62	4.1
Manawatu River (floodplain)	Shortfin	20	8-23	47-84	0.120	6.9	0.13	4.3
Manawatu River (lower)	Longfin	17	9-22	45-73	0.167	5.8	0.10	3.4
	Shortfin	20	8-28	44-96	0.227	1.4	0.66	3.8
Manawatu River (lower) 2	Longfin	4	10-19	47-115	0.107	5.2	0.88	5.1
Ngaruroro River	Longfin	5	15-19	64-79	0.085	11.8	0.11	3.7
	Shortfin	6	12-29	73-79	1.673	-109.0	0.40	4.1
Ohau River	Longfin	19	13-31	38-99	0.244	6.6	0.83	2.5
Papamoa Drain	Shortfin	12	9-30	50-74	0.337	-0.9	0.25	3.2
Porangahau River	Longfin	20	12-22	44-97	0.087	11.1	0.23	3.5
	Shortfin	20	10-32	46-82	0.379	-1.1	0.69	2.6
Porangahau River 2	Longfin	2	26-27	92-94	0.500	-20.0	1.00	3.3
Rangiotu Drain	Shortfin	18	7-22	46.5-84	0.192	0.9	0.35	4.8
Rangitikei River Drain	Longfin	3	21-24	48-88	0.063	18.4	0.86	2.5
	Shortfin	11	11-37	47-89	0.045	19.5	0.01	2.8
Ruamahanga River	Longfin	7	15-27	48-66	0.217	9.9	0.15	2.3
	Shortfin	18	12-25	49-94	0.165	8.8	0.36	2.8
Tauherenikau River	Longfin	14	21-36	45-91	0.091	21.3	0.09	2.4
	Shortfin	12	12-25	44-72	0.251	3.6	0.30	3.1

Table 5 cont.

Area	Spp	N	Age Range	Length Range	Slope	Intercept	R^2	MLI
Tokomaru River	Longfin	3	13-18	47-85	0.126	8.1	0.70	3.7
	Shortfin	12	9-26	47-89	0.198	6.3	0.52	3.2
Tokomaru River Drain	Longfin	2	24-27	89-98.5	-0.316	55.1	1.00	3.5
	Shortfin	14	9-23	50-81	0.169	4.2	0.16	4.2
Tukituki River	Longfin	20	8-19	46-84	-0.001	13.6	0.00	4.2
	Shortfin	20	8-34	42-94	0.280	-2.0	0.65	3.8
Turakina Dam	Shortfin	18	4-15	44-110	0.114	0.5	0.78	7.8
Turakina Dam 2	Longfin	1	19-19	62-62	-	-	-	3.0
	Shortfin	20	9-32	46-78.5	0.537	-15.2	0.65	3.5
Turakina River	Longfin	19	14-30	45.5-90	0.204	9.2	0.40	2.4
	Shortfin	19	17-32	45.5-82.5	0.306	5.5	0.49	2.3
Waiohine River	Longfin	19	18-33	43.5-105	0.135	15.4	0.30	2.4
	Shortfin	1	26-26	77.5-77.5	-	-	-	2.8
Waiomou Stream	Longfin	10	16-34	43-122	0.200	9.2	0.69	2.6
	Shortfin	7	16-34	47-75	0.236	14.3	0.17	1.9
Waiomou Stream 2	Longfin	4	21-30	46-77	0.177	12.8	0.53	2.5
	Shortfin	4	28-38	44-71	0.146	23.0	0.16	1.8
Waipukurau Dam	Shortfin	17	12-25	48-86	-0.030	20.9	0.01	3.5
Wallingford 2	Longfin	5	22-32	46-82	0.232	11.9	0.79	2.1
	Shortfin	20	11-30	47-90	0.049	13.4	0.05	3.9

Table 6: Age range, weight range, weight at age coefficients, annual weight increments, calculated age at minimum legal size and near maximum size for shortfinned and longfinned eels from the North Island. (N= number, MWI= mean annual weight increment, MLS= minimum legal size, NMS= near maximum size).

Area	Spp	N	Age Range	Weight Range	Slope	Intercept	R^2	MWI	Age at MLS (220 g)	Age at NMS (4 kg)
Buckleys Drain	Longfin	1	21-21	1493-1493	-	-	-	71.1	-	-
	Shortfin	15	10-37	207-1315	0.012	9.9	0.42	34.1	12.6	58.1
Drain to Manawatu River	Longfin	1	17-17	271-271	-	-	-	15.9	-	-
	Shortfin	14	9-22	150-896	0.015	6.2	0.66	37.1	9.6	67.5
Drain to Oroua river	Shortfin	15	10-33	162-1076	0.013	10.3	0.39	32.9	13.0	60.5
Flemington	Shortfin	14	8-26	193-1356	0.012	9.5	0.66	35.3	12.0	55.7
Horseshoe Lake	Longfin	1	12-12	218-218	-	-	-	18.2	-	-
	Shortfin	13	10-25	219-1896	0.004	12.5	0.15	56.7	13.3	26.9
Hutt River Drain	Longfin	8	15-36	197-1380	0.016	14.6	0.90	20.7	18.1	78.0
	Shortfin	14	20-42	209-751	0.013	22.8	0.11	15.4	25.5	72.9
Kakahu Stream	Longfin	8	18-46	241-2143	0.006	20.3	0.23	45.6	21.6	44.3
	Shortfin	1	19-19	610-610	-	-	-	32.1	-	-
Kopuaranga River	Longfin	20	17-53	178-3346	0.006	25.1	0.44	31.4	26.5	50.7
Koputaroa Dam	Longfin	1	21-21	1285-1285	-	-	-	61.2	-	-
	Shortfin	19	15-30	182-1062	0.009	15.8	0.43	21.7	17.8	51.0
Koputaroa Dam 2	Shortfin	11	16-27	212-756	0.004	18.2	0.06	28.1	19.0	34.2
Lake Alice	Longfin	2	14-18	222-412	0.021	9.3	1.00	19.4	14.0	93.5
	Shortfin	20	11-45	213-2069	0.009	17.0	0.29	30.7	18.9	52.8
Lake Hatuma	Shortfin	20	12-21	99-489	0.013	12.4	0.45	15.9	15.3	65.7
Lake Shannon	Shortfin	12	18-45	271-1619	0.004	23.3	0.02	35.1	24.0	37.4
Linton Drain	Shortfin	17	8-28	252-1484	0.009	6.7	0.57	52.6	8.5	40.8

Table 6 cont.

Area	Spp	N	Age Range	Weight Range	Slope	Intercept	R^2	MWI	Age at MLS (220 g)	Age at NMS (4 kg)
Manawatu River	Longfin	2	17-18	461-597	-0.007	21.4	1.00	30.4	19.8	-8.0
	Shortfin	18	7-21	202-727	0.015	7.3	0.65	25.6	10.6	68.5
Manawatu River (floodplain)	Shortfin	20	8-23	200-1350	0.005	11.4	0.21	41.2	12.5	31.5
Manawatu River (lower)	Longfin	17	9-22	194-1129	0.004	13.1	0.05	24.7	13.9	29.1
	Shortfin	20	8-28	169-1432	0.008	10.6	0.66	37.5	12.4	44.3
Manawatu River (lower) 2	Longfin	4	10-19	209-4725	0.002	9.9	0.93	129.9	10.3	16.8
Ngaruroro River	Longfin	5	15-19	702-1609	0.001	16.7	0.06	54.7	17.0	21.1
	Shortfin	6	12-29	838-1097	0.006	13.3	0.01	55.5	14.6	36.8
Ohau River	Longfin	19	13-31	106-2671	0.006	16.6	0.70	30.3	17.9	41.4
Papamoa Drain	Shortfin	12	9-30	216-731	0.014	13.3	0.21	22.5	16.3	69.1
Porangahau River	Longfin	20	12-22	182-2807	0.002	15.2	0.16	47.6	15.6	22.2
	Shortfin	20	10-32	183-1207	0.014	15.0	0.64	23.7	18.1	71.1
Porangahau River 2	Longfin	2	26-27	2289-2624	0.003	19.2	1.00	92.6	19.8	31.1
Rangiotu Drain	Shortfin	18	7-22	230-1253	0.006	9.3	0.30	51.0	10.7	34.0
Rangitikei River Drain	Longfin	3	21-24	238-2021	0.001	21.2	0.88	35.9	21.5	26.8
	Shortfin	11	11-37	199-1978	0.005	19.5	0.20	27.3	20.5	39.3
Ruamahanga River	Longfin	7	15-27	208-679	0.009	18.2	0.18	16.6	20.2	55.7
	Shortfin	17	12-25	217-1782	0.005	16.4	0.34	26.6	17.5	36.5
Tauherenikau River	Longfin	14	21-36	171-1700	0.003	25.2	0.08	34.7	25.7	35.7
	Shortfin	12	12-25	163-666	0.013	13.3	0.32	22.8	16.1	64.3
Tokomaru River	Longfin	3	13-18	227-1975	0.002	14.4	0.44	53.3	14.9	22.7
	Shortfin	12	9-26	198-1197	0.007	14.9	0.45	31.3	16.4	42.4

Table 6 cont.

Area	Spp	N	Age Range	Weight Range	Slope	Intercept	R^2	MWI	Age at MLS (220 g)	Age at NMS (4 kg)
Tokomaru River Drain	Longfin	2	24-27	1813-3055	-0.002	31.4	1.00	97.2	30.8	21.7
	Shortfin	14	9-23	219-1088	0.007	11.3	0.17	39.0	12.8	38.3
Tukituki River	Longfin	20	8-19	223-1834	0.000	13.5	0.00	45.2	13.5	13.6
	Shortfin	20	8-34	152-1919	0.010	9.4	0.68	36.0	11.5	47.4
Turakina Dam	Shortfin	18	4-15	181-3157	0.003	5.4	0.78	110.5	6.1	16.9
Turakina Dam 2	Longfin	1	19-19	622-622	-	-	-	32.7	-	-
	Shortfin	20	9-32	189-1003	0.020	7.4	0.66	29.4	11.8	87.1
Turakina River	Longfin	19	14-30	204-2002	0.006	17.8	0.43	20.3	19.0	40.1
	Shortfin	19	17-32	173-1142	0.012	18.4	0.48	19.6	21.0	65.3
Waiohine River	Longfin	18	18-33	159-2532	0.004	20.9	0.35	33.3	21.8	36.7
	Shortfin	1	26-26	946-946	-	-	-	36.4	-	-
Waiomou Stream	Longfin	10	16-34	185-4933	0.003	18.8	0.67	33.1	19.5	31.3
	Shortfin	7	16-34	181-850	0.010	23.8	0.17	13.6	25.9	62.3
Waiomou Stream 2	Longfin	4	21-30	217-1298	0.005	20.7	0.36	37.4	21.7	38.8
	Shortfin	4	28-38	200-738	0.005	29.8	0.05	16.6	30.8	47.9
Waipukurau Dam	Shortfin	17	12-25	185-1208	-0.001	19.6	0.02	36.1	19.4	14.9
Wallingford 2	Longfin	5	22-32	207-1486	0.006	21.9	0.74	23.1	23.3	46.9
	Shortfin	20	11-30	160-1786	0.001	16.3	0.01	45.9	16.4	18.4

Table 7: Length, weight and age summary statistics for shortfinned and longfinned eels sampled at near minimum legal size from the North Island. (N= number, SE= standard error).

			Length			Weight			Age		
Area	Spp	N	Mean	SE	Range	Mean	SE	Range	Mean	SE	Range
Buckleys Drain	Shortfin	6	49.2	0.8	47-52	219.3	3.8	207-231	12.2	0.6	10-14
Drain to Manawatu River	Longfin	1	48.0	-	48-48	271.0	-	271-271	17.0	-	17-17
	Shortfin	4	47.5	2.4	41-52	217.3	30.1	150-291	9.5	0.5	9-11
Drain to Oroua River	Shortfin	5	50.4	2.0	44-55	223.6	22.9	162-296	13.2	1.4	10-18
Flemigton	Shortfin	6	47.7	0.9	46-52	207.3	6.2	193-234	11.3	0.7	8-13
Horseshoe Lake	Longfin	1	47.0	-	47-47	218.0	-	218-218	12.0	-	12-12
	Shortfin	3	50.0	0.6	49-51	230.0	5.7	219-238	11.7	0.9	10-13
Hutt River Drain	Longfin	4	49.0	2.4	45-56	256.8	45.7	197-393	18.0	1.3	15-21
	Shortfin	6	48.3	0.4	47-50	224.2	4.2	209-235	23.8	1.4	20-27
Kakahu Stream	Longfin	2	50.0	0.0	50-50	263.0	22.0	241-285	24.5	6.5	18-31
Kopuaranga River	Longfin	10	46.6	0.6	44-50	220.4	8.9	178-254	26.8	1.3	21-31
Koputaroa Dam	Shortfin	10	48.6	0.6	46-51	215.2	6.6	182-247	17.8	0.8	15-22
Koputaroa Dam 2	Shortfin	2	49.5	2.5	47-52	221.5	9.5	212-231	18.0	2.0	16-20
Lake Alice	Longfin	2	51.0	4.0	47-55	317.0	95.0	222-412	16.0	2.0	14-18
	Shortfin	10	49.3	0.5	47-52	222.0	2.4	213-234	17.5	2.3	11-33
Lake Hatuma	Shortfin	10	43.4	0.8	40-47	139.2	8.9	99-185	14.0	0.6	12-18
Lake Shannon	Shortfin	1	55.0	-	55-55	271.0	-	271-271	24.0	-	24-24
Linton Drain	Shortfin	8	52.3	0.6	50-54	273.3	4.7	252-291	9.5	0.4	8-11
Manawatu River	Longfin	1	57.0	-	57-57	461.0	-	461-461	18.0	-	18-18
	Shortfin	10	48.6	0.6	45-51	219.0	3.9	202-239	10.7	0.7	7-14
Manawatu River (floodplain)	Shortfin	10	49.1	0.5	47-52	216.6	3.0	200-232	12.8	1.2	8-19
Manawatu River (lower 2)	Longfin	2	47.0	0.0	47-47	214.0	5.0	209-219	10.5	0.5	10-11

Table 7 cont.

Area	Spp	N	Length Mean	Length SE	Length Range	Weight Mean	Weight SE	Weight Range	Age Mean	Age SE	Age Range
Manawatu River (lower)	Longfin	14	48.6	1.2	45-56	262.5	22.6	194-412	14.3	1.2	9-22
	Shortfin	10	47.7	0.7	44-51	199.6	4.9	169-217	12.2	0.8	8-16
Ohau River	Longfin	10	41.9	1.0	38-48	156.7	13.3	106-222	16.7	0.8	13-21
Papamoa Drain	Shortfin	7	51.1	0.5	50-53	226.0	2.3	216-232	16.4	2.1	9-26
Porangahau River	Longfin	10	47.4	0.6	44-50	237.1	8.4	182-267	15.2	0.9	12-20
	Shortfin	10	50.3	0.8	46-54	240.3	9.4	183-294	18.1	1.7	10-29
Rangiotu Drain	Shortfin	8	50.5	1.0	46.5-54	247.3	6.3	230-271	10.8	0.9	7-13
Rangitikei River Drain	Longfin	2	49.0	1.0	48-50	251.0	13.0	238-264	21.5	0.5	21-22
	Shortfin	7	49.6	0.9	47-53	214.9	4.0	199-229	22.1	0.5	20-24
Ruamahanga River	Longfin	6	51.8	2.0	48-58.5	308.7	48.5	208-474	21.5	1.7	15-27
	Shortfin	8	51.0	0.7	49-55	232.0	8.0	217-285	17.3	1.1	12-20
Tauherenikau River	Longfin	4	46.4	0.7	45-48	200.0	10.2	171-218	25.8	3.5	21-36
	Shortfin	5	50.2	1.6	44-53	221.0	18.3	163-273	15.8	1.6	12-21
Tokomaru River	Longfin	1	47.0	-	47-47	227.0	-	227-227	13.0	-	13-13
	Shortfin	6	49.7	0.6	47-51	220.8	5.8	198-239	16.2	1.6	9-20
Tokomaru River Drain	Shortfin	5	51.7	0.7	50-54	253.0	12.3	219-289	12.2	2.3	9-21
Tukituki River	Longfin	10	49.3	0.8	46-53	284.5	17.2	223-381	13.8	1.1	9-19
	Shortfin	10	45.2	0.6	42-47	178.5	6.1	152-208	11.0	0.6	8-15
Turakina Dam	Shortfin	9	48.6	1.0	44-53.5	253.0	16.6	181-335	6.1	0.5	4-8
Turakina Dam 2	Shortfin	10	50.5	0.7	46-53	228.2	7.1	189-253	12.0	0.7	9-16
Turakina River	Longfin	16	50.0	0.9	45.5-57	297.9	21.0	204-459	19.6	0.7	14-25
	Shortfin	9	50.4	1.2	45.5-54.5	243.3	17.2	173-302	20.8	1.3	17-28

Table 7 cont.

Area	Spp	N	Length			Weight			Age		
			Mean	SE	Range	Mean	SE	Range	Mean	SE	Range
Waihine River	Longfin	8	47.4	0.8	43.5-50.5	211.1	9.4	159-246	22.6	1.4	18-28
Waiomou Stream	Longfin	5	47.0	1.3	43-51	235.0	16.4	185-283	18.4	1.1	16-22
	Shortfin	5	48.8	0.9	47-51	206.6	9.6	181-238	25.6	3.3	16-33
Waiomou Stream 2	Longfin	1	46.0	-	46-46	217.0	-	217-217	21.0	-	21-21
	Shortfin	1	44.0	-	44-44	200.0	-	200-200	29.0	-	29-29
Waipukurau Dam	Shortfin	7	51.7	0.8	48-55	224.1	8.2	185-244	19.6	0.9	16-24
Wallingford 2	Longfin	3	49.0	1.5	46-51	232.0	13.4	207-253	23.0	0.6	22-24
	Shortfin	10	50.1	0.6	47-52	213.7	7.6	160-247	15.7	0.9	11-20

Table 8 cont.

Area	Spp	N	Length Mean	Length SE	Length Range	Weight Mean	Weight SE	Weight Range	Age Mean	Age SE	Age Range
Manawatu River (lower 2)	Longfin	2	107.0	8.0	99-115	3972.5	752.5	3220-4725	16.5	2.5	14-19
Manawatu River (lower)	Longfin	3	65.3	4.1	59-73	768.0	190.3	483-1129	15.3	0.3	15-16
	Shortfin	10	83.6	1.7	78-96	1154.2	61.9	912-1432	20.4	1.2	14-28
Ngaruroro River	Longfin	5	70.8	2.9	64-79	974.0	167.4	702-1609	17.8	0.7	15-19
	Shortfin	6	76.5	1.0	73-79	971.7	45.7	838-1097	19.0	2.5	12-29
Ohau River	Longfin	9	80.2	3.3	69.5-99	1417.4	191.5	833-2671	26.3	0.9	23-31
Papamoa Drain	Shortfin	5	70.4	1.6	66-74	667.4	21.9	612-731	22.6	3.3	13-30
Porangahau River	Longfin	10	79.0	2.6	70-97	1401.4	187.0	879-2807	18.1	0.9	13-22
	Shortfin	10	78.3	1.0	74-82	945.6	54.6	728-1207	28.5	0.6	26-32
Porangahau River 2	Longfin	2	93.0	1.0	92-94	2456.5	167.5	2289-2624	26.5	0.5	26-27
Rangiotu Drain	Shortfin	10	78.0	1.6	71-84	1025.3	61.1	784-1253	15.7	1.6	9-22
Rangitikei River Drain	Longfin	1	88.0	-	88-88	2021.0	-	2021-2021	24.0	-	24-24
	Shortfin	4	82.0	3.1	75-89	1187.3	270.1	758-1978	22.5	5.8	11-37
Ruamahanga River	Longfin	1	66.0	-	66-66	679.0	-	679-679	22.0	-	22-22
	Shortfin	9	71.7	3.6	60-94	797.1	146.0	428-1782	20.7	1.1	16-25
Tauherenikau River	Longfin	10	80.4	2.3	69-91	1274.5	103.2	725-1700	28.5	1.4	21-34
	Shortfin	7	67.7	0.8	66-72	580.7	22.6	493-666	20.9	1.4	15-25
Tokomaru River	Longfin	2	74.5	10.5	64-85	1283.0	692.0	591-1975	18.0	0.0	18-18
	Shortfin	6	81.3	2.0	74-89	1060.5	66.4	771-1197	22.5	1.1	19-26
Tokomaru River Drain	Longfin	2	93.8	4.8	89-98.5	2434.0	621.0	1813-3055	25.5	1.5	24-27
	Shortfin	9	73.3	1.6	64.5-81	777.7	56.5	619-1088	17.0	1.3	12-23
Tukituki River	Longfin	10	67.9	2.4	59-84	883.6	122.2	520-1834	13.2	1.0	8-18
	Shortfin	10	77.5	2.2	71-94	1044.3	121.6	747-1919	19.4	1.8	13-34

Table 8 cont.

Area	Spp	N	Length Mean	Length SE	Length Range	Weight Mean	Weight SE	Weight Range	Age Mean	Age SE	Age Range
Turakina Dam	Shortfin	9	94.6	3.0	84-110	1997.4	192.0	1395-3157	11.2	0.7	8-15
Turakina Dam 2	Longfin	1	62.0	-	62-62	622.0	-	622-622	19.0	-	19-19
	Shortfin	10	74.1	1.0	68.5-78.5	862.7	36.9	638-1003	24.5	2.3	10-32
Turakina River	Longfin	3	74.7	7.7	66-90	1149.0	426.6	703-2002	23.3	3.5	18-30
	Shortfin	10	70.6	2.2	61-82.5	726.3	76.0	446-1142	27.3	1.3	19-32
Waihine River	Longfin	10	80.7	4.1	61-105	1363.7	183.9	595-2532	25.6	1.6	18-33
	Shortfin	1	77.5	-	77.5-77.5	946.0	-	946-946	26.0	-	26-26
Waiomou Stream	Longfin	5	76.2	11.5	63-122	1503.6	858.5	565-4933	24.6	2.8	18-34
	Shortfin	2	72.5	2.5	70-75	811.0	39.0	772-850	32.0	2.0	30-34
Waiomou Stream 2	Longfin	3	76.7	0.3	76-77	1203.3	54.6	1109-1298	26.3	1.9	24-30
	Shortfin	3	69.7	0.7	69-71	643.7	47.6	586-738	33.3	2.9	28-38
Waipukurau Dam	Shortfin	10	78.6	1.1	75-86	936.7	44.8	787-1208	18.4	1.4	12-25
Wallingford 2	Longfin	2	78.5	3.5	75-82	1281.5	204.5	1077-1486	30.5	1.5	29-32
	Shortfin	10	84.8	1.2	80-90	1260.6	88.2	906-1786	17.7	1.6	13-30

Table 9: Age range, length range, length at age coefficients and annual length increments for shortfinned and longfinned eels from the South Island. (N= number, MLI= mean annual length increment).

Area	Spp	N	Age Range	Length Range	Slope	Intercept	R^2	MLI
Ahaura River	Longfin	27	11-32	47-71	0.632	-12.4	0.43	2.4
	Shortfin	10	13-29	51-83	-0.189	36.7	0.11	3.1
Aorere River (lower)	Longfin	16	14-32	39-102	-0.051	26.2	0.03	2.4
	Shortfin	14	13-25	52-76	0.207	4.4	0.20	3.4
Aorere River (mid)	Longfin	15	15-31	42-83	0.144	11.0	0.26	2.7
Aorere River (upper)	Longfin	9	14-50	47-100	0.332	1.7	0.35	2.8
	Shortfin	5	24-27	54-91	-0.036	28.5	0.18	2.8
Bradshaw Creek	Longfin	15	10-31	39-81	0.290	4.6	0.45	2.5
	Shortfin	5	13-24	46-74	0.180	4.9	0.24	3.7
Coal Creek	Longfin	14	25-37	44-81	0.070	27.3	0.07	1.7
Crooked River	Longfin	18	20-57	48-95	0.749	-16.2	0.84	2.0
	Shortfin	2	15-16	57-75	-0.056	19.2	1.00	4.0
Heathcote River	Longfin	20	15-28	45-82	0.069	17.9	0.06	2.7
Heathcote River 2	Longfin	20	18-30	44-92	0.050	19.8	0.06	2.7
	Shortfin	21	16-31	47-93	-0.055	25.2	0.04	2.9
Heathcote River 3	Longfin	14	19-30	46-114	0.099	16.9	0.46	2.7
	Shortfin	5	19-30	49-69	0.301	4.8	0.48	2.4
Kokatahi	Longfin	22	15-46	48-102	0.589	-7.2	0.48	2.1
Lake Brunner	Longfin	25	18-50	43-72	0.391	9.7	0.32	1.6
	Shortfin	15	23-37	54-80	0.337	7.0	0.19	2.2
Lake Hordern	Longfin	16	18-50	49-100	0.506	0.0	0.56	1.9
	Shortfin	8	21-34	56-90	0.270	5.2	0.64	2.8

Table 9 cont.

Area	Spp	N	Age Range	Length Range	Slope	Intercept	R^2	MLI
Lake Kangaroo	Longfin	13	23-40	43-62.3	0.121	22.3	0.02	1.7
	Shortfin	7	24-30	61.4-88	0.030	24.6	0.02	2.8
Motueka River	Longfin	20	14-25	44-79	-0.040	22.7	0.02	2.6
Okari River	Longfin	17	10-43	49-96	0.575	-10.9	0.29	2.7
	Shortfin	6	16-32	49-92	0.212	10.2	0.35	2.5
Paturau River (lower)	Longfin	20	19-54	43-89	0.469	-1.2	0.55	2.1
Paturau River (mid)	Longfin	16	17-44	45-89	0.163	14.3	0.13	2.2
Paturau River (upper)	Longfin	20	12-33	42-96	0.165	12.5	0.24	2.6
Rai River	Longfin	14	12-30	44-91	0.186	9.5	0.48	2.8
	Shortfin	19	18-35	49-84	0.267	9.1	0.35	2.3
Raleigh Creek	Longfin	11	25-45	50-87	0.315	9.7	0.50	2.0
Seven Mile Creek	Longfin	6	34-50	52-106	0.113	30.6	0.16	1.7
Takaka River (lower)	Longfin	19	13-36	46-106	0.043	21.7	0.03	2.5
	Shortfin	7	13-25	56-79	-0.051	22.1	0.01	3.5
Takaka River (mid)	Longfin	20	16-47	44-74	0.146	18.4	0.08	2.0
Takaka River (upper)	Longfin	20	9-33	45-76	0.128	11.4	0.05	2.9
	Shortfin	18	9-22	40-92	0.140	4.6	0.48	4.6
Taylor Dam	Shortfin	18	14-32	48-79	0.291	4.4	0.29	2.6
Waimakariri River	Longfin	20	13-34	45-91	0.033	20.5	0.01	2.6
Wairau River	Longfin	1	26-26	85-85	-	-	-	3.1
	Shortfin	9	16-30	49-87	0.136	13.8	0.14	2.6

Table 10: Age range, weight range, weight at age coefficients, annual weight increments, calculated age at minimum legal size and near maximum size for shortfinned and longfinned eels from the North Island. (N= number, MWI= mean annual weight increment, MLS= minimum legal size, NMS= near maximum size).

Area	Spp	N	Age Range	Weight Range	Slope	Intercept	R^2	MWI	Age at MLS (220 g)	Age at NMS (4 kg)
Ahaura River	Longfin	27	11-32	220-984	0.023	13.1	0.41	18.4	18.1	103.5
	Shortfin	10	13-29	285-1111	-0.004	26.4	0.04	35.4	25.5	9.7
Aorere River (lower)	Longfin	16	14-32	125-2872	-0.001	23.8	0.01	27.9	23.6	20.5
	Shortfin	14	13-25	272-1029	0.007	13.5	0.24	27.0	15.1	42.8
Aorere River (mid)	Longfin	15	15-31	171-1374	0.006	16.1	0.36	23.7	17.5	40.4
Aorere River (upper)	Longfin	9	14-50	235-3050	0.007	17.3	0.37	57.5	18.7	44.2
	Shortfin	5	24-27	362-1518	-0.001	26.6	0.09	38.1	26.4	23.4
Bradshaw Creek	Longfin	15	10-31	121-1342	0.010	15.8	0.30	19.2	18.0	55.4
	Shortfin	5	13-24	170-816	0.013	10.2	0.56	33.1	13.1	63.5
Coal Creek	Longfin	14	25-37	166-1274	0.002	30.2	0.06	15.8	30.7	39.3
Crooked River	Longfin	18	20-57	254-2285	0.018	17.7	0.89	17.8	21.8	91.3
	Shortfin	2	15-16	341-815	-0.002	16.7	1.00	37.8	16.3	8.3
Heathcote River	Longfin	20	15-28	219-1490	0.002	20.7	0.07	32.0	21.2	29.6
Heathcote River 2	Longfin	20	18-30	169-2529	0.001	21.9	0.07	39.2	22.2	26.9
	Shortfin	21	16-31	194-1891	-0.002	22.7	0.04	31.1	22.3	16.3
Heathcote River 3	Longfin	14	19-30	202-4559	0.002	21.9	0.43	44.4	22.3	28.8
	Shortfin	5	19-30	210-834	0.013	16.5	0.66	21.3	19.2	66.9
Kokatahi	Longfin	22	15-46	251-1402	0.016	19.1	0.43	18.5	22.7	84.8
Lake Brunner	Longfin	25	18-50	184-987	0.014	24.6	0.33	12.2	27.7	80.1
	Shortfin	15	23-37	299-1125	0.010	23.6	0.22	22.9	25.7	62.4

Table 10 cont.

Area	Spp	N	Age Range	Weight Range	Slope	Intercept	R^2	MWI	Age at MLS (220 g)	Age at NMS (4 kg)
Lake Hordern	Longfin	16	18-50	265-2677	0.010	24.9	0.51	28.1	27.2	65.9
	Shortfin	8	21-34	318-1436	0.008	18.6	0.65	34.0	20.3	49.5
Lake Kangaroo	Longfin	13	23-40	161-559	0.009	25.8	0.03	12.2	27.7	60.4
	Shortfin	7	24-30	430-1358	0.001	25.8	0.04	39.8	26.0	30.3
Motueka River	Longfin	20	14-25	216-1257	-0.002	21.2	0.03	24.8	20.9	15.1
Okari River	Longfin	17	10-43	266-1313	0.021	12.4	0.41	25.3	16.9	95.5
	Shortfin	6	16-32	271-1695	0.005	20.7	0.20	24.7	21.7	39.3
Paturau River (lower)	Longfin	20	19-54	172-1799	0.015	17.1	0.63	22.5	20.5	78.2
	Longfin	16	17-44	204-1929	0.004	21.5	0.08	22.4	22.4	36.4
Paturau River (upper)	Longfin	20	12-33	184-2322	0.004	19.7	0.19	33.9	20.5	35.8
Rai River	Longfin	14	12-30	208-2114	0.005	17.1	0.54	35.7	18.2	37.7
	Shortfin	19	18-35	235-1449	0.009	20.9	0.34	22.6	22.8	55.9
Raleigh Creek	Longfin	11	25-45	224-1827	0.009	23.3	0.61	24.4	25.3	60.4
Seven Mile Creek	Longfin	6	34-50	284-2765	0.002	36.5	0.11	30.2	36.9	44.3
Takaka River (lower)	Longfin	19	13-36	207-3233	0.001	23.4	0.05	36.7	23.7	28.0
	Shortfin	7	13-25	340-928	0.000	19.0	0.00	35.1	18.9	17.3
Takaka River (mid)	Longfin	20	16-47	207-1234	0.005	24.2	0.07	19.3	25.3	44.0
Takaka River (upper)	Longfin	20	9-33	187-926	0.005	16.5	0.05	24.0	17.6	36.4
	Shortfin	18	9-22	104-1631	0.004	10.9	0.50	53.7	11.8	28.3
Taylor Dam	Shortfin	18	14-32	212-1042	0.012	16.8	0.28	19.3	19.3	63.6
Waimakariri River	Longfin	20	13-34	211-2561	0.000	22.3	0.00	32.1	22.4	23.3
Wairau River	Longfin	1	26-26	1325-1325	-	-	-	51.0	-	-

Table 10 cont.

Area	Spp	N	Age Range	Weight Range	Slope	Intercept	R^2	MWI	Age at MLS (220 g)	Age at NMS (4 kg)
Wairau River	Shortfin	9	16-30	212-1381	0.005	19.9	0.13	20.9	20.9	38.1

Table 11: Length, weight and age summary statistics for South Island shortfinned and longfinned eels sampled at near minimum legal size in the South Island. (N= number, SE= standard error).

