

Juvenile grass carp in the Waikato River, May 1997

B L Chisnall
National Institute of Water & Atmospheric Research Ltd
PO Box 11-115
Hamilton

Published by
Department of Conservation
Head Office, PO Box 10-420
Wellington, New Zealand

This report was commissioned by the Waikato Conservancy

ISSN 1173-2946

© 1998 Department of Conservation, P.O. Box 10-420, Wellington, New Zealand

Reference to material in this report should be cited thus:

Chisnall, B., 1998

Juvenile grass carp in the Waikato River, May 1997. *Conservation Advisory Science Notes No. 190*, Department of Conservation, Wellington.

Keywords: grass carp, Waikato River, escapee

1. Introduction

A small-sized grass carp (43 cm long) was caught in Lake Whangape, lower Waikato River basin, in May 1997. This fish was too small to be a recapture from the escapement from trial sites in 1984 (fish which are now mostly longer than 70 cm), so could have been either a recent escapee, or the result of natural reproduction in the river. Either way, the finding of this fish indicates a potential problem. The Department of Conservation asked the National Institute for Water and Atmospheric Research to examine the wild-caught fish along with fish captured from recent release sites and culture ponds, and provide a report on the likely origin of the fish captured from Lake Whangape.

As all grass carp stocked into waterways recently have been diploid, the origin of the wild-caught grass carp cannot be differentiated on the basis of genetic ploidy. However, stocked fish, from artificial spawning in February 1995, were released into the Mangawhero and Eastern Drains (see Map 1) at between 17.5 and 23 cm FL on 29 August 1996, and into the Whangamaire Stream at > 17 cm FL on 25 March 1997 (Appendix, Pullan 1997). Since then, there has been escapement of stock from the Eastern Drain as a result of damaged screens (Appendix, Pullan 1997). Thus, the wild-caught juvenile could be an escapee from these releases. Alternatively, if the wild-caught grass carp was a wild fish it would have been spawned in the spring of 1995. Weather patterns of high rainfall and warm temperatures, and consequently good spawning conditions (Rowe & Schipper 1985), did occur in the spring of 1995.

This report compares the growth patterns on scales and otoliths of the wild-caught juvenile grass carp with those from fish both kept in ponds and stocked in the catchment, to determine whether this fish could be an escapee or the progeny of natural reproduction in the Waikato.

2. Age and growth patterns

2.1 METHOD

Five juvenile grass carp from the Mangawhero Drain and three from the holding ponds at Warkworth were provided by the Ministry of Fisheries for comparison with the wild-caught juvenile. Several scales were removed from the upper mid-flank of each specimen and stored in a paper envelope. Pairs of sagittal otoliths were extracted from carp heads and stored. Both scales and otoliths were oven-dried at 70°C for two hours prior to examination to desiccate the attached tissue and to avoid explosion of the otoliths during the burning part of the preparation process.

Scales were viewed under a microfiche reader, and several photo impressions taken for each specimen including the wild-caught fish. Otoliths were fractured

axially and fragments were burnt and mounted in silicon Sealastic on microscope slides, with the fractured face downwards (Hu & Todd 1981). Fragments were examined using a stereo-microscope and viewed under 40x magnification with reflected light. Exposure to the bunsen flame for more than 20 seconds caused excessive charring and made fragments impossible to view. Burning for 10-15 seconds provided reasonable preparations.

2.2 RESULTS

Environmental effects on fish growth are visible on both scales and otoliths, so growth patterns should be similar on fish from the same stocks. This seemed to be evident in the fish from the three sources. Scales from all three pond-kept fish had one distinct winter annulus and a check beyond the winter annulus (i.e., only one winter annulus was apparent, as the initial winter check would have occurred when the fish were around 20 cm long and still in culture ponds). Fish from the Mangawhero Drain also all had a single distinct winter annulus, but only one fish of the five exhibited a slight second outer check on its scales. Interpretation of scales from stocked fish (pond and drain) suggested that all were in their 3rd year's growth season. The wild-caught fish was also in its 3rd growth season, and although its scale pattern was similar to that of the stocked fish, checks appeared to be more numerous in the central section of its scales. A second outer check was more pronounced than in the stocked fish. Burnt otoliths were difficult to interpret for stocked fish, with readings of between 3 and 6 growth checks. The wild-caught fish appeared to be in its 3rd growth season, corroborating the scale reading.

