



NSW DEPARTMENT OF
PRIMARY INDUSTRIES

Carp in NSW: Assessment of distribution, fishery and fishing methods

This document is part of a larger publication. The remaining parts and full version of the publication can be found at:

<http://www.dpi.nsw.gov.au/research/areas/systems-research/wild-fisheries/outputs/2005/455>

Updated versions of this document can also be found at the above web address.

This document is subject to the disclaimers and copyright of the full version from which it is extracted. These disclaimers and copyright statements are available in the appropriate document at the above web address.

Carp in NSW: Assessment of Distribution, Fishery and Fishing Methods

K.J. Graham, M.B. Lowry and T.R. Walford

Cronulla Fisheries Research Centre of Excellence
P.O. Box 21, Cronulla, NSW, 2230
Australia



NSW DEPARTMENT OF
PRIMARY INDUSTRIES

February 2005

NSW Department of Primary Industries –
Fisheries Final Report Series

No. 72

ISSN 1449-9967

Carp in NSW: Assessment of distribution, fishery and fishing methods

February 2005

Authors: K.J. Graham, M.B. Lowry and T.R. Walford
Published By: NSW Department of Primary Industries (now incorporating NSW Fisheries)
Postal Address: Cronulla Fisheries Research Centre of Excellence, PO Box 21, NSW, 2230
Internet: www.dpi.nsw.gov.au

© NSW Department of Primary Industries.

This work is copyright. Except as permitted under the Copyright Act, no part of this reproduction may be reproduced by any process, electronic or otherwise, without the specific written permission of the copyright owners. Neither may information be stored electronically in any form whatsoever without such permission.

DISCLAIMER

The publishers do not warrant that the information in this report is free from errors or omissions. The publishers do not accept any form of liability, be it contractual, tortuous or otherwise, for the contents of this report for any consequences arising from its use or any reliance placed on it. The information, opinions and advice contained in this report may not relate to, or be relevant to, a reader's particular circumstance.

ISSN 1449-9967

(Note: Prior to July 2004, this report series was published as the 'NSW Fisheries Final Report Series' with ISSN number 1440-3544)

TABLE OF CONTENTS

TABLE OF CONTENTS	I
LIST OF TABLES	II
LIST OF FIGURES	II
ACKNOWLEDGEMENTS	III
NON-TECHNICAL SUMMARY	IV
1. INTRODUCTION	8
2. OBJECTIVES	9
3. MAPPING OF CARP DISTRIBUTION IN NSW	10
3.1. Introduction.....	10
3.2. Methods.....	10
3.3. Results and Discussion.....	11
4. COMMERCIAL FISHING METHODS	19
4.1. Introduction.....	19
4.2. Carp harvesting methods.....	19
4.3. Discussion and summary.....	21
4.4. Case Study: Mesh-netting in northern NSW storage dams by C & P Hyde	22
5. NSW CARP PRODUCTION & MARKETS	27
5.1. Introduction.....	27
5.2. Annual production.....	27
5.3. Sydney Fish Market Sales	28
5.4. Other markets	29
5.5. Discussion	29
6. ENVIRO-TRAP TRIALS	33
6.1. Introduction.....	33
6.2. Description of Enviro-Trap.....	34
6.3. Carp retention trials.....	34
6.4. Turtle escape experiment	35
6.5. Platypus escape experiment	37
6.6. General discussion	39
7. FISHING GEAR TRIALS	46
7.1. Introduction.....	46
7.2. Small-scale gear	46
7.3. Trials with large fish traps.....	47
7.4. General discussion	53
8. CONCLUSIONS	58
9. REFERENCES	59
10. APPENDICES	61
Appendix 1. Mapping of carp distribution: data sources and metadata.....	61
Appendix 2. Inland production areas.....	64
Appendix 3. Morphometric data for short-necked turtles from Botany Pond.....	65
Appendix 4. Titles and abstracts of published papers detailing envirotrap experiments.....	66
Appendix 5. Report on carp trapping in Eagle Creek.....	68
Appendix 6. Capture details and size data for bass and turtles caught in the Lane Cove River.....	83

LIST OF TABLES

Table 3.1. Upper catchments of west draining rivers reported to be free of carp.....	14
Table 3.2. Localised occurrences of carp in NSW coastal catchments	14
Table 3.3. Degree of carp infestation in each catchment	15
Table 4.1. Summary of carp harvesting methods applicable to NSW inland waters.....	21
Table 5.1. Number of licensed fishers landing carp between 1996/97 and 2002/03	30
Table 6.1. Escape times for short-necked turtles during envirotrap experiments	41
Table 6.2. Details and escape responses of platypus in the envirotrap BRD Experiment 1.....	42
Table 6.3. Details and escape responses of platypuses in envirotrap BRD Experiment 2.....	42
Table 7.1. Water temperature, fish and turtle captures at the three sites in South Creek.	53

LIST OF FIGURES

Figure 3.1. Map of NSW showing all watercourses	16
Figure 3.2. Locations of all sampling sites from various research databases.....	16
Figure 3.3. Carp distribution in NSW compiled from Fisheries Officers' information.....	17
Figure 3.4. Composite map of carp distribution in NSW	17
Figure 3.5. Details of carp distribution in the Richmond Fisheries District	18
Figure 4.1. Lake Keepit with net boat in foreground.....	24
Figure 4.2. Fishing unit of truck and trailer with net boat	24
Figure 4.3. Setting net along shallow shoreline.....	24
Figure 4.4. Net set through flooded woodland.	25
Figure 4.5. Scouting for feeding carp in shallows.	25
Figure 4.6. Untangling carp caught by its dorsal spine.	25
Figure 4.7. Collapsible box-trap	26
Figure 4.8. Rectangular trap dismantled and ready for transport	26
Figure 4.9. Fresh carp catch.....	26
Figure 5.1. Annual NSW commercial carp catch 1970-2003	31
Figure 5.2. Annual NSW commercial carp catch 1984-2003 by main fishing methods	31
Figure 5.3. Annual NSW commercial carp catch 1884-2003 from main catchment areas	31
Figure 5.4. Annual carp sales and mean price through the Sydney Fish Market 1980-2003	32
Figure 5.5. Annual carp sales and mean price for each size grade through SFM 1992-2003	32
Figure 6.1. Original Enviro-Trap showing the conical entrance and the black upper lining	42
Figure 6.2. Envirotrap with netting funnel-entrance.....	43
Figure 6.3. Envirotrap showing escape aperture	43
Figure 6.4. Close-up of funnel perimeter of envirotrap showing platypus escape holes	43
Figure 6.5. Diagram of envirotraps showing positions of the BRDs.....	44
Figure 6.6. Length distribution of carp from Lake Liddell.....	44
Figure 6.7. Length distribution of short-necked turtles from Botany Pond.....	44
Figure 6.8. CL/CW and CL/girth relationships for short-necked turtles.	45
Figure 6.9. Escape rates of short-necked turtles in BRD experiments	45
Figure 7.1. Box-trap with carp catch from Eagle Creek.	54
Figure 7.2. Daily carp catch from Eagle Creek	54
Figure 7.3. Length frequency distribution of carp from Eagle Creek.....	55
Figure 7.4. Length-weight relationship for carp from Eagle Creek.....	55
Figure 7.5. Diagrams of upper sections of envirotraps showing escape chute modifications.	55
Figure 7.6. South Creek trapping site 1.	56
Figure 7.7. South Creek trapping site 2.	56
Figure 7.8. South Creek trapping site 3.	56
Figure 7.9. Modified envirotrap (Trap 2) used in South Creek	57
Figure 7.10. Modified envirotrap (Trap 3) used in South Creek	57

