

INLAND FISHERIES COMMISSION NEWSLETTER

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TASMANIA'S TROUT FISHERIES – CURRENT STATUS AND CHANGES SINCE 1945

This edition of the Newsletter is devoted to a report based on the results of the 1986 and 1987 Inland Fisheries Commission postal questionnaire surveys and CSIR licence census returns for the period 1945 to 1958. The report has been prepared by Dr Peter Davies, Mr William Thompson and Dr Robert Sloane.

Introduction

The Inland Fisheries Commission is concerned with the management and conservation of a complex system with three principal components: the fish, its habitat and the angler. All too often, fisheries authorities concern themselves with the fish and may neglect both the habitat and, even more particularly, the angler. The angler may produce marked effects on fish populations and also, often indirectly, on the fish's environment. It is vital that reliable information be gained in relation to the habits of a sufficiently large sample of anglers in order to assess and determine management policy. The Commission sought answers to the following questions:

- 1) How have things changed in our trout fisheries?
- 2) Has the increase in the number of anglers caused damage to our fisheries – or will it?
- 3) How do you, the angler, behave? Where do you fish, where do you live, what fishing methods do you use, how many seasons experience do you have, do you own a shack and are you a member of a club?
- 4) How are various waters performing? How many fish are taken each season, how much effort are people putting into catching a trout at each water, and how has that changed?

This study describes the results of the first intensive examination of the nature and behaviour of Tasmania's recreational trout anglers, together with the current status of the State's trout fisheries. It can be compared with an original report written by Dr. A.G. Nicholls in 1957, entitled 'The Trout Fishery of Tasmania', in which 10 years' information from a study of the state of the trout fishery was examined.

Changes in various important fisheries since the mid 1940s are examined in this Newsletter and some specific case histories are described.

Nicholls analysed changes in Tasmania's trout river fisheries between 1945 and 1958 by means of a voluntary licence report form to be completed at the end of a fishing season. Despite the low return rate (1-2%), he was able to examine changes in the fisheries over a 13 year period for all the major rivers of the State. Anglers were asked to provide information on total catch and total days fished at each of the waters visited during the season. Both the early published results for the rivers and the raw statistics for the unpublished lake information were available for comparison with the new data from the 1980s derived by postal questionnaire.

2000 questionnaires were sent to anglers whose addresses were randomly picked from full-season licence books at the completion of both the 1985/86 and 1986/87 angling seasons. The recipients were asked to complete the form with details of the whole season's fishing for each of the waters visited. There were some differences in the questions asked in 1986 and 1987, the former questionnaire being part of an economic survey of Tasmania's trout fisheries, still being analysed. In both years anglers were asked to provide information on total catch and total days fished at each of the waters visited during the season.

Questionnaires sent in 1986 were marked with a three letter code which identified the address of the recipient. On completion of a 5 week period when the return of these questionnaires ('unprompted' returns) had almost ceased, further questionnaires were sent out to 1000 anglers who had not replied.

They were also sent a prompting letter with the second copy of the questionnaire. The returns from this second batch of questionnaires ('prompted' returns) were not included in the survey results but were analysed separately and compared statistically with the unprompted returns in order to detect any bias in the questionnaire.

Results

A total of 1623 questionnaires were returned over the two years of the survey, an average return rate of 37%. These results, in which 4% of the angling body was censused, compare favourably with those of Nicholls' licence responses in which only 1-2% of anglers responded to his licence report forms at the end of a season.

A number of the figures derived from the unprompted questionnaires returned at the end of the 1986/87 season were compared with those returned after the receipt of a prompting letter. There was no evidence for bias due to non-return of questionnaires in catch per day, days fished per angler or the proportion of all anglers fishing a water. There is therefore likely to be no bias due to non-response to the questionnaires in the estimates of total catch, total harvest, total effort or the number of anglers fishing a water, and unprompted replies can be used in the future. There was also no bias in the number of 'novice' anglers and the average number of seasons fishing experience.

Characteristics of Tasmanian Anglers

Of the responses returned for the 1986/87 season, 44% fished with natural bait as their first preference, 35% fished with artificial lures and 21%



Tasmanians of all ages enjoy trout fishing

fly fished. An average of 21% of anglers over both seasons owned shacks or kept caravans at a trout fishing location and 18% were members of a trout fishing club. The 1986 club membership figures for Tasmania (IFC Newsletters, Volume 15 : 1 and 2) indicated a club membership of 11% for full season anglers and pensioners. There is thus a slight bias toward club members in questionnaire responses.

Only 14% had less than three seasons experience and 29% had previously fished 20 or more seasons. The average previous experience for all respondents was 16 seasons. It appears, therefore, that most Tasmanian full-season licensed trout anglers have had a considerable number of seasons fishing experience, and that the turnover due to the addition of 'novice' anglers is low.

64% of both seasons respondents declared a preference for lake fishing, 27% declared a preference for river fishing and 9% had no preference.

Characteristics of the Fisheries

Table 1 presents fisheries data calculated for all of the lakes in the Central Highlands region and the other major lakes in order of total angling effort expended per season averaged for both 1985/86 and 1986/87. Similar data are presented in Table 2 for the rivers. Data for waters for which there were less than 10 responses in each questionnaire were not analysed.

The total effort for the Central Highlands region, harvest and number of trips (1985/86 only) are

shown in Table 3. The difference in effort between the two seasons may be partly attributed to the difference in weather conditions. Analysis of total effort data for the period 1945/46 to 1957/58 for the major Central Highlands lakes showed a negative relationship between the number of days of westerly weather and total effort. The total effort expended in the Central Highlands was 25% lower in 1986/87 than in 1985/86, matched by a 25% increase in the number of westerly days during the fishing season.

In Table 4 a breakdown of angler characteristics is given for some of the most popular lake fisheries. The results for these waters also indicate that the fishing efforts of shack owners are reasonably evenly distributed throughout the highland waters, and that no particular lake was favoured by club members.

The data from the State's rivers (Table 2) shows that most effort is expended in the North Central region - including the Mersey river - (108,000 angler days per season), followed by the North West (37,000 days) and South (30,000 days). The total effort expended on river fishing (175,000 days) was substantially less than for highland lakes (269,000 days).

Total fishing effort on all waters for 1985/86 was 611,000 angler days, 7% more than that in 1986/87 (570,000 angler days). In contrast, the effort expended fishing the rivers in 1986/87 was substantially more than in 1985/86, indicating that the drop in effort expended in the highlands was matched by a switch to river fishing.

Table 1.

Fisheries data calculated for major Tasmanian lakes, averaged for both the 1985/86 and 1986/87 trout fishing seasons. The number of anglers includes all licence types and pensioners and is rounded to nearest 50. Lakes are listed in order of total angling effort expended.