3. Size and growth rates

The size-at-age of all fish caught since the 1984 escapement, including those provided for this assessment, were graphed (Figures 1,2) (various sources, six recent captures provided by the New Zealand Bowhunters Society). All wild-caught fish were assumed to have originated from the 1984 escapement for comparative purposes (age calculated on that basis). Because of the assumption of common age, more recent wild-spawned fish would appear as a distinct outlier from the general growth curves.

Growth attained by the wild-caught juvenile was plausible compared with known growth of recaptured 1984 stocks (Figures 1, 2). One other wild-caught fish appeared as a distinct outlier on the weight-at-assumed age plot.

4. Discussion and conclusion

The wild-caught juvenile grass carp from Lake Whangape did not show distinctive scale or otolith patterns that would distinguish it as a wild fish. It was also within the size range of fish from the Mangawhero Drain.

It is conceivable that, if fish that escaped in 1984 began to spawn annually, having reached maturity by at least 1989 (ripe male captured in the Whangamarino Swamp in 1989), surviving progeny would result in a wide variation in size of fish displayed on the plots of growth of assumed escapees. However, growth curves are well correlated, with a single exception apparent in the weight-at-age curve: one of two individuals captured this year in Lake Waahi was almost half the weight of the other (Figure 2), but the two fish were of similar length, suggesting that they were of similar age. The larger fish was recorded as a ripe female. If the other was a male, the difference in gonadal weight could account for the difference in weight of fish.

Given that there has been recent escapement of stocked fish (Appendix, Pullan 1997) and that the wild-caught fish was within the size and age range (although in the upper quartile of growth) of fish from the stocked drains, it is likely that this individual was an escapee. The sparseness of sightings of only large grass carp since the 1984 escapement would further tend to suggest that no wild spawning has taken place. However, without further evidence the absolute origin of the wild-caught fish must remain in question.

5. Further investigations

1. Obtain comparative stock from another area (such as Jock Patterson's ponds at Tuakau) to assess a different environmental growth pattern on scales and otoliths. These fish may have a different growth pattern on scales and otoliths which would tend to support the contention that the wild-caught juvenile grass carp is a recent escapee from the Warkworth stocks.
2. Undertake DNA analysis to compare genetic differences between the stocks and wild-caught fish. This option is unlikely to prove fruitful because the ancestral stocks are common, but if there have been several wild generations (likely maximum of 6) there is still potential to differentiate the families. However, this work is also particularly expensive (development of microsatellite primers costs \$60,000-70,000, L. Dijkstra, pers. comm.), and may take as long as three years to accomplish without guarantee of results. It would also require the provision of recapture specimens (fish from the 1984 escapement).

6. Recommendations

It is recommended that the growth patterns of 2-3 fish of similar size and age from another stock be assessed, but that DNA analyses not be undertaken.

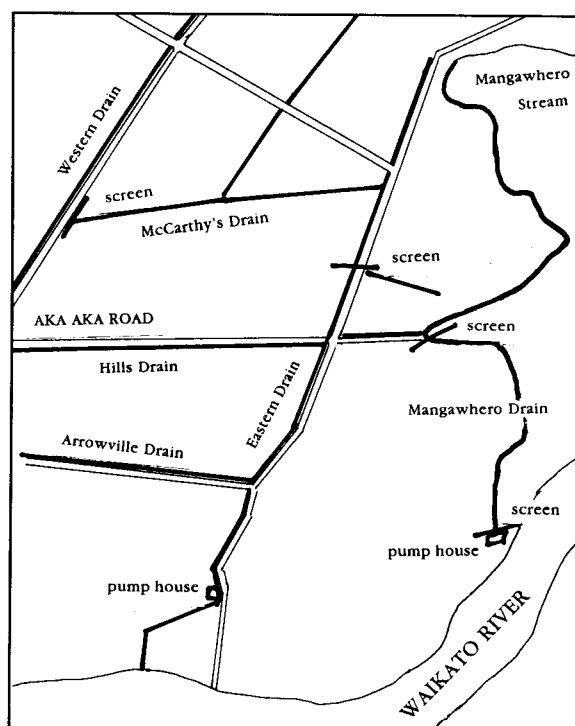
Commercial eel and mullet fishermen and bowhunters should be encouraged/solicited to report their observations of grass carp in the wild (including measurements if taken, and scales + otoliths retained if possible), and a database of these records should be kept.

7. References

Gousmett, D. 1997: Game records of the New Zealand Bowhunters Society.

