SCIENCE AND RESEARCH INTERNAL REPORT N0.26

EXTENDED SUMMARIES OF SELECTED RESEARCH PROJECTS.

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Bioloy and habitat requirements of MacGregor's skink (*Cyclodonia macgregori*) on Mana Island

PROJECT LEADER

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ACCESSION NUMBER: S5040/115

PROJECT

Information is being sought on the general biology and habitat requirements of MacGregor's skink on Mana Island so that recommendations can be made regarding the conservation of existing populations and the possible establishment of additional colonies to improve the species' prospects of long term survival.

OBJECTIVES

- To determine the habitat requirements of MacGregor's skink.
- To collect information on the size distribution, dispersion, movements and density of the Mana Island population.
- To obtain data on the diet and breeding biology of the species.

METHODS

Pitfall trapping (using pear as bait) is being used to locate sites where McGregor's skink occur. Captured skinks are weighed, measured, marked, then released alongside the trap where they were caught. Micro-climate is being monitored at the site where most McGregor's skinks have been captured. Droppings of the lizards have been preserved and will be later analysed to try to identify their foods.

This season (1987/88) new traps were installed at sites along the north, south and SE coasts, and at an inland boulder bank of the island. The maximum number of traps operated was 220.

INTERIM RESULTS

Over 11 trapping sessions (4065 trap nights) made between November 1987 and April 1988, 1781 lizards were caught including 108 captures of McGregor's skink. Other lizards caught were the common skink, *Leiolopisma nigriplantare maccanni* (1051 captures), the copper skink, *Cyclodina aenea* (137 captures) and the common gecko, *Hoplodactylus maculatus* (485 captures). Since trapping commenced in January 1986, 163 captures of McGregor's skink have been recorded (Table 1).

As in past years, with one exception, all McGregor's skinks have been caught in a small area (2 ha) along the island's NE coast, between the shingle spit and

McGregor's Rock. Most captures (n = 120) were from a site just to the north of the shingle spit. The exception was a juvenile found north of Rock in a pitfall trap being set at the start of a trapping period.

Overall, 11 captures of *C. macgregori* have been made in traps that were being set, giving a total of 174 captures of 64 individuals. Thirty three of these individuals have been caught only once, while one skink has been recovered 13 times (Table 2). Three skinks are now known to be dead. Most animals recaptured were either in the same trap, or in an adjoining one. The median distance between captures of individuals (traps are about 4 m apart) was 0m (n = 110, no. of individuals = 31, range = 0-14 m). It appears, therefore, that animals limit their activity to small areas.

McGregor's skinks showed signs of apparent heat stress much more readily than other lizard species when handled on warm days. Following release on such days, individual *C. macgregori* often remained motionless for periods up to 45 seconds, except for occasional thoracic contractions (panting). These observations suggest that the species may have narrow environmental (habitat) tolerances.

Rarely have two or more *C. macgregori* been caught together in the same trap. Whenever this occurred, fresh wounds on the animals suggested that they had been fighting. Licenced holders of captive specimens of this species have commented on their intense aggression between individuals.

House mice on the island seasonally reach very high densities. Numbers appear to peak in late summer through to autumn. Seeding grasses are available during summer, but by autumn mice have to seek alternative food sources. From this time, the rodents regularly enter pitfall traps to take the pear baits and, occasionally, lizards. Generally, mice are able to jump out of the traps, but some are caught. Numbers caught and numbers of partly eaten lizards recovered from traps increased throughout the season (Table 3). A mouse was actually observed in a trap eating a still-live copper skink. Of the 14 partly eaten lizards recovered, 12 were common skinks, one a copper skink and the other a common gecko. One mouse-killed skink was found last season.

INTERIM CONCLUSIONS

On Mana Island MacGregor’s skink displays restricted distribution, narrow habitat tolerance and, relative to other lizard species on the island, large size; all are features that have been identified as characteristic of extinction-prone species. Mice may be a predator in late summer and autumn.

INTERIM RECOMMENDATIONS

(1) An attempt should be made to increase the distribution of McGregor’s skink on Mana Island. Before this can be done, however, more information should be sought about the lizard and it’s ecological requirements.

- To characterise the species' habitat preferences, information on aspect, vegetation and substrate should be recorded at each trap site.

- An attempt should be made to determine the environmental preferences (tolerances) of the lizard. A contract could be let to ascertain temperature and humidity tolerances using experiments not requiring the sacrificing of animals.

- Next season (1988-89) trapping should be confined to those areas where MaqcGregor’s skinks have been caught previously to obtain a better estimate of the size of the population. It will then be possible to gauge more accurately the number of lizards that could be removed to start new colonies, or for experimental manipulation (testing of tolerances).

(2) Consideration should be given to attempting to eradicate mice from Mana Island.

TABLE 1 Yearly trapping effort on Mana Island.

Year	No. trips	No. trap nights	Captures	
			All lizards	McGregor’s skink
1985-86	3	582	119	7
1986-87	8	2022	1187	48
1987/88	11	4065	1781	108
Total	22	6669	3087	163

TABLE 2 Individual capture records of Macgregor’s skink since commencement of projects on Mana Island in January 1986.

No. Captures	No. Individuals
1	33
2	11
3	4
4	7
5	-
6	2
7	-
8	4
9	-
10	-
11	2
12	-
13	1

TABLE 3 Mouse activity at lizard trapping stations, Mana Island, 1987/88 season.

Trip	Month	Mice caught	Partly eaten lizards
1	Nov	-	-
2	Nov	-	-
3	Dec	-	1
4	Dec	1	1
5	Jan	2	-
6	Jan	1	-
7	Feb	-	-
8	Feb	-	-
9	Mar	2	2
10	Mar	5	3
11	Apr	4	7

BANDING IN NEW ZEALAND
1987 -1988

A PROGRESS REPORT

R O Cossee

Introduction

In New Zealand, like in many other countries around the world, bird banding is an important research tool for both amateur and professional ornithologists. Although there are records for banded birds which go back to the last century, bird banding in New Zealand did not become organised until 1950. Then the Ornithological Society of New Zealand started its banding scheme, soon to be followed by the Wildlife Branch of the Department of Internal Affairs. At that stage the latter organisation was mainly involved with game birds.

Both schemes evolved separately until in 1967 they were merged into a single scheme, the New National Banding Scheme, under the umbrella of the Wildlife Branch (later the New Wildlife Service) of the Department of Internal Affairs. On 1 April 1987 the Wildlife Service was disbanded and the new Department of Conservation took over responsibility for the Banding Scheme.

The aim of the New Zealand National Banding Scheme is to obtain accurate information about movements and habits of birds. Apart from its purely scientific value, such knowledge is essential for the effective conservation of native species, for management of game birds, and for the control of those species that are considered pests.

During the nearly forty years of organised bird banding in this country well over a million birds (the millionth bird was banded during this report year!) were banded, of which around 140,000 have been recovered at least once. Some other interesting details -one of the Royal Albatrosses at Taiaroa Head, by the colony guardians lovingly referred to as "Grandma", is the **oldest banded bird in the world.** She was originally banded in 1937 as a breeding adult by Lance Richdale. The Chatham Island Black Robin is the only species in the country of which the whole population is banded. This report summarises the bird banding activity in New Zealand during the 1987/88 season.

Methods

Totals were taken from Banding Totals Lists for the period 1 April 1987 to 31 March 1988, except where schedules relating to previous years were received after the cut-off date for the 1986187 report. Totals for these bandings have been included in this report. Previously banded birds which were during the year are not included in the totals, nor in Table One.

Naming and order of species are based on the 'Annotated Checklist of the Birds of New Zealand' (1970 and subsequent amendments and additions); species code numbers are those used by the Banding Scheme. Numbers in open brackets denote provisional totals and figures in square brackets indicate birds banded as unknown species of a particular genus. These latter figures are included in the table because they contribute to the total number of birds banded, but are not included in the total number of birds banded.

Results

During the report year 26,497 birds of 105 species were banded, and 434 previously banded birds were re-banded; 15,676 (59.2%) of the new birds were game species and 10,821 (40.8%) non-game species. The total number of birds banded in New Zealand up to the end of this report year is 1,012,135 (previously 985,638). The total number of species banded increased by one to 224 with the addition of Leach's Fork-tailed Petrel. Table One gives a breakdown of numbers banded for each species. A summary of birds and species banded during the last 10 report years can be found in Figure 1.

A total of 12,040 recoveries was added to the computer files. It should be noted that these are recoveries processed during the year; they are not a true reflection of the number of recoveries reported. Actual numbers per species may be found in Table Two. In comparison with the 1986187 season, the number of records processed during the report year has almost doubled and is nearly fourfold that of earlier years. However, this does not mean a higher activity of the banders in the field. The increase is due to staffing levels in the Banding Office being at the required level during the whole year for the first time since 1981. This in turn allowed the processing of many previously untouched operator recoveries.

Of the recoveries added, 2,735 records (22.7%) were for birds recovered dead and 9,307 (77.3%) for birds recovered alive; 3,923 (32.6%) had been recovered at least once before. Of the birds recovered dead 2,180 (79.7%) were game birds and 555 (20.3%) non-game species. The live recoveries consisted of 2,144 (23%) game birds and 7,163 (77%) non-game birds. Of the repeat recoveries 727 (1 8.5%) were game species and 3,196 (81.5%) non-game species. Dead and live recoveries combined for each species group are 4,324 (35.9%) and 7,716 (64.1%) respectively.

Some notable recoveries this year are given below. Please note that actual dates may refer to previous years because overseas reports usually take a long time to reach the Banding Office.

R-41900, Southern Royal Albatross, banded as a chick on 23/6/85 on Campbell Island was found dead at Punta Tombo, Argentina on 31/1/87.

41505, Cape Pigeon, banded as an adult of unknown sex at Tory Channel Whaling Station on 23/7/58 was found dead at Ardery Island, Antarctica on 21/1/87.

Two New Zealand Black-browed Mollymawks were recovered in New South Wales, Australia. M-21097 was banded as a chick on Campbell Island on 5/4/69. It was recovered 12 miles due east of Sydney Heads on 01/6/87. The bird had become entangled in a long line and drowned. The second bird, M-46242, was also banded as a chick on Campbell Island on 1/4/87. It was caught in a fishing line near 12 Mile Reef, off Bermagui, on 10/6/87 and released alive.

L-10268, an Antarctic Skua which was banded at Cape Bird, Antarctica on 29/11/68 as an adult of unknown sex, was found on the beach at Kogane, Japan on 3/7/86. The bird was being attacked by a mob of Ravens and was generally in a very bad shape. It was transfered to a nearby zoo for recovery.

During the year many birds banded overseas were recovered in New Zealand:

- Giant Petrels banded by the Brazilians in the South Shetlands, by the Poles on King George Island, Antarctica and by the South Africans on Marion Island, Southern Ocean.
- a Brown Booby, banded by the Americans in the Northern Pacific Ocean.
- a Wandering Albatross banded by the British Antarctic Survey team on Bird Island, Antarctica.

Data output

During the year a number of computer programmes were developed and run to provide managers and scientists, both within and outside the Department of Conservation, with raw data, summaries, frequency tables, material for life tables and completed analyses. Some of these activities were of international importance.

Permits

During 1987/88 bird banding in New Zealand was regulated by 29 active individual and 26 institutional/group permits.
Of the institutional/group permits 6 were held by Department of Conservation regions, one by the Department's Science & Research Directorate and 4 by Acclimatisation Societies. A further 4 were held by Universities, one by the Ecology Division of the D S I R, and 10 by study groups specialising in selected species.

Acknowledgements

I am indebted to Mrs G D Tofield and K T Moynihan for their contributions to the banding administration and to C J R Robertson for valuable advice during the year. Mike Wakelin prepared Figure 1.

Summary

During the 1987/88 banding year 26,497 birds of 105 species were banded and 434 previously banded birds were re-banded, bringing the grand total of birds banded in New Zealand over all years to 1,012,135. One species previously not banded (Leach's Fork-tailed Petrel) was added during the season. The number of species banded over all years increased to 224. Banding was regulated by 55 permits.

Roderick O Cossee
June 1988

Figure 1

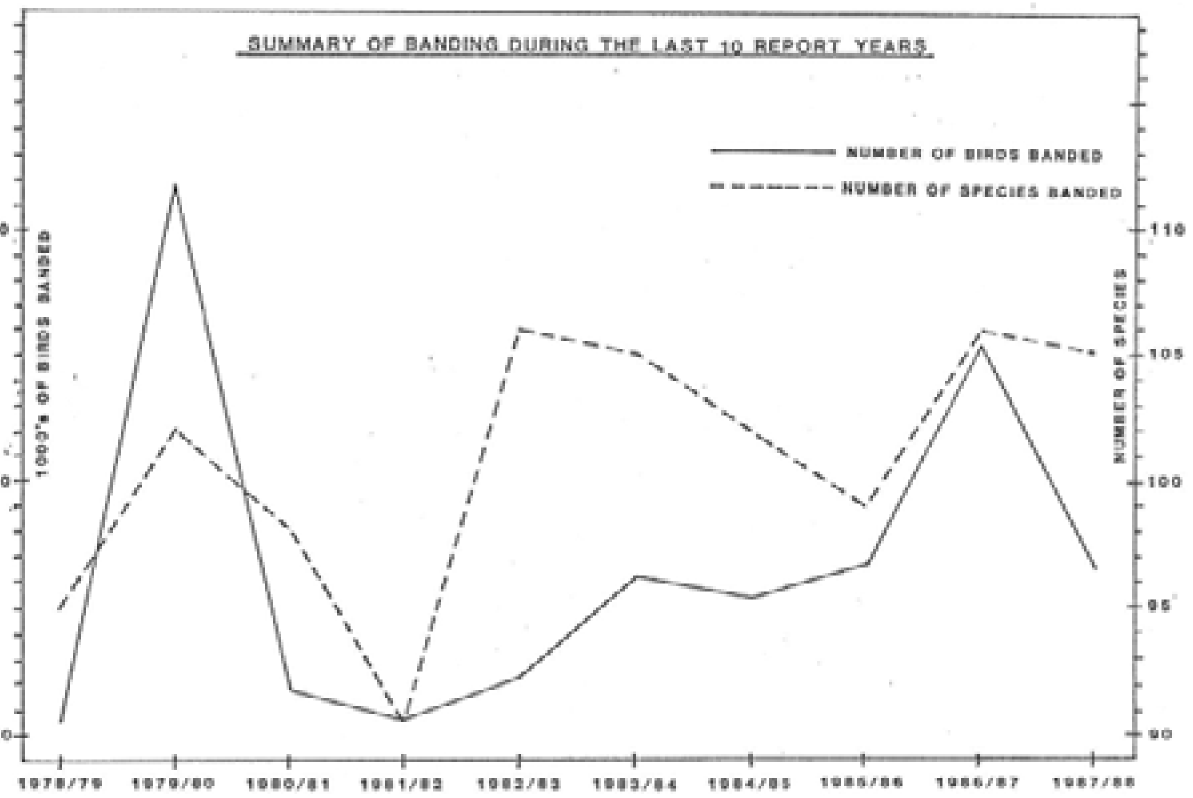

SUMMARY OF BANDING DURING THE LAST 10 REPORT YEARS
NUMBER OF BIRDS BANDED
NUMBER OF SPECIES BANDED
1000's OF BIRDS BANDED
40
30
20
NUMBER OF SPECIES
110
105
100
95
90
1978/79
1979/80
1980/81
1981/82
1982/83
1983/84
1984/85
1985/86
1986/87
1987/88

TABLE ONE
GENERAL BANDING TOTALS
(REBANDS EXCLUDED)

SPECIES NUMBER AND NAME	TOTAL PRE 1987	TOTAL 87/88	TOTAL FOR ALL YEARS
001 NORTH ISLAND BROWN KIWI	302	8	310
002 SOUTH ISLAND BROWN KIWI	4	0	4
003 STEWART ISLAND BROWN KIWI	5	0	5
004 LITTLE SPOTTED KIWI	81	0	81
012 YELLOW-EYED PENGUIN	2679	6	2685
026 NORTHERN BLUE PENGUIN	615	0	615
014 COOK STRAIT BLUE PENGUIN	1883	25	1908
016 WHITE_FLIPPERED BLUE PENGUIN	8685	873	9558
015 SOUTHERN BLUE PENGUIN	726	0	726
017 ROCKHOPPER PENGUIN	1815	248	2063
019 FIORDLAND CRESTED PENGUIN	364	0	364
020 SNARES CRESTED PENGUIN	1776	351	2125
021 ERECT-CRESTED PENGUIN	41	0	41
041 WANDERING ALBATROSS	2995	5	3000
044 NORTHERN ROYAL ALBATROSS	2448	25	2473
043 SOUTHERN ROYAL ALBATROSS	31972	296	32268
045 BLACK-BROWED MOLLYMAWK	6	0	6
046 NEW ZEALAND BLACK-BROWED MOLLYMAWK	20706	754	21460
047 GREY-HEADED MOLLYMAWK	5259	31	5290
049 BULLER'S MOLLYMAWK	2100	0	2100
050 WHITE-CAPPED (SHY) MOLLYMAWK	561	0	561
052 SALVIN'S MOLLYMAWK	1296	0	1296
051 CHATHAM ISLAND MOLLYMAWK	1	0	1
054 LIGHT-MANTLED SOOTY ALBATROSS	430	7	437
109 NORTHERN GIANT PETREL	1238	1	1239
061 SOUTHERN GIANT PETREL	6	0	6
064 ANTARCTIC FULMAR	2	0	2
063 SNARES CAPE PIGEON	695	178	873
062 CAPE PIGEON	6800	0	6800
093 GREY-FACED PETREL	15479	482	15961
094 WHITE-HEADED PETREL	31	0	31
095 WHITE-NAPED PETREL	228	0	228
098 MOTTLED PETREL	372	10	382
110 SOFT-PLUMAGED PETREL	20	0	20
100 KERMADEC PETREL	944	0	944
111 CHATHAM ISLAND TAIKO	30	10	40
101 PYCROFT'S PETREL	332	32	364
102 GOULD'S PETREL	1	0	1
104 COOK'S PETREL	269	23	292
106 BLACK-WINGED PETREL	2180	44	2224
105 CHATHAM ISLAND PETREL	27	1	28
065 BLUE PETREL	1	0	1
066 BROAD-BILLED PRION	1460	105	1565
069 ANTARCTIC PRION	20	0	20
071 AUCKLAND ISLAND PRION	24	0	24
072 NARROW-BILLED PRION	1	0	1
073 FAIRY PRION	40077	238	40315
075 FULMAR PRION	61	0	61
074 CHATHAM FULMAR PRION	2	0	2
089 GREY PETREL	8	0	8

TABLE ONE
GENERAL BANDING TOTALS
(REBANDS EXCLUDED)

SPECIES NUMBER AND NAME	TOTAL PRE 1987	TOTAL 87/88	TOTAL FOR ALL YEARS
090 BLACK PETREL	367	0	367
091 WESTLAND BLACK PETREL	2770	261	3031
092 WHITE-CHINNED PETREL	31	0	31
077 FLESH-FOOTED SHEARWATER	1677	0	1677
078 WEDGE-TAILED SHEARWATER	311	0	311
079 BULLER'S SHEARWATER	1049	0	1049
080 SOOTY SHEARWATER	6633	12	6645
082 FLUTTERING SHEARWATER	1380	1	1381
083 HUTTON’S SHEARWATER	964	170	1134
084 NORFOLK ISLAND LITTLE SHEARWATER	1	0	1
085 KERMADEC LITTLE SHEARWATER	4	0	4
086 NORTH ISLAND LITTLE (ALLIED) SHEARWATER	368	20	388
087 SUBANTARCTIC LITTLE SHEARWATER	5	0	5
- - PRION SPECIES	[4]	0	[4]
121 LEACH'S FORK-TAILED PETREL	0	1	1
123 GREY-BACKED STORM PETREL	498	189	687
124 WHITE-FACED STORM PETREL	6346	24	6370
126 BLACK-BELLIED STORM PETREL	6	0	6
127 WHITE-BELLIED STORM PETREL	1	0	1
131 NORTHERN DIVING PETREL	6731	2	6733
133 SUBANTARCTIC DIVING PETREL	19	0	19
132 SOUTHERN DIVING PETREL	53	48	101
135 DIVING PETREL	1	0	1
- - PETREL SPECIES	[1]	0	[1]
141 RED-TAILED TROPIC BIRD	117	0	117
142 WHITE-TAILED TROPIC BIRD	13	0	13
161 AUSTRALASIAN GANNET	14730	142	14872
162 BROWN BOOBY	1	0	1
163 MASKED (BLUE-FACED) BOOBY	148	0	148
171 BLACK SHAG	443	7	150
172 PIED SHAG	168	0	168
173 LITTLE BLACK SHAG	954	0	954
174 LITTLE (WHITE-THROATED) SHAG	116	0	116
176 STEWART ISLAND SHAG	2	0	2
179 AUCKLAND ISLAND SHAG	154	0	154
180 CAMPBELL ISLAND SHAG	65	0	66
182 SPOTTED SHAG	411	6	417
216 WHITE-FACED HERON	13	0	13
213 WHITE HERON	2	0	2
215 REEF HERON	46	1	47
220 CATTLE EGRET	1	0	1
218 BITTERN	7	0	7
242 MUTE SWAN	4	0	4
243 BLACK SWAN	(59651)	308	(59959)
241 CANADA GOOSE	(49770)	1624	(51394)
245 PARADISE SHELDUCK	(56477)	5655	(62132)
252 MALLARD	(79687)	4096	(83783)
259 HYBRID MALLARD (CROSS)	(1760)	0	(1760)
251 GREY DUCK	(34146)	32	(34178)

TABLE ONE
GENERAL BANDING TOTALS
(REBANDS EXCLUDED)

SPECIES NUMBER AND NAME	TOTAL PRE 1987	TOTAL 87/88	TOTAL FOR ALL YEARS
247 GREY TEAL	(1490)	0	(1490)
248 BROWN TEAL	(1065)	384	(1449)
249 AUCKLAND ISLAND TEAL	12	0	12
250 CAMPBELL ISLAND TEAL	3	0	3
253 NEW ZEALAND SHOVELER	(4494)	0	(4494)
254 BLUE DUCK	(115)	6	(121)
256 NEW ZEALAND SCAUP	(96)	0	(96)
- - DUCK (GREY OR MALLARD)	[(13)]	0	[(13)]
272 AUSTRALASIAN HARRIER	4292	50	4342
281 NEW ZEALAND FALCON	38	0	38
296 CHUKOR	2055	67	2122
299 RED-LEGGED PARTRIDGE	9541	3656	13197
300 RED-LEGGED PARTRIDGE (HYBRID)	42	0	42
298 GREY PARTRIDGE	(14144)	71	(14215)
292 BROWN QUAIL	18	0	18
295 CALIFORNIA QUAIL	(12204)	0	(12204)
293 PHEASANT	(55831)	542	(56373)
331 BANDED RAIL	32	0	32
335 NORTH ISLAND WEKA	3457	17	3474
336 WESTERN WEKA	442	8	450
337 BUFF WEKA	19	12	31
338 STEWART ISLAND WEKA	781	0	781
340 MARSH CRAKE	5	0	5
341 SPOTLESS CRAKE	23	0	23
342 PUKEKO	1833	0	1833
343 NOTORNIS	198	0	198
- - WEKA SPECIES	[1]	0	[1]
401 SOUTH ISLAND PIED OYSTERCATCHER	1153	97	1250
402 VARIABLE OYSTERCATCHER	256	9	265
404 CHATHAM ISLAND OYSTERCATCHER	80	0	80
403 (BLACK OYSTERCATCHER)	101	0	101
411 SPUR-WINGED PLOVER	629	0	629
413 LEAST GOLDEN PLOVER (PACIFIC GOLDEN PLOVER)	1	0	1
418 NEW ZEALAND DOTTEREL	207	24	231
415 BANDED DOTTEREL	3169	474	3643
422 BLACK-FRONTED DOTTEREL	42	0	42
419 NEW ZEALAND SHORE PLOVER	365	0	365
420 WRYBILL	2198	188	2386
445 EASTERN BAR-TAILED GODWIT	59	0	59
451 TURNSTONE	9	0	9
453 CHTAHAM ISLAND SNIPE	127	0	127
454 SNARES ISLAND SNIPE	223	45	268
458 KNOT	1568	0	1568
461 CURLEW SANDPIPER	4	0	4
462 RED-NECKED STINT	1	0	1
481 PIED STILT	434	0	434
482 BLACK STILT	125	0	125
511 SOUTHERN GREAT SKUA	1288	38	1326
512 ANTARCTIC SKUA	2414	0	2414

TABLE ONE
GENERAL BANDING TOTALS
(REBANDS EXCLUDED)