			Length			Weight			Age		
Area	Spp	N	Mean	SE	Range	Mean	SE	Range	Mean	SE	Range
Ahaura River	Longfin	22	52.3	0.8	47-59	336.0	16.4	220-517	20.3	1.1	11-31
	Shortfin	1	51.0	-	51-51	285.0	-	285-285	27.0	-	27-27
Aorere River (lower)	Longfin	10	45.5	1.1	39-50	211.9	17.8	112-296	23.9	2.0	14-32
	Shortfin	9	55.0	0.6	52-58	304.8	9.6	272-355	14.9	0.6	13-19
Aorere River (mid)	Longfin	10	45.6	0.5	42-47	199.8	6.0	171-233	17.8	0.9	15-23
Aorere River (upper)	Longfin	2	48.5	1.5	47-50	266.0	31.0	235-297	16.5	2.5	14-19
	Shortfin	1	54.0	-	54-54	362.0	-	362-362	27.0	-	27-27
Bradshaw Creek	Longfin	12	47.5	1.3	39-55	266.3	27.9	121-468	18.8	1.2	10-27
	Shortfin	1	46.0	-	46-46	170.0	-	170-170	13.0	-	13-13
Coal Creek	Longfin	9	47.4	0.6	44-50	207.9	6.9	166-241	30.4	1.4	25-37
Crooked River	Longfin	13	52.9	0.9	48-59	338.7	17.7	254-470	23.8	1.0	20-33
	Shortfin	1	57.0	-	57-57	341.0	-	341-341	16.0	-	16-16
Heathcote River	Longfin	10	49.1	0.6	45-51	260.4	6.9	219-296	21.5	0.7	18-24
Heathcote River 2	Longfin	10	49.9	1.0	44-53.5	263.3	13.0	169-308	22.5	1.0	18-27
	Shortfin	9	53.1	1.0	47-56.5	268.0	15.9	194-334	22.3	1.5	16-31
Heathcote River 3	Longfin	6	48.8	0.6	46-50.5	237.3	8.3	202-262	21.8	0.7	19-24
	Shortfin	2	49.5	0.5	49-50	224.0	14.0	210-238	20.0	1.0	19-21
Kokatahi	Longfin	13	52.1	0.7	48-56	310.7	12.7	251-386	23.5	1.2	16-30
Lake Brunner	Longfin	19	46.8	0.5	43-53	238.6	8.8	184-339	28.1	1.1	18-39
	Shortfin	1	54.0	-	54-54	299.0	-	299-299	23.0	-	23-23
Lake Hordern	Longfin	6	55.7	1.5	49-59	409.7	40.3	265-512	25.8	3.3	18-36
	Shortfin	1	56.0	-	56-56	318.0	-	318-318	21.0	-	21-21

Table 11 cont.

Area	Spp	N	Length Mean	Length SE	Length Range	Weight Mean	Weight SE	Weight Range	Age Mean	Age SE	Age Range
Lake Kangaroo	Longfin	11	51.6	1.1	43-58	317.5	22.6	161-477	28.9	1.6	23-40
Motueka River	Longfin	13	48.6	1.4	44-58	286.3	34.8	216-543	20.8	0.9	14-25
Okari River	Longfin	8	53.6	1.3	49-59	357.9	30.0	266-502	22.3	3.4	10-34
	Shortfin	4	51.5	0.9	49-53	275.8	5.9	263-291	19.3	2.4	16-24
Paturau River (lower)	Longfin	10	45.5	0.5	43-48	208.1	7.7	172-253	21.6	0.6	19-25
Paturau River (mid)	Longfin	10	45.9	0.2	45-47	217.4	2.8	204-229	21.0	0.9	18-27
Paturau River (upper)	Longfin	10	45.7	0.6	42-48	206.4	5.5	184-234	19.7	1.8	12-30
Rai River	Longfin	7	46.3	0.5	44-48	223.4	3.8	208-233	18.3	1.2	12-22
	Shortfin	9	52.2	0.7	49-55	269.1	8.7	235-308	23.0	1.7	18-32
Raleigh Creek	Longfin	4	50.5	0.5	50-52	250.0	9.1	224-266	26.3	0.8	25-28
Seven Mile Creek	Longfin	3	53.3	0.7	52-54	309.3	16.4	284-340	38.0	3.5	34-45
Takaka River (lower)	Longfin	10	47.6	0.4	46-50	216.4	2.6	207-230	24.2	1.4	16-30
	Shortfin	1	56.0	-	56-56	340.0	-	340-340	17.0	-	17-17
Takaka River (mid)	Longfin	10	45.8	0.4	44-48	219.0	2.1	207-229	25.3	1.1	21-30
Takaka River (upper)	Longfin	14	50.1	1.1	45-57	290.1	29.1	187-483	17.5	1.1	9-24
	Shortfin	9	55.0	2.1	40-61	311.8	30.0	104-432	12.1	0.7	9-14
Taylor Dam	Shortfin	9	50.4	0.6	48-54	219.7	1.7	212-224	19.1	1.4	14-27
Waimakariri River	Longfin	10	47.5	0.5	45-51	220.5	1.5	211-229	22.1	0.6	19-24
Wairau River	Shortfin	6	51.5	0.7	49-53	218.7	2.1	212-226	20.7	1.7	16-27

Table 12: Length, weight and age summary statistics for shortfinned and longfinned eels sampled from the South Island at near maximum size. (N= number, SE= standard error).

			Length			Weight			Age		
Area	Spp	N	Mean	SE	Range	Mean	SE	Range	Mean	SE	Range
Ahaura River	Longfin	5	65.8	2.2	61-71	702.0	85.3	527-984	31.0	0.4	30-32
	Shortfin	9	73.8	2.0	66-83	820.2	58.4	663-1111	22.8	1.8	13-29
Aorere River (lower)	Longfin	6	80.2	4.6	69-102	1364.8	310.3	759-2872	22.0	1.6	19-26
	Shortfin	5	69.8	2.9	60-76	741.6	109.6	377-1029	20.4	1.9	15-25
Aorere River (mid)	Longfin	5	75.8	3.0	70-83	1023.0	127.4	791-1374	21.4	2.7	15-31
Aorere River (upper)	Longfin	7	88.4	3.2	77-100	1999.3	262.8	1264-3050	31.4	3.6	18-50
	Shortfin	4	81.3	5.7	65-91	1129.0	195.5	586-1518	25.5	0.6	24-27
Bradshaw Creek	Longfin	3	71.3	5.2	63-81	933.3	217.7	599-1342	23.7	3.7	19-31
	Shortfin	4	70.0	3.1	61-74	648.3	83.4	423-816	17.5	2.3	14-24
Coal Creek	Longfin	5	75.2	2.5	68-81	1033.6	101.1	765-1274	33.0	1.4	28-36
Crooked River	Longfin	5	74.8	5.3	66-95	1115.2	318.6	425-2285	38.6	5.8	22-57
	Shortfin	1	75.0	-	75-75	815.0	-	815-815	15.0	-	15-15
Heathcote River	Longfin	10	76.3	1.2	71-82	1139.6	66.5	891-1490	23.0	1.6	15-28
Heathcote River 2	Longfin	10	81.8	2.2	70-92	1555.3	149.4	946-2529	23.6	1.2	19-30
	Shortfin	12	75.0	3.0	60-93	928.0	128.5	379-1891	21.2	0.8	18-27
Heathcote River 3	Longfin	8	85.3	5.5	66-114	1809.6	446.0	664-4559	25.4	1.2	21-30
	Shortfin	3	67.0	1.2	65-69	689.7	77.2	570-834	24.7	2.7	22-30
Kokatahi	Longfin	10	72.6	3.8	60-102	1000.4	196.1	502-2533	33.7	3.1	15-46
Lake Brunner	Longfin	6	66.8	1.7	61-72	811.8	62.3	595-987	35.5	3.2	27-50
	Shortfin	14	70.4	1.2	65-80	724.8	53.6	498-1125	30.9	1.1	24-37
Lake Hordern	Longfin	10	80.2	3.9	61-100	1465.6	207.7	615-2677	41.9	2.1	30-50
	Shortfin	7	78.0	4.0	61-90	980.0	150.7	433-1436	26.1	1.5	22-34

Table 12 cont.

Area	Spp	N	Length Mean	Length SE	Length Range	Weight Mean	Weight SE	Weight Range	Age Mean	Age SE	Age Range
Lake Kangaroo	Longfin	2	61.2	1.1	60-62.3	508.5	50.5	458-559	28.0	1.0	27-29
	Shortfin	7	80.5	3.6	61.4-88	1072.4	130.2	430-1358	27.0	0.8	24-30
Motueka River	Longfin	7	69.1	2.4	59-79	865.0	92.4	506-1257	19.7	1.0	16-23
Okari River	Longfin	11	71.5	3.1	61-96	976.1	207.3	476-2876	26.9	3.7	16-43
	Shortfin	3	74.0	9.3	61-92	932.3	389.1	417-1695	27.7	2.2	25-32
Paturau River (lower)	Longfin	10	75.5	2.7	66-89	1111.8	130.3	733-1799	32.8	4.0	19-54
Paturau River (mid)	Longfin	6	72.0	4.2	61-89	997.2	221.9	490-1929	27.5	3.7	17-44
Paturau River (upper)	Longfin	10	80.4	2.8	70-96	1404.2	144.0	933-2322	26.1	1.8	18-33
Rai River	Longfin	7	81.0	3.6	66-91	1441.1	210.0	681-2114	24.4	1.9	18-30
	Shortfin	10	75.4	2.0	68-84	921.5	81.7	640-1449	29.2	1.5	19-35
Raleigh Creek	Longfin	7	75.0	2.5	68-87	1086.4	134.7	795-1827	33.0	2.4	28-45
Seven Mile Creek	Longfin	3	91.7	11.5	69-106	2073.3	612.0	853-2765	39.7	5.2	34-50
Takaka River (lower)	Longfin	9	82.8	4.6	71-106	1616.0	324.4	831-3233	24.7	2.1	13-36
	Shortfin	6	68.8	3.4	58-79	657.0	95.7	370-928	19.0	2.0	13-25
Takaka River (mid)	Longfin	10	68.0	1.3	63-74	797.1	72.6	585-1234	28.1	2.5	16-47
Takaka River (upper)	Longfin	6	68.2	2.6	59-76	718.2	71.0	452-926	21.0	3.1	11-33
	Shortfin	10	86.3	1.3	78-92	1336.6	64.3	965-1631	16.8	0.9	13-22
Taylor Dam	Shortfin	9	69.0	1.8	63-79	627.8	66.2	413-1042	24.3	1.9	15-32
Waimakariri River	Longfin	10	73.9	2.5	63-91	1146.7	170.1	679-2561	22.9	2.1	13-34
Wairau River	Longfin	1	85.0	-	85-85	1325.0	-	1325-1325	26.0	-	26-26
	Shortfin	3	78.0	5.2	69-87	956.7	218.0	658-1381	24.7	3.9	17-30

Table 13: Length, weight and age summary statistics by sex for shortfinned and longfinned eels sampled from the North Island. (N=number, SE= standard error).

Area	Spp	Sex	N	Length Mean	Length SE	Length Range	Weight Mean	Weight SE	Weight Range	Age Mean	Age SE	Age Range
Buckleys Drain	Longfin	Female	1	82.0	-	82-82	1493.0	-	1493-1493	21.0	-	21-21
	Shortfin	Female	10	73.9	2.8	52-86	815.8	87.6	231-1315	20.1	2.1	14-37
		Male	5	48.6	0.7	47-50	217.0	3.7	207-226	11.8	0.6	10-13
Drain to Manawatu River	Longfin	Male	1	48.0	-	48-48	271.0	-	271-271	17.0	-	17-17
	Shortfin	Female	13	64.3	2.8	41-75	596.8	63.4	150-896	15.4	1.2	9-22
		Male	1	47.0	-	47-47	193.0	-	193-193	9.0	-	9-9
Drain to Oroua River	Shortfin	Female	15	65.1	2.9	44-80	584.5	73.9	162-1076	17.6	1.5	10-33
Flemigton	Shortfin	Female	14	66.3	4.5	46-84	649.8	113.5	193-1356	17.0	1.6	8-26
Horseshoe Lake	Longfin	Male	1	47.0	-	47-47	218.0	-	218-218	12.0	-	12-12
	Shortfin	Female	13	72.7	4.0	49-97	890.7	131.4	219-1896	15.7	1.2	10-25
Hutt River Drain	Longfin	Female	3	70.0	6.8	60-83	890.3	251.5	546-1380	29.3	3.3	26-36
		Immature	2	46.5	1.5	45-48	209.0	12.0	197-221	16.0	1.0	15-17
		Male	3	54.7	4.1	47-61	357.3	73.5	216-463	21.0	1.2	19-23
	Shortfin	Female	14	57.9	2.4	47-72	421.9	50.8	209-751	28.1	1.9	20-42
Kakahu Stream	Longfin	Female	6	87.3	2.8	78-99	1595.0	153.8	1139-2143	29.0	3.7	22-46
		Male	2	50.0	0.0	50-50	263.0	22.0	241-285	24.5	6.5	18-31
	Shortfin	Female	1	68.0	-	68-68	610.0	-	610-610	19.0	-	19-19
Kopuaranga River	Longfin	Female	10	89.3	3.1	78-106	1944.7	203.2	1239-3346	37.3	3.3	17-53
		Immature	1	46.0	-	46-46	178.0	-	178-178	25.0	-	25-25
		Male	9	46.7	0.7	44-50	225.1	8.4	181-254	27.0	1.5	21-31
Koputaroa Dam	Longfin	Female	1	80.0	-	80-80	1285.0	-	1285-1285	21.0	-	21-21
	Shortfin	Female	13	64.5	3.1	50-82	552.2	73.2	211-1062	20.8	1.0	15-30
		Male	6	47.3	0.3	46-48	208.7	9.2	182-238	17.5	0.9	15-21

Table 13 cont.

Area	Spp	Sex	N	Length Mean	Length SE	Length Range	Weight Mean	Weight SE	Weight Range	Age Mean	Age SE	Age Range
Koputaroa Dam 2	Shortfin	Female	10	66.0	1.8	52-71	606.2	49.5	231-756	20.5	1.0	16-27
		Male	1	47.0	-	47-47	212.0	-	212-212	20.0	-	20-20
Lake Alice	Longfin	Male	2	51.0	4.0	47-55	317.0	95.0	222-412	16.0	2.0	14-18
	Shortfin	Female	20	68.5	4.5	47-99	769.8	136.1	213-2069	23.9	2.3	11-45
Lake Hatuma	Shortfin	Female	20	53.0	2.3	40-67	259.6	29.8	99-489	15.9	0.6	12-21
Lake Shannon	Shortfin	Female	10	75.3	2.6	55-84.5	821.3	72.4	271-1075	25.6	2.3	18-45
		Male	2	81.5	5.5	76-87	1228.0	391.0	837-1619	30.5	2.5	28-33
Linton Drain	Shortfin	Female	17	65.5	3.3	50-88	680.5	105.9	252-1484	12.5	1.2	8-28
Manawatu River	Longfin	Female	2	58.5	1.5	57-60	529.0	68.0	461-597	17.5	0.5	17-18
	Shortfin	Female	16	59.8	2.5	49-75	404.7	53.8	212-727	13.7	1.0	7-21
		Male	3	46.3	0.9	45-48	214.7	12.2	202-239	10.3	0.9	9-12
Manawatu River (floodplain)	Shortfin	Female	19	62.8	3.1	47-84	609.0	93.0	200-1350	14.2	1.0	8-23
		Male	1	48.0	-	48-48	220.0	-	220-220	19.0	-	19-19
Manawatu River (lower 2)	Longfin	Female	2	107.0	8.0	99-115	3972.5	752.5	3220-4725	16.5	2.5	14-19
		Male	2	47.0	0.0	47-47	214.0	5.0	209-219	10.5	0.5	10-11
Manawatu River (lower)	Longfin	Female	7	59.4	2.6	53-73	551.6	105.2	354-1129	16.1	1.4	11-22
		Immature	1	45.0	-	45-45	196.0	-	196-196	9.0	-	9-9
		Male	9	46.2	0.3	45-48	213.6	3.5	194-229	13.8	1.4	10-21
	Shortfin	Female	17	69.2	4.4	46-96	763.5	122.1	184-1432	16.9	1.3	8-28
		Immature	1	45.0	-	45-45	184.0	-	184-184	16.0	-	16-16
		Male	2	45.5	1.5	44-47	187.0	18.0	169-205	11.0	1.0	10-12
Ngaruroro River	Longfin	Female	1	64.0	-	64-64	702.0	-	702-702	18.0	-	18-18
		Male	4	72.5	3.0	67-79	1042.0	197.5	731-1609	17.8	0.9	15-19
	Shortfin	Female	6	76.5	1.0	73-79	971.7	45.7	838-1097	19.0	2.5	12-29

Table 13 cont.

Area	Spp	Sex	N	Length Mean	Length SE	Length Range	Weight Mean	Weight SE	Weight Range	Age Mean	Age SE	Age Range
Ohau River	Longfin	Female	9	80.2	3.3	69.5-99	1417.4	191.5	833-2671	26.3	0.9	23-31
		Immature	1	38.0	-	38-38	106.0	-	106-106	18.0	-	18-18
		Male	9	42.3	1.1	38-48	162.3	13.5	114-222	16.6	0.9	13-21
Papamoa Drain	Shortfin	Female	12	59.2	2.9	50-74	409.9	66.2	216-731	19.0	2.0	9-30
Porangahau River	Longfin	Female	10	79.0	2.6	70-97	1401.4	187.0	879-2807	18.1	0.9	13-22
		Immature	10	47.4	0.6	44-50	237.1	8.4	182-267	15.2	0.9	12-20
	Shortfin	Female	20	64.3	3.3	46-82	593.0	85.3	183-1207	23.3	1.5	10-32
Porangahau River 2	Longfin	Female	2	93.0	1.0	92-94	2456.5	167.5	2289-2624	26.5	0.5	26-27
Rangiotu Drain	Shortfin	Female	16	67.7	3.6	46.5-84	733.4	104.3	230-1253	13.6	1.3	7-22
		Male	2	50.8	3.3	47.5-54	248.5	17.5	231-266	13.0	0.0	13-13
Rangitikei River Drain	Longfin	Female	1	88.0	-	88-88	2021.0	-	2021-2021	24.0	-	24-24
		Male	2	49.0	1.0	48-50	251.0	13.0	238-264	21.5	0.5	21-22
	Shortfin	Female	11	61.4	5.1	47-89	568.5	172.8	199-1978	22.3	1.9	11-37
Ruamahanga River	Longfin	Female	3	60.8	2.6	58-66	533.3	73.2	447-679	23.7	1.7	22-27
		Immature	3	48.8	0.4	48-49.5	228.3	11.3	208-247	18.3	1.8	15-21
		Male	1	48.0	-	48-48	246.0	-	246-246	25.0	-	25-25
	Shortfin	Female	17	61.9	3.2	49-94	531.2	103.1	217-1782	19.2	0.8	12-25
Tauherenikau River	Longfin	Female	8	81.1	2.5	69-91	1304.0	99.3	800-1700	29.4	1.6	21-34
		Male	6	56.8	6.9	45-85	518.8	230.5	171-1588	25.5	2.3	21-36
	Shortfin	Female	11	61.9	2.5	50-72	455.2	54.5	203-666	18.5	1.4	12-25
		Male	1	44.0	-	44-44	163.0	-	163-163	21.0	-	21-21
Tokomaru River	Longfin	Female	2	74.5	10.5	64-85	1283.0	692.0	591-1975	18.0	0.0	18-18
		Male	1	47.0	-	47-47	227.0	-	227-227	13.0	-	13-13
	Shortfin	Female	9	71.1	5.3	50-89	781.8	145.8	214-1197	21.3	0.9	18-26
		Male	3	48.7	0.9	47-50	217.3	9.8	198-230	13.3	2.2	9-16

Table 13 cont.

Area	Spp	Sex	N	Length Mean	Length SE	Length Range	Weight Mean	Weight SE	Weight Range	Age Mean	Age SE	Age Range
Tokomaru River Drain	Longfin	Female	2	93.8	4.8	89-98.5	2434.0	621.0	1813-3055	25.5	1.5	24-27
	Shortfin	Female	14	65.6	3.0	50-81	590.3	78.4	219-1088	15.3	1.3	9-23
Tukituki River	Longfin	Female	1	52.0	-	52-52	347.0	-	347-347	12.0	-	12-12
		Immature	1	47.0	-	47-47	240.0	-	240-240	9.0	-	9-9
		Male	18	59.6	2.6	46-84	616.3	98.5	223-1834	13.8	0.7	8-19
	Shortfin	Female	15	67.2	4.1	46-94	759.3	134.0	167-1919	16.6	1.6	9-34
		Immature	5	43.8	0.6	42-45	167.8	7.3	152-191	11.0	1.2	8-15
Turakina Dam	Shortfin	Female	8	48.1	1.1	44-53.5	242.8	14.8	181-306	6.1	0.6	4-8
		Male	10	90.4	5.0	52-110	1831.2	239.0	335-3157	10.7	0.8	6-15
Turakina Dam 2	Longfin	Female	1	62.0	-	62-62	622.0	-	622-622	19.0	-	19-19
	Shortfin	Female	14	60.1	3.3	46-78.5	478.0	84.4	189-954	16.9	2.1	9-32
		Male	6	67.3	4.8	52-76.5	702.8	145.1	253-1003	21.3	3.8	10-32
Turakina River	Longfin	Female	4	66.5	8.3	53-90	876.3	385.1	344-2002	22.8	2.6	18-30
		Immature	3	47.7	1.2	46-50	240.0	18.0	204-260	21.3	2.0	18-25
		Male	12	51.2	1.8	45.5-68	332.4	41.5	219-703	19.1	0.7	14-22
	Shortfin	Female	15	60.4	2.7	45.5-78	465.1	66.7	173-966	23.7	1.3	17-32
		Immature	1	51.0	-	51-51	291.0	-	291-291	27.0	-	27-27
		Male	3	67.5	10.6	47-82.5	728.7	286.6	178-1142	26.0	4.0	18-31
Waihine River	Longfin	Female	5	79.9	3.1	73-89.5	1342.4	162.9	1018-1763	26.6	2.4	18-32
		Male	13	60.5	5.6	43.5-105	662.6	208.1	159-2532	23.4	1.2	18-33
	Shortfin	Female	1	77.5	-		946.0	-		26.0	-	26-26
Waiomou Stream	Longfin	Female	5	73.8	27.7		1439.0	1962.3		22.6	3.2	16-34
		Male	5	49.4	7.8		299.6	173.1		20.4	1.7	16-26
	Shortfin	Female	6	57.0	12.2		412.3	310.1		26.5	2.8	16-34
		Immature	1	47.0	-		181.0	-		33.0	-	33-33

Table 13 cont.

Area	Spp	Sex	N	Length			Weight			Age		
				Mean	SE	Range	Mean	SE	Range	Mean	SE	Range
Waiomou Stream 2	Longfin	Female	3	76.7	0.6		1203.3	94.5		26.3	1.9	24-30
		Male	1	46.0	-		217.0	-		21.0	-	21-21
	Shortfin	Female	3	69.7	1.2		643.7	82.4		33.3	2.9	28-38
		Male	1	44.0	-		200.0	-		29.0	-	29-29
Waipukurau Dam	Shortfin	Female	17	67.5	14.0		643.3	377.0		18.9	0.9	12-25
Wallingford 2	Longfin	Female	2	78.5	4.9		1281.5	289.2		30.5	1.5	29-32
		Immature	3	49.0	2.6		232.0	23.3		23.0	0.6	22-24
	Shortfin	Female	20	67.5	18.1		737.2	570.6		16.7	0.9	11-30

Table 14: Summary statistics for gonad stages for North Island catches. (N= number, SE= standard error).

Spp	Sex	Gonad Stage	N	Length Mean	SE	Range	Weight Mean	SE	Range	Age Mean	SE	Range
Longfin	**Immature**	**0**	25	47.2	0.5	38-51	224.4	7.1	106-267	24.6	1.1	9-34
	Female	**1**	24	60.0	1.1	51-74	538.0	34.8	283-1018	21.4	1.5	11-42
		2	35	78.3	1.0	68-90	1267.2	54.4	800-1975	26.0	1.6	14-53
		3	19	85.6	1.6	75-99	1658.3	89.9	1046-2671	25.5	1.7	13-44
		4	13	98.7	3.0	85-122	2845.2	287.9	1497-4933	27.2	2.9	10-51
	Male	**1**	37	46.0	0.5	38-55	209.4	7.9	114-377	20.5	1.1	10-36
		2	30	50.8	1.3	43-70	311.4	28.2	181-725	18.8	1.1	8-31
		3	21	58.2	2.7	45-85	554.2	85.8	199-1588	21.2	1.3	11-34
		4	13	70.2	4.8	46-105	1038.2	195.1	218-2532	18.5	1.8	11-31
Shortfin	**Immature**	**0**	8	45.3	1.0	42-51	186.9	15.7	152-291	14.1	1.1	8-18
	Female	**1**	154	49.4	0.2	40-55	220.8	2.8	99-306	15.3	0.5	4-41
		2	98	66.0	1.0	46-83	599.3	26.2	189-1129	19.2	0.7	5-41
		3	119	74.0	0.7	53-96	824.3	23.0	273-1382	19.9	0.6	8-45
		4	66	80.3	1.1	44-99	1133.2	44.8	162-2069	18.5	0.7	9-37
	Male	**1**	14	48.1	0.8	44-52.5	213.4	11.8	163-335	14.7	1.9	6-30
		2	4	49.1	1.6	47-54	236.5	11.4	211-266	15.5	1.9	13-21
		3	14	76.7	3.8	47-98.5	1121.1	145.9	226-2169	18.9	2.4	8-33
		4	15	64.3	6.6	45-110	869.0	268.7	182-3157	14.7	1.2	7-22

Table 15: Length, weight and age summary statistics by sex for shortfinned and longfinned eels sampled from the South Island. (N= number, SE= standard error).

				Length			Weight			Age		
Area	Spp	Sex	N	Mean	SE	Range	Mean	SE	Range	Mean	SE	Range
Ahaura River	Longfin	Female	10	59.9	7.5		538.3	222.1		25.5	2.2	15-32
		Immature	5	51.6	2.7		310.6	48.8		18.8	2.4	13-23
		Male	12	51.9	3.8		330.6	81.6		21.0	1.5	11-31
	Shortfin	Female	10	71.5	9.1		766.7	236.5		23.2	1.6	13-29
Aorere River (lower)	Longfin	Female	7	75.9	15.4		1212.1	802.9		21.4	1.4	19-26
		Immature	9	45.0	3.3		202.6	50.9		24.5	2.1	14-32
	Shortfin	Female	14	60.3	8.3		460.8	257.3		16.9	1.0	13-25
Aorere River (mid)	Longfin	Female	5	75.8	6.6		1023.0	284.8		21.4	2.7	15-31
		Immature	10	45.6	1.6		199.8	18.8		17.8	0.9	15-23
Aorere River (upper)	Longfin	Female	7	88.4	8.5		1999.3	695.3		31.4	3.6	18-50
		Immature	2	48.5	2.1		266.0	43.8		16.5	2.5	14-19
	Shortfin	Female	5	75.8	15.7		975.6	482.0		25.8	0.6	24-27
Bradshaw Creek	Longfin	Immature	6	44.8	4.2		201.8	53.3		16.5	1.6	10-21
		Male	9	57.2	11.8		531.7	362.0		21.9	1.4	19-31
	Shortfin	Female	3	69.7	7.5		651.3	204.1		18.7	2.7	15-24
		Male	2	58.5	17.7		404.5	331.6		13.5	0.5	13-14
Coal Creek	Longfin	Female	5	75.2	5.6		1033.6	226.0		33.0	1.4	28-36
		Male	9	47.4	1.9		207.9	20.8		30.4	1.4	25-37
Crooked River	Longfin	Female	1	95.0	-		2285.0	-		57.0	-	57-57
		Immature	2	52.5	2.1		320.5	30.4		22.5	0.5	22-23
		Male	15	57.5	8.4		470.2	273.1		26.7	1.8	20-42
	Shortfin	Female	1	75.0	-		815.0	-		15.0	-	15-15
		Male	1	57.0	-		341.0	-		16.0	-	16-16

Table 15 cont.

Area	Spp	Sex	N	Length Mean	Length SE	Length Range	Weight Mean	Weight SE	Weight Range	Age Mean	Age SE	Age Range
Heathcote River	Longfin	Female	14	68.4	13.3		886.1	451.3		22.2	1.2	15-28
		Immature	5	48.9	2.5		262.2	21.1		22.0	1.0	19-24
		Male	1	51.0	-		283.0	-		24.0	-	24-24
Heathcote River 2	Longfin	Female	16	70.4	16.2		1077.4	734.9		23.4	0.9	18-30
		Immature	4	47.5	3.0		237.0	54.8		21.8	1.5	18-25
	Shortfin	Female	18	63.1	11.8		535.1	331.1		21.7	0.9	16-31
		Male	3	81.0	15.9		1305.3	724.6		21.3	1.3	20-24
Heathcote River 3	Longfin	Female	10	78.1	20.5		1496.7	1293.3		24.6	1.1	21-30
		Immature	4	48.5	2.0		233.5	24.6		22.0	1.1	19-24
	Shortfin	Female	5	60.0	9.7		503.4	272.2		22.8	1.9	19-30
Kokatahi	Longfin	Female	6	76.1	14.3		1193.5	745.8		34.2	5.2	15-46
		Immature	7	51.3	2.7		287.7	24.4		21.6	1.4	16-26
		Male	10	58.8	8.4		486.8	228.5		28.7	2.0	19-43
Lake Brunner	Longfin	Female	12	53.9	10.2		442.0	302.0		32.8	2.1	20-50
		Immature	9	45.8	2.1		218.7	31.0		26.8	1.4	18-31
		Male	4	57.8	10.2		533.0	292.5		28.0	1.5	25-32
	Shortfin	Female	14	68.8	5.8		669.5	203.8		30.1	1.3	23-37
Lake Hordern	Longfin	Female	10	78.0	14.7		1385.8	736.7		41.0	2.3	30-50
		Immature	2	57.0	1.4		405.5	115.3		25.5	5.5	20-31
		Male	4	60.5	11.8		611.3	404.6		28.3	6.0	18-41
	Shortfin	Female	8	75.3	12.5		897.3	437.2		25.5	1.5	21-34
Lake Kangaroo	Longfin	Female	1	60.0	-		458.0	-		29.0	-	29-29
		Immature	2	52.0	4.2		312.0	69.3		30.0	5.0	25-35
		Male	10	52.6	5.0		342.8	107.1		28.5	1.5	23-40
	Shortfin	Female	7	80.5	9.4		1072.4	344.4		27.0	0.8	24-30

Table 15 cont.

Area	Spp	Sex	N	Length Mean	Length SE	Length Range	Weight Mean	Weight SE	Weight Range	Age Mean	Age SE	Age Range
Motueka River	Longfin	Female	6	70.8	5.0		924.8	204.2		19.2	1.0	16-23
		Male	14	49.4	5.6		302.0	134.2		21.0	0.8	14-25
Okari River	Longfin	Female	13	66.8	12.1		818.9	683.9		25.6	3.3	14-43
		Immature	3	52.3	3.5		320.3	35.1		19.3	7.4	10-34
		Male	3	63.0	12.5		664.3	396.5		26.7	3.9	19-32
	Shortfin	Female	6	62.5	16.2		601.5	559.5		24.6	2.6	16-32
		Male	1	53.0	-		291.0	-		18.0	-	18-18
Paturau River (lower)	Longfin	Female	10	75.5	8.5		1111.8	411.9		32.8	4.0	19-54
		Male	10	45.5	1.7		208.1	24.5		21.6	0.6	19-25
Paturau River (mid)	Longfin	Female	6	72.0	10.3		997.2	543.5		27.5	3.7	17-44
		Male	10	45.9	0.7		217.4	8.7		21.0	0.9	18-27
Paturau River (upper)	Longfin	Female	7	81.6	9.5		1493.9	488.5		25.7	1.9	18-33
		Male	13	53.1	14.4		434.5	456.8		21.4	1.8	12-32
Rai River	Longfin	Female	7	81.0	9.6		1441.1	555.5		24.4	1.9	18-30
		Male	7	46.3	1.4		223.4	10.1		18.3	1.2	12-22
	Shortfin	Female	18	65.2	12.6		633.4	381.3		26.4	1.4	18-35
		Male	1	50.0	-		235.0	-		24.0	-	24-24
Raleigh Creek	Longfin	Female	7	75.0	6.7		1086.4	356.3		33.0	2.4	28-45
		Male	4	50.5	1.0		250.0	18.3		26.3	0.8	25-28
Seven Mile Creek	Longfin	Female	3	91.7	19.9		2073.3	1060.0		39.7	5.2	34-50
		Male	3	53.3	1.2		309.3	28.4		38.0	3.5	34-45
Takaka River (lower)	Longfin	Female	7	82.6	19.6		1731.7	1140.5		27.1	1.9	20-36
		Male	12	53.6	11.3		382.2	301.3		22.8	1.4	13-30
	Shortfin	Female	7	67.0	9.0		611.7	245.3		18.7	1.7	13-25

Table 15 cont.

