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Review of freshwater fish in the Wellington Region

Prepared for

Wellington Regional Council

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by

Rowan Strickland
and
Aaron Quarterman

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Cawthron Institute
98 Halifax Street East
Private Bag 2
NELSON
NEW ZEALAND

Phone: +64.3.548.2319
Fax: +64.3.546.9464
Email: info@cawthron.org.nz

Cover Photo: Waikanae River. Cawthron 2001

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Report reviewed by: Approved for release by:

Dr Roger Young, Freshwater Ecologist   Rowan Strickland, Freshwater Group Manager

1. INTRODUCTION

The purpose of this review is to provide Wellington Regional Council (WRC) with information from which they can identify knowledge gaps and plan where future fish investigations should focus. The review objectives were to:

1. Bring together existing information on the freshwater fish of the Wellington Region
2. Describe and characterise freshwater fish for catchments (including their vulnerability)
3. Make recommendations on priority areas for further freshwater fish surveys

As part of the review we have created a series of geographic information system (GIS) files on the existing fish information and included a CD ROM containing these with this report.

Recommendations have been made for further study or improvement to the baseline created here, but order of priority was difficult to assess in the absence of knowing what changes are imminent. Much of the past data on fish distribution was collected for specific scientific studies over the past eighty years. Little of the data collected appears to have been in response to potential catchment use change or consent applications. Generally, river systems identified with high values for fish should all be considered vulnerable if measures are not in place to ensure that land use within their catchments will not change.

2. APPROACH

The primary source of information used for this review was the New Zealand Freshwater Fish Database (NZFFD), as at June 2001, which was linked with an Arcview GIS for map production. GIS files were also created from data provided by Fish & Game New Zealand, Wellington Region, on reaches of importance for sports fish. Copies of the GIS files are included with this report for further use and updating by WRC.

The amount of detail in the GIS files is equivalent to the detail provided on NZMS 260 (1:50,000 scale) topographic maps. This level of detail had to be removed for presentation in A4 format, but can be viewed by using the GIS, particularly for viewing or adding information at the reach scale. The positions of waterways are the most basic information requirement on a map in this type of exercise. In A4 format the view of the Wellington Region becomes a myriad of waterways (Figure 1). Therefore, the remaining figures in this report include only third order or higher watercourses.

Unmodified catchments, or catchments with a low percentage of their area modified, generally offer the best fish habitat and are often the most species rich. As a means of making a coarse distinction between areas of catchments that were modified and those that were not, areas of the region that had a cover of native vegetation (forest or scrub) were plotted (Figure 2). The presence or absence of native vegetation was then used to broadly determine the value and vulnerability of each catchment as fish habitat. This approach could be improved with the addition of detailed land use information to the GIS. Figure 2 is the base map used for all other maps produced in this report.

The methods used to determine values and vulnerability are explained in Sections 3.4 and 4.4.
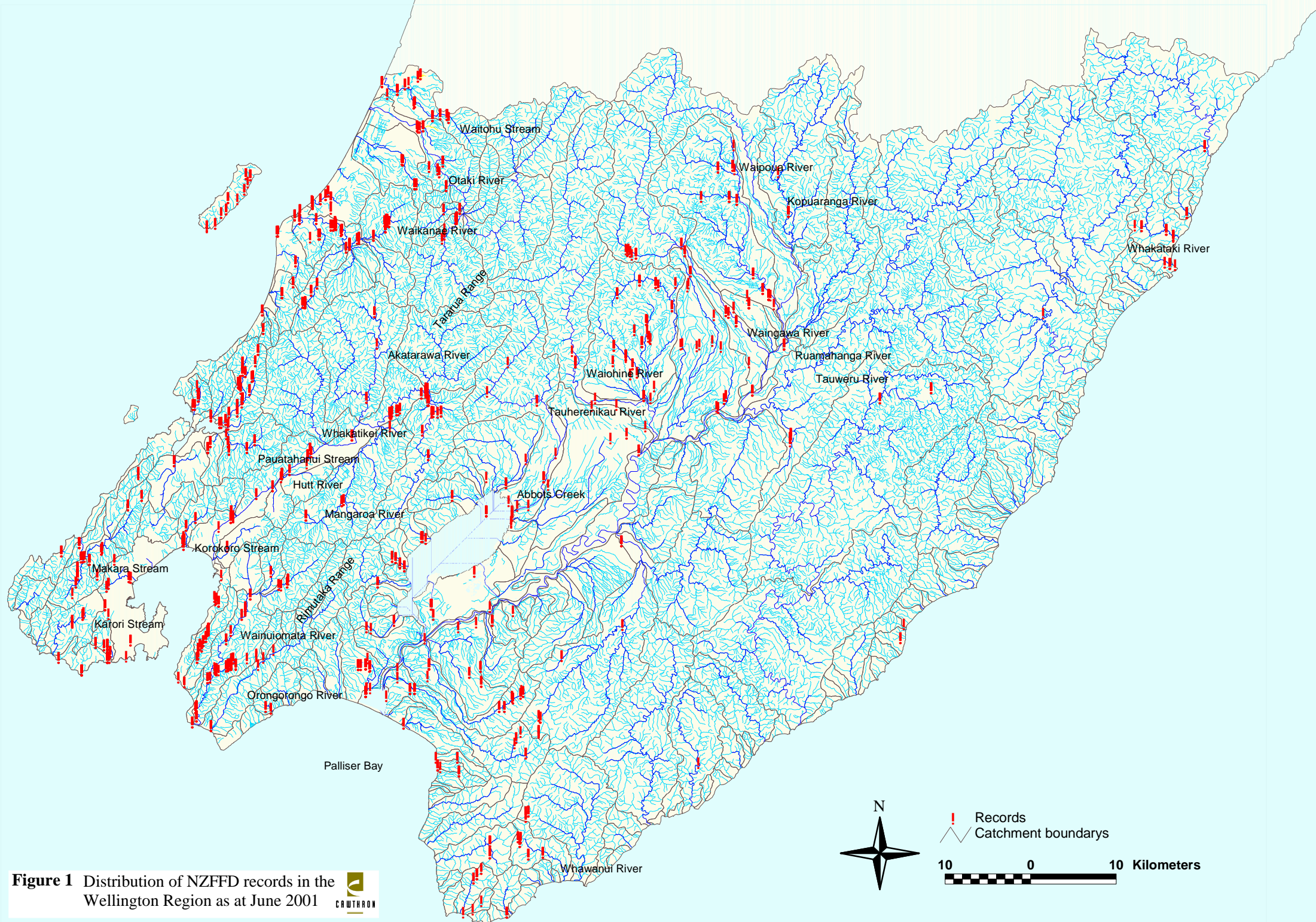
Figure 1 Distribution of NZFFD records in the Wellington Region as at June 2001
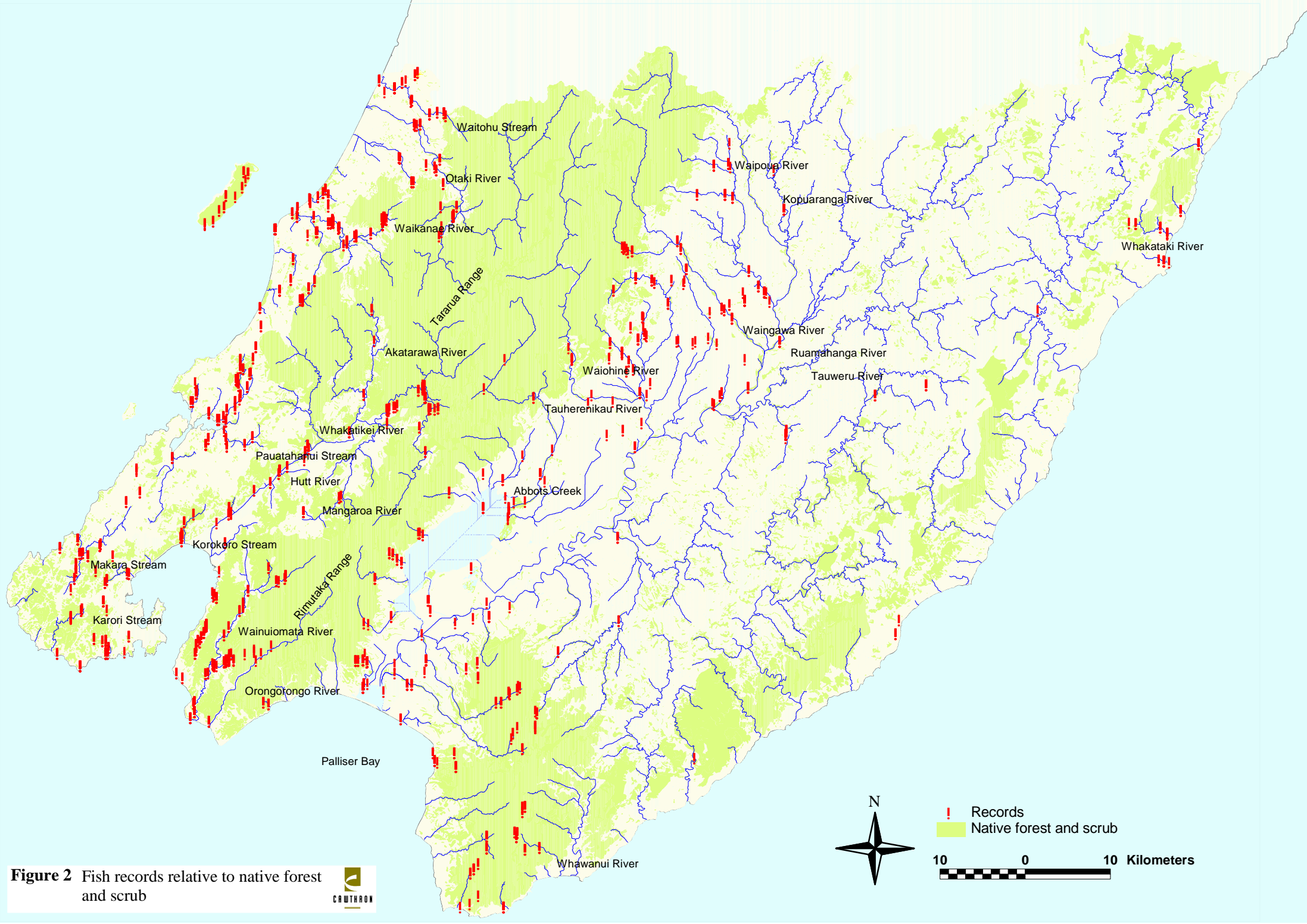
Figure 2 Fish records relative to native forest and scrub
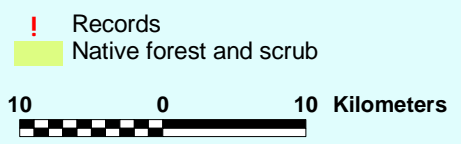
3. ABOUT THE DATA