SPECIES NUMBER AND NAME	TOTAL PRE 1987	TOTAL 87/88	TOTAL FOR ALL YEARS
514 ARCTIC SKUA	1	0	1
521 SOUTHERN BLACK-BACKED GULL	66034	595	66629
523 RED-BILLED GULL	86947	261	87208
524 BLACK-BILLED GULL	34923	220	35143
527 CASPIAN TERN	5231	62	5293
525 BLACK-FRONTED TERN	1259	16	1275
529 ANTARCTIC TERN	94	64	158
531 FAIRY TERN	8	0	8
532 WHITE-FRONTED TERN	23332	0	23332
533 SOOTY TERN	14588	0	14588
534 COMMON NODDY	2	0	2
535 WHITE-CAPPED NODDY	7	0	7
536 WHITE TERN	3	0	3
537 GREY TERNLET	49	0	49
551 NEW ZEALAND PIGEON	106	18	124
552 CHATHAM ISLAND PIGEON	10	0	10
553 ROCK PIGEON	60	0	60
554 MALAY SPOTTED DOVE	2	0	2
561 KAKAPO	60	5	65
563 SOUTH ISLAND KAKA	29	5	34
564 KEA	1164	49	1213
566 EASTERN ROSELLA	1	0	1
572 ANTIPODES ISLAND PARAKEET	69	0	69
567 KERMADEC PARAKEET	6	0	6
568 RED-CROWNED PARAKEET	692	23	715
569 CHATHAM ISLAND RED-CROWNED PARAKEET	1	0	1
570 REISCHECK'S PARAKEET	56	0	56
573 YELLOW-CROWNED PARAKEET	38	0	38
574 CHATHAM ISLAND YELLOW-CROWNED PARAKEET	9	0	9
583 SHINING CUCKOO	54	4	58
584 LONG-TAILED CUCKOO	4	0	4
601 MOREPORK	47	0	47
604 LITTLE OWL	16	0	16
621 NEW ZEALAND KINGFISHER	219	5	224
641 NORTH ISLAND RIFLEMAN	119	11	130
642 SOUTH ISLAND RIFLEMAN	582	0	582
646 ROCK WREN	4	0	4
651 SKYLARK	33	2	35
662 WELCOME SWALLOW	307	9	316
741 NEW ZEALAND PIPIT	46	0	46
731 HEDGESPARROW	1854	110	1964
701 NORTH ISLAND FERNBIRD	34	0	34
702 SOUTH ISLAND FERNBIRD	246	11	257
703 STEWART ISLAND FERNBIRD	27	0	27
706 SNARES FERNBIRD	138	14	152
711 BROWN CREEPER	283	1	284
712 WHITEHEAD	273	8	281
713 YELLOWHEAD	78	5	93
714 GREY WARBLER	878	37	915

TABLE ONE
GENERAL BANDING TOTALS
(REBANDS EXCLUDED)

SPECIES NUMBER AND NAME	TOTAL PRE 1987	TOTAL 87/88	TOTAL FOR ALL YEARS
715 CHATHAM ISLAND WARBLER	74	0	74
681 NORTH ISLAND FANTAIL	476	34	510
682 SOUTH ISLAND FANTAIL	761	19	780
684 PIED TIT	175	0	175
685 YELLOW-BREASTED TIT	414	2	416
686 CHATHAM ISLAND TIT	14	12	26
687 BLACK TIT	74	32	106
689 NORTH ISLAND ROBIN	49	0	49
690 SOUTH ISLAND ROBIN	1680	79	1759
691 STEWART ISLAND ROBIN	10	0	10
692 BLACK ROBIN	106	39	145
721 SONG THRUSH	2708	59	2767
722 BLACKBIRD	5943	180	6123
761 SILVEREYE	53516	715	54231
751 STITCHBIRD	271	0	271
753 BELLBIRD	5414	119	5533
755 TUI	809	41	850
756 CHATHAM ISLAND TUI	1	0	1
775 YELLOWHAMMER	733	35	768
776 CIRL BUNTING	2	9	11
774 CHAFFINCH	2053	91	2144
771 GREENFINCH	4518	246	4764
772 GOLDFINCH	2027	42	2069
773 REDPOLL	6502	323	6825
781 HOUSE SPARROW	24070	673	24743
791 STARLING	17349	32	17381
792 INDIAN MYNA	1397	0	1397
821 NORTH ISLAND SADDLEBACK	1018	61	1079
822 SOUTH ISLAND SADDLEBACK	289	0	289
824 NORTH ISLAND KOKAKO	29	3	32
811 BLACK-BACKED MAGPIE	38	0	38
812 WHITE-BACKED MAGPIE	250	0	250
813 HYBRID MAGPIE	25	0	25
- - MAGPIE SPECIES	[4]	0	[4]
802 ROOK	957	75	1032
*** Total ***	985638	26497	1012135

TABLE TWO

Summary of recoveries added to the computer file during the report year. NOTE: The figures in the repeat column are already incorporated in the total column.

SPECIES NUMBER AND NAME	DEAD	ALIVE	TOTAL	REPEAT
001 NORTH ISLAND BROWN KIWI	2	76	78	58
012 YELLOW-EYED PENGUIN	41	777	818	538
014 COOK STRAIT BLUE PENGUIN	4	1	5	1
016 WHITE-FLIPPERED BLUE PENGUIN	29	1284	1313	911
017 ROCKHOPPER PENGUIN	34	112	146	28
020 SNARES CRESTED PENGUIN	0	91	91	19
026 NORTHERN BLUE PENGUIN	1	0	1	0
041 WANDERING ALBATROSS	0	14	14	7
043 SOUTHERN ROYAL ALBATROSS	17	306	323	83
044 NORTHERN ROYAL ALBATROSS	2	1	3	1
045 BLACK-BROWED MOLLYMAWK	0	14	14	12
046 NEW ZEALAND BLACK-BROWED MOLLYMAWK	9	159	168	48
047 GREY-HEADED MOLLYMAWK	1	88	89	26
049 BULLER'S MOLLYMAWK	1	120	121	91
054 LIGHT-MANTLED SOOTY ALBATROSS	1	3	2	0
061 SOUTHERN GIANT PETREL	3	3	6	1
062 CAPE PIGEON	2	0	2	0
063 SNARES CAPE PIGEON	0	126	126	6
066 BROAD-BILLED PRION	0	3	3	1
073 FAIRY PRION	6	62	68	3
080 SOOTY SHEARWATER	3	637	640	335
083 SHEARWATER	2	15	17	1
090 BLACK PETREL	1	0	1	0
091 BLACK PETREL	1	179	189	77
093 GREY-FACED PETREL	6	22	28	12
104 COOK'S PETREL	0	1	1	0
105 CHATHAM ISLAND PETREL	0	2	2	0
109 NORTHERN GIANT PETREL	0	1	1	0
123 GREY-BACKED STORM PETREL	0	7	7	0
124 WHITE-FACED STORM PETREL	1	0	1	0
131 NORTHERN DIVING PETREL	0	5	5	1
161 AUSTRALASIAN GANNET	13	9	22	7
171 BLACK SHAG	1	0	1	0
173 LITTLE BLACK SHAG	0	1	1	0
182 SPOTTED SHAG	2	0	2	0
215 REEF HERON	0	1	1	0
241 CANADA GOOSE	857	1093	1950	654
243 BLACK SWAN	386	537	923	34
245 PARADISE SHELDUCK	425	485	910	29
248 BROWN TEAL	2	0	2	0
251 GREY DUCK	11	0	11	0
252 MALLARD	391	29	420	6
253 NEW ZEALAND SHOVELER	26	0	26	1
259 HYBRID MALLARD (CROSS)	2	0	2	0
272 AUSTRALASIAN HARRIER	8	21	29	3
293 PHEASANT	47	0	47	
296 CHUKOR	2	0	2	0

299 RED-LEGGED PARTRIDGE	32	1	33	0
336 WESTERN WEKA	2	0	2	0
342 PUKEKO	1	0	1	0
401 SOUTH ISLAND PIED OYSTERCATCHER	1	1	2	0
402 VARIABLE OYSTERCATCHER	3	3	6	1
404 CHATHAM ISLAND OYSTERCATCHER	0	19	19	18
415 BANDED DOTTEREL	5	12	18	5
418 NEW ZEALAND DOTTEREL	0	27	27	24
420 WRYBILL	0	16	16	2
453 CHATHAM ISLAND SNIPE	0	10	10	0
454 SNARES ISLAND SNIPE	3	129	132	72
458 KNOT	1	4	5	0
482 BLACK STILT	0	2	2	0
511 SOUTHERN GREAT SKUA	3	122	125	83
512 ANTARCTIC SKUA	0	1	1	0
521 SOUTHERN BLACK-BACKED GULL	102	7	109	1
523 RED-BILLED GULL	95	1502	1597	172
524 BLACK-BILLED GULL	85	9	94	0
527 CASPIAN TERN	1	0	1	0
529 ANTARCTIC TERN	0	37	37	22
532 WHITE-FRONTED TERN	10	14	14	1
561 KAKAPO	0	1	1	1
564 KEA	0	32	32	7
568 RED-CROWNED PARAKEET	0	6	6	0
583 SHINING CUCKOO	0	1	1	0
601 MOREPORK	0	2	2	0
621 NEW ZEALAND KINGFISHER	0	1	1	1
641 NORTH ISLAND RIFLEMAN	0	8	8	4
662 WELCOME SWALLOW	1	0	1	0
681 NORTH ISLAND FANTAIL	0	8	8	2
687 BLACK TIT	1	0	1	0
690 SOUTH ISLAND ROBIN	0	1	1	0
692 BLACK ROBIN	6	79	85	43
702 SOUTH ISLAND	0	13	13	0
714 GREY WARBLER	0	8	8	1
715 CHATHAM ISLAND WARBLER	0	2	2	0
721 SONG THRUSH	1	20	21	6
722 BLACKBIRD	5	100	105	51
731 HEDGESPARROW	1	17	18	8
753 BELLBIRD	0	125	125	30
755 TUI	4	38	42	10
761 SILVEREYE	2	586	588	351
773 REDPOLL	0	1	1	0
774 CHAFFINCH	1	29	30	8
781 HOUSE SPARROW	5	22	27	3
791 STARLING	7	2	9	2
812 WHITE-BACKED MAGPIE	4	0	4	0
821 NORTH ISLAND SADDLEBACK	3	3	6	0
822 SOUTH ISLAND SADDLEBACK	0	1	1	0

*** Total ***

PROJECT NO: S5030/131
CORPORATE OBJECTIVE NO: 8

TITLE: Conservation of the Chatham Island Taiko (*Pterodroma magentae*)

PROJECT LEADER: M J Imber

PROJECT: The Chatham Island Taiko, or Magenta Petrel *Pterodroma magentae* is an endangered nocturnal seabird now reduced to less than 100 individuals. The search for its breeding places has been in progress since it was rediscovered in 1973. In 1982 the New Zealand Wildlife Service initiated trials with transmitters suitable for use on Taikos. The Department of Conservation has continued with this project in collaboration with the Taiko Expedition, lead by D.E. Crockett and largely sponsored by the Ornithological Society of New Zealand

OBJECTIVES:

a) To find the nesting burrows of Taikos.

b) To assess the threats to survival of Taikos at their breeding places, and recommend corrective action.

c) To learn as much as possible about the biology of this petrel.

METHODS

Radiotelemetry is being used to track Taikos in the suspected breeding area. Although it is anticipated that most Taikos radio-tagged will be non-breeders without burrows, it is hoped that a few will go to ground. Having found burrows, the status of these burrows and effects of potential predators in their neighbourhood will be studied. However, because of the endangered status of this petrel, management will have to proceed with research. If predators are discovered near the burrows, trapping will begin to provide some protection for the birds.

INTERIM RESULTS:

During October to December 1987, when the main expedition took place, 12 Taikos were captured at the light station in the Tuku-a-tamatea valley (where the species was rediscovered). Transmitters were affixed to the central tail feathers of the first 10 caught (Table 1).

A network of 5 receiving stations was established; 3 of these were in the south-west of the Chatham Island, one on Mangere Island, and one on Houruakopara Island. Tracking of the Taikos took place from 16 October to the end of December, but most results were attained before mid-November. This was because, as expected, most Taikos caught were non-breeders and their visits to the breeding area ceased during November.

However, 2 of the Taikos with transmitters went to burrows and may have been breeders. One of these provided a good cross-bearing from 2 stations, but the other was far to the north and not well located because of intervening hills.

After studying aerial photographs of the two areas, searching for burrows began. One burrow was found in November and 4 in April 1988, during a later trip. These were in two areas 4 km apart (Table 2). Only one of these burrows produced a fledgling. Although one Taiko has been seen, none has been handled at these burrows, all of which are at least 1.5 m long and slope deeply under tree roots.

Potential predators, particularly feral cats, were more numerous in the first area found (Taiko valley). Trapping there over 1 month from mid-November produced 10 feral cats, numerous possums and wekas, and a ship rat. No predation of Taiko was found but a weka may have killed the chick in one burrow.

INTERIM CONCLUSIONS:

The achievements of the main expedition and its follow-up far exceeded our expectations. Five burrows in two areas 4 apart were found, and one produced a fledgling which hopefully flew. Destinations of the only 2 transmittered Taikos that definitely went to burrows were found, though it was a little disappointing not to have tracked one right into its burrow. At least there are now known routes into the two areas.

However, the activities of some transmittered Taikos near the cliffs eastwards from false Green Point, and near Otawae are unexplained. These areas could be significant and may repay further exploration.

INTERIM RECOMMENDATIONS:

a) A similar radiotelemetry operation should be carried out in 1988. If another 7-10 transmitted birds can be tracked, they should give an indication of whether there are more areas with burrows than the two now found.

b) Decisions on how management should proceed would perhaps be best left until after the 1988 operation.

c) A trained bird-dog could be very useful for searching out burrows in the bush.

d) Predator control (feral cats and wekas) should be carried out, to such an extent as is possible, where needed.

TABLE 1

Taiko sightings and captures in 1987 at the Tuku light station, in 12-day periods (full moon on 7 Oct, 6 Nov and 5 Dec).

Dates	Taiko seen =	Not caught +	Caught
9/10 to 20/10	8	3	5
21/10 to 1/11	6	4	2
9/11 to 20/11	6	2	4
21/11 to 2/12	0	0	0
6/12 to 17/12	3	2	1
TOTALS	23	11	12

TABLE 2

Taiko burrows found during the 1987/88 research period, and their status.

	Number of burrows	Breeding burrows			Being dug
		Egg	Chick	Fledged	
Taiko Valley	3	2	1?	0	1
North Taiko Hill	2	1	1	1	1

PROJECT TITLE: The distribution, abundance, production, and potential activity of the rainbow trout (Salmo gardneri Richardson) population in Lake Taupo and its tributaries.

(To be conducted on contract for DOC as a National Research Advisory Council Fellowship by Martin Cryer.)

OBJECTIVES:

There is some concern that increasing angler pressure on the Taupo fishery may be resulting in a decrease in the catch rate of trout (catch per unit effort or CPUE). This perceived problem, allied with an increasing annual harvest approaching the lower of the best available of total annual of trout in the lake, led to the instigation of this fellowship. The project is designed to provide reliable information on the fishery to enable objective and informed management of the resource in the future. Specific objectives are as follows:

- To determine the spatio-temporal distribution patterns of trout in Lake Taupo.
- To determine the size-, age-, and location-specific diets of trout in the lake.
- To estimate -the productivity of trout and forage species such as smelt in the lake.
- Model the fishery to predict the consequences present and future patterns of exploitation.

The first phase of the project will entail acquisition of the necessary equipment and expertise, followed by the completion of a first annual cycle of samples (improved through experience gained from the first), and a preliminary estimation of production. Finally a third phase would involve more precise work on production, and the creation of a predictive computer model and final reports. To date all work has been part of phase 1.

* Distribution and abundance of trout.

The basis of the whole study is a computer-interfaced split-beam echo sounder. This VDU-type sounder (SIMRAD model ES470 imported from Norway) operates on a frequency of 70 kHz and a cone size of 5 degrees either side of the acoustic axis using a quadruple transducer and microprocessor-controlled logic.

It overcomes many of the quantitative problems inherent in simpler sounders by assessing the position of each individual target within the acoustic beam by reference to phase differences among echoes returning to each of the transducer elements. This system, allied with TVG ("time-varied amplifier gain") settings suitable for freshwater operation, allows precise estimates to be made of the size of each identified target -a conclusion not possible using a simple sounder where the position of the fish with the beam cannot be determined. As well as producing the usual echogram (hard copy printout), the sounder transmits information on identified single targets directly to an on-board computer (ATARI 1040 STF) in the form of data triplets (“ping” number; depth; target strength), which are suitable for later analysis.

Auxilliary information on size distribution, and diet of trout is being derived from fish captured in gill nets. These nets have been specifically designed and constructed for this project (each having a range of mesh sizes to sample the whole range of trout sizes in the lake) and can be set at predetermined depths in any area of the lake. In practice, the nets are set overnight at each of 5 or 6 selected sites, with
nets at the surface, two on the bottom, and two in midwater. Captured fish are retained for analysis of size distribution, maturity, gut contents, and life history traits (from scales).

Areas of the lake inaccessible to the sounder (< ~20 m depth) are being sampled by direct observation by SCUBA divers. It is not yet known whether free-swimming or manta-board towed search patterns will be the most appropriate method in Taupo.

* Distribution and abundance of prey fish.

Prey fish are being surveyed using a drop net and a purse seine, with some extra information from the sounder. The drop net is a large conical net made of fine (1.5 mm aperture) mesh attached to a heavy metal collar weighted with lead. It is operated by allowing it fall unimpeded from the surface to within < 5 m of the bottom of the lake, whereupon it is "throttled" and winched back to the surface. Smelt and immature bullies are the major species caught using this net and, using previously-determined avoidance coefficients for different sizes of fish (R.T.T Stephens), quantitative estimates of abundance can be derived for limnetic regions of the lake. The purse seine is modelled on a net successfully used in the Rotorua (P. Mylechreest), and is 30 m long and 7 m (max.) deep. It is used to sample prey fish in areas too shallow for the drop net, and enables quantitative estimates to be made for this important littoral region.

While the sounder is used primarily to determine trout density and distribution patterns, it is also capable of detecting concentrations of fish (ie those under the theoretical lower limit of ~ 10 cm imposed by the sounder’s TVG regime). This is usually exhibited on echograms as a "cloud" of small targets in more or less well-defined bands. It should be possible to exploit this "extra" information and increase the coverage and precision of prey fish surveys by calibrating the total output of the sounder (corrected for depth and ping repetition frequencies) against drop net catches at sites sampled using both methods.

INTERIM RESULTS:-

* Trout distribution and diet studies

The sounder has been successfully fitted to ‘Koaro’, and calibrated for use in the fresh water of Lake Taupo. One full survey of the lake has been completed using a stratified random design of 90 1km transects in 15 strata. The experiences of this survey suggest, however, that 90 transects are rather too many to complete in the time available for each survey and that samples were rather too concentrated around certain areas. Future surveys will be conducted using 70 transects spread among 14 slightly modified strata. Preliminary analysis of the first survey was conducted by examining the 90 echograms by eye and entering the number of trout observed in each depth band of each transect into a spreadsheet. Corrections for cone size at depth and the area of each depth band surveyed were then applied to derive an estimate of the density of trout on each transect (Figure 1), and subsequently a rough estimate of approximately one million individuals within the limnetic region of the lake was calculated. This does not represent a final analysis, and contains no information on size distribution, which will come from the more complete examination of the data currently underway.

The specialised nets and techniques necessary to this study have been successfully acquired. The first quarterly survey has been completed during which gill netting was conducted at 5 sites over a two week period, and 114 trout were captured. The selectivity of each mesh size is being examined by noting the size and method of capture (gilled or tangled) of all fish caught within each panel (Figure 2). This will be used in the future to make estimates of the true size distribution of fish from the size distribution of captured specimens. Scales and stomachs were removed from all captured fish and these have been preserved for later analysis of diet and life history.

* Prey fish studies.

Expertise in drop netting and purse seining has been acquired, but no quantitative surveys have yet been undertaken. Some modifications of Koaro still need to be made to enable safe operation of the drop net.

Figure 1. Lake Taupo showing the results of a preliminary analysis of the first hydroacoustic survey in March 1988 (numbers of trout per hectare). Data were collected at 6 stations within each of 15 strata, although the 14 modified strata for subsequent surveys are shown here.

A Gilled Fish (N = 73: 18xF; 19xM; 35xU)

Length (cm)	Mesh Panel 1	2	3	4	5	6
< 20	¦	¦	¦	***	*****	¦
20-25	¦	*	****	*************	****	¦
25-30	¦	*	*********	****	¦	¦
30-35	*	***	***	**	¦	¦
35-40	*	*	**	*	¦	¦
40-45	*	****	¦	¦	¦	¦
45-50	**	****	¦	¦	¦	¦
50-55	*	¦	¦	¦	¦	¦
55-60	**	*	¦	¦	¦	¦
> 60	¦	¦	¦	¦	¦	¦

B Tangled Fish (N = 41: 17xF; 24xM)

Length (cm)	Mesh Panel 1	2	3	4	5	6
< 20	¦	¦	¦	¦	¦	¦
20-25	¦	¦	¦	¦	¦	¦
25-30	¦	¦	¦	¦	¦	¦
30-35	¦	¦	*	¦	¦	¦
35-40	¦	¦	¦	**	¦	¦
40-45	¦	*	¦	¦	¦	¦
45-50	¦	*	********	¦	***	¦
50-55	¦	*	****	***	***	¦
55-60	*	***	******	**	*	¦
> 60	*	¦	¦	¦	¦	¦

Figure 2. The size distribution of fish caught in the various mesh panels of research gill nets set in Taupo in March 1988. Each asterisk indicates a single fish. Fish caught by gilling and tangling are presented separately.

Project summary from Peter Mylechreest July 1988

EXPERIMENTAL FISHERIES MANAGEMENT IN THE ROTORUA LAKES

Between 1979 and 1985 a succession of overlapping experimental management projects have been commenced; with the exception of 1980, a new project was started each year. The projects have used, in an experimental way, the continuing Management commitment to stock the Rotorua Lakes with hatchery reared rainbow trout. The overall objective has been to explore ways of improving the 'return to the angler' of hatchery-reared rainbow trout, in terms of size of fish, quality of fish, and numbers of fish. In addition to testing enhancement potentials, some projects have also identified harmful practices.

Reviewing the standard Ngongotaha Hatchery procedures, as they were in 1978 (Figure 1), it became apparent that some practices were carried out largely for the convenience of the hatchery operation rather than for sound biological reasons; genetic considerations had received little attention.

The first project (1979) focussed on the seasonal timing of collection for the hatchery, and demonstrated the degree of heritability of the seasonal timing of the spawning migration in rainbow trout (Figure 2). The findings have since been applied with considerable enhancement of the autumn fly-fishing in the Rotorua Lakes (notably Rotoiti). The dangers of liberating late-strain hatchery fish in to lake systems which support a population of wild early-strain fish (N.B. super-imposition) was highlighted (e.g.Lake Tarawera). The appropriateness of the closed season for angling (July-September inclusive) was questioned, and changes have been made which have increased the angling opportunity in the Rotorua Lakes District. The project also incidentally revealed a significant difference between the shallow eutrophic lakes and the deeper oligo/meso-trophic lakes - i.e. poor winter growth and good winter growth respectively, which opened a new avenue of understanding regarding the effects of eutrophication on trout.