Area	Spp	Sex	N	Length Mean	Length SE	Length Range	Weight Mean	Weight SE	Weight Range	Age Mean	Age SE	Age Range
Takaka River (mid)	Longfin	Female	7	69.3	4.2		852.4	254.3		30.1	2.9	25-47
		Male	13	50.2	8.5		322.6	200.1		24.8	1.2	16-31
Takaka River (upper)	Longfin	Female	5	69.2	6.6		735.4	188.8		22.0	3.5	11-33
		Immature	1	48.0	-		213.0	-		21.0	-	21-21
		Male	14	51.2	5.3		320.0	139.4		17.1	1.1	9-24
	Shortfin	Female	18	73.2	15.5		892.7	532.6		14.5	0.8	9-22
		Immature	1	40.0	-		104.0	-		14.0	-	14-14
Taylor Dam	Shortfin	Female	16	61.1	10.1		448.8	254.9		22.4	1.4	14-32
		Male	2	48.5	0.7		223.5	0.7		16.5	0.5	16-17
Waimakariri River	Longfin	Female	10	73.9	8.0		1146.7	537.9		22.9	2.1	13-34
		Male	10	47.5	1.6		220.5	4.7		22.1	0.6	19-24
Wairau River	Longfin	Female	1	85.0	-		1325.0	-		26.0	-	26-26
	Shortfin	Female	9	60.3	14.1		464.7	414.5		22.0	1.7	16-30

Table 16: Summary statistics for gonad stages for South Island catches. (N= number, SE= standard error).

Spp	Sex	Gonad Stage	N	Length Mean	SE	Range	Weight Mean	SE	Range	Age Mean	SE	Range
Longfin	Immature	0	73	48.1	0.5	39-58	248.1	7.3	112-487	20.9	0.6	10-34
	Female	1	60	59.1	1.2	45-76	505.1	30.5	214-1038	24.2	1.0	9-39
		2	76	72.7	0.9	49-88	1004.6	36.6	253-1658	25.7	1.0	10-47
		3	40	83.2	1.4	68-102	1598.2	91.0	631-3050	27.9	1.7	13-57
		4	18	95.1	2.3	73-114	2432.1	183.1	1025-4559	27.8	2.8	17-50
	Male	1	85	50.0	0.5	43-66	282.7	9.4	161-559	24.2	0.6	12-45
		2	43	50.0	0.9	42-65	292.3	20.9	186-668	25.3	0.9	13-43
		3	33	57.8	2.2	44-81	531.0	65.5	211-1342	25.4	1.4	10-45
		4	26	54.7	2.2	44-86	453.5	66.9	214-1593	20.7	1.1	10-33
Shortfin	Immature	0	1	40.0	-	40-40	104.0	-	104-104	21.0	-	21-21
	Female	1	43	53.6	0.6	47-69	281.5	11.9	194-636	22.8	0.8	11-35
		2	56	64.5	1.1	49-90	546.5	31.0	208-1436	24.6	1.0	11-50
		3	40	76.9	1.2	60-91	944.1	42.5	379-1518	25.9	1.4	13-50
		4	20	82.7	1.6	69-92	1211.4	68.5	685-1695	21.4	1.5	9-32
	Male	1	2	51.5	1.5	50-53	263.0	28.0	235-291	31.5	0.5	31-32
		2	1	46.0	-	46-46	170.0	-	170-170	24.0	-	24-24
		3	4	71.0	7.9	57-93	841.5	355.1	341-1891	19.3	2.2	15-25
		4	3	61.3	12.8	48-87	659.0	435.5	223-1530	18.0	1.5	16-21

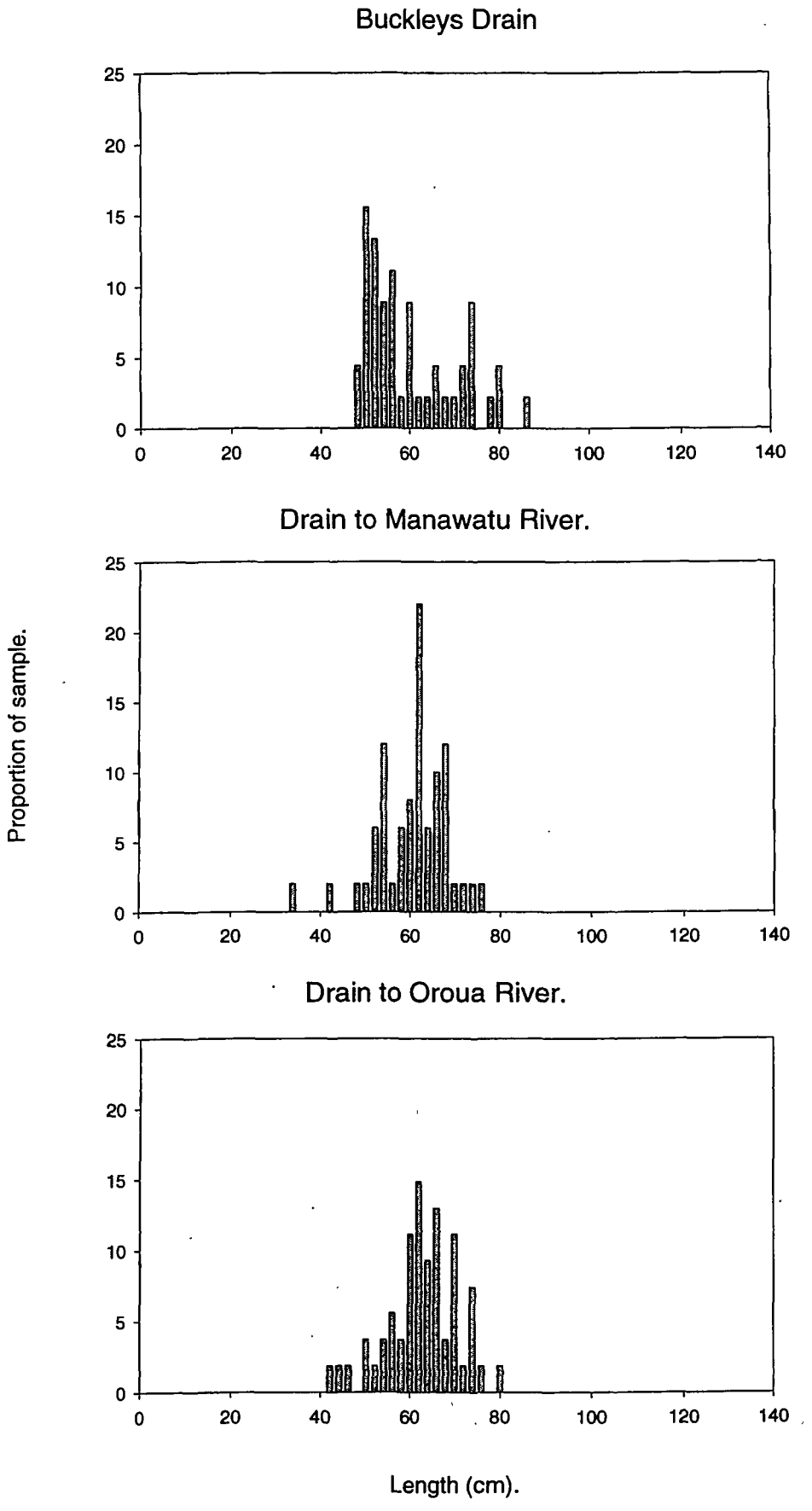

Figure 2: Length frequency histograms of North Island shortfinned eels

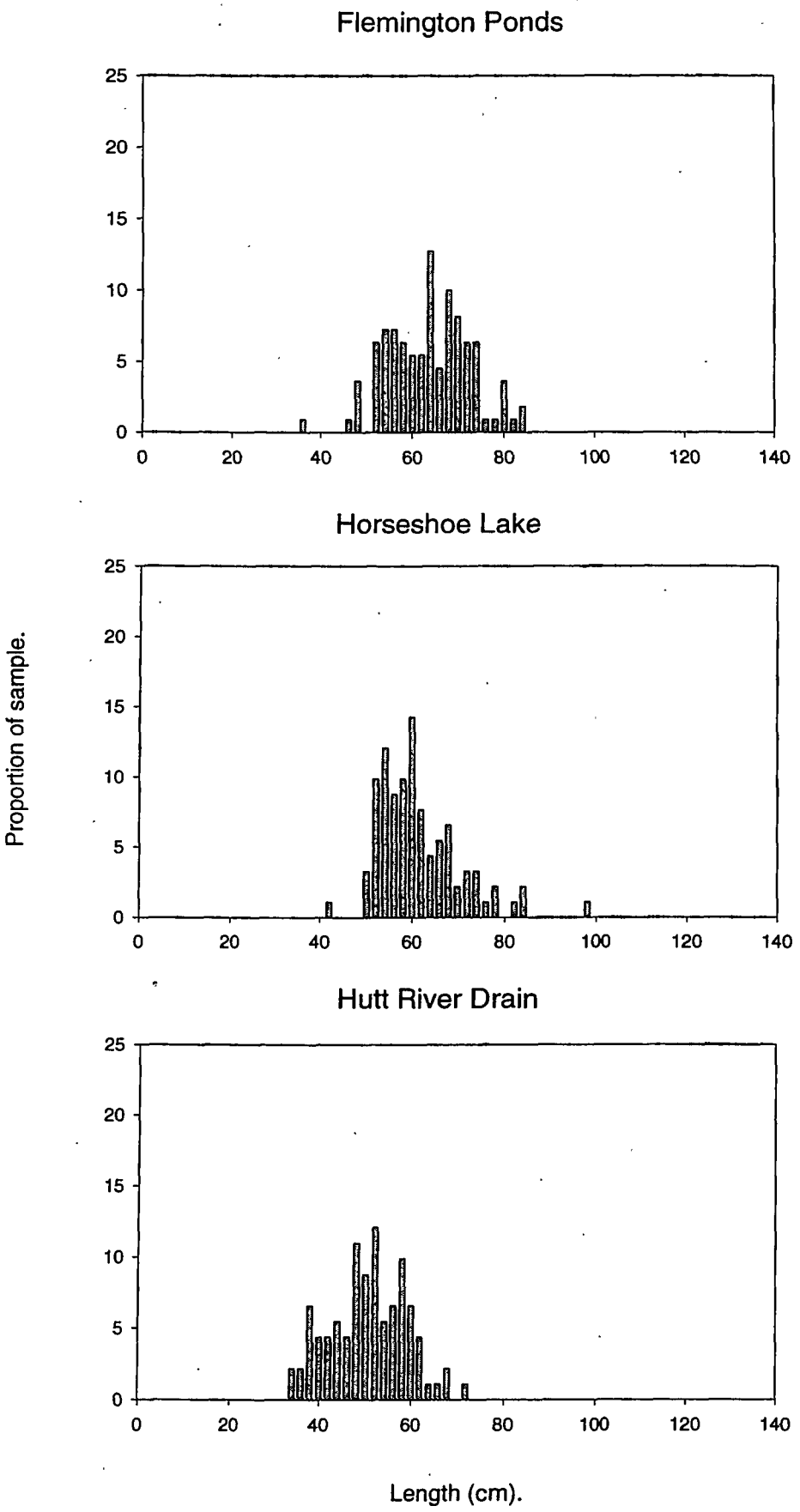

Figure 2: *Continued*.