3.1 Freshwater Fish of the Wellington Region

Table 1 lists the number of records in the NZFFD for each fish species found in the Wellington region. A number of records were omitted from this list and our analysis because they were single records of individual species (Table 2).

There were 1911 records for the Wellington Region as of June 2001, 12% of the 16382 records in the NZFFD. In the Wellington Region these records cover mostly the Ruamahanga and western catchments (Figure 1 & 2). Fish sampling has therefore been quite intensive in these catchments, but leaves knowledge gaps for the remainder of the region.

NZFFD records for the Wellington Region have been accumulated over the period 1921 to 2001. Caution should therefore be used when interpreting any of the fish distribution maps contained in this report, as the records may not represent present day conditions *e.g.* record of grayling which is now considered to be extinct.

The total number of freshwater fish species recorded in the Wellington Region was 31, of which 23 were native species, 8 were exotic species and 1 (grayling) was extinct. Only 4 of the 23 native species were non-migratory. Longfin eel was the most frequently recorded fish species, followed by redfin bully, brown trout and shortfin eel (Table 1).

Table 1 Freshwater fish records in the NZFFD for the Wellington region, June 2001

	Scientific Name	Common Name	Frequency
*	*Anguilla dieffenbachii*	Longfin eel	314
*	*Anguilla australis*	Shortfin eel	173
*	ANGUILLIDAE	Unidentified eel	20
*	*Gobiomorphus huttoni*	Redfin bully	233
*	*Gobiomorphus cotidianus*	Common bully	102
*	*Gobiomorphus hubbsi*	Bluegill bully	26
*	*Gobiomorphus gobioides*	Giant bully	15
	GOBIIDAE	Unidentified bully	10
	Gobiomorphus basalis	Cran's bully	24
	Gobiomorphus breviceps	Upland bully	54
*	*Galaxias brevipinnis*	Koaro	93
	Galaxias divergens	Dwarf galaxias	36
*	*Galaxias maculatus*	Inanga	89
*	*Galaxias fasciatus*	Banded kokopu	80
*	*Galaxias argenteus*	Giant kokopu	53
*	*Galaxias postvectis*	Shortjaw kokopu	27
	GALAXIIDAE	Unidentified galaxiid	5
	Salmo trutta	Brown trout	195
	Oncorhynchus mykiss	Rainbow trout	4
	SALMONIDAE	Unidentified salmonid	3
*	*Cheimarrichthys fosteri*	Torrentfish	53
*	*Geotria australis*	Lamprey	43
*	*Retropinna retropinna*	Common smelt	36
	Perca fluviatilis	Perch	10
	Scardinius erythrophthalmus	Rudd	5
	Tinca tinca	Tench	4
*	*Rhombosolea retiaria*	Black flounder	6
*	*Aldrichetta forsteri*	Yelloweye mullet	6
*	TRIPTERYGIIDAE	Unidentified triplefin	5
*	*Mugil cephalus*	Grey mullet	2
	Neochanna apoda	Brown mudfish	50

* Diadromous – fishes that migrate between fresh and saltwater, usually in relation to spawning.

Table 2 List of records from the NZFFD not used in this analysis

Scientific Name	Common Name	Frequency
Oncorhynchus tshawytscha	Chinook salmon	1
Carassius auratus	Goldfish	1
Cyprinus carpio	Koi carp	1
	Marine species	1
Leptoscopus macropygus	Stargazer	1
Pleuronectidae	Unidentified flounder	1
Prototroctes oxyrhynchus	Grayling	1
	No species recorded	1

4.   INTERPRETING THE DATA

4.1 Sampling distribution

Fish sampling coverage of the Wellington area is shown by the distribution of sampling records (Figure 2). As a first step, this map gives a good indication of where knowledge gaps on freshwater fish are. Generally, river systems that have been well sampled are those that have been easily accessed by road. Consequently, it is the middle and lower reaches of most systems that sampling has concentrated.

A lack of fish distribution information for the headwaters of river systems does not necessarily mean that these reaches are unimportant for fish. Providing unknown areas of the catchment are unmodified and fish access to them is unimpeded, there is a reasonable chance that there will be fish inhabiting them. Often, as has been the case, limited sampling excursions into the lower areas of headwaters are sufficient to determine the species that might be found in the remaining catchment upstream. Catchments with nil or few records are often physically similar to neighbouring catchments with reasonable numbers of records. It is not unreasonable to extrapolate what is known of species distribution from one catchment to another providing the catchments are physically similar and discharge to a common area of the coast. The only part of the WRC district where extrapolation of data from one catchment to another is not feasible is in the eastern catchments, where there are very few records.

Any of the sample sites shown in Figure 2 can be searched using the GIS for all details of fish found, date sampled *etc*. This stage of interpretation is likely to be the most frequently used.

4.2 Fish distribution

A quick check on fish species distribution within the WRC district can be sought from Appendices 1.1 to 1.11. To date, most of the species rich communities of fish in the WRC district have been associated with small river systems that have large portions of native forest in their catchment and a relatively small portion of modified coastal lowland. Some of the best examples are the Orongorongo River and tributaries of the Wainuiomata River draining south out of the Rimutaka Range, but there are other smaller examples draining west from the Tararua Range between Otaki and Pauatahanui. Generally this is because these systems remain relatively intact and consequently offer a diversity of habitat types for a wider range of fish species. The better sampled of these systems are ideal for extrapolating species distribution for less known systems of similar character. For example, the unsampled small streams flowing directly into Palliser Bay from the Rimutaka Range could be expected to host similar fish communities to those found in either the Wainuiomata or Orongorongo rivers.

One factor that would improve this method of prediction is identifying how accessible the various waterways are to fish. It would therefore be useful to create a GIS file that identifies access barriers for fish. This should include manmade (weirs, culverts, bridge aprons *etc*.) and natural (waterfalls and significant changes in elevation) barriers and in each case identify which species would be limited.

Ultimately, no end of prediction substitutes for a well conducted survey.

4.3 Ranking river reaches for native fish

As a guide to interpreting the data further, a number of files in the GIS have been created which rank and categorise the data according to various values – species richness, threatened species, angling reaches etc. These allow the reader to make general comparisons between marked reaches. However, reaches that are unmarked are open to a number of interpretations, the safest of which is that they have important values for fish.

Because many of the native fish are diadromous (> 80% in the Wellington Region), the following ranking system is based primarily on these species. A reach for any species is defined as – from the sea to the upstream most limit of penetration. The ranking system devised for this exercise, factors in both biodiversity and conservation values and is based loosely on two existing classification methods.

The first classification used was a species richness classification based on Richardson and Jowett (1996) but uses the combined records for selected reaches. Richardson and Jowett categorised as "high", any site where more than three species occurred and included exotic species. Because we have extended the classification over a reach, which often included more than one record, we arbitrarily doubled the criteria for "high" to six or more species (excluding non-migratory native species and exotic species). Systems and parts of systems that fell within these criteria are highlighted with a thin orange line in Figure 3.

The second classification used was the Department of Conservation listing of threatened species (Tisdall 1994) – Category A being the highest priority species for conservation action. The Wellington Region recorded five species from this list as follows:

Category A - Shortjaw kokopu
Category B - Giant kokopu, brown mudfish
Category C – Koaro, banded kokopu

We have used this classification as a means of identifying any reach that might be significantly important for threatened species. To make this distinction, any reach containing Category A species, or with a combination of Category B+C+C species or higher was highlighted with a thick red line (Figure 3).

Combination of the species richness and threatened species classification systems indicates important reaches for migratory native fish. Most rivers sampled in the WRC district had reaches that were important for native fish. Unsampled tributaries of river systems that are high in species richness, or that contain threatened species should be regarded as having similar values until sampling proves otherwise.