Name of Water	Total Effort (Angler days)	Total Catch (Harvest)	Number of Anglers	Days Fished per angler	Catch per day
Arthurs Lake	57700	143700	9600	7	2.5
Great Lake	57300	47600	8800	8	0.9
Lake Sorell	44200	73300	7400	7	1.7
Bronte System	29500	41900	6200	6	1.4
Lake Pedder	16400	13600	3300	6	0.8
Bronte Lagoon	15600	19500	3500	6	1.3
Western Lakes 1	14100	22800	3700	5	1.6
Lake Rowallan	9700	20500	2200	5	2.1
Western Lakes 2	9200	12200	2500	5	1.3
Dee Lagoon	7200	5200	1800	4	0.8
Woods Lake	6800	10700	2050	4	1.6
Bradys Lake	5600	6200	1800	4	1.1
Lake Echo	5300	9300	1750	4	1.8
Lagoon of Islands	5300	5100	1600	4	0.9
Little Pine Lagoon	4900	5900	1300	5	1.2
Lake Leake	4700	3700	950	8	0.8
Tooms Lake	4600	6500	500	12	1.4
Tungatinah Lagoon	4000	3200	1100	4	0.9
Meadowbank Dam	3800	4000	1000	5	1.1
Lake St. Clair	3100	6100	550	6	1.9
Western Lakes 3	2900	8000	1000	5	2.2
Pine Tier Lagoon	2900	9500	950	4	3.2
Lake Crescent	2900	2000	900	5	0.7
Lake King William	2500	8000	1100	3	3.5
Laughing Jack Lagoon	2100	2700	900	2	1.7
Lake Mackenzie	1800	3200	500	5	1.9
Gunns Lake Area	1500	7400	450	4	4.8
Lake Rosebery	1300	800	200	6	0.6
Tarraleah Area	1100	1200	350	4	1.1
Lake Barrington	1000	1000	250	4	1.0
Western Lakes 4	1000	2200	450	4	2.0
Lake Mackintosh	650	1200	100	6	1.8
Lake Fergus	600	1140	300	2	2.0
Craigbourne Dam	300	470	200	2	1.6

Please note:

Western Lakes 1 includes all waters of the high plateau west of and including Lake Augusta, as far as Lake Ina and Junction Lake, not including Clarence Lagoon, and including Lake Mackenzie. Western Lakes 2 corresponds to the area commonly known as the "western lakes". Western Lakes 3 is the northern part of the western plateau including the Pillans - Julians system and Lake Mackenzie. Western Lakes 4 coincides with the Central Plateau Conservation Area plus the Silver Lake - Lake Olive area. The Bronte system area includes the following waters: Bronte Lagoon, Pine Tier Lagoon, Bradys Lake, Tungatinah Lagoon and Lake Binney. The Tarraleah area includes the following waters: Liapootah, Mossy Marsh, Nos. 1 and 2 ponds at Tarraleah and Hornes Weir.

Lowland lakes contribute little to the overall trout fishery but are important at a local level. Only 9% of total fishing effort is expended at these waters and most anglers come from surrounding areas.

Changes in the Fisheries

In Figure 1 changes in the number of anglers, the average days fished per angler, total harvest per season and the average catch per day since 1945 are shown for a number of waters. Total harvest is plotted against total effort in angler days expended at each of the same waters (Figure 2). Such catch-effort plots are valuable keys in determining if a water is being fished at a pressure which is beyond its maximum or optimum yield. If the plot shows a plateau or a maximum it indicates that the water is approaching its maximum yield or may have gone past it. The latter occurs when fishing pressure has reached a point where it directly affects the ability of the trout population to provide adequate recruitment. We have been able to construct such graphs for twelve waters thanks to the availability of Nicholls' early data.

The data for the remaining waters are discussed in a more detailed report which is available from the Commission. The data for all lakes and rivers indicate a growth in number of anglers and in fishing effort combined with a growth in the annual harvest. In most cases there appears to be no effect of fishing pressure on the average catch per day, although there is evidence for some concern at certain waters in the near future (particularly Great Lake and the St. Patricks, South Esk and Leven rivers).

The number of licensed anglers in Tasmania has increased dramatically since the 1950s, as shown in Figure 3. This increase in the total number of anglers fishing for trout in Tasmania is matched by a general growth in the number of anglers fishing all the waters in the State. The increase has been particularly pronounced for the highland lakes.

Plots of total harvest against total effort show that Tasmania's most important trout fisheries are more than adequately sustaining the large increase in fishing pressure which has occurred since the 1940s, and are capable of withstanding even greater fishing effort. In a few cases there are indications that warn of potential limits being reached and that expected increases in effort over the next 10-20 years may be deleterious. However, more data are needed to confirm this.

Rainbow Trout

There are five significant fisheries in Tasmania which depend heavily on rainbow trout, twelve waters which support a mixed brown trout and rainbow trout population in which rainbow trout form a significant part of the catch, five or so major waters in which the occasional rainbow trout is caught and a number of minor waters which provide local rainbow trout fishing (e.g. Meston, Junction, Dulverton).

Data for the harvest and catch per day for the rainbow trout waters of the State were derived for the 1986/87 season (Table 5). In terms of harvest of rainbow trout, Great Lake was the number one water (46,900 caught) followed by Lake Sorell (15,000), Lake Rowallan (5,400), Bronte Lagoon (3,800), Dee Lagoon (3,700) and Pine Tier Lagoon (3,500). With the exception of Dee Lagoon and Lake Crescent (1,700 rainbows caught) and smaller waters like Lake Meston and Junction Lake, brown trout are still the dominant species in the catch in the rainbow trout waters. As the 1986/87 season was the only one in which questionnaire data were recorded for the two species separately, no trends in the catches can be examined, except for Lake Crescent where increases in catch per day and total effort expended during the last two seasons are undoubtedly due to the presence of rainbow trout, released for the first time in 1985.

Geographical Patterns of Angler Use of Fisheries

An analysis of the proportion of all anglers fishing in various areas of the State was carried out, along

Table 2.

Fisheries data calculated for Tasmanian rivers averaged for the 1985/86 and 1986/1987 trout fishing seasons. * indicates results derived from the 86/87 questionnaire data only.

Please note: All data are derived from a minimum of 10 questionnaire responses. Number of anglers includes all licence types and pensioners and is rounded to nearest 50. Rivers are listed in order of total angling effort expended.

Name of River	Total Effort (Angler days)	Total Catch (Harvest)	Number of Anglers	Days Fished per angler	Catch per day
Mersey	26500	38400	2800	11.8	1.45
South Esk	21700	36800	3100	8.9	1.70
Leven	16200	22700	1900	10.4	1.40
Derwent	16100	12400	2500	8.1	0.77
Meander	12800	29800	2300	7.0	2.33
Macquarie	10600	19800	2100	6.2	1.87
Tyenna*	9900	28400	1800	7.0	2.85
North Esk	9700	26200	1900	6.5	2.71
Brumbys Creek	9300	12300	1800	6.6	1.33
Inglis	7300	11200	1000	9.5	1.54
Lake	5500	17600	1200	5.7	3.22
Cam*	4700	7800	700	8.3	1.65
Forth	4500	4200	1200	4.9	0.92
St. Patricks	4500	15200	1500	3.8	3.35
Great Forester*	3100	6700	600	6.9	2.13
Emu*	2800	1900	500	7.8	0.69
Clyde*	2700	4200	800	4.6	1.55
Liffey*	2100	6000	800	3.3	2.87
Rubicon*	1900	2100	350	6.3	1.13
Styx*	1600	1800	350	6.0	1.13
Blythe*	1600	2500	400	4.7	1.62

Table 3.