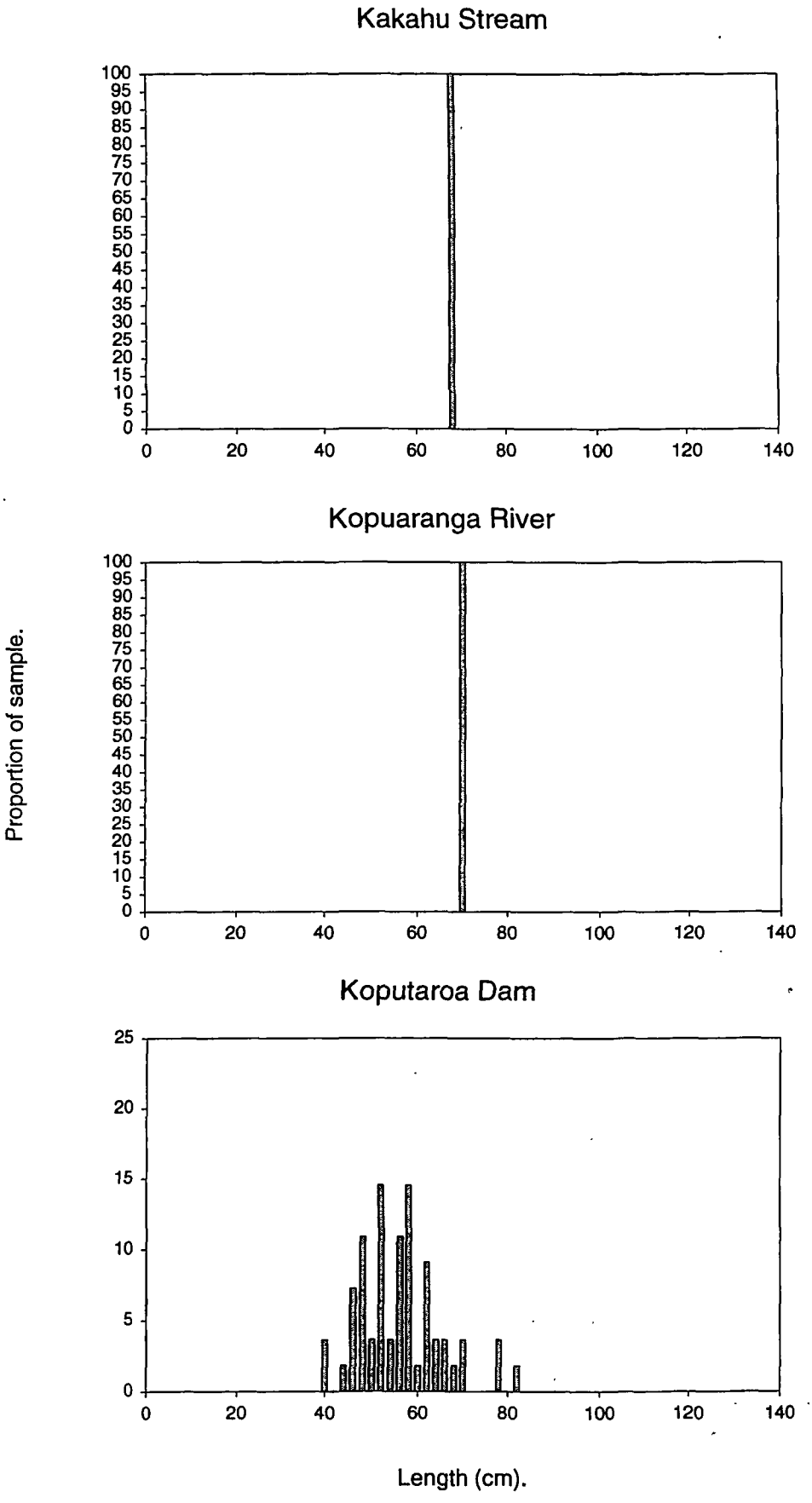

Figure 2: *Continued*

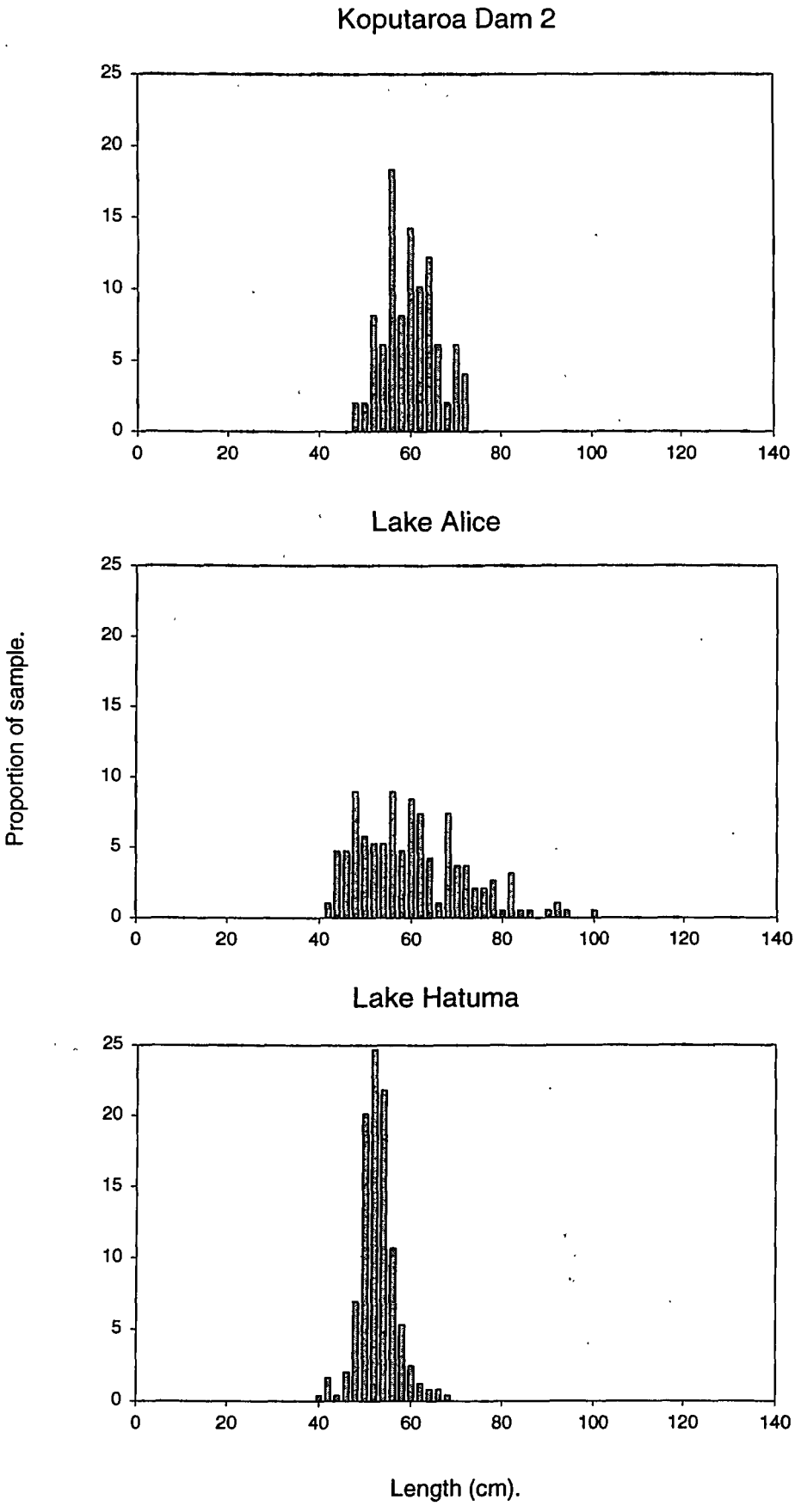

Figure 2: *Continued*

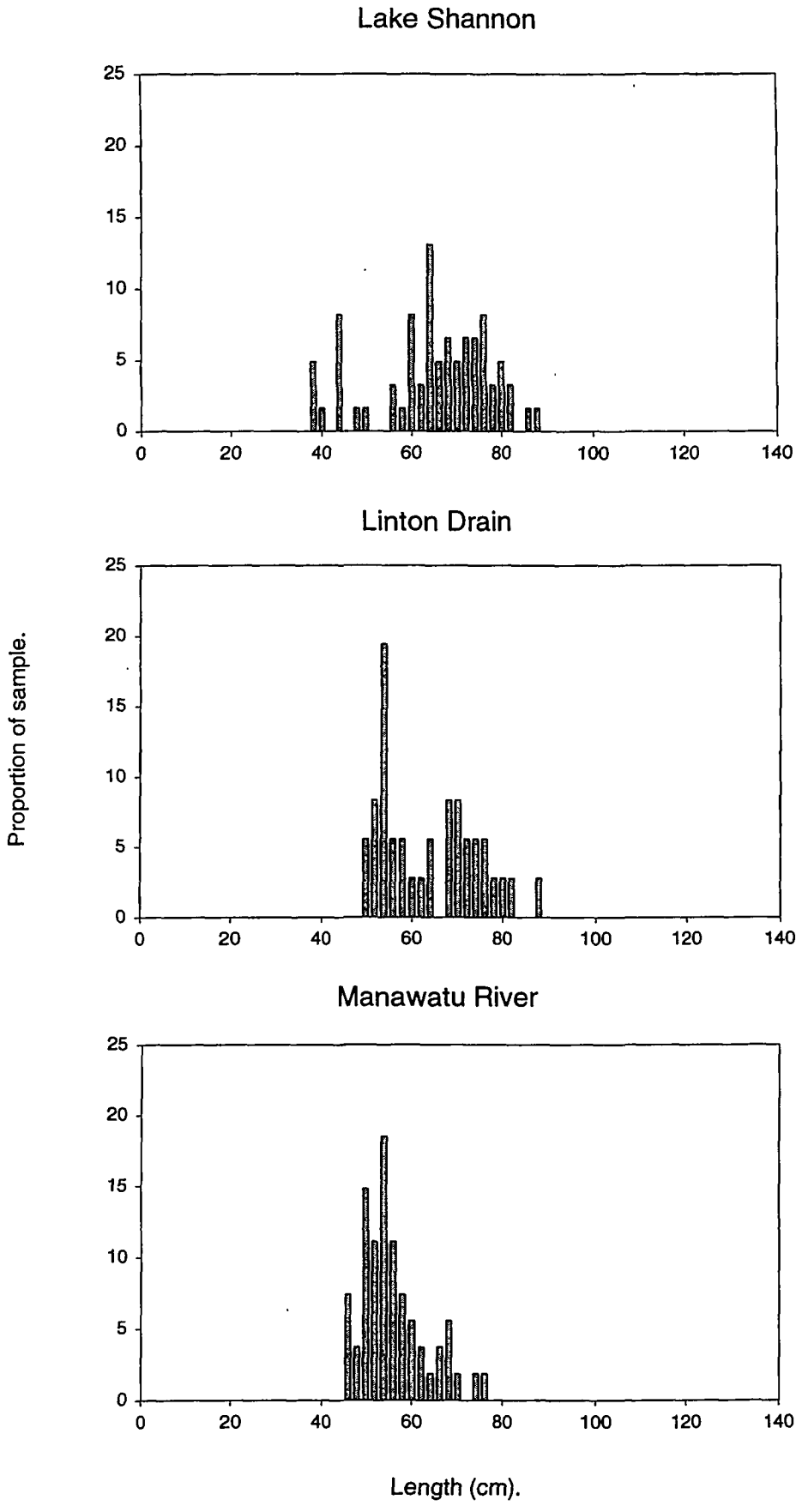

Figure 2: *Continued*

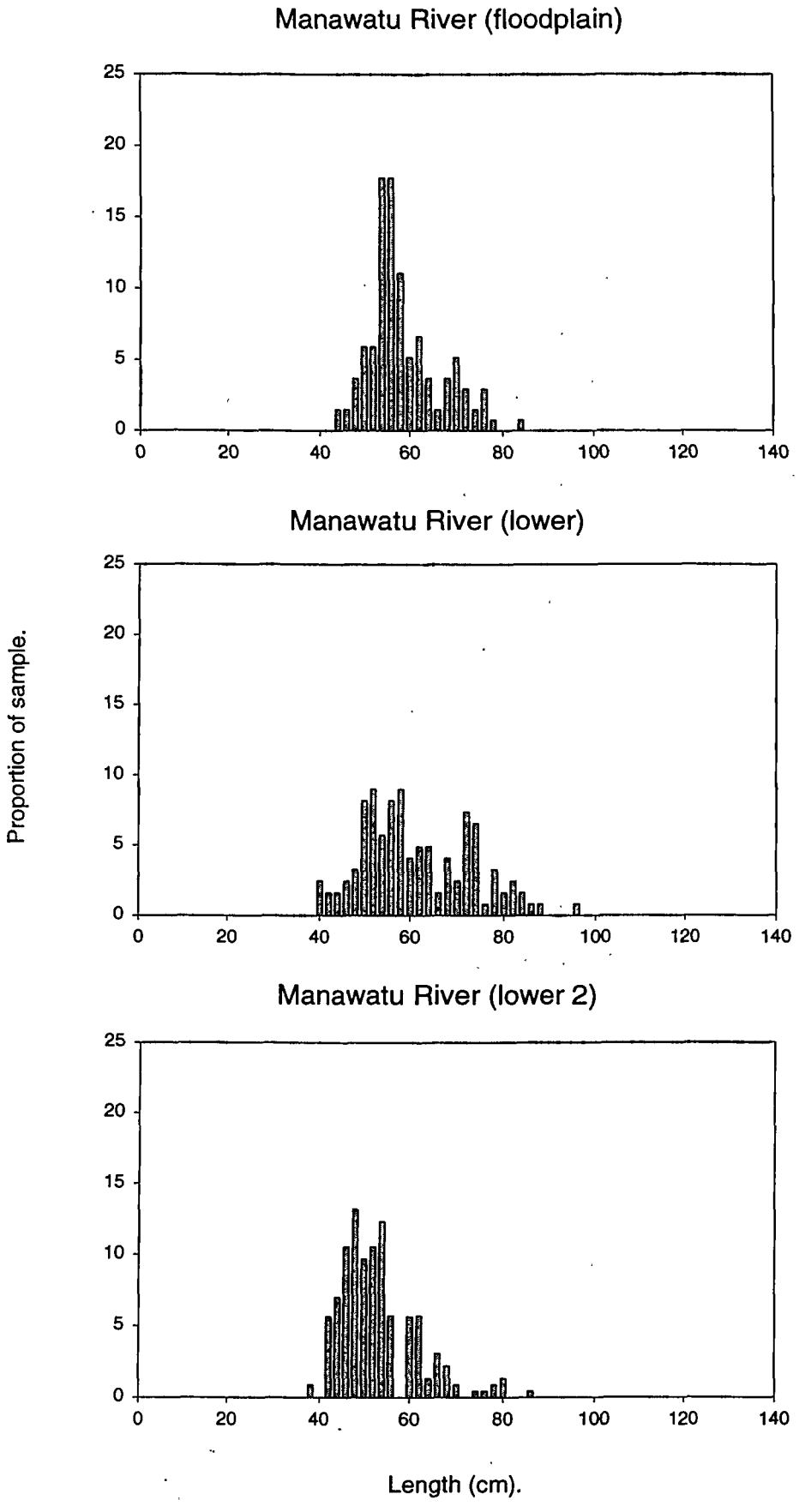

Figure 2: *Continued*

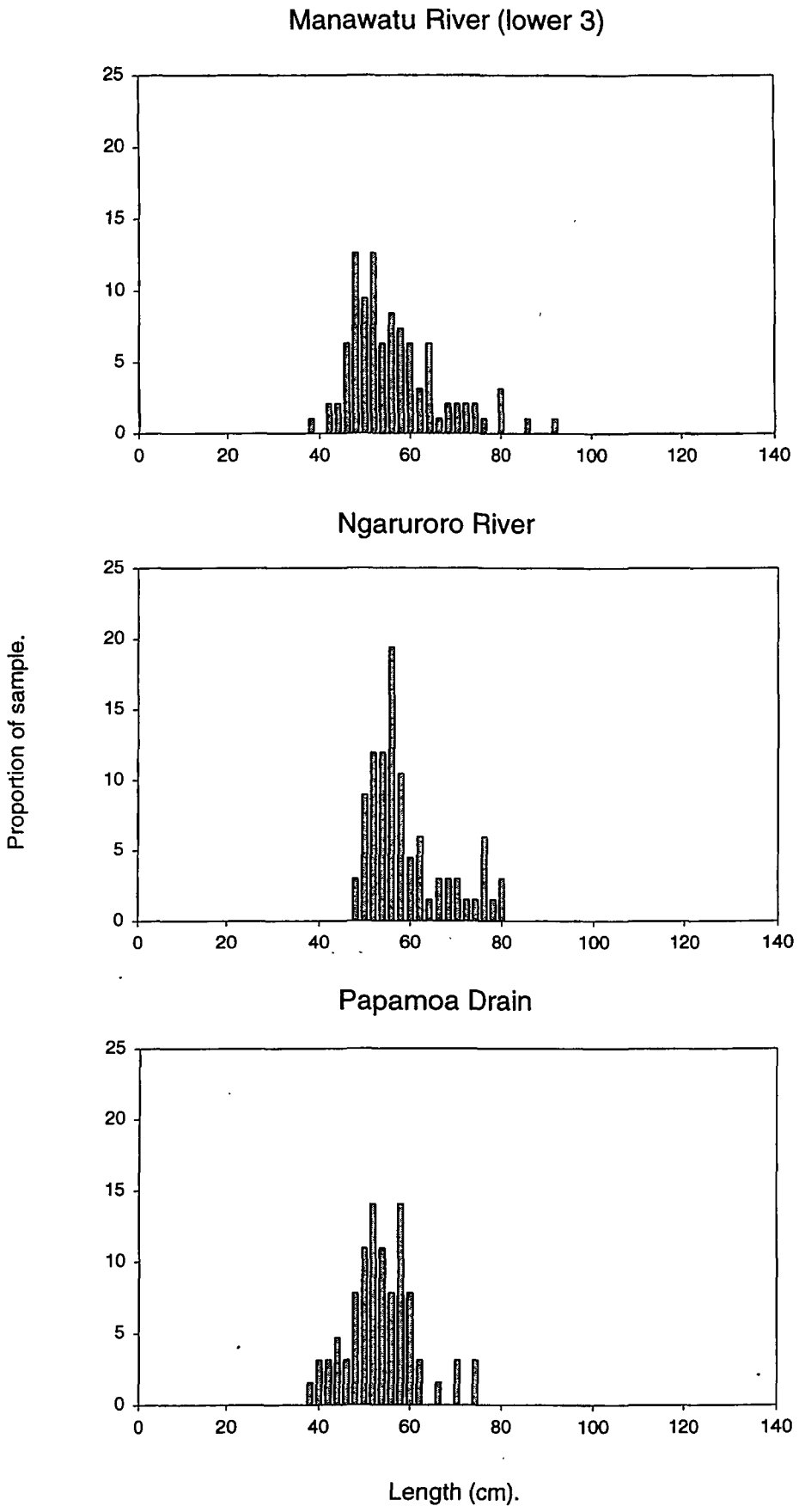

Figure 2: *Continued*

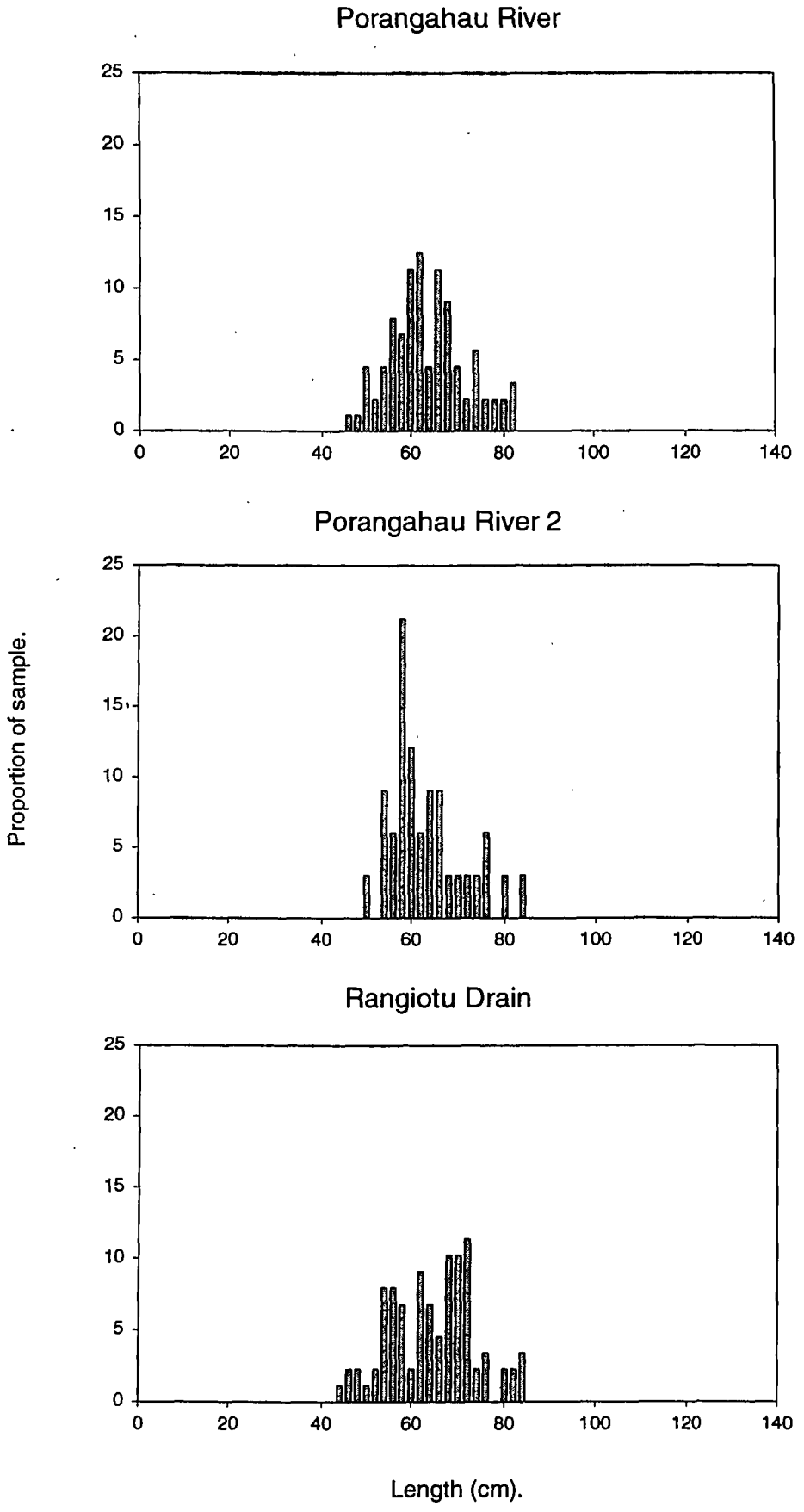

Figure 2: *Continued*

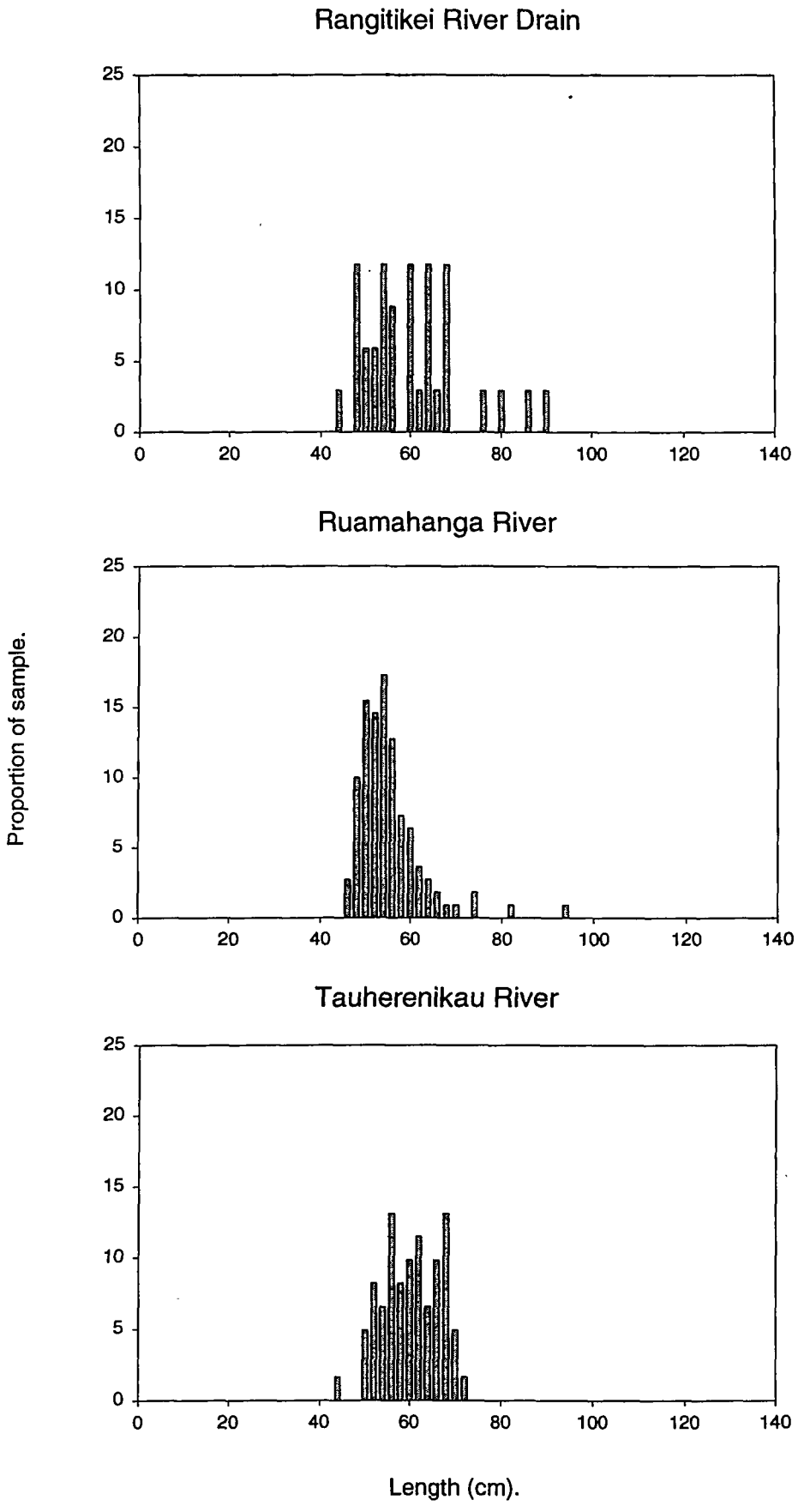

Figure 2: *Continued*

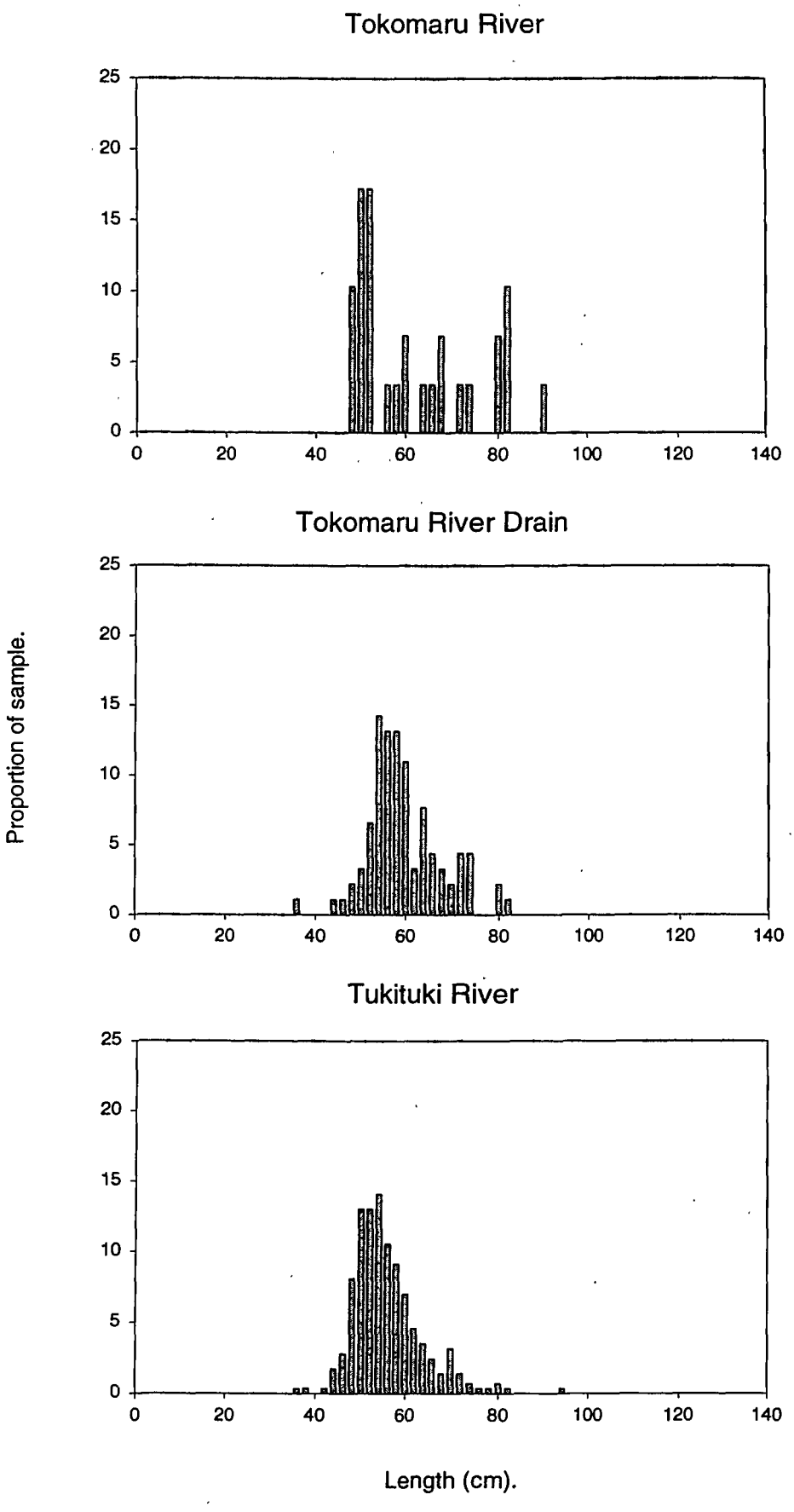

Figure 2: *Continued*

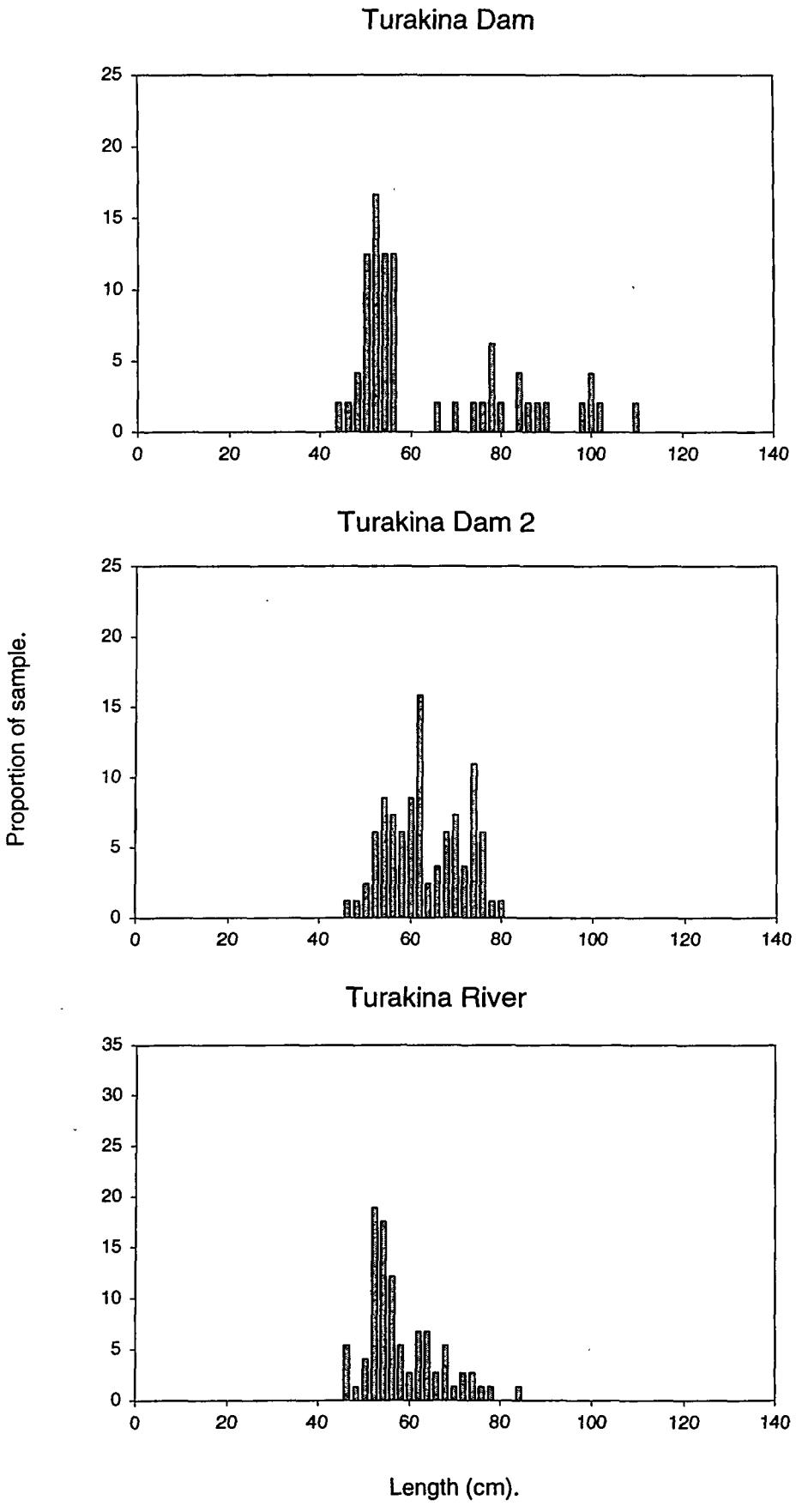

Figure 2: *Continued*

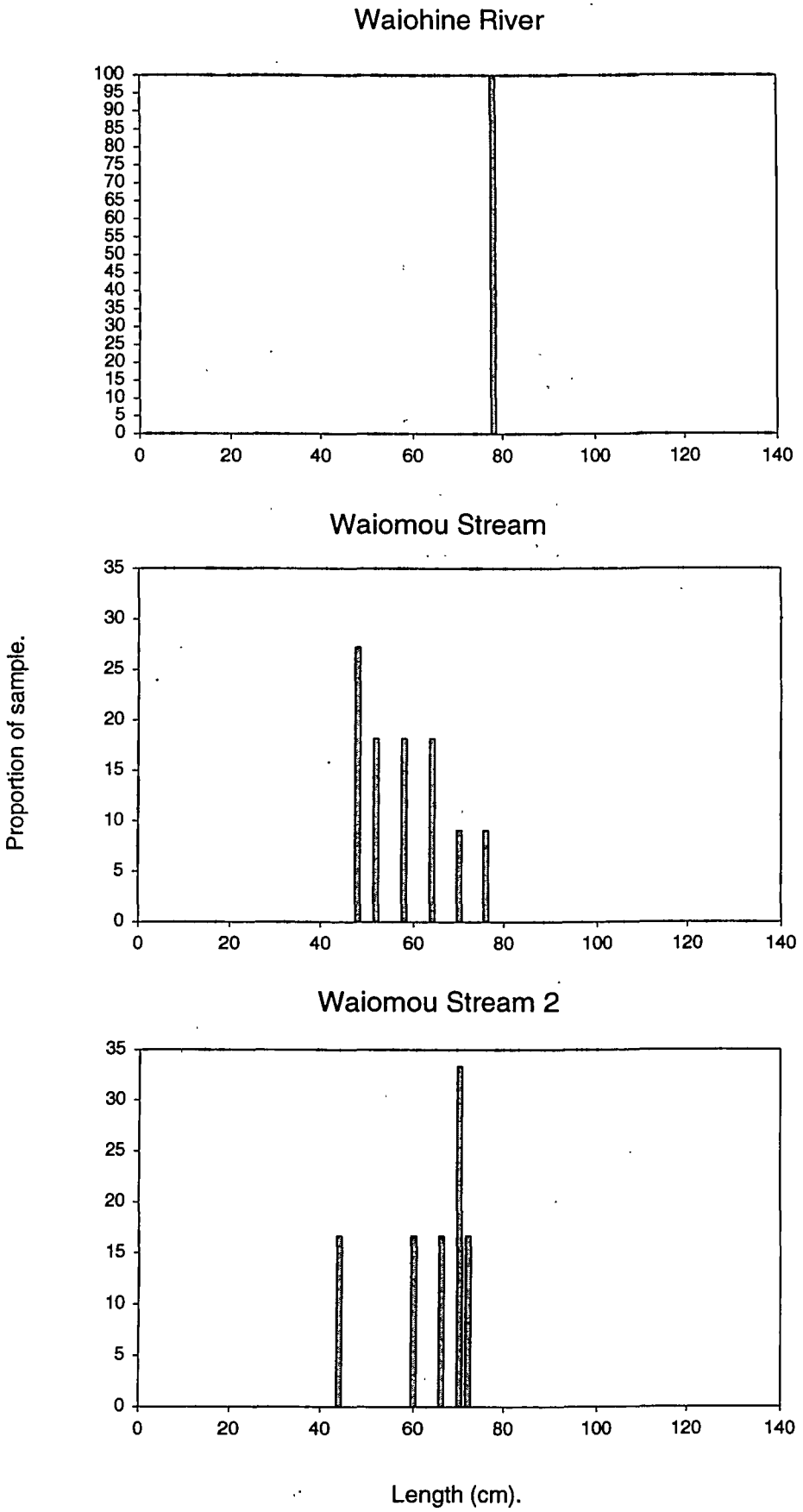

Figure 2: *Continued*

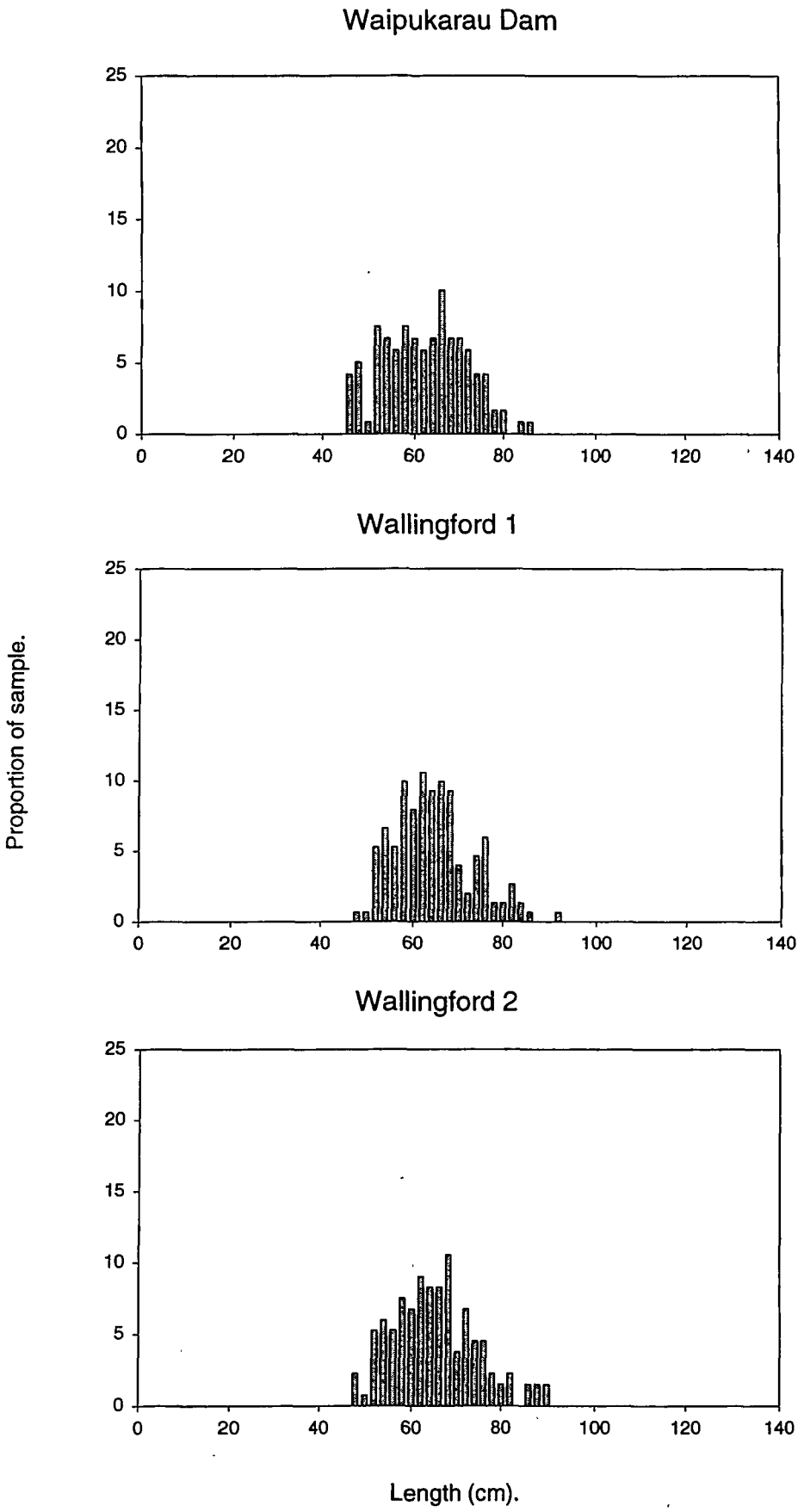

Figure 2: *Continued*

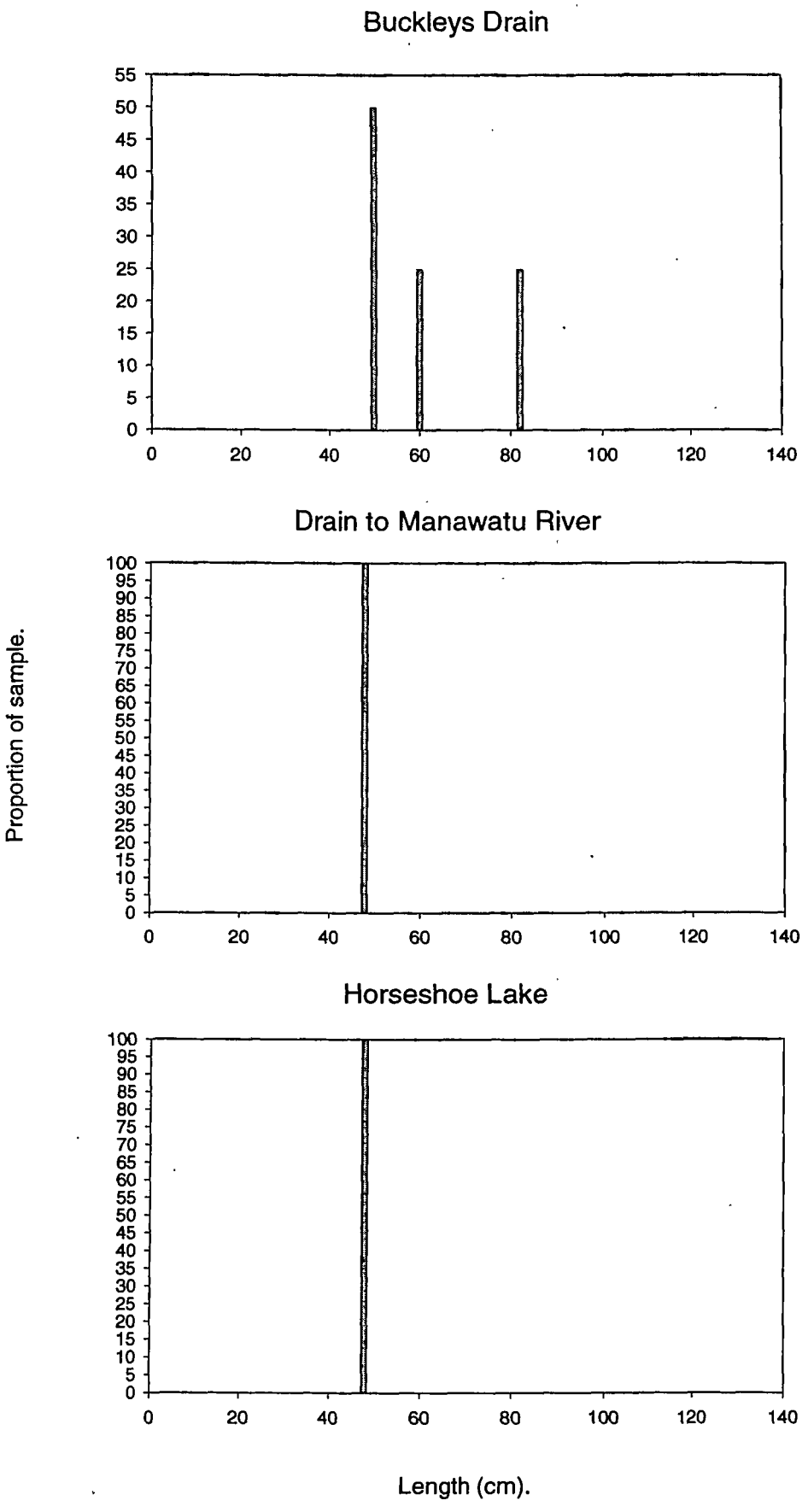

Figure 3: Length frequency histograms for North Island longfinned eels