We have ended up with three importance rankings in Figure 3 (1 being important and 3 very important):
1. Reaches containing more than five migratory native species (thin orange line).
2. Reaches containing Category A threatened species or at least Category B+C+C threatened species (thick red line).
3. Reaches that have the attributes of both 1 and 2 above (overlap of orange and red lines).

Examples are the Orongorongo - ranked 3, the Whawanui – ranked 2 and the Waipoua River – ranked 1.
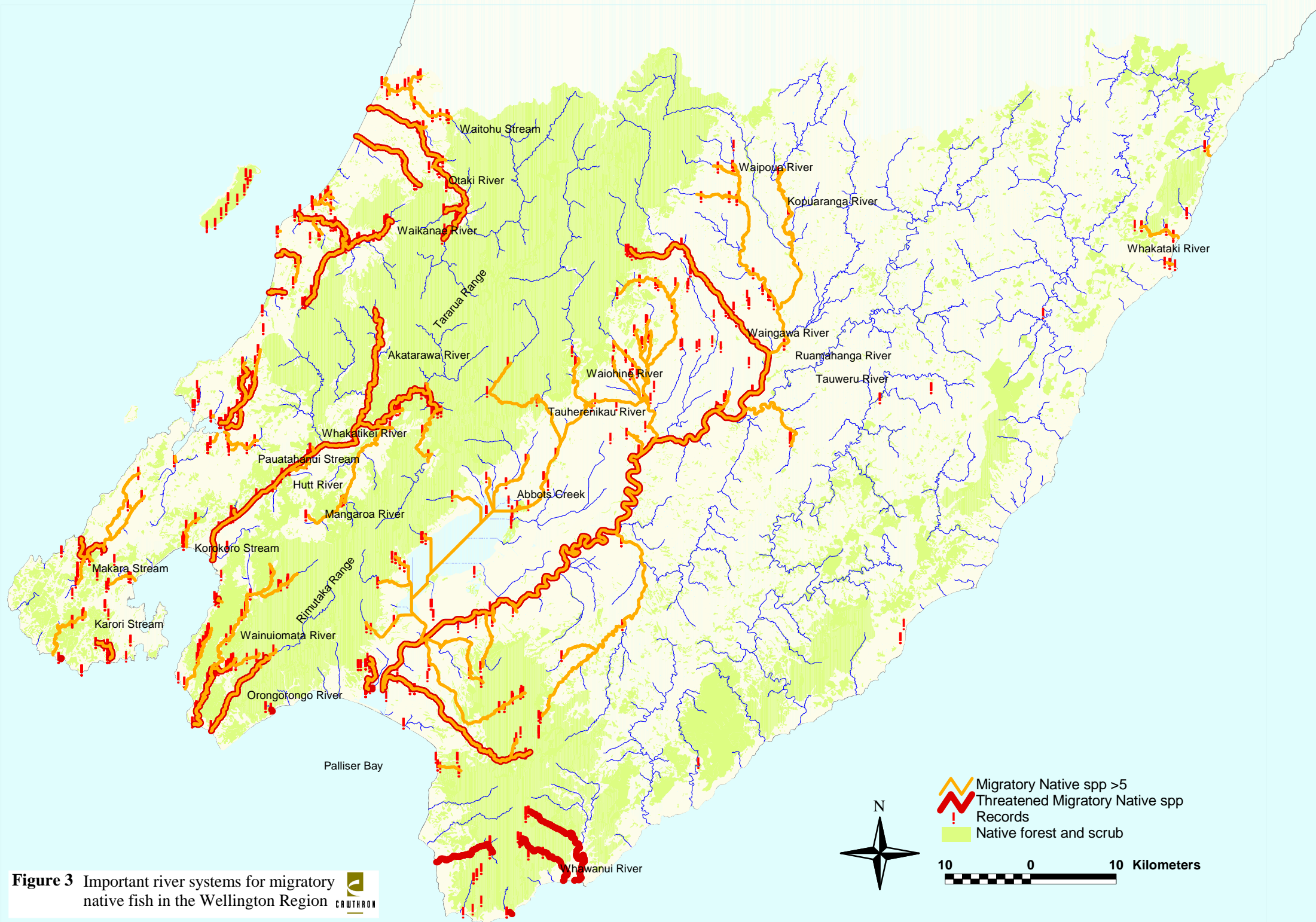
Figure 3 Important river systems for migratory native fish in the Wellington Region

Map labels:

Waitohu Stream
Otaki River
Waikanae River
Tararua Range
Akatarawa River
Whakatikei River
Pauatahanui Stream
Hutt River
Mangaroa River
Korokoro Stream
Makara Stream
Karori Stream
Rimutaka Range
Wainuiomata River
Orongorongo River
Palliser Bay
Whawanui River
Waipoua River
Kopuaranga River
Whakataki River
Waingawa River
Ruamahanga River
Waiohine River
Tauweru River
Tauherenikau River
Abbots Creek

Legend:
Migratory Native spp >5
Threatened Migratory Native spp
Records
Native forest and scrub

10   0   10   Kilometers

N

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This ranking system has not taken into account non-migratory native species in the WRC district, of which one (brown mudfish) is a Category B threatened species. Brown mudfish appear to be widespread through the Ruamahanga catchment (Appendix 1.8) but this may well have changed if their habitat has since been modified. Their rare occurrence elsewhere in the district indicates their threatened status is appropriate. Wetlands are the preferred habitat of brown mudfish but are not well represented throughout the district – less than 10 percent of the Region's original wetlands remain (WRC 1999). Those remnant pockets of wetland that remain should be highly valued and the status of brown mudfish in them checked.

Other non-migratory native species, such as dwarf galaxias, Cran's and upland bullies, occur relatively infrequently at sample sites compared with migratory species (Table 1), but are distributed quite widely through the district (Appendices 1.3 & 1.6). The presence of these non-migratory species is possibly more threatened than many of the migratory species as they would be less able to recolonise if some event was to remove them from a river system.

All records for dwarf galaxias (36), Cran's (24) and upland bullies (54) were checked for presence of trout. Brown trout were also present in almost all cases. Based on this exercise, there does not appear to be a strong association between the absence of these species and the presence of trout, as has been suggested elsewhere (McDowall 1990).

To a large extent, the non-migratory native species are accounted for in the rankings for migratory native species shown in Figure 3, as migratory species were found at all sample sites that non-migratory species were found.

Native fish spawning areas have not been included in this assessment of native fish values, but would be a useful inclusion. Spawning areas for inanga have been identified recently by WRC and this work should be extended to include spawning areas for other native fish.

4.4 Vulnerable river reaches for native fish (see also Section 4.6)

Fish are vulnerable to instream changes such as floodgates, river alignment, water abstraction, weirs, culverts *etc*., particularly if any of their life stages are migratory. Fish are also vulnerable to any catchment changes that might affect their habitat, such as forest removal, wetland drainage, roading *etc*.

The ranking system developed for migratory native fish in Figure 3 can be used to determine vulnerable reaches for native fish. Because the land use status of any area falling outside the native forest and scrub zone was unknown, it was considered to be potentially more vulnerable to changes that might ultimately affect fish. This approach assumes that native forest and scrub zones have no potential for any immediate change in status. This approach also offers a worst case scenario, as it does not recognise the value of any other land use category. Exotic forest and low intensive pastoral farming catchments can also have important values providing there is a reasonable degree of native riparian vegetation or protection. These could be among the first land use categories worth determining for further analysis with the GIS.

An example of a vulnerable river reach is the highly ranked Waikanae River (3), where the reach flows outside of the native forest and scrub zone (Figure 3). The worst effect on migratory fish would be a structure, discharge or flow alteration that affected their ability to gain access upstream. However any alteration to habitat in the lower reach has the potential to affect the value of the

Waikanae for native fish. A highly ranked river that is not as vulnerable as the Waikanae, is the Orongorongo, which has most of its catchment protected by native forest and scrub.

4.5 Ranking river reaches for sports fish

Two GIS files have been made; one depicting angling importance, categorised into high, medium and low (Figure 4); the second file depicts those reaches of known importance for trout spawning and rearing (Figure 5).

Angling importance categories shown in Figure 4 were derived from a blend of information on relative angler use and the quality of the angling experience. Angling experience was in turn a blend of: proximity to home, ease of access, remoteness, scenery, water quality, catch rate, size of fish and uniqueness. In other words, the most important fishery would be one that enabled lots of anglers to fish it successfully but provided a feeling of solitude, was close to home, easily accessed and had clear water and beautiful scenery.

Important trout spawning and rearing reaches shown in Figure 5, are useful baselines, but will require a lot more addition and fine-tuning. Because known spawning sites in the WRC district are generally small and seemingly insignificant, it can be assumed that this is characteristic of most rivers throughout the district. While small pockets of spawning appear insignificant when viewed at the reach scale, collectively the contribution to the fishery they support can be quite significant. In fact not having spawning limited to just one or two reaches in any river system keeps the trout population more resilient to events such as floods and droughts. This is an important concept to keep in mind when looking at the tributaries of trout rivers not presently categorised.

