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FISHERIES ENVIRONMENTAL REPORT NO. 24

SUBMISSION ON

THE WANGANUI RIVER

FLOW MANAGEMENT PLAN

FISHERIES RESEARCH DIVISION
MINISTRY OF AGRICULTURE AND FISHERIES
WELLINGTON

Report to: Rangitikei-Wanganui Catchment Board

SUBMISSION ON
THE WANGANUI RIVER
FLOW MANAGEMENT PLAN

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1. INTRODUCTION

In August 1982, Fisheries Research Division (FRD) received from the Rangitikei-Wanganui Catchment Board (RWCB) a flow management plan for the Wanganui River (RWCB 1982). FRD is concerned that the proposed management plan is unsuitable for fisheries. This submission discusses the implications of the proposed plan on the fish and fisheries values of the Wanganui River, and outlines alternative minimum flows adequate for maintenance of fisheries.

Under the Fisheries Act (1908), FRD has responsibility for research and advisory functions related to freshwater fish and fishery values. The Ministry of Agriculture and Fisheries as a whole also has responsibility for management of these resources. This submission is made in respect of these responsibilities. FRD has recently undertaken extensive investigations of the Manganui-a-te-Ao and Whakapapa Rivers within the Wanganui system, and is thus able to make recommendations concerning fisheries values on the basis of both field data and general fisheries experience.

FRD is concerned that the RWCB report has failed to recognise the multiplicity and extent of fisheries values associated with the Wanganui River, and as a consequence, the report has recommended a set of minimum flows which would have an adverse impact on fish and fisheries throughout the Wanganui River system.

The means by which controlled flows would or could be achieved are not discussed in the RWCB report, but because of an historical interest in the Wanganui River for hydro-electric development, it is probable that power generation would be one of the methods. While the 1981 Amendment to the Water and Soil Conservation Act (1967), has the power to protect rivers from development (as mentioned in RWCB (1982), p.11), the legislation has yet to be tested. There is no certainty that a river, even one with a strong case for protection,

will necessarily have protection granted. Thus the possibility of damming the Wanganui River still remains an issue from FRD's point of view. If this were the case, the effects on fish and fisheries could be more accurately predicted. However, until details of proposals to alter the natural flow regime of the Wanganui River are known, evaluation of hypothetical sets of flows outside the natural regime is difficult from the fisheries viewpoint.

Though the RWCB report recognises that brown and rainbow trout provide a fishery, no mention is made of 18 other fish species found in the Wanganui River or the fisheries values associated with them. In addition, the Wanganui River supports commercial fisheries significant to the livelihood of fishermen, as well as traditional Maori fisheries, which are now rare, and of increasing cultural importance. Together these fisheries and the fish upon which they depend constitute an outstanding national resource.

The proposed flow management plan makes no mention of fisheries and fish fauna as a whole, but rather focuses primarily on trout fisheries, in a very general way. If the overall fisheries values of the river had been considered, along with the diverse needs of the various fish species, the flow recommendations could have been quite different.

While the flow recommendations reflect a failure to consider the diverse fisheries values or their importance, the most serious aspect from a fisheries viewpoint concerns the way in which a 16 m^3/s minimum flow was derived. RWCB (1982) (Section 6.1, No. 2, p.9) suggested two flow options: a 16 m^3/s minimum flow; and a proportional flow. In the recommendations, the 16 m^3/s minimum flow is discussed and eventually decided on as adequate, but the option of a minimum flow based on a proportion of the natural flow is not discussed.

From the fisheries viewpoint, proportional flows are desirable, as they reflect the natural situation to which the fish species and their populations are adapted. FRD is concerned that the merits of a proportional flow have not been discussed fully, despite being considered an option earlier in the

report. Furthermore, once having arrived at a figure of 16 m^3/s (which appears to be based largely on a compromise between navigability by canoeists and financial considerations), the report does not explore the implications of such a minimum flow on fisheries. The RWCB (1982) assumed that minimum flows which will satisfy canoeists and rafters will also maintain fisheries at their present level. This is not necessarily so and FRD's submission seeks to rectify the lack of fisheries considerations in setting a minimum flow for the Wanganui River.

Further inadequacies occur in the section in the report dealing with river values. The RWCB's (1982) assessment of recreational values (Figure 2 in the report) has been made purely from the viewpoint of two canoeists (Egarr and Egarr 1981). FRD notes that angling is also a form of recreation, which has a wide range of activities associated with it, including camping, tramping, tubing, picnicking and swimming. Thus Figure 2 in the report should be retitled "Assessment of canoeing values", because it is limited to this. The report has not fully addressed the wider issue of recreation.

Similarly, the scenic evaluation also has been made from a limited viewpoint. For example, Egarr and Egarr (1981) did not describe the most breathtaking section of the Manganui-a-te-Ao River - a deeply entrenched gorge beginning below the confluence of the Makatote Stream and the Manganui-a-te-Ao, and upstream of the popular Ruatiti Domain (Fig. 1). The journey through this gorge, though arduous, passes through spectacular scenery. However, this section has been given only an "impressive" rating in RWCB's report. FRD recommends that the gorge section be rated "exceptional".

Therefore, FRD's submission has been prepared:

1. to emphasise aspects of the fisheries values which are inadequately dealt with by the RWCB (1982), and

2. to recommend a flow regime which would protect the fish and fisheries of the Wanganui River and its tributaries.

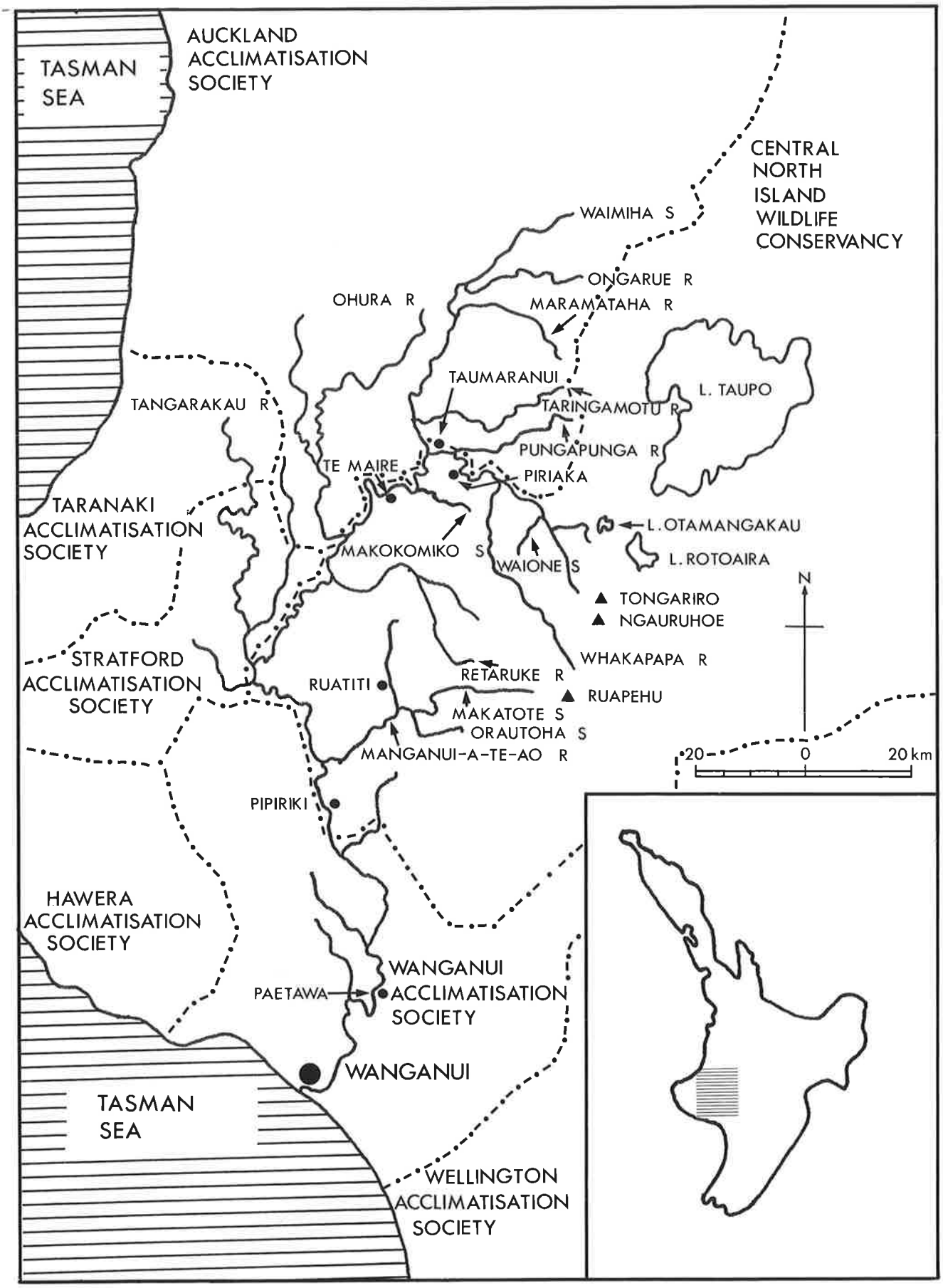

FIGURE 1. The Wanganui River system and acclimatisation districts through which it flows.

2. THE FISH AND FISHERIES

2.1 Fish Species and Their Distribution

The Wanganui River and its tributaries are shown in Figure 1. Twenty species of fish have been recorded in the Wanganui River system (Table 1). Two species of large invertebrate, koura (*Paranephrops planifrons*) and the freshwater shrimp (*Paratya curvirostris*) are also widespread. Many of these species (65%) migrate between the sea and freshwater at some stage during their life history, and most penetrate inland to well upstream of Taumaranui.

Distribution of the fish species in the Wanganui River is shown in Table 2. This distribution must not however be considered exclusive because most of the Wanganui River catchment has not been the subject of fisheries surveys. In addition, koura occur in the Manganui-a-te-Ao, Retaruke, and Whakapapa Rivers, and Te Maire, Taringamotu, and Waimiha Streams, and shrimps occur in the Wanganui River upstream from the sea as far as Paetawa.

Migrations are important for the survival of many New Zealand fish species, and some, such as lampreys, smelt and whitebait (juvenile galaxiids) are entirely dependent on the migratory phase of their life cycle for their distribution. Currently, the Wanganui River provides traditional, commercial and recreational fisheries (Table 3), which have been described by Cudby and Strickland (in press). The biology and a brief description of the fishery of each species follows.

2.2 Lampreys

Adult lampreys migrate from the sea into freshwater during autumn and winter months, while high river levels prevail. It is most likely that spawning takes place in sand and gravels of small bush tributaries, after which the adults die. After spending several years inhabiting the silty backwaters of rivers and streams, juveniles migrate to sea in late autumn and winter.

Todd (1979) reported that at Pipiriki (Fig. 1), Maori people still

TABLE 1. Fish of the Wanganui River system.

Scientific Name	Common Name
+ * *Salmo trutta*	Brown trout
+ *Salmo gairdnerii*	Rainbow trout
* *Geotria australis*	Lamprey
* *Anguilla australis*	Shortfinned eel
* *Anguilla dieffenbachii*	Longfinned eel
* *Retropinna retropinna*	Common smelt
* *Galaxias fasciatus*	Banded kokopu
* *Galaxias postvectis*	Shortjawed kokopu
* *Galaxias maculatus*	Inanga
* *Galaxias brevipinnis*	Koaro
* *Cheimarrichthys fosteri*	Torrentfish
* *Gobiomorphus huttoni*	Redfinned bully
* *Gobiomorphus cotidianus*	Common bully
Gobiomorphus breviceps	Upland bully
Gobiomorphus basalis	Cran's bully
° *Aldrichetta forsteri*	Yelloweyed mullet
° *Mugil cephalus*	Grey mullet
° *Arripis trutta*	Kahawai
* *Rhombosolea retiaria*	Black flounder
° *Rhombosolea leporina*	Yellowbelly flounder

* migratory species

\+ introduced species

° estuarine species

TABLE 2. Known fish distribution in the Wanganui River.

River Reach / Fish Species	Wanganui River - Estuary	Wanganui River - Paetawa	Wanganui River - Pipiriki	Manganui-a-te-Ao River	Retaruke River	Te Maire Stream	Taringamotu Stream	Whakapapa River	Waimiha Stream
Brown trout	+	+	+	+	+	+	+	+	+
Rainbow trout				+	+	+	+	+	+
Lamprey	+	+	+	+	+	+			
Shortfinned eel	+	+	+	+	+	+	+	+	
Longfinned eel	+	+	+	+	+	+	+	+	+
Common smelt	+	+	+	+	+	+	+		+
Banded kokopu	+	+	+	+					
Shortjawed kokopu	+	+	+	+	+	+			
Inanga	+	+	+	+	+	+	+		+
Koaro	+	+	+	+	+				
Torrentfish	+	+	+	+	+	+		+	
Redfinned bully	+	+	+	+					
Common bully	+	+	+	+	+				
Upland bully							+	+	
Cran's bully				+	+		+	+	
Yelloweyed mullet	+	+							
Grey mullet	+								
Kahawai	+								
Black flounder	+	+	+	+	+	+			
Yellowbelly flounder	+								

\+ present

TABLE 3. Fisheries of the Wanganui River.

Fish Species	Fishery		
	Traditional	Commercial	Recreational
Brown trout			*
Rainbow trout			*
Lamprey	*		
Shortfinned eel	*	*	*
Longfinned eel	*	*	*
Common smelt	*		*
Banded kokopu			*
Shortjawed kokopu			*
Inanga			*
Koaro			*
Yelloweyed mullet		*	*
Grey mullet			*
Kahawai			*
Black flounder		*	*
Yellowbelly flounder		*	*

catch lampreys using a weir (utu piharau), a system which originated before European settlement of New Zealand. Up to 600 lampreys may be caught on a good night, with a total season's catch amounting to several thousand. Lamprey weirs are built or maintained during low river levels, but lampreys are taken only during floods (Downes 1918), during the adult migration in spring. This fishery and the traditions attached to it are now unique to the Wanganui River.

2.3 Longfinned and shortfinned eels

Both longfinned and shortfinned eels migrate to sea to spawn during late summer and autumn, and their juveniles enter rivers in late winter and spring. Generally, shortfinned eels are found in abundance in the lower reaches of

rivers, while longfinned eels can penetrate very long distances inland, and as juveniles often climb high falls in search of suitable habitat. Only longfinned eels are found above the confluence of the Ongarue River and Waimiha Stream, but otherwise both species are well distributed throughout the Wanganui River and its tributaries. Both species are even found as far upstream as Lake Otamangakau, despite the intake dams of the Tongariro power scheme across the access to the lake.

Commercial eeling in New Zealand has an export value in the vicinity of four million dollars per annum (Todd 1981), but while it is based on wild stocks, the continued success of this industry depends on a sustained yield from existing fishing areas. To achieve this, eels must have adequate, suitable habitat, and access to it.

In the Wanganui area, approximately five full-time and 25 part-time commercial eelers are known to base their operations in the Wanganui River, but fishermen from other areas, such as Auckland, are known to operate large numbers of nets in the river from time to time. Up to 400 fyke nets may be used in the river at any one time (I.C. Stoneman pers. comm.). Some commercial eeling is also carried out in Lake Otamangakau and tributaries of the Wanganui such as the Ohura River.

Previously, the Maori people built large and elaborate weirs in the Wanganui River for trapping the downstream migration of adult eels (Downes 1918, Best 1929). Traditional methods, which employ the hinaki or eel basket, are still used in the Wanganui River (Koha 1982).

Recreational eeling takes place regularly throughout the Wanganui River and its tributaries, including Lake Otamangakau. Spears, gaffs, handlines and hinakis are the most common methods used.

2.4 Common smelt

Adult smelt migrate upstream from the sea into freshwater to spawn during early spring and summer. Spawning occurs in the lower areas of rivers, and

immediately after hatching the larvae are washed out to sea. Smelt are commonly found in shoals in the middle reaches of the Manganui-a-te-Ao River (Cudby and Strickland in press), and have been recorded in the Wanganui River well upstream of Taumaranui. Since part of the upstream migration of smelt occurs during the whitebait season, they are sometimes taken by recreational whitebaiters.

Hubbard (1979) reported the presence of a traditional smelt fishery in the Wanganui River, 80 kilometres upstream from the sea at Pipiriki. Maori people build blind diversion channels on the shallow boulder and shingle fans to trap these fish.

As well as providing food for human consumption, smelt form an important part of the food chain for larger fish, such as trout, and for various birds.

2.5 Banded kokopu

This fish begins its life cycle when the adults spawn in forest litter during floods (C.P. Mitchell pers. comm.), and the larvae hatch and are washed out to sea. Here they live for about six months until returning to freshwater in spring as whitebait. The whitebait find their way upstream into suitable adult habitats, often negotiating rapids and steep waterfalls by climbing wet rocky surfaces in the splash zone. Adults are most commonly found in small bush streams that offer cover by way of logs and overhung banks. This fish has been recorded by FRD in a headwater tributary of the Manganui-a-te-Ao River (Cudby and Strickland in press), and its distribution is likely to be wider throughout the Wanganui River system than indicated in Table 2.

Juveniles of this family of fish contribute to the Wanganui's important recreational whitebait fishery, which is described under "Inanga" below. In addition to banded kokopu, the shortjawed kokopu, koaro, and inanga also belong to the Family Galaxiidae and have 'whitebait' juveniles.

2.6 Shortjawed kokopu

The shortjawed kokopu is a rare species and very few locations of this

fish are known in New Zealand. Consequently, its biology and habitat requirements are not fully known, but indications are that it is similar in some respects to the banded kokopu (Cudby and Strickland in press). The shortjawed kokopu occurs in the Manganui-a-te-Ao River, and has been recorded in a smaller tributary, the Makokomiko Stream, upstream of Te Maire.

Juveniles return from the sea in spring as whitebait, but probably make a minor contribution to the whitebait fishery.

2.7 Inanga

This is the best known of the galaxiid species, and juvenile inanga are generally the most important species in the whitebait catch. The life history is well known (McDowall 1978). Inanga mature during their first summer in freshwater, and ripe adults migrate downstream to river estuaries in autumn, where spawning takes place during spring tides. During these high spring tides, grasses and rushes on the river banks are flooded and inanga shoals spawn amongst this vegetation. Eggs are washed down amongst the bases of grasses on the falling tide and remain out of water in the dampness of the grasses until hatching several weeks later, upon immersion during the next spring tide.

Larvae are washed out to sea and migrate back into freshwater as the familiar whitebait about six months later during spring. They form an important recreational fishery, along with juveniles of the other galaxiid species.

Whitebaiting is mostly carried out in the lower reaches of the Wanganui River. Up to one hundred people can be found whitebaiting at any one time in this area (I.C. Stoneman pers. comm.).

2.8 Koaro

Another whitebait species, the koaro is the second most abundant in the whitebait catch (McDowall 1978). Koaro have a life history pattern similar to that described for banded kokopu. Adult fish live in the swift rapids of streams, high up in unmodified catchments such as headwater areas of the Manganui-a-te-Ao and Retaruke Rivers.

2.9 Torrentfish

Very little is known about the biology of torrentfish. Spawning is thought to occur in the river during summer and early autumn and the eggs or larvae subsequently washed out to sea. Juveniles migrate upstream into freshwater in spring. Adults are commonly found in the tumbling broken water of riffles in the main river and larger tributaries. They are found as far upstream as the Whakapapa River in the Wanganui system.

Records of the Maori people netting these fish in the upper Wanganui River (Mair 1880) suggest that torrentfish were formerly abundant, but present day status of numbers or the persistence of a fishery are unknown.

2.10 Bullies

There are four species of bullies found in the Wanganui River - redfinned, common, upland and Cran's bully. All bullies belong to the genus *Gobiomorphus*, and spawn in freshwater near their adult habitat. Larvae of the redfinned and common bully are washed out to sea and migrate upstream in spring and summer. There is no marine stage for larvae of the upland and Cran's bully.

Redfinned and Cran's bullies generally live amongst rocks in pools and runs of gently to moderately flowing water. The upland and common bullies occupy a more diverse range of habitats, including those described for the other two bullies, and also quiet pool margins. In the Wanganui River, redfinned bullies are found upstream in tributaries such as the Manganui-a-te-Ao River, while common bullies are more widely distributed, and are found further upstream in the Retaruke River.

Upland bullies are confined to the main river above Taumaranui, and Cran's bully has a similar distribution in the upper Wanganui River, but is also found in the Manganui-a-te-Ao and Retaruke Rivers. Although no fishery is established around bullies, they are valuable as food for larger fish species such as eels and trout.

2.11 Yellow-eyed mullet

This is basically a marine fish, but is commonly found in the lower reaches of the Wanganui River during summer months. A recreational fishery and a small commercial fishery are based on these fish in the estuarine area (I.C. Stoneman pers. comm.). They are caught by rod and in nets, and are used for food, and as bait for sea fishing.

2.12 Grey mullet

The grey mullet is also basically a marine fish, although it has been known to frequent freshwater habitats in northern areas of New Zealand all year round. In the Wanganui River, details of this fish's distribution and abundance have not been established. However it has been reported (A. Carruthers pers. comm.) that they are occasionally caught in nets in the estuarine area of the Wanganui River.

2.13 Kahawai

Kahawai is normally a marine species, but moves into river estuaries, occasionally in large shoals, to feed on smaller fish.

They provide a recreational fishery in the estuarine area of the Wanganui River, where they are caught by line and net.

2.14 Flounders

Two species of flounder are found in the Wanganui River - black flounder and yellowbelly flounder. Yellowbelly flounder is a marine fish and is found only in the lower estuarine area of the Wanganui River. Black flounder is the only flounder which enters the true freshwater environment, and in the Wanganui River has been recorded as far upstream as Taumaranui. The biology of black flounder is still not fully understood, but juveniles are known to begin migrating upstream in spring.

Both species provide a recreational fishery in the lower estuarine area of the Wanganui River, and are sometimes taken commercially (I.C. Stoneman pers. comm.).

2.15 Koura

Koura, or freshwater crayfish, occur in a wide variety of habitats, ranging from gravel streams to slow moving rivers with muddy substrates. Their life history does not incorporate a marine stage and their complete life cycle can take place in a single pool in a river. They are common and widely distributed throughout the Wanganui River and its tributaries. They have been harvested in the past as a traditional fishery, but the extent of their present use is not known.

2.16 Shrimps

Downes (1918) recorded that the Maori people captured shrimps for food in the Wanganui River. The abundance and distribution of shrimps in the Wanganui River today are unknown.

Chapman and Lewis (1976) reported that (like whitebait) young shrimps may migrate or be washed out to sea to undergo their early development in saltwater, before returning upstream to complete their development and to breed. Although the existence of a fishery for shrimps has not been established, they are undoubtedly a food source for large fish such as eels and trout.

2.17 Trout

Brown and rainbow trout are both introduced fish and are well distributed throughout the Wanganui River system. Auckland Acclimatisation Society records show that the Ongarue River and other Wanganui River headwater streams were first stocked with trout in 1900 (Ashby 1967). Since then, artificial stocking of the system with trout has continued to the present day, despite evidence (Hobbs 1940) of natural recruitment throughout the system.

Natural recruitment in the river depends on trout being able to move freely throughout the system, both for spawning migrations, and for dispersal of juveniles. Cudby and Strickland (in press) report that trout from estuarine habitats migrate up the Wanganui River to spawn in the Manganui-a-te-Ao

River. Similar movements, associated with spawning, are likely to occur elsewhere throughout the Wanganui River system.

In addition to the Manganui-a-te-Ao River, trout spawning has been identified in the Wanganui River above Taumaranui, and in the Waimiha Stream, Ongarue River, Taringamotu River and in Pungapunga River (Hobbs 1940). More recently, Richardson and Teirney (1982) reported that trout spawn in the Whakapapa River.

In the Manganui-a-te-Ao River (Cudby and Strickland in press), the brown trout spawning migration begins in March and tapers off by July. In the same river, rainbow trout migrations were observed in June and had ended by August. In both cases, runs coincided with, or preceded, a rise in river flow. Frost and Brown (1967) also reported an association between a rise in water level and the upstream movement of trout.

After moving into suitable spawning areas, male and female trout pair, and the female excavates a redd in which to deposit her eggs. Spawning areas are usually in moderately flowing water at the tails of pools, with gravel substrates permeable to water.

Graynoth, Pierce and Wing (1981) reported that brown and rainbow trout in the Waitaki River system in the South Island normally dig redds in about a 31 cm depth of water, with velocities averaging 0.55 m/s for brown trout and 0.51 m/s for rainbow trout.

Eggs can take up to two months to develop if water temperatures are low. After hatching, the young trout live among the gravels for several weeks before emerging. Upon emergence, some juveniles disperse downstream, while others inhabit suitable areas nearby.

Juvenile trout are usually found in shallow, swiftly flowing stretches of water which offer surface turbulence and boulders as cover. This type of habitat is available in side streams, where the reduced habitat size is

not so suitable for large fish, and so juveniles do not have to compete with them or risk being preyed upon.

Due to the current ease of access throughout the Wanganui River system for adult trout, their habitat ranges from the estuarine area to small inland bush tributaries. It is usually associated with stable cover, provided by boulders and other obstructions, bank-shading and depth of water.

3. RECREATIONAL ANGLING

Recreational angling for both brown and rainbow trout occurs throughout the Wanganui River system. The evaluation of angling waters presented in the draft Management Plan was based on FRD's knowledge and experience, and indicates that some tributaries and mainstem reaches are more important to anglers than others. A preliminary analysis of data collected in FRD's National River Angling Survey reinforces this view. Information on the national survey's objectives and methodology is summarised by Teirney (1980). The responses of anglers who were sampled from each acclimatisation society district throughout the country, are the subject of a series of reports currently in preparation. Further details of the survey appear in two regional reports which have been completed for the South Canterbury and Waitaki Valley Acclimatisation Societies (Teirney, Richardson and Unwin 1982a, 1982b).

The Wanganui River system flows through three separate angling districts - the Central North Island Wildlife Conservancy (CNIWC), and the Auckland and Wanganui Acclimatisation Societies (Fig. 1). For this reason, and the fact that survey results from CNIWC are not yet complete, only a preliminary analysis of results has been possible. Survey samples were restricted to adult whole season licence holders from each district (Table 4), which means that provisional estimates of angler usage (presented in Table 5) are an absolute minimum. For instance, adult whole season licence holders represent only about 14% of all CNIWC licence holders, unlike ordinary acclimatisation

TABLE 4. Information about adult whole season licence holders sampled from the three angling districts through which the Wanganui River flows.

District	No. of adult whole season licence holders	No. sampled	No. who provided information on rivers they fished
CNIWC (1980/81)	15 609	1 500 (9.6%)	397 (replies received to August 1982)
Auckland (1979/80)	2 132	393 (18.4%)	174
Wanganui (1979/80)	83	77 (92.8%)	24

TABLE 5. Estimates of angler usage for the Wanganui River and its most-fished tributaries. (Importance grade is based on anglers' assessments of the overall importance of each river on a 1-5 scale.)

River	District	Estimated no. of anglers	Estimated no. of visits	Visits/ angler	*Importance grade
Wanganui	CNIWC Auckland Wanganui	498	7 289	14.6	5
Whakapapa	CNIWC	479	4 553	9.5	4
Ongarue	Auckland	147	770	5.2	3
Waimiha	Auckland	139	354	2.5	3
Manganui-a-te-Ao	CNIWC	411	3 817	9.3	5

* Importance grade: 1 = not highly valued
5 = very highly valued

districts, where whole season licence holders comprise up to 65% of total licences sold. This problem was further compounded by other sampling difficulties encountered within the Central North Island Conservancy, making estimates of angling use for CNIWC district rivers of questionable value. Although information was also provided for other Wanganui River tributaries including the Pungapunga, Taringamotu, Waione, Maramataha, Ohura, Retaruke and Orautoha Rivers, it was only possible to estimate angling use and assign importance grades to those rivers for which a sufficient number of responses had been received. Therefore a detailed discussion of the results has been limited to those rivers listed in Table 5.

3.1 Wanganui River

The Wanganui River attracts anglers from almost every acclimatisation district in the North Island. In addition to CNIWC, Auckland, and Wanganui respondents, information was provided by anglers from the Northern Federation (districts north of Auckland), Hawkes Bay, Wellington, Stratford, and Taranaki districts. Although some fishing takes place in the lower river reaches, the majority of angling effort is expended in the headwaters and middle reaches. Abstraction of water from the upper-most reaches of the Wanganui into the Western Diversion (Tongariro power scheme) does not appear to have seriously affected the high value which anglers place on this river. Although approximately 30% of both Auckland and CNIWC respondents travelled a considerable distance to fish the Wanganui River, over 60% of the respondents lived in close proximity to the river. In combination with relatively easy access to extensive areas of fishable water, this probably accounted for the high angling effort (visits/angler) expended in the vicinity of Taumarunui. Picnicking and swimming were most commonly carried out in association with fishing along this river reach, which anglers considered to be scenically attractive.

3.2 Whakapapa River

The Whakapapa was reputedly the best river fishery in the Waimarino

acclimatisation district prior to the occurrence of two lahars, activities associated with construction of the Whakapapa intake, and abstraction of water along the Western Diversion, which began in 1972. Recently, a fisheries investigation was conducted by FRD to assess the effect which diversion of water has had on the trout stocks, habitat and fishery values of the Whakapapa River (Richardson and Teirney 1982). Although the fishery may not now be as highly valued as that of the Wanganui and Manganui-a-te-Ao Rivers, anglers' importance ratings indicate that it is still of high quality. Most of the fishing, however, takes place in the middle and lower reaches, where the effect of the intake is offset to some degree by the inflows of two major tributaries. Some anglers lived locally, but others travelled a considerable distance to reach the river. Anglers provided information about the Whakapapa River from throughout the North Island, including Auckland, Tauranga, Hawkes Bay, Wellington, Wanganui and Stratford acclimatisation districts. Both scenic beauty and the opportunity of fishing in peace and solitude were very highly valued by Whakapapa anglers, some of whom combined fishing with picnicking, camping, swimming and shooting.

3.3 Ongarue River and Waimiha Stream

Located within the Auckland acclimatisation district, the Ongarue River and its tributary, the Waimiha Stream, appear to afford anglers a very similar type of fishing experience, and for that reason will be discussed together. Few anglers from outside the Auckland district visited these rivers which, in combination with importance grades of between 3 and 4, indicate that neither river was as highly valued as the Wanganui River and its true left bank tributaries located within the CNIWC district. While a similar number of Auckland anglers fished the Ongarue River and Waimiha Stream, only half the angling effort was expended on the latter. The fact that the popular middle reaches of the Ongarue River are not as remote as the headwaters of the Waimiha Stream, where angling effort is concentrated, probably accounts for this difference. Certainly anglers had to travel further to reach the Waimiha and valued the opportunity of fishing in peace and solitude very highly.

3.4 Manganui-a-te-Ao River

The Manganui-a-te-Ao River is the most downstream tributary of the Wanganui River for which sufficient data are available to analyse the fishing experience in detail. In comparison with the other rivers under discussion, this river received the highest overall importance ratings from both CNIWC respondents and anglers who travelled to the river from five other North Island acclimatisation districts. Despite the remoteness of the Manganui-a-te-Ao River from any population centre, and problems of access due to the physical nature of the river, angling effort was comparable with that expended on the Whakapapa River. The Manganui-a-te-Ao was exceptionally highly valued for its scenery and for the tranquillity of its surroundings, and its value to anglers is directly related to these attributes. Picnicking, swimming and camping were all very popular activities associated with fishing the Manganui-a-te-Ao.

3.5 Summary

Analysis of the survey data for the whole country has now proceeded to the point where a tentative classification system for angling rivers has been devised. Three categories of rivers can be identified including those of national, regional and local importance. For each category the survey data indicate that there are a number of criteria which define the rivers in each group. The combination of high importance ratings and anglers' willingness to travel from other society districts indicates that the Manganui-a-te-Ao River is an angling river of national importance, with exceptional scenic qualities. The Wanganui and Whakapapa Rivers are at least regionally important, while the Ongarue River and Waimiha Stream are generally only fished by anglers within the Auckland acclimatisation district.

4. FLOW REQUIREMENTS

The RWCB (1982) report indicated that flows above Piriaka are under separate negotiation between New Zealand Electricity and fishery interests, and noted that these reaches are mainly of interest to anglers rather than canoeists - who are the group seeking a minimum flow in the Wanganui River. The minimum flow options in the report are therefore centred on the Te Maire area, but they can be correlated with other sites. It is FRD's opinion that flow levels should be set for a range of sites along the river, to maintain a natural flow pattern throughout the system, including the tributaries. Flows should be set at Paetawa, Pipiriki, Te Maire, and Piriaka (Fig. 1), so that tributary inflows are included. This should ensure adequate protection of most fisheries values throughout the Wanganui River.

4.1 Setting Minimum Flows for Fisheries Purposes

Waters (1976) reported that a change in flow results in a change in the physical characteristics of all microhabitats of all fish species present, their predators, their competitors, and the food organisms upon which they depend. Any reduction in the natural flow of the Wanganui River could affect the biology of the fish described in Section 2 of this report. The minimum flow in the Wanganui River which should not affect these fish or their fisheries is the minimum flow which occurs naturally and within the present flow regime. To determine the effects of any flow other than this would involve a major detailed study, for which Fraser (1978) recommended a period of at least three years being necessary.

The instream flow incremental methodology (Teirney 1982) could be used to provide guidance in setting a minimum flow. However, this method has limitations and also requires detailed field measurements and computer analysis of data. Under the present circumstances, lack of time, staff and resources preclude use of this method.

In the limited time available for preparation of this submission, the only

method for determining the minimum flow requirements for fish and fish stocks is the application of a "rule of thumb", such as the Montana method (Tennant 1972).

To obtain guidance in setting minimum flows in New Zealand, the National Water and Soil Conservation Organisation funded a visit to New Zealand by J.C. Fraser in 1978. He recommended a modification of the Montana method for application in New Zealand (Fraser 1978) as follows:

Optimum or suitable*	-	100% of mean monthly flow
Acceptable	-	75-99% of mean monthly flow
Poor to Fair	-	30-74% of mean monthly flow
Unacceptable	-	29% or less of mean monthly flow

* plus flushing or attraction flows when needed.

Using Fraser's recommendations as a guide, minimum flows for fisheries are illustrated in Figure 2, based on flows measured at Te Maire during September 1962 - December 1977. The critical flow is selected or negotiated from the 75-99% range of the mean monthly flow. This is the range regarded as "acceptable" for fisheries purposes.

In Figure 2, an allowance for a reduction in flow of 21% has been made to approximate present day flows influenced by diversion of headwater tributaries to the Tongariro power development scheme. The reduction was calculated using the present and established post-diversion annual mean flows (Tonkin and Taylor 1978), shown in Table 6.

However, when the mean monthly flows in Figure 2 are compared to the graph of daily flow records in RWCB (1982, Figure 7), it is apparent that they exceed the flow at Te Maire for much of the time during average and dry years. Since it is important for fisheries to maintain natural fluctuations in the flow regime, FRD recommends that the minimum flow therefore be set at no less than 75% of the instantaneous flow, after the Tongariro

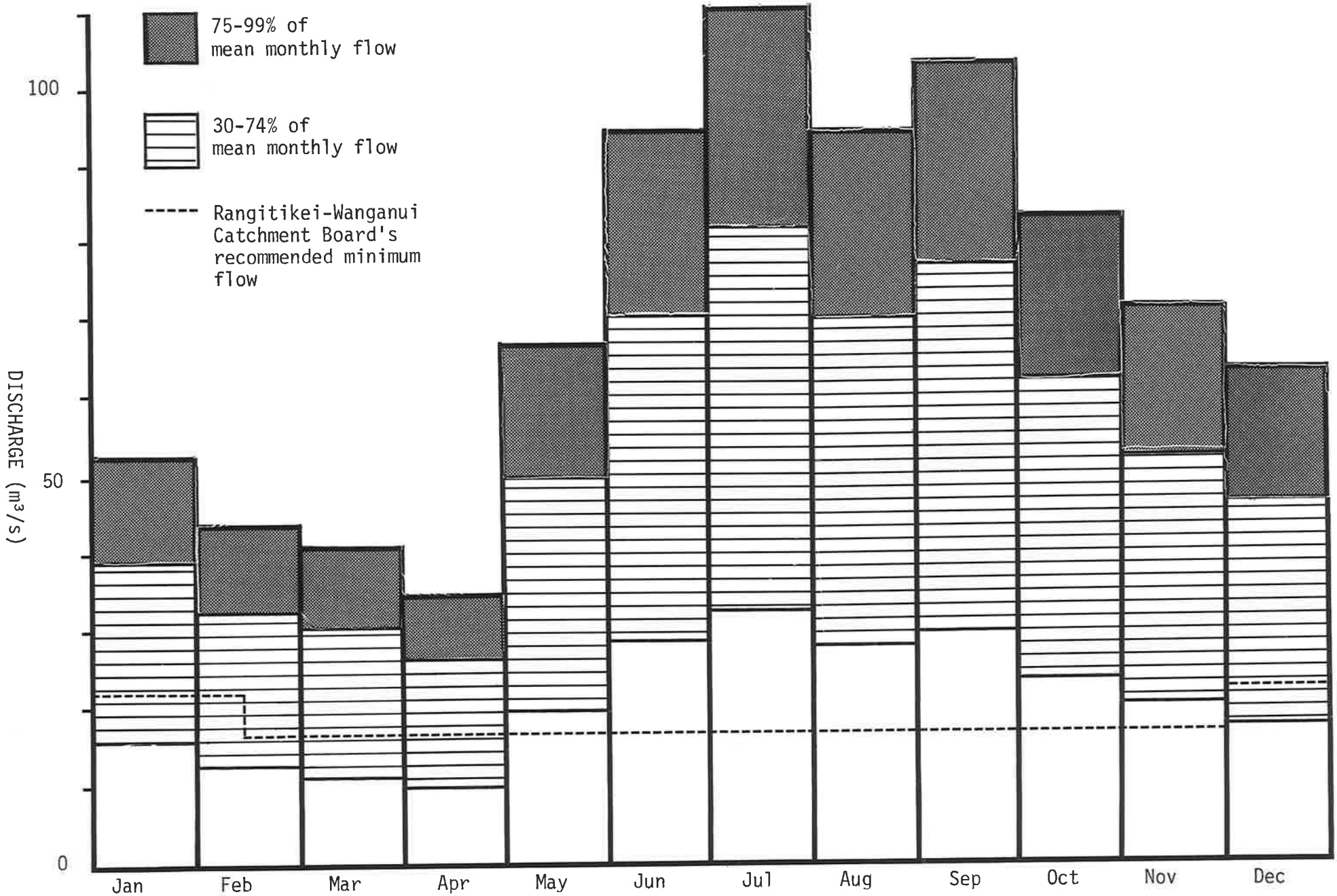

FIGURE 2. Guide for setting a minimum flow for fisheries in the Wanganui River at Te Maire.

diversion flows have been taken into account.

TABLE 6. Effects of Tongariro power development abstractions on mean monthly flows in the Wanganui River (from Tonkin and Taylor 1978).

Site	Annual mean flow 1975-77 (m^3/s)		Percent of *available flow diverted to Tongariro power scheme
	Available*	Recorded	
Piriaka	45.5	24.9	45
Te Maire	95.7	75.1	22
Paetawa	250	229	8.4

* Available flow is recorded flow plus Wairehu Canal flow

It has been demonstrated in Section 2 of this report that fish rely on the stimulus of a fluctuating flow regime for various phases of their life history, including migration and spawning. FRD is concerned that if the recommendations made in RWCB's (1982) report are adopted, the flow could be held at 16 m^3/s for 9½ months of the year. Flood peaks and freshes could be abstracted or diverted into storage, resulting in a loss of day-to-day variations in flow - conditions to which the fish and insect fauna are adapted.

It appears the minimum flow of 22 m^2/s during December - mid-February has been recommended to satisfy the needs of canoeists, who originally requested the fixing of a minimum flow. Although this flow could sometimes be greater than 75% of the instantaneous flow during this period, FRD would prefer adoption of a minimum flow which would provide a natural, fluctuating flow regime, which could not be held artificially for long periods.

Therefore, FRD recommends that if RWCB fix a minimum flow for the Wanganui River, it should not be less than 75% of the instantaneous flow after the current Tongariro diversion flows have been taken into account.

4.2 Summary of Flow Recommendations

(i) Minimum flows should be set at Paetawa, Pipiriki, Te Maire and Piriaka, to maintain a natural flow pattern along the river, making allowances for tributary inflows.

(ii) At each site, the minimum flow should not be less than 75% of the instantaneous flow, after the existing Tongariro diversion flows have been taken into account.

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