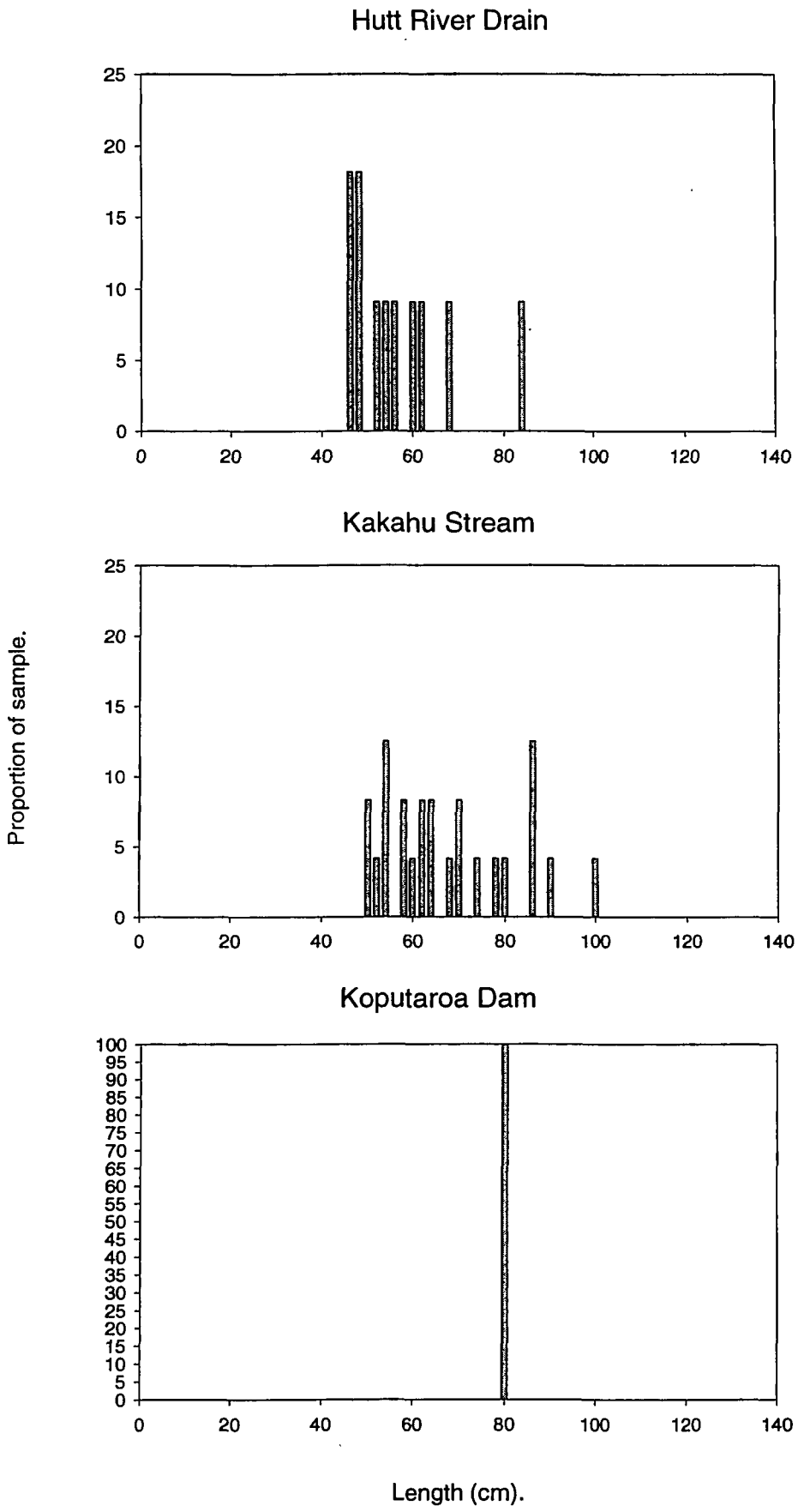

Figure 3: *Continued*

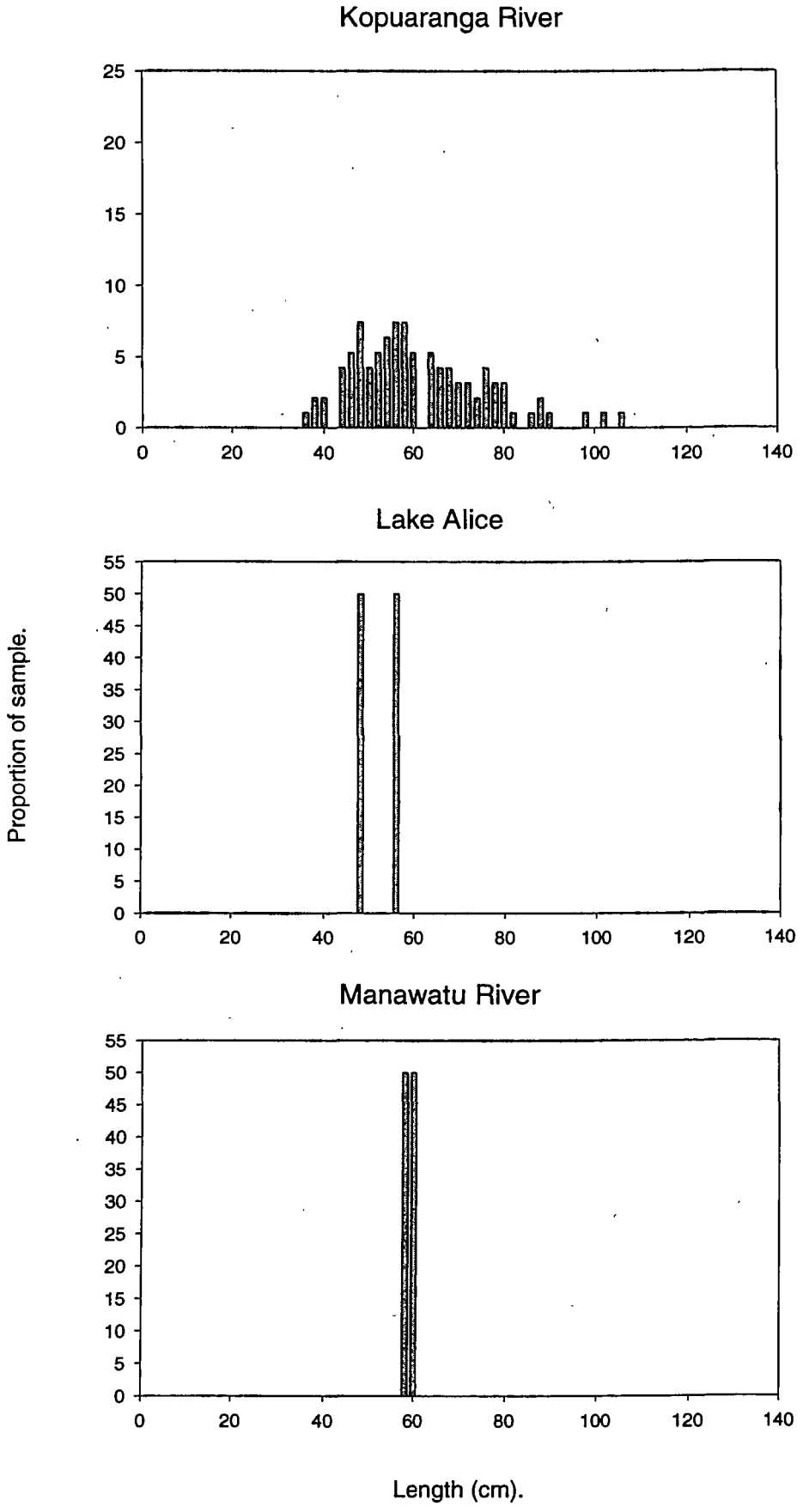

Figure 3: *Continued*

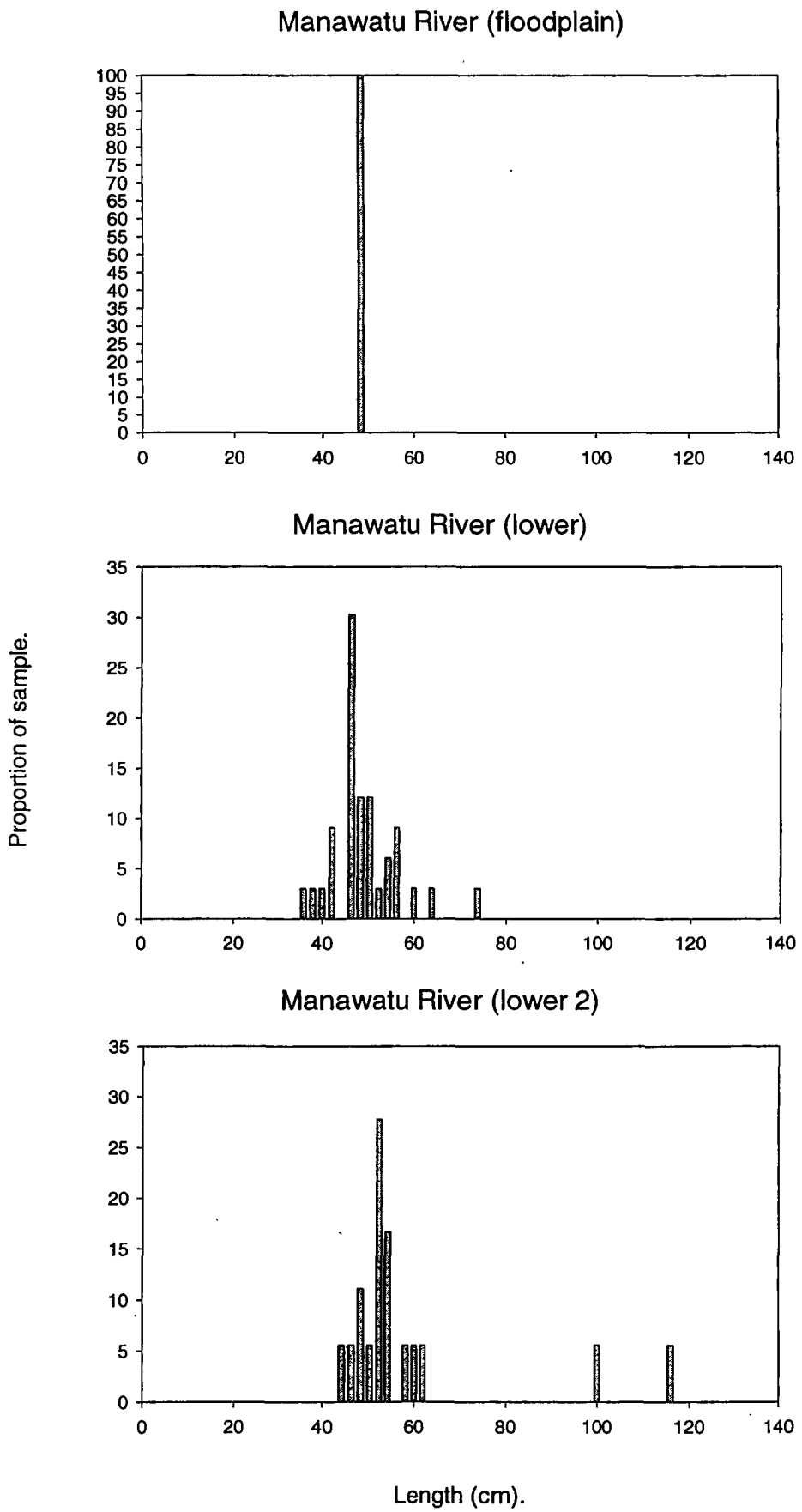

Figure 3: *Continued*

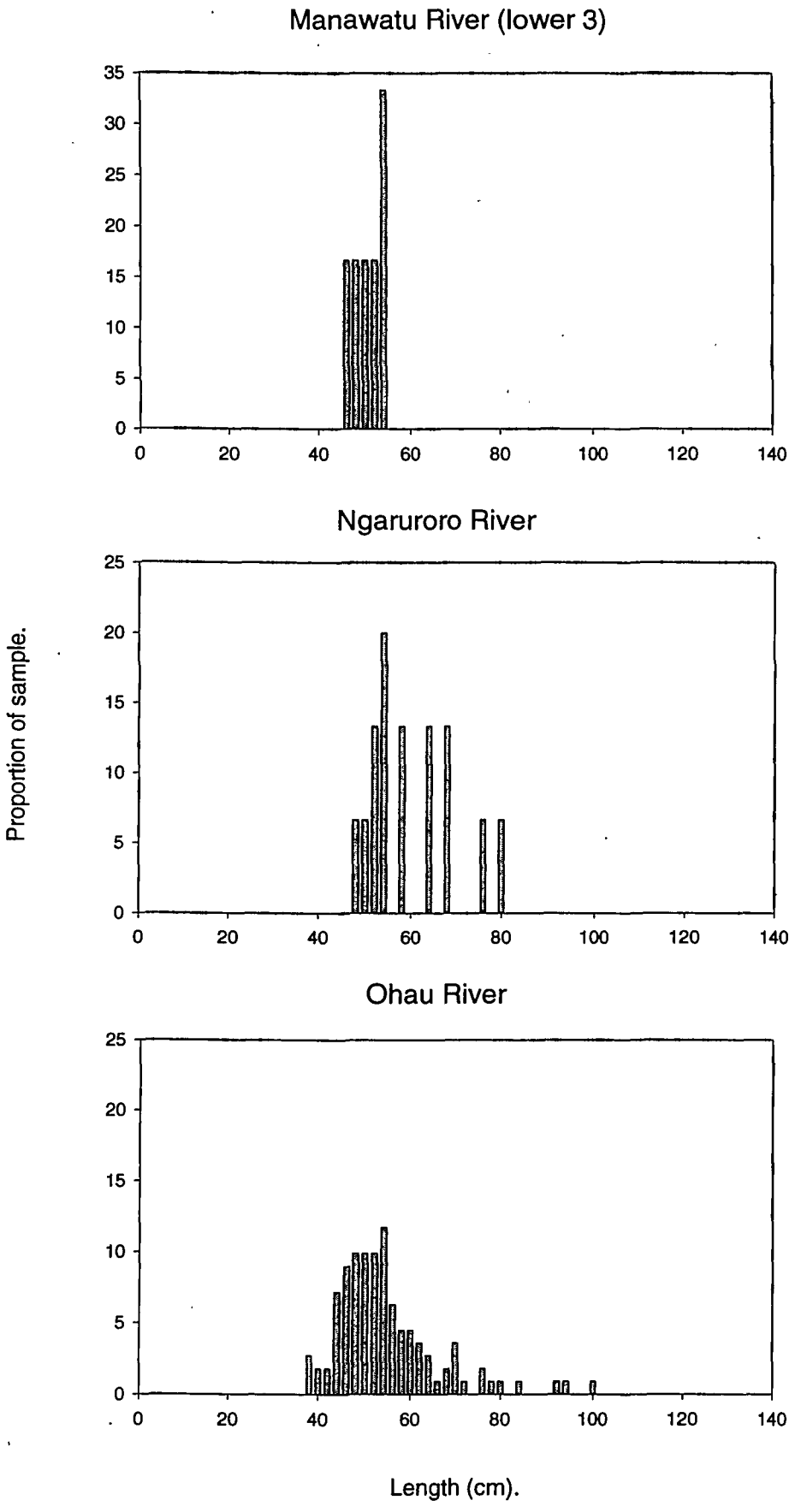

Figure 3: *Continued*

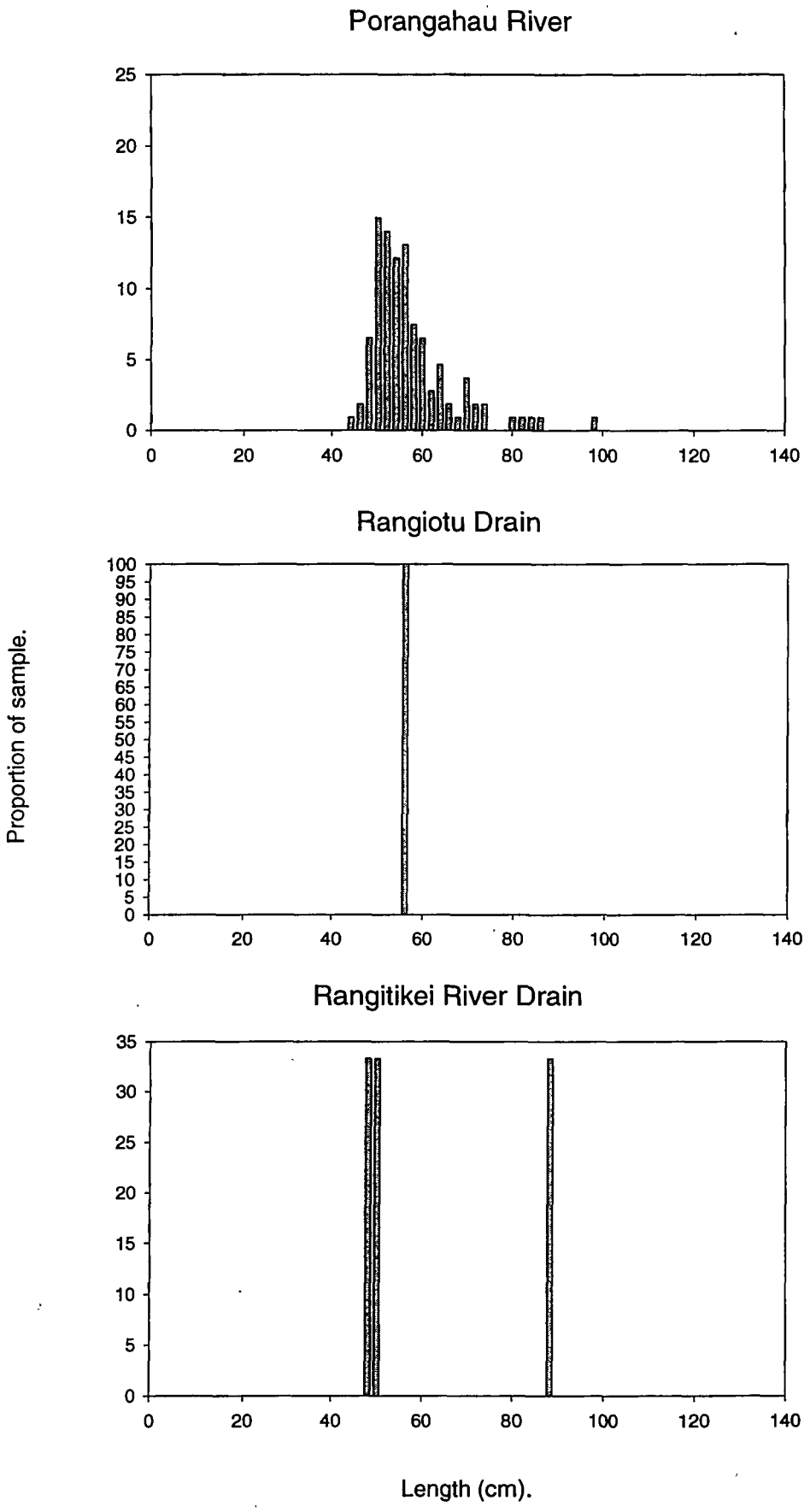

Figure 3: *Continued*

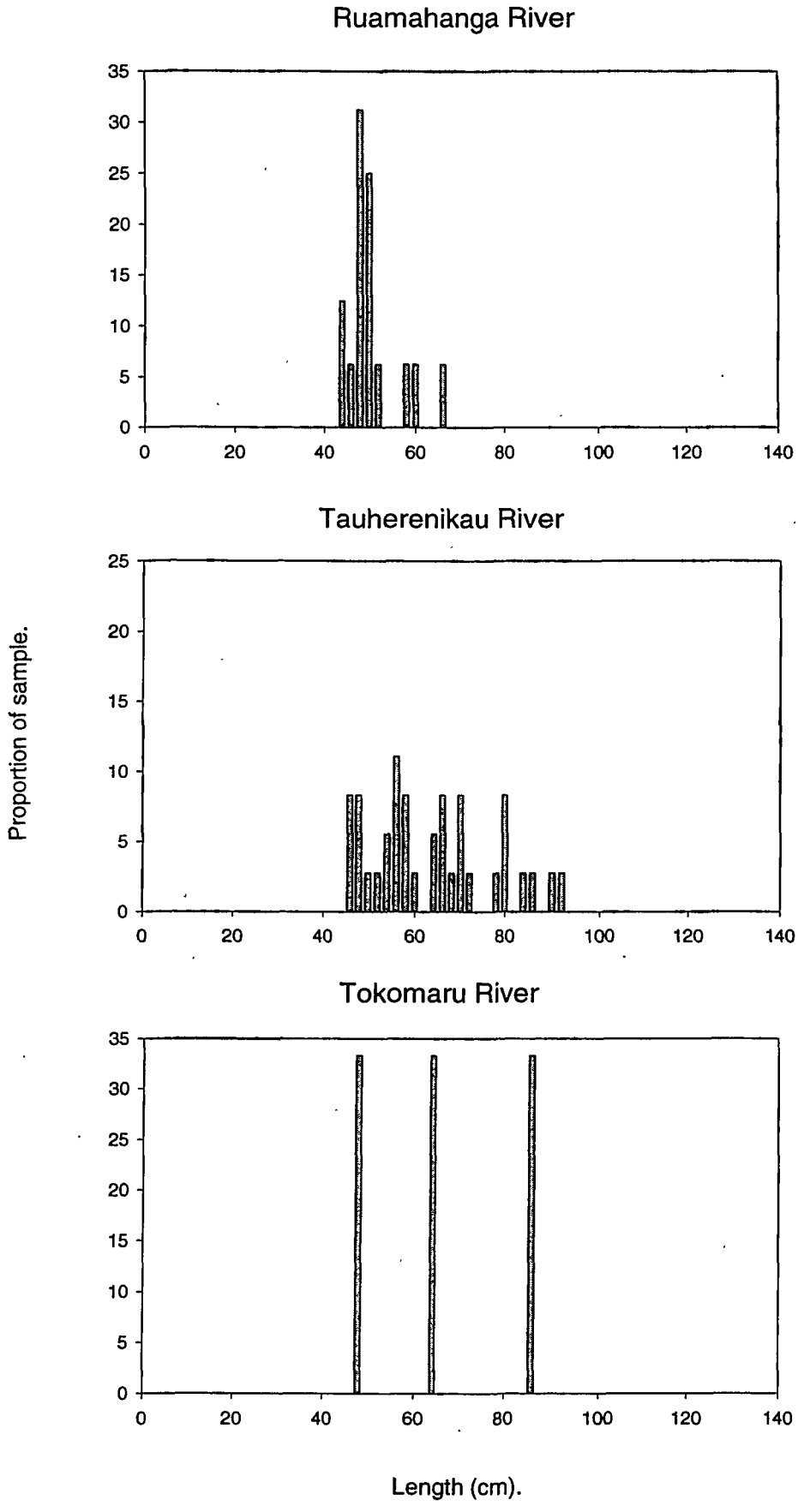

Figure 3: *Continued*

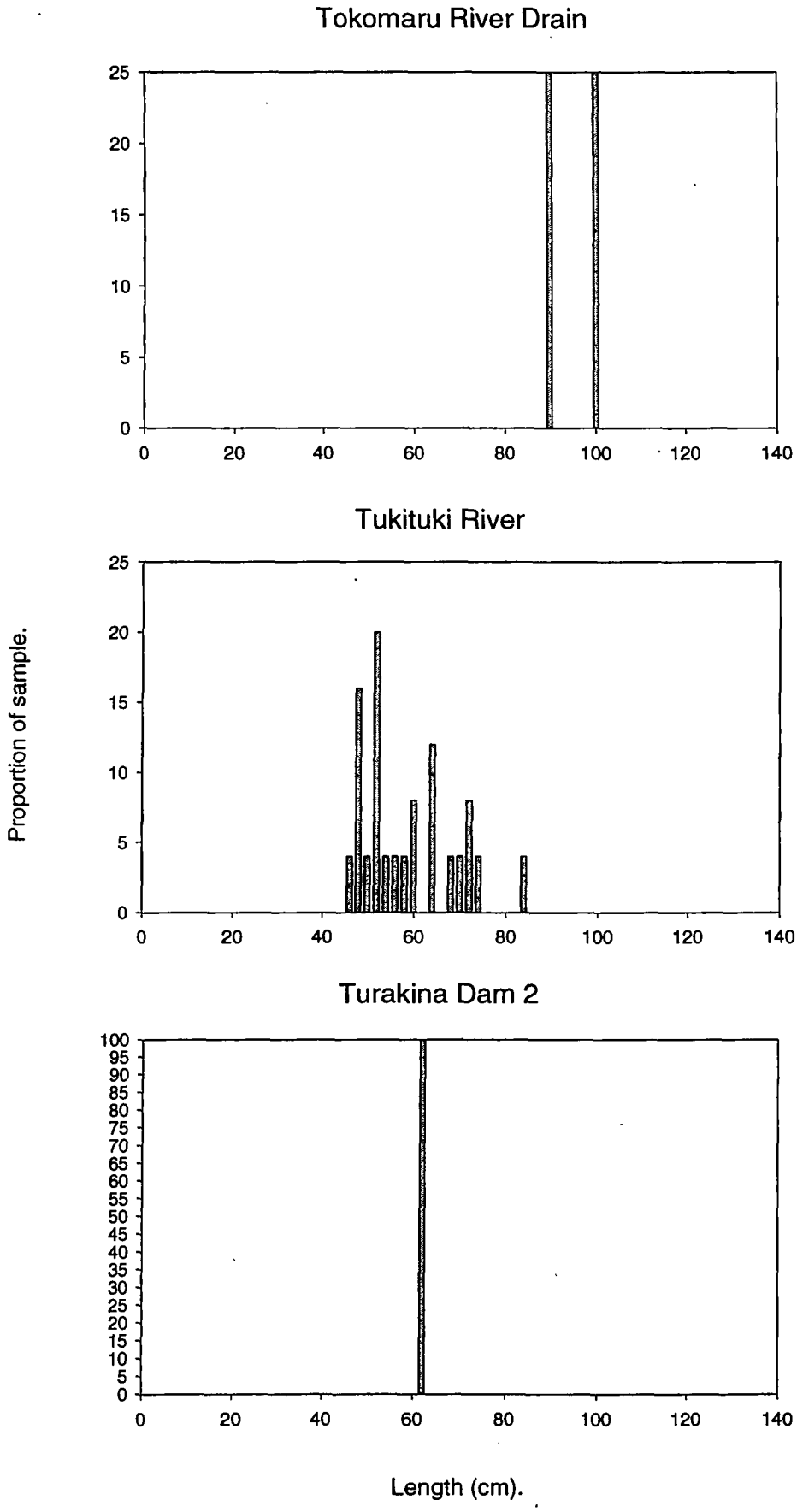

Figure 3: *Continued*

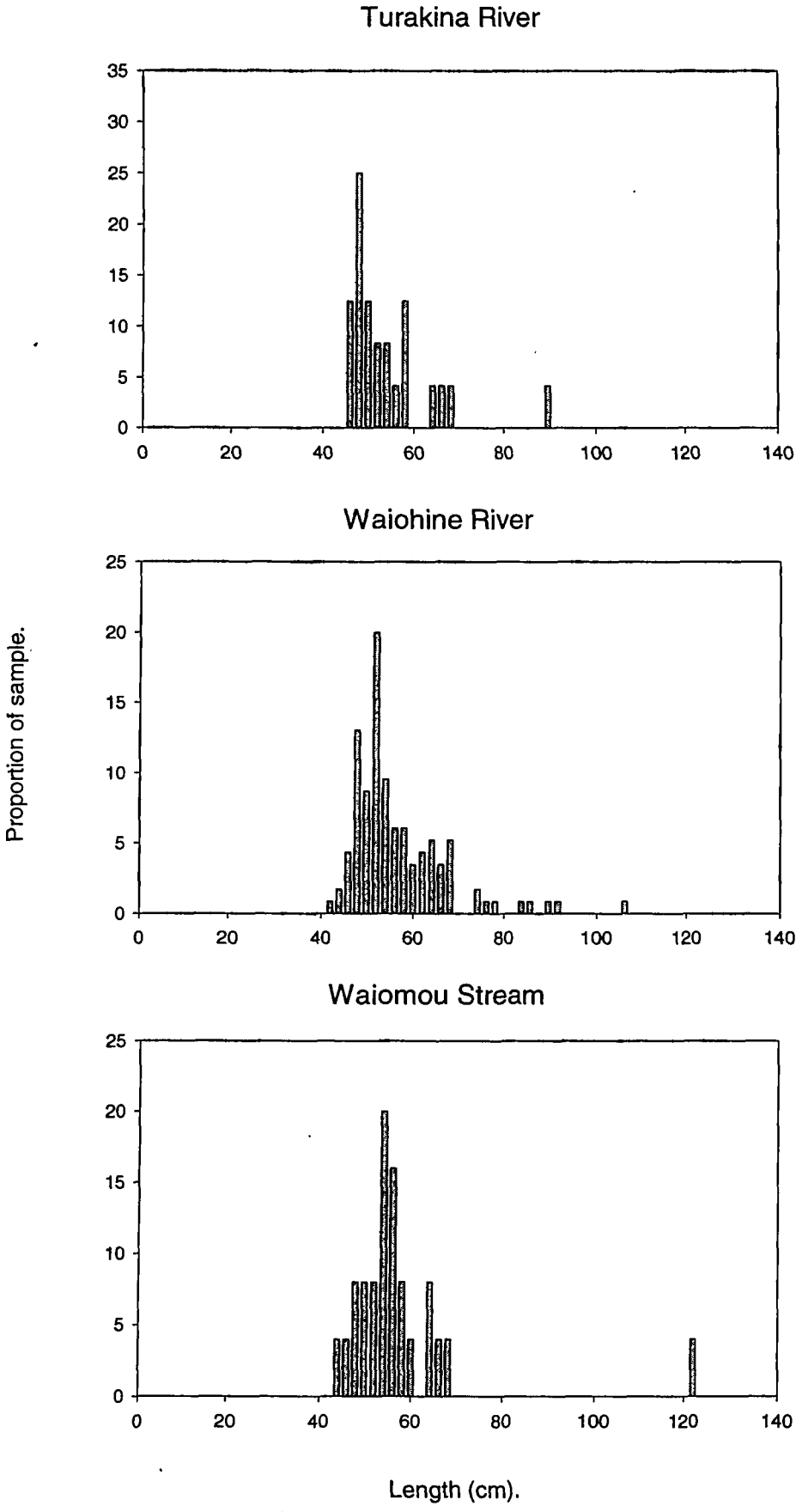

Figure 3: *Continued*

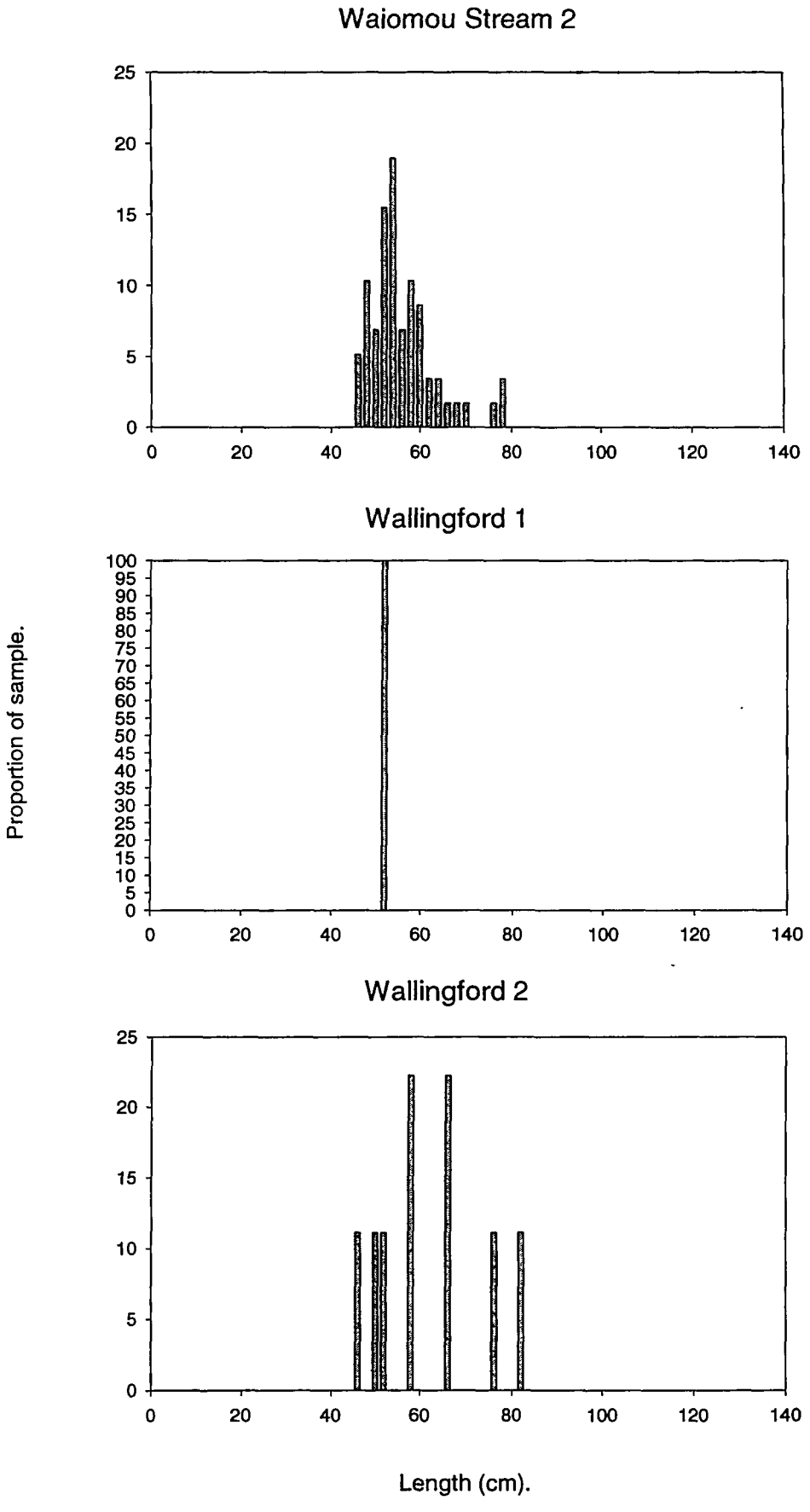

Figure 3: *Continued*

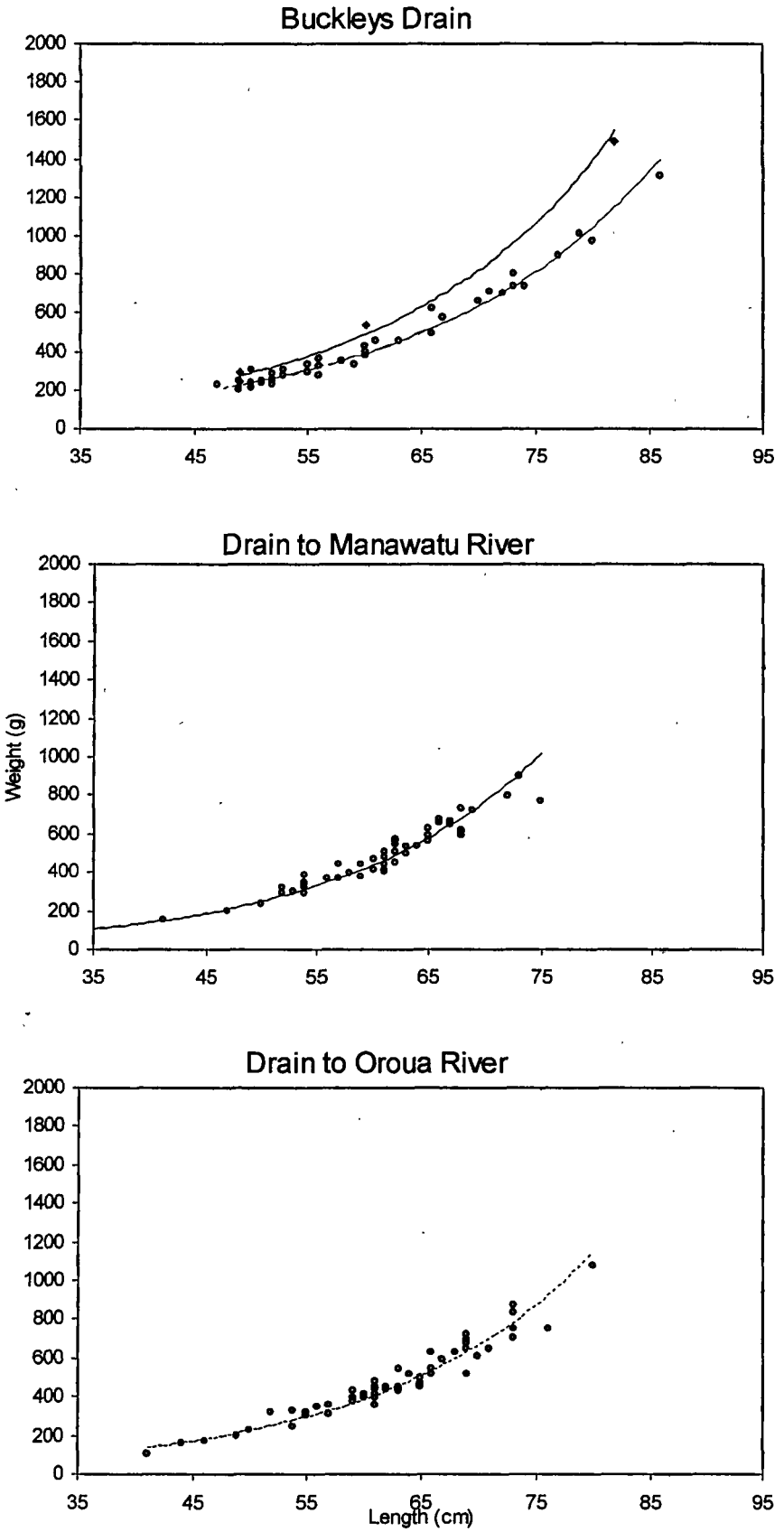

Figure 4: Scatter plots showing length and weight relationship for both shortfinned and longfinned eels together with trend lines for each species.
Key ° shortfin, ♦ longfin