There are a number of rivers that have not been categorised for sports fish. Future assessments need to distinguish between those that have values and those that have none. For example, there are several rivers on the east coast that are reputed to have received trout liberations (Peter Taylor pers. comm.), but the current status of these fish populations is unknown (Figure 4 and Appendix l.9). A survey of the relative value of Wellington rivers to New Zealand anglers (Richardson *et al.* 1984), also has no mention of trout fisheries from the east coast of the Wellington Region.
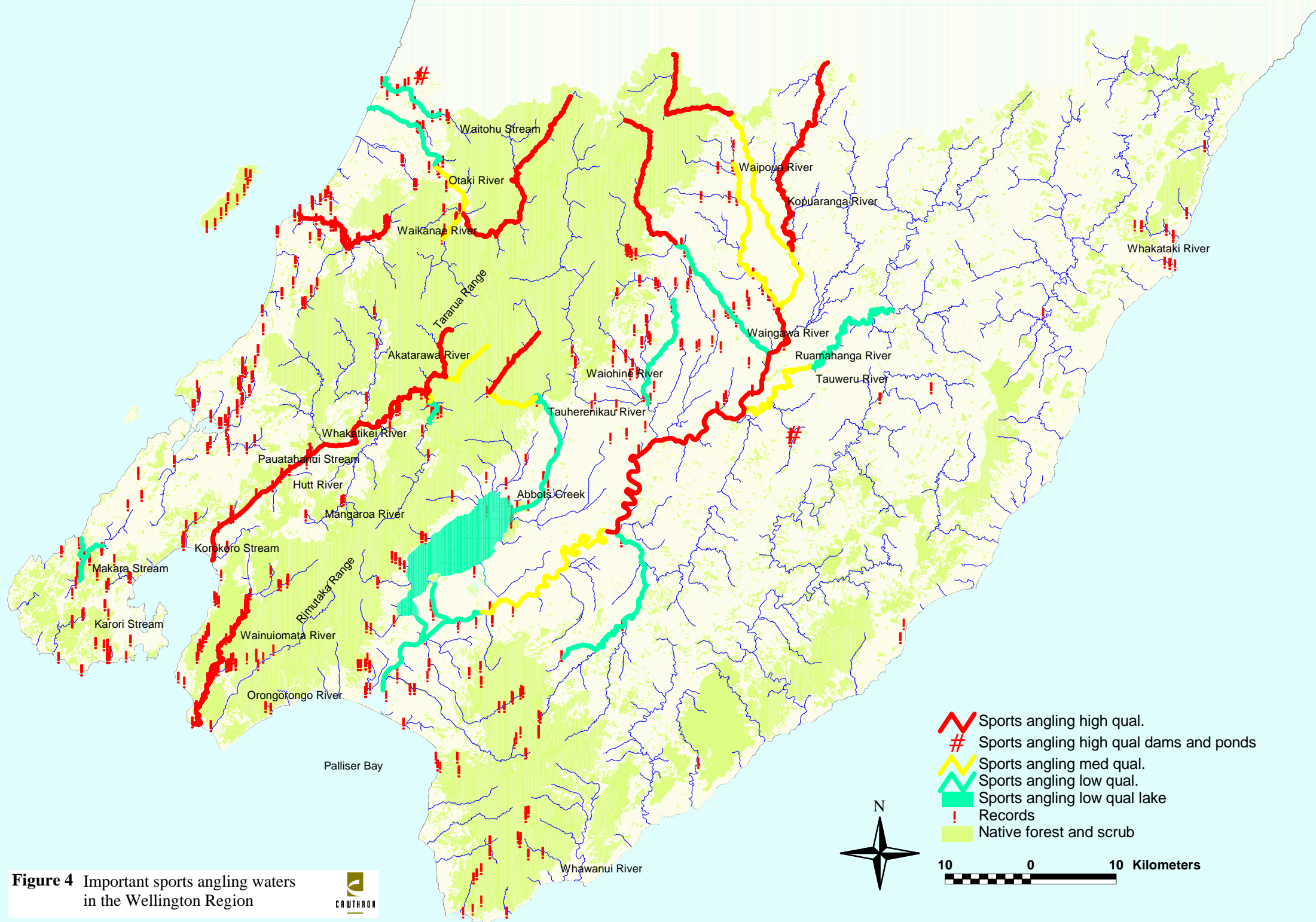
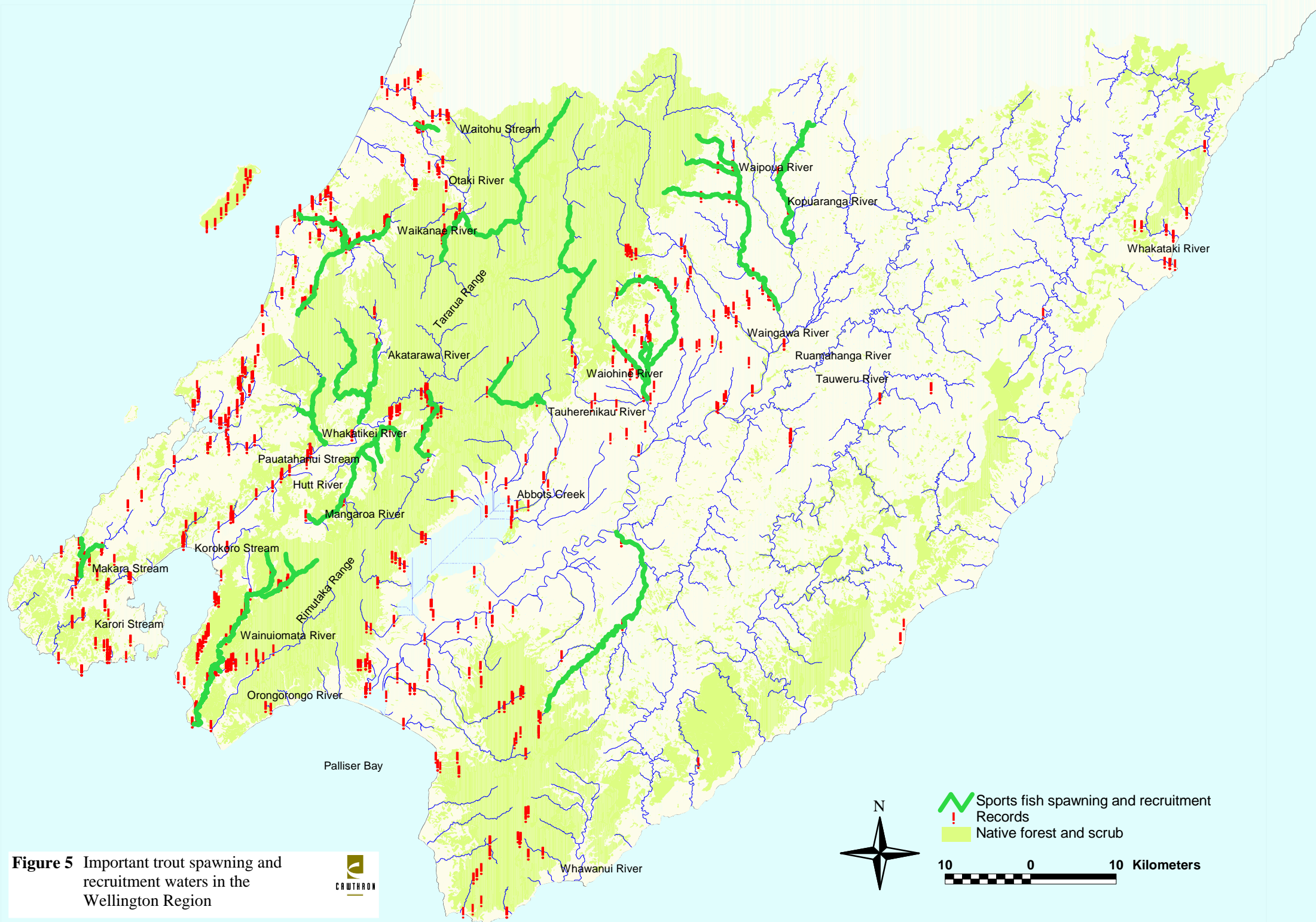**Figure 4** Important sports angling waters in the Wellington Region

Legend:
- Sports angling high qual.
- Sports angling high qual dams and ponds
- Sports angling med qual.
- Sports angling low qual.
- Sports angling low qual lake
- Records
- Native forest and scrub

Labels on map:
Waitohu Stream, Otaki River, Waikanae River, Tararua Range, Akatarawa River, Whakatikei River, Pauatahanui Stream, Hutt River, Mangaroa River, Korokoro Stream, Makara Stream, Karori Stream, Rimutaka Range, Wainuiomata River, Orongorongo River, Palliser Bay, Whawanui River, Tauherenikau River, Abbots Creek, Waiohine River, Waingawa River, Ruamahanga River, Tauweru River, Waipoua River, Kopuaranga River, Whakataki River

Scale: 10 0 10 Kilometers

N (compass)

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Figure 5 Important trout spawning and recruitment waters in the Wellington Region

Labels on map:
- Waitohu Stream
- Otaki River
- Waikanae River
- Tararua Range
- Akatarawa River
- Whakatikei River
- Pauatahanui Stream
- Hutt River
- Mangaroa River
- Korokoro Stream
- Makara Stream
- Karori Stream
- Rimutaka Range
- Wainuiomata River
- Orongorongo River
- Palliser Bay
- Waipoua River
- Kopuaranga River
- Waingawa River
- Ruamahanga River
- Tauweru River
- Waiohine River
- Tauherenikau River
- Abbots Creek
- Whakataki River
- Whawanui River

Legend:
- Sports fish spawning and recruitment Records
- Native forest and scrub

N

10   0   10   Kilometers

4.6 Combining sports fish and native fish rankings

An indication of the full value of any river system to fish can be achieved by combining the information in Figures 3, 4 and 5 as overlays. For example Figure 6 was produced by combining reaches that include more than 5 migratory native species and threatened native species (Figure 3), with high quality angling reaches (Figure 4) and sports fish spawning and rearing reaches (Figure 5). This is one way of ascertaining the most significant reaches for fish based on sampling to date.