Fisheries data for the Central Highlands region for the 1985/86 and 1986/87 fishing seasons.

	Number of anglers	Total Effort (angler days)	Total harvest of trout	Number of fishing trips
1985/86	24,200	361,000	595,000	171,000
1986/87	22,600	272,000	484,000	-

Table 4.

Characteristics of anglers fishing at the most important lake fisheries (percentages of respondents for the unprompted 1986/87 questionnaire).

		Arthurs Lake	Great Lake	Lake Sorell	Lake Pedder	Bronte Lagoon	Dee Lagoon	Lagoon of Islands
Fishing Method								
Artificial	%	44.6	31.2	74.5	69.3	54.8	64.0	51.5
Natural Bait	%	28.6	37.9	-	-	-	-	-
Fly	%	26.8	15.4	25.3	23.9	45.2	36.0	48.5
Other								
Shack	%	25.4	24.8	24.3	18.2	25.4	26.7	13.5
Club Member	%	17.5	17.1	22.2	22.7	18.3	20.0	21.6

Table 5.

Catch statistics for the major rainbow trout fisheries based on 1986/87 data only.

Water	% of catch as rainbows	Catch per day		Total Harvest	
		Rainbow	Brown	Rainbow	Brown
Great Lake	33	0.30	0.62	46900	96800
Lake Sorell	20	0.38	1.48	15000	58000
Lake Rowallan	34	0.64	1.22	5400	10300
Bronte Lagoon	19	0.27	1.13	3800	15800
Dee Lagoon	71	0.62	0.25	3700	1500
Pine Tier Lagoon	37	0.84	1.44	3500	6000
Lagoon Of Islands	58	0.29	0.21	3000	2100
Lake Augusta	45	1.71	2.13	2400	3000
Lake Crescent	56	0.50	0.39	1700	1300
Bradys Lake	24	0.26	0.84	1500	4700
Lake Echo	15	0.25	1.48	1300	8000
Lake King William	13	0.33	2.13	1100	6800
Lake St. Clair	9	0.21	2.09	900	8500
Penstock Lagoon	41	0.28	0.41	700	1000

with an analysis of the origin of anglers fishing certain waters and regions, based on postal codes given by anglers in questionnaire responses. Seventeen fishing regions were designated and some of these are indicated on the map in Figure 4.

The principal areas used by all anglers were region 1, the Central Highlands (37% of all angler visits) followed by region 2, the Bronte system (19%). All other areas were used by far fewer anglers (0-4% of visits).

The general behaviour of anglers with regard to their most fished waters followed a similar pattern all around the State. Overall, most anglers fished the Central Highlands and their local waters with little other travelling. No matter where anglers came from, the first priority was the Central Highlands, region 1.

The second most popular areas were:

- for all southern anglers – the Bronte system, region 2;
- for northern anglers – the rivers of regions 3 and 4 (South Esk – Macquarie and North Esk);
- for north-western anglers – the rivers of regions 5 and 6 (e.g. the Mersey and Leven rivers).

The third most important areas for anglers depended on their area of residence i.e. their local fishing. Thus, anglers from Hobart, the South East and the Derwent areas fished the Derwent Valley and Lake Pedder. Anglers from the Channel area fished the southern rivers and Lake Pedder. Anglers from the North East and Launceston fished the north-eastern and midlands rivers as well as lakes Dulverton and Leake. Anglers from the north-eastern Tamar area fished only the north-eastern rivers (region 4, Figure 4) followed by the Bronte system. Anglers from the north-western Tamar area (including Devonport) fished the rivers in the immediate area (Mersey and Leven particularly). Anglers from the north-west fished the local rivers in regions 5 and 6 (Figure 4).

The residential area of anglers fishing the most important waters in the State was also examined. These results show a distinct bias by region. Arthurs Lake and Great Lake draw over 70% of their anglers from the northern postal code areas, whereas Lake Sorell and Bronte Lagoon draw over 70% of their anglers from the southern areas. Lake Pedder draws 77% of its anglers from the southern areas, whereas the 3 main river fisheries show a strong dependence on local angling from the northern areas. Anglers from the southern areas represented only 5% of those fishing the South Esk, North Esk, Macquarie and Mersey rivers. The Mersey River drew 71% of its anglers from the postal code area immediately around the river catchment itself, 93% from the north and north-west and took no anglers from the Launceston area. By contrast the South Esk and North Esk and the Macquarie River took 57% of their anglers from the Launceston area and only 14% from the postal code area of the Mersey River and environs.

Discussion

The use of postal questionnaires for the collection of angler-based statistics has a number of advantages when compared with interview surveys or creel programs. Questionnaires allow the information to be obtained at much lower cost and commitment of manpower. They also allow information to be gathered from a large range of waters in a standard format at the completion of a season, which is not possible in creel surveys.

The major problems with questionnaire data are: low return rate; possible bias in the returns; and some unreliability of recalled data. The return rates of postal questionnaires are notoriously low. This may lead to an inherent bias in the data due to the fact that people who do reply may be a particular group within the surveyed population. In the case of anglers, they may be i) better or poorer anglers, ii) keener anglers or iii) more literate anglers. These three concerns may all lead to a bias in any results