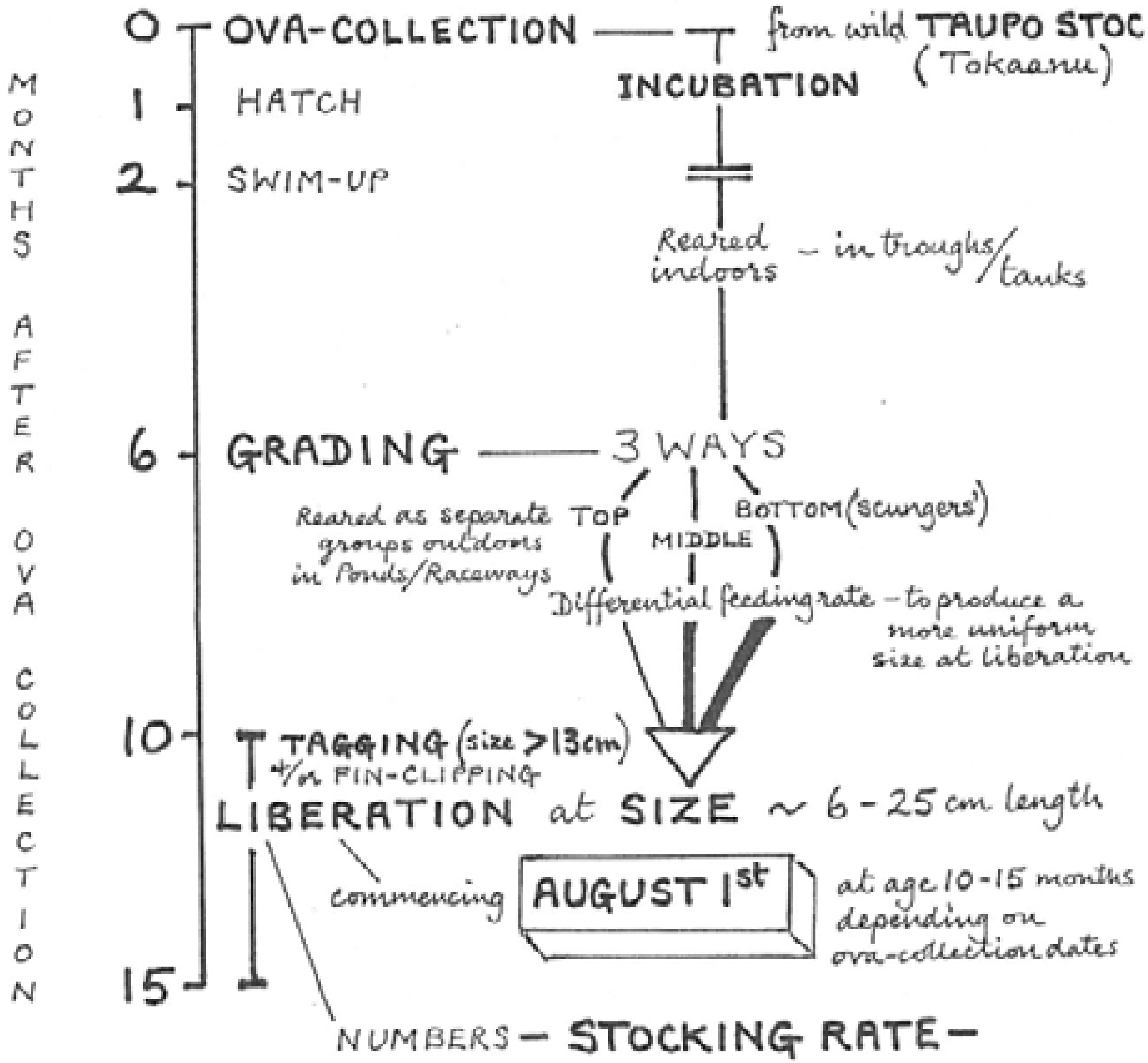


FIGURE 1 :- Standard Hatchery Procedure
— Ngongotaha Hatchery 1978 —

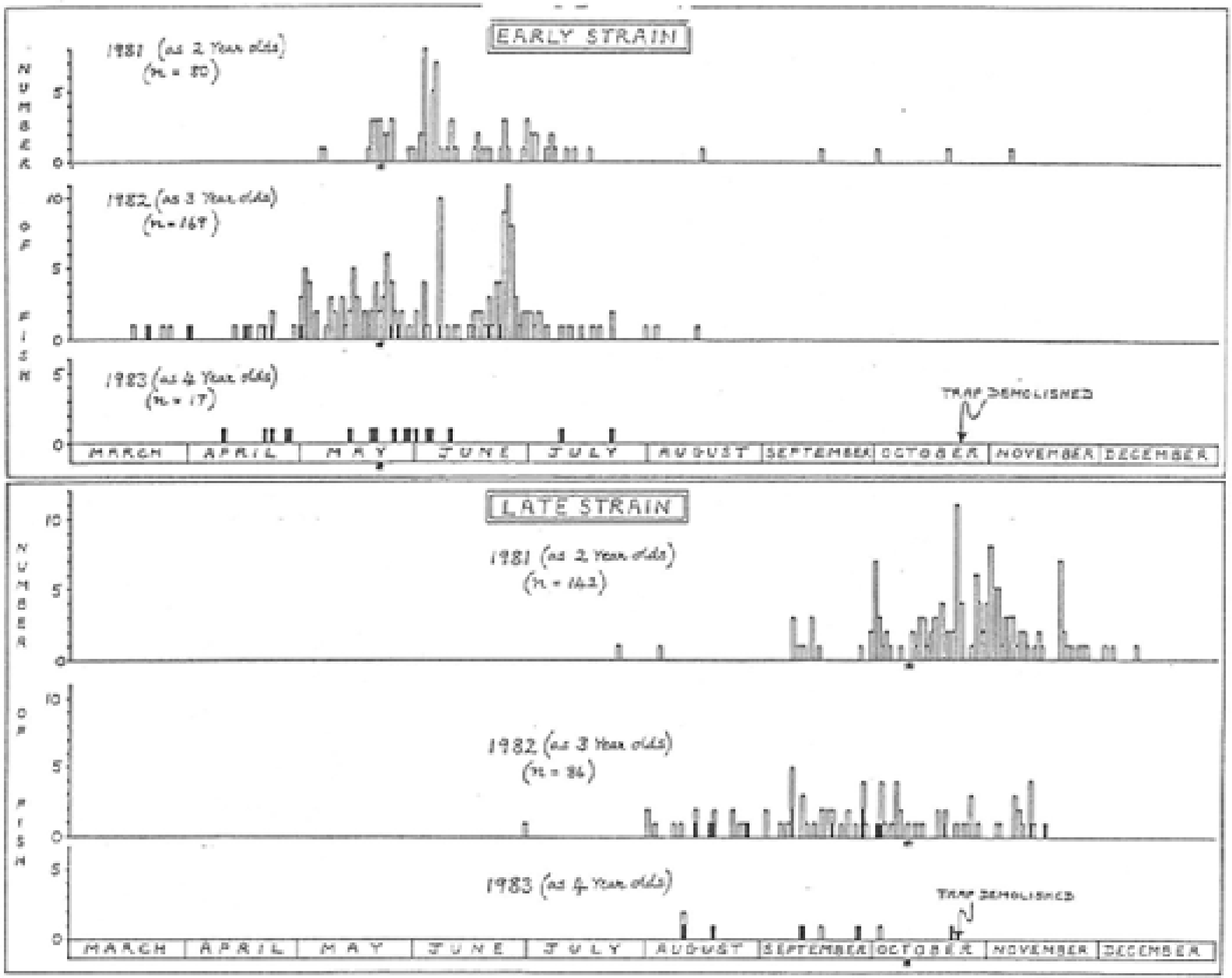


FIGURE 2:- The daily numbers of upstream migrant, hatchery-reared rainbow trout (from the 1980 liberation of 2500 early-strain, + 2500 late-strain, tagged 'yearlings' into Lake Rotorua) running through the Ngongotaha trap on their spawning migration: at 2, 3, + 4 years old. (■ = birthday – ie. date collected as ova)

(▮ = fish with previous year's trap fin-clip)

The second project (1981) focussed on age-at-maturity in rainbow trout. In the Rotorua Lakes rainbow trout put on little further growth after reaching maturity, and mature fish are generally in poor condition. Fish which delay maturity to age 3, or better still age 4, provide larger and better quality fish than those which mature at age 2, for trollers (boat fishermen)…

These two fish were caught by trolling on opening day (Oct 1st) 1985 Lake Tarawera.
They (the fish!) are of the same age (i.e. 3 years + ~3 months) and they demonstrate the effects of maturity at age 2 on growth and condition, compared with delayed maturity to age 4.

♀ 60·5 cm,
1·85 kg
spawned at age 2
+ again at age 3

♀ 65 cm,
4·3 kg
immature

and for autumn fly-fishermen

This large maturing male rainbow trout was caught by Jock Dunn flyfishing at the Wairua stream mouth – where it flows in to Lake Tarawera – on 12·6·84. It was kept alive in a floating holding bag and donated to the Ngongotaha hatchery for breeding.

♂ 72·5 cm, 4·9 kg
nicknamed 'MacSporran'

Among the wild rainbow trout in Lake Tarawera there has been a decline in age-at-maturity from predominantly at age 3 in the 1950's to predominantly at age 2 30 years later (Figure 3).
In 1981 bulk cross breeding trials using wild Tarawera stock 2 year old parents, wild Tarawera stock 3 year old maturing parents, and standard Taupo stock parents -in 3 separate groups -were carried out. The progeny were reared separately, marked differently, and liberated together into Lake Tarawera in 1982. They were followed up through angling returns, and, at maturity, through the Te Wairoa trap situated close to their liberation site. The Tarawera stock progeny (X and R tags) revealed a genetic influence over maturity at age 2 years (Figure 4). The R tags (progeny of 3 year maturing parents) demonstrated that it was possible to select for faster immature growth combined with delayed age-at-maturity; this was something of a breakthrough, because hitherto it was assumed that faster immature growth was inevitably linked to earlier age-at-maturity. Comparison of the age-at-maturity and growth characteristics of the standard Taupo stock with the Tarawera stock (Figure 4) revealed a similarity between the Taupo stock and the X tags (progeny of 2 year maturing parents). The decline in age-at-maturity, and hence size, of the wild Tarawera rainbow trout since the 1950's could now be explained on the basis of a change in the genetic constitution of the trout population; this directed attention towards a search for the selective pressures which could have brought about this change. The annual liberations of the hatchery-reared Taupo stock since the 1950’s may well have been an important factor but strong selective pressures for earlier age-at-maturity have been identified – e.g. the Wairua Waterfall (Figure *5)* and angling (Figure 6).

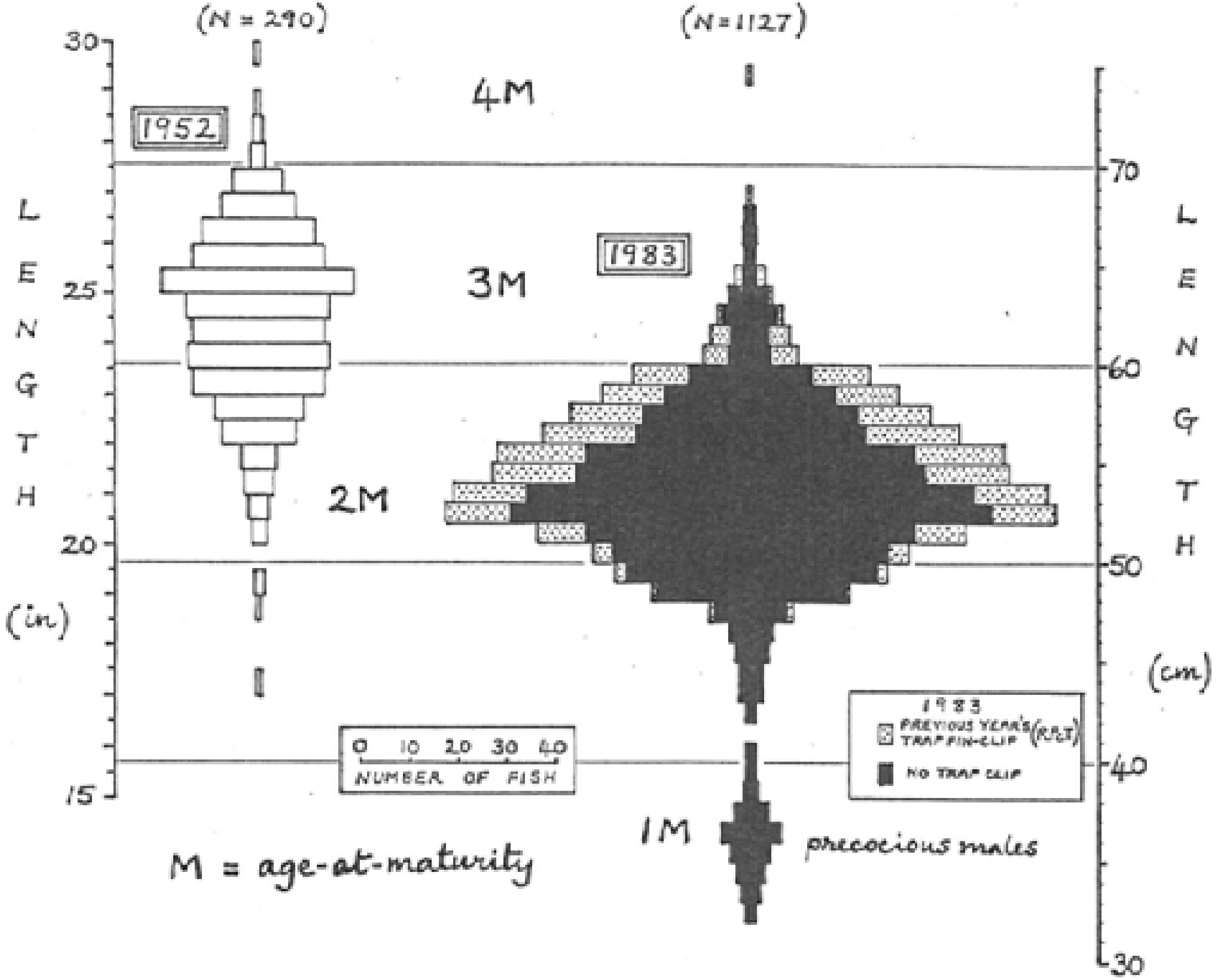


FIGURE 3 :- The length frequency distributions of wild rainbow trout running upstream through the Wairua trap, on their spawning migration from Lake Tarawera, between 21st April and 28th May of 1952 and 1983.

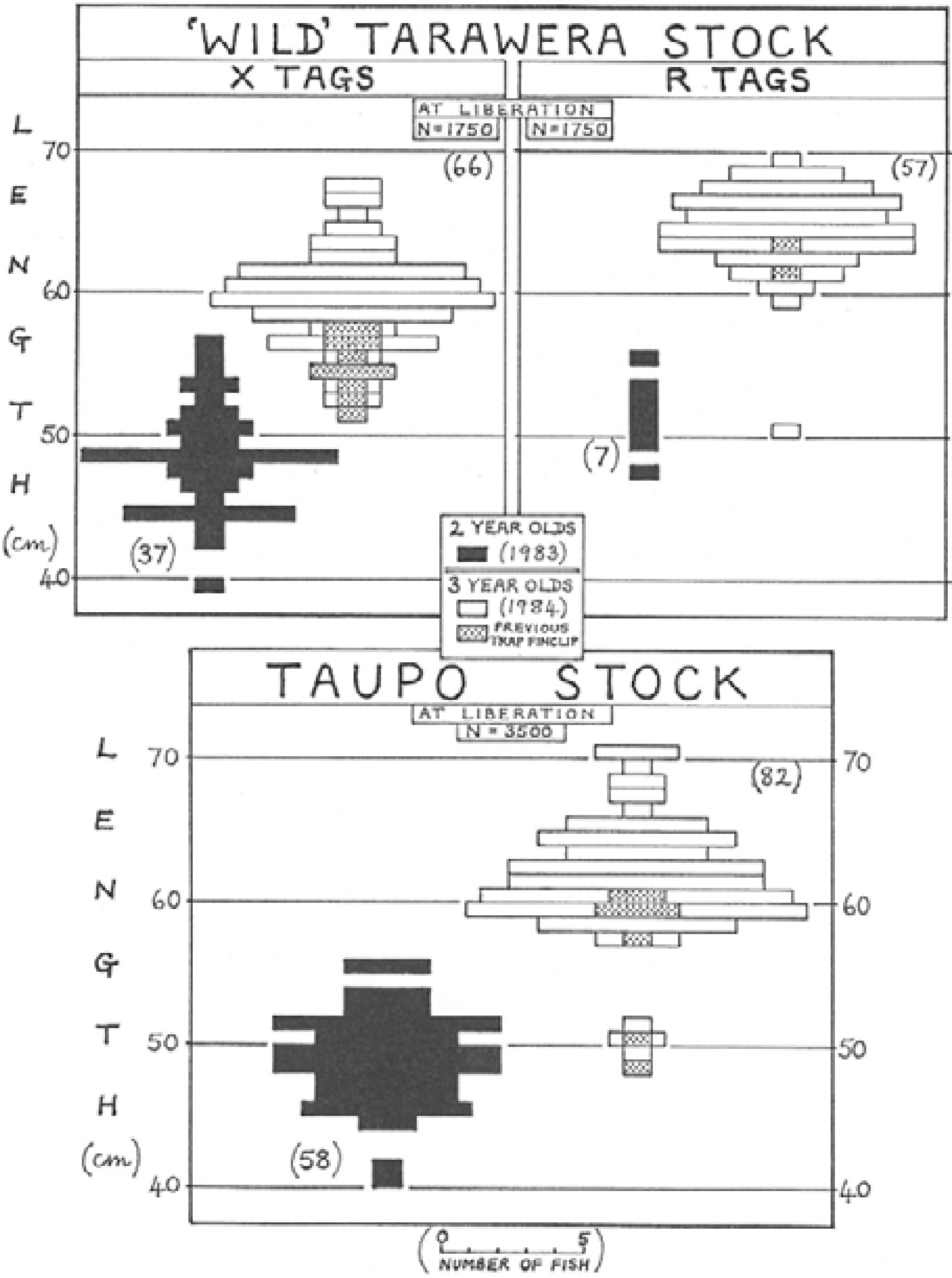


FIGURE 4:- The numbers and size composition of 2 year old (1983) and 3 year old (1984) mature hatchery rainbow trout running upstream through the Te Wairoa trap originating from the 1982 liberation into Lake Tarawera.

(▨ = repeat spawners, i.e. ran at age 2 and again at age 3)

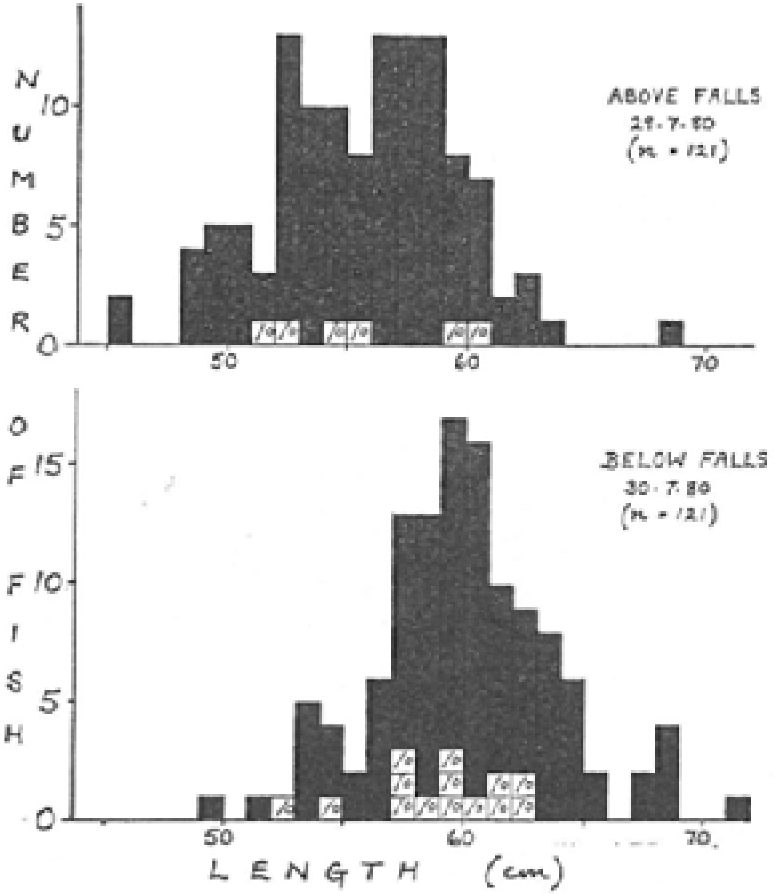
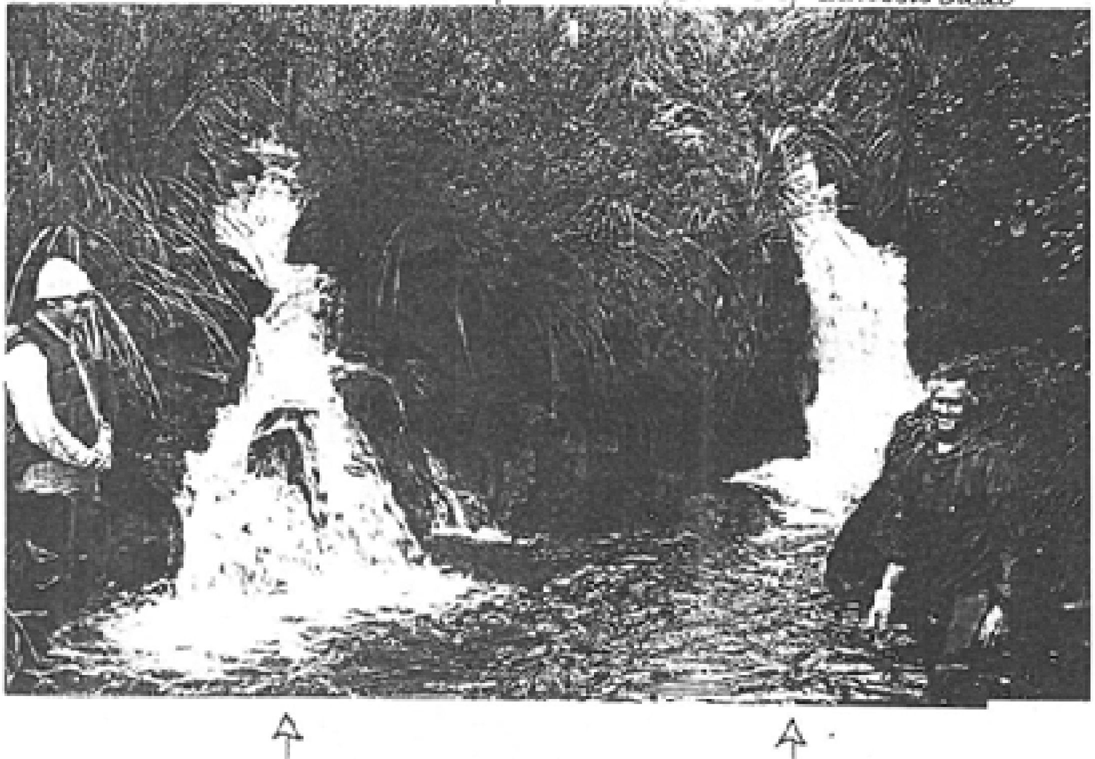


FIGURE 5 :- The length frequency distributions of mature rainbow trout captured in drives above + below the Wairua waterfall — July 1980.

(▨ = Fish with 1979 Trap fin-clip)

The Wairua waterfall - July 1980

a size selective barrier to the upstream migration of rainbow trout



The smaller fish (< 60 cm length) swim up through this series of shallow cascades — The larger, deep-bodied fish find insufficient depth of water

This side is impassable — The plunge pool is filled with rocks + rubble.

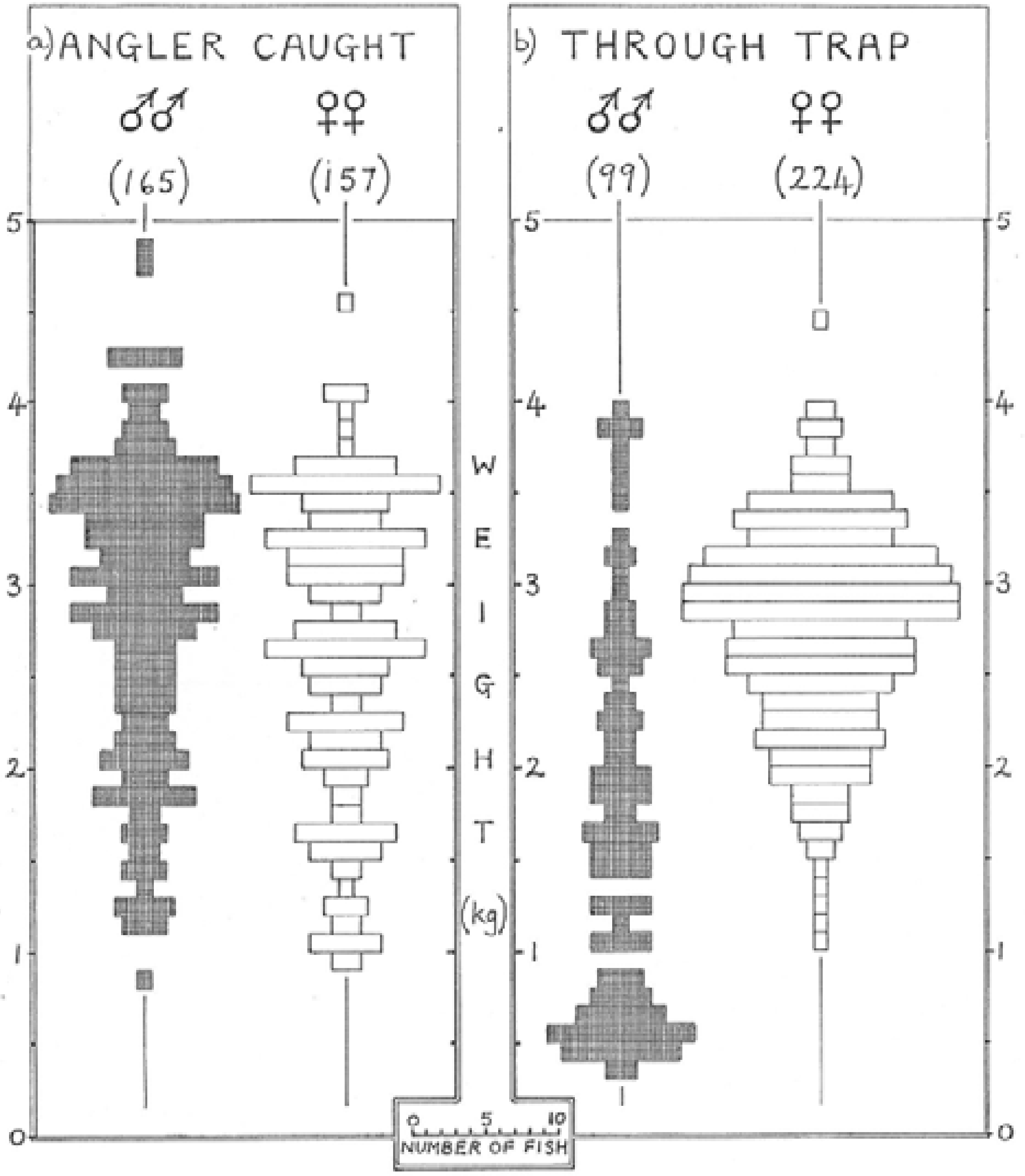


FIGURE 6 :- The numbers and size of male and female rainbow trout
a) caught by anglers at the Te Wairoa stream-mouth and b) running upstream through the Te Wairoa trap during the last 2½ months of the 1986/87 angling season (i.e. 17.4 – 30.6.87) — Lake Tarawera system.