A similar approach to assessing vulnerability as that described in Section 4.4 could be used for the reaches highlighted in Figure 6. Once again, those portions of the reach falling outside native forest and scrub zones could be considered the most vulnerable.
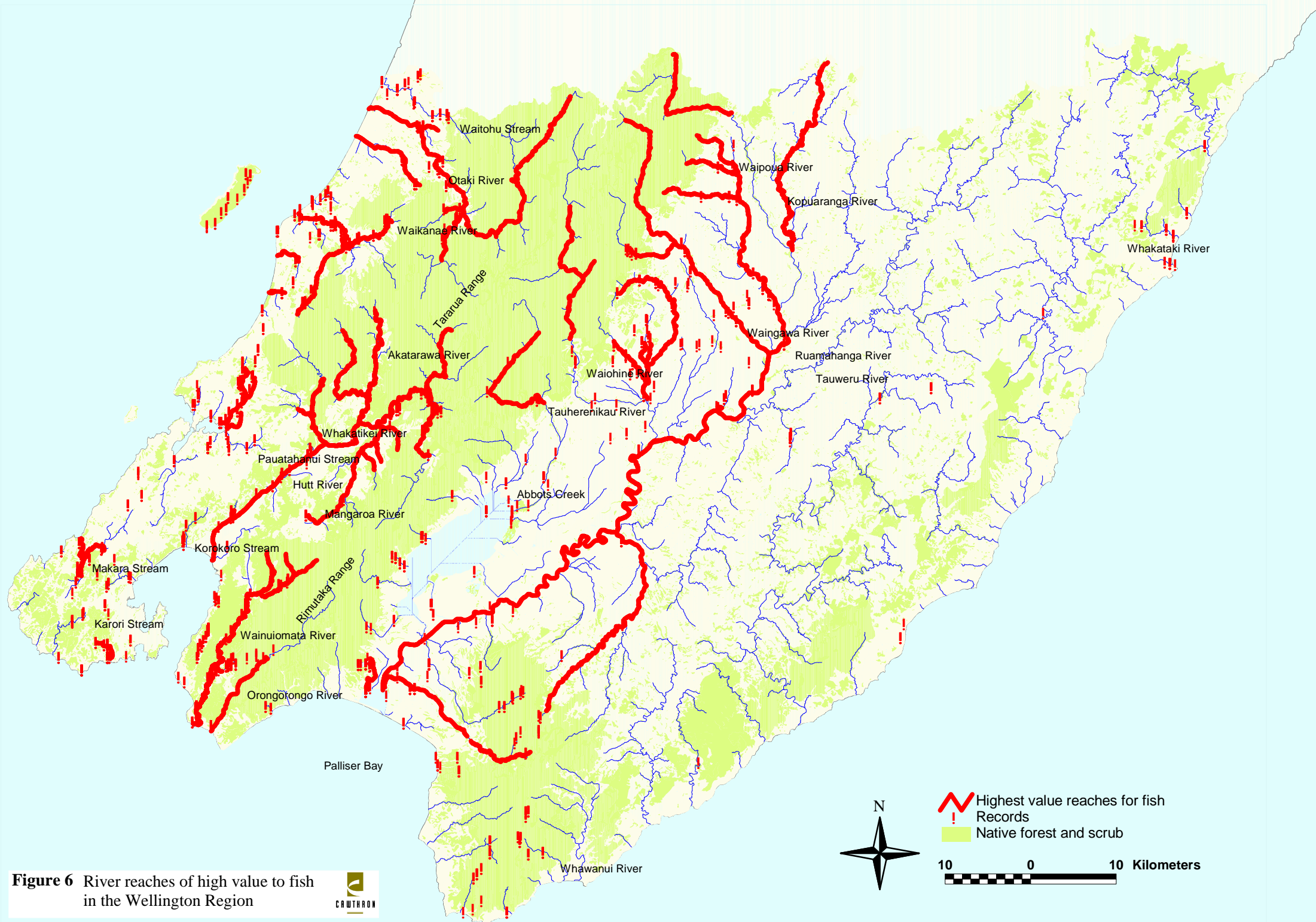
Figure 6 River reaches of high value to fish in the Wellington Region

Legend:
- Highest value reaches for fish
- Records
- Native forest and scrub

Labels on map:
Waitohu Stream, Otaki River, Waikanae River, Tararua Range, Akatarawa River, Whakatikei River, Pauatahanui Stream, Hutt River, Mangaroa River, Korokoro Stream, Makara Stream, Karori Stream, Rimutaka Range, Wainuiomata River, Orongorongo River, Palliser Bay, Whawanui River, Waiohine River, Tauherenikau River, Abbots Creek, Waipoua River, Kopuaranga River, Waingawa River, Ruamahanga River, Tauweru River, Whakataki River

5. WHERE TO NEXT?

1. Figure 1 indicates rivers and streams within the WRC district that have been sampled. Most rivers and streams not sampled have had sufficient fish sampling done in similar catchments adjacent to them to allow some extrapolation of existing information. The most obvious exceptions to this are the streams along the east coast. Therefore sampling a representative selection of east coast streams would fill this obvious gap.

2. To be sure that data from the NZFFD is applicable to present day conditions follow up surveys will be necessary, particularly where it is suspected land use change has occurred since the record date. For sites with a time series of records that show a change in species community composition, it may be possible to detect the cause of change, which could be change in land use.

3. It would be useful to have more land use detail in the GIS. This will allow the future impact assessment of land use change on any change to fish communities. It may also allow better catchment comparisons based on land use from which more accurate extrapolation of fish presence and absence could be determined.

4. Because less than 10 percent of the Region's original wetlands remain, remnant pockets of wetland should be highly valued and the status of brown mudfish in them checked.

5. Given the high percentage of migratory freshwater fish in the WRC rivers, it would be useful to create a GIS file that identifies access barriers, with an estimate of which species the barriers pose problems for. This assessment should include manmade (weirs, culverts, bridge aprons *etc*.) and natural (waterfalls and significant changes in elevation) barriers.

6. GIS files should be created for native fish spawning areas. Spawning areas for inanga have been identified recently by WRC and this work should be extended to include spawning areas for other native fish.

7. There are a number of rivers that have not been categorised for sports fish. To add more value to Figure 4, future assessments need to distinguish between those that have values and those that have none.

8. The value of the GIS files created for this report and the accompanying data set can only be improved with additional land use files and with continual updating. Consequently this is merely a baseline from which to start a ground-truthing programme.

6.   ACKNOWLEDGEMENTS

7.   REFERENCES

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Richardson, J.; Teirney, L. D.; Unwin, M. J. 1984. The relative value of Wellington rivers to New Zealand anglers. *N.Z. Ministry of Agriculture and Fisheries, Fisheries Environmental Report No. 40.* 73p.

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Appendix 1

Fish distribution maps for the Wellington Region from records contained on the NZFFD as at June 2001.