ACKNOWLEDGEMENTS

Fisheries Officers are thanked for generously giving their time to map the local carp distributions. Our appreciation is also extended to Ces and Paul Hyde for providing advice and permitting us to document methods used in their commercial carp fishing operation, and to Keith Bell for providing information on the commercial fishery and marketing of carp in Australia.

The authors would like to acknowledge Peter Forbes for supplying the original “Enviro-Trap” and giving permission to use the design, and John Matthews for initially bringing the design concept to our attention. The organisation and expertise of Tom Grant resulted in successful outcomes from the experiments with platypus in the envirotraps.

Leonard Pinto is thanked for his advice and permission to sample at the Eastlakes site; the management of the Eastlakes golf course is also thanked for permission to use the area for part of the study. Thankyou also to Arthur Willis and Michelle Cooper of the NSW Parks and Wildlife Service for their advice and permission to conduct trials in the Lane Cove River. Daniel Williams, Project Manager of Greening Western Sydney, facilitated the trials in South Creek.

The considerable assistance and advice from Alan Mathers of the Eagle Creek Management Committee was greatly appreciated and essential to the success of the trials in Eagle Creek.

Dean Gilligan critically reviewed the manuscript and offered many helpful suggestions and improvements. Robert Faragher, Charles Gray, Dennis Reid and Aldo Steffe are also thanked for their advice and comments on the report.

NON-TECHNICAL SUMMARY

Carp in NSW: Assessment of Distribution, Fishery and Fishing Methods

PRINCIPAL INVESTIGATORS: K.J. Graham
Dr M.B. Lowry

ADDRESS: NSW Department of Primary Industries
Cronulla Fisheries Research Centre of Excellence
PO Box 21
Cronulla NSW 2230
Telephone: 02 9527 8411 Fax: 02 9527 8576

OBJECTIVES:

1. Map the current carp distribution in New South Wales (2002-03).
2. Assess current and potential fishing methods with respect to impact on native fish and air-breathing vertebrates.
3. Update current fishery production and markets.
4. Test the effectiveness of an experimental carp trap (“Enviro-Trap”) fitted with a bycatch reduction device (BRD) designed to release air-breathing vertebrates.
5. Conduct trials with small-scale and commercial fishing gear.

NON TECHNICAL SUMMARY:

The common carp (*Cyprinus carpio*) is an introduced species now widespread through much of southeastern Australia, including most of inland New South Wales (NSW). Carp are considered a major pest and contributor to the environmental degradation of many inland waterways. In particular, carp are blamed for increased water turbidity, bank erosion, and loss of native aquatic vegetation, all combining to reduce native fish populations. Consequently, there has been considerable ongoing research, both nationally and within New South Wales, into ways of controlling carp numbers. Following the 1997 NSW Rivers Survey which reported a serious decline in native fish numbers, the inland commercial fishery was reviewed resulting in a phasing out by September 2001 of the commercial harvesting of native fish. Although incentives were given to encourage commercial fishing for carp, few fishers showed interest in the fishery and commercial production has fallen to historically low levels.

Key components of the research described in this report were to map the present distribution of carp in NSW, review the carp fishery including catch data, and assess harvesting methods which were effective in catching carp but did not impact on native fish species or air-breathing vertebrates such as turtles and platypus. A fish trap designed for carp and incorporating a bycatch reduction device was tested and assessed.

Mapping of carp distribution in NSW

District Fisheries Officers provided up-to-date information on the distribution of carp in each of the inspectorial regions of NSW. This information, along with data derived from earlier scientific river survey studies, the Fish Kill database, recreational fisher reports, and commercial catch records were collated and compiled in a GIS database. This database is designed to be a living document which can be continually updated.

Overall, the data indicated that carp now inhabit about 77% of NSW waterways, and a further 2% are also likely to be infested. The data show that carp have continued to disperse throughout the inland waterways so that in the Murray-Darling Basin, only some upper catchment areas along the Great Dividing Range (mainly around New England and in the Snowy Mountains) are free of carp. Along the central coast of NSW, carp are now widespread in the Hunter River and the Hawkesbury-Nepean River systems. Carp have also spread through the southern tablelands, including the Shoalhaven River, the upper Murrumbidgee River, and in much of the ACT. From northern NSW, small numbers of carp were reported at several locations in the Richmond and Bellinger Rivers and tributaries.

Commercial fishing methods

Commercial fishing methods that have proven effective for carp include electro-fishing, hauling (seining), mesh-netting and trapping. The efficiency and viability of each of these methods varies and are dependent on the environmental conditions at the fishing locations, and ultimately the economic return to the fisher.

Hauling is the most effective method for catching large quantities of carp but can only be used in locations such as shallow lakes or dams where the lake-bed is clear of obstructions. However, there are few waterways in NSW that are suitable for hauling. As a harvesting method, hauling has relatively low impact on bycatch species (native fish and air-breathing animals) as they can be sorted from the carp catch and released unharmed.

Electro-fishing has been effective for carp harvest or removal in areas of high density but its high capital cost and labour intensity make it an unviable commercial method in most areas. Species other than carp stunned during electro-fishing will recover unharmed if left in the water. At present, no carp are commercially harvested in NSW using electro-fishing equipment.