In 1983, through some chance correspondence from Canada, the possibility of a 'Kootenay connection' with the renowned Gerrard stock of rainbow trout came to light, and raised speculation that the R-tagged fish (or "R-type' as they came to be known) might owe something to a residual genetic influence from an undocumented introduction of Gerrard stock rainbow trout from British Columbia to New Zealand.

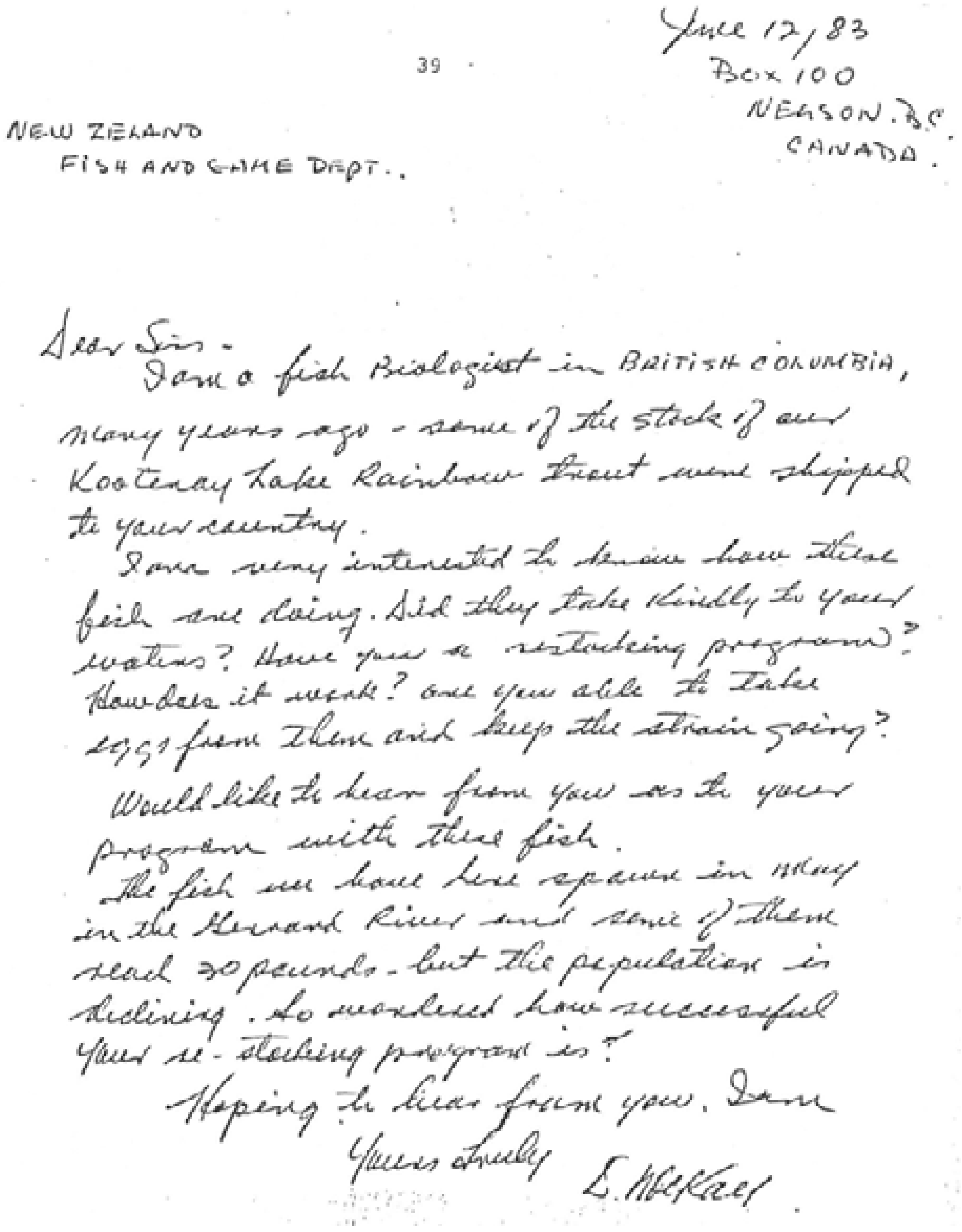
The outstanding performance of the R-tagged fish...

13½ MONTHS
AFTER LIBERATION

(2 . 10 . 83)

RC Tagged hatchery
rainbow trout
2+ immature
♂ 63 cm, 3.95 kg

... which was already apparent by opening day (October 1st) 1983, provided the inspiration for the Tarawera selective breeding programme. The initiative came from the anglers, who donated some of their best wild rainbow trout caught by fly - fishing in the autumn/winter of 1984. Logistic support for holding and transporting large live trout to the Ngongotaha Hatchery was quickly developed with more than a touch of Kiwi ingenuity. The programme has continued each year since then, supplemented with selected fish taken from the Te Wairoa trap. Since 1987 the programme has provided the bulk of the ova intake (approx. 150,000 ova per year) for the Ngongotaha Hatchery's liberations in the Rotorua Region.



39

June 17/83
Box 100
NELSON. B.C.
CANADA.

NEW ZEALAND
FISH AND GAME DEPT..

Dear Sir -
I am a fish Biologist in BRITISH COLUMBIA, many years ago - some of the stock of our Kootenay Lake Rainbow trout were shipped to your country.

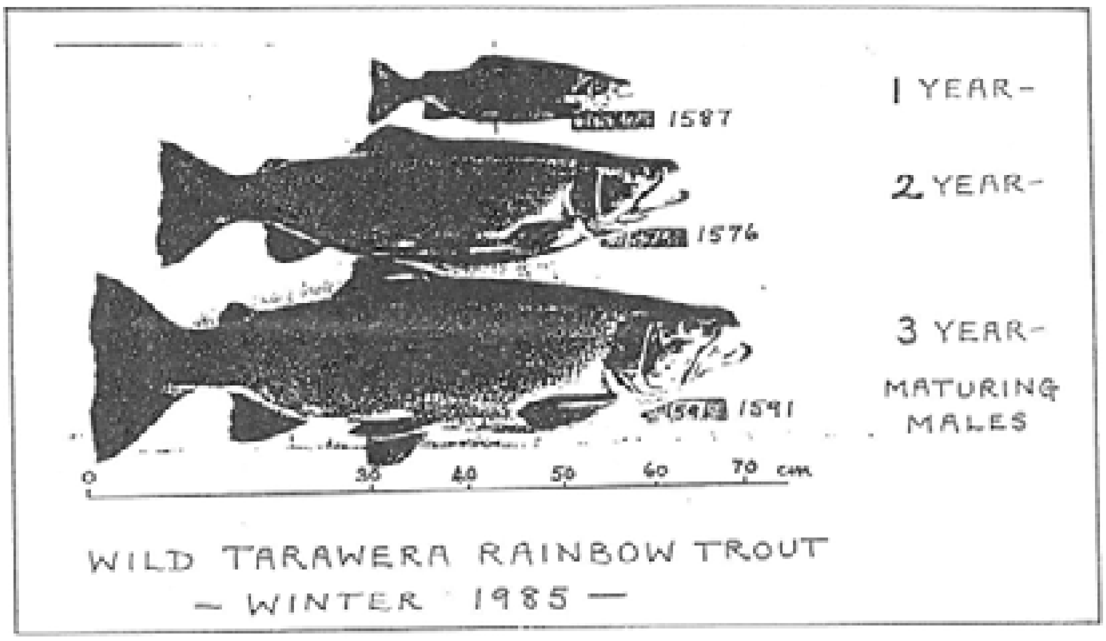
I am very interested to know how these fish are doing. Did they take kindly to your waters? Have you a restocking program? How does it work? are you able to take eggs from them and keep the strain going?

Would like to hear from you as to your program with these fish.

The fish we have here spawn in May in the Gerrard River and some of them reach 30 pounds - but the population is declining. So wondered how successful your re-stocking program is?

Hoping to hear from you. I am

Yours truly
E. McKay



WILD TARAWERA RAINBOW TROUT
— WINTER 1985 —

	♂♂ / ♀♀	AGE - AT - MATURITY											
		1 YEAR P				2 YEAR M				3 YEAR L			
		1577 28cm 0.45kg TWT	1601 35, 0.7 TWT	1555 32, 0.55 TWT	1587 29, 0.35 TWT	1575 52cm 2.35kg TWT	1551 56.5, 2.85 TWT	1576 55.5, 2.55 TWT	1650 52, 2.05 TWT	1580 66cm 3.7kg Dennis Hodson outlet	1597 68.5, 4.7 Bill Rohe, outlet	1591 69, 4.6 Ivan Allison outlet	1574 68, 3.8 TWT
AGE AT MATURITY 2 YEAR M	53 cm 2.25 kg TWT 1627	26·6				26·6				26·6			
	53 2.2 TWT 1572		26·6				26·6				26·6		
	54 2.6 Bill Rohe, outlet 1598			10·7				10·7				10·7	
	55 2.2 TWT				26·7				26·7				26·7
3 YEAR L	63 cm 3.9 Kg Bill Rohe, outlet 1573	27·6				27·6				27·6			
	66 4.15 Bill Rohe, outlet 1628		26·6				26·6				26·6		
	64 3.8 TWT 1578			4·7				4·7				4·7	
	66 4.4 Russell King, outlet 1588				☒ 18·7				☒ 18·7				☒ 18·7

FIGURE 7 :- The 1985 breeding trials — the date in each square indicates the ova collection date for each pair-cross — The 3 year female (1588) produced such a low fertility that her 3 batches had to be discarded (TWT = from the Te Wairoa trap, names = anglers donating parent fish)

In the winter of 1987 a study of stream-mouth fly-fishing at Te Wairoa, in conjunction with the Te Wairoa trapping, demonstrated intense angling selectivity on large (older maturing) male rainbow trout (Figure 6).

Pair cross breeding trials were carried out in 1985 (Figure 7), and the progeny have been followed up to age 3 (in progress, winter 1988). The results will provide some insight into the consequences of the angling depletion of large males, and will help to develop optimum strategies in the selective breeding programme.

A significant discovery from the pair cross breeding trials was bimodality in the length frequency distributions of yearling progeny from some individual pair crosses (Figure 8). This is being followed up through tagging; the results could have significant implications regarding a standard hatchery procedure - i.e. grading.

The 'third' experimental management project (1983) explored the consequences of the seasonal timing of (and age at) liberation of early-strain hatchery-reared rainbow trout in a shallow, eutrophic lake (Rotorua) and a deep, oligo/mesotrophic lake (Tarawera). The standard spring liberation of early-strain hatchery rainbow trout at age 1+ gives the fish 2 summers and 1 winter in the lake prior to age 3; autumn liberation at age 0+ gives the fish 2 winters and 2 summers prior to age 3. Autumn liberation was a comparative failure in Lake Rotorua (Figure 9), but in Lake Tarawera it not only gave a slightly better return of numbers than spring liberation, but it also resulted in a substantial growth advantage, with a greater number of trophy specimens (over 10 lbs) at age 3.

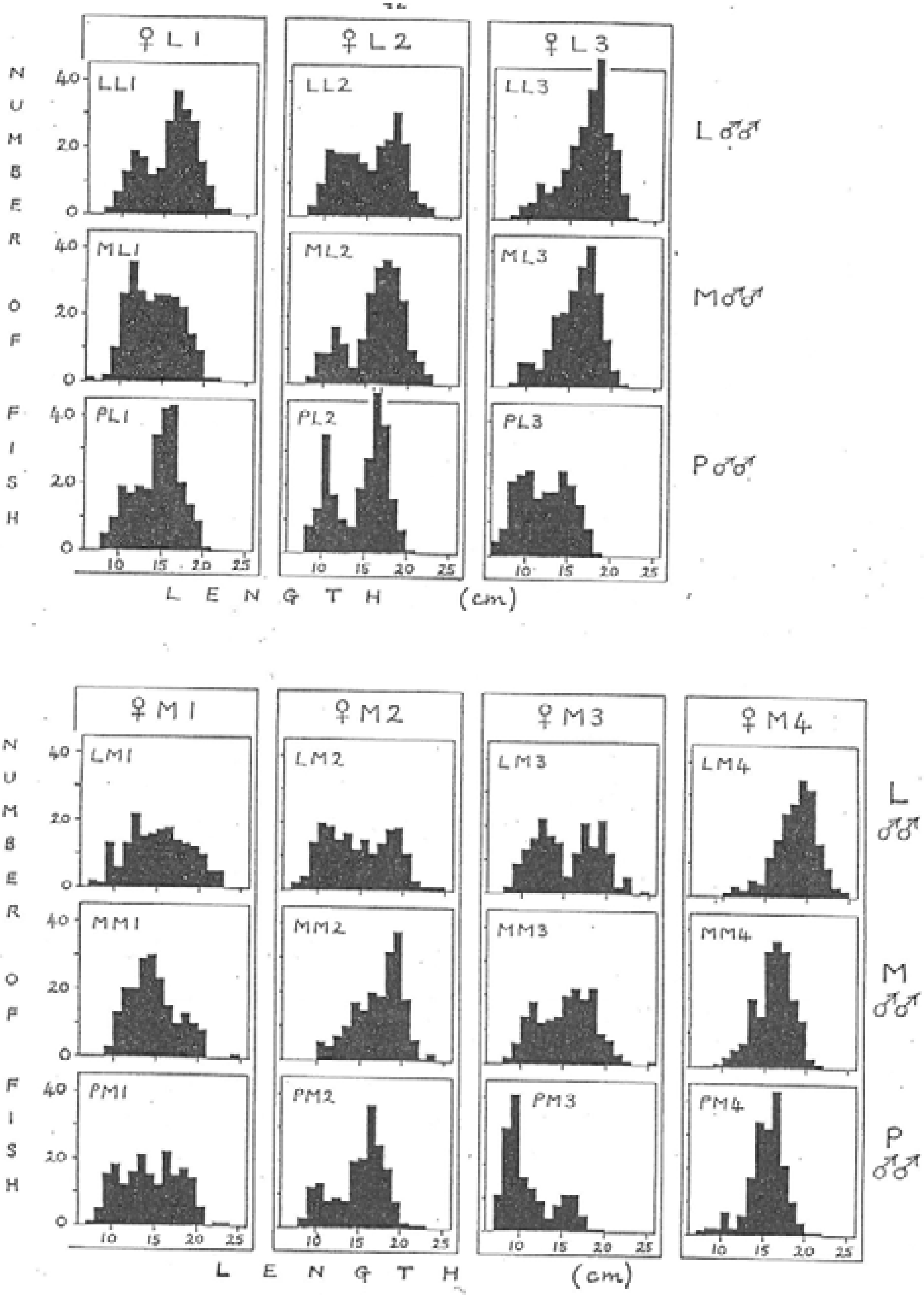


FIGURE 8 :- The length frequency distributions of 1+ progeny from individual pair-crosses at the time of tagging - August 1986

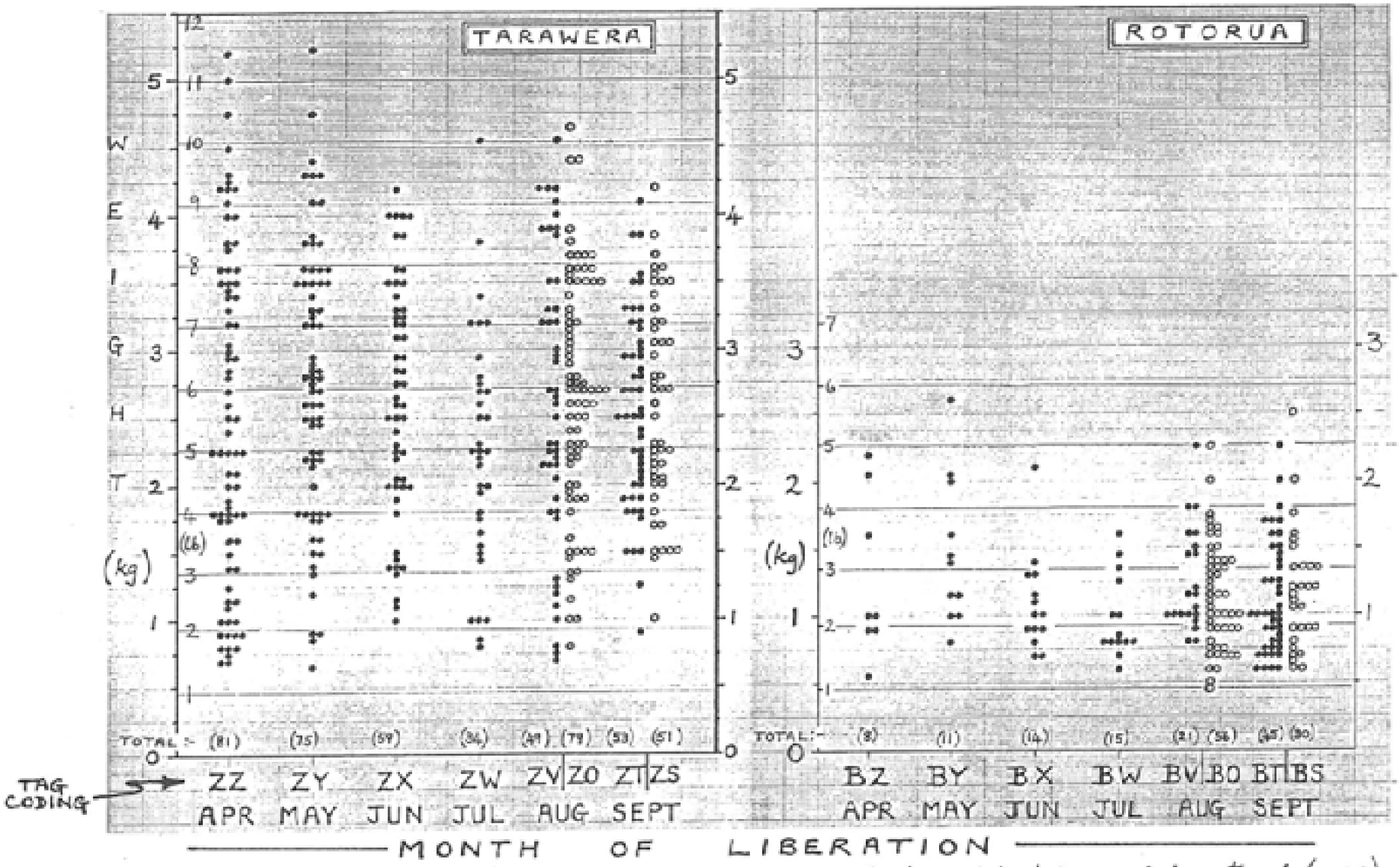


FIGURE 9:- The weight of individual, angler caught, tagged hatchery rainbow trout (•, n o) originating from 500 tagged fish in each tag coding liberated at monthly intervals from autumn (April) through to spring (September) in Lakes Tarawera and Rotorua. (• = from accelerated hatchery growth; o = from normal hatchery growth)

Liberating hatchery fish at age 0+ in the autumn results in considerable cost savings in feed (which escalate during the later months of hatchery rearing as the trout grow larger); it also overcomes the problem of 'fin-rot', which develops in hatchery fish due to overcrowding, and causes permanent damage to the dorsal fin in particular.

In 1985 extended trials of autumn liberation, using 'R-type' fish from the Tarawera selective breeding programme, were carried out in5 other lakes (Rotoiti, Rotoma, Okataina, Rotoehu and Okareka). In all but Okareka autumn liberation has proved successful in terms of survival and growth enhancement to age 3.

In Rotoiti the autumn liberation produced 3 year olds with a mean weight of 4.2 kg (approx. 9 ¼ lbs), with some individuals up to 5 kg. However the returns at age 4 (in progress) are beginning to suggest that there may be a better showing of delayed maturity to age 4 from the spring liberations.

The fourth project (1984) explored the mode of liberation to see if immediate post liberation survival could be improved either by a period of acclimatisation to the lake water or by the time of day liberated (morning versus evening). The best survival to size which has been accounted for from tag returns has been approx. 30%, suggesting that there could be room for substantial improvement. The results have shown no dramatic effect from either a period of acclimatisation or time of day liberated; our first 'negative' result!

In 1984 a netting programme was carried out on Lake Tarawera to study the distribution, food and growth of rainbow trout.
It revealed that smelt contribute about 80% to the trout's diet to age 3 in hatchery fish, and to age 2 in wild fish (Figure 10).

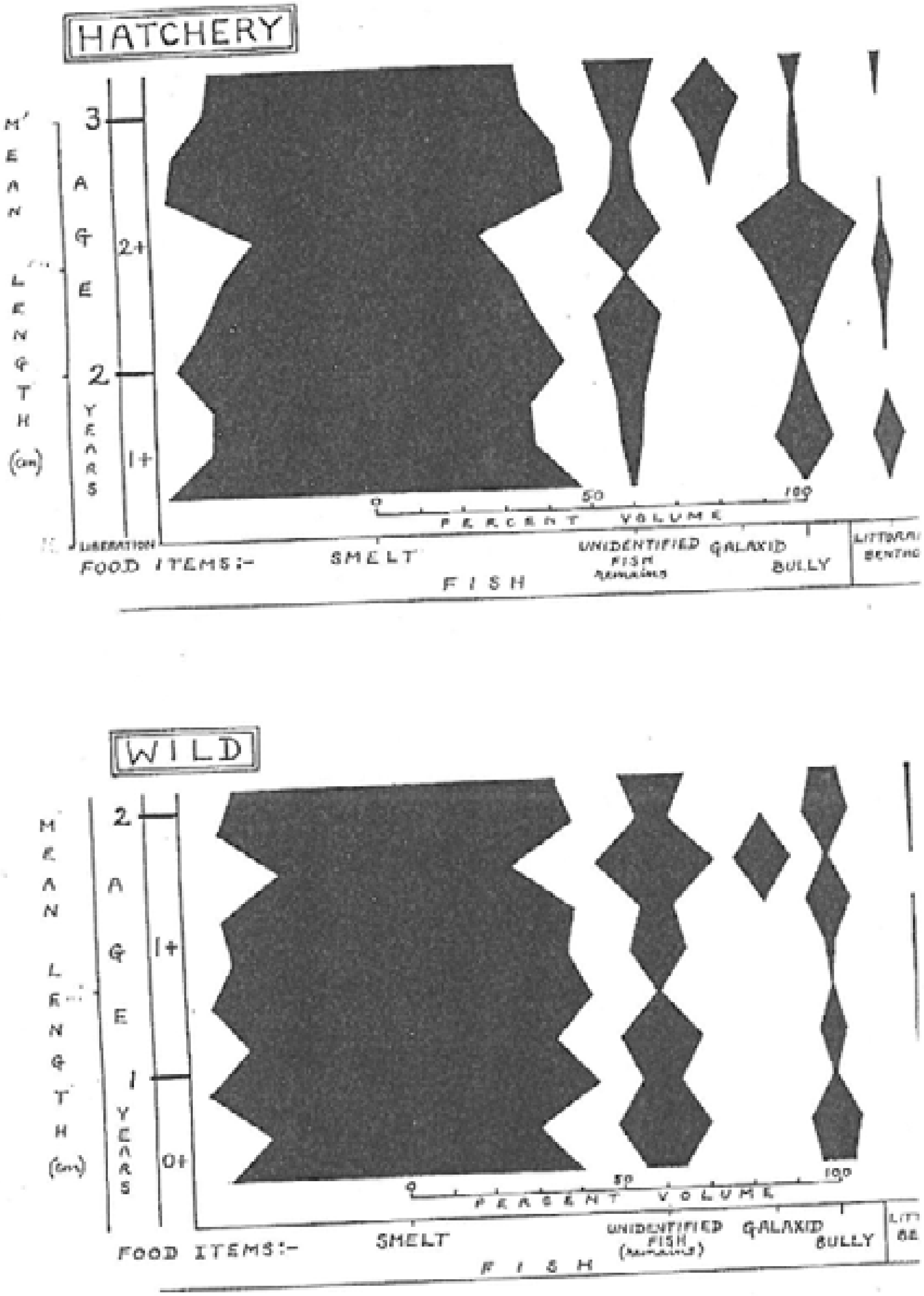


FIGURE 10 :- The composition of the diet of
trout with increasing age and size in
– to age 2 years in wild trout – + to age 3 years in

The final project, with perhaps the greatest potential for improving 'return to the angler' in terms of the number of hatchery fish caught, is the stocking rate trials in Lake Okareka. A 5 year baseline study (1980-1985) of the forage fish (smelt and bully), and monitoring of the growth of trout, was carried out before the annual stocking rate of hatchery fish in to Lake Okareka was doubled in 1985. This was achieved by keeping the annual spring liberation of 5000 1+ fish constant, and liberating an additional 5000 at age 0+ in the autumn. By 1988, assuming that there has been no significant change in the survival of the spring liberated fish, an approximately 1 ½ fold increase in the trout population has been achieved -without any significant effect on growth to age 2 or 3 years (Figure This would appear to confirm earlier suspicions that the Rotorua Lakes are not stocked to their carrying capacity for trout.