Appendix 1.1 Distribution of longfin, shortfin and unidentified eels.
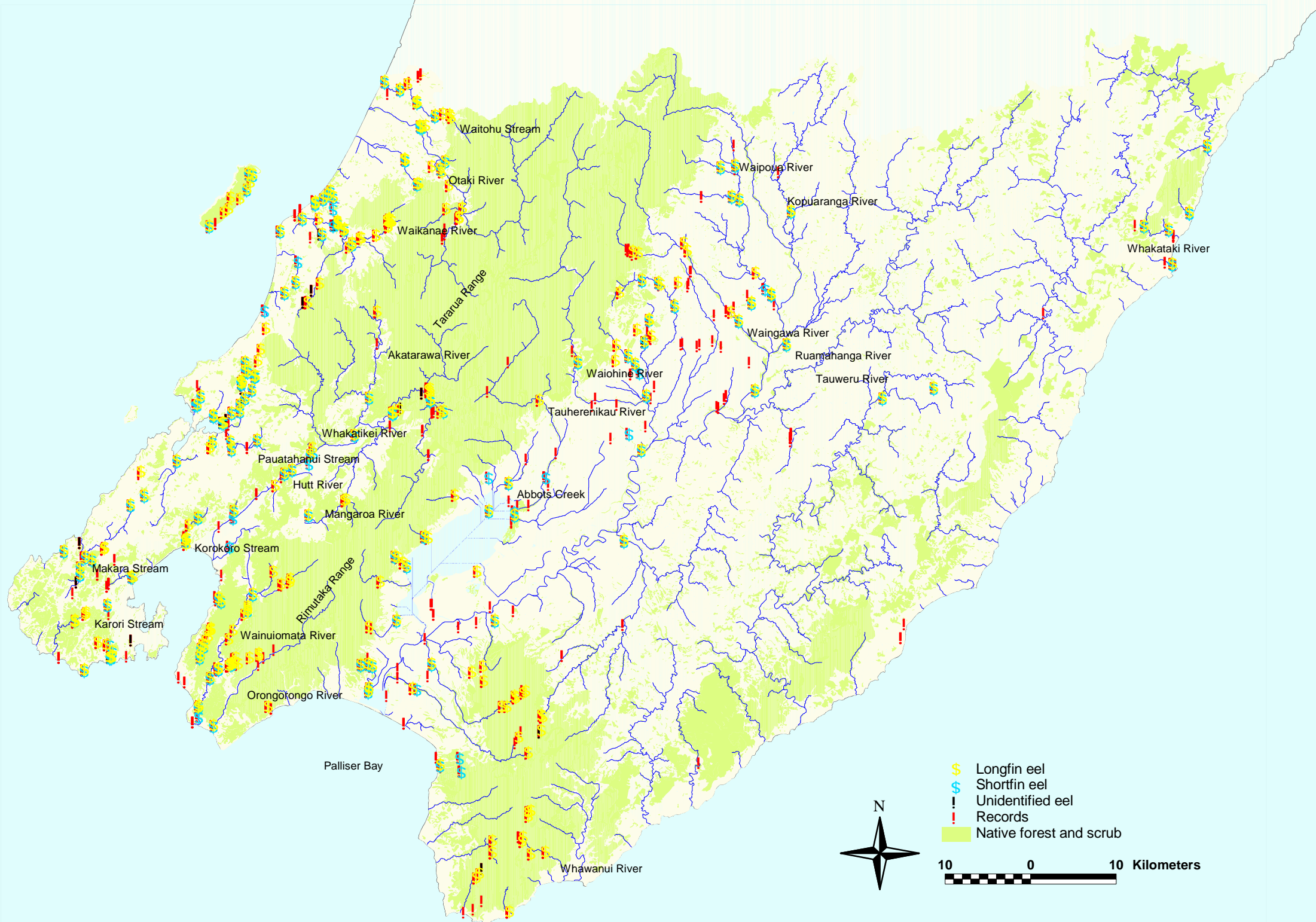
Waitohu Stream
Otaki River
Waikanae River
Tararua Range
Akatarawa River
Whakatikei River
Pauatahanui Stream
Hutt River
Mangaroa River
Korokoro Stream
Makara Stream
Karori Stream
Rimutaka Range
Wainuiomata River
Orongorongo River
Palliser Bay
Whawanui River

Waipoua River
Kopuaranga River
Waingawa River
Ruamahanga River
Tauweru River
Waiohine River
Tauherenikau River
Abbots Creek
Whakataki River

$ Longfin eel
$ Shortfin eel
! Unidentified eel
! Records
  Native forest and scrub

N

10   0   10   Kilometers

Appendix 1.2 Distribution of banded, giant, shortjaw and unidentified kokopu.
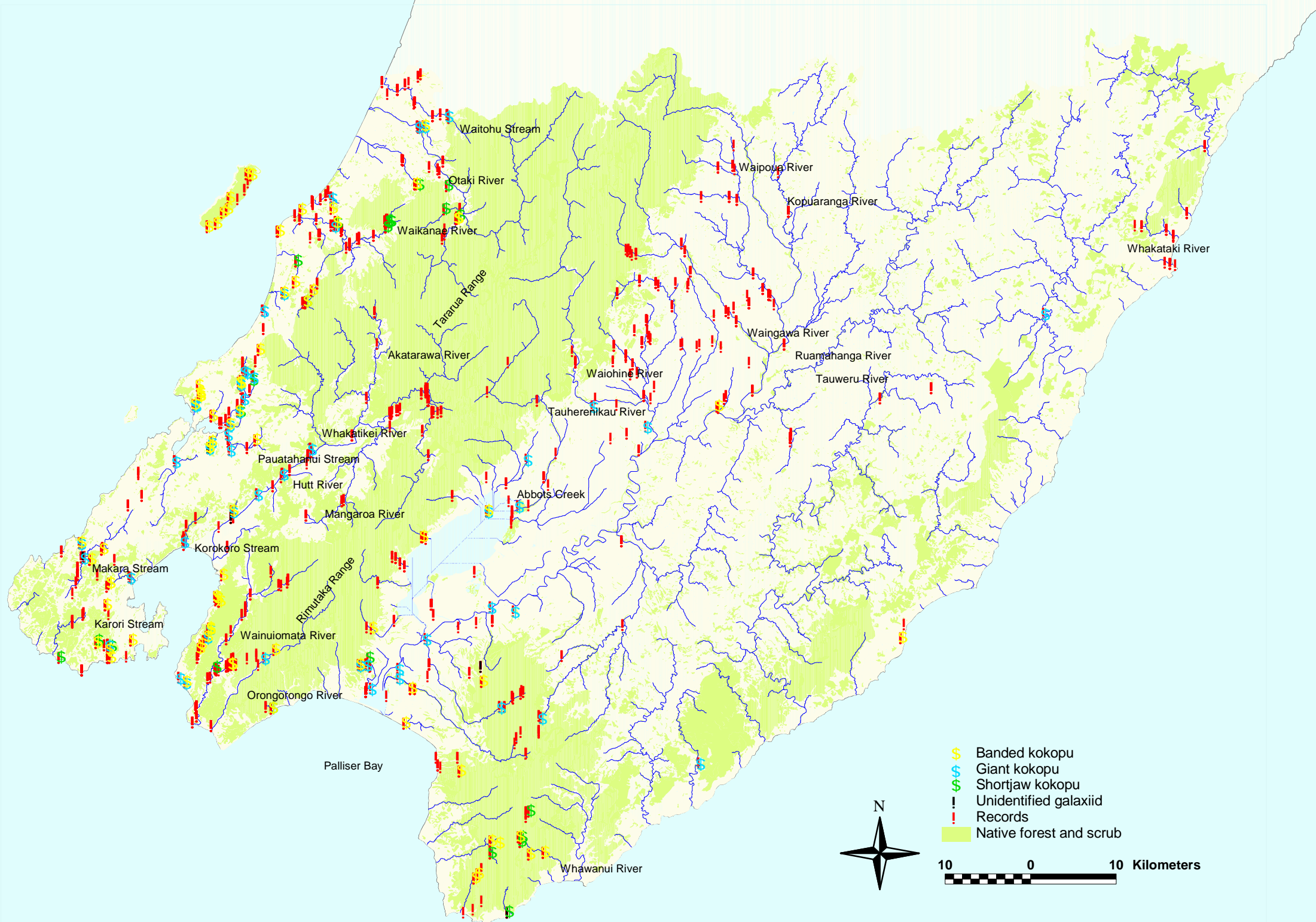
Waitohu Stream