Historically, most commercial fishing in inland NSW for native freshwater fish was with mesh-nets and traps (drum nets, hoop nets), with the gear often being set for relatively long periods (several hours or more). In their traditional (unmodified) form, these methods are unsuitable for carp as they have the potential to adversely impact on native bycatch species. Mesh-nets damage captured fish (through scale loss etc.) and drown air breathing animals that become entangled in the net. Similarly, while native fish can be released from traps unharmed, air-breathing vertebrates will drown in traps that have no inbuilt escape device.

By modifying their design and methods of deployment, mesh-nets and traps can be used for carp fishing with minimal or no bycatch mortality. One commercial fishing crew is successfully harvesting carp by 'splash-meshing', a technique that involves setting a mesh-net in shallow water, actively frightening carp into the net, and then immediately retrieving the net. The short soak-time allows for the immediate release of vulnerable bycatch species such as turtles and native fish. Traps that project above the water or are fitted with effective bycatch reduction devices (BRDs) may also be used to safely harvest carp.

NSW fishery, production and markets

From a peak of about 550 tonnes in 1977/78, NSW carp production quickly declined and from the mid 1980s has been less than 200 tonnes per annum. Since 2001, there have been about 30 fishers licensed to fish inland waters with most targeting yabbies. In 2002/03, the first full year after the native finfish fishery was closed, only seven fishers landed carp for a total reported production of about 70 t. In contrast to the small commercial fishery, the National Recreational and Indigenous Fishing Survey found that carp was the most common species caught by anglers fishing NSW inland waters and estimated annual catch by recreational fishers in NSW to be approximately 1.2 million carp weighing 877 tonnes. Although some recreational fishers target carp, most anglers catch carp while targeting native fish.

Most of the commercial catch in NSW is sold through the Sydney Fish Market (SFM) but demand is small. Annual volumes of carp through the SFM ranged between 30 and 70 tonnes during the ten years from 1980/81. In 1991/92 sales more than doubled to 124 t but have gradually declined to about 70 t in the last two years (2001/03). Average price has gradually risen, but appears to be sensitive to supply with supplies in excess of two tonnes within any week receiving very low prices; average price in 2003 was \$1.63/kg, a return that is only marginally profitable to the main suppliers. Small quantities of carp are periodically utilised for other products such as fertiliser and pet-food but, again, the limited demand and low price offered (< \$0.80) make carp production for these purposes unprofitable. It is this lack of market demand for carp, the low price, and general remoteness of the fish stocks that combine to make commercial fishing for carp unprofitable for most fishers.

Assessment of ‘Enviro-Trap’

Accidental mortality of air-breathing vertebrates is potentially a major problem for inland fisheries that utilise fully submerged traps. A trap intended for commercial carp fishing (‘Enviro-Trap’) was made available to NSW Fisheries for testing. The design incorporated an escape aperture or bycatch reduction device (BRD) in the top of the trap to facilitate the escape of air-breathing vertebrates. Two more traps to the same design (‘envirotraps’) were made, and the effectiveness of these traps to release turtles and platypus was tested experimentally. These traps were later field tested in a number of localities containing carp and turtles.

Under experimental conditions, about 80% of freshwater turtles escaped through the BRD. Platypuses placed in the envirotrap were observed by video camera to actively avoid the in-built BRD. Small escape holes were then made around the front perimeter of the trap and proved successful, with all platypuses exiting the trap in less than two minutes of entry. Along with a box-trap, three envirotraps were trialed in an irrigation creek off the Murray River near Barham, southwestern NSW. When the creek was flowing, the traps caught substantial numbers of carp (up to 18 carp/28 kg per trap per night); almost no bycatch was taken. Envirotraps were also trialed in the Lane Cove River, Sydney; no carp but moderate numbers of freshwater turtles were trapped. Of 15 active turtles replaced in the traps, only two escaped before the traps were next inspected suggesting that further improvements were required to fully reduce bycatch mortality.

Conclusions

Carp continue to spread throughout inland NSW and are now present in several coastal catchments. Despite the widespread distribution and abundance of carp, a number of factors combine to inhibit any expansion of the commercial carp fishery in the near future. The general remoteness of the main carp resource, combined with the lack of market demand and hence low price for any product, make commercial fishing for carp largely unprofitable.

Electro-fishing, hauling, meshing and trapping, with appropriate modifications and deployment procedures, can safely be used for commercial carp fishing with minimal effects on bycatch species. Should the economic viability for carp improve, fishers will be in the best position to adapt and develop the most effective gear for harvesting carp. For government and non-government organisations which frequently contact NSW Fisheries about carp control in public and private waterways, any of the above methods can be adapted to help control carp numbers in relatively small waterways and streams. However, any gear or methods used to catch carp must be environmentally safe and conform to any legislative conservation requirements.

KEYWORDS:

carp, trapping, mesh-netting, bycatch reduction device, turtles, platypus

1. INTRODUCTION

Common carp (*Cyprinus carpio*) are widespread in lowland rivers and wetlands of inland southeastern Australia and have also invaded some major coastal river systems. The NSW Fisheries Rivers Survey (Harris & Gehrke 1997) and the Native Fish Recruitment Project have shown that carp are the dominant fish in many waterways, often contributing 80% or more of the total fish biomass. There is a widespread public concern that these high levels of carp infestation pose a major threat to these aquatic ecosystems. Carp are associated with the loss of native fish species and aquatic vegetation, poor water quality (eg. high turbidity), algal blooms, and bank erosion.

While carp spread quickly through much of the Murray-Darling River Basin in the 1970s, there has been no recent assessment detailing its present distribution. Carp have continued to spread into the upper reaches of many inland rivers, and the species has also become established in several coastal rivers and waterways after deliberate introductions. One of the primary objectives of the program was to collect and document current knowledge of carp distribution into a single working database. Mapping the current range of carp provides a means of identifying environmentally valuable areas as a basis for the implementation of strategies for high risk / high value areas most likely to respond to investment in carp control.

Although a national biological control program (e.g. Thresher & Bax 2003) offers the most promising long-term solution to the carp problem, encouraging the active harvesting of carp is a practical short to medium-term option for reducing carp numbers. Large-scale carp harvesting has the potential to remove thousands of tonnes of carp and, as a consequence, increase the health of aquatic systems degraded through the actions of carp. However, with minimal market demand, commercial fishing for carp is currently not financially viable through most of its range. Should these circumstances change and the commercial fishery expands, harvesting methods employed must have minimal impact on native species of fishes and other protected bycatch, and the aquatic ecosystem in general.