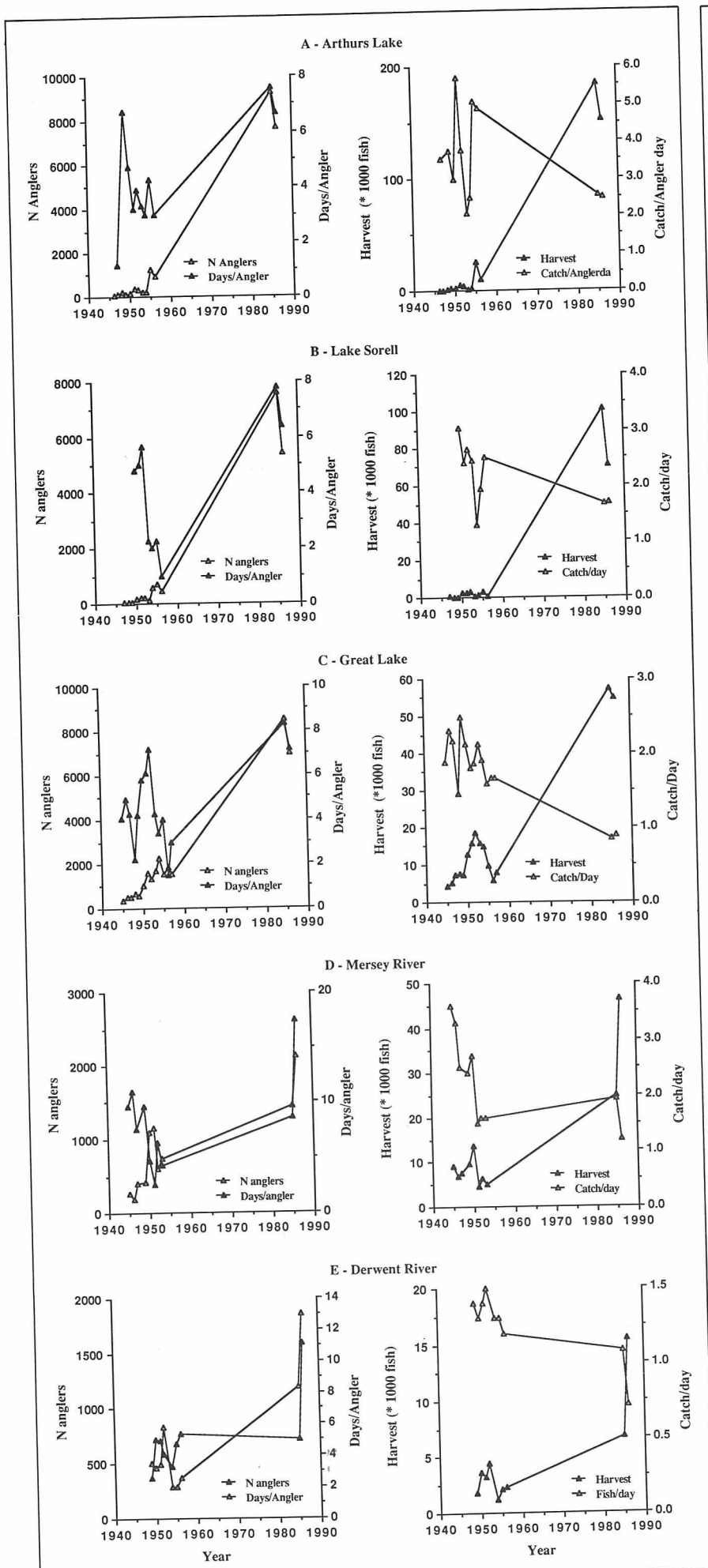


Figure 1: Trends in the major trout fisheries of Tasmania since 1945. Total numbers of anglers in 1985/86 and 1986/87 include full season licence holders, juvenile anglers and pensioners. Estimates of harvest are made with the inclusion of a factor for 3 and 14 day licence holders. Anglers under the age of 17 were not included in the analysis.

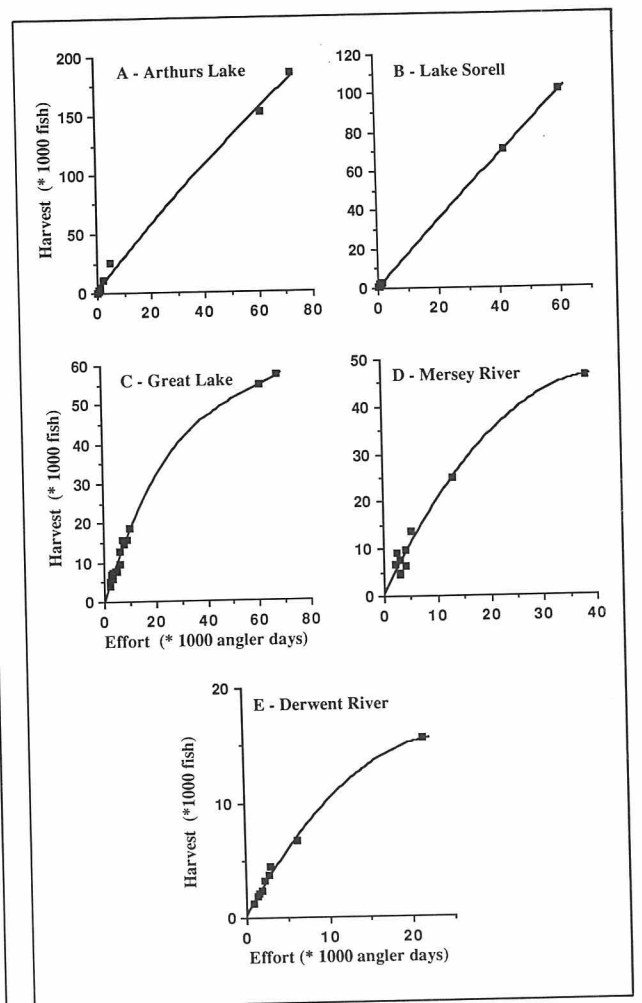


Figure 2: Plots of total harvest against angling effort in angler days expended at a water.

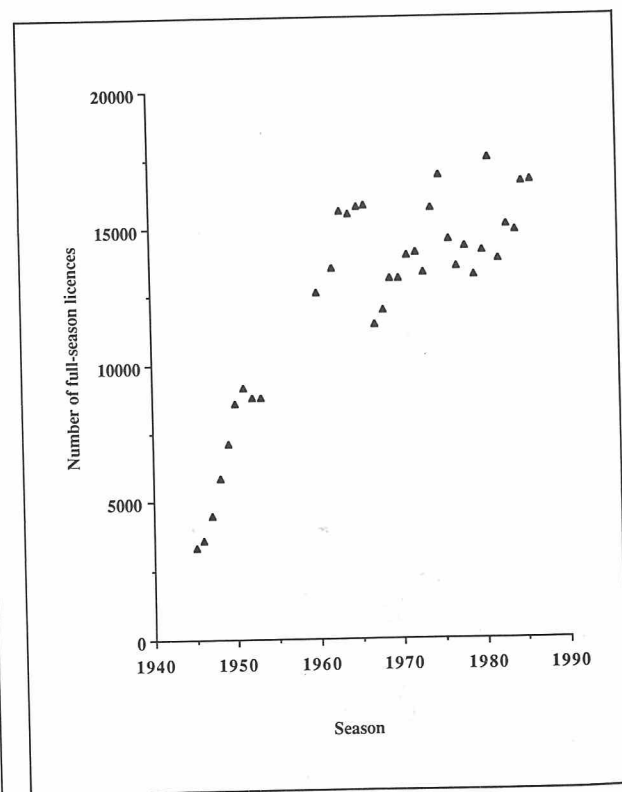


Figure 3: Increase in the number of full season trout licences (male and female adults only) issued in Tasmania since 1945.