Long term studies (since 5980) of the forage fish in a number of the Rotorua Lakes suggest that carrying capacity for trout varies significantly from year to year, and even more so from lake to lake in relation to trophic status. Trout growth in each lake varies from year to year and climatic variation appears to be an important factor. At the time DOC was being formed, I put this forward as a priority topic for further research in the Rotorua Lakes, but since then I have become more concerned about the relationship between land-use in the lake catchments, nitrogen limitation in the lakes, blooms of the blue green alga Anabaena sp., and the food web leading to trout production.

There is, I believe, an insidious deterioration in the environmental conditions for trout growth in many of the lakes, and continuing changes in land use (notably the planting of *Pinus radiata* in lake catchments) are likely to push the lakes further towards nitrogen limitation. If the lake environment for trout deteriorates, then most of our work through the experimental management projects will become rather futile.

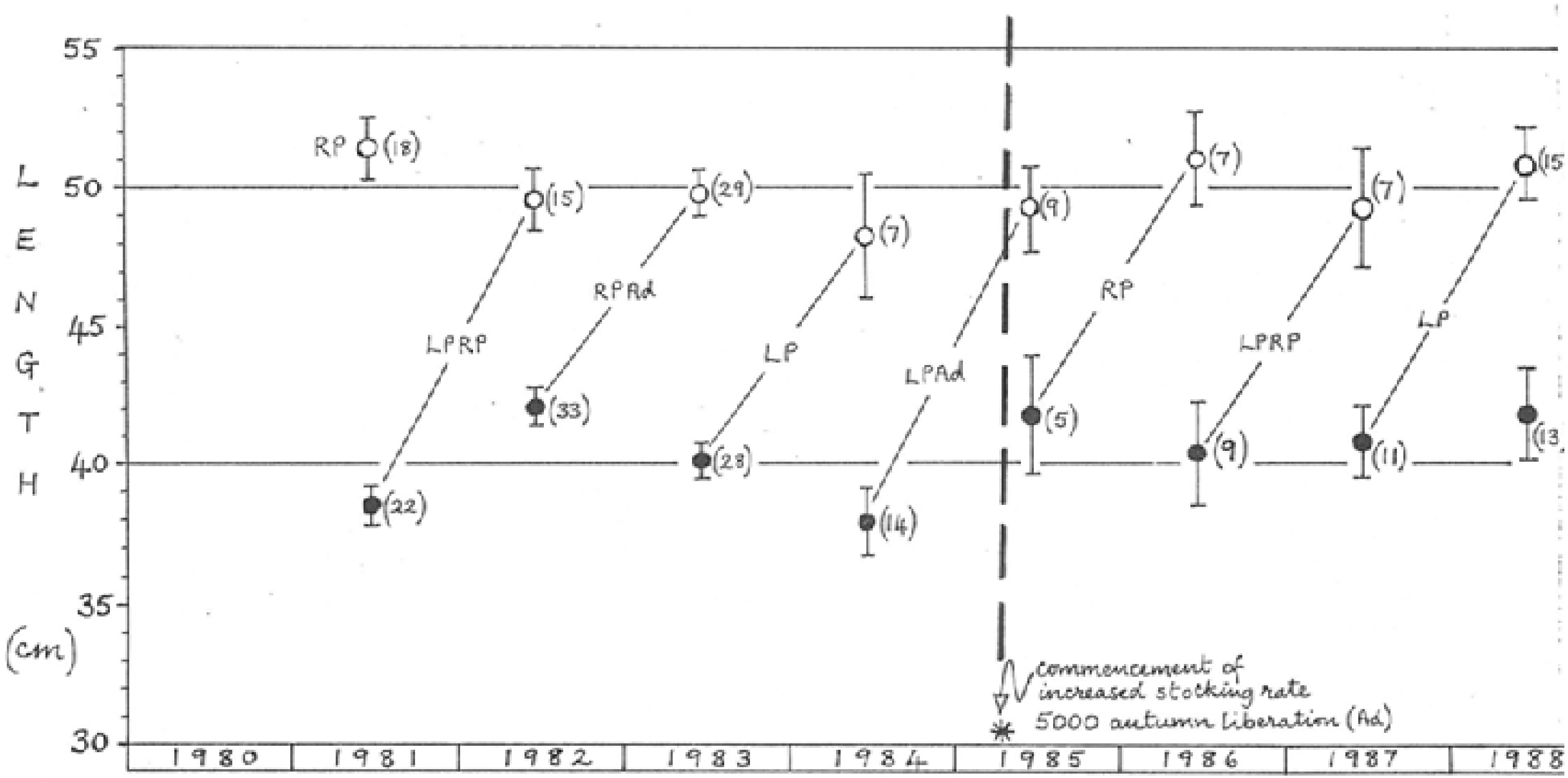
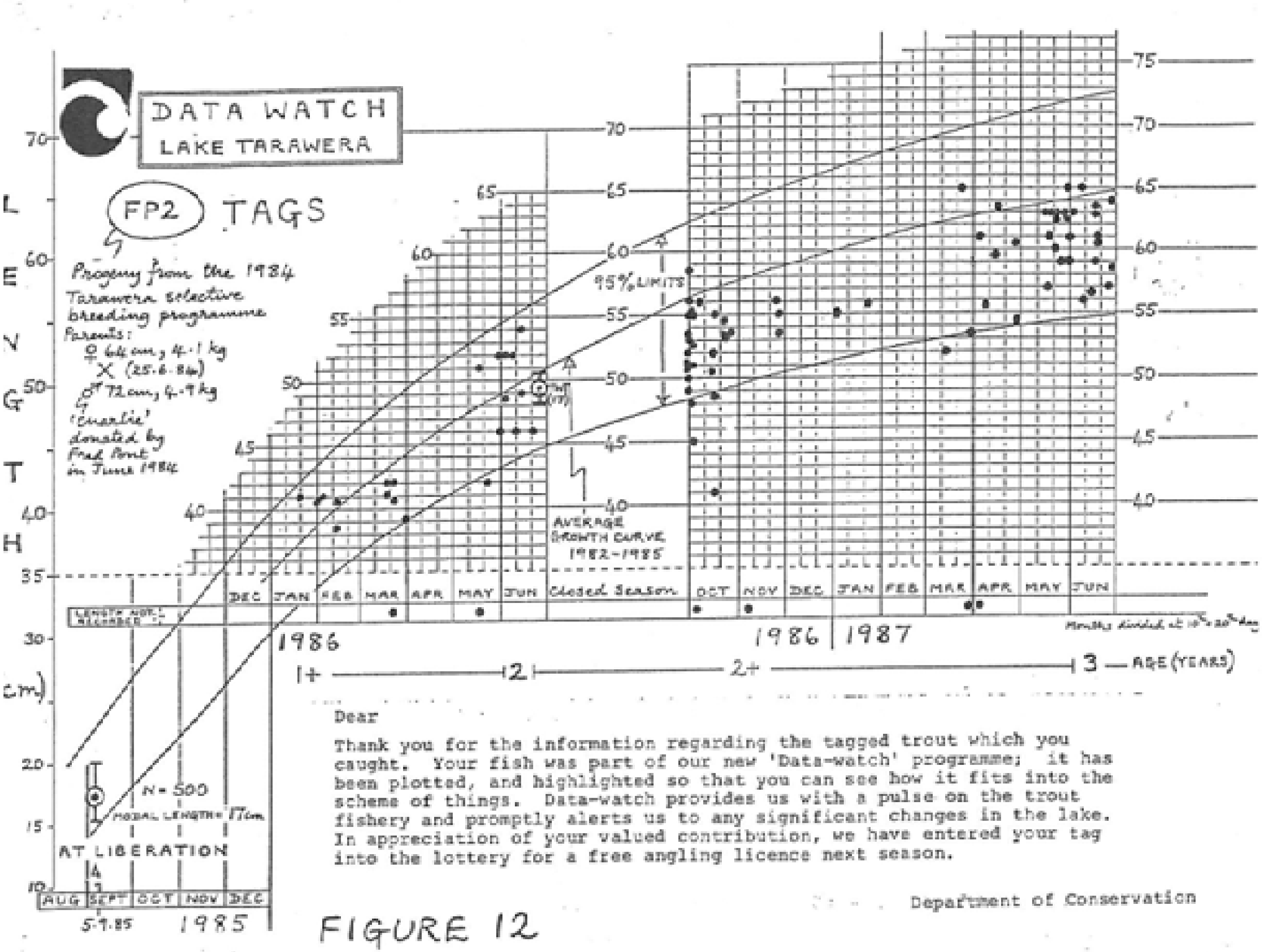


FIGURE 11 :- The mean length and 95% confidence limits (I) of spring-liberated 2 year old (●), and 3 year old (○) hatchery reared rainbow trout caught during the June Lake Okareka fishing competitions (1981 - 1988 inclusive)

(n) = sample size

In 1985 a more sensitive method of monitoring the growth of trout was devised - i.e. "data-watch'. It was designed to meet an oft-stated plea by Management for a 'pulse' (rather than 'autopsy') on the state of the fisheries in the Rotorua Lakes (Figure 12).



Dear

Thank you for the information regarding the tagged trout which you caught. Your fish was part of our new 'Data-watch' programme; it has been plotted, and highlighted so that you can see how it fits into the scheme of things. Data-watch provides us with a pulse on the trout fishery and promptly alerts us to any significant changes in the lake. In appreciation of your valued contribution, we have entered your tag into the lottery for a free angling licence next season.

Department of Conservation

FIGURE 12

INTERNAL REPORTS

1. Justification report for the Ngongotaha Hatchery, July 1984 (published in Freshwater Catch, Autumn 1985 No. 26).

2. The heritability of the seasonal timing of the spawning migrations of hatchery-reared trout *Salmo gairdneri.*

3. Tarawera selective breeding programme -progress reports 1, 2, 3 and 4 for 1984, 1985, 1986 and 1987 respectively.

4. The selectivity of stream-mouth angling on rainbow trout during their spawning migration in to the Te Wairoa Stream - August 1987.

5. Towards the development of optimum stocking rates of hatchery-reared rainbow trout in the Rotorua Lakes 1983.

6. Experimental management in the Rotorua lakes -a review - September 1986.

7. Tarawera and the Kootenay connection –New Zealand Wildlife Service, 1985.

8. The links between exotic forest land use and trout growth - April 1988.

FLOW MANAGEMENT IN THE TONGARIRO RIVER.

PROJECT LEADER : Theo Stephens

INTRODUCTION

The Tongariro River supports a world-famous trout fishery and is also an integral part of a nationally important hydroelectric power scheme. The fishery is based on the winter spawning migration of adult rainbow trout from Lake Taupo returning to the tributary streams where they were born. The power scheme depends upon diversion of water from the upper Tongariro, as well as several other rivers draining the Volcanic Plateau.

The Government authorized construction of the power scheme with the condition that the Tongariro trout fishery must be protected. This requirement has been a major factor influencing the siting, design and operation of many components of the scheme. However, experience gained since diversions commenced in 1973 has shown firstly that neither the design nor the present operational procedures are always sufficent to protect all fishery interests; and secondly, that certain flow specifications and operational rules required to protect the fishery constitute a significant constraint on generation capacity whilst doing little to protect fishery interests.

The goal of this study is to refine procedures for flow management to enable efficient use of the water for both the fishery and electricity generation. Specific objectives of the study were :

1. To assess the impact of the power scheme on the hydrology and fishery of the lower Tongariro River.
2. To identify factors which influence numbers of trout caught by anglers.
3. To identify factors which influence the number of trout running into the Tongariro River.
4. To find more appropriate flow specification for trout and angling.

IMPACT OF THE POWER SCHEME.

Abstraction not only reduces the amount of water (flow) in the lower river, it also changes the flow regime, on the way flow varies through time. In the Tongariro River the mean flow has been reduced from 50 to 28 cubic metres per second (cumecs), and the frequency of minor freshes has been reduced, thereby increasing the duration of stable flows. Flow reductions now occur for 12 km of river downstream from Poutu intake whenever minor freshes occur (see upper and middle panels of This is the converse of the natural response of river to rainfall. Floods now recede more rapidly, brief flow reductions are common and seasonal patterns of flow variation (low in summer-autumn, high in winter-spring) have been removed.

Clearly, the power scheme has had a major impact on the hydrology of the Tongariro River. However, this has caused only minor changes to the fishery (Fig.2). Numbers of trout running into the Waihukahuka Stream (a tributary of the lower Tongariro River) has not changed significantly since diversion although angler's catch rates appear to have declined. Thus it seems that the regulated flow regime may have caused the trout to become less catchable.

FACTORS AFFECTING ANGLING SUCCESS.

One can construct several hypotheses as to why flow regulation might cause trout to be less susceptible to capture. Firstly, at lower flows and associated clear, slower flowing and shallower water, the trout may be more spooky and so harder to catch. This hypothesis can be tested by examining correlation between individual angler's catch rates and flow, whilst also taking into account variation in catch rates associated with other influential factors (Table 1).

Multiple regression procedures indicated that catch rates were most strongly associated with the angler's familiarity with the river, flow, years of angling experience, angling method and numbers of trout entering the Waihukahuka Stream during the previous 50 days. Contrary to the hypothesis as stated above, catch rates were found to increase as flows decreased. Thus it seems that trout became more accessible to anglers at lower flows.

Table 1. Factors affecting angler catch rates. The t values indicate a statistically significant ($p<0.05$) association when greater than 1.962.

FACTOR	**T**
Method (floating or sinking line)	3.708
Years of angling experience.	4.747
Familiarity (days/yrs spent fishing the Tongariro)	9.537
Trout trapped during previous 5 days	0.545
Trout trapped during previous 50 days	3.233
Water clarity	1.467
Daily mean flow	-8.809

The contradictory evidence obtained from long term monitoring (Fig. 1) and this analysis can be reconciled if flow reductions speed upstream migration, thereby reducing the time during which trout are exposed to anglers. This hypothesis is to be the subject of future research.

WHAT INFLUENCES ADULT TROUT NUMBERS.

This question was approached in two ways. Firstly, by testing for associations between numbers of trout entering the Waihukahuka Stream and potentially influential factors such as hatchery activities and flood events three years earlier during juvenile life. Secondly, through field surveys to explore how juvenile trout use the Tongariro River and tributaries.

Large runs of trout occurred three years after years in which there had been no summer floods, or only one winter flood, or about 5 spring floods, or when nearly 2 million ova were collected. There was no significant associations with fry or fingerling liberations, or with autumn flood frequency.

Field surveys showed that juvenile trout were most numerous during spring and summer, but their numbers were decimated by floods. Recovery was rapid after spring floods because the population was replenished by fry emerging from spawning areas. However, in summer when most eggs had hatched and the juveniles were older and larger, recovery from a major flood was slow and incomplete.

Microscopic examination of trout scales revealed patterns associated with stream growth and another pattern associated with growth in Lake Taupo. From this, it was possible to show that young trout must reach at least 10 cm before emigrating to Lake Taupo if they are to survive and contribute to the fishery. Thus summer floods cause reduced runs of adult trout three years later because floods flush juvenile trout from the streams, forcing them to enter the lake before they are large enough to live there. Autumn floods have no such influence, presumably because by autumn, many juveniles are large enough for life in Lake Taupo.

The association between high adult returns and an optimum number of ova stripped from the parent stock three years earlier is particularly interesting. Trout spawn by digging a pit or redd in which eggs are laid. When breeding trout are numerous, they often dig up redds made earlier by other trout and so destroy their eggs. It seems that ova stripping, which reduces the total number of trout spawning in the Waihukahuka Stream, can increase the survival of naturally spawned eggs sufficiently to more than compensate for reduced spawning. Excessive stripping (more than 3 million ova) was associated with reduced runs 3 years later.

FLOW REQUIREMENTS FOR TROUT

The extent of physical habitat space in any stream is different for different species and life stages and varies with flow. Juvenile trout need shallow, slow flowing water with plenty of cover provided by cobbles and debris. Spawning trout need swift shallow water with coarse gravel streambeds. Prolific and diverse invertebrate populations need deep, swift water with a cobble or boulder bottom.

The actual extent of physical habitat suitable for different uses can be estimated by measurement of depth, current speed and bottom composition at intervals along a series of cross-sections to define the physical character of the reach. The impact of changing flow can be estimated by repeating the procedure at several flows or'by simulation using data collected at only one flow. Simulation modelling generated the relationships between flow and physical habitat (Weighted Usable Area, WUA) shown by Fig.3 for four reaches of the Tongariro River. Interestingly, maximum habitat for all life stages and for invertebrate food production occurred at lower flows than those which naturally occur in the Tongariro River. This could explain why trout numbers have not fallen since diversion, despite undesirable artefacts in the flow regime, increased angling pressure and improved angling techniques. It also suggests that higher flows in the lower Tongariro River would not benefit the trout population.

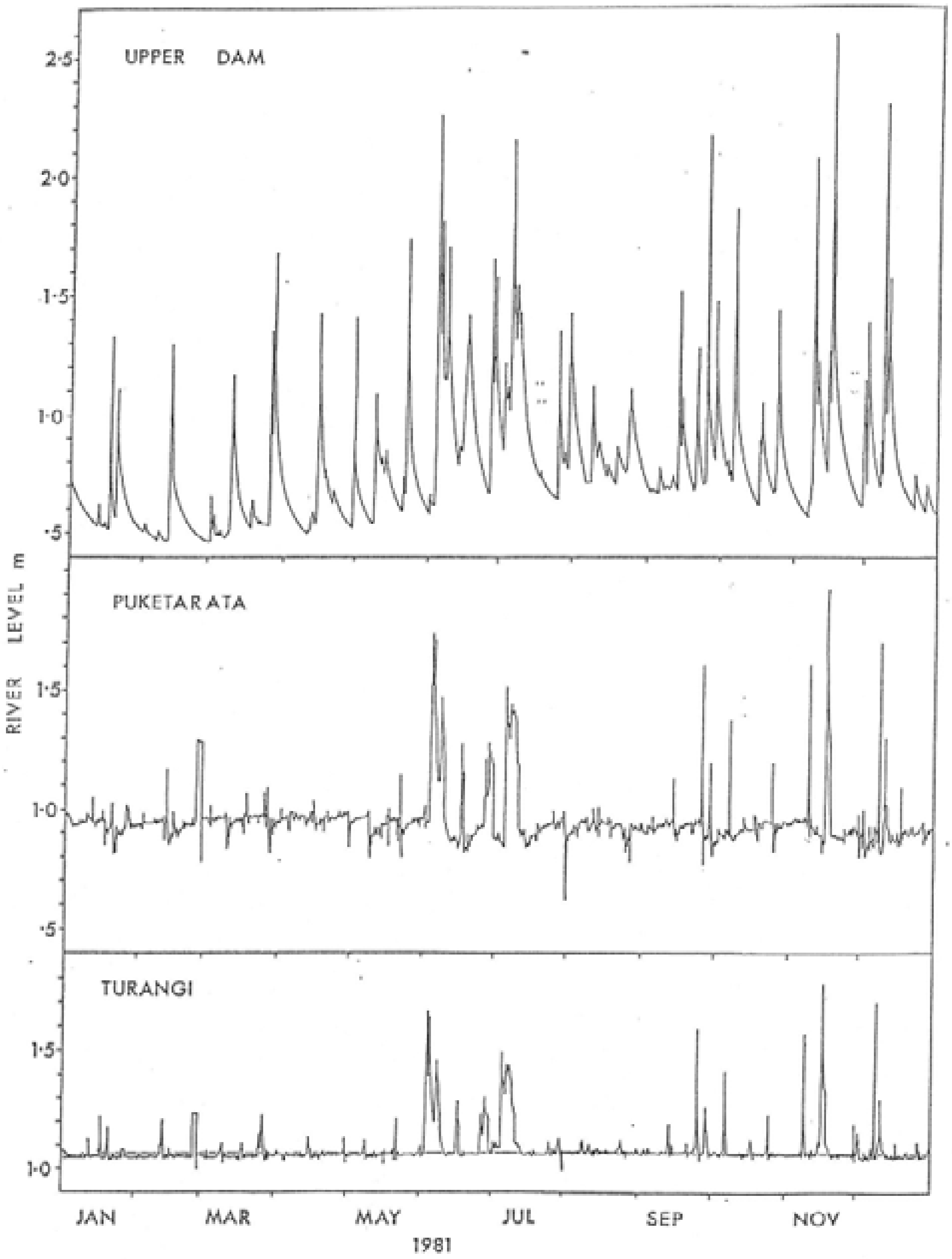
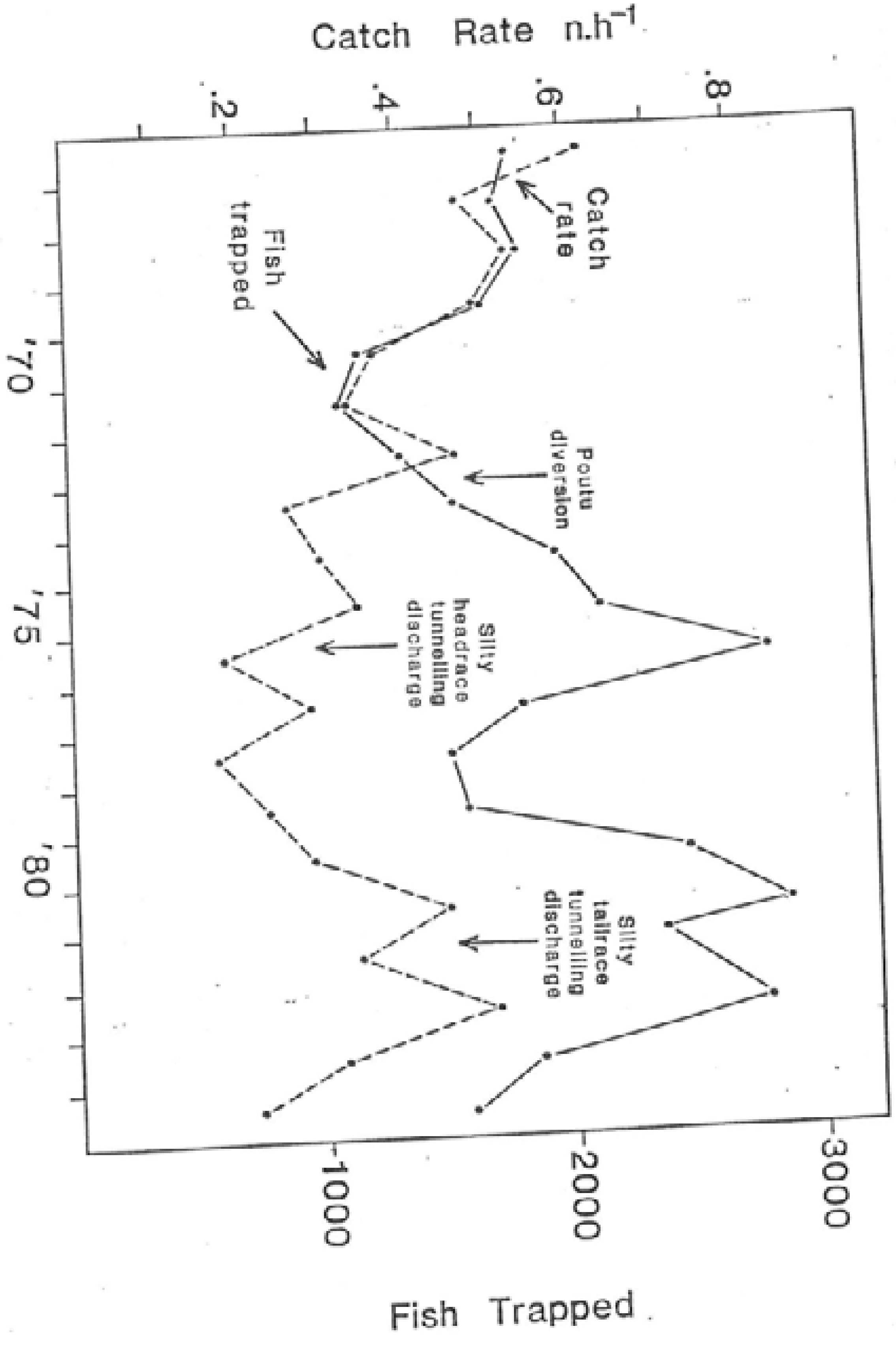


Figure 1: Tongariro River stage hydrographs for the upper, mid and lower river, showing differences in flood frequency and river level variation associated with each event. (Data supplied by Water & Soil Div. of M.W.D.)