In the past, commercial fishing in inland waters mainly targeted native species with carp usually an unwanted bycatch. The total annual catch of carp rose to over 500 tonnes in the late 1970s but has since declined to less than 100 tonnes. To stimulate the harvesting of carp, the NSW Government implemented a Carp Production Incentive Scheme in 1999-2001. Now, with the banning of commercial fishing for native fish in 2001, a need arose to identify methods of catching carp that either exclude native species or enable their release unharmed. This project has mapped the current distribution of carp in NSW, assessed and investigated fishing methods for carp that have minimal impact on other species and habitats, and updated the catch history of the NSW carp fishery.

2. OBJECTIVES

1. Map the current carp distribution in New South Wales (2002-03).
2. Assess current and potential fishing methods with respect to impact on native fish and air-breathing vertebrates.
3. Update current fishery production and markets.
4. Test the effectiveness of an experimental carp trap (“Enviro-trap”) fitted with a bycatch reduction device (BRD) designed to release air-breathing vertebrates.
5. Conduct trials with small-scale and commercial fishing gear.

3. MAPPING OF CARP DISTRIBUTION IN NSW

3.1. Introduction

Details of the introduction and spread of carp in Australia are given in Koehn *et al.* (2000). In summary, carp were first imported around 1860 but deliberate attempts to establish them outside Melbourne and Sydney were initially unsuccessful. In 1907 there was a documented release of carp into an inlet pond above Prospect Reservoir, Sydney, and in the 1940s carp were introduced into irrigation canals of the Murrumbidgee Irrigation Area. However, the main spread of carp began in the 1960s, originating from an aquaculture venture at Boolarra in Gippsland, Victoria. Carp were sold to farmers for their dams, and some local waterways and reservoirs were also stocked. The Victorian fisheries authorities tried to stop this practice, but by the time legislation was invoked carp had spread throughout much of Victoria. In 1964 and 1965 carp were reported in Lake Hawthorn near Mildura, from where they gained access to the Murray River and quickly radiated throughout most of the Murray-Darling System. Carp are now established through most of inland NSW, much of Victoria, and the lower reaches of the Murray River in South Australia. There are localised infestations along coastal NSW and in the other states of Australia (Koehn 2004).

The distribution maps in Koehn *et al.* (2000) and Koehn (2004) provide overviews of the spread of carp across southeastern Australia. However, detailed information on the distribution and abundance of carp within NSW is limited to various scientific surveys and catch databases (both commercial and recreational). It was anticipated that expert local knowledge, principally sourced from departmental personnel (Regional Fisheries Officers), would provide a more comprehensive and accurate picture of carp distribution. The overall aim of the mapping project was to collect and integrate all available carp distribution information into a single GIS database that could be periodically updated, and also be made available to other agencies in NSW.

3.2. Methods

Digital geo-referenced 1:250,000 topographic maps purchased from Geoscience Australia were used to provide background display maps overlaid with the 28 Fisheries Districts. An enlarged map of each district was printed onto A3 size paper and sent to the respective Fisheries Offices. Fisheries Officers were briefed on the objectives of the project, and requested to give details of carp distribution along the waterways in their region, and/or to record waterways known to be free of carp. This information from Fisheries Officers was a combination of their personal knowledge of the region and reliable anecdotal reports by local residents, visitors and fishers. All information was marked on the supplied maps and returned to the Cronulla Fisheries Centre.

The underlying structural layer for the database was a 1:250,000-scale map of NSW water bodies, rivers and streams (Figure 3.1) provided by AUSLIG, and displayed in GIS format with Arcview software; this map included many small watercourses that are ephemeral but no map with only permanent watercourses was available in digital format.

A protocol for interpreting and entering the data was developed to standardise the mapping procedure. The carp distribution information for each waterway was coded as follows:

- 0 = carp absent
- 1 = carp present
- 2 = no information
- 3 = likely presence of carp

After allocating each code a colour, the information for each waterway was then entered in digital form onto the base or 'carp-layer'. In many areas, there were no data available for tributaries connected to main waterways known to contain carp. Code 3 ('likely presence of carp') was allocated to those tributaries where there was no obvious barrier (weir, dam etc.) to prevent the movement of carp from the main waterway. A data layer showing weir sites was constructed from departmental records; unless there was information to the contrary, areas upstream of the barriers were deemed to be free of carp. During the early stages of the process, Code 2 was used for many areas where the presence of carp was unknown; this was gradually replaced with the other codes as more information became available.

Scientific data came from departmental river surveys and other inland research projects between 1992 and 2004 (Freshwater Fish Research Database), the Fish Kills Database (1977-2001), and Section 37 permit data (Fishfiles Database) (Figure 3.2). Commercial catch information between 1984 and 2001 (NSW Fisheries ComCatch Database), and anecdotal reports from recreational fishers (e.g. Carp Location Database) were also collated (see Appendix 1).

In order to provide additional interpretive information for the final distribution map, point data were arbitrarily ranked according to the level of confidence in species identification and location data. Criteria were:

- Level 1 - scientific data (accurate identifications and location coordinates).
- Level 2 - Fisheries Officers' reports.
- Level 3 - recreational fisher (mostly from the Carp Location Database) and anecdotal reports: may contain misidentifications with goldfish; positional coordinates were not always available although accurate descriptions of the locations were frequently given.
- Level 4 - commercial data: commercial catch locations were generally vague; recorded positions were the regions or general descriptions given in fisher Catch Return forms.

The locations of carp captures from all these sources were entered onto a separate layer over the 'carp-layer'. A polygon layer was produced from these data broadly delineating the carp distribution; this was then overlaid with another layer showing the river catchments (see Figure 3.4 for NSW catchment boundaries). By projecting this composite map onto a grid map (Geographic Datum Australia 1994 Map Grids Australia Zone 55), estimates of carp infestation in each catchment were made by calculating the percentage of land area encompassing waterways containing carp (Table 3.3).

The GIS database and associated files are now administered by the Introduced Pests Section of DPI at the Port Stephens Fisheries Centre (see Appendix 1).

3.3. Results and Discussion

Carp distribution maps and associated information were returned from Fisheries Officers in all regions; Figure 3.3 shows the broad distribution of carp in NSW based on this information. Figure 3.4 is a composite map showing the broad distribution of carp in NSW and includes all point-data sites where carp were captured or reported. An enlarged map of the Richmond Fisheries District (Figure 3.5) gives an example of the fine detail available in the database.

The scientific, recreational fisher and anecdotal data mostly coincided with the distributional pattern derived from the Fisheries Officers' information, as well as highlighting some isolated areas inhabited by carp. The distributional information derived from commercial fishery data was mostly limited to areas of known high carp abundance.