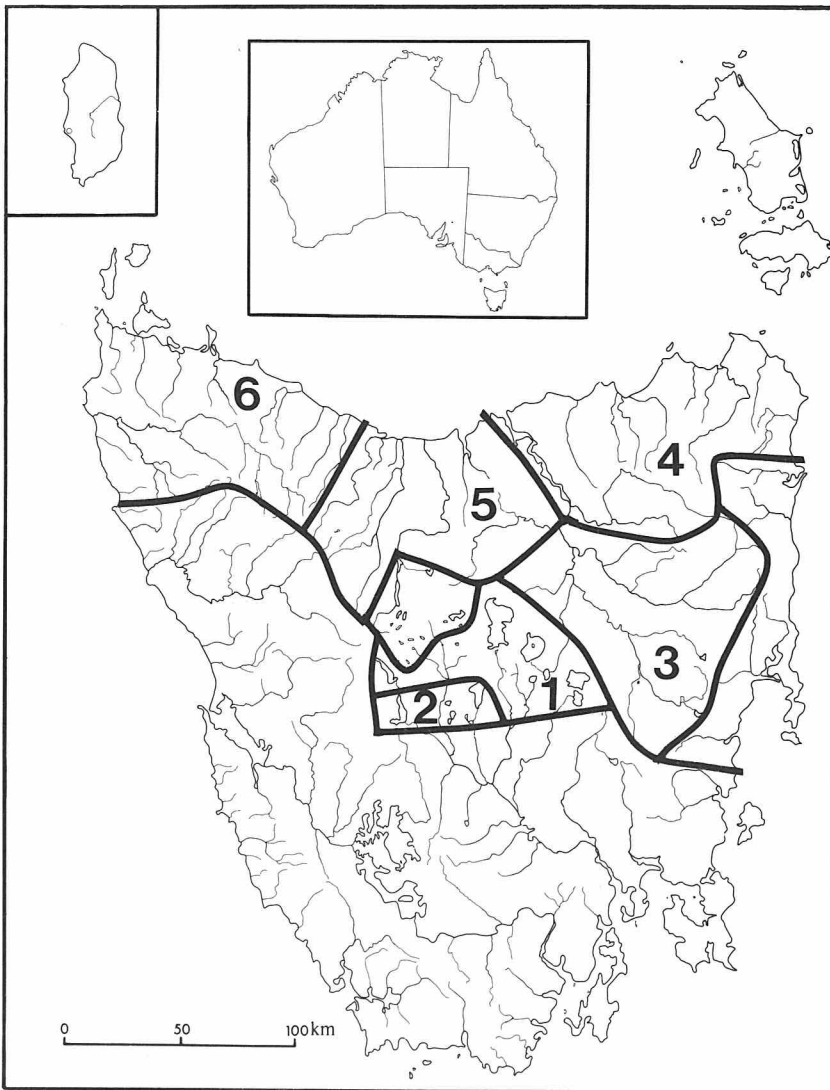


Figure 4: Map of Tasmania depicting fishing regions. Region 1 = Central Highlands. Region 2 = Bronte System. Region 3 = Midlands Rivers. Region 4 = North East Rivers. Region 5 = North Coast Rivers. Region 6 = North West Rivers.

based on extrapolating the data to the population as a whole. Such bias must be tested in order to be able to use the results in any management decisions. Bias due to poor recall at the end of a season of both catches and visits by anglers is an inherent problem in both questionnaire and interview surveys, and can be minimised by sending questionnaires to anglers as soon as the season is complete.

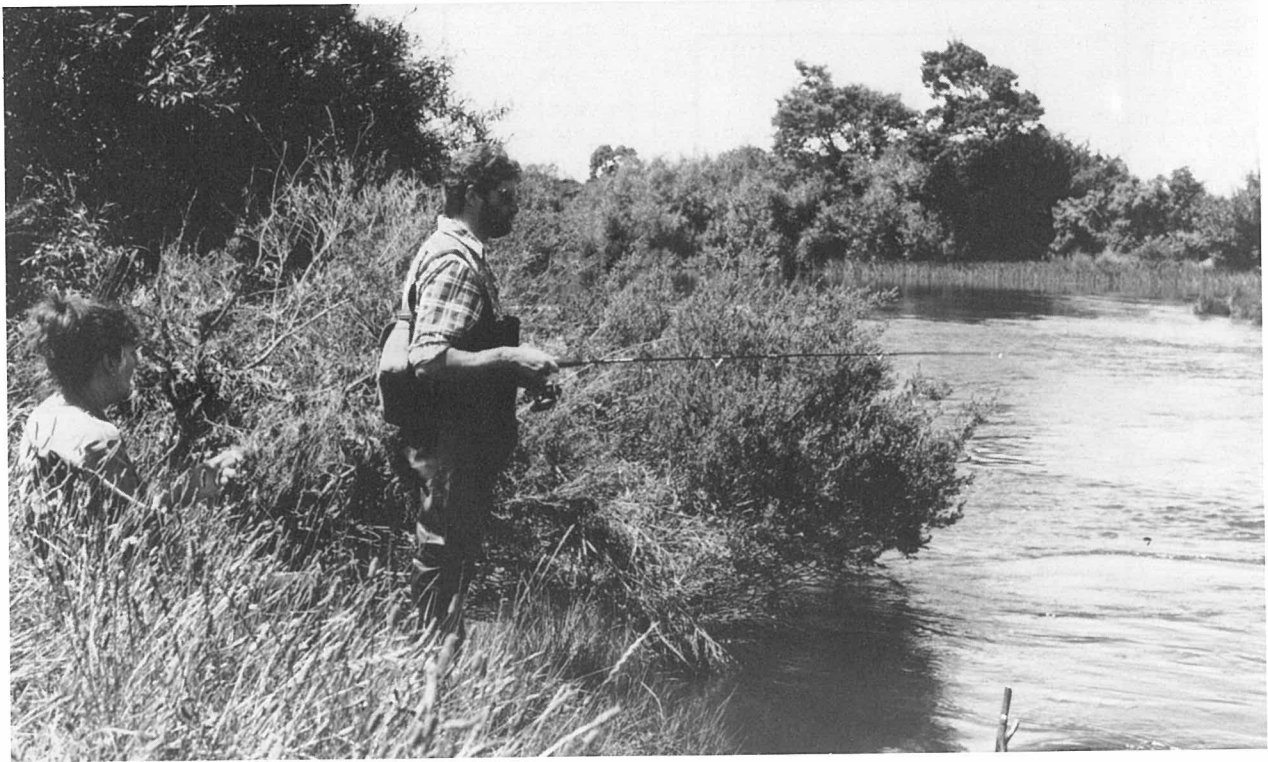
Two other methods may be used to validate the questionnaire program, both for bias and recall - an interview program and a creel survey based on key waters. The latter course has been adopted by the Inland Fisheries Commission at Great Lake and the Mersey River for the 1987/88 fishing season and the results will be compared with the questionnaire results for the same season in 1988 in a later article.

The present study involved a test of the bias in the questionnaires by the use of prompting letters. No differences were detected between the prompted and unprompted replies for all factors examined and it appears that the questionnaire is essentially unbiased. Analysis of data for the less popular waters is however limited by the small data set available through the 700-800 responses received for a 2000 address survey. Such waters may only be examined for changes in their fisheries by the use of creel surveys on site. Overall, the apparent lack of bias due to non-response and the high, consistent rate of return makes this questionnaire approach to the monitoring of Tasmania's trout fisheries a very valuable one indeed.

The question of the representativeness of club members is an important one in the light of the direct political role that the angling club fraternity has in the management of Tasmania's trout fisheries. It appears from this survey that club membership contains a higher proportion of shack owners and older anglers and twice the proportion of fly fishers than occur in the main angling body. However, it should be noted that fly fishing clubs are not represented in the Associations and this offsets any political bias. In general, the three types of angler are fairly evenly represented in the club membership and the fly fishing bias is not great.

Commission officer Bill Thompson interviewing anglers at Great Lake





River fishing close to home is popular in Tasmania

Tasmanian full season licensed anglers have a large number of seasons experience, and there are few 'novice' anglers in any one year. Only 14% have less than three seasons experience. It should be noted that these responses are for full season licence holders only and do not include juveniles, pensioners or short term licence holders who collectively constitute 37% of the total angling body. No effort has been made to include juvenile anglers less than 17 years of age, although they are several thousand in number.