Waipoua River

Otaki River

Kopuaranga River

Waikanae River

Whakataki River

Tararua Range

Akatarawa River

Waingawa River

Ruamahanga River

Waiohine River

Tauweru River

Tauherenikau River

Whakatikei River

Pauatahanui Stream

Hutt River

Abbots Creek

Mangaroa River
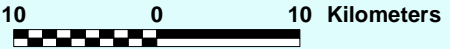
Korokoro Stream

Makara Stream
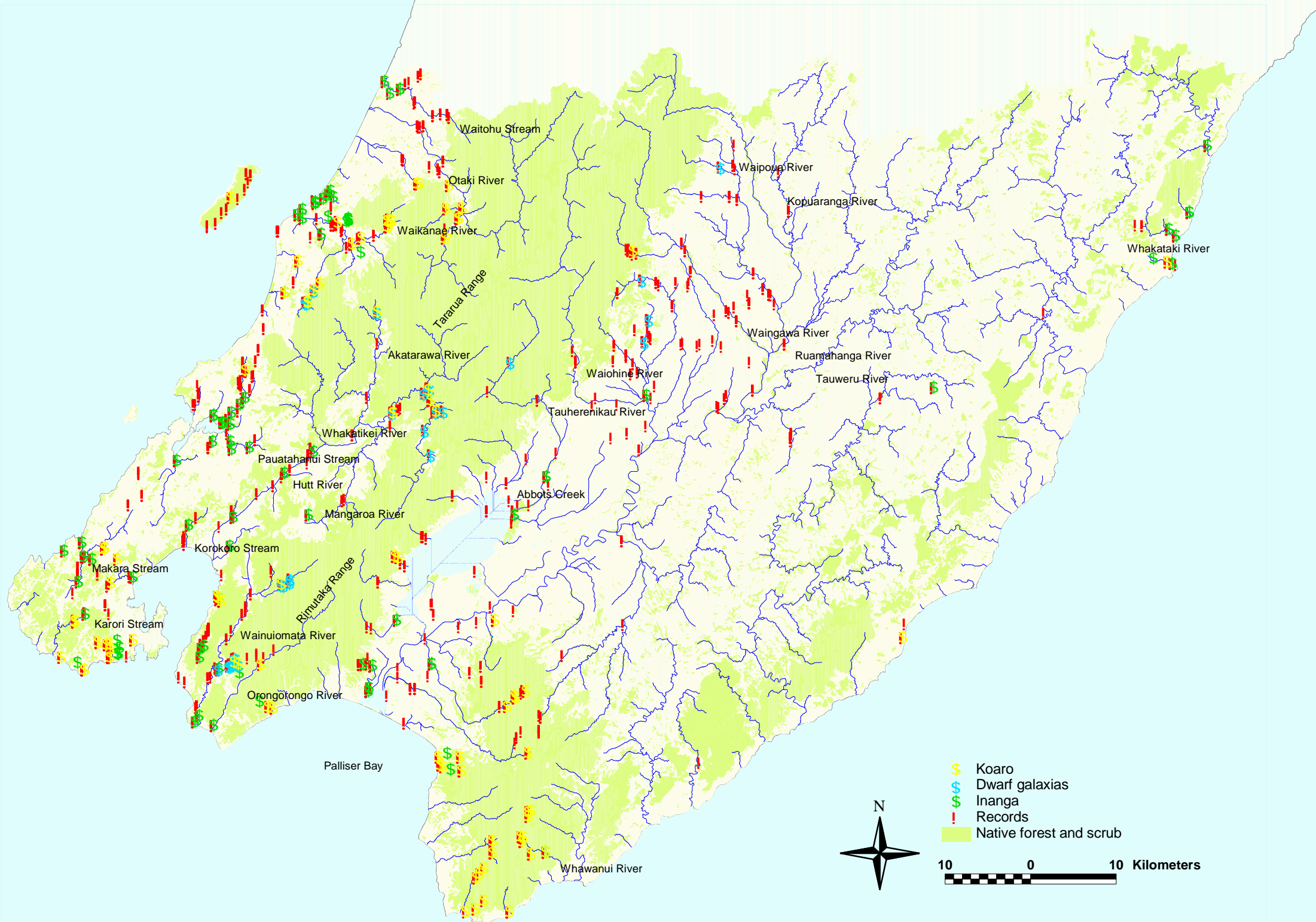
Rimutaka Range

Karori Stream

Wainuiomata River

Orongorongo River

Palliser Bay

Whawanui River

$ Banded kokopu
$ Giant kokopu
$ Shortjaw kokopu
! Unidentified galaxiid
! Records
Native forest and scrub

N

10   0   10   Kilometers

Appendix 1.3 Distribution of koaro, dwarf galaxias and inanga.

Waitohu Stream
Otaki River
Waikanae River
Waipoua River
Kopuaranga River
Tararua Range
Akatarawa River
Waingawa River
Ruamahanga River
Waiohine River
Tauweru River
Whakatikei River
Tauherenikau River
Pauatahanui Stream
Hutt River
Abbots Creek
Mangaroa River
Korokoro Stream
Makara Stream
Rimutaka Range
Karori Stream
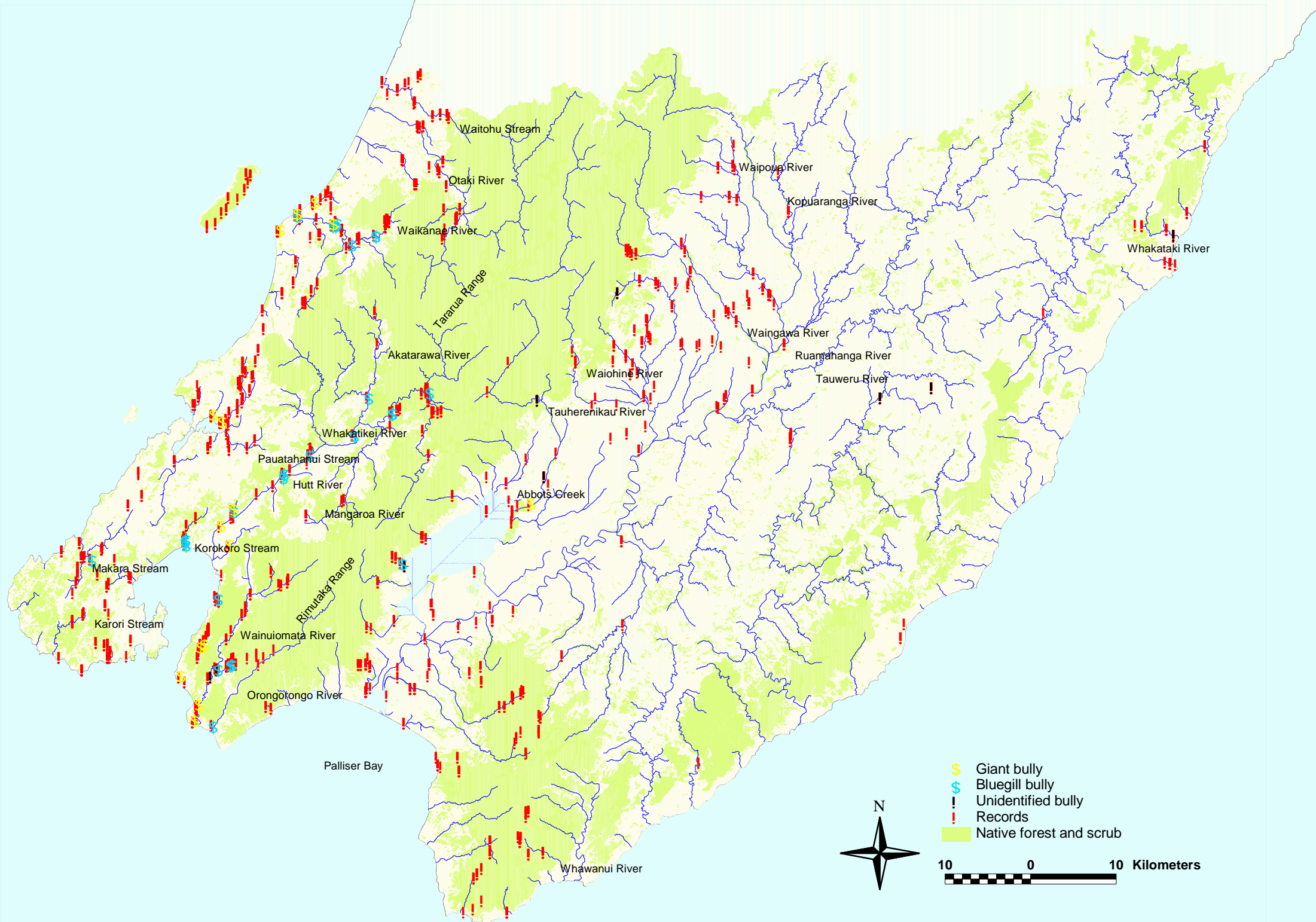Wainuiomata River
Orongorongo River
Palliser Bay
Whawanui River
Whakataki River

Koaro
Dwarf galaxias
Inanga
Records
Native forest and scrub

N

10   0   10 Kilometers

Appendix 1.4 Distribution of giant, bluegill and unidentified bullies.

Appendix 1.5 Distribution of redfin and common bullies.

Map legend:
- Redfin bully
- Common bully
- Records
- Native forest and scrub

Labelled features: Waitohu Stream, Otaki River, Waikanae River, Tararua Range, Akatarawa River, Whakatikei River, Pauatahanui Stream, Hutt River, Mangaroa River, Abbots Creek, Korokoro Stream, Makara Stream, Karori Stream, Rimutaka Range, Wainuiomata River, Orongorongo River, Palliser Bay, Whawanui River, Waipoua River, Kopuaranga River, Whakataki River, Waingawa River, Ruamahanga River, Tauweru River, Waiohine River, Tauherenikau River

Scale: 10 — 0 — 10 Kilometers

Appendix 1.6 Distribution of Cran's and upland bullies.

Waitohu Stream
Otaki River
Waikanae River
Waipoua River
Kopuaranga River
Whakataki River
Tararua Range
Akatarawa River
Waingawa River
Ruamahanga River
Waiohine River
Tauweru River
Tauherenikau River
Whakatikei River
Pauatahanui Stream
Hutt River
Abbots Creek
Mangaroa River
Korokoro Stream
Makara Stream
Rimutaka Range
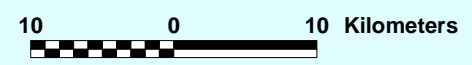Karori Stream
Wainuiomata River
Orongorongo River
Palliser Bay
Whawanui River

$ Cran's bully
$ Upland bully
! Records
Native forest and scrub

N

10   0   10   Kilometers

Appendix 1.7 Distribution of torrentfish, lamprey and common smelt.