Hu, L. C.; Todd, P. R. 1981: An improved technique for preparing eel otoliths for aging. *New Zealand Journal of Marine and Freshwater Research* 15: 445 - 446.

Rowe, D.; Schipper, C. M. 1985: An assessment of the impact of grass carp (*Ctenopharyngodon idella*) in New Zealand waters. *Fisheries Environmental Report No. 58, Fisheries Research Division, Ministry of Agriculture and Fisheries.*



Map 1. Sketch map of the drains and screens near the Waikato River.

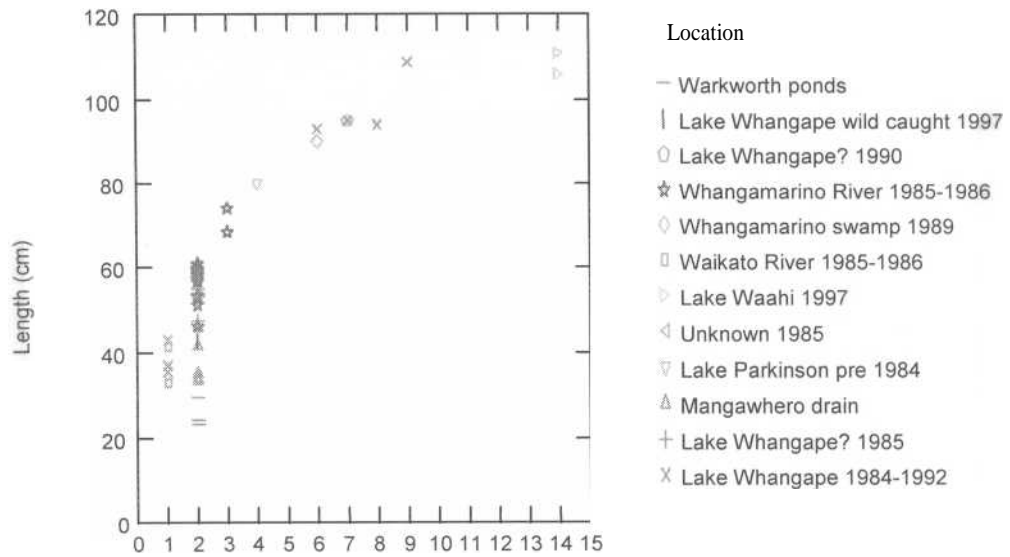


Figure 1. Length-at-age of grass carp in the Waikato.

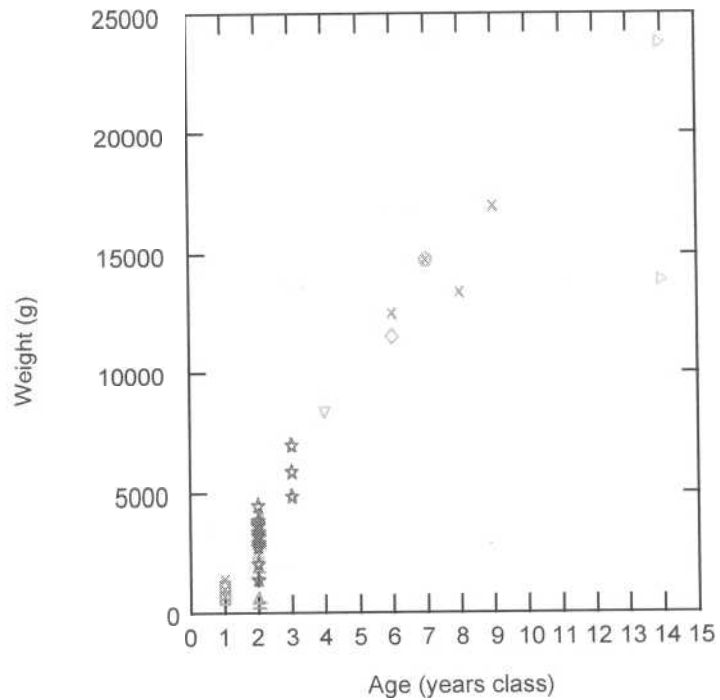


Figure 2. Weight-at-age of grass carp in the Waikato.