3.3.1. *Western drainages*

The only relatively large carp-free areas west of the Great Dividing Range are the northwest region of the state, and areas of high altitude in New England and Snowy Mountains (Figures 3.3 & 3.4). The catchments in the Far West Region (Cooper, Bulloo, Lake Bancannia, Lake Frome, and a small section of the Darling) contain mostly ephemeral waterways making them unlikely to sustain permanent populations of carp. However, carp were found in the area during a river survey in February 1999, and there were reports of two commercial catches from one river in 1992 and 1996. The Bureau of Meteorology Annual Rainfall Records show above average rainfall at the times of these reports, suggesting that carp moved with floodwaters into this flat country.

Several relatively small carp-free areas on the western slopes of the Great Dividing Range are detailed in Table 3.1. Around New England, high altitude sections of rivers free of carp include the upper MacIntyre and Severn Rivers, the Gwydir River above the Copeton Dam, the MacDonald River above Woolbrook, and the upper reaches of the Namoi River. In the central tablelands, the Cudgegong River above Rylstone, Winburndale Rivulet and Reservoir on the upper Macquarie River, Fish River above and including Lake Oberon, the Crookwell River and Blakney Creek (tributaries of the upper Lachlan River) were all reported to be free of carp.

Further south, carp were reported to be absent from the upper Queanbeyan River (including Googong Reservoir), the Tumut River above the Blowering Dam, Swampy Plain River above Khancoban, and storage lakes and headwaters of other rivers in the higher altitudes of the Snowy Mountains. In addition, there appears to be no carp in the Lake George catchment probably because of the ephemeral nature of the lake.

No new information was collected for the Australian Capital Territory. However, carp are widespread in parts of the ACT and there is recreational “coarse fishing” for carp in Lake Burley-Griffin. Streams in the ACT that are free of carp include the Tidbinbilla, Naas, Orroral, and Cotter (*ACT Vertebrate Pest Management Strategy*, ACT Government 2002).

3.3.2. *Coastal NSW*

In the northern rivers area of NSW, there were several reports of carp, mostly koi, in a number of small areas of the Richmond catchment. These locations were in Iron Pot Creek in the upper catchment, the Horseshoe Lagoon near Casino, the Richmond River downstream from Tatham, Bungawalbyn Creek (a large area of swampland), and Emigrant Creek (Table 3.2, Figure 3.5). Recreational fishers also reported carp in the Mann and Timbarra Rivers, tributaries to the upper Clarence River (Carp Location Database); however, scientific sampling has only ever caught goldfish (*Carrasius auratus*) in these rivers suggesting that the reports were based on misidentifications (D. Gilligan, personal communication). Independent scientific collectors reported koi carp in the Bellinger River, and the Coffs Harbour Fisheries Officer also reported koi in Warrell Creek, a tributary of the Nambucca River. A report by recreational fishers of koi carp in the upper Macleay (Carp Location Database) has not been confirmed by scientific sampling at a number of sites on the river.

Carp are widespread in the Hunter, Hawkesbury-Nepean, Port Jackson and Shoalhaven catchments. The Fish Kills database and recreational fisher reports confirm the presence of carp in several of the Hunter Valley tributaries and lakes, confirming that carp have spread from the main river e.g. Williams and Paterson Rivers in the lower valley, and Lakes Liddell and Glenbawn, the Isis River and Pages Creek in the upper Hunter Valley. Most freshwater bodies in and around the Sydney metropolitan area contain carp (e.g. Botany Ponds, Lane Cove River, upper Georges River) as does much of the Hawkesbury-Nepean system, including the Colo River, Wollemi River, and Cattai and

Mangrove Creeks. Above Warragamba Dam, carp are found in Lake Burragorang, the Wingecarribee River, and the lower reaches of the Wollondilly River. However, in the southern highlands, some parts of the upper system were reported to be free of carp e.g. Guineacor and Murruin Creeks above Barralier, the upper Wollondilly River above the Pejar Reservoir dam, and the Tarlo River. Carp have also spread through most of the Shoalhaven River catchment, above and below Tallowa Dam.

South coast catchments are mainly carp free. There is an isolated population in Long Swamp, a small coastal lagoon near Bermagui on the south coast. The local Fisheries Officer reported koi carp in the Towamba River, inland from Eden, but the extent of any spread in that catchment is unknown. The capture of a single small carp in the Snowy River below the Dalgety Weir was reported by P. Gibbs (NSW Fisheries, personal communication) but it may have been an escaped fish used for live-bait as all other reports from that river system (including the McLaughlan River) have proved to be goldfish (*Carassius auratus*). Recent research sampling of the Snowy River and tributaries below Jindabyne Dam, including the Dalgety Weir, did not find any carp (D. Gilligan, personal communication).

3.3.3. Summary

Based on land areas, the data indicate that carp now inhabit over 85% of NSW and ACT waterways west of the Great Divide, and about 30% in the eastern drainages (Table 3.3).

With no permanent waterways, the northwest corner of the state is free of carp, and the small pockets of carp-free waterways in the higher altitude regions of the Great Dividing Range are mostly above dams or waterfalls that form impediments to the unassisted spread of carp. More than half of coastal NSW remains free of carp although they now appear to be more widespread than indicated by Koehn *et al.* (2000). Carp now inhabit most freshwater rivers and lakes along the central coast between and including the Hunter and Shoalhaven catchments, and through much of the Southern Highlands and Tablelands (upper Shoalhaven catchment).

Almost all reports from northern NSW (north of the Hunter catchment) were of small numbers of ornamental koi carp (Table 3.2), a potentially less invasive strain than the Boolara phenotype which infests the Murray-Darling system. Regular scientific river surveys in these catchments during recent years have found no evidence to suggest that these introductions have spread widely through any of the northern NSW river systems (D. Gilligan, personal communication). It is also likely that some reports, particularly from recreational fishers, include misidentifications of goldfish.

Carp probably now inhabit all waters in NSW into which they can naturally spread. Any further spread of carp will most likely be achieved through deliberate introductions or the use of small carp as live-bait by anglers.

Table 3.1. Upper catchments of west draining rivers reported to be free of carp; the barriers are the upper limits of the reported carp distribution in each river.