Catch Rate n.h⁻¹
.2
.4
.6
.8
Catch rate
Fish trapped
'70
'75
'80
Poutu diversion
Silty headrace tunnelling discharge
Silty tailrace tunnelling discharge
1000
2000
3000
Fish Trapped

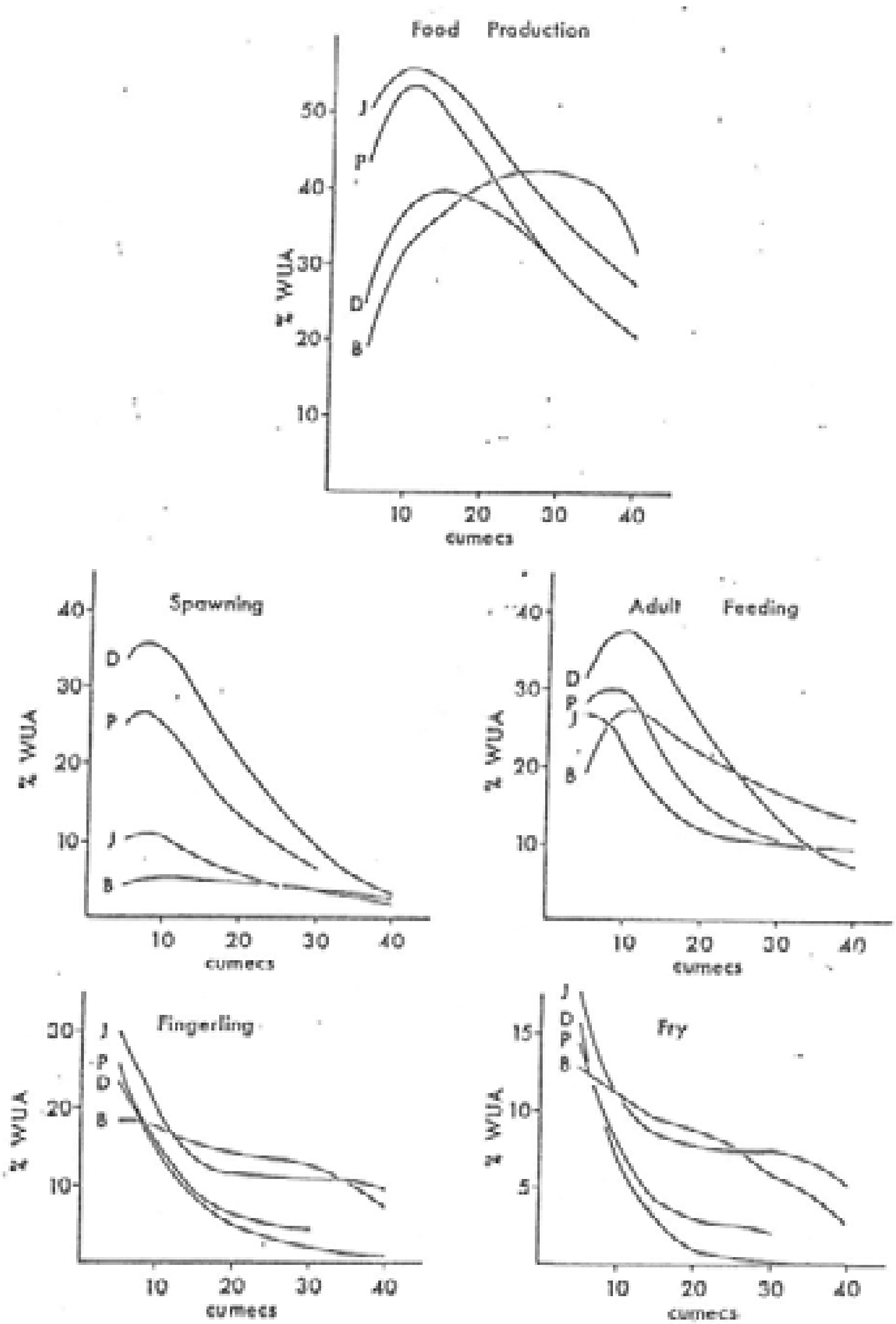


Figure 3: The relationship between flow and habitat for stream invertebrates four rainbow trout life stages at four sites on the lower Tongariro River.

The sites were:

300 below Poutu intake - P
Boulder Reach - B
Judges Pool - J
DeLaTours Reach - D

FOREST BIRD STUDIES IN SOUTH WESTLAND

Research Leader: Colin O'Donnell, Department of Conservation

Other Personnel: Peter Dilks

INTRODUCTION

In 1981 the Ministers of Forest and Environment announced a moratorium on timber production in State Forests south of the Cook River until 1990. Research was carried out in an investigation area covering 600 000 ha of Crown Land to enable decisions on future land use and land classification.

Knowledge of the habitat requirements of forest birds is a prerequisite for understanding their ecology. Today, conservation agencies are required to make specific recommendations as to size and composition of reserves and management options for rare, threatened and endangered species. To accomplish this, information must be obtained on:

a) how birds use their habitat;
b) the area of habitat required to maintain viable populations:
c) the degree of overlap in habitat use between species; and
d) the potential for competition between species.

This information is used to predict the impact of forest management practices on birds by identifying important components of forest structure.

Studies of factors influencing habitat requirements of forest birds were undertaken in South between 1983 and 1986. Over 65 500 observations of habitat use were collected, 2500 5-minute bird counts undertaken, and bird distribution mapped over nearly 150 000 ha of forest.

In 1987 and 1988 we have been concentrating on writing management reports and scientific papers particularly in relation to predicting the impacts of logging on forest birds in South Westland. This work also has much wider implications for forest bird conservation generally.

OBJECTIVES

1. To develop methods for bird distribution mapping and collection of habitat use data in forests.

2. To quantify distribution of forest birds in South Westland.

3. To quantify and describes habitat-use by forest birds in representative forest types of South Westland.
4. To develop a model for predicting the impacts of logging on forest birds.

METHODS

Bird mapping: Field methods were developed and tested for mapping bird distribution in forests. Species lists for 1000-yard grid squares were compiled by recording birds while walking a transect through each square in a chosen survey area. The scale of the survey enables observers to sample large areas of forest in a relatively short time and in considerably more detail than previous mapping methods. Transect counts are the most effective method for recording the number of species in a square, and are particularly useful for detecting small, rare or sparsely distributed species.

Habitat use: Observations were made along transects that sampled forest types representative of the South Westland area. Whenever birds were encountered their activity and precise position within the forest structure were recorded each minute for up to 5 minutes. Also recorded were the plant species used, trunk diameter and canopy height; the height of the bird above the ground, forest tier occupied, perch and food types: and the site topography. Observations were undertaken in the Windbag Valley area.

Plant species preferences: Habitat-use data were converted by computer into frequency histograms for each bird species to show such variables as percent use of plant species, or use of different stem diameter classes for different activities. Percent use was summarised both overall or for each of the 6 seasonal surveys. Bird preferences for plants were examined by comparing a plant's frequency of abundance with its frequency of use. A plant was regarded as a preferred species if it was used more than expected. The framework for determining preferences is summarised in Figure 1.

Developing the logging model: To predict the impacts of logging the relationship between habitat use patterns and proposed logging regimes must be reconciled. To determine degree of conflict we:

- Defined the habitat use pattern by:
  - -describing plants and stem diameters used
  - -defining plants preferred
- Defined logging regimes by:
  - -listing target tree species
  - -and target trunk diameter classes
  - -determining proportions of merchantable trees to be removed.

We assumed that in future logging will aim at selected target tree species and stem diameter classes based on a percentage extraction rate. Therefore, for merchantable tree species we calculated the percentage of habitat-use observations in each stem diameter class for all indigenous bird species which preferred each tree. We assumed that percent use of each diameter class represented the proportion of preferred habitat which would disappear if all trees within that class were removed.

RESULTS

Methods manuals: The manual for bird distribution mapping is currently the manual for recording habitat use *In review*. Data summarising our findings regarding bird distribution patterns in South Westland were published by O'Donnell & Dilks (1986).

Foods and behaviour of forest birds: Food items taken by 18 bird species are summarised in Table 1. Foraging patterns were related to fruiting and flowering patterns of forest plants in South Westland. Of the species studied only NZ pigeon was totally herbivorous. The 3 parrot species, 2 honeyeaters and the silvereye had broad omnivorous diets which varied considerably with season. Of the remaining species, flycatchers, warblers and rifleman were almost entirely insectivorous and introduced finches had mixed seed and invertebrate diets. The South Westland bird community was comprised of a large number of generalist feeders and specialists. The kaka had the most diverse repertoire of foods and foraging techniques. However, it was a sequential specialist, moving from one specialist food source to another throughout its annual cycle. The marked irregularity of flowering and fruiting of many forest plants makes these unpredictable food sources.

Plant use and preference: All plants species (59 groups representing 82 species) were used at some time by forest birds. However, nearly 70% of feeding observations were in the 13 species of canopy tree. About one fifth of the observations were in the 29 groups of shrubs and the remaining records were in the 17 groups of vine, epiphyte, grass and fern species.

The number of plants used by individual bird species varied considerably. Yellow-breasted tit and silvereye used over 50 species groups while brown creeper, grey warbler, fantail and each used over 40 species groups. Birds which used a much more limited range of plants included 3 introduced finches (redpoll, goldfinch, greenfinch; 6-10 plant species), and the endemic kea, kakariki and yellowhead (11-17 plants). Percent use of canopy tree species is summarised in Figure 2.

All birds used a wide range of plant sizes.However, most use was of large diameter stems. For example, kea and yellowhead mainly used stems 81-100 cm in diameter while bellbirds and rifleman made greatest use of stems 41-60 cm. Tit, fantail grey warbler and silvereye used markedly smaller stems, with peak use of those 11-20 cm.

Figure 3 summarises canopy tree species preferences. The diagram shows which plants were preferred (critical and focal species), those used at random, and those used less than expected. Preferences varied considerably between bird species. The most important plants were rimu (preferred by 11 bird species), silver pine (by 9 species) and silver beech and rata (by 7 species each). The results also highlight the importance of dead trees for endemic birds. Standing dead trees were critical overall for kaka and kea and seasonally critical for yellowhead. Use of each tree species varied significantly between seasons e.g. Figure 4.

The most important shrubs were raukawa and wineberry which were each preferred by 7 bird species. *Fuchsia,* haumakaroa and putaputaweta were each preferred by 5 species and hutu, broadleaf, lancewood and pate by 3 bird species.

Effects of on forest birds: Our habitat use data indicate that trees targeted for logging are also highly preferred by many forest birds and that their removal would have a disproportionately severe effect on birds using them.

Birds most affected are the endemic forest dwellers which feed largely on invertebrate larvae characteristic of deadwood or on seasonally abundant fruit or nectar foods which are generally restricted to, or more abundant on, mature trees. Examples of predicted habitat loss if different stem diameter classes are targeted by logging are illustrated in Figure 5. If clearfelling of rimu were to occur in South Westland: that is, removal of all stems over 20 cm dbh, and assuming that non-merchantable stems

were left intact, then between 90 and 100% of preferred stems would be lost. If stems over 100 cm only were removed (only 6.7% of merchantable stems available) this would result in the loss of 33% of kaka habitat, 18% of kea habitat, 10% of tui habitat and 2.5% of kakariki habitat. If all trees over 80 cm were removed then, for example, nearly 60% of kaka habitat would disappear. While kaka may be able to move to alternative food trees it is unlikely that they would be able to sustain their populations on plant species that they would normally avoid.

MANAGEMENT APPLICATIONS

HABITAT USE INFORMATION CAN BE USED TO:

1) Determine how generalist or specialist forest birds are in their requirments and therefore the vulnerablity of their conservation status.

2) Predict the impacts of habitat modification (e.g. logging) on forest birds. By modelling response to habitat change we can assess the impacts of different extraction rates or new and future logging techniques.

3) Provide specifications for the optimum plant composition of reserves and conservation areas.

BIRD DISTRIBUTION MAPPING TECHNIQUES CAN BE USED FOR:

1) Standardising information collected on bird distribution throughout the country. In this way better comparisons can be made.

2) Establishing the national significance of wildlife populations and their conservation values.

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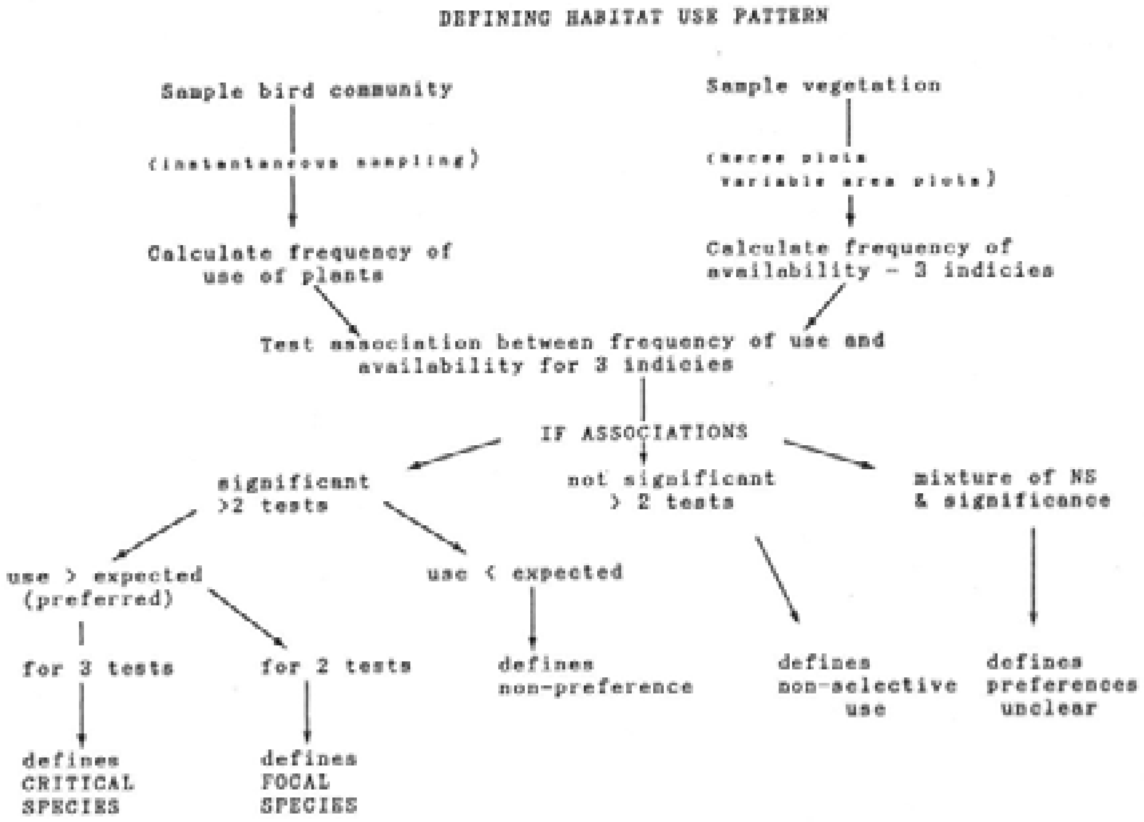
O'Donnell, C.F.J.: Dilks. P.J. 1986. Forest birds in South Westland. Status, distribution and habitat use. NZ Wildlife Service Occasional No. 10. Dept. Internal Affairs, Wellington.

O'Donnell, C.F.J.; Dilks. P.J. 1987. Preliminary modelling of the impacts of logging on forest birds in South Westland. Science & Research Internal Report No. 1. Dept Conservation, Wellington.

Figure 1 : Procedure for defining tree species preferences by forest birds



DEFINITION OF PREFERENCES.

We have defined preferences using the following terms :

(a) when percent use of a plant was statistically less than expected, this indicated "non-preference" for that species.

(b) when use was statistically greater than expected, this indicated "preference" for that particular plant.

-Plant species for which use was significantly greater than expected for all three measures of availability were defined as "critical".

-Plants for which use was greater than expected for two measures of availability were defined as "focal".

(c) when there was no significant differences between use and availability of a plant this denoted that the species was being used randomly.

Figure 2: Percent use of canopy tree species by forest birds in temperate rainforest, South Westland, New Zealand.

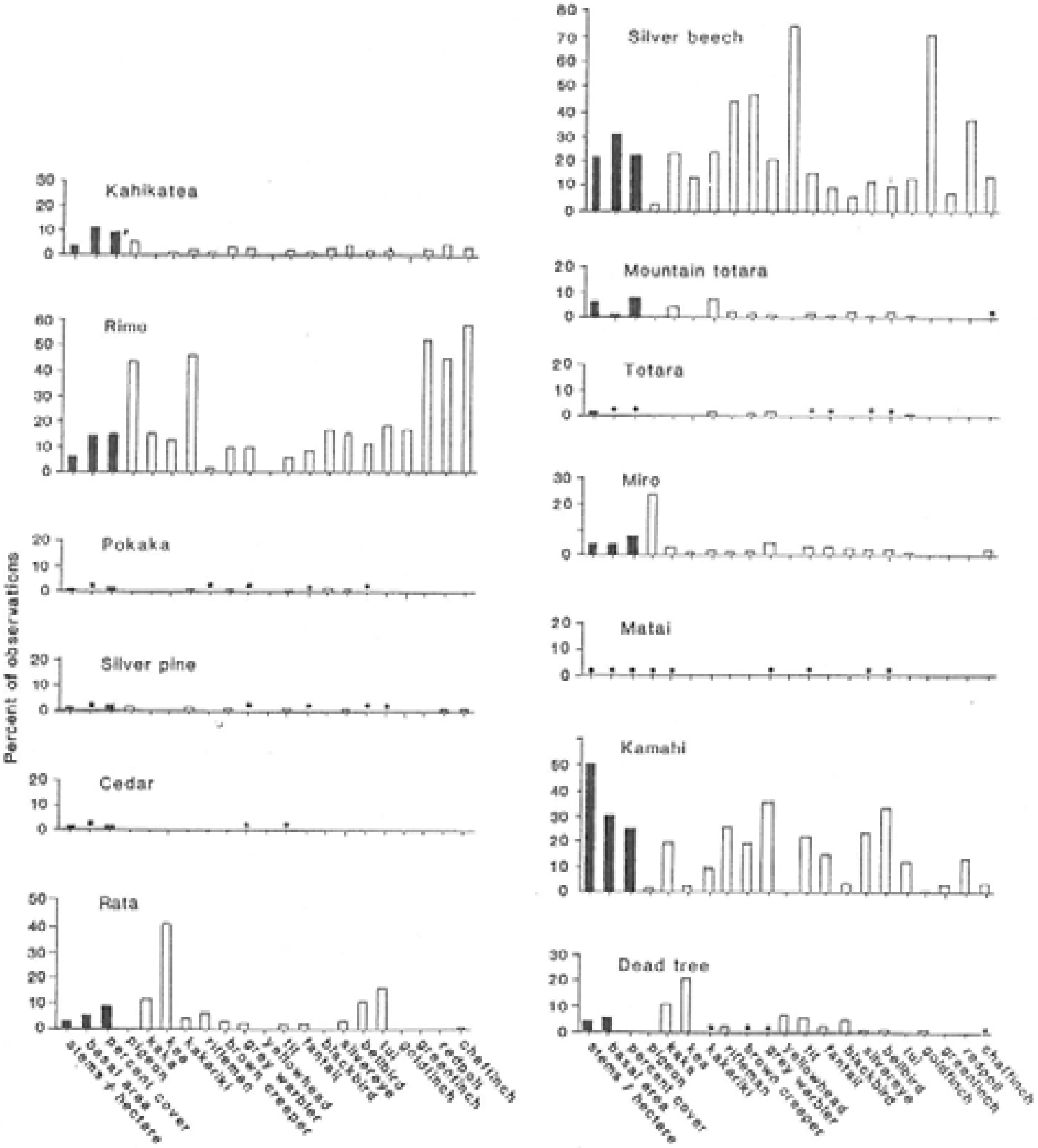
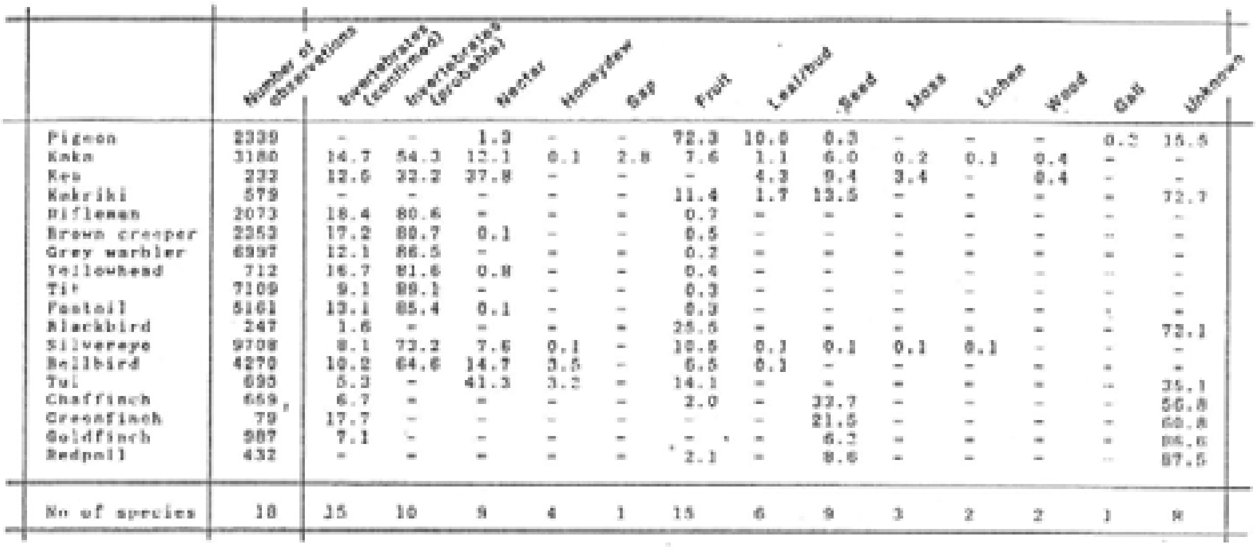
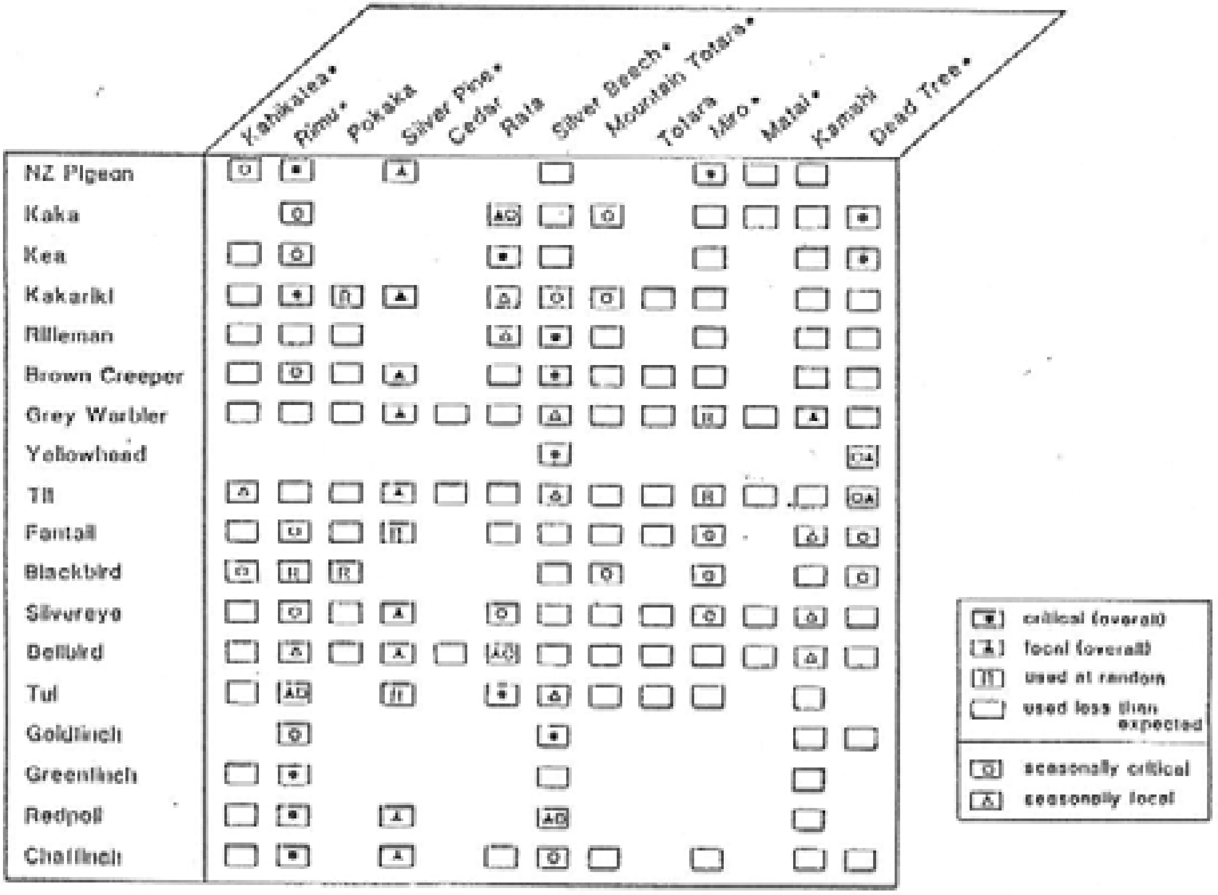


Table 1 : Food types of forest birds in South Westland (Percent of feeding observations).