8. Appendix

PRELIMINARY REPORT (16 MAY 1997) ON CATCH OF A JUVENILE GRASS CARP IN THE WAIKATO RIVER SYSTEM AND SUBSEQUENT INVESTIGATIONS

Steve Pullan

Policy Analyst, Ministry of Fisheries, PO Box 3437, Auckland

Introduction

On Thursday 6 May 1997, a juvenile grass carp measuring 43 cm in length and 1.43 kg, was caught by a mullet fisherman in Lake Whangape, one of the shallow lakes connected to the lower Waikato River system. The carp is now held by NIWA in Hamilton.

The discovery raises concerns over whether the fish has escaped from one of the sites adjacent to the Waikato River where grass carp have recently been introduced or is the offspring from the carp that escaped in 1984, in other words, a feral grass carp.

The 1984 escape of grass carp

In January 1984, grass carp escaped from trial sites in the Aka Aka area. About 2200 fish were released into the McCarthy's Drain by the Aka Aka Otatau Drainage Board in November 1983. On 2 February 1984, a grass carp was caught by a mullet fisherman, and subsequently about 26 grass carp were taken by either eel or mullet fishermen from the Waikato River system - 13 of these as far up as Lake Whangape and others taken well down towards the lower estuary. The captures showed that fish had spread very widely in the lower Waikato.

Examination of the screens showed scouring around McCarthy's Drain screen, and deficiencies in fit which created gaps through which the fish could have escaped. Tagging trials indicated that most fish had escaped, although a comment in a report on the incident suggested heavy shag predation may have caused extensive losses.

There are still some of these carp in the lower Waikato, but they are too big to be caught in mullet or fyke nets. They are prized fish by bow fishermen who have caught several large specimens (over 12 kg) in Lakes Whangape and Waahi, the largest being 23.75 kg in January 1997. Until the recent capture of the juvenile carp, no reports of smaller fish have been received.

It would seem unlikely that the recently caught carp was one of the fish that escaped in 1984 from the Aka Aka drains, as it was only 1.43 kg and was immature.

Details of recent releases of grass carp into locations adjacent to the Waikato River

The Minister of Fisheries has given approval to transfer and release grass carp into two sites where the fish currently exist and are close to the Waikato River. The approval of the Minister of Conservation is required for locations where the species in question does not exist, and no such approvals have been given for the area by the Minister of Conservation although some are under consideration.

The two approved sites were:

<i>Site</i>	<i>Date approval granted</i>	<i>Quantity</i>
Mangawhero Drain, Aka Aka	28 August 1997	1800
Whangamaire Stream	13 February 1997	5000

The supplier, Gray Jamieson Holdings Ltd, provided further information on these releases:

<i>Site</i>	<i>Date of transfer</i>	<i>Size (cm)</i>	<i>Quantity</i>
Mangawhero and Eastern Drains	29 Aug 1996	17.5-23	1000
Whangamaire Stream	25 March 1997	17+	1600

Note that some fish were placed into an unapproved site (Eastern Drain) although grass carp are still present there from original trials (pre-1984).

All the recent releases were of carp from Mr Jamieson's farm. These were all the same age and were bred on 9 February 1995. Because the carp were kept in different ponds with different stocking rates, considerable variation occurs in weights and sizes of the fish.

Events after the capture of a grass carp in Lake Whangape

Two immediate steps needed to be taken. The first was to inspect the sites and check the security and the other was to examine the recently captured carp to try and ascertain whether it was a farm fish (i.e. 2 years old) or a feral carp (probably one year old).

To determine this, it was necessary to obtain some fish from Mr Jamieson's fish farm and from the Mangawhero Drain to compare the scales and otoliths with the recently caught fish. This work is being carried out by NIWA and funded by DoC.

Fish from the fish farm

On Monday 5 May, three fish were collected from the fish farm, killed and placed on ice. Details of the fish were:

<i>Weight (g)</i>	<i>Length (mm)</i>
422.7	296
210.0	243
202.0	233

Fish from Mangawhero Drain

On Tuesday 6 May 1997, a survey was conducted in the Mangawhero Drain to collect some specimens for the investigation. Two nets were placed across the drain one metre apart to contain the fish at one end (the second net was to catch carp which jumped over the first). Electric fishing was then conducted using a generator set and two electrodes. Two large grass carp were caught; these were almost certainly from the earlier release in 1983. Several small carp were caught and the five largest were retained. Details were:

<i>Fish no.</i>	<i>Length (cm)</i>
1	34
2	35.2
4	33.5
5	46
6	41.5

These were killed and placed on ice and transported to NIWA.