Catchment	River	Barrier	Barrier Position
McIntyre	Tenterfield Ck	Tenterfield Falls	29°00', 151°42'
McIntyre	McIntyre R.	McIntyre Falls	29°09', 150°58'
McIntyre	Severn R	'Dungeon' gorge area	29°06', 150°57'
Gwyder	Gwyder R.	Copeton Dam	29°59', 150°59'
Namoi	upper MacDonald R.	no apparent barrier	
Macquarie	Cudgegong R.	Windamere Dam	32°44', 149°46'
Macquarie	Winburndale R.	Winburndale Reservoir dam	33°23', 149°46'
Macquarie	Fish R.	L. Oberon dam	33°43', 149°52'
Lachlan	Crookwell R.	no apparent barrier	
Lachlan	Blakney Creek	no apparent barrier	
Lake George		ephemeral	
Murrumbidgee	Tumut R.	Blowering Dam	35°24', 148°15'
Murrumbidgee	Queanbeyan R.	Googong Reservoir dam	35°25', 149°16'
Murrumbidgee	Cotter R.	Cotter Dam	35°24', 148°15'
Murrumbidgee	Tidbinbilla R.	no apparent barrier	
Murrumbidgee	Naas-Gudgenby R.	no apparent barrier	
Lake Hume	Swampy Plain R.	Khancoban Pondage (dam)	36°13', 148°06'

Table 3.2. Localised occurrences of carp in NSW coastal catchments recorded during scientific surveys or from fishkill data (research), or reported by fisheries officers (FO) and/or recreational fishers (rec.). This data excludes widespread populations in the Hunter, Hawkesbury-Nepean, Port Jackson and Shoalhaven catchments.

Catchment	Waterway and area	Location	Report	Comment
Richmond	Iron Pot Creek near Toonumbar Dam	28°36', 152°45'	FO/rec.	
Richmond	Horseshoe Lagoon near Casino	28°53', 153°04'	FO/rec.	
Richmond	Richmond R. near Tatham	28°56', 153°10'	FO	koi carp
Richmond	Bungawalbyn Creek	28°46', 153°31'	FO	koi carp
Richmond	Lismore Lake	28°49', 153°17'	research	
Richmond	Emigrant Creek	28°47', 153°31'	research	koi carp
Clarence	Harwood	29°25', 153°15'	research	
Bellinger	Bellinger R.	30°25', 152°52'	research	koi carp
Bellinger	Warrell Ck, Nambucca R.	30°47', 152°53'	FO	koi carp
Hastings	Hastings R. at Beechwood	31°27', 152°40'	research	koi carp
Hastings	Hastings R. at Emerald Downs	31°27', 152°54'	FO	koi carp
Hastings	Wrights & Mimosa Park Creeks	31°27', 152°55'	FO	koi carp
P Stephens	Wallamba R. - dams on upper river	32°06', 152°08'	FO	koi carp
P Stephens	Wallamba R. - dams near Darawank	32°07', 152°29'	FO	koi carp
P Stephens	Pipers Bay – small creek	32°13', 152°33'	FO	koi carp
P Stephens	Karuah R. near Booral	32°28', 151°57'	FO	
L	Wyong R.	33o16', 151o25'	rec.	
Macquarie				
Bega	Long Swamp near Bermagui	36°24', 150°04'	research	
Snowy	Snowy R. at Dalgety Weir	36°34', 148°50'	rec.	single fish
Towamba	Towamba R. near Towamba	37°06', 149°43'	FO	koi carp

Table 3.3. Degree of carp infestation in each catchment (% land area with waterways inhabited by carp) (* unconfirmed in headwaters)

Catchment	Total area	Carp absent		Carp present		Carp likely	
		Area	%	Area	%	Area	%
Coastal							
Bega	2837	2837	100				
Bellinger	3484	3257	93	20	1	207	6
Brunswick	516	516	100				
Clarence	22420	22420	100				
Clyde	3438	3438	100				
Genoa	1140	1140	100				
Hastings	4550	4550	100				
Hawkesbury	22085	3094	14	12280	56	6711	30
Hunter	19244			19244	100		
L Illawarra				798	100		
L Macquarie				1583	100		
Macleay	11456	11456	100				
Manning	8218	8218	100				
Moruya	1486	1486	100				
Port Jackson				1828	100		
Port Stephens	4513	4513	100				
Richmond	7090	876	12	99	1	6114	86
Shoalhaven	7216	793	11	6424	89		
Snowy	8933	8933	100				
Towamba	2164	2164	100				
Tuross	2164	2164	100				
Tweed	1089	1089	100				
<i>Total coastal:</i>	<i>138232</i>	<i>82944</i>	<i>60</i>	<i>42256</i>	<i>31</i>	<i>13032</i>	<i>9</i>
Inland							
ACT	2360	800 ?	34	1560	66		
Bulloo	20393	20393	100				
Castlereagh	17422			17422	100		
Condamine	25767			25767	100		
Cooper	627	627	100				
Darling	113050	923	1	112127	99		
Gwydir	26627	5328	20	21300	80		
Lachlan	90858	1499	2	89359	98		
Lake Bancannia	23376	23376	100				
Lake Frome	19552	18284	94	1268	6		
Lake George	943	943	100				
Lake Hume	5205	1652	32	3553	68		
Lake Victoria	9084			9084	100		
Macintyre	24243	3753	15	20490	85		
Macquarie	74768	854	1	73914	99		
Moonie	745			745	100		
Murray	15041			15041	100		
Murrumbidgee	79259	7926	10	71333	90		
Namoi	42053	944	2	41109	98		
Paroo	40451			40451	100		
Peacock Creek	21406			21406	100		
Warrego	11375			11375	100		
<i>Total Inland:</i>	<i>664605</i>	<i>87302</i>	<i>13</i>	<i>577304</i>	<i>87</i>		
TOTAL:	802837	170246	21	619560	77	13032	2