	Number of observations	Invertebrates (confirmed)	Invertebrates (probable)	Nectar	Honeydew	Sap	Fruit	Leaf/bud	Seed	Moss	Lichen	Wood	Gall	Unknown
Pigeon	2339	-	-	1.3	-	-	72.3	10.0	0.3	-	-	-	0.2	15.5
Kaka	3180	14.7	54.3	12.1	0.1	2.8	7.6	1.1	6.0	0.2	0.1	0.4	-	-
Kea	233	12.6	32.2	37.8	-	-	-	4.3	9.4	3.4	-	0.4	-	-
Kakriki	579	-	-	-	-	-	11.4	1.7	13.5	-	-	-	-	72.7
Rifleman	2073	18.4	80.6	-	-	-	0.7	-	-	-	-	-	-	-
Brown creeper	2353	17.2	80.7	0.1	-	-	0.5	-	-	-	-	-	-	-
Grey warbler	6997	12.1	86.5	-	-	-	0.2	-	-	-	-	-	-	-
Yellowhead	712	16.7	81.6	0.8	-	-	0.4	-	-	-	-	-	-	-
Tit	7109	9.1	89.1	-	-	-	0.3	-	-	-	-	-	-	-
Fantail	5161	13.1	85.4	0.1	-	-	0.3	-	-	-	-	-	-	-
Blackbird	247	1.6	-	-	-	-	25.5	-	-	-	-	-	-	72.1
Silvereye	9708	8.1	73.2	7.6	0.1	-	10.5	0.1	0.1	0.1	0.1	-	-	-
Bellbird	4270	10.2	64.6	14.7	3.5	-	6.5	0.1	-	-	-	-	-	-
Tui	695	5.3	-	41.3	3.2	-	14.1	-	-	-	-	-	-	35.1
Chaffinch	659	6.7	-	-	-	-	2.0	-	33.7	-	-	-	-	56.8
Greenfinch	79	17.7	-	-	-	-	-	-	21.5	-	-	-	-	60.8
Goldfinch	987	7.1	-	-	-	-	-	-	6.2	-	-	-	-	86.6
Redpoll	432	-	-	-	-	-	2.1	-	8.6	-	-	-	-	87.5
No of species	18	15	10	9	4	1	15	6	9	3	2	2	1	8

Figure 3: Canopy tree species preferences in South Westland forest birds (gaps indicate plants not used by particular bird species).



* Merchantable species

Figure 4: Percent use of standing dead trees by selected bird species in different seasons.

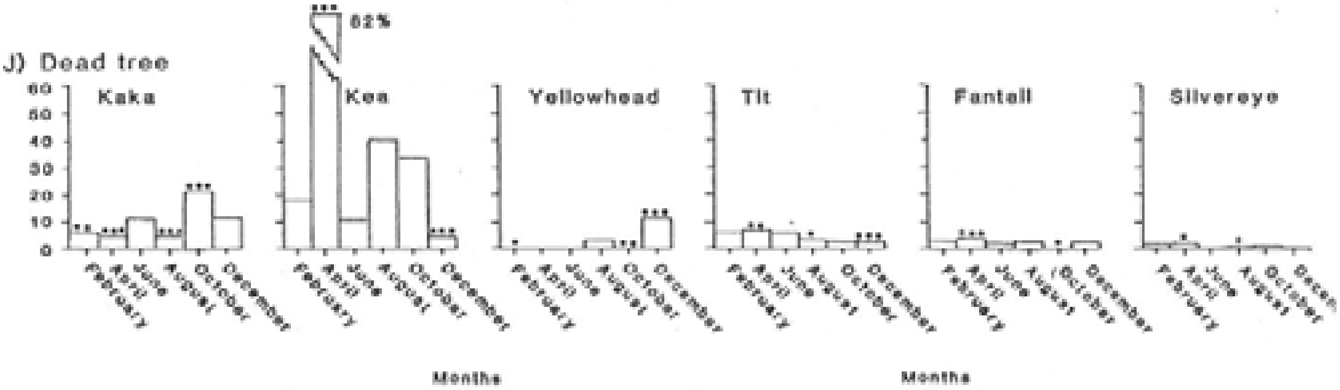
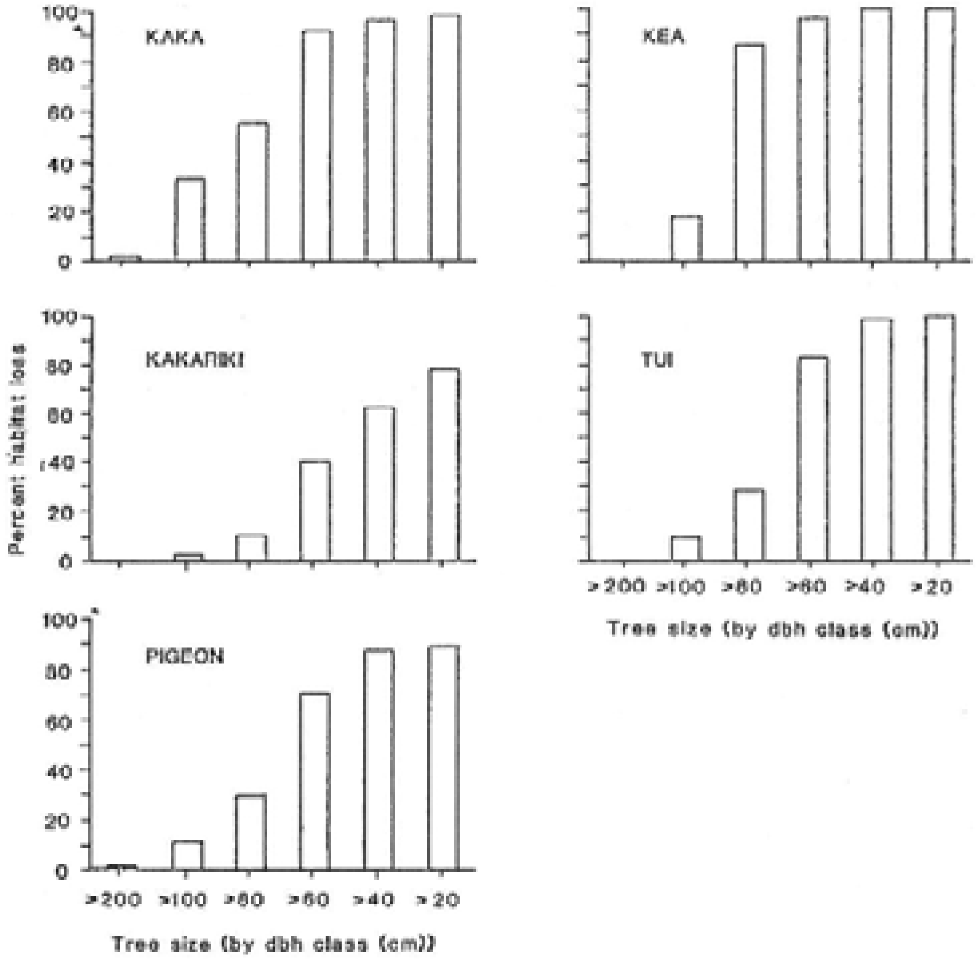


Figure 5 : Impacts of rimu logging: Example of predicted habitat loss if different stem diameter classes are targeted by logging.



TITLE: Hooker's sea lion

PROJECT LEADER: Martin Cawthorn

PROJECT NO: S5010/173, S5010/175
CORPORATE OBJECTIVE NO: 20

Proiect

Hookers sea lion (*Phocarctos hookeri*) is New Zealand's largest indigenous mammal. The population has been reduced from initial level by Maori subsistence harvesting, commercial sealing and subsistence catches by castaways at the Auckland Islands. A current constraint to population recovery is from incidental catches of sea lions in the trawl squid fishery to the south of New Zealand.

Information is being sought on the population size and status, biology behaviour and fisheries interactions of this sea lion so that the appropriate management decisions can be made to ensure the long term survival of the species.

Objectives

- To continue to monitor the size and status of the Hookers sea lion population.
- To investigate the biology, physiology, behaviour and distribution.
- To monitor levels of interaction between sea lions and commercial fisheries and the effect of incidental catches on the continued viability of the population.

Methods

Population censusing is carried out at the rookeries during the breeding season. Ground counts are augmented by aerial photography. Pups are tagged at their natal rookeries to quantify numbers and mortality in the first few months of life, to assess interchange between rookeries and monitor dispersal
and physiology is investigated through sampling in the field and instrumentation and radio tracking of individuals at sea. All sea lions taken incidentally during fishing operations are returned to New Zealand for autopsy.

Interim Result

All work in the field at the rookeries has to take place the short one and a half month long breeding season from December to mid-January. Annual surveys at the Auckland Islands and Campbell Island indicate that the world population of Hookers sea lion is currently between 5,500 and 7,500 animals. Because of the difficulty of landing on the principal rookery (Dundas Island) at the Auckland Islands and the habit sea lions have of roaming far inland at Campbell Island, an absolute population size
far, been impossible to obtain. All pre-breeding animals go through a vagrant stage when they roam far from the rookeries. For this reason, and others, it has not yet been possible to accurately gauge the effect on the population of continued

incidental catches of sea lions in the trawl squid fishery. Repeated censuses at the major rookery suggest the population may be in a slow decline. In the 1985-86 season 24 sea lions were returned from the squid fishery, 21 in 1986-87 and 11 so far in 1987-88. An initial analysis of incidental catch data indicated that an annual catch of about 125 adult sea lions would halve the population in a little over 50 years. This analysis was limited by a lack of knowledge of many parameters affecting both the fishery and sea lion recruitment and behaviour. Although the recent incidental catches of sea lions are small the high proportion of adult females taken is cause for concern.

The key to an understanding of the incidental catch problem lies in the maintenance of maximum observer coverage of all trawlers working the fishery. Observers aboard the vessels record behavioural data in a standard format noting, for example, thenumber, species and size of seals around each vessel, whether the seals approach or avoid the ship when the gear is being hauled or shot away and whether the animals are feeding from the net or waste chutes. From this information, added to catch is possible to detect changes in vulnerability and mortality by year class. Observation of tagged animals have shown that pups only five months old can make open-sea journeys of more than 250 nautical by adults. Sub-adult and non-breeding males roam farthest from the rookeries ,some being observed as far north as Banks Peninsula and as far south as Macquarie Island. Recently, a tagged juvenile from the Enderby Island rookery appeared in Lake Waihola, confirming the propensity for this species to roam, by way of rivers and drainage systems, up to 18km inland.

Female sea lions produce their first pup at age 4-5 years. There is no evidence of twinning. Males, although sexually mature at 5-6 years, are not socially mature until 8 years or more. The oldest and the heaviest sea lions recorded so far are 18 years and 160kg for females, and 23 years and 326 kg for males. Few females are likely to exceed 160 kg in weight, but large males probably reach a maximum of 450kg at the beginning of the mating season.

Physiological investigations in 1985-6 and 1986-7 concentrated on diving ability, behaviour and adaptation to prolonged apnoea and extreme pressure. Female sea lions at Enderby Island were instrumented with time, depth and flow recorders to monitor their underwater activity. Results show a remarkable ability to make repetitive dives to over 400m with no apparent fatigue. In one 32-hour feeding excursion one small mature female took just 70 minutes rest.

Studies of diet and feeding behaviour are crucial to understanding the relationship of these animals to the local fisheries. Hookers sea lions show a preference for squid, octopus and fish in the summer. During autumn large quantities of the Auckland Island spider crab (*Jacquinotia edwardsi*) appear in regurgitations, along with the remains of southern blue whiting, sharks and rays. The sea lion has a varied diet and will consume food ranging from bivalves to penguins and fur seal pups.

During the trawl squid season (February-May) sea lions of all ages will associate closely with trawlers. They are intelligent animals and are particularly inquisitive. Accounts from ships crews and observers suggest sea lions are learning to climb over floating net cod-ends to pull squid from the meshes without being caught. Once the gear is aboard, they take up station beneath the factory discharge chutes to feed on the continuous supply of fish scraps dumped overboard. They will investigate large commercial crab pots and small sea lions will swim into the pots to investigate the bait. Large crab and crayfish traps are a potential cause of mortality if any fishery were to be opened up at the Auckland Islands (which is currently a zone closed to all fishing).

The annual natural mortality rate of adults is unknown. A likely major contributing factor is predation. White sharks, whales and leopard seals, all of which are known to kill sea lions, are found in the vicinity of the Auckland Islands. At least 30% of all animals observed at the rookeries bear scars from attacks by one or other of these predators.

Until sufficient data are gathered to prove otherwise, it would be prudent to assume that the Hookers sea lion population is declining.

Breeding is restricted to small rookeries close to major commercial trawl fisheries. Recruitment rates are slow and any addition to natural mortality, such as incidental catches in the fishery, will only slow recovery to pre-exploitation levels.

Any inshore fishery development is likely to adversely affect the population, especially at rookeries easily accessible by man.

Improved population estimates require long-term monitoring of pup production at the rookeries and the maintenance of adequate manning levels of observers on vessels fishing the subantarctic area.

Interim Recommendations

1. Annual pup production at all rookeries should be monitored carefully to assess any fluctuations in recruitment.
2. Aerial photography techniques should be developed as an adjunct to ground counts in censusing the population.
3. Preferred feeding grounds should be identified through instrumentation and radio telemetry.
4. The discreteness of breeding units and amount of interchange of breeding sea lions between rookeries should be investigated using genetic techniques.

5. Commercial trawlers working the trawl squid fishery should continue to carry observers, and Masters should be strongly

encouraged to continue reporting all incidental catches of sea lions and other marine mammals and return required specimens to New Zealand.

Table 1. Dundas Island Censuses from Comparable Years.

Year	Month	Day	No. females	No. pups	No. males	Total
1978	Jan.	21	1955	1700	144	3,799
1980	Jan	29	1344	1120	400	2,864
1986	Jan	19	1304	1087	155	2,506
1987	Jan	30	1345	1121	2 6	2,492

Table 2. Observer Coverage of Trawlers Operating in the Auckland Islands area between November 1986 and June 1987.

Month	Year	Total No. tows	% Observed
Nov.	86	182	63
Dec.	86	491	44
Jan.	87	1096	27
Feb.	87	1365	30
Mar.	87	1444	52
Apr.	87	787	61
May.	87	254	69
Jun.	87	1	0

(Data supplied by MAF Scientific Observer Programme)

KAKAPO RESEARCH ON STEWART. LITTLE BARRIER AND CODFISH ISLANDS IN 1987-88

Staff: Ralph Powlesland, research leader Brian Lloyd
Accession number: 116

1 SUMMARY

1.1 PROJECT

Mortality and breeding behaviour of kakapo on Stewart Island were investigated. In addition, the accuracy of the remote radio-tracking equipment was determined and a quantitative assessment was made of the vegetation types in the study area. Field work was completed in 1988. The booming behaviour of male kakapo transferred to Little Barrier Island in 1982 and to Codfish Island in 1987-88 was monitored. On Codfish Island the phenology of some kakapo food plants was assessed.

1.2 OBJECTIVES

a) To provide information about several aspects of the Stewart Island population's biology, especially information that might be helpful in making decisions for the conservation of the species.

b) To determine whether kakapo breed successfully on Little Barrier and Codfish Islands.

1.3 METHODS

a) Stewart Island -Mortality and breeding behaviour were monitored using radio-telemetry. The accuracy of the remote radio-tracking equipment in determining the position of radio-tagged kakapo was investigated using test transmitters placed at various surveyed sites within the study area. A quantitative assessment of plant species' diversity and abundance in each of 10 vegetation types was made using a point-height intercept technique. Since July 1987 all kakapo located on Stewart Island have been transferred to Codfish Island.

b) Little Barrier Island -The extent of use by kakapo of track-and-bowl systems in January-April 1988 was determined from sign at the systems.

c) Codfish Island -In January 1988 the phenology of 132 tagged plants was noted and kakapo calls were listened for at night from prominent landforms.

1.4 INTERIM RESULTS

STEWART ISLAND

Brian Lloyd has determined the accuracy of bearings taken on transmitter signals using a remote radio-tracking system. The positions of test transmitters were most accurately determined using the remote radio-tracking equipment when experienced people were operating it, and when the transmitter was moving and in line-of-sight with the tracking stations. It has yet to be assessed how much of the movement data on radio-tagged kakapo will be sufficiently accurate to determine the positions and sizes of kakapo home ranges, and the kakapos' seasonal movements in relation to vegetation type and breeding status.

Most time during two field-trips to Stewart Island in 1987-88 was devoted to the quantitative assessment of the vegetation in the Scollay's Flat study area. There the vegetation is a mosaic of 17 recognised types. Fieldwork involved going to about 10 different patches of each vegetation type and quantifying the species diversity and abundance in each of six possible strata. By relating the results to the diet and movements of kakapo, it should be possible to determine which vegetation types were important food sources for the birds and whether some long-distance movements of the parrot were related to seasonally available foods.

Following the eradication of wekas and possums from Codfish Island by 1987, the island became available as a transfer site for kakapo, away from the threat of cat predation on Stewart Island. The Department of Conservation accepted the recommendation of the Fauna Protection Advisory Council that all remaining kakapo on Stewart Island be shifted to Codfish Island and, consequently, most of the known birds were located and transferred. While it was relatively straight-forward to capture males when they occupied their track-and-bowl systems in summer, finding some of the females proved very difficult. This was because of their large home ranges (about 50 ha/bird) which had repeatedly searched. Also, the birds' arboreal wanderings made it impossible for the dogs to follow their scent trails. Sixteen birds are now on Codfish Island; five females and eleven males (Table 1). No dead kakapo were found in the past twelve months. I suggest, from the number of kakapo estimated to be present following a survey in that 25-30 birds still remain on Stewart Island. With most known kakapo now removed from Stewart Island, fieldwork by Science & Research Directorate staff has ceased there, and analysis and writing up of the results is under way.

Recently a report was published (S & R internal report no. 11) detailing the results of a kakapo survey conducted in southern Stewart Island, December 1984 -March 1985. From this survey, the population was estimated to be 45 birds (25 adult males, 16 adult females and 4 immatures). Also reported were the results of bird and lizard surveys carried out in conjunction with the kakapo search.

Over the past four months progress has been made on the preparation of a paper about the breeding biology of Stewart Island kakapo. The results presented will draw on the observations of many people (not just those of Science & Research Directorate staff) made since the population was discovered in 1977.

LITTLE BARRIER ISLAND

The activity of Little Barrier Island males at their track-and-bowl systems was monitored between January and April 1988. The males have developed track-and-bowl systems on ridges and hilltops about the centre of the island where the elevation is greatest and the canopy is lowest and often open (Figure 1). Males began using these systems in mid-January and continued to do so until late April. However, few systems were in use immediately after cyclone Bola (early March), but the number increased to that prior to the cyclone about a week later. Six to eight males simultaneously occupied systems during each of our monthly visits. The finding of feathers in and near some occupied systems is of interest. On Stewart Island 10 or more down and contour feathers were found at systems mainly in the first month of a breeding season, but not in seasons when males boomed and females did not breed. Such "clumps" of feathers may signify that mating has occurred. Although it is tempting to suggest that mating took place on Little Barrier this summer, the evidence is not conclusive because mostly down feathers were found, and these were found late in the season generally some distance from the systems. Proof of successful breeding must await the sighting or capture of an unbanded kakapo.

CODFISH ISLAND

Although several evenings were spent listening for kakapo calls in January and February 1988, none were heard. Rimu bore many pollen cones in December 1987 and if pollination was reasonably successful, then a good crop of rimu fruit should eventuate in autumn 1989.

1.5 INTERIM CONCLUSIONS

It is likely that rimu will fruit on Stewart Island in autumn 1989 and, as a consequence kakapo remaining there are likely to breed.

Although feathers were found at and near track-and-bowl systems on

Little Barrier Island, this does not constitute definitive evidence that mating occurred.

Should rimu on Codfish Island produce fruit in autumn 1989 then breeding of the kakapo will be made more likely, but breeding may not occur because the birds will have been on the island for only 12-18 months.

1.6 RECOMMENDATIONS

If male kakapo on Stewart Island boom intensively in January 1989, then breeding is very likely to occur. This being the case, neither males nor females should be radio-tagged for transfer until March, by which time all mating will have occurred and the females have laid eggs.

Unless further evidence is found to suggest that kakapo on Little Barrier Island bred in 1988, a search during the next six months for unbanded birds seems unwarranted. The monitoring of activity at track-and-bowl systems should continue for the next six years, unless breeding is evident before then.

Each year on Codfish Island until kakapo breed, the phenology of fruiting trees and shrubs, and the booming of male kakapo should be monitored.

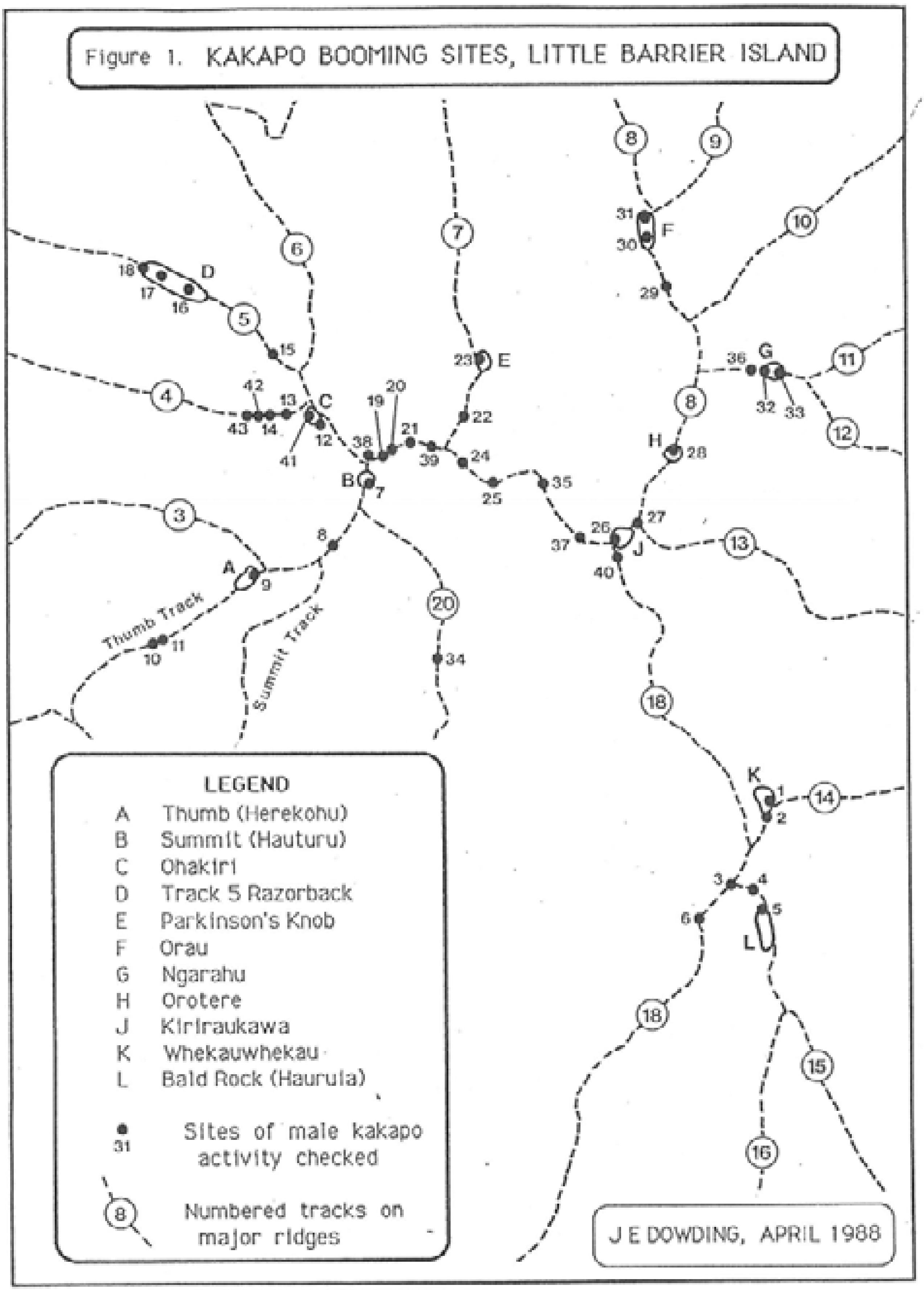


Figure 1. KAKAPO BOOMING SITES, LITTLE BARRIER ISLAND

TABLE 1 Details relating to the kakapo transferred Stewart Island to Codfish Island between July 1987 and February 1988

Name	Sex	Date transferred	Weight (kg)	Location found
Alice	F	10/07/87	1.26	Scollay’s Flat
Sass	M	10/07/87	NW	Scollay’s Flat
Nora	F	14/10/87	1.58	Scollay’s Flat
Rangi	M	05/12/87	NW	Scollay’s Flat
Lionel	M	08/12/87	2.40	Scollay’s Flat
Gunter	M	15/12/87	2.05	Scollay’s Flat
Cyndy*	F	15/12/87	1.65	Scollay’s Flat
Ben*	M	18/01/88	2.75	E. Skyline
Gumboots*	M	27/01/88	2.45	E. Skyline
Lee	M	27/01/88	2.70	Plateau
Pierre	M	27/01/88	2.30	E. Skyline
Tramp	M	27/01/88	2.80	Tramline
Sue	F	03/02/88	1.60	Pegasus
Ralph	M	03/02/88	3.05	Pegasus
Margaret-M.	F	10/02/88	1.70	Tramline
Gunner	M	10/02/88	2.45	Scollay’s Flat

* = new bird
NW = not weighed

The lifetime production of red-billed gulls

PROJECT LEADER: J.A. Mills

PROJECT NO: S5030/117

CORPORATE OBJECTIVE NO: 8

To determine the number of young red-billed gulls produce
their lifetime, and to identify factors which contribute
differences in the lifetime reproductive success of indiv

1.3 JUSTIFICATION : Why study lifetime production and, in particular, lifetime production of the red-billed gul

- Reproductive success expressed conventionally as the
of young raised at individual attempts, or in indivi
years, can be misleading because marked differences
reproductive performance can occur from year to year
from individual to individual according to age and
experience.