Waitohu Stream

Otaki River

Waipoua River

Kopuaranga River

Waikanae River

Whakataki River

Tararua Range

Akatarawa River

Waingawa River

Ruamahanga River

Waiohine River

Tauweru River

Tauherenikau River

Whakatikei River

Pauatahanui Stream

Hutt River

Mangaroa River

Abbots Creek

Korokoro Stream

Makara Stream

Rimutaka Range

Karori Stream

Wainuiomata River

Orongorongo River

Palliser Bay

Whawanui River

Legend

$ Torrentfish
$ Lamprey
! Common smelt
! Records
Native forest and scrub

N

10   0   10 Kilometers

Appendix 1.8 Distribution of brown mudfish and wetlands.
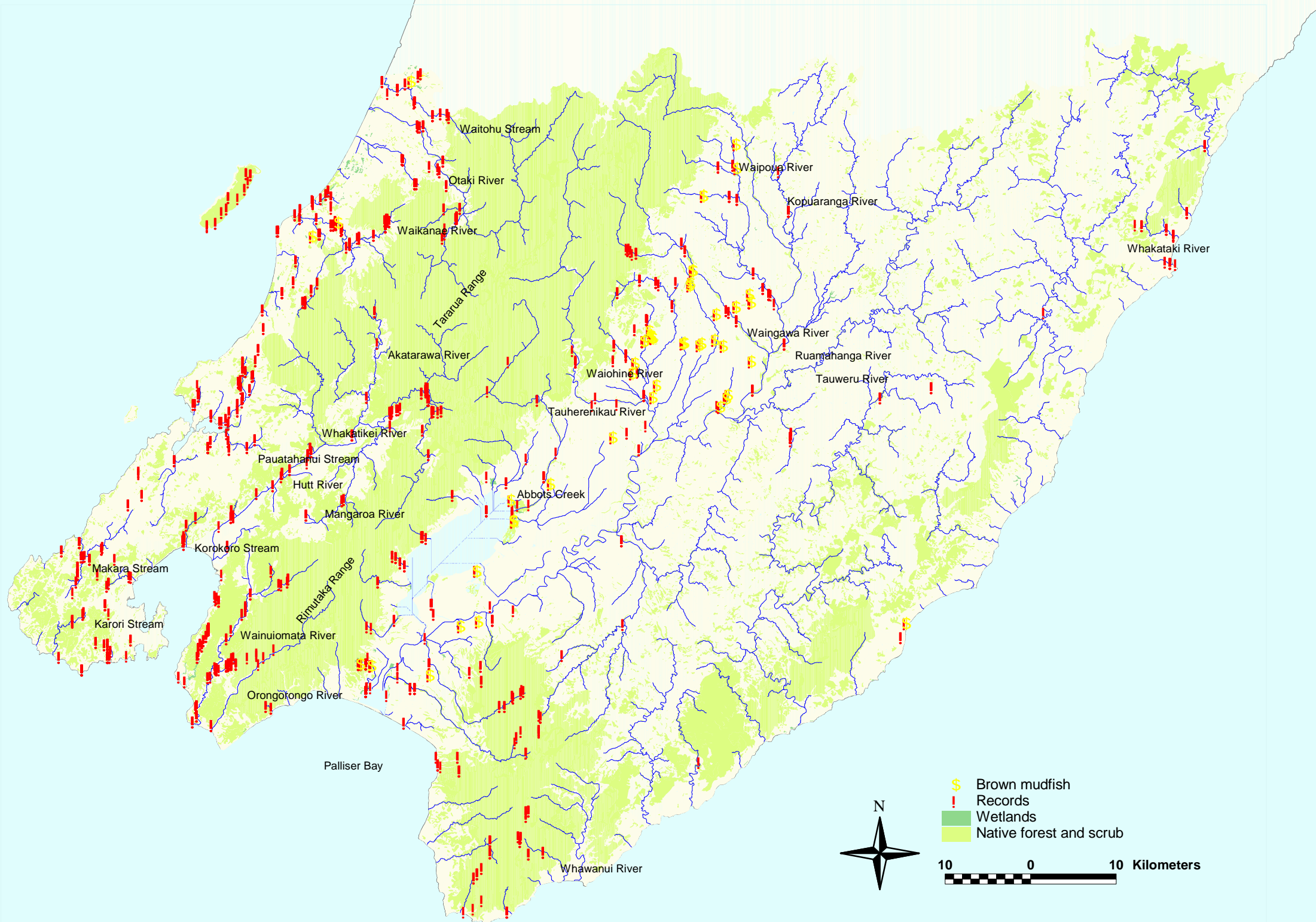
Appendix 1.9 Distribution of brown, rainbow and unidentified trout.

Waitohu Stream

Otaki River

Waikanae River

Waipoua River

Kopuaranga River

Whakataki River

Tararua Range

Akatarawa River

Waingawa River

Ruamahanga River

Waiohine River

Tauweru River

Whakatikei River

Tauherenikau River

Pauatahanui Stream

Abbots Creek

Hutt River

Mangaroa River

Korokoro Stream

Makara Stream

Rimutaka Range

Karori Stream

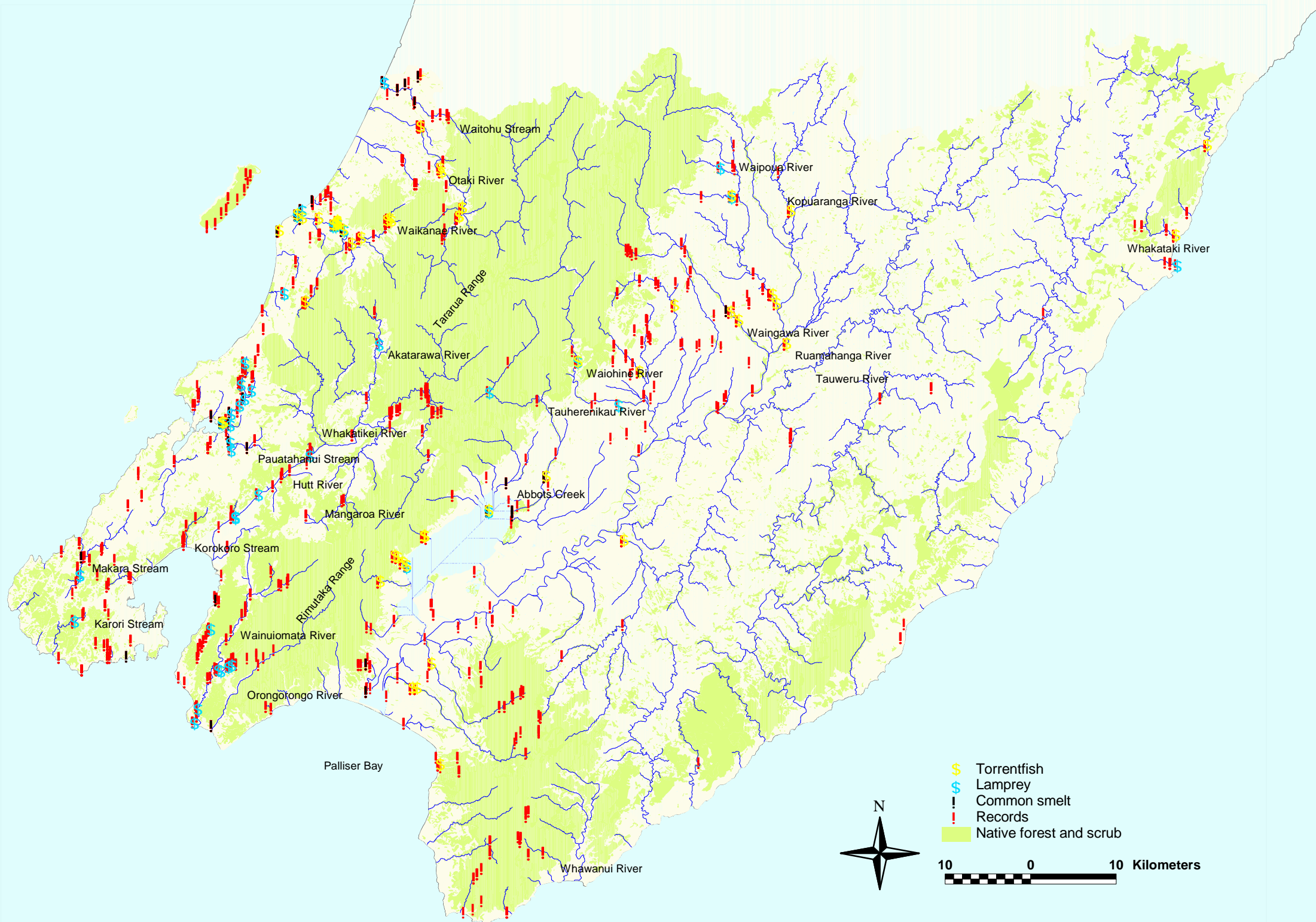Wainuiomata River

Orongorongo River

Palliser Bay

Whawanui River

Brown trout
Rainbow trout
Unidentified salmonid
Records
Native forest and scrub

N

10   0   10   Kilometers

Appendix 1.10 Distribution of perch, rudd and tench.

Waitohu Stream
Otaki River
Waikanae River
Waipoua River
Kopuaranga River
Whakataki River
Tararua Range
Akatarawa River
Waingawa River
Ruamahanga River
Waiohine River
Tauweru River
Tauherenikau River
Whakatikei River
Pauatahanui Stream
Hutt River
Abbots Creek
Mangaroa River
Korokoro Stream
Makara Stream
Rimutaka Range
Karori Stream
Wainuiomata River
Orongorongo River
Palliser Bay
Whawanui River

$ Perch
$ Rudd
! Tench
! Records
Native forest and scrub

N

10   0   10   Kilometers

Appendix 1.11 Distribution of black flounder, yelloweye and grey mullet and triplefins.

Waitohu Stream

Otaki River

Waikanae River

Waipoua River

Kopuaranga River

Whakataki River

Tararua Range

Akatarawa River

Waingawa River

Ruamahanga River

Waiohine River

Tauweru River

Tauherenikau River

Whakatikei River

Pauatahanui Stream

Hutt River

Abbots Creek

Mangaroa River

Korokoro Stream

Makara Stream

Rimutaka Range

Karori Stream

Wainuiomata River

Orongorongo River

Palliser Bay

Whawanui River

$ Black flounder
$ Yelloweye mullet
$ Grey mullet
! Unidentified triplefin
! Records
Native forest and scrub

N

10   0   10   Kilometers