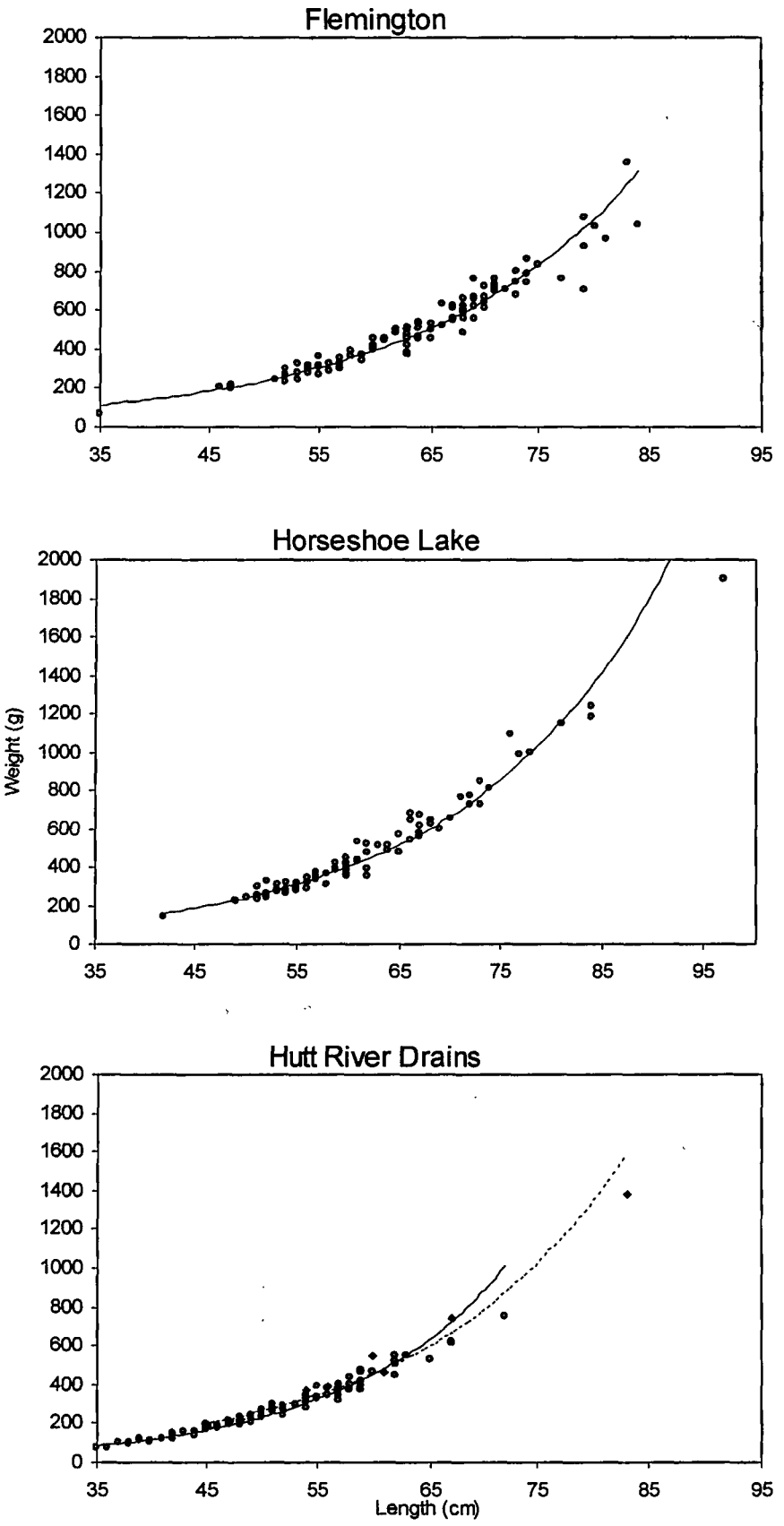

Figure 4 *Continued*: Key ° shortfin, ◆ longfin

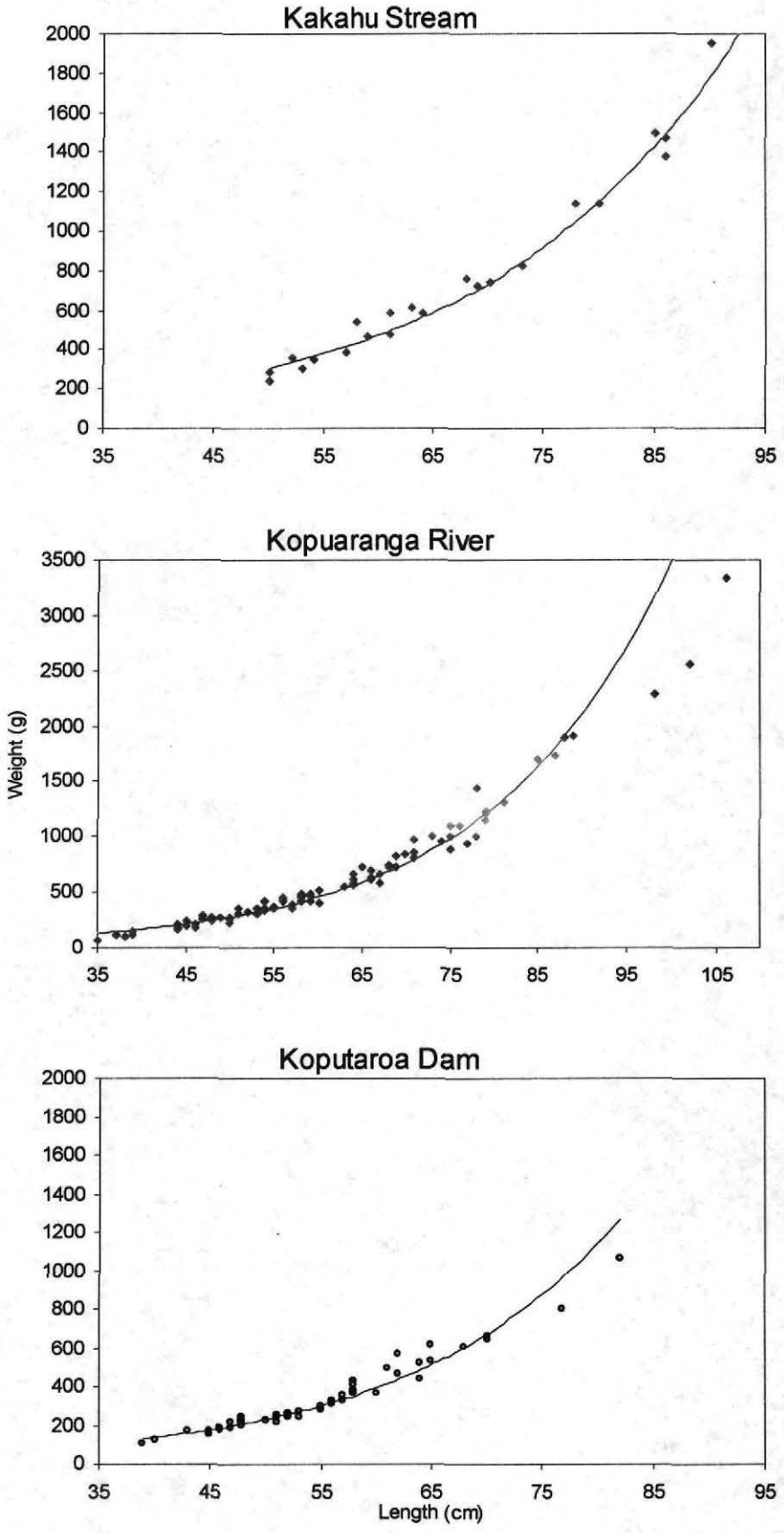

Figure 4 *Continued*: Key ° shortfin, * longfin

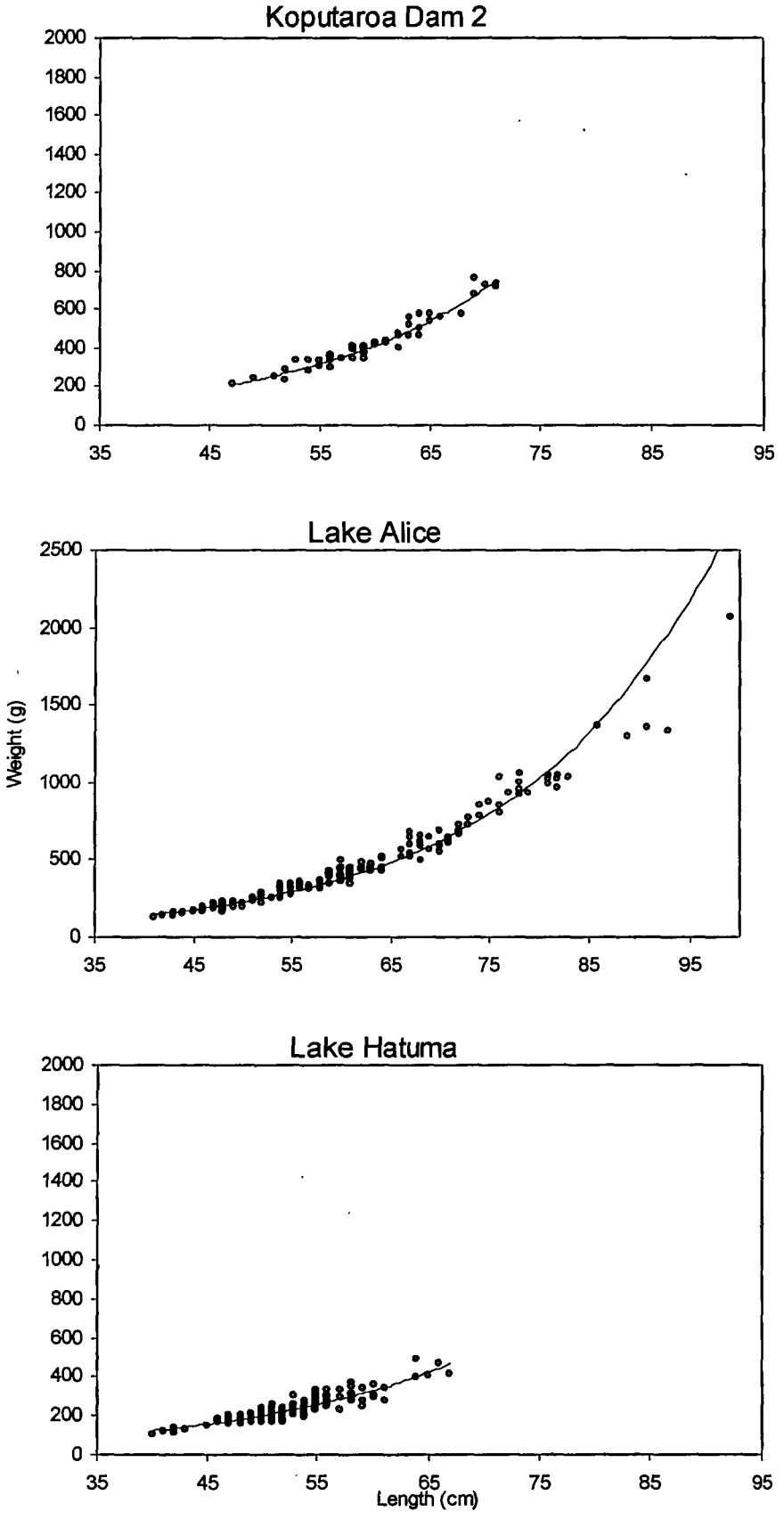

Figure 4 *Continued*: Key ° shortfin, • longfin

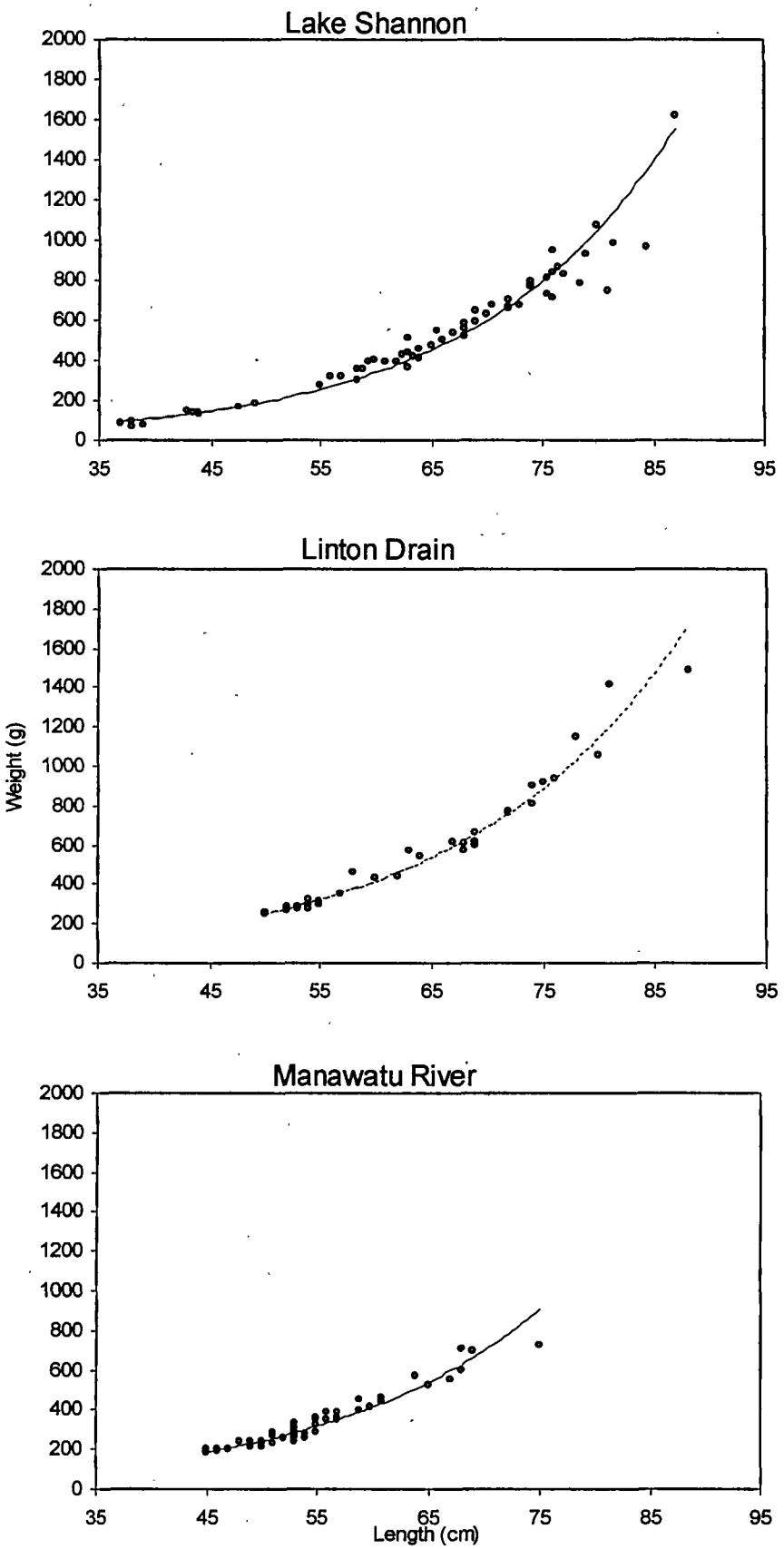

Figure 4 *Continued*: Key ° shortfin, ◆ longfin

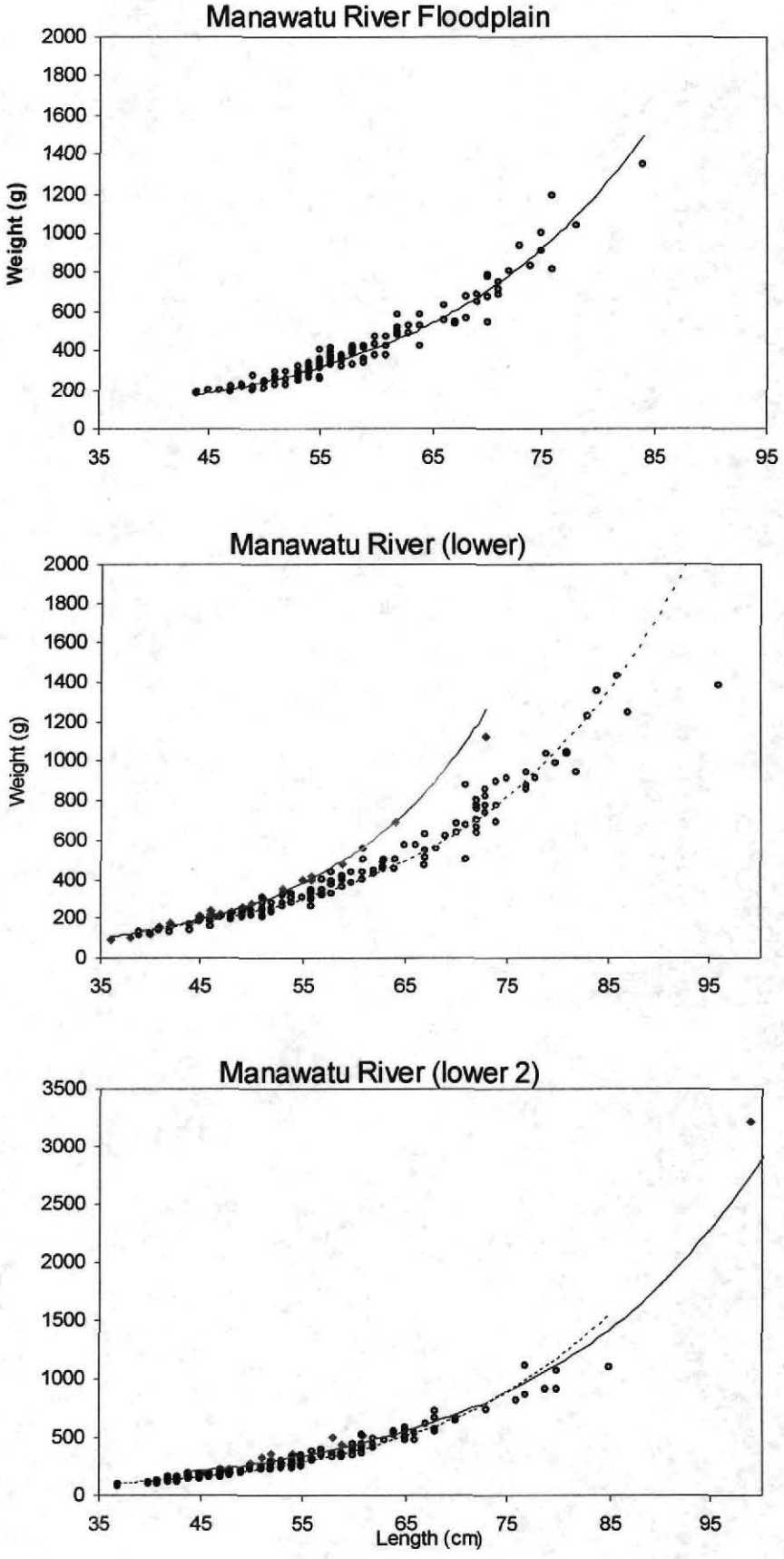

Figure 4 *Continued*: Key ° shortfin, * longfin

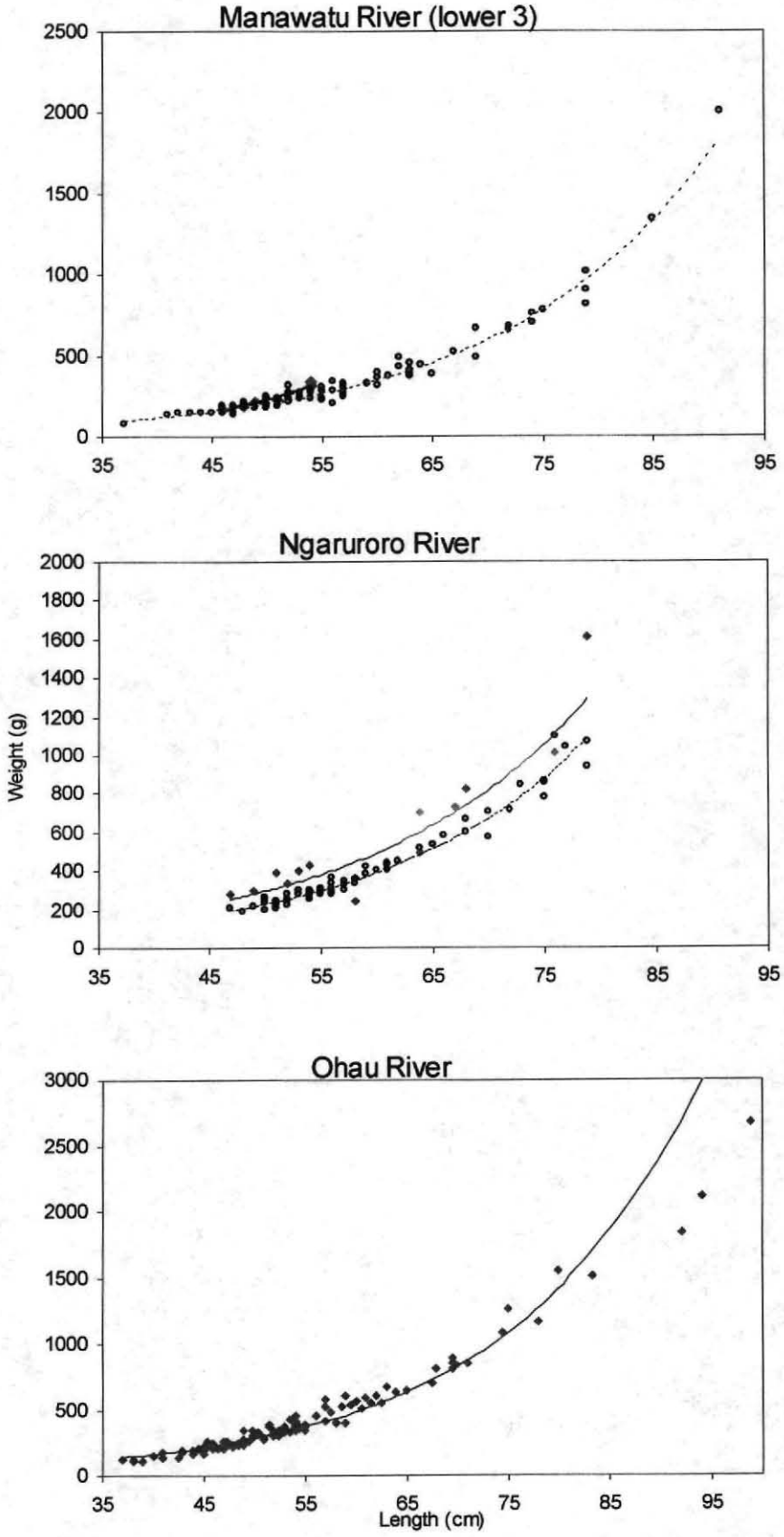

Figure 4 *Continued*: Key ° shortfin, * longfin

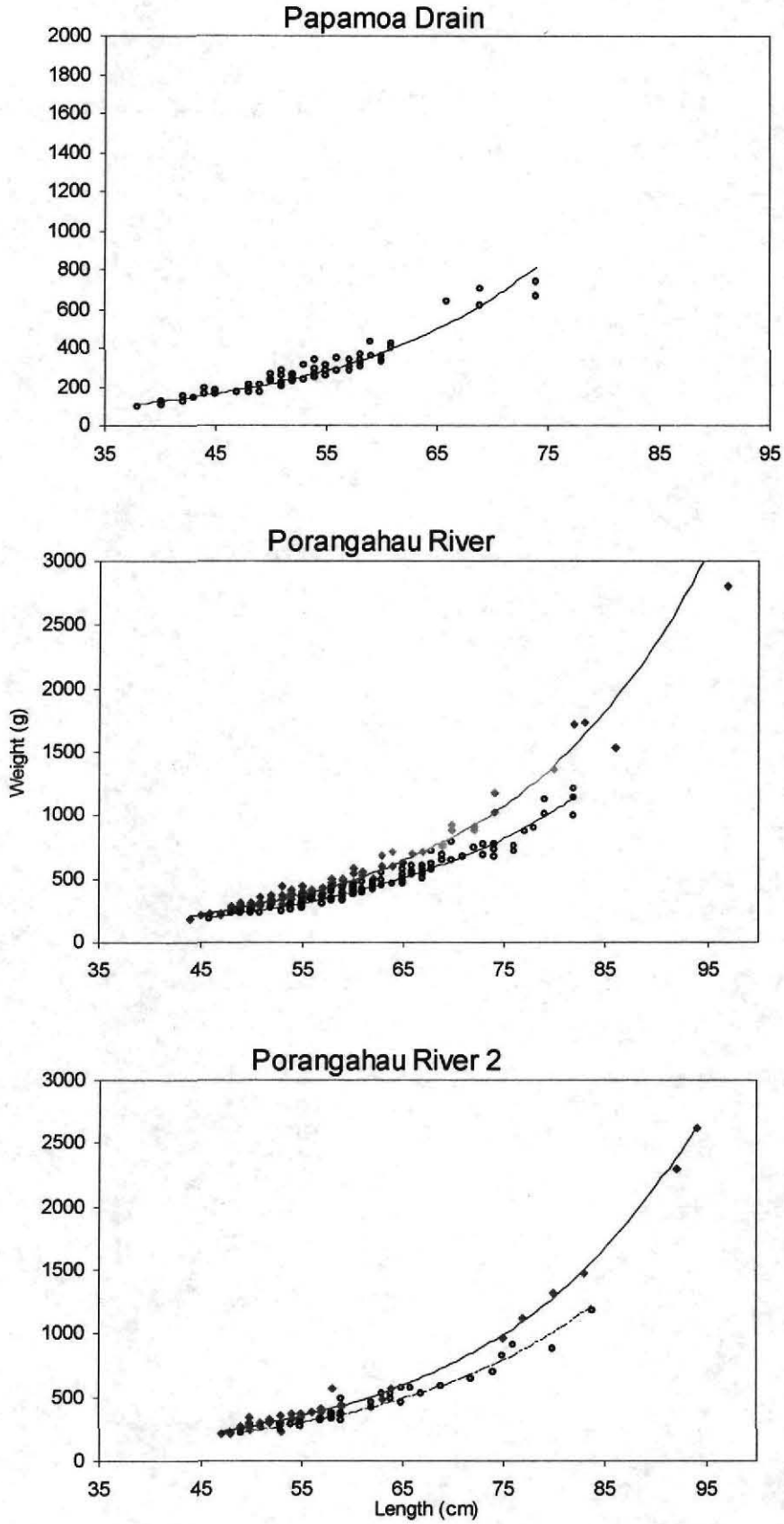

Figure 4 *Continued*: Key ° shortfin, * longfin

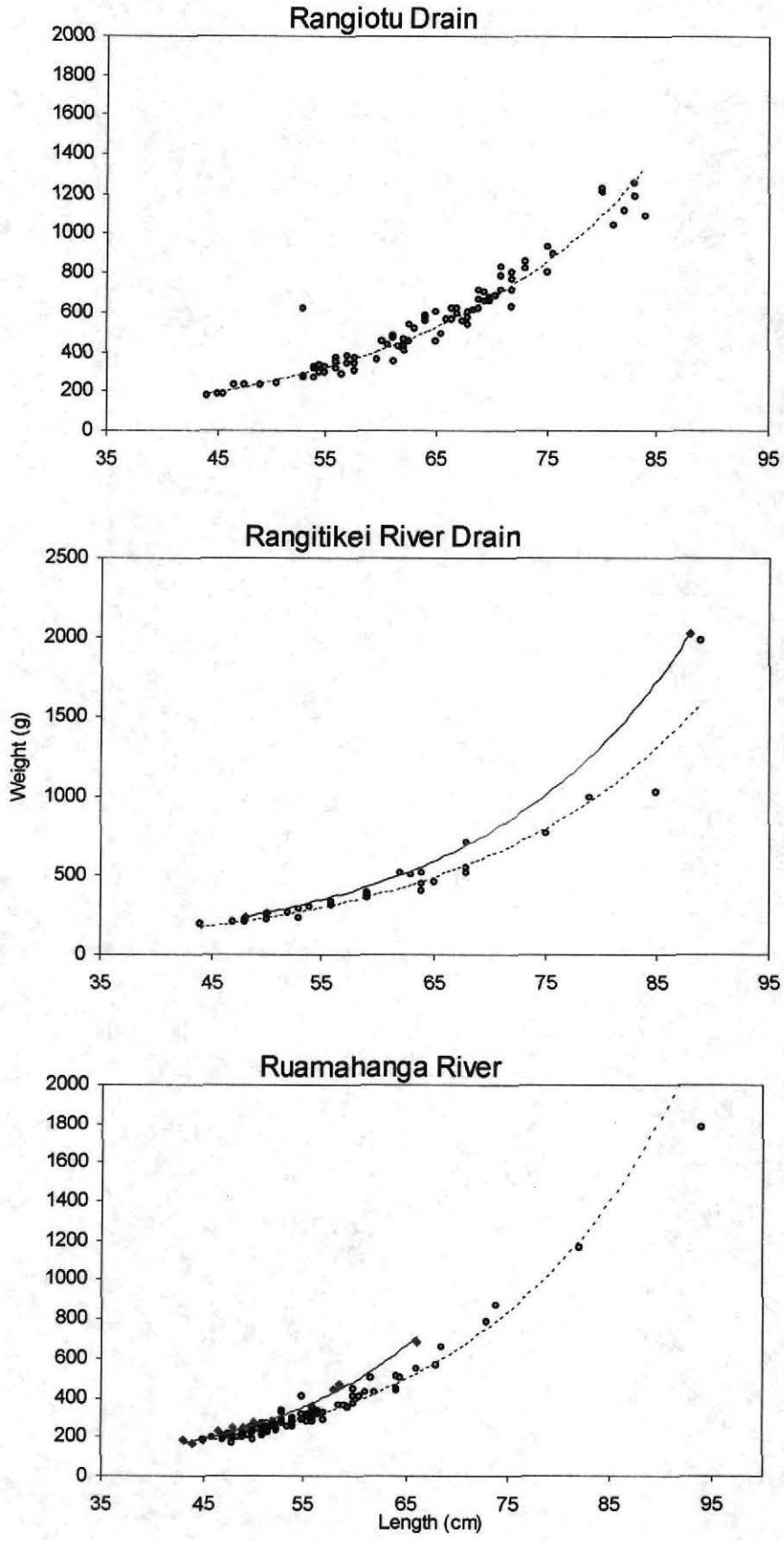

Figure 4 *Continued*: Key ° shortfin, * longfin

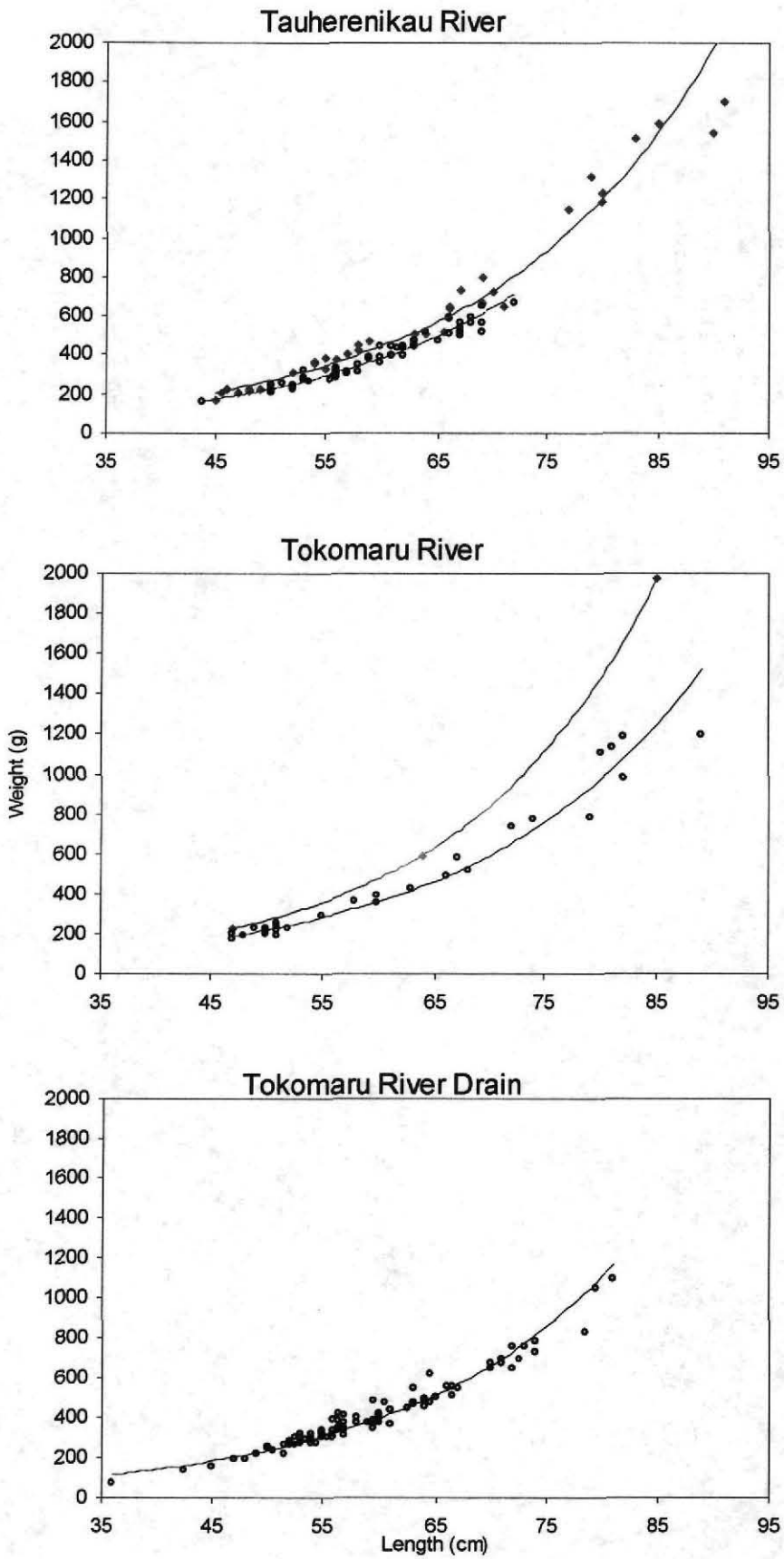

Figure 4 *Continued*: Key ° shortfin, * longfin

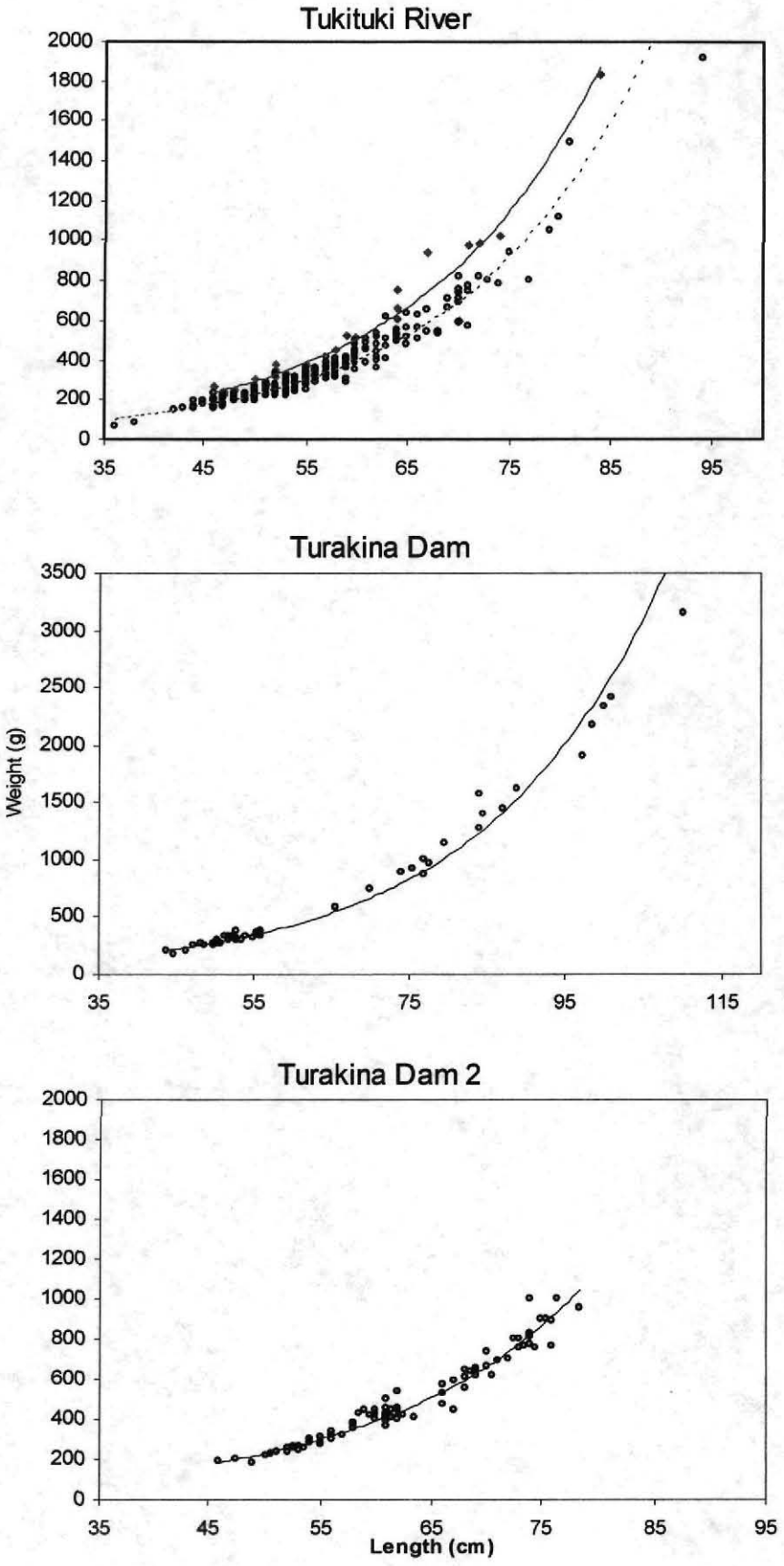

Figure 4 *Continued*: Key ° shortfin, * longfin