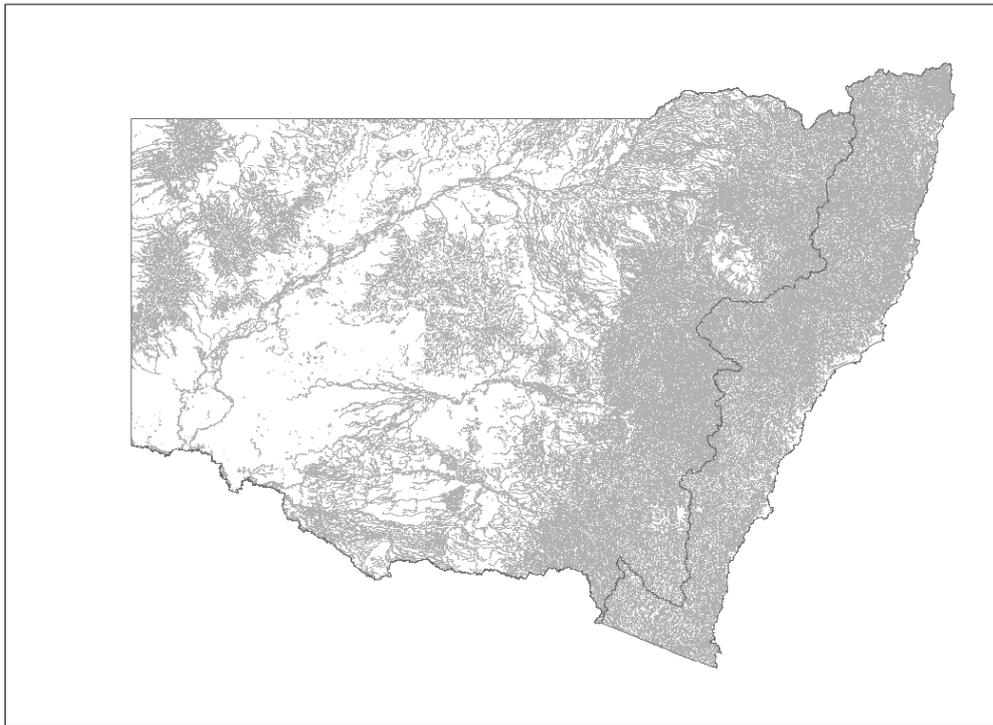


Figure 3.1. Map of NSW showing all watercourses, used as the underlying structural layer for the carp distribution database.

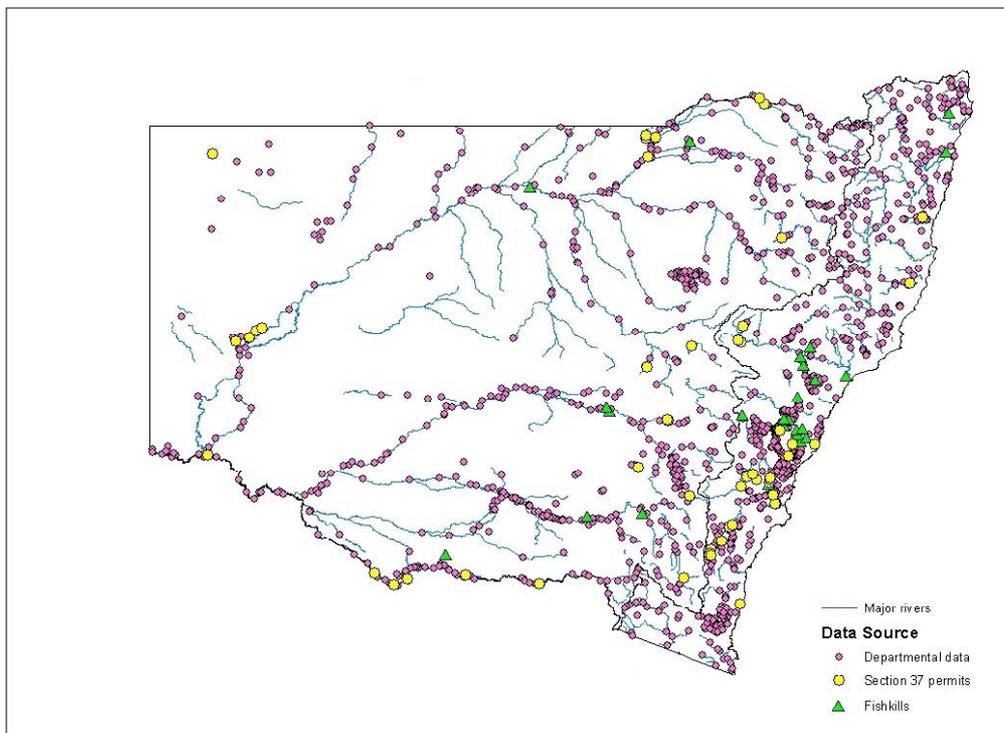


Figure 3.2. Locations of all sampling sites from various scientific research databases.

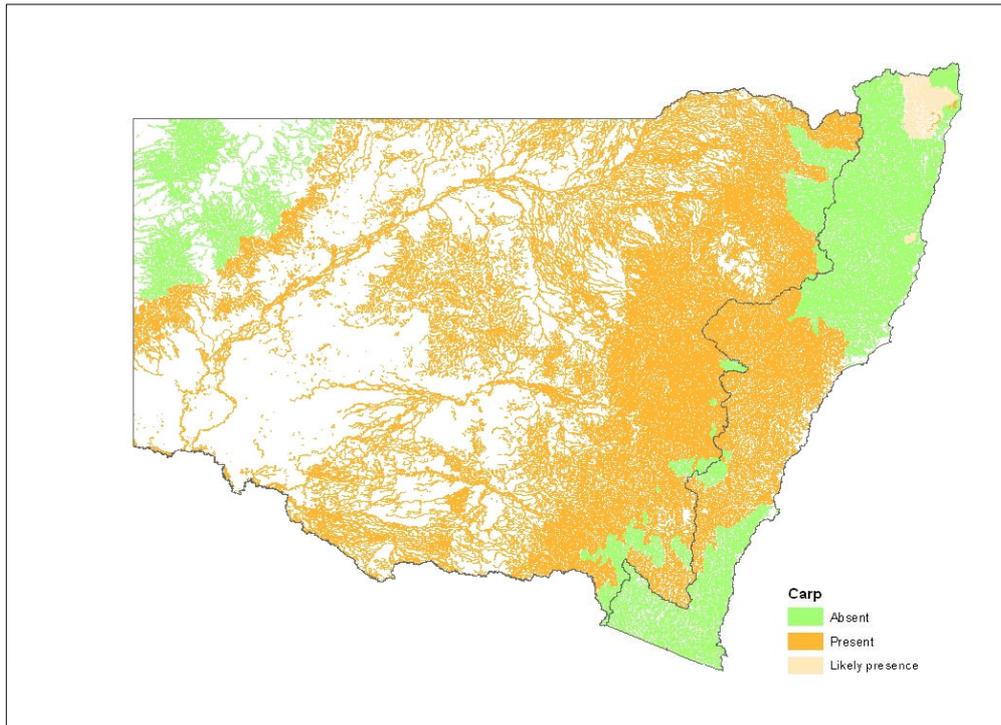


Figure 3.3. Map of NSW showing carp distribution compiled from the information supplied by Fisheries Officers; the black line on the eastern side delineates the Great Dividing Range.