Inspection of the sites

An inspection of the sites was carried out with staff from MFish, DoC, the Aka Aka-Otaua Drainage Board of the Franklin District Council, and Gray Jamieson, the supplier of the carp for these releases.

Mangawhero Drain site

An inspection of the screen on the inlet end of the Mangawhero Drain culvert revealed that the screen was still intact and secure and the bars were only 1 cm apart. This screen is hidden behind a growth of bamboo. The McKewan flood gate on the other end of the culvert was overgrown with weeds and appeared not to have opened for some time. The outlet end is also screened, and although there were some small gaps in the screen over the pumphouse intakes, fish would need to pass through the pumps before being able to escape into the Waikato River.

There had been no flood events in recent months and it would seem highly unlikely that fish have escaped from this site. Although grass carp can jump, it would be very unlikely that the carp jumped high enough to pass over the screen.

Eastern Drain site

This site had a different screen installed. The screen has a rotary device which is supposed to clear the screen of debris, but it has not been working for some time. The screen has several holes in it, and some sticks and metal rods had been placed in some gaps to reduce their size. The screen was examined during the visit and found to have some large gaps - one of at least 5 cm close to the centre strut. Apparently, plastic sheeting was placed over the screen for a few days after the carp were released to increase water levels. During the release of the carp, one of the Drainage Board staff checked to see if a carp could pass through the gaps. While attempting to place the fish in a gap, it slipped out of his hands and escaped through the gap. This drain has a pump station similar to the

Mangawhero Drain at the outlet end, but there is also an overflow direct into the Waikato River. The carp in this drain would also have access through to the McCarthy's Drain. The screen on this drain had been damaged during weed removal by drag liners prior to the recent carp release. Slag from the steel works had been placed on the bottom to cover gaps along the base of the screen. The screen was examined and, although there were some gaps up to 3 cm, it was intact.

It appears that about 500 fish were placed in the Mangawhero Drain and 500 in the Eastern Drain.

If the carp caught in Lake Whangape is an escaped fish, it is very likely it came from the stock placed in the Eastern Drain, a site that was not approved.

Whangamaire Stream

This site was also inspected and screens were found to be secure. As an additional precaution, chicken mesh had been placed over the screens. The carp had only been at this site for less than two months and it is unlikely they would have reached 43 cm by then. It is therefore considered highly unlikely that grass carp have escaped from this site.

Follow up work

The discovery of a juvenile grass carp in the Lower Waikato River system is a serious concern. Whether it is an escaped fish or a feral fish is yet to be determined. The next steps to be taken with this matter will depend on the results of the NIWA study which should be available within a week.

Another serious concern is that grass carp were placed in a site where no approval was granted. This may be due to some misunderstandings that the approval related to only one drain of an interconnected system of drains. The next steps have yet to be determined, but a meeting is proposed with DoC and MFish staff to assess the situation and to determine a course of action. The drainage board have indicated they will carry out repairs on the Eastern Drain screen immediately after materials arrive.

A further report will be prepared after the DoC and MFish meeting and once the NIWA results are available.

8. Addendum

The Department of Conservation followed-up on the recommendation to assess growth patterns of similar-sized grass carp from J. Patterson's ponds (Tuakau). The Ministry of Fisheries provided two fish to NIWA after electrofishing these ponds on the 11 June 1997.

The two specimens were of similar length and weight (A, 41 cm and 1407 g; B, 42 cm and 1121 g), and were spawned in November of 1994. Scales and otoliths from each were removed and examined using the methods described in Section 2.1 above.

Since the spawning of the Patterson's fish occurred within three months of the Warkworth fish, they are of similar age, and any difference in growth pattern must therefore be attributable to environmental differences in growing conditions between the two sites. Growth patterns in both scales and otoliths appeared to be different from that of any of the three possible sources assessed previously (Warkworth ponds, Mangawhero/Eastern Drains, and "wild Waikato"). First and second winter annuli were visible in scales from the Patterson fish, and each fish was in its third year's growth. Observation of otoliths corroborated this assessment. These fish had grown particularly well during their first two years compared with fish from elsewhere. Their third growth period has not resulted in as extensive growth as in previous years, and growth during this period appeared to be less than that of fish from the other sources.

The different growth pattern from the Patterson's fish would tend to endorse the previous conclusion of this report; that the wild-caught fish had growth patterns that were very similar to progeny from the Warkworth spawning, and was an escapee from recent stock rather than a wild fish.