The Central Highlands

Angling effort both in terms of angler days, trips and the number of anglers fishing is highly concentrated in the Central Highlands region. 87% of anglers fish this region and 46% of the total effort is spent in this area each year. A conservative estimate of average expenditure on trout fishing in this region, based on a \$30 per day figure derived from trout fishing in a Victorian study, is \$7.4 million per season. It appears that this changes significantly between years and is at least partly dependent on the incidence of poor weather conditions. Approximately 171,000 "trips" (for 361,000 angler days effort) were made to the waters of the Central Highlands region during the 10 months of the 1985/86 fishing season (similar data were unavailable for the 1986/87 season). The total harvest of trout during a season was 394,000 (average for 1985/86 and 1986/87), at an average expenditure of \$19 per fish.

The bulk of this harvest was caught in the top 4 water systems: Arthurs Lake (32%), Lake Sorell (16%), Great Lake (10%) and the Bronte system (9%).

Of the anglers fishing the Central Highlands region, 19,500 (81%) fished either one or more of Arthurs Lake, Great Lake or Lake Sorell during the 1985/86 season. Thus, 81% of highland anglers fished these waters, catching 291,000 trout and expending a total of 180,000 angler days effort. This represents an estimated annual expenditure of some \$5 million on these lakes alone.

Most highland waters were fished by northern anglers, with the exception of the Bronte system and Lake Sorell where southern anglers predominated. Certain northern and highland lakes, such as Lake Mackenzie and Lake Rowellan, are the exclusive domain of northern anglers.

In summary, it appears as though angling in Tasmania shows a strong regional bias with little long distance movement except in the case of the Central Highlands where anglers from all areas in the State fish at some time of the season.

The Rivers

A total of 177,000 angler days effort per season was spent in fishing the rivers. At \$30 per day this represented expenditure in the order of \$5 million per year on trout fishing in the State's rivers. The total catch was 317,000 trout during the year (at an average cost of around \$17 per fish). The figure of \$30 per day is probably too high for river fishing, but is a best guess until the results of the 1986 economic survey are completed.

The bulk of this harvest (58%) was caught in six river systems: the Mersey, South Esk, Meander, Tyenna, North Esk and Leven.

On average, the catch per day was higher for rivers than the highland lakes, as was the number of days spent fishing these waters per season.

Rivers were fished by 27% of Tasmania's anglers, of these 39% fished the northern rivers – the South Esk, Macquarie, Mersey and North Esk. Few southern anglers fished these waters, and the Mersey was almost exclusively fished by anglers from the central north coast.

Changes in the Fisheries

Dramatic increases in the numbers of anglers and the number of days each angler spends fishing have occurred at nearly all waters in Tasmania. There are few exceptions to this. Concurrent with these changes has been a dramatic increase in the numbers of fish harvested in each season, yet generally this has not led to any consistent decline in the average catch per unit effort – here defined as catch per day. Thus, it appears that most of Tasmania's trout fisheries are withstanding this increase in exploitation very well, and there is probably considerable room for more pressure. However, the possibility of a plateauing in the catch-effort statistics for a number of the river fisheries should serve as an initial warning that pressure may be approaching limits in some cases. More census data are needed over the next few years to confirm or deny this.

These results dramatically confirm Nicholls' conclusion in his overall report on the state of Tasmania's trout fisheries. In 1957 he wrote:

"Summing up, it may be stated that in spite of the increase in the number of anglers indulging in this sport there is no evidence of an overall decline in the catch."

This comment was made when angler numbers had increased from 3,300 in 1945/46 to 8,810 in 1953/54. It still holds even when the number of anglers has increased to around 20,000 in the 1980s! Nicholls compared the situation in the 1950s with that current in California at the time when there were 400,000 licensed trout anglers fishing an area of lakes and streams somewhat less than that of Tasmania and catching around 18 million trout! He concluded that the number of trout anglers in Tasmania would have to reach the equivalent of 70,000 in order for the then current state of the Californian fisheries to be achieved such that "overfishing may constitute a serious problem". At that stage most of California's fisheries were still sustained by natural recruitment although a number of major waters were managed by means of stocking with hatchery reared fish. Nowadays in California, stocking or catch and release is the rule of the day as trout angler numbers passed the 1 million mark in 1970 with 37 million trout being caught. Nicholls was certainly correct in his assessment as the current increase to 20,000 anglers in Tasmania has led to little change in the quality of trout fishing. The one major change in the Tasmanian trout fishery is that more people are enjoying the resource.

Fishing pressure on Tasmania's trout has increased by up to 10 times since the 1950s, by a combination of increases in the number of people fishing and the number of days each season that they fish. The number of people trout fishing rose quickly to a plateau by the 1970s and has increased only slightly since then (Figure 3). It is unlikely that increases in the population of anglers or increases in leisure time will be large enough to cause significant increases in fishing pressure on Tasmanian waters in the near future.

Conclusion

Analysis of statistics from the questionnaire surveys and the early licence form reports indicates that the majority of Tasmania's trout fisheries are in

a satisfactory condition as regards catch per effort and that the large increases in fishing pressure that have occurred since the 1950s have been accommodated with few ill effects. It is consequently very unlikely that most waters will suffer serious overfishing in the foreseeable future – this is remarkable by world standards when considering that all our major lakes and rivers are supported by self maintaining wild trout stocks.

Catch-effort plots for several fisheries indicate the possibility that they may be approaching their optimum sustainable yield. Statistics collected to date are at present insufficient to fully clarify these changes and they should only be regarded as warnings of possible long term trends. It would therefore appear essential that the questionnaire program be continued either on an annual or biennial basis, especially given the relatively high interannual variability of the results.

The postal questionnaire method of collecting data on Tasmania's trout fisheries appears to be a cheap, very effective method of obtaining replicable detailed information with little bias.

Commission staff would like to acknowledge the generous support of all those anglers who took the time to complete and return questionnaires – the information provided will contribute greatly towards future trout management in Tasmania.

Specific Cases

A series of detailed cases is presented for waters of particular interest:

Arthurs Lake

There has been a large increase in the number of anglers and the number of days fished per season per angler as well as in the total harvest of trout per season at Arthurs Lake (Figure 1A) since the early 1950s. The natural lake-swamp complex was dammed in 1956 and has become the most popular fishery in the State since that time. The average catch per day has not changed since the 1950s and remains high, around 2.5 fish per day, despite the high angling pressure. The catch-effort plot (Figure 2A) indicates that the water is not yet approaching its maximum yield despite some 140,000 trout being caught each season!

Lake Sorell

Large increases in the number of anglers and the total harvest have also occurred at Lake Sorell (Figure 1B), by factors of around 10 and 50 respectively. The latter is also related to an increase in the number of days fished per angler per season (by a factor of 2), while the overall catch per day has not changed. The catch effort plot (Figure 2B) also indicates that this lake is not yet approaching its maximum yield with some 70,000 trout being caught each season.