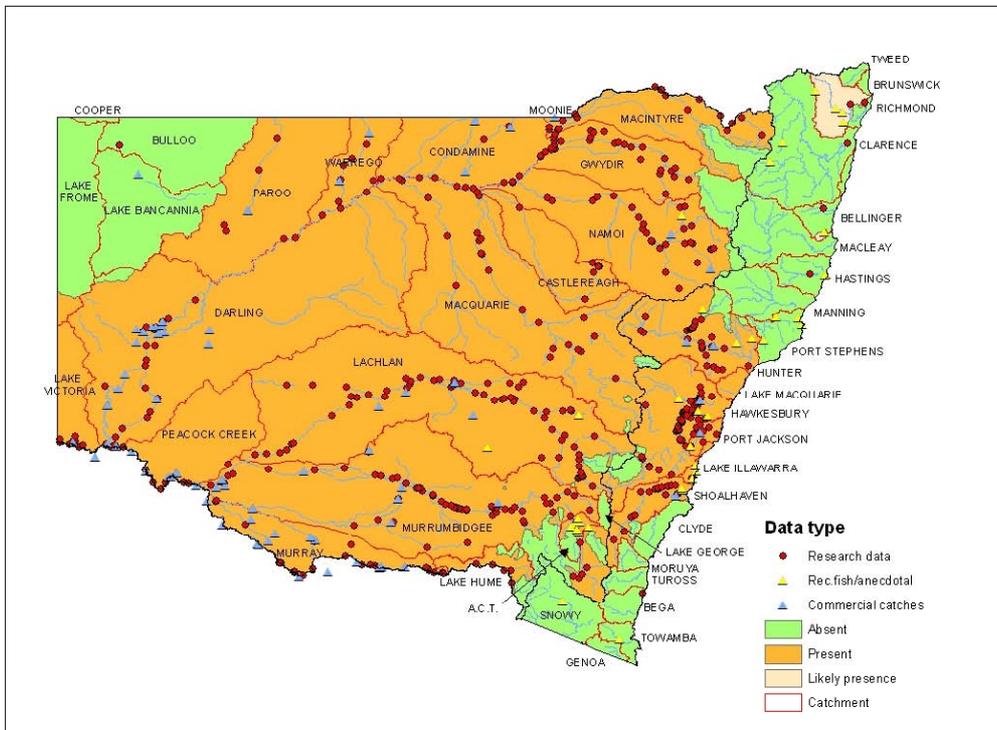


Figure 3.4. Map of carp distribution in NSW including locations of all carp capture sites from the research databases (scientific surveys, fishfiles, fishkills), commercial catch database, and carp observations from recreational fisher and anecdotal sources.

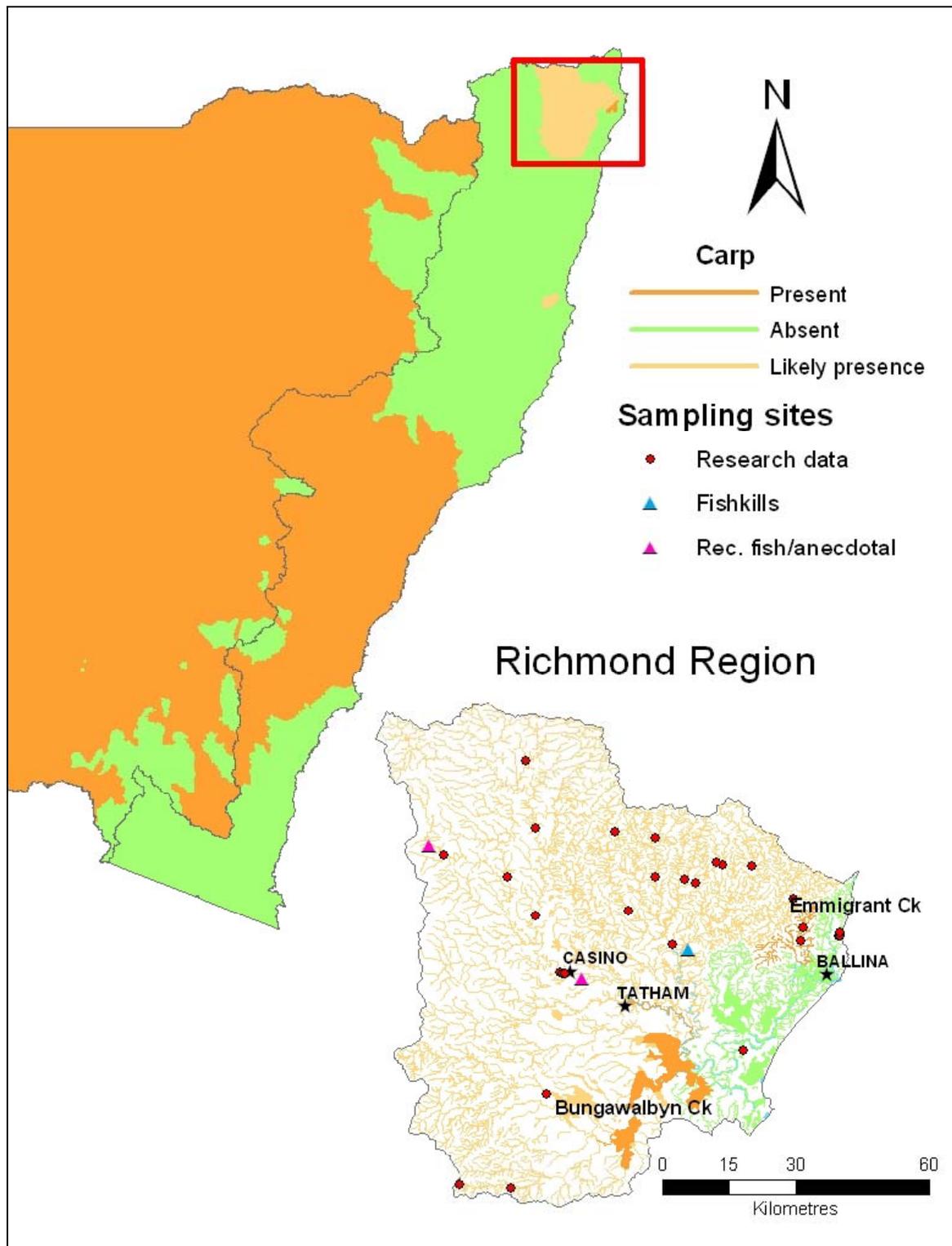


Figure 3.5. Details of carp distribution in the Richmond Fisheries District in northern NSW. Shown are locations of known carp presence (Emmigrant Creek, Lismore Lake, upper Richmond River near Toonumbar, Casino and Tatham, and the Bungawalbyn Creek swamps); the adjoining watercourses have no impediments to prevent the spread of carp from the known infested waterways.