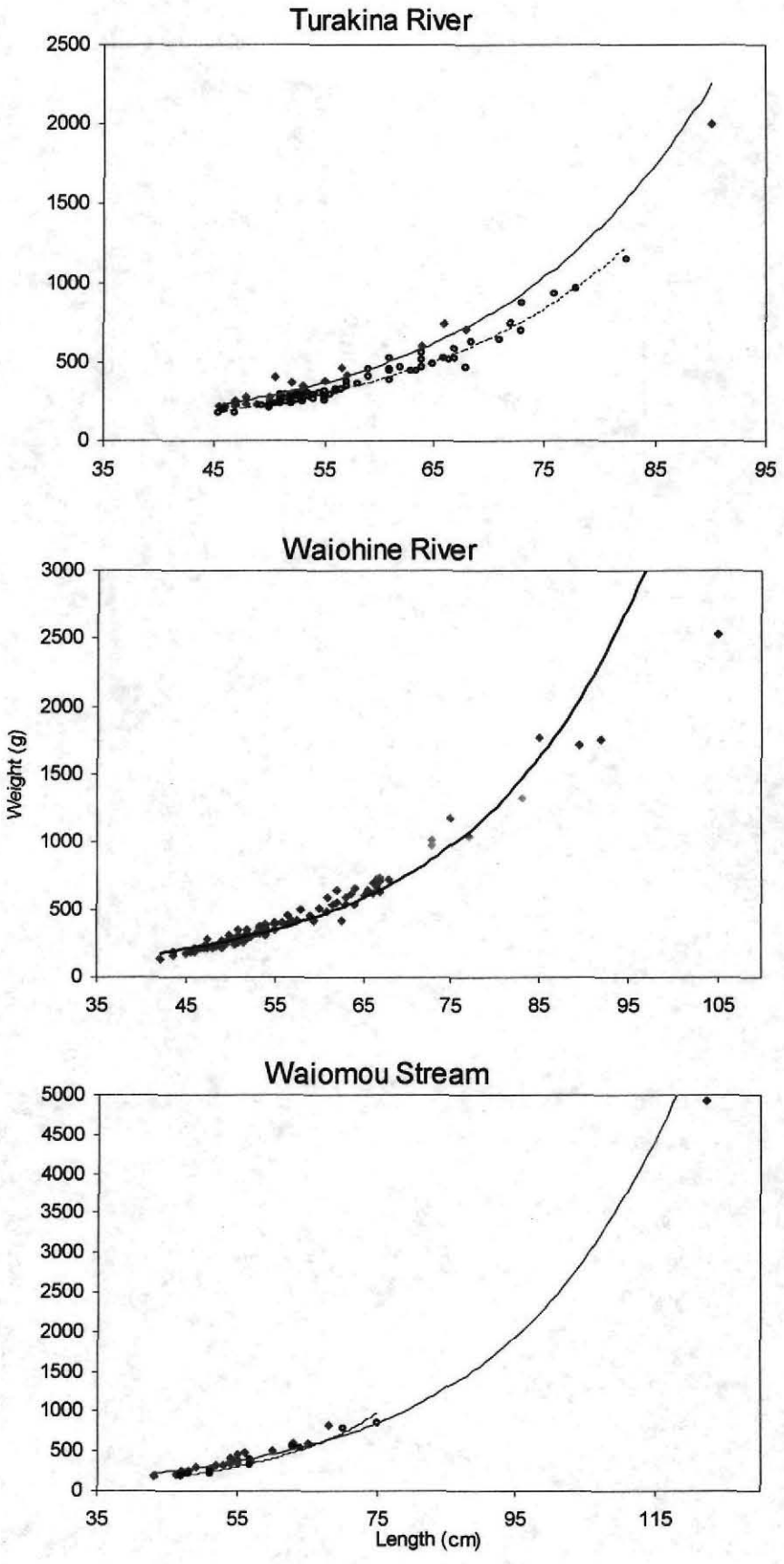

Figure 4 *Continued*: Key ° shortfin, * longfin

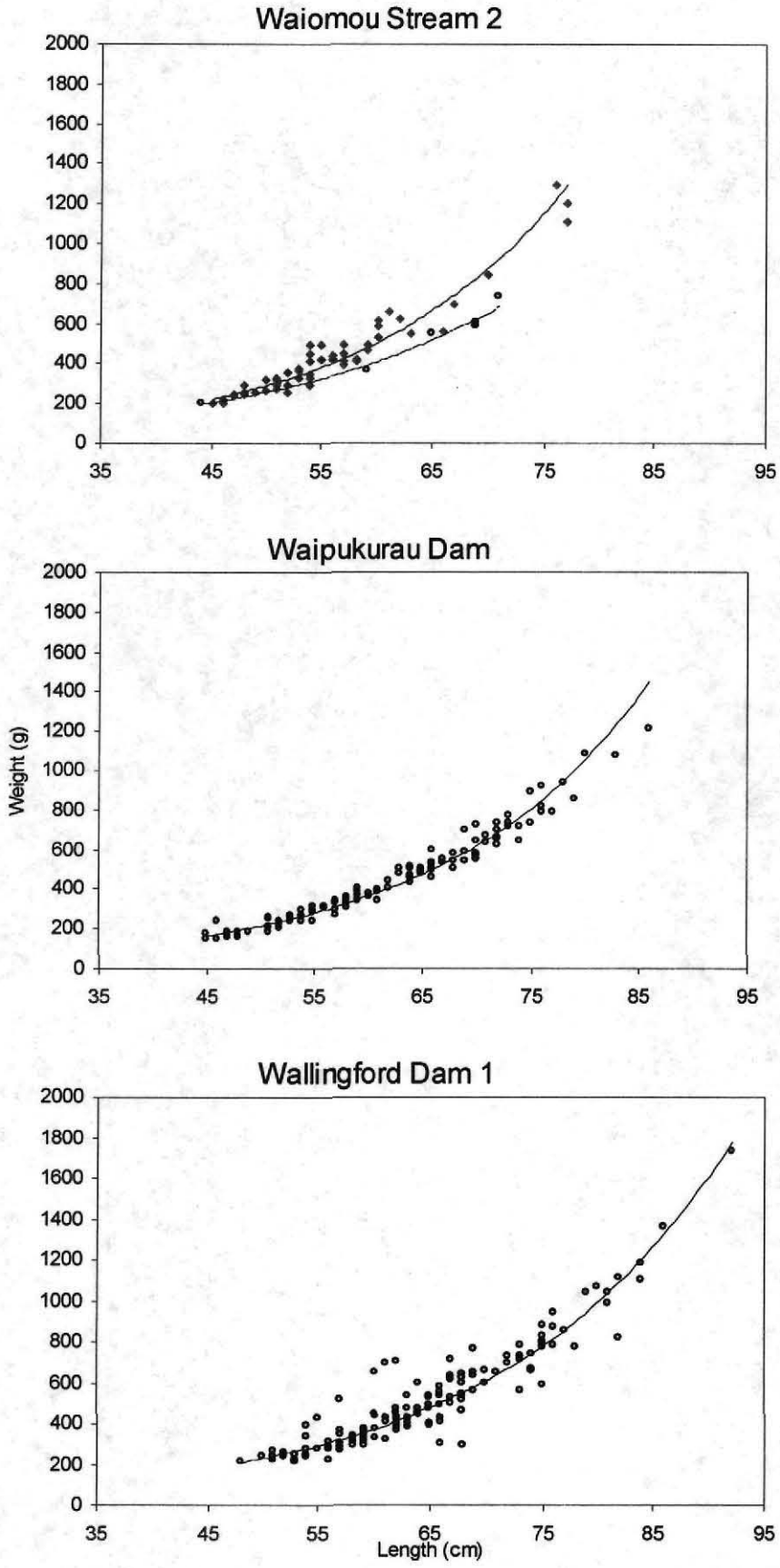

Figure 4 *Continued*: Key ° shortfin, * longfin

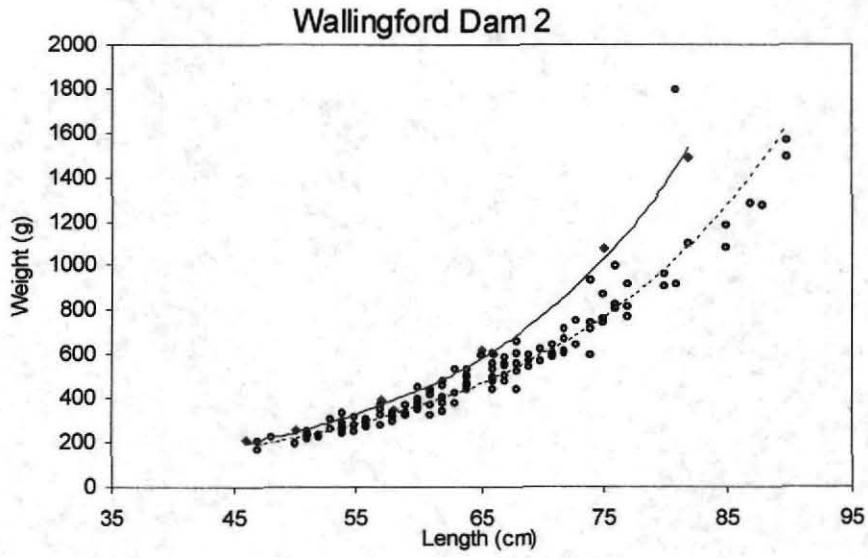

Figure 4 *Continued*: Key ° shortfin, ◆ longfin

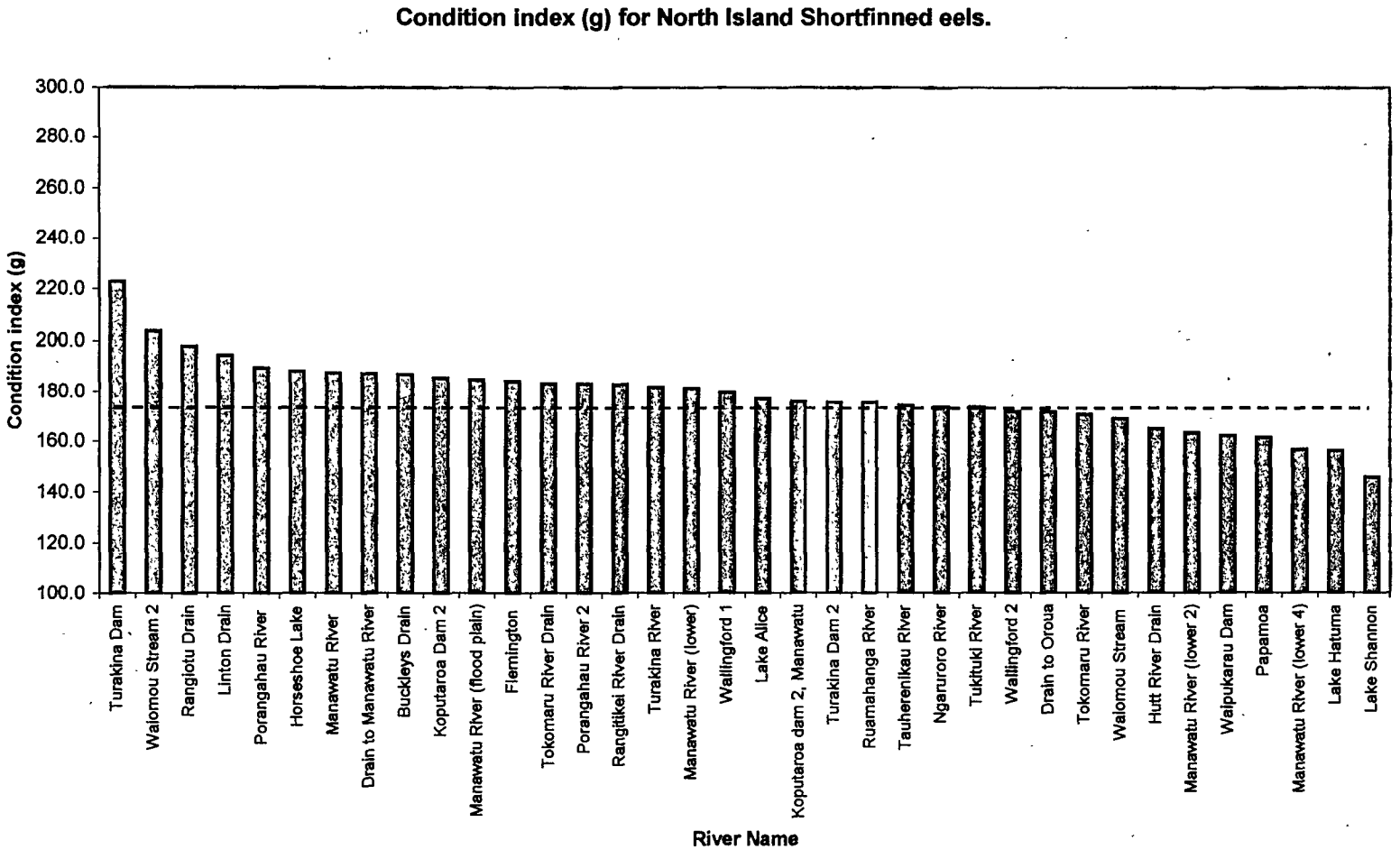

Figure 5: Ranked Mean Condition Index graphs for North Island shortfinned and longfinned eels.

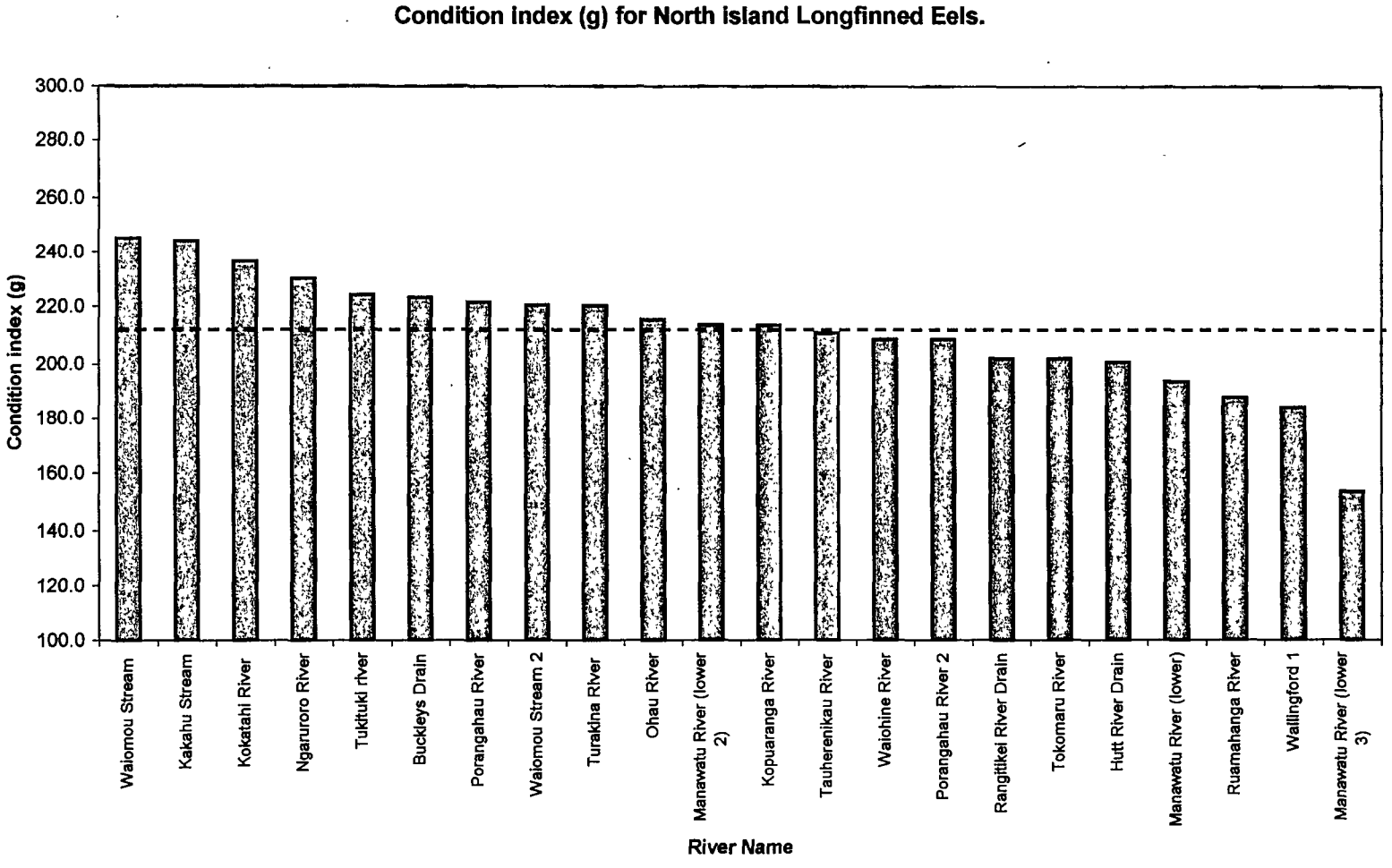

Figure 5 (cont.): Ranked Mean Condition Index graphs for North Island shortfinned and longfinned eels.

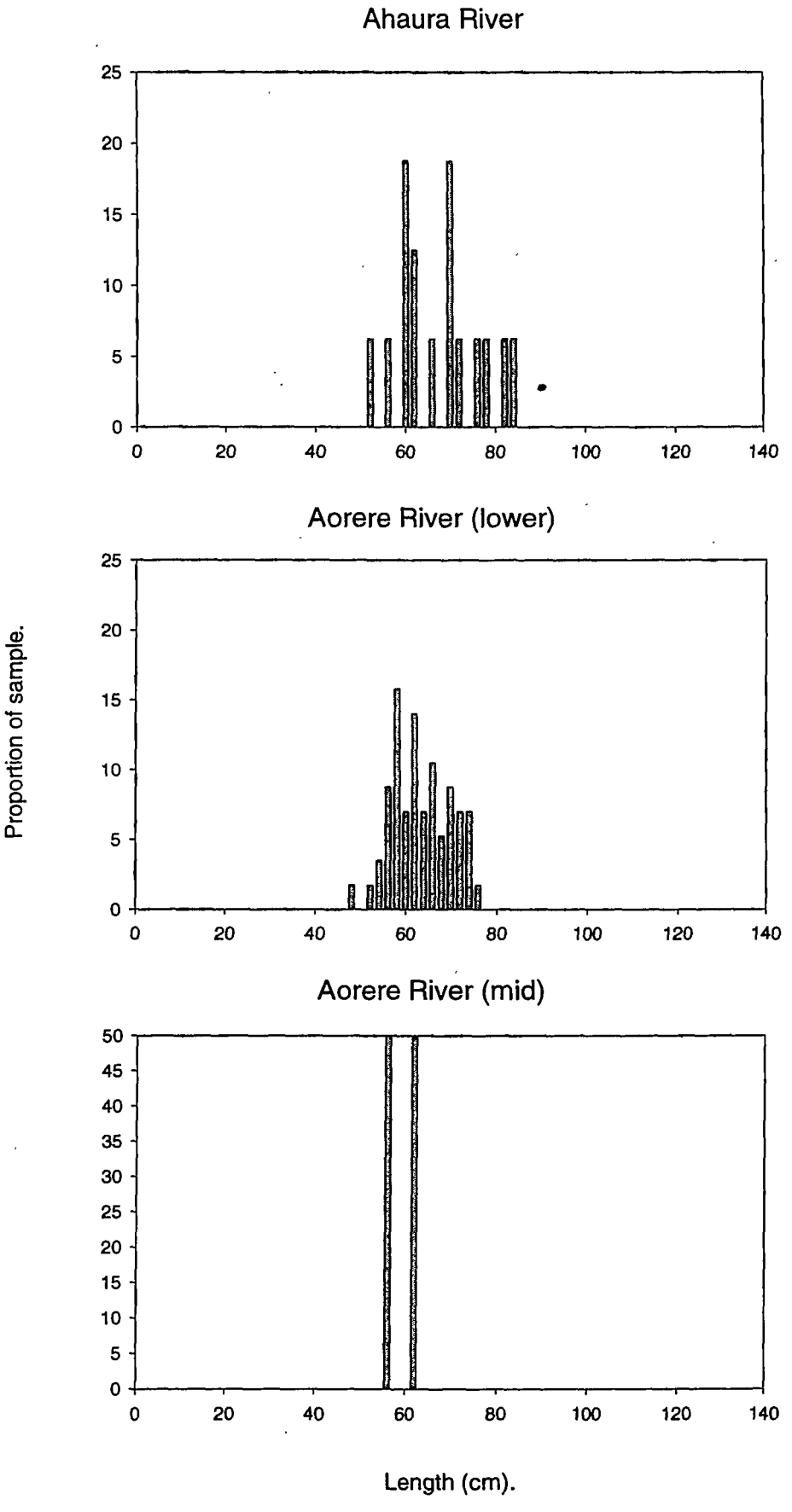

Figure 6: Length frequency histograms for South Island shortfinned eels

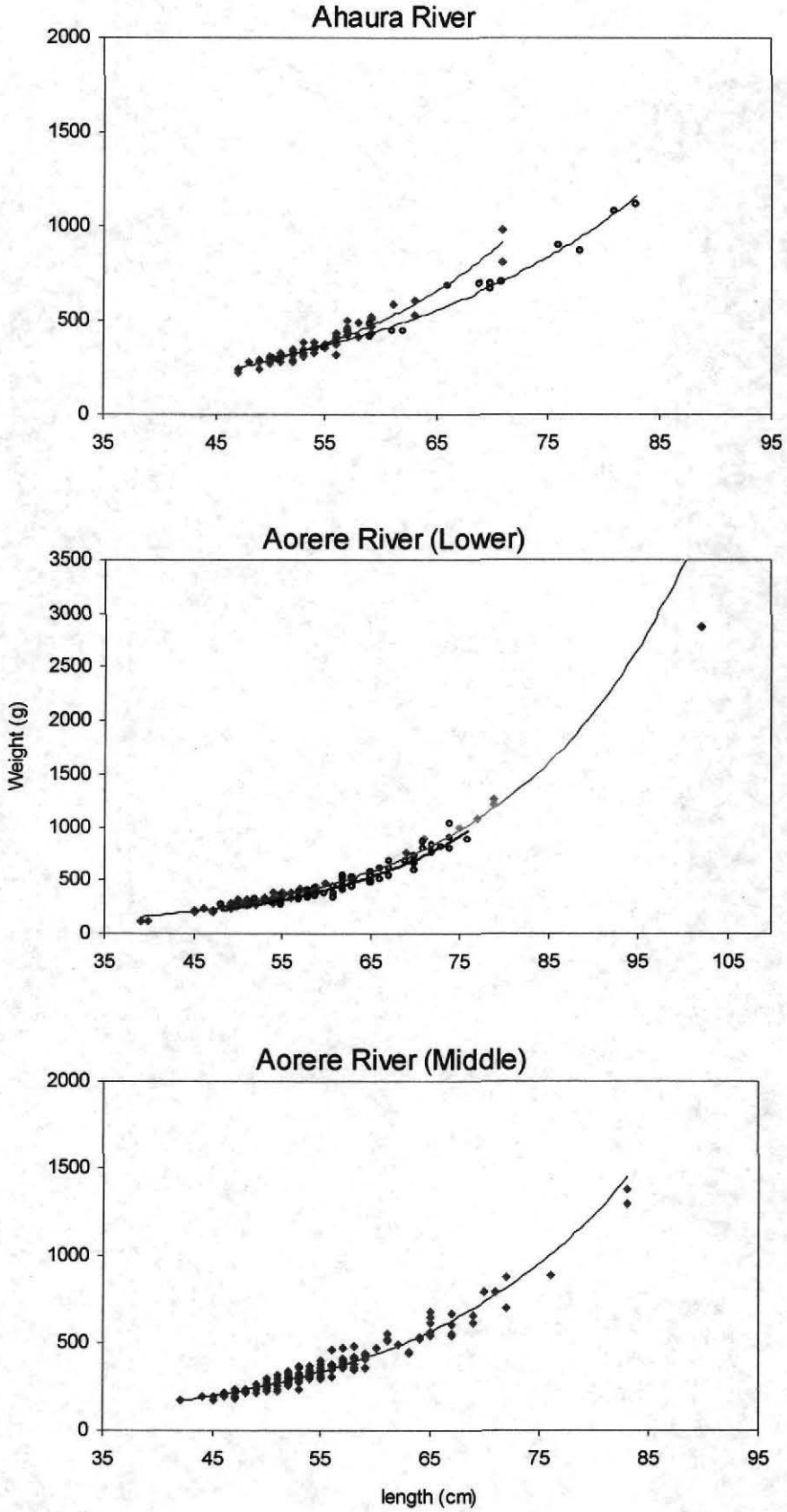

Figure 8: Scatter plots showing length and weight relationship for both shortfinned and longfinned eels together with trend lines for each species. Key ° shortfin, ◆ longfin