Great Lake

Results from the analysis of the early licence form data and the current questionnaire data for the Great Lake fishery are shown in Figure 1C. This indicates a large increase in total harvest due to increases in angling effort (number of anglers and days fished per season per angler), accompanied by a significant drop in catch per day.

As questions which could allow a separation of data for brown trout and rainbow trout were not asked in the questionnaires until 1986/87, reliance had to be made on catch records from a variety of other sources. These indicate large variations in the ratio of brown trout to rainbow trout in the catch from year to year over the 37 year period 1950 to 1987, with an overall ratio of 1:1. Analysis of questionnaire data for the 1986/87 season indicates a ratio of 2:1 brown trout to rainbow trout in the catch. It appears that rainbow trout at Great Lake are experiencing considerably more angling pressure (by a factor of 10) than the brown trout.

Much has already been written about the Great

Lake trout population from the point of view of changes in spawning runs, changes in catch composition and location of trout with respect to algal beds (IFC Newsletter, Volume 16 No. 2, 1987).

Research by the Commission has shown little change in the age and size composition of spawning brown trout and rainbow trout or in the size of fish in anglers' catch in Great Lake during the period 1950 to 1985. Tag studies have shown one fundamental change in the rainbow trout fishery during this period – a marked increase in the proportion of mortalities due to fishing from 20% to 45%. It appears that the rainbow trout population is heavily exploited – to the point that each year's annual recruitment is caught out by anglers. This heavy exploitation of rainbow trout has apparently resulted in the marked decrease in the average catch per day from the lake.

This situation is partially caused by the recognised higher catchability of rainbow trout than brown trout. It may also be partially caused by the fishing methods currently in use at Great Lake which actively select for rainbow trout. It seems fair to say that the rainbow trout population is approaching the point where it is limited by angling pressure. Indeed, increased angling pressure over the next few years may well lead to a decline in rainbow trout numbers. This is in marked contrast to the situation for brown trout in Great Lake, where a large population has been identified on the deeper weed beds, relatively unexploited by the anglers fishing from the shore or surface trolling.

This water is currently the subject of an intensive creel census interview program. The results of this

program will be used to examine the conclusions drawn from the questionnaire survey.

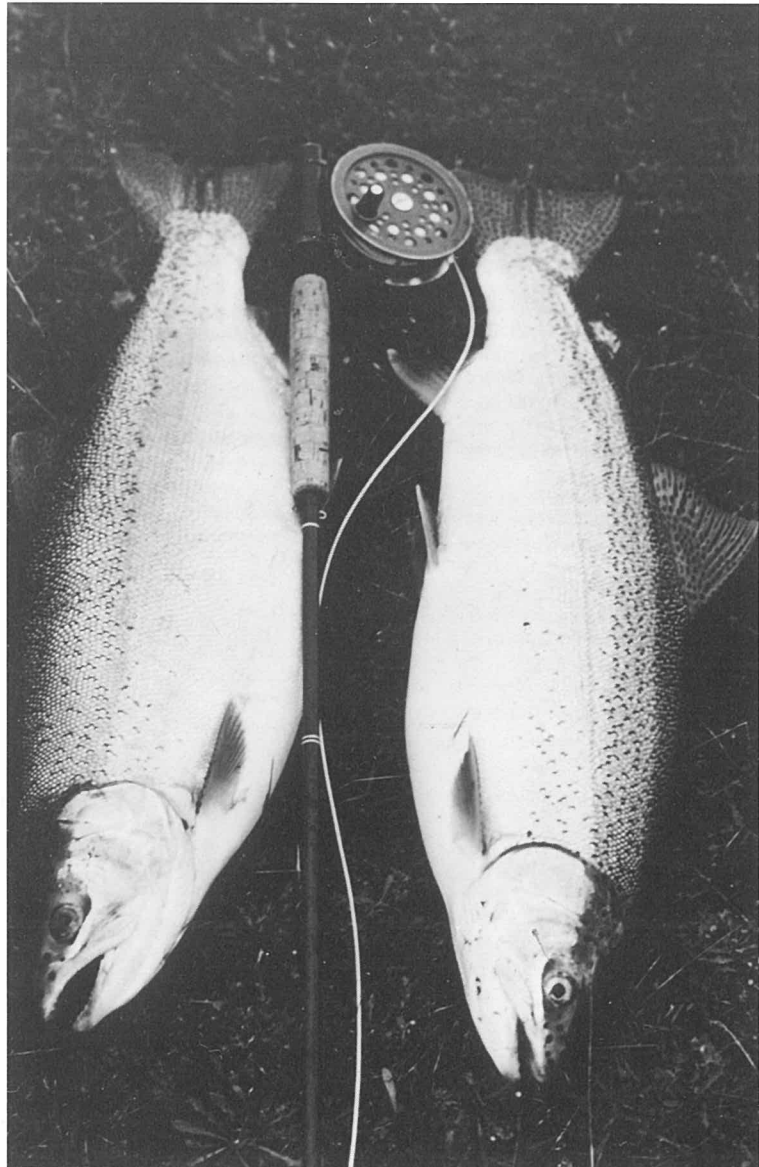
Lake Crescent

Large increases in angler patronage and the average catch per day have occurred for this lake during the past two years. Previously a brown trout water with a low catch rate, rainbow trout were stocked in 1985 and rapidly grew to a catchable size, reaching 1.5 kg in 1 year. Only 2.7% of anglers fished this water in the 1985/86 season, but this has increased to 4.4% in 1986/87 and is known to have increased dramatically in the current season. This may be attributed to the stocking of the water with rainbow trout as the increase in catch per day is almost entirely due to rainbows. Catch per day in 1985/86 was 0.5 fish (species not separated), one of the poorest in the Central Highlands, whereas it had reached 0.9 in 1986/87 (0.4 per day brown trout, 0.5 per day rainbow trout). It is expected to have increased still further in the 1987/88 season. No comparative data are available from the 1945-58 period.

Lake Leake

Long being a source of contention, Lake Leake has suffered from a poor reputation due to controversial management activities during the 1960s. Currently it is fished by 3% of Tasmania's anglers (around 500 full season licence holders) who catch an average of one fish per angler day, comparable with many other well reputed trout waters. Approximately 7% of the catch is rainbow trout, formerly more significant in the fishery – 25% of the catch

Big rainbow trout like these have increased the popularity of Lake Crescent



during the period 1945/46 to 1957/58 was rainbow trout.

The number of anglers fishing the water now is only marginally greater than during the 1950s. Total fishing effort appears to have increased, but only by a small factor. The number of fish caught from the lake has not increased significantly. The catch per day has, however, decreased significantly. It is difficult at this stage to say whether this is due to a real change in the fish population or to angler behaviour.

Lake Mackenzie

Recent survey work performed by the Inland Fisheries Commission has demonstrated the existence of a large population of brown trout despite widely fluctuating lake levels. It is fished by some 500 anglers mostly from the north coast and who catch some 3000 fish each season. The catch per day is good and the fishery appears healthy.

Craigbourne Dam

A recently established reservoir, first stocked with rainbow trout in 1985. The level of interest is growing, with 200 anglers fishing this water in 1986/87. The catch per day figure has been good at 1.6 per day, 1.5 due to stocked rainbow trout. Angler patronage is likely to have increased greatly during the 1987/88 season.