  A better measurement of reproductive success is the
of young an individual produces in its lifetime. Th
gives greater understanding of how populations are
maintained from one generation to the next and,
consequently, of how populations should be managed.

- To date only two studies have been published on the
lifetime production of birds (sparrowhawk and pipit
because most studies are not long enough to cover
representative lifespans of individuals.

  At Kaikoura Peninsula individual red-billed gulls
studied for 24 years, allowing their lifetime prod
to be determined. The results from this study and
the sparrowhawk and pipit show similar trends, and
highly likely that other populations, including th
endangered species, will behave in a similar mann

METHODS:

Banding of nestling red-billed gulls at Kaikoura
undertaken annually for 30 years (1958-1987) and
90,000 have been marked. Since 1967, 5,000 adult
been colour-marked for identification. Each sea
nests of colour-marked gulls were numbered and th
each was determined.

Only a small proportion of the colour-marked ind
was eligible for inclusion in the lifetime analy
the age of their first breeding had to be known.
uncertainty over lifespan and fledging success
many individuals. In all there were 66 females
males for which lifetime data were available.

RESULTS:

The ages of birds analysed ranged from 1 to 1
Although long-lived, the maximum number fledg
six for males and nine for females (Fig.1).

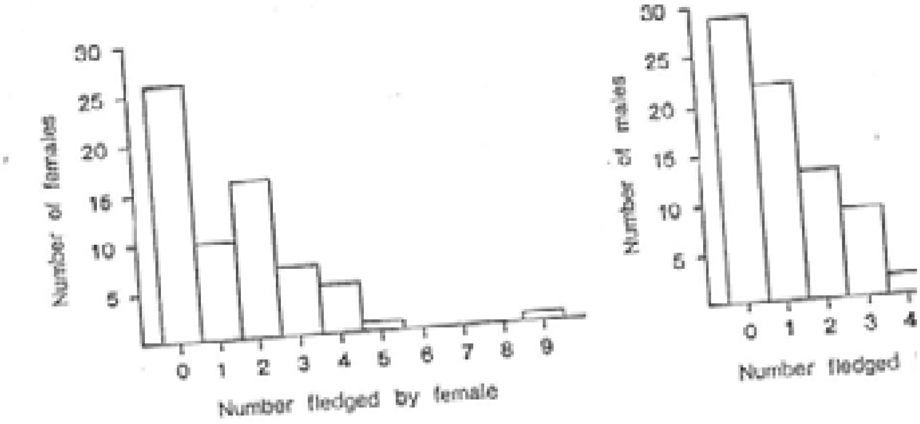


Figure 1. Lifetime fledging success of 66
male red-billed gulls.

- Of those birds which attempted to breed, 36
and 39% of the females fledged no young in
Overall, 20% of the males produced 58% of t
and 15% of the females produced 52%.

  Thus relatively few individuals maintained
from one generation to the next. Only 17%
24% of the females produced young which su

- Young from parents which fledged just one
lifetime had a similar chance of being rec
breeding population as those from parents
many as nine. However, parents which proc
number of fledged young tended by weight
have more progeny recruited into the next
generation.

- Those individuals that lived longest tend
young into the breeding population. Simi
seasons a bird bred the greater the numbe
fledged. However, some birds which livec
never fledged any young.

- Heavier females hatched more eggs than l
individuals. Although heavier females d
than lighter individuals they tended to
frequently and to have more partners. T
for heavier females to fledge more young
females.

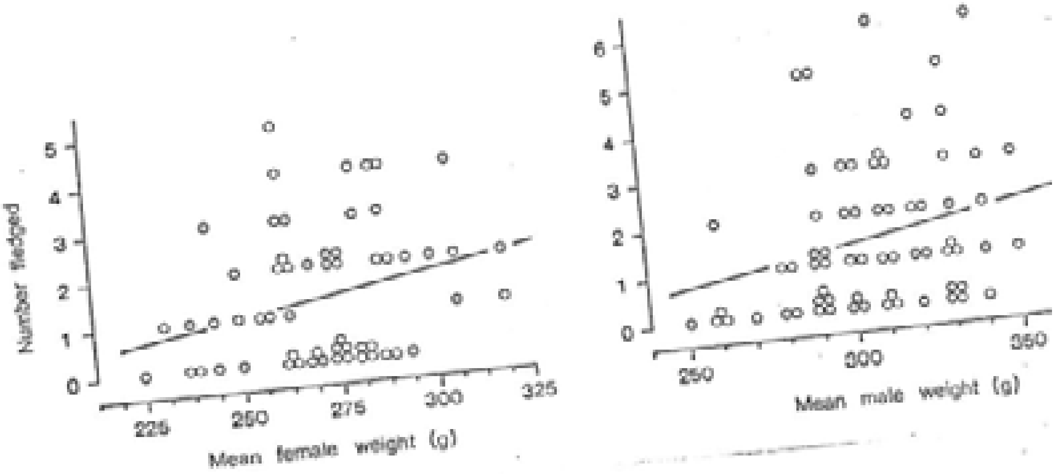


Figure 2. Lifetime productivity to fledging of fema
red-billed gulls in relation to body weig

- Heavier males fledged a greater number of young
lighter males (Fig.2).
- The red-billed gull has an extremely long egg-l
period, from late September to the end of Decem
birds that consistently bred early in the seas
the most surviving young (Fig.3).

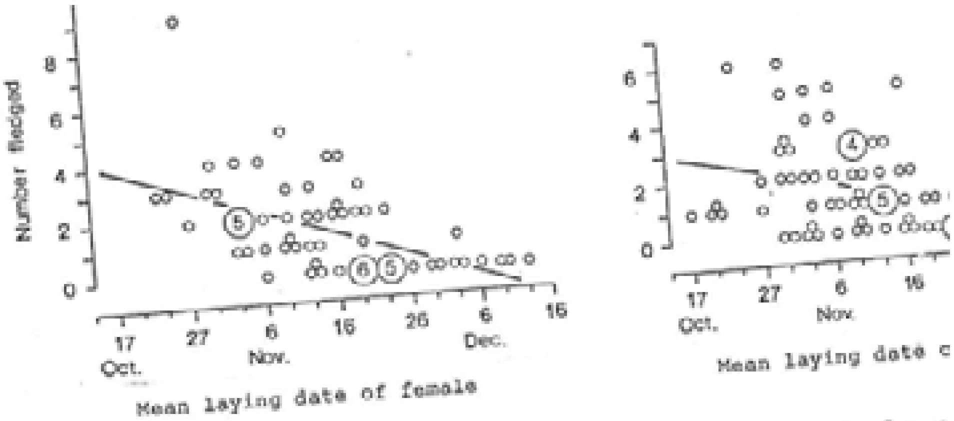


Figure 3. Lifetime fledging success of fema
in relation to laying date.

MANAGEMENT IMPLICATIONS:

The widely held belief that most individual
populations produce enough young to replace
not true. Only a few individuals produce t
young which survive to breed in the next ge

Therefore not all individuals in the populati of the same conservation effort. This is ver variance with current management practices.

- The findings from this project have implicati current takahe management. It is essential w clutches from the field for artifical rearing most productive individuals are left with at egg. The removal of complete clutches may we counter-productive because replacement nests be less successful.

- This project has emphasised the importance of studies in gaining fundamental information o populations are maintained and regulated.

Lizard translocation research: *Cyclodina whitakeri* on Korapuki Island

PROJECT LEADER: Dr David Towns
COLLABORATORS

- Ian McFadden DOC Science Technician -Rodent and rabbit eradication
- Murray Douglas DOC Science Technician -Data logger development
- Dr Charles Daugherty - VUW Zoology Department -Ecological genetics
- Dr Ian Atkinson - DSIR Botany Division - Vegetation studies
- Mrs H Polly - DSIR Soil Bureau - Litter invertebrate studies

PROJECT

Protocols for island transfers of endangered lizards are being developed which address questions of genetic identity, maintenance of heterozygosity, minimum viable population size and habitat selection. The long-term goal is to use endangered lizards as a model when planning the rehabilitation and management of small offshore island ecosystems.

OBJECTIVES

- To develop techniques and planning criteria for the rehabilitation of island ecosystems.
- To eliminate kiore (*Rattus exulans*) and rabbits from 18 ha Korapuki Island.
- To measure the response of resident lizard populations to removal of an introduced predator and to compare this with neighbouring islands where predatory rodents remain (Stanley Island), and where they have never been present (Middle Island).
- To measure the microhabitat conditions under which the endangered skink , *Cvclodina whitakeri* occurs on Middle Island.
- To establish *Cvclodina whitakeri* from Middle Island on Korapuki Island in appropriate microhabitats following rodent eradication.

METHODS

Criteria for transfer

Korapuki Island was chosen as a suitable site for transfer of *Cvclodina whitakeri* using the criteria established by Towns et al. (in press). These criteria were based on three considerations: the ecological value of remaining predator-free locations; feasibility of habitat rehabilitation following eradication of predators; and the genetic basis for establishing populations in new locations.

Rodent eradication

Eradication of kiore from Korapuki Island was undertaken using poison dispensing silos described by McFadden (1984). One hundred and twenty silos were installed on the island in November 1986, baited with kibbled maize, and left for four nights. By the fourth night bait take was locally high, with much scattered grain and rat faeces in the silos. All grain was then removed and replaced by kibbled maize dosed with bromodialone, an anticoagulant rodenticide.

Lizard populations

Lizard population densities and composition are being studied using pitfall traps along fixed transect lines on Middle Island (rodent free), Korapuki Island (rodent eradication) and Stanley Island (rodents still present). Each island has at least three transect lines set in each of shoreline and forest habitats. The transects are 100 m long and consist of 20 traps set in blocks of four 2 m apart at 20 m intervals. Within each block one trap is baited with meat, one with fish, one with fruit, and one left unbaited. All lizards captured are identified, weighed and released.

Genetic diversity of the scattered populations of *Cyclodina whitakeri* is being studied using allozyme analysis of blood, muscle and liver tissue in collaboration with the Genetics Unit, Victoria University of Wellington. Results of these analyses are being used as the basis for identifying suitable populations of *Cyclodina whitakeri* for transfer to Korapuki Island.

The most appropriate population structure and demography to be used for transfer has been determined using computer models developed specifically for this project by Ross Pickard (DOC). The models make it possible to predict likely mortality rates (and therefore population expansion rates) under different release regimes. Data from the genetic studies have then been added to this model to determine the most appropriate sex ratios of the groups of released animals.

Invertebrate studies

Invertebrate community structure on Korapuki Island is being studied in collaboration with Soil Bureau, DSIR. The studies are aimed at determining the impacts of the presence of rodents and the response of the fauna to rodent eradication. Controls are provided by neighbouring islands which lack rodents and those where kiore are still present. The data provided enable sites of high invertebrate density to be identified on Korapuki Island. These are then assessed for their suitability as release sites for *Cvclodina whitakeri.*

Vegetation analyses

Invertebrate densities on Korapuki Island are strongly influenced by composition of the vegetation and this in turn reflects the impacts of soils and browsing by kiore and rabbits. An understanding of the course of vegetation succession on the island following removal of all browsers will enable estimation of the extent of available habitat for the transferred lizards. Soil structure and vegetation changes on Korapuki Island are being studied in collaboration with Botany Division, DSIR.

Microhabitat requirements

Field studies on the relationship between intensity of activity and microclimate indicate that *Cvclodina whitakeri* has unusually narrow thermal requirements as well as a need for high moisture levels. These conditions are likely to be met in the seabird complexes in which the species is found on Middle Island. What these conditions are, and the extent to which they are duplicated on Korapuki Island, are likely to influence the success of the release programme. Microhabitat conditions (temperature and humidity) are therefore being studied on Korapuki and Middle Islands using electronic data loggers.

INTERIM RESULTS

Rodent eradication

Korapuki Island was checked for kiore approximately six weeks after the poison was laid in November 1986, but although all silos were refilled with unpoisoned kibbled grain, there was no further take by rats. There has been no sign of rats in 12 checks of Korapuki Island since the poisoning operation. Rabbits were eradicated by shooting, with the last animal being seen in August 1987. A flush of growth of highly palatable seedlings since late 1987 indicates that the rabbit eradication has been successful.

Lizard populations

Korapuki Island locally supports high densities of lizards which are diurnal and live in coastal areas. Forest dwelling species are rare and large ground-dwelling skinks of the genus *Cyclodina* are absent. Lizard densities are low everywhere on Stanley Island, and so far no lizards have been captured in the forested transect. Middle Island supports high densities of lizards in coastal habitats and although fewer individuals are captured in forest areas, these sites are distinctive for their high biomass of *Cyclodina* skinks (Towns in prep).

There has been no measurable increase in the frequency of captures of lizards in forest areas, nor evidence of expansion of coastal species into forest areas, following eradication of the rats from Korapuki. This is not surprising in view of the low litter size (2) and slow growth rate of the forest dwelling species.

None of the three populations of *Cyclodina whitakeri* can be distinguished on genetic criteria, despite the geographic range of 500 km. This is consistent with the low levels of genetic diversity now found in a range of unrelated terrestrial reptile species with distribution patterns similar to that of *Cyclodina_whitakeri*. This implies that many island populations of lizards are the result of continuous populations fragmented by rising sea levels following the Last Glaciation.

Twenty five *Cyclodina whitakeri* were transferred from Middle to Korapuki Island in February 1988 into an area whose suitability was determined from microhabitat data and invertebrate density.

Invertebrates

Mahoe and tawapou groves have been identified as supporting the highest density and diversity of invertebrates on Korapuki Island. Based on these findings an area of almost pure forest was chosen as the first release site for *Cyclodina whitakeri*. Other studies relating invertebrate diversity to vegetation composition and the effects of predation are being continued by Mrs McColl.

Vegetation

Since rabbits have been removed there has been a proliferation of seedlings in some parts of Korapuki Island. Most common species include taupata, karo, poroporo, and ngaio. The latter species has become particularly widespread with some plants growing over 1 m in less than 12 months. More detailed studies of vegetation and soils are being continued by Dr Atkinson.

Microhabitat requirements

Use of the data loggers has demonstrated that temperatures and humidity fluctuate little within seabird burrows. Temperatures often remain near 20°C and humidity at over 90%. Conditions vary little between islands but do change according to exposure to prevailing winds and the form of the burrows being investigated. Fluctuations are least in burrows with a narrow aperture such as those produced by diving petrels.

INTERIM CONCLUSIONS

- Korapuki Island is undergoing a rapid change in vegetation composition following removal of rabbits.
- Despite the removal of rats from Korapuki, resident lizard distributions have not undergone measurable change with forest areas still supporting very low lizard densities.
- Forest habitats represent "empty" habitats for lizards on Korapuki Island, making them suitable for the intoduction of forest species such as *Cyclodina whitakeri*, as long as these transfers are conducted soon after rodent removal.
- There is genetic divergence between populations of *Cyclodina whitakeri*, indicating that they are fragments of a continuous population isolated by rising sealevels. Such a model supports the great antiquity and high levels of now being proposed for the New Zealand lizard fauna (Daugherty et al. in prep).

PUBLICATIONS

Towns, D.R. 1988 Rodent eradication from islands - the conservation potential Forest and Bird 1988: 32-33

Towns, D.R., Daugherty, C.H., Pickard, C.R. in press Developing protocols for island transfers: a case study based on endangered lizard conservation in New Zealand. Proceedings of the International Workshop on Herpetology in the Galapagos. University of New Mexico Press.

Papers to be delivered at Australian Bicentennial Herptological Conference:

Daugherty, C.H., Towns, D.R., Thorn, C. Relationship between genetic distance and geographic isolation in some rare New Zealand reptiles (Sphenodontidae, Gekkonidae, Scincidae).

Towns, D.R. Rats revisited: the impact of kiore (*Rattus exulans*) on the lizard assemblages of some New Zealand offshore islands.

PROJECT NO: S5020/168
CORPORATE OBJECTIVE NO: 8

TITLE: Population dynamics of Blue Duck on the Manganui-a-te-ao, River.

PROJECT LEADER: Murray Williams

PROJECT: The biology and population dynamics of blue ducks inhabiting the Manganui-a-te-ao River in central North Island have been studied since 1980 to provide knowledge upon which a national conservation strategy for the species can be based.

OBJECTIVES:

a) To study long-term changes in the population by measuring the number of young produced annually, the survival and dispersal of juveniles, longevity of adults and changes in the density of the population.

b) To determine what factors influence the number of birds on the river by measuring (a) territory size and the seasonal variation in the use of those territories; (b) relating the pattern of territory use to the distribution and abundance of food within the river.

c) To determine what proportion of each year's production of juveniles may be removed (to establish populations elsewhere) without having a long-term effect on the population.

METHODS:

All birds and their young living on an 8 km section of the river have been caught and banded each year since 1980. The study, thus, depends on regular re-sightings of the banded birds. This is done by brief 3-day visits every second month from January to August, and monthly visits during the breeding season.

Blue ducks are also present on a further 20 km of river above the study area. Most of this river is inaccessible except by floating down its entire length. This is done at least once a year to locate any banded individuals and to measure the breeding success of birds on that section of river.

RESULTS (1987):

a) The 1987/88 breeding season was a poor breeding year, the second worst since 1980. Only 5 ducklings were raised, yet 8 pairs held territories within the study area and at least 6 of these attempted to breed. The 2 pairs who successfully raised ducklings both hatched their eggs in early September, the earliest I have ever recorded ducklings, and I attribute this to the very mild and dry winter which followed the summer El Nino event. However, October was extremely wet and at least 3 pairs had their nests flooded then.

b) Poor breeding occurred elsewhere on the river. A survey in November of the 10 pairs living on the 9 km stretch of river immediately above the study area failed to locate a single family brood. A follow-up survey in December found several pairs already moulting, a sign of a failed breeding attempt, and still no broods of ducklings.

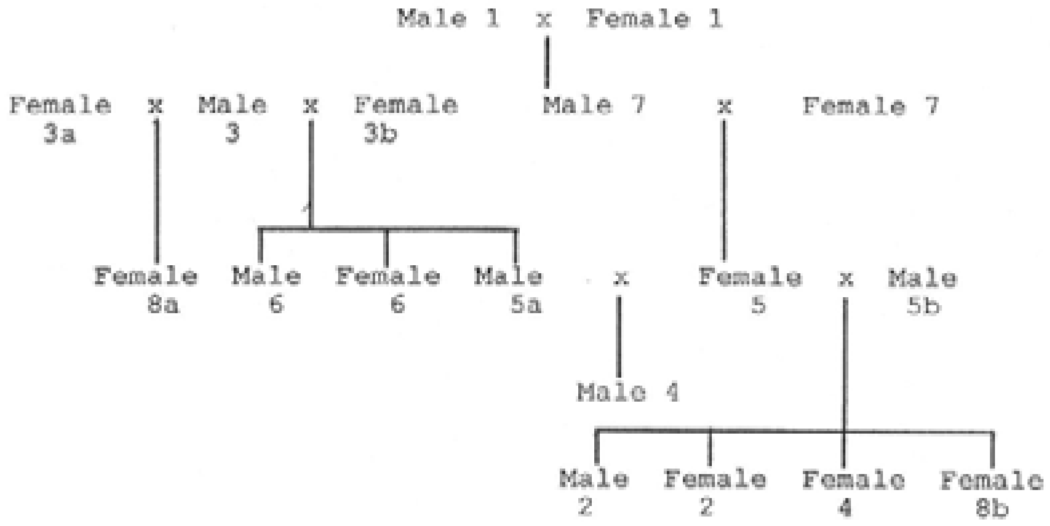
c) Five of the previous year's ducklings had claimed territories within the study area and the number of territorial pairs increased from 6 to 8. These findings confirmed previous evidence that:

(i) ducklings reared in the study area attempt to forge a territory as close as possible to where they were raised. For example, 4 ducklings from the same brood in 1986/87 established territories: one immediately next door to their natal area, two (as a pair) 2 territories distant down river (about 1.5 km away); and another 2 territories distant up river;

(ii) increases in the number of pairs occupying territories follows immediately after an outstanding breeding year (which 1986/87 was).

d) Three of the 8 pairs occupying territories within the study area comprised birds whose parents were the same. In one case, the two birds were brother and sister from the same clutch, in another the male was raised two years earlier than the female. In the third pair the male was a half-brother to the female, having the same mother but different fathers.

e) The finding that closely-related birds were pairing prompted a review of the known genetic relationships of the study birds. It revealed a tangled web of relationships as shown below.



As a consequence, blood was taken from 16 birds within and beyond the study area for analysis using the DNA fingerprinting technique to assess just how interbred the population may be. This has not yet been completed.

CONCLUSIONS TO DATE

This study is, necessarily, long-term. Blue ducks seem to be long-lived: two of 8 adult birds present when the study started in 1980 are still alive and, on average blue ducks live 6 years once they become territorial (at 1-3 years of age). Thus, up to 20% of the breeding population is likely to comprise birds of 10 years of or older. To asses stability of numbers and average breeding success based on 1-3 years of observations would lead to highly erroneous conclusions. This study will need to cover the maximum lifespan of a blue duck.

Having now continued for 8 years, several points relevant to the species' conservation have emerged.

1. Erratic Breeding

In 4 of the 8 years, breeding success has equated to one chick per pair, or less. Furthermore, the good and bad years have alternated regularly for reasons which still remain a mystery. The table below outlines breeding performance.

	Year								
	1980	1981	1982	1983	1984	1985	1986	1987	Total
No. territorial pairs	4	5	4	6	6	7	6	8	46
No. pairs breeding	4	4	4	5	6	7	6	5	41
No. young fledged	6	4	9	0	11	7	16	5	58
Mean No. young per pair	1.5	0.8	2.25	0	1.8	1.0	2.7	0.6	1.3

2. Increased Breeding:

The number of pairs occupying territories within the study area has doubled, from 4 to 8 over the 8 year period of study. This is comforting but it begs the question as to why the number of pairs was so low in 1980. However, the more important finding is that any major increase in territorial pairs has followed an outstandingly productive year (1982, 1986), not an average or below average one. The initial impression is that very good years compensate for the lack of productivity in previous bad years. This has major implications if birds are to be "milked" from a population for release elsewhere.

3. Pairs Differ:

When breeding results are analysed on a pair by pair basis rather than collectively, it becomes immediately apparent that some pairs are more productive than others. The table below shows the performances of individual pairs.

	Individual Pairs						
	A	B	C	D	E	F	G
No. young fledged	11	22	5	7	13	4	1
No. breeding attempts	8	8	6	3	8	5	5
Mean per attempt	1.4	2.75	0.8	2.6	1.6	0.8	0.2

Three pairs (C, F, G) have, collectively, bred 16 times and raised only 10 young; pair B has raised more than twice that number of young in half the number of attempts. Pair B raised ducklings in every year except 1983, the next most productive pair (E) failed to raise ducklings on 4 of their 8 attempts.

These data indicate that, from a conservation point of view, not all pairs are equal. Pair G, for example, is not worth the same conservation effort as B or E. If young were being caught for removal to establish a new population elsewhere, it would obviously be better to take the young of pairs B, and E than C, F or G because the productivity of the parents is likely to be reflected by that of the youngster.

4. Inbreeding

The apparent high degree of relatedness amongst pairs within the study area needs to be confirmed by the DNA finger-printing technique and it also needs to be checked elsewhere on the river (we are now doing that). If all birds on the river are closely related to each other, how do we interpret this? It could be the direct result of isolation, for blue ducks on the Manganui-a-te-Ao River have little or no opportunity to mix with other populations of blue ducks. If this is so, then it raises serious conservation problems for all existing (and mostly small) blue duck populations in the North Island, and a major loss of genetic variability is taking place. Inbreeding depression manifest by poor breeding performance may already be evident if we had a yardstick to measure it against.

On the other hand, inbreeding amongst blue ducks could be a natural phenomenon causing no long-term problems. This could be the common result of limited dispersal of the fledglings.

The only way to check which of the two possible conclusions is the right one is to check the genetic relationships amongst birds on a river or catchment much larger than the Manganui-a-te-Ao. If blue ducks inhabiting the Motu River, or the rivers of north-west Nelson or Fiordland are also closely related to each other, then there need be no conservation concern. But if they are not, then what we find on the Manganui-a-te-Ao is a product of isolation and will have a major influence on our conservation approach to this species.