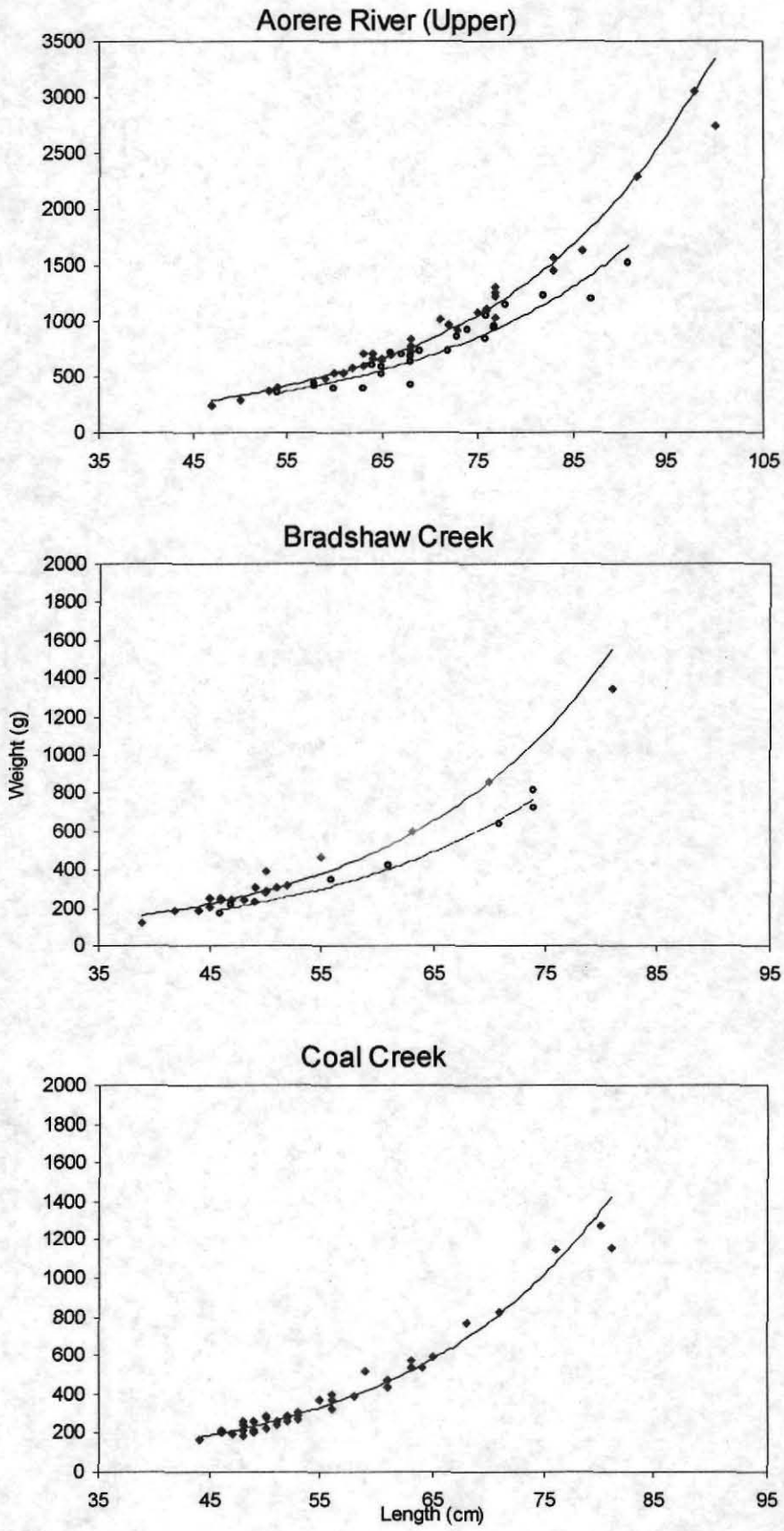

Figure 8 *Continued*: Key ° shortfin, * longfin

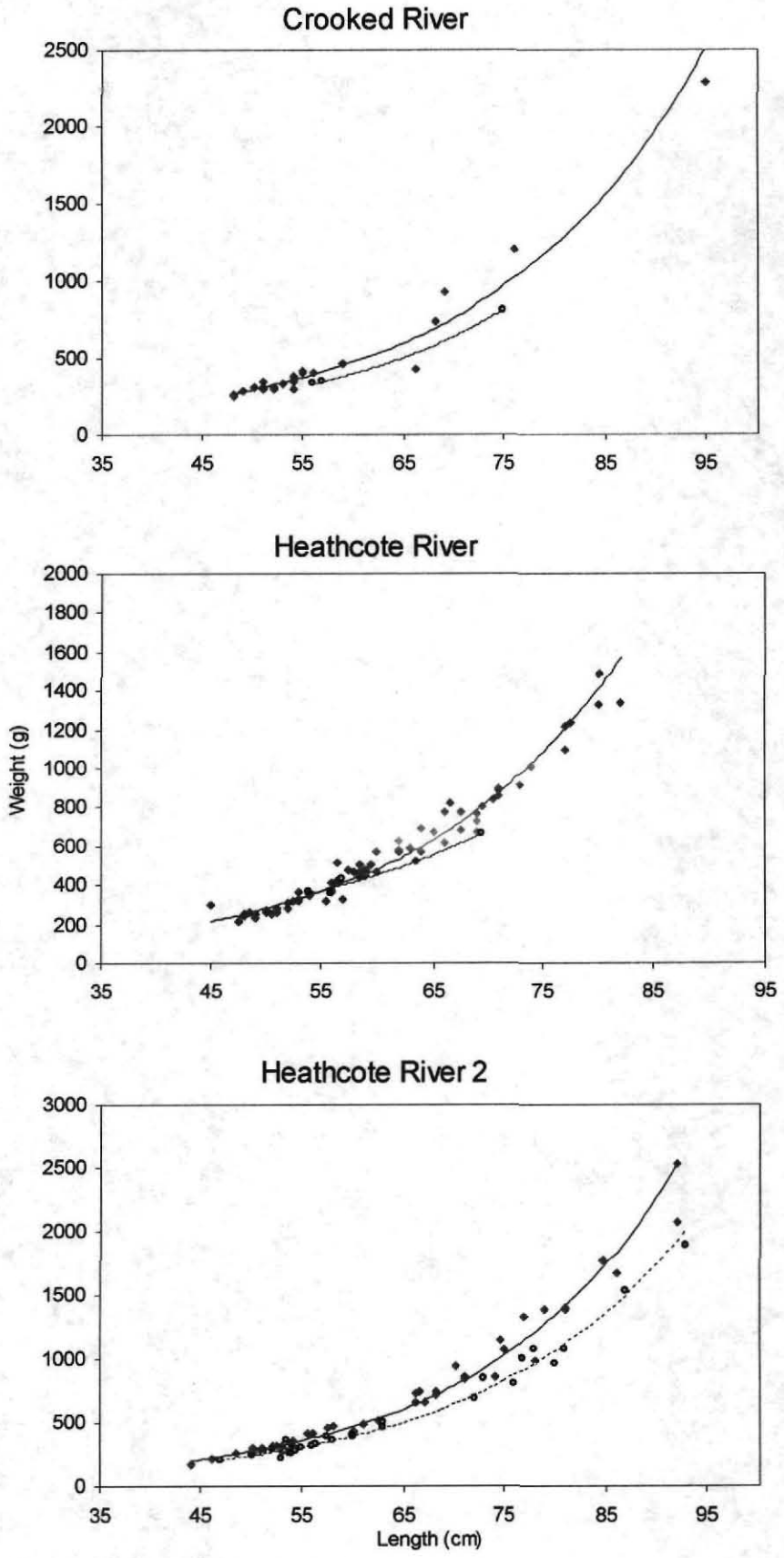

Figure 8 *Continued*: Key ° shortfin, * longfin

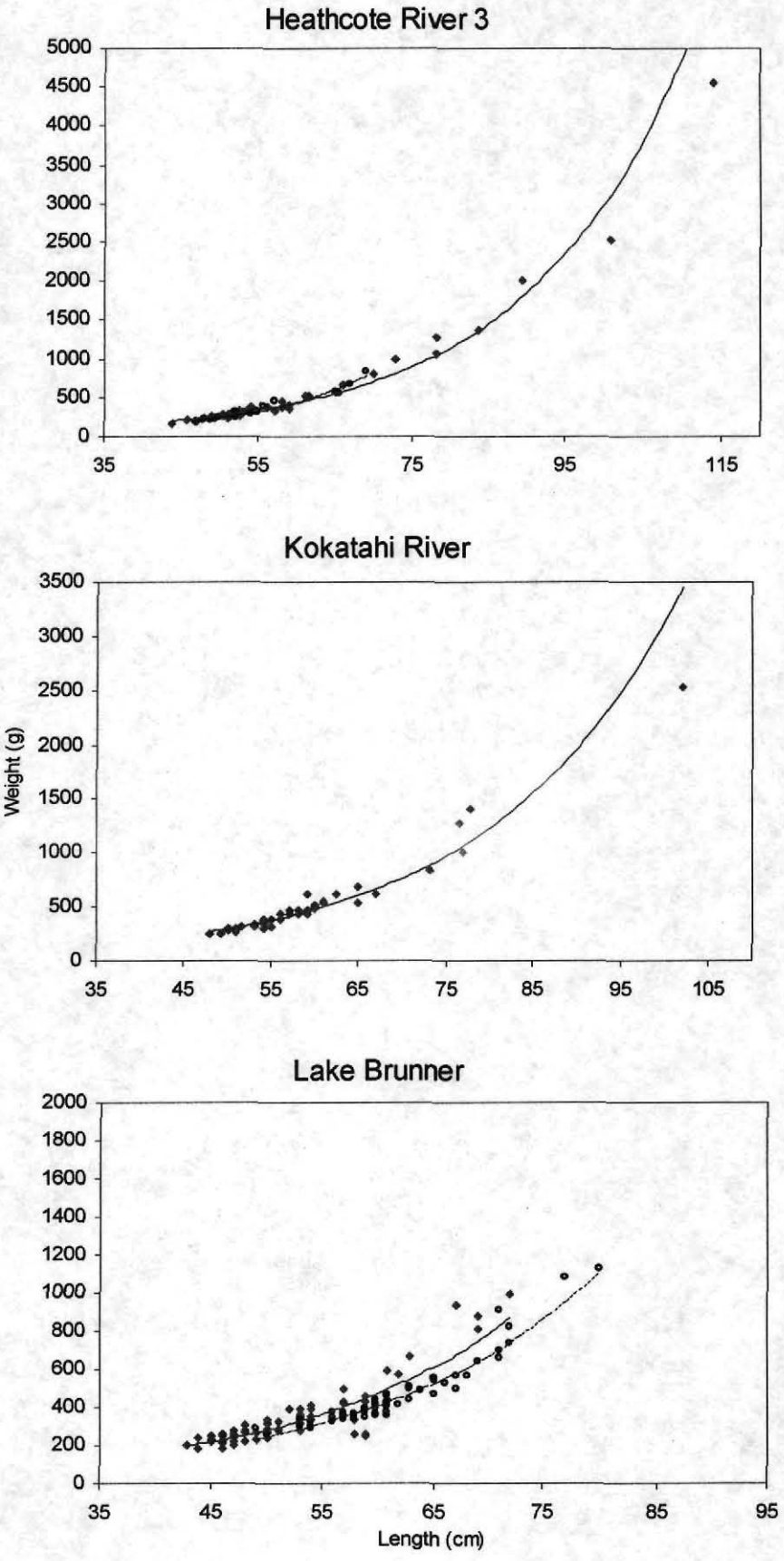

Figure 8 *Continued*: Key ° shortfin, * longfin

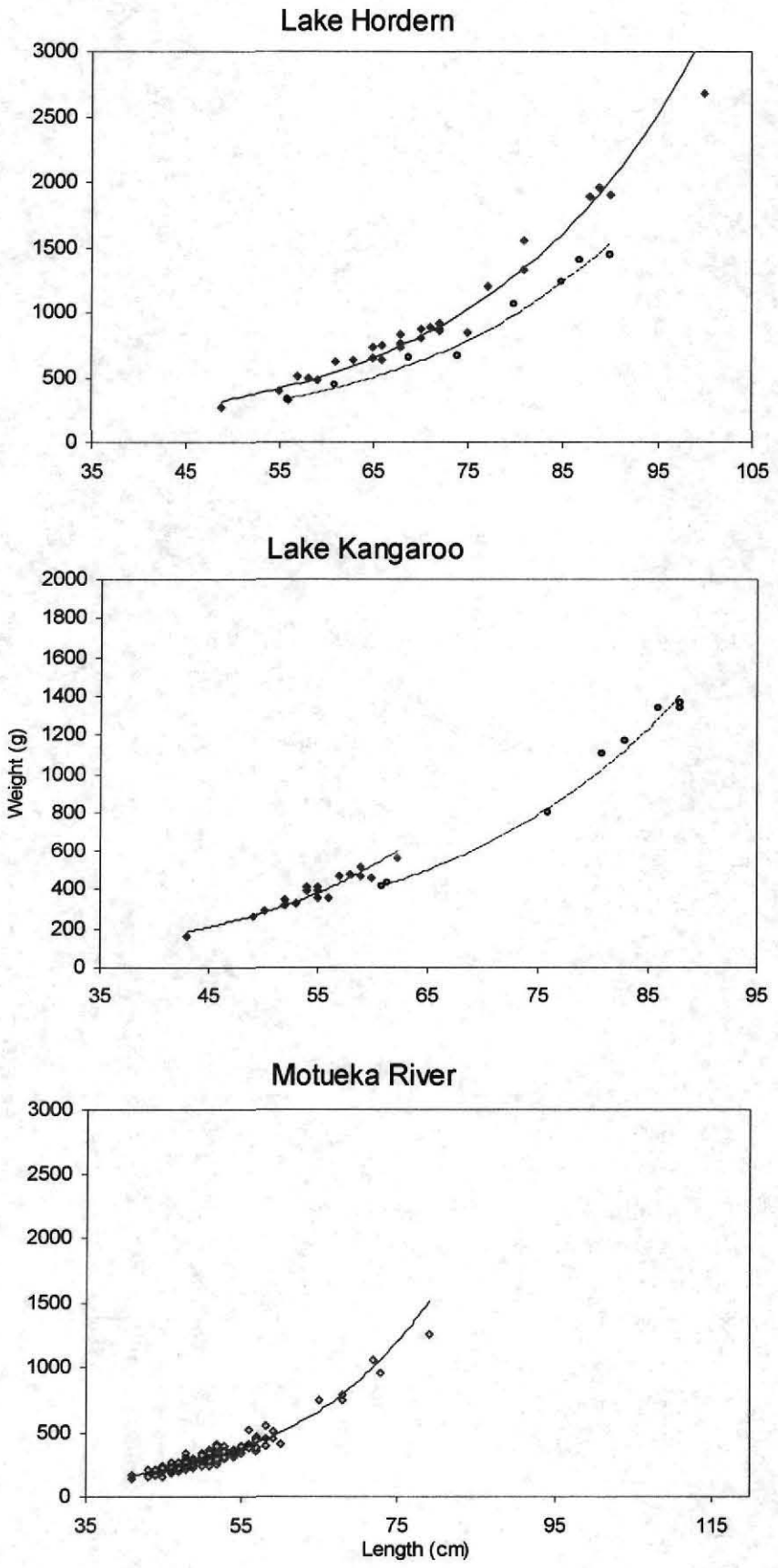

Figure 8 *Continued*: Key ° shortfin, * longfin

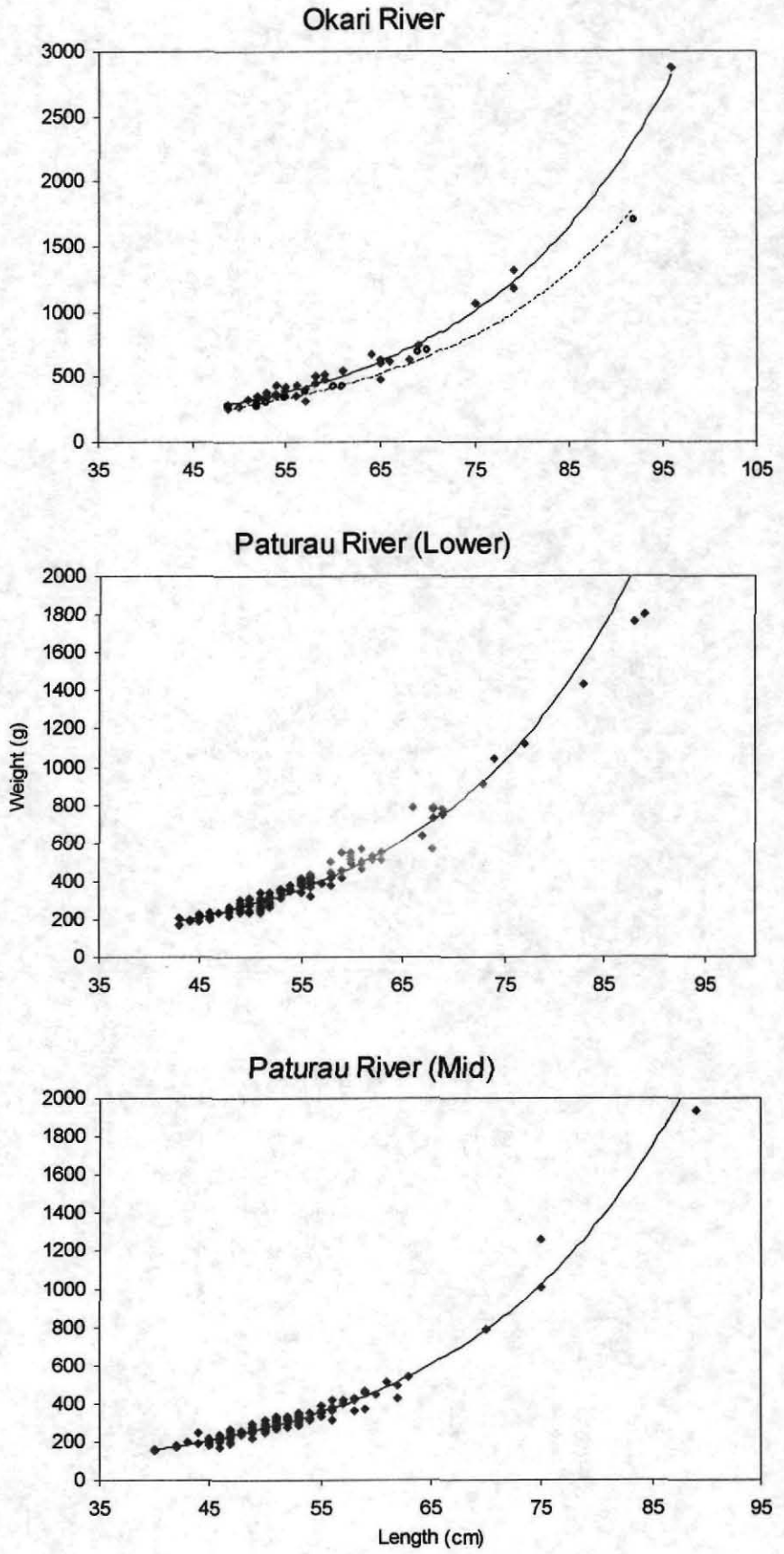

Figure 8 *Continued*: Key ° shortfin, * longfin

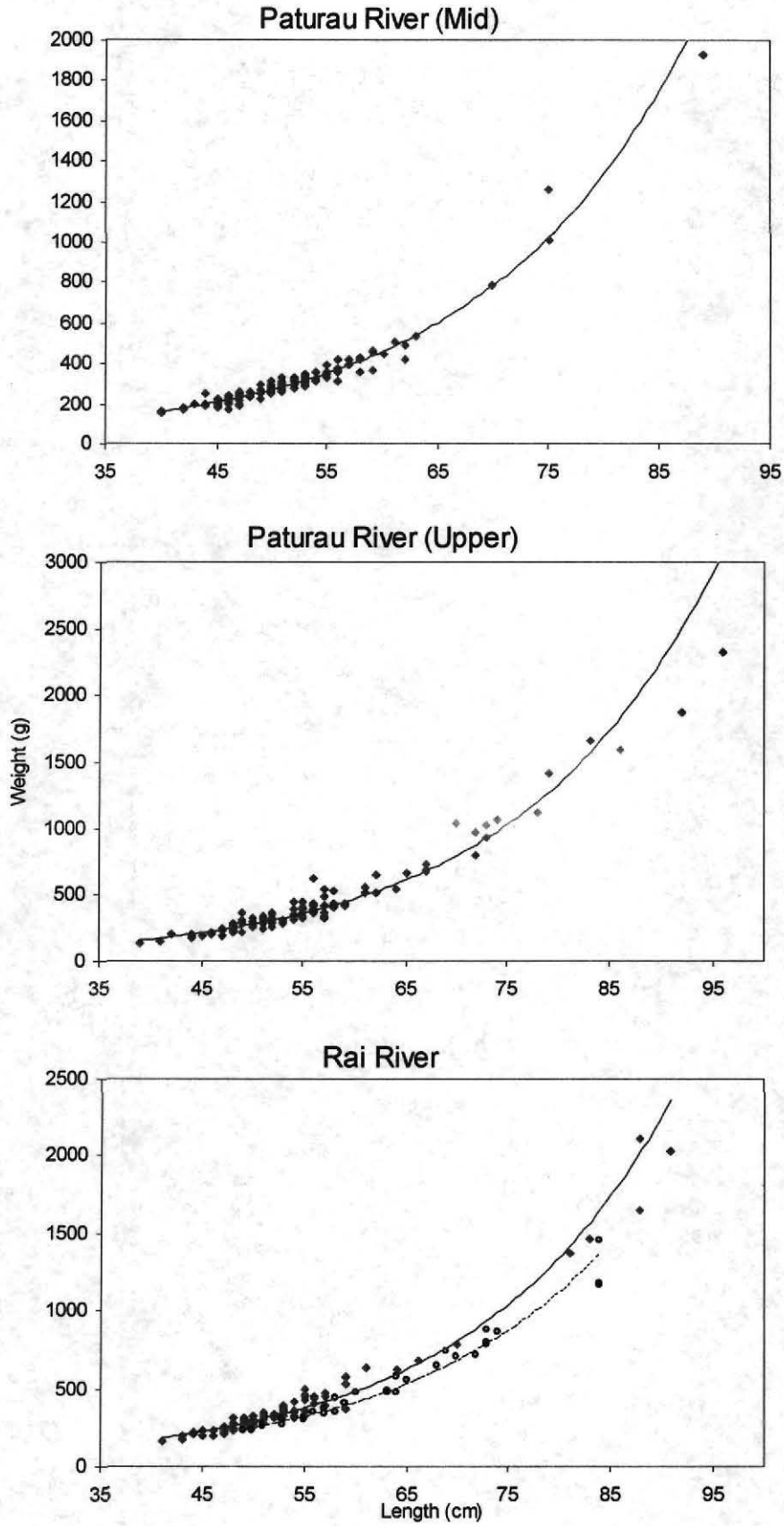

Figure 8 *Continued*: Key ° shortfin, • longfin

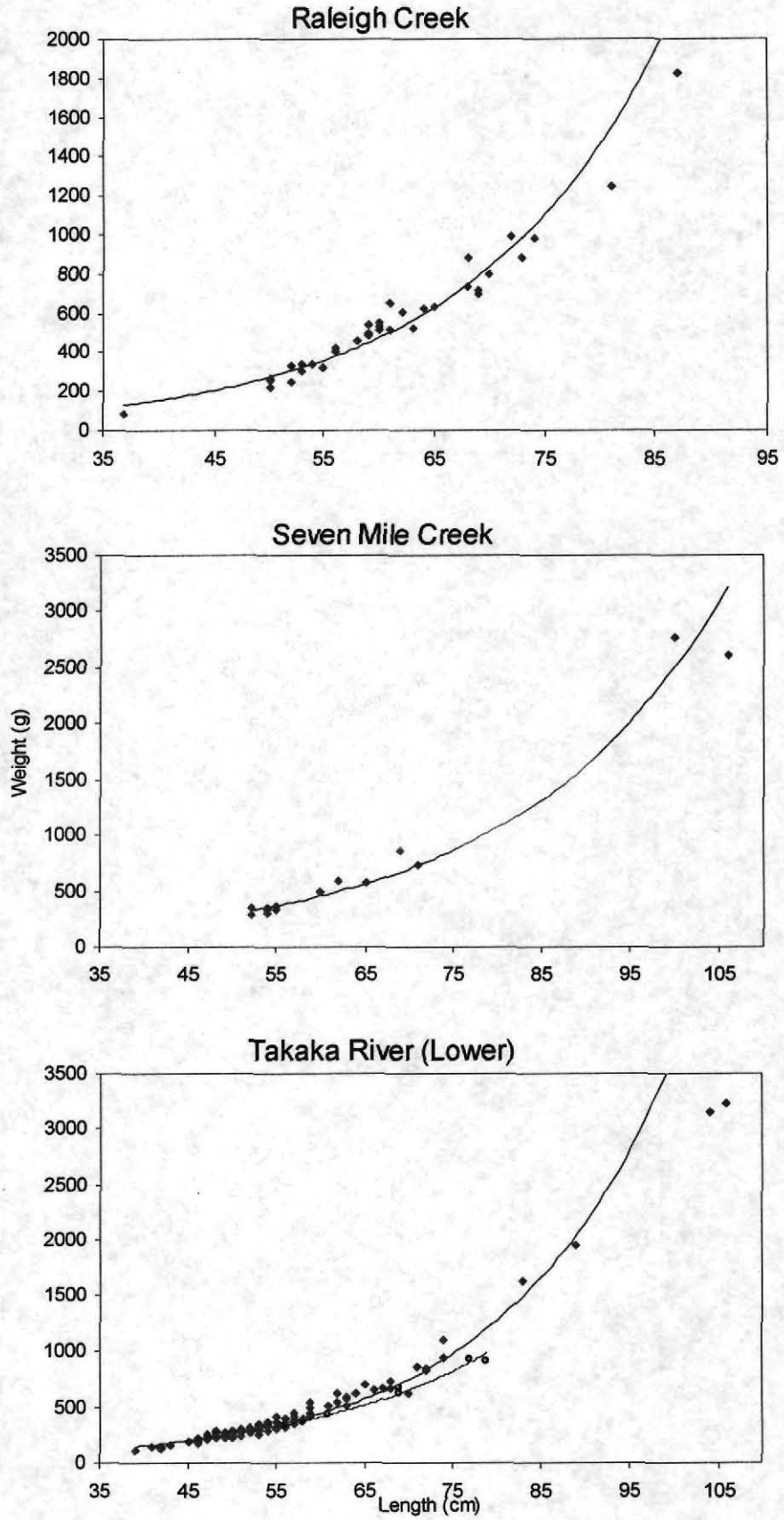

Figure 8 *Continued*: Key ° shortfin, * longfin

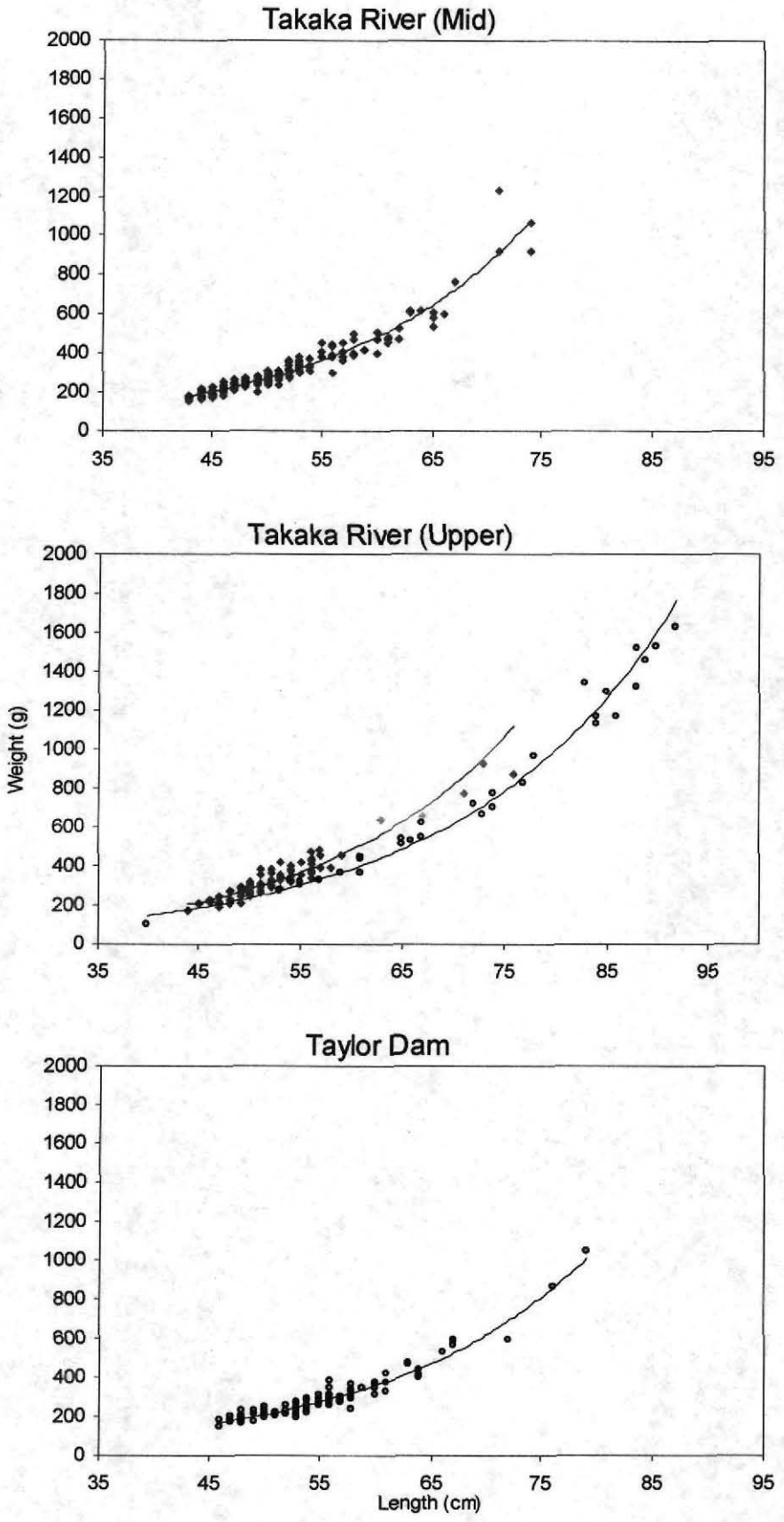

Figure 8 *Continued*: Key ° shortfin, * longfin

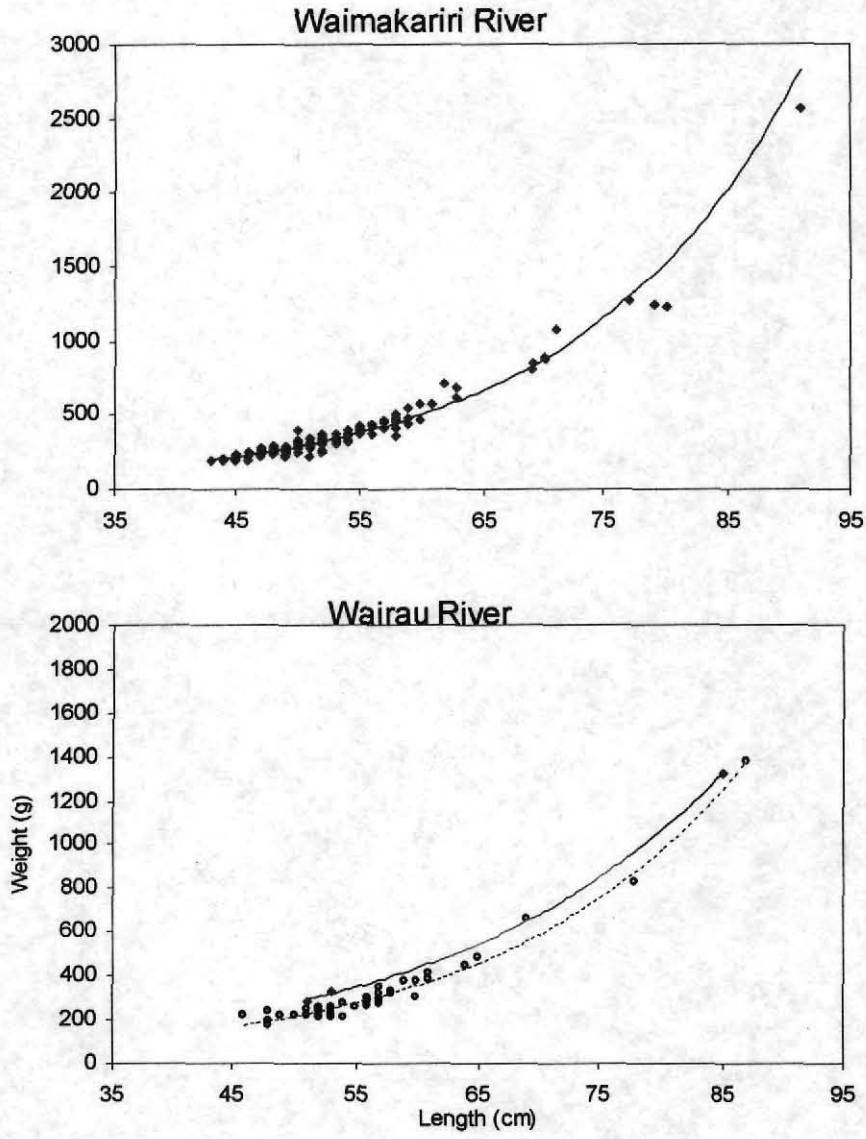

Figure 8 *Continued*: Key ° shortfin, ◆ longfin

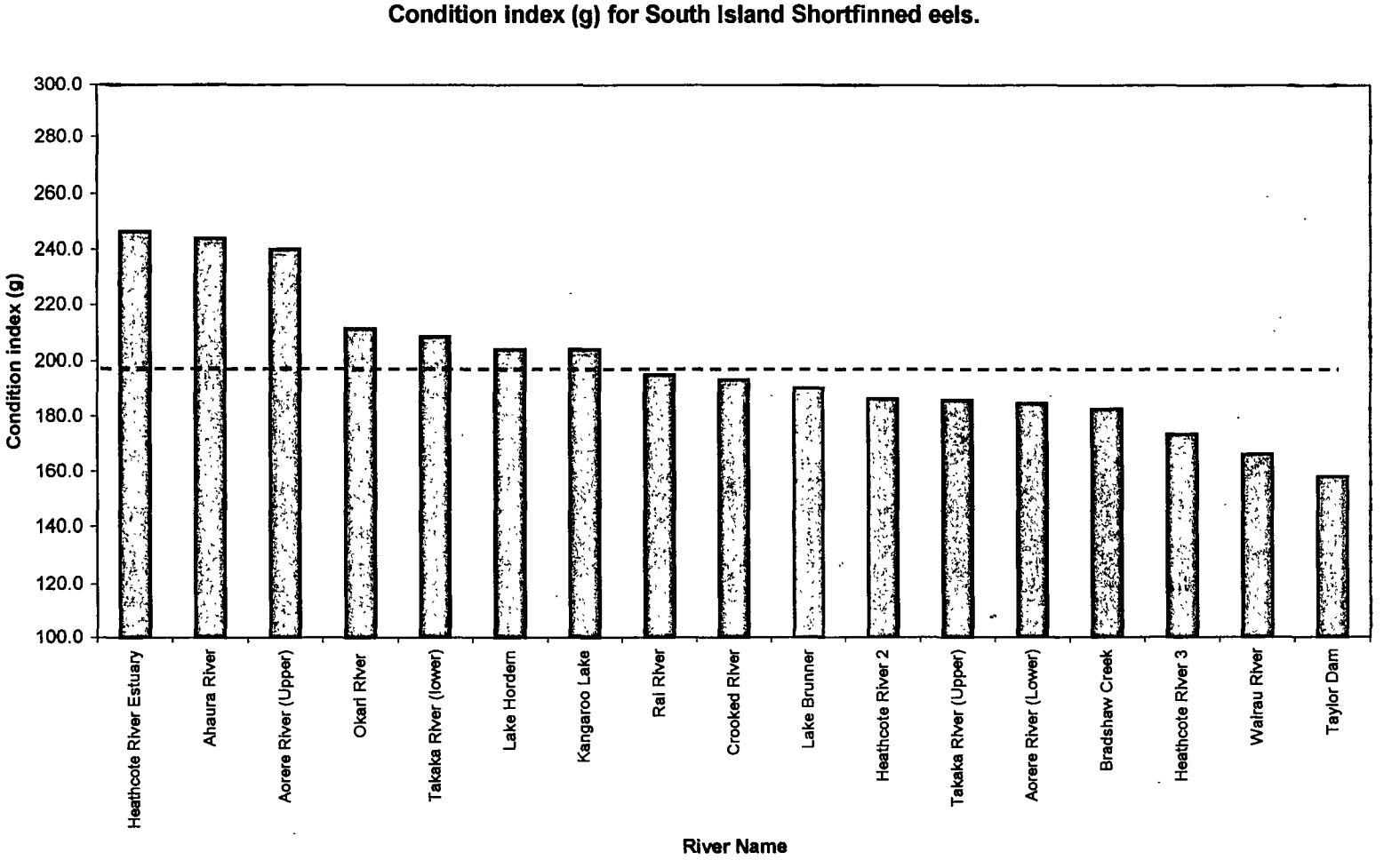

Figure 9: Ranked Mean Condition Index graphs for South Island shortfinned and longfinned eels.

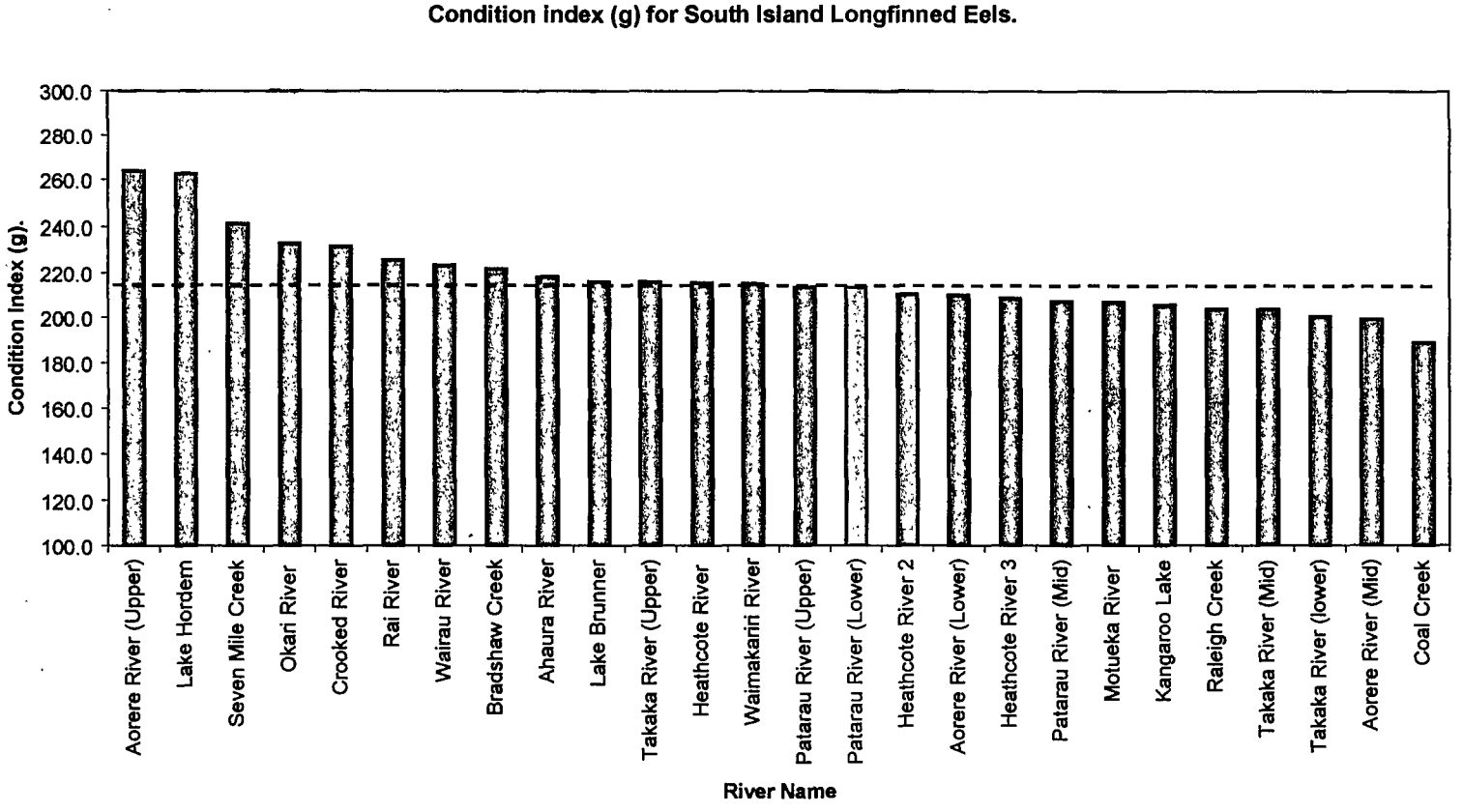

Figure 9 (cont.): Ranked Mean Condition Index graphs for South Island shortfinned and longfinned eels.