Lakes Rosebery and Mackintosh

Lake Rosebery, established in the early 1980s, is fished by around 200 anglers at a low average catch per day of 0.6 fish (90% due to brown trout). Lake Mackintosh is fished by few anglers. The catch per day reported is high, 1.8 fish per day (17% due to rainbows), although it should be noted that this is based on a small number of questionnaire returns.

Mersey River

The Mersey River fishery is the most important river fishery on the North West Coast. This study shows clearly that dramatic increases have occurred in the number of anglers fishing the water, the average number of days fished per season per angler and the total harvest, and that the average catch per day may be lower than in 1945-58 (Figures 1D, 2D). More data are required to confirm the latter observation.

Several other features of the fishery are available for direct comparison with the early 1950s, in particular the growth rate of riverine brown trout and the average weight of fish in the catch. Nicholls examined scale samples from brown trout caught by anglers in the Mersey and recorded growth rates which are similar to those recorded for brown trout caught by electrofishing in the Mersey River at Mersylea in 1986. The time for a fish to reach legal size was 1 year and 11 months in 1949-51 while it is estimated at 1 year 8 months from the 1986 sample. The average catch weight reported by Nicholls for the period 1949-54 was 1.2 lbs, similar to catch weights being reported by anglers at present. There is thus only limited evidence at present to suggest a decline in the Mersey River trout fishery, despite the drastic changes that have occurred to the flow as a result of damming the upper reaches during the 1960s.

The Inland Fisheries Commission has adopted the river as a study case. A creel survey program has been carried out to examine these matters in detail and to validate the results of the questionnaire survey. The average catch per day for the Mersey River is, however, comparable with other rivers in the north and the fish growth rate is the highest recorded.

Derwent River

The Derwent River fishery, predominantly an estuarine fishery for sea trout, has not experienced a marked increase in the number of anglers since the 1950s, although the total effort has increased (Figures 1E and 2E). This has been accompanied by a slight decline in the catch per day. The size of the spawning run at the Plenty River has not

changed significantly since the 1950's. Trap records show a run in the order of 200-400 brown trout in 1985 and 1986, compared to runs ranging from 170 to 1070 trout reported by Nicholls for the period 1951-1959. The average size composition of the spawning runs and growth of spawning fish has also not changed.

Two fundamental changes have occurred in the Derwent river during this time – pollution from industrial plants and the damming of the Derwent river system. Both factors may have affected the sea trout population and thus the nature of the fishery. However, it is also likely that the lack of increase in trout fishing in the Derwent may be partly due to a poor reputation, rather than to any real change in fish populations.

Comparisons with Victorian and New Zealand Waters

A recent Morgan poll on recreational fishing in Victoria showed that 916,000 people, 28% of the population, fished at some time in 1987. 42% of these people (385,000) fished mostly in freshwater rivers or lakes. 48% fished between 2 and 10 times a year. The Fisheries Division of the Victorian Department of Conservation, Forests and Lands has also conducted a number of creel census surveys at the most important trout fishing waters in the State. These interview surveys were conducted for 1984/85, 1985/86 and 1986/87 at 6 to 12 key waters in Victoria. Some of the results are shown in Table 6 for the 1984/85 fishing year. There is no closed season in Victoria.

Can we compare our statistics from postal questionnaires with those derived in Victoria by angler interviews? Apart from the apparent lack of bias tested for in the questionnaire survey, we can compare our statistics with those derived from creel interview surveys conducted during the 1987/88 fishing season at Great Lake and the Mersey River. Preliminary results indicate that the estimates of the total number of anglers, the catch per day, the extent of an 'angler day' and the total effort spent in fishing these waters are similar for both survey methods. This will be the subject of a future Newsletter article. We feel justified, then, at this stage in at least roughly comparing the Tasmanian and Victorian data.

Despite the large number of people fishing in fresh water in Victoria, most waters were fished by less than 2,000 anglers, in contrast to the situation

in Tasmania. It is possible that the smaller distances between waters allow anglers in Tasmania to fish more waters per season than those in Victoria, thus leading to a greater number of angler visits at each water per head of population. Total angling effort in angler days at Victorian waters compares with that exerted in our less fished highland lakes. The total effort expended at the top highland lakes in Tasmania appears to be much greater than that expended at any of the Victorian waters studied so far. Despite this, the average number of trout caught per day is higher in our waters. It should be remembered that the Tasmanian trout populations are sustained by natural reproduction in nearly all cases, whereas most Victorian waters studied are regularly stocked with domestic rainbow trout. This reinforces the need for careful protection and management of our waters' spawning areas.

The most important trout fishery in New Zealand is unquestionably that of Lake Taupo in the North Island. This water, with an area several times that of Great Lake, carries a self sustaining rainbow trout fishery which experiences great fishing effort. The total effort in angler days has increased from 87,000 in 1951/52 to 645,500 in 1982/83. This has been accompanied by an increase in total harvest of fish from 208,000 to 626,700. However, a decrease in the average catch per angler day has been experienced, from 3.4 to 1.0 fish per day accompanied by a decrease in the average size of fish landed, from 2.1 kg to 1.4 kg.

This is believed to be due to an influx of inexperienced and visitor anglers rather than any genuine decline in the fish populations, along with a bias in earlier data toward river fishing rather than lake fishing and/or a possible shift toward lake fishing in recent years. It should also be noted that Taupo adult whole season licence holders have much the same level of angling experience as our anglers – 15 seasons on average compared with our 16 seasons. Whatever has happened in the past, the increasing fishing pressure (total licence sales for the Taupo fishery alone now number some 70,000 per year) highlights the need for appropriate management and monitoring programs such as field interview and postal surveys.

Certainly, our trout fisheries compare well in terms of their response to increasing fishing pressure over the last 40 years, their yield to the angler and their ability to sustain viable trout populations without supplementary stocking.

Table 6.
Fisheries statistics for Victorian waters in 1984/85. (Data from Hume, 1987*).

Water	Number of Anglers	Total Angler Days Effort	Length of Angler Day (hrs)	Catch per Day (Species)	Total Harvest (Salmonids)
L. Dartmouth	4,742	19,700	4.5	0.33 (Rainbow) 1.58 (Brown)	17,000
L. Purrumbete	1,202	8,000	3.5	0.75 (Rainbow) 0.19 (Chinook)	5,500
L. Bullen Merri	1,999	13,800	4.0	0.8 (Rainbow) 0.04 (Chinook)	9,800
L. Burrumbeet	1,846	12,300	3.5	0.38 (Rainbow)	3,000
Hepburn Lagoon	326	1,300	3.0	0.38 (Rainbow) 0.003 (Brown)	450
L. Learmonth	929	5,600	3.1	0.03 (Rainbow) 0.003 (Brown)	100
Tullaroop River	307	1,200	3.0	0.49 (Brown)	200
Waranga Basin	1,146	5,000	2.7	0.003 (Rainbow) 0.016 (Brown)	-

* Hume, D.J. 1987. Creel Survey Report: 1984-85. Fisheries Management Report No. 16. Department of Conservation, Forests and Lands